Methodological Issues in Linking Regional and Global Scale Air Quality Models

- **New results in the HTAP framework using 1-way coupling of global and regional models**:
  - Indentifying differences in both import impacts and export amounts
  - Need to inter-compare results and define metrics
  - Interpretation of the differences (process analysis, etc.)
- **New observational analysis point out the influence of upwind & above surface ozone on surface ozone** & impact of changing background levels (trends)
  - Thus need to extend attribution to above surface quantities.
  - Do models capture these correlations?
- **What methodological challenges have been encountered? How have these challenges been addressed?**
  - Differences between global/regional models (resolution, chemical mechanisms)
  - Uncertainties in emissions
  - Temporal resolution of the coupling (hourly vs monthly)
  - Operational multimodel platforms will provide valuable information (results as well as experience)
  - Coupling within a single model frameworks being developed

Methodological Issues in Linking Regional and Global Scale Air Quality Models

– How do the results of downscaling or one-way nesting compare to the results from multi-scale, two-way nested models?

– What lessons are available to be learned about the processes and resolution needed in models to quantify intercontinental transport?

- **In better position to answer these questions, issue is what can be done in the near term to contribute to the 2010 report**

The Impacts of Climate Change on Air Quality

- The participants discussed how changes in climate and climate variability may influence air quality regionally and globally, as well as the potential for long range transport. Important feedback mechanisms between climate change and air pollution, such as the temperature effect on biogenic VOC emissions and particulate matter-cloud interactions, were identified.
- The participants found that a changed climate may influence both the chemical processes, such as reaction rates and chemical balances, as well as the physical processes, such as advection and dispersion, frequency of inversions, radiation fields, clouds and precipitation, and storm tracks.

The Impacts of Climate Change on Air Quality

- Analysis of air pollution and climate records in most regions indicates that measures taken to reduce ozone pollution have been off-set by a changed climate, a phenomena known as the “climate change penalty”.
- The future climate scenarios examined so far indicate that regional emissions will have a slightly stronger influence on ozone regionally, whereas the long range influence would be slightly weakened. These future scenarios are influenced by projected changes in CO2 concentrations, air pollutant emissions from natural and anthropogenic sources, and changed land use, including changes in albedo and surface structure.

The Impacts of Air Pollutants on Climate Change

- Co benefits were discussed in several presentations, with a particular attention to BC. The high climate relevance was emphasized, the fact that BC emission per capita in several world regions is much more similar than e.g. CO2 (equal footing). Perhaps more emphasis should be given to abate BC emissions faster than Sulfur. The high relevance of AP on human health was highlighted in the case of Asia (large fraction above threshold)

The Impacts of Air Pollutants on Climate Change

- Several new datasets on aerosol parameters in India and China were presented, a welcome addition to the otherwise very limited data set.
- Need for good emissions estimates was highlighted, in case of India a national inventory for NOx resulted in significantly lower NOx emissions, with an important impact on O3. Global simulations in HTAP context showed mixed skills to represent a limited set of O3 observations in India.

The Impacts of Air Pollutants on Climate Change

- Several model studies focused on a systematic (methodological) evaluation of the relationships between the emission of specific components, emission sectors, and the location of the emissions and the impact on climate (e.g. temperature change). In case of NOx emissions there is an important issue surrounding the short-time scale effect on O3, and the long time scale impact on CH4, which may lead to different forcing depending on the timescale considered. In all cases there may be a strong model dependency of these results, so a coordinated effort to explore the robustness of results is needed.

The Impacts of Air Pollutants on Climate Change

- The potential to derive new climate relevant information from newer generation of satellite products, and especially the combination of different instruments (e.g. Modis and Calipso) showed promising results. Furthermore the integration of fused remote sensing products (both space and surface based) into models was shown to lead to substantial improved model simulations of air quality parameters, which will in turn also change the answer regarding climate impacts of those components.

The Impacts of Air Pollutants on Climate Change: Further Focus on Ozone

- RF from satellite: O_3 (Bowman) and aerosols (Remer)
  - Total radiative effect vs RF since pre-industrial
  - Modellers need to exploit these data (+all observations)
  - Data assimilation to understand processes/models/obs
- Impacts on vegetation (Klingberg) and C-cycle (Collins)
  - Coupled biosphere is important (for AQ and RF as well as impacts on vegetation itself)

The Impacts of Air Pollutants on Climate Change: Further Focus on Ozone

- Multiple impacts of NO_x and other O_3 precursors (Collins/Derwent)
  - Even if uncertain, need to consider all effects, and be honest that we aren't sure of overall effects
  - Metric choice is important (RF vs GWP/IRF vs GTP) regional metrics?
  - Regional vs global forcings (Shindell