

Machine-learned atmospheric optical properties for radiative transfer computations

Menno Veerman¹, Robert Pincus^{2,3}, Caspar van Leeuwen⁴, Damian Podareanu⁴, Robin Stoffer¹, Chiel van Heerwaarden¹

A fast and accurate treatment of radiation is essential for high quality atmospheric simulations, but radiative transfer solvers are computationally very expensive. In this study, we use machine learning to determine the optical properties of the atmosphere, which control the absorption, scattering and emission of radiation. We train multiple neural networks to predict all optical properties calculated by the RRTM for General circulation model applications - Parallel (RRTMGP) from the pressure, temperature, water vapour content and ozone mixing ratio of each grid cell. The predicted optical properties are highly accurate and resulting downward longwave and shortwave radiative fluxes have errors within 0.5 W/m² at the surface. Depending on the size of the neural networks, our implementation is up to 4 times faster than RRTMGP. We thus conclude that neural networks are very suitable to emulate the calculation of optical properties.