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First Doppler lidar and cloud radar measurements of orographic convection initiation from a mountain observatory in the Al Hajar Mountains of the United Arab Emirates.

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We present exciting Doppler lidar and cloud radar measurements from a high-vantage mountain observatory in the hyper-arid United Arab Emirates (UAE) - initiated as part of the UAE Research Program for Rain Enhancement Science (UAEREP). The observatory was designed to study the clear-air pre-convective environment and subsequent convective events in the arid Al Hajar Mountains, with the overarching goal of improving understanding and nowcasting of seedable orographic clouds. During summer in the Al Hajar Mountains (June to September), weather processes are often complex, with summer convection being initiated by several phenomena acting in concert, e.g., interaction between sea breeze and horizontal convective rolls. These interactions can combine to initiate sporadic convective storms and these can be intense enough to cause flash floods and erosion. Such events here are influenced by mesoscale phenomena like the low-level jet and local sea breeze, and are constrained by larger-scale synoptic conditions.

The Doppler lidar and cloud radar were employed for approximately two years at a high vantage-point to capture valley wind flows and observe convective cells. The instruments were configured to run synchronized polar (PPI) scans at 0°, 5°, and 45° elevation angles and vertical cross-section (RHI) scans at 0°, 30°, 60, 90°, 120°, and 150° azimuth angles. Using this imagery, along with local C-band radar and satellite data, we were able to identify and analyze several convective cases. To illustrate our results, we have selected two cases under unstable conditions - the 5 and 6 September 2018. In both cases, we observed areas of low-level convergence/divergence, particularly associated with wind flow around a peak 2 km to the south-west of the observatory. The extension of these deformations are visible in the atmosphere to a height of 3 km above sea level. Subsequently, we observed convective cells developing at those approximate locations – apparently initiated because of these phenomena. The cloud radar images provided detailed observations of cloud structure, evolution, and precipitation. In both convective cases, pre-convective signatures were apparent before CI, in the form of convergence, wind shear structures, and updrafts.

These results have demonstrated the value of synergetic observations for understanding orographic convection initiation, improvement of forecast models, and cloud seeding guidance. The manuscript based on these results is now the subject of a peer review (Branch et al., 2021).

Branch, O., Behrendt, Andreas Alnayef, O., Späth, F., Schwitalla, Thomas, Temimi, M., Weston, M., Farrah, S., Al Yazeedi, O., Tampi, S., Waal, K. de and Wulfmeyer, V.: The new Mountain Observatory of the Project "Optimizing Cloud Seeding by Advanced Remote Sensing and Land Cover Modification (OCAL)" in the United Arab Emirates: First results on Convection Initiation, J. Geophys. Res. Atmos., 2021. In review (submitted 23.11.2020).