**Introduction**

The MODIS cloud optical properties algorithm (MOD06/ MYD06 for Terra and Aqua MODIS, respectively) has undergone a number of improvements and enhancements since the launch of Terra. The latest version is incorporated into the Collection 5 processing stream. Here, we calculate trends in the nearly 10 year MODIS Terra cloud record from archived Collection 5 Monthly Level-3 data (1° grid) as described in King et al. (TGRS, 2003) and the Level-3 Atmosphere Team Algorithm Theoretical Basis Document: http://modis-atmos.gsfc.nasa.gov/reference_atbd.php.

MOD06 provides thermodynamic phase, optical properties (optical thickness and effective radius), and derived water path. Compared to previous versions, the Collection 5 processing stream included changes to the phase algorithm, ice cloud radiative models, spectral surface albedo maps (including the spectral albedo of snow by ecosystem), and inclusion of baseline pixel-level uncertainty estimates for optical thickness, effective radius, and water path. To improve overall retrieval quality, Collection 5 implemented a Clear-Sky Restoration algorithm to exclude pixels identified by the MODIS Cloud Mask (MOD35) that are expected to be unsuitable for cloud retrievals, including: flagging heavy aerosol and sunglint, cloud edge removal, and partly cloudy detection using the MOD35 cloud mask 250m tests.

**MODIS Terra Trending Analysis**

For the time period July 2000–June 2009, we calculate linear decadal trends in either annual or seasonal global means of cloud optical properties, retrieved cloud fraction, and cloud fraction from the MODIS Cloud Mask (daytime). Annual and NH winter/summer trends for selected cloud properties are shown. In the figures, trends associated with goodness-of-fit $r^2 > 0.5$ are highlighted by contours.

**Discussion**

Differences in the MODIS Cloud Mask (MOD35) and the Cloud Retrieval Fraction (all phases) are consistent with the clear-sky restoration used in MOD06 (explained above).

Of particular note is the large decrease in liquid cloud optical thickness (COT) over many land masses, generally associated with a decrease in cloud amount. This is similar to Aqua 7-year trends (not shown).

Meaningful trending from a 9-year data record is problematic due to significant interannual variability (approximate time to detect trend $\Delta x$ in quantity $x$ to 95% confidence $\sim \alpha_x/\sqrt{N}$, with $\alpha_x$ the climate/retrieval noise in $x$; Weatherhead et al., JGR, 1998). For example, if in a particular region $\Delta_{\text{COT}}=10%/\text{decade}$, and $\alpha_{\text{COT}}=20%$ (interannual), then trend detection would take $\sim 16$ years (assuming zero autocorrelation).

---

**Decadal Trend (DJF mean)**

**Decadal Trend (JJA mean)**

**Decadal Trend (annual mean)**

---

**Cloud Fraction (MOD35 Cloud Mask)**

**Cloud Retrieval Fraction (MOD06 all phases)**

**Cloud Retrieval Fraction (MOD06 liquid phase)**

**Cloud Retrieval Fraction (MOD06 ice phase)**

**Cloud Optical Thickness (MOD06 liquid phase)**

**Cloud Optical Thickness (MOD06 ice phase)**

---

**Yr 1 Mean: Jul 2000-Jun 2001**

---