ADDITIONAL INFORMATION ON LINKS BETWEEN CLIMATE AND AIR POLLUTION POLICY

Prepared by the Chair of the Task Force on Integrated Assessment Modelling

During its forty-third session in March 2009 the Working Group on Strategies and Review requested further information on the possible roles of methane (NH_4) and nitrogen. Also new information about black carbon has become available after the forty-third session that might be useful for developing a long term strategy for the Convention on Long-range Transboundary Air Pollution.

Methane

Exceedances of the 35 ppb ozone level in Europe can be effectively limited, inter alia, via a reduction of global methane emissions. Important sources of global methane emissions are coal mining, oil and gas production and distribution, waste and waste water treatment, and livestock. The 27 Member States of the European Union, the Russian Federation and North America together contribute about 20% to current global anthropogenic methane emissions. Several cost-effective measures have already been taken, such as recovery and flaring methane from underground mining, reduction of leakages from gas distribution, and waste and waste water treatment. Also methane emissions from landfills declined, amongst others due to more recycling and burning of municipal waste. The analyses of the Centre for Integrated Assessment Modelling (CIAM) point out that more than 80% of the global CH_4 mitigation potential with costs below 40 €/ton of carbon dioxide equivalent (CO_2-eq) can be found in China, India and other low income countries. Such measures concern coal mining, municipal solid waste management and waste water treatment. All these measures have co-benefits: improvement of workers safety in mines and less diseases due to better sanitation and waste management. Implementation of all measures that cost less than 40 €/ton CO_2-eq could decrease global methane emissions by 17% between 2000 and 2020 (or 38% from the baseline level for 2020, as baseline emissions are expected to increase by 1.3% per year).

The remaining abatement potential in Europe is less than 10% of the reduction potential in e.g. China. Remaining possibilities in Europe concern mainly the agricultural sector: a ban on agricultural waste burning, anaerobic digestion of animal manure and modest changes in animal diets[1]. Such measures are related to and could be effectively combined with abatement options for ammonia emissions and particulate matter.

However, given the fact that anthropogenic CH_4 emissions are much larger in developing countries than in industrialized countries, realizing this mitigation potential in Europe is likely to have only little effect on hemispheric background concentrations of ozone. Within the current geographical scope of the Convention, emission reductions in China and India cannot be part of a new protocol. Such

[1] Dietary changes for dairy cows and cattle may decrease methane emissions from ruminants by 5 to 10%. However, as the ingredients in the diet for methane production decrease, the protein content tends to increase and thereby also the nitrogen excretion by the ruminants and the potential for ammonia emissions. This antagonistic effect occurs especially when drastic changes are made. As long as the changes in the diet are modest, the antagonistic effects are much smaller or even absent. For example, dietary changes to lower the protein content can be made without much change in the amounts of ingredients (e.g. celluloses) for methane production. Research on measures to decrease methane emissions from ruminants is still in its infancy. It is complex and there are many other trade-offs, including animal health and welfare.

emission reductions would need to be encouraged through different institutional arrangements, e.g., within the clean development mechanism under the UNFCCC. Regulating national methane ceilings might be seen as an overlap with the UNFCCC, although in the Kyoto Protocol only the sum of the greenhouse gas emissions is regulated. The Working Group on Strategies and Review might wish to consider reflecting the role of methane as a precursor to ozone formation in one of the technical Annexes to a new Gothenburg protocol. Measures could involve the agricultural sector and oil and gas distribution (frequent maintenance of pipes and valves). Emissions from coal mining are already regulated via workers safety regulations.

Nitrogen and carbon sequestration

Several studies indicate a positive relationship between nitrogen (N) deposition and carbon (C) sequestration in forests. Recent data indicate a total carbon sequestration range of 20–75 kg C per kg N, but the impact is counteracted by increasing N_2O-emissions[2]. Terrestrial ecosystems will only respond to elevated nitrogen inputs if they are N-limited. In areas with high nitrogen deposition, nitrogen fertilization may not be beneficial anymore, because it could lead to adverse growth effects due to impacts of nitrogen induced eutrophication and acidification on forest health. For example, in a highly N-saturated Dutch Scots pine stand a growth *improvement* was observed when the N-input to the forest floor was *reduced* by means of a roof.

The impact of nitrogen on carbon sequestration may be negative for peatlands. Nitrogen induced eutrophication leads to vegetation change, most notably to the loss of peat-forming species such as Sphagnum, with a replacement by grasses and mosses. This may reduce or even reverse the positive effect of nitrogen deposition on carbon sequestration, putting existing peatland carbon stocks at risk. It therefore seems risky to count too much on maintaining high nitrogen deposition levels as a measure to mitigate climate change.

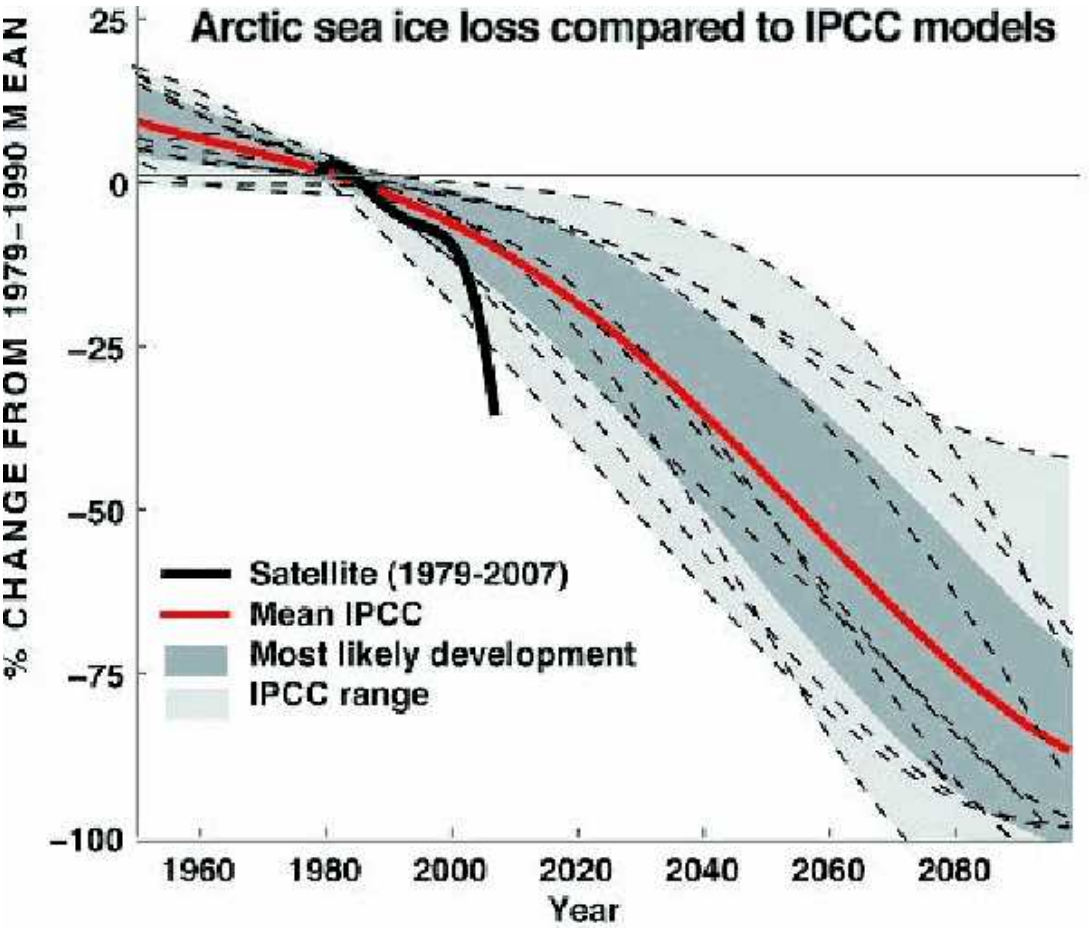
There are also some articles indicating a possible negative influence of nitrogen pollution of oceans and seas on the carbon sequestration by oceans. These articles show increases in nitrogen concentrations in rivers and seas that seem correlated with decreases in dissolved silicate concentrations. Dissolved silicate is crucial for diatoms. Diatoms are responsible for 25% of the global carbon sequestration. In several seas changes have been observed between the proportion of diatoms and the proportion of harmful (non-diatom) algae[3]. However, a negative role of nitrogen in carbon sequestration cannot be excluded nor confirmed yet.

Black carbon

Satellite observations indicate that Arctic ice is melting more rapidly than estimated by models of the Intergovernmental Panel on Climate Change (IPCC) (see figure). The reasons are not quite clear yet. One element that plays a role in the melting process is the graying of Arctic ice due to black carbon deposition. Black carbon reduces the reflection of the ice sheet and contributes to an earlier start of the

[2] De Vries, W., S. Solberg, M. Dobbertin, H. Sterba, D. Laubhann, M. van Oijen, C. Evans, P. Gundersen, J. Kros, G.W.W. Wamelink, G.J Reinds and M.A. Sutton, 2008. The impact of nitrogen deposition on carbon sequestration by terrestrial ecosystems. Forest Ecology and Management (Accepted).
[3] e.g. Billen & Garnier, Indicator of Coastal Eutrophication Potential, Marine Chemistry, 2007.

melting season. Also the abatement of sulphur emissions contributes to the speed of temperature change.



The Arctic council is reviewing possible measures that could slow down the process. More attention should then be given to the short-lived greenhouse gases: methane, ozone and black carbon. One measure that could be given more priority is the abatement of black carbon emissions via reduction of biomass burning in all countries above 40^{o} north latitude. This could include a ban on open air burning of agricultural waste and in inefficient wood stoves. Such measures could also be reflected in one of the technical annexes to a new Gothenburg protocol. Reduction of black carbon seems to be a no-regret option as black carbon is often mentioned as one of the prime suspects of health risks due to particulate matter exposure. Rapid reduction of black carbon emissions could partly compensate the increased radiative forcing due to sulfur reduction.
