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Glass flask air sample analysis through Gas Chromatography in India: Implications for constraining CO_2 surface fluxes

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Introduction

In recent years, the thrust of Transcom and the research community has shifted to investigate the interannual variability of fluxes (Baker et al., 2006) rather than long-term means. Some researchers (Peter Rayner, personal communication) believe these estimates to be more robust than the mean estimates. While this may be true in general, the scarcity of tropical data is unforgiving and large uncertainties continue to plague the estimates. The only land station in the tropics, Cape Rama in India which operated for 10 years (Francey et al., 2003) has been discontinued since 2002, although efforts are underway to revive this station. LSCE (France), Centre for Mathematical Modeling and Computer Simulation (CMMACS), Bangalore, India and Indian Institute of Astrophysics (IIA), Bangalore, India jointly established two new stations in 2005 (Hanle and Pondicherry). LSCE is doing routine analysis of the glass flasks sampled at these two Indian stations. The ability to analyze glass flask samples to the precision required for inversion has been limited to a few labs such as MPI-BGC Jena, NOAA, LSCE, CSIRO etc. With several new stations being planned for the future in India, it is imperative that India also contribute to the analysis. Recently we have established a Gas Chromatograph (GC) lab, equipped with two detectors ECD (Electron Capture Detector) and FID (Flame Ionization Detector), at the Indian Institute of Tropical Meteorology (IITM), Pune, India which uses Calibration Standards imported from NOAA/ESRL Carbon Cycle Greenhouse Gasses Group (Duane Kitzis). In future it is proposed to conduct intercalibration exercises with International labs (e.g. MPI-BGC Jena, LSCE France, etc.) to reach the level of precision required for use in inversions. Air samples in two separate glass flasks are collected once every week at the selected sites. Flasks are analyzed for CO_2 and other greenhouse gases at GC laboratory at the IITM Pune, India. Results will be used to obtain better constrained global and regional carbon fluxes.

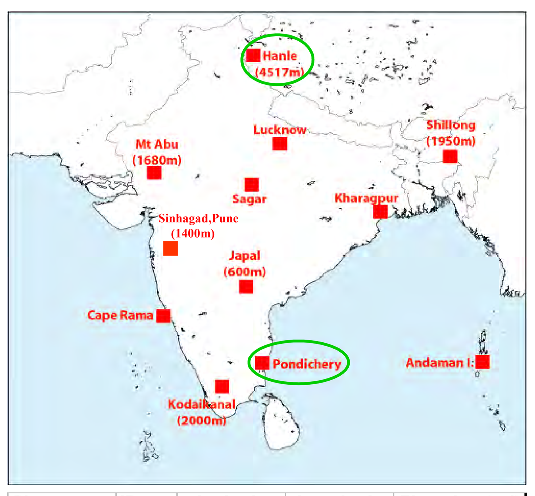
Observations and Methods

●Air samples collected at Came Rama and Sinhagad sites (Fig.1) are on weekly interval and in two separate one liter glass flasks. Sampling time is afternoon local time.

● Air sampler: The sampling units are manufactured by LSCE France. It consists of a small suit-case pre-equipped with a connection for an air inlet (equipped with a 7µm filter), a pump and a battery placed below the ON/OFF button, a flow meter, flasks fitting positions, a valve and a pressure gauge (Fig.2)

● Glass flask: Glass flasks are imported from NORMAG Germany. New glass-flasks are made of borosilicate glass 3.3 volume 1 liter, with new PCTFE valves, coated with black hose.

●Flasks preparation: At IITM Pune India, before sending the flasks to the site measurements, they are prepared and evacuated. We pump and heat the flasks. During pumping the temperature is +60 dc. Flasks are pumped for 72 hours.



Site	ID	Latitude	Longitude	Elevation (asl)
Hanle	HLE	32.77	78.95	4517
Pondichery	PON	12.00	79.80	20
Mount Abu	ABU	24.65	72.77	1680
Cape Rama	CRI	15.08	73.83	50
Andaman I.	AND	11.63	92.72	20
Sagar	SAG	24.00	79.00	50
Kharagpur	KHA	22.00	87.18	50
Shillong	SHI	25.50	91.83	1900
Kodaikanal	KOD	10.17	77.33	2000
Japal	JAP	17.11	78.67	600
Lucknow	LUC	26.83	80.83	150
Sinhagad	**SND**	**18.35**	**73.75**	**1400**

Fig.1: Station network

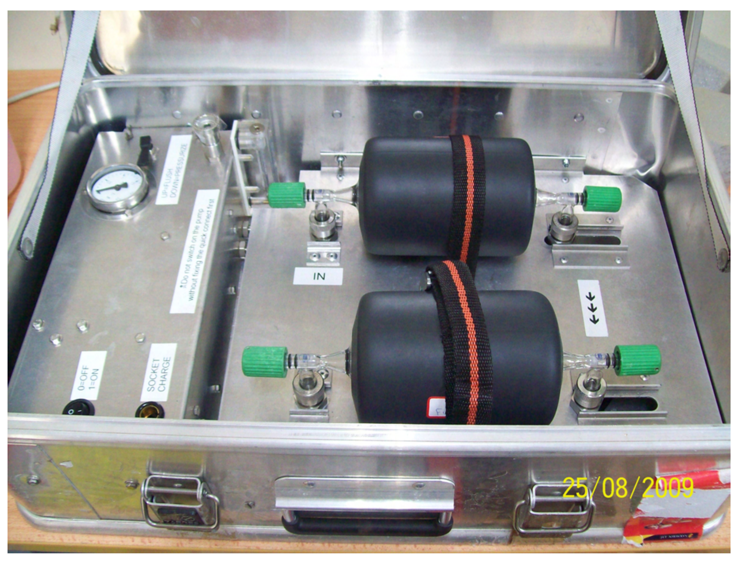


Fig.2: Air sampler and flasks

Analytical facility: Gas Chromatography

● The filled glass flasks are analyzed at IITM Pune India for determination of the concentrations of trace gases CO2, CH4, N2O by Gas Chromatographic (GC) methods.

● Calibration standards are from NOAA/ESRL (Global Monitoring Division, Carbon Cycle Greenhouse Gases Group)

● Schematic diagram of GC system at the IITM Pune India is shown here in Fig.3-lower panel.

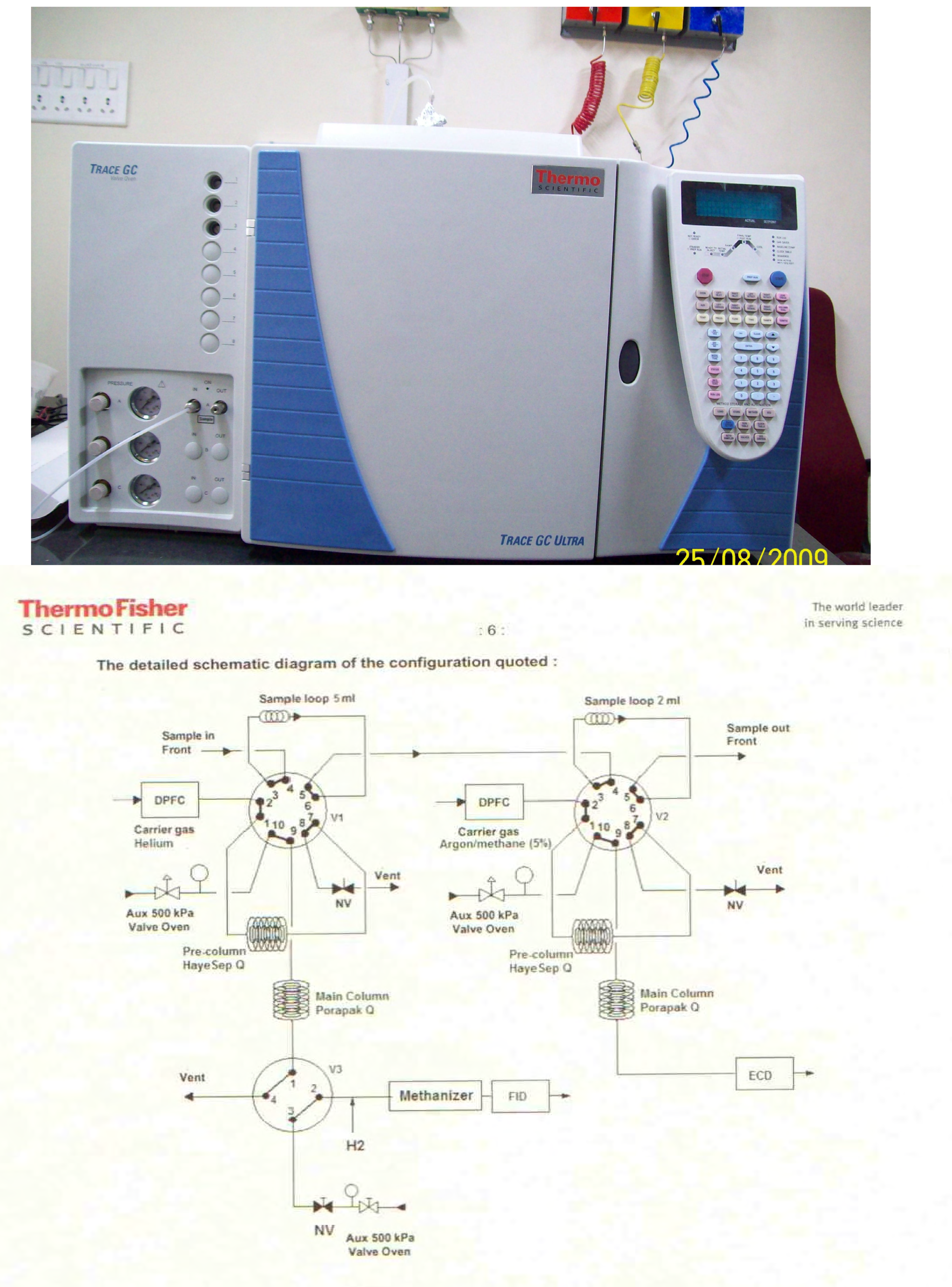


Fig.3: upper panel, lab photo of GC; lower panel, Ray diagram of GC system

Outlook

● Air sampling started at two new stations, Cape Rama and Sinhagad India (Fig.1)

● Routine analysis of glass flasks air samples are done at Indian Institute of Tropical Meteorology Pune India

● Preliminary output data are under observations

● Output data will improve our understanding of the processes that mediate CO_2 fluxes between the atmosphere and the terrestrial biota and will help to obtain better constrained inverse solutions (estimates) of carbon fluxes over India and Central Asia.

References

[1] Baker, D. F., et al.,(2006), Global Biogeochem. Cycles, 20, GB1002, doi:10.1029/2004GB002439.[2] Francey, R., et al., (2003), WMO GAW Report No. 148, 97-106;