6a.11 Resolving WRF surface clear sky irradiance bias in the New Goddard Shortwave scheme

Zhong, Xiaohui, and Jan Kleissl, *University of California San Diego*

The parameterization of aerosol optical properties for clear sky broadband shortwave (SW) surface irradiance has been examined using the Rapid Radiative Transfer Model for GCMs (RRTMG) and the New Goddard shortwave radiation scheme in version 3.6 of the Weather Research and Forecasting (WRF) model. The WRF simulations were forced with constant values of aerosol optical properties and without aerosols. We intercompared WRF with and without aerosols against the REST2 clear sky model forced with WRF aerosol optical properties and precipitable water (PW), as well as REST2 forced with measurements of aerosol optical properties and PW from one AERONET site. The intercomparisons of the global horizontal irradiance (GHI), direct normal irradiance (DNI) and diffuse horizontal irradiance (DIF) have demonstrated that adding aerosols to the WRF SW schemes is only a partial solution to the WRF positive clear sky GHI bias issue.
In this work, two methods are presented to separate the effects of each constituent (Rayleigh scattering, aerosols, PW and ozone) on irradiance for the New Goddard SW scheme: 1) subtract irradiance with only Rayleigh scattering considered by irradiance with Rayleigh scattering and aerosols/PW/ozone considered; 2) subtract irradiance only without Rayleigh scattering/aerosols/PW/ozone considered by irradiance with all the constituents considered. The two methods provided similar results: the main source of the clear sky irradiance bias is not WRF-simulated atmospheric composition data, but WRF New Goddard modeled Rayleigh scattering. Since Rayleigh scattering optical thickness is calculated by multiplying Rayleigh scattering extinction coefficient by pressure, two other WRF New Goddard ensembles with the extinction coefficient multiplied by 1.9 and 2.0 were run. Overall, it has been verified that the clear sky irradiance biases are significantly reduced. In addition, the impacts of correcting irradiance on atmospheric heating and moistening were studied for both clear and cloudy conditions.