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Assimilation experiments of Sentinel-derived and GNSS-derived products to improve the WRF forecasts of extreme events: results of the STEAM project

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The Mediterranean region is frequently struck by severe floods and flash floods causing impressive losses of lives and several millions euros of damages every year. Thus, improving the forecast accuracy is a fundamental goal to limit social and economic damages. The Numerical Weather Prediction (NWP) modeling is a mathematical problem determined by its initial and boundary conditions and forecast challenges often derive from the uncertainty related to the initial state of the atmosphere at small spatio-temporal scales. The inevitable model spin-up often results in an inaccurate simulation of the timing, the location and the severity of convective events. This challenge becomes even more relevant when the model grid spacing is approaching the kilometric scale, mainly as a consequence of the lack of high spatio-temporal resolution observations. In this scenario the STEAM (SaTellite Earth observation for Atmospheric Modelling) project is funded by the European Space Agency with the aim of investigating if Sentinel satellites constellation weather observation data can be used to better understand and predict with an higher spatial-temporal resolution the atmospheric phenomena resulting in severe weather events and intense atmospheric turbulence phenomena. To assess this, STEAM has identified the WRF model as reference atmospheric modeling suite and has fed it for the first time ever tried with variables observed by satellites of the Sentinel constellation such as humidity, soil and sea temperature, wind on the sea, the amount of water vapour in the atmospheric band closest to the earth derived from Atmospheric Phase Screen (APS). Most of these data are not normally used in atmospheric forecasting models, but they are rather taken into account mainly for hydrological and marine modeling. Furthermore, the possible availability of a spatially dense network of Global Navigation Satellite Systems (GNSS) stations is also exploited to allow the model to assimilate timely updated data about water vapor in the atmosphere. The STEAM project focuses on high impact weather events (HIWEs), which are the most interesting from an applicative point of view. The experimental results presented concern two flood events occurred in Italy in the autumn 2017.