Regional and global climate

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- London
  - Great Smog of 1952,
  - 4,000 additional deaths over a couple of days, actual death toll now believed to be around 12,000
  - Clean Air Act 1956
  - Ban of the use of coal for domestic fires in urban areas (1306).
- Los Angeles
  - LA smog
  - 60´s smog alerts
  - California Motor Vehicle Pollution Control Board
  - Clean Air Act 1970
  - Best available technology approach

Air quality management (2)

- Industrial interests pleaded for less-stringent standards.
- Claimed that air pollution control is expensive and economically damaging.
- Industries blamed the inflation of the 1970s on environmental protection legislation.
- EPA delayed requirements and devised strategies for reducing pollution without placing undue burdens on manufacturers.
- The "bubble" concept was formally adopted in a 1979 amendment to the Clean Air Act

Bubble concept

- Placed an imaginary bubble over an entire region and required the air in the bubble to meet Clean Air Act levels.
- Firms in the same bubble could trade pollution rights with each other, allowing excess pollution at one source as long as it was offset by lower emissions at another.
- The previous approach had forced each individual "stack" to meet national standards.
- By defining each factory as part of a larger air shed, the bubble concept was a step toward an ecosystem-oriented approach.
- Along these lines, the Clean Air Act of 1990 capped the nation's total sulfur oxide emissions and allowed firms to set up a nationwide market in pollution permits.

Global bubble

- On the eve of COP 3, the Russian Federation put forward a new proposal for what it termed a “universal bubble”; that is, each Annex I Party would undertake the commitment it had proposed, and the total reduction achieved would become a collective target.

Emissions trading

- At COP 2, the issue of emissions trading gained greater importance when Mr. Timothy Wirth, then US Under-Secretary of State for Global Affairs, formally announced that the US would advocate such a system in the context of legally binding targets.
- During the COP 2 sessional period, emissions trading was mentioned as a means of promoting flexibility.
- Five proposals were supporting emissions trading, from Australia, France, New Zealand et al.,60 Norway and the US (the only one in legal text). A more detailed proposal in legal text was subsequently received from New Zealand.
- Both the Islamic Republic of Iran et al. and Kenya made submissions against the adoption of emissions trading in the protocol, with Kenya specifying that emissions trading should not be adopted until it had been considered by the SBSTA and its environmental benefits demonstrated.
- The proposals from New Zealand and the US were similar. Both were simple, advocating provisions relating to reporting and verification and participation of “domestic entities”. The US added that a “meeting of the Parties” could elaborate further guidelines.
- A more detailed proposal on emissions trading was put forward by the US, stipulating cases where trading would be restricted (for example if a Party was over its emissions “budget” it could no longer sell).

Fungibility

- Fungible : being of such a nature that one part or quantity may be replaced by another equal part or quantity in the satisfaction of an obligation; interchangeable
- Synonym: exchangeable
- New Latin *fungibilis,* from Latin *fungi* to perform
- First Known Use: 1818

Fungibility of gases

- An exchange rate was established by the Kyoto protocol (GWP).
- Unprecedented measure.
- Acid Rain Program established in the U.S. created an allowance market system only for sulfur dioxide.
- A NOx market was also created later.
- There is no pH or acidity exchange rate.

Kyoto protocol's basket of gases FCCC/TP/2000/2

- Australia, the EU, Iceland, New Zealand, Norway, the Russian Federation, Switzerland and the US, among others, all argued in their proposals for the so-called "basket" approach.
- This means that all gases covered by the target would be considered together for the achievement of the target according to their carbon dioxide (or carbon) equivalence based on their global warming potentials (GWPs), rather than the target applying to each gas individually (known as the "gas-by-gas" approach).
- Opponents to the basket approach included AOSIS and, initially, Japan, both of whom advocated CO2-only targets (AOSIS proposed that gas-by-gas targets should be developed for other gases by the "MOP" to the protocol).
- Germany, in an early proposal, also called for single-gas targets .
- The G-77 and China opposed the basket approach, partly because they were against the use of GWPs, pointing to inaccuracies in the use of this methodology. When the Group announced its proposed emission targets , it adopted the gas-by-gas approach. On Dec. 3, 1997, G-77 and China withdrew their opposition to the basket approach.

Present debate

- GWP vs GTP
- Uncertainties of global warming metrics: CO_2 and CH_4, Reisinger et al., Geophys. Res. Letters, VOL. 37, L14707, AGU
  - Based on our analysis, uncertainties in the GWP of CH_4 now appear significantly larger than indicated in the last IPCC assessment [Forster et al., 2007].
  - As pointed out by previous studies, uncertainties for metrics that have a more direct relationship with climate impacts (such as GTPs), and could thus be regarded as more relevant, also face greater uncertainties [Fuglestvedt et al., 2003, 2009; Shine et al., 2005].
  - Our analysis confirms and quantifies this trade-off, with GTPs having roughly 1.3, 2 and 3–4 times wider confidence intervals than GWPs for time horizons of 20, 100 and 500 years, respectively.
  - The primary reason for the greater uncertainties for GTPs is that, unlike for GWPs, uncertainties related to the climate system's temperature response to radiative forcing are folded into the GTP metric.

Present debate (2)

- Scientific judgments alone are generally insufficient to judge whether one metric is superior to another one, but one metric can be better suited to achieve certain policy goals.
- For example, staying below 2°C warming, a policy goal adopted in the Copenhagen Accord, might require a strategy that minimizes the maximal warming, which can be expected during the second half of the 21st century under strong mitigation scenarios.
- Reducing short-lived emissions now would contribute less to achieving this goal than suggested by GWPs, but would contribute more to limiting the medium-term rate of warming.
- It is a question for policy in how far the potential advantages of GTPs over GWPs with regard to achieving long-term climate targets might be cancelled by other medium-term policy goals and the disadvantage of being subject to considerably larger uncertainties.

The case of methane

- Moving target: GWP
- Pick yours: 21, 23, 25, 35
- Methane values for the 100-year horizon: 21 [FAR and SAR]; 23 [TAR]; 25 [AR4], 35 in recent papers
- Methane GWP accounts for "indirect" effects
  - increases its own lifetime through OH
  - changes in tropospheric ozone
  - enhances stratospheric H2O (5% in TAR to 15% in AR4)
  - oxidation to CO2 not considered

The case of methane (2)

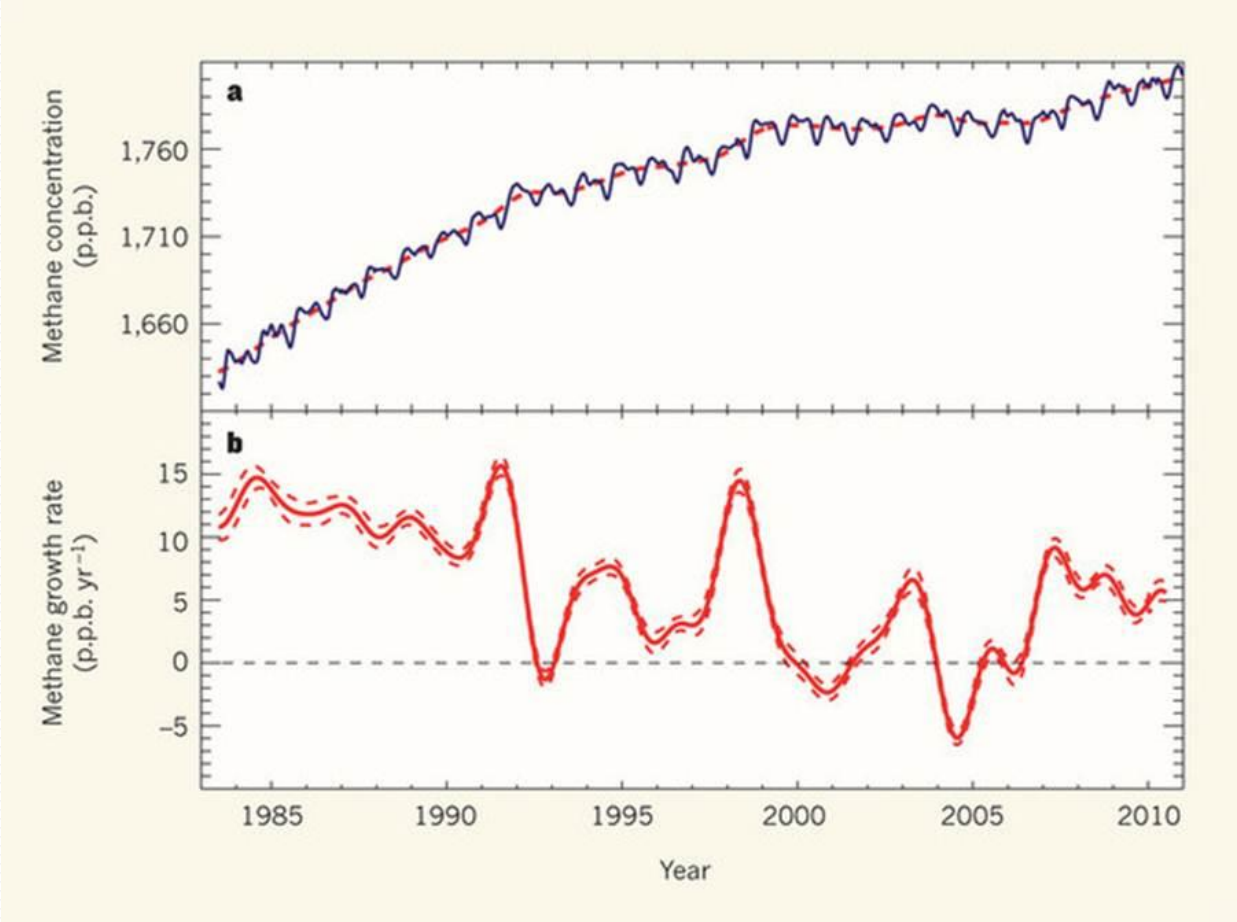
- Lifetime of this gas in the atmosphere is approx. 8 to 12 yrs.
- Hydroxyl radicals a.k.a Atmospheric detergent
  - The OH hydroxyl radical acts to remove methane from the troposphere.
  - The short lifespan of OH makes it difficult to measure; it can prove easier to measure the gases it attacks.
  - OH concentrations are greatest in **tropical regions**, due to intense solar radiation and high humidity.
- Methanotrophs occur mostly in soils, and are especially common near oceans, mud, marshes, underground environments, soils, rice paddies and landfills.
- Calcium carbide significantly reduces CH_4 emission and increases rice yield by inhibiting nitrification

The case of methane (3)

- Destruction
  - Reaction with hydroxyl radical (~90%)
  - Transport to the stratosphere (~5%)
  - Dry soil oxidation (~5%)
- Total : ~560 $TgCH_4/yr.$

The case of methane (4)

Data and graphic are from E. Dlugokencky



The case of methane (5)

- Gulf oil spill – Methane vanished according to David Valentine, microbial geochemist at the University of California, Santa Barbara.
- Great Tropical Reactor
- NOx pollution from cities contributes to ozone, and CH_4 destruction
- Potential of monensin rumensin
- Gas less kangaroos in Australia by Succinivibrionaceae

Conclusions

- As Heimann stated recently in Nature, the methane budget is still an enigma.
- Shall we focus only in methane sources, as now, or also in methane sinks?
- Is appropriate to use a global bubble for methane? Or more regional conditions shall apply?
- Shall methane fungibility continue?
- Shall it be still based on GWP?
- Will it not be better to review our mitigation strategies related to Non-CO_2 gases?