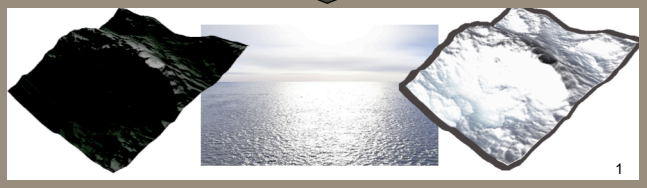
Reflectance Spectra of Extrasolar Planets

M.Wagner[1], P.H. Hauschildt[1]

[1] Hamburger Sternwarte, Gojenbergsweg 112, 21029 Hamburg, Germany

We are simulating reflectance and transmission spectra of extrasolar planets around Sun-like and M-stars. Furthermore we are focussing on Earth-like planets and Superearths with optically thin atmospheres.

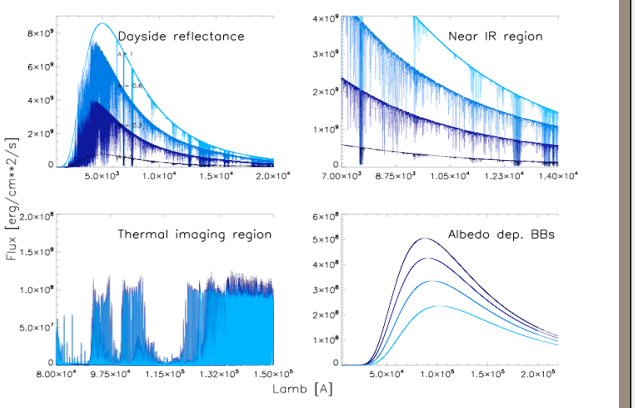
Image sources: Mars [NASA/JPL/Malin Space Science Systems], Earth [Nasa, Apollo Mission], Ocean planet [clevelandwebs.com], Ice pLanet [www.artemis-uk.org]



1

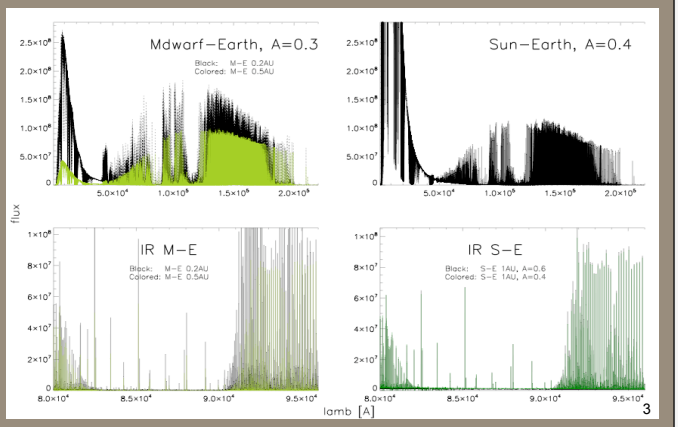
What kind of signature will different surface textures produce in the reflected light?

The numerical tool for this simulation is provided by the PHOENIX code (Hauschildt et al. 2010). The code has been enhanced to treat reflecting surfaces with either angular independent (soils, rocks, snow..) or angular dependent (oceans, liquids) gray albedos, as well as wavelength dependent albedos.



2

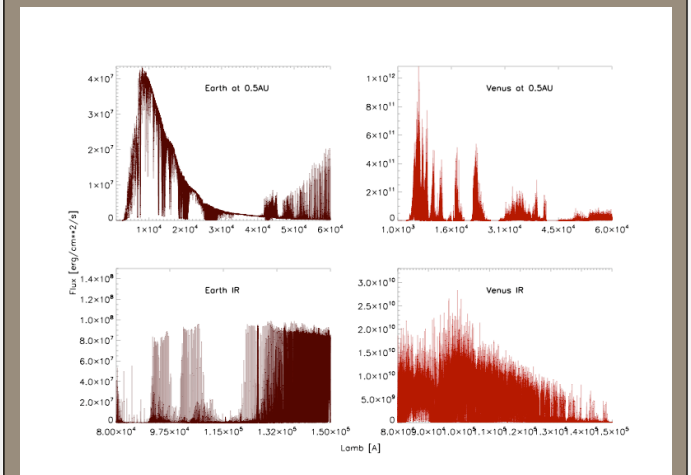
Figure 1 above shows a simulated dayside reflectance spectrum of an Earth-like exoplanet around a Sun-like host star. With increasing surface albedo the energy stored by the surface decreases.



3

Figure 3 shows a comparison of an Earth-analogue with an optically thin atmopshere (no clouds) around a Sun-like and around an M-star (3500 K) at different heliocentric distances.

There are crucial differences in the way optically thin and thick atmospheres store and redistribute the impinging radiation, here from a Sun analogue (figure 4).



4

OUTLOOK:

All simulations presented here use the 1-dimensional radiative transfer equation in spherical symmetry. Expanding into 3 dimensions will bring numerous interesting possibilities in order to archieve more realistic simulations, e.g. the input of biogenic molecules such as chlorophyll by vegetation or mapping of the planetary surface with different albedos (e.g. Earth-like with land and ocean).

In order to compare the high resolution spectra to current and future observations, a photometry simulator has been added that uses filters similar to current and planned telescopes (e.g. James Webb Telescope).

email: mwagner@hs.uni-hamburg.de