Did long-range transport contribute to high ozone in Sequoia National Park during CABOTS?

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UNITED STATES DEPARTMENT OF COMMERCE

Where the Smog Ends Up: The Giant Sequoia Forest

The air in the Sierra Nevadas is getting cleaner—but the smog tide still rises every summer day.

By **Jeff Wheelwright**, for National Geographic

PUBLISHED SEPTEMBER 12, 2014

The Sierra Nevada Mountains rise above the Kaweah River in the San Joaquin Valley, an industrial-agricultural basin in California.

PHOTOGRAPH BY PURESTOCK/ALAMY

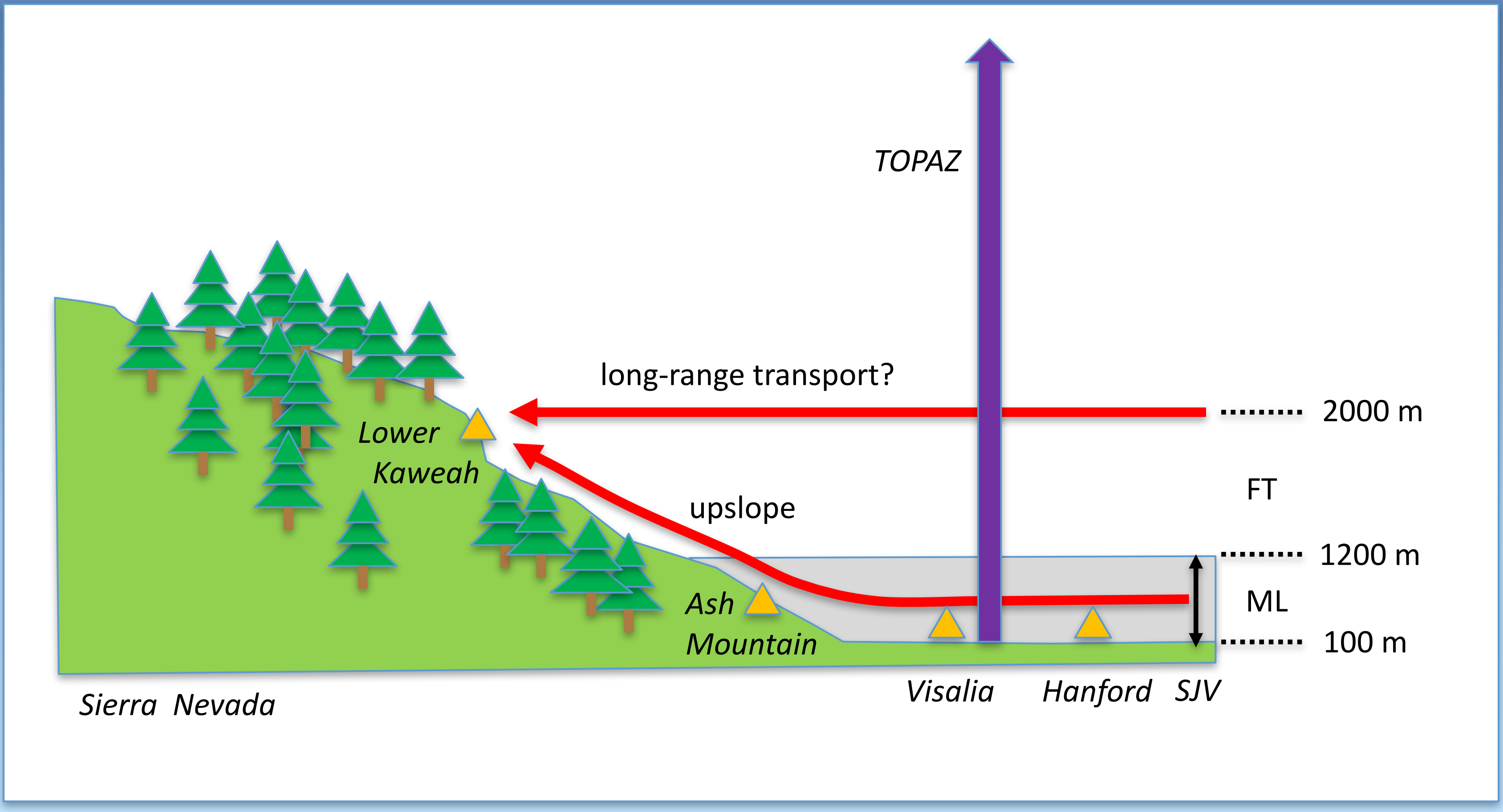
Exceedances of the ozone NAAQS* in Sequoia NP during 2016

- **59 exceedance days at Ash Mountain (515 m asl)**
  - **9** during IOP1 (5/29 - 6/18)
  - **13** during IOP2 (7/18 - 8/7)

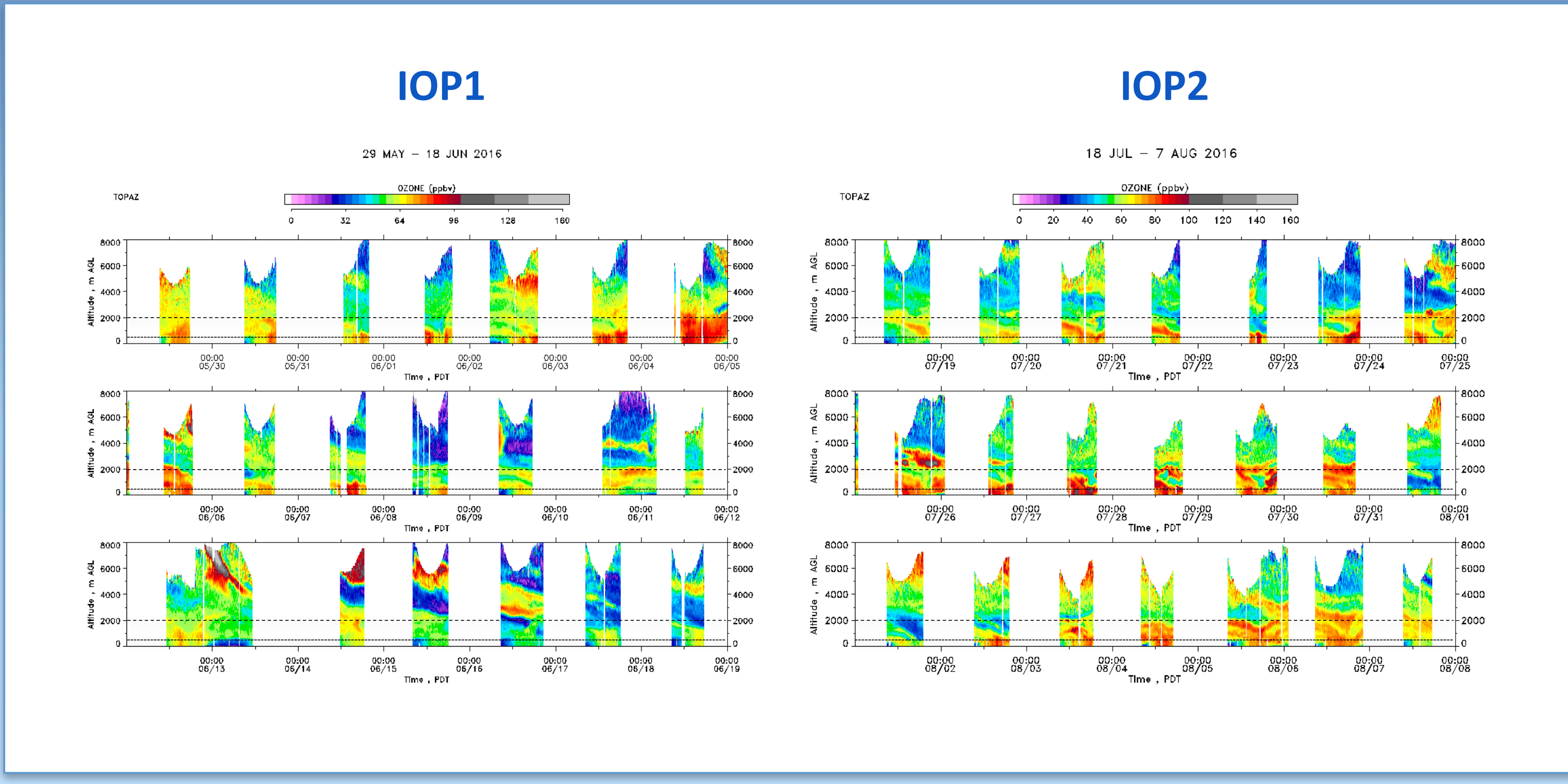
- **42 exceedance days at Lower Kaweah (1926 m asl)**
  - **4** during IOP1 (5/29 - 6/18)
  - **16** during IOP2 (7/18 - 8/7)

***National Ambient Air Quality Standard, set to 75 ppbv for the maximum daily 8-h average (MDA8) set in 2008**

Where does this ozone come from?

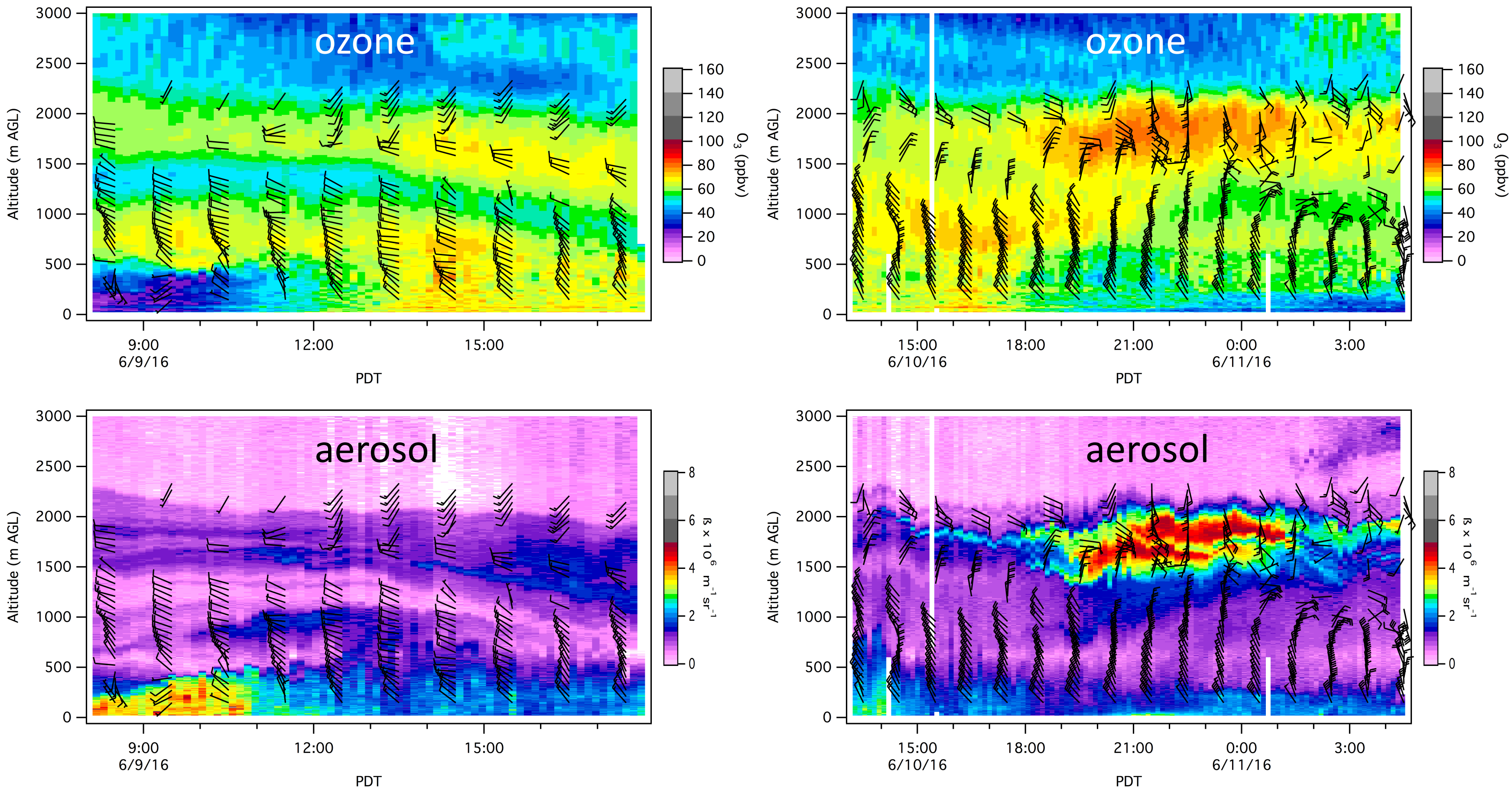


Elevated ozone layers were frequently observed above South-Central SJV during CABOTS

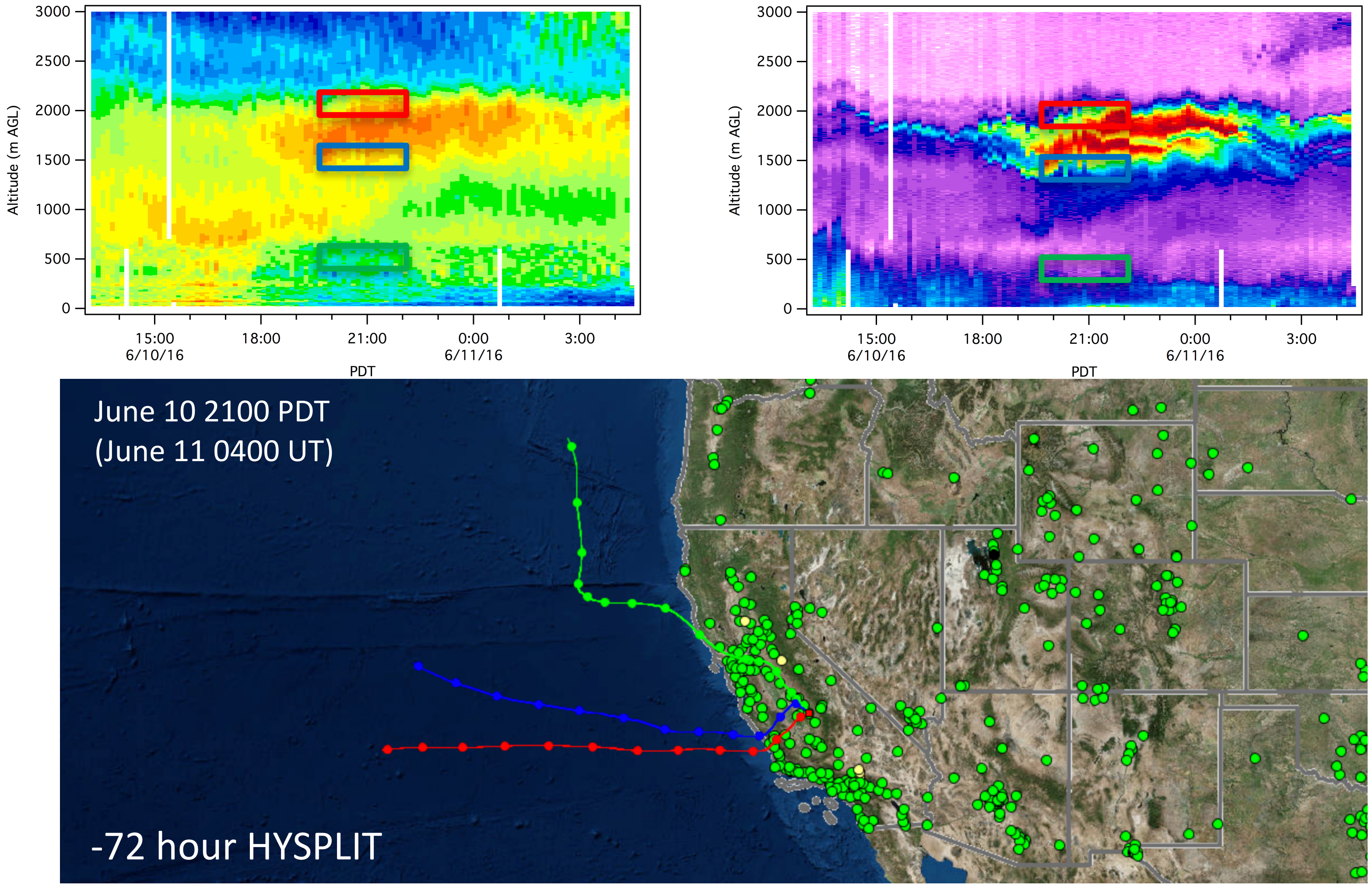


Example: ozone transport event June 9-10, 2016

TOPAZ ozone and aerosol with SJVAPCD Visalia radar wind profiler

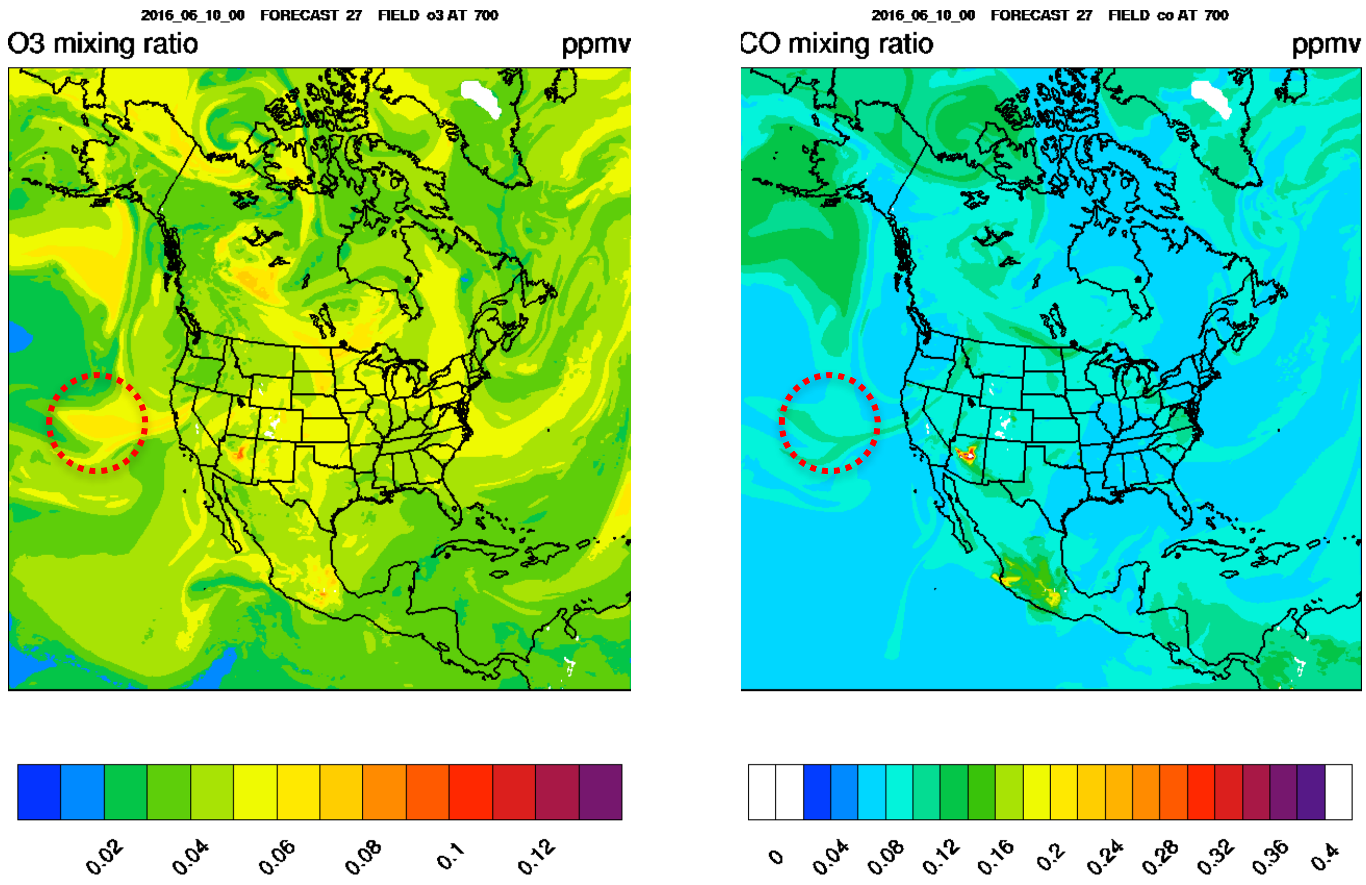


Example: ozone transport event June 9-10, 2016



Example: ozone transport event June 9-10, 2016

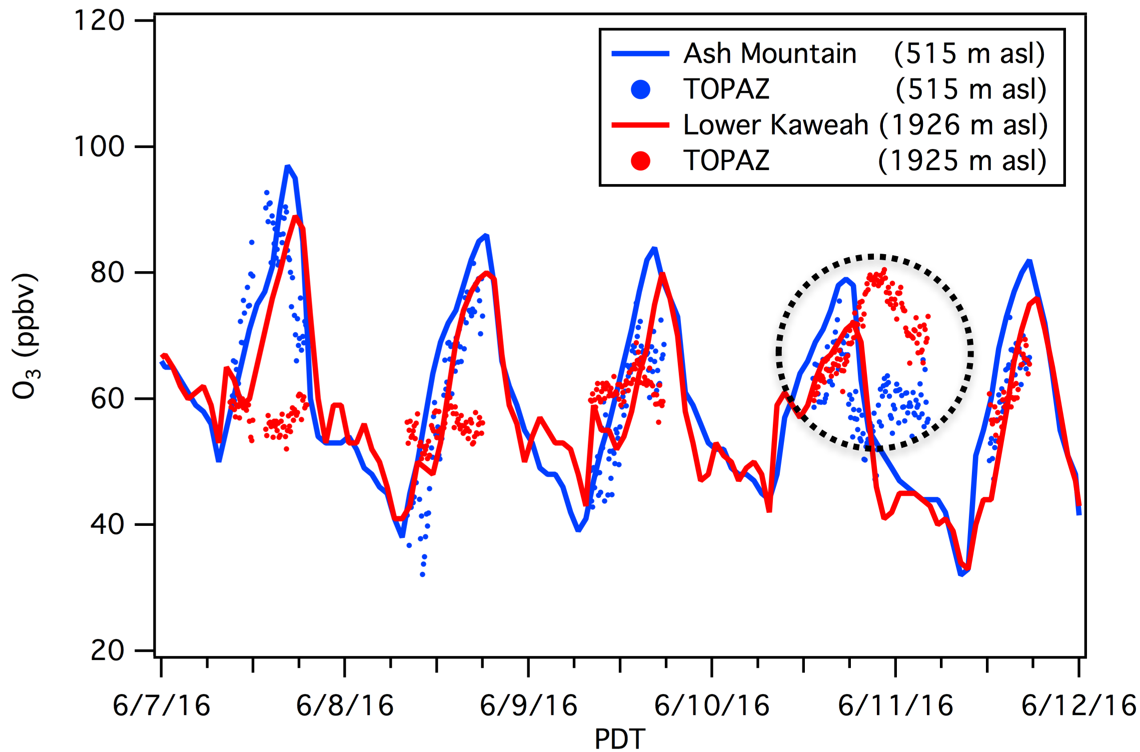
Transported ozone may have originated from Siberian or Alaskan wildfires



NOAA PSD RR-Chem model

Example: ozone transport event June 9-10, 2016

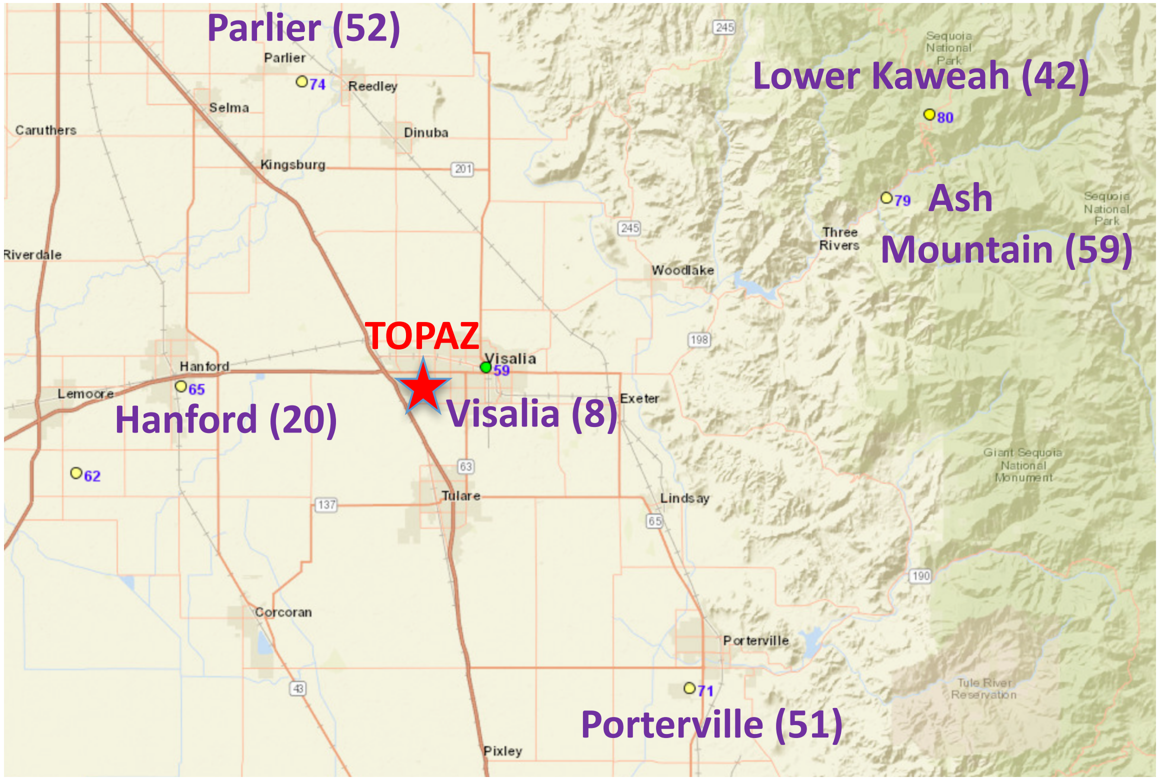
Impact on surface ozone in Sequoia NP



Transport layer did *not* increase surface ozone at Lower Kaweah (Lower Kaweah lags Ash Mountain = upslope transport)

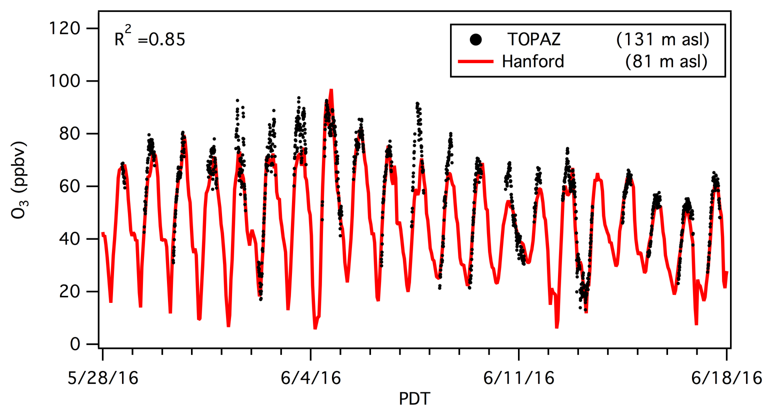
Is this result representative?

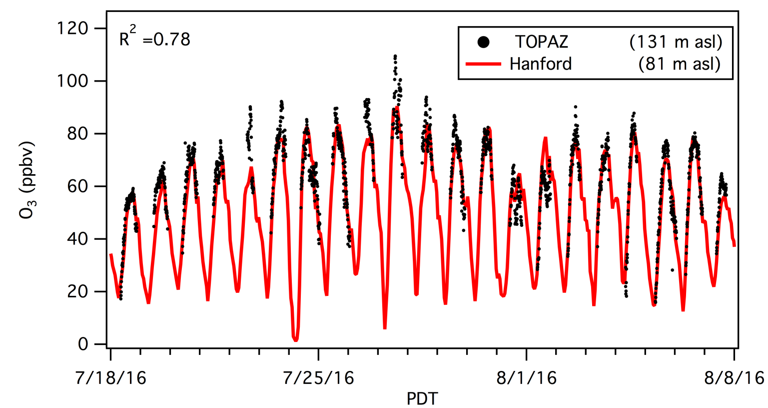
Exceedances were also frequent in the South-central SJV



(Number of 2016 exceedance days in parentheses)

Comparison between TOPAZ*and ARB monitors



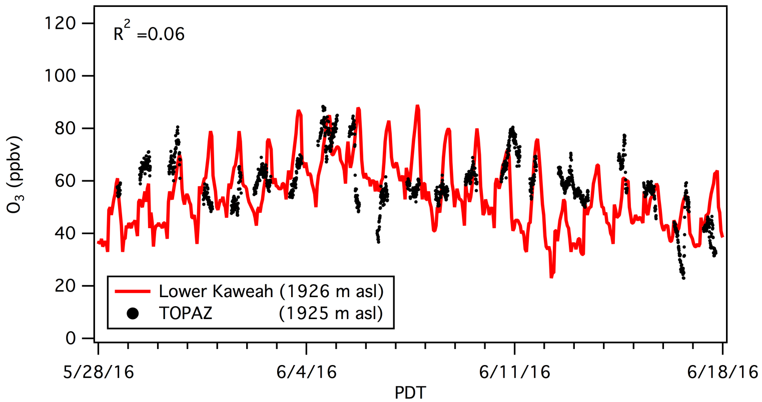


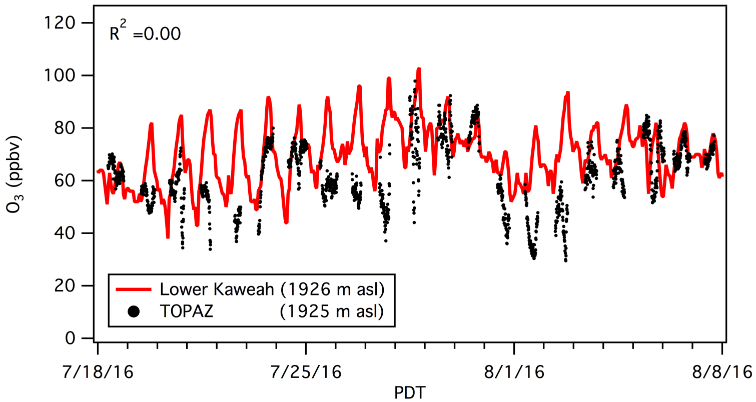
Monitor	intercept	slope	R^2
Visalia (102 m)	5.5±0.5	1.06±0.09	0.91
Hanford (81 m)	0.8±0.6	1.04±0.01	0.85
Parlier (104 m)	9.5±0.6	0.82±0.01	0.82
Porterville (141 m)	8.3±0.6	0.82±0.01	0.82
Seq NP-KC (515 m)	**0.6±1.1**	**0.92±0.02**	**0.68**
Seq NP-LK (1926 m)	**2.6±1.4**	**0.95±0.02**	**0.54**

Monitor	intercept	slope	R^2
Visalia (102 m)	14.3±0.6	0.87±0.01	0.80
Hanford (81 m)	4.9±0.8	0.95±0.01	0.78
Parlier (104 m)	19.8±0.7	0.65±0.01	0.74
Porterville (141 m)	14.4±0.9	0.74±0.01	0.66
Seq NP-KC (515 m)	**5.7±1.8**	**0.92±0.02**	**0.49**
Seq NP-LK (1926 m)	**0.5±2.0**	**0.87±0.03**	**0.38**

*** TOPAZ measurements at 50±10 m agl or 131±10 m asl**

Comparison between TOPAZ and Sequoia NP Lower Kaweah monitor





TOPAZ alt (m asl)	intercept	slope	R^2
131	2.6±1.4	0.95±0.02	0.54
281	10.9±1.2	0.85±0.02	0.53
515	18.7±1.1	0.76±0.02	0.55
1925	**47.1±1.3**	**0.21±0.02**	**0.06**

TOPAZ alt (m asl)	intercept	slope	R^2
131	0.5±2.0	0.87±0.03	0.38
281	6.3±1.9	0.83±0.0	0.40
515	16.1±1.7	0.74±0.02	0.40
1925	**56.5±2.2**	**0.07±0.03**	**0.00**

No correlation between surface ozone at Lower Kaweah and elevated layers

Conclusions

- **Long-range transport was not a significant source of high ozone in Sequoia NP during CABOTS.**

- **Most of the ozone at Lower Kaweah was transported from the SJV.**

- **Mountain-plains circulation probably did not create elevated (≈2-3 km) ozone layers above SJV.**

Acknowledgements

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Christoph Senff
Ann Weickmann

Visalia-Church St ozone monitor

Ozone exceedances in the south-central SJV

- 42 exceedances at Lower Kaweah (1926 m asl)
- 59 exceedances at Ash Mountain (515 m asl)
- 51 exceedances at Porterville (141 m asl)
- 52 exceedances at Parlier (104 m asl)
- 8 exceedances at Visalia (102 m asl)
- 20 exceedances at Hanford (82 m asl)