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Adriatic Extreme Weather – State of the Art

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Cyclone activity in the Adriatic and the central Mediterranean provides a trigger mechanism for a range of extreme weather phenomena such as local downslope wind-storm bora, or bura in Croatian, strong southesterly sirocco, hevy precipitation and mesoscale convective systems. Spatial distribution of the frequency of cyclogenesis in the Mediterranean presents one of relative maxima in the Adriatic. Therefore, investigations of different cyclone types in the region and assessment of associated extreme weather, including heavy precipitation and severe local wind, are of great importance for a more complete undestanding of weather and climate impacts and for the improvement of wether forecasting in the Adriatic. The capability to predict such high-impact events remains weak because of the contribution of very fine-scale processes and their non-linear interactions with the larger scale processes. The general objectives for MEDEX are the better understanding and the better forecasting of the cyclones that produce high impact weather in the Mediterranean. Much work has been done, but many doubts still remain and new research is needed in this field.

Recent progress and advances in the research of the Adriatic extreme weather are assessed. The link, even though complex, between heavy precipitation and synoptic scale troughs and cyclones has been well established by the past. Heavy precipitation occurred preferentially downstream of a cyclone aloft. Convection plays an important role in most such events in the region. Synoptic ingredients help to destabilise air mass and enhance convection. The key elements are a synoptic pattern inducing a southerly to easterly low-level flow that transports moist and unstable Mediterranean air masses towards the eastern Adriatic coast. Additionaly, at low-levels, a long fetch of flow over the sea interacts with terrain features, driving local low-level circulation favourable to triggering of deep convection and enhancement of precipitation.

There has been substantial progress in severe local wind observations and measurements, understanding, modelling and its more detailed prediction during the last 30 years. Wave breaking is identified as the primary mechanism for severe bora formation. Understandings of bora interactions and influences on other processes have taken place as well, most notably in the air-sea interaction, but are not completed yet. Moreover, the role of the boundary layer and waves on the upwind side of the bora evolution and the consequent lee side flow structures are inadequately understood. This is especially so for bora at the southern Adriatic coast.

Adriatic region, uncovered by radar observation, has received little attention up to now. The success of high-resolution modelling however strongly depends on the initial conditions. At the current resolution, the operational numerical weather prediction models, although quite capable of predicting the general conditions for the onset and development of extreme event, are unable to simulate the small-scale details. This results in imprecise precipitation and wind forecast, which might lead to economic as well as ecologic losses in the area. Therefore, knowledge is needed to progress in the predictability of intense events though collaboration within the framework of the HyMeX.