The CSIRO/CAWCR Australian Tropical Atmospheric Research Station (ATARS)

Asian GAW GHG Workshop
Sep 2012

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The Centre for Australian Weather and Climate Research
A partnership between CSIRO and the Bureau of Meteorology

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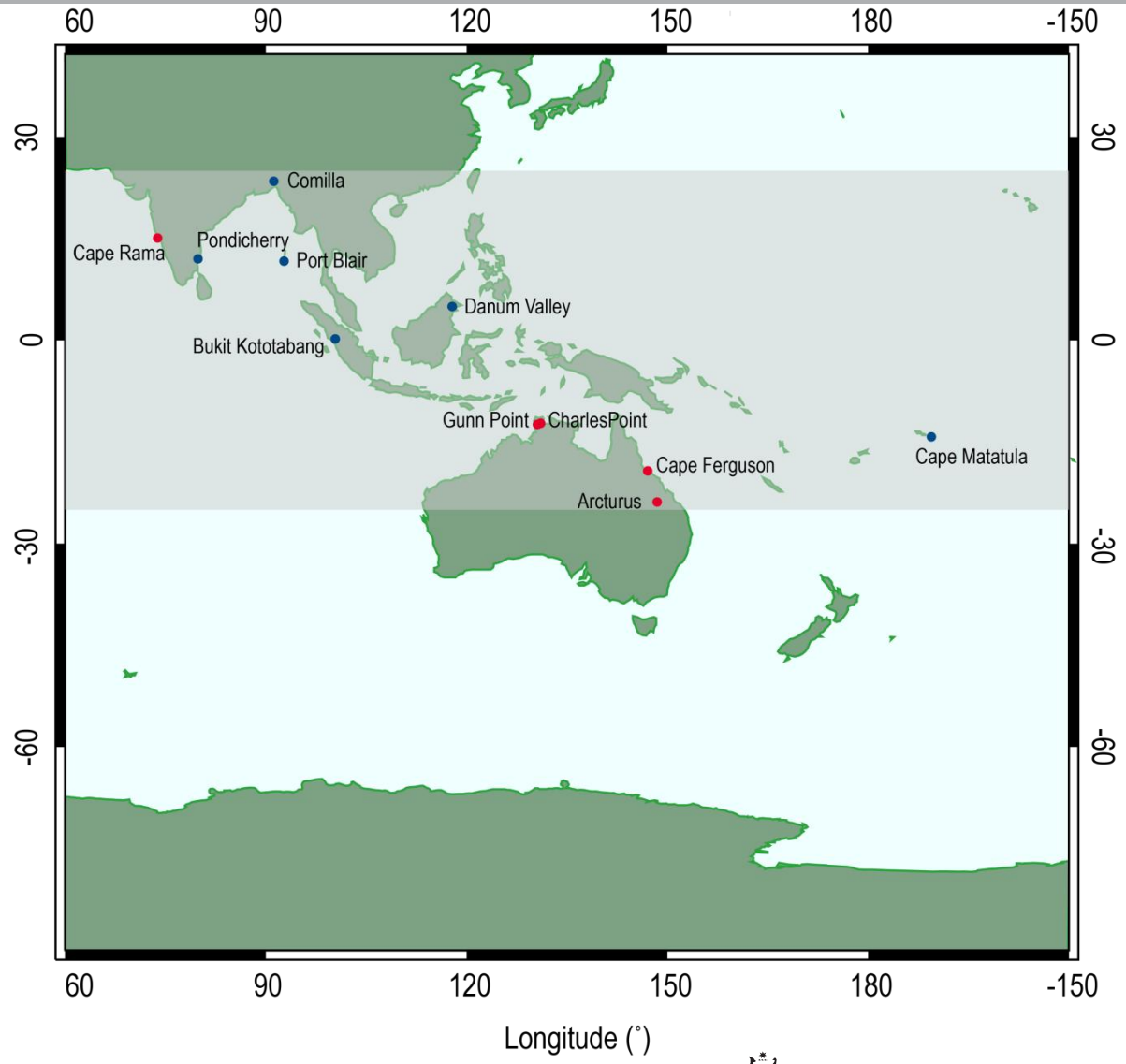
Outline of today's talk

- Asian/Australian tropics regional GHG observation network
- Importance of tropics on global (and regional) climate
- Update on pilot Australian Tropical Atmospheric Research Station (ATARS)

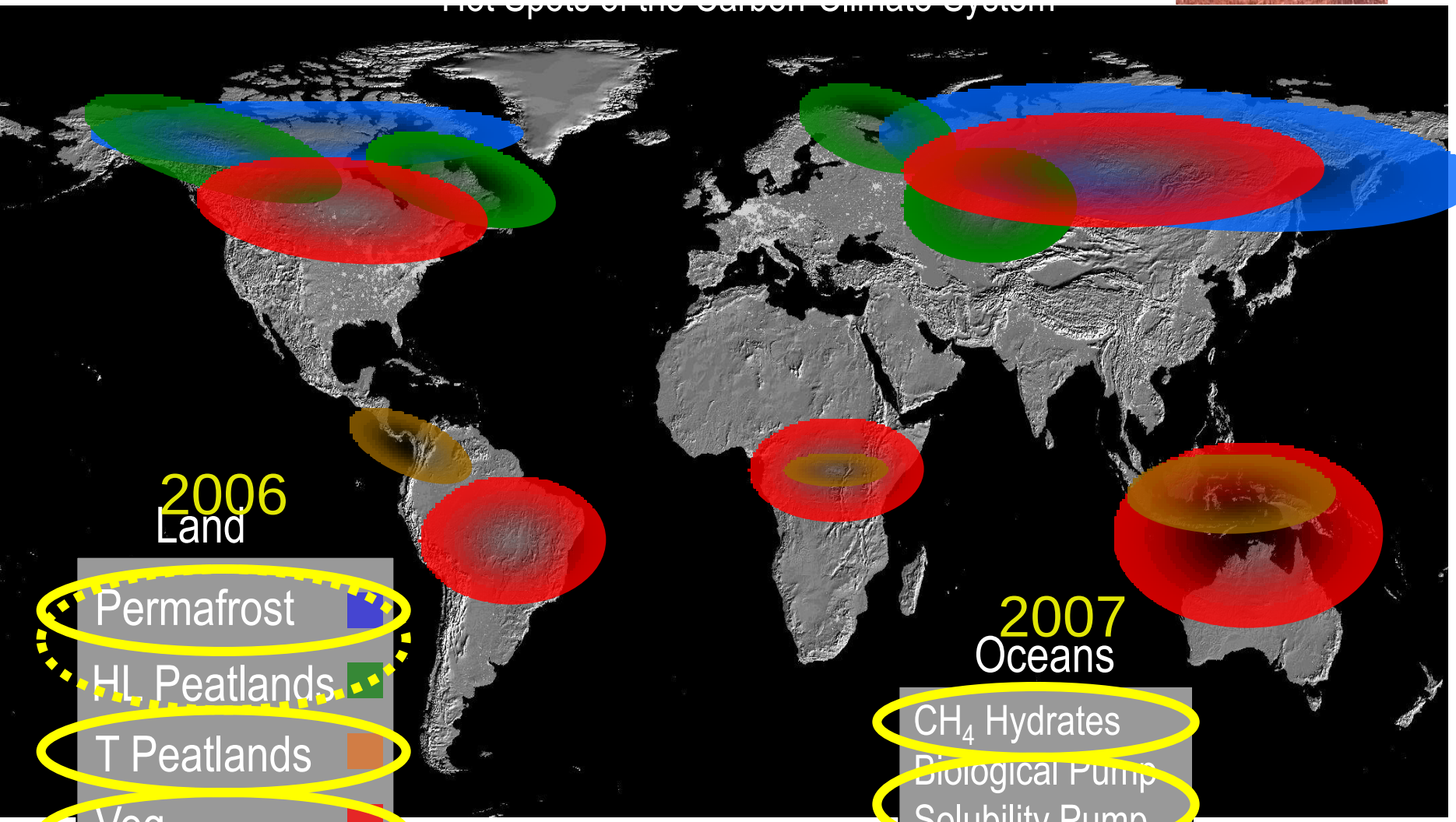
AGGON


120°E
150°E
Gunn Pt
Broome
Cape Ferguson
Alice Springs
Arcturus
Gnangara
30°S
Aspendale
Otway
Cape Grim
Amsterdam Is.
Baring Head
Macquarie Is.
60°S
Casey

Southeast Asia-Australian Regional Network



Carbon cycle vulnerability in the 21st Century



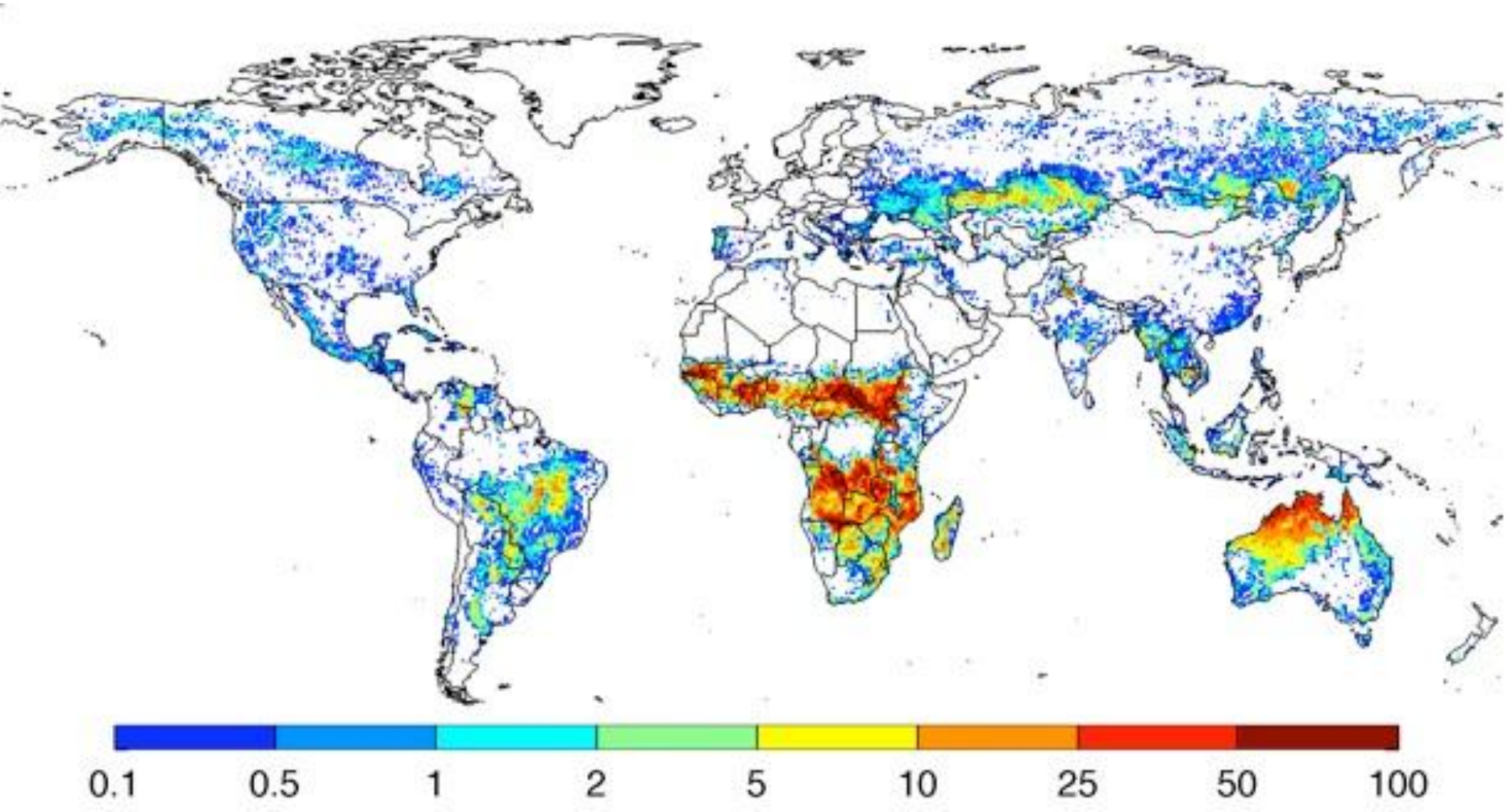
Why are tropics important?

- Tropics play a major role in global climate processes (not well defined):
  - home to ~1/2 of global population & rapid economic development (eg. India & China)
  - major global biomass burning, peatland drainage, wetlands
  - major source and sink region for CO_2, CH_4, N_2O, O_3, OH, H_2.....
  - short-lived halocarbons (stratospheric influence with deep tropical convection)

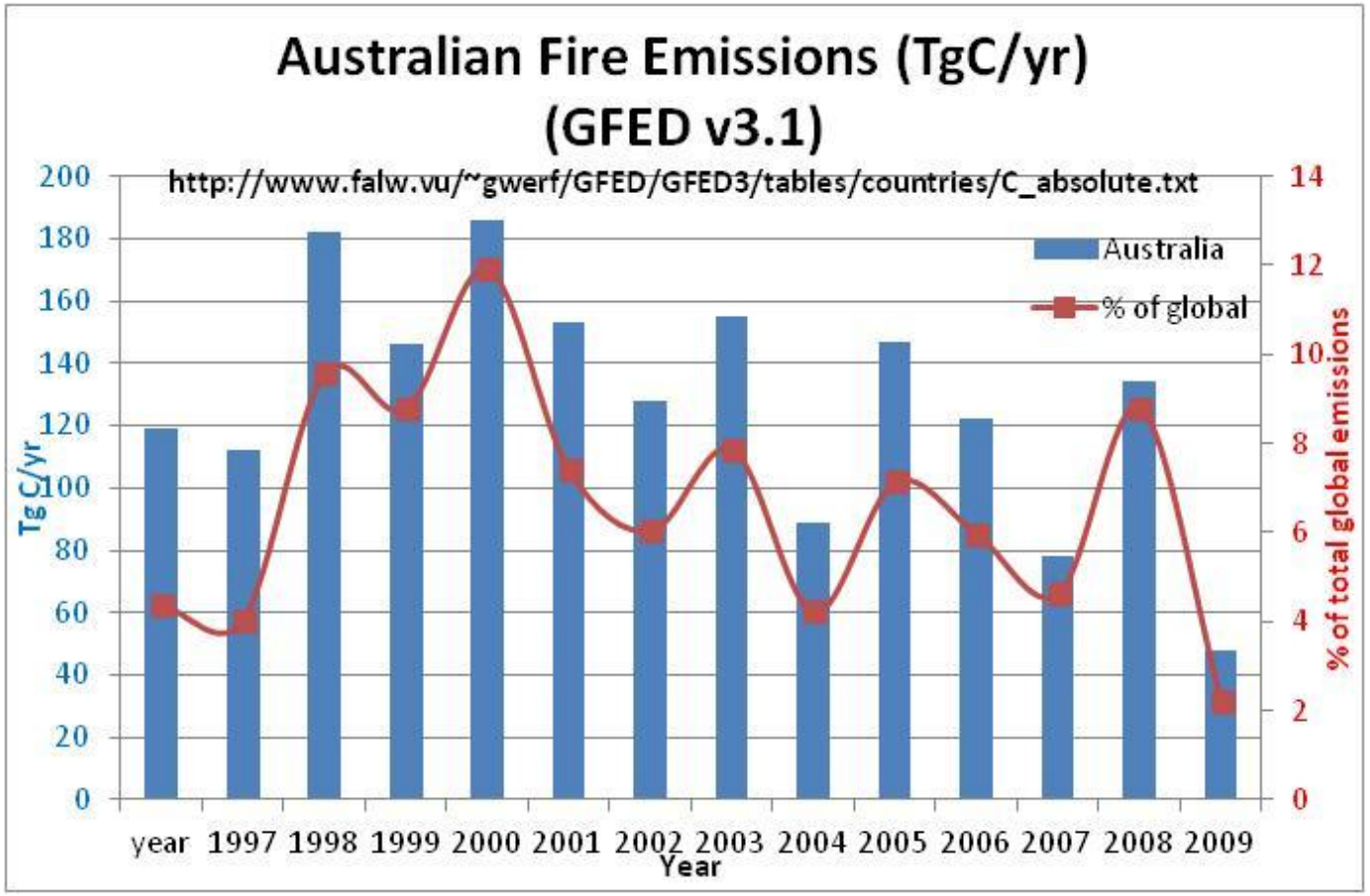
- Tropics are a critically under-sampled region (global atmospheric observation networks)

- Research objectives:
  - reduce uncertainties in sources/sinks of many climatically active constituents (CO_2, CH_4, N_2O, O_3, OH, H_2.....)
  - quantify GHG impact of Australian and SE Asian biomass burning and tropical forest clearing (peatland emissions)
  - why has global CH_4 increased since 2007 (after a decade of stability)?
    - Boreal and tropics (wetland emissions)
    - Biomass burning changes unlikely as little activity since 2002
    - Dominant variability in tropics is ENSO (biomass burning)

Mean annual burned area (1997-2009) (GFED3) *(as % of area of the grid cell)*



Australian fire emissions (GFED)



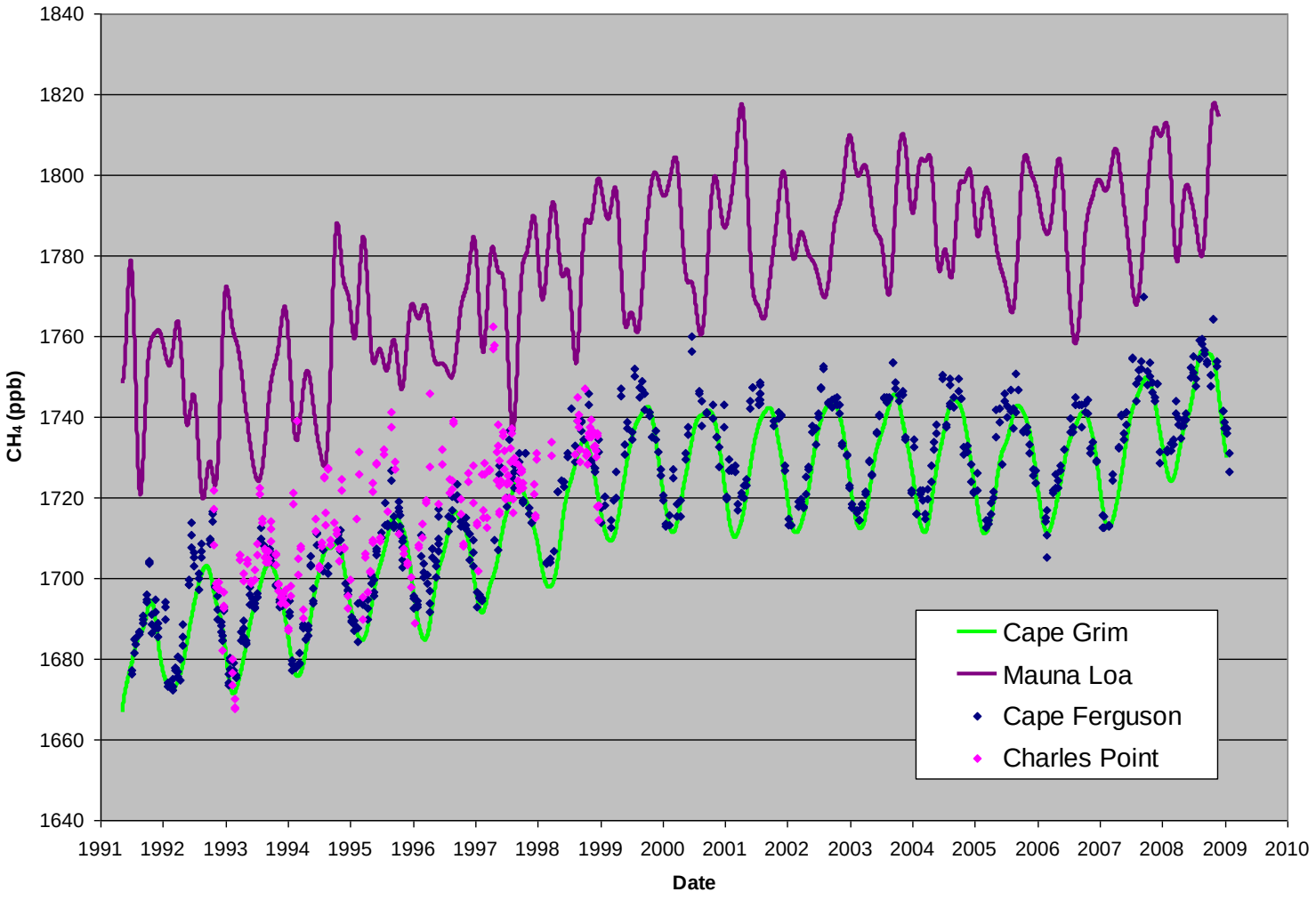
Tropical Sampling Sites in Australia

Cape Ferguson, QLD	Dec 1989 –
Great Barrier Reef, QLD	Jun 1986 – Dec 1988 (sporadic)
Charles Point, NT	Sep 1990 – Dec 1990
	Oct 1992 – Dec 1998
Jabiru, NT	Jan 1987 – May 1991
Myilly Point, NT	Aug 1990 – Mar 1993 (sporadic)

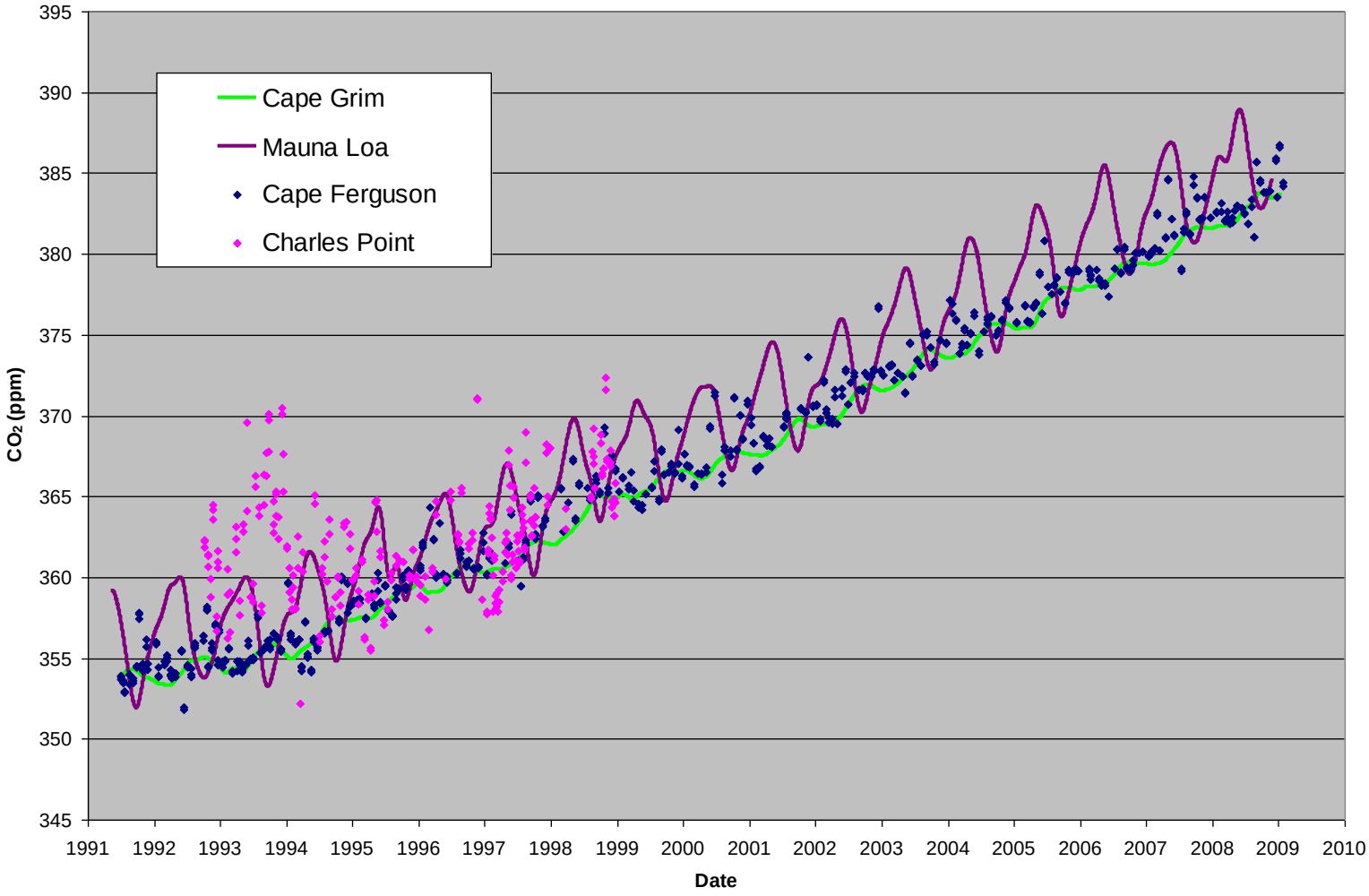
<u>Trace gas species analysed:</u>

Before 1991/92:	CO_2, CH_4, CO
After 1991/92:	CO_2 and its $\delta^{13}C$ and $\delta^{18}O$, CH_4, CO, H_2, N_2O

Australian Tropical Sites – CH_4



Australian Tropical Sites – CO_2



Estimating greenhouse gas sources from biomass burning (Australian tropics)

Key Question

- Can a new high precision atmospheric observatory in the Australian tropics enhance the estimation of greenhouse gas emissions from biomass burning, particularly focussed in the Australian tropics?

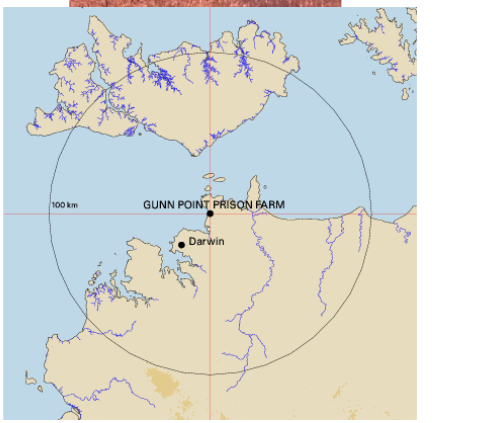
Project Objectives

1. Create a comprehensive, precise and integrated data set for CO2, CO2 isotopes, CH4, N2O in the Australian region;
2. Prepare a qualitative description of the impact of biomass burning on cycling of GHGs in the Australian region, in particular in the tropics;
3. Develop the new high precision Australian tropical baseline station (Gunn Pt., NT) and integrate it into existing Australian GHG monitoring network
4. Via existing and future (ACCESS) carbon cycle models, combine high precision atmospheric CO2, isotopic CO2, CH4 and N2O data to make the most accurate estimate to date of the magnitude Australian source of GHGs from biomass burning.

Gunn Point (NT) – New tropical Australian monitoring site

- Wet / Dry season air masses giving continental coverage with Cape Grim station, clean Indian Ocean air & SE Asian air masses
- Based at existing research radar site at Gunn Point (BoM)
- Unique opportunity to combine existing **physical** atmospheric research facilities currently in Darwin (BoM / US DoE Atmospheric Radiation Measurement program) with **chemical** atmospheric measurements
  - Regular field campaigns (Mctex, TRMM, Dawex, TWPICE...)
- TCCON network site at Darwin (FTS) for satellite validation (GOSAT, SCHIAMACHY) since September 2005 (University of Wollongong/Caltech)
- Extensive tropical ecosystem (Savanah) research (CSIRO, Charles Darwin University)

Gunn Point Pilot Tropical Atmospheric Research Station



- **Latitude :** 12.2ºS
- **Longitude :** 131.0ºE
- **Elevation:** 25 m
- **Road Access**
  - 1-2 hours from Darwin (70 km road)
  - 4WD
  - 35 km unsealed road subject to wet season flooding
- Site History
  - Ex-prison farm (closed 1990)
  - Radar Site - Bureau of Meteorology lease since 2004
  - Atmospheric Radiation Measurement Site (ARM funded US Department of Energy)
- Power
  - Town power (generally reliable but does fail in storms)
  - Backup generator for essential applications (~3 days)
- Communications
  - Land line and mobile next G reception

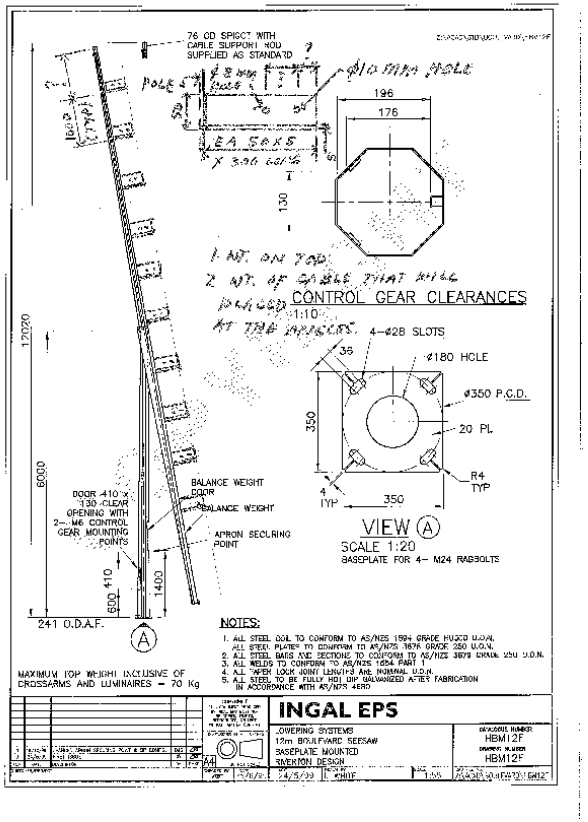
Gunn Point – Lab details

Laboratory:

- 20 ft. container from CSIRO (Highett)
- Dual A/C
- Dual air intake roof ports
- Roof top platform and mast sampling
- Network cameras inside
- Telstra next 3G (landline due anyday)

Mast :

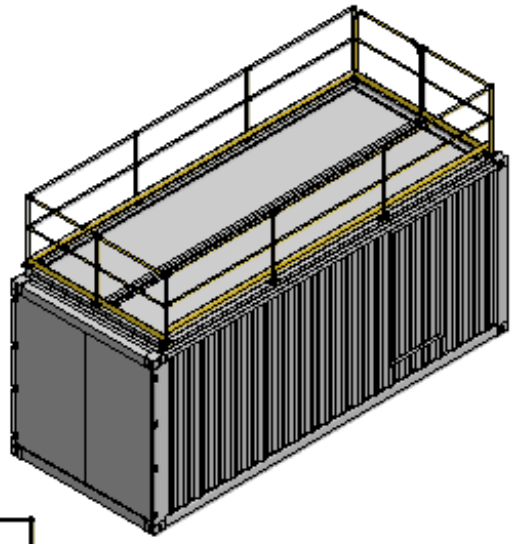
- 12m See-saw pole (commercial light pole, cyclone rated)
- Multiple air intakes
- Anemometer

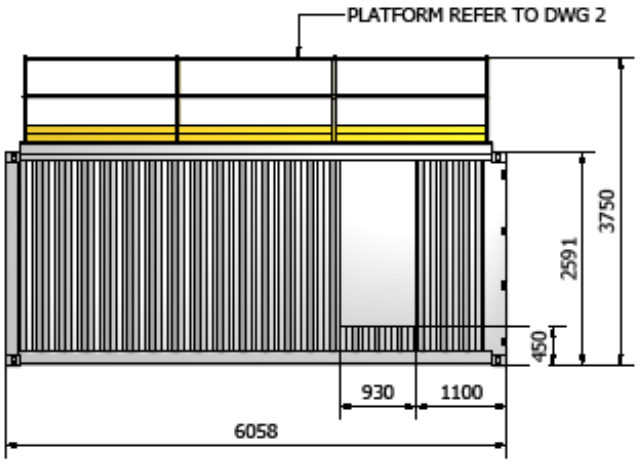


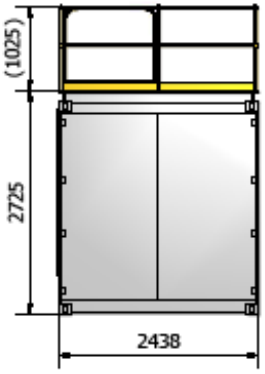
Power:

- 3-phase
- 2 power feeds – mains and generator back-up
- Individual instrument UPS for critical equipment









NOTE:
PLATFORM AND HANDRAILS COMPLY WITH AS2550.10 AND AS1657

NO	REVISION DESCRIPTION	DWN	CHK	APP	DATE
0	INITIAL RELEASE				

	BY	DATE
DWN	R.CIBA	7/07/09
CHK	-	07/07/09
APP	-	07/07/09

CLAYTON CONSOLIDATED ENGINEERING FACILITY

SCALE N.T.S.

CSIRO

TITLE
ASSEMBLY -20 FT CONTAINER

DRAWING NUMBER I2267 | SHEET 1 | REV 01 | A3

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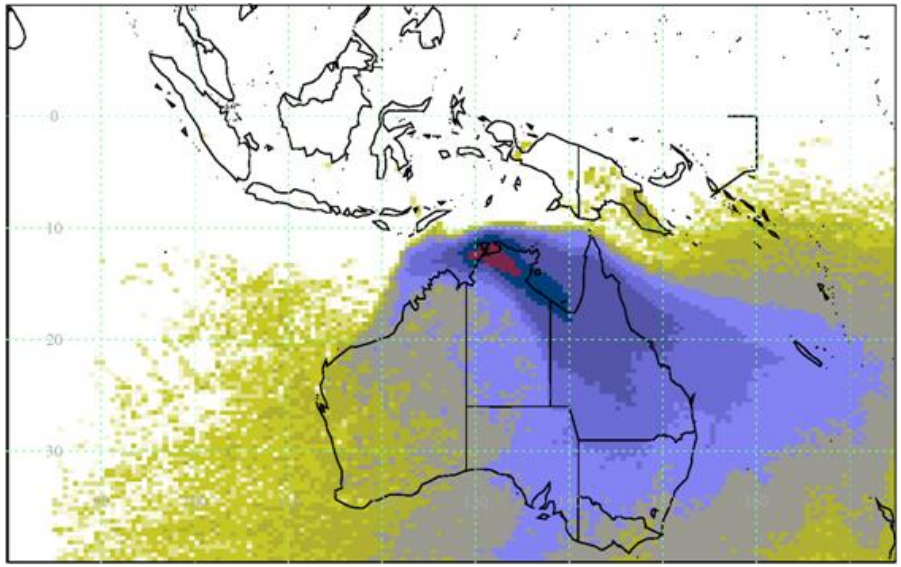
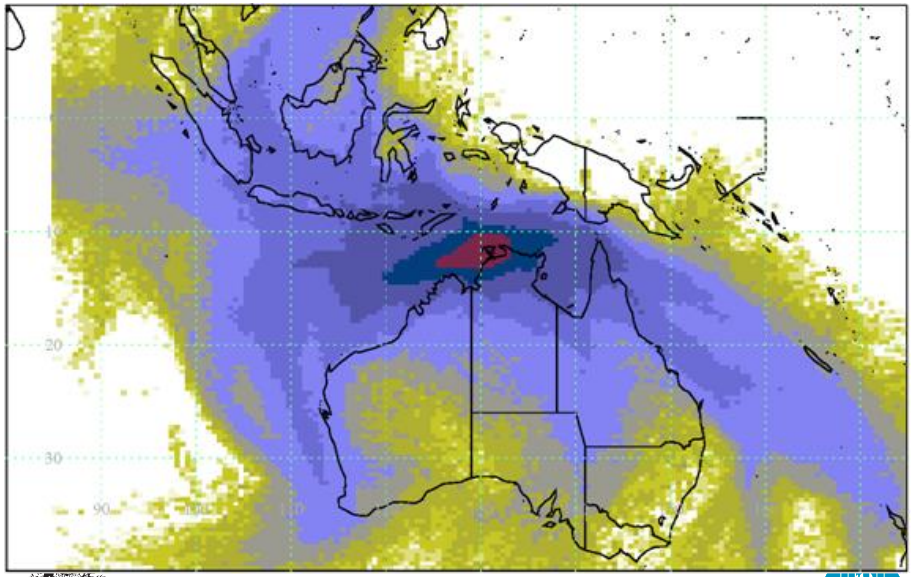
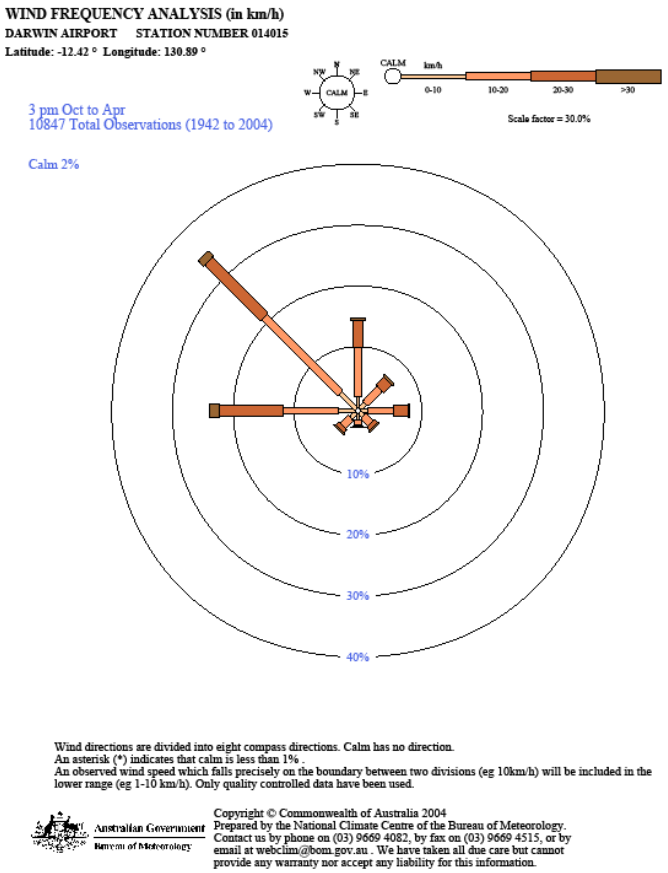
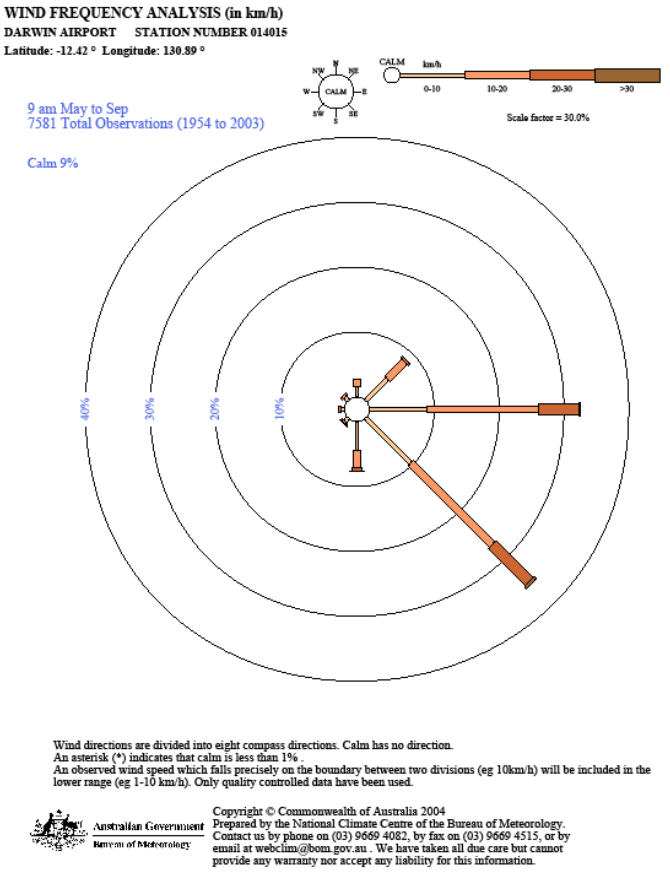
Air mass origin maps Gunn Point
(courtesy Alistair Manning UK Met Office)





Darwin wind frequency (Darwin airport)





wet season (3pm)

dry season (9am)


Gunn Point
2 km
1 mi
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Southern Ocean Carbon Sink

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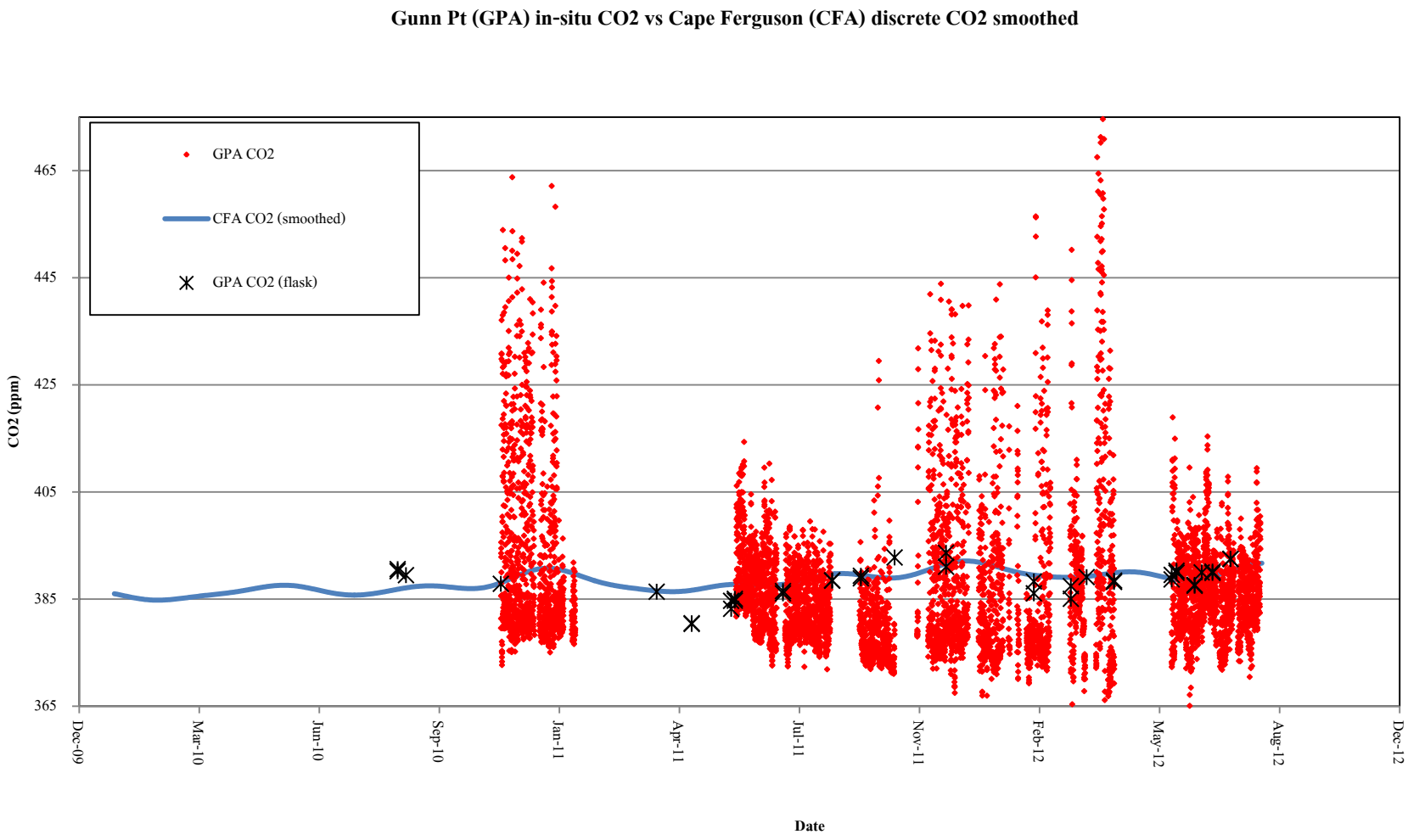
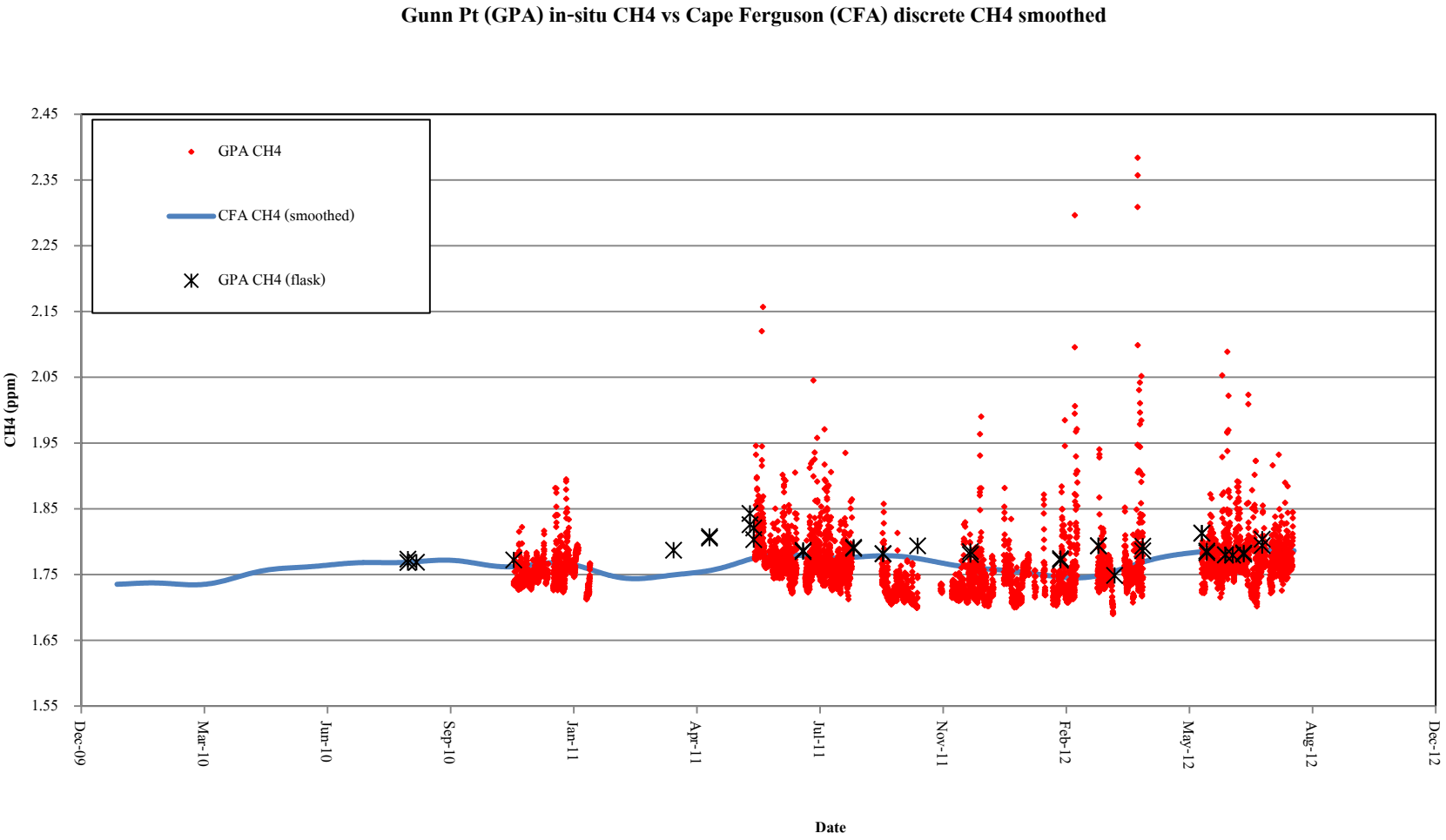
Gunn Point – atmospheric measurement program

- Current (Sep 2011)
  - *In-situ* CO_2 & CH_4 (CRDS)
  - *In-situ* $^{13}CO_2/^{12}CO_2$ *(CRDS)**
  - Flask CO_2, CH_4,$^{13}CO_2/^{12}CO_2$, N_2O, CO, H_2
  - Radon (ANSTO)
  - Basic meteorological parameters (WS, WD)
  - O_3 (UV spectrometry) / CO (NDIR) /NO/NO_X *(chemiluminescence)*
  - *Aetholometer and nephelometer*
- Proposed measurement program
  - *In-situ* CO/N_2O (Off-axis ICOS) (2012)
  - AWS
  - $PM_{2.5}/PM_{10}$
  - Aerosols+VOCs (dry season campaign completed June 2010)
  - Short-lived halocarbons ($CHBr_3/CH_2Br_2/CHCl_3/C_2Cl_4/CH_2CCl_3/CCl_4$..): GC-ECD (N. Harris, U. Cambridge, UK) (2012)
  - ODS: Medusa (2013?)

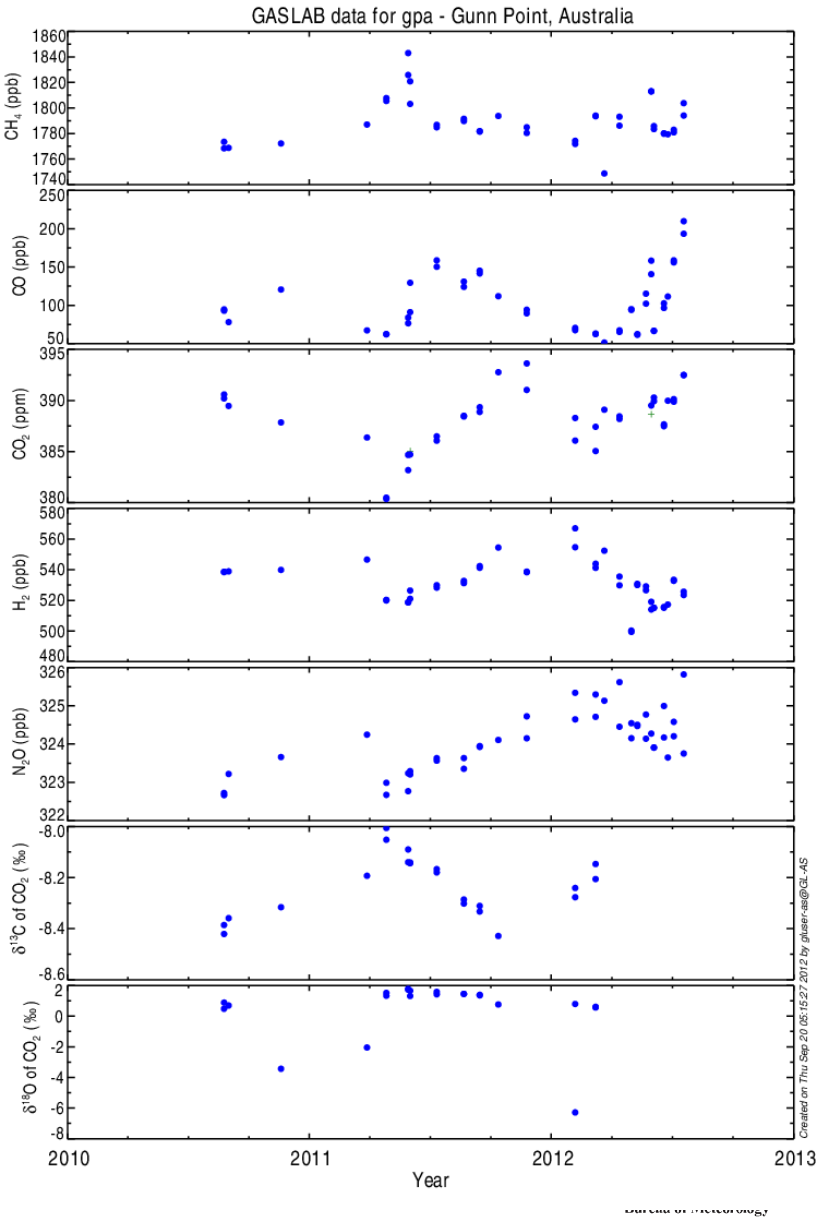
Preliminary Gunn Pt. CO_2



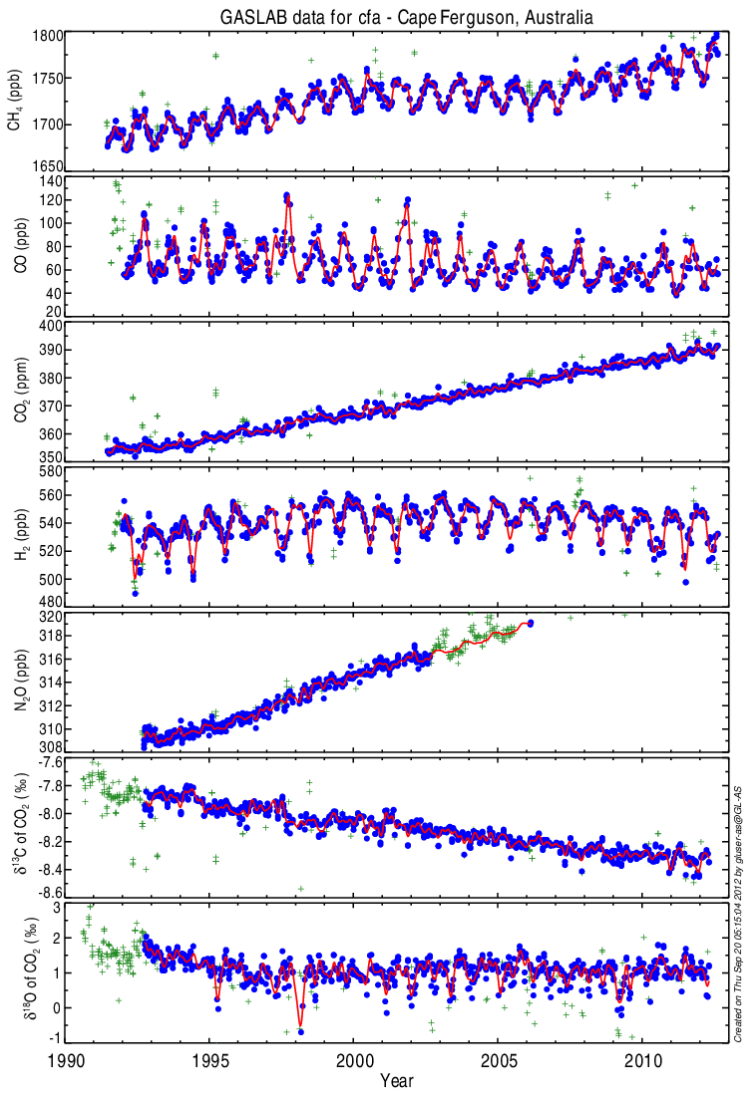
Preliminary Gunn Pt. CH_4



Gunn Pt. flask data



Cape Ferguson



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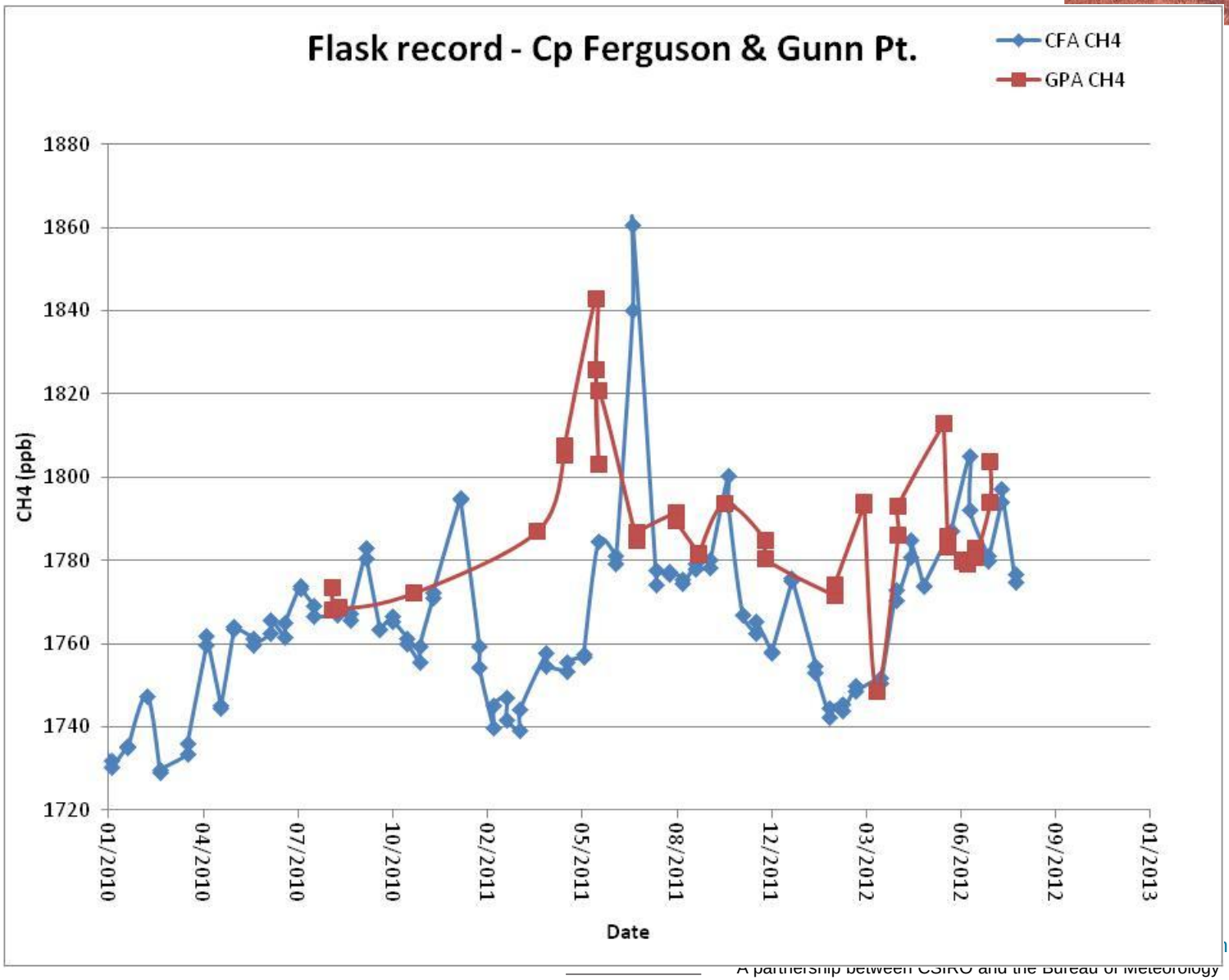
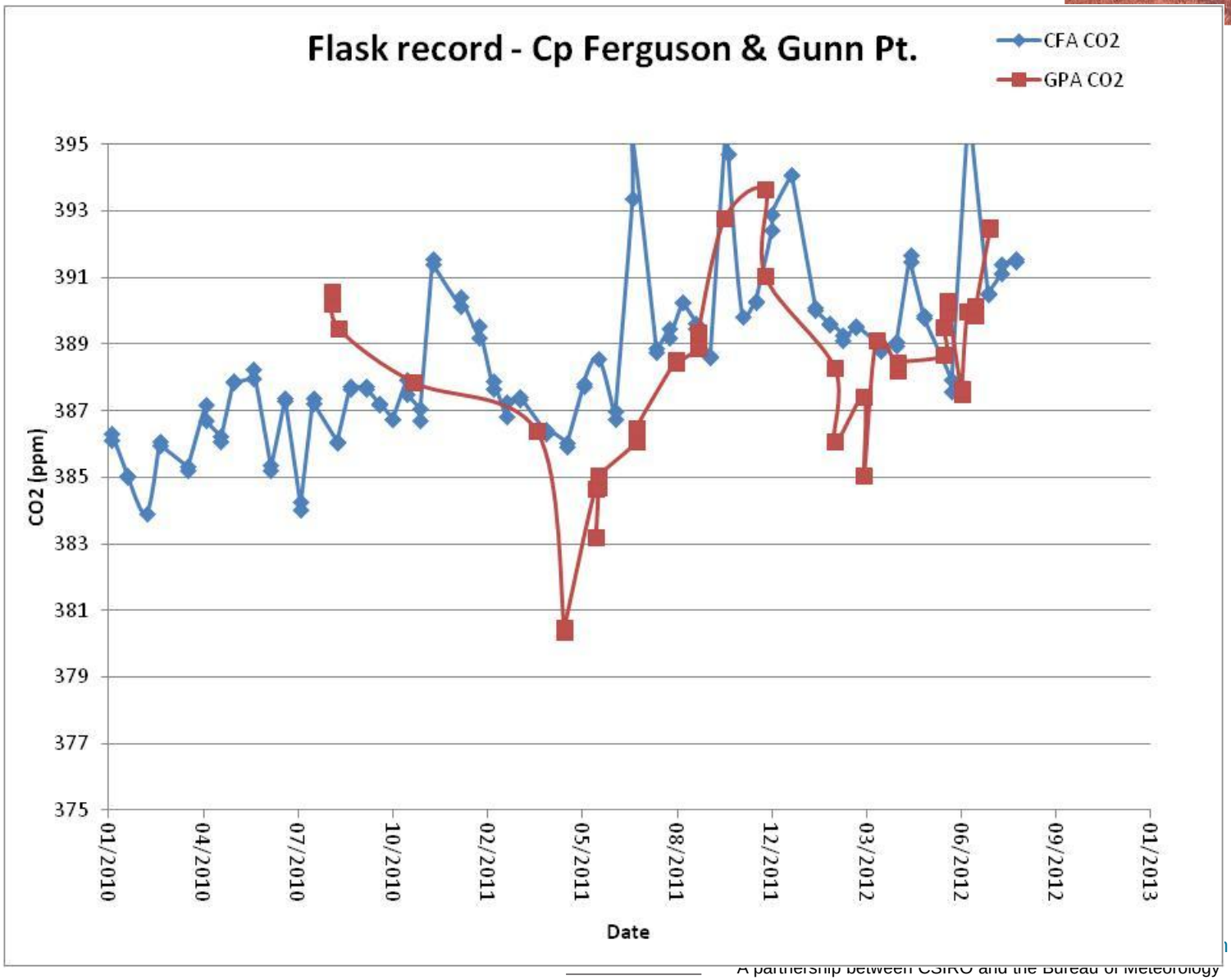
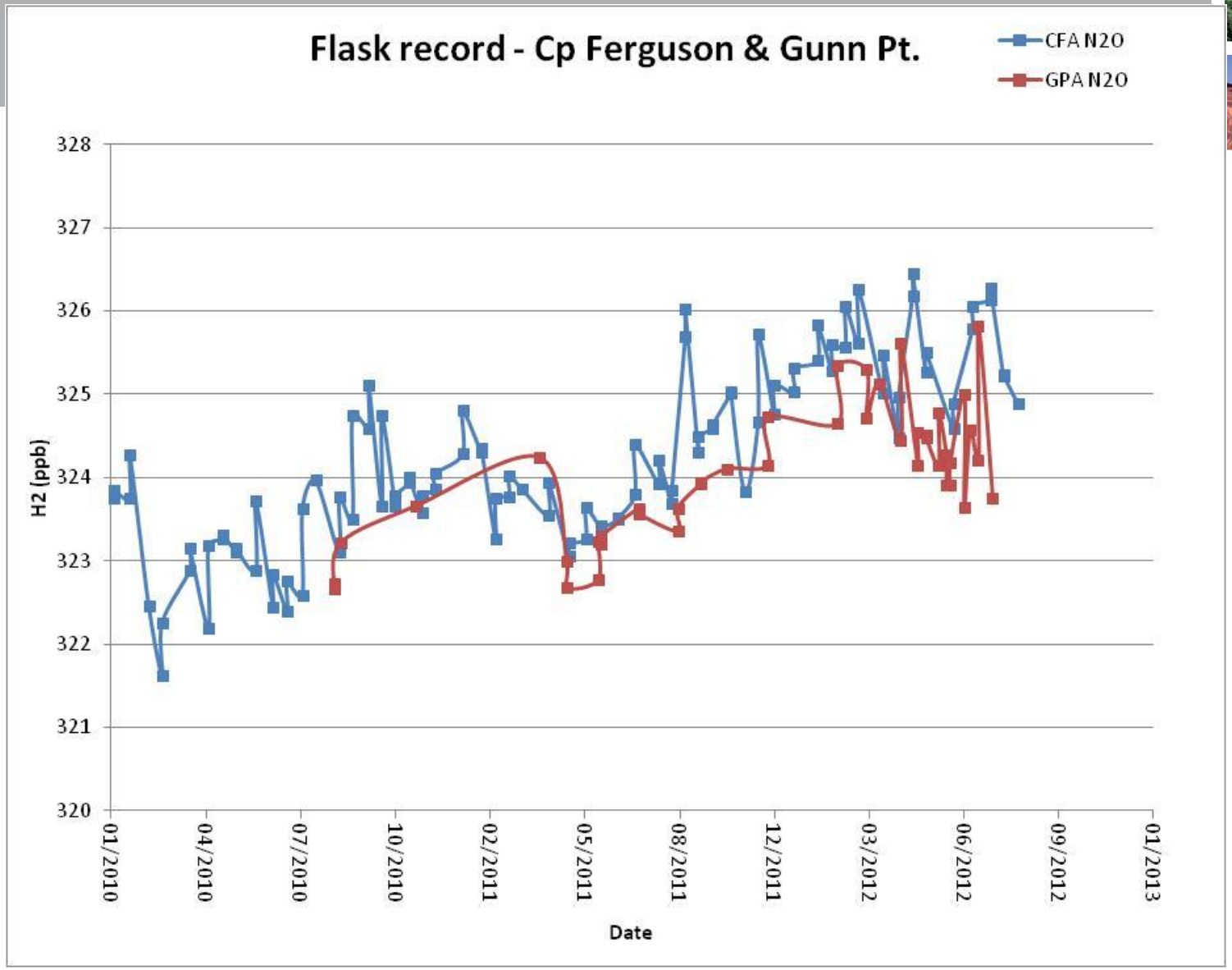

Flask record - Cp Ferguson & Gunn Pt.
CFA CH4
GPA CH4
CH4 (ppb)
1880
1860
1840
1820
1800
1780
1760
1740
1720
01/2010
04/2010
07/2010
10/2010
02/2011
05/2011
08/2011
12/2011
03/2012
06/2012
09/2012
01/2013
Date


Flask record - Cp Ferguson & Gunn Pt.
CFA CO2
GPA CO2
CO2 (ppm)
395
393
391
389
387
385
383
381
379
377
375
01/2010
04/2010
07/2010
10/2010
02/2011
05/2011
08/2011
12/2011
03/2012
06/2012
09/2012
01/2013
Date




Flask record - Cp Ferguson & Gunn Pt.
CFA N2O
GPA N2O
H2 (ppb)
328
327
326
325
324
323
322
321
320
01/2010
04/2010
07/2010
10/2010
02/2011
05/2011
08/2011
12/2011
03/2012
06/2012
09/2012
01/2013
Date

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