

Effects of detailed vegetation database on simulated meteorological fields, biogenic VOC emissions, and ambient pollutant concentrations over Japan

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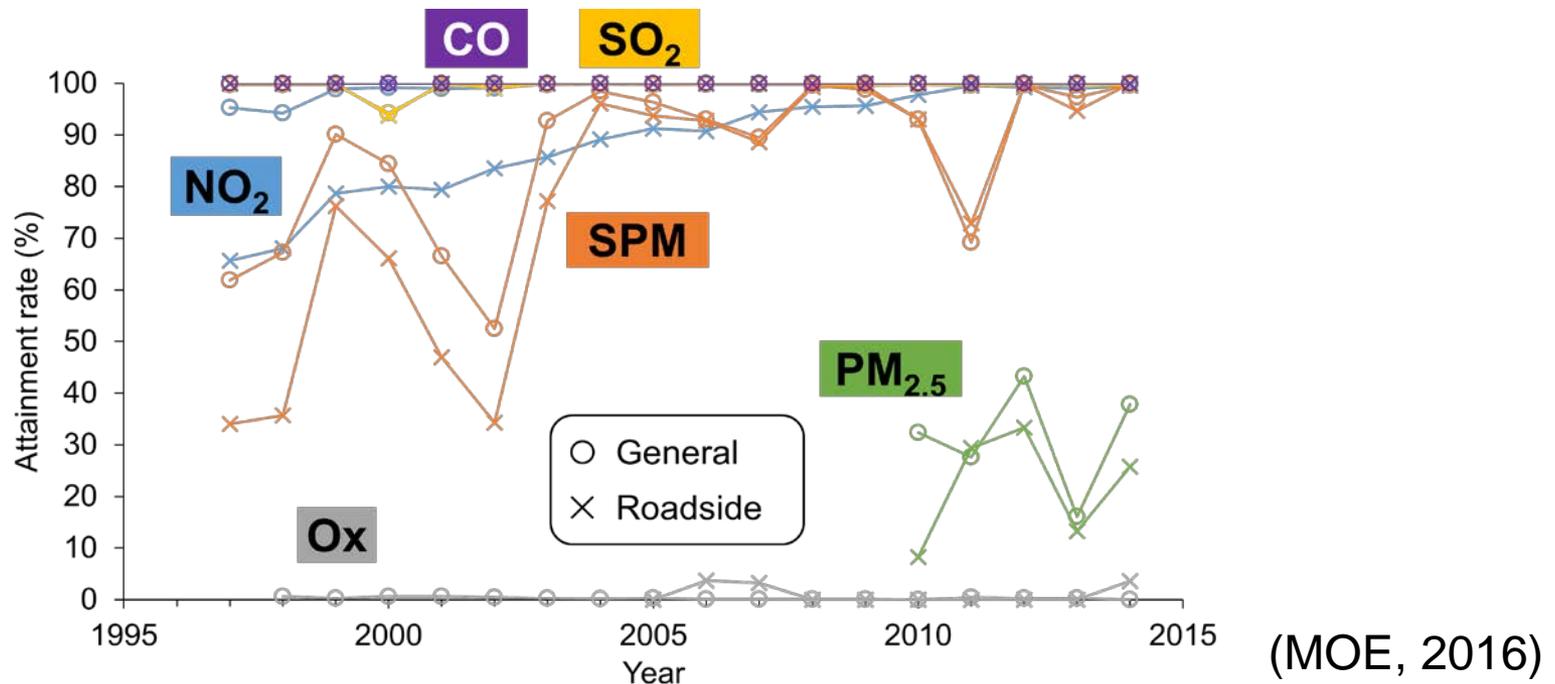
*Land Cover/Land Use Changes (LC/LUC)
and Impacts on Environment in
South/Southeast Asia*

*- International Regional Science Meeting
May 29, 2018 @ Quezon City, Philippines*



Background

- **Secondary pollutants : Ozone and PM_{2.5}**
 - Low attainment rates of the Environmental Quality Standards.



- Air quality modeling required to consider effective strategies.

Overview of J-STREAM

- Japan's study for reference air quality modeling

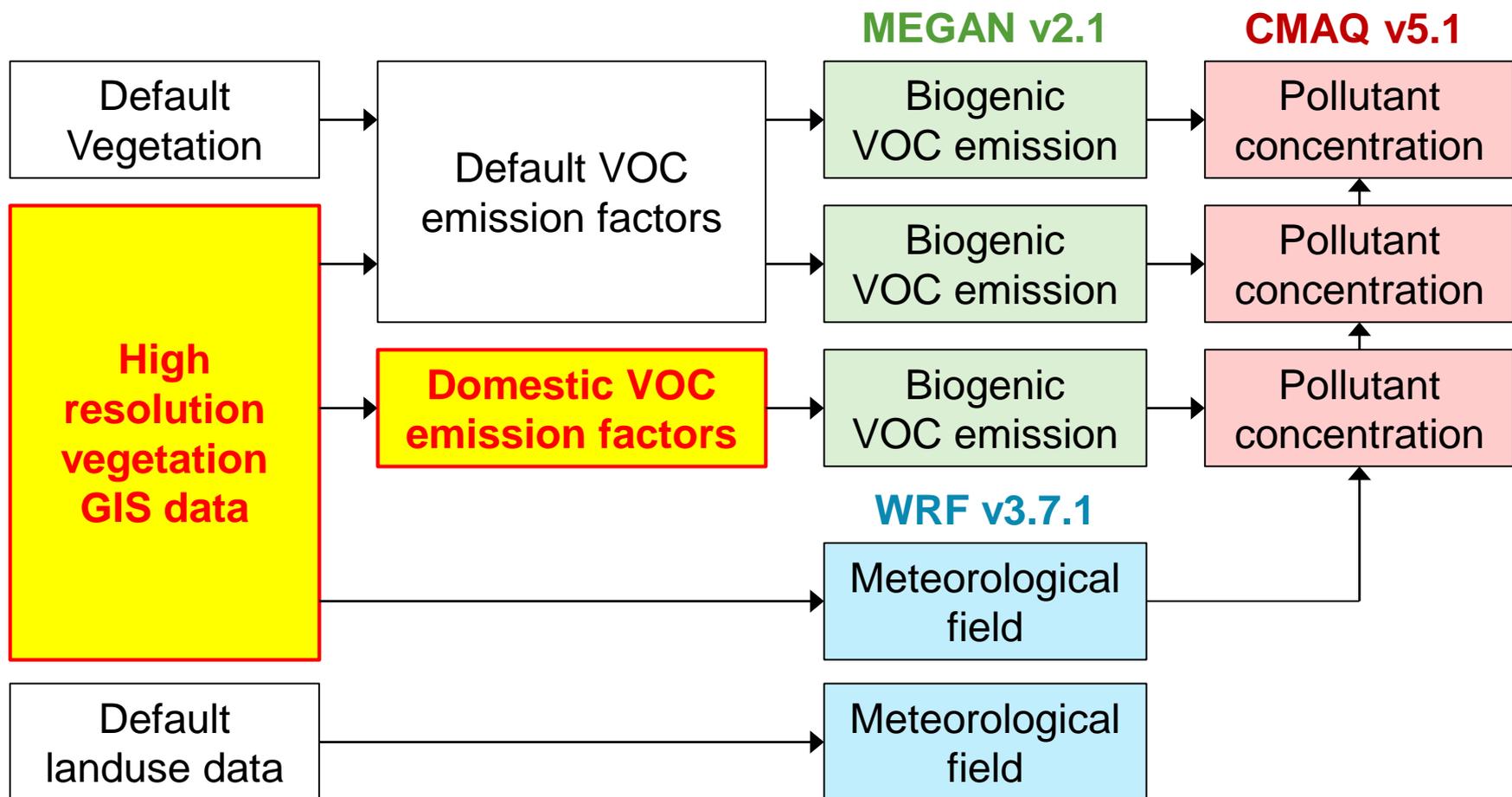
Establishment of a reference modeling for source apportionment and effective strategy making to suppress secondary air pollutants

- Funded by the Environment Research and Technology Development Fund (5-1601).
- 3 years (FY2016 – 2018).
- Major components:
 - Model inter-comparison.
 - Emission inventory for model inputs.
 - Observation to validate and develop models.



Objective and methodology

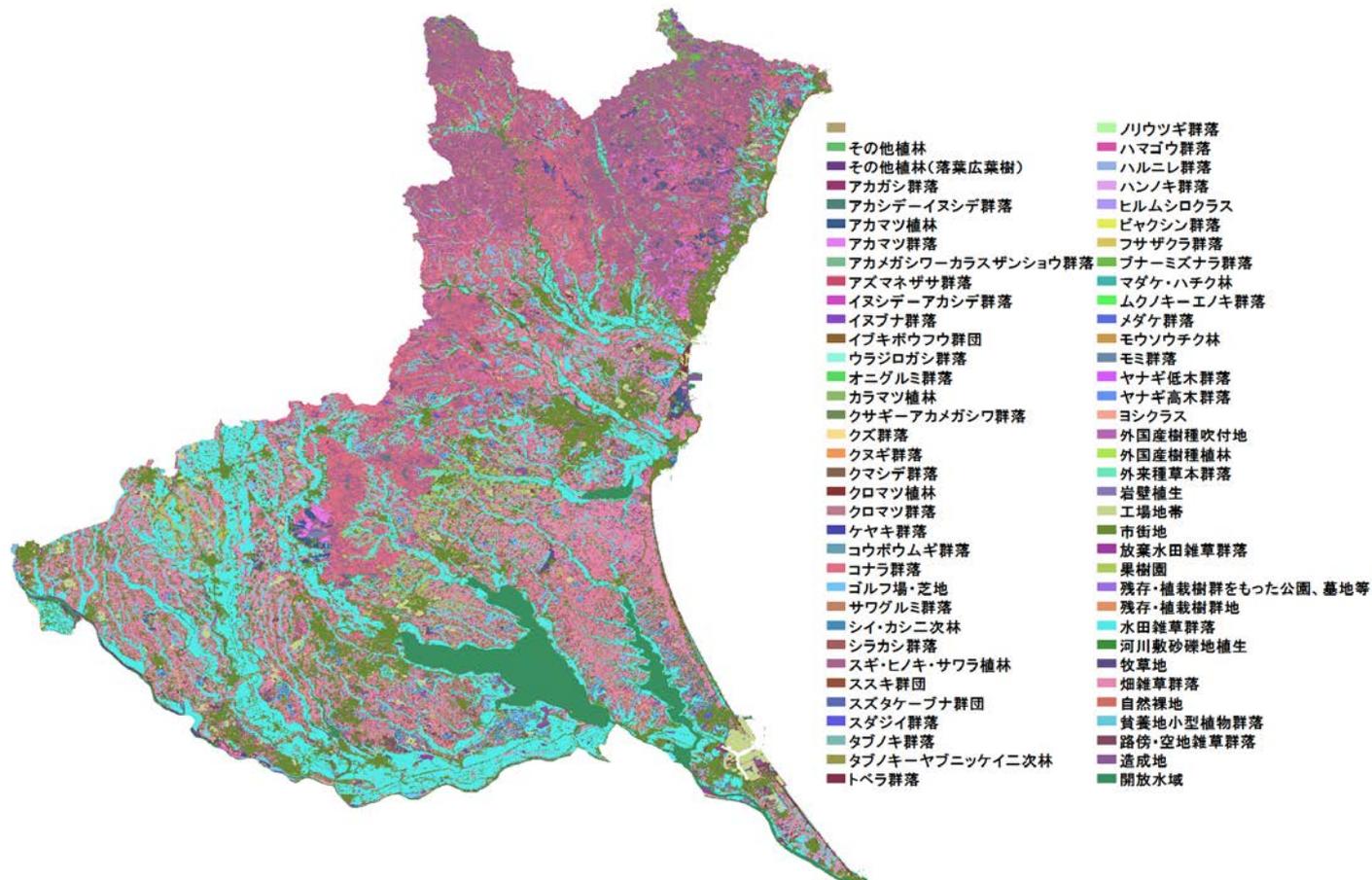
- Evaluate effects of new vegetation data and emission factors on biogenic VOC emissions, meteorological fields, and pollutant concentrations.



High resolution vegetation GIS data

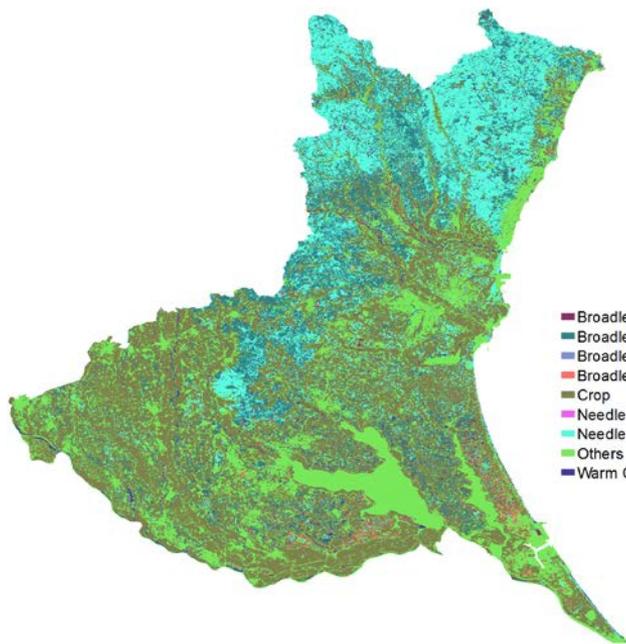
- 1/25,000 or 1/50,000 vegetation GIS map released by the Biodiversity Center of Japan, Ministry of Environment.

<http://gis.biodic.go.jp/webgis/index.html>

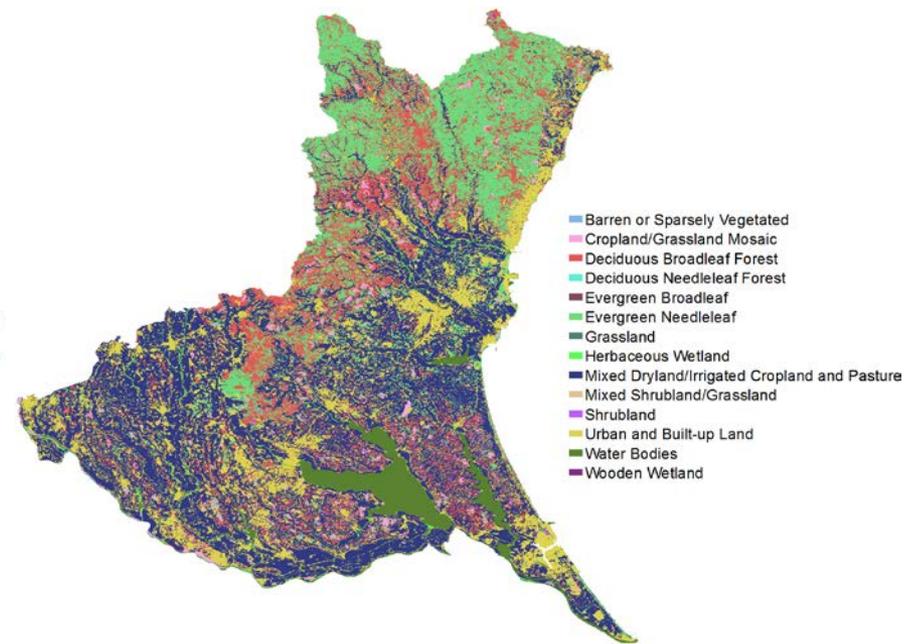


Allocating vegetation types

- ❑ Allocate to 16 plant functional types used in MEGAN.
- ❑ Keep original information to set specific emission factors for dominant vegetation types in Japan.
- ❑ Allocate to 24 USGS landuse categories for WRF.



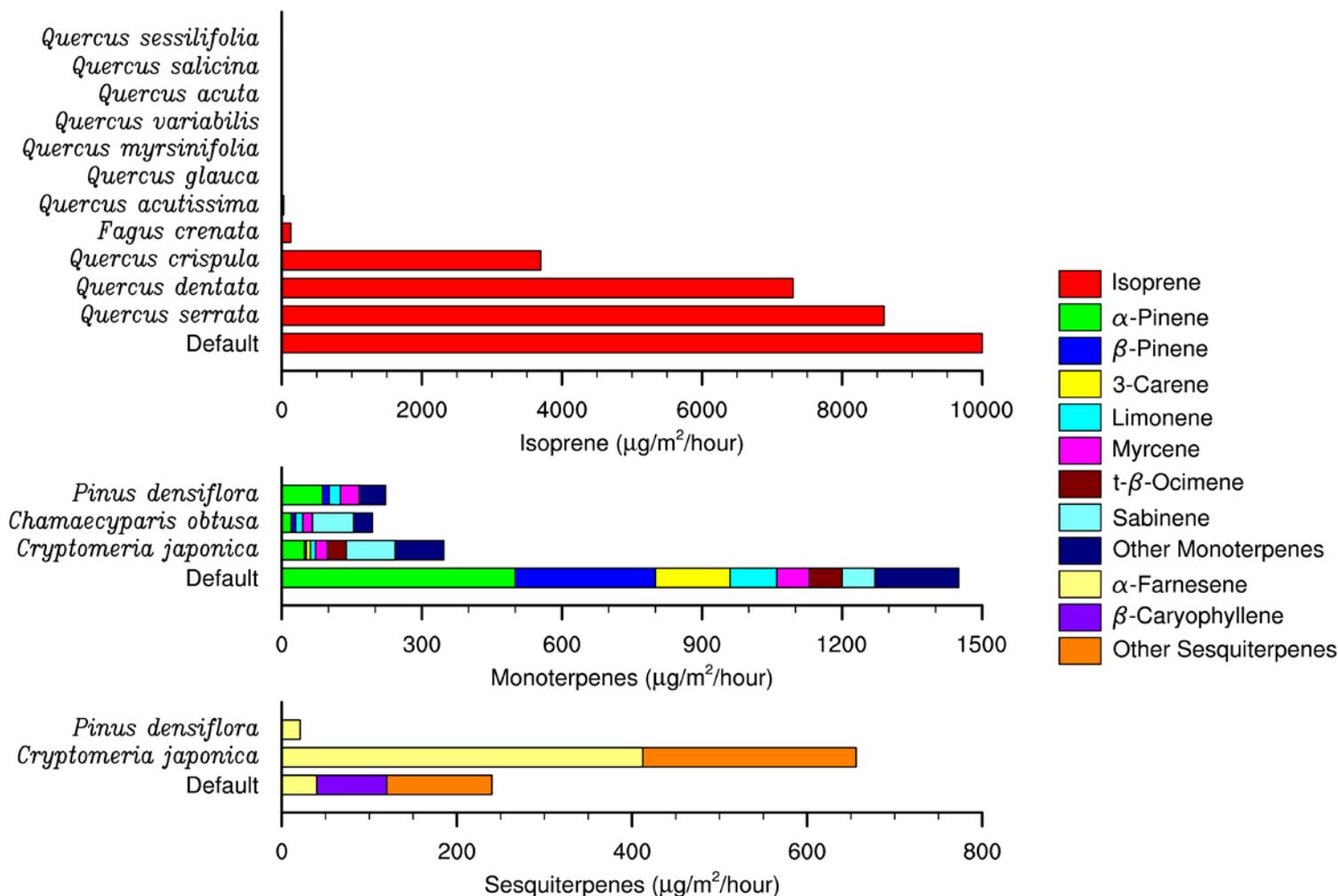
MEGAN



USGS

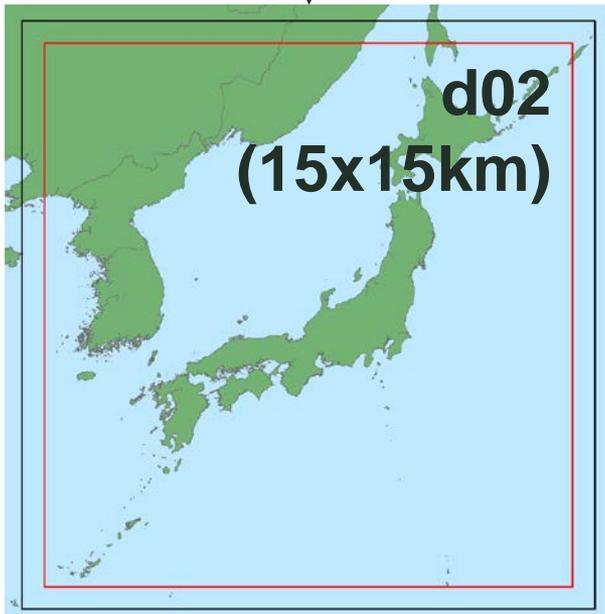
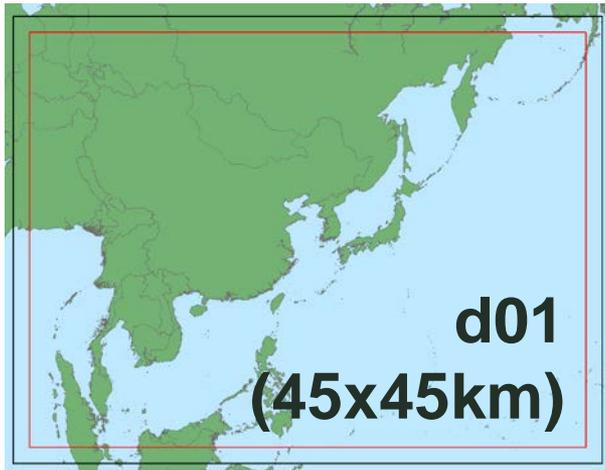
Emission factors for dominant plants

- Gather emission factors for dominant plants in Japan from existing literature.

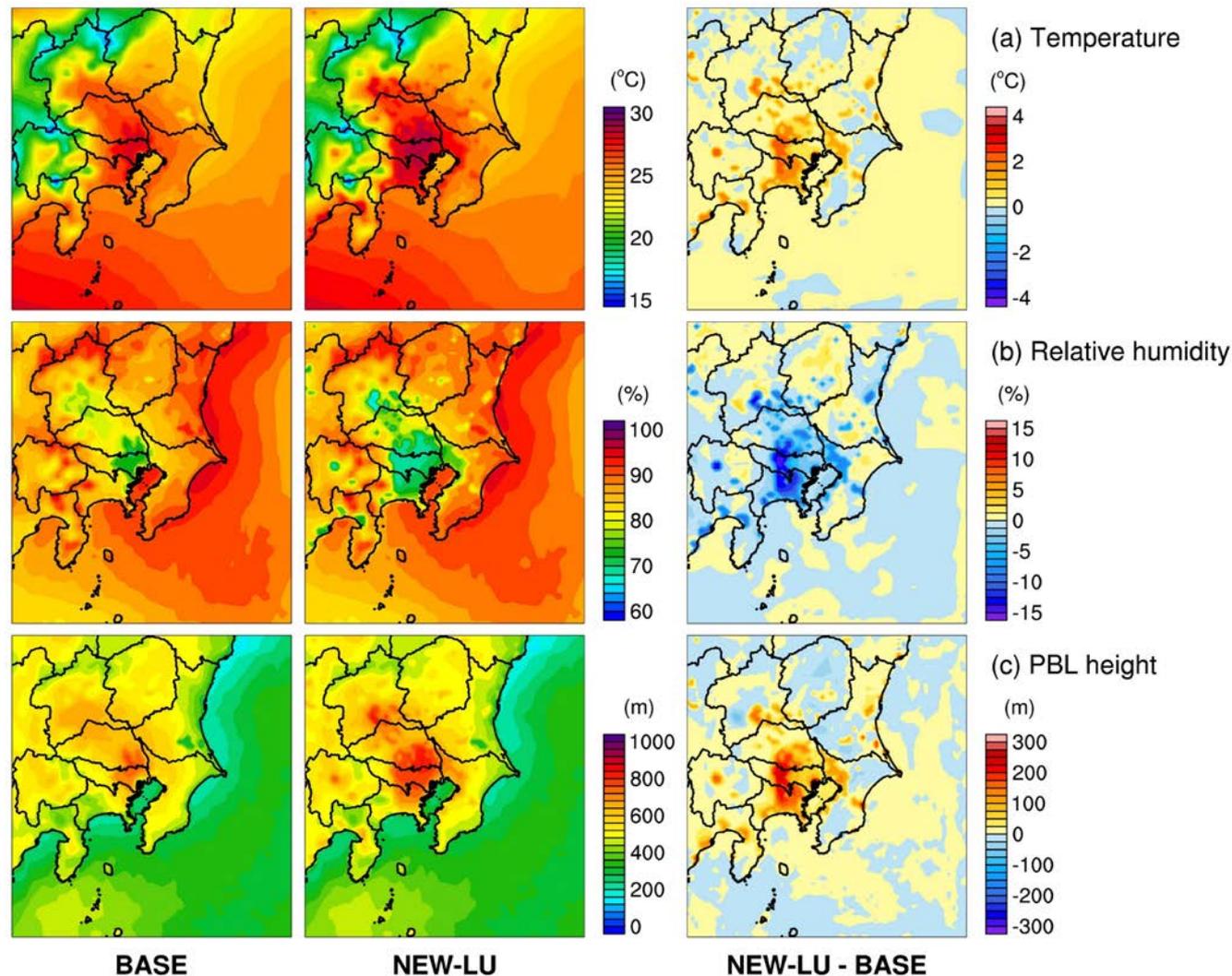


Simulation settings

- ❑ Common model configurations in J-STREAM. (Chatani et al., 2018)
- ❑ Replace inputs in d02 and d04.
- ❑ Target period: 22 July to 10 August 2013.

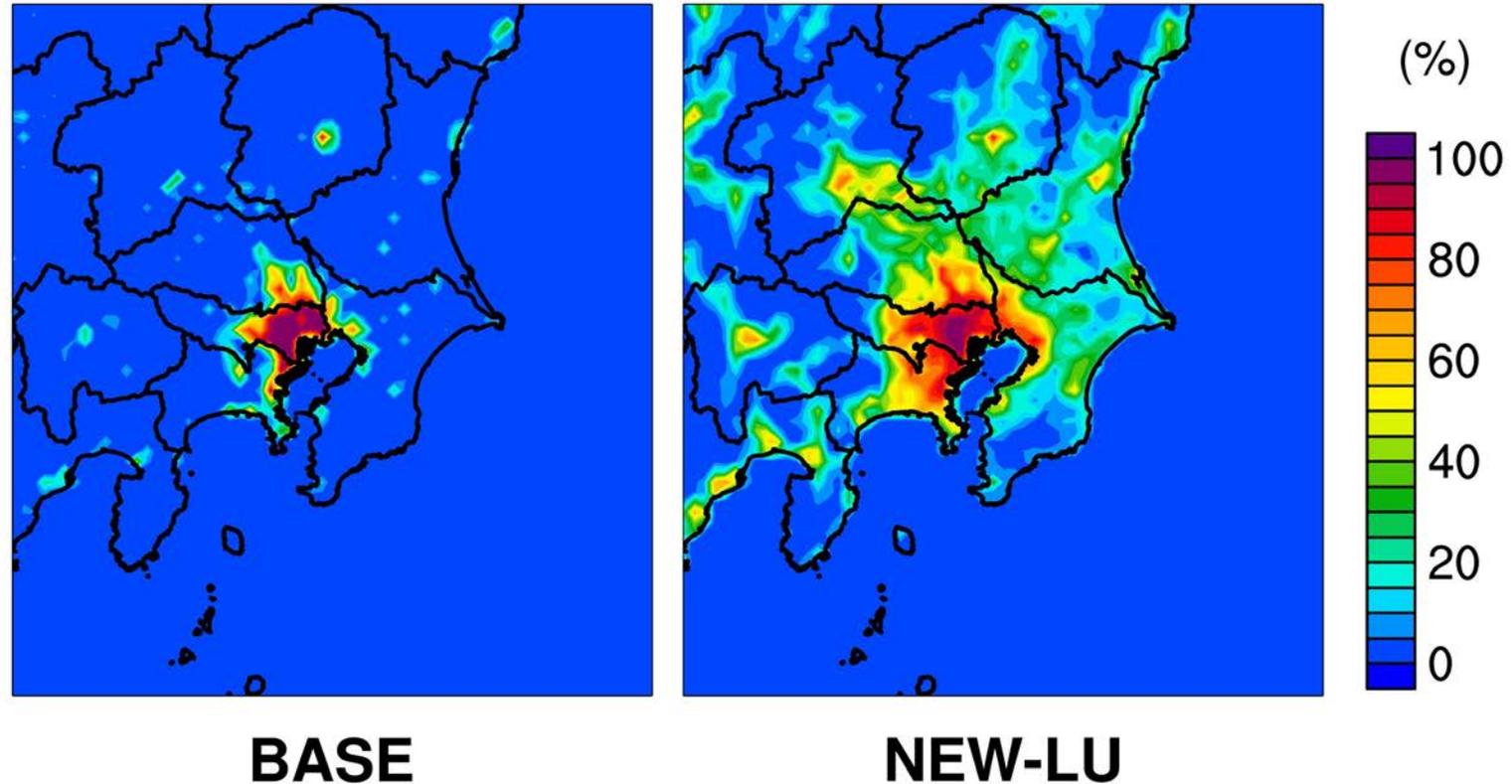


Effects on meteorological fields



- Higher temperature and PBL, and lower humidity.

Representation of urban areas



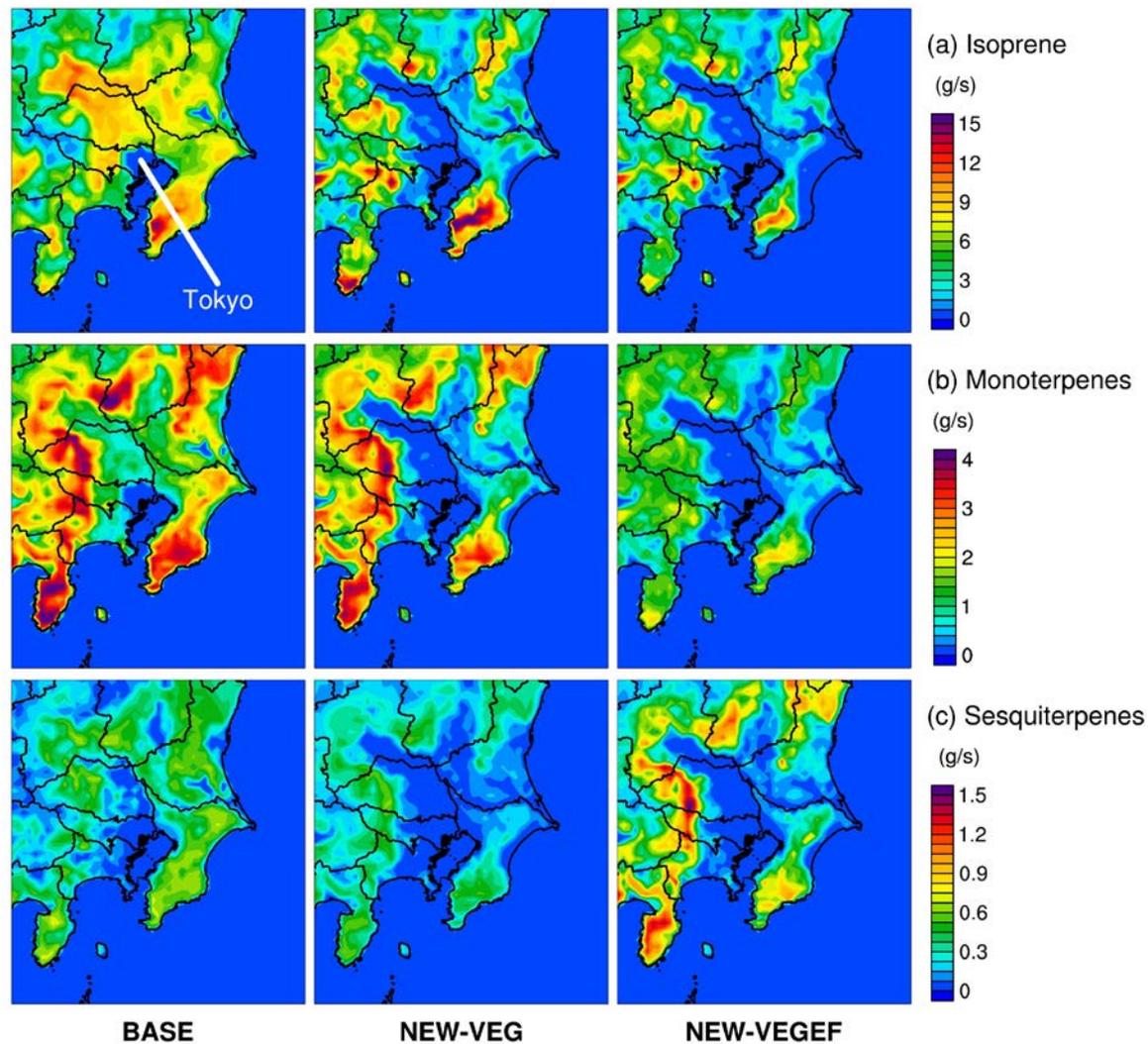
- Differences of urban areas largely influence on simulated meteorological fields.

Performance on meteorological fields.

Parameter	Domain	Network	Case	MB	RMSE	R
Temperature (°C)	d03	Office	BASE	-0.93	2.2	0.82
			NEW-LU	-0.047	2.1	0.81
		AMeDAS	BASE	-0.96	2.2	0.86
			NEW-LU	-0.46	2.1	0.85
	d04	Office	BASE	-0.54	2.9	0.84
			NEW-LU	0.40	2.5	0.88
		AMeDAS	BASE	-0.86	2.4	0.85
			NEW-LU	-0.39	2.3	0.86
Relative humidity (%)	d03	Office	BASE	2.8	11	0.72
			NEW-LU	-2.6	11	0.70
	d04	Office	BASE	3.4	10	0.70
			NEW-LU	-1.9	10	0.72
Wind speed (m/s)	d03	Office	BASE	0.50	1.6	0.52
			NEW-LU	0.42	1.4	0.55
		AMeDAS	BASE	1.2	2.0	0.42
			NEW-LU	1.0	1.8	0.45
	d04	Office	BASE	0.51	1.6	0.51
			NEW-LU	0.43	1.5	0.54
		AMeDAS	BASE	0.85	1.7	0.46
			NEW-LU	0.73	1.5	0.50

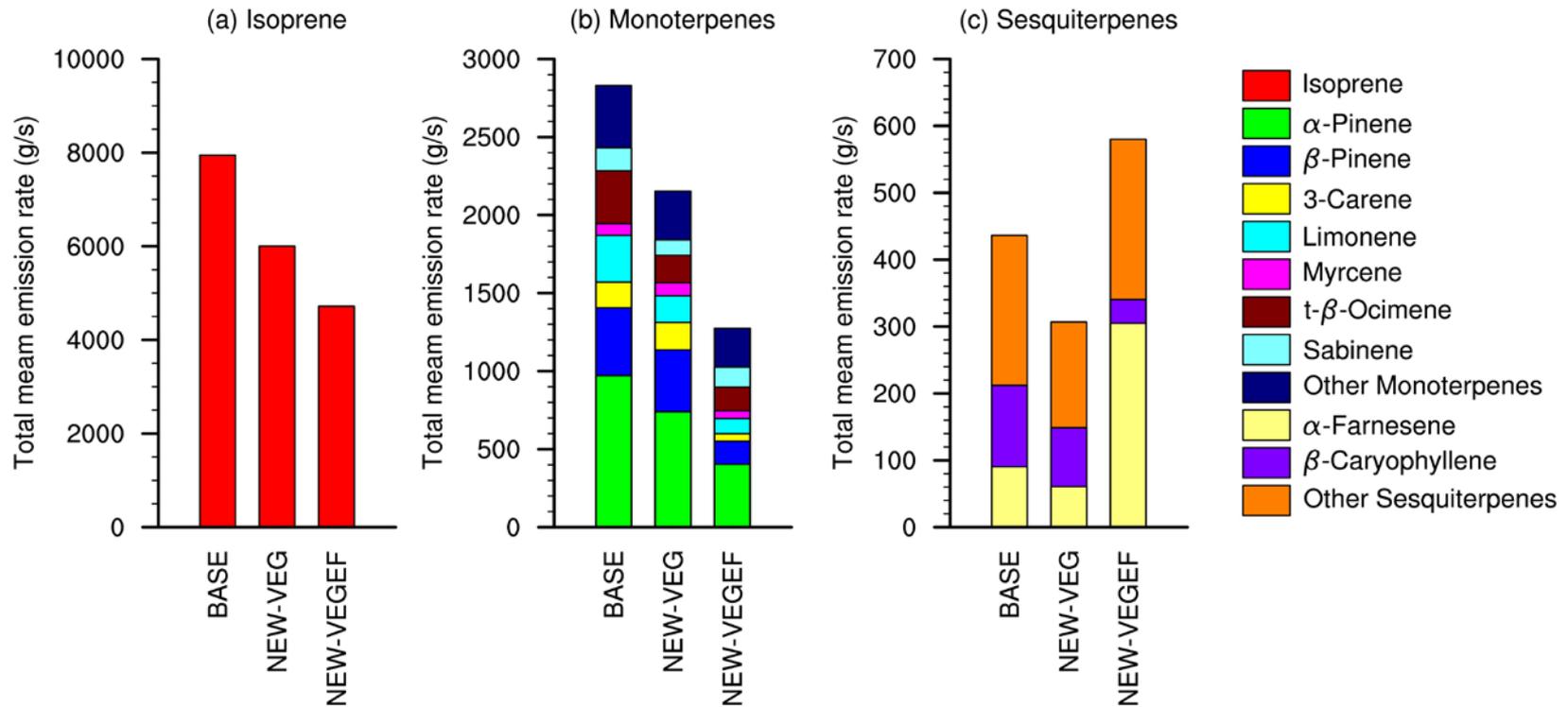
- New database contributed to better model performances on meteorological fields.

Effects on BVOC emissions



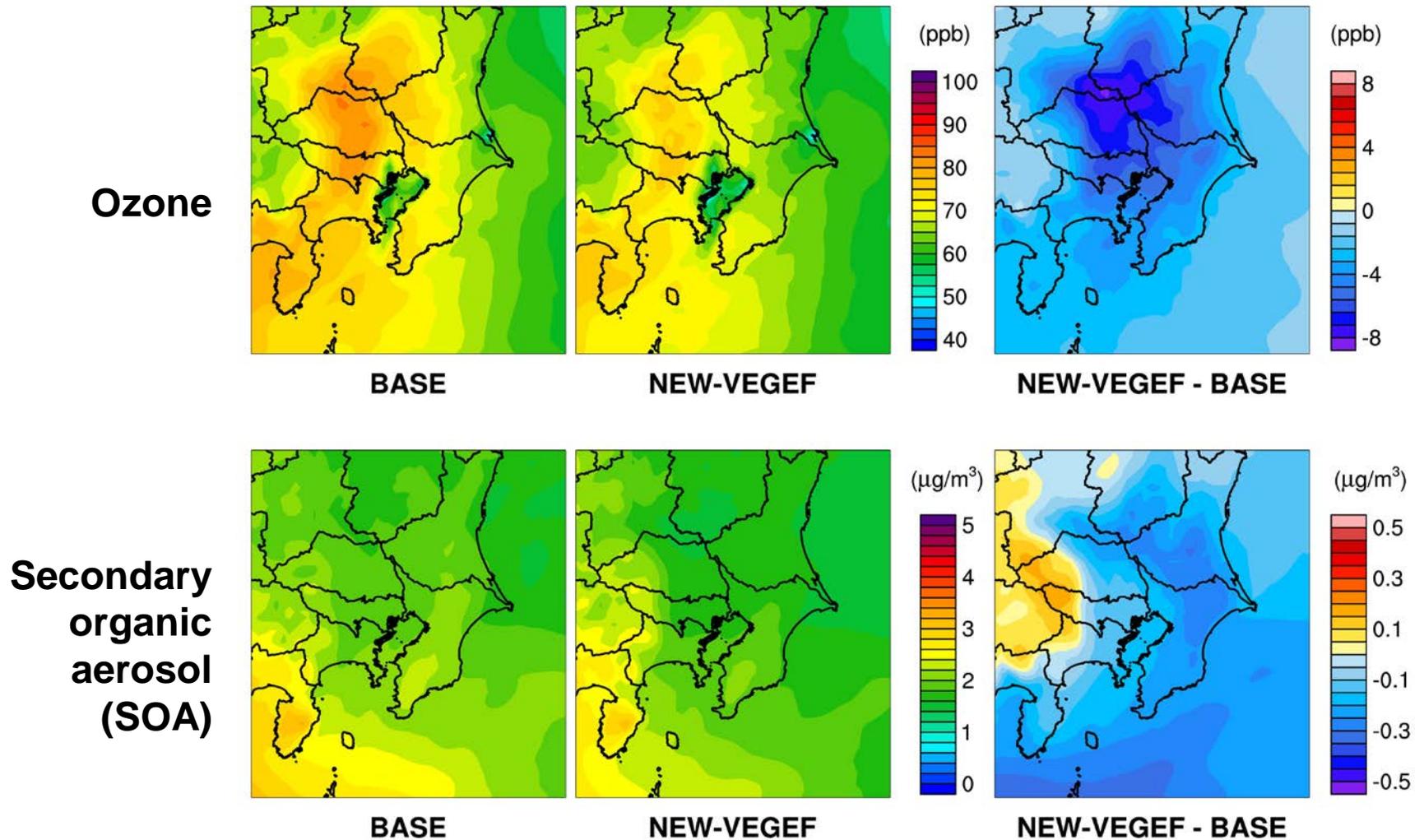
- Differences in distributions.

Total BVOC emissions in d04



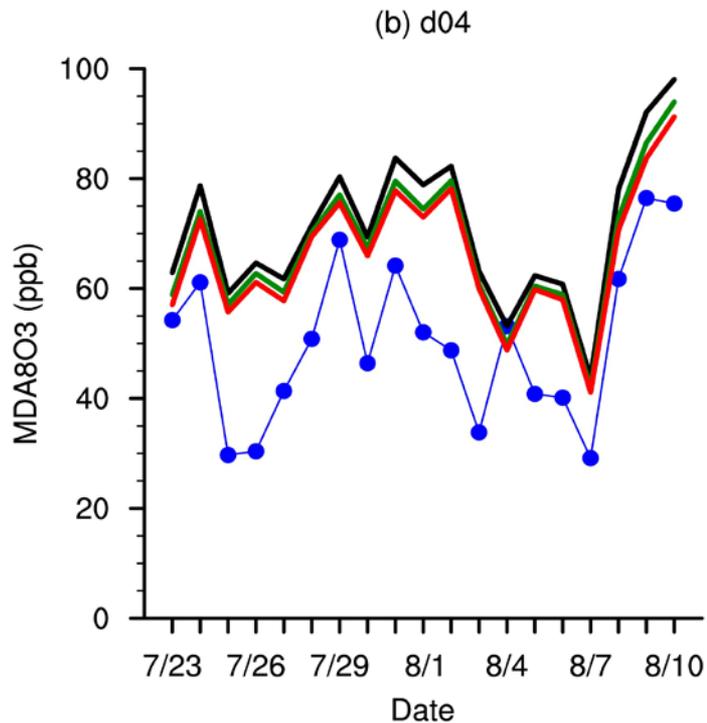
- New database resulted in lower isoprene and monoterpene, and higher sesquiterpenes emissions.

Effects on pollutant concentrations

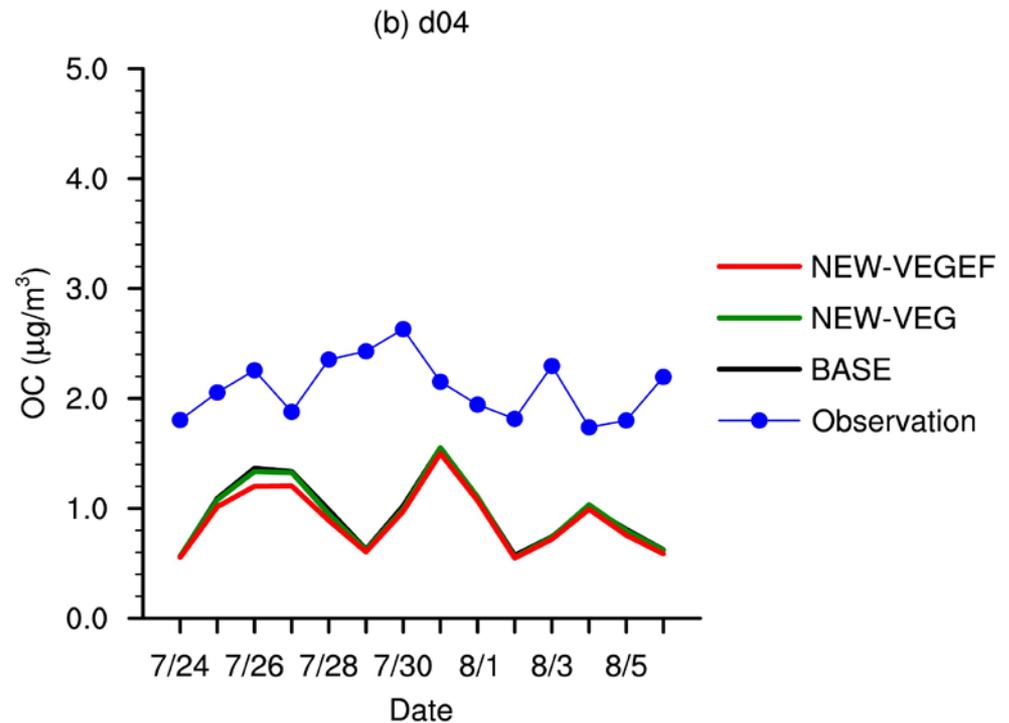


- Lower concentrations except for high sesquiterpenes.

Comparisons with observations



Ozone



Organic carbon (OC)

- New database contributed to slightly better performance on ozone concentrations.

Summary

- ❑ New database of vegetation and BVOC emission factors in Japan has been developed.
- ❑ New database contributed to better model performance on meteorological fields.
- ❑ New database contributed to slightly better model performance on ozone concentrations.
- ❑ More works in J-STREAM are necessary for further better model performance.

- ❑ Details are available in:
Chatani, S., Okumura, M., Shimadera, H., Yamaji, K., Kitayama, K., and Matsunaga, S.N.: Effects of a Detailed Vegetation Database on Simulated Meteorological Fields, Biogenic VOC Emissions, and Ambient Pollutant Concentrations over Japan. *Atmosphere*, 9, 179 (2018).

Acknowledgement

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Thank you
for your attention