The promise of polarimetry for biosignatures and habitability markers. K. Bott[1,2] , J. Bailey[3,4], V. Meadows[1,2], L. Kedziora-Chudczer[3,4], D. V. Cotton[3,4], and J. Marshall[3,4], [1]Virtual Planetary Laboratory (NASA Astrobiology Institute Virtual Planetary Laboratory, University of Washington, Seattle, Washington; email: kimbott@uw.edu), [2]Astronomy Department (University of Washington, Seattle, Washington), [3]Department of Astrophysics (University of New South Wales, Sydney, NSW, Australia; email: j.bailey@unsw.edu.au), [4]Australian Centre for Astrobiology (University of New South Wales, Sydney, NSW, Australia)

Context: Polarimetry provides unique information about planetary atmospheres and surface properties complementing more conventional observations. However, polarimetry is currently an under-utilized technique for exoplanet characterization, especially for smaller planets, where its utility is poorly understood. Models of polarised light from terrestrial planets can allow for the detection of biosignatures and habitabilty markers.

Methods: Combining the abilities of the Virtual Planetary Laboratory's SMART radiative transfer code (glint capabilities from a Cox-Munk Formalism [1]) and the University of New South Wales' VSTAR radiative transfer code (polarimetric cababilites) we explore the detectability of ocean glint for an Earth-like planet in polarised light. This is compared to theory (e.g. [2] [3] [4]) and assessed in observational contexts.

Results and Significance: The practical utility of polarimetry in determining cloud species, identifying biomarkers, and detecting ocean glint is assessed with a first order example in the form of the Earth as an exoplanet. In a similar vein to photometric surface mapping (see [5]), polarimetric surface mapping can provide detailed information about terrestrial exoplanets which may be crucial to exotic worlds such as super Earths and planets around red dwarfs. We explore the capabilities of polarimetry in the context of state-of-the-art Earth-based imaging and aperture polarimeters (e.g. SPHERE [6] or HiPPI [7]) and next era space telescopes (e.g. HabEx or LUVOIR). This research is relevant to upcoming large ground-based and future NASA exoplanet characterization missions, such as the proposed HabEx and LUVOIR telescope concepts, particularly in the context of choronography.

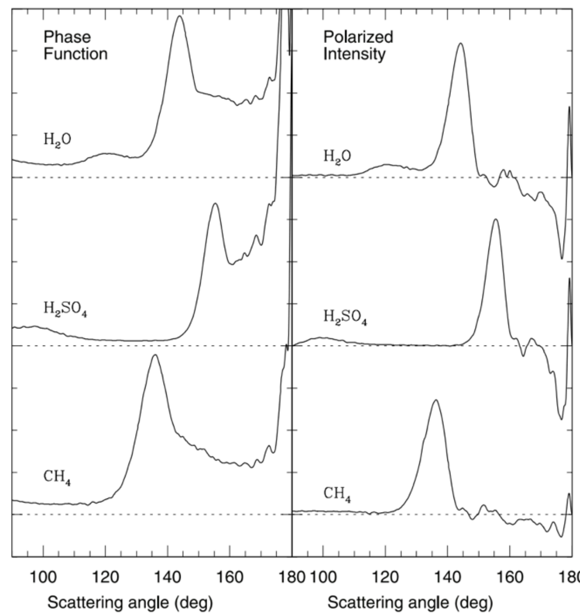

Fig 4. from [2] showing the unpolarised and polarized phase functions of rainbows of various species, illustrating the value in including polarimetric measurements for this habitability measurement.

References:

[1] Cox, C. and Munk, W. (1954) JOSA, 44, 11 [2] Bailey, J. (2007) *Astrobiology, 7,* 2 [3] Seager, S. et al. (2000) ApJ 540, 1, 504-520 [4] Zugger, M.E. et al. (2010) ApJ, 723, 1168-1179 [5] Cowan, N. et al. (2009) ApJ, 700, 2, 915-923 [6] Thalmann et al. (2008) *SPIE, 7014* [7] Bailey, J. (2015) MNRAS, 449, 3, 3064-3073