## Observation of greenhouse gases and estimation of eddy covarinace fluxes at urban and natural environments in India

#### Supriyo Chakraborty



Indian Institute of Tropical Meteorology Pune, India Collaborators Y. K. Tiwari, Abirlal Metya, P.K. Deb Burman Indian Institute of Tropical Meteorology Pune, India

A. Karipot, Savitri Bai Phule Pune University, Pune

Nirmali Gogoi, Dipankar Sarma Tezpur Central University, Tezpur, India

V. Selvam, P. Ganamoorthy M.S. Swaminanathan Research Foundation, India

A. Chatterjee, Bose Institute, Kolkata

S. Mukherjee, P. Lohani, K. Kumar G.B. Pant Institute of Himalayan Environment and Development, Almora, India

GEOSS Asia Pacific Symposium, Oct 24-26, 2018, Kyoto, TERRSA



GHGs Observational Network.

Flux tower: Project coordinated by IITM, Pune ("MetFlux India Project")

Project coordinated by ISRO

### Outline:

A brief description of the EC based measurements mainly of CO<sub>2</sub> fluxes at

Kaziranga National Park (KNP), NE India Selimbong Forest, Darjeeling, NE India Barkachha, North India Betul, Central India (ISRO) Sunderban Mangrove Forest, East India (ISRO)

More description of GHGs conc. measurement at

Sinhagad, near Pune, West India CO<sub>2</sub> and CH<sub>4</sub> flux measurements at Pichavaram Mangrove Forest, S. India



### Kaziranga National Park, Assam, NE India





### Surface energy budget closure at KNP



Burman et al. 2018 (under review)

An evergreen forest : Dhotre in Himalayan foothills; altitude ~ 2000m

Area: 41 square kilometer Dhotrey range, Darjeeling division Coniferous forest: Large evergreen tree

### CO<sub>2</sub> fluxes at Dhotre, Darjeeling District, NE India



during Mar-Apr (2015), the net ecosystem exchange (NEE) was -656.5 g  $CO_2$  m<sup>-2</sup>,

Chatterjee et al. 2018

## CO<sub>2</sub> flux measurement in an agricultural environment

Eastern edge of the Vindhyan ranges facing the Ganges basin at Barkacahha, near Varanasi, India.

Latitude 25.06 °N Longitude 82.59 °E 169 m above mean sea level

Homogeneous with croplands and scattered short trees

Measurement period: 2014-16

## **Diurnal variation of CO<sub>2</sub> flux and concentration**



## Diurnal variation of monthly averaged CO2 flux at Betul, Central Indian Teak forest



Time (hr)

Jha et al. 2013

## Diurnal variation of monthly averaged CO<sub>2</sub> flux at Sunderban Mangrove Forest



Rodda et al. 2016

## GHGs measurement at a semi-urban site, Sinhagad, near Pune, W. India



Location: 18.51N, 73.85E

Flask based measurement of CO2/CH4 since 2009 – to date

CO2/CH4 measurement using an LGR sensor (measurement period 7/2014 – 1/2016)

### Observation of atmospheric CO<sub>2</sub> and CH<sub>4</sub> concentration from SNG station (flask based)





End of Southwest Monsoon (JJAS): low CO<sub>2</sub> and CH<sub>4</sub>
For CO<sub>2</sub>: Photosynthetic uptake related to crop harvesting & transport
For CH<sub>4</sub>: transport & OH radical related sink process



NDVI variation suggest the effect of crop production



Metya et al. (ms under preparation)







1400 ha; 700 ha forest 400 ha water body 300 ha mudflat

Coastal semi-arid zone

Dry months: 7 months March to September

Mean Rainfall (70years): 1310 mm October to December

Shallow water: 0.5 to 1.0 m Micro tidal: 0.48 to 0.73 m

Single species (Avicennia marina) dominant ecosystem

#### Comparison of CO<sub>2</sub> fluxes at Pichavaram and Sunderban mangrove ecosystems



## Diurnal variation of CH<sub>4</sub> fluxes on seasonal time scale



## Methane fluxes at Sunderban, West Bengal [Jha et al. 2014]



## Comparison of CH<sub>4</sub> results

Methane emission using static chamber method at Pichavaram (Purvaja and Ramesh 2001):

2 - 13 mg.m<sup>-2</sup>.hr<sup>-1</sup>

Methane emission at Sunderban mangrove Forest using eddy covariance method (Jha et al. 2014): 0 - 145 mg.m<sup>-2</sup>.hr<sup>-1</sup>

Methane emission at Pichavaram (EC method; this study):  $0 - 3 \text{ mg.m}^{-2}.\text{hr}^{-1}$ 

So methane at the Pichavaram forest is characterized by HIGH concentration but very LOW fluxes compared to similar other environments.

Is it controlled by meteorology/chemistry?

## Dependency of CH<sub>4</sub> conc. with wind



## Summary

Characteristics of CO<sub>2</sub>/CH<sub>4</sub> fluxes at Pichavaram mangrove ecosystem

Eddy covariance based GHGs flux measurement has been done for the first time

 $CO_2$  fluxes show moderate uptake by vegetation.

Though surface water is characterised by high pCO<sub>2</sub>,eddy covariance based estimation of moderate CO2 fluxes may be indicative of some other mechanism leading to fast removal of organic carbon in the aquatic system.

Methane concentration shows high values, though the methane fluxes is characterised by 7-8 times lower values compared to the static chamber measurement in the same environment

Chemical processes, rather than meteorological conditions may play a major role in the dynamics of GHGs fluxes in this environment.

# Thank you