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Evaluation of the atmospheric model WRF on the Qatar peninsula for a converging sea-breeze event

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Qatar, a narrow peninsula covering an area of 11437 sq km, extends northwards into the Arabian Gulf for about 160km and has a maximum width of 88km. The convex shape of the coast-line and narrowness of the peninsula results in the Qatar region experiencing complex wind patterns. The geometry is favorable for formation of the land-sea breeze from both coastal sides of the peninsula. This can lead to the development of sea breeze convergence zones in the middle of the country. Although circulations arising from diurnal thermal contrast of land and water are amongst most intensively studied meteorological phenomena, there is no reported study for the Qatar peninsula and very few studies are reported for the Arabian Gulf region as whole. It is necessary to characterize the wind field for applications such as assessing air pollution, renewable energy etc. A non-hydrostatic mesoscale model, Weather Research and Forecast (WRF) with a nested high resolution grid permits the investigation of such fine scale phenomena. Data from eighteen land based Automated Weather Stations (AWS) and two offshore buoys deployed and maintained by the Qatar Meteorological Department were analyzed. Based on the analysis a clear case of sea breeze convergence were seen on 18 September 2015. Model simulations were used to investigate the synoptic conditions associated with the formation of this event. The season is characterized by week ambient north westerly wind over the Arabian Gulf. The WRF model performance is validated using observed in-situ data. Model simulations show that vertical extent of sea breeze cell was up to 1 km and the converging sea breeze regions were characterized with high vertical velocities. The WRF simulation also revealed that with high resolution, the model is capable of reproducing the fine scale patterns accurately. The error of predictions in the inner domain (highest resolution) are found to be relatively lower than coarse resolution domain. The maximum wind speed were of the order of 9 m/s. The period of convergence lasted approximately for about 8 hours (with maximum intensity about 2 PM local time).The model winds compared favorably for all the 18 AWS stations, with better match seen for the offshore locations.