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Assessment of the sensitivity to the thermal roughness length in Noah and Noah-MP Land surface model using WRF in an arid region

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Atmospheric models are known to underestimate land surface temperature and, by association, 2 m air temperature over dry arid regions during the day due to the treatment of the thermal roughness length also known as roughness length of heat. The thermal roughness length can be controlled by the Zilitinkevich parameter, known as Czil, which is a tunable parameter within the models.

We run three different scenarios with the WRF model to test the impact of the Czil parameter on the simulations using two land surface models: the Noah and Noah-MP models. In this study we tested a modified version of the Noah-MP model in which Czil parameter, and therefore the thermal roughness length varies depending on the land cover and vegetation height.

Our model domain is over the United Arab Emirates (UAE) where the major land cover type is desert. We tested the Noah model with Czil=0.1 and the Noah-MP model with Czil=0.5 over desert. We verified the results of 2 m air temperature against three stations in the UAE. Mean gross error was observed reducing by up to 1.48 ˚C and 1.54 ˚C in the 24 hour and 48 hour forecasts, respectively. This reduced the cold bias in the model. This improvement in air temperature showed to improve the diurnal cycle of relative humidity at the three monitoring stations as well as the duration of the sea-breeze.