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High-resolution satellite-based cloud detection for the analysis of land surface effects on boundary layer clouds

Julia Fuchs[1], Hendrik Andersen[1], Jan Cermak[1], Eva Pauli[1], and Rob Roebeling[2]
[1]Karlsruhe Institute of Technology, Karlsruhe, Germany (julia.fuchs@kit.edu)
[2]European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), Darmstadt, Germany

This study aims at improving an empirical cloud masking approach for the high-resolution analysis of land surface effects on boundary layer clouds.

The observation of boundary layer clouds with high-resolution satellite data can provide comprehensive insights into spatiotemporal patterns of land surface-driven modification of cloud occurrence, such as the diurnal variation of the occurrence of fog holes and cloud enhancements attributed to the impact of the urban heat island. High-resolution satellite-based cloud masking approaches are often based on locally-optimized thresholds that are compared against satellite-observed reflectances to separate cloudy from clear-sky observations that can be affected by the local surface reflectance. Therefore, spatial differences in surface albedo, as found in and around urban areas or forests, can introduce spatial biases in the detected cloud cover that may impede the analysis of spatial pattern changes due to land surface influences. In this study, two approaches for cloud masking using the High Resolution Visible channel of the Spinning Enhanced Visible and Infrared Imager aboard Meteosat Second Generation are developed and validated for the region of Paris to show and improve applicability for analyses of urban effects on clouds. Firstly, a local approach that uses an optimized threshold to separate the distribution of visible reflectances into cloudy and clear sky for each individual pixel accounting for its locally specific brightness. Secondly, a regional approach that uses visible reflectance thresholds that are independent of surface reflection at the observed location. While the first approach is representative for the widespread usage of locally-optimized approaches, derived cloud masks result in regional biases that are caused by the differences in surface reflectance. This makes the regional approach a more appropriate choice for the high-resolution satellite-based analysis of cloud cover changes over different surface types and the interpretation of locally induced cloud processes.