Daily reference evapotranspiration for California using satellite imagery and weather station measurement interpolation

Quinn Hart [a,*] Marcela Brugnach [a,1] Bekele Temesgen [b]
Carlos Rueda [a] Susan Ustin [a] Kent Frame [b]

[a] *CalSpace, University of California, Davis, Davis, CA, USA*

[b] *California Irrigation Management Information System (CIMIS), California Department of Water Resources, Sacramento, CA, USA*

Abstract

Spatially distributed ET_0 is calculated to produce daily ET_0 maps for the State of California at high spatial resolution, $(2\,\mathrm{km})^2$. Hourly NOAA GOES visible channel imager data are used to modify modeled radiation estimates. These are combined with interpolated California Irrigation Management Information System (CIMIS) weather station meteorological data to satisfy the Penman-Monteith ET_0 equation. Data have been acquired and ET_0 estimated daily from February 2003 through April 2006.

Key words: evapotranspiration, Penman-Monteith equation, satellite imaging, remote sensing
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1 Average ET_0 values

Although the main goal of producing daily ET_0 maps is to provide support for short term irrigation strategies, examination of long term averages can provide

* Corresponding author.
Email addresses: qjhart@ucdavis.edu (Quinn Hart), mbrugnac@usf.uos.de (Marcela Brugnach), temesgen@water.ca.gov (Bekele Temesgen), carueda@ucdavis.edu (Carlos Rueda), slustin@ucdavis.edu (Susan Ustin), kframe@water.ca.gov (Kent Frame).
[1] Currently: Institute of Environmental Systems Research, University of Osnabrueck, Germany

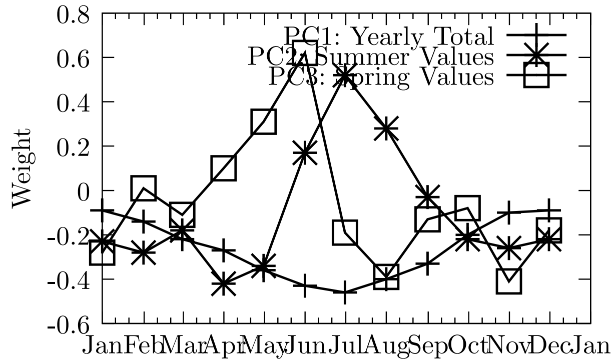

Fig. 1. Three most important principle component vectors for monthly contribution to ET_0

insight into major evapotranspiration (ET) regimes in California, and provide validation of the model when compared to similar maps. Approximately 3 years of data for each month were combined to provide 12 monthly averages of ET_0 throughout California. A Principal Components Analysis (PCA) transformation (**?**) was applied to these 12 values, and the top three components were used in an unsupervised classification of California's ET_0 zones. Figure 1 shows the contributions of the monthly ET_0 values to each PCA vector. These components can be roughly identified as picking out the total yearly amount of ET_0 for a pixel and the spring and summer contributions to the ET_0.

An unsupervised classification of 6 regions derived from these PCA vectors is shown in Figure 2. These are generally labeled with their prominent location within California. Given these regions, summary information about expected ET_0 amounts through the year can be calculated. These are shown in Table 1, which describes the average ET_0 for each region and month.

The Department of Water Resources and UC Davis, have previously developed a map of ET_0 zones in California (**?**), shown in Figure 3. This map was the result of experts delineating regions in California, based on long term weather station data. Comparison of this map to that of Figure 2 show good agreement, and provide a qualitative validation of the Geostationary Operational Environmental Satellite (GOES) and CIMIS derived map products.

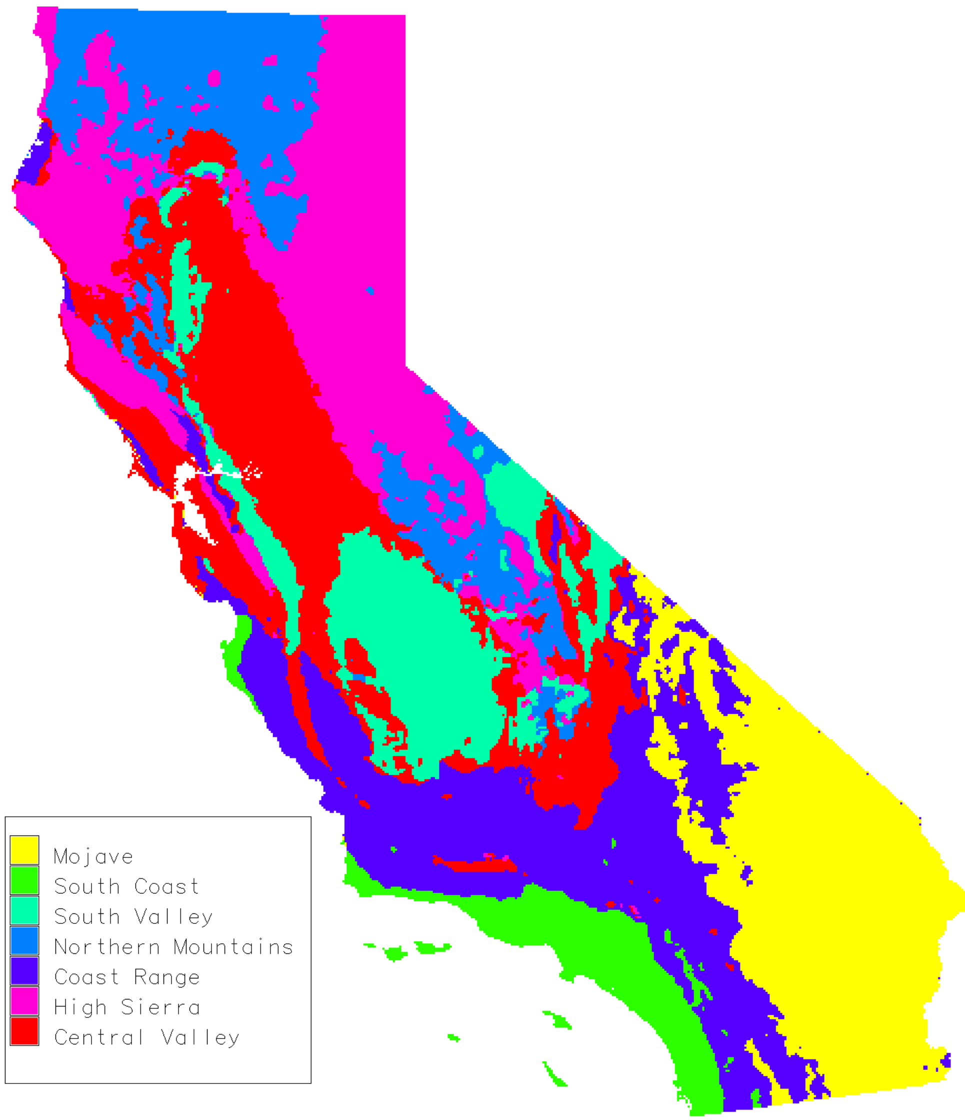

Fig. 2. Unsupervised classification ET_0 regions based on three years of data.

Table 1
Average ET_0 values for different California regions

Month	South Coast	South Valley	Northern Mountains	Mojave Desert	Coast Range	High Sierra	Central Valley
Jan	1.68	0.88	0.73	2.01	1.47	0.75	0.88
Feb	2.13	1.68	1.46	2.69	2.11	1.47	1.69
Mar	3.01	2.93	2.54	4.38	3.35	2.61	2.88
Apr	3.60	3.85	2.93	5.57	4.15	2.99	3.61
May	4.40	5.28	4.23	7.22	5.49	4.26	4.90
Jun	4.52	6.47	5.78	8.25	6.40	5.65	6.06
Jul	5.33	6.87	6.50	8.21	6.90	6.51	6.48
Aug	4.94	6.05	5.47	7.20	6.22	5.55	5.73
Sep	4.10	4.78	4.20	6.20	5.09	4.29	4.65
Oct	2.62	2.76	2.35	3.86	3.13	2.42	2.77
Nov	1.98	1.36	1.04	2.24	1.86	1.08	1.33
Dec	1.54	0.88	0.68	1.80	1.40	0.70	0.86

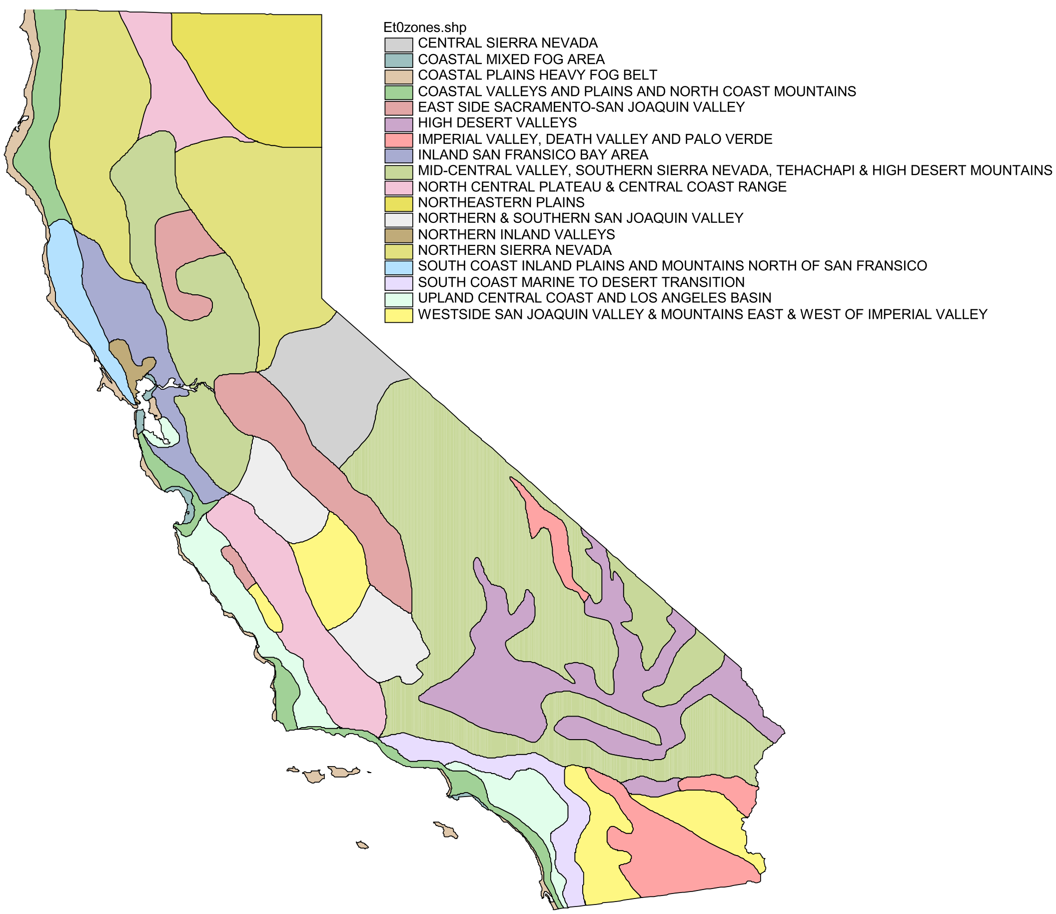

Fig. 3. Map of different ET_0 zones for California. 18 separate zones, derived from monthly ET_0 averages, delineate different regions and influences in California.