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Evaluating Modelled Aerosol Absorption by Simulating the UV Aerosol Index using Machine Learning

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The environmental effects of absorbing aerosols are complex: they warm the surface and the atmosphere on a large scale, while locally they cool the surface. Absorbing aerosols also affect precipitation and cloud formation. A comprehensive understanding of aerosol absorption is important to reduce the uncertainties in aerosol radiative forcing assessments. The ultraviolet aerosol index (UVAI) is a qualitative measure of aerosol absorption provided by multiple satellite missions since 1978. UVAI is directly calculated by the difference between the measured spectral contrast and the simulated ones in the near-UV channel, without assumptions on aerosol properties. This long-term global daily data set is advantageous for many applications. In previous work, we have attempted to derive the single scattering albedo (SSA) from UVAI. In this work, we evaluate the UVAI derived from a chemistry transport model (CTM) with satellite observations. Conventionally, UVAI from a model aerosol fields at a satellite footprint is simulated using a radiative transfer model. In order to do this, one has to make assumptions on the spectral dependence of the aerosol optical properties. The lack of measurements and our poor knowledge of these properties may lead to large uncertainties in the simulated UVAI, and these uncertainties are difficult to quantify. In this work, we propose an alternative method, that is to simulate the UVAI based on Machine Learning (ML) approaches. A training data set is constructed by independent measurements and/or model simulations with strict quality controls. We simulate the UVAI using modelled aerosol properties, the Sun-satellite geometry and the surface parameters. The discrepancy between the retrieved UVAI and the ML predictions can help us to identify the unrealistic inputs of aerosol absorption in the model.