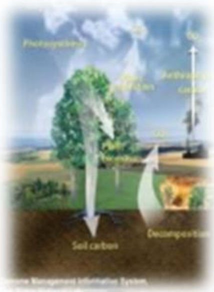
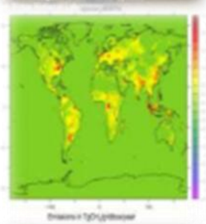
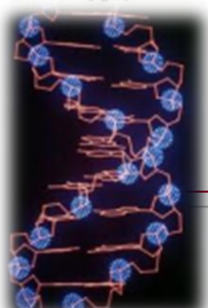






A Close-up of the Methane Global Budget

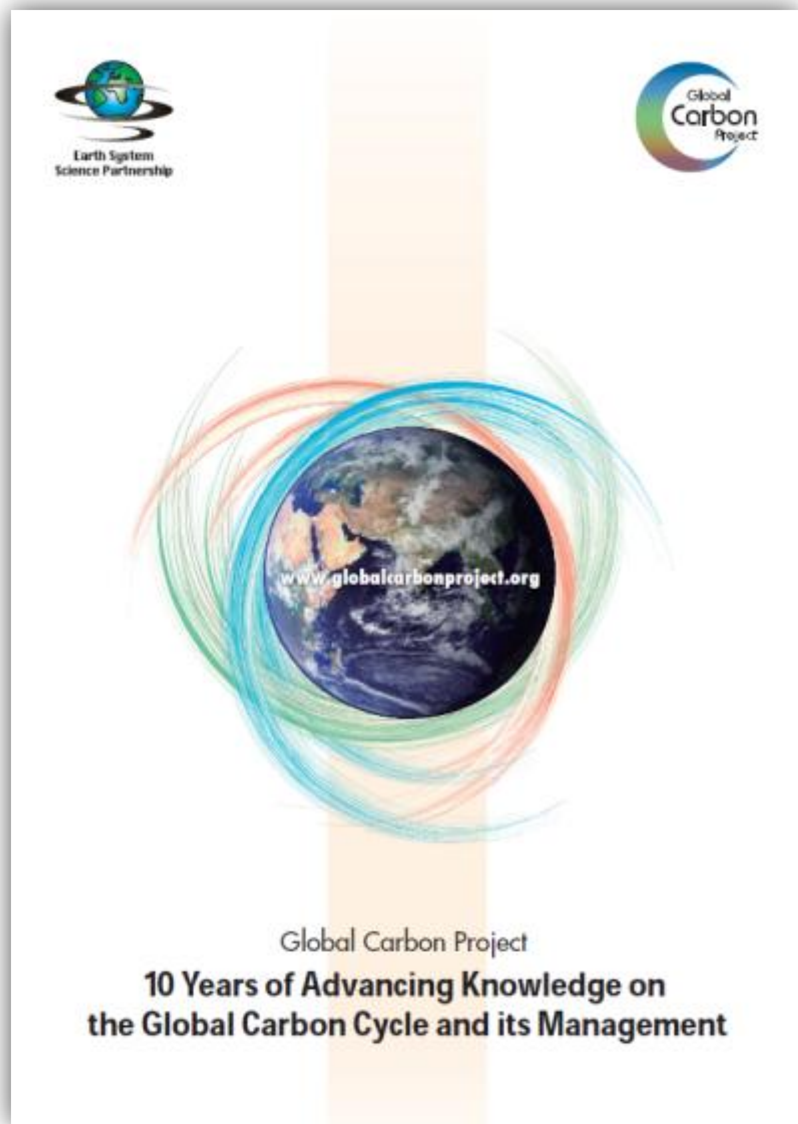
Vienna, EGU 2011

S. Kirschke, P. Ciais, P. Bousquet LSCE

P. Canadell Global Carbon Project, CSIRO

C. LeQuéré Tyndall Centre for Climate Change Research

Global Carbon Project (GCP): Objectives



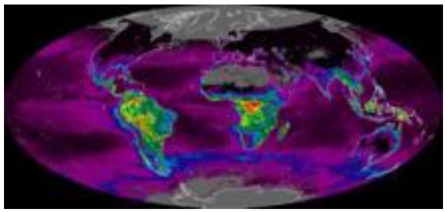
To develop comprehensive, policy-relevant understanding of the global carbon cycle, encompassing its natural and human dimensions and their interactions.

GCP: Mandate

1. Providing international coordination (gaps, duplications, recommendations)
2. Leveraging resources among countries
3. Increasing comparability and standardization among national programmes
4. Adding global connectivity and constraints to national and regional programmes
5. Providing capacity building opportunities
6. Working with FCCC and other Conventions as a Research Non Governmental Organization
7. Leading a highly interdisciplinary research agenda on the CC

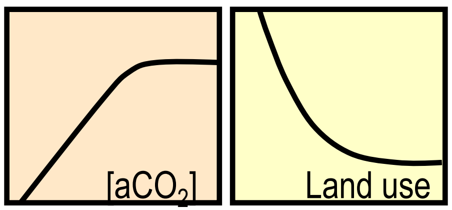
GCP: Science Themes

Theme 1



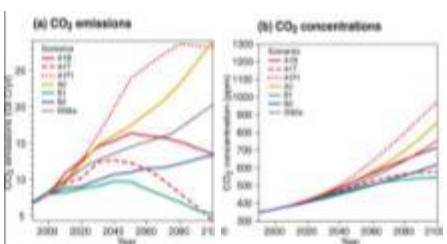
What are the geographical and temporal patterns of carbon sources and sinks?

Theme 2



What are the control and feedback mechanisms – both anthropogenic and non-anthropogenic – that determine the dynamics of the carbon cycle?

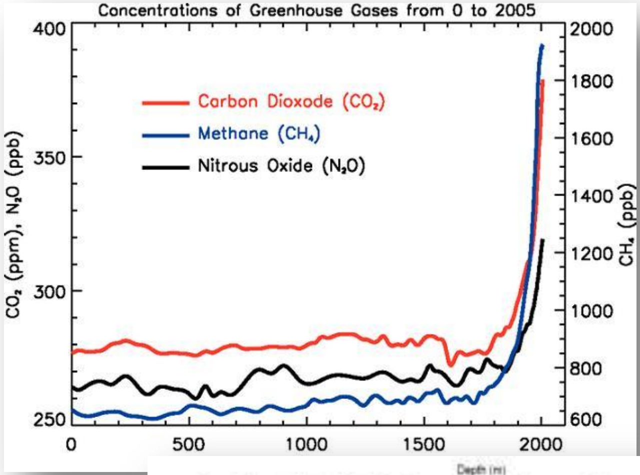
Theme 3



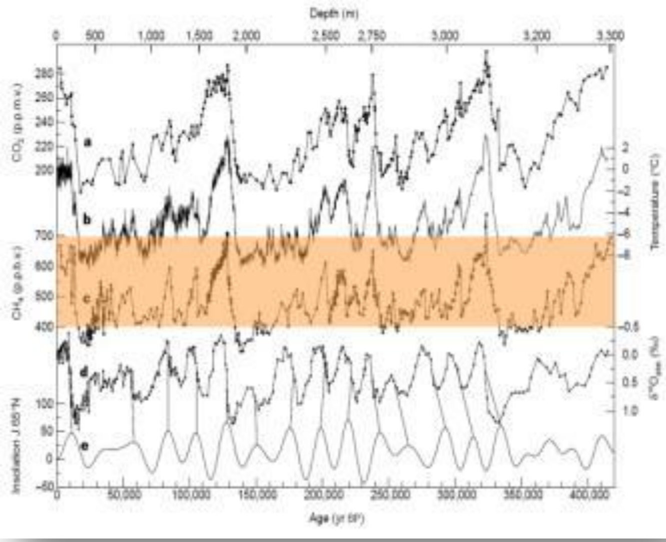
What are the likely dynamics of the carbon-climate system into the future and what points of intervention exist for human societies to manage this system?

Why Methane?

- CH_4 – one of the most important radiatively active trace gases
- 0.5 W m^{-2} direct RF
- Important for tropospheric chemistry
- Wide range of sources with high uncertainties
- Rapid rise in atmospheric concentrations since start of records in 1978 (0.8-2% y^{-1})
- High variability in atmospheric growth rate
- Target for emissions reductions due to short life time

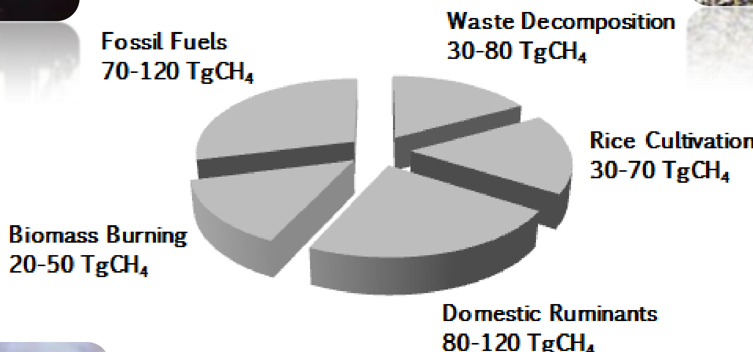


IPCC 2007

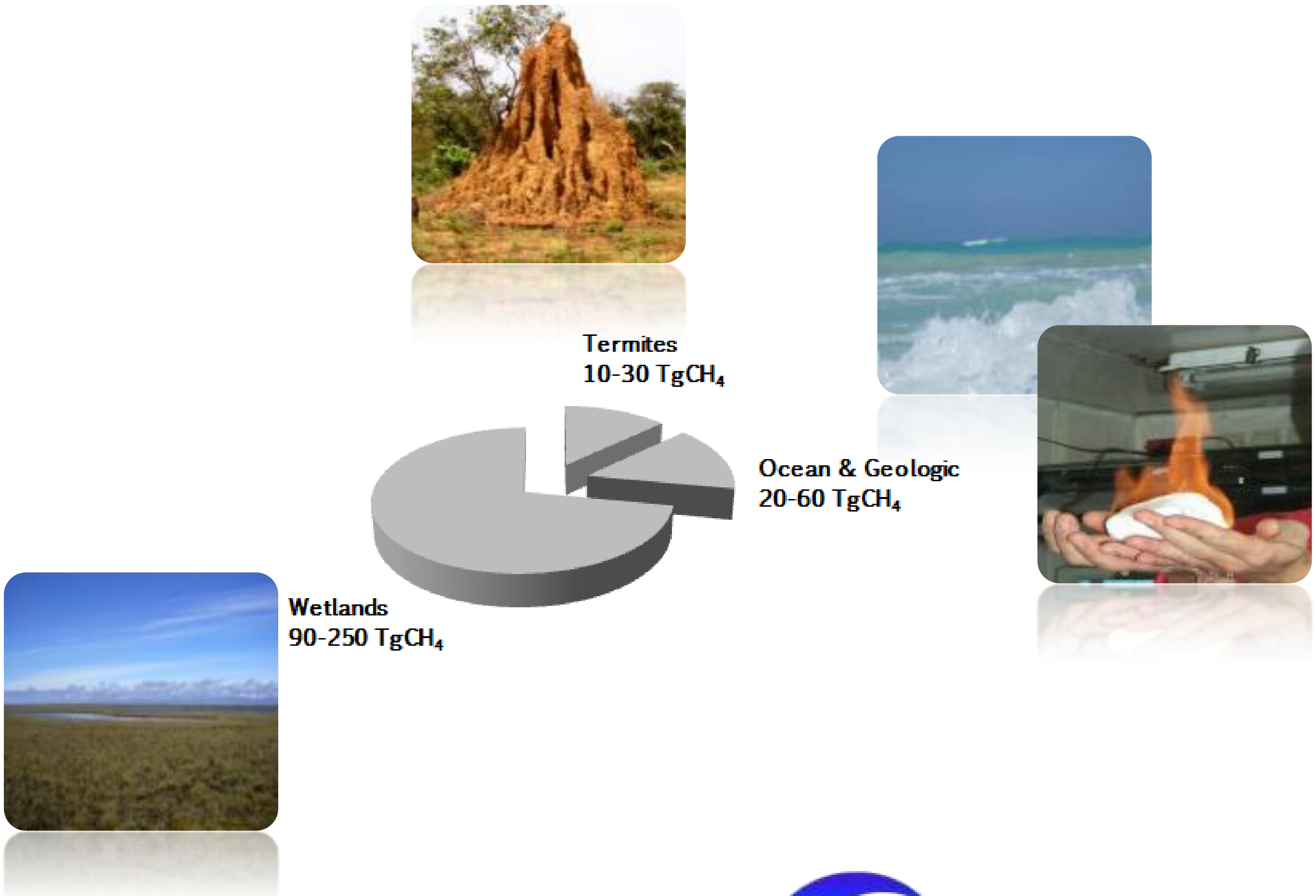


After Petit et al., 1999

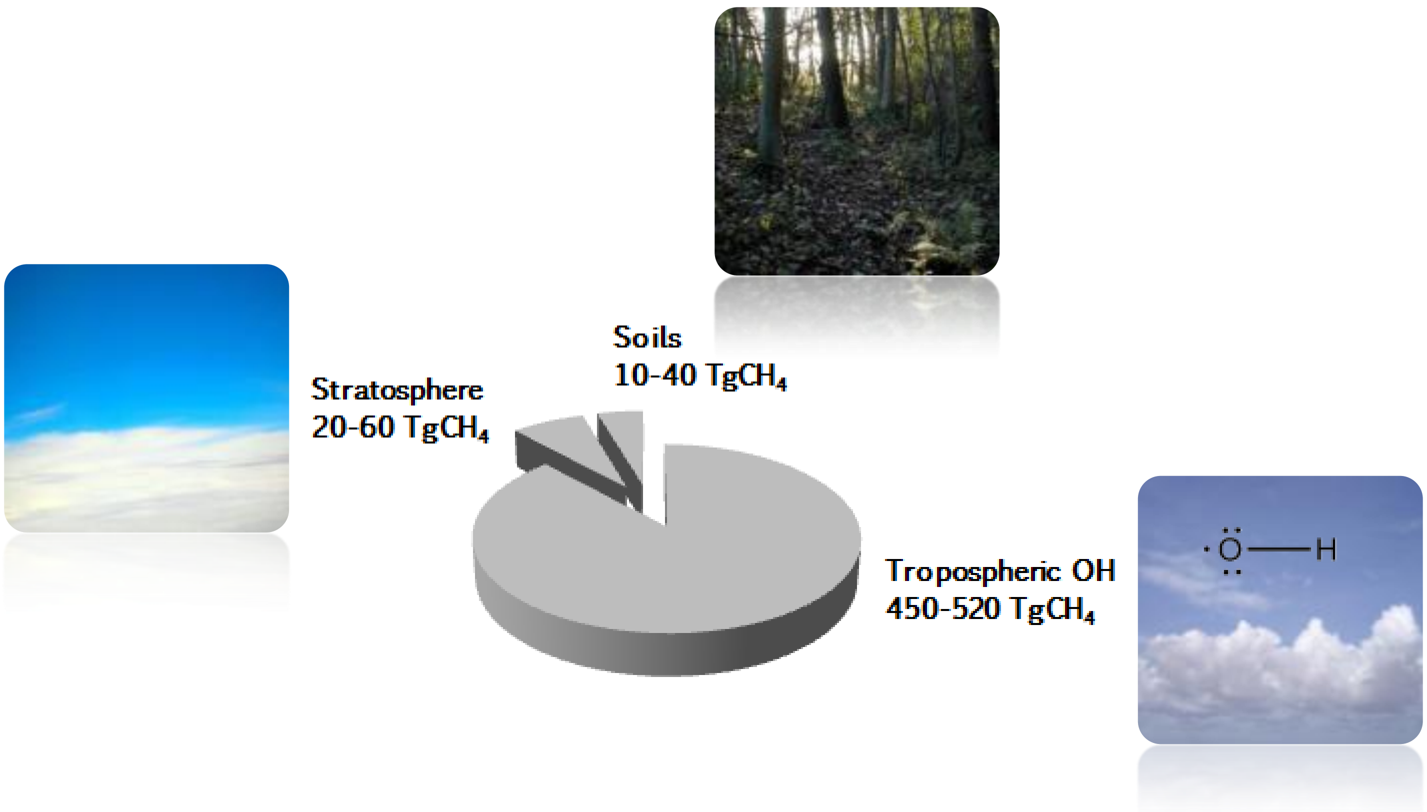
Anthropogenic CH_4 Sources



Natural CH_4 Sources



CH_4 Sinks


Soils
10-40 $TgCH_4$
Stratosphere
20-60 $TgCH_4$
Tropospheric OH
450-520 $TgCH_4$
·Ö—H

GCP Global Methane Budget

- Regular update of the CH_4 global budget, annually or bi-annually – similar to global CO_2 budget
- Synthesis of existing data, bottom-up and top-down
- Contributions from
  - Observational networks (NOAA, CSIRO, LSCE, AGAGE)
  - Inventories (EDGAR, GEIA, GFED)
  - Inverse modeling groups, wetland models, chemical transport models (OH)
- Budget release in a high-profile paper each year

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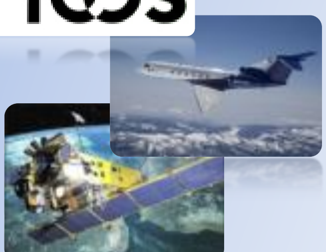
Atmospheric Observations

Ground-based data from observation networks.

Airborne observations.

Satellite data.



Emission Inventories

Number of livestock, area of rice cultivation (FAO).

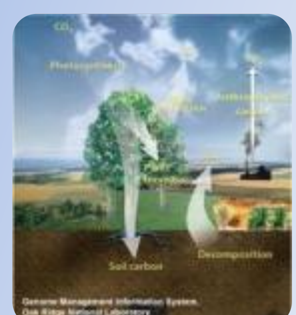
Fossil fuel CH_4 emissions.

Fire emissions (GFED/GEIA).

Biogeochemistry Models

Ensemble of different wetland models, e.g. LPJ-WHyMe, ORCHIDEE, …

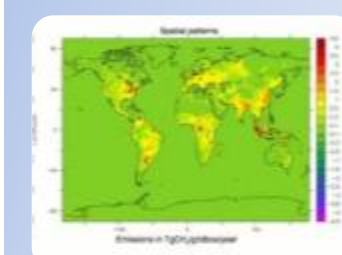
Top-down model to calculate annual flooded area.



Inverse Models

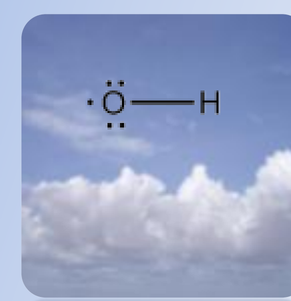
Ensemble of different atmospheric inversion models.

Groups from the TransCom project.

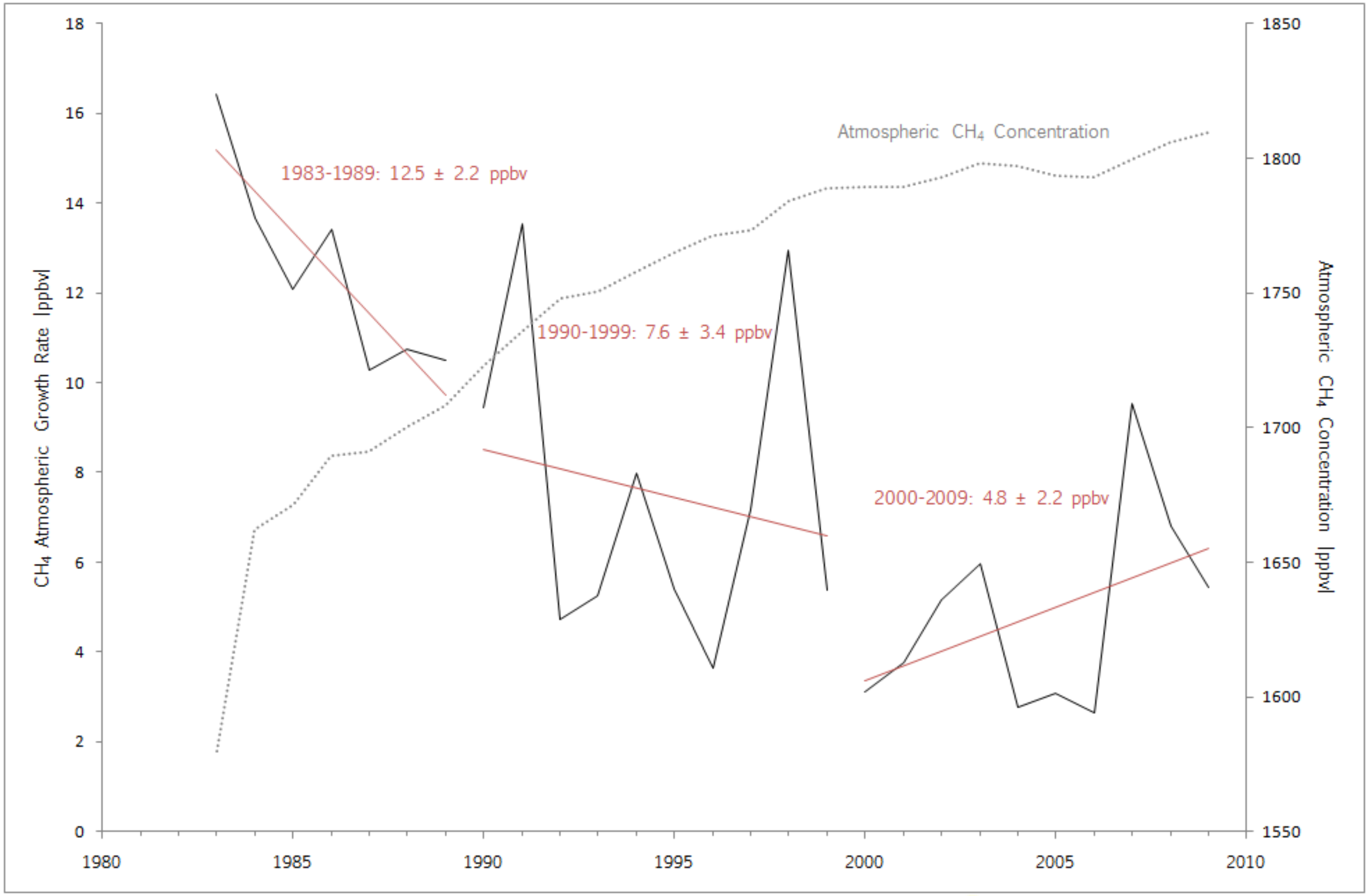


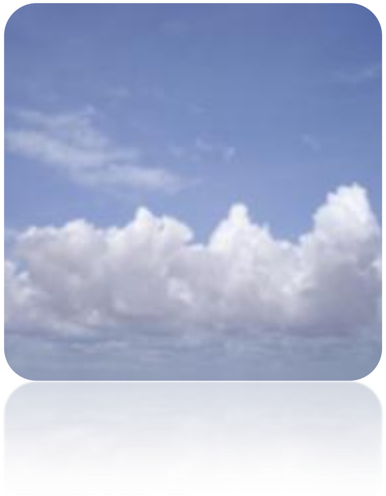
OH Sink

Long-term trends of the OH sink, not year-to-year variability.



CH_4 Atmospheric Growth Rate, 1983-2009





1983-1989: 12.5±2.2ppbv

1990-1990: 7.6±3.4ppbv

2000-2009: 4.8±2.2ppbv

Data from NOAA, CSIRO, LSCE atmospheric networks

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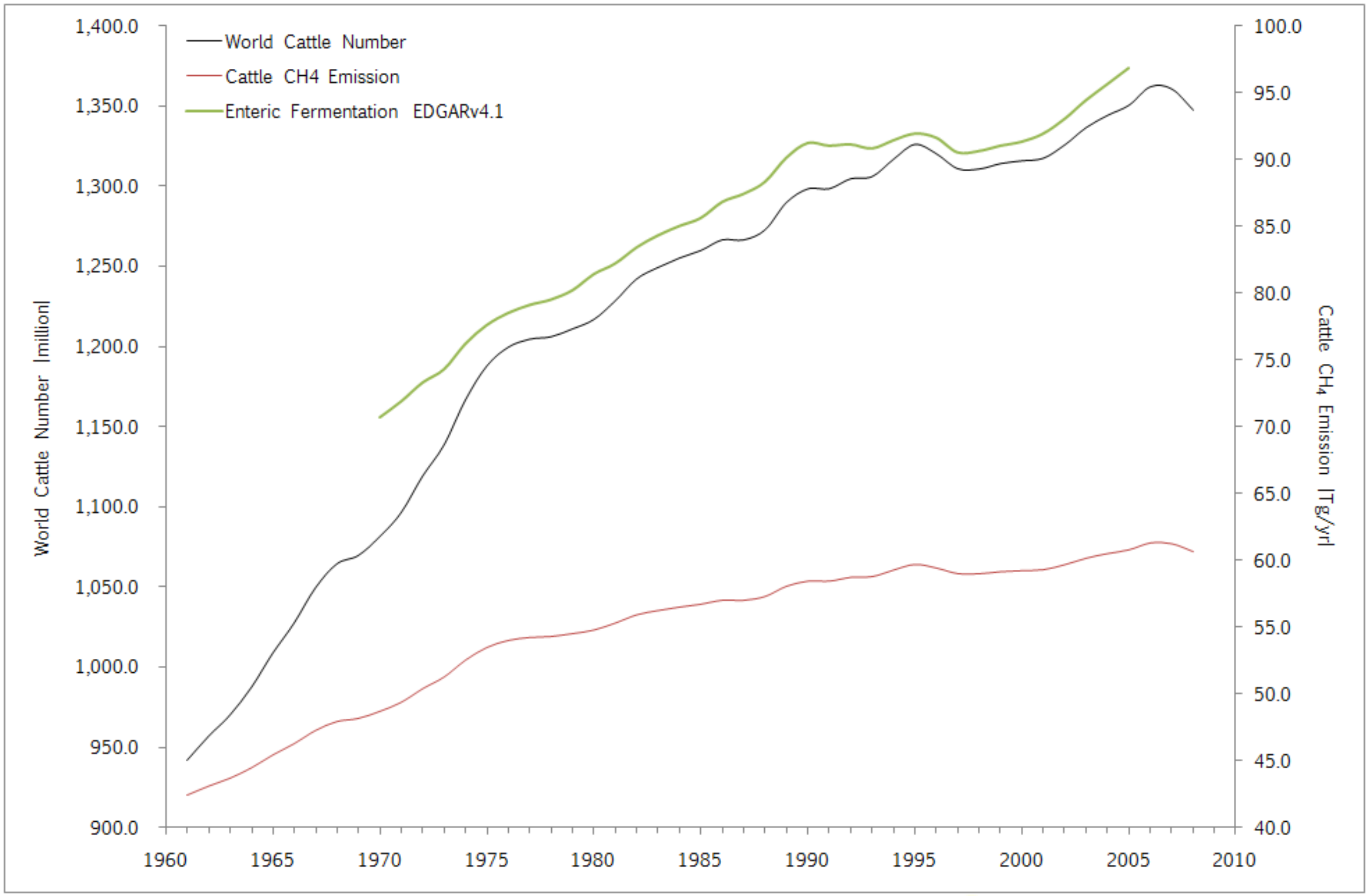
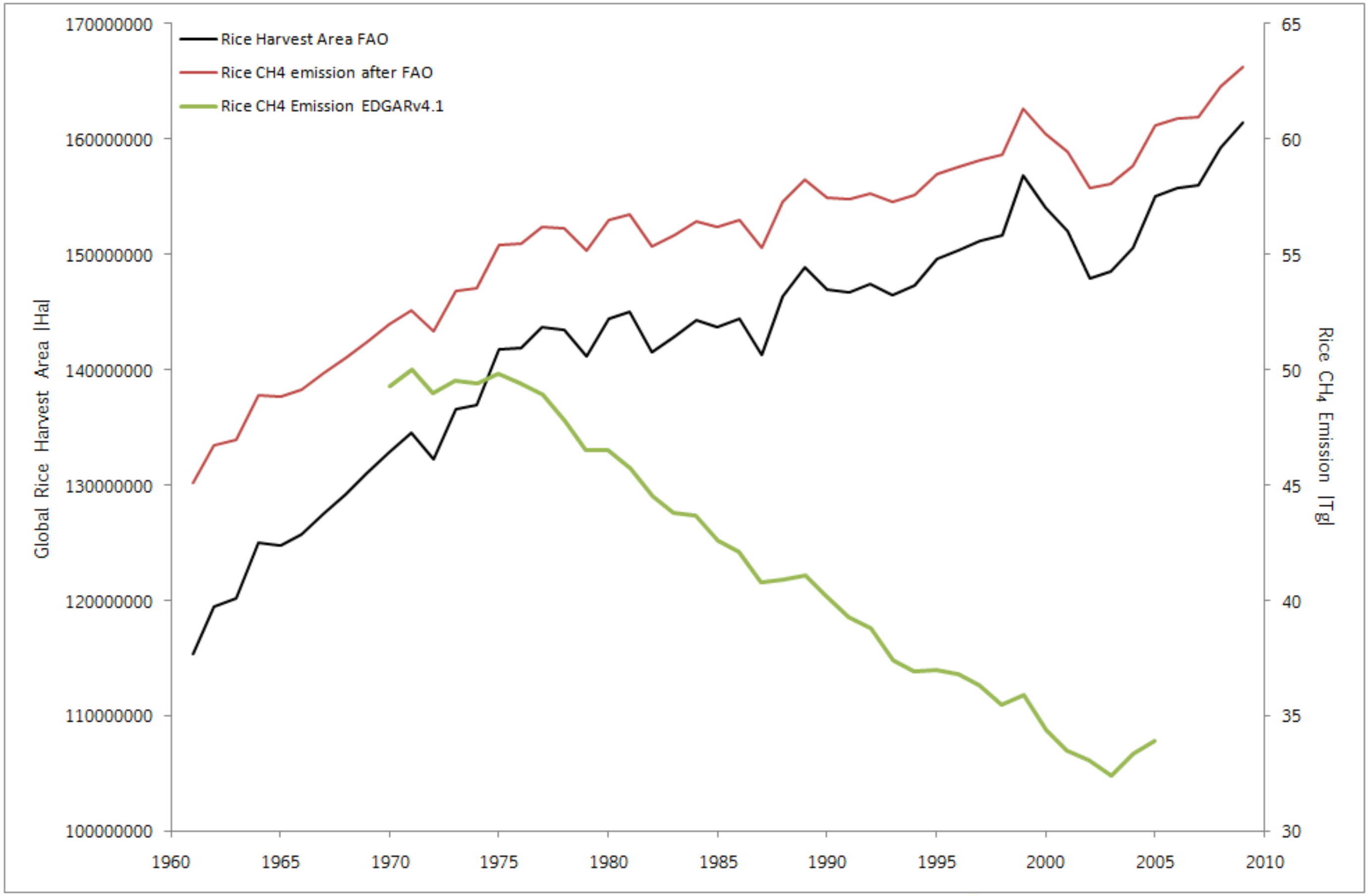
Livestock CH_4 Emissions, 1961-2009



FAOSTAT, 2011; EDGARv4.1

	1984-1989	1990-1999	2000-2008
Ruminants[Tg] Bousquet et al. 2010	92.0	92.0	92.7

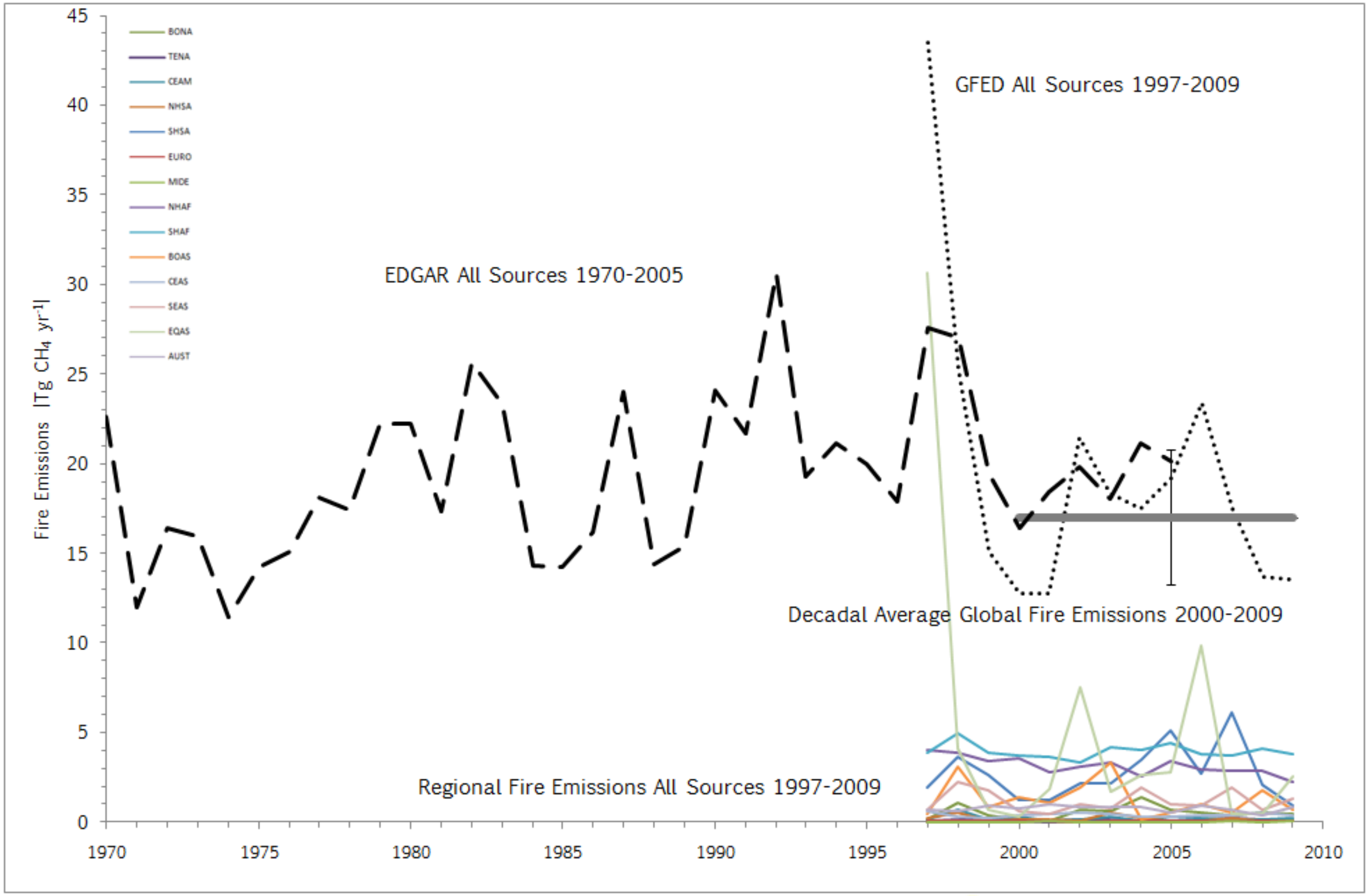
Rice CH_4 Emissions, 1961-2009



FAOSTAT, 2011; EDGARv4.1

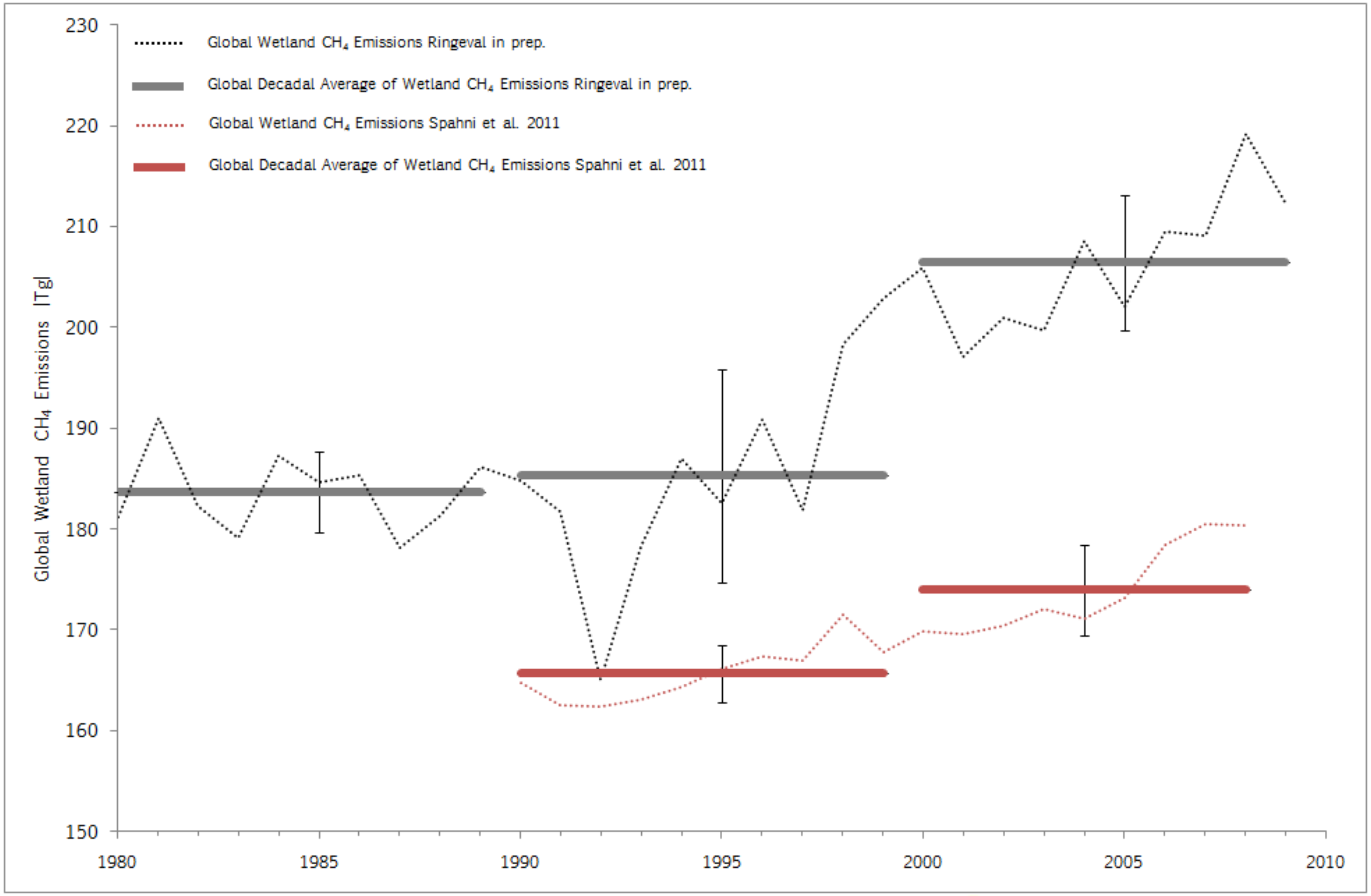
	1984-1989	1990-1999	2000-2008
Rice Emissions [Tg] Bousquet et al. 2010	38.0	34.4	35.4

Fire CH_4 Emissions, 1970-2009



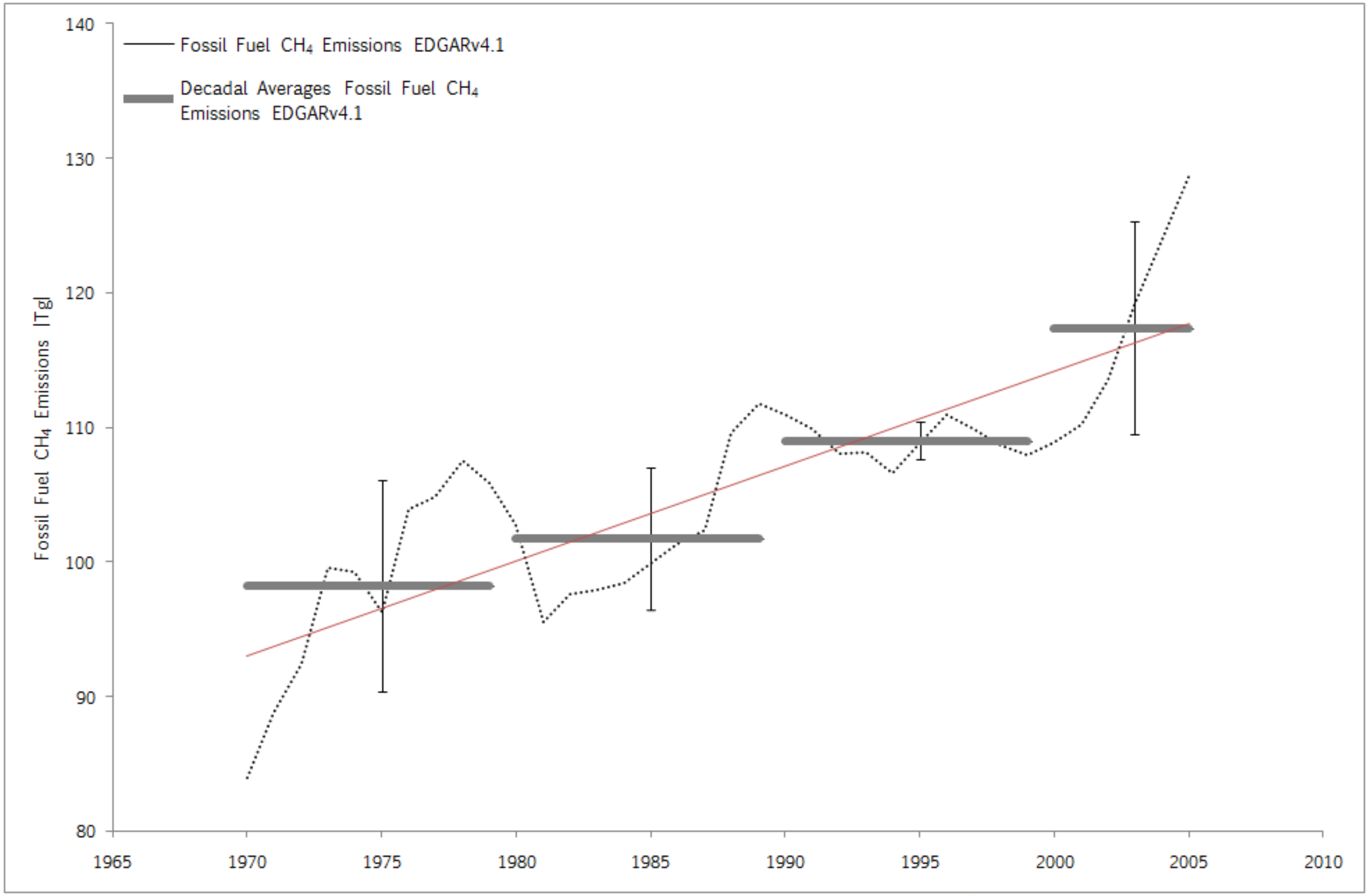
GFED3.1, 2011; EDGARv4.1

Wetland CH_4 Emissions, 1980-2009



Increase 2005-2009 due to precipitation forcing (increase in tropical land precipitation)

Fossil Fuel CH_4 Emissions



EDGARv4.1

Inversion Results

	1984-1989	1990-1999	2000-2008
Average Atmospheric Concentration	1671.8±43.5[1]	1759.8±20.9[1]	1796.9±6.9[1]
Average Atmospheric Growth Rate	12.5±2.2[1]	7.6±3.4[1]	4.8±2.2[1]
Total Sources	537.7	535.9 533.0	537.8 533.2 540.5
Total Anthropogenic Sources	337.3	333.4	336.2 354.0
Total Natural Sources	200.3	202.5	201.6 186.5
Total Sinks			-525.0

Bousquet et al. 2010

PYVAR-SAC Inversion (Pison et al. 2009)

Houweling (in prep.)

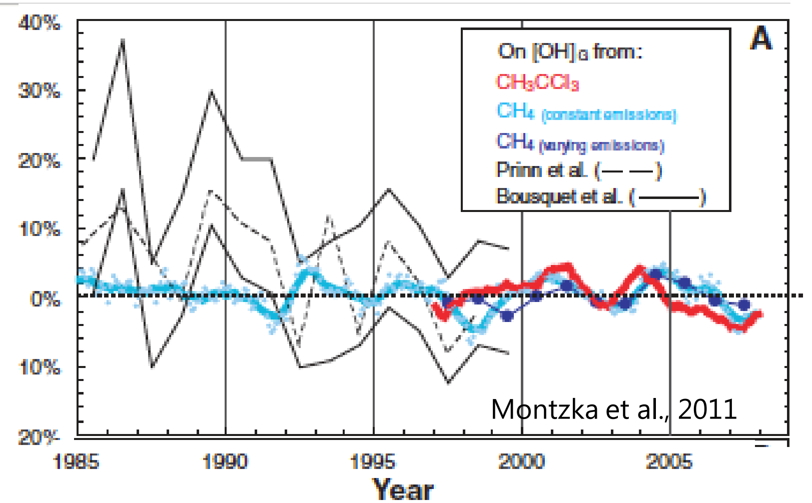
[1] Data from NOAA, CSIRO, LSCE atmospheric networks

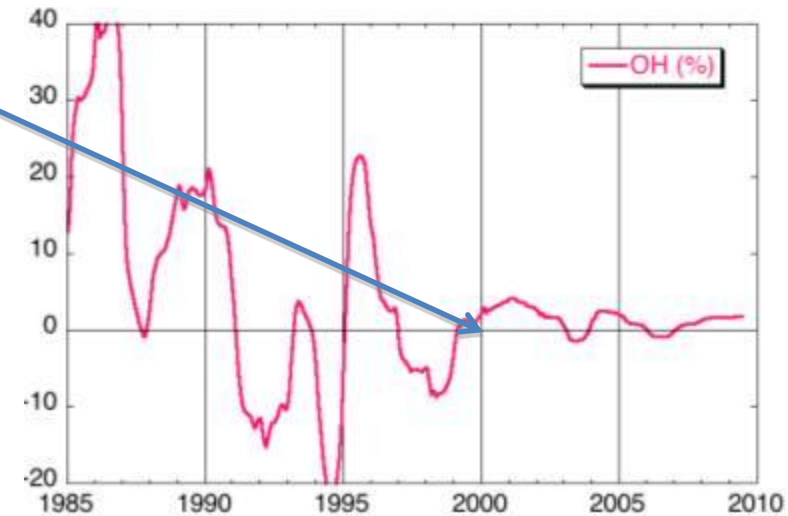
OH Sink

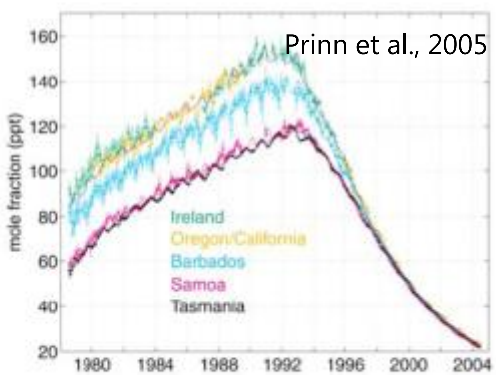
Optimized using Methyl Chloroform proxy

Small variations inferred for 2000-2009 (<5%) by recent Montzka paper

Agreement with Bousquet et al. for the last decade







Conclusions

- Regular update of the CH_4 global budget within GCP
- Elements of the budget have been identified, initial data gathering has started and will continue
- Data analysis and synthesis of top-down and bottom-up approaches
- First budget release planned for end of the year, together with CO_2 budget

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Thank you.

www.globalcarbonproject.org

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