

The Indo-French collaboration for greenhouse gases monitoring in India

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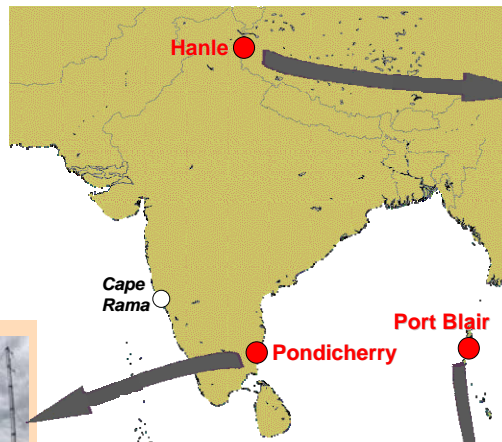
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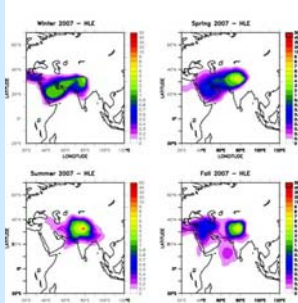
Introduction

The rapidly expanding economies of East Asia is showing a swift increase in greenhouse gases emissions. From 1993 to 2003 CO₂ emissions from India have increased by 57 percent, and such trend will likely continue since per capita emissions still lag far behind those of Europe and the United States. The development of the Indian sub-continent with a population of ~1.2 billion, may lead to significant changes in the regional distribution of GHGs in the atmosphere. Such development emphasizes the urgent need of initiating a long term monitoring of the greenhouse gases concentrations over the Indian subcontinent. As part of the CaFICA/IFPAR Indo-French program we have set up the first Indian continuous CO₂ monitoring station at Hanle in August 2005. In addition we have started a regular flask sampling program at Pondicherry in 2007, and we will set up a second in-situ station on the Andaman Islands in 2010. This project is involving several institutes in India which are in charge to maintain the instruments, to sample the air, and to develop the analysis tool in collaboration with LSCE.



Hanle (HLE)

32.779°N - 78.964°E - 4517 m asl



The Hanle station is located in western Himalayas at the high altitude Indian Astronomical Observatory operated by IIA. The surrounding area is a dry, cold desert with sparse human population and the ancient Hanle monastery as its nearest neighbour. The station is located atop Mt Saraswati in the Nilamkhul Plain in the Hanle Valley of Changthang, Ladakh. In addition to the in-situ CO₂ analyzer, flasks are sampled on a weekly basis.

Pondicherry (PON)

12.012°N - 79.858°E - 20 m asl



In collaboration with the Pondicherry University we have started a regular flask sampling program in 2007. This sampling site in South East India

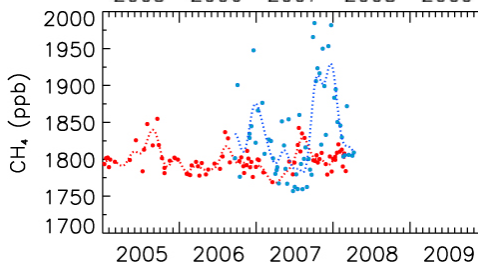
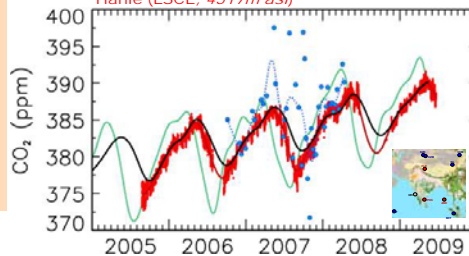
is located about 8 km North of the city of Pondicherry. The air is sampled on a 10m mast installed on the University Guest House roof. A pair of flask is sampled once a week, between noon and 2 pm after the night sea breeze.

Station	Hanle	Pondicherry	Port Blair
ID	HLE	PON	PBL
CO ₂ in-situ	2005	-	2010
CH ₄ in-situ	2010	-	2010
CO in-situ	-	2010	2010
Radon in-situ	-	2010	2010
Flask	CO ₂ , CH ₄ , N ₂ O, SF ₆ , H ₂ , CO	2007	2009

List of measurements and starting year

CO₂ & CH₄ time series

Mauna Loa (ESRL, 3397m asl)
 Plateau Assy - KZM (ESRL, 2519m asl)
 Pondicherry (LSCE, 20m asl)
 Hanle (LSCE, 4517m asl)

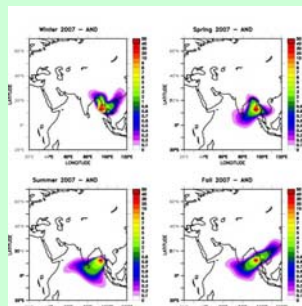


Port Blair (PBL)

11.550°N - 92.733°E - 20 m asl

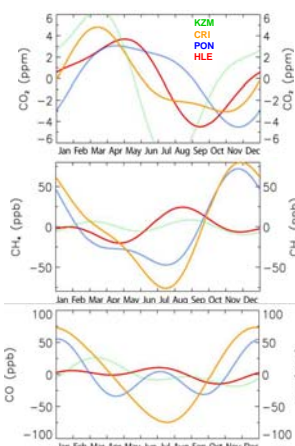


Andaman Islands are located in the Bay of Bengal ~1400 km from Pondicherry, and ~600 km West of Myanmar & Thailand. Port Blair is the main city of the islands and host the majority of the ~350,000 population.

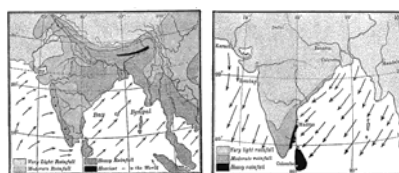


A sampling site was selected last summer, in collaboration with NIOT. Weekly flask sampling has been started on July 2009. A shelter fully equipped for continuous measurements of CO₂, CH₄, CO and Radon will be set up at the same location in 2010.

Mean seasonal cycles



We observe a CO₂ seasonal amplitude of about 7-8 ppm at both Hanle and Pondicherry with a two months delay for the minimum concentration at Pondicherry. For CH₄ the seasonal cycles at the two stations are in opposite phase. The CH₄ maximum is observed in Summer at Hanle, whereas it is occurring in November at Pondicherry. It should be noted that the CH₄ seasonal cycle observed at Pondicherry is very similar to the mean cycle at Cape Rama. This signal illustrates very clearly the influence of the Indian monsoon, with the CH₄ emissions detected in North India during summertime and the in South India in Winter.



Schematic representation of the Indian Monsoon

The Indo-French collaboration started in 2001 between LSCE, CMMACS and IIA, and extended to University of Pondicherry and NIOT, has provided the framework to develop greenhouse gases measurements at three stations in India. We expect that collaborations with other partners involved in GHGs measurements in India like IMD, IITM, CSIRO, NIES, etc... will make possible the development of an optimized monitoring network over the Indian subcontinent.

