Investigation of the Added Utility of Different SST products in Prediction of Floods with WRF-Hydro Modeling System over Eastern Black Sea and Mediterranean Regions

Berina Kilicarslan[1], ismail yucel[1], Heves Pilatin[1], Eren Duzenli[1], and Mustafa Yılmaz[1]

[1]Middle East Technical University

January 12, 2021

Abstract

In this study, the impact of integrating four different sea surface temperatures (SST) datasets on the accuracy of the Weather Research and Forecasting (WRF)-Hydro system to simulate hydrological response during two catastrophic flood events triggered by the changes in SST is investigated. The selected events occurred over Eastern Black Sea (EBS) and Mediterranean (MED) regions of Turkey, where complex geographical characteristics exist and flash flood occurrences are associated with climatic conditions. Three time-varying and high-resolution external SST products (GHRSST, Medspiration, and NCEP-SST) and one coarse-resolution SST product (ECMWF-SST and GFS-SST for EBS and MED regions, respectively) already embedded in the initial and boundary condition dataset of WRF model are used in deriving near-surface weather variables through WRF. Using these meteorological inputs, the flood hydrographs of topographically complex small catchments located over EBS and MED regions are derived by a calibrated WRF-Hydro model coupled one way with WRF 3-km nest domain. After the proper event-based calibration performed to the WRF-Hydro using hourly and daily streamflow data of small catchments in both regions, model simulations for independent SST events are conducted to assess the impact of SST-triggered precipitation on simulated extreme runoff. The calibrated model over both regions revealed significant improvement in flood hydrographs. Some localized and temporal differences in the occurrence of the flood events with respect to observations depending on the SST representation are noticeable. The high-resolution SST dataset cases (Medspiration and GHRSST) show error reduction up to 20% and increase in correlation from 0.3 to 0.8 with respect to the coarse SST in simulated runoffs of the EBS region. The error reduction reached 35% after the calibration. The same high-resolution SST data revealed the exact match with the observed runoff peak after 100 m3/s reductions obtained with calibration in the MED region.

Investigation of the Added Utility of Different SST products in Prediction of Floods with WRF-Hydro Modeling System over Eastern Black Sea and Mediterranean Regions

Flood prediction with WRF-Hydro: Influences of Sea Surface Temperature

Berina Mina Kilicarslan [1], Ismail Yucel[1], Heves Pilatin [2], Eren Duzenli[1], and Mustafa Tugrul Yilmaz [1]

[1] Department of Civil Engineering, Middle East Technical University, Ankara, Turkey

[2] Earth System Science Department, Graduate School of Natural and Applied Sciences, Middle East Technical University, Ankara, Turkey

ACKNOWLEDGEMENTS

We thank to GDM and SHW of Turkey for the ground-based meteorological observation and streamflow datasets, The Group for High Resolution Sea Surface Temperature for GHRSST datasets, CERSAT for Medspiration datasets, NCEP for RTG_SST datasets and GFS products, ECMWF for ERA5 products, and

NCAR/NOAA for serving and improving the WRF model. This project is funded by The Scientific and Technological Research Council of Turkey (TUBITAK) [Grant Number 116Y193].

Hosted file

Main Document.pdf available at https://authorea.com/users/388828/articles/503558-investigation-of-the-added-utility-of-different-sst-products-in-prediction-of-floods-with-wrf-hydro-modeling-system-over-eastern-black-sea-and-mediterranean-regions

Hosted file

Novelty and International Appeal Statement.pdf available at https://authorea.com/users/388828/articles/503558-investigation-of-the-added-utility-of-different-sst-products-in-prediction-of-floods-with-wrf-hydro-modeling-system-over-eastern-black-sea-and-mediterranean-regions