

Enhanced Satellite Cloud Products for Climate Studies

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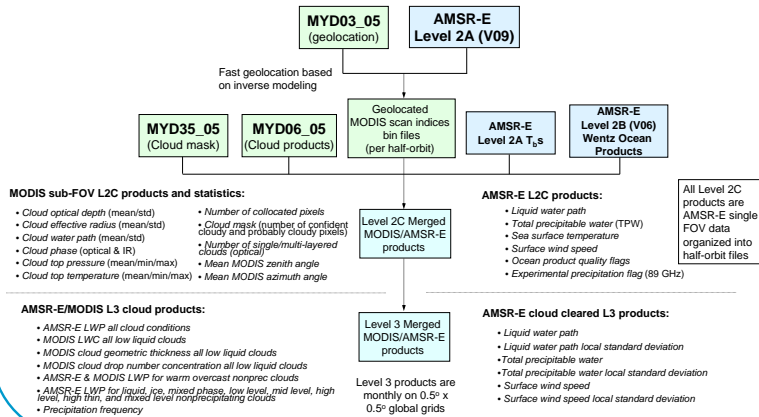


Motivation

Satellite-based climate studies of clouds rarely take advantage of the complimentary information provided by passive microwave observations. These observations can supply, for example, cloud liquid water path (LWP) estimates in conditions where solar/IR measurements cannot, such as overlying ice clouds and mixed phase clouds, as well as provide estimates of water vapor, surface winds, and sea surface temperature under overcast conditions. Solar/IR observations, on the other hand, can complement microwave observations by characterizing the cloud conditions that occur within the field-of-view (FOV) of the microwave instrument.

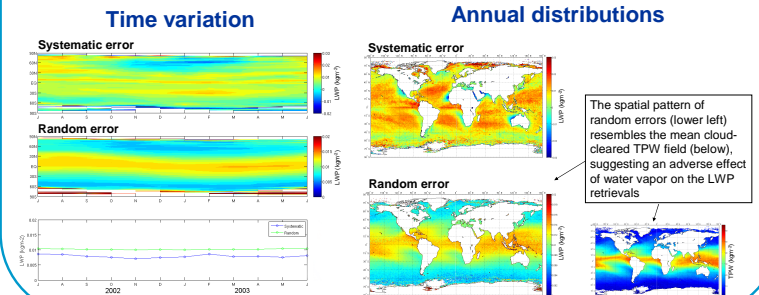
To take full advantage of the information content from these different observations for use in climate studies, new merged cloud products are being developed that combine instantaneous, full-resolution Level 2 products from the Advanced Microwave Scanning Radiometer-EOS (AMSR-E) and the MODerate resolution Imaging Spectroradiometer (MODIS) on Aqua. This study examines a year's worth of these new products (July 2002 – June 2003) with respect to 1) quantifying certain errors in AMSR-E LWP products, 2) comparing AMSR-E and MODIS cloud products (including new MODIS cloud droplet number concentration and geometric thickness products; Bennartz 2007), and 3) assigning cloud types to AMSR-E LWP products.

Data Product Generation & Characteristics



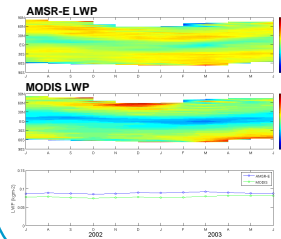
Estimation of AMSR-E LWP Errors

Greenwald et al. (2007) showed that cloud-cleared microwave-derived LWP products are useful for estimating minimum errors in the LWP products themselves. These errors are attributed to uncertainties in the ocean surface and the atmosphere. Cloud-cleared LWP values are a measure of systematic errors (since the LWP should be zero), while the local spatial variation of the cloud-cleared LWP (represented as standard deviations within 0.5° lat/lon grid boxes) is a measure of the random errors in the LWP products. Here we investigate the time variation and geographic distribution of these errors.



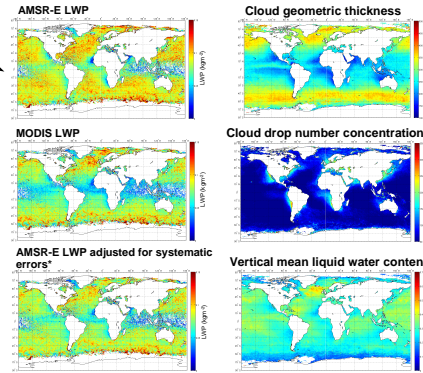
Comparison of AMSR-E LWP and MODIS LWP for warm (cloud top temperature > 273 K), overcast nonprecipitating clouds reveals significant differences. Most differences appear to be associated with regional systematic errors in the AMSR-E products

Time variation

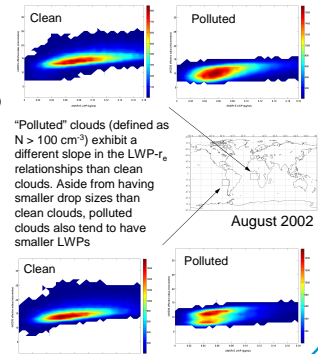


Comparison of Cloud Properties

Annual distributions



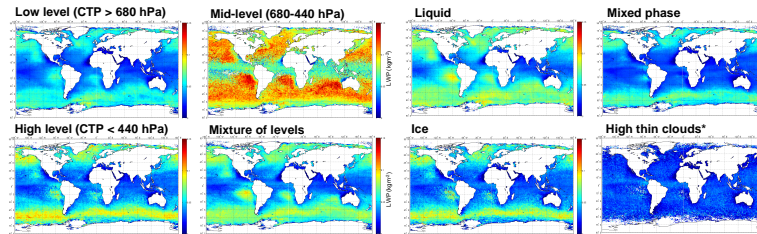
LWP-effective radius relationships



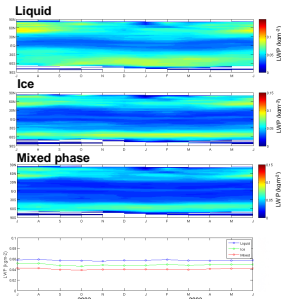
Classification of AMSR-E LWP Products

A major limitation of current climatic LWP datasets derived from passive microwave measurements (e.g., O'Dell et al. 2008, Ferraro et al. 1996) is that they do not provide information on cloud type. With the new data products generated by this study, MODIS-derived IR cloud phase and cloud top pressure (CTP) can be used to classify the clouds occurring within the AMSR-E FOV. These results are for nonprecipitating clouds only.

Annual distributions



Time variation



Summary and Further Work

- Enhanced cloud products have been created that merge MODIS and AMSR-E Level 2 products. These products include new cloud properties currently not available in the MODIS cloud product suite, i.e., cloud geometric thickness and cloud droplet number concentration
- Detailed comparisons (at the FOV level) can now be done between AMSR-E and MODIS LWP products to better understand their strengths and weaknesses
- These merged products provide for the first time a means of evaluating certain AMSR-E LWP errors over large areas and long time periods and provide a means of classifying the LWP according to cloud type
- Plans are to produce these products over the entire Aqua mission and to include MODIS aerosol products and CERES radiation budget products

References

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