CALIBRATION OF VISIBLE AND NEAR-INFRARED CHANNELS OF THE FY1C USING TIME-SERIES OBSERVATION BASED ON PSEUDO-INVARIANT TARGET SITES IN CHINA

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Vicarious calibration is advantageous in that is supplies an in-flight method of absolute radiometeric calibration independent of the pre-launch and on-board calibration. As one of the common methods of vicarious calibration, time series calibration is used for visible and near-infrared channels of many satellites, especially for meteorologic satellites. The key of time series calibration is supposed that the images of sites have a pseudo-invariant reflectance all the year round. Desert and ice sheet are two primary scenes in time series calibration. A lot of research on time series calibration had been done since 1990s, and many pseudo-invariant target sites had been selected, such as Dome C area in Antarctica, ice sheet in Greenland, deserts in Algeria, Arabia, Libya and Sudan in Africa. Based on these pseudo-invariant target sites, the time series calibration result is used for monitoring the degradation of satellite sensors and analyzing subtle long-term vegetation changes.

There are several criterions in selecting the pseudo-invariant target sites. First the target sites must be large enough. As the satellites in time series calibration are meteorologic satellite mostly, the target site should larger than 10 by 10 km. Second, the variance of reflectance through a year should be small and no vegetation on the ground surface. And last, the atmosphere of target sites should be clear and aerosol and water vapor should be small in most time of the year. Based on these criterions, three target sites in China have been selected in time series calibration, which are Dunhuang, Wuwei and Tumushuke. Dunhuang target site (latitude N40°8′, longitude E94°24′) is covered with small stone and sand, and no vegetation on the ground. The area is about 30 by 40 km. Wuwei target site (latitude N38°5′, longitude E102°58′) is a gobi and area is about 20 by 30km. Tumushuke target site (latitude N39°46′, longitude E80°1′) is on the Taklimakan Desert. This target site is very large and flat and the area is about 100 by 100 km. All these three sites are droughty and the water vapor is small. The aerosol optical thickness is 0.1-0.3, except the sandstorm time.

FY1C is a polar meteorologic satellite of China. It launched on May 10, 1999 and disabled in March, 2003. MVISR(Multi channel Visible and IR Scanning Radiometer) is the exclusive sensor on FY1C, which has seven channels in visible and near-infrared range, one channel in shortwave infrared range and two channels in thermal infrared range. Its spatial resolution is 1.1 km and swath is 3100 km.

More than 2000 FY1C images of these three sites are obtained. And the images covered with cloudy and sandstorm must be eliminated firstly. Variety coefficients in spatial and spectrum is calculated, and variety coefficients larger than 5% is identified as cloudy or sandstorm. Then the BRDF functions of three test sites were obtained by MODIS images. The BRDF algorithm relies on kernel-driven linear BRDF model, defined as a weighted sum of an isotropic parameter, a Ross Thick and a Li-Sparse Reciprocal kernel. After the correction of BRDF, atmosphere correction using look-up table method is proceed and ground reflectance is obtained. As the ground reflectance is supposed to be invariant, the variance of reflectance retrieved is caused by the degradation of sensor. With the reflectance ratios of different images, the degradation coefficient of FY-1C visible and Near-Infrared channels can be obtained. Result shows that the degradation ratio per year of ch1, ch7 and ch8 is larger than 8%, and ratio of ch2, ch9 and 10 is less than 5%.

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