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The use of ground-based microwave radiometer observations to forecast heavy precipitation in the Mediterranean area

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The Mediterranean coastal areas are regularly affected by heavy rainfall events that cause damage to life and property. Numerical weather prediction (NWP), the cornerstone of early-warning systems, is in the front line of mitigation strategies relating to those threats. The quality of weather forecasts - and hence, the relevance of early warnings - largely depends on the accuracy of initial states, which in turn depends on the observations used to estimate initial conditions.

Ground-based microwave radiometers (MWRs) have proved to be robust instruments providing continuous unattended operations and real-time accurate atmospheric observations under nearly all-weather conditions. In particular, temperature and humidity profiles may be retrieved, which potentially provide useful information about key meteorological phenomena such as moist low-level jets feeding mesoscale convective systems responsible for large rainfall accumulations.

In this study, temperature and humidity retrievals from an international network of ground-based microwave radiometers
(MWR) have been collected to assess the potential of their assimilation into a convective-scale NWP system. Thirteen stations over a domain encompassing the western Mediterranean basin were considered for a time period of forty-one days in autumn, when heavy-precipitation events most often plague this area.

Prior to their assimilation, MWR data were compared to very-short-term forecasts. Observation-minus-background statistics revealed some biases, but standard deviations were comparable to that obtained with
radiosondes. The MWR data were then assimilated in a three-dimensional variational (3DVar) data assimilation system through the use of a rapid update cycle. A set of sensitivity experiments allowed assessing extensively the impact of the assimilation of temperature and humidity profiles, both separately and jointly. The respective benefit of MWR data and radiosonde data on analyses and forecasts was also investigated.