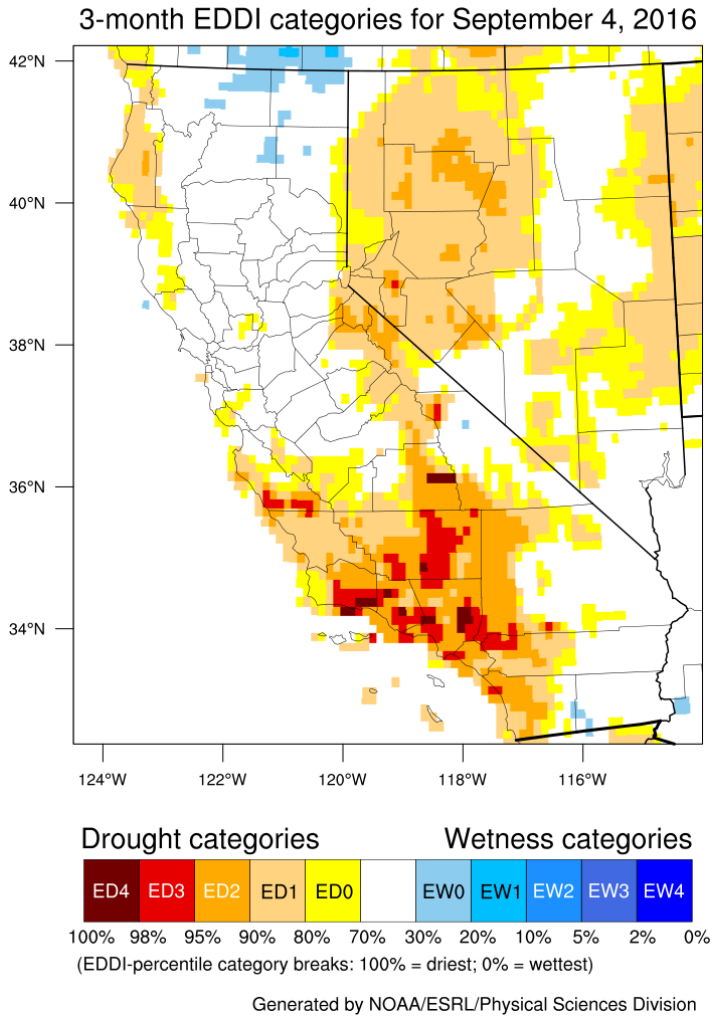
A New Tool for Drought Monitoring in California: The Evaporative Demand Drought Index



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Central Valley Drought and Climate Outlook
October 12, 2016
University of California Merced Center
Fresno, CA

DRI Desert Research Institute

Western Regional Climate Center
Providing climate services since 1986

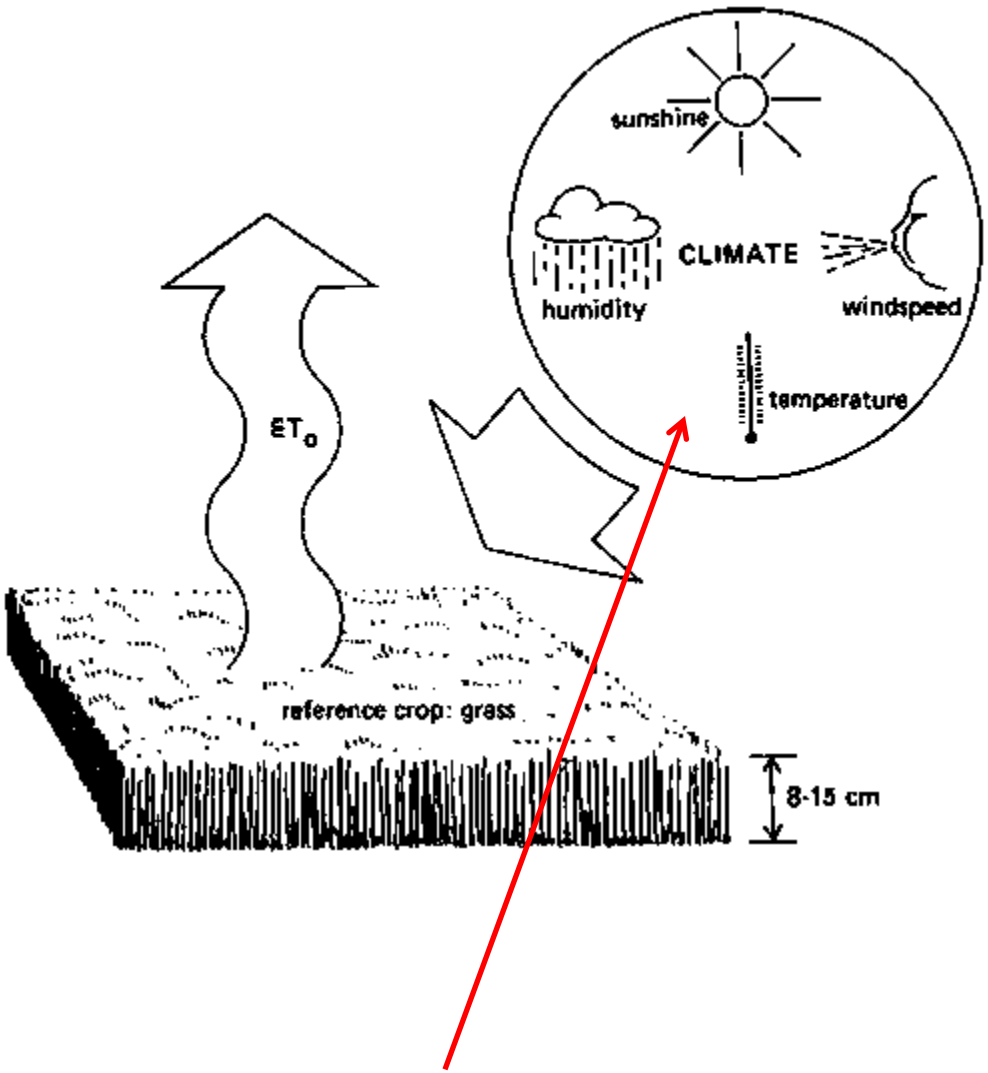
CNAP California-Nevada Climate Applications Program
A NOAA RISA team

NIDIS
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

Evaporative Demand Background

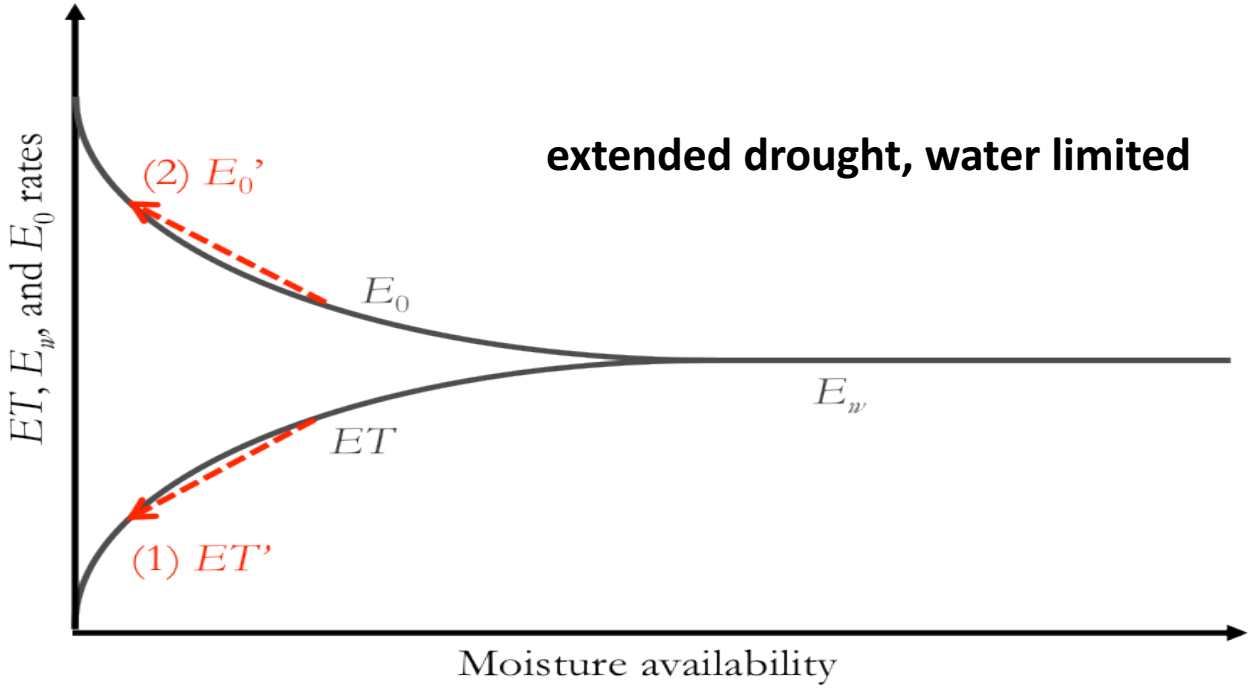
What is evaporative demand (ET_o)?

- Evapotranspiration rate that could occur given an unlimited water supply
- Potential evapotranspiration
- Atmospheric demand
- **Reference evapotranspiration**
- Often estimated using temperature alone, but a physically based model should be used



Physically-based ET_o contains valuable information related to drought dynamics

ET_o as a Drought Indicator

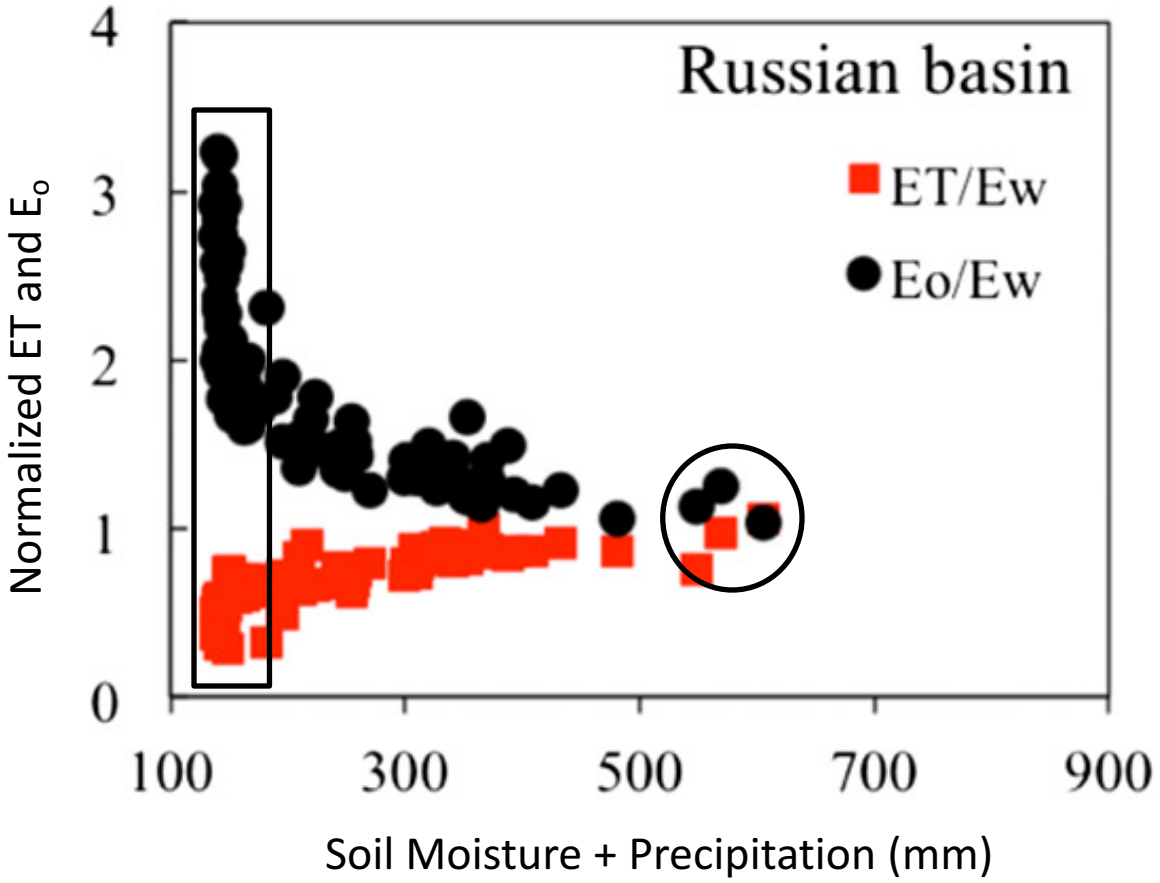


- Water limited: ET and ET_o vary in opposing directions (complementary relationship)
- In both situations, ET_o increases under drought conditions
- Complementary relationship (Bouchet, 1963)

Figure credit: Mike Hobbins

Complementary Relationship in California

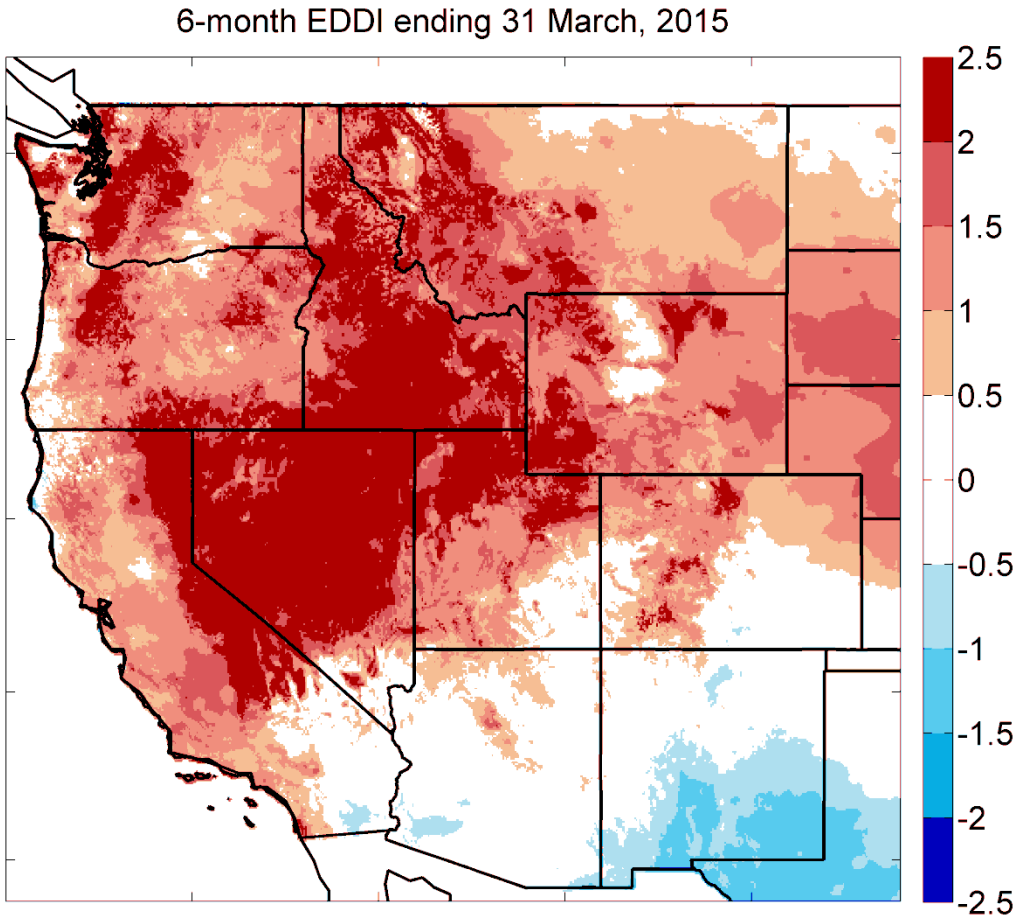
Apr – Sep, Russian River Basin, CA



- Wet years: ET and ET_o very close to each other
- Dry years: ET and ET_o much more separated
- ET_o anomalies can be used as a drought indicator similar to precipitation anomalies
- ET_o easier to estimate that actual ET with confidence

[Hobbins et al., 2016]

Evaporative Demand Drought Index (EDDI)

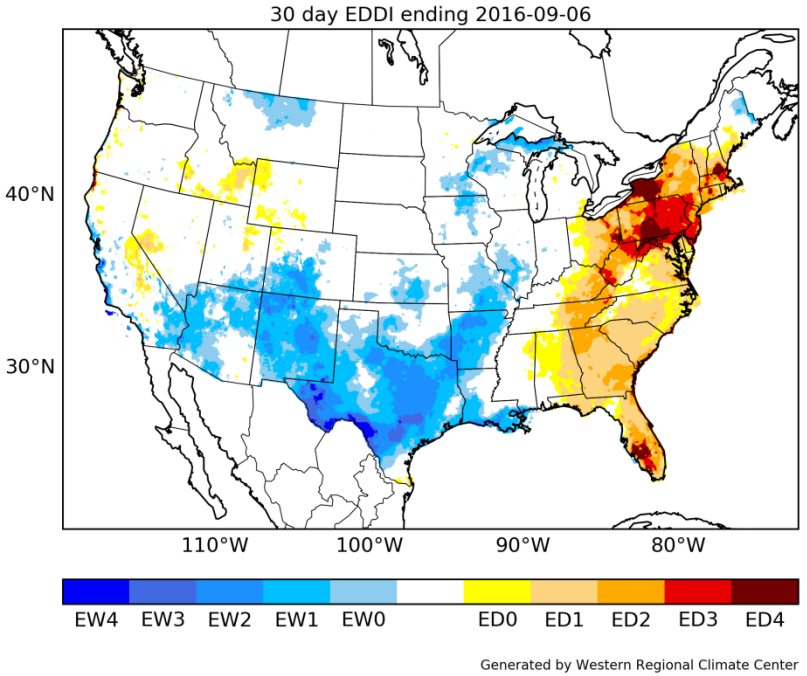


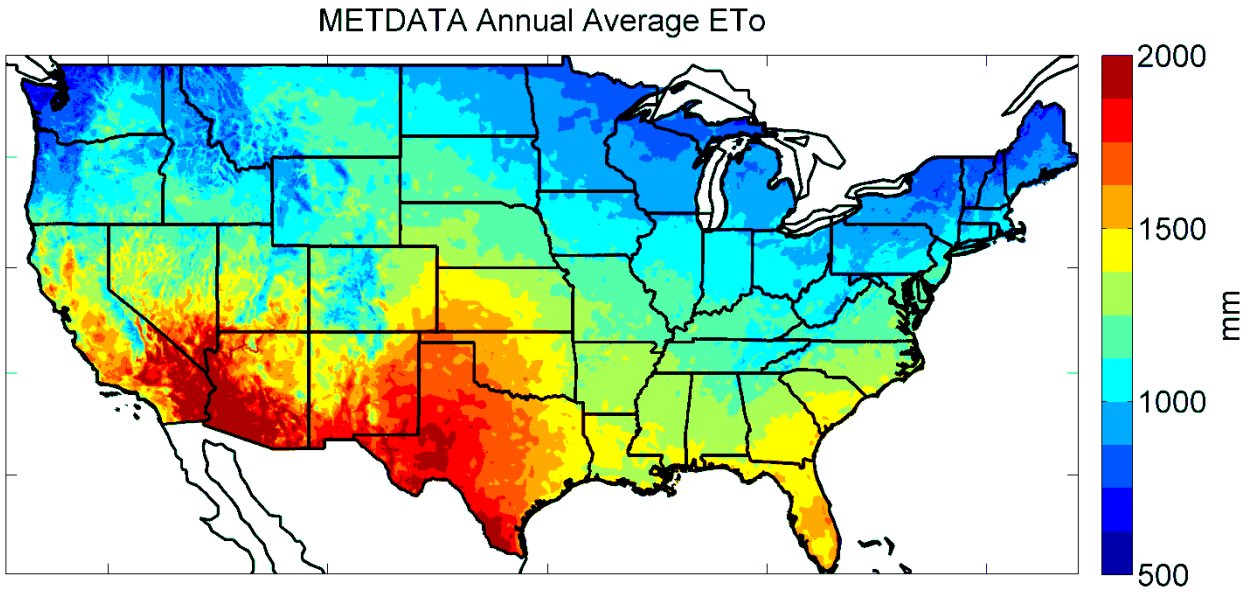
- Figure represents Oct – Mar standardized accumulated ET_o anomalies
- The Great Snow Drought of 2015 in PNW clearly captured

- Pair of papers in Journal of Hydrometeorology
- Hobbins et al. 2016: EDDI theory and formulation
- McEvoy et al. 2016: EDDI assessment against other drought indices
- EDDI represents standardized anomalies in ET_o
- Based on gridMET 4-km daily data, 1979-present
- + EDDI = drought or drought development likely
- - EDDI = cool and moist conditions

Evaporative Demand Drought Index (EDDI)

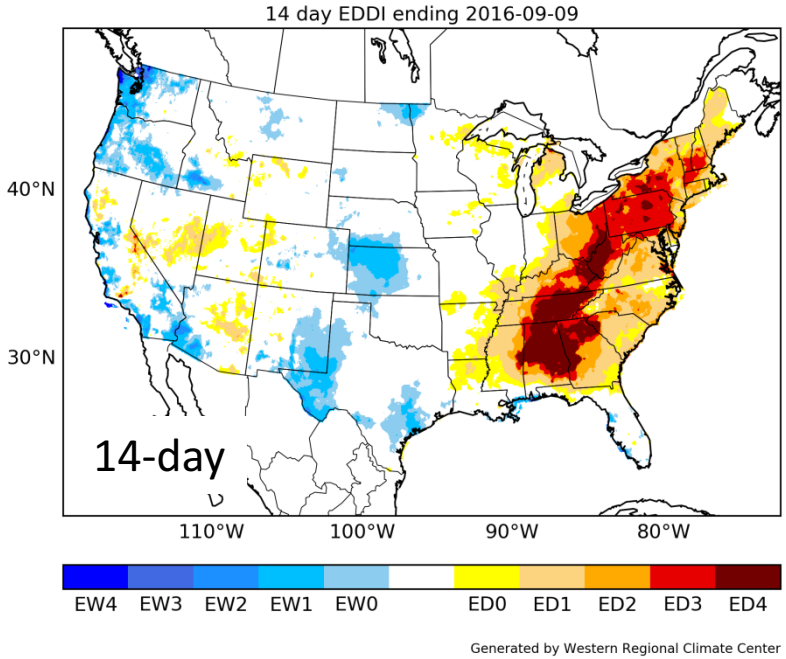
- METDATA (Abatzoglou 2011):
- 4-km spatial resolution
- Daily temporal resolution, 1979 - present

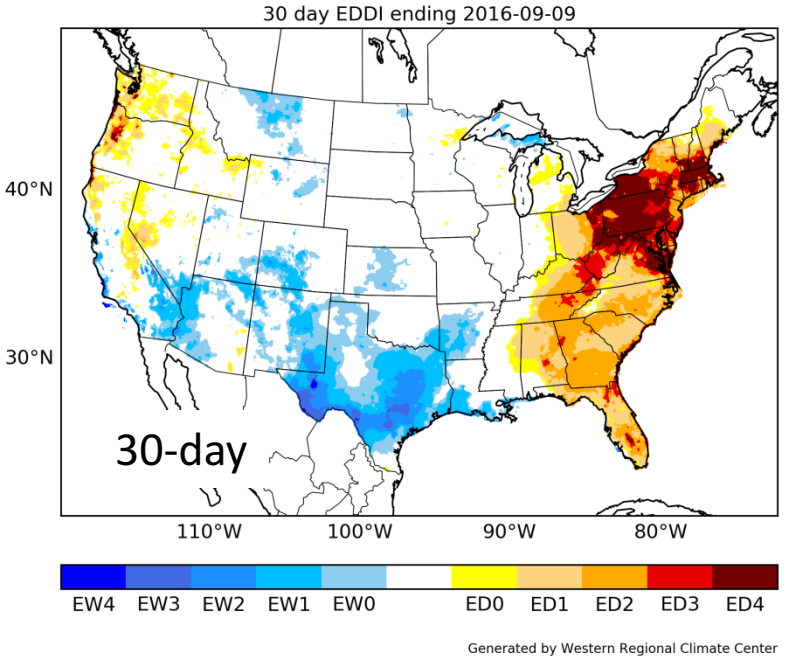


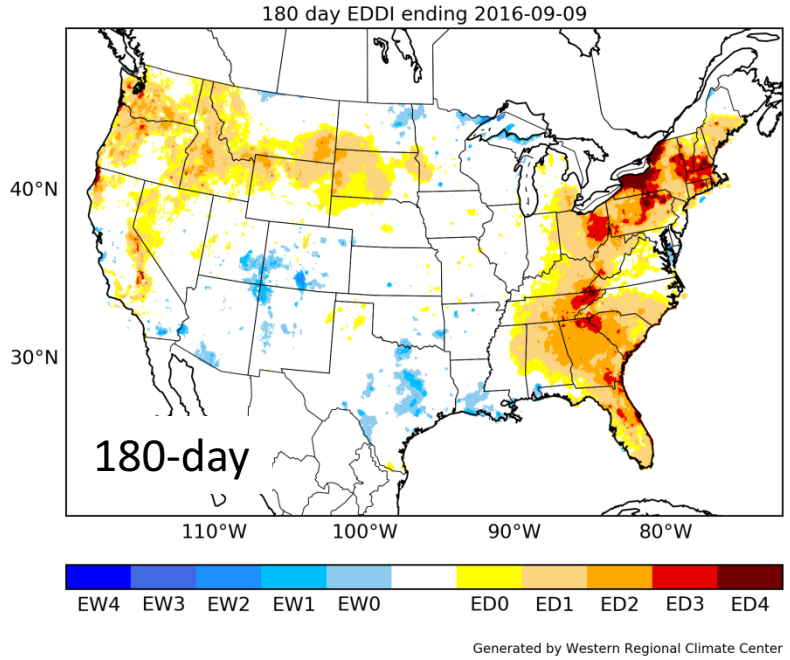


- T_{max}, T_{min}, specific humidity, wind speed, and shortwave radiation at the surface
- ASCE Standardized Reference ET (ET_o)

EDDI Products

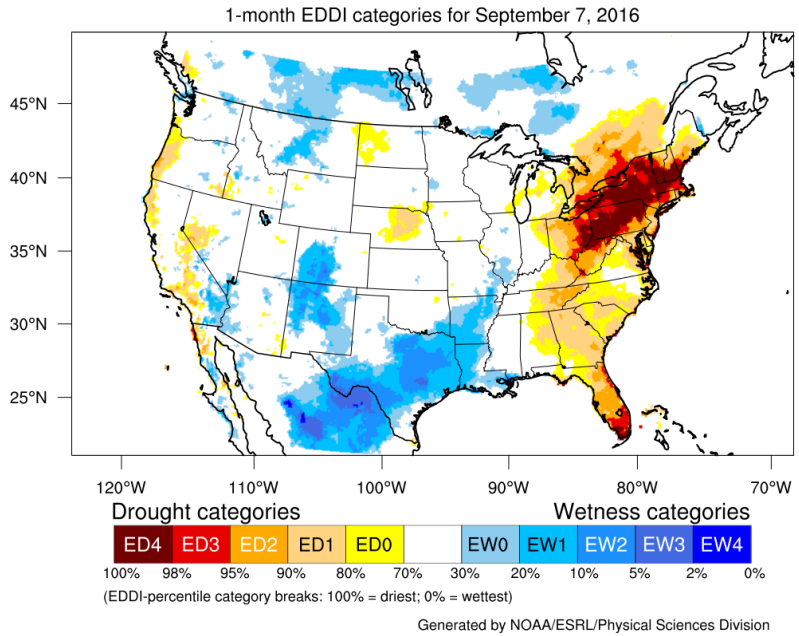


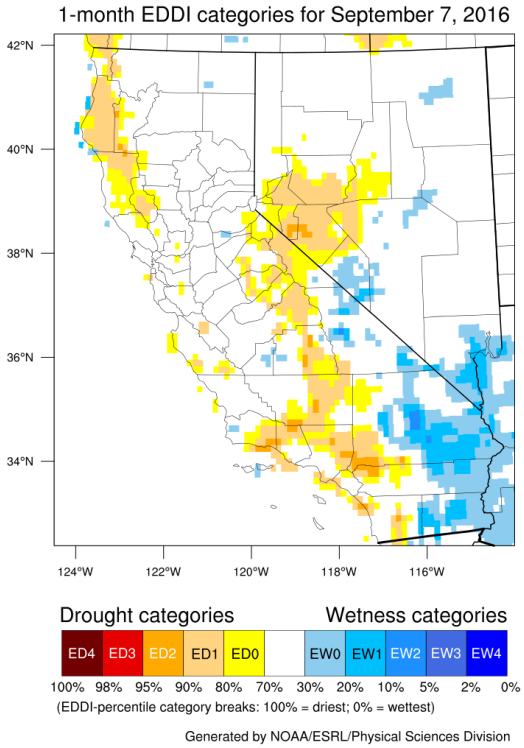


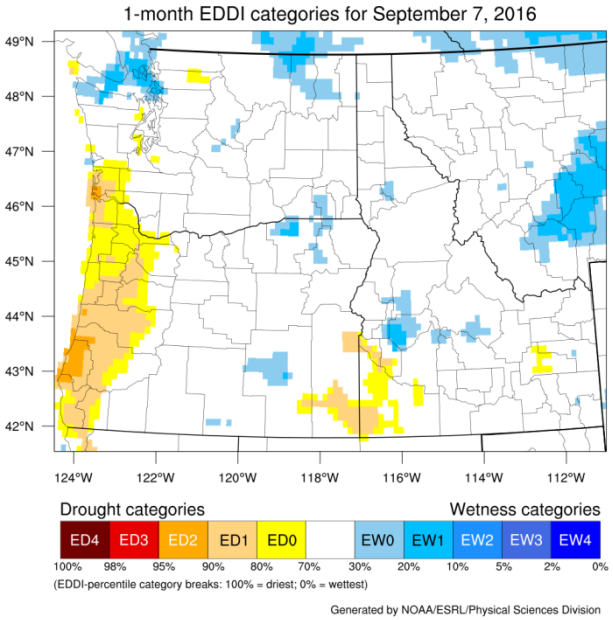


- WRCC products: https://mydrive.dri.edu/index.php/s/XgGuJ2CKJ3sa3L6
- CONUS maps, updated daily
- 14-, 30-, 90-, 180-, 365-day time scales
- USDM percentile drought and wet categories

EDDI Products

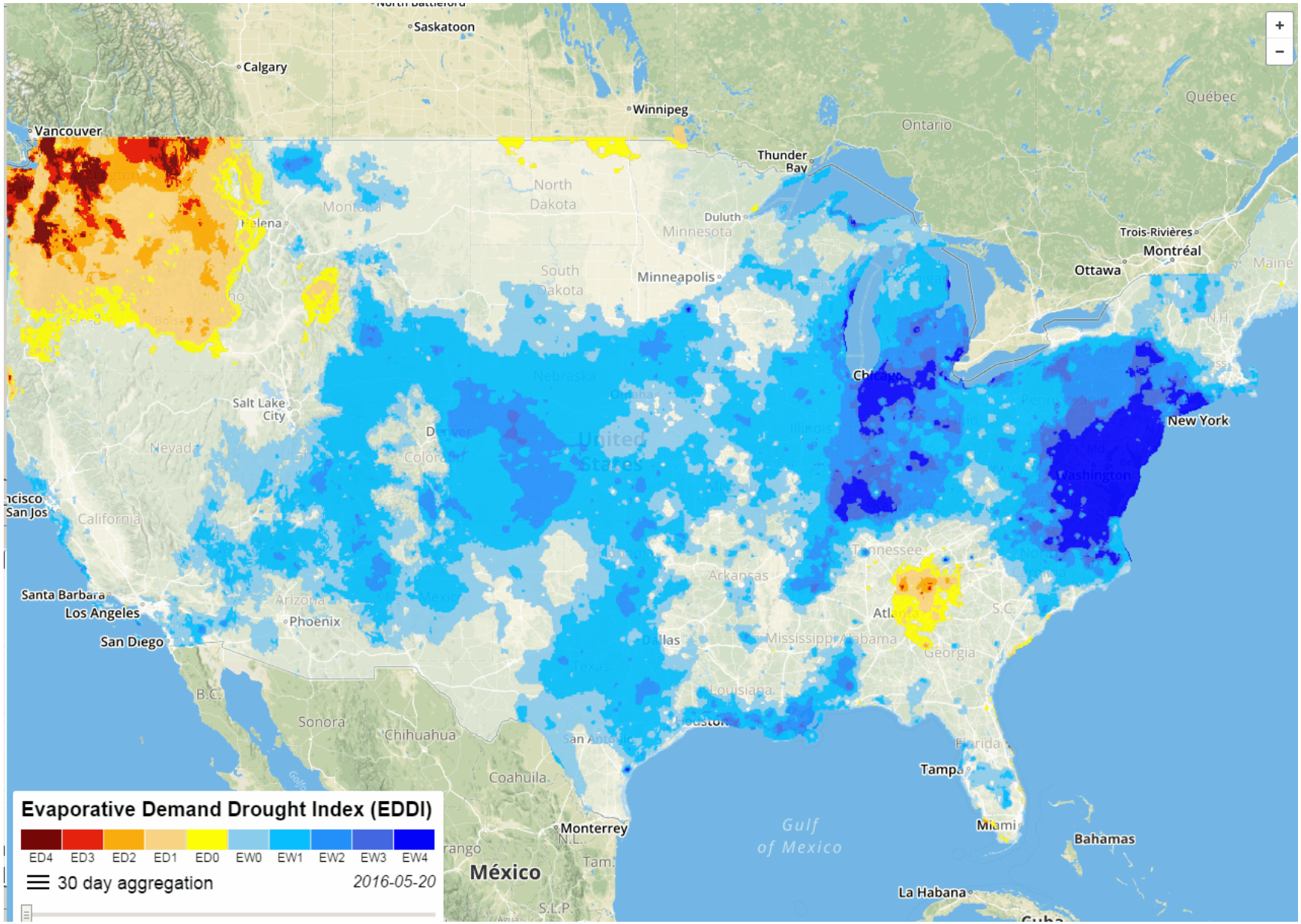






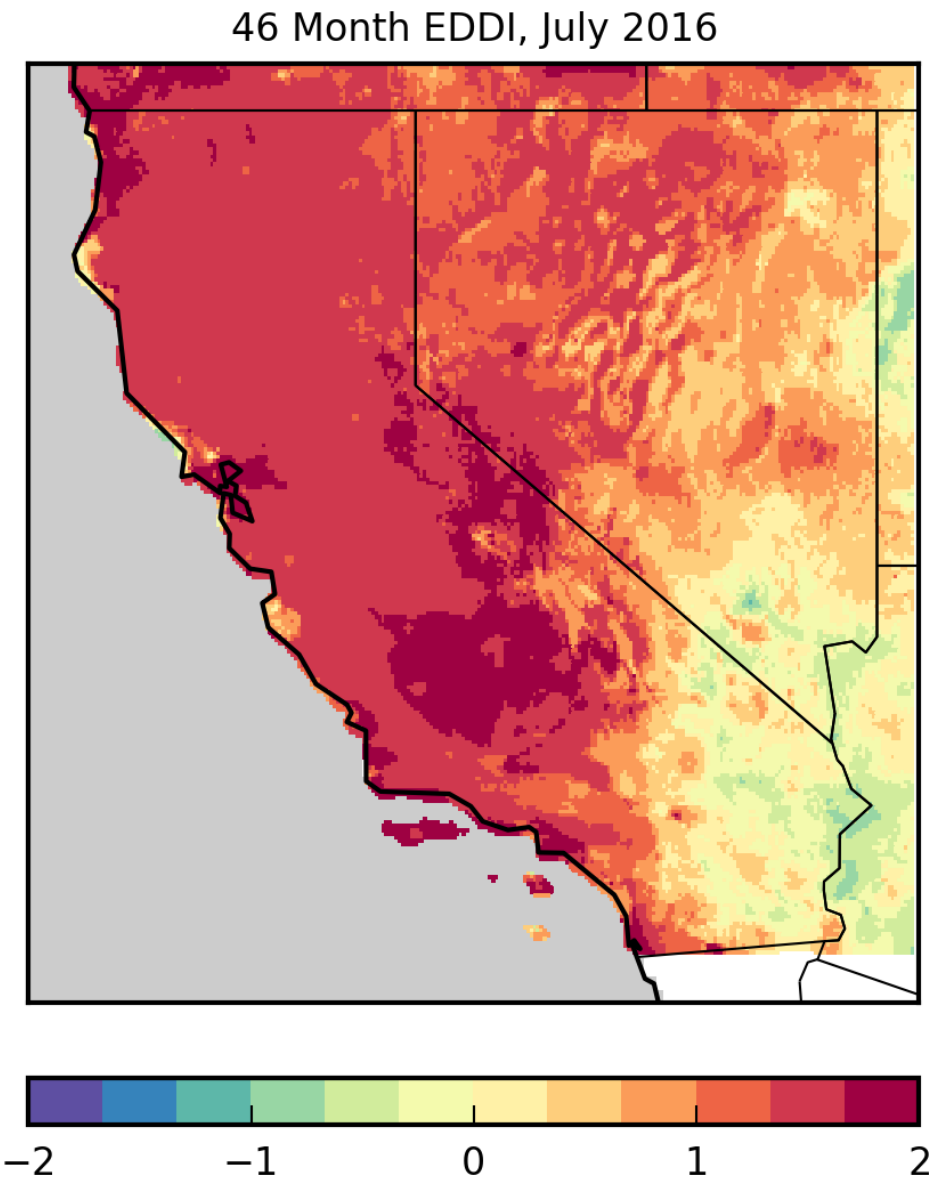
- ftp://ftp.cdc.noaa.gov/pub/Public/mhobbins/EDDI/
- Updated daily
- 1-12 week and 1-12 month time scales
- DEWS regions zoomed in
- Contact: Mike Hobbins, mike.hobbins@noaa.gov

EDDI Products

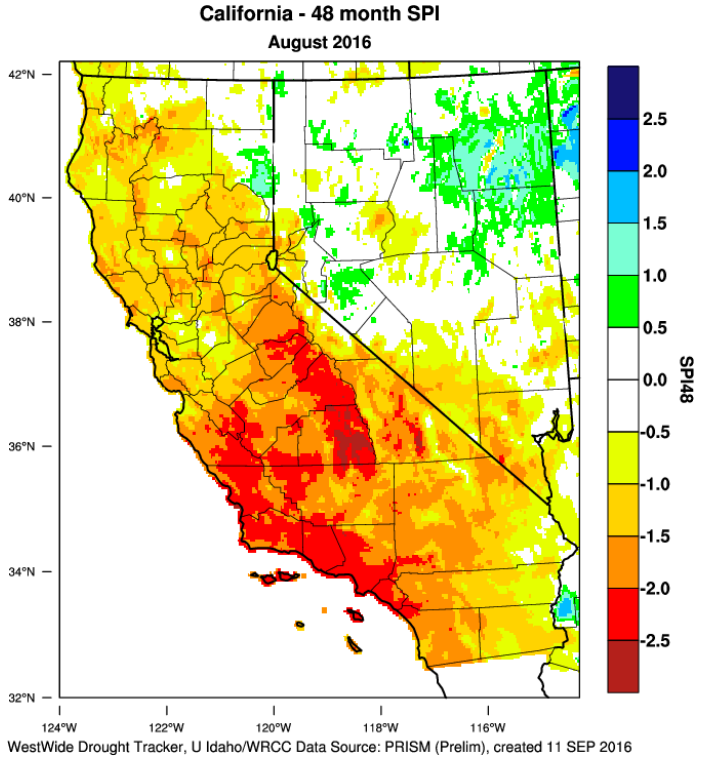


EDDI slider: https://eddi-dri.appspot.com/, developed by Charles Morton, DRI

EDDI: CA Examples



- 46-month EDDI
- October 2012 through July 2016
- Long-term demand surplus stand out similar to precipitation deficits

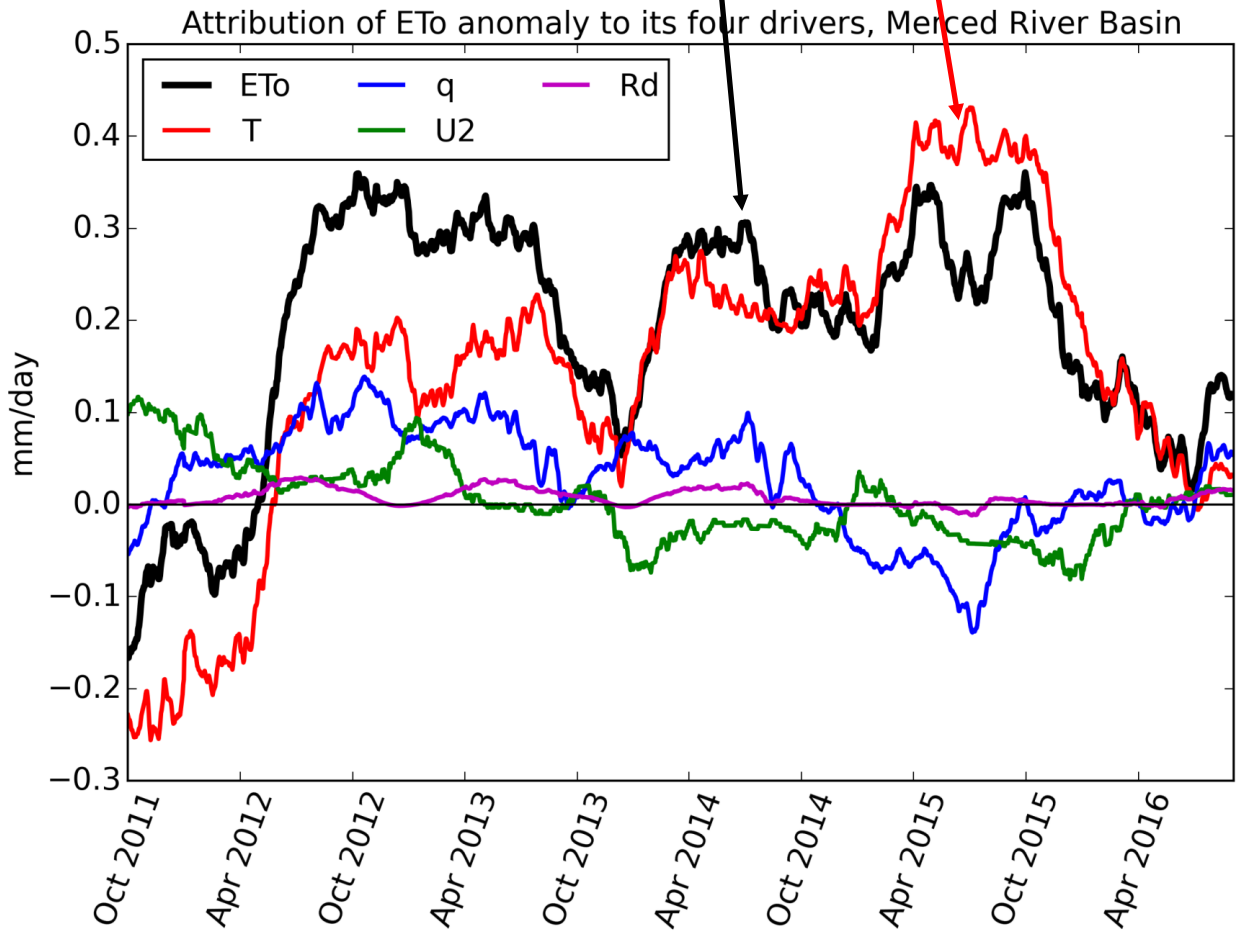


ET_o decomposition and attribution, Merced River Basin

12-month running mean ET_0 anomaly

$$\Delta E_0 = \frac{\partial E_0}{\partial T_{air}} \Delta T_{air} + \frac{\partial E_0}{\partial q} \Delta q + \frac{\partial E_0}{\partial R_d} \Delta R_d + \frac{\partial E_0}{\partial U_{10}} \Delta U$$

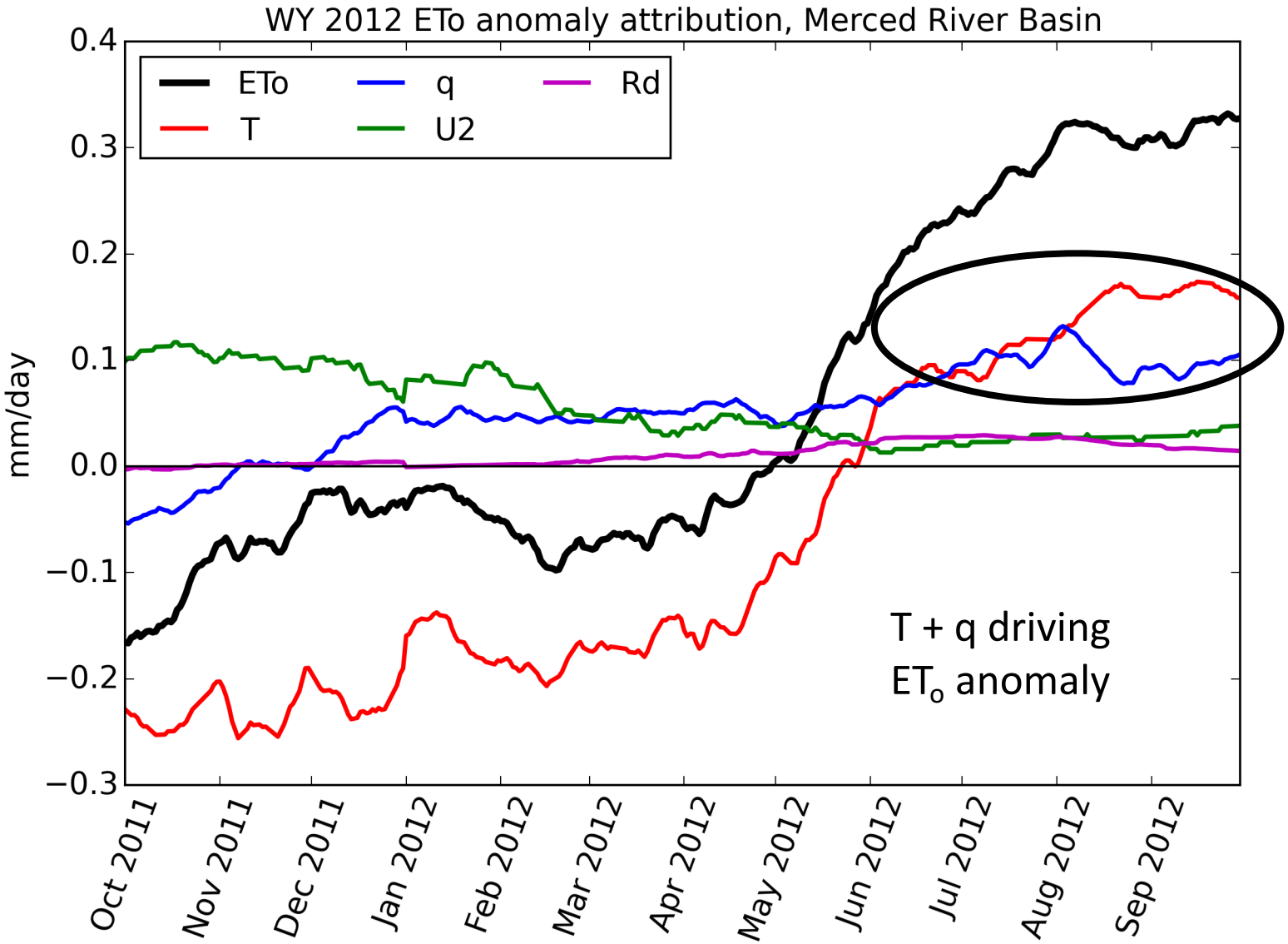
T sensitivity x T anomaly



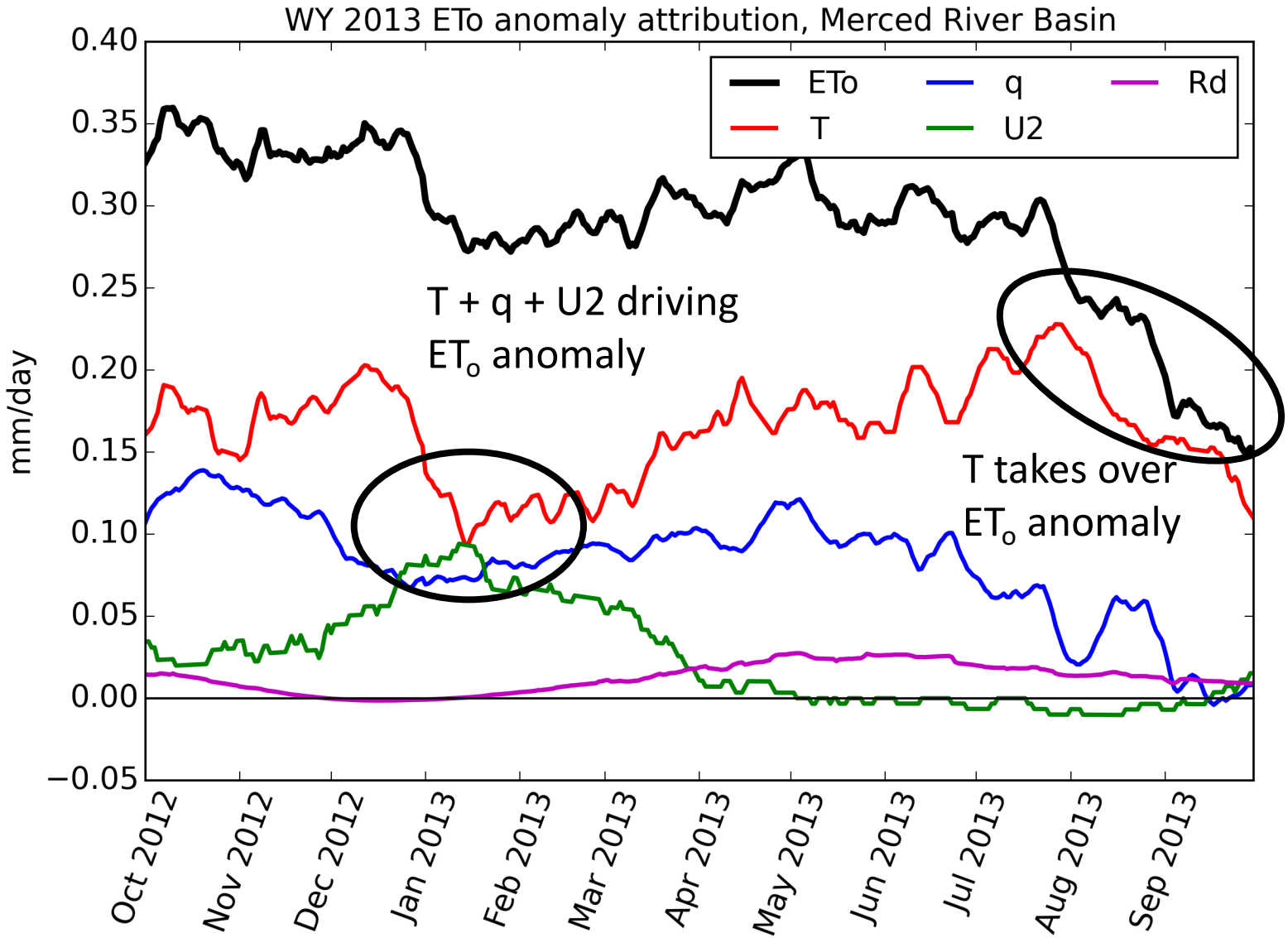
- Sum of ET_o drivers = ET_o anomaly
- Positive ET_o anomaly since early 2012
- Shift to mostly temperature dominant late 2013

[Hobbins, 2016; results courtesy of Mike Hobbins]

ET_o decomposition and attribution



ET_o decomposition and attribution



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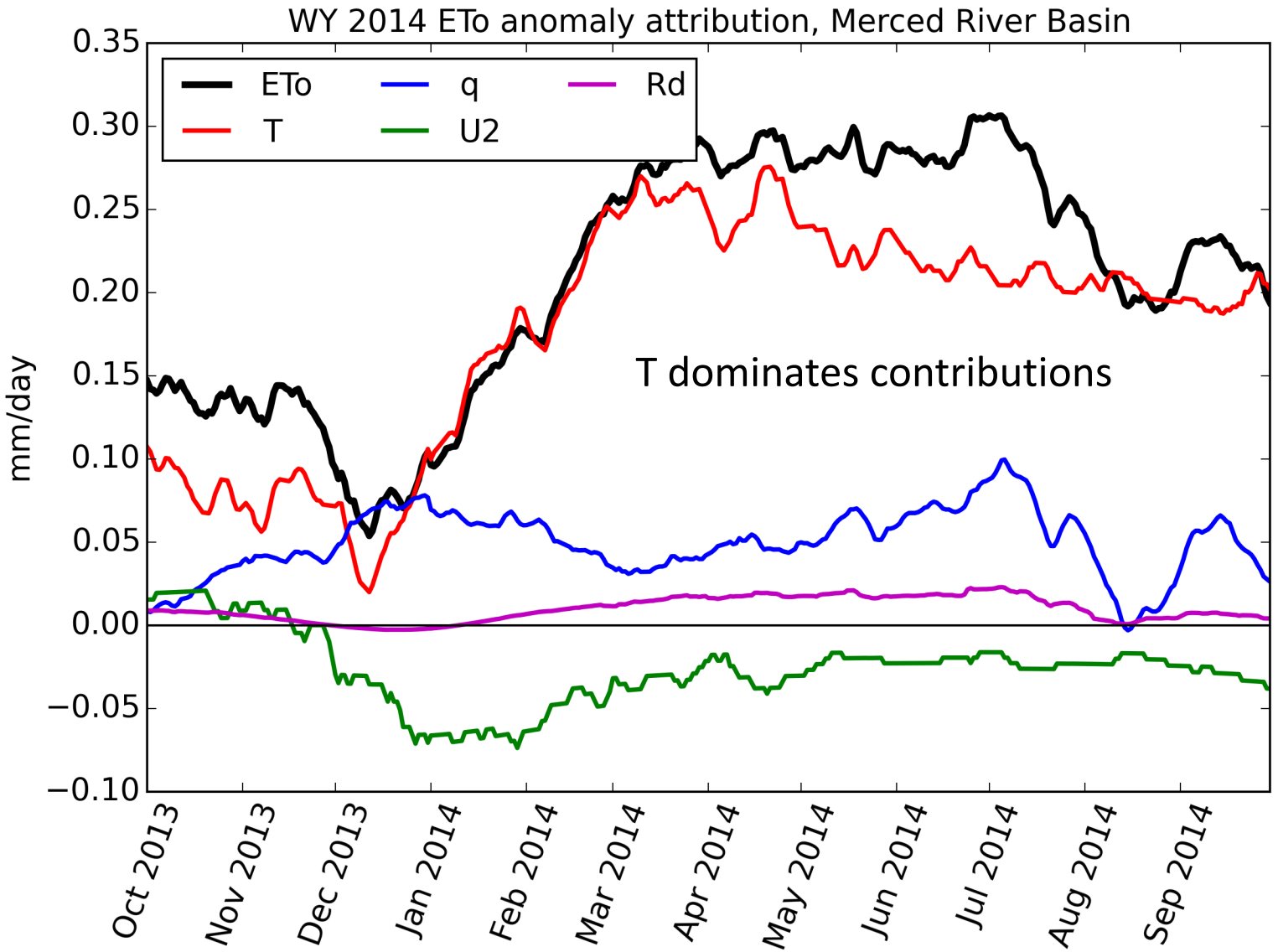

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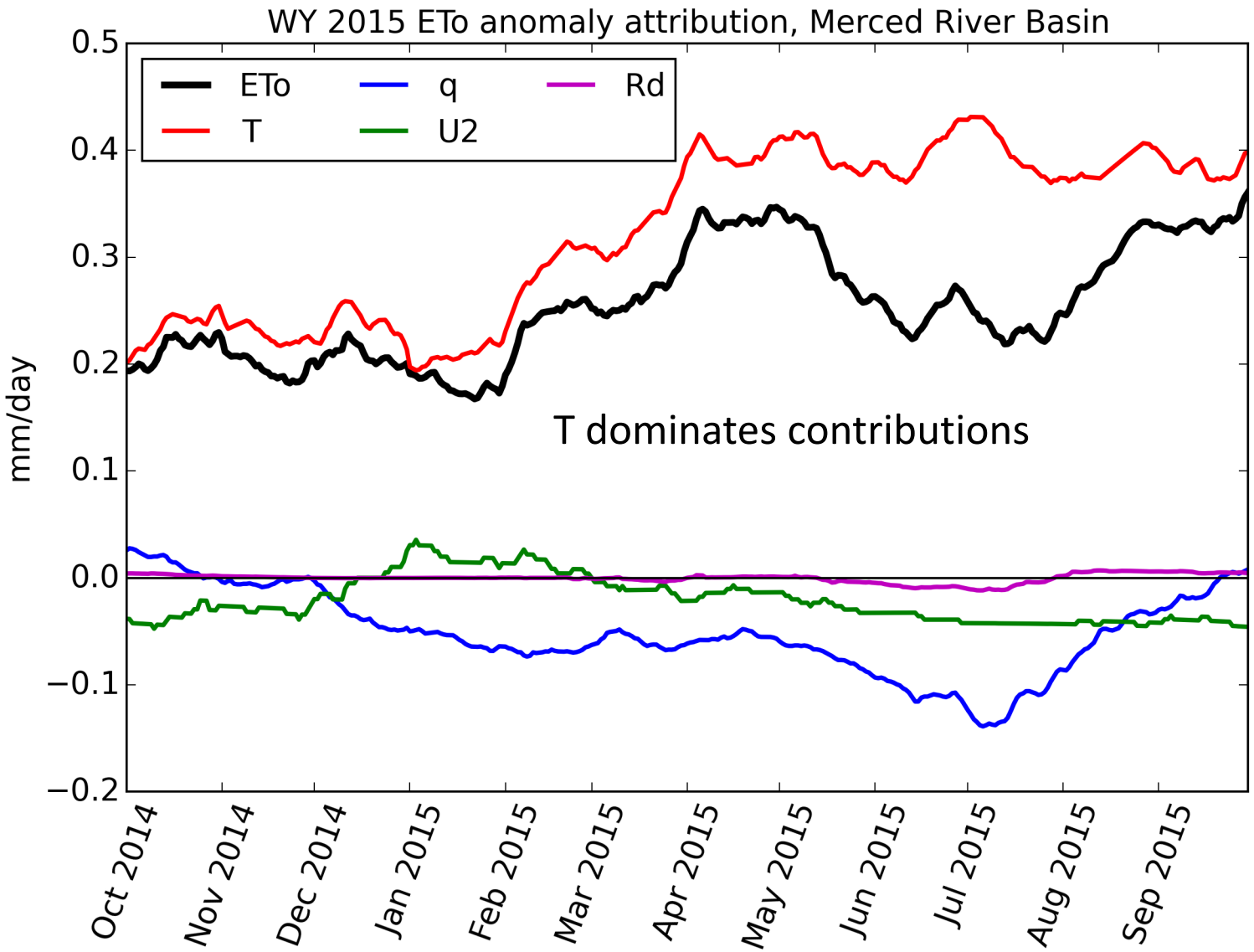

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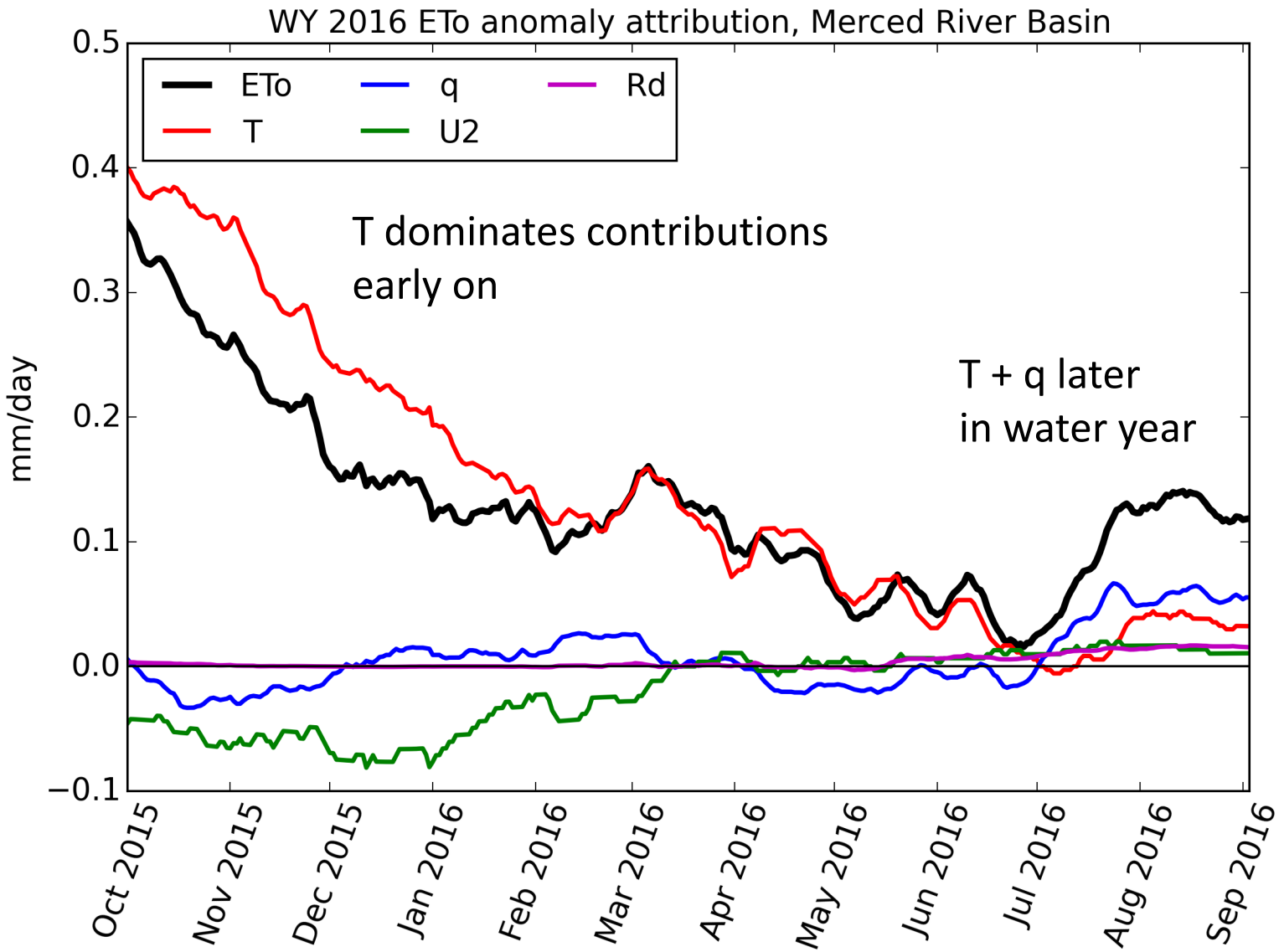
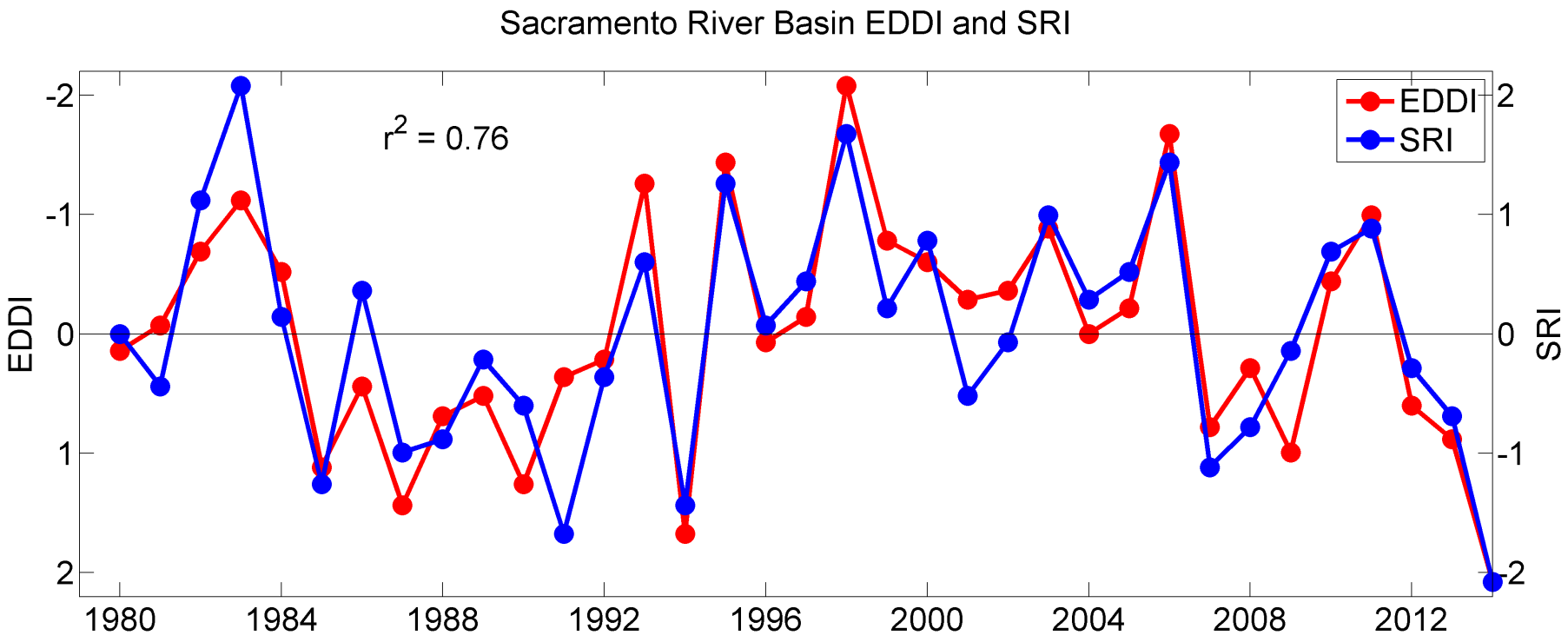


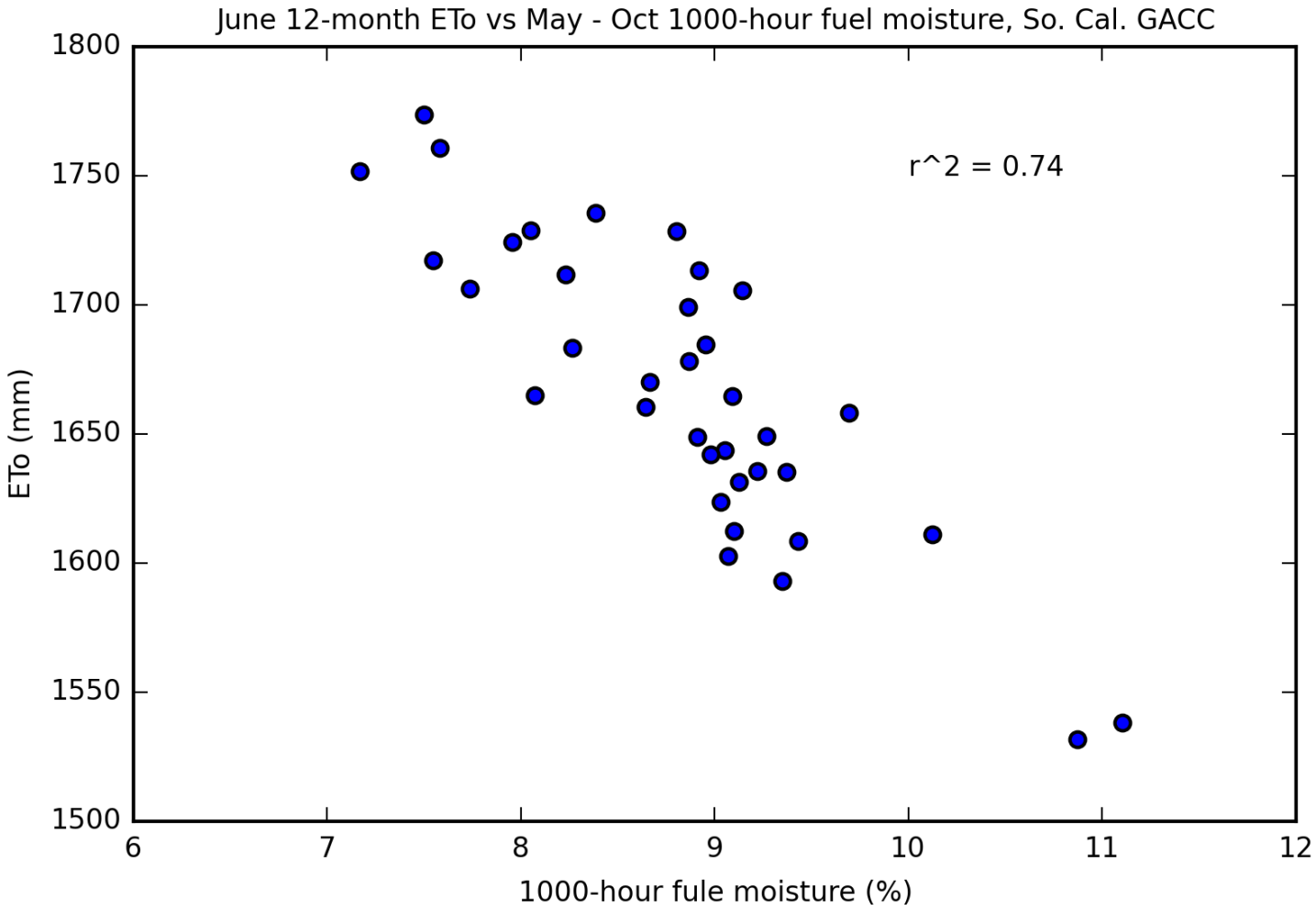
EDDI: Research and Applications

- Relationships between EDDI and streamflow
- 6 month EDDI ending in April (Nov-Apr) and 12-month Standardized Runoff Index (SRI)ending in September (Oct-Sep)
- Potential to improve late summer low flow streamflow predictions



EDDI: Research and Applications

- Relationships between EDDI and fire danger indices
- NOAA funded Sectoral Applications Research Program grant: *Developing a wildfire component for the NIDIS CA Drought Early Warning System*
- 2-years, $295K

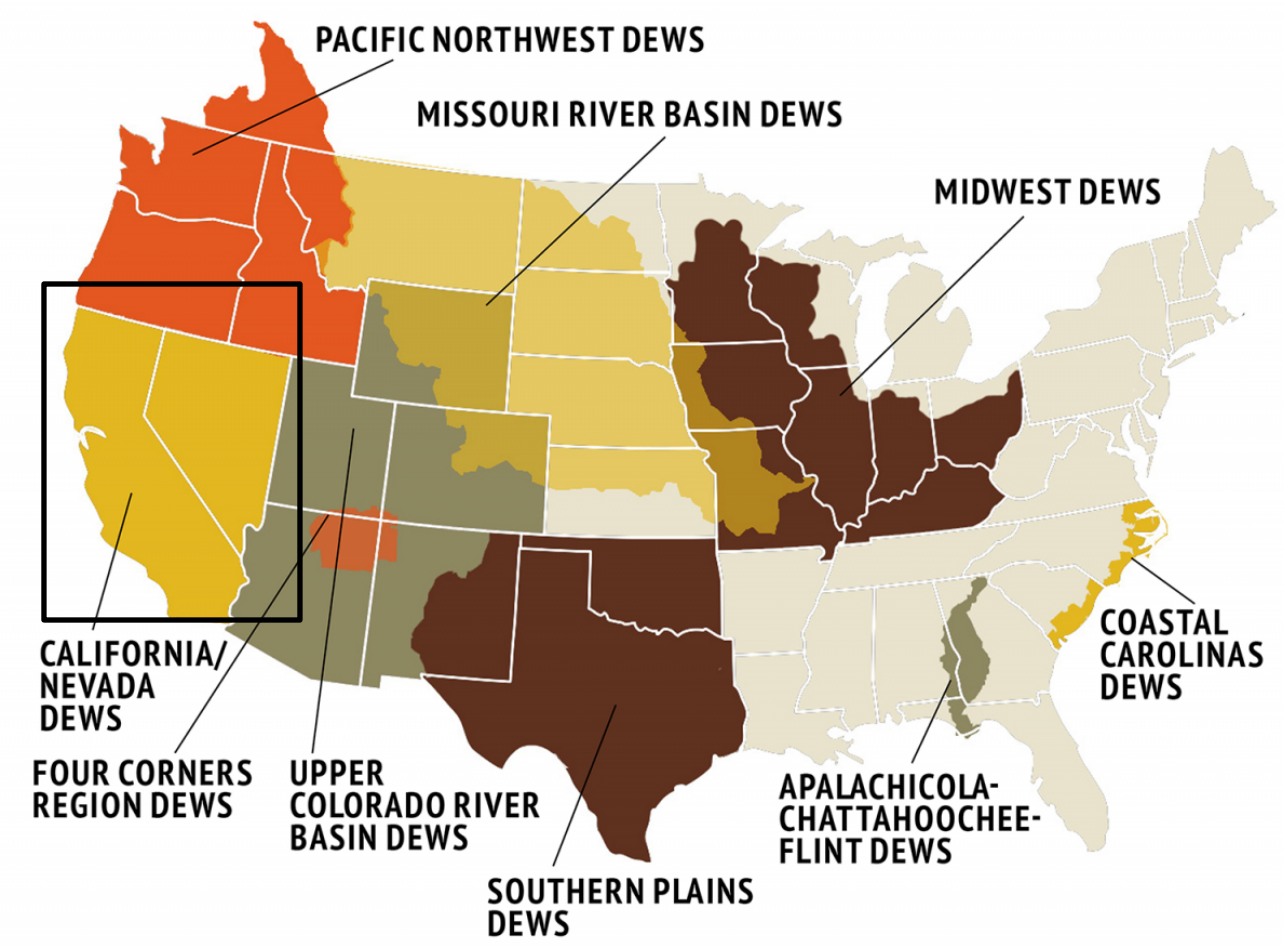


EDDI: Research and Applications

- *Operationalizing an Evaporative Demand Drought Index Service for Drought Monitoring and Early Warning*
- NOAA Research Transition Acceleration Program (RTAP)
- 3-years, ~ $900K
- Collaboration between DRI/WRCC, NOAA-PSD, NOAA-ESRL, NIDIS, University of Colorado, CIRES, and NWS
- Develop EDDI into an operational product to be housed at the NOAA National Water Center

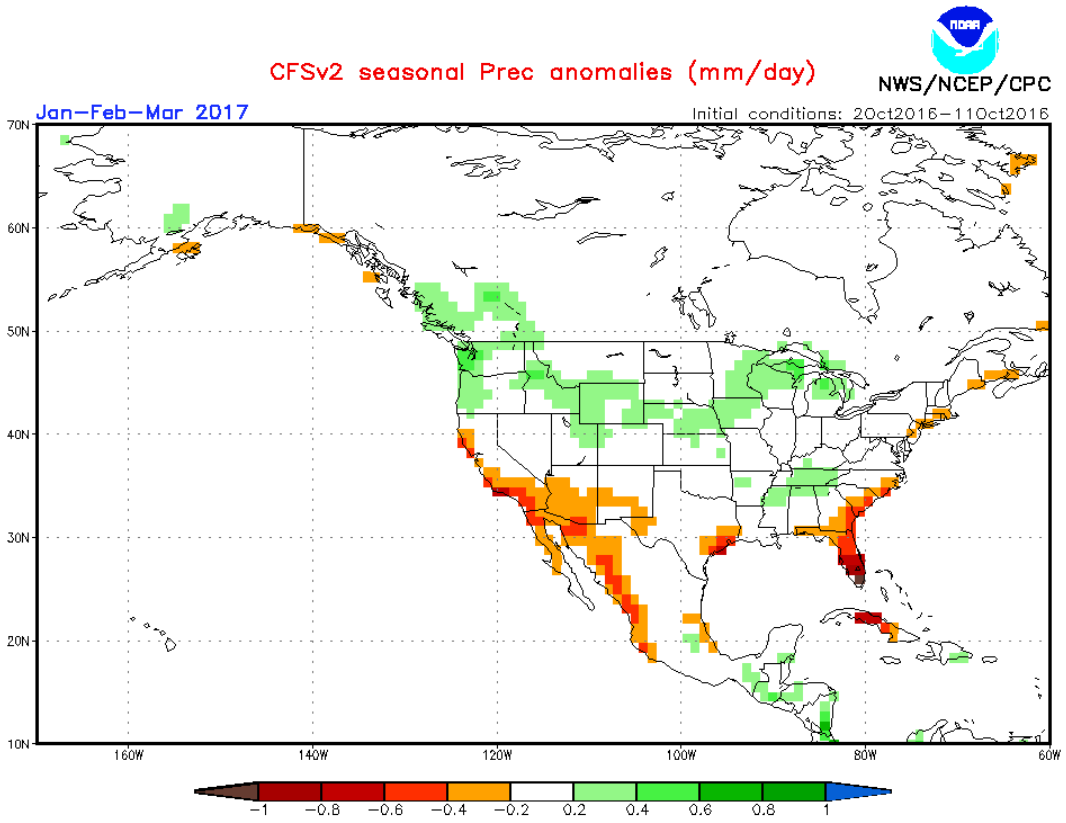
EDDI: Research and Applications

- *Development of a Nevada Drought Early Warning System*
- NIDIS Drought Early Warning Systems
- 3-years, ~ $800K



Future Directions

- Continue to develop EDDI into a mature operational product
- Continued user testing, evaluation, and training
- Seasonal forecast of ET_o anomalies for drought early warning



Thank you!

Questions?

mcevoyd@dri.edu

Lake Tahoe as seen from top of Incline Peak, NV. February, 2014