Global profile training database for satellite regression retrievals with estimates of skin temperature and ecosystem-based emissivity

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Abstract
Regression retrieval of atmospheric properties requires a global dataset of temperature, moisture, and ozone profiles in addition to estimates of skin temperature and emissivity to train the regression. A new data set consisting of 12,245 global profiles of temperature, moisture, and ozone has been created, drawn from NOAA88, ECMWF, TIGR-3, ozonesondes, desert radiosondes. In addition, a skin temperature and emissivity value has been assigned relatively randomly to each profile. In earlier satellite regression retrieval algorithms, skin temperature and emissivity were assigned relatively randomly to each profile. In this poster, we present a more physical basis for characterizing the surface. Skin temperature estimates are based on a study of the skin temperature/surface air temperature difference over different land types, and a global ecosystem-based emissivity is developed. Application of the database to MODIS retrievals will be presented.

Characterizing the Profiles

New Training Database of Global profiles (SeaBor v3): 12,245 global profiles of temperature, moisture, and ozone. Profiles are taken from NOAA88 (8396), ECMWF training set (4182), TIGR-3 (1125), CMDL ozonesondes (992 from 8 sites), desert radiosondes (561) -- all with saturation checks and other QC. Where ozone data were not available Paul Vandeven's regression-based ozone profiles were used.

Surface Emissivity

New Emissivity for 17 IGBP ecosystem groups, as a function of month and latitude band was created using MODIS MOD011 emissivity (see example at right) and laboratory measurements (UCSB and JPL emissivity libraries).

Emissivity for 17 IGBP ecosystem classes derived from the laboratory “baseline” emissivity and measured MODIS MOD011 emissivity. Emissivities shown in SeaBor v3-305, for four years in the month of August 2001 (top left), 2002 (top right), 2003 (bottom left), and 2004 (bottom right).

New Emissivity for 17 IGBP ecosystem classes shown for SGP CART site using MODIS MOD011 emissivity for 8.5 µm (left). SeaBor v3 emissivity for desert (right). SeaBor v3 emissivity for desert (right).

Comparison with NWP analyses and GOES

MODIS Terra MODIS TPW (mm) for August 24, 2002 in the Sahara Desert region

Conclusions

Historically, satellite regression retrievals have relied on training data sets that made little attempt to physically characterize the surface. In this poster, a new global training data set that combines profiles from a number of sources is presented. Associated with each profile in the data set is a physically-based characterization of the surface skin temperature and surface emissivity. Application of this SeaBor v3 training data set to MODIS MOD07 retrievals of total precipitable water show good improvement over the NOAA88 training data set. With the new training data set and an updated forward model, the RMS difference between MOD07 TPW and the ARM SGP MWR was reduced from 4.4 mm to 2.5 mm.

Future Plans
Profile improvements: Handling of upper atmosphere above levels of existing radiosonde data, adding more global radiosondes including improved desert radiosondes and more ozonesondes.

Introduction: Include more years of MOD011 emissivity data to derive global ecosystem-based emissivity. Create non-ecosystem based emissivity global atlas over all seasons. Expand skin temperature parameterization to include other areas of the globe.

4. Enhanced RAMS: Improve upon current radiation bias estimates using global cloud and surface emissivity maps (now running as an operational product).

Forward model: Replace PPAAST with NOAA pCRTM (formerly OCPRTN). Preliminary results using this model are shown above.