Satellite-Based Detection of Fog and Very Low Stratus – A High-Latitude Case Study Centred on the Helsinki Testbed Experiment

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Knowledge of the spatial and temporal dynamics of fog and low stratus is of great importance for applications in the fields of climatology, traffic safety and air quality monitoring. Satellite data is a good basis for this type of information. Geostationary systems are especially suitable due to the good temporal resolution offered. However, the atmospheric limb effect impacts on algorithm performance at high latitudes. This paper presents an investigation of the potential of Meteosat SEVIRI for fog detection at high latitudes in a case study centred on the Helsinki Testbed experiment.

Satellite-based fog detection is performed based on the diagnostic scheme presented by CERMAK & BENDIX (2006a). In order to compensate for the atmospheric limb effect, thresholds are extracted dynamically depending on satellite zenith angles (cf. CERMAK & BENDIX 2006b). A distinction between ground fog and other low stratus clouds is reached by comparing surface elevation with cloud base height computed using a microphysical model of the vertical cloud profile.

The ground measurements utilized in this study are obtained from the Helsinki Testbed mesoscale research and development facility (DABBERDT 2005). It was recently established by The Finnish Meteorological Institute and Vaisala meteorological measurements company together with other public, private and academic partners. The Helsinki Testbed domain is located in coastal high-latitude environment in Southern Finland. The existing weather observation network has been supplemented with a large number of new observations to upgrade it to versatile mesoscale observational network.

As a validation data set, measurements of several fog days were selected from the Helsinki Testbed campaign months November 2005, January 2006 and February 2006. Data from automated visibility and cloud sensors and also SYNOP observations are used for detection of low cloud and fog presence at the ground level. A qualitative and quantitative appraisal of the fog detection skill is performed with ground-based measurements. In addition, the Meteosat SEVIRI classification is compared with a classification based on the polar orbiting Terra MODIS sensor (cf. BENDIX et al. 2005, 2006), which does not suffer from the limb effect.

References

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