Detectability of Planetary Surface Biosignatures: modeled and measured disk-averaged spectra of the Earth

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We are using a 3D model to explore the observational sensitivity to changes in atmospheric and surface properties, and the detectability of biosignatures, in the globally-averaged spectra and light-curves of the Earth. We used Atmospheric Infrared Sounder (AIRS) data as input to the SMART radiative transfer model to generate spatially-resolved, high-resolution spectra from the far-IR to the UV. Those were then averaged over selected visible disks.

Among the results, we examined the sensitivity of the red-edge detectability to varying

planetary geometric views (varying visible land cover), clouds (effect of both cloud type and amount of cover) over the current Earth' surface, and the concentration of clorophyll in phytoplankton. The surface cover of vegetation on Earth is evidently adequate to produce a strong enough disk-averaged signal to show the red-edge even when we average on the diurnal cycle. This information can be useful for a mission like TPF-C which probably will have to deal with integration times of the order of a day. The damping effect of clouds was quantified with NDVI indexes.

Previous works have utilized Earthshine data to look for a vegetation signature in disk-averaged spectra: with our model we can generate the full range of scenarios (clouds, atmospheric gases, geometries, phases) that are not available from a single observational data set, and thus study their separate contributions.

These results were processed with an instrument simulator to study the detectable characteristics of the Earth-like planets as viewed by the first generation of extrasolar terrestrial planet detection and characterization missions(NASA-TerrestrialPlanetsFinder/ESA-Darwin)