

Monitoring California drought using NOAA Green Vegetation fraction products

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Abstract

Drought is one of the costliest natural disasters in the United States. California has been experiencing a severe drought since 2012. As drought conditions develop gradually, they are often not identifiable immediately. The effect of the drought may not be fully noticed for a long period, making it difficult to accurately evaluate the impacts of the drought, and determine how to mitigate the impacts. Satellites provide a rapid and efficient method of acquiring information over a large geographical area. Green Vegetation fraction (GVF) products have been developed from the NOAA Advanced Very High Resolution Radiometer (AVHRR) data at 16-km resolution since 1981 and from the Visible Infrared Imaging Radiometer Suite (VIIRS) on board the Suomi National Polar-Orbiting Partnership (SNPP) satellite at 1-km and 4-km resolutions since 2012. The GVF data provide an opportunity to measure and analyze the effects of drought on green vegetation over California since 2012. Both AVHRR and VIIRS GVF data sets showed GVF decreasing since 2012. The mean VIIRS GVF over California in August decreased from 0.323 in 2012 to 0.277 in 2015. GVF over forest areas have decreased by 0.1-0.2 since 2012. GVF over agricultural areas showed relatively less change after 2012, maybe due to irrigation.

Data and method

Two NOAA GVF data sets are used in this study.

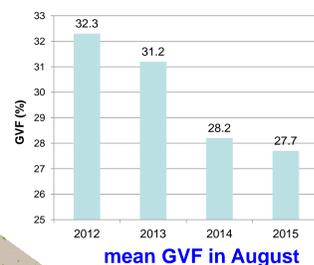
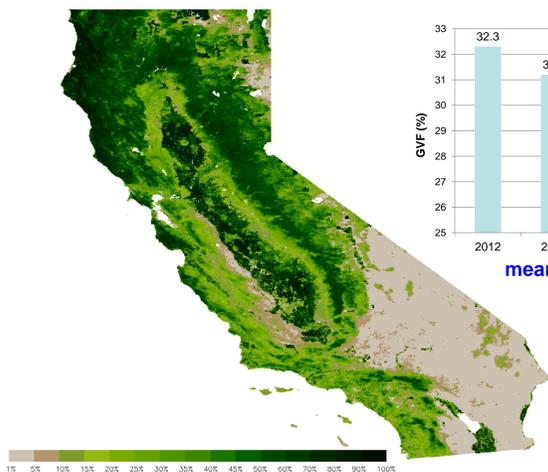
- (1) Weekly 16-km global AVHRR GVF since August 1981
- (2) Daily rolling weekly 1-km regional VIIRS GVF since August 2012

- AVHRR and VIIRS GVF maps over California are produced
- GVF difference between years are calculated to show the GVF variations due to drought
- Weekly mean GVF between 1982 and 2011 (30 years) are calculated using AVHRR GVF data
- GVF deviation from the 30-year mean AVHRR GVF is calculated to show the GVF anomaly during drought years
- Time series of AVHRR GVF are extracted at PhenoCan sites (<http://phenocam.sr.unh.edu/>) in California

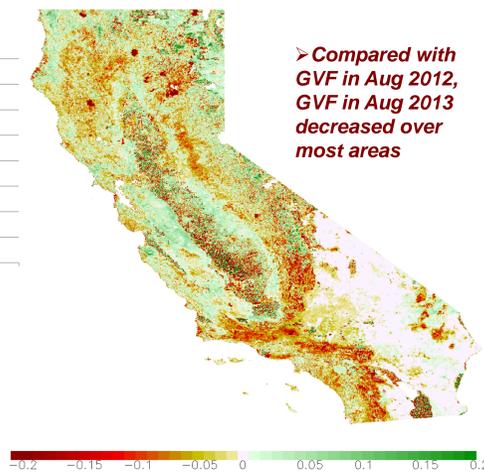


Google map of the study area

Results A. 1-km VIIRS GVF

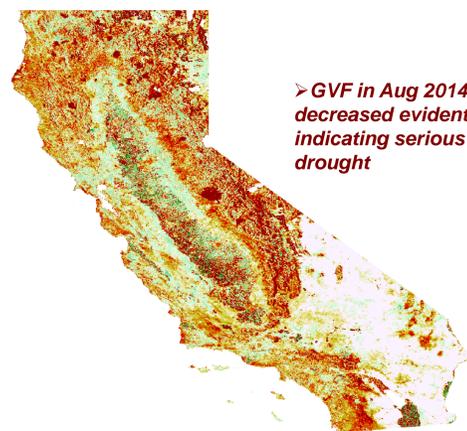


mean GVF in August



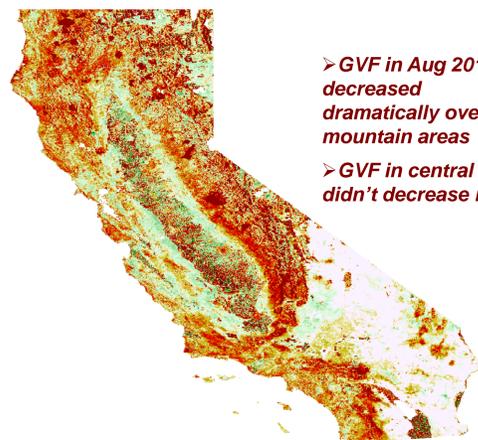
➢ Compared with GVF in Aug 2012, GVF in Aug 2013 decreased over most areas

GVF difference in August (2013-2012)



➢ GVF in Aug 2014 decreased evidently, indicating serious drought

GVF difference in August (2014-2012)



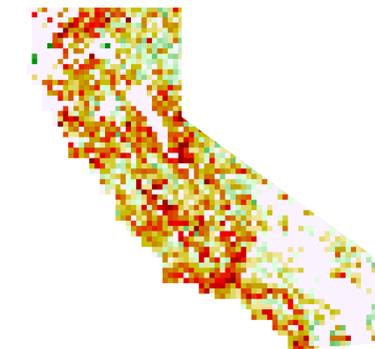
➢ GVF in Aug 2015 decreased dramatically over mountain areas
➢ GVF in central valley didn't decrease much

GVF difference in August (2015-2012)

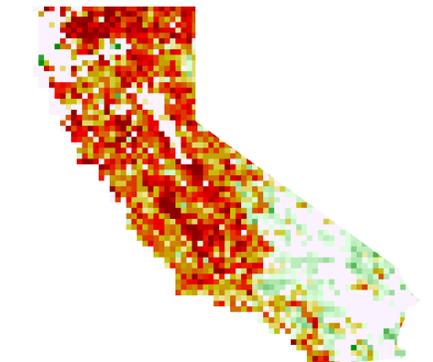
B. 16-km AVHRR GVF



AVHRR GVF in August 2012 in California

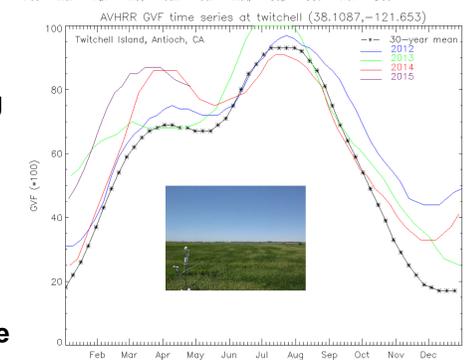
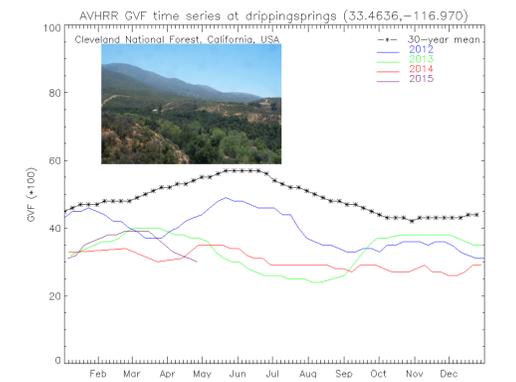
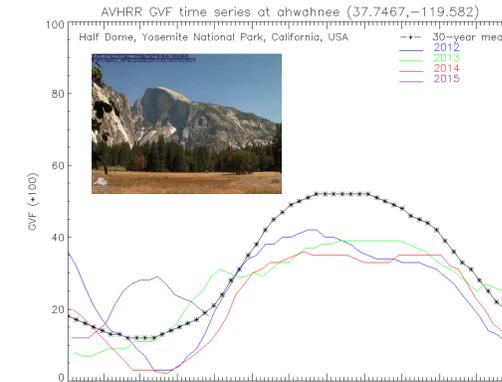
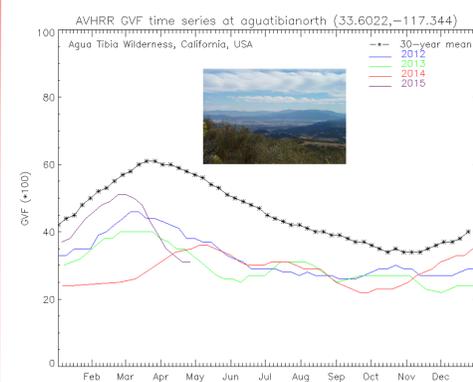
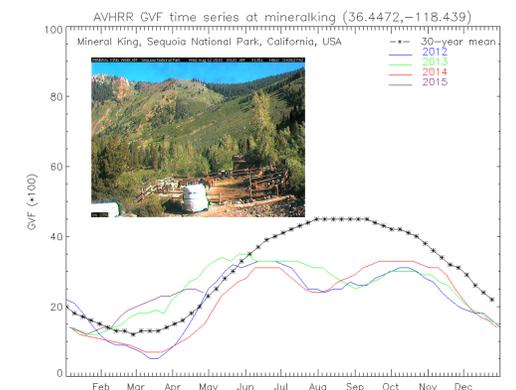
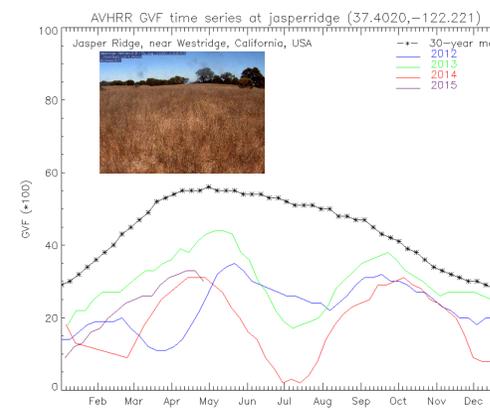
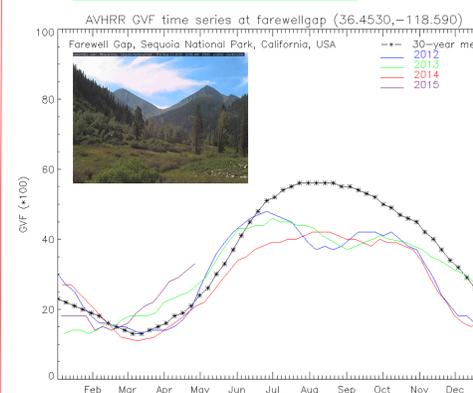


AVHRR GVF difference in August (2013-2012)



AVHRR GVF difference in August (2014-2012)

AVHRR GVF time series



GVF at this agricultural site didn't decrease during drought years 2012-2015, probably due to irrigation.

Conclusions:

- 1) Both AVHRR and VIIRS GVF products showed GVF decreased evidently during drought years 2012-2015
- 2) Drought in California started in 2012 and has been deteriorating until now
- 3) GVF in the mountain areas decreased by 0.1-0.2 since 2012
- 4) VIIRS GVF in central valley showed less decrease, probably due to irrigation
- 5) 1-km VIIRS GVF provided more detailed GVF variation and showed different patterns over forest (mountain) and agriculture (central valley) areas, whereas the AVHRR GVF didn't show the difference
- 6) AVHRR GVF decreased evidently during 2012-2015 compared with the 30-year mean GVF, except for some agricultural areas
- 7) Long-term monitoring is needed to track the drought effects on green vegetation