Summary of the Final Report of Research Results

1) Title of the proposed research

Evaluation and improvement of the phenology monitoring algorithm of terrestrial vegetation

2) Principal Investigator (PI) and Co-Investigators (Co-Is)

PI:

Dr. Hideki Kobayashi

Co-I:

Dr. Rikie Suzuki

Dr. Tsuneo Matsunaga

Dr. Nicolas Delbart

3) PI's affiliation

Japan Agency for Marine-Earth Science and Technology

4) Summary of the Final Report of Research Results

Reliable monitoring of vegetation seasonality (leaf appearance date, growing length, maximum leaf area index etc.) is important to estimate the terrestrial carbon budget. GOSAT Cloud Aerosol Imager (CAI) provides not only the optical properties of the atmospheric particles but also provides phenological information; spectral channels of CAI are similar to those of MODIS and SPOT-VEGETATION. Our research goals include 1) the synergistic use of satellite data using SPOT-VEGETATION and MODIS data, 2) evaluation of CAI, and 3) estimation of phenological information. We conducted this study in three difference locations in the world: a grassland site in Qinghai Tibetan plateau, a deciduous needleleaf forest (larch) site in Yakutsk, Russia, and an evergreen needleleaf forest (black spruce) site in Poker Flat Research Range near Fairbanks, Alaska, USA. In these sites, we first collected SPOT-VEGETATION S10 and Terra-MODIS MOD09 surface reflectance datasets as well as TANSO/CAI. SPOT-VEGETATION S10 is an atmospherically corrected surface reflectance data sets produced at 10-day interval since April 1998. The spatial resolution is 1/112 degree. MODIS MOD09 is also atmospherically corrected surface reflectance data sets produced at 8-day interval since the beginning of 2000. The spatial resolution of the data product is 500m. The CAI data used are the level 1B top of atmosphere radiance and the level 3 NDVI data sets. For CAI L1B data sets, we applied atmospheric correction using the 6S radiative transfer model assuming a mid-latitude summer atmospheric model and continental aerosol with aerosol optical thickness at 550m = 0.05. Before using the actual CAI data, we compared NDVI and NDWI from Terra-MODIS and SPOT-VEGETATION to understand whether the VI seasonal patterns can yield consistent seasonal patterns. We found a good agreement in terms of their seasonal timings and absolute values in Yakutsk and Qinghai sites. Then, we compared NDWI and NDVI from CAI L1B data with SPOT-VEGETAION data. The NDVI has similar seasonal patterns in the Qinghai site, although only a limited number of data was retrieved due to cloud contamination. The NDWI from CAI was substantially lower than that of SPOT-VEGETATION. To investigate the cause of this large difference in NDWI, we also compared reflectance data sets in red, NIR, and SWIR in the Qinghai site. The biases in red and NIR reflectances are small in the vegetation growing season, however in SWIR, the biases was as large as 0.1 in a reflectance unit. Therefore, the NDWI difference was mainly caused by the SWIR reflectance difference between CAI and SPOT-VEGETATION. From these analyses, we concluded that the use of NDVI for phenology monitoring is more robust than NDWI method when using multiple satellite data sets. Indeed, the seasonal timing and the maximum of the CAI L3 NDVI agree well with SPOT-VEGETATION at three study sites. One limitation using CAI data is that CAI L3 NDVI does not contain the actual date of measurements when computing a 15-day composite. As a surrogate of NDWI-based phenology measurements, which we initially proposed, NDVI with an appropriate threshold could work for CAI-based vegetation phenology monitoring.

5) List of publications relating to the proposed research

No publication has been published yet.