First measurements of major greenhouse gases in Bangladesh

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Abstract: A flask sampling programme has been started in collaboration between JAMSTEC, DU and NIES since June 2012. Air samples are collected at weekly intervals in 1.5 litre glass flask at 2 atmospheric pressure from Comilla (23.45°N, 91.20°E), Bangladesh. The site is maintained by the Bangladesh Meteorological Department (BMD) and the air sampling operation is conducted by DU personnel. Four air samples are transported between DU and NIES, via JAMSTEC, at monthly intervals.

The NIES ensures that the air samples are analysed for carbon dioxide (CO_2), methane (CH_4), carbon monoxide (CO), nitrous oxide (N_2O), sulphur hexafluoride (SF_6) and hydrogen (H_2) within about a month from the sampling date. The region of sampling can be categorised as agricultural land, devoid of dense forest and away from urban environment. Although the site cannot be categorised baseline station, the air inlet is set up at about 25 m above ground for sampling regionally representative air under well mixed planetary boundary layer (around 1500 local time).

The CCSR/NIES/FRCGC AGCM-based chemistry-transport model (ACTM) simulations of CO_2, CH_4, CO, N_2O and SF_6 observations are being compared with the measurements data. We find the model simulations are in general agreement with the measurements during the period of analysis June-December 2012. The simulated CH_4 concentrations are found to be amongst the highest on the earth surface, depending on the emission database, and these observations are serving as critical checks for model simulations.

Why Bangladesh (or South Asia)?

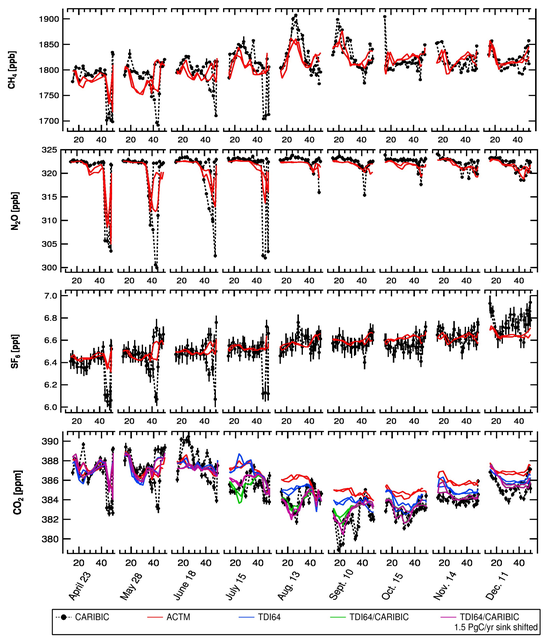

Figure 1: Comparison of multiple CARIBIC-measured long-lived trace gases with simulations by ACTM (Patra et al., ACP, 4163ff, 2011a)

Contrasting observational features for greenhouse gases are measured over the South Asia region from aircraft floating altitudes (Fig. 1) and from satellites (Fig. 2).

However, longer in situ data record or remote sensing data products resolving all seasons are still lacking from this region.

Measurements from Comilla would provide a linkage between the South and Southeast Asian ecosystems, and fill a gap in the present observational network (Fig. 3)

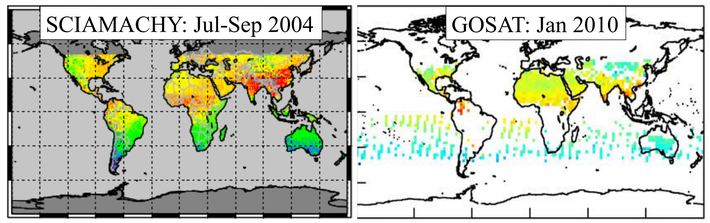

Figure 2: Bangladesh and the South Asia are the hottest spot on the Earth for CH_4 column abundance as observed from the satellites (left: Bergamaschi et al., JGR, 2009; right: Yoshida et al., AMT, 2011)

Results and Outlook:

Measurements of GHGs from Comilla are being conducted successfully since June 2012. Here we present preliminary results for the period of 29 June 2012 and 12 April 2013, along with ACTM simulations since Jan 2010 (Fig. 4).

These plots suggest that the measurements from Comilla are in broad agreement with state-of-the-art model results, which are based up on common understanding of the emissions, transport and chemical loss corresponding to individual species.

However, CH_4 simulations using wetland and rice emissions from VISIT ecosystem model are clearly higher than the observed values, indicating the validity of REAS emissions (Yan et al., GBC, 2009).

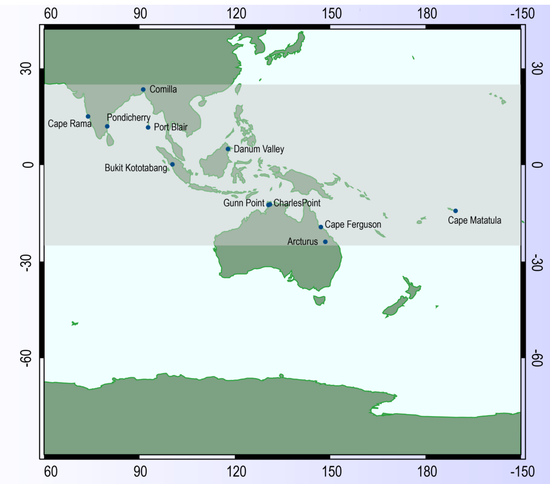

Figure 3: Tropical Asian GHGs observational network (plot by Marcel van der Schoot, CSIRO)

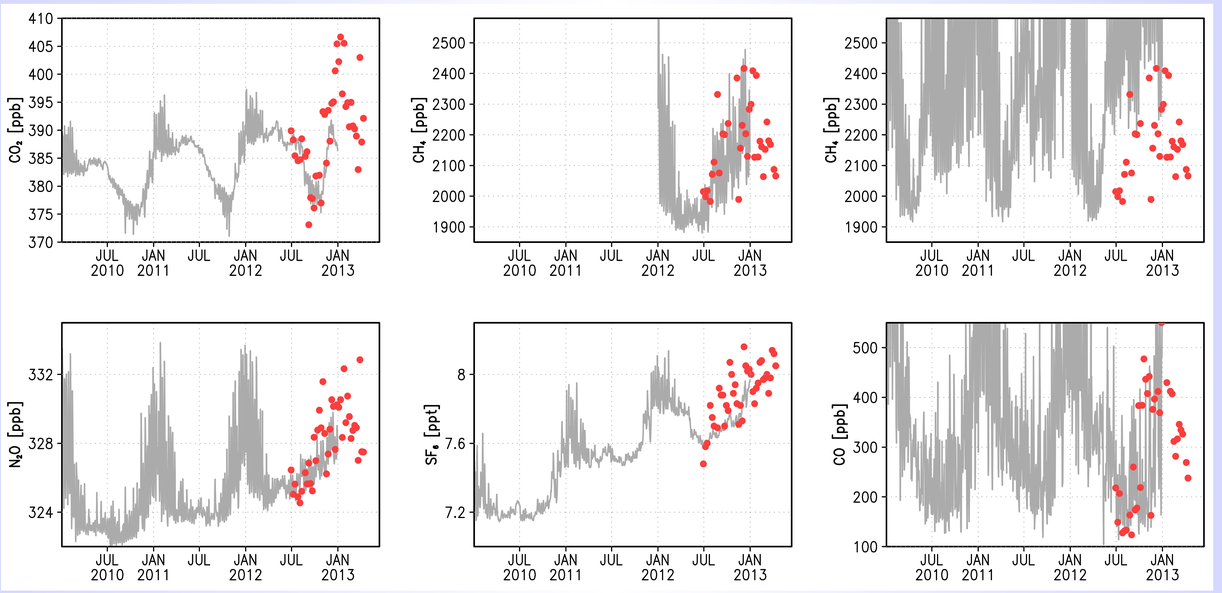

Figure 4: Time series of CO_2, CH_4, N_2O, SF_6 and CO as measured at Comilla (red symbols) since June 2012. ACTM simulated PM averages are also shown (line) using the control flux scenarios (Patra et al., 2011a). In addition, CH_4 simulations using TransCom-CH_4 EXTRA emissions (Patra et al., ACP, 12813ff, 2011b) are also shown (top-right).

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Further co-operations from the international communities are sort for strengthening the observational programme in Bangladesh.