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Synoptic and mesoscale aspects of an interaction between the cumulonimbus clouds and sea breeze above Istria

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This study investigates the impact of the combined large-scale wind and thermally induced local wind on the moist convection development over Istria. Former analyses revealed that Istria is the area with (i) the highest frequency of thunderstorms in Croatia, typically during three wind regimes on a large scale (from the southwest (SW), northeast (NE) and northwest (NW)), and (ii) frequent appearances of sea breeze along the coast (every other summer day on average). In average, the NE wind and NW winds are usually generated by the rear side of the upper-level cyclones or trough located eastward /northeastward from target area with the advection of a cold(er) air above Croatia. On the contrary, the SW (more often) and SE (less frequent) flow is usually created by the eastern and/or southern part of a well-developed cyclone or a trough distributing warm and moist air over Istria/Croatia. The highest density of lightning strikes was also observed in the NE mountainous part of the peninsula. Therefore, the six selected periods (~ with overall 36 days) were analysed using the available near-surface and remote measurements. They were simulated also by WRF high-resolution numerical model and examined by the sensitivity tests.

The near-surface wind patterns consisted of sea breezes along the coastline played very important role generating a narrow eastward-moving convergence zone along the Istria. When the large-scale SW wind (as an onshore wind) dominated in the upper troposphere, the thunderstorm event was the shortest and weakest with only a minor impact on the sea breeze. The synoptic conditions for this type of wind regimes revealed that SW type occurred usually in high pressure formations (in the rear side of the ridge or an anticyclone). The origins and locations of storm cells were completely controlled by the low-level convergence zone and the upward advection of low-level moisture at the sea breeze front. In the other two examined cases with offshore large-scale winds from the NE and NW, the mountain range hastened the beginning of convection and affected its intensity. Except for the low-level convergence zone, the advection of large-scale wind influenced the lifetimes and low pressure centre pattern determines whether it will be the NE or NW wind direction.