TRACKING SHADOW BAND METHODOLOGY FOR ACCURATE AND COST-EFFECTIVE DIFFUSE HORIZONTAL IRRADIANCE MEASUREMENTS

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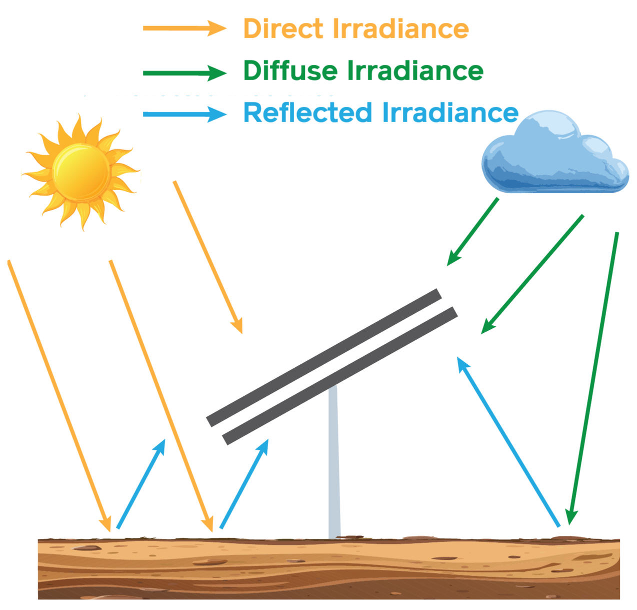
1 Introduction

As bifacial PV installations become more common, monitoring diffuse and ground-reflected irradiance is increasingly important. Pyranometers, are the most commonly used instruments for attaining solar irradiance readings with minimal uncertainties.



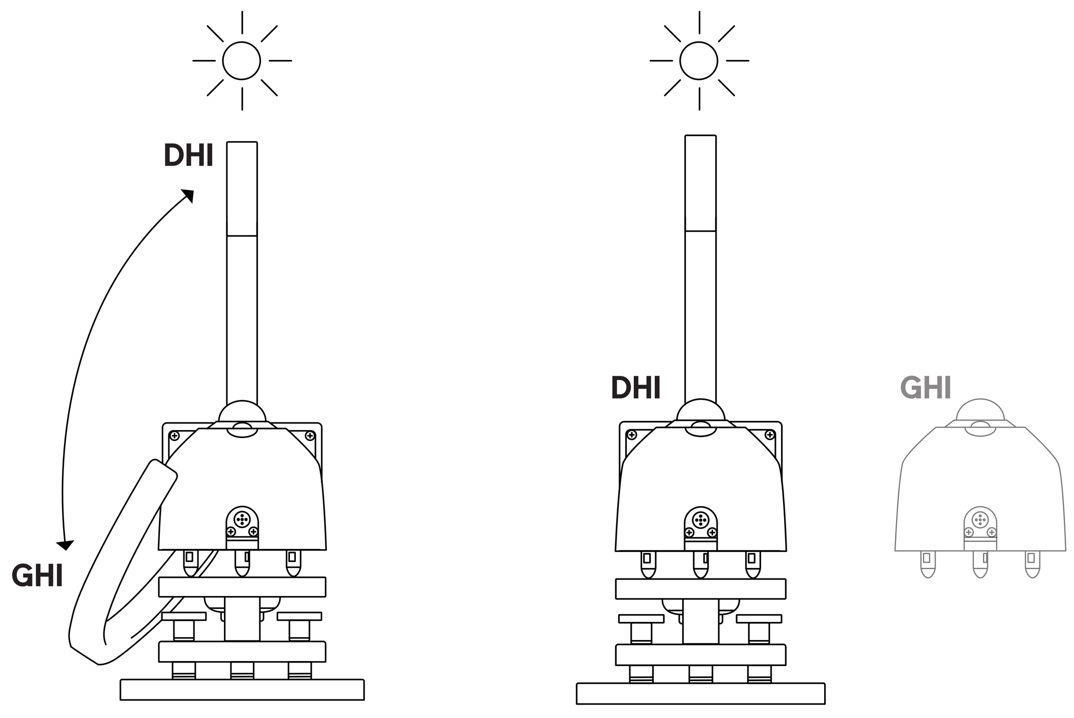
Class A ISO.9060:2018

Class A IEC 61724-1:2021

ISO 9847:2023

2 MS-80SH Plus+ Solar station

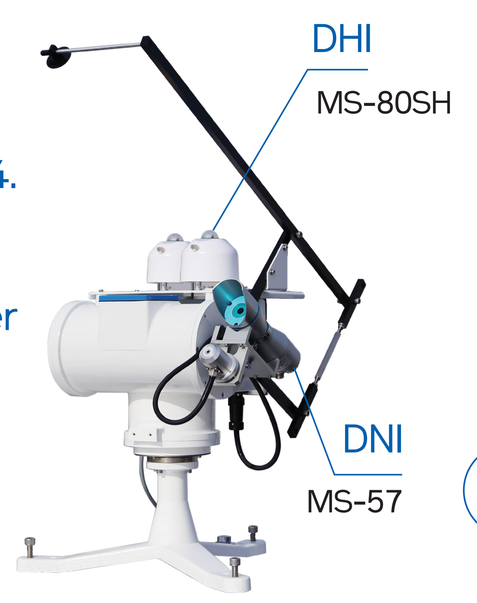
We developed a Rotating Shadow Band (RSB) for the EKO MS-80SH ISO 9060:2018 Class A pyranometer, which features a rapid 0.5s response time and flat spectral sensitivity. It enables precise irradiance measurements in fluctuating conditions and integrates well with the RSB concept.



In RSB mode, the shadow band alternates between shading and unshading the pyranometer, allowing the measurement of both DHI and GHI, while calculating DNI with a single instrument. In this work, we introduce and evaluate a new operational mode called the Tracking Shadow Band (TSB) mode, where the instrument continuously measures diffuse irradiance. When combined with an additional pyranometer to measure GHI, DNI can also be determined.

3 Measurement & Data Processing

We evaluated the solution at the EKO AMI Solar Park in Japan, where two MS-80SH Plus+ irradiance monitoring stations collected data from January to August 2024. Data produced from these stations were compared to high-precision sun-tracker based measurements, using a pyrheliometer for DNI and a shaded pyranometer for DHI, which have a typical measurement uncertainty of 2% to 3% (k = 2).



System	Parameters	Interval Sampling /Averaging
STR Sun-tracker	GHI / DHI / DNI	1 sec / 1 min
MS-80SH Plus+ in RSB mode	GHI / DHI / DNI	15 sec / 1 min
MS-80SH Plus+ in TSB mode with extra MS-80SH	GHI / DHI / DNI	1 sec / 1 min

The Sun-tracker based reference data quality is assessed using K-tests and BSRN Quality check procedures. The clear Sky conditions are detected using Reno, M.J. and C.W. Hansen (2016) methodology.

4 Results

Sun-Tracker based reference data

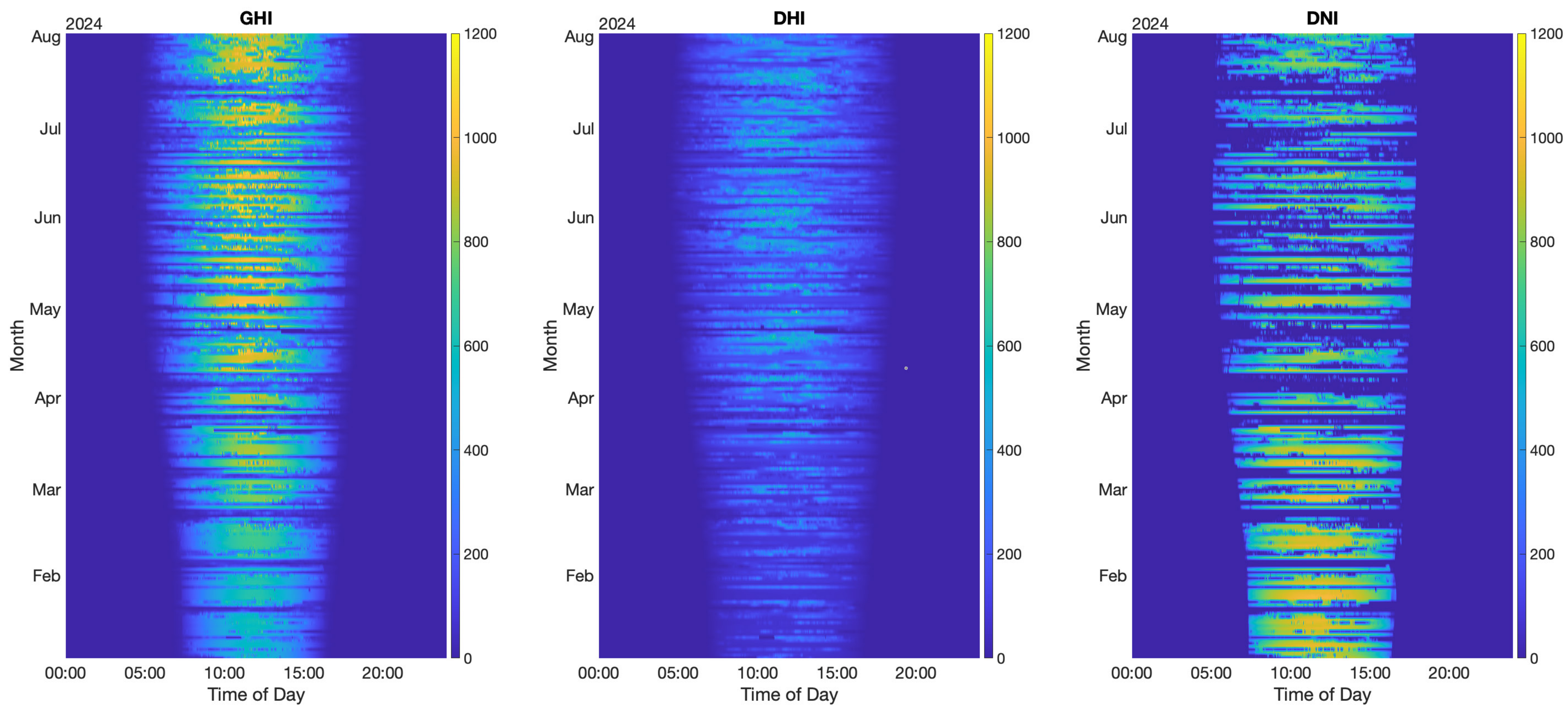


Figure 1. Reference suntracker based GHI, DHI and DNI measurements, collected from January to August 2024

System Comparison Results: Rotating Shadow Band mode

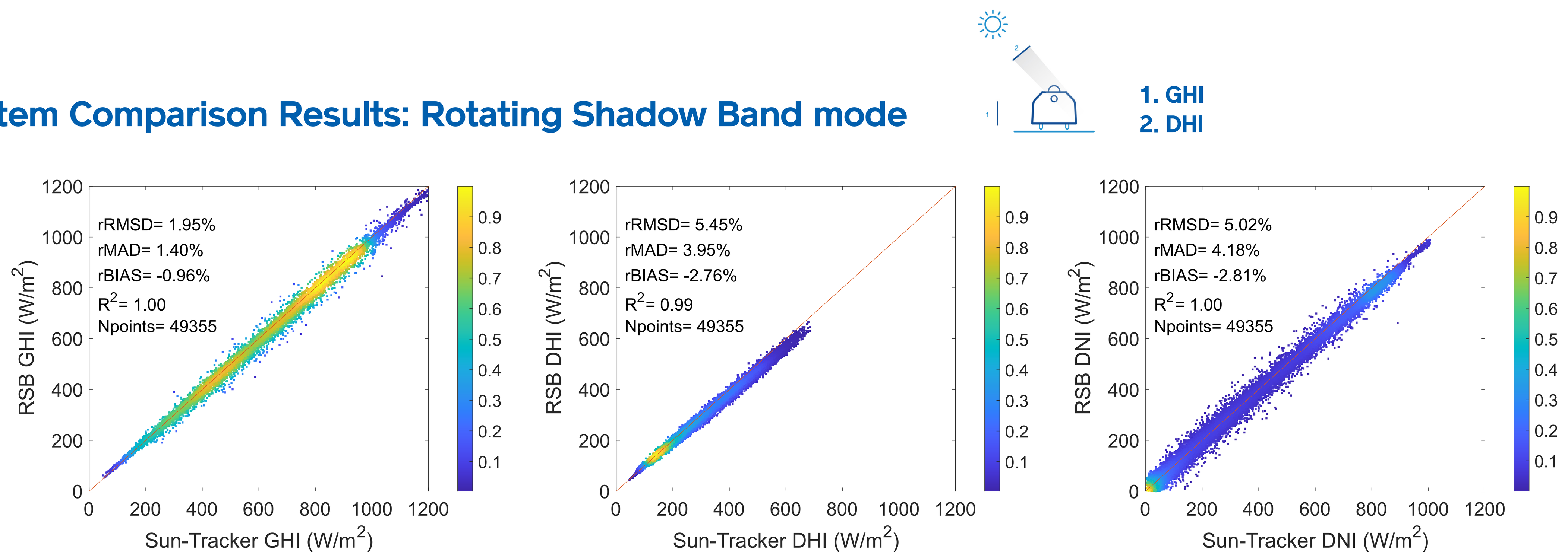


Figure 2. All Weather comparison, RSB vs. Suntracker based GHI, DHI and DNI measurements.

System Comparison Results: Tracking Shadow Band mode

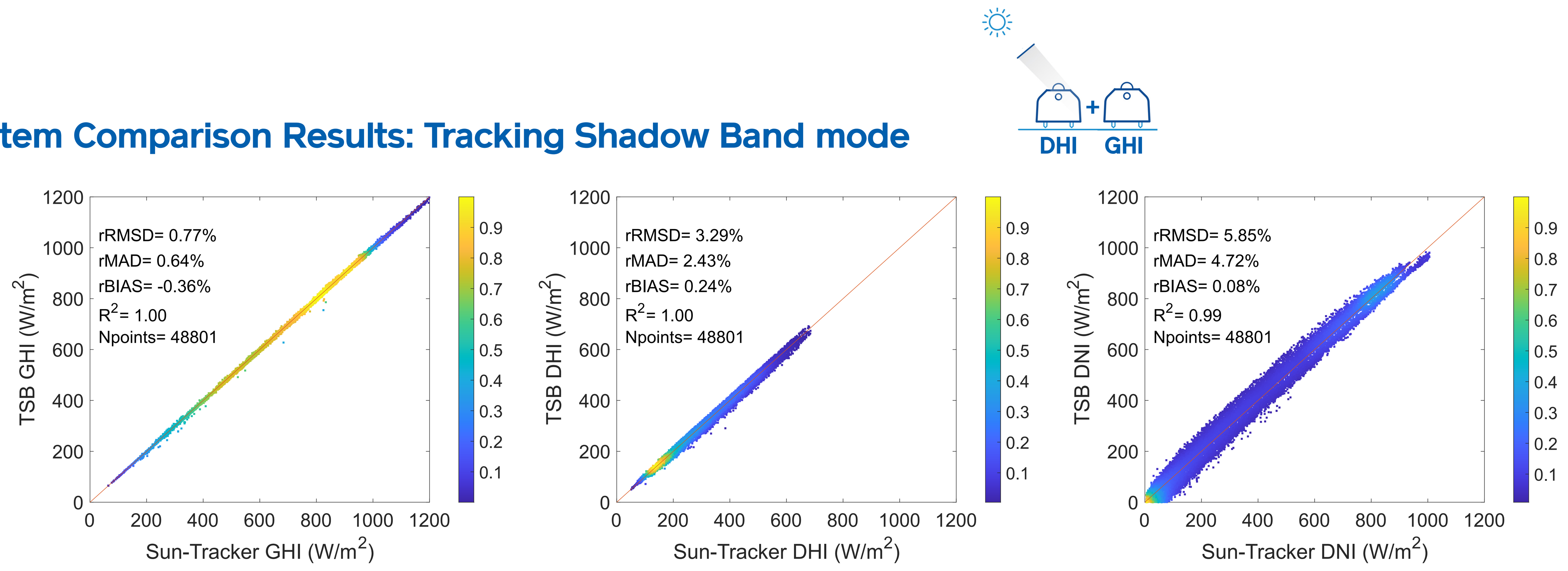


Figure 3. All Weather comparison, TSB vs. Suntracker based GHI, DHI and DNI measurements.

5 Conclusions

The MS-80SH Plus+ monitoring station delivers precise measurements that closely match the tracker-based reference data.

The most accurate DHI results are obtained using the TSB mode, though the RSB mode also maintains reliable data quality.

Both methods show improvement and provide similarly accurate data under clear sky conditions.

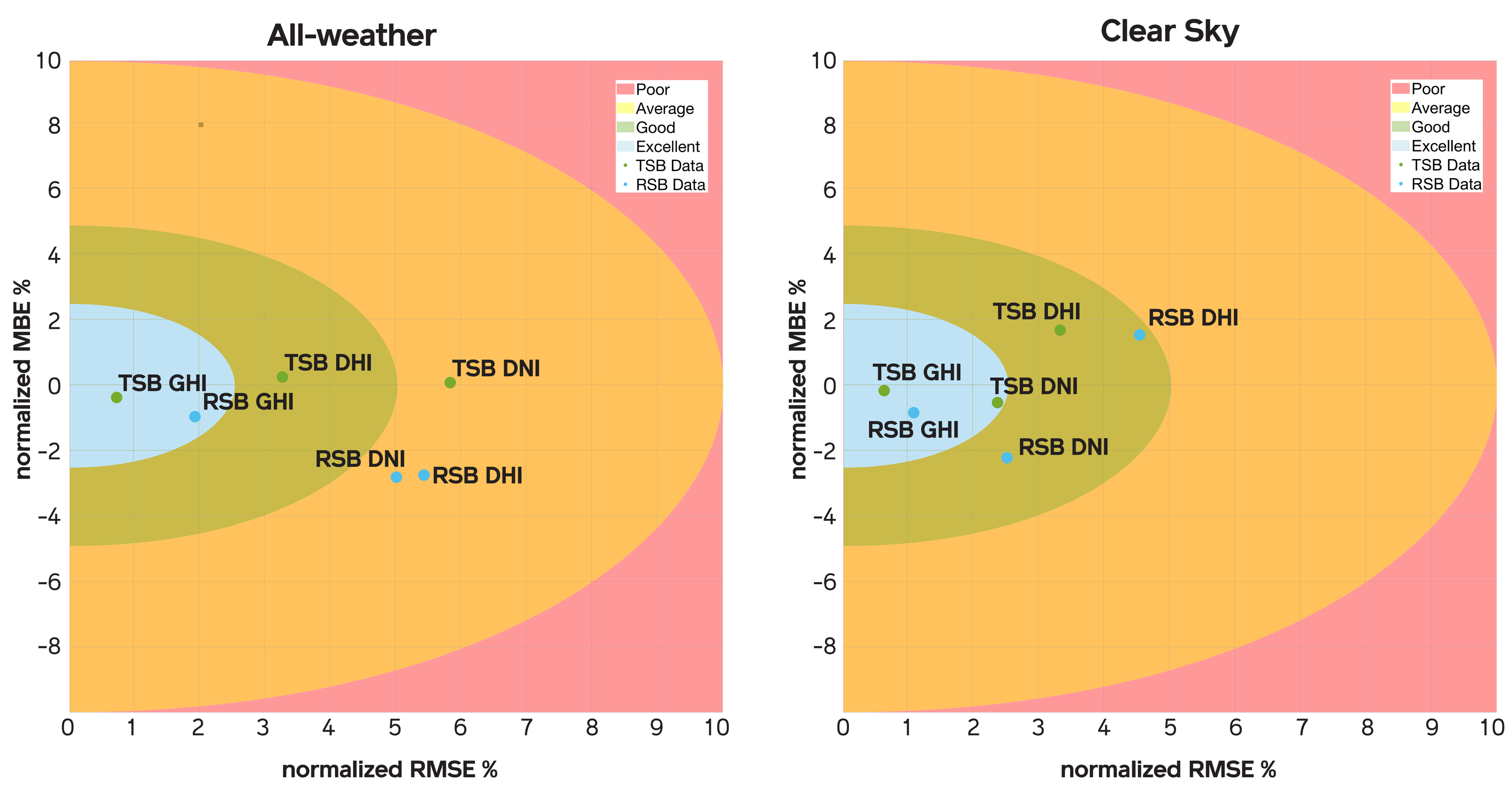


Figure 4. RSB and TSB Measurement accuracy under All-Weather and Clear Sky conditions

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