International Workshop on Uncertainty in Greenhouse Gas Inventories: Verification Compliance and Trading

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Global Emission Estimates for GHG within the EU EVERGREEN project

(EnVisat for Environmental Regulation of GREENhouse gases)

European Commission – 5th FP EESD-ESD-$_3$: Earth Observation Technologies

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EU EVERGREEN PROJECT

MAIN OBJECTIVE:

- To employ ENVISAT satellite measurements to improve the greenhouse gas flux estimates derived from theoretical modeling, surface and airborne measurements

EU EVERGREEN PROJECT

SPECIFIC OBJECTIVES:

- Quality assessment and improvement of greenhouse (CO_2, CH_4) and related gas (CO) measurements from ENIVSAT instruments SCIAMACHY and MIPAS.
- Assessment of the role of constituent parts in the radiative forcing based on ENVISAT measurements and atmospheric radiative transfer modelling.
- Quantification of greenhouse and related biospheric gas fluxes through inverse modelling constrained by ENVISAT measurements, with focus on CH_4 and CO.
- Provision of greenhouse gas emission data to National and European institutes as a value added product from ENVISAT.

EU EVERGREEN PROJECT

MAIN TASKS:

Task 1. Quality assessment and improvement of ENVISAT greenhouse gas data.

Trace gas concentrations measured by SCIAMACHY and MIPAS will be retrieved and validated. Advanced radiation transport models and retrieval techniques will allow higher precision and accuracy compared with standard ENVISAT data products. This is necessary in order to meet the EVERGREEN objectives. Extensive validation will establish precision and accuracy figures.

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MAIN TASKS:

Task 2. Radiation and budget modelling.

Greenhouse gas data derived from Task 1 will serve as input to atmospheric radiation transfer modelling. The quality of the measurements is expected to lead to improved model performance. Interpretation of model sensitivities will be given in relation to the Kyoto Protocol requirements with the involvement of end-users as participant in this task. Monthly averaged data will be used to calculate radiative forcing.

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MAIN TASKS:

Task 3. Inverse modelling.

Source and sink magnitudes will be established from inverse modelling using the measured gas distribution data of Task 1 as a model constraint. Data will be assimilated in a meteorology transport model. The focus will be on CH_4 and CO and on regional and seasonal variations. The feasibility of the method will be assessesd and requirements on space-based data will be established. The Kyoto Protocol end-user is involved as participant to this task. The output of this task will be used to establish limitations and requirements for a space-borne Global Climate Observing System for top-down emission inventory assessment relevant to the Kyoto Protocol.

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MAIN RESULTS EXPECTED:

- Advanced retrieval and validation of greenhouse and related gas concentrations from ENVISAT
- Improved global emission inventory of selected greenhouse gases as a value added product from ENVISAT measurements
- Component assessment of the global radiation budget based on ENVISAT measurements
- Involvement of data end-users from government and industry
- Contribution to the Global Climate Observing System (GMES) relevant to the Kyoto Protocol by providing a value added emission inventory product from ENVISAT

Overview of characteristics of main global data sources considered in EVERGREEN

	Main characteristics of datasets
UNFCCC+ EVERGREEN (Anthropogenic + Biomass burning) http://ghg.unfccc.int/	CO, CO2, CH4 (1990, 2000) annual by country CO2: 49 countries, up to 30 sectors (including biomass burning) + 176 countries with less complete data CO: 49 countries, up to 20 sectors (no data for biomass burning) CH4: 49 countries, up to 27 sectors (no data for biomass burning)
EDGAR 3.2 / GEIA (Anthropogenic + Biomass burning) http://www.rivm.nl/env/int/coredata/edgar/	CO, CO2, CH4 (1990, 1995) annual by country and gridded 1 x 1 degree EDGAR CO2: 233 countries, up to 16 sectors including BB-deforestation EDGAR CO: 234 countries, up to 21 sectors including BB-deforestation, savannah burning, agricultural waste burning and (boreal) vegetation fires EDGAR CH4: 234 countries, up to 32 sectors including BB-deforestation, savannah burning, agricultural waste burning and (boreal) vegetation fires
Generoso et al. (Biomass burning)	BC, POM (1997-2001) gridded 1 x 1 degree, monthly, based on fire counts and emission inventories of Liousse et al, 1996 (including savanna, forest and agricultural fires) and Lavoué et al, 2000 (boreal and temperate regions).
Hoelzemann et al. (Biomass burning)	CO2, CO annual gridded 0.5 x 0.5 degree, based on burnt area
Takahashi et al. (Ocean flux)	CO2 (air-sea flux) (1995) annual gridded 4 x 5 degree

UNFCCC database

- http://ghg.unfccc.int
- Annex I countries – emissions for 1990 and 2000
- non-Annex I Countries – data for 1990 and 1994
  Next inventory shall be prepared for year 2000 – requirements not fulfilled by countries

UNFCCC database

- Emissions in accordance with the source categories of the IPCC Guidelines,
- but with the exception of emissions from burning of biomass - reported separately from other source categories.

UNFCCC database

- Emissions from combustion of biomass fuels are not included in totals for the energy sector.

- However „Total Agriculture” includes field burning of agricultural residues and prescribed burning of savannas

UNFCCC database

- Category "National Total" does not include emissions from international transport
- In the case of CO2, the "National Total" does include also emissions from the land-use change and forestry sector (LUCF).

UNFCCC / EDGAR

- UNFCCC database and EDGAR 1990 data are comparable for most of the sectors.

- However there are differences in sector definitions.

  UNFCCC data sets include often relatively high emissions from industrial processes while the respective EDGAR fields are blank.

UNFCCC / EDGAR

- UNFCCC datasets contain negative values for "Total Land-Use Change & Forestry” (sinks).

- In the EDGAR datasets there are only emissions.

UNFCCC / EDGAR

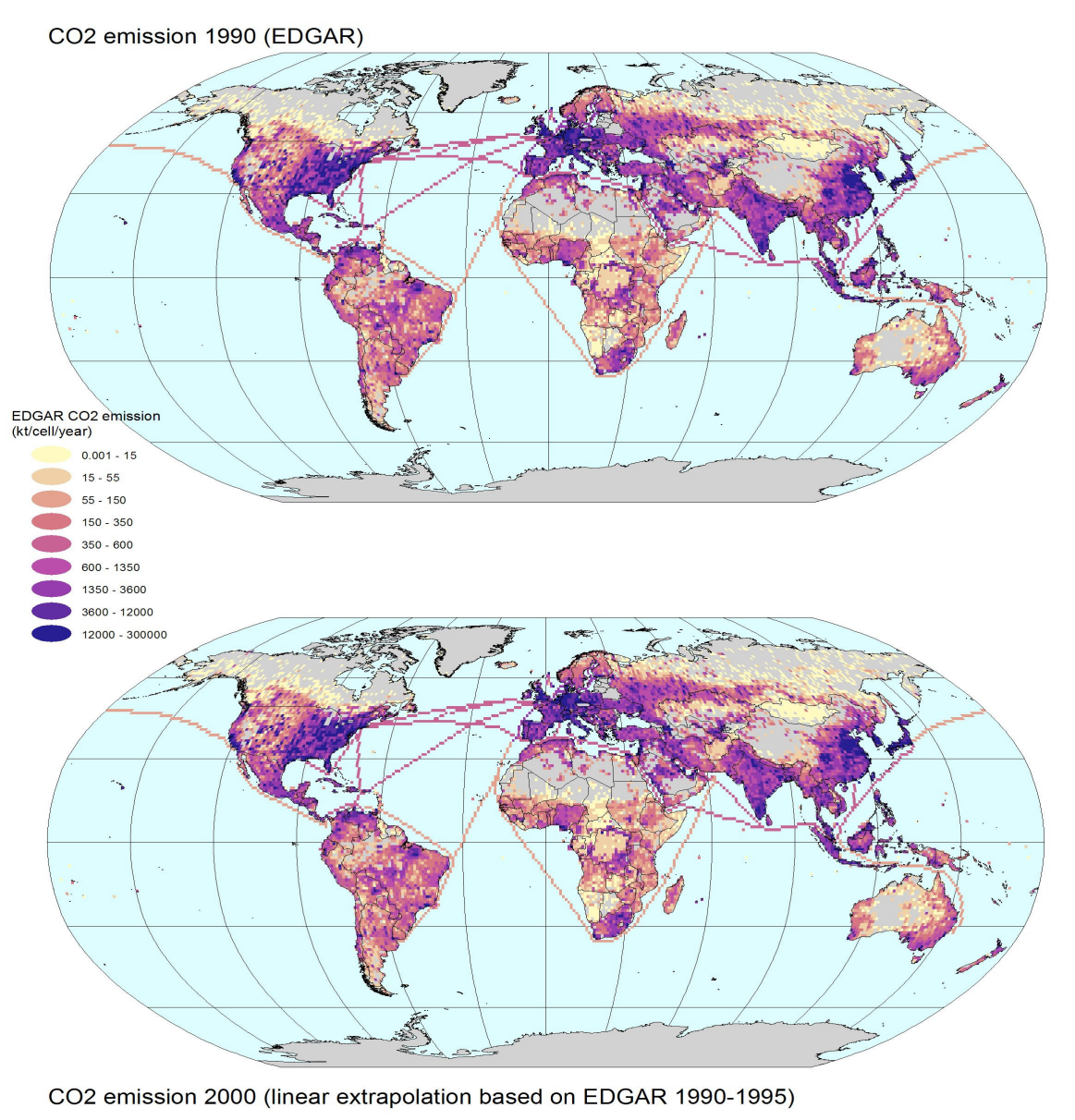
- In the EDGAR datasets, emissions from biomass burning are divided between various sectors.

- In the UNFCCC datasets there are:

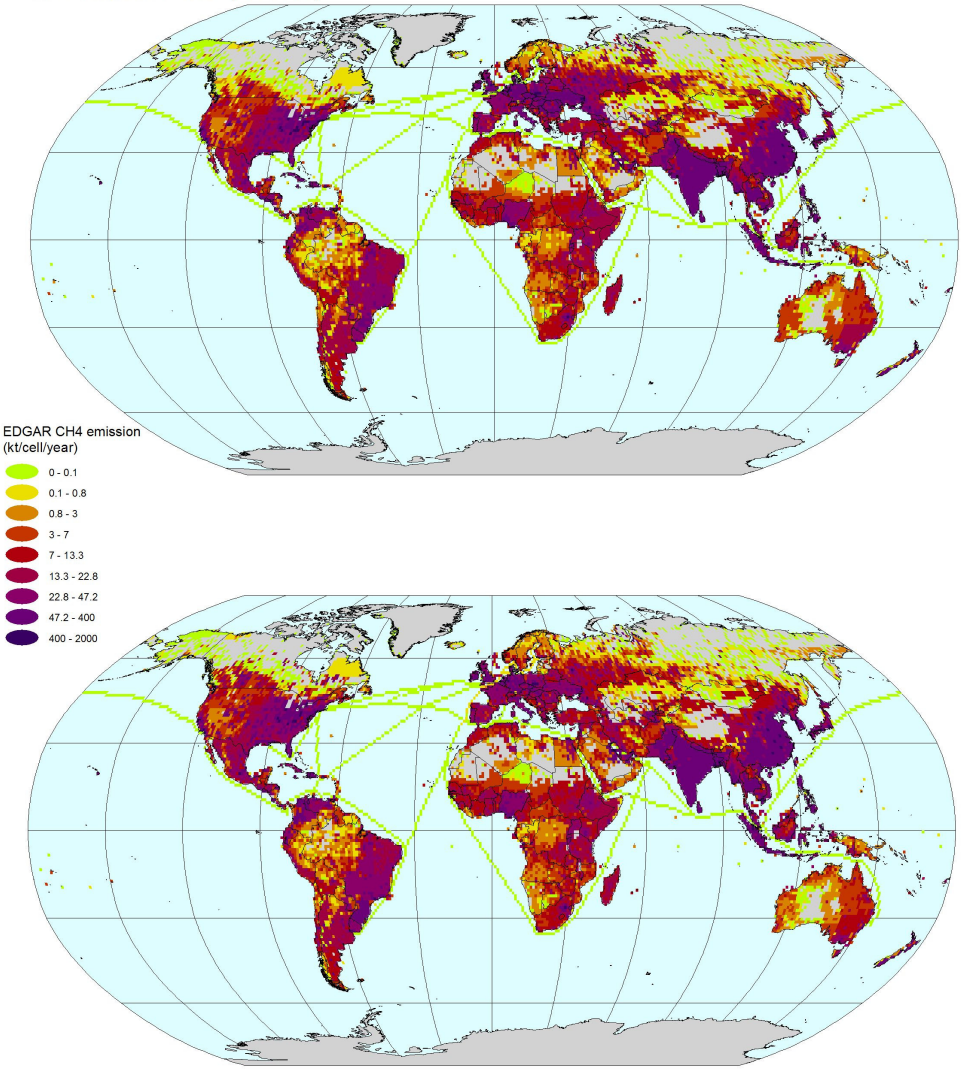
  - emission from combustion of biomass fuels excluding from sectors,

  - remain emissions in sector „Agriculture”.

Spatially distributed CO_2 emission estimates for 1990 (EDGAR 3.2) and 2000 (EVERGREEN – based on projection of EDGAR 1990-1995 trends) – for all sectors combined

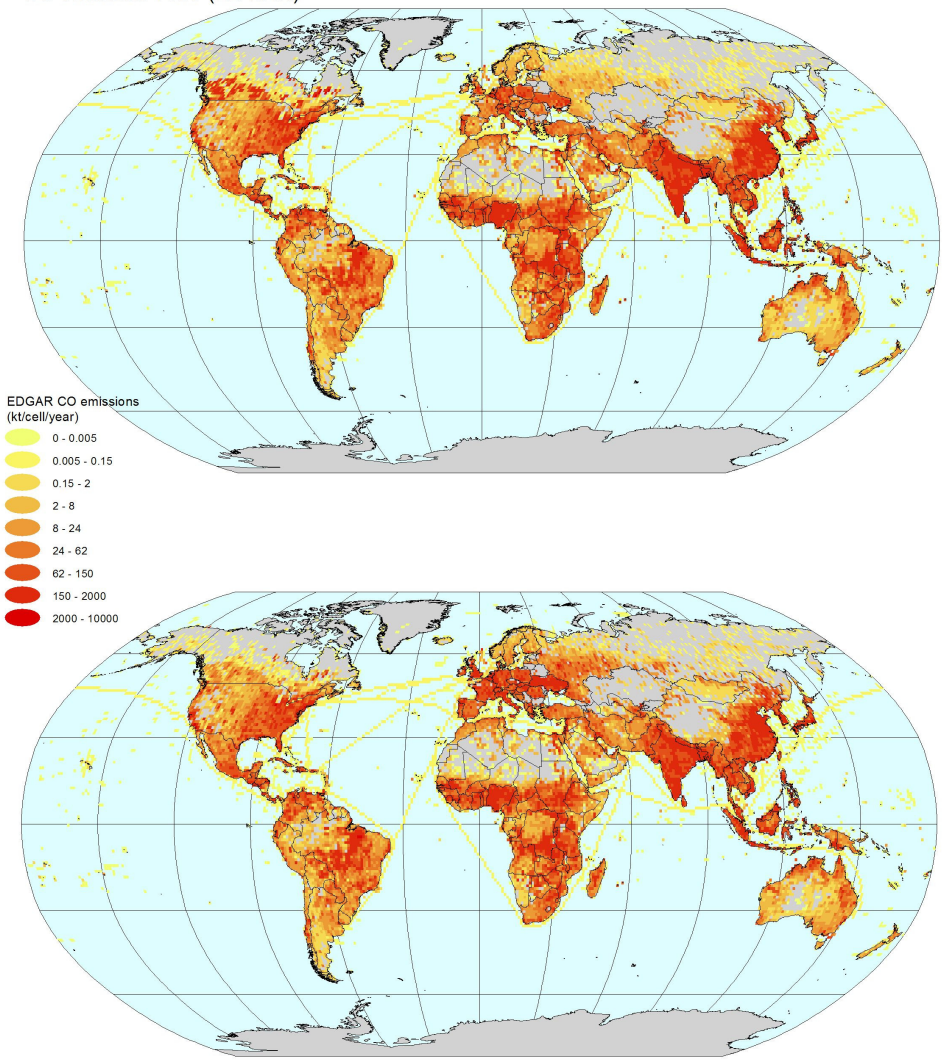


CH4 emission 1990 (EDGAR)



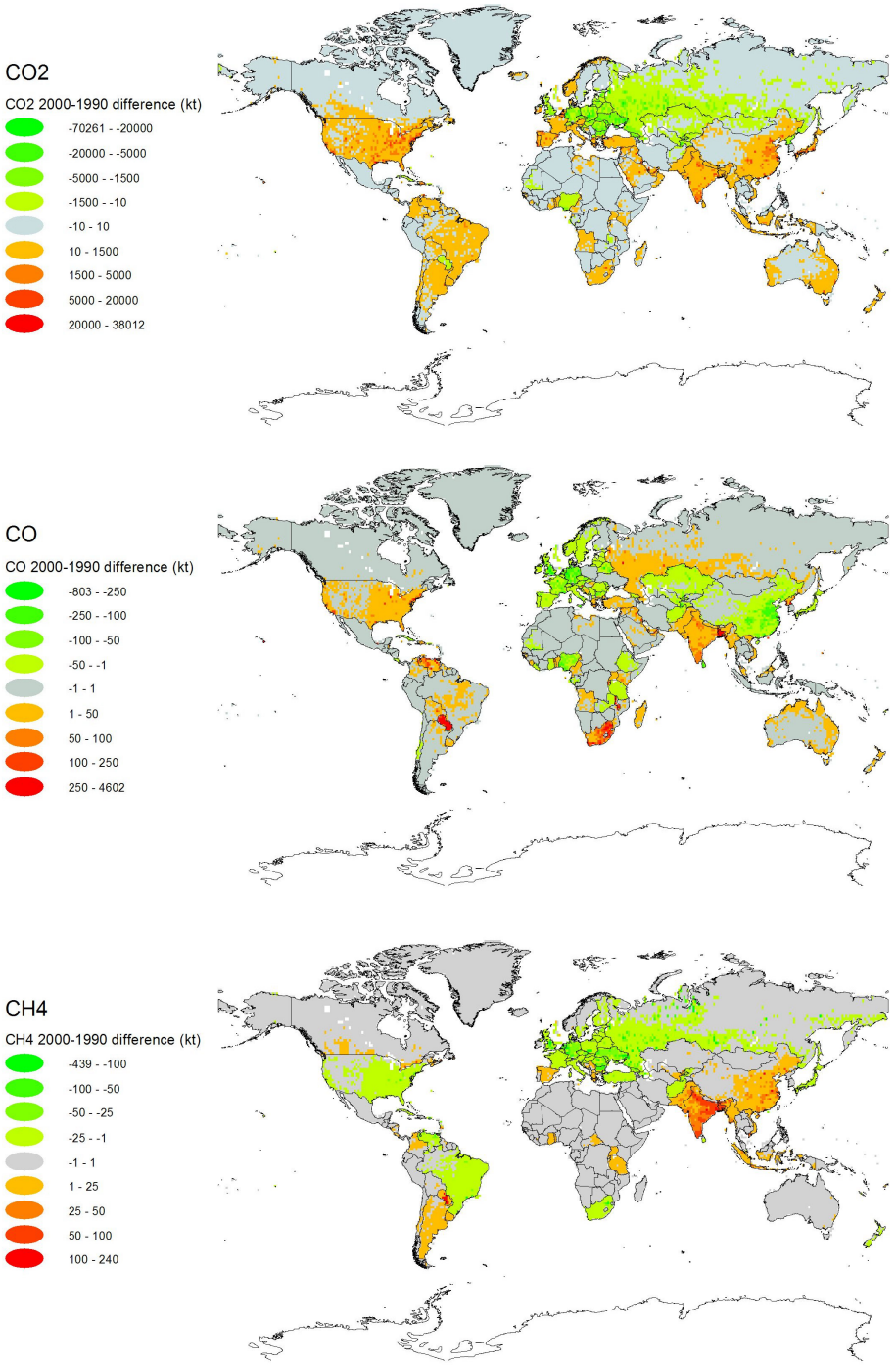
CH4 emission 2000 (linear extrapolation based on EDGAR 1990-1995)

CO emission 1990 (EDGAR)



CO emission 2000 (linear extrapolation based on EDGAR 1990-1995)

Changes in estimated emissions of CO_2, CO and CH_4, 1990 to 2000 (green shades imply reductions, red shades imply increased emissions).



Problems associated with: Individual Datasets and Comparing Data from Different Sources

	UNFCCC+ EVERGREEN	EDGAR 3.2 / GEIA	Generoso et al.	Hoelzemann et al.
UNFCCC+ EVERGREEN (Anthropogenic + Biomass burning)	Incomplete or missing data for many countries, especially for CO and CH4 Lack of estimates of CO2 emissions from biomass burning from significant countries (e.g. Brazil) Interpretation of negative values associated with 'Land Use Change and Forestry' sectors (emission trading?) Validity of / problems associated with adopting EDGAR spatial distributions to produce gridded data.	Incompatible with respect to countries Differences and incompatibility in sector breakdowns Need for assumptions regarding spatial distribution methodology	Possibilities to compare C02 emissions depend on whether these can be derived from Generoso et al. datasets	Comparison of biomass estimates for CO2 still to be done
EDGAR 3.2 / GEIA (Anthropogenic + Biomass burning)		Validity of use of extrapolation to derive 2000 datasets from 1990-1995 trends Lack of availability of proxy datasets used to spatially distribute emissions estimates	Possibilities to compare C02 emissions depend on whether these can be derived from Generoso et al. datasets	Comparison of biomass estimates for CO2 and CO still to be done
Generoso et al. (Biomass burning)			Is it possible to derive reasonable emission estimates for CO2, CO and CH4 from BC to obtain monthly datasets for CO, CO2 from biomass burning?	Possibilities to compare C02 emissions depend on whether these can be derived from Generoso et al. datasets
Hoelzemann et al. (Biomass burning)				Datasets obtained, not yet processed, can data be resolved to monthly estmates?

TOPICS ON INACCURACIES TO BE DISCUSSED WITHIN EVERGREEN

- Availability and completeness of global emission data sets for the years 1990 and 2000/2003
- Modeling vs measurements in global emission inventorying (particularly for biomass burning and natural sources)
- Uncertainties in economic activity data and emission factors for GHGs
- Spatial distribution of source sectors/activities, use of ”proxy” or ”surrogate” data sets for development of gridded emission maps