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Predicting nocturnal wind and temperature profiles based on external forcing parameters

J Donda (1), B. Van de Wiel (1), F. Bosveld (2), F. Beyrich (3), GJ Van Heijst (1), and H. Clercx (1)

(1) Eindhoven Technical University, The Netherlands, j.m.m.donda@tue.nl, (2) Royal Netherlands Meteorological Institute, fred.bosveld@knmi.nl, (3) German Meteorological Service, Lindenberg, frank.beyrich@dwd.de

In this work we introduce a simple, physically consistent method to predict nocturnal wind and temperature profiles from external forcing parameters like the geostrophic wind. As an indicator of the radiative 'forcing' net longwave radiative cooling is used as a proxy. Surface fluxes are expressed in terms of these parameters by coupling an Ekman model to a rudimentary surface energy balance. Additionally the model assumes validity of Monin-Obukhov similarity in order to predict near-surface wind and temperature profiles up to $z \sim O(L)$. Predictions are validated against an independent data set that covers 11-years of observations at Cabauw (The Netherlands). It is shown that the characteristic profiles in response to external forcings are well-captured by the conceptual model. For this period the observational climatology is in close agreement with ECMWF reanalysis data. As such, the conceptual model provides an alternative tool to have a first-order estimate of the nocturnal wind and temperature profile near the surface in cases when advanced numerical or observational infrastructure is not available.