10th Annual Emission Inventory Conference
May 1-3, 2001 Denver

The SMOKE Emission Processor and Community Multiscale Air Quality Model (CMAQ) applied to Southern Ontario

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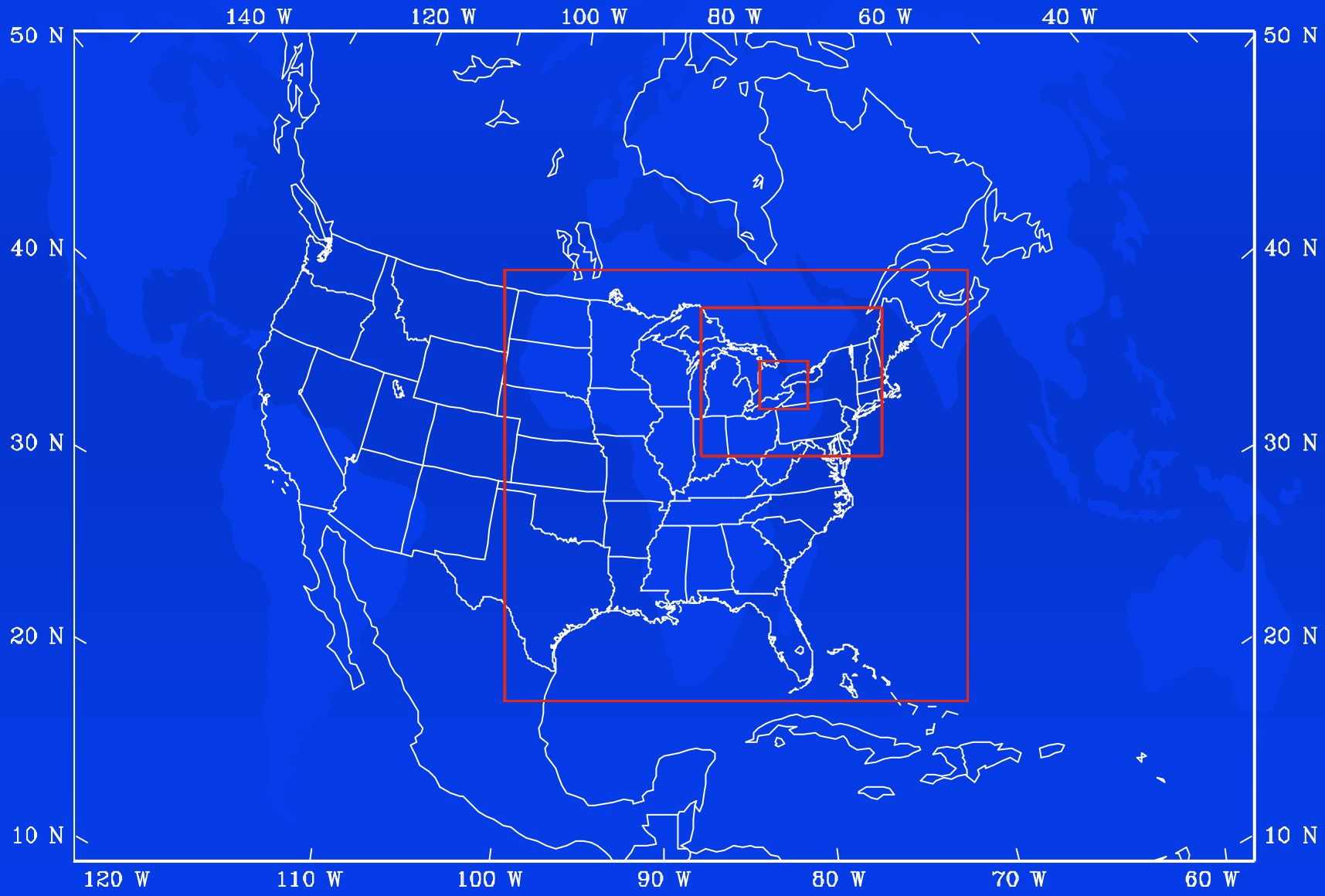
RWDI, Ontario
CANADA

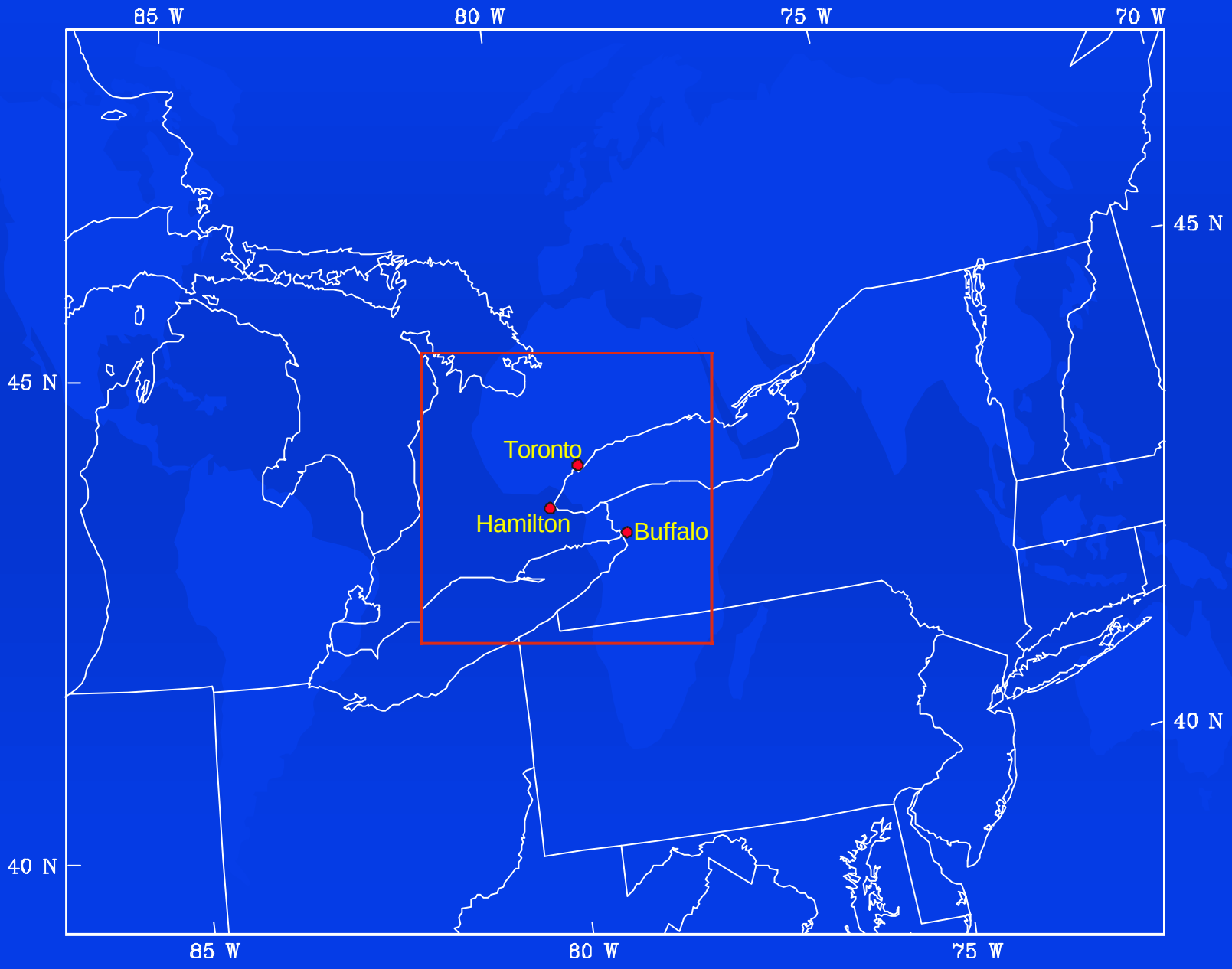
MM5 Nested Modelling Domains

Domain 1: 108 x 108 km grid cells

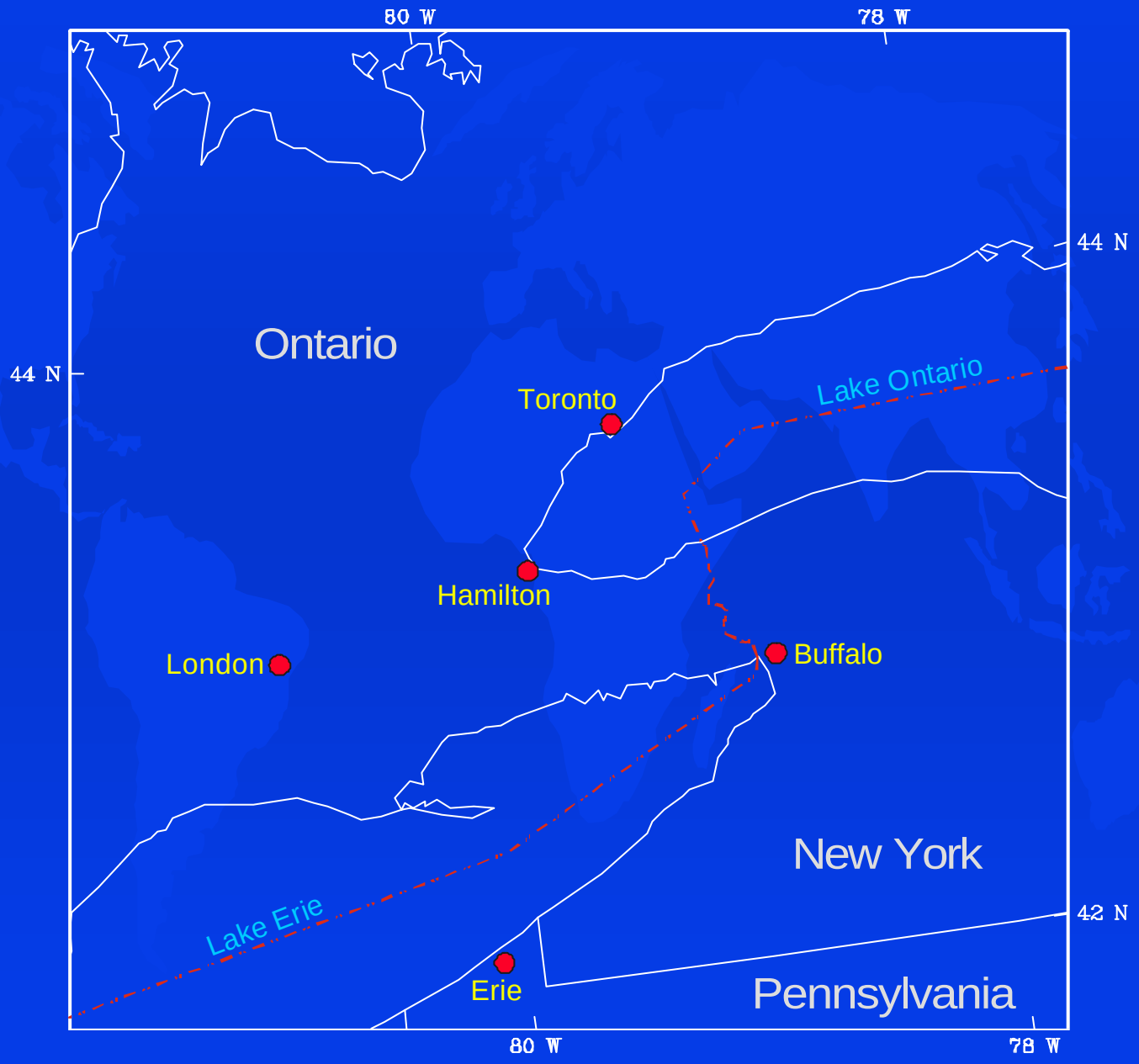


Domain 2: 36 x 36 km grid cells

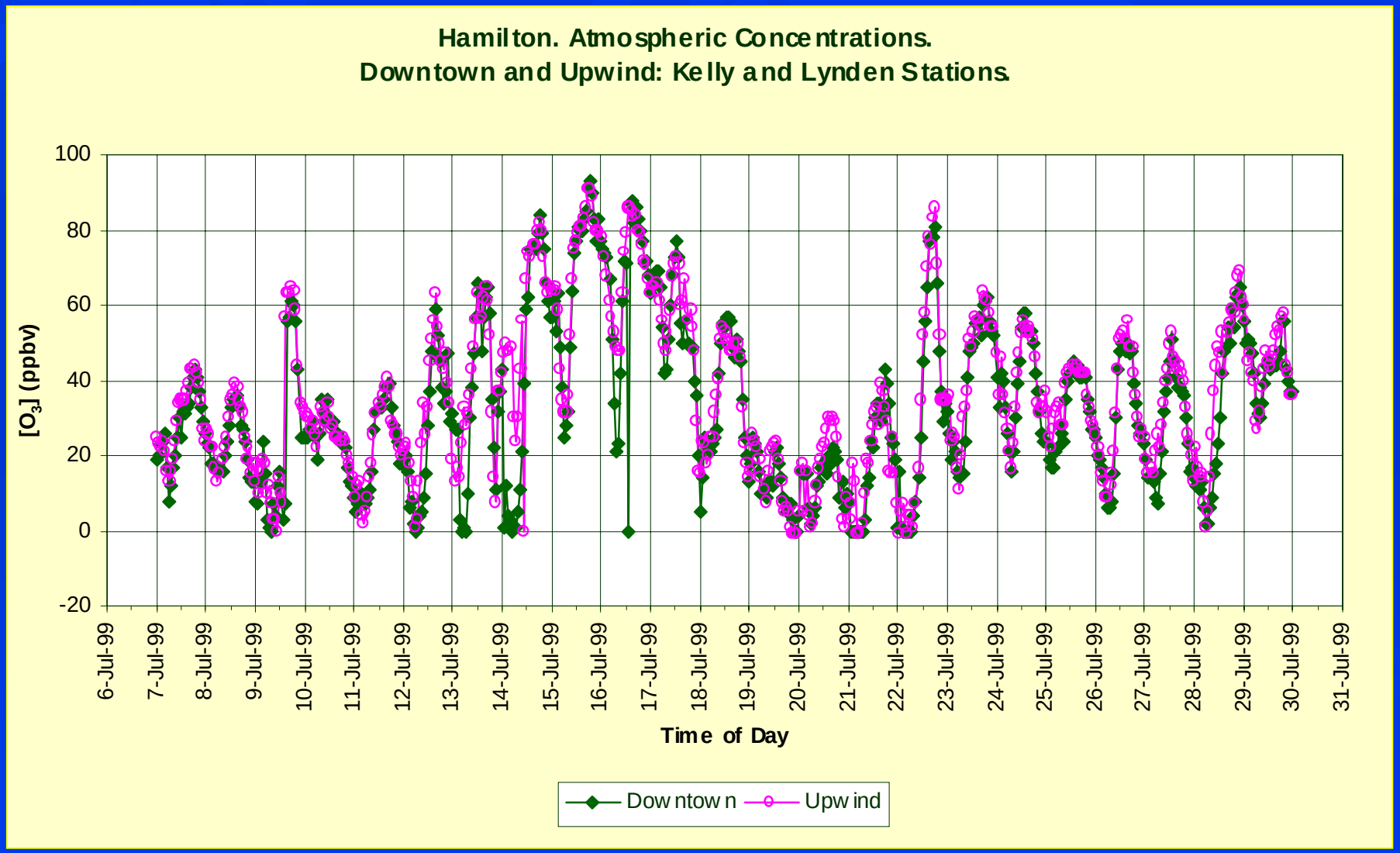
Domain 3: 12 x 12 km grid cells



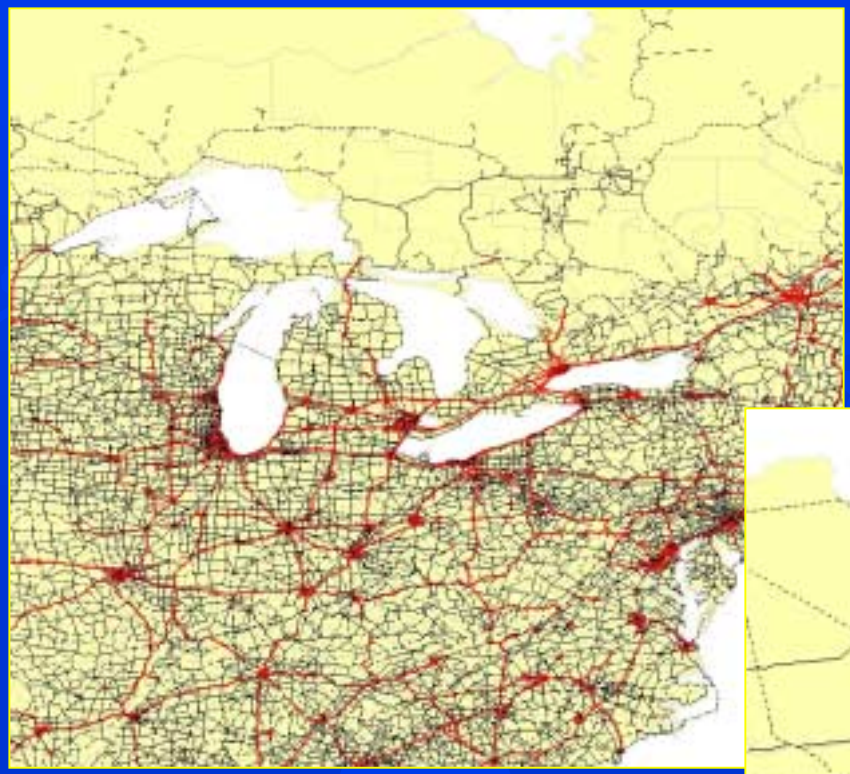
Domain 4: 4 x 4 km grid cells



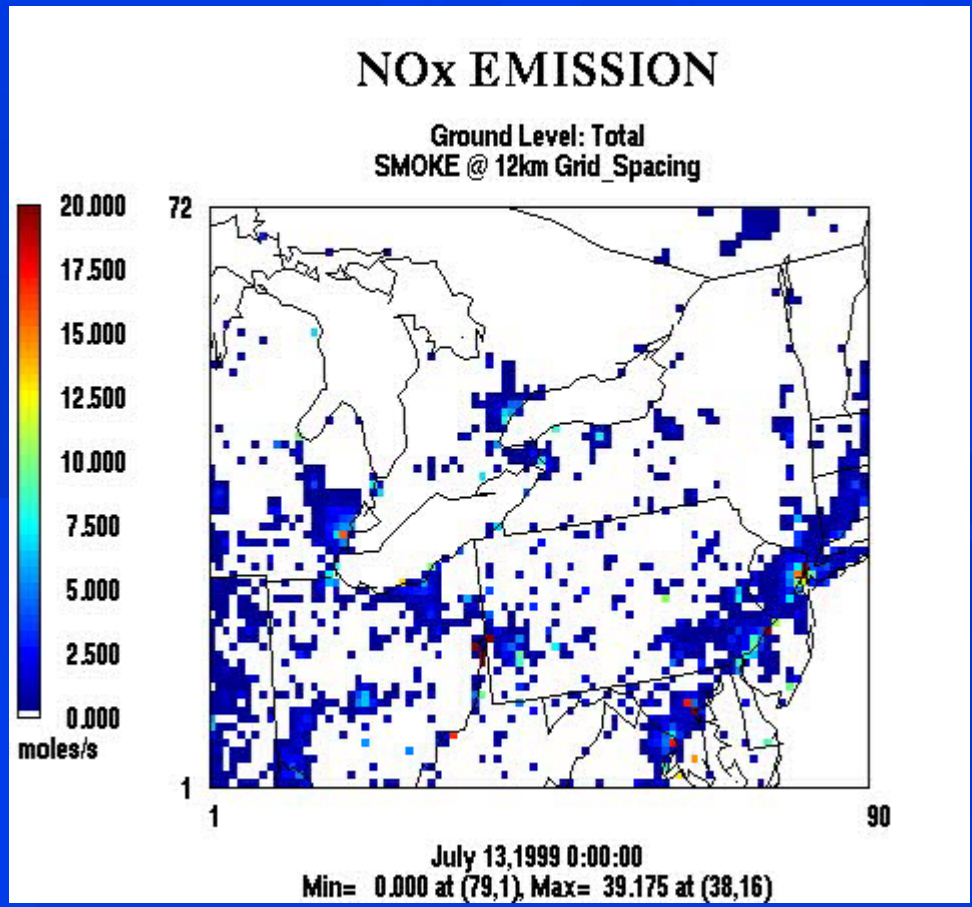
Results from the MOE Samplers for the 1999 Ambient Monitoring Program (O_3)



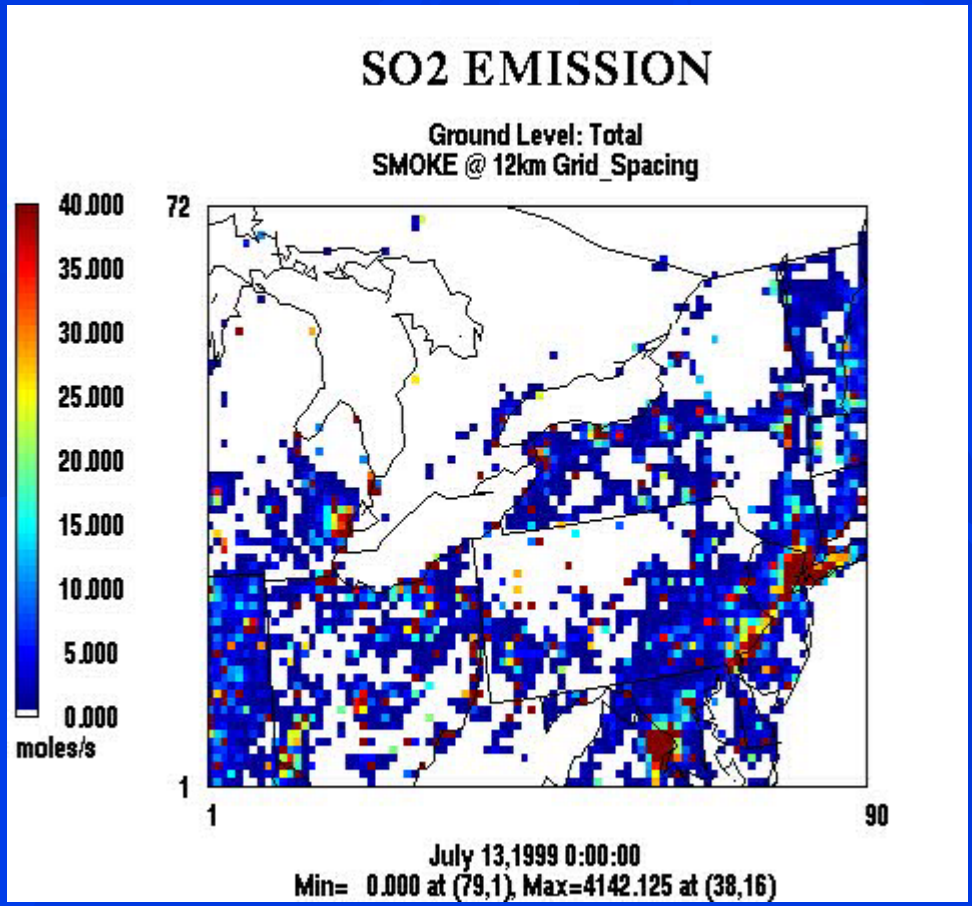
Digital Road Network



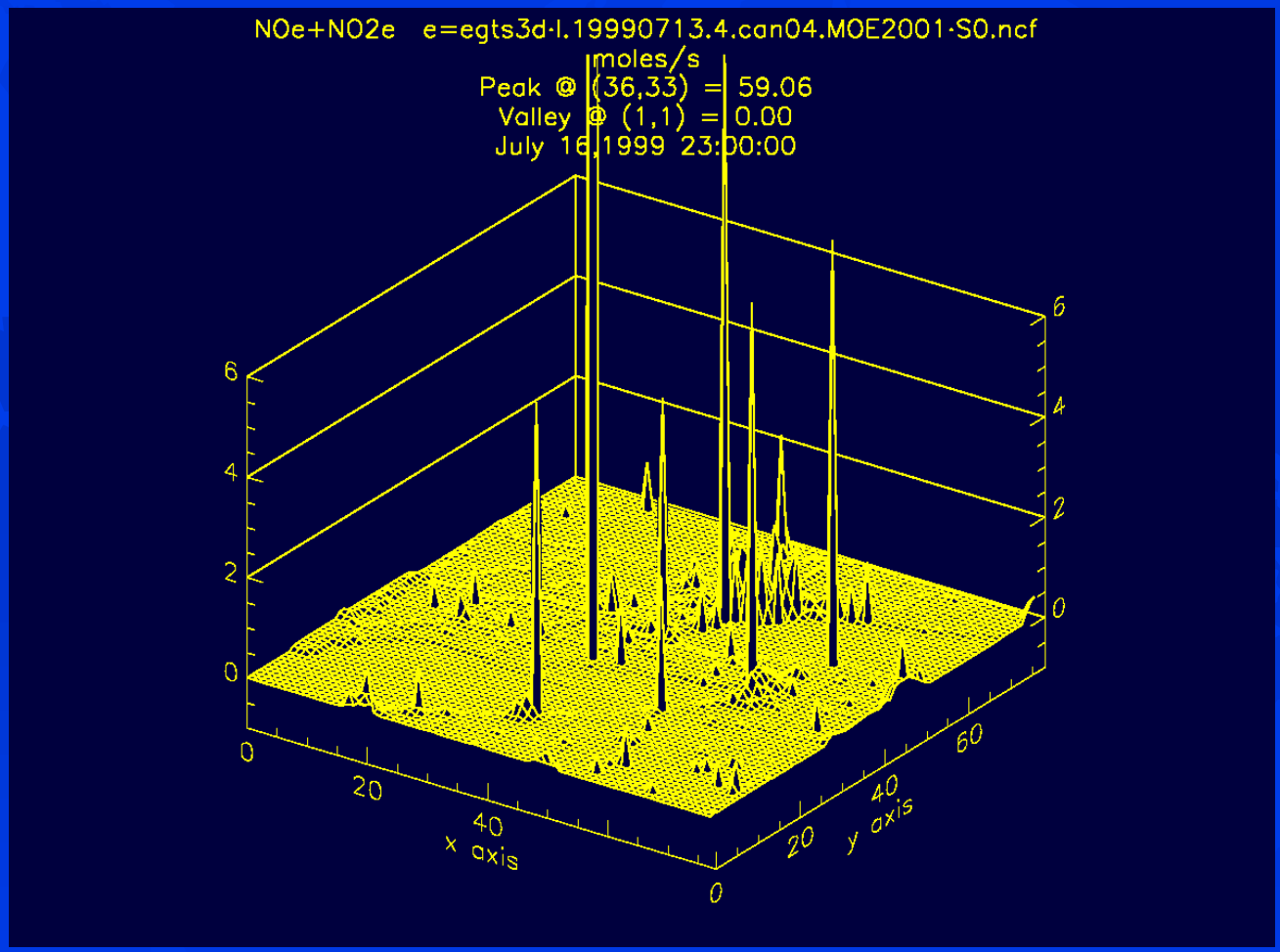
NOx Emissions Processed through SMOKE



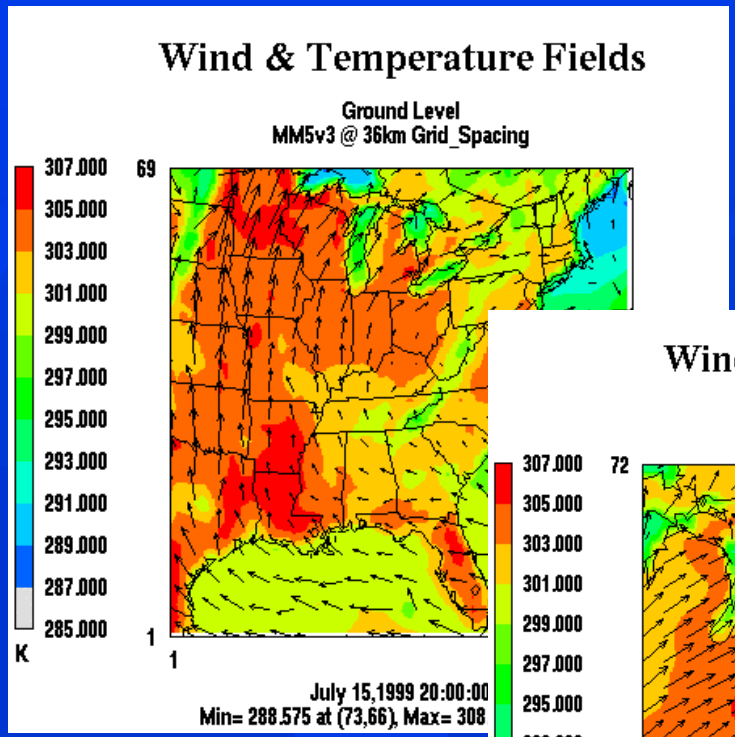
SO_2 Emissions Processed through SMOKE

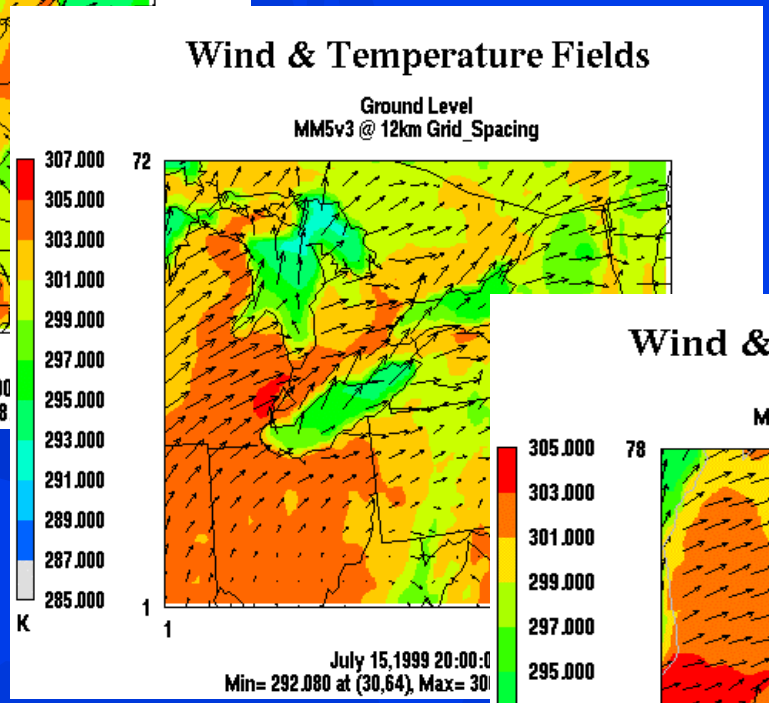


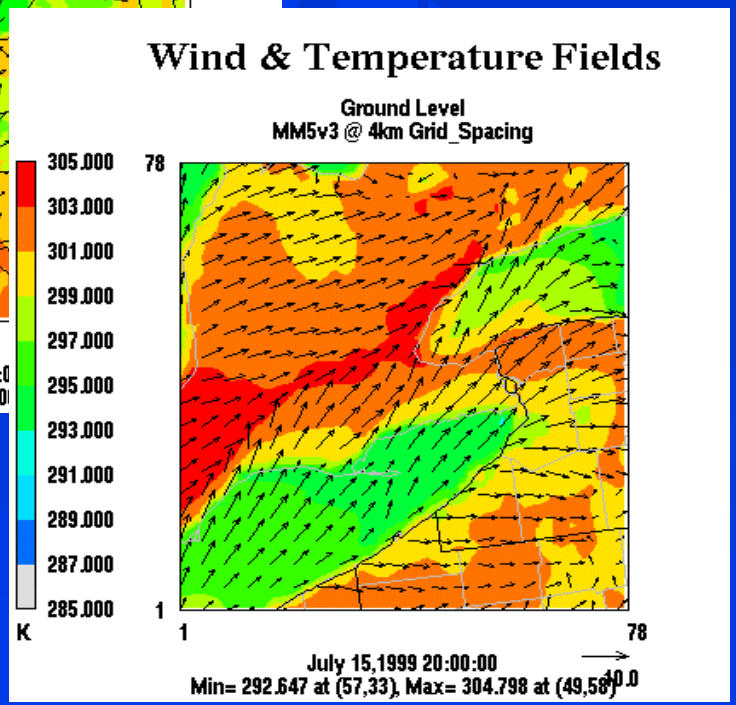
NOx Emissions Processed through SMOKE



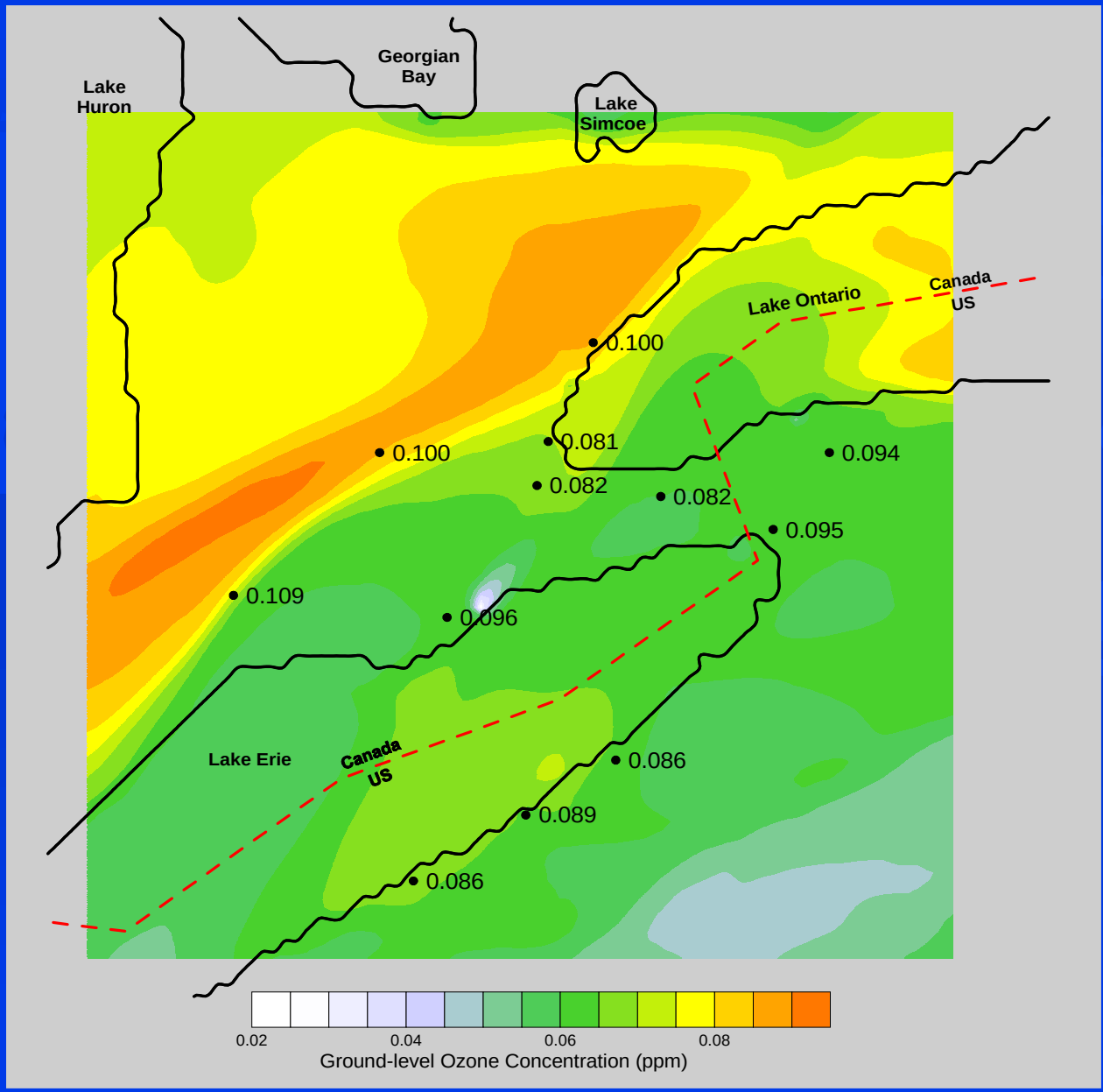
MM5 Results


Wind & Temperature Fields
Ground Level
MM5v3 @ 36km Grid_Spacing
307.000
305.000
303.000
301.000
299.000
297.000
295.000
293.000
291.000
289.000
287.000
285.000
K
69
1
1
July 15,1999 20:00:00
Min= 288.575 at (73,66), Max= 308

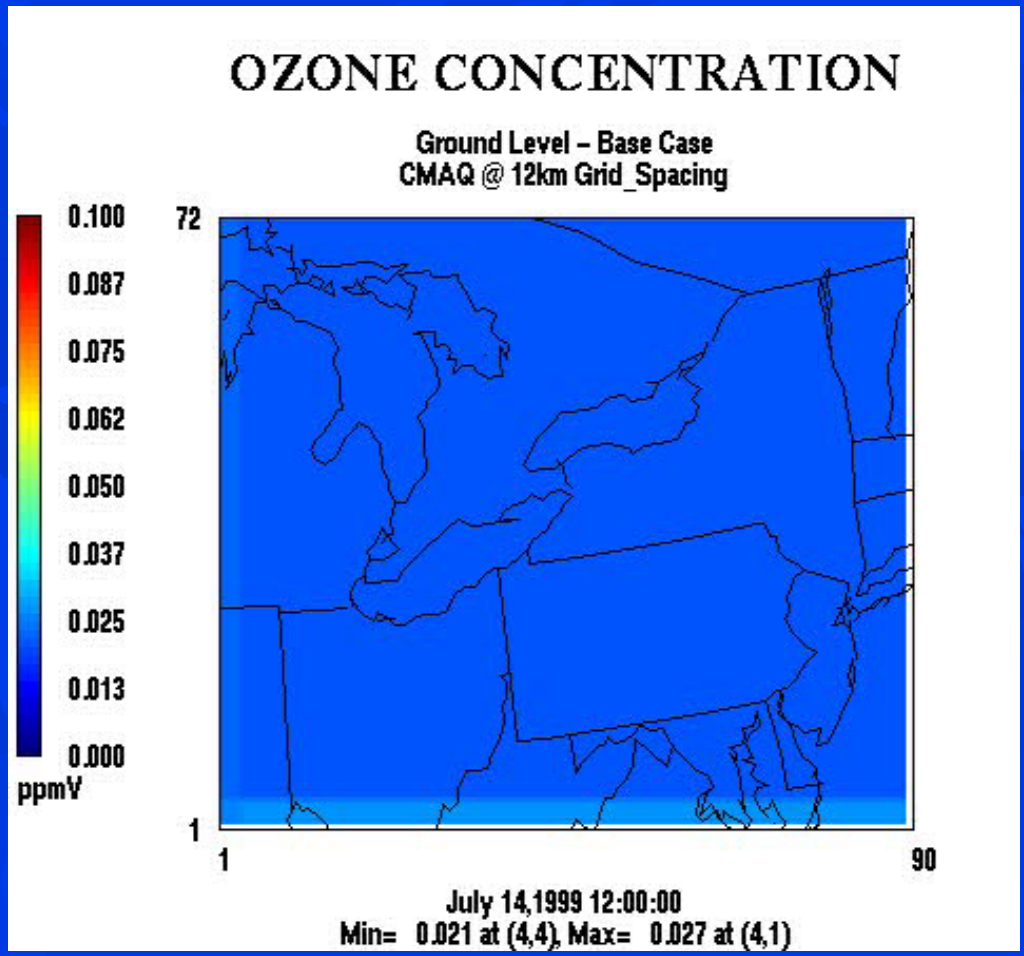

Wind & Temperature Fields
Ground Level
MM5v3 @ 12km Grid_Spacing
307.000
305.000
303.000
301.000
299.000
297.000
295.000
293.000
291.000
289.000
287.000
285.000
K
72
1
1
July 15,1999 20:00:0
Min= 292.080 at (30,64), Max= 30


Wind & Temperature Fields
Ground Level
MM5v3 @ 4km Grid_Spacing
305.000
303.000
301.000
299.000
297.000
295.000
293.000
291.000
289.000
287.000
285.000
K
78
1
1
78
July 15,1999 20:00:00
Min= 292.647 at (57,33), Max= 304.798 at (49,58)
40.0

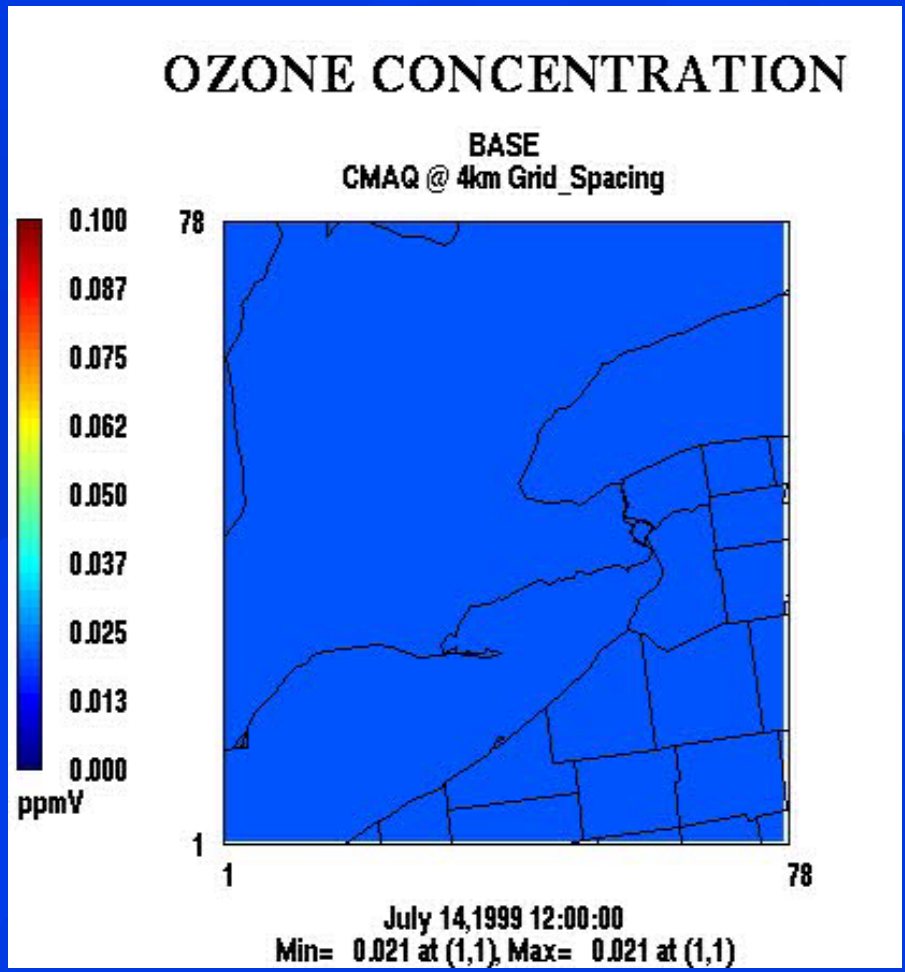
O_3 Concentrations – Modelled vs Observed



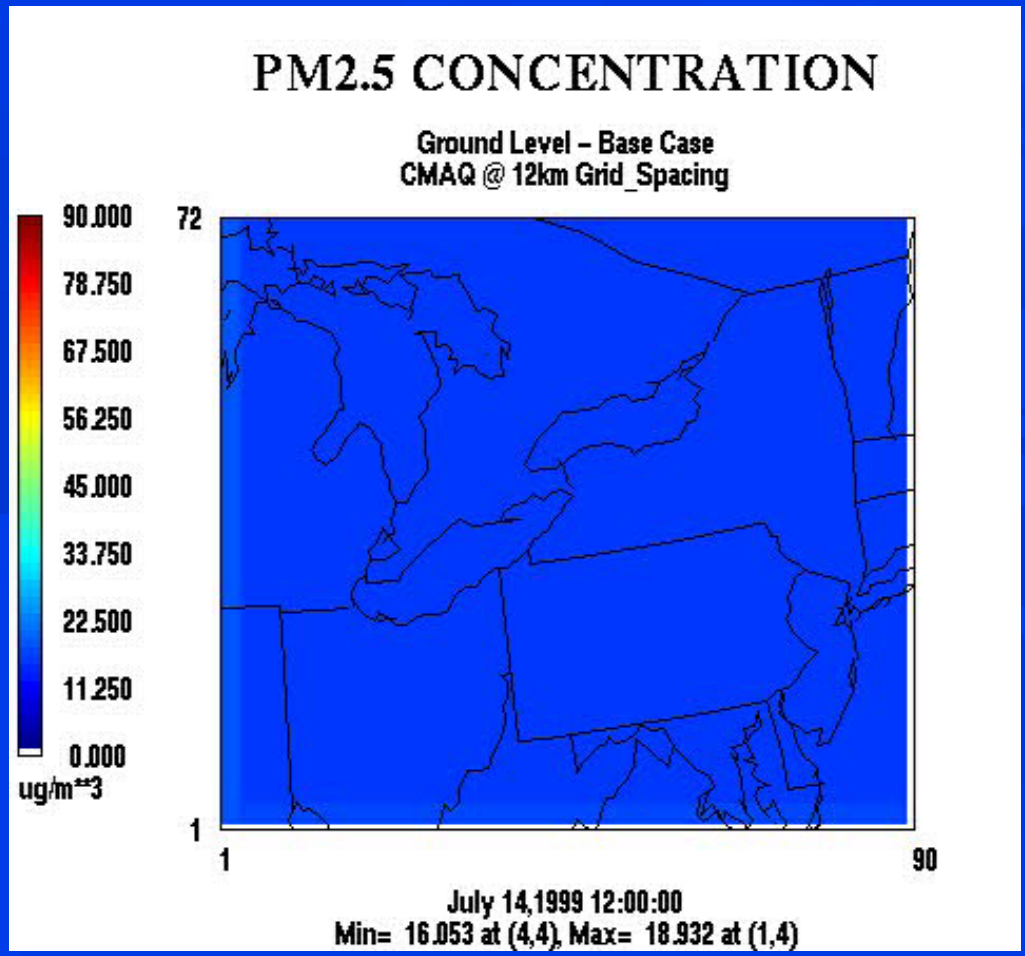
Modelled O_3 Concentrations – 12 km Domain



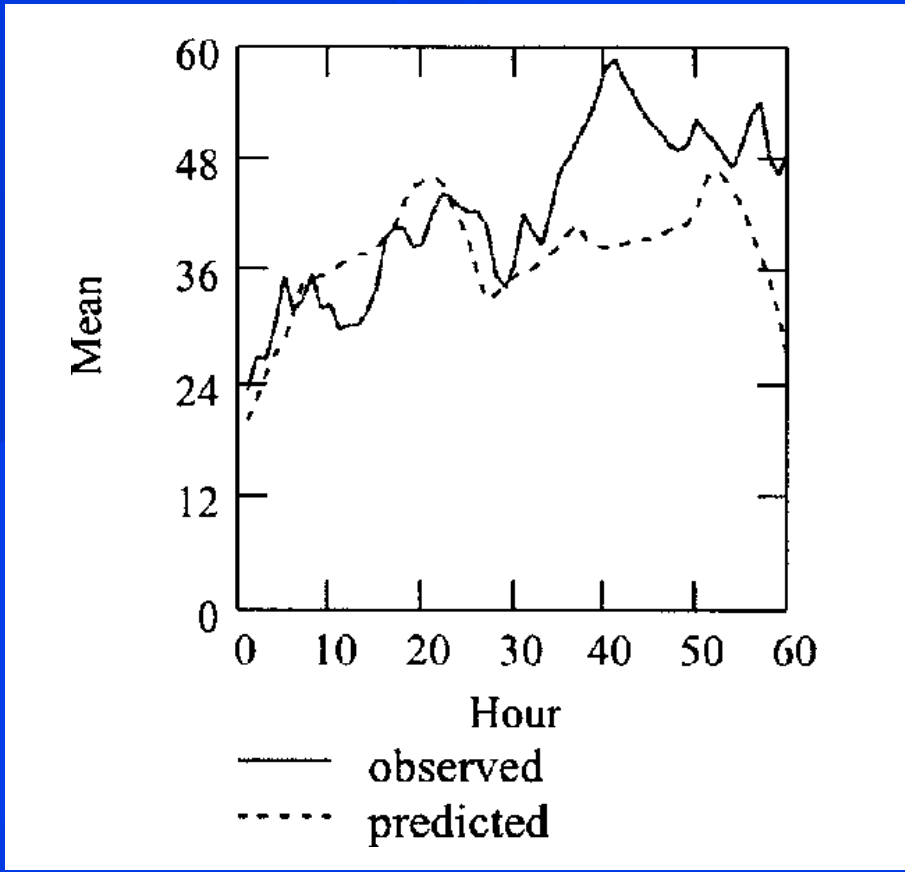
Modelled O_3 Concentrations – 4 km Domain



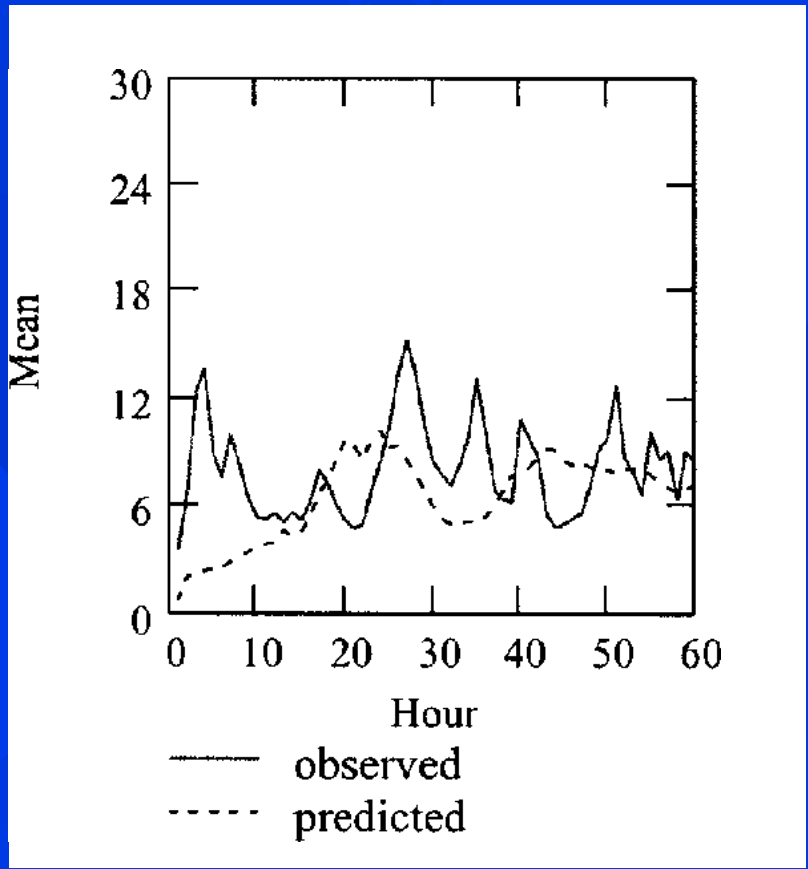
Modelled $PM_{2.5}$ Concentrations



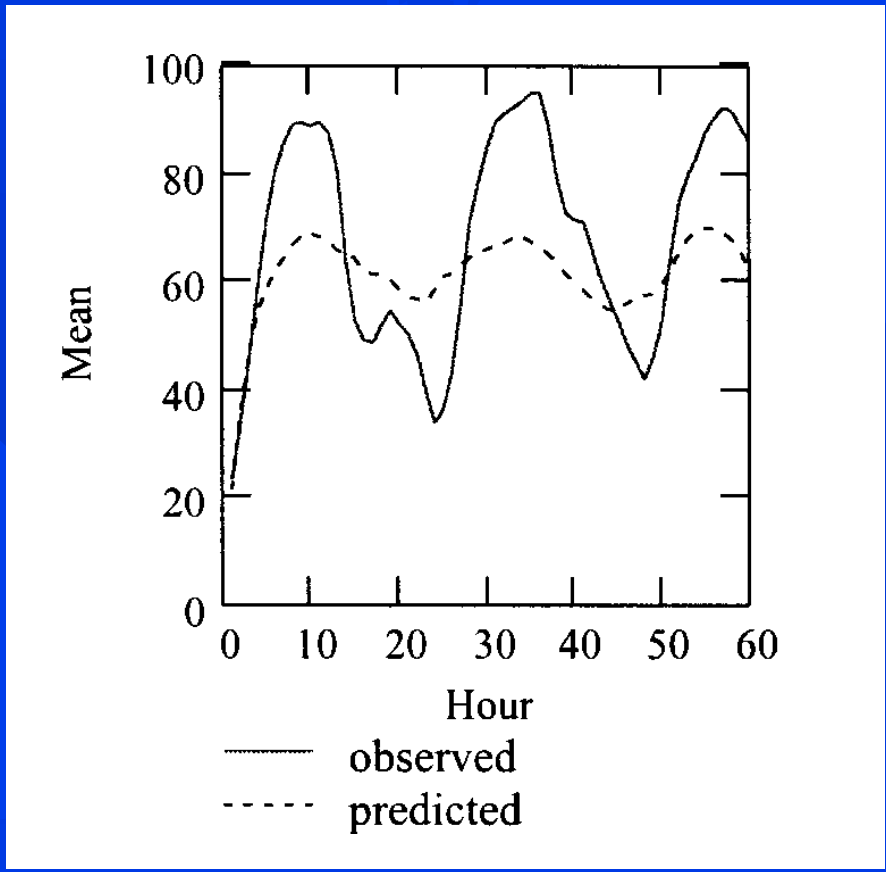
Average $PM_{2.5}$ Concentrations Modelled vs Observed



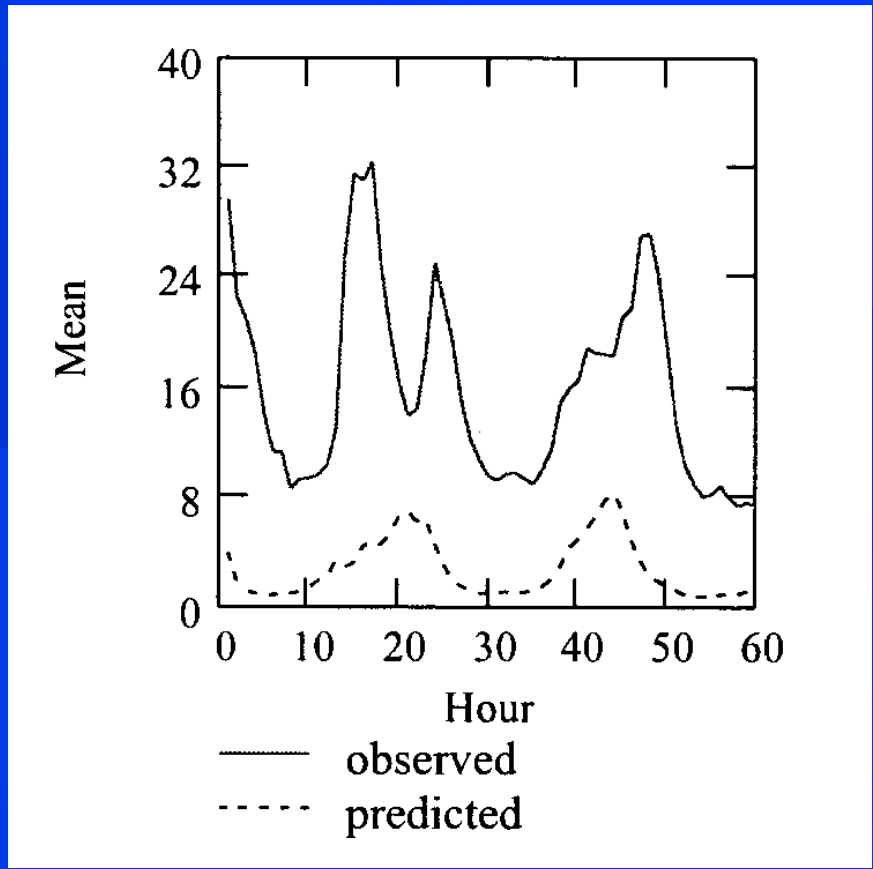
Average SO_2 Concentrations Modelled vs Observed



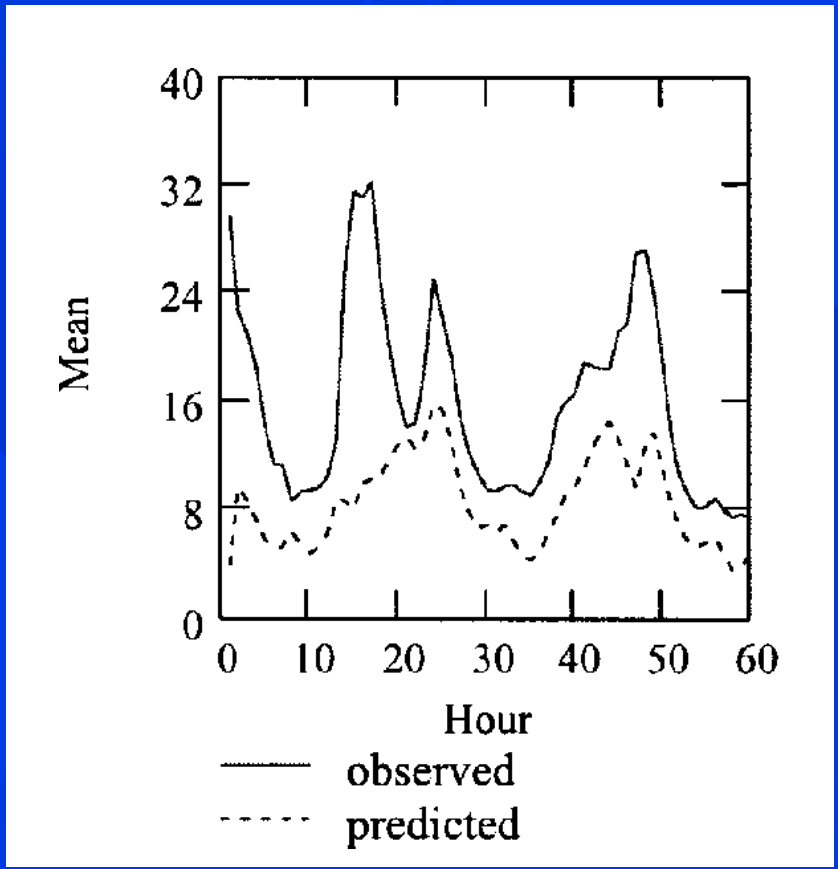
Average O_3 Concentrations Modelled vs Observed



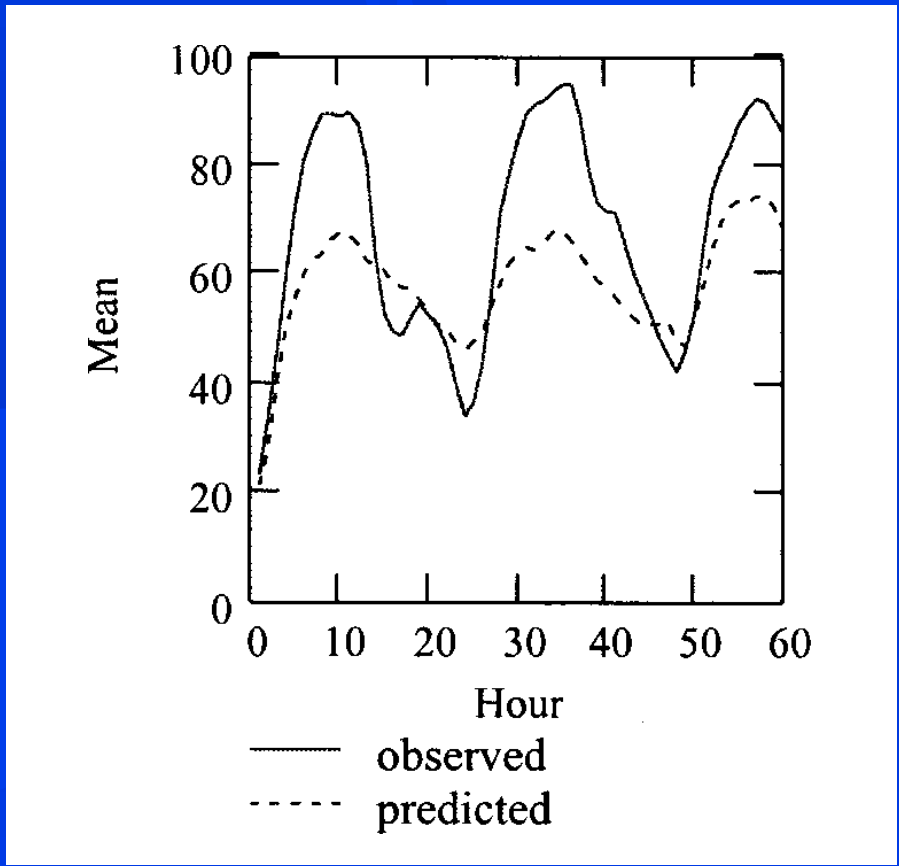
Average NO_2 Concentrations Modelled vs Observed



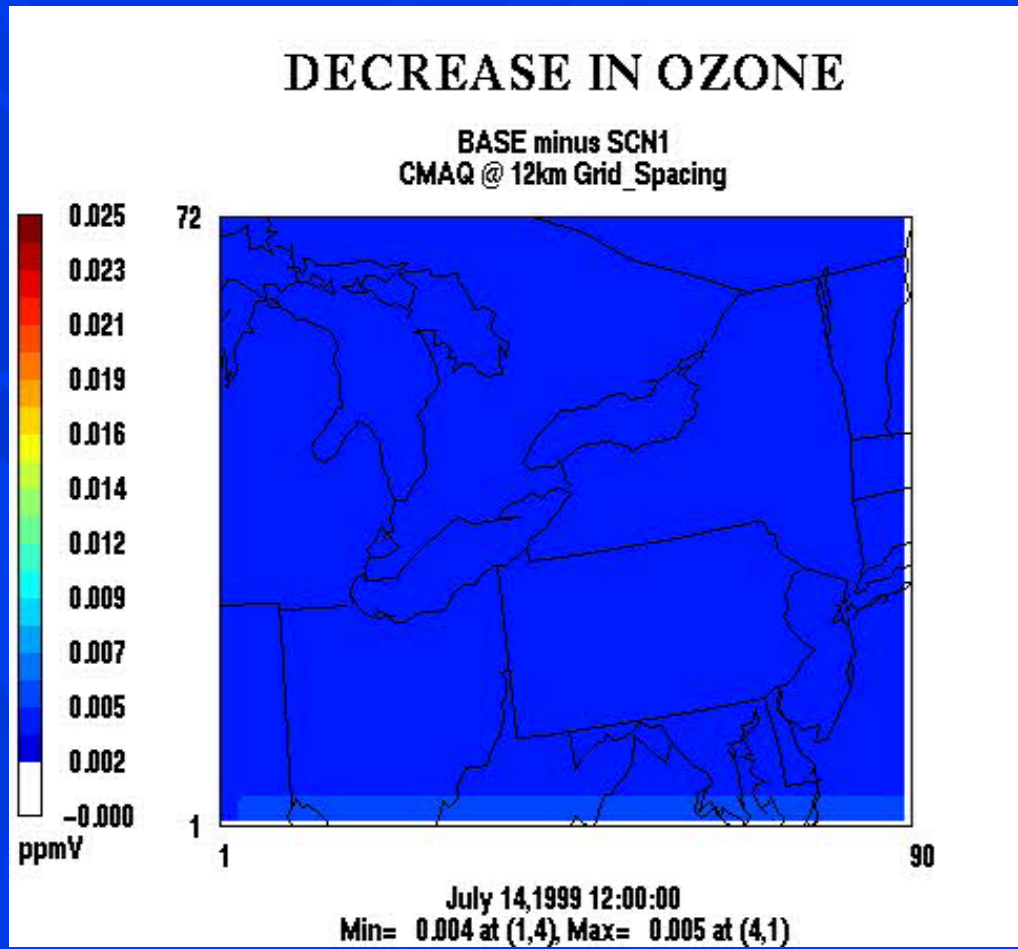
Average NO_2 Concentrations Modelled vs Observed Increased NO_x from US Point Sources by 50%



Average O_3 Concentrations Modelled vs Observed Increased NO_x from US Point Sources by 50%



Scenario 1: Turn off all US SO2 Emissions with no change in Canada



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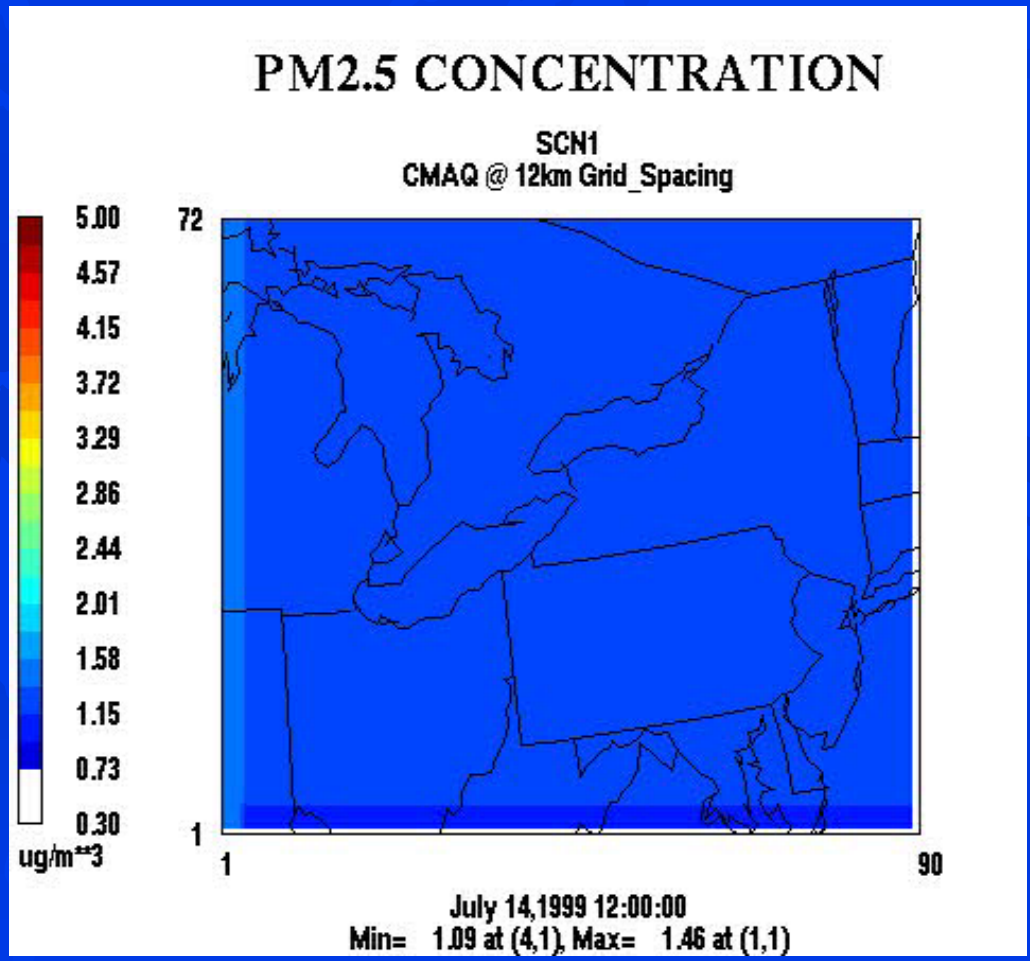

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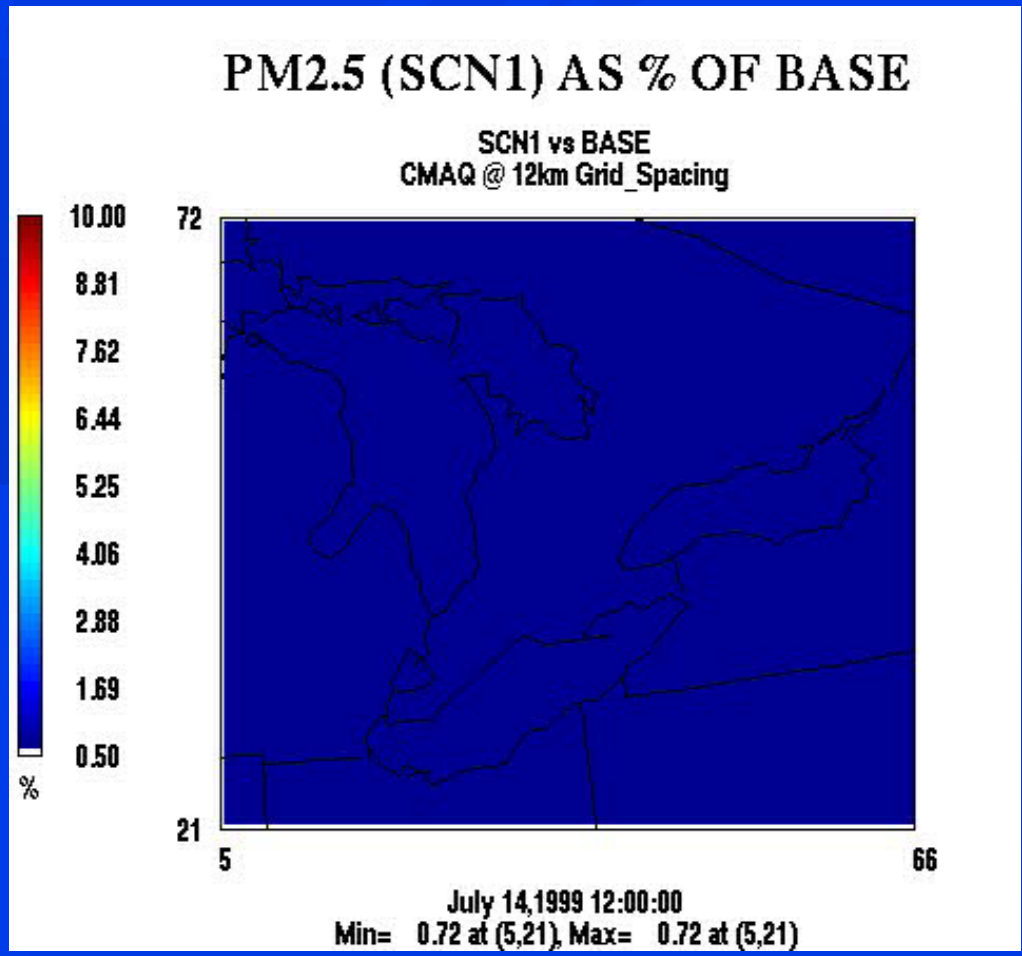
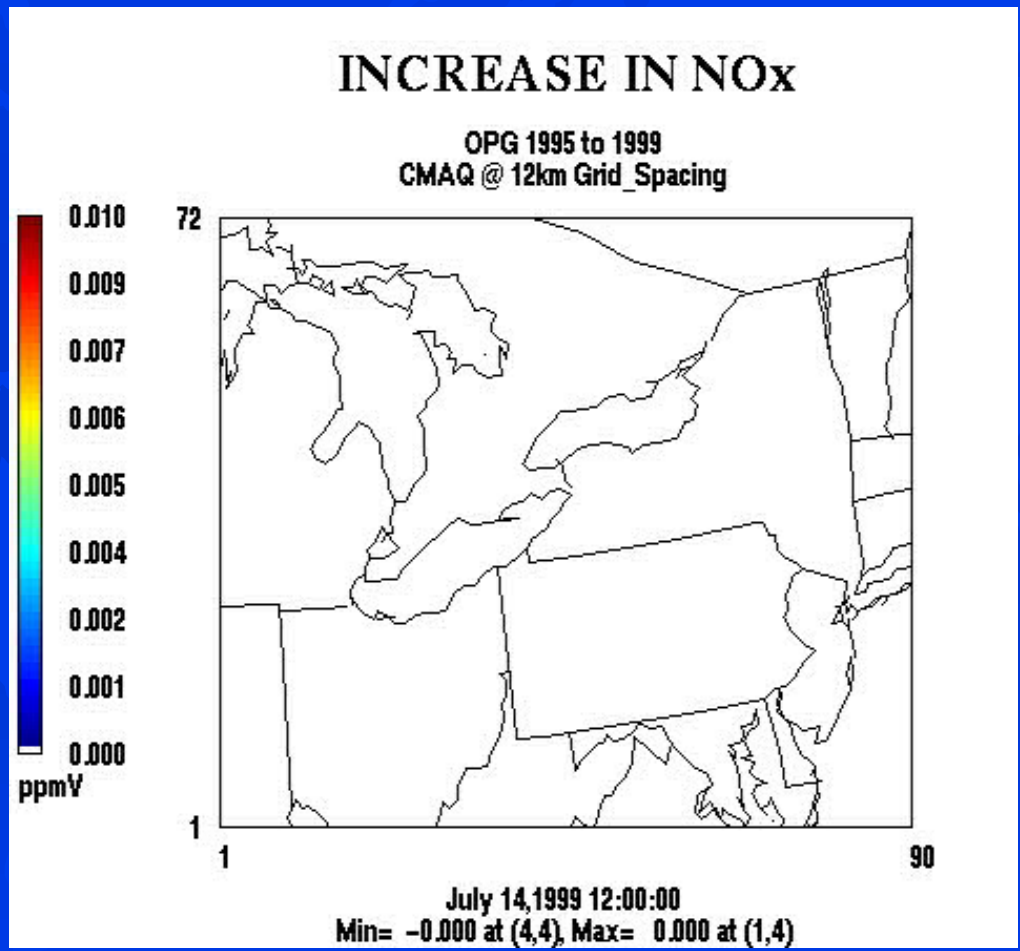


Scenario 2: CMAQ Simulations Based on OPG Power Plants Emission Data Update

- From 1995 base year to 1999
- Annual emission increased ~90%
- Summer emission increased ~40% above average

Scenario 2: CMAQ Simulations Based on OPG Power Plants Emission Data Update



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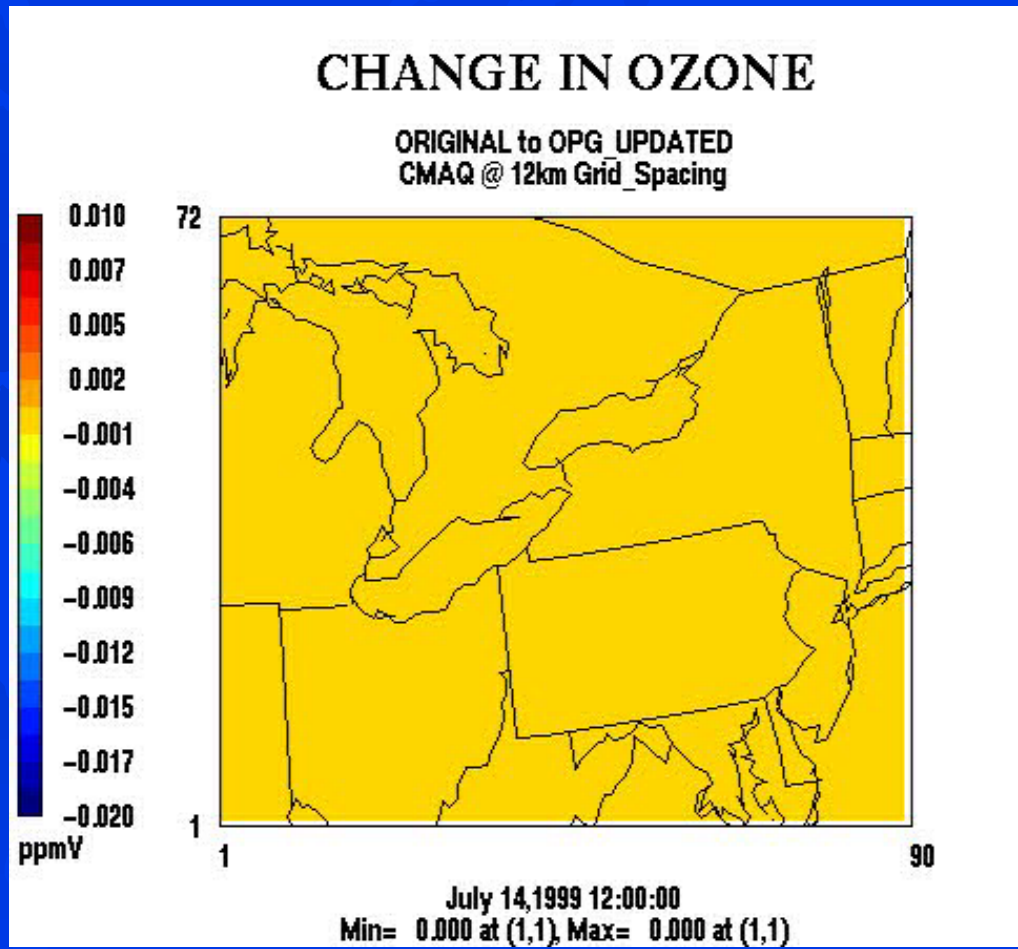

Conclusions

- Emission processor SMOKE performed well for Canadian and US inventories
- Model output compared reasonably well to monitoring data for O_3
- Model output compared well to monitoring data for CO, $PM_{2.5}$ and SO_2
- Model underestimated NO_2 levels
- $PM_{2.5}$ in Southern Ontario mostly (~ 90%) from major US SO_2 sources in summer smog episode
- O_3 in Southern Ontario mainly (>70%) from US NO_x and VOC sources in summer smog episode

Conclusions (cont'd)

- SO_2 emissions not only affect particulate matter, but also ground level O_3
- Major point sources and their temporal profiles play an important role on ground level concentration predictions
- Finer resolutions (12 km and 4 km) were important to resolve lake breeze effects in Southern Ontario
- Overall Performance is good and the modelling system (MM5+SMOKE+CMAQ) is ready for running scenarios