EMS Annual Meeting Abstracts
Vol. 12, EMS2015-454, 2015
15th EMS / 12th ECAM


# Prediction of nocturnal boundary layer regimes

Bas van de Wiel (1), Ivo Van Hooijdonk (1), Judith Donda (1), Arnold Moene (2), Harm Jonker (3), Herman Clercx (1), and Fred Bosveld (4)

(1) Eindhoven Technical University, Tilburg, Netherlands (b.j.h.v.d.wiel@tue.nl), (2) Wageningen University and Research Centre, Netherlands, (3) Delft University of Technology, (4) Royal Netherlands Weather Institute

In this study field observations and theoretical analysis are used to investigate the appearance of different nocturnal boundary layer regimes. Recent theoretical findings predict the appearance of two different regimes: the continuously turbulent (weakly stable) boundary layer and the relatively “quiet” (very stable) boundary layer. As the situation in the latter case promotes the occurrence of fog and frost events, the topic appears to be relevant to forecasting practice (present generation forecasting models are incapable to predict whether turbulence will ‘survive’ or not during the night).

Here, a large number of nights (approximately 4500) are analyzed using an ensemble averaging technique. The observations support the existence of these two, fundamentally different, regimes: weakly stable (turbulent) nights rapidly reach a steady state (within 2-3 h). In contrast, very stable nights reach a steady state much later after the transition period (2-6 h). During this period turbulence is weak and non-stationary.

To characterize the regime, a new parameter is introduced: the shear capacity. It compares the actual wind speed after sunset with the minimum wind needed to sustain turbulence. In turn, the minimum wind speed depends on the heat flux demand at the surface (net radiative cooling). As such, the shear capacity combines flow information with knowledge of the boundary condition. It is shown that the shear capacity enables prediction of the flow regimes and that this result has potential for practical use in future applications.