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Validity margins of Monin-Obukhov similarity theory for space and time averaged data

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Monin–Obukhov Similarity Theory (MOST) is the ubiquitous framework for the estimation of surface fluxes in atmospheric models. Motivated by tower-measurements, it is conceptually designed in an ensemble or time averaging context and does not take into account non-local effects. Hence, the limit of an infinite homogeneous surface is implicit in the assumptions underlying MOST. This limit is rarely encountered in the coupled land–atmosphere system which is characterized by broad scale heterogeneities in all quantities. Despite these known conceptual and practical deficiencies over heterogeneous surfaces, MOST or versions thereof, such as the MOSAIC approach, are routinely used over heterogeneous surfaces. In this talk, I present a systematic assessment of the scale margins and quantify the temporal and spatial limits of the validity of MOST by use of direct numerical simulation (DNS) of Ekman flow. This investigation of the scale limits of MOST over a homogeneous surface provides a physically-based temporal and spatial scale margin below which the interaction of the atmosphere and surface is to be modelled by physically different approaches. Further, the availability of a DNS dataset systematically investigating MOST allows an improved representation of interfacial fluxes.