Comparitive Planetology of Solar System Spectra Supporting Direct-Imaging of Exoplanets

Ally Payne[1,2], Geronimo Villanueva[1], Vincent Kofman[1,3], Thomas Fauchez[1,3], Avi Mandell[1], Sara Faggi[1,3]

1. NASA Goddard Space Flight Center, 2. SURA, 3. American University

How can we use existing data from solar system planets to better characterize potentially habitable exoplanets?

By combining spectra from various ground- and space-based missions to create a more extensive baseline for the reflectance signatures of solar system planets. The diversity of planets in our solar system is key to developing this framework for comparative planetology. By comparing new exoplanet observations to known planetary spectra, we can begin to classify them based on similarities with the planets that we know best.

Motivation

The search and characterization of habitable exoplanets can be greatly supported by studying reflected light from planets within our own solar system. Data collected from these nearby planets have higher signal-to-noise ratios (SNRs) and provide the most reliable spectral data. Light from the sun that is reflected off a planetary surface will pass through its atmosphere, and spectrometry reveals the unique absorption signatures that allow us to determine the chemical constituents of that atmosphere.

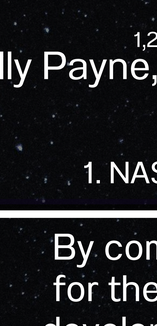
- HWO is the first telescope specifically designed to search for signs of life on planets orbiting other stars
- It will search for and characterize potentially habitable (Earth-like) planets
  - close examination of atmospheres for possibility of life
- Relevant science output: A spectral library with standardized units and planetary geometry will be essential for characterizing new exoplanet detections.

Future Goals

- Create a representation for the solar system seen through a future Habitable Worlds Observatory coronagraph instrument
- Compile results for each of the solar system planets and Titan to be submitted in my upcoming publication!

Case 1 Jupiter

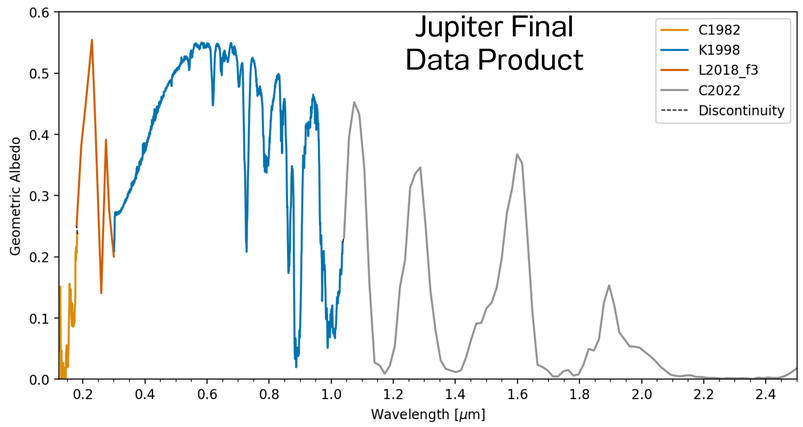
Uninhabitable, gas giant, thick Hydrogen (~90%) - Helium (~10%) atmosphere, lack of solid surface



1: Original Data
Original reflected light intensities are shown

2: Geometric Adjustments
Data are adjusted to phase zero and Lambertian limb darkening corrections are applied

3: Adjusted Geometric Albedo
Sources are scaled to match the intensity of the chosen reference spectrum

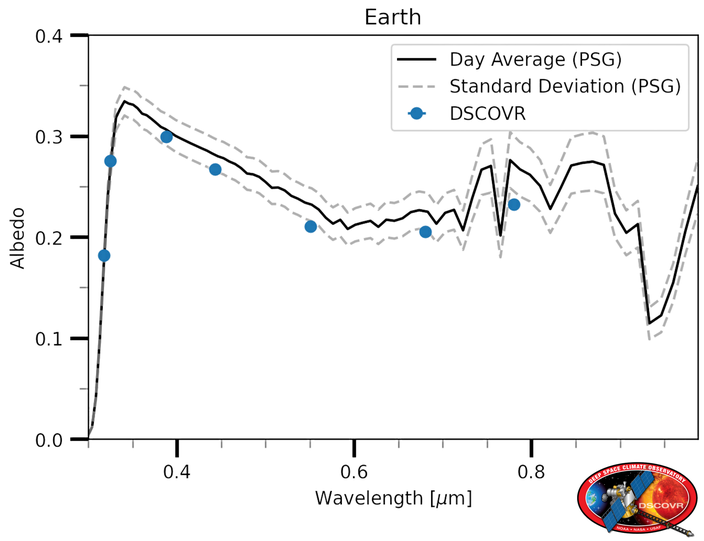


Case 2: Earth

Habitable, rocky terrestrial planet, with oceans of liquid water, oxygen-rich atmosphere, moderate climate

Earth Model

DSCOVR



Data from Dr. Vincent Kofman, produced using PSG, GlobES, and the Deep Space Climate Observatory (DSCOVR) data

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Case 3: Venus

Uninhabitable, rocky terrestrial planet, CO2 dominated atmosphere (~96%), runaway greenhouse effect