Ensemble Particulate Matter Forecast System over North East Asia / Korea during 2012-Present

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Introduction

- Recent increase of surface PM over Asia has been a rising issue.
- Multi-year particulate matter (PM) forecasts over Asia, based on an ensemble of multiple meteorology and chemistry models have performed.
- Performances of multiple regional air quality simulation systems are evaluated using surface and remote sensing observations.
- Model Inter-Comparison Study for Asia (MICS-Asia) & (INTEX-B) are utilized for foreign emissions and Clean Air Policy Support System (CAPSS) is utilized for domestic emissions using the SMOKE model.
- Ensemble model application to PM forecast is tested.
- PM concentrations are averaged for each quarter : Q1(Jan, Feb, Mar), Q2(Apr, Mar, Jun), Q3(Jul, Aug, Sep), Q4(Oct, Nov, Dec)

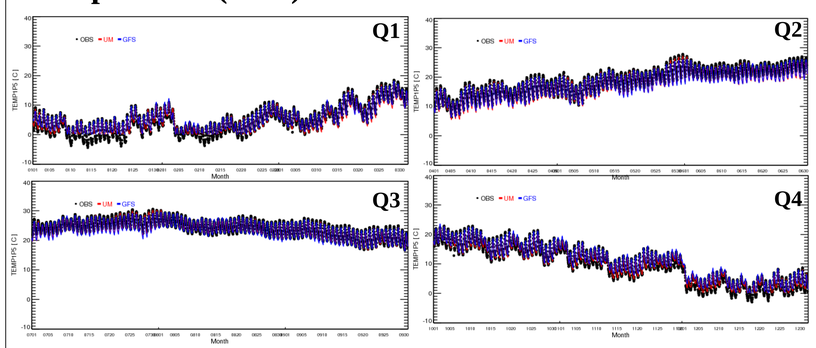
Simulation descriptions

	Meteorological model	Vertical layer	Emission inventory	Photo-chemical model	Simulation period
Base (IMAQS-K)	GFS-WRF	15	INTEX-B 2006 & CAPSS 2007	CMAQ	May, 2012 ~ Dec, 2014
Case 1	UM	47	INTEX-B 2006 & CAPSS 2009	CMAQ	Jan, 2012 ~ Dec, 2014
Case 2	GFS-WRF	15	INTEX-B 2006 & CAPSS 2007	CAMx	Jan, 2014 ~ Dec, 2014
Case 3	Average for base, case 1 and case 2				Jan, 2014 ~ Dec, 2014

- Base & case 1 have 27-km resolutions and case 2 has 25-km resolution over the domain included north east Asia.
- Differences according to emission inventory should be considered.

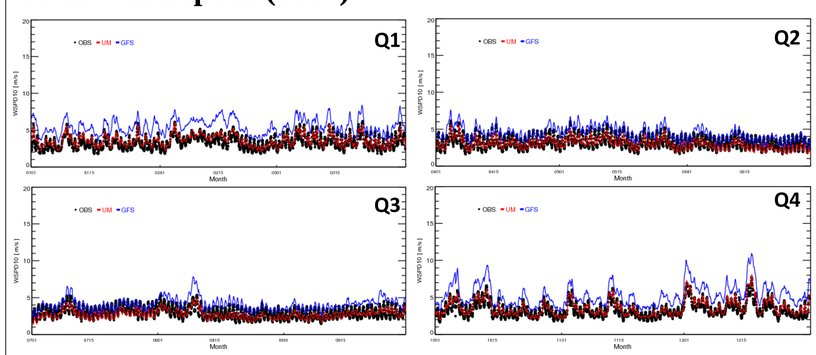
Result 1: Meteorology variations

Temperature (2014)



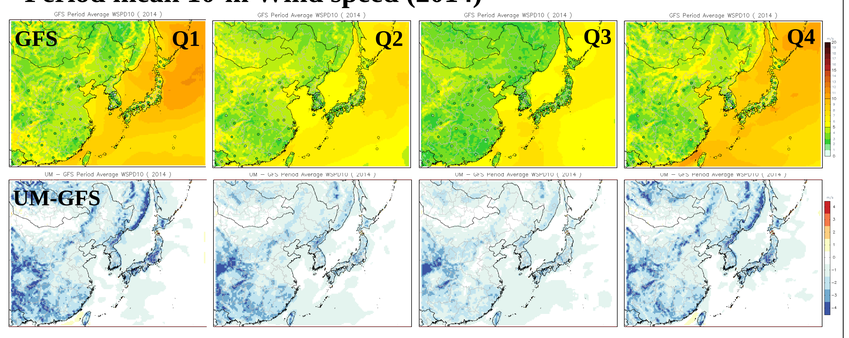
- 2-m temperature and 1.5-m temperature were compared with MADIS 2-m temperature observation data.

10-m Wind speed (2014)



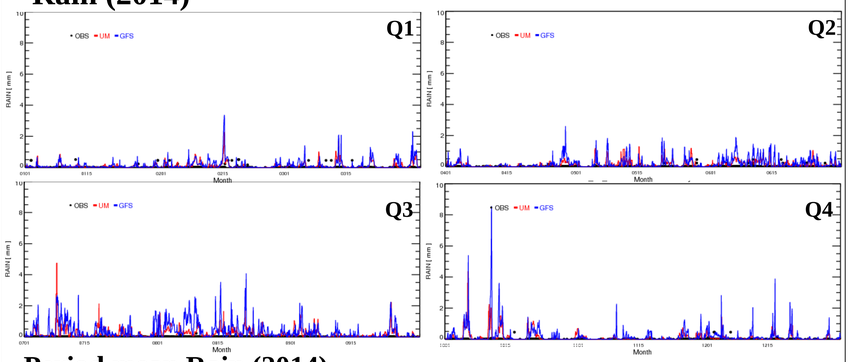
- GFS-WRF over-predicts 10-m wind speed when compared with MADIS observation data during 2014.
- UM under-predicts 10-m wind speed.

Period mean 10-m Wind speed (2014)

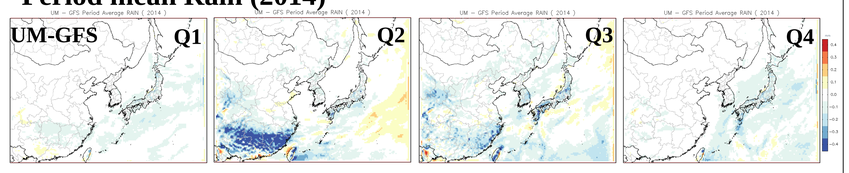


- The differences in simulated wind speed for land is bigger than that for ocean.
- Q1 presents the biggest differences in 10-m wind speed.

Rain (2014)



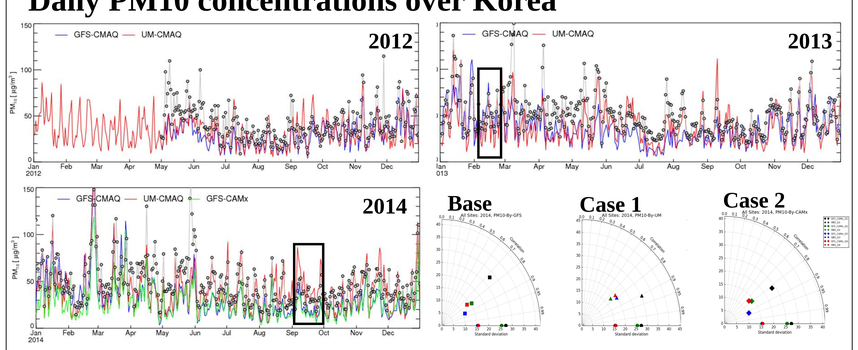
Period mean Rain (2014)



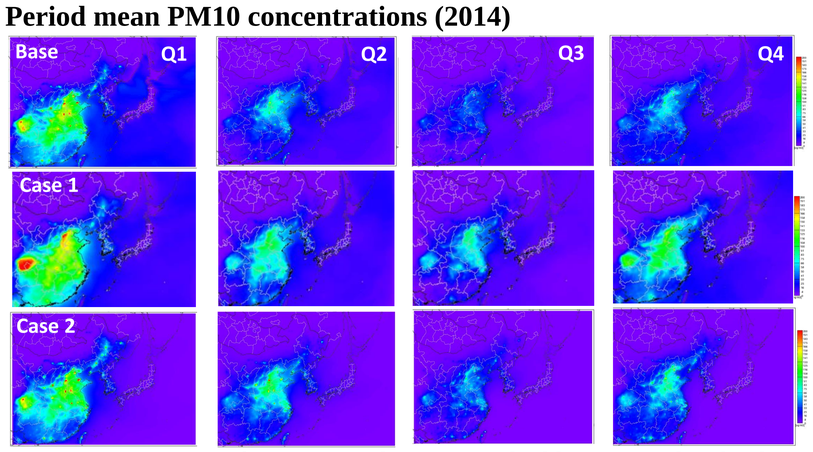
- Both models over-estimates rain compared with observations.
- The differences of simulated rain between GFS-WRF and UM may affect simulated concentrations of PM.

Result 2 : PM10 variations (2012 ~ 2014)

Daily PM10 concentrations over Korea



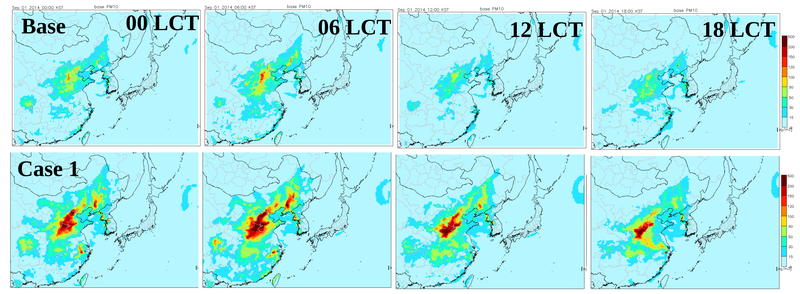
Period mean PM10 concentrations (2014)



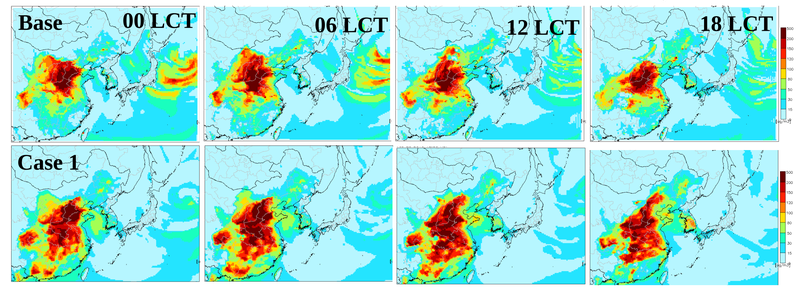
- PM10 concentrations for case 1 tend to estimate highly compared with others.
- Taylor diagram shows correlation and RMSE between model and OBS for 2014.
- Big differences could be caused by different emission inventories in part.
- Result 3 indicates that meteorology can play a role to cause large variability in PM10 concentrations predicted.

Result 3 : Case study

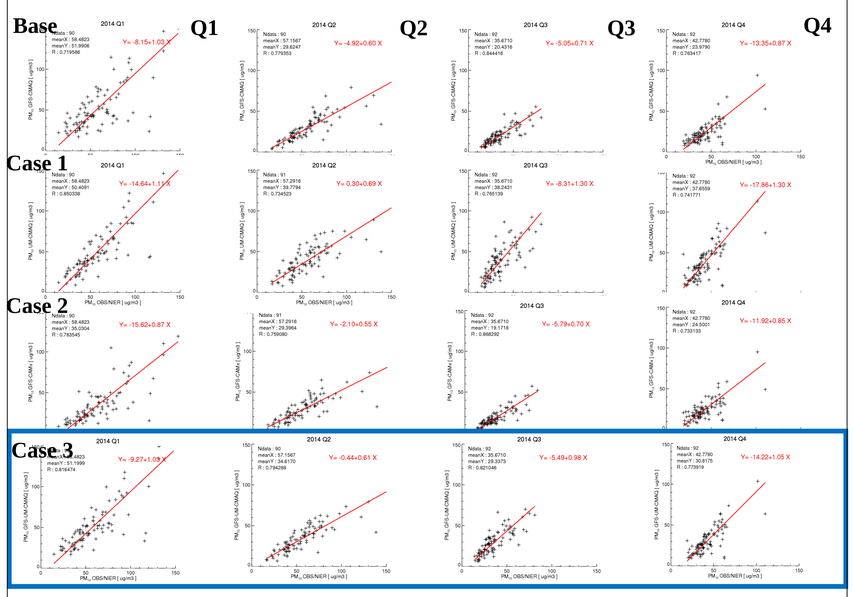
Predicted PM10 for case 1 is higher than base : September 1st , 2014



Predicted PM10 for case 1 is lower than base : February 25th , 2013



Result 4 : Ensemble model results



- Each model has different result for PM10 concentrations
- Model performance was improved by using ensemble model(case 3)

Conclusions

- PM forecasts over Asia, based on an ensemble of multiple meteorology and chemistry models have performed for 3 years.
- GFS-WRF tend to over-estimates wind speed while UM under-estimates.
- Both base & case 2 tend to predict PM10 concentrations lower while case 1 predict the concentrations higher than observations.
- Case study shows that meteorology can play a role to cause large variability in PM10 concentrations predicted.
- The accuracy of simulated PM10 for ensemble model averaged individual model results was improved.

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