

# Dust Outflow and Deposition to the Ocean:

# DODO

## *F.A.A.M BAE-146 Aircraft Flight Summary*

**DODO(2) 21<sup>st</sup> August – 29<sup>th</sup> August 2006**

**Dakar, Senegal**



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Author: Claire McConnell

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## Introduction to DODO

Dust Outflow and Deposition to the Ocean (DODO) is a NERC funded campaign within the SOLAS (Surface Ocean Lower Atmosphere System). Saharan dust deposition provides a major source of nutrients to the subtropical Atlantic Ocean. Dust outflow is sporadic and depends on source, transport and the microphysical properties of the dust itself, being sensitive to size, mixing state and source. Dust outbreaks from the Saharan region over the Atlantic are frequent, with intense outbreaks having a periodicity of 5-10 days and sometimes reaching as far as the Americas. The outbreaks impact on atmospheric composition, dynamics and provide a significant local and regional climate forcing. Dust provides iron input to the ocean which allows nitrogen fixation supplying nutrients to surface phytoplankton in the otherwise nutrient starved regions of the subtropical gyres. Thus the amount and location of dust deposition impacts biological productivity and subsequently the global carbon cycle – of fundamental importance to the climate system.

The dust flux to the North Atlantic is not well constrained. To achieve a reliable and quantitative estimate it is necessary to understand the mechanisms controlling dust deposition throughout the year. Iron content also depends on dust source, therefore it is important to be able to characterise the source of the airborne dust. The transport of the dust, and therefore the deposition to the ocean, depends on the size distribution and vertical profile of the dust close to the sources and the wet and dry deposition processes. The soluble iron appears preferentially in the fine mode of aerosol, although there is to date no consistent picture of the role of aerosol in iron processing.

DODO takes advantage of planned campaigns DABEX and AMMA, to characterise these important microphysical and chemical properties of dust, in order to inform and develop regional predictive modelling of dust deposition.

The overarching aims of DODO are to:

1. Deliver case study based predictions of dust deposition to the northern hemisphere Atlantic Ocean constrained by in-situ aircraft measurements.
2. Describe how chemical and physical changes in the dust affect its transport over the ocean, and are themselves affected by the transport.
3. Assess the size distributed iron loading in the dust, and characterise the chemical form of the iron.
4. Fingerprint dust sources using single particle characterisation and assess their main composition, including iron content.
5. Assess the climatological representivity of the case studies and therefore predict the seasonal footprint of dust deposition and its associated iron to the North Atlantic.
6. Assess the radiative impact of the dust over the Atlantic ocean and its effect on sea surface temperatures.

To this end, two aircraft campaigns based in Dakar are planned:

**DODO1: 3<sup>rd</sup>-17<sup>th</sup> February 2006**

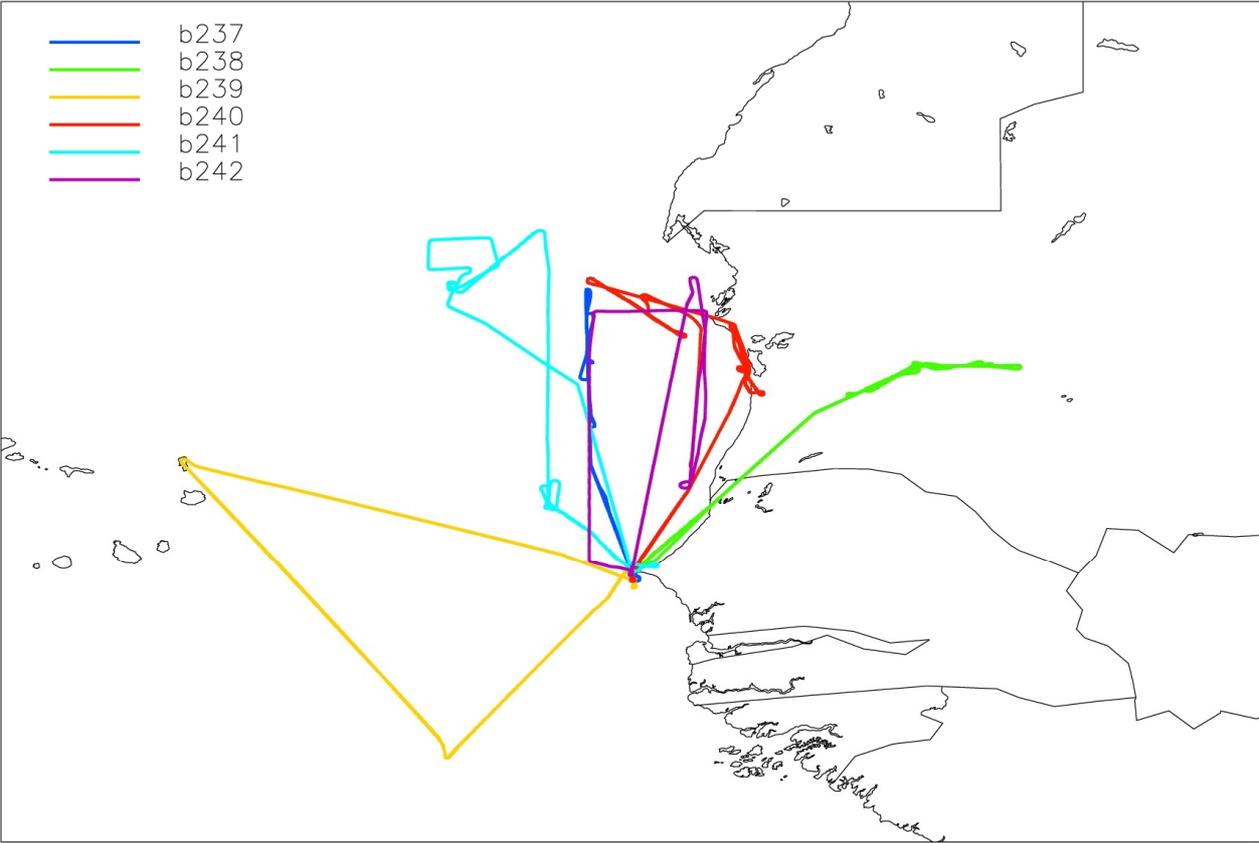
**DODO2: 21<sup>st</sup>-29<sup>th</sup> August 2006**

DODO1 has co-incident ship based measurements of deposition and single particle composition from POSEIDON courtesy of another SOLAS proposal (Southampton, PI Eric Achterberg).

This summary document outlines the flights in DODO2.

**Table 1: Summary of Flights during DODO 2**

<b>Flight No</b>	<b>Date</b>	<b>Take off time (UTC)</b>	<b>Land time (UTC)</b>	<b>Flight time (hrs,mins)</b>	<b>Region</b>	<b>Sortie Objectives</b>
B236a b	21/8/06	072144 141458	105749 160735	3, 36 1, 52	Niamey – Bamako – Dakar	Scientific transit
B237	22/8/06	135855	182401	4, 25	Over ocean northwest of Dakar	In-situ and radiation measurements of dust over ocean off Senegal/Mauritania coast
B238	23/8/06	130025	173152	4, 31	Land regions in Northern Mauritania	Sample heavy dust loadings over land in Mauritania forecast by dust models & visible in satellite imagery
B239	24/8/06	095141	135328	4, 01	Over Ocean, between and to the south of Dakar and Sal	In-situ measurements of dust forecast over ocean to south of Dakar-Sal area
B240	24/8/06	151619	193645	4, 20	Over ocean northwest of Dakar	Mapping of in-situ dust to north of Dakar for comparison with B239
B241	25/8/06	135438	183200	4, 37	Over ocean between Nouadhibou and Dakar	Intercomparison flight with NASA DC8 and high level calibration of radiometers
B242	28/8/06	110243	153338	4, 30	Over ocean northwest of Dakar	In-situ and radiation measurements of moderate dust loadings to north of Dakar



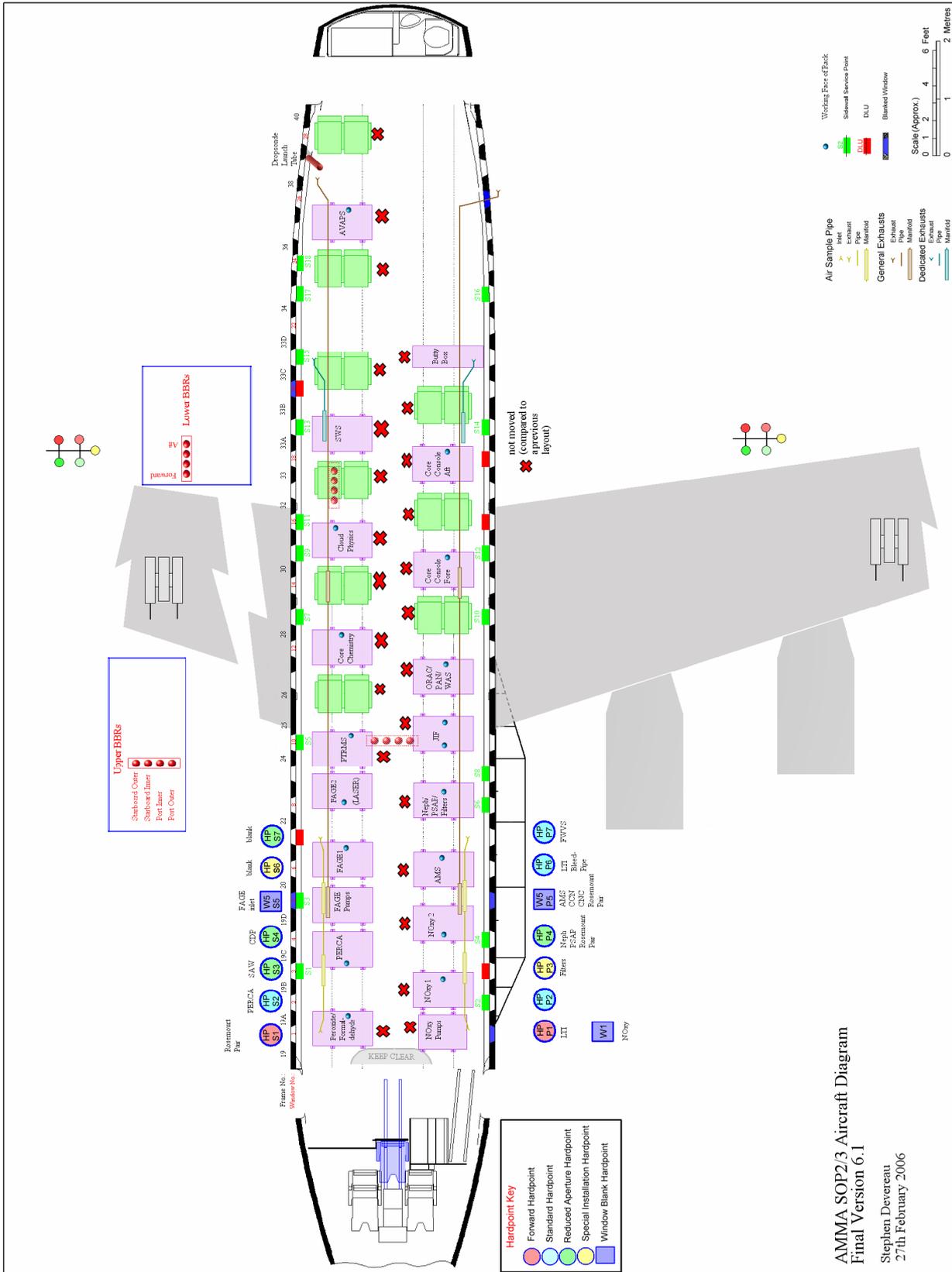
DODO2 flight tracks

## BAE-146 Measurements Summary

Table 2

Type of measurement	Instrument	Size range, wavelengths etc	Comment
Aerosol microphysics	PMS PCASP SID-1 TSI CPC3025	0.05 -1 $\mu$ m 1-20 $\mu$ m	
Aerosol optical properties	TSI nephelometer  Radiance Research PSAP	$\lambda = 0.45, 0.55, 0.7 \mu\text{m}$  $\lambda=0.568 \mu\text{m}$	
Aerosol chemical composition	Filters  Aerodyne AMS  VACC (University of Leeds)	Particle sizes 50-500nm  Temp range 50-300°C PCASP 0.05-1.5 $\mu$ m	Inorganics (elements and water-soluble fraction) Carbon (EC and OC)  Volatile and semi-volatile aerosols Water and volatile material
Radiative fluxes	BBRs (upper and lower)	Clear dome: $\lambda=0.3-3\mu\text{m}$ Read dome: $\lambda=0.7-3\mu\text{m}$	Possible problems with functionality of one of the lower BBRs?
Spectral radiances	SWS  SHIMS	303.4nm to 1706.5nm  303.4nm – 948.7nm	Resolution: 3.2nm up to 948.7nm, 6.3nm thereafter Intermittent performance on some flights Resolution 3.2nm
Trace gas chemistry	Ozone CO NO <sub>x</sub> SO <sub>2</sub> PAN (Leeds) WAS (Leeds)		Bags/tubes and bottles
Thermodynamics	AVAPS		Temp, pressure, winds, GPS. B168 onwards

# DODO 2 Aircraft Layout



## DODO II "Medalled Day" Satellite Prediction Dakar & Capo Verde 21-29 Aug 2006

Date			21/08/06	22/08/06	23/08/06	24/08/06	25/08/06	26/08/06	27/08/06	28/08/06	29/08/06
Day			Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue
<b>Dakar</b> 14.39N 16.96W	Terra	Time (UTC)	9 52 G	8 58	9 40 G	8 45 L	9 28 G	10 11 L	9 16	9 59 G	9 04
		Distance (km)	640	736	319	1150	3.02	1132	326	813	650
		MODIS	x	x	x	x	x	x	x	x	x
		MOPPITT			x		x				
		MISR					x				
		Aqua (MODIS)	Time (UTC)	12 56 L	12 01 G	12 44	11 49 G	12 32	11 37 L/g	12 19 G	
		Distance (km)	1060	407	735	728	411	1048	88		234
	EnviSat (AATSR)	Time (UTC)	8 20 L	8 28 G	8 57 G	8 26	9 34 L/G	9 03 G	8 32	9 40 L/g	9 08 G!
		Distance (km)	1049	768	60	894	921	94	739	1073	248
<b>Capo-Verde</b> 16.73N 22.94W	Terra	Time (UTC)		8 57 g	9 39 L/g	8 44	9 27 G	8 32 L	9 15 G!		9 03 G
		Distance (km)		245	880	564	564	885	246		72
		MODIS		x	x	x	x	x	x	x	
		MOPPITT		x					x		x
		MISR									x
		Aqua (MODIS)	Time (UTC)	11 19 L/g	12 02 g		11 49 G	12 32 L	11 37 G	12 20	11 25 G
	Distance (km)		850	274		44	1089	362	767	680	447
	EnviSat (AATSR)	Time (UTC)	8 19	8 22 L	8 56 G	8 25	7 54 L	9 02 G	8 31 g	7 59 L	9 07 G
		Distance (km)	468	1300	505	315	1142	656	162	988	807

Explanation of data and colouring:

Basic data via

<http://www-angler.larc.nasa.gov/cgi-bin/predict/satellite.cgi>

Nightly data and those without any instrument working excluded, 8am - 7pm only

1 point per measuring instrument

marked L -> no points given

marked G -> 1/2 point, marked G! -> no points

L = low Terra/Aqua satellite peak elevation of below 35 deg

G = glint probability > 5.0 ; G! > 90

g = glint probability > 1.0, but <= 5.0

Maximum possible number of points = 5

> 2 points =

**Gold**

1.5 - 2 points =

**Silver**

1 - 1.5 points =

**Bronze**

< 1 point =

## **B236a/b: Niamey-Bamako-Dakar Transit**

Flight Number: B236

Date: 21<sup>st</sup> August 2006

Mission: Ellie Highwood

Sortie Objectives: Science transit Niamey-Bamako-Dakar. In situ sampling of dust if possible.

Operating area: Over land to North of Niamey – Bamako. Then Bamako to Dakar direct.

Weather: Mixtures of cloud throughout. Considerable mid and high level cloud to north of flight tracks, and 6/8 low/mid cloud along much of Bamako to Dakar flight.

### Flight Patterns:

Flight planning was based on interest in the vertical structure of air to the far north of Niamey where it was suggested a dry layer would overlie moist air to the north. After take off from Niamey, a profile ascent showed a peak layer of dust between FL070 and FL100, anti-correlated with ozone. The visual top of the total dust layer was observed to be around FL165. This haze layer seemed fairly uniform from above until close to the northern extreme of the flight pattern. Tall Cu just breaking top of haze layer to east of track. Towards northern extreme a considerable amount of AlSt was observed on top of the haze layer (4/8). One drop sonde was launched at a forecasted position of dry layer overrunning moist air. A second sonde was launched through the drier air. Subsequently, as descent to low level revealed very little dust, although the nephelometer showed dust present in small amounts. A filter sample was collected in this “background” dust concentration on the leg towards Bamako. After very little dust was seen, and to conserve fuel, a profile ascent was made to FL220 (note this was at faster than usual climb so data should be treated with caution). On the profile into Bamako, the dust had returned being present between FL165 and peaking at FL090. A clear blue slot was visible between the base of the dust and the low cloud. Good visibility at low level.

On arriving Bamako, no suitable ground power was available and all science instruments were shut down, rendering the AMS un-usable for the remainder of the transit. At Bamako, only a limited amount of fuel was available, therefore the vast majority of the science brief for B236B was cancelled.

On leaving Bamako, a profile ascent showed low cloud at around 5000ft, and a dust layer between FL065 and FL165, peaking at FL100. The CO was reduced to 70ppbv during the dust layer. Relative humidity did fall coincident with the dust layer, but was still very high. A transit to Dakar at FL240 followed. Cloud increased towards Dakar and was more extensive to southern side of flight track. A profile descent into Dakar showed a weak dust layer at FL145, and a stronger one at FL120. The base of the layer was at FL090 with good visibility and scattered Cu below. Possible sea salt observations in last part of profile although sea state appeared relatively slight.

### Summary:

A typical DODO flight. Not much dust, and virtually no science on the second half for reasons beyond our control.

### Problems

No AMS for Bamako to Dakar leg.

Lower SHIMs has a shutter problem allowing only one module at a time. SWS intermittent in both modules.

Lower pyrgeometer giving nonsense. Some diagnostic tests run by flight manager.

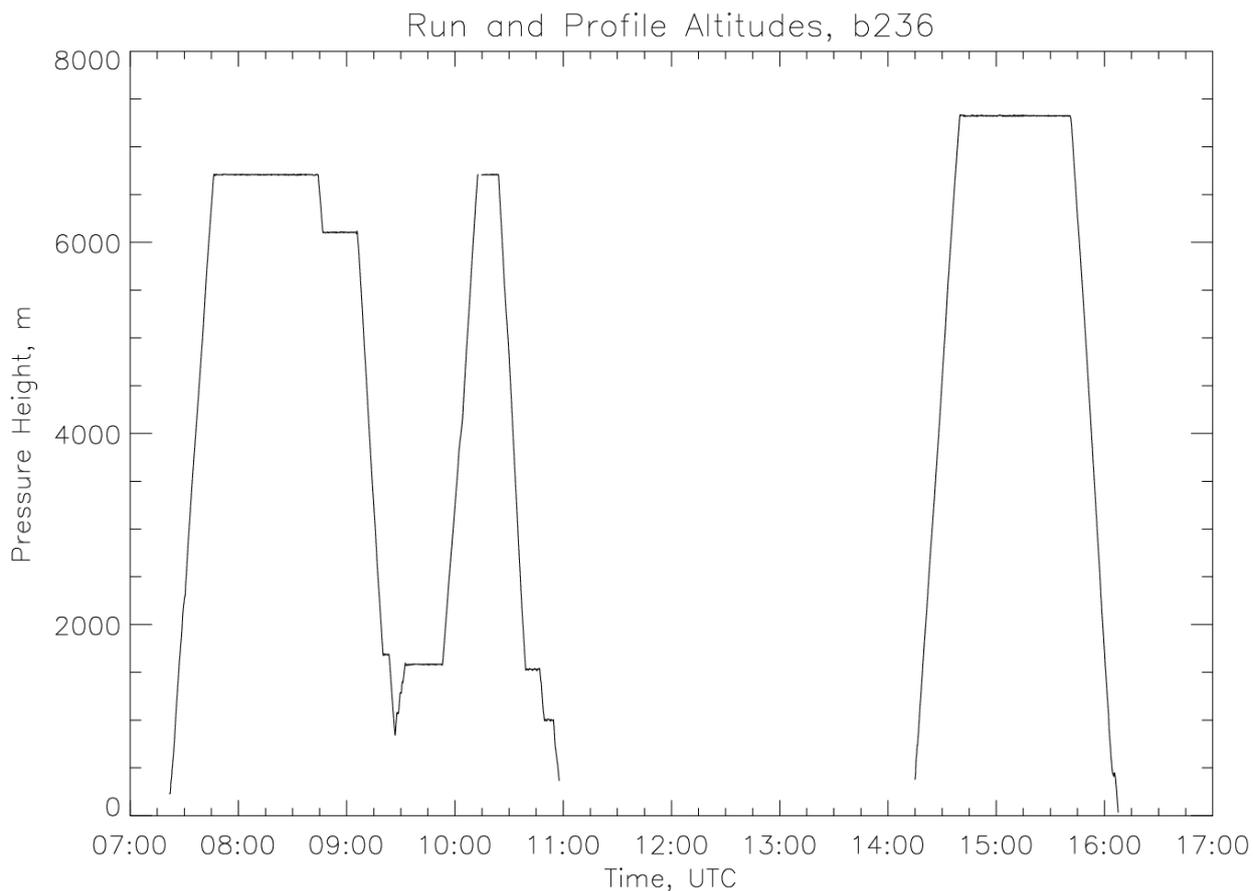
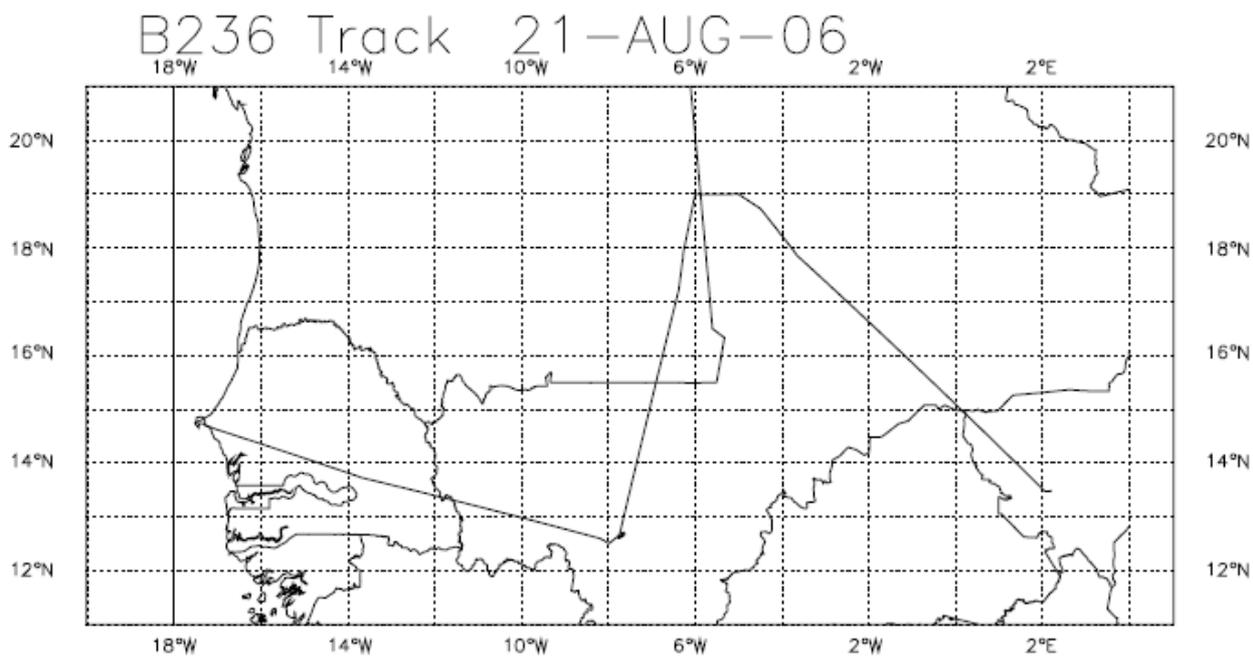
## DODO2 Summary Document

Dewpoint sensor appeared to not recover well on short power up at Bamako so lowest part of profile

Start Time	End Time	Event	Height(s)	Hdg	Comments
65438		INU	0.79 kft	316	to nav
65453		cgps	0.79 kft	316	log B236A
65541		gps	0.79 kft	316	13'28.65N 2'10.53E
72144		T/O	0.76 kft	267	Niamey
72156	74625	Profile 1	0.76 - 22.0 kft	267	
72416		!	2.3 kft	267	profile 1 from surface
72540		!	3.8 kft	308	psap operated from surface
72628		Video	4.5 kft	309	#1 dfc #2 ffc starte
73207		!	9.3 kft	311	240kts indicated 1000ft/min
74527		bbr	21.3 kft	308	retract
74625	84409	Run 1.1	22.0 kft	308	
74940		heiman	22.0 kft	308	cal 11
75054		nev	22.0 kft	308	zero
75223		JW	22.0 kft	308	zero
81501		bbr	22.0 kft	309	lower unit reset
84318		Sonde 1	22.0 kft	308	speed reduced to 220i as
84409	84648	Profile 2	22.0 - 20.0 kft	321	
84648	90547	Run 2.1	20.0 - 20.1 kft	321	
90151		video	20.0 kft	302	#3 dfc #4 ffc start
90505		Sonde 2	20.0 kft	302	
90547	92645	Profile 3	20.1 - 2.8 kft	269	
91210		lbbr	13.6 kft	272	swap test
91317		bbr	12.4 kft	275	extend
92041		p3	5.5 kft	191	interrupted
92322		p3	5.5 kft	191	resumed
92645	92746	Profile 4	2.8 - 3.5 kft	195	
92746	92840	Run 3.1	3.5 kft	194	
92840	92937	Profile 5	3.5 - 4.2 kft	194	
92937	93014	Run 4.1	4.2 kft	192	
93014	93253	Profile 6	4.2 - 5.2 kft	193	
93253	95257	Run 5.1	5.2 kft	185	
95257	101244	Profile 7	5.2 - 22.0 kft	202	
100307		!	13.0 kft	193	accelerate to best climb
100442		!	14.2 kft	193	240kts ias
101245	102400	Run 6.1	22.0 kft	195	
102400	105749	Profile 8	22.0 - 5.0 kft	194	
103914			5.0 kft	197	interrupted
104735		P8	4.7 kft	58	resumed
104936		P8	3.3 kft	237	interrupted
105314		P8	3.3 kft	230	resumed
105749		Land	1.2 kft	236	Bamako & P8 end
111254		cgps	1.2 kft	182	shutdown
111837		shut down	1.2 kft	182	no ground power
141458		T/O	1.2 kft	237	Bamako
141458	143948	Profile 9	2.0 - 24.0 kft	260	start at t/o
141900		Video	4.8 kft	284	#5dfc #6ffc
141944		psap	5.5 kft	282	interrupt for cloud layer
142206		psap	7.7 kft	285	restarted

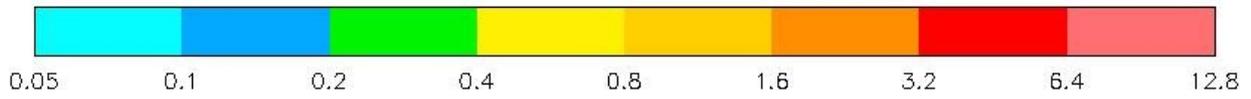
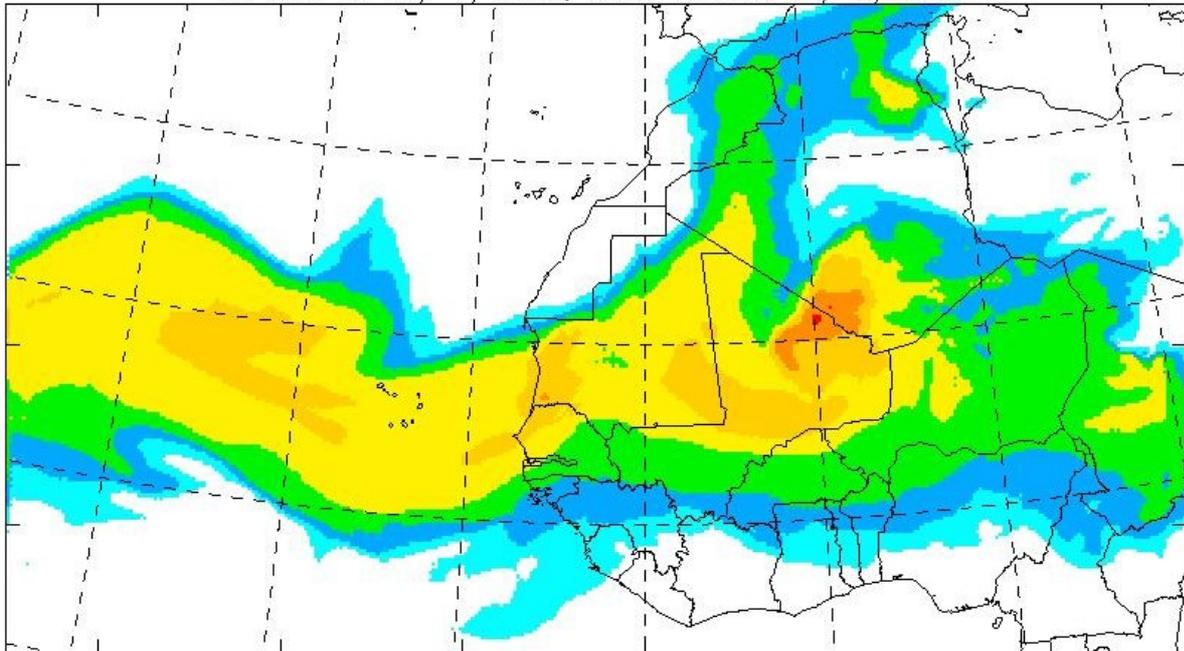
DODO2 Summary Document

142807		psap	13.1 kft	286	new filter for this 'B' flight
143949	154116	Run 7.1	24.0 kft	282	
144716		nev	24.0 kft	282	zero
154117	160735	Profile 10	24.0 - 0.12 kft	284	
160735		Land	0.12 kft	173	Dakar, Senegal
162016		shut down	0.13 kft	17	14'44.60N 17'29.11W



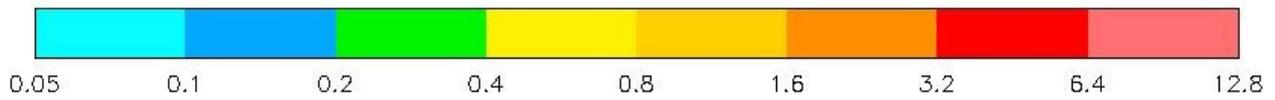
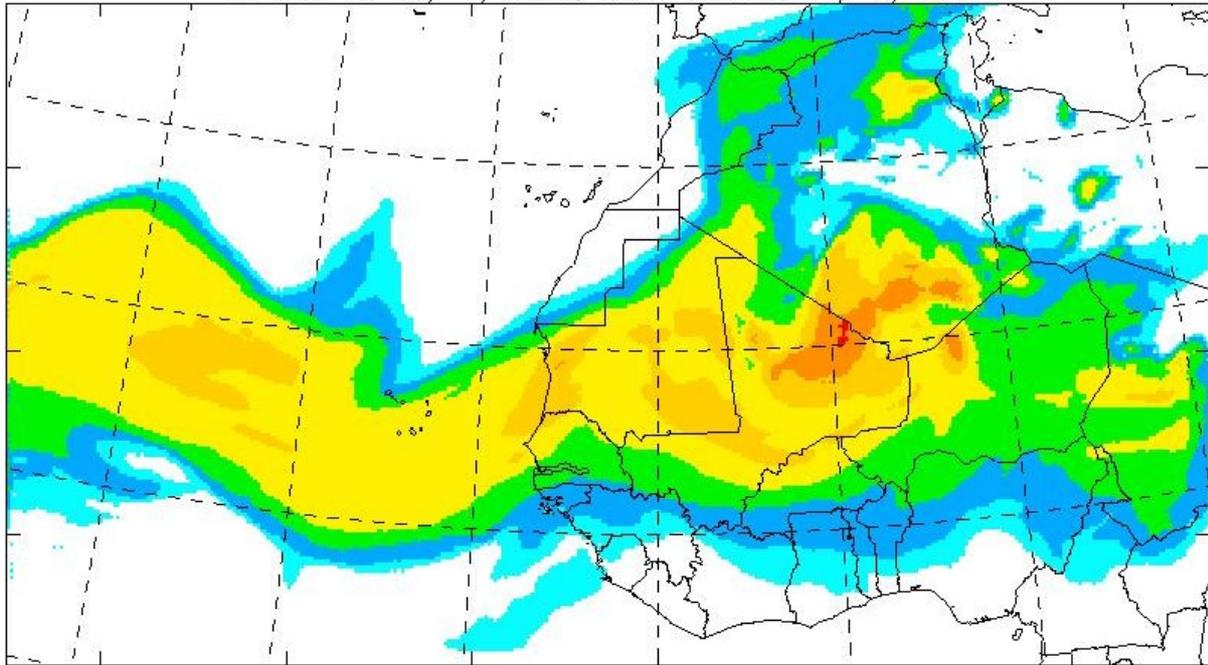
23z\_190806 AOD T+36

At 06Z on 21/ 8/2006, from 18Z on 19/ 8/2006

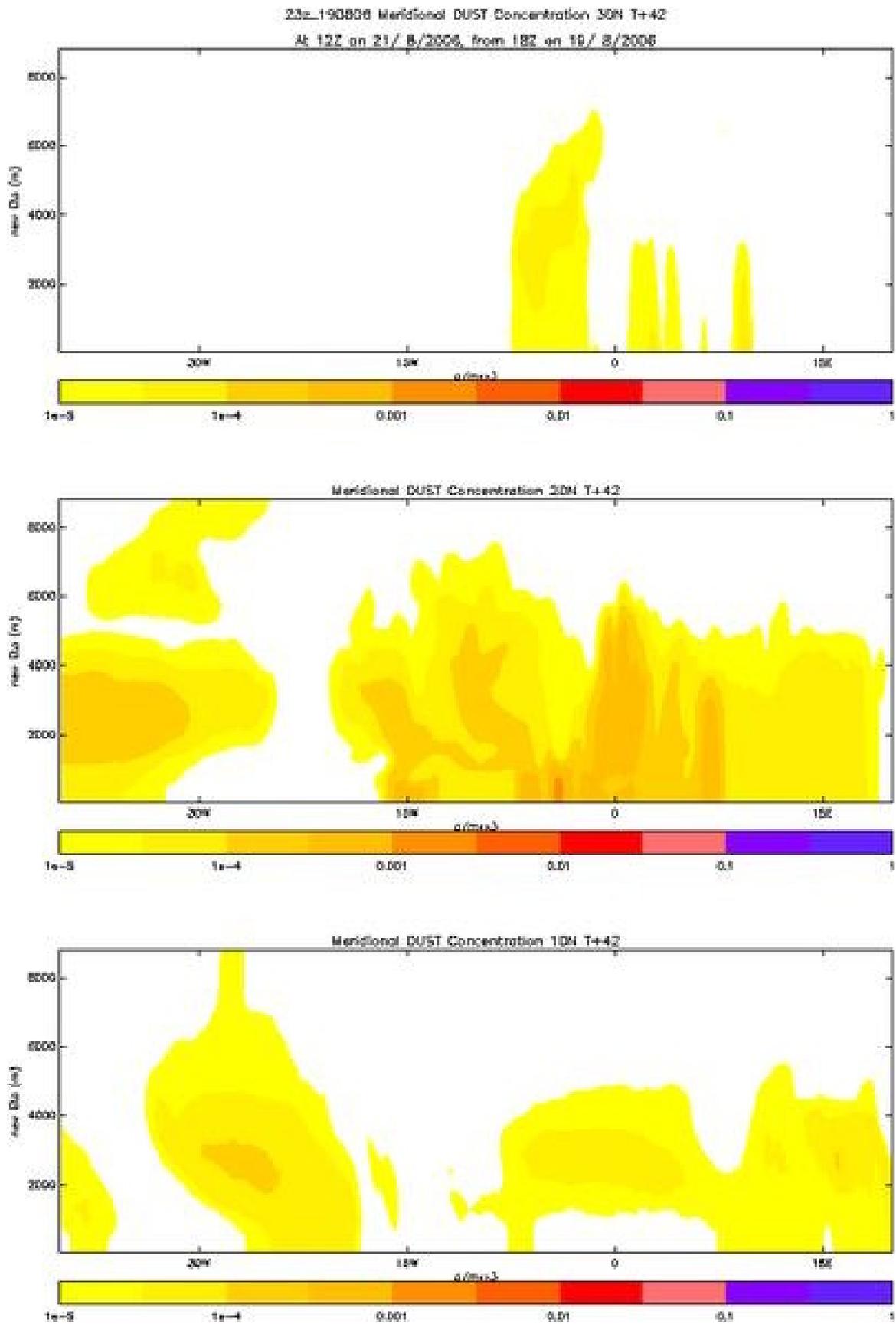


23z\_190806 AOD T+42

At 12Z on 21/ 8/2006, from 18Z on 19/ 8/2006



DODO2 Summary Document



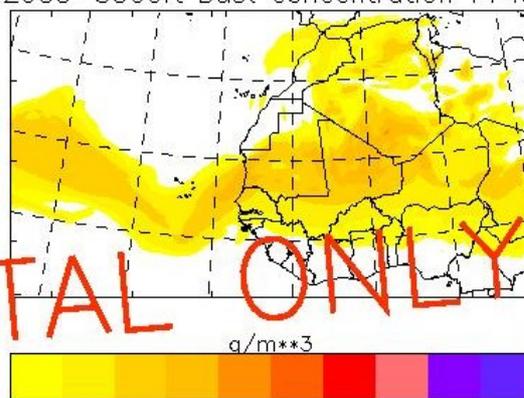
DODO2 Summary Document

23z\_190806 Surface Dust concentration T+48

At 18Z on 21/ 8/2006, from 18Z on 19/ 8/2006



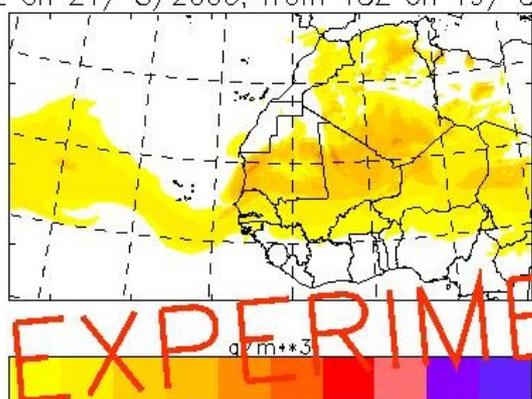
2000-5000ft Dust concentration T+48



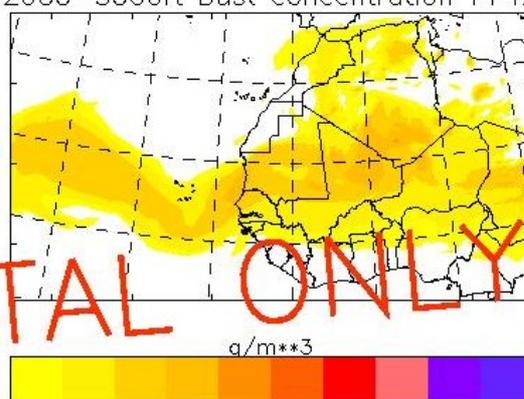
EXPERIMENTAL ONLY

23z\_190806 Surface Dust concentration T+42

At 12Z on 21/ 8/2006, from 18Z on 19/ 8/2006

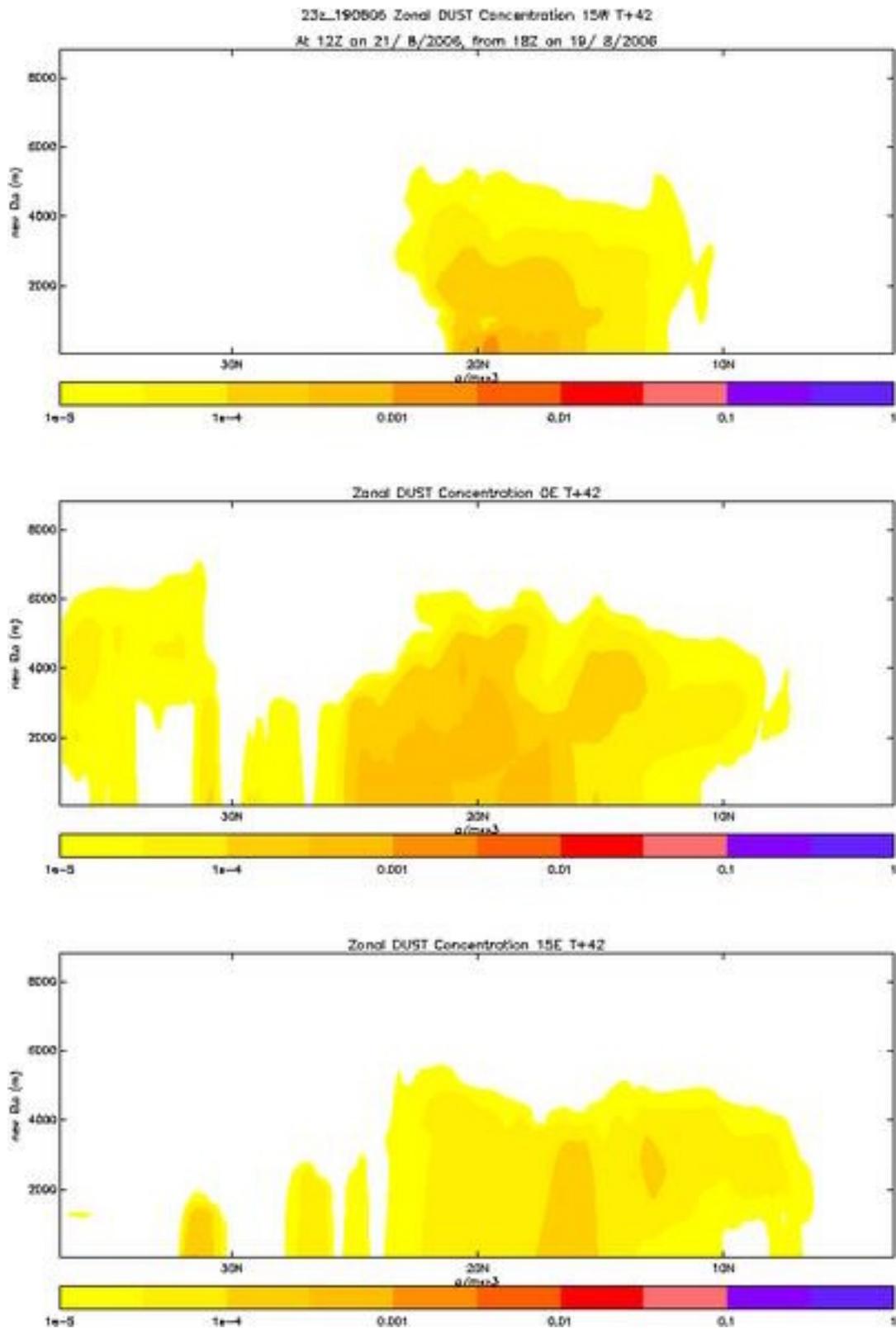


2000-5000ft Dust concentration T+42

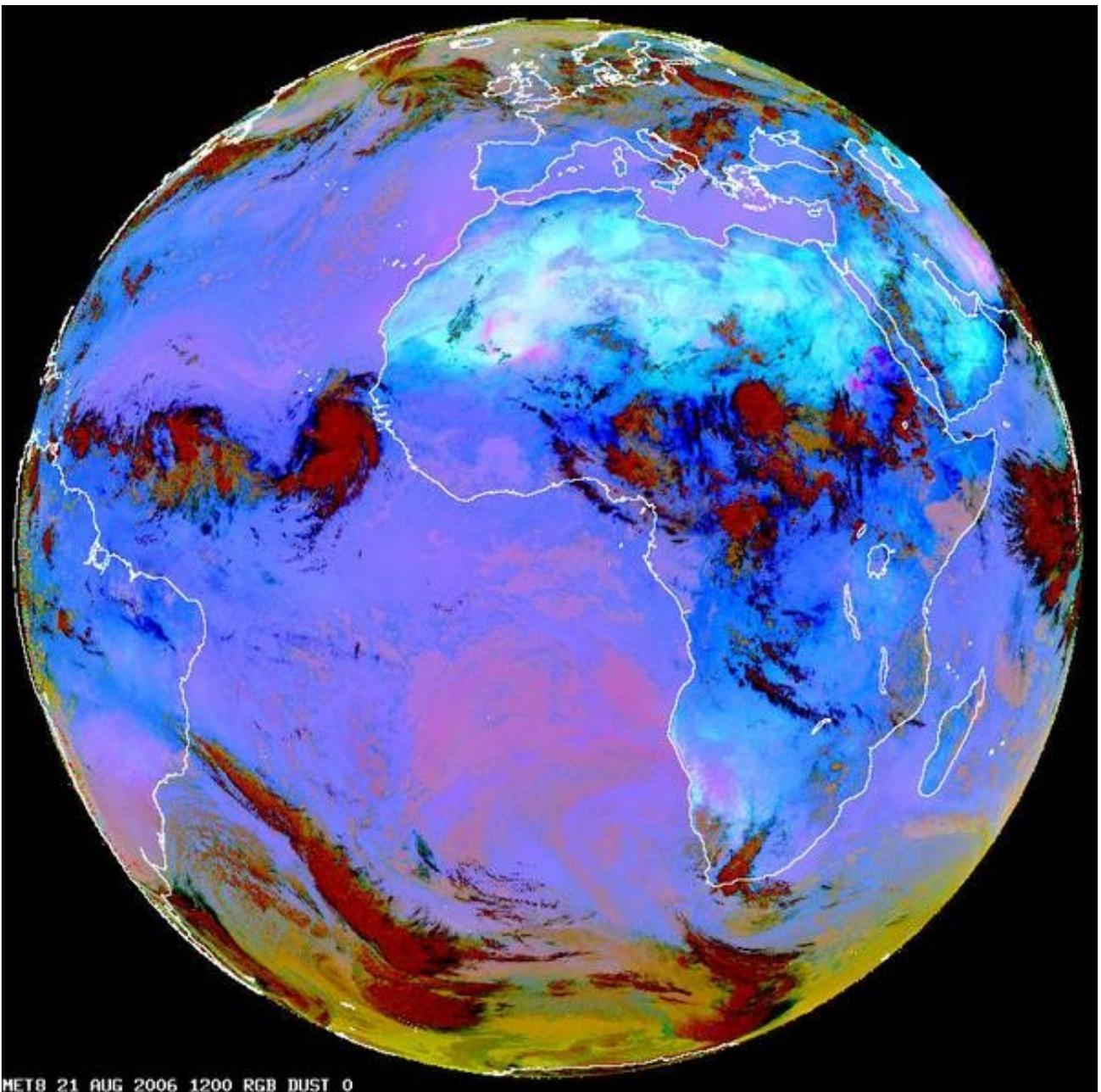
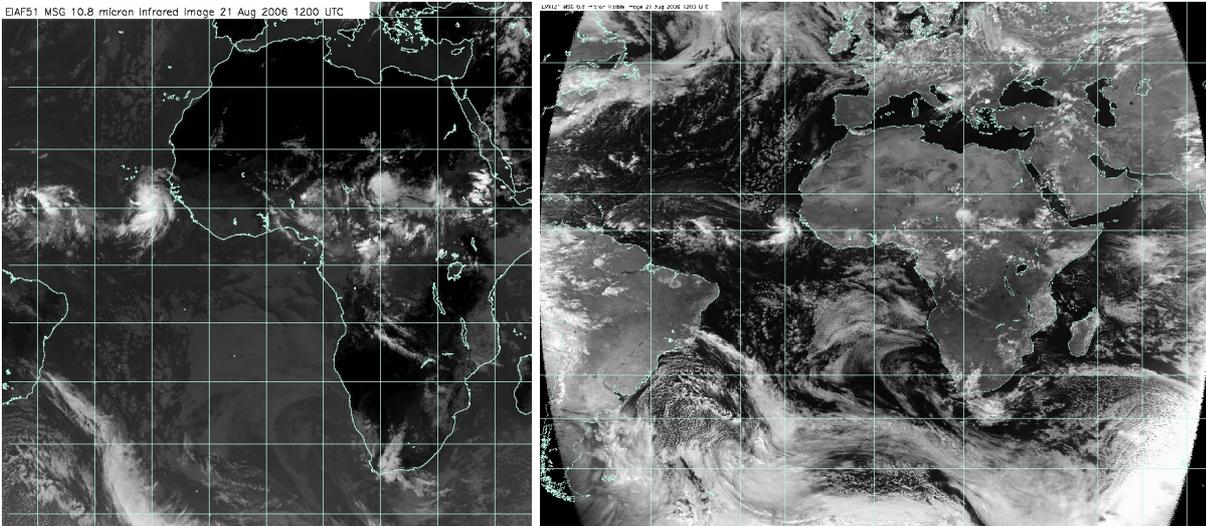


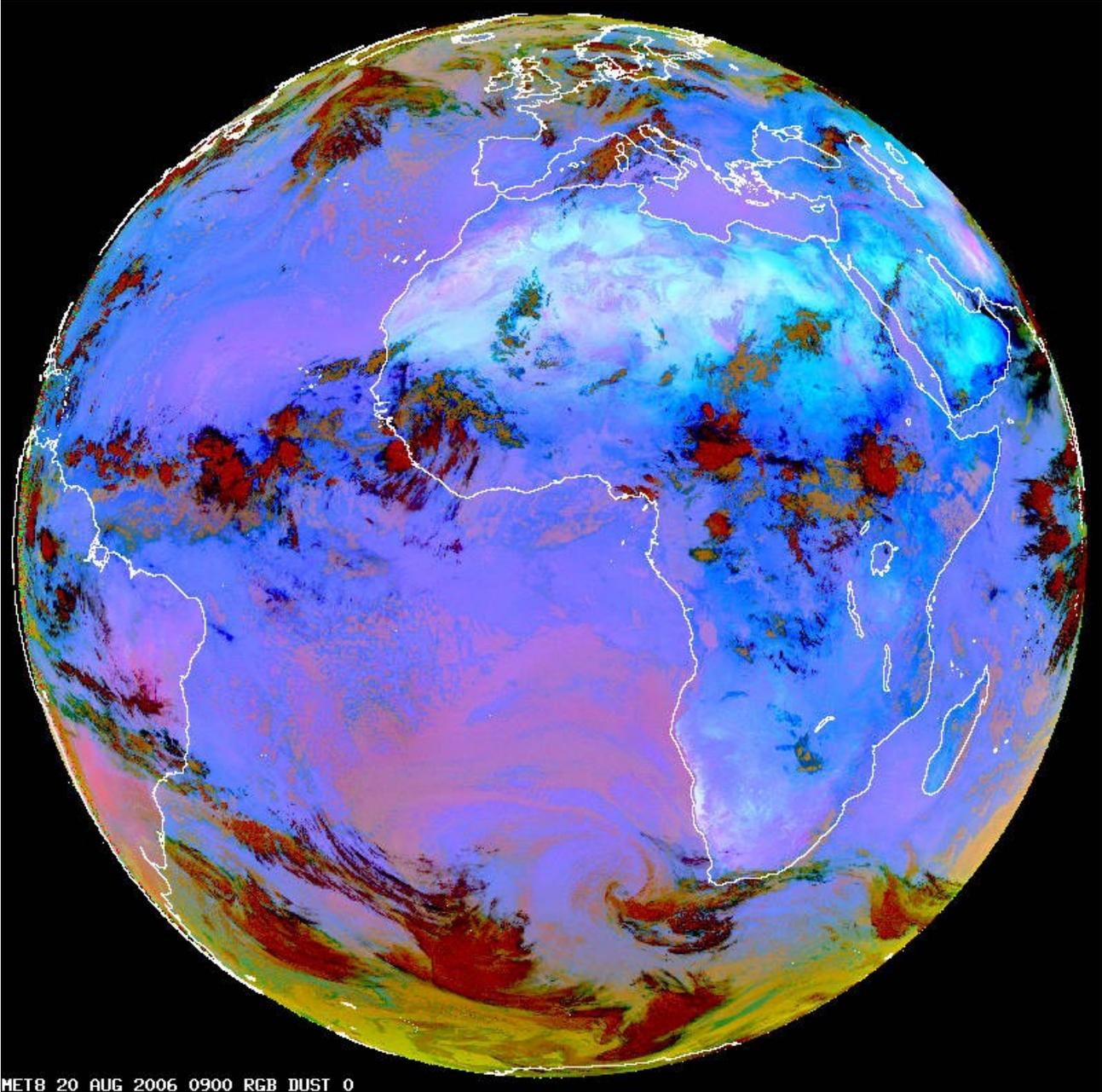
EXPERIMENTAL ONLY

# DODO2 Summary Document

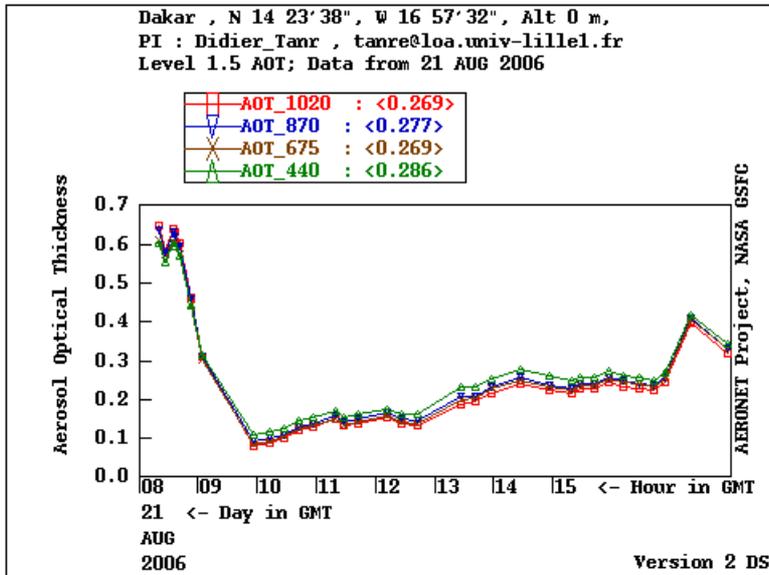


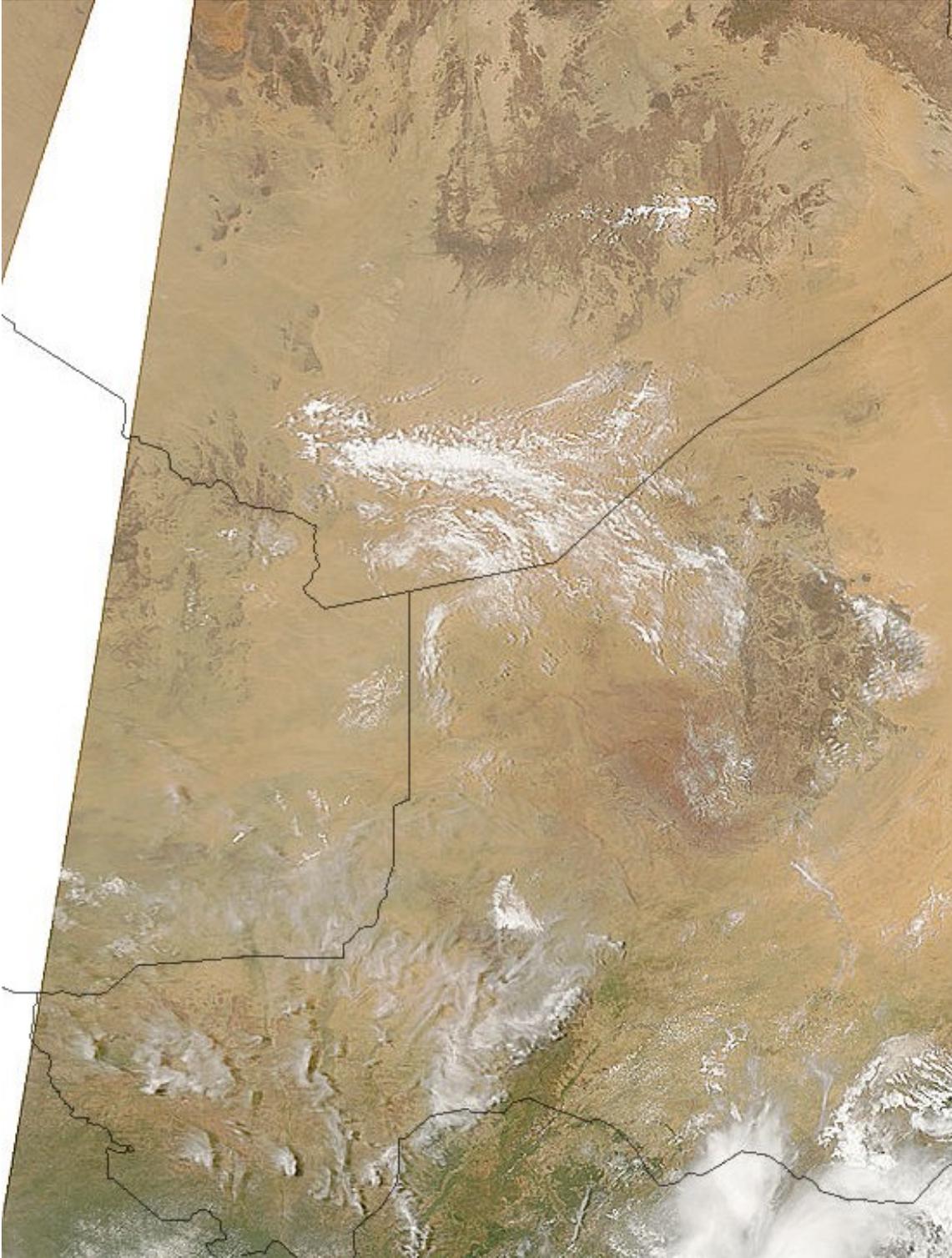
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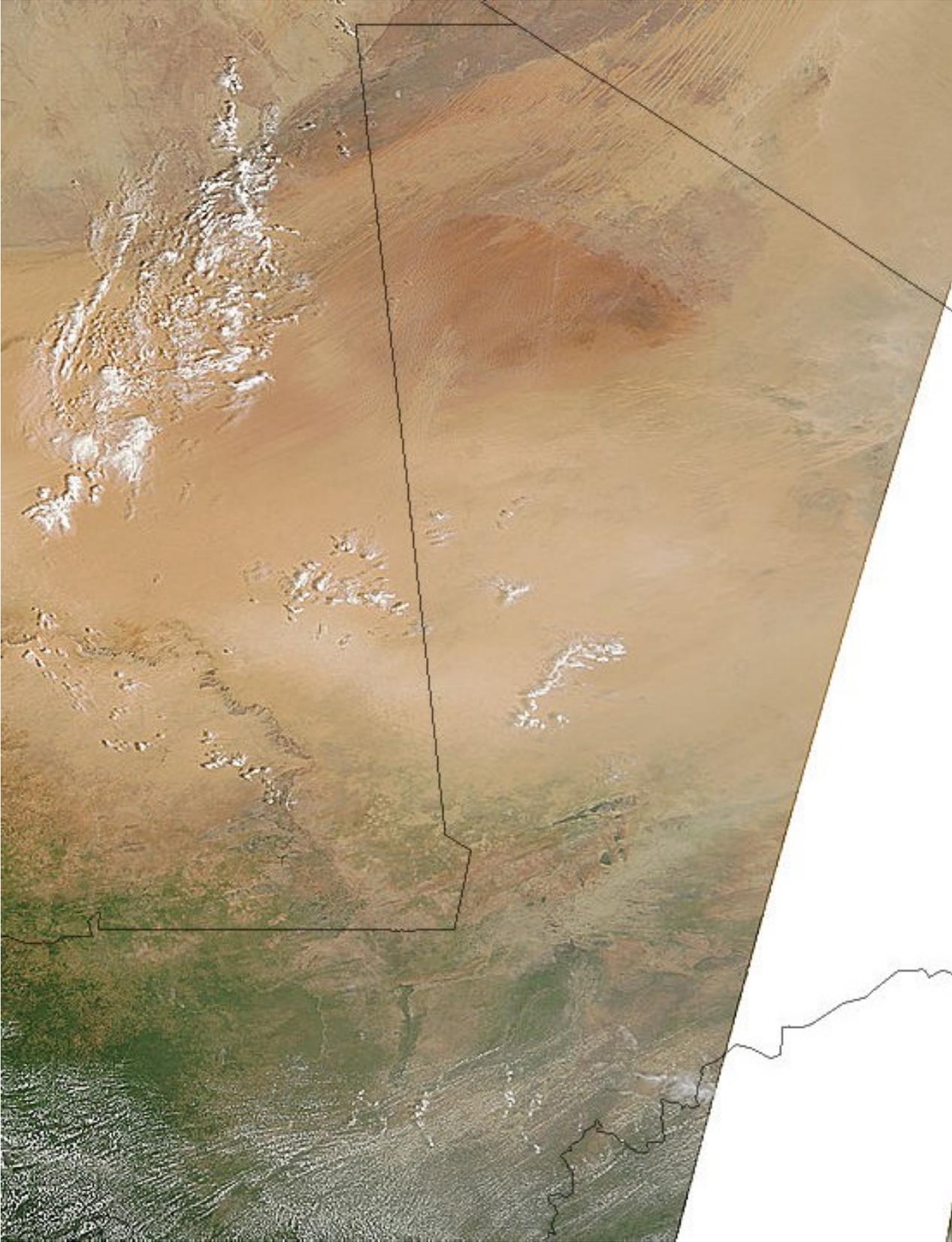


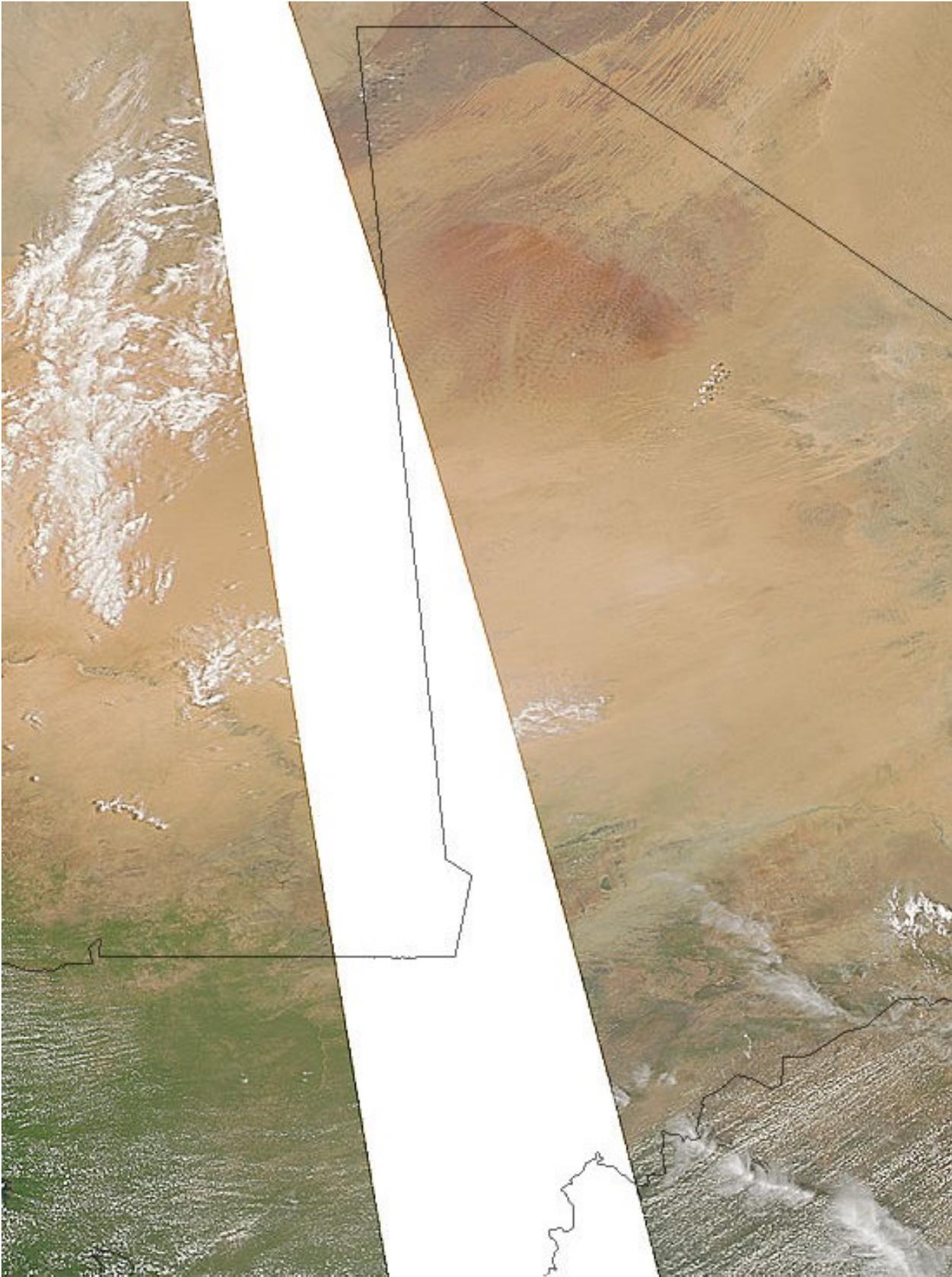


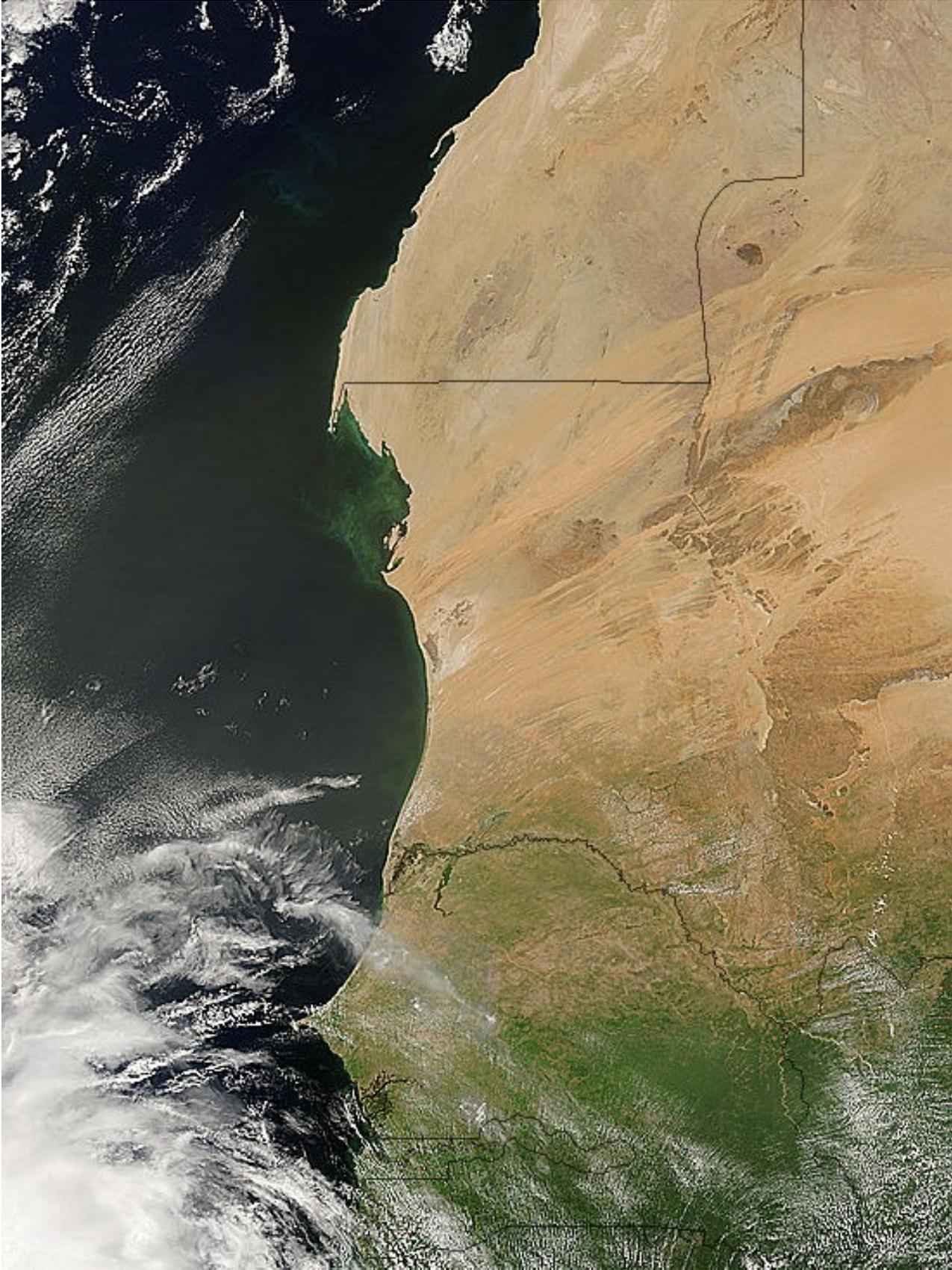
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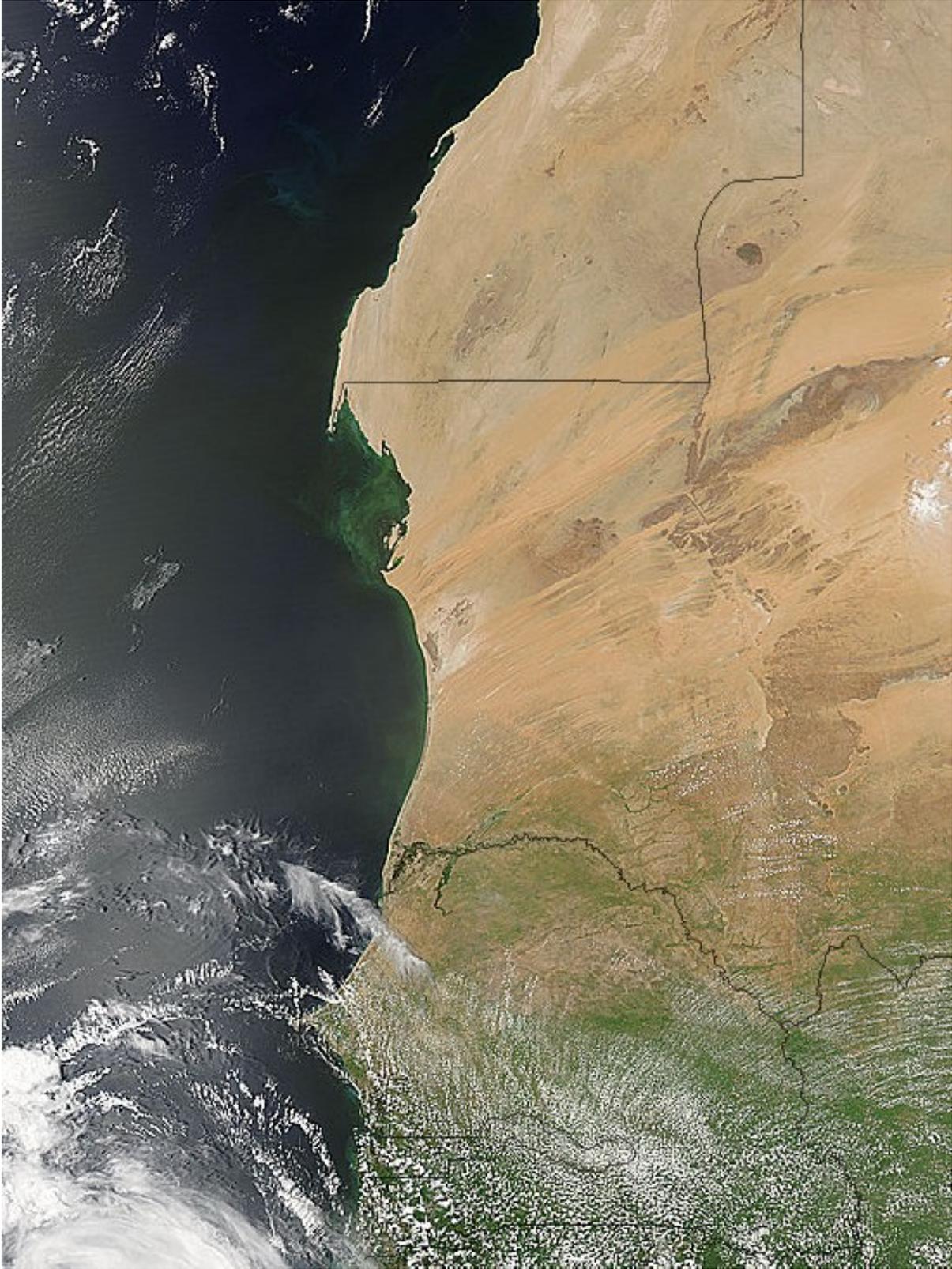


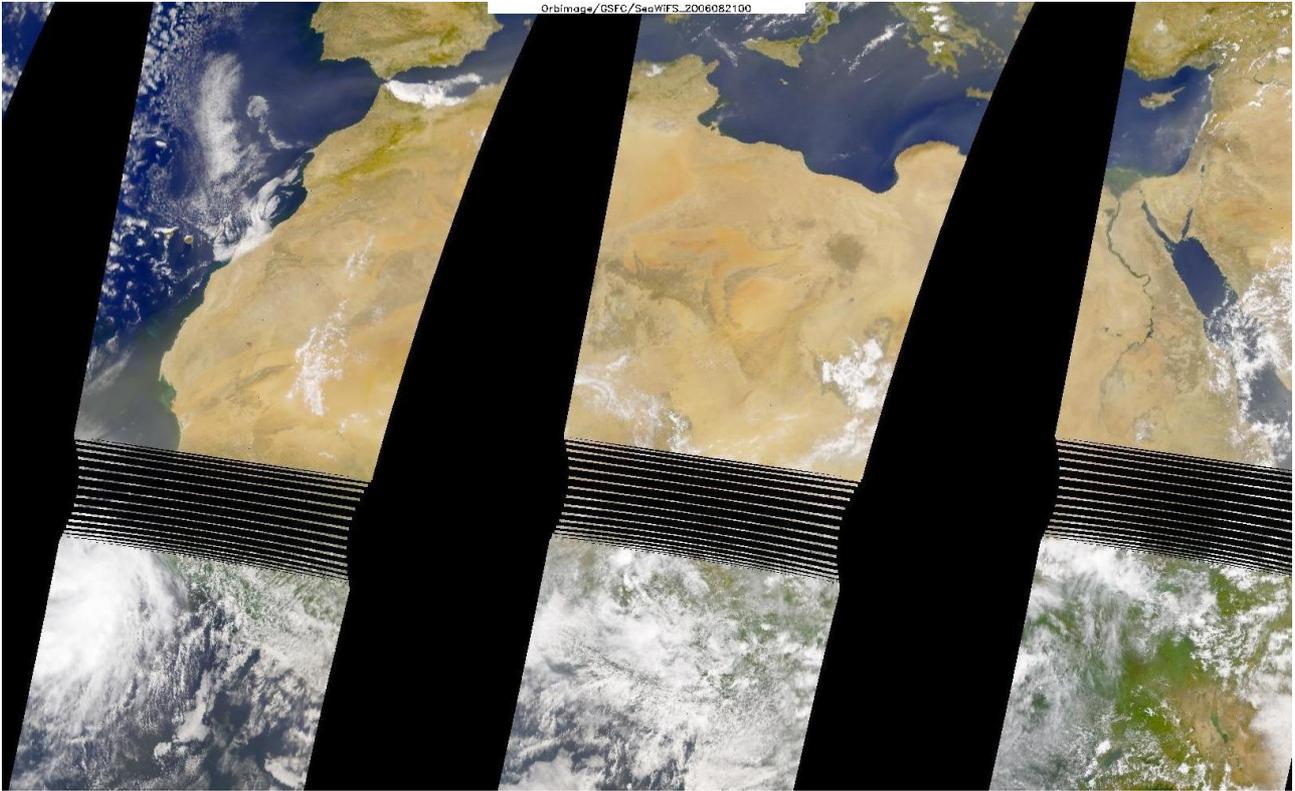




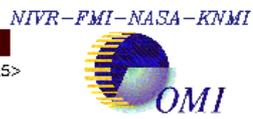
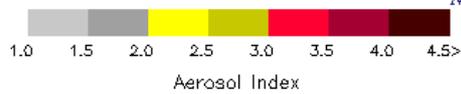
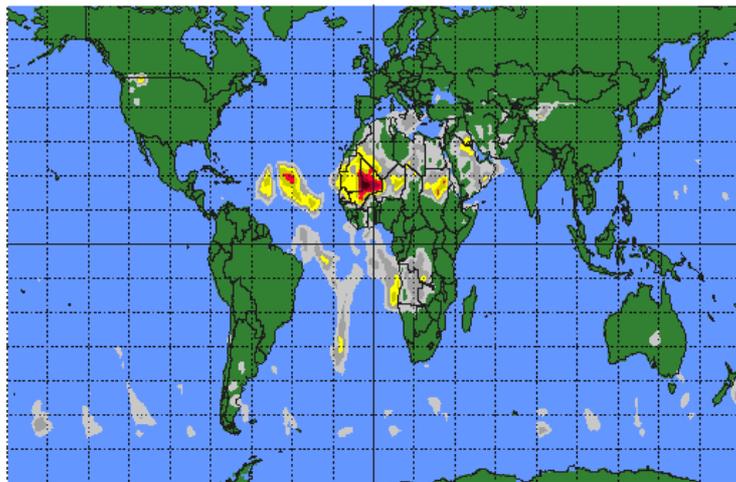








OMI Aerosol Index  
on August 21, 2006



**B237**Flight Number: B237Date: 22<sup>nd</sup> August 2006Mission: Jim Haywood

Sortie Objectives: DODO2 initial flight. The objective is to investigate the in-situ and radiative properties of mineral dust over ocean areas off the coast of Senegal/Mauritania.

Operating area: North of Dakar. Oceanic areas.

Weather: A tropical disturbance (that became tropical storm Debbie) passed through the region early in the morning on the 20<sup>th</sup> August. The 20<sup>th</sup> showed low AODS (Dakar AERONET), but the forecasts were for significant dust AODs to the north of Dakar. The forecast also suggested only a few intrusions of scattered Cu throughout the operating region. Both of these forecasts proved accurate.

Flight Patterns: Subsequent to take-off, a short positioning run was performed at 5000ft before a profile descent to 50ft (1000ft/minute above 1000ft, and 500ft/minute below 1000ft), followed by a deep profile ascent to the north to FL200. 2/8 Cu cloud was present from 2500-4000ft. The aerosol showed some significant structure with the nephelometer suggesting a weak dust layer from 5000ft to 13000ft with neph scat at  $25 \times 10^{-6} \text{m}^{-1}$  and a stronger layer from 13000ft to 18000ft with neph scattering reaching  $130 \times 10^{-6} \text{m}^{-1}$ . A SLR was then performed at FL160 in a northerly direction in the peak of the aerosol layer. The BBRs suggested a lower clear flux of  $95 \text{Wm}^{-2}$  suggesting a direct radiative effect of around  $45 \text{Wm}^{-2}$ . A broken profile descent was then performed together with a reciprocal turn to FL080 where a SLR was performed in the lower, weaker dust layer in a southerly direction. A profile descent and reciprocal turn were then performed to 100ft. A 100ft SLR was then performed in a northerly direction to the northernmost point of the operations – a set of four orbits were performed half way along this run at 500ft and a bank angle of 50degrees. The SWS saturated for part of the orbit. The sea state varied from a benign SS2 to a SS6 at the northerly end of the run. A profile ascent was made to FL160 where another insitu sampling SLR was performed. The aircraft then profiled to FL200 and made a SLR above the aerosol layer back towards Dakar before recovering to land. The BBRs continued to suggest a significant DRE of around  $50 \text{Wm}^{-2}$ .

Summary: A successful flight in terms of both in-situ sampling and radiation measurements. The radiation measurements both above and below the dust layer mean that the DRE should be relatively simple to diagnose. There were a few intrusions of scattered Cu, mainly to the south of the operating region - care should be taken to exclude this data from the radiation measurements.

Problems:

Lower pyrgeometer – U/S. Will be fixed tomorrow.

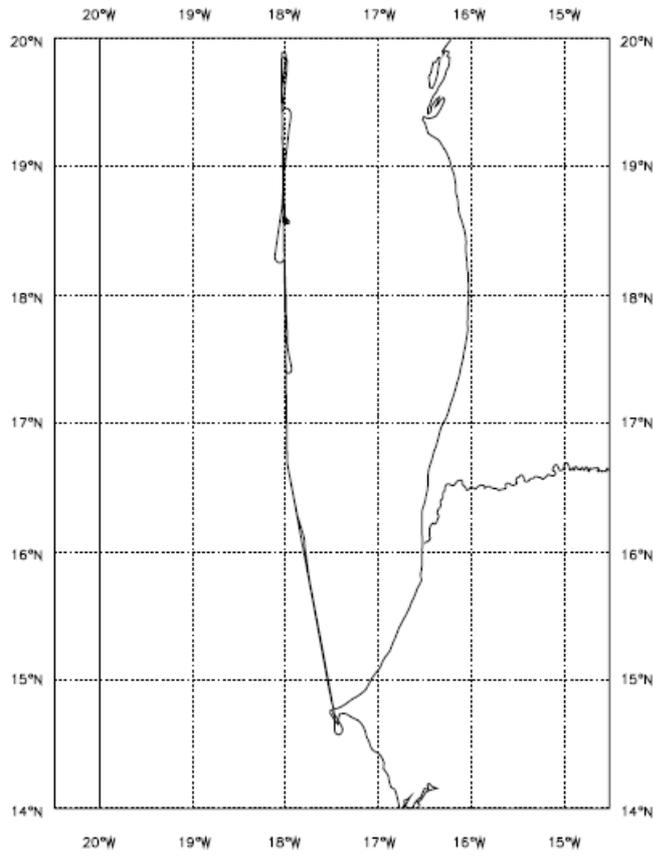
Lower red pyranometer was reading some significant negative values when the shutter was closed.

Start Time	End Time	Event	Height (s)	Hdg	Comments
134449		engine start	0.04 kft	330	
134759		power change	0.04 kft	330	
135027		taxy	0.04 kft	330	
135855		T/O	0.03 kft	173	from Dakar
140345	141713	Run 1	5.0 kft	323	
140743		bbr	5.0 kft	348	Shutter Up (U)
141714	142437	Profile 1	5.0 - 0.03 kft	347	qnh 1017

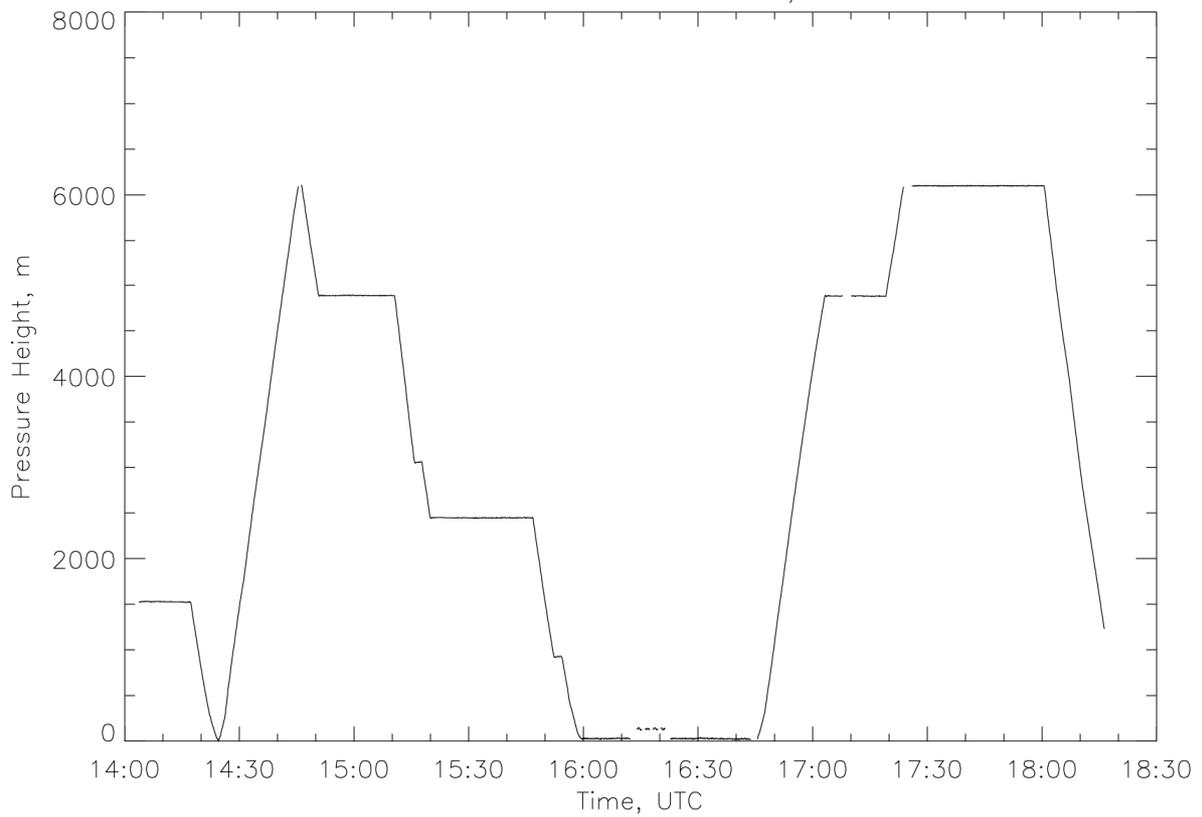
## DODO2 Summary Document

142437	144527	Profile 2	0.03 - 20.0 kft	348	
142712		bbr	2.0 kft	342	Shutter Down (D)
143134		jw/nevz zero	6.2 kft	347	
144612	145048	Profile 3	20.0 - 16.0 kft	359	
145048	151029	Run 2	16.0 kft	4	
145141		bbr	16.0 kft	5	U
151030	152001	Profile 4	16.0 - 8.0 kft	3	
151124		bbr	15.1 kft	3	D
151554		Profile 4	10.0 kft	1	interrupt
151739		Profile 4	10.0 kft	180	resume
152001	154644	Run 3	8.0 kft	186	
152010		bbr	8.0 kft	186	U
153532		Video	8.0 kft	175	tapes change
154645	155929	Profile 5	8.0 - 0.09 kft	175	
154654		bbr	8.0 kft	175	D
155220		Profile 5	3.0 kft	180	interrupt
155418		Profile 5	3.0 kft	345	resume
155800		PSAP	0.09 kft	356	Filter Change
155929	161217	Run 4	0.09 kft	356	
155944		bbr	0.08 kft	355	U
161401	161516	Orbit 1	0.45 - 0.41 kft	70	right hand down
161612	161720	Orbit 2	0.43 kft	242	rhd
161817	161927	Orbit 3	0.44 - 0.43 kft	330	rhd
162017	162124	Orbit 4	0.47 - 0.44 kft	24	rhd
162250	164348	Run 5	0.09 - 0.07 kft	357	
164533	170308	Profile 6	0.07 - 16.0 kft	187	
164707		bbr	0.83 kft	189	D
170308	170752	Run 6	16.0 kft	174	
170855		Video	16.0 kft	273	tapes changed
171003		bbr	16.0 kft	17	U
171008	171907	Run 7	16.0 kft	16	
171908	172346	Profile 7	16.0 - 20.0 kft	3	
171931		bbr	16.3 kft	3	D
172407		bbr	20.0 kft	17	U
172600	180026	Run 8	20.0 kft	186	
172610		Sonde 1	20.0 kft	188	
173247		speed	20.0 kft	176	above science spd
173601		Sonde 2	20.0 kft	178	
180026	181620	Profile 8	20.0 - 4.0 kft	164	
180116		bbr	19.2 kft	163	D
180640		bbr	13.5 kft	159	U
181718		bbr	4.0 kft	167	D
182401		Land	0.07 kft	177	at Dakar

B237 Track 22-AUG-06

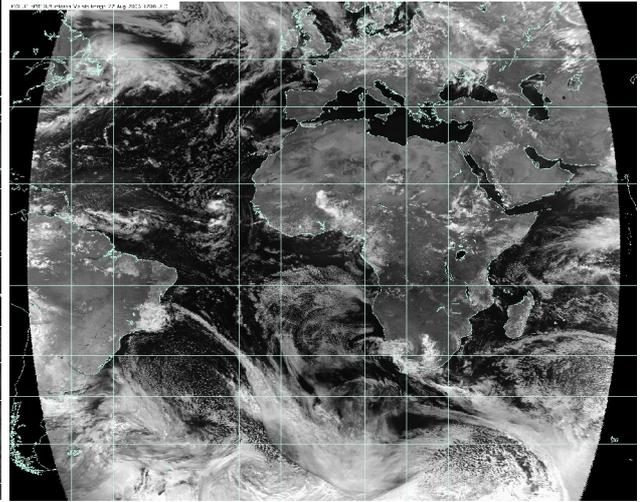
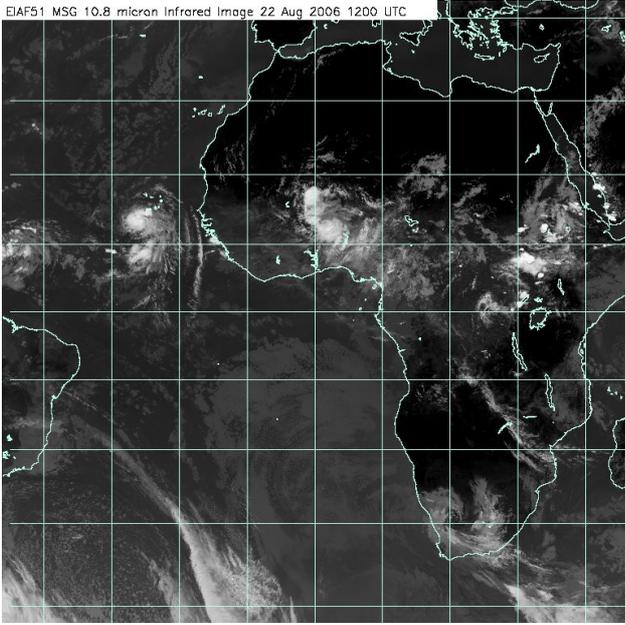


Run and Profile Altitudes, b237



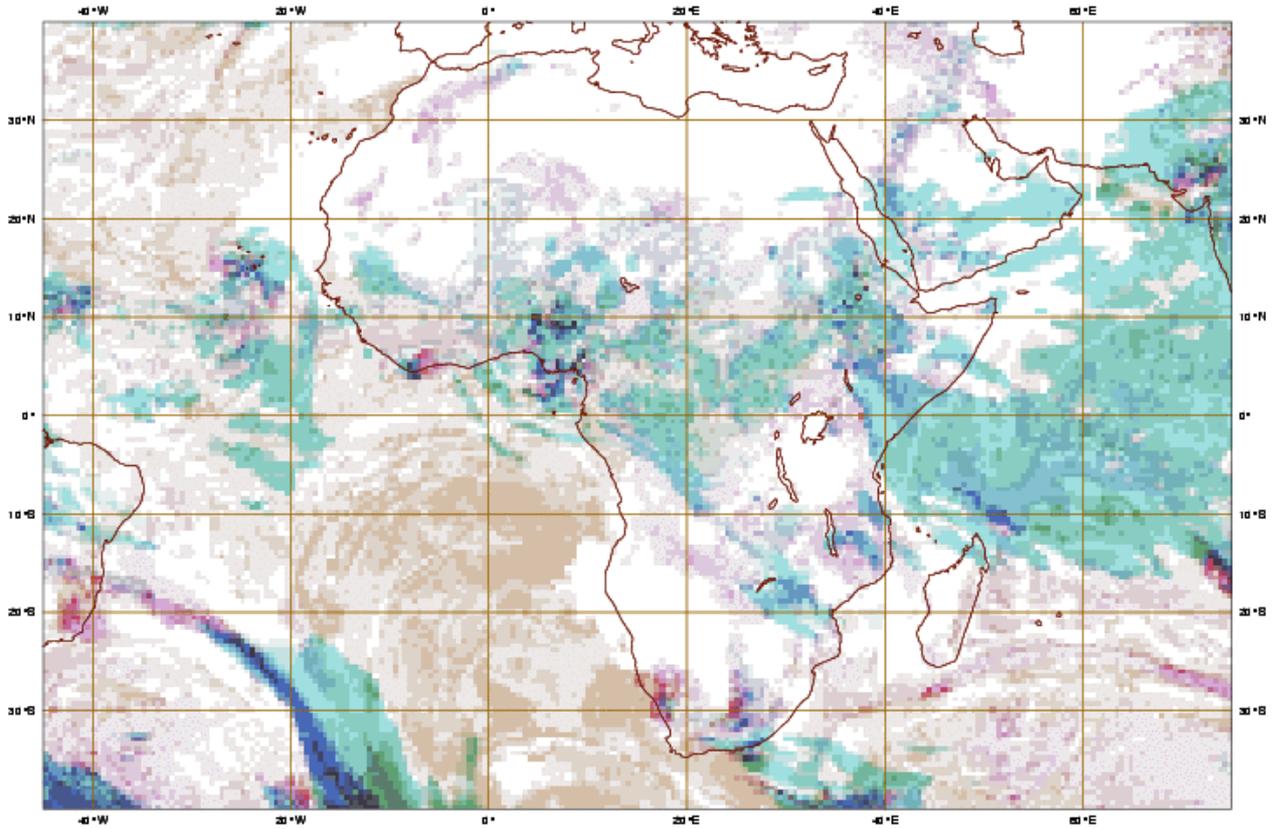
DODO2 Summary Document

EIAF51 MSG 10.8 micron Infrared Image 22 Aug 2006 1200 UTC



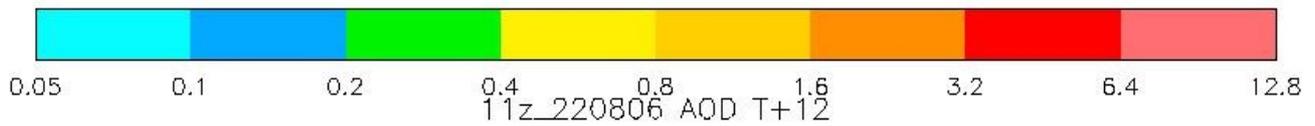
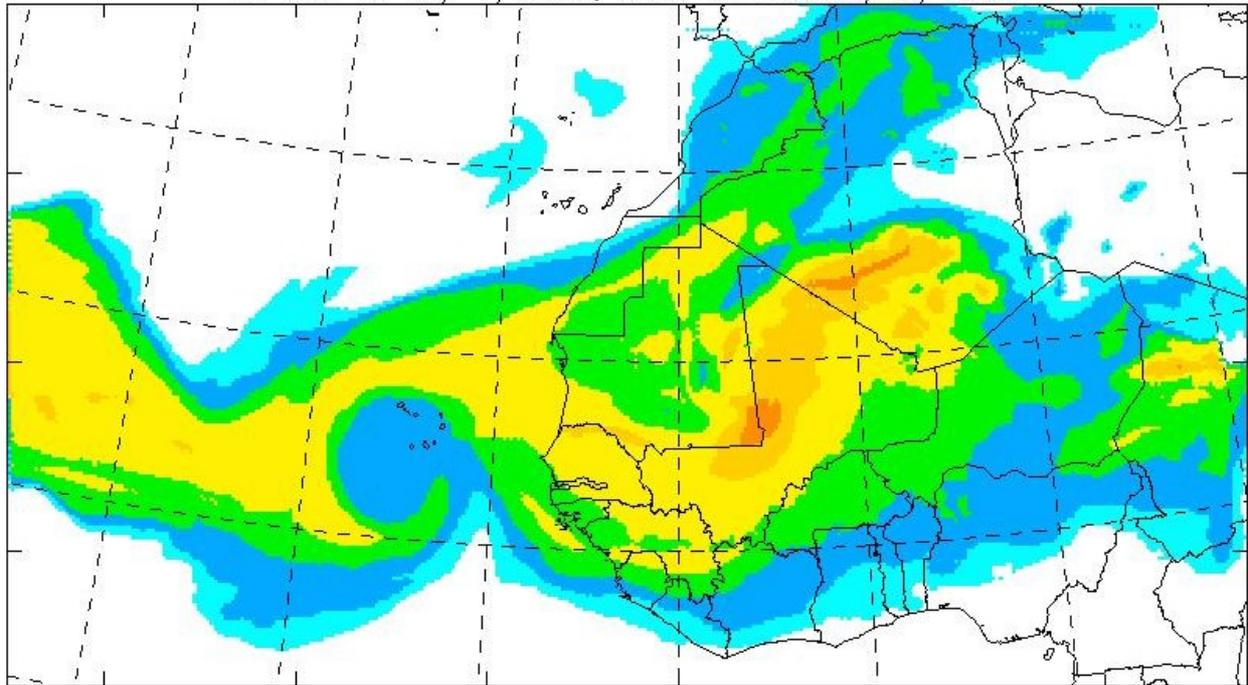
Tuesday 22 August 2006 00UTC ©ECMWF Forecast t+012 VT: Tuesday 22 August 2006 12UTC

Low, L+M, Medium, M+H, High, H+L, H+M+L clouds



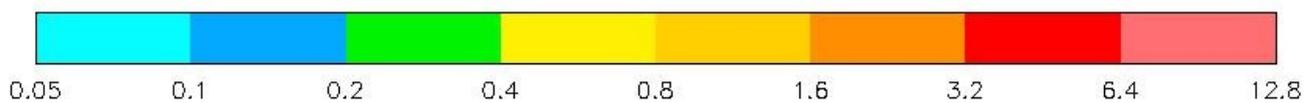
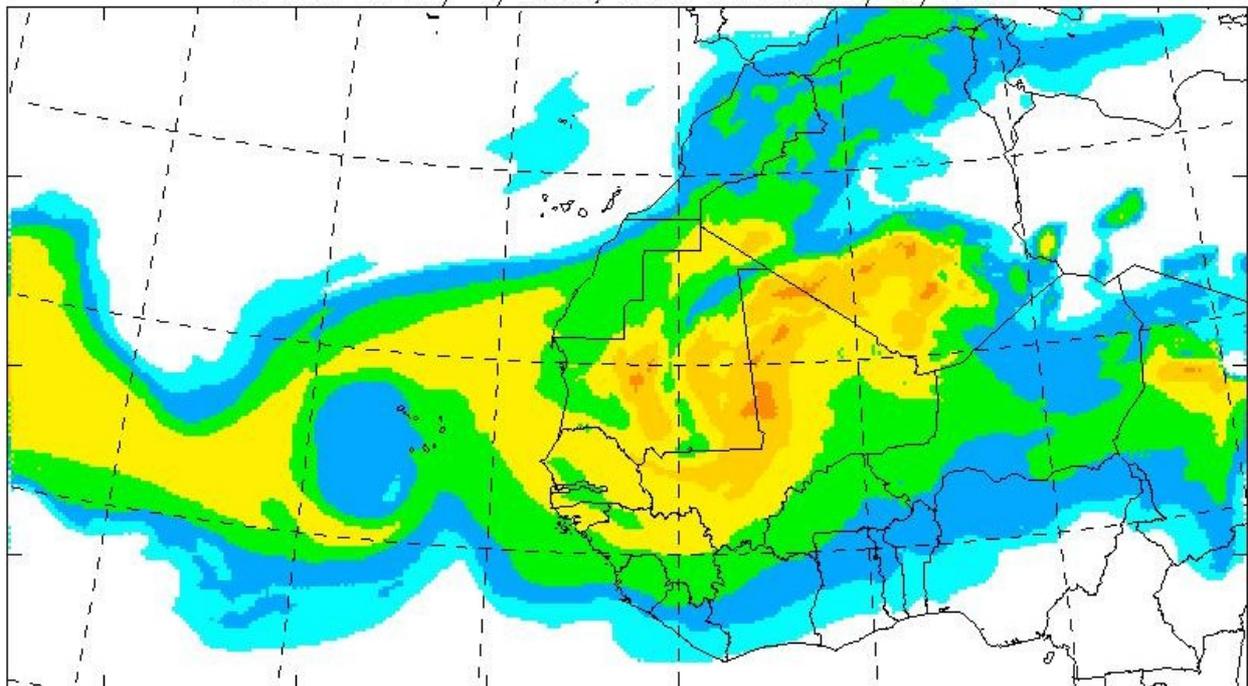
11z\_220806 AOD T+6

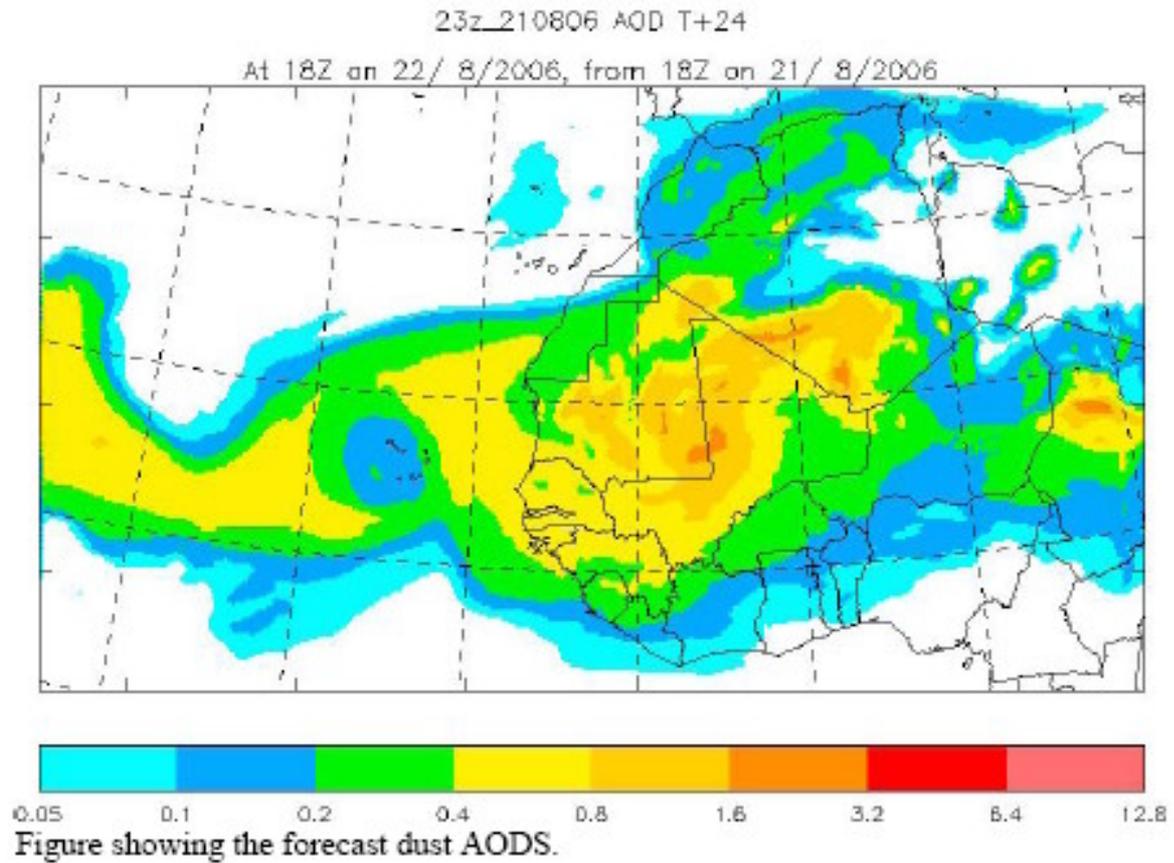
At 12Z on 22/ 8/2006, from 06Z on 22/ 8/2006



11z\_220806 AOD T+12

At 18Z on 22/ 8/2006, from 06Z on 22/ 8/2006





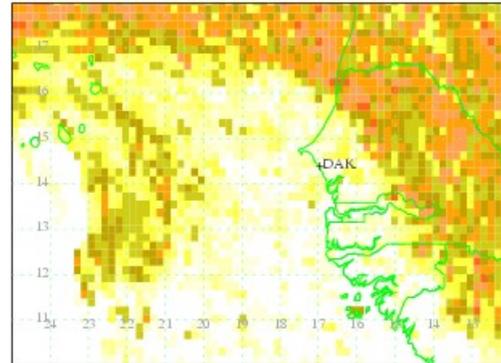
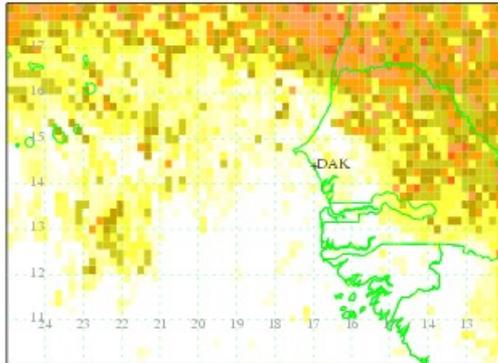
NAME version 814

Sahara forecast

Valid at 1200UTC 22/08/2006

From 2000 – 5000 ft agl Air concentration

From 5000 – 10000 ft agl Air concentration



Maximum value = 3.72e-02 g/m<sup>3</sup>  
1.00e-07 1.00e-05 1.00e-03 1.00e-01 1.00e+01

Maximum value = 2.91e-02 g/m<sup>3</sup>  
1.00e-07 1.00e-05 1.00e-03 1.00e-01 1.00e+01

Start of release: 0600UTC 29/06/2006  
End of release: 0000UTC\_07/01/1957  
Release rate: multiple sources  
Release location: multiple sources  
Release heights: \*\*\*\*\* to 0m agl

Pollutant: PM10\_MINERAL  
Met data: Mesoscale  
Run time: 0023UTC 22/08/2006

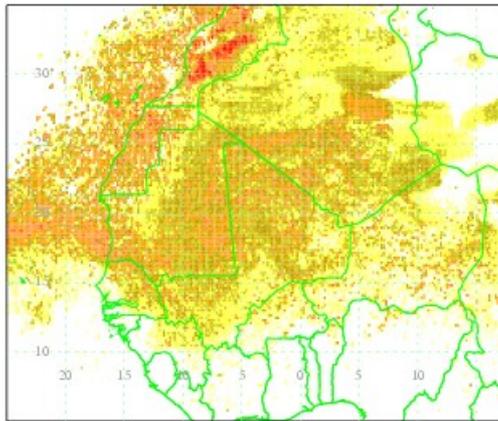
Met Office (GMR) Crown copyright

NAME version 814

Sahara forecast

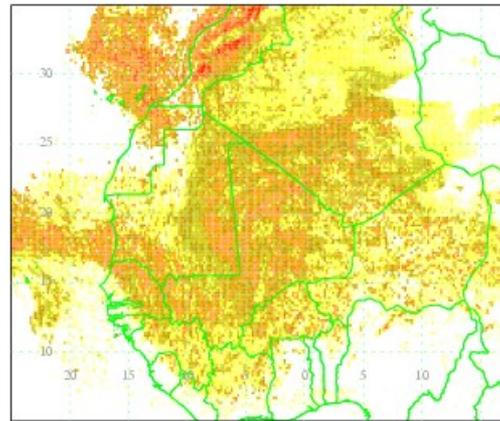
Valid at 1200UTC 22/08/2006

From 2000 – 5000 ft agl Air concentration



Maximum value =  $3.72 \times 10^{-2}$  g/m<sup>3</sup>  
1.00e-07 1.00e-05 1.00e-03 1.00e-01 1.00e+01

From 5000 – 10000 ft agl Air concentration

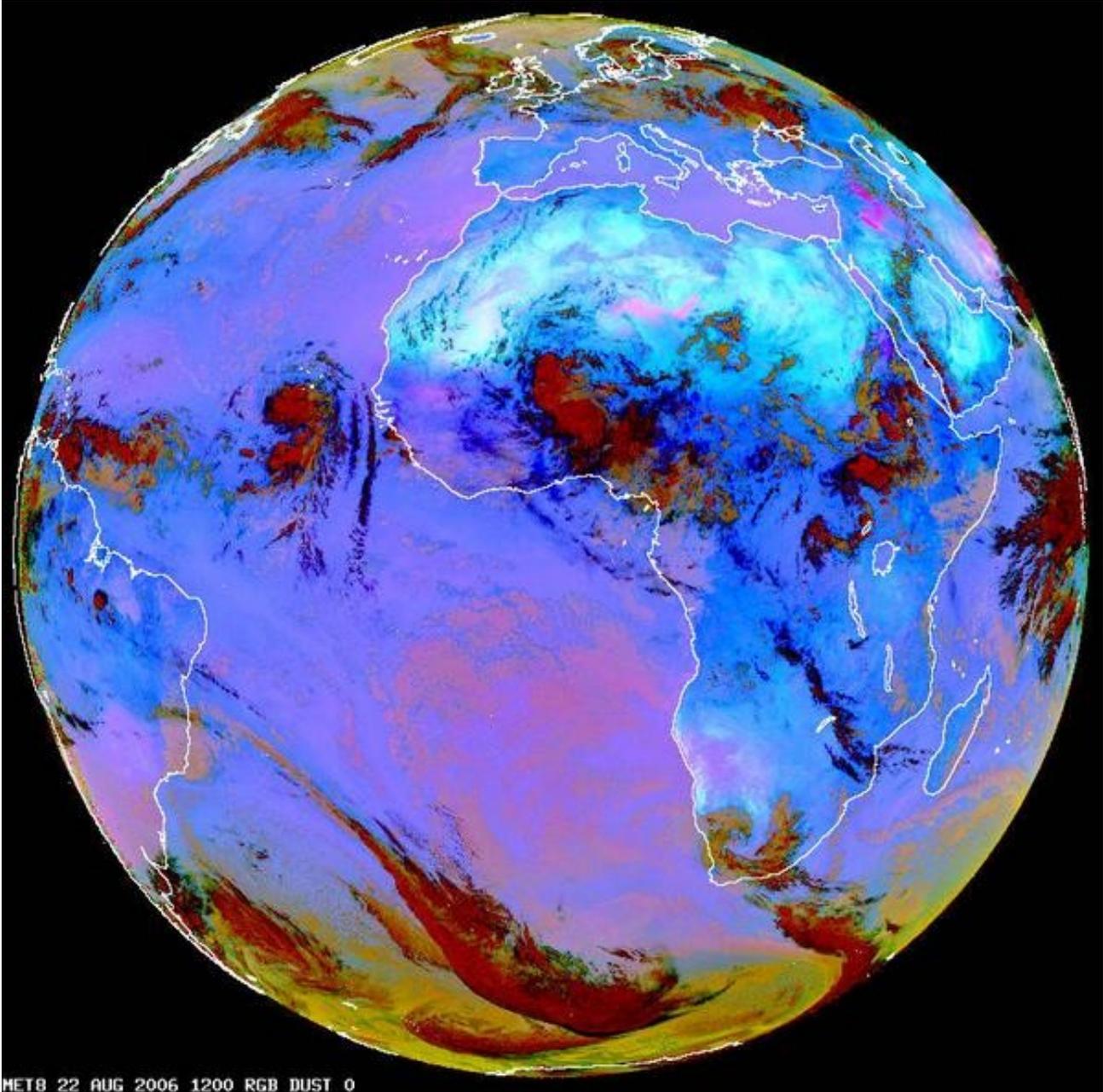


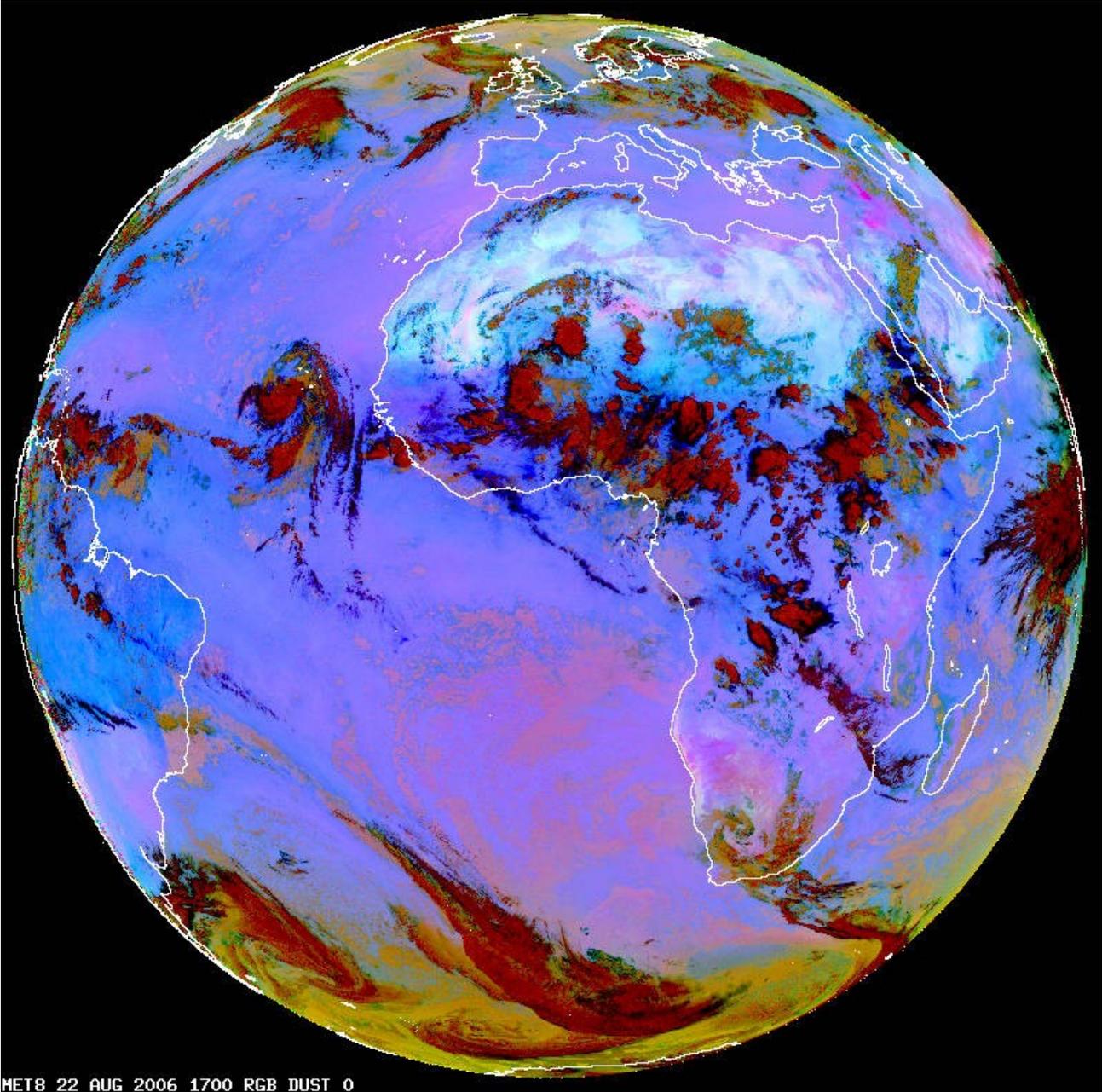
Maximum value =  $2.91 \times 10^{-2}$  g/m<sup>3</sup>  
1.00e-07 1.00e-05 1.00e-03 1.00e-01 1.00e+01

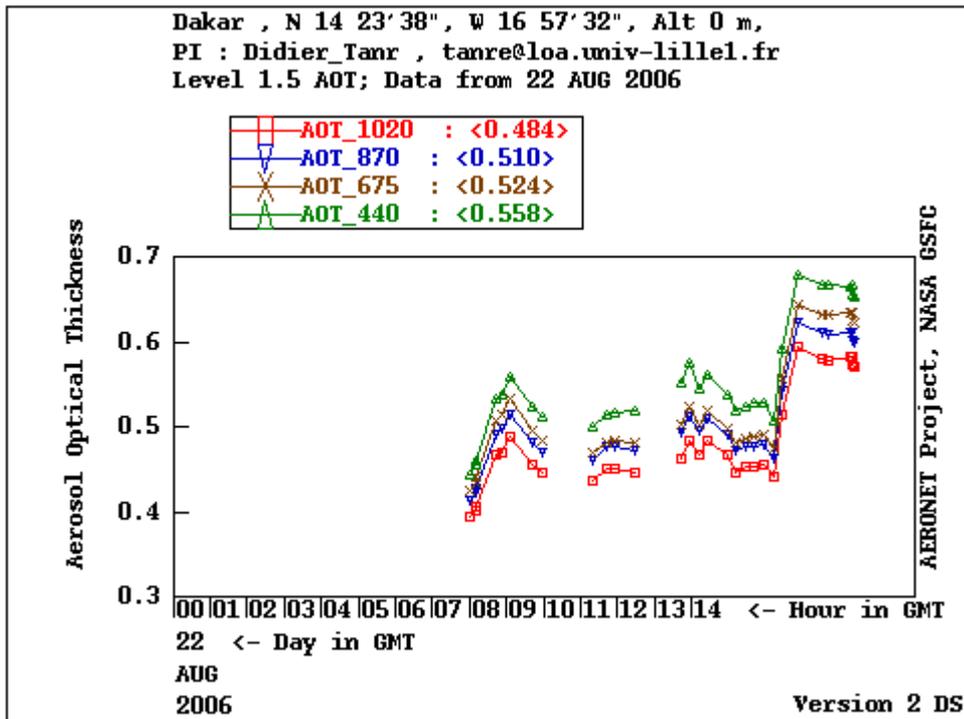
Start of release: 0600UTC 29/06/2006  
End of release: 0000UTC\_07/01/1957  
Release rate: multiple sources  
Release location: multiple sources  
Release heights : \*\*\*\*\* to 0m agl

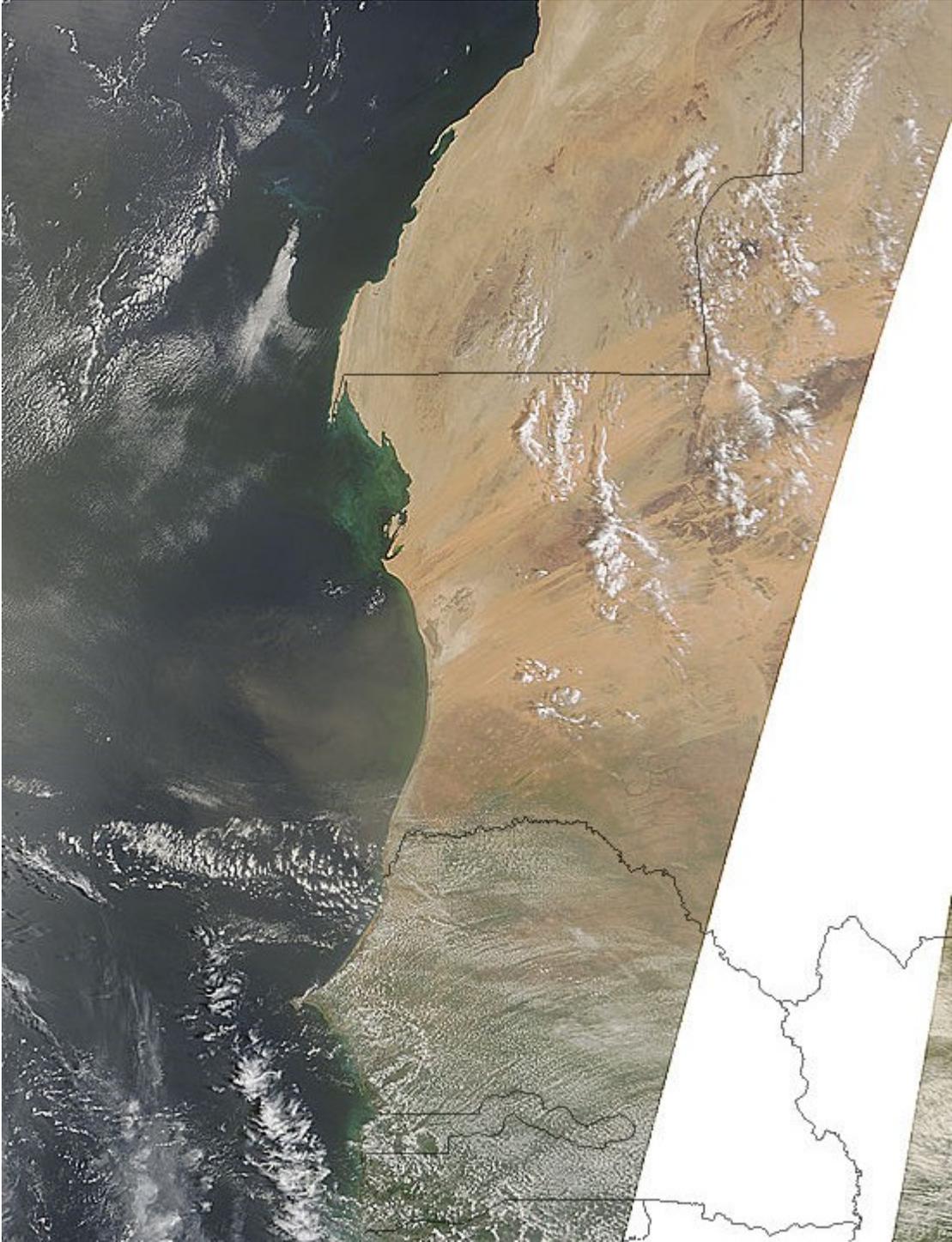
Pollutant: PM10\_MINERAL  
Met data: Mesoscale  
Run time: 0023UTC 22/08/2006

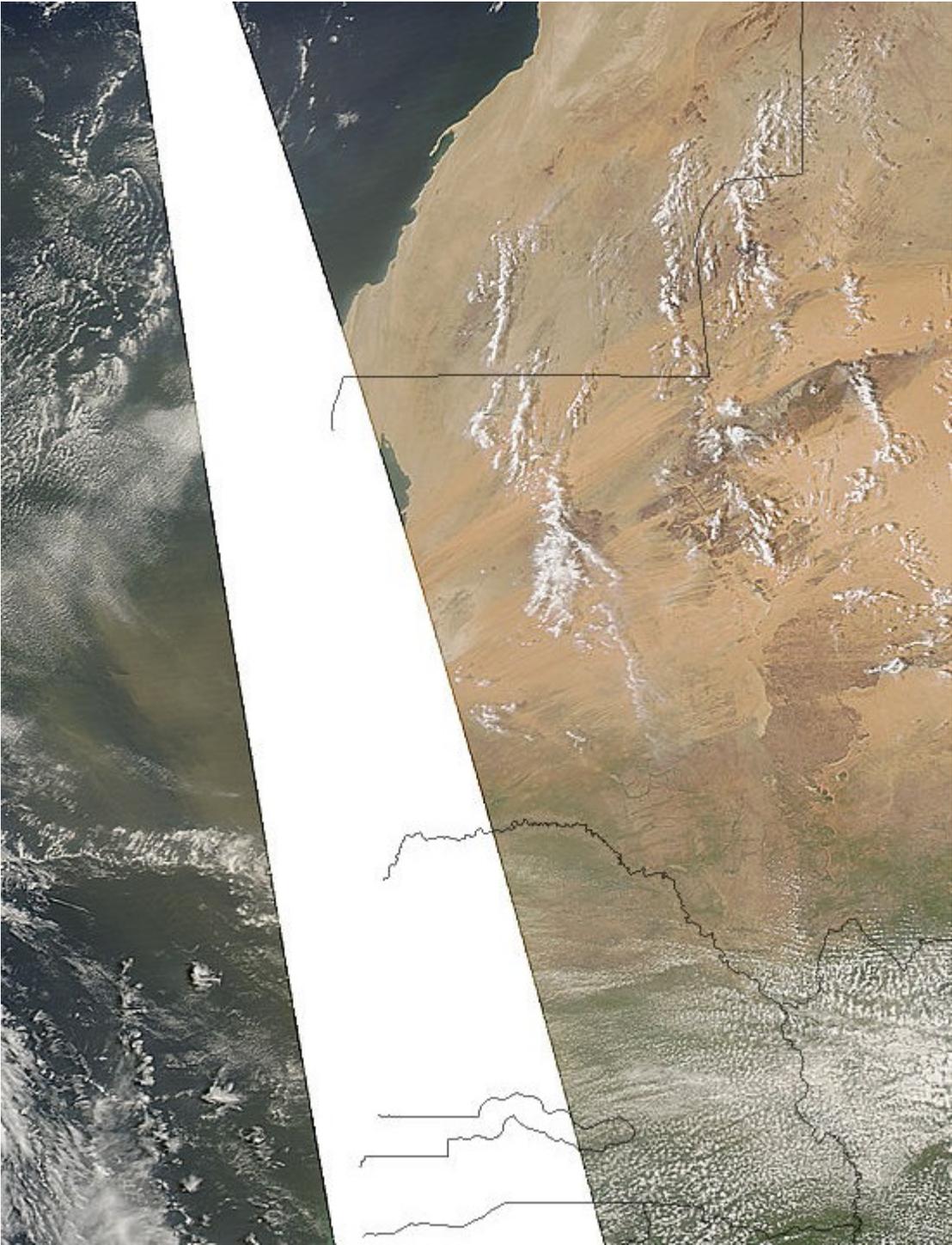
Met Office (GMR) Crown copyright

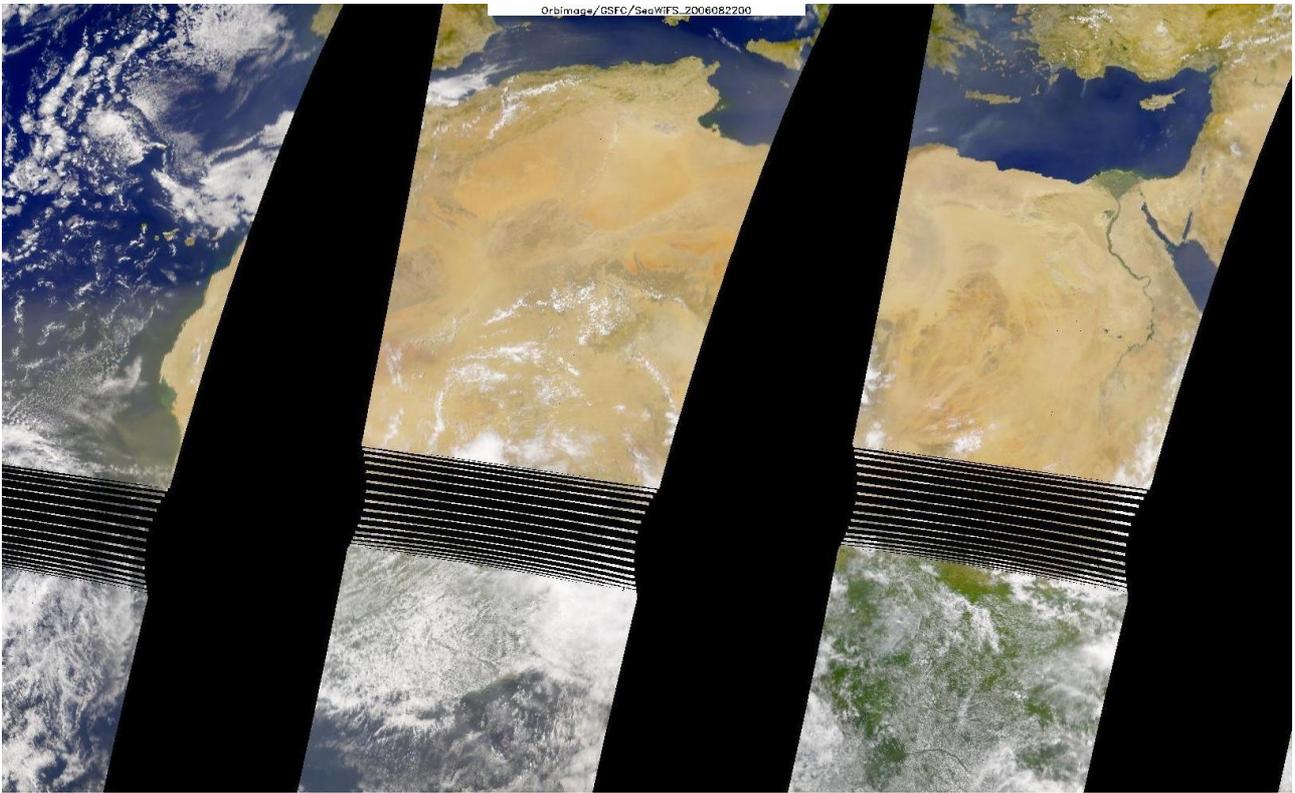




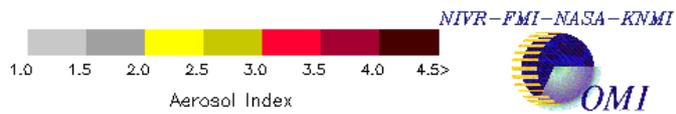
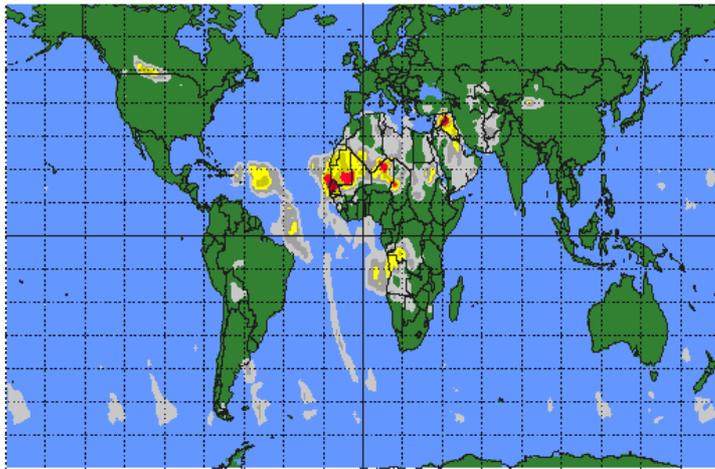








OMI Aerosol Index  
on August 22, 2006



## **B238: Blowing Sand**

Flight Number: B238

Date: 23rd August 2006

Mission: Ellie Highwood

Sortie Objectives: Sample heavy dust loading over land in Mauritania forecast by models and visible in EUMETSAT image.

Operating area:

From Dakar, over land to point A(14W, 18,30N) and then east to B(13W, 18,30N) based on satellite image discussed in flight.

Weather: Mixtures of cloud throughout, particularly cirrus. Strong winds near surface

Flight Patterns:

After take off from Dakar at 13Z, a profile ascent to the north was completed showing moderate dust layer between 5000 and 6000ft (nephelometer anti-correlated with ozone). A deeper layer with neph scattering around 25 Mm<sup>-1</sup> centred on FL100 and dropping by FL160 was seen above this. Low cloud decreased on transit north. An SLR towards the operating area was performed at FL210m above the dust. A sonde was dropped from FL230 over point A before a broken profile descent to the surface. Cloud and the intermittency prevented much radiation work but there may be some BBR information from these SLRs. An SLR back towards Dakar at MSA (700ft) was underneath the dust layer and ground level visibility was good. The run towards Dakar at this altitude was cut short and a run at the same altitude back to point A performed, whereupon information from the ground suggested running east west to new point B. The filter at this altitude resembles sandpaper. Nephelometer peaks co-incident with updrafts or changes in wind direction. Surface temperature suggested as 51 degrees. SWS visible module recovered for low level eastwards run. Nephelometer consistently reading 250Mm<sup>-1</sup> and peaking at 600Mm<sup>-1</sup>. Strong surface winds. Too much cirrus for orbits. A profile ascent was performed to 3000ft. A 10 minute run at 3000ft continued to show a peak in nephelometer. A further stacked SLR was performed at 7500ft (designed for NAME model validation). Dust concentrations were still high here. A profile ascent was followed by a run at FL165 in a weaker dust layer. Aerosol optical depth around 1.5 measured, therefore around 3 allowing for us not capturing supermicron scattering. IN reasonable agreement with model estimates and DODO's heaviest dust loading. The top of the dust was around FL190. A final sonde was dropped since the winds on the first one were not reported all the way to the ground. Still cirrus above.

The peaks in the dust concentration at each of the MSA, 3000ft and 7500ft were at exactly the same longitude. This could be used to compare with model forecasts of vertical distribution.

On profile descent into Dakar at end of recovery transit, the dust layer was similar to the initial profile with haze above scattered Cu and dust maxima (only up to 40Mm<sup>-1</sup>) at FL150 and FL090. Extensive StCu deck obvious.

On landing, the intensity of the dust loading was apparent as all leading edges and nooks and crannies were coated with sand. Not a popular move with the engineers!

Summary:

A good in-situ sampling flight over strong dust sources and concentrations over land. Useful model validation for CAMM and satellite validation. Co-incident with MODIS overpass. Lots of blowing sand.

## DODO2 Summary Document

### Problems

SWS intermittent

Lower SHIMs has a shutter problem allowing only one module at a time.

Lower pyrgeometer still not working.

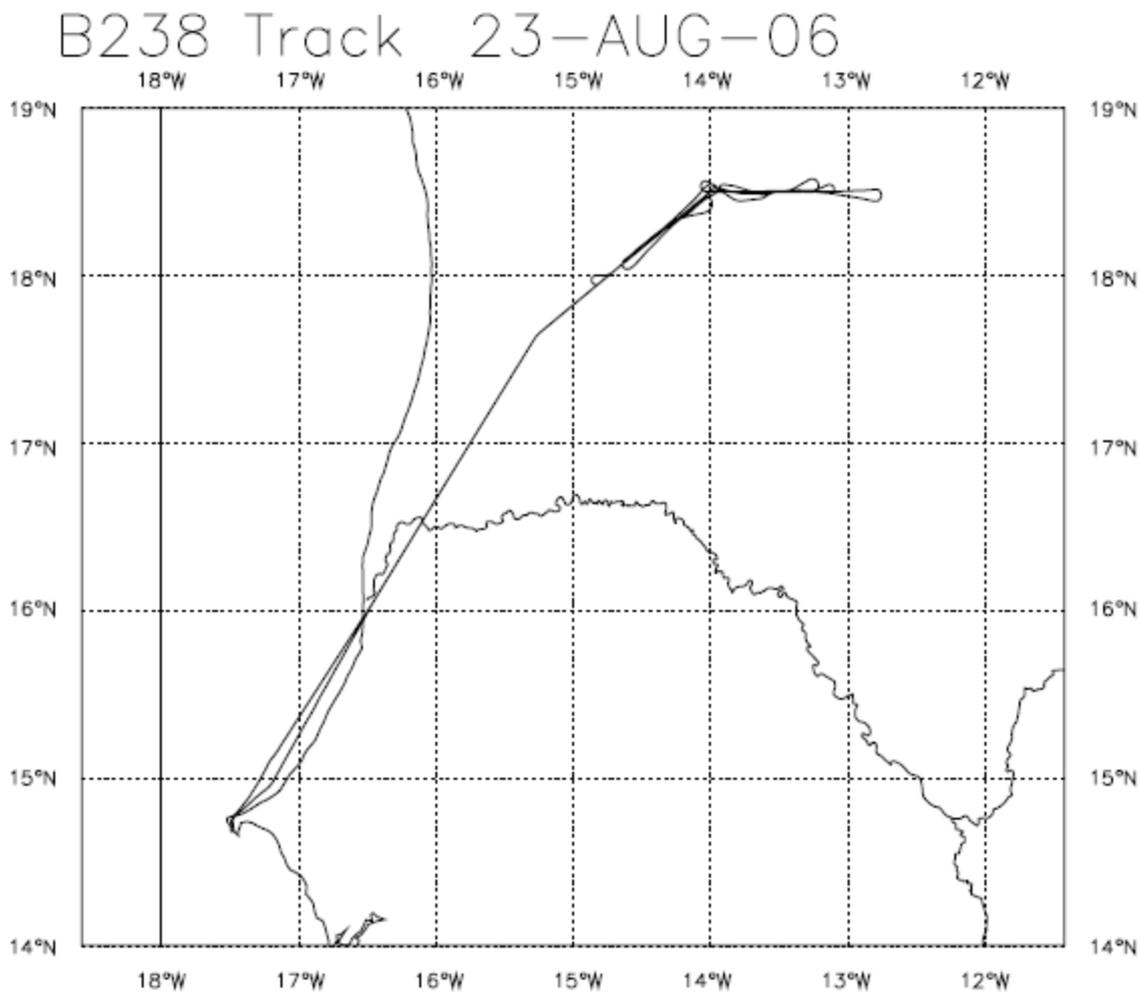
2-D probe lost laser power due to sand coating so had to be switched off. Forward camera suffered sand coating.

Neph needs calibrating? Blue scattering is very low all the time.

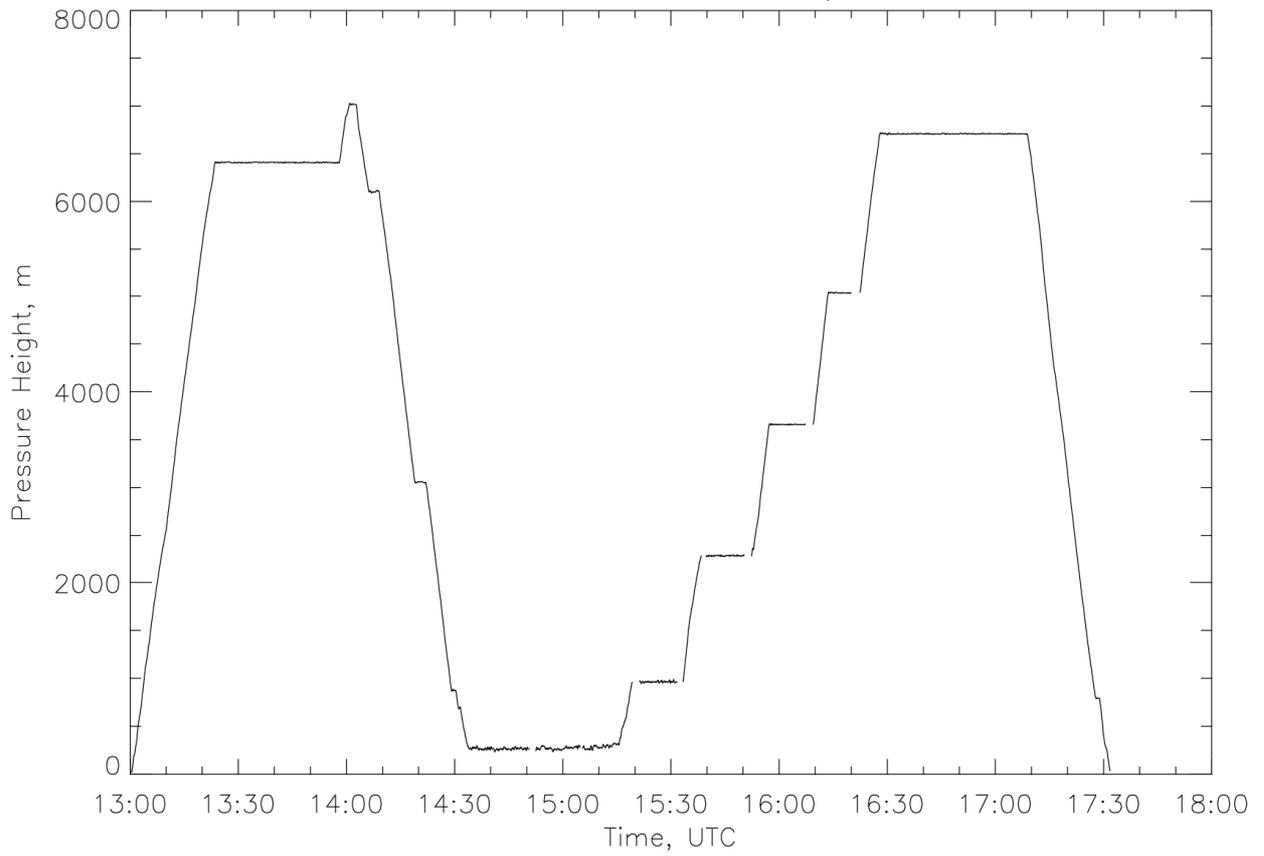
Start Time	End Time	Event	Height (s)	Hdg	Comments
123501		!	0.08 kft	15	FM pc preflight crash
123510		INU	0.08 kft	15	to nav
123526		CGPS	0.08 kft	15	B238cgps.log
123625		XR5M	0.08 kft	15	14'44.60N 17'29.11W
124158		!	0.08 kft	15	H_INU stopped & restarted
130025		T/O	0.06 kft	351	Dakar
130025	132332	Profile 1	0.40 - 21.0 kft	358	
131120		Video	9.7 kft	40	#1 Ffc #2Ufc
132333	135806	Run 1.1	21.0 kft	37	
132745		!	21.0 kft	36	speed increase
133611		bbr	21.0 kft	36	retract
133839		Heiman	21.0 kft	37	cal 13
133900		Nev	21.0 kft	37	zero
134027		JW	21.0 kft	36	zero
135806	140050	Profile 2	21.0 - 23.0 kft	54	
140051	140242	Run 2.1	23.0 kft	54	
140212		Sonde 1	23.0 kft	55	
140242	143414	Profile 3	23.0 - 20.0 kft	55	
140613	140747	P3	20.0 kft	55	interrupted
140716		!	20.0 kft	117	manouever
140854		P3	20.0 kft	259	resumed
141116		bbr	18.0 kft	248	extend
141902		P3	10.0 kft	236	interrupt
142157		P3	10.0 kft	78	resumed
142712		Video	4.8 kft	53	#3 Ffc #4Ufc
142912		P3	2.8 kft	52	interrupted
143032		P3	2.7 kft	53	resumed
143414		Run 3.1	0.94 kft	57	
144041	145046	Run 3.2	0.88 - 0.86 kft	226	
144150		nev	0.86 kft	233	zero
144336		JW	0.90 kft	234	zero
145232	150452	Run 3.3	0.82 - 0.94 kft	58	
150531	151533	Run 3.4	0.89 - 1.0 kft	84	
151533	151914	Profile 4	1.1 - 3.1 kft	88	
152116	153142	Run 4.1	3.2 - 3.1 kft	248	
153321	153826	Profile 5	3.2 - 7.5 kft	87	
153942	155021	Run 5.1	7.5 kft	84	
155221	155719	Profile 6	7.5 - 12.0 kft	282	
155311		bbr	8.0 kft	286	extend
155629		Video	11.2 kft	287	#5 Ffc #6 Ufc
155719	160721	Run 6.1	12.0 kft	274	

# DODO2 Summary Document

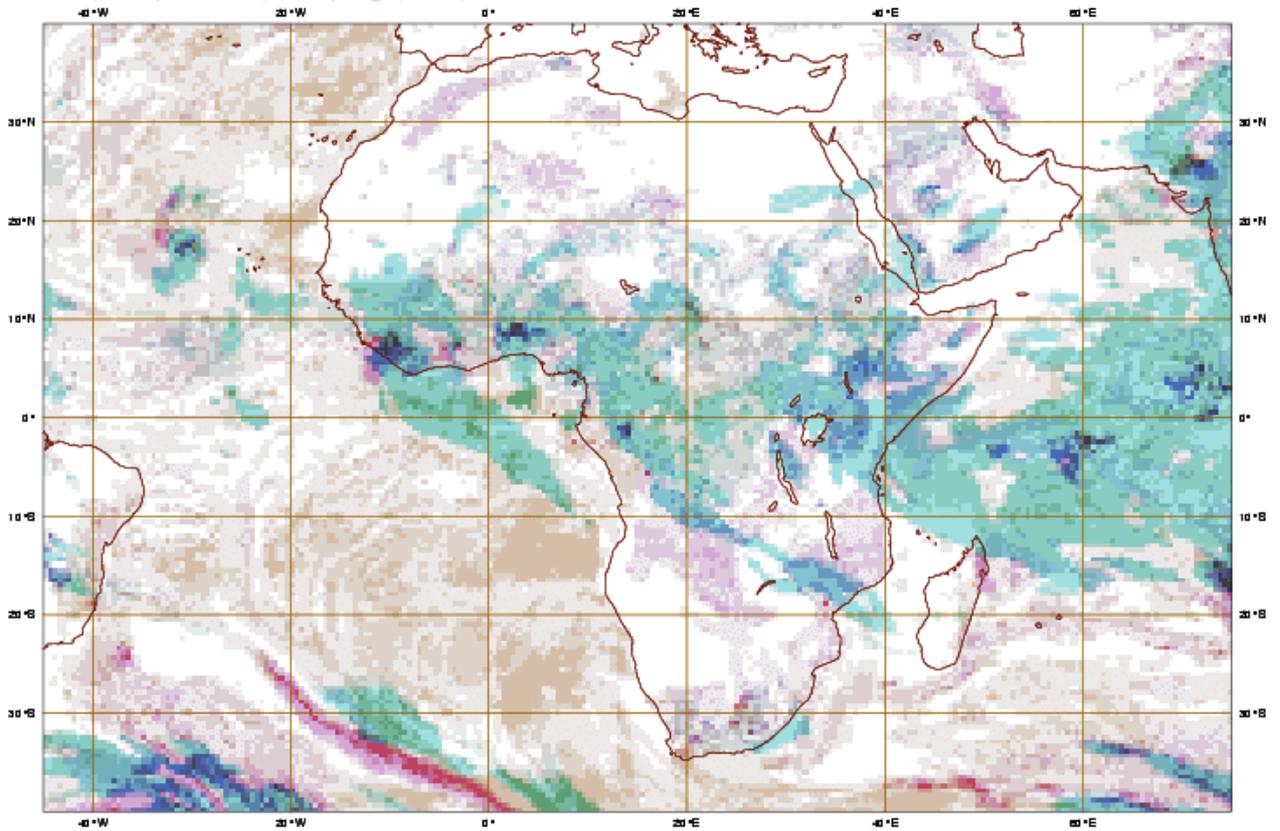
160924	161339	Profile 7	12.0 - 16.5 kft	114	
161254		bbr	15.8 kft	90	retract
161339	162002	Run 7.1	16.5 kft	80	
161521		nev	16.5 kft	65	zero
161641		heiman	16.5 kft	79	cal 12
161733		JW	16.5 kft	88	zero
162223	162758	Profile 8	16.5 - 22.0 kft	246	
162258		bbr extend	17.1 kft	246	
162633		bbr	20.8 kft	271	retract
162807		Sonde	22.0 kft	274	
162826		!	22.0 kft	273	sonde 2
162758	170845	Run 8.1	22.0 kft	272	as end profile 8
163014		!	22.0 kft	249	manouver
164619		!	22.0 kft	218	manouver
170845	173151	Profile 9	21.7 - 0.13 kft	211	
170945		!	21.3 kft	214	start p9 as end r 8.1
173152		Land	0.13 kft	351	
173422		ASP	0.16 kft	281	closed
173914		XR5M	0.15 kft	332	14'43.75N 17'28.43W



Run and Profile Altitudes, b238

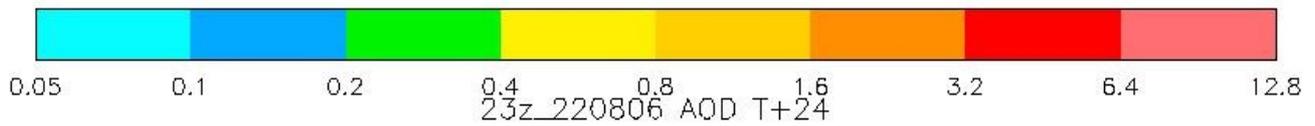
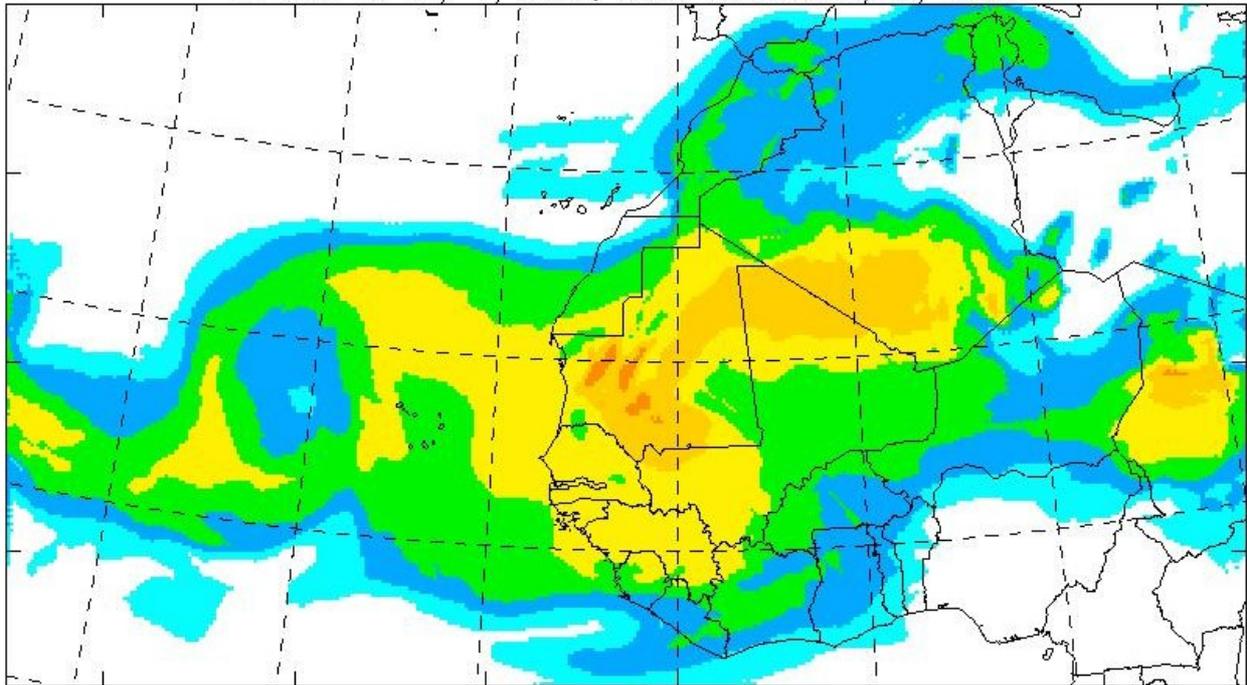


Wednesday 23 August 2006 00UTC ©ECMWF Forecast t+012 VT: Wednesday 23 August 2006 12UTC  
Low, L+M, Medium, M+H, High, H+L, H+M+L clouds



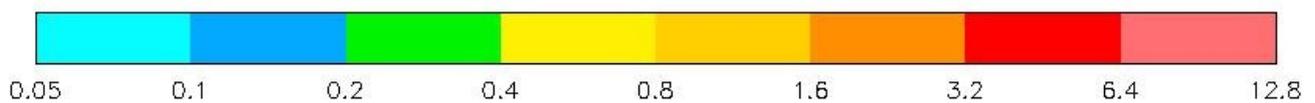
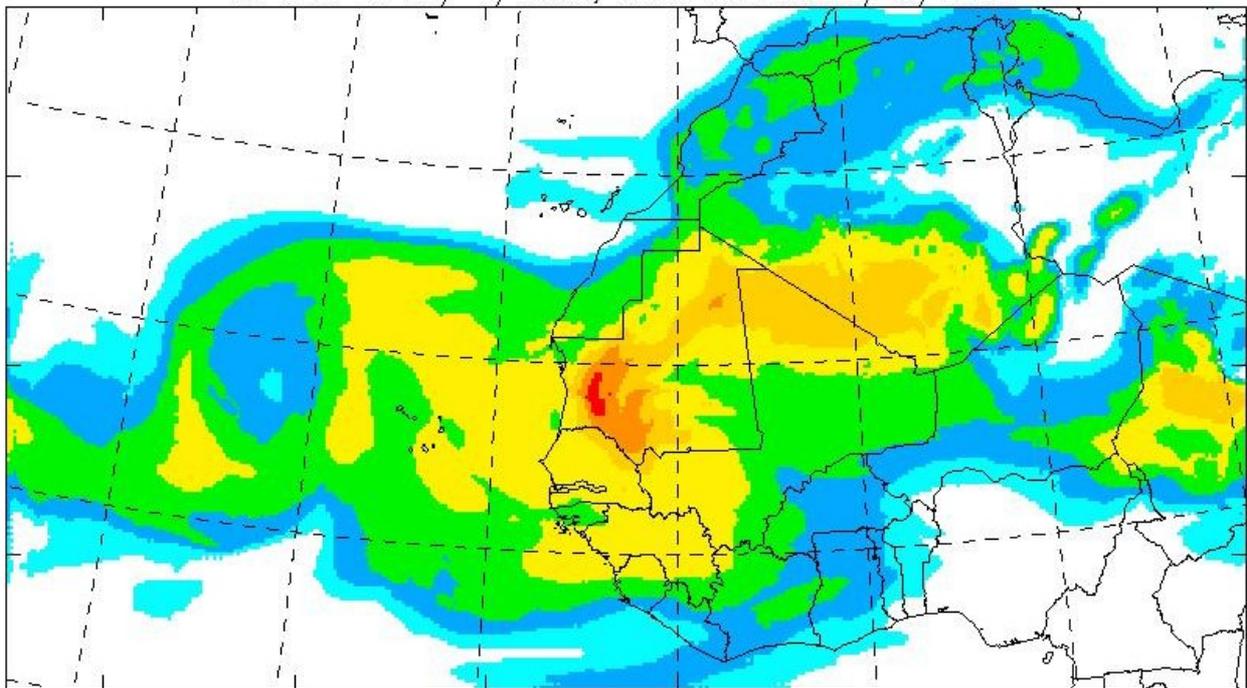
23z\_220806 AOD T+18

At 12Z on 23/ 8/2006, from 18Z on 22/ 8/2006

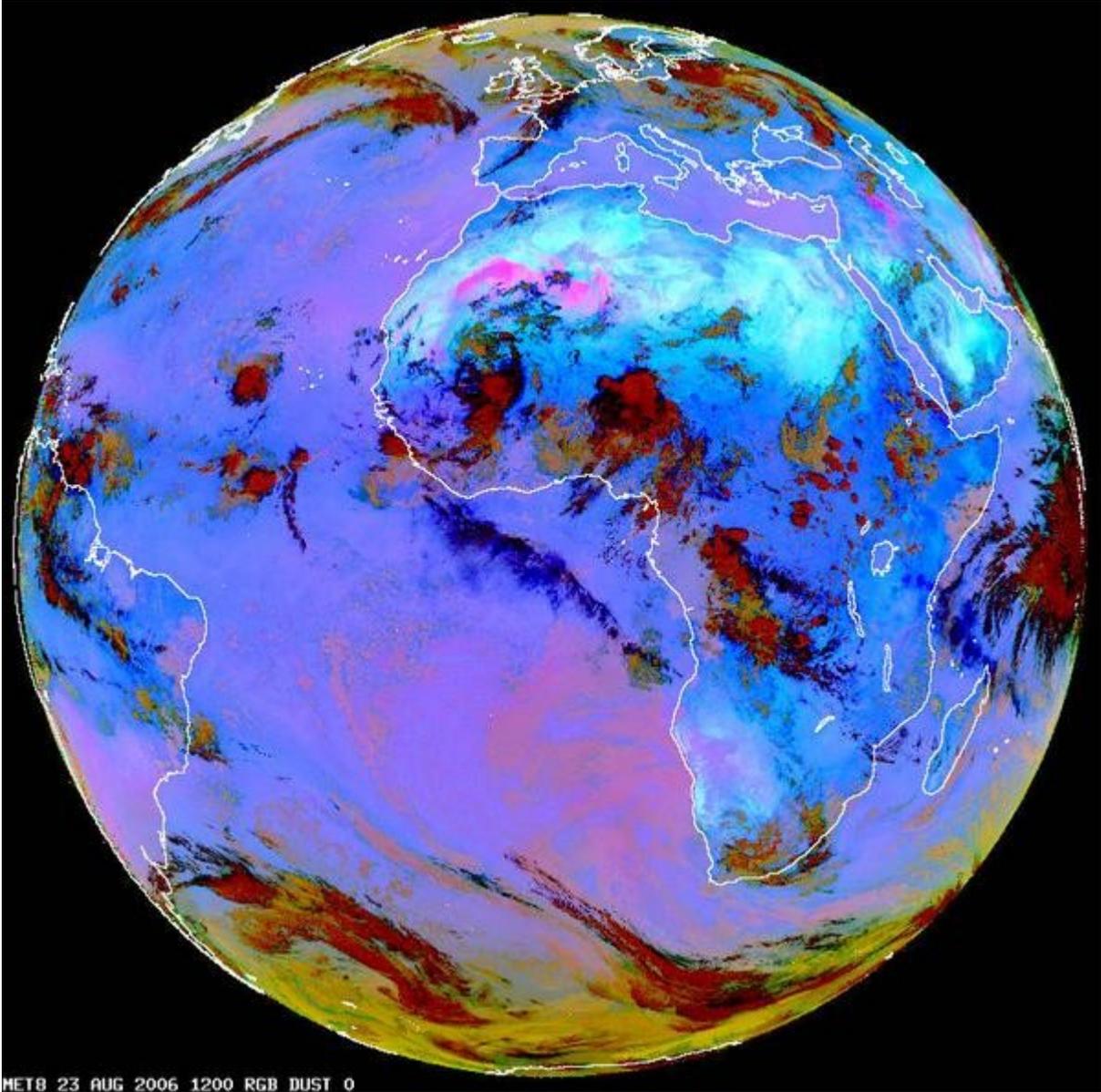
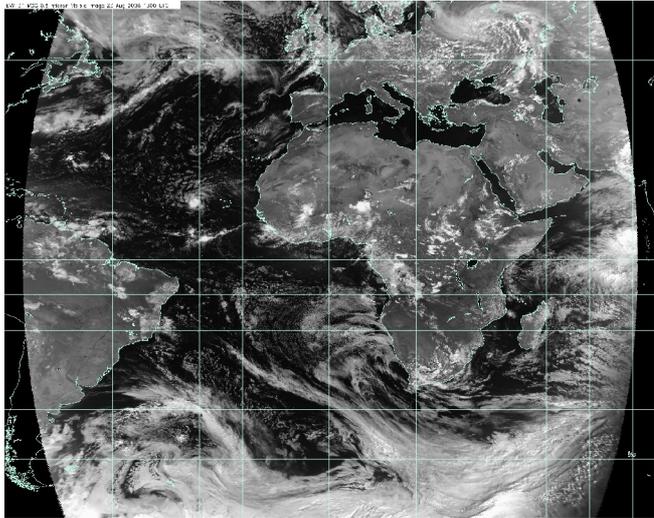
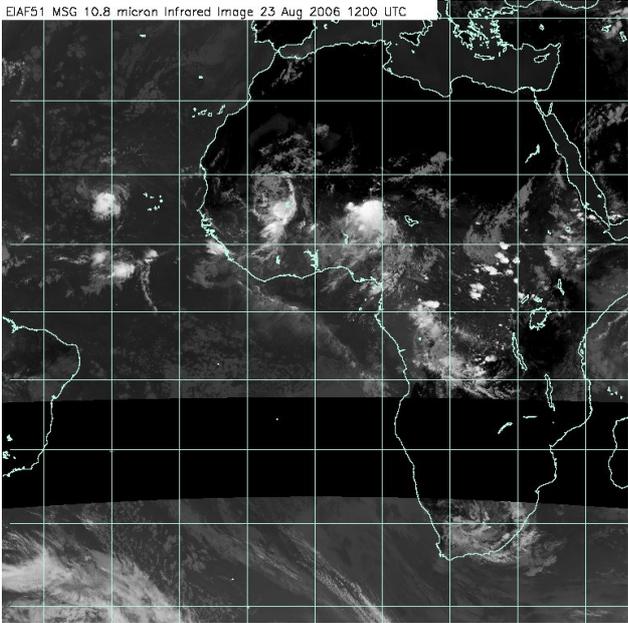


23z\_220806 AOD T+24

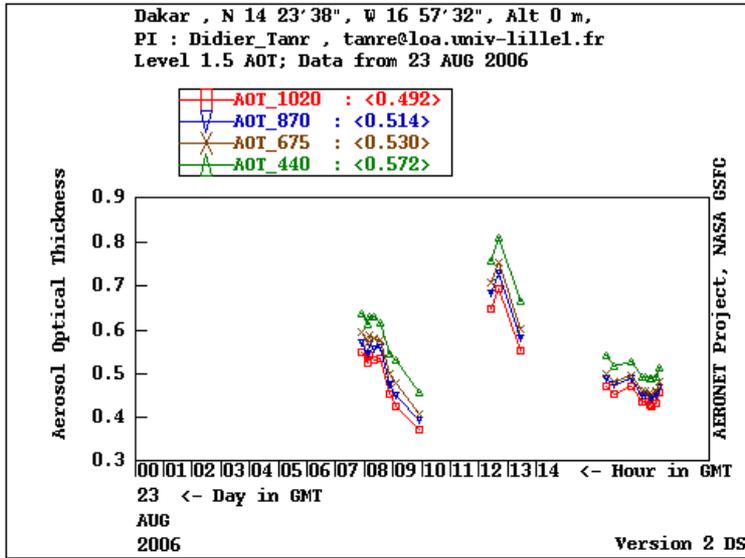
At 18Z on 23/ 8/2006, from 18Z on 22/ 8/2006

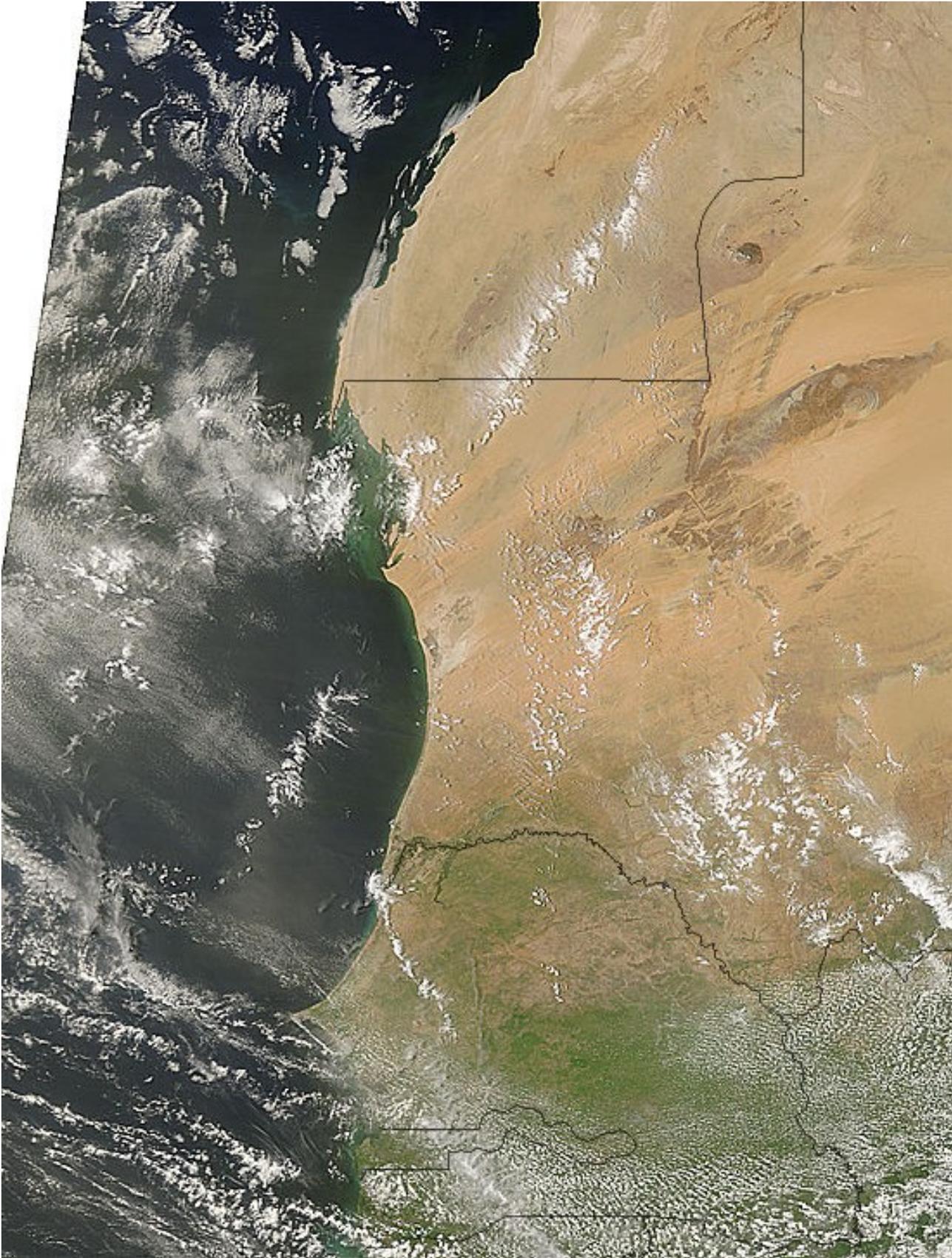


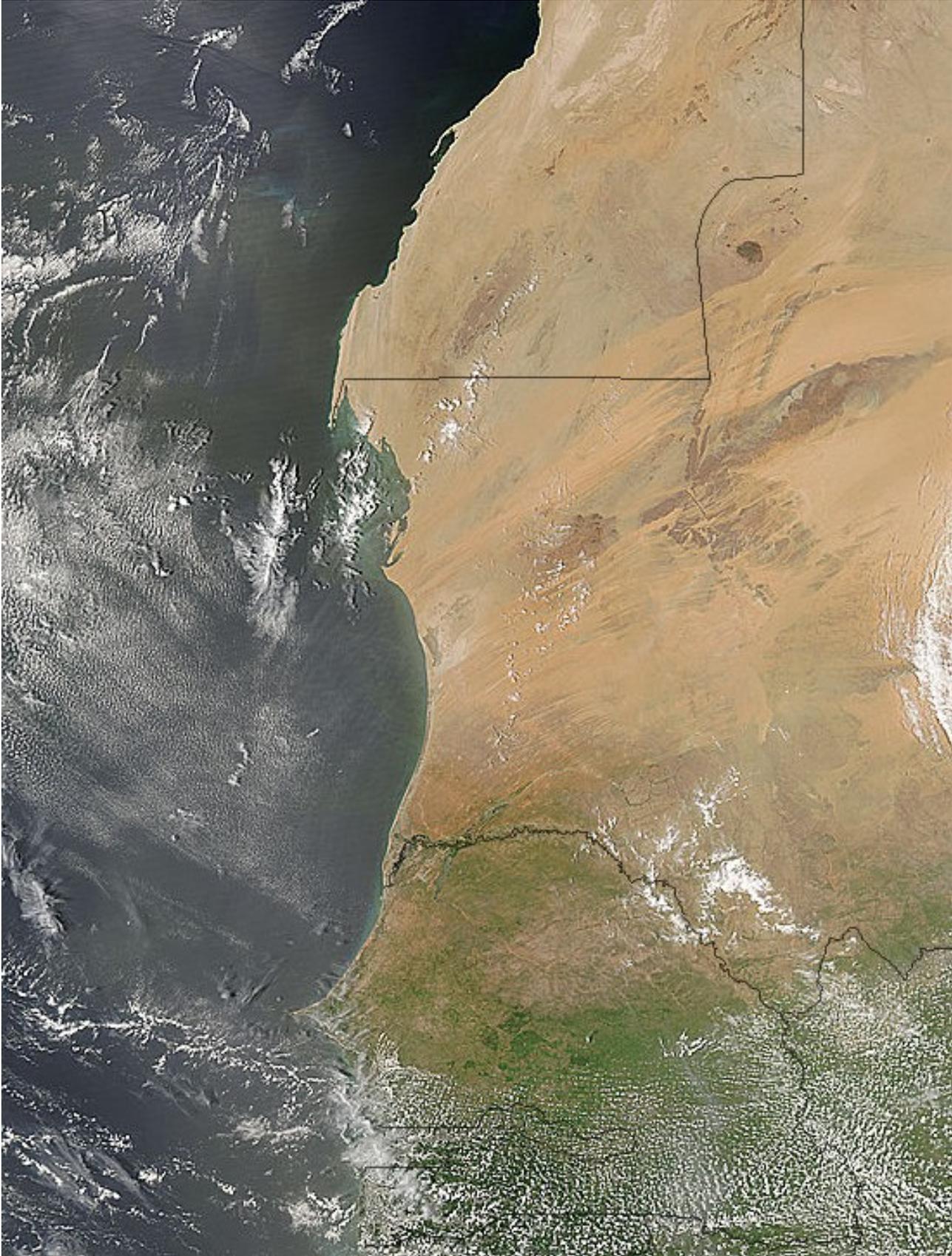
DODO2 Summary Document

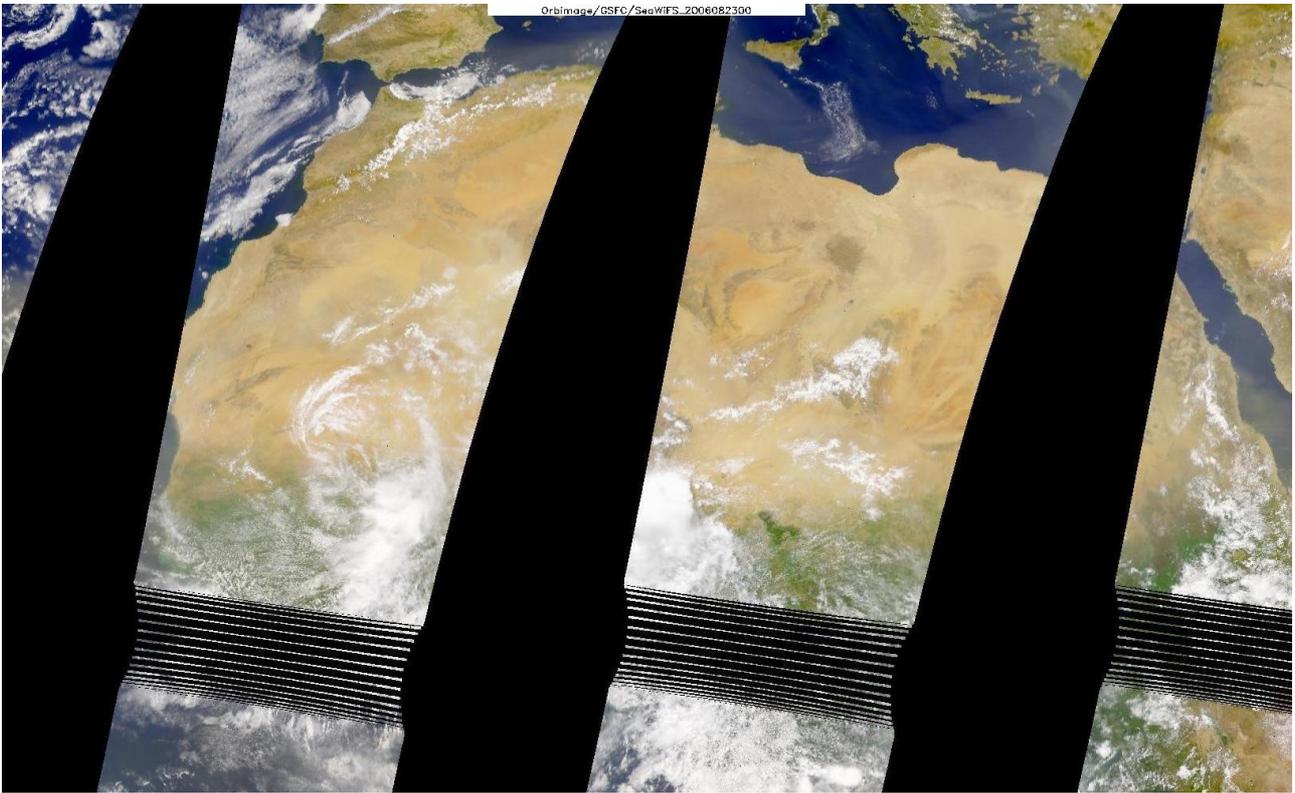


# DODO2 Summary Document

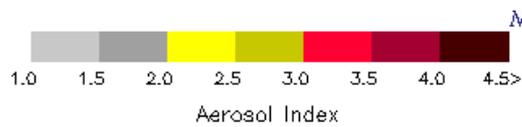
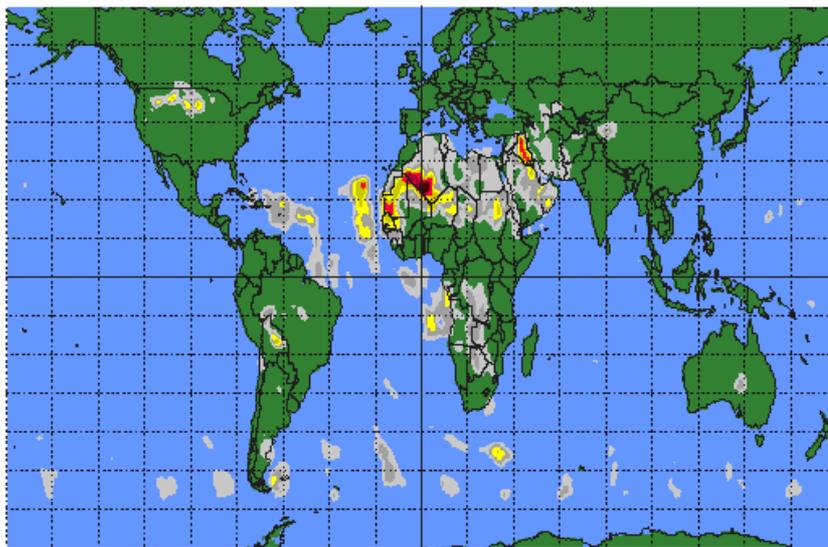








OMI Aerosal Index  
on August 23, 2006



NIVR-FMI-NASA-KNMI



## B239

Flight Number: B239

Date: 24<sup>th</sup> August 2006

Mission: Hugh Coe

Sortie Objectives: To conduct in-situ measurements of mineral dust over the ocean, surveying in an area to the south Dakar-Sal.

Operating area: An area between Dakar- Point alpha (TAROT)-point Beta (Sal)

Point alpha TAROT = 11 27.9 N 19 40 W

Point beta (Sal) = 16.75 N 22.92 W

Dakar = 14.7 N 17.45 W

Weather: Low level Sc more broken to W but extensive everywhere; widespread cirrus across the entire region.

### Flight Patterns:

Flight planning was based on the large region of dust observed on B238 to the NE over the Sahara. Overnight trajectory runs suggested the dust had advected to the south of Dakar. Model predictions of the dust suggested a widespread region of dust to the south and across the ocean between Dakar and Sal. Satellite imagery showed the cloud cover was extensive over the region at low and high levels.

After take off, a profile to FL200 was conducted in the direction of TAROT and a sonde was released successfully at the top. Cloud was present in the boundary layer below 3500 ft, above which a clear slot was present. A light dust layer was intercepted between FL060 and FL100 with a maximum scattering coefficient of  $50 \text{ Mm}^{-1}$ . Extensive cirrus was present at FL240. An immediate profile descent to FL080 showed a similar structure to the previous profile. This was followed by a 10 minute SLR which showed variable dust loadings with scattering coefficients of between 50 and  $100 \text{ Mm}^{-1}$ , the greater values occurring at towards the southern end of the leg. A descending profile into TAROT to 100 ft and immediate ascending profile to FL200 in the direction of Sal showed a similar structure to the previous profile except for a filamentary layer of high dust loading (scattering coefficient  $250 \text{ Mm}^{-1}$ ) that was no more than 1000 ft in depth and was centred on FL070. Visually, there appeared to be more dust to the NE than the SW. The second sonde was released at the top of the profile (P4) and all data were successfully recovered. An immediate profile descent to 6500' showed that the filament of high dust loading was still present. This was in the region that the trajectory calculations predicted the dust, sampled during B238, should have been advected into.

However, the layer rapidly disappeared as the aircraft headed west and sawtooth manoeuvres showed that no dust was present beyond approximately 21 W. A further profile was conducted between FL060 and FL200 and a third sonde was released. Cirrus remained extensive. A further profile ascent and descent between the top of the Sc layer at around FL050 and FL200 was performed to provide model validation profiles but little dust was present. A final SLR on approach to Dakar revealed increased, though not large dust loadings on the approach to the coast.

### Summary:

A successful DODO flight to map out the model predicted outflow of dust in the region between and to the south of Sal and Dakar. Though no radiation work was possible because of the extensive cirrus, an in situ dust measurement was possible and many profiles should provide model constraint information.

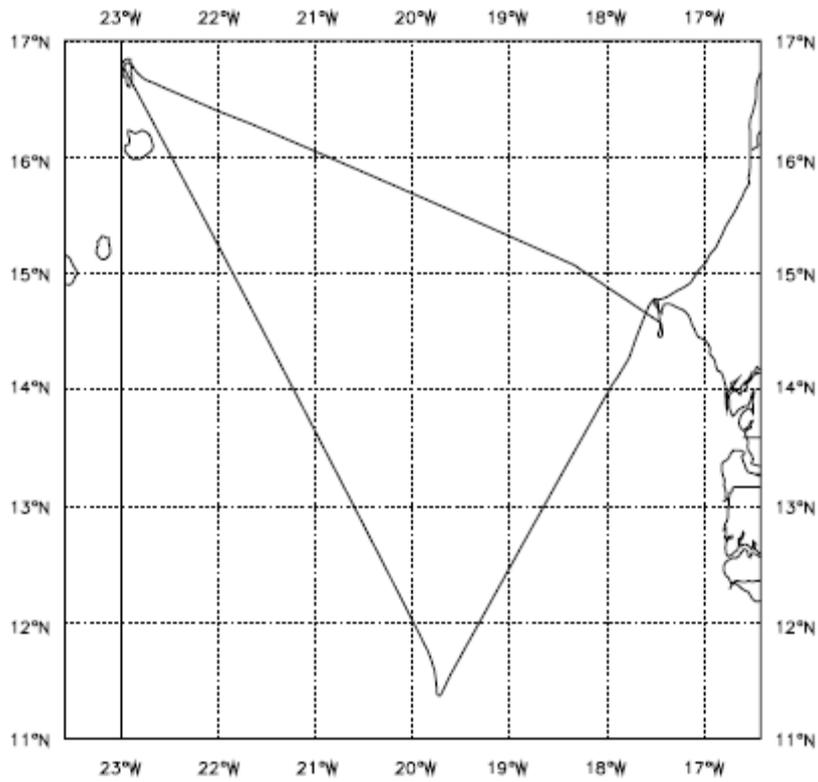
### Problems

None noted.

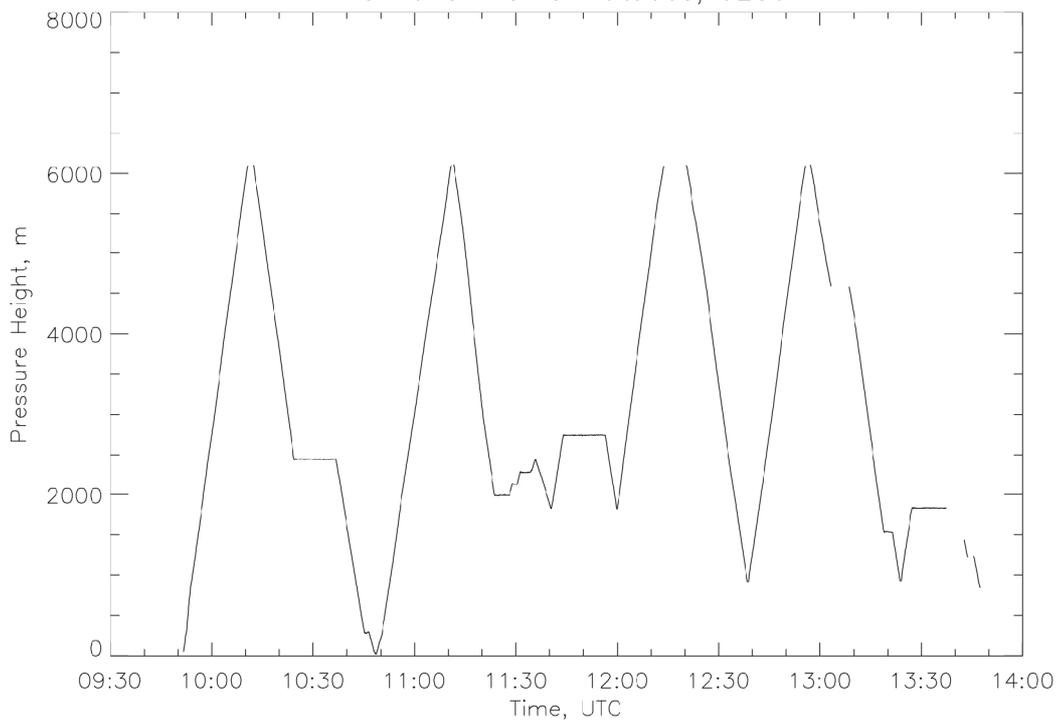
DODO2 Summary Document

Start Time	End Time	Event	Height (s)	Hdg	Comments
91844		engine start	0.19 kft	359	
93916		inu to nav	0.19 kft	15	
95141		T/O	0.16 kft	353	
95436	101039	Profile 1	3.6 - 20.0 kft	205	from TO
101047		Sonde 1	20.0 kft	212	
101216	102423	Profile 2	20.0 - 8.0 kft	211	
102424	103642	Run 1	8.0 kft	212	
102511		BBR	8.0 kft	212	shutter up (U)
103642	104836	Profile 3	8.0 - 0.07 kft	212	
104509		Profile 3	0.94 kft	215	interrupt
104520		qnh	0.91 kft	218	1017
104626		Profile 3	0.97 kft	352	resume
104837	111047	Profile 4	0.07 - 20.0 kft	348	
105328		bbr	3.7 kft	327	shutter down (d)
105616		Video	6.5 kft	332	tapes change
110336		PSAP	13.3 kft	336	stopped logging around 1100
111057		Sonde 2	20.0 kft	332	
111129	112343	Profile 5	20.0 - 6.6 kft	331	
112343	112804	Run 2	6.6 - 6.5 kft	332	
112422		bbr	6.5 kft	332	U
112805	112903	Profile 6	6.5 - 7.0 kft	333	
112903	113018	Run 3	7.0 kft	334	
113019	113114	Profile 7	7.0 - 7.5 kft	334	
113114	113416	Run 4	7.5 kft	335	
113417	114409	Sawtooth 1	7.5 - 9.0 kft	335	
114409	115630	Run 5	9.0 kft	335	
115630	115954	Profile 8	9.0 - 6.0 kft	335	
115821		bbr	7.3 kft	336	D
115955	121346	Profile 9	6.0 - 20.0 kft	334	
121354		Sonde 3	20.0 kft	334	
122021	123835	Profile 10	20.0 - 3.0 kft	132	
123849	125544	Profile 11	3.0 - 20.0 kft	107	
125706	130313	Profile 12	20.0 - 15.1 kft	108	
125950		jw/nevz zero	17.7 kft	108	
130832	132345	Profile 13	15.0 - 3.0 kft	104	
131906		Profile 13	5.0 kft	108	interrupt
132127		Profile 13	5.0 kft	108	resume
132400	132727	Profile 14	3.0 - 6.0 kft	106	
132727	133730	Run 6	6.0 kft	106	
134247	134345	Profile 15	4.7 - 4.0 kft	116	
134524	134719	Profile 16	4.0 - 2.8 kft	175	
135328		Land	0.19 kft	351	

### B239 Track 24-AUG-06

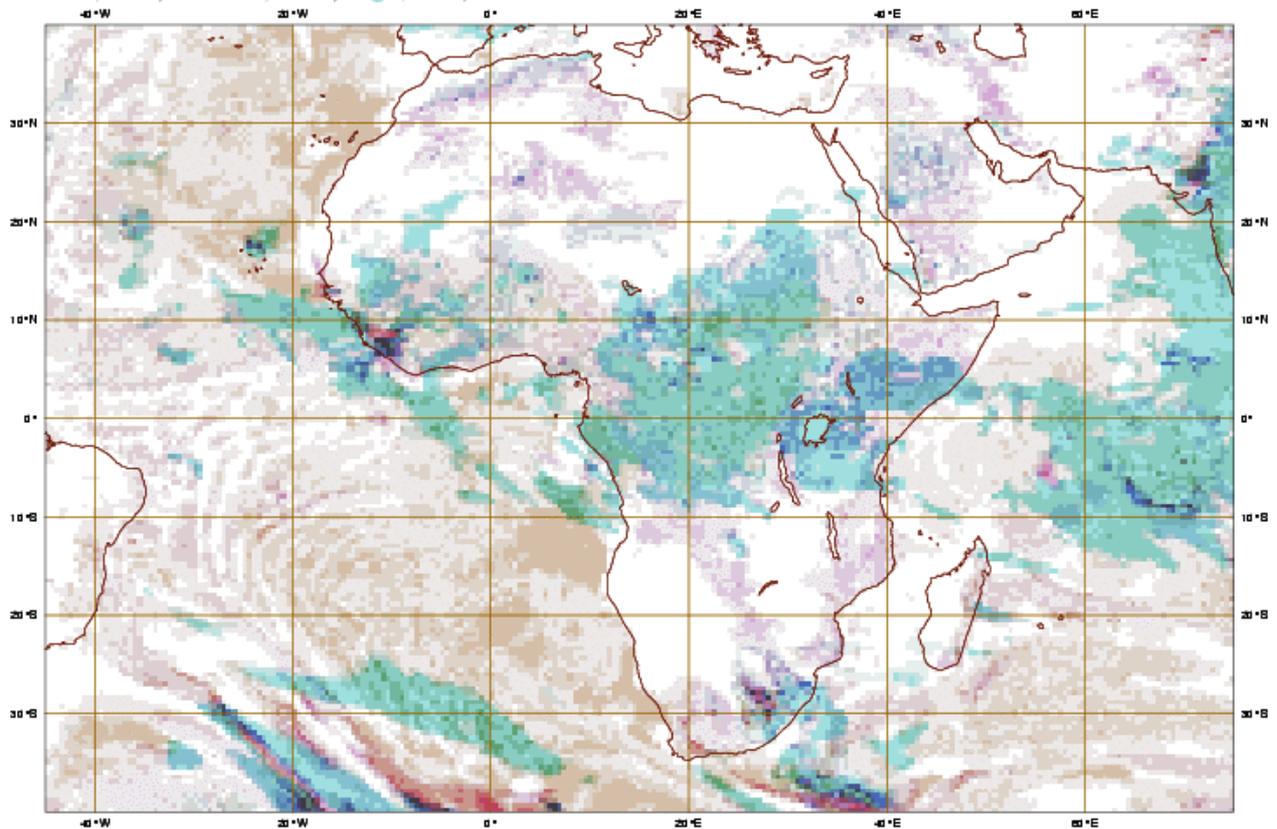


Run and Profile Altitudes, b239



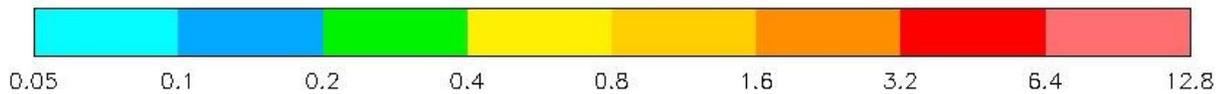
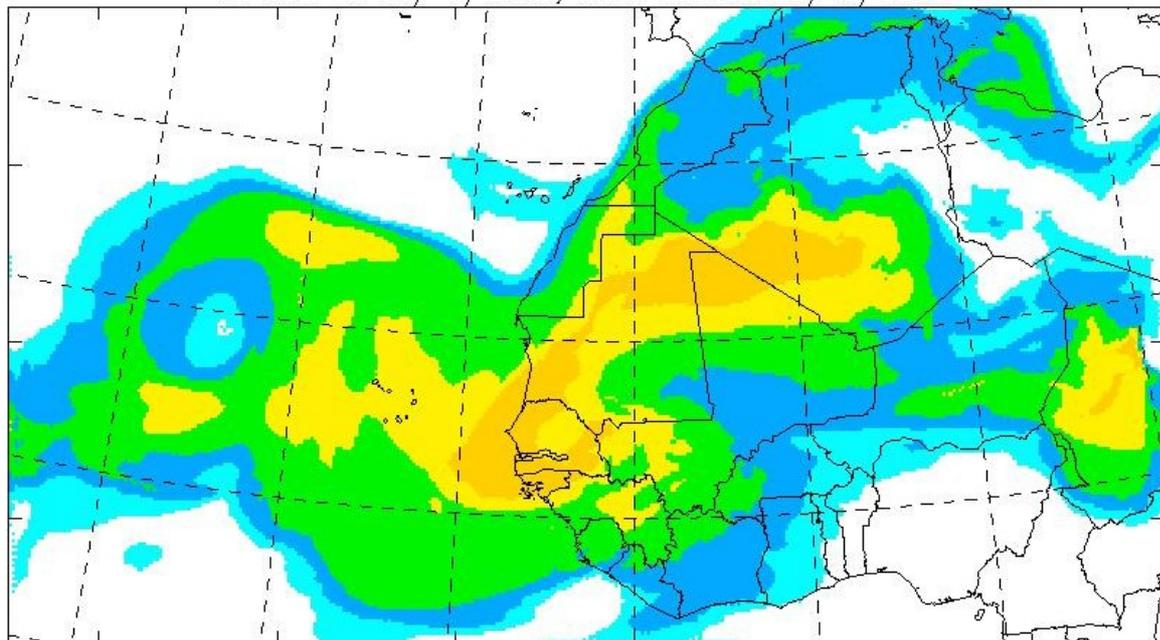
Thursday 24 August 2006 00UTC ©ECMWF Forecast t+012 VT: Thursday 24 August 2006 12UTC

Low, L+M, Medium, M+H, High, H+L, H+M+L clouds



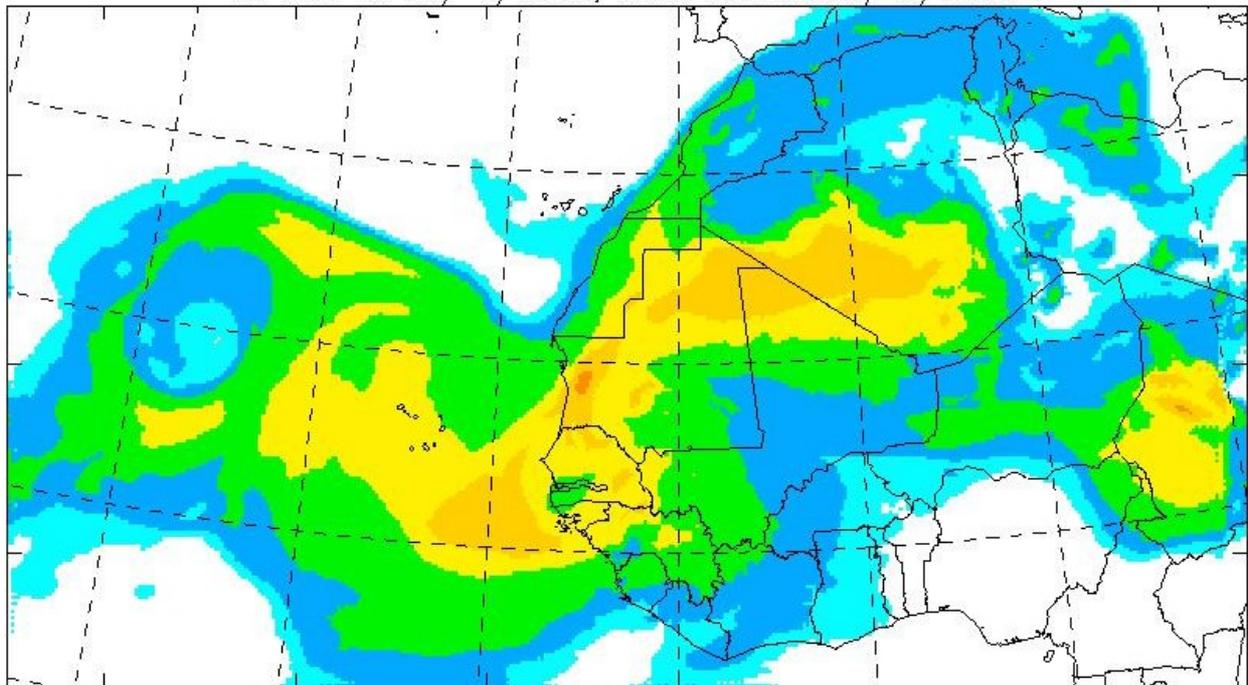
23z\_230806 AOD T+12

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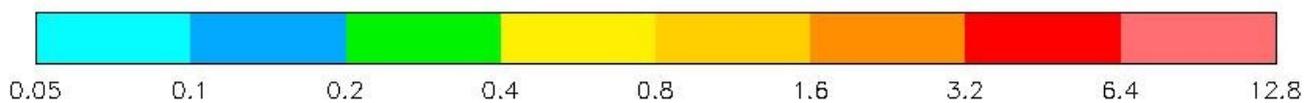
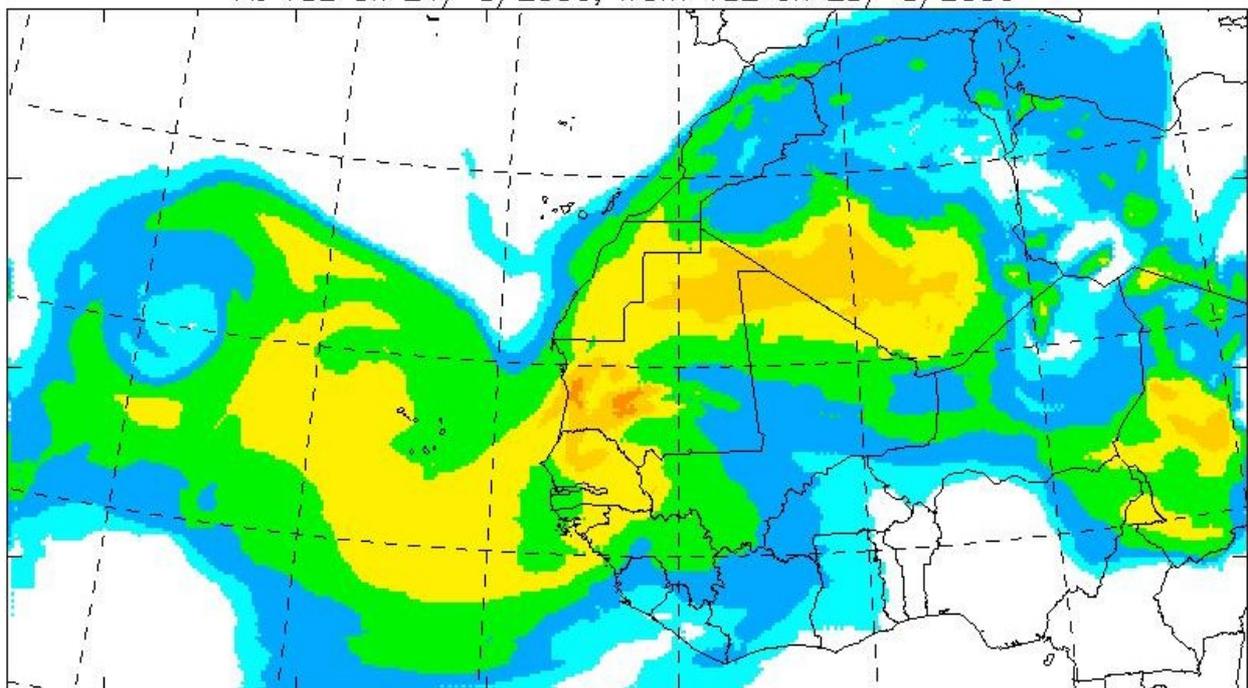
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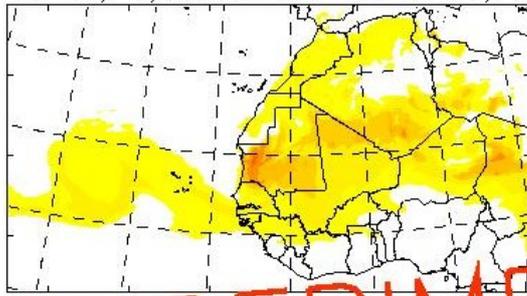
23z\_230806 AOD T+24

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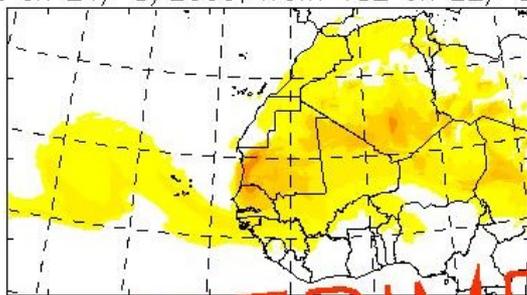
23z\_220806 Surface Dust concentration T+36

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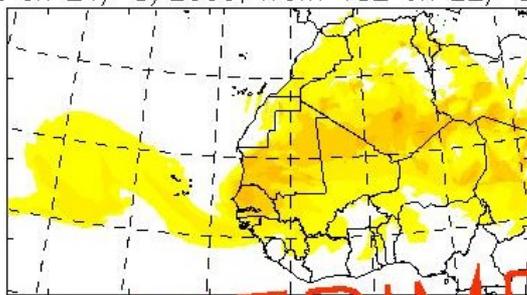
23z\_220806 Surface Dust concentration T+42

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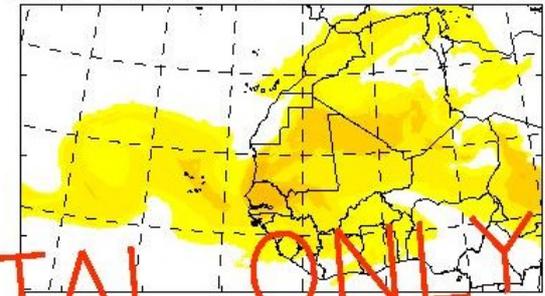


23z\_220806 Surface Dust concentration T+48

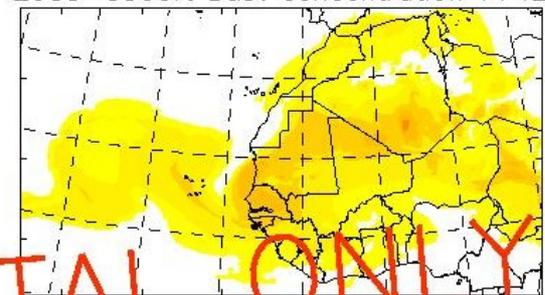
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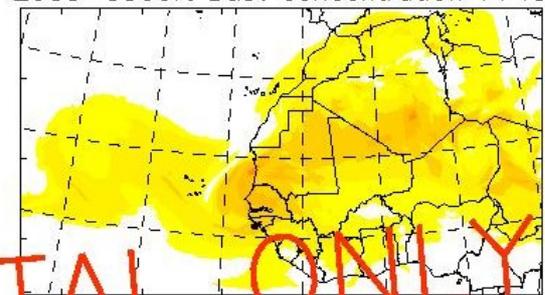
2000-5000ft Dust concentration T+36



2000-5000ft Dust concentration T+42



2000-5000ft Dust concentration T+48



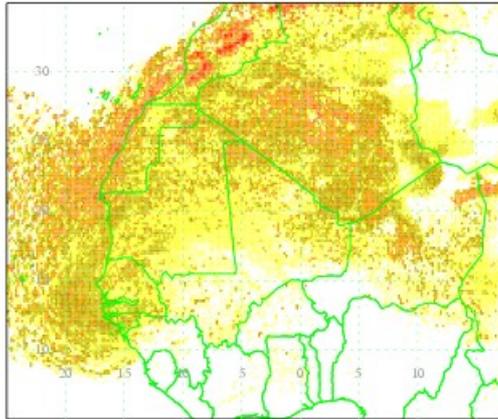
EXPERIMENTAL ONLY

NAME version 814

Sahara forecast

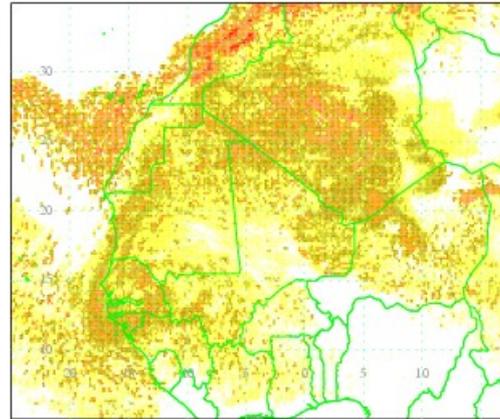
Valid at 1300UTC 24/08/2006

From 2000 – 5000 ft agl Air concentration



Maximum value =  $3.94 \times 10^{-2}$  g/m<sup>3</sup>  
1.00e-07 1.00e-05 1.00e-03 1.00e-01 1.00e+01

From 5000 – 10000 ft agl Air concentration



Maximum value =  $3.54 \times 10^{-2}$  g/m<sup>3</sup>  
1.00e-07 1.00e-05 1.00e-03 1.00e-01 1.00e+01

Start of release: 0600UTC 29/06/2006  
End of release: 0000UTC\_07/01/1957  
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Release location: multiple sources  
Release heights : \*\*\*\*\* to 0m agl

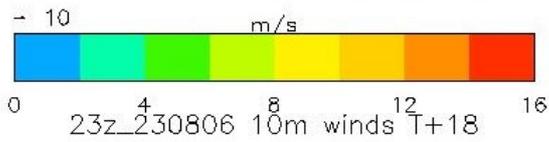
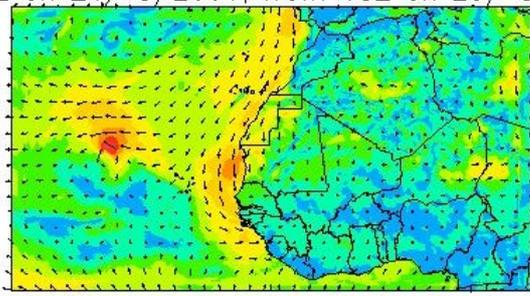
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Met data: Mesoscale  
Run time: 0035UTC 24/08/2006

Met Office (GMR) Crown copyright

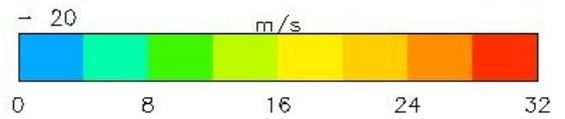
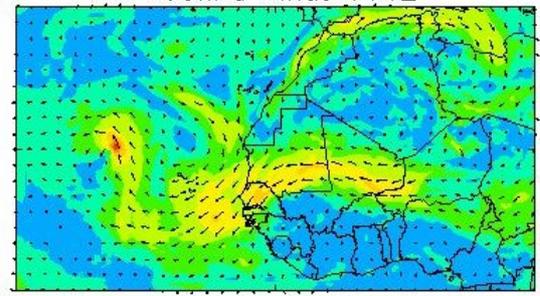
DODO2 Summary Document

23z\_230806 10m winds T+12

At 06Z on 24/ 8/2006, from 18Z on 23/ 8/2006

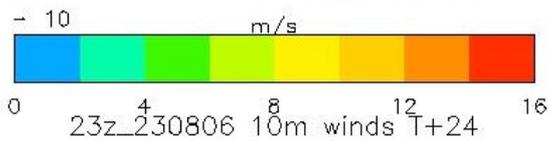
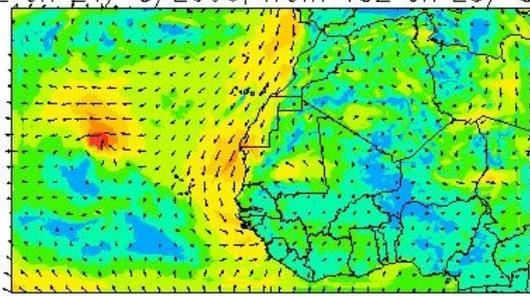


700hPa winds T+12

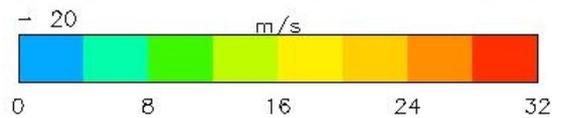
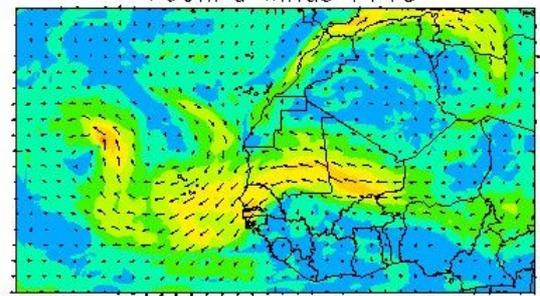


23z\_230806 10m winds T+18

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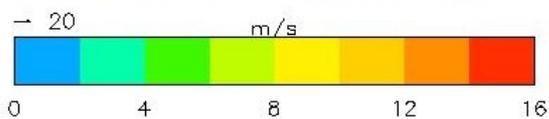
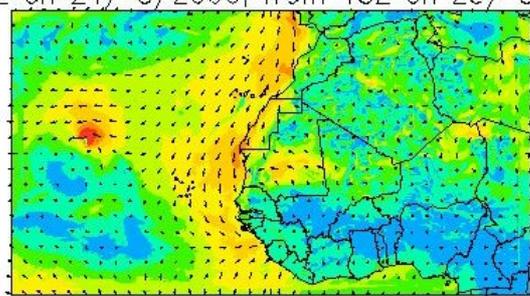


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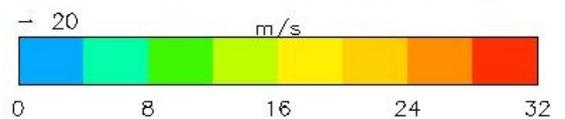
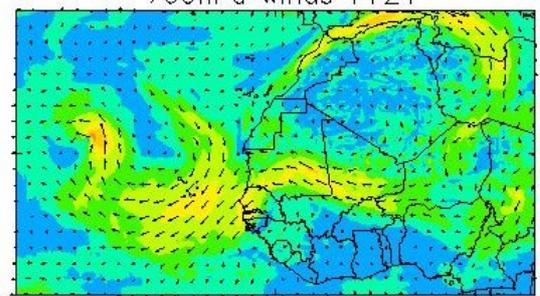


23z\_230806 10m winds T+24

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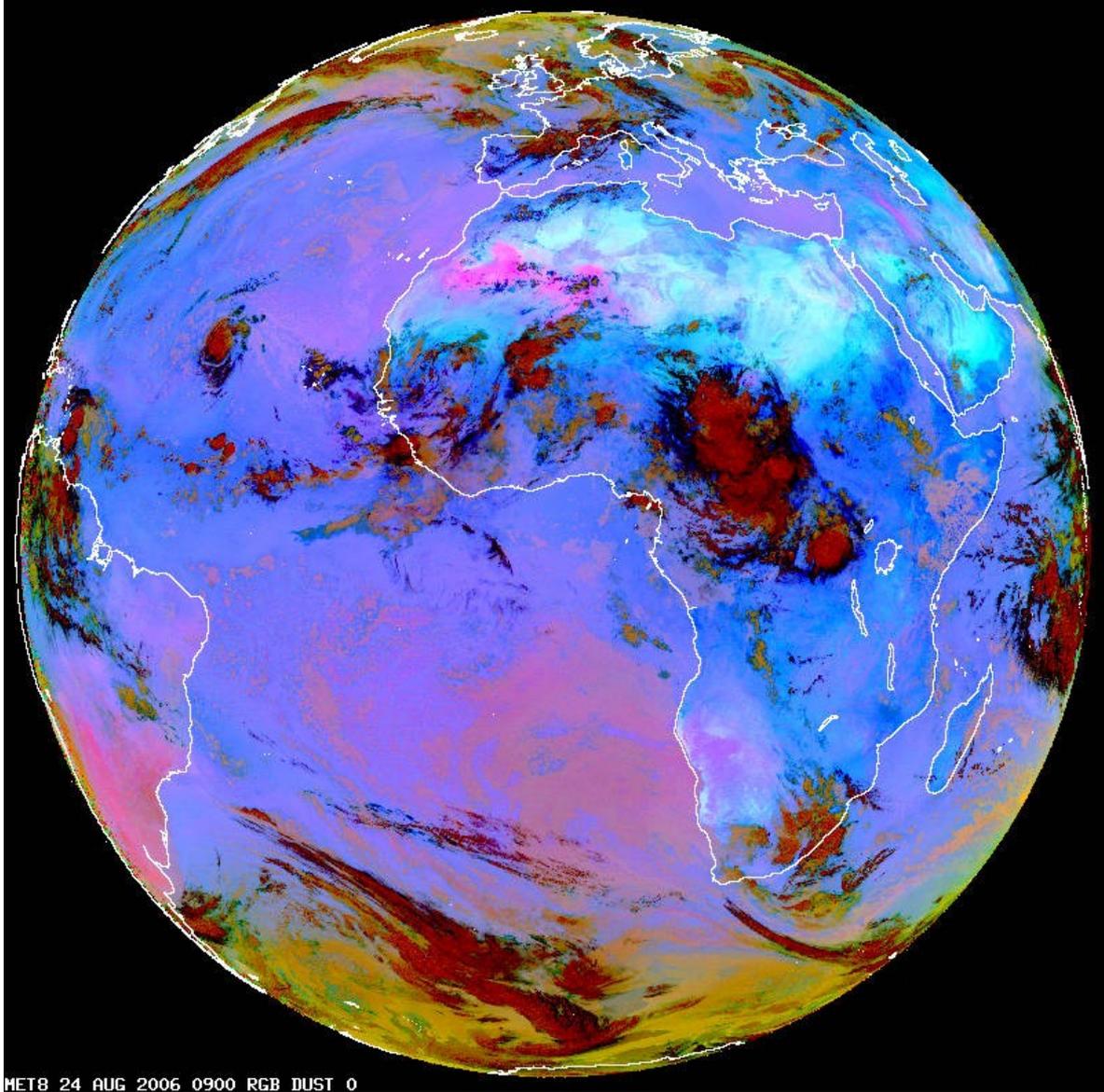
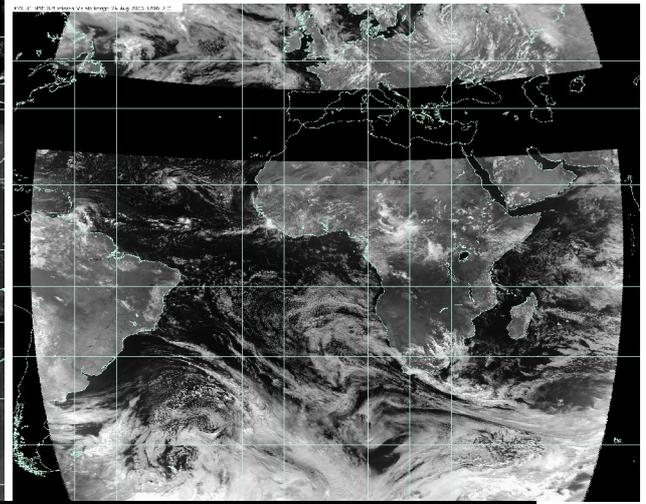
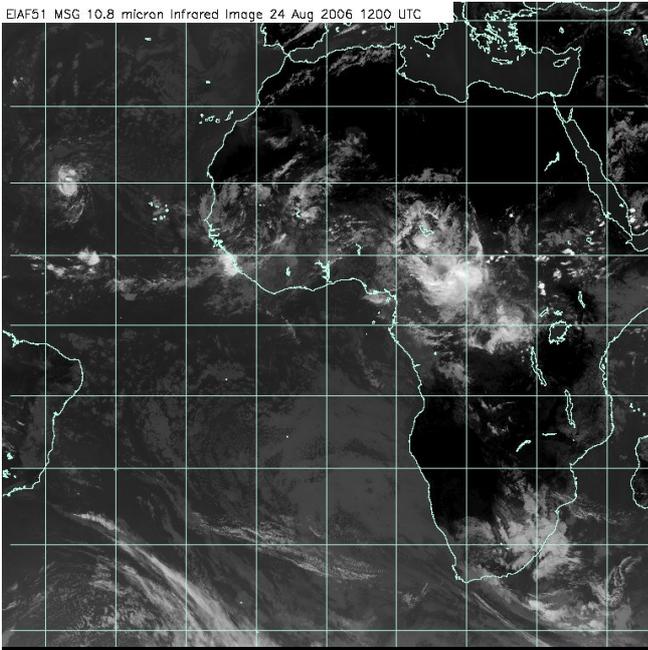


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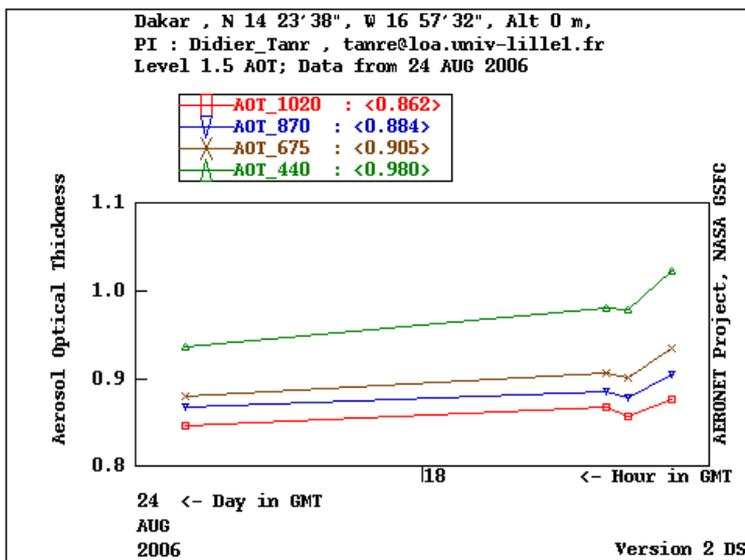
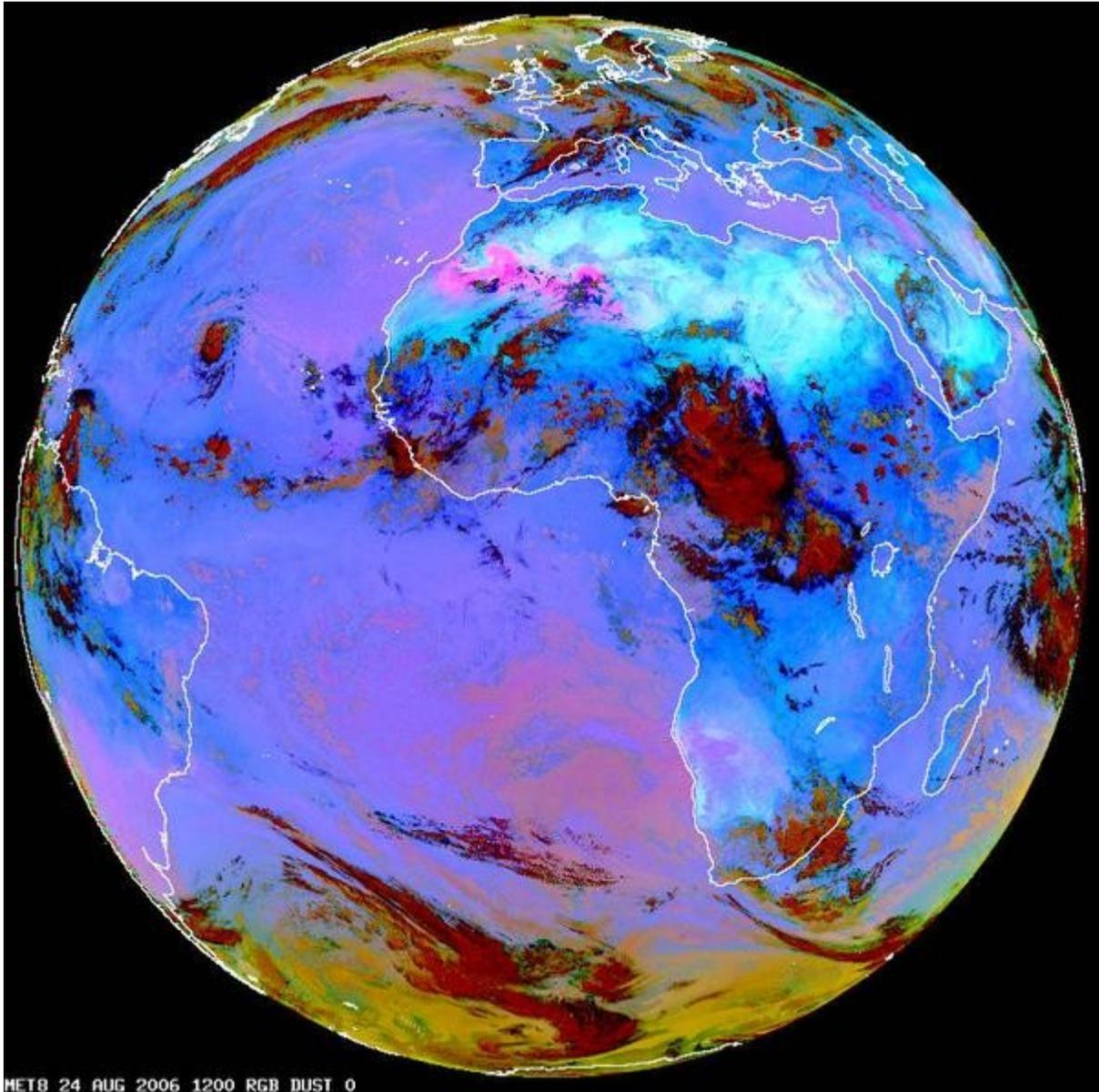


DODO2 Summary Document

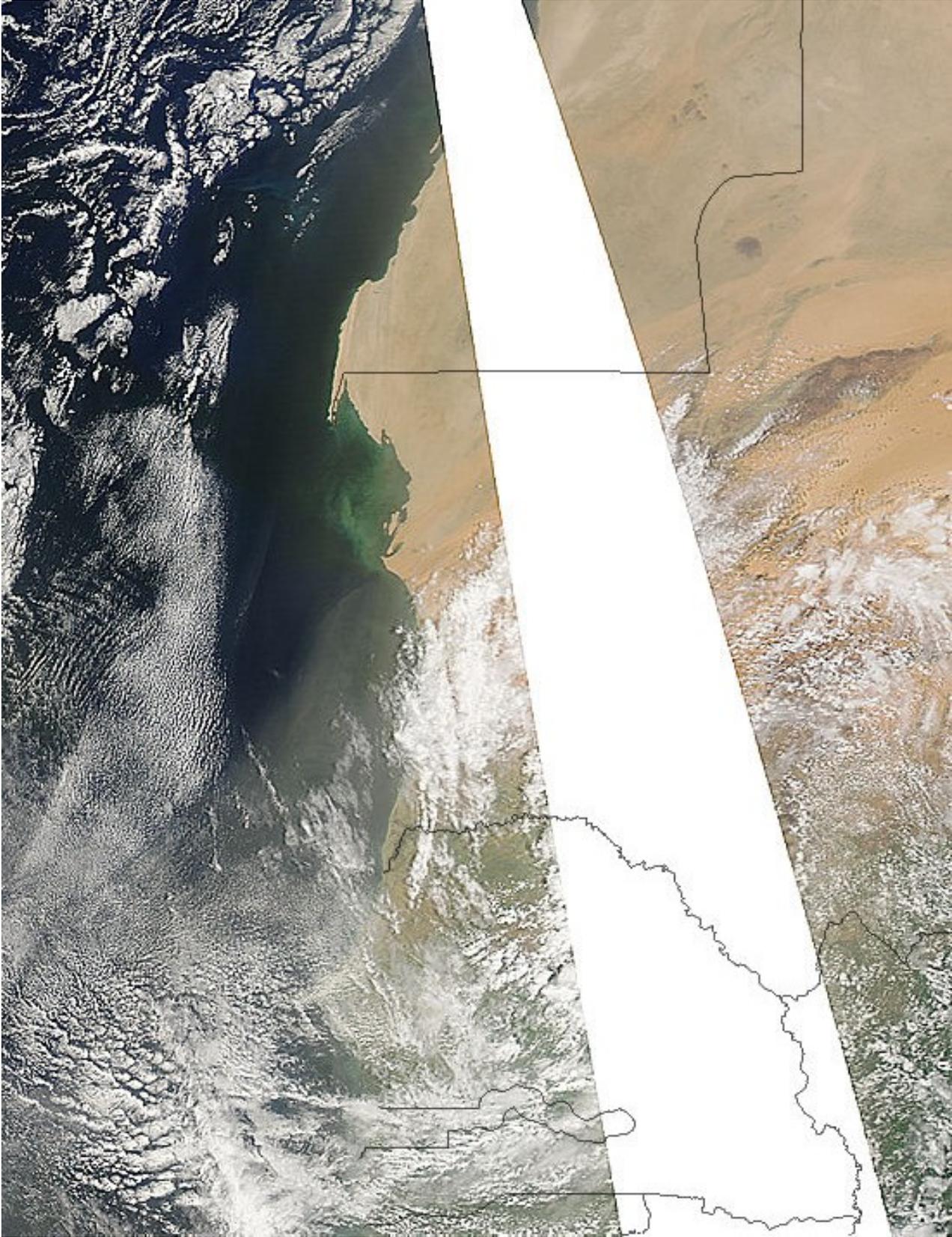
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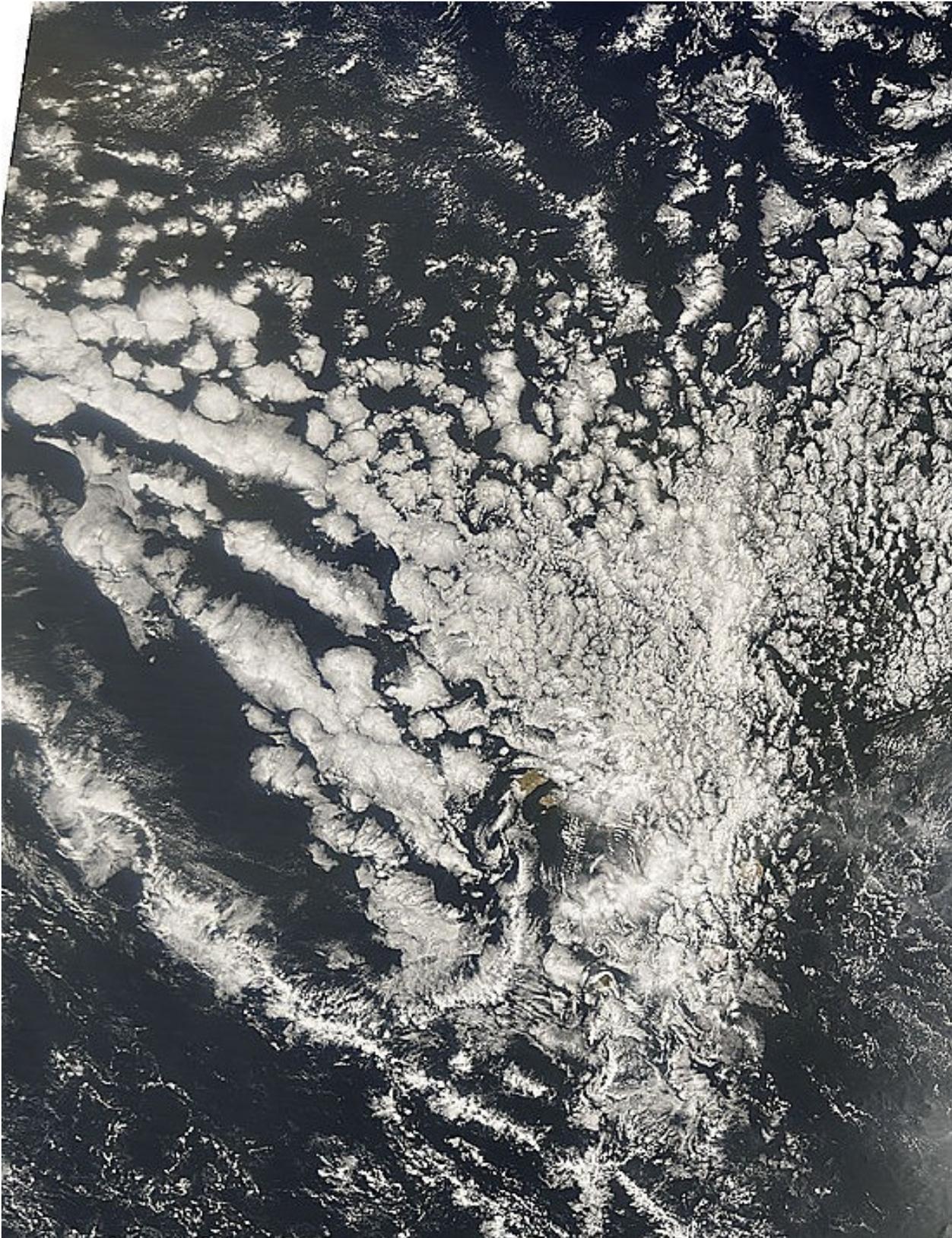


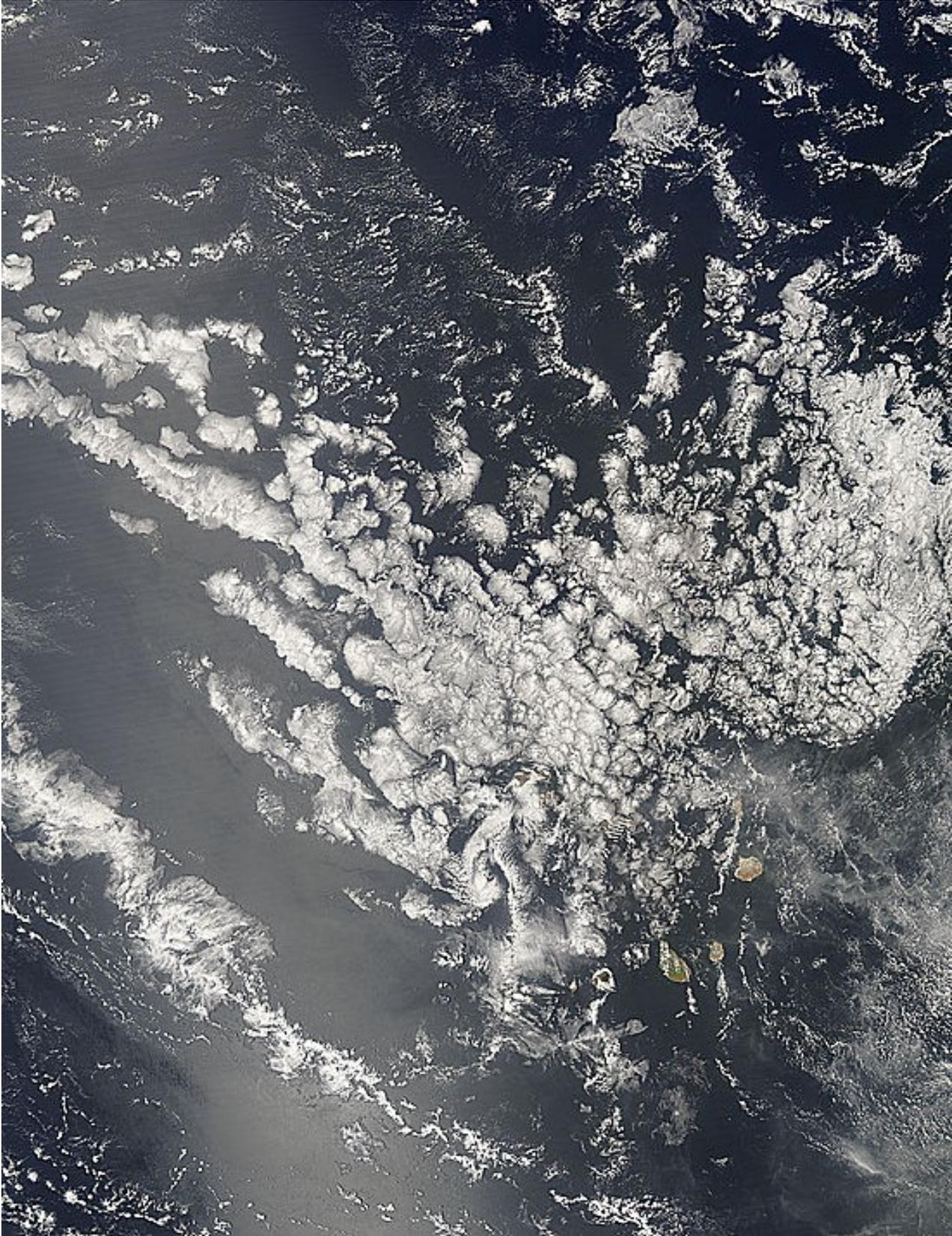
MET8 24 AUG 2006 0900 RGB DUST 0

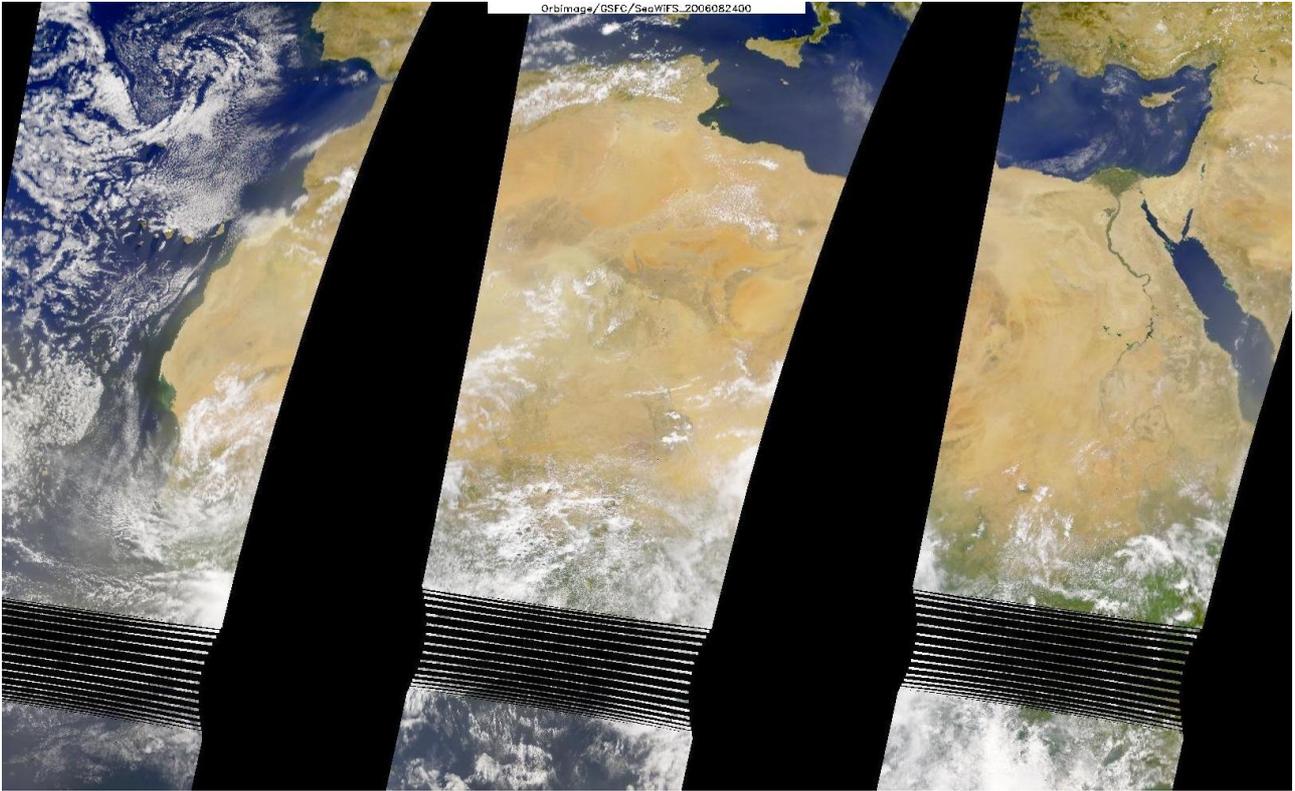




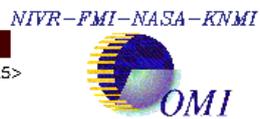
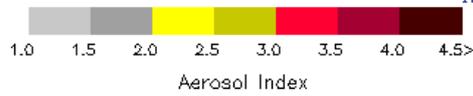
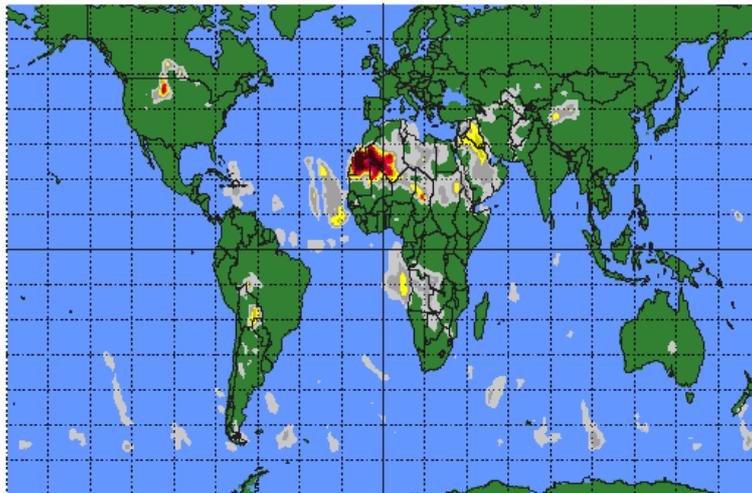








OMI Aerosol Index  
on August 24, 2006



## **B240: Mapping Coastal Dust to North**

Flight Number: B240

Date: 24th August 2006

Mission: Ellie Highwood

Sortie Objectives: Mapping of dust in-situ to north of Dakar (for comparison with B239 to south). Radiation work in gap between encroaching cirrus and cloud streets.

Operating area:

Over ocean area off the Senegal and Mauritania coast, originally up to 18,30N, 1640W. Coastal region between Nouadibhou and Nouackchott.

Weather: Cloud throughout southern part of area and to east and west. Small cloud free region found over ocean.

Flight Patterns:

Profile from Dakar take off at ~1530 showed cloud between 1200ft and 3000ft. Some haze (neph 30Mm-1) above cloud. No sign of previously observed layer at FL065. Cirrus above the profile. CuNbs to east mark encroaching convection line. Cloud to west also. A SLR at FL210 is unlikely to be useful for radiation work due to cloud contamination. Towards the end of the run the cirrus did decrease and a radiative effect of around 60Wm<sup>-2</sup> was observed. A profile descent to 100ft showed moderate dust between FL150 and FL080 below which there was a clear blue slot. Some indication of non spherical particles at FL045. Sea state was around 3 with lots of whitcaps.

Having found very little dust, the sortie brief was abandoned and a profile to FL050 was carried out towards the coast. A sawtooth pattern was then begun towards the coast and then proceeding south along it. During this, layers were observed at 3500ft and FL050. PSAP had a logging problem for part of this flight. The top of the sawtooth was at FL120. Much air traffic control manouvering was necessary on the descent down around Nouackchott. Dust was only found in any great quantity at around 1000ft along the coast line so an SLR was carried out following the coastline. (Note this would be good to compare with B173). The nephelometer maximum was only 80 Mm-1. A further profile ascent was followed by an in-situ sampling run at FL065 where relatively little dust was found. A final profile climb was made to FL220 before returning to Dakar.

Summary:

A frustrating in-situ flight with little opportunity for radiation. Some radiative work at northern most end but little dust compared to previous flights. What dust was present was in patchy and very thin layers that made in-situ work very difficult. Consistent with findings to the south in B239 too.

Problems

SWS intermittent

Lower SHIMs has a shutter problem allowing only one module at a time.

Lower pyrgeometer still not working.

Neph needs calibrating? Blue scattering is very low all the time.

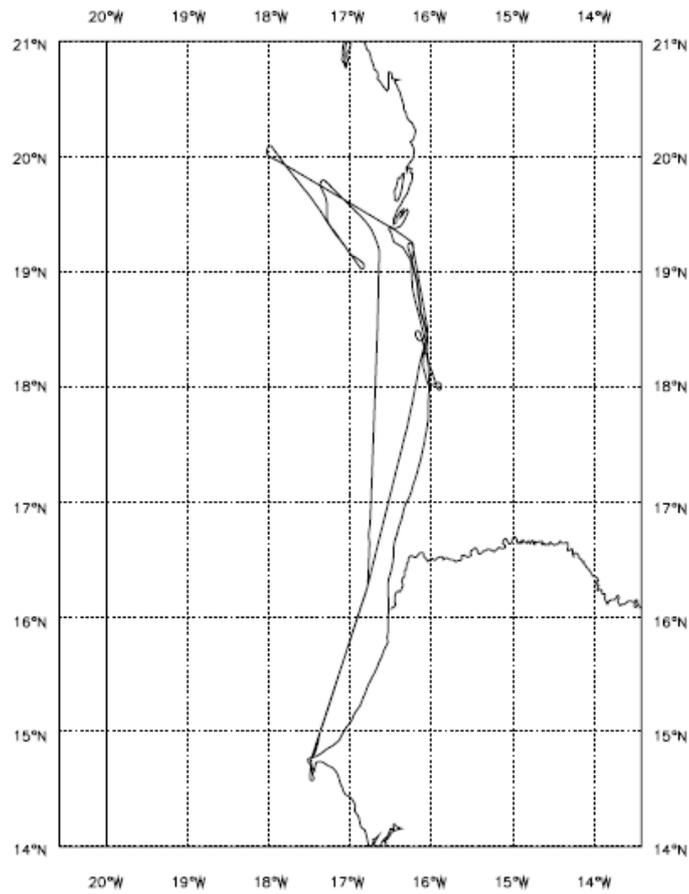
PSAP stopped logging for part of the run.

Flow rates may need re-calibration on neph and psap.

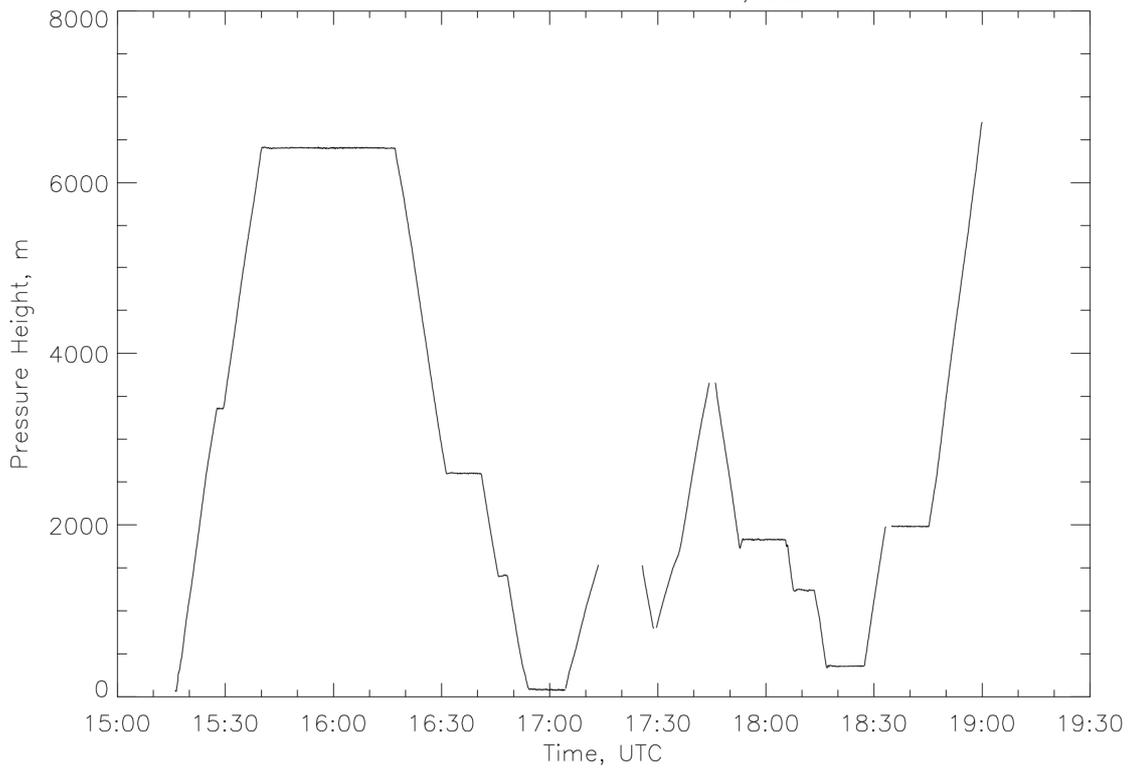
DODO2 Summary Document

Start Time	End Time	Event	Height (s)	Hdg	Comments
150429		engines start	0.22 kft	334	
150818		inu to nav	0.22 kft	337	
150823		taxy	0.22 kft	344	
151600	154006	Profile 1	0.24 - 21.0 kft	352	
151619		T/O	0.22 kft	353	from Dakar
152741		Profile 1	11.0 kft	22	interrupt
152919		Profile 1	11.0 kft	22	resume
154006	161702	Run 1	21.0 kft	27	
154050		Sonde 1	21.0 kft	27	
154118		bbr	21.0 kft	27	shutter up (U)
154805		jw nevz zero	21.0 kft	353	
161054		Sonde 2	21.0 kft	8	
161702	165417	Profile 2	21.0 - 0.29 kft	7	
162255		bbr	16.1 kft	321	shutter down (D)
162326		bbr	15.6 kft	317	U
163126		Profile 2	8.5 kft	309	interrupt
164059		Profile 2	8.5 kft	133	resume
164139		bbr	8.0 kft	132	shuts discount (JH)
164545		Profile 2	4.6 kft	134	interrupt
164813		Profile 2	4.6 kft	302	resume
165258		Profile 2	0.94 kft	317	500ft/min
165417	170416	Run 2	0.29 - 0.27 kft	316	
170425	171333	Profile 3	0.31 - 5.0 kft	314	3
170609		qnh	1.3 kft	319	1009
172536	172851	Profile 4	5.0 - 2.6 kft	110	
172936	174417	Profile 5	2.6 - 12.0 kft	109	
170000	173600	PSAP	7.3 kft	109	stop logging
174556	181649	Profile 6	12.0 - 5.7 kft	185	
175241		Profile 6	6.0 kft	156	interrupt
180522		Profile 6	6.0 kft	152	resume
180743		Profile 6	4.1 kft	152	interrupt
181320		Profile 6	4.1 kft	341	resume
181649		Profile 6	1.1 kft	20	real end
181649	182716	Run 3	1.2 kft	19	
182717	183315	Profile 7	1.2 - 6.5 kft	348	
183454	184505	Run 4	6.5 kft	157	
184505	190000	Profile 8	6.5 - 22.0 kft	161	
184000	184400	PSAP	12.4 kft	188	stopped loggig
193645		Land	0.23 kft	349	At Dakar

### B240 Track 24-AUG-06



Run and Profile Altitudes, b240



## **B241: Intercomparison Flight**

Flight Number: B241

Date: 25th August 2006

Mission: Ellie Highwood

Sortie Objectives: Intercomparison with NASA DC-8. Formation in-situ sampling at levels determined by US Lidar, radiation work.

Operating area:

Originally along N-S line, 16N,1830W and 19N,1830W. Then in region near GUNET.

Weather: Extensive convective cloud between Dakar and around 19N. Relatively little dust in thin layers. Mostly to north of region.

Flight Patterns:

An early take off allowed plenty of time for an ascent to FL050 and then a descent to 50 ft over the ocean and a profile climb towards the rendezvous point at FL180, 16N:18,30W. This profile showed considerable convective cloud with StCu below between 1500 and 2500 ft. Another cloud level around 5000ft. Sea salt sampled (with blue neph reading high) in bottom 500ft of profile. Cloud top towards rendezvous point around FL150 although cirrus above. Dewpoints artificial at this point in the profile. After rendezvousing with the DC-8 we flew in formation and descended to FL070 which showed little dust. Nephelometer readings (submicron only) around 30Mm-1, increasing slightly to the north. An in-situ run at FL070 was carried out, followed by an in-situ run at FL080. These runs took us substantially further north than the original plan so we broke from the formation at this point. Since the area was relatively cloud free, a broken profile ascent to FL220 was performed in the cloud free area followed by a box pattern with 5 minute legs, into, across, down and across sun. Two legs had SHIMS upper and two SHIMS lower. The SWS was ramped on the into sun leg, but visible module dropped out in down sun leg. One orbit at 57 degrees (7 over SZA) was performed before SWS dropped out again. A profile descent was completed to 2000ft towards the coast and Dakar (due to lack of fuel and dust and the presence of considerable cloud, no underflying of DC-8 line was completed.) Nouackchott was reporting blowing sand, but no outflow over ocean was observed. Multiple and thick cloud including CuNbs on way back.

Summary:

A successful in-situ intercomparison with the DC-8. Frustratingly little radiation work in conjunction with them due to cloud contamination on route. Also rather little dust, except possibly to the far north. Some radiometer calibrations completed.

Problems

SWS intermittent

Lower SHIMS has a shutter problem allowing only one module at a time.

Lower pyrgeometer still not working.

Neph needs calibrating? Blue scattering is very low all the time.

PSAP stopped logging for part of the run.

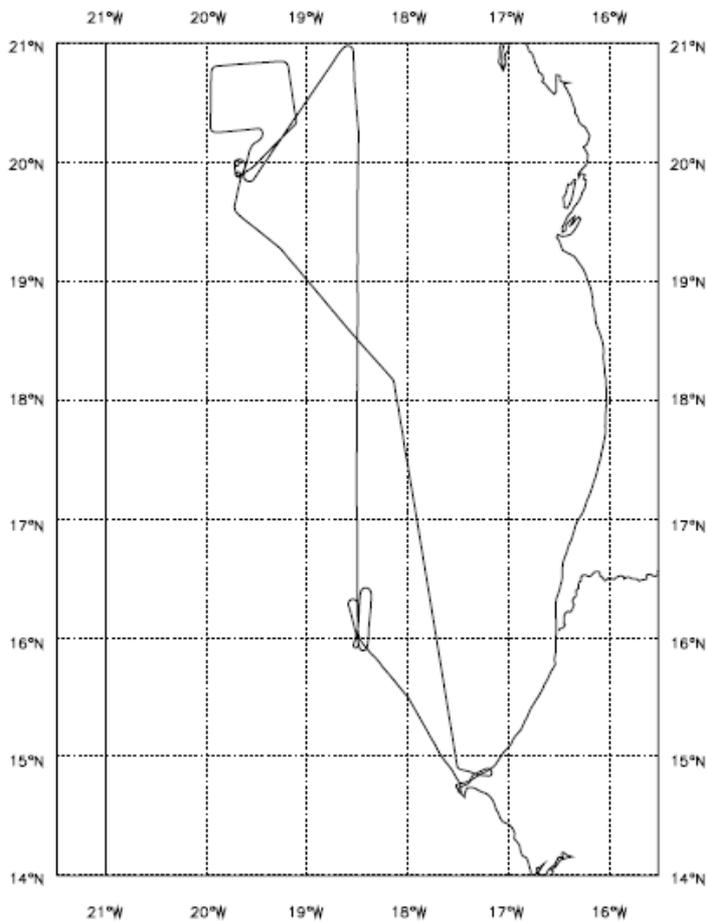
Flow rates may need re-calibration on neph and psap.

Frostpoint/dewpoint unreliable.

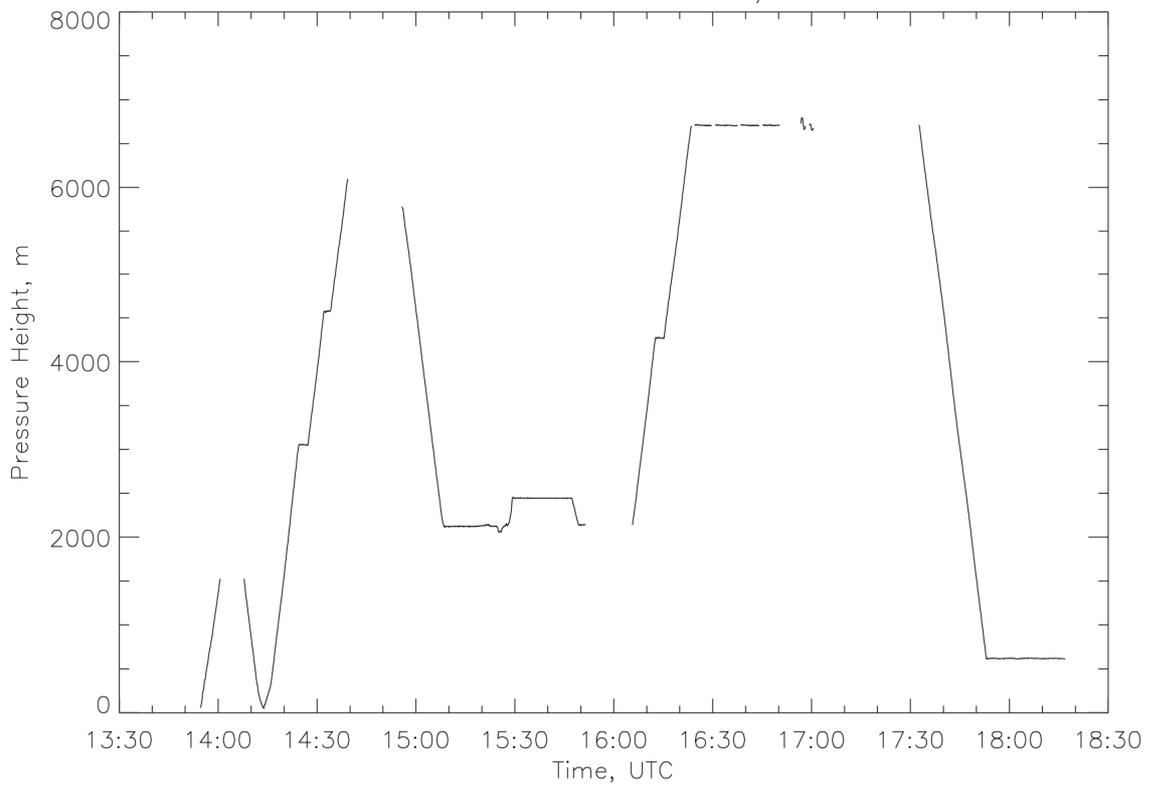
DODO2 Summary Document

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133944		inu to nav	0.22 kft	16	
134242		power change	0.23 kft	16	
134304		push back	0.22 kft	16	= taxi
135438		T/O	0.21 kft	353	
135438	140038	Profile 1	0.84 - 5.0 kft	329	
140748	141350	Profile 2	5.0 - 0.17 kft	327	
141350	143918	Profile 3	0.17 - 20.0 kft	316	
142431		Profile 3	10.0 kft	6	interrupt
142709		Profile 3	10.0 kft	159	resume
143218		Profile 3	15.0 kft	162	interrupt
143400		Profile 3	15.0 kft	13	resume
144418		ge max cool	18.0 kft	183	
145006		ge max cool	18.5 kft	358	stopped
145024		NASA DC8	18.6 kft	359	link up
145209		ge	19.0 kft	1	still dew layer
145540	150912	Profile 4	18.9 - 7.0 kft	0	
150912	152806	Run 1	7.0 - 7.1 kft	3	start at p4 end
151347		bbr	7.0 kft	4	shutter up (U)
152806	152931	Profile 5	7.1 - 8.0 kft	8	
152931		Run 2	8.0 kft	5	
154709	154924	Profile 6	8.0 - 7.0 kft	0	
154924	155124	Run 3	7.0 kft	3	
155142		NASA DC8	7.1 kft	327	break away
160537	162332	Profile 7	7.0 - 22.0 kft	210	
161252		Profile 7	14.0 kft	210	interrupt
161515		Profile 7	14.0 kft	65	resume
162437	162937	Run 4.1	22.0 kft	355	cross sun
163054	163728	Run 4.2	22.0 kft	267	up sun
163837	164404	Run 4.3	22.0 kft	179	cross sun
164514	165019	Run 4.4	22.0 kft	91	down sun
165648	165808	Orbit 1	22.1 - 22.0 kft	342	
165919	170040	Orbit 2	22.0 - 21.9 kft	41	
173233	175250	Profile 8	22.0 - 2.2 kft	166	
175250	181651	Run 5	2.2 - 2.0 kft	169	
175348		qnh 1013	2.0 kft	169	
183200		Land	0.22 kft	353	

### B241 Track 25-AUG-06

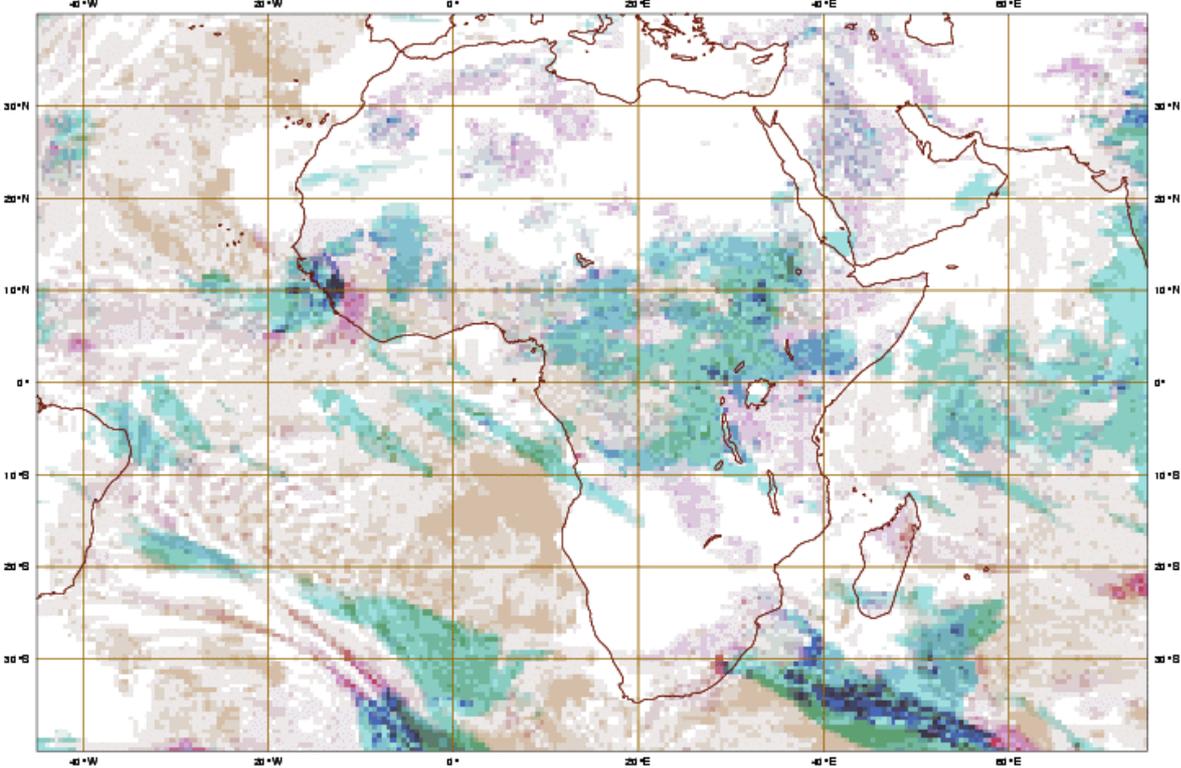


Run and Profile Altitudes, b241



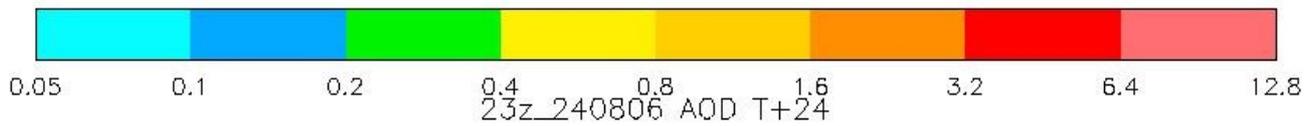
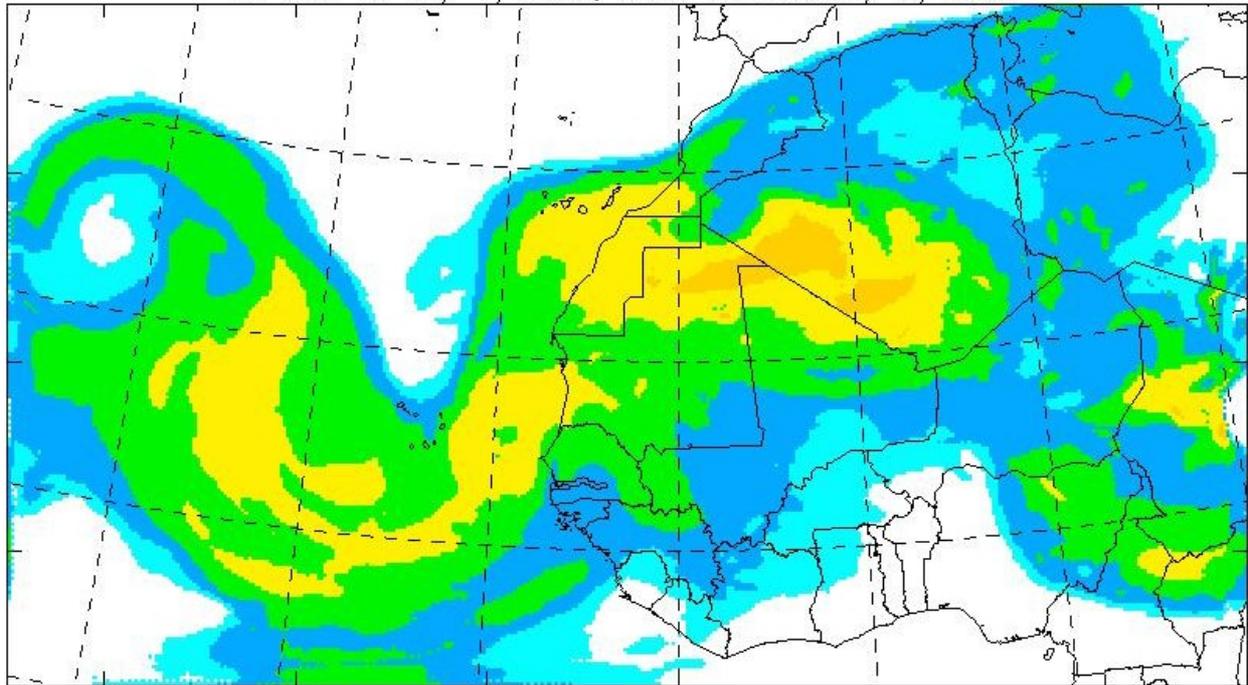
Friday 25 August 2006 00UTC ©ECMWF Forecast t+012 VT: Friday 25 August 2006 12UTC

Low, L+M, Medium, M+H, High, H+L, H+M+L clouds



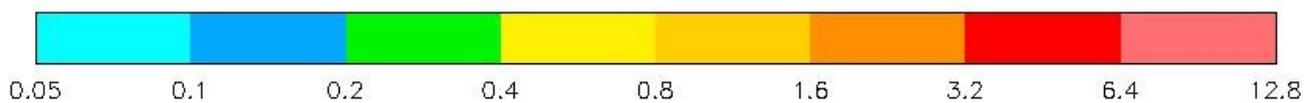
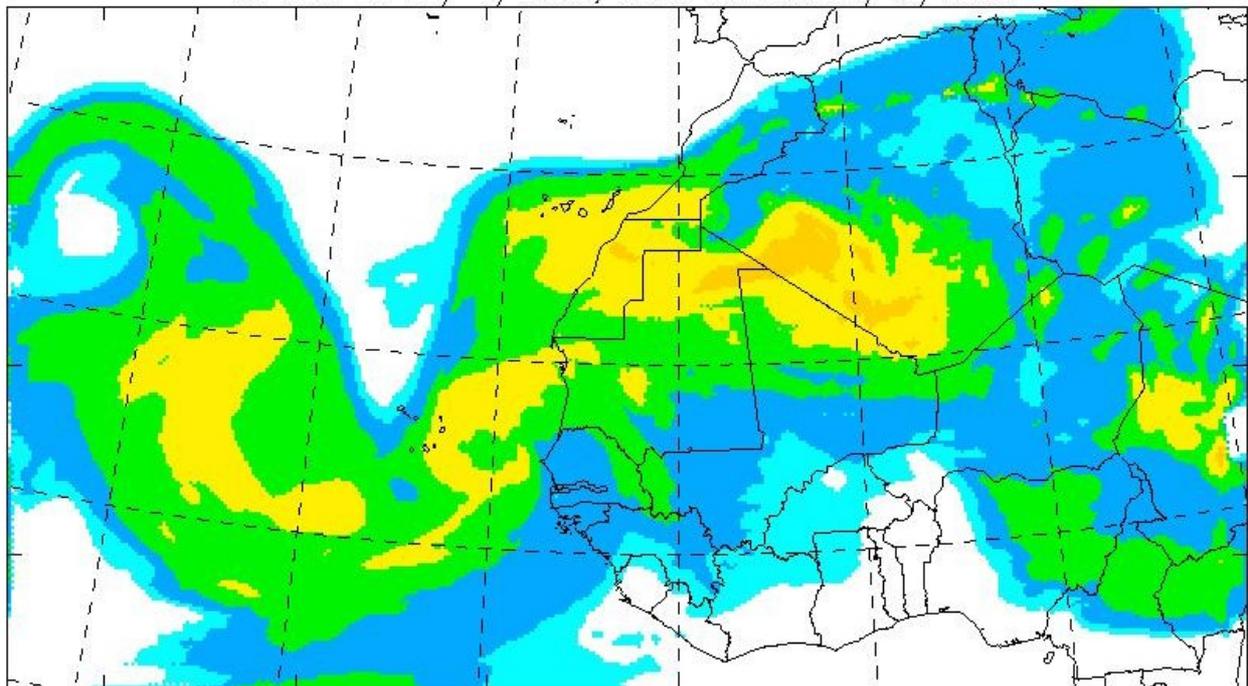
23z\_240806 AOD T+18

At 12Z on 25/ 8/2006, from 18Z on 24/ 8/2006



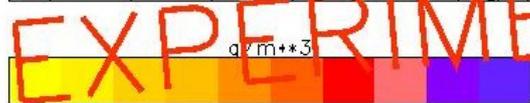
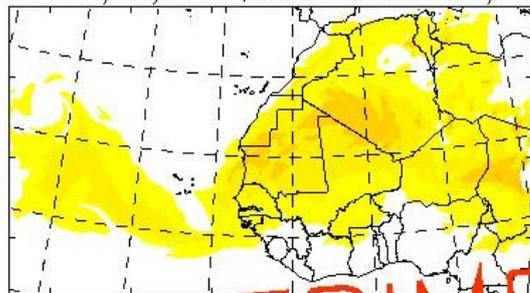
23z\_240806 AOD T+24

At 18Z on 25/ 8/2006, from 18Z on 24/ 8/2006



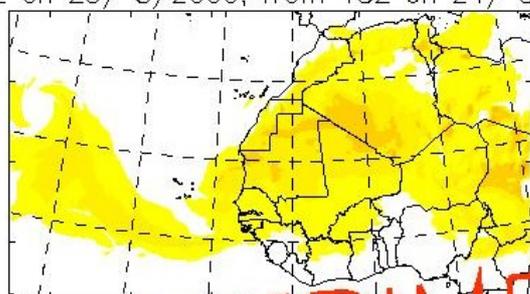
23z\_240806 Surface Dust concentration T+18

At 12Z on 25/ 8/2006, from 18Z on 24/ 8/2006



23z\_240806 Surface Dust concentration T+24

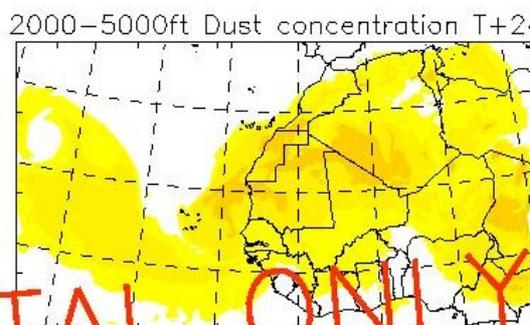
At 18Z on 25/ 8/2006, from 18Z on 24/ 8/2006



2000-5000ft Dust concentration T+18



2000-5000ft Dust concentration T+24



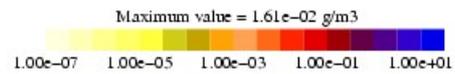
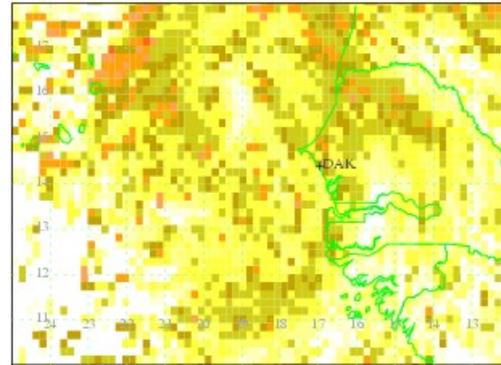
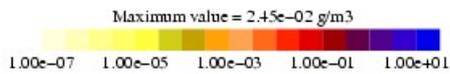
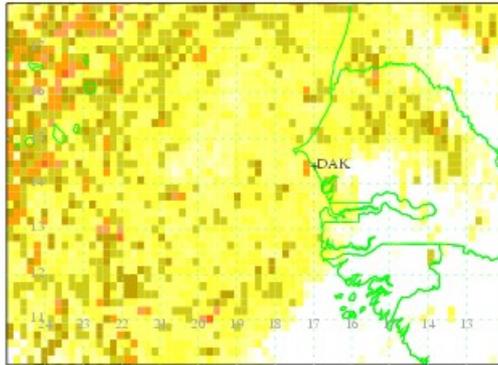
NAME version 814

Sahara forecast

Valid at 1200UTC 25/08/2006

From 2000 – 5000 ft agl Air concentration

From 5000 – 10000 ft agl Air concentration



Start of release: 0600UTC 29/06/2006  
End of release: 0000UTC\_07/01/1957  
Release rate: multiple sources  
Release location: multiple sources  
Release heights : \*\*\*\*\* to 0m agl

Pollutant: PM10\_MINERAL  
Met data: Mesoscale  
Run time: 0031UTC 25/08/2006

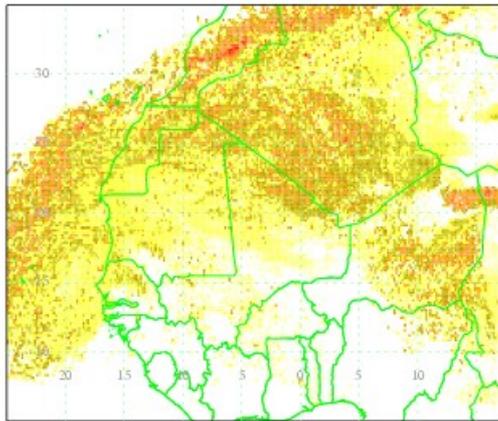
Met Office (GMR) Crown copyright

NAME version 814

Sahara forecast

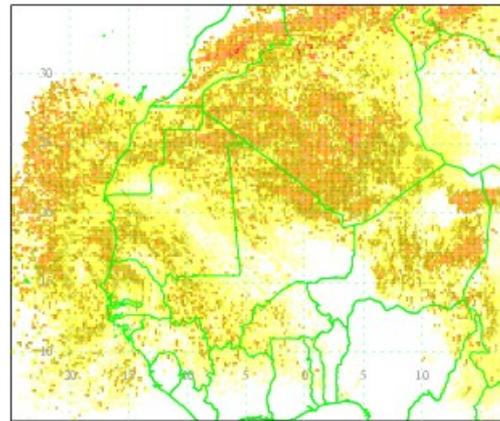
Valid at 1200UTC 25/08/2006

From 2000 – 5000 ft agl Air concentration



Maximum value = 2.45e-02 g/m3  
1.00e-07 1.00e-05 1.00e-03 1.00e-01 1.00e+01

From 5000 – 10000 ft agl Air concentration

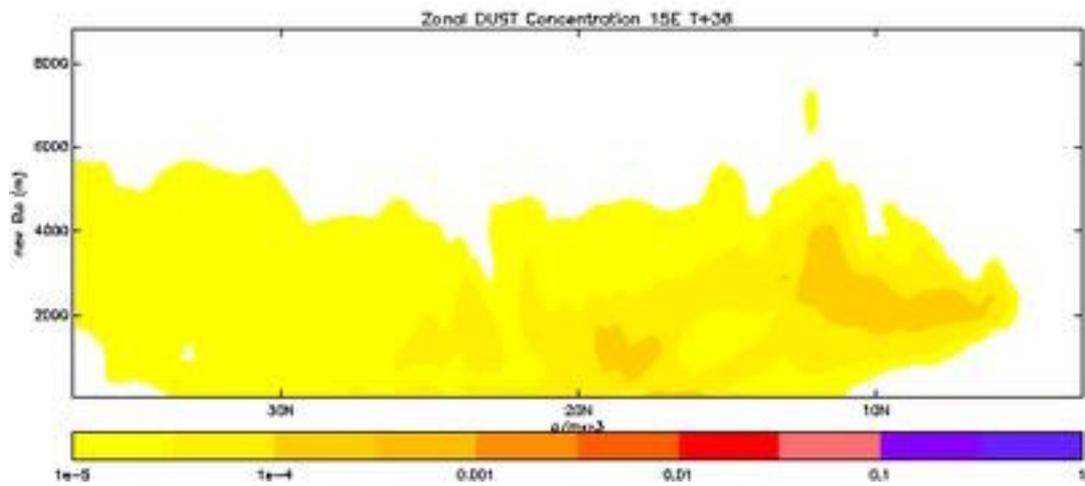
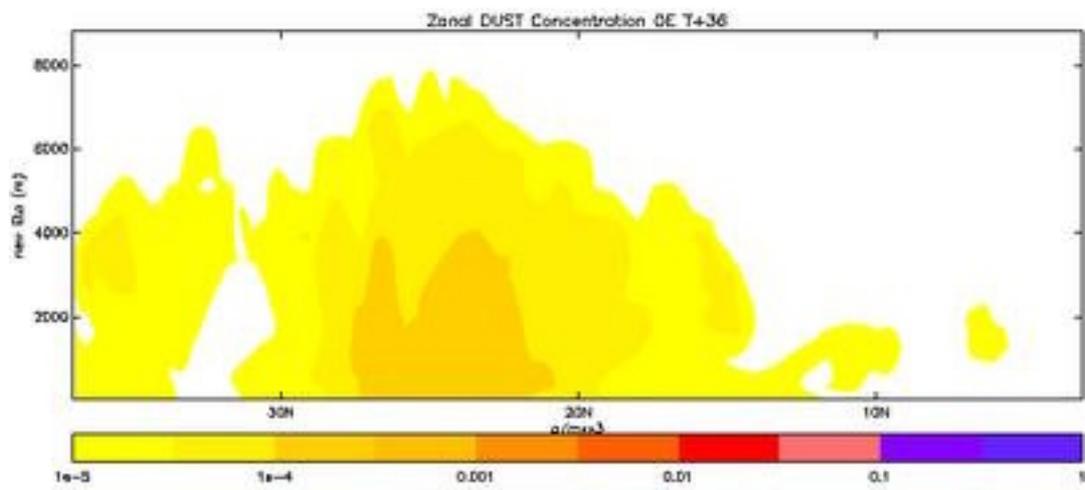
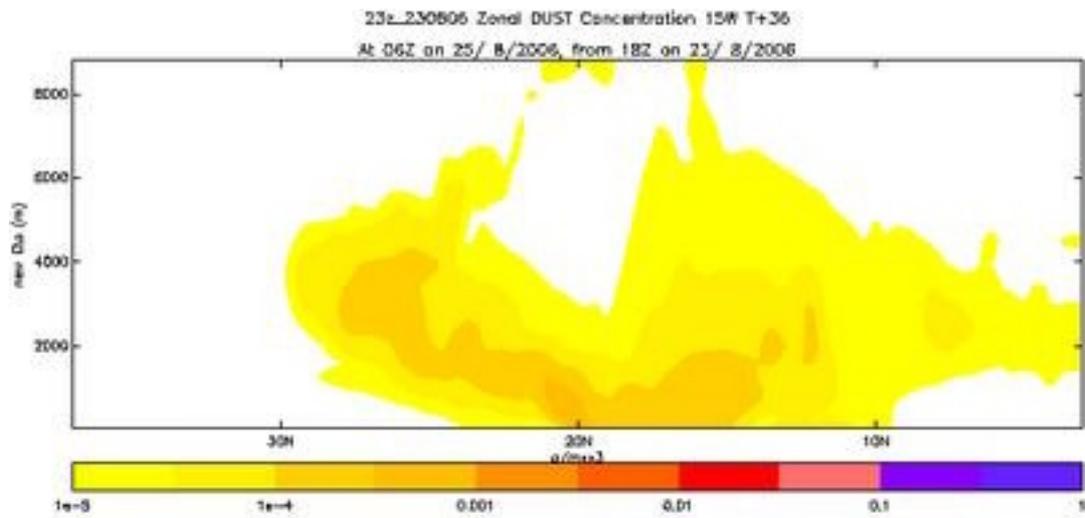


Maximum value = 1.61e-02 g/m3  
1.00e-07 1.00e-05 1.00e-03 1.00e-01 1.00e+01

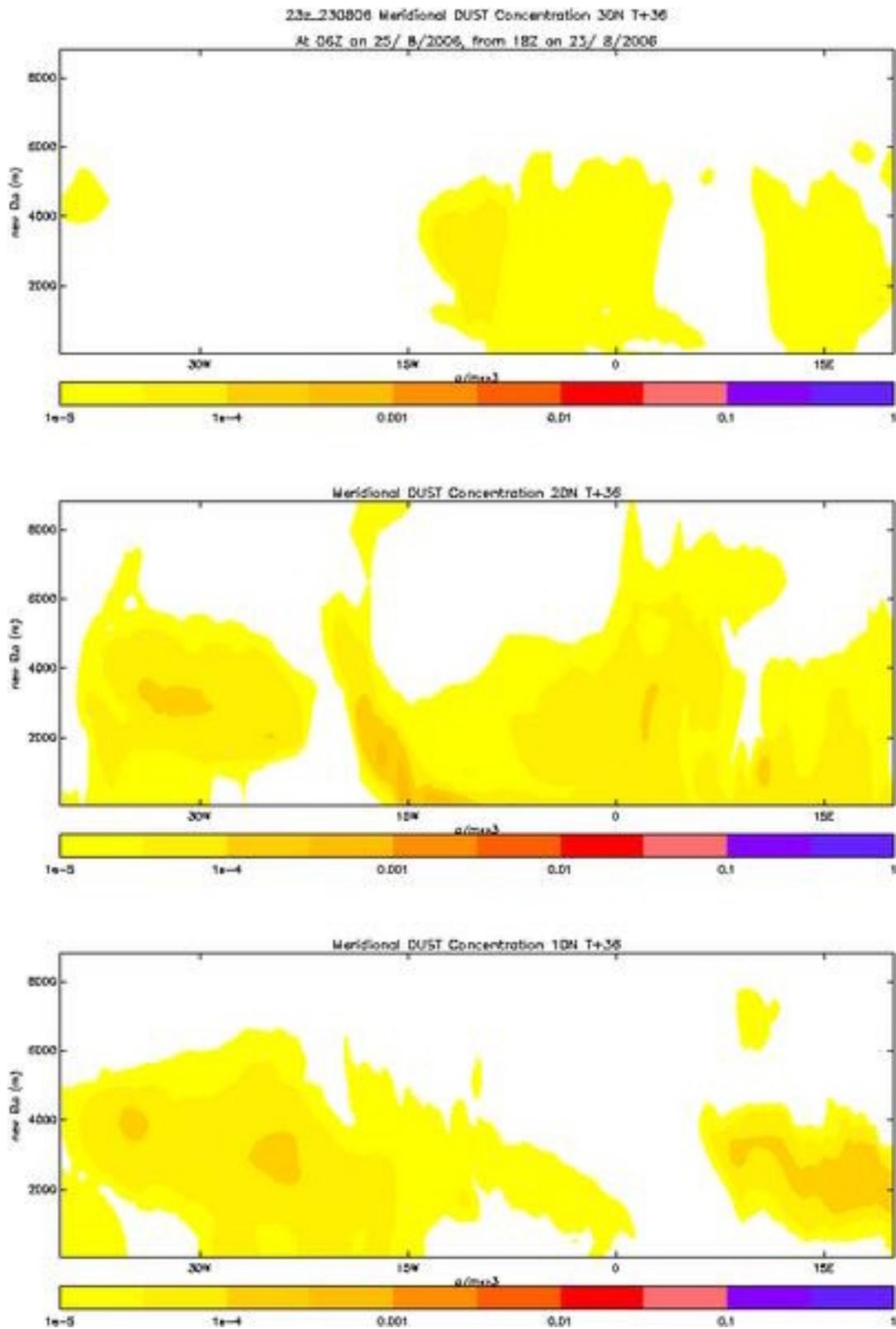
Start of release: 0600UTC 29/06/2006  
End of release: 0000UTC\_07/01/1957  
Release rate: multiple sources  
Release location: multiple sources  
Release heights : \*\*\*\*\* to 0m agl

Pollutant: PM10\_MINERAL  
Met data: Mesoscale  
Run time: 0031UTC 25/08/2006

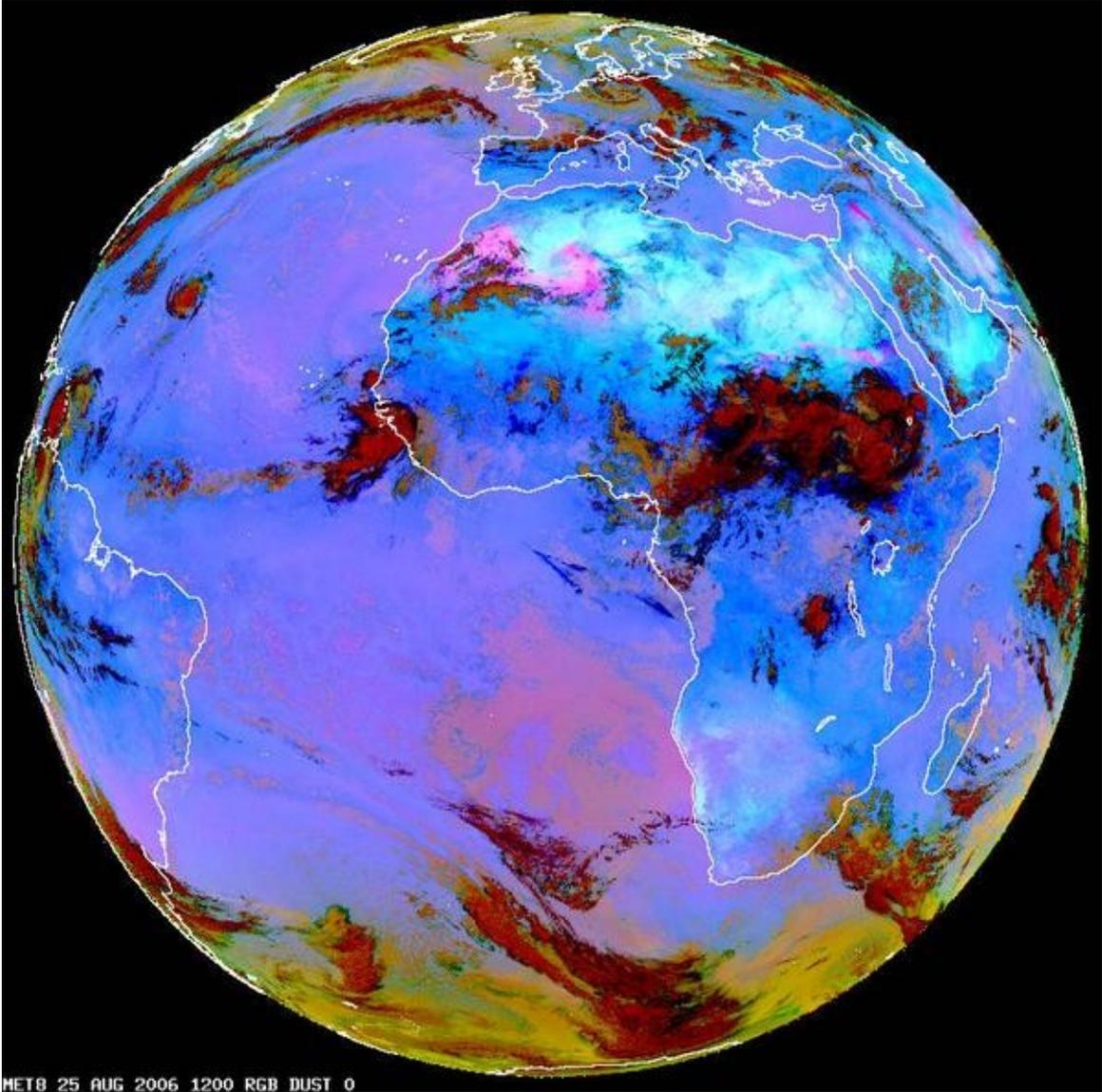
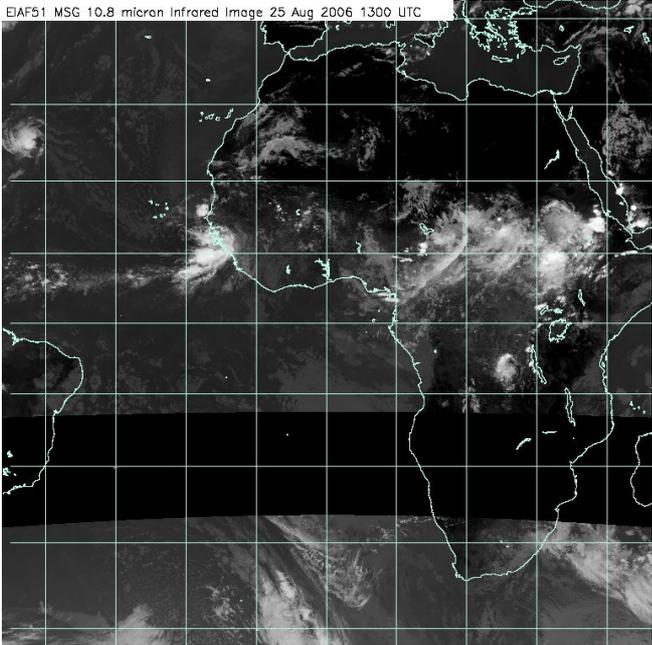
Met Office (GMR) Crown copyright

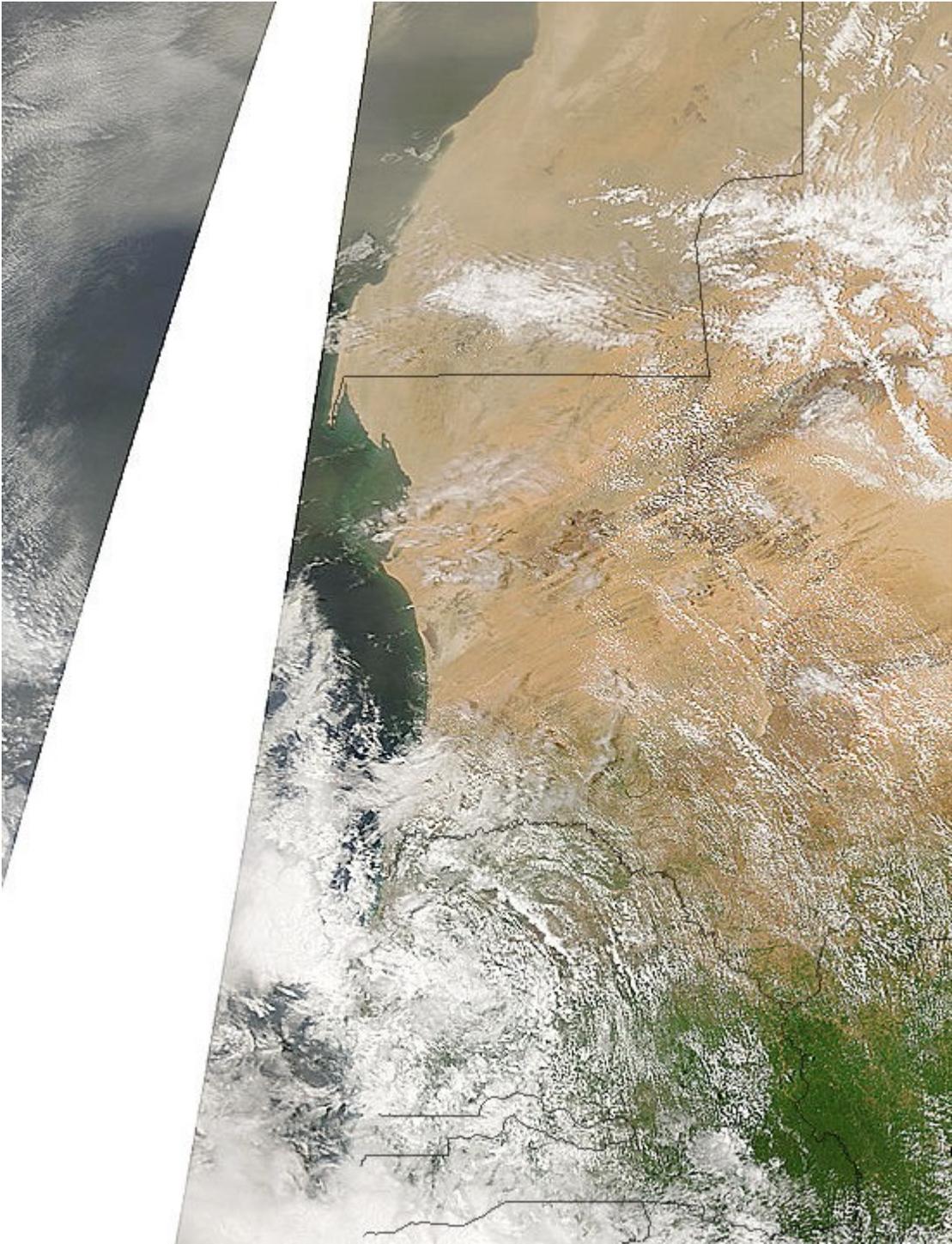


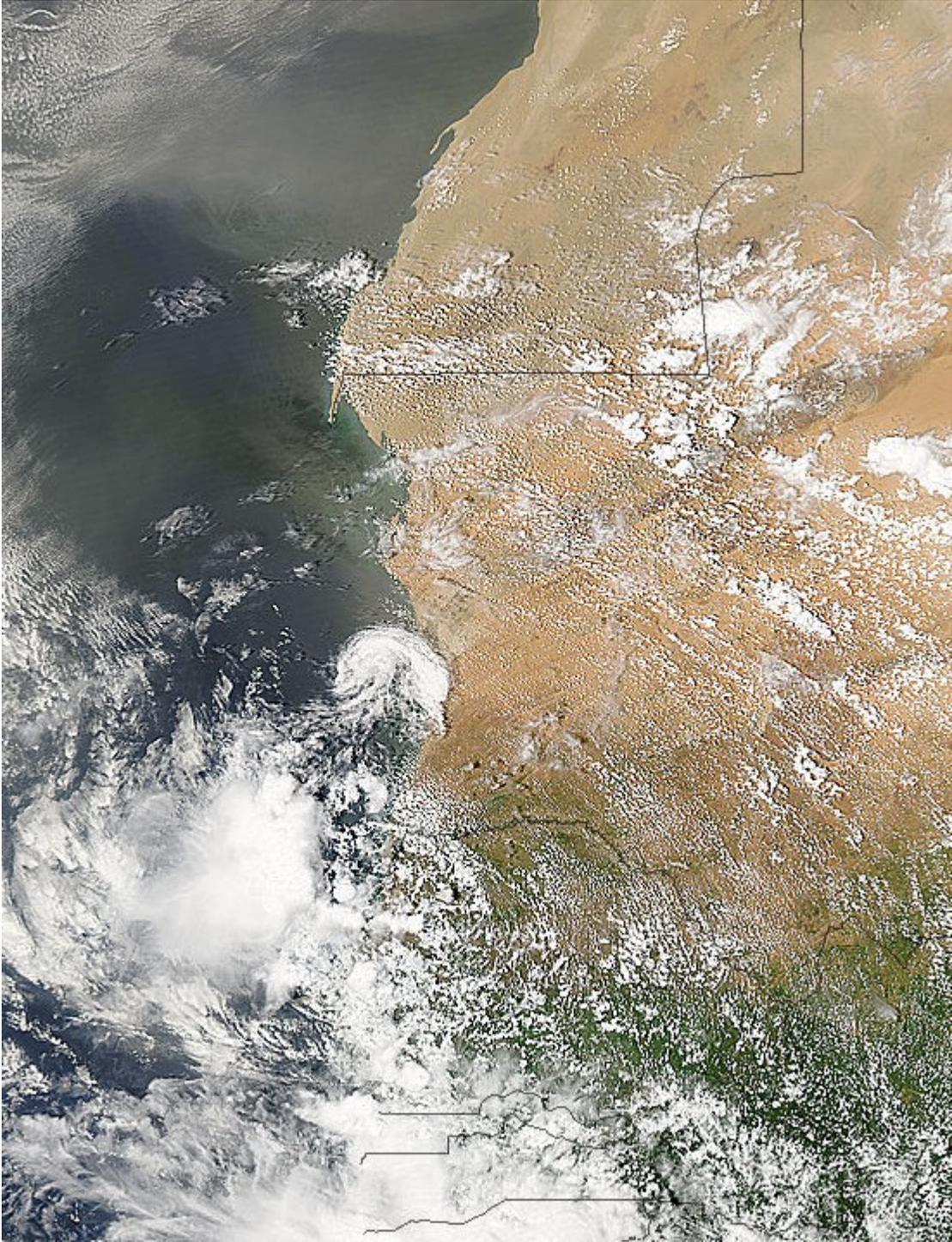
# DODO2 Summary Document



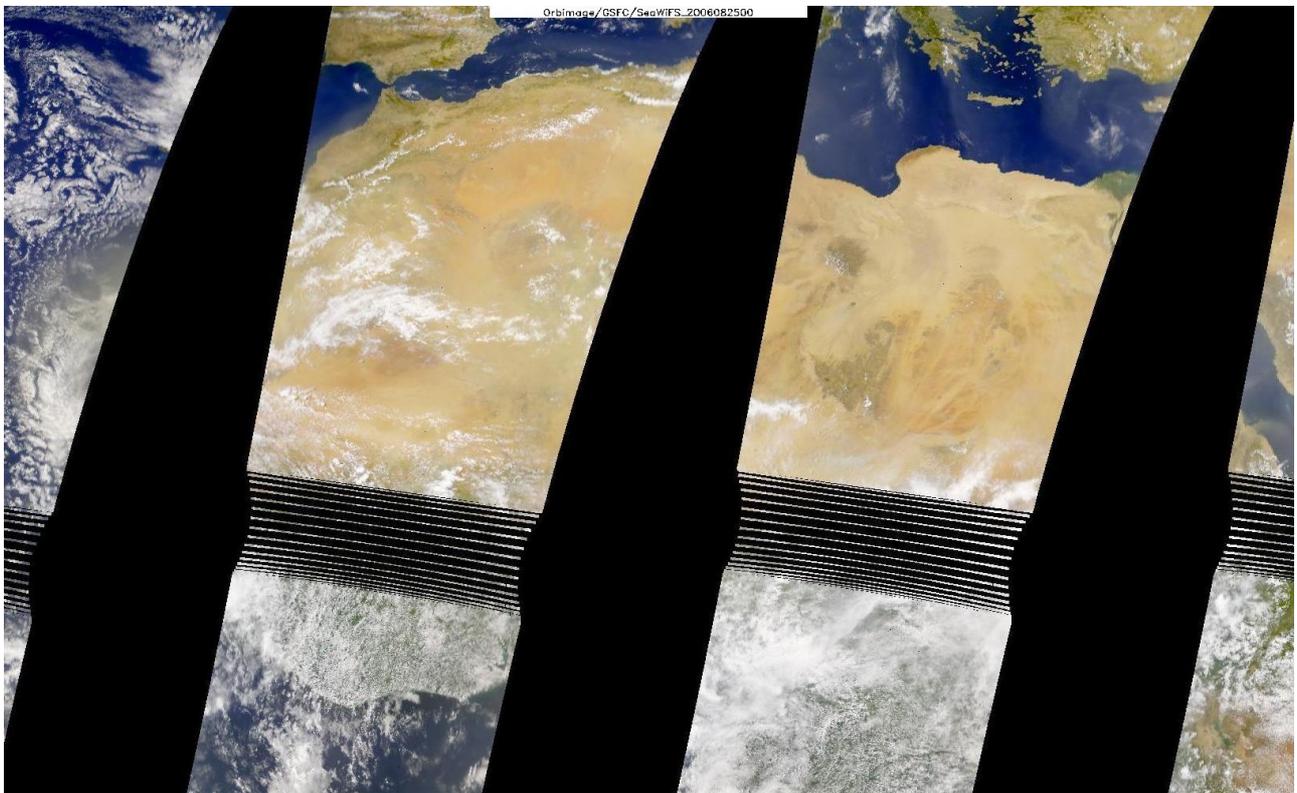
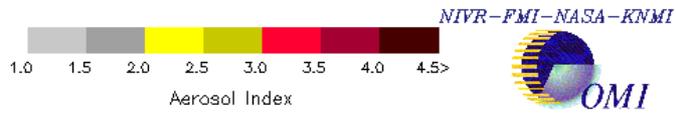
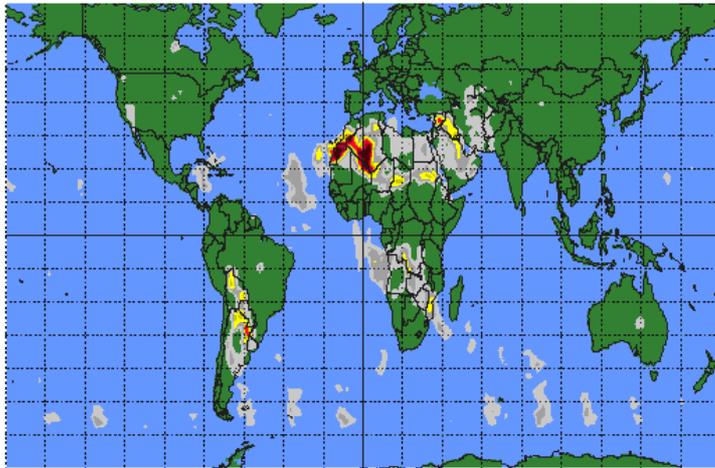
DODO2 Summary Document

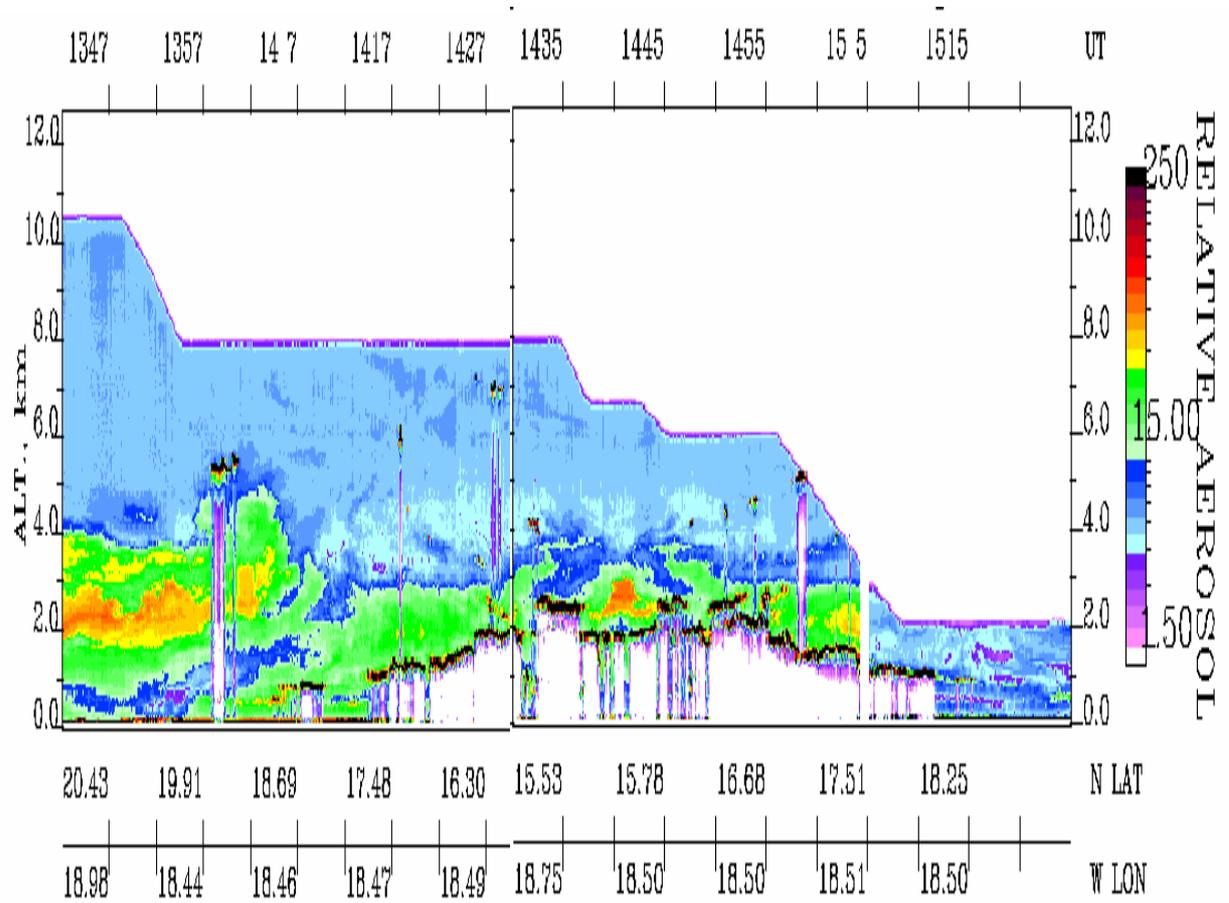






OMI Aerosol Index  
on August 25, 2006





## B242

Flight Number: B242

Date: 28/08/06

Sortie Objectives: Investigation of the in-situ and radiative properties over oceans.

Operating area: Oceanic areas off the coast of Senegal and Mauritania. Initially along the 18W line of longitude, followed by the 16.5W line of longitude.

Weather: A wave depression on the ITCZ had passed to the south of the region the night before the flight. There had been some precipitation in Dakar. However, the models forecast dust moving in behind the wave.

Flight Patterns: Subsequent to take off a profile ascent was performed immediately to FL210 heading in a northerly direction. The profile showed two distinct dust layers, the first from the surface to FL70, then a clear slot to FL100 and a more intense elevated dust layer from approximately FL100 to FL150. A profile descent was then performed to the middle of the upper dust layer at FL125. There were significant amounts of both Ci above (4/8) and Cu below (4/8). The run was continued to the north where the aerosol concentrations increased before a profile descent was performed to 100ft. The descent showed a peak nephelometer scattering of  $100 \times 10^{-6} \text{m}^{-1}$  at approximately FL100 and a clear slot from FL80 to FL60 with a lower dust layer from 1000ft to FL60 and a sea-salt layer up to 1000ft. There was still significant Ci observed during this descent. An email message was received suggesting clearer skies to the east, so a turn to the east was performed on a profile ascent towards the east to FL210. The Ci and Cu cleared during this profile ascent. A profile descent was then performed to FL50. The lower external shutter on the BBRs was not used during this flight so that the SHIMS instrument could be fully utilised. Cu re-appeared from about 12:55Z. The profile down was curtailed at FL50 which was a marked clear slot above the scattered Cu below, but below the main dust layer. This run was performed for 10 minutes with upper SHIMS recording. A profile ascent from FL50 to FL180 was then performed to the south to FL180 - again this should be good for both SHIMS and SWS work. There was less aerosol to the south of the region as predicted by the model and confirmed by the OMI satellite image. The aircraft then performed a reciprocal turn to the north and a profile descent to FL50, followed by an ascent to FL180. A sonde was dropped at the north of this run. A profile descent was then performed to the south. The lower BBRs reached  $\sim 120 \text{Wm}^{-2}$  indicating a significant DRE. Further profiles were performed across the dust layer before fuel meant that we turned for home.

Summary: A successful flight – the SHIMS instrument should provide a good analysis. The vertical profile of the dust showed interesting structure. Careful analysis should make BBR and SHIMS data useable.

Problems: SWS showed very patchy performance – the visible module hardly worked at all during this flight.

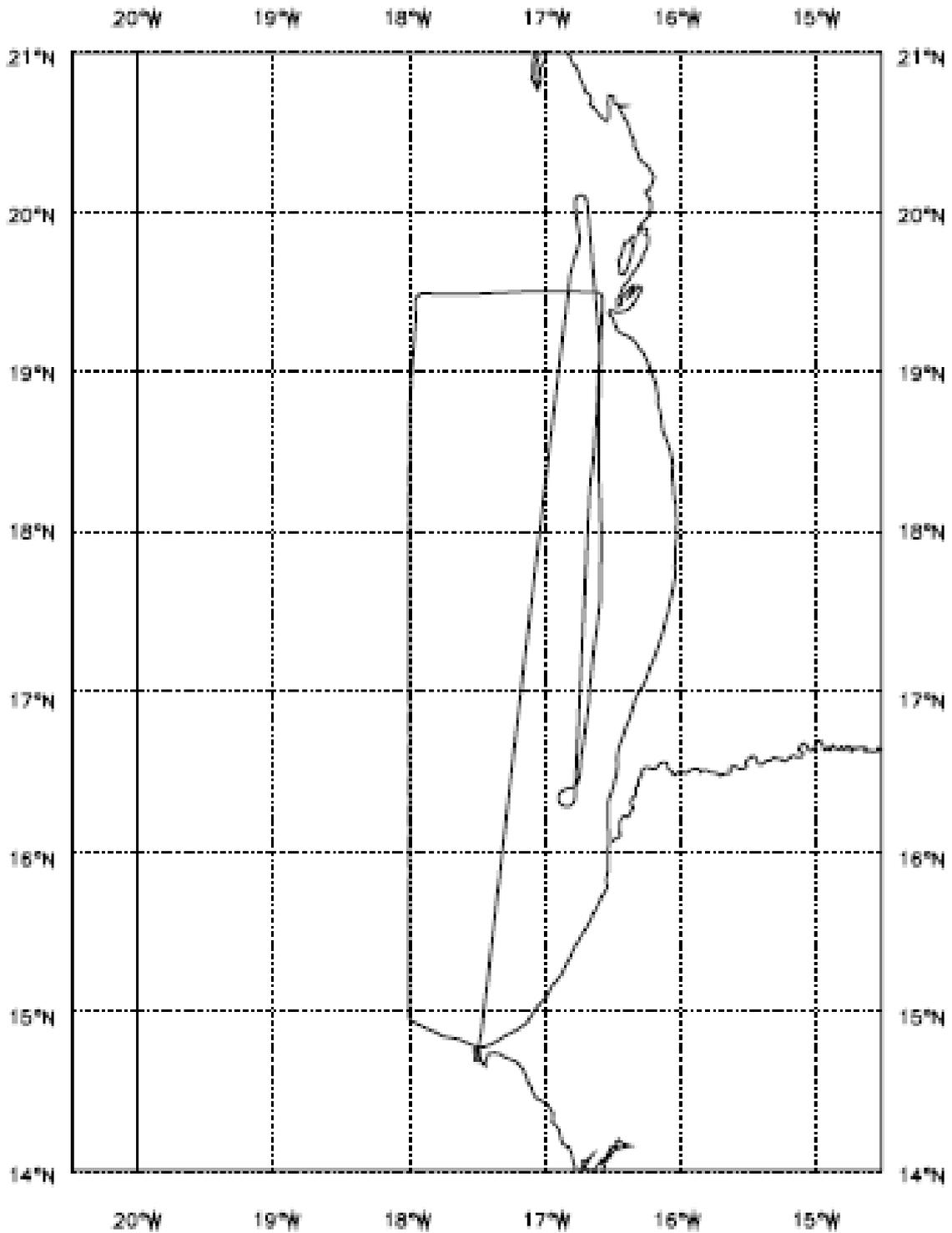
The nephelometer blue scattering is showing a very obvious problem – it is far too low – not sure if this is due to the flight constants being used in HORACE being old or whether it needs a recalibration.

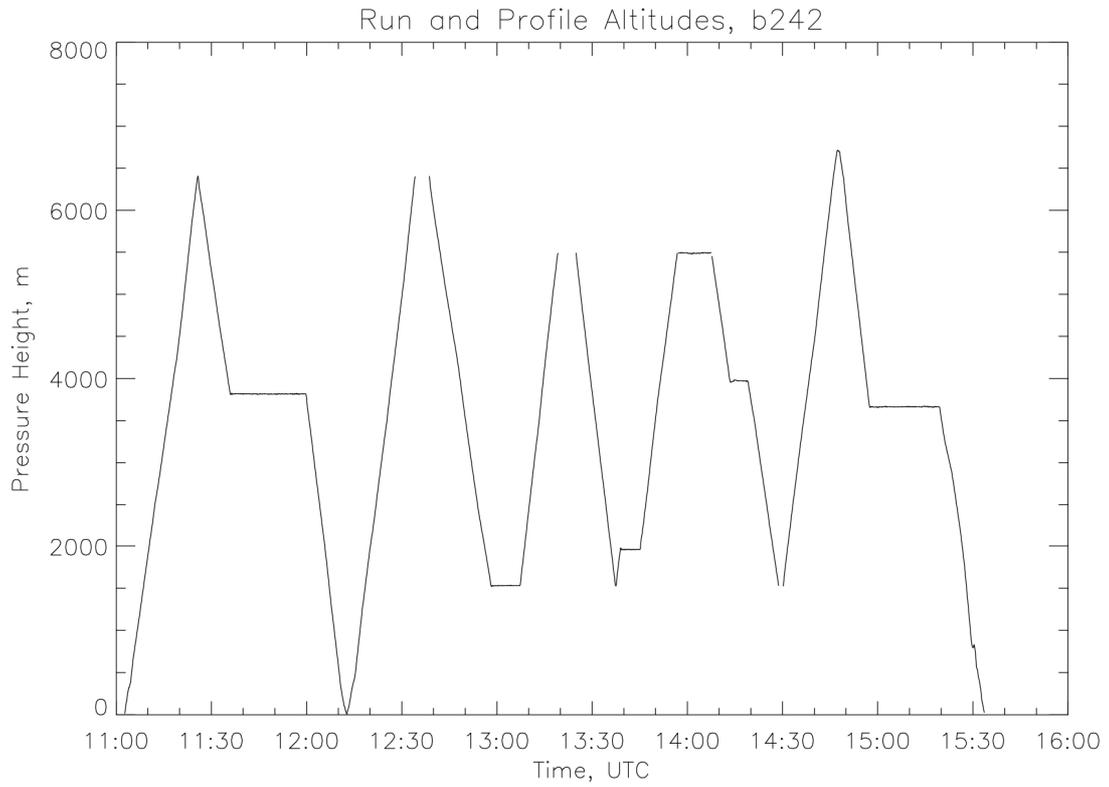
The low pyrgeometer was U/S.

DODO2 Summary Document

Start Time	End Time	Event	Height (s)	Hdg	Comments
94907		XR5M	0.05 kft	336	14'44.61N 17'29.45W
102450		INU	0.04 kft	336	to nav
102727		CGPS	0.04 kft	336	b242cgps.log
105257		ASP	0.05 kft	105	open
105336		psap	0.05 kft	105	flow on
110243		T/O	0.04 kft	352	Dakar
110243	112542	Profile 1	0.41 - 21.0 kft	333	from t/o
110331		bbr	0.75 kft	294	retract
110347		heimann	0.92 kft	292	shutter open
110427		psap	1.2 kft	288	flow on at t/o
110509		Video	2.0 kft	290	#1 Ufc #2 Dfc starte
112543	113558	Profile 2	21.0 - 12.5 kft	1	
113558	115942	Run 1.1	12.5 kft	4	
113639		heimann	12.5 kft	4	cal 10
113657		nev	12.5 kft	5	zero
113751		JW	12.5 kft	6	zero
115942	121241	Profile 3	12.5 - 0.03 kft	6	
121242	123415	Profile 4	0.04 - 21.0 kft	354	
121317		P4	0.29 kft	351	turn in profile
121625		qnh	2.8 kft	91	1017
123435		!	21.0 kft	114	manouver
123516		CO	21.0 kft	179	cal
123652		video	21.0 kft	182	#3 Ufc #4 Dfc start
123836	125809	Profile 5	21.0 - 5.0 kft	181	
125810	130712	Run 2.1	5.0 kft	181	
130713	131915	Profile 6	5.0 - 18.0 kft	180	
131931		Sonde 1	18.0 kft	179	
131950		!	18.0 kft	179	manouvre
132449	133724	Profile 7	18.0 - 5.0 kft	17	
133725	135656	Profile 8	5.0 - 18.0 kft	11	
133914		p8	6.4 kft	9	interrupted
133914	134606	Run 3.1	6.4 kft	3	
134606		p8	7.4 kft	3	resumed
135705		Sonde2	18.0 kft	3	
135713	140732	Run 4.1	18.0 kft	3	
140747	142849	Profile 9	17.9 - 5.0 kft	357	
140957		Video	16.0 kft	357	#5 Ufc #6 Dfc
141324		p9	13.0 kft	357	interrupted
141909		p9	13.0 kft	189	resumed
143009	144747	Profile 10	5.0 - 22.0 kft	184	
144747	145725	Profile 11	22.0 - 12.0 kft	184	
145725	151928	Run 5.1	12.0 kft	179	
151929	153337	Profile 12	12.0 - 0.09 kft	182	
151948	153338	p12	11.7 kft	182	down to land
153338		Land	0.09 kft	351	Dakar
154014		XR5M	0.11 kft	153	14'44.66N 17'29.43W

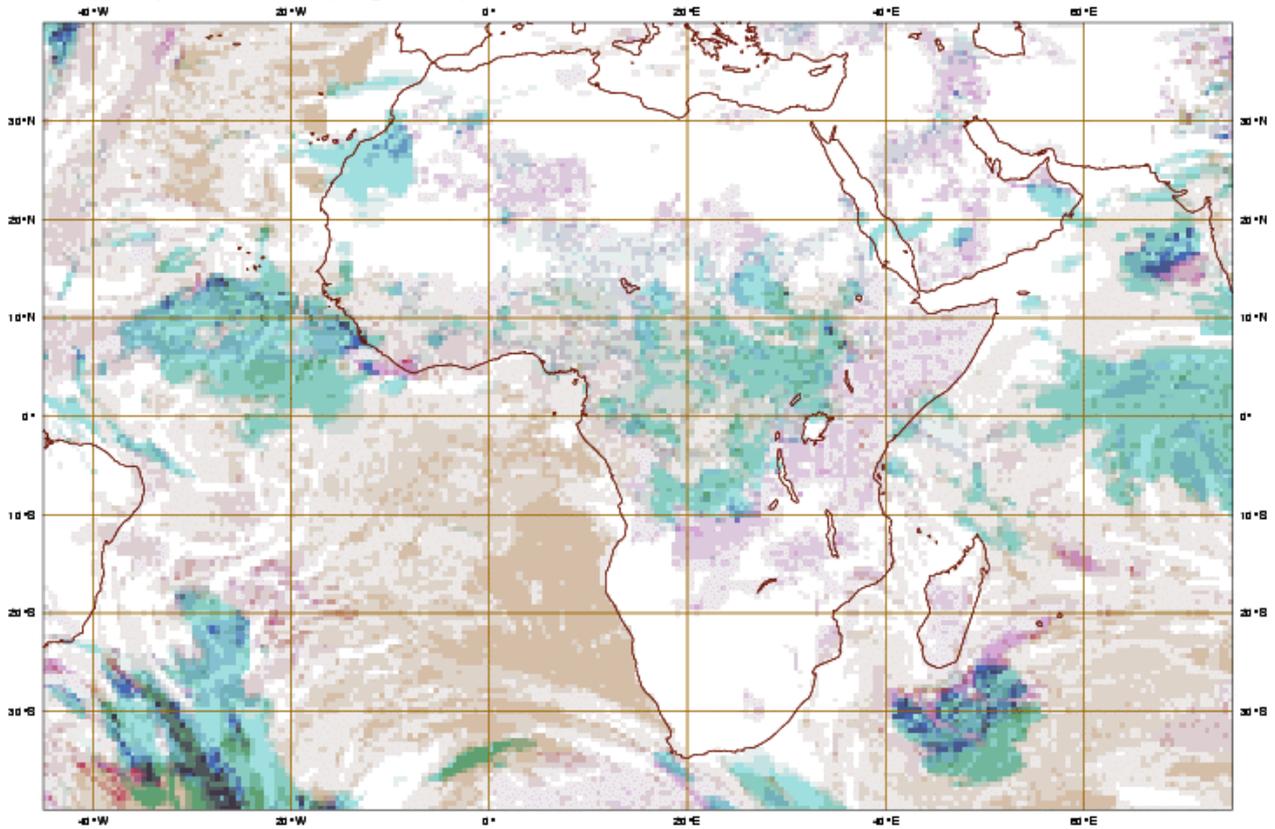
# B242 Track 28-AUG-06





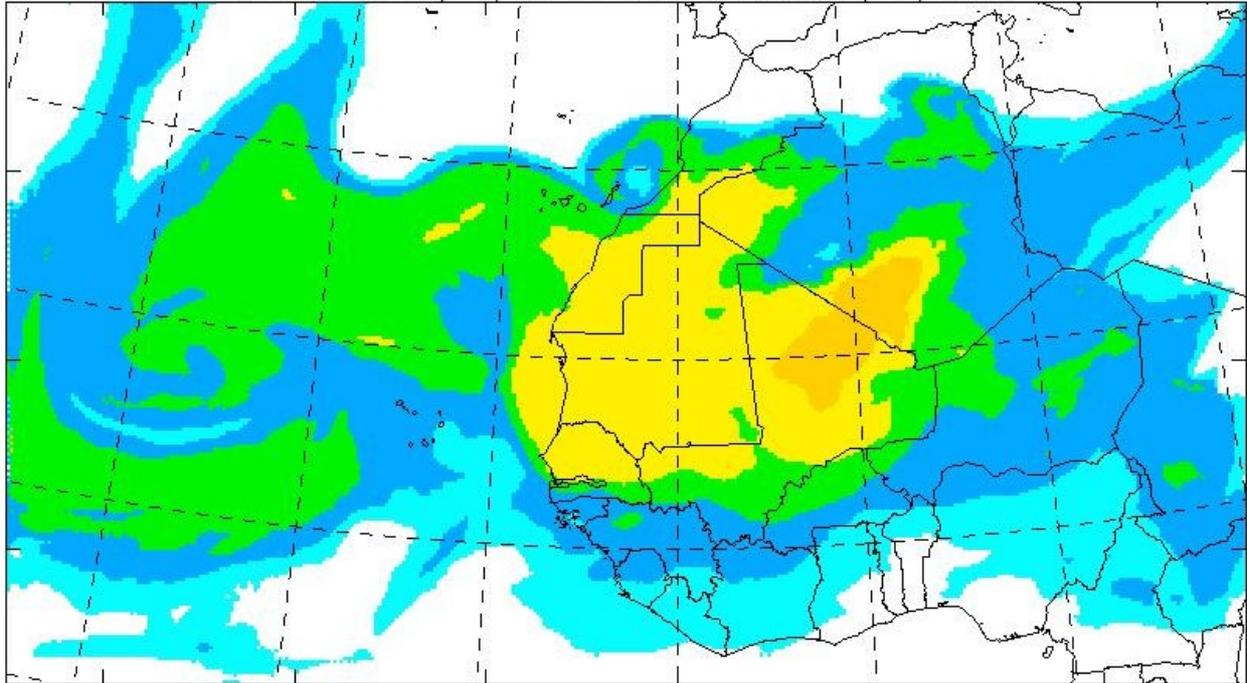
Monday 28 August 2006 00UTC ©ECMWF Forecast t+012 VT: Monday 28 August 2006 12UTC

Low, L+M, Medium, M+H, High, H+L, H+M+L clouds



23z\_270806 AOD T+12

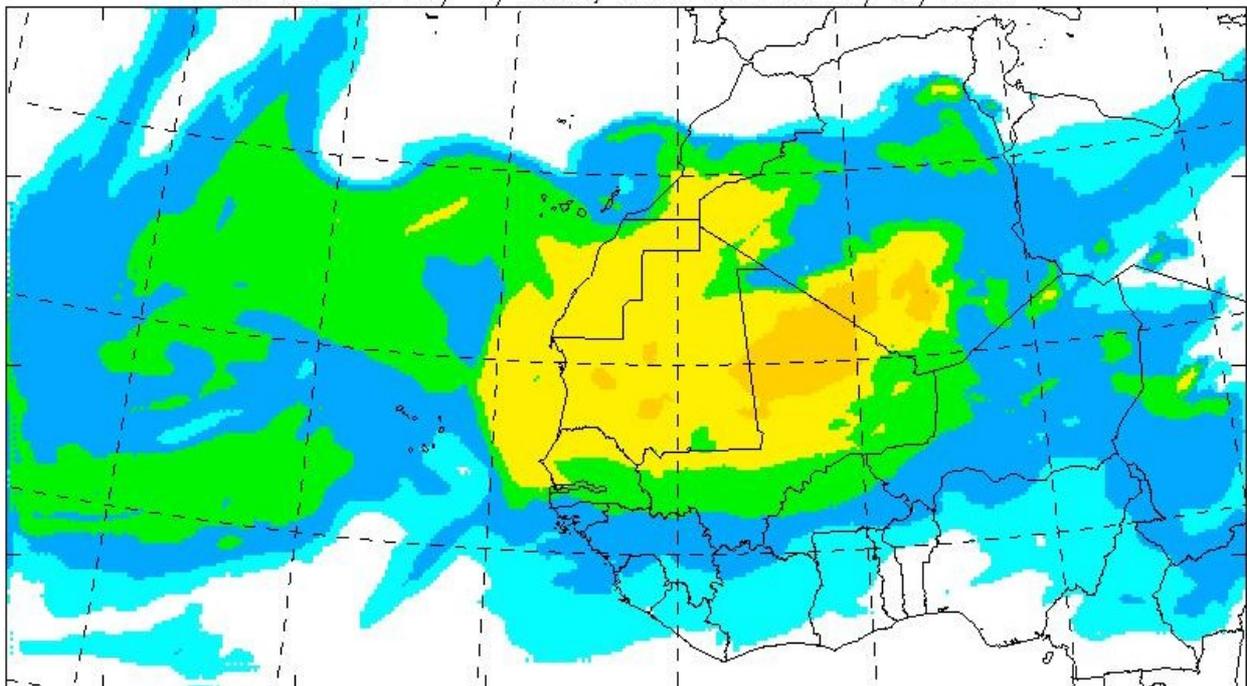
At 06Z on 28/ 8/2006, from 18Z on 27/ 8/2006



0.05 0.1 0.2 0.4 0.8 1.6 3.2 6.4 12.8

23z\_270806 AOD T+18

At 12Z on 28/ 8/2006, from 18Z on 27/ 8/2006



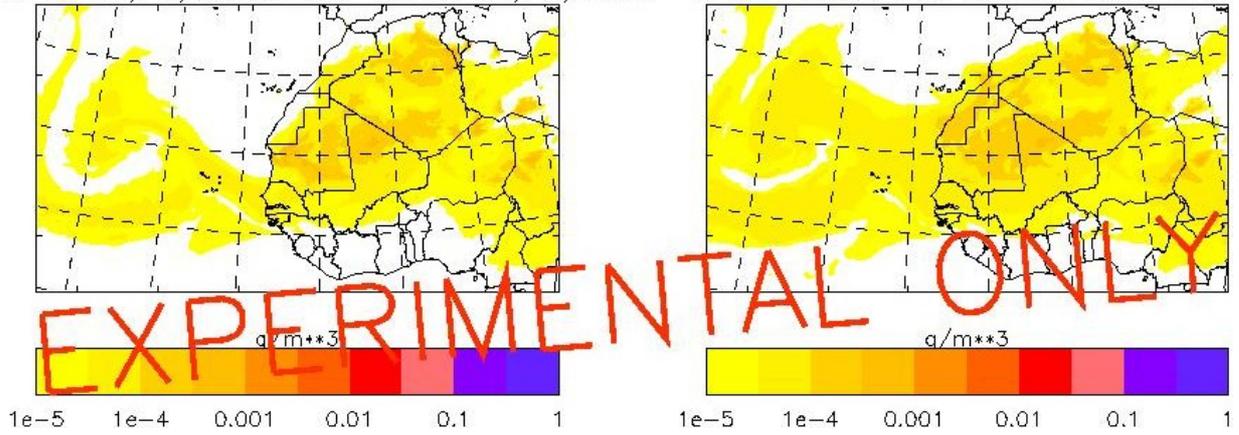
0.05 0.1 0.2 0.4 0.8 1.6 3.2 6.4 12.8

DODO2 Summary Document

23z\_260806 Surface Dust concentration T+42

At 12Z on 28/ 8/2006, from 18Z on 26/ 8/2006

2000-5000ft Dust concentration T+42

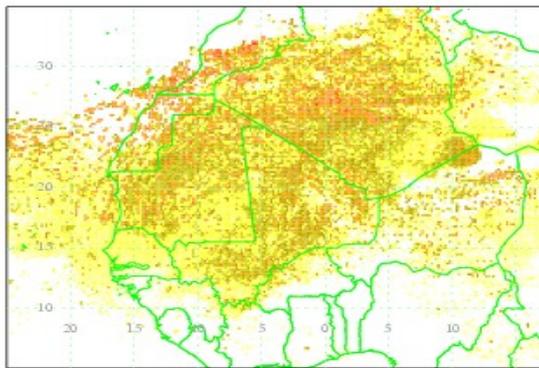


NAME version 814

Sahara forecast

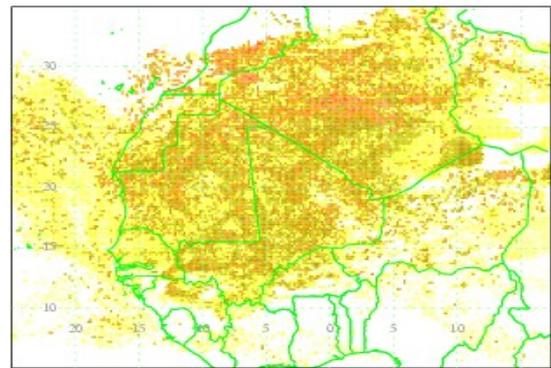
Valid at 1300UTC 28/08/2006

From 2000 - 5000 ft agl Air concentration



Maximum value =  $1.79 \times 10^{-2}$  g/m<sup>3</sup>  
 1.00e-07 1.00e-05 1.00e-03 1.00e-01 1.00e+01

From 5000 - 10000 ft agl Air concentration



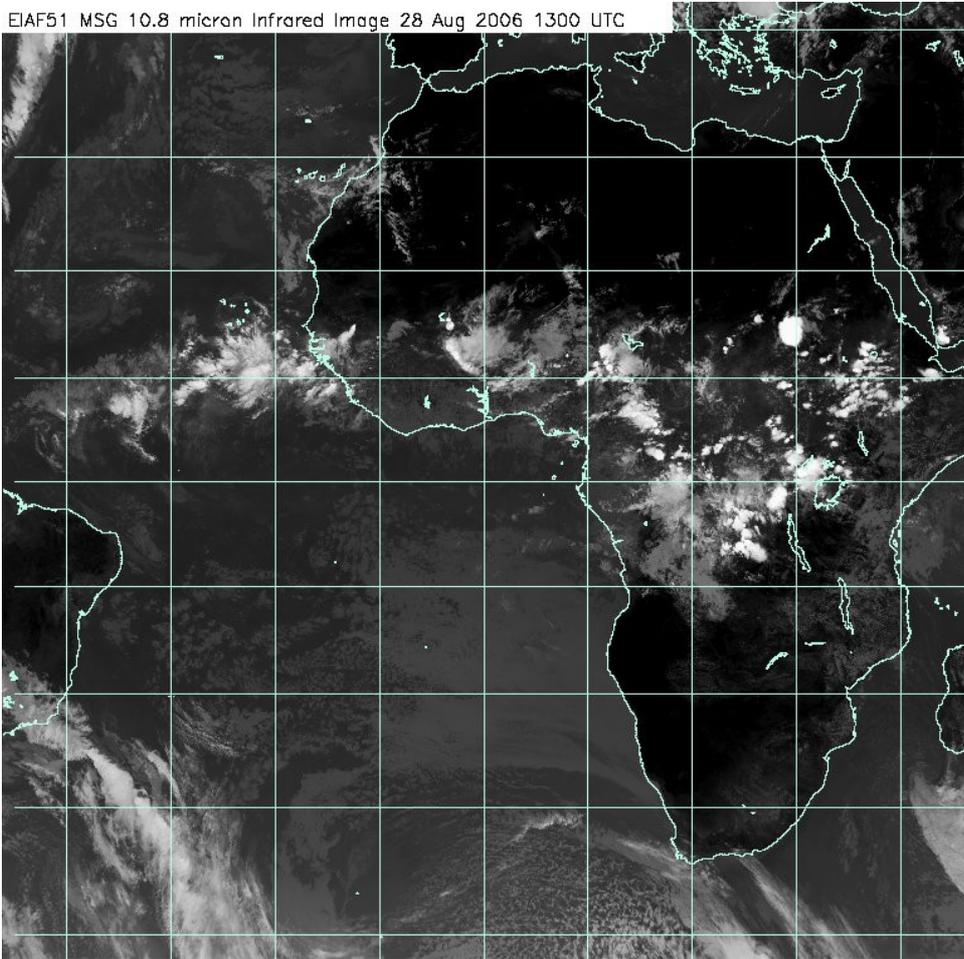
Maximum value =  $1.48 \times 10^{-2}$  g/m<sup>3</sup>  
 1.00e-07 1.00e-05 1.00e-03 1.00e-01 1.00e+01

Start of release: 0600UTC 29/06/2006  
 End of release: 0000UTC\_07/01/1957  
 Release rate: multiple sources  
 Release location: multiple sources  
 Release heights : \*\*\*\*\* to 0m agl

Pollutant: PM10\_MINERAL  
 Met data: Mesoscale  
 Run time: 0029UTC 28/08/2006

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EIAF51 MSG 10.8 micron Infrared Image 28 Aug 2006 1300 UTC



EW31 MSG 0.8 micron Visible Image 28 Aug 2006 1200 UTC

