

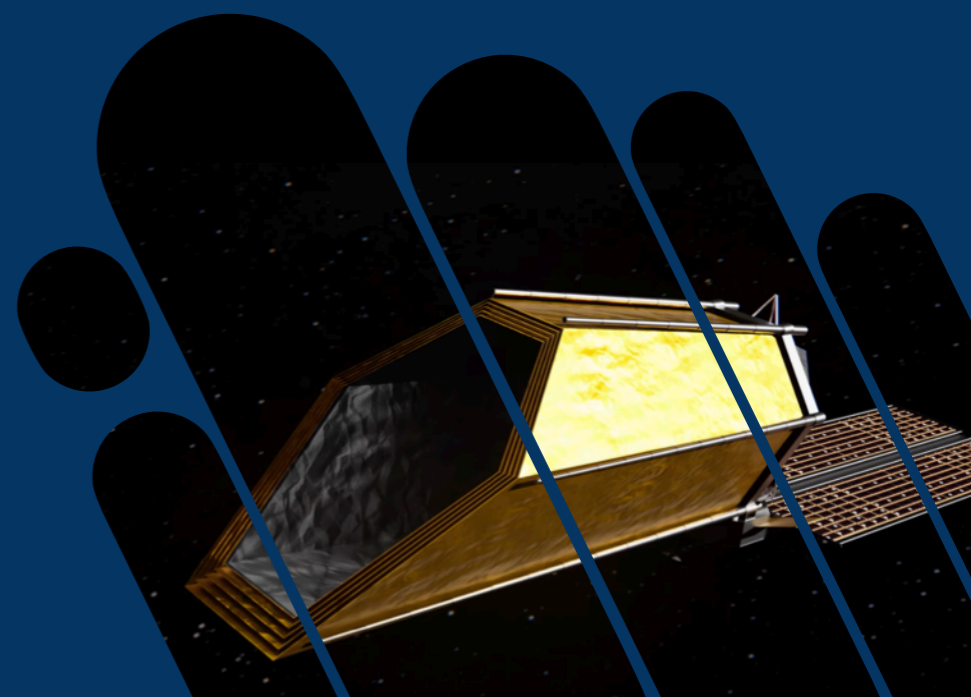


Polarization

An opportunity for surface features

Julia Victoria Seidel

ESO Fellow
Now at OCA, Nice





Polarization

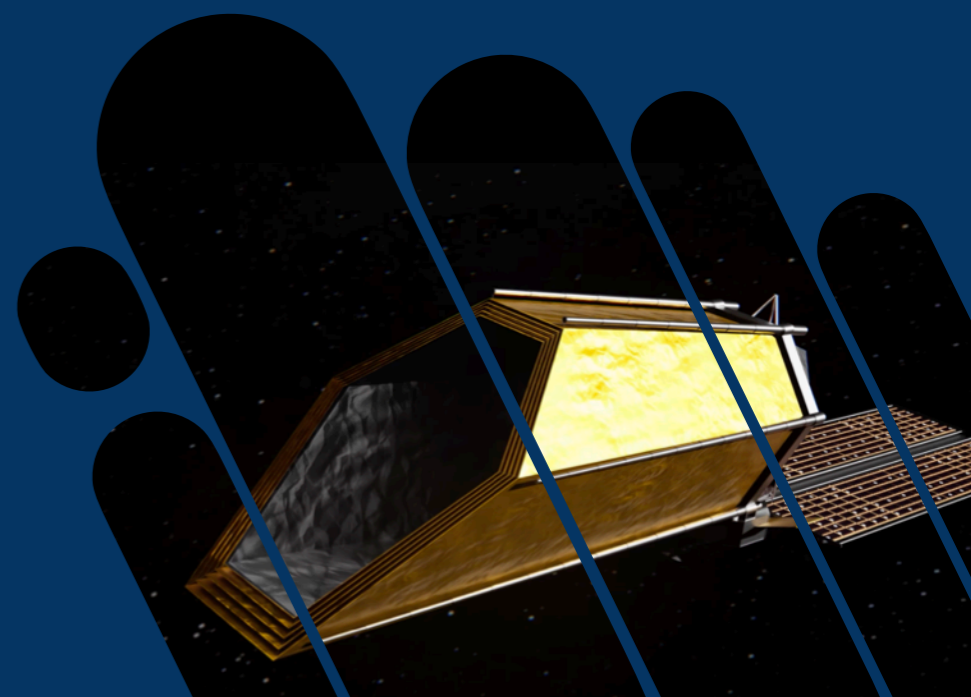
An opportunity for surface features



Giulia Roccetti

ESO PhD student
with M. Sterzik (ESO)
& C. Emde (LMU)

(On the job market)



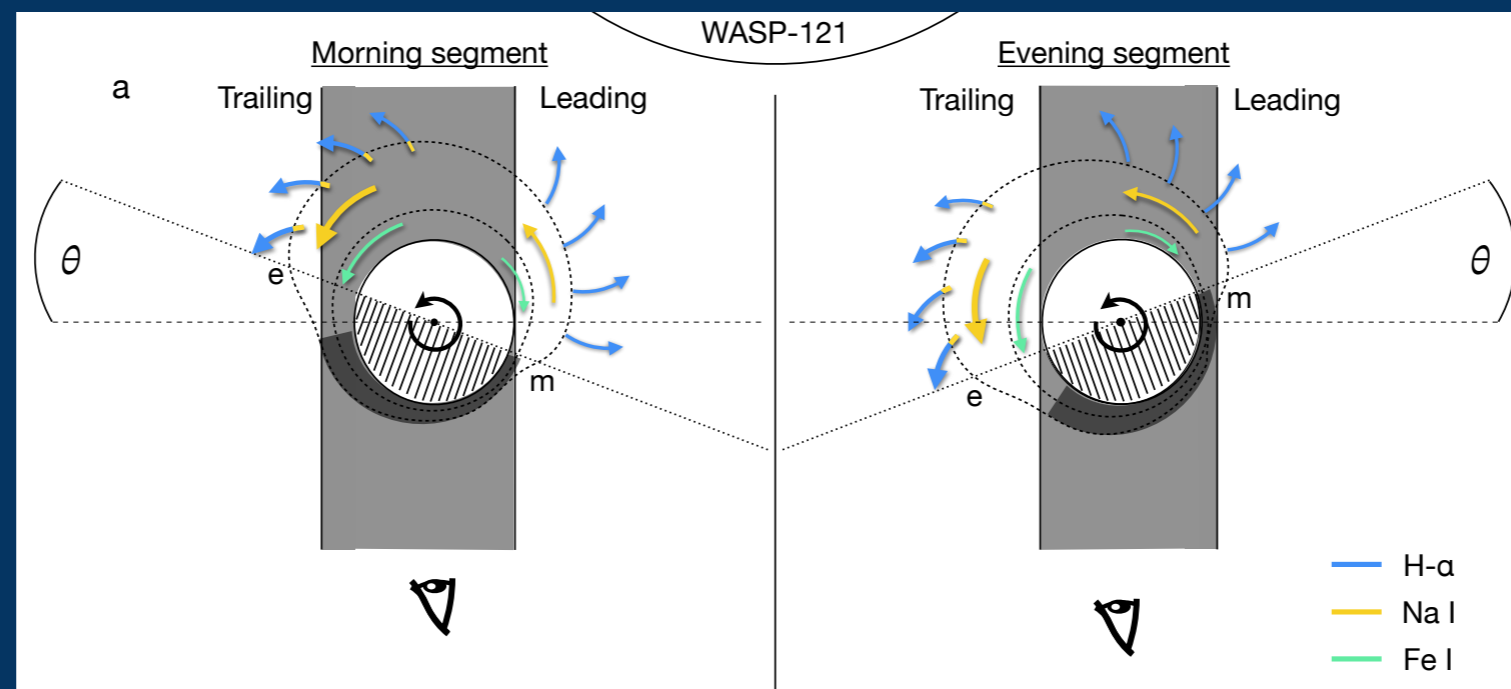
What I usually work on:

- Before Oct: 270 nights on Paranal, ESPRESSO instrument fellow
- Detection of elements from high-resolution spectra
- Retrieval of spatially resolved atmospheric dynamics from these resolved lines

Morning dominated

Evening dominated

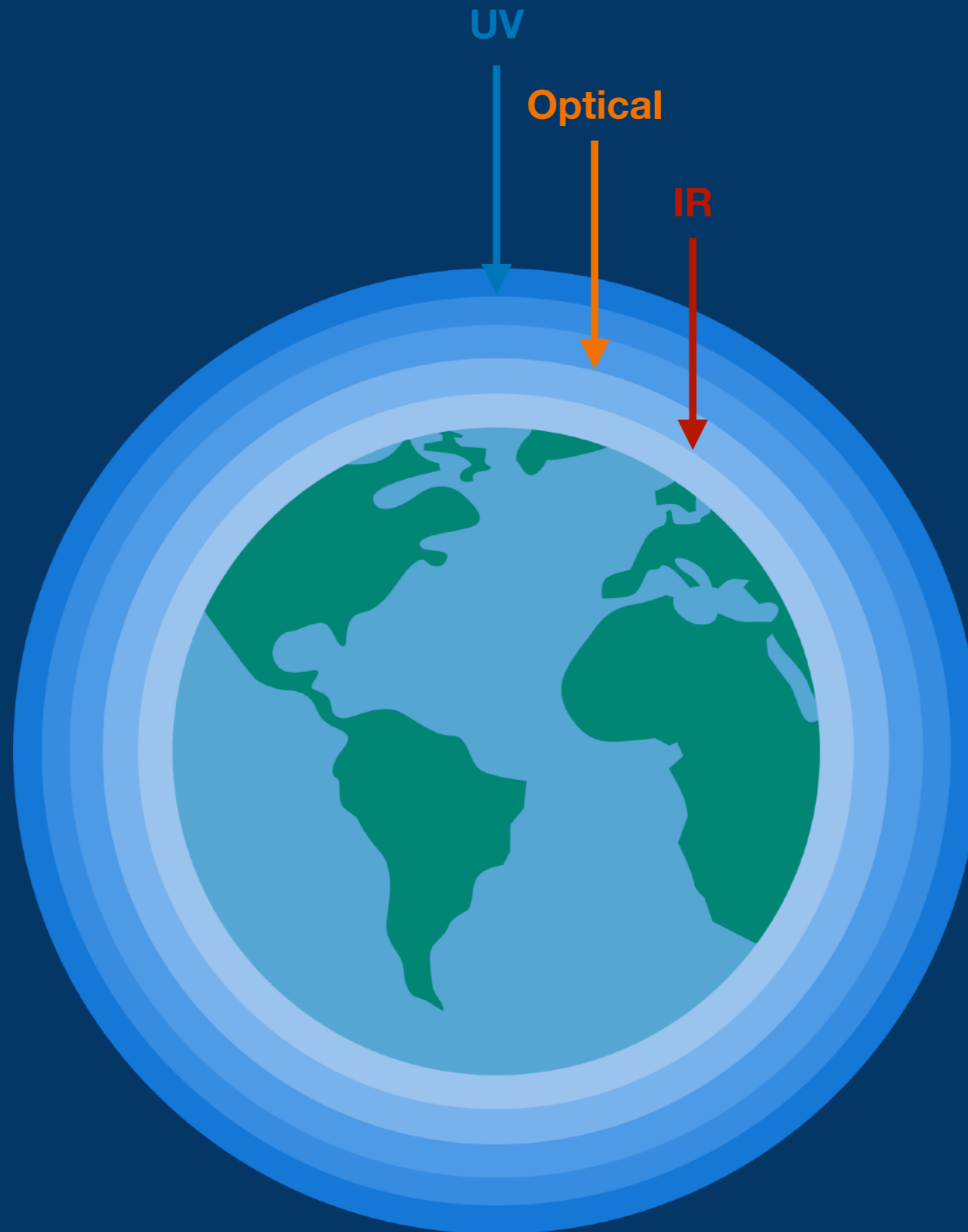
EMBARGOED (sorry)



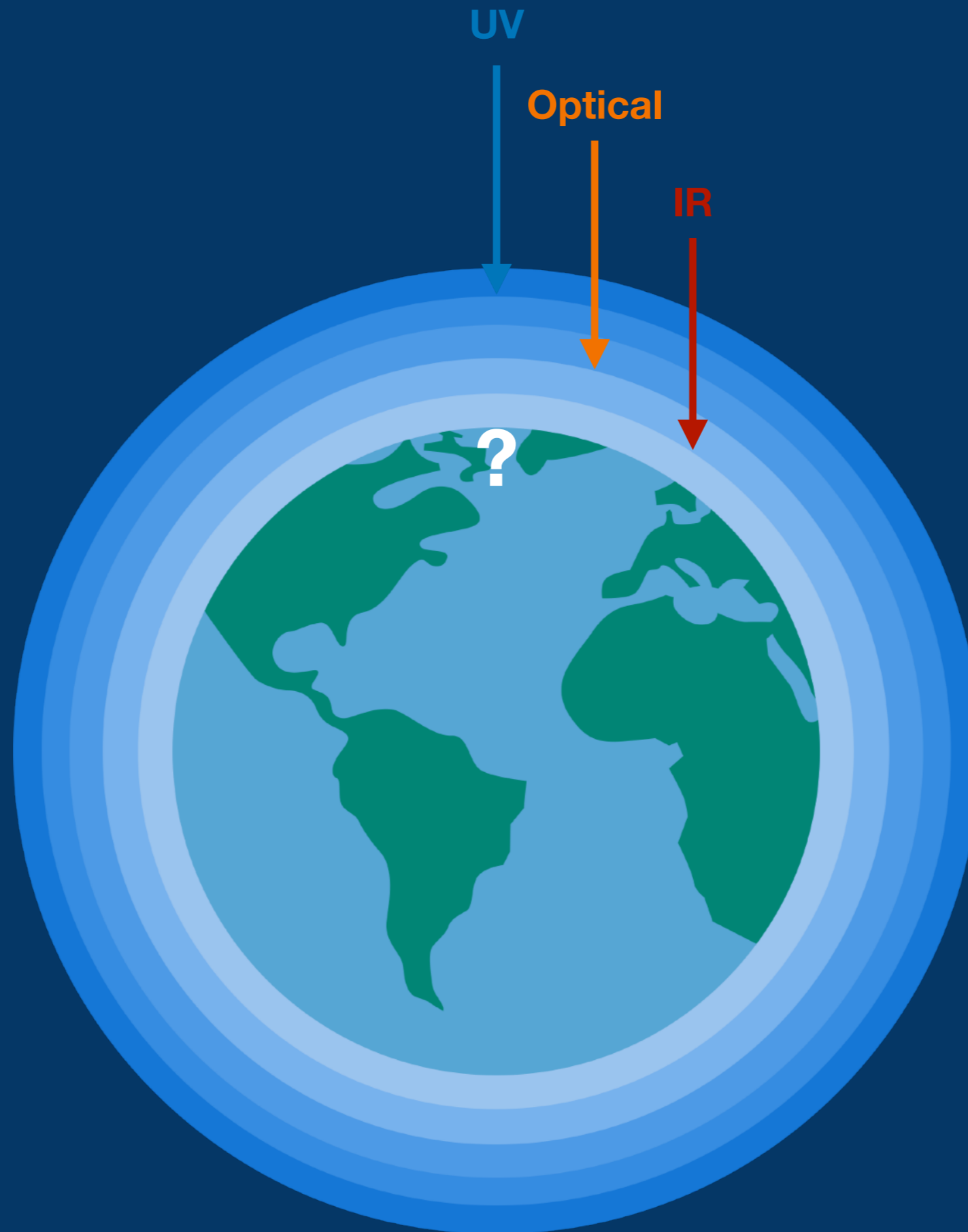
Seidel et al. 2024 (accepted for publication yesterday)



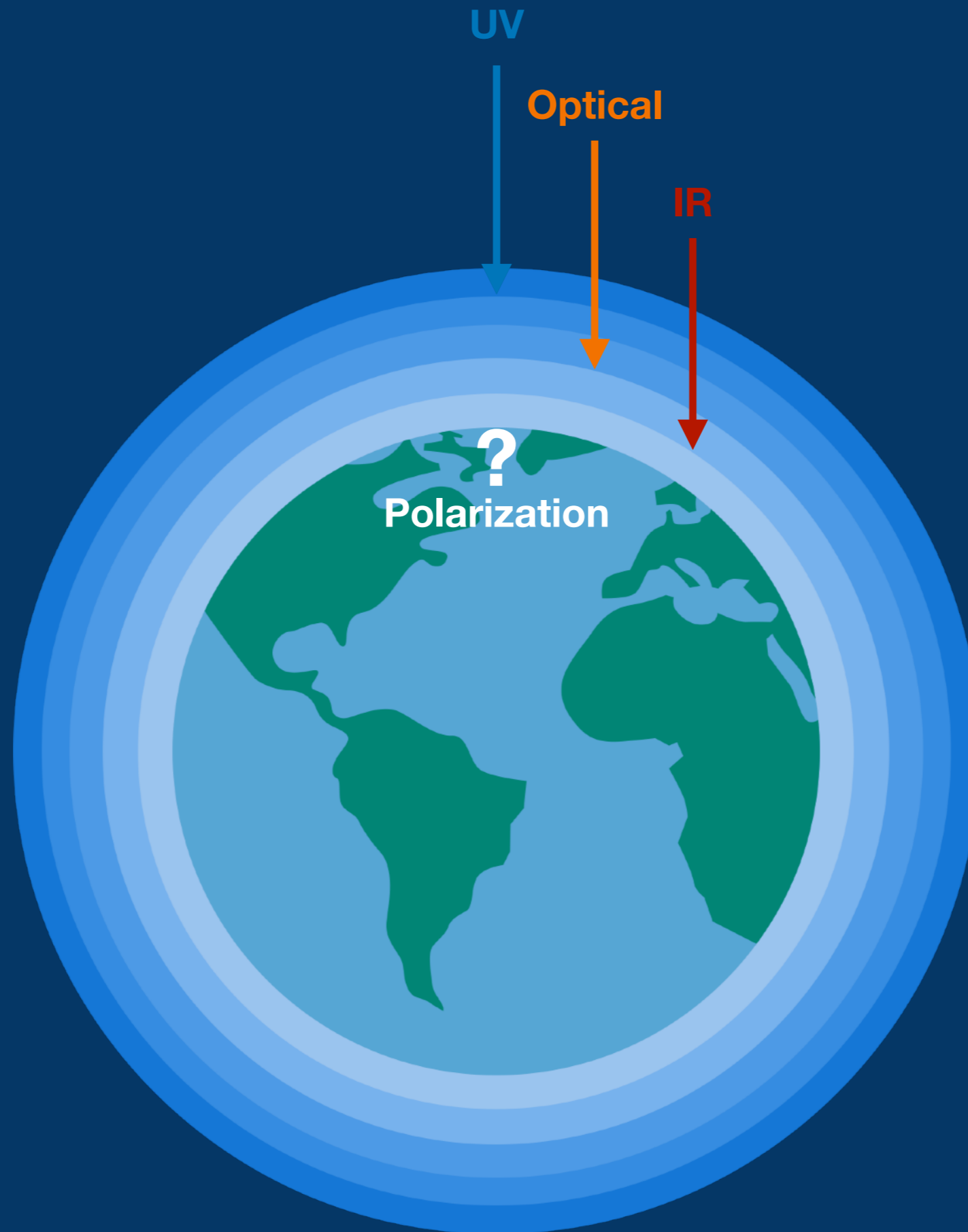
Probing depth overview



Probing depth overview

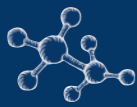


Probing depth overview



What causes polarization ?

Single scattering



Molecules

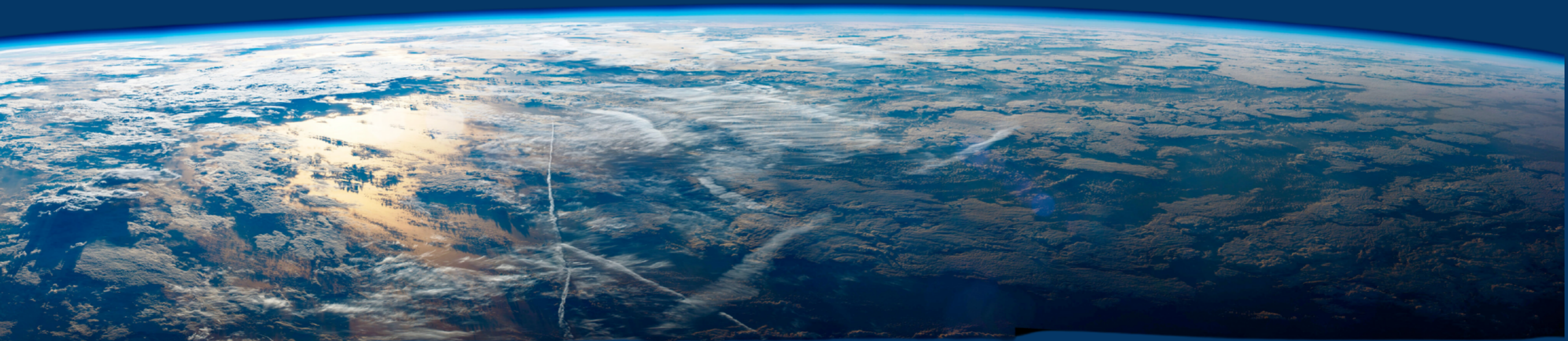


Droplets

Surface reflection

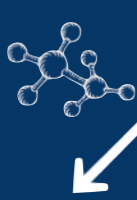


Ocean glint
(specular reflection)



What causes polarization ?

Single scattering



Molecules



Droplets

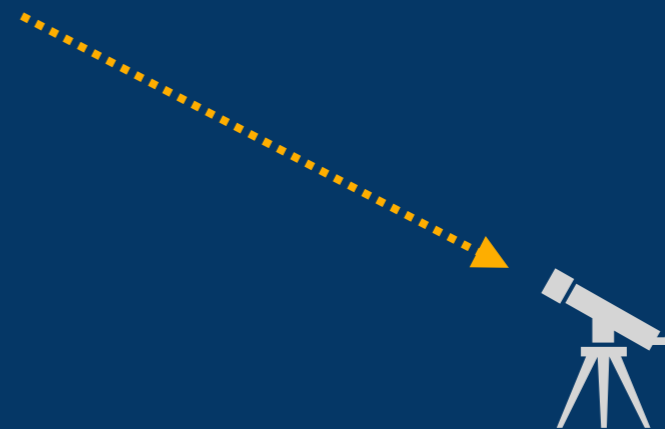
Surface reflection



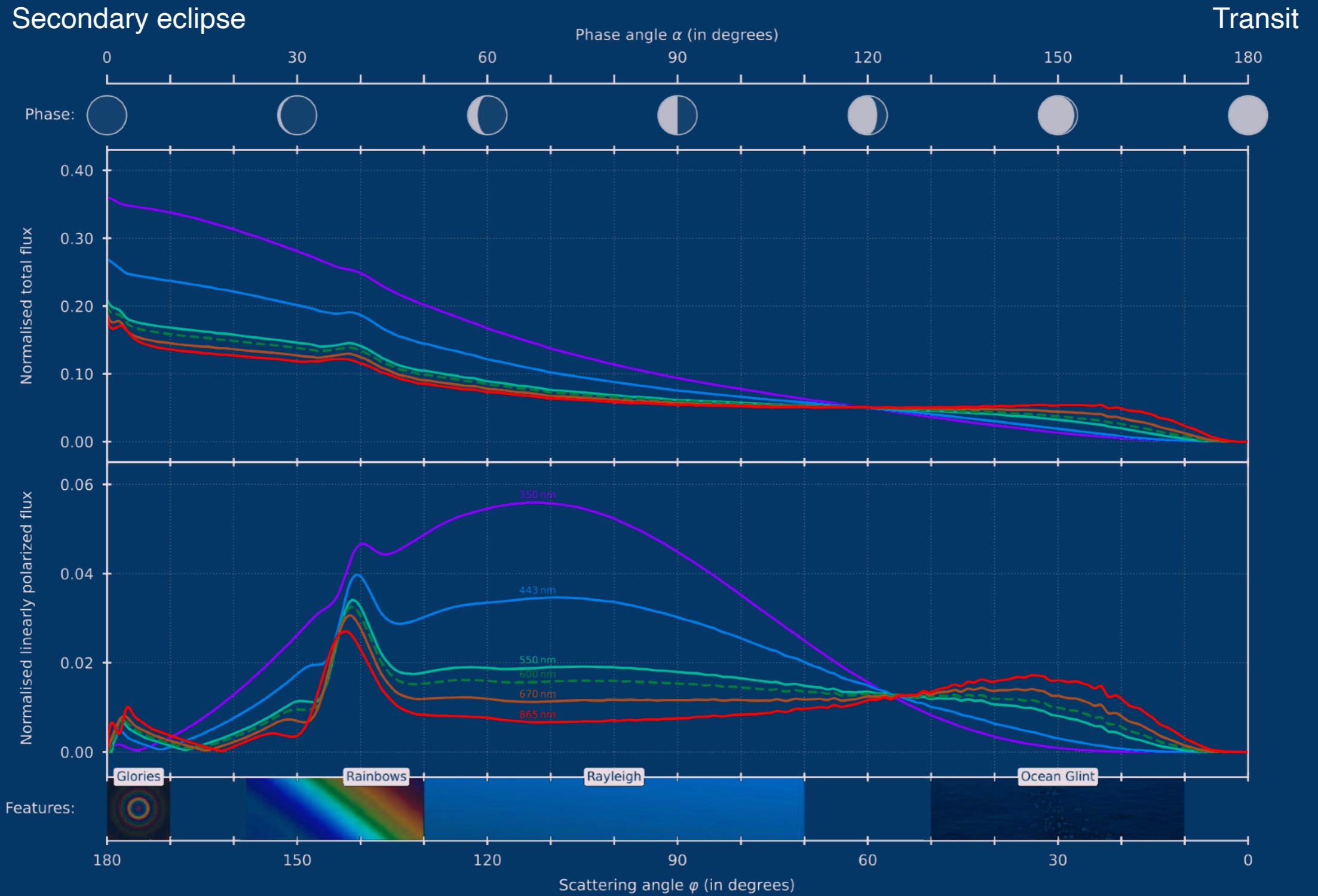
Ocean glint

polarization as a function of angle

un-polarized



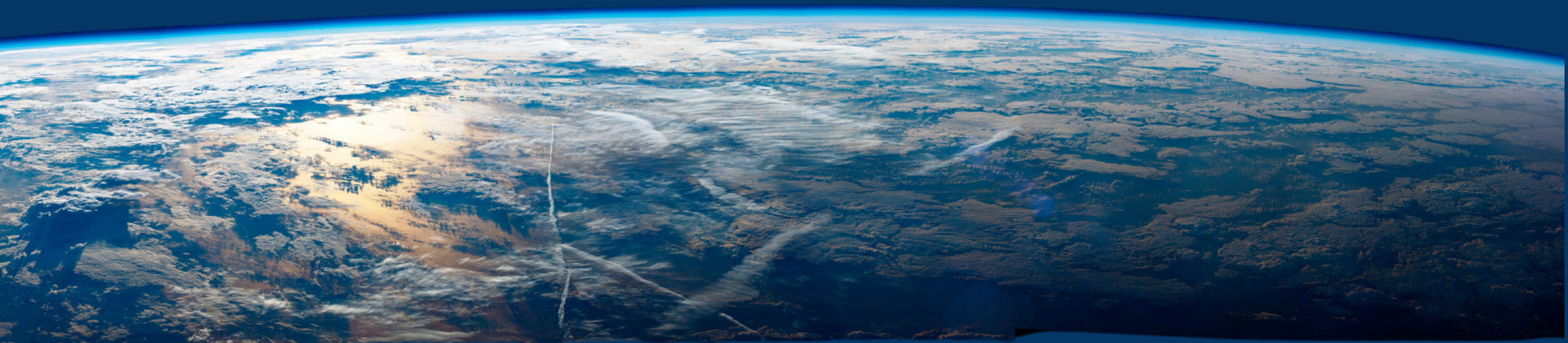
Features probed with polarization as a function of angle



Vaughan et al. 2023
(adapted from Trees and Tam 2019)

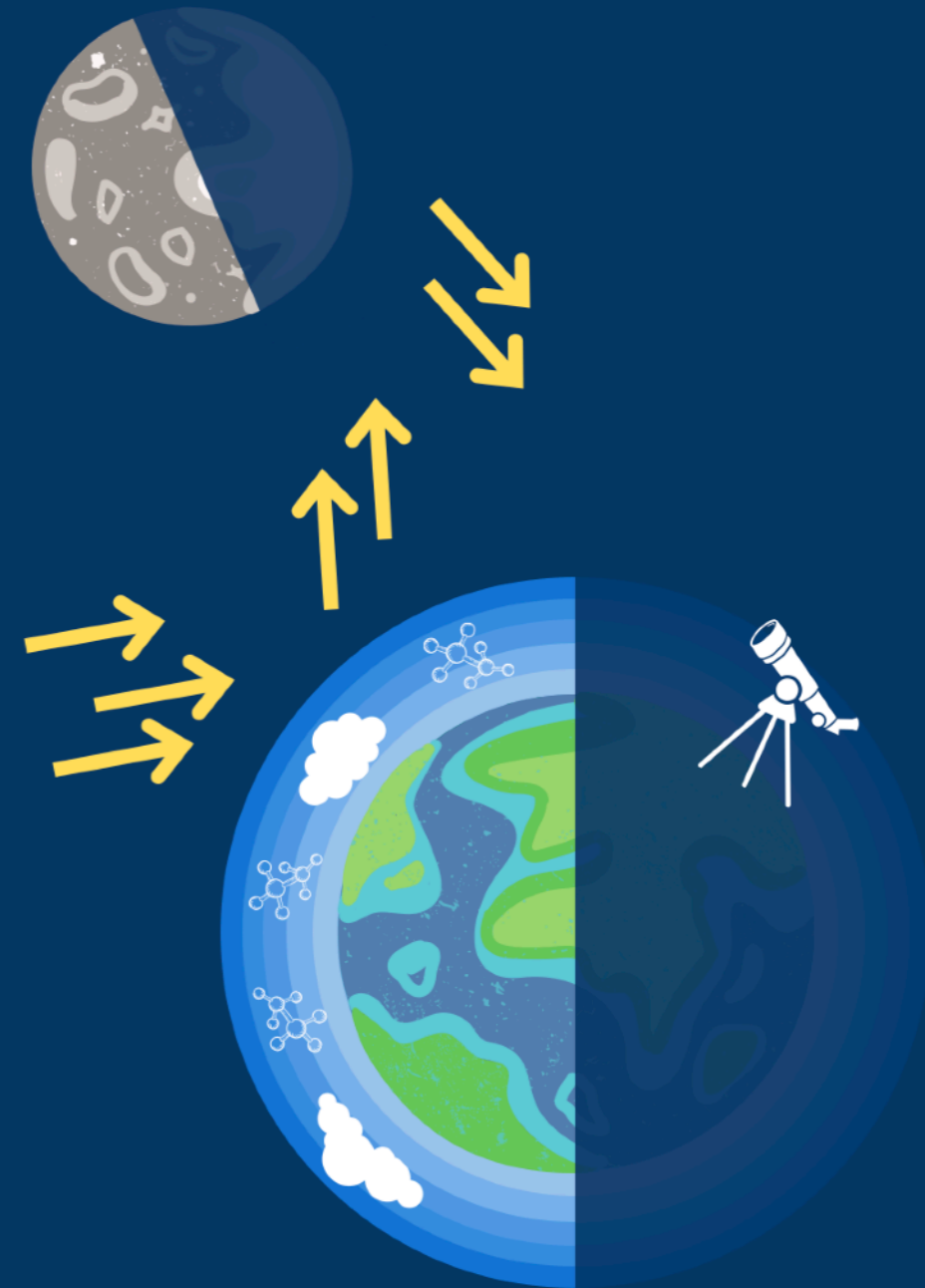
Has this been tried before?

Earth shine



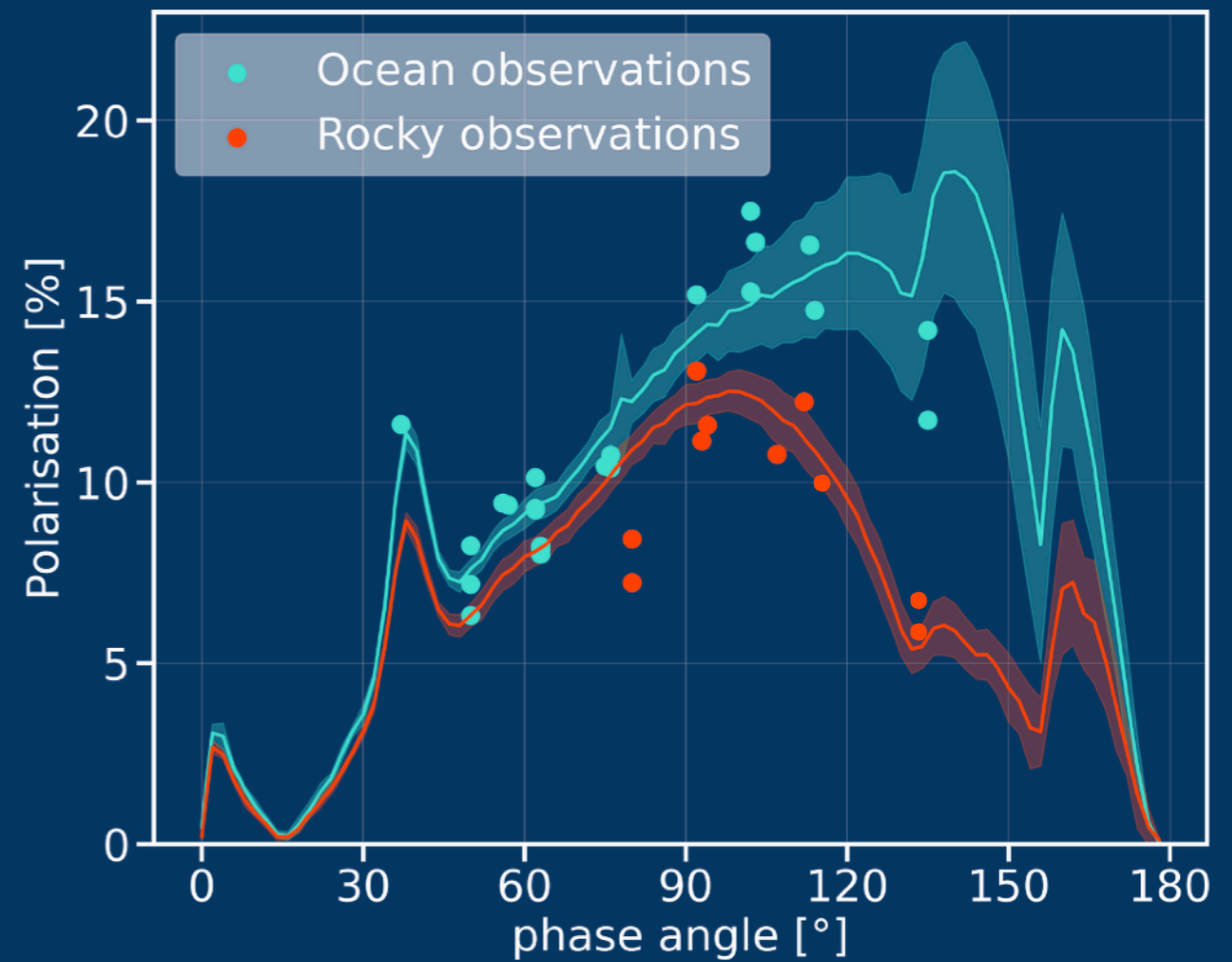
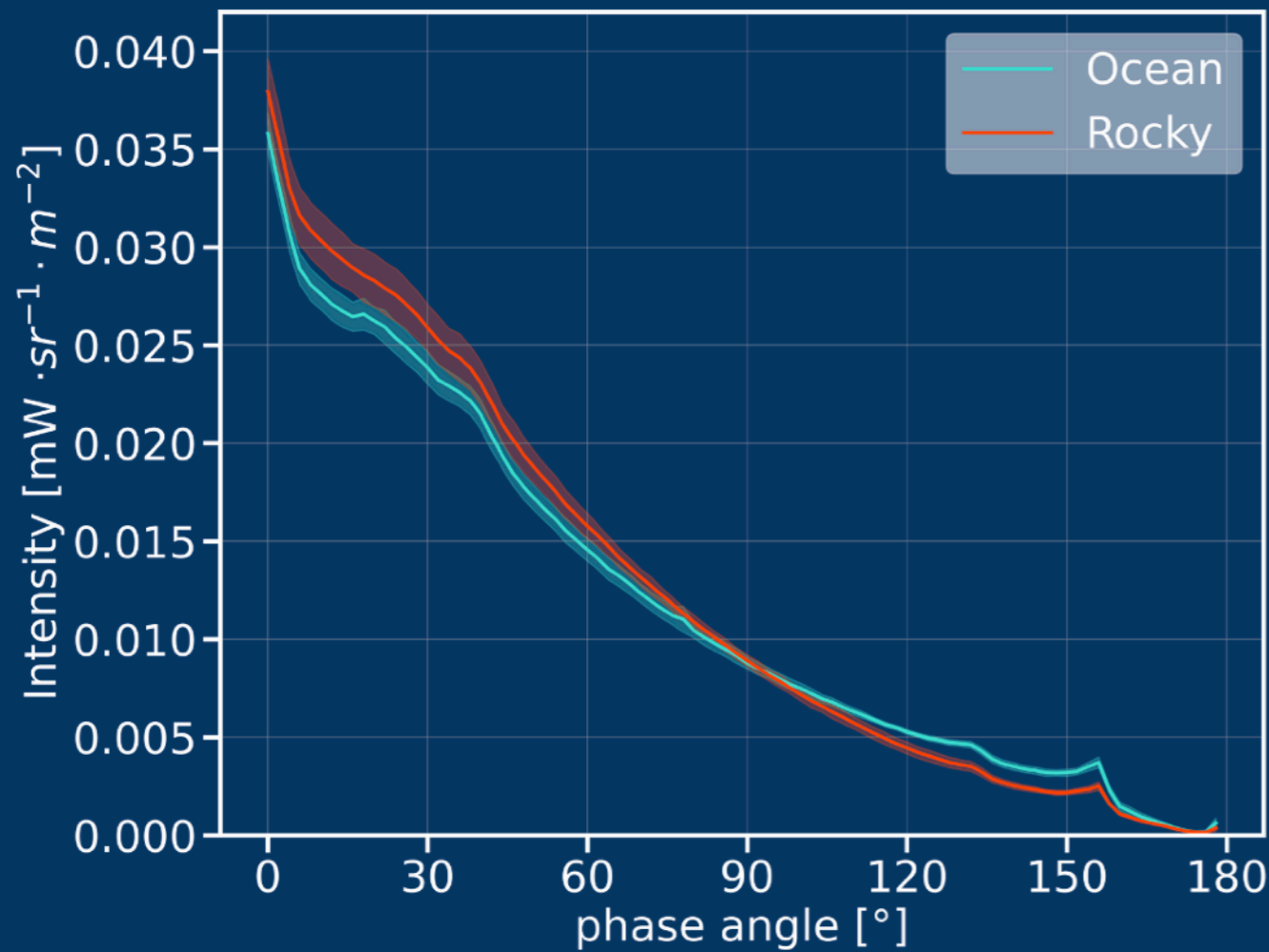
EARTHSHINE OBSERVATIONS

- Sunlight scattered by Earth's atmosphere and reflected from the lunar surface
- The Moon acts as a diffuse mirror
- Resemble the way we can observe the Earth as an exoplanet



SURFACE VARIABILITY: OCEAN VS. LAND

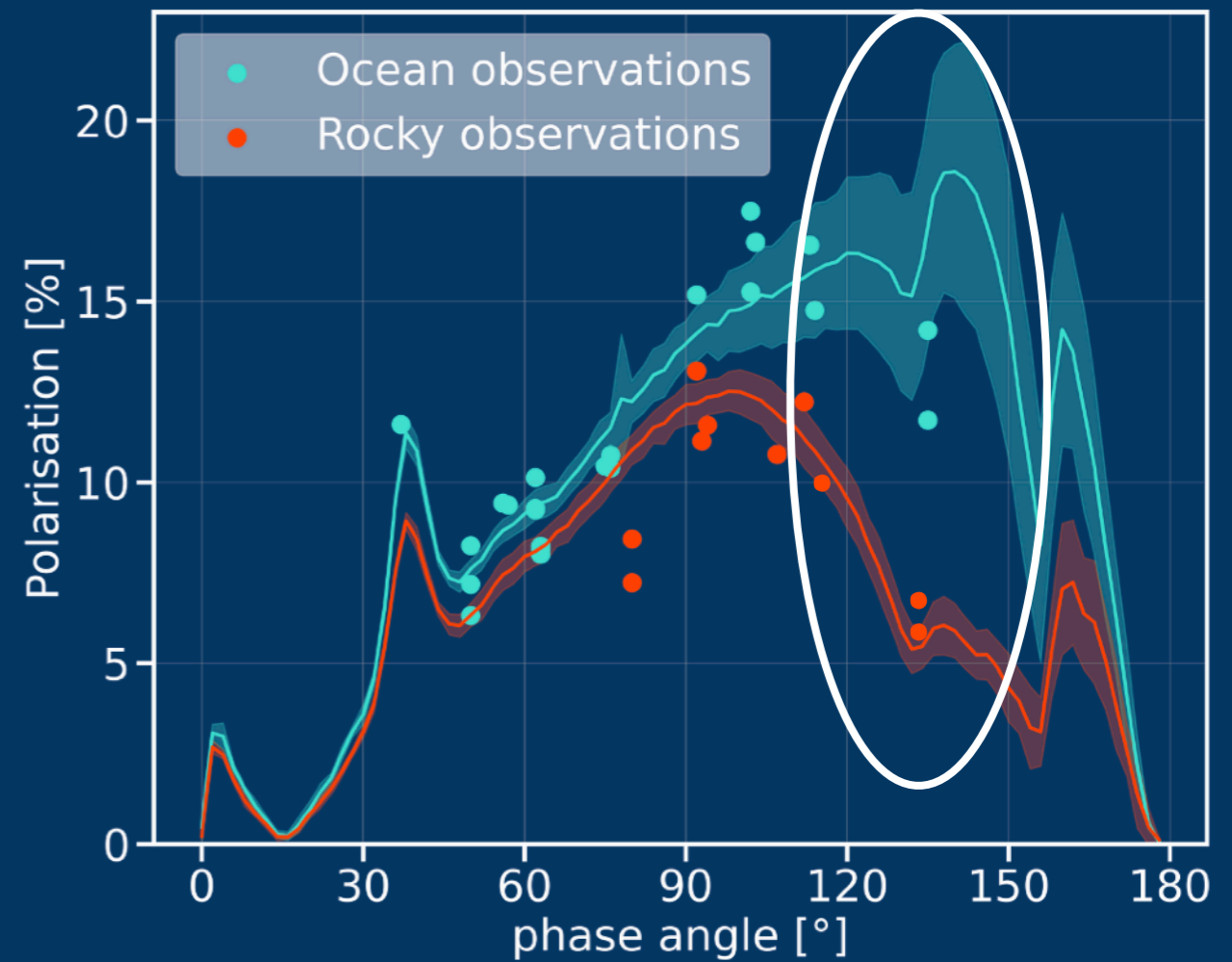
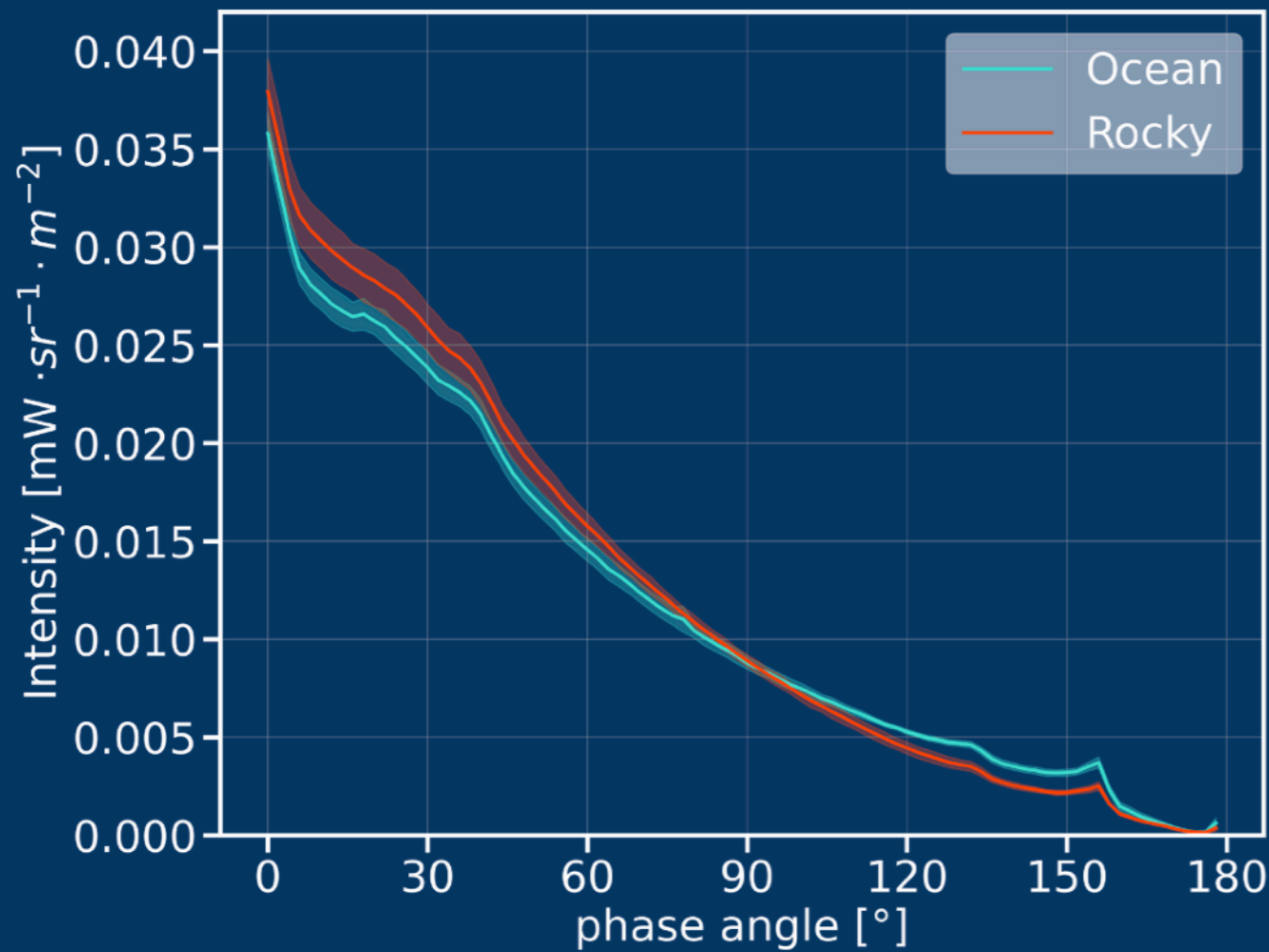
$\lambda = 700 \text{ nm}$



Roccetti, ... ,Seidel et al. 2024c (in prep.)

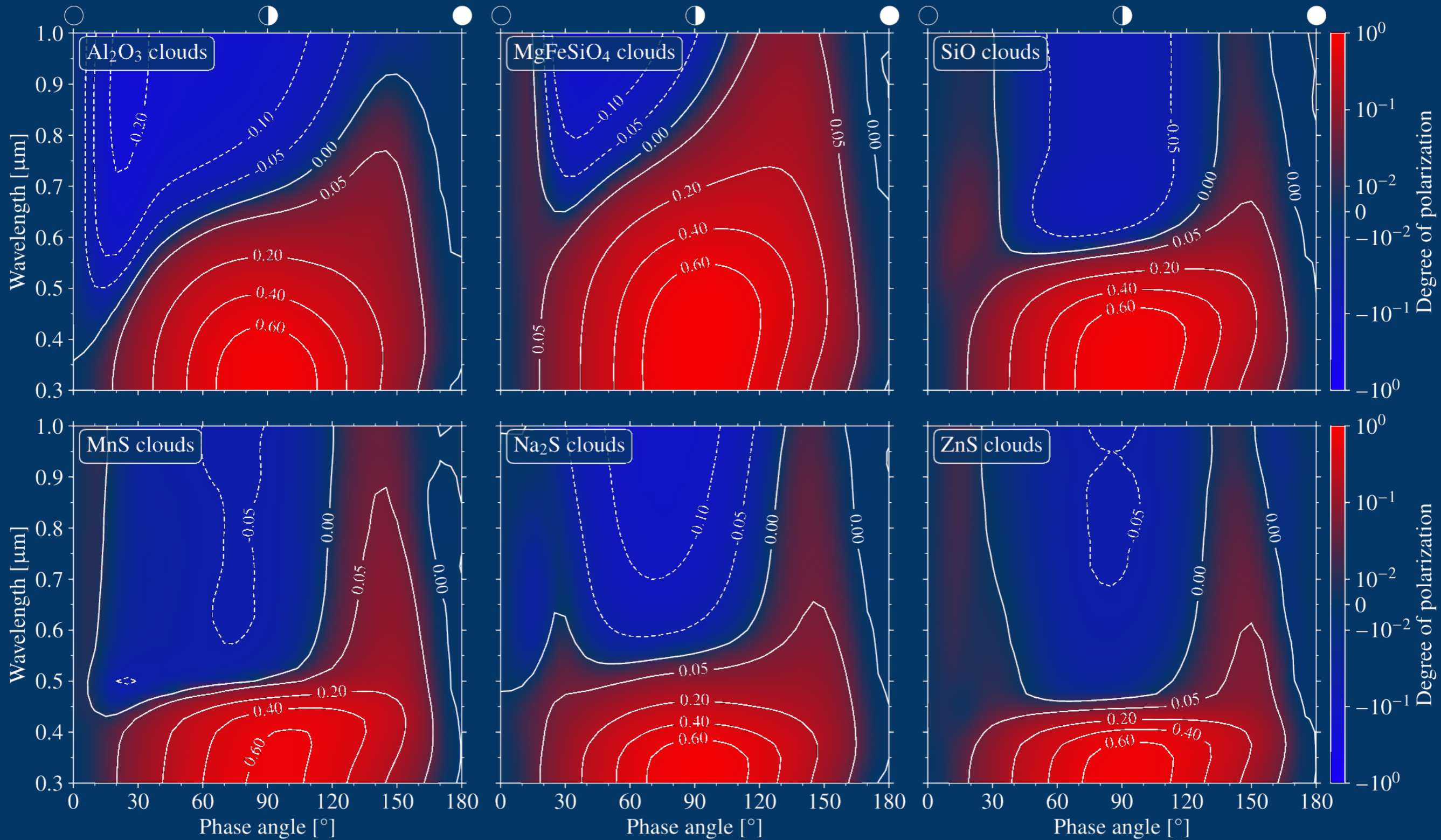
SURFACE VARIABILITY: OCEAN VS. LAND

$\lambda = 700 \text{ nm}$



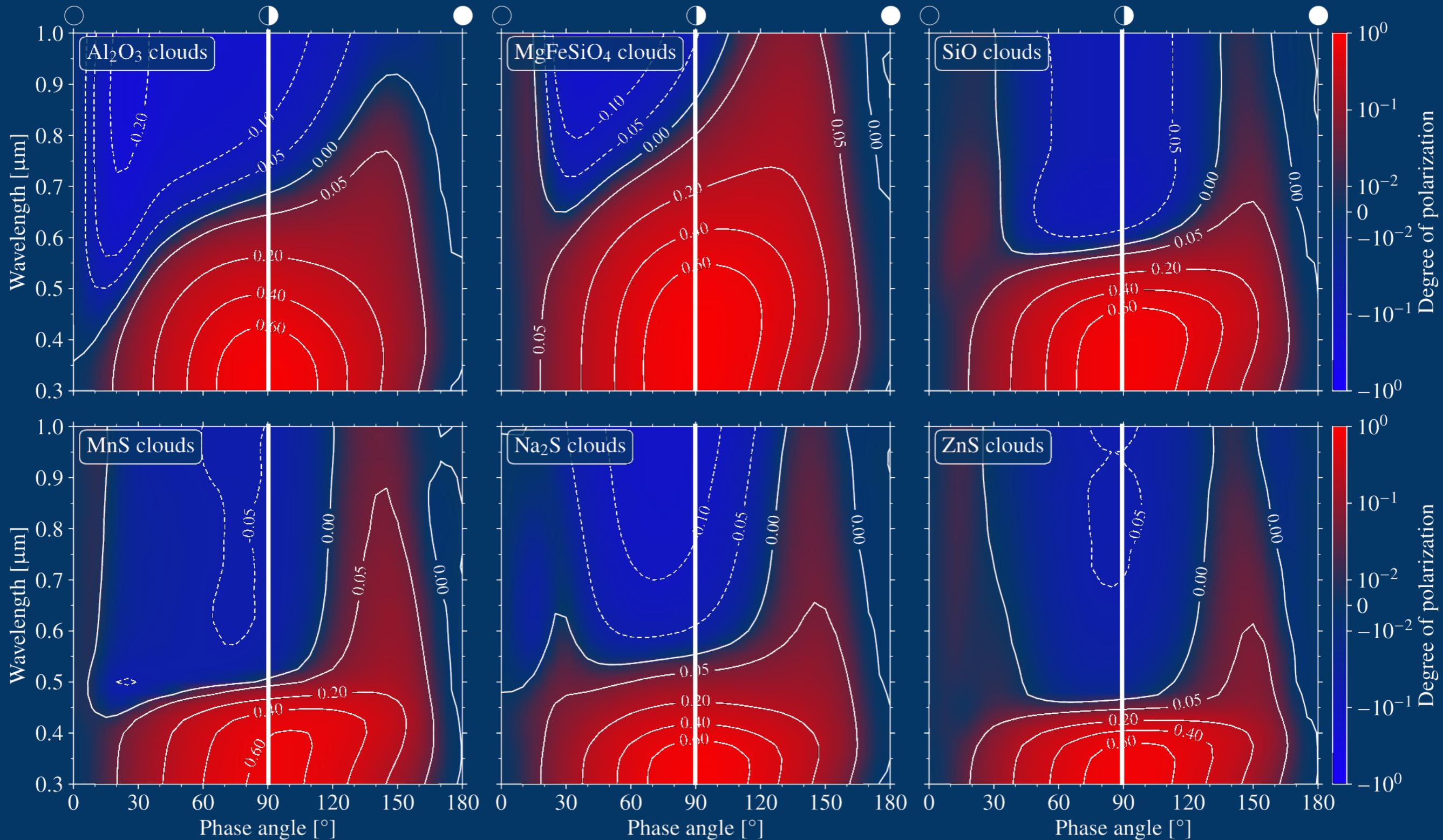
Roccetti, ... ,Seidel et al. 2024c (in prep.)

Application to hot Jupiters



Lietzow and Wolf 2023

Application to hot Jupiters



Proof of concept study with FORS2 (PI Roccetti, dPI Seidel)

Clear signal of exoplanetary polarization (but analysis not concluded)

In Summary

Table 3. The expected number of targets for which the peak phase angle of each phenomenon would be detectable when assuming randomly inclined, eccentric orbits (see Section 2.3.2). For reference, the HabWorlds target list consists of 164 targets in total.

Feature	IWA			
	21 mas	41 mas	62 mas	83 mas
Glory	0	0	0	0
Ocean Glint	79	43	16	6
Rainbow	109	90	46	22
Rayleigh	154	152	125	78

Vaughan et al. 2023

