Precipitation and Temperature Intensity Indicators in NCA-LDAS using LVT

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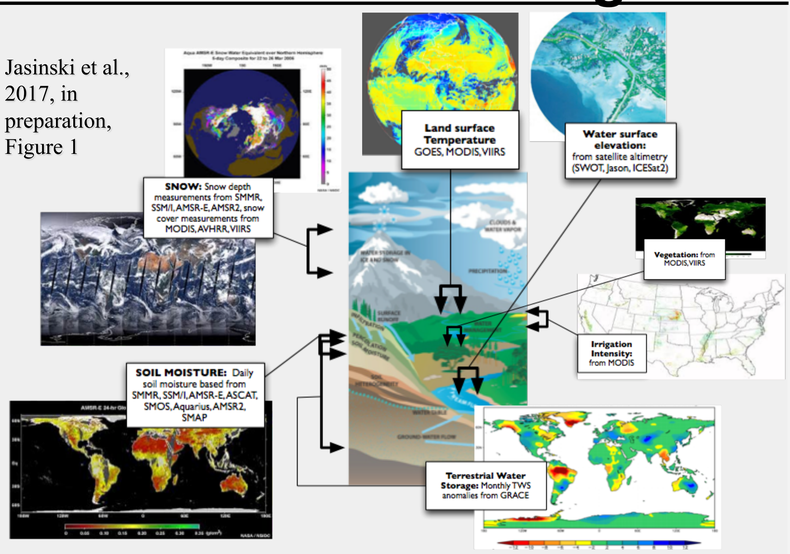
Abstract

The NASA Land Verification Toolkit (LVT) software provides tools to aid in the analysis of hydrological data. New metrics can be added in accordance with scientists' interests related to hydrology and drought monitoring. We are interested in the relationship between air temperature and moisture/precipitation. Using existing metrics, we analyzed the correlations between precipitation and air temperature, as well as precipitation and soil moisture indices of various regions of the U.S. With these data, and by modifying LVT, we can create a new metric to aid in analyzing air temperature and its effect on the intensity of precipitation.

Introduction and Background



Jasinski et al., 2017, in preparation, Figure 1

The National Climate Assessment – Land Data Assimilation System (NCA-LDAS; Fig. 1) is meant to provide hydrologic indicators and correct biases in various hydrological models by combining modeling and observational data.

LVT is used to analyze NCA-LDAS data over 1979-2016 over the continental U.S.

Metrics in LVT that were used to calculate different indicators of precipitation, temperature, and soil moisture included:

- -Means and Anomalies
- -Raw and Anomaly Correlation
- -Standardized Precipitation Index (SPI)
- -Standardized Soil Water Index (SSWI)

Methods / Approach

Each LVT computation run was modified through three main files:

- -lvt.config file: organizes specifications of run (i.e. metric computation frequency, etc.)
- -METRICS table file: specifies what metrics to compute
- -lvt.job file: submits run to Discover at NCCS

Data was plotted using the GrADS (Grid Analysis and Display System) visualization tool.

Results

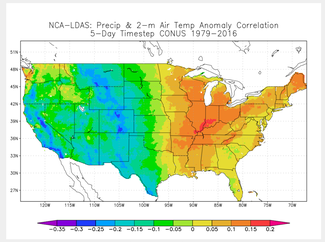


Figure 2: Anomaly correlation of 5-day precipitation and 2-meter air temperature

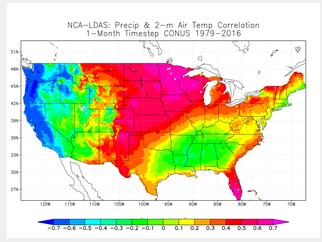


Figure 3: Correlation of 1-month precipitation and 2-meter air temperature

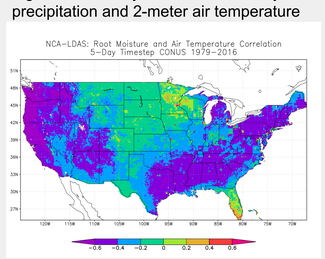


Figure 4: Correlation of 5-day soil moisture and air temperature

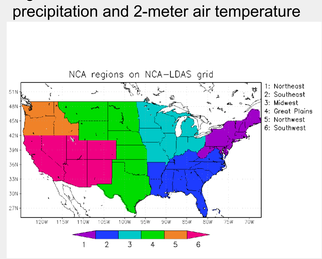


Figure 5: NCA-LDAS regions

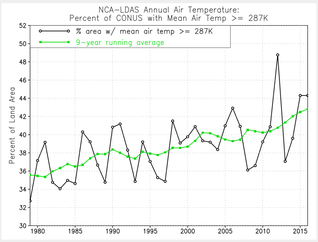


Figure 6: Annual mean air temperature of contiguous U.S.

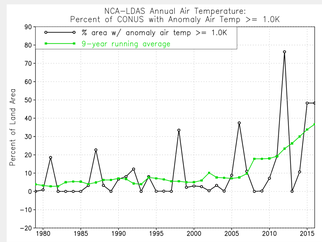


Figure 7: Annual anomaly air temperature of contiguous U.S.

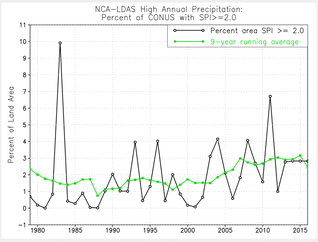


Figure 8: Annual SPI of contiguous U.S.

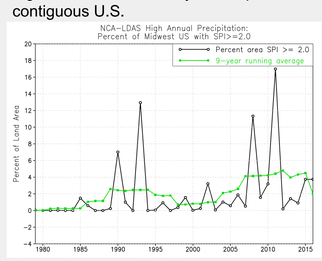


Figure 9: Annual SPI of Midwest U.S.

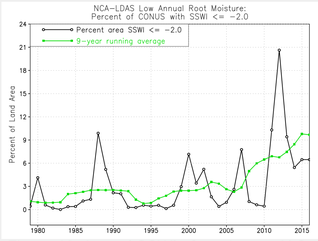


Figure 10: Annual SSWI of contiguous U.S.

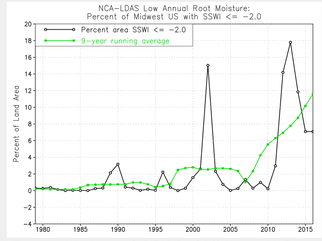


Figure 11: Annual SSWI of Midwest U.S.

Discussion and Conclusions

The LVT code was modified to calculate most metrics on frequencies of any X number of days. Previously, LVT was limited to frequencies of 1day or 7x days. This change will aid in getting a clearer picture of metrics over a wider variety of frequencies, as seen in 5-day analyses of Fig. 2 and 4.

5-day, 1-month, and 1-year computation frequencies were analyzed. Fig. 2 shows the 5-day anomaly correlation between precipitation and air temperature. High-mountain areas have a negative correlation, showing higher precipitation when it is cold. Fig. 3 is the 1-month correlation, highlighting higher precipitation in the West and Southeast during the winter. Fig 4 is the 5-day correlation between soil moisture and air temperature, and shows higher correlation in the Midwest.

We also analyzed time series in the CONUS and the NCA Midwest (3 on Fig. 5) regions. These figures show the percentage of land area that is above or is below the specified value or index. An increasing trend in mean air temperature (Fig. 6) and in anomalously warm temperatures (Fig. 7) over CONUS were found. Figs. 8 and 9 show the SPI for CONUS and for NCA Midwest, while Fig. 10 and 11 show the SSWI for the top 1-m soil moisture for these same regions. Notable hydrological phenomena shown are the 1983 El Niño and 2012 Midwest drought.

The plan for the rest of the summer is to create a metric in LVT to calculate an indicator of changes in precipitation intensity and its correlation with changes in air temperature.

References / Acknowledgements

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NCA-LDAS was funded by the NASA Science Mission Directorate's Earth Science Division. Computing was supported by the resources at the NASA Center for Climate Simulation. I would also like to acknowledge the support of David Mocko, Melissa Cannon, and Alex Robertson.