Development of the Northeast Asia Emission Inventory Using the CREATE Emissions Inventory Framework

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CAIS Climate Air quality Information Systems group
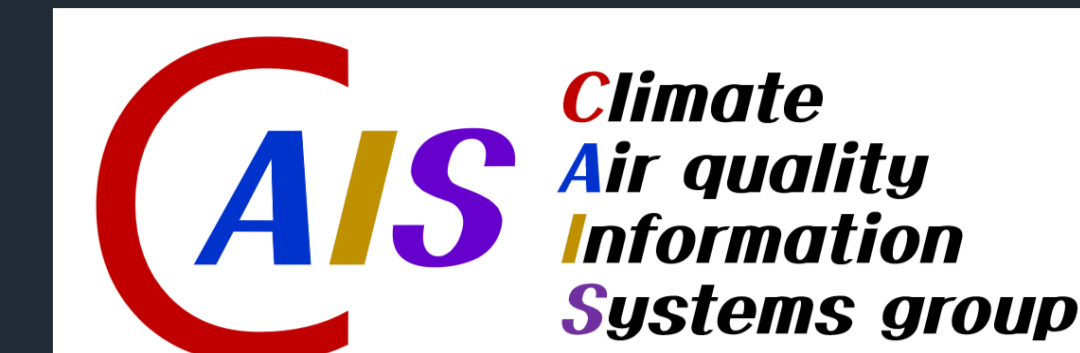
Ⅰ. Introduction & Objectives

- Northeast Asia has emerged as the region with the highest emissions due to rapid economic and population growth, significantly impacting global air pollution. Governments in this region, particularly China and Korea, have been implementing more stringent air pollution control policies for years.

- To effectively mitigate air pollution, it is essential to accurately understand the current state of air quality. Emission inventories are a key dataset required for understanding air quality and identifying improvement measures. The most up-to-date emission data and comprehensive air quality modeling are crucial for quantitative evaluation.

- In this study, we developed the latest emission inventory for Northeast Asia, based on the Comprehensive Regional Emissions inventory for Atmospheric Transport Experiment (CREATE) emission inventory framework, named AQNEA.

Ⅱ. Data and Methodology

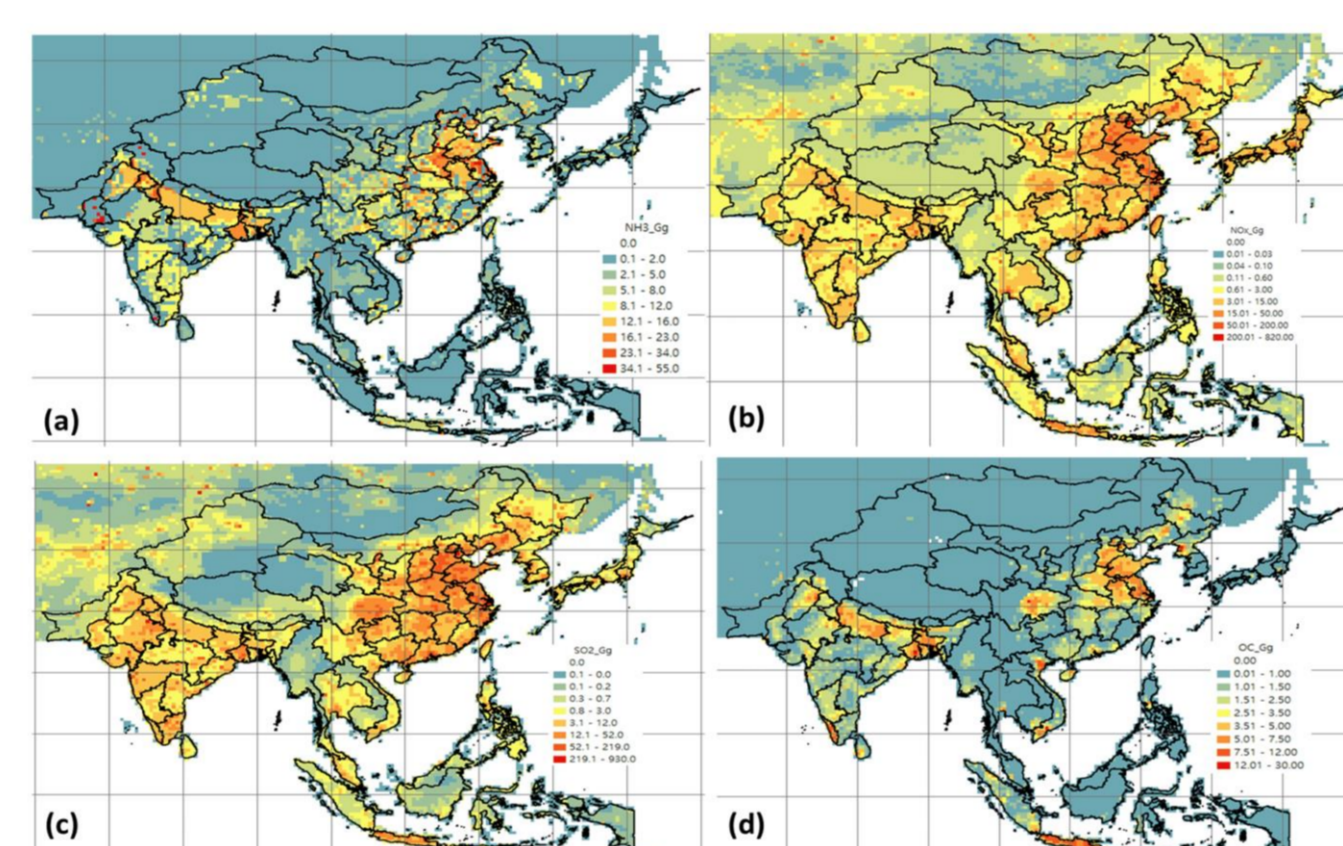### Ⅱ-1. CREATE Emission Inventory
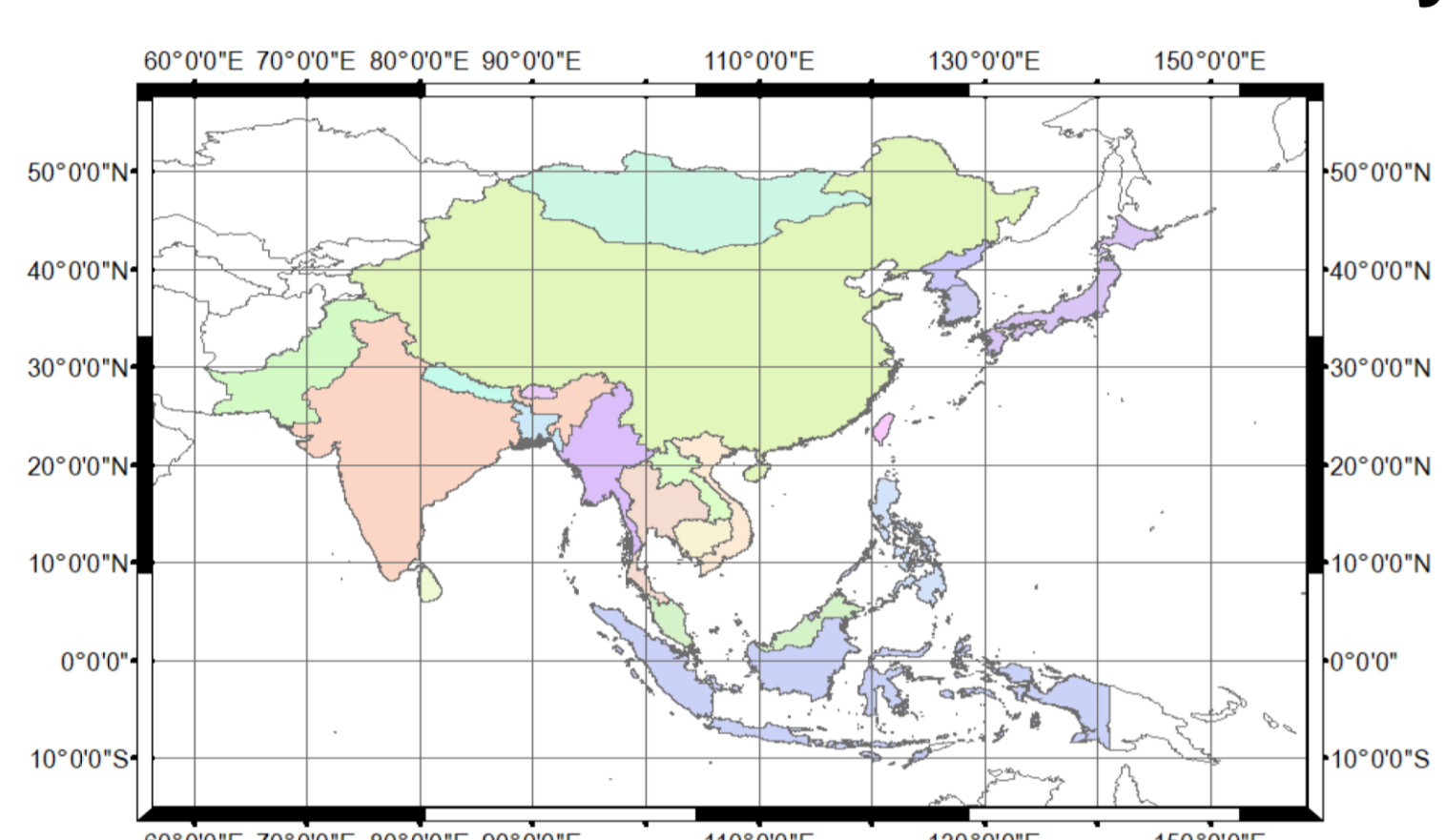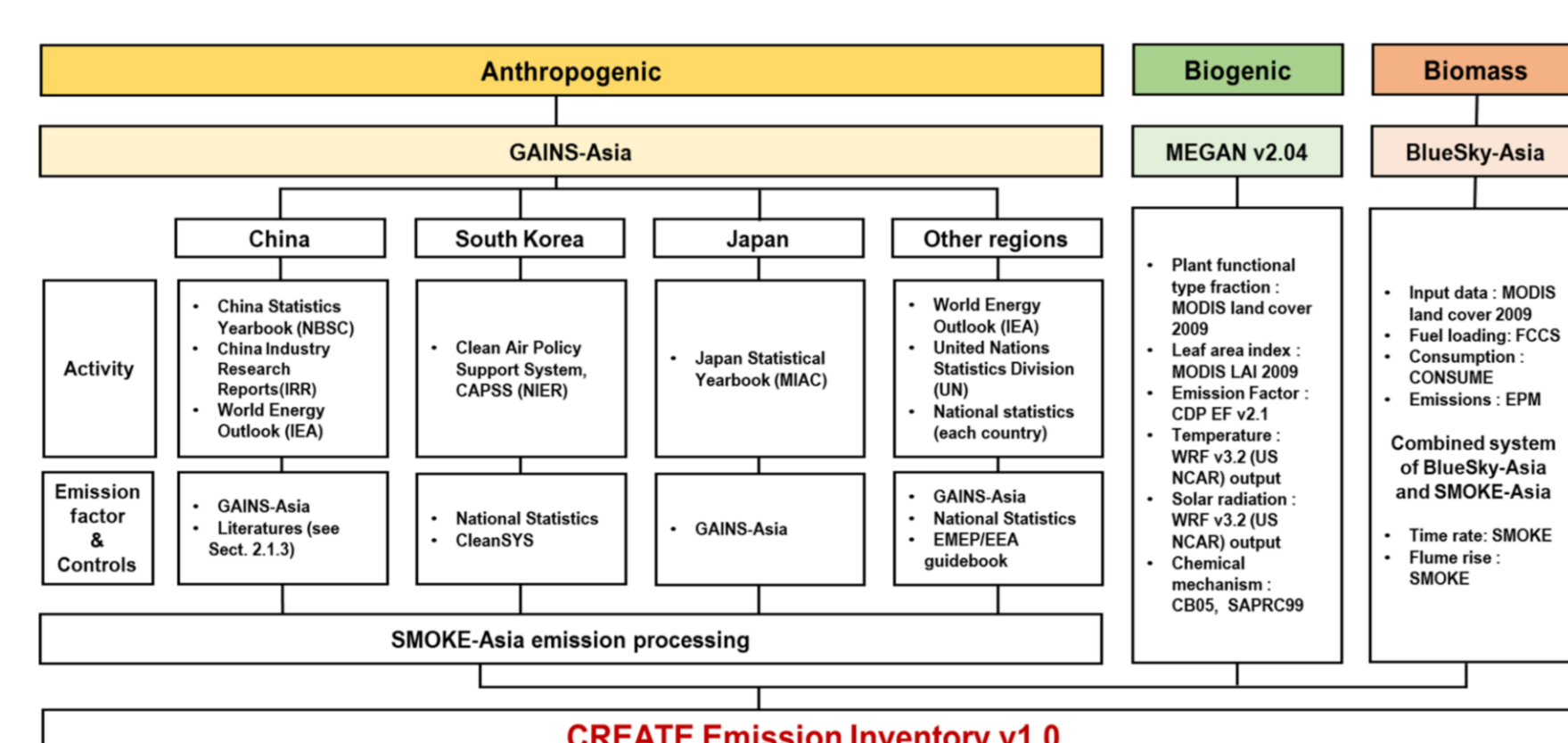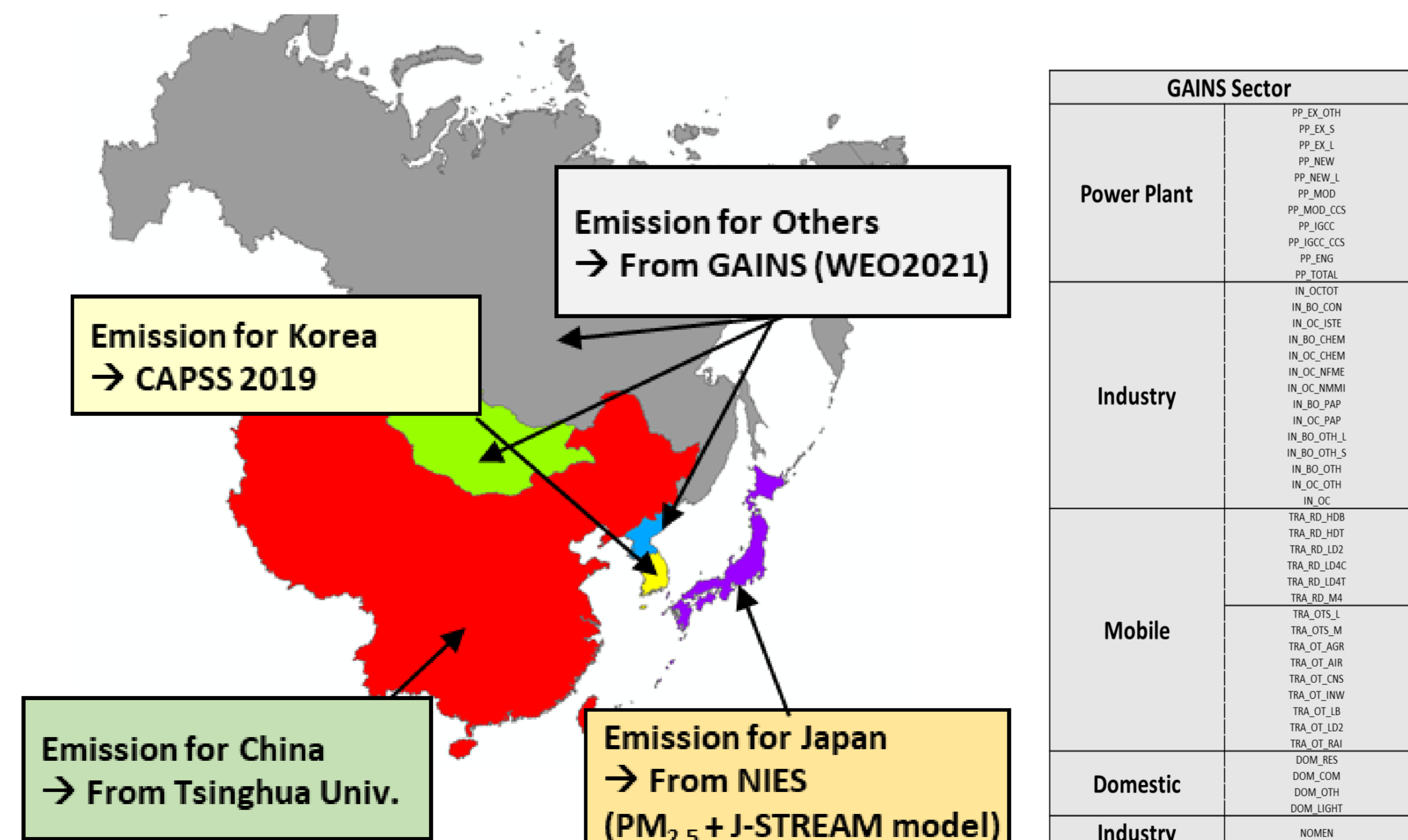

< CREATE Domain >   < Data and flow used >   < Emission map >

- The CREATE inventory, a bottom-up approach for Asia, encompasses 54 fuel classes and 201 subsectors and 13 pollutants, namely SO_2, NO_x, CO, NMVOC, NH_3, OC, BC, PM_{10}, $PM_{2.5}$, CO_2, CH_4, N_2O, and Hg.

- Developed with IAM frameworks like GAINS, the CREATE emissions framework integrates with comprehensive emission systems, making it highly effective for climate and air quality modeling and field experiments. It was initially developed with 2010 as the base year and subsequently updated in 2015.

Ⅱ-2. Development of emission inventory
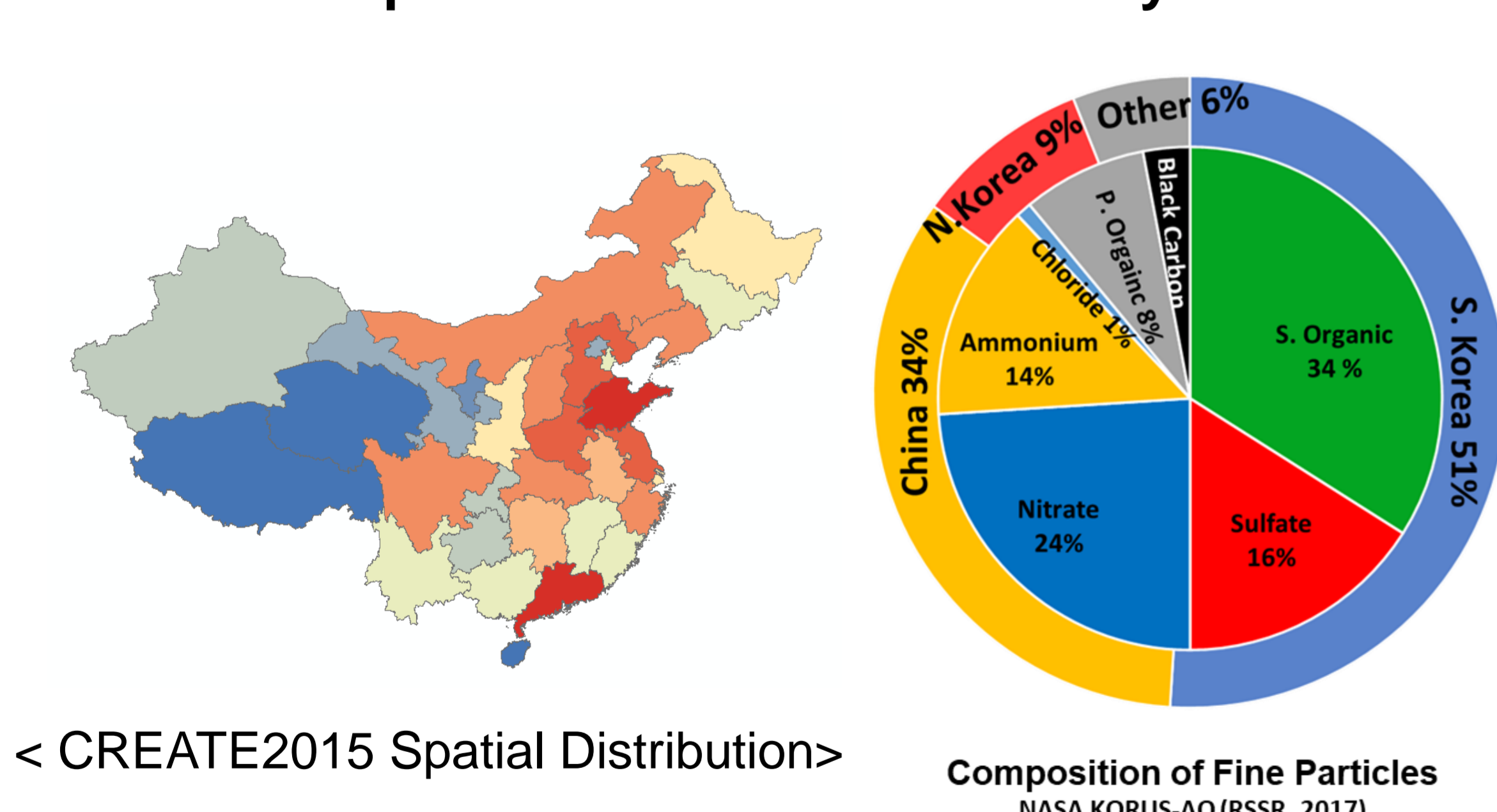
< CREATE2015 Spatial Distribution>

Composition of Fine Particles
NASA KORUS-AQ(RSSR, 2017)

- This inventory was developed targeting six countries (China, Korea, Japan, South Korea, Russia(Asia part), Mongolia) in Northeast Asia to compile project-based regional emission inventories such as KORUS-AQ, LTP, and SIJAQ.

- The target pollutants included particulate matter and its precursors : CO, CO_2, SO_2, NO_x, NMVOC, NH_3, $PM_{2.5}$, and PM_{10}.

Emission for Others → From GAINS (WEO2021)
Emission for Korea → CAPSS 2019
Emission for China → From Tsinghua Univ.
Emission for Japan → From NIES ($PM_{2.5}$ + J-STREAM model)

- Utilizing the emission sectors of the GAINS framework, we compiled the emission inventory for 2019 as the base year, gathering the latest emission data from Korea, China, and Japan for gridding and modeling support in accordance with the CREATE inventory.

Ⅲ. Result

Ⅲ-1. Northeast Asia Emission Inter-comparison
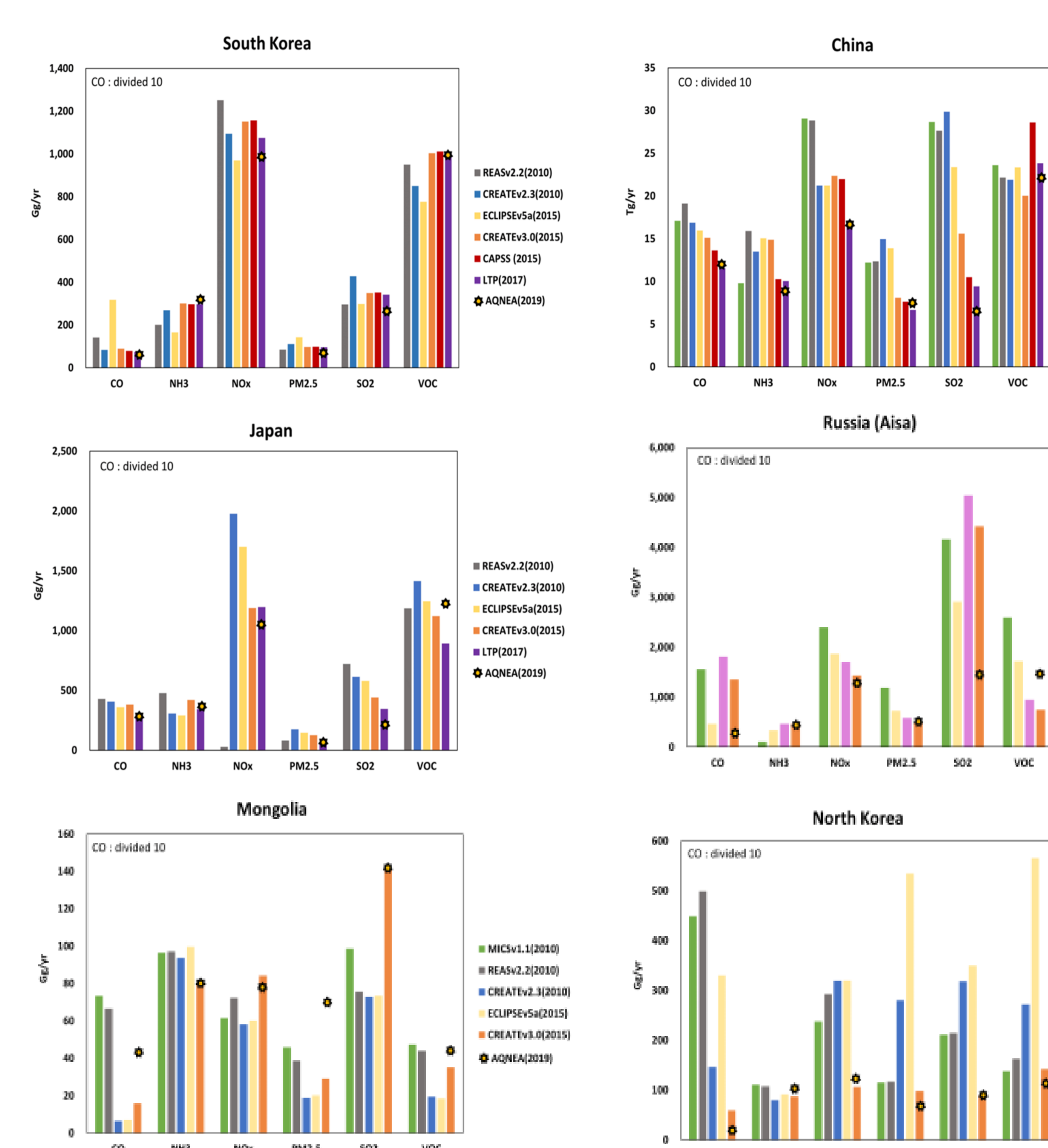
- The emissions from Korea, China, and Japan show a tendency to decrease compared to the relatively recent emission inventory values from LTP (2017).

- Russia, Mongolia, and North Korea exhibit significant variations in emissions by substance across different emission inventories.

Ⅲ-2. Sector-specific emission ratios by country

Power | Industry | Residential | Transportation | Agriculture | Solvents | Other
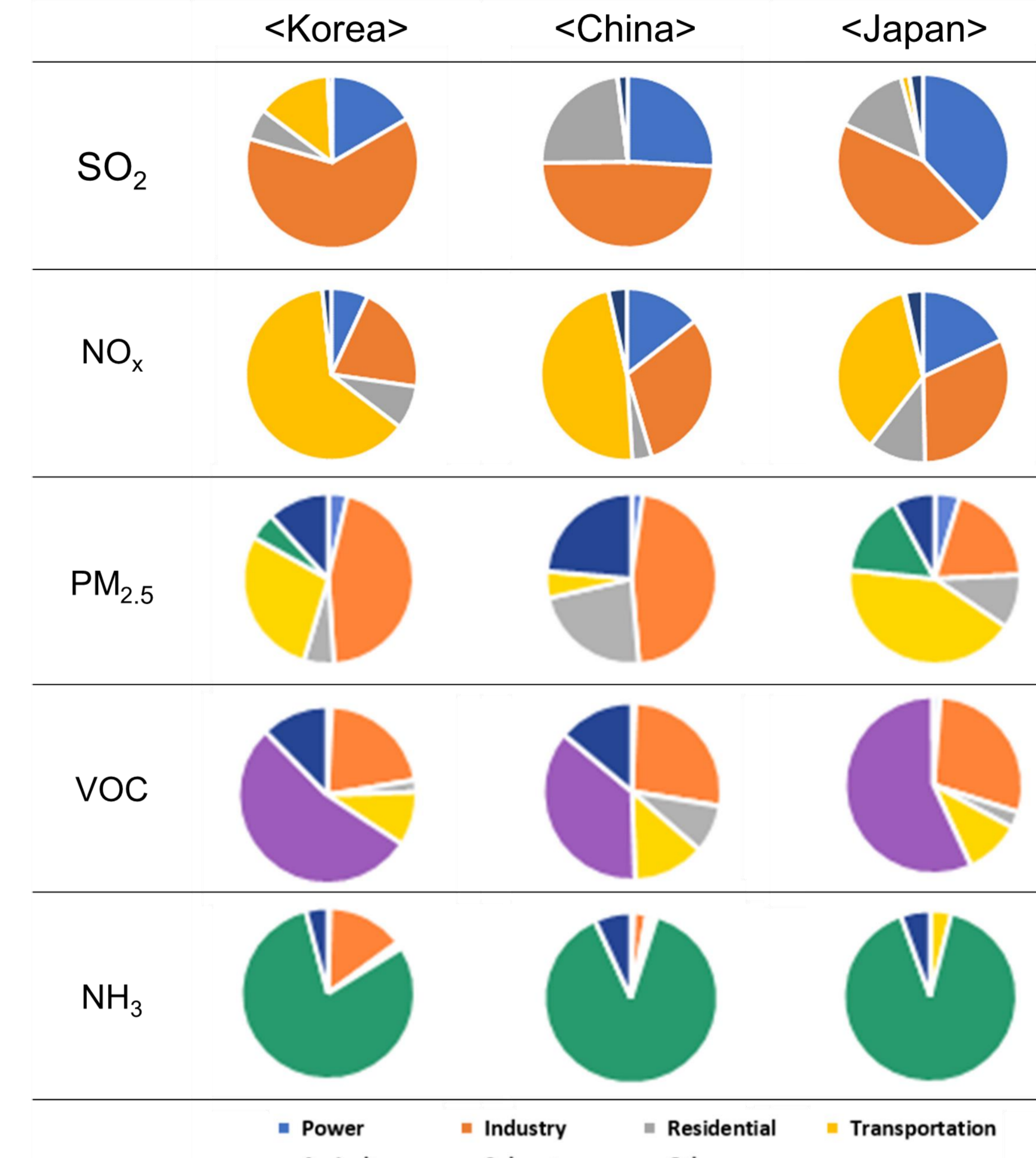
- The emission sectors of Korea, China, and Japan generally display similar sector-specific emission ratios, but there are differences in the emissions of specific substances.

- In the case of CO, the most pronounced differences are observed across the three countries, with China's manufacturing sector contributing significantly due to higher emission rates and lower combustion efficiency in the residential sector, accounting for these variations.

Ⅴ. Summary & Future Works

- In order to establish an emission inventory that reflects the rapid economic growth of the East Asia region, we developed an emission inventory based on the CREATE inventory framework.

- Korea, China, and Japan showed a decreasing trend in emissions compared to the latest emission inventory, while Russia, Mongolia, and North Korea exhibited significant differences in emissions by substance across different inventories.

- The constructed emission inventory, utilizing the CREATE framework, is formatted for gridding and modeling support, making it a valuable input for improving integrated assessment modeling.

Ⅵ. Reference

- Woo et al., (2020). Development of the CREATE inventory in support of integrated climate and air quality modeling for Asia. Sustainability, 12(19), 7930.
- Akimoto, H. (2008). Regional Emission inventory in ASia (REAS) version 2. Atmos. Chem. Phys, 13.
- Kim et al., (2023). Long-term historical trends in air pollutant emissions in South Korea (2000–2018). Asian Journal of Atmospheric Environment, 17(1), 12.
- Li et al., (2017). MIX: a mosaic Asian anthropogenic emission inventory under the international collaboration framework of the MICS-Asia and HTAP. Atmospheric Chemistry and Physics, 17(2), 935-963.   • GAINS-Online available at: http://gains.iiasa.ac.at/models/index.htm