Research Networking Programmes

Short Visit Grant ☒ or Exchange Visit Grant ☐

(please tick the relevant box)

Scientific Report

The scientific report (WORD or PDF file – maximum of eight A4 pages) should be submitted online within one month of the event. It will be published on the ESF website.

Proposal Title: 1st ICOS International Conference on Greenhouse Gases and Biogeochemical Cycles

Application Reference N°: 6849

1) Purpose of the visit

The 1st ICOS International Conference on Greenhouse Gases and Biogeochemical Cycles on 23-25 September 2014, Belgium was open for scientists interested in research on greenhouse gas (GHG), biochemical cycles and climate change. The Integreated Carbon Observation System (ICOS RI) is a European Research Infrastructure dedicated to understanding the GHG budgets and pertubations, and provides long-term observations required to understand the present state and predict future behavior of the global carbon cycle and GHG emissions. The conference addressed the following issues: Atmosphere GHG concentrations and anthropogenic sources, ICOS data and global biogeochemical modeling, biogiochemical cycles of forests, grasslands, wetlands and agricultural ecosystems, ocean GHG observations and fluxes, regional integration studies, different GHG species, freshwaters, urban environments, etc.

As one of participant, I am a second year PhD student working at Le Laboratoire des Sciences du Climat et de l'Environnement, France. My PhD study focuses on GHG measurements and inverse modeling of GHG fluxes in South Asia. The aim of the visit is three folded: 1) to present CO2 and CH4 flask measurements at three new Indian ground stations, as well as CO2 and CH4 forward simulation with a chemical transport zoom model (LMDZORINCA with Asian zoom); 2) to exchange ideas with scientists who are also interested in regional GHG flux assessments via atmospheric measurements and inverse modeling; 3) to broaden my knowledge in atmospheric science and earth system.

2) Description of the work carried out during the visit

The 3-day conference included General Sessions, Parallel Sessions, and Poster Sessions. In General Sessions, plenary talks were given by leading scientists in the fields of atmospheric science and earth system, on the following topics: atmospheric greenhouse gas monitoring, ecosystem eddy flux measurements, global carbon cycle in land and ocean, and urban greenhouse gas emissions and monitoring. The Parallel Sessions were focused on several themes: 1) better assessment of greenhouse gases surface fluxes in Europe using atmospheric measurements and transport models; 2) pbservation of subtle changes in the net greenhouse gases flux from land surface at ecosystem level; 3) the role of oceans in the general global carbon cycle and CO2 fluxes, an update and future perspectives; 4) ICOS data and modelling; 5) freshwaters and urban environments. In the Poster Sessions, the presenters also showcased their most recent studies or projects on greenhouse gas monitoring, and flux measurements and modeling at different ecosystems and on different spatial/temporal scales. Besides, there was also a special session for the early career scientists about finding funding and applying for a research grant. A detailed conference program is attached with the report.

During the conference, I presented a poster "CO2 and CH4 over the Indian subcontinent: A study based on surface flask measurements and a chemical transport zoom model" in the poster session on September 24. The poster is attached with the report.

3) Description of the main results obtained

The 1st ICOS Science Conference was a success, with 200 participants from 25 countries and six continents. The conference provided a good platform for a diverse group of researchers as well as project managers to congregate and discuss the opportunities and challenges of greenhouse gas monitoring and flux measurements across different scales, the potential of observations and modeling in understanding global carbon cycle and fluxes of greenhouse gases, and the possibility of collaboration between different research institutes and an extension of current monitoring network. The conference also provided an opportunity for young scientists to exchange ideas with experienced scientists concerning scientific questions as well as how to prepare themselves in the science career.

4) Future collaboration with host institution (if applicable)

N/A

5)* Projected publications / articles resulting or to result from the grant *(ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant)

1) Five years of flask measurements of long-lived trace gases in India (to be submitted); 2) CO2 and CH4 over Asian: A forward simulation with a chemical zoom model (in preparation)

6) Other comments (if any)

N/A

CONFERENCE PROGRAMME

Tuesday 23 September	
11.00-13.00	Registration open
12.00-14.45 Opening of the Congress and Plenary Session (Espace Roi Beaudouin) Chair: Reinhart Ceulemans	
	Opening words by Belgian representative (TBC) and ICOS Director General *Werner Kutsch*
	Ingeborg Levin: THE CHALLENGE OF DEDICATED GREENHOUSE GASES MONITORING IN EUROPE
	Bob Scholes: INTEGRATION ON A SHOESTRING: CARBON CYCLE OBSERVATIONS AT A RANGE OF SCALES IN SOUTH AFRICA
	Dorothee Bakker: THE SURFACE OCEAN CO_2 ATLAS (SOCAT) ENABLES DETECTION OF CHANGES IN THE OCEAN CARBON SINK
14.45-15.15	Coffee break (Atrium)
15.15-16.30	General Session (Espace Roi Beaudouin) Chair: TBA
	Alessandro Cescatti: SOURCES AND PATTERNS OF INTER-ANNUAL VARIABILITY IN THE CARBON BUDGET OF TERRESTRIAL ECOSYSTEM
	Philip Nightingale: ENVIRONMENTAL DRIVERS OF VARIABILITY IN AIR-SEA GAS TRANSFER
	Lilong Wang: POTENTIAL OF EUROPEAN $^{14}CO_2$ OBSERVATION NETWORK TO ESTIMATE THE FOSSIL FUEL CARBON DIOXIDE EMISSIONS VIA ATMOSPHERIC INVERSIONS
16.30-16.50	Health break with coffee (Atrium)
	Christopher Williams: WHICH MATTERS MORE FOR CONTEMPORARY LAND CARBON STORAGE: LAND CHANGE, CLIMATE CHANGE, OR CLIMATE EXTREMES?
	Lukas Emmenegger: FIVE YEARS OF REAL-TIME ^{d13}C-CO_2 and ^{d18}O-CO_2 MEASUREMENTS AT JUNGFRAUJOCH
17.40-19.30	Poster Session I (Atrium)

Wednesday 24 September	
Parallel Sessions	
8.30-10.10	Parallel Session 1: *Better assessment of greenhouse gases surface fluxes in Europe using atmospheric measurements and transport models* (Ockeghemzaal) Chair: Leonard Rivier
	Samuel Hammer: ^{14}C SUPPORTED INTERPRETATION OF LONG-TERM ATMOSPHERIC TRACE GAS RECORDS IN THE URBAN ENVIRONMENT OF HEIDELBERG, GERMANY
	Philip Desmet: GREENHOUSE GAS MEASUREMENTS AT THE ILE DE LA RÉUNION IN THE FRAME OF TCCON AND ICOS
	Felix Vogel: STABLE CARBON ISOTOPES TO MONITOR THE CO_2 SOURCE MIX IN THE URBAN ENVIRONMENT
	Dietrich Feist: RETRIEVING MIXING HEIGHT FROM LIDAR AND CEILOMETER NETWORKS
	Thomas Röckmann: HOW DO ISOTOPE EFFECTS IN THE STRATOSPHERIC SINK REACTIONS OF LONG-LIVED GASES AFFECT THEIR TROPOSSPHERIC ISOTOPE BUDGETS?

CONFERENCE PROGRAMME

8.30-10.10	Parallel Session 2: *Observation of subtle changes in the net greenhouse gases flux from land surface at ecosystem level* (Espace Roi Beaudouin) Chair: Denis Loustau
	Katja Klumpp: PLANT TRAITS AS PREDICTORS OF ECOSYSTEM CARBON FLUXES – A CASE STUDY ACROSS EUROPEAN GRASSLANDS
	Lutz Merbold: LONG-TERM EDDY COVARIANCE FLUX DATA FROM A SUB-ALPINE FOREST: CHALLENGES AND OPPORTUNITIES
	Stefanos Mystakidis: EMERGENT CONSTRAINTS ON FUTURE TERRESTRIAL CARBON FLUXES
	Jan Reent Köster: SOIL pH AS A MAIN CONTROLLER OF N_2O EMISSIONS – PROOF OF CONCEPT USING AN AUTOMATED FIELD ROBOT FOR HIGH FREQUENCY FLUX MEASUREMENT
	Jonard Mathieu: IS TREE MINERAL NUTRITION DETERIORATING IN EUROPE
8.30-10.10	Parallel Session 3: *The role of oceans in the general global carbon cycle and CO_2-fluxes, an update and future perspectives* (Rubensauditorium) Chair: Truls Johannessen
	Ute Schuster: SEA SURFACE pCO_2 THE SEA-AIR CO_2 FLUX OBTAINED BY VOLUNTARY OBSERVING SHIPS IN THE ATLANTIC
	Tobias Steinhoff: SEASONAL AND INTERANNUAL VARIABILITY OF CO_2 FLUXES IN THE NORTH ATLANTIC OCEAN
	Nathalie Lefevre: SUSTAINED CO_2 OBSERVATIONS IN THE ATLANTIC OCEAN FROM 50°N TO 25°S
	Pedro Monteiro: OCEAN ROBOTICS AS PLATFORMS TO REDUCE THE UNCERTAINTY OF AIR-SEA CO_2 FLUXES IN THE SOUTHERN OCEAN
	Luke Gregor: OPTIMISING STRATEGIES FOR SAMPLING AIR-SEA CARBON DIOXIDE FLUXES IN THE SOUTHERN OCEAN: A GENETIC ALGORITHM APPROACH
	Goulven G. Laruelle: GLOBAL ATMOSPHERIC CO_2 UPTAKE BY CONTINENTAL SHELF SEAS: A REVISED ESTIMATE
10.10-10.40	Coffee break (Atrium)
Parallel Sessions	
10.40-12.00	Parallel Session 4 *ICOS Data and modelling* (Ockeghemzaal) Chair: Alex Vermeulen
	Dominik Brummer (Lukas Emmenegger): THE CARBOCOUNT CH INTERACTIVE VISUALIZATION TOOL FOR GREENHOUSE GAS OBSERVATIONS AND SOURCE SENSITIVITY MAPS
	Benjamin Pfeil: THE ROLE OF ICOS DATA WITHIN THE GLOBAL MARINE CARBON NETWORK
	Gregor Josef Schürmann: IMPROVING THE MODELLED GLOBAL TERRESTRIAL CARBON CYCLE BY ASSIMILATING CO_2 MOLE FRACTIONS AND FAPAR WITH THE MPI - CARBON CYCLE
	Christoph Gerbig: NETWORK ASSESSMENT AND DESIGN USING MESOSCALE MODELS WITHIN ICOS-INWIRE
10.40-12.00	Parallel Session 2 continues (Espace Roi Beaudouin) Chair: Denis Loustau
	Bruce Osborne: CONTRASTING IMPACTS OF AFFORESTATION ON TRACE GAS EMISSIONS
	TBA
	Sigrid Dengel: HIGH LATITUDE FOREST DYNAMICS
	Tiphaine Tallec: MANAGEMENT AND CLIMATE EFFECTS ON NET ECOSYSTEM CARBON, GHG AND WATER BUDGETS ON CROP SITES OF SOUTH WEST FRANCE

10.40-12.00	Parallel Session 5: *Freshwaters and urban environments* (Rubensauditorium) Chair: Timo Vesala	
	Cristopher Caldow: THE INVESTIGATION AND IN-SITU MEASUREMENT OF INLAND WATER-ATMOSPHERE GREENHOUSE GAS (CO_2, CH_4 & N_2O) EXCHANGE	
	Mats Öquist: THE FULL ANNUAL CARBON BALANCE OF BOREAL FORESTS IS HIGHLY SENSITIVE TO PRECIPITATION	
	Johannes Staufer: INVERSIONS OF CO_2 EMISSIONS FROM THE PARIS AREA USING YEARLONG MEASUREMENT SERIES	
	Leena Järvi: THE EFFECT OF VEGETATION ON THE EXCHANGE ON CO_2 AND N_2O IN AN URBAN AREA	
12.00-13.00	Lunch (Atrium)	
13.00-15.45	Plenary Session (Espace Roi Beaudouin) Chair: Timo Vesala	
	John Finnigan: THE INFLUENCE OF TOPOGRAPHY ON EDDY FLUX MEASUREMENTS-LONG STANDING PROBLEMS AND A WAY FORWARD	
	Sue Grimmond: URBAN GREENHOUSE GASES: VARIABILITY AND KEY DRIVERS	
14.30-15.00	Coffee break (Atrium)	
	Xunhua Zheng: SOME ESSENTIAL ISSUES IN FIELD EXPERIMENT STUDIES AND BIOGEOCHEMICAL MODELLING ON GHG FLUXES FROM TERRESTRIAL ECOSYSTEMS	
15.45-16.40	General Session (Espace Roi Beaudouin) Chair: Timo Vesala	
	Emanuel Gloor: INTER-ANNUAL VARIABILITY OF AMAZONIAN GREENHOUSE GAS BALANCES	
	Marcos Fernández-Martínez: NUTRIENTS MATTERS MOST FOR GLOBAL FOREST CARBON BALANCE	
16.40-18.30	Poster Session II (Atrium)	
20.00-	Conference Dinner (Marbelzaal)	

Thursday 25 September		
9.00-10.30	General Session (Espace Roi Beaudouin) Chair: TBA	
	Mathias Herbst: LONG-TERM OBSERVATIONS OF ECOSYSTEM CARBON EXCHANGE REVEAL CONTROL MECHANISMS NOT CAPTURED BY TRADITIONAL MODELS	
	Reiner Steinfeldt: STORAGE OF ANTHROPOGENIC CARBON IN ATLANTIC OCEAN WATER MASSES AND ITS DECADAL VARIABILITY	
	Ana Bastos: THE ROLE OF THE NORTH-ATLANTIC OSCILLATION AND EAST-ATLANTIC PATTERN IN THE INTER-ANNUAL VARIABILITY OF THE EUROPEAN CO_2 SINK	
10.30-11.00	Coffee break (Atrium)	
11.00-13.00	Plenary Session (Espace Roi Beaudouin) Chair: TBA	
	Philippe Ciais: TBA	
	Beverly Law: TBA	
	Werner Kutsch: TBA	
13.00-15.00	ICOS Annual Celebrations (Atrium)	
15.00-17.00	Early Career Meeting (Ockeghemzaal)	ICOS Focal Point meeting with IRICom (Rubensauditorium)
	Grant Allen: FINDING FUNDING: HOW TO APPLY FOR A RESEARCH GRANT	
	Discussion	
19.30-	Hosted Dinner (Restaurant La Quincallerie)	

CO_2 and CH_4 over the Indian subcontinent: A study based on surface flask measurements and a chemical transport zoom model

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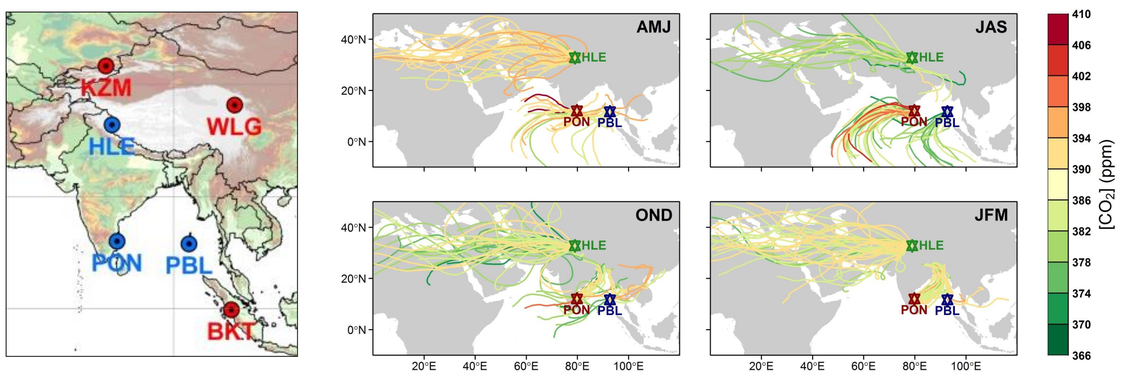
Overview

India has become the world's third largest GHG emitter, with anthropogenic GHG emissions increasing by 100% from 1.4 to 2.8 $GtCO_2eq$ between 1990 and 2010 (EDGARv4.2). However, current inversed estimates of GHG budgets in India have large uncertainties, due to the lack of atmospheric observations and differences in modelled atmospheric transport.

In this study, first we present CO_2 and CH_4 flask measurements at three newly-established stations at Hanle (HLE), Pondicherry (PON) and Port Blair (PBL), analyzing gradients between stations in terms of annual mean and seasonal cycles. Then we apply an chemical transport model (CTM) with Asian zoom using prior fluxes to model CO_2 and CH_4 concentration fields during 2006-2010. We compare the modelled seasonal cycles and synoptic variations with observations at the three Indian stations and several other Asian stations nearby. We also try to attribute the seasonal and synoptic variations to different sources/sinks.

Surface flask measurements

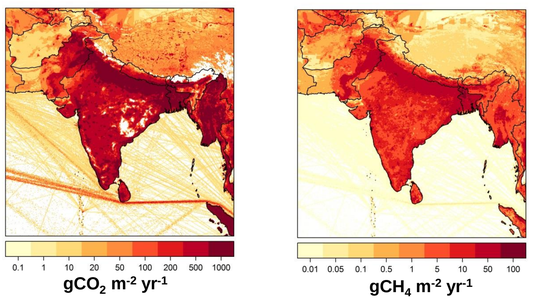
Since 2005, three new atmospheric ground stations have been established in India as part of a cooperation between Laboratoire des Sciences du Climat et de l'Environnement (LSCE), France and CSIR Fourth Paradigm Institute (CSIR-4PI), India. HLE is a high-altitude station situated in western Himalayas, while PON and PBL are tropical surface stations located at the southeast coast of South India and an oceanic island in Bay of Bengal, respectively.



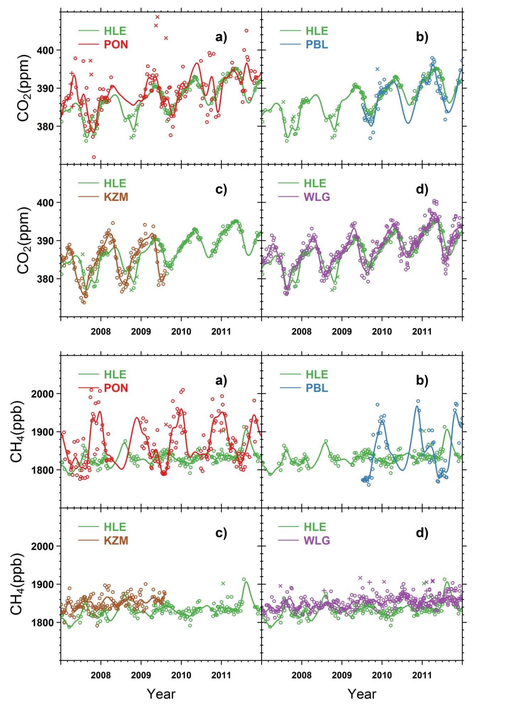
Back-trajectories show that HLE dominantly samples air masses from N. Africa and Middle East throughout the year, except for air masses coming from S. and SE Asia during the SW monsoon season in JAS. Air masses received at PON and PBL are strongly related to monsoon circulations.

❑ 1. Time series

The gradients between HLE and PON/PBL in annual means derived from smoothed fitting curves (Thoning et al., 1989) suggest significant CO_2 and CH_4 emissions in S. and NE India.

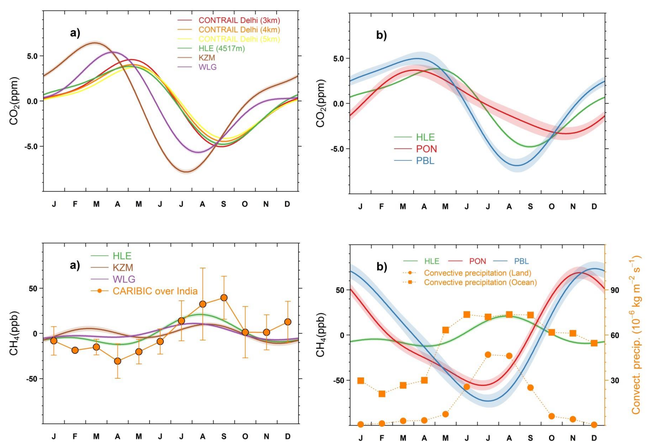


CO_2 and CH_4 Emissions in 2010 (EDGARv4.2)



❑ 2. Mean seasonal cycles

- **CO_2**: Phase shifts between HLE and KZM/WLG due to different air mass origins; the seasonal cycles at PON and PBL are mainly controlled by monsoon circulations
- **CH_4**: summer maximum at HLE, and summer minima at PON and PBL, due to deep convection associated with the SW monsoon; winter maxima at PON and PBL due to polluted air from NE India and SE Asia



Acknowledgement

This work has been done within the framework of CaFICA-CEFIPRA project (2809-1). We thank the staff from IAO, Hanle for operating and maintaining CARIBOU and handling the manual sampling. We acknowledge the LSCE staff in charge of the RAMCES network logistics, and data processing. We also thank PIs of other stations for making datasets available in NOAA/ESRL GMD network. Wind fields to drive back-trajectories analyses are from the Global Data Assimilation System (GDAS) archive data based on National Centers for Environmental Prediction (NCEP) model output. The participation of the author in the ICOS Science Conference is supported by a short visit grant from TTorch program of European Science Foundation.

Reference

EC-JRC/PBL (European Commission, Joint Research Centre/Netherlands Environmental Assessment Agency): Emission Database for Global Atmospheric Research (EDGAR), release version 4.2: available at: http://edgar.jrc.ec.europa.eu (last access: August 2014), 2011

Hourdin F, et al. (2006) The LMDZ4 general circulation model: climate performance and sensitivity to parametrized physics with emphasis on tropical convection, *Clim. Dyn.* 27(7-8):787–813.

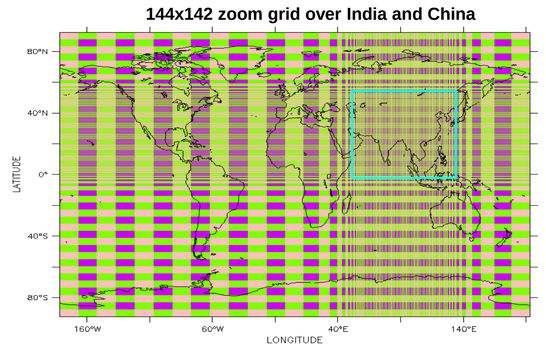
Thoning KW, Tans PP, Komhyr WD (1989) Atmospheric carbon dioxide at Mauna Loa Observatory: 2. Analysis of the NOAA GMCC data 1974-1985, *J. Geophys. Res.*, 94, 8549–8565.

Wang R, et al. (2014) Exposure to ambient black carbon derived from a unique inventory and high-resolution model, *Proc. Natl. Acad. Sci.*, 111, 2459-2463.

LMDZORINCA with Asian zoom

LMDZORINCA is a global model that couples a general circulation model (**LMD**) to a terrestrial biosphere module (**ORCHIDEE**) and an aerosol and chemistry module (**INCA**). The model has a horizontal resolution of 144 grids (Lon.) by 142 grids (Lat.), and sigma-p coordinates with 19 levels from 3.88 to 1013 hPa. The Asian zoom version is run at a resolution of 0.51° in latitude and 0.66° in longitude for a region of 50-130°E, 0-55°N centered over China and India.

144x142 zoom grid over India and China



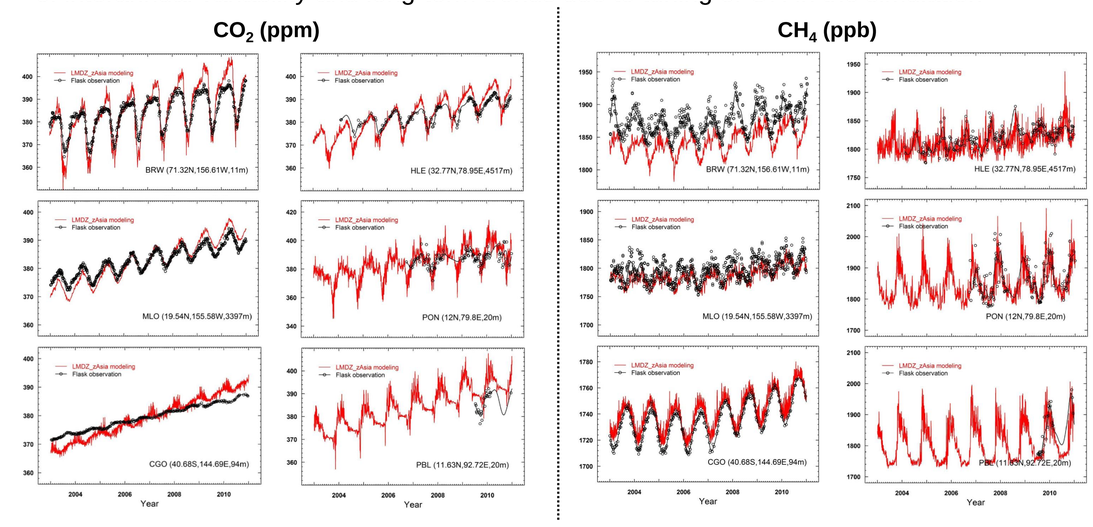
CO_2 and CH_4 fluxes used in the simulation

CO_2	Data source	interann./clim.	time step	resolution
Anthropogenic	IER products for CARBONES; GEOCARBON products	interannual	monthly	1°
Biomass burning	GFEDv3.1	interannual	monthly	0.5°
Land flux (NEE)	ORCHIDEE outputs for CARBONES	interannual	daily	0.72°
Ocean flux	NOAA/AOML product; Park et al. (2010)	interannual	monthly	4° ×5°
CH_4	**Data source**	**interann./clim.**	**time step**	**resolution**
Anthropogenic	EDGARv4.2	interannual	yearly	0.1°
Wetland	Kaplan et al. (2006)	climatological	monthly	1°
Biomass burning	GFEDv3.0	interannual	monthly	0.5°
Termite	Sanderson et al. (1996)	climatological	monthly	1°
Soil	Ridgwell et al. (1999)	climatological	monthly	1°
Ocean	Lambert & Schmidt (1993)	climatological	monthly	1°

Model v.s. Observations

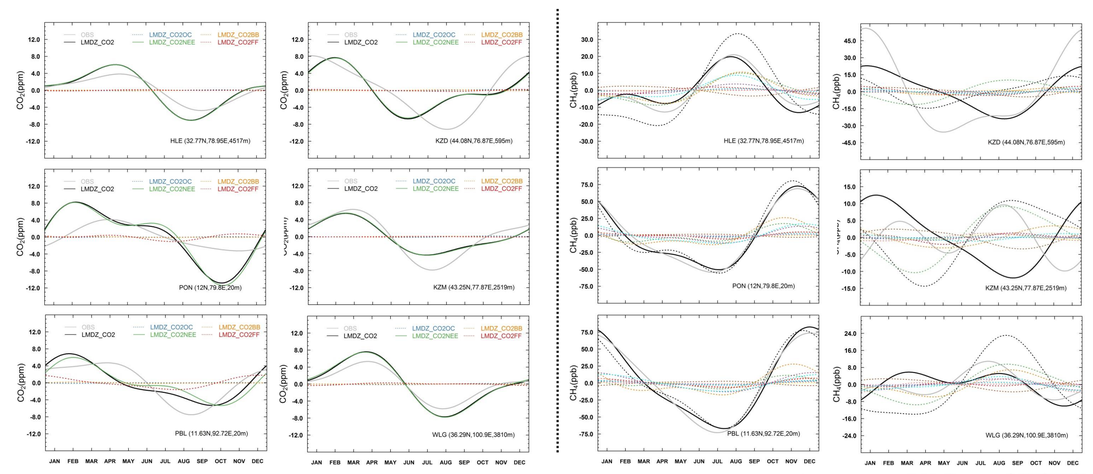
❑ 1. Time series

- **CO_2**: overestimation of long-term trends due to the prior CO_2 fluxes used in the simulation
- **CH_4**: underestimation of N-S gradients due to faster interhemispheric mixing; well capture of interannual variability and long-term trends due to tuning of OH in the simulation



❑ 2. Seasonal cycles

- **CO_2**: overestimation of seasonal cycle amplitudes; dominantly contributed by land fluxes
- **CH_4**: well capture of seasonal cycles at HLE, PON and PBL, but poor at KZD, KZM and WLG; contributed mainly by wetland, rice and ruminant emissions at HLE, PON and PBL



❑ 3. Synoptic variability

- **CO_2**: land fluxes dominate synoptic variability, for PBL in OND, fossil fuels also contribute
- **CH_4**: large contribution by ruminant emissions throughout the year, followed by waste disposal; significant contributions of wetland and rice emissions depending on seasons