EGU24-3536, updated on 06 Oct 2024
https://doi.org/10.5194/egusphere-egu24-3536
EGU General Assembly 2024

Low-altitude measurement of CRCS Dunhuang surface reflectance based on multi-rotor electric UAV

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The CRCS Dunhuang site (40.1821°N, 94.3244°E) is located in the Gobi Desert in northwest China, about 35 km west of Dunhuang City, Gansu Province. Covering approximately 30 km × 30 km, the entire site is formed on a stable alluvial fan of the Danghe River and its surface consists of cemented gravel without vegetation. Dunhuang was chosen as a CRCS site due to its extremely homogeneous surface conditions. The central area (600 m × 600 m) of the site is designed for high spatial resolution visible/near-infrared (VIS/NIR) sensors such as the China-Brazil Earth Resources Satellite (CBERS) series. An extended large area (20 km × 20 km) is used for low spatial resolution sensors such as the Multichannel Visible and Infrared Scanning Radiometer, Visible and Infrared Radiometer, and Medium Resolution Spectral Imager on board the Fengyun-1 and 3 (FY-1/3) series of polar-orbiting satellites. It is also used for the field calibration of the VIS/NIR channels on Chinese geostationary weather satellites (Fengyun-2 or FY-2 series). Field calibration of the FY series of satellites has been conducted operationally since 2001 for only the VIS/NIR channels.

Due to the lack of onboard VIS/NIR calibrators, the in-orbit field calibration based on the CRCS Dunhuang site is still the primary method for China's satellite sensors' VIS/NIR channels, such as the FY series satellites, Haiyang (HY) series of Ocean Satellites, Disaster and Environmental Monitoring Satellites (HJ), and CBERS series satellites. However, the traditional satellite-ground synchronous measurement method of surface reflectance is based on car running field observation, which not only consumes a lot of manpower and material resources, easily causes damage to the site surface, but also lacks regional representativeness of the obtained measurement data.

In view of this, CRCS Dunhuang 2016 satellite-ground synchronous observation experiment mainly based on low-altitude surface reflectance measurement by rotor drones, supplemented by car running field measurements, and completed all aspects of whole process test including route design, altitude selection, instrument parameter configuration, sampling strategy, and aviation data processing.

Through this flight test, it can be proved that the use of multi-rotor drones to fly at low altitudes instead of the traditional car running satellite-ground synchronous measurement of surface reflectance not only improves the spatial consistency and representativeness of the ground reflection characteristics, but also improves the measurement efficiency of the ground reflectivity. Using flight measurement method can effectively protect the surface of the precious CRCS

Dunhuang Gobi site and greatly save manpower and material resources.

Through the comparisons and analysis of the surface reflectance data measured by aerial flight method and traditional car running field observations, it can be found that the mean values of multiple surface reflectance measurement data are relatively close, and the standard deviation of the airborne measurement data is smaller. The airborne data can replace the car running field data to complete the radiometric calibrations.