Calibration method for broadband ultraviolet radiometers: Improving solar zenith angle dependence

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Calibration campaign: from 30th September to 27th October 2005
at the Atmospheric Sounding Station (ESAt/ INTA/ "El Arenosillo" (Huelva, Spain)

INSTRUMENTS AND LOCATION

Three broadband radiometers UV-S-E-T model (erythema weighted) Kipp & Zonen

ESAt/ INTA/ "El Arenosillo"
37.1º N, 6.7º W, 20 m a.s.l.

Brewer MK III double monochromator spectrophotometer (Kipp & Zonen)

CALIBRATION METHODS

ONE STEP METHODS

- ratio model $C_r = \frac{1}{N}\sum_{i=1}^{N}\frac{UVER_i^{Brewer-CIE}}{V_i}$
- first-order model $UVER_i^{Brewer-CIE} = C_f V_i$
- second-order model $UVER_i^{Brewer-CIE} = C_{s1}V_i + C_{s2}V_i^2$
- **angular method** $UVER_i^{Brewer-CIE} = C_1 V_i + C_2 V_i^2 \cos\theta_i$

$UVER^{Brewer-CIE}$ represents Brewer erythematic irradiance, V the output voltage of broadband radiometer; C_f, C_{s1}, C_{s2}, C_1 and C_2 the regressión coefficients and θ the solar zenith angle.

TWO STEPS METHOD

Calibration matrix $f([O_3], \theta)$ determined using:

- spectral response function of broadband instrument (SRF), applied to spectroradiometer data to obtain an absolute calibration factor
- transfer radiation model (UVSpec) to obtain spectral UV irradiance (CIE and SRF weighted)

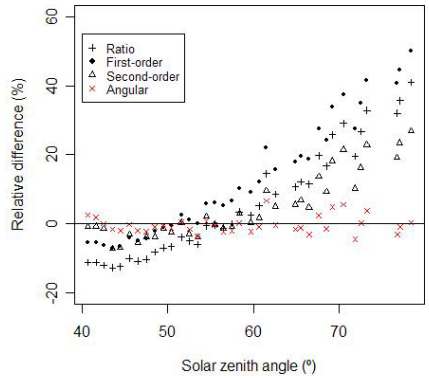
$$UVER^{CIE} = (V - V_o)\cdot C \cdot f_n(\theta, [O_3])\cdot COSCOR(\theta))$$

Data used
733 minute average data

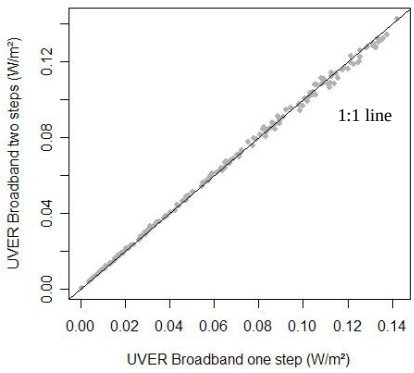
To fit the models: subset of 564 data randomly selected (77% of the whole data set)

Validation of the models: subset of 169 data (23% remaining)

RESULTS



Relative differences between UV irradiance measured by Brewer spectrophotometer and estimated by broadband radiometer #1 using the four one-step models



Comparison of broadband values obtained applying one-step (angular method) and two-steps methods (matrix calibration method) using subset of 169 data reserved for validation

The new calibration model proposed - angular method - means a remarkable improvement of broadband radiometer's calibration procedures based in one-step methodology. The excellent agreement with results obtained by the two-steps method, confirms the reliability and usefulness of the new one-step method proposed, even for high solar zenith angles.

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