



Spectrafy
solar spectral sensors

Spectral effects in Hawaii

WCPEC-7, June 2018

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Overview

- Data measured at WCPEC-7 in Waikaloa, Hawaii
- SolarSIM-GPV mounted on tripod on the Lagoon Lanai
- Data acquired 11th-14th June 2018. 2s time resolution.



SolarSIM-GPV datasets: GHI and SCFs

- The SolarSIM-GPV resolves full-range global solar spectral irradiance (280-4000nm).
- From that, GHI and spectral correction factors (SCF) for a range of PV panel types are automatically calculated.
- SCFs convert large spectral datasets into simpler time series that can be used like any other pro/derate.
- SCF > 1 = boost in PV performance. SCF < 1 = reduction in PV performance.

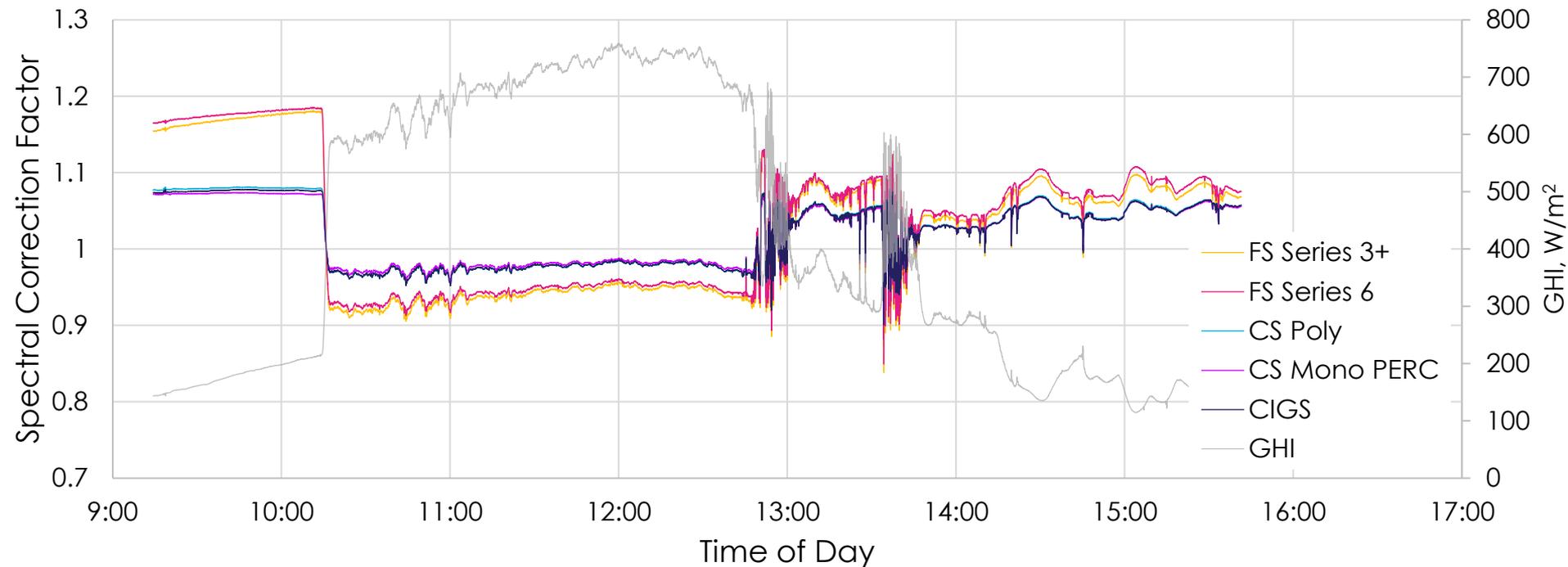
$$SCF = \frac{\int A \cdot B \, d\lambda \int C \, d\lambda}{\int A \cdot C \, d\lambda \int B \, d\lambda}$$

A = spectral response of PV panel

B = reference spectra

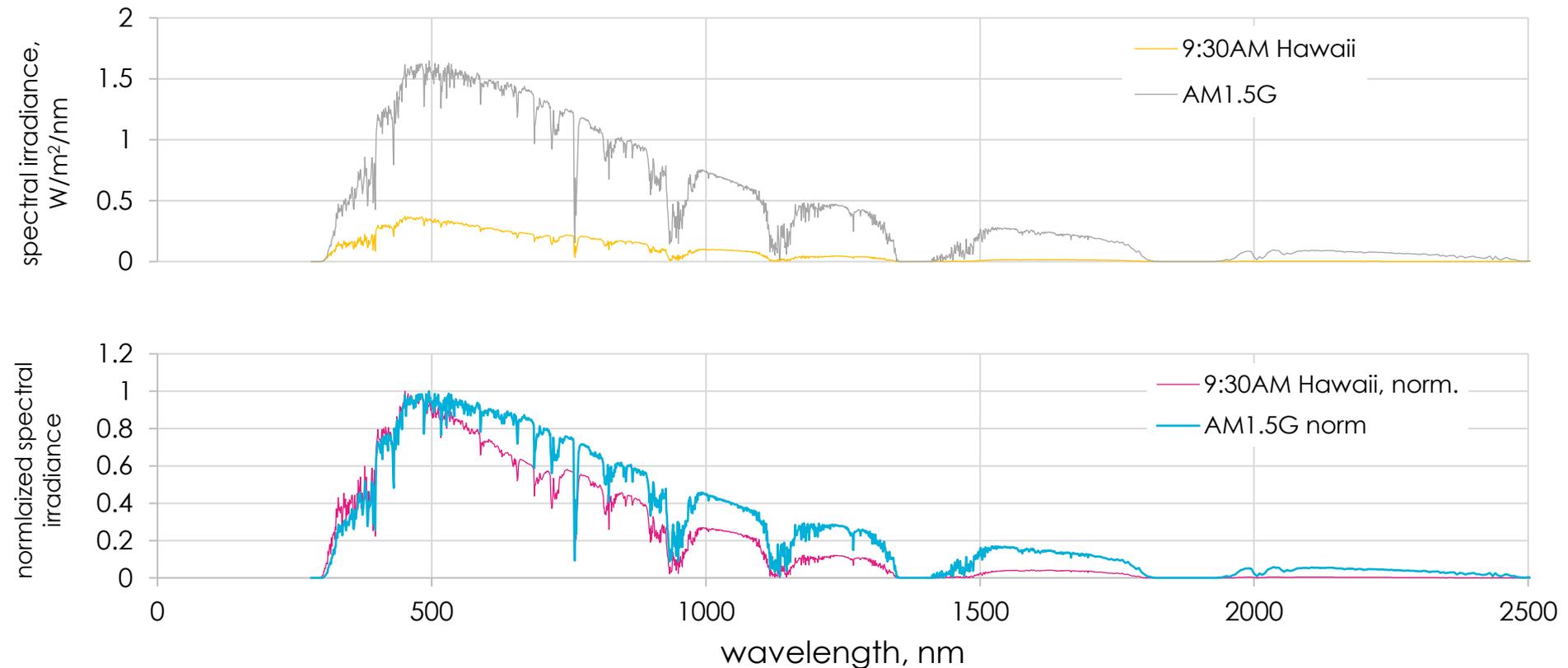
C = measured spectra

14th June 2018 SCF factors



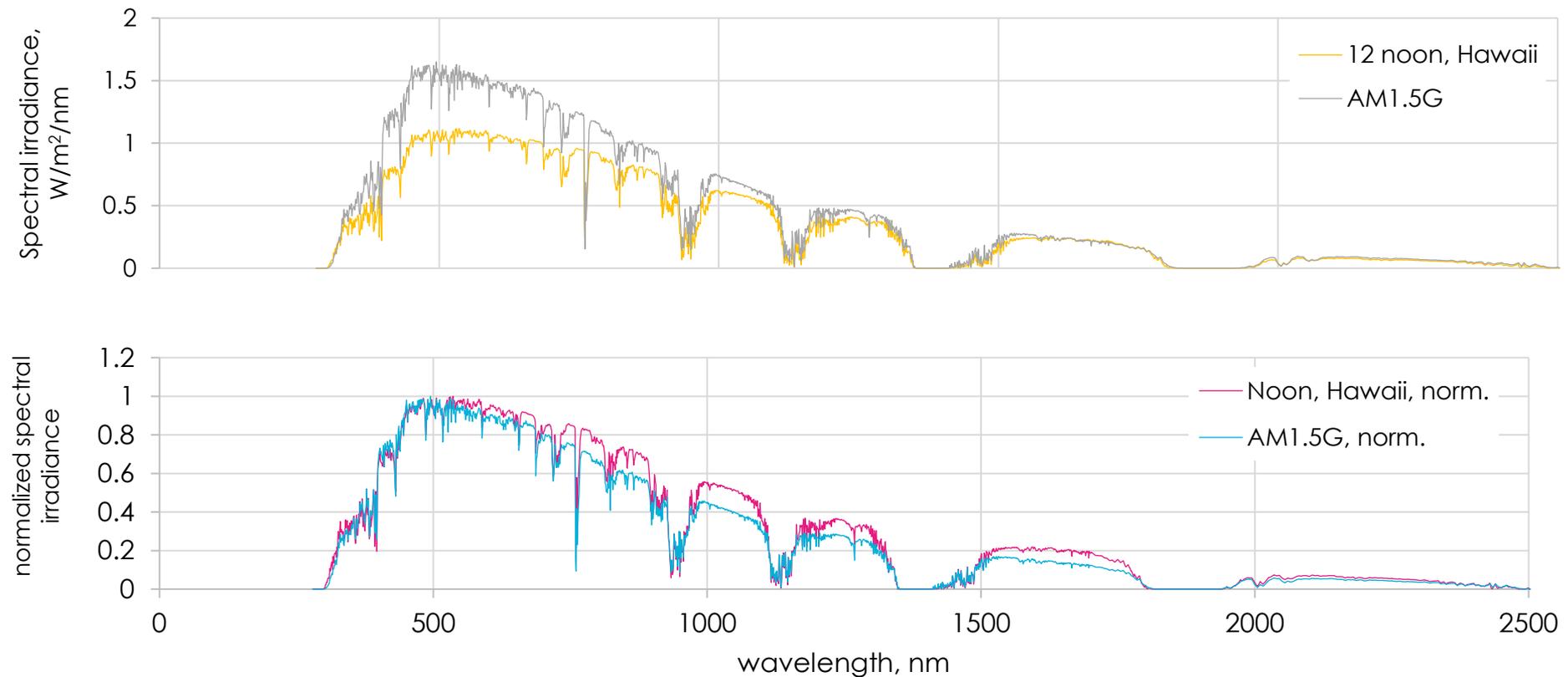
- High SCFs before 10:15AM due to shade.
- Low SCFs from 10:15AM – 12:45PM due to volcanic smog.

14th June 2018, 9:30AM spectra



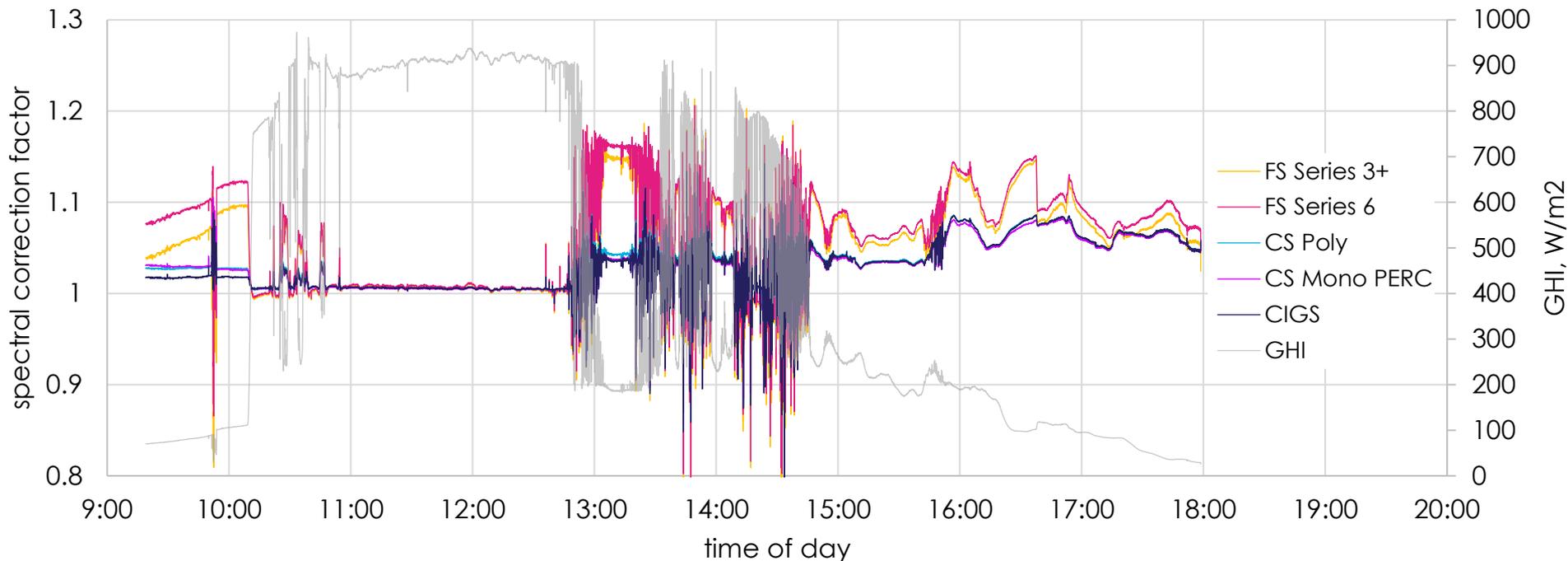
- Low absolute irradiance due to shading.
- 'Pointy' spectral shape, dominated by diffuse light due to shading.

14th June 2018, 12:00PM spectra



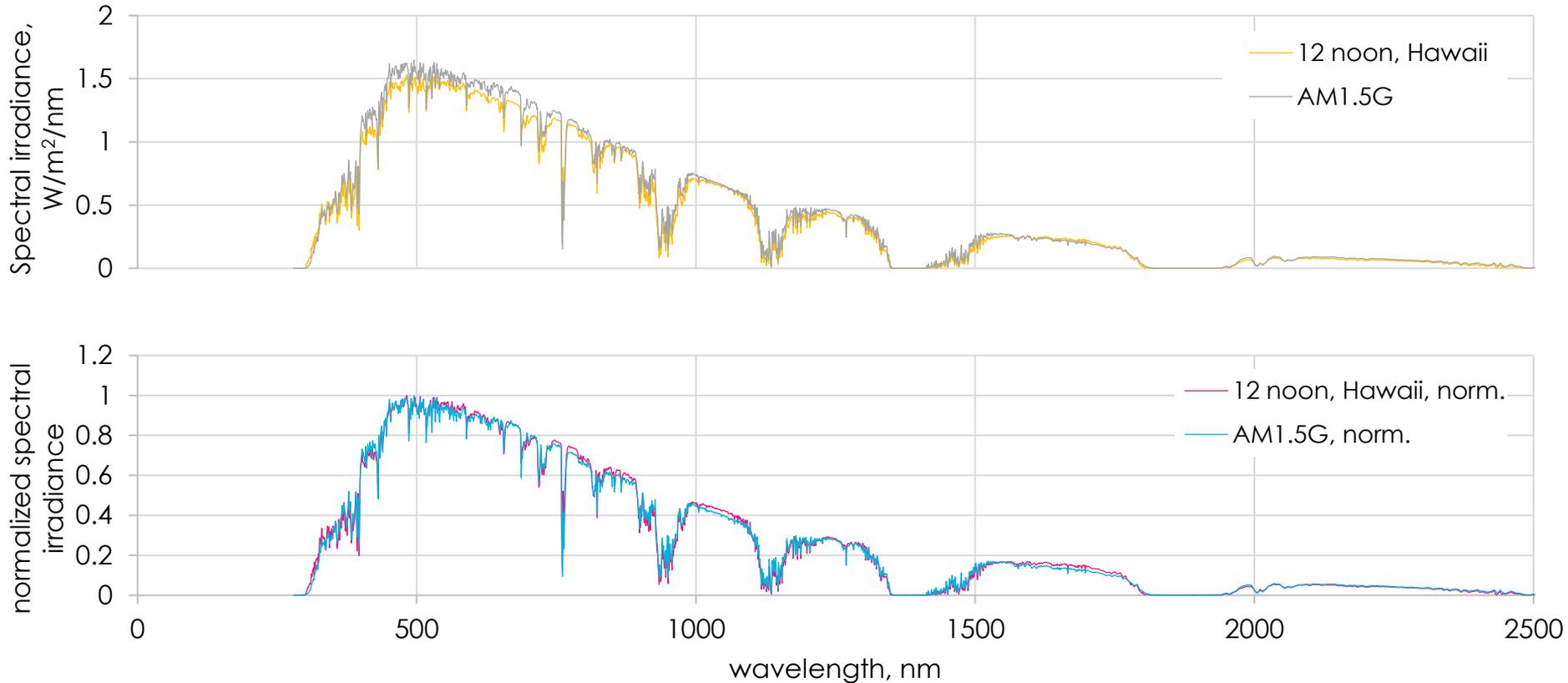
- Irradiance unshaded but attenuated by vog.
- Relatively 'flat' spectra due to spectrally flat vog aerosol profile.

13th June 2018 SCF factors



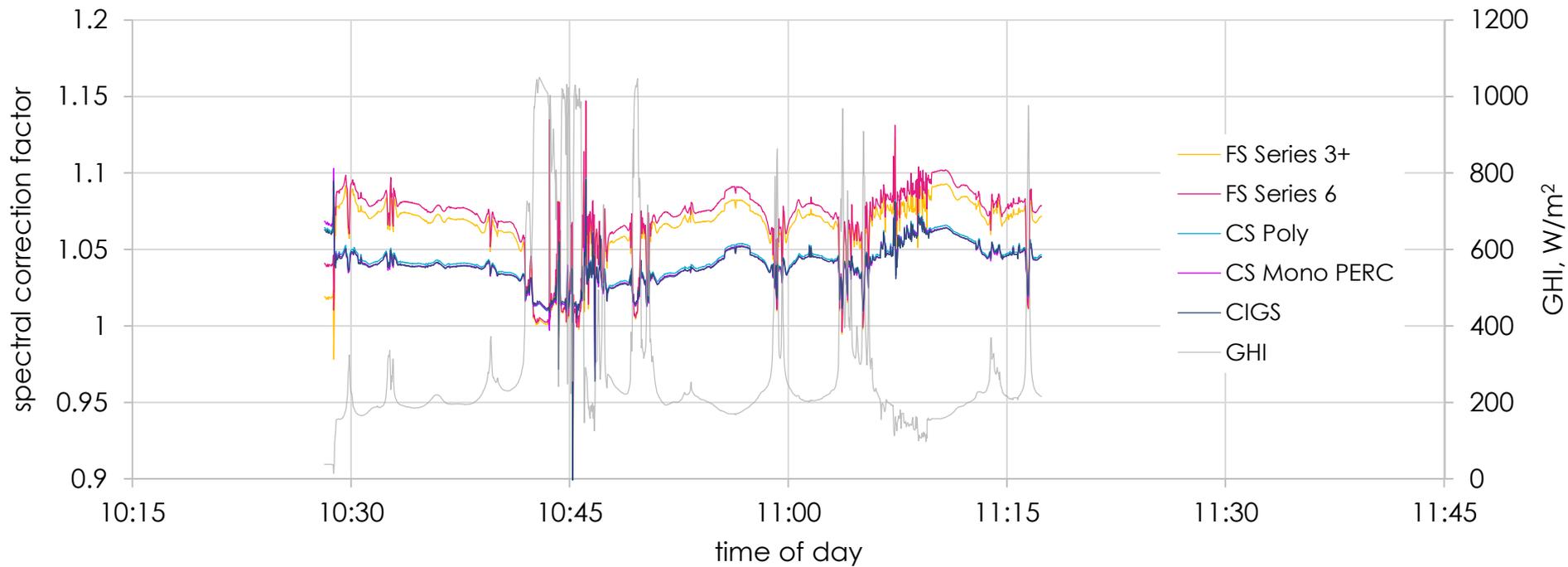
- A more 'normal' day. Under shade before 10:15AM.
- Clear sky period (10:48AM – 12:30PM) with SCF close to 1.
- Various shading (palm trees etc.) beyond 12:45PM.

13th June 2018, 12:00PM spectra

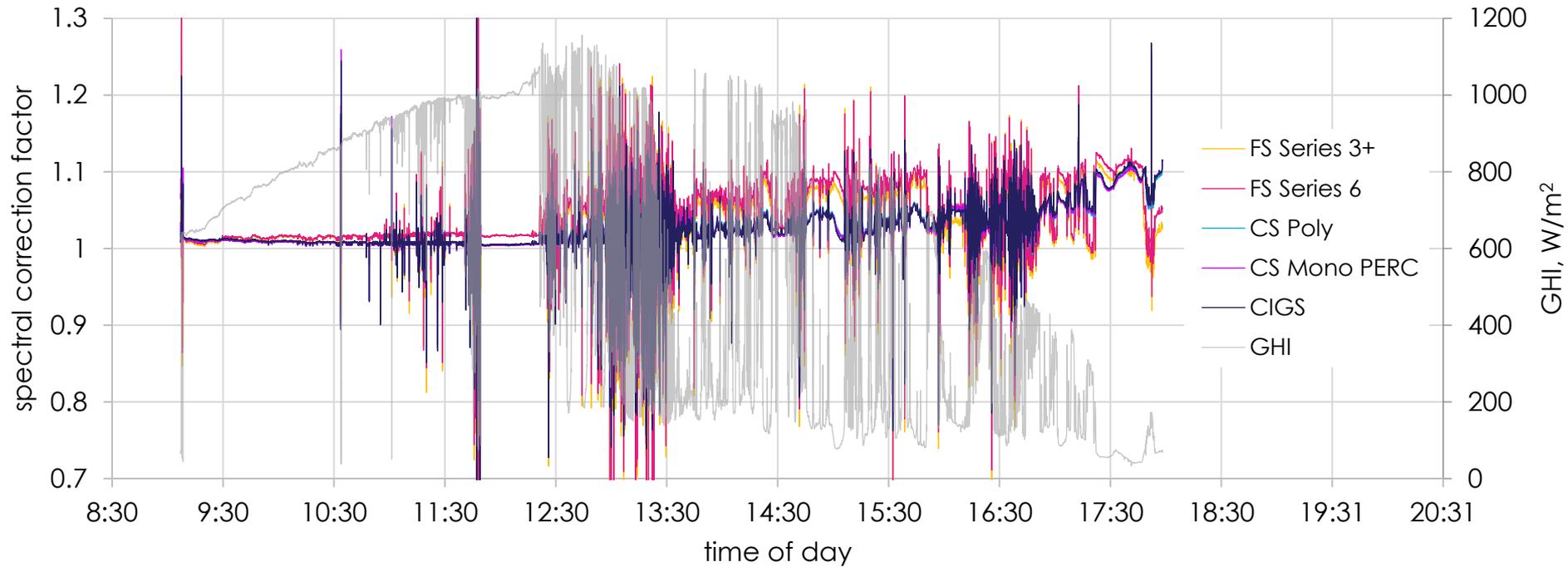


- High irradiance due to relatively clear sky.
- Spectra very similar to AM1.5G reference spectra, leading to SCF = 1

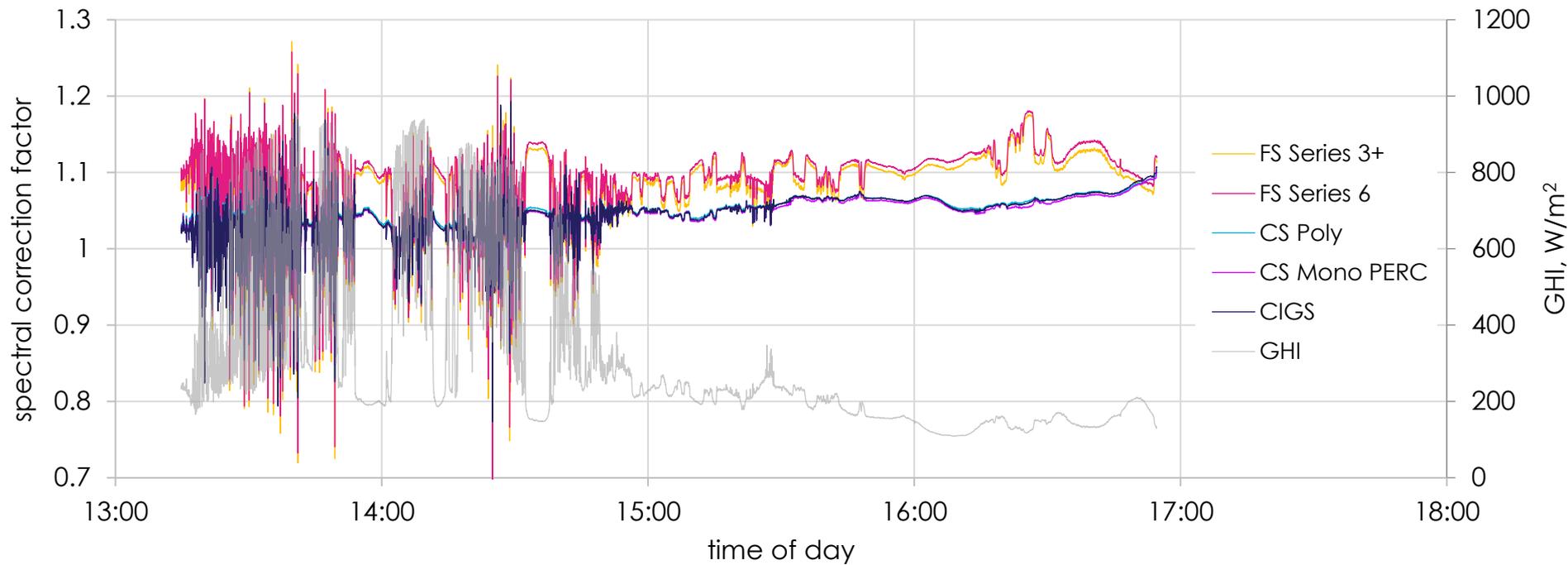
Other data: 10th June 2018



Other data: 11th June 2018



Other data: 12th June 2018



Spectral effect on daily GHI sums

Date	GHI sum, kWh	Spectrally effect on GHI Sum, %				
		FS S3+	FS S6	CS Poly	CS Mono PERC	CIGS
10th June	0.234	+5.19%	+5.66%	+3.48%	+3.34%	+3.42%
11th June	4.742	+2.22%	+2.41%	+1.43%	+1.38%	+1.48%
12th June	1.099	+5.33%	+5.89%	+3.44%	+3.31%	+3.41%
13th June	3.659	+2.31%	+2.65%	+1.50%	+1.45%	+1.49%
14th June	2.673	-0.86%	-1.44%	-0.10%	+0.05%	-0.12%

- Generally positive, except for the 14th, which was affected by vog.
- Larger effect for CdTe, versus Si and CIGS. Larger effect on cloudy days.

Conclusions

- Global solar spectra were measured on the Lagoon Lanai at the Hilton Waikaloa Village Hotel, from 11th-14th June 2018.
- For the time period, instantaneous spectral correction factors varied from 0.92 – 1.18.
- Particularly low spectral correction factors (~ 0.92) were observed on June 14th, caused by volcanic smog from the Kilauea eruption.
- Generally, the spectral effect on daily GHI sums was positive. Higher for CdTe vs. Si and CIGS. Greater effect on cloudy days.



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