

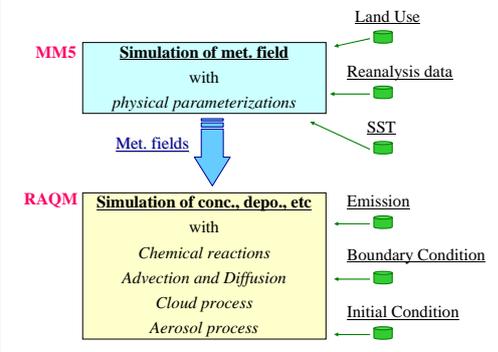
MODELING STUDY ON LONG-RANGE TRANSBOUNDARY AIR POLLUTIONS IN NORTHEAST ASIA

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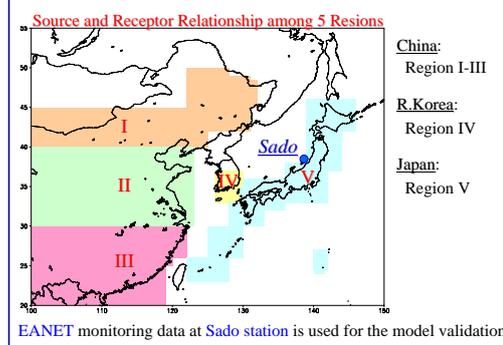
1. Outline of Regional Air Quality Model (RAQM)



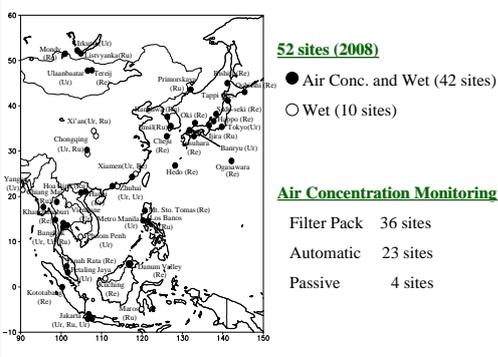
2. Parameters for Simulations

- **MMS simulation**
 - 1 x 1 deg. NCEP-FNL
 - 125 x 95 grids with 45km grid resolution, 23σ layers up to 100hPa
 - **RAQM simulation**
 - Simulation periods are **March, July and December 2001**
 - 90 x 60 grids with 0.5deg. grid resolution, 12σ layers up to 10km (100E-145E, 20N-50N)
 - BCs and ICs are derived from recent studies for East Asia (Carmichael, 1998; Luo, 2000)
 - Seasonal emissions are derived from **MICS Phase 2 emission data**.
- Latest Information:
Han Z. et al., 2006., Atmospheric Environment, Vol. 40, pp2360-2373

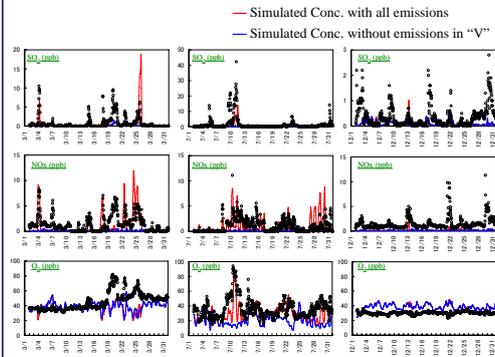
3. Simulation Domain for S-R Relationship Analysis



4. EANET stations for the Atmospheric Monitoring



5. Model Validation



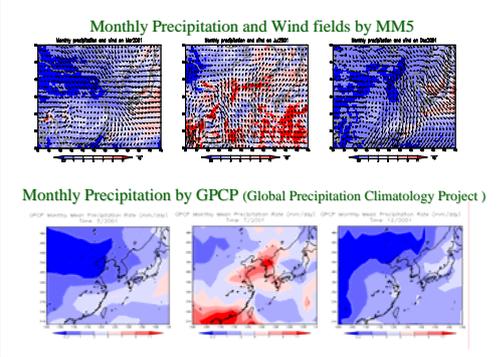
6. Sensitivity related to the emission reduction

Variation of the monthly averaged concentrations at Sado station related to the emission reduction for Region I to V

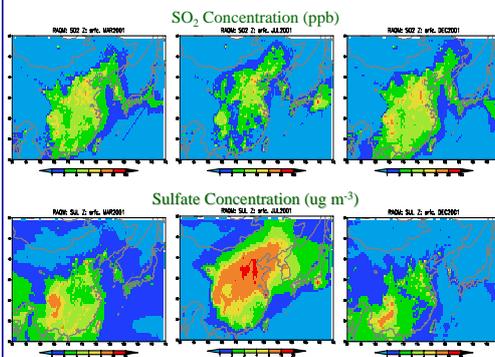
	Simulated Conc. (ppb)	without I	without II	without III	without IV	without V	without ALL	
SO ₂	Mar	0.64	-6.7%	-12.0%	-0.2%	-5.0%	-69.1%	-91.4%
	Jul	0.65	0.4%	0.1%	0.6%	-2.8%	-83.8%	-88.4%
	Dec	0.12	-21.1%	-39.6%	-1.3%	-5.6%	-11.3%	-68.4%
NOx	Mar	0.99	-3.7%	-0.5%	0.1%	-1.5%	-80.4%	-88.6%
	Jul	1.03	0.8%	0.9%	0.8%	0.6%	-78.9%	-82.4%
	Dec	0.17	-24.2%	-8.5%	-1.9%	-4.4%	-21.4%	-62.1%
O ₃	Mar	38.69	-2.9%	-2.3%	-0.1%	-0.9%	-0.3%	-7.6%
	Jul	29.99	-1.6%	-4.5%	-2.6%	-7.6%	-31.5%	-50.5%
	Dec	38.44	-1.7%	-1.6%	-0.2%	-0.1%	-0.3%	-4.3%

* "without ALL" includes the contribution from boundary/initial conditions.

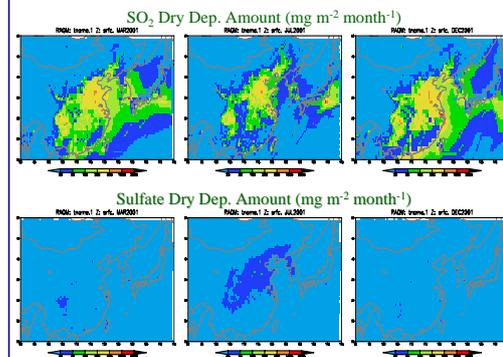
7. Monthly Accumulated Rainfall Amount (mm/day)



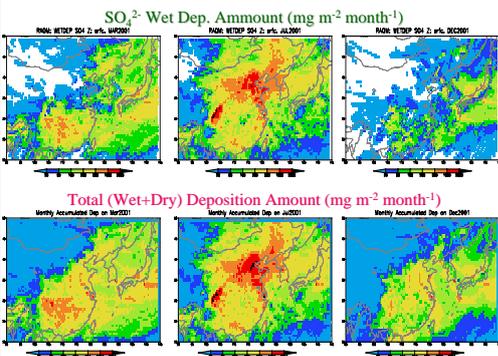
8. Monthly Averaged Conc. of SO₂ and Sulfate



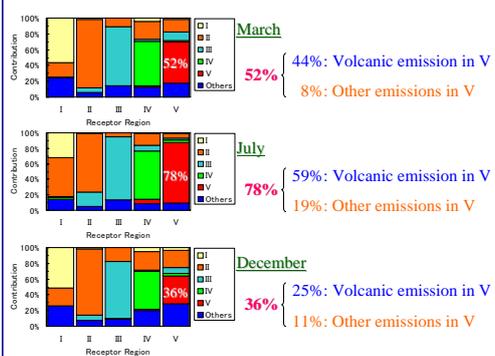
9. Monthly Accumulated Dry Dep. of SO₂ and Sulfate



10. Monthly Accumulated Wet Dep. of SO₄²⁻



11. S-R Relationship for Sulfur Deposition



12. Conclusions

- Model validation and **Source-Receptor Relationship analysis** for Sulfur compounds in Northeast Asia in March, July and December 2001 were conducted using **MMS/RAQM**.
- Model shows the reasonable agreement on the level of SO₂, NOx and O₃ concentration monitored at Sado EANET station.
- The **volcanic emission** played a large role in SO₂ concentration in Japan on **July** because the prevailing seasonal winds from the southeast (Pacific Ocean) exists in summer season.
- Since **Region V** is the downwind region in March and December, the contributions to the total deposition amount from outside become larger and the ratio is **March: 48%** and **December: 64%**. In July, the **outside contribution** becomes smaller, with the ratio of **22%**, due to the prevailing wind from Pacific Ocean.
- The **volcanic emissions** have a large influence on the Sulfur deposition in Region V.

Reference

Carmichael G.R., T. Sakurai, D. Streets, Y. Hozumi, H. Ueda, S.U. Park, C. Fung, Z. Han, M. Kajino, M. Engardt, C. Bennet, H. Hayami, K. Sartelet, T. Holloway, Z. Wang, A. Kannari, J. Fu, K. Matsuda, N. Thongboonchoo and M. Amann, 2008: MICS- Asia II: The model intercomparison study for Asia Phase II methodology and overview of findings, Atmospheric Environment 42, pp3468-3490.

EAUNET, 2009: Data Report on the Acid Deposition in the East Asian Region 2008.