Extreme Weather in a Changing Climate

Michael Wehner presentation to Environmental Concerns Speaker Series, March 10, 2014
Summary by Gail Schickele

Lawrence Berkeley National Laboratory Senior Staff Scientist Michael Wehner presented "Extreme Weather in a Changing Climate" for Environmental Concerns Speaker Series March 10, 2014. A physicist and the first climate scientist at LBNL, Wehner said warming is 'unequivocal' with global mean surface air temperature rapidly increasing with multivariate evidence consistent across multiple aspects of the climate system. Ten indicators of this are: sea ice; ocean heat content; sea surface temperature; sea level; temperature over the ocean; water vapor; air temperatures near surface (troposphere); glaciers; snow cover; and temperatures over land.

CO_2 is increasing due to humans with climate models identifying greenhouse gases (GHGs) or other human changes to the atmosphere as the largest factor. Dipolar molecules like CO_2 and H_20 are very effective at trapping heat. Changing concentrations of these gases changes the radiative balance of the climate system. Key uncertainties include human activities, climate sensitivity and natural variability. Our behavior matters, Wehner said. Scenarios range from aggressive mitigation to "no policy" between -2 to 6+ºC, with variance by season. All futures come with aggressive impacts.

Warmer air holds more water that will result in flooding and significant impacts on agriculture. Expansion of the tropics induces a circulation change. According to the Intergovernmental Panel on Climate Change (IPCC) it is *virtually certain* that, in most places, there will be more hot and fewer cold temperature extremes as global mean temperatures increase.

Under the most aggressive "no policy" scenario (one of four IPCC scenarios known as Representative Concentration Pathways or RCPs) it is *likely* that, in most land regions, a current 20-year high temperature event will occur more frequently by the end of the 21^{st} century (at least doubling its frequency, but in many regions becoming an annual or two-year event) and a current 20-year low temperature will become exceedingly rare. This means that today's rare hot events become commonplace while cold extremes increase more than hot extremes. Globally, for short-duration precipitation events, a shift to more intense individual storms and fewer weak storms is *likely* as temperatures increase. Regional to global scale projected decreases in soil moisture and increased risk of agricultural drought are *likely* in presently dry regions and are projected with medium confidence by the end of this century under the RCP8.5 scenario according to the IPCC Fifth Assessment Report.

In a warmer world we can expect fewer tropical cyclones but more intense storms while hurricanes will last longer and rain harder.

Wehner further explained Coupled Model Intercomparison Project (CIMP) statistical analysis, a public database of output from the worlds' leading climate model; Fractional Attributable Risk (FAR) often used to determine liability; and Extreme Event Attribution CIMP analysis that shows the risk of extreme weather events has at least doubled since the preindustrial era.

LBNLs upcoming project brings together Impacts Scientists who help define what is “extreme;” Statisticians who develop non-asymptotic methods; and Climate Analysts who design targeted numerical experiments.

In conclusion, Wehner confirmed that claims of current and future climate change are well-founded, that the risk of extreme weather is changing and attributable to humans; and the change in risk of an individual extreme event due to humans can be estimated. There will be an increase in heat waves; extreme precipitation; intense hurricanes; drought; and certain types of floods. There will be a decrease in cold snaps and certain types of floods. Ending on a positive note, the affable Wehner said that opportunities are plentiful and that “It’s an exciting time!”