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Global climate change and mental health

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Although several empirical studies and systematic reviews have documented the mental health impacts of global climate change, the range of impacts has not been well understood. This review examines mental health impacts of three types of climate-related events: (1) acute events such as hurricanes, floods, and wildfires; (2) subacute or long-term changes such as drought and heat stress; and (3) the existential threat of long-lasting changes, including higher temperatures, rising sea levels and a permanently altered and potentially uninhabitable physical environment. The impacts represent both direct (i.e. heat stress) and indirect (i.e. economic loss, threats to health and well-being, displacement and forced migration, collective violence and civil conflict, and alienation from a degraded environment) consequences of global climate change.

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Introductions

In the past decade, several empirical studies and systematic reviews of the literature have documented the public health impacts of global climate change. Although similar reviews have been conducted assessing the mental health impacts [1^{**},2^{*},3,4,5^{**},6^{**},7], the range of impacts has not been well understood. There is a robust literature documenting the mental health impacts of natural disasters such as hurricanes and wildfires [8^{**},9^{*},10–12]. However, to understand the significance of these impacts, this literature must be placed in the broader context of global climate change, including long-term changes in the physical and social environment [1^{**},2^{*},6^{**}].

In this paper, we summarize recent developments in understanding the mental health impacts of three specific forms of climate change to mental health impacts:

(1) extreme weather events (EWE) and natural disasters lasting for days, such as hurricanes, floods, wildfires, and short-duration heat waves; (2) subacute weather events lasting for months or years such as droughts and long-duration heat waves; and (3) environmental changes lasting to the end of this century and beyond such as higher temperatures, sea level rise, and a permanently altered and potentially uninhabitable physical environment. Each form of climate change can result in varying degrees of economic losses associated with property damage, loss of income and employment opportunities, and reduced economic productivity, especially in agriculture and fisheries; threats to health and well-being associated with EWE injuries and deaths, spread of vector-borne and respiratory illnesses, and heat-related stress; population displacement; loss of attachment to the natural environment; and social conflict and inter-group violence, each of which significantly impact mental health. Moreover, both the timing and nature of these events as well as the manifestation of specific associations between an event and its psychological consequences have important implications for development and implementation of policies and practices to prevent and treat climate-related mental health problems.

Impacts of acute climate-related events

There exists a substantial literature documenting the mental health consequences of extreme weather events and natural disasters lasting for days, such as hurricanes [8^{**},9^{*},10], floods [11], wildfires [12], and short-duration heat waves [13^{*},14]. These consequences include elevated rates of anxiety and mood disorders, acute stress reactions and post-traumatic stress disorders, sleep disruption, suicide and suicidal ideation, as well as a decreased sense of self and identity from loss of place and grief reactions [1^{**},2^{*},3,4,5^{**},15]. These outcomes can linger for months or even years [16]. Risk factors for developing mental illness in the aftermath of such disasters include the magnitude of the traumatic event, exposure to the injury or death of a loved one, female gender, younger age, lower socioeconomic status, less education, minority or ethnic status, psychiatric history, family instability, and inadequate social support [1^{**},2^{*},6^{**},7,17^{**}]. Residents of low and middle-income countries are especially vulnerable to these outcomes due to their increased exposure to extreme weather events, high levels of poverty, and lack of access to services [10,16,18,19]. Between 25% and 50% of those exposed to extreme weather events will experience negative mental health outcomes; these outcomes will diminish over time for most but not all individuals [7,8^{**},12,16].

One of the most recent examples of how extreme weather events combine with pre-existing vulnerabilities is Puerto Rico. Even before the arrival of Hurricane Maria in October, 2017, Puerto Rico was struggling with an increase in mental illness amid a 10-year recession that brought soaring unemployment, poverty, and family separation caused by emigration. Public health officials and caregivers say that Maria exacerbated the problem [20]. One study reported a 16% increase in the suicide rate from 2016 and a 26% increase in the number of suicides over the same period after Maria [21]. Another study by Scaramutti *et al.* [22] found rates of PTSD to be higher among displaced Puerto Rican residents living in Florida than those living in Puerto Rico (OR, 2.94; 95% CI, 1.67–5.26), perhaps due to their having suffered the greatest personal and property losses during and after the storm. Among participants in both Florida and Puerto Rico, those living in urban areas were more likely than those in rural/suburban areas to meet criteria for PTSD and generalized anxiety disorder. A cross-sectional survey of 74 households in the low-income community of Punta Santiago conducted six months after the storm found that 54.1% of study participants scored in the clinically significant range for major depression, 48.6% for generalized anxiety disorder, and 41.9% for PTSD [23]. Another study of 96 108 students representative of grades 3–12 across all 7 educational regions of Puerto Rico found 83.9% of youths saw houses damaged, 57.8% had a friend or family member leave the island, 45.7% reported damage to their own homes, 32.3% experienced shortages of food or water, 29.9% perceived their lives to be at risk, and 16.7% still had no electricity 5–9 months after the hurricane. Overall, 7.2% of youths reported clinically significant symptoms of PTSD [9*].

Impacts of subacute climate-related events

Depending on their duration, heat waves can be viewed as an acute or subacute event. However, the mental health impacts of heat waves can be expected to be more profound as they increase in duration. Obradovich *et al.* [15] examined the relationship between historic climatic conditions and mental health of two million randomly sampled US residents between 2002 and 2012. They found that shifting from monthly temperatures between 25°C and 30°C to greater than 30°C increased the probability of mental health difficulties by 0.5%, and that 1°C of five-year warming is associated with a 2% increase in the prevalence of mental health issues.

Increasing ambient temperatures is likely to increase rates of aggressive and criminal behavior, which may lead to increased rates of physical assaults and homicides [24,25], as well as an increase in suicide rates, especially among men and older adults [26,27]. Heat also suppresses thyroid hormones, resulting in functional hypothyroidism, which may be manifested as lethargy,

low mood, and cognitive impairment [28]. Heat also stimulates growth hormone and prolactin, which can also cause lethargy [29]. Body dehydration that occurs with heat stress can produce significant deterioration in cognitive functioning [30].

One segment of the population that is especially vulnerable to the mental health impacts of heat stress is those with pre-existing mental health problems. Heat waves are known to exacerbate underlying mental illnesses and behavioral disorders, contributing to higher rates of morbidity, mortality, and hospitalizations among individuals with these conditions, especially among those with dementia, schizophrenia, and substance use disorders [14], due to poor thermoregulation associated with psychotropic medication and heat-related cognitive impairment [14,31].

Another form of exposure to long-term changes in the environment has been the increasing occurrences of prolonged drought. Studies conducted primarily in Australia have demonstrated that prolonged droughts due to climate change can lead to more psychosocial distress, generalized anxiety, depression and an increased incidence of suicide in rural areas [1**,2*,32,33]. Older adults appear to be particularly vulnerable to these negative mental health outcomes [7].

The mental health outcomes associated with drought also highlight the importance of understanding and responding to the indirect impacts of climate-related events. A review conducted by Vins *et al.* [34] found evidence supporting an economic effects pathway, particularly its impacts on rural farming populations, as well as the migration pathway, linking drought to mental health. The causal pathways model proposed by Berry *et al.* [1**] identified two specific indirect pathways likely to occur in response to subacute events: (1) physical health, through increased heat stress, injury, disease, and disruption to food supply, and (2) community wellbeing, through damage to the economic and, consequently, the social fabric of communities. Impacts to physical health and well-being associated with prolonged heat stress, respiratory illnesses, vector-borne infectious disease and malnutrition are causally and reciprocally related to mental health [1**,7]. Impacts to community well-being will occur through economic losses associated with property damage, loss of income and employment opportunities, and reduced economic productivity, especially in agriculture and fisheries [34,35]; population displacement [36*]; loss of attachment to the natural environment [37,38]; and social conflict and inter-group violence [39**,40,41**], each of which significantly impact mental health. These effects will fall disproportionately on those who are already vulnerable, including indigenous peoples and those living in developing countries [2*,18,37,41**]. Children are especially vulnerable to these indirect

impacts because of their biological sensitivity, immature physiology, unique ways of interacting with their environment, limited adaptive capacity, dependence on stressed adults, and lifelong exposure [42].

Impacts of long-lasting climate-related events

Even if planned mitigation efforts are successful, higher temperatures and rising sea levels are anticipated to persist into the next century and beyond [43]. Even regions not currently experiencing acute extreme weather events or subacute events like droughts will nevertheless be impacted by the economic losses, displacement, conflicts, and environmental degradation associated with these changes, producing increases in the mental health problems associated with the other climate-related events on a global scale [44]. In the long term, however, poor countries will continue suffer economically from climate change much more than rich countries due to their greater exposure to very high temperatures, reliance on agriculture, and other industrial sectors that are vulnerable to extreme weather variability, and limited access to infrastructure and resources that are critical to risk management [10,41**]. Economic disparities, in turn, will lead to greater threats to health and well-being, population displacement and civil and international conflicts [35,36*].

Perhaps the greatest mental health outcome associated with long-lasting events, however, is the existential threat associated with climate change. Psychological distress and anxiety about the future may result from acknowledging climate change as a global environmental threat [3,6**,37,38]. A report by the American Psychological Association and ecoAmerica proposed that the worsening state of the environment is already causing a sense of stress that influences the way people interact in their communities [3]. Worry about climate change itself may exacerbate the environmental impacts on mental well-being [2*,45]. “The overarching threats of a changing climate can also incite despair and hopelessness as actions to address the ‘wicked problem’ of climate change seem intangible or insignificant in comparison to the scale and magnitude of the threats” [6**, p. 2]. This awareness contributes to ‘psychoterratic’ syndromes, including phenomena such as ‘ecoanxiety’, ‘ecoparalysis’, and ‘solastalgia’, the distress, and isolation caused by the gradual removal of solace from the present state of one’s home environment [6**,46*,47*]. Young people, including those living in high-income countries, are believed to be especially vulnerable to these syndromes [42].

Conclusion

Understanding the scope and scale of mental health impacts associated with climate change is an important first step to developing and implementing services designed to treat or prevent these impacts [48,49,50*]. The impacts represent both direct (i.e. heat stress, exposure to extreme weather events) and indirect

(i.e. economic loss, threats to health and well-being, displacement and forced migration, collective violence and civil conflict, and alienation from a degraded and potentially uninhabitable environment) consequences of three types of climate-related events: acute, subacute, and long lasting. Some of the mental health impacts and services employed as forms of adaptation to climate change will be specific to each type of event, while other impacts and services will cross cut all three event types. While delivery of services in response to acute and extreme weather events may appear to be of greater priority at the present time, what services are developed, how they are implemented and by whom will have important implications for addressing longer duration events. Subacute and long-lasting climate-related events will also require development and implementation of new types of mental health services like planned relocation of communities, public health education, violence prevention, risk communication, personal engagement in environmental conservation, and promotion of positive psychological outcomes associated with climate change.

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References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- of special interest
- of outstanding interest

1. Berry HL, Bowen K, Kjellstrom T: **Climate change and mental health: a causal pathways framework.** *Int J Public Health* 2010, **55**:123-132 <http://dx.doi.org/10.1007/s00038-009-0112-0>.
- The framework introduced by the authors is considered a standard in the literature for assessing and describing the direct and indirect mental health impacts of three types of climate-related changes.
2. Bourque F, Cunsolo Willox A: **Climate change: the next great challenge for public mental health?** *Int Rev Psychiatry* 2014, **26**:415-422 <http://dx.doi.org/10.3109/09540261.2014.925851>.
- This article highlights some climate-sensitive impacts that may be encountered by mental health professionals and suggests potential avenues for public mental health in light of current and projected changes.
3. Clayton S, Manning C, Hodge C: *Beyond Storms and Droughts: The Psychological Impacts of Climate Change.* Washington DC: American Psychological Association and ecoAmerica; 2014.
4. Dodgen D, Donato D, Kelly N, La Greca A, Morganstein J, Reser J, Ruzek J, Schweitzer S, Shimamoto MM *et al.*: **Chapter 8. Mental health and well-being.** In *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment.* Edited by Balbus AJ, Gamble JL, Beard CB, Bell JE, Dodgen D, Eisen RJ, Fann N, Hawkins MD, Herring SC, Jantarasami L, Mills DM, Saha S, Sarofim MC, Trtanj J, Ziska L. Washington DC: U.S. Global Change Research Program; 2016:217-246 <http://dx.doi.org/10.7930/J0TX3C9H>.

5. Doherty TJ, Clayton S: **The psychological impacts of global climate change.** *Am Psychol* 2011, **66**:265-276 <http://dx.doi.org/10.1037/a0023141>.
- This article describes three classes of psychological impacts: direct (e.g. acute or traumatic effects of extreme weather events and a changed environment); indirect (e.g. threats to emotional well-being based on observation of impacts and concern or uncertainty about future risks); and psychosocial (e.g. chronic social and community effects of heat, drought, migrations, and climate-related conflicts, and postdisaster adjustment).
6. Hayes K, Blashki G, Wiseman J, Burke S, Reifels L: **Climate change and mental health: risks, impacts and priority actions.** *Int J Ment Health Syst* 2018, **12**:28 <http://dx.doi.org/10.1186/s13033-018-0210-6>.
- This article provides an overview of the current and projected climate change risks and impacts to mental health and provides recommendations for priority actions to address the mental health consequences of climate change.
7. Trombly J, Chalupka S, Anderko L: **Climate change and mental health.** *Am J Nurs* 2017, **117**:44-52 <http://dx.doi.org/10.1097/01.NAJ.0000515232.51795.fa>.
8. Galea S, Brewin CR, Gruber M, Jones RT, King DW, King LA, McNally RJ, Ursano RJ, Petukhova M, Kessler RC: **Exposure to hurricane related stressors and mental illness after Hurricane Katrina.** *Arch Gen Psychiatry* 2007, **64**:1427-1434.
- This study of 1043 residents of the areas affected by Hurricane Katrina found New Orleans residents were estimated to have a 49.1% 30-day prevalence of any DSM-IV anxiety-mood disorder and 30.3% estimated prevalence of PTSD.
9. Orengo-Aguayo R, Stewart RW, de Arellano MA, Suárez-Kindy JL, Young J: **Disaster exposure and mental health among Puerto Rican youths after Hurricane Maria.** *JAMA Netw Open* 2019, **2**:e192619 <http://dx.doi.org/10.1001/jamanetworkopen.2019.2619>.
- This recently published study is one of the most comprehensive assessments of the mental health impacts of Hurricane Maria to date and illustrates the extent of impacts in low resource settings.
10. Nahar N, Blomstedt Y, Wu B, Kandarina I, Trisnantoro L, Kinsman J: **Increasing the provision of mental health care for vulnerable, disaster-affected people in Bangladesh.** *BMC Public Health* 2014, **14**:708 <http://dx.doi.org/10.1186/1471-2458-14-708>.
11. Fernandez A, Black J, Jones M, Wilson L, Salvador-Carulla L, Astell-Burt T, Black D: **Flooding and mental health: a systematic mapping review.** *PLoS One* 2015, **10**:e0119929 <http://dx.doi.org/10.1371/journal.pone.0119929>.
12. Bryant R, Waters E, Gibbs L, Gallagher HC, Pattison P, Lusher D, MacDougall C, Harms L, Block K, Snowdon E et al.: **Psychological outcomes following the Victorian Black Saturday bushfires.** *Aust N Z J Psychiatry* 2014, **48**:634-643 <http://dx.doi.org/10.1177/0004867414534476>.
13. Basu R, Gavin L, Pearson D, Ebusu K, Baliq B: **Examining the association between apparent temperature and mental health-related emergency room visits in California.** *Am J Epidemiol* 2018, **187**:726-735 <http://dx.doi.org/10.1093/aje/kwx295>.
- During the warm season, a 10°F (5.6°C) increase in same-day mean apparent temperature was associated with 4.8%, 5.8%, and 7.9% increases in the risk of emergency room visits for mental health disorders, self-injury/suicide, and intentional injury/homicide, respectively.
14. Schmeltz MT, Gamble JL: **Risk characterization of hospitalizations for mental illness and/or behavioral disorders with concurrent heat-related illness.** *PLoS One* 2017, **12**:e0186509 <http://dx.doi.org/10.1371/journal.pone.0186509>.
15. Obradovich N, Migliorini R, Paulus MP, Rahwan I: **Empirical evidence of mental health risks posed by climate change.** *Proc Natl Acad Sci U S A* 2018, **115**:10953-10958 <http://dx.doi.org/10.1073/pnas.1801528115>.
16. Schwartz RM, Gillezeau CN, Lieberman-Cribbin W, Taioli E: **Longitudinal impact of Hurricane Sandy exposure on mental health symptoms.** *Int J Environ Res Public Health* 2017, **14** <http://dx.doi.org/10.3390/ijerph14090957> pii: E957.
17. Norris FH, Friedman MJ, Watson PJ, Byrne CM, Diaz E, Kaniasty K: **60,000 disaster victims speak: part 1. An empirical review of the empirical literature, 1981–2001.** *Psychiatry* 2002, **65**:207-239.
- This classic in the disaster mental health literature identifies sociodemographic and event exposure characteristics of populations that are especially vulnerable to mental health impacts of natural disasters.
18. Rataj E, Kunzweiler K, Garthus-Niegel S: **Extreme weather events in developing countries and related injuries and mental health disorders – a systematic review.** *BMC Public Health* 2016, **16**:1020 <http://dx.doi.org/10.1186/s1288-016-3692-7>.
19. McDermott B, Cobham V, Berry H, Kim B: **Correlates of persisting posttraumatic symptoms in children and adolescents 18 months after a cyclone disaster.** *Aust N Z J Psychiatry* 2014, **48**:80-86 <http://dx.doi.org/10.1177/0004867413500349>.
20. Alvarez L: **A great migration from Puerto Rico is set to transform Orlando.** *New York Times*. 2017 . November 17. Retrieved from: <https://www.nytimes.com/2017/11/17/us/puerto-ricans-orlando.html>.
21. Ramphal L: **Medical and psychosocial needs of the Puerto Rican people after Hurricane Maria.** *Proc (Bayl Univ Med Cent)* 2018, **31**:294-296.
22. Scaramutti C, Salas-Wright CP, Vos SR, Schwartz SJ: **The mental health impact of Hurricane Maria on Puerto Ricans in Puerto Rico and Florida.** *Disaster Med Public Health Prep* 2019, **30**:1-4 <http://dx.doi.org/10.1017/dmp.2018.151>.
23. Ferré IM, Negron S, Shultz JM, Schwartz SJ, Kossin JP, Pantin H: **Hurricane Maria's impact on Punta Santiago, Puerto Rico: community needs and mental health assessment six months postimpact.** *Disaster Med Public Health Prep* 2018, **208**:103.
24. Stevens HR, Beggs PJ, Graham PL, Chang HC: **Hot and bothered? Associations between temperature and crime in Australia.** *Int J Biometeorol* 2019, **63**:747-762 <http://dx.doi.org/10.1007/s00484-019-01689-y>.
25. Younan D, Li L, Tuvblad C, Wu J, Lurmann F, Franklin M, Berhane K, McConnell R, Wu AH, Baker LA, Chen JC: **Long-term ambient temperature and externalizing behaviors in adolescents.** *Am J Epidemiol* 2018, **187**:1931-1941.
26. Gao J, Cheng Q, Duan J, Xu Z, Bai L, Zhang Y, Zhang H, Wang S, Zhang Z, Su H: **Ambient temperature, sunlight duration, and suicide: a systematic review and meta-analysis.** *Sci Total Environ* 2019, **646**:1021-1029 <http://dx.doi.org/10.1016/j.scitotenv.2018.07.098>.
27. Thompson R, Hornigold R, Page L, Waite T: **Associations between high ambient temperatures and heat waves with mental health outcomes: a systematic review.** *Public Health* 2018, **61**:171-191 <http://dx.doi.org/10.1016/j.puhe.2018.06.008>.
28. Norloei S, Jafari MJ, Omidi L, Khodakarim S, Bashash D, Abdollahi MB, Jafari M: **The effects of heat stress on a number of hematological parameters and levels of thyroid hormones in foundry workers.** *Int J Occup Saf Ergon* 2015, **23**:481-490 <http://dx.doi.org/10.1080/10803548.2016.1246122>.
29. Pranskunas A, Pranskuniene Z, Milieskaite E, Daniuseviciute L, Kudreviciene A, Vitkauskienė A, Brazaitis M: **Effects of whole body heat stress on sublingual microcirculation in healthy humans.** *Eur J Appl Physiol* 2015, **115**:157-165 <http://dx.doi.org/10.1007/s00421-014-2999-2>.
30. Piil JF, Lundbye-Jensen J, Christiansen L, Ioannou L, Tsoutsoubi L, Dallas CN, Mantzios K, Flouris AD, Nybo L: **High prevalence of hypohydration in occupations with heat-stress: perspectives for performance in combined cognitive and motor tasks.** *PLoS One* 2018, **13**:e0205321 <http://dx.doi.org/10.1371/journal.pone.0205321>.
31. Vida S, Durocher M, Ouarda TB, Gosselin P: **Relationship between ambient temperature and humidity and visits to mental health emergency departments in Quebec.** *Psychiatr Serv* 2012, **63**:1150-1153.
32. Hanigan IC, Butler CD, Kocic PN, Hutchinson ME: **Suicide and drought in New South Wales, Australia, 1970–2007.** *Proc Natl Acad Sci U S A* 2012, **109**:13950-13955 <http://dx.doi.org/10.1073/pnas.1112965109>.

33. O'Brien LV, Berry HL, Coleman C, Hanigan IC: **Drought as a mental health exposure**. *Environ Res* 2014, **131**:181-187.
34. Vins H, Bell J, Saha S, Hess JJ: **The mental health outcomes of drought: a systematic review and causal process diagram**. *Int J Environ Res Public Health* 2015, **12**:13251-13275 <http://dx.doi.org/10.3390/ijerph121013251>.
35. Burke MB, Hsiang S, Miguel E: **Global non-linear effect of temperature on economic production**. *Nature* 2015, **527**:225-235 <http://dx.doi.org/10.1038/nature15725>.
36. Shultz JM, Rechkemmer A, Rai A, McManus KT: **Public health and mental health implications of environmentally induced forced migration**. *Disaster Med Public Health Prep* 2019, **13**:116-122 <http://dx.doi.org/10.1017/dmp.2018.27>.
- This article provides three case illustrations of the impacts of population displacement related to climate change in low resource settings. Particular emphasis is placed on the economic and conflict drivers of displacement.
37. Cunsolo A, Ellis NR: **Ecological grief as a mental health response to climate change-related loss**. *Nat Clim Change* 2018, **8**:275-281.
38. Fritze J, Blashki G, Burke S, Wiseman J: **Hope, despair and transformation: climate change and promotion of mental health and wellbeing**. *Int J Ment Health Syst* 2008, **2**:13 <http://dx.doi.org/10.1186/1752-4458-2-13>.
39. Gleick PH: **Water, drought, climate change, and conflict in Syria**. *Weather Clim Soc* 2014, **6**:331-340 <http://dx.doi.org/10.1175/WCAS-D-13-00059.1>.
- This study attributes the economic impacts of prolonged drought in Eastern Syria as one of the factors contributing to the civil conflict and mass migration of refugees from Syria.
40. Hsiang SM, Meng KC, Cane MA: **Civil conflicts are associated with global climate**. *Nature* 2011, **476**:438-440 <http://dx.doi.org/10.1038/nature10311>.
41. Levy BS, Sidel VW, Patz J: **Climate change and collective violence**. *Ann Rev Public Health* 2017, **38**:241-257 <http://dx.doi.org/10.1146/annurev-publichealth-031816-044232>.
- This excellent review summarizes the research on the association between climate change and collective violence and identifies future research needs and challenges.
42. Burke SEL, Sanson AV, Van Hoorn J: **The psychological effects of climate change on children**. *Curr Psychiatry Rep* 2018, **20**:35 <http://dx.doi.org/10.1007/s11920-018-0896-9>.
43. Intergovernmental Panel on Climate Change (IPCC): **Climate change 2013: the physical science basis**. *Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. New York: Cambridge University Press; 2013.
44. Intergovernmental Panel on Climate Change (IPCC): **AR5 climate change 2014: impacts, adaptations and vulnerability**. *Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. New York: Cambridge University Press; 2014.
45. Asugeni J, MacLaren D, Massey PD, Speare R: **Mental health issues from rising sea level in a remote coastal region of the Solomon Islands: current and future**. *Australas Psychiatry* 2017, **23**:22-25 <http://dx.doi.org/10.1177/1039856215609767>.
46. Albrecht G: **Chronic environmental change: emerging 'psychoterratic' syndromes**. In *Climate Change and Human Well-Being: Global Challenges and Opportunities*. Edited by Weissbecker I. New York: Springer; 2011:43-56.
- Describes three syndromes: ecoanxiety – anxiety people face when constantly being surrounded by the wicked and threatening problems associated with a changing climate; ecoparalysis – complex feelings of not being able to take effective action to significantly mitigate climate change risks; and solastalgia – distress and isolation caused by the gradual removal of solace from the present state of one's home environment.
47. Weissbecker I (Ed): *Climate Change and Human Well-Being: Global Challenges and Opportunities*. New York: Springer; 2011.
- This book includes chapters that focus on post-traumatic growth and resilience in the face of natural disasters and identify characteristics that strengthen community resilience to the threats and challenges of climate change.
48. Hayes K, Poland B: **Addressing mental health in a changing climate: incorporating mental health indicators into climate change and health vulnerability and adaptation assessments**. *Int J Environ Res Public Health* 2018, **15**:1806.
49. Palinkas LA, Wong M: **Social sustainability and global climate change: a new challenge for social work**. In *Social Work and Sustainability in Asia: Facing the Challenges of Global Environmental Changes*. Edited by Chong A, Chi I. London: Routledge; 2019:33-47.
50. Grolnick WS, Schonfeld DJ, Schreiber M, Cohen J, Cole V, Jaycox L, Lochman J, Pfefferbaum B, Ruggiero K, Wells K *et al.*: **Improving adjustment and resilience in children following a disaster: addressing research challenges**. *Am Psychol* 2018, **73**:215-229 <http://dx.doi.org/10.1037/amp0000181>.
- This position paper outlines a strategy for the development of new evidence-based interventions and practices designed for children who have been exposed to natural disasters and other traumatic events.