

## 1. Introduction

This document gives information for gridded datasets of Regional Emission inventory in ASia (REAS) version 2.1 that present monthly gridded emissions for each sub-sector. See Kurokawa et al. (2013) for basic methodology, results, and other information about REAS 2.1. Please note that REAS 2.1 used inventories from recent studies for several countries and sources as follows:

- Emissions in Japan except for the maritime sector were from the Japan Auto-Oil Program (JATOP) Emission Inventory-Data Base (JEI-DB) developed by JPEC (2012a, 2012b, 2012c). JEI-DB includes vehicle emissions in 2000, 2005, and 2010 and non-vehicle emissions in 2000 and 2005 for SO<sub>2</sub>, NO<sub>x</sub>, CO, NMVOC, PM<sub>10</sub>, and NH<sub>3</sub>, with monthly variations and spatial resolution of 1 km.
- NMVOC evaporative emissions from stationary sources in Japan were from data developed by Ministry of the Environment of Japan (MOEJ, 2009).
- Japanese emissions from the maritime sector were taken from the database developed by the Ocean Policy Research Foundation (OPRF, 2012), which contains gridded inventory of emissions (i.e. SO<sub>2</sub>, NO<sub>x</sub>, CO, NMVOC, PM<sub>10</sub>, CH<sub>4</sub>, N<sub>2</sub>O and fuel consumed) in 2005. The inventory identified three categories as inland navigation, fishery activities and international navigation in EEZ of Japan. These data were developed under the project named 'the comprehensive project of assessment for improving the air quality by establishment of the emission control areas (ECA) in Japan'. The project was supported from the grant by the Nippon Foundation, which was derived from revenues from motorboat racing.
- For emissions from South Korea, we relied on the Clean Air Policy Support System (CAPSS) developed by Lee et al. (2011). City-level and provincial-level emissions for SO<sub>2</sub>, NO<sub>x</sub>, CO, NMVOC, and PM<sub>10</sub> for each sector and fuel type are taken from the National Air Pollutants Emission website maintained by the National Institute of Environment Research-Korea (<http://airemiss.nier.go.kr>).
- For Taiwan, we obtained data on emissions for SO<sub>2</sub>, NO<sub>x</sub>, CO, NMVOC, PM<sub>10</sub> and PM<sub>2.5</sub> developed by the Environmental Protection Administration of Taiwan at its website (<http://ivy2.epa.gov.tw/air-ei>). Detailed emissions for each sector and fuel type in 2000, 2003 and 2007 as well as historical and projected total emissions between 1987 and 2021 were obtained from the website.
- For emissions from aviation (both domestic and international at altitude less than 1 km) and international ship navigation were from EDGAR 4.2 (EC-JRC/PBL, 2011)

for SO<sub>2</sub>, NO<sub>x</sub>, CO, NMVOC, PM<sub>10</sub>, BC, OC, CH<sub>4</sub>, N<sub>2</sub>O, and CO<sub>2</sub> between 2000 and 2008.

- For emissions relate to agricultural activities (fertilizer application, manure management, enteric fermentation of livestock, and rice cultivation), datasets from EDGAR 4.2 were used for Asian Russia and Central Asia.

## 2 Directories and file names

All gridded data are tarred and zipped (with gzip) as XXX\_YYYY\_GRID.tar.gz. Directories and files are created by unpacking the files as follows:

### - Species except for NMVOC

XXX/

YYYY/

REASv2.1\_XXX\_ZZZZZZ\_YYYY\_0.25x0.25

### - NMVOC

NMV/

YYYY/

SC/

REASv2.1\_NMV\_SC\_ZZZZZZ\_YYYY\_0.25x0.25

XXX: Species codes

SC: NMVOC species codes

YYYY: Years

ZZZZZZ: Sector categories codes

\* See next pages for definition of each code.

(1) XXX: Species codes

Species codes	Species
SO2	Sulfur dioxide
NOX	Nitrogen oxides (as NO <sub>2</sub> )
CO_	Carbon monoxide
NMV	Non-methane volatile organic compounds
PM10_	PM <sub>10</sub>
PM2.5	PM <sub>2.5</sub>
BC_	Black carbon
OC_	Organic carbon
NH3	Ammonia
CH4	Methane
N2O	Nitrous oxides
CO2	Carbon dioxide

(2) SC: NMVOC species codes

NMVOC species codes	Species
01	Ethane
02	Propane
03	Butanes
04	Pentanes
05	Other Alkanes
06	Ethylene
07	Propene
08	Terminal Alkenes
09	Internal Alkenes
10	Acetylene
11	Benzene
12	Toluene
13	Xylenes
14	Other Aromatics
15	Formaldehyde
16	Other Aldehyde
17	Ketones
18	Halocarbons
19	Others
20	Total

(3) ZZZZZZ: Sector categories codes

Sector categories codes	Sector categories
POWER_PLANTS_POINT	Power and heat plants as point sources
POWER_PLANTS_NON-POINT	Power and heat plants as non-point sources except for Japan
POWER_PLANTS_NON-POINT_JPN	Power and heat plants as non-point sources for Japan
INDUSTRY	Industry (emissions both from fuel combustion and industrial processes)
ROAD_TRANSPORT	Road transport (cars, buses, trucks, motor cycles, and other on-road vehicles)
AVIATION	Domestic and international aviation (0-1km)
INTNNV	International navigation
OTHER_TRANSPORT	Domestic navigation, railway, and other off-road transports
DOMESTIC	Residential, commerce and public services, agricultural equipment, fishing, and others.
FUGITIVE_COAL	Fugitive emissions from production, processing, and distribution of coal (For CH <sub>4</sub> )
FUGITIVE_OIL	Fugitive emissions from production, processing, and distribution of oil (For CH <sub>4</sub> )
FUGITIVE_GAS	Fugitive emissions from production, processing, and distribution of gas (For CH <sub>4</sub> )
EXTRACTION	Extraction and handling of fossil fuels (For NMVOC)
SOLVENTS	Solvent use (including paint use)
FERTILIZER	Fertilizer application
MANURE_MANAGEMENT	Manure management of livestock
ENTERIC_FERMENTATION	Enteric fermentation of livestock (For CH <sub>4</sub> )
RICE_CULTIVATION	Rice cultivation (For CH <sub>4</sub> )
SOIL	Soil NO <sub>x</sub> emissions
SOIL_DIRECT	Direct soil N <sub>2</sub> O emissions
SOIL_INDIRECT	Indirect soil N <sub>2</sub> O emissions
WASTE	Waste treatment (both solid and water waste)
MISC	Human respiration and perspiration, latrines, and others (For NH <sub>3</sub> )

### 3. Information to read files

All gridded data are text files and their data format is common. Points to read gridded data sets are as follows:

- First 10 lines are for header information and following lines are for monthly emissions in each grid cell from January to December. (Leap and non-leap year are considered for emissions in February.)

- Spatial resolution is 0.25 degree by 0.25 degree except for POWER\_PLANTS\_POINT. Longitude and latitude of data other than POWER\_PLANTS\_POINT mean lower left (southwest) corner of grid cells. Longitude and latitude of data for POWER\_PLANTS\_POINT mean place for each Longitude and latitude for power plants.

- Unit of NO<sub>x</sub> emissions is NO<sub>2</sub> ton per month.

Ex.

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NOX emissions on 0.25 degree by 0.25 degree grid

REASv2.0\_NOX\_INDUSTRY\_2008\_0.25x0.25

NOX[tNO2/mon],2008,monthly,0.25 degree by 0.25 degree

Industry (Asian region except for China, India, S.Korea, and Japan)

min : 0.7443E-07 max : 0.1273E+04 sum : 0.1509E+07

Format:2F8.2,12E14.7(longitude, latitude, monthly emission value)

\* Longitude and latitude are at lower left (southwest) corner of grid cell

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156.50 76.75 0.5901849E-03 0.5524696E-03 0.5943432E-03 0.5657751E-03  
0.5944664E-03 0.5693790E-03 0.5828077E-03 0.5853027E-03 0.5627564E-03  
0.5431031E-03 0.5025220E-03 0.5039376E-03

156.50 76.75 -> Longitude: 156.50E-156.75E and Latitude 76.75N-77.00N

0.5901849E-03 -> January, 0.5524696E-03-> February, .....,

0.5025220E-03 -> November, 0.5039376E-03 -> December

## References

Kurokawa, J., Ohara, T., Morikawa, T., Hanayama, S., Greet, J.-M., Fukui, T., Kawashima, K., and Akimoto, H.: Emissions of air pollutants and greenhouse gases over Asian regions during 2000–2008: Regional Emission inventory in ASia (REAS) version 2, submitted to Atmospheric Chemistry and Physics, 2013.

EC-JRC/PBL (European Commission, Joint Research Center/Netherlands Environmental Assessment Agency), Emission Database for Global Atmospheric Research (EDGAR), release version 4.2, available at: <http://edgar.jrc.ec.europa.eu/index.php>, 2011.

JPEC (Japan Petroleum Energy Center): Emission inventory of road transport in Japan, JPEC Technical Report, JPEC-2011AQ-02-06, 136pp [in Japanese], 2012a.

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Lee, D. G., Lee, Y.-M., Jang, K.-W., Yoo, C., Kang, K.-H., Lee, J.-H., Jung, S.-W., Park, J.-M., Lee, S.-B., Han, J.-S., Hong, J.-H., and Lee, S.-J.: Korean national emissions inventory system and 2007 air pollutant emissions, Asian J. Atmos. Environ., 5, 278–291, 2011.

MOEJ (Ministry of Environment of Japan): Report on Volatile Organic Compound (VOC) Emission Inventory Compiled [in Japanese], available at <http://www.env.go.jp/air/osen/voc/inventory.html>, 2009.

OPRF (Ocean Policy Research Foundation (Ship and Ocean Fundation)): Report for comprehensive study for environmental impact lead by the establishment of emission control area in Japan, ISBN978-4-88404-282-0, 524pp [in Japanese], 2012.