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Satellite altimetry for hydraulic model calibration: potential of single and multi-mission series

Giada Molari¹, Alessio Domeneghetti¹, Mohammad Tourian², Angelica Tarpanelli³, Tommaso Moramarco³, and Nicolaas Sneeuw²

¹University of Bologna, DICAM, Rimini, Italy (giada.molari@unibo.it)

²Institute of Geodesy, University of Stuttgart, Germany

³Research Institute for Geo-Hydrological Protection, National Research Council, Perugia, Italy

The recent improvement of satellite products has provided an increasing data availability with an unprecedented coverage, stimulating their usage in hydraulic and hydrological fields. Notwithstanding, regarding the satellite water level monitoring, the limited temporal resolution (i.e. revisit time varying from 10 to 35 days) and decimeter accuracy of altimetry satellites strongly restrict their applications. Recently proposed multi-mission (MM) densified time series might represent a possible alternative to ensure higher spatial and temporal coverage. However, an assessment of the potential of different altimetry products, including MM series, for hydrodynamic model calibration is still missing. The goal of this study is the assessment of remotely sensed water surface elevations usefulness for the calibration of a hydraulic model implemented for a 140-km stretch of the Po River (Italy). In particular this study presents: i) a comparison of altimetry satellite data collected from different missions (ENVISAT (E), ENVISAT extended (EX), TOPEX/Poseidon (TP), SARAL/AltiKa (SA), Jason-2 (J2) and Jason-3 (J3); ii) insights to the effects of satellite series length on hydraulic model calibration; iii) the analysis of how data uncertainty influences model accuracy; iv) the potential of multi-mission (MM) densified time series as possible alternative to overcome spatial and temporal limitations of single mission. The results highlight a good agreement among satellite and in-situ observations for all the series, excluding EX series. J2 provides the best outcome in terms of calibration error (about 30 cm) and number of measurements required to achieve a reliable calibration (less than 1 year of data). In case of frequent and accurate satellite data (i.e. J2 and TP), the MM series seem unable to provide additional benefits in calibrating the hydraulic model. On the other hand, MM series outperform low frequency products (i.e. E and SA) when the latter are available only for short period. This research offers a wide overview of the potential of altimetry products, providing a general comparison of different satellite missions series and showing the potential, as well as limitations, offered by multi-mission series.