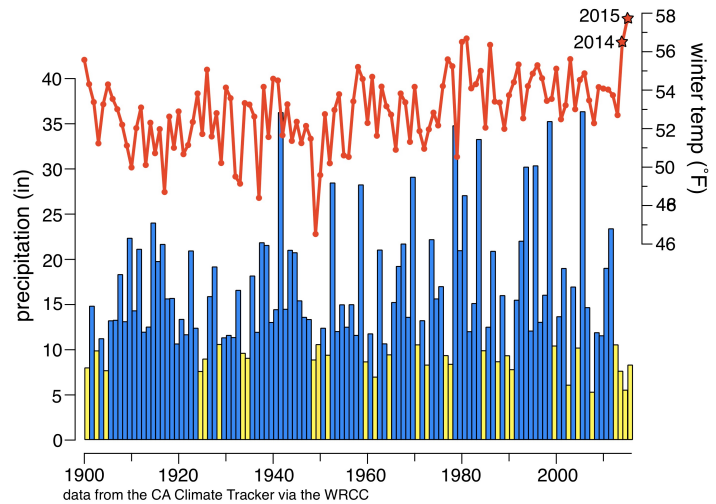


DROUGHT IN SOUTHERN CALIFORNIA

Four Years of Drought

California is in its fourth consecutive year of drought. The blue and yellow bars in the graph on the right show the total precipitation in the South Coast Region during each water year (October to September) since 1900. The yellow bars indicate the 30 driest years in the record, and the only time that four such years occurred in a row is from 2012-2015. Since 2013, rainfall accumulation in the South Coast region has been 21.5 inches, which is 30 inches less than the average accumulation for a three year period, and Southern California was already experiencing a deficit as we entered the 2013 water year.



The red line on the top shows the average winter (December, January and February) temperature for the region. The two warmest winters on record were 2014 and 2015. These record temperatures exacerbate the drought by increasing evaporation from soils and vegetation, thereby increasing irrigation demands. Drier and warmer conditions prolong and exacerbate seasonal wild fire risks. In mountain catchments, the warm temperatures also led to more precipitation falling as rain instead of snow, yielding by far the lowest snowpack amounts ever recorded, which directly impact Southern California's water supply (see back).

Year-to-Year Variability & Large Storms

California has a uniquely variable historic range of precipitation, and Southern California has the most variability of all (Dettinger et al. 2011). California's year-to-year variability derives primarily from the vagaries of its largest storms. In Southern California about 90% of year-to-year precipitation variability comes from year-to-year fluctuations in its wettest handfuls of days. This means that wet and dry years in California are opposite sides of the same coin. Drought in California occurs during years missing a few large storms and wet years occur when there are extra large storms (Dettinger and Cayan, 2014).

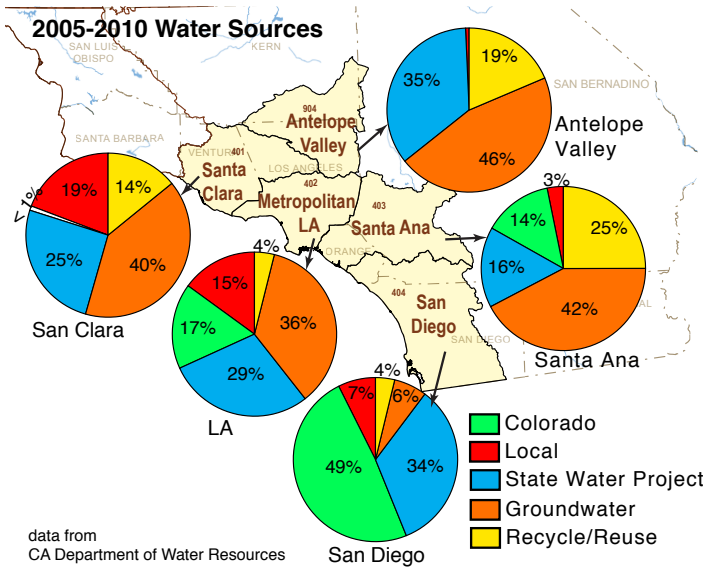
Is it Climate Change?

The persistent dryness and the unusual warmth during the current drought raise the question of whether climate change is playing a role. The recent lack of precipitation remains difficult to attribute directly to climate change. However, tree ring-reconstructions of precipitation and soil moisture in California going back 1200 years have indicated that the severity of the ongoing drought is highly unusual if temperature is also taken into account (Griffin and Anchukaitis, 2014). The study shows that California has experienced over 60 droughts lasting between 3-9 years in the last 1200 years, but the current drought, from 2012-2015, has been the most extreme when the high temperatures in Southern and Central California are factored in. Future projections of precipitation in California are uncertain, but all climate models predict significant warming in the next century. As in the current drought, warmer temperatures make the effects of drought more severe. Thus, although it is hard to distinguish climate change from natural climate variability, the current drought is an analogue of the kind of drought that we expect to become more common and even more severe in the future.

The **CA State Climatologist** is supported by California Department of Water Resources to collaborate with NOAA programs to provide climate information and interpretation for CA. **CNAP**, the California Nevada Applications Program, is a NOAA RISA team conducting applied climate research that is inspired by and useful to decision makers in the region. **NIDIS**, National Integrated Drought Information System, works with federal, state, tribal and local partners to improve drought early warning, preparedness and response to impacts. The **Climate Science Alliance**, South Coast, is a partnership of organizations and agencies working to safeguard the region from climate risks using ecosystem-based approaches.

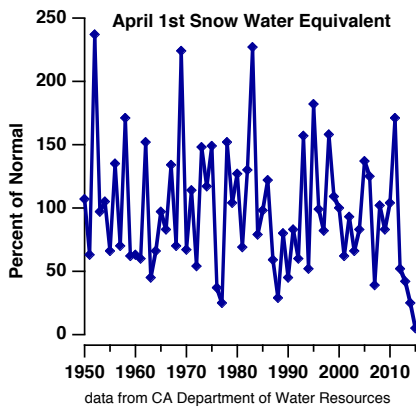
Griffin and Anchukaitis., 2014, Geophys. Res. Lett., 41(24).
Dettinger, M. D., et al., 2011, Water, 3, 455-478.
Dettinger, M.D. and Cayan, D.R., 2014, San Francisco Estuary and Watershed Science, 12(2).

Southern California's Water Supply



Southern California receives its water from a variety of sources, the most important of which are several hundreds of miles away. The figure above shows average percentages of water that came from various sources in 2005-2010. The different regions marked in light yellow shading correspond to planning areas denoted by California's Department of Water Resources.

The State Water Project is a system of reservoirs, dams and aqueducts—operated by the state—that brings water from Northern California to Southern California. This year, 2015, the State Water Project will only be able to deliver 20% of its contracted supply. Deliveries from the State Water Project remain low not only due to the reduced rainfall but also because of record low

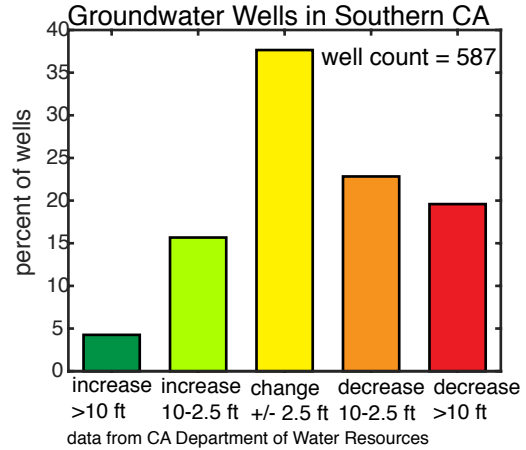


snowpack in the Sierra Nevada. The blue line in the figure to the left shows the amount of water estimated to be in California's April 1st snow pack as a fraction of the average amount that has been present in past

decades. The snowpack in 2015 has been the lowest on record due to modest (but not lowest) precipitation totals and the high winter temperatures.

Groundwater is another important water source in Southern California. The duration and severity of the current drought has led many utilities, homeowners and especially irrigators to increase their pumping from groundwater sources as surface water supplies have declined. The

figure below shows the percentages of wells in Southern California that experienced various levels of water-level change between fall 2013 and fall 2014. Water levels in over 40% of the wells in Southern California have declined by more than 2.5 feet, in response to increasing stresses on groundwater sources in the region.



The Colorado River supplies many parts of Southern California with water. Last year, precipitation in the Colorado River Basin was above normal (108%); however, as of April 1st, 2015, precipitation it has returned to subpar levels (only 62% of normal for this time of year). The two biggest reservoirs in the basin, Lake Powell and Lake Mead, are currently at 45% and 38% of capacity, respectively. Next year, 2016, may be the first year that there is a shortfall in the Lower Colorado, meaning that water in the reservoirs may not meet the demands placed on them. Nonetheless, under current arrangements, California will receive all of its allocated of water from the Colorado in 2016.

Southern California has built an increasingly diverse water supply as water agencies have worked consistently to make their supplies more resilient by spreading their risks among many different sources. Thus in addition to distant surface water supplies and groundwater sources, water sources for Southern California also include local reservoirs, lakes and streams and recycled/reused water. Recycle/reused water is often used for irrigation and some water utilities are using it to help refill groundwater. However, the severity and duration of the drought, together with remarkably warm temperatures, are challenging the region's and state's water supplies in unprecedented ways.

For more information on CA drought and water conservation: DWR Bulletin 120, CA Water Action Plan, CNAP (<http://cnap.ucsd.edu>), NIDIS (www.drought.gov), Metropolitan Water District (www.mwdh2o.com) and <http://saveourwater.com>