기후 분과 [P-029]

The Future of Landfalling Tropical Cyclones in the Arabian Sea and Associated Population Vulnerability

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The Arabian Sea coasts are increasingly threatened by the rising frequency and intensity of tropical cyclones (TCs). This study assesses the projected impacts of future TCs and associated rainfall, incorporating projected changes in population exposure in the region. The study has been designed to simulate landfalling intense TCs over the Arabian Sea in the Weather Research and Forecast model with a real-world run (ALL) and four future runs. Selected TCs include Chapala (2015), Luban (2018), Gati (2020), and Tej (2023). To analyse the rainfall pattern shifts at landfall of TC in the near-future (NF) and far-future (FF) periods, we extracted the future-warming (delta) pattern from SSP2-4.5 and SSP3-7.0 simulations of the Coupled Model Intercomparison Project phase-6 (CMIP6). These patterns represent the difference between historical (2011-2030) and future projections. The future runs are executed by perturbing the ALL's initial and boundary conditions with reference to the pseudo-global warming framework. The model is configured with convection-permitting microphysics schemes and the spectral nudging technique enabled to align tracks with observations. The enhanced sea surface temperature, along with relative humidity and atmospheric temperature in the pressure levels, renders the east coast of the Arabian Peninsula more susceptible to the intensification of TCs prior to landfall. It is evident that the FF runs of SSP3-7.0 reflect these changes in environmental factors with greater clarity. The combination of projected cyclone damage potential and increased population density on the Arabian Peninsula's coasts leads to greater economic loss and population exposure. To address the uncertainties in the delta patterns and for more reliable results, we classify the models into different clusters according to global warming levels and design ensemble runs for each TC.

Keywords: Tropical Cyclones, Arabian Sea, Climate Change, Convection-permitting Model, Future Warming