

Review comments:

Title: Measurement report: Regional characteristics of seasonal and long-term variations in greenhouse gases at Nainital, India and Comilla, Bangladesh

Author(s): Shohei Nomura et al.

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This study presents GHG observations over Northern Indian sites of Nainital NTL and Comilla CLA, Bangladesh. Factors like transported airmass, local cropping, biomass burning and precipitation locally seem to play a role in the observed variability at these sites. CLA show overall high CH₄ concentration throughout the year. On the other hand, SF₆ concentrations are similar to that at MLO, suggests that not many urban activities or anthropogenic emissions are active near these sites. This study emphasizes that Indian Dipole DMI affects circulation and precipitation which in turn affects the growth rates of GHGs.

NTL and CLA long-term observations can play an important role towards understanding the regional carbon budget over South Asia. GHG variability in terms of seasonality, airmass transport dynamics, are already reported in various studies in the past (papers are cited in this study). However, studies reporting carbon flux estimation using top-down modelling are limited over this region.

Observations presented in this study are very useful to understand carbon budget over South Asia. NTL and CLA observed data should be available on public domain for other researchers at the earliest.

This manuscript may be accepted for publication in ACP after replying following comments.

- 1) L21-21: NTL do not show minima in Feb-March (ref. Fig. 6)
- 2) L25: "...in addition to other sources..", what are other sources, pls specify.
- 3) L26-27: "High CH₄ mole fractions.....Plain", Is it due to large scale airmass transport or local emission?
- 4) L32-33: SF₆ mole fraction is similar to that at MLO this suggests that there are few anthropogenic emissions sources near those places. However, CO observations are high at both the sites. Is it not a that a contradictory result?

- 5) L49-50: "...because there are few measured GHG mole fractions in the South Asian region" ; "Several observations on GHG mole fractions in the atmosphere have been done around India".....Two contradictory statement. Consider revising.
- 6) L56-59: Do you mean CH₄ and CO sources are co-located over these regions. Consider revising text in these lines.
- 7) L83-84: "Thus the GHG observationslong-term trend remain limited". This sentence is not clear. What do you mean by long term trend remain limited? Consider revising.
- 8) L84-94: "In this workENSO index". Why this study is important and how it fills gap areas left behind from past studies. Consider revising this paragraph.
- 9) L100: "...Mt. Mauna Peak....", is it Manora Peak? Pls check and correct.
- 10) L103-104: "We estimated thatnearby", have you estimated or assumed? If you estimated then what is the basis for estimation? Same for assumption
- 11) L107-109: "Farmers in Comillanearby emissions", this indicates that CLA is strongly influenced by the local anthropogenic emissions. On the other hand, based on SF₆ observations you say that these sites are free from local emissions (ref. abstract). Its better to be consistent with the site characteristics described in the text. Also, be consistent in mentioning site name. Use either Comilla or CLA.
- 12) L112: ".....(on the roof of the second floor of the station) in NTL.....", What is height of the inlet head from the roof surface? What is height of the canopy close to the inlet head?
- 13) L113: What sealing material used in Pyrex flasks? Is it comparable to the borosil 3.3 flasks (from Normag) and PCTFE sealing material used at MPI Jena.
- 14) L121: Air samples were cooled at -30 °C while sampling at NTL and CLA. Again, they are cooled at -80 °C before injecting to the analytical system at NIES. An explanation should given about this. Whether cooling twice (double dehumidification) have any scientific basis?
- 15) L122: Fig.2b should be simplified for the ease of readers. Put the direction of sample flow. Too many text inside the figure makes it complicated. Avoid writing text such as "Peak labs, Peak Performer, Agilent 7890, etc." inside this figure. It may be mentioned in the figure caption.
- 16) L126-127: "....GC-ECD or GC-micro-ECD", which one is used exactly?
- 17) L135-149: A figure may be shown similar like Fig.2b

- 18) L151-158: MLO is a reference site, however CRI does not represent a global/continental signal. It's a sub-regional site. Air masses arriving at CRI are different than that of NTL and CLA. Hanle (HLE: French controlled site in India) or Seychelles (SEY) better represents large air masses in this region and can be considered as reference site. HLE represents northern hemisphere and SEY southern hemisphere. I suggest replacing CRI with HLE and SEY.
- 19) L176-177: Give more details about calculating the ratio.
- 20) L180: How you supplemented the value of missing period and any error in it. Describe in detail.
- 21) L191: Consider revising title of section 3.1, use of word "levels" may be misleading. May be replaced with concentration and low-concentration, high-concentration in the text.
- 22) Fig. 4: MLO curve clearly not visible after 2013 onward. Also, I do not understand the scientific reason behind using CRI data here. It is used because data is freely available at WDCGG? HLE would have been better background site like MLO. CRI is not advisable to use as a reference unless strong scientific motive is described.
- 23) L223-224: "...CRI site represents Southern Hemisphere during JJAS...", in that case you can use Seychelles (SEY) which is better representative of southern hemisphere.
- 24) L227-233: CRI represents large part of Indian land mass during Nov-March. Oct and April are air mass transition months (seasonal change). So CRI site observations are good example of seasonal reversal of wind pattern. GHG mole fractions at CRI during JJAS represents oceanic air masses (pristine environment) and rest of the months it represents Indian land mass. Mole fractions representing Indian land mass may dominate in annual average. Such discussions should be written in the section 3.2.1.
- 25) L234-235: As mean growth rate (CO₂) at NTL and CLA agrees with MLO, curves showing this should be added in Fig. 5a
- 26) L238-252: NTL and CLA CO₂ growth and its relationship with ENSO and IOD are discussed in these paragraphs. However, no such statement is made in the conclusions section. Please add few lines about this in conclusion section as well. I am very surprised to see that there is no relationship between NTL and ENSO index. As ENSO is global phenomenon so its impact also is global particularly in GHG observations. India faces drought during most El Niño years and photosynthesis

activities are weak during this period and so CO₂ enhancement occurs. I suggest authors to re-check your analysis in the case.

Manuscript may be accepted for publication after addressing above comments. And GHG observations data at NTL and CLA should be made available to the researchers for further useful research.