CSIRO Collaborative GHG Observation Programs
Southeast Asia-Australia Regional Network

The 3rd international workshop on greenhouse gases
29-30 Sep 2011
Seoul, Korea

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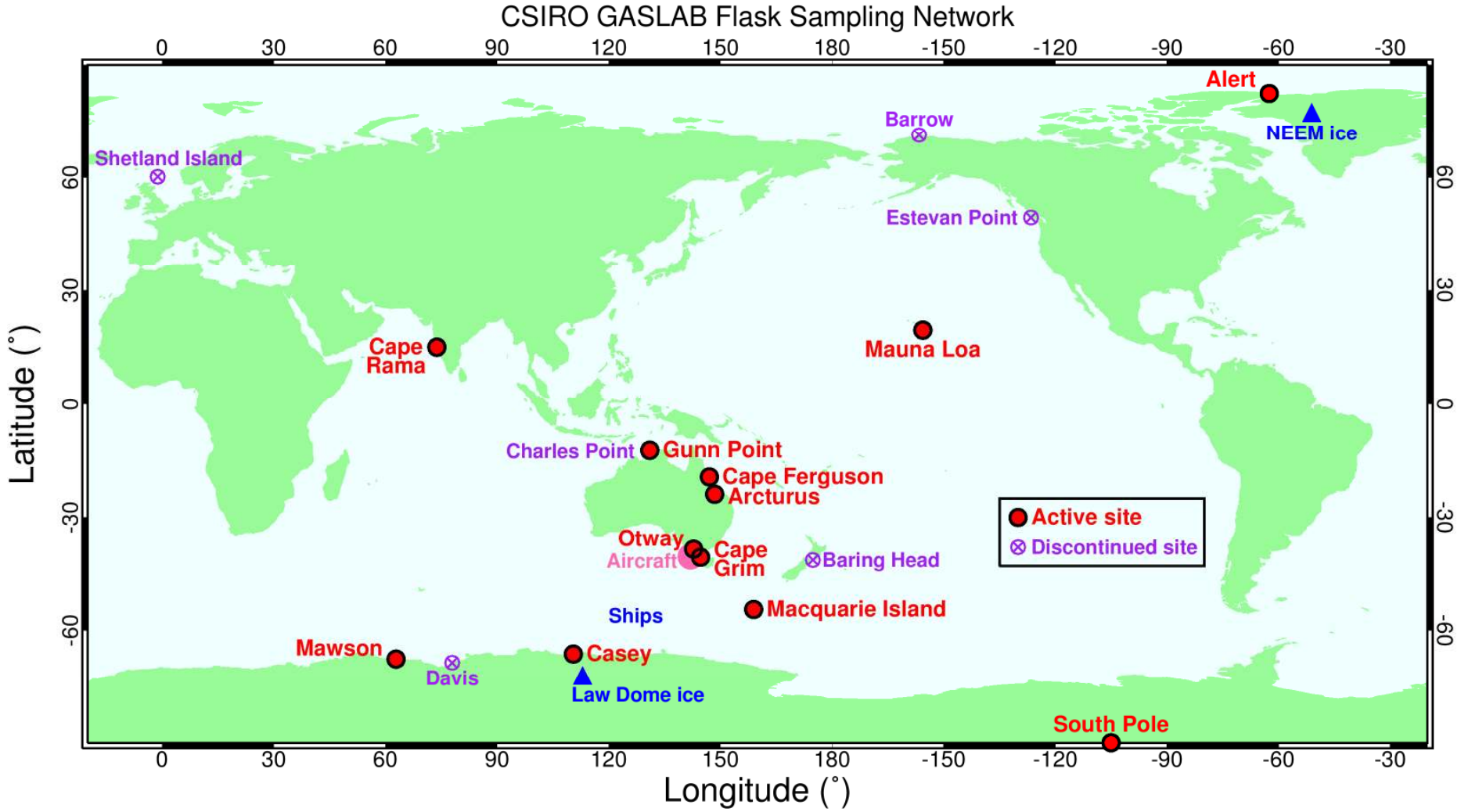
Outline of today's talk

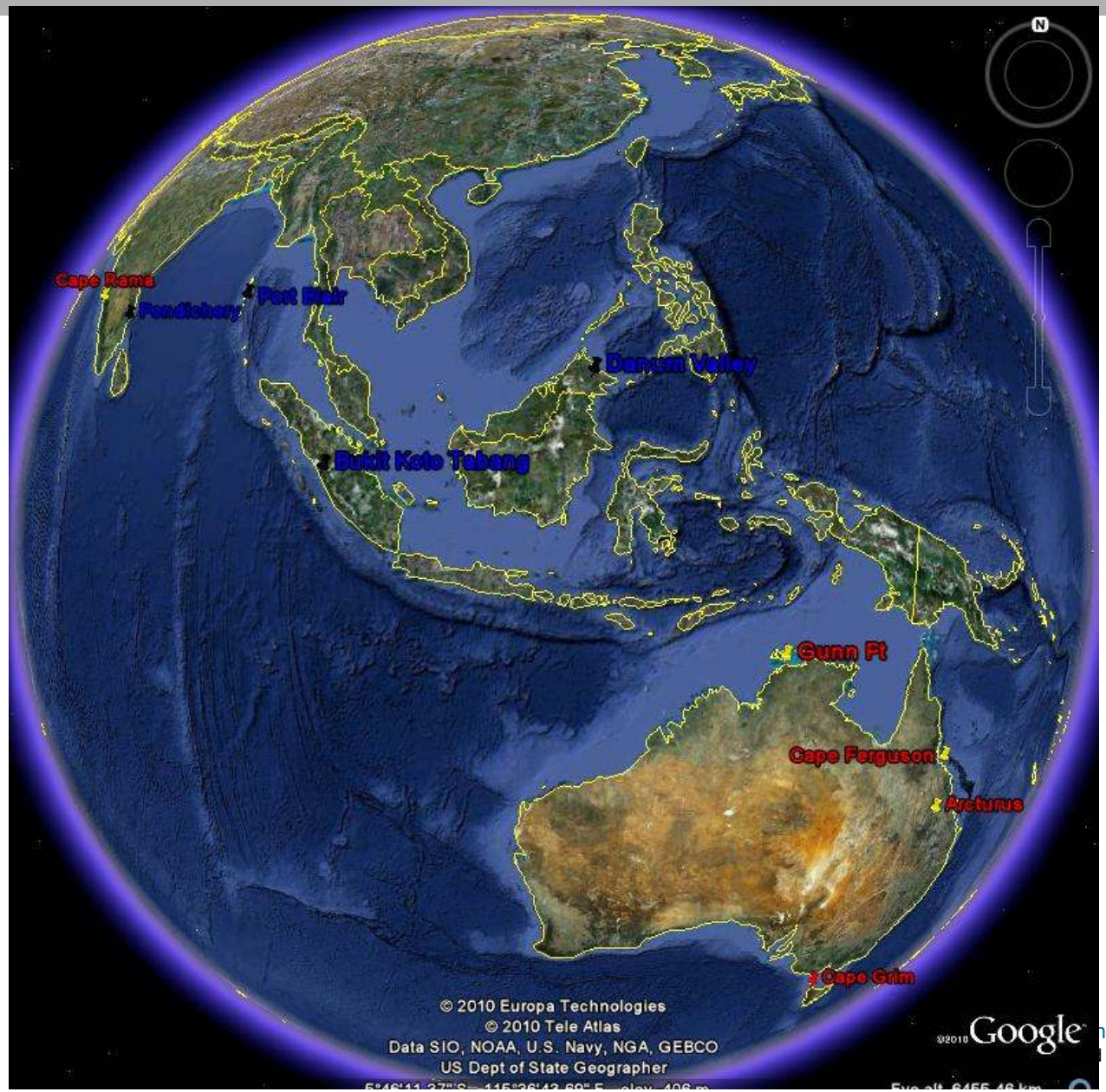
- Importance of tropics on global (and regional) climate
- Southeast Asian – Australian tropical regional GHG observation network
- New pilot Australian Tropical Atmospheric Research Station (ATARS)

The CSIRO Global Atmospheric Sampling LABoratory (GASLAB) flask network

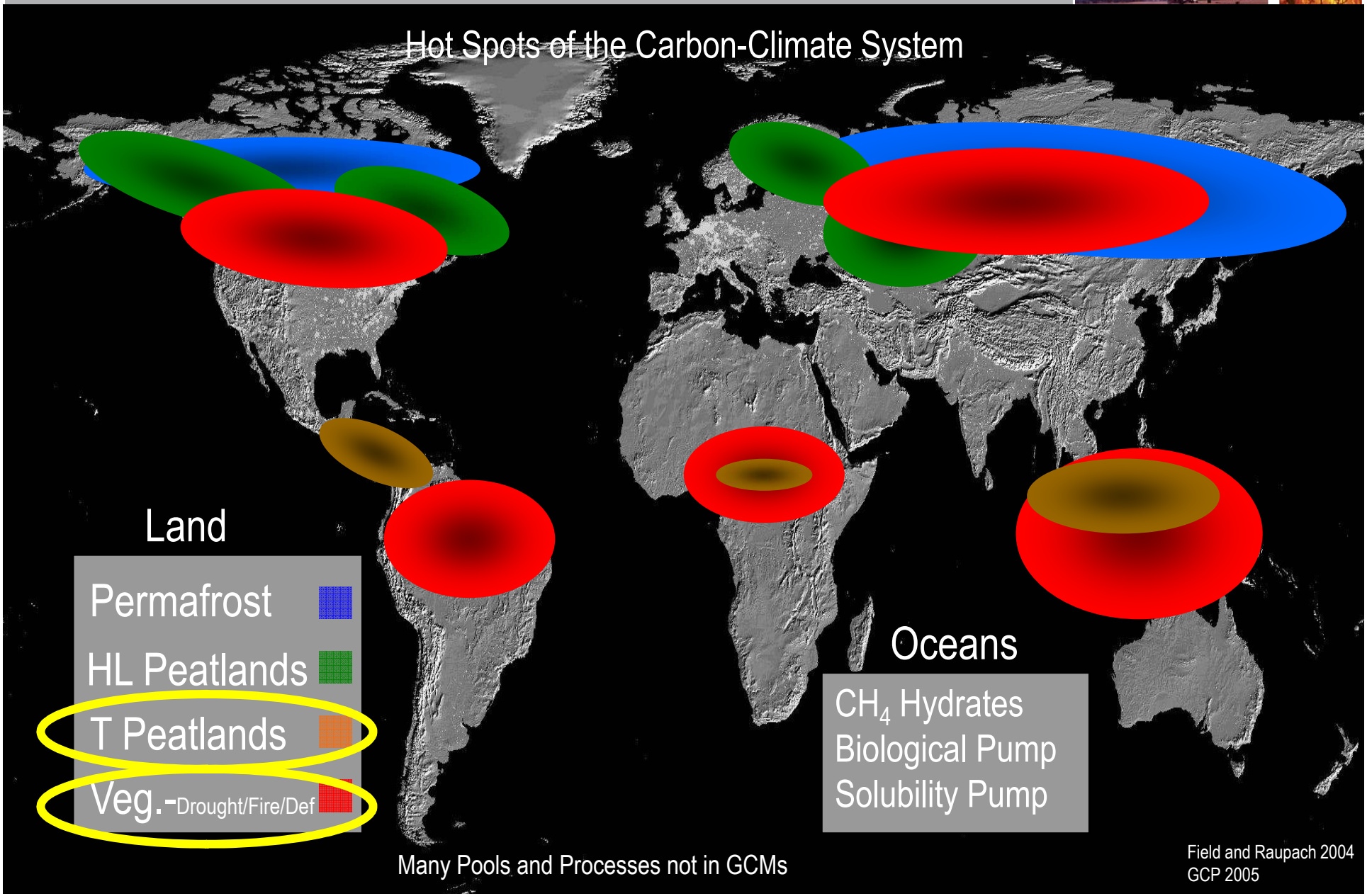


Southeast Asia-Australian Regional Network





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)
- ~80% global biomass burning
  - 20% total global GHG emissions (mainly CO_2)
  - major source of 'anthropogenic' aerosol (global climate feedbacks)
  - ~ 13 – 40% of global CO_2 from 1997 El Nino Indonesian fires (Page, 2002) (~1Gt Carbon)
- substantial terrestrial CO_2 sink (Stephens et al, 2007)
- ~75% of CH_4 oxidation occurs in tropics (Lawrence et al 2001)
- ~50% of global wetlands
  - Indonesia alone has 4th largest peatland area in world (30-40 MHa) (~10-12% of total) (Page, 2002)
  - 50% of global sources of CH_4 (rice, wetlands, biomass burning)
- ~80% of global sources of N_2O (25% of which from Asian tropics) *(*Huang *et al,* 2008)
- ~75% of global sources & 60% global sinks H_2 (Xiao *et al*, 2007)
- Short-lived halocarbons (stratospheric influence)

- Tropics are a critically under-sampled region
  - Only 1 global tropical GAW station matches GLOBALVIEW CO2 criteria (Samoa)
  - Asian tropics unique (land-sea interactions important in SE Asia)

Some key research questions in tropics

Do Asian aerosols (tropical biomass burning) influence regional climate?

- Increase rainfall in NW Australia

Why has global CH_4 increased since 2007 (after a decade of stability)?

- Boreal (likely to be very gradual) and tropics
- Biomass burning changes unlikely as little activity since 2002
- Increased CH_4 wetland emissions
- Dominant variability in tropics is ENSO (biomass burning)
- OH variability possible?

• Reduce uncertainties in sources/sinks of many climatically active constituents

- CO_2, CH_4, N_2O, H_2, halocarbons…
- Large potential feedbacks in tropical forests under stress (droughts)
  - Large droughts in Amazon (2005) caused 1.4Pg/C/yr switch from sink to source (Lewis, 2009)

Gunn Point (NT) - existing radar station (BoM) (Lat/Long: 12.2 S, 131.0 E)

Gunn Point Pilot Tropical Atmospheric Research Station

- **Latitude :** 12.2°S
- **Longitude :** 131.0°E
- **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

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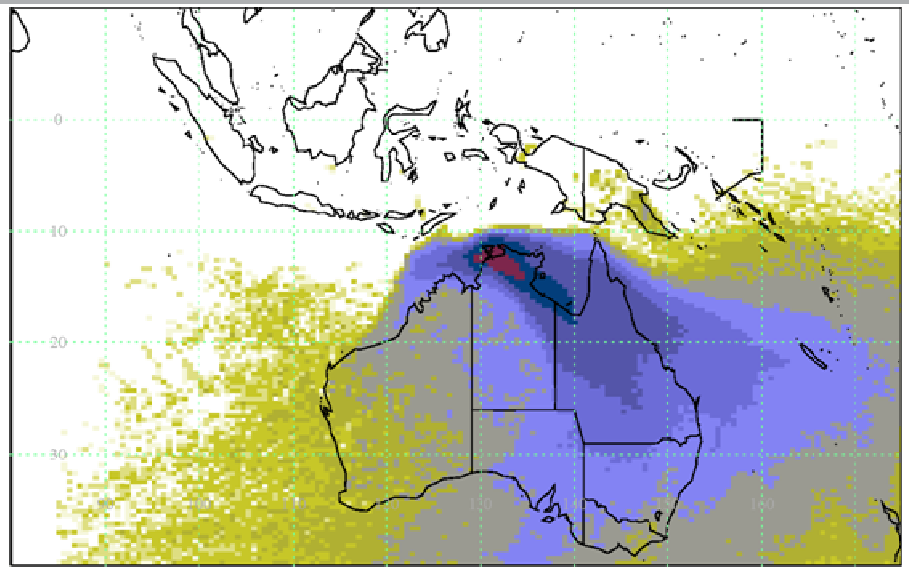
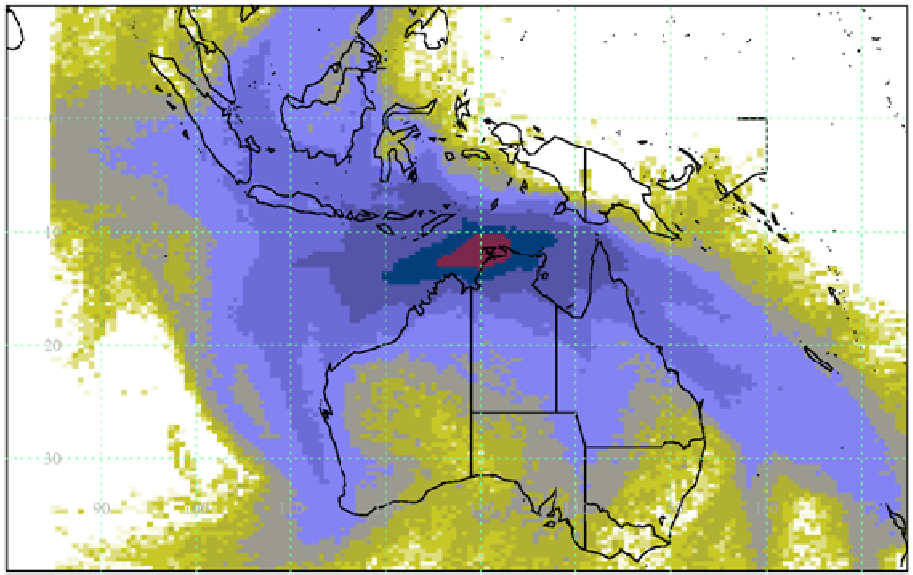
Air mass origin maps Gunn Point
(courtesy Alistair Manning UK Met Office)





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
- Strategically located to reduce global scale atm. inversion CO_2 flux uncertainties
- Based at existing research radar site at Gunn Point (BoM)
- Unique opportunity to combine existing state-of-the-art **physical** atmospheric research facilities currently in Darwin (BoM / US DoE Atmospheric Radiation Measurement program) with high precision **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)

Southern Ocean Carbon Sink

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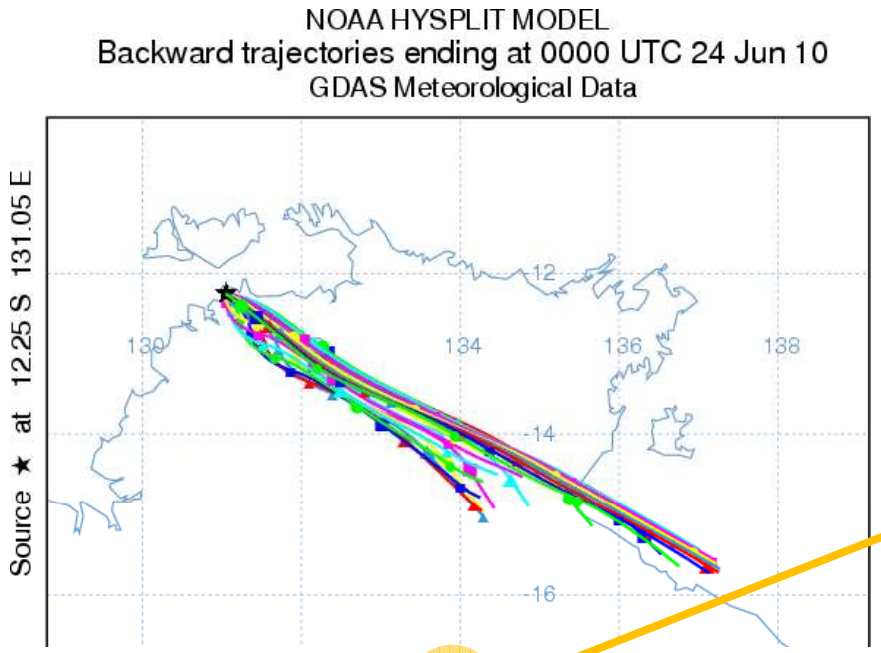
Gunn Point – atmospheric measurement program

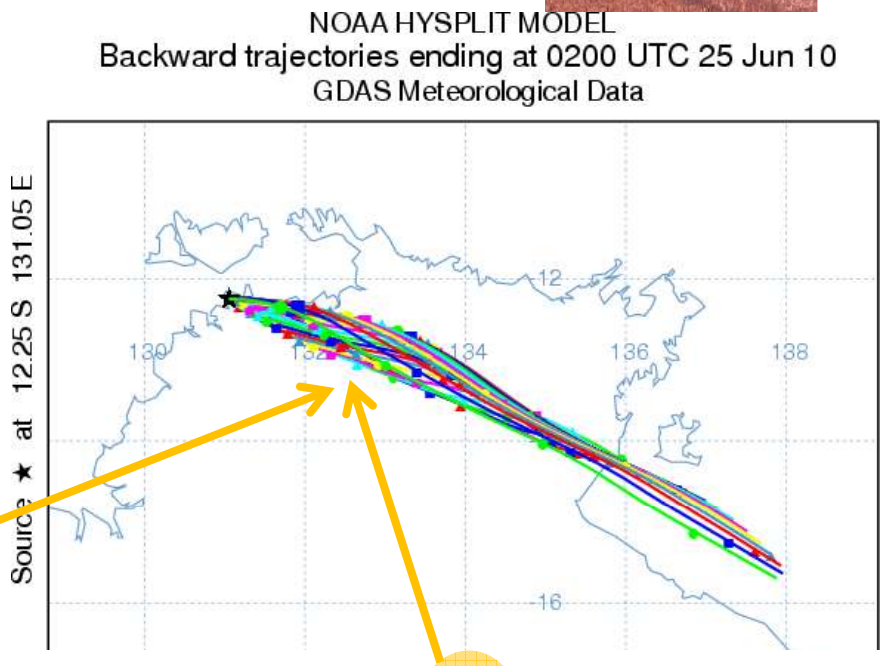
- Current (Sep 2011)
  - In-situ CO_2 & CH_4 (CRDS)
  - In-situ $^{13}CO_2/^{12}CO_2$ (CRDS)
  - Flask CO_2, CH_4,$^{13}CO_2/^{12}CO_2$, N_2O, CO, H_2
  - Met (WS, WD)
  - Radon (ANSTO)
  - O_3, CO, NO/NO_X
- Proposed measurement program
  - $PM_{2.5}/PM_{10}$
  - Aerosols (dry season campaign completed June 2010)
  - Short-lived halocarbons, C_4-C_{12} HCs: GC-ECD (N. Harris, U. Cambridge, UK) (Oct 2011 or May 2012)
  - Medusa (2012/13?)

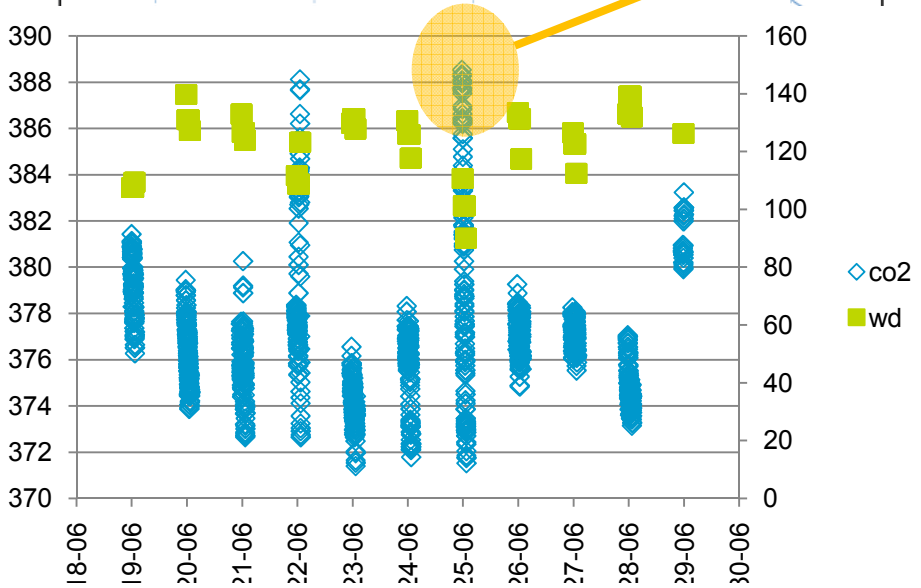
Measurement details- VOC and Aerosol Campaign, June 2010 (early dry season)

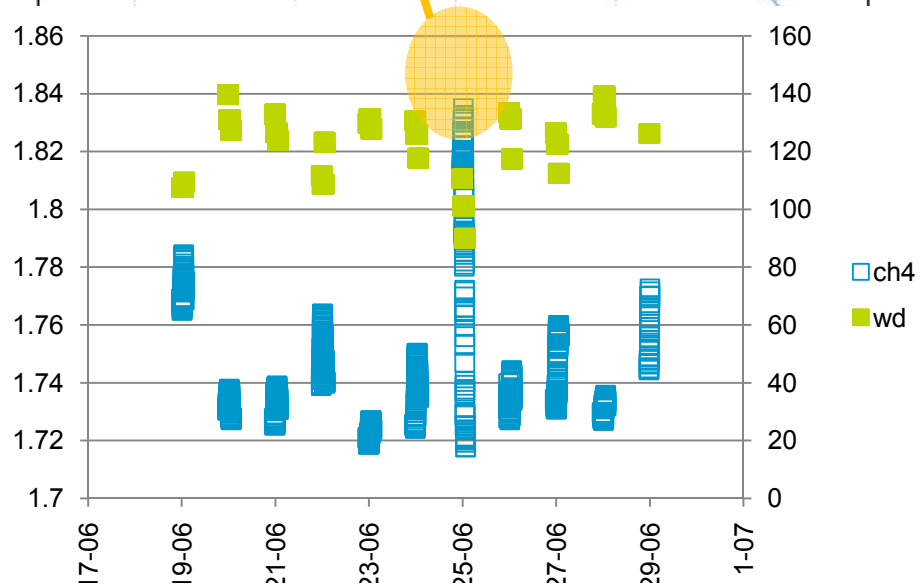
- VOC
  - 12 hour samples (daytime – night-time 7am-7pm)
    - DNPH cartridges – aldehydes and ketones- HPLC analysis
    - Adsorbent tubes– VOCs - GC-FID/MS
- Aerosol
  - Size distributed number (14 – 700 nm) SMPS
  - CCN
  - MOUDI / Microvols (chemistry)
- Greenhouse Gases
  - CO_2, CH_4 (Picarro)

Preliminary data events (dry season)

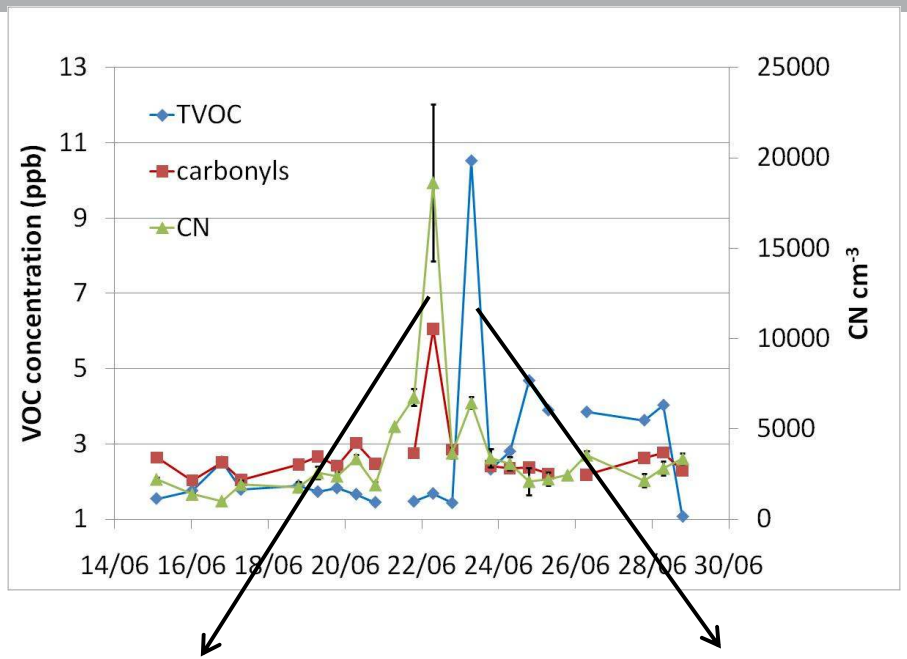


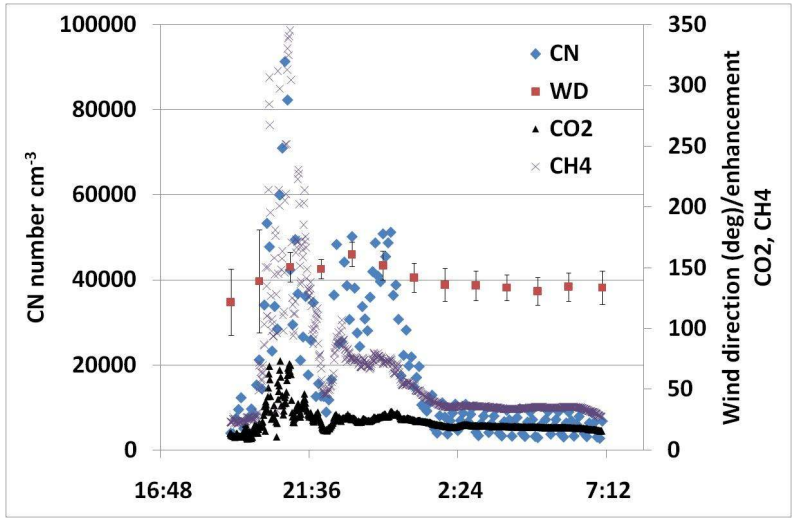


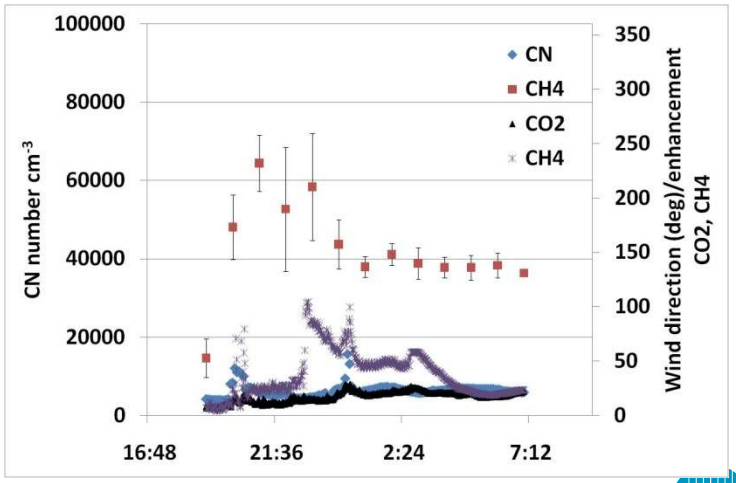




Two local biomass burning events







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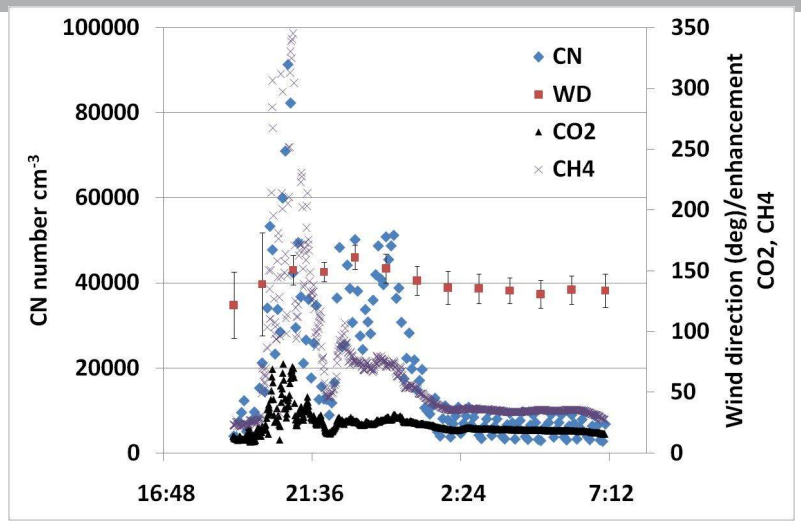
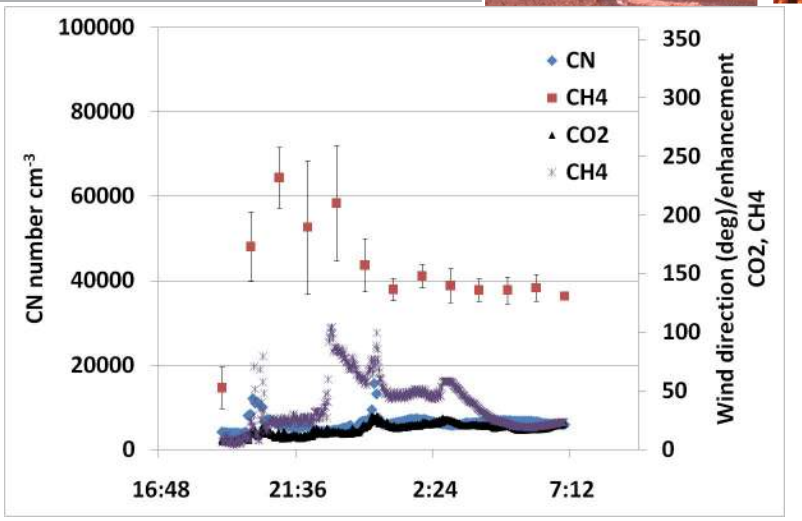
Two distinct biomass burning events





VOC	Conc (ppt)	Increase
Formaldehyde	1320	1.9
acetaldehyde	1940	3.8
glyoxal	190	3.8
Me glyoxal	210	2
MEK	240	2.6
Toluene	300	1.5
Cyclopentane	41	1.3
styrene	22	1.1
xylenes	47	1.3

VOC	Conc (ppt)	Increase
Formaldehyde	-	-
acetaldehyde	-	-
glyoxal	-	-
Me glyoxal	-	-
MEK	-	-
Toluene	4800	27
Cyclopentane	675	21
styrene	300	15
xylenes	861	24

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Thank you

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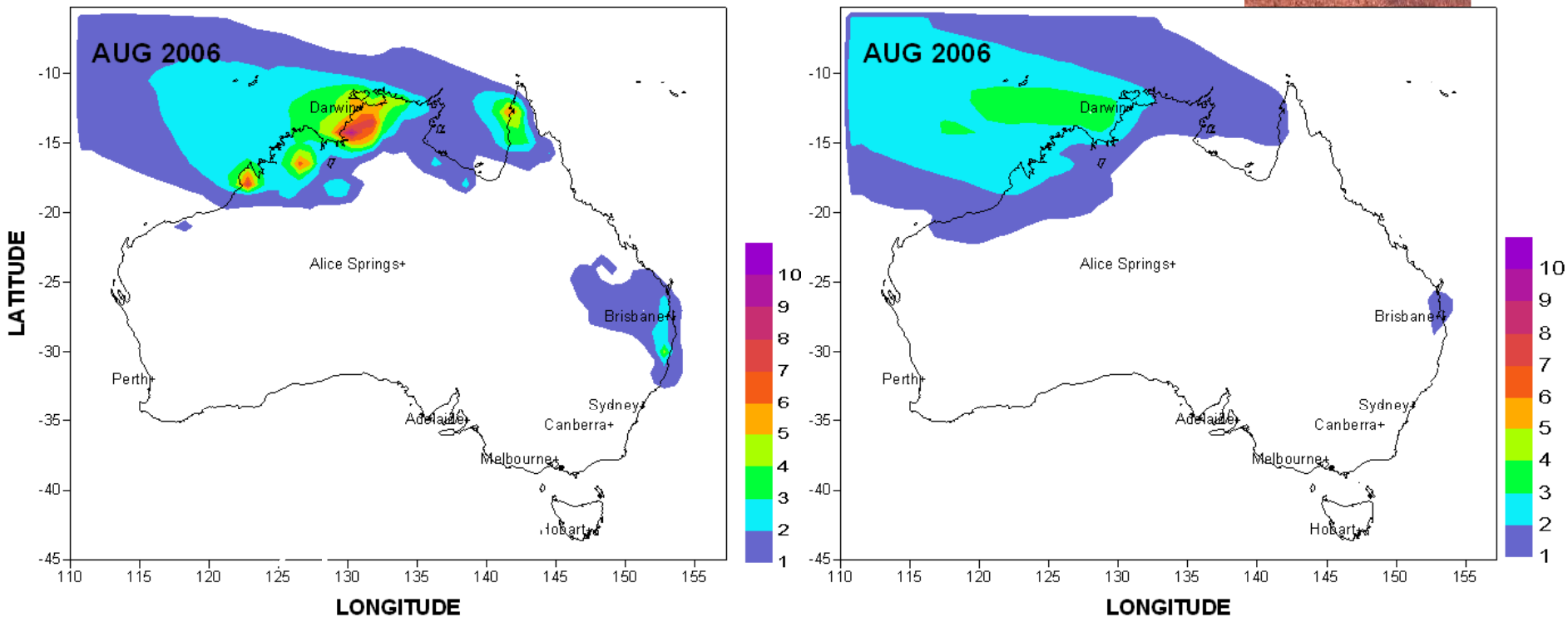
SOA Production From Biomass Burning



- How does biomass burning affect SOA formation in Northern Australia?
  - Is the total radiative forcing from BB positive or negative?

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Danum Valley (Malaysia) GAW observatory

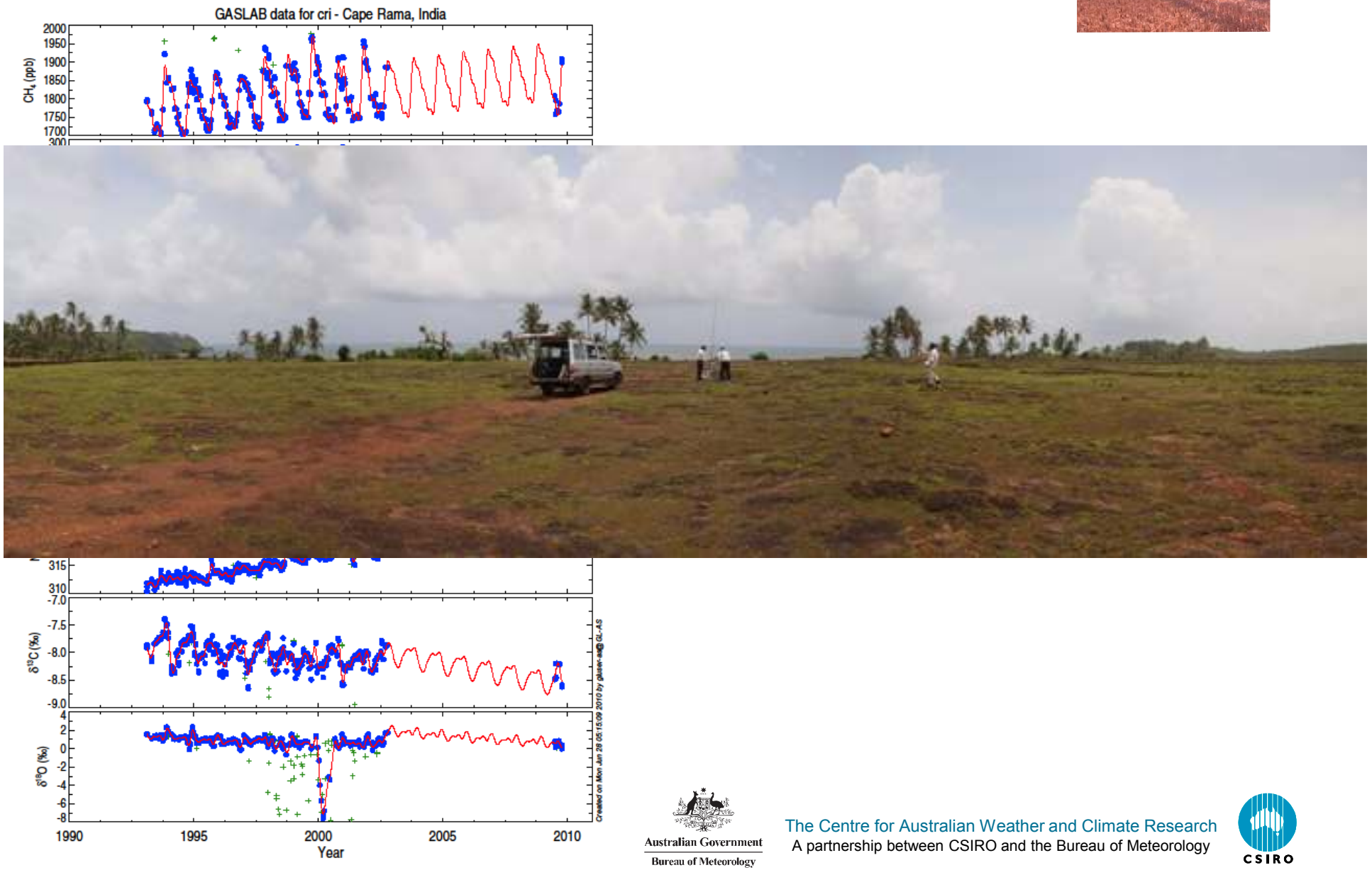
- Bukit Atur Global Atmospheric Watch (GAW) (04°58'53"N, 117°50'37"E, elevation 426m) in Danum Valley Conservation Area
- located on a ridge above the forest canopy (~70m).
- Danum Valley Conservation Area is 438 sq km Class 1 Protection Forest Reserve.
- ~ 90% is lowland dipterocarp forest (remainder is sub-montane forest).
- conservation area is surrounded by a 9500 sq km sustainably-managed natural Forest Management Area.
- CSIRO installed LoFlo CO_2 analyser system September 2004
- dual air intakes at 3 levels (100m, 60m and 30m)
  - (Future option for virtual tall tower capability & local CO_2 flux measurements)

5°N, 118°E

Danum Valley existing research program

Atmospheric species	Analytical method	Intake position	Research group
Meteorological parameters	AWS (temp, RH, WS, WD, Rad)	Roof (10m)	MMD (Sep 2005)
In-situ CO_2	LoFlo (NDIR)	Tower 100m (60, 30m)	CSIRO (Aug 2004)
Particles (PM_{10})	TEOM 1400a /MAAP	Roof	IFT Leipzig (Apr 2006)
Short-lived halocarbons, C4-C12 HCs	GC-ECD	15m	University of Cambridge (2008)
Aerosols (AOD) multi wavelength optical depth	AOD Precision Filter Radiometer (Sun photometer)	Roof	PMOD-WRC (Aug 2007)
Aerosols (PM10)	Nephelometer	Roof	IFT Leipzig (Apr 2006)
Surface O_3	UV absorption (TEI 49i & 49c)	Roof	MMD (2008)
Precipitation	Rain Gauge	Roof (platform)	MMD (Sep 2005)
Multi-species OP3 campaign (Apr/June 08)	Multi	Tower (10m)	UK consortium
pH and chemical composition	wet sampler	Roof (platform)	EANET (Sep 2005)

Cabo de Rama (CSIRO/NIO)



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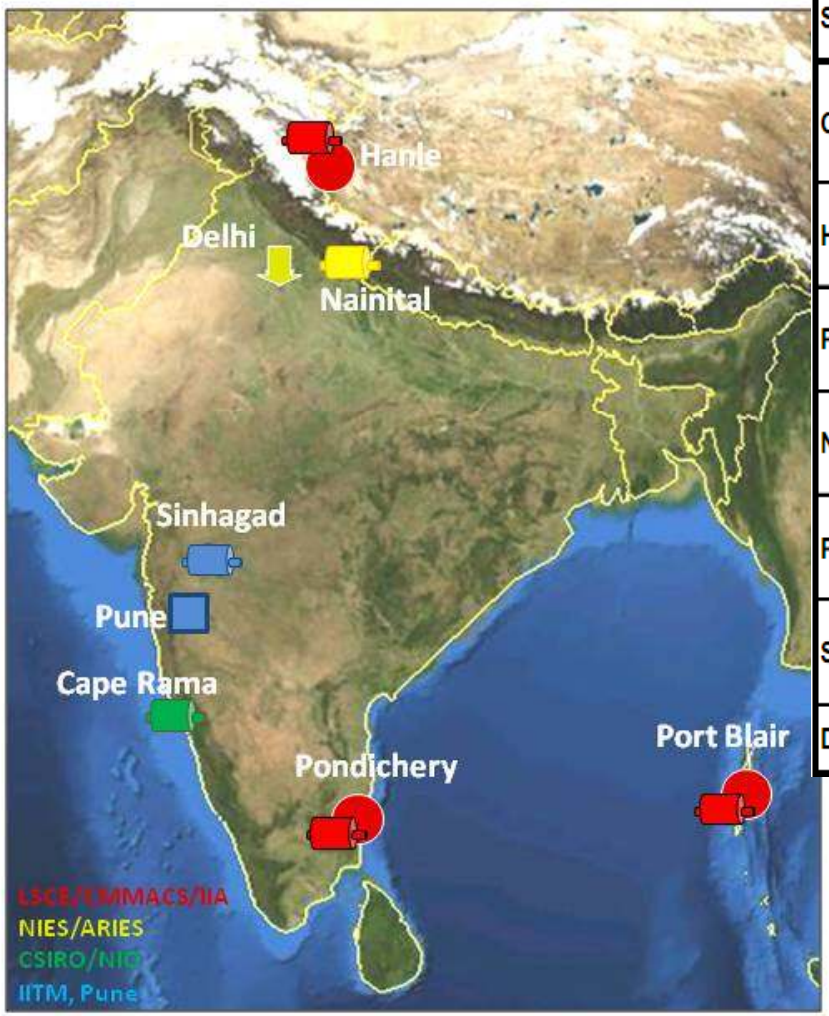
Indian GHG observation network
(courtesy M. Ramonet, LSCE, France)



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 - ...	CO2, CH4, CO 2011 - ...
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 (JAL commercial aircrafts)					

- In-situ measurements
- Flask sampling
- Airborne measurements

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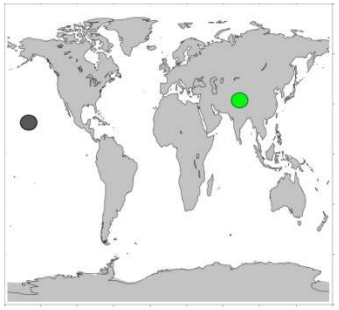
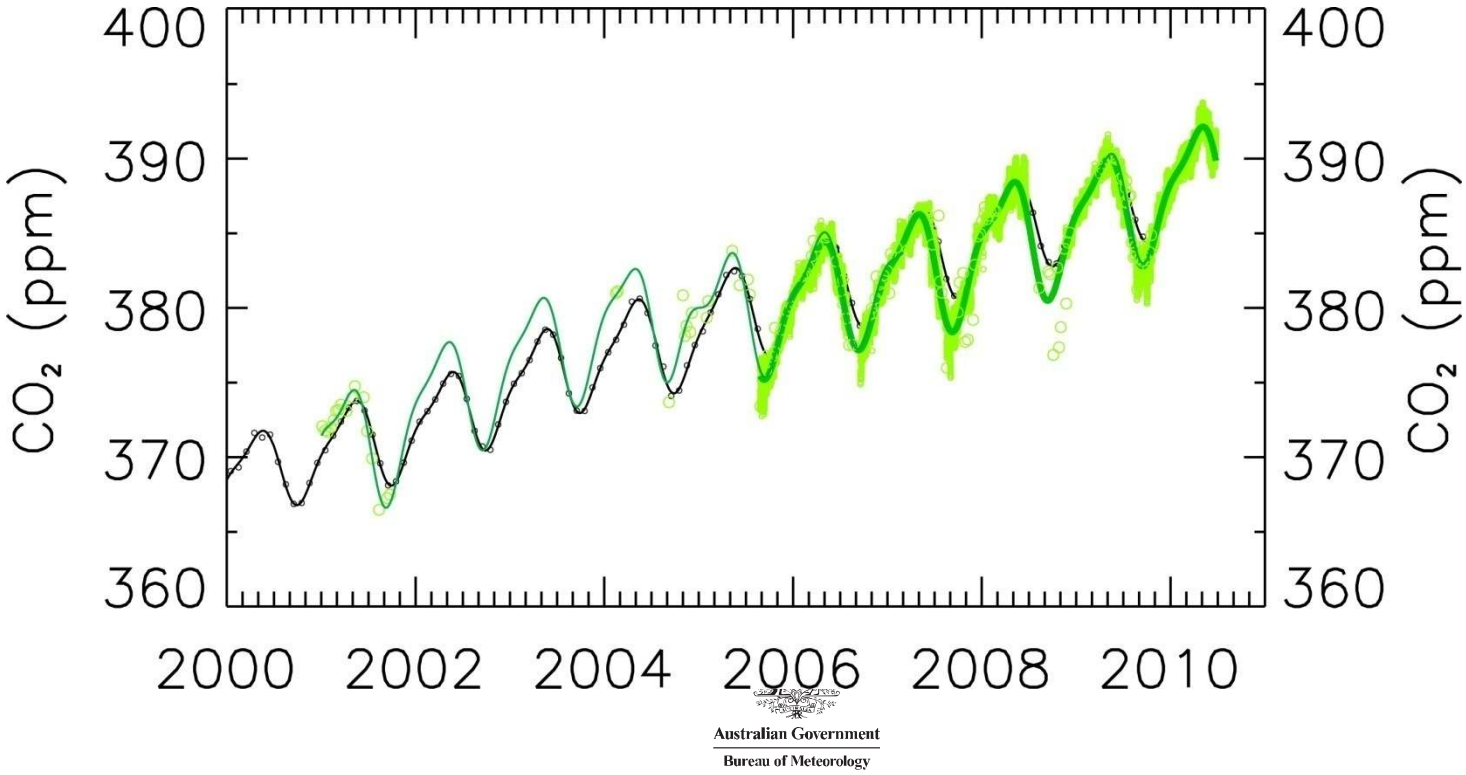
Long term observatories for background measurements *(courtesy of M. Ramonet, LSCE)*

Mauna Loa



Hanle



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