Task Force on Hemispheric Transport of Air Pollution

Assessing the Impacts of the Hemispheric Transport of Air Pollution

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Objectives:

1. **Deliver Policy Relevant Information to the LRTAP Convention, Other Multi-Lateral Forums, and National Governments; EU**

   In different (sub)continental scale world regions:

   a. What fraction of air pollution concentrations or deposition can be attributed to sources of contemporary anthropogenic emissions within the region as compared to extra-regional, non-anthropogenic, or legacy sources of pollution?

   b. How do these fractions impact on human health, ecosystems and climate change?

   c. How sensitive are regional pollution levels and related impacts to changes in the sources of the various fractions?

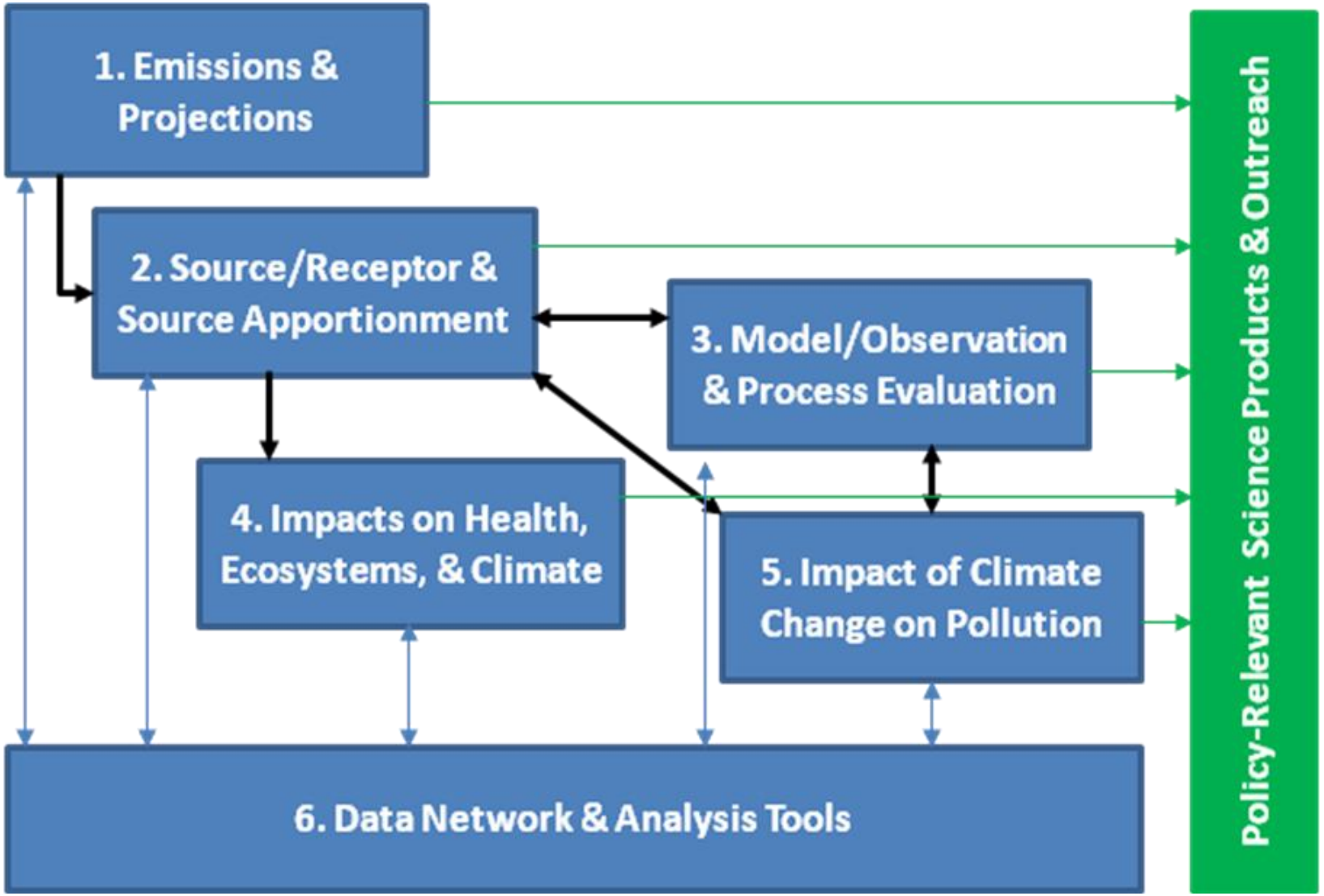
   d. How will the various fractions and sensitivities defined above change as a result of expected air pollution abatement efforts or climate change?

   e. How do the availability, costs and impacts of additional emission abatement options compare across different regions?

2. **Improve Our Scientific Understanding of Air Pollution at the Global to Hemispheric Scale**

3. **Build a Common Understanding by Engaging Experts Inside and Outside the LRTAP Convention**

Themes of Cooperative Activities (2012-2016)



Themes of Cooperative Activities (2012-2016)

- **Assessment of Health, Ecosystem, and Climate Impacts**
  - Improve Methods and Resolution of Impact Assessments

  - 4.1 Assessment of hemispheric scale pollution on human health
  - 4.2 Assessment of hemispheric scale pollution on ecosystems
  - 4.3 Assessment of hemispheric scale pollution on climate

- **Assessment of Climate Change Impacts on Pollution**
  - 5.1 Analysis of Future Scenario (Climate and Emissions) simulations
  - 5.2 Analysis of related studies on impacts of climate change

Assessment of Health Impacts

***HTAP 2010* estimated O_3 and PM effects using relatively coarse global models.**
For example, Anenberg et al. (2009) estimated that O_3 resulting from emissions from foreign regions contributes 20% to >50% of O_3 mortalities, subject to large uncertainty.

Hundreds of annual avoided mortalities due to O_3 transport, threshold=35ppb in *italics*

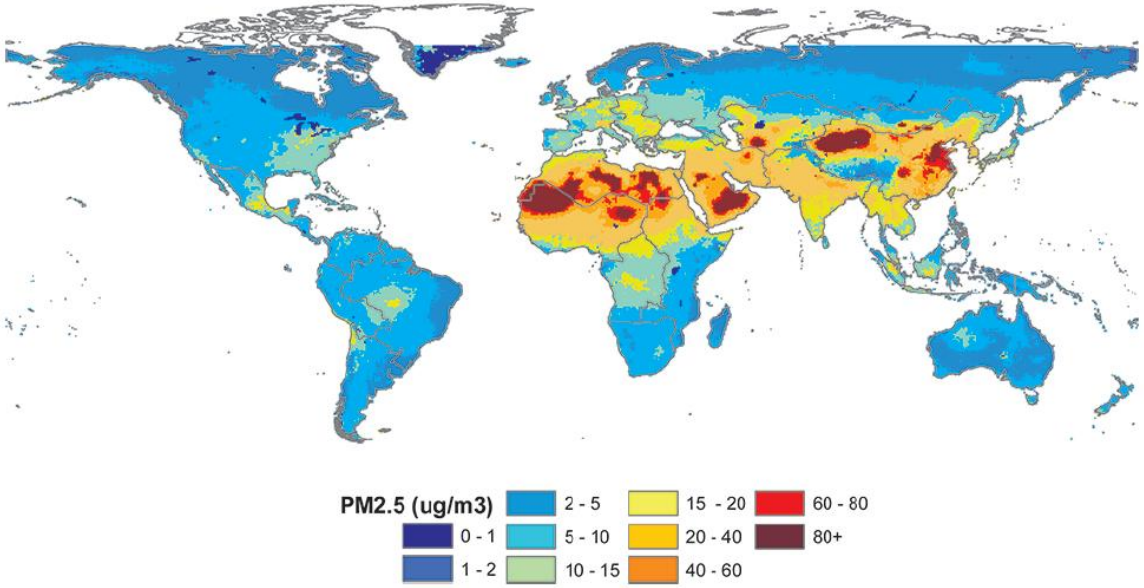
Source Region	Receptor Region				
	NA	EA	SA	EU	NH
NA	9 (4 - 13) *9 (4 - 14)*	7 (3 - 10) *4 (2 - 6)*	6 (3 - 9) *5 (3 - 8)*	11 (5 - 17) *6 (3 - 9)*	36 (18 - 55) *27 (13 - 41)*
EA	2 (1 - 3) *1 (1 - 2)*	43 (21 - 66) *40 (19 - 61)*	6 (3 - 9) *5 (2 - 8)*	5 (3 - 8) *3 (1 - 4)*	59 (29 - 91) *49 (24 - 76)*
SA	1 (0 - 1) *0 (0 - 1)*	4 (2 - 6) *3 (1 - 4)*	76 (37 - 117) *66 (32 - 101)*	2 (1 - 3) *1 (0 - 2)*	85 (41 - 130) *71 (34 - 108)*
EU	2 (1 - 3) *1 (0 - 1)*	8 (4 - 12) *6 (3 - 8)*	6 (3 - 10) *6 (3 - 9)*	17 (8 - 26) *25 (12 - 38)*	38 (18 - 58) *40 (19 - 61)*

Relative Intercontinental Response: ↑ 30% ↑ 30% ↑ 20% ↑ >50%

Assessment of Health Impacts

Global Burden of Disease (GBD) Study

- Developed global and regional rankings of risk factors for disease
- Air pollution is in the top 10 risk factors in most regions.
- Used merged model estimates with satellite observations, compared to surface $PM_{2.5}$ and PM_{10} measurements to estimate outdoor concentrations.
- Produced updated exposure/response functions (especially for high and low end of PM concentrations).



Estimated Annual Average $PM_{2.5}$ Concentrations

Brauer, et al., 2012

Figure 2. Estimated 2005 annual average $PM_{2.5}$ concentrations ($\mu g/m^3$). The $PM_{2.5}$ estimates are generated from the grid cell average of SAT and TM5 and calibrated with a prediction model incorporating surface measurements.

Assessment of Health Impacts

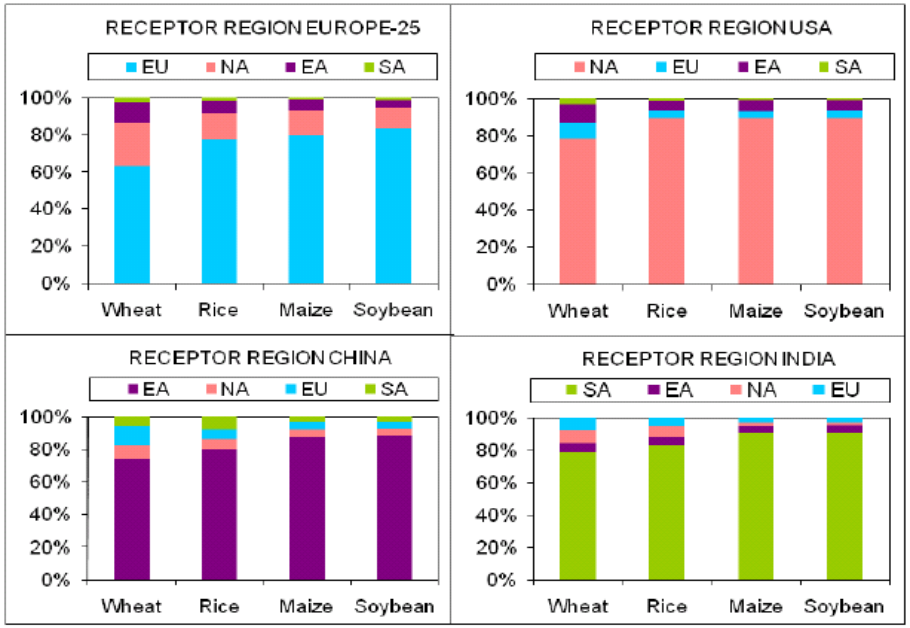
What can HTAP do as part of current work plan:

- Improve spatial resolution by merging global and regional models:

  Currently linking to regional modelling activities in North America, Europe, and East Asia
- Provide multiple model estimates
- Attribute impacts to source regions
- Assess impacts associated with past and future scenarios
- Examine the use of surface and satellite observations to supplement model estimates
- Use experience on scale issues from TF MM and translate to global scale.

Assessment of Ecosystem Impacts

HTAP 2010 showed a fairly substantial effect of transport on crop yields …causing between 5 to 35 % of the O_3 induced crop yield loss.



BUT…. By necessity, assessment used Concentration based indices….

….for future we have the possibility to perform **stomatal ozone flux** based ecosystem assessments in line with adopted LRTAP/WGE methods

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Assessment of Ecosystem Impacts

What can be done within HTAP to improve estimates of O_3 dry deposition and estimate stomatal O_3 flux for ecosystem effects?

1. Literature review of O_3 dry deposition methods identify those most commonly used within global scale CTMs
2. Identification of the key differences in these dry deposition schemes and in parameterizations for different land cover types.
3. Off-line assessment of the implications of differences in O_3 dry deposition schemes…comparison with observations from site-specific flux data
4. On-line assessment of the effect O_3 dry deposition schemes on hemispheric transport of O_3; regional O_3 concentrations and regional O_3 induced ecosystem damage. Global modeling could show spatial fields of stomtal O_3 flux, total O_3 deposition, and effect on atmospheric O_3 concentration.
5. HTAP modeling experiments could
    a. investigate S-R relationship for stomatal O_3 flux,
    b. alter key climate relevant characteristics (i.e. simulate an extended drought period, elevated CO_2 effects on stomatal conductance, changes in surface ToC and RH% etc…) on resulting stomatal O_3 flux to indicate how ecosystem risk might change under future climates, and
    c. investigate the role of landcover on O_3 deposition and stomatal O_3 flux.

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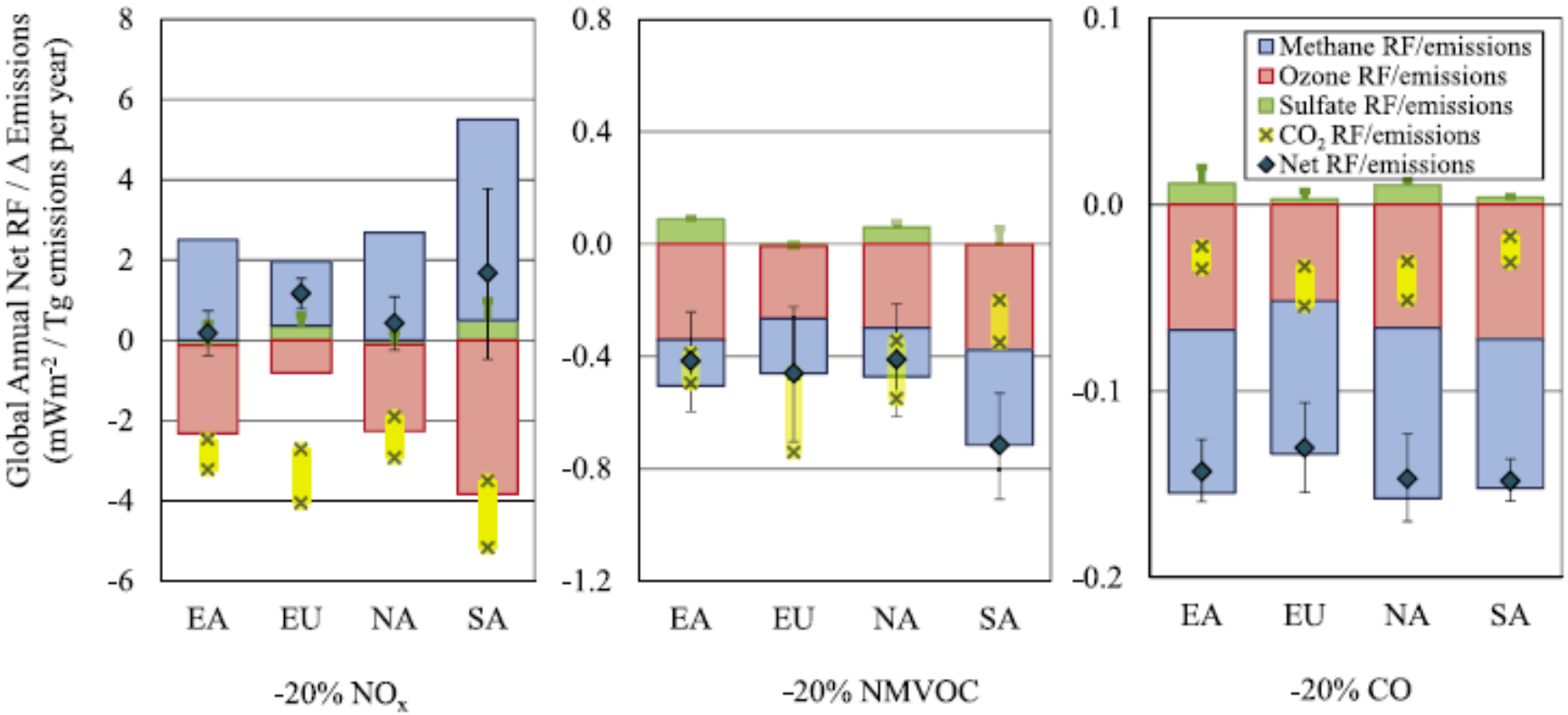
Assessment of Impacts on Climate

Fry et al. (2012) calculated radiative forcing changes due to emission reductions of NO_x, VOC, CO in HTAP regions and global changes in CH_4 abundance.



NO_x ↓ OH down ↓ => CH_4 ↑

CO/VOC ↓ OH ↑ => CH_4 ↓

NO_x > VOC > CO opposing signs

Vegetation feedback potentially important (Collins et al. 2010)

Assessment of Impacts on Climate

What can be done within HTAP to improve estimates of climate impacts?

- Changes in Direct Radiative Forcing, with multi-pollutant and vegetation feedbacks (CO_2; isoprene)
- GWP and other climate metric calculations related to pollution emissions

In collaboration with climate modelling community, e.g. as in ACCMIP:

- Evaluate climate responses (temperature; hydrologic cycle) due to changes in emissions.

Schedule and Participation

- Evolving 2012-1016 Work Plan divided into 35 Work Packages
- Work package leaders have been recruited and currently working to further specify activities.
- Actively working on historical emissions and future scenarios for analysis.
- Expect new global and regional modeling analyses starting in early 2013.
- How can we work with WGE to help design the impact assessment work that will begin in late 2013 and 2014?

2013 Workshop Proposal

Focus:	Impact Assessment Methodologies (Health, Ecosystems, Climate)
Location:	South Asia (propose Pune, India)
Timing:	October-November 2013
Potential Partners:	WGE, Male Declaration, EANET, ABC-Asia, UNEP, HEI, GBD

Potential Interest? Potential Conflicts?