The comparison analysis for various global Greenhouse emissions inventories datasets

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1.Background

➢ Various of GHG inventory databases have been developed in the world since 2006 IPCC Guidelines for national GHG inventories was issued.

➢ The objectives of this study are to clarify the magnitude and trend of uncertainty in inventory datasets from 17 existing global GHG inventories, and to explore the sources and decrease measures of uncertainties.

2.Methodology

Table 1. Detailed information on 17 existing global GHG inventories

Dataset	Time series	Scope*	Data source	Calculation method	Results on emissions estimation
BP	1965-2015	73	BP energy Statistics	Partly refers to IPCC guidelines	CO₂ emissions from fossil fuels combustion
CDIAC	1751-2013	219	UN statistics and publications	Estimated from fuel production	Global, regional total, and national CO2 emissions data by fuel type, cement production, and gas flaring with yearly grid map (1° resolution)
EDGAR	1970-2008	214	IEA and other statistics	IPCC guidelines	Global total, national GHG emissions from all sectors, and other polluting gases with yearly grid map (0.1° resolution)
EIA	1980-2014	226	EIA statistics and publications	Partly refers to IPCC guidelines	Global emissions on CO2, CH4, N2O from energy combustion by 5 sectors and national CO2 emissions
FAOSTAT	1990-2010	233	FAOSTAT and EDGAR	IPCC guidelines	CO2, CH4, N2O and F-gases emissions from energy combustion in 7 sectors
FFDAS	1997-2011	203	IEA statistics and publications	Kaya identity	Global and national CO2 emissions from fossil fuel combustion with hourly grid map (0.1° resolution)
GCA	1960-2015	218	CDIAC , UNFCCC data sets; IEA, BP	CDIAC method	National CO2 emissions by fuel types, cement and gas flaring and CH4
GCB	1959-2015	219	CDIAC and publications	CDIAC method	Global carbon budget, fossil emissions, land-use change emissions, ocean and terrestrial sink, national territorial emissions
IEA	1971-2014	148	IEA statistics	Partly refers to IPCC guidelines	CO2 emissions from fuel combustion by fuel types or by 5 sectors
REAS	2000-2008	30	EDGAR, FAOSTAT; UN, IEA and other statistics	Partly refers to IPCC guidelines	National anthropogenic CO2 and other polluting gases emissions in Asia with monthly grid map (0.25° resolution)
ODIAC	2000-2015	226	BP and some statistics	Proxy point sources and nightlight	Global and national fossil fuel CO2 emissions from proxy sources with monthly grid map (1° resolution)
OECD	1990-2014	34	IEA dataset	Partly refers to IPCC guidelines	National CO2 emissions from fossil fuel combustion by 5 sectors and other GHGs emissions
PBL	1990-2015	214	EDGAR; BP and IEA statistics	Partly refers to IPCC guidelines	Global, regional CO2 emissions from fossil fuels and cement by fuel types
PKU	2007-2008	223	EDGAR, FAOSTAT; EIA, IEA, UN and statistics	Special proxy sources	Global and national CO2 emissions from fuel combustion by eight groups, with annual grid map (0.1° resolution)
UNFCCC	1990-2014	44	Governmental submissions	IPCC guidelines	National CO₂, CH₄, N₂O and F-gases emissions by 7 sectors
WB	1960-2013	217	CDIAC and statistics	CDIAC method	National CO₂ emissions by fuel types, cement and gas flaring
WRI	1990-2013	186	CDIAC, IEA, FAOSTAT datasets; EIA statistics	Partly refers to IPCC guidelines	National CO₂, CH₄, N₂O and F-gases emissions from fossil fuels and cement by fuel types and by sectors

Table 2. Sensitivity analysis of estimation by CDIAC`s method for CO₂ emissions of USA in 2008.

Item adjusted	Sensitivity-5% adjusted	Sensitivity-10% adjusted	Sensitivity-15% adjusted	Sensitivity-20% adjusted
Primary fuel-solid	-1.53%	-3.07%	-4.60%	-6.13%
Primary fuel-liquid	-1.90%	-3.80%	-5.71%	-7.61%
Primary fuel-gaseous	-1.14%	-2.29%	-3.43%	-4.58%
Secondary fuel-solid	-0.24%	-0.49%	-0.73%	-0.97%
Secondary fuel-liquid	-0.13%	-0.26%	-0.38%	-0.51%
Gas flaring	-0.01%	-0.02%	-0.03%	-0.03%
Cement manufacture	-0.04%	-0.08%	-0.12%	-0.16%
Oxidation rate-solid	-1.78%	-3.55%	-5.33%	-7.11%
Oxidation rate-liquid	-2.03%	-4.06%	-6.09%	-8.12%
Oxidation rate-gaseous	-1.14%	-2.29%	-3.43%	-4.58%
Oxidation rate-gas flaring	-0.01%	-0.02%	-0.03%	-0.03%
Carbon content rate-solid	-1.78%	-3.55%	-5.33%	-7.11%
C content rate-liquid	-2.03%	-4.06%	-6.09%	-8.12%
C content rate-gaseous	-1.14%	-2.29%	-3.43%	-4.58%
C content rate-gas flaring	-0.01%	-0.02%	-0.03%	-0.03%
C content rate-cement manufacture	-0.04%	-0.08%	-0.12%	-0.16%

$$MPAD = Mean \sum \left(Absolute \left(\frac{E_\alpha - Mean \sum E_\alpha}{Mean \sum E_\alpha}\right)\right) \quad (1)$$

Where E_α is the 2008 emissions value for nation α (Gt-CO₂/year), $\sum E_\alpha$ is the total emissions for nation α across 11 datasets, and $Mean \sum E_\alpha$ is the average emissions value for nation α across 11 datasets.

Figure 1. Uncertainty values across 11 datasets for 57 nations in 2008 (as the resolution limitation part of the nations are extracted here). The left y-axis shows the average and deviation of CO₂ emissions in 2008, while the right y-axis shows the MPAD from mean annual emissions. The vertical bar represents mean annual emissions, while the line denotes the deviation of emissions across all 11 datasets.
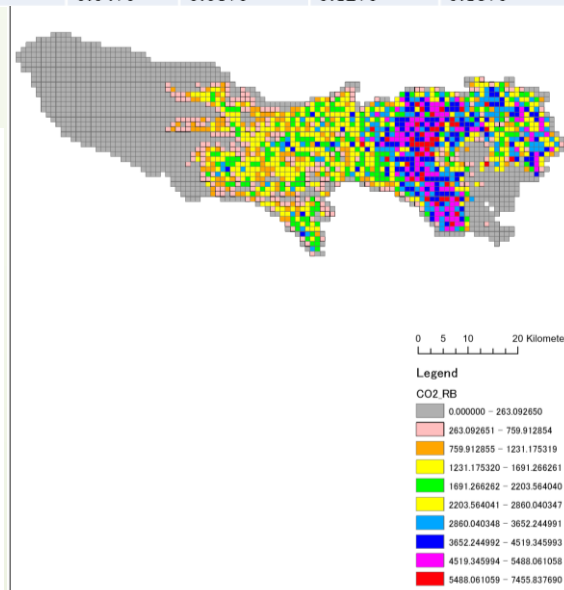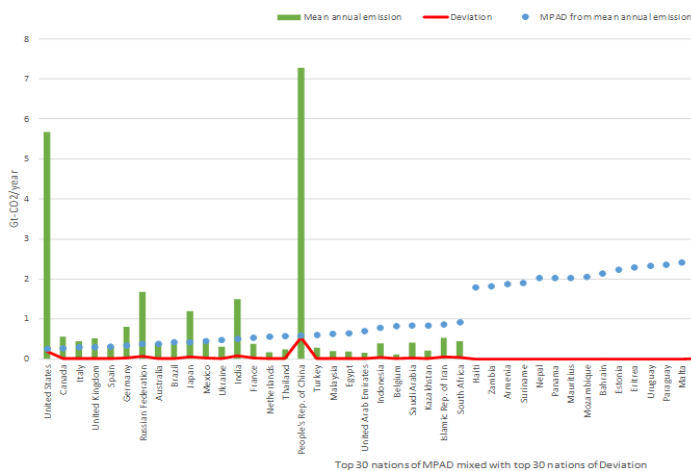
Figure 2. The CO₂ emissions from residential sector in Tokyo by building level summarized in 1*1km mesh

3.Conclusions and Suggestions

◆ By characterization on 17 global GHG inventories, the uncertainties mainly result from the choice of data sources and estimate methodologies. Therefore, identical data statistics method and professional estimate procedures are essential.

◆ The magnitude of uncertainty remains considerable, particularly for the huge emitter nations with larger deviation and small emitter nations with higher proportion of uncertainty. The parameters with higher sensitivity should be processed carefully.

◆ More efforts are desired for improving the GHG emissions inventory such as compiling high spatial level inventory and validation by the satellite observation.