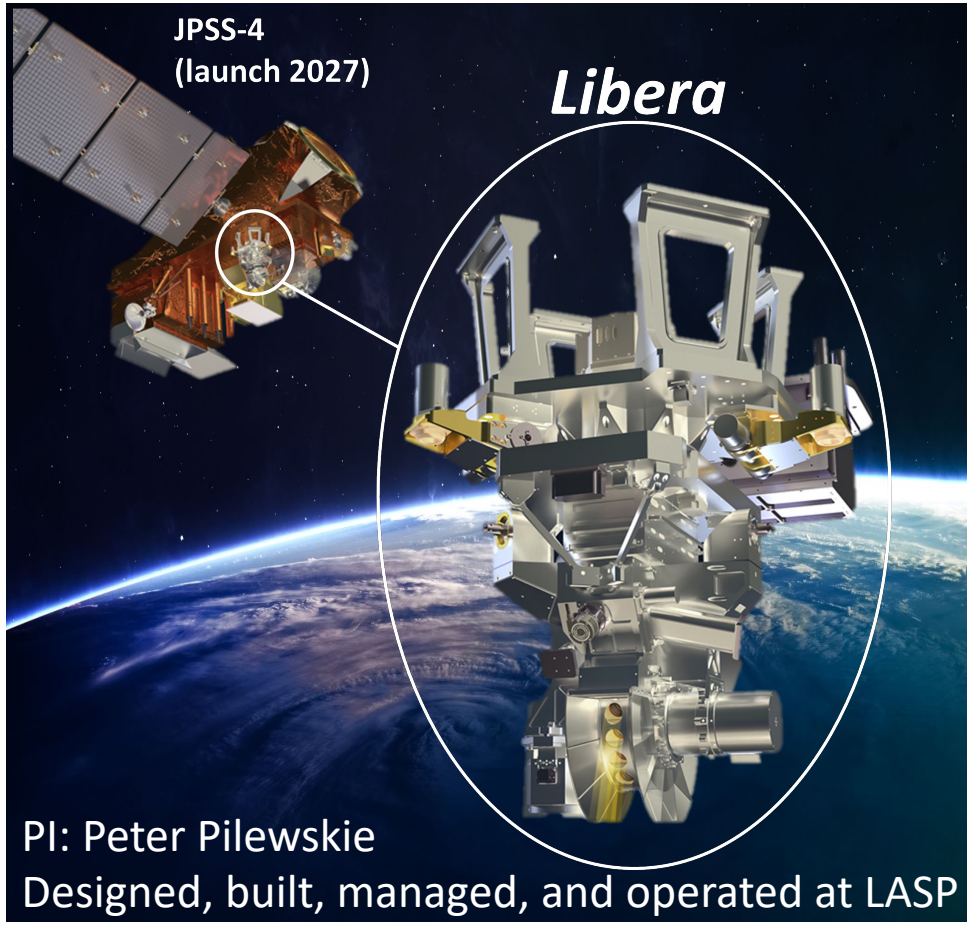
Libera Earth-Target Scan Simulations



Jake Gristey[1,2,3], Sebastian Schmidt[3], Dave Harber[3], Maria Hakuba[4], Peter Pilewskie[3]

[1]Cooperative Institute for Research in Environmental Sciences (**CIRES**)

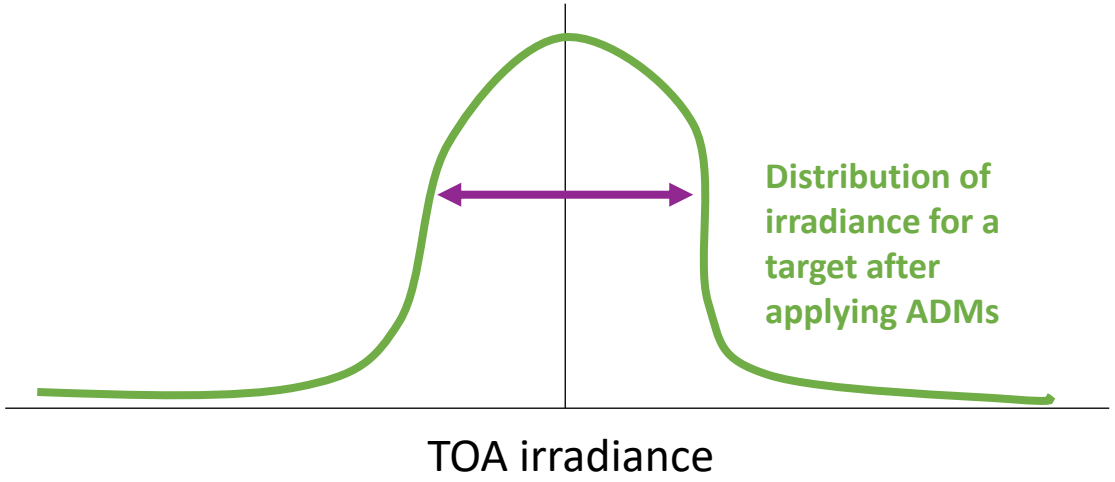
[2]NOAA Chemical Sciences Laboratory (**NOAA CSL**)

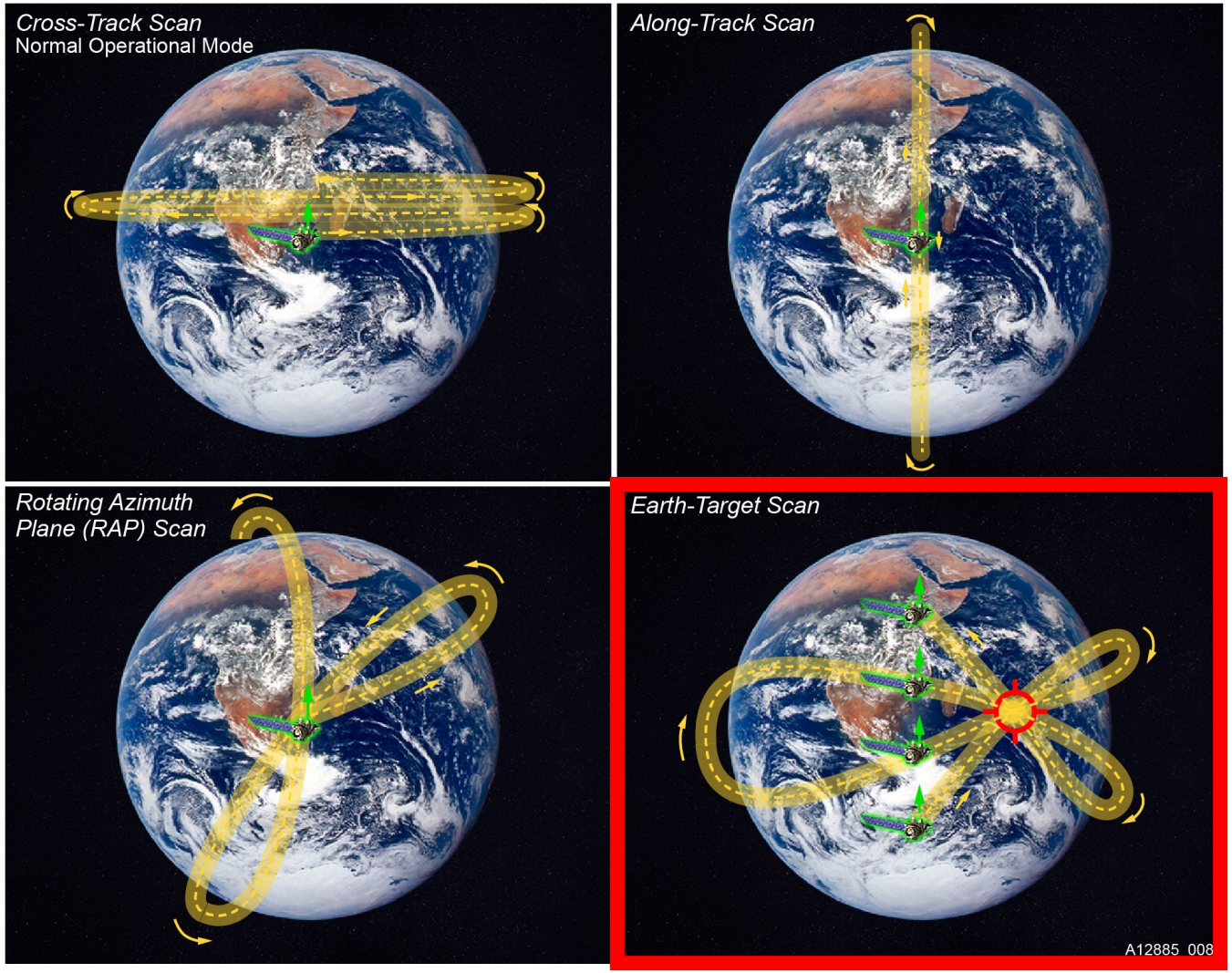
[3]Laboratory for Atmospheric and Space Physics (**LASP**)

[4]NASA Jet Propulsion Laboratory (**NASA JPL**)

The idea: view a fixed location from different angles

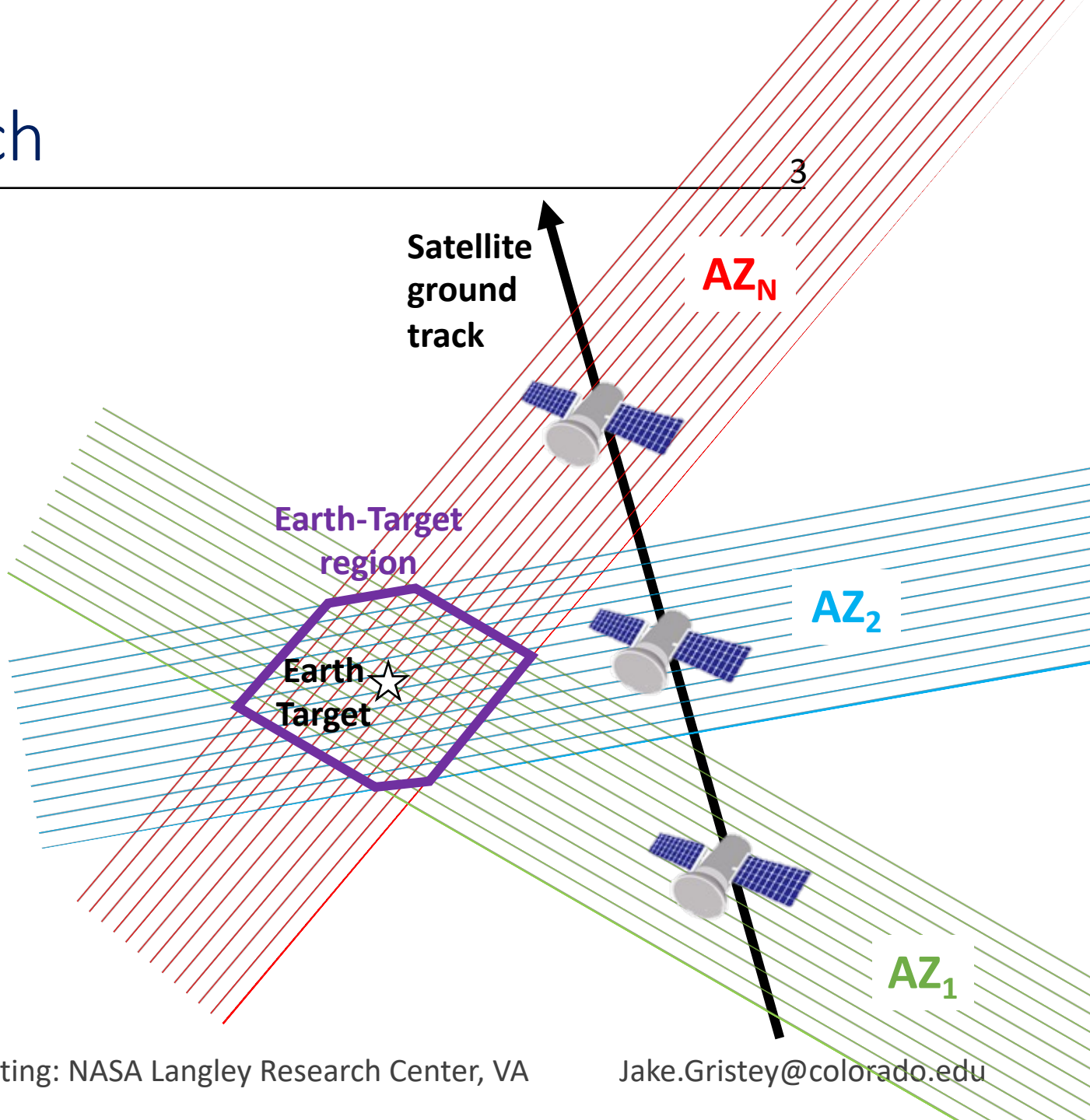
- Radiance will vary, irradiance should not
- Width of the distribution of retrieved irradiance is therefore a measure of instantaneous angular distribution model (ADM) uncertainty
- Being considered as a small fraction of existing non-cross-track operations



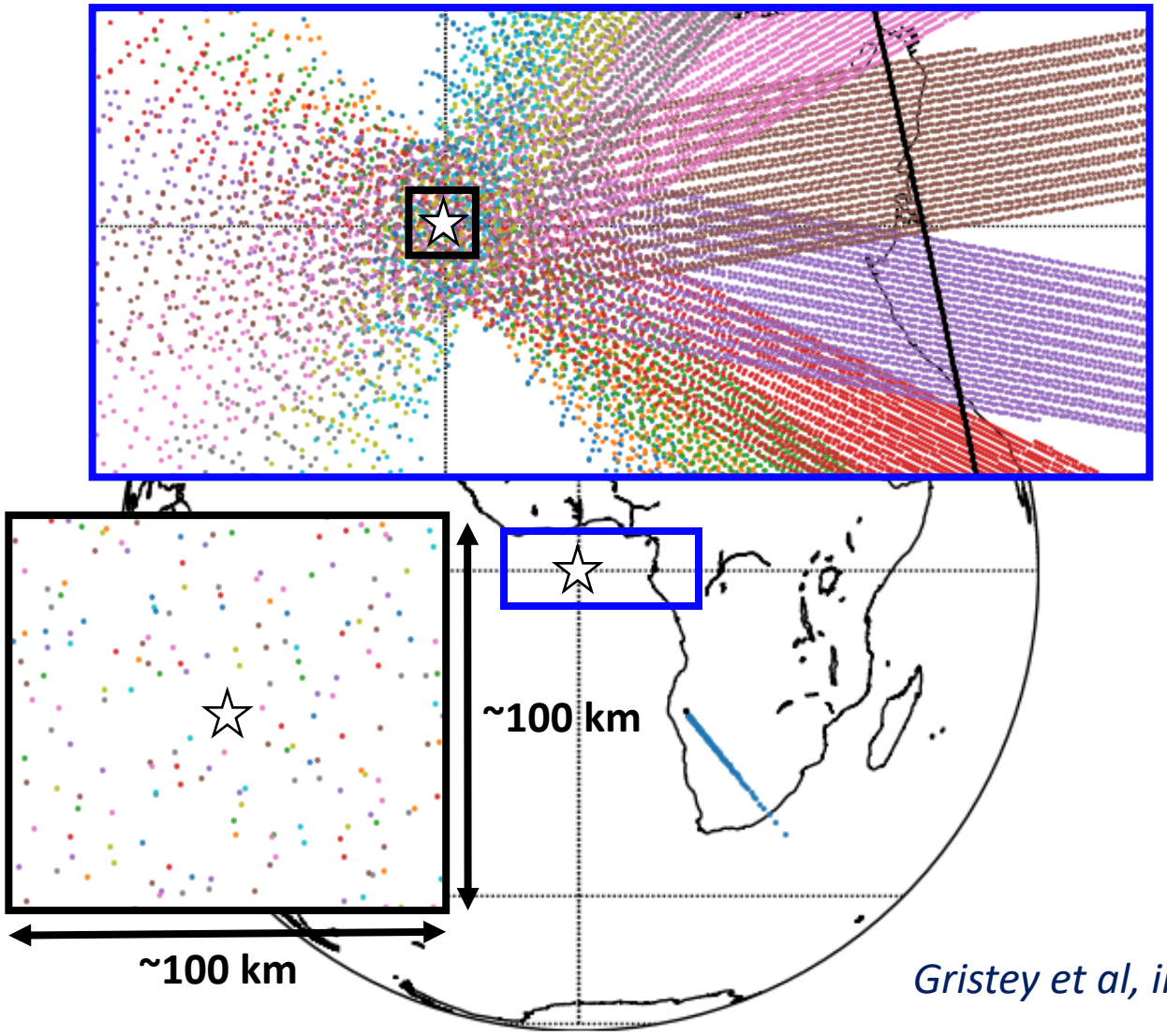


“Lock and update” approach

- Azimuth only updates occasionally
  - Manageable number of commands to send to spacecraft
- Result: **Earth-Target region**
  - More robust to orbit prediction errors
  - Extract matched Footprints in post-processing

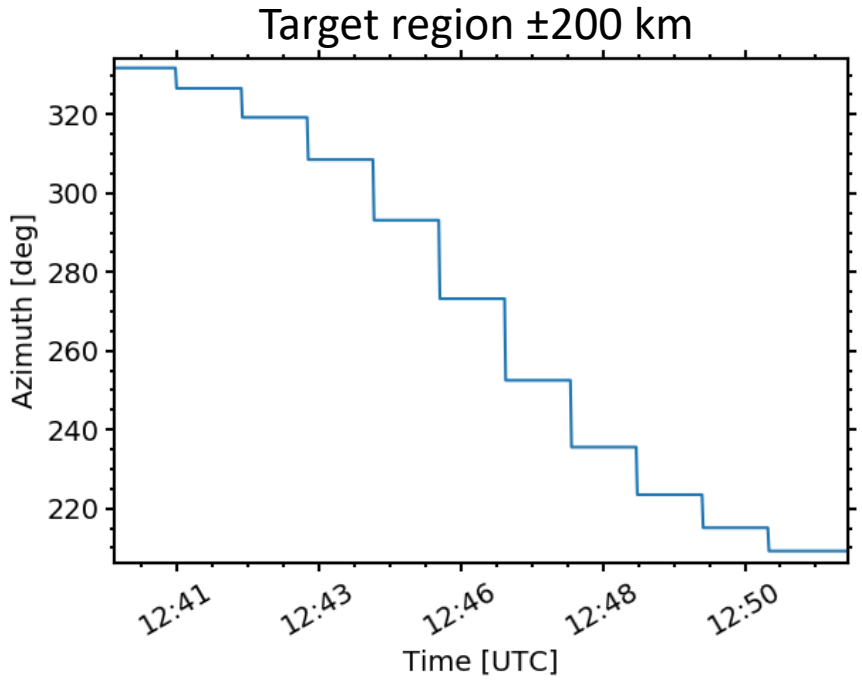


Example simulated Earth-Target Scan



Key

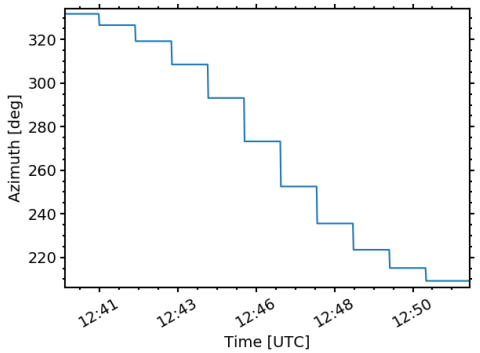
Star:	Target location (0°, 0°)
Black line:	NOAA-20 ground track (2023-02-28)
Colored dots:	Radiometer footprints at 100 Hz (color changes each time the azimuth angle is updated)

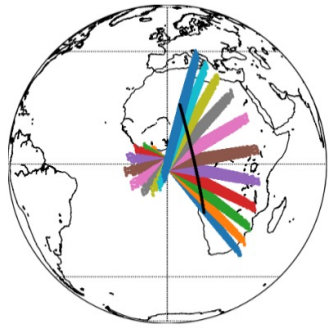


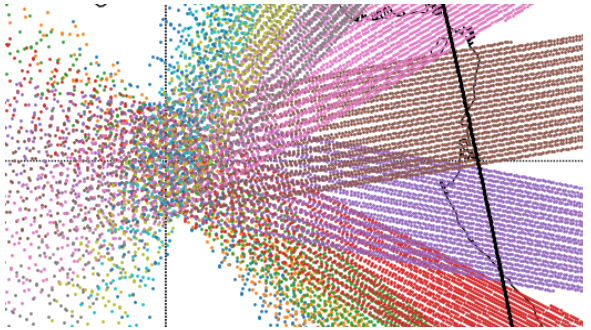
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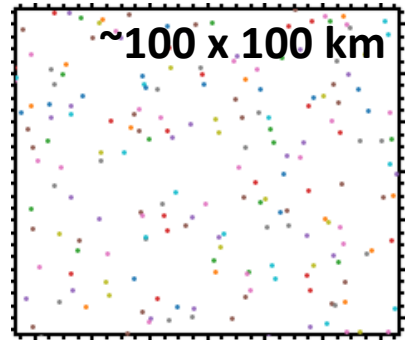
Sensitivity to target region size

± 200 km

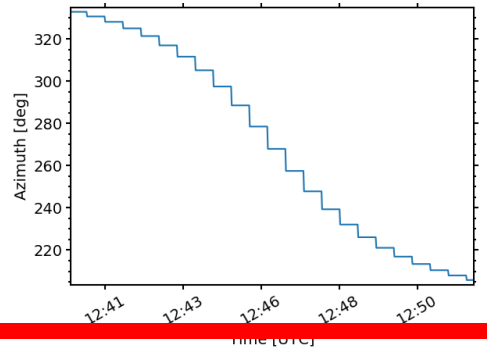


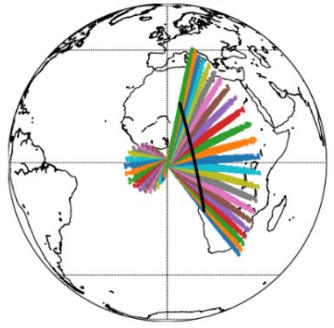


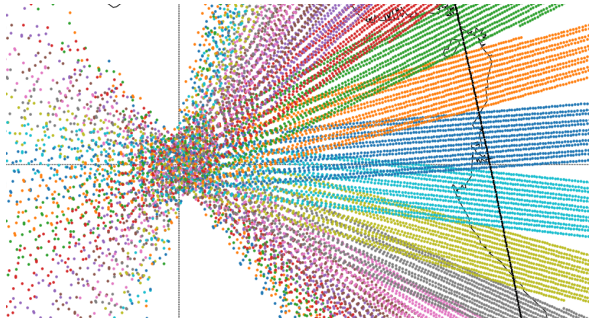


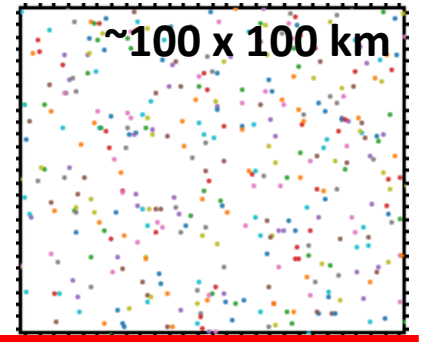


± 100 km

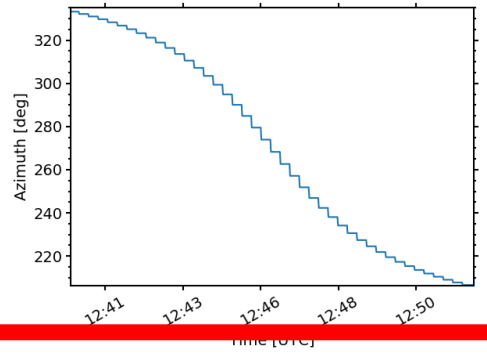


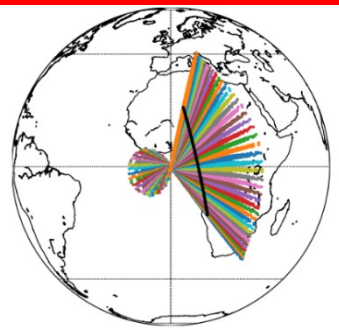


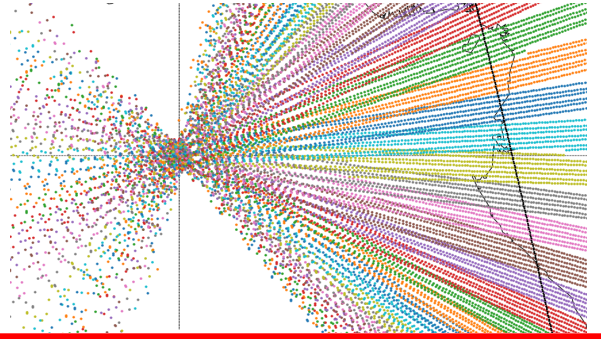


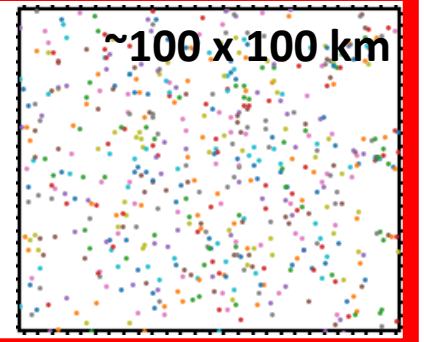


± 50 km





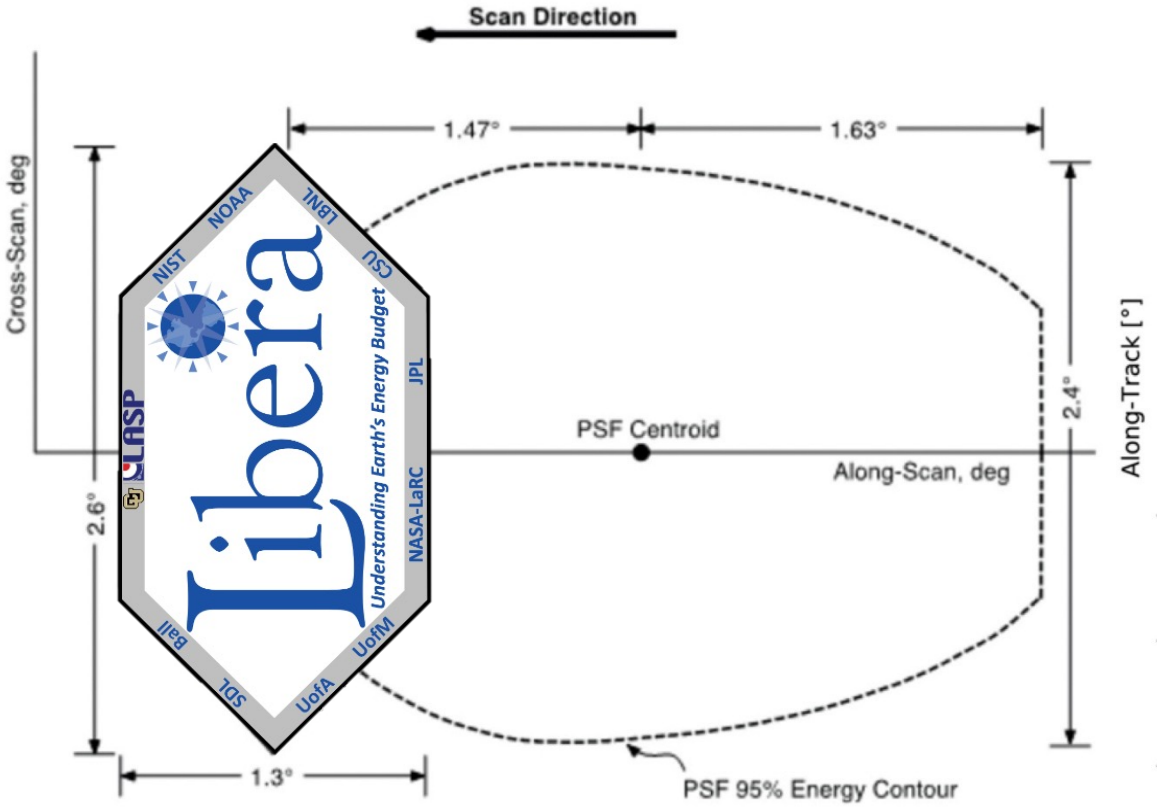


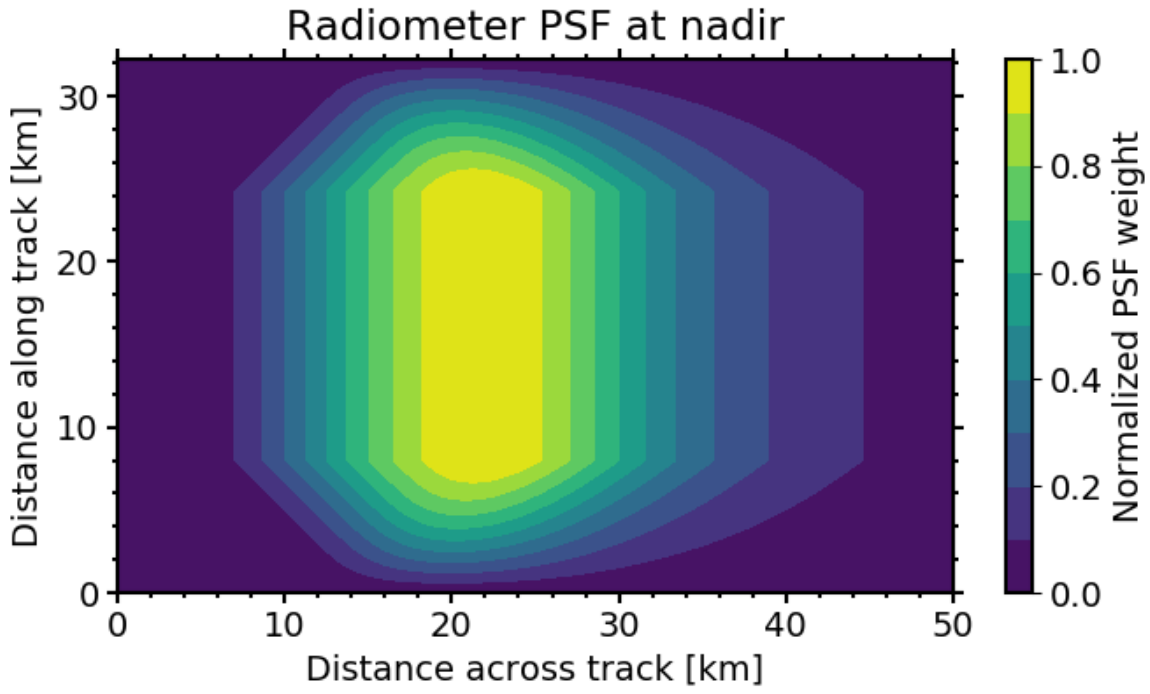


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Libera point spread function (PSF)





Provided by Dave Harber, LASP

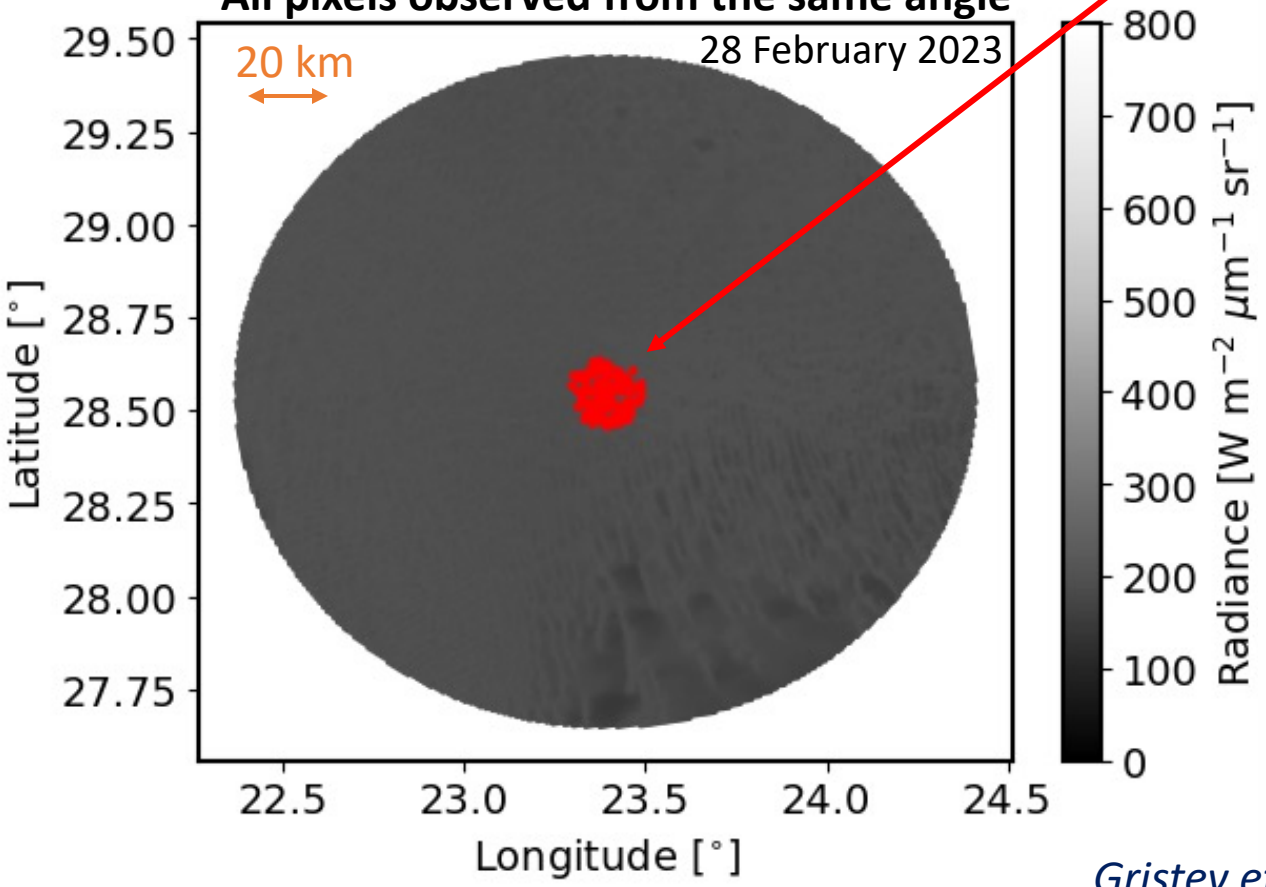
VIIRS to assess footprint mismatch uncertainty

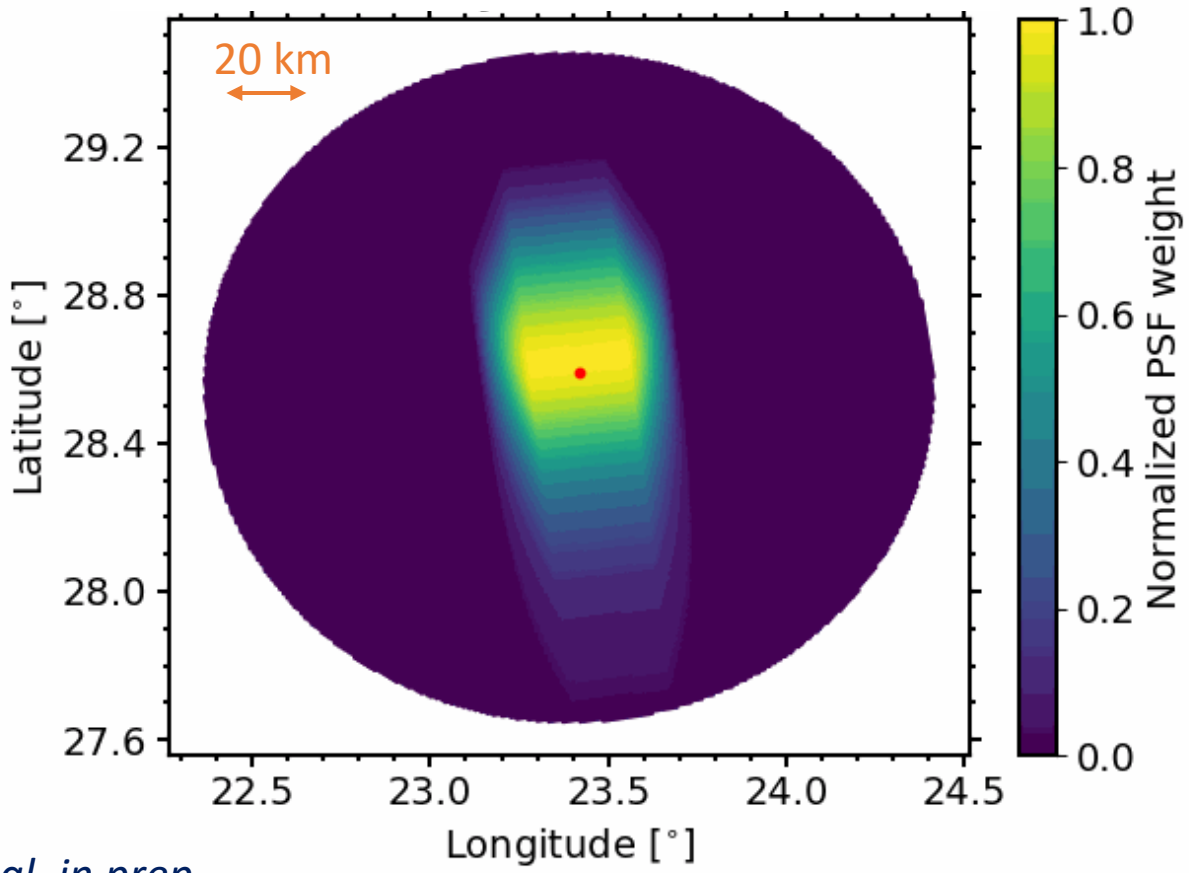
Sahara Desert

VIIRS 555 nm radiance (M4 band, 750 m resolution)

All pixels observed from the same angle

Simulated Earth-Target Scan radiometer footprint centroids within 10 km of target

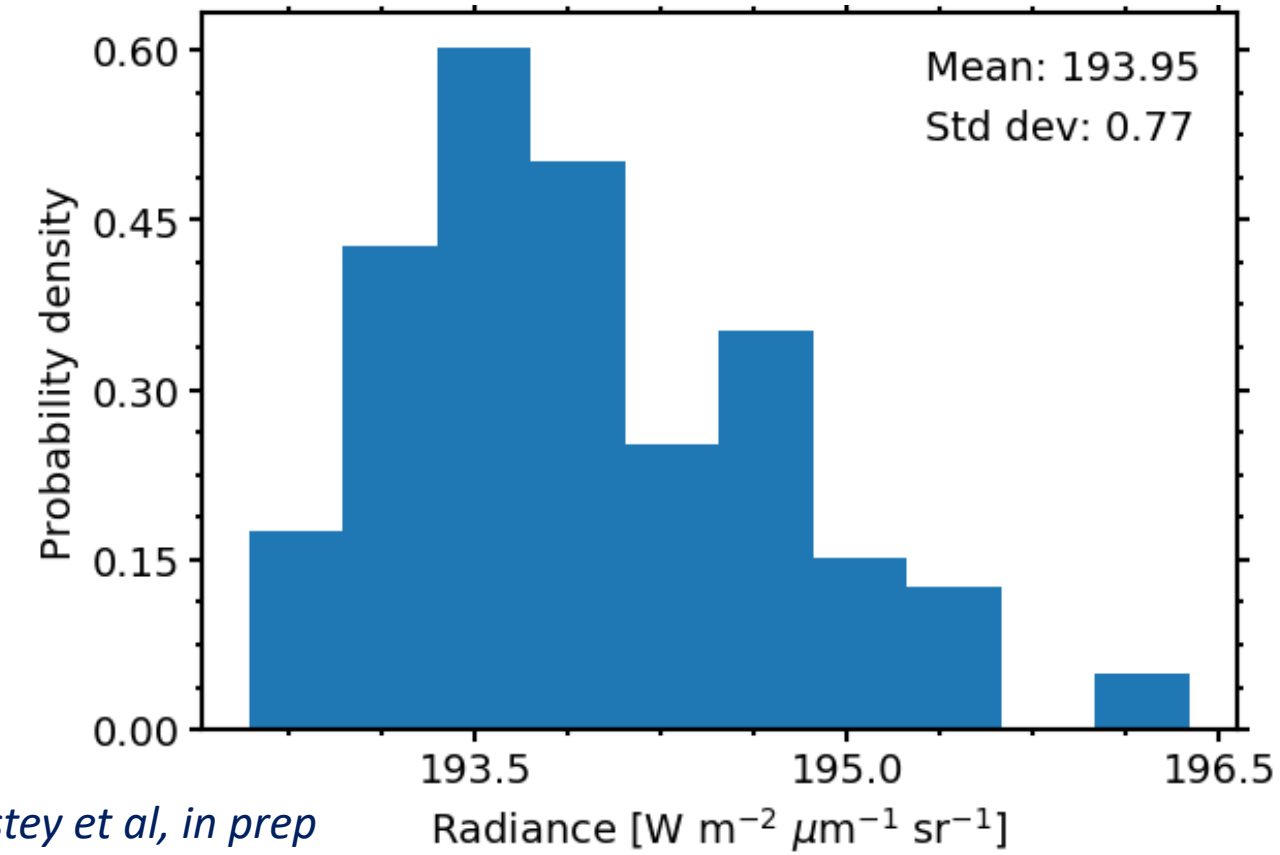




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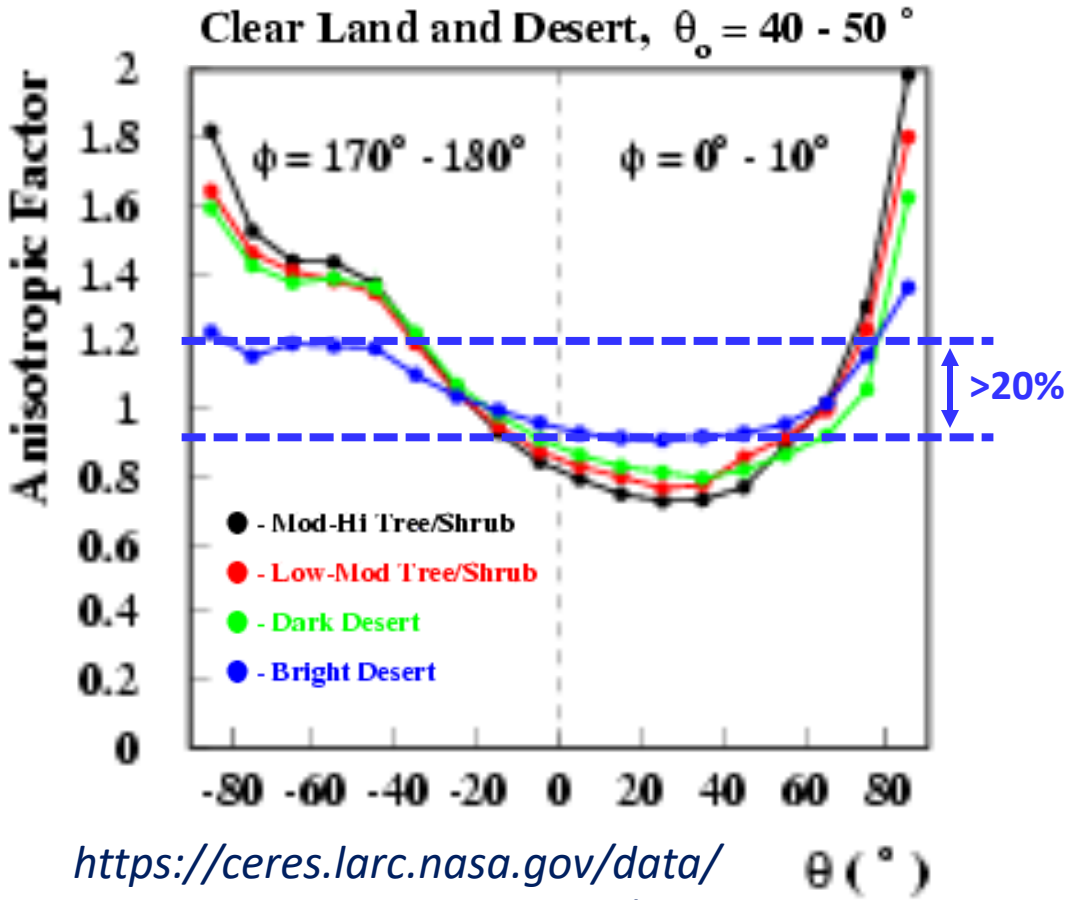
Footprint mismatch uncertainty

Footprint mismatch uncertainty:
0.79% (2σ) "The noise"



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Angular radiance variability:
>20% "The signal"

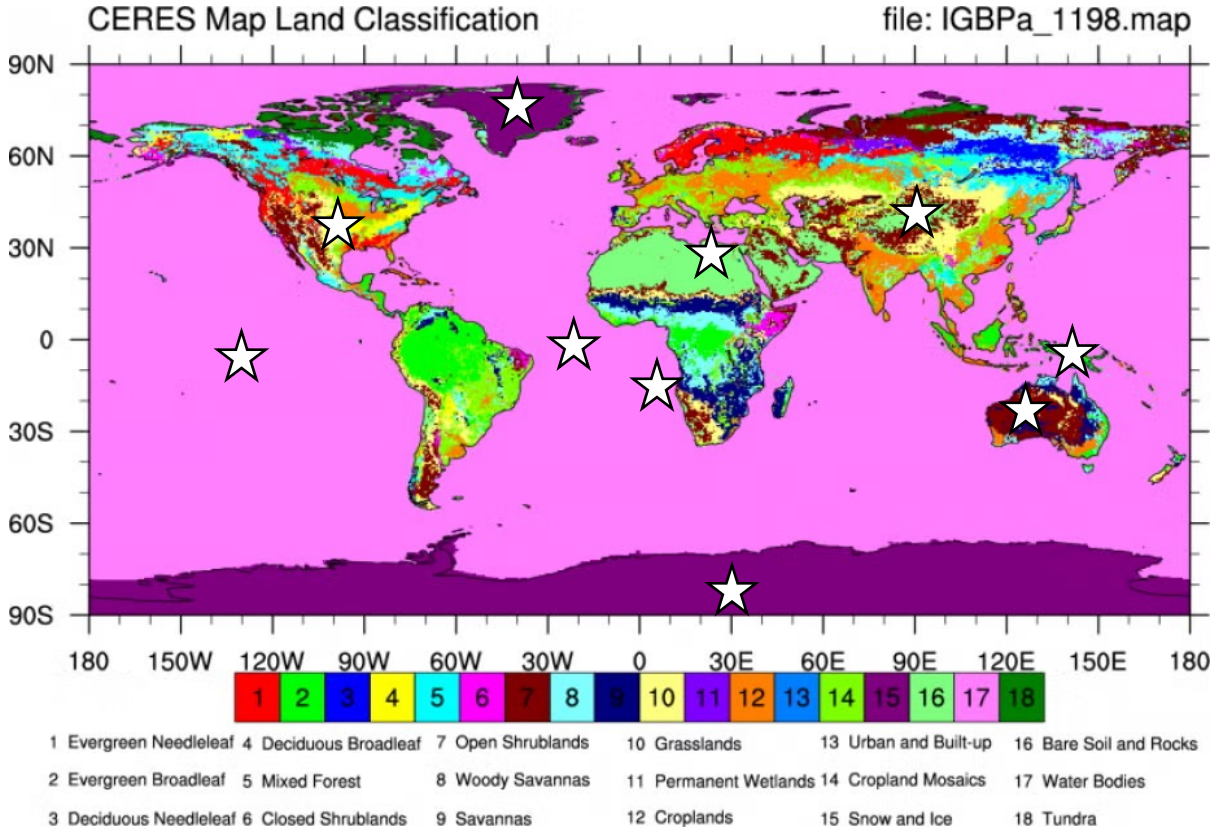


https://ceres.larc.nasa.gov/data/angular-distribution-models/

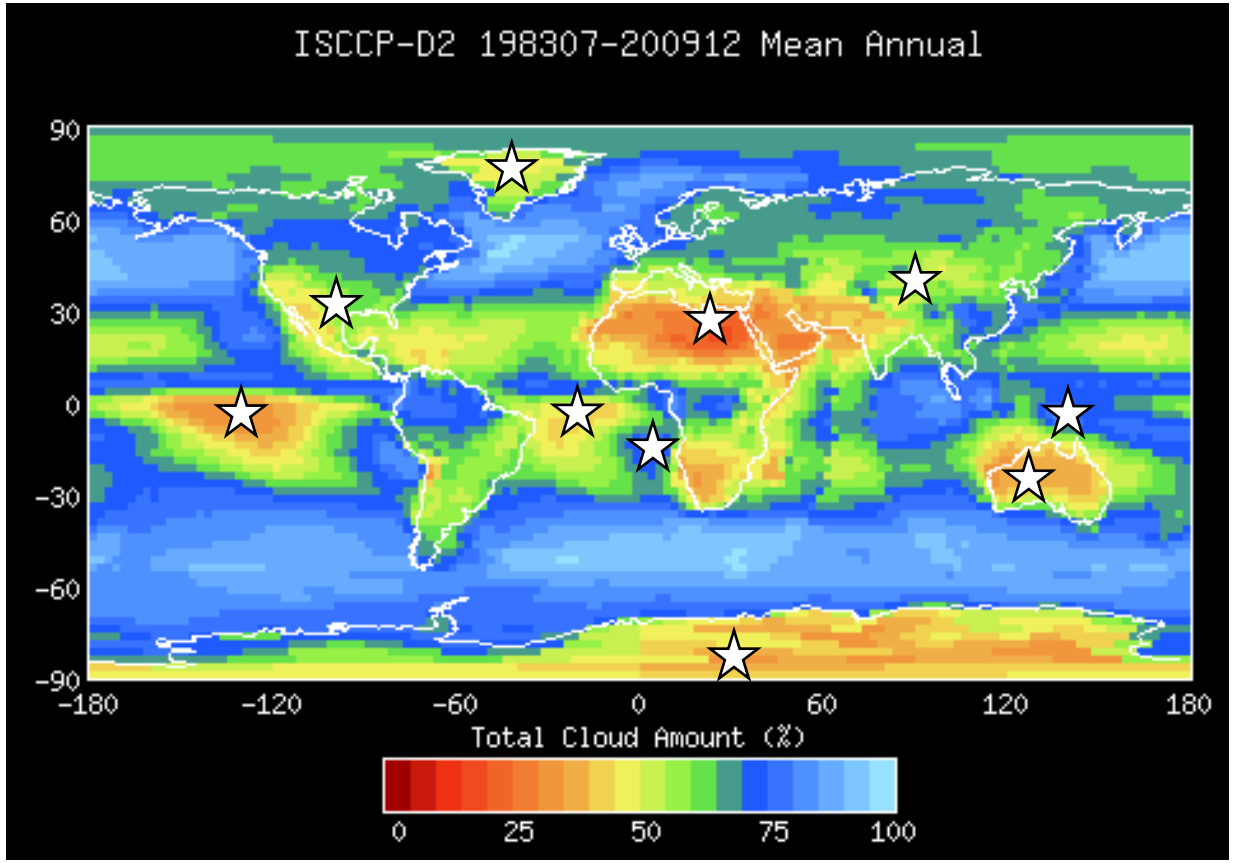
Candidate locations for Earth-Target Scans

- Generally looking for:
  - *No cloud (or homogeneous cloud)*
  - *Homogeneous surface*

In practice: update some locations on ~monthly basis



https://climatedataguide.ucar.edu/climate-data/ceres-igbp-land-classification

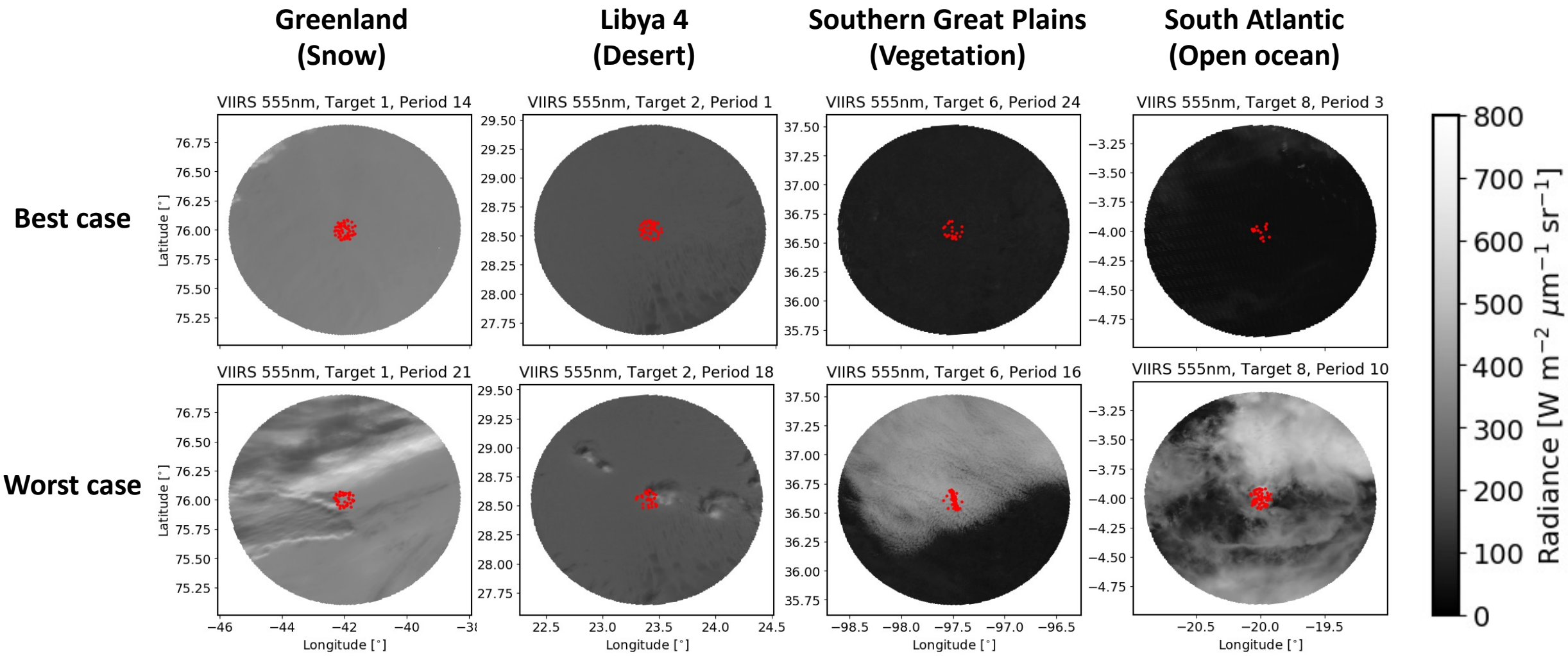


https://isccp.giss.nasa.gov/products/browsed2.html

Candidate locations for Earth-Target Scans

Target #	Latitude	Longitude	Note
1	76	-42	Greenland (snow)
2	28.55	23.39	Libya-4 calibration site (desert)
3	-15	3	South-East Atlantic (marine stratocumulus)
4	-5	-130	South Pacific (open ocean)
5	-28	131	Australia (desert)
6	36.61	-97.49	ARM SGP site (vegetation)
7	-86	30	Antarctica (snow)
8	-4	-20	South Atlantic (open ocean)
9	-6	144	Papua New Guinea (Deep convection)
10	39.5	84	North-West China (desert)

VIIRS radiance examples (16 days): Surface targets



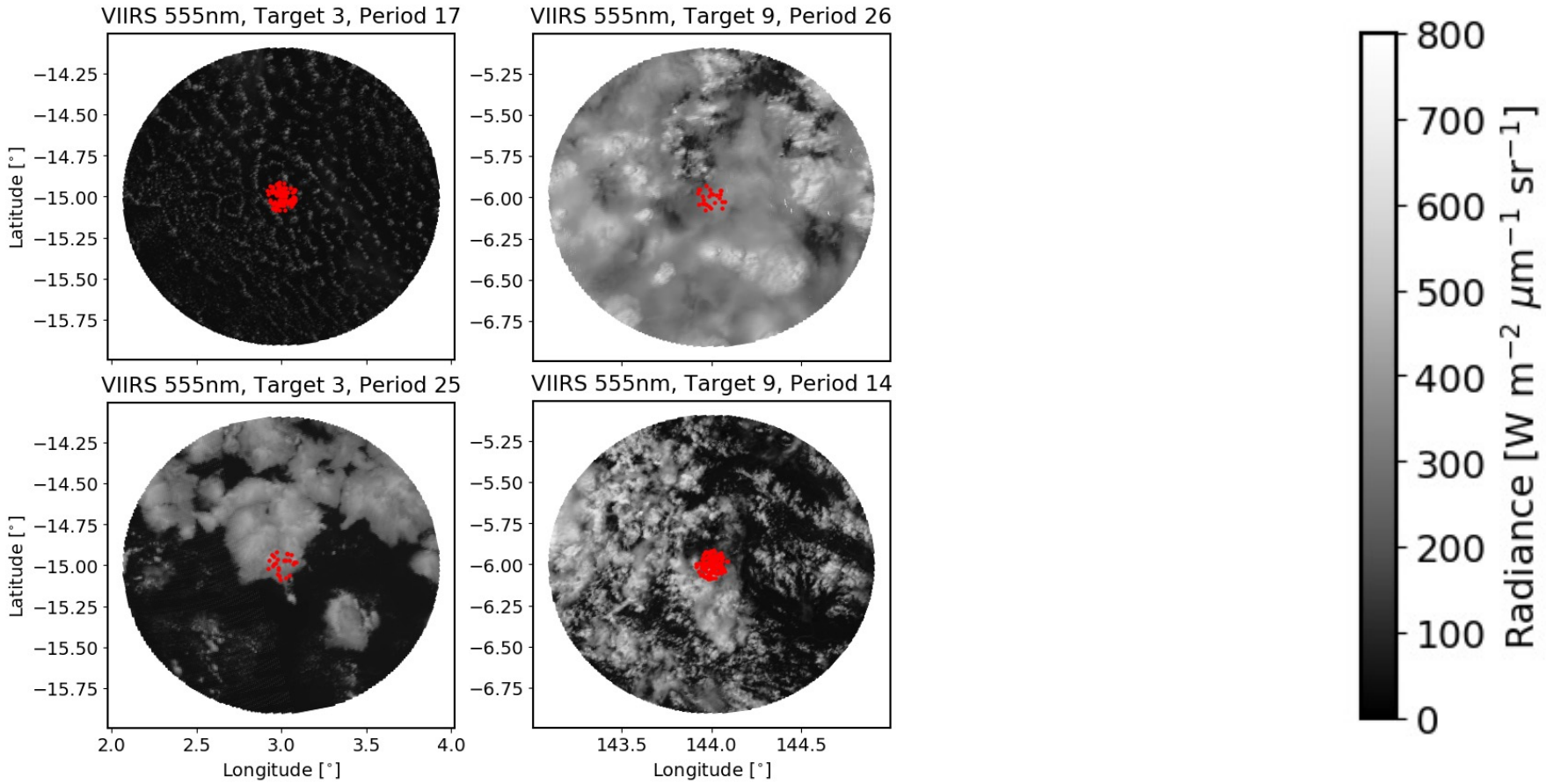
VIIRS radiance examples (16 days): Cloud targets

South-East Atlantic (Marine stratocumulus)

Papua New Guinea (Deep convection)

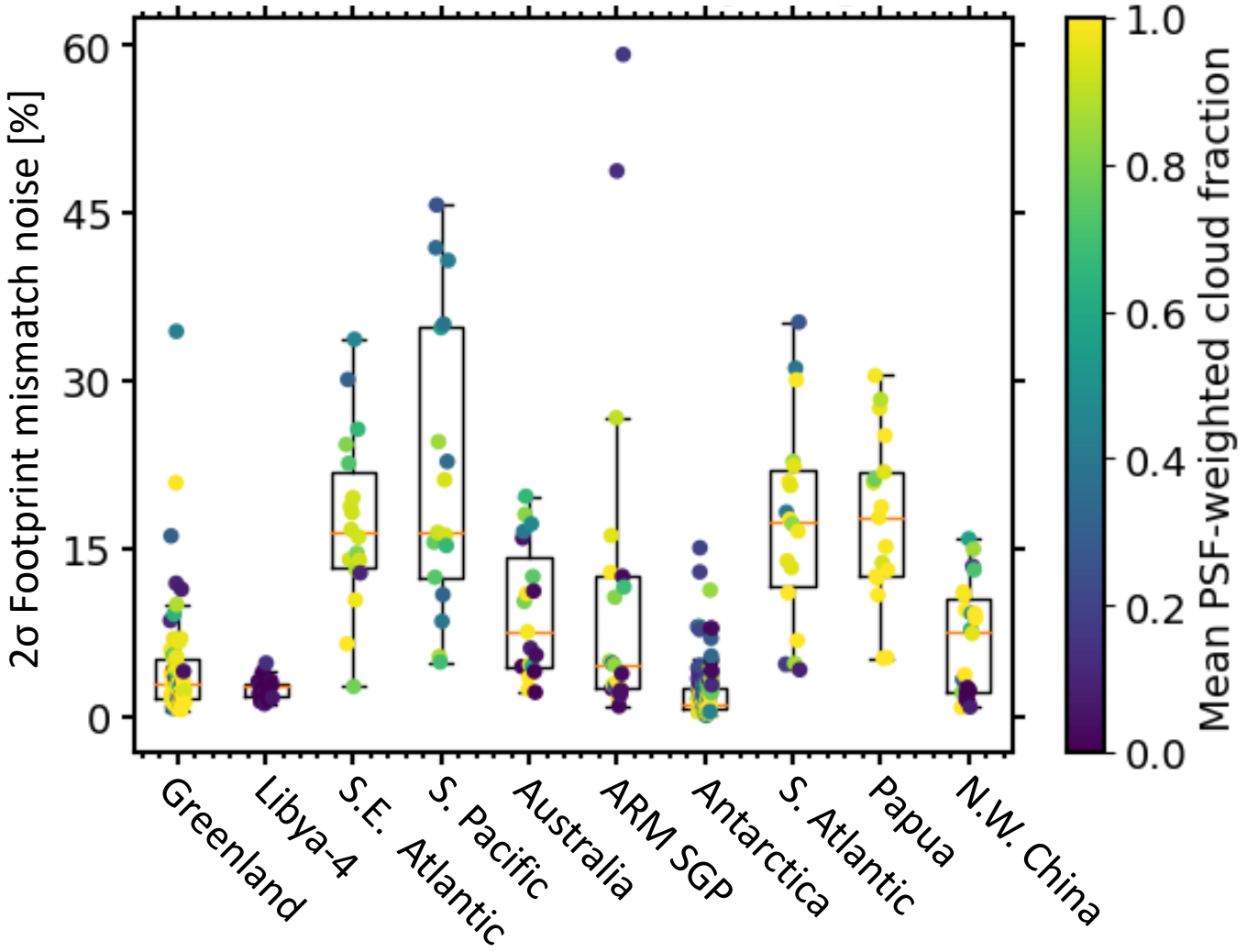
Best case

Worst case



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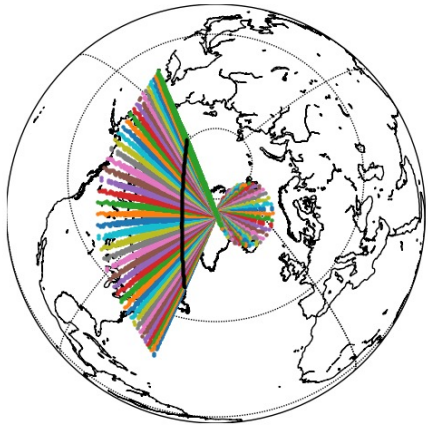
Footprint mismatch noise per target



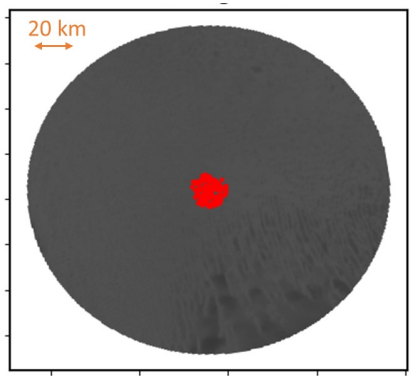
- All targets include Earth-Target Scans with noise within ~few percent
- Expect to sub-select best cases for analysis
- Challenges:
  - Open ocean scenes
  - Cloud scenes
  - Intermediate cloud fraction
- Future work:
  - Refine target locations
  - Explore seasonal variability
  - Finalize prioritization approach

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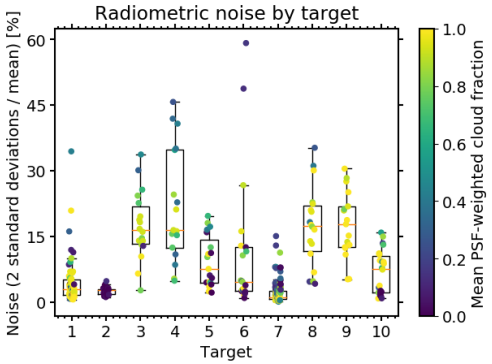
Summary and conclusions



- Developed **simulation capability for Libera Earth-Target Scans** and used it to optimize sampling strategy
  - ± 50 km target region



- Demonstrated that **evaluation of ADMs would be viable** for a carefully chosen target
  - Angular radiance variability >> footprint mismatch noise

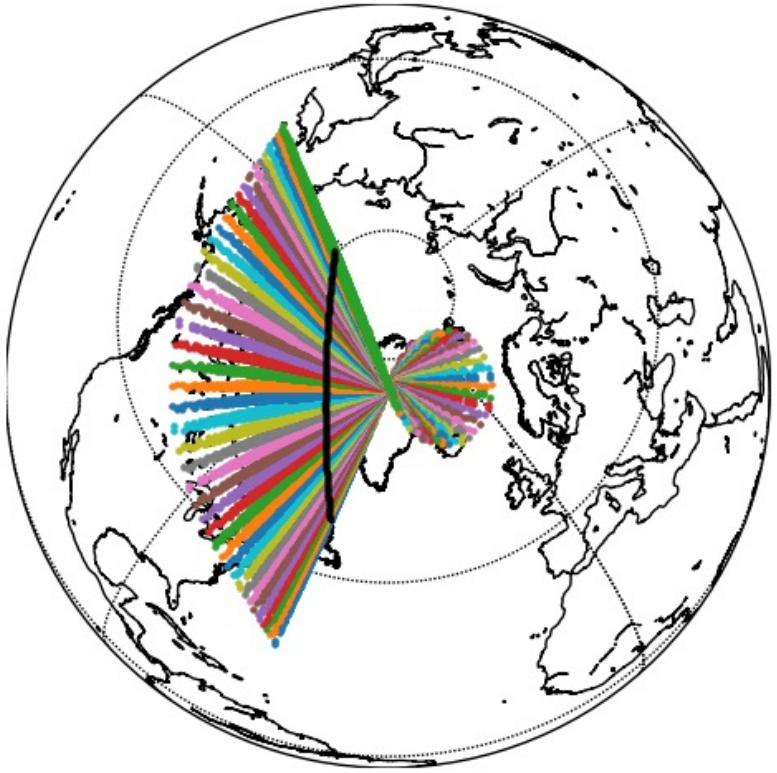


- Extended to **10 candidate targets** over 16 days
  - Cloud presence dominates “noise”
  - BUT **all targets include usable scans**

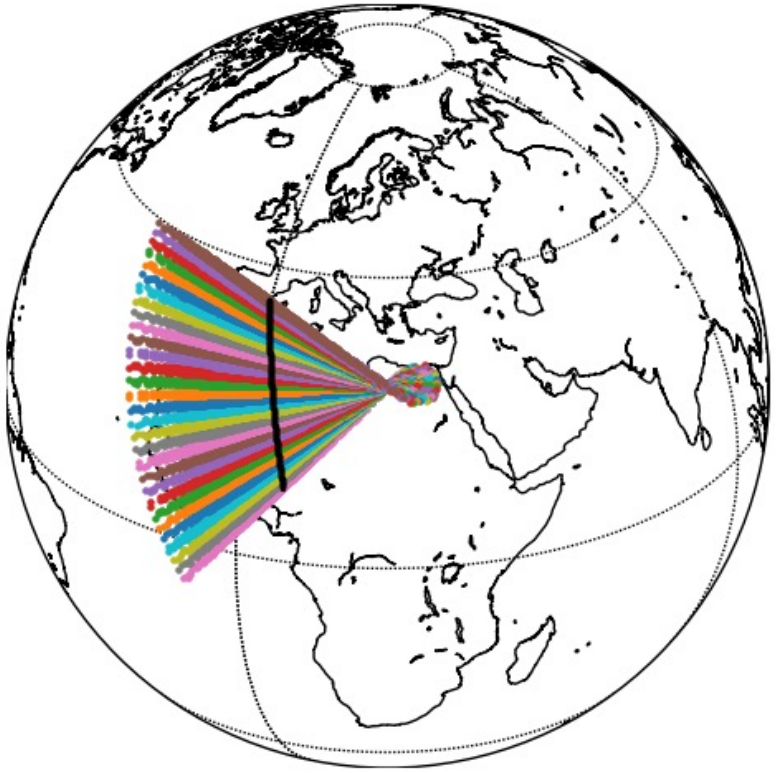
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Example Earth-Target Scans from 16-day cycle

Greenland



Libya



Antarctica

