A study of the critical processes which determine the severe precipitation events over the Hajar Mountains using observations and model simulations

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Severe precipitation events occur over the Hajar Mountains, Northern Oman, can result in significant amounts of rainfall and flooding. Predictions and understanding of the occurrence of these events has been relatively poor. This paper examines those processes, which are important in the precipitation generation. The work proposes that the monsoonal flow of boundary layer air is the controlling factor, which determines precipitation over the Hajar Mountains. Atmospheric profiles of the typical climatologies for the region are presented for the first time.

Observations indicate the overriding influence of the boundary layer air advection, the moist monsoonal flow, from the Arabian Sea and convergence of with the sea-breeze from the Gulf of Oman triggers convection over the mountain peaks during the afternoon and early evening. An increase in the depth of the moist monsoonal flow results in more intense and longer lasting precipitation.

High resolution non-hydrostatic (EULAG) model simulations examines the effects in various flow regimes. Modelling studies confirm the key importance of the monsoonal flow and that precipitation occurs may occur before the sea-breeze from Gulf of Oman converges with the main flow at the mountain peaks. The synoptic air flow is determined by the location of the heat low over the "Empty Quarter" of Saudi Arabia. The sea-breeze acts to enhance the convection giving higher and longer lasting precipitation. The shape, height and location of the mountain range also contributes to the magnitude of these precipitation events, but does not control their occurrence. The model results support the hypothesis that the moist air advection from the Arabian Gulf is the major factor in controlling the heavy precipitation events.