Potential of the coupled WRF-Hydro modeling system for flood forecasting in the Ouémé-river basin (Benin, West Africa): an assessment with the Stochastic Kinetic-Energy Backscatter Scheme

Gandome Mayeul Leger Davy Quenum[1], Joël Arnault[2], Nana Ama Klutse[3], Philip Oguntunde[4], and Harald Kunstmann[5]

[1]University of Abomey-Calavi Faculty of Science and Technology
[2]KIT
[3]University of Ghana
[4]Federal University of Technology, Akure
[5]Karlsruhe Institute of Technology (KIT)

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Abstract

Since 2000s, most of West-African countries and particularly Benin have experienced an increased frequency of extreme flood events. In this study we focus on the case of the Ouémé-river basin in Benin for the period 2008-2010. To investigate on how to early warn flood events in this basin, the coupled atmosphere-hydrology model system WRF-Hydro is selected. Such a coupled model allows to explore the contribution of atmospheric components into the flood event, and its ability to simulate and predict accurate streamflow. The potential of WRF-Hydro in correctly simulating streamflow in the Ouémé-river basin is assessed by forcing the model with operational analysis datasets from the ECMWF. Atmospheric and land surface processes are resolved at a spatial resolution of 5km. The additional surface and subsurface water flow routing is computed at a resolution 1:10. Key parameters of the hydrological module of WRF-Hydro are calibrated offline, and tested online with the coupled WRF-Hydro. The uncertainty of atmospheric modeling on coupled results is assessed with the stochastic kinetic-energy backscatter scheme (SKEBS). WRF-Hydro is able to simulate the discharge in Ouémé river on offline and fully-coupled modes with a Kling-Gupta Efficiency (KGE) around 0.70 and 076 respectively. In fully-coupled mode the model captures the flood event that occurred in 2010. A stochastic perturbation ensemble of 10 members for three rain seasons shows that the coupled model performance in terms of KGE is from 0.14 to 0.79. This ability in realistically reproducing observed discharge in the Ouémé-river basin demonstrates the potential of the coupled WRF-Hydro modeling system for future flood forecasting applications.

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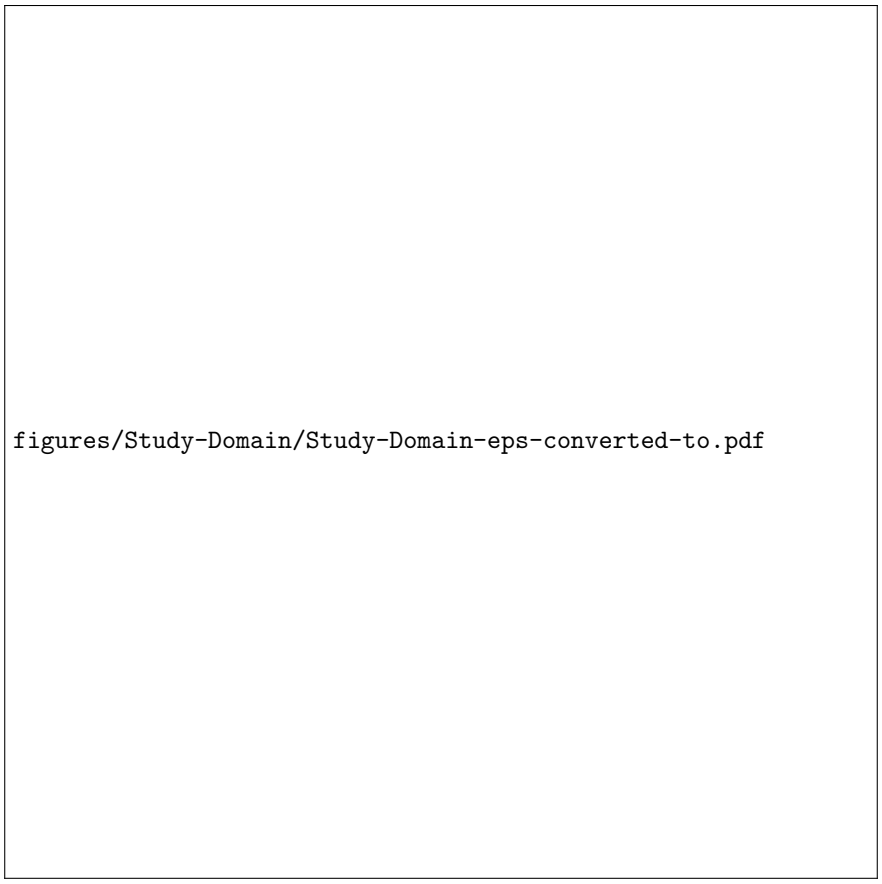

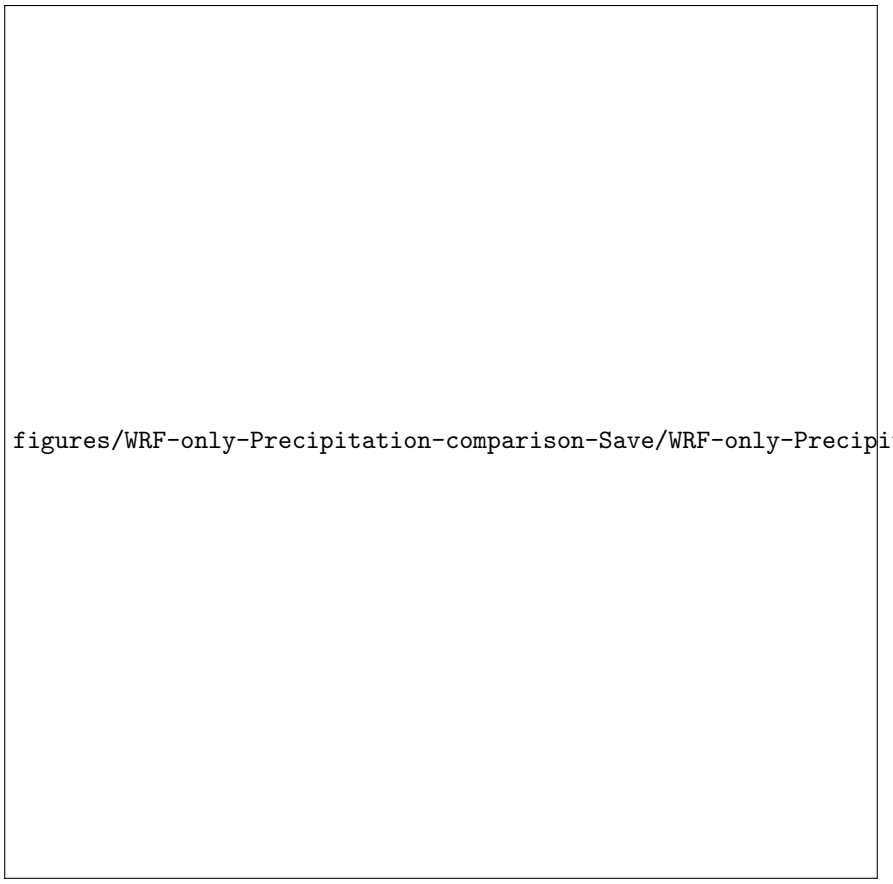

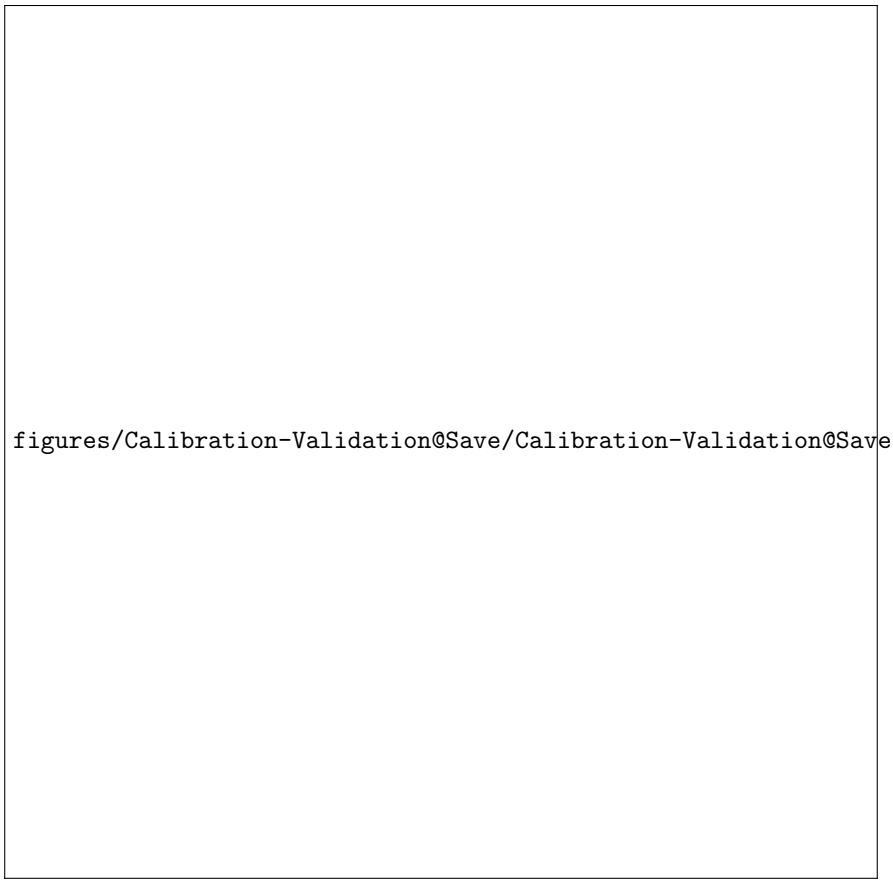

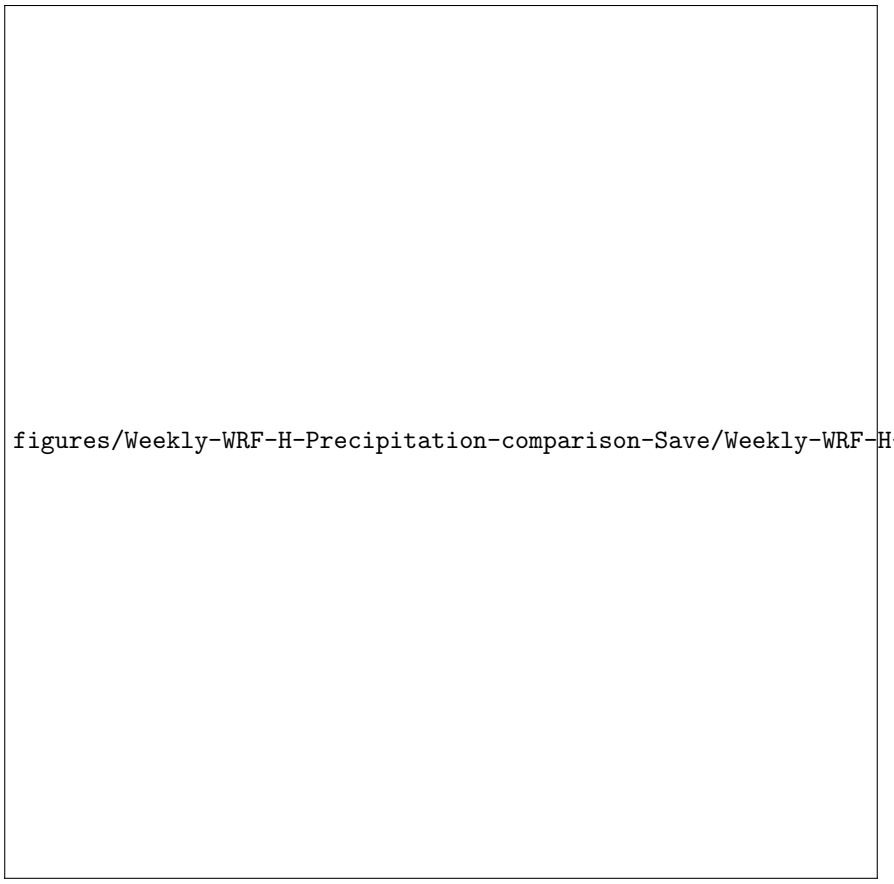

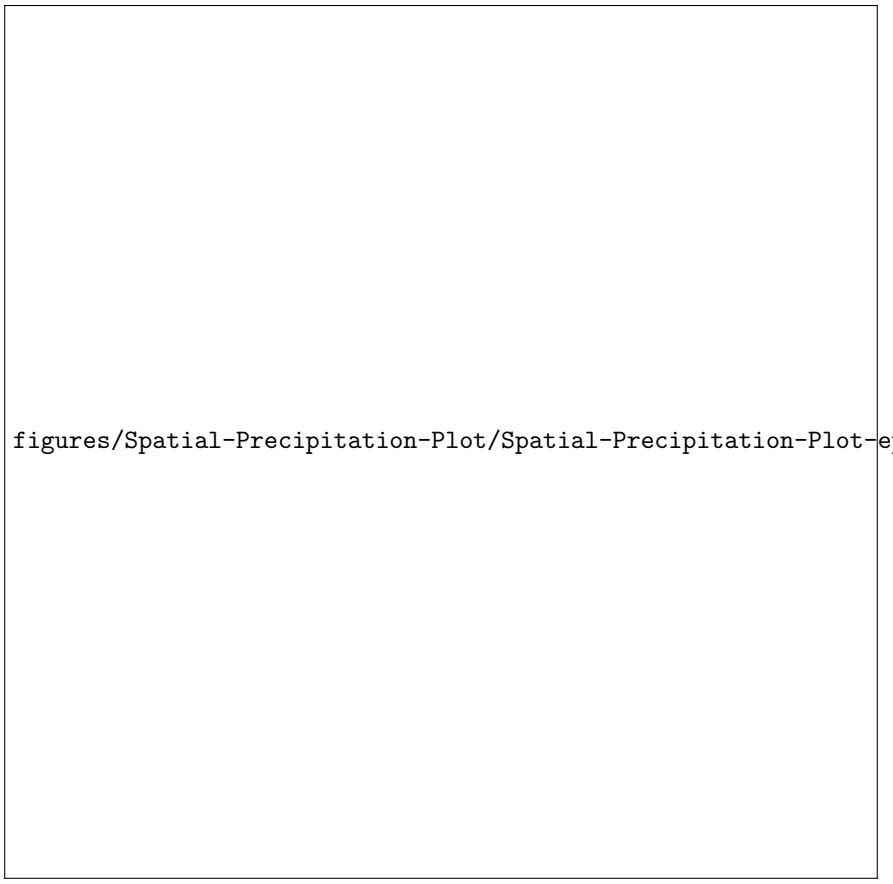

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