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REMOTE SENSING OF FOREST CARBON SINKS: TERRESTRIAL ECOSYSTEM CARBON INVENTORY SATELLITE (TECIS)

**Abstract**

Carbon sinks and carbon sources are two key processes in the carbon cycle. Carbon sinks accumulate $CO_2$ from the atmosphere and contribute to climate change mitigation. Forests are considered to contain about 80% of the terrestrial ecosystem carbon sinks and they are main approach to reduce greenhouse gases. To evaluate the carbon sinks of forests, the Terrestrial Ecosystem Carbon Inventory Satellite (TECIS), nicknamed "Goumang" was developed in China and launched in 4 August, 2022. TECIS is supported by the China National Civil Space Infrastructure Program and built by the China Academy of Space Technology (CAST). TECIS in launched in a sun-synchronous orbit with height of about 506 km and its local time of descending node is 10:30 AM. Four payloads are equipped on the satellite, including Carbon Sinks and Aerosol LIDAR (CASAL), Directional Multi-Spectral Camera (DMC), Fluorescence Spectral Imager (FSI) and Directional Polarization Camera (DPC). It focuses on the "mass" and "quality" of terrestrial ecosystems. CASAL employs 5 laser beams with each 40-Hz frequency to measure the tree height, and DMC obtains multi-spectral images from 5 different angles to derive the horizontal structure of forests. By combination of active remote sensing from CASAL and passive remote sensing from DMC, the aboveground biomass (AGB) of plants can be retrieved. FSI detects the solar induced chlorophyll fluorescence (SIF) with ultra-hyper spectral resolution of 0.3 nm, which indicates terrestrial ecosystem productivity. Meanwhile, CASAL and DPC monitors aerosol content and gives atmospheric correction to the data of other payloads to increase the accuracy of ranging and radiometric quantification. Several kinds of calibration modes are designed to improve the data quality, especially lunar calibration mode for DMC and solar calibration mode for FSI. In a word, several remote sensing methods are adopted on TECIS, including lidar, multi-direction, multi-spectrum, hyper-spectrum and polarization. After calibration and validation, retrieval products such as forest height, AGB and SIF are published. The precision of forest mean height is better than 1.5m where ground slope is less than 5 degree. AGB products in regional scale are inspected to be better than 85%. TECIS is now providing remote sensing service in investigating the carbon sink, ecological conditions and resources, and evaluating ecological projects. It will contribute to the carbon peaking and carbon neutrality goals of China. We also hope that TECIS will play a contributive role in dealing with global warming and climate change.