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Earth Observing Missions and Systems to Address Climate Change and Its Impacts [1] (3A)

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SYSTEM DESIGN AND APPLICATION RESULTS OF THE TERRESTRIAL ECOSYSTEM CARBON INVENTORY SATELLITE (TECIS)

Abstract

Carbon sinks accumulate carbon dioxide from the atmosphere and contribute to climate change mitigation. Forests are considered to contain about 80% of the terrestrial ecosystem carbon sinks. 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). It focuses on the "mass" and "quality" of terrestrial ecosystems. TECIS operates on a sun-synchronous orbit with height of about 506 km and its local time of descending node is 10:30 AM. The satellite is equipped with 4 payloads including Carbon Sinks and Aerosol LIDAR (CASAL), Directional Multi-Spectral Camera (DMC), Fluorescence Spectral Imager (FSI) and Directional Polarization Camera (DPC). 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. Adopting diversified remote sensing of including lidar, multi-direction, multi-spectrum, hyper-spectrum and polarization, retrieval products of TECIS such as forest height, AGB and SIF are published after calibration and validation. 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.