10 years of cloud properties and amount from MODIS

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1. INTRODUCTION

Understanding the impact of clouds on the Earth's radiation balance and detecting changes in the amount and vertical distribution of global cloud cover requires accurate global cloud climatologies with well-characterized uncertainties. To meet this challenge, significant effort has been given to generating climate quality long-term cloud data sets using over 30 years of polar-orbiting satellite measurements [Rossow, 1989; Jacobowitz et al, 2003; Wylie and Menzel, 1999] with plans to continue the cloud record using the next generation of polar orbiting sensors [e.g. King et al 2003]. A "Climate Quality" climatology requires that both the uncertainties and the physical sensitivities are quantified and are smaller than the expected climate signature.

This paper describes the efforts of the MODIS cloud team, providing an overview of the uncertainties and the highlights of 10 years of observations.

2. VALIDATION

Recent advances in active remote sensing technology have provided satellite-based lidar and radar measurements, which allow us to fully assess the cloud detection and height assignment of MODIS. In particular, the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) onboard NASA's Cloud Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and passive observations from the MODerate resolution Imaging Spectrometer (MODIS). A fused data set of these instrument measurements, along with others on the A-Train, provides a new opportunity to evaluate passive sensor cloud property retrievals over the entire polar region. With the collocated MODIS and CALIOP retrievals, nearly instantaneous comparisons are compiled to quantify our uncertainty in monitoring cloud conditions. We will begin the presentation with a short overview of the uncertainties in the cloud detection and height assignment algorithms.

3. GLOBAL DISTRIBUTIONS

This presentation will discuss the global distribution of cloud amount and pressure derived from MODIS from both Terra and Aqua satellites. As expected, the large-scale patterns are similar to other satellite data sets of cloud amount (Rossow, 1989; Thomas, et al., 2004; Wylie, et al., 1994, Ackerman, et al., 2008). The Inter-tropical convergence zone (ITCZ) is clearly evident as are the subtropical high-pressure systems and the marine stratocumulus regions. The presentation will compare the MODIS results with other global climatologies.

The presentation will briefly demonstrate the differences between MODIS Aqua and Terra cloud fractions (i.e., 1:30 pm minus 10:30 am local time). Global means indicate that the differences between the two satellites are about 2% with Terra greater then Aqua in the long term mean. For example, over ocean surfaces, Aqua generally has a greater cloud fraction, with the notable exception over the marine stratocumulus regions. There are regional differences as well, such as maritime stratus regions.

4. REGIONAL DISTRIBUTIONS

The presentation will provide examples of the variation of cloud cover and properties on the regional scale. Understanding regional distributions is important in climate studies. For example, cloud plays a critical role in the Arctic climate system, through interacting with other important climate processes, including snow/ice albedo feedback. Clouds modulate the surface radiative fluxes (Wang and Key, 2003), which would influence the growth and melting of sea ice. Assessing changes in polar conditions during

winter has been a challenge. We'll explore the spatial and temporal distributions for the polar regions as well as other regions of the globe.

5. LOCAL DISTRIBUTIONS

The spatial scale of MODIS and its averaging scheme enables us to explore changes in cloud cover at the local scale, as demonstrated in Figure 1.

(a) Cloud Fraction (b) Cloud Top Pressure

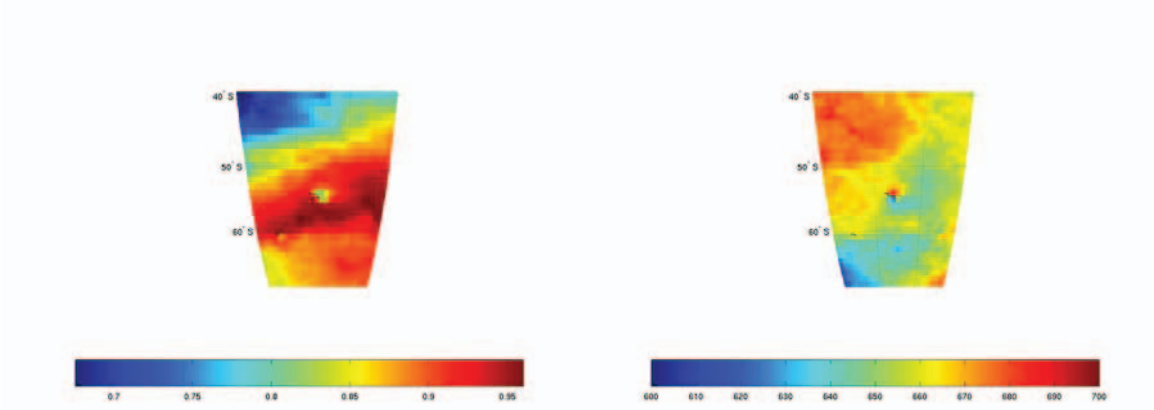

Figure 1: The annual mean cloud fraction (a) and cloud top pressure (b) show a decrease in cloud fraction and increase in cloud top pressure in the wake of South Georgia Island.

6. SUMMARY

This presentation provides a description of the capability of the MODIS cloud amount and cloud top pressure algorithm. We will describe the spatial and temporal variations of cloud amount and cloud top pressure derived from the 10 years of MODIS observations. The presentation will include areas of agreement with other data sets, areas where there are differences and the unique capabilities of the MODIS data set.

7. REFERENCES

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