South Asian Workgroup for HTAP

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Scientific Area Identified

1. **South Asian emission Inventory for HTAP**
2. **HTAP Model Experiments & Identify Uncertainities HTAP-existing v/s Local emissions**:

   Global Model: MOZART

   Regional Model: WRF-Chem
3. **Diagnostic Analysis of HTAP runs wrt SA**
4. **Model Evaluation with observations: SAFAR (3 Mega cityx10 =30), MAPAN (16 stations @ India); 2 @ Pakistan, Others?**
5. **Impacts**

EMISSIONS (1991-2001-2011)

OBJECTIVES:

(1) Bridge between urban and large scale inventory builders;
(2) Exploration of uncertainties which is under-explored area.

ACTION:

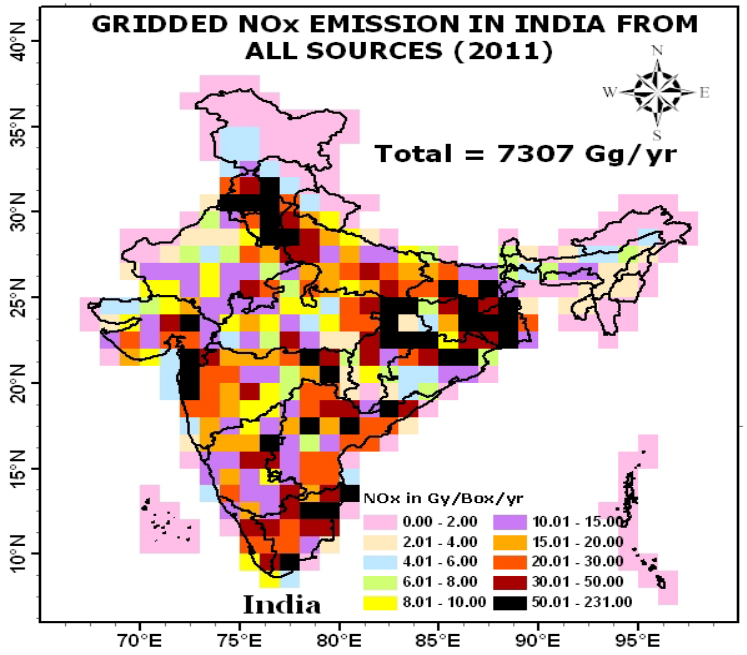
- Checking by people having access to local data would be valuable which hardly ever happened. HTAP would be a good incentive to share these datasets.
- How to convince? We think that HTAP can play a role by providing reference data sets, which can be the starting for improvements by local people. Form WG to convince.
- We propose to bridge the gaps and then identify uncertainities within HTAP framework runs.

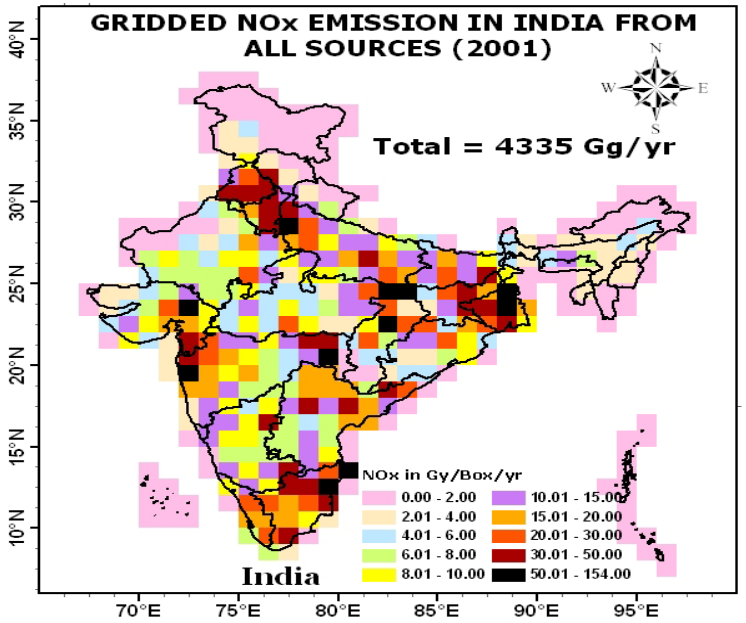
Nasreen Farah (Emission-Pakistan region)

- Available-2008 gross. To be converted in Gridded form.
- Regional Activity Data Information available to WG:

1. Population map
2. Vehicle types and numbers
3. Fuel used in villages like wood and kerosene, etc.
4. Vehicle counts of different types on districts level,
5. Type of fuel used in transport and cooking,
6. Industrial details like capacity of plant & plant production

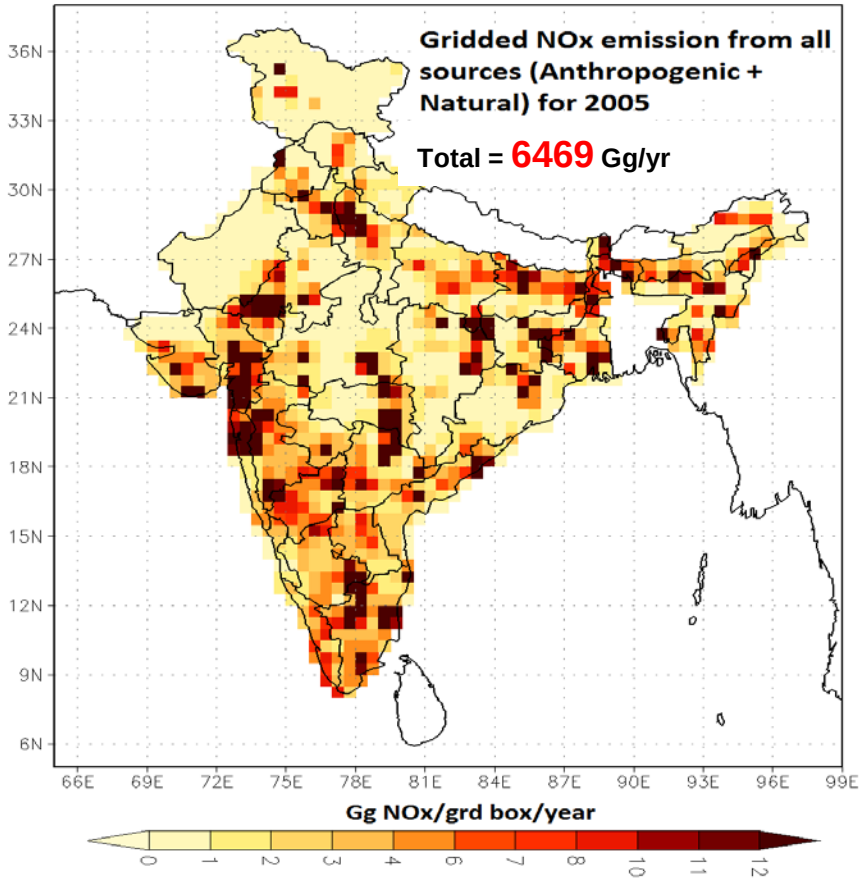
Bottom up emission (Anthropogenic)





Resolution: 0.5ºx0.5º

Top down emission (Anthropogenic + Natural)



- **Bottom Up (Field Data)**
- **-Anthropogenic: 5524 Gg/yr**
- **Top Down (satellite)**
- **Satellite+WRF-Chem: 5819 Gg/yr**
- **Natural (Soil): ~650 Gg/Yr**
- **Bias.: 5.3%**

Ghude et al., GRL, 2012)
Sahu et al, AE, 2011)

Sachin Ghude, IITM (Global-Regional Model)

- **Global simulations using Mozart using recent HTAP emission inventory for 2008-2010 for base case simulations.**

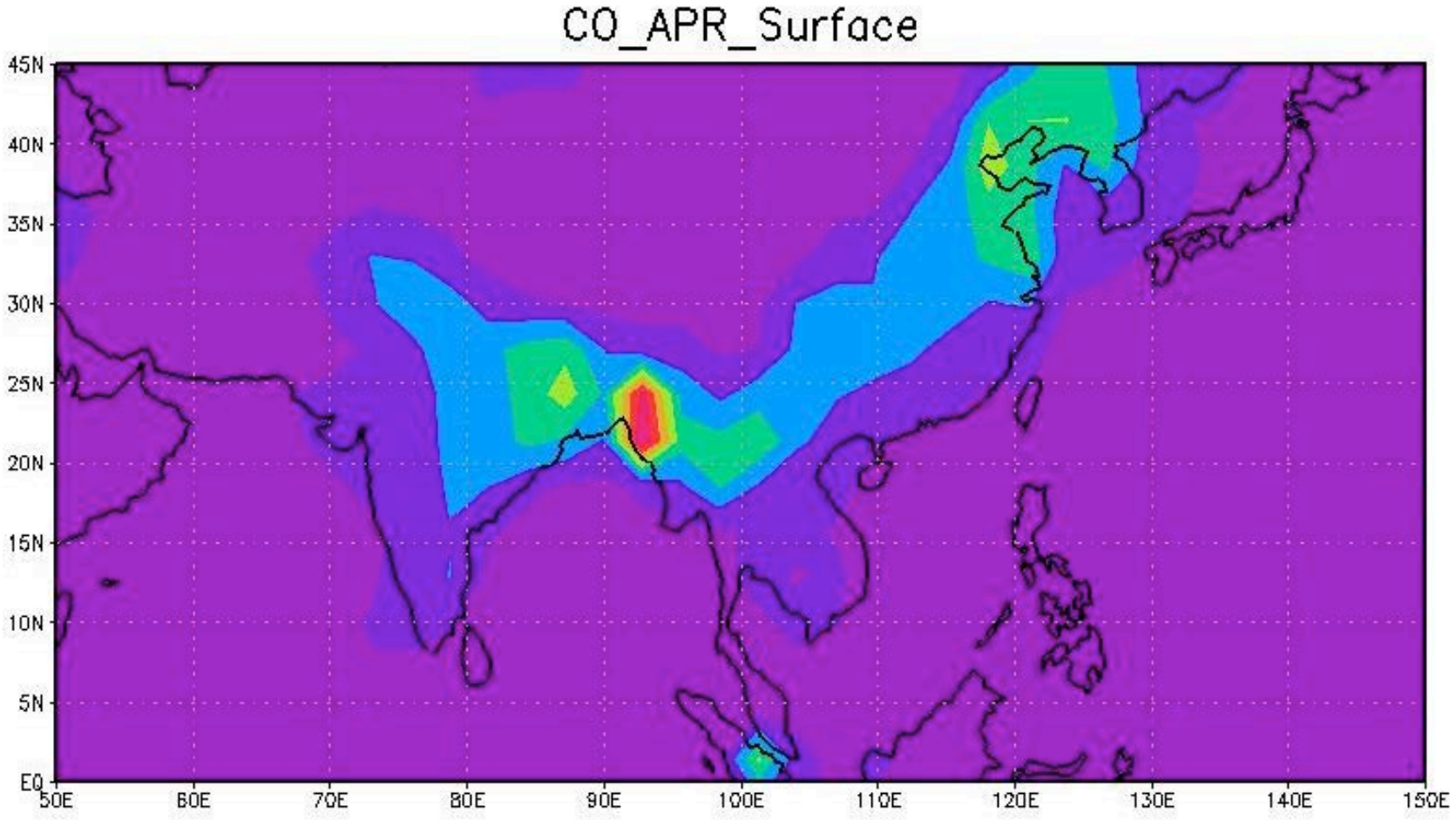
  1. Validation with OMI NO_2 and MOPITT CO and TES O_3 for South Asia
  2. Validation with surface based measurements (from the available sites)
  3. Replace CO, NOx and BC HTAP emissions with our own emission estimate (SAFAR-India) and repeat point 1 and 2.

- **Global simulations with Emission Perturbation (20% all and by pollutant) using MOZART and HTAP emission inventory for 2008-2010 for base case simulations**

- **Regional Simulations using WRF-Chem (with boundary conditions from global model run from HTAP) for 2008-2010 for base case simulations.**

  1. Validation with OMI NO2 and MOPITT for South Asia
  2. Validation with surface based measurements (from the available sites)
  3. Replace NOx HTAP emissions with other emission estimate (SAFAR-India, EDGAR, INTEX-B, REAS, etc) and repeat point 1 and 2.
  4. Impact of fire emissions on Air quality in South Aisa
  5. Impact assessment: Crop yield and Human Health

MOZART-Transport of CO
IGP-China-NA



Some outstanding scientific issues

1. Transport potential from South Asia.

2. What quantity of various trace species are transported into the tropical lower stratosphere through Asian monsoon deep convection? Is this a major channel for the intercontinental transport of pollution from south Asia?

3. Is ozone generally enhanced or depleted in the Asian monsoon plume and how dose it vary in the transport pathways?

4. To what extent do meso-scale meteorological patterns, orographic flows and convection enhanced mixing between the boundary layer and free troposphere influence the pollution transport potential, particularly during Asian monsoon period?

S.K. Sahu et al., Juelich, Germany and Indian Group

Global Chemical Transport Model (CTM) simulation using new regional emission inventory over South Asia

Objective

1. **Compare the recently developed emission inventory for India with the MACCity emissions and evaluate the impact of the differences over South and East Asia.**
2. **Validate MOZART model results with surface observations from the emerging AQ network in India.**

Evaluation of Models:
Emission inventory & associated uncertainty ....

- **Emissions in majority of models are inaccurate for developing countries like India, Pakistan & China due to lack of activity data.**

  It is much more than merely population to use as proxy.

- **Uncertainty in emission inventory could be due to many factors, some of them may not be even known to outside community**

  1) Missing of various antropogenic/natural sources

  2) Lack of reliable high resolution fuel activity data

  3) Lack of country specific technological emission factors

  4) Inaccurate spatial distributions of emissions

  5) Crop residue burning (not normal bio-mass)

  6) Brick klin, cremetorium, slums, small scale industries, kerosine, adulteration, etc.

- **The robustness of emission inventories must be tested using modeling studies and validate these with observations.**

Sensitivity Runs :::::::
Base year : 2010

- **Two independent MOZART simulations were carried out:**
  - **Base case: MACCity emission inventory**
  - **SAFAR: New Indian emission inventory for NOx and CO**

- **MACCity is a global emission inventory used for forecasting of atmospheric pollutants under the project MACC (Monitoring of Atmospheric Composition and Climate), whereas**

- **New Indian emission inventory (SAFAR) has been developed using high resolution activity data and corresponding emission factors (*Sahu et al, 2008, 2011, 2012, 2013*).**

Conclusions

- **The two simulations reveal a fairly large difference in the mixing ratios of CO and NOx over the Indian sub-continent.**
- **The changing emission is sensitive to mixing ratio over South Asia and very little influences over East Asia and China.**
- **The run with new emissions tends to be closer to the observations than MACCity.**
- **We found little difference in ozone concentration between the two runs. The model also underestimated the O_3 urban station observations.**
- **It may be worth considering the new emission inventory for use in MACC, however, more validation is underway.**

Manju Mohan (Regional model)

Work Plan:

a)WRF and WRF/Chem model Sensitivities to different LULC data, Physical parameterisations and chemistry options

b)Model Evaluation based on in-situ and Remote Sensing data

c)Model intercomparison of results -based on current options (FNL, USGS and EDGAR) and results obtained by input of HTAP community.

d)Model runs as per HTAP defined scenarios and time period.

Inputs desired from HTAP global community:

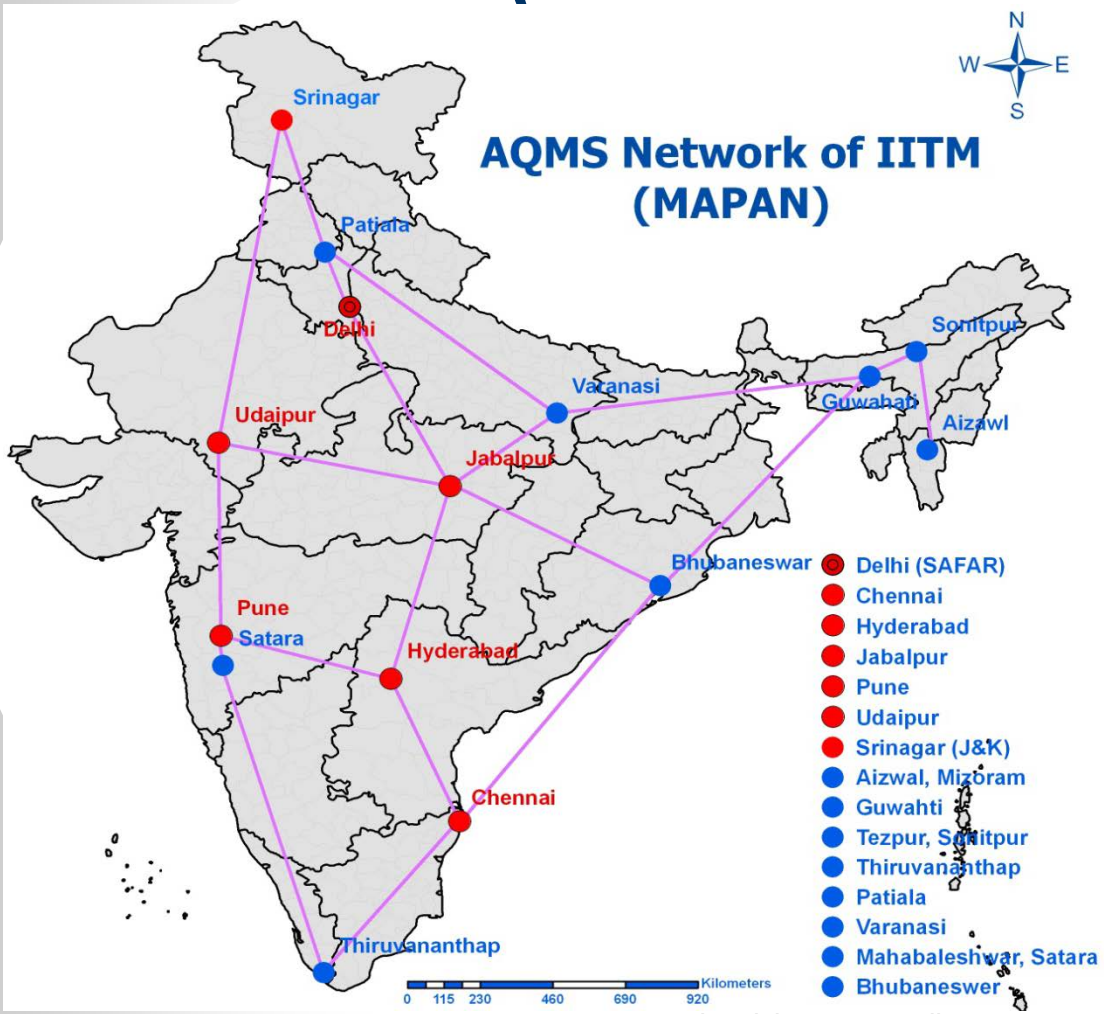
a)Gridded emission, meteorological and LULC data for WRF/Chem runs.

b)Observations data from HTAP for model evaluation for the SA region

c)Detailed scenario description and identification of gaps.

Model Evaluation over SA Observational Data Opportunity for HTAP

Modeling Atmospheric Pollution and Networking (MAPAN-India –15 stations)



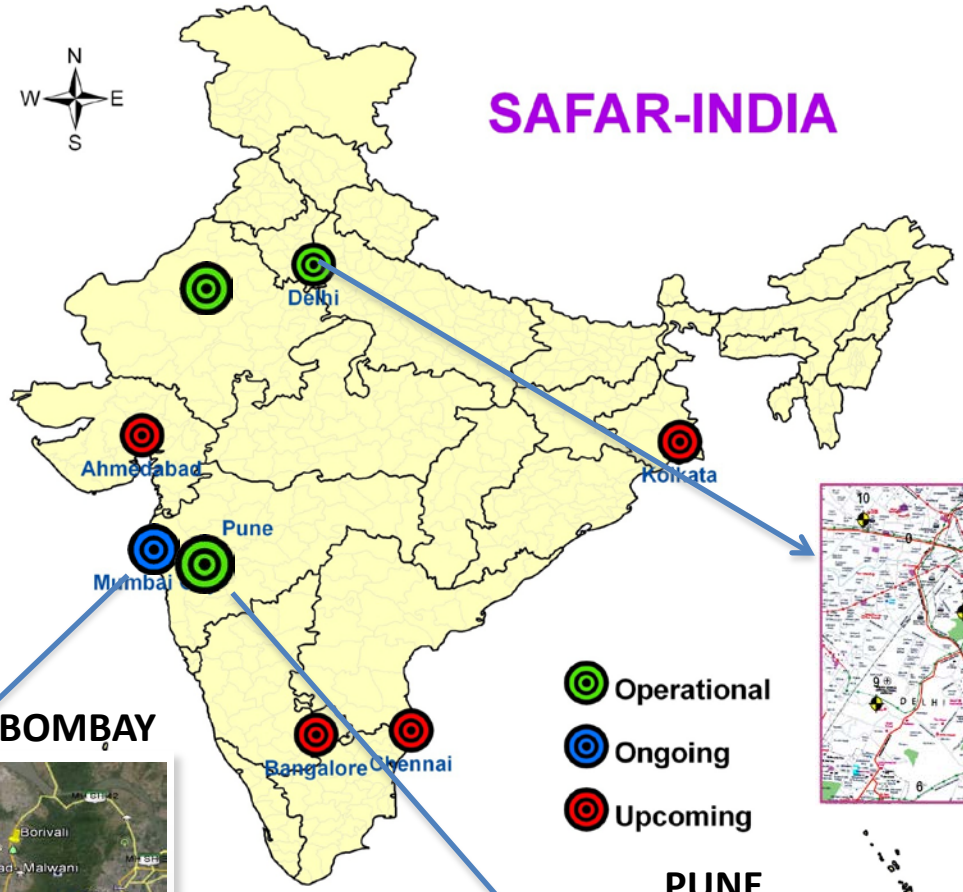
Monitoring

- PM10, PM2.5, O3, CO, NOx, BTX, BC, OC
- Weather Parameters

GURME (WMO)-Pilot

Mega Cities of India –SAFAR

(10 AQMS at Each Mega City (50x50 km)



DELHI

BOMBAY

PUNE

PARAMETERS:

PM10, PM2.5, O3
NOx, CO, BC, OC
Hg, PTRMS-VOCS
Weather

1. **DELHI**
2. **PUNE**
3. **MUMBAI**
4. **CALCUTTA**
5. **CHENNAI**
6. **JAIPUR**

THANK YOU