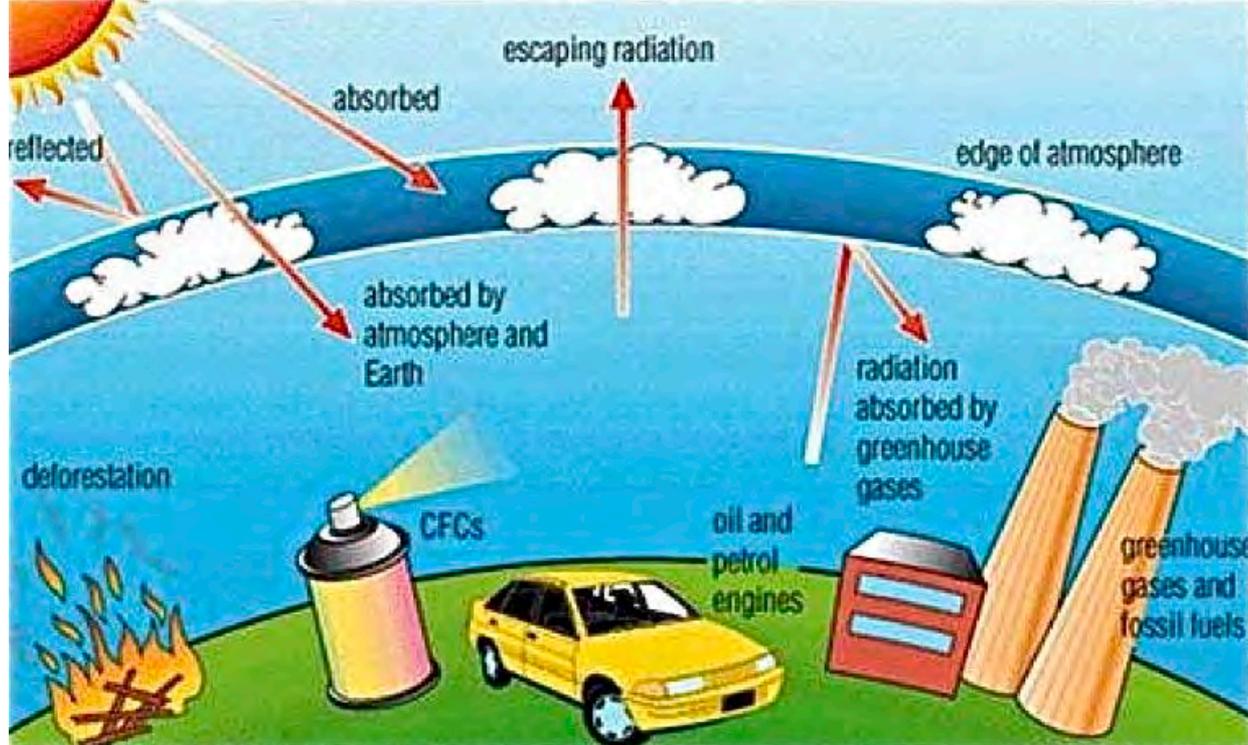




Short Term Climate Forcers and Local Impacts

Dr. Susan Kaspari
Department of Geological Sciences
Central Washington University



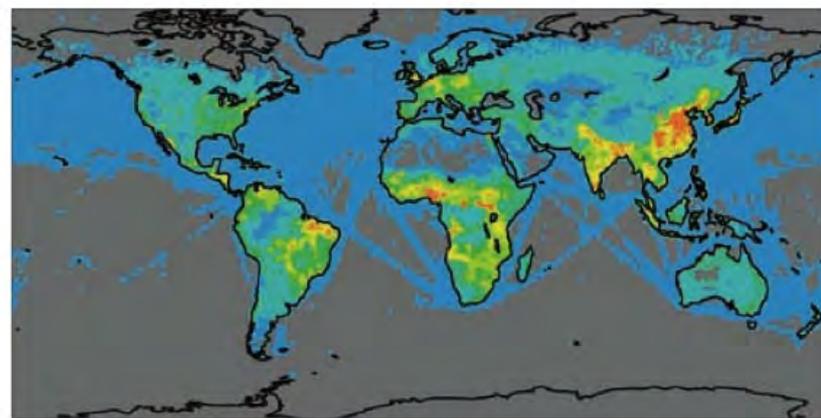
A **climate forcer** is any gas or particle that alters the Earth's energy balance by absorbing or reflecting radiation.

Long lived climate forcers: Greenhouse gases

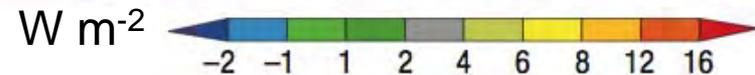
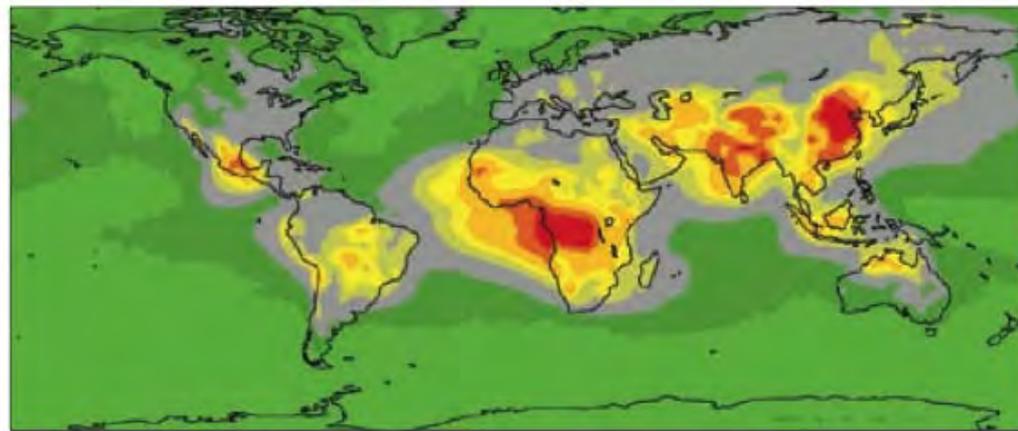
Atmospheric lifetime = decades to centuries (and longer)

Short lived climate forcers: ozone, NO_x, black carbon, methane

Atmospheric lifetime = days to weeks



BC emission strength in tons/yr
Includes fuel combustion and open biomass burning.



Atmospheric solar heating due to BC

From Ramanathan et al., 2008

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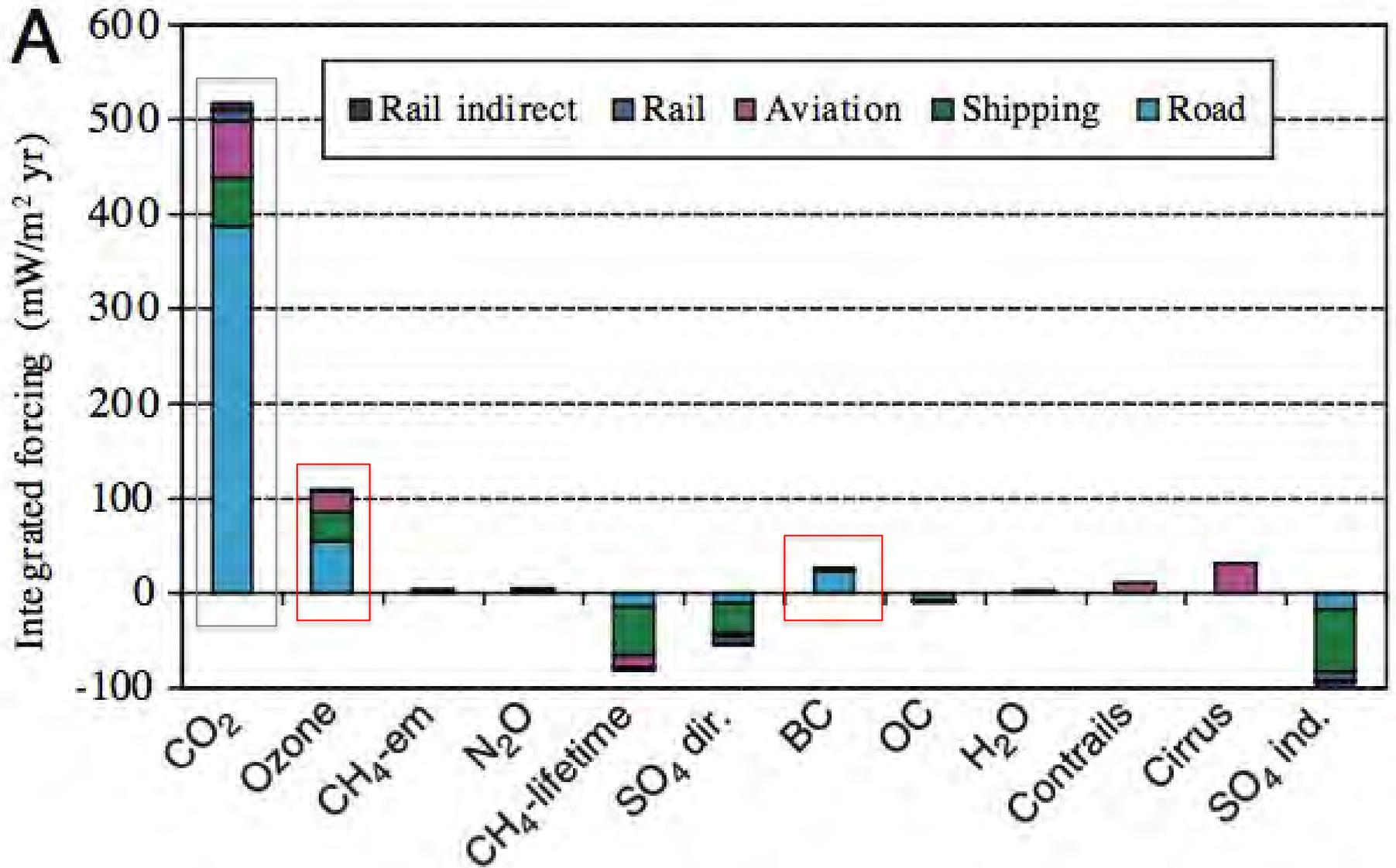
Dominant Short Lived Climate Forcers from the Transportation Sector:

Ozone: secondary pollutant formed in the troposphere by sunlight-driven chemical reactions. Major constituent of smog.

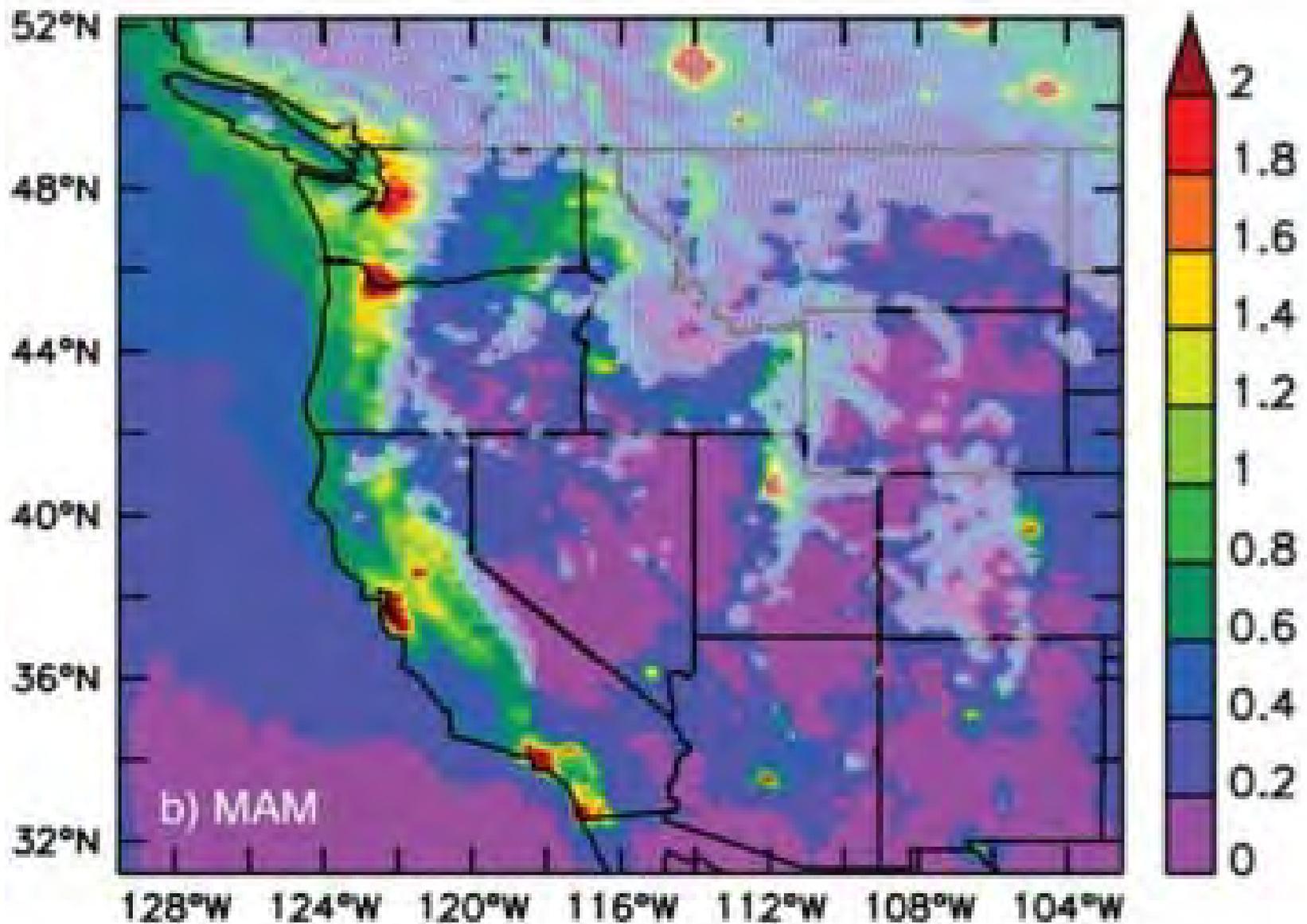
Black Carbon: (soot). Dark absorptive particle formed from the incomplete combustion of bio and fossil fuels.

NO_x: generic term for NO and NO₂ (nitric oxide and nitrogen dioxide). Formed in the air during combustion, especially at high temperatures (engines)

Climate Forcing from the Transport Sector

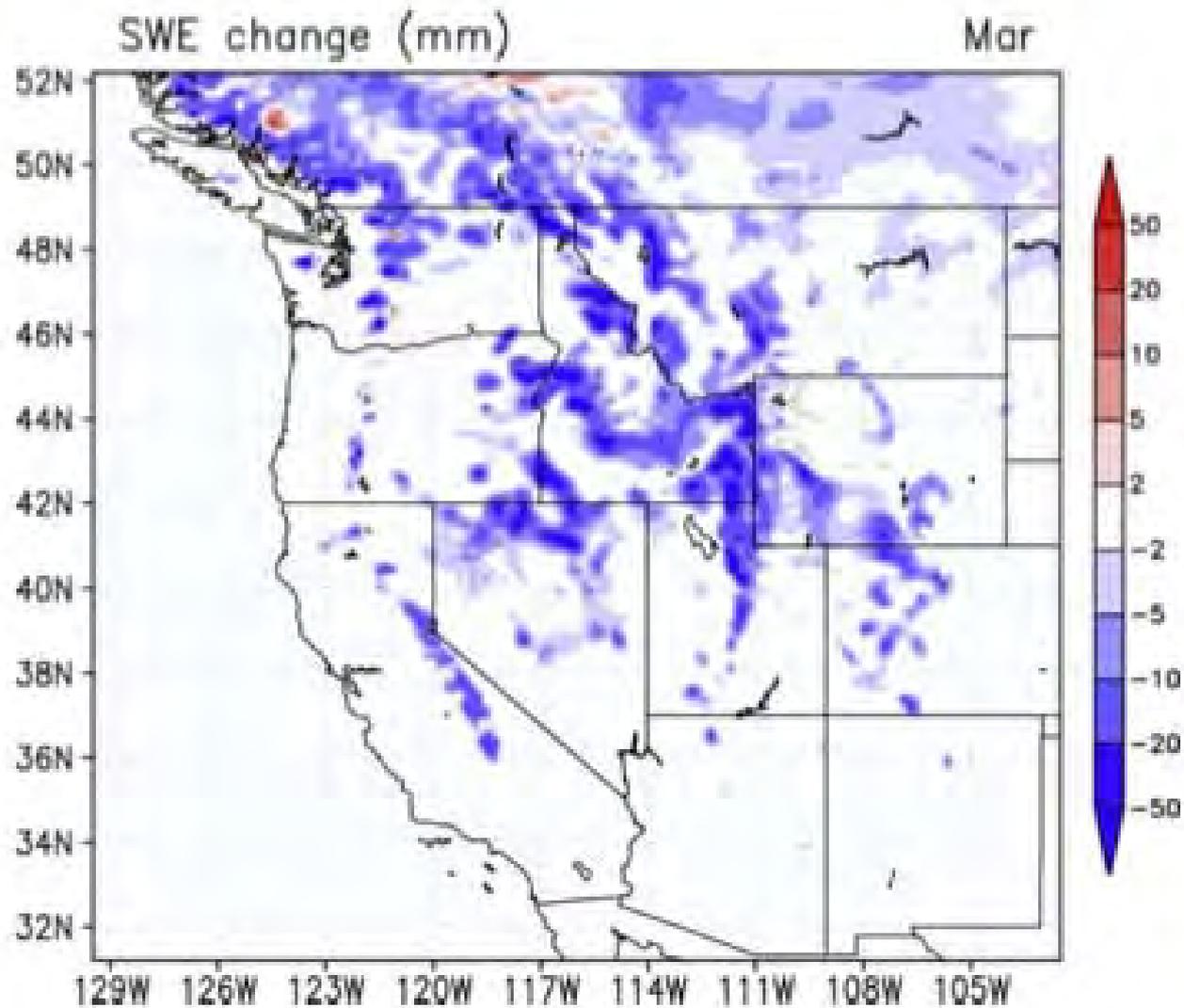


From Fuglestvedt et al., 2008

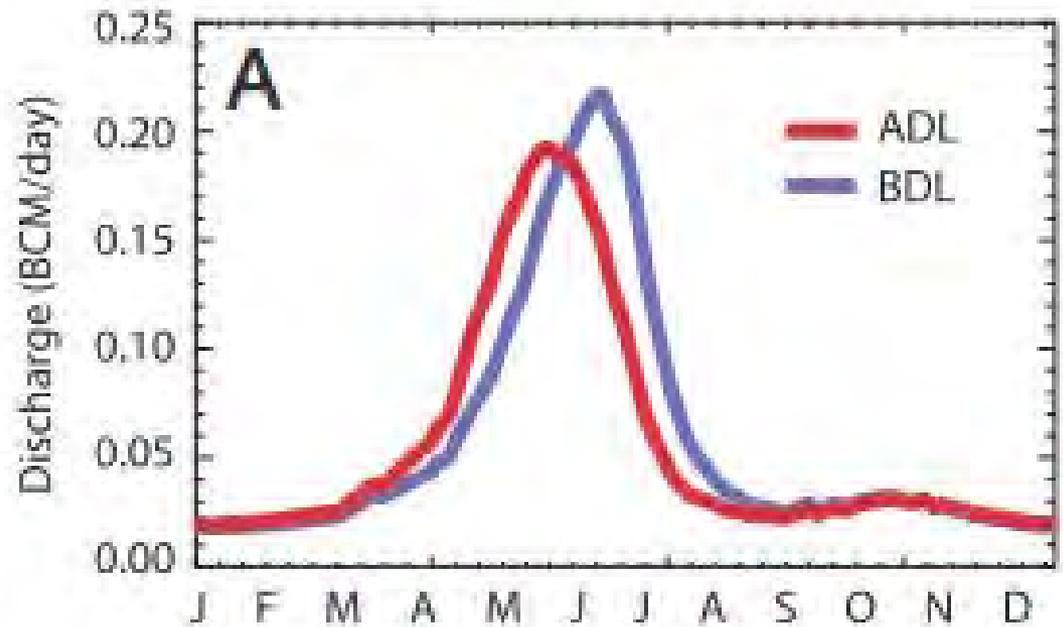


Modeled black carbon deposition ($\mu\text{g}/\text{m}^2$) for March-May (From Qian et al., 2009)





Spatial distribution of change in mean snow water equivalent (SWE, mm) for March with black carbon perturbation.
From *Qian et al.* [2009]



Modeled hydrographs for the Colorado River at Lees Ferry, Arizona showing a shift in the timing and magnitude of water resources due to dust deposition. ADL= after dust disturbance dust loading, BDL= before dust disturbance loading. From [*Painter et al.*, 2010].

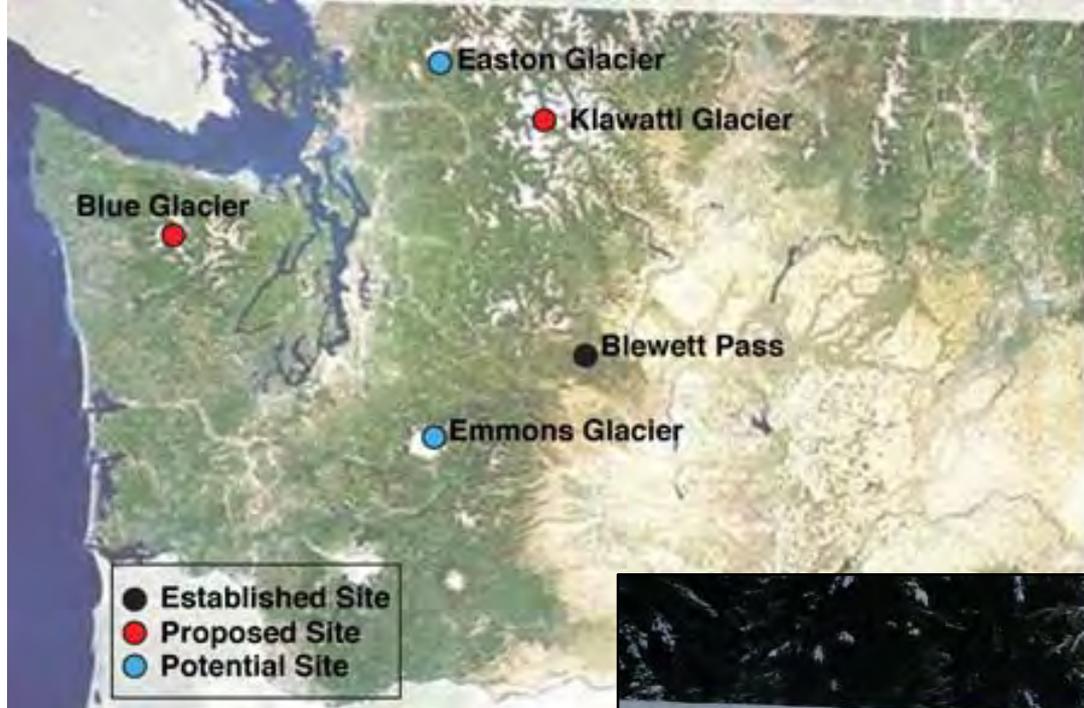
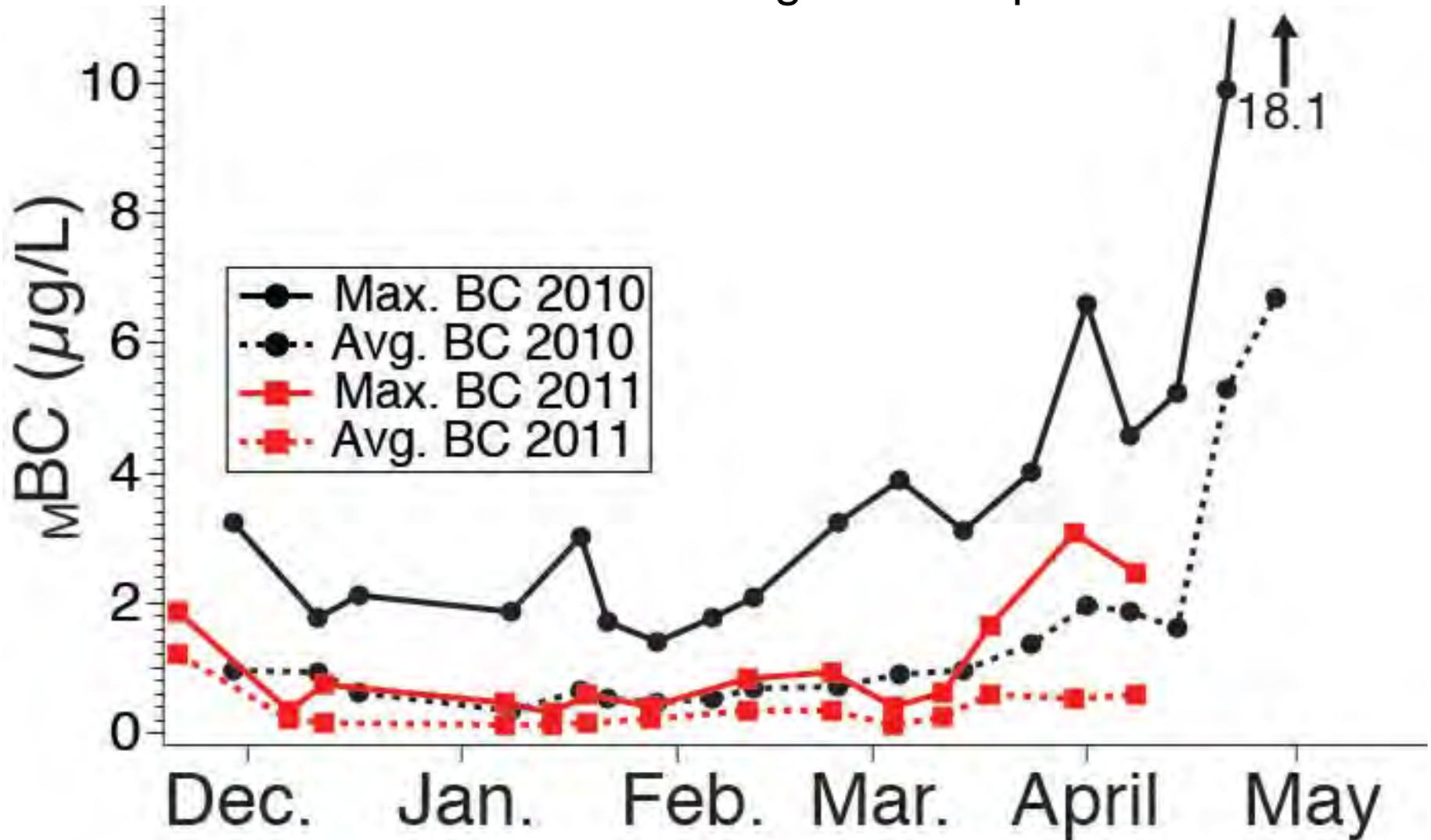


Photo: Ian Delaney

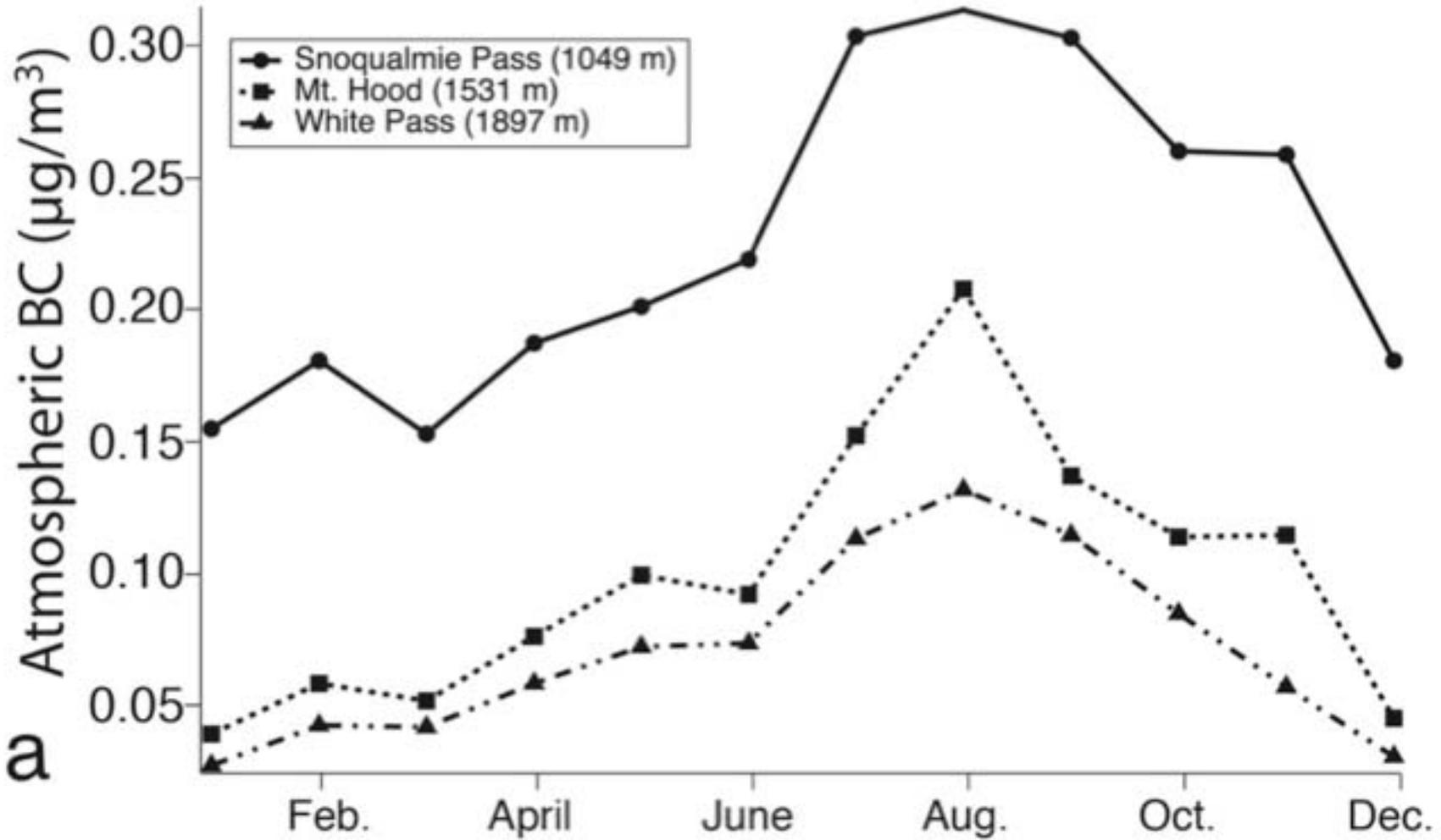


Black Carbon in Washington Snowpack



Maximum and average BC observed in snowpits from Blewett Pass, Washington. From *Jenkins and Kaspari*, [in prep.]

Atmospheric black carbon: Implications for snow and glacier melt





- Reducing short-lived climate forcers can lead to immediate climate benefits
- Complexity of impacts from short-lived climate forcers are still not fully realized.
- Reductions in short-lived climate forcers (particularly ozone and black carbon) can also provide substantial public health benefits
- Controls on short-lived climate forcers does not eliminate the need for controls on long-lived climate forcers (e.g., greenhouse gases). Controls on both long-lived and short-lived climate forcers are necessary