Ultraviolet Radiation evolution during the 21st century

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Introduction

In the context of a changing climate, the acceleration of the Brewer-Dobson circulation (Butchart 2014) leads to a decrease of the ozone total column in the tropics. This decrease affects directly surface ultraviolet radiation, which are already very high in this area. Following the work of (Bais et al., 2011), (Buchard, 2014) (Hegglin & Shepherd, 2009, Sep) the future evolution of stratosphere derived from Chemistry Climate Models (CCM) projections, we projected here surface irradiance from 2010 to 2100 with focus on the tropics. We used the latest chemistry climate projection exercise; Chemistry Climate Model Initiative (CCMI) coupled with a radiative transfer model (TUV (Madronich, 1993)) to calculate the evolution of surface ultraviolet irradiance through the 21st century. Ultraviolet Index (UVI) has been specifically considered (McKenzie, Matthews, & Johnston, 1991).

At first, simulation from ReC2 Chemistry Climate Climate Model Initiative have been coupled with a radiative transfer model, in order to obtained modeled UV index (UVi-M). UVi-M is then compared against available satellite ultraviolet radiation observations (OMI OMIUVbd product) between 2005 and 2016. Statistical difference and variance have been analysed versus different parameters: geographical location, model or ensemble of model outputs used in the radiative transfer calculation. From these conclusions we have computed the UV evolution throughout the 21 st century with the ReC2.

Main Objectives

- CCMI + Radiative Transfer (RT) Modelling in order to retrieve solar irradiance.
- Validation of CCMI and CCMI-RT result against climatological observations from present period.
- Ultraviolet Radiation Evolution through the 21st century.

Radiative Transfer Modelling

Radiative Transfer Model used is the Tropospheric Ultraviolet Model (TUV) (Madronich, 1993), with Serdyuchenko, Gorshelev, Weber, Chehade, & Burrows, (2014) ozone cross section and (Chance & Kurucz, 2010) on the future evolution of surface irradiance derived from Chemistry Climate Model Initiative (CCMI) projections, we projected here surface irradiance from 2010 to 2100 with focus on the tropics. We used the latest chemistry climate projection exercise; Chemistry Climate Model Initiative (CCMI) coupled with a radiative transfer model (TUV (Madronich, 1993)) to calculate the evolution of surface ultraviolet irradiance through the 21st century. Ultraviolet Index (UVI) has been specifically considered (McKenzie, Matthews, & Johnston, 1991).

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Valuation


Projections

- CCMI-Median-TOV shows a Mean Relative Difference of 14.13% versus OMI-TOZ product, CCMI Median-TOZ are 9.15 % higher than observed OMI UV product.
- Surface UV decreases in mid to high latitude during the 21st century. Tropical variation of UV radiation is very small and will need further research.
- Tropical radiation will be small but will need further research.

Conclusion

- CCMI + TUV Validation against Ground UV observations.
- Single Model Radiative Transfer Calculation
- Further analysis on tropical variation during the 21st century.
- Multi-scenario studies with ACCMIP or CCMI available SEN-C2 result.

Forthcoming Research

- CCMI + TUV Validation against Ground UV observations.
- Single Model Radiative Transfer Calculation
- Further analysis on tropical variation during the 21st century.
- Multi-scenario studies with ACCMIP or CCMI available SEN-C2 result.

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References


