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Convection initiation in connection with a mountain wave episode

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Areas around major mountain ranges are known to be preferential regions for deep moist convection. Convection initiation (CI) is favoured by the terrain through mechanically forced air ascent, or through thermally-induced circulations along sloping terrain. Forced lifting of air masses occurs on the windward side of mountains, while thermally-driven breezes converge at mountain tops. Therefore, most studies of orographically-induced convection focus on CI upstream or over the mountain peaks.

However, lee-side convection events are not uncommon. For instance, analyses of storm tracks in the Eastern Alps reveal that the majority of convective cells originate north of the ridge in southerly flow regimes. Such asymmetry depends on well-known lee-side destabilization processes, but possibly also on specific lee-side CI mechanisms. It has been suggested that mountain wave updrafts or hydraulic jumps can provide enough lifting to conditionally unstable air parcels to overcome their level of free convection. Evidence of CI related to mountain waves has been provided for several cases observed near major mountain ranges (Rocky Mountains, Andes, Apennines).

In this contribution we focus on 5th July 2018, when convective cells developed over the Po Valley (Northern Italy), in the lee of the Apennines in south-westerly flow. WRF simulations of this event at convection-permitting resolution (1-km grid spacing) allow a detailed dynamical analysis of this event. CI occurs along an airmass boundary between relatively dry air descending from the mountains and pre-existing moister air on the plain. The boundary is seemingly co-located with a hydraulic jump and a near-surface convergence line. Both are connected to a dynamically-generated lee-side pressure minimum. The impacts of the upstream topography and of the daily cycle of the planetary boundary layer on the development of the event are discussed.