

Measuring Greenhouse Gases through their Consumption?



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The Climate Change Problem as a Dilemma



- A recent study by Sokolov et al. (MIT 2009) presented by Prinn (MIT 2010) shows that we are already at 469 equiv. CO₂ ppm in terms of concentration of greenhouse gases in the atmosphere
- The same study shows that stopping at 550 ppm we have a 75% chance of keeping the temperature increase below 2° C, but at 660 ppm we only have a 20% chance of reaching that goal

The Climate Change Problem as a Dilemma continued



- Still the same study shows that going beyond 620 ppm CO₂ we are likely to reach some irreversible climate change damages such as a collapse of the role of the Ocean as a carbon sink due to over acidification of the seawater
- In the mean time we can expect energy consumption all over to increase as we are on our way to have a global population of 9 billion and an equalization of per capita energy consumption which as of now is still more than about 85% fossil fuels

Policy Questions



- If we want to avoid these danger zones, policy measures at the international level will have to be put into place, which will amount to the equivalent of several magnitudes of the measures included in the Kyoto protocol
- These measures will involve problems of allocating reduction targets in terms of greenhouse gas emissions not just for industrialized (Annex I) countries but at least also for emerging ones (China, India, Brazil, etc.)
- Thus measurements of what a country emits per annum become crucially important

So far such Measurements have been based on Production Figures!

- These are based upon quantities of greenhouse gases emitted in a territory over a given period of time
- Of course such quantities cannot be observed directly so far
- Thus methodologies based upon consumption of fossil fuels and the production of other greenhouse gases such as methane and N_2O by agriculture. Estimates of quantities removed by carbon sinks are also available. Some errors are unavoidable: e.g. Gas Tourism.
- These production figures are so far the bases used in international conventions such as the UNFCCC and the Kyoto protocol

Lately Production based Figures have been under Attack



- Quite a few authors have argued that one should take into account consumption as well
- What is meant by that?
- Essentially the indirect emissions that a country generates by importing goods
- Some countries like China have also used the “consumption” argument to explain their big increases in greenhouse gas emissions
- Is it easy to estimate these imbedded consumption greenhouse gases?

The Estimates of “Imported” Greenhouse Gases is rather difficult



- A production process is full of intricacies and involves in terms of imports and exports several imports, re-imports and re-exports of intermediary goods in a given country
- To get good estimates of what is going on in terms of emissions embedded in exports minus those embedded in imports, input-output models and matrices of practically every country would have to be available to get an accurate idea
- Accurate models and matrices are not available for big emerging countries such as India and in particular China which has only released official GHG estimates for 1994!

Despite these Difficulties, Estimates of such Consumption Figures have recently been published



- In the Proceedings of the National Academy of Science of the US of March 2010 such figures appear based on work done by Stephen Davis and Ken Caldeira
- The authors use essentially a method based upon the monetary estimates of GDP components from which Greenhouse gas estimates are then teased out via GHG “intensities” for various countries, i.e. how many gases are used to produce one unit of GDP in \$ or €
- Such figures are calculated by international agencies like the European EA

Estimation Methodology



- So for instance for Switzerland the figure stands at 172 g equiv. CO₂ per € of GDP produced, for Sweden 210 and for Germany 433. The US is about 1.5 times Germany in terms of intensity so 3.78 times Switzerland or 650
- Davis and Caldeira keep track of such numbers and try to estimate through them GHG content of exports respectively imports from one country to the other
- To get around the re-export and re-import problem they construct input output matrices on a regional basis using a world general equilibrium trade model

Critical Discussion of the Davis Caldeira Methodology



- The Davis Caldeira approach despite the corrective measures taken by using their input output matrices consists basically in extrapolating GHG intensity ratios to imports and exports
- Their corrective use of input output matrices change little in that regard since they use a constructed (and not a real) country based input output system
- Their results are intrinsically biased since an improvement in terms of intensity in a country will then mean through their methodology a greater imported share of greenhouse gases!

Critical Discussion Continued



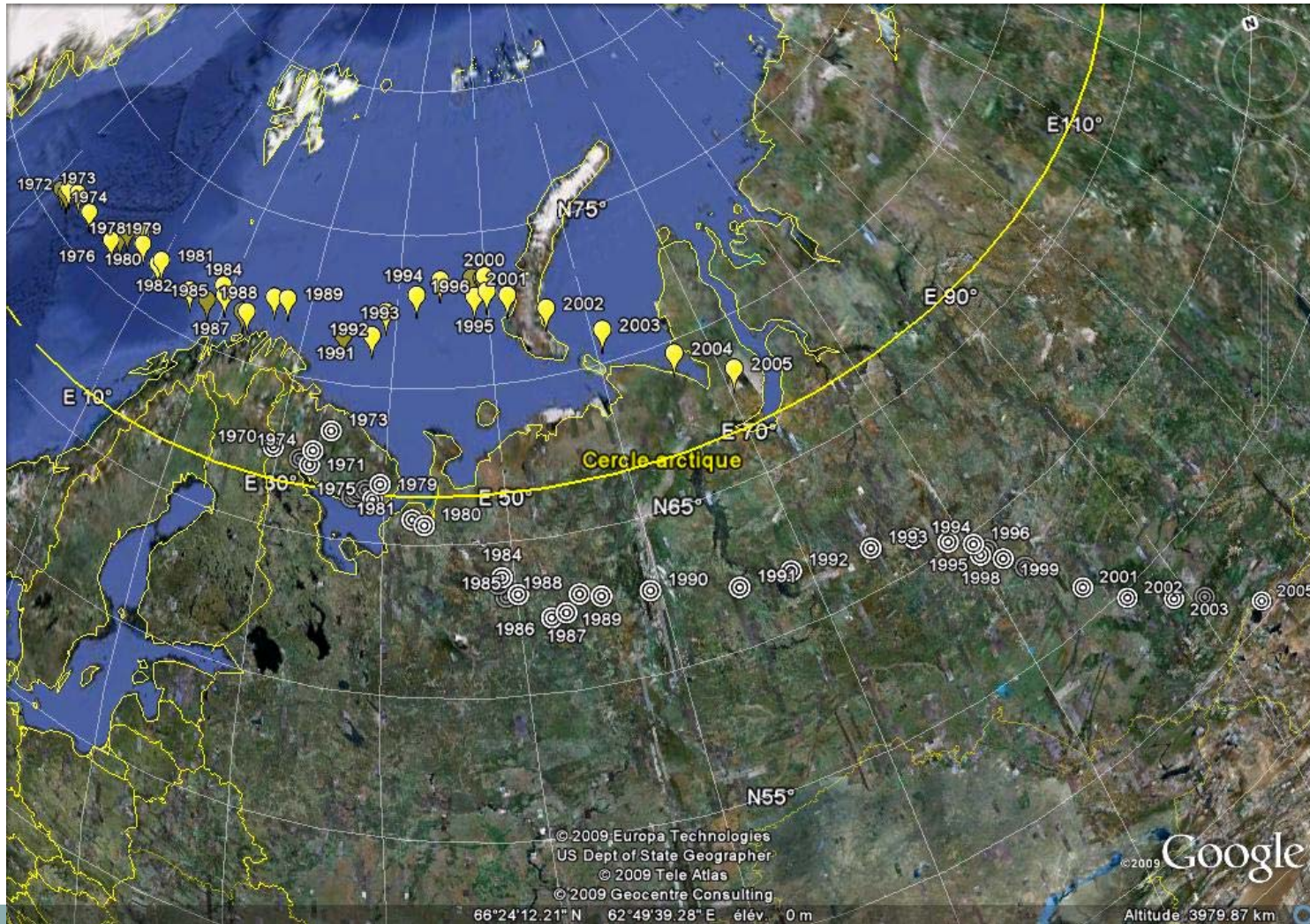
- E.G. if a country exports 50 and imports 60 and its intensity goes from 170 to 150 whereas the country from which it imports stays at 200 its (negative) balance of imported GHG goes from 3500 to 4500!
- The corrections due to re-imports and re-exports as calculated by the authors don't change much here
- Not surprisingly small efficient countries such as Sweden and Switzerland appear as big GHG importers in their calculations whereas the US does not

What is missing here?

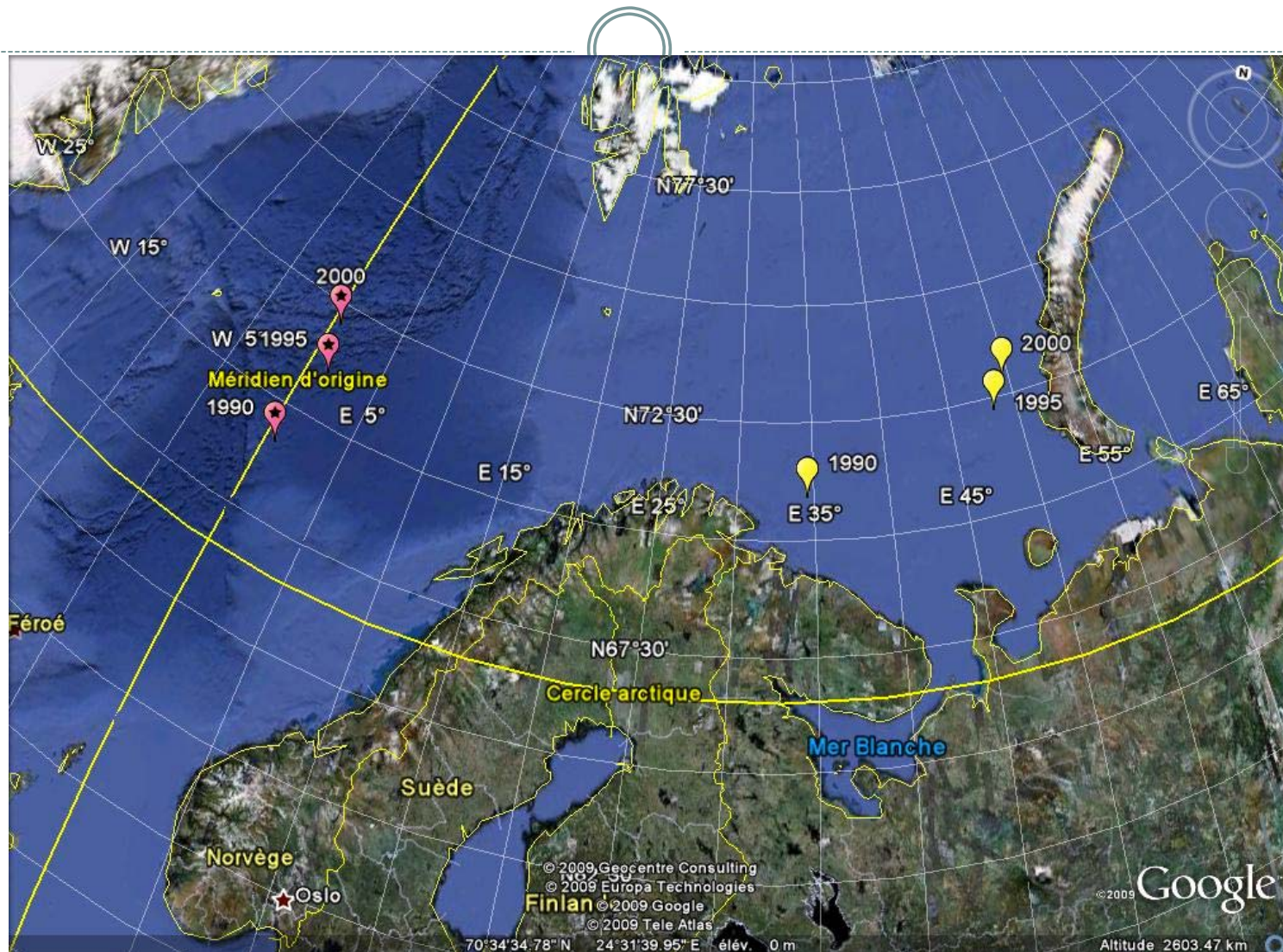


- Davis and Caldeira seem to forget that when a more GHG efficient country exports to a less efficient one, this does not only affect its exports but also the whole production of the importing country
- The importing country does not have to produce these imported goods itself using more GHG's (especially if the imported goods are equipment and production goods such as machinery for instance)
- This “saving” has to be credited to the exporting country
- In the case of a country like Switzerland this has to be significant since it is one of the few western countries to have a positive trade balance with China

These Graphs by Grether and Mathys shows that Movement of Industry to the East is inefficient



Grether and Mathys continued



In the End is the Whole Exercise Worth it?



- Not really because consumption estimates are bound to be very inaccurate, much more so than production figures
- Also the consumption measures are bound to be much more volatile because they will depend on trade shifts which can be quite erratic since they will depend on changing price structures
- Countries's performances would likely to be blurred and so targets would be more difficult to establish
- The existing system has in the end a lot of advantages!