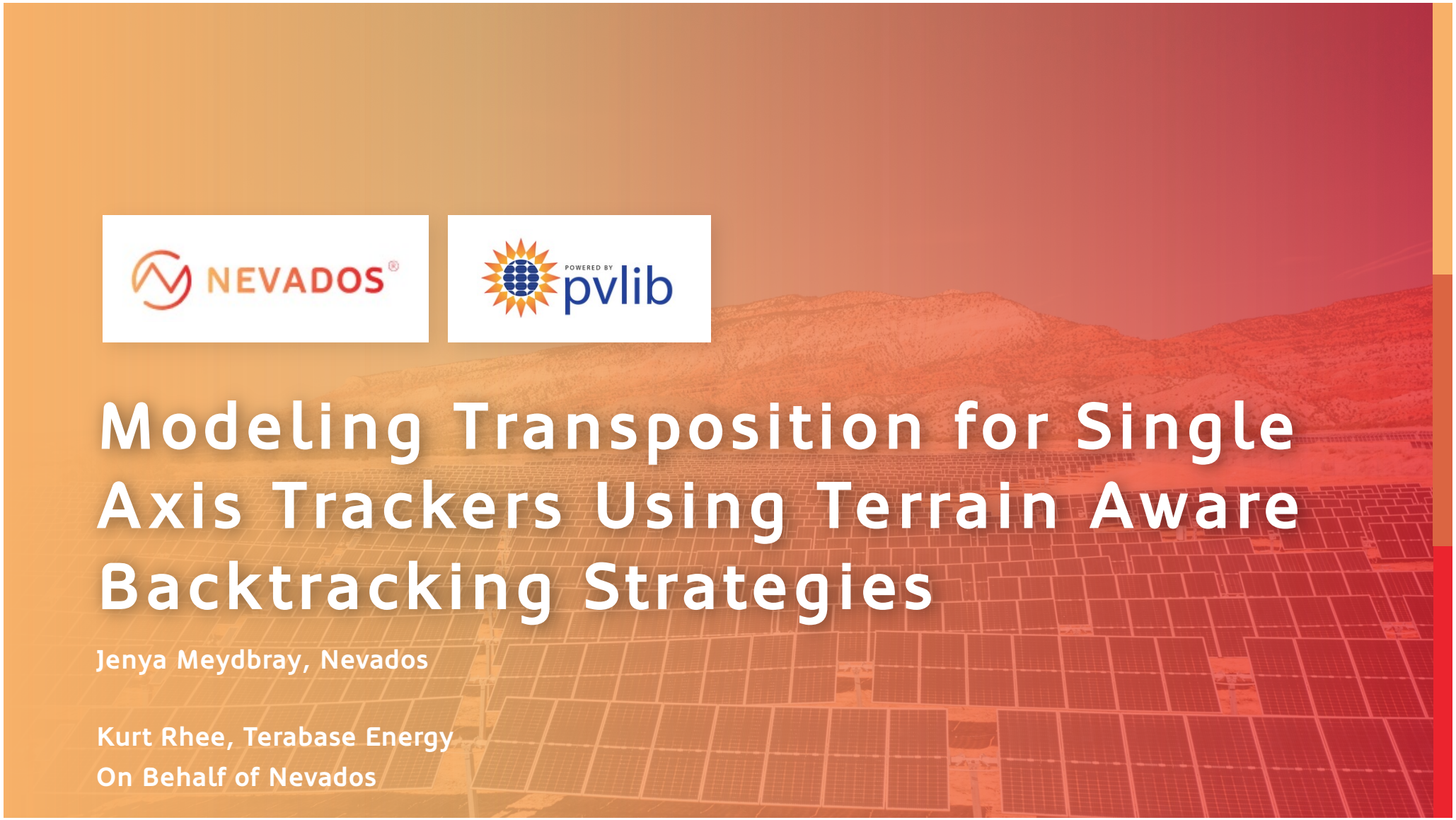
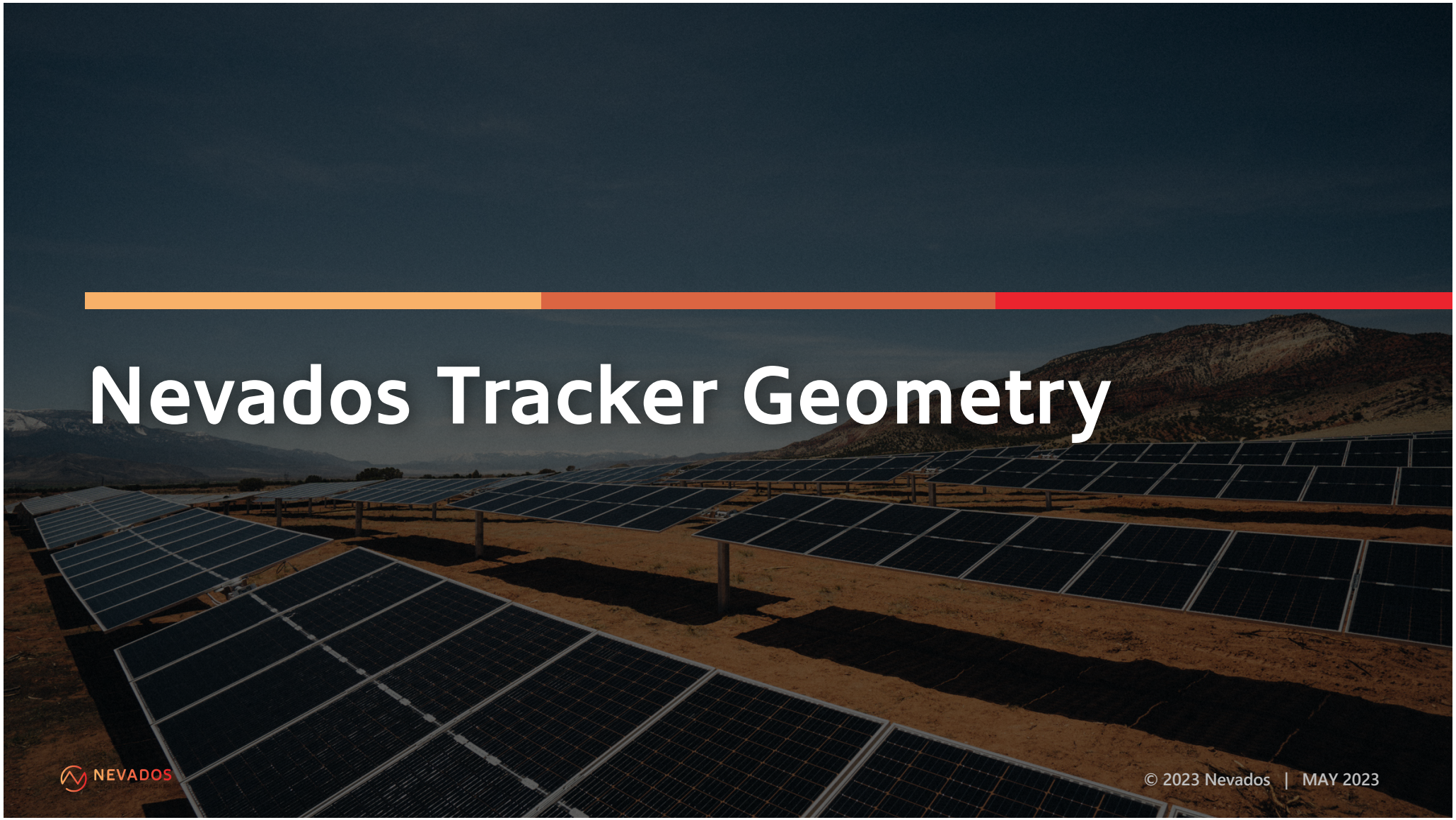


Modeling Transposition for Single Axis Trackers Using Terrain Aware Backtracking Strategies

Jenya Meydbray, Nevados

Kurt Rhee, Terabase Energy
On Behalf of Nevados


Nevados Tracker Geometry
NEVADOS
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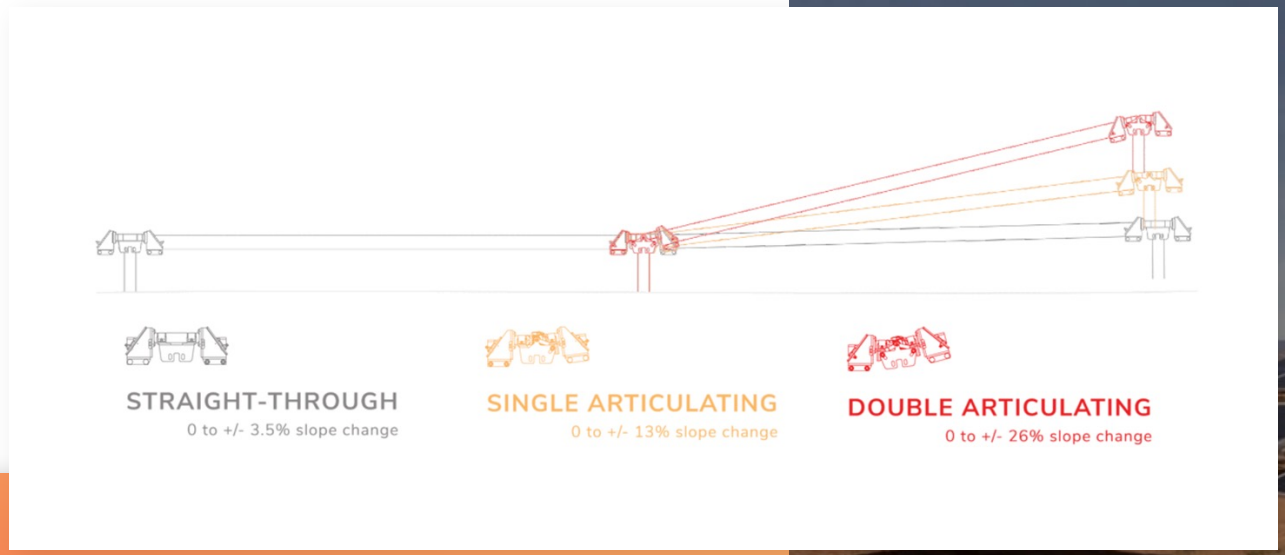
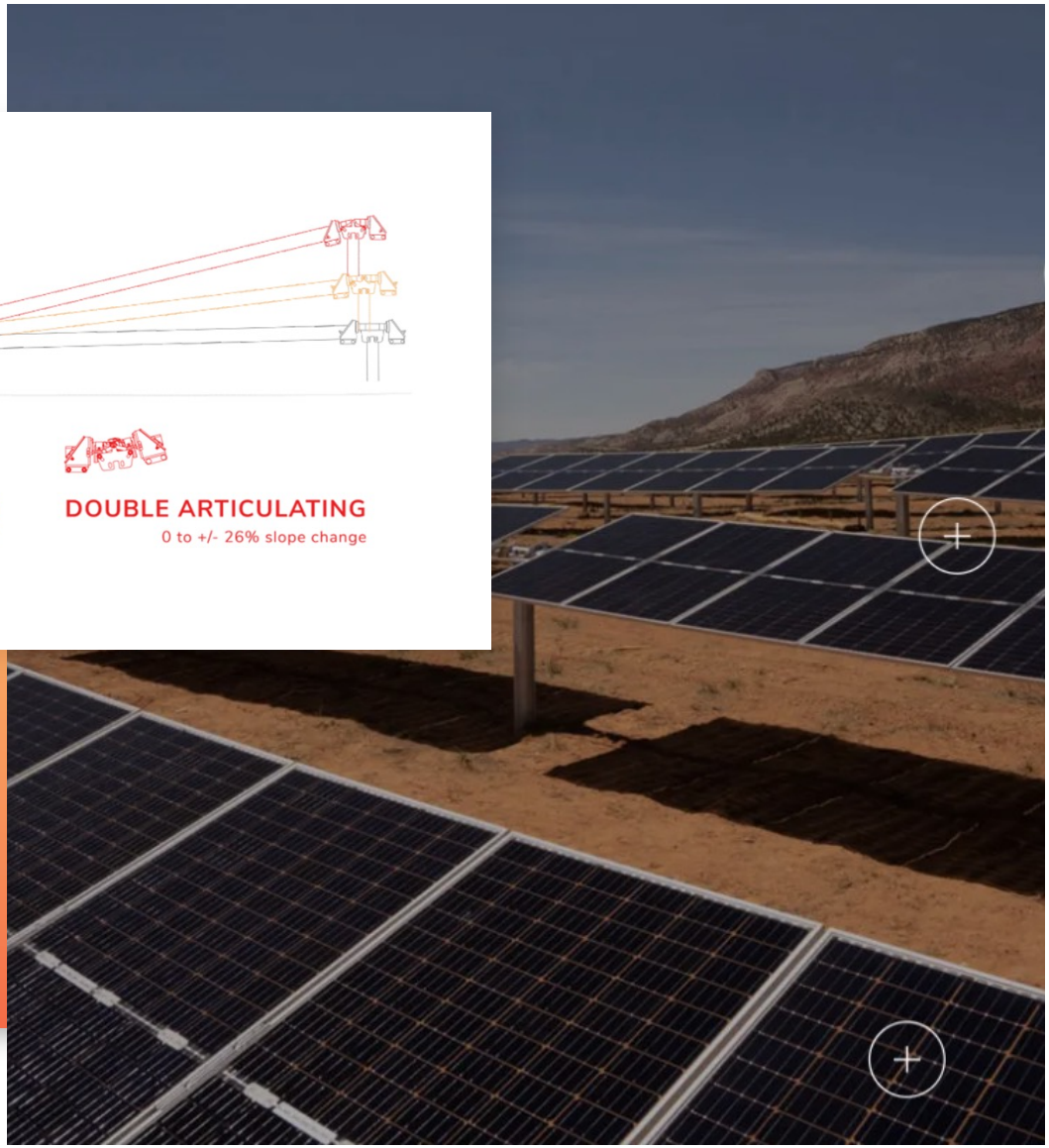


ANATOMY OF A TERRAIN FOLLOWING HORIZONTAL SINGLE AXIS TRACKER



NEVADOS
ALL TERRAIN TRACKER

T.R.A.C.E

Tracker Rotation Angle Computation Engine

NEVADOS

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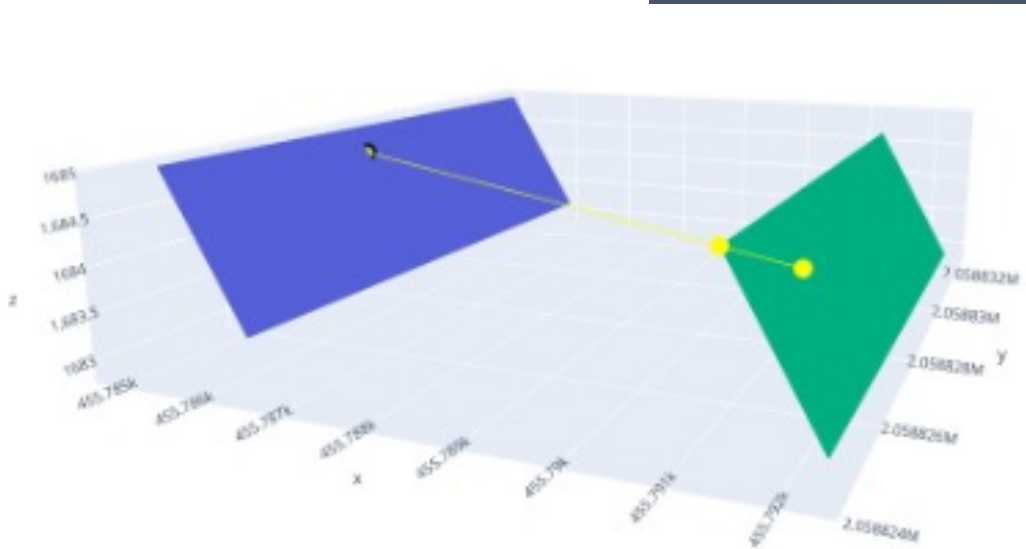


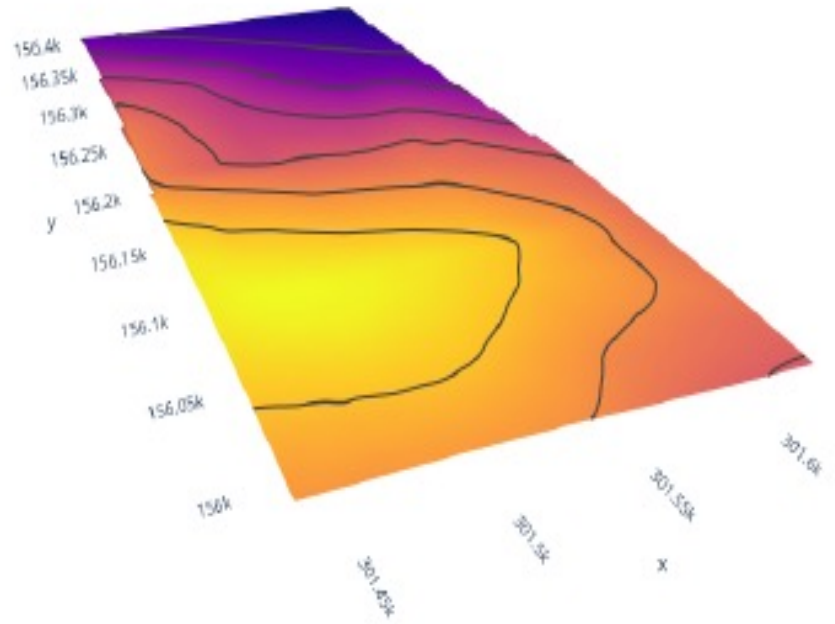
TRACKER ROTATION ANGLE CALCULATION ENGINE

NEVADOS
ALL TERRAIN TRACKER

Site Terrain Characterization

NEVADOS

Example Site Terrain



North facing site

NE location


Modeling in PVLIB
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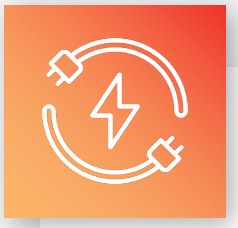
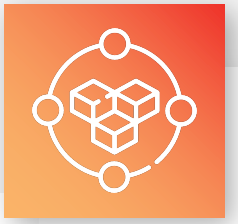
What was not studied?

Effects of electrical mismatch

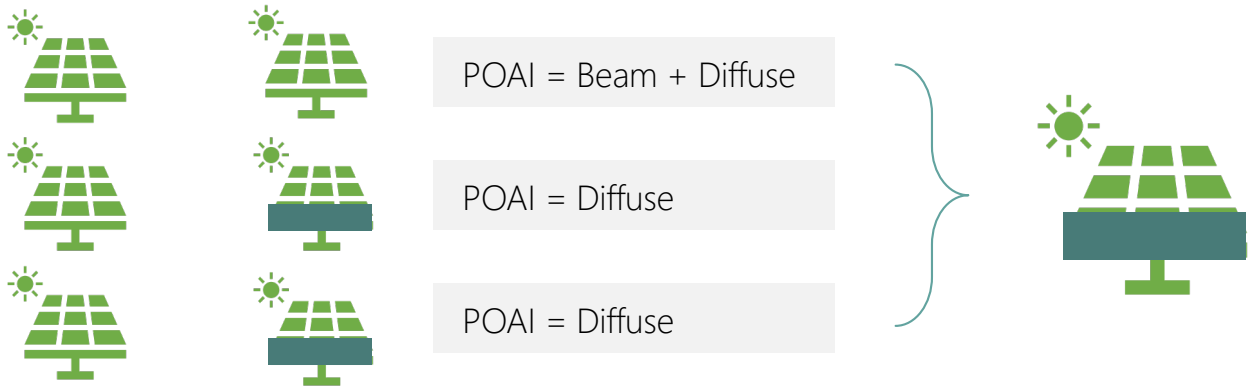


Effects of self-shading



Hay Transposition Model (This study focuses entirely on Perez)

Experiment 1: Terrain Naïve Strategy (2D algorithm)



01

Using GCR Based Backtracking Calculate POAI for every surface

02

Calculate shade on every surface

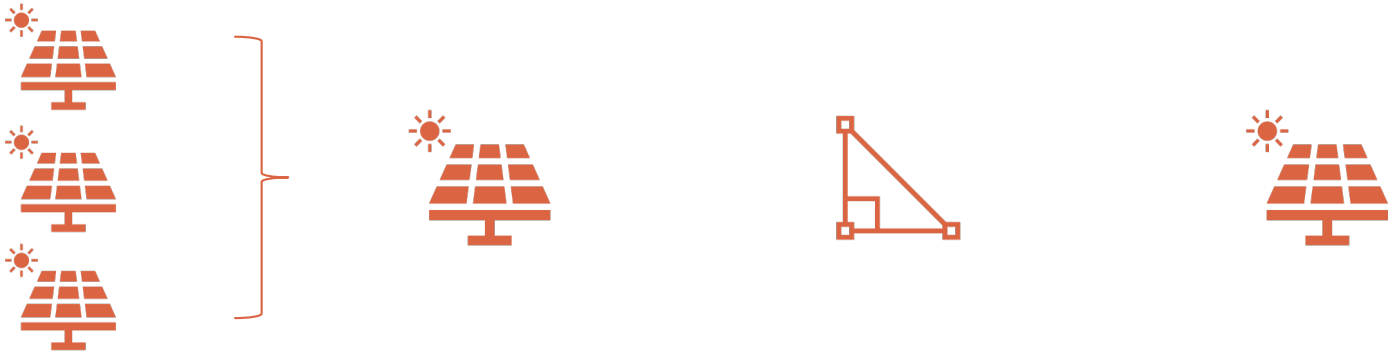
03

If shaded, set beam portion of irradiance on that surface to zero

04

Calculate the weighted average effective POAI

Experiment 2: Terrain Aware Strategy



Using Terrain Aware Backtracking Calculate POAI at every surface (bay)

01

Create an average POAI of all surfaces

02

No shade on module surface, but less favorable incidence angle

03

Calculate the average effective POAI

04

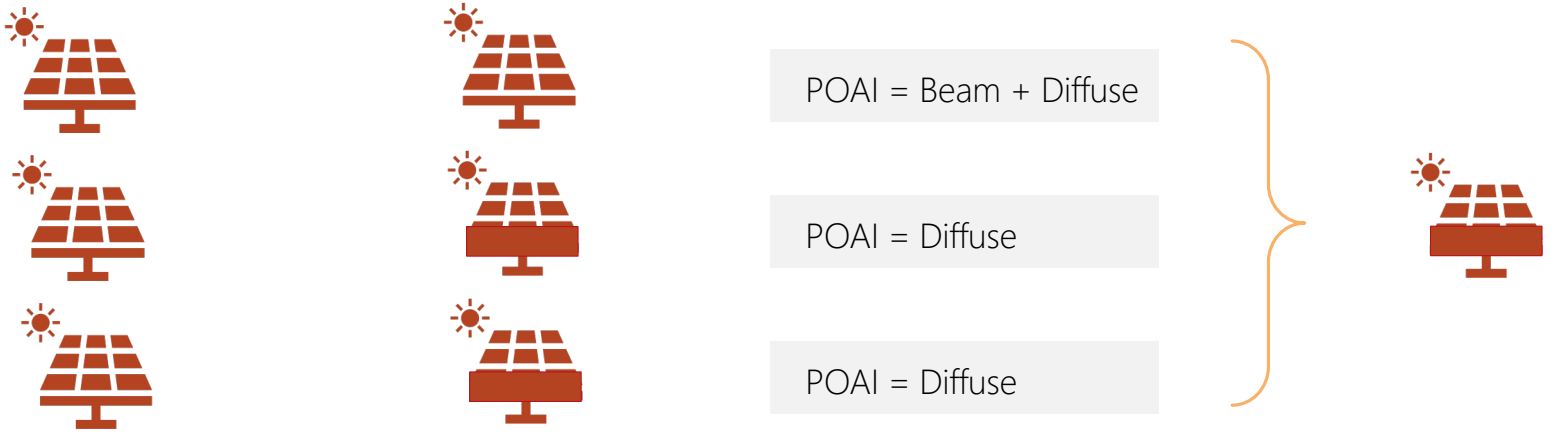
Compare Results: example site IL

	Transposition Gain (%)	Effective Insolation (kWh/m^2)
GCR Based Backtracking	25.0	2000
Nevados Backtracking	29.3	2068

Compare Results

	Transposition Gain (%)	Effective Insolation (kWh/m^2)
 GCR Based Backtracking	25.0	2000
 GCR Based Backtracking w/New GCR Setpoint	?	?
 Nevados Backtracking	29.3	2068

Experiment 1: Terrain Naïve Strategy



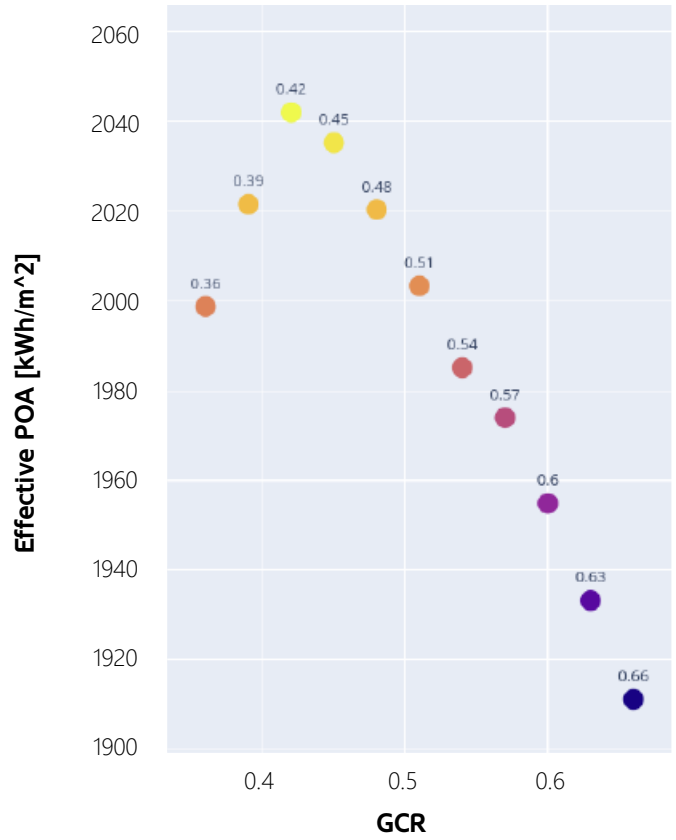
Using GCR Based Backtracking, Change the Tracking Setpoint without changing the physical geometry Calculate POAI for every surface

Calculate shade on every surface

If shaded, set beam portion of irradiance on that surface to zero

Calculate the average effective POAI

GCR BASED BACKTRACKING WITH MANY DIFFERENT GCR SETPOINT (WEIGHTED AVERAGE)



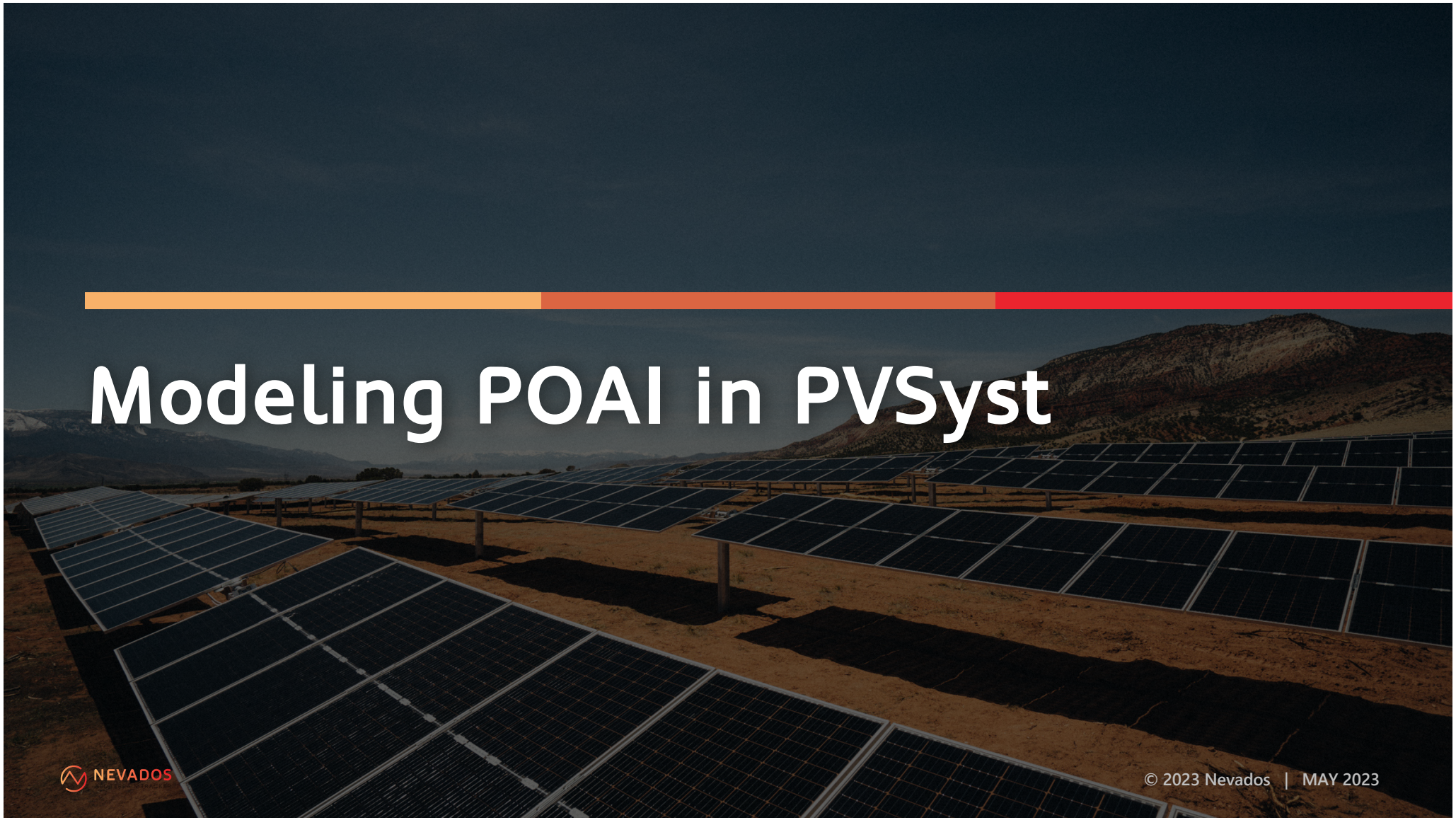
Compare Results

Transposition Gain: POA vs. GHI

	Transposition Gain (%)	Effective Insolation (kWh/m^2)
 GCR Based Backtracking	25.0	2000
 GCR Based Backtracking w/New Setpoint	27.5	2040
 Nevados Backtracking	29.3	2068

Energy Results

- [100%] Grade the site entirely flat
- [83%] Account for Northerly aspect of the site slope
- [63%] Nevados Backtracking
- [33%] No Grading, GCR based backtracking, Increase the algorithm GCR setpoint
- [0%] No Grading, GCR based backtracking



Modeling POAI in PVSyst

NEVADOS

PVSyst

CONSTRAINTS:

PVSyst will calculate tracker rotation angles for you.

PVSyst will use Hay for the retro-transposition model

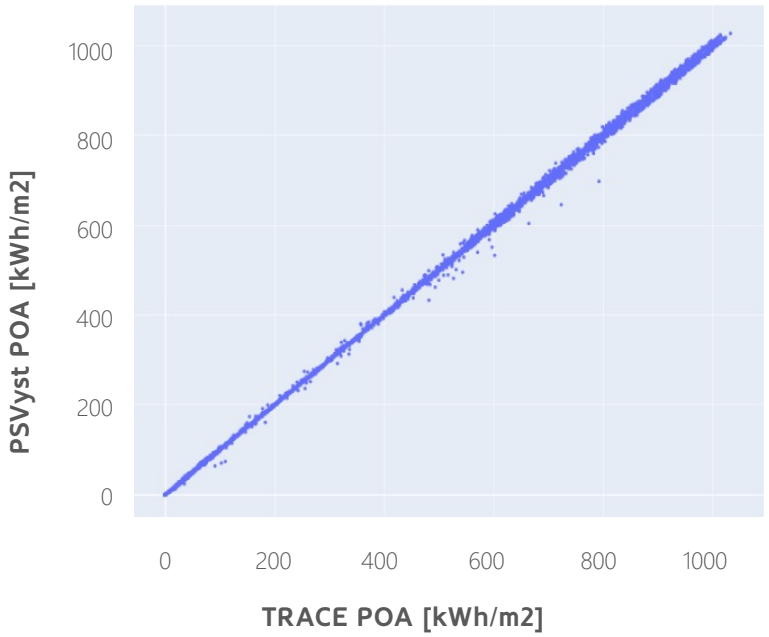
PVSyst

Start with Plant Average POA w/ Terrain Aware Backtracking Calculated in PVLIB

Retro-Transpose into horizontal components using GTI-Dirint in PVLIB, using PVSyst's tracker rotation angles

Create a custom MET file, upload Horizontal Components

PVSyst will now transpose the custom components to the same plane of array irradiance as calculated by PVLIB



Retain Naive tracking


Modeling in PlantPredict
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PlantPredict

CAPABILITIES:

Custom tracker timeseries available

CONSTRAINTS:

Must control an entire DC Field object, not individual trackers (will change in the future)

PlantPredict

Calculate the weighted average tracker rotation angle at every timestep

Upload average tracker rotation angle data, turn off direct shading

PlantPredict will now transpose the custom components to the same plane of array irradiance as calculated by PVLIB

Averaging POAI	Average Rotation Angle, then calculate POAI
2071.87	2068.23
	-0.18%


The End
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