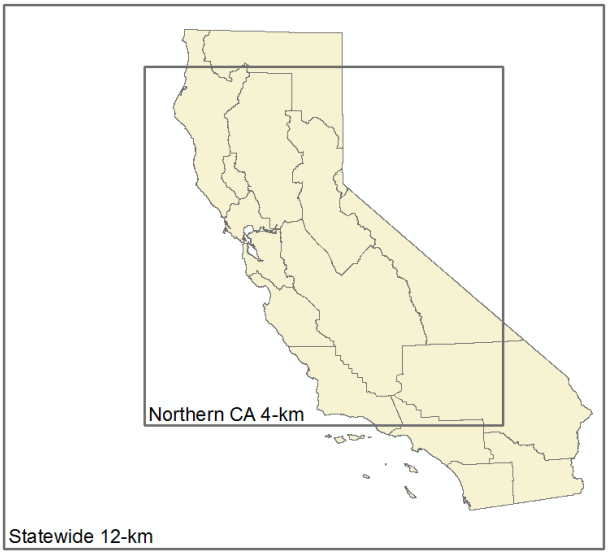
Modeling 8-Hour Ozone for the SJV's 2016 State Implementation Plan for the 75 ppb 8-Hour Ozone Standard

WHAT TOOLS DID WE USE?

The modeling tools utilized in the SJV attainment demonstration modeling are all state-of-the-science and U.S. EPA approved for use in SIP modeling.

- **Emissions**: The U.S. EPA's emissions processing tool (SMOKE) was used to process annual county level emissions; ARB's EMFAC model was used to develop the mobile emissions inventory; the MEGAN biogenic emissions model was used to estimate emissions from natural plant sources.
- **Meteorology**: The Weather Research and Forecasting (WRF) model was used to simulate the meteorological fields used in the air quality modeling.
- **Air Quality**: The U.S. EPA's Community Multi-scale Air Quality (CMAQ) model was used to simulate the baseline period and future year ozone.
- **Chemistry**: Atmospheric chemistry was modeled within CMAQ using the SAPRC07 chemical mechanism.
- **Background Conditions**: Boundary (or background) conditions outside of the modeling domain were defined using MOZART-4 global chemistry model output from the National Center for Atmospheric Research.

WHAT AREA DID WE MODEL?



Modeling was conducted for the entire state at a 12-km x 12-km resolution and for northern California and the San Joaquin Valley (SJV) at a higher 4-km x 4-km resolution (see Figure at left). It was necessary to simulate a larger region than just the San Joaquin Valley to more accurately define the background conditions and to minimize the influence of boundary effects on the modeling.

WHAT YEARS DID WE MODEL?

- 2012 – baseline period
- 2031 – attainment deadline

HOW DID WE PROJECT FUTURE AIR QUALITY?

Based on U.S. EPA modeling guidance, modeling was used in a relative sense to project observed Design Values (DVs) to the future. DVs are the three-year average of the annual 4th highest 8-hour O_3 concentration observed at each monitor and are used to determine compliance with the standard. The U.S. EPA recommends using an average of three DVs to account for the effects of variability in the meteorology, so DVs were calculated for the three year period ending in 2012, 2013, and 2014 and then the three DVs were averaged. This average DV is called a weighted DV.

In order to use the modeling in a relative sense, three simulations were conducted: 1) base year simulation for 2012, which was used to verify that the model reasonably reproduces observed air quality; 2) reference year simulation for 2012, which was the same as the base year simulation, but excluded exceptional event emissions such as wildfires; 3) future year simulation for 2031, which was the same as the reference year simulation, except projected emissions for 2031 were used in lieu of the 2012 emissions.

The reference and future year modeling was used to determine the relative change in ozone from 2012 to 2031 at each monitor, by calculating the ratio of the modeled future year ozone to reference year ozone at the monitor. This ratio is called a Relative Response Factor (or RRF). To predict the future year DVs, the site-specific RRF was multiplied by the weighted DV for the corresponding monitor. Weighted DVs for sites within the SJV are shown in the second column of Table 2.

HOW WELL HAS RECENT MODELING DONE IN PREDICTING AIR QUALITY?

The RRF approach was first used in the SJV for the 2007 8-hour Ozone SIP and later in the 2013 1-hour Ozone SIP. In both cases, the RRF approach has appropriately characterized emission targets for attainment. In the 2007 SIP, attainment was projected to occur in 2023 and all sites are currently on target for attainment of the 84 ppb standard, with most sites already having attained. In the 2013 SIP, attainment of the 124 ppb standard was projected by 2017 and the Valley has already achieved attainment. In addition, two peer-reviewed scientific publications focused primarily on the eastern U.S. (one from researchers at Rice University and one from U.S. EPA scientists), both found that the RRF approach is very robust in its ability to predict future DVs.

WHAT ARE EMISSIONS IN 2012 AND 2031?

Table 1. Summer emission inventory totals (CEPAM v1.03) for 2012 and 2031. Biogenic emission totals are averaged over May – September, 2012.

Source	NOx			ROG		
	2012 [tpd]	2031 [tpd]	Percent Difference	2012 [tpd]	2031 [tpd]	Percent Difference
Stationary	43	30	-31	85	100	+17
Area	5	5	+4	147	153	+4
On-road Mobile	188	45	-76	61	18	-70
Off-road Mobile	106	51	-52	45	25	-44
Total	341	130	-62	338	296	-12
Biogenic	--		--	1323		--

WHAT ARE THE PROJECTED 2031 DESIGN VALUES?

Projected DVs for 2031, to show attainment of the 75 ppb standard, are shown in the last column of Table 2.

WHAT ADDITIONAL SCIENTIFIC STUDIES SUPPORT THE MODELING RESULTS?

Recent peer-reviewed, published studies conducted by UC Berkeley researchers conclude that on-going NO_x controls have successfully transitioned the southern and central portions of the SJV into a NO_x-limited chemistry regime where NO_x emission reductions will become increasingly effective at reducing ozone, while the northern portion of the SJV is currently transitioning to the same chemical regime. These findings are supported by observed changes in the weekend-effect, where ozone on weekends is now generally lower than ozone on weekdays (in contrast to higher weekend ozone in the past), which is consistent with the NO_x-limited chemical regime.

Table 2. Base year Design Value, modeled RRF, and projected future year Design Value by site.

Site Name	Weighted Design Value [ppb]	RRF	Future Year (2031) Design Value [ppb]
Clovis	95.7	0.7729	74
SequoKingCan	93.0	0.7038	65
Fresno-Drmnd	92.3	0.7713	71
Parlier	92.0	0.7513	69
Fresno-Grld	90.7	0.7813	70
Arvin	89.3	0.7242	64
Fresno-Sky2	89.0	0.7685	68
Edison	87.7	0.7398	64
Baker-5558Ca	86.7	0.7573	65
Portrvlle-Ne	86.3	0.7328	63
Hanford-Irwn	86.0	0.7538	64
Turlock-SMin	86.0	0.8020	69
Oildale-3311	84.7	0.7773	65
Madera-Av14	84.7	0.7746	65
Seq_NP-Kawea	84.0	0.7302	61
Maricopa-Stn	83.3	0.7562	63
Shafter-Wlkr	83.0	0.7557	62
Visalia-NChu	82.3	0.7392	60
Merced-SCofe	81.7	0.8009	65
Madera-Rd29	79.3	0.7790	61
Tracy_Air	79.3	0.8429	66
Tranquility	76.3	0.7937	60
Modesto-14th	76.0	0.8102	61
Stockton-Haz	68.3	0.8446	57