FRAMEWORK FOR THE DEVELOPMENT
OF ENVIRONMENT STATISTICS (FDES 2013)

MANUAL ON THE BSES: GHG STATISTICS

Session One: Environment Statistics Toolbox

Sixth Meeting of the Expert Group on Environment Statistics, New York 21-23 May 2019

United Nations Statistics Division

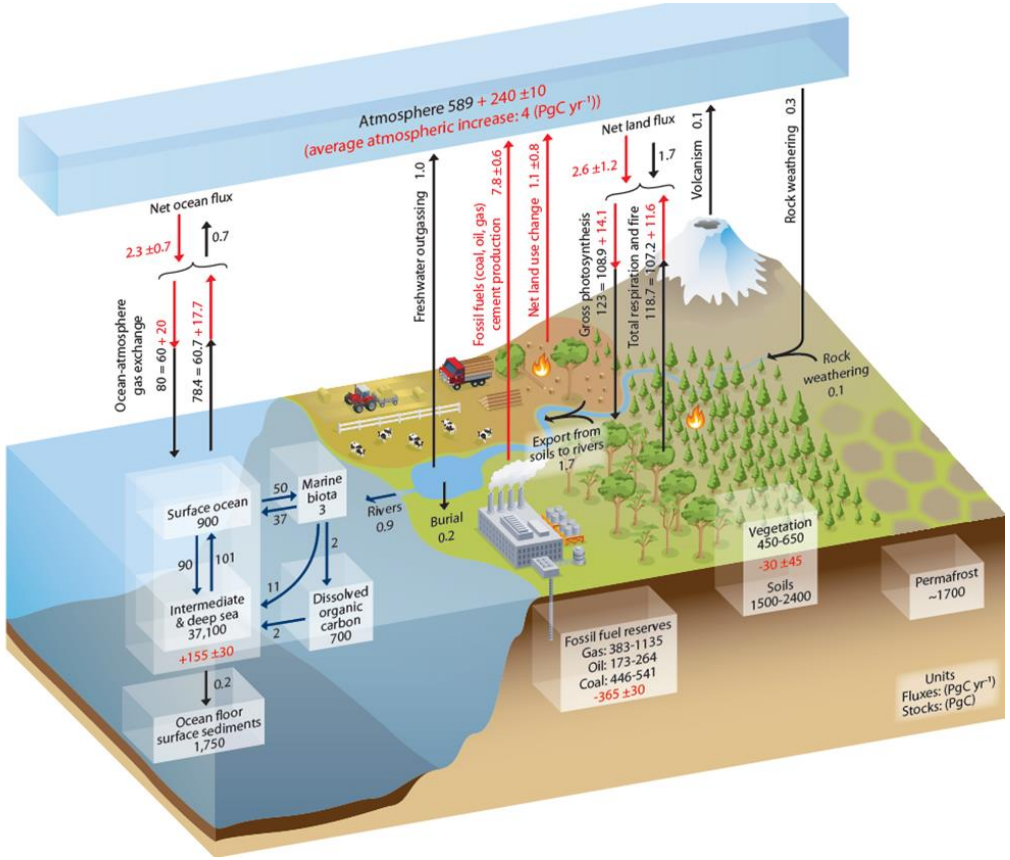
1. Outline

- Present methodology sheet
- Outline key issues: coverage, measurement, disaggregation
- Outline feedback:

2. Introduction

- Focus on GHG (also part of cross-cutting climate change)
- Context/importance
- Role of statistics
  - Coverage, multi-purpose?
  - Quality, novel methods?
  - Dissemination
  - Need more examples of NSO Involvements

Suggestion to change topic 3.1.1. title: from 'Emissions of GHG' to 'GHG emissions by sources and removals by sinks'



3 Definitions and description of the statistics

'**Greenhouse gases** are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere'.

Global Warming Potential (GWP) an index translating the level of emissions of various gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations…

CO_2 equivalent : is the representation of GHG in terms of CO_2

Emissions are the release of greenhouse gases and/or their precursors into the atmosphere

Removals are the absorption of atmospheric GHG, mainly CO_2 by a sink = **sequestration**

More narrow definitions needed, e.g. removals by land and oceans sinks?

How about likely development of technological means to sequester carbon?

3 Definitions and description of the statistics

Statistics and Related Information (Bold Text - Core Set/Tier 1; Regular Text - Tier 2; Italicized Text - Tier 3)		Characteristics
a.	**Total emissions of direct GHG**	
	1. Carbon dioxide (CO_2)	Natural, main GHG, GWP=1, 409 ppm (0.04% content)
	2. Methane (CH_4)	Natural, second GHG, GWP=28, 1.8 ppm
	3. Nitrous oxide (N_2O)	Natural, third, GWP=265, 0.324 ppm
	4. Perfluorocarbons (Pl	
	5. Hydrofluorocarbons	
	6. Sulphur hexafluoride (SF_6)	Synthetic, in electronics, GWP= 22800
	New. Nitrogen trifluoride (NF_3)	Synthetic, used in microelectronics, GWP= 17200
b.	**Total emissions of indirect GHG**	
	1. Sulphur dioxide (SO_2)	Cooling effect, acid deposition
	2. Nitrogen oxides (NO_x)	Pollutants
	3. Non-methane volatile organic compounds (NM-VOCs)	Pollutants
	4. Other	

Different meaning of Tiers in IPCC and FDES

- Clarify which mass units should be used for each gas, e.g. CO2-e
- Specify source of GWP, AR4 or AR5

Suggestion to include carbon monoxide

3 Definitions and description of the statistics

Coverage differences

- UNFCCC covers production-based anthropogenic GHG emissions and removals according to territorial principle, excluding international (air) transport and unmanaged/natural ecosystems
- REDD+ consistent with UNFCCC, but focused on natural forests, ex: Indonesia (https://theredddesk.org/countries/Indonesia)
- Numerous science assertions: unmanaged forest are big GHG sinks (for example the Amazon, Espírito-Santo, et al. 2014)

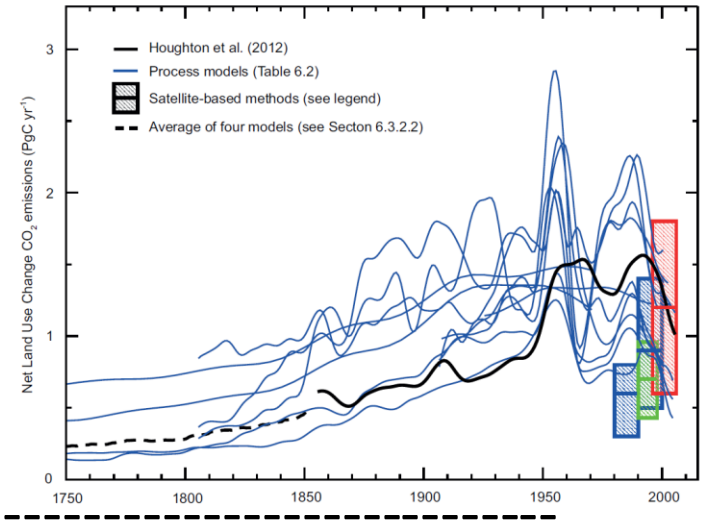
Should FDES GHG statistics address extended coverage: all GHG emissions and removals?

Consider possible environmental changes in the future, such as permafrosts melt down, climate induced forest growth/degradation

3 Definitions and description of the statistics

Measurement challenges:

- GHG emission reports often cited as 10 – 20% uncertain
- GHG removals even more uncertain, especially at regional scales



Net land use change CO2 emissions (PgC yr–1). All methods are based on land cover change data (see Table 6.2) and are smoothed with a 10-year filter to remove interannual variability. The bookkeeping estimate of Houghton et al. (2012) (thick black over 1850–2011) and the average of four process models (dash black) over 1750–1850 (see 6.3.2.2) are used in Table 6.1. The process model results for net land use change CO2 emissions from Table 6.2 are shown in blue. Satellite-based methods are available for the tropics only, from (red) van der Werf et al. (2010), (blue) DeFries et al. (2002), and (green) Achard et al. (2004). Note that the definitions of land use change fluxes vary between models (Table 6.2). The grey shading shows a constant uncertainty of ±0.8 PgC yr-1 around the mean

Source: IPCC (2013). Climate Change 2013: The Physical Science Basis.

Statistical data quality control/validation standards matched with novel methods (ground and remote sensing) can help (ex. REDD+)

4. References to:

- Classifications
- Standards
- Examples

2006 IPCC Guidelines divides the GHG estimates into five main sectors, with sources and sinks:

1. Energy (incl. transport)
2. Industrial Processes and Product Use (IPPU)
3. Agriculture, Forestry and Other Land Use (AFOLU)
4. Waste:
5. Other

Six AFOLU classes

1. Forest Land
2. Cropland
3. Grassland
4. Wetlands
5. Settlements
6. Other Land

With detailed classes, for example:

1 ENERGY
1A Fuel combustion activities
1A1 Energy industries
1A1a Main activity electricity and heat production
1A1ai Electricity generation
1A1aii Combined heat and power generation
1A1aiii Heat plants
1A1b Petroleum refining

4. References to:

- Classifications
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- Examples

SEEA-CF Land cover classification (p.178)

1 Artificial surfaces (including urban and associated areas)
2 Herbaceous crops
3 Woody crops
4 Multiple or layered crops
5 Grassland
6 Tree-covered areas
7 Mangroves
8 Shrub-covered areas
9 Shrubs and/or herbaceous vegetation, aquatic or regularly flooded
10 Sparsely natural vegetated areas
11 Terrestrial barren land
12 Permanent snow and glaciers
13 Inland water bodies
14 Coastal water bodies and intertidal areas

4. References to:

- Classifications
- Standards
- Examples

1. 2006 IPCC Guidelines for National Greenhouse Gas Inventories ***(http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html)***

- New IPCC guidelines coming
- Tiering structure differs

2. IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories ***(http://www.ipcc-nggip.iges.or.jp/public/gp/english)***

3. IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry ***(http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html)***

The European Environment Agency is missing from the list of sources about GHG emissions. The list of regional databases on p. 16 mentions Eurostat, which is not the primary provider of GHG data for the EU (the EEA is). We could mention:

- The EEA greenhouse gas data viewer: https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer
- The EEA EU ETS data viewer: https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1
- The EEA database on national climate change mitigation policies and measures: http://pam.apps.eea.europa.eu/

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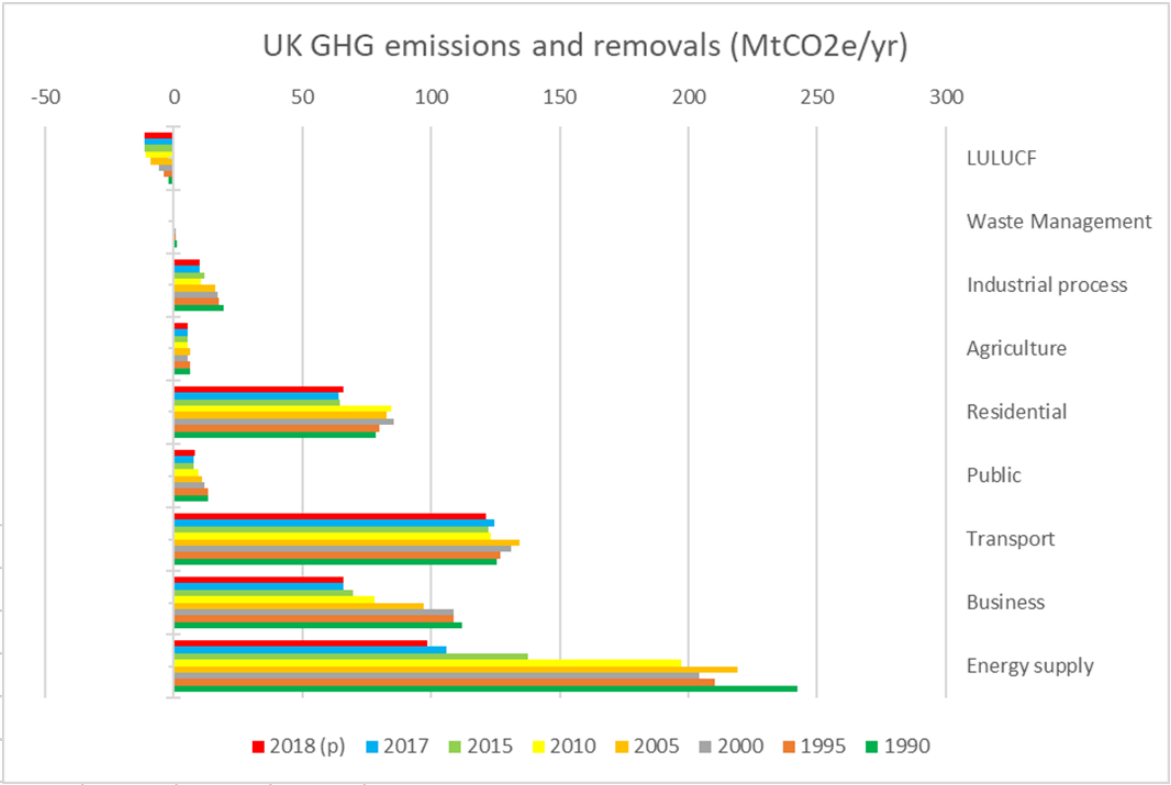

Sector	1990	1995	2000	2005				
Energy supply	242	210	204	219				
Business	112	109	109	97				
Transport	125	127	131	134				
Public	13	13	12	11				
Residential	78	80	86	82				
Agriculture	6	6	5	6	5	5	6	6
Industrial process	19	18	17	16	11	12	10	10
Waste Management	1	1	1	0	0	0	0	0
LULUCF	-2	-4	-6	-9	-11	-11	-11	-11

Source: Department for Business, Energy and Industrial Strategy: https://data.gov.uk/dataset/9a1e58e5-d1b6-457d-a414-335ca546d52c/provisional-uk-greenhouse-gas-emissions-national-statistics

5. Data collection and sources of data

- FDES does not cover tourism and transport, could be added in next FDES
- Emissions relating to tourism that happened on the national territory are included in GHG inventory

- Scope
- Statistical units
- Measurements
- Sources and institutions
- Data collection
- Aggregation/disaggregation
- Quality control and validation

partitioned for consistency with the following reporting mechanisms:

- Emissions and removals as defined by UNFCCC, according to the IPCC guidelines, considering the sources linked to human activities/managed land within a country (territorial principle)
- Emissions from international transport and tourism
- Emissions and removals from natural sources, either existing or expected (e.g., from melt of permafrost soils in sub-Arctic areas, peatlands etc.) which may not be currently reported

5. Data collection and sources of data

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The following units apply in accordance to the above scoping divisions:

- National territory
- The globe
- Ecosystem/land use/land cover types

5. Data collection and sources of data

- Scope
- Statistical units
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- For national reporting purposes from anthropogenic sources [$tCO_2\ yr^{-1}$ -equivalent]
- [$tCO_2\ ha\ yr^{-1}$ -equivalent] for 'natural' emissions and removals.
- These units allow for possibilities to convert between the mass of different gases and different temporal and spatial units.

5. Data collection and sources of data

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- National Statistical Agencies (Ex. Surveys, Census information);
- National regulatory authorities responsible for permitting of industrial and other processes subject to pollution emission legislation
- Ministries, in particular on Energy, Industry, Environment, Agriculture and Forestry
- National and international experts
- Universities and reference libraries
- Scientific and technical articles in environmental books, journals and reports
- National Inventory Reports from Parties to the UNFCCC
- International organizations that publish statistics: UNSD, US Geological Survey (USGS), OECD, IPCC Emission Factor Database, and so on.

5. Data collection and sources of data

Basic equation used to estimate GHG emissions applying emission factors is:

Emissions/removals = AD (extent of human activity) x EF (emission or removals per unit activity)

Where:

***EF* = emission factor**

Emission factor is a coefficient that quantifies the emissions or removals of a gas per unit activity data.

AD = activity data

Magnitude of a human activity resulting in emission or removals of GHG over a specified area in a given period of time.

Consider more detail on spatial dimensions?

5. Data collection and sources of data

Stats Netherlands produce quarterly estimates, and in NZ quarterly energy emissions are available

- Scope
- Statistical units
- Measurements
- Sources and institutions
- Data collection
- Aggregation/disaggregation
- Quality control and validation

- Temporal aspect – annual
- Spatial aspect – globally, nationally, by ISIC sector, by gas, by ecosystem/land-use/land cover types, other statistical reporting units?
- Particularly relevant in consideration of climate change statistics. Cross-cutting indicators need to be consistent and comparable at various reporting/policy-support units (for example ecosystems or catchments) to enable DSPIR analysis

Another comment relates to the timing at which GHG data are available, which seems to be a dimension completely missing from the manual. In most cases (incl. official submissions to UNFCCC), the data sets relate to GHG emissions up until 'year-2' (e.g. 2019 information covers GHG emissions until 2017).

5. Data collection and sources of data

- Scope
- Statistical units
- Measurements
- Sources and institutions
- Data collection
- Aggregation/disaggregation
- Quality control and validation

- Estimates of anthropogenic emissions and removals of greenhouse gases presented in inventories are subject to uncertainty due to several causes, from the lack of precision of basic data to incomplete knowledge of the processes that cause emissions or removals of greenhouse gases.
- The data on emissions/removals on GHGs, especially for reporting the GHG inventories to UNFCCC are subject to the principles of TACCC (Transparency, Accuracy, Consistency, Completeness and Comparability).
- It is good practice to assess the quality of national level or site-specific level activity data…

- More work needed on data quality and validation to strengthen statistics for multiple uses (e.g. IPCC, REDD+ and SEEA)

6. Uses and dissemination

- **Presentation formats**
- **SEEA accounts/tables that use these statistics**
- **Common statistics/indicators**
- **SDGs**

Tabular: GHG emissions and removals can be presented in tables, gas by gas, by country or region, by activity sector of emission. Indicators could be presented *per capita* or related to activity sector for selected years or longer time series.

Graph: graphs could show long term trends in GHG emissions, if data availability allows (total, by gas and by activity sector).

Maps: geographical maps are important to view difference among GHG emissions from countries.

Infographics: infographics are teaching tools which are visual representations of GHG emissions and removals.

Videos: videos are teaching tools that present information on greenhouse gas emissions, among others.

6. Uses and dissemination

- **Presentation formats**

Tabular, ex. From UK's report (2018) to UNFCCC
(https://unfccc.int/documents/65762)

Source Category	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
1. Energy	616.4	573.8	566.3	563.2	508.2	466.2	484.3	471.5	432.1	416.3	393.3
2. Industrial Processes and Product Use	66.5	60.8	40.6	39.7	35.6	32.1	32.4	34.5	34.3	33.8	30.8
3. Agriculture	50.0	48.9	46.7	44.4	41.7	41.8	41.4	41.2	42.6	41.9	42.0
4. LULUCF	-2.1	-5.0	-7.9	-11.4	-14.4	-15.0	-12.6	-13.6	-14.4	-15.1	-14.5
5. Waste	67.0	69.4	63.2	49.3	30.0	28.0	26.4	22.7	20.3	19.3	20.2
Total (net emissions)	797.8	748.0	708.9	685.3	601.1	553.0	571.9	556.4	514.8	496.2	471.7

Aggregated emission trends per source category, including all estimated GHG emissions from the Crown Dependencies and selected relevant Overseas Territories (Mt CO_2 equivalent)

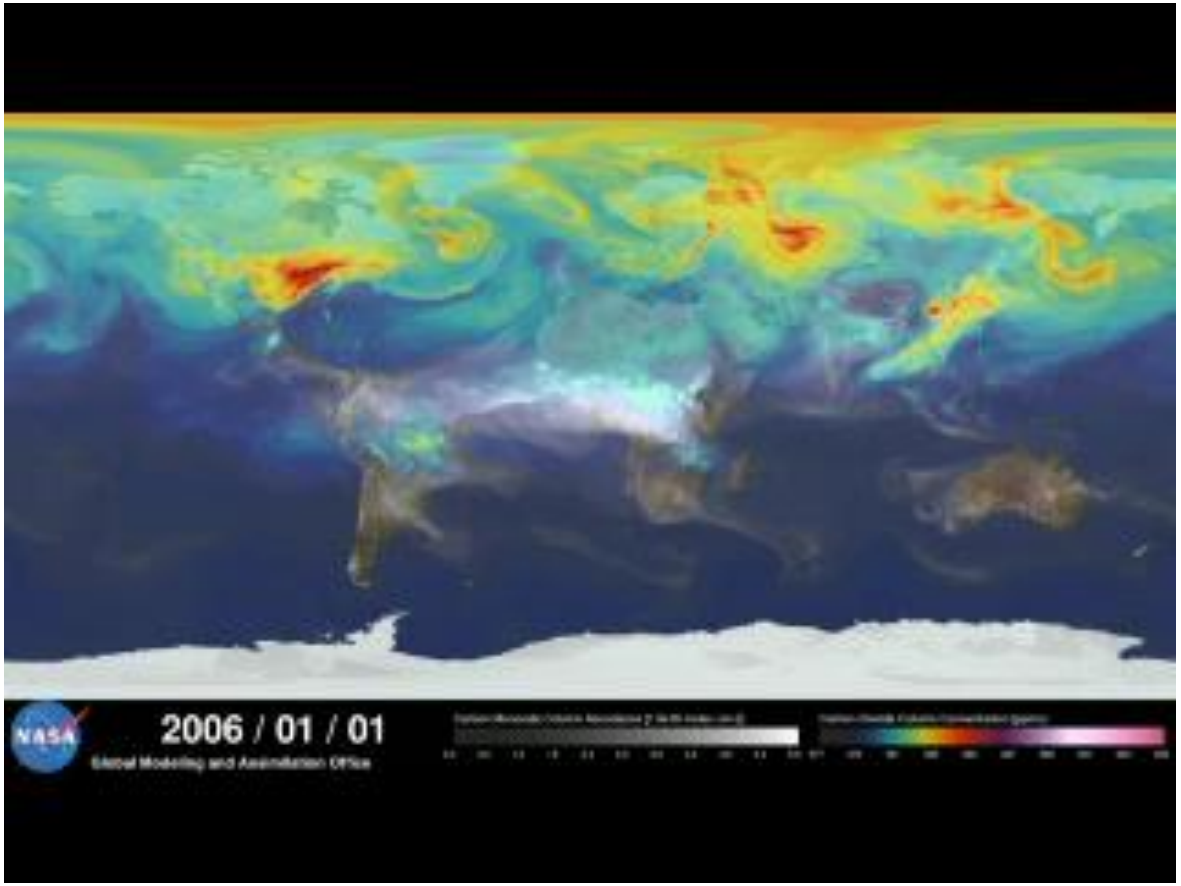
Emissions of GHGs in terms of carbon dioxide equivalent emissions including all estimated GHG emissions from the Crown Dependencies and relevant Overseas Territories, 1990-2016. (Mt CO_2 Equivalent)

Table ES2.1	Mt CO_2 Equivalent												% change
	1990	1995	2000	2005	2009	2010	2011	2012	2013	2014	2015	2016	1990 - 2016
CO_2 (Inc. net LULUCF)	596.9	559.6	556.9	556.6	479.5	495.9	453.0	473.1	462.3	422.3	405.6	382.0	-36%
CO_2 (Exc. net LULUCF)	601.3	566.8	566.9	569.9	494.4	512.0	469.5	487.3	477.4	438.3	422.2	398.0	-34%
CH_4 (Inc. net LULUCF)	133.8	127.2	109.6	88.1	69.6	65.0	62.3	60.6	55.9	53.5	52.0	52.0	-61%
CH_4 (Exc. net LULUCF)	133.7	127.2	109.6	88.0	69.5	64.9	62.2	60.5	55.9	53.5	52.0	52.0	-61%
N_2O (Inc. net LULUCF)	49.8	40.2	30.1	26.0	22.4	22.7	21.8	21.8	21.5	22.1	21.7	21.5	-57%
N_2O (Exc. net LULUCF)	47.5	38.0	28.0	24.1	20.8	21.1	20.2	20.2	20.0	20.6	20.2	20.1	-58%
HFCs	14.4	19.1	9.9	13.2	15.7	16.5	15.0	15.5	15.9	16.1	16.1	15.3	6%
PFCs	1.7	0.6	0.6	0.4	0.2	0.3	0.4	0.3	0.3	0.3	0.3	0.4	-79%
SF_6	1.3	1.3	1.8	1.1	0.6	0.7	0.6	0.6	0.5	0.5	0.5	0.5	-60%
NF_3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16%
Total (Inc. net LULUCF)	797.8	748.0	708.9	685.3	587.9	601.1	553.0	571.9	556.4	514.8	496.2	471.7	-41%
Total (Exc. net LULUCF)	799.9	753.0	716.8	696.7	601.1	615.5	568.0	584.5	569.9	529.2	511.3	486.3	-39%

6. Uses and dissemination

- **Presentation formats**

Videos, Example NASA CO2:
https://svs.gsfc.nasa.gov/11719



6. Uses and dissemination

- **SEEA accounts/tables that use these statistics**

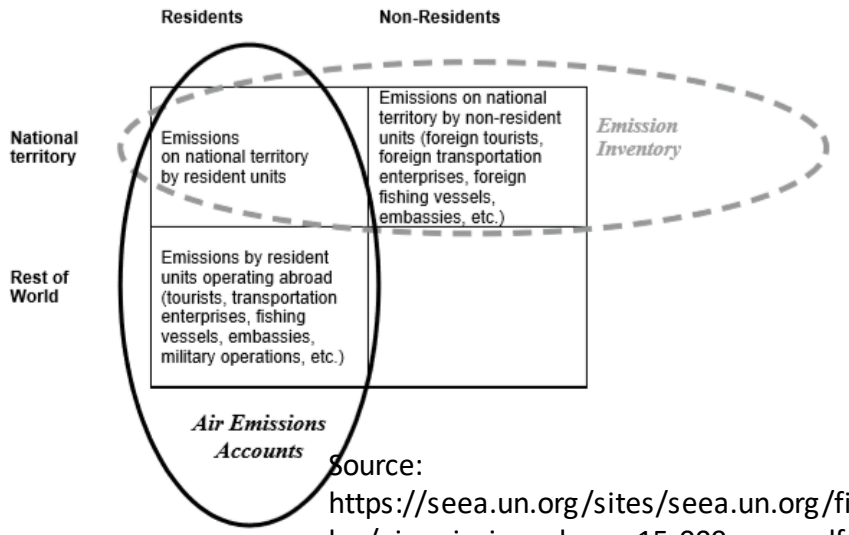
  These statistics can also be used to populate environmental-economic accounts, in particular, if they are available according to ISIC.

SEEA CF (2012) Air emission account, p82

Table 3.7
Air emissions account *(tonnes)*

	Supply table for air emissions								Use table for air emissions	
	Generation of emissions							Accumulation	Flows to the environment	
	Industries—by ISIC					Households				
	Agriculture ISIC A	Mining ISIC B	Manufacturing ISIC C	Transport ISIC H	Other	Transport	Heating	Oth	Emissions	Total
Type of substance										
Carbon dioxide	10 610.3	2 602.2	41 434.4	27 957.0	82 402.4	18 920.5	17 542.2	1 9		
Methane	492.0	34.1	15.8	0.8	21.9	2.4	15.5			
Dinitrogen oxide	23.7		3.5	0.8	2.6	1.0	0.2			
Nitrous oxides	69.4	6.0	37.9	259.5	89.0	38.0	12.1			
Hydrofluorocarbons			0.3		0.4					
Perfluorocarbons										
Sulphur hexafluoride										
Carbon monoxide	41.0	2.5	123.8	46.2	66.2	329.1	51.2			
Non-methane volatile organic compounds	5.2	6.5	40.0	16.4	27.2	34.5	29.4			
Sulphur dioxide	2.7	0.4	28.0	62.4	8.1	0.4	0.4			
Ammonia	107.9		1.7	0.2	0.9	2.3	11.4			
Heavy metals										
Persistent organic pollutants										
Particulates (including PM10 and dust)	7.0	0.1	8.5	9.3	4.4	6.0	2.8			

Geographic and economic (resident) definition of a country



Source: https://seea.un.org/sites/seea.un.org/files/airemissions_ks-gq-15-009-en-n.pdf

More issues to consider:

- Updates on guidance and GHG figures/facts will be needed to reflect on new (2019) IPCC guidance and reports
- Do we need more specific definitions of removals: e.g. by land (vegetation, soil) and ocean sinks?
- Should FDES GHG statistics address extended coverage: all GHG emissions and removals? Consider possible environmental changes in the future, such as permafrosts melt down, climate induced forest growth/degradation. Key issue is how to maintain consistency with existing reporting mechanisms. Does it become too complex?
- Should this manual explore more detailed/novel methods, including ground and remote sensing mapping of emissions and removals?
- Do we need common units for disaggregated statistics that can compare across related topics (especially for cross-cutting climate change statistics)?

The End

- Thank you
- Благодаря