Earth Observation and Science: Monitoring Vegetation Dynamics from Deep Space Gateway. Y. Knyazikhin, Taejin Park, B. Xu, Department of Earth andEnvironment, Boston University, 685 Commonwealth Avenue, Boston, MA 02215, jknjazi@bu.edu.

Introduction: Vegetation plays an important role in the Earth's energy balance. Its monitoring is required to understand how ecosystems, land cover, and biogeochemical cycles respond to and affect global environmental change. The current state of art for mapping biophysical variables is limited to leaf area index (LAI) from passive sensors. Parameters of interest also include light use efficiency and diurnal courses of sunlit (SLAI) and shaded (ShLAI) leaf area indices, fraction of photosynthetically active radiation (PAR) absorbed by vegetation (FPAR), and Normalized Difference Vegetation Index (NDVI). Their retrieval from space measurements requires high temporal resolution of satellite data. Uniqueness of the Deep Space Gateway (DSG) observation strategy is its ability to provide frequent observations of the Earth that the existing Low-Earth-Orbiting and Geostationary satellites do not have. This feature therefore provides a strong basis for retrieving these variables, which are key paramters in most ecosystem productivity models and carbon/nitrogen cycle.

Ideal instrument: narrow band spectrometer that can register radiance in the spectral interval between 400 nm and 1000 nm at about 5-10 nm spectral resolution. Minimum requirements: spectrometer that register radiance at blue, green, red and near-infrared narrow spectral bands.

Below are prototyps of Earth' science products that can be derived from DSG data.

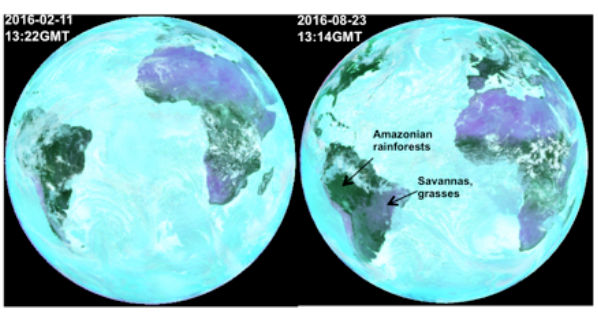

Figure 1. Vegetation dynamics. False color image (688-551-680) of the scattering coefficient derived from the NASA's Earth Polychromatic Imaging Camera (EPIC) onboared NOAA's Deep Space Climte Observatory (DSCOVR) images taken on Feb-11-2016 at 13:22GMT and Aug-23-2016 at 13:14GMT using a simple algorithm documented in [1]. The green color indicates green leaves that EPIC sees through the atmosphere. The images capture changes in savannas from wet (approximately June to September) and dry (October to May) seasons when area of green leaves increases during the wet season and decreases during the dry season.

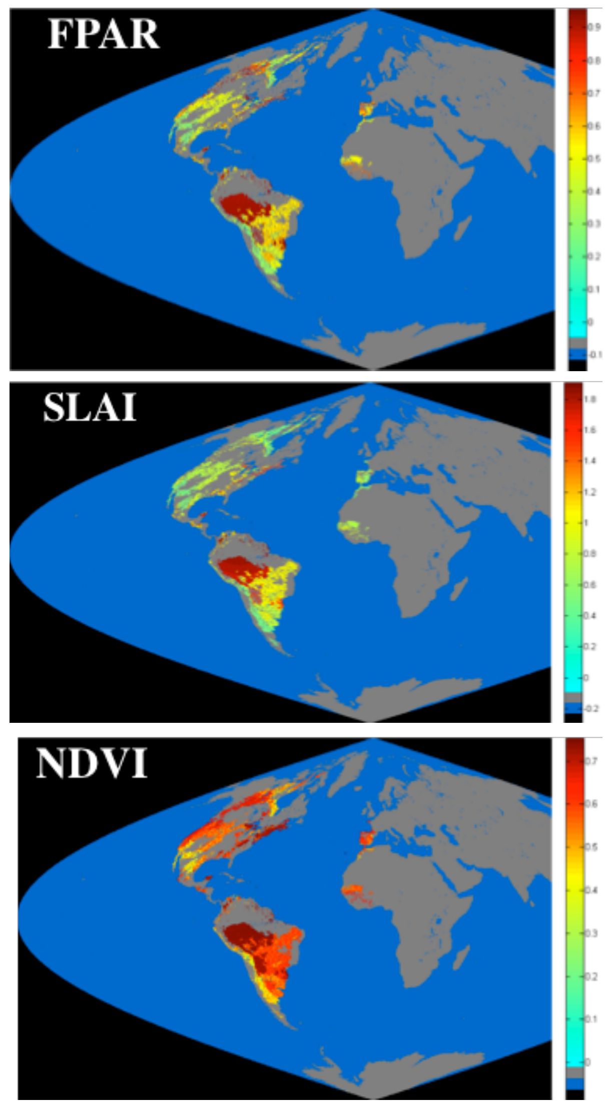

Figure 2. FPAR, Sunli Leaf Area Index (SLAI) and NDVI on Aug-23-2016 at 15:24:58 GMT [2].

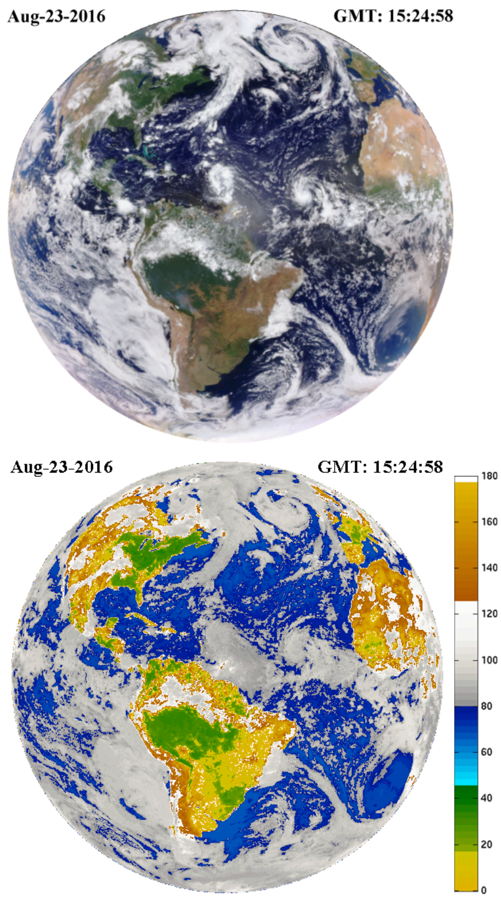

Figure 3. *Upper Panel*. An Enchance RGB DSCOVR EPIC image taken on Aug-23-2016 at 15:24:58 GMT. *Lower Pane*l. Earth Surface Type Index (ESTI). This index can discriminate between signals originated from ocean, land, vegetation and clouds [3].

References:

[1] A. Marshak and Y. Knyazikhin (2017). The spectral invariant approximation within canopy radiative transfer to support the use of the EPIC/DSCOVR oxygen B-band for monitoring vegetation, *Journal of Quantitative Spectroscopy and Radiative Transfer*, 191, 7-12. [2] Yang, B., Knyazikhin, Y., Mõttus, M., Rautiainen, M., Stenberg, P., Yan, L., Chen, C., Yan, K., Choi, S., Park, T., & Myneni, R.B. (2017). Estimation of leaf area index and its sunlit portion from DSCOVR EPIC data: Theoretical basis. *Remote Sensing of Environment,* 198, 69-84. [3] W Song, Y. Knyazikhin, G. Wen, A. Marshak, G. Yan, and X. Mu, Earth Reflectivity from Deep Space Climate Observatory (DSCOVR) Earth Polychromatic Camera (EPIC), Poster A33D-2387, 2017 Fall Meeting, AGU, New Orleans, LA.