Parallel Session C: Climate Change Impacts

C1: High impact regional phenomena

Using dynamically downscaled output for climate change risk analysis: results from an application to southeastern USA

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In this presentation we will talk about the application of dynamically downscaled climate output for a high impact of climate change risk analysis on critical infrastructure for support of AT&T, a communication company.

Our dynamic downscaling (using WRF) covers most of North America (7200km x 6192km) at a spatial resolution of 12km. We developed six ensemble members, with one 30yr of WRF simulations driven by NCEP-R2, and five ensemble members of simulation and projection driven by three different Coupled Model Intercomparison Project Phase 5 Earth system models (ESMs): GFDL-ESM 2G, HadGEM2-ES, and CCSM4, to represent the range of the sensitivities of all ESM responses to doubled CO2. For most of the ensemble simulations we ran each of the lateral boundary conditions with two scenarios — RCP4.5 and RCP8.5, each for one historical period and two future time periods —2045–2054 and 2085–2094. The model output have been extensively evaluated and studied, especially for temperature and precipitation and their extreme features. We have published a dozen of journal articles directly out of this project, in addition to several scientific reports and a PhD thesis.

This presentation will focus on southeastern US (north Carolina, south Carolina, Georgia, and florida), looking at inland flooding due to heavy precipitation, coastal flooding due to storm surge from tropical cyclone and hurricanes, as well as high-intensity wind speeds. The 12km WRF output were used as input for all these three tasks. We modeled the historical and future inland flooding using WRF-Hydro® (Version 5) at spatial resolution of 200 meters. The input provided by WRF include 3hourly precipitation, temperature, wind, solar radiation, surface pressure, vegetation fraction, as well as relative humidity. We modeled the historical and future coastal flooding using ADCIRC (which has a unstructured mesh) with finest resolution of 50m along the coastal area. The input provided by WRF include sea level pressure and 10m wind speed and direction. All the future scenarios were projected at mid-21st century considering a business-as-usual scenario (RCP8.5). We also conducted general extreme value (GEV) analysis using these model output to generate 10-yr, 30yr and 50yr return levels of surface water depth and wind speeds.

Results shows that due to the increase of heavy precipitation under climate change, the surface water level are increased by more than 5% in the southeastern regions. The extremes are increased even greater. For example, a once-every-50 yr event will produce water depth up to 10 feet along the coastal areas along southeastern Georgia. The sea level rise signal associated with warming projections consistent with the RCP8.5 scenario appear to be the largest driver of future warm-season flooding and increases nuisance-level flooding events and severe flooding along the four priority states. While the wind speed changes vary across regions and seasonal, southern Florida tends to show the greatest change in maximum sustained wind conditions. For example, once-every-50yr wind speeds can go up to 90 mph for a large part of the southern Florida coastal region by mid-century.

Keywords: climate change impact,infrastructure