Geophysical Research Abstracts
Vol. 14, EGU2012-10571, 2012
EGU General Assembly 2012
© Author(s) 2012

Observing the Earth as an exoplanet

T. Karalidi (1), D.M. Stam (1), F. Snik (2), C.U. Keller (2), W.B. Sparks (3), and S. Bagnulo (4)

(1) SRON Netherlands Institute for Space Research, Utrecht, Netherlands (t.karalidi@sron.nl), (2) Sterrewacht Leiden, University Leiden, Netherlands, (3) STScI, Baltimore, USA, (4) Armagh Observatory, College Hill, Armagh BT61 9DG, United Kingdom

Observations of Solar System planets, including the Earth, have shown the power of polarimetry for the characterization of planetary atmospheres and surfaces, and its ability to break degeneracies in retrievals from flux observations only and is thus essential for the full characterization of atmospheres and surfaces of (exo-) planets.

With the discoveries of the first rocky exoplanets, the quest for Earth-like exoplanets and signs of their habitability has started. Since exoplanet observations will yield a signal that is integrated over the illuminated and visible part of the planet's disk, the main challenge for the interpretation of future exoplanet observations in terms of habitability will be disentangling the contributions from the different surface types and clouds.

Numerical codes have been developed to model the spectral signals of oceans, continents, atmospheric gases, aerosols and clouds, but neither these codes nor retrieval algorithms can be validated by lack of disk-integrated observations of the Earth at a range of phase angles and wavelengths.

We present LOUPE (Lunar Observatory for Unresolved Polarimetry of the Earth) as an instrument for a lunar lander. LOUPE will measure the disk-integrated flux and state of polarization of sunlight that is reflected by the Earth. LOUPE will offer a unique opportunity to observe the Earth as if it were an exoplanet. Thanks to the characteristics of the Moon's orbit around our planet, such a lunar observatory will witness the daily rotation of the Earth, with various surface types rotating in and out of view. During a month, it will also see the Earth through all phase angles, ranging from a full Earth to a new or almost new Earth, just as we can expect for observations of an exoplanet (depending on its orbital inclination angle). Finally, during the year, seasonal variations will become apparent. Such observations cannot be obtained by integrating spatially resolved observations by Earth remote-sensing satellites, nor by so-called Earthshine measurements, which capture sunlight that has first been reflected by the Earth and then by the lunar surface, because these can only be done when the moon is seen at large phase angles (thus when a large fraction of the lunar nightside and hence a large fraction of the Earth dayside are in view).

Apart from a description of the LOUPE instrument, we will show numerically simulated flux and polarization spectra of Earth-like exoplanets to 1. illustrate the spectral and temporal variations that we can expect to observe from the moon, 2. point out the information that could be retrieved from such observations