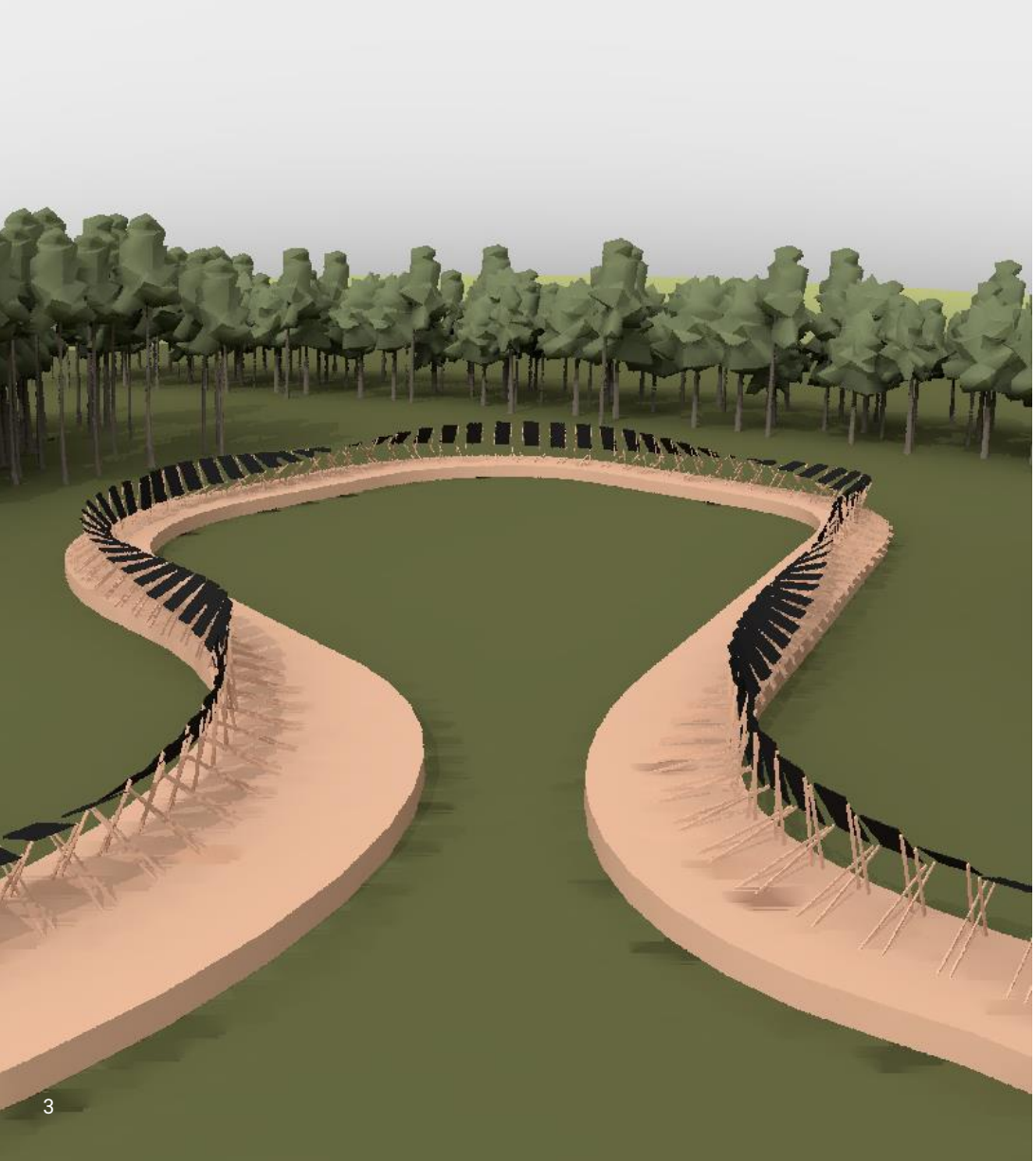
Bifacial radiance simulations

A case study of *Solvåg*

Solvåg

- Bifacial
- 65°N
- Complex geometry
- Lacking some azimuths and tilts
- Uneven shading
- Difficult to analyze

This case study was performed to better understand the impact of shading at the site



Parameters

- Measured data: July 2021 — June 2022
  - Power output from each module (from MLPE)
  - GHI as well as PoA front and back irradiance for select PV-modules
- Simulations
  - 3D-model of the site
  - Ray traced simulations using *bifacial radiance*
  - Hourly modelled climate data from STRÅNG, run by the Swedish Meteorological and Hydrological Institute.

Simulations

- Two scenarios
  - With and without shading from surroundings and other PV-modules
- Snow on the ground during winter
  - Year split into three periods. Early year with snow, mid year without snow, end of year with snow. Cumulative sky irradiance used for each period.
- No snow losses have been simulated
- Results in terms of front and back side irradiance, bifaciality accounted for, median of multiple spot measures, no mismatch losses considered

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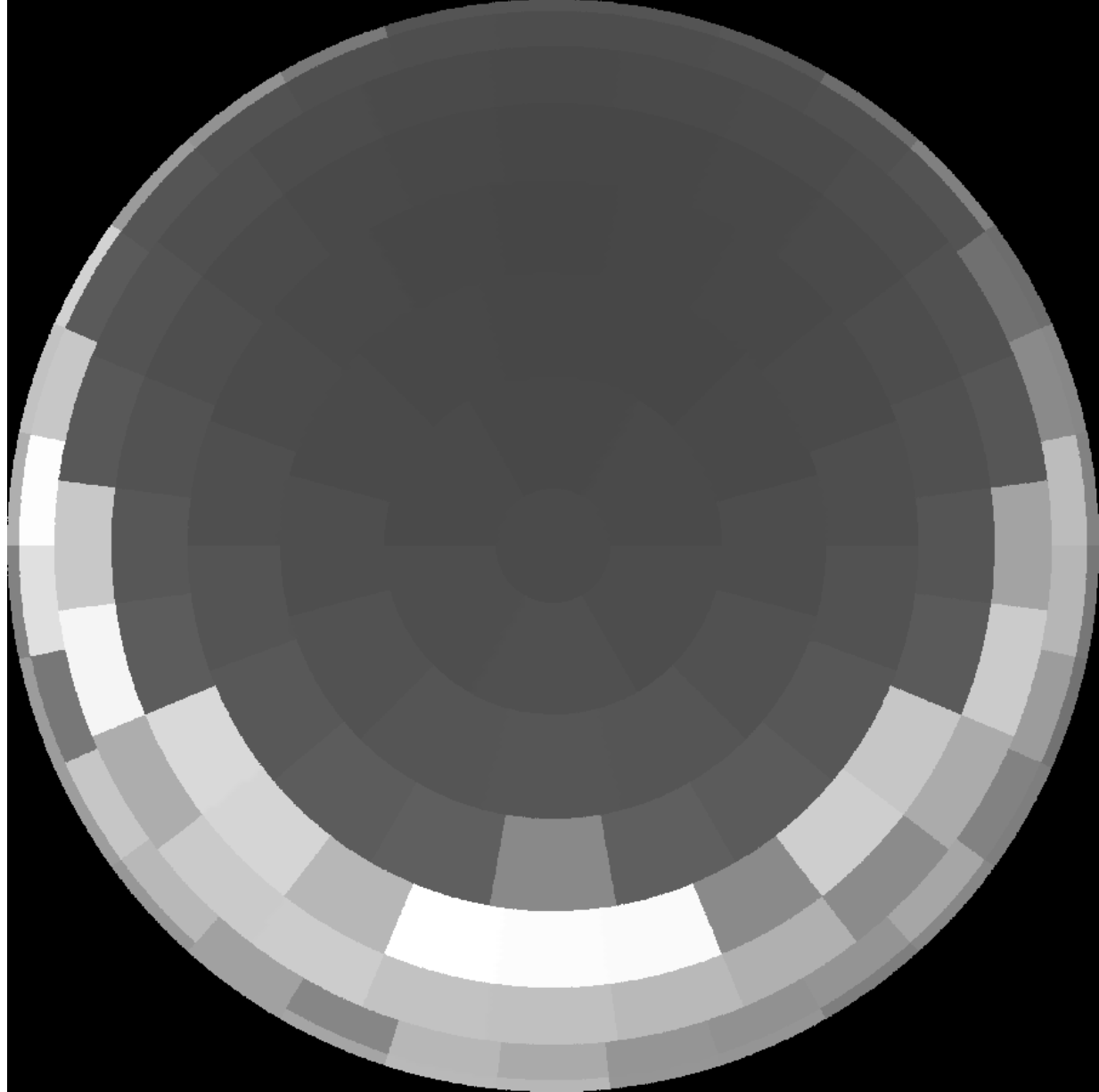
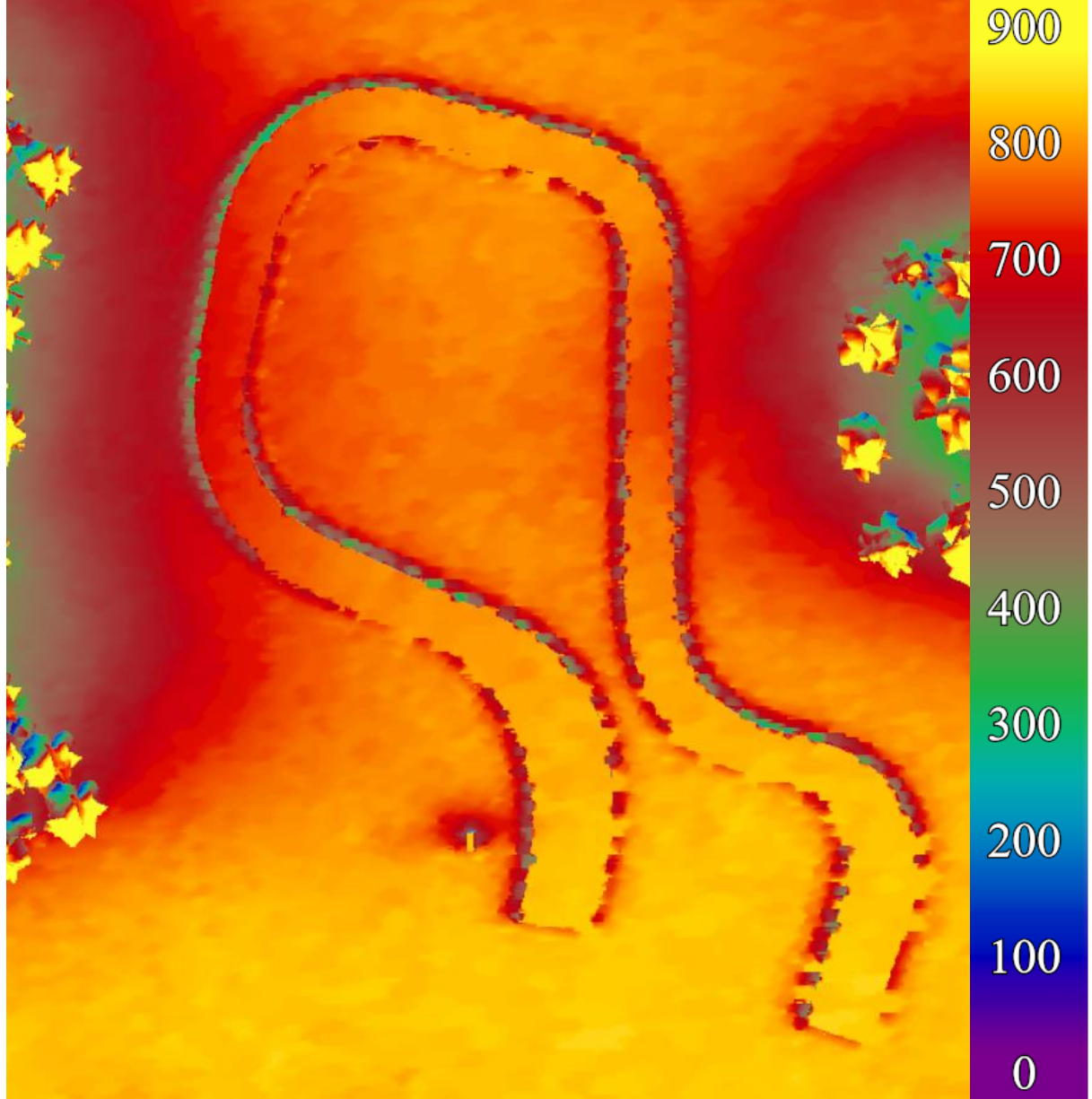
Sky modelling

- Cumulatively bins hourly irradiance data for an extended period in different sky patches
- The standard in bifacial radiance is 145 patches
- More patches increase computation time



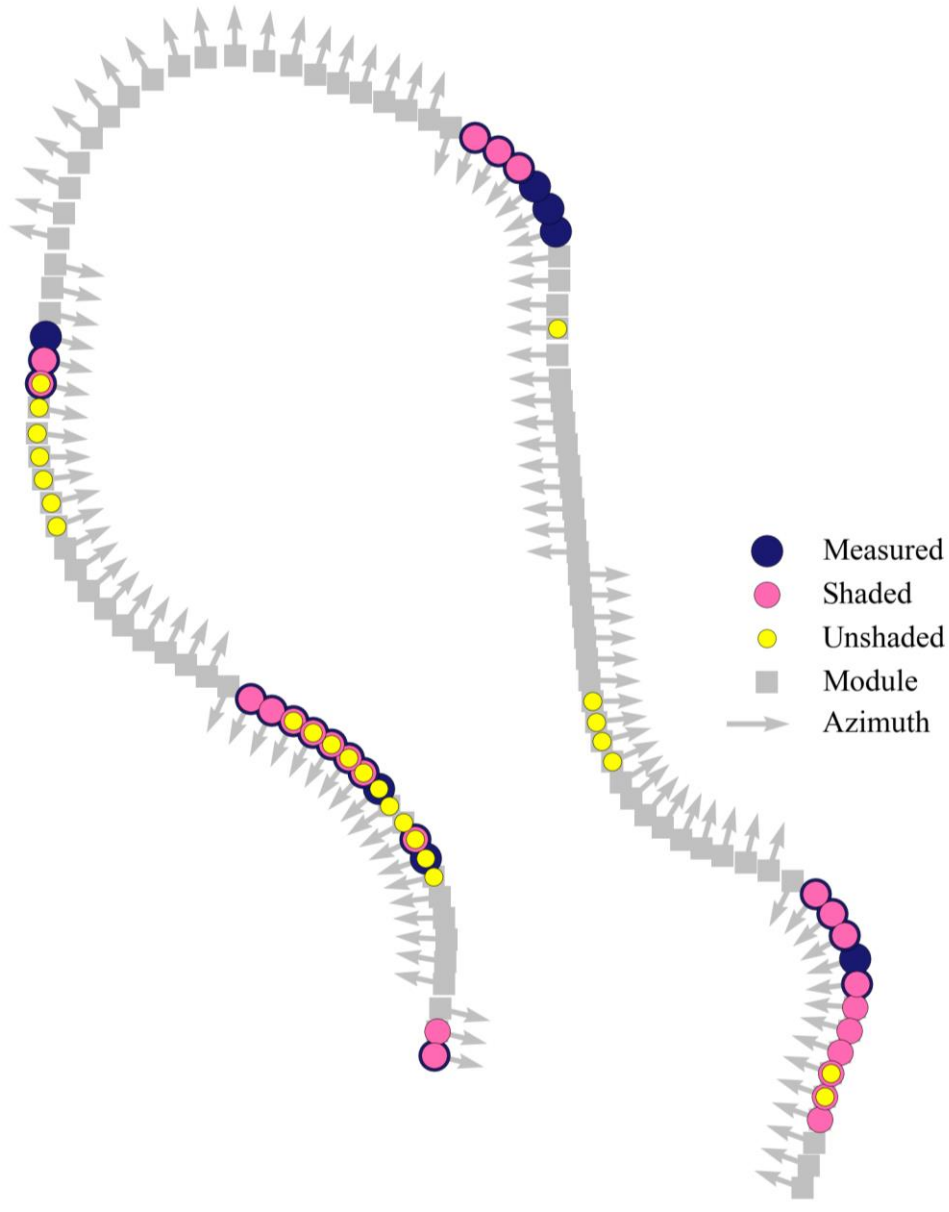
Shading

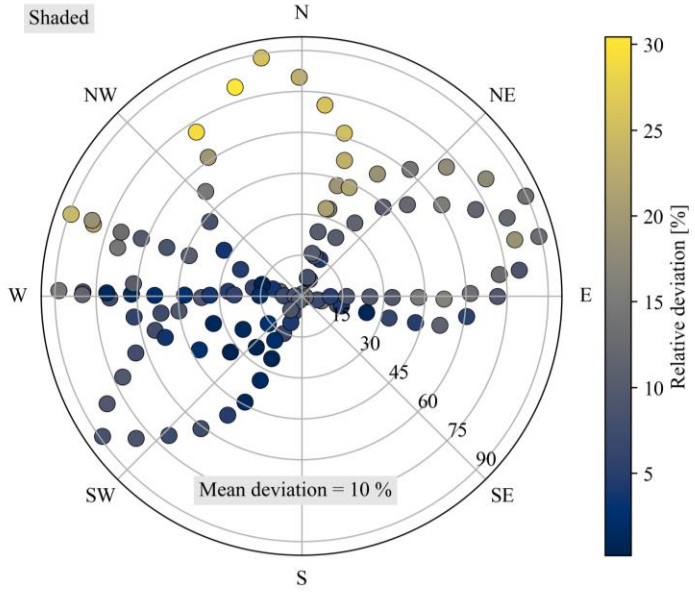
- Annual irradiance at the site
  - Trees to the east and west
  - Most shading on modules facing east/west

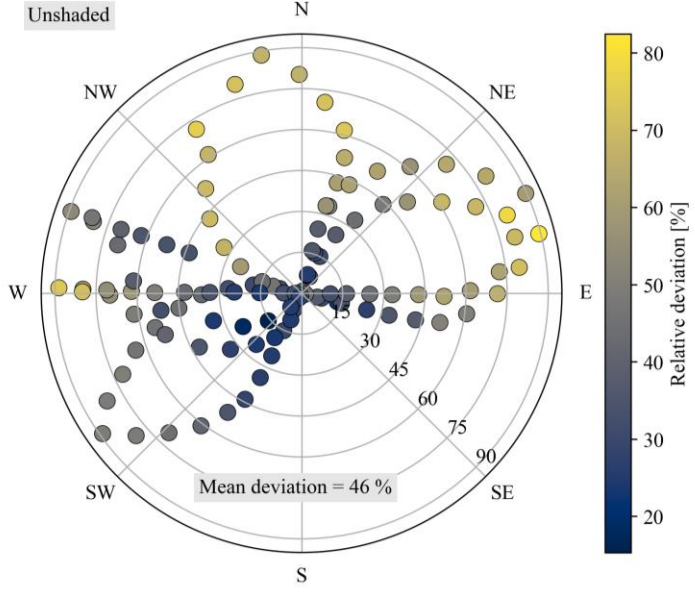


Best performing modules

- Top 25 performing modules for three categories
- High overlap between measured power output and irradiance from shaded simulations
- Areas with little shading perform best
- For unshaded simulations east/west facing modules perform well







Deviation from measured output

- Shaded simulations deviate mostly for north-facing and vertical/high tilt modules
- Unshaded simulations deviate more, especially east/west facing modules

Limitations

- No south facing modules
- Resolution of cumulative sky
- Modelled climate data
- Lack of measured PoA irradiance data

Conclusion

- Shaded simulations overlap well for ***reasonable*** azimuths and tilts
- The surroundings have a significant impact on performance
- ***Unshaded*** vertical east/west bifacial modules seem promising at high latitudes

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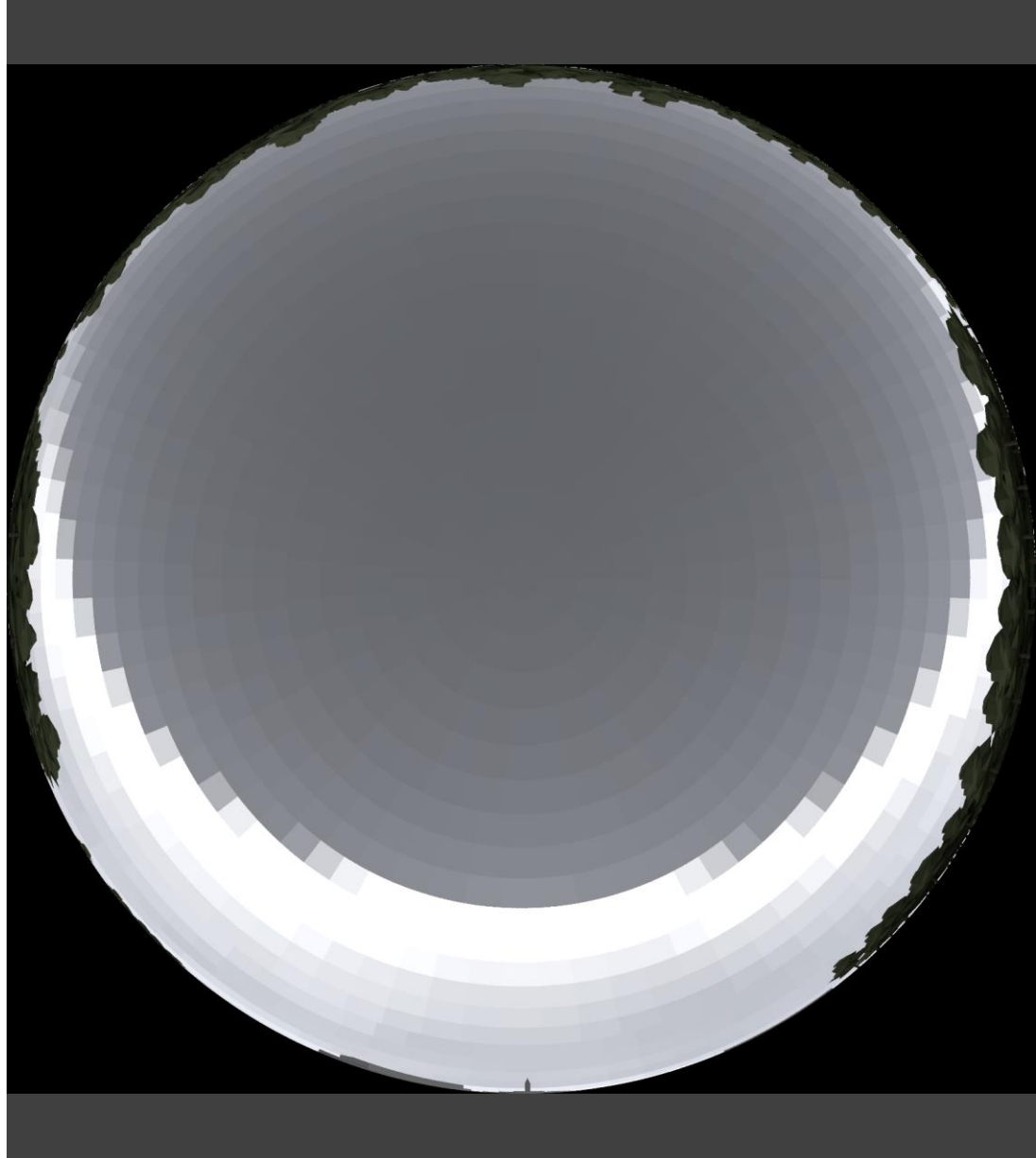
Post WCPEC Bonus

- Wanted to see if sky resolution would have a significant impact
- Used radiance's ***gendaymtx*** function
- Used minute level climate data from ESA's CAMS
- Increased computation time many times over
- No significant change in irradiance ~1-2%



Alexander Granlund

Research Engineer, RISE

alexander.granlund@ri.se