Evaluation of regional-scale water level simulations using various river routing schemes within a hydrometeorological modelling framework for the preparation of the SWOT mission

The ability of a regional hydrometeorological model to simulate water depth is assessed in order to prepare for the SWOT (Surface Water and Ocean Topography) mission that will observe free surface water elevations for rivers having a width larger than 50/100 m. The Garonne river (56 000 km2, in south-western France) has been selected owing to the availability of operational gauges, and the fact that different modeling platforms, the hydrometeorological model SAFRAN-ISBA-MODCOU and several fine scale hydraulic models, have been extensively evaluated over two reaches of the river. Several routing schemes, ranging from the simple Muskingum method to time-variable parameter kinematic and diffusive waves schemes with time varying parameters, are tested using predetermined hydraulic parameters. The results show that the variable flow velocity scheme is advantageous for discharge computations when compared to the original Muskingum routing method. Additionally, comparisons between water level computations and in situ observations led to root mean square errors of 50-60 cm for the improved Muskingum method and 40-50 cm for the kinematic-diffusive wave method, in the downstream Garonne river. The error is larger than the anticipated SWOT resolution, showing the potential of the mission to improve knowledge of the continental water cycle. Discharge computations are also shown to be comparable to those obtained with high-resolution hydraulic models over two reaches. However, due to the high variability of river parameters (e.g. slope and river width), a robust averaging method is needed to compare the hydraulic model outputs and the regional model. Sensitivity tests are finally performed in order to have a better understanding of the mechanisms which control the key hydrological processes. The results give valuable information about the linearity, Gaussianity and symetry of the model, in order to prepare the assimilation of river heights in the model.

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