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Neural network satellite retrievals of nocturnal stratocumulus cloud properties

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We investigate the feasibility of retrieving cloud effective radius, optical thickness and cloud top temperature of nocturnal marine stratocumulus clouds by inverting infrared satellite measurements using an artificial neural network. For our study, we use the information contained in the three infrared channels centred at 3.7, 11.0 and 12.0 μm of the Moderate Resolution Imaging Spectroradiometer (MODIS) on board NASA's Terra and Aqua satellites. A database of simulated top-of-atmosphere radiances of a range of cloud parameters is computed using a correlated-k parameterisation which we have embedded in the radiative transfer package libRadtran (Mayer and Kylling, Atmos. Chem. Phys., 2005). The database is used to train a feed-forward neural network to perform the inversion of the satellite measurements for the cloud properties. Our approach follows that of Cerdeña et al. (J. Ocean. Atmos. Tech., in press), who for the same purpose use neural networks to invert radiances measured by the Advanced Very High Resolution Radiometer (AVHRR). We extend the network architecture by including Bayesian methods to estimate the retrieval uncertainties, and compare the resulting retrievals with in-situ cloud measurements taken during the second Dynamics and Chemistry of Marine Stratocumulus experiment (Stevens et. al., Bull. Amer. Meteor. Soc., 2003).