

# Dust Outflow and Deposition to the Ocean (DODO)

## AMMA SOP-0 and SOP-3

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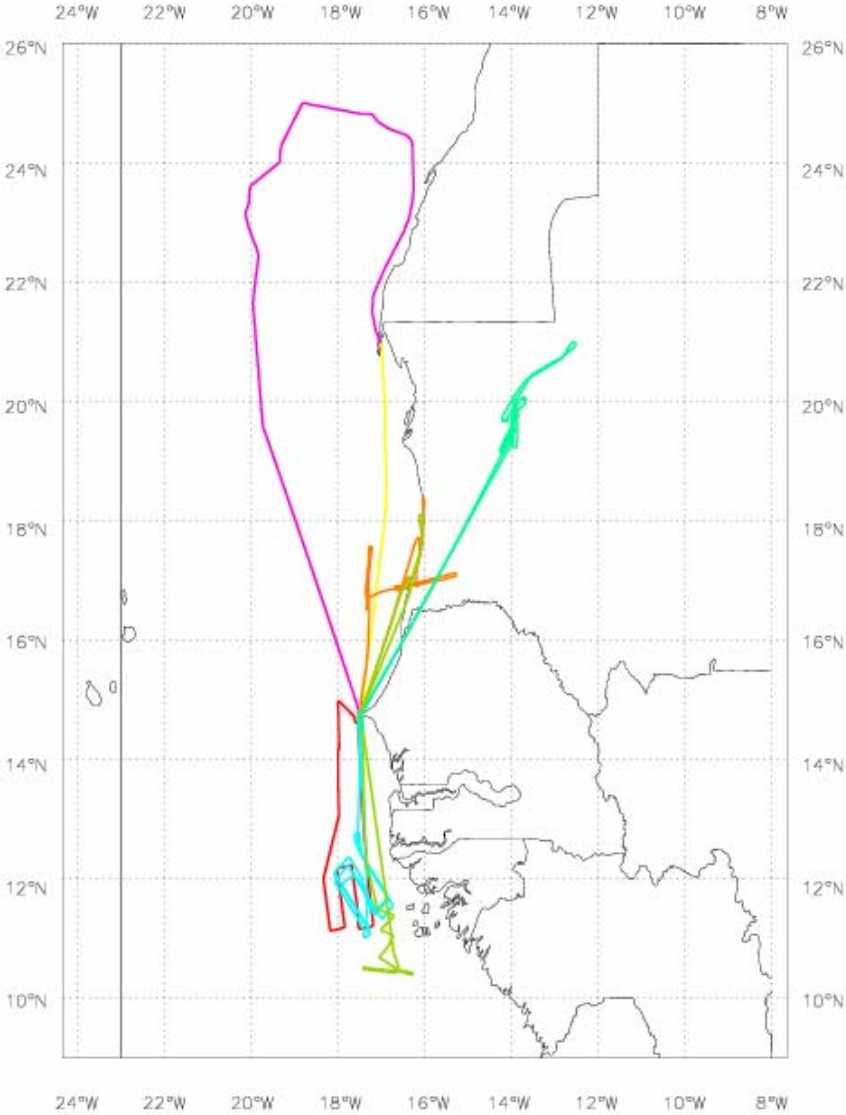
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Jim Haywood (Met Office) DABEX PI

# DODO Aims

- Case study based predictions of dust deposition to the NH Atlantic Ocean, constrained by in situ aircraft measurements
- Describe interaction of transport processes and aerosol chemistry and microphysics
- Fingerprint dust sources using single particle characterisation → composition, including iron content
- Assess the climatological representivity of the case studies and predict the seasonal footprint of dust deposition to the north Atlantic ocean.
- Assess the radiative impact of the dust over the Atlantic ocean and its effect on sea surface temperatures.

Links with DABEX, AMMA and NAMMA – downstream activities

# Aircraft campaign DODO1 (Feb 06)



Flight No	Date	Length	Objectives
B169	07 Feb	2,56	Shake-down /biomass
B170	11 Feb	4,59	In-situ biomass
B171/B172	13 Feb	4,18/1,40	Major dust storm
B173	14 Feb	4,46	In situ, local dust source
B174	15 Feb	4,48	In situ, dust advected over ocean
B175	16 Feb	5,24	In situ and radiation over land, moderate dust loading

# Proposed Case studies from DODO1

1. Dust radiative closure over land **B175**
2. In-situ changes dust source to advection **B173/B174**
3. Dust/biomass + radiation (and links to biomass/dust flights in DABEX) **B174**
4. Advected biomass consistency (**B169**, **B170**, **B174** and links to DABEX)
5. Dust model non-validation **B171/B174**

# Issues / features/ problems / challenges from DODO1

- Coarse particle sizing.. No SID data yet for B173-175
- Weren't able to get our multi-stage impactor for larger sizes on the aircraft in time due to inlet design problems
- No dust outflow over the ocean and in particular nothing towards Capo Verde, therefore no work with the ship POSEIDON (although they did collect aerosol during DABEX)
- Almost complete cloudy conditions meant very little radiation work at all, and also meant we abandoned trying to hit satellite overpasses to some extent.

# Ship based observations:

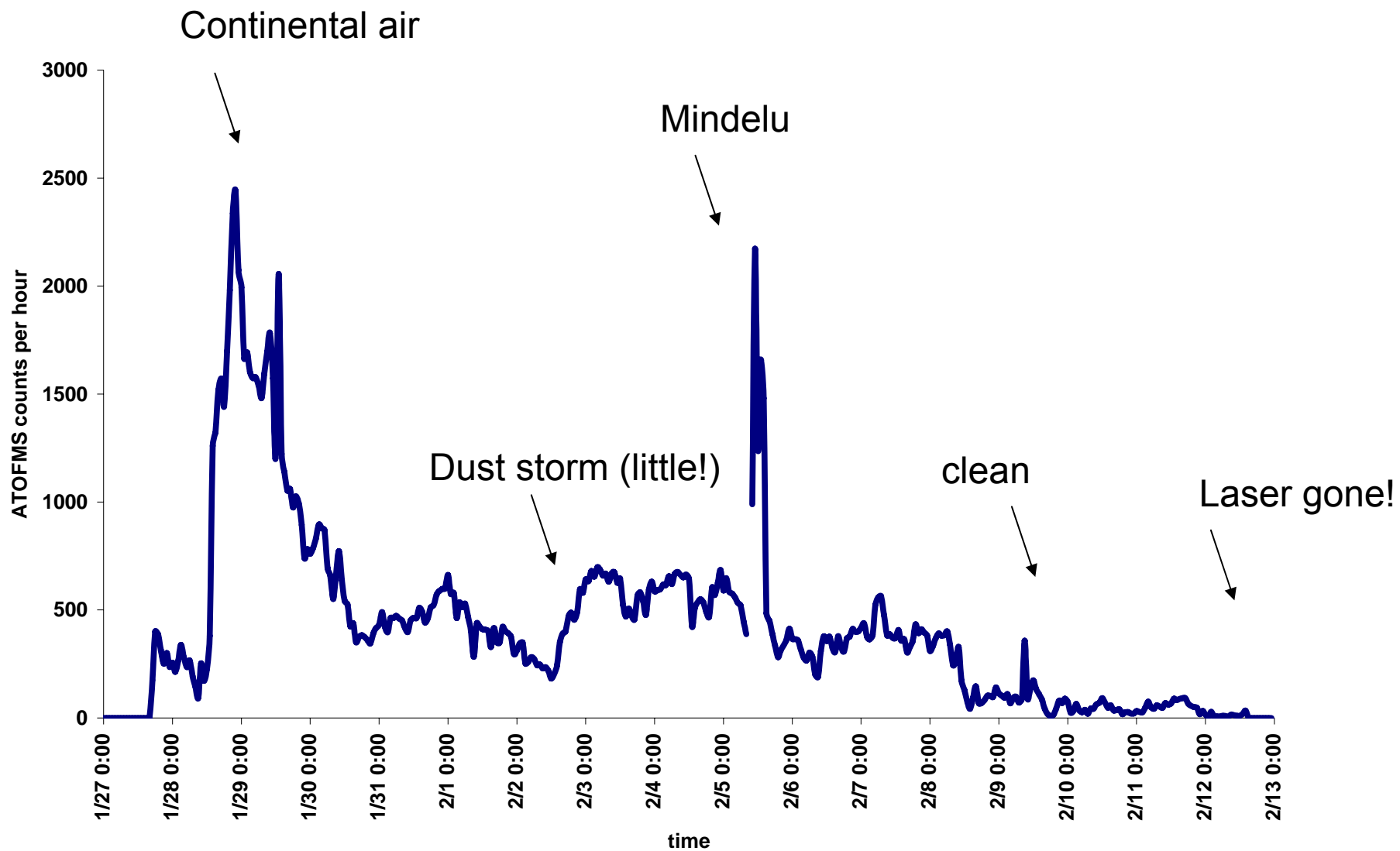
University of Birmingham  
– Manuel Dall’Osto

**ATOFMS detected 187205 single particles in the range 0.2-1.3 um.**

**ATOFMS data analysed with ART-2a (group single particle mass spectra together depending upon spectral similarity; UCSD- California).**

**20 particle types found during DODO. Main types are: sea salt (fresh and aged), carbon (Elemental and Organic carbon), dust, vanadium (ship emission).**

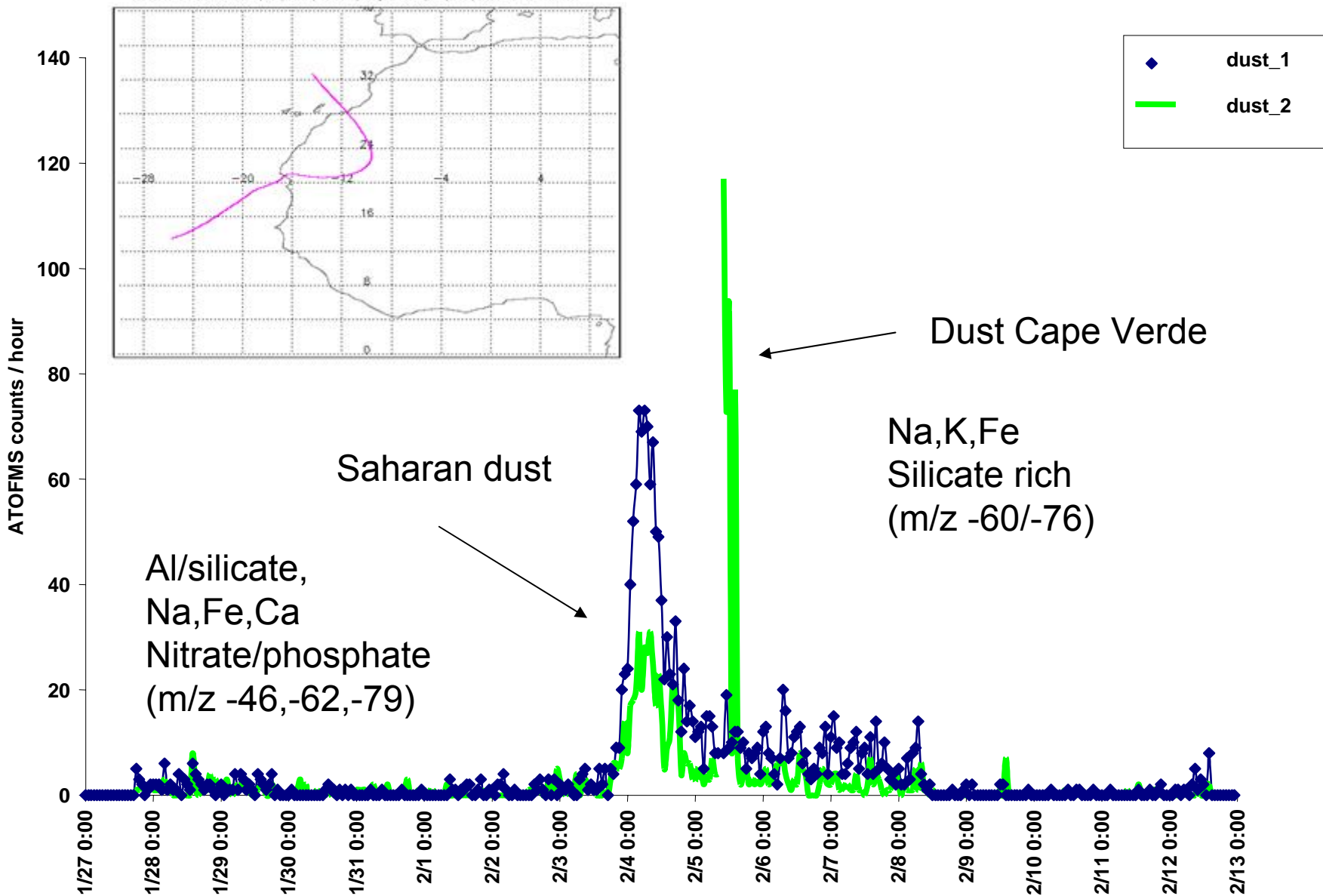
Cluster type	Particle number	% cluster
SS	26512	15.4
V_1	2003	1.2
V_2	978	0.6
Cu	437	0.3
org-rich	1650	1.0
dust_1	1930	1.1
dust_2	1174	0.7
EC-long	377	0.2
EC	15829	9.2
KECSOx	56273	32.7
EC SOx	47851	27.8
tobacco	8004	4.7
nicotine	67	0.0
EC-OC-SOX	1311	0.8
incenerator	176	0.1
K_only	1755	1.0
dust_bio	82	0.0
mixed_ss	4386	2.6
NaK	612	0.4
MgNOx	582	0.3
TOTAL	171989	100



Temporal trends of particle number detected with ATOFMS during DODO

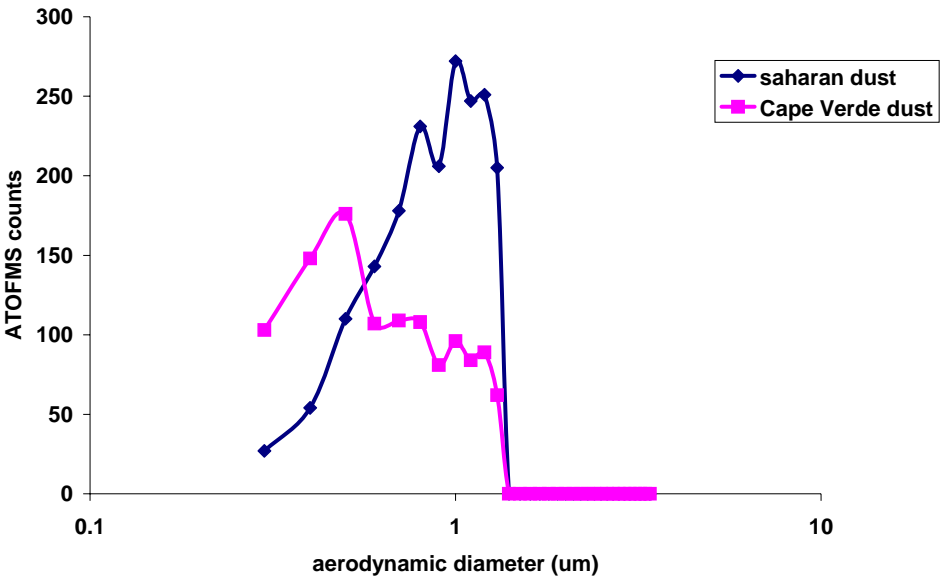
# DUST

Produced at the BADC /requests/sborda/traj\_service/exp197/t12006020400.nc



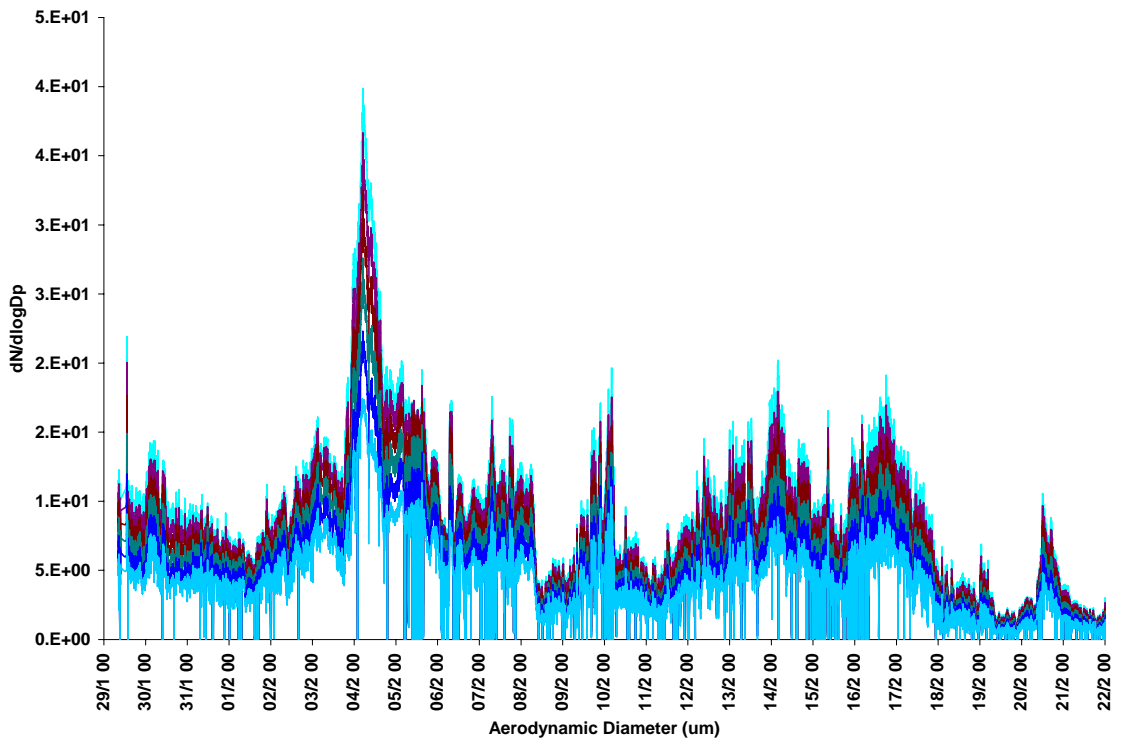
Temporal trends of different types of dust particles detected during DODO

# Size distributions of the dust particle types



ATOFMS detects only the tail of the Saharan dust, likely to be bigger than 1.3 um.  
 Cape Verde dust presents a smaller size distribution (about 500 nm), likely to be due to a local source (perhaps coal burning?). The two dust types are different in composition and in size.

APS coarse particles  
 (3um < Da < 4um)  
 Peak of coarse particles detected with the dust event.

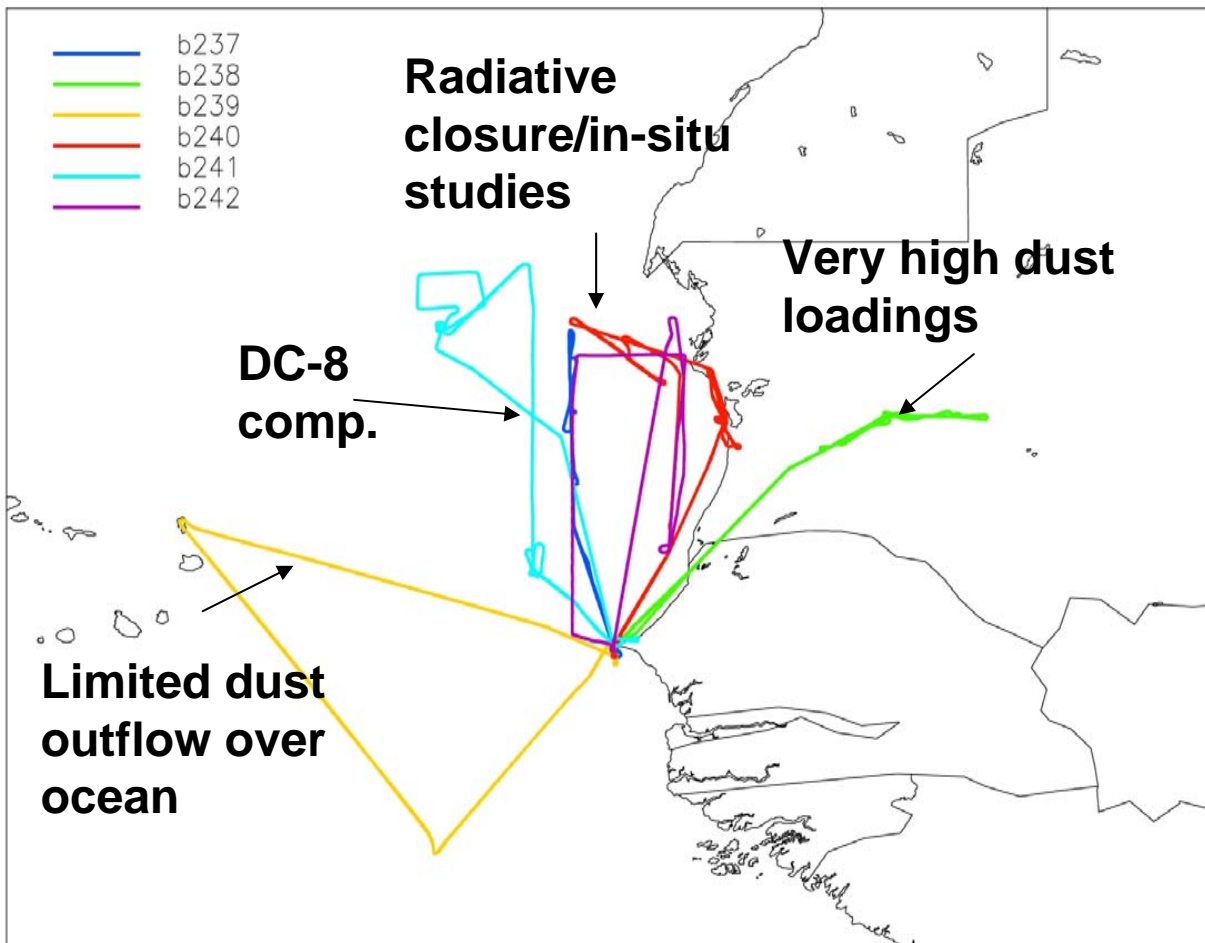


# DODO2 (August 2006)

- Dakar based during 21-28 August 2006
- 25 flying hours
- Compare dust vertical profiles, extent and microphysics to DODO1 (albeit limited) results – seasonal differences for model use.
- Try to get further off the coast (double flight, refueling at Sal intended).
- Other flying depending on dust conditions

## NASA-AMMA Collaboration

- Downstream dust microphysics changes (or lack of) by DC-8 from Sal and further afield by P-3 as we'll probably be closest to source.
- Intercomparison flight with DC-8 in vicinity of Sal
- Model prediction intercomparisons (including trajectory models)
- DC-8 will collect more filters for Manchester SEM work



- Several good dust flights (25 hours in total)

- Sampled dust outbreak at variety of stages (from very heavy loading over land – B238) to lighter loading with many thin layers over the ocean (B240)

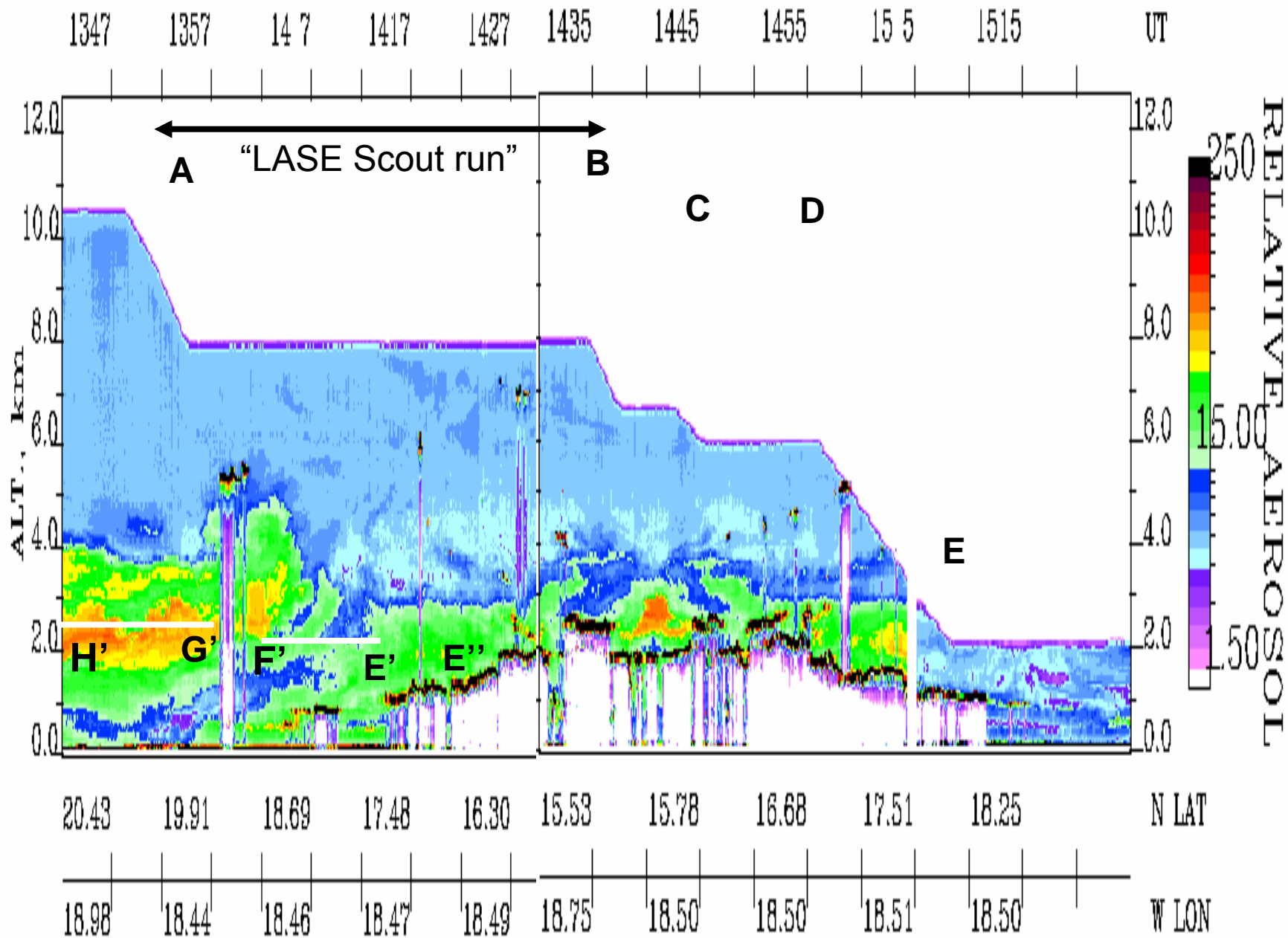
- Good range of longitudes flown out towards Sal

- Intercomparison flight with DC-8 (although dust load not as heavy as we might have liked)

- Good seasonal comparisons with DODO1 (SOP-0)

- Initial results show a difference between SSA from DODO1 to DODO2.. Is it real?

# NAMMA LASE Flight 7 Aug. 25 Dust Intercomparison



# DODO Year 2 and 3

- Aircraft analysis DODO1 and 2 (Claire McConnell, Reading PhD, Gerard Capes, Manchester PhD)
  - Campaign “averages” of microphysics, optical and chemical properties
  - Variability on variety of space and time scales
  - Detailed case studies looking at changes
  - Modelling of radiative impact and attempts at radiative closure
  - Comparison with AMMA ground based sites, AERONET and satellite data
  - Intercomparison with DC-8 in order to allow downstream comparisons
- Dust modelling PDRA at Reading and Met Office
  - Model evaluation using DODO case studies
  - Improvement of model dust schemes (already some improvement from DODO1 to DODO2 – but why?)
  - Climatology from the model
- SEM analysis and iron content measurements (Manchester, LISA)
- Repeat of dust work on ship on second SOLAS cruise, January 2007 (Eric Achterberg and Manuel Dall'Osto).