AIRS drought application and beyond: Opportunities, challenges, and future direction

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Why AIRS is important?

The key factor in drying over land is that land surfaces (and the air just above them) warm, on average, about 50% more than ocean surfaces (M. M. Joshi et al. 2008).

\[(\text{VPD} = e_s - e)\] will increase

Time series of percent area of CONUS in which 3-month standardized VPD is more than 1.25 standard deviation above normal.

- The analysis of recent observational data shows that associations of ENSO and PDO with U.S. drought have weakened over time (Kam et al. 2014).

- Droughts are becoming less associated with oceanic variability (Kam et al. 2014) [and more with atmospheric variability]
AIRS help understand drought development processes

2012 drought

Early detection of drought onset

Time series of corresponding SP, SRH, SVPD, ST, and SSM for a grid box (latitude 38.5°N, longitude 103.5°W) at the central US during the 2012 drought. SSM is calculated from MERRA and the rest of the indices are calculated from PRISM.
Early detection of drought onset

Mean lead time

Effective Fraction

Effective lead time

SRH

SVPD

ST

month

Longitude

month
The length of data record matters

Constructed from 12 years (2003-2014) of PRISM data.

Similar to figure at left, but constructed from 65 years (1960-2014) of PRISM data.
Temperature is important for Seasonal precipitation forecast

3 month lead predictions based on initial conditions in February 2002

AIRS to understand the environment of drought

Application:
Opportunities and challenges
AIRS and US drought monitor (USDM)

Feb 2016

USDM Feb 23, 2016

Legend:
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought
AIRS and US drought monitor (USDM)

March 2016 precip.
Not available yet
MODIS Irrigated Agriculture Dataset for the U.S. (MIrAD-US 2012) @250m,1km

National Land Cover Dataset (NLCD 2011) @30m

Human impact: Irrigated and non-irrigated regions

NLCD Land Cover Classification Legend
- 11 Open Water
- 12 Perennial Ice/ Snow
- 21 Developed, Open Space
- 22 Developed, Low Intensity
- 23 Developed, Medium Intensity
- 24 Developed, High Intensity
- 31 Barren Land (Rock/Sand/Clay)
- 41 Deciduous Forest
- 42 Evergreen Forest
- 43 Mixed Forest
- 51 Dwarf Scrub*
- 62 Shrub/Scrub
- 71 Grassland/Herbaceous
- 72 Sedge/Herbaceous*
- 73 Lichens*
- 74 Moss*
- 81 Pasture/Hay
- 82 Cultivated Crops
- 90 Woody Wetlands
- 95 Emergent Herbaceous Wetlands

* Alaska only
AIRS should contribute to USDM

Non-irrigated areas in Southern California

- sVPD
- -ve sRH
- sTemp
- -ve sPrecip

Moderate Drought
Severe Drought
Impact on vegetation dryness

Annual burned forest area v. mean March–August VPD in SW forest area during 1894–2013. The figure is from Williams et al. (2014a)
VPD and Fire danger

USDM drought category

VPD anomaly

August 2012

The national fire danger rating system (NFDRS) energy release component (ERC)

Fire occurrence: hectares burned
VPD and Fire danger

ERC using AIRS surface T and RH

ERC using Reanalysis data (U of Idaho)

The absolute difference between mean ERC of AIRS and reanalysis

Natasha Stavros

d) Weather stations
e) Topography
Moving from 4km to 100 km grid can cause >3 °C temperature difference.

- More than 3 °C in temperature is easily seen due to the spatial scale issue.
- Suggestion: higher resolution data?
AIRS and Heat index (human comfort)

July 31 2015 (Iran Heat Index reached 165°F)

AIRS ascending
Evaluation of AIRS product

AIRS (2003-2013)

2011 Texas

Surface air temp. anomaly

2012 US Midwest

Td anomaly

2014 California

VPD anomaly

Contribution of surface air temp. to VPD anomaly

Contribution of dewpoint to VPD anomaly

JAS

JAS

AMJ
Evaluation of AIRS product

PRISM (2003-2013)

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Contribution of surface air temp. to VPD anomaly

Contribution of dewpoint to VPD anomaly
What is needed:

- More rigorous validation of near surface temperature and humidity is needed: our case studies show that the pattern is captured fairly well, but the magnitude may not be accurate.

- Resolution is important for some applications, especially for regions with rugged topography.