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Modelling the influence of the sea on “Rapid Cyclogenesis”: 2018 “VAIA” events.

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During the period from 26 to 30 October 2018, northern Italy was affected by a sequence of baroclinic waves moving slowly from the Balearic Islands. The cyclonic circulation was stationary in the central Mediterranean, blocked between two strong anticyclonic fields at its western and eastern sides. The strong cyclones generated during this cyclogenesis, that reached 979 hPa and generating an extreme weather phenomena occurred throughout the Italian territory on October 29. Severe weather took place both in terms of precipitation, with accumulations close to 400 mm/day in Liguria (north-western Italy), due to the formation of an intense convergence line over the Tyrrhenian Sea, and 500 mm/day in Veneto (north-eastern Italy), and in terms of wind. In particular, very intense wind gusts, close to 220 km/h, affected the Eastern Alpine valleys, causing the destruction of about 60 mln of trees and extensive economic damage throughout Italy. As a consequence of these intense atmospheric phenomena, wave storms were recorded along all the coasts exposed to Sirocco (local name for southeasterly wind), in particular in the Adriatic Sea (north-eastern Mediterranean basin), where 7 meters high waves reached the “Acqua Alta” oceanographic tower. In the present work, we simulated this event by means of the atmospheric model WRF (Weather and Research Forecasting system) implemented at 4 km grid spacing, with 100 vertical levels. Numerical simulations was initialized at 00 UTC, October 27, with the aim to identify the causes of the intense storm and the motivation of the underestimation of its intensity by most operational numerical models. We focused mainly on the effect of Sea Surface Temperature (SST), +/-2 C perturbation with a one-degree increment. The changes in terms of trajectory and intensity of the pressure minimum were then analyzed with respect to the control simulation (i.e. the run with the observed SST), in order to isolate the triggering factors responsible for such an explosive intensification. Modifying the SST doesn’t imply significant changes in the development of the cyclonic structure. An additional simulation was performed by eliminating the latent heat release associated to condensation in the microphysical scheme. Using the latter approach, the pressure minimum developed with characteristics similar to the control run, but the trajectory was significantly shifted westward; this results in less intense pressure gradients and in general a significantly weaker phenomenology. At last, with the aims to investigate the relevance of SST gradient we perform simulation with homogeneous SST over entire basin and two runs with different mixed layer depth. In general the results show that the rapid deepening of the cyclone is induced by an intense intrusion of stratospheric dry air and a consequent intense potential vorticity anomaly moving down to 3000 m altitude.