NINS Astrobiology Center

The Astrobiology Center (ABC) was established in 2015 to promote interdisciplinary studies including astronomy, earth science, and biology. Our ultimate goal is to find a so called ‘Second Earth’ and other extraterrestrial life on this planet. Astronomers and earth scientists in the Exo-Planet Search Project and Astrobiology Instrument Project at the main office in Tokyo are now discovering habitable planets around the nearest stars using the latest observation technologies. To support these observation projects, biologists from NIBB participating in the Exo-Life Search Project are investigating life on Earth to predict the biosignature of hypothetical life on the aforementioned ‘Second Earth’.

This year, ABC (jointly with NAOJ) hosted the 4th ‘In the Spirit of Lyot’ international symposium in Tokyo, where the international research community found new ways to work together toward direct imaging of the ‘Second Earth’. The solar coronagraph, a telescopic attachment for blocking bright light from the Sun, was invented by the namesake of this symposium, Bernard Lyot, in 1931. Stellar coronagraphs enable high contrast imaging of Earth-like planets around Sun-like stars in combination with adaptive optics and other advanced observation technologies.

Figure 1. Lyot 2019 Poster

Laboratory of Biological Diversity

TAKIZAWA Group

Specially Appointed Associate Professor
TAKIZAWA, Kenji

The Takizawa group operating out of ABC is currently studying environmental responses of photosynthesis in order to predict photosynthetic apparatus of ‘Alien’ plants under extreme conditions on the ‘Second Earth’.

Remote sensing of vegetation red-edge

One of the most plausible biosignatures on habitable exoplanets is a specific reflection pattern on the land surface named ‘red-edge’ that is caused by land vegetation. Red-edge appears on Earth between red light which is absorbed by photosynthetic pigments, and near infrared radiation (NIR), which is reflected via leaf tissue structure. Vegetation indexes calculated from reflectance in red and NIR are roughly related to photosynthetic capacity. Remote sensing by drone-based, multiband sensors revealed light reflection properties of plants growing in various habitats.

Floating plants in water world

The light reflection properties peculiar to land vegetation cannot be formed by algae and plants under water. Even though aquaplanet is rare within the universe, most of the water-containing planets are considered ‘ocean planets’, which are filled with a substantial amount of water. If there are no continents, detection of vegetation red-edge is unlikely. We proposed there was a possibility remaining that a strong biosignature could be detected on ‘water planets’ due to extensive flourishing of drifting algae and floating plants. Some species of aquatic plants have sponge-like floating leaves and thus reflect NIR in a manner comparable to land vegetation.

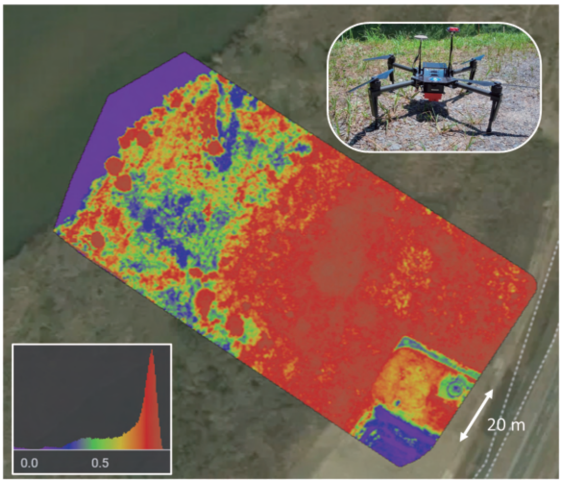

Figure 2. Normalized difference vegetation index (NDVI) survey for grassland on a riverbank. NDVI is a graphical indicator for green vegetation calculated from light reflectance in Red and NIR as (NIR-Red)/(NIR+Red). Grass covered area showed high NDVI (red color) in contrast with low NDVI (blue color) for water (upper left) and soil (lower right) area. Multiband images were obtained by drone-based sensors (pictured at upper right).