



Blue Marble Space  
Institute of Science

# Prospects for Technosignatures

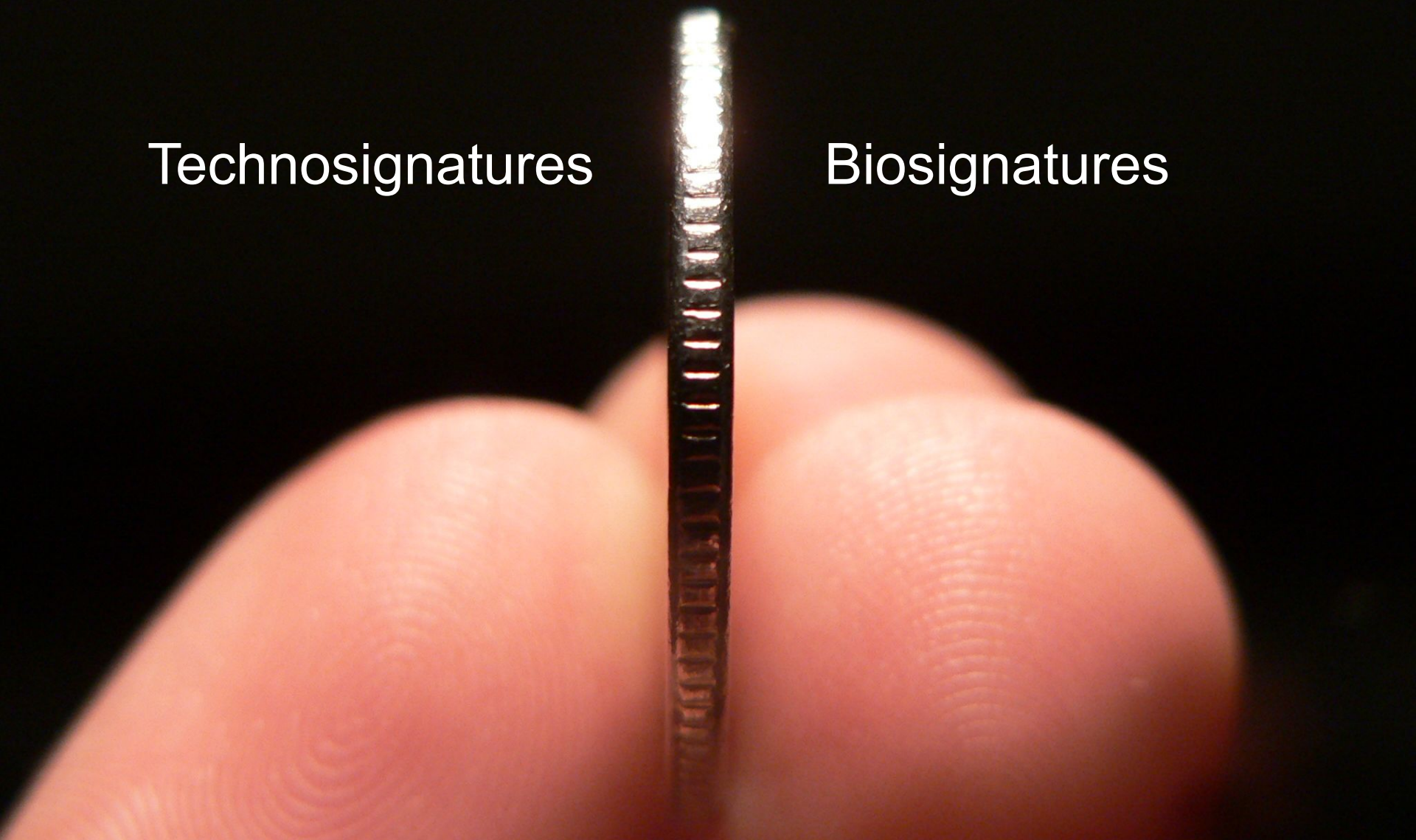
Jacob Haqq-Misra

Email: [jacob@bmsis.org](mailto:jacob@bmsis.org)

Twitter: [@haqqmisra](https://twitter.com/haqqmisra)

Technosignatures

Biosignatures

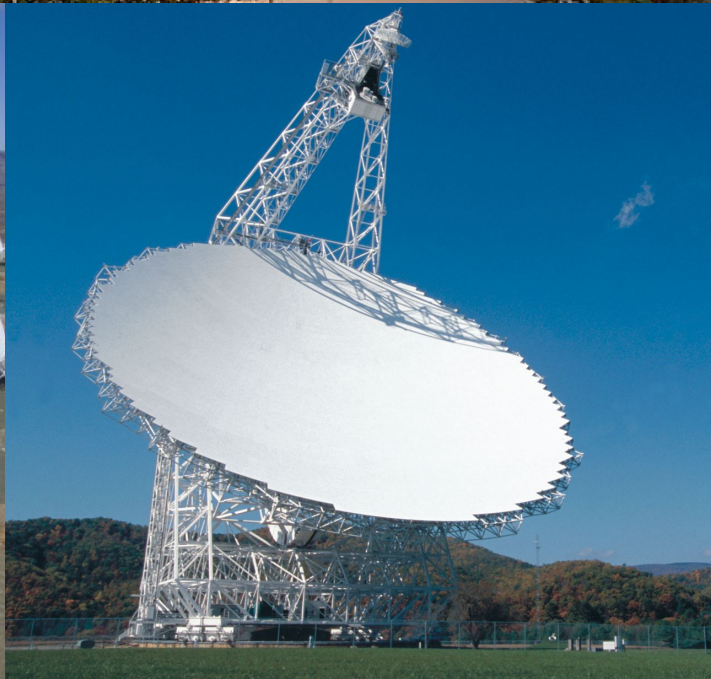


# SETI is “SET-T”

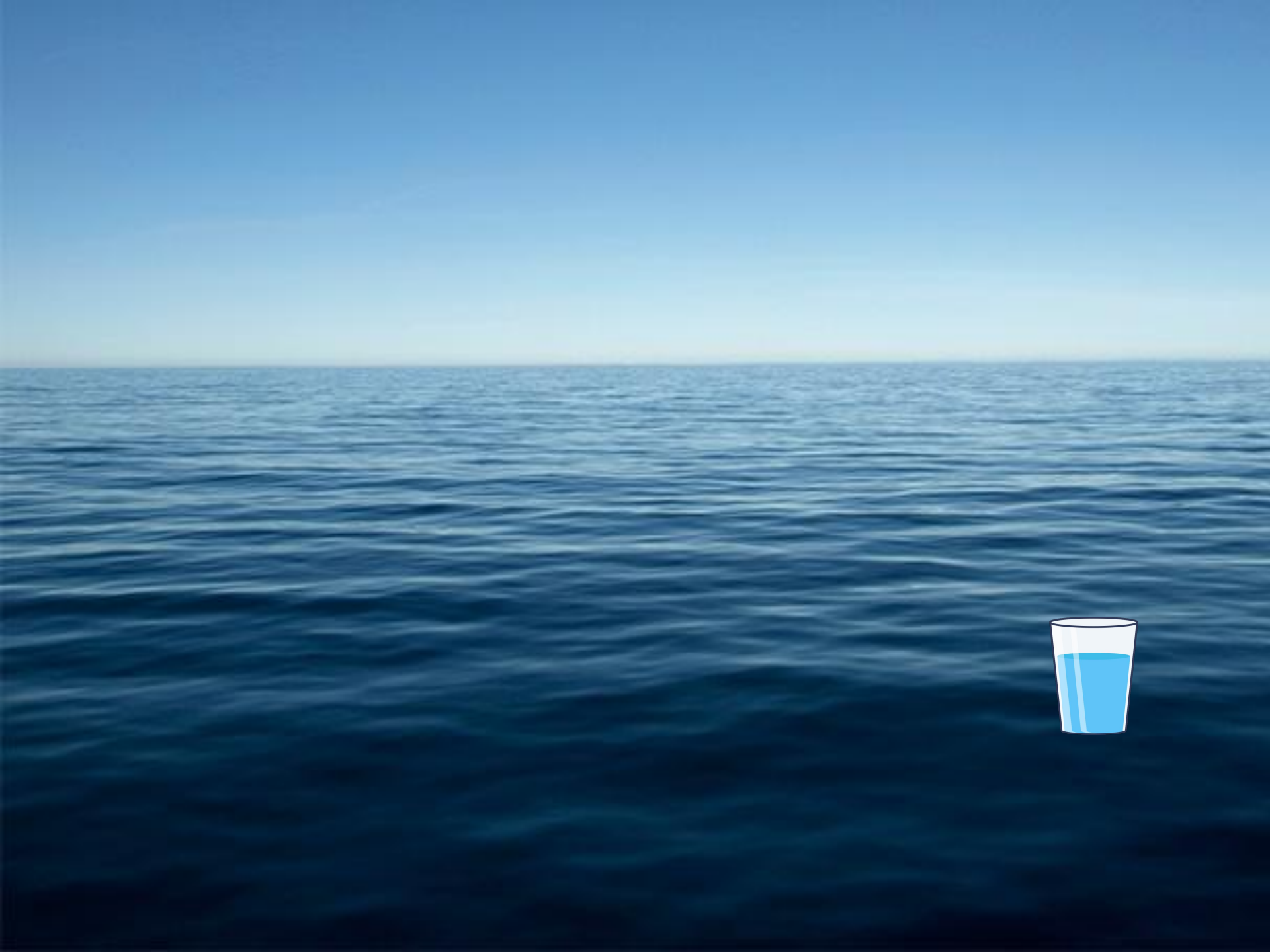
We can search for technology



Haqq-Misra, J., Schwieterman, E. W., Socas-Navarro, H., Kopparapu, R. K., et al. (2022) Searching for technosignatures in exoplanetary systems with current and future missions. *Acta Astronautica* 198: 194-207.





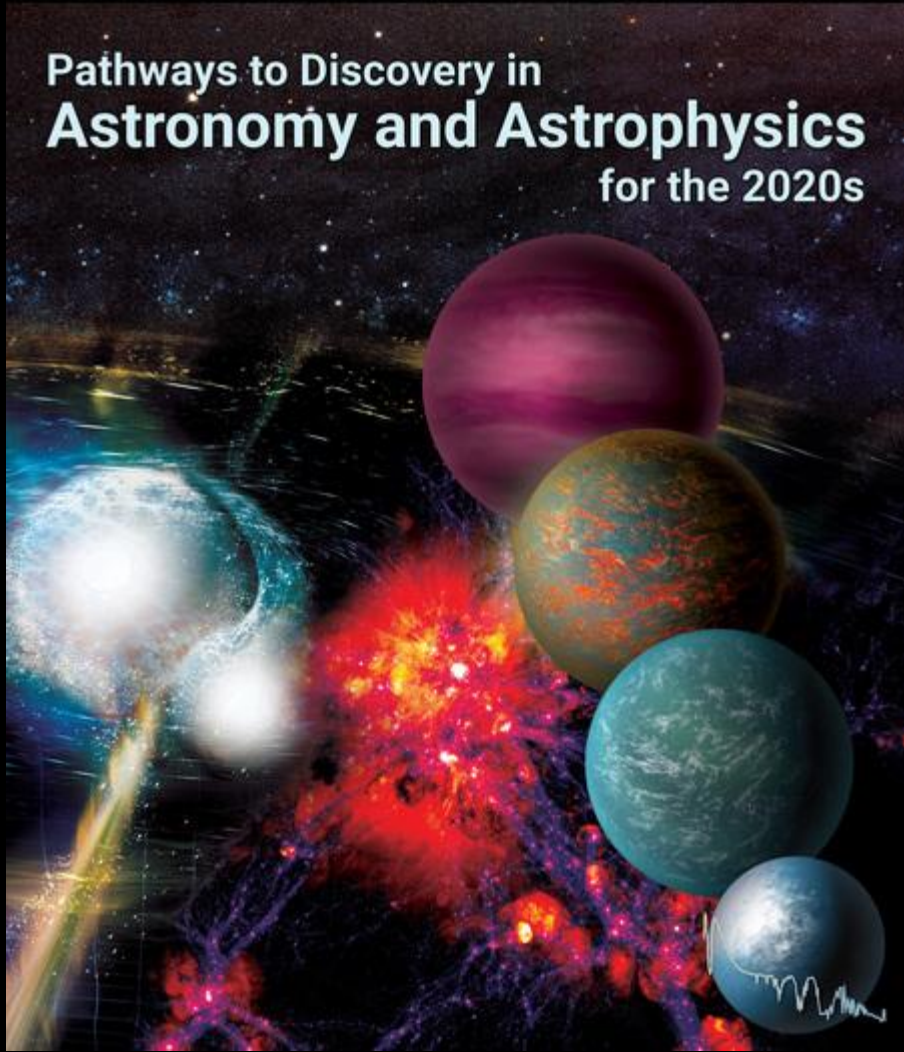




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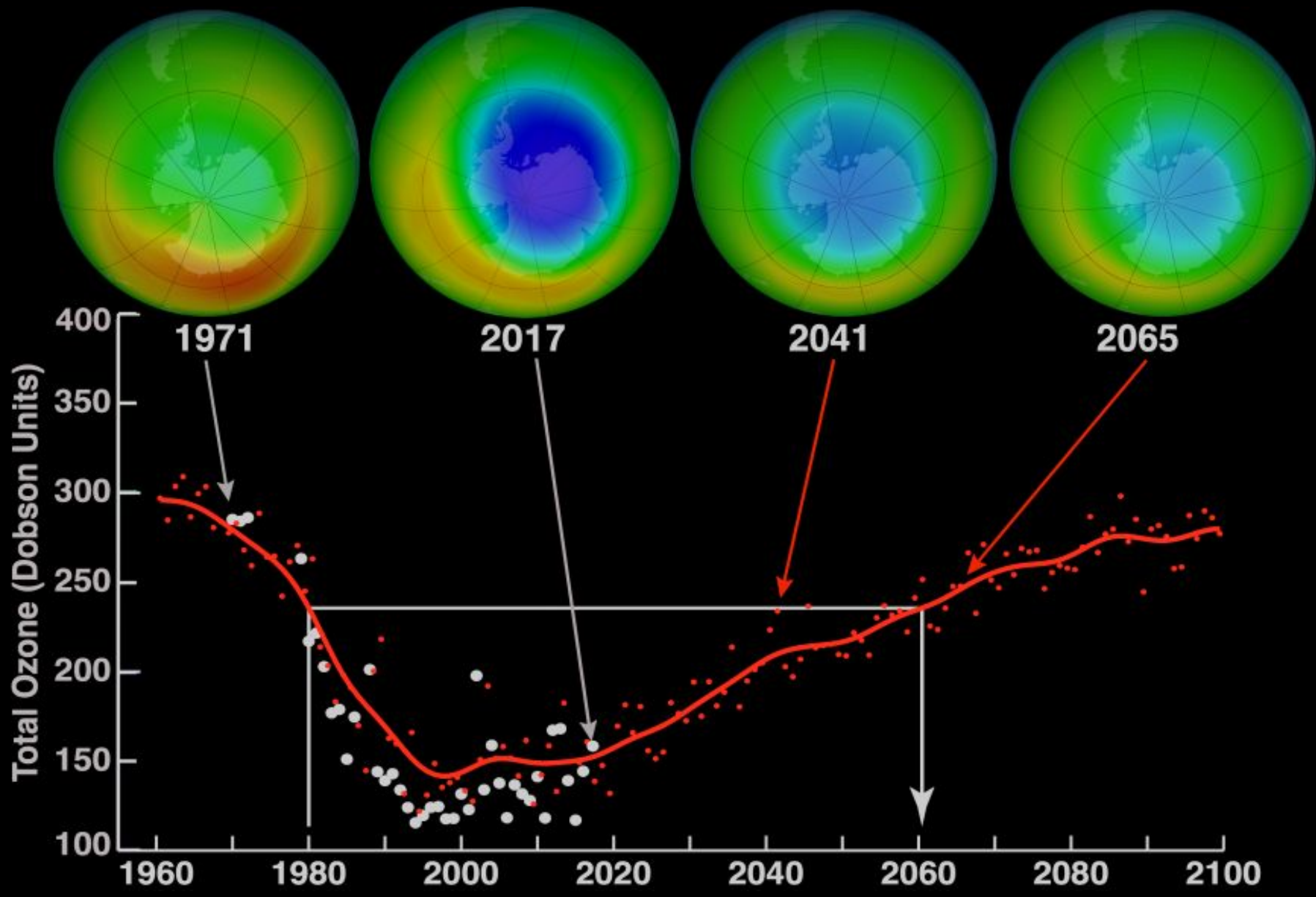
CONSENSUS STUDY REPORT

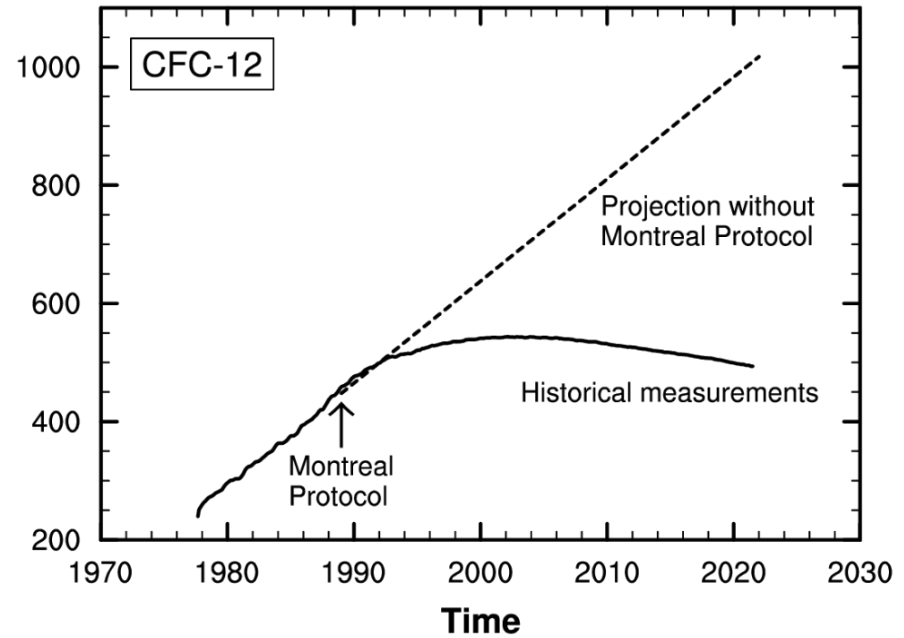
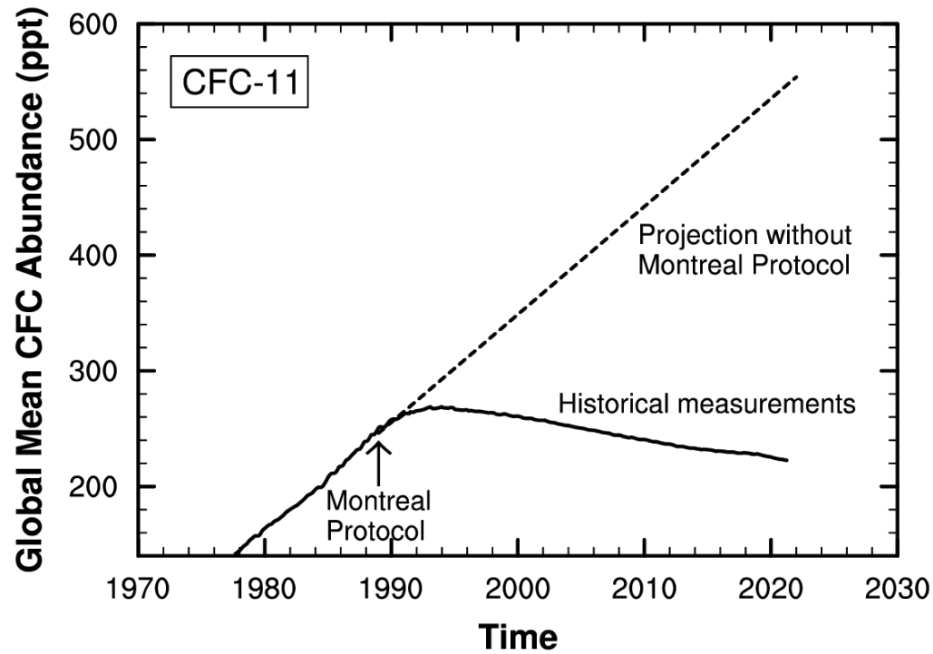
# Pathways to Discovery in Astronomy and Astrophysics for the 2020s



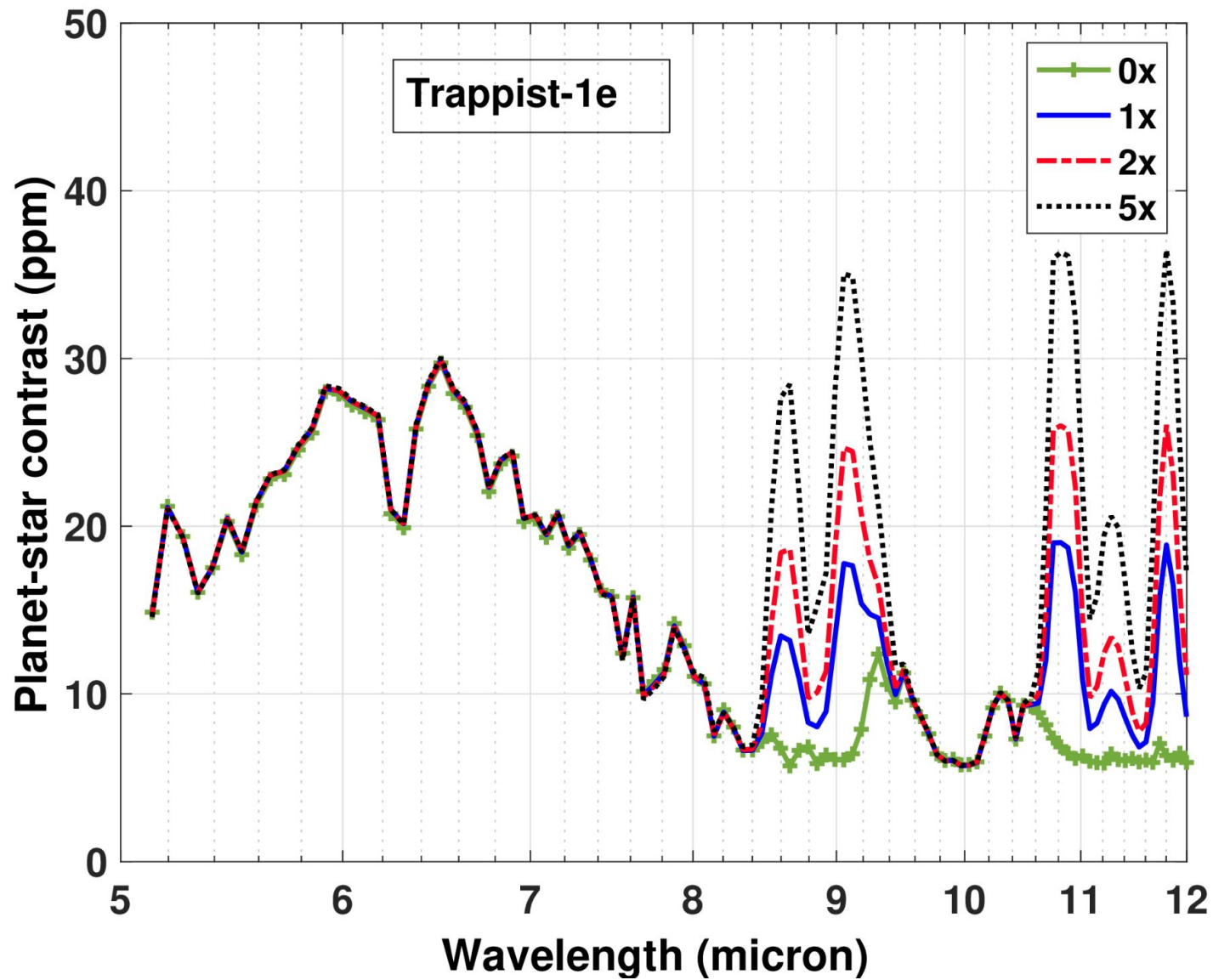
H A B I T A B L E  
W  R L D S  
O B S E R V A T O R Y





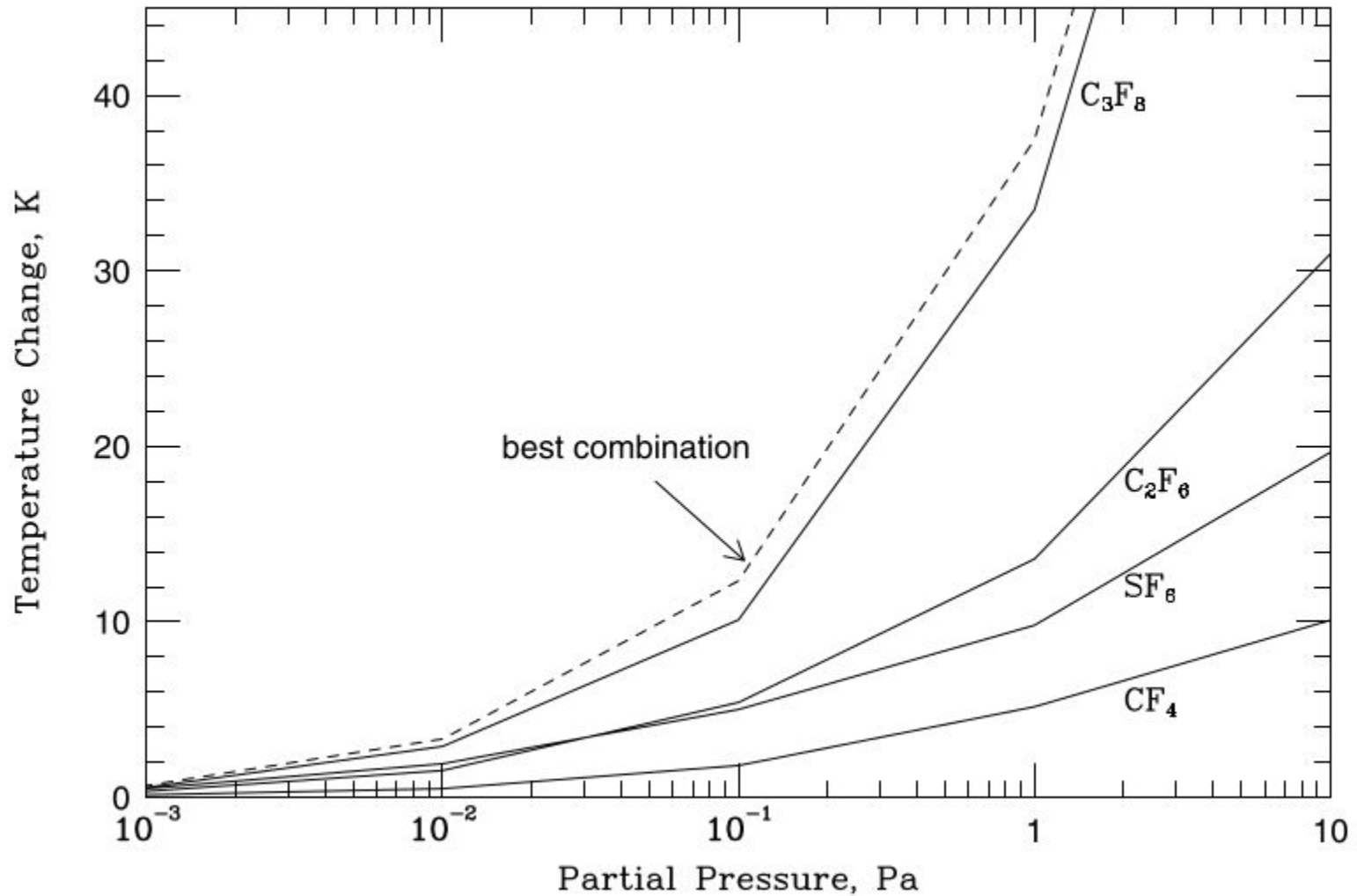


Haqq-Misra, J., Kopparapu, R., Fauchez, T. J., Frank, A., Wright, J. T., & Lingam, M. (2022) Detectability of Chlorofluorocarbons in the Atmospheres of Habitable M-dwarf Planets. *The Planetary Science Journal* 3: 60.



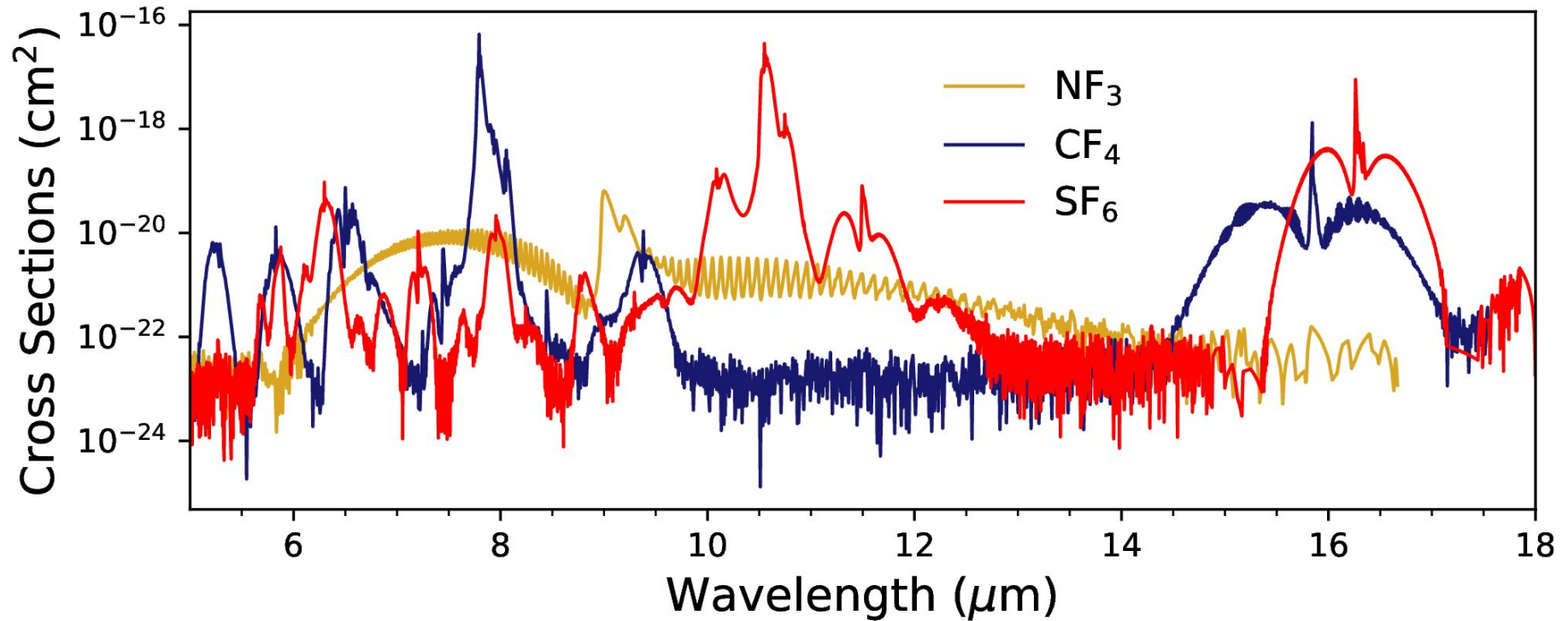
Haqq-Misra, J., Kopparapu, R., Fauchez, T. J., Frank, A., Wright, J. T., & Lingam, M. (2022) Detectability of Chlorofluorocarbons in the Atmospheres of Habitable M-dwarf Planets. *The Planetary Science Journal* 3: 60.

# Terraforming



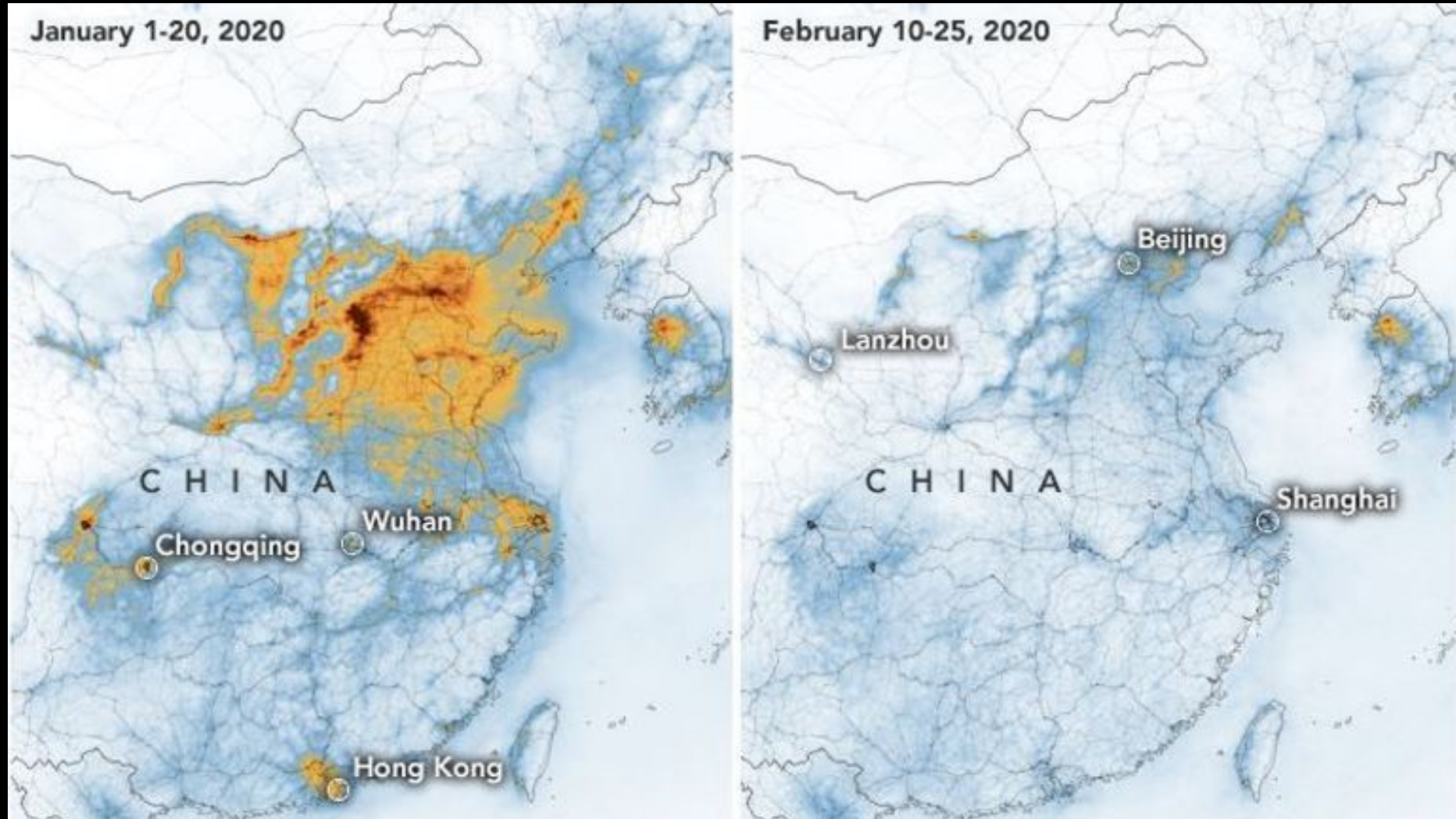
Marinova, M. M., McKay, C. P., & Hashimoto, H. (2005). Radiative-convective model of warming Mars with artificial greenhouse gases. *Journal of Geophysical Research: Planets* 110: E3.

# Terraforming



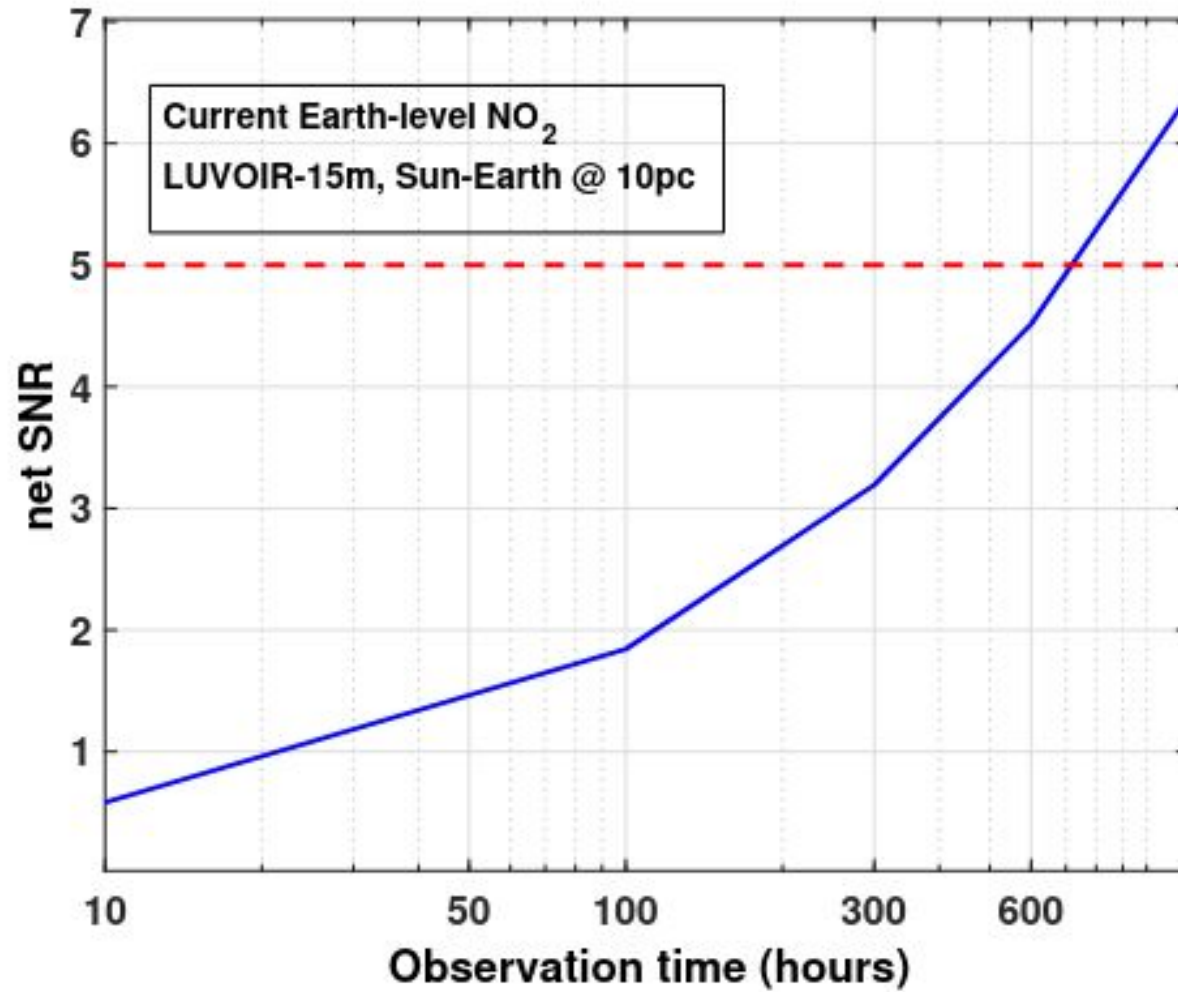
Schwieterman, E., Fauchez, T. J., Haqq-Misra, J., & Kopparapu, R., Pidhorodetska, D., Leung, M., et al. (2022) Detectability of Artificial Greenhouse Gases as Exoplanet Technosignatures. In preparation.

# Nitrogen Dioxide

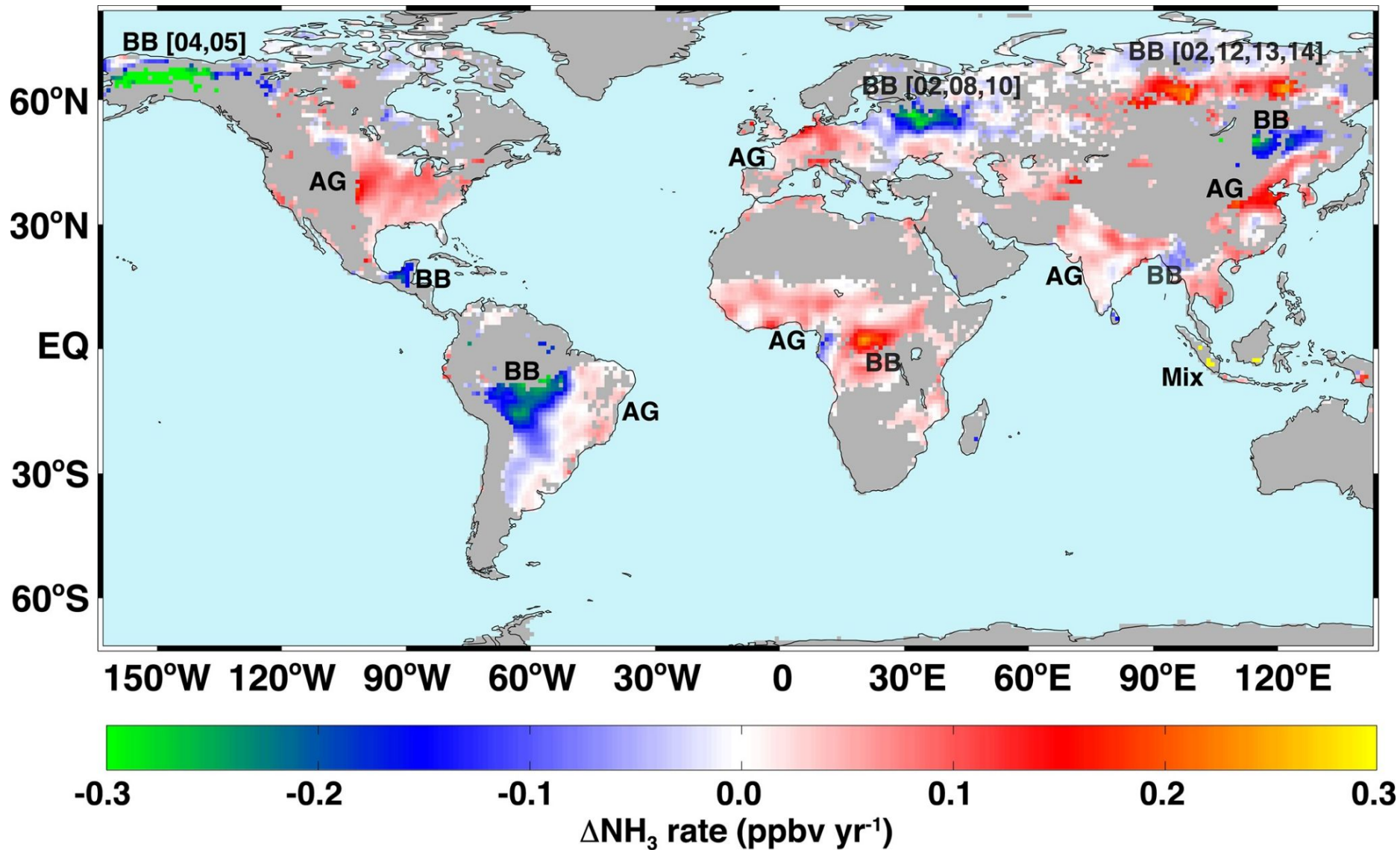


See: Kopparapu, R., Arney, G., Haqq-Misra, J., Lustig-Yaeger, J., & Villanueva, G. (2021) Nitrogen dioxide pollution as a signature of extraterrestrial technology. *The Astrophysical Journal* 908: 164.

# Nitrogen Dioxide

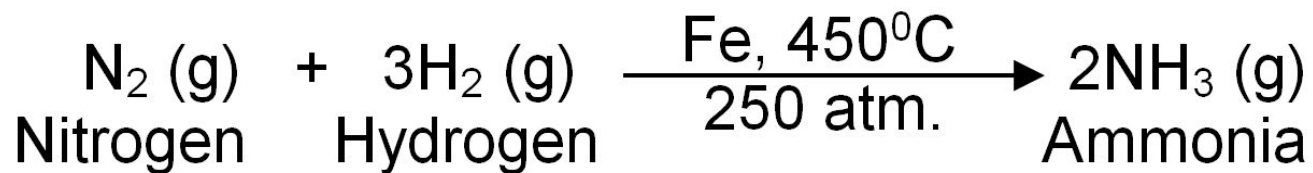


Kopparapu, R., Arney, G., Haqq-Misra, J., Lustig-Yaeger, J., & Villanueva, G. (2021) Nitrogen dioxide pollution as a signature of extraterrestrial technology. *The Astrophysical Journal* 908: 164.

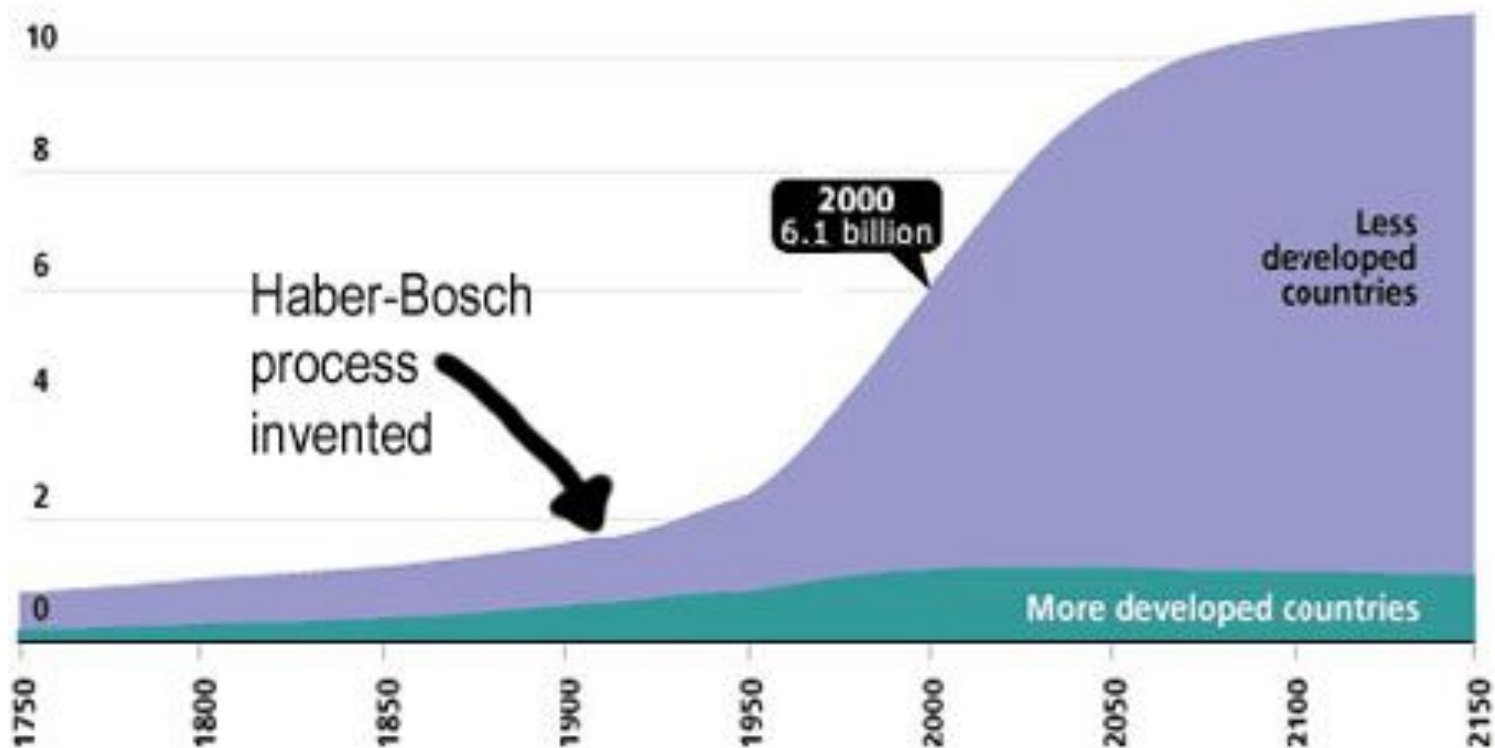


Warner, J.X., Dickerson, R.R., Wei, Z., Strow, L.L., Wang, Y., & Liang, Q. (2017) Increased atmospheric ammonia over the world's major agricultural areas detected from space. *Geophysical Research Letters* 44: 2875-2884.



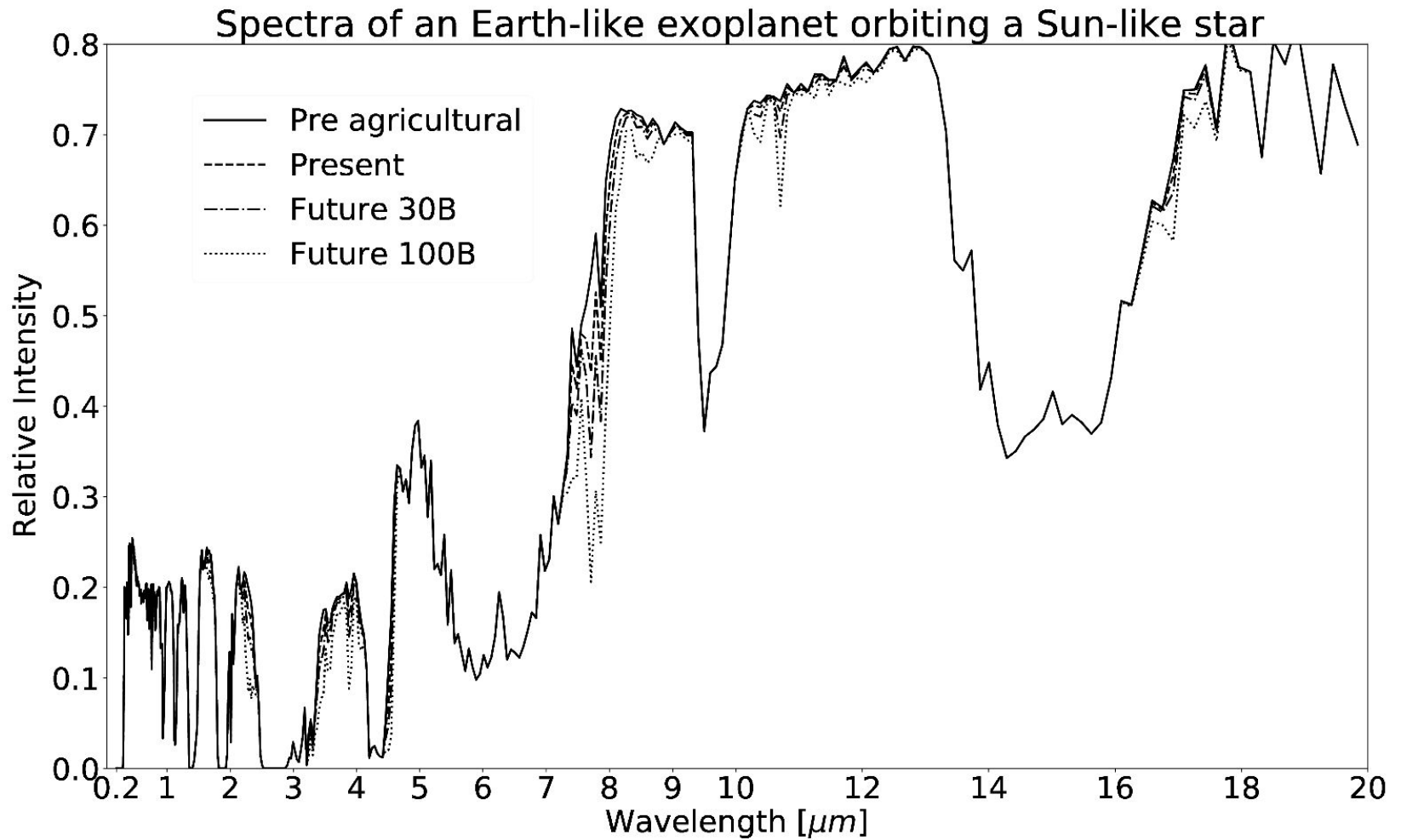


Population (in billions)



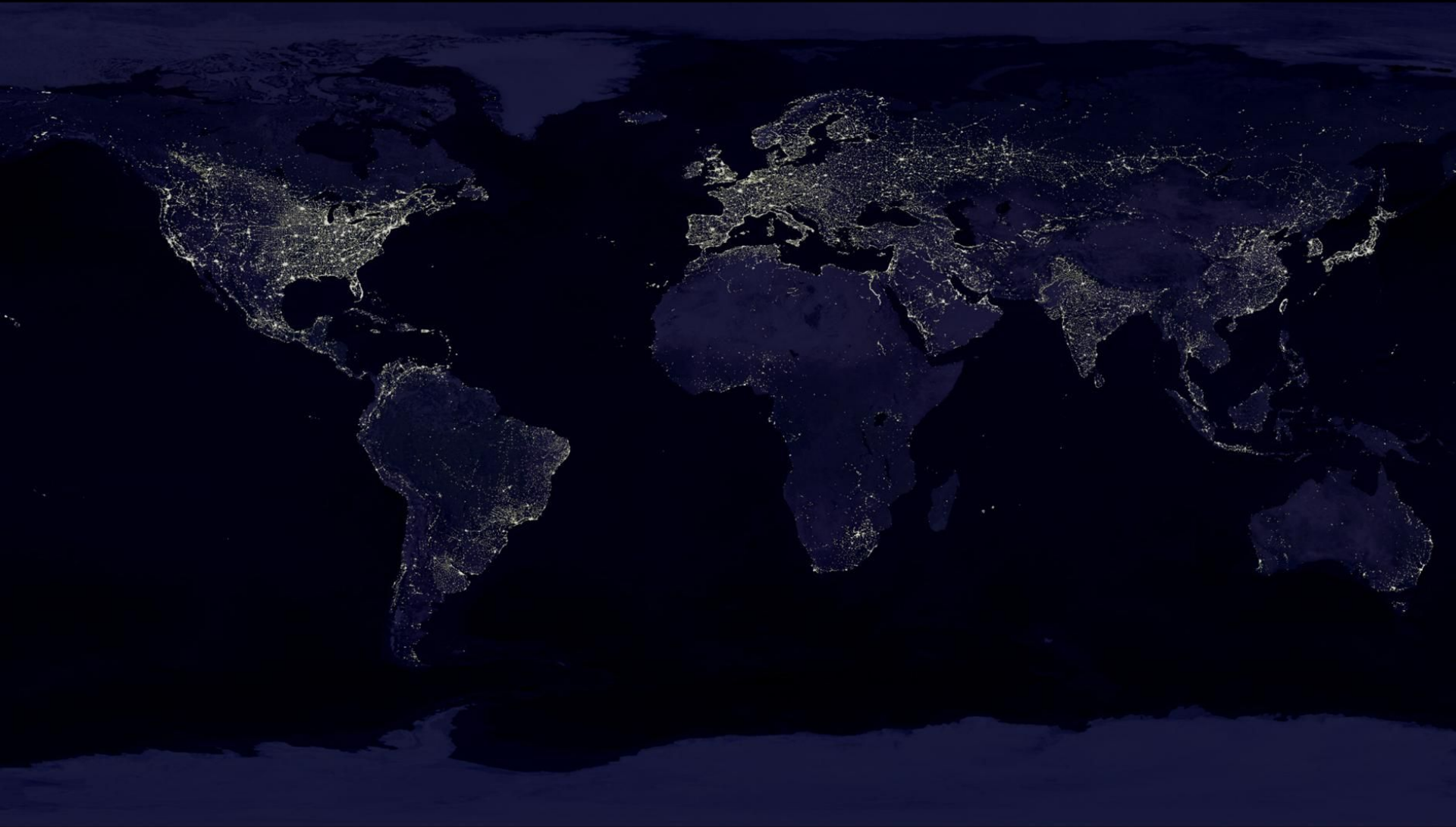
# ExoFarm

A

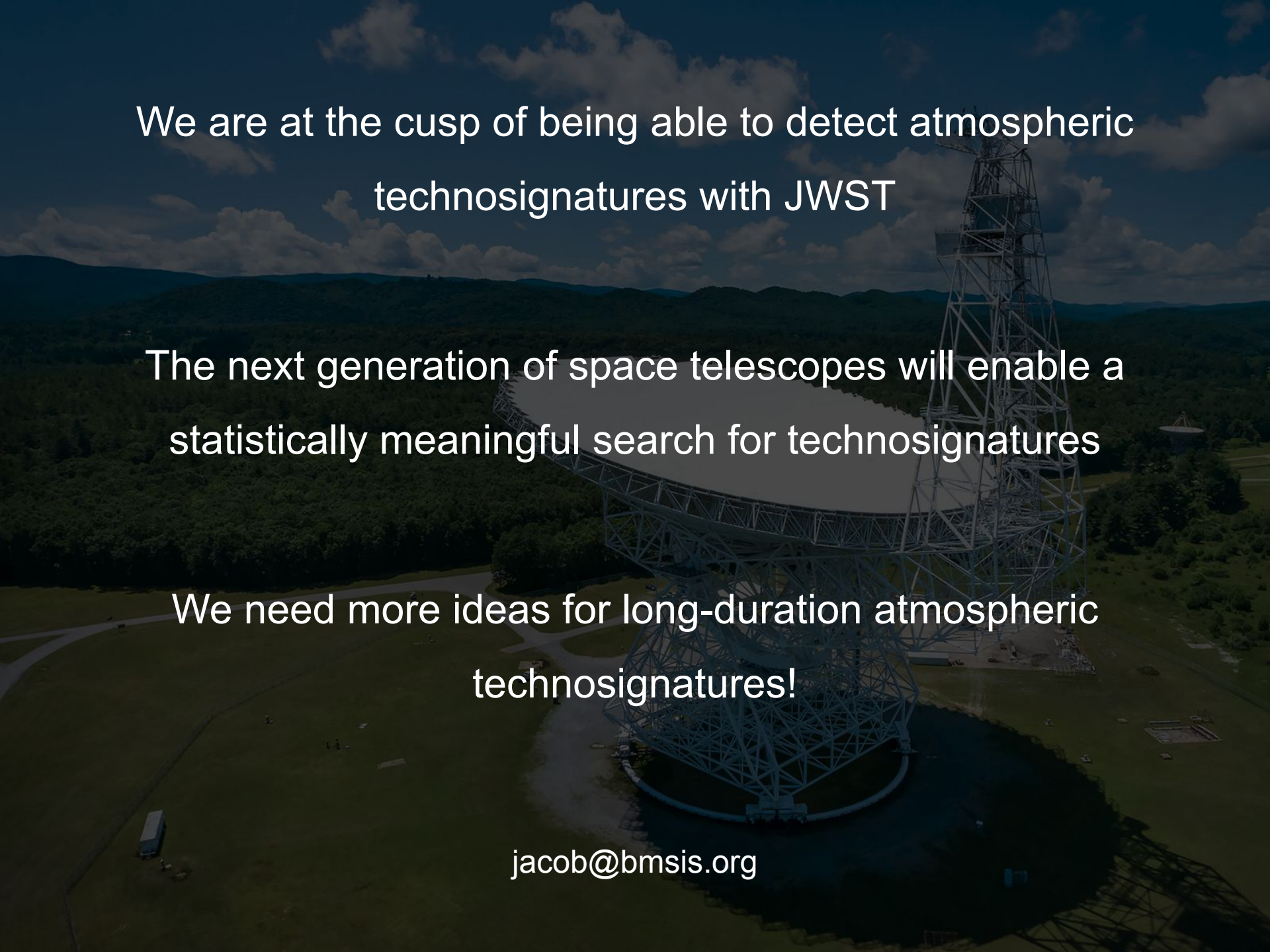


Haqq-Misra, J., Fauchez, T. J., Schwieterman, E., & Kopparapu, R. (2022) Disruption of a Planetary Nitrogen Cycle as Evidence of Extraterrestrial Agriculture. *The Astrophysical Journal Letters*, in review.

# City Lights



See: Beatty, T. G. (2022) The detectability of nightside city lights on exoplanets. *Monthly Notices of the Royal Astronomical Society*, 513(2), 2652-2662.

An aerial photograph of a large radio telescope dish, likely the Green Bank Telescope, situated in a lush, green forested area. The dish is a large, white, parabolic structure supported by a complex metal lattice. The surrounding landscape is dense with trees and rolling hills under a blue sky with scattered clouds. The image is overlaid with white text.

We are at the cusp of being able to detect atmospheric  
technosignatures with JWST

The next generation of space telescopes will enable a  
statistically meaningful search for technosignatures

We need more ideas for long-duration atmospheric  
technosignatures!

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