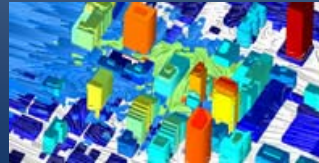


14th International Conference on  
Harmonisation within Atmospheric Dispersion  
Modelling for Regulatory Purposes  
Kos Island, Greece, 2-6 October 2011



## Air Quality Simulations for North America within AQMEII Initiative

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*University of Aveiro, Portugal*  
*University of Santiago de Compostela, Spain*  
*ENVIRON, USA*



# Framework

## Air Quality Model Evaluation International Initiative

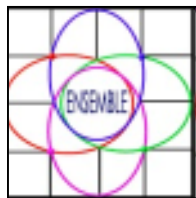


*Research on regional air quality model evaluation across the European and North American atmospheric modelling communities*

- Common emission inventories →
- Optional common meteorology →
- Common IC-BC →
- Observations →

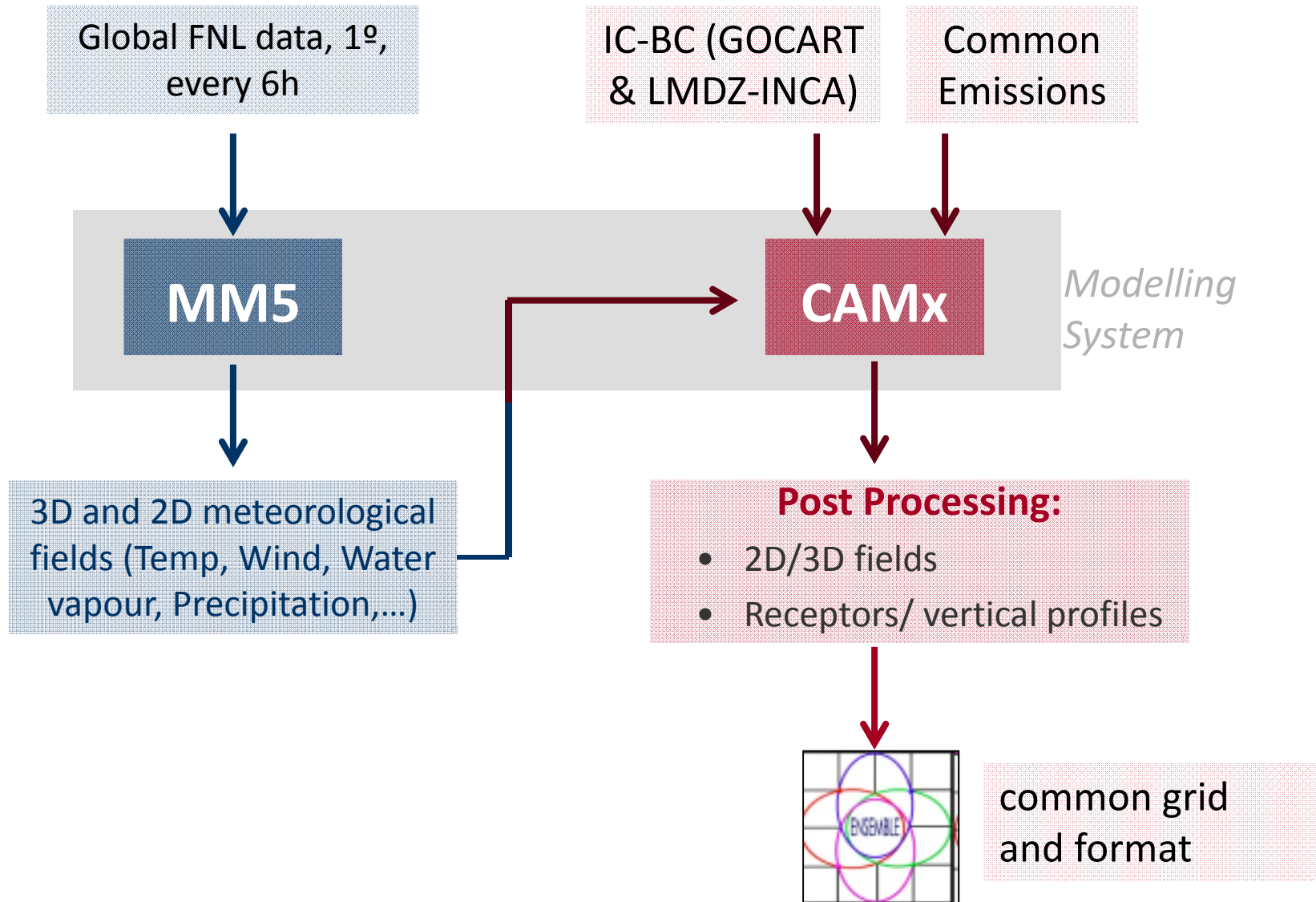
**Yearly simulations** with **different** air quality **models**/ model configurations

**ENSEMBLE platform**  
analysis and  
visualization of results



3D fields and time series of **meteo** and **AQ parameters**

# Air quality simulation



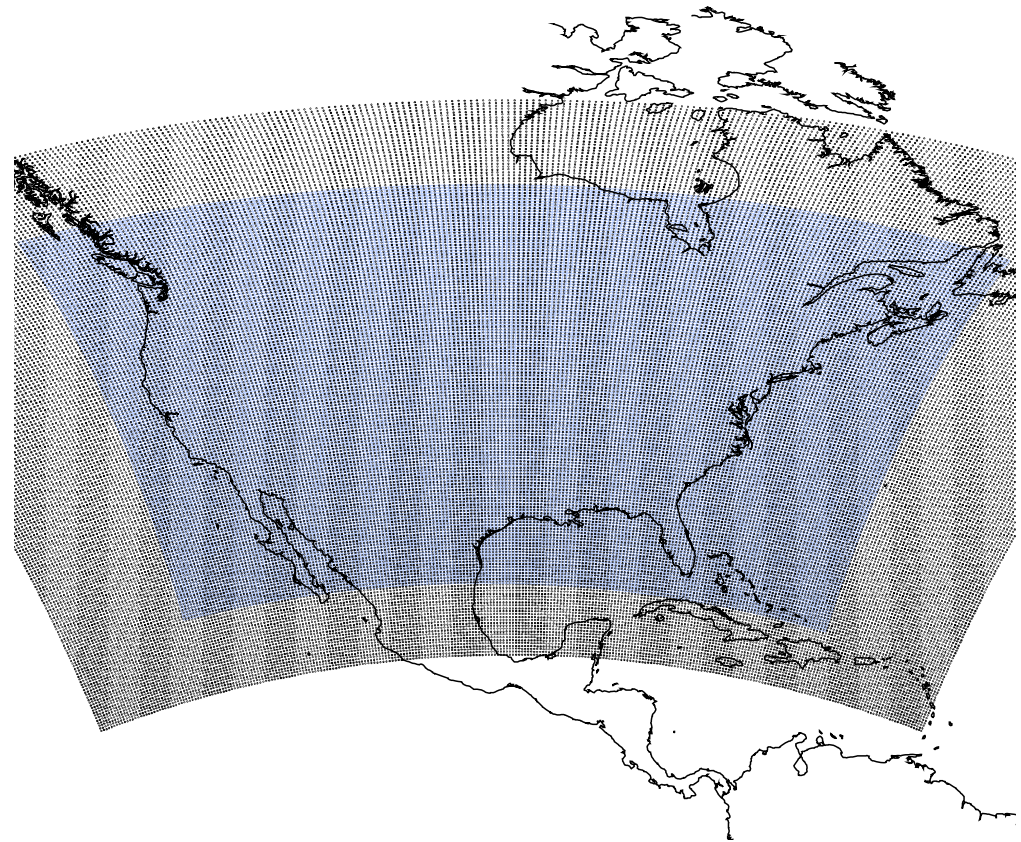
# Air quality simulation

## MM5 setup

- Lambert conformal map projection
- 5-day period runs with 6h spin-up
  - Graupel moisture scheme
  - Grell cumulus scheme
  - MRF PBL type
- 187 x 287 cells
- 27 km resolution, 23  $\sigma$  levels

## CAMx setup

- Lambert conformal map projection
- CBV chemical mech
- 149 x 229 cels
- 24 km horiz resol, 15 vertical levels



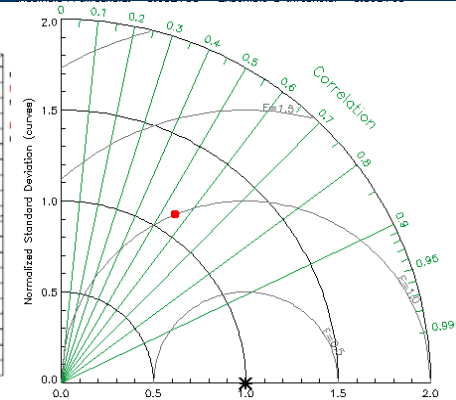
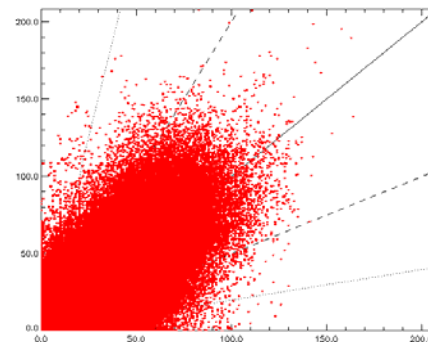
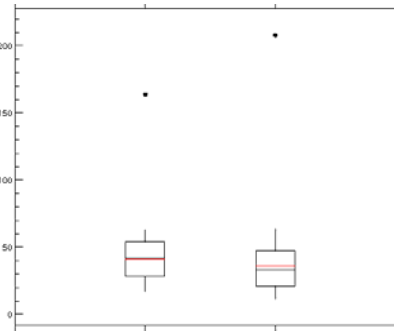
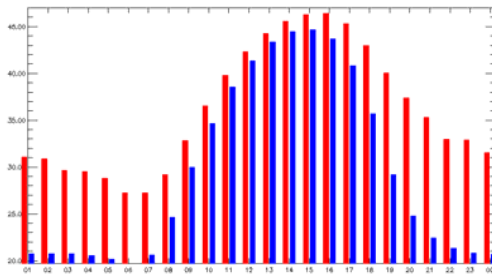
# Results

- Regulated gaseous pollutants:  $O_3$ ,  $NO_2$ ,  $CO$ ,  $SO_2$
- Model evaluation:
  - Comparison with surface observations from regional monitoring stations – spatial and temporal analysis:
    - Time-series
    - Daily profile
    - Box plot
    - Scatter plot
    - Taylor diagram
  - Analysis of air pollution episodes, for  $O_3$

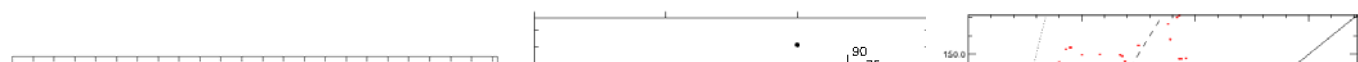
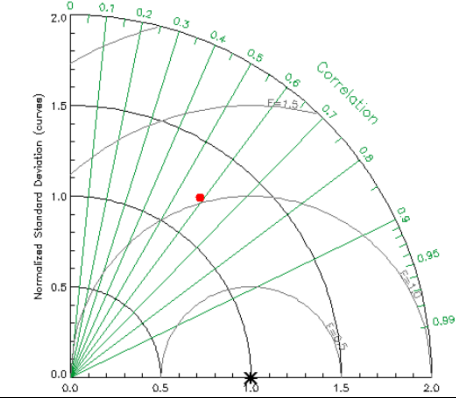
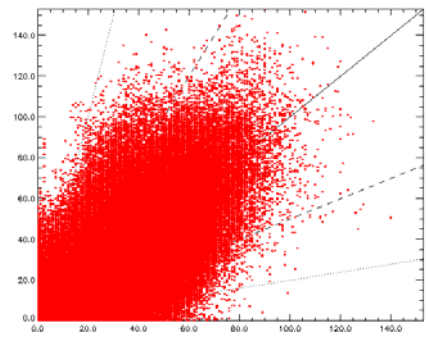
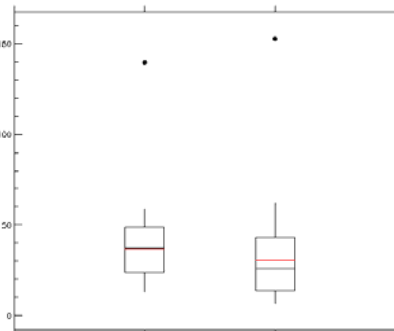
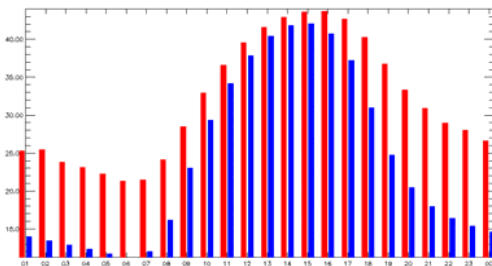


# Results – O<sub>3</sub>

D1



D2

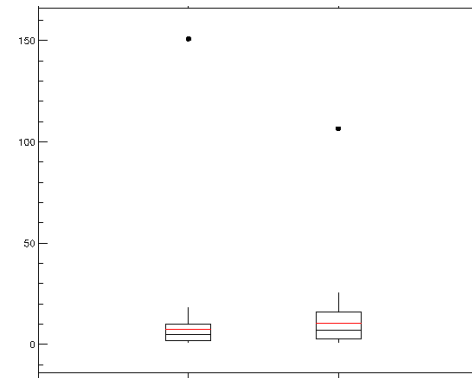
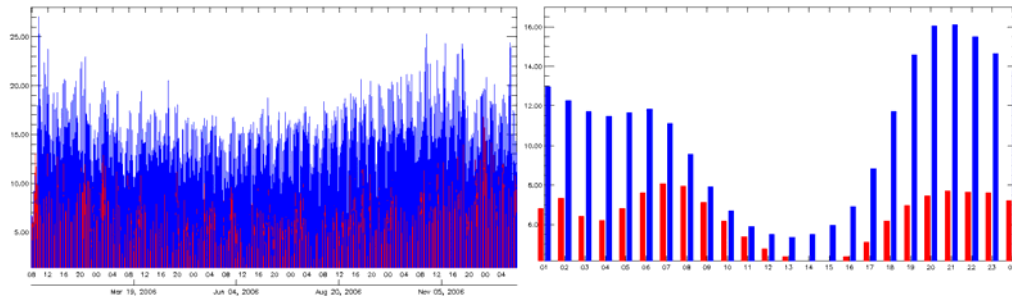


- Model skills similar for 3 different regions
  - correlation factor around 0.6 for all sub-domains and normalized SD of 1.
- D
- slight underestimation of O<sub>3</sub> concentrations, mainly during night period

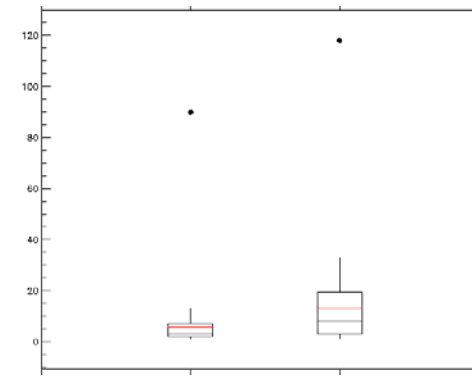
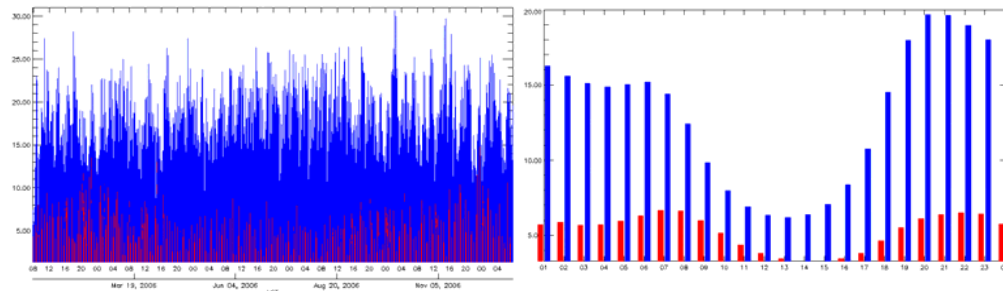


# Results – NO<sub>2</sub>

D1

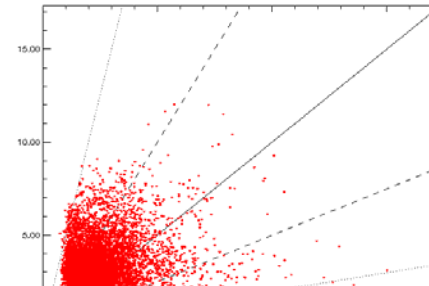
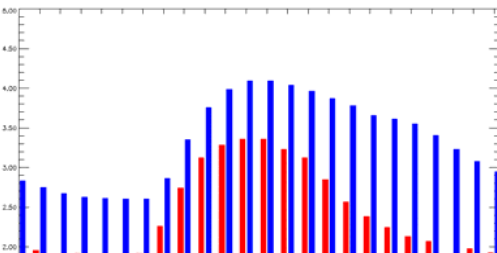
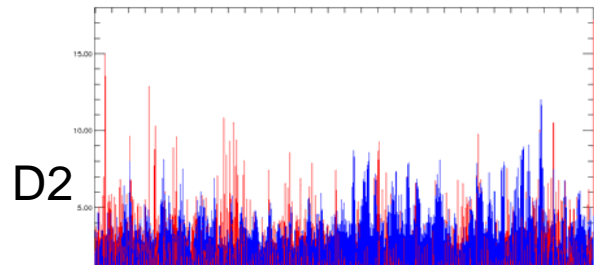
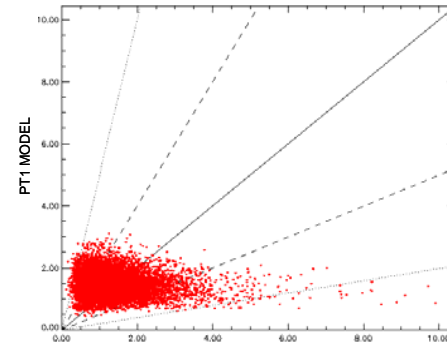
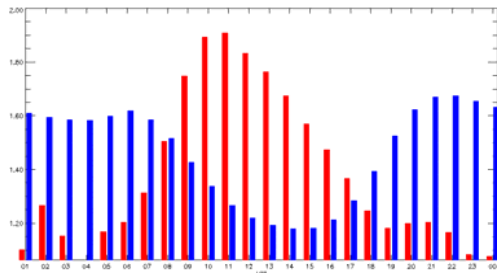
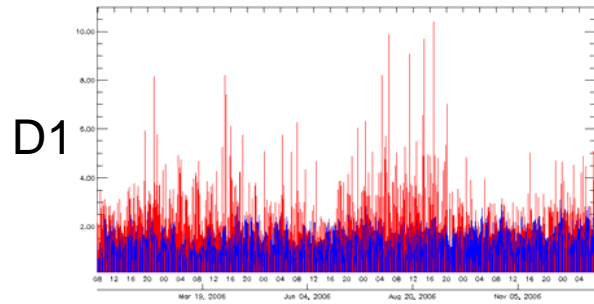


D2



- Over prediction of NO<sub>2</sub> levels → weaker model performance
- $0.4 < \text{Low correlation factor} < 0.5$
- D: • Main cause may be weak vertical mixing → surface emissions trapped near the ground

# Results – SO<sub>2</sub>

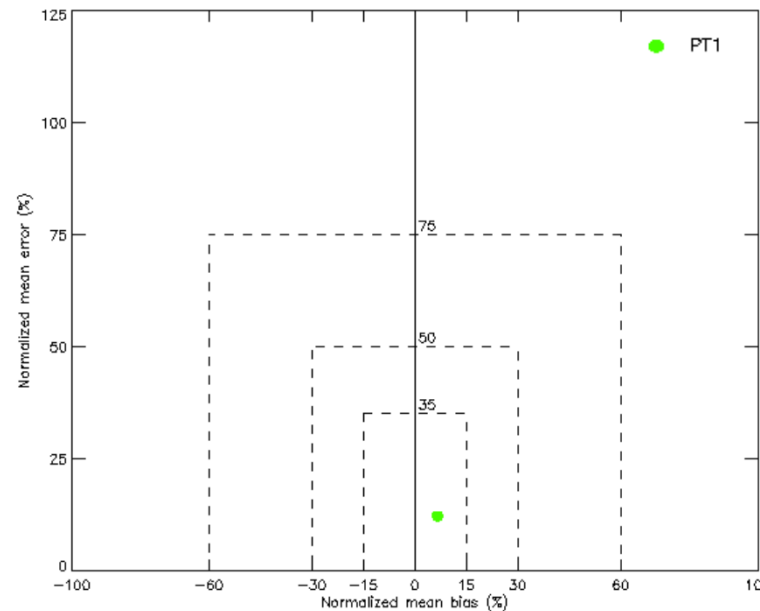
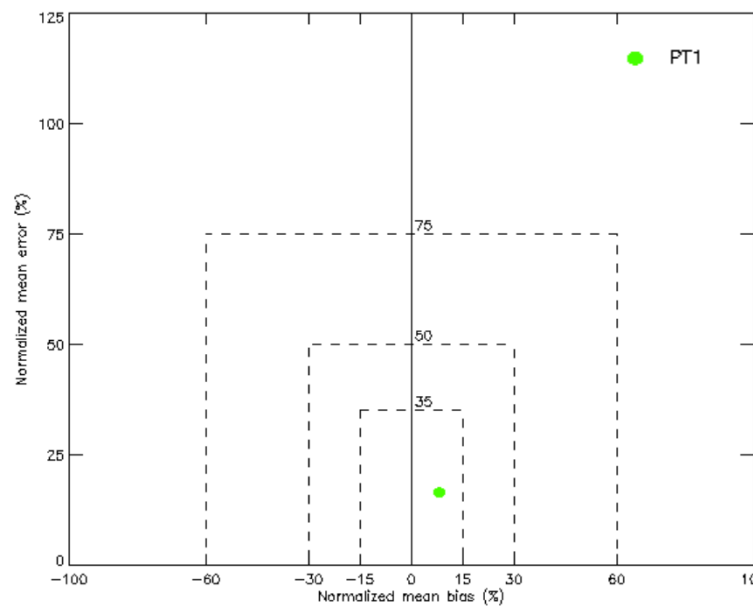


- very distinct SO<sub>2</sub> patterns among the 3 domains
- D1 – lower model skill, underestimation of peaks → can be related to PBL and model resolution
- Over prediction for D2 and D3 → lack of vertical mixing
- CO predictions exhibit similar behaviour



# Results – O<sub>3</sub> episodes

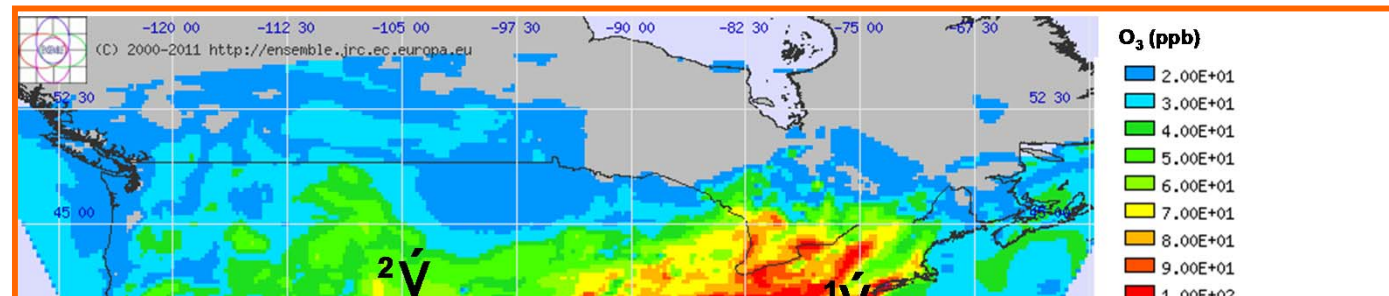
**Soccer-goal plots for O<sub>3</sub>**, considering the range of observed values higher than:  
60 ppb and 120 ppb.



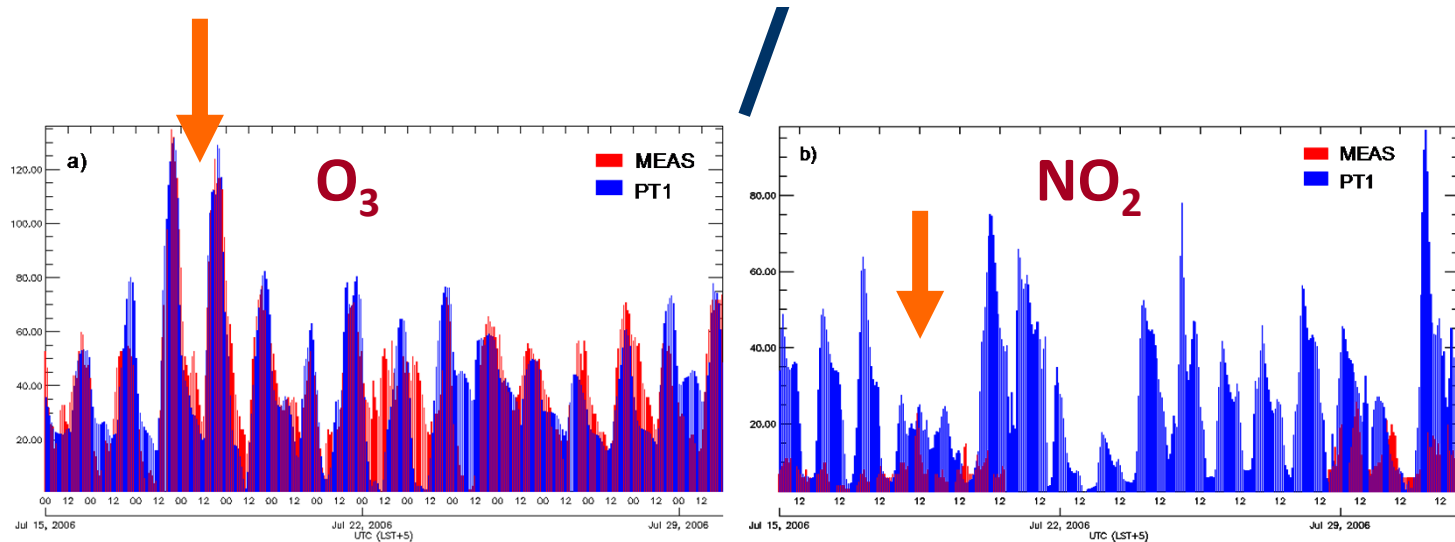
- the only pollutant registering exceedances to the regulated limit value in 2006.
- normalized mean bias and error low (< 15%), suggesting a very **good model prediction of O<sub>3</sub> peak** episodes.

# Results – O<sub>3</sub> episodes

15-30 July 2006

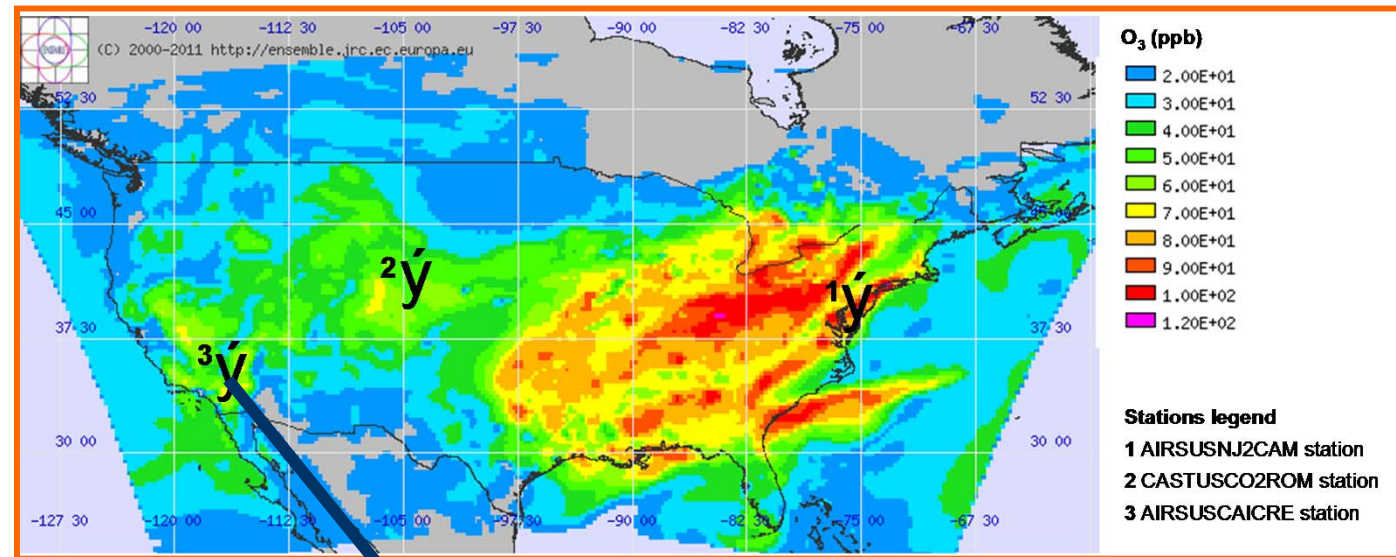


- observed O<sub>3</sub> pattern very well reproduced by the model, with peaks correctly predicted
- for NO<sub>2</sub>, model overestimated monitoring values. However, for 17-18 July observed and simulated values have the same magnitude

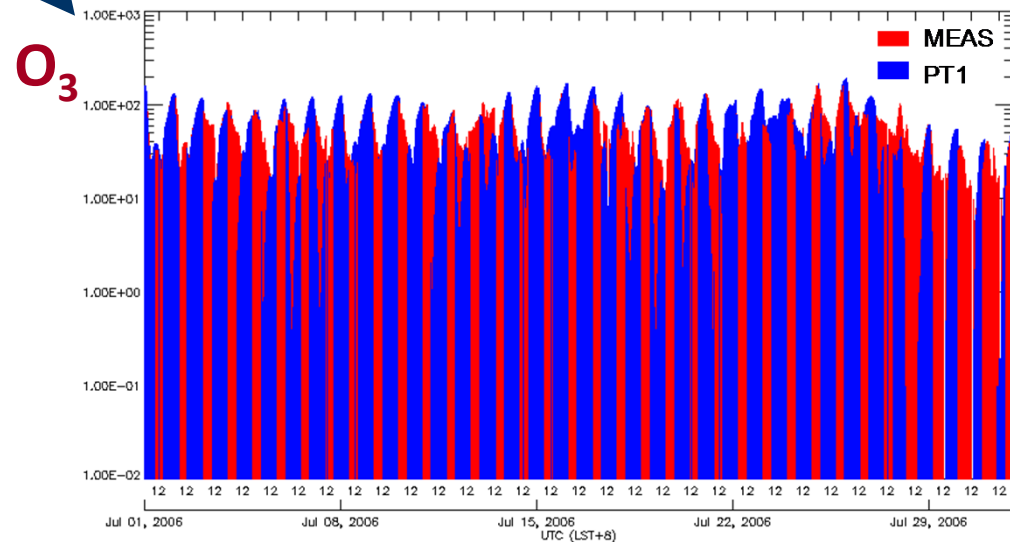


# Results – O<sub>3</sub> episodes

July 2006



- Daily pattern and photochemical cycle of O<sub>3</sub> correctly simulated, and also maximum concentrations of 110-120 ppb registered along the days.



# Final Remarks

- **Good** model skills for **O<sub>3</sub>**, **lower** performance for **NO<sub>2</sub>, SO<sub>2</sub> and CO** – weak vertical mixing, coarse horizontal resolution to capture high observations of CO and SO<sub>2</sub>
- overestimation of NO<sub>2</sub> and CO levels, and slight under-prediction of O<sub>3</sub> concentrations at night.
- model **able to predict** occurrence of **O<sub>3</sub> episodes** → important to prevent harmful effects on human health
- importance of using **emission inventories** as detailed and accurate as possible; **meteorological modelling performance** has implications on the performance of the air quality model.
- **additional research** on the improvement of air quality modelling needed → **multi-pollutant approach**, covering not only O<sub>3</sub> and PM, but specially CO and SO<sub>2</sub> not always well simulated by models.

# Thank You!!

## Aknowledgements

*Thanks to the AQMEII initiative and support*

*The following agencies are acknowledged: U.S. EPA, Environment Canada, Mexican Secretariat of the Environment and Natural Resources (SEMARNAT) and National Institute of Ecology (INE); Environment Canada's National Atmospheric Chemistry Database (NAtChem) and several U.S. and Canadian agencies (AQS, CAPMoN, CASTNet, IMPROVE, NAPS, SEARCH and STN networks).*