INTRODUCTION

One of the most pressing climate issues identified by the IPCC’s Fourth Assessment is the need for a long-term analysis of cloud properties to better understand the impact of cloud radiative forcing on various aspects of climate, especially surface temperature and its diurnal variation. To understand this radiative forcing over long time periods, it is necessary to measure global cloud properties using a consistent set of proven algorithms applied to a long-term record of consistently calibrated and quality-controlled satellite imagery data. Knowing how clouds vary with climate change and how well climate models reproduce such variability through modeled feedbacks is critical to understanding how the models can predict climate. In addition, cloud properties derived from these calibrated satellite observations can be used to improve the representation of clouds in global numerical weather prediction models.

As part of the NOAA NIDC Climate Data Record (CDR) program, we are currently developing a Thematic CDR (TCDR) consisting of cloud amount, phase, optical depth, effective particle size, and temperature extending back to 1979 using data from the Advanced Very High Resolution Radiometer (AVHRR) instrument. The TCDR will be consistent with cloud properties derived from MODIS for the Clouds and Earth’s Radiant Energy System (CERES) program, though some modifications to these algorithms will be required to operate on the 5-channel and lower spatial resolution AVHRR Global Area Coverage (GAC) data. Stable and accurate visible channel calibration is ensured through matching modern AVHRR data with that of Aqua MODIS using observations of deep convective clouds, desert scenes, and simultaneous ray-matched observations. These calibrations are then transferred back in time through the use of time-overlapping LEO and GEO data.

Within the CERES program, hourly global cloud mask/properties and fluxes are derived from the geostationary (GEO) satellite observations. During daytime, cloudy pixels are analyzed with the visible infrared split-window technique (VISST), which matches the observed values with theoretical models of cloud reflectance and emittance. At night and near rear, cloudy properties are determined using the solar-infrared split-window technique (SIST).

EVALUATION OF ACTUAL AND PREDICTED CLIMATE DATA RECORD PRODUCTS

AVHRR CLIMATE DATA RECORD PROJECT DESCRIPTION

- Calibrated AVHRR 0.64, 0.88, and 3.7- and 11.3-µm channels
- Calibration of GEO VIS, 0.88- to 11.3-µm channels

- Algorithms
  - CERES MODIS cloud mask and retrieval algorithm adapted to operate using 5-channel AVHRR radiances
  - Algorithms for multispectral AVHRR for VIS and IR channels

- Testing
  - Near Simultaneous Ray-Matched and Deep Convective Cloud techniques used for calibration (Hu et al. 2004; Morstad et al. 2011)
  - CERES-like cloud macro- and micro-physical property climatology for the entire AVHRR data record

- Gridded Product
  - Gridded product: retrieved at instrument nominal resolution
  - Pixel-level product: 0.25° x 0.25° average separated by cloud height/phase (netc format)

- Data Products
  - Generated cloud product: VISST (daytime) + SIST (nighttime)

- Additional Features
  - Geosynchronous satellite data

- REFERENCES AND ACKNOWLEDGEMENTS

- Geostationary satellite cloud and surface temperature product dataset

- GOES-EAST FULL DISK, 2 MAY 2012

- NASA LANGLEY CLOUD PRODUCTS

- Standard, Single-Channel VISST/SIST

- Multi-Channel, O3, CO channel only

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- DATA PRODUCT FORMATS

- Pixel-level Product: retrieved at instrument nominal resolution (netc format)

- Gridded Product: 0.25° x 0.25° average separated by cloud height/phase (netc format)

- Includes surface reflectance, and albedo temperature product

- Cloud property retrievals during both day and night

- Cloud property retrievals utilizing infrared window channel brightness temperature gradients

- Multi-layer, ID (single or 2-layer)

- Geosynchronous satellite data

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