Naval Research Laboratory

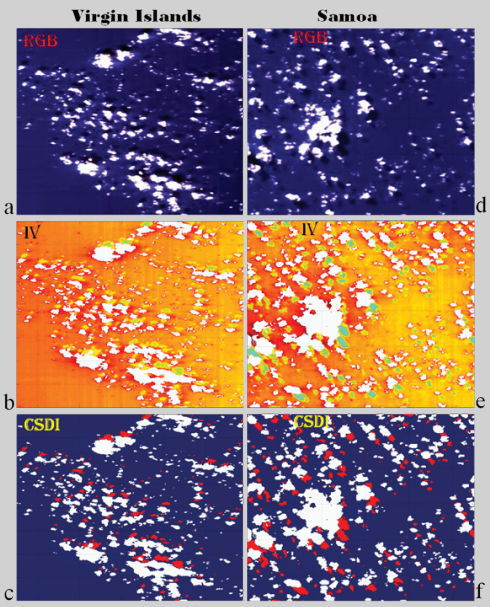
The Corporate Laboratory for the Navy and Marine Corps

Cloud Shadow Detection Index (CSDI)

NRL's Cloud Shadow Detection Index (CSDI) for optical imageries acquired over water by satellite/airborne sensors, does not require any angular information (viewing or solar) or any estimation of clouds vertical heights. It is entirely based on measurements in the optical channels. This approach is for homogeneous water bodies such as deep waters where shadow detection is very challenging due to the relatively small differences in the brightness values of the shadows and neighboring sunlit regions.

The CSDI technique is based on the small difference between the total radiance reaching a sensor from the shadowed region and from neighboring sunlit regions with similar optical properties. The differences are amplified through integrating the spectra of the two regions.

The CSDI technique will not only improve ocean color products retrievel such as chlorophyll but will also enable NRL to do tasks such as automating sensor's calibration, atmospheric correction, improve local weather forecasting, and estimate cloud base and cloud top heights.



Examples of cloud shadow detection using the CSDI technique. Left panel: HICO image acquired over Virgin Islands on December 20, 2009; (a) true color image, (b) corresponding IV image, and (c) corresponding CSDI image. Right panel: HICO image acquired over Samoa on October 2, 2010 (image size: 260 × 260 pixels); (d) true color image, (e) corresponding IV image and (f) corresponding CSDI image. The clouds are shown in white on both CSDI and IV images, the shadows are shown in red on the CSDI images and in slightly cooler color on the IV image, and the sunlit regions are shown in blue on the CSDI images and in warmer color on the IV images.

Advantages Over Geometry Based or Reflectance Based Techniques

Does not require thermal or short wave infrared channels • Is entirely based on visible channels • Can detect shadow locations that are more precise • Is easy to use and faster than the geometry based approach • Works well with sensors with high radiometric calibration errors

Applications

Local weather forecasting • Atmospheric correction for ocean color sensors • Detecting shadow over land • Detecting shadows on digital images • Improving ocean color product retrieval

Licensing or Collaboration Opportunity

US Patent 8,509,476 is available for license to companies with commercial interest. Collaborative research and development is available under a Cooperative Research and Development Agreement (CRADA).

References:

J. J. Simpson and J. R. Stitt, "A procedure for the detection and removal of cloud shadow from AVHRR data over land," IEEE Trans. Geosci. Remote Sens. 36, 880-897, 1998.

R. T. McNider, J. A. Song, and S. Q. Kidder, "Assimilation of GOES-derived solar insolation into a mesoscale model for studies of cloud shading effects," Int. J. Remote Sensing, 16, 2207-2231, 1995.

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