

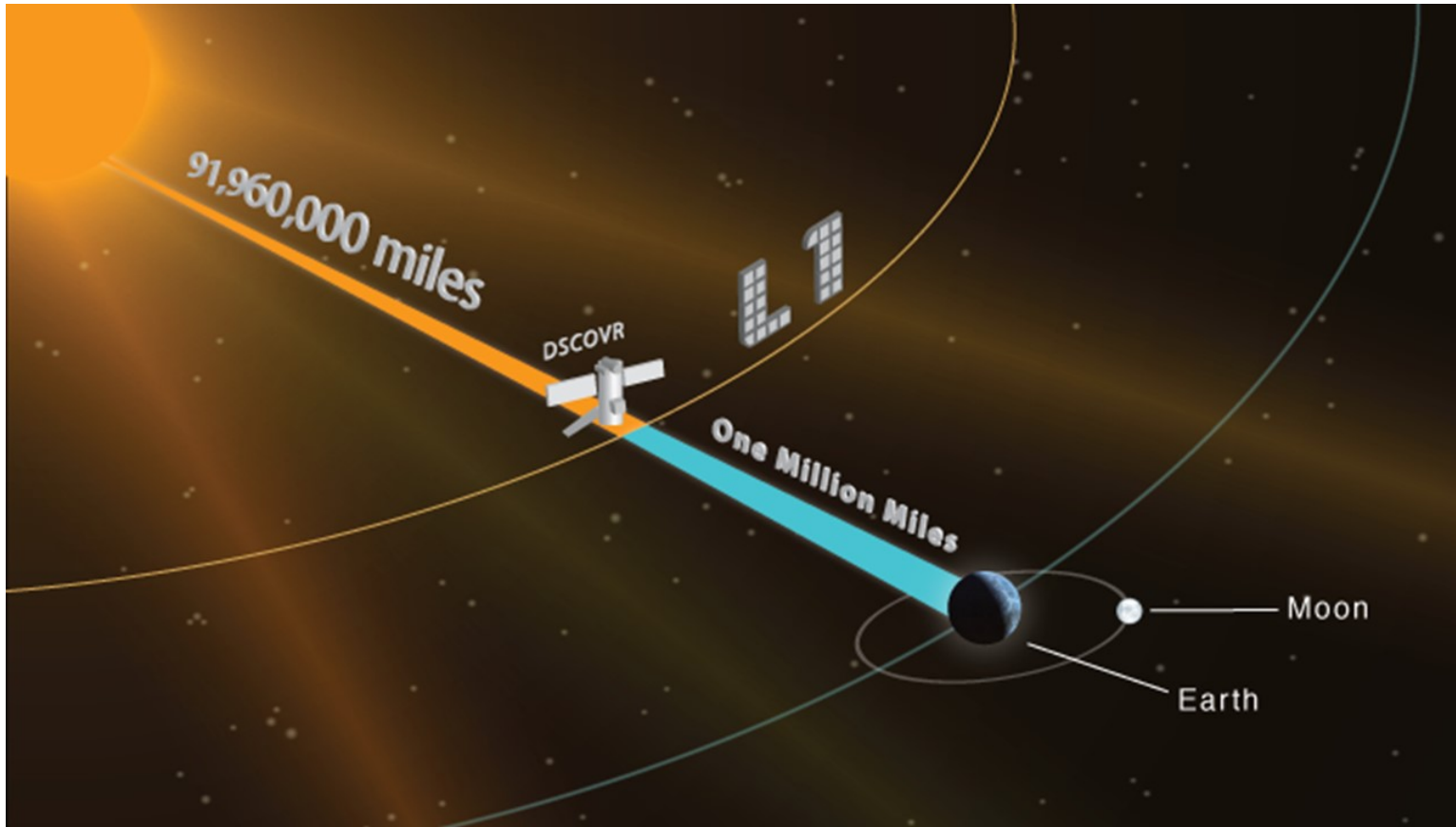


Deep space observations of sun glint over oceans

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1: NASA GSFC, 2: UMBC JCET, 3: Michigan Technological University

The DSCOVR spacecraft is at the L1 Lagrangian point



View from DSCOVR by the EPIC camera



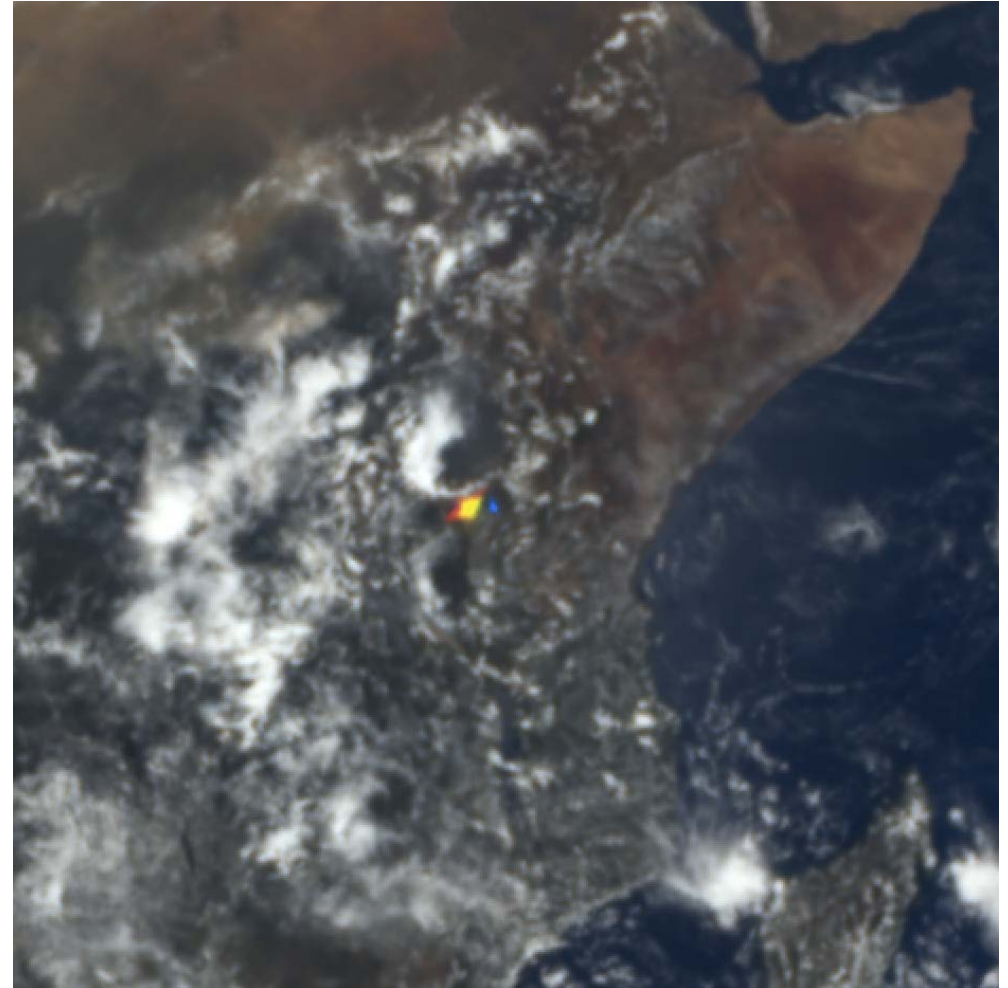
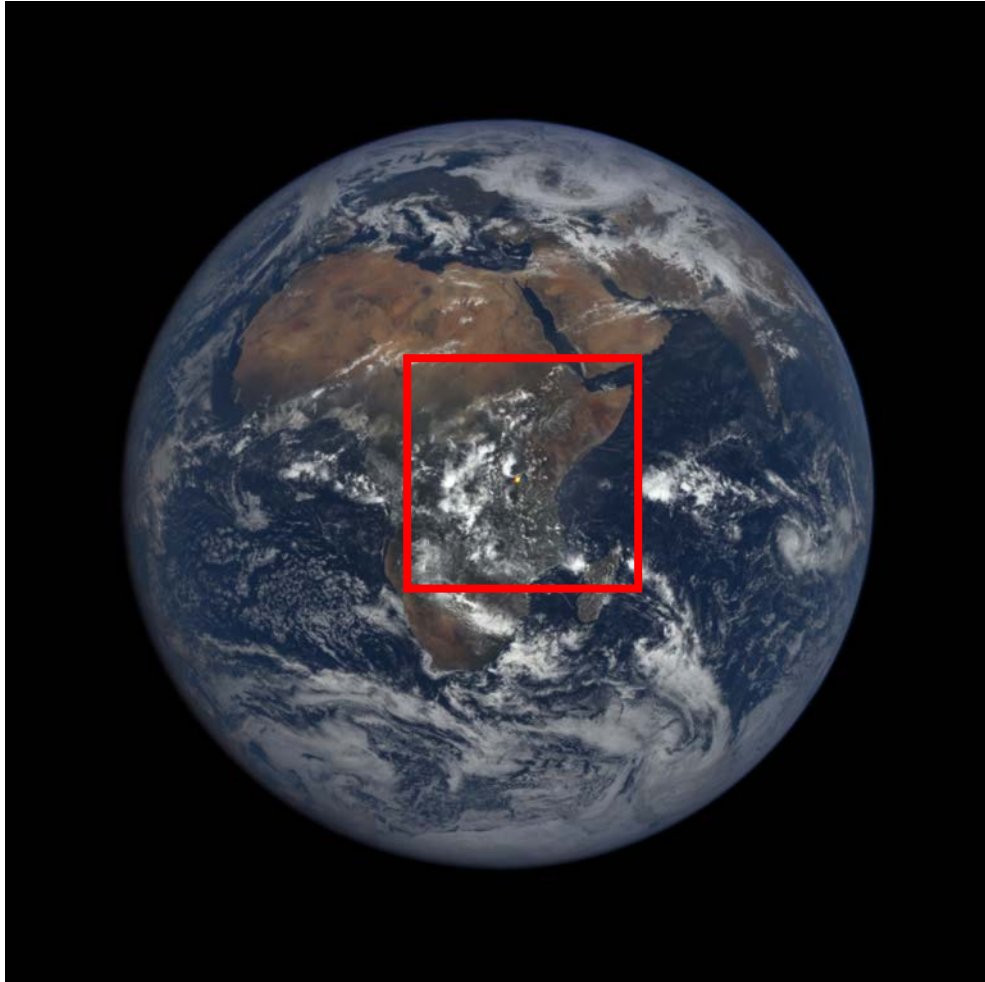
2016 03 23



2016 05 29

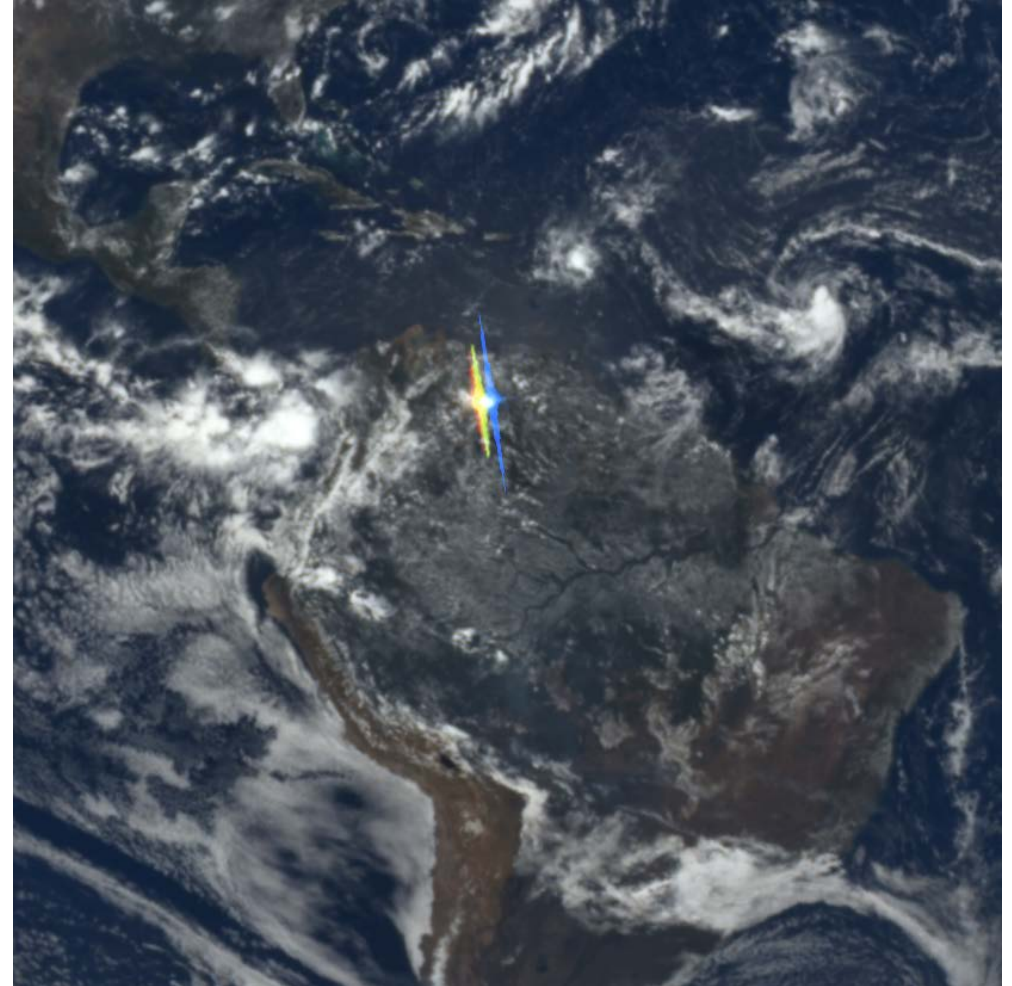
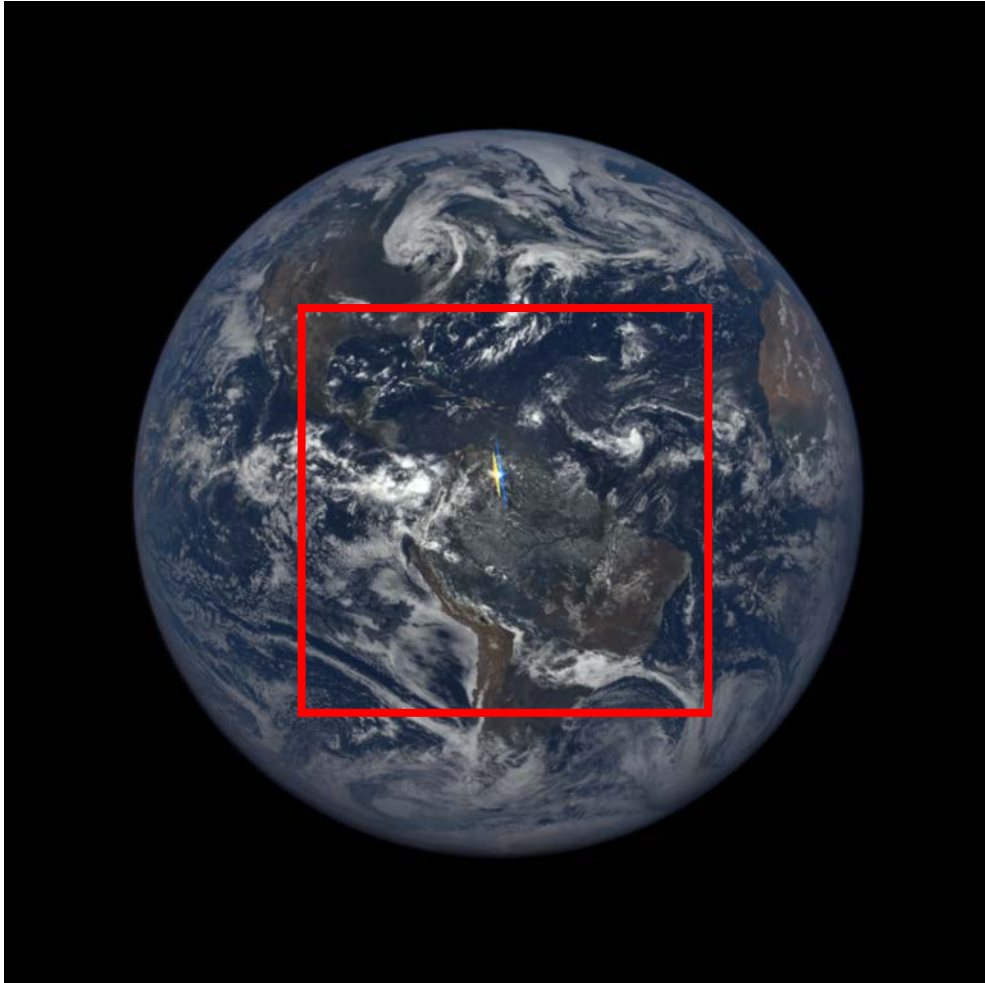
EPIC: Earth Polychromatic Imaging Camera

Colorful bright spot over Africa



2016 03 17, 09:46 UTC

Colorful bright spot over South America



2015 08 24, 16:35 UTC

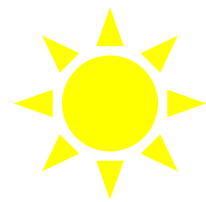
Glint from horizontal ice crystals in clouds (subsun)

Photo from aircraft

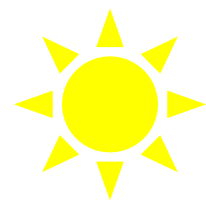
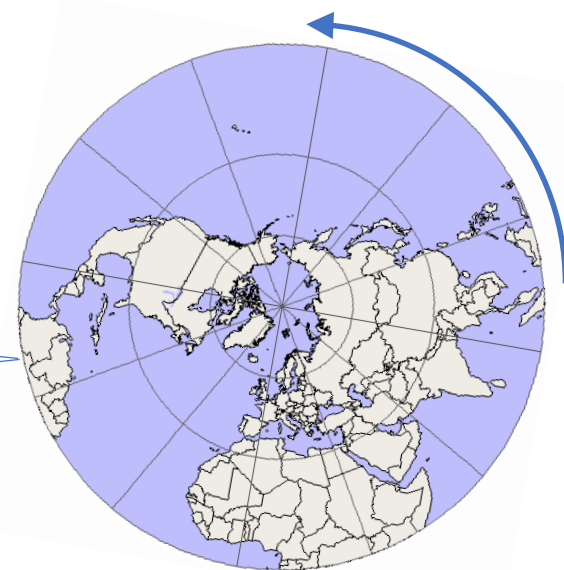


Glints appear colorful, as the Earth turns between blue & red images

Time of blue image



DSCOV



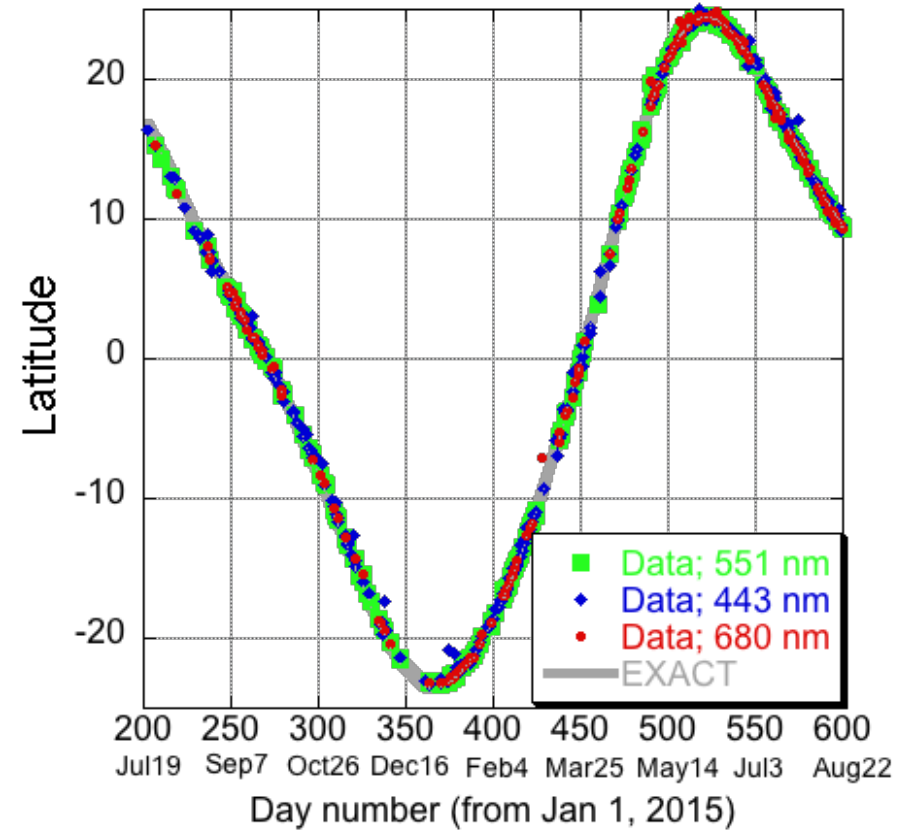
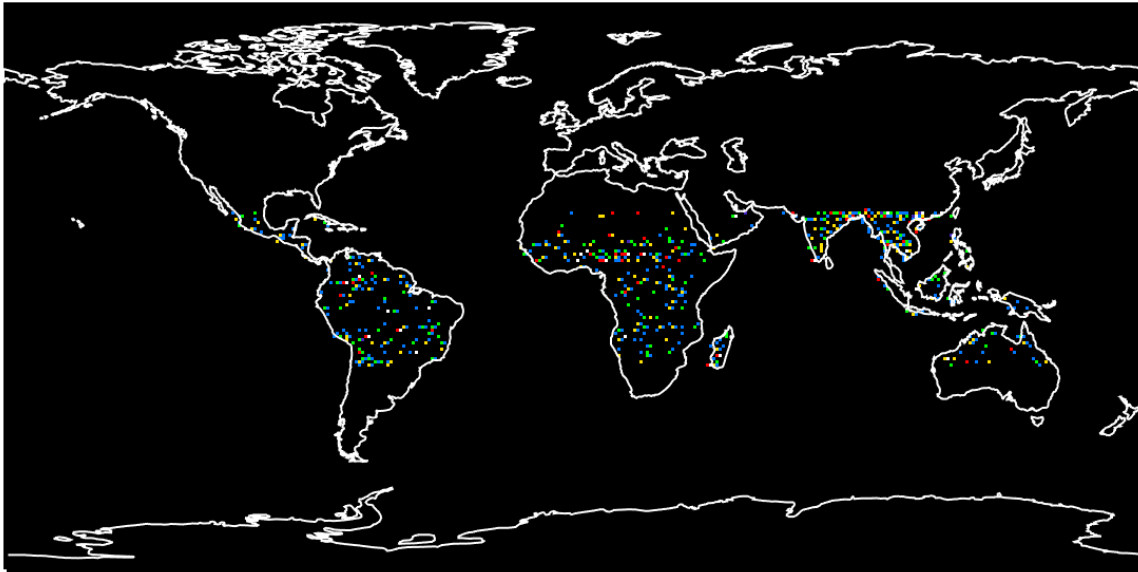
DSCOV



Time of red image
(≈ 4 minutes later)

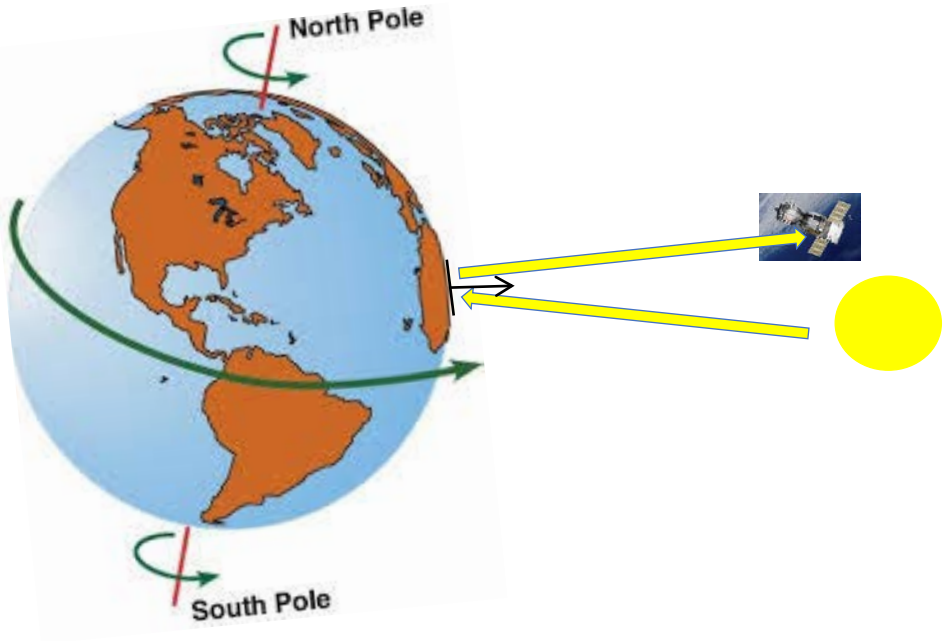
Glint shifts by ≈ 100 km

Location of glints observed over land during a year

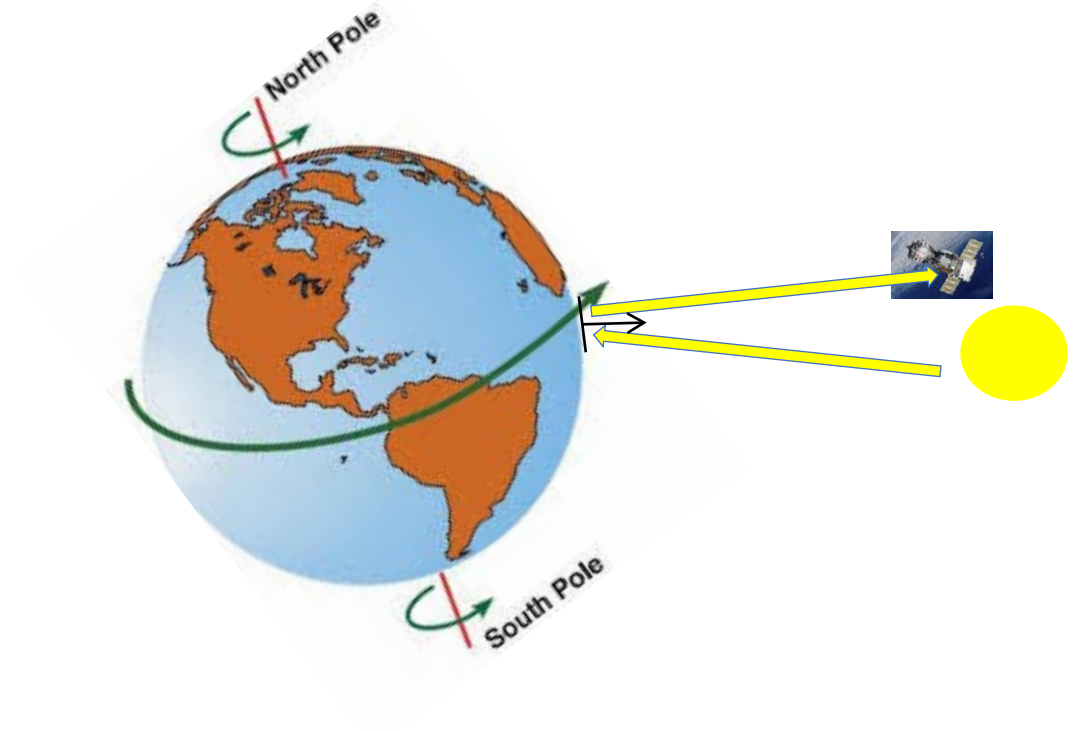


Latitude of expected glints varies through the year

Northern summer

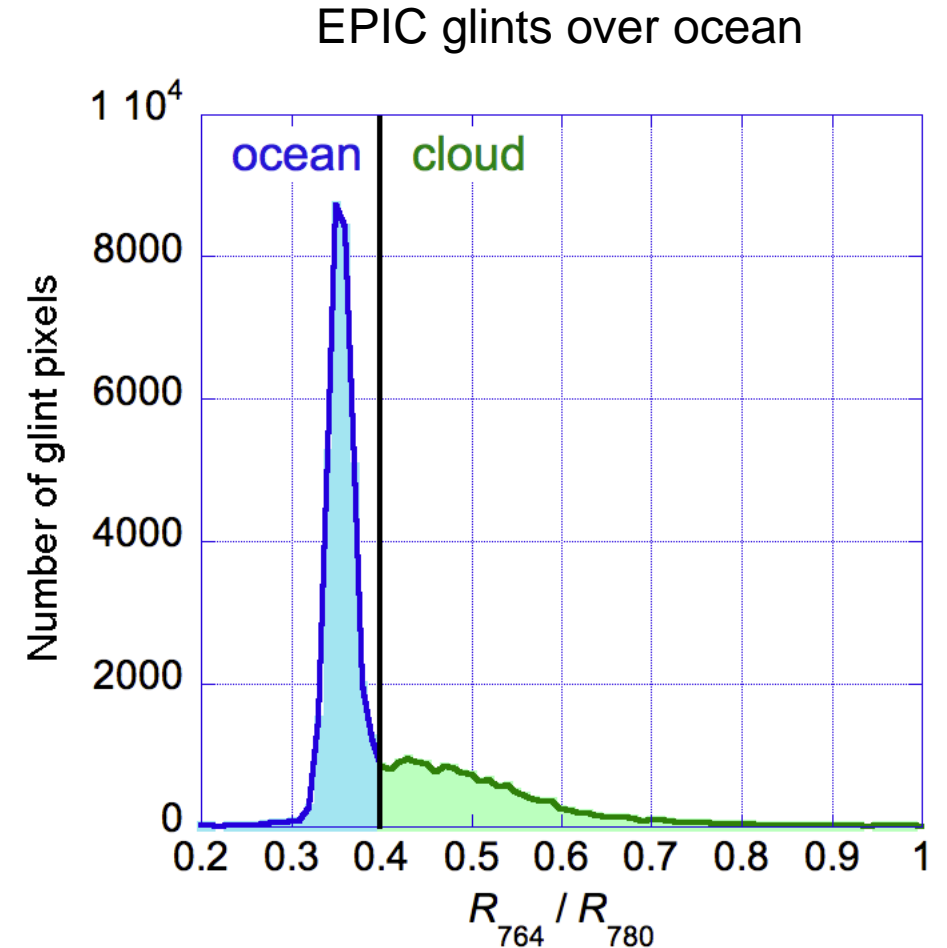
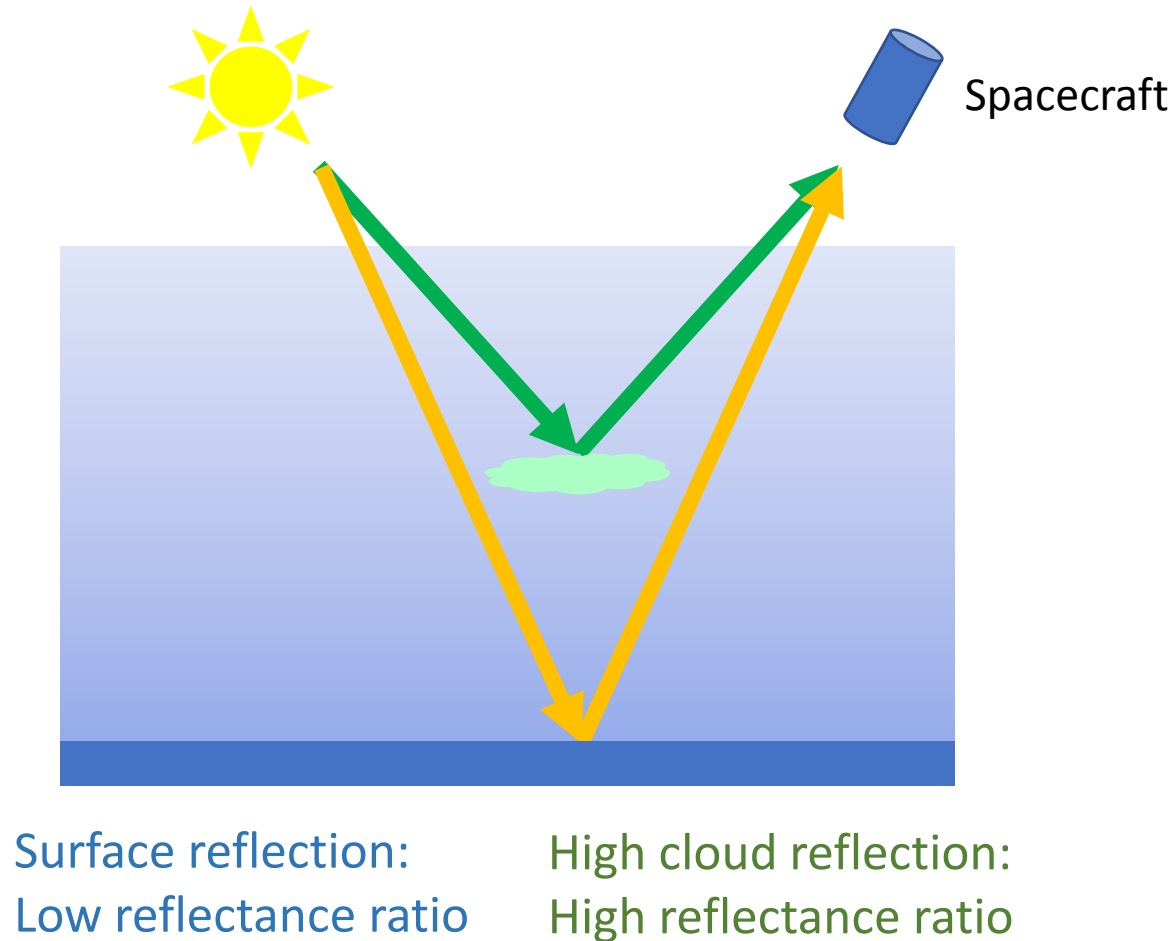


Northern winter



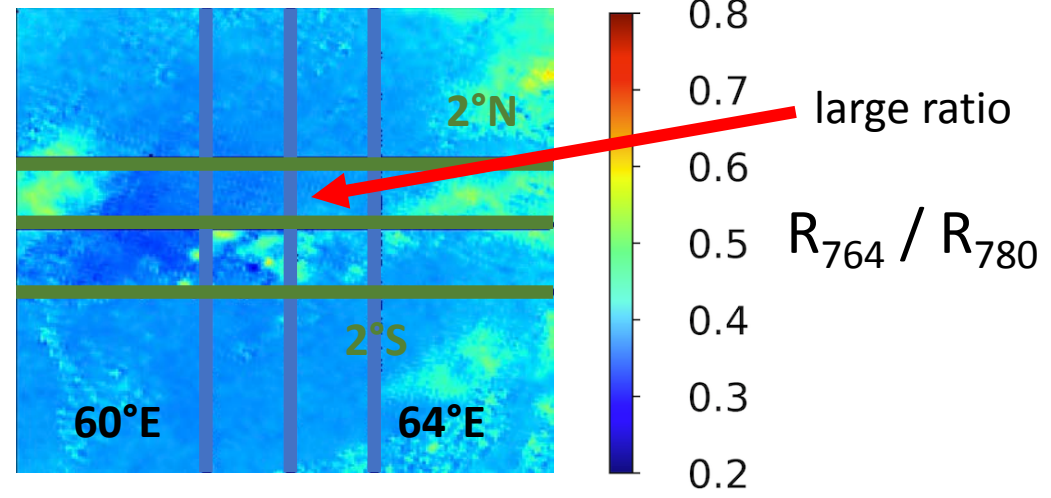
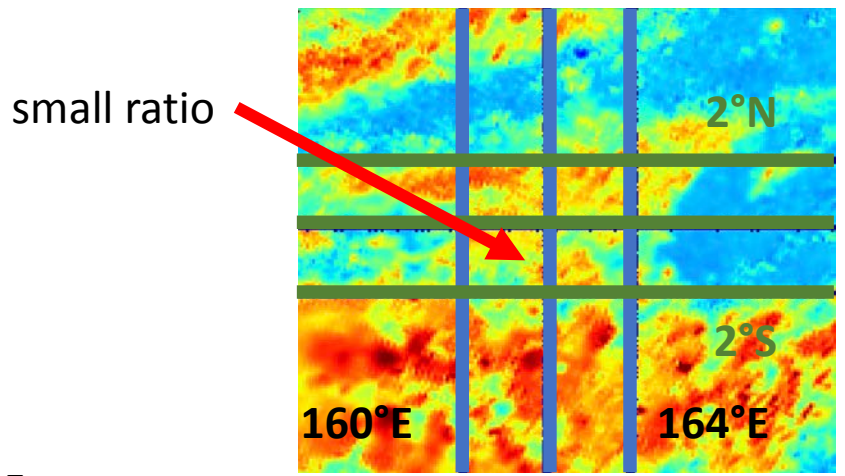
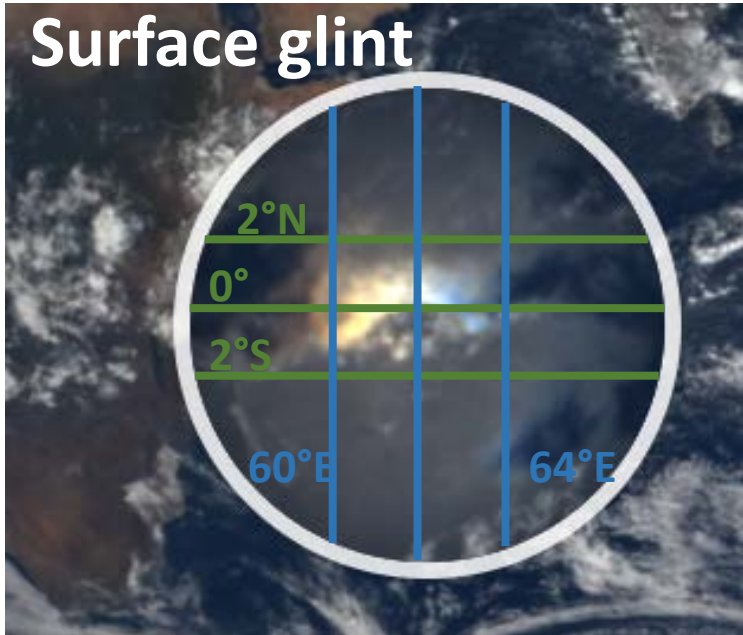
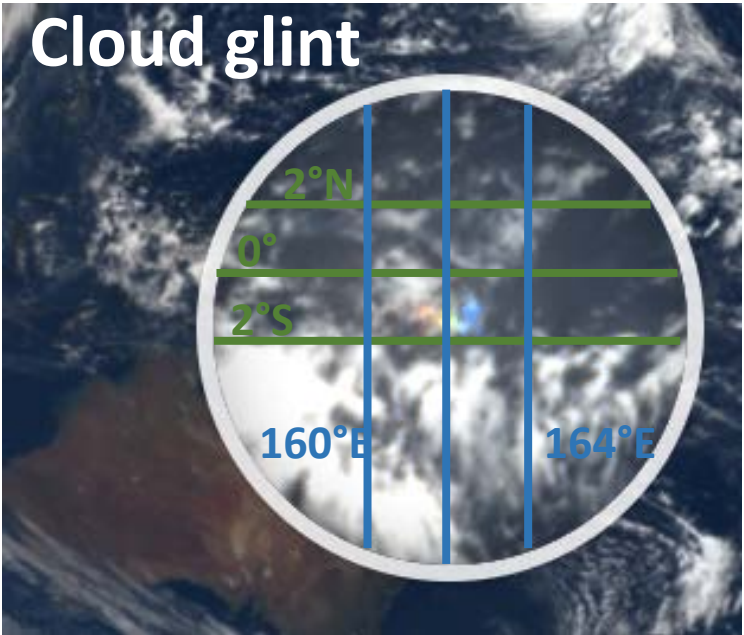
Oxygen absorption bands can reveal altitude of glints

$$\text{Ratio} = I_{\text{abs}} / I_{\text{non-abs}}$$

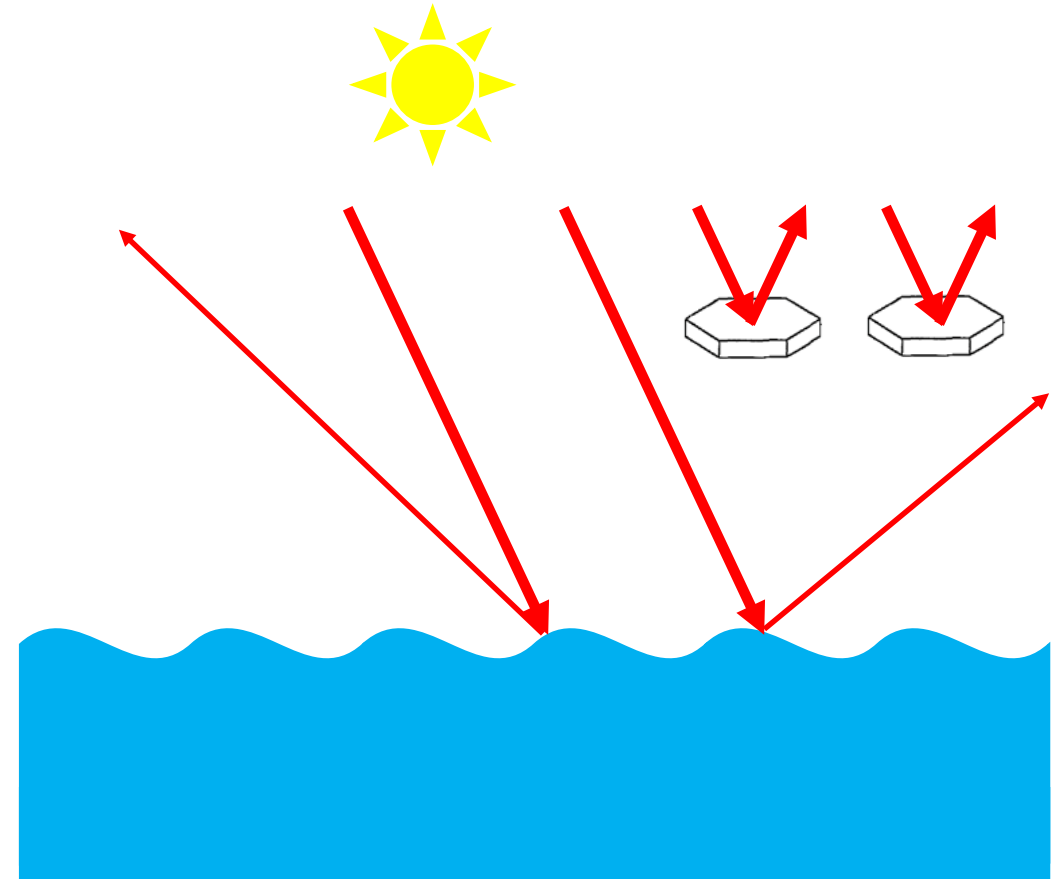
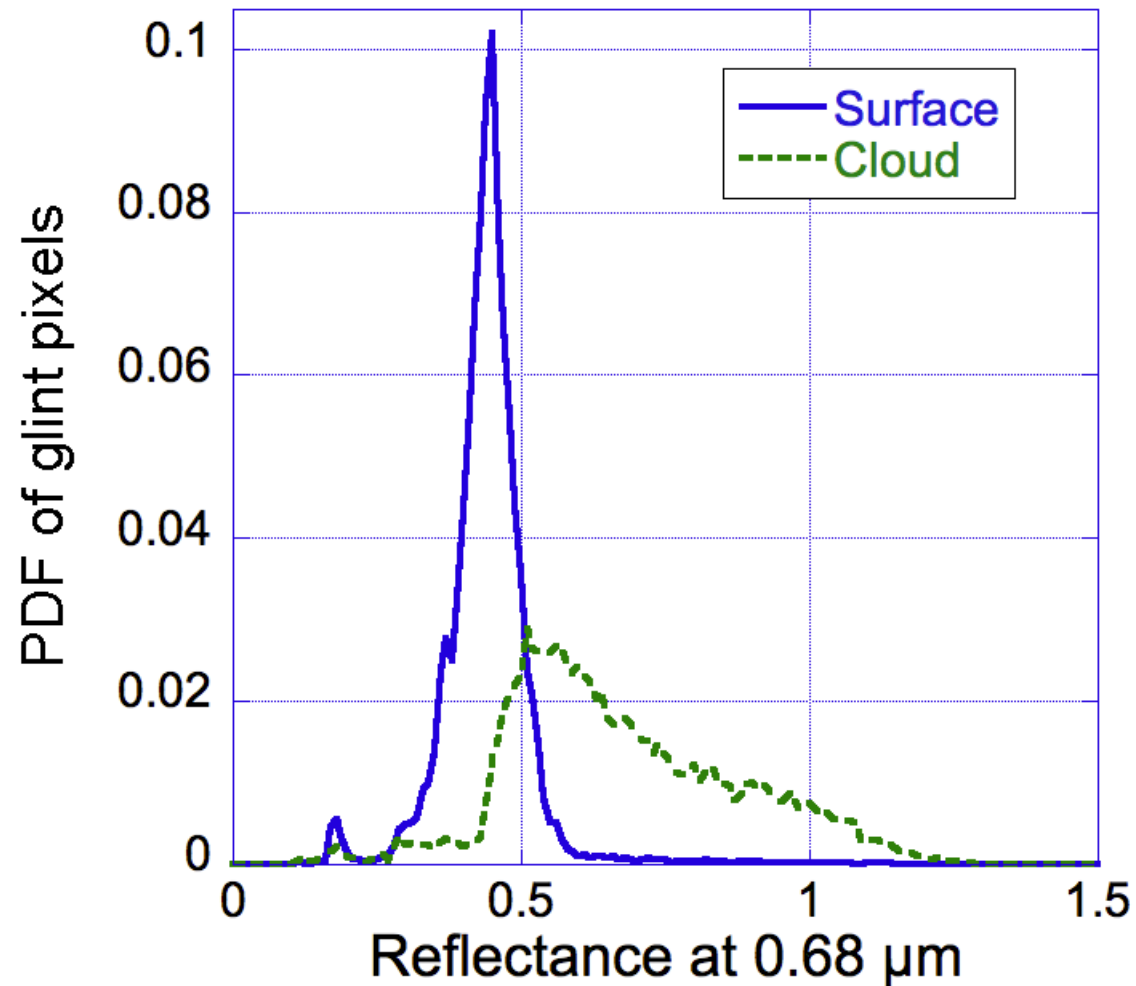


1 year long dataset

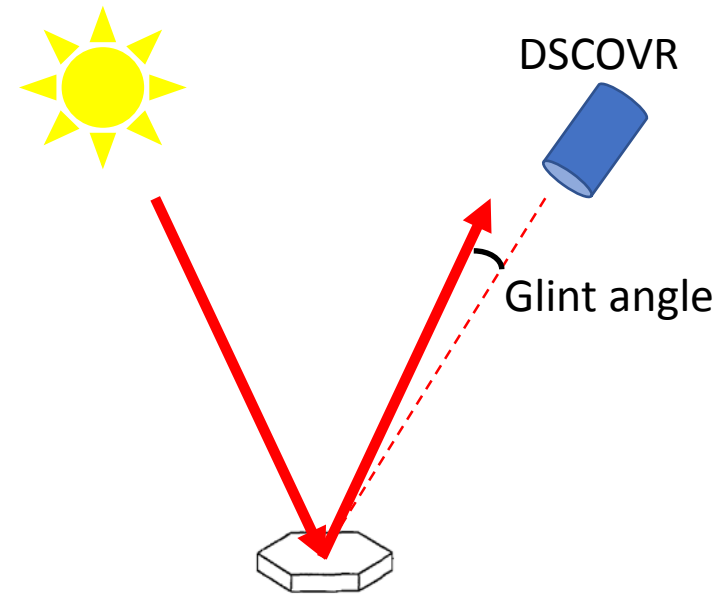
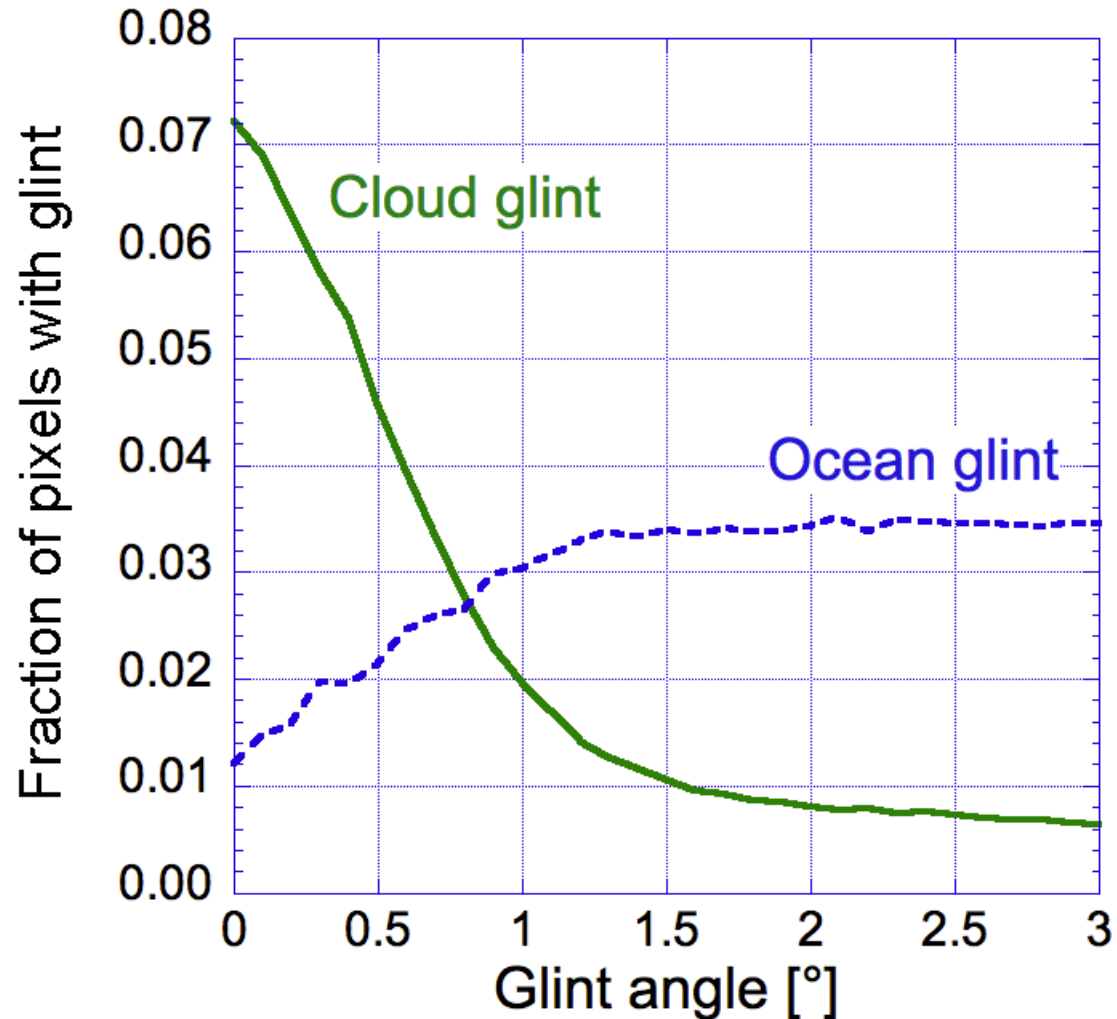
Comparison of a cloud glint and a surface glint



Red glints are brighter from clouds than from ocean



Cloud glints are narrow and fairly frequent in ice clouds



- At potentially ideal glint locations over ocean, cloud glint is detected for 6% of EPIC pixels
- MODIS ice cloud fraction: 22%
- Glint is detected in roughly $\frac{1}{4}$ of ice clouds

Summary

- Many DSCOVR/EPIC images contain colorful bright spots over land and ocean.
- Analysis of sun-view geometry and O₂ absorption bands demonstrate that these spots are caused by specular reflection from water surfaces and from horizontally oriented ice platelets floating in clouds.
- Over ocean, cloud glints are detected in roughly 6% of pixels or 1/4 of ice clouds at the locations where EPIC can observe specular reflection.
- Such observations can help to constrain the likelihood of oriented ice crystals and their contribution to Earth's albedo.
- Glint observations may even help in characterizing exoplanets.

Marshak, A., T. Várnai, and A. Kostinski (2017), Terrestrial glint seen from deep space: Oriented ice crystals detected from the Lagrangian point, *Geophys. Res. Lett.*, **44**, doi:10.1002/ 2017GL073248.