Geophysical Research Abstracts
Vol. 20, EGU2018-2197-1, 2018
EGU General Assembly 2018

In-flight calibration for high resolution satellite using Rayleigh scattering

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China is planning to launch more optical satellites with high spatial resolution and multistep gains. Field calibration, the current operational method of satellite in-flight calibration, still doesn't have enough capacity to meet these demands. Gaofen-1 (GF-1), as the first satellite of the Chinese High-resolution Earth Observation System, has been specially arranged to obtain 22 images over ocean. The Rayleigh scattering calibration was carried out for the visible channels with these images after appropriate data processing. To guarantee a high precision, uncertainty was analyzed in advance taking into account ozone, aerosol optical depth (AOD), seawater salinity, chlorophyll concentration, wind speed and solar zenith angle. AOD and wind speed were found to be the biggest error sources, which were closely coupled to the solar zenith angle. Therefore, the best sample data for Rayleigh scattering calibration were selected at the following solar zenith angle of 19–22° and wind speed of 5–13 m/s to reduce the reflection contributed by the water surface. The total calibration uncertainties of visible bands are 2.44 % (blue), 3.86 % (green), and 4.63 % (red) respectively. Compared with field calibration results, the errors are -1.69 % (blue), 1.83 % (green), and -0.79 % (red). Therefore, Rayleigh scattering calibration can become an operational method for the high spatial resolution satellites.