Greenhouse Gases High Precision Measurements and the efforts in construct the GHG Brazilian Network

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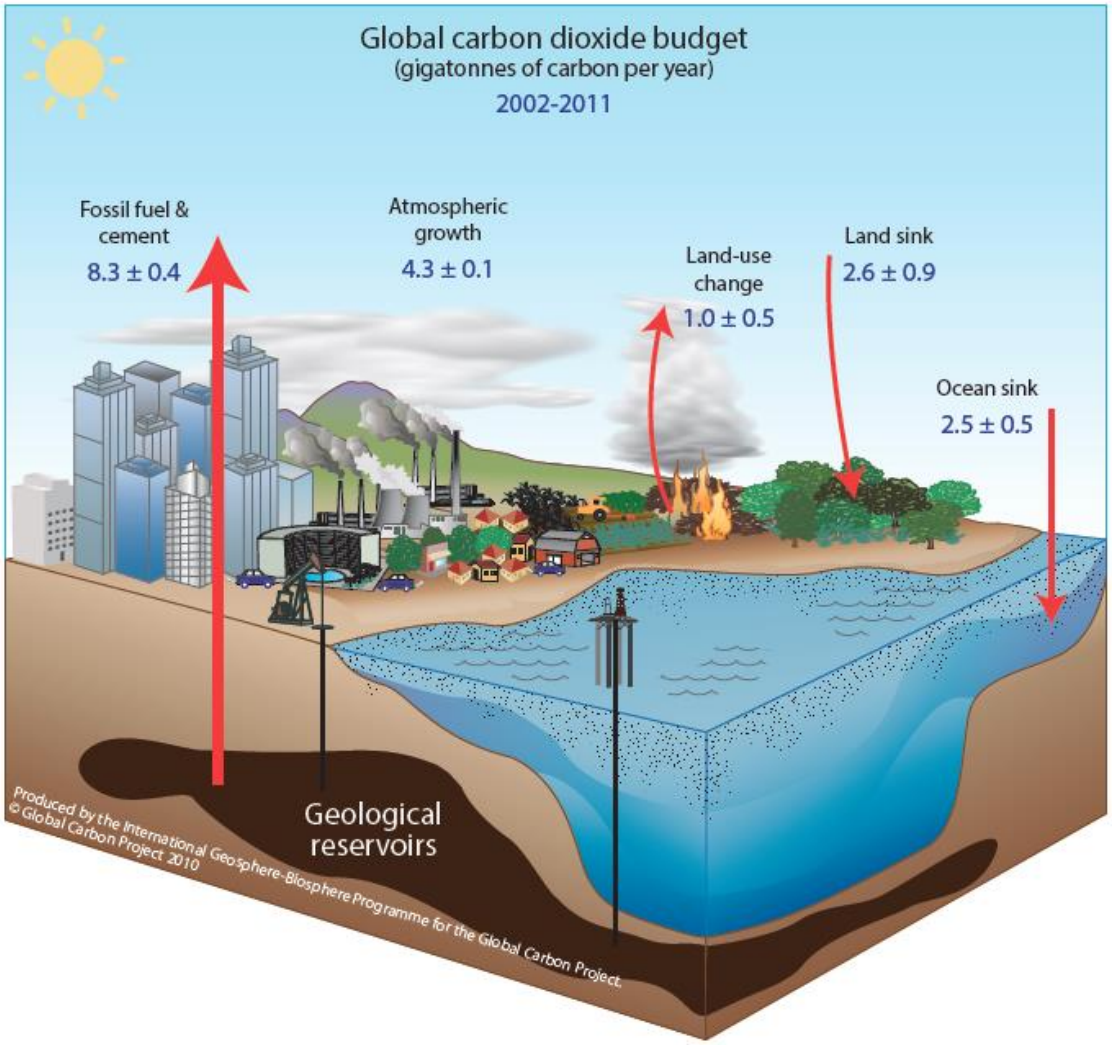
Anthropogenic Perturbation of the Global Carbon Cycle

Perturbation of the global carbon cycle caused by anthropogenic activities, averaged globally for the decade 2002–2011 (PgC/yr)

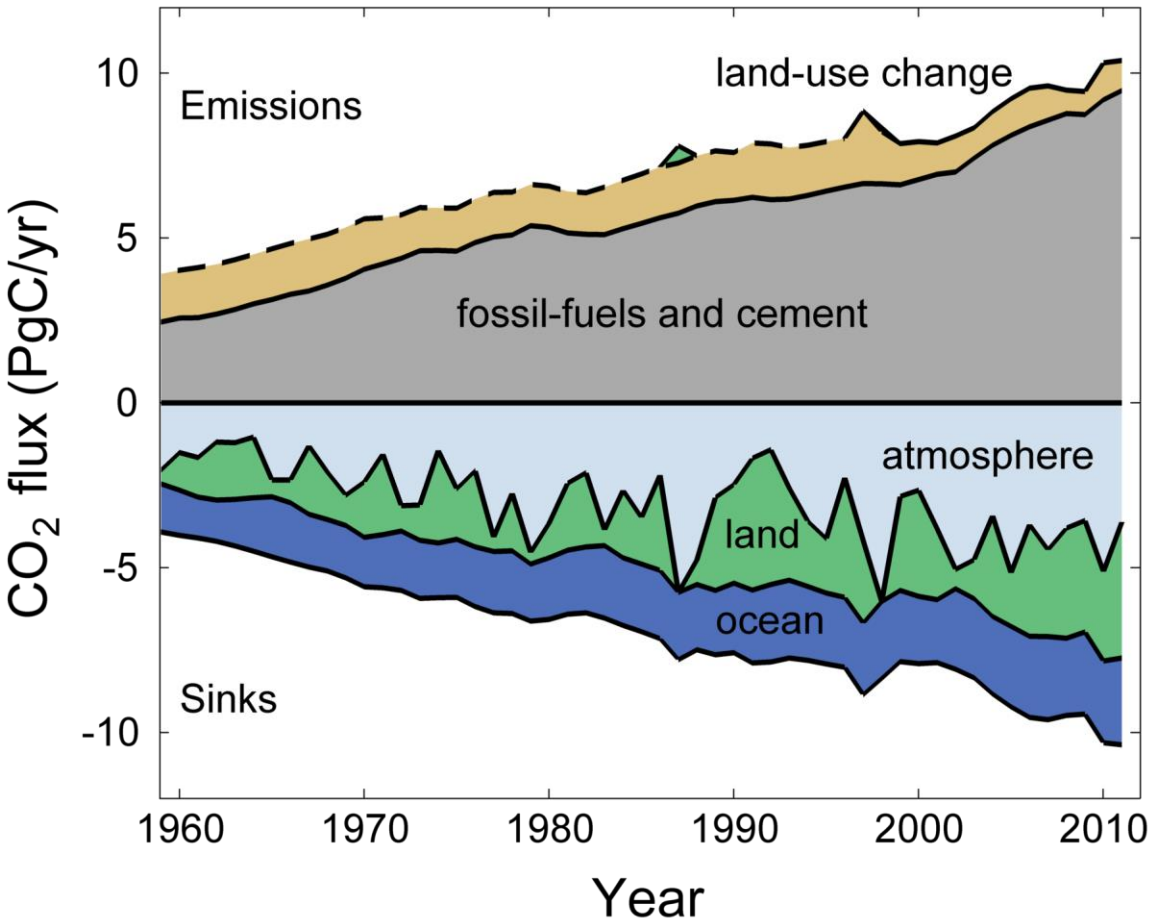


Source: Le Quéré et al. 2012; Global Carbon Project 2012

Global Carbon Budget

Emissions to the atmosphere are balanced by the sinks

Averaged sinks since 1959: 44% atmosphere, 28% land, 28% ocean



The dashed land-use change line does not include management-climate interactions

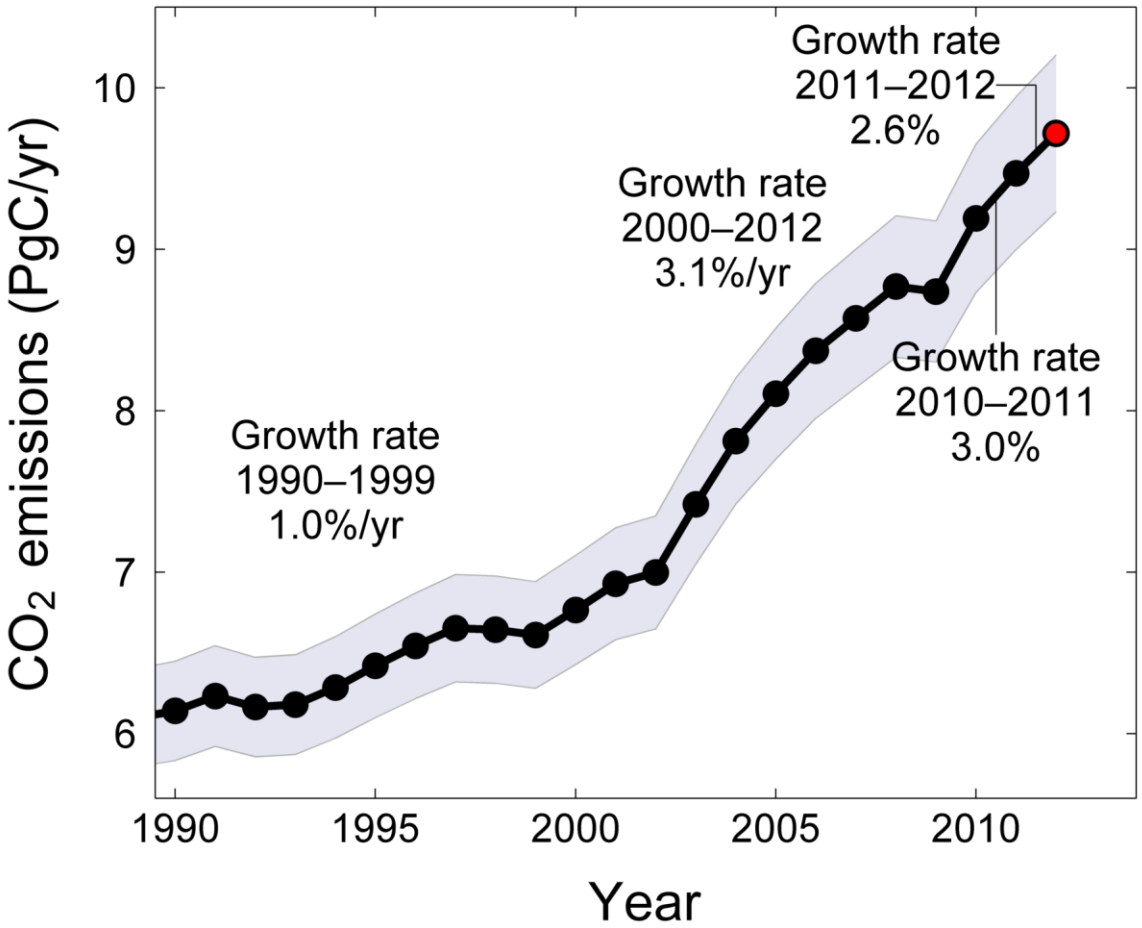
The land sink was a source in 1987 and 1998 (1997 visible as an emission)

Source: Le Quéré et al. 2012; Global Carbon Project 2012

Fossil and Cement Emissions

Global fossil and cement emissions: 9.5±0.5PgC in 2011, 54% over 1990

Projection for 2012: 9.7±0.5PgC, 58% over 1990



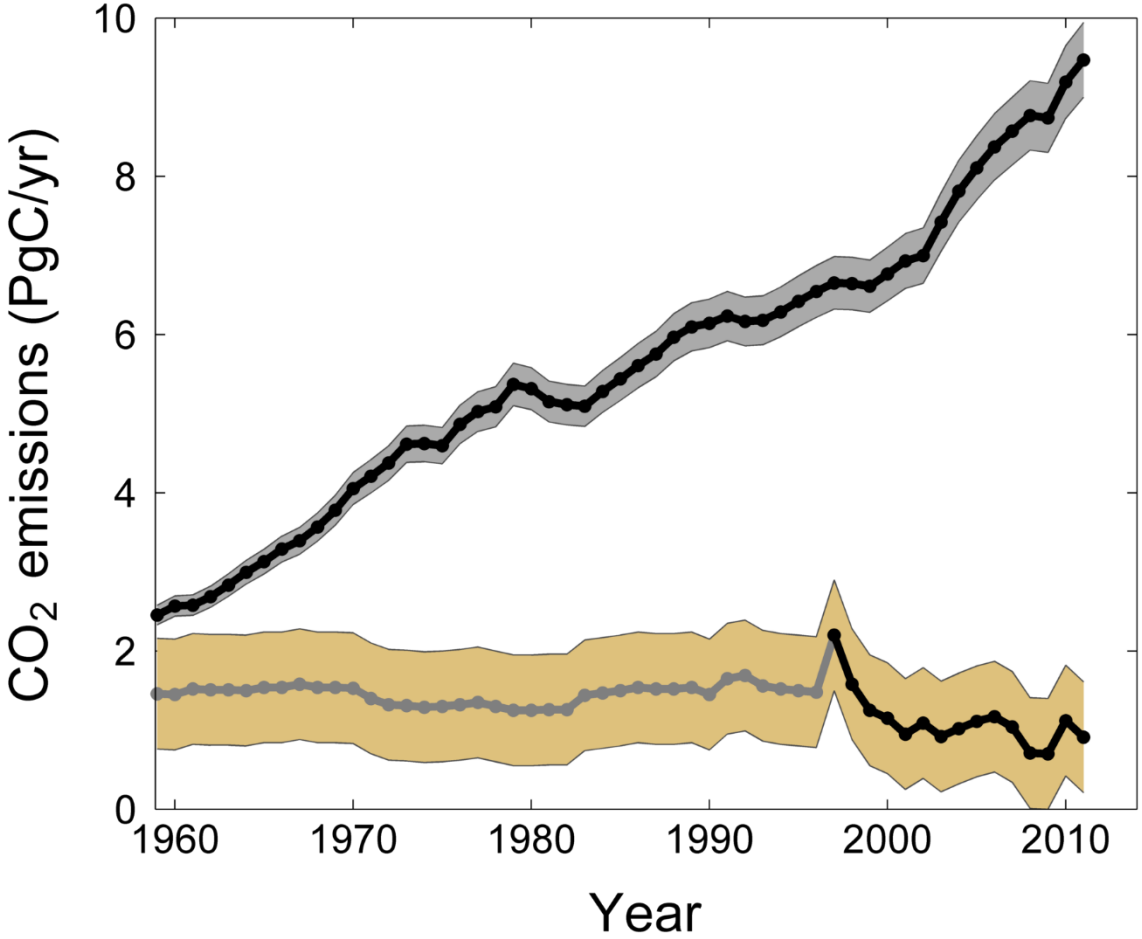
Uncertainty is ±5% for one standard deviation (IPCC "likely" range)

Source: Peters et al. 2012a; Le Quéré et al. 2012; CDIAC Data; Global Carbon Project 2012

Total Global Emissions

Total global emissions: 10.4±0.7PgC in 2011, 37% over 1990

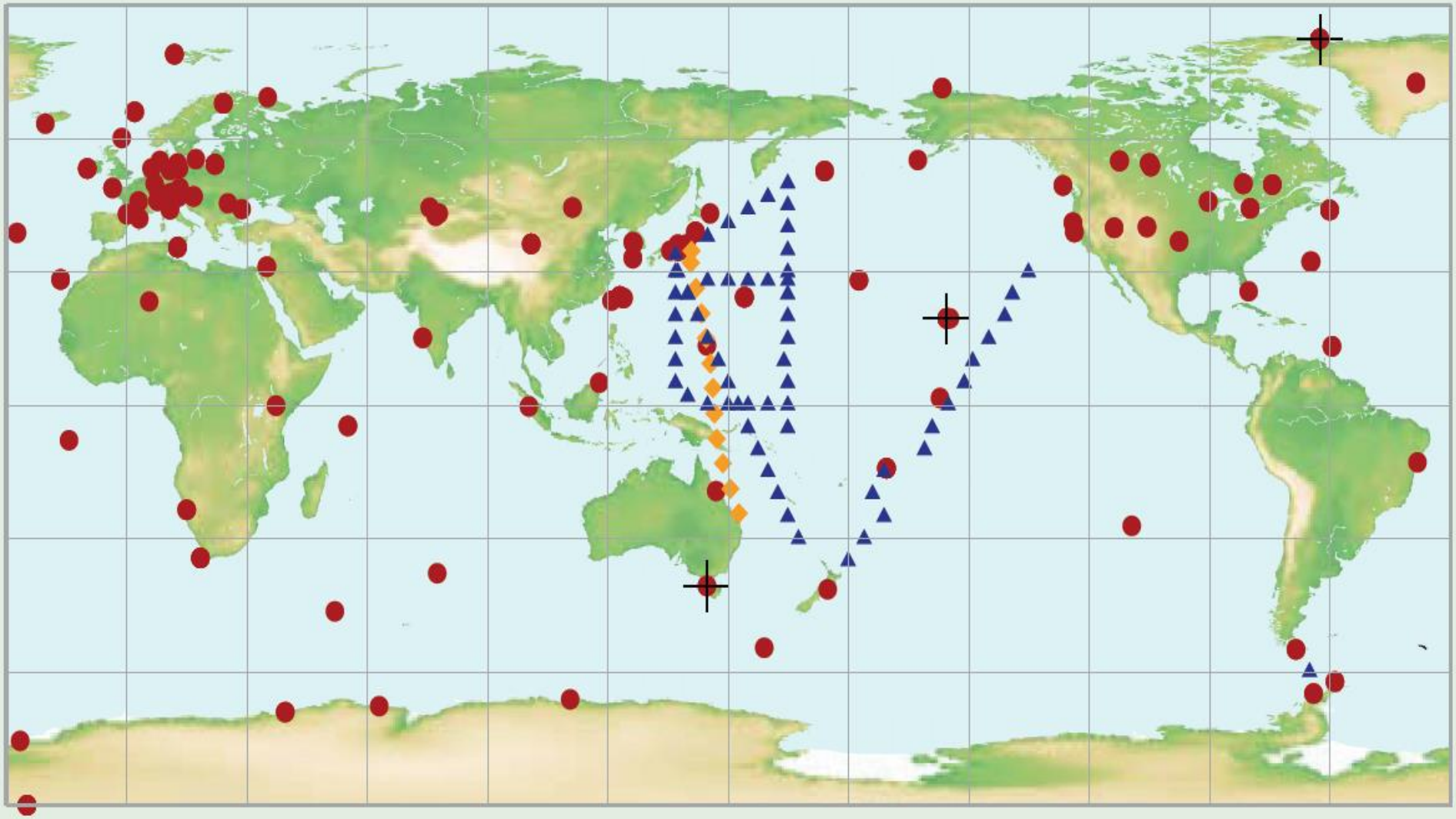
Percentage land-use change: 36% in 1960, 18% in 1990, 9% in 2011



Land-use change black line: Includes management-climate interactions

Source: Le Quéré et al. 2012; Global Carbon Project 2012

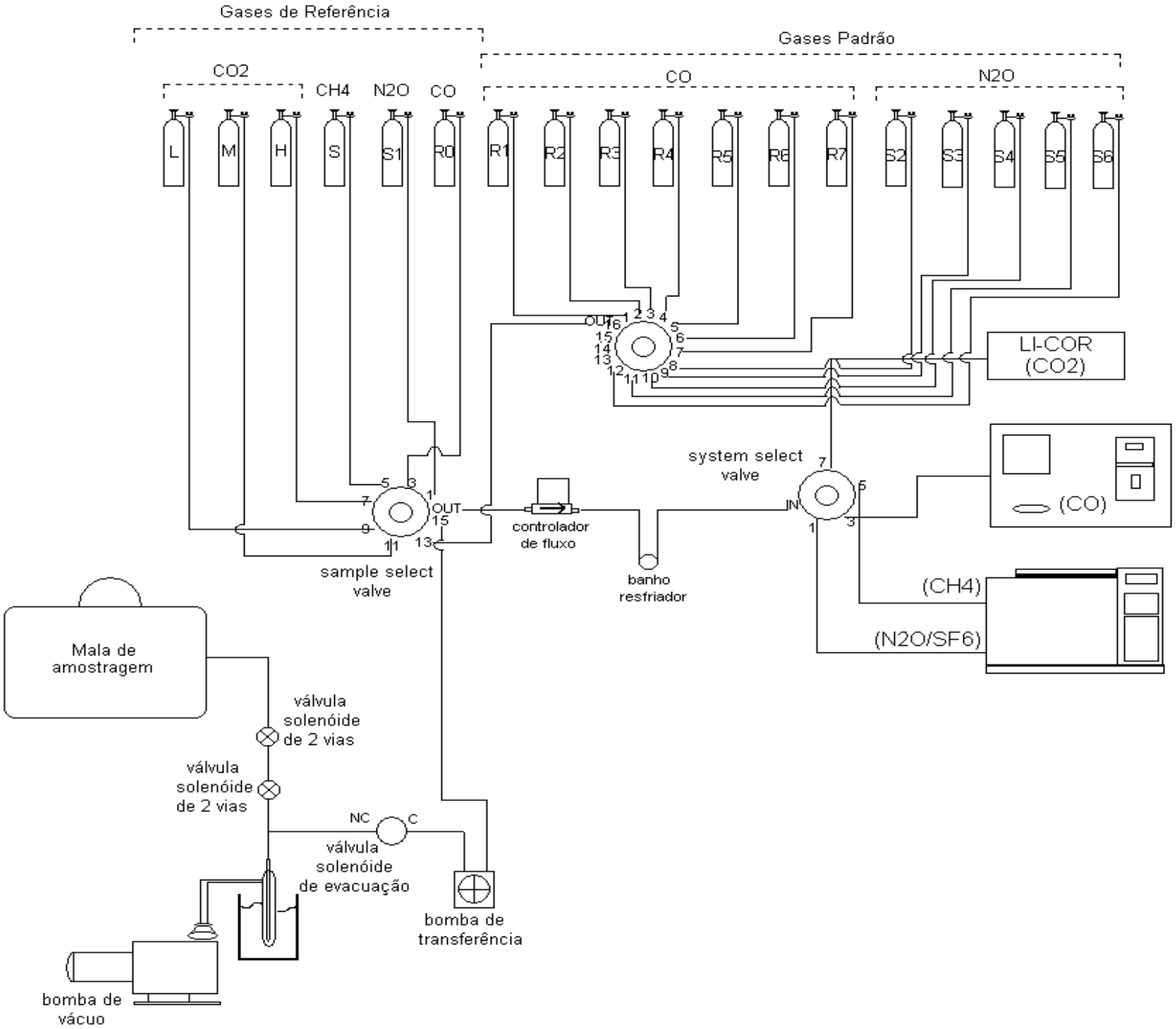
WMO/GAW Global CO_2 Monitoring Network



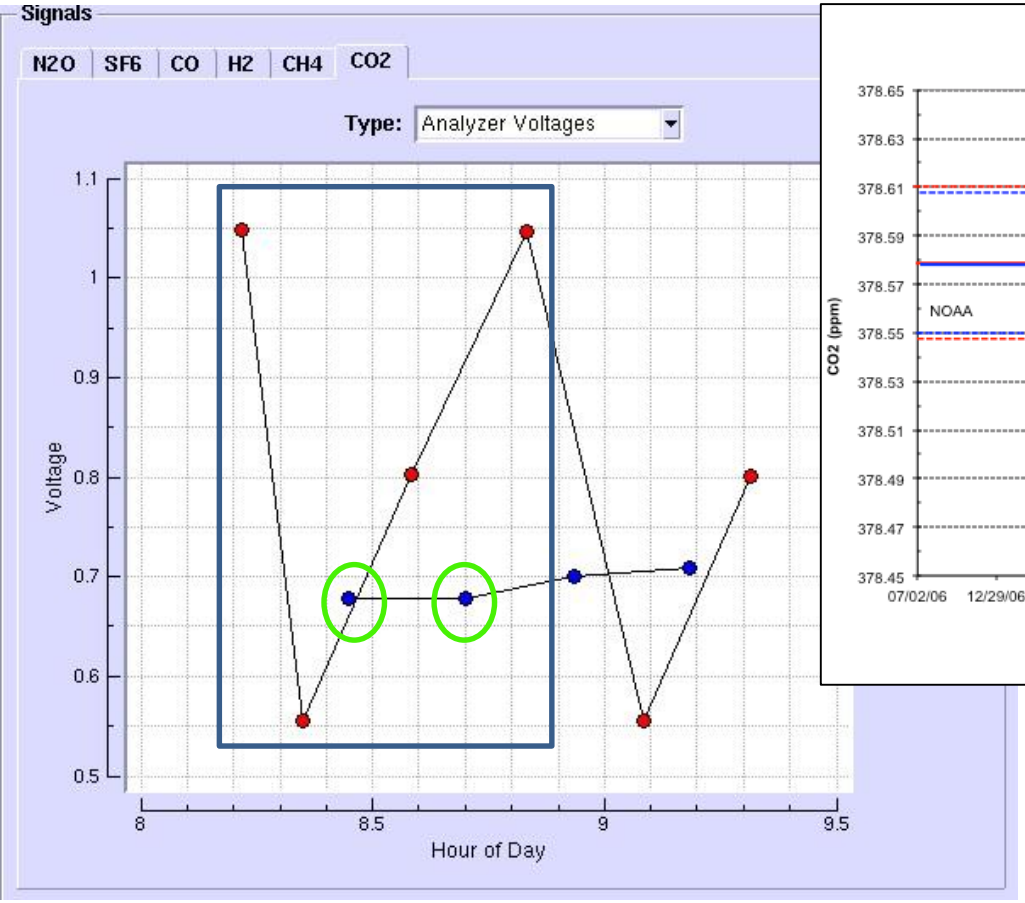
Ground-based Aircraft Ship GHG Comparison Sites

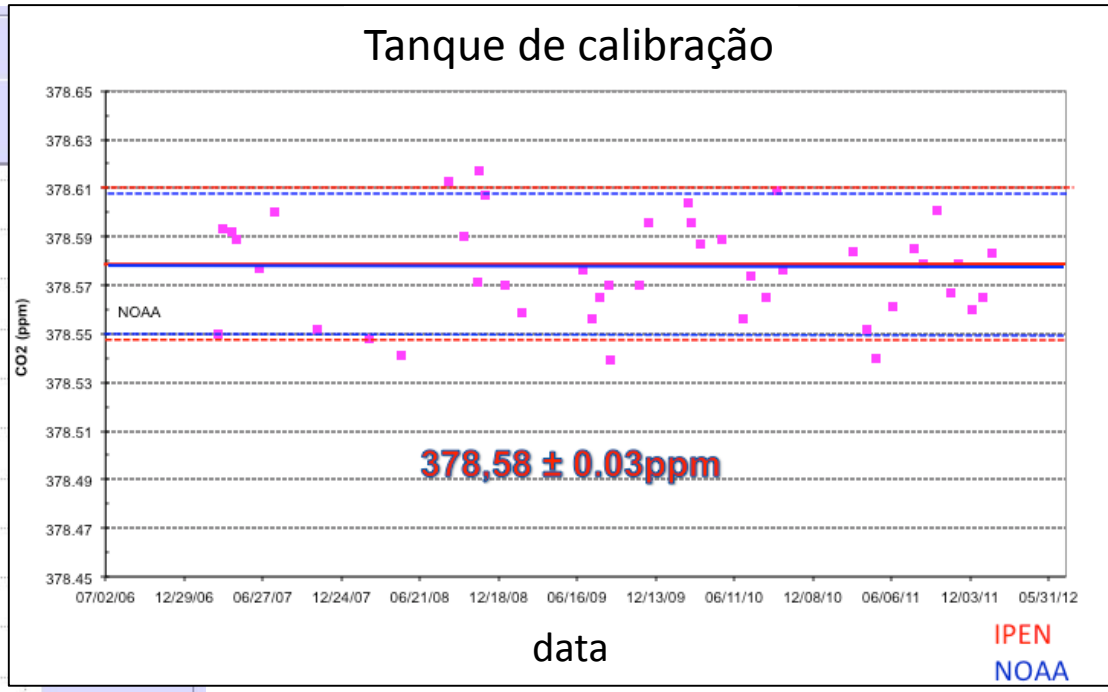
Lab. de Química Atmosférica CQMA/IPEN
Réplica do Laboratório da NOAA/ESRL/GMD

(National Oceanic Atmospheric Administration / Earth System Research Laboratory / Global Monitoring Division)


Gases de Referência
Gases Padrão
CO2
CH4
N2O
CO
CO
N2O
L
M
H
S
S1
R0
R1
R2
R3
R4
R5
R6
R7
S2
S3
S4
S5
S6
OUT
LI-COR
(CO2)
system select
valve
IN
(CO)
(CH4)
(N2O/SF6)
OUT
controlador
de fluxo
banho
resfriador
sample select
valve
Mala de
amostragem
válvula
solenóide
de 2 vias
válvula
solenóide
de 2 vias
NC
C
válvula
solenóide
de evacuação
bomba de
transferência
bomba de
vácuo

CO_2


Signals
N2O
SF6
CO
H2
CH4
CO2
Type:
Analyzer Voltages
Voltage
1.1
1
0.9
0.8
0.7
0.6
0.5
8
8.5
9
9.5
Hour of Day


Tanque de calibração
CO2 (ppm)
378.65
378.63
378.61
378.59
378.57
378.55
378.53
378.51
378.49
378.47
378.45
NOAA
378,58 ± 0.03ppm
07/02/06
12/29/06
06/27/07
12/24/07
06/21/08
12/18/08
06/16/09
12/13/09
06/11/10
12/08/10
06/06/11
12/03/11
05/31/12
data
IPEN
NOAA

LI-COR
LI-7000 CO2/H2O Analyzer

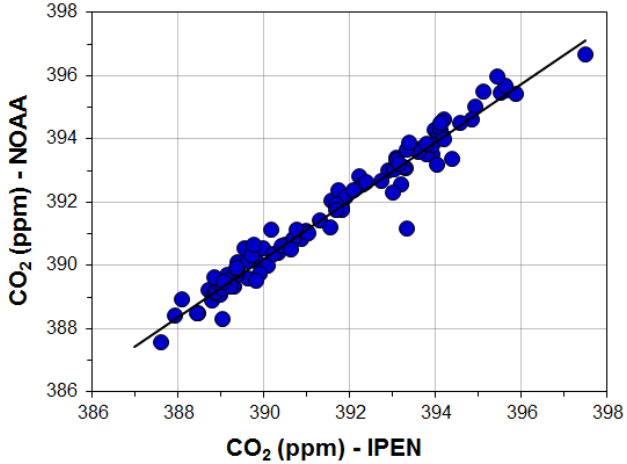
Ref gas – sample – Ref gas – sample – Ref gas – sample ……..

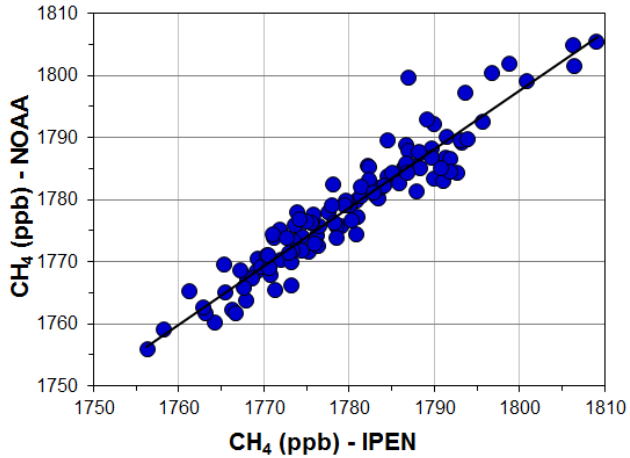
$$\frac{\text{Sample}}{(\text{Ref gas}_{\text{before}} + \text{Ref gas}_{\text{after}})/2}$$

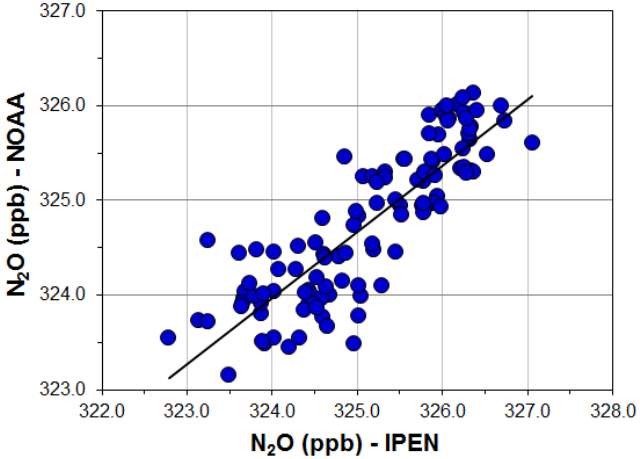
Calibration curve

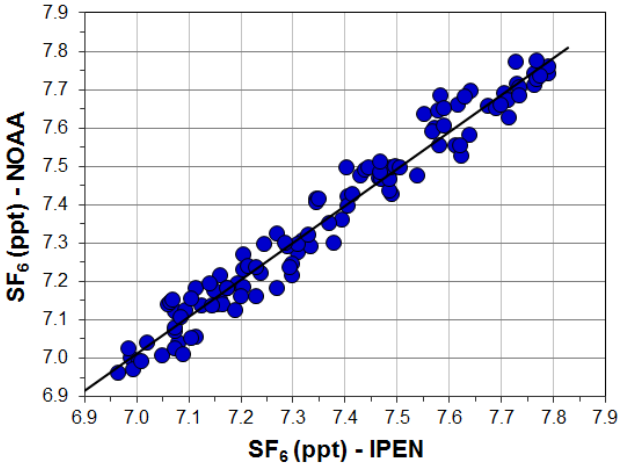
Each point in the curve: 9 Ref gas – 8 $\text{Std}_{\mathbf{1}}$, 9 Ref gas – 8 $\text{Std}_{\mathbf{2}}$, …….

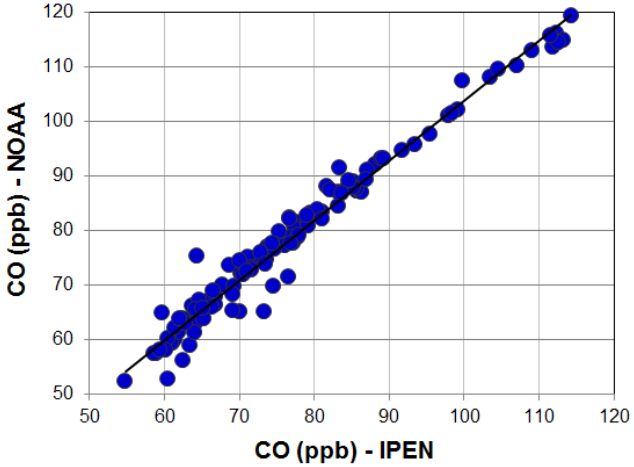
Natal IPEN / NOAA weekly inter comparison











Constructing a Brazil Network in Climate Change Observation System

-Vertical Profiles

Constructing a Brazil Network in Climate Change Observation System

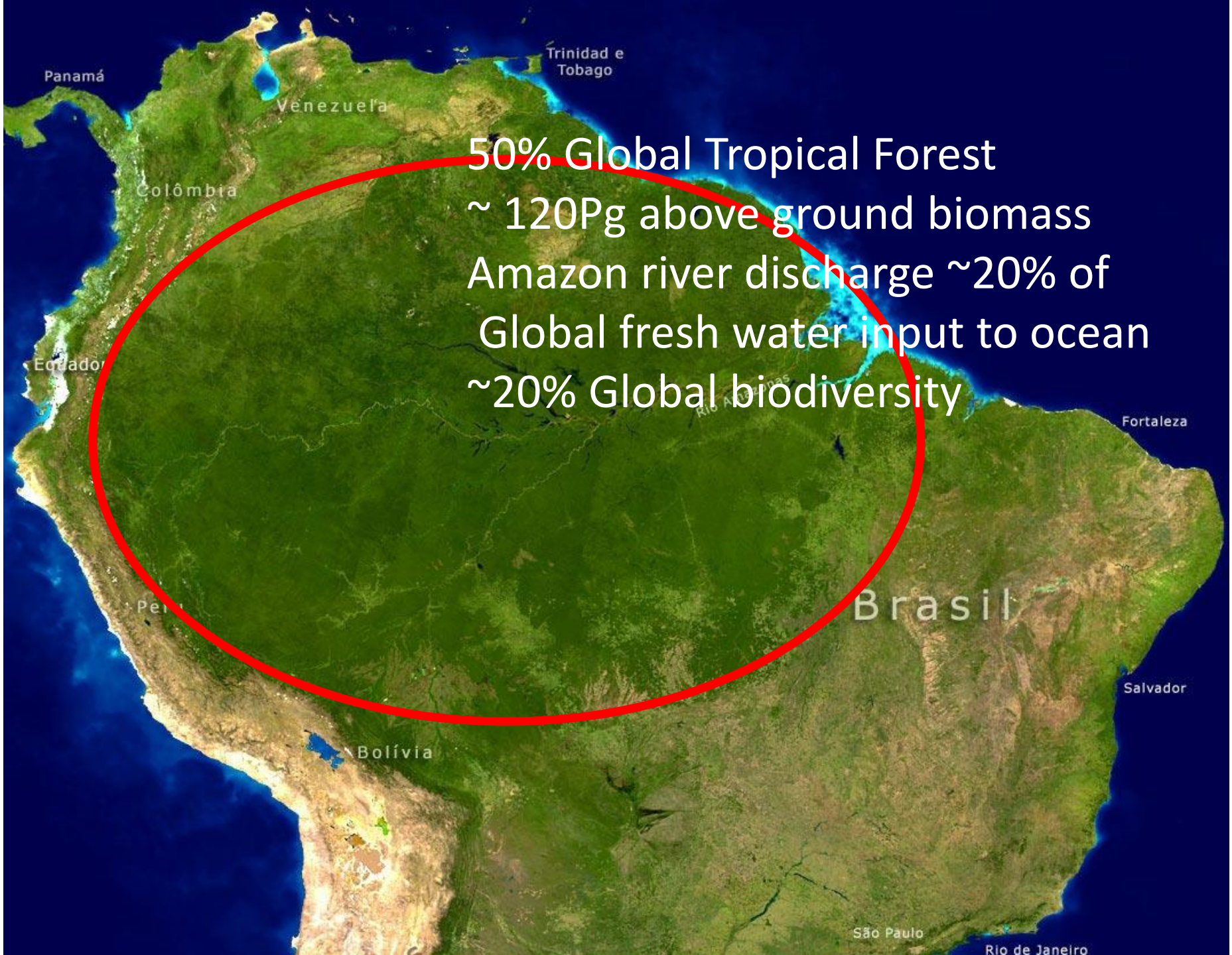
-Towers

1- Vertical profiles

2- Towers

3- Central Laboratory Facilities

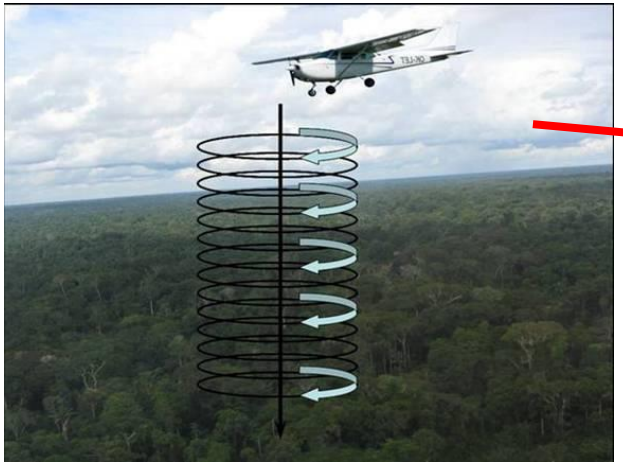
- standards from natural air
- produce a prototype for tower GHG calibrated measures
- Training courses



50% Global Tropical Forest
~ 120Pg above ground biomass
Amazon river discharge ~20% of
Global fresh water input to ocean
~20% Global biodiversity

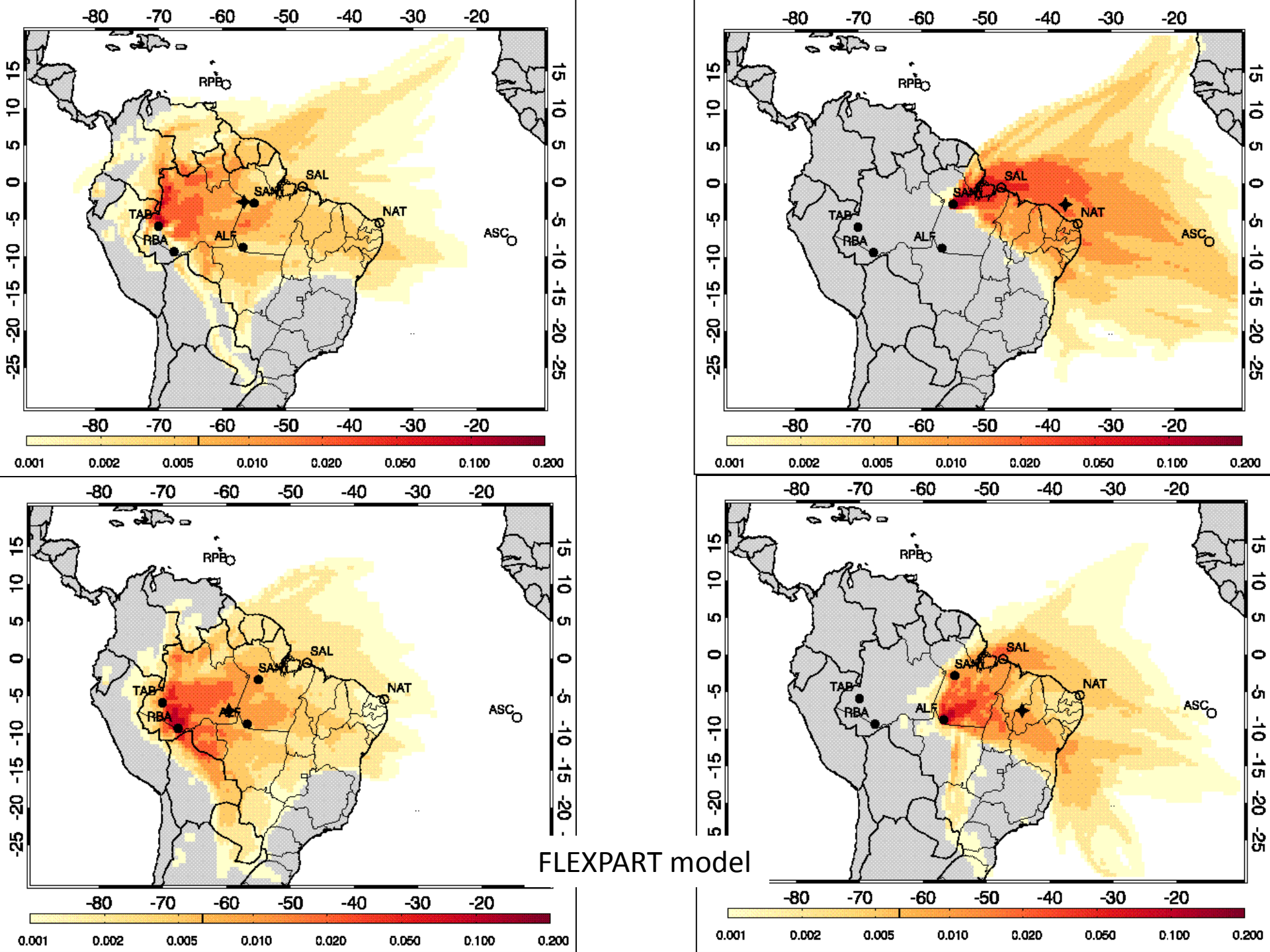
BARBADOS
SANTAREM
TABATINGA
ALTA FLORESTA
RIO BRANCO
ASCENSION

Sampling with Aircraft Vertical Profiles in Amazon Basin

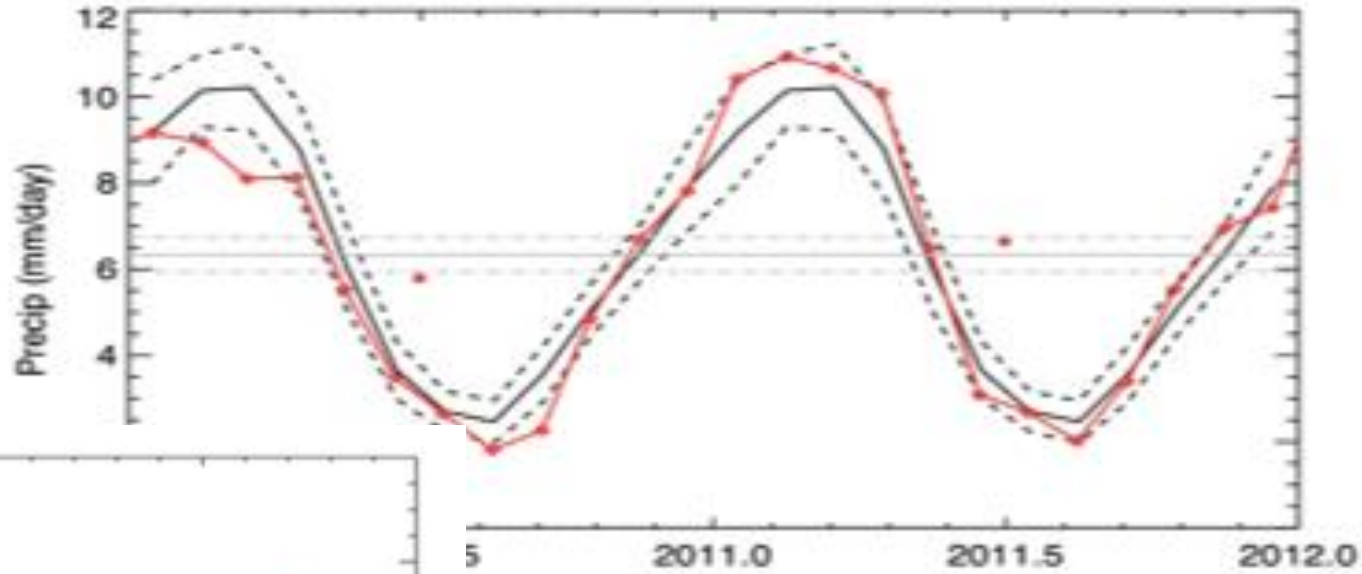


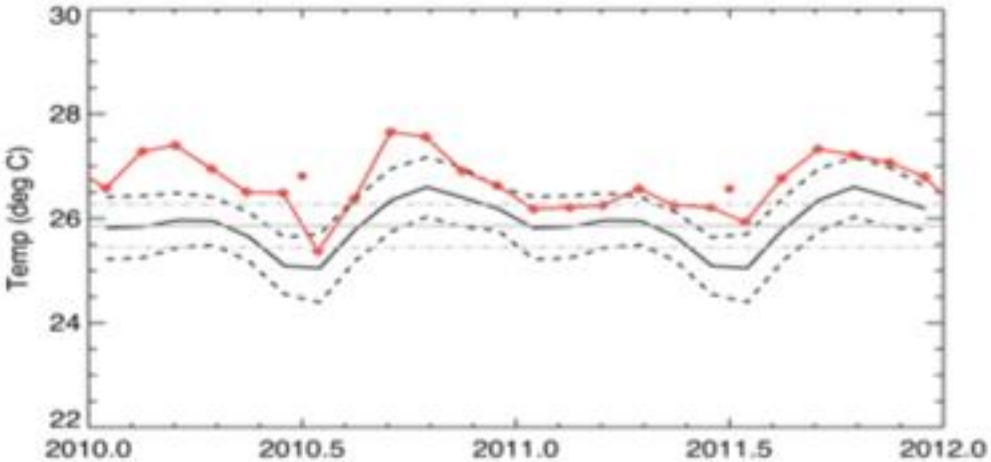
PFP and PCP

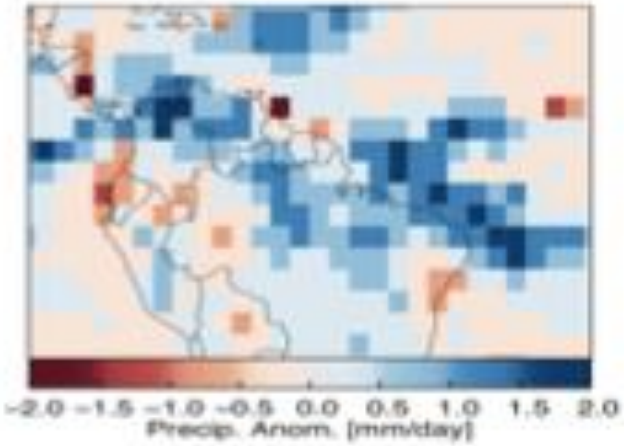
MAGICC System

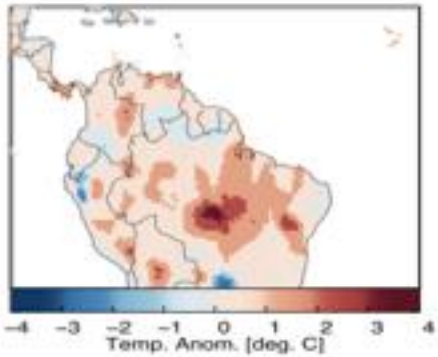


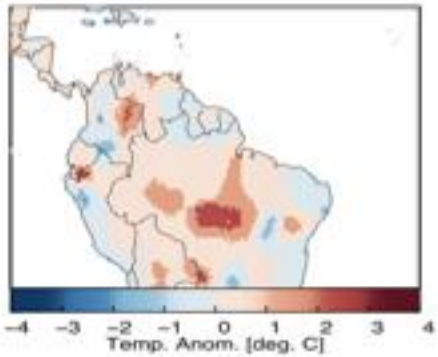
FLEXPART model

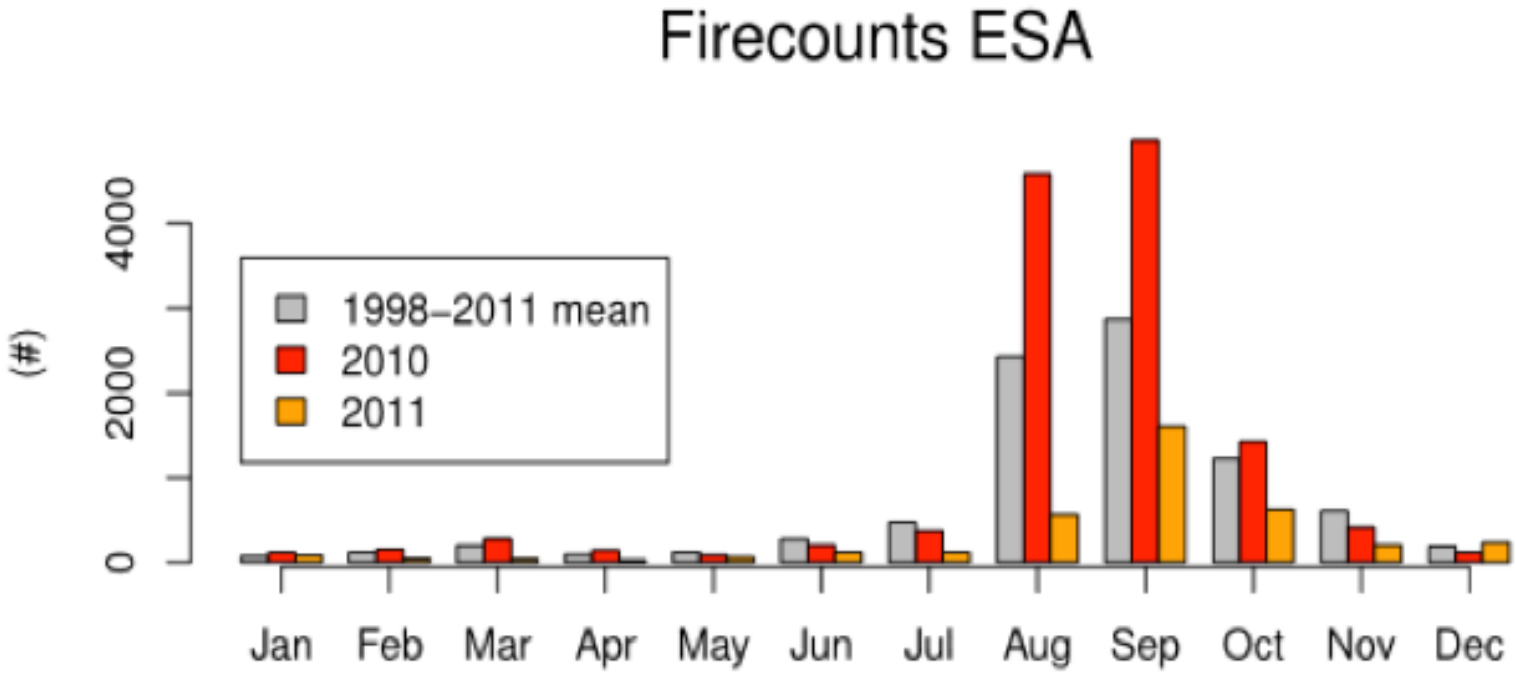

Precip (mm/day)
12
10
8
6
4
2011.0
2011.5
2012.0

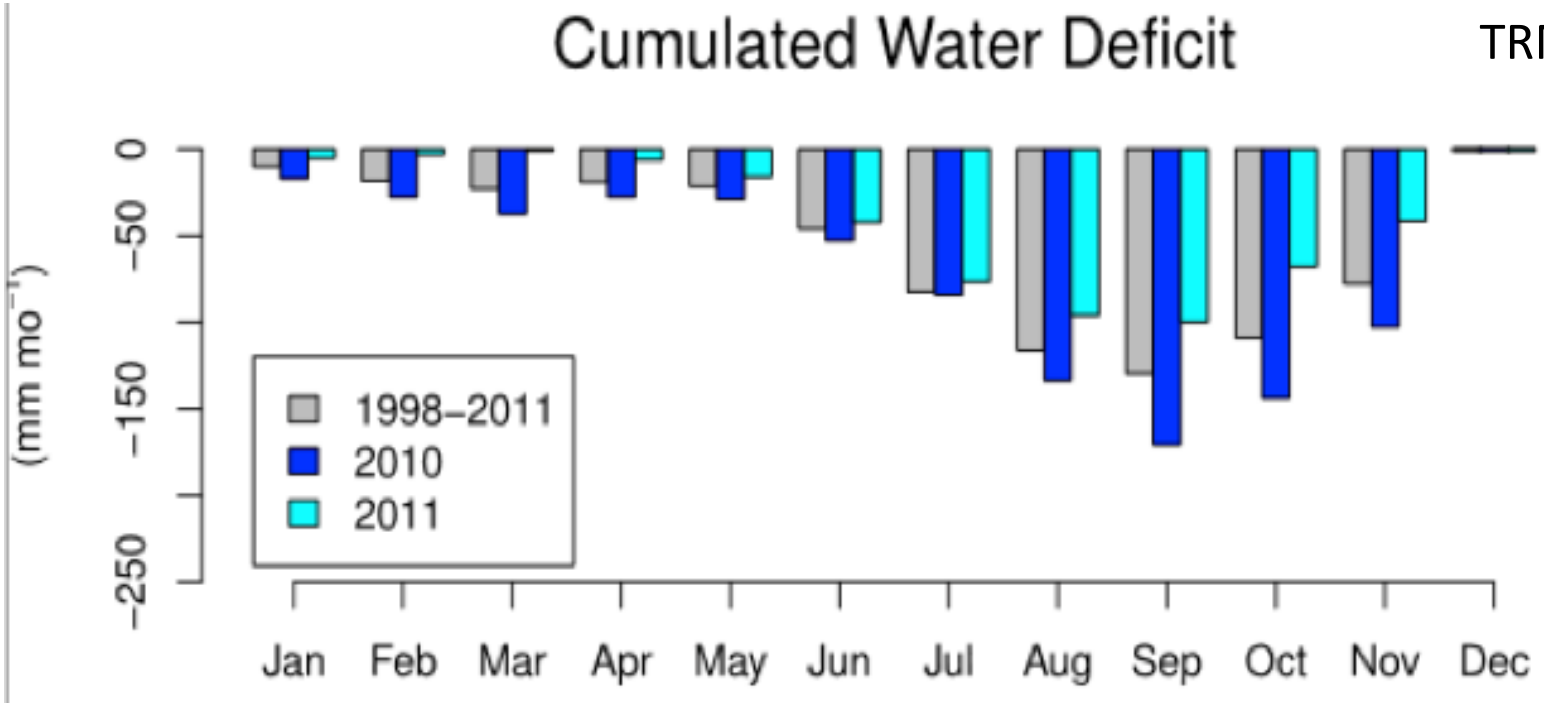

Temp (deg C)
30
28
26
24
22
2010.0
2010.5
2011.0
2011.5
2012.0

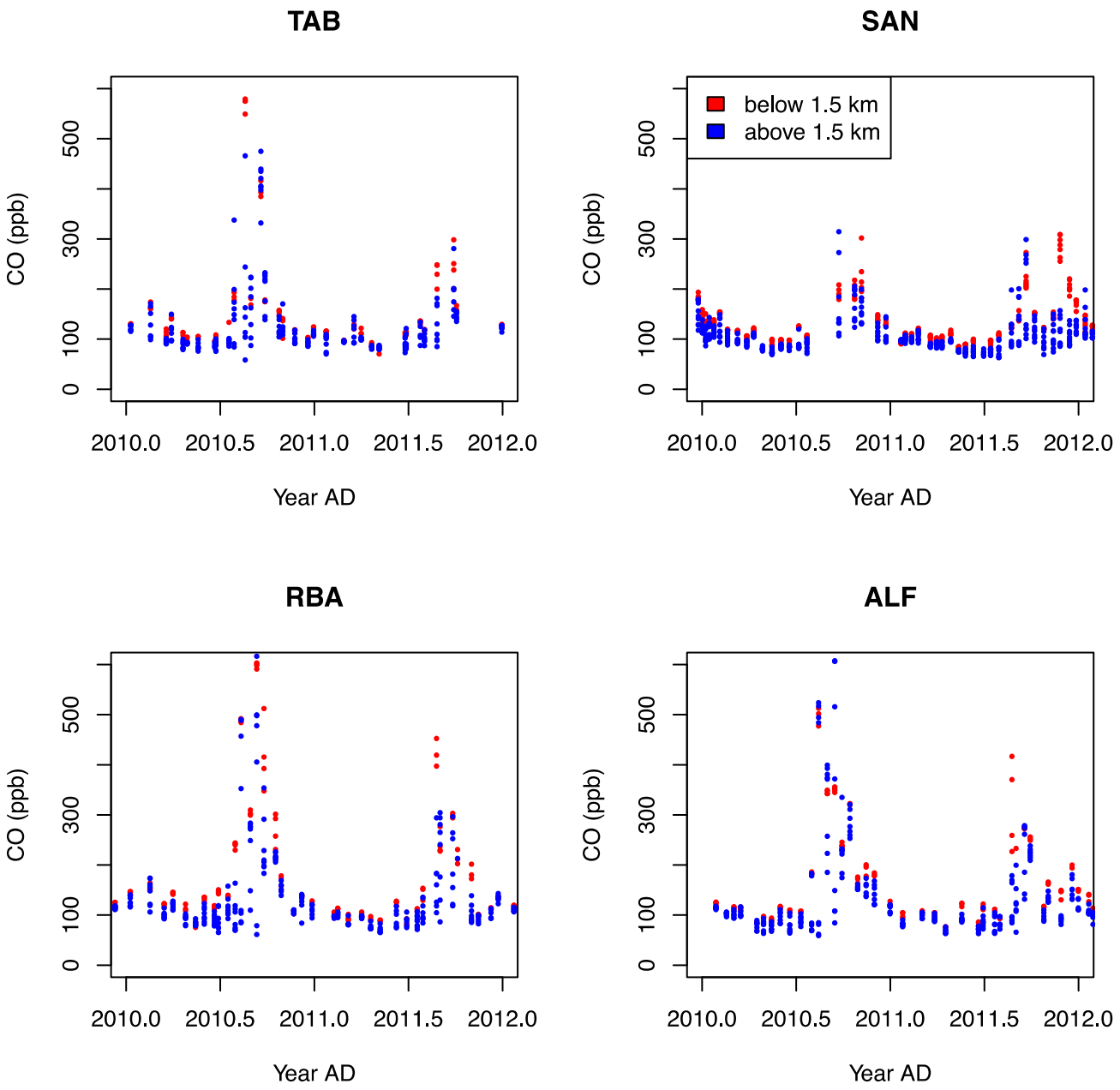

-2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2.0
Precip. Anom. [mm/day]

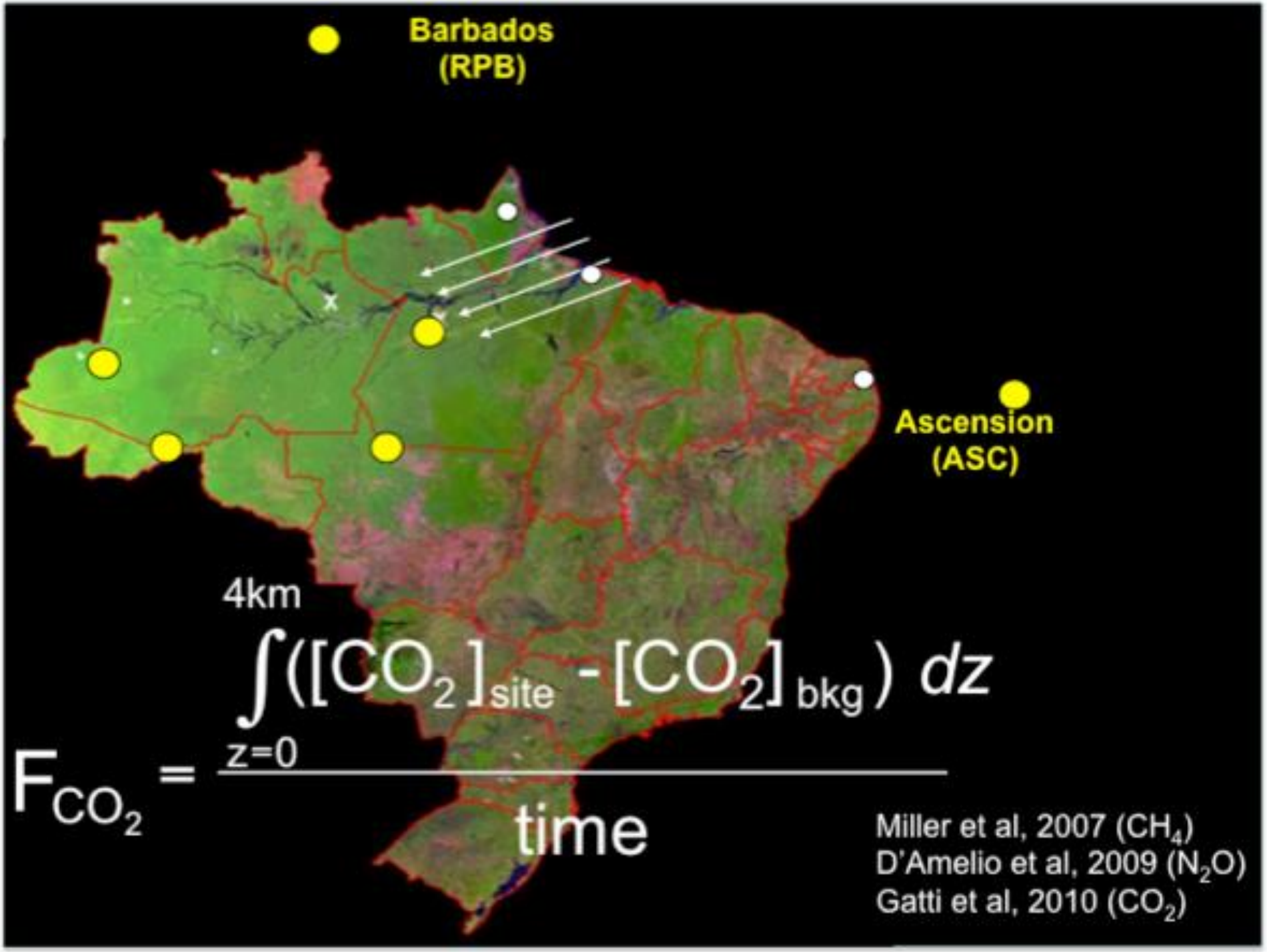

-4 -3 -2 -1 0 1 2 3 4
Temp. Anom. [deg. C]


-4 -3 -2 -1 0 1 2 3 4
Temp. Anom. [deg. C]


Firecounts ESA
(#)
0
2000
4000
1998–2011 mean
2010
2011
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Cumulated Water Deficit
TRMM
(mm mo⁻¹)
0
−50
−150
−250
1998–2011
2010
2011
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


TAB
SAN
RBA
ALF
below 1.5 km
above 1.5 km
CO (ppb)
0
100
300
500
2010.0
2010.5
2011.0
2011.5
2012.0
Year AD


Barbados
(RPB)
Ascension
(ASC)
$$F_{CO_2} = \frac{\int_{z=0}^{4km} ([CO_2]_{site} - [CO_2]_{bkg})\, dz}{time}$$
Miller et al, 2007 (CH_4)
D'Amelio et al, 2009 (N_2O)
Gatti et al, 2010 (CO_2)

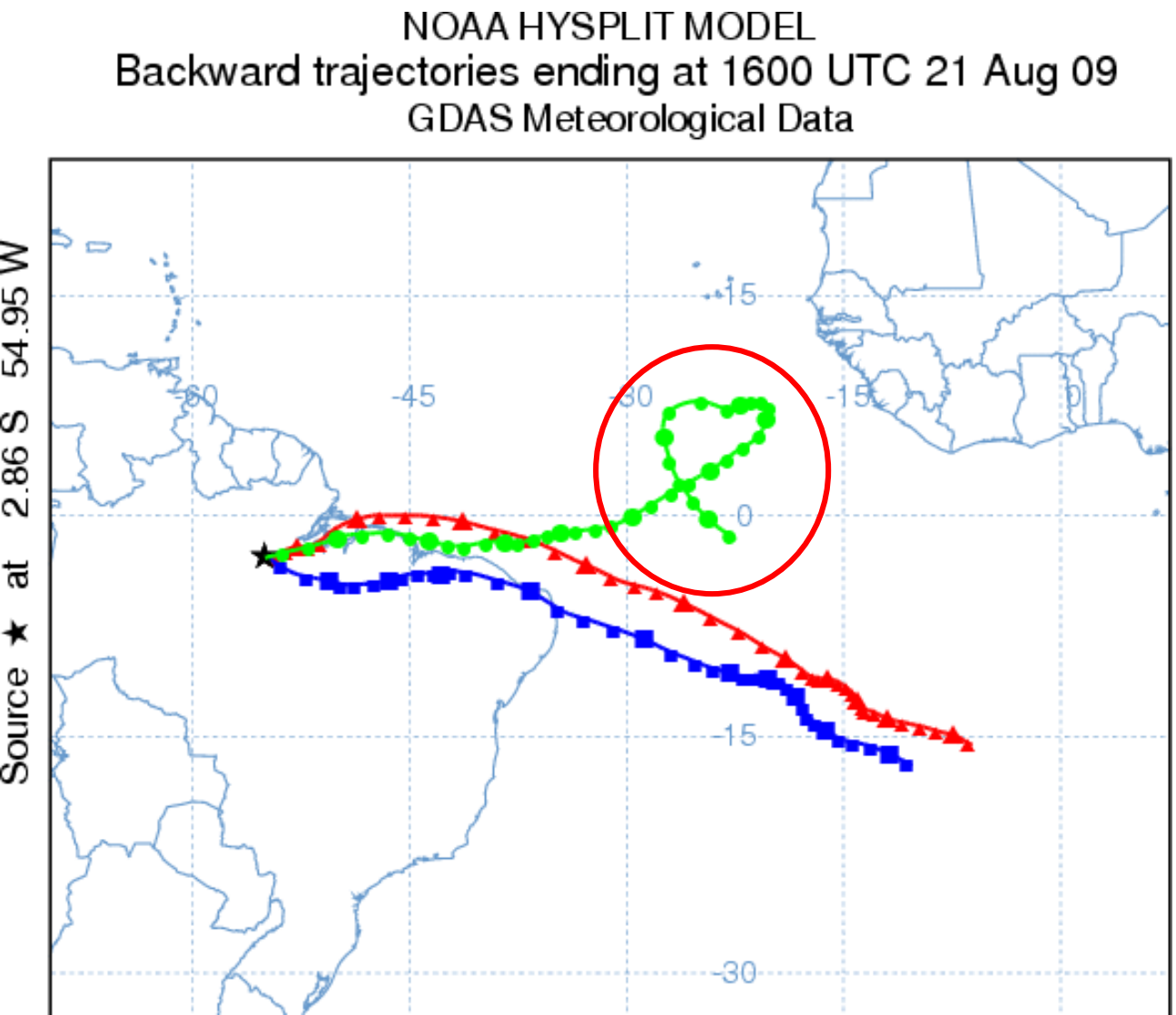
Summary

2010: DRY and HOT Carbon Balance = Source

2011: WET and HOT Carbon Balance = neutral

($PgCyr^{-1}$)	C total	C Fire	C Bio
2010:	0.5±0.2	0.5±0.1	-0.03±0.22
2011:	0.06±0.1	0.3±0.1	-0.25±0.14

Thank you



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FAPESP

CNPq

MCTI

SEVENTH FRAMEWORK PROGRAMME

NOAA

CAPES