Comparison and Evaluation of Fire Emissions in a Global Chemistry Model with SEAC^{4}RS Observations

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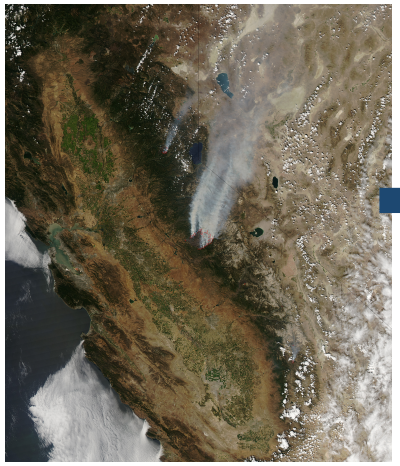
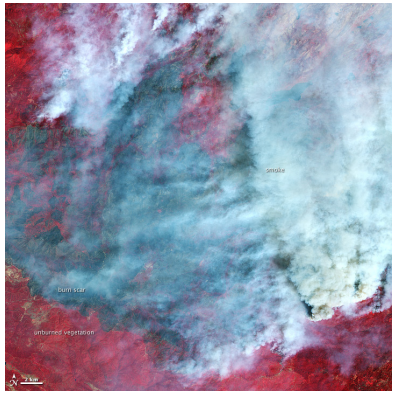
Wildfires - major sources of trace gases

Rim Fire (Aug, 2013)



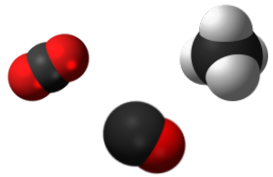
MODIS on Aqua



ASTER on Terra

Tropospheric chemistry & **Air pollution**

- Greenhouse Gases (**CO_2**, **CH_4** and **N_2O**)
- **CO, NMVOC** and **NO_x**
- Fine and Coarse Particulate Matter (**PM**)



Fire Emissions Estimates

- the use of fire hot spots
- assumed area burned, land cover maps
- biomass consumption estimates
- emission factors [Wiedinmyer et al., 2011]

uncertainties

Q. How to Better Estimate Emissions and Their Impact on Chemistry and Climate?

-> ***In-situ*** **Measurements**

-> **Global Chemistry Transport Models**

Fire Emissions Inventories

	method	resolution	reference
FINN (v1.5) (v2.0-beta)	MODIS active fire detection	1 x 1 km	Wiedinmyer et al. [2011]
QFED (v2.4)	MODIS FRP	0.25°x0.3125°	Darmenov and da Silva [2013]

CAM-chem
(Community Atmosphere Model with Chemistry)
GEOS-5, 1.9°x2.5°, 56 levels

FINN **QFED** **NOFIRE**

Also AG Fire Only

NASA SEAC^{4}RS
(Aug-Sep 2013)

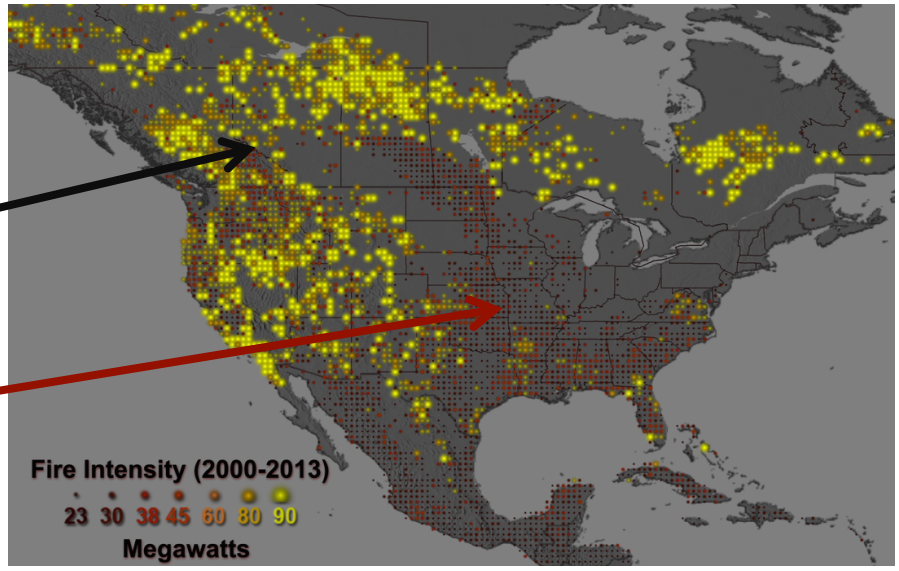
DC-8 measurements

Fire Activity – N. America

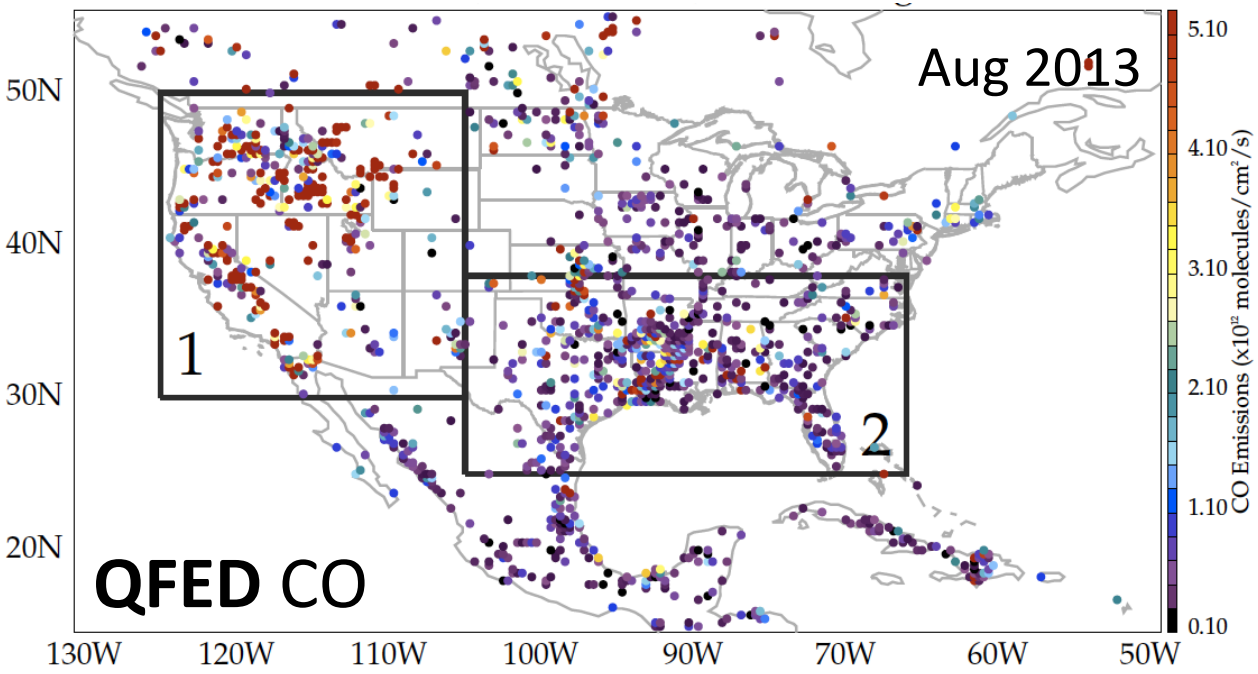
MODIS Mean **FRP**

(high) – Western US (yellow)

(low) – Prescribed &
Agricultural Fires (red)



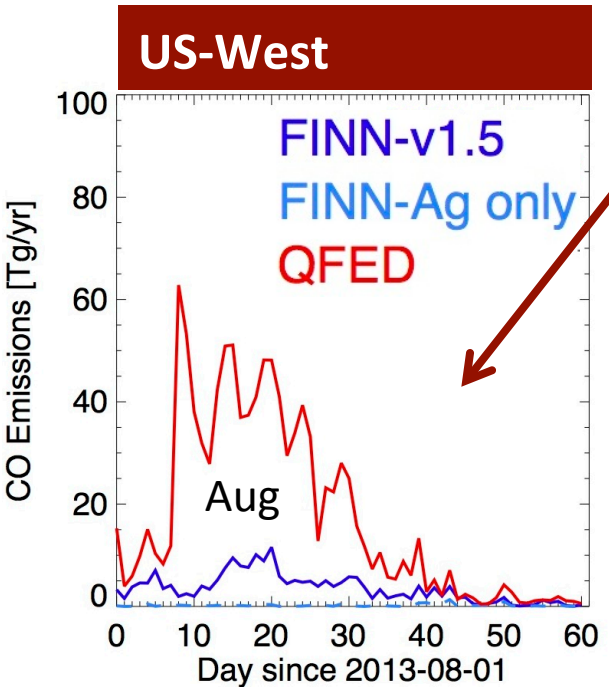
http://svs.gsfc.nasa.gov

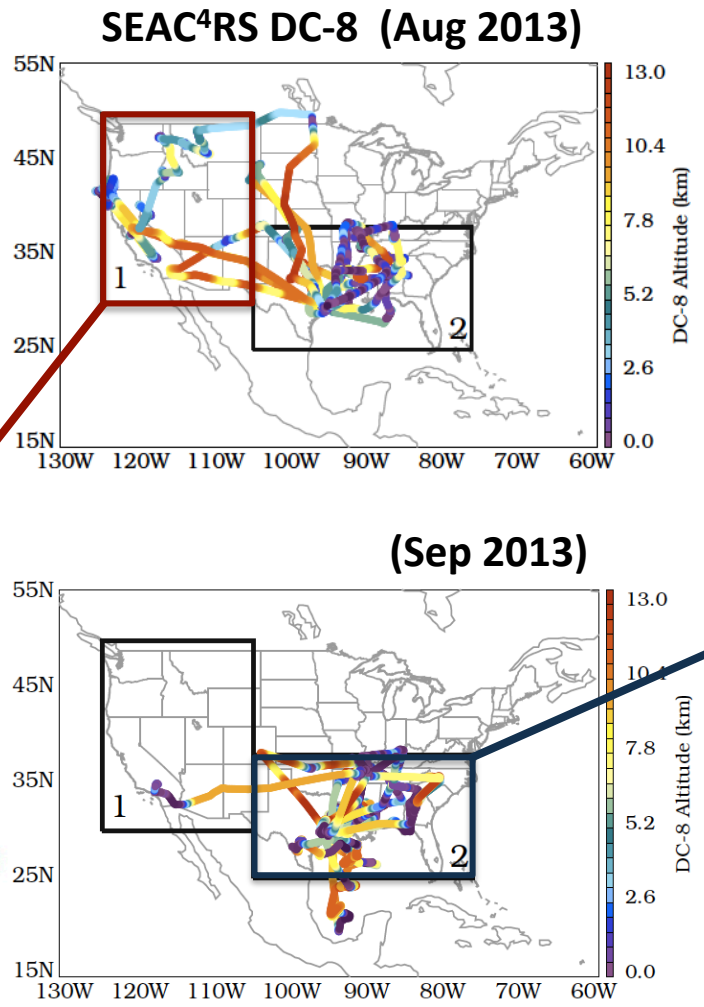


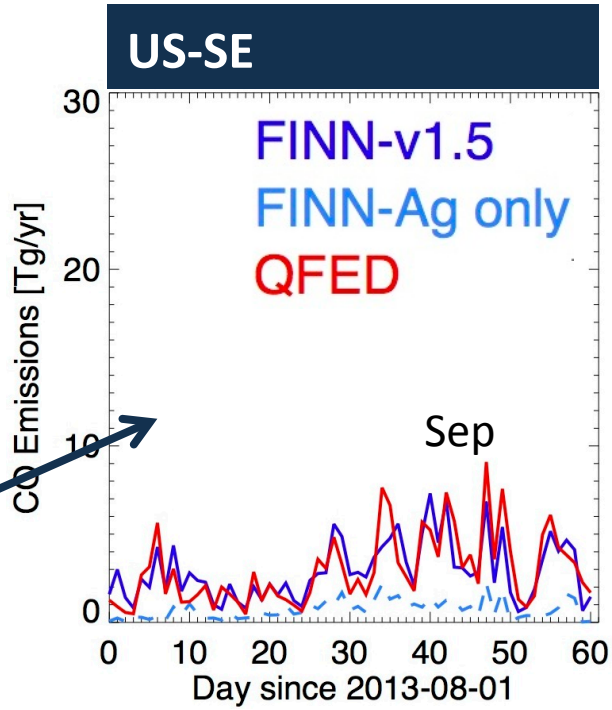
1. **US-West (Forest Fires)**

2. **US-SE (Ag fires + Other)**

CO Daily Emissions (US)



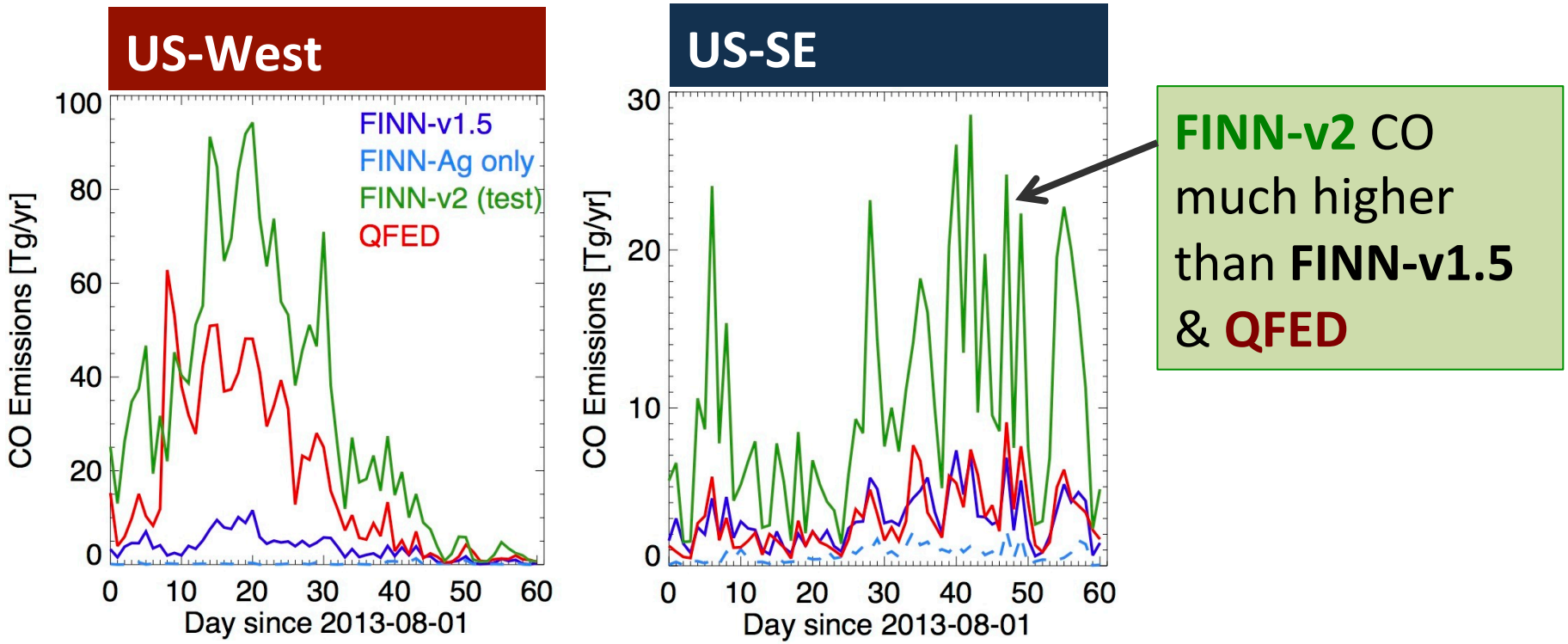




FINN-v1.5 << **QFED**
(Underestimation of emissions from large **Wildfires**)

Emissions in the SE result from **Ag and non-Ag** fires

FINN-v2 (under development)



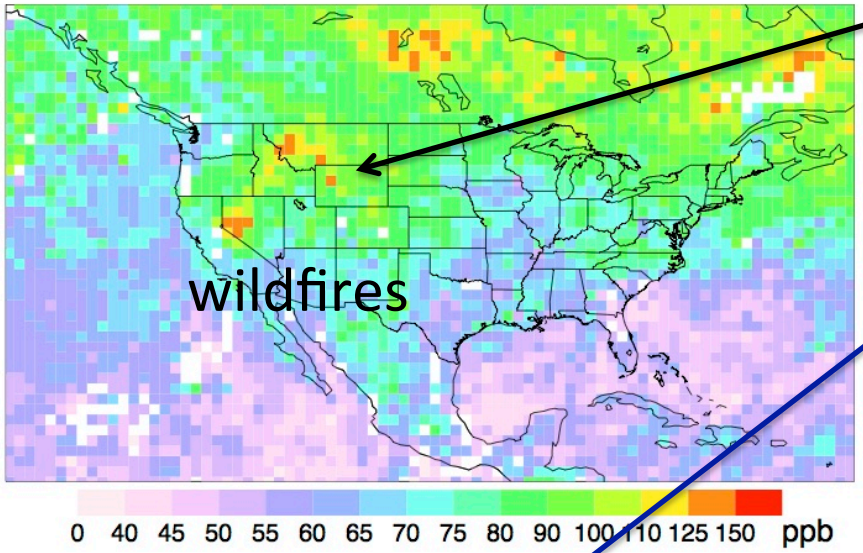
FINN-v2 CO much higher than **FINN-v1.5** & **QFED**

FINN-v2

- Improved estimate of fire size (particularly important for large fires)
- Used different vegetation map (correctly identifies forests instead of shrubs - *e.g.*, in California)
- Emission estimates will be finalized and released in the next few months

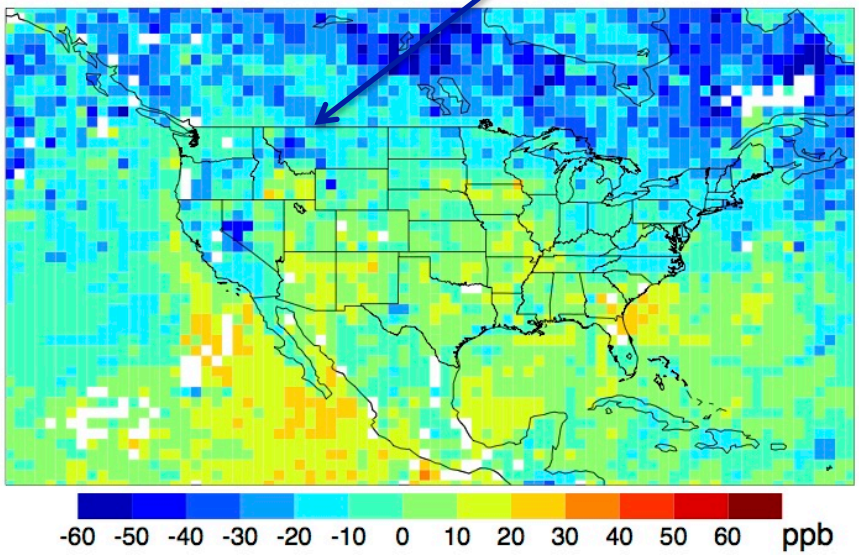
CAM-chem CO bias (MOPITT-700 hPa)

MOPITT V6J CO at 700 hPa Aug

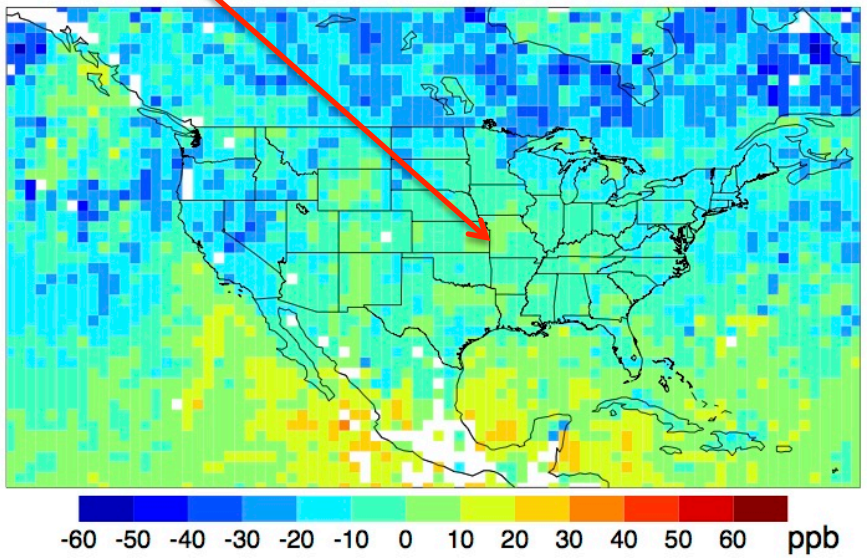


- **MOPITT** - Joint TIR & NIR retrievals
- Model profiles transformed with MOPITT averaging kernels and a priori
- CAM-chem underestimates CO in **US-West** (forest fires)
- CO over **US-SE** is within +/- 10 ppb

CAMchem-QFED CO bias Aug

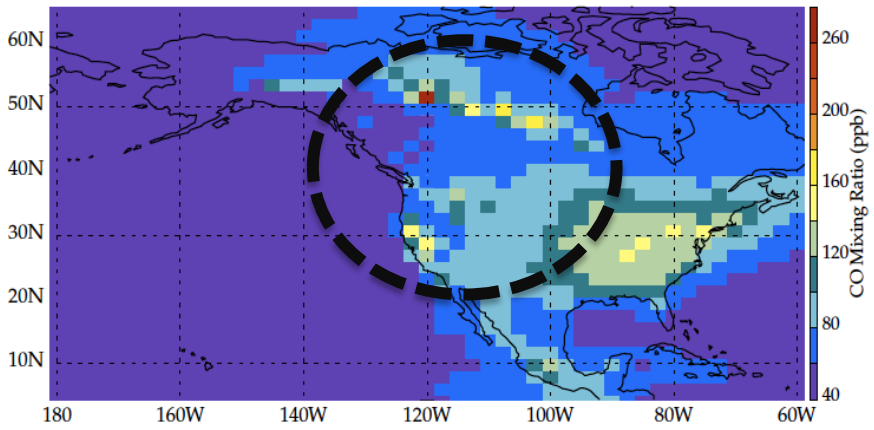


CAMchem-QFED CO bias Sep

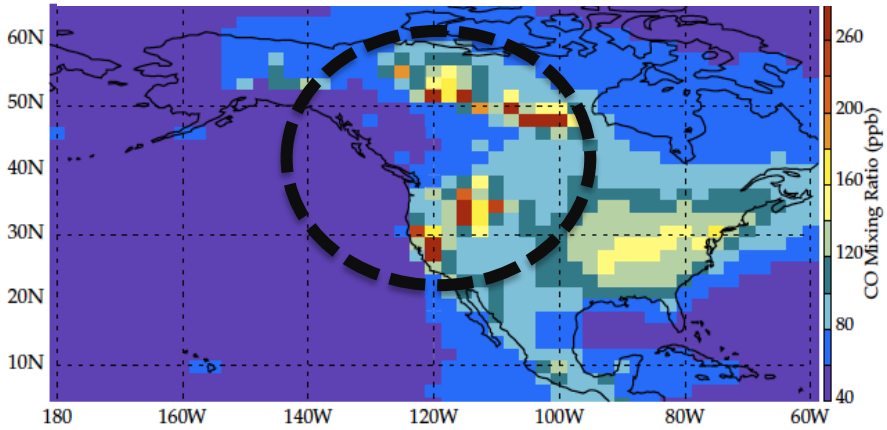


CAM-chem (FINN & QFED) Aug 2013

CAM-chem CO (FINN)



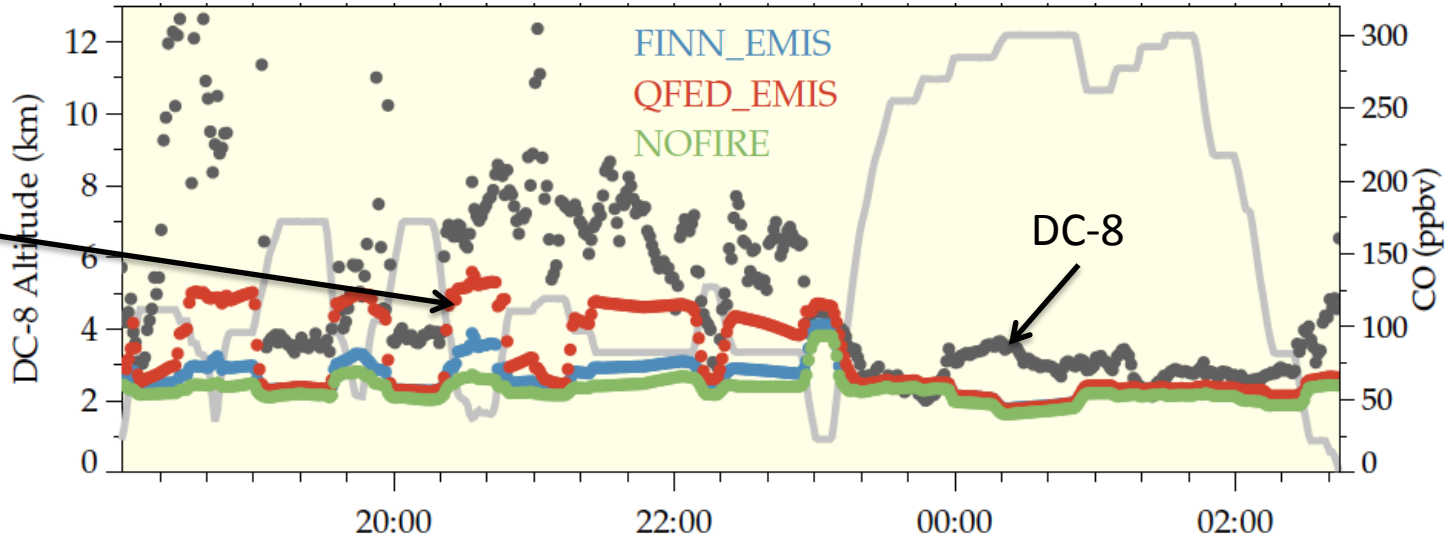
CAM-chem CO (QFED)



CAM-chem simulates wild fires over US-West (QFED>FINN)

CAM-chem underestimates **CO** from wildfires

SEAC⁴RS (DC-8)/CAM-chem CO (Aug 27, Rim Fire)



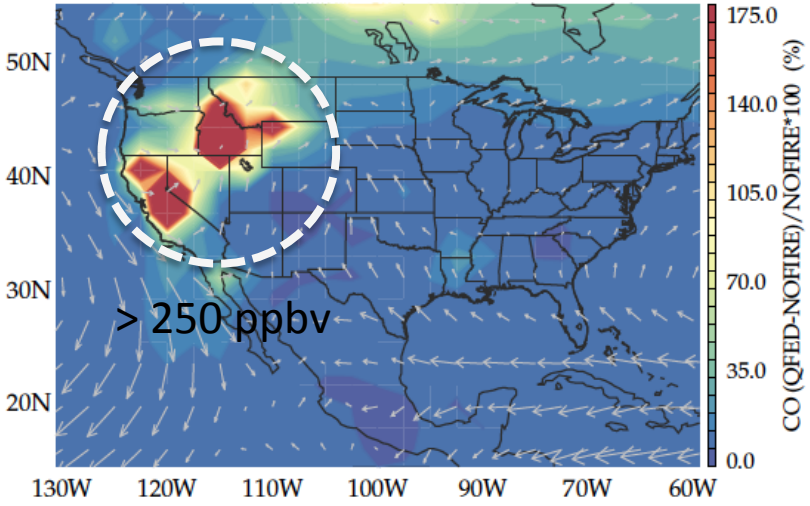
CO & O_3 Diff. – CAM-chem (US-West)

Aug 2013 (surface)

(QFED-NOFIRE) /NOFIREx100 (%)

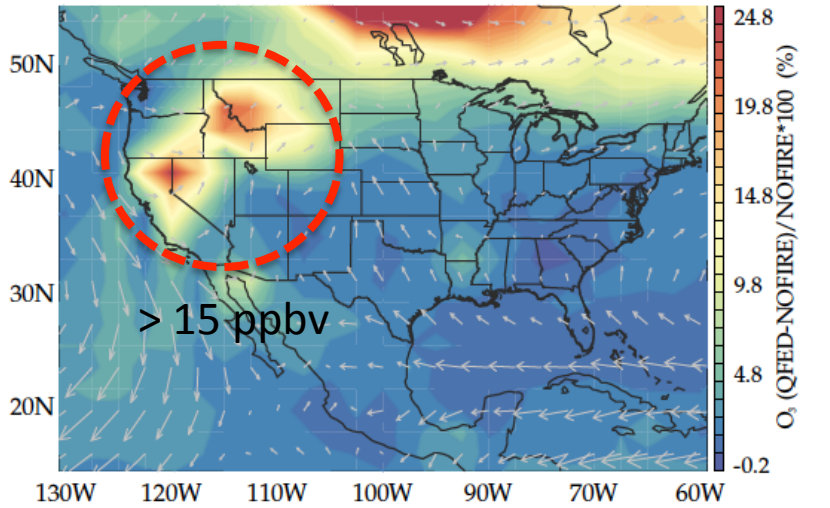
QFED-NOFIRE

CO



QFED-NOFIRE

O_3



CO increase (wild fires) -> O_3 increase (US-West)

CAM-chem (FINN-NOFIRE) has smaller differences in CO & O_3 over US-West (due to lower emissions of CO)

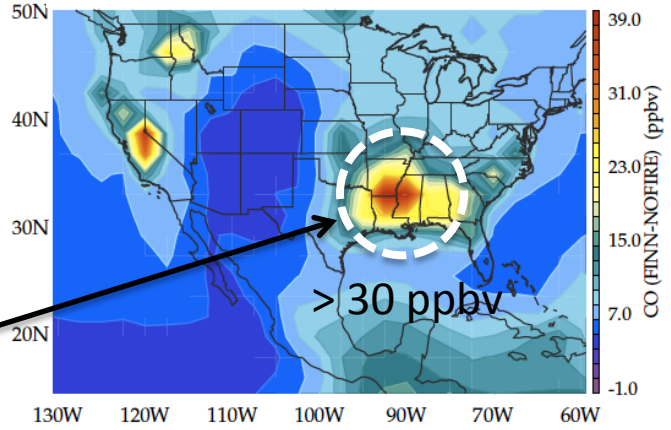
CAM-chem (FINNv1.5 & AG fire) – Sep 2013

Sep 2013 (surface)

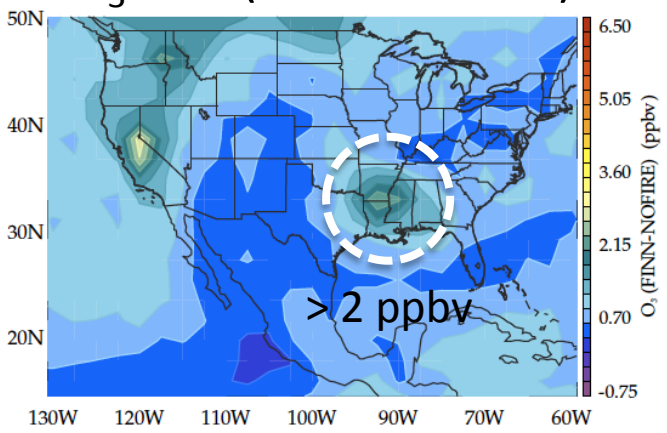
CO

O_3

CO (FINN-NOFIRE)



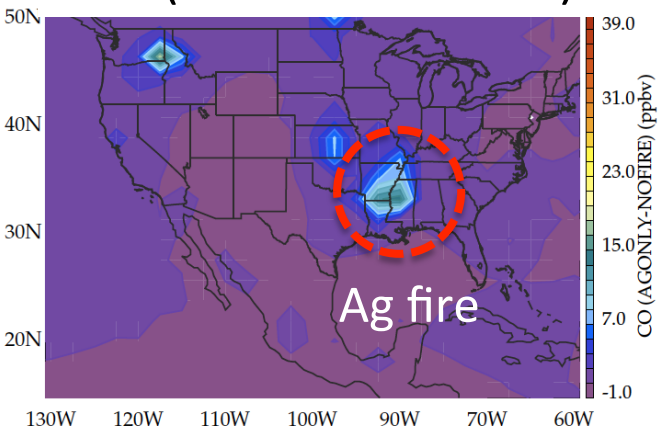
O_3 (FINN-NOFIRE)



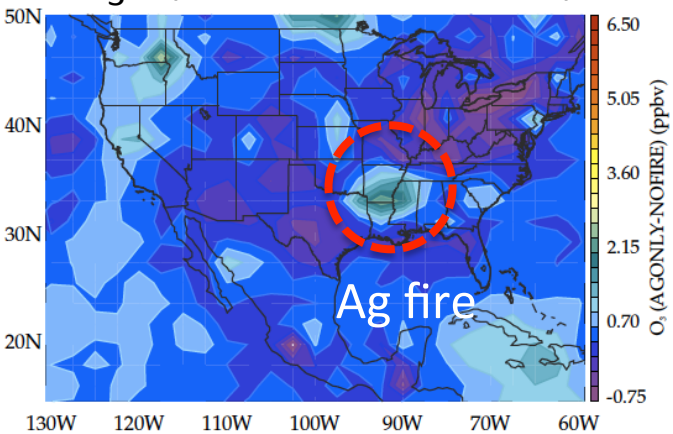
Larger contribution in **US-SE** in Sep (than Aug)

CO, VOCs, NOx (fire) -> O_3

CO (AGONLY-NOFIRE)



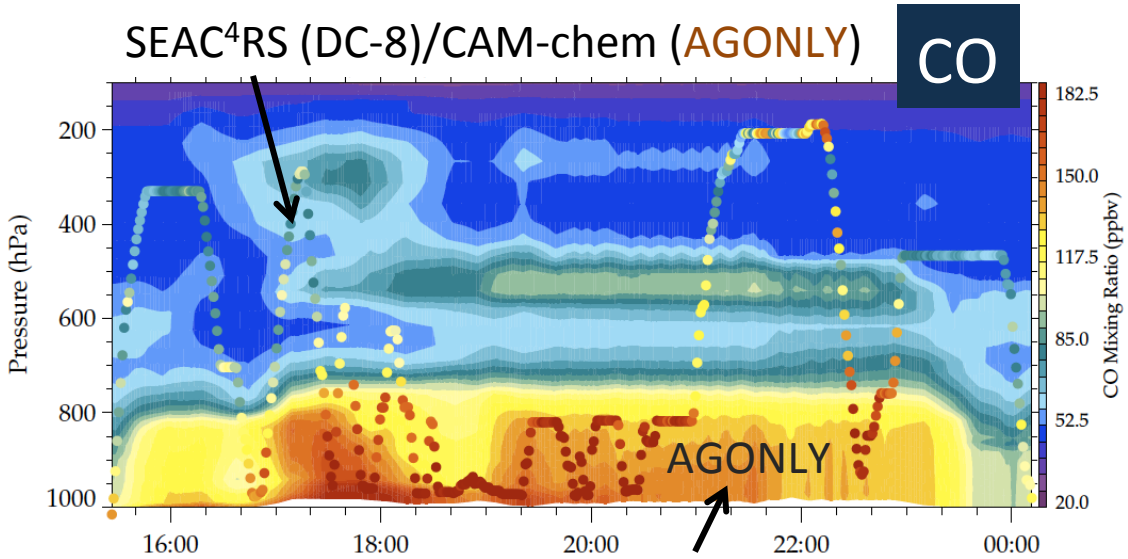
O_3 (AGONLY-NOFIRE)



Ag fires from FINN can be used to quantify impact of Ag fire only

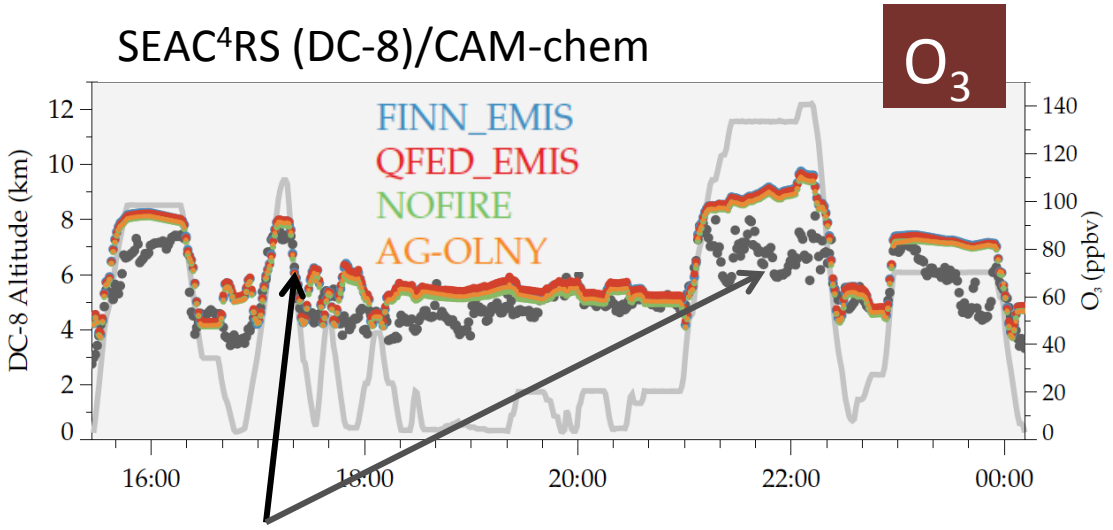
AG Fires - CAM-chem & DC-8 (Sep 11, 2013)

SEAC^{4}RS (DC-8)/CAM-chem (AGONLY)



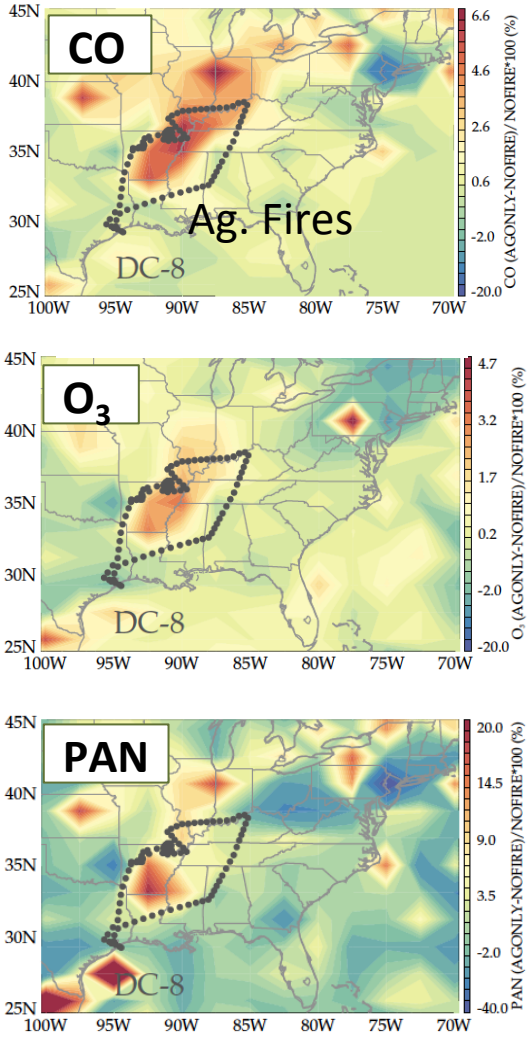
Ag. Fire (FINN) – large contribution to CO

SEAC^{4}RS (DC-8)/CAM-chem



CAM-chem & DC-8 O_3 (some agreement/differences)

CAM-chem (sfc, 18Z)
(AGONLY-NOFIRE)/NOFIREx100 (%)



Ag fires-> CO, O_3 and PAN

Summary

1. **FINN-QFED** inter-comparison
   - FINN-v1.5 agrees with QFED in **US-SE**
   - FINN-v1.5 lower than QFED in **US-West** (forest fires)
   - FINN-v2 (test) significantly higher than v1.5
2. **CAM-chem** (QFED, FINN, and NOFIRE)
   - Differences in emissions have direct impact on simulated CO (& other tracers) -> O_3
3. **CAM-chem** (FINN - Ag Fire only)
   - Large contribution from Ag fires to CO -> O_3 (**US-SE**)

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