Spectrafy
solar spectral sensors

Towards routine measurement and use of solar spectral irradiance data

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why use spectra?

It has long been known that spectral irradiance data can reduce the uncertainty of PV efficiency measurements, performance models and O&M metrics by enabling spectral correction.

However, use of spectral data in the PV industry has historically been limited by the following factors:

- too expensive to deploy and maintain
- limited spectral range
- inaccurate/unreliable data
- too much data
- incompatible with standard PV software

spectral pyranometers

In 2017 Spectrafy launched the SolarSIM-G; the world's first spectral pyranometer that enables accurate measurement of both full-range solar spectral irradiance and GHI, in one compact sensor.

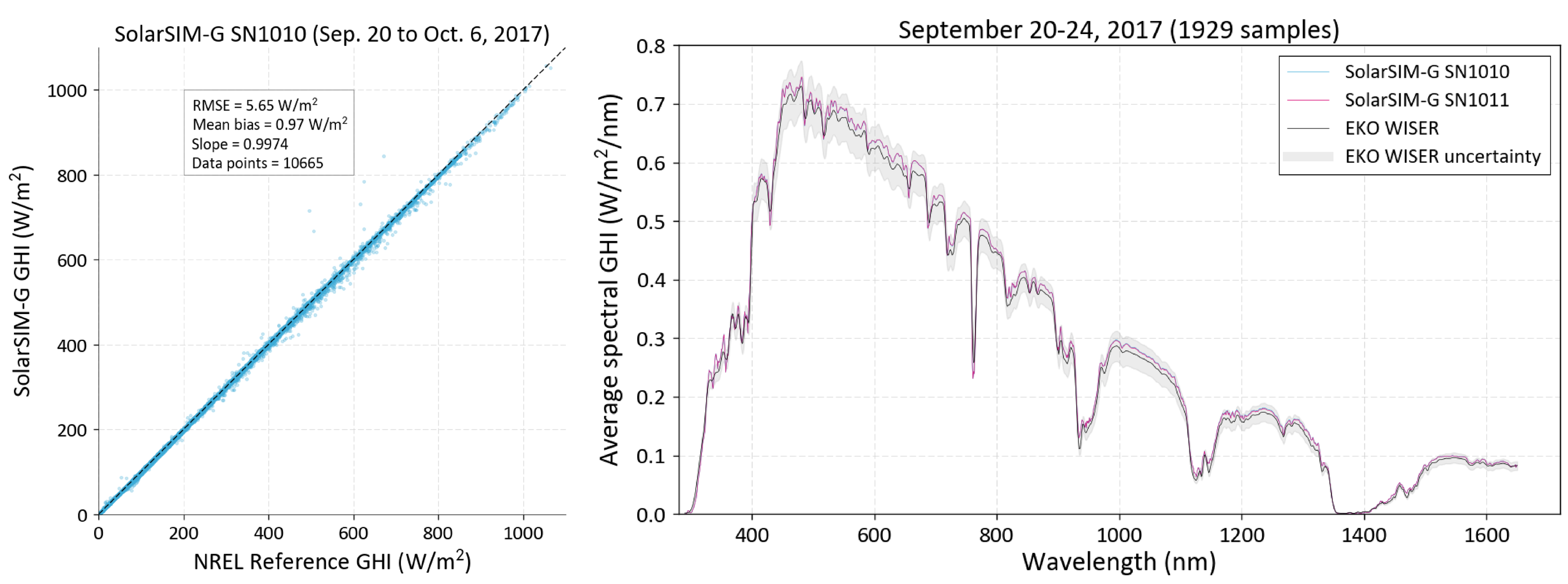
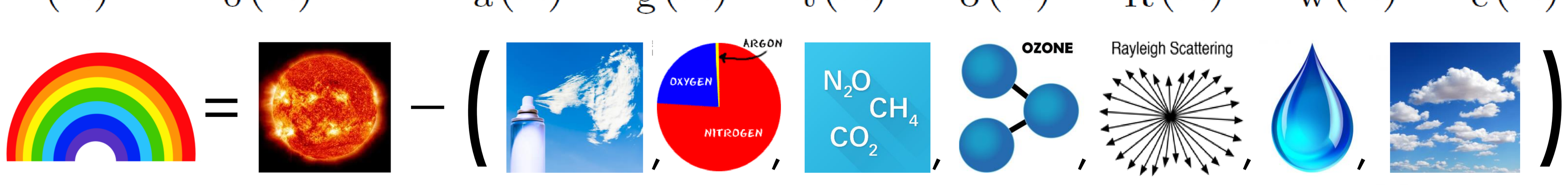


Fig 1. Comparative performance data for the SolarSIM-G, measured at NREL, Sept-Oct 2017

how they work

The SolarSIM-G takes advantage of the fact that sunlight is a constrained light source. The SolarSIM-G uses filtered photodiodes to measure several specific bands within the solar spectrum. These measurements are then fed into Spectrafy's radiative transfer software to accurately resolve the spectrum over the complete 280-4000nm range, under all sky conditions.

$$E(\lambda) = E_0(\lambda) \cdot r^2 \cdot T_a(\lambda) \cdot T_g(\lambda) \cdot T_t(\lambda) \cdot T_o(\lambda) \cdot T_R(\lambda) \cdot T_w(\lambda) \cdot T_c(\lambda)$$



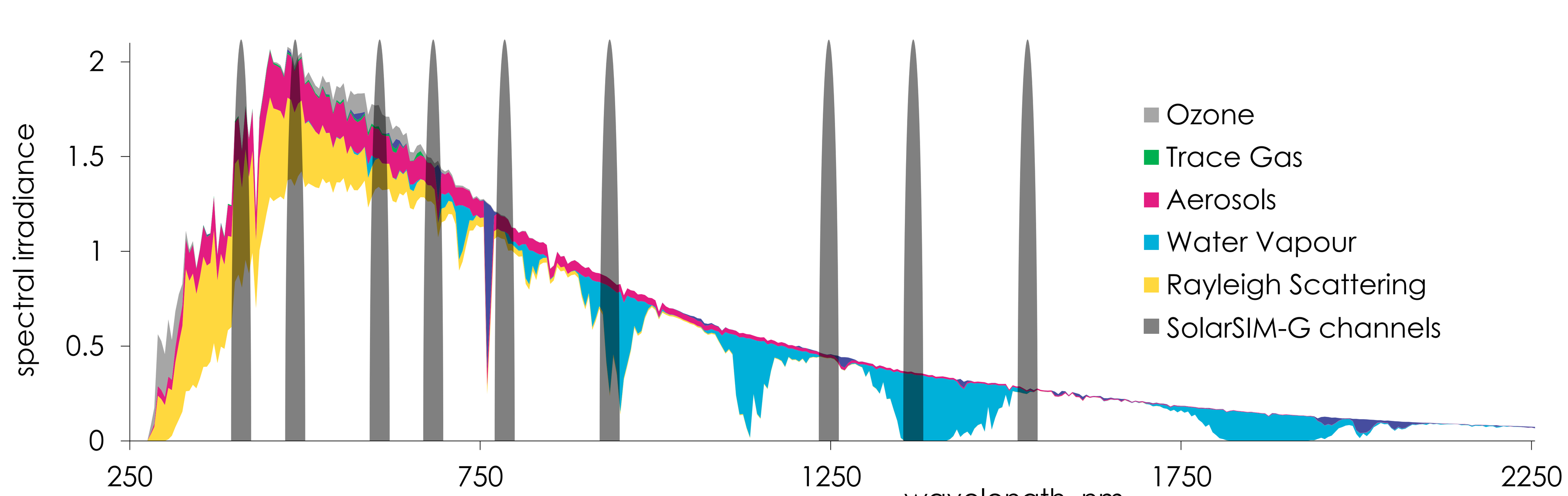


Fig 2. Solar spectra showing absorptive effects of various atmospheric constituents and the spectral locations of the SolarSIM-G's measurement channels

spectral correction factors

Recently, Spectrafy has been working to simplify the use of spectral data by automating the calculation of spectral correction factors (SCF)[1] within our software.

$$\mathrm{SCF} = \frac{\int_{280}^{4000} E_m(\lambda) \cdot SR(\lambda)\, d\lambda}{\int_{280}^{4000} E_m(\lambda)\, d\lambda} \times \frac{\int_{280}^{4000} E_{ref}(\lambda)\, d\lambda}{\int_{280}^{4000} E_{ref}(\lambda) \cdot SR(\lambda)\, d\lambda}$$

SCF is a function of the measured spectra (E_m), the reference spectrum (E_{ref}) and a given solar panel's spectral response (SR).

$$\mathrm{SCF} \cdot \mathrm{GHI} = \mathrm{GHI}_{spec.cor.}$$

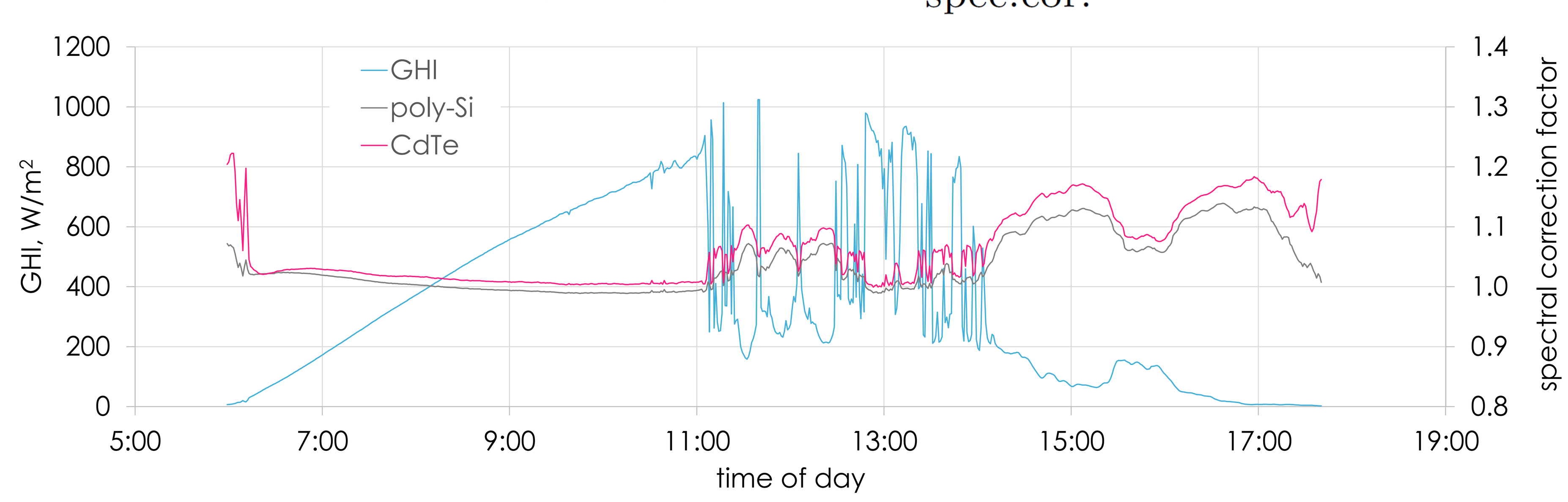
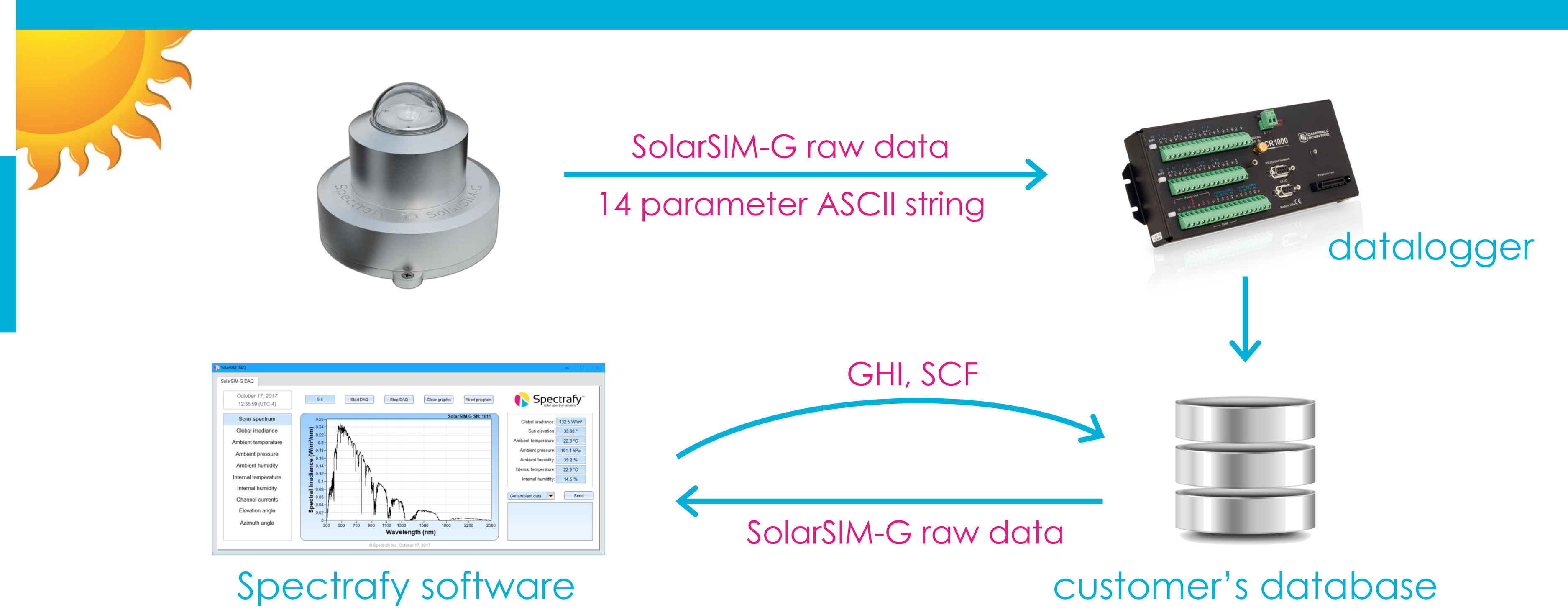


Fig 3. GHI and spectral correction factors for poly-Si and CdTe solar panels @NREL, 1st Oct 2017

implementation



advantages

- Acquiring spectral data is now as simple as deploying a pyranometer.
- No need to store large spectral datasets – just the SolarSIM-G raw data.
- Use of SCFs converts spectral data into a simple time series that can be applied like any other derate.

offer to PV manufacturers

- Ask about having your products' spectral response data included in our software.

[1] "Translation of Device Performance Measurements to Reference Conditions" Solar Cells, 18, 1986