

Modeling biomass burnings by coupling a sub-grid scale plume model with Adaptive Grid CMAQ

Aika Yano (Georgia Institute of Technology)

Fernando Garcia-Menendez (Georgia Institute of Technology)

Yongtao Hu (Georgia Institute of Technology)

M. Talat Odman (Georgia Institute of Technology)

Gary Achtemeier (USDA Forest Service)

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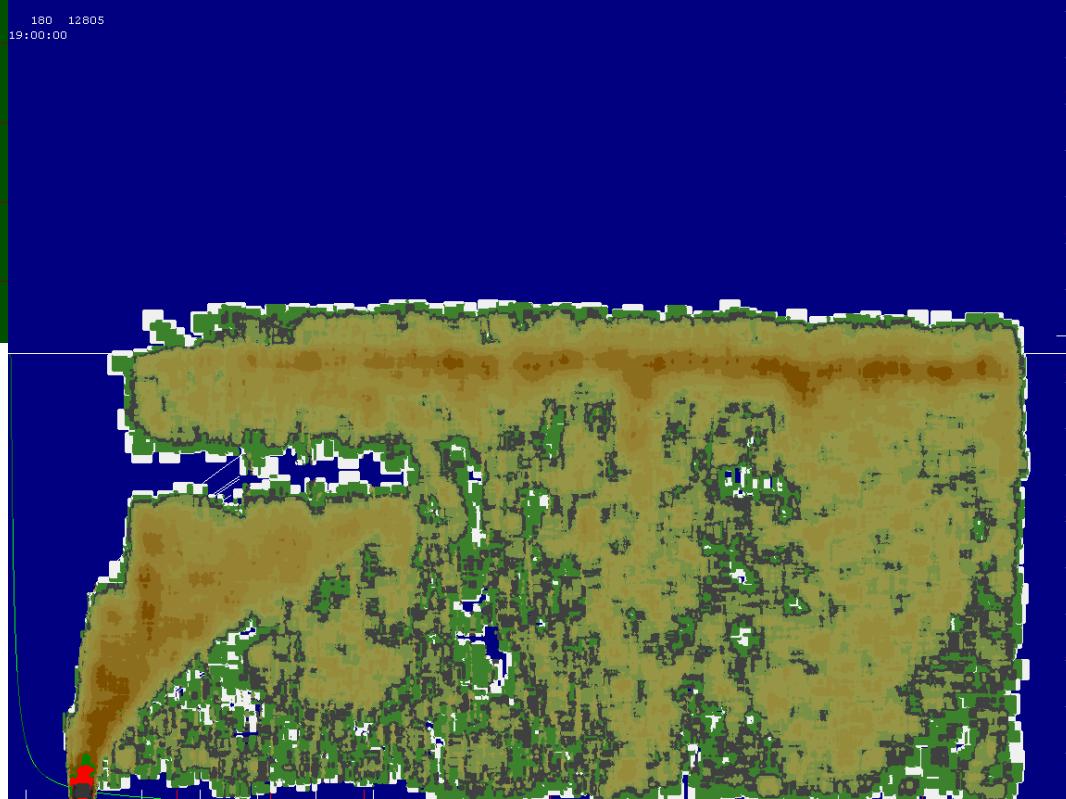
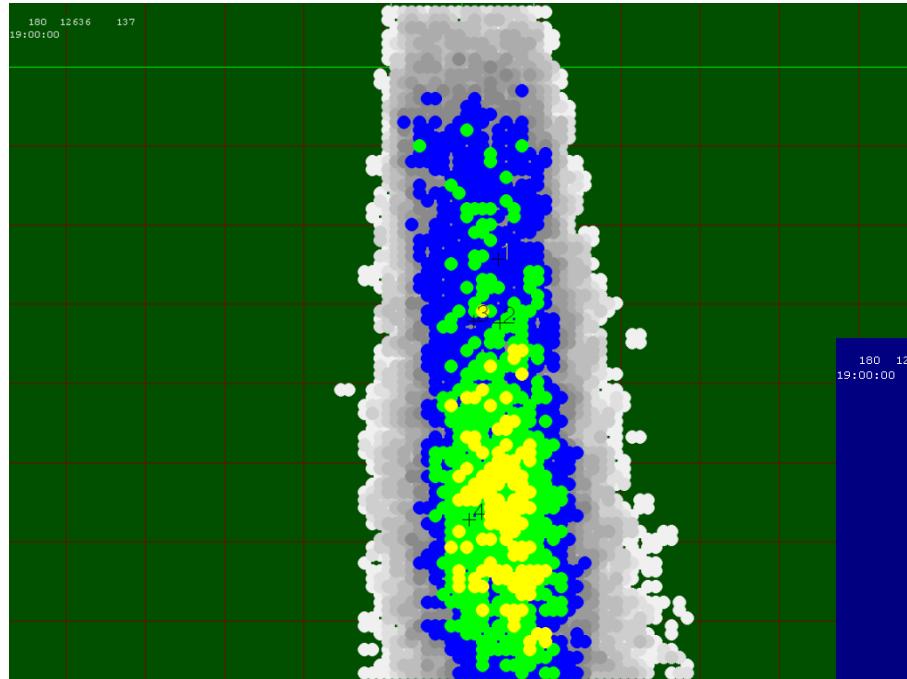


Use of subgrid-scale modeling

- the representation of important small-scale physical processes that occur at length-scales that cannot be adequately resolved on a computational mesh
- represent the effects of unresolved small-scale fluid motions; small eddies, swirls, vortices

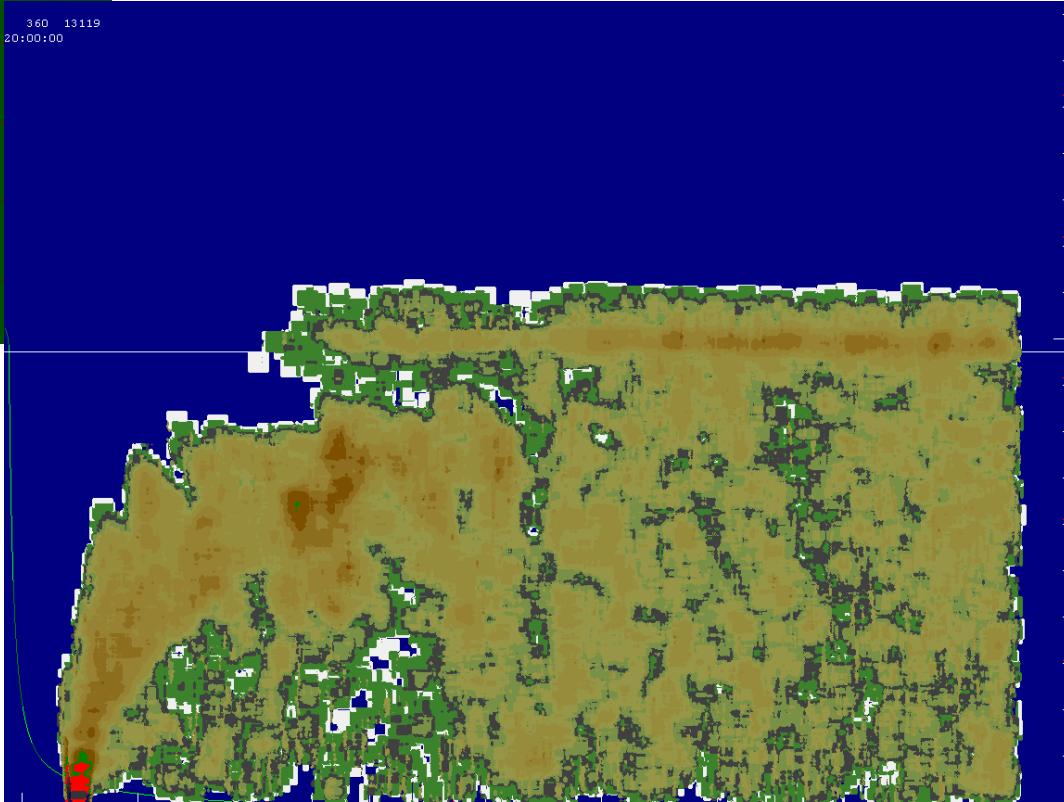
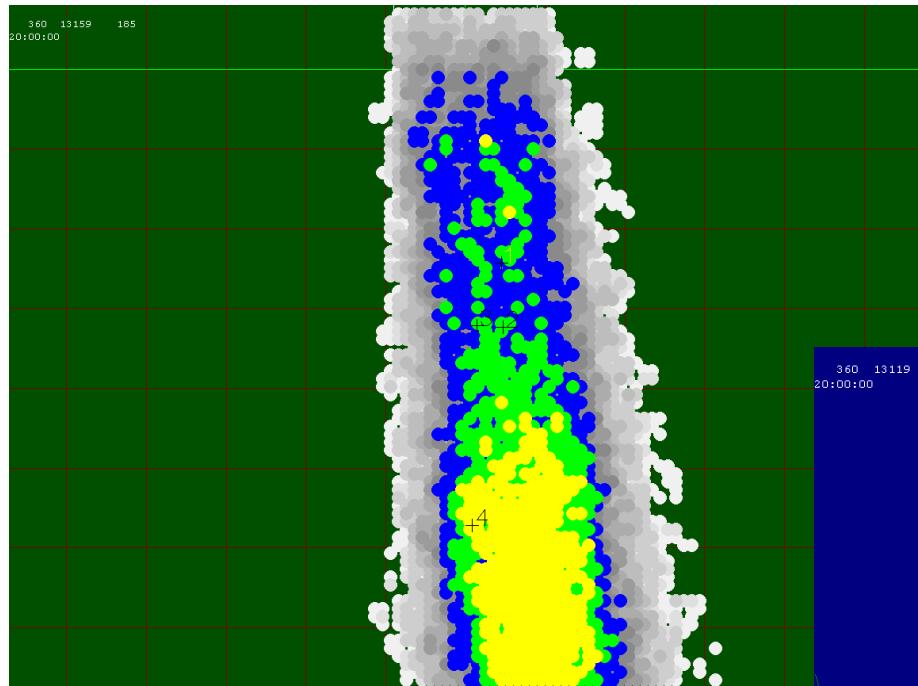


sub-grid scale plume model: Daysmoke



sub-grid scale plume model:

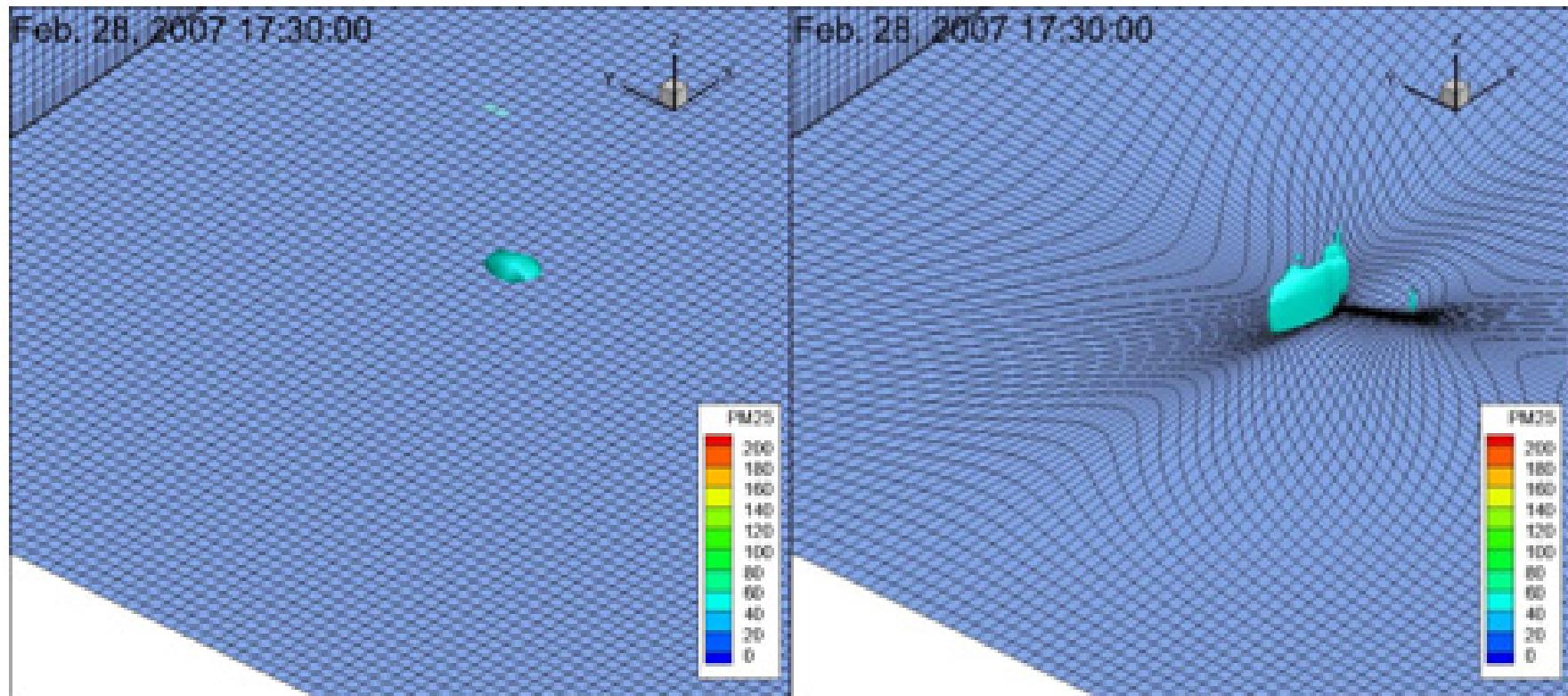
Daysmoke



Air Quality model: CMAQ



Sub-grid model + Uniform grid vs. Adaptive grid

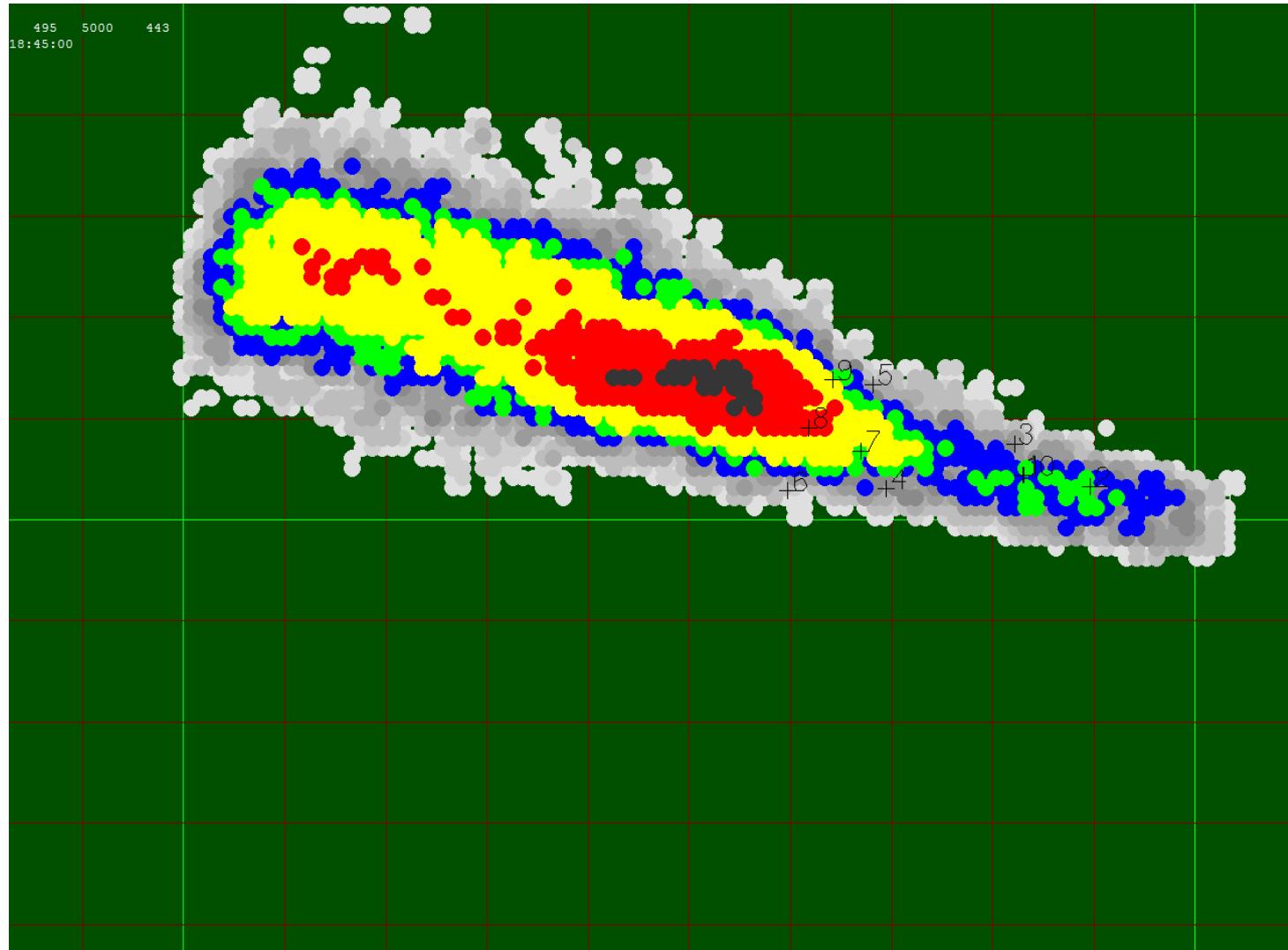


To investigate

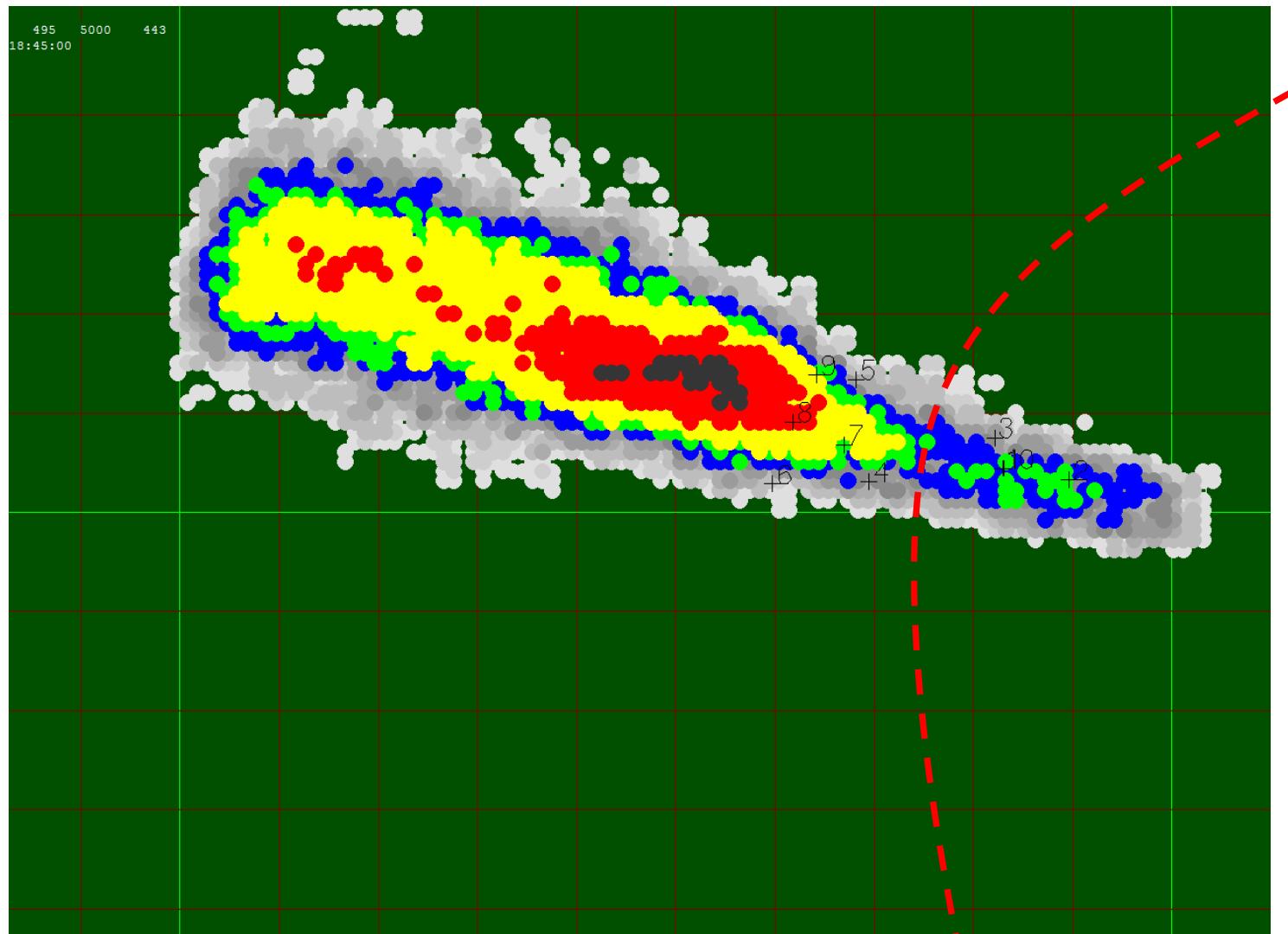
1. How far out from the source should an air quality model rely on a sub-grid plume model?
2. If the number of parcels in the sub-grid model increases, will the plume be different?
3. How does increase in emissions affect downwind ground concentrations?



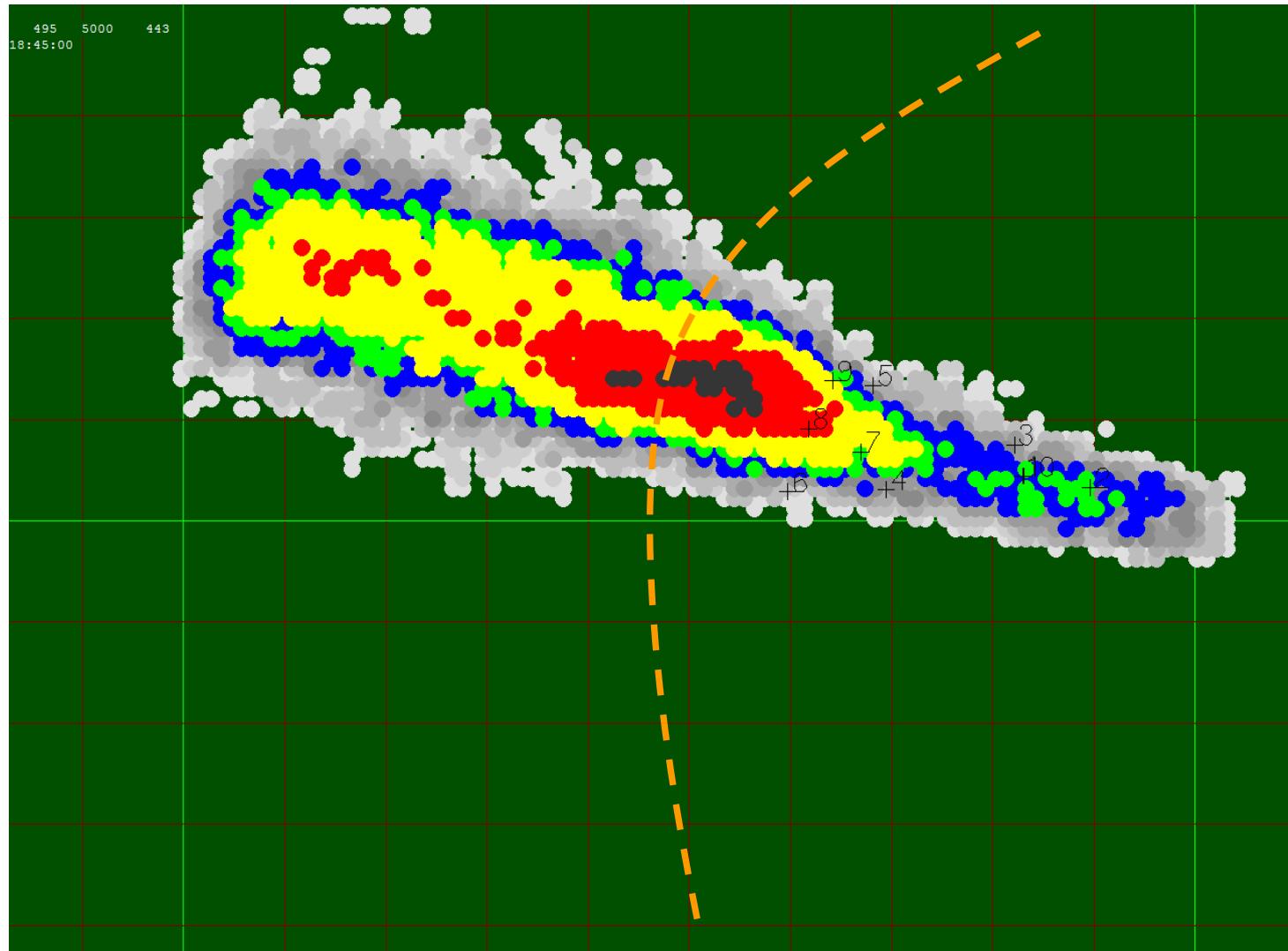
1) Where to couple Daysmoke with AG-CMAQ?



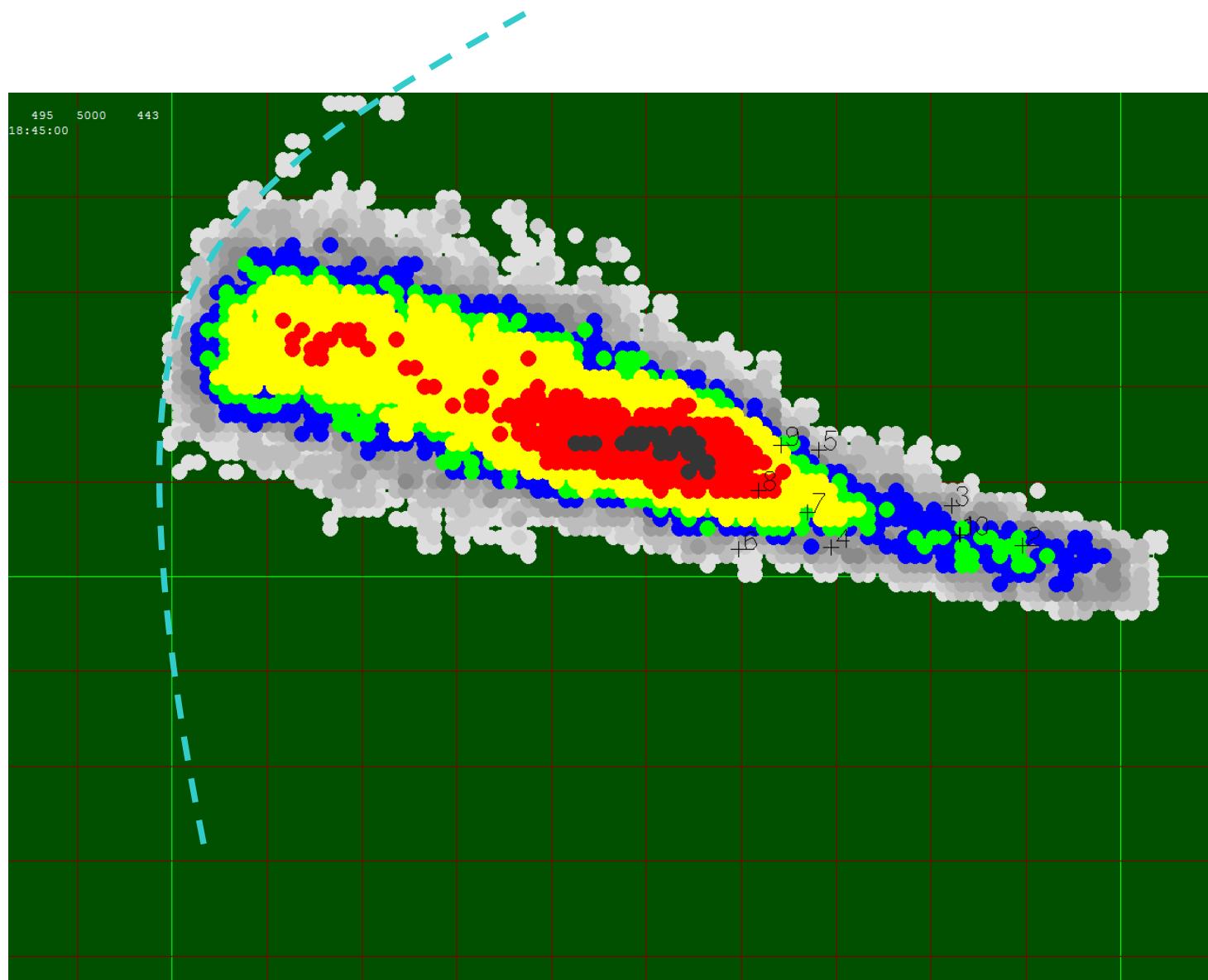
2 miles?



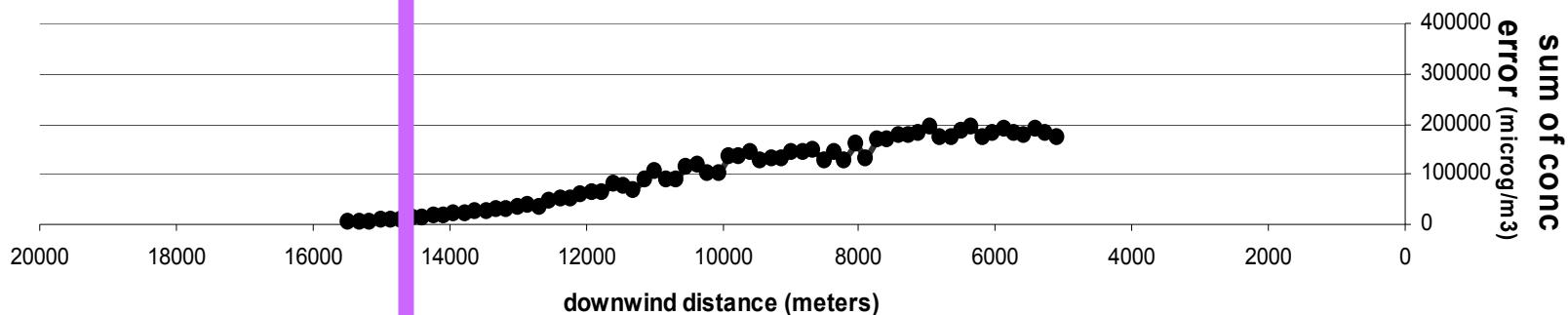
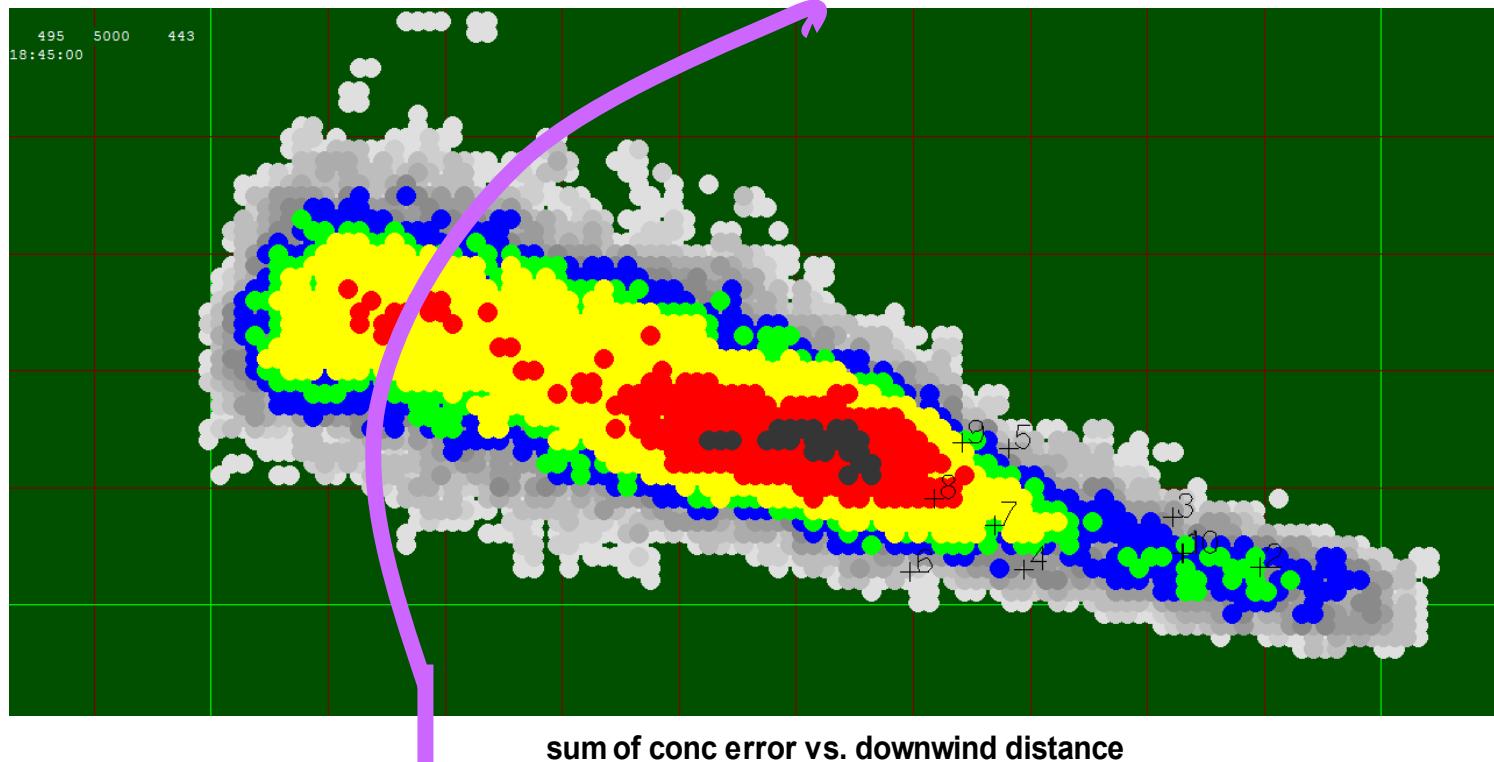
5miles ?



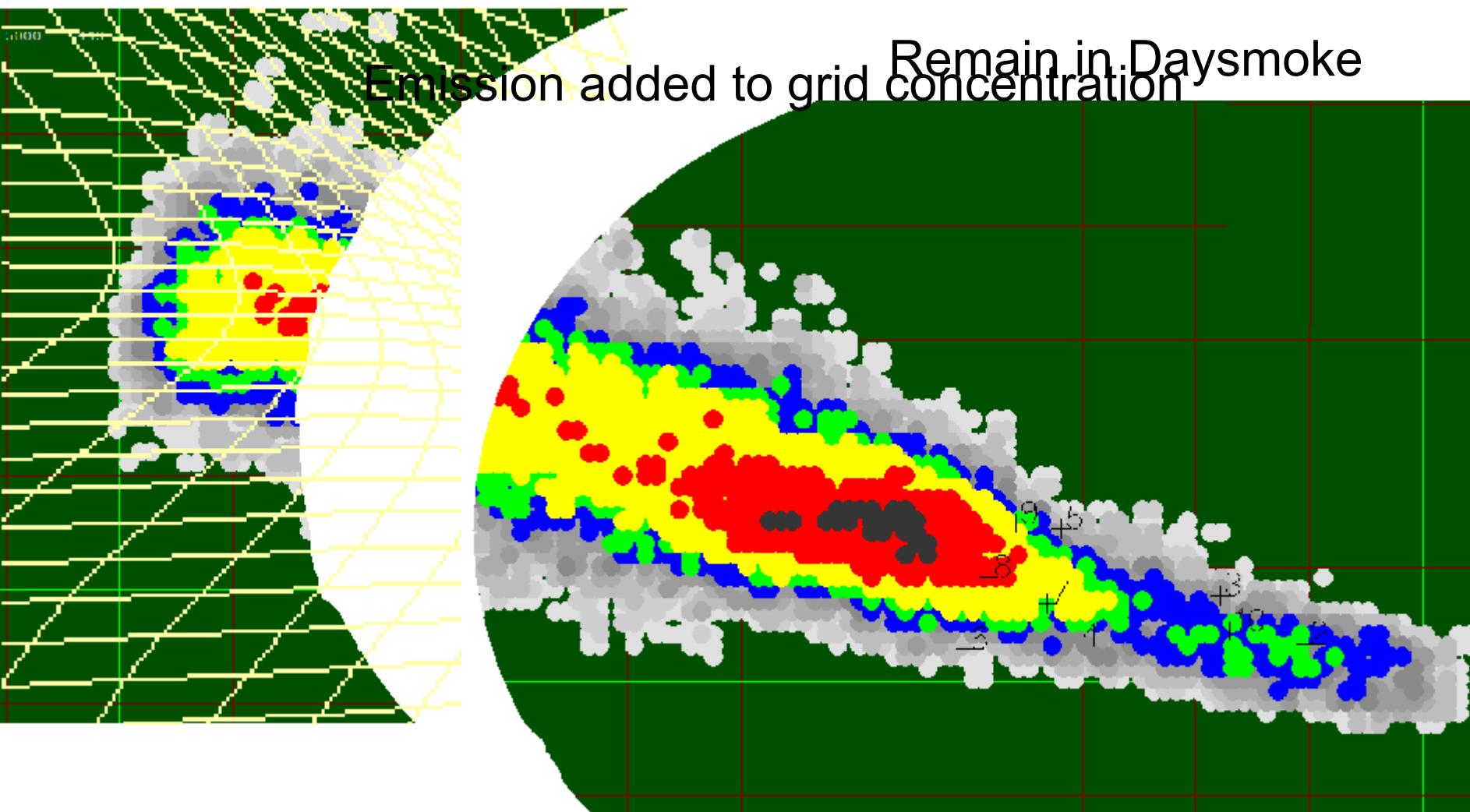
10 miles ?



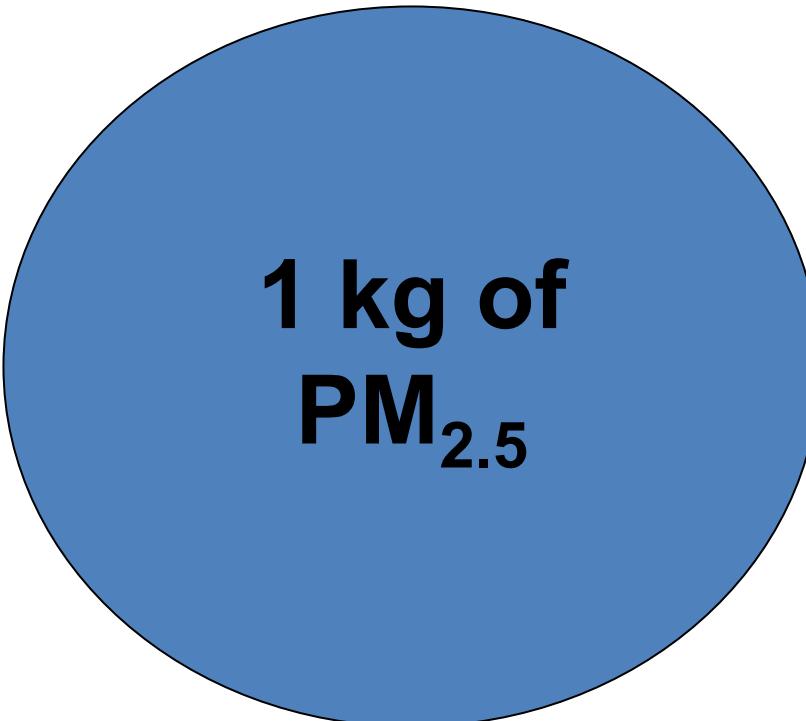
Handover



Handover



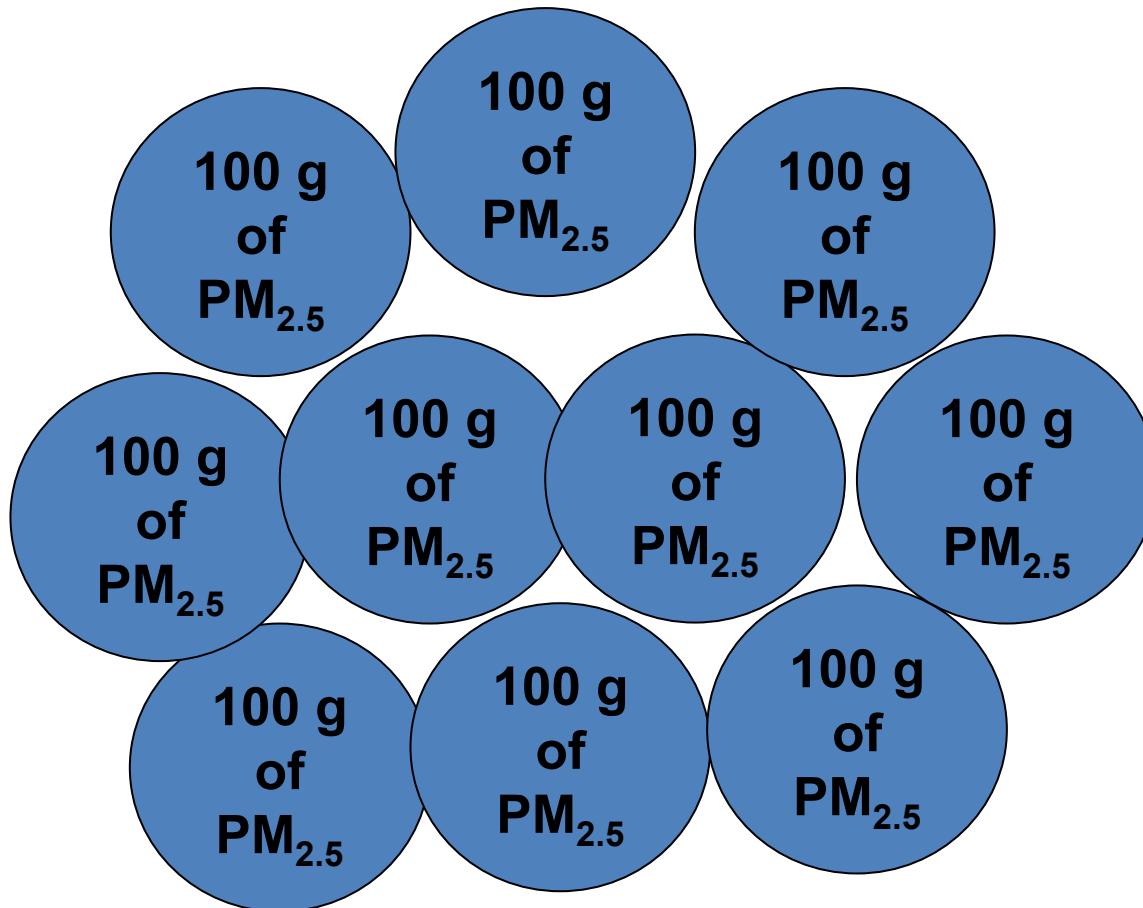
2) Number of parcels?



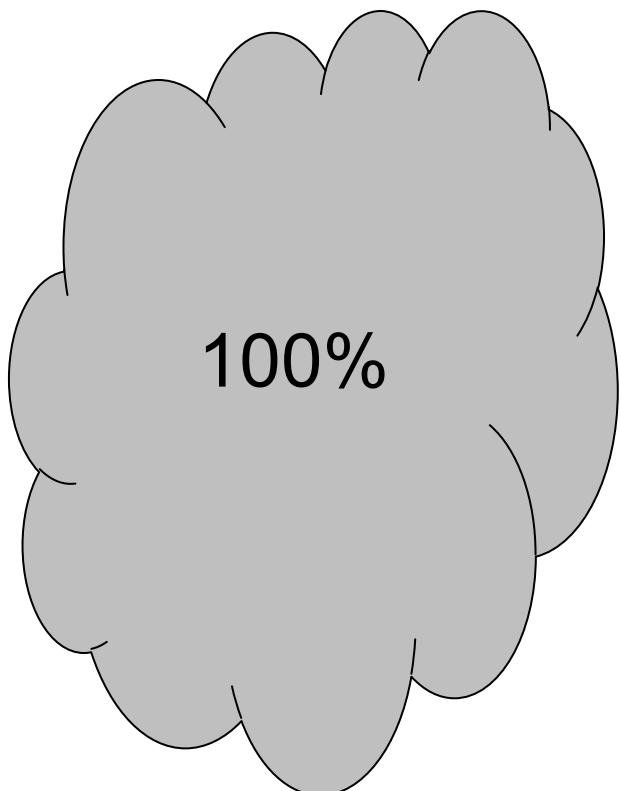
1 kg of
PM_{2.5}



2) Number of parcels?

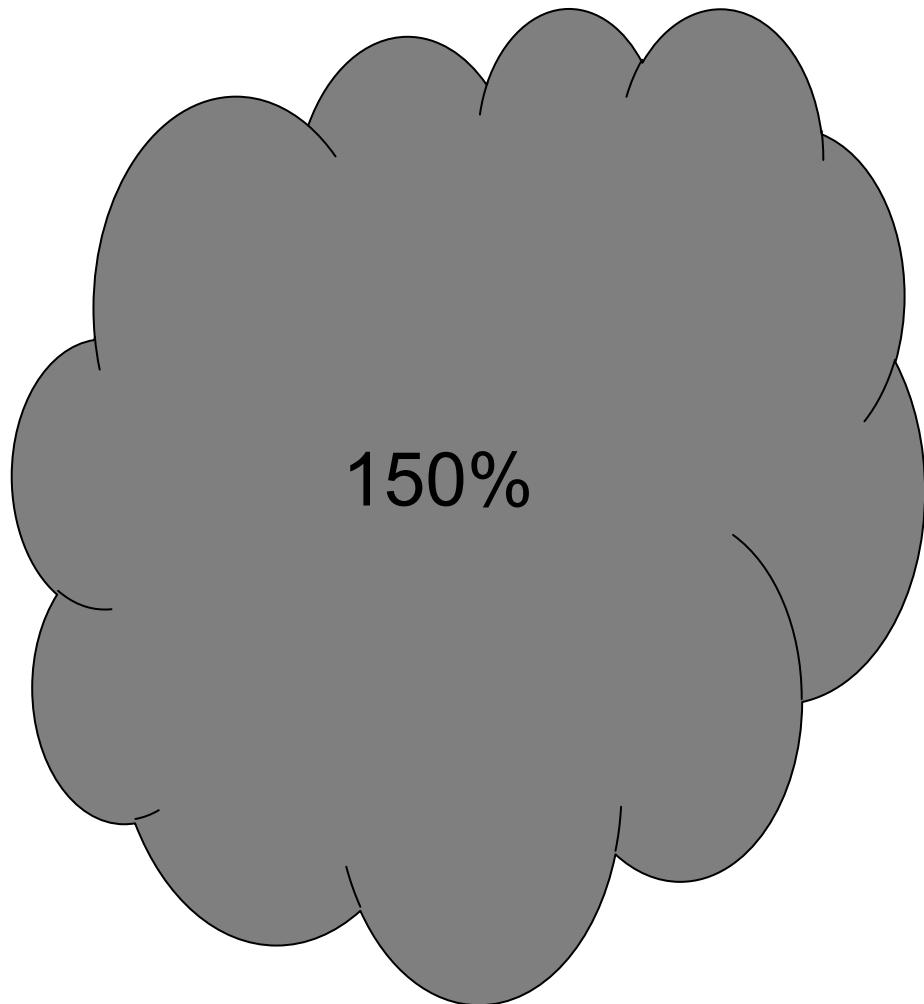


3) 50 % increase in emission



100%

vs



150%

Atlanta Smoke Case

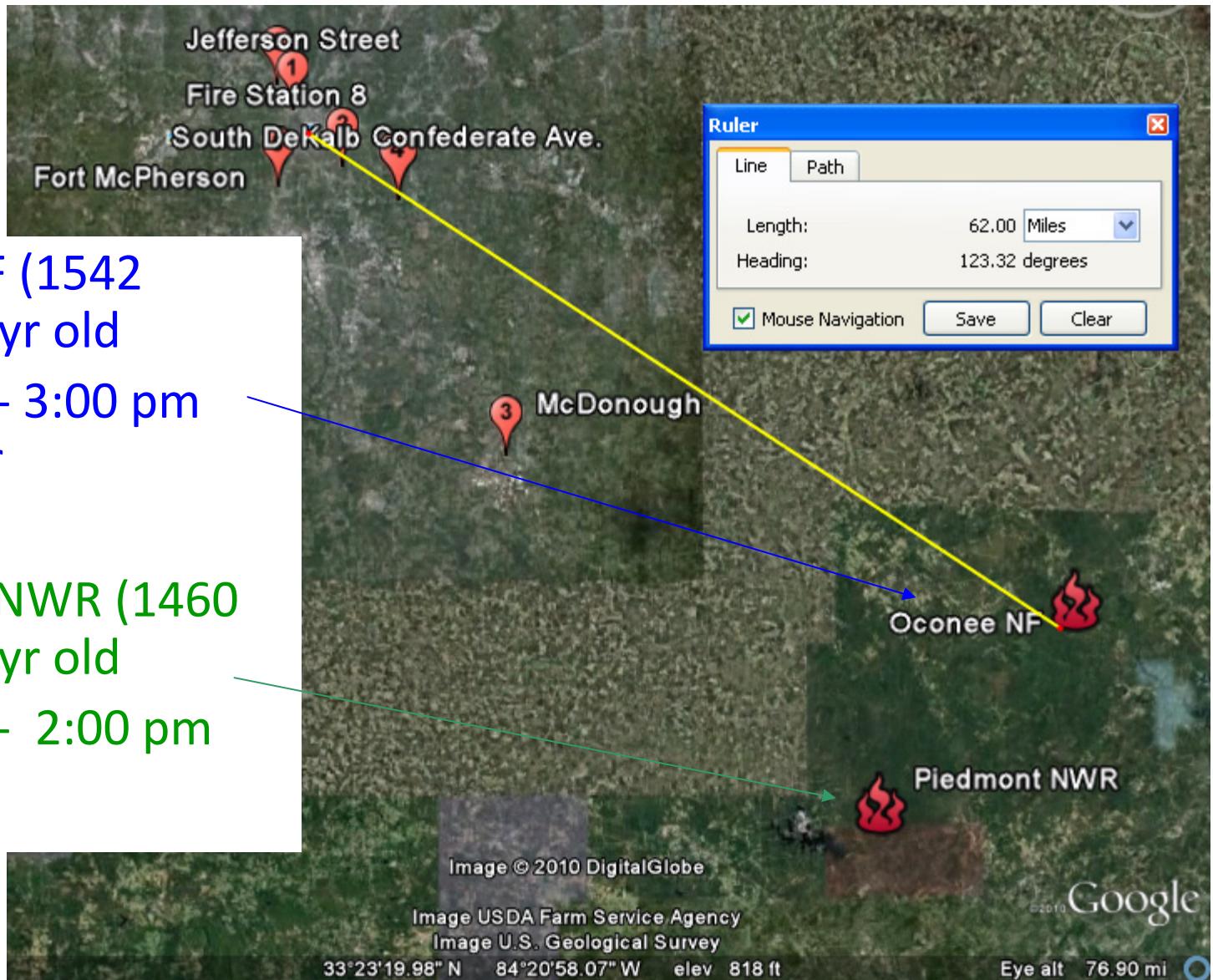
Feb. 28 2007

Oconee NF (1542
acres) 5 yr old

10:00 am - 3:00 pm
total 5hr

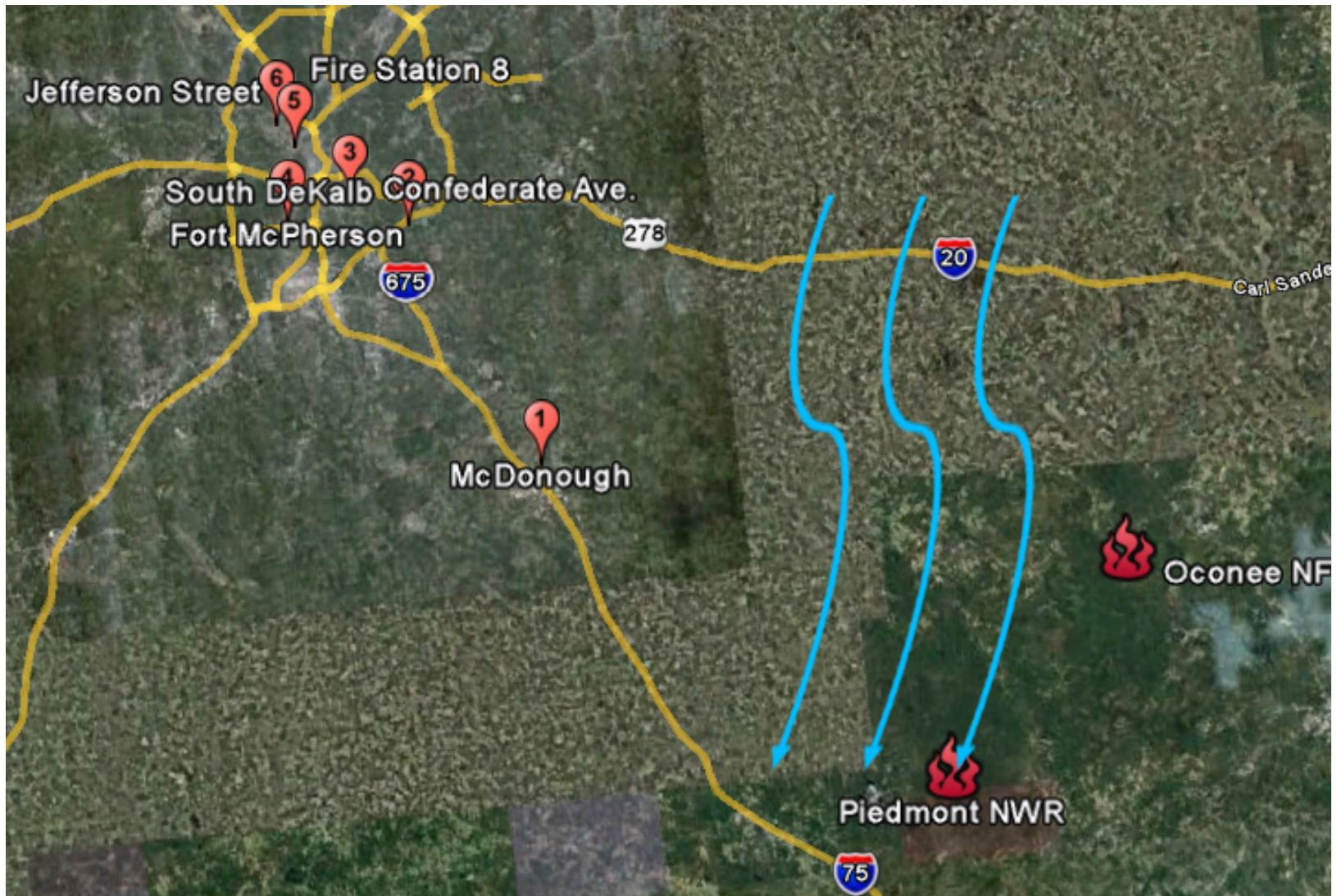
Piedmont NWR (1460
acres) 1 yr old

11:00 am - 2:00 pm
total 3hr



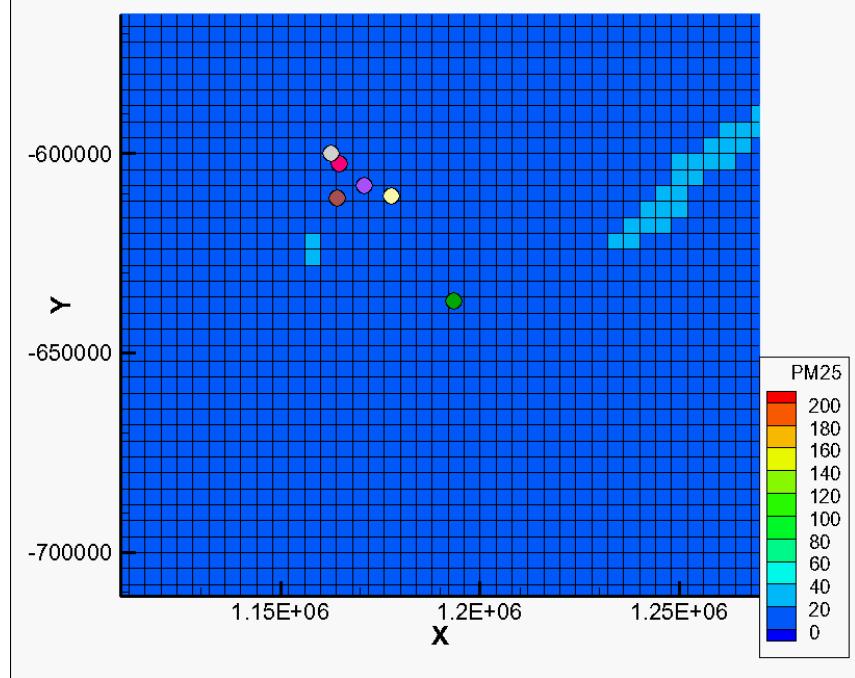
Atlanta Smoke Case

Feb. 28 2007

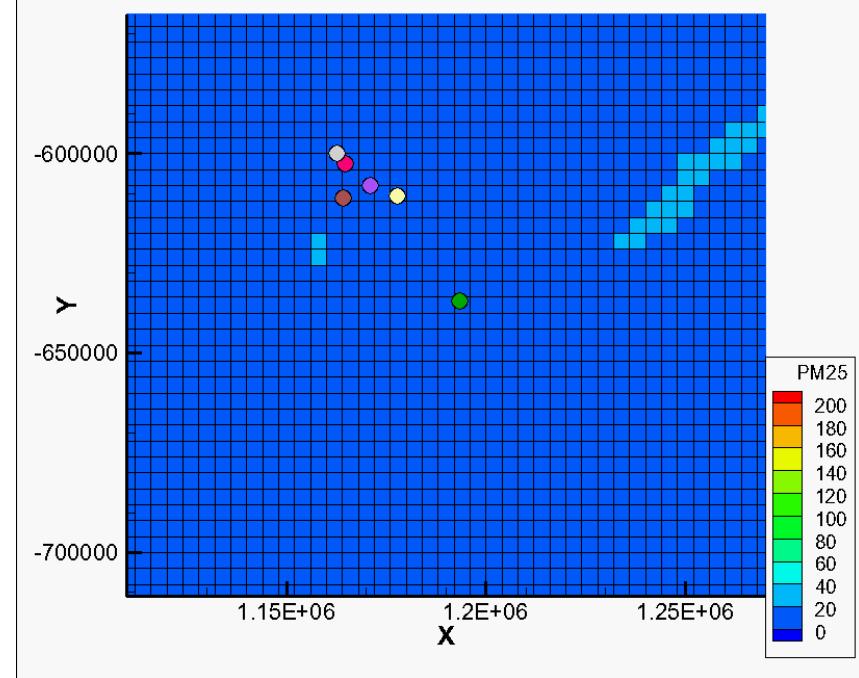


Uniform vs. adaptive CMAQ

Feb. 28, 2007 15:00:00

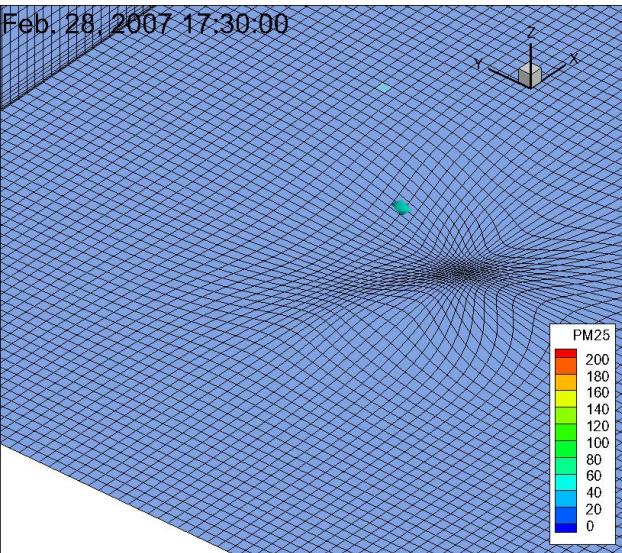
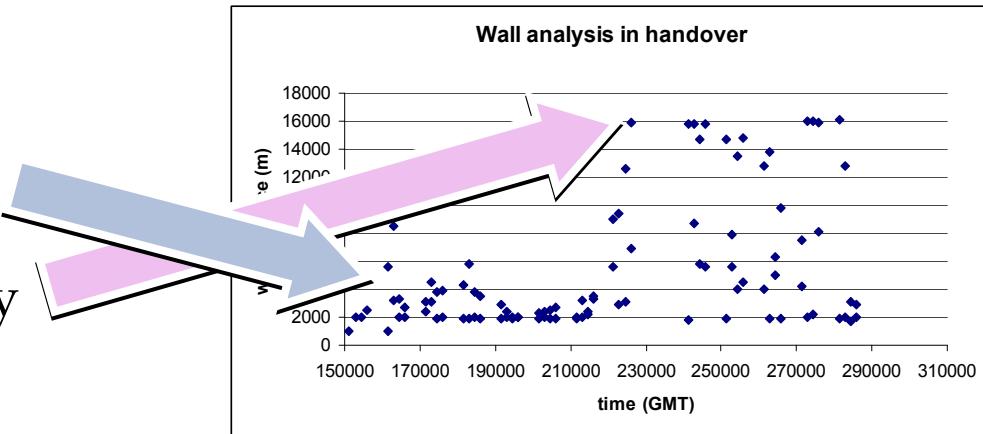


Feb. 28, 2007 15:00:00

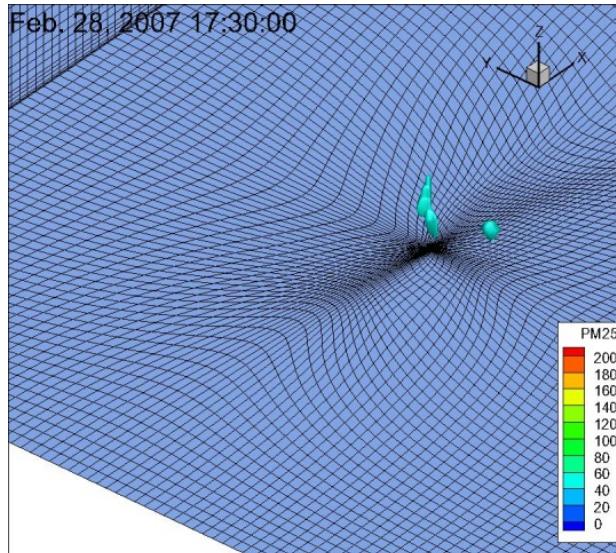


1) Distance to carry over pollution concentration to AQ model

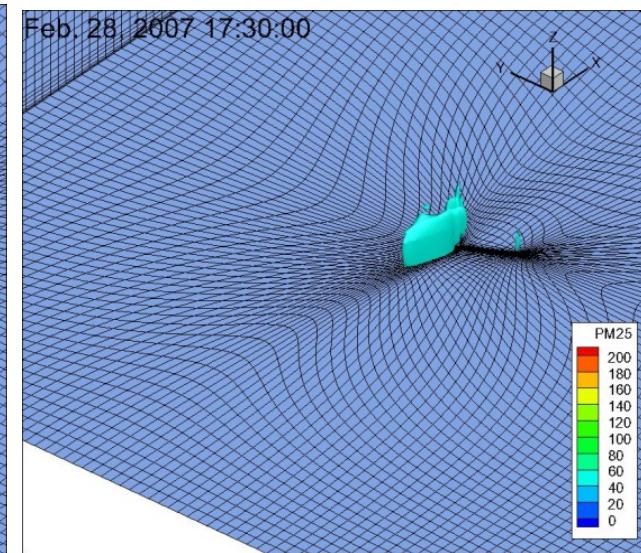
Handover wall varies between **2-4 km** during flaming phase, then moves up to **16km** away



10 miles



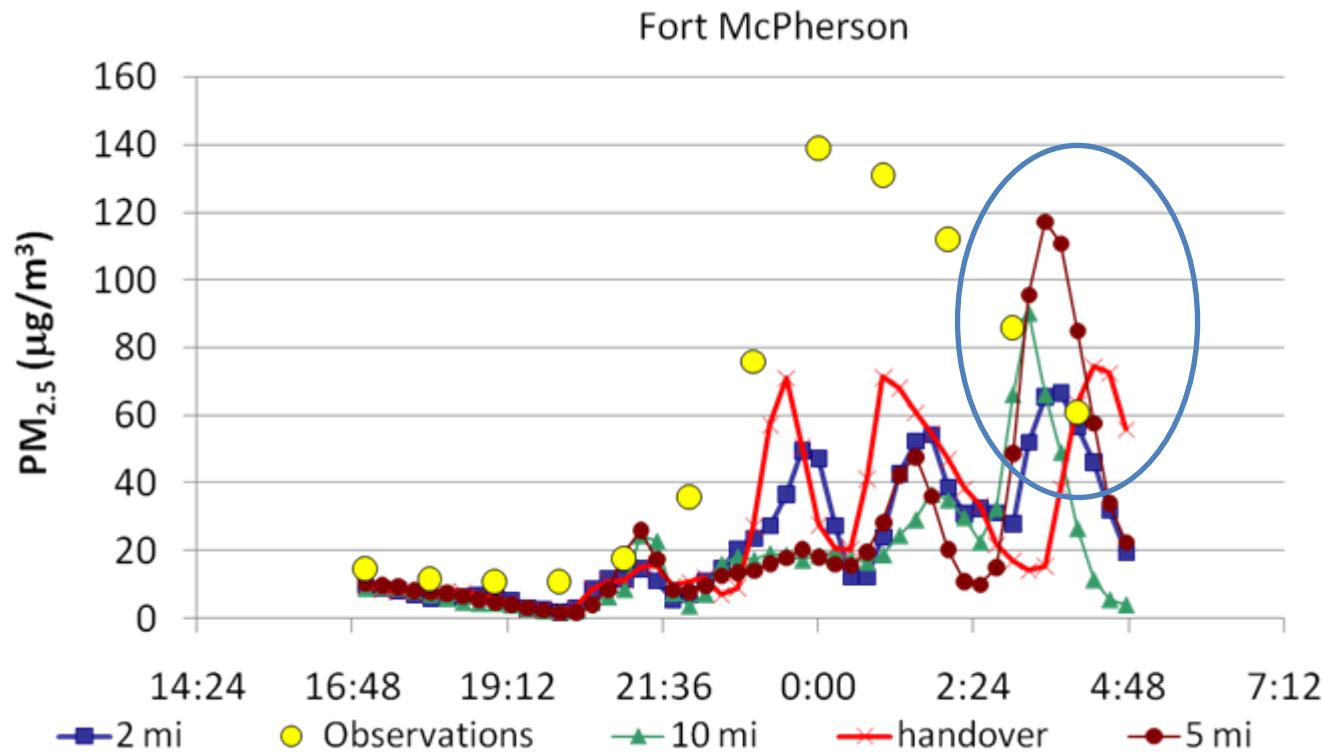
5 miles



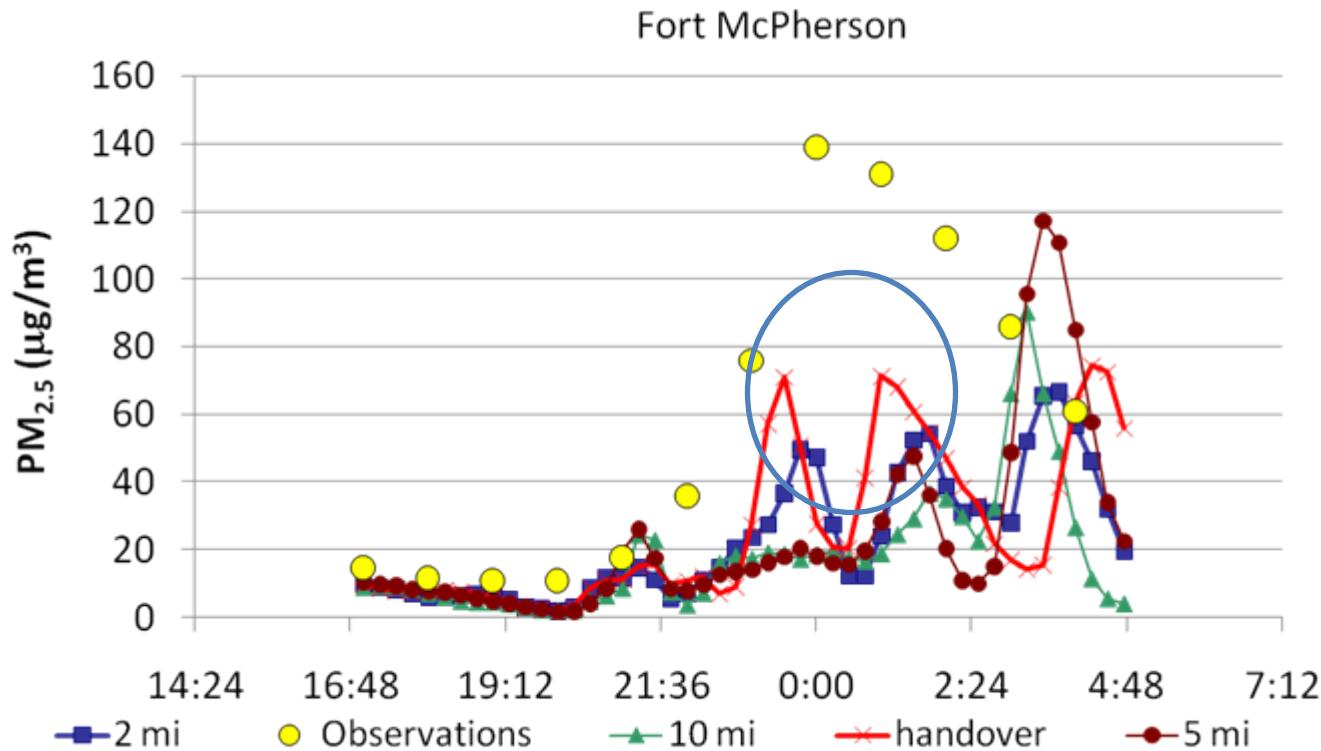
handover



1) Distance to carry over pollution concentration to AQ model



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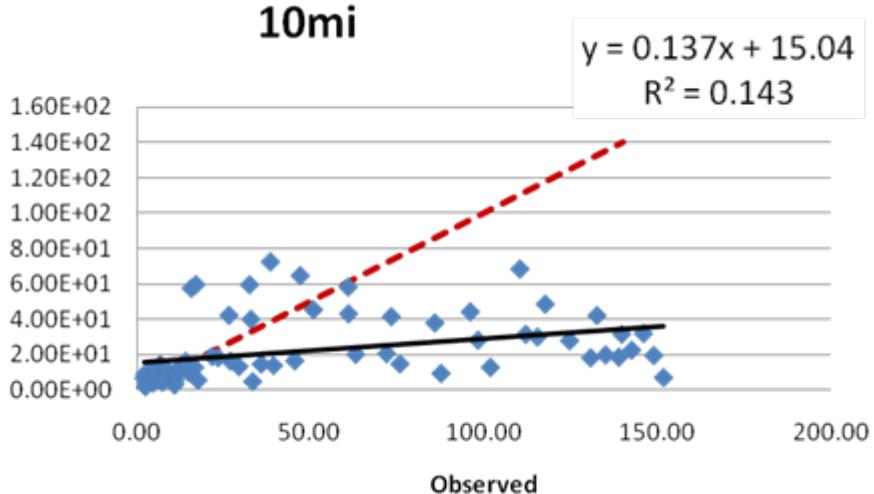
Mean Fractional Error

2 mi	5 mi	10 mi	handover
67.26%	74.79%	75.66%	65.19%

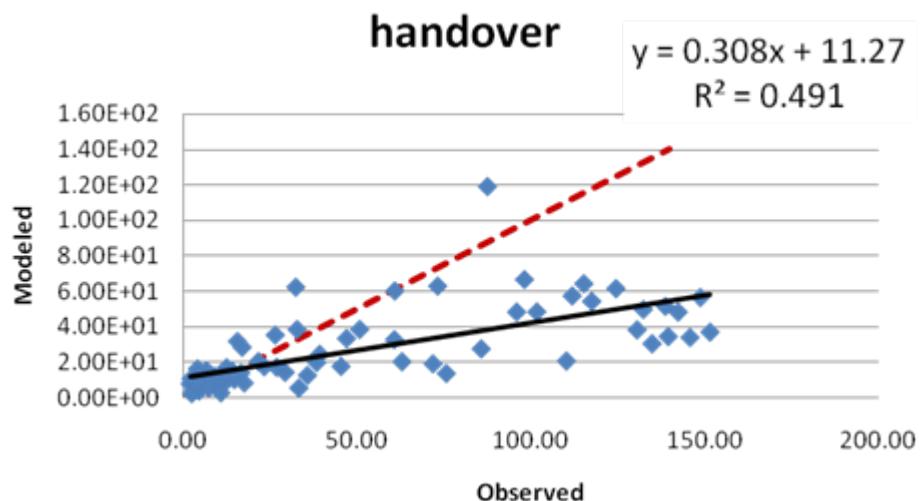


Model vs. Observation

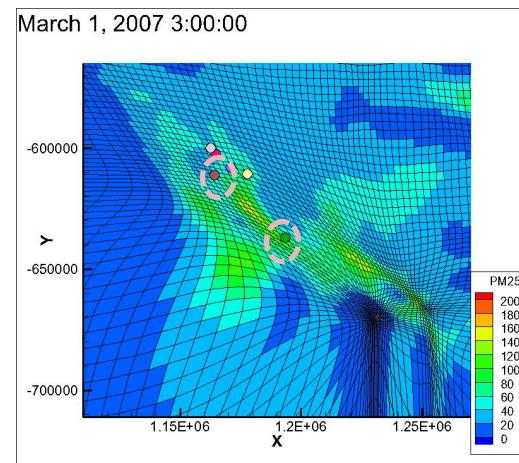
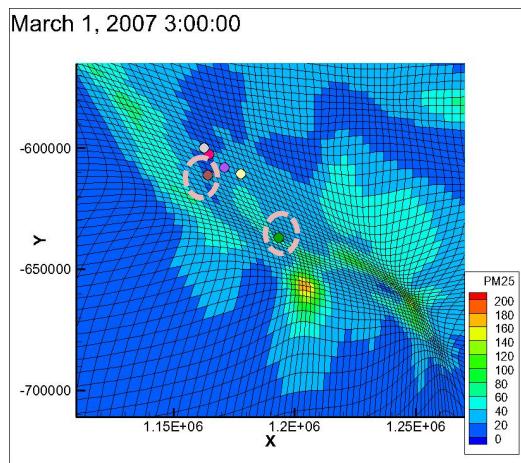
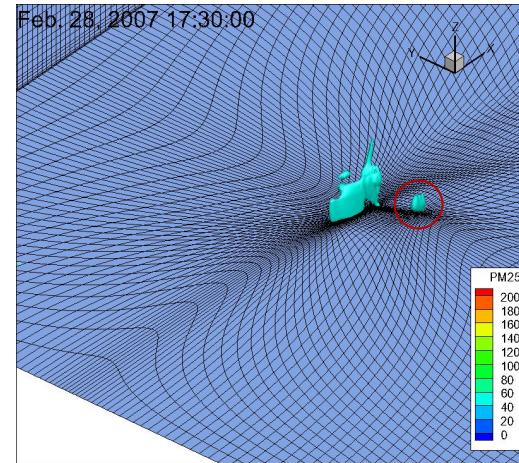
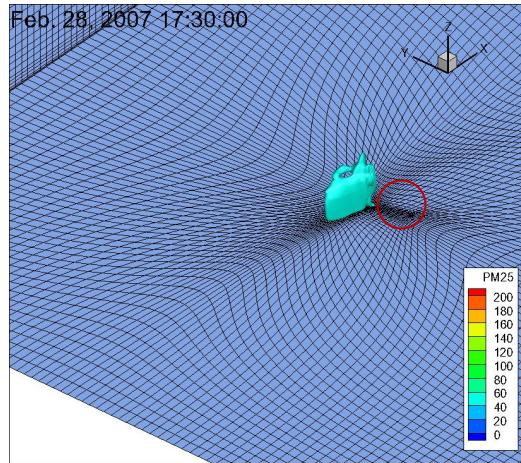
10mi



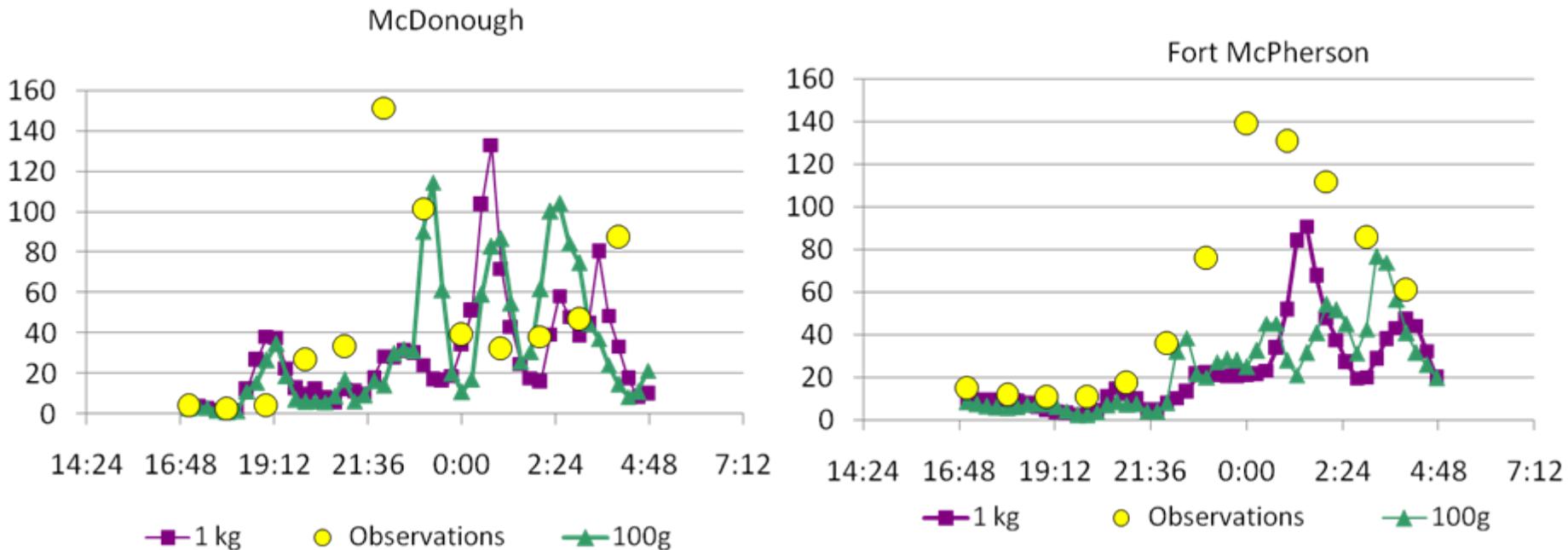
handover



2) 1kg/parcel vs 100g/parcel



2) 1kg/parcel vs 100g/parcel



	1kg	100g
Mean fractional error	65.13%	67.02%

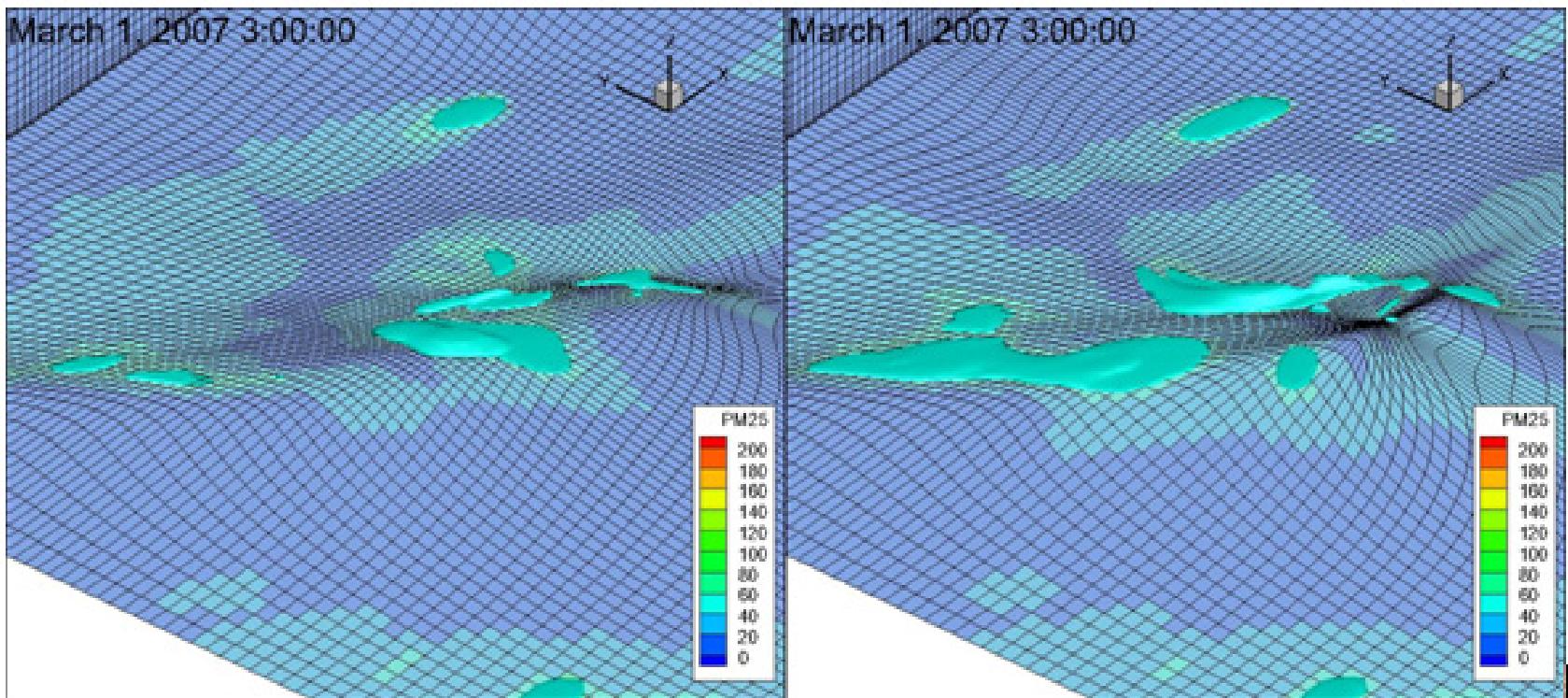


3) Sensitivity to emission increase by 50%

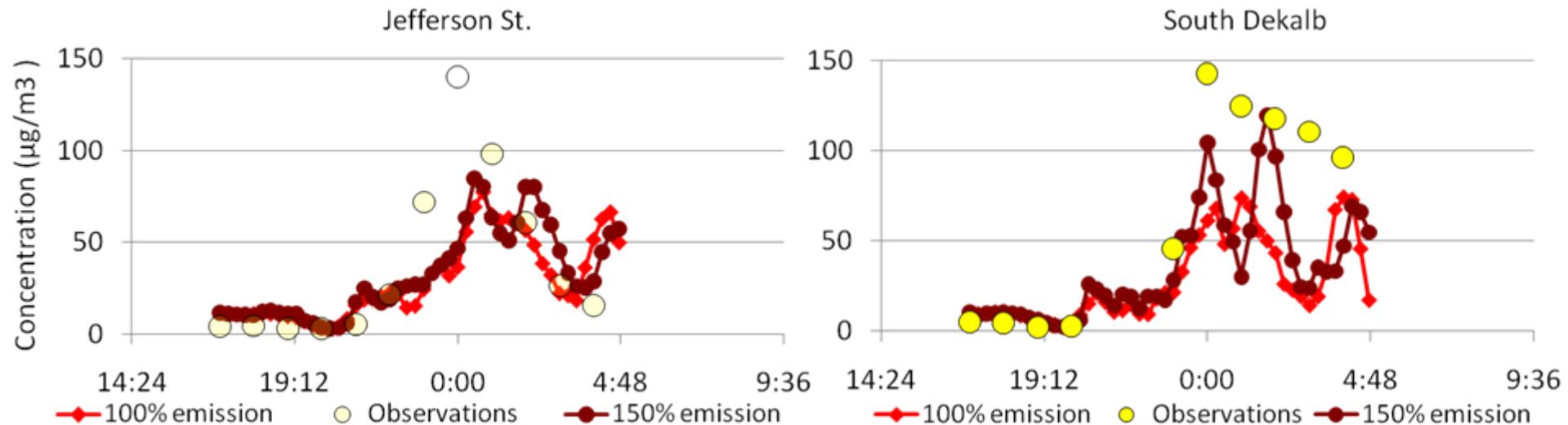
At 3GMT: 100% emission

vs.

150% emission



3) Sensitivity to emission increase by 50%



	Calc. emis	1.5 emis
Mean fractional error	65.19%	64.78%

Maximum concentration increased 23% more and ground concentration increased by 9%



Summary

1. A coupling method called handover is introduced and proves to help predict concentration downwind more accurate than setting a stationary boundary for the sub-grid model.
2. Smaller parcel mass of the plume in Daysmoke causes higher accumulation of ground concentration over the period of an event but fractional error is larger.
3. Small positive relationship between increase in input emissions and concentration increase at downwind sites.



Thank you for your attention

Questions/Comments?

