Comments to the CORAS Spectrometer Dataset

The COmpact RAdiation measurement System (CORAS) provides spectral resolved downward irradiances (Ed_xxxnm in units of W m^-2 nm^-1) or spectral resolved downward radiances (Ls_xxxnm in units of W m^-2 nm^-1 sr^-1) covering the wavelength region between 400nm-2200nm.

The instrument consists of two different spectrometers with different spectral resolutions for each quantity (Visible to near infrared (VNIR)=400-927nm; Shortwave infrared (SWIR)=933-2200nm). The FWHM of VNIR is 2-3 nm and 8-10 nm for SWIR. The resulting data set is a merged spectrum from both spectrometers.
An example of a clear sky measurement should look like Figure 1a-b. Absorption bands of different atmospheric gases (O3: 470 nm; O2: 760 nm; H2O: 720 nm, 820 nm, 940 nm, 110 nm, 1380 nm, and 1870 nm; and CO2: 1400 nm, 1600 nm, and 2000 nm) are represented in the downward spectral irradiance and radiance.

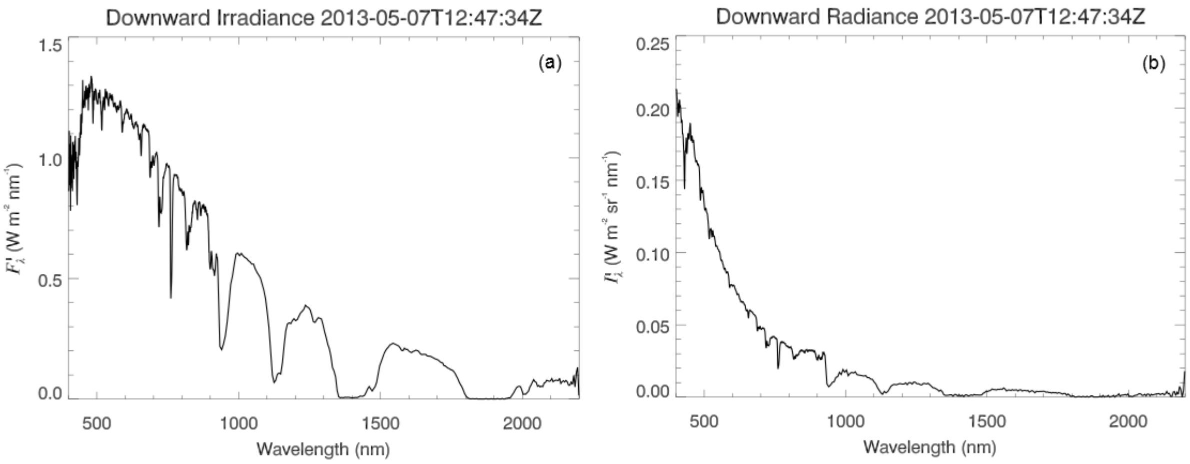

Fig. 1: Downward spectral irradiance (a) and downward spectral radiance (b) measurement under clear sky conditions. Data were observed on May 7 2013 at 12:47:34Z during Meteor M96 campaign over the Atlantic ocean.

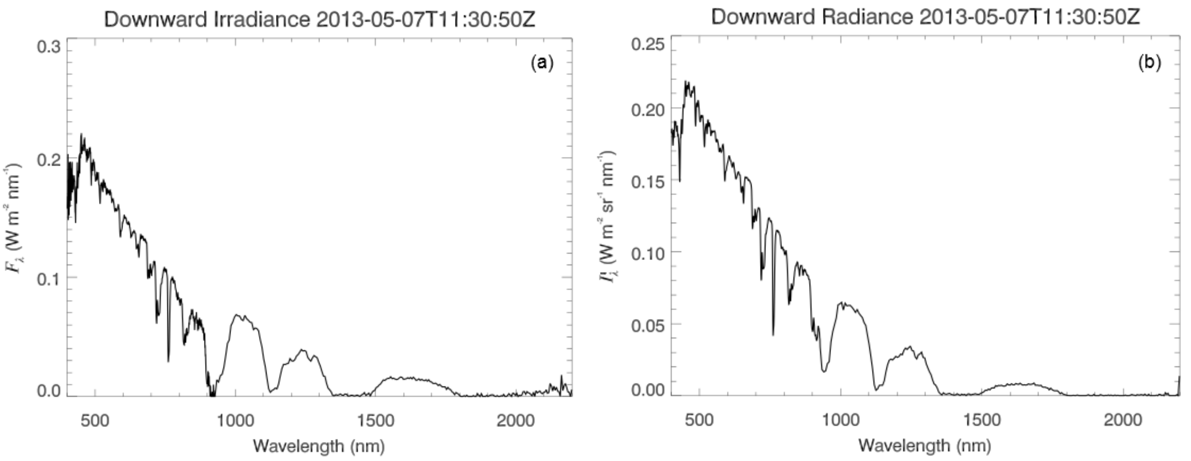

Fig. 2: Downward spectral irradiance (a) and downward spectral radiance (b) measurement under cloudy conditions. Data were observed on May 7 2013 at 11:30:50Z during Meteor M96 campaign over the Atlantic ocean.

In the presence of clouds a spectrum should look like Figure 2a-b, depending on the cloud optical thickness and droplet effective radius of a liquid water or ice cloud.

Each quantity is measured in sequence with a certain integration time. Used integration times T_int for VNIR are 1000 ms or 3000 ms, while used T_int for SWIR are 300 ms or 500 ms, respectively. Depending on the cloud situation and position of the sun (at low solar zenith angles) different combinations of integration times for VNIR and SWIR have to be used. These combinations are either 1000 ms and 300 ms (VNIR+SWIR) or 3000 ms and 500 ms (VNIR+SWIR). This results in a temporal resolution of either 8 s or 15 s, respectively.

There are possible error sources that influence the data quality, and therefore the dataset is highly uncertain at those times. Possible reasons for low data quality are listed below. In case of a scientifically usage these data should be excluded from analysis (for further question please always contact authors!).

- Under some circumstances it is possible that the two merged spectra (VNIR-SWIR) don’t match to each other (see Figure 3). A gap at the wavelength overlap is obvious. For those cases, the chosen integration time (T_int) of measurements was not correct for the actual atmospheric conditions. The spectral behavior should be consistent but with some correction procedures the “uncorrect” signal could also be used for analysis.
- At very low solar zenith angles (<20°) in combination with scattering clouds even the higher temporal resolution might not be sufficient to count all received photons on the photodiode of the optical sensor. The result is a signal overload. Unusually high values and also negative values are not deleted in the dataset (all values >5 are highly uncertain). Those events often occur during local noon and are strengthened in the presence of scattering clouds. Those data have to be excluded from further analysis. Please see Figure 4 and Figure 5.
- To obtain spectral quantities from photon counts a calibration in the laboratory and field has to be performed and applied to the dataset. Due to calibration uncertainties it might be possible that unusually high values in the wavelength region between 400-450nm and 2000-2200nm are obvious. These values are not deleted in the dataset.
- The dataset quality at high solar zenith angles decreases (>75°) as the detected photons lessens (see Figure 4).

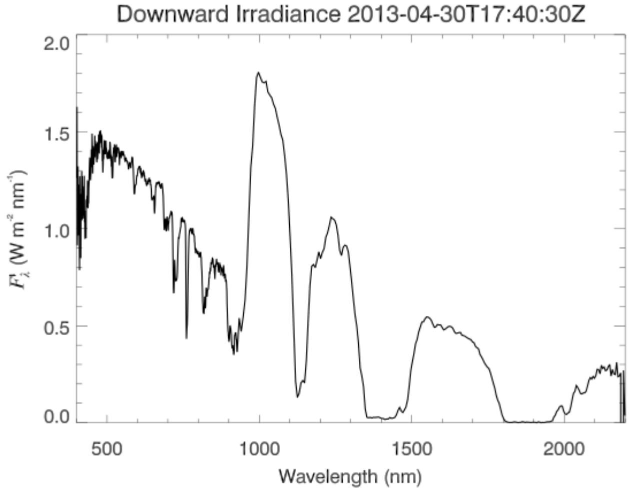

Fig.3: Downward spectral irradiance on April 30 2013 at 17:40:30Z during Meteor M96 campaign over the Atlantic ocean. Here, the two spectra obtained from measurements with two spectrometers (VNIR, SWIR) don't match. The offset results from inappropriate integration times. Beside the offset, the spectral behavior is consistent.

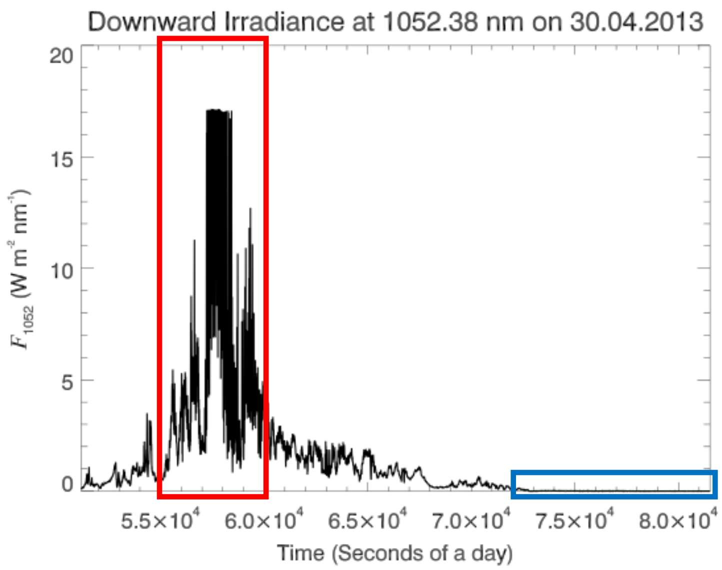

Fig. 4: Time series of spectral downward irradiance at 1052.38 nm on April 30 2013. During noon (red box) the signal is overloaded. Those times have to be excluded from further data analysis. In the evening, at large solar zenith angles the signal quality decreases (signal noise, see blue box).

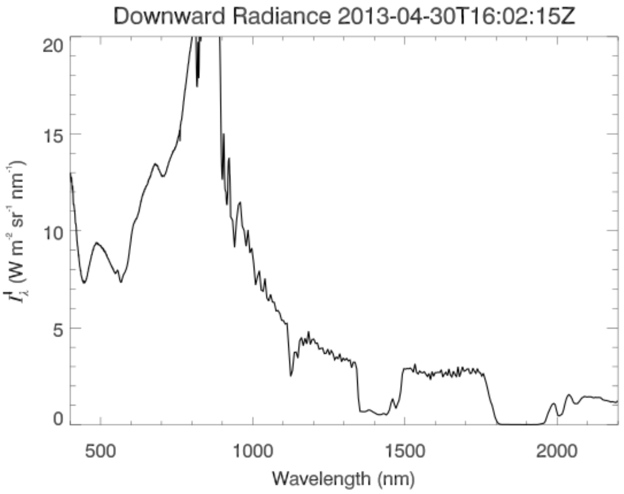

Fig. 5: Example of an overloaded spectrum of downward spectral radiance on April 30 2013 at 16:02:15Z. Note the completely divergent spectral behavior compared to Fig. 2b. Those spectra (times) have to be excluded from further data analysis.

In the case of further question please contact:

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