ABSOLUTE RADIOMETRIC CALIBRATION USING PSEUDO INVARIANT CALIBRATION SITES

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Abstract: Pseudo Invariant Calibration Sites, or PICS, have been used extensively for long-term trending of optical satellite sensors, as well as cross-calibration of these sensors. However, PICS can also be used for absolute calibration. Two approaches are possible. The first relies on a calibrated radiometer, in this case a calibrated satellite sensor, and the second uses a calibrated source—the Sun. In this paper we report on the development and use of a semi-empirical model that relies on a calibrated radiometer. Using MODIS Terra as the radiometer, an accurate model can be developed for the spectral channels covered with this instrument. To extend the model to cover the visible and shortwave infrared regions, Hyperion is used to obtain hyperspectral coverage at 10nm spectral sampling. Because of the off-nadir viewing geometries that are capable with these two instruments the model can be developed to accurately cover viewing angles up to 20 degrees. Even though this model has been developed for the Committee on Earth Observation Satellites (CEOS) site commonly known as Libya 4 which is situated in the Sahara Desert, there is still an appreciable atmospheric variation that needs to be accounted for. Fortunately, there is an annual pattern that can be exploited and a simple empirical model was developed which can further reduce the uncertainties in the model by about 1%. The model is capable of absolute accuracy on the order of 3%. Results will be shown for a variety of sensors, including the Operational Land Imager onboard Landsat 8 which was just launched in February.

Initial results will be presented from a first principles model based on using the Sun as a calibrated source, a full atmospheric model, and a surface Bidirectional Reflectance Distribution Function (BRDF) model. The atmospheric model is based on National Oceanic and Atmospheric Administration (NOAA) reanalysis data coupled with satellite measurements of the atmospheric used as input to the MODTRAN radiative transfer model. The surface BRDF is based on an approach developed from the Snyder-Roujean model .

Because these absolute calibration models are sensor independent and do not rely on instrumentation carried by the satellite, they can be used as either a primary calibration reference mechanism or as a backup approach for calibration. The approach is very low cost since the only expenditure of effort required is to collect imagery of the PICS. Since these targets are located in regions of the Earth that change very little, it is normally easy to schedule calibration image

acquisitions without impacting the normal operational data collection practices of the satellite system. This approach also provides an excellent mechanism for inter-comparison of sensors.

Keywords: Radiometric, calibration, Landsat, PICS, BRDF