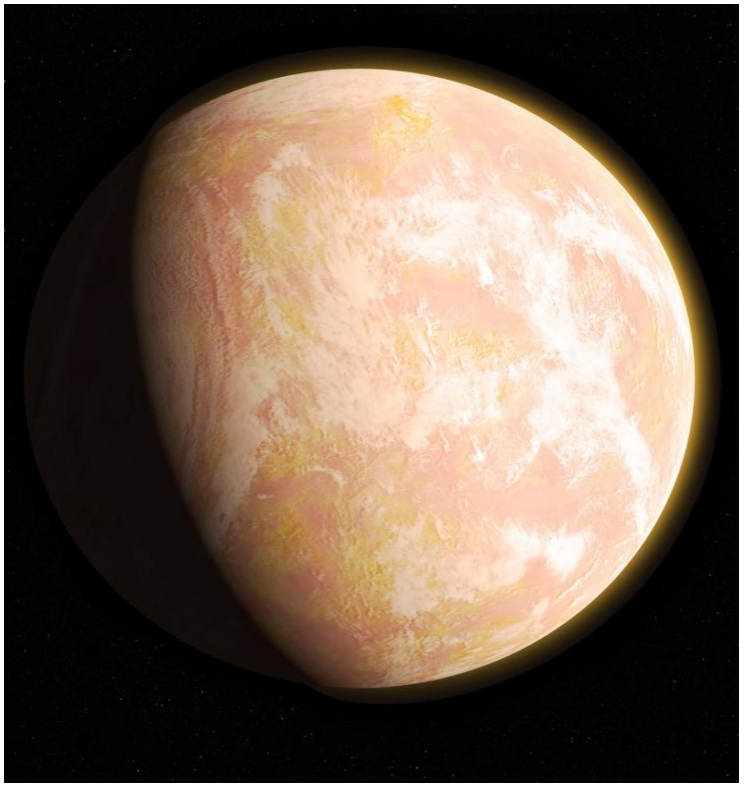
Pale Orange Dots: Organic Haze as a Biosignature on Other Earths

What is the science question? What are the biosignatures of habitable, methane-rich exoplanets?

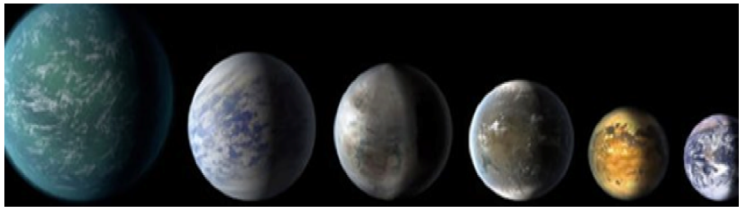
What were your findings? Organic haze, a type of orange-colored “smog”, can indicate high methane production rates that suggest biological processes on exoplanets with atmospheres that contain carbon dioxide. Additionally, since organic haze requires less methane to form in the presence of biogenic organic sulfur gases, the presence of organic haze at unexpectedly low methane concentrations can also suggest the influence of these gases and imply biological activity on the exoplanet.

What was the impact? This work helps us understand what biosignatures to look for in the atmospheres of exoplanets with dominant biospheres that are different from modern Earth. Organic haze produces prominent remotely-detectable features in the UV-blue and near infrared light observed from exoplanet atmospheres that could be used as indirect evidence of life.

Why does it matter to non-scientists? This work will help future astronomers search for life on distant exoplanets.



An artistic depiction of Earth during the Archean Eon as a “pale orange dot” with atmospheric organic haze



G. A. Arney, S. D. Domagal-Goldman, V. S. Meadows (2018), “Organic Haze as a Biosignature in Anoxic Earthlike Atmospheres”, *Astrobiology*, 18(2), 311-329, https://doi.org/10.1089/ast.2017.1666