California Irrigation Management Information System (CIMIS)
Western States Water Council
Water Management Symposium

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Outline

- CIMIS
  - Introduction and history.
  - Stations and data.
  - Users and uses.
  - Data gaps.
- Spatial CIMIS (CIMIS-GOES)
  - The GOES project and its status.
  - Data collection and calculations.
  - Model refinements and future plans.

What is CIMIS?

- **CIMIS** – a network of over 130 fully automated weather stations that collect weather data and provide estimates of reference evapotranspiration (ETo) to the users.

- **Reference Evapotranspiration** - ET from standardized grass (ETo) and/or alfalfa (ETr) surfaces.

History of CIMIS

- 1982 - CIMIS was developed by the California Department of Water Resource and the University of California at Davis.
- 1985 - DWR assumed control of all operations of the CIMIS program.
- 1995 - began using Ingress database and telnet access in addition to the dial-up system.
- 1997 - initiated web access.

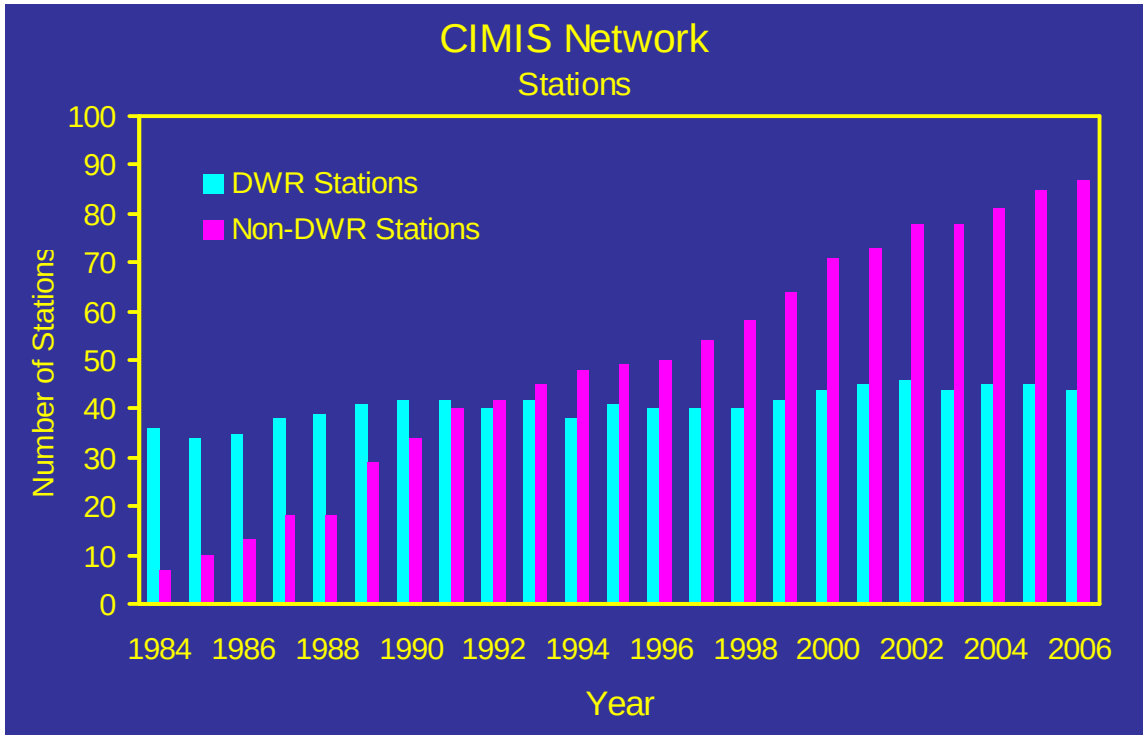
History (cont.)

- 2001 - converted to Oracle database with both web and telnet access.
- 2002 – data access changed to web only with FTP site for automated downloads.
- 2004 – upgraded to new web site
- Today – over 130 active and 67 inactive stations statewide.
- Web – http://wwwcimis.water.ca.gov.
- FTP – ftpcimis.water.ca.gov.

Who Owns CIMIS Stations?

- Some CIMIS stations are owned by DWR.
- Others are owned by cooperators, such as:
  - Local water agencies
  - Universities
  - Cities
  - U.S. Department of Agriculture (USDA)
  - U.S. Bureau of Reclamation (USBR)
  - Conservation Districts (CD)
  - Private industries

Who Owns (cont.)

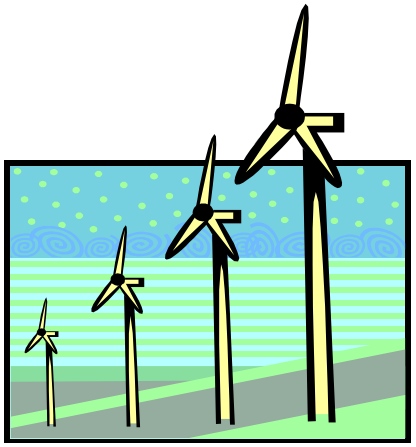


Who Uses CIMIS Data?

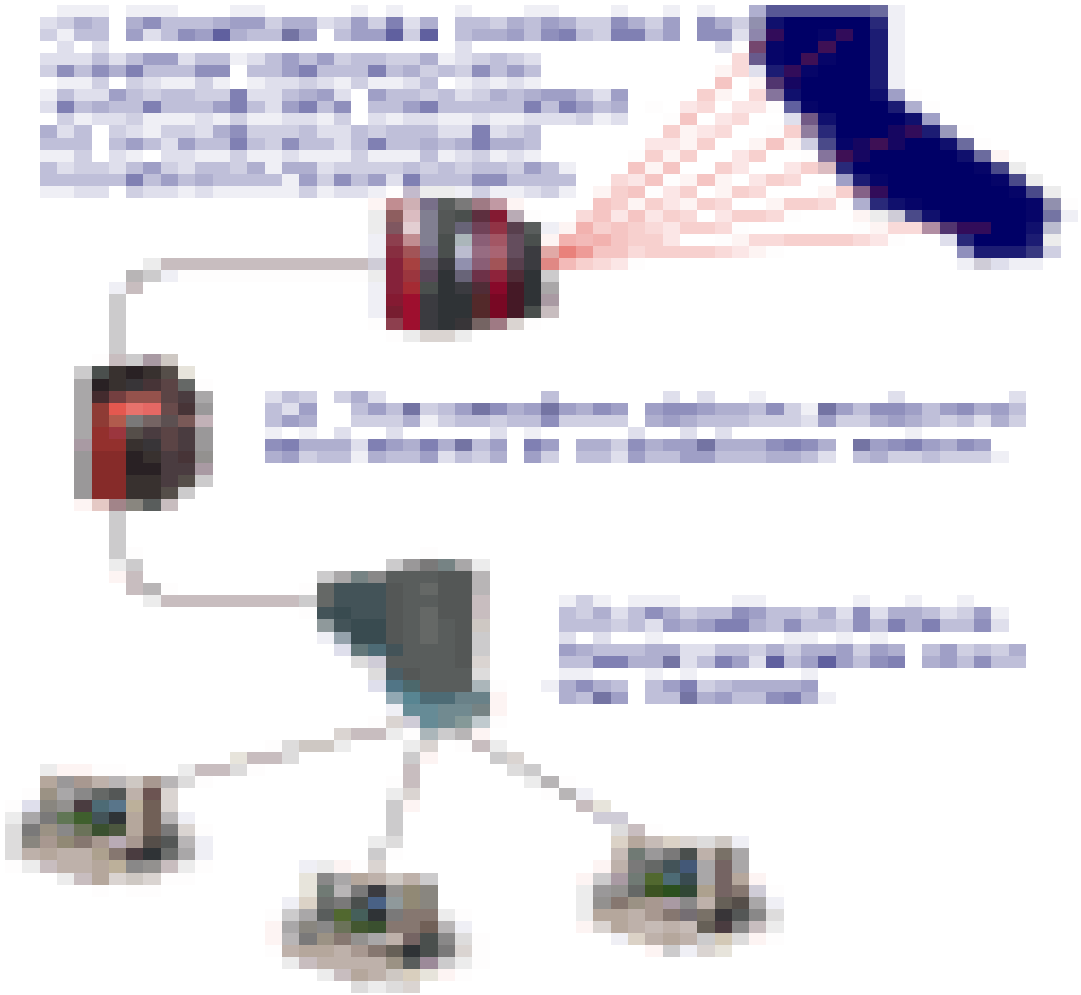
- Growers.
- Consultants.
- Water agencies.
- Public agencies.
- Researchers.
- Investigators.
- Landscape Managers
- Many, Many More

For What Purposes?

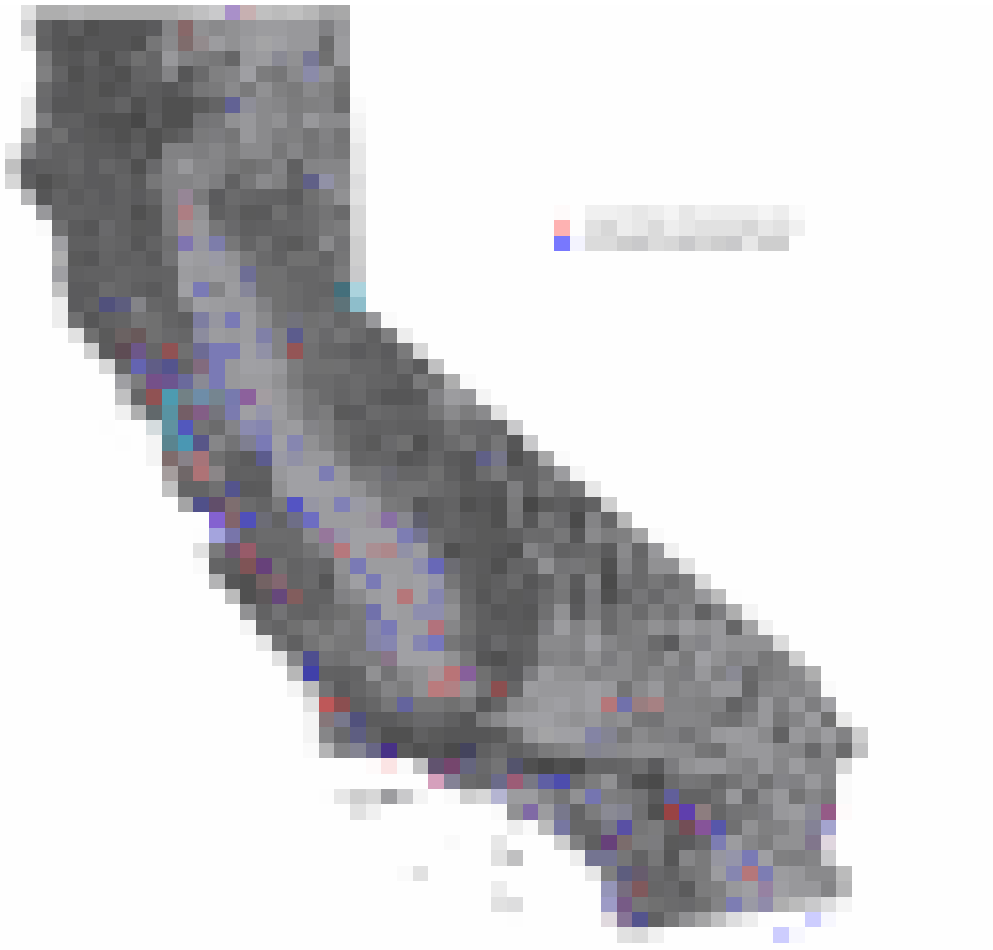
- Irrigation scheduling.
- Pest management.
- Air quality monitoring.
- Fire fighting.
- Energy generation.
- Engineering designs.
- Weather forecasting.
- Research.



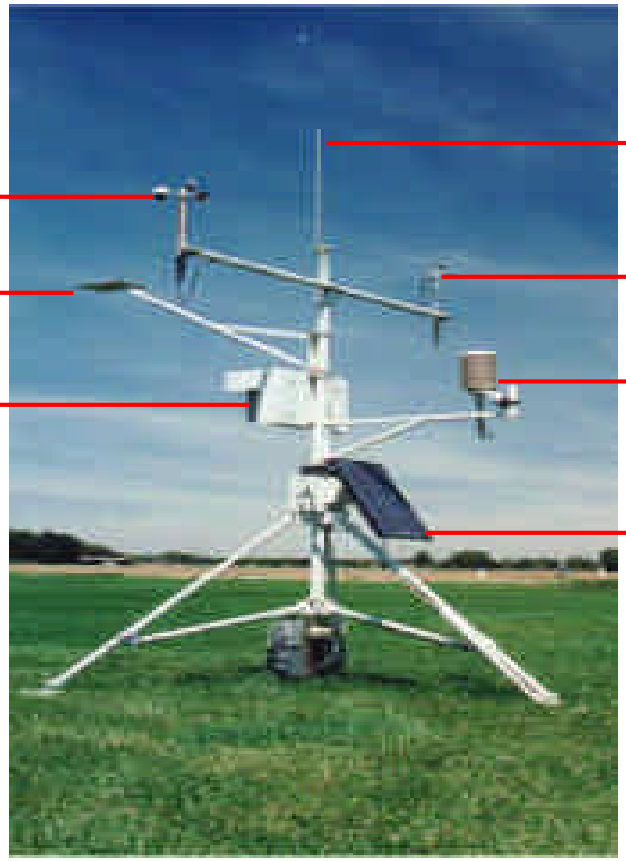
How Does CIMIS Work?



CIMIS Station Locations



Typical CIMIS Station



At the CIMIS Stations

- Dataloggers poll the sensors every minute and measure:
  - Solar radiation
  - Air temperature
  - Wind speed
  - Vapor pressure
  - Precipitation

At the Headquarter

- The CIMIS computer calls every station.
- Data is retrieved via telephone lines.
- Data goes through quality control (QC) procedures.
- Reference evapotranspiration (ETo) is calculated.
- Measured and calculated parameters are stored in the CIMIS database.

The GOES Project.

- Is a project that CIMIS initiated with the UC Davis remote sensing group to explore the potential for using remotely sensed data for the estimation of reference evapotranspiration (ETo).
- The Geostationary Operational Environmental Satellites (GOES) were selected – hence the GOES Project.

ETo Estimation.

- The ASCE version of the PM equation is used:

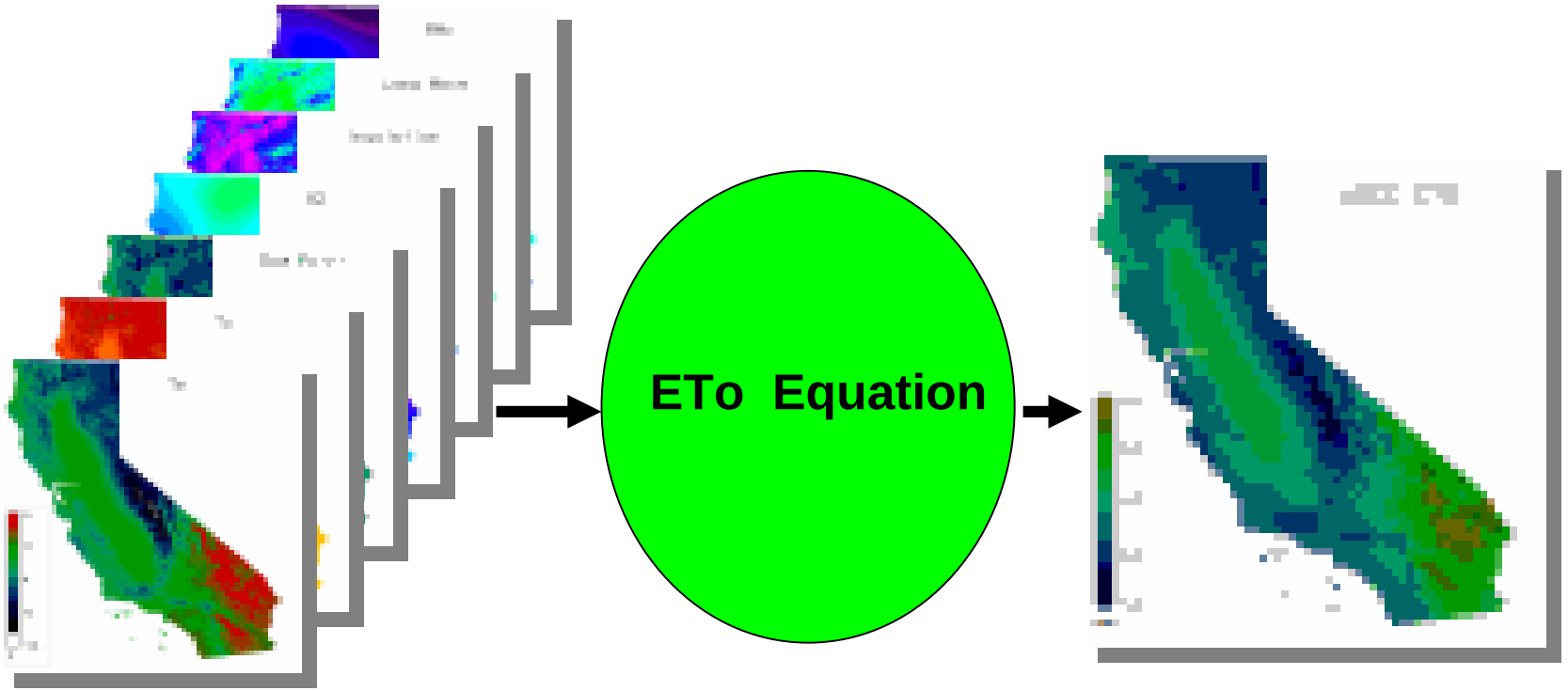
$$ETo = \frac{0.408\Delta(Rn - G) + \gamma \frac{900}{T + 273} u_2 (es - ea)}{\Delta + \gamma(1 + 0.34u_2)}$$

- Rn is calculated from net shortwave (Rns) and net longwave (Rnl) radiations.
- Rns is calculated from solar radiation (Rs), which is in turn derived from the GOES.

ETo Estimation (cont.)

- Rnl is calculated from air temperature, vapor pressure, and solar radiations (actual and clear sky).
- Air temperature, relative humidity, and wind speed are either interpolated from CIMIS stations or, possibly, derived from WRF model.
- We are also planning to use the WRF model for ETo forecast.

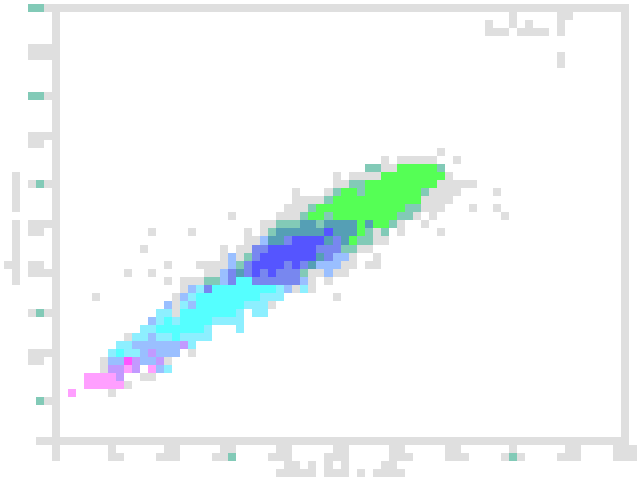
ETo Estimation (cont.)



Solar Radiation.

- Cloud brightness is estimated from GOES visible images.
- Clear sky factor (k) is calculated as a function of cloud brightness.
- Clear sky solar radiation (Rso) is calculated using the Heliosat model.
- Rs is then calculated from k and Rso.

Solar Radiation (cont.)



- Using 3 years worth of data for comparison, the GOES Rs was higher by only 2% with an R^2 of 0.99.

Ta, RH, and U2.

- Two interpolation methods were used; DayMet and Spline.
- DayMet - generates daily surfaces of temperature, humidity, precipitation, and radiation over large regions of complex terrain using truncated Gaussian weighting filter.

Ta, RH, and U2 (cont.)

- DayMet – area of relative influence is inversely related to the density of neighbor stations.
- DayMet – relative influence decreases with increasing distance from observation.

Ta, RH, and U2 (cont.)

- Spline – fits a surface through or near known points using a function with continuous derivatives.
- 2D and 3D splines were used.
- Parameters for the spline method were selected through cross validation.

Ta, RH, and U2 (cont.)

- Cross validation analyses showed that both methods have similar errors.
- Statistical analyses and visual inspections were used to determine which method to use for each weather parameter.
- In some cases, there were significant differences between the two methods – hence WRF.

Model Refinements

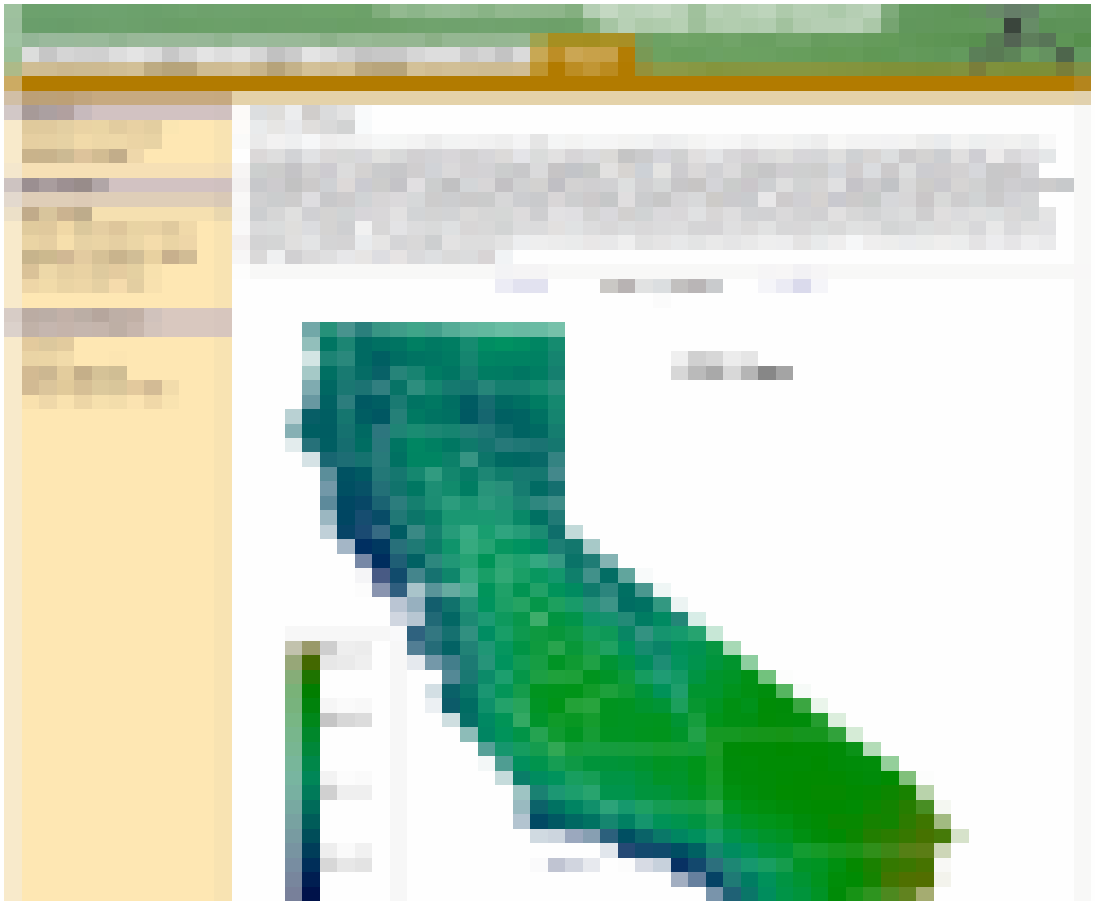
- Snow versus cloud.
- Surface reflectance (albedo) values.
- Turbidity.
- Interpolation versus model.

Future Plans.

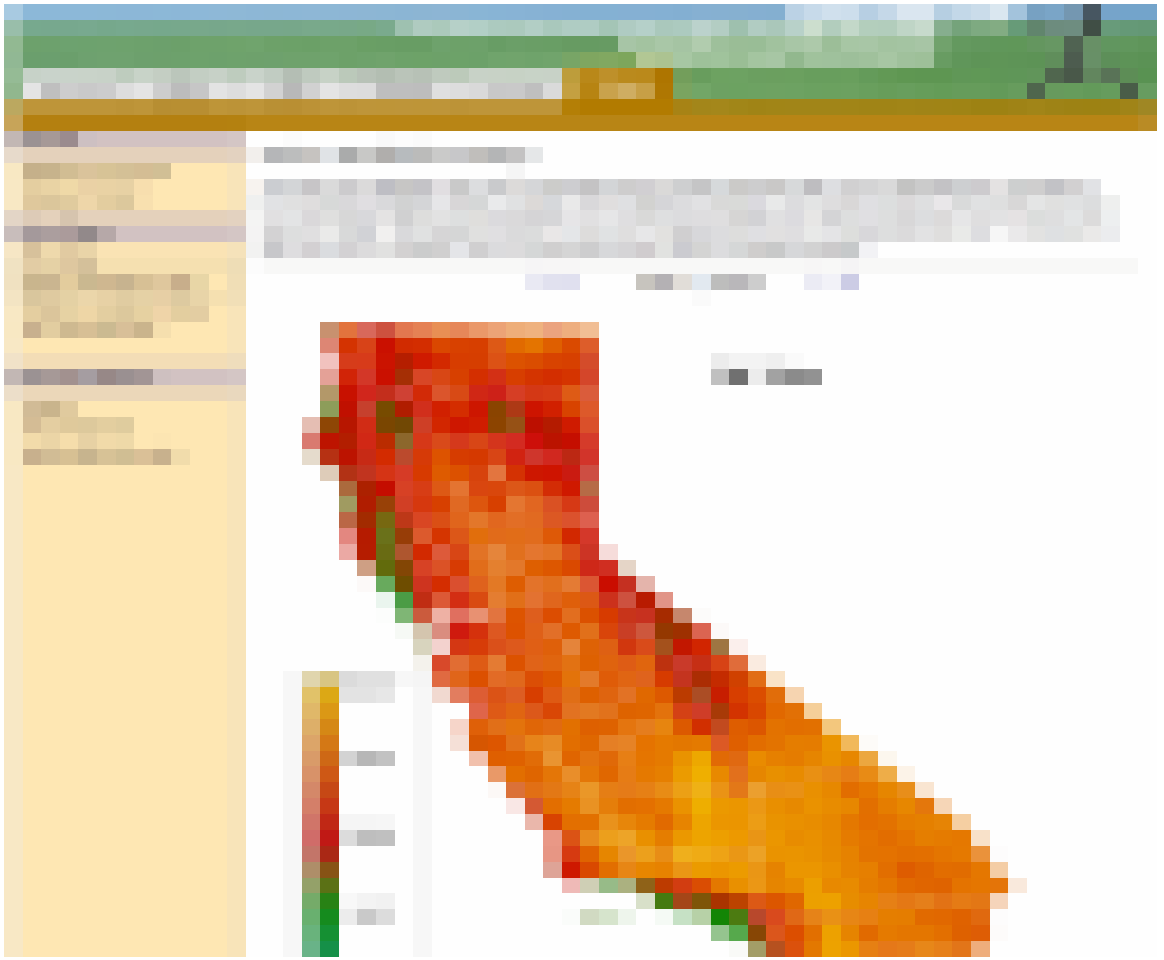
- ETo forecasting.
- Land use and crop-coefficient (Kc) maps.
- Actual ET (ETc) maps.
- Interactive (web services) data delivery with improved features to automatically deliver data to any type of end user (ET controllers, data bases, PDA's, & etc..

Spatial CIMIS

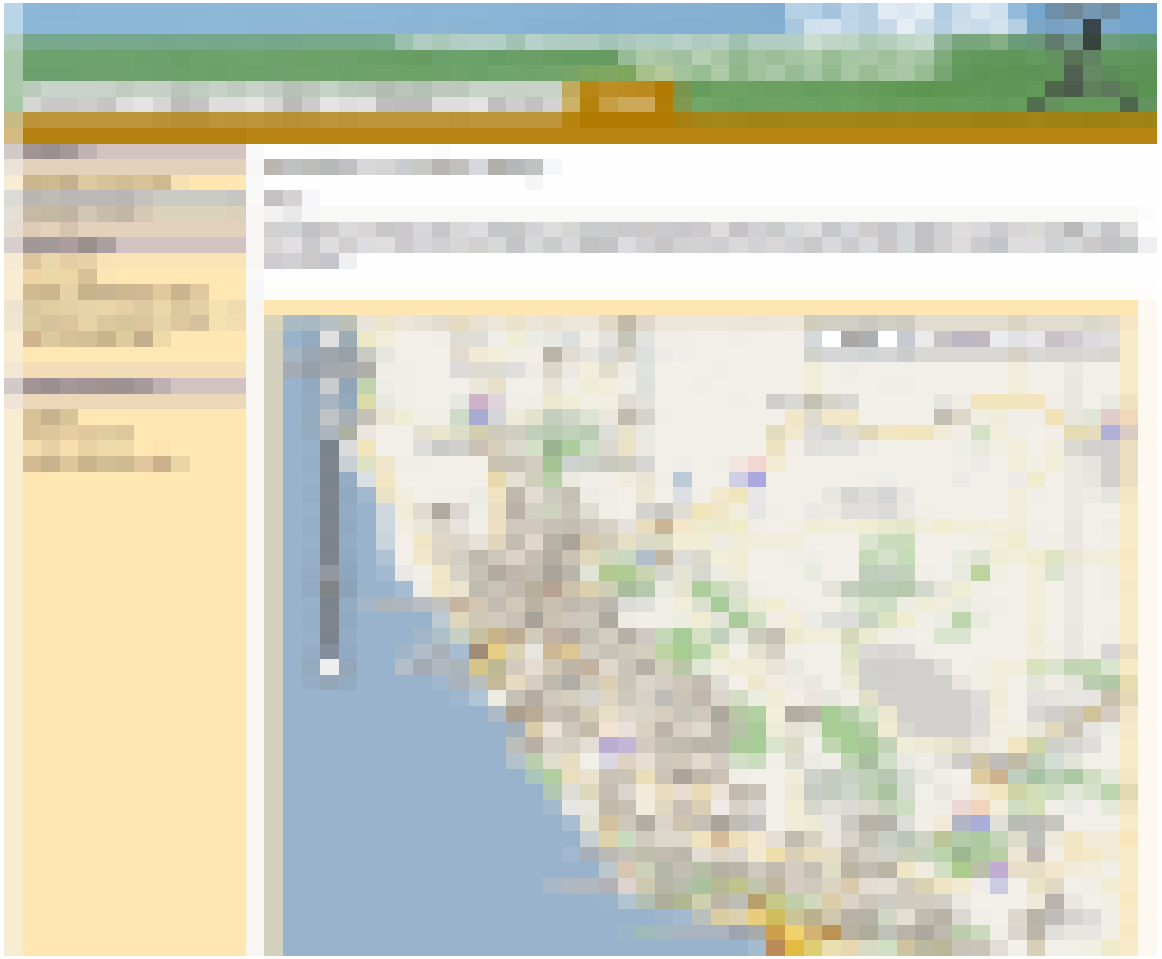
View ETo Map



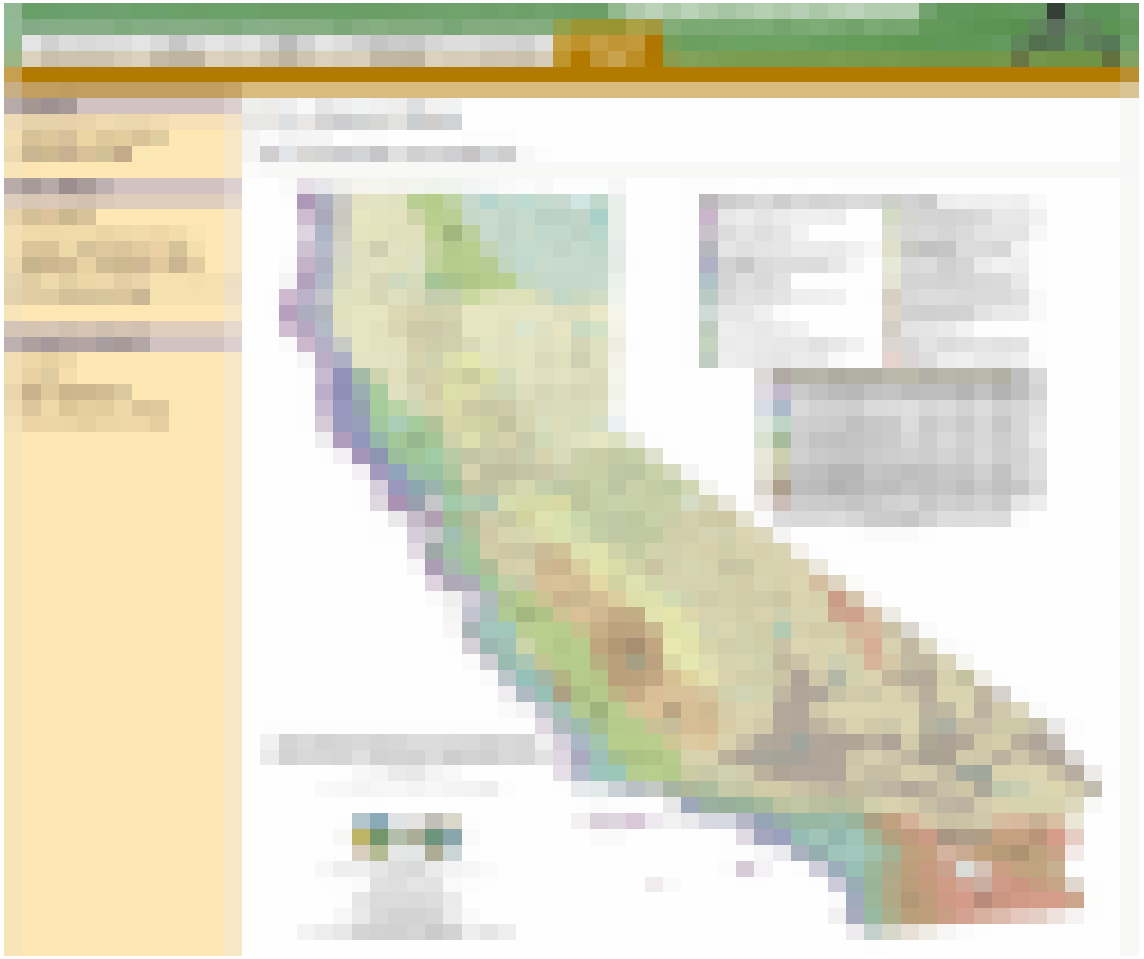
View Rs Map



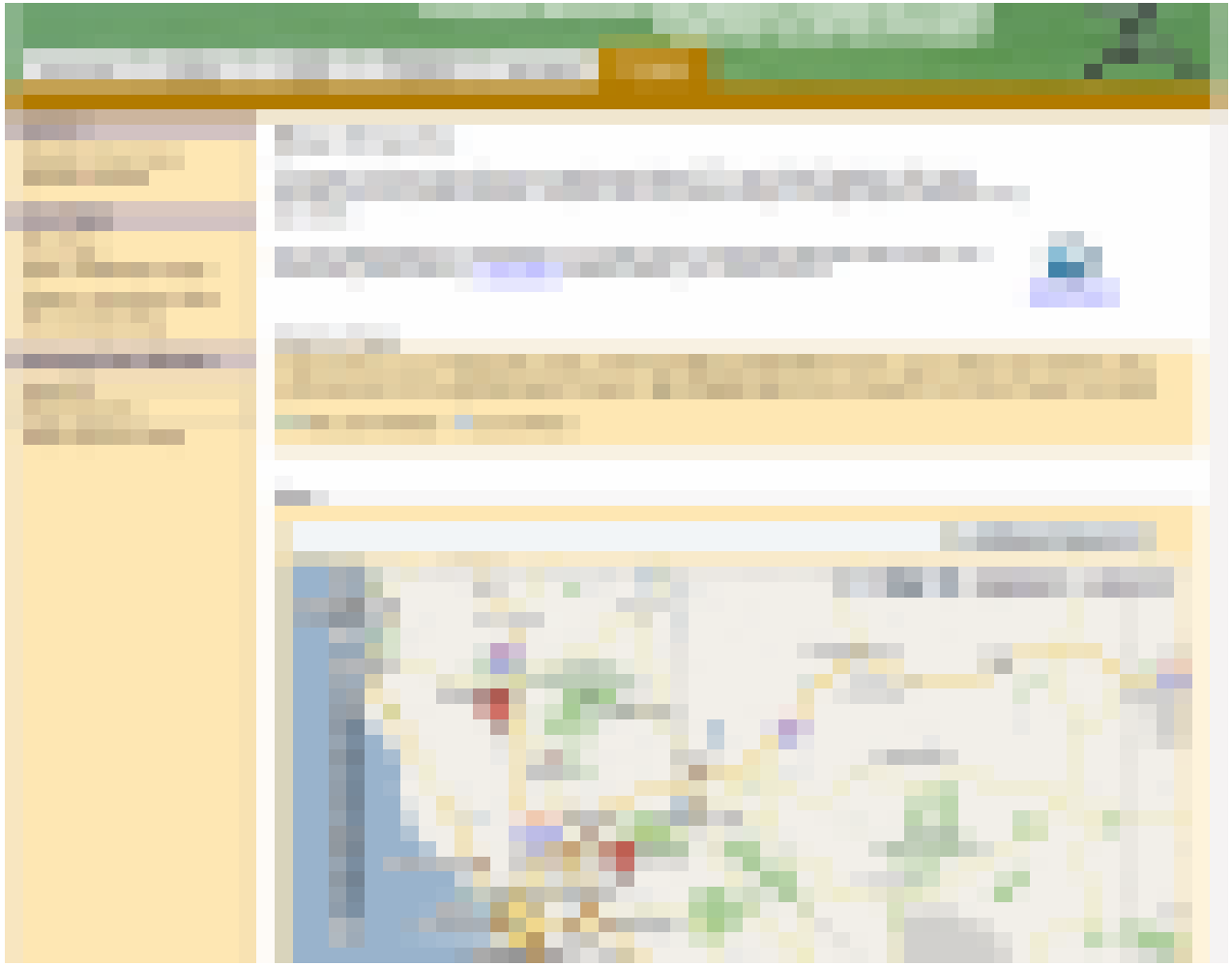
View Station Locations



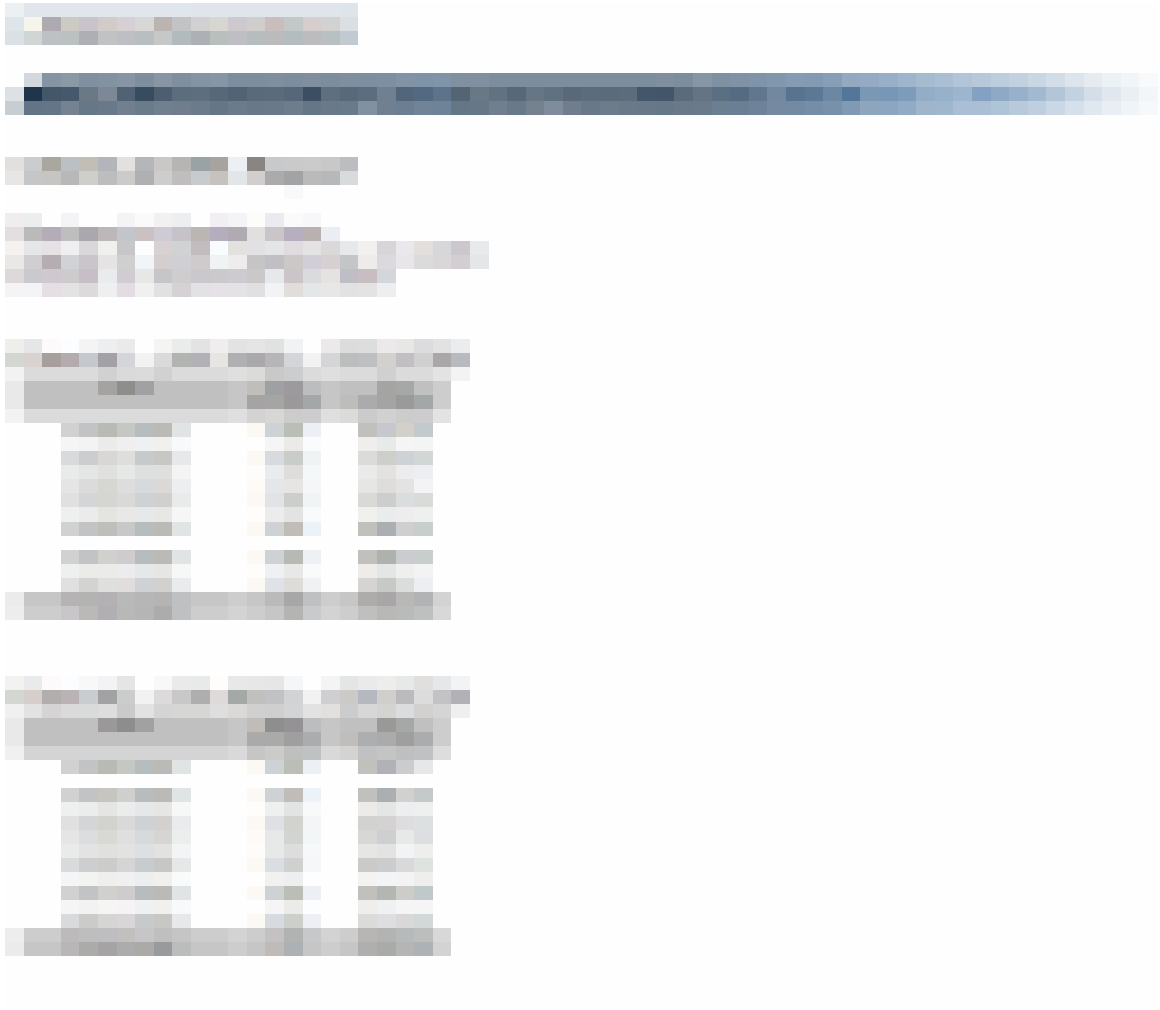
View ETo Zones Map



Map Reports



Spatial CIMIS Report.



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Questions?