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Evaluation of Air Pollutant Emission Inventories in East Asia

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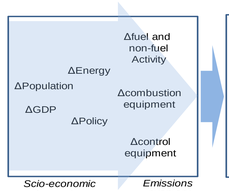
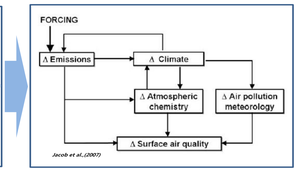
Ⅰ. Introduction & Objectives

- Concentration of air pollutants such as tropospheric ozone and aerosols are mainly affected by meteorological variables and emissions. East Asia has large amount of anthropogenic and natural air pollutant emissions and has been putting lots of efforts to improve air quality. In order to seek effective ways to mitigate future air pollution, it is essential to understand the current emissions and their impacts on air quality.
- Emission inventory is one of the key datasets required to understand air quality and find ways to improve it. Amounts and spatial-temporal distributions of emissions are, however, not easy to estimate due to their complicate nature, therefore introduce significant uncertainties.
- In this study, we had developed an updated version of our Asian emissions inventory, named NIER/KU-CREATE (Comprehensive Regional Emissions inventory for Atmospheric Transport Experiment) in support of climate-air quality study.

Ⅱ. Data and Methodology

- Fuel and non-fuel activities, emission factors, and control technologies are the major parameters to estimate emissions which are the components of bottom-up emission inventory.
- The emission scenario of the GAINS model was generated by reflecting the energy consumption by country provided by the IEA's Energy Balance statistics. The mapping of IEA fuels and sectors to GAINS was performed using GAINS-Asia.
- The satellite-derived top-down emission estimates are from the DECSO (Daily Emission derived Constrained by Satellite Observations) algorithm from the GlobEmissions website.

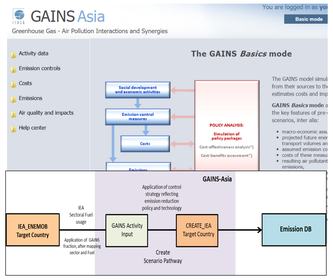


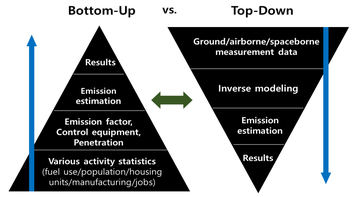


Modeling Emissions – Air Quality

$Em_A = (EF_A)(Act)\ [(1- (CE)(RP)(RE)]$

Em_A = Controlled point/area source emissions of pollutant A
EF_A = Uncontrolled emission factor for pollutant A
Act = Category activity CE = % Control efficiency/100
RE = % Rule effectiveness RP = % Rule penetration/100

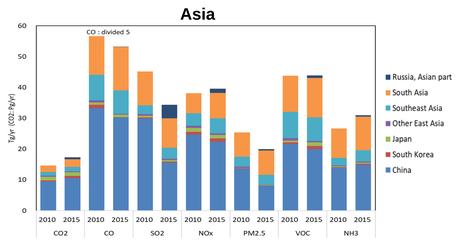


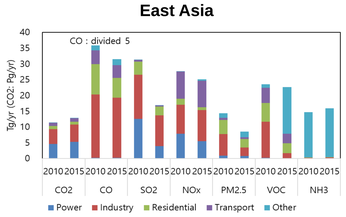


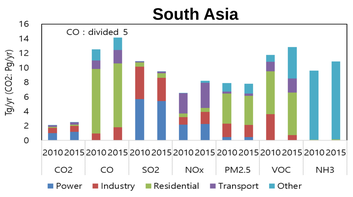
Comparison of Bottom-Up and Top-Down Emissions Estimation

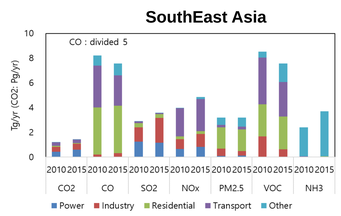
Ⅲ. Bottom-up Emissions Inter-comparison

III-1. Yr 2010(CREATE ver 2.3) vs. Yr 2015(CREATE ver 3.0)



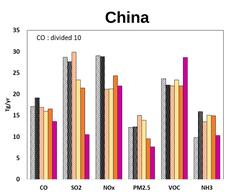


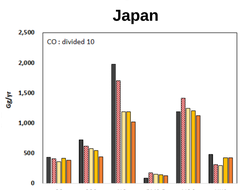


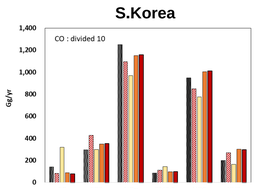


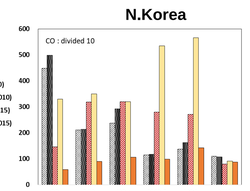
- The combustion pollutants(CO, SOx...) decreased, non-combustion including the fugitive emissions increased. These results are contributed from China's emission change.
- Russia(asia region) estimated in the year 2015 to support on the activities of North-East Asia Clean Air Partnership(NEACAP).

III-2. Inter-comparison with other inventory in East Asia



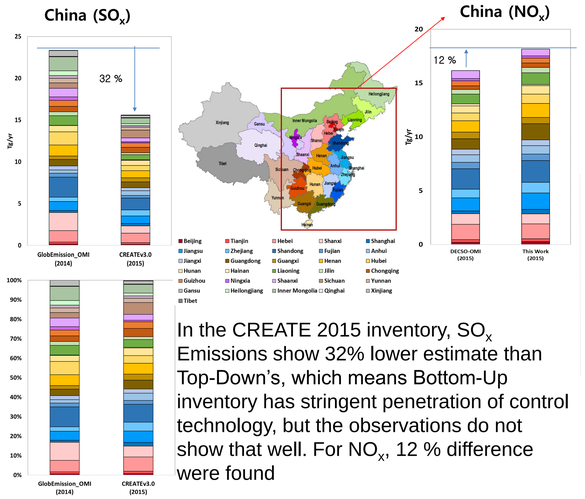






- Emission differences in the bottom-up inventories are less than 20% for NO_x as smallest but more than 30% for NH_3 for China.
- Emissions for South Korea and Japan show less differences than China and North Korea
- The discrepancies of emission amounts are very high for the most of pollutants in North Korea, which show much less amounts in year 2015 compares to the previous years.

Ⅳ. Bottom-up to Top-down Emissions Inter-comparison

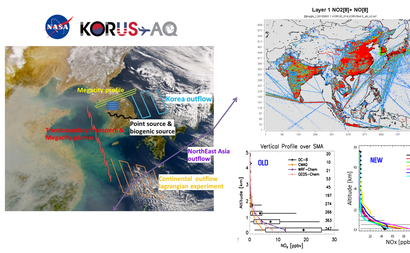


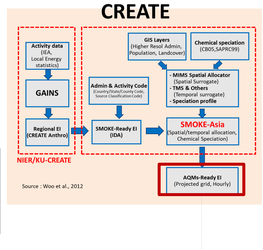
In the CREATE 2015 inventory, SO_x Emissions show 32% lower estimate than Top-Down's, which means Bottom-Up inventory has stringent penetration of control technology, but the observations do not show that well. For NO_x, 12 % difference were found

- In the CREATE 2015 inventory, NO_x Emissions in North Korea show only 10% difference against Top-Down's, which is much lower than previous Bottom-Up emission estimates
- Big emissions difference found over South Korea without sea area. It was reduced to 8% with sea and coast around the peninsular

Ⅴ. Support of Air Quality Modeling and Aircraft Field Campaign

V-1. KORUS-AQ/MAPS-Seoul field campaign

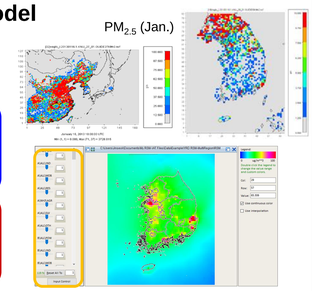




- The KORUS-AQ/MAPS-Seoul field Campaign was conducted in South Korea during May-June, 2016. The overarching goal of this study was to improve our understanding of the factors contributing to poor air quality in Korea.
- Those findings and Understandings from KORUS-AQ was very helpful to upgrade inventory of next version and support the field campaign of next stage.

V-2. GUIDE IAM model

GHGs and air pollutants Unified Information Design system for Environment



- GUIDE is supporting inventory-based analysis, using the current emission reflecting Korea's characteristics..
- At the regional level, the emission inventory and decision-making model are linked to each other, making it possible to predict and evaluate the characteristics of the municipality.

Ⅵ. Summary & Future Works

- In order to establish an emission inventory that reflects regional emission conditions in East Asia, which show rapid economic growth, NIER/KU-CREATE inventory was updated with the latest data.
- Differences in the bottom-up inventories are less than 5 % for NOx as smallest but more than 30% for NH3 for China. The discrepancies of emission amounts, however, are very high in North Korea. South Korea emissions remains stable and show relatively good agreements
- The satellite-driven top-down estimates show relatively good agreement in total emissions amounts in China, but show some possibility of overestimation of control policy penetration
- We will continue to build a baseline inventory on a five-year basis to increase uncertainty and the utilization of relevant studies and programs.

Ⅶ. Reference

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• ACKNOWLEDGEMENT

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