

## **An evaluation of transport of pollutants from the Bay Area**

The airborne transport of pollutants is of continuing interest because it affects every region and air basin. This SIP modeling effort is focused on attainment planning for the San Francisco Bay Area, but will provide some information on transport patterns during the selected ozone episodes. This section considers transport of pollutants from the Bay Area to selected sites in the Central Valley and Monterey area for four candidate episode periods (June 11-12, 1999, June 15 and July 31, 2000 and July 9-10, 2002).

Pollutant transport potential between two areas can be assessed by back trajectory analysis, where simulated particles are released at specified times and locations and are transported by winds back in time. The path that the particle takes defines the back trajectory and defines a transport connection between any two points on the back trajectory. For this analysis back trajectories were computed on a NOAA Air Resources Laboratory web site using the HYSPLIT software. However, we must recognize the limitations of this analysis. The back trajectories computed by HYSPLIT used meteorological data with a 80 km grid spacing, which does not resolve wind variations due to narrow mountains, valleys, and gaps in and around the Coastal Ranges. Hence, we have more confidence in the accuracy of these back trajectories in the Central Valley where the terrain is relatively smooth than in the San Francisco Bay and Monterey areas where the terrain is more rugged. The back trajectories in this report were selected as follows:

1. For each of the four candidate episodes, we expanded the date range by 2 days before and 2 days after the episode period. The SIP modeling work is likely to include these additional dates, and thus, we may be able to broaden the analysis of transport.
2. For each expanded episode days, we identified all stations in the Central Valley and Monterey area with ozone exceedances. There were no ozone exceedances in the Monterey area in any of the episode periods. The highest ozone in the Monterey area was 115 ppm observed at Pinnacles at 17 PST on July 10, 2002. The back trajectory from this Pinnacles observation station is included.
3. For each of these stations, we identified the hour of maximum ozone. These station locations and times defined the initial points for each back trajectory.
4. For all these initial points, 24- and 48-hour back trajectories were computed.

Figures 1-4 show the composites of all 24-hour back trajectories for each of the four candidate episodes and these are discussed for each episode below.

### **Transport for the July 11-12, 1999 episode**

Figure 1 shows 17 back trajectories for the 1999 episode. The Sacramento area has definite Bay Area transport connections. Eight of the back trajectories from the Sacramento area passed through the North Bay Area. As noted earlier, the 80 km resolution wind data may not sufficiently resolve the detailed wind variations generated by important topographic features, such as the Carquinez Strait, an ostensible transport

corridor. In reality, such features may cause the true back trajectories to be located south of those indicated in Figure 1, putting them over the densely populated North Bay Area. Three additional back trajectories started just north of Sacramento did not reach the Bay Area within 24 hours. Two of these eventually traversed the North Bay Area 24- to 48-hours earlier. The influence of any Bay Area emissions on the Sacramento area will be diluted significantly after traverse times greater than 24 hours.

The six San Joaquin Valley 24-hour back trajectories all had a NW to SE orientation. One back trajectory from the Modesto area traversed the Bay Area. The other Modesto area back trajectory and the two Fresno back trajectories traversed the Stockton area 24-hours earlier and traversed the Bay Area 24- to 48-hours earlier. The back trajectory from Bakersfield and one from near the Sequoia National Park did not show any Bay Area connections.

### **Transport for the June 15, 2000 episode**

Figure 2 shows six back trajectories for the June 15, 2000 episode. All back trajectories ended in the Sierra. There were no Bay Area connections even up to 48 hours.

### **Transport for the July 31, 2000 episode**

Figure 3 shows five back trajectories for the July 31, 2000 episode. The Fresno back trajectory traversed the Bay Area. The two 24-hour Bakersfield back trajectories did not traverse the Bay Area but the 48-hour back trajectories did. The two back trajectories from the Sacramento area traversed the North Bay Area.

### **Transport for the July 9-10, 2002 episode**

Figure 4 shows 19 back trajectories for the July 9-10, 2002 episode. Three of the four Sacramento area back trajectories traversed the North Bay Area. The fourth one had no Bay Area connection. The three back trajectories from Merced County had clear Bay Area connections, with two passing through the central Bay Area and the other passing through the North Bay Area. Of the eight back trajectories from Fresno, only one traversed the Bay Area within 24 hours, and two others traversed the North Bay Area within 48-hours. The three back trajectories from Bakersfield passed over Fresno within 24 hours and two of these reached the central Bay Area within 48-hours. The back trajectory from the Pinnacles meandered through the Santa Clara Valley and East Bay Area before reaching the North Bay Area 24 hours later.

### **Summary**

The potential for transport of pollutants from the Bay Area to the Central Valley and Monterey areas for four candidate Bay Area SIP episodes were assessed using the HYSPLIT back trajectory analysis. The results are summarized in Table 1. More than 50% of the Sacramento Valley 24-hour back trajectories pass through the Bay Area. For San Joaquin Valley, this ratio is less than 25%. This is understandable because most high

ozone days occur during stagnant or weak wind conditions. Hence, pollutants from the Bay Area will not be able to reach Fresno or Bakersfield within 24 hours. If the back trajectory computation is extended to 48 hours, this ratio increases to 65% in the Sacramento Valley and to 55% in the San Joaquin Valley. The one back trajectory computed for the Monterey area does show a clear Bay Area transport connection.

We rank these episodes for suitability of use in transport analyses as follows:

1. The July 11-12, 1999 episode.
2. The July 31, 2000 or the July 9-10, 2002 episodes. The July 9-10, 2002 episode includes the only Pinnacles high ozone case.
3. The June 15, 2000 episode. No back trajectories in this episode showed any transport connection from the Bay Area to the Central Valley or the Monterey area.

Episode	Sacramento Valley		San Joaquin Valley		Monterey Area	
	24-hour	48-hour	24-hour	48-hour	24-hour	48-hour
7/11-12/99	7/10	9/10	2/7	5/7	0/0	0/0
6/15/00	0/1	0/1	0/5	0/5	0/0	0/0
7/31/00	2/2	2/2	1/3	3/3	0/0	0/0
7/9-10/02	3/4	3/4	4/14	8/14	1/1	1/1
Total	9/17	11/17	7/29	16/29	1/1	1/1

Table 1. The ratios of the number of back trajectories passing through the Bay Area to the total number computed. The 24- and 48-hour columns indicate the ratios for the 24- and 48-hour back trajectories, respectively. Sacramento Valley includes Stockton area. San Joaquin Valley includes Merced County area.

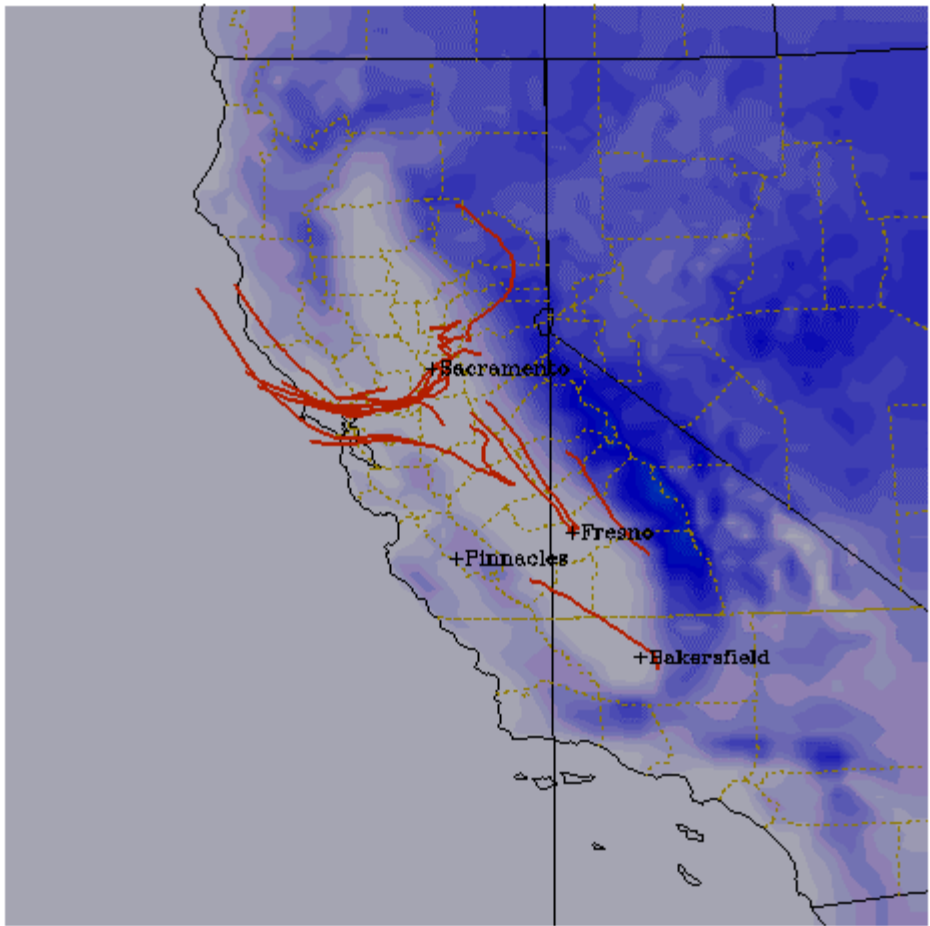


Figure 1. The 24-hour back trajectories for the July 11-12, 1999 episode.

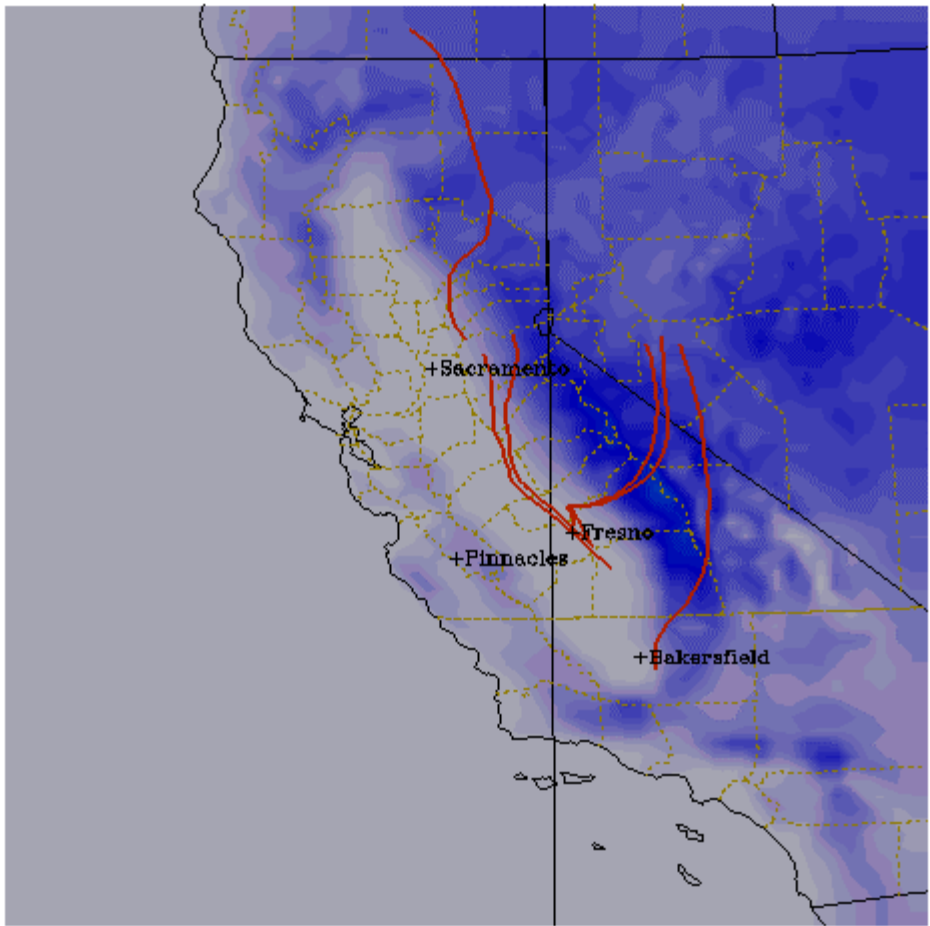


Figure 2. The 24-hour back trajectories for the June 16, 2000 episode.

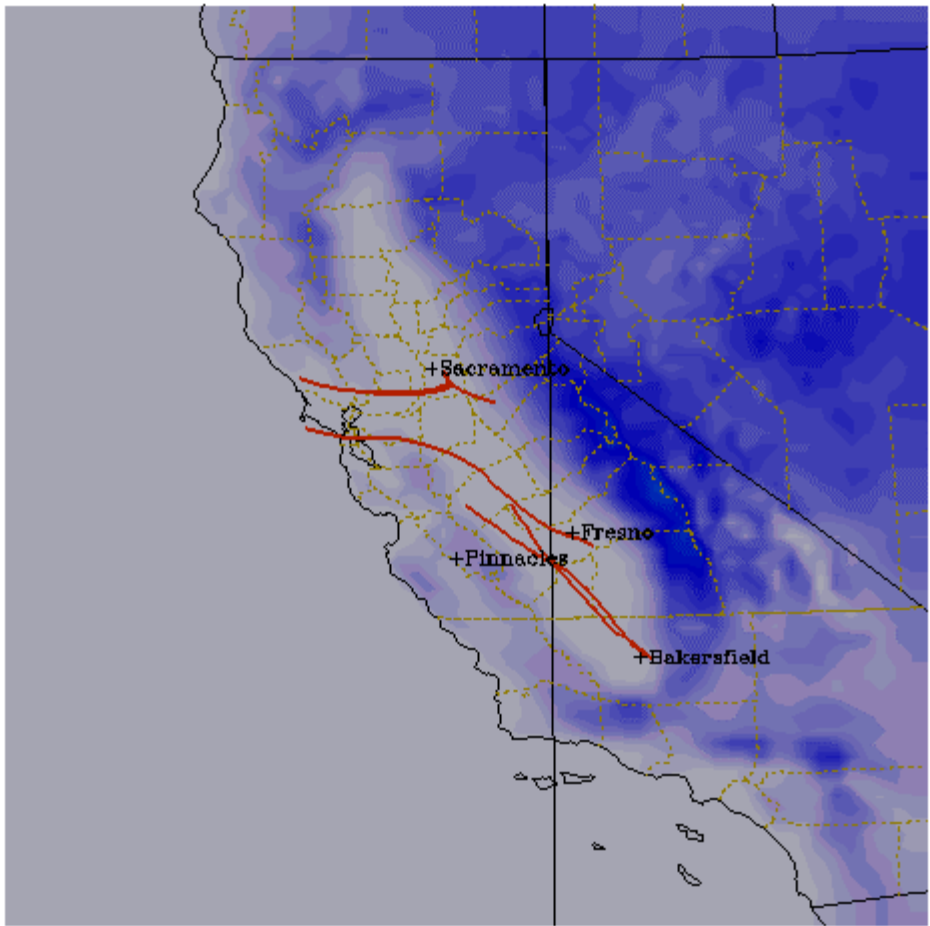


Figure 3. The 24-hour back trajectories for the July 31, 2000 episode.

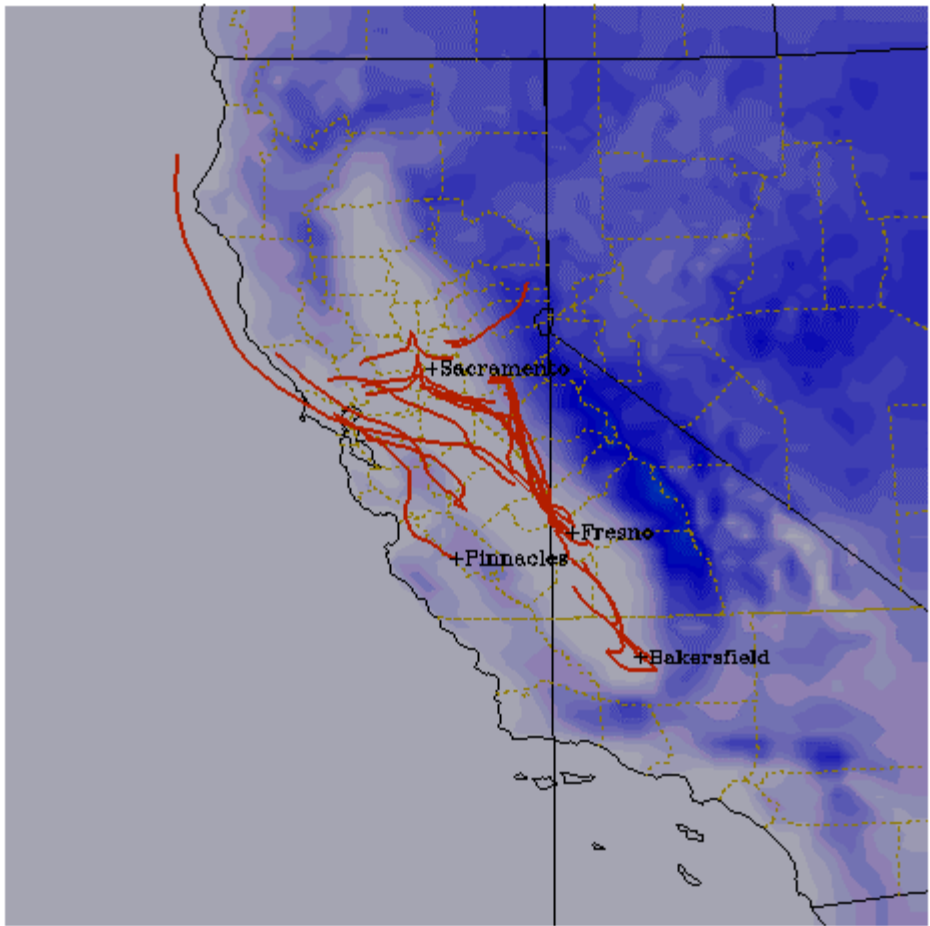


Figure 4. The 24-hour back trajectories for the July 9-10, 2002 episode.