Decision support tools:
Features of the GAINS model that could be relevant for HTAP

HTAP/TFIAM Workshop
Potsdam, February 17-19, 2016

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Focus on policy interventions

- GAINS focuses on specific pollution control measures
- Capturing co-controls between 10 air pollutants, 6 GHGs and Hg
- Cost estimates (local and international costs)
- Cost-effectiveness analysis
- Global coverage, 180 world regions
- Up to 2050, for different activity projections
Deriving population exposure from global models

- Hemispheric/global models typically provides concentrations at 0.5*0.5 degree resolution, assuming emissions smeared out within the grid cells
- Even mega-cities cover only a small share of such grid-cells
- Global model results systematically underestimate population exposure

Delhi: Population 16 millions

Urban and rural population
World, 2010
PM$_{2.5}$ in Indian and Chinese cities

- GAINS estimates population exposure with source-receptor relationships derived from EMEP 0.5*0.5 degree results, refined by city-specific downscaling distinguishing rural/urban populations.
- Under development for G-20 countries.

India
Monitoring data derived from satellite AOD merged with in-situ measurements (Dey et al., 2012)

India
WHO 1600 cities database, derived from in-situ PM$_{10/2.5}$ measurements

China
In-situ PM$_{10/2.5}$ measurements

Graphs showing comparisons between observed and modelled PM$_{2.5}$ levels in various cities.
Sources of ambient PM2.5 in Delhi
Provisional estimates

- Mobile sources *)
  (diesel soot and non-exhaust)
- Waste burning *)
  (residential and agricultural)
- Cookstoves *)
- Small industries *)
- High stack sources
  (power & industry)
- Secondary inorganic PM:
  Agricultural NH3 with SO2
- Natural sources *)
  (soil dust, biogenic, etc.)

*) incl. SOA

WHO guideline
Health impacts

PM2.5: implemented for alternative hypotheses on response functions (incl. WHO-Europe, IER/GBD, different baseline mortalities, smokers, etc.)

Future health impacts of ambient pollution in India

For IEA/ETP energy projection, assuming continuation of current trends in population growth, aging, urbanization and access to clean energy.

Inclusion of indoor pollution (coherent with GBD) is planned
Health impacts from indoor pollution

- Under development in GAINS, coherent with GBD/IER and outdoor methodology

Socio-economic heterogeneity

- Enables assessment of socio-economic heterogeneity of air pollution (gender, age, income, urban/rural, etc.)
  - Who suffers from pollution?
  - Who causes pollution?
  - Who would pay for clean-up?

- Relationships to SDG targets
O$_3$ impacts

Health impacts:
• Spatial resolution of exposure estimates (0.5*0.5) and modeled ozone response within cities is likely to be inadequate for reliable estimates of population exposure

Vegetation impacts:
• Information for source-receptor relationships available from EMEP for G-20 countries:
  – SOMO35, O$_3$ fluxes (various metrics), O$_3$ max, O3 annual mean
  – For constant 2010 hemispheric background/CH$_4$
  – HTAP could provide impacts of background changes
Climate impacts

Alternative metrics implemented in GAINS:

– Global climate indicators: GTP20, GWP100
– Based on ECPLIPSE results
– Values depend on world regions