Nonuniform rear-irradiance on bifacial PV systems can cause additional mismatch loss, which may not be appropriately captured in PV energy production estimates and software.

Reduced Order Model

A simplified empirical relationship was found that links the spatial variation of irradiance (to the resulting mismatch loss factor)

\[ L_{DC} = M = 1 - \frac{P_1}{P_0} \]

Slight climate dependence is visible for the high-albedo rooftop simulations. For HSAT simulations, the effect of climate was similarly modest but reversed from what was is shown in the high-albedo rooftop simulations, possibly due to the greater influence of diffuse irradiance in a low-albedo tracking scenario.

Experimental Validation

A 4800 long-pulse flash I-V curve simulator was used, along with two Siemens SM55 36-cell monocrystalline modules (mono-facial, FF = 0.7) to investigate the effect of irradiance mismatch using filters to achieve artificial shading.

Application to Performance Models

Mismatch loss factors for bifacial or monofacial simulations are considered by a single annual DC loss factor \( X \), applied after array power is calculated. This value is often ~10x higher than system-level mismatch numbers shown here.

Emission of PV modules with reduced FF are susceptible to reduced mismatch loss. This is expected due to the smaller slope \( dP/dI \) in low-FF modules.

For the two tracking scenarios, results do not fall directly in line with the curves established for fixed-tilt simulations.

Similar curve form, but different empirical-fit parameters. Agreement is much better at \( \Delta < 4 \), where bulk of the agreements is at. Future steps: explore edge effects on additional mismatch losses. (i.e. 6% annually for HSAT case at 0.75 H.)