A summary of the 2014 "demonstration activity" at Bachok Marine and Atmospheric Research Station, Malaysia: aims, set-up and preliminary results.

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Introduction: Bachok Marine and Atmospheric Research Station is located on the eastern coast of Peninsular Malaysia by the South China Sea and represents a new research initiative owned and operated by the University of Malaya (UM). During January and February 2014 the station hosted a NERC and UM funded "demonstration activity" involving several UK universities, NCAS, UM and the Malaysia Meteorological Department. The purpose was to initiate a programme of long-term atmospheric chemistry and meteorological observations from the station's atmospheric observation tower. The overarching aim of which is to achieve WMO/GAW status for the station in the near future. The demonstration activity comprised of an intense observation period in which measurements were made of a large range of atmospheric trace gases. We present the initial findings from this demonstration activity and highlight the main features (i.e. chemical and meteorological) of the station.

B: Bachok Station (University of Malaya); **BA**: Bukit Atur (Danum) GAW site (Malaysian Meteorological Department); **D**: Darwin Site (CSIRO); **LL**: Lu-Lin GAW site (Taiwan National Central University); **TR**: Tana Ratah Site (Malaysian Meteorological Department); **X**: Taiwan Coastal Site (Taiwan National Central University).

Set-up

- The "demonstration activity" took place between 22nd Jan – 9th Feb 2014 and the week prior was used for instrument set-up and stabilisation.
- Station located at 6.00 °N, 102.25 °E
- XX m inlet height
- 15 m from the shore

↓ View of Bachok Marine and Atmospheric Research station.

↑ View of laboratory on the top floor of the tower.

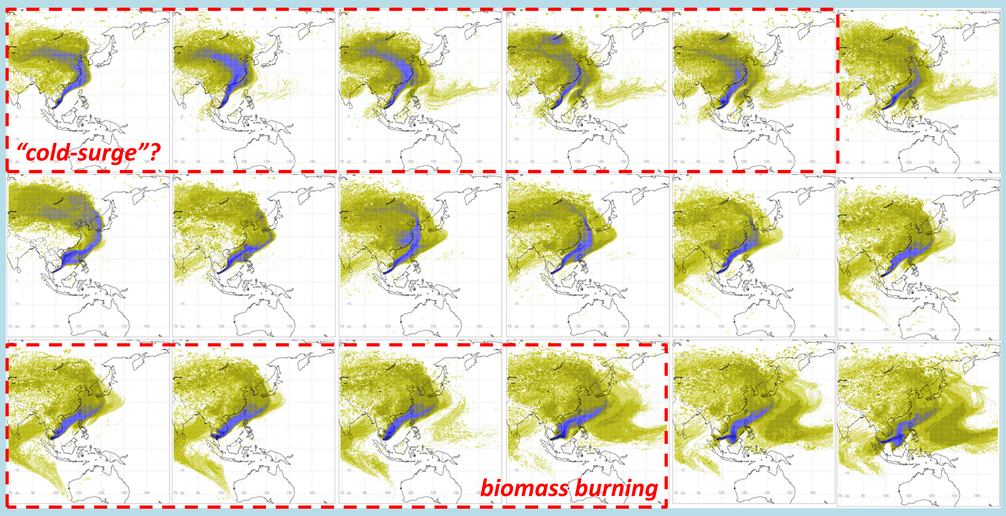
Selected parameter/s	Instrument/s	Institution/s
carbon dioxide (CO_2) and methane (CH_4)	LGR analyser	RHUL
carbon monoxide (CO) and hydrogen (H_2)	TA3000 Reduction Gas Analyser	UEA
Volatile Organic Compounds (VOC's) and Oxygenated Volatile Organic Compounds (OVOC's)	PTr-MS and GCxGC	UEA and UOY
nitric oxide (NO) and nitrogen dioxide (NO_2)	Thermo 42i	UEA
sulphur dioxide (SO_2)	Thermo 43i	UEA
ozone (O_3)	Thermo T49C	UEA
formaldehyde (CH_2O)	Aerolaser	UEA
$\delta^{13}CH_4$	Tedlar bag sampling	RHUL
Halogen oxides	MAX-DOAS	NIWA
Halocarbons	In situ µDirac and flask sampling	UCAM and UEA
Aerosols	GRIMM analyser and	UKM
Vertical structure	Radiosondes	MMD

Preliminary results

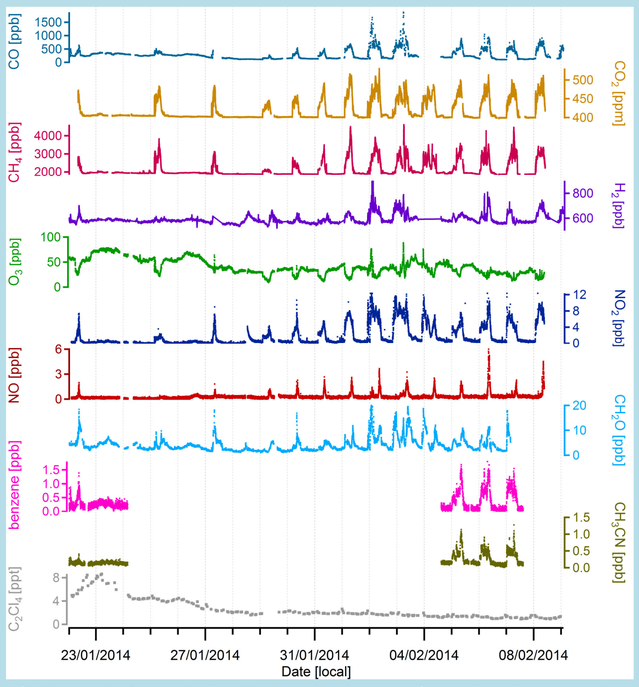
2 contrasting meteorological regimes at Bachok encountered during the "demonstration period"!

- Local/regional pollution
- Transport of pollution from China and the Indo-Chinese Peninsular

NAME air history maps



↑ Figure 1: NAME 12 –day air history maps for the boundary layer (<100m) for 0300 hours (UTC) for each day during the "demonstration activity". Courtesy of Dr Alistair Manning.

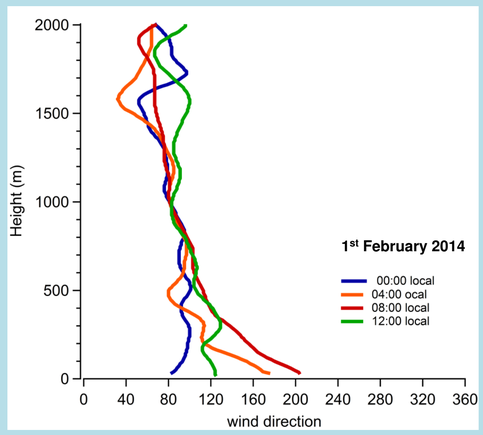


↑ Figure 2: Selected chemistry measurements from the demonstration activity from the 22nd January to 9th February 2014.

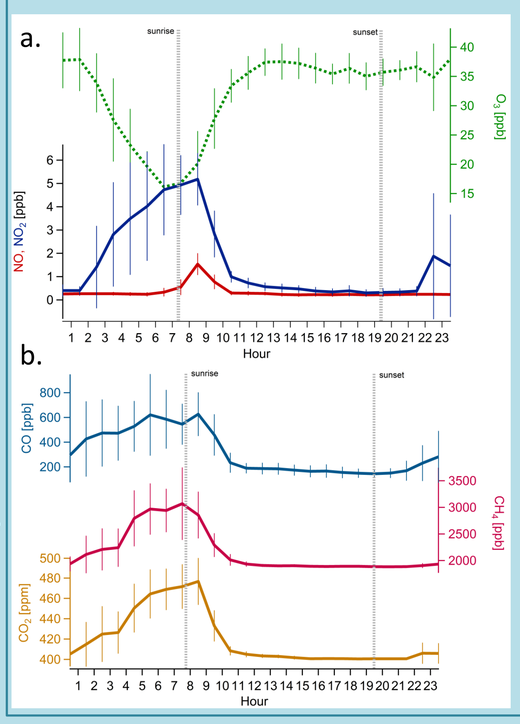
Local/regional influence:

At Bachok the effects of local/regional circulation are evident for 14 of the 18 days sampled. This manifests as a switch in wind direction from landward to seaward over night and returns to a strong landward flow between 0800 – 1100 hours (local). Figure 3 shows the wind direction retrieved from a radiosonde launched overnight on the 31st January into the 1st February 2014, a period strongly influenced by local circulation.

→ Figure 3 : Wind direction retrieved from a radiosonde launched overnight at Bachok from 31st January into 1st February 2014.



← Figures 4 shows the strong mean deil cycle observed at Bachok for a) O_3, NO_2 and NO, from the 30th Jan - 2nd Feb 2014; b) CO, CH_4 and CO_2. for the 30th Jan – 9th Feb 2014. Error bars represent 1 sigma SD of the mean.

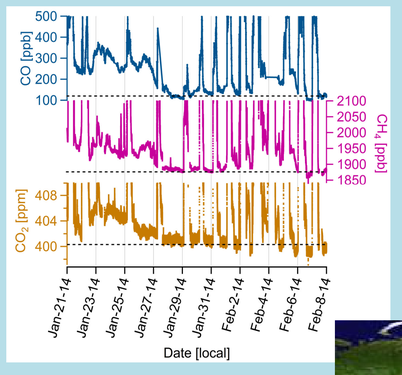


Key features (local / regional influence)

- nocturnal O_3 decrease likely due to deposition to the surface during transport. This could also be caused by O_3 titration by NO closer to the emission source.
- post-sunrise NO production via photolysis of NO_2.
- increases in most measured gas species (see figure 2) when the seaward breeze dominates the local flow.
- rapid decrease in pollution levels between 0900 – 1100 when the landward flow once again dominates.
- concentrations of acetonitrile (CH_3CN) above background indicates significant contributions from biomass burning.

Transport from China and the Indo-Chinese Peninsular:

- Tail-end of "cold-surge" event captured between 22nd – 27th January. O_3 and CO more than double the background concentrations.
- During the "cold-surge" the air arriving at Bachok was influenced by emissions from China (very high tetrachloroethylene, C_2Cl_4) and by biomass burning emissions (high CH_3CN) from the Indo-Chinese Peninsular.
- Second biomass burning event captured between 2nd – 6th Feb.



←Figure 5: Expanded view of CO, CH_4 and CO_2 concentrations measured at Bachok during long-range pollution episodes. Dashed lines indicate the background concentrations estimated by eye.

↓Figure 6: Firemap showing the detection of fired by MODIS from 21st – 30th Jan 2014. The colours in the firemap refer to number of fires where red is low and yellow is high.

Future plans

- Following on from the "demonstration activity" a range of measurements continue to be made at Bachok Marine Research Station. These are CO, H_2, CH_4, CO_2, nitrous oxide (N_2O), NO_2, NO, O_3, SO_2, aerosols and meteorology.
- Proposed return for a follow up mini-campaign to target a "cold-surge" in early Jan 2015.

References and web-based resources

- Firemaps: http://lance-modis.eosdis.nasa.gov/cgi-bin/imagery/firemaps.cgi
- Giglio, L., J. Descloitres, C. O. Justice, and Y. J. Kaufman. 2003. An enhanced contextual fire detection algorithm for MODIS. *Remote Sensing of Environment*, 87:273-282
- Davies, D., Kumar, S., and Descloitres, J. (2004). Global fire monitoring using MODIS near-real-time satellite data. GIM International, 18(4):41-43

Acknowledgements

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