Accessing Recent Trend of Land Surface Temperature from Satellite Observations

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Abstract:

Land surface temperature (Ts) is an important element to measure the state of terrestrial ecosystems and to study surface energy budgets. In support of the land cover/land use change-related international program MAIRS (Monsoon Asia Integrated Regional Study), we have collected global monthly Ts measured by MODIS since the beginning of the missions. The MODIS Ts time series have ~11 years of data from Terra since 2000 and ~9 years of data from Aqua since 2002, which makes possible to study the recent climate, such as trend. In this study, monthly climatology from two platforms are calculated and compared with that from AIRS. The spatial patterns of Ts trends are accessed, focusing on the Eurasia region. Furthermore, MODIS Ts trends are compared with those from AIRS and NASA's atmospheric assimilation model, MERRA (Modern Era Retrospective-analysis for Research and Applications). The preliminary results indicate that the recent 8-year Ts trend shows an oscillation-type spatial variation over Eurasia. The pattern is consistent for data from MODIS, AIRS, and MERRA, with the positive center over Eastern Europe, and the negative center over Central Siberia. The calculated climatology and anomaly of MODIS Ts will be integrated into the online visualization system, Giovanni, at NASA GES DISC for easy use by scientists and general public.

Data:

MODIS: Monthly Land Surface Temperature (Ts) and Cloud Fraction (CldFrc) from MODIS-Terra (2000.03 – 2011.02) and MODIS-Aqua (2002.08 – 2011.07) for daytime and nighttime, version 5;

AIRS: Monthly Surface Skin Temperature (Ts), Cloud Fraction (CldFrc), Clear-sky Outgoing Longwave Radiation (ClrOLR), Total Column Water Vapor (TotH2O), and Geopotential Height at 500 hPa (GH500) for ascending and descending (2002.08 – 2011.07), version 5;

MERRA: Monthly Surface Skin Temperature (Ts) for 1979.01-2010.12 (daily mean).

All data above may be downloaded from NASA GES DISC through the online visualization system (**Giovanni**) and the online search and ordering system (**Mirador**). The AIRS ascending (descending) is equivalent to MODIS daytime (nighttime), except over the near-polar region.

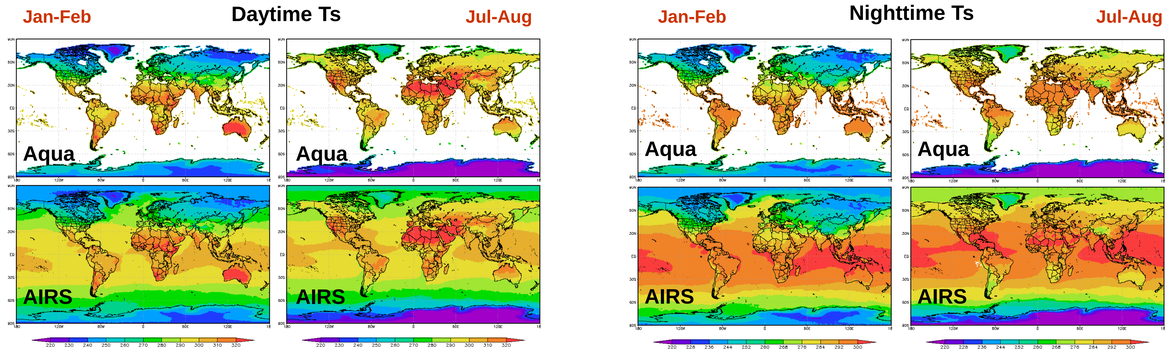
http://disc.gsfc.nasa.gov/giovanni

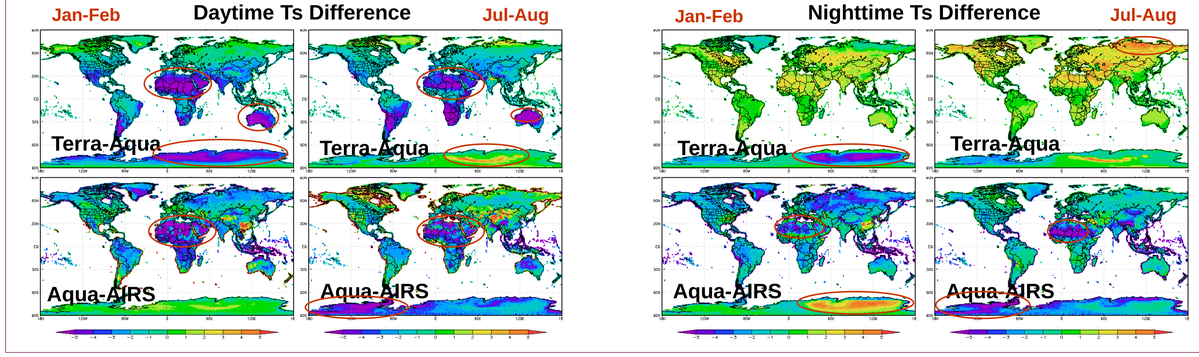
http://mirador.gsfc.nasa.gov/

Climatology of Ts:

Monthly climatologies were calculated as the arithmetic average at each grid point. The base periods used for each sensor are slightly different depending on the availability of the data, as shown in the following table:

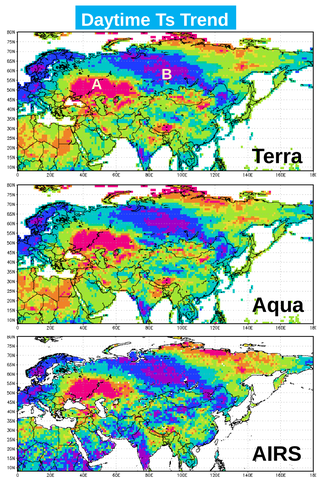
MODIS-Terra (Terra)	MODIS-Aqua (Aqua)	AIRS-Aqua (AIRS)	MERRA
2000.03 - 2011.02	2002.08 – 2011.07	2002.08 – 2011.07	2000.01 – 2010.12

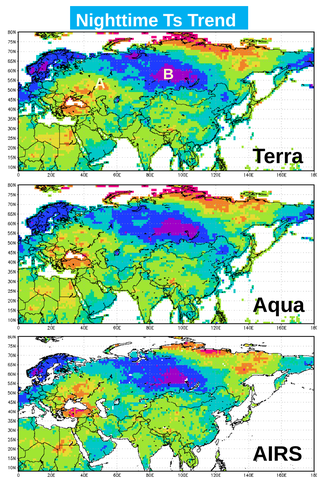




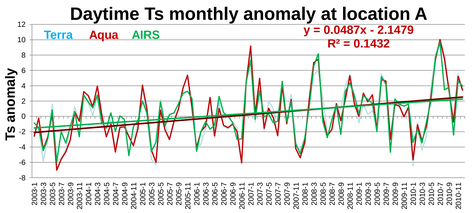
Recent Monthly Anomaly Trend of Ts:

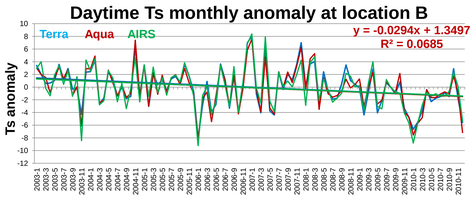
The trend in this study is defined as the linear regression coefficient (slope) of the 8-year monthly anomaly from 2003.01 to 2010.12.

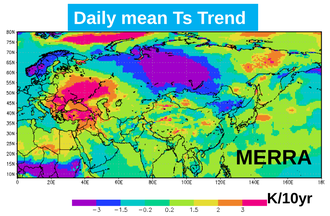


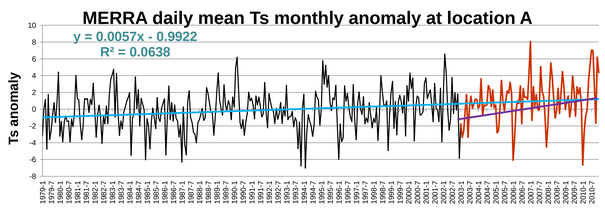


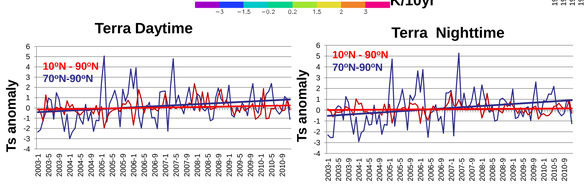
A: (46-50ºE, 50-54ºN), B: (90-94ºE, 56-60ºN)





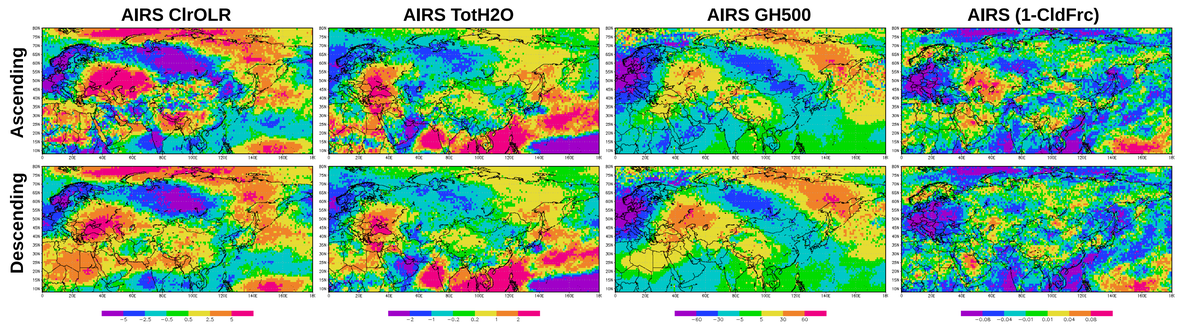






Ts trends for the recent 8-year period (2003.01-2010.12) show oscillation-type spatial variations over Eurasia. The trend patterns are consistent for data from MODIS, AIRS, and the MERRA assimilation model. The positive trend is centered over the Eastern Europe, and the negative trend is centered over the Central Siberia. Due to spatial variation, the whole Eurasia region (0-180ºE , 10ºN - 90ºN) averaged Ts has no significant trend. The polar region (0-180ºE, 70ºN-90ºN) is the only region that shows significant trend (positive) if a zonal average of Ts is performed.

Monthly Anomaly Trend of Atmospheric Elements:



Trends of selected atmospheric parameters from AIRS were calculated for the same period (2003.01-2010.12). Clear-sky OLR and Geopotential Height at 500 hPa show similar trend patterns to Ts.

Summary:

- Monthly climatology Ts values are different from different sensors due to observation time, retrieval algorithm, spatial resolution, etc. Most significant differences are observed over desert, and near south pole regions. The observed mean differences is over 6K at some region.
- Ts trends for the recent 8-year period (2003.01-2010.12) show oscillation-type spatial variations over Eurasia. The pattern is consistent for data from MODIS, AIRS and the MERRA assimilation model, with the positive trend center over the Eastern Europe (45ºE, 55ºN), and the negative trend center over the Central Siberia (90ºE, 60ºN). The entire Eurasia region (0-180ºE , 10ºN - 90ºN) averaged Ts has no significant trend.
- Atmospheric parameters, such as Clear-sky OLR and Geopotential Height at 500 hPa show similar trend patterns as Ts, suggesting that the large-scale Ts change is likely associated with a shift of atmospheric circulation over the mid-high latitudes.

Acknowledgments:

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GES DISC MAIRS portal: **http://disc.gsfc.nasa.gov/mairs/**