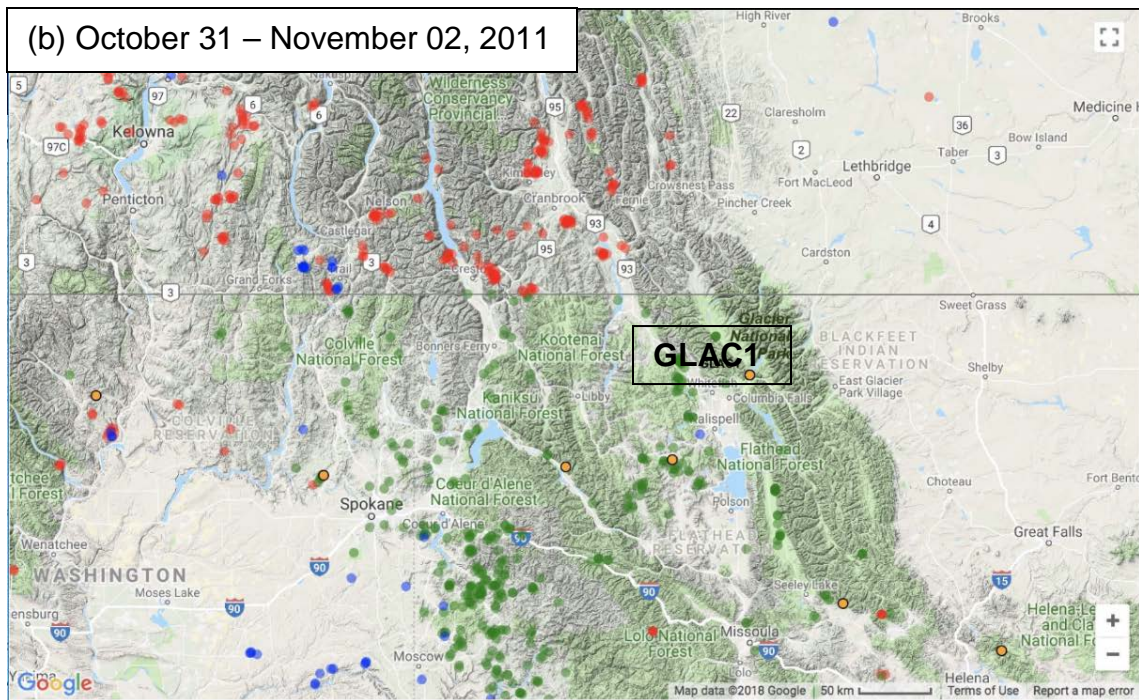
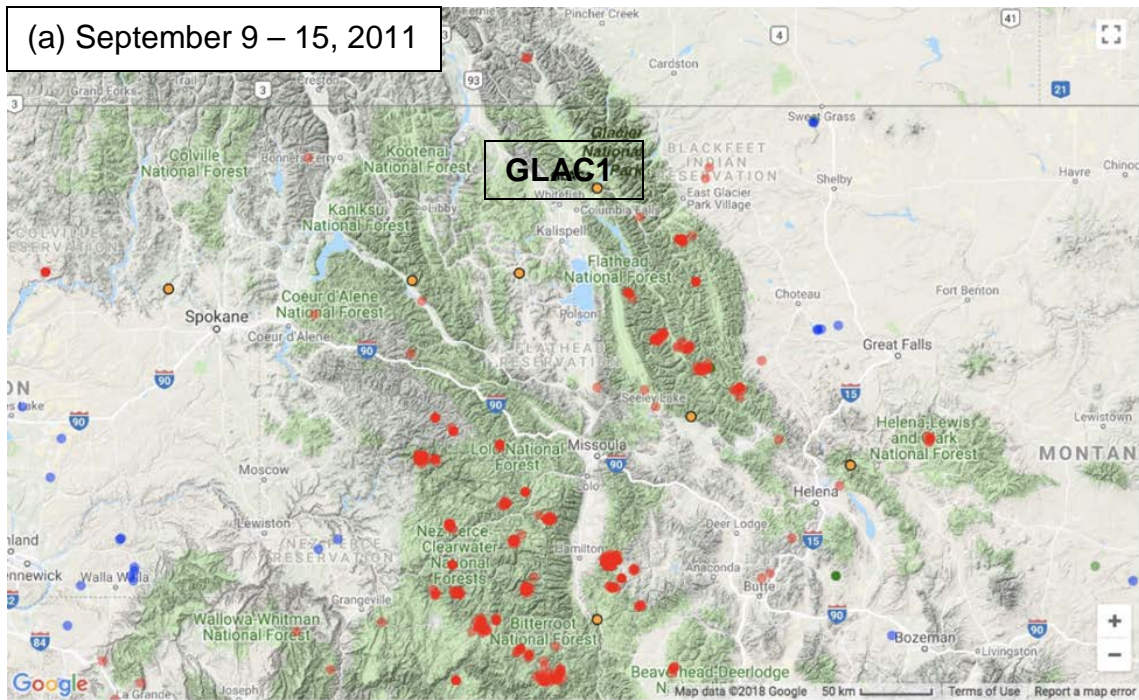


Supplement Table 1. Typical sources that affect visibility at Class I areas and treatment in source apportionment analysis in the 2011 Western Air Quality Study.

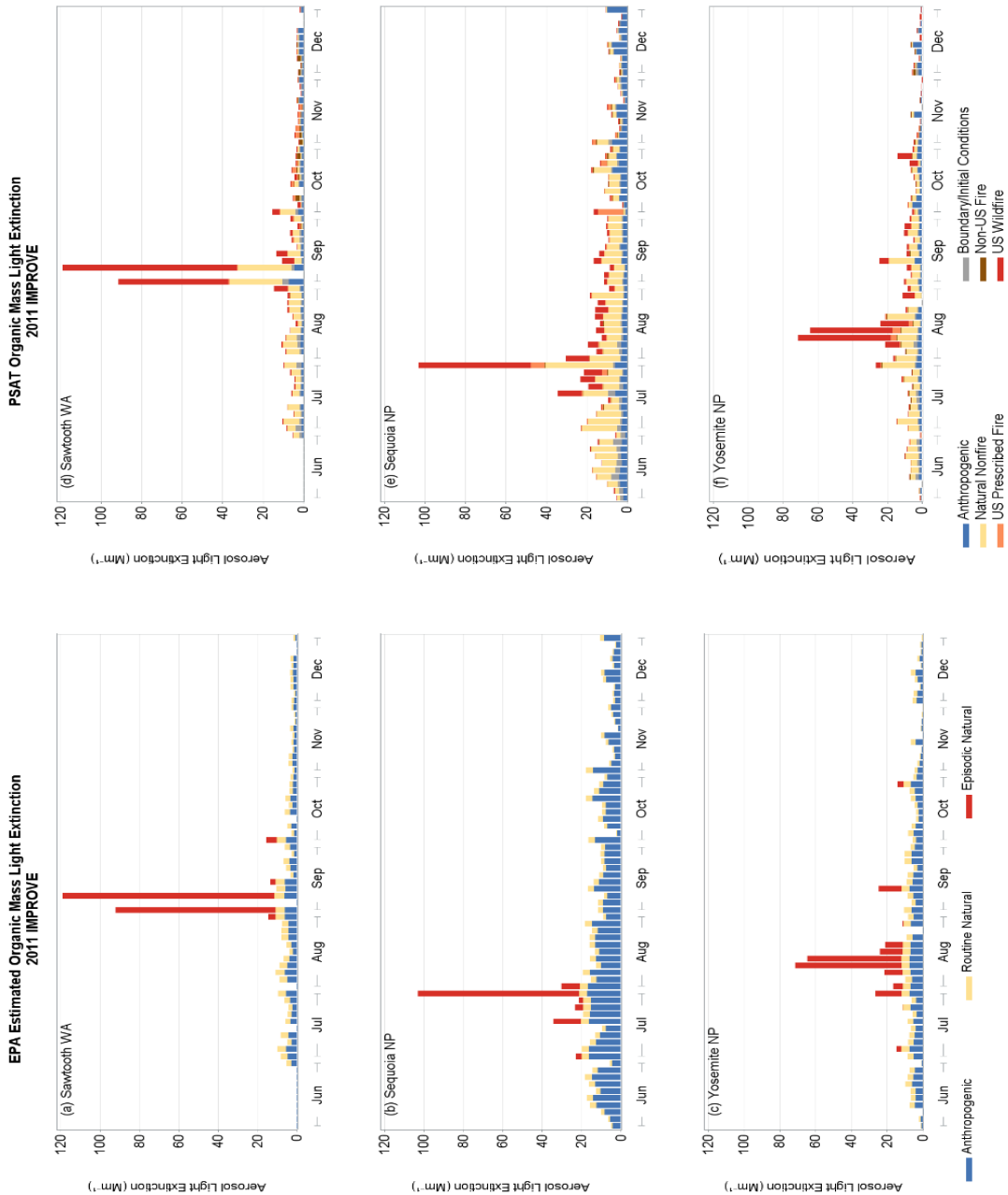
EPA split of IMPROVE monitoring data	Source Category and Air Emissions	Controllability	Source Apportionment Tagged Categories ¹
Anthropogenic	U.S. anthropogenic (SO ₂ , NO _x , NH ₃ , PM, VOC)	Most emissions are controllable	Within 36 km model domain: Each 17 western states plus eastern region and ocean
	Agricultural fire, biomass fuel (predominantly OC +EC); Road/construction dust (PM)	Most emissions are controllable	Within 36 km domain: Agricultural fire and road dust combined in U.S., Canadian, or Mexican anthropogenic.
	International anthropogenic (SO ₂ , NO _x , NH ₃ , PM, VOC)	Not controllable by U.S. state or federal regulations	Within 36 km domain: Canadian, Mexican, or marine shipping anthropogenic Boundary Conditions (Outside 36 km domain): All international contributions (combined anthropogenic and natural) ²
Natural	Wildfire Prescribed fire (predominantly OC, EC, some SO ₂ , NO _x)	Not controllable	Within 36 km domain: Wildfire and Prescribed fire tracked separately as U.S., Canadian, or Mexican.
	Volcanic SO ₂ Wind-blown Dust (PM) Other Natural (sea salt, Cl ⁻ ; lightning and soils, N; vegetative, VOC)	Mostly un-controllable	Seasalt tagged separately, other natural sources combined.

¹ Source categories used in Particle Source Apportionment Tool (PSAT) in Comprehensive Air Quality Model with Extensions (CAMx) as described in Adelman et al., 2016.

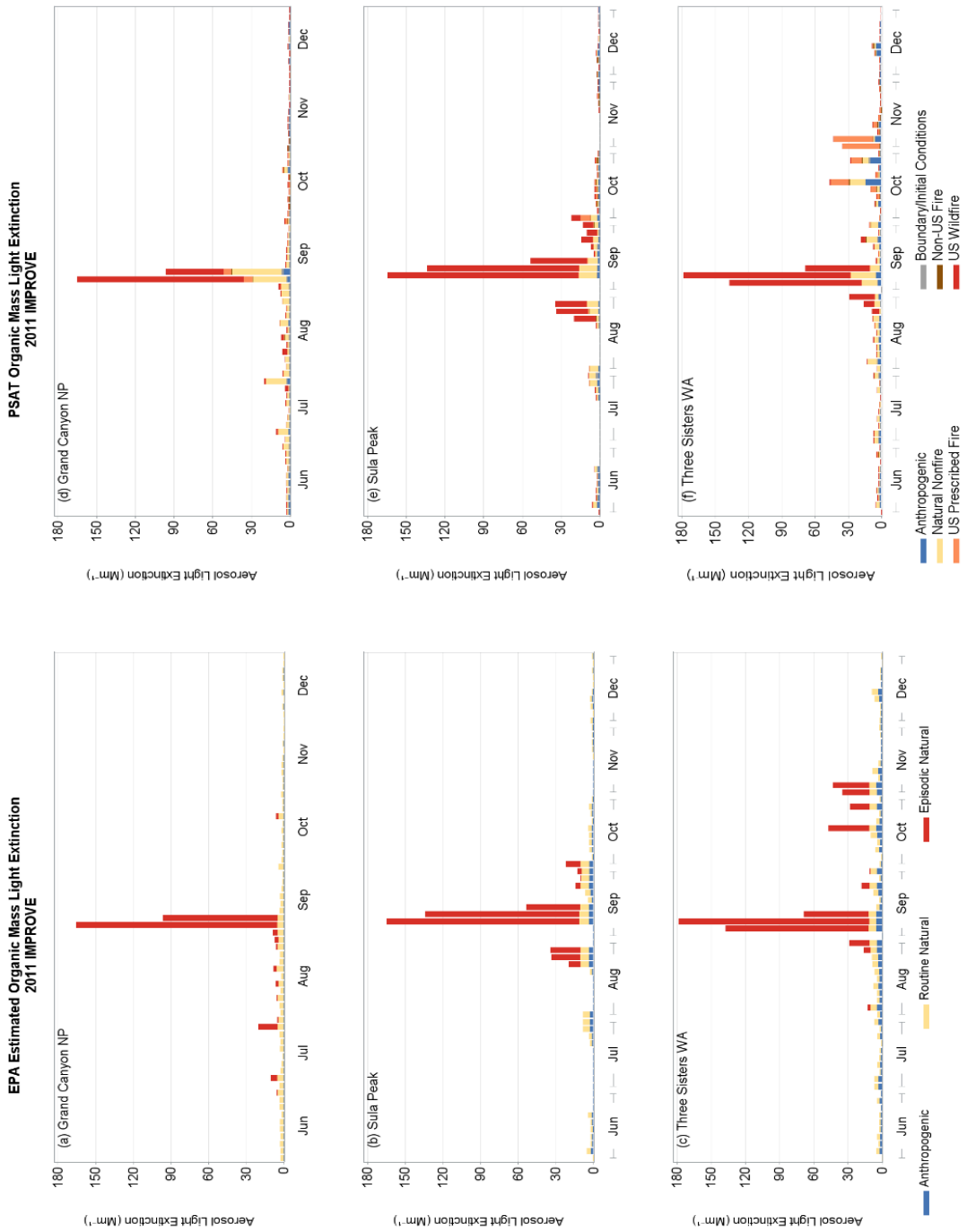
² The boundary conditions from the MOZART global model did not separate international emissions into anthropogenic and natural contributions.



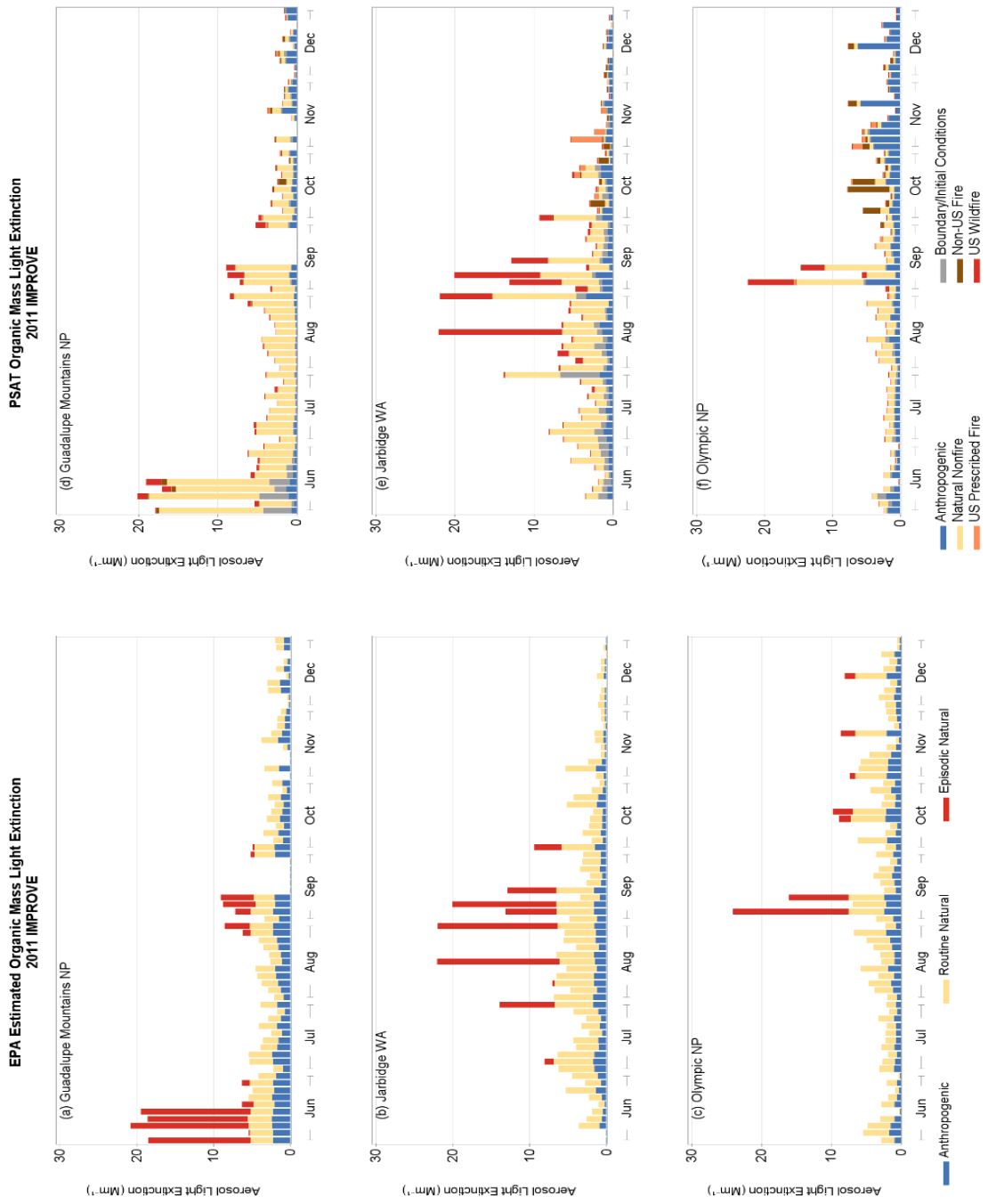
Supplemental Figure 1. Fire activity data in the vicinity of Glacier National Park on days that EPA’s episodic carbon threshold was exceeded at GLAC1 IMPROVE monitor. Wildfires are illustrated in red, prescribed fires in green, and agricultural fires in blue. a) Wildfires in the vicinity of Glacier National Park on 9/09/2011-9/15/2011, b) Prescribed fires in the vicinity of Glacier National Park on 10/31-11/02/2011.



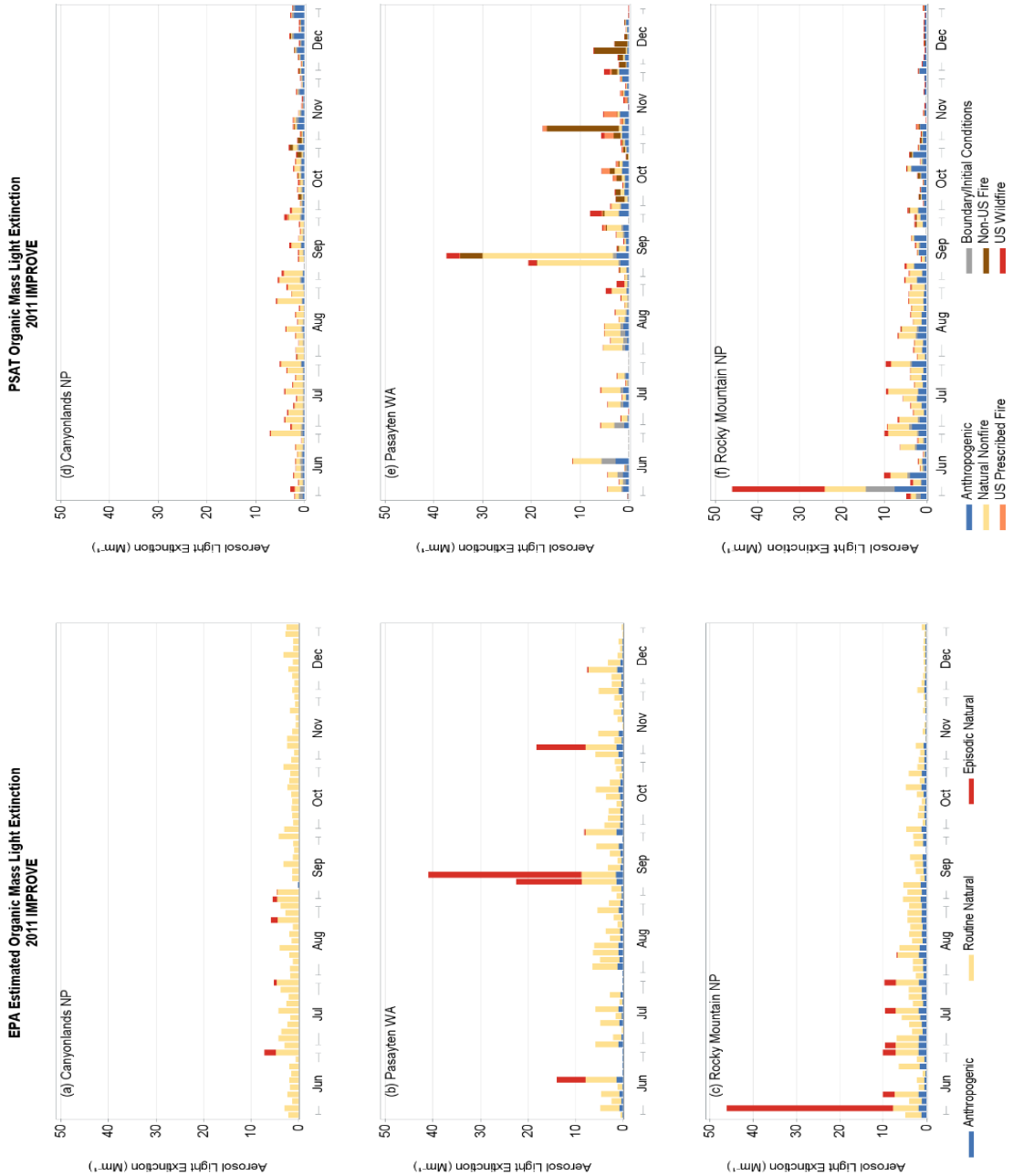
Supplement Figure 2. IMPROVE organic mass (OM) light extinction (Mm^{-1}) for June through December 2011, illustrating the EPA method’s assignment of OM to episodic natural, routine natural, or anthropogenic contributions at (a) Sawtooth Wilderness, (b) Sequoia National Park (NP), and (c) Yosemite NP and illustrating CAMx-PSAT source apportionment for OM at the same sites (d) Sawtooth Wilderness, (e) Sequoia NP, and (f) Yosemite NP.



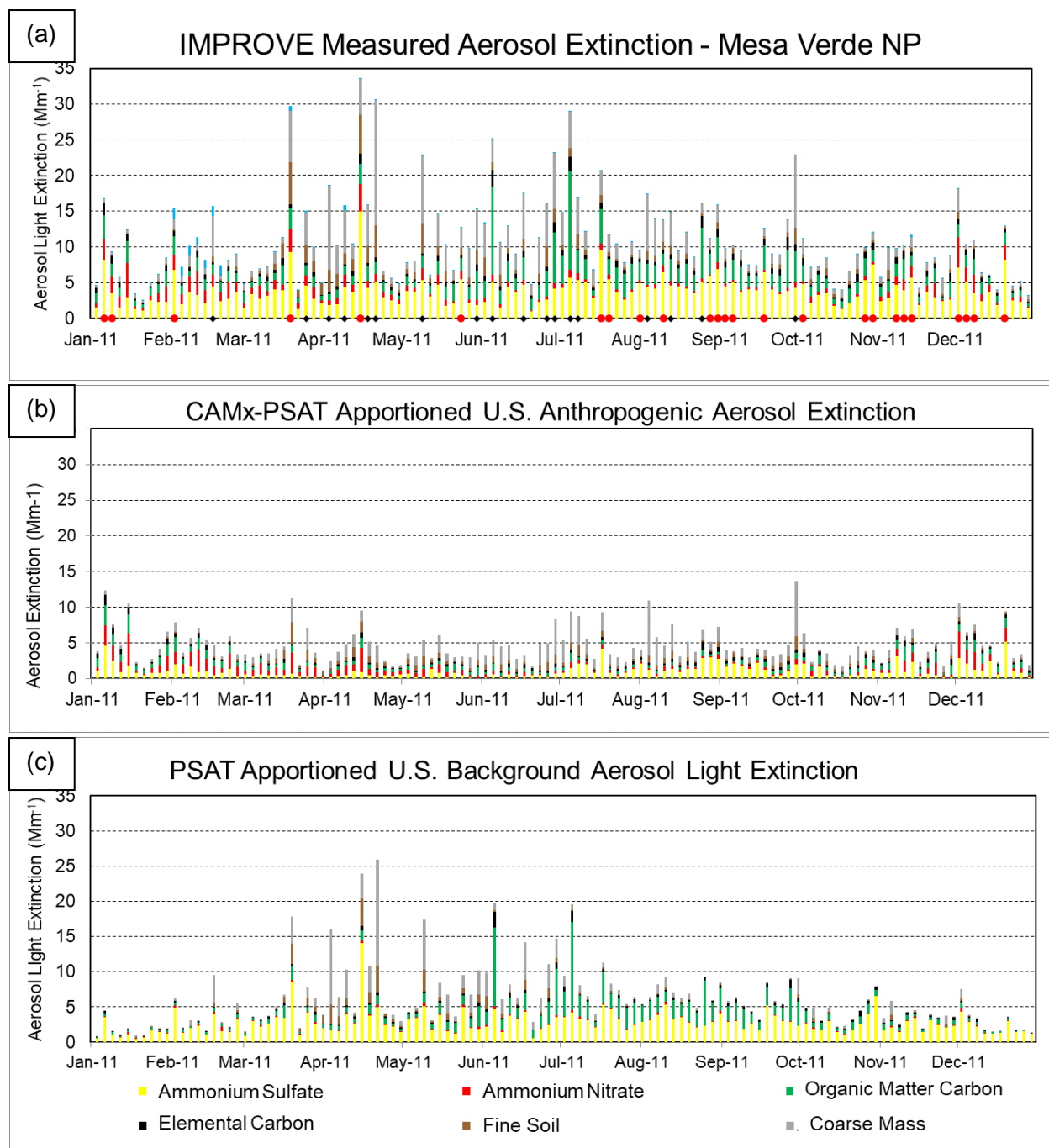
Supplement Figure 3. IMPROVE organic mass (OM) light extinction (Mm^{-1}) for June through December 2011, illustrating the EPA method's assignment of OM to episodic natural, routine natural, or anthropogenic contributions at (a) Grand Canyon National Park (NP), AZ, (b) Sula Peak Wilderness Area (WA), MT, and (c) Three Sisters WA, OR and illustrating CAMx-PSAT source apportionment for OM at the same sites (d) Grand Canyon NP, (e) Sula Peak WA, and (f) Three Sisters WA.



Supplement Figure 4. IMPROVE organic mass (OM) light extinction (Mm^{-1}) for June through December 2011, illustrating the EPA method’s assignment of OM to episodic natural, routine natural, or anthropogenic contributions at (a) Guadalupe Moutains National Park, NP, TX, (b) Jarbridge Wilderness Area (WA), NV, and (c) Olympic NP, WA and illustrating CAMx-PSAT source apportionment for OM at the same sites (d) Guadalupe Mountains NP, (e) Jarbridge WA, and (f) Olympic NP.

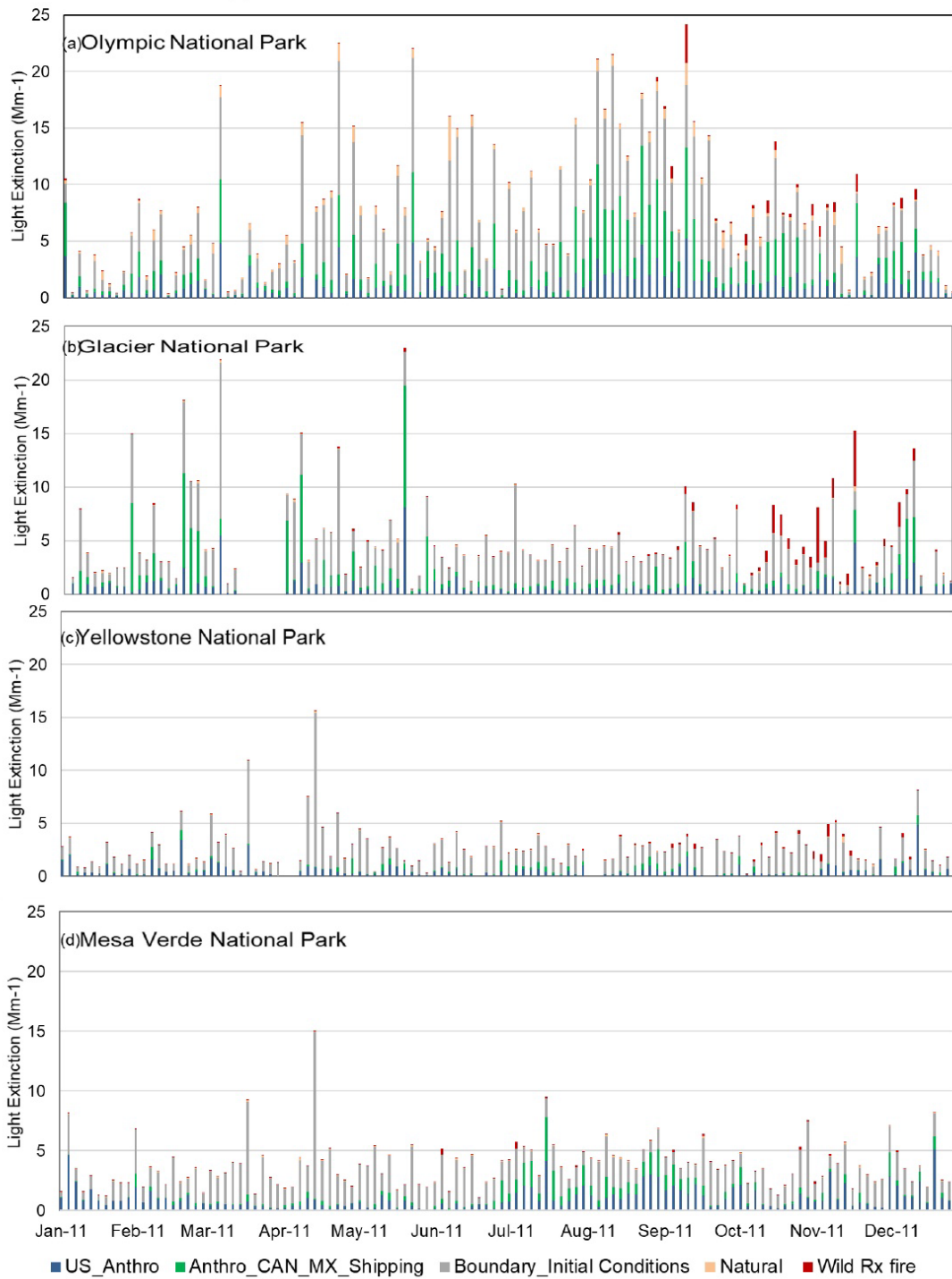


Supplement Figure 5. IMPROVE organic mass (OM) light extinction (Mm⁻¹) for June through December 2011, illustrating the EPA method's assignment of OM to episodic natural, routine natural, or anthropogenic contributions at (a) Canyonlands National Park, NP, UT, (b) Pasayten Wilderness Area (WA), WA, and (c) Rocky Mountain NP, CO and illustrating CAMx-PSAT source apportionment for OM at the same sites (d) Canyonlands NP, (e) Pasayten WA, and (f) Rocky Mountain NP.

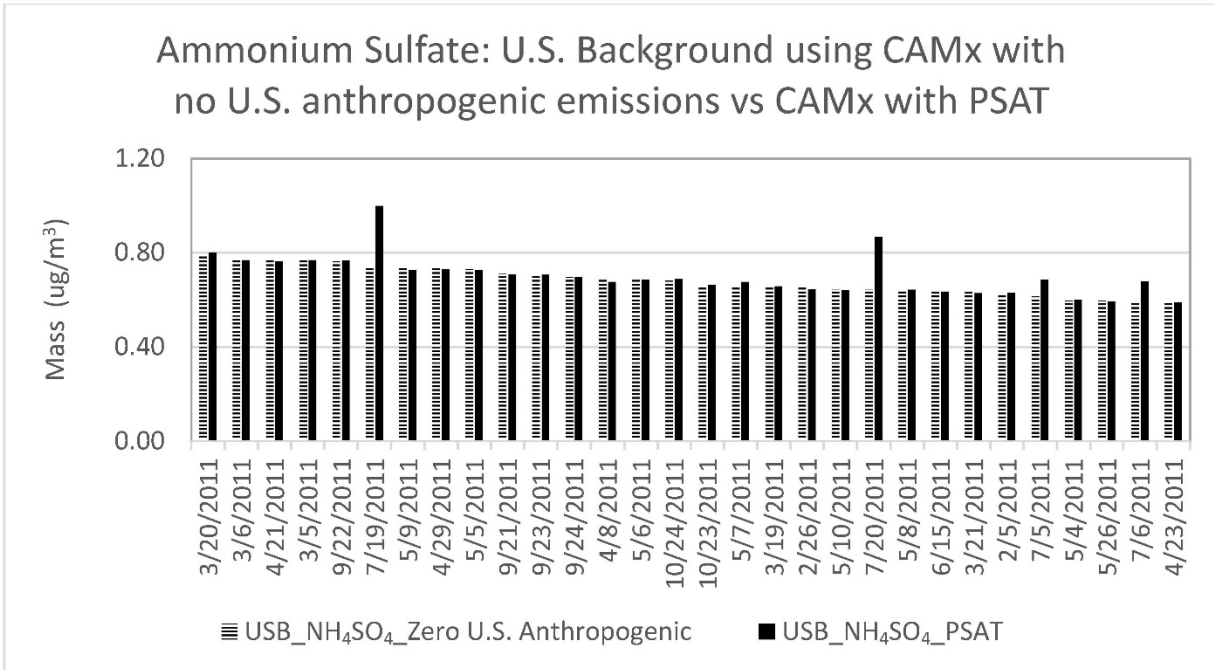


Supplement Figure 6. For Mesa Verde National Park, (a) haziest and most impaired IMPROVE days in 2011, (b) PSAT apportionment of aerosol light extinction to U.S. anthropogenic emissions, and (c) PSAT apportionment of aerosol light extinction to uncontrollable (U. S. Background) emissions.

PSAT Apportionment of 2011 IMPROVE Ammonium Sulfate



Supplement Figure 7. 2011 CAMx-PSAT modeled apportionment of IMPROVE ammonium sulfate light extinction (Mm⁻¹) to U.S. anthropogenic and U.S. background for (a) Olympic, (b) Yellowstone, (c) Glacier, and (d) Mesa Verde National Parks.



Supplement Figure 8. 2011 Ammonium Sulfate Mass ($\mu\text{g}/\text{m}^3$) at Mesa Verde National Park on days with highest U.S. Background (USB) defined by CAMx run with no U.S. anthropogenic emissions compared to results of CAMx PSAT attribution.