

Spaceborne observations of sun glint and near-cloud aerosols

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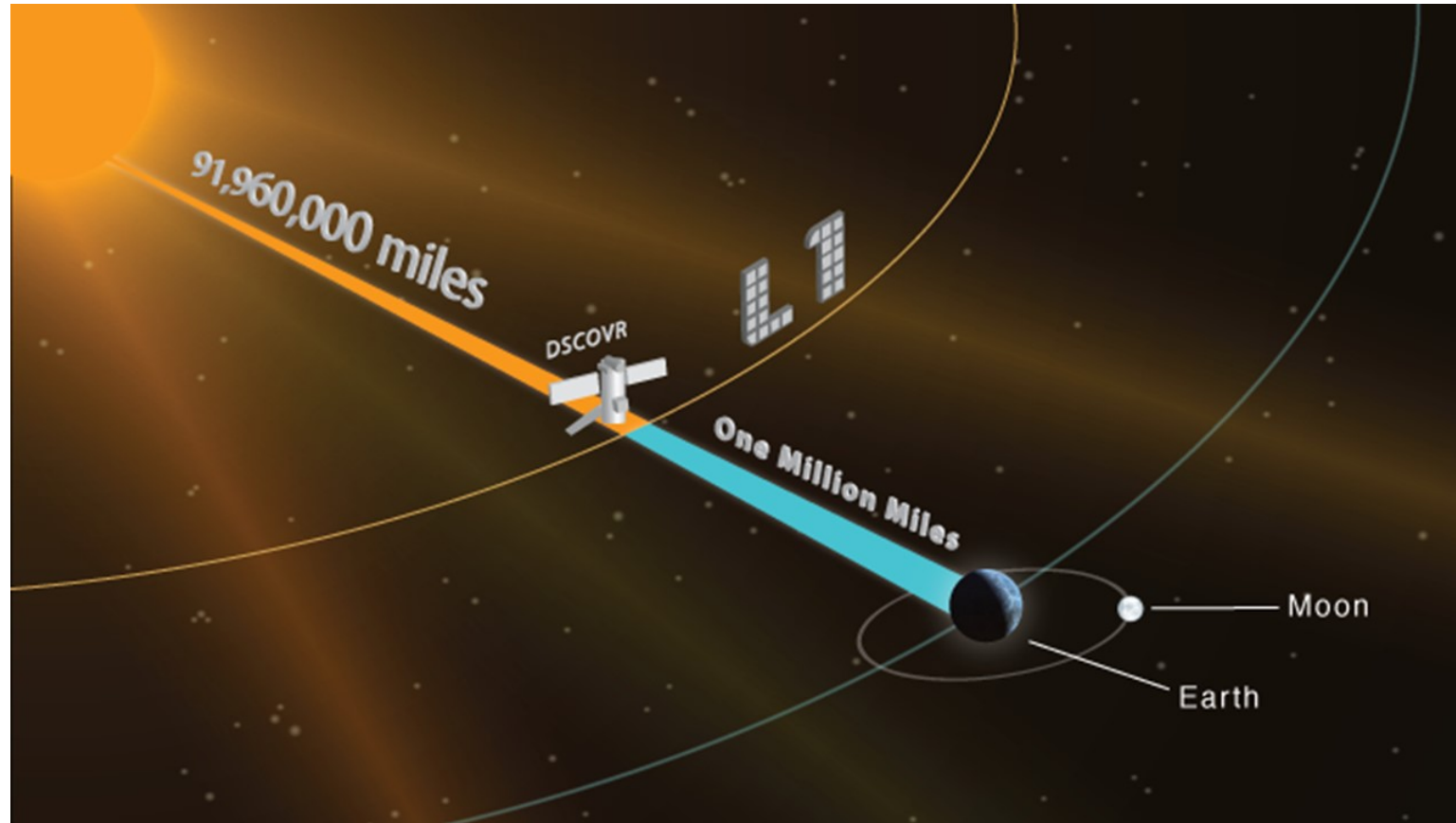
Earth Day tweet from Al Gore



DSCOVR's EPIC camera: images of Earth's sunlit side



The DSCOVR spacecraft is at the L1 Lagrangian point

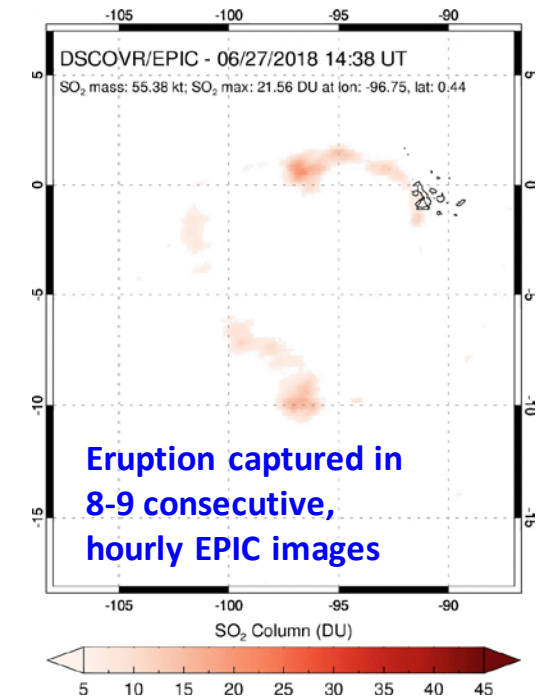
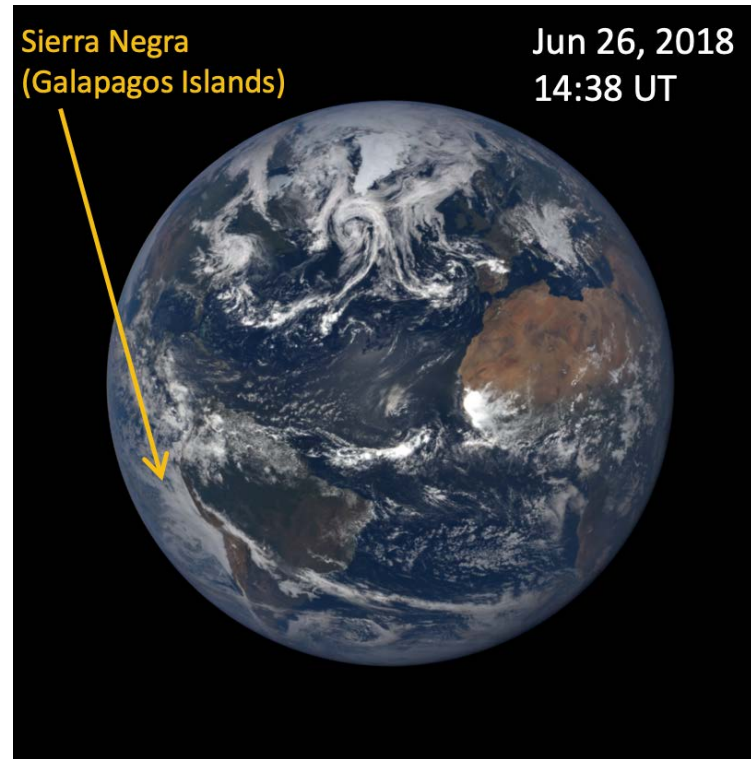


In 2018, [Epic.gsfc.nasa.gov](https://epic.gsfc.nasa.gov) was the 9th most popular NASA website



Many DSCOVR science products are available

- Ozone
- Volcanic SO₂
- UV aerosol
- Clouds
- Atmospheric correction
- Vegetation

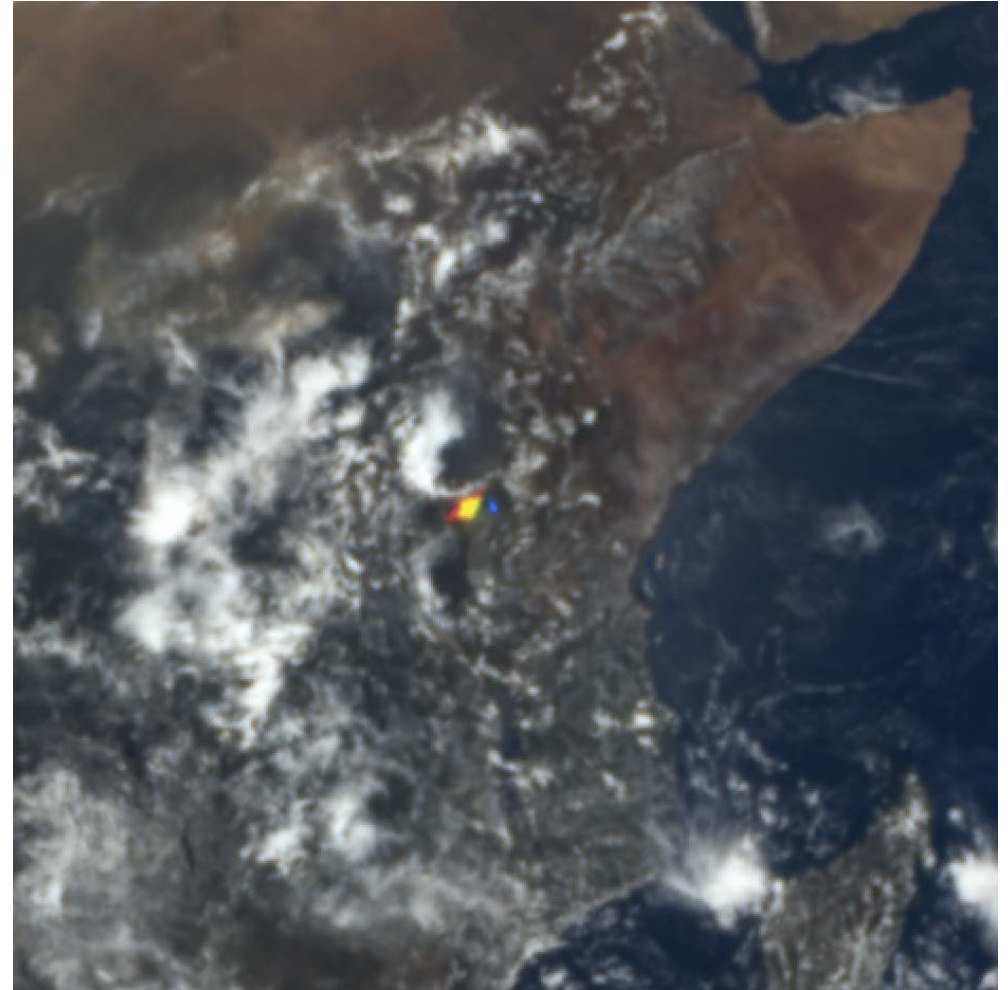
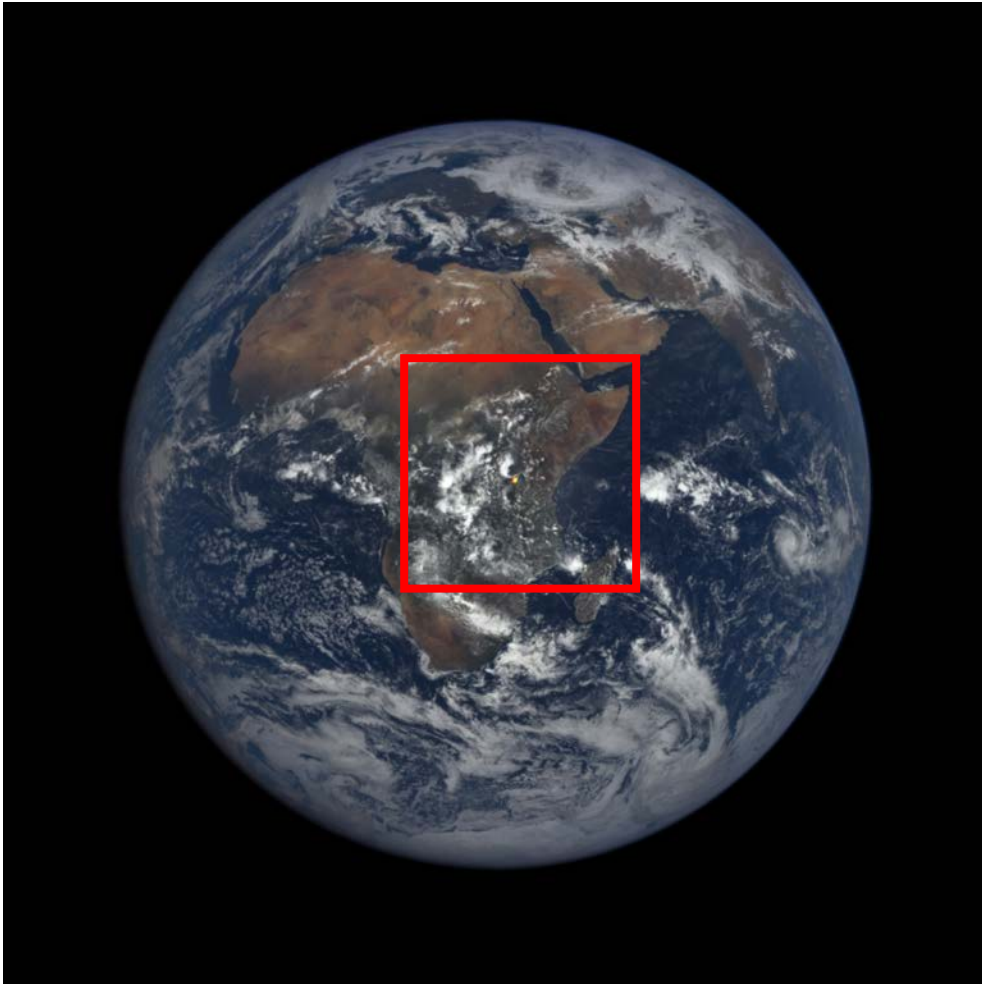


First observations of volcanic eruption clouds from the L1 Earth-Sun Lagrange point by DSCOVR/EPIC

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EPIC images often contain colorful bright spots



2016 03 17, 09:46 UTC

Likely cause of such spots: ice crystals in clouds

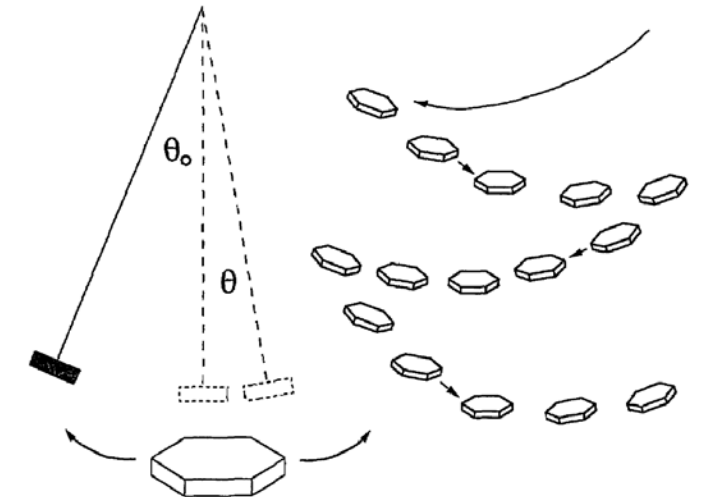
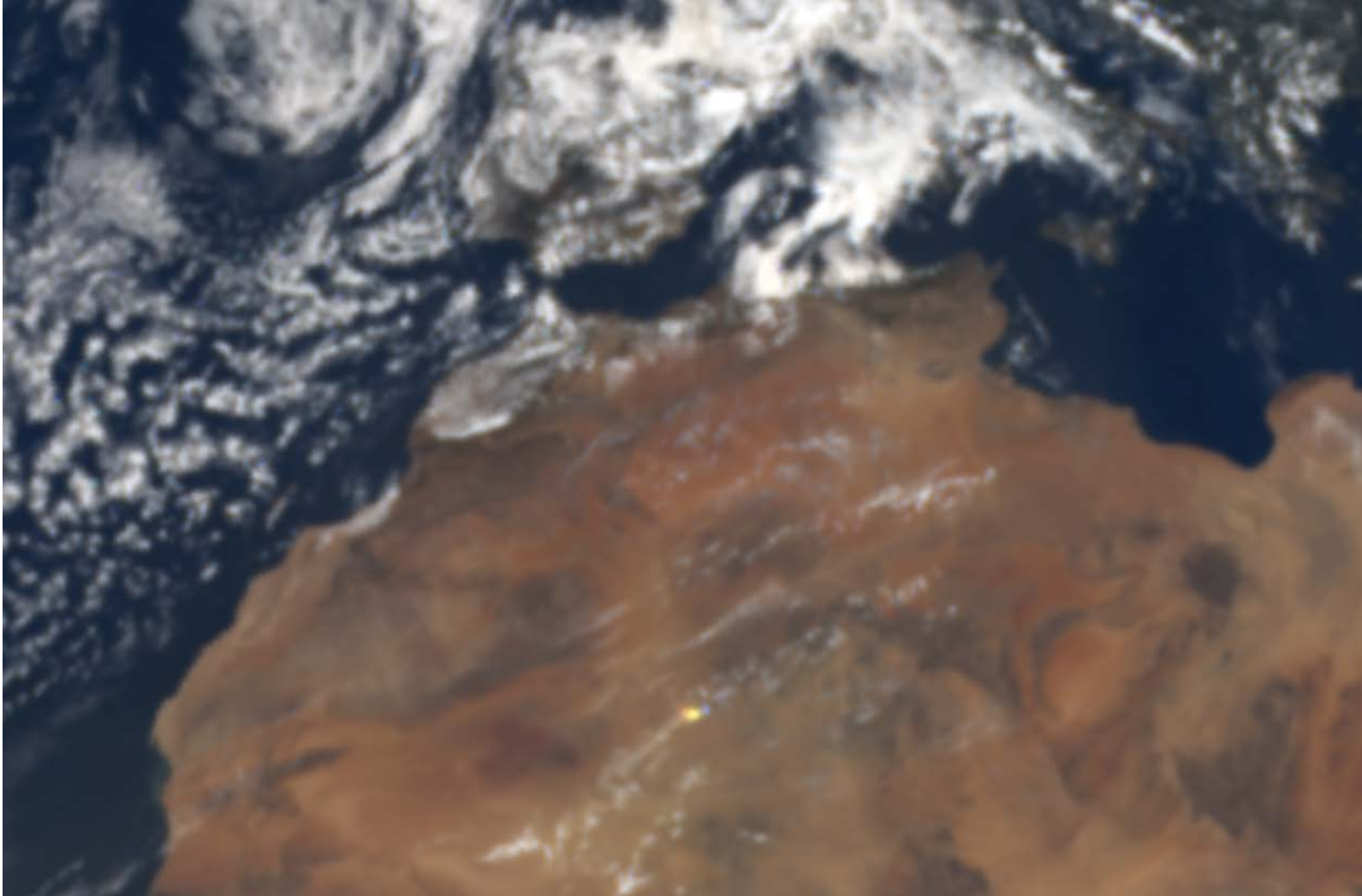


Fig. 8. Pendulum motion of a plate crystal.

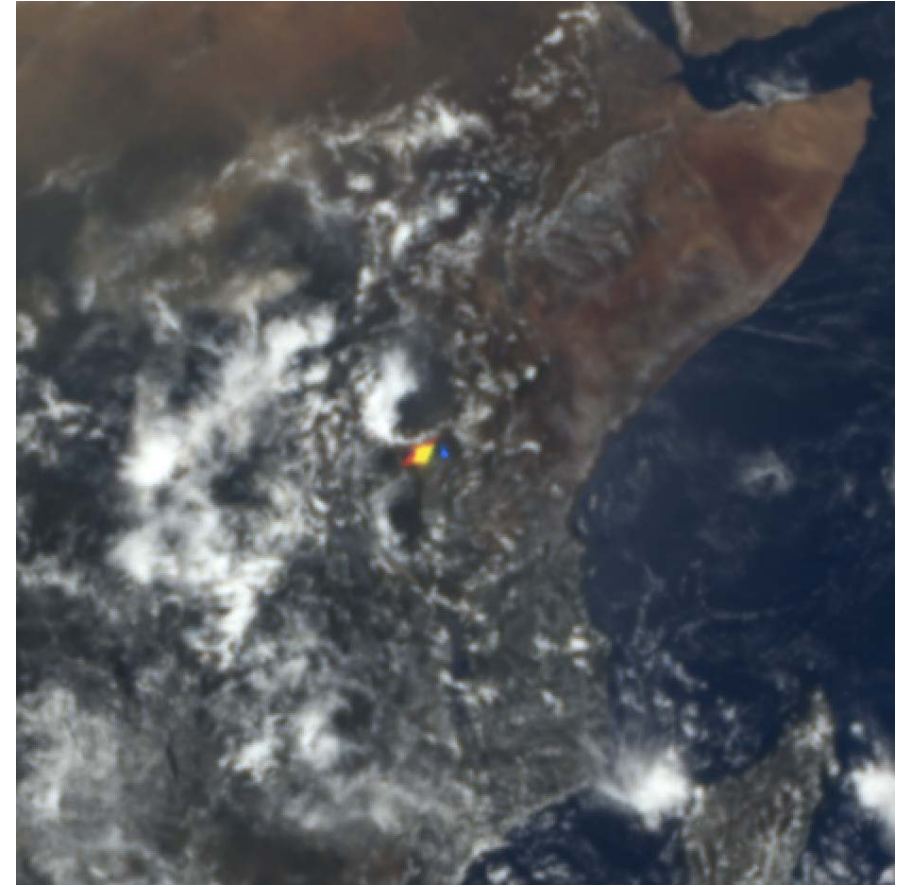
20 July 1994 / Vol. 33, No. 21 / APPLIED OPTICS 4583

Glint form horizontal ice crystals in clouds (subsun)

Photo from aircraft



EPIC image

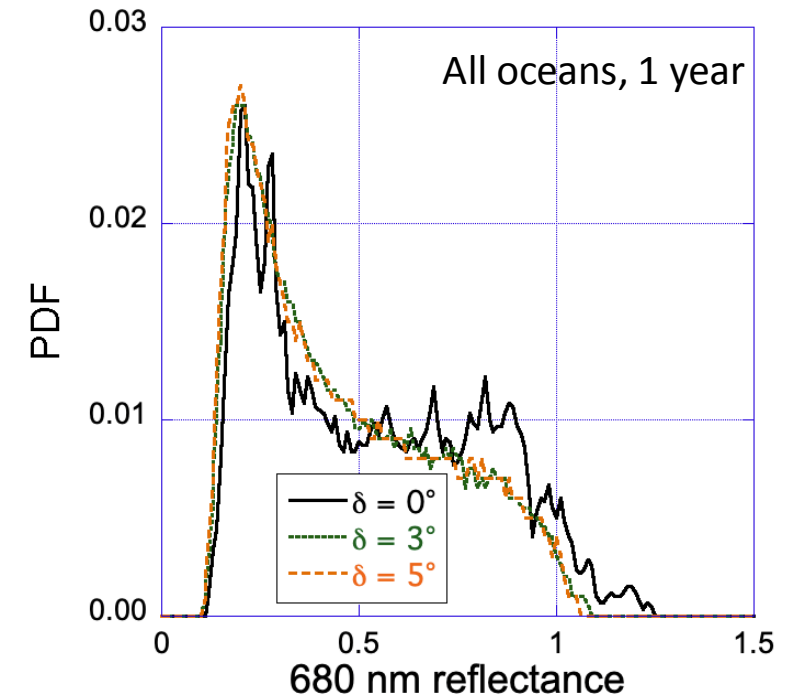
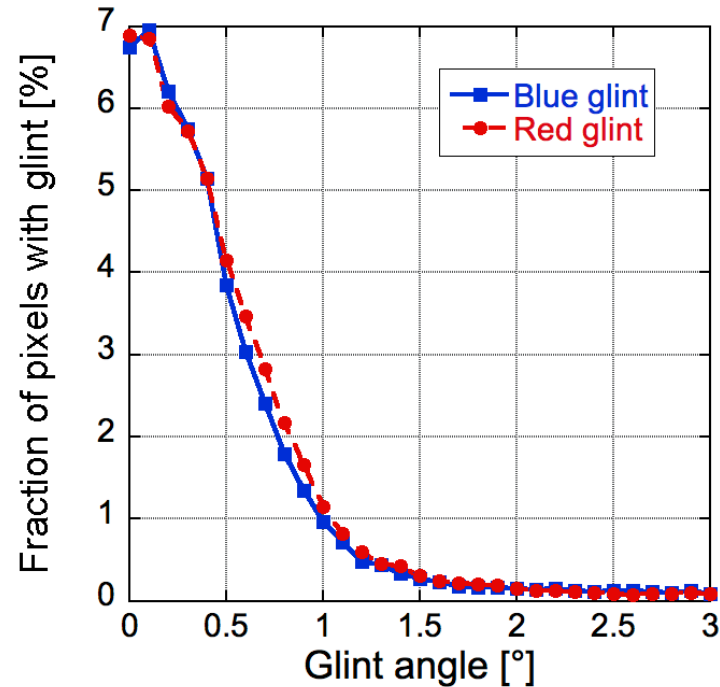
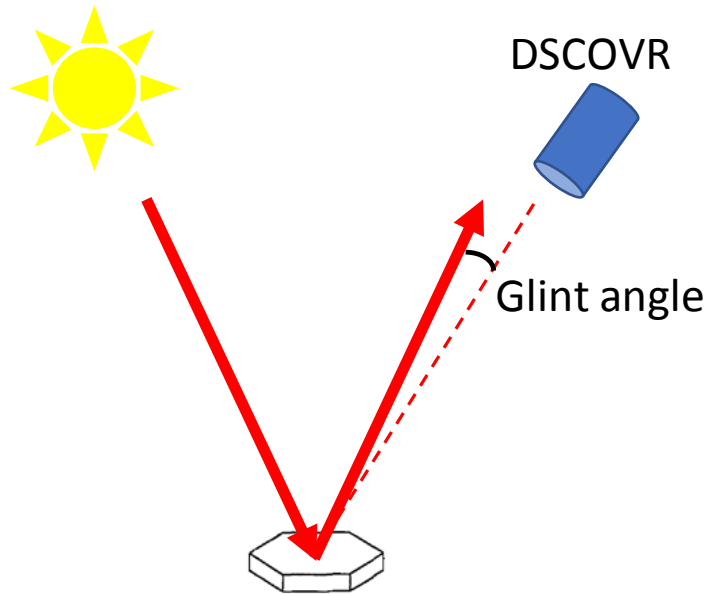


EPIC filter wheel



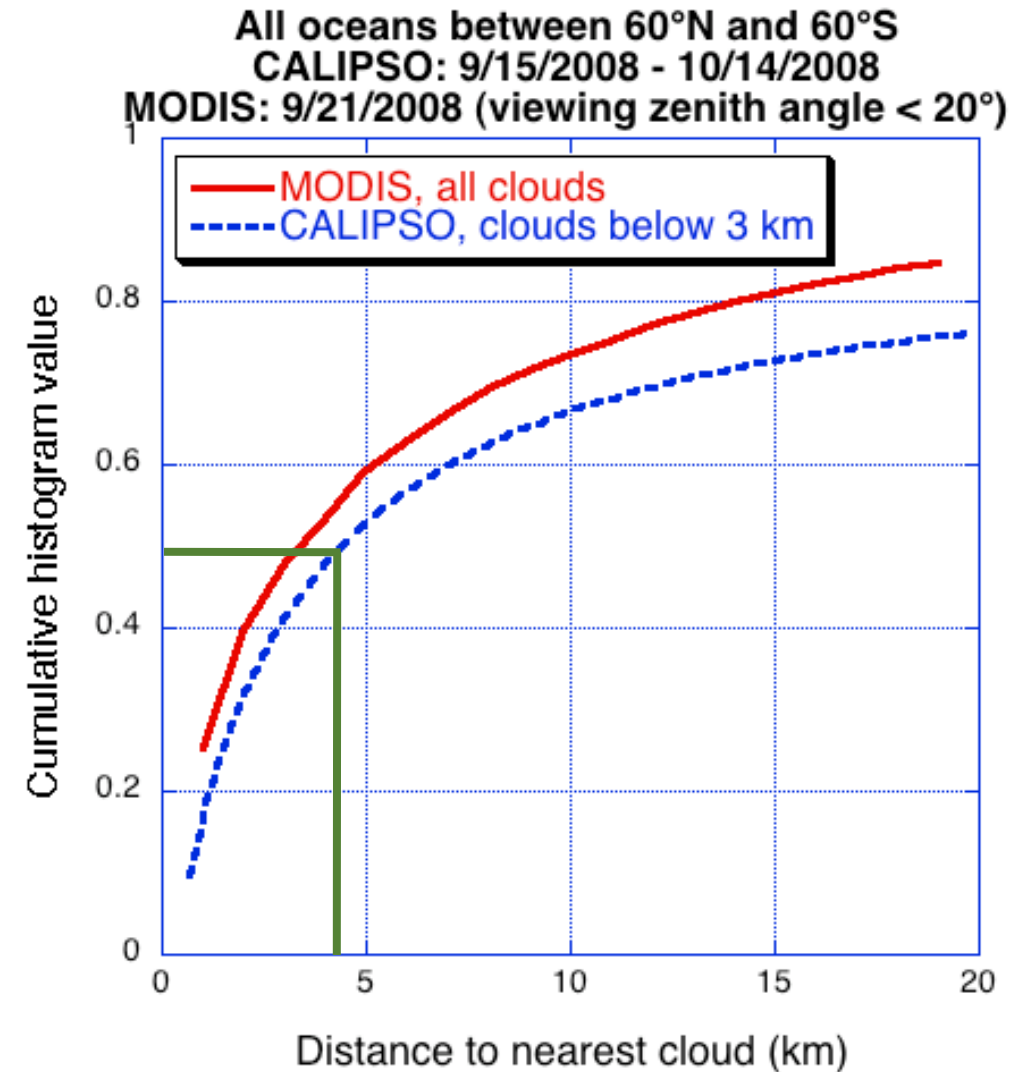
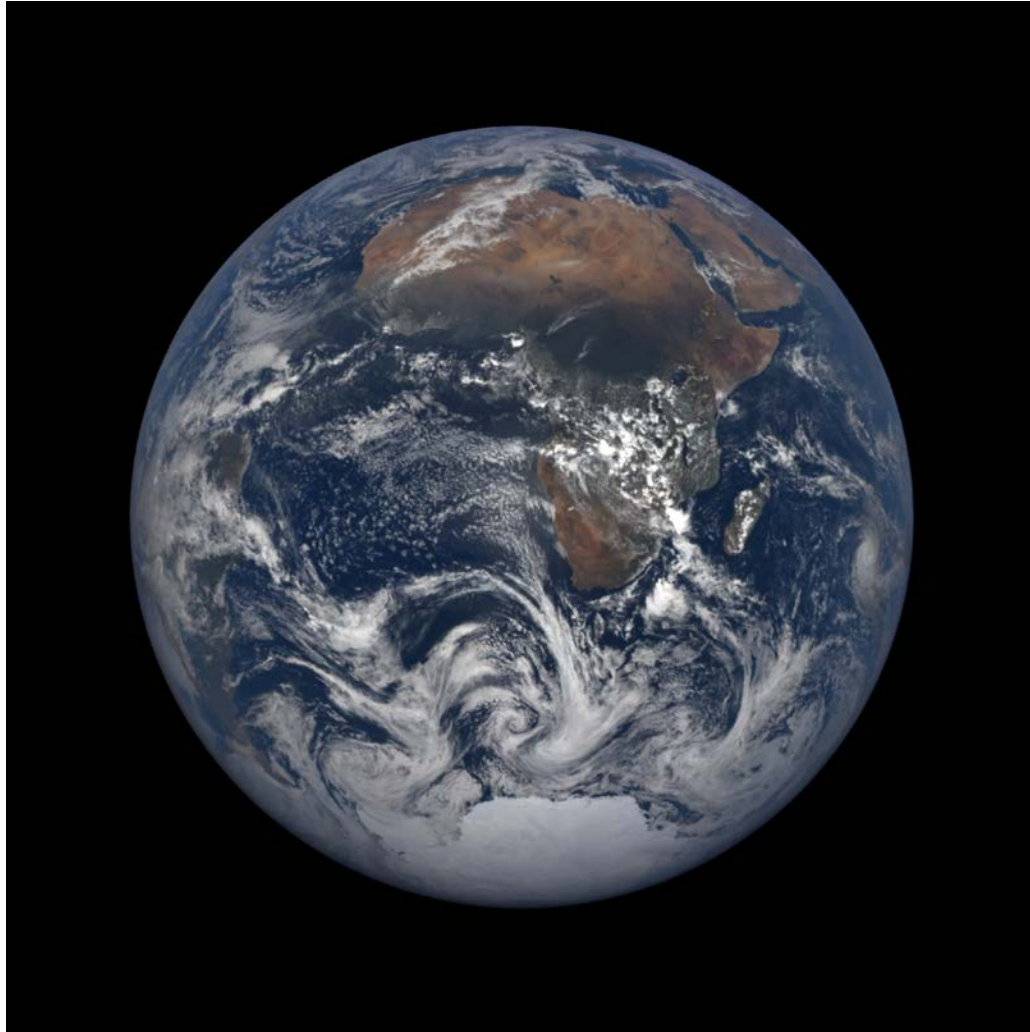
EPIC can be used as quasi multi-angle instrument

Statistically, how bright and wide are glints at various wavelengths?



What are the prevalence, size, and tilt of horizontally oriented ice crystals, and how do these crystals affect cloud albedo?

Most clear areas are not too far from clouds



Aerosol remote sensing is especially difficult near clouds

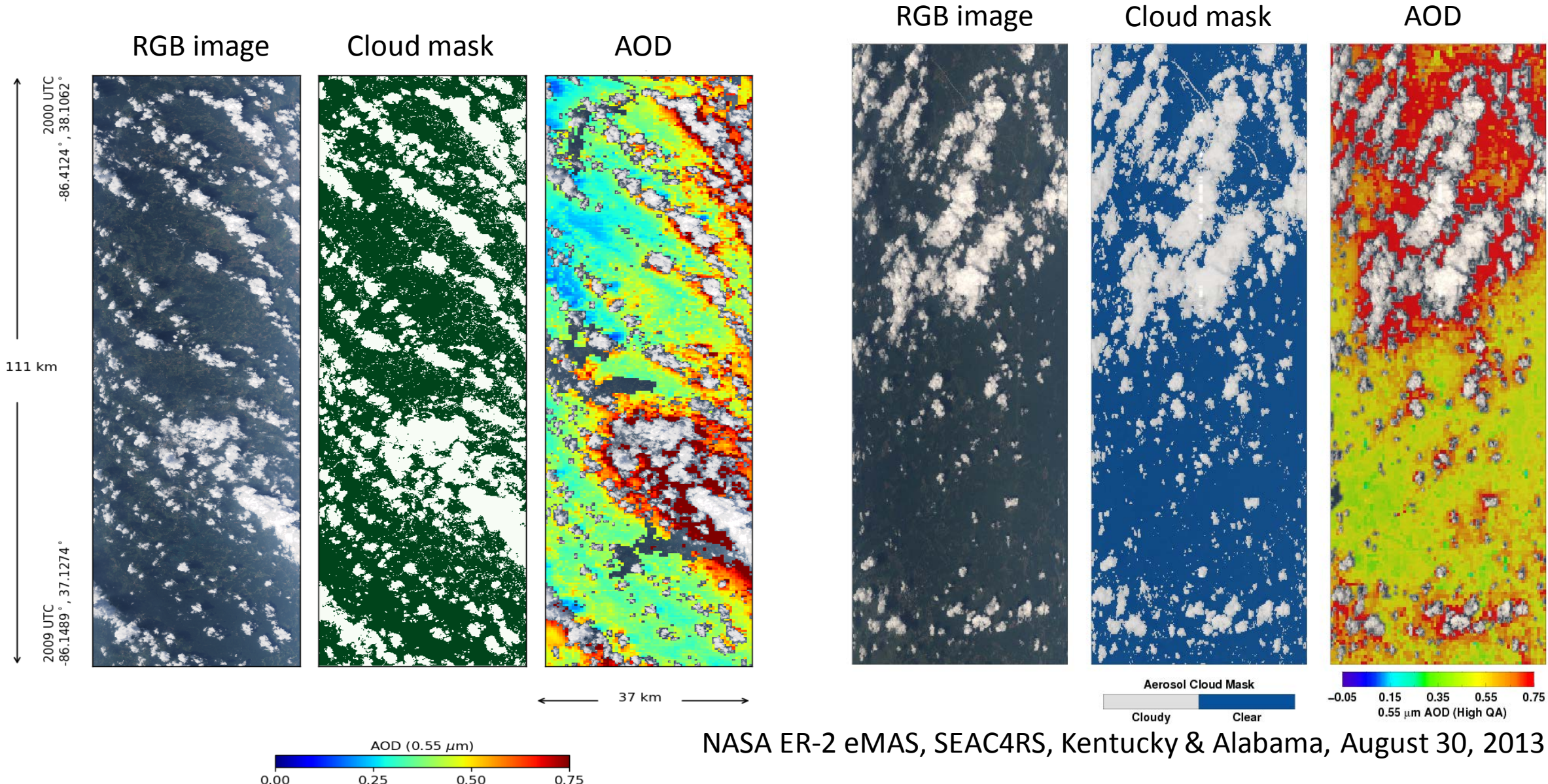


Saharan dust & clouds

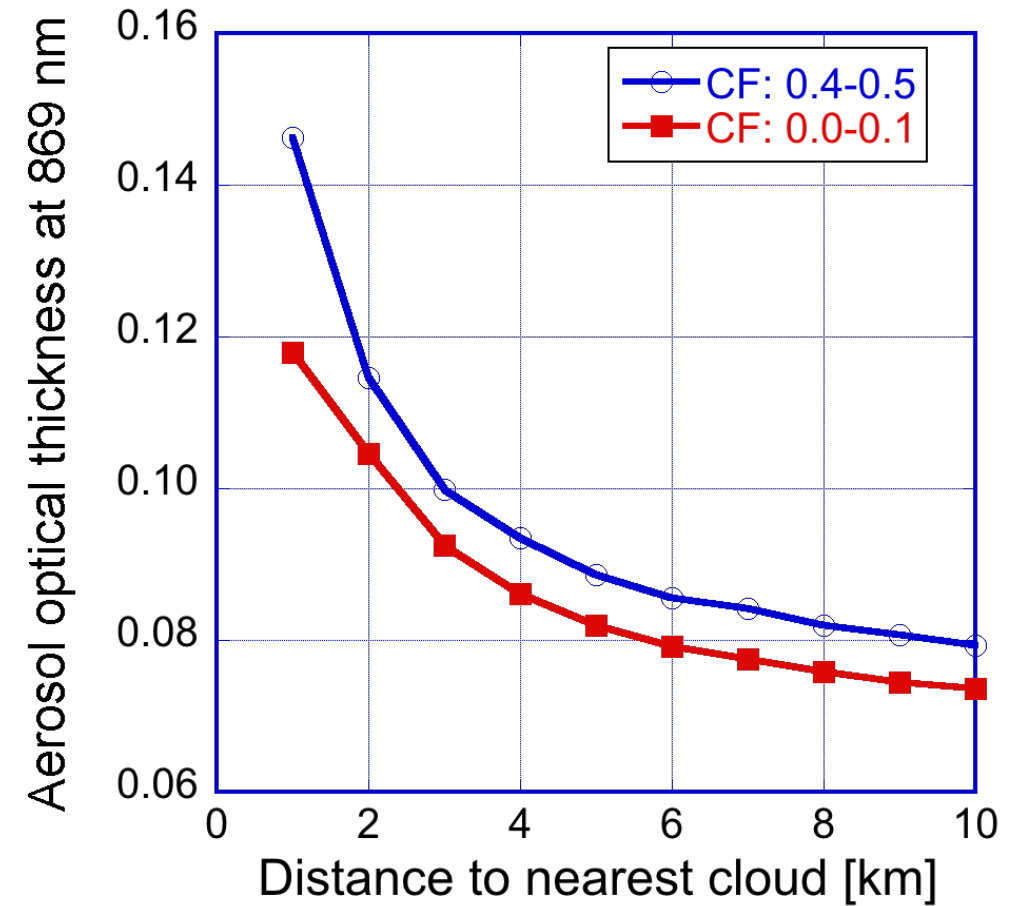


Arctic haze

Aerosols are different near clouds; ignoring this would underestimate aerosol direct and indirect radiative effects

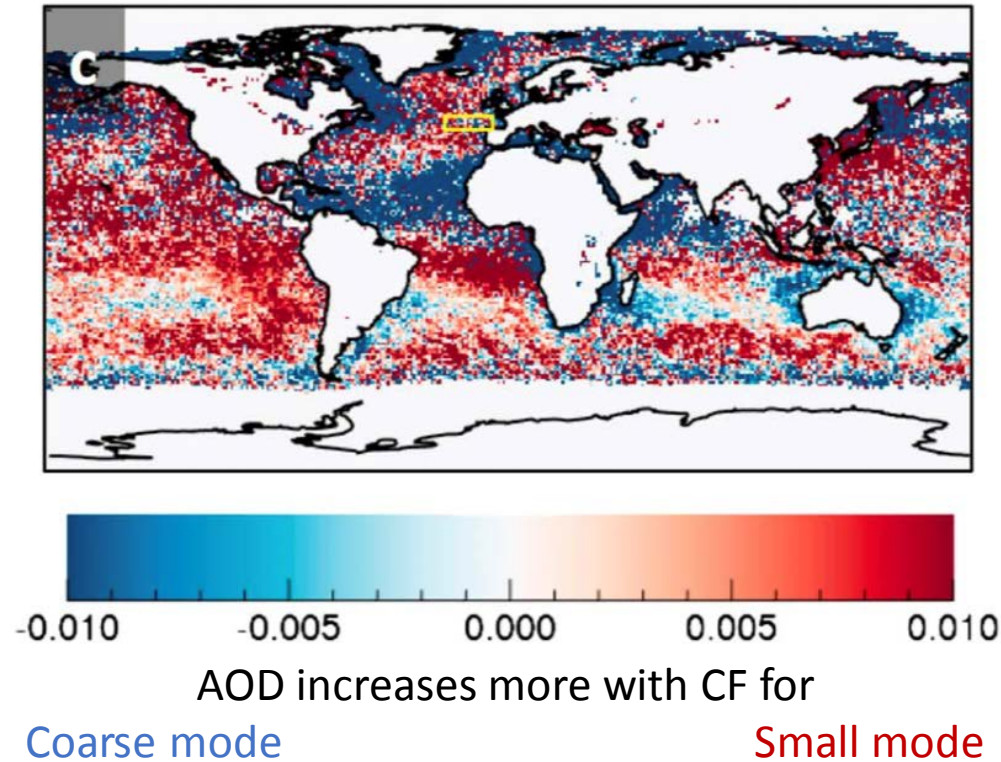


AOD increases near clouds



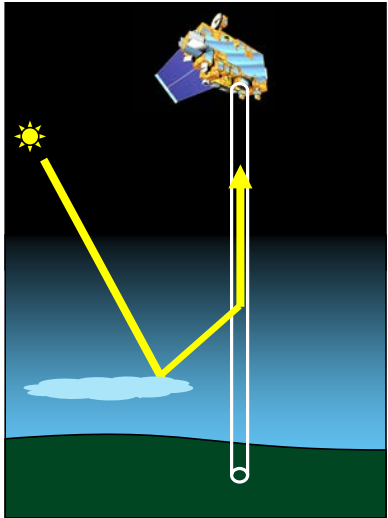
Retrieved $0.55 \mu\text{m}$ AOD is 50% higher in the half of data that is closer to clouds

Cloud effects on size distributions are more complex

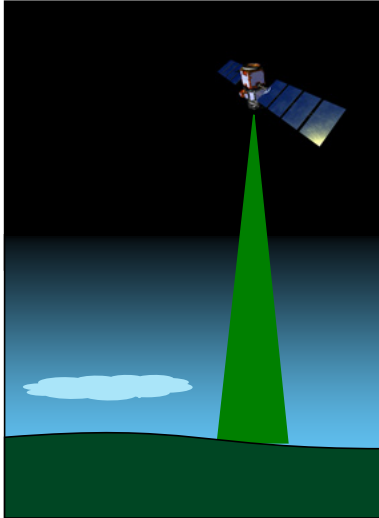


Several processes contribute to near-cloud enhancements

MODIS



CALIOP

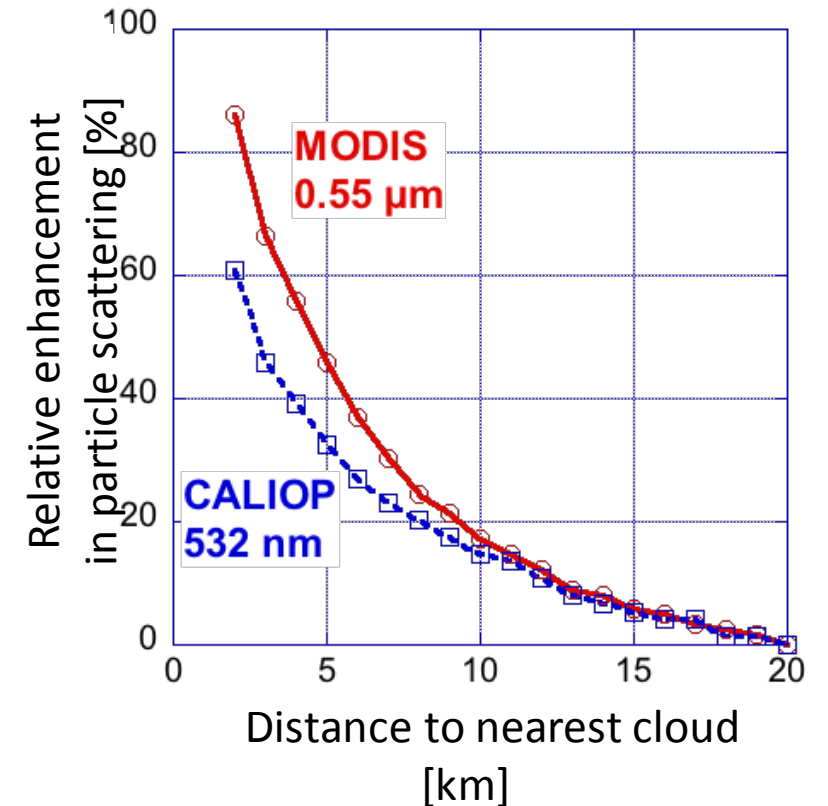


Both MODIS & CALIOP observe:

- Aerosol swelling
- Cloud processing
- Cloud contamination

MODIS data also affected by:

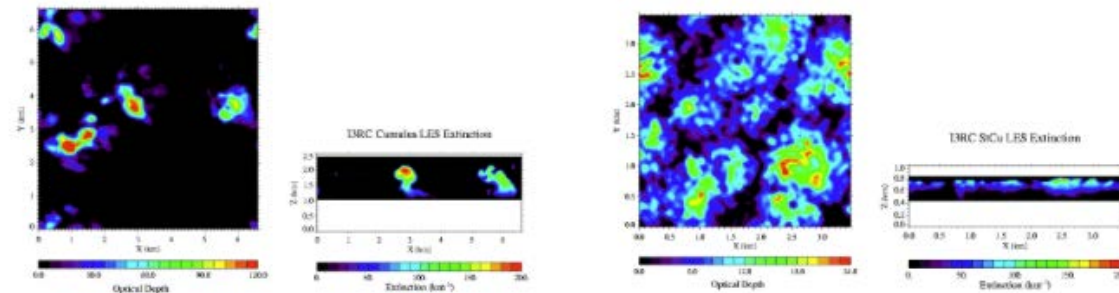
- 3D enhancement
- Instrument blurring



Online 3D radiative transfer simulator is available

- Quick 1D & 3D Monte Carlo simulations through web interface (15 sec - 4 min)
- Goal: help initial exploration of ideas, class projects
- Part of the Intercomparison of 3D Radiation Codes (I3RC) project: i3rcsimulator.umbc.edu

Sample input LES fields



Summary

- We explore using EPIC data to constrain the prevalence and size of horizontally oriented ice crystals and their impact on Earth's albedo.
- Clouds and cloud-related processes affect a large portion of aerosols; we seek to help better characterize the affected aerosols and their radiative impacts.