1. Introduction

This document gives information for the country and regional emission tables of Regional Emission inventory in ASia (REAS) version 2.1 that present annual emissions for detailed sub-sectors and fuel types. 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 $SO_2$, $NO_x$, CO, NMVOC, $PM_{10}$, and $NH_3$, 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. $SO_2$, $NO_x$, CO, NMVOC, $PM_{10}$, $CH_4$, $N_2O$ and fuel consumed) in 2005. The inventory identified three categories as inland navigation, fishery activates 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 $SO_2$, $NO_x$, CO, NMVOC, and $PM_{10}$ 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 $SO_2$, $NO_x$, CO, NMVOC, $PM_{10}$ and $PM_{2.5}$ 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 $SO_2$, $NO_x$, CO, NMVOC, $PM_{10}$, BC, OC, $CH_4$, $N_2O$, and $CO_2$ 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 table data are tarred and zipped (with gzip) as XXX_YYYY_GRID.tar.gz, XXX_GRID.tar.gz, and YYYY_GRID.tar.gz. Directories and files are created by unpacking the files as follows:

XXX/
    YYYY/
        REASv2.1_XXX_ YYYY_CNT_RGN.txt

    XXX: Species codes
    YYYY: Years
    CNT: Country codes
    RGN: Region codes
    * See next pages for definition of each code.

(1) XXX: Species codes

| Species codes | Species |
|---|---|
| SO2 | Sulfur dioxide |
| NOX | Nitrogen oxides (as $NO_2$) |
| CO_ | Carbon monoxide |
| NMV | Non-methane volatile organic compounds |
| PM10_ | $PM_{10}$ |
| PM2.5 | $PM_{2.5}$ |
| BC_ | Black carbon |
| OC_ | Organic carbon |
| NH3 | Ammonia |
| CH4 | Methane |
| N2O | Nitrous oxides |
| CO2 | Carbon dioxide |

(2) CNT: Country codes

| Country codes | Countories |
|---|---|
| AFG | Afghanistan |
| BGD | Bangladesh |
| BRN | Brunei Darussalam |
| BTN | Bhutan |
| CHN | Chnia |
| IDN | Indonesia |
| IND | India |
| JPN | Japan |
| KAZ | Kazakhstan |
| KGZ | Kyrgyzstan |
| KHM | Cambodia |
| KOR | Republic of Korea |
| LAO | Laos |
| LKA | Sri Lanka |
| MDV | Maldives |
| MMR | Myanmar |
| MNG | Mongolia |
| MYS | Malaysia |
| NPL | Nepal |
| PAK | Pakistan |
| PHL | Philippines |
| PRK | People's Republic of Korea |
| RUS | Russia |
| SGP | Singapore |
| THA | Thailand |
| TJK | Tajikistan |
| TKM | Turkmenistan |
| TWN | Taiwan |
| UZB | Uzbekistan |
| VNM | Vietnam |

(3) RGN: Region codes

| Region codes | Regions |
|---|---|
| WHOL | Country Total |
| BEIJ | China: Beijing |
| TIAN | China: Tianjin |
| HEBE | China: Hebei |
| SHNX | China: Shanxi |
| NEMO | China: Inner Mongolia |
| LIAO | China: Liaoning |
| JILI | China: Jilin |
| HEIL | China: Heilongjiang |
| SHAN | China: Shanghai |
| JINU | China: Jiangsu |
| ZHEJ | China: Zhejiang |
| ANHU | China: Anhui |
| FUJI | China: Fujian |
| JINX | China: Jiangxi |
| SHND | China: Shandong |
| HENA | China: Henan |
| HUBE | China: Hubei |
| HUNA | China: Hunan |
| GUAD | China: Guangdong |
| GUAX | China: Guangxi |
| HAIN | China: Hainan |
| CHON | China: Chogqing |
| SICH | China: Sichuan |
| GUIZ | China: Guizhou |
| YUNN | China: Yunnan |
| TIBE | China: Tibet |
| SHAA | China: Shaanxi |
| GANS | China: Gansu |
| QING | China: Qinghai |
| NINX | China: Ningxia |
| XING | China: Xinjiang |
| HONG | China: Hong Kong |
| MACA | China: Macau |

| Region codes | Regions |
| --- | --- |
| ANPR | Andhra Pradesh |
| BIHA | Bihar + Jharkhand |
| EHIM | Assam + North East (Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, etc.) |
| GUJA | Gujarat |
| HARY | Haryana |
| KARN | Karnataka + Goa |
| KERA | Kerala |
| MAPR | Madhya Pradesh + Chhattisgarh |
| MAHA | Maharashtra |
| ORIS | Orissa |
| PUNJ | Punjab + Chandigarh |
| RAJA | Rajasthan |
| TAMI | Tamil Nadu |
| UTPR | Uttar Pradesh + Uttaranchal |
| BENG | West Bengal |
| WHIM | Himachal Pradesh + Jammu and Kashmir |
| DELH | Delhi |

3. Information to read files

In the table files, emissions from combustion sources are shown for each fuel type and sub-sector category. Emission values for non-combustion sources such as industrial process and agricultural activities are also provided. Basically, fuel types and sub-sector categories for fuel combustions and industrial processes are common but there are some exceptions. In addition, sub-categories for other non-combustion sources are different from each species. Followings are the codes for fuel types and sector categories:

3.1 Fuel types

| Fuel type codes | Fuel types |
| --- | --- |
| HARD_COAL | Hard coal (Ex. Coking coal, anthracite, and other bituminous coal) |
| BROWN_COAL | Brown coal (Ex. Sub-bituminous coal and lignite) |
| DERIVED_COAL | Derived coal (Ex. Coke oven coke and lignite) |
| NATURAL_GAS | Natural gas |
| COKE_OVEN_GAS | Coke oven gas |
| OTHER_GAS | Other gases (Ex. Gas works gas and blast furnace gas) |
| MOTOR_GASOLINE | Motor gasoline |
| KEROSENE | Kerosene |
| OTHER_LF | Other light oil (Ex. Liquefied petroleum gases and natural gas liquids) |
| DIESEL_OIL | Gas/Diesel oil |
| CRUDE_OIL | Crude oil |
| HEAVY_FUEL_OIL | Heavy fuel oil |
| OTHER_HF | Other heavy oil (Ex. Petroleum coke, bitumen, non-specified petroleum products) |
| FUELWOOD | Fuelwood |
| CROP_RESIDUE | Crop residue used as biofuel |
| ANIMAL_WASTE | Animal waste used as biofuel |
| OTHERS | Other fuels |

## 3.2 Combustion sources

### 3.2.1 Combustion sources

A. Japan except for $CH_4$ and $N_2O$

| Sector category codes | Sector categories |
|---|---|
| POWER_PLANTS | Power plants: Electricity and heat production |
| GAS_PROD | Industry: Gas production |
| MINING | Industry: Mining and quarrying |
| CONSTRUCTION | Industry: Construction |
| MANUFACTURING | Industry: Manufacturing |
| FERT_PROD | Industry: Fertilizer production |
| ROAD_CARS | Road transport: Passenger cars |
| ROAD_BUSES | Road transport: Busses |
| ROAD_L_TRUCKS | Road transport: Light trucks |
| ROAD_H_TRUCKS | Road transport: Heavy trucks |
| ROAD_MC | Road transport: Motorcycles |
| ROAD_OTHERS | Road transport: Other vehicles |
| DOM_NAVI | Other transport: Domestic navigation |
| RAILWAY_ETC | Other transport: Railway, etc. |
| AGR_FORE | Domestic: Agriculture and forestory |
| FISHING | Domestic: Fishing |
| RESIDENT | Domestic: Residential |
| COMM_PUB | Domestic: Commerce and puclic service |
| WASTE_INCIN | Domestic: Waste incineration |
| SMALL_INCIN | Domestic: Small incineration |

B. Others

| Sector category codes | Sector categories |
|---|---|
| POWER_PLANTS | Power plants: Electricity and heat production |
| ENERGY | Industry: Energy sector |
| IRON_STEEL | Industry: Iron and steel |
| CHEM_PETRCHEM | Industry: Chemical and petrochemical |
| NON_FERR_MET | Industry: Non-ferrous metals |
| NON_MET_MINE | Industry: Non-metallic minerals |
| OTHER_IND | Industry: Others |
| ROAD_CARS | Road transport: Passenger cars |
| ROAD_BUSES | Road transport: Busses |
| ROAD_L_TRUCKS | Road transport: Light trucks |
| ROAD_H_TRUCKS | Road transport: Heavy trucks |
| ROAD_MC | Road transport: Motorcycles |
| ROAD_OTHERS | Road transport: Other vehicles |
| DOM_NAVI | Other transport: Domestic navigation |
| RAILWAY_ETC | Other transport: Railway, etc. |
| RESIDENT | Domestic: Residential |
| COMM_PUB | Domestic: Commerce and public services |
| AGR_FORE_FISH | Domestic: Agriculture/Forestry/Fishing |
| OTHERS | Domestic: Others |

3.2.2 Non-combustion sources except for NMVOC

(1) Industry

A. Japan except for $CH_4$ and $N_2O$

| Sector category codes | Sector categories |
| --- | --- |
| GAS_PRD | Gas production |
| MINING | Mining and quarrying |
| CONSTRUCTION | Construction |
| MANUFACTURING | Manufacturing |
| FERT_PROD | Fertilizer production |

B. Taiwan except for $NH_3$, $CH_4$, $N_2O$, and $CO_2$

| Sector category codes | Sector categories |
| --- | --- |
| POWER_PLANTS | Electricity and heat production |
| OIL_REFINERY | Oil refinery |
| CHEMICAL_MATERIAL | Chemical materials |
| CHEMICAL_PRODUCT | Chemical products |
| IRON_AND_STEEL | Iron and steel |
| CEMENT | Cement |
| PAPER | Paper, pulp, etc. |
| GLASS | Glasses |
| BRICK | Bricks |
| CERAMICS | Ceramics |
| WOOD | Wood and wood products |
| FOOD | Food and beverage |
| LEATHER | Leather |
| TEXTILE | Textile |
| NON_FERROUS_METAL | Non-ferrous metals |
| MINING | Mining and quarrying |
| PLASTIC | Plastic |
| RUBBER | Rubber |

C. $NH_3$ except for Japan

| Sector category codes | Sector categories |
| --- | --- |
| AMMONIA | Ammonia production |
| AMMONIUM_NITRATE | Ammonium nitrate production |
| UREA | Urea production |

D. N$_2$O

| Sector category codes | Sector categories |
|---|---|
| ADIPIC_ACID | Production of adipic acid |
| NITRIC_ACID | Production of nitric acid |
| NON_SPECIFID | Miscellaneous |

E. Others

| Sector category codes | Sector categories |
|---|---|
| PIG_IRON | Pig iron |
| CRUDE_STEEL | Crude steel |
| IRON_STEEL_OTHERS | Other steel |
| ALUMINUM_ALUMINA | Aluminum and alumina |
| COPPER | Copper |
| ZINC | Zinc |
| LEAD | Lead |
| CEMENT | Cement |
| BRICKS | Bricks |
| LIME | Lime |
| COKE_OVENS | Coke ovens |
| OIL_REFINERY | Oil refinery |
| OTH_TRANSFORMATION | Other transformation sector |
| SULPHURIC_ACID | Sulphuric acid |
| OTHERS | Others |

(2) Agriculture

| Sector category codes | Sector categories |
|---|---|
| FERTILIZER | Emissions related to fertilizer application |
| MANURE_MANAGEMENT | Emissions related to manure management |
| ENTERIC_FERMENTATION | CH$_4$ emissions from enteric fermentation |
| RICE_CULTIVATION | CH$_4$ emissions from rice cultivation |
| SOIL | Soil NO$_x$ emissions |
| DIRECT_SOIL | Direct soil N$_2$O emissions |
| INDIRECT_SOIL | Indirect soil N$_2$O emissions |

(3) Fugitive emissions

| Sector category codes | Sector categories |
|---|---|
| FUGITIVE_COAL | Fugitive emissions from production, processing, and distribution of coal |
| FUGITIVE_OIL | Fugitive emissions from production, processing, and distribution of oil |
| FUGITIVE_GAS | Fugitive emissions from production, processing, and distribution of gas |

(4) Others

| Sector category codes | Sector categories |
|---|---|
| SOLID_WASTE | Solid waste disposal |
| WASTE_WATER | Waste water treatment |
| HUMAN | Human perspiration and respiration |
| PET_DOG | Pet dogs |

## 3.2.2 Non-combustion sources for NMVOC

### (1) Evaporative emissions from vehicles

| Sector category codes | Sector categories |
|---|---|
| CAR_EVAP | Evaporative emissions from vehicles |

### (2) Solvent use

| Sector category codes | Sector categories |
|---|---|
| DRY_CLEANING | Dry cleaning |
| DEGREASING | Degreasing operations |
| VEHICLE | Vehicle treatment |
| DOM | Domestic use of solvents |
| PAINT_PROD | Paint production |
| INK_PROD | Ink production |
| PRINTING | Printing (Packing, offset printing, publication, and screen printing) |
| OTHER_PROD | Other production of solvents |
| OTHER_USAGE | Other usage of solvents |

### (3) Paint Use (both from solvent- and water-based paint)

| Sector category codes | Sector categories |
|---|---|
| ARCHITECTURAL | Paint application for architectural purpose |
| DOM | Paint application for domestic purpose |
| VEHICLE | Paint application for automobile manufacturing |
| OTHER_USAGE | Paint application for other purpose |

### (4) Industry

| Sector category codes | Sector categories |
|---|---|
| OIL_REFINERY | Oil refinery |
| CHEMICAL_IND | Chemical industry |
| COKE_OVENS | Coke production |
| STEEL | Steel production |
| OTHERS | Pulp and paper production |

### (5) Others

| Sector category codes | Sector categories |
|---|---|
| EXTRACT_PROC | Extraction process (Ex. Extraction and handling of fossil fuels, service station) |
| WASTE | Solid waste disposal |

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