

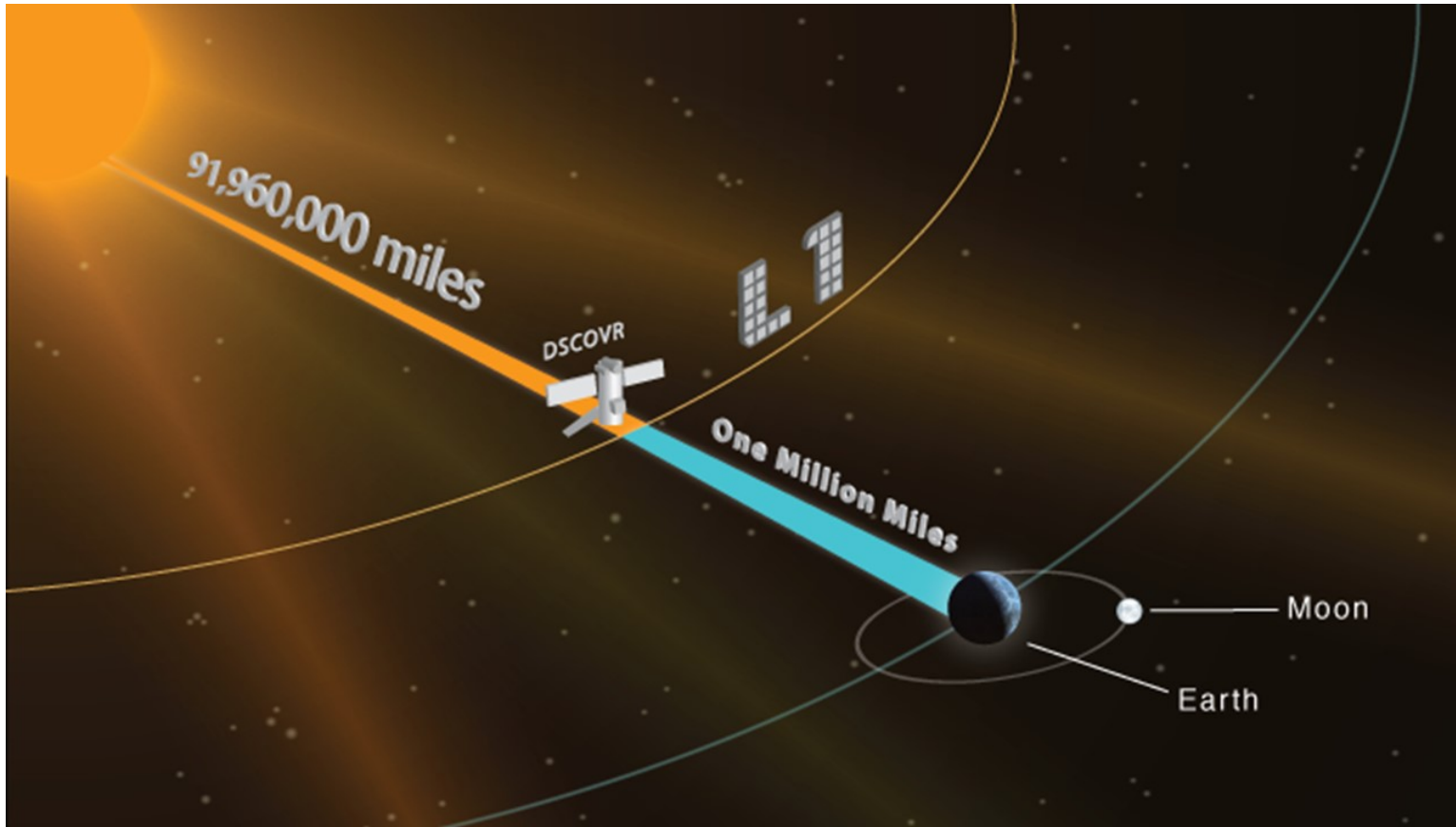


# Deep space observations of sun glint over oceans

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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

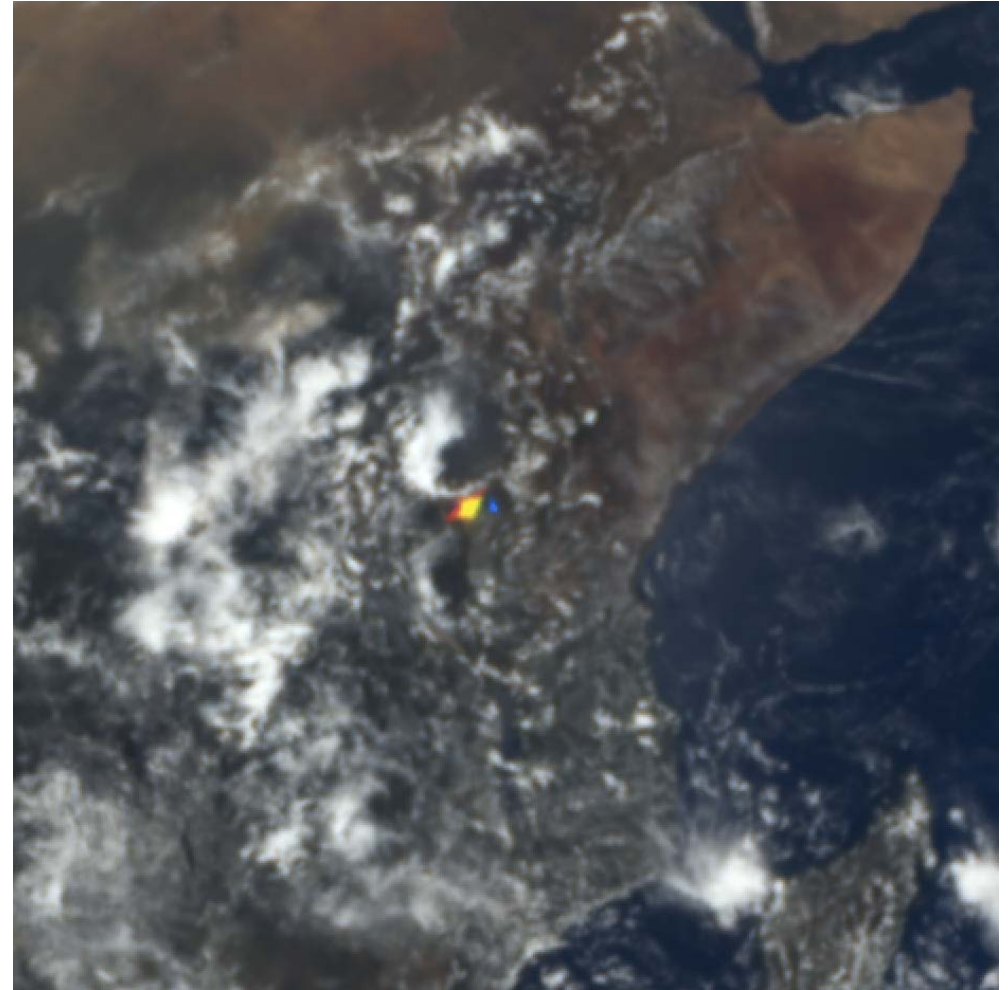
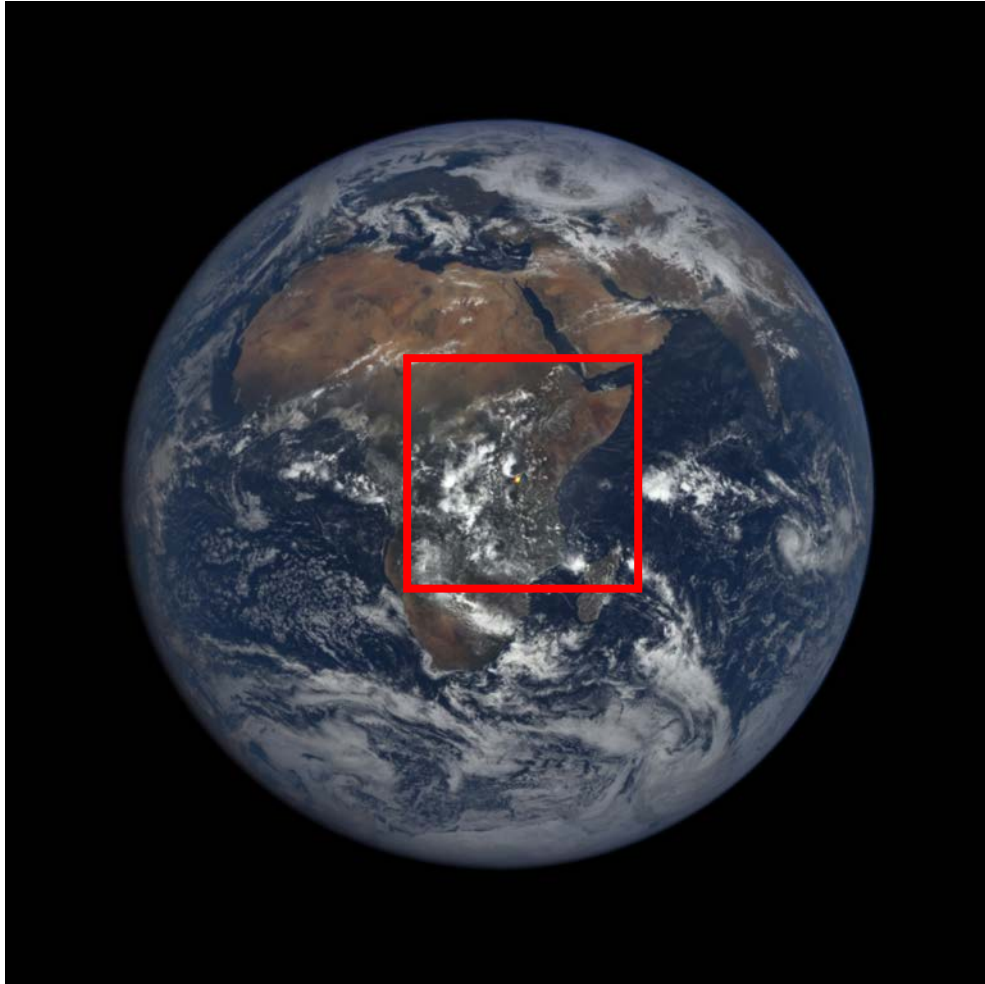


2016 05 29

EPIC: Earth Polychromatic Imaging Camera

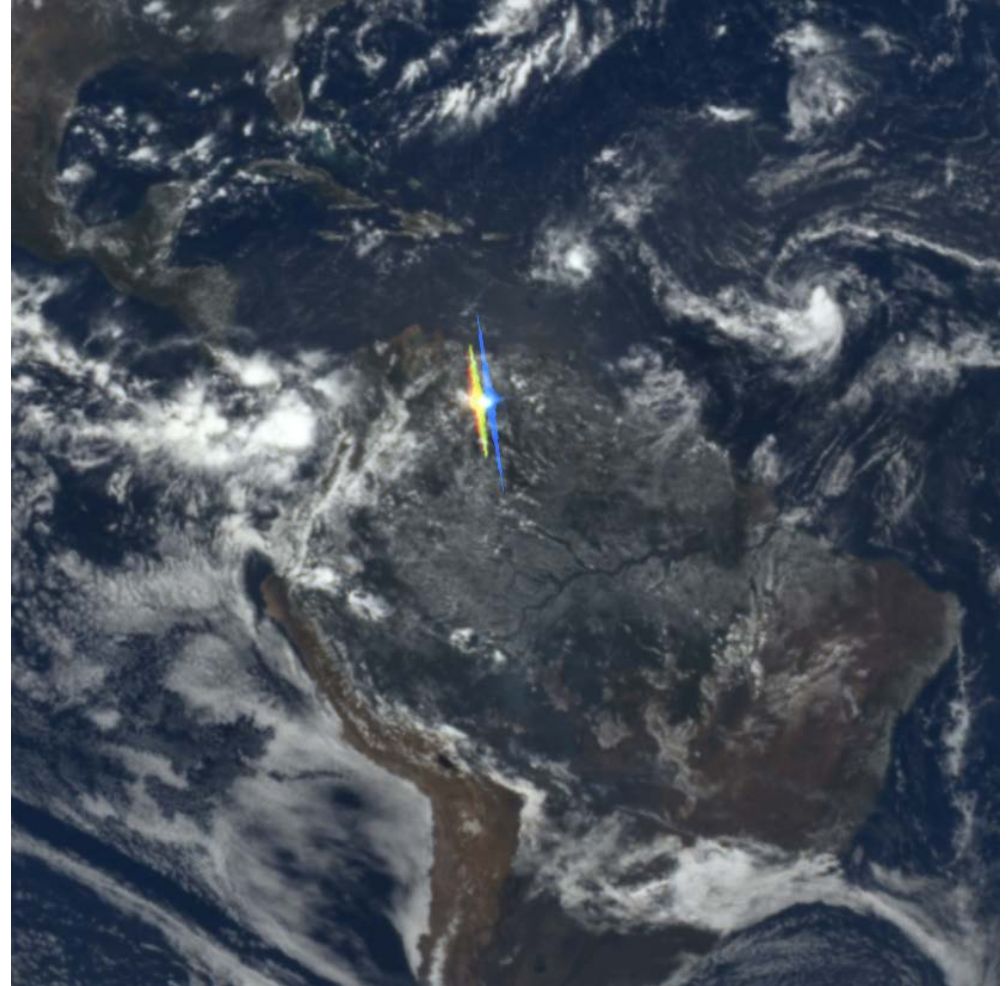
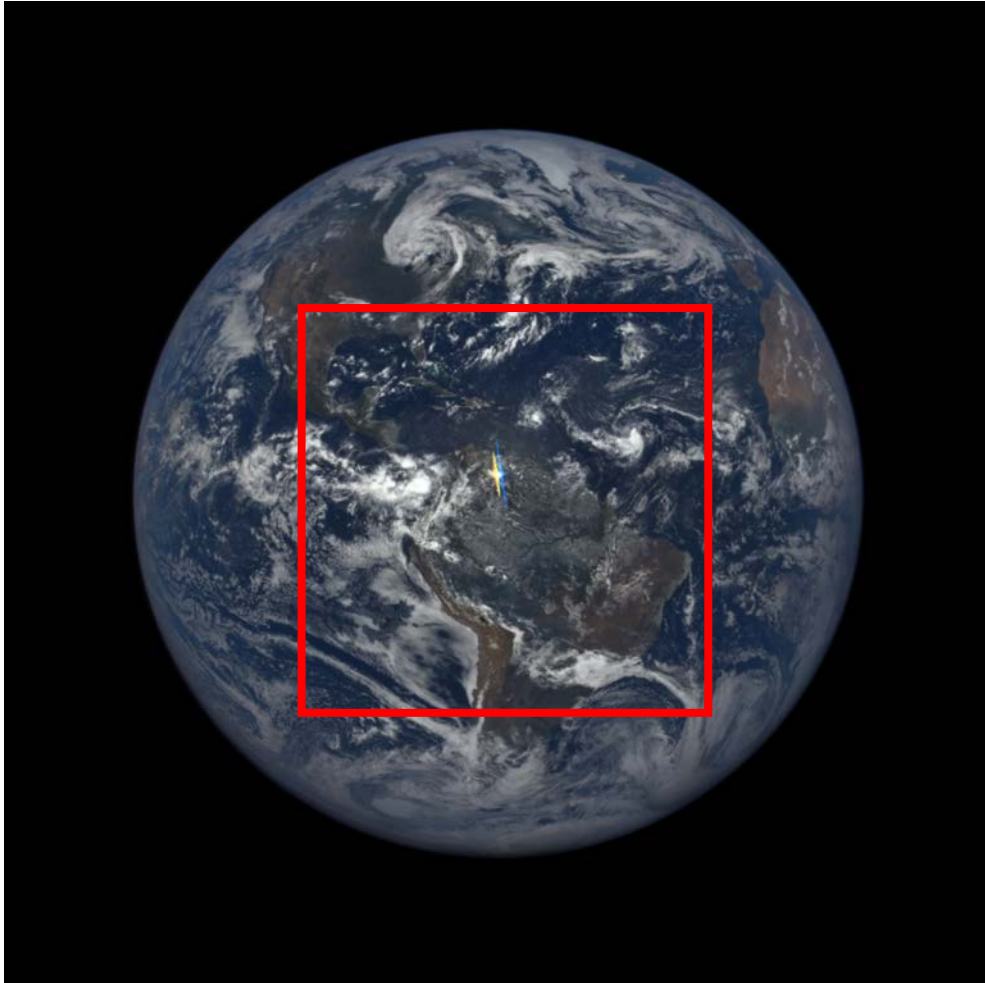


# Colorful bright spot over Africa



2016 03 17, 09:46 UTC

# Colorful bright spot over South America



2015 08 24, 16:35 UTC

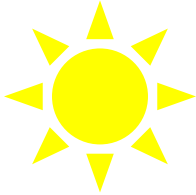
# Glint from horizontal ice crystals in clouds (subsun)

Photo from aircraft

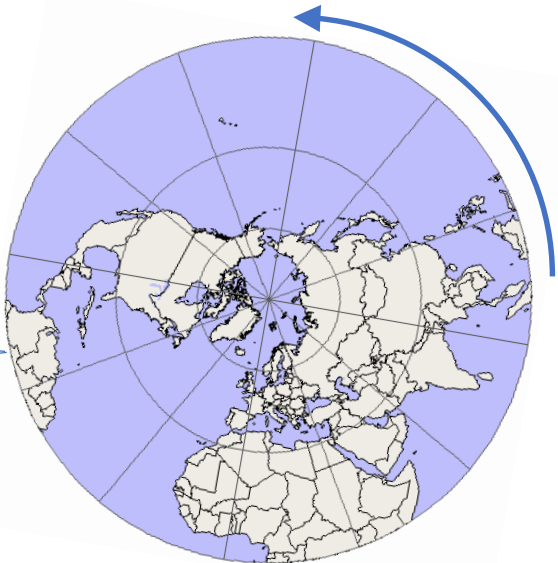


# Glints appear colorful, as the Earth turns between blue & red images

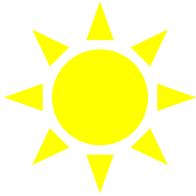
Time of blue image



DSCOVR



Time of red image  
(≈4 minutes later)  
Glint shifts by ≈ 100 km

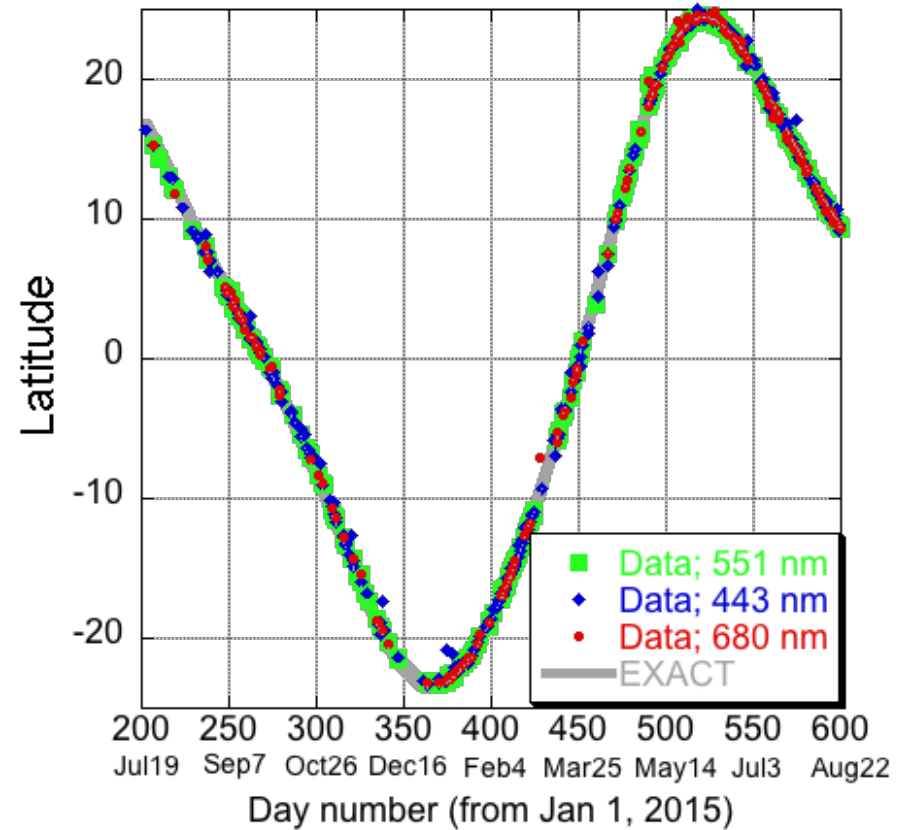
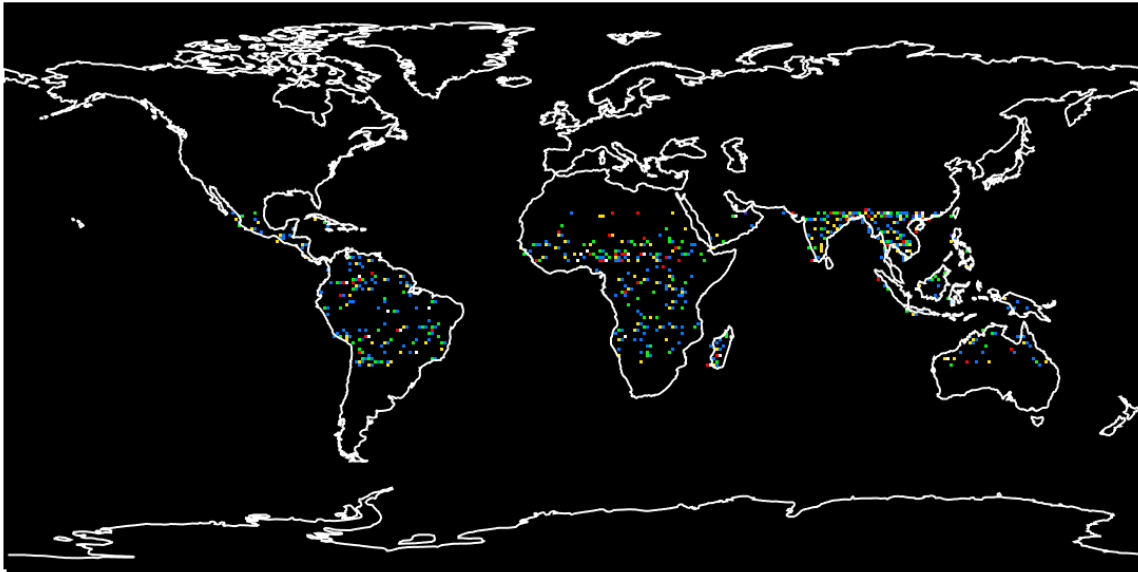


DSCOVR





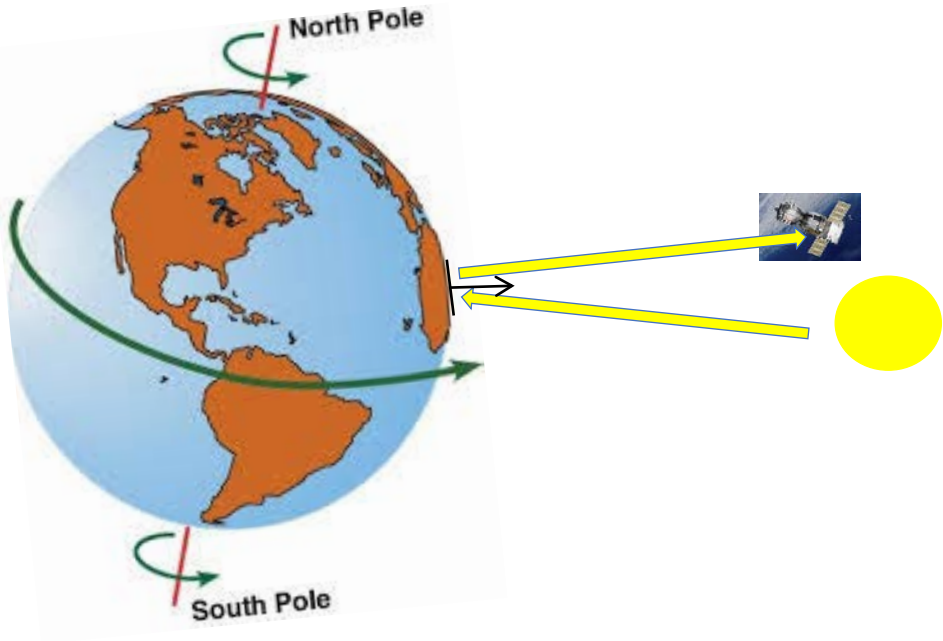
# Location of glints observed over land during a year



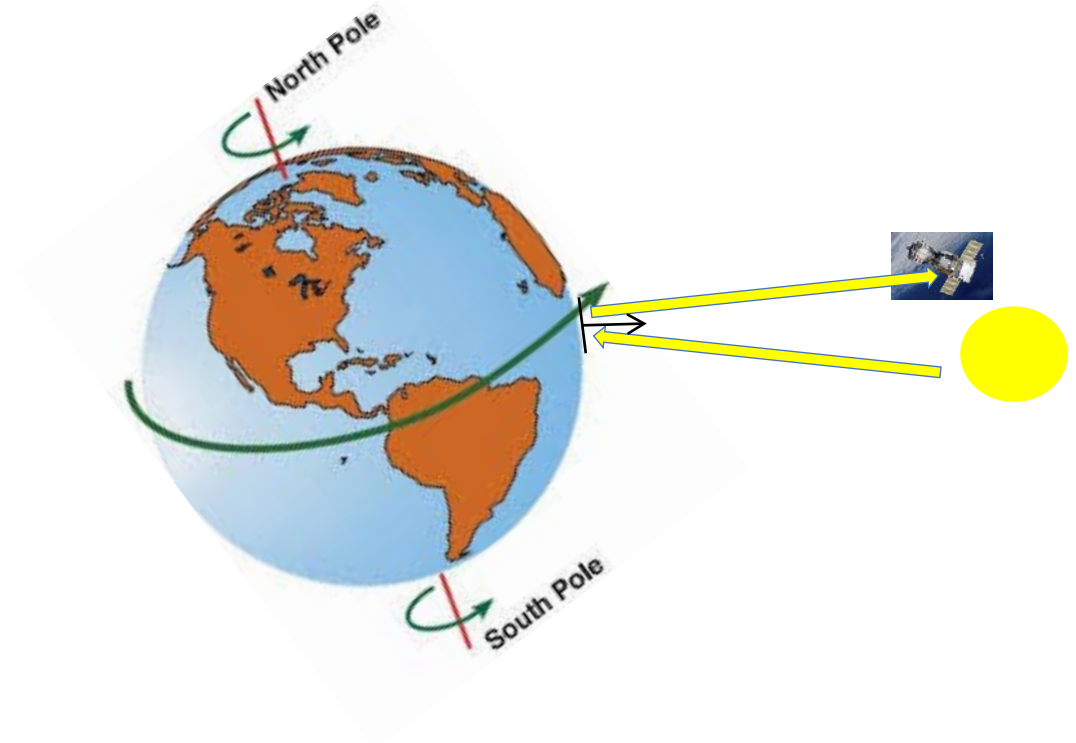


# Latitude of expected glints varies through the year

Northern summer

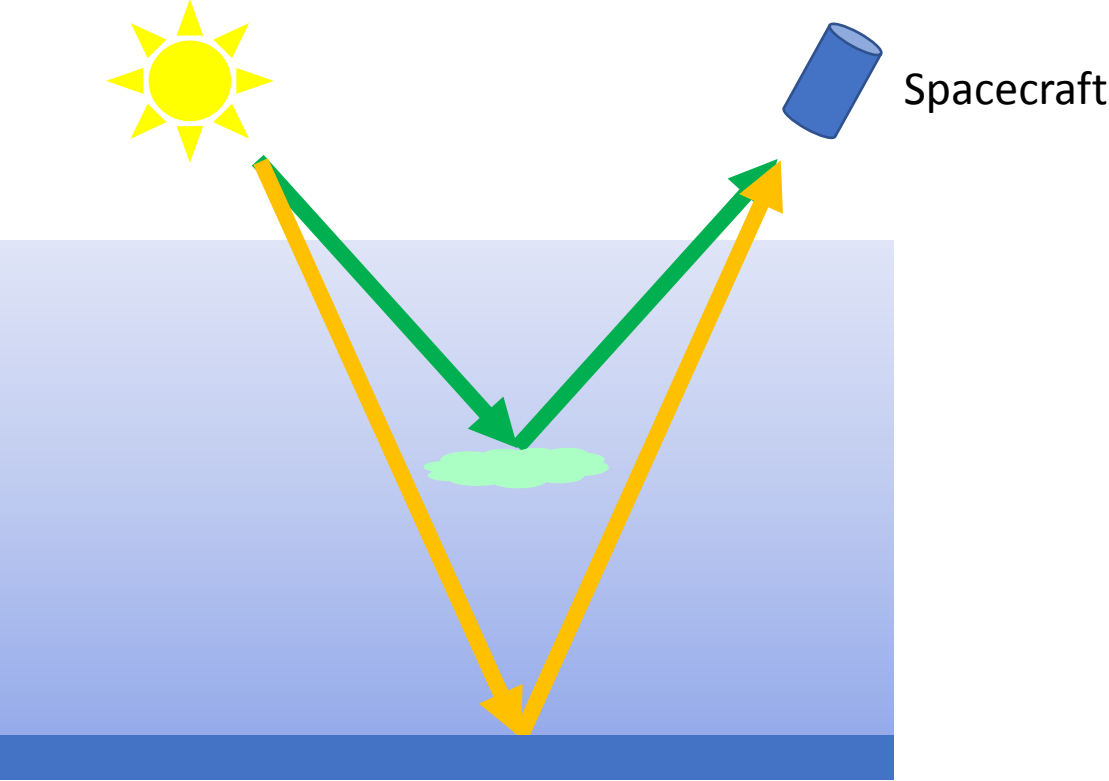


Northern winter



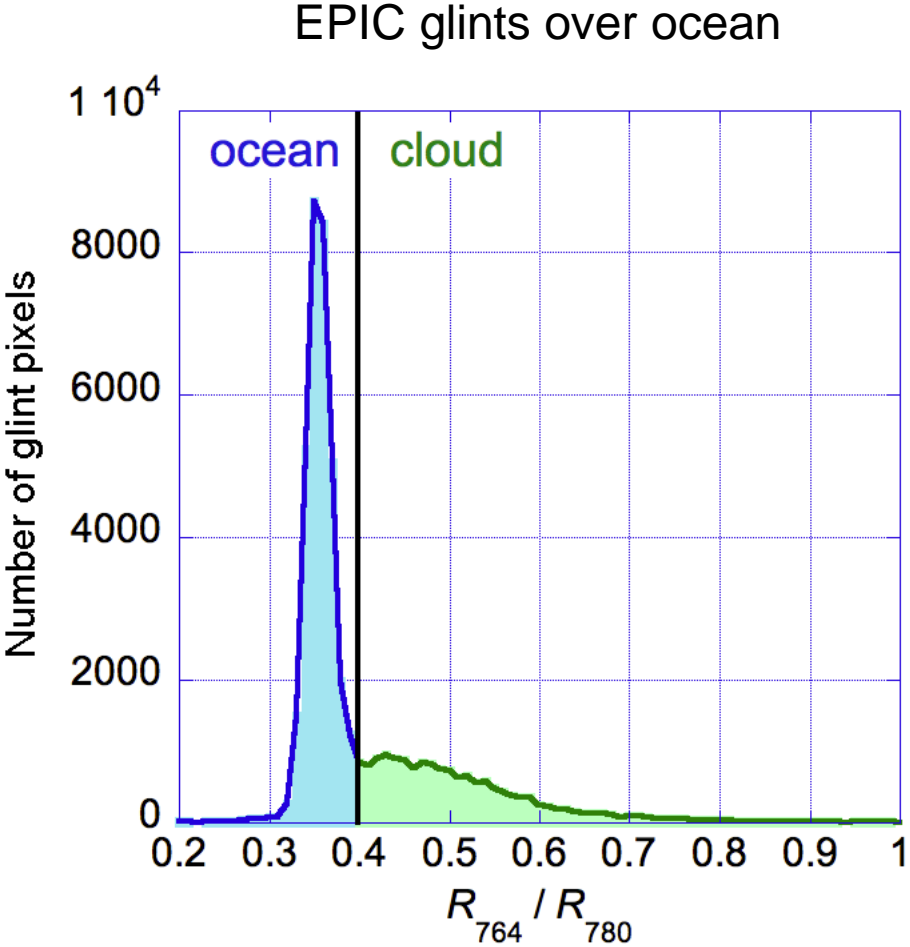
# Oxygen absorption bands can reveal altitude of glints

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



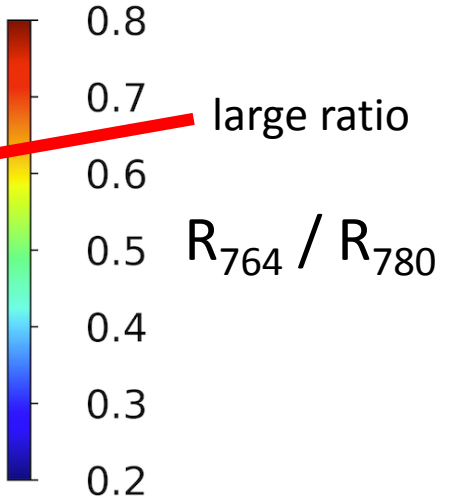
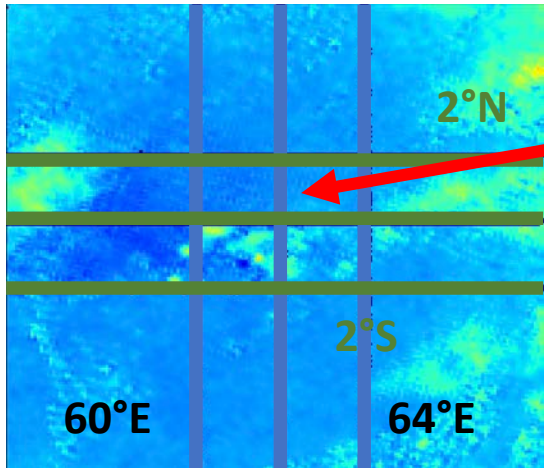
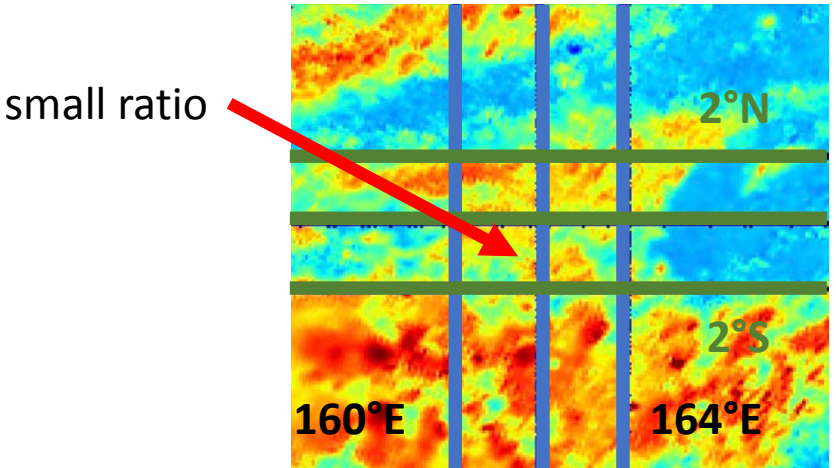
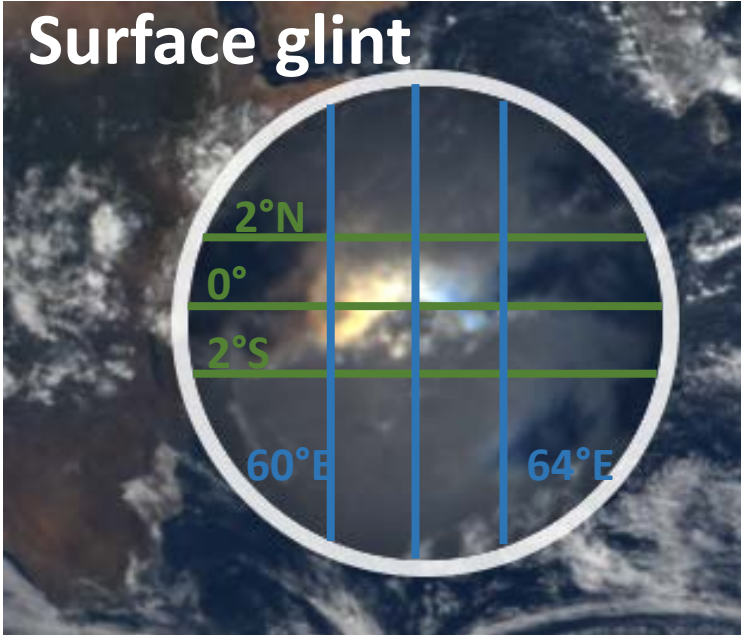
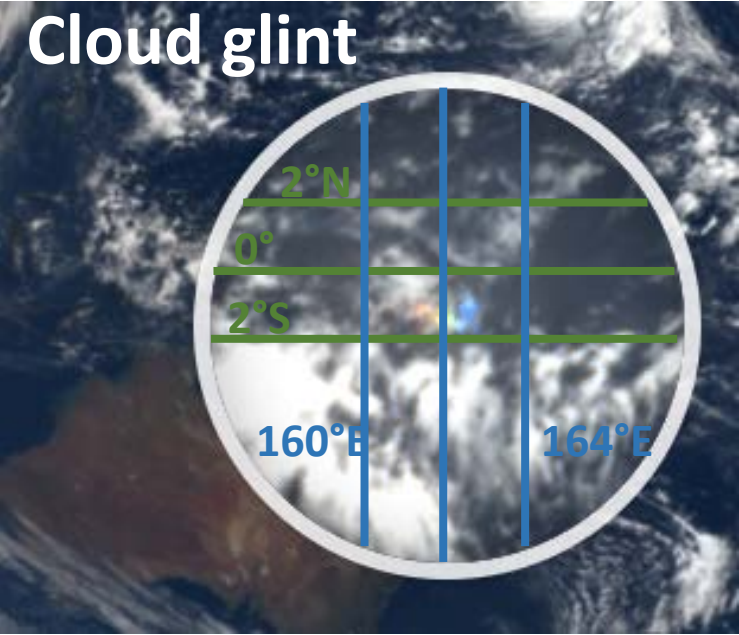
Surface reflection:  
Low reflectance ratio

High cloud reflection:  
High reflectance ratio

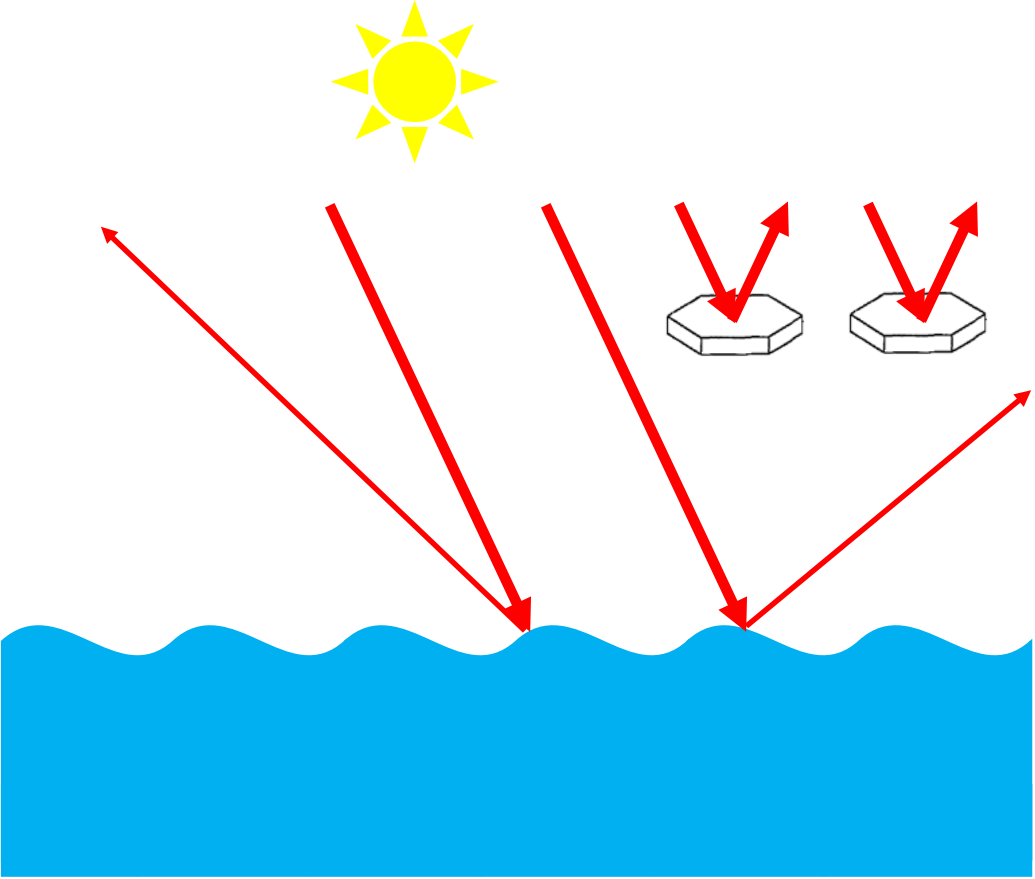
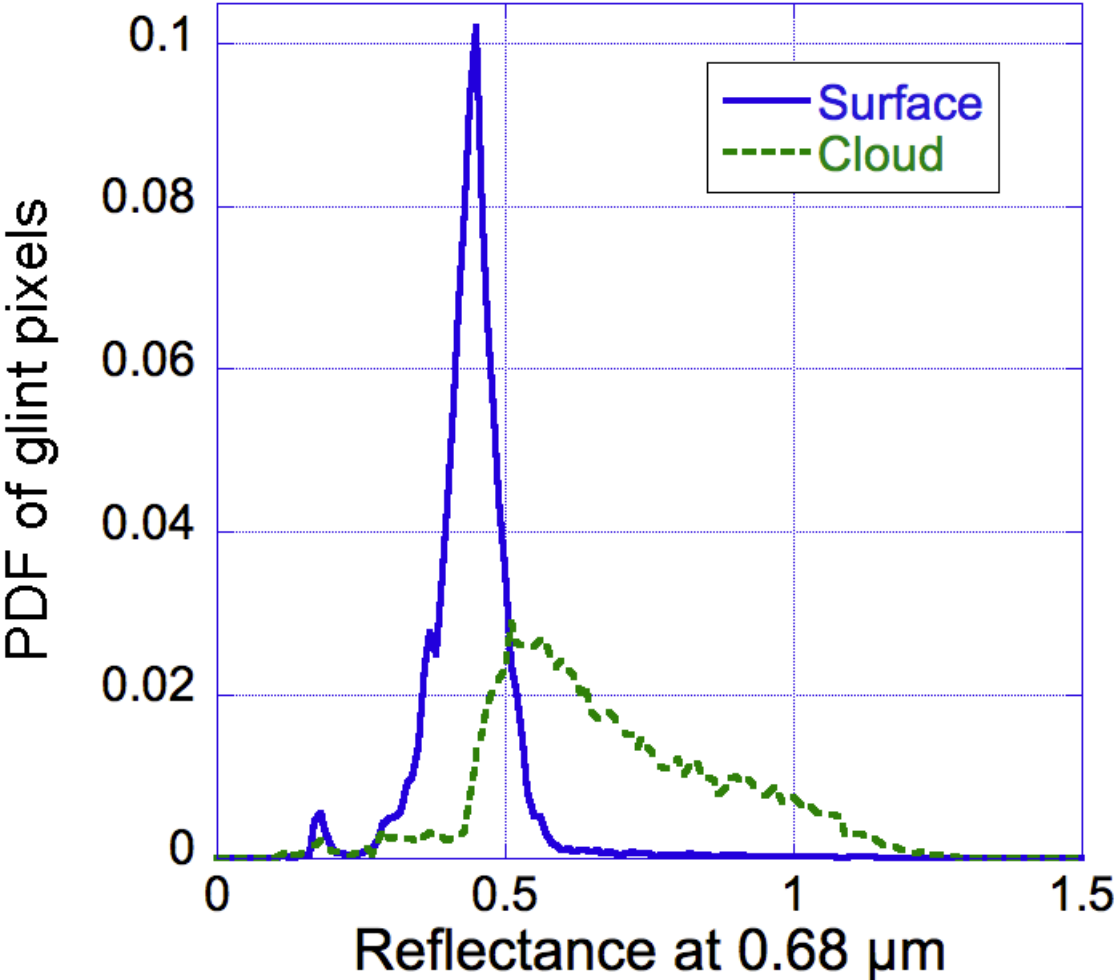


1 year long dataset

# Comparison of a cloud glint and a surface glint

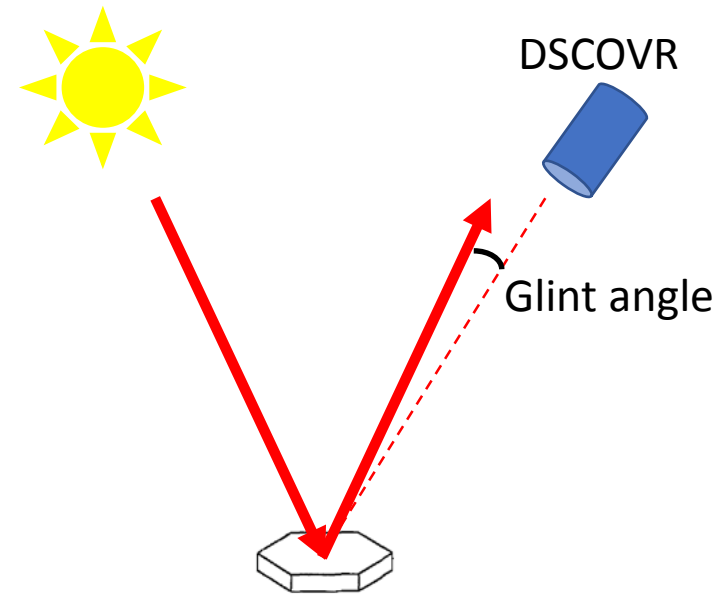
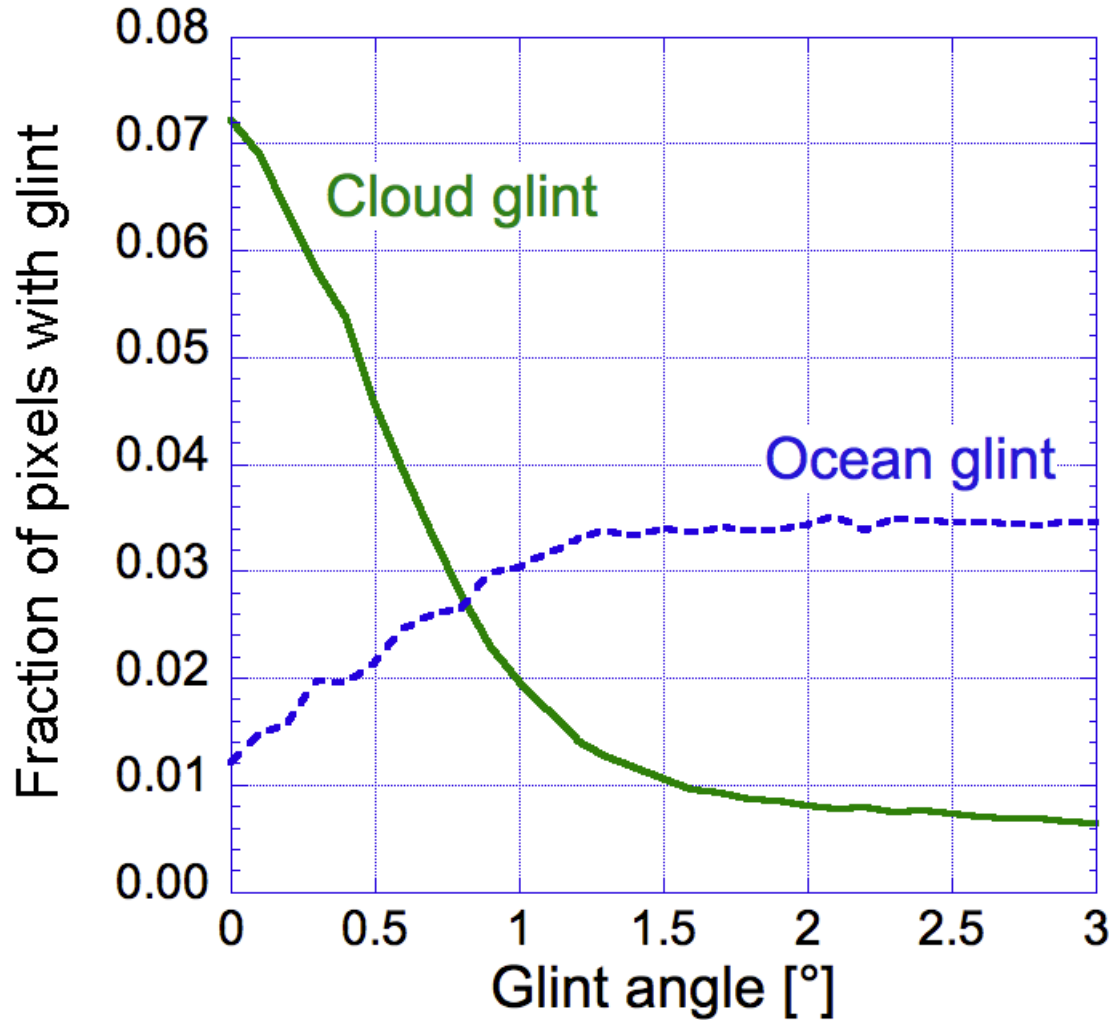


# Red glints are brighter from clouds than from ocean





# 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 O<sub>2</sub> 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.