Smoke Forecast Tool

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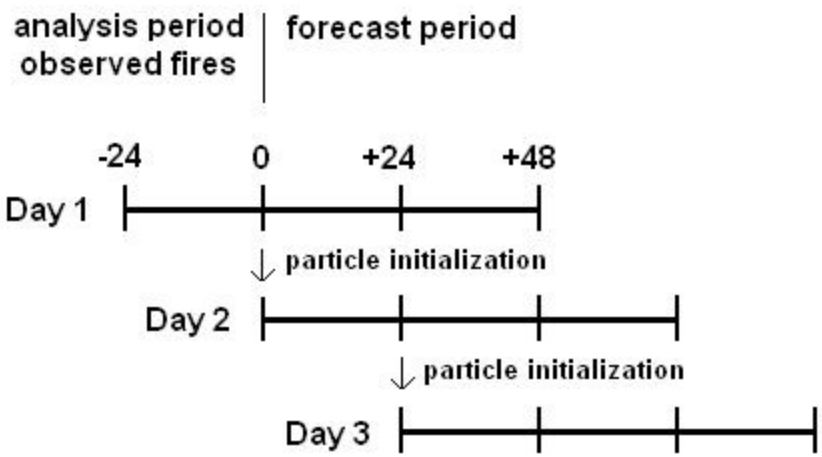
Smoke Forecast Tool

Overview

- Moved to production at NCEP March 7, 2007
- Run daily using the 6Z cycle for a 24-hr analysis and a 48-hr forecast
- Transport & dispersion computed with HYSPLIT using WRF-NMM (AQF version) and GFS meteorology (outside the WRF-NMM domain)

Computational Cycle



All smoke particles and large fires initialize the next day's calculation

Smoke Forecast Tool

Fire Locations

- Produced by NESDIS operational staff from satellite imagery
- Only fires with observed associated smoke are used in calculation
- Fires are noted as continuous or by a start time and duration
- “Undetected” old fires decay at 75% / day with each new analysis
- Fire intensities remain constant during the forecast period

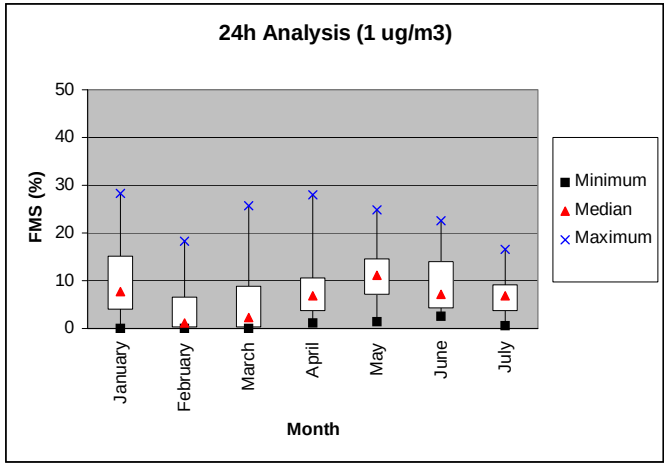
Emissions

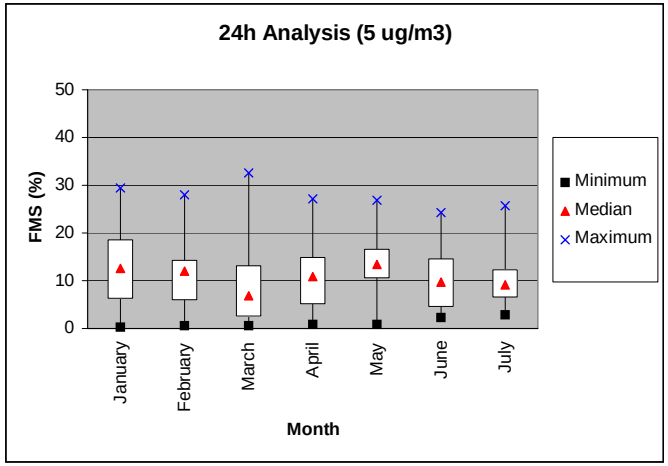
- USFS’ BlueSky emissions algorithm gives rates for PM2.5
- Emission area is computed from the number of fire locations in a grid cell
- Only 10% of each fire pixel (1 km^2) is assumed to be burning

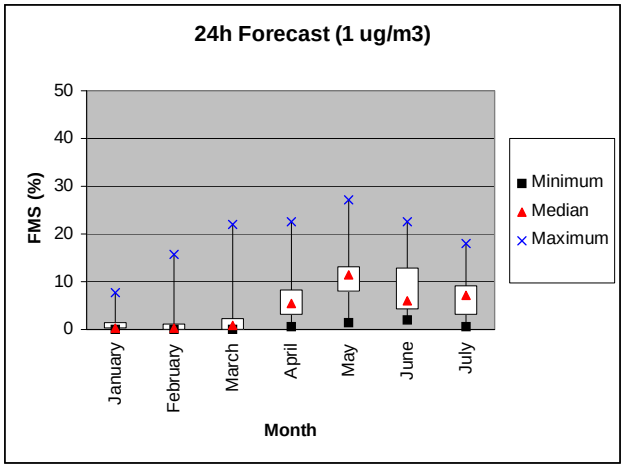
HYSPLIT Transport/Dispersion

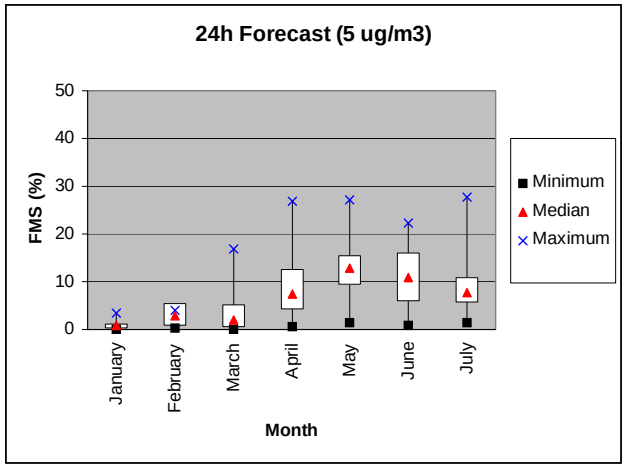
- Release height (Briggs) based on combustion heat from BlueSky and meteorology
- Surface to 100 m and surface to 5000 m 1-hr average PM2.5 concentrations on a 15-km grid
- Only continuous fires emit into the forecast period
- The focus is on primary rather than secondary pollutants (age < 72 hrs)
- Wet and dry deposition can also reduce smoke concentrations

FMS-HMS Performance for 2007



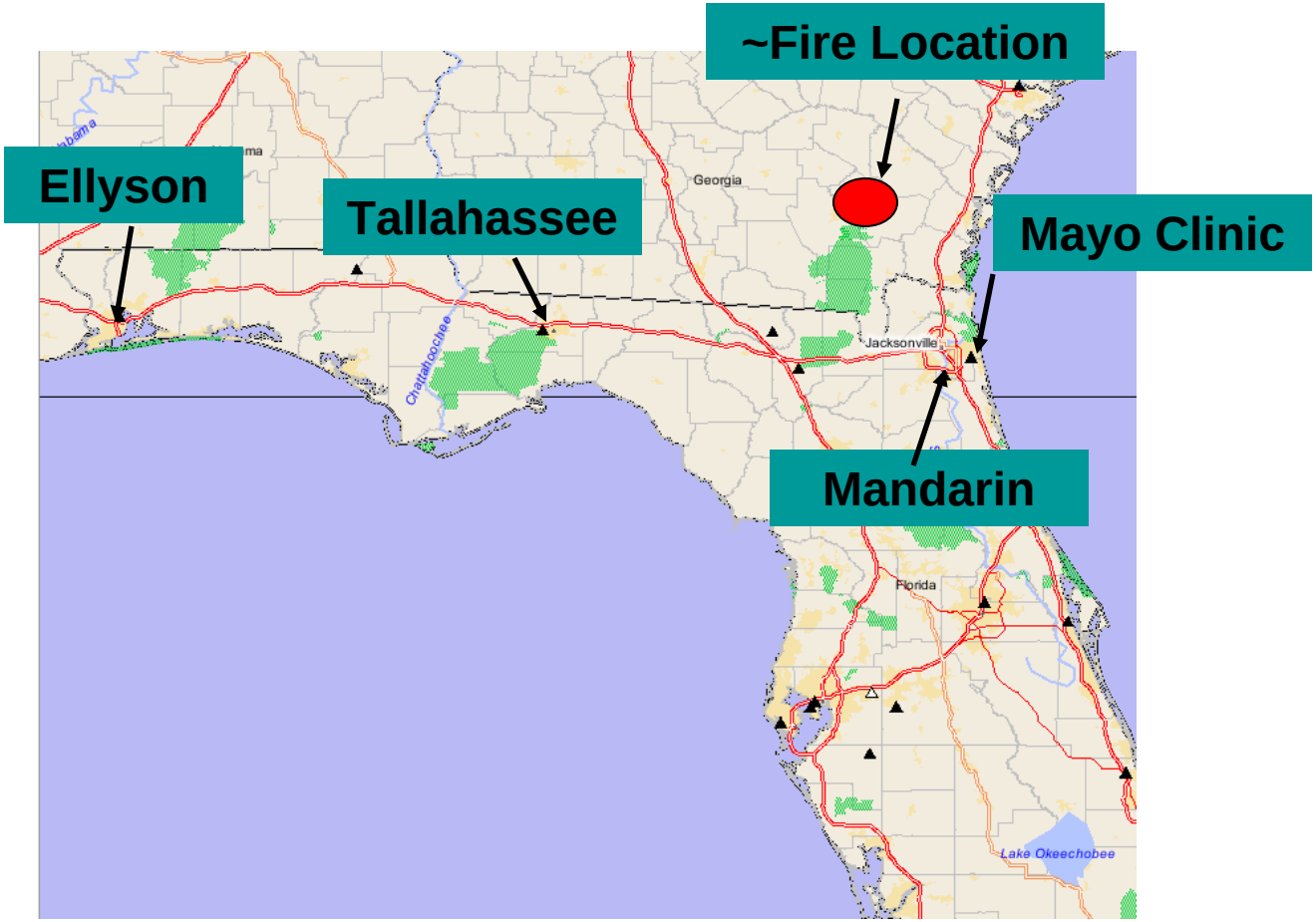




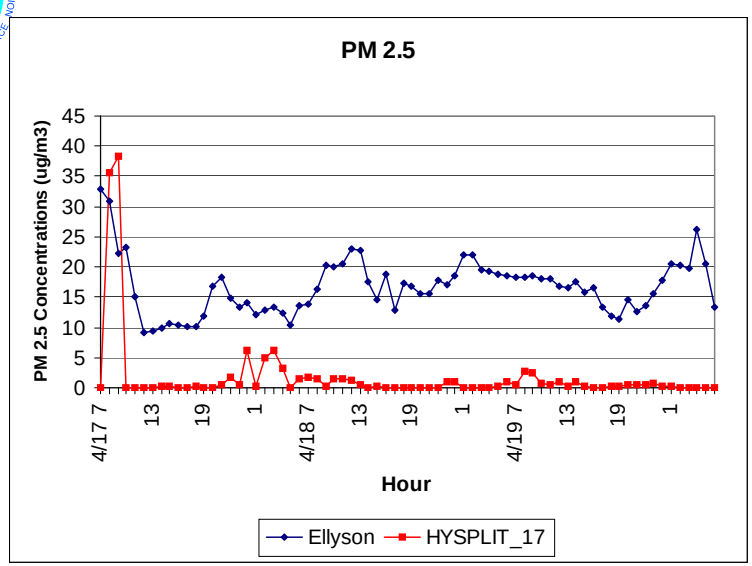


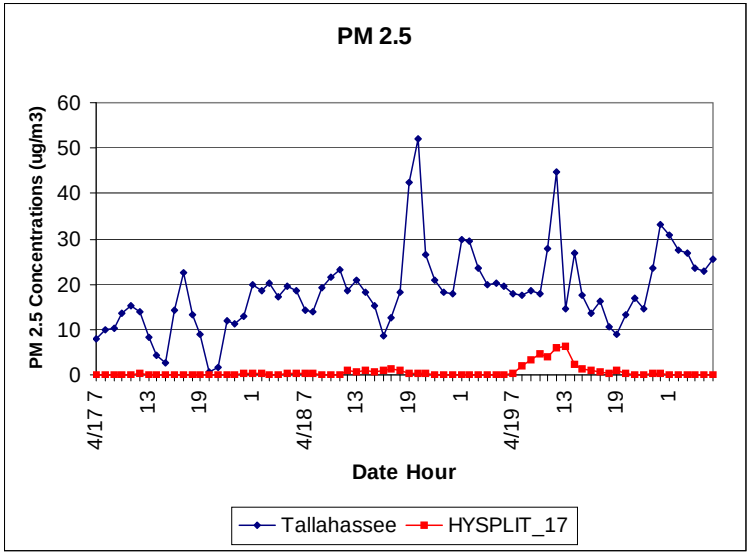
Surface Layer Concentrations

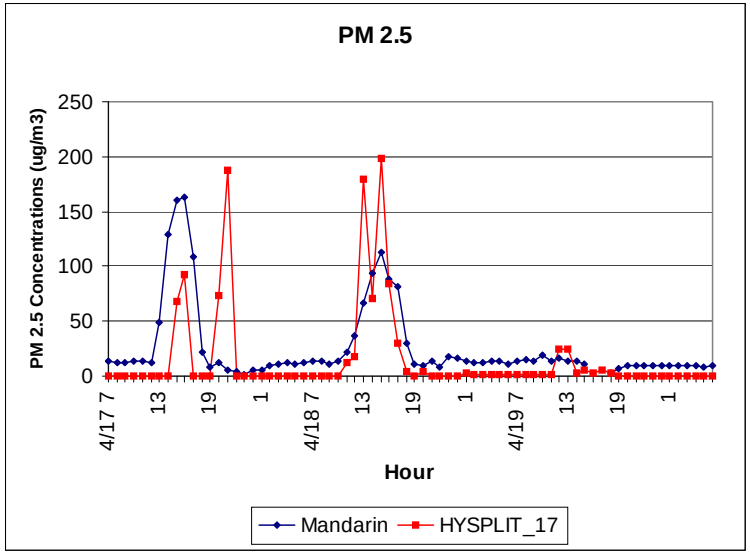
04/17/2007 to 04/19/2007

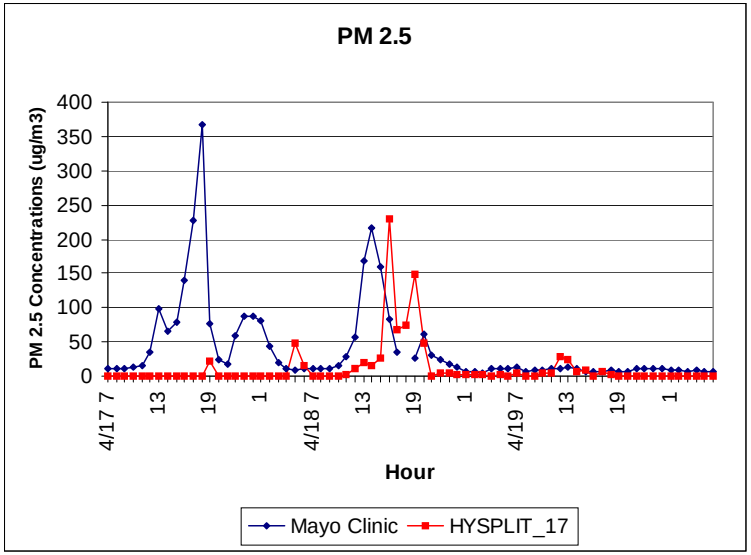


NWS OPS RUN 04/17/2007

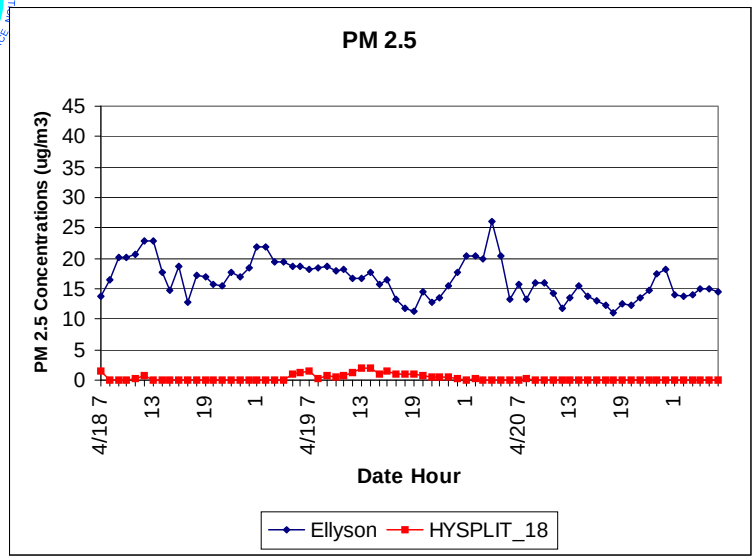


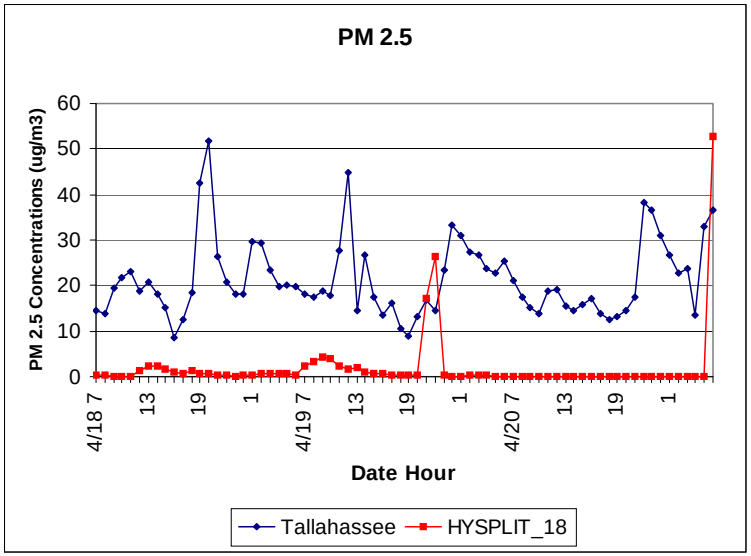


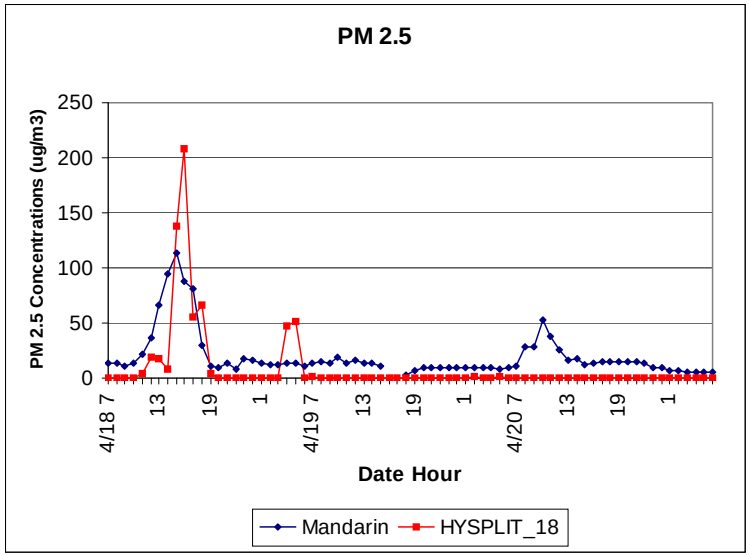


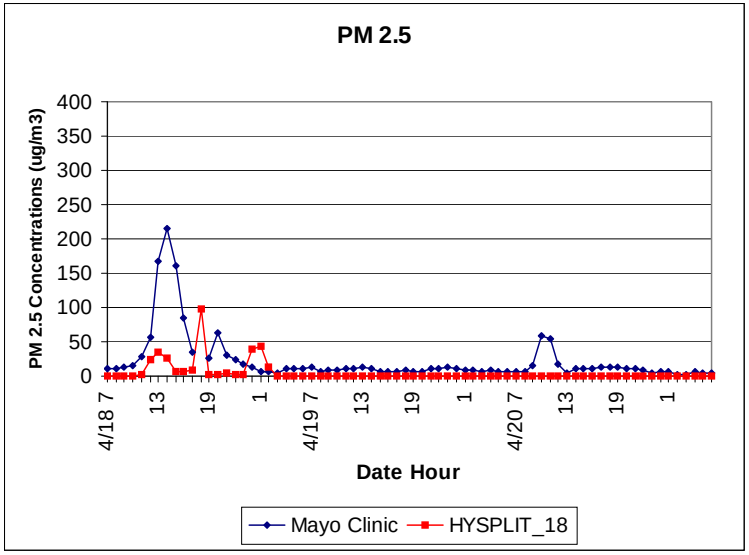


NWS OPS RUN 04/18/2007

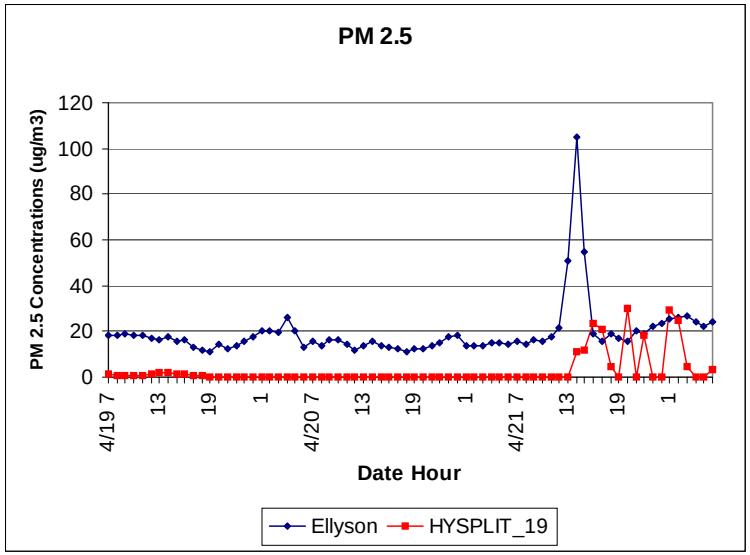


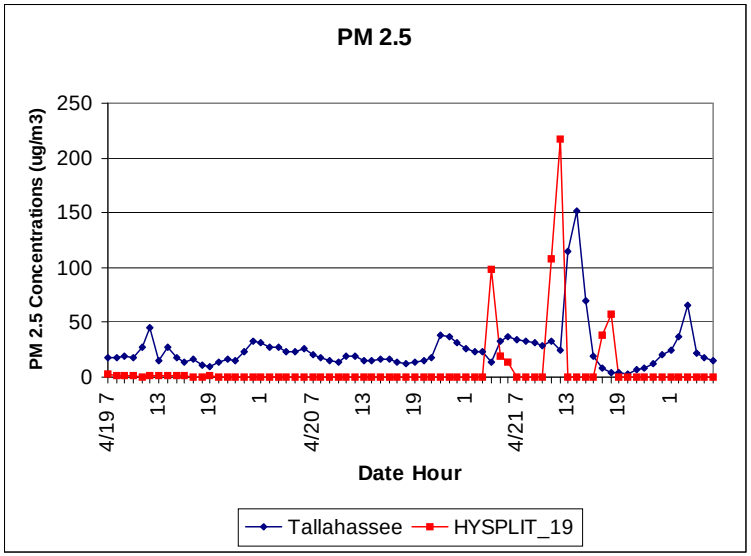


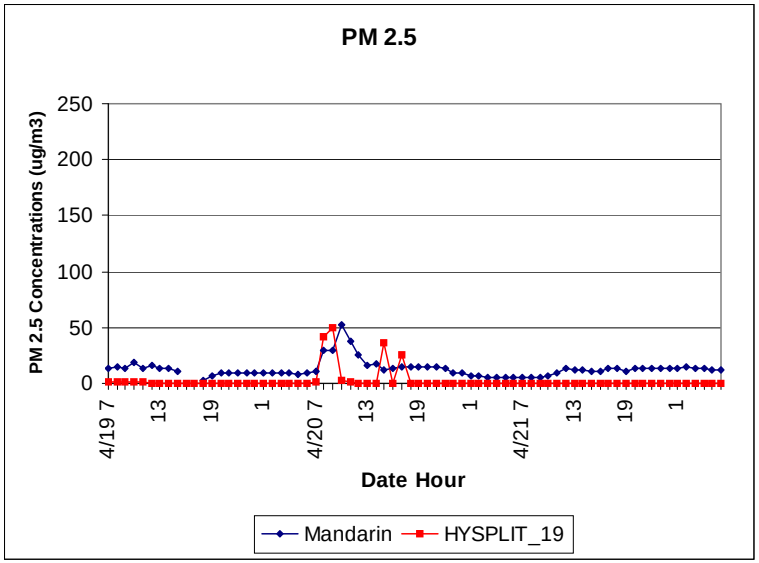


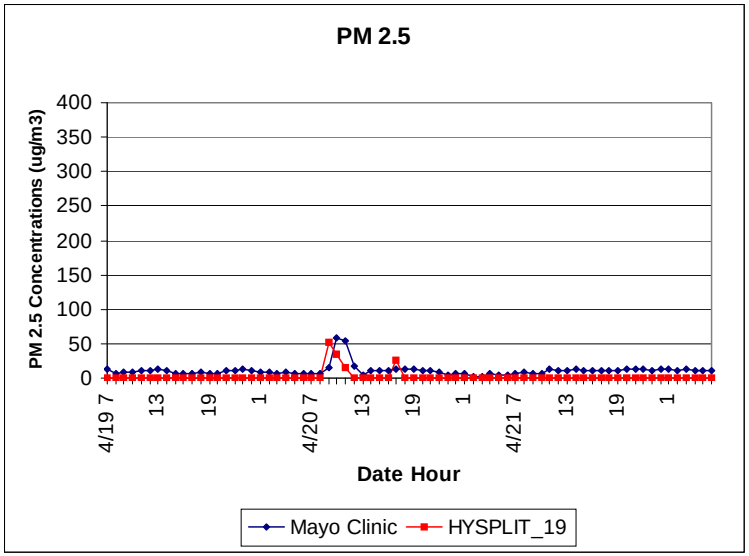


NWS OPS RUN 04/19/2007







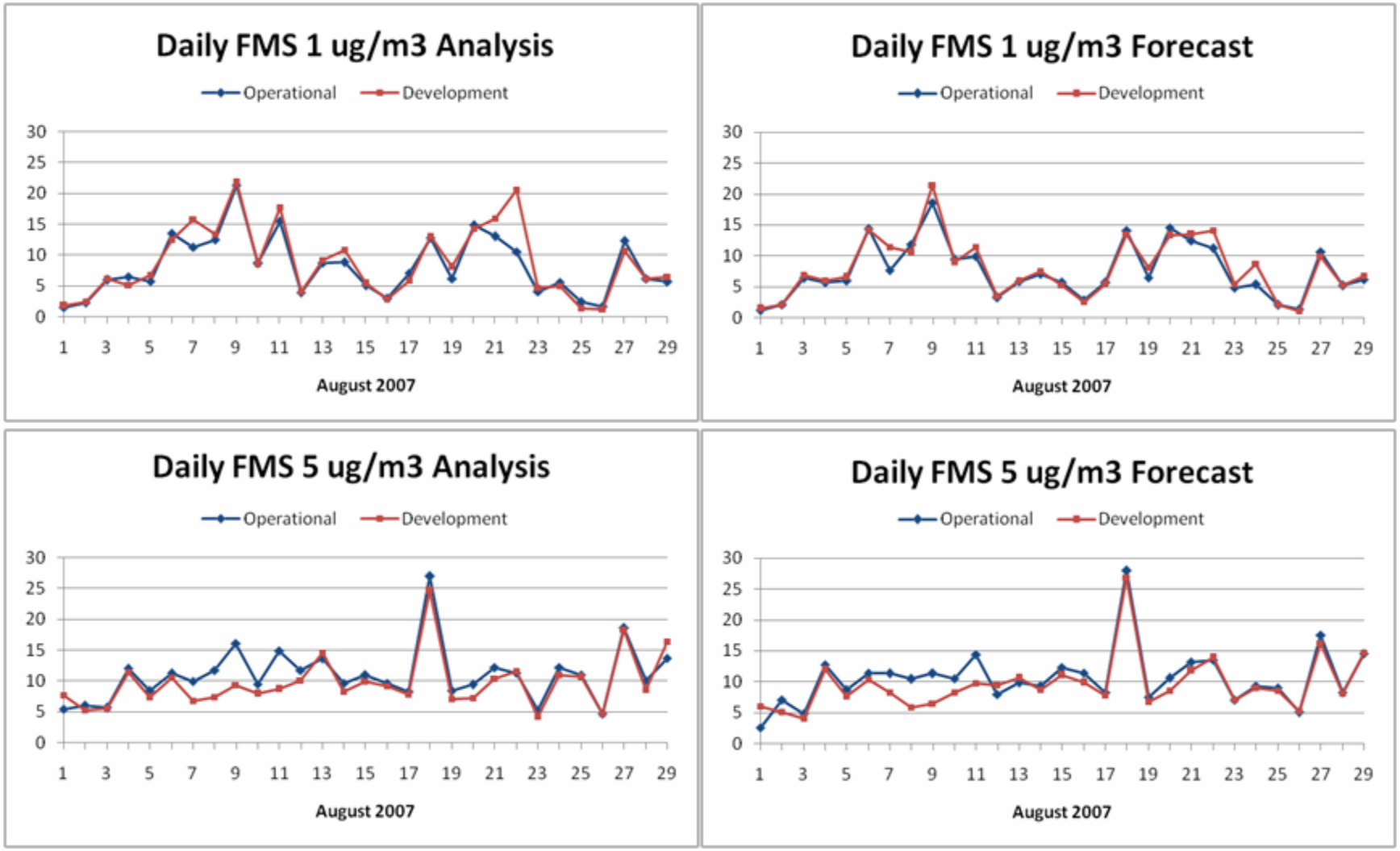


Development Version Testing

	NAM	AQM
		0.6690
25	0.6777	
24	0.7182	
		0.7185
23	0.7565	
		0.7585
		0.7890
22	0.7923	
		0.8190
21	0.8258	
		0.8480
20	0.8562	
		0.8755
19	0.8828	
		0.9015
18	0.9039	
17	0.9124	
16	0.9200	
		0.9260
15	0.9270	
14	0.9337	
13	0.9400	
12	0.9460	
		0.9490
11	0.9518	
10	0.9574	
9	0.9628	
		0.9650
8	0.9681	
7	0.9732	
		0.9745
6	0.9783	
5	0.9833	
		0.9835
4	0.9881	
		0.9915
3	0.9929	
		0.9975
2	0.9977	
1	surface	

- The HYSPLIT model configuration is identical to the current production version
- The meteorology has been changed to use the NAM on its native hybrid vertical coordinate rather than the AQM-NAM
- The native NAM has double the number of vertical levels available in the AQM-NAM
- The calculation uses the multi-processor (4 CPUs) version of HYSPLIT rather than the single processor version

Operational Versus Development Runs



Updates in the pipeline for testing …

- ***Use the horizontal velocity divergence to compute vertical motion***
- ***Modified method to compute mixed layer depth***
- ***Fire location aggregation on a finer grid (20 km to 12 km)***
- ***Use profile method rather than heat and momentum fluxes to compute vertical mixing***
- ***Remove restrictions on plume rise***

Release Height Sensitivity

Case study: September 1-15 2006

Hysplit settings: same as current forecasting system

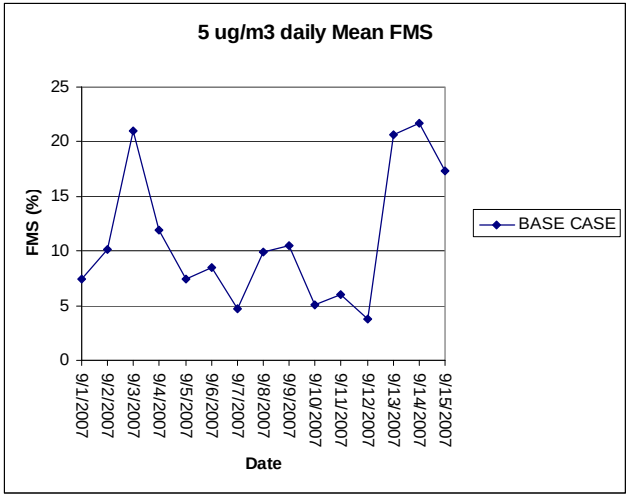
Base Case: release height calculated using heat from fire

Fixed release height: 100, 750, 1500, 3000, and 5000 m.

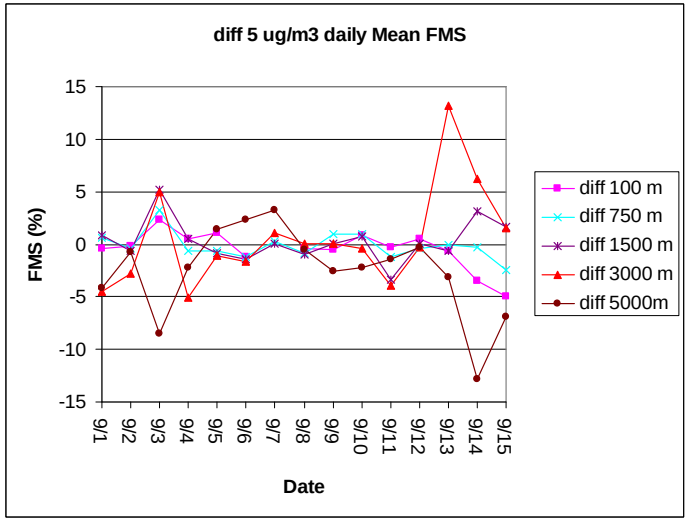
Variable release height:

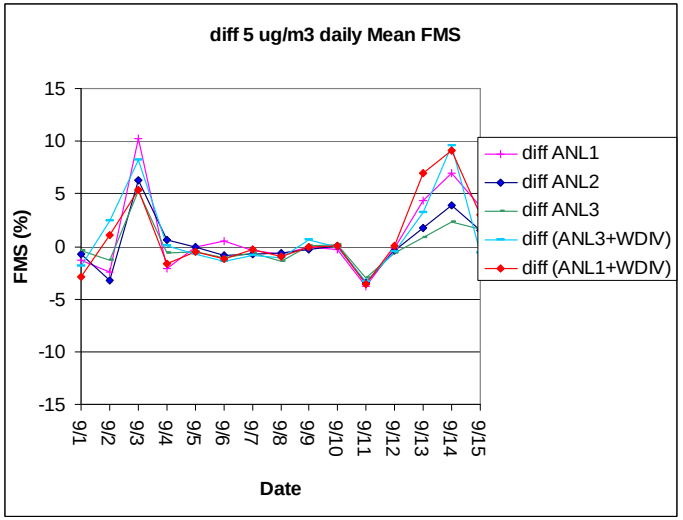
- ANL1: Same as Base Case but allowing plume rise up to 3 km
- ANL2: 2 release heights: 100 m and variable up to 3 km
- ANL3: 4 release heights: 100, 750, 1500, and 3 km
  - ***If release height estimated using heat is lower that any of these heights then release at estimated height.***
- ANL1+WDIV: same as ANL1 case but using the estimated vertical velocity from the divergence field.

Daily FMS

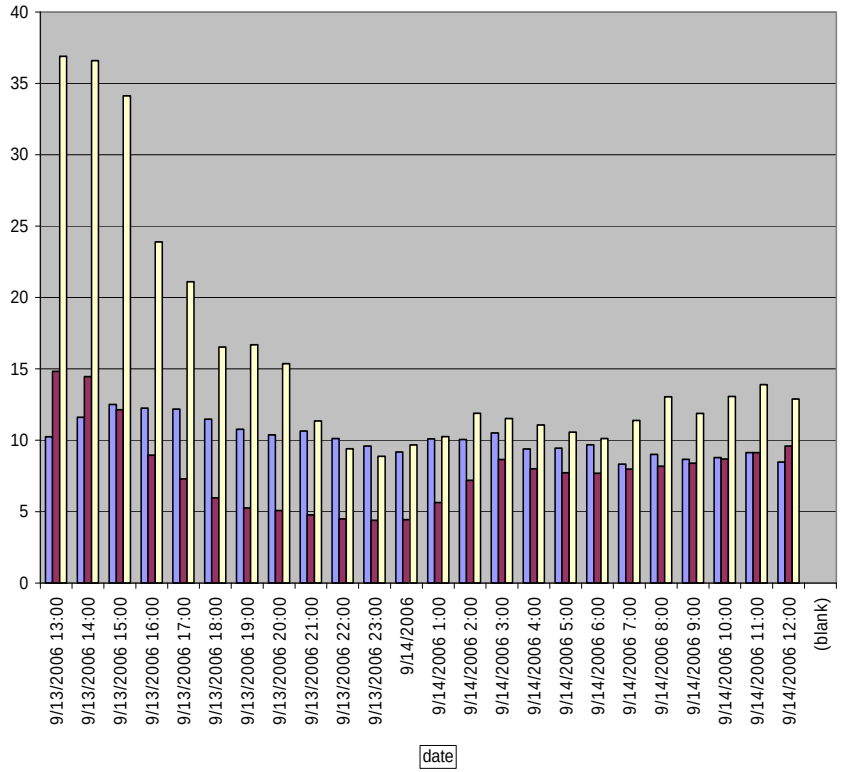


- *FMS can vary up to ~10% when changing the release height from the base case*
- *Fixed release heights give mixed results*
- *ANL cases give 5% higher FMS than base*
- *ANL1+WDIV gives the best cost benefit*
- *Not as many particles required as in ANL2 & 3*

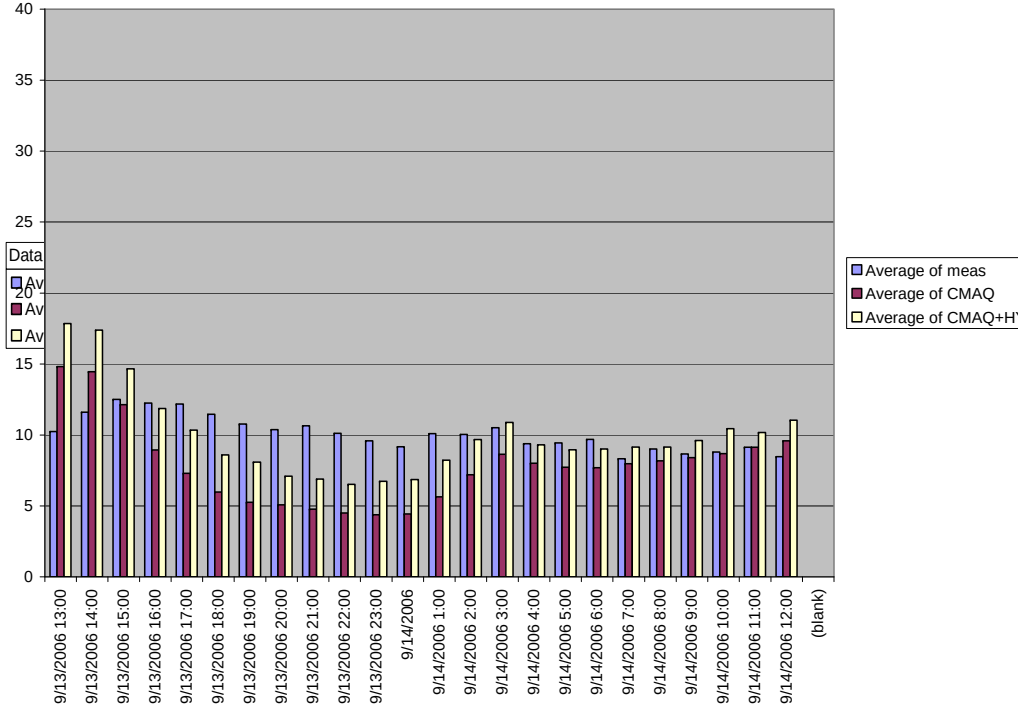




Example: Surface PM2.5 concentrations (μg/m3)
September 13, 2006



Base Case



ANL1+WDIV