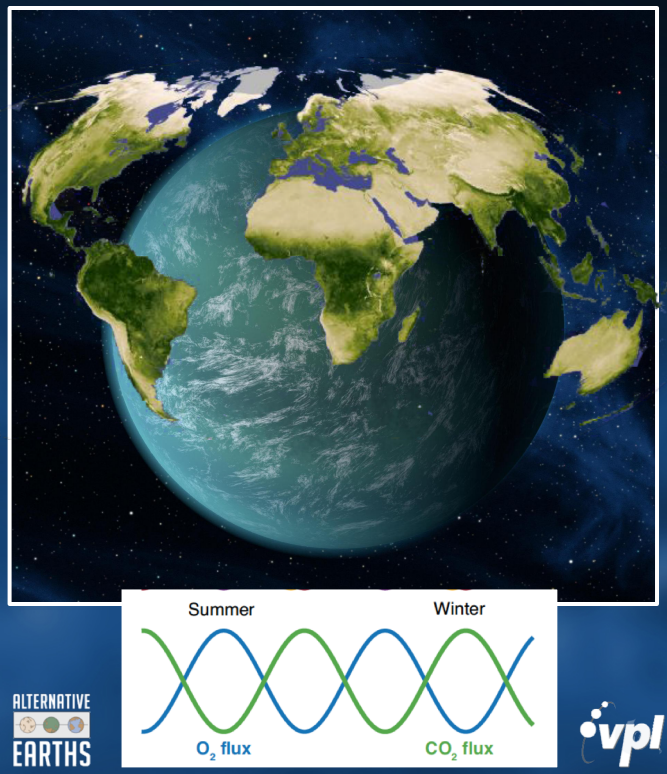
Atmospheric Seasonality as an Exoplanet Biosignature



EXPLORING EXO-SEASONS | Satellites monitor how 'greenness' changes with Earth's seasons (world map). This study assesses the accompanying changes in atmospheric composition of gases such as O_2 and CO_2 (graph) as a marker for life on distant planets like Kepler 22B (NASA artist's depiction in background).

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A powerful way to assess exoplanets for inhabitation may be observations of their atmospheres throughout their orbits—potentially revealing life-driven changes in biosignature gases over the course of a year.

INNOVATION | In the first quantitative framework for dynamic biosignatures based on seasonal changes in the Earth's atmosphere, this study characterized the seasonal formation and destruction of oxygen, carbon dioxide, and methane. They also modeled fluctuations of atmospheric oxygen on a life-bearing planet with low oxygen content, like that of Earth billions of years ago.

DISCOVERY | Ozone is produced in the atmosphere through reactions involving oxygen gas (O_2) produced by life. On weakly oxygenated planets, ozone would be a more easily measured marker for the seasonal variability in O_2.

MISSION RELEVANCE | Remote detection of life on exoplanets will require telescopes with broad spectral capabilities. This study makes the case that ozone may be the only detectable biosignature on planets like the early Earth, making ultraviolet capability essential. The study results also support the argument for direct imaging capabilities on future telescopes.