| Bibliography | primary authors | year published | category | key words | abstract | data | analysis | results summary |
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| Abara W Wilson S Burwell K. Environmental Justice and Infectious Disease: Gaps, Issues, and Research Needs. Environmental Justice 2012 vol: 5 (1) pp: 8-20 | Abara W Wilson S Burwell K. | 2012 | pathogens/ vectors | urbanization, agriculture, and climate variability, pathogen dynamics, vector transmission, host susceptibility, disease outcomes, environmental justice populations. | Abstract The purpose of this article is to examine the relationship between environmental changes and infectious diseases and their impact on health in environmental justice (EJ) communities. The evolution of EJ science and research is contingent upon an integrated approach that takes into account social processes and environmental changes to address the burden of infectious diseases in EJ communities. We recognize that infectious disease and environmental justice is novel and calls for more research in this area, especially as the focus of public health shifts towards an ecologic and social approach to disease prevention. We attempt to explore in further detail how environmental changes such as urbanization, agriculture, and climate variability could potentially influence pathogen dynamics, vector transmission, host susceptibility, and disease outcomes among environmental justice populations. | NA: requires article purchase | NA: requires article purchase | NA: requires article purchase |
| Aguto J Beetso D Bushnell D Cordalis D Cosens B Passell H Reno M Richards B Stansbury M. WATER IN INDIAN COUNTRY: CHALLENGES AND OPPORTUNITIES A REPORT PREPARED BY THE TRIBAL WATER WORKING GROUP 2 ACKNOWLEDGMENTS EXECUTIVE SUMMARY. Sosoba Band of Luiseno Indians Settlement Act of 2008, Pub. L. 110-297, 122 Stat. 2975; Northwestern New Mexico Rural Water Projects Act), Pub. L. No. 111-11; 123 Stat 1367 (2009). | Aguto J Beetso D Bushnell D Cordalis D Cosens B Passell H Reno M Richards B Stansbury M. | 2009 | water | water, indigenous people, challenges | Throughout Indian County, water is considered sacred. It is used in ceremonies and in prayer and serves as a symbol of the interconnectedness of all life. Native American communities throughout the United States are faced with external circumstances that govern their relationship to water. Some tribes are water rich, living in areas with abundant, high quality supplies which support important fisheries, commerce and navigation. Other tribes face acute problems of shortage and impaired quality. Inevitably, nearly all tribal communities address trade-offs between the use of water for cultural, drinking, agriculture, energy production, and economic development. Complicating the management of water resources is the serious threat of global climate change. Persistent drought, reduced snowpack, altered runoff patterns, and warmer water present new challenges for tribes as they seek to access water of sufficient quantity and quality. In response to these pressing challenges, the Tribal Water Working Group formed to identify opportunities for improving the resolution of Indian water rights and other water resource issues critical for the development of their water supplies. | previous work | NA | Tribes across the U.S are faced with numerous challenges in the management of water quality . Variation among tribes in geography, governance and resources leads to vast differences in the state of water quality and the capacity of tribes to effectively manage it. Some tribes have access to abundant supplies of cl ean water, the technical expertise to address water quality issues, ample financial resources and the authority to regulate. Others struggle with limited or severely polluted supplies, limited technical capacity and limited or ambiguous authority. Foremost among these challenges is the ability of tribes to regulate water quality within their reservations. Federal Indian policies, such as the General Allotment Act25, resulted in significant non-Indian ownership of lands within reservation boundaries.26 Consequently, differe nt governing authorities - tribal, state, county and federal – either claim the au thority to regulate land use or to promulgate water quality standards or challenge the ability of others to do so . Tribes that wish to develop water quality standards or regulate certain activities in order to protect or enhance water quality may be prevented from doing so by challenges to their authority and sovereignty. Global climate change presents one of the most difficult challenges for the sustainable management of water resources. Though scientific consensus squarely affirms climate change, public policy has reacted slowly. However, the federal government is currently adopting plans to adapt to changes of hydrological patterns.45 Few communities – Indian or non-Indian – have pursued climate change adaptation and/or mitigation plans. Climate change adds pressure and urgency to existing challenges in securing Indian water rights as well as threatening existing water resources and infrastructure. Prolonged drought, severe weather events, warmer temperatures, and changes in seasonal hydrologic patterns increase uncertainty over w ater supplies and water administration, making the assertion of water rights extremely important for tribes. |
| Akerlof, Karen L. Delamater, Paul L. Boules, Caroline R. Upperman, Crystal R. Mitchell, Clifford S.Vulnerable populations perceive their health as at risk from climate change. Int J of Envrion. Research and Public Hlth.2015, 12, 12, 15419-15433. | Akerlof KA, Delamater PA | 2015 | vulnerable pop. | Vulnerable Populations, Health risks, Climate change | We demonstrate that some people whose health will suffer the greatest harms from climate change—due to social vulnerability, health susceptibility, and exposure to hazards—already feel they are at risk. In a 2013 survey we measured Maryland residents' climate beliefs, health risk perceptions, and household social vulnerability characteristics, including medical conditions (n = 2126). We paired survey responses with secondary data sources for residence in a floodplain and/or urban heat island to predict perceptions of personal and household climate health risk. General health risk perceptions, political ideology, and climate beliefs are the strongest predictors. | Data for this study were collected as part of a survey fielded from 28 March to 4 June 2013 with 6401 households in Maryland. Final sample of respondents was 2126 with a response rate of 38%. | We performed two tests for bias. Testing for mean differences between the first 10% of responders (n = 212) and last 10% (n = 212), we find no statistically significant difference in the dependent variable. we utilized regression scores from a six-item factor analysis of respondents' perceived risk from general threats to their health and wellbeing, including second-hand smoke, air pollution, obesity, flu epidemics, chemicals, and polluted water (α = 0.82). The Kaiser-Meyer-Olkin measure of sampling adequacy. Bartlett's Test of Sphericity, testing the equivalence of the variances. The analysis consists of two steps. First, we used hierarchical multiple regression (OLS) with blockwise entry [45] to model perceptions of personal and household climate change health risk using the following sets of independent variables as predictors: climate beliefs, social vulnerability and health susceptibility, and exposure to risk from climate change impacts. Political ideology and a composite measure of general health risk perceptions are covariates.<br>Second, we performed a logistic regression with the same control and predictor variables as in the hierarchical multiple regression. | In 2013, more than half of Marylanders (53%) said that they and their households are moderately or very vulnerable to the potential health effects of climate change. Only 17% of residents said that there would be no health impacts from climate change, or that they and members of their household were not vulnerable. There is substantial variation in climate health risk perceptions across the state. Visual interpretation of the mapped results suggests that some of the higher areas of perceived risk are both more exposed to physical risks and have greater social vulnerability. |
| Alderman K Turner L Tong S. Floods and human health: A systematic review. Environment International 2012 vol: 47 pp: 37-47 | Alderman K Turner L Tong S. | 2012 | flooding | floods, human hlth | Floods are the most common type of disaster globally, responsible for almost 53,000 deaths in the last decade alone (23:1 low-versus high-income countries). This review assessed recent epidemiological evidence on the impacts of floods on human health. Published articles (2004-2011) on the quantitative relationship between floods and health were systematically reviewed. 35 relevant epidemiological studies were identified. Health outcomes were categorized into short-and long-term and were found to depend on the flood characteristics and people's vulnerability. It was found that long-term health effects are currently not well understood. Mortality rates were found to increase by up to 50% in the first year post-flood. After floods, it was found there is an increased risk of disease outbreaks such as hepatitis E, gastrointestinal disease and leptospirosis, particularly in areas with poor hygiene and displaced populations. Psychological distress in survivors (prevalence 8.6% to 53% two years post-flood) can also exacerbate their physical illness. There is a need for effective policies to reduce and prevent flood-related morbidity and mortality. Such steps are contingent upon the improved understanding of potential health impacts of floods. Global trends in urbanization, burden of disease, malnutrition and maternal and child health must be better reflected in flood preparedness and mit-igation programs. | This review assessed recent epidemiological evidence on the impacts of floods on human health. Published articles (2004-2011) on the quantitative relationship between floods and health were systematically reviewed. 35 relevant epidemiological studies were identified. Health outcomes were categorized into short-and long-term and were found to depend on the flood characteristics and people's vulnerability. | quantitative assessment of previous research | It was found that long-term health effects are currently not well understood. Mortality rates were found to increase by up to 50% in the first year post-flood. After floods, it was found there is an increased risk of disease outbreaks such as hepatitis E, gastrointestinal disease and leptospirosis, particularly in areas with poor hygiene and displaced populations. Psychological distress in survivors (prevalence 8.6% to 53% two years post-flood) can also exacerbate their physical illness. There is a need for effective policies to reduce and prevent flood-related morbidity and mortality. Such steps are contingent upon the improved understanding of potential health impacts of floods. Global trends in urbanization, burden of disease, malnutrition and maternal and child health must be better reflected in flood preparedness and mit-igation programs. |

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| Global Climate change and children's health. American Acad. of Pediatrics 2019 | American Acad. of Pediatrics | 2019 | children | climate change, childrens hlth | There is broad scientific consensus that Earth's climate is warming rapidly and at an accelerating rate. Human activities, primarily the burning of fossil fuels, are very likely ( 90% probability) to be the main cause of this warming. Climate-sensitive changes in ecosystems are already being observed, and fundamental, potentially irreversible, ecological changes may occur in the coming decades. Conservative environmental estimates of the impact of climate changes that are already in process indicate that they will result in numerous health effects to children. The nature and extent of these changes will be greatly affected by actions taken or not taken now at the global level. Physicians have written on the projected effects of climate change on public health, but little has been written specifically on anticipated effects of climate change on children's health. Children represent a particularly vulnerable group that is likely to suffer disproportionately from both direct and indirect adverse health effects of climate change. Pediatric health care professionals should under-stand these threats, anticipate their effects on children's health, and participate as children's advocates for strong mitigation and adaptation strategies now. Any solutions that address climate change must be developed within the context of overall sustainability (the use of resources by the current generation to meet current needs while ensuring that future generations will be able to meet their needs). Pediatric health care professionals can be leaders in a move away from a traditional focus on disease prevention to a broad, integrated focus on sustainabil-ity as synonymous with health. This policy statement is supported by a technical report that examines in some depth the nature of the problem of climate change, likely effects on children's health as a result of climate change, and the critical importance of responding promptly and aggressively to reduce activities that are contributing to this change. | previous studies | quantitative assessments of previous research | Pediatricians are dedicated to the promotion and protec-tion of children's health. Climate change threatens the health, welfare, and future of current and subsequent generations of children. Pediatricians can incorporate considerations of the effects of climate change on health into their professional practice and personal lives in many ways, including patient education, lifestyle prac-tices, and political advocacy |
| Arrieta M Foreman R Crook E Icenogle M. Providing Continuity of Care for Chronic Diseases in the Aftermath of Katrina: From Field Experience to Policy Recommendations. Disaster Medicine and Public Health Preparedness 2009 vol: 3 (03) pp: 174-182 | Arrieta M Foreman R Crook E Icenogle M. | 2009 | Extreme events | hurricanes, chronic diseases, continuity of care | This study sought to elicit challenges and solutions in the provision of health care to those with chronic diseases after Hurricane Katrina in coastal Alabama and Mississippi. In-depth interviews with 30 health and social service providers (key informants) and 4 focus groups with patients with chronic diseases were conducted. Subsequently an advisory panel of key informants was convened. Findings were summarized and key informants submitted additional feedback. The chronic diseases identified as medical management priorities by key informants were mental health, diabetes mellitus, hypertension, respiratory illness, end-stage renal disease, cardiovascular disease, and cancer. The most frequently mentioned barrier to providing care was maintaining continuity of medications. Contributing factors were inadequate information (inaccessible medical records, poor patient knowledge) and financial constraints. Implemented or suggested solutions included relaxation of insurance limitations preventing advance prescription refills; better predisaster patient education to improve medical knowledge; promotion of personal health records; support for information technology systems at community health centers, in particular electronic medical records; improved allocation of donated medications/medical supplies (centralized coordination, decentralized distribution); and networking between local responders and external aid. | Interviews, work groups, focus groups, and electronic communications were used to collect qualitative data in 3 phases from July 2006 to June 2007. Semistructured, in-depth key informant (KI) interviews were conducted with 30 health and social service providers from organizations in coastal Mississippi and Alabama (Table 1). Four focus groups were conducted with patients with CDs (n = 28 participants). Two of the focus groups were made up of HIV/AIDS patients, recruited from support organizations; the other 2 included patients with various CDs recruited from CHCs. Facilitators used an open-ended question guide to elucidate from participants the chronic diseases deserving priority and their post-disaster management needs. Sessions were recorded and professionally transcribed for analysis. Written informed consent was obtained from all of the participants, in accordance with institutional review board protocol. | Using a grounded theory approach,21 2 research team members (R.D.F., M.L.I.) independently analyzed and coded phase I transcripts for emerging concepts using Atlas.ti software version 5.2.9.22 The use of emergent (as opposed to predetermined) coding promotes the inductive identification of patterns among the responses from which conceptual hypotheses are developed without forcing the data into preset categories or theories. Instead, identified patterns in the data are grouped into categories, which summarize the underlying thematic constructs and provide explanations of the experiences of participants.23 | This study recorded and analyzed the experiences and perceptions of frontline medical care responders in the aftermath of Katrina. We systematically documented the CD management challenges experienced by indigenous health care providers, administrators, pharmacists, and community-based support organizations in the Mississippi and Alabama Gulf coasts. Challenges included inadequacy of predisaster preparation; lack/loss of medical and prescription medication records; insufficient patient knowledge of CD medications; regulatory, financial, and insurance barriers to medication purchase; inadequate and/or insufficient medication supplies; and lack of an effective structure to coordinate internal and external operations. Furthermore, we recorded field strategies used to provide continuity of care after Katrina and, through qualitative analysis, extracted policy recommendations formulated by study participants. The major challenges to CD management were availability and affordability of prescription medications.7,8,26,27 Strategies that could ensure the immediate availability of medications postdisaster are predisaster stockpiling coupled with safe storage, and the staging of supplies in locations just outside the perimeter of a potential disaster area under imminent threat.8,27,28 Coordination of the receipt and distribution of medical/medication supplies is a key operational element in adequate CD management postdisaster. KIs advocated for a centralized structure for receiving supplies and medications, but a decentralized access model with patients retrieving medications at multiple community sites. Such a model is a recommended standard for the management of international drug donations. |
| Basu R. Environmental Health High ambient temperature and mortality: a review of epidemiologic studies from 2001 to 2008 | Basu R | 2009 | heat | high ambient temperature, mortality | This review examines recent evidence on mortality from elevated ambient temperature for studies published from January 2001 to December 2008. | previous research | quantitative assessment of previous literature | Thirty-six total studies were presented in three tables: 1) elevated ambient temperature and mortality; 2) air pollutants as confounders and/or effect modifiers of the elevated ambient temperature and mortality association; and 3) vulnerable subgroups of the elevated ambient temperature-mortality association. The evidence suggests that particulate matter with less than 10 um in aerodynamic diameter and ozone may confound the association, while ozone was an effect modifier in the warmer months in some locations. Nonetheless, the independent effect of temperature and mortality was withheld. Elevated temperature was associated with increased risk for those dying from cardiovascular, respiratory, cerebrovascular, and some specific cardiovascular diseases, such as ischemic heart disease, congestive heart failure, and myocardial infarction. Vulnerable subgroups also included: Black racial/ethnic group, women, those with lower socioeconomic status, and several age groups, particularly the elderly over 65 years of age as well as infants and young children. |
| Basu R Ostro B. Original Contribution A Multicounty Analysis Identifying the Populations Vulnerable to Mortality Associated with High Ambient Temperature in California. American Journal of Epidemiology, Volume 168, Issue 6, 15 September 2008, Pages 632–637, | Basu R Ostro B. | 2008 | heat | high ambient temperature | The association between ambient temperature and mortality has been established worldwide, including the authors' prior study in California. Here, they examined cause-specific mortality, age, race/ethnicity, gender, and educational level to identify subgroups vulnerable to high ambient temperature. They obtained data on nine California counties from May through September of 1999-2003 from the National Climatic Data Center (county-wide weather) and the California Department of Health Services (individual mortality). Using a time-stratified case-crossover approach, they obtained county-specific estimates of mortality, which were combined in meta-analyses. A total of 231,676 nonaccidental deaths were included. Each 10°F (~4.7°C) increase in mean daily apparent temperature corresponded to a 2.6% (95% confidence interval (CI): 1.3, 3.9) increase for cardiovascular mortality, with the most significant risk found for ischemic heart disease. Elevated risks were also found for persons at least 65 years of age (2.2%, 95% CI: 0.04, 4.0), infants 1 year of age or less (4.9%, 95% CI: À1.8, 11.6), and the Black racial/ethnic group (4.9%, 95% CI: 2.0, 7.9). No differences were found by gender or educational level. To prevent the mortality associated with ambient temperature, persons with cardiovascular disease, the elderly, infants, and Blacks among others should be targeted. | They obtained data on nine California counties from May through September of 1999-2003 from the National Climatic Data Center (county-wide weather) and the California Department of Health Services (individual mortality). Hourly weather data were obtained from the National Climatic Data Center, National Oceanic and Atmospheric Administration (13). We calculated the mean daily apparent temperature in degrees Fahrenheit (°F), also known as the heat index, to incorporate the effects of both temperature and relative humidity using formulas published previously (10). | Using a time-stratified case-crossover approach, they obtained county-specific estimates of mortality, which were combined in meta-analyses. | A total of 231,676 nonaccidental deaths were included. Each 10°F (~4.7°C) increase in mean daily apparent temperature corresponded to a 2.6% (95% confidence interval (CI): 1.3, 3.9) increase for cardiovascular mortality, with the most significant risk found for ischemic heart disease. Elevated risks were also found for persons at least 65 years of age (2.2%, 95% CI: 0.04, 4.0), infants 1 year of age or less (4.9%, 95% CI: À1.8, 11.6), and the Black racial/ethnic group (4.9%, 95% CI: 2.0, 7.9). No differences were found by gender or educational level. To prevent the mortality associated with ambient temperature, persons with cardiovascular disease, the elderly, infants, and Blacks among others should be targeted. |

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| Becker-Blease K Turner H Finkelhor D. Disasters, Victimization, and Children's Mental Health. Child Development 2010 vol: 81 (4) pp: 1040-1052 | Becker-Blease K Turner H Finkelhor D | 2010 | children | children, mental health, disasters | In a representative sample of 2,030 U.S. children aged 2–17, 13.9% report lifetime exposure to disaster, and 4.1% report experiencing a disaster in the past year. Disaster exposure was associated with some forms of victimiza-tion and adversity. Victimization was associated with depression among 2- to 9-year-old disaster survivors, and with depression and aggression among 10- to 17-year-old disaster survivors. Children exposed to either victimization only or both disaster and victimization had worse mental health compared to those who experi-enced neither. More research into the prevalence and effects of disasters and other stressful events among chil-dren is needed o better understand the interactive risks for and effects of multiple forms of trauma. | This research is based on data from the Devel-opmental Victimization Survey (DVS), designed to obtain 1-year incidence estimates of a comprehen-sive range of childhood victimizations across gen-der, race, and developmental stage. The survey, conducted between December 2002 and February 2003, assessed the experiences of a nationally rep-resentative sample of 2,030 children aged 2–17 living in the contiguous United States. | We used 2002 Census estimates (U.S. Census Bureau, 2000) to apply poststratification weights to adjust for the underrepresentation of Blacks and Hispanics in our sample relative to the national population. In tests of group differences, children who had experienced any incident within a victimization domain (sexual assault, maltreatment, witness domestic violence, other major violence) were included in that category of victimization and in the category of ''any victimization.'' To test for associations between experiencing a disaster and victimization (Hypothesis 2), we con-ducted chi-square analyses to examine associations between lifetime disaster, victimization, adversity experience. We also used partial correlation to test for associations among disaster exposure, adversity, any victimization, sexual victimization, maltreat-ment, domestic violence, and other major violence, controlling for age. For Hypothesis 3, we ran regression analyses with victimization and control variables predicting mental health symptoms among participants who reported experiencing a disaster. For Hypothesis 4, we used analysis of covariance (ANCOVA) to compare mental health symptoms among four groups: no disaster or victimization, disaster only, victimization only, and both disaster and victimization, controlling for demographic fac-tors. Bonferroni-corrected contrasts were used to identify significant differences among the four groups. Regression analyses were used to identify pre-dictors of mental health symptoms when group dif-ferences indicated greater symptoms among disaster victims relative to peers who did not expe-rience disaster. In these analyses, victimization was calculating by summing the number of reported incidents across the four domains assessed. The theoretical range was 0–20 and participants reported between 0 and 12 incidents (M = 0.82, SD = 1.52). Adversity scores were obtained by giv-ing a score of 1 for each type of adversity that the child had ever experienced and summing to form a continuous score. Race and ethnicity was coded into four groups: White and non-Hispanic, Black and non-Hispanic, Other Race and non-Hispanic, and Hispanic. Family structure was coded into three groups: single parent, stepparent household, and two biological or adoptive parents. To con-struct an index of SES, income and parental educa-tion scores were separately standardized, summed and then restandardized. When either income or education data were missing, the SES score is based on the variable available. | Based on the analysis with weighted data, 281 or 13.9% of children and teens had been in a disaster during their lifetime, and 4.1% of the sample expe-rienced a disaster in the past year. By comparison, 13.7% reported sexual victimization, 20.0% reported maltreatment, 10.6% reported witnessing family violence, and 17.3% reported witnessing other major violence within their lifetimes. In total, 36.4% reported experiencing at least one victimization incident. Age at the time of disaster ranged from < 1 year old through 16 years old. Of those who had experienced a disaster in their lifetime, 24.6% reported experiencing more than one. |
| Berry H, Bowen K, Kjellstrom T. Climate change and mental health: a causal pathways framework. Int J Public Health (2010) 55:123–132. | Berry H, Bowen K, Kjellstrom T | 2010 | mental hlth | climate change, mental hlth | Objectives Climate change will bring more frequent, long lasting and severe adverse weather events and these changes will affect mental health. We propose an explanatory framework to enhance consideration of how these effects may operate and to encourage debate about this important aspect of the health impacts of climate change. Methods Literature review. | Previous studies | quantitative assessments of previous research | Results Climate change may affect mental health directly by exposing people to trauma. It may also affect mental health indirectly, by affecting (1) physical health (for example, extreme heat exposure causes heat exhaustion in vulnerable people, and associated mental health consequences) and (2) community wellbeing. Within community, wellbeing is a sub-process in which climate change erodes physical environments which, in turn, damage social environments. Vulnerable people and places, especially in low-income countries, will be particularly badly affected. |
| Berry H, Hogan A, Owen J, Rickwood D, Fragar L. Climate Change and Farmers' Mental Health: Risks and Responses. Asia-Pacific Journal of Public Health Supplement to 2011 vol: 23 (2) pp: 119-132 | Berry H, Hogan A, Owen J, Rickwood D, Fragar L | 2011 | mental hlth | Climate Change, Farmers, Mental Health | Climate change is exacerbating climate variability, evident in more frequent and severe weather-related disasters, such as droughts, fires, and floods. Most of what is known about the possible effects of climate change on rural mental health relates to prolonged drought. But though drought is known to be a disproportionate and general stressor, evidence is mixed and inconclusive. Over time, like drought other weather-related disasters may erode the social and economic bases on which farming communities depend. Rural vulnerability to mental health problems is greatly increased by socioeconomic disadvantage. Related factors may compound this, such as reduced access to health services as communities decline and a "stoical" culture that inhibits help-seeking. Australia has the world's most variable climate and is a major global agricultural producer. Yet despite Australia's (and, especially, rural communities') dependence on farmers' well-being and success, there is very little-and inconclusive-quantitative evidence about farmers' mental health. The aim of this review is to consider, with a view to informing other countries, how climate change and related factors may affect farmers' mental health in Australia. That information is a prerequisite to identifying, selecting, and evaluating adaptive strategies, to lessen the risks of adverse mental health outcomes. The authors identify the need for a systematic epidemiology of the mental health of farmers facing increasing climate change-related weather adversity. The aim of this review is to consider, with a view to informing other countries, how climate change and related factors may affect farmers' mental health in Australia. That information is a prerequisite to identifying, selecting, and evaluating adaptive strategies, to lessen the risks of adverse mental health outcomes. The authors identify the need for a systematic epidemiology of the mental health of farmers facing increasing climate change-related weather adversity. | A range of electronic scientific databases, such as MedLine, ProQuest, and Web of Science, were searched to locate peer-reviewed publications featuring key search terms in 3 domains: (a ) climate change–related terms such as climate change, climate, weather, weather disaster, extreme weather event, drought, flood, cyclone, bushfire, and wildfire; AND (b ) mental health– related terms such as mental, mental health, mental disorder, affective disorder, mood disorder, depression, anxiety, general psychological distress, psychosis, hopelessness, despair, helpless-ness, suicide and PTSD; AND (c ) farmer-related terms such as farmer, farming, agriculture, and primary production. | quantitative assessments of previous research. With respect to mental well-being, rather than to mental disorders, the life satisfaction of 500 farmers and farm workers in drought was compared with that of the general rural population in a national study of 1202 adults42 using the Personal Wellbeing Index-Adult* (PWI-A).43 Statis-tically significant differences were evident between drought-affected farmers and the compara-tive sample of nonfarmers from rural Australia for 8 of the 9 domains of life satisfaction that comprise the PWI-A. | Drought, economic hardship, and out-migration (especially of the young) has left an aging farm population, altered the social structure of many rural communities,36 and had an adverse impact on personal and community morale.30 Additional climate change–related pres-sures facing farmers10 exacerbate the stresses inherent in farming.62,90 Farmers' poor sense of future is of considerable concern because of its possible links to hopelessness and suicide. While it is tempting to rush to causal inferences and, hence, policy interventions, we argue that farmers' mental health status, and its relationship to climate change–related factors, cannot be assumed but must be empirically studied. Emerging findings suggest that mental health problems might not be elevated among farmers as a group, relative to the general population—though averaged survey scores may mask systematic variation between types of farmer. Finally, the levels and sources of farmers' resilience must be considered, along with their place- and occupation-based vulnerability. The general population may have much to learn from rural Australia about main-taining well-being in the face of adversity. |
| Berry H Bowen K Kjellstrom T. Climate change and mental health: a causal pathways framework. International Journal of Public Health April 2010, Volume 55, Issue 2, pp 123–132 | Berry HL, Bowen K | 2010 | mental hlth | Climate change, mental hlth, causal pathways framework | Climate change will bring more frequent, long lasting and severe adverse weather events and these changes will affect mental health. We propose an explanatory framework to enhance consideration of how these effects may operate. Methods: Literature Review. Different types of extreme weather events appear to relate to somewhat different mental health impacts, particularly at onset. The link between extreme anxiety reactions (such as post-traumatic stress disorder, or PTSD) and acute weather disasters, such as floods (the most common disas- ters at global level), forest fires, heat waves and cyclones, is well established well established (e.g. Salcioglu et al. 2007). Symptomatology related to chronic loss and failure, such as helplessness depression, chronic psychological distress and generalized anxiety may be expected (Coelho et al. 2004). | Previous studies: (Salcioglu et al. 2007). (Coelho et al. 2004). (Brugha and Cragg 1990). Fritze et al. (2008). (Kjell- strom 2009a). (Higginbotham et al. 2007). (Norris et al. 2002). (Beaudoin 2007; Wickrama and Wickrama 2008). (Brearley 1929; Cheatwood 1995; Cohn et al. 2004). Bouchama et al. (2007). (Conger et al. 1992). (Coelho et al. 2004). (Judd et al. 2002; Smith et al. 2008). | quantitative assessments of previous research | Mental health is a major and growing global concern (Prince et al. 2007), likely constituting the second greatest burden of non-fatal disease by 2030 (Mathers and Loncar 2006), and we cannot ignore it. Within the mental health system, a graded spectrum of approaches, ranging from prevention and early intervention to treatment, is needed to properly respond to mental health needs from onset through recovery, especially for indigenous peoples. The WHO's pyramid (World Health Organization 2008a) for an optimal mix of services for mental health identifies an appropriate range: from self-care and informal community care; through mental health services via primary health care; community mental health services; and the most intensive interventions at the treatment end of the spectrum (long-stay facilities and specialist services). This pyramid is relevant and can be adapted to the needs of climate change-related mental health problems. |

| Bibliography | primary authors | year published | category | key words | abstract | data | analysis | results summary |
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| Booth S Z. Mercury, food webs, and marine mammals: Implications of diet and climate change for human health. | Booth S Z. | 2005 | toxins | mercury, food webs, diet, climate change, human hlth | We modeled the flow of methyl mercury, a toxic global pollutant, in the Faroe Islands marine ecosystem and compared average human methyl mercury exposure from consumption of pilot whale meat and fish (cod, *Gadus morhua* ) with current tolerable weekly intake (TWI) levels. Under present conditions and climate change scenarios, methyl mercury increased in the ecosystem, translating into increased human exposure over time. However, we saw greater changes as a result of changing fishing mortalities. A large portion of the general human population exceed the TWI levels set by the World Health Organization [WHO; 1.6 µg/kg body weight (bw)], and they all exceed the reference dose (RfD) of 0.1 µg/kg bw/day set by the U.S. Environmental Protection Agency (EPA; equivalent to a TWI of 0.7 µg/kg bw). As a result of an independent study documenting that Faroese children exposed prenatally to methyl mercury had reduced cognitive abilities, pregnant women have decreased their intake of whale meat and were below the TWI levels set by the WHO and the U.S. EPA. Cod had approximately 95% lower methyl mercury concentrations than did pilot whale. Thus, the high and harmful levels of methyl mercury in the diet of Faroe Islanders are driven by whale meat consumption, and the increasing impact of climate change is likely to exacerbate this situation. Significantly, base inflow rates of mercury into the environment would need to be reduced by approximately 50% to ensure levels of intake below the WHO TWI levels, given current levels of whale consumption. | previous research | We modeled the transfer of methyl mercury through the food web in the marine ecosystem of the Faroe Islands using Ecotracer, a novel routine of the trophic ecosystem modeling approach Ecopath with Ecosim (Christensen and Walters 2004). Using Ecotracer (Christensen and Walters 2004), we traced the transfer and bioaccumulation of methyl mercury through all ecosystem components (functional groups, composed of either individual species or species groups) based on diet transfers and direct uptake from the environment. | We deemed the human dietary intake of 12 g/person/day of pilot whale meat, as observed in the 1980s (Vestergaard and Zachariassen 1987), to be the representative intake for the general population, because availability based on supply was 14.8 g/person/day in 2000 (Hagstova føroya 2001). Although consumption may have declined in recent years, no study has documented a change in dietary intake for the general population, other than for pregnant women (Weihe et al. 2003). Based on the average dietary intake of whale meat (12 g/person/day) and cod (72 g/person/day), a large portion of the general adult population exceeded the WHO limit under all simulated conditions (Figure 3). At present, individuals with a body weight of < 102 kg are above the TWI level set by the WHO for methyl mercury (FAO/WHO 2003), based on seafood consumption alone. The calculated weekly intake for the general adult population also exceeded the U.S. EPA's limit (EPRI 2004) irrespective of body weight (Figure 3). Ocean temperature changes will increase the number of people above the WHO TWI level to individuals weighing < 105 kg and 107 kg for temperature increases of 0.4°C and 1.0°C, respectively, per century. Simulating a 20% decrease in fishing mortality resulted in members of the general population weighing < 117 kg being above the TWI set by WHO. Significantly, base environmental inflow rates of mercury would need to be reduced by approximately 50% (ignoring climate change scenarios) to ensure that levels of methyl mercury intake fall below the WHO TWI levels for current consumption patterns by the general population (Figure 3). Methyl mercury poses substantial health risks (Fujuki 1980; UNEP 2002), and concerns of non-point-source mercury pollution was highlighted by Grandjean et al. (1992, 1997), who documented cognitive impairments in young children exposed to elevated levels of methyl mercury prenatally. This exposure was linked to the consumption of whale meat by pregnant women. Of additional concern are the likely effects of climate change, resulting in even higher concentrations of contaminants in the marine food supply of Faroe Islanders. The increasing methylation rate due to higher water temperatures will lead to continuous increases in concentrations of methyl |
| Converse R Piehler M Noble R. Contrasts in concentrations and loads of conventional and alternative indicators of fecal contamination in coastal stormwater. Water Research Volume 45, Issue 16, 15 October 2011, Pages 5229-5240 | Converse R Piehler M Noble R. | 2011 | water quality | fecal contamination, stormwater | Fecal contamination in stormwater is often complex. Because conventional fecal indicator bacteria (FIB) cannot be used to ascertain source of fecal contamination, alternative indicators are being explored to partition these sources. As they are assessed for future use, it is critical to compare alternative indicators to conventional FIB under a range of storm-water delivery conditions. In this study, conventional FIB and fecal Bacteroides spp. were monitored throughout the duration of five storm events from coastal stormwater outfalls in Dare County, North Carolina, USA to characterize relationships among FIB concentrations , alternative fecal markers, and loading of contaminants. | Water samples were collected multiple times during each storm and analyzed for Enterococcus sp. and Escherichia coli using enzymatic tests and fecal Bacteroides spp. by QPCR. Both conventional FIB and fecal Bacteroides spp. concentrations in stormwater were generally high and extremely variable over the course of the storm events. | | Over the very short distances between sites, we observed statistically significant spatial and temporal variability, indicating that stormwater monitoring based on single grab-samples is inappropriate. Loading of FIB and fecal Bacteroides spp. appeared to be affected differently by various hydrologic factors. Specifically, Spearman correlations between fecal Bacteroides spp. and drainage area and antecedent rainfall were lower than those between conventional FIB and these hydrologic factors. Furthermore, the patterns of fecal Bacteroides spp. concentrations generally increased over the duration of the storms, whereas E. coli and Enterococcus sp. concentrations generally followed the patterns of the hydrograph, peaking early and tailing off. Given the greater source-specificity and limited persistence of fecal Bacteroides spp. in oxygenated environments, differences in these patterns suggest multiple delivery modes of fecal contamination (i.e. landscape scouring versus groundwater discharge). |
| Cozzetto K Chief K Dittmer K Brubaker M Gough R Souza K Ettawageshik F Wotkyns S Opitz-Stapleton S Duren S Chavan P Koppel Maldonado J Pandya R Colombi B Souza PRiMO K. Climate change impacts on the water resources of American Indians and Alaska Natives in the U.S. Climatic Change 2013 vol: 120 pp: 569-584 | Cozzetto K Chief K Dittmer K Brubaker M Gough R | 2013 | water | water resources, indigenous people, climate change | This paper provides an overview of climate change impacts on tribal water resources and the subsequent cascading effects on the livelihoods and cultures of American Indians and Alaska Natives living on tribal lands in the U.S. A hazards and vulnerability framework for understanding these impacts is first presented followed by context on the framework components, including climate, hydrologic, and ecosystem changes (i.e. hazards) and tribe-specific vulnerability factors (socioeconomic, political, infrastructural, environmental, spiritual and cultural), which when combined with hazards lead to impacts. Next regional summaries of impacts around the U.S. are discussed. Although each tribal community experiences unique sets of impacts because of their individual history, culture, and geographic setting, many of the observed impacts are common among different groups and can be categorized as impacts on-1) water supply and management (including water sources and infrastructure), 2) aquatic species important for culture and subsistence, 3) ranching and agriculture particularly from climate extremes (e.g., droughts, floods), 4) tribal sovereignty and rights associated with water resources, fishing, hunting, and gathering, and 5) soil quality (e.g., from coastal and riverine erosion prompting tribal relocation or from drought-related land degradation). The paper finishes by highlighting potentially relevant research questions based on the five impact categories. | previous research | quantitative assessments of previous research | From the discussion above, it is evident that tribes have an urgent need to prepare for and respond to climate change impacts and that tribes as well as non-tribal entities supporting such efforts need to do so in a way that considers cultural values. In addressing these issues, it is important to take into account not only climate hazards but also socioeconomic, political, and other factors (Fig. 2) that contribute both to a community's vulnerability and adaptive capacity. In the supplemental section, we have provided an extensive table (Table S6) with general categories of actions that could increase the adaptive capacity of tribes, how they relate to contributing hazard and vulnerability factors, and examples of such actions currently taking place. More specifically, Native American tribes need relevant and culturally appropriate (supplemental Sec. 5) monitoring, assessment, and research on their waters and lands and to develop or be included in the development of contingency, management, and mitigation plans. Tribes also greatly need actual implementation of projects. Although climate change preparedness can take place as a stand-alone effort, climate change considerations can be included as part of planning and implementation that is already occurring |
| Craun G Brunkard J Yoder J Roberts V Carpenter J Wade T Calderon R Roberts J Beach M Roy S. Causes of outbreaks associated with drinking water in the US from 1971 to 2006. CLINICAL MICROBIOLOGY REVIEWS 2010 vol: 23 (3) pp: 507-528 | Craun G Brunkard J Yoder J Roberts V Carpenter J Wade T Calderon R Roberts J Beach M Roy S. | 2010 | water quality | outbreaks, drinking water | Since 1971, the CDC, EPA, and Council of State and Territorial Epidemiologists (CSTE) have maintained the collaborative national Waterborne Disease and Outbreak Surveillance System (WBDOSS) to document waterborne disease outbreaks (WBDOs) reported by local, state, and territorial health departments. WBDOs were recently reclassified to better characterize water system deficiencies and risk factors; data were analyzed for trends in outbreak occurrence, etiologies, and deficiencies during 1971 to 2006. A total of 833 WBDOs, 577,991 cases of illness, and 106 deaths were reported during 1971 to 2006. Trends of public health significance include (i) a decrease in the number of reported outbreaks over time and in the annual proportion of outbreaks reported in public water systems, (ii) an increase in the annual proportion of outbreaks reported in individual water systems and in the proportion of outbreaks associated with premise plumbing deficiencies in public water systems, (iii) no change in the annual proportion of outbreaks associated with distribution system deficiencies or the use of untreated and improperly treated groundwater in public water systems, and (iv) the increasing importance of *Legionella* since its inclusion in WBDOSS in 2001. Data from WBDOSS have helped inform public health and regulatory responses. Additional resources for waterborne disease surveillance and outbreak detection are essential to improve our ability to monitor, detect, and prevent waterborne disease in the United States. | Data were analyzed for trends in outbreak occurrence, etiologies, and deficiencies during 1971 to 2006. A total of 833 WBDOs, 577,991 cases of illness, and 106 deaths were reported during 1971 to 2006. Trends of public health significance include (i) a decrease in the number of reported outbreaks over time and in the annual proportion of outbreaks reported in public water systems, (ii) an increase in the annual proportion of outbreaks reported in individual water systems and in the proportion of outbreaks associated with premise plumbing deficiencies in public water systems, (iii) no change in the annual proportion of outbreaks associated with distribution system deficiencies or the use of untreated and improperly treated groundwater in public water systems, and (iv) the increasing importance of *Legionella* since its inclusion in WBDOSS in 2001. | WBDOSS data were analyzed using SAS 9.1 (SAS Institute Inc., Cary, NC). Trends in counts over time were investigated using Poisson regression. Trends in proportions were analyzed using logistic regression. Exact logistic regression was used when data were too sparse or skewed to assume large sample approximations. The chi-square test for equality of proportions was used to assess seasonal differences. Statistical significance was defined as a *P* value of <0.0500. | A total of 833 outbreaks associated with drinking water, water not intended for drinking, and water of unknown intent; 577,991 cases of illness; and 106 deaths reported during 1971 to 2006 met the criteria for inclusion in WBDOSS and are included in this review. WBDOs were reported in 48 states, Puerto Rico, the U.S. Virgin Islands, the Northern Mariana Islands, Palau, and the Republic of the Marshall Islands (Fig. (Fig.1).1). Included in the count of outbreaks are 15 single-case events where acute symptoms occurred shortly after water consumption and high levels of chemicals were identified in the water. Almost all of the reported outbreaks (n = 780 [93.6%], including 15 single-case chemical events), cases (n = 577,094, 99.8%), and deaths (n = 93, 87.7%) were associated with the contamination of drinking water. Forty-seven outbreaks (5.6%), 861 cases (0.1%), and 13 deaths (12.3%) were associated with water not intended for drinking; six outbreaks (0.7%) and 36 cases (<0.1%) were associated with water of unknown intent. |
| Curriero F Patz J Rose J Lele S. Association between Extreme precipitation and waterborne disease outbreaks in the US, 1948-1994. Public Health 2001 vol: 91 (8) pp: 1194-1199 | Curriero F Patz J Rose J Lele S. | 2001 | stormwater | extreme precipitation, water-borne, disease outbreak | Rainfall and runoff have been implicated in site-specific waterborne disease outbreaks. Because upward trends in heavy precipitation in the United States are projected to increase with climate change, this study sought to quantify the relationship between precipitation and disease outbreaks. | The US Environmental Protection Agency waterborne disease database, totaling 548 reported outbreaks from 1948 through 1994, and precipitation data of the National Climatic Data Center were used to analyze the relationship between precipitation and waterborne diseases. | Analyses were at the watershed level, stratified by groundwater and surface water contamination and controlled for effects due to season and hydrologic region.A Monte Carlo version of the Fisher exact test was used to test for statistical significance. | Fifty-one percent of waterborne disease outbreaks were preceded by precipitation events above the 90th percentile (P = .002), and 68% by events above the 80th percentile (P = .001). Outbreaks due to surface water contamination showed the strongest association with extreme precipitation during the month of the outbreak; a 2-month lag applied to groundwater contamination events. Conclusions. The statistically significant association found between rainfall and disease in the United States is important for water managers, public health officials, and risk assessors of future climate change. |

| Bibliography | primary authors | year published | category | key words | abstract | data | analysis | results summary |
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| Das, T., Maurer, E. P., Pierce, D. W., Dettinger, M. D. & Cayan, D. R. Increases in flood magnitudes in California under warming climates. *J. Hydrol.* 501, 101–110 (2013). | Das T, Maurer EP | 2013 | flooding | Increase flood magnitude, CA, warming climates | 3-day peak flow used to measure flood planning historically, based on output from three global climate models using single greenhouse gas emission scenerio a robust increase in 21st century was found (CA DWR 2006; Chung et al. 2009; Das et al. 2011;). Expand flood analysis to include to emission scenerios, one with hig A2 (as in Das et al. 2011) and one with lower atmosp. Concentrations of greenhouse gases (SRES B1). | Temp and precip data from Surface Water Modeling Group at Univ. of Washington (http://www.hydro.washington.edu); Spatial resolution see Maurer et al. (2002) and Hamlet and Lettenmaier (2005) NOAA . Wind speed data from National Centers for Environmental Prediction/National Center for Atmospheric Research (NCEP– NCAR) reanalysis (Kalnay et al., 1996). | Focused on changes in flood magnitude with specific recurrence intervals. For every member of the group of routed flows, 3-day maximum discharges identified for each yr. Probabilities of exceedance (using Weibull plotting position) for return periods estimated. Weibull plotting fit with standard theoretical frequency distribution to compare flood magnitudes. Inverse of the probability (frequency factor, K) calculated for each group member and study period. Log-Pearson III distribution assumed as the theoritical distribution in the calculation. K values plotted against the base 10 logarithm of the 3-day max streamflow. | Results showed variability in peak flow projection increases through the 21st century, variability manifested in one direction, with more extreme high peak flows. For the SRES B1 emissions pathway, this degree of increase in peak flows is not attained until late in the 21st century for the Southern Sierra, and is not achieved during the 21st century for the Northern Sierra. This illustrates the potential benefits in terms of reduced flooding from reducing emissions but also shows the uncertainties. SRES A2 scenerio indicated that more than 75% of the ensemble members yield 50-year flood increases by the 49-year window centered on 2025. |
| Dennekamp M Abramson M. The effects of bushfire smoke on respiratory health. Respirology<br>2011 vol: 16 (2) pp: 198-209 | Dennekamp M Abramson M. | 2011 | fire | bushfire smoke, respiratory health | Bushfire smoke has the potential to affect millions of people and is therefore a major public health problem. The air pollutant that increases most significantly as a result of bushfire smoke is particulate matter (PM). During bushfire smoke episodes, PM concentrations are usually much higher than urban background concentrations, at which effects on respiratory health have been observed. The smoke can cover large areas including major cities and even small increases in the risk of respiratory health effects can cause large public health problems. The association between respiratory morbidity and exposure to bushfire smoke is consistent with the associations found with urban air pollution. Although using different methods, all studies looking at Emergency Department presentations in relation to a bushfire smoke event have found associations and most studies have also found an association with hospital admissions. However, only a few studies have distinguished between the effects of bushfire PM10 (particles with a median aerodynamic diameter less than 10 μm) and background PM10. These studies suggest that PM10 from bushfire smoke is at least as toxic as urban PM10, but more research is needed. | Previous Research: In this review, we will summarize the literature on the respiratory health effects of bushfire smoke. We will first summarize the literature available in the Asia–Pacific region, followed by studies from North America and Europe. | quantitative assessment of previous literature | The peer-reviewed literature to date suggests that there is a modest association between bushfire smoke and respiratory health. For example, a comprehensive Australian study over several years found an increase in hospital admissions of 1.2% for each 10 μg/m3 increase in PM10 from bushfire smoke.14 Estimating the overall effects of bushfire smoke on asthma, COPD or mortality is complicated because of the different methods used in the studies. |
| Depla AV, Jung E, Baures M T. Impacts of climate change on surface water quality in relation to drinking water production. Environmental Internatioal Volume 35, Issue 8, November 2009, Pages 1225-1233 | Depla AV, Jung E, Baures M T. | 2009 | water quality | climate change, drinking water | Besides climate change impacts on water availability and hydrological risks, the consequences on water quality is just beginning to be studied. This review aims at proposing a synthesis of the most recent existing interdisciplinary literature on the topic. After a short presentation about the role of the main factors (warming and consequences of extreme events) explaining climate change effects on water quality, the focus will be on two main points. First, the impacts on water quality of resources (rivers and lakes) modifying parameters values (physico-chemical parameters, micropollutants and biological parameters) are considered. Then, the expected impacts on drinking water production and quality of supplied water are discussed. The main conclusion which can be drawn is that a degradation trend of drinking water quality in the context of climate change leads to an increase of at risk situations related to potential health impact. | Previous studies | quantitative assessments of previous research and modelling | The climate change impacts on drinking water treatment issues can be summarized in Fig. 2. Remind that climate change may cause at the resource level (surface water), huge hydrologic variations, water temperature rise and increases of pollution load (chemical and microbiological). For treatment plants, considering that all remediation actions have been made (pollution source reduction, run off limitation, fertilizers and pesticides reduction management, etc.), adaptation measures must be envisaged for a better efficiency, particularly with regards to extreme events (heavy rainfalls and droughts). These measures integrate complementary treatment steps and process control even for small water supply systems. Moreover, water quality monitoring with analysis of micropollutants among which emerging substances and treatment by products must be carry out, as well as health risk assessment (following the water safety plan procedure). Obviously, in case of severe floods, transportation of bottles or tanks may be the only solution for safe drinking water supply. |
| Dominici F, Peng R, Bell M, Pham L, McDermott A, Zeger S, Samet J. Fine Particulate Air Pollution and Hospital Admission for Cardiovascular and Respiratory Diseases. JAMA 2006 vol: 295 (10) pp: 1127-1134 | Dominici F, Peng R, Bell M, Pham L, McDermott A, Zeger S, Samet J | 2006 | air quality | Fine Particulate Air Pollution, Hospital Admission, Cardiovascular and Respiratory Diseases | Evidence on the health risks associated with short-term exposure to fine particles (particulate matter ≤2.5 μm in aerodynamic diameter [PM 2.5 ]) is limited. Results from the new national monitoring network for PM 2.5 make possible systematic research on health risks at national and regional scales. | Design, Setting, and Participants-A national database comprising daily time-series data daily for 1999 through 2002 on hospital admission rates (constructed from the Medicare National Claims History Files) for cardiovascular and respiratory outcomes and injuries, ambient PM 2.5 levels, and temperature and dew-point temperature for 204 US urban counties (population >200 000) with 11.5 million Medicare enrollees (aged >65 years) living an average of 5.9 miles from a PM 2.5 monitor. The PM2.5 and ozone data were obtained from the EPA's Aerometric Information Retrieval Service (now referred to as the Air Quality System database). | This analysis is based on daily counts of hospital admissions for 1999–2002 obtained from billing claims of Medicare enrollees. To calculate hospitalization rates, we Dominici et al. constructed a time series of the numbers of individuals at risk in each county for each day. The analysis was restricted to the 204 US counties with populations larger than 200 000. Of these 204 counties, 90 had daily PM2.5 data across the study period and the remaining counties had PM2.5 data collected once every 3 days for at least 1 full year. The locations of the 204 counties appear in Figure 1. The counties were clustered into 7 geographic regions by applying the K-means clustering algorithm tolongitude and latitude for the counties. We applied Bayesian 2-stage hierarchical models14–16 to estimate county-specific, region-specific, and national average associations between day-to-day variation of PM2.5 (at lags 0, 1, and 2 days) and day-to-day variation in the county-level hospital admission rates, accounting for weather, seasonality, and long-term trends. In the first stage, single lag and distributed lag overdispersed Poisson regression models 21,22 were used for estimating county-specific RRs of hospital admissions associated with ambient levels of PM2.5 . In the second stage, to produce a national average estimate of the short-term association between PM2.5 and hospital admissions, we used Bayesian hierarchical models. To explore effect modification of air pollution risks by location-specific characteristics, we fitted a weighted linear regression model with the dependent variable as the location-specific RR estimate and the independent variable as the location-specific characteristic.The county and regional averages of PM2.5 concentration, ozone concentration, and temperature for 2000 through 2002 were calculated as potential modifiers. A regional average was calculated by using all of the county-specific concentrations within the region. Finally, the annual reduction in hospital admissions (H) attributable to a 10-μg/m3 reduction in the daily PM2.5 level for the 204 counties by cause-specific admissions were calculated. | There was a short-term increase in hospital admission rates associated with PM2.5 for all of the health outcomes except injuries. The largest association was for heart failure, which had a 1.28% (95% confidence interval, 0.78%–1.78%) increase in risk per 10-μg/m3 increase in same-day PM2.5 . Cardiovascular risks tended to be higher in counties located in the Eastern region of the United States, which included the Northeast, the Southeast, the Midwest, and the South. |
| Donatuto J Grossman E Konovsky J Grossman S Campbell L. Indigenous Community Health and Climate Change: Integrating Biophysical and Social Science Indicators. Coastal Management 2014 vol: 42 (4) pp: 355-373 | Donatuto J Grossman E Konovsky J Grossman S Campbell L. | 2014 | vulnerable pop. | climate impacts, indigenous peopple, health | This article describes a pilot study evaluating the sensitivity of Indigenous community health to climate change impacts on Salish Sea shorelines (Washington State, United States and British Columbia, Canada). Current climate change assessments omit key community health concerns, which are vital to successful adaptation plans, particularly for Indigenous communities. Descriptive scaling techniques, employed in facilitated workshops with two Indigenous communities, tested the efficacy of ranking six key indicators of community health in relation to projected impacts to shellfish habitat and shoreline archaeological sites stemming from changes in the biophysical environment. Findings demonstrate that: when shellfish habitat and archaeological resources are impacted, so is Indigenous community health; not all community health indicators are equally impacted; and, the community health indicators of highest concern are not necessarily the same indicators most likely to be impacted. Based on the findings and feedback from community participants, exploratory trials were successful; Indigenousspecific health indicators may be useful to Indigenous communities who are assessing climate change sensitivities and creating adaptation plans. | The U.S. Environmental Protection Agency and Environment Canada have identified a number of environmental indicators to evaluate the health and trends of the transboundary Salish Sea water body (Puget Sound Partnership 2012; USEPA 2013). Swinomish selected shellfish beds and shoreline armoring as indicators. Swinomish has an established shellfish and nearshore monitoring program with nearly two decades of data<br>on shellfish density, species composition, and shorelines profiles for several Reservation<br>beaches. | Researchers synthesized digital datasets representing shellfish biomass, sediment characteristics, beach elevation, and shoreline armoring from existing sources to model climate change impacts to the chosen environmental indicators in each community (Table 1). Datasets were compiled into an Environmental Systems Research Institute geographic information systems (GIS) database and plotted using ArcGIS 10.1. Each community analyzed how community health, as presented in the IHIs, may be connected to the chosen environmental indicators. This task was primarily a literature review<br>combined with ground-truthing via interviews with community knowledge holders. Project staff evaluated each IHI in the context of current community health data, current environmental indicator data, and how community members might define and assess each IHI. | The analyses of environmental indicators focused on examining likely impacts of climate change on tribal shellfish and archeological resources. While sophisticated numerical models are required to forecast changes in shoreline morphology, this project used a simple estimate of projected sea-level rise inundation to test the utility of integrating environmental indicators with community health indicators. Based on the mapping exercise, Lone Tree Point currently has 11.0 hectares of harvestable shellfish area situated across a low-sloping "low tide terrace" and a relatively steep mid and upper beach face. With a projected sea-level rise of 1.29 meters by 2100, the lowest extent of the harvest band across the low-tide terrace will become subtidal and inaccessible, and the upper harvest band will migrate landward where (lack of) armoring allows. Shellfish beds could be reduced to 8.0 hectares by the change in inundation alone by the year 2100, a 27% reduction driven primarily by inundation and loss of the large low-tide terrace area commonly accessed today (Figure 3). This is likely an underestimate of impacts to shellfish and harvest area, as armoring can enhance scour that leads to substrate coarsening (Kraus and McDougal 1996), which indirectly increases the resuspension of fine sediment, both of which are unfavorable for shellfish. At Tsleil-Waututh, the analyses of environmental indicators examined the impacts of climate change on community shellfish resources and archeological sites. The same caveats for the Swinomish analyses of environmental indicators apply. The results show a loss of 75% of current intertidal shellfish habitat, and damage to the majority of the archeological sites along the shoreline. |

| Bibliography | primary authors | year published | category | key words | abstract | data | analysis | results summary |
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| Donner W Rodriguez H. Population Composition, Migration and Inequality: The Influence of Demographic Changes on Disaster Risk and Vulnerability. Social Forces 2008 vol: 87 (2) pp: 1089-1114 | Donner W Rodriguez H. | 2008 | vulnerable pop. | Population Composition, Migration, Inequality, Demographics, Disaster Risk, Vulnerability | The changing demographic landscape of the United States calls for a reassessment of the societal impacts and consequences of so called "natural" and technological disasters. An increasing trend towards greater demographic and socio-economic diversity (in part due to high rates of international immigration), combined with mounting disaster losses, have brought about a more serious focus among scholars on how changingpopulation patterns shape the vulnerability and resiliency of social systems. Recent disasters, such as the Indian Ocean Tsunami (2004) and Hurricane Katrina (2005), point to the differential impacts of disasters on certain communities, particularly those that do not have the necessary resources to cope with and recoverfrom such events. 7his paper interprets these impacts within the context of economic, cultural, and social capital, as well as broader human ecological forces. The paper also makes important contributions to the social science disaster research literature by examining population growth, composition, and distribution in the context of disaster risk and vulnerability. Population dynamics (e.g., population growth, migration, and urbanization) areperhaps one of the most importantfactors that have increased our exposure to disasters and have contributed to the devastating impacts of these events, as the case of Hurricane Katrina illustrates. Nevertheless, the scientific literature exploring these issues is quite limited. We argue that if wefail to acknowledge and act on the mounting evidence regarding population composition, migration, inequality, and disaster vulnerability, we will continue to experience disasters with greater regularity and intensity. | previous research | quantitative assessment of previous literature | Events such as Hurricane Andrews and, more recently, Hurricane Katrina, illustrate how disasters can be amplified by demographic and socio economic factors. The devastating results of these disasters - and, to be sure, any disaster - were a result of the intersection of poverty (in some cases, chronic poverty), decades of neglect and years of discrimination and racism, exacerbated by the changing composition of coastal communities in the region. Economic, cultural and social capital, as well as human ecological trends, held equal hands in placing some population groups at greater risk. Theoretically, however, the problem is much more complex and, at times, vulnerabilities are a result of multiple forms of social capital. The forms of capital discussed earlier seem to interact and the distinctions, at times, seem more analytical than empirical. One such example involves poorer groups' relegation to at-risk areas - near levees, the inner cities and coastal industry. Living in such areas is an immediate source of risk; therefore, we might be inclined to trace this to human ecological dynamics. Capitalism and urbanization, driving the need for new industrial and commercial sectors, forces people into dangerous areas. But it is often the poor who live in such regions, making the problem as much an issue of human ecology as economic capital. |
| Fann N, Lamson A, Anenberg S, Wesson K, Risley D, Hubbell B. Estimating the National Public Health Burden Associated with Exposure to Ambient PM2.5 and Ozone. Risk Analysis 2012 vol: 32 (1) pp: 81-95 | Fann N, Lamson A, Anenberg S, Wesson K, Risley D, Hubbell B | 2012 | air quality | Public Health Burden, Ambient PM2.5, Ozone | Ground-level ozone (O3) and fine particulate matter (PM2.5) are associated with increased risk of mortality. We quantify the burden of modeled 2005 concentrations of O3 and PM2.5 on health in the United States. We use the photochemical Community Multiscale Air Quality (CMAQ) model in conjunction with ambient monitored data to create fused surfaces of summer season average 8-hour ozone and annual mean PM2.5 levels at a 12 km grid resolution across the continental United States. Employing spatially resolved demographic and concentration data, we assess the spatial and age distribution of air-pollution-related mortality and morbidity. For both PM2.5and O3 we also estimate: the percentage of total deaths due to each pollutant; the reduction in life years and life expectancy; and the deaths avoided according to hypothetical air quality improvements. Using PM2.5 and O3mortality risk coefficients drawn from the long-term American Cancer Society (ACS) cohort study and National Mortality and Morbidity Air Pollution Study (NMMAPS), respectively, we estimate 130,000 PM2.5-related deaths and 4,700 ozone-related deaths to result from 2005 air quality levels. Among populations aged 65–99, we estimate nearly 1.1 million life years lost from PM2.5 exposure and approximately 36,000 life years lost from ozone exposure. Among the 10 most populous counties, the percentage of deaths attributable to PM2.5 and ozone ranges from 3.5% in San Jose to 10% in Los Angeles. These results show that despite significant improvements in air quality in recent decades, recent levels of PM2.5 and ozone still pose a nontrivial risk to public health. | We use the photochemical Community Multiscale Air Quality (CMAQ) model in conjunction with ambient monitored data to create fused surfaces of summer season average 8-hour ozone and annual mean PM2.5 levels at a 12 km grid resolution across the continental United States. Employing spatially resolved demographic and concentration data, we assess the spatial and age distribution of air-pollution-related mortality and morbidity. | We estimate the number of adverse health outcomes associated with population exposure to air pollution using a health impact function. The health impact function used in this analysis has four components: the change in air quality, the affected population, the baseline incidence rate, and the effect estimate drawn from the epidemiological studies. We utilize the CMAQ model(7) to estimate annual PM2.5 and summer season ozone concentrations for the year 2005 for a horizontal grid covering the continental United States at a 12 km resolution. The CMAQ model is a nonproprietary computer model that simulates the formation and fate of photochemical oxidants, including PM2.5 and ozone, for given input sets of meteorological conditions and emissions. We improve the accuracy of the air quality data used in this analysis by combining the CMAQ-modeled PM2.5 and ozone concentrations with ambient monitored PM2.5 and ozone measurements to create “fused” spatial surfaces for the domain shown in Figs. 1 and 2. We performed the fusion using the EPA's Model Attainment Test Software (MATS),(16) which employs the Voronoi neighbor averaging interpolation technique. We calculate the total public health burden attributable to PM2.5 and ozone relative to “nonanthropogenic background” concentrations of summer-season ozone and annual mean PM2.5 concentrations that would occur in the absence of anthropogenic emissions in the United States, Canada, and Mexico.(18) We identified two options to specifying these background levels. The first option was to apply PM2.5 and ozone levels observed from monitors in remote locations. In that analysis, the authors applied GEOS-Chem, a global circulation model, to model ozone formation due to emissions originating outside of the United States. We aggregate U.S. Census block-level population data(21) to the national 12 km CMAQ modeling domain. We stratify population for the year 2000 by age, sex, race, and ethnicity categories corresponding to the demographic classifications considered in the health impact functions (see later) and project these data to 2005 using an economic forecasting model. We estimate impacts to several PM2.5-related human health endpoints, including premature deaths from long-term exposure, respiratory and cardiovascular-related hospital visits, asthma-related emergency department visits, chronic bronchitis, and nonfatal heart attacks among others. | We predict over 100,000 PM2.5-related premature mortalities and tens of thousands of ozone-related premature mortalities to result from 2005 air quality levels (Table I).7 We estimate over double the PM2.5-related mortalities using a risk estimate drawn the Laden et al. (2006)(27) H6C-based study as compared to the ACS-based Krewski et al. (2009).(2) We estimate about four times the number of ozone-related mortalities using the Jerrett et al. (2009) long-term respiratory mortality risk estimate as compared to the Bell et al. (2004) short-term mortality risk nonaccidental estimate. We also estimate an array of morbidity impacts, including almost 200,000 PM2.5-related nonfatal acute myocardial infarctions, tens of thousands of PM2.5 and ozone-related hospitalizations and emergency department visits, and hundreds of thousands of PM2.5-related cases of acute bronchitis. |
| Fann N, Nolte C, Dolwick P, Spero T, Brown A, Phillips S, Anenberg S. The geographic distribution and economic value of climate change-related ozone health impacts in the United States in 2030. Journal of the Air & Waste Management Association 2015 vol: 65 (5) pp: 570-580 | Fann N, Nolte C, Dolwick P, Spero T, Brown A, Phillips S, Anenberg S | 2015 | air quality | geographic distribution, economic value, climate change, ozone health impacts | In this United States-focused analysis we use outputs from two general circulation models (GCMs) driven by different greenhouse gas forcing scenarios as inputs to regional climate and chemical transport models to investigate potential changes in near-term U.S. air quality due to climate change. We conduct multiyear simulations to account for interannual variability and characterize the near-term influence of a changing climate on tropospheric ozone-related health impacts near the year 2030, which is a policy-relevant time frame that is subject to fewer uncertainties than other approaches employed in the literature. We adopt a 2030 emissions inventory that accounts for fully implementing anthropogenic emissions controls required by federal, state, and/or local policies, which is projected to strongly influence future ozone levels. We quantify a comprehensive suite of ozone-related mortality and morbidity impacts including emergency department visits, hospital admissions, acute respiratory symptoms, and lost school days, and estimate the economic value of these impacts. Both GCMs project average daily maximum temperature to increase by 1–4°C and 1–5 ppb increases in daily 8-hr maximum ozone at 2030, though each climate scenario produces ozone levels that vary greatly over space and time. We estimate tens to thousands of additional ozone-related premature deaths and illnesses per year for these two scenarios and calculate an economic burden of these health outcomes of hundreds of millions to tens of billions of U.S. dollars (2010$). | We select among the existing suite of climate models, greenhouse gas forcing scenarios, and population projections to examine the scope, magnitude, spatial distribution and economic value of climate-change related air quality and health impacts in the year 2030 relative to meteorology in the year 2000. We quantify a comprehensive suite of ozone-related mortality and morbidity impacts including emergency department visits, hospital admissions, acute respiratory symptoms, and lost school days and estimate the economic value of these impacts. | Specifically, in this analysis we use multiple years within a time slice centered on 2030 from two GCMs and different climate forcing scenarios to account for different assumptions regarding the influence of future greenhouse gas concentrations on climate and to account for year-to-year variability in projected air quality impacts. We characterize the near-term influence of a changing climate on tropospheric ozone-related health impacts near the year 2030, which is a policy-relevant time frame that is subject to fewer uncertainties than previous studies that have focused on 2050 or later (e.g., Post et al., 2012Post, E.S., A. Grambsch, C.Weaver, P. Morefield, J. Huang, L.-Y. Leung, C.G. Nolte, et al. 2012. Variation in estimated ozone-related health impacts of climate change due to modeling choices and assumptions. *Environ. Health Perspect* . 120(11): 1559–64. doi:10.1289/ehp.1104271.[Crossref], [PubMed], [Web of Science ®], , [Google Scholar]). The historical and future climate WRF outputs were processed by the Meteorology–Chemistry Interface Processor (MCIP) (Otte and Pleim, 2010 Otte, T.L., and J.E. Pleim. 2010. Review of the governing equations, computational algorithms, and other components of the models—3 Community Multiscale Air Quality (CMAQ) modeling system. Appl. Mech. Rev. 59(2): 51. doi:10.1115/1.2128636. To assess how the climate-driven meteorological changes would impact near-surface ozone levels (i.e., concentrations within the lowest model layer, about 38 m deep) over the continental United States. The air quality modeling was also conducted at 36-km grid spacing. We assess health impacts associated with surface-level ozone in the 5969 36-km grid cells in the continental United States. In each grid cell, we apply a health impact function relating changes in ambient concentrations with ozone-related adverse outcomes. A log-linear health impact function, which we use to quantify most of the impacts in this analysis. To estimate the economic value of the health impacts of a changing climate on air quality, we assign a dollar value to the incidence of premature deaths and illnesses occurring in 2030. We derive both cost of illness (COI) and willingness to pay (WTP) measures from the published economic literature, which we then multiply by the counts of adverse health outcomes to express the economic value of these impacts. | Both the CESM/RCP 8.5 and GISS/RCP 6.0 scenarios are associated with large changes in daily maximum temperatures over the months when ozone levels tend to be highest over the United States. In both scenarios, average daily maximum temperatures are projected to increase by 1–4°C over a broad swath of the continental U.S. The locations of the largest projected temperature increases vary by scenario, and the average U.S. warming is greater in the CESM/RCP 8.5 scenario, as could be expected. Concurrently, other pollution-relevant weather variables (not shown) are also projected to change. The net effect on near-surface ozone is shown in Figure 2. Seasonal (May–September) mean increases in MDA8 ozone levels of 1–5 ppb are common in the CESM/RCP 8.5 scenario, resulting in more exceedances of the 75-ppb ozone NAAQS than in the historical climate case. The GISS/RCP 6.0 scenario also shows large increases in ozone over some parts of the country (e.g., central United States, California) but projects decreases in ozone over other locations (e.g., Pacific Northwest, Gulf Coast). |

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| Fowler C. Human Health Impacts of Forest Fires in the Southern United States: A Literature Review. Journal of Ecological Anthropology 2013 vol: 7 (1) pp: 39-63 | Fowler C | 2013 | fire | forest fires, human hlth, southern US | Forestry management practices can shape patterns of health, illness, and disease. A primary goal for owners of federal, state, and private forests is to craft ecosystem management plans that simultaneously optimize forest health and human health. Fire—a major forest management issue in the United States—complicates these goals. Wild- fires are natural phenomena with unpredictable effects. Controlled fires, on the other hand, are often prescribed to reduce biomass fuels, reduce wildfire risks, and protect resource values. While fires can enhance the health of fire-adapted ecosystems, research on the human health impacts of smoke from forest fires is somewhat equivocal. This article synthesizes 30 years of research on the human health impacts of forest fires. It summarizes our current state of knowledge about the following: biophysical effects of environmental contamination resulting from forest fires; psychosocial impacts of forest fires; occupational exposure issues among fire crew; visibility impairment from forest fire smoke; and health care measures that address the impacts of forest fires. This article provides informa- tion that may be useful for land managers, researchers, policy makers, health care workers, and the general public in decision-making about forest management practices. It also recommends that future research use integrative health models and adopt ethnographic research methods. | This article synthesizes 30 years of research on the human health impacts of forest fires. | quantitative assessment of previous researcb | Each facet of the health-fire relationship ought to be contextualized in a particular fire event and a particular environment. A theme that emerges from the literature reviewed in this article is the variability of health effects. Throughout the literature, researchers state that the degree to which fires impact air quality, water quality, and thus human health, vary depending on the particular fire's behavior, meteorological conditions, and human behavior. To be accurate, future research ought to coordinate the characteristics of particular fires with local environmental traits, in addition to local human conditions. The inseparability of human health and ecosystem health in the context of forest fires is apparent in the research currently available. Yet, our present understanding is somewhat reductionistic and gives disproportionate attention to the physiological effects of fire. A more holistic view of the health impacts of forest fires would investigate psychological, social, cultural, economic, and political consequences as well. Future investigations should pay more attention to links between physiological and other types of effects of forest fires on people (e.g., psychological, economic, cultural). A holistic presentation requires both scaling up by contextualizing biomedical and chemical analyses and scaling down by adding fine-grained understandings of individuals' lived experiences. In sum, I suggest that in the future, researchers expand their methodological repertoire and use integrative models to better understand relationships between people and fire. |
| Gingold DB, Strickland MJ, Hess JJ. 2014. Ciguatera fish poisoning and climate change: analysis of National Poison Center data in the United States, 2001–2011. Environ Health Perspect 122:580–586; http://dx.doi.org/10.1289/ehp.1307196 | Gingold DB S. | 2014 | toxins | climate change, fish poisoning | Warm sea surface temperatures (SSTs) are positively related to incidence of ciguatera fish poisoning (CFP). Increased severe storm frequency may create more habitat for cigua -toxic organisms. Although climate change could expand the endemic range of CFP, the relationship between CFP incidence and specific environmental conditions is unknown. | We obtained information on 1,102 CFP-related calls to U.S. poison control centers dur -ing 2001–2011 from the National Poison Data System. | We performed a time-series analysis using Poisson regression to relate monthly CFP call incidence to SST and tropical storms. We investigated associations across a range of plausible lag structures. | Results showed associations between monthly CFP calls and both warmer SSTs and increased tropical storm frequency. The SST variable with the strongest association linked current monthly CFP calls to the peak August SST of the previous year. The lag period with the strongest association for storms was 18 months. If climate change increases SST in the Caribbean 2.5–3.5°C over the coming century as projected, this model implies that CFP incidence in the United States is likely to increase 200–400%. |
| Gunter Weller, Patricia Anderson, Bronwen Wang. The Potential Consequences of Climate Variability and Change ALASKA A Report of the Alaska Regional Assessment Group PREPARING FOR A CHANGING CLIMATE. 1999. Published by the Center for Global Change and Arctic System Research University of Alaska Fairbanks Fairbanks, Alaska | Gunter Weller, Patricia Anderson, Bronwen Wang. | 1999 | alaska | Alaska, climate change | Alaska is vulnerable to climate change. Climate trends over the last three decades have shown considerable warming. This has already led to major impacts on the environment and the economy. If present climate trends continue these impacts will be exacerbated and will hit the state's strongly natural resource-dependent economy hard. In Alaska there are few cities and many rural communities. Predominant economic activities include oil production along the Arctic coast (20% of total U.S. production), fishing in the Bering Sea and off the south coast, forestry in the southeast, agriculture and forestry in the interior, and a growing tourism industry. Subsistence livelihoods in Native communities throughout the state depend on fish, marine mammals and other wildlife, and play a very important social and cultural role. Alaska's ecosystems are also threatened. They range from cool spruce-hemlock forest in the southeast and southcentral coastal regions to boreal spruce forest in theinterior and south-central region. Further north, tundra meadows and barrens dominate. Large areas of land are set aside in national parks, wilderness areas, and nature preserves. Small areas of land are in agriculture, with rather larger areas used for pasture and reindeer grazing. The marine ecosystems of the Bering Sea and Gulf of Alaska are among the most productive in the world and are highly susceptible to climate change. | Previous research | quantitative assessment of previous literature | Responsible institutions in Alaska are not generally aware of the problems resulting from climate change that will be witnessed in the future. This awareness is important as there are some coping and adaptation strategies that can be applied now. They include: • Long-term forecasting and planning. The greater the extent to which one can anticipate the longer-term effects due to climate change, the better one can adjust to changes. This is true whether the impacts are in fisheries, forestry or other economic activities. Even though long-term forecasts may be highly uncertain, they may still be valuable. • Changes in management and political institutions. How management and political institutions are designed will affect the nature and scale of economic and social disruptions caused by climate change. For example, political agreement over fisheries allocations should recognize that significant future changes in harvest levels are not only possible but also likely. • Public expenditures to reduce public risk. In Alaska, engineers continue business as usual by building roads, houses and other infrastructure on permafrost and repairing the damage later at great cost. Through planning and by using modern and initially more expensive techniques it may be possible to avoid these continuing repair costs in future years. • Incentives to reduce public cost and risks. An aggressive strategy to reduce the cost of climate-related impacts such as forest fires would be a set of policies that puts the cost on the individuals who settle in risky areas, rather than on society.<br>Also, since most areas now at risk from damaging forest fires in Alaska have only recently been settled, infrastructure for economic development could only be provided in areas that are already densely settled, thus reducing the fire risk. • Native strategies. While scientists often view change as a shortterm and rapid phenomenon, Native residents can live with long-term uncertainties and generally can cope with change. There are many examples of successful Native adaptations to climate change across the arctic region, both in pre-history and in modern times. Factors that enhance Native adaptability and decrease vulnerabilities to climate change include maintaining a diverse economy, use of alternate natural resources |
| Hess J, Saha S, Luber G. Summertime Acute Heat Illness in U.S. Emergency Departments from 2006 through 2010: Analysis of a Nationally Representative Sample. Environmental Health Perspectives 2014 vol: 122 (11) pp: 1209-1215 | Hess J, Saha S, Luber G | 2014 | heat | Acute Heat Illness, U.S. Emergency Departments | Background: Patients with acute heat illness present primarily to emergency departments (EDs), yet little is known regarding these visits. Objectives. We had three objectives with this analysis. The first was to estimate the burden of summertime acute heat illness using a nationally representative sample of ED patients to generate population-based rates for acute heat illness ED visits. The second was to characterize acute heat illness case profiles across time and different ED dispositions. Our third objective was to identify demographic factors and comorbid conditions associated with adverse outcomes of hospital admission or death in the ED among patients with acute heat illness. | We extracted ED case-level data from the Nationwide Emergency Department Sample (NEDS) for 2006–2010, defining cases as ED visits from May through September with any heat illness diagnosis (ICD-9-CM 992.0–992.9). We correlated visit rates and temperature anomalies, analyzed demographics and ED disposition, identified risk factors for adverse outcomes, and examined ED case fatality rates (CFR). | To pursue our first and second objectives we estimated total counts and population-based rates of ED visits for acute heat illness by ED disposition. We then disaggregated these counts based on *a* ) whether or not heat illness was listed as the first diagnosis for the visit; *b* ) year of visit and demographic and geographic factors; and *c* ) different heat illness diagnoses. We used the statistical methodology prescribed by AHRQ (2012) to incorporate the complex survey design and use appropriate weights to generate national counts of ED episodes. We also used prescribed AHRQ methodology to estimate national rates for specific variables (AHRQ 2012). Because ambient temperature anomalies varied across time (see Supplemental Material Table S2), we used Spearman's rho to evaluate the association between average annual temperature anomaly in NEDS states and annual ED heat illness visit rate. we conducted a series of regressions on the entire sample and on subsets defined by specific heat illness diagnoses. Our last set of regressions used chronic disease burden category as described above as a predictor variable and examined adjusted odds of the composite outcome in the entire sample and in cases with heat stroke and any acute heat illness except heat stroke, controlling for the same variables described in the analyses above. Our hypothesis in this analysis was that adjusted odds of the composite outcome would be positively correlated with chronic disease burden. | Annual counts and rates showed significant interannual variation, with highest counts and rates (apart from the rate of death in the ED) in 2010. Annual temperature anomalies for NEDS states are shown in Supplemental Material, Table S2. As shown in Figure 1, there is a significant correlation between annual temperature anomalies and annual population-based rate for ED heat illness visits. In regard to demographic variables, the 18–45 age group had the highest treat-and-release rate, whereas the ≥ 65 age group had the highest rates of hospital admission and death in the ED. Males were more likely than females to have heat illness across all dispositions. The highest rates for treat-and-release and hospital admissions were in the South; the highest rate of death in the ED was in the West. |

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| Hinzman L Bettez N Bolton W Chapin F Dyurgerov M Fastie C Griffith B Hollister R, et al. EVIDENCE AND IMPLICATIONS OF RECENT CLIMATE CHANGE IN NORTHERN ALASKA AND OTHER ARCTIC REGIONS. Climatic Change (2005) 72: 251–298. | Hinzman L Bettez N Bolton W Chapin F | 2005 | alaska | climate change, arctic, alaska | The Arctic climate is changing. Permafrost is warming, hydrological processes are changing and biological and social systems are also evolving in response to these changing conditions. Knowing how the structure and function of arctic terrestrial ecosystems are responding to recent and persistent climate change is paramount to understanding the future state of the Earth system and how humans will need to adapt. Our holistic review presents a broad array of evidence that illustrates convincingly ; the Arctic is undergoing a system-wide response to an altered climatic state. New extreme and seasonal surface climatic conditions are being experienced, a range of biophysical states and processes influenced by the threshold and phase change of freezing point are being altered, hydrological and biogeochemical cycles are shifting, and more regularly human subsystems are being affected. Importantly, the patterns, magnitude and mechanisms of change have sometimes been unpredictable or difficult to isolate due to compounding factors. In almost every discipline represented, we show Climatic Change (2005) 72: 251-298 how the biocomplexity of the Arctic system has highlighted and challenged a paucity of integrated scientific knowledge, the lack of sustained observational and experimental time series, and the technical and logistic constraints of researching the Arctic environment. This study supports ongoing efforts to strengthen the interdisciplinarity of arctic system science and improve the coupling of large scale experimental manipulation with sustained time series observations by incorporating and integrating novel technologies, remote sensing and modeling. | This paper attempts to present a synthesis of observed changes that have been documented in Arctic Alaska. In selecting which sources of evidence to include, emphasis was placed upon processes where documentation of a long-term change could be related to climate. | quantitative assessment of previous research | At this time, it is difficult to reconcile all of the observed changes in physical and ecosystem processes to a simple response to warming temperatures. The degradation of glaciers or permafrost can exert conflicting responses in watershed runoff. Increases in precipitation may be offset by increases in evapotranspiration or increased infiltration to subpermafrost groundwater. Decreased sea ice may cause greater autumn snowfall, which in turn can slow the freeze-up of the active layer and insulate permafrost from cold winter air. Warmer winter and summer temperatures may be the cause of increased shrub growth, which may in turn trap more snow. The changes in vegetation may then affect foraging mammals and birds. Humans are an integral component of the system, influencing and responding to a changing climate and the consequent ecosystem dynamics. The accumulated evidence of changes among many components of the Arctic terrestrial system provides a diverse but consistent set of indicators of regional and global warming. Documented changes are only a part of the changes likely to have occurred. Further changes are expected in the coming decades, emphasizing the need for expanded monitoring programs that will also help improve our understanding of the interdependence of physical, biological, and social processes in the Arctic. The complexity of the system may confound attempts at prediction, but it is already apparent that observed changes are influencing the landscape, the ecosystems, and the societies of the Arctic. Our growing ability to link observed changes to interdependent processes shows that we are making progress in understanding the arctic terrestrial system. Further progress requires extending the existing time series and new datasets especially in the biological and social realms, and more work in systemic analysis to quantify the relationships among primary drivers of change and key feedbacks. Change is occurring in the Arctic, some of which is either directly or indirectly driven by global climate change. Increased understanding of the influence of climate change on the complexity of arctic systems is essential for the adaptation of human social, economic, and cultural systems to the changes taking place in the Arctic. The qualitative consistency of observed changes and their |
| Jacobson M. On the causal link between carbon dioxide and air pollution mortality. Geophysical Research Letters 2008 vol: 35 (3) pp: L03809 | Jacobson M | 2008 | air quality | carbon dioxide, air pollution, mortality | Greenhouse gases and particle soot have been linked to enhanced sea-level, snowmelt, disease, heat stress, severe weather, and ocean acidification, but the effect of carbon dioxide (CO2 ) on air pollution mortality has not been examined or quantified. Here, it is shown that increased water vapor and temperatures from higher CO2 separately increase ozone more with higher ozone; thus, global warming may exacerbate ozone the most in already-polluted areas. This policy statement is supported by a technical report that examines in some depth the nature of the problem of climate change, likely effects on children's health as a result of climate change, and the critical importance of responding promptly and aggressively to reduce activities that are contributing to this change. | previous studies | quantitative assessments of previous research | A high-resolution global-regional model then found that CO2 may increase U.S. annual air pollution deaths by about 1000 (350–1800) and cancers by 20–30 per 1 K rise in CO2 -induced temperature. About 40% of the additional deaths may be due to ozone and the rest, to particles, which increase due to CO2 -enhanced stability, humidity and biogenic particle mass. An extrapolation by population could render 21,600 (7400–39,000) excess CO2 -caused annual pollution deaths worldwide, more than those from CO2 enhanced storminess. |
| Jesdale B Morello-Frosch R Cushing L. The Racial/Ethnic Distribution of Heat Risk–Related Land Cover in Relation to Residential Segregation. Environmental Health Perspectives 2013 vol: 121 (7) pp: 811-817 | Jesdale B Morello-Frosch R Cushing L. | 2013 | vulnerable pop. | Racial/Ethnic Distribution, Heat Risk, Land Cover, Residential Segregation | Objective: We examined the distribution of heat risk–related land cover (HRRLC) characteristics across racial/ethnic groups and degrees of residential segregation. | Block group–level tree canopy and impervious surface estimates were derived from the 2001 National Land Cover Dataset for densely populated urban areas of the United States and Puerto Rico, and linked to demographic characteristics from the 2000 Census. Racial/ethnic groups in a given block group were considered to live in HRRLC if at least half their population experienced the absence of tree canopy and at least half of the ground was covered by impervious surface (roofs, driveways, sidewalks, roads). Residential segregation was characterized for metropolitan areas in the United States and Puerto Rico using the multigroup dissimilarity index. | *Unit of analysis and assessment of HRRLC* . Each census block was classified as having either no tree canopy or some tree canopy, and as having either ≥ 50% impervious surface or < 50% impervious surface. *Segregation measure. We used a multigroup dissimilarity index, Dm (Sakoda 1981), to characterize the unevenness of the residential distribution of the four racial/ethnic groups described above, plus a residual category consisting of all other residents, at the core-based statistical area (CBSA) level. Biophysical variables. Tree growth is dependent on ecological (or biophysical) parameters that we wanted to control for when comparing tree cover across areas of the country. Therefore, we classified each census block group according to level I ecoregions developed by Omernik (Commission for Environmental Cooperation 1997) to classify regions with similar ecological characteristics and environmental resources. We combined ecoregions that included fewer than five metropolitan areas (temperate Sierras and northwestern forested mountains, and southern semi-arid highlands and North American deserts) and assigned Hawaii and Puerto Rico to the tropical wet forests ecoregion, resulting in a variable with eight possible categories. Analytic approach. We used robust Poisson models to estimate prevalence ratios (Deddens and Petersen 2008) for the co-occurrence of two dichotomous heat risk-related measures: whether at least half of a subpopulation of a census block group lived in census blocks with no tree canopy reported in the NLCD and at least half of a subpopulation of a census block group lived in census blocks with at least 50% impervious surface.*<br><br>*We used a generalized estimating equation approach for all models to account for the fact that up to eight subpopulations might be assessed within each block group, so there were closely correlated measures for each block group. We weighted subpopulations within each block group by population, with a sum equal to the number of block groups in the analysis.* | Results: After adjustment for ecoregion and precipitation, holding segregation level constant, non-Hispanic blacks were 52% more likely (95% CI: 37%, 69%), non-Hispanic Asians 32% more likely (95% CI: 18%, 47%), and Hispanics 21% more likely (95% CI: 8%, 35%) to live in HRRLC conditions compared with non-Hispanic whites. Within each racial/ethnic group, HRRLC conditions increased with increasing degrees of metropolitan area-level segregation. Further adjustment for home ownership and poverty did not substantially alter these results, but adjustment for population density and metropolitan area population attenuated the segregation effects, suggesting a mediating or confounding role. Conclusions: Land cover was associated with segregation within each racial/ethnic group, which may be explained partly by the concentration of racial/ethnic minorities into densely populated neighborhoods within larger, more segregated cities. In anticipation of greater frequency and duration of extreme heat events, climate change adaptation strategies, such as planting trees in urban areas, should explicitly incorporate an environmental justice framework that addresses racial/ethnic disparities in HRRLC. |
| Jhun I, Fann N, Zanobetti A, Hubbell B. Effect modification of ozone-related mortality risks by temperature in 97 US cities. Environment International 73 (2014) 128–134. | Jhun I, Fann N, Zanobetti A, Hubbell B | 2014 | air quality, Heat | ozone, mortality, temperature | Many time-series studies have characterized the relationship between short-term ozone exposure and adverse health outcomes, controlling for temperature as a confounder. Temperature may also modify ozone effects, though this has been largely under-investigated. In this study, we explored whether temperature modifies the effect of short-term ozone exposure on mortality. | We obtained daily data on non-accidental mortality, air pollution, and weather condition for 97 communities in the continental US in 1987–2000 from the National Morbidity, Mortality, and Air Pollution Study (NMMAPS) database (Fig. 1)(iHAPPS, 2007; Samet et al., 2000 ). A detailed description of this extensively employed database can be found elsewhere (Samet et al., 2000 ). | We treated temperature as a confounder as well as an effect modifier by estimating risks at low, moderate, and high temperature categories. We utilized a two-stage statistical approach to estimate national estimates of ozone-related mortality risks. Performed a time-series analysis using a poisson regression model to etimate community related mortality risk from exposure to same day ozone. The time series of daily mortality counts were modeled against ozone and other covariates using a generalized linear regression model with a quasi-Poisson link function to account for overdispersion. The model controlled for long-term patterns and seasonality using natural splines with 3 degrees of freedom (df ) for each warm season (May to September). We included indicator variables to allow mortality rates to vary by day of the week. We also controlled for potential confounding due to weather conditions by including smoothing functions of 24-h dew point and 24-h temper-ature in the baseline model, which does not account for interaction between ozone and temperature (see Supplemental information for ad-ditional details on model construction). In the second stage of the analysis, we combined city-specifi c estimates through a random-effects meta-analysis technique ( Berkey et al., 1998). Briefly, we used a random-effects regression model in which city-specifi c estimates were pooled. The modifyingeffectof temperature can be sensitive to howtemper-ature is characterized in the model. Therefore, we conducted a sensitiv-ity analysis with two additional ways of defi ning temperature categories by utilizing city-specifi c 10th/90th and 5th/95th percentile 24-h temperature values as cutoffs. With these additional categories, we assessed ozone-related mortality risk by expanding the moderate temperature category, while narrowing the low and high temperature categories to lower and higher temperature days, respectively. Note that doing so increases the number of days assigned as moderate tem-perature, and decreases the number of days assigned as low and high temperatures. We also conducted sensitivity analyses on the choice of exposure metrics for ozone and temperature. | When temperature was treated as a confounder, a 10-ppb increase in daily 24-h ozone was associated with a 0.47% (95% CI: 0.19%-0.76%) increase in mortality. When we assessed effect modification by temperature, the interaction between ozone and temperature was not statistically significant. However, there was a U-shaped pattern in mortality risk, which was greater at the low (b 25th percentile) and high (N 75th percentile) temperature levels than moderate temperature levels. At the high temperature category, a 10% increase in AC prevalence mitigated mortality risk associated with 10-ppb of ozone exposure by − 0.18% (95% CI: − 0.35%, − 0.02%). Furthermore, ozone mortality risk in the high temperature category increased as we restricted our analyses to hotter days. On days where temperatures exceeded the 75th, 90th, and 95th percentile temperatures, a 10-ppb increase in ozone was associated with a 0.65% (95% CI: 0.20%-1.09%), 0.83% (95% CI: 0.17%-1.48%), and 1.35% (95% CI: 0.44%-2.27%) increase in mortality, respectively. These results suggested that high temperatures may exacerbate physiological responses to short-term ozone exposure. |

| Bibliography | primary authors | year published | category | key words | abstract | data | analysis | results summary |
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| Jofre J Blanch A Lucena F Jofre J Blanch A Lucena F Sabater S Barceló D. Water-Borne Infectious Disease Outbreaks Associated with Water Scarcity and Rainfall Events. Hdb Env Chem (2010) 8: 147–159 | Jofre J Blanch A Lucena F Jofre J Blanch A Lucena F Sabater S Barceló D | 2010 | water quality, stormwater | Water-Borne Infectious Disease, water scarcity, rainfall | An important number of major infectious diseases are related to water. The greatest consequences for the human population are the faecal-oral water-borne infectious diseases, which are transmitted by ingestion of the causal agents that are released into water through faeces. The occurrence of outbreaks of water-borne infectious diseases could be affected by water scarcity at different degrees depending on the level of water scarcity, density of population, degree of economical development, presence in the area of wild and farmed animals, etc. Still, at least in developed countries the laws and regulatory programmes regarding water quality cope with most of the problems and generally protect the population, even when scarcity obliges use of non-conventional water resources. Weather conditions influence the fate of pathogens in the water environment. Indeed rainfall favours their dissemination, and natural stressors-such as temperature and solar irradiation among others-determine their persistence. At present, heavy rain events rather than water scarcity are the main cause of failure of protective measures in developed countries. This situation is likely due to an increased dissemination of the pathogens that have survived the deleterious effects of natural stressors. Higher frequency of drought followed by heavy rains, as forecasted in Mediterranean climate areas, will likely increase deficiencies in watershed protection, infrastructure and storm drainage. Consequently, the risk of contamination events of the water resources will be greater than before. This combination of factors might also increase the failures in the drinking water treatments, and subsequently the occurrence of water-borne infectious disease outbreaks. A better knowledge about the origin, survival and transport of water-borne pathogens in the water environment is a key factor for predicting risks and taking measures to minimize them. Unfortunately in many developing countries, the quality of water for consumption is still very poor independently of whether there is scarcity or abundance of water. Measures to improve the present situation are urgently needed. These measures could be optimized by considering the influence of weather conditions on survival and transport of the microorganisms of faecal origin. | Previous studies | quantitative assessments of previous research and modelling | In addition to these and other case-reports, some retrospective studies using data from water-borne disease and precipitation databases have been carried out in the United States, Canada, and England and Wales, where complete databases allow these studies. In a study with data from 1948 to 1994 corresponding to the United States, Curriero et al. [1] found a statistically significant association between rainfall and faecal-oral infectious water-borne diseases. Indeed, 51% of the waterborne outbreaks were preceded by precipitation events above the 90th percentile and 69% by events over the 80th percentile. The study performed in Canada also shows a significant association between heavy rainfall events and warm temperatures during the snow melting period with outbreaks of water-borne infectious diseases. For rainfall events greater than the 93% percentile, the relative odds of an outbreak increased by a factor greater than 2,200 [4]. A study of drinking water related outbreaks in England and Wales during almost the whole twentieth century found a significant association between excess rainfall over the previous week and low rainfall in the 3 weeks before the week of the outbreak [3] |
| Johnston F Bailie R Pilotto L Hanigan I. Ambient biomass smoke and cardio-respiratory hospital admissions in Darwin, Australia. BMC Public Health<br>2007 vol: 7 pp: 1-8 | Johnston F Bailie R Pilotto L Hanigan I. | 2007 | fire | Ambient biomass smoke, cardio-respiratory, hospital admissions | Increasing severe vegetation fires worldwide has been attributed to both global environmental change and land management practices. However there is little evidence concerning the population health effects of outdoor air pollution derived from biomass fires. Frequent seasonal bushfires near Darwin, Australia provide an opportunity to examine this issue. | We examined the relationship between atmospheric particle loadings <10 microns in diameter (PM10), and emergency hospital admissions for cardio-respiratory conditions over the three fire seasons of 2000, 2004 and 2005. In addition we examined the differential impacts on Indigenous Australians, a high risk population subgroup. | METHODS: We conducted a case-crossover analysis of emergency hospital admissions with principal ICD10 diagnosis codes J00-J99 and I00-I99. Conditional logistic regression models were used to calculate odds ratios for admission with 10 microg/m3 rises in PM10. These were adjusted for weekly influenza rates, same day mean temperature and humidity, the mean temperature and humidity of the previous three days, days with rainfall > 5 mm, public holidays and holiday periods. RESULTS: PM10 ranged from 6.4 - 70.0 microg/m3 (mean 19.1). 2466 admissions were examined of which 23% were for Indigenous people. | There was a positive relationship between PM10 and admissions for all respiratory conditions (OR 1.08 95%CI 0.98-1.18) with a larger magnitude in the Indigenous subpopulation (OR1.17 95% CI 0.98-1.40). While there was no relationship between PM10 and cardiovascular admissions overall, there was a positive association with ischaemic heart disease in Indigenous people, greatest at a lag of 3 days (OR 1.71 95%CI 1.14-2.55). CONCLUSION: PM10 derived from vegetation fires was predominantly associated with respiratory rather than cardiovascular admissions. This outcome is consistent with the few available studies of ambient biomass smoke pollution. Indigenous people appear to be at higher risk of cardio-respiratory hospital admissions associated with exposure to PM10. |
| Johnston F Hanigan I Henderson S Morgan G Bowman D. Extreme air pollution events from bushfires and dust storms and their association with mortality in Sydney, Australia 1994-2007. Environmental Research<br>2011 vol: 111 (6) pp: 811-816 | Johnston F Hanigan I Henderson S Morgan G Bowman D. | 2011 | fire | air pollution, bushfires, dust storms, mortality | Extreme air pollution events due to bushfire smoke and dust storms are expected to increase as a consequence of climate change, yet little has been published about their population health impacts. We examined the association between air pollution events and mortality in Sydney from 1997 to 2004. Methods: Events were defined as days for which the 24h city-wide concentration of PM10 exceeded the 99th percentile. All events were researched and categorised as being caused by either smoke or dust. We used a time-stratified case-crossover design with conditional logistic regression modelling adjusted for influenza epidemics, same day and lagged temperature and humidity. Reported odds ratios (OR) and 95% confidence intervals are for mortality on event days compared with non-event days. The contribution of elevated average temperatures to mortality during smoke events was explored. Results: There were 52 event days, 48 attributable to bushfire smoke, six to dust and two affected by both. Smoke events were associated with a 5% increase in non-accidental mortality at a lag of 1 day OR (95% confidence interval (CI)) 1.05 (95%CI: 1.00-1.10). When same day temperature was removed from the model, additional same day associations were observed with non-accidental mortality OR 1.05 (95%CI: 1.00-1.09), and with cardiovascular mortality OR (95%CI) 1.10 (95%CI: 1.00-1.20). Dust events were associated with a 15% increase in non-accidental mortality at a lag of 3 days, OR (95%CI) 1.16 (95%CI: 1.03-1.30). Conclusions: The magnitude and temporal patterns of association with mortality were different for smoke and dust events. Public health advisories during bushfire smoke pollution episodes should include advice about hot weather in addition to air pollution. | Air quality data were provided by the New South Wales Department of Environment, Climate Change and Water. We obtained thirteen and a half years of daily average concentrations of particulate matter less than 10 μm in aeronautic diameter (PM10). PM10 was measured at 7 monitoring stations across the city for which data were available for 70% or greater of days in the time series. All stations used tapered element oscillating microbalances for measuring PM concentrations. Smoke and dust events were identified from a validated database that is the subject of another paper (Johnston et al., 2011). In brief, an extreme pollution event was defined as any day on which the PM10 concentration exceeded the 99th percentile of the time series (47.3 μg/m3), and multiple sources of information were used to evaluate the cause of each event. We began by searching news archives for stories related to dust and smoke pollution. Next we searched for evidence of smoke and dust plumes using readily-available remote sensing data from the moderate resolution imaging spectroradiometer and the total ozone mapping spectrometer provided by the US National Aeronautical and Space Administration (NASA, 2010). Daily average ambient temperature and humidity (as measured by dew point temperature) were provided by the Bureau of Meteorology and merged with the health data using a technique that weights observations from different weather stations according to population density (Hanigan et al., 2006). | All analyses were conducted using the R statistical software package (R Foundation for Statistical Computing, 2006). We used a time-stratified case-crossover design in which the event status, coded as a binary indicator variable for smoke and dust, on (and up to three days before) the day of death was compared with the event status on control days matched by day of week, month and calendar year. By design this approach controls for the effects of day of week, season and long term trends on mortality (Maclure, 1991). We used conditional logistic regression models adjusted for meteorology and influenza epidemics to estimate the odds ratio (OR) for mortality associated with smoke and dust events compared with the background. To determine the optimal number of degrees of freedom for modelling the meteorological variables in the logistic models, we first conducted Poisson time-series generalised additive models using the mgcv package in R to display the concentration response function for each variable (Wood, 2006). All models included the following covariates: (1) influenza epidemics, a binary variable coded as 1 if influenza hospital admission rates were <90th percentile and otherwise 0; (2) average temperature (°C) for the previous 3 days (lags 1–3) modelled as a non-linear response with 2 degrees of freedom; (3) average dew point for the previous 3 days (lags 1–3) modelled as a non-linear response with 2 degrees of freedom; (4) same-day average temperature (°C) modelled as a non-linear response with 2 degrees of freedom; and (5) same-day average dew point (°C) modelled as a linear response. | Smoke events were associated with a 5% increase in non-accidental mortality at a lag of one day OR (95%CI) 1.05 (95%CI: 1.00–1.10). When same-day average temperature was excluded from the model, associations of a similar magnitude were also observed on the day of the event (lag 0) OR (95%CI) 1.05 (95%CI: 1.00–1.09). As there were fewer dust events, our effect estimates for this exposure were much less precise. We observed a 15% increase in non-accidental mortality three days following the event OR (95%CI) 1.16 (95%CI: 1.03–1.30). In contrast to smoke events, the outcomes for dust events were not sensitive to the inclusion of same-day temperature. Daily maximum ozone and the number of degrees of freedom used for the meteorological covariates did not influence results for smoke or dust events (Table 2). We did not find any associations with mortality when we included less severe smoke (and dust) pollution events in which PM10 exceeded the 95th percentile of 32.0 μg/m3 (Table 2.) This is not surprising given that almost half of these events were not validated as being attributable to smoke or dust, and were therefore included as background concentrations. A larger same day association was observed with smoke events and cardiovascular mortality, but only when same day temperature was excluded from the model OR (95%CI) 1.10 (95%CI: 1.00–1.20). Associations between same day dust events also had a larger point estimates for cardiovascular than for non-accidental mortality, but neither association approached statistical significance. Although we looked for associations between pollution events and respiratory mortality, our results were imprecise as deaths attributed to respiratory causes occur less frequently than those attributed to cardiovascular causes (Table 1). In all analyses of respiratory mortality the 95% confidence intervals were very wide and all included the null |
| Kellogg J Wang J Flint C Ribnicky D Kuhn P González De Mejia E Raskin I Lila M. Alaskan Wild Berry Resources and Human Health Under the Cloud of Climate Change. J Agric Food Chem. 2010 Apr 14; 58(7): 3884–3900. | Kellogg J Wang J Flint C Ribnicky D Kuhn P | 2010 | vulnerable pop. | Wild Berry, Resources, Human Health, Climate change | Wild berries are integral dietary components for Alaska Native tribes and a rich source of polyphenolic metabolites that can ameliorate metabolic disorders such as obesity and diabetes. In this study, five species of wild Alaskan berries (Vaccinium ovalifolium, V. uliginosum, Rubus chamaemorus, R. spectabilis, and Empetrum nigrum) were screened for bioactivity through a community-participatory research method involving three geographically-distinct tribal communities. Local observations provided robust insights into effects of climatic fluctuations on berry abundance and quality, and preliminary site-specific compositional and bioactivity differences were noted, suggesting the need to monitor this Alaska Native resource as climate shifts impact the region. The objectives of this study were to characterize the phytochemical composition, especially the anthocyanin and proanthocyanidin constituents, of wild Alaskan berries from differing climatic regimes, and to evaluate their potential efficacy against symptoms of T2DM and obesity via in vitro bioassays (adipogenesis and lipid accumulation in 3T3-L1 cells) (52) and in an in vivo hyperglycemic rodent model, and to integrate the bioscience discoveries with TEK, local climate change observations, and community health concerns. | This study involved NA/AN people in the biodiscovery process, in a community-participatory framework that investigated and validated traditional ecological knowledge, and conducted field surveys of bioactive constituents of local medicinal plants. The research team engaged local community members to implement a set of field bioassays known as "Screens-to-Nature" (STN), an innovation developed through the Global Institute for BioExploration (www.gibex.org). Community members were trained by the research team in the process of data collection and analysis of bioassay readings. Assays were carried out according to defined protocols described in GIBEX field manuals, provided to each community. | Based on the preliminary STN analyses, as well as recommendations from community elders, five berry species were collected for in-depth analyses. Compositional analysis by HPLC and LC-MS 2 revealed substantial site-specific variation in anthocyanins (0.01-4.39 mg/g-FW) and proanthocyanidins (0.74-6.25 mg/g-FW), and identified A-type proanthocyanidin polymers. R. spectabilis increased expression levels of preadipocyte-factor-1 (182%), and proanthocyanidin-enriched fractions from other species reduced lipid accumulation in 3T3-L1 adipocytes. Selected extracts reduced serum glucose levels in C57bl/ 6j mice by up to 45%. Linear correlation for lipid accumulation was achieved using Microsoft Excel (Microsoft Corporation, Redmond, WA). Mean separation of in vivo results were achieved through the LSD procedure of SAS (SAS Institute) with α=0.01. | The three STN bioassays provided a strong preliminary indication of bioactivity relevant to diabetes and obesity, and simultaneously served to engage local community members in the objectives of the research initiative. As an illustration of the outcomes, a representative data summary for the three berries assayed in Akutan is shown in Table 1. All berries demonstrated antioxidant capacity. E. nigrum and V. ovalifolium were effective α-amylase inhibitors, whereas R. spectabilis was not. All three berry species inhibited protease digestion of gel substrates, and correspondingly had undetectable levels of protease activity. Both ripe and unripe berries were assayed in each community, which illustrated to the community members that the secondary phytochemicals accumulated in ripe fruit were responsible for the observed bioactive properties. Berries from each of the other two sites (Seldovia and Point Hope) also demonstrated similar bioactivies and trends. |

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| Knowlton K Rotkin-Ellman M King G Margolis H Smith D Solomon G Trent R English P. The 2006 California Heat Wave: Impacts on Hospitalizations and Emergency Department Visits. Environmental Health Perspectives 2009 vol: 117 (1) pp: 61-67 | Knowlton K Rotkin-Ellman M King G | 2009 | heat | Heat Wave, Hospitalizations, Emergency Department Visits, California | Climate models project that heat waves will increase in frequency and severity. Despite many studies of mortality from heat waves, few studies have examined morbidity. In this study we investigated whether any age or race/ethnicity groups experienced increased hospitalizations and emergency department (ED) visits overall or for selected illnesses during the 2006 California heat wave. | We aggregated county-level hospitalizations and ED visits for all causes and for 10 cause groups into six geographic regions of California. We calculated excess morbidity and rate ratios (RRs) during the heat wave (15 July to 1 August 2006) and compared these data with those of a reference period (8–14 July and 12–22 August 2006). | Assuming that the California population changed little over the course of one summer, and selecting the reference period with the same number of days and distribution of days of the week as the heat wave period, the person-time units in the denominators of the two rates were equivalent. This allowed us to compare the ratio of the numbers of cases in the two time periods as an RR (Rothman and Greenland 1998). We calculated excess cases as the difference in the numbers of cases in the two periods. We calculated exact 95% confidence intervals (95% CIs) for the RRs using SAS version 9.1 (Daly 1992; SAS Institute, Inc., Cary, NC). We calculated RRs reported to two decimal places and 95% CIs for each of the six California regions and for the state as a whole across a range of cause–age and cause–race/ethnicity categories. We tested variation in the RRs across regions with a chi-square test for homogeneity (Rothman and Greenland 1998). | During the heat wave, 16,166 excess ED visits and 1,182 excess hospitalizations occurred statewide. ED visits for heat-related causes increased across the state [RR = 6.30; 95% confidence interval (CI), 5.67–7.01], especially in the Central Coast region, which includes San Francisco. Children (0–4 years of age) and the elderly (≥ 65 years of age) were at greatest risk. ED visits also showed significant increases for acute renal failure, cardiovascular diseases, diabetes, electrolyte imbalance, and nephritis. We observed significantly elevated RRs for hospitalizations for heat-related illnesses (RR = 10.15; 95% CI, 7.79–13.43), acute renal failure, electrolyte imbalance, and nephritis. The 2006 California heat wave had a substantial effect on morbidity, including regions with relatively modest temperatures. This suggests that population acclimatization and adaptive capacity influenced risk. By better understanding these impacts and population vulnerabilities, local communities can improve heat wave preparedness to cope with a globally warming future. |
| Kollanus V Tiittanen P Niemi J Lanki T. Effects of long-range transported air pollution from vegetation fires on daily mortality and hospital admissions in the Helsinki metropolitan area, Finland. Environmental Research 2016 vol: 151 pp: 351-358 | Kollanus V Tiittanen P Niemi J Lanki T. | 2016 | fire | long-range transported air pollution, vegetation fires, daily mortality, hospital admissions | Fine particulate matter (PM2.5) emissions from vegetation fires can be transported over long distances and may cause significant air pollution episodes far from the fires. However, epidemiological evidence on health effects of vegetation-fire originated air pollution is limited, particularly for mortality and cardiovascular outcomes. Objective We examined association between short-term exposure to long-range transported PM2.5from vegetation fires and daily mortality due to non-accidental, cardiovascular, and respiratory causes and daily hospital admissions due to cardiovascular and respiratory causes in the Helsinki metropolitan area, Finland. Methods Days significantly affected by smoke from vegetation fires between 2001 and 2010 were identified using air quality measurements at an urban background and a regional background monitoring station, and modelled data on surface concentrations of vegetation-fire smoke. Associations between daily PM2.5concentration and health outcomes on i) smoke-affected days and ii) all other days (i.e. non-smoke days) were analysed using Poisson time series regression. All statistical models were adjusted for daily temperature and relative humidity, influenza, pollen, and public holidays. Results On smoke-affected days, 10 μg/m3increase in PM2.5was associated with a borderline statistically significant increase in cardiovascular mortality among total population at a lag of three days (12.4%, 95% CI −0.2% to 26.5%), and among the elderly (≥65 years) following same-day exposure (13.8%, 95% CI −0.6% to 30.4%) and at a lag of three days (11.8%, 95% CI −2.2% to 27.7%). Smoke day PM2.5was not associated with non-accidental mortality or hospital admissions due to cardiovascular causes. However, there was an indication of a positive association with hospital admissions due to respiratory causes among the elderly, and admissions due to chronic obstructive pulmonary disease or asthma among the total population. In contrast, on non-smoke days PM2.5was generally not associated with the health outcomes, apart from suggestive small positive effects on non-accidental mortality at a lag of one day among the elderly and hospital admissions due to all respiratory causes following same-day exposure among the total population. Conclusions Our research provides suggestive evidence for an association of exposure to long-range transported PM2.5from vegetation fires with increased cardiovascular mortality, and to a lesser extent with increased hospital admissions due to respiratory causes. Hence, vegetation-fire originated air pollution may have adverse effects on public health over a distance of hundreds to thousands of kilometres from the fires. | Association between short-term exposure to long-range transported PM2.5 originating from vegetation fires and mortality and hospital admissions was studied in the Helsinki metropolitan area in Finland. The study area consists of four cities (Helsinki, Espoo, Vantaa, and Kauniainen), has a total population around one million, and covers a land surface area of 770 km2. Study period included years from 2001 to 2010. Daily data on mortality counts for non-accidental, cardiovascular and respiratory causes were obtained from Statistics Finland and on acute hospital admission counts for cardiovascular and respiratory causes from the national inpatient registry maintained by the National Institute for Health and Welfare. | Associations between outdoor PM2.5 concentrations on smoke and non-smoke days and the health outcomes were estimated using Poisson time series regression. Time trends and seasonality were controlled in the models with a triple interaction of year, month, and day of the week. This corresponds to a time-stratified case-crossover analysis where the stratification is made by selecting referent days that fall on the same day of the week and in the same month and in the same year as the index day, and where all the covariates are common (Levy et al., 2001, Lu and Zeger, 2007). An overdispersion parameter, estimated as the deviance divided by the degrees of freedom, was also included in the model. Statistical analyses were conducted in SAS for Windows 9.3 TS1M0. All effect estimates were adjusted for temperature, relative humidity, influenza, pollen, and public holidays. The core model, which included the interaction term for year, month, and day of the week, was built step-by-step. First, the most appropriate exposure lag and the shape of the association with temperature was defined and selected based on the minimum Akaike's information criteria (AIC). For the exposure lag, 0 (same day) to 3 days lags were tested. To determine the shape of the association with temperature, we tested linear and quadratic terms as well as two and three days averaged temperatures. Second, the same procedure was repeated for relative humidity. Lastly, the dummy variables for public holidays, influenza, and pollen were included in all of the models even though they did not always reduce the AIC. We examined lags of 0–4 days between exposure and health outcomes. Effect estimates are reported as % change in risk per 10 μg/m3 PM2.5. | In 2001–2010, there were overall 65,362 deaths from non-accidental causes, 26,642 deaths from cardiovascular causes, and 4287 deaths from respiratory causes in the Helsinki metropolitan area. The total number of hospital admissions was 82,827 for cardiovascular causes, 68,450 for respiratory causes, and 13,982 for COPD/asthma. |
| Kuhnlein H Receveur O Soueida R Egeland G. Community and International Nutrition Arctic Indigenous Peoples Experience the Nutrition Transition with Changing Dietary Patterns and Obesity 1-3. J. Nutr 2004 vol: 124 pp: 1447-1453 | Kuhnlein H Receveur O Soueida R Egeland G. | 2004 | vulnerable pop. | indigenous people, nutrition, obesity | Indigenous Peoples globally are part of the nutrition transition. They may be among the most extreme for the extent of dietary change experienced in the last few decades. In this paper, we report survey data from 44 representative communities from 3 large cultural areas of the Canadian Arctic: the Yukon First Nations, Dene/Métis, and Inuit communities. Dietary change was represented in 2 ways: *1*) considering the current proportion of traditional food (TF) in contrast to the precontact period (100% TF); and *2*) the amount of TF consumed by older vs. younger generations. Total diet, TF, and BMI data from adults were investigated. On days when TF was consumed, there was significantly less ($P < 0.01$) fat, carbohydrate, and sugar in the diet, and more protein, vitamin A, vitamin D, vitamin E, riboflavin, vitamin B-6, iron, zinc, copper, magnesium, manganese, phosphorus, potassium, and selenium. Vitamin C and folate, provided mainly by fortified food, and fiber were higher ($P < 0.01$) on days without TF for Inuit. Only 10–36% of energy was derived from TF; adults > 40 y old consistently consumed more ($P < 0.05$) TF than those younger. Overall obesity (BMI ≥ 30 kg/m2) of Arctic adults exceeded all-Canadian rates. Measures to improve nutrient-dense market food (MF) availability and use are called for, as are ways to maintain or increase TF use. | Research took place during 2 seasons, a season of high TF use (September–November) and a season of low TF use (February–April). Interviews included 24-h recalls, a food-frequency interview (TF only), a sociocultural interview, and a 7-d food record (Inuit communities only). This report emphasizes information from 24-h recall and frequency interviews, and height and weight data from men and nonpregnant or lactating women ≥ 20 y old. Interviews were conducted in Denendeh during 1994, in Yukon during 1995, and in Inuit communities in 1998–1999. Random sampling of 10% of households was done using community household or utility lists; in smaller communities, all households, up to a maximum of 25 households, were interviewed. In each household, 1 adult man and 1 adult woman were selected by convenience and interviewed. | In each study, data were entered into Epi-Info, version 6 (USD). Extensive checking and double entry of a 10% random subset were completed and analyses were conducted with SAS, versions 6 and 8 (SAS Institute). Means or least-square means (LSM) with SEM were compiled as descriptive statistics. Adjusting for unbalanced sample sizes across communities, age groups, and seasons was done using LSM. When nutrient intakes did not meet the assumption of normality, differences between groups were tested by Kruskal-Wallis nonparametric ANOVA (43). Bonferroni multiple comparisons were used to identify significant differences between mean values during multiple comparisons (42). All statistical analyses used $P < 0.05$ for the level of significance. | Estimates of consumption frequency by region (2-season mean of number of days per week)7 revealed that moose, caribou, fish (whitefish, char, trout), and seal were the most heavily consumed TF items in all cultures and regions. Using all 24-h recall datasets, the ranked top 16 MF in each of the 3 cultural areas were consistent across the Canadian Arctic (Table 1). A total of >200 MF items were mentioned in the recalls; a more detailed description of MF items in food groups frequently consumed in the Dene/Métis area is presented in Receveur et al. (21). In all three cultures, significantly more TF was consumed by older individuals than by those younger (Fig. 1). In the 20- to 40-y-old age group, men consumed more TF than did women, and this pattern occurred in the 41- to 60-y-old age group for Inuit. Other than these, there were no differences between genders among the cultural age groups. Mean intake of all TF was >100 g/d, and for older individuals, could exceed 400 g/d (Fig. 1). Because many individuals did not consume TF on the days interviewed, intakes of TF derived from the 24-h recalls of only those who consumed TF yielded a range of TF intake by age and gender groups from a low of 242 g (Yukon women aged 20–40 y, n = 103) to a high of 567 g (Inuit men 61+ y, n = 63). Dichotomizing recall data for all ages combined into those containing TF and those without TF8 (Table 2), days with TF had a consistent pattern across cultural groups. TF days had higher ($P < 0.01$) total energy and percentage of energy as protein. Days without TF had significantly higher percentage of energy as carbohydrate, fat, sucrose, SFA, and PUFA. The phenomenon of TF providing significantly more nutrients was emphasized. |

| Bibliography | primary authors | year published | category | key words | abstract | data | analysis | results summary |
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| Laidler G Ford J Gough W Ikummaq T Gagnon A Kowal S Qrunnut K Irngaut C Laidler G Ford J Gough W Kowal · Gagnon A. Travelling and hunting in a changing Arctic: assessing Inuit vulnerability to sea ice change in Igloolik, Nunavut. Climatic Change<br>2009 vol: 94 pp: 363-397 | Laidler G Ford J Gough W Ikummaq T Gagnon A Kowal S | 2009 | vulnerable pop. | sea ice, changing arctic, travel, hunting | The observations of community members and instrumental records indicate changes in sea ice around the Inuit community of Igloolik, in the Canadian territory of Nunavut. This paper characterizes local vulnerability to these changes, identifying who is vulnerable, to what stresses, and why, focusing on local and regional use of sea ice for the harvesting of renewable resources and travel. This analysis is coupled with instrumental and sea ice data to evaluate changing tem-perature/wind/sea ice trends over time, to complement local observations. We demonstrate the relationships between changing sea ice conditions/dynamics and harvesting activities (i.e. dangers and accessibility), with specific emphasis on ringed 364 Climatic Change (2009) 94:363-397 seal and walrus seasonal hunting, to illustrate current sea ice exposures that hunters are facing. Community members are adapting to such changes, as they have done for generations. However, current adaptive capacity is both enabled, and constrained, by social, cultural, and economic factors that manifest within the modern northern Hamlet. Enabling factors include the ability of hunters to manage or share the risks associated with sea ice travel, as well as through their flexibility in resource use, as facilitated by sophisticated local knowledge and land/navigational skills. Constraining factors include the erosion of land-based knowledge and skills, altered sharing networks, as well as financial and temporal limitations on travel/harvesting. The differential ability of community members to balance enabling and constraining factors, in relation to current exposures, comprises their level of vulnerability to sea ice change. | Inuit and scientific observations | To characterize vulnerability to sea ice change, this paper utilizes the model of Fordand Smit (2004) and Ford et al. (2006b). Defining vulnerability as the susceptibilityfor harm in a system in response to a stimulus or stimuli, they conceptualizevulnerability as a function of exposure and adaptive capacity. Exposure reflects thesusceptibility of people and communities to biophysical conditions that representrisks, while adaptive capacity reflects a community's potential or ability to address,plan for, or adapt to exposure. In this conceptualization, vulnerability at a local levelis viewed as being conditioned by social, economic, cultural, political and climaticconditions and processes operating at multiple scales over time and space, whichaffect community exposure and adaptive capacity. A two stage analytical framework is used to assess vulnerability to sea ice changein Igloolik (refer to Ford and Smit (2004) for more details). The first stage documentsand examines past and present experience and response to sea ice seasonal or inter-annual variability, long-term change, and particular extreme events, to characterizecurrent vulnerability (current exposure and current adaptive capacity). This involves:(1) identification and characterization of sea ice conditions that represent risks tocommunity members (i.e. current exposure); (2) characterization of how communi-ties manage and experience these risks (i.e. current adaptive capacity); and, (3) iden-tification of those processes and conditions that influence exposure to climatic risksand determine the efficacy, availability, and success of past and present adaptations(i.e. current adaptive capacity). The observations, experience, and the knowledgeof local inhabitants are central to assessing current vulnerability. | Sea ice variability and change is not a new phenomenon in the Igloolik region. However, Inuit knowledge and instrumental data indicate that recently observed changes in ice conditions are beyond natural variability and long-term norms, and are consistent with the detection of human-induced climate change noted in the Arctic in general (ACIA, 2005). Based on analysis of how Inuit experience and manage sea ice extremes, variability, and change, a number of conclusions about local vulnerability to sea ice change can be made. Firstly, vulnerability to sea ice change is unequal within the community. Various groups in Igloolik are differentially exposed to changing ice conditions depending on their use of the sea ice, their engagement in hunting activities, and their consumption of country food or use of related products. |
| Lane K Charles-Guzman K Wheeler K Abid Z Graber N Matte T. Health effects of coastal storms and flooding in urban areas: a review and vulnerability assessment. Journal of environmental and public health<br>2013 vol: 2013 pp: 913064 | Lane K Charles-Guzman K Wheeler K Abid Z Graber N Matte T. | 2013 | flooding | Health effects, coastal storms, flooding, urban areas, vulnerability assessment. | Coastal storms can take a devastating toll on the public's health. Urban areas like New York City (NYC) may be particularly at risk, given their dense population, reliance on transportation, energy infrastructure that is vulnerable to flood damage, and high-rise residential housing, which may be hard-hit by power and utility outages. Climate change will exacerbate these risks in the coming decades. Sea levels are rising due to global warming, which will intensify storm surge. These projections make preparing for the health impacts of storms even more important. We conducted a broad review of the health impacts of US coastal storms to inform climate adaptation planning efforts, with a focus on outcomes relevant to NYC and urban coastal areas, and incorporated some lessons learned from recent experience with Superstorm Sandy. Based on the literature, indicators of health vulnerability were selected and mapped within NYC neighborhoods. Preparing for the broad range of anticipated effects of coastal storms and floods may help reduce the public health burden from these events. | Recent literature about the health impacts of coastal storms and floods, such as injuries, depression, anxiety, and poor physical health, was reviewed. The intent was not to be exhaustive but to describe the range of potential health effects that could occur in NYC and other urban areas and describe likely and/or potentially severe outcomes. Using the US National Library of Medicine's PubMed database, we searched a set of general terms relating to storms and flooding to capture a broad range of health outcomes | quantitative assessment of previous literature | Health outcomes can occur through multiple pathways (see Figure 1) including (1) hazards from exposure to storm impact; (2) evacuation; (3) post-storm hazards from utility outages and sheltering in place in inadequate housing; (4) exposure to secondary hazards including contaminated drinking water, contact with contaminated floodwaters, and mold and moisture in housing; (5) population displacement and disruption of services; (6) mental health effects from traumatic or stressful experiences during and after the storms and (7) health and safety risks from clean-up and recovery activities. The most severe acute effect of hurricane landfall is death from drowning, electrocutions, or physical trauma [6–9]. Older age increases the risk of death—nearly 85% of people killed during and in the immediate aftermath of Hurricane Katrina were aged 51 and older, and almost half were older than 75 years of age [9]. Residents of nursing homes that sheltered in place were among those killed by drowning [10]. As with other natural disasters, low-income populations may be particularly vulnerable [11]. |
| Lewitus A Horner R Caron D Garcia-Mendoza E Hickey B Hunter M Huppert D Kudela R Langlois G Largier J Lessard E Ralonde R Jack Rensel J Strutton P Trainer V Tweddle J. Harmful algal blooms along the North American west coast region: History, trends, causes, and impacts. Harmful Algae<br>2012 vol: 19 pp: 133-159 | Lewitus A Horner R Caron D Garcia-Mendoza E Hickey B | 2012 | toxins | algal blooms, harmful, causes | Along the Pacific coast of North America, from Alaska to Mexico, harmful algal blooms (HABs) have caused losses to natural resources and coastal economies, and have resulted in human sicknesses and deaths for decades. Recent reports indicate a possible increase in their prevalence and impacts of these events on living resources over the last 10-15 years. Two types of HABs pose the most significant threat to coastal ecosystems in this "west coast" region: dinoflagellates of the genera Alexandrium, Gymnodinium, and Pyrodinium that cause paralytic shellfish poisoning (PSP) and diatoms of the genus Pseudo-nitzschia that produce domoic acid (DA), the cause of amnesic shellfish poisoning (ASP) in humans. These species extend throughout the region, while problems from other HABs (e.g., fish kills linked to raphidophytes or Cochlodinium, macroalgal blooms related to invasive species, sea bird deaths caused by surfactant-like proteins produced by Akashiwo sanguinea, hepatotoxins from Microcystis, diarrhetic shellfish poisoning from Dinophysis, and dinoflagellate-produced yessotoxins) are less prevalent but potentially expanding. This paper presents the state-of-knowledge on HABs along the west coast as a step toward meeting the need for integration of HAB outreach, research, and management efforts. | Data from the CDPH biotoxin monitoring program. Previous studies | quantitative assessments of previous research and modelling | Systematic economic assessments of HAB impacts and cost-benefit analyses for management strategic planning purposes remain important needs for the west coast region. Impacts to the shellfish industry in the Pacific Northwest region are significant, annually persistent, and well-documented. The effect of Heterosigma on the salmon aquaculture industry is another well-recognized economic threat (Rensel et al., 2010b); however, much of the impact of west coast HABs on coastal communities may not translate as well to economic losses. The threat to human health is always present, and the June 2010 death of two Alaskans attributed to PSP is a tragic reminder. The August 2011 discovery of DSP with human illnesses for the first time in BC and WA indicates that continued vigilance is necessary. Also, DA poisoning has led to thousands of sick or dead seals, sea lions, sea otters, dolphins, birds, and whales along the west coast in the last decade. |
| Logue, J. N., Hansen, H. & Struening, E. Emotional and Physical Distress following Hurricane Agnes in Wyoming Valley of Pennsylvania. *Public Health Rep.* 94, 495–502 (1979). | Logue J, Hansen H | 1979 | extreme events | Emotional and Physical Distress Hurricane Agnes, Pennsylvania | Long term mental and physical health problems associated with natural disasters summarized by the National Institute of Mental Health. Stressors can serve as a precipitating factor for other health issues. Important stressor characteristics to be included with natural disasters: magnitude, intensity, duration, unpredictability, and novelty of event. Hurricane Agnes has been referred to as the greatest natural disaster in US history. Melick (21) conducted a cross-sectional study in 1975 of Agnes flood victims compared with control group. | | Dependent variables treated as continuous variables. Unpaired Student's t-test applied to between-group comparisons. ANOVA also used | Survey items grouped under four topics: severity of disaster experience, use of sedatives and alcohol, extent of emotional distress, duration of emotional and physical stress. More than half respondents had severe destruction of property-physically taxing. Financial problems judged severe by 1/3 of families (only 3% of control). 50% flood group found alcohol helpful (16% of control). 64% deeply discouraged after flood (7% of control), unemployment judged stressful by 82% of flood group (55% of control). Both emotional and physical distress lasted about 1 year longer among flood group than control group. |
| Martinez-Urtaza J Bowers J Trinanes J Depaola A. Climate anomalies and the increasing risk of Vibrio parahaemolyticus and Vibrio vulnificus illnesses | Martinez-Urtaza J Bowers J Trinanes J Depaola A. | 2010 | toxins | Vibrio parahaemolyticus, Vibrio vulnificus, illnesses, climate anomalies | We examined the potential influence of climate anomalies in expanding the geographical and seasonal range of seafood-borne illnesses from Vibrio parahaemolyticus and Vibrio vulnificus. Archived climate data from areas of implicated seafood production were obtained from various sources, including in situ monitoring devices and satellite imagery. The geographical expansion of V. parahaemolyticus outbreaks into Peru and Alaska corresponded closely with climate anomalies such as El Niño, which brought large masses of abnormally warm water into these regions. Seasonal expansion of V. vulnificus illnesses associated with oysters harvested from the Gulf of Mexico in April and November correspond with warmer water temperatures (>20 °C) recorded during these months since 1998. This retrospective review indicates that climate anomalies have already greatly expanded the risk area and season for vibrio illnesses and suggest that these events can be forecasted. Certainly, when similar circumstances occur in the future, adjustments in industry practices and regulatory policy should be considered, especially for seafood that is consumed raw, such as bivalve mollusks. | Previous studies. Re-examined monthly illness data, oyster landings, and climate data for two periods (1989–1997 and 1998–2007) to develop a clearer understanding of how climate may have extended the *V. vulnificus* risk season since 1997. | quantitative assessments of previous research | Further development of risk models for V. parahaemolyticusand V. vulnificus may also help elucidate the risks resulting from climate change and temperature anomalies. Current models are based almost entirely on water temperature, which explain only about half of the inter-annual variation in levels of these pathogens (Anonymous, 2005, FAO/WHO, 2005). These risk models are being integrated with satellite imagery of sea surface temperature to provide near real-time risk assessment for V. parahaemolyticus levels (Phillips, DePaola, Bowers, Ladner, & Grimes, 2007). A web site is under development to use this approach to estimate levels of V. parahaemolyticus and V. vulnificus at harvest and consumption as well as risk under various post-harvest management practices (personal communication, Jay Grimes, University of Southern Mississippi). Other parameters such as salinity, turbidity, and chlorophyll are impacted by climate events and have been associated with vibrio levels (Zimmerman et al., 2007). These parameters can also be monitored remotely by satellite imagery. Refining risk models to include effects of additional parameters will facilitate more accurate predictions which, when coupled with satellite imagery data, could provide a useful tool to guide regulators and industry for timely implementation of controls proportional to the ever-changing risk due to climate variations. |

| Bibliography | primary authors | year published | category | key words | abstract | data | analysis | results summary |
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| Miller W Lewis D Lennox M Pereira M Tate K Conrad P Atwill E. Climate and On-Farm Risk Factors Associated with Giardia duodenalis Cysts in Storm Runoff from California Coastal Dairies. APPLIED AND ENVIRONMENTAL MICROBIOLOGY<br>2007 vol: 73 (21) pp: 6972-6979 | Miller W Lewis D Lennox M Pereira M Tate K Conrad P Atwill E. | 2007 | stormwater | Climate, On-Farm, Risk Factors, Giardia duodenalis Cysts, Storm Runoff, California, Coastal, Dairies | Climatic factors and on-farm management practices were evaluated for their association with the concentrations (cyst/liter) and instantaneous loads (cysts/second) of Giardia duodenalis in storm-based runoff from dairy lots and other high-cattle-use areas on five coastal California farms over two storm seasons. | Fifty-seven cattle lots stratified across the five dairies were enrolled the study. For each lot, we recorded the acreage, number of cattle present at the time of sampling, and percent slope. We assigned soil hydrologic conductivity based upon soil hydrologic group (15). A set of BMPs that were either already in practice by one or more dairy farms or newly installed for this project were evaluated. These included modifying the density of cattle or completely excluding cattle from the lot during the duration of the rainfall season, using a tractor to scrape and remove the accumulated layer of manure from the lot prior to the onset of winter rains, and channeling runoff from the lot through vegetative buffer strips as a means to reduce the load of waterborne microbial contaminants (2, 3, 8, 27, 29). Building upon these preexisting practices, we implemented vegetative surface treatments in October, prior to the onset of winter rains, for a subset of the dairy lots. This vegetative surface treatment involved adding 5.4 metric tons/hectare straw across the lot in order to provide cover during early winter storms combined with seeding the lot with 112 kg/hectare of annual barley (*Hordeum vulgare* ) and 28 kg/hectare rye grasses (*Lolium multiflorum* ) to provide ground cover during later winter storms after the straw had decomposed. Following each rainstorm during the 2002-2003 and 2003-2004 water years, surface runoff water samples were collected from the different dairy lots on a rotating basis so that each dairy was visited several times per water year, ranging from early in the season (first flush events) to late spring (final flush events). Following each rainstorm during the 2002-2003 and 2003-2004 water years, surface runoff water samples were collected from the different dairy lots on a rotating basis so that each dairy was visited several times per water year, ranging from early in the season (first flush events) to late spring (final flush events) | Direct fluorescent antibody analysis was used to quantitate cysts in 350 storm runoff samples. | Cysts were detected in 41% of runoff samples collected near cattle less than 2 months old, compared to 10% of runoff samples collected near cattle over 6 months old. Furthermore, the concentrations and instantaneous loads of cysts were ≥65 and ≥79 times greater, respectively, in runoff from sites housing young calves than in sites housing other age classes of animals. Factors associated with environmental loading of G. duodenalis included cattle age, cattle stocking number, and precipitation but not lot area, land slope, or cattle density. Vegetated buffer strips were found to significantly reduce waterborne cysts in storm runoff: each additional meter of vegetated buffer placed below high-cattle-use areas was associated with reductions in the concentration and instantaneous load of cysts by factors of 0.86 and 0.79 (−0.07 and −0.10 log10/m), respectively. Straw mulch, seed application, scraping of manure, and cattle exclusion did not significantly affect the concentration or load of G. duodenalis cysts. The study findings suggest that vegetated buffer strips, especially when placed near dairy calf areas, should help reduce the environmental loading of these fecal protozoa discharging from dairy farms. |
| Moerlein K Carothers C. Total Environment of Change: Impacts of Climate Change and Social Transitions on Subsistence Fisheries in Northwest Alaska. Ecology and Society<br>2012 | Moerlein K Carothers C. | 2012 | vulnerable pop. | environ. Change, social transitions, fisheries, NW Alaska | Arctic ecosystems are undergoing rapid changes as a result of global climate change, with significant implications for the livelihoods of Arctic peoples. In this paper, based on ethnographic research conducted with the Iñupiaq communities of Noatak and Selawik in northwestern Alaska, we detail prominent environmental changes observed over the past twenty to thirty years and their impacts on subsistence-based lifestyles. However, we suggest that it is ultimately insufficient to try to understand how Arctic communities are experiencing and responding to climate change in isolation from other stressors. During interviews and participant observation documenting local observations of climatic and related environmental shifts and impacts to subsistence fishing practices, we find the inseparability of environmental, social, economic, cultural, and political realms for community residents. Many of our informants, who live in a mixed economy based on various forms of income and widespread subsistence harvesting of fish and game, perceive and experience climate change as embedded among numerous other factors affecting subsistence patterns and practices. Changing lifestyles, decreasing interest by younger generations in pursuing subsistence livelihoods, and economic challenges are greatly affecting contemporary subsistence patterns and practices in rural Alaska. Observations of climate change are perceived, experienced, and articulated to researchers through a broader lens of these linked lifestyle and cultural shifts. Therefore, we argue that to properly assess and understand the impacts of climate change on the subsistence practices in Arctic communities, we must also consider the total environment of change that is dramatically shaping the relationship between people, communities, and their surrounding environments. | Interviews and participant observation documentation | quantitative assessment of interview material | We find the inseparability of environmental, social, economic, cultural, and political realms for community residents. Many of our informants, who live in a mixed economy based on various forms of income and widespread subsistence harvesting of fish and game, perceive and experience climate change as embedded among numerous other factors affecting subsistence patterns and practices. Changing lifestyles, decreasing interest by younger generations in pursuing subsistence livelihoods, and economic challenges are greatly affecting contemporary subsistence patterns and practices in rural Alaska. Observations of climate change are perceived, experienced, and articulated to researchers through a broader lens of these linked lifestyle and cultural shifts. Therefore, we argue that to properly assess and understand the impacts of climate change on the subsistence practices in Arctic communities, we must also consider the total environment of change that is dramatically shaping the relationship between people, communities, and their surrounding environments. |
| Moore S Mantua N Salathé E. Past trends and future scenarios for environmental conditions favoring the accumulation of paralytic shellfish toxins in Puget Sound shellfish. Harmful Algae<br>2011 vol: 10 pp: 521-529 | Moore S Mantua N Salathé E. | 2011 | toxins | accumulation, paralytic shellfish toxins, Puget Sound | The risk of harmful algal blooms (HABs) of the dinoflagellate Alexandrium catenella in Puget Sound, Washington State, can be assessed by identifying and predicting climate and environmental conditions that are favorable for bloom development and the accumulation of paralytic shellfish toxins (PSTs) in shellfish. When these favorable conditions occur in combination, a harmful algal bloom window of opportunity (HAB-WOO) exists for A. catenella. The original HAB-WOO was identified by Moore et al. (2009) for the time period 1993–2007. In general, it showed that warm air and water temperatures, low streamflow, low winds, and small tidal variability precede PST events. Here, we use the HAB-WOO model to examine (i) changes in the annual HAB-WOO duration over the period from 1967 to 2006, and (ii) the potential effect of future climate change on HAB risk through the late 21st century. The annual HAB-WOO duration increased between 1978 and 2006, as did the frequency and geographic extent of PST events. Two step-like changes occurred in 1978 and 1992 with higher annual values attained by the HAB-WOO compared to previous years. The 1978 step change may be related to the 1977 reversal of the Pacific Decadal Oscillation from cool to warm phase. Climate change projections from global climate models and regionally downscaled climate models for the Pacific Northwest are used to evaluate scenarios for the future HAB-WOO. Under a moderate greenhouse gas emissions scenario (i.e., A1B), the annual HAB-WOO for A. catenella in Puget Sound is projected to increase by an average of 13 days by the end of the 21st century. Furthermore, the annual HAB-WOO may begin up to 2 months earlier in the year and persist for up to 1 month later in the year compared to the present day. This research provides managers, health authorities, and shellfish growers in Washington State with critical information for anticipating climate impacts on toxic HABs in the Pacific Northwest now and in a future warmer climate. | Here, we use the HAB-WOO model to examine (i) changes in the annual HAB-WOO duration over the period from 1967 to 2006, and (ii) the potential effect of future climate change on HAB risk through the late 21st century. The monitoring sites for PSTs in M. edulis in Puget Sound used to identify the HAB-WOO are shown in Fig. 1. “Hot spot” sites at Sequim Bay, Discovery Bay, Mystery Bay, and Kingston Marina were used to identify the exceptionally toxic events that formulated the HAB-WOO model. The mean PST values at all 20 sites from 1993 to 2007 were used to validate the model (Moore et al., 2009). HAB-WOO time periods not only preceded the 5 exceptionally toxic events that were used to create the model, but also preceded most of the other toxic events from 1993 to 2007.<br><br>The local weather and environmental conditions that comprise the HAB-WOO model are sea surface temperature and salinity observations at Race Rocks lighthouse (SST and SSS, respectively), British Columbia, Canada, obtained from the Department of Fisheries and Oceans, Canada (http://www.pac.dfo-mpo.gc.ca/SCI/osap/data/SearchTools/Searchlighthouse_e.htm); air temperature and precipitation observations at Port Townsend (station 456678) (AIR and PRCP, respectively), obtained from the United States Historical Climatology Network. | The original HAB-WOO model described in Moore et al. (2009)and summarized above was slightly modified for this study. For some environmental parameters, we relax the upper or lower boundary that defines the range within which values had to fall for the HAB-WOO model to be satisfied. Warm air temperatures, low precipitation and streamflow, weak winds, and small tidal height variability were found to be favorable for toxic events. Therefore, we remove the upper boundary for AIR and the lower boundaries for PRCP, STRM, WIND, and TIDE such that the values of these parameters only had to fall above or below a single threshold. These parameters are thought to indirectly influence growth of A. *catenella* . | The annual HAB-WOO duration increased between 1978 and 2006, as did the frequency and geographic extent of PST events. Two step-like changes occurred in 1978 and 1992 with higher annual values attained by the HAB-WOO compared to previous years. The 1978 step change may be related to the 1977 reversal of the Pacific Decadal Oscillation from cool to warm phase. Climate change projections from global climate models and regionally downscaled climate models for the Pacific Northwest are used to evaluate scenarios for the future HAB-WOO. Under a moderate greenhouse gas emissions scenario (i.e., A1B), the annual HAB-WOO for A. catenella in Puget Sound is projected to increase by an average of 13 days by the end of the 21st century. Furthermore, the annual HAB-WOO may begin up to 2 months earlier in the year and persist for up to 1 month later in the year compared to the present day. This research provides managers, health authorities, and shellfish growers in Washington State with critical information for anticipating climate impacts on toxic HABs in the Pacific Northwest now and in a future warmer climate. |

| Bibliography | primary authors | year published | category | key words | abstract | data | analysis | results summary |
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| Moore S Trainer V Mantua N Parker M Laws E Backer L Fleming L. Environmental Health Impacts of climate variability and future climate change on harmful algal blooms and human health | Moore S Trainer V Mantua N Parker M Laws E Backer L Fleming L. | 2008 | toxins | climate variability, harmful algal blooms, human health | Anthropogenically-derived increases in atmospheric greenhouse gas concentrations have been implicated in recent climate change, and are projected to substantially impact the climate on a global scale in the future. For marine and freshwater systems, increasing concentrations of greenhouse gases are expected to increase surface temperatures, lower pH, and cause changes to vertical mixing, upwelling, precipitation, and evaporation patterns. The potential consequences of these changes for harmful algal blooms (HABs) have received relatively little attention and are not well understood. Given the apparent increase in HABs around the world and the potential for greater problems as a result of climate change and ocean acidification, substantial research is needed to evaluate the direct and indirect associations between HABs, climate change, ocean acidification, and human health. This research will require a multidisciplinary approach utilizing expertise in climatology, oceanography, biology, epidemiology, and other disciplines. We review the interactions between selected patterns of large-scale climate variability and climate change, oceanic conditions, and harmful algae. The aim of this paper is to provide a synopsis of the current state of knowledge of climate impacts on HABs and their known and potential consequences for human health, particularly as it relates to the main research themes of the NSF/NIEHS and NOAA Centers for Oceans and Human Health. | Previous studies | quantitative assessments of previous research | The approach to downscaling future climate change pro-jections should be guided by the mechanisms that are both (i) demonstrated to be important environmental links to HAB risks, and (ii) demonstrated to be well-informed by climate model outputs. For example, sea sur-face temperature in many estuaries is well correlated with regional surface air temperature, so statistical downscaling of temperature may prove useful in situations where HAB risks are clearly sensitive to surface water temperatures. In contrast, where local wind-forcing, stratification, and estuarine circulation are critical factors for HAB risks, it may be necessary to run much higher resolution (1 km) nested atmosphere and estuarine circulation models to assess the potential impacts of climate change on HAB risks. Whatever the case, efforts to match the outputs from global scale climate studies to more localized climate change impacts studies must first elucidate the local proc-esses that give rise to HAB variations. Finally, future research should focus on better elucidating relationships between HA and other biological compo-nents of the ecosystem. For example, interactions between the toxin-producing species of Pseudo-nitzschia and bacte-ria have been shown to influence production of domoic acid (see [13] and references therein). However, it is uncertain if and how anthropogenic climate change will influence this interaction. Similarly, physiological rates of uptake of HA-derived toxins by finfish and shellfish may change. Given the public uncertainty that already sur-rounds seafood consumption, recently termed the "sea-food dilemma" [98], it will be important to monitor any increases in the susceptibility of seafood species to con-tamination by HABs, as well as the subsequent risks to consumers. |
| Morris R, Munasinghe R. Geographic Variability in Hospital Admission Rates for Respiratory Disease Among the Elderly in the United States. Chest<br>1994 vol: 106 (4) pp: 1172-1181 | Morris R, Munasinghe R | 1994 | respiratory | Hospital Admission Rates, Respiratory Disease, elderly | BACKGROUND The elderly represent a susceptible subpopulation that experiences disproportionate levels of morbidity and mortality from respiratory disease. As a consequence, they are frequently hospitalized for these conditions. Evaluating the geographic distributions of these hospital admissions can provide useful insights concerning patterns in incidence and medical care for respiratory diseases. METHODS All hospital admissions for pneumonia, acute respiratory infections, asthma, and chronic obstructive pulmonary disease from the United States for a 6-year period (1984 through 1989) were identified using Medicare admissions records. | All hospital admissions for pneumonia, acute respiratory infections, asthma, and chronic obstructive pulmonary disease from the United States for a 6-year period (1984 through 1989) were identified using Medicare admissions records. | Age-, race-, and sex-standardized annual admission rates were calculated for each county and spatial clustering of disease specific rates was evaluated using Moran's I statistic. Ecologic analyses were conducted using multiple regression procedures with county-specific measures of average annual temperature, average income, household crowding, median educational level, population density, physicians per capita, and hospital beds per capita together with surrogate measures of cigarette consumption and occupational exposures as predictor variables. | Hospital admission rates in the elderly for all four categories of respiratory disease showed marked regional elevations (p<0.0001), particularly in the southeast and the northern plains states. Low median education level, low per capita income, and household crowding were all associated with elevated hospital admission rates. Surrogate measures of cigarette consumption were strongly associated with hospital admissions in all four disease groups. Hospital beds per capita demonstrated positive associations with hospital admissions, but the number of physicians per capita exhibited consistent inverse relationships with hospital admissions. |
| Nichols G Lane C Asgari N Verlander N Charlett A. Rainfall and outbreaks of drinking water related disease and in England and Wales. 2009 Journal of water and health 07.01 | Nichols G Lane C Asgari N Verlander N Charlett A. | 2009 | water quality | rainfall, drinking water | A case-crossover study compared rainfall in the 4 weeks before drinking water related outbreaks with that in the five previous control years. This included public and private drinking water related outbreaks in England and Wales from 1910 to 1999. Of 111 outbreaks, 89 met inclusion criteria and the implicated pathogens included Giardia, Cryptosporidium, E. coli, S. Typhi, S. Paratyphi, Campylobacter and Streptobacillus moniliformis. | Weather data was derived from the British Atmospheric Data Centre There was a significant association between excess cumulative rainfall in the previous 7 days and outbreaks (p ¼ 0.001). There was an excess of rainfall below 20 mm for the three weeks previous to this in outbreak compared to control weeks (p ¼ 0.002). Cumulative rainfall exceedances were associated with outbreak years. Waterborne outbreak cases have been reported during the years 1910–1999 where the location and time of the outbreak is known. The sources used included Medline, Communicable Disease Reports, unpublished reports held by the HPA Centre for Infections and published papers. | Due to paired nature of case study and control data, a conditional logistic regression analysis was performed to estimate the strength of assocaition between the cumulative rainfall categories and waterborne outbreaks. | This study provides evidence that both low rainfall and heavy rain precede many drinking water outbreaks and assessing the health impacts of climate change should examine both. |
| Otto Hänninen, Raimo Salonen, Kimmo Koistinen, Matti Jantunen. Population exposure to fine particles and estimated excess mortality in Finland from an East European wildfire episode. 2009. Journal of Exposure Science and Environmental Epidemiology 19(4):414-22 | Otto Hänninen, Raimo Salonen, Kimmo Koistinen, Matti Jantunen | 2009 | fire | wildfire, Population exposure, fine particles, mortality | Long-<br>range transported particulate matter (PM) air pollution episodes associated with wildfires in the Eastern Europe are relatively common in Southern and Southeastern Finland. In severe cases such as in August-<br>September 2002, the reduced visibility and smell of the smoke, and symptoms such as irritation of eyes and airw ays experienced by the population raise the issue into the headlines. Because PM air pollution, in general, has be en identified as a major health risk, and the exposures are of repeating nature, the issue warrants a risk assessm ent to estimate the magnitude of the problem. The current work uses the available air quality data in Finland to estimate population exposures caused by one of the worst episodes experienced in this decade. This episode ori ginated from wildfires in Russia, Belarus, Ukraine, and the Baltic countries. The populations of 11 Southern Finni sh provinces were exposed between 26 August and 8 September 2002, for 2 weeks to an additional population-<br>weighted average PM(2.5) level of 15.7 microg/m(3). Assuming similar effect on mortality for these particles as o bserved in epidemiological time series studies on urban particles (0.5%-<br>2% increase in mortality per 10 microg/m(3), central estimate 1%), this exposure level would be associated with 9-<br>34 cases (17 cases central estimate) of additional mortality. Epidemiological evidence specific to particles from bi omass combustion is scarce, affecting also the reliability of the current risk assessment. | PM2.5 or PM10 data were available from eight stations on an area covering approximately 100,000 km2 and 3.4 million inhabitants (Table 1). To estimate the exposure levels, the concentrationsfrom variousstationswere plotted as time series together, displaying convincing similarities in the profiles. Exposuresin the 11 provincesaffected by the smoke were estimated using the most representative urban background monitoring data (Table 1) after subtraction of the seasonal background. Seasonal background concentrations were visually estimated using the baseline levels of hourly concentration data and subtracted from the observations using the minimum daily average value. | The additional daily mortality caused by the episode was estimated by using air quality monitoring data in combination with exposure–response values from epidemiological studiesassuggested by WHO (Schwela et al., 1999), but with the exposure–response factor of PM2.5 instead of the value for PM10. The calculation was based on the assumption that the daily mortality isincreased by 1% per each increment of 10 mg/m3 (WHO, 2004, 2006). Population and daily mortality for the provincesaffected by the episode were provided by Statistics Finland (Table 1, top part of Figure 4). To assess the uncertainty of our analysis, a range of mortality estimateswastested. A lower estimate of 0.5%/10 mg/m3 PM2.5 wasselected on the basisof the lowest estimatesfor total mortality presented in previous original studies selected into the meta-analysis of WHO (2004) and review by Pope and Dockery (2006). | The additional mortality potentially associated with the episode was calculated to be 17 (lower and upper estimates 9 and 34, respectively) cases in 2 weeks (Table 2). Risk in each province is a combination of the size of population and the exposure level listed in Table 1. Highest contribution (3.5 cases) was associated with Uusimaa (no. 1) containing the Metropolitan area of Helsinki, due to the largest population and relatively high exposure, followed by provinces Kymenlaakso (no. 8; 2.5 cases), Pirkanmaa (no. 6, 2.4 cases), and Etela¨-Savo (no. 10, 2.2 cases). The result for Pirkanmaa is<br>related to high population, whereas the two others represent high exposures. |
| Patz J Vavrus S Uejio C McLellan S. Climate Change and Waterborne Disease Risk in the Great Lakes Region of the U.S. Background Climate Change and Hydrologic Extremes. Am J Prev Med<br>2008 vol: 35 (5) pp: 451-458 | Patz J Vavrus S Uejio C McLellan S. | 2008 | water quality | climate change, water-borne disease, hydrologic extremes | Extremes of the hydrologic cycle will accompany global warming, causing precipitation intensity to increase, particularly in middle and high latitudes. During the twentieth century, the frequency of major storms has already increased, and the total precipitation increase over this time period has primarily come from the greater number of heavy events. The Great Lakes region is projected to experience a rise these extreme precipitation events. | For southern Wisconsin, the precipitation rate of the 10 wettest days was simulated using a suite of seven global climate models from the UN Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report. For each ranking, the precipitation rate of these very heavy events increases in the future. | analysis of global climate models | Overall, the models project that extreme precipitation events will become 10% to 40% stronger in southern Wisconsin, resulting in greater potential for flooding, and for the waterborne diseases that often accompany high discharge into Lake Michigan. Using 6.4 cm (2.5 in) of daily precipitation as the threshold for initiating combined sewer overflow into Lake Michigan, the frequency of these events is expected to rise by 50% to 120% by the end of this century. The combination of future thermal and hydrologic changes may affect the usability of recreational beaches. Chicago beach closures are dependent on the magnitude of recent precipitation (within the past 24 hours), lake temperature, and lake stage. Projected increases in heavy rainfall, warmer lake waters, and lowered lake levels would all be expected to contribute to beach contamination in the future. The Great Lakes serve as a drinking water source for more than 40 million people. Ongoing studies and past events illustrate a strong connection between rain events and the amount of pollutants entering the Great Lakes. Extreme precipitation under global warming projections may overwhelm the combined sewer systems and lead to overflow events that can threaten both human health and recreation in the region. |

| Bibliography | primary authors | year published | category | key words | abstract | data | analysis | results summary |
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| Redsteer MH K. Disaster Risk Assessment Case Study: Recent Drought on the Navajo Nation, Southwestern United States. Conference: 2011 Global Platform on Disaster Risk ReductionAt: Geneva, Switzerland | Redsteer MH K. | 2010 | vulnerable pop. | drought, risk assessment, Navajo Nation | The Navajo Nation is an ecologically sensitive semi-arid to arid section of the southern Colorado Plateau. In this remote part of the United States, located at the Four Corners (Arizona, New Mexico, Colorado, and Utah), traditional people live a subsistence lifestyle that is inextricably tied to, and dependent upon, landscape conditions and water supplies. Soft bedrock lithologies and sand dunes dominate the region, making it highly sensitive to fluctuations in precipitation intensity, percent vegetation cover, and local land use practices. However, this region has sparse and discontinuous meteorological monitoring records. As a complement to the scant long-term meteorological records and historical documentation, we conducted interviews with 50 Native American elders from the Navajo Nation and compiled their lifetime observations on the changes in water availability, weather, and sand or dust storms. We then used these observations to further refine our understanding of the historical trends and impacts of climate change and drought for the region. In addition to altered landscape conditions due to climatic change, drought, and varying land use practices over the last 130 years, the Navajo people have been affected by federal policies and harsh economic conditions which weaken their cultural fabric. We conclude that a long-term drying trend and decreasing snowpack, superimposed on regional drought cycles, will magnify drought impacts on the Navajo Nation and leave its people increasingly vulnerable. | Collected meteorological monitoring records. As a complement to the scant long-term meteorological records and historical documentation, we conducted interviews with 50 Native American elders from the Navajo Nation and compiled their lifetime observations on the changes in water availability, weather, and sand or dust storms. We then used these observations to further refine our understanding of the historical trends and impacts of climate change and drought for the region. | quantitative assessment of interview material with historical records | In addition to altered landscape conditions due to climatic change, drought, and varying land use practices over the last 130 years, the Navajo people have been affected by federal policies and harsh economic conditions which weaken their cultural fabric. We conclude that a long-term drying trend and decreasing snowpack, superimposed on regional drought cycles, will magnify drought impacts on the Navajo Nation and leave its people increasingly vulnerable. |
| Ruckelshaus M Doney S Galindo H Barry J Chan F Duffy J English C Gaines S Grebmeier J Hollowed A Knowlton N Polovina J Rabalais N Sydeman W Talley L. Securing ocean benefits for society in the face of climate change. Marine Policy<br>2013 vol: 40 pp: 154-159 | Ruckelshaus M Doney S Galindo H Barry J Chan F Duffy J | 2013 | coastal | marine, coastal, benefits, climate change | Benefits humans rely on from the ocean-marine ecosystem services-are increasingly vulnerable under future climate. This paper reviews how three valued services have, and will continue to, shift under climate change: (1) capture fisheries, (2) food from aquaculture, and (3) protection from coastal hazards such as storms and sea-level rise. Climate adaptation planning is just beginning for fisheries, aquaculture production, and risk mitigation for coastal erosion and inundation. A few examples are highlighted, showing the promise of considering multiple ecosystem services in developing approaches to adapt to sea-level rise, ocean acidification, and rising sea temperatures. Ecosystem-based adaptation in fisheries and along coastlines and changes in aquaculture practices can improve resilience of species and habitats to future environmental challenges. Opportunities to use market incentives-such as compensation for services or nutrient trading schemes-are relatively untested in marine systems. Relocation of communities in response to rising sea levels illustrates the urgent need to manage human activities and investments in ecosystems to provide a sustainable flow of benefits in the face of future climate change. | previous research | quantitative assessment of previous literature | Given the precarious state of global and local economies and increasing vulnerability of people living near coastlines, linking market and human wellbeing outcomes to ecosystem protection and restoration offers hope for sustaining and securing services from marine systems. For example, information on the sources of both biophysical and social vulnerabilities of communities to future climate impacts [19], [21], [135] can be used to target adaptation strategies towards solutions (e.g., increasing adaptive capacity of a community, restoring degraded coastal habitats) that will make a difference. Promising examples linking ecosystem change to human well-being are growing, such as the Coral Triangle Initiative [136], an integrated strategy to increase the resilience of a marine system in the face of future climate change. The Initiative is overseen by six country governments, NGOs, and representatives from the private sector, and encompasses a population of over 200 million people. Its main aims are to support the biodiversity protection of coral reefs, fisheries economies, and food security. A key part of their strategy is to establish multiple MPAs, increasingly coupled to exclusive fishing zones, to help secure benefits for local fishers. These protected areas are designed from the outset to reduce the region's vulnerability to climate change by providing coastal protection, food security, and livelihoods [137], [138], [139]. |
| Sauer E Vandewalle J Bootsma M Mclellan S. Detection of the human specific Bacteroides genetic marker provides evidence of widespread sewage contamination of stormwater in the urban environment. Water Research<br>2011 vol: 45 pp: 4081-4091 | Sauer E Vandewalle J Bootsma M Mclellan S. | 2011 | stormwater | Bacteroides genetic marker, sewage contamination, stormwater | Human sewage contamination of surface waters is a major human health concern. We found urban stormwater systems that collect and convey runoff from impervious surfaces act as a conduit for sewage originating from breeches in sanitary sewer infrastructure. | A total of 828 samples at 45 stormwater outfalls were collected over a four-year period and assessed by culture based methods, PCR, and quantitative PCR (qPCR) to test for traditional and alternative indicators of fecal pollution. | All statistical analyses were performed in SPSS v11.0. After statistical tests showed non-normally distributed data, all data were log10 transformed before statistical analysis. The relationship between rainfall, days since previous rainfall, and the human Bacteroides genetic marker was explored using logistic regression. The correlation between the human Bacteroides genetic marker and standard fecal indicators was tested using Pearson's correlation coefficient. All other data was analyzed using the t-test. All tests were considered significant at p ¯ 0.05. | All outfalls had the HF183 (human) Bacteroides genetic marker detected in at least one sample, suggesting sewage contamination is nearly ubiquitous in the urban environment. However, most outfalls were intermittently positive, ranging from detection in 11%–100% of the samples. Positive results did not correlate with seasonality, rainfall amounts, or days since previous rainfall. Approximately two-thirds of the outfalls had high (>5000 copy number, i.e. CN, per 100 ml) or moderate levels (1000–5000 CN per 100 ml) of the human Bacteroides genetic marker. Escherichia coli (E. coli) and enterococci levels did not correlate to human Bacteroides. A total of 66% of all outfall samples had standard fecal indicator levels above 10,000 CFU per 100 ml. A tiered assessment using this benchmark to identify high priority sites would have failed to flag 35% of the samples that had evidence of sewage contamination. In addition, high fecal indicators would have flagged 33% of samples as priority that had low or no evidence of sewage. Enteric virus levels in one outfall with high levels of the human Bacteroides genetic marker were similar to untreated wastewater, which illustrates stormwater can serve as a pathway for pathogen contamination. The major source of fecal pollution at four of five river sites that receive stormwater discharge appeared to be from sewage sources rather than non-human sources based on the ratios of human Bacteroides to total Bacteroides spp. This study shows the feasibility and benefits of employing molecular methods to test for alternative indicators of fecal pollution to identify sewage sources and potential health risks and for prioritization of remediation efforts. |
| Schmidhuber J, Tubiello F. Global food security under climate change. PNAS. December 11, 2007 vol. 104 no. 50 19703–19708 | Schmidhuber J, Tubiello F | 2007 | food security | Global food security, climate change | This article reviews the potential impacts of climate change on food security. It is found that of the four main elements of food security, i.e., availability, stability, utilization, and access, only the first is routinely addressed in simulation studies. To this end, published results indicate that the impacts of climate change are significant, however, with a wide projected range (between 5 million and 170 million additional people at risk of hunger by 2080) strongly depending on assumed socioeconomic development. The likely impacts of climate change on the other important dimensions of food security are discussed qualitatively, indicating the potential for further negative impacts beyond those currently assessed with models. Finally, strengths and weaknesses of current assessment studies are discussed, suggesting improvements and proposing avenues for new analyses. | previous studies | quantitative assessments of previous research | Climate change will affect all four dimensions of food security, namely food availability (i.e., production and trade), access to food, stability of food supplies, and food utilization (1, 43). The importance of the various dimensions and the overall impact of climate change on food security will differ across regions and over time and, most importantly, will depend on the overall socio-economic status that a country has accomplished as the effects of climate change set it. |
| Vezzulli L Brettar I Pezzati E Reid P Colwell R Hö Fle M Pruzzo C. Long-term effects of ocean warming on the prokaryotic community: evidence from the vibrios. The ISME Journal<br>2011 vol: 6 pp: 21-30 | Vezzulli L Brettar I Pezzati E Reid P Colwell R Hö Fle M Pruzzo C. | 2011 | toxins | ocean warming, prokaryotic community, vibrios | The long-term effects of ocean warming on prokaryotic communities are unknown because of lack of historical data. We overcame this gap by applying a retrospective molecular analysis to the bacterial community on formalin-fixed samples from the historical Continuous Plankton Recorder archive, which is one of the longest and most geographically extensive collections of marine biological samples in the world. We showed that during the last half century, ubiquitous marine bacteria of the Vibrio genus, including Vibrio cholerae, increased in dominance within the plankton-associated bacterial community of the North Sea, where an unprecedented increase in bathing infections related to these bacteria was recently reported. Among environmental variables, increased sea surface temperature explained 45% of the variance in Vibrio data, supporting the view that ocean warming is favouring the spread of vibrios and may be the cause of the globally increasing trend in their associated diseases. | CPR sampling: The CPR is a high-speed plankton sampler designed to be towed from commercially operated ships of opportunity over long distances (Reidet al ., 2003, Figure 1). Sampling takes place in the surface layer (B 7m) and plankton is collected on a band of silk (mesh size 270m m) that moves across the sampling aperture at a rate proportional to the speed of the towing ship (Reidet al ., 2003). | The relationship betweenVibrio abundance and the predictor variables (SST, phytoplankton colour index and total copepod abundance) was assessed using a non-parametric multiple regression analysis that was based on Euclidean distances calculated on normalised data using the routine DISTLM forward 1.3 (University of Auckla nd, Auckland, New Zealand) (Anderson, 2003). Forward selection of individual variables was used, where the amounts explained by each variable are added to the model and are conditional on variables al ready present in the model. | ncrease over four decades in the relative abundance of Vibrios with rising SST We analysed a set of 55 samples collected by the CPR survey in the North Sea from off the Rhine and Humber estuaries between 1961 and 2005 (Figure 1, Supplementary Table S1). we provide evidence that bacteria belonging to the genusVibrio not only increased in relative abundance over the last half century in the southern North Sea, but also became dominant within the plankton-associated bacterial community of coastal marine waters. The bacterial community composition of five selected CPR samples collected off the Rhine Estuary in 1961, 1972 and 1976 (before the regime shift) and in 1998 and 2004 (after the regime shift) was examined. |

| Bibliography | primary authors | year published | category | key words | abstract | data | analysis | results summary |
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| Wakefield J. A Toxicological Review of the Products of Combustion. 2010. Human Health Agency, Center for radiation, chemical and environmental hazards. Chilton, Didcot, Oxfordshire OX11ORQ | Wakefield J. | 2010 | fire | toxicity, combustion products | The Chemical Hazards and Poisons Division (CHaPD) is frequently required to advise on the health effects arising from incidents due to fires. The purpose of this review is to consider the toxicity of combustion products. Following smoke inhalation, toxicity may result either from thermal injury, or from the toxic effects of substances present. This review considers only the latter, and not thermal injury, and aims to identify generalisations which may be made regarding the toxicity of common products present in fire smoke, with respect to the combustion conditions (temperature, oxygen availability, etc.), focusing largely on the adverse health effects to humans following acute exposure to these chemicals in smoke. The prediction of toxic combustion products is a complex area and there is the potential for generation of a huge range of pyrolysis products depending on the nature of the fire and the conditions of burning. Although each fire will have individual characteristics and will ultimately need to be considered on a case by case basis there are commonalities, particularly with regard to the most important components relating to toxicity. | previous research | quantitative assessment of previous researcb | The prediction of toxic combustion products is a complex area and there is the potential for generation of a huge range of pyrolysis products depending on the nature of the fire and the conditions of burning. Although each fire will have individual characteristics and will ultimately need to be considered on a case by case basis there are commonalities, particularly with regard to the most important components relating to toxicity. |
| Wang J Deng Z. Detection and forecasting of oyster norovirus outbreaks: Recent advances and future perspectives | Wang J Deng Z | 2012 | toxins | oyster norovirus outbreaks | Norovirus is a highly infectious pathogen that is commonly found in oysters growing in fecally contaminated waters. Norovirus outbreaks can cause the closure of oyster harvesting waters and acute gastroenteritis in humans associated with consumption of contaminated raw oysters. Extensive efforts and progresses have been made in detection and forecasting of oyster norovirus outbreaks over the past decades. The main objective of this paper is to provide a literature review of methods and techniques for detecting and forecasting oyster norovirus outbreaks and thereby to identify the future directions for improving the detection and forecasting of norovirus outbreaks. It is found that (1) norovirus outbreaks display strong seasonality with the outbreak peak occurring commonly in DecembereMarch in the U.S. and AprileMay in the Europe; (2) norovirus outbreaks are affected by multiple environmental factors, including but not limited to precipitation, temperature, solar radiation, wind, and salinity; (3) various modeling approaches may be employed to forecast norovirus outbreaks, including Bayesian models, regression models, Artificial Neural Networks, and process-based models; and (4) diverse techniques are available for near real-time detection of norovirus outbreaks, including multiplex PCR, seminested PCR, real-time PCR, quantitative PCR, and satellite remote sensing. The findings are important to the management of oyster growing waters and to future investigations into norovirus outbreaks. It is recommended that a combined approach of sensor-assisted real time monitoring and modeling-based forecasting should be utilized for an efficient and effective detection and forecasting of norovirus outbreaks caused by consumption of contaminated oysters. | Previous studies | quantitative assessments of previous research and modelling | In order to respond promptly to oyster norovirus outbreaks and protect human health, future efforts should focus on real-time detection and forecasting of oyster norovirus. In terms of real-time detection, DNA microarray-based techniques have shown promise in the fast, large scale analysis of viruses (Maunula, 2007). DNA microarray offers a nanoscale molecular method. The advantages of this method are high throughput and small format, which enable rapid testing. It suits genotyping well, since it is easy to include tens or hundreds of sequences in spots on one glass slide. Also, the detection of a panel of different pathogens is convenient. The main barrier to wide applications of DNA microarray is the high cost which might be reduced in future. In terms of norovirus forecasting, future efforts should focus on the combined application of predictive models and real-time monitoring data. Effective models can be constructed using regression analysis, ANNs, Bayesian inference, and process modeling. Although it is reported that several environmental variables, such as salinity, temperature, precipitation, and humidity, are related with oyster norovirus outbreaks, the specific mechanisms responsible for norovirus outbreaks remain unclear. Further investigations into the mechanisms are needed to develop effective process-based models. ANN models and regression models have shown great promise in predicting bacterial concentrations in coastal waters (Zhang et al., 2012). The forecasting models require real-time and forecasting data for independent variables as model input data. The real-time or near real-time data can be obtained from in-situ sensing stations and satellite remote sensing data. NASA MODIS data are available without charge from several data archive and distribution centers (http://modis.gsfc.nasa.gov/index.php), which makes MODIS 250 and 500 m bands very promising for coastal monitoring and decision-making applications. One of the unique features of the MODIS instrument is its Direct Broadcast capability – in addition to storing data for later download at designated intervals, MODIS immediately broadcasts the raw data it collects, making it possible to obtain near real-time water quality data using remote sensing technology |
| Weisler R Barbee J Townsend M. Mental Health and Recovery in the Gulf Coast After Hurricanes Katrina and Rita. JAMA 2006 vol: 296 (5) pp: 585 | Weisler R Barbee J Townsend M. | 2006 | extreme events | mental health, hurricane | HURRICANE KATRINA WAS THE MOST DEVASTATING natural disaster in US history. Large parts of New Orleans and nearby Louisiana parishes were destroyed. About 90 000 square miles of the Gulf Coast, an area roughly the size of Great Britain, was declared a federal disaster area. The often contaminated flood waters covering much of New Orleans for almost 2 months contained a mix of raw sewage, bacteria, millions of gallons of oil, heavy metals, pesticides, and toxic chemicals, raising health concerns for residents and cleanup workers. As recently as June 19, 2006, Federal Emergency Management Agency (FEMA) officials estimated that as many as 2.5 million Gulf Coast residents may have been displaced from their homes by hurricanes Katrina and Rita; this number is based on FEMA applicants whose mailing addresses were outside of their home ZIP code and the assumption that each applicant represents an average of 2.5 people.1 Although more than 1.5 million residents fled the storm, hundreds of thousands remained behind, many of whom died or were injured during or in the immediate aftermath of the storm. As of July 2006, more than 1800 deaths were reported, including 1577 in Louisiana, and 231 in Mississippi.2,3 The number of fatalities would undoubtedly have been higher without prestorm evacuation and the efforts of many government and military personnel, first responders, area citizens, and volunteers. | previous research | quantitative assessment of previous literature | The aftermath of hurricanes Katrina and Rita yields a long list of needs, including long-term funding for rebuilding the health care infrastructure in the Gulf Coast area and for attracting physicians and other health care professionals for outreach and treatment programs. Federal assistance is needed to jump-start the National Health Care Service program for the region; continue funding for the federal SAMHSA volunteer counseling programs until more resources are available; fund disaster and environmentally related medical and psychiatric research studies of residents, workers, and rescuers; and rebuild the area's teaching hospitals and training programs to steadily increase the number of physicians and other health care professionals. |