

# Creation and Use of Synthetic High-Frequency Solar Simulations for Distribution System QSTS Simulations

# Creation and Use of Synthetic High-Frequency Solar Simulations for Distribution System QSTS Simulations

Matthew Lave, Matthew J. Reno, Robert J. Broderick,

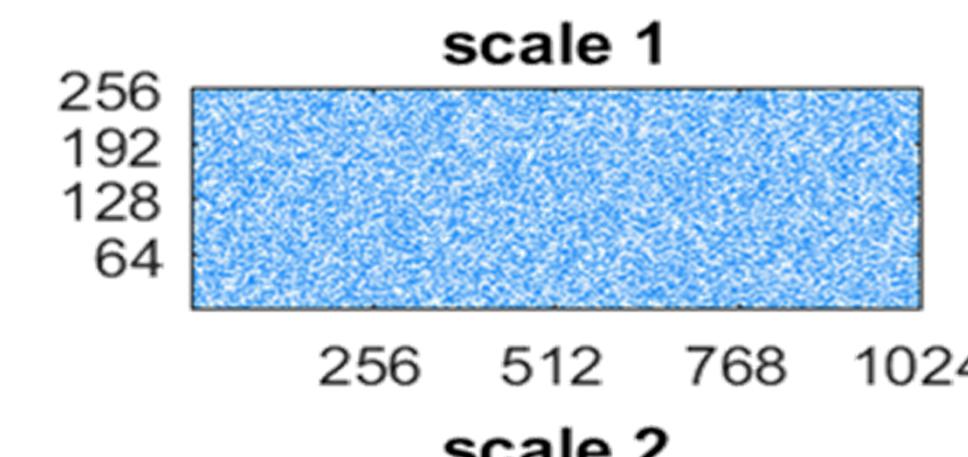
Sandia National Laboratories, Livermore, CA and Albuquerque, NM, 94550 and 87185, USA

## Introduction

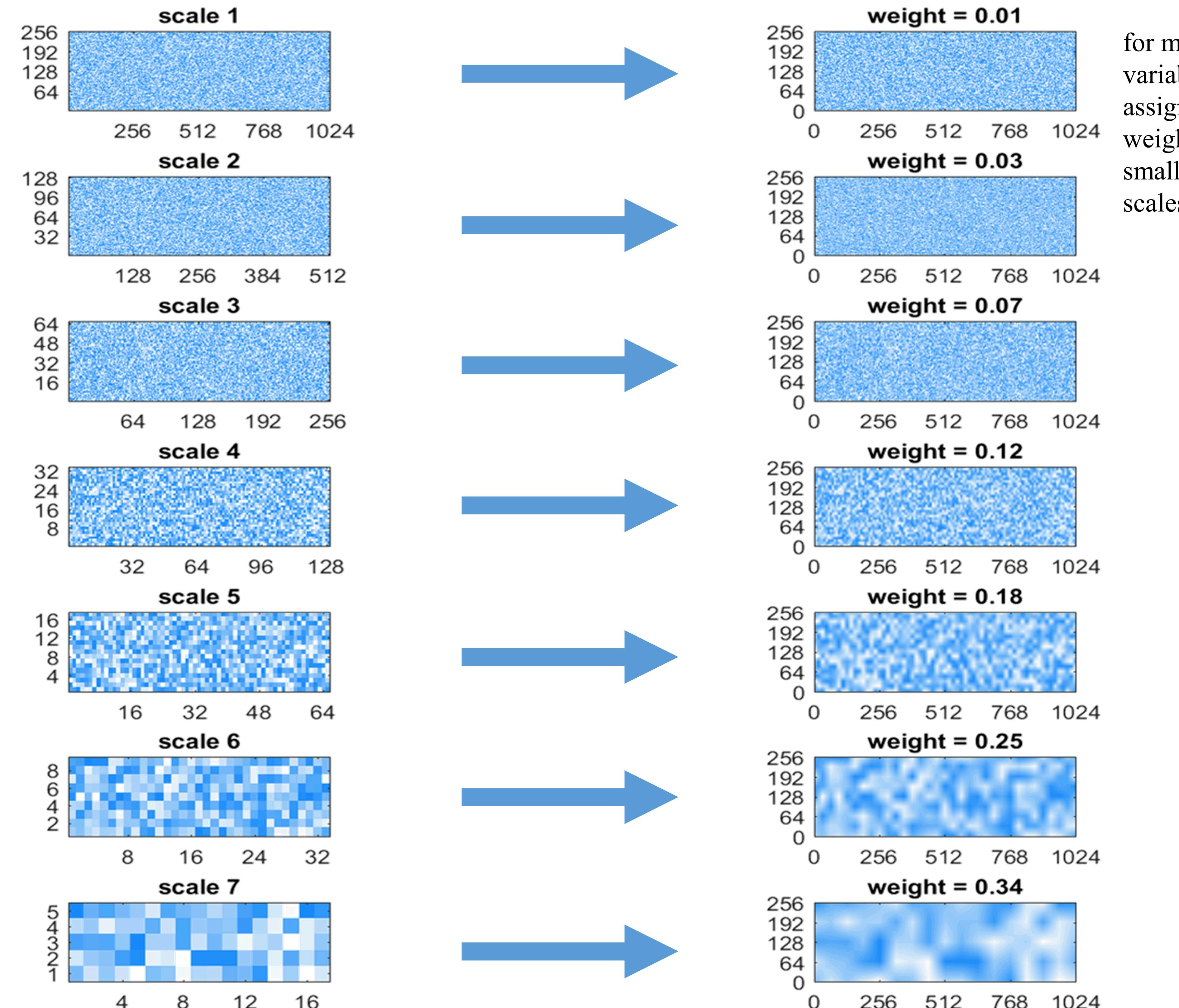
High-frequency solar variability with unique inputs for different interconnection points on distribution feeders are important inputs to accurate quasi-static time series (QSTS) distribution grid integration studies: low-frequency solar variability results in underestimation of the impact of PV, while using a single PV profile for all interconnection points results in an overestimation of the PV impact since it ignores spatial smoothing.

## Synthetic Cloud Fields Methods

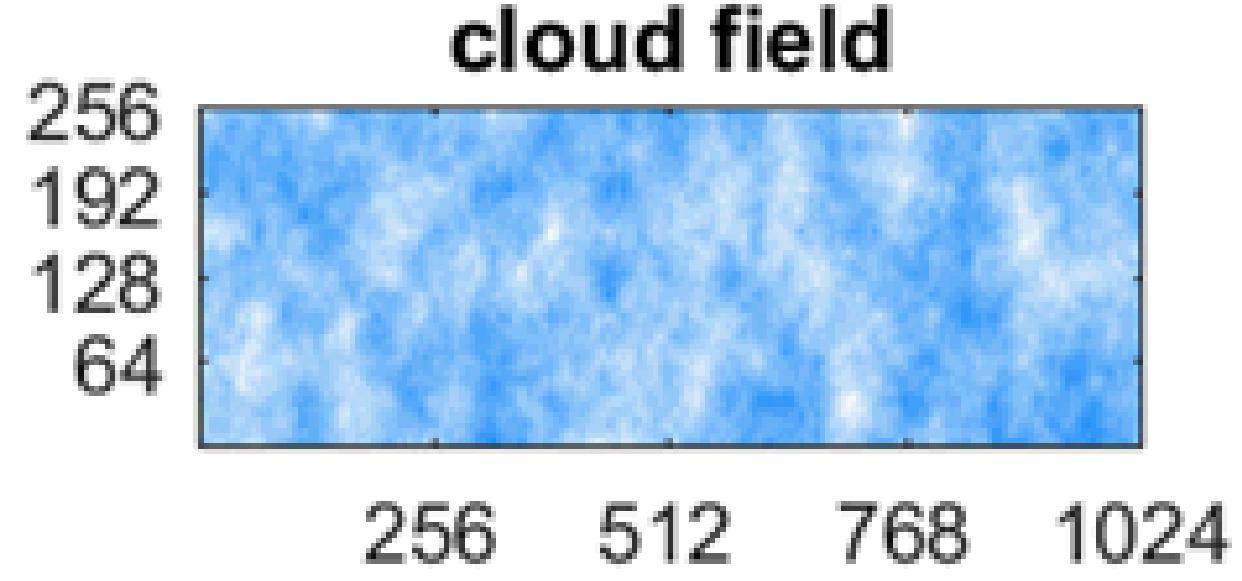
1 Fields of random values (0 to 1) at various spatial scales



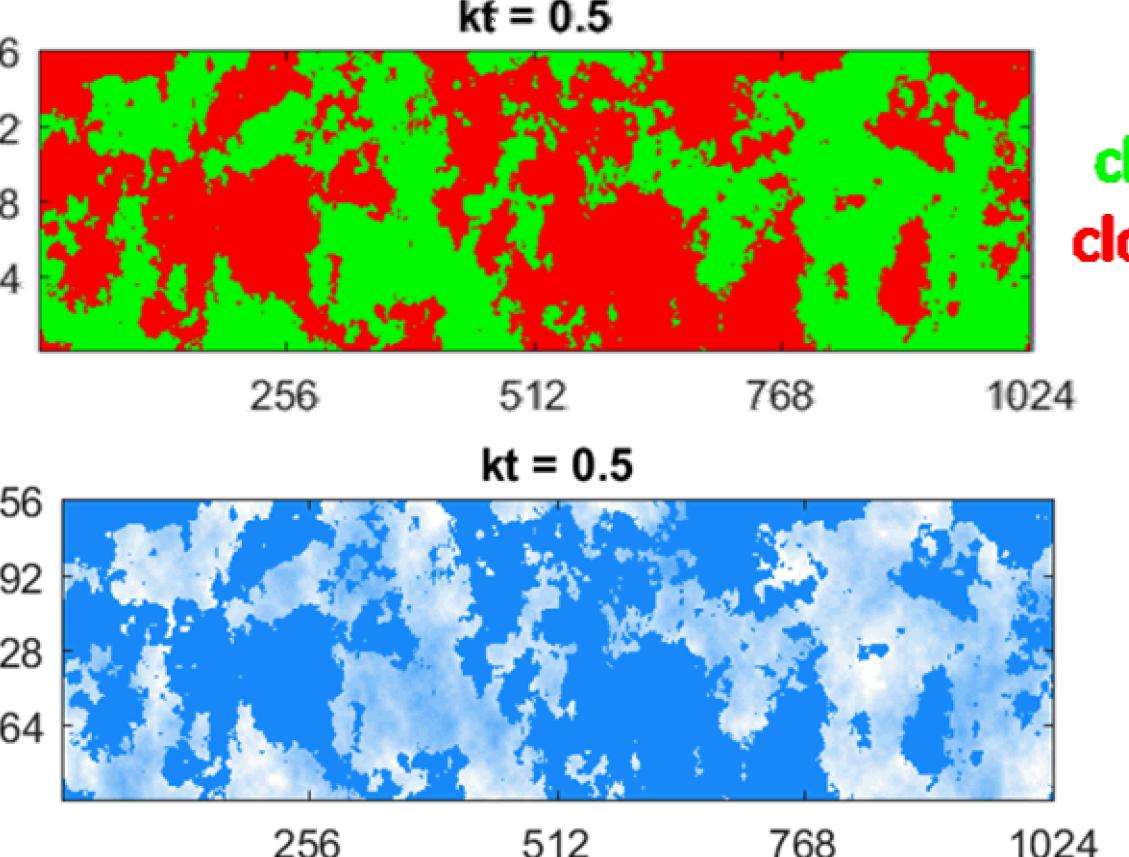
2 Interpolate fields to the same spatial scale, assign a weight to each scale



3 Compute the weighted sum of all interpolated fields

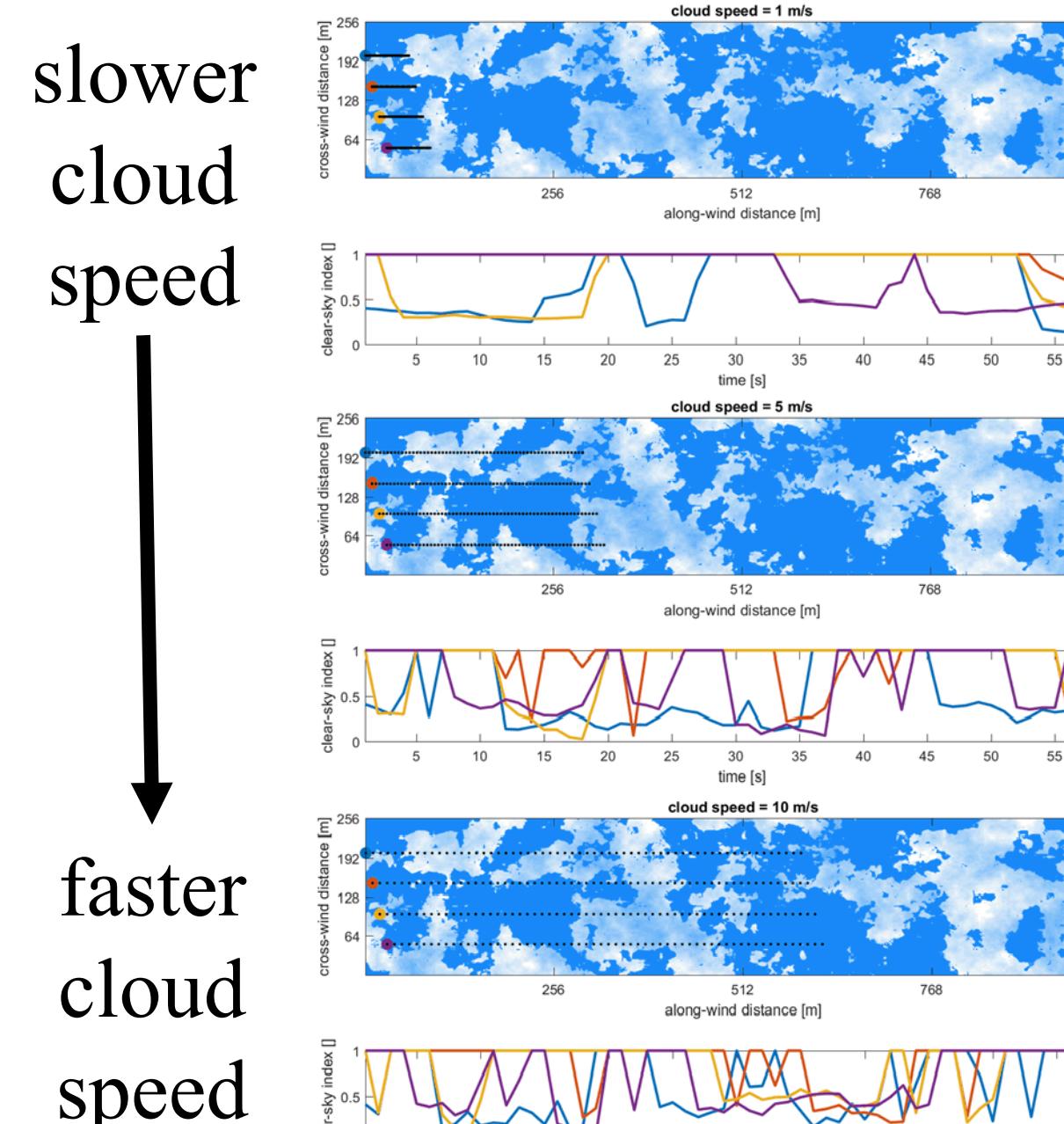
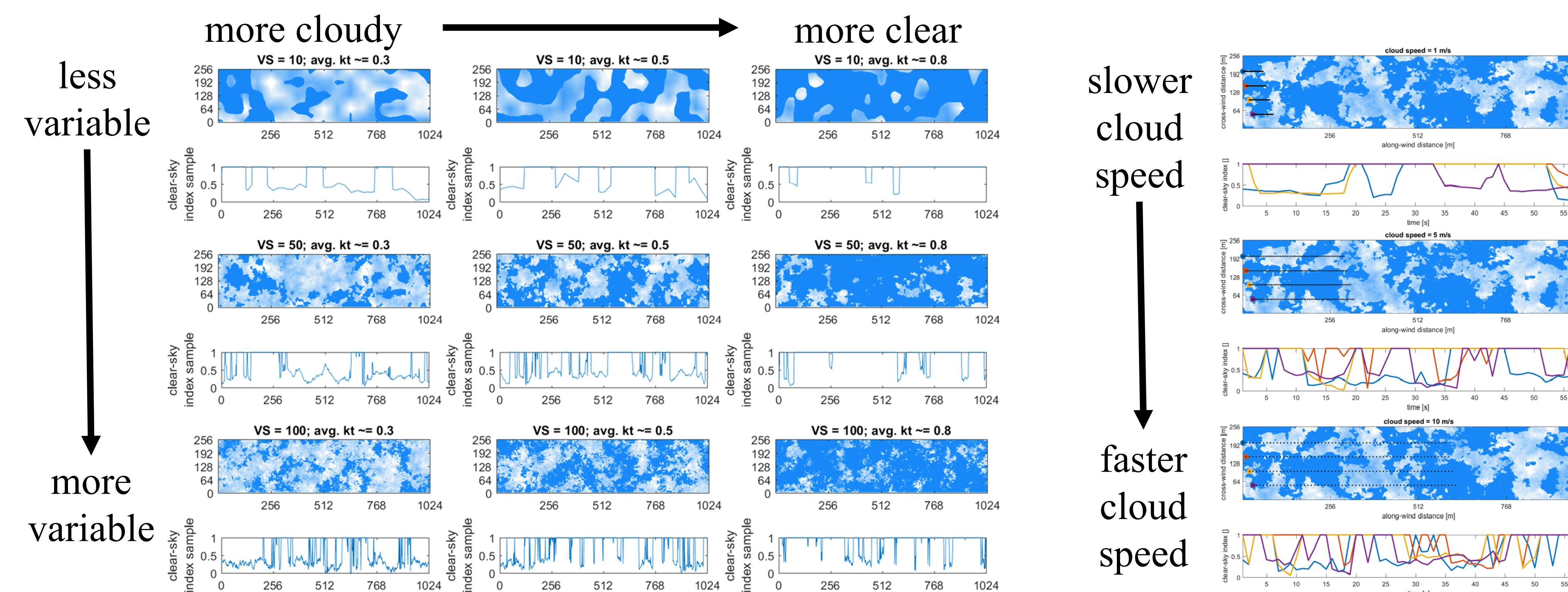


4 Apply a cloud mask based on the fraction of clear-sky pixels



## Examples of Synthetic Cloud Fields Resulting Timeseries

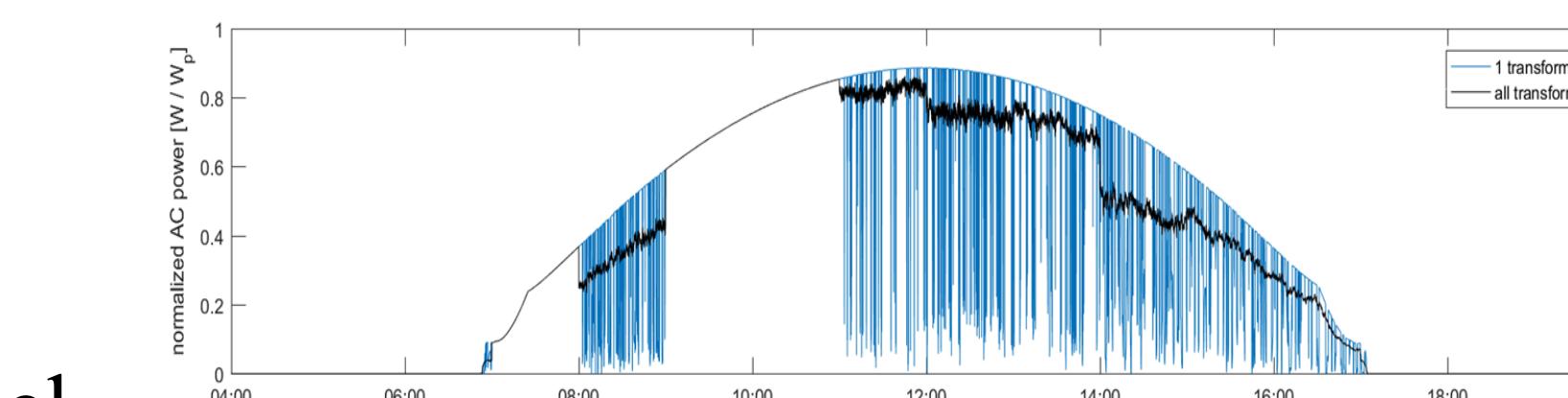
Cloud fields vary by variability (VS), amount of cloud cover (kt), and cloud speed.



To create simulated PV power output at each interconnection point,

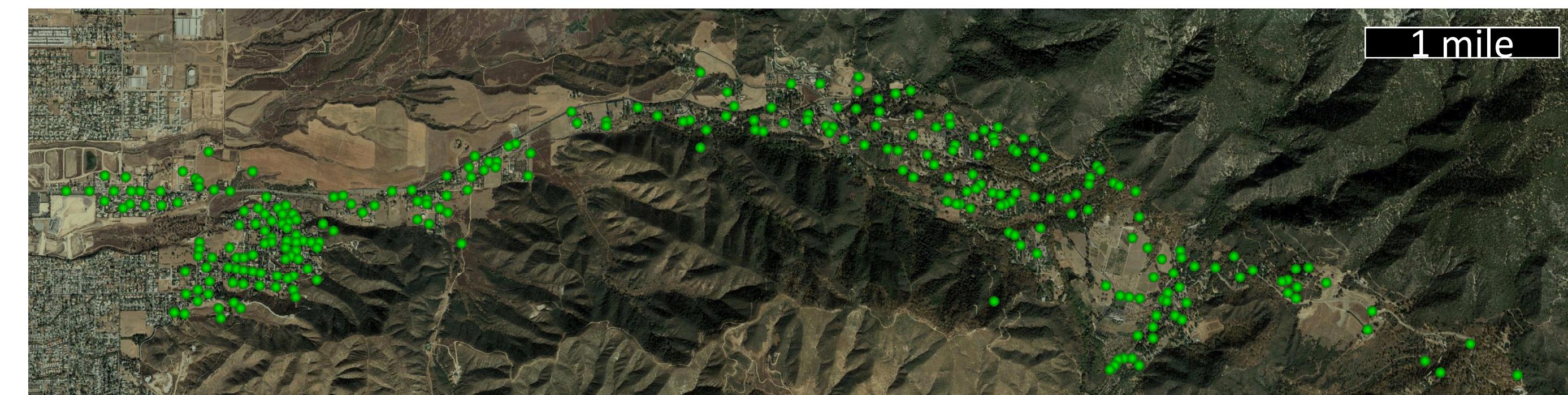
1. Sample from a cloud field; sample timeseries is analogous to clear-sky index values.
2. Convert to GHI by multiplying by a clear-sky model.
3. Convert to power output: GHI to POA and use irradiance to power model.

## Simulated Power

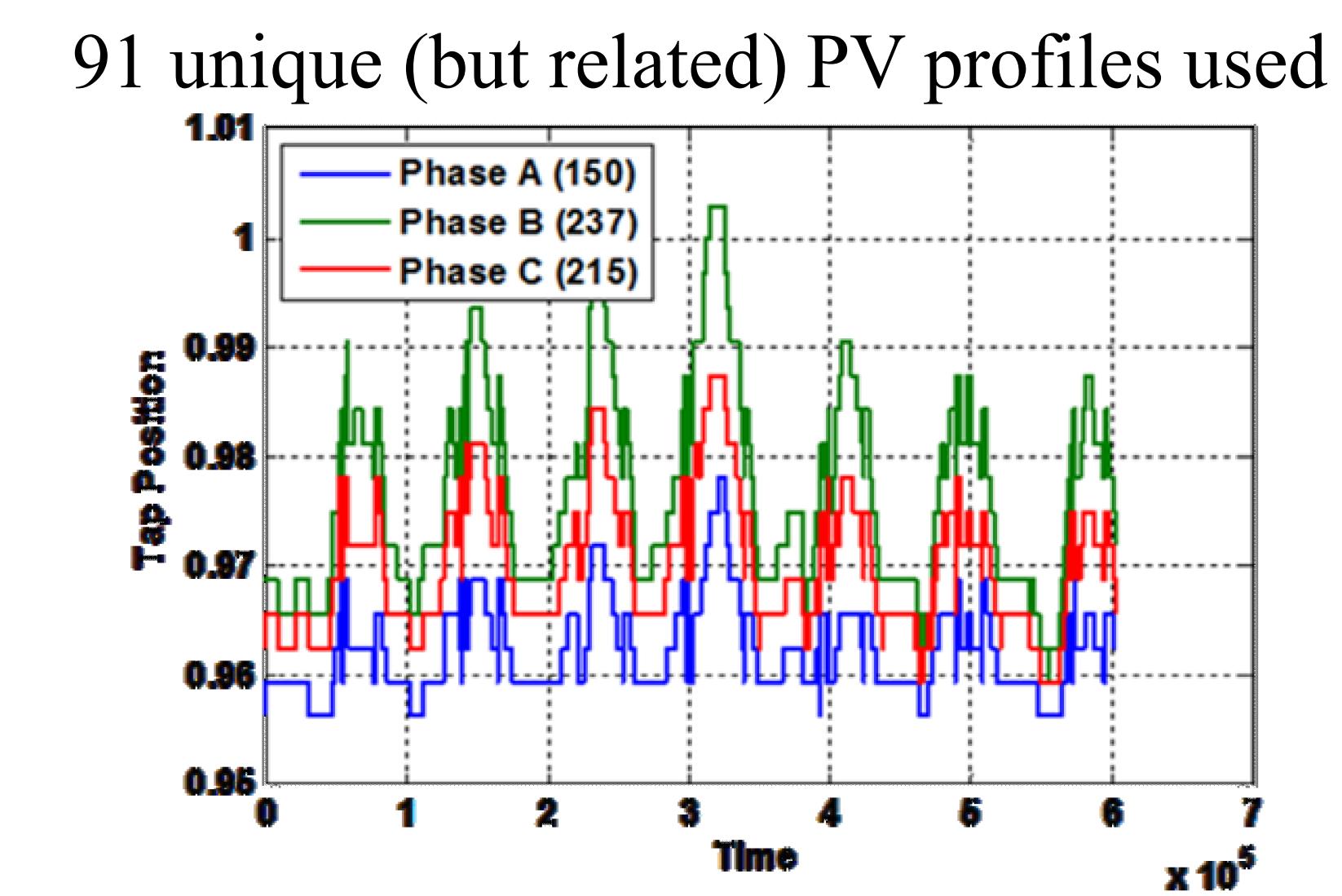
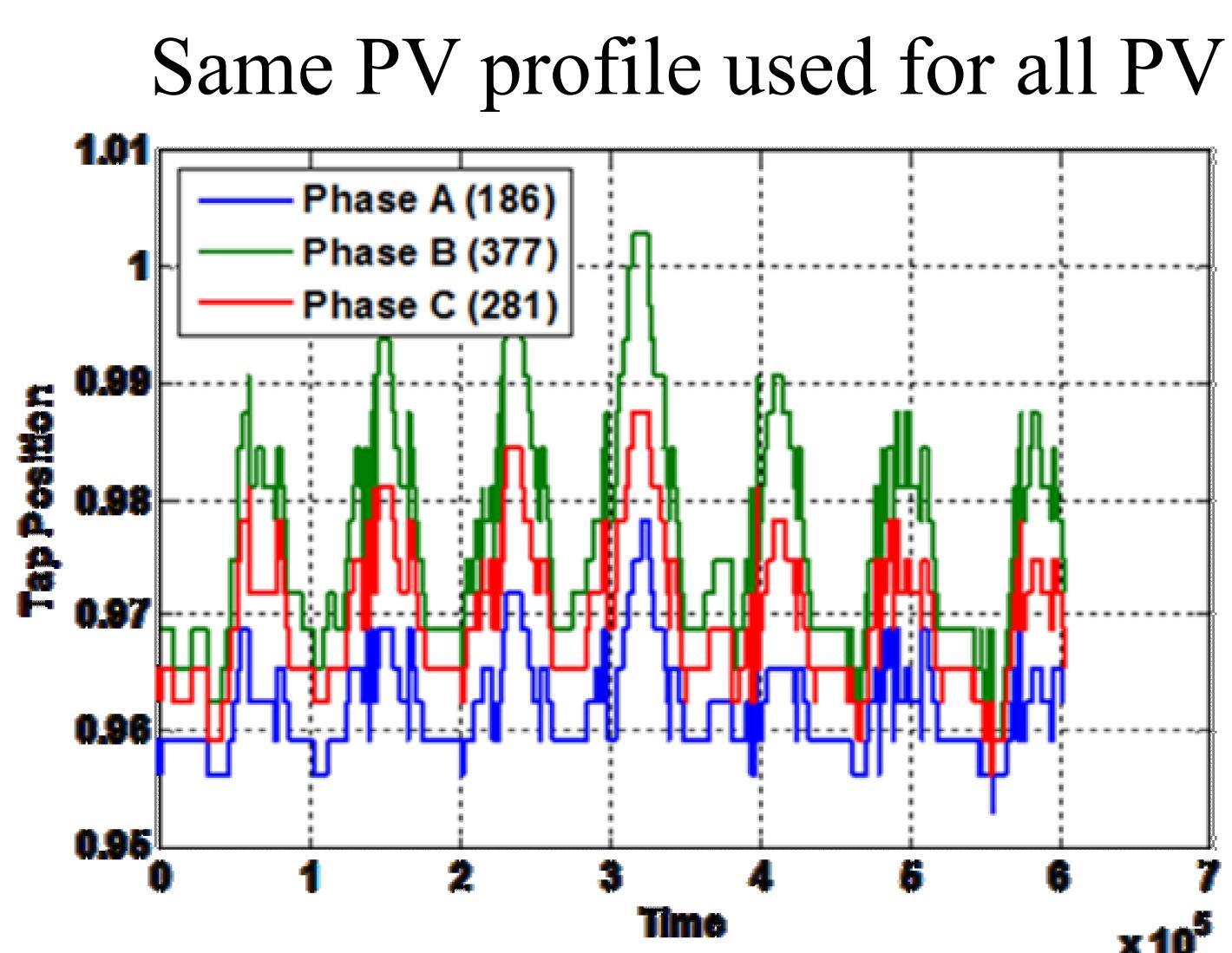


## Importance of Unique PV Inputs at Each Interconnection

Sample feeder with 265 PV interconnections.



Used QSTS analysis to simulated the voltage regulator tap change operations:



Up to 60% more tap change operations when using same PV profile.

## Outlook

- Cloud fields can be used to generate synthetic PV power output timeseries.
- Additional tweaks to the cloud field methodology are needed to make the sampled timeseries better match measured irradiance data.
- Further demonstration of the value and accuracy of synthetic cloud-field generated PV power samples to QSTS simulations is forthcoming.