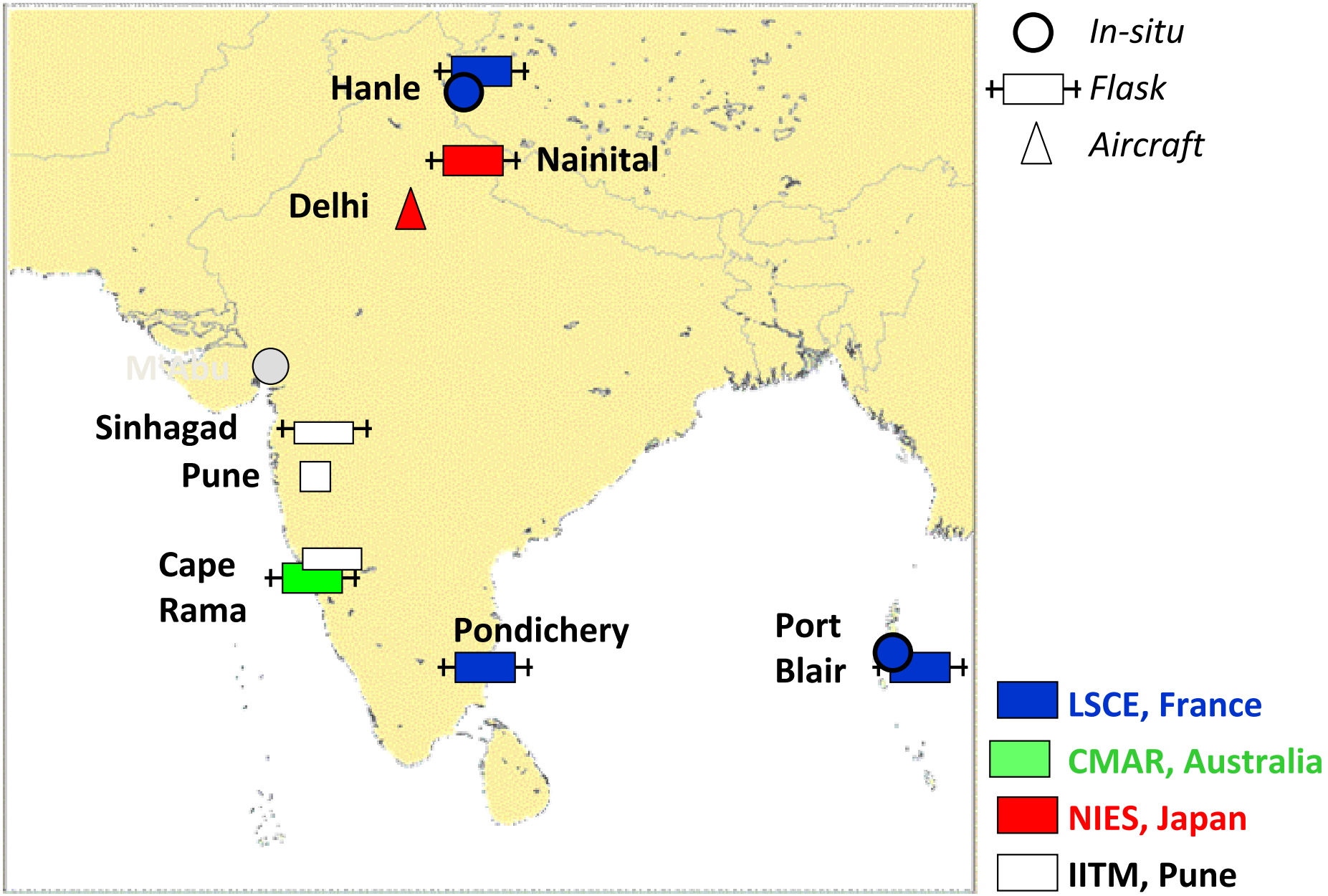
Effort in Measuring Greenhouse gases by setting up stations in India

N.K. Indira, B.C. Bhatt, P.S. Swathi, V.K. Gaur,
C-MMACS and IIA, Bangalore, India and
Michel Ramonet, Martina Schmidt, Marc Delmotte,
LSCE, France
Yogesh Tiwari, IITM, Pune, India
D.V. Borole, NIO,Goa, S.K. Bhattacharya, PRL, Ahmedabad, India and Roger Francey, Marcel Van der Schoot, CSIRO, Australia
Manish Naja, ARIES, India and Hitoshi Mukai, NIES, Japan
T. Machida, NIES, Japan and Japan Airlines

15th WMO/IAEA CO2 expert meeting, Jena
10th Sept.2009


Hanle
Nainital
Delhi
Mt Abu
Sinhagad
Pune
Cape
Rama
Pondichery
Port
Blair
In-situ
Flask
Aircraft
LSCE, France
CMAR, Australia
NIES, Japan
IITM, Pune

Site	Code	Lat °N	Long °E	Alt m.asl	Flask	In-situ
Cape Rama	CRI	15.080	73.830	20	CMAR *1993 - 2003* *2009 - ...*	-
Hanle	HLE	32.779	78.964	4517	LSCE *2005 - ...*	CO2 *2005 - ...*
Pondichery	PON	12.013	79.858	20	LSCE *2006 - ...*	-
Nainital		29.400	79.500	1958	NIES *2006 - ...*	-
Port Blair	PBL	11.550	92.733	10	LSCE *2009 - ...*	CO2, CH4, CO *2010 - ...*
Sinhagad		18.350	73.750	1400	IITM *Project*	-
Delhi	>> Regular vertical profiles from T.Machida program (commercial aircrafts)					

INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH

Carbon Fluxes in India and Central Asia

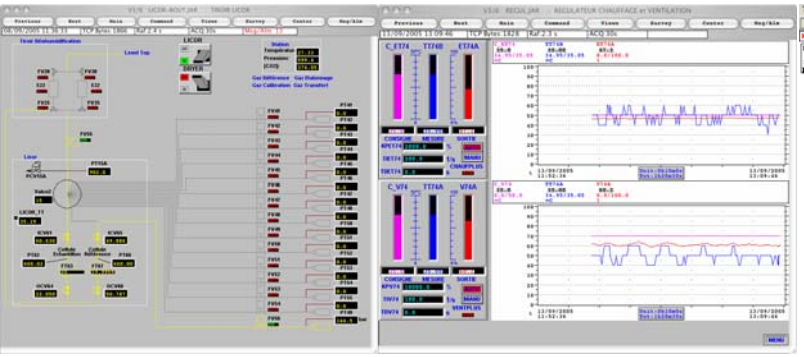
CaFICA

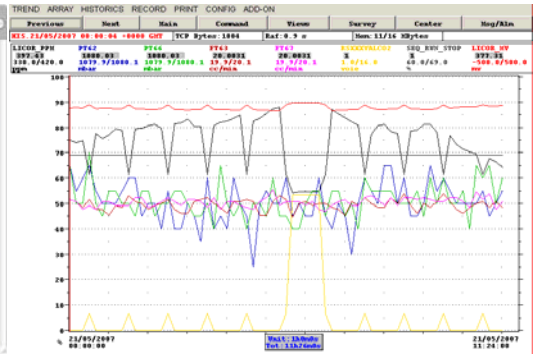
Sampling: B.C. Bhatt (IIA, Bangalore)
D. Angchuk (IAO, Hanle)
Flask Sampling: 2002 onwards
In-situ: 2005 onwards
Analytical lab: LSCE, France

Indian Astronomical Observatory, Hanle

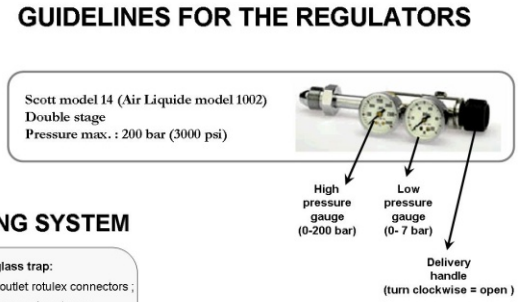
Running the Hanle station

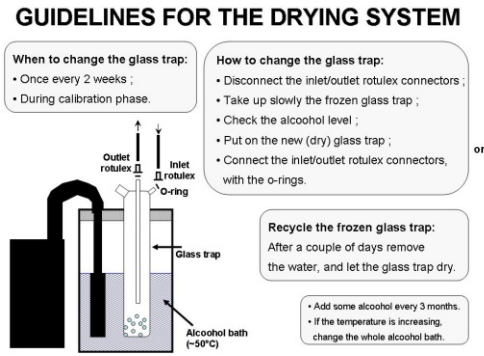
1. Remote control of the CO_2 analyzer





2. Support from IIA engineers & infrastructure

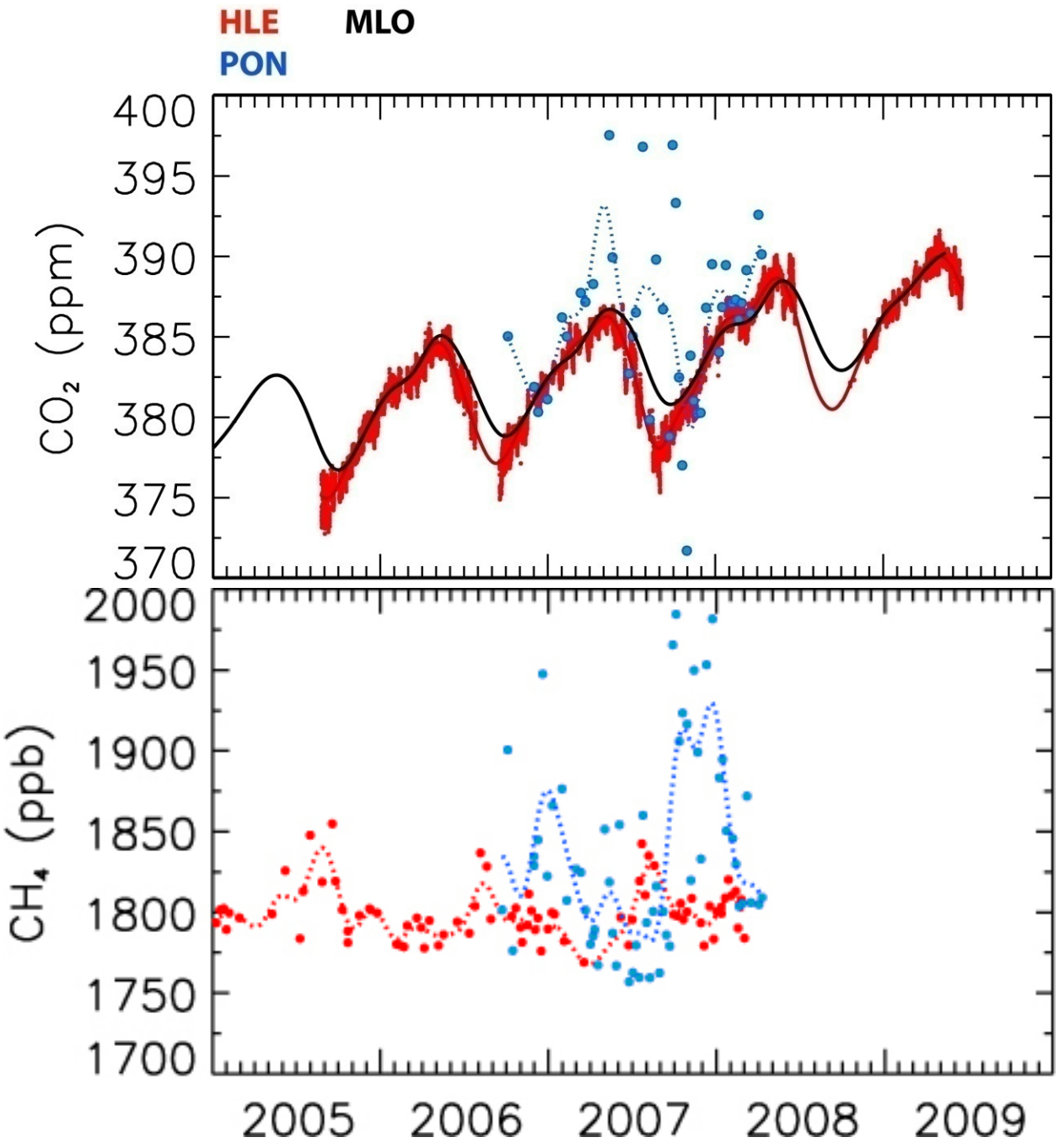


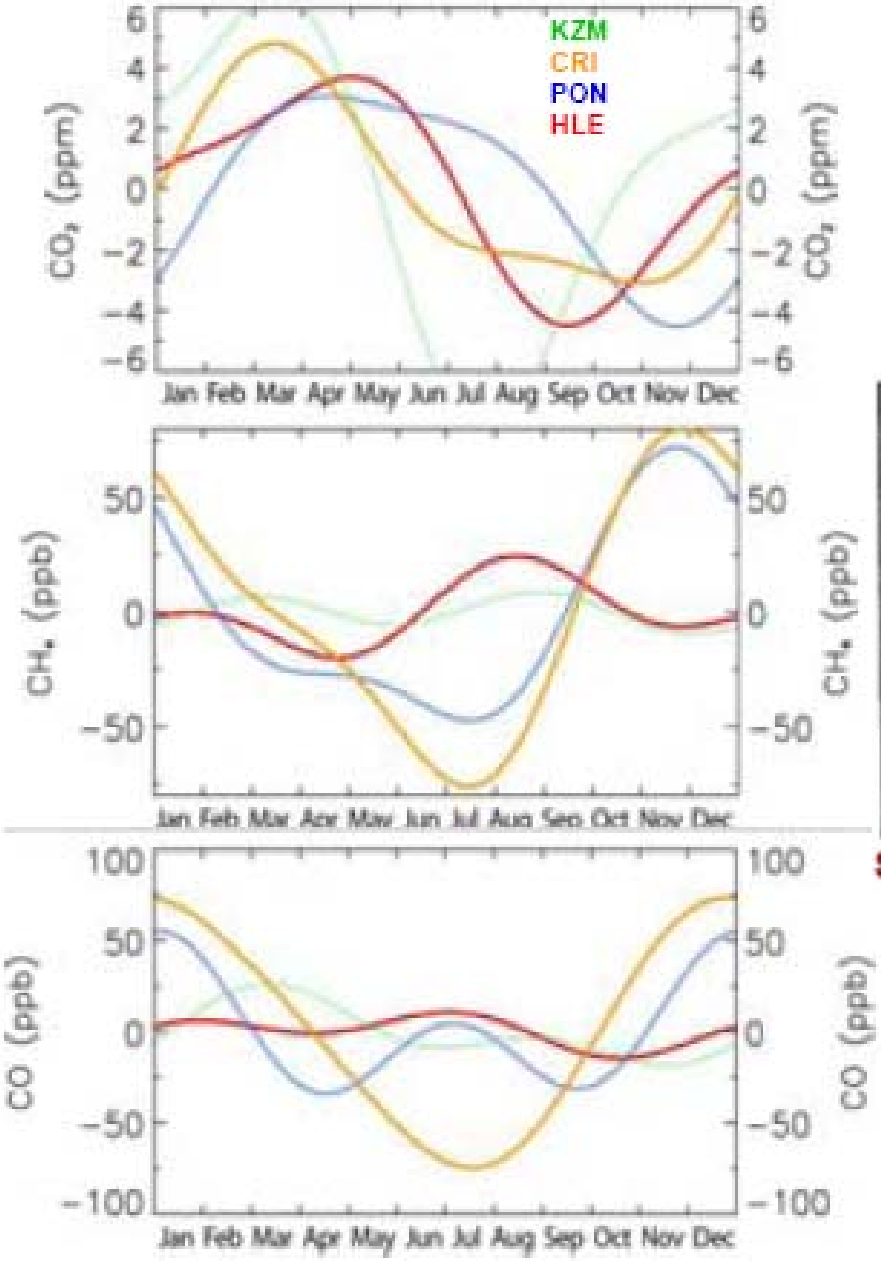


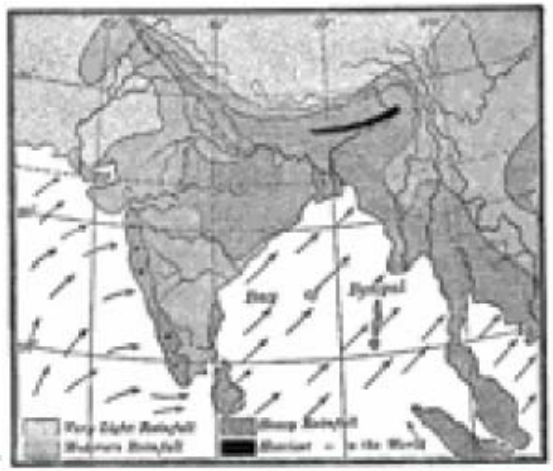
om/PDFFiles.nsf/0/af277a8381ad585285256a0d0056e35f/$FILE/3044.pdf

Pondicherry University

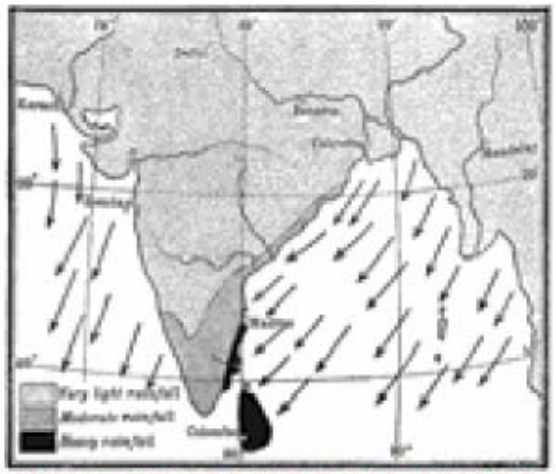
Sampling: Swati patnaik (Pondicherry Univ.)
M.V. Reddy (Pondicherry Univ.)
Flask Sampling: 2006 onwards
Analytical Lab: LSCE, France


HLE
MLO
PON
400
395
390
385
380
375
370
CO_2 (ppm)
2000
1950
1900
1850
1800
1750
1700
CH_4 (ppb)
2005
2006
2007
2008
2009





SUMMER MONSOON WINDS



WINTER MONSOON WINDS

National Institute of Ocean Technology, Port Blair

(Andaman Islands)

Sampling: **R. Kirubagaran, (NIOT, Chennai)**

D. K. Jha (NIOT, Port Blair)

B.C. Bhatt (IIA, Bangalore)

Flask sampling: 2009 - ...

In-situ: CO_2, CH_4, CO (2010 - ...)

Analytical Lab: LSCE, France

Cape Rama

Sampling: D.V. Borole (NIO, Goa)

Flask sampling: 1993 - 2002
2009 - ...

Analytical Lab: CMAR, Australia

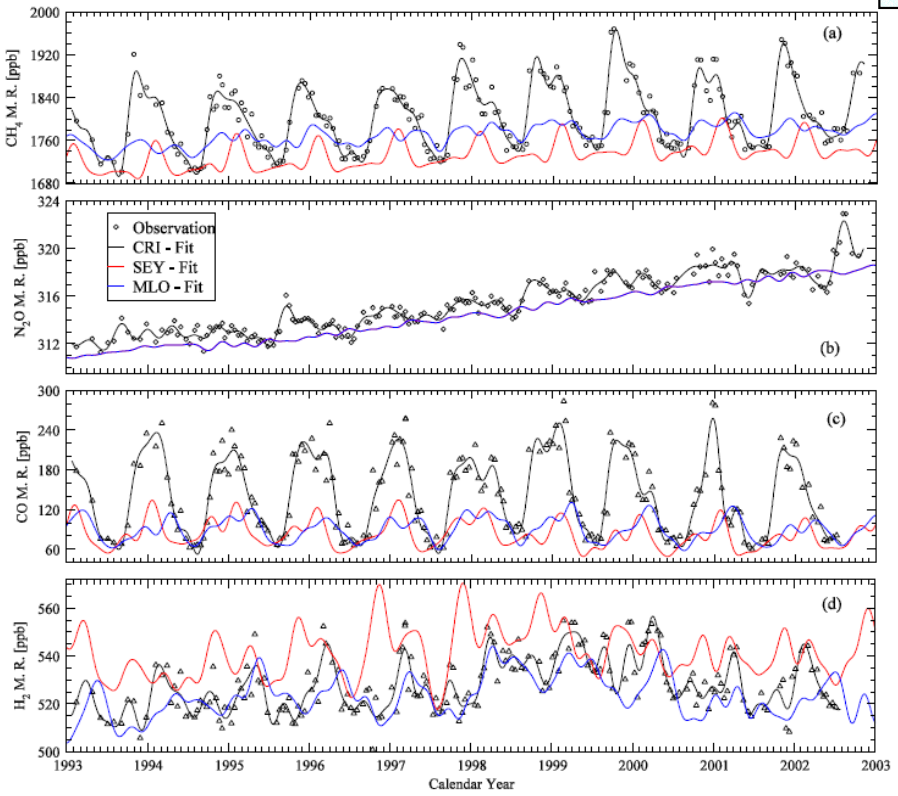


Figure 3: Same as Fig. 2, but for CH_4, N_2O, CO and H_2. Smoothed fits to the Mauna Loa (blue line; data source: CMAR) or SEY data (red line; except for N_2O; data source: ESRL) are given for comparison.

Aryabhatta Research Institute Of Observational Sciences, Nainital

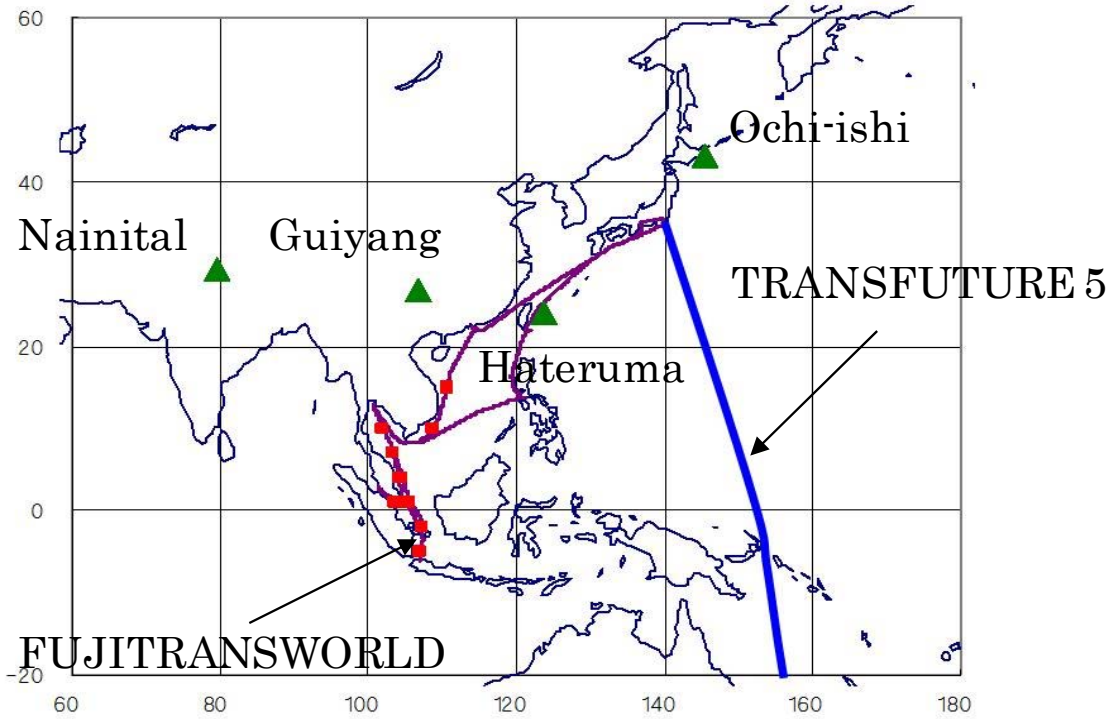
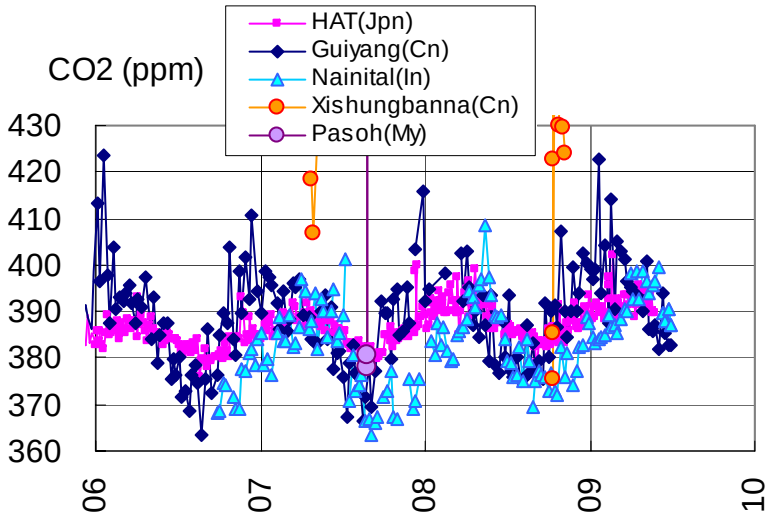
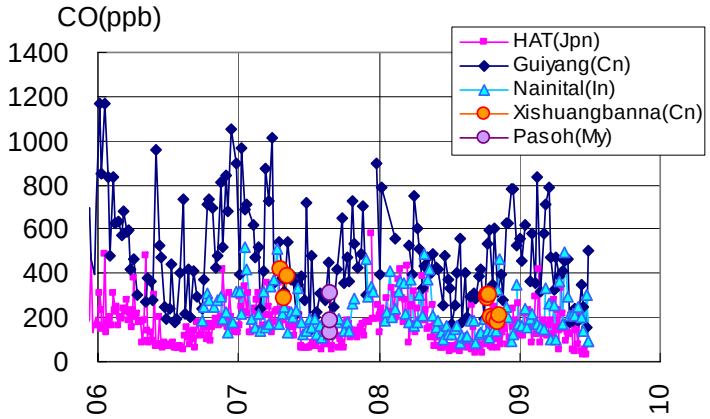
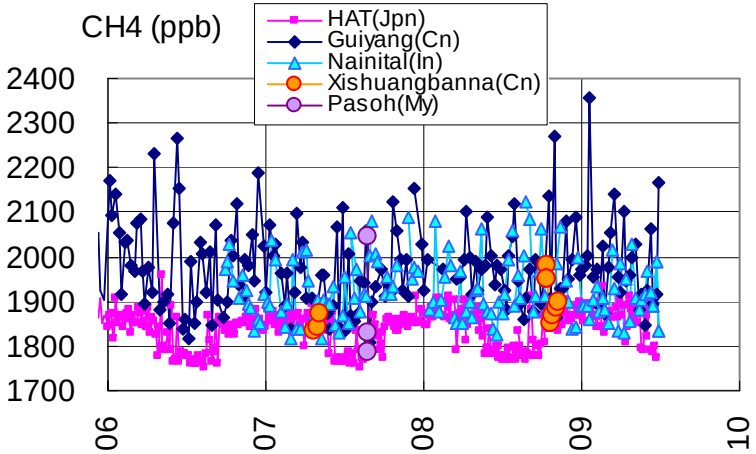


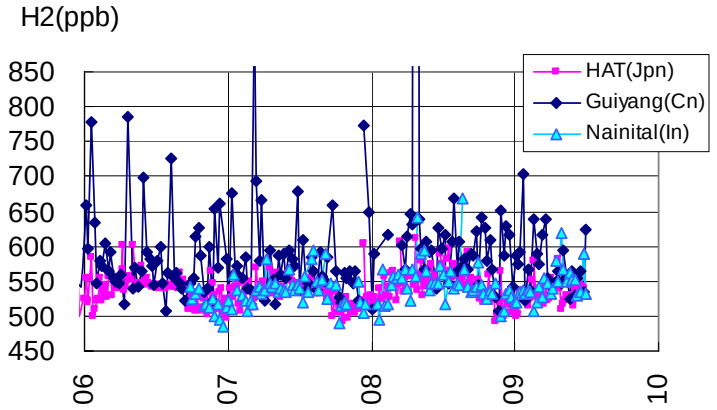
Fig. 1 Observation network in East Asia. Sites are shown in plots. Ship routes are shown in lines.

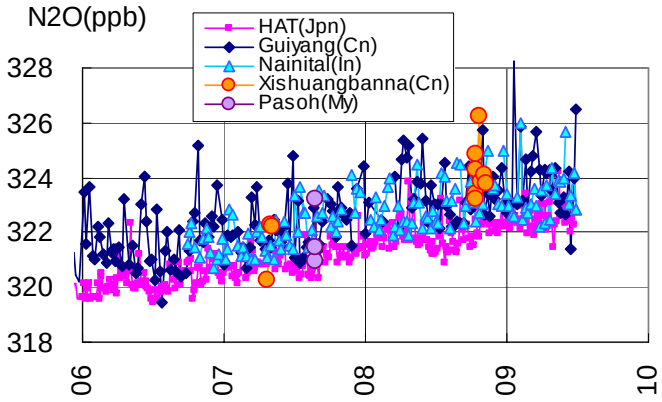
Sampling: Manish Naja (ARIES, Nainital)
Flask Sampling: 2006 onwards
Analytical Lab: NIES, Japan

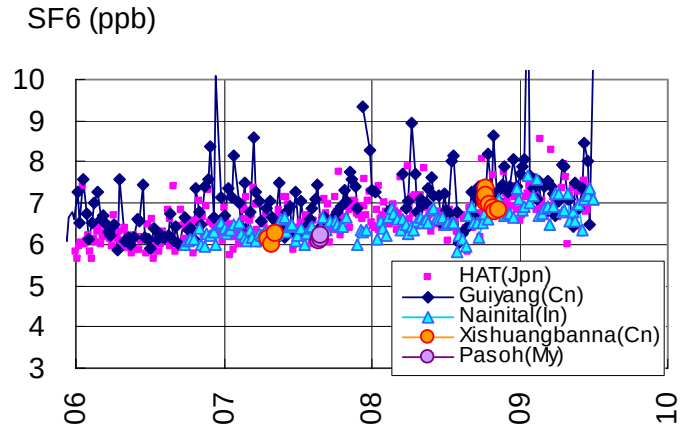

CO2 (ppm)
HAT(Jpn)
Guiyang(Cn)
Nainital(In)
Xishungbanna(Cn)
Pasoh(My)
430
420
410
400
390
380
370
360
06
07
08
09
10


CO(ppb)
HAT(Jpn)
Guiyang(Cn)
Nainital(In)
Xishuangbanna(Cn)
Pasoh(My)
1400
1200
1000
800
600
400
200
0
06
07
08
09
10


CH4 (ppb)
HAT(Jpn)
Guiyang(Cn)
Nainital(In)
Xishuangbanna(Cn)
Pasoh(My)
2400
2300
2200
2100
2000
1900
1800
1700
06
07
08
09
10

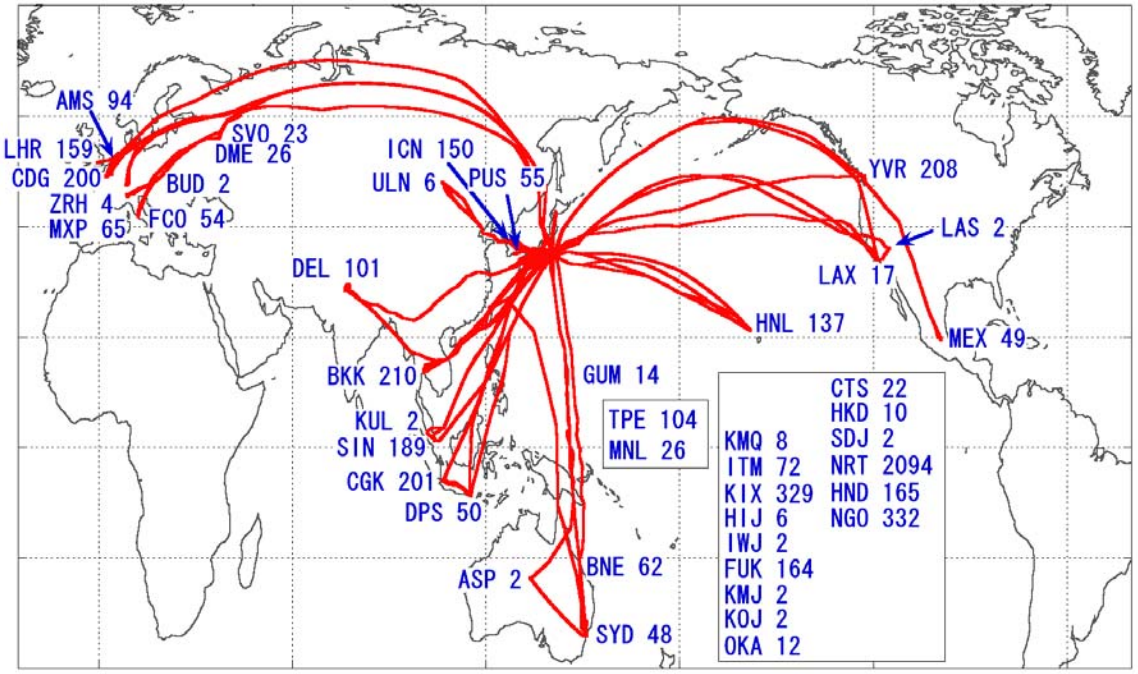

H2(ppb)
HAT(Jpn)
Guiyang(Cn)
Nainital(In)
850
800
750
700
650
600
550
500
450
06
07
08
09
10

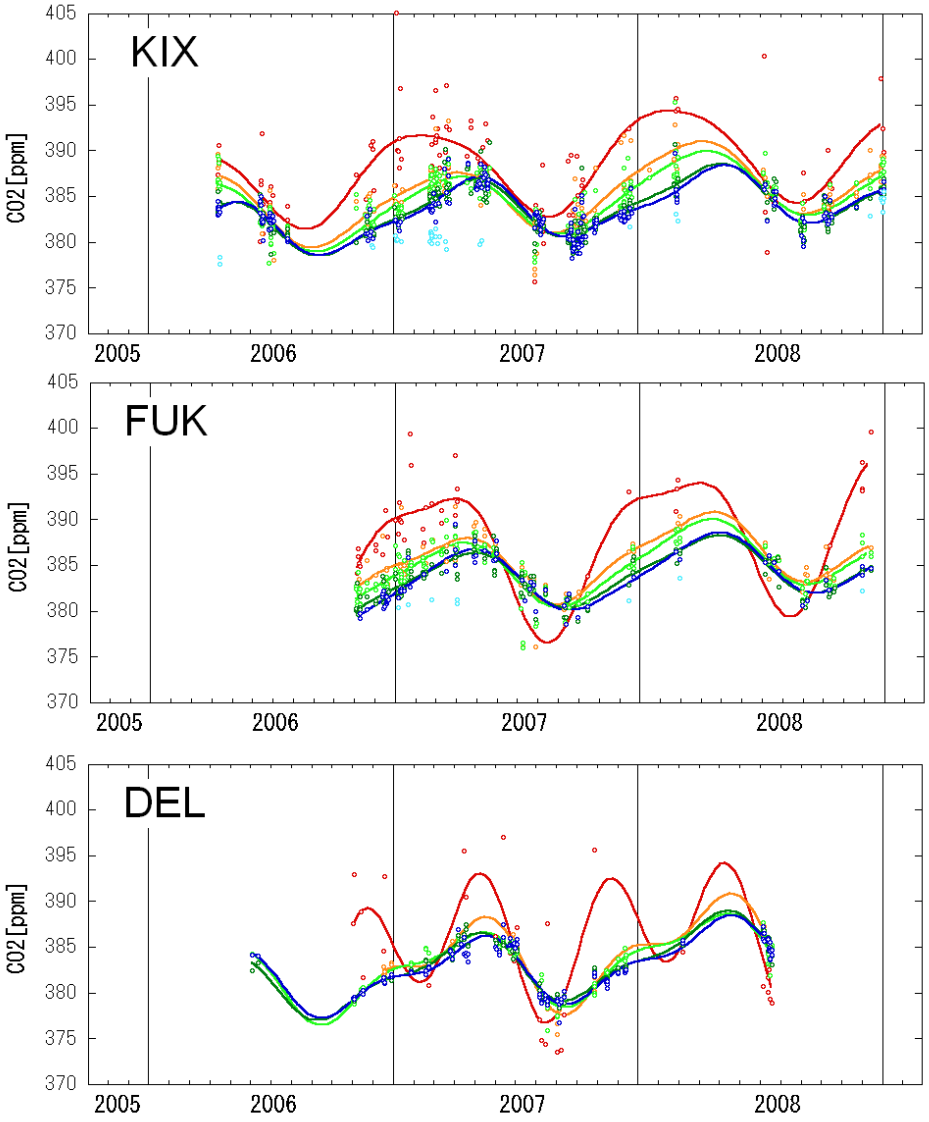

N2O(ppb)
HAT(Jpn)
Guiyang(Cn)
Nainital(In)
Xishuangbanna(Cn)
Pasoh(My)
328
326
324
322
320
318
06
07
08
09
10


SF6 (ppb)
HAT(Jpn)
Guiyang(Cn)
Nainital(In)
Xishuangbanna(Cn)
Pasoh(My)
10
9
8
7
6
5
4
3
06
07
08
09
10

Fright routes and Frequency

From Nov. 2005 to Dec. 2008, we conducted more than 3,000 flight and 5,800 vertical profiles were obtained by CME.





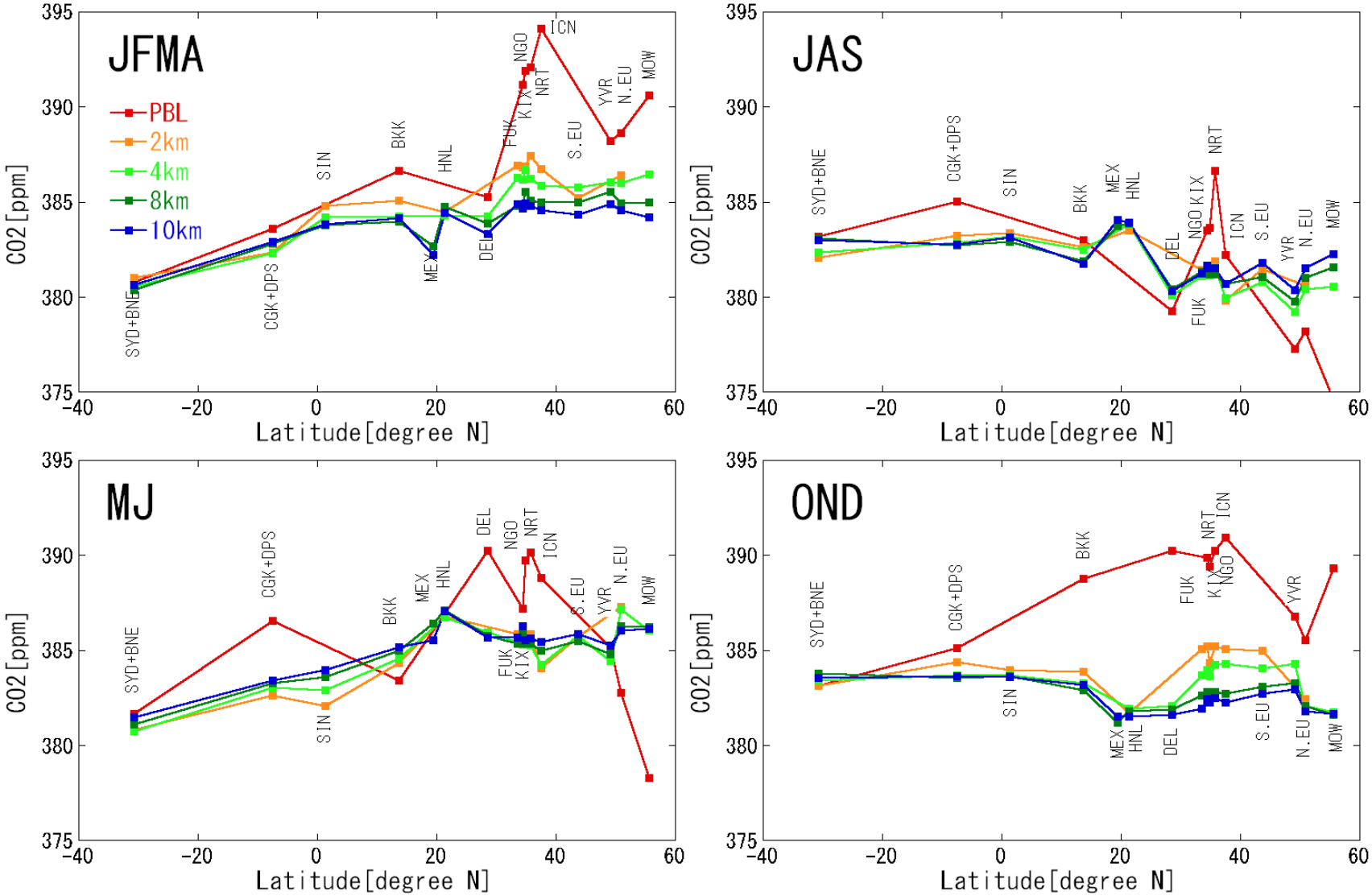
Sampling: T. Machida and Japan Airlines

In situ: 2005 onwards

NIES, Japan

Seasonal CO_2 Difference

In JAS and OND, no latitudinal gradient in FT in SH.
Northern summer CO_2 are lower than SH even in FT.
Vertical gradients in NH are small in MJ and negative in JAS.
Lower CO_2 in summer–fall lead low Delhi annual mean.
Not only summer low CO_2 but also winter high bring large amplitude over Moscow.

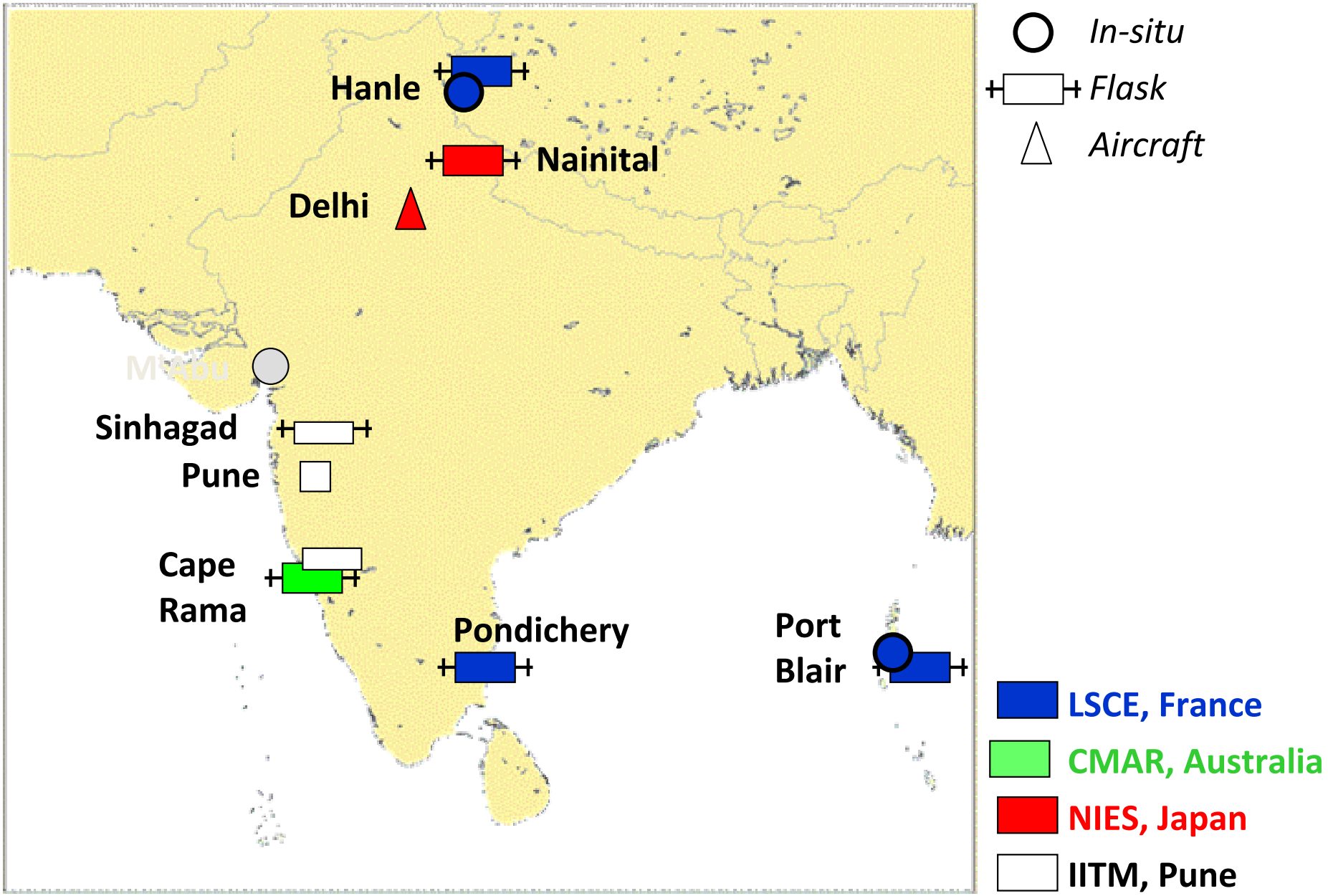


Flask analysis lab, Gas Chromatograph

At the Indian Institute of Tropical Meteorology (IITM), Pune, India

(Detectors: ECD, FID initially for CO2, CH4, N2O)
(Reference standards: NOAA/ESRL)

Yogesh Tiwari, IITM, Pune, India


Hanle
Nainital
Delhi
Mt Abu
Sinhagad
Pune
Cape
Rama
Pondichery
Port
Blair
In-situ
Flask
Aircraft
LSCE, France
CMAR, Australia
NIES, Japan
IITM, Pune

Acknowledgements:

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T. Machida,NIES

Len Barrie, WMO
Oksana Tarasova, WMO

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India