Spatial Correlations of Anomaly Time Series of AIRS Version-6 Land Surface Skin Temperatures with the Niño-4 Index

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Background Information
The AIRS Science Team AIRS/AMSU Version-6 Data Set
AIRS is the advanced IR Sounder flying on EOS Aqua accompanied by AMSU, an advanced microwave sounder. There are 9 AIRS 15 km x 15 km Fields of View (FOVs) within a single AMSU 45 km x 45 km Field of Regard (FOR). AIRS products include land/sea surface skin temperature $T_{ski}$, atmospheric temperature profile $T_{atm}$, water vapor profile $v$, and trace gas profiles; fractional cloud cover and cloud top pressure; and Outgoing Longwave Radiation (OLR). Most level-2 (single retrieval) products are generated on an AMSU FOR, but cloud products and OLR are generated for each AIRS FOV. Successful Quality Controlled AIRS soundings are generated in up to 80% fractional cloud cover. Level-3 products are gridded separately for 1:30 AM and 1:30 PM over a global 1 x 1 spatial grid on a daily, eight day, and monthly mean basis.

Improved AIRS Version-6 Surface Skin Parameters
AIRS Version-6 has many significant improvements in retrieval methodology over the previously operational Version-5 retrieval algorithm. The surface skin temperatures are determined over all spatial domains using observations in 36 shortwave window channels in the spectral range 2420 cm$^{-1}$ to 2664 cm$^{-1}$, simultaneously with shortwave surface spectral emissivity and surface spectral bi-directional reflectance of solar radiation. Longwave surface spectral emissivity is determined in a subsequent step using 77 channels in the long wave window region between 758 cm$^{-1}$ and 1250 cm$^{-1}$.

Data Sets Used in This Study
AIRS Science Team Version-6 monthly mean level-3 data for skin temperature and cloud fraction, each gridded separately for 1:30 AM and 1:30 PM.

- Data products used extend from September 2002 (the start of the data set) to August 2013.
- Eleven-year monthly mean climatologies were generated for each grid box by averaging monthly mean data for all Januaries, Februarys, etc.
- Separate climatologies were generated for 1:30 AM and 1:30 PM.
- The monthly anomaly for each grid box is the difference of the value for that month from that month's climatology.

Correlations of Skin Temperature Anomalies with those of Cloud Cover
El Niño/La Niña activity affects the spatial distribution of anomalies of cloud cover, but does not directly affect land skin temperature anomalies. Rather, skin temperature anomalies over land are affected to a great extent by cloud fraction anomalies, and associated precipitation anomalies, especially during the day. Over most non-polar land areas, land skin temperature anomalies are highly negatively correlated with cloud fraction anomalies during the day (clear areas warm more during the day) and tend to be positively correlated with cloud fraction anomalies at night (clearer areas cool more at night). Polar land areas have positive skin temperature and cloud cover anomaly correlations both day and night (warmer time periods generate more cloud cover). Anomaly correlations over ocean are spatially complex, but do not change appreciably from day to night.

Correlation of $T_{ski}$ and Cloud Fraction Anomalies

<table>
<thead>
<tr>
<th>Correlation</th>
<th>$T_{ski}$ (K)</th>
<th>Cloud Fraction (W/m$^2$/K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td></td>
<td></td>
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<tr>
<td>Negative</td>
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Examples of areas with positive and negative correlations of $T_{ski}$ with cloud cover anomaly time series, and their correlograms, are shown below for the cooling box and the warming box.