An Introduction to a New S. E. Asian Monitoring Station in Malaysia for Regional and Local Observations

The Universiti Malaya Bachok Atmospheric Research Laboratory.

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University Malaya Bachok Atmospheric Research Laboratory

Part of the New Universiti Malaya Marine Research Station

Based on the North Malaysian Peninsula

- New atmospheric research activity
- Institute of Ocean and Earth Sciences
- I was in Malaysia from July 2013 to Sept 2014 as a Senior Fellow
- Main role was to develop the atmospheric laboratory
- Now back in the UK based at the University of Manchester
- Continue to play an on-going role at the station
- Partnerships in place with UK collaborators as well as regional collaborators
- Large national level schemes in place at Bachok

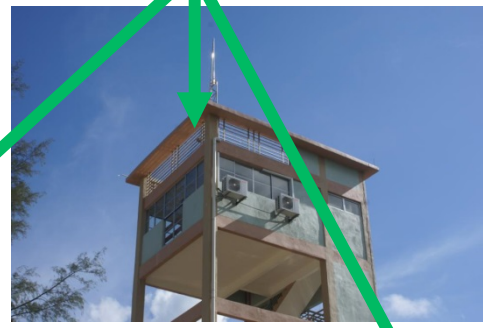
- (Iq Mead iq.mead@manchester.ac.uk)

Bachok Site Detail

- Bachok, N Coast of Malaysia.
- Very large investment in infrastructure.
- Hugely expanded measurement capability.
- Developing in country capacity.
- Build national and international collaborative networks.
- Ultimate aim is become part of WMO GAW activity.
- Tower site, facing the sea.

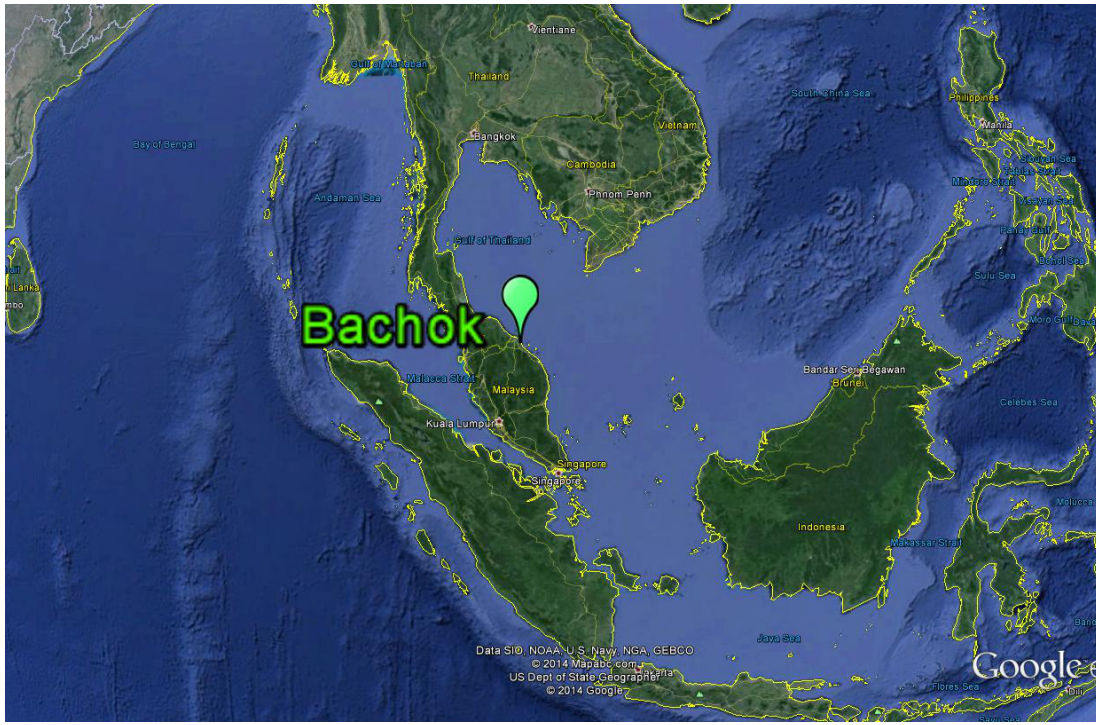
Bachok July 2010

Weather Research Lab (5th Floor).



Sampling Tower

Bachok Site Overview



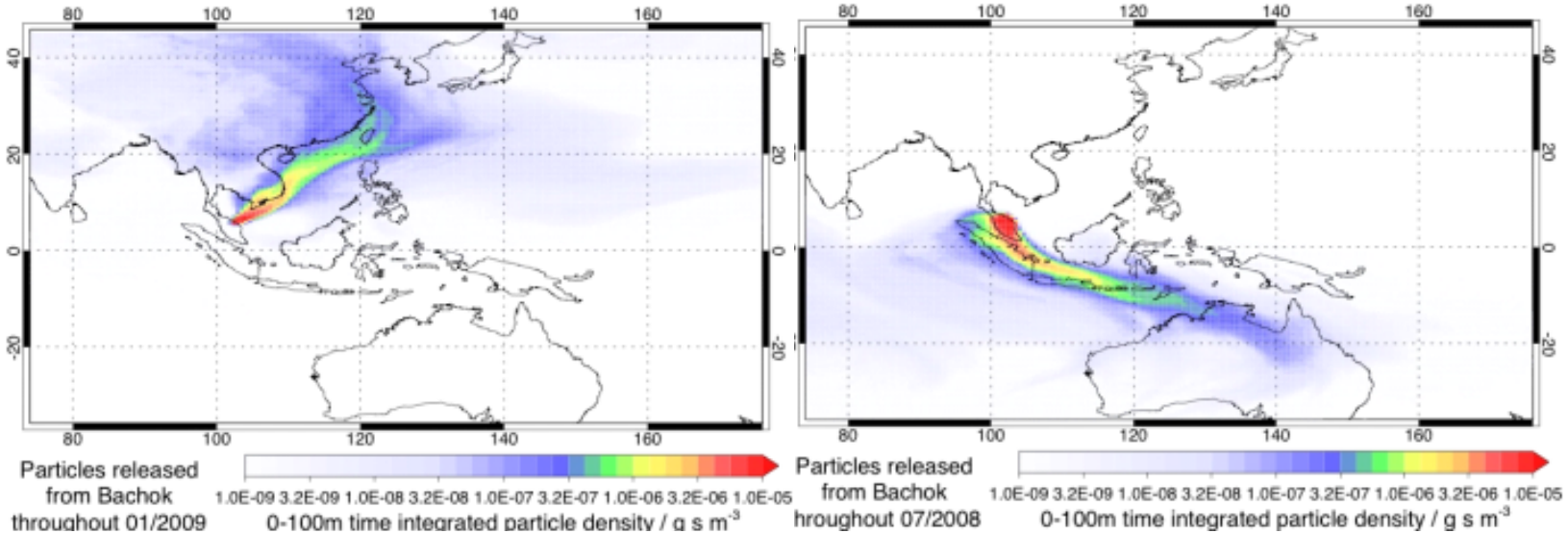
Site as is now

Tower lab

Site being built currently. Expected to be finished in plus 1 year.

Why Bachok?

NAME back-trajectories in lowest 100m from Bachok during January 2009 (left) and July 2008 (right). Warmer colours show the chance of air being in that place in the previous 12 days.



- Ideal Location. Developing Infrastructure.
- East coast of Malaysia facing the South China Sea.
- Studies conducted at the site since 2010 show wind fields can transport air masses from across the region to the site.
- Depending on season and prevailing conditions information can be collected on local regional and long range composition and transport.

Winter: Northern Monsoon with flow from Siberian High over SE Asia.

Summer: Southwest Monsoon with Flow from Australia and sometimes Bay of Bengal.

Capability

- NO/NO_2(Ecotech, Aus)
- SO_2 (Ecotech, Aus)
- O_3 (Thermo Scientific, USA)

Reactive Gases Suite

- N_2O (Thermo Scientific, USA)
- $CO_2/CH_4/H_2O(g)$ (Los Gatos Research, USA)

GHG Suite

- Size Speciated Aerosol (GRIMM Aerosol, Ger)

Start of Aerosol Suite

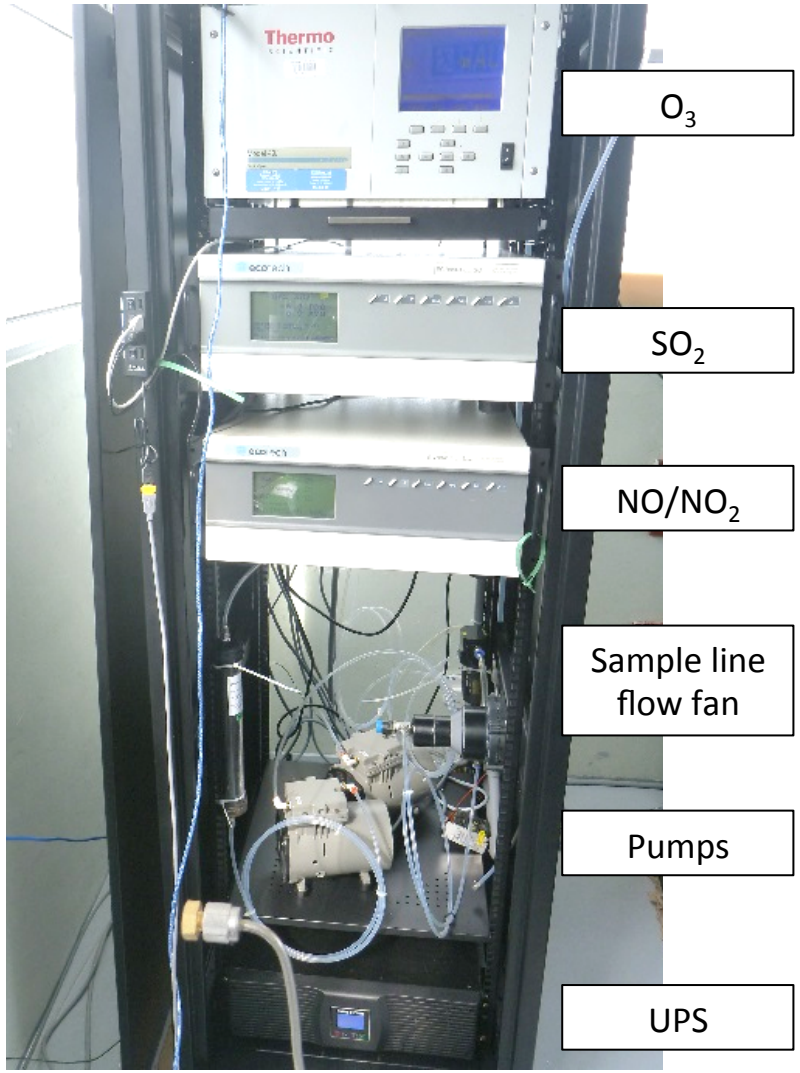
- Halocarbon suite (uDirac UCAM)
- CO (UEA).

Long term Collaborations

- Sonic Anemometer
- LSI Assembly

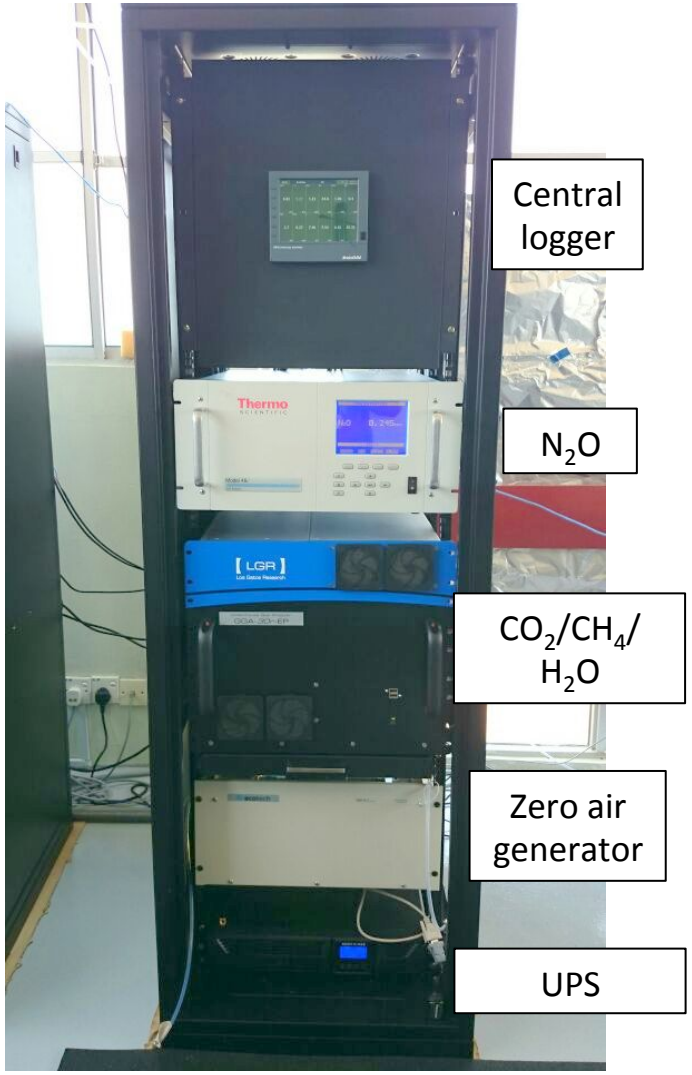
Station Met

Reactive Gases



- Thermo 49i O_3 dual cell photometer
- Ecotech EC9850T Trace SO_2 analyser (UV fluorescence).
- Ecotech EC9841T Trace NO_x analyser
- Shared sample line (fan aspirated large bore sample line out to roof).
- Separate inline scrubbers for humidity and O_3 (added for SO_2 in particular)
- External pump array (for SO_2 and NO_x). Over capacity available so pumps are never stressed.
- 6kVA UPS backup power
- Separate analogue outputs feeding data.

GHG Suite



- Thermo 46i N_2O instrument
- Los Gatos Enhanced baseline $CO_2/CH_4/H_2O$ instrument
- Shared sample line (fan aspirated from roof)
- 1kVA UPS power backup unit for this rack
- Inlet is not dried at this point
- Refrigerated drier in place potentially for use with nafion counter purge.

Aerosol Enclosure

Optical particle counter with heated inlet (mounted in weatherproof enclosure)

- EDM 180 Aerosol spectrometer
- Installed 19” rack mount Weather proof enclosure on roof.
- Incorporates space (with power) for 2 additional pieces of instrumentation.
- Continuous automatic monitoring (ties in with existing standards).
- Simultaneous PM values with total particles (0.25 to 32 µm in 31 channels).
- Humidity and temperature measurements at instrument inlet.
- Collocate with instrumentation from partners for selected periods.

Met Instruments

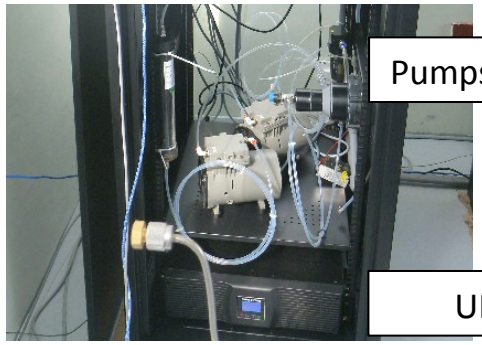
- Sonic 3D anemometer at top of mast (Metek Omni 3).
- Using external power with separate data logging.
- New met station successfully bid and tendered for. In the process of installation.
- Currently using met output from Kota Bharu (regional) airport.

Sonic anemometer on roof of tower

Met station tendered for

General Infrastructure

- Key part of ongoing development
- Air conditioned and weatherproof lab.
- Clean gas system (local gas supplier identified).
- External pump assemblies
- Zero air generator
- Refrigerated air dryer.
- Central logging for instrument analogue signals.
- Data logged locally and routinely backed up.
- Instrument UPS power backup.
- Gas scrubber arrays.
- Tools and peripherals on site.



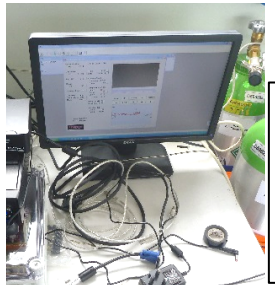
Pumps array

UPS

Zero air generator

UPS

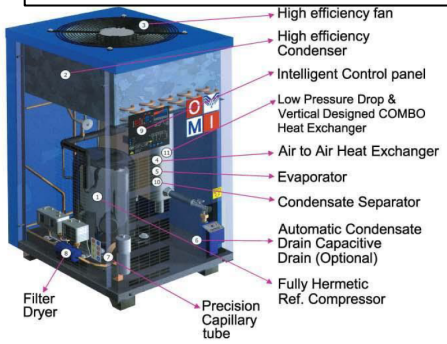
Central logger



Lab computing for remote access and operation of instruments

Sample inlets

General air dryer



Switching clean gas system at base of tower

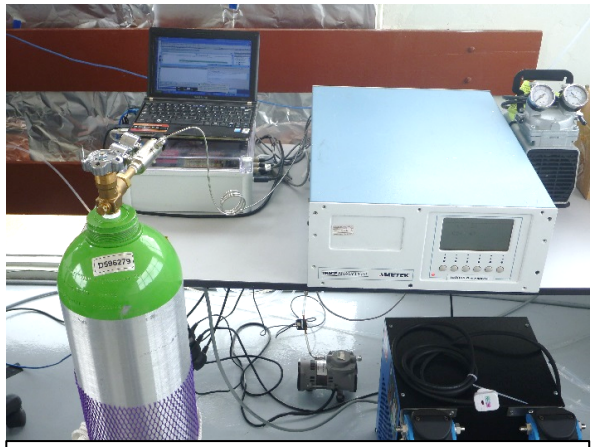
On site selected gas standards (UK collaboration)

Long Term Collaborations

- **uDirac GC**
- Range of halogenated species
- Operated by the University of Cambridge

uDirac, standards and operating laptop (Cambridge collaboration)

- **TA3000**
- CO and H_2
- Operated by UEA
- Calibrant from UEA on site
- Front end automation system in place



CO, standard cylinder, front end system and operating laptop (UEA collaboration)

Additional Sensors

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Fig. 11. Static sensor unit (or node) plus mounting baseplate. CO, NO, NO_2, temperature and relative humidity are recorded, along with GPS location and time. A view of the open sensor node is also shown (left).

~49 cm

~2.8kg

- UM purchased. Commercialised version of University of Cambridge units.
- Sensing CO, NO, NO_2, SO_2 and O_3, temp and %RH (designed for use as part of routine AQ networks).
- I have used 10-17 of these as part of NASA DISCOVER-AQ mission over the last year.
- To be deployed in Danum, Borneo. (canopy gradients).
- 1 min to hourly data acquisition. Hourly to daily data transmission.
- 12-24 month operational lifetime (variable dependent on data transmission routine).

Mead et al., Low-cost electrochemical sensors for monitoring air quality. Including the deployment of a real time high density autonomous network. Atmospheric Environment. Volume 70. 186-203. 2013.

NERC IOF CAMPAIGN

The University of Manchester

Overview

- NERC IOF "Demonstration Activity" Jan/Feb 2014.
- International Opportunity Fund (NERC/NCAS) research at the Bachok.
- Improve UK/NCAS capability to observe atmospheric changes in SE Asia.
- Install instruments.
- Demonstrate potential of site.
- Maintain observational program.
- Create and develop scientific networks.

UK Coordinators:

Neil Harris and Dr M. Iq Mead (University of Cambridge)

Bill Sturges and David Oram (University of East Anglia)

International Partners:

Phang Siew Moi, Azizan Abu Samah and Dr M. Iq Mead (University of Malaya, Malaysia)

Maznorizan Mohamad (Malaysian Meteorological Department, Malaysia)

KuoYing Wang and Jai-Lin Wang (National Central University, Taiwan)

Marcel van der Schoot (CSIRO, Australia)

Project Supporters:

Karin Kreher (NIWA, New Zealand)

NCAS Composition and FGAM, including the Universities of York, Leeds, Leicester and London Royal Holloway

https://www.ncas.ac.uk/index.php/en/participants

Instruments:

- UCamb microDIRAC
- UM ozone
- UM sonic anemometer
- UM AWS
- UM Los Gatos CO2/CH4/H2O
- UM/MMD radiosondes UEA/York TA3000 CO, H2
- UEA SO2
- UEA NO, NOx
- UEA ozone
- UEA formaldehyde
- UEA PTRMS VOCs/OVOCs
- UEA whole air sampler
- York GC-FID VOCs/OVOCs
- York low volume filter
- Leeds spectral radiometer
- UKM Grimm aerosol analyser
- NIWA MAX-DOAS
- CSIRO flask sampling
- MMD rain water sampling
- Met Data

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Ongoing Papers

1. Rough title: "An overview of the 2014 Jan/ Feb International Opportunities Fund observation activity in Northern peninsular Malaysia.“

2. Rough title: "Influence of regional biomass burning and anthropogenic emissions on Northern peninsular Malaysia in the inter monsoon period."