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How coastal surges may be generated by mesoscale atmospheric disturbances that in turn are related to propagating convective systems

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On the morning of 21 June 1978, exceptional sea-level oscillations with a trough-to-crest height of 6 m and a period of 10-20 min were observed in Vela Luka Bay. Slightly less pronounced variability was observed in a wider Middle and South Adriatic east coastal area and, with some delay, along the west coast. In the presentation, one of the original hypotheses put forward to interpret the event, relating it to a mesoscale air-pressure disturbance, is reconsidered by using all the available data as well as state-of-the-art meteorological and oceanographic models. A fresh look at the meteorological data confirms that the atmospheric disturbance propagated at about 22 m/s in a northeastward direction. Additionally, the data suggest that it had the shape of the boxcar function characterized by an air-pressure offset of 3 mbar and duration of 10 min. The meteorological model employed (WRF-ARW) proves unable to reproduce the mesoscale disturbance coinciding with the surge, but it shows that the background atmospheric conditions were favorable for the development of convective systems and therefore also for the formation of mesoscale disturbances. The oceanographic model ADCIRC-2DDI, forced by the described air-pressure disturbance, successfully reproduces sea-level variability in Vela Luka Bay reaching a few meters and thus surpassing the inverted barometer response by two orders of magnitude. The enhancement appears to be due to a four-phase process. The model also suggests that the scattering due to the variable bathymetry and the reflection from the east Adriatic coast resulted in waves that returned towards the west coast and generated considerable sea-level activity there. Similar surges that were observed in the Adriatic more recently (Stari Grad and Mali Ston, 2003; Ist, 2007; Mali Losinj, 2008; Stari Grad, 2010) are also mentioned and the dynamics revealed is used as the basis for a brief discussion of terminology appropriate for such processes.