Geophysical Research Abstracts
Vol. 21, EGU2019-17197, 2019
EGU General Assembly 2019

Ensemble-Based Extreme Precipitation Simulations for Modified Sea Surface Temperature over the Black Sea

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In this study, extreme precipitation case has been examined by using numerical weather model WRF-ARW over the Eastern Black Sea coast of Turkey. The flood is triggered by extreme rainfall in coastal city Hopa and 11 people died because of the two days excessive precipitation in August 2015. The station based measurement for total precipitation is 255 mm in two days. One of the most significant usual suspect of this excessive rainfall is positive anomaly of the sea surface temperature (SST) over the Black Sea. Increasing SST trend has been detected clearly for the last three decades. The monthly mean SST anomaly in August 2015 is higher than 3 C with respect to the 1981-2010 period. Six sensitivity simulations have been designed by modified SST with WRF in order to analyze the effects of the Black Sea over the extreme rainfall. The simulations have been forced by ECMWF ERA-Interim Reanalysis and NCEP-NOAA SST with 3-nested domains used 27-9-3 km horizontal resolutions. The initial conditions have been customized to produced ensemble simulations and nine different simulations have been generated (2, 4, 7, 15, 24, 24.5, 25, 25.5 and 26-days). The reference simulations (Sim-Refs) are consistent with GPM (Global Precipitation Measurement) in terms of the spatial precipitation distribution and 4-days simulation produced 185 mm precipitation over the corresponding station location. To investigate the SST sensitivity on the extreme precipitation case, the modified SST (considering only the Black Sea) have calculated by subtracting 1 °C (Sim-1s), 2 °C (Sim-2s), 3 °C (Sim-3s) and by adding up 1 °C (Sim+1s), 2 °C (Sim+2s), 3 °C (Sim+3s) for the simulation period. The sensitivity simulations indicate that daily total precipitation rates for all negative SST simulations decreased progressively based on the SimRefs (forced by observed SST). However the precipitation intensity does not decrease in a same magnitude for all the simulations forced by the negative SSTs. The ensemble-based sensitivity simulations have been indicated that the critical SST threshold for extreme precipitation is minus 2 °C. Positive SST simulations conclude that ensemble mean precipitation increases clearly but more importantly the number of grids points over the Eastern Black Sea Region where the total precipitation excess 100 mm increase from 7.6% (Sim+1s) to 12.7% (Sim+3s). The ensemble mean precipitation rates from Sim-3 to Sim+3 on the day of extreme precipitation case have been gradually increase from 14.1 mm to 46.7 mm, respectively over the Eastern Black Sea region.