Earth Observations from Space and Agricultural Water Management In California

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Mapping Crop Water Requirements with Satellite Observations and CIMIS Data

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Project Team:
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Partners:
California Department of Water Resources
Western Growers Association
USGS
Center for Irrigation Technology, CSU Fresno
USDA Agricultural Research Service / NRCS
Univ. of California, Cooperative Extension
Booth Ranches, Chiquita / Fresh Express Constellation Wines, Del Monte Produce
E. & J. Gallo, Farming D, Periera Farms
Ryan Palm Farms, Tanimura & Antle

Support provided by the NASA Applied Sciences Program, CSU Agricultural Research Initiative, CDFA
Challenges to Water Management in California

• Variability of precipitation
  – Seasonal
  – Inter-annual
  – Climate change

• Competing demands
  – Usage
  – Water quality
  – Environmental quality

• Groundwater overdraft

• Population growth

• Aging water conveyance infrastructure
California Agriculture*

- $43.5B in cash farm receipts in 2012 from 81,500 farms
- Major domestic/international supplier of specialty crops
- Half of US-grown fruits, nuts, vegetables
- Diversity of crops
  *Source: Calif. Dept. Food & Agriculture

*Agriculture accounts for ~80% of the water used in the state. Increasing irrigation efficiency will provide greater flexibility for water management, lower costs of production and help assure a sustainable water supply.*
California Irrigation Management Information System (CIMIS)

- Operated by CA DWR since 1982
- More than 139 ground stations currently providing daily measurements of Evapotranspiration ET₀
- **Spatial CIMIS** data now available for CA; 2km statewide grid, daily

Standard approach for incorporating weather information into irrigation management practices

\[
ET_c = ET_o \times K_c
\]
Growers who utilized weather and ET₀ data reported an increase in yields of 8% and a decrease in applied irrigation of 13% (DWR, 1997)

**Objective:** Apply satellite data to provide a new capability for mapping crop coefficients and crop water requirements to further enhance CIMIS capabilities for supporting growers

\[ \text{ET}_{cb} = \text{ET}_0 * K_{cb} \]

CIMIS Satellite

Landsat (30m) MODIS (250m)
**Satellite Irrigation Management Support (SIMS) Framework**

*Processing Steps*

- At sensor radiance
- LEDAPS
- Surface reflect.
- NDVI
- Fractional cover
- \( K_{cb} \times E_T \)
- \( E_T^{cb} \)

*Satellite (Landsat & MODIS)*

*Web browser*

*Mobile*

*Site info.*

*NASA Earth Exchange*

*Satellite Irrigation Management Support (SIMS) Framework*
Approach (Why NASA?)

Approach integrates data from satellite and surface sensor networks. Project builds on past research by NASA, USDA ARS, CA Dept. of Water Resources that has shown:

- Consistent relationships between satellite indices, crop canopy conditions, and crop water requirements
- Approach shown to reduce applied water and increase yields: “win-win”

Approach integrates data from a constellation of satellites to map daily crop water requirements. Data distributed via web browser using web services architecture. Prototyping accelerated by NEX / NASA high end computing resources.
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NASA Satellites Contributing Most to Water Cycle Studies
Thank you

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