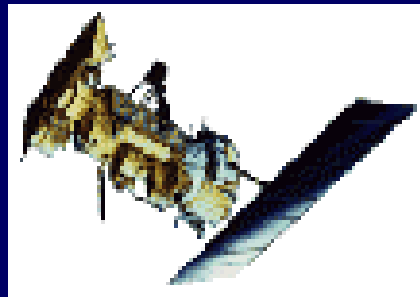


# The need for faster delivery of satellite data to NWP centres

*Roger Saunders  
Met Office*



Satellite data

Delay < 1hrs



Customer



NWP model

## Acknowledgements

**Brett Candy, Keith Whyte, Stephen English,  
Mike Bush**

# Talk Outline

- Use of satellite data at Met Office
- Regional NWP model at Met Office
- Study of ATOVS data delays
- Quick look at timeliness of other observations
- Impacts on model forecasts

# Met Office NWP Models

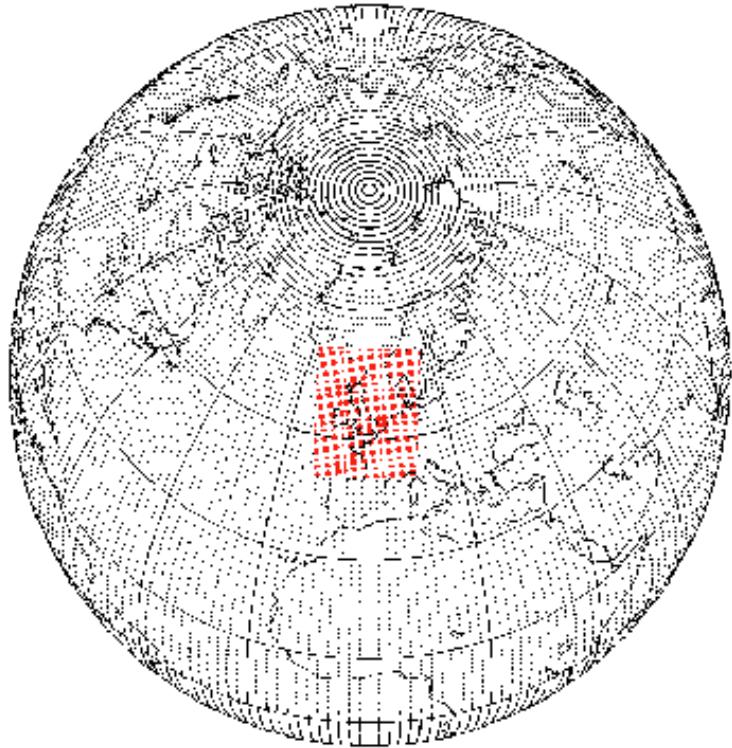


Figure 2: The grids used by the global and UK Mesoscale forecast systems.

## Data Assimilation:

3DVar, FGAT, 6 hr cycle  
1hr 50min cut-off with 7hr  
update runs for next cycle

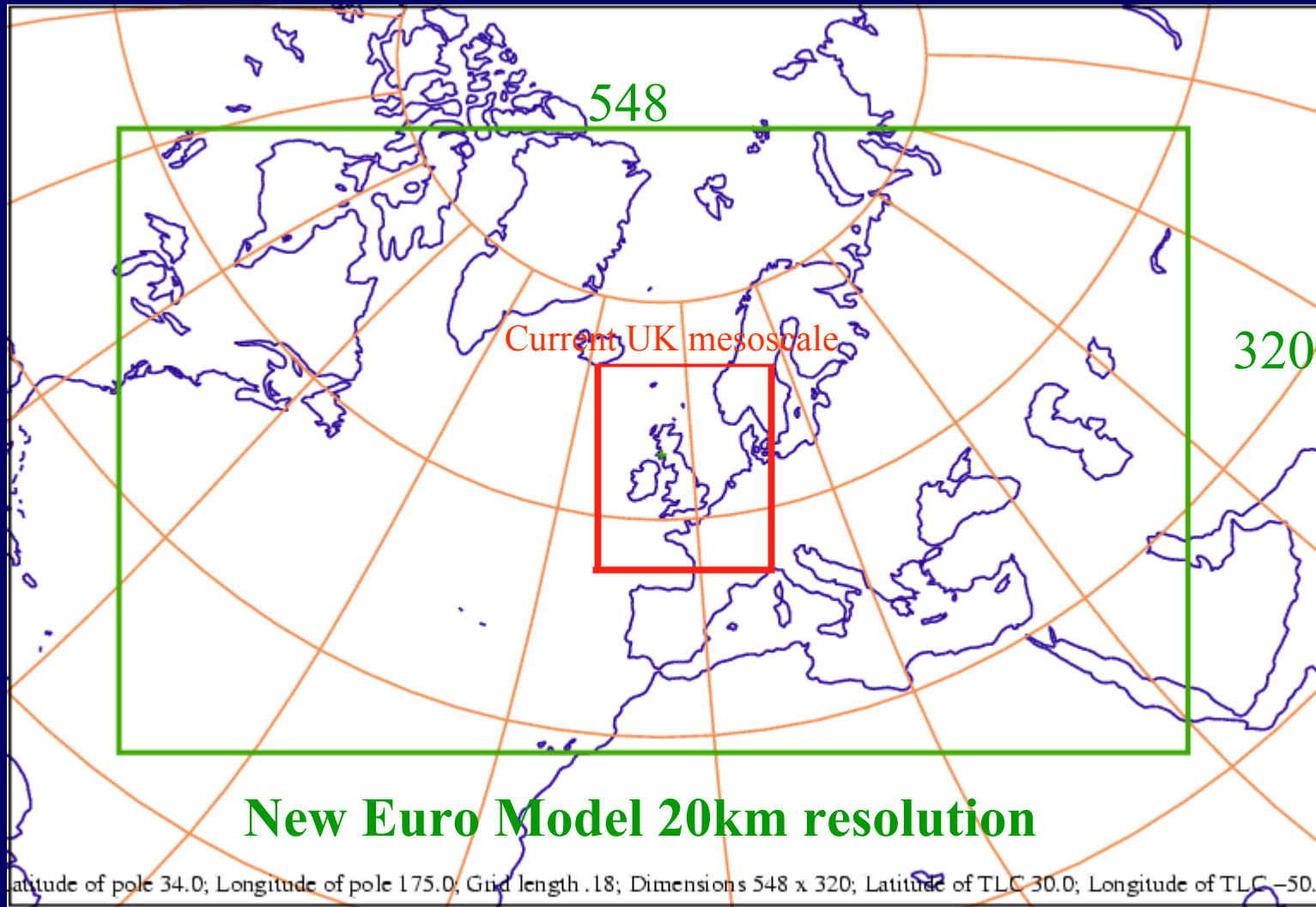
## Model formulation:

Exact equations of motion  
in 3D, non-hydrostatic  
effects included, semi-  
Langrangian  
scheme, hybrid-eta in  
height.

	Horizontal Resolution	Horizontal Grid EW x NS	Vertical Levels
Global Forecast	0.83° x 0.56°	432 x 325	30
UK Mesoscale	12km	146 x 182	38
HADAM4	2.50° x 3.75°	96 x 73	38

Table 1: Resolutions used by main UM atmospheric configurations.

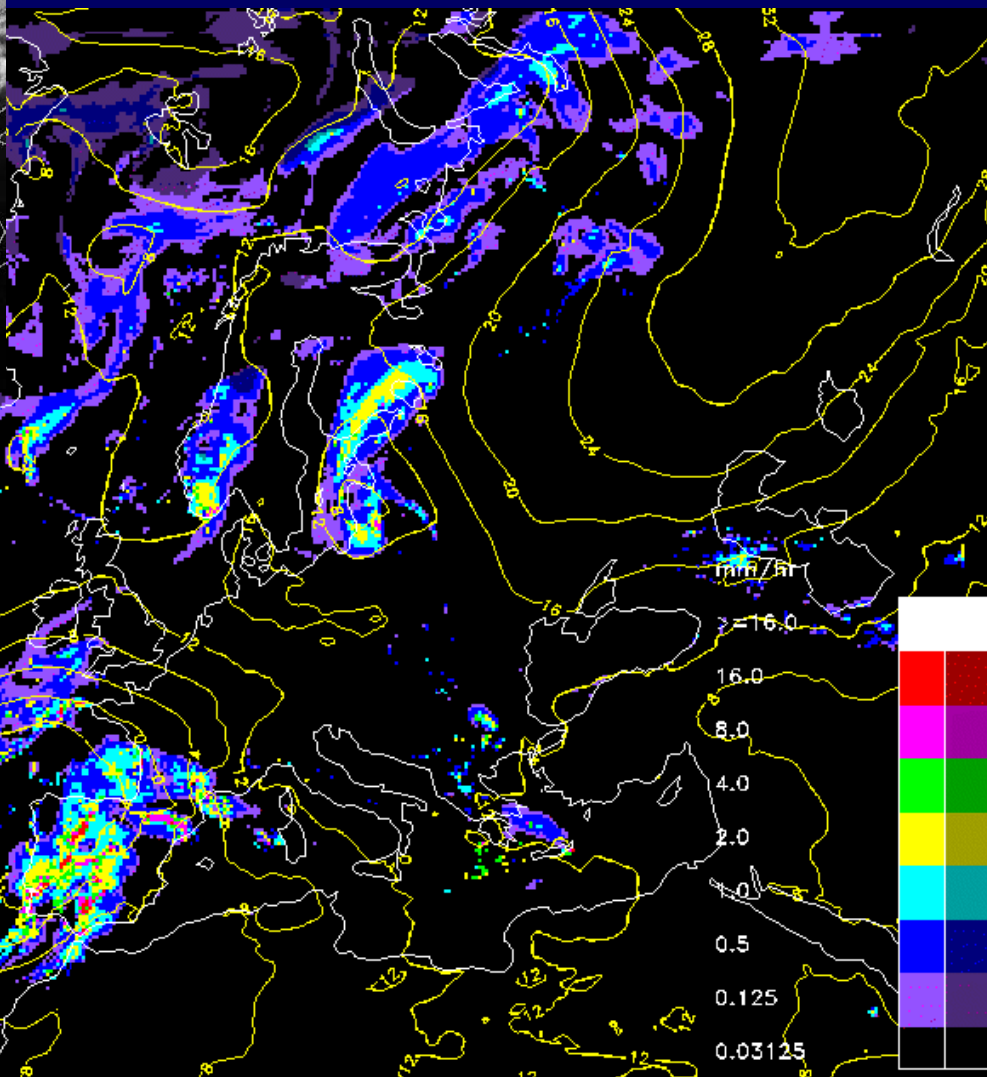
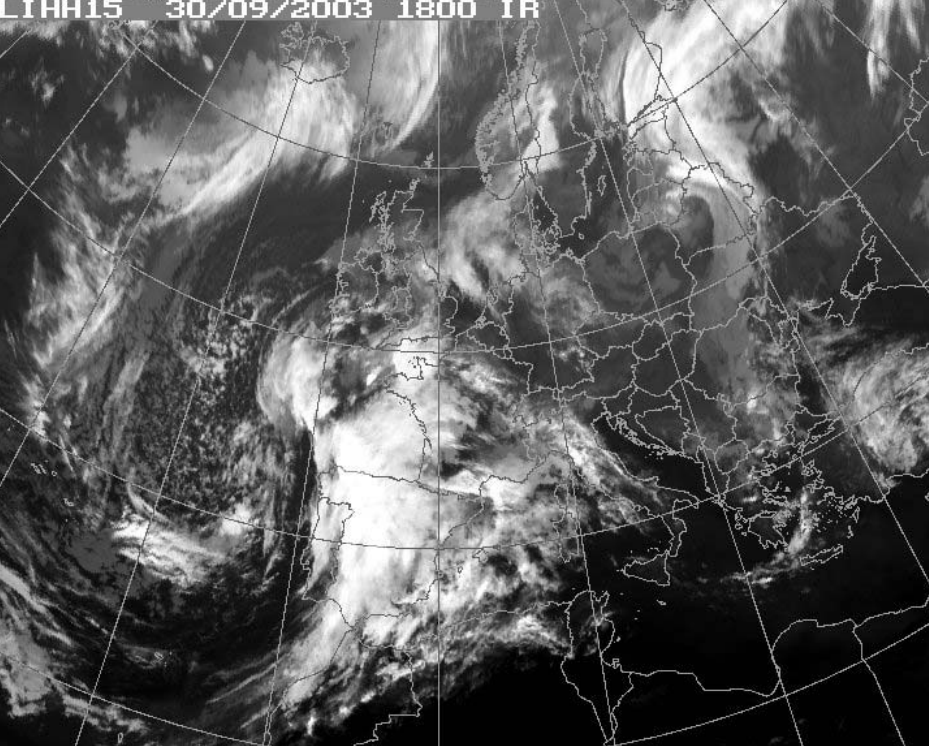
# European model Domain



# European Model

- 20km, 38 levels
- Introduced Dec 02 semi-operational (06/18UTC)
- Data assimilation from 12 Aug 03 cut-off 1:50
- Plans :
  - Port to SX6 - Operational March 2004
  - 4 runs /day, 50 levels Q2/2004
  - 12km resolution Q4/2004
  - Global 4D-Var 4Q/2004
  - European 60/70 levels 2Q/2005
  - 4km UK 4Q/2005

# EUROLAM Forecast



TOTAL PRECIPITATION  
VALID AT 18Z ON 30/ 9/ 2003

# Observations used in global and mesoscale models (Oct 03)

Ob type	Notes	Global	UK Mesoscale
Synops	Surface Pressure	✓	✓
	U,V (land)	×	✓
	U,V (sea)	✓	✓
	Temperature	×	✓
	Relative Humidity	×	✓
	Visibility	×	✓
Drifting buoys		✓	✓
Aircraft	AIREPS, AMDARS	✓	✓
Sondes	TEMP, PILOT, Dropsondes	✓	✓
Satellite atmospheric motion winds	Meteosat-5 (IR,WV, VIS)	✓	×
	Meteosat-7 (IR,WV, VIS)	✓	✓
	GOES-8 (IR)	✓	×
	GOES-10 (IR)	✓	×
	GMS-5 (IR,WV, VIS)	✓	×
Scatwinds	Locally processed ERS scatterometer	×	×
	SeaWinds (Quikscat)	✓	×
ATOVS	Radiances rather than retrieved profiles used as of Oct 1999	✓	✓
Wind profilers	European and US wind profilers .	✓	✓
SSM/I	10m windspeed	✓	×
	Total column water vapour	×	×
MOPS	Satellite derived cloud product	×	✓

Table 3: Observing systems used or being assessed for use in the data assimilation system. A tick in the 3<sup>rd</sup> or 4<sup>th</sup> column indicates operational use.

# Use of ATOVS data

- **Global level 1b data from NESDIS**
- **Converted to level 1d (all IFOVS mapped to HIRS) using AAPP software**
- **Level 1d radiances pre-processed with 1D-Var**
- **Level 1d radiances assimilated in 3D-Var**
- **HIRS/AMSU in Global and AMSU only in Euro and mesoscale models**
- **Main global model run (cut-off 1:50 since Dec 02 was 3hrs)**
- **Update model run (cut-off ~7:00)**

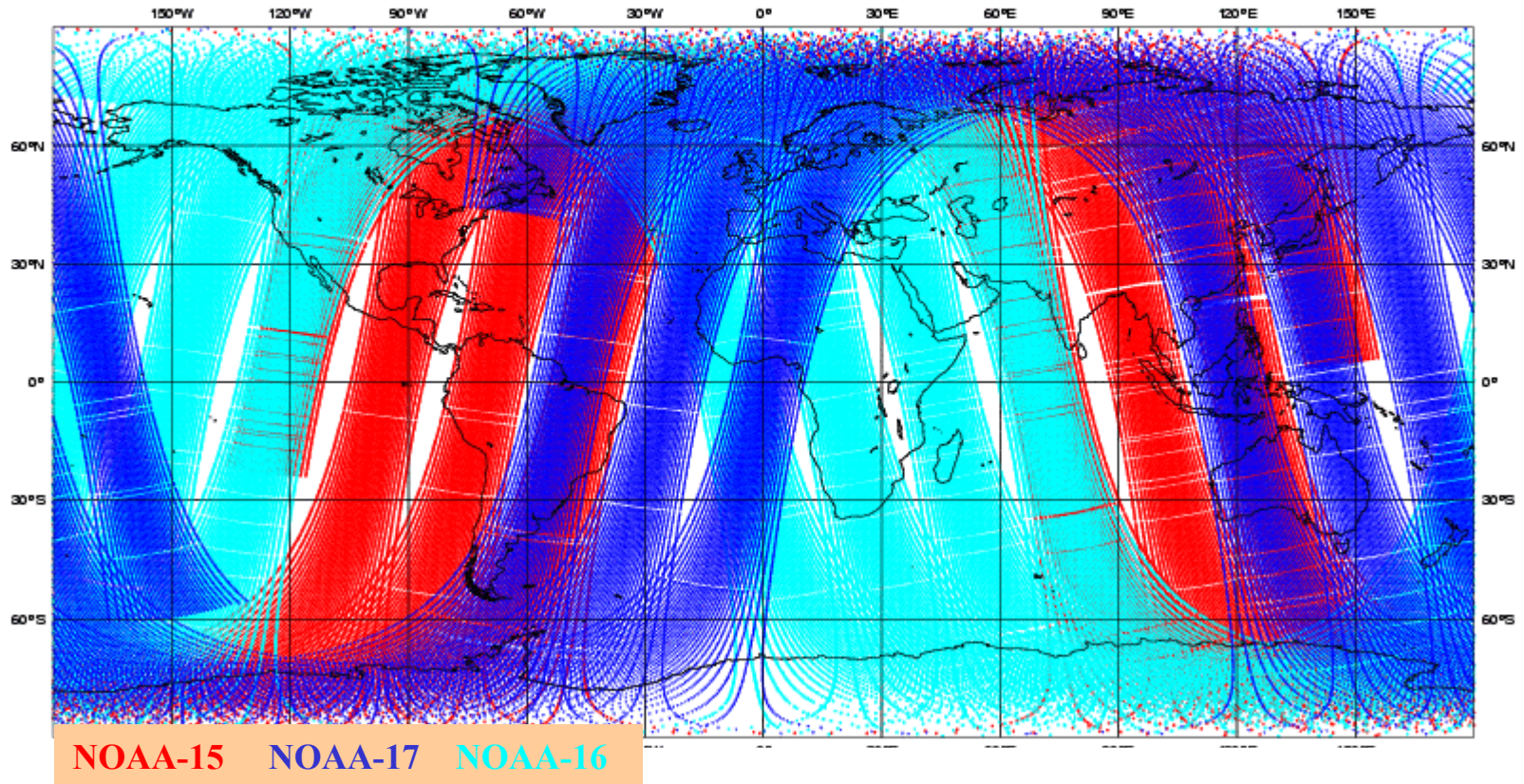


# Global Coverage: Polar Satellite

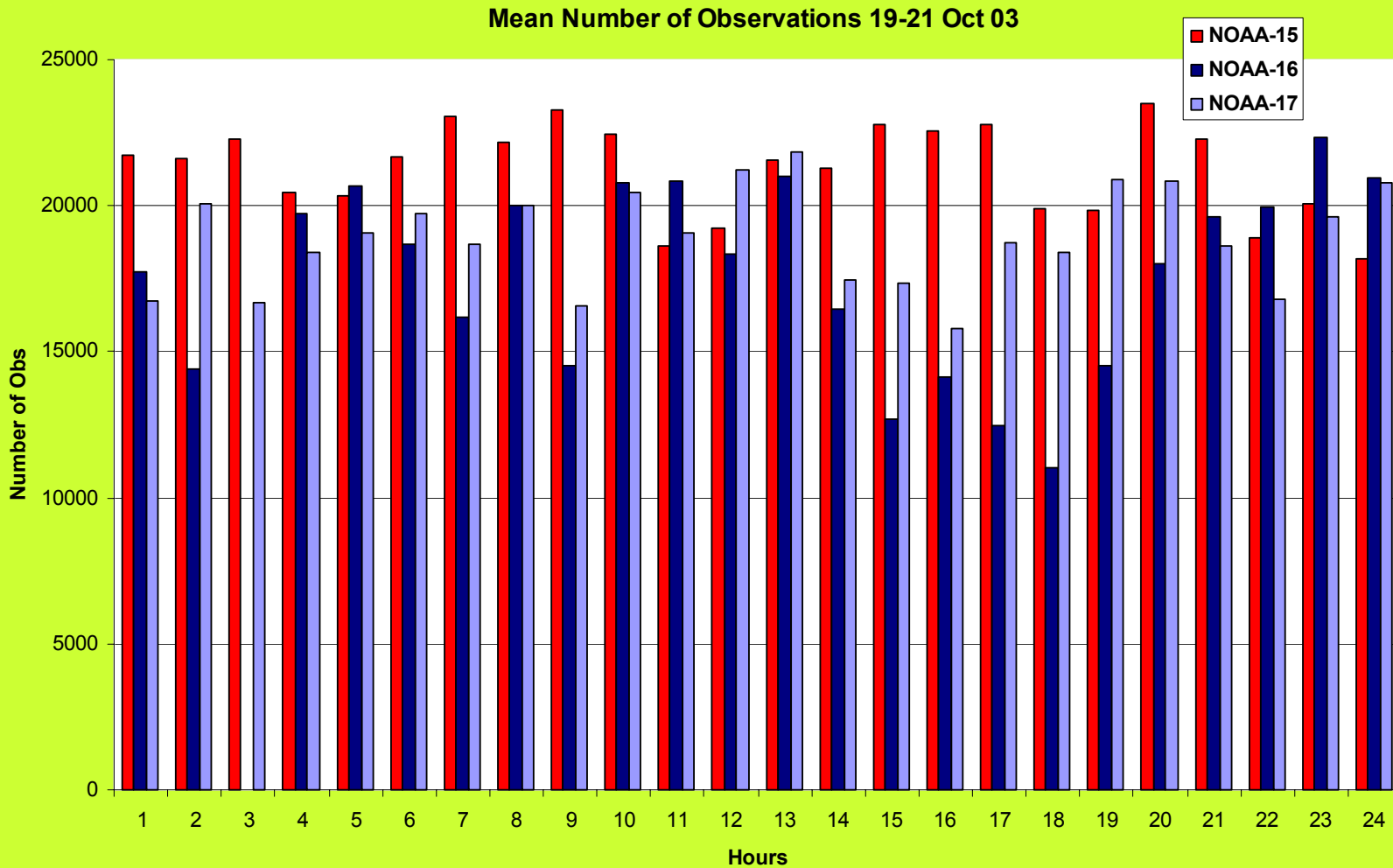
ECMWF Data Coverage (All obs) - ATOVS

28/APR/2003; 12 UTC

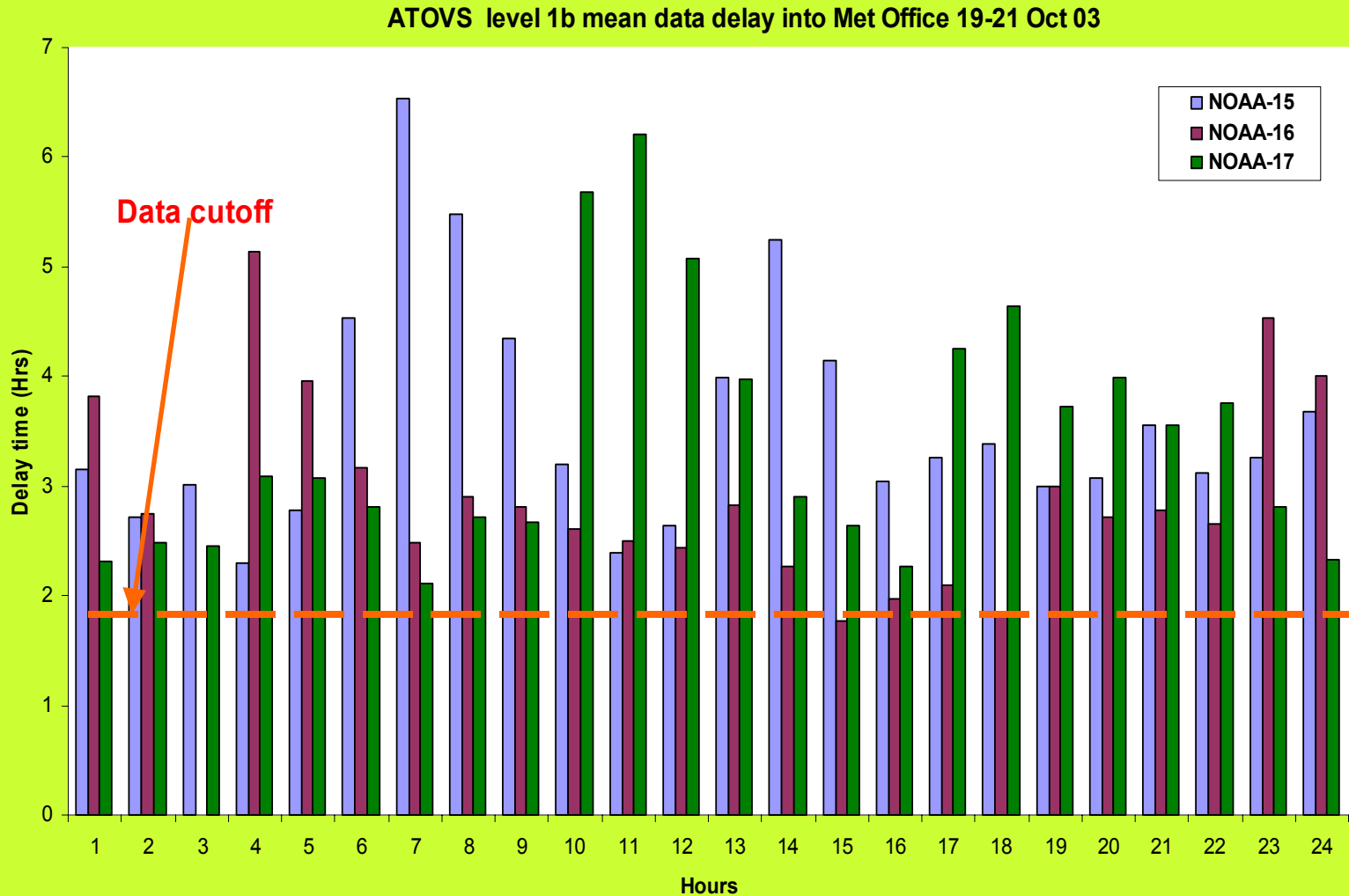
Total number of obs = 235160



# ATOVS Number of Obs Recvd

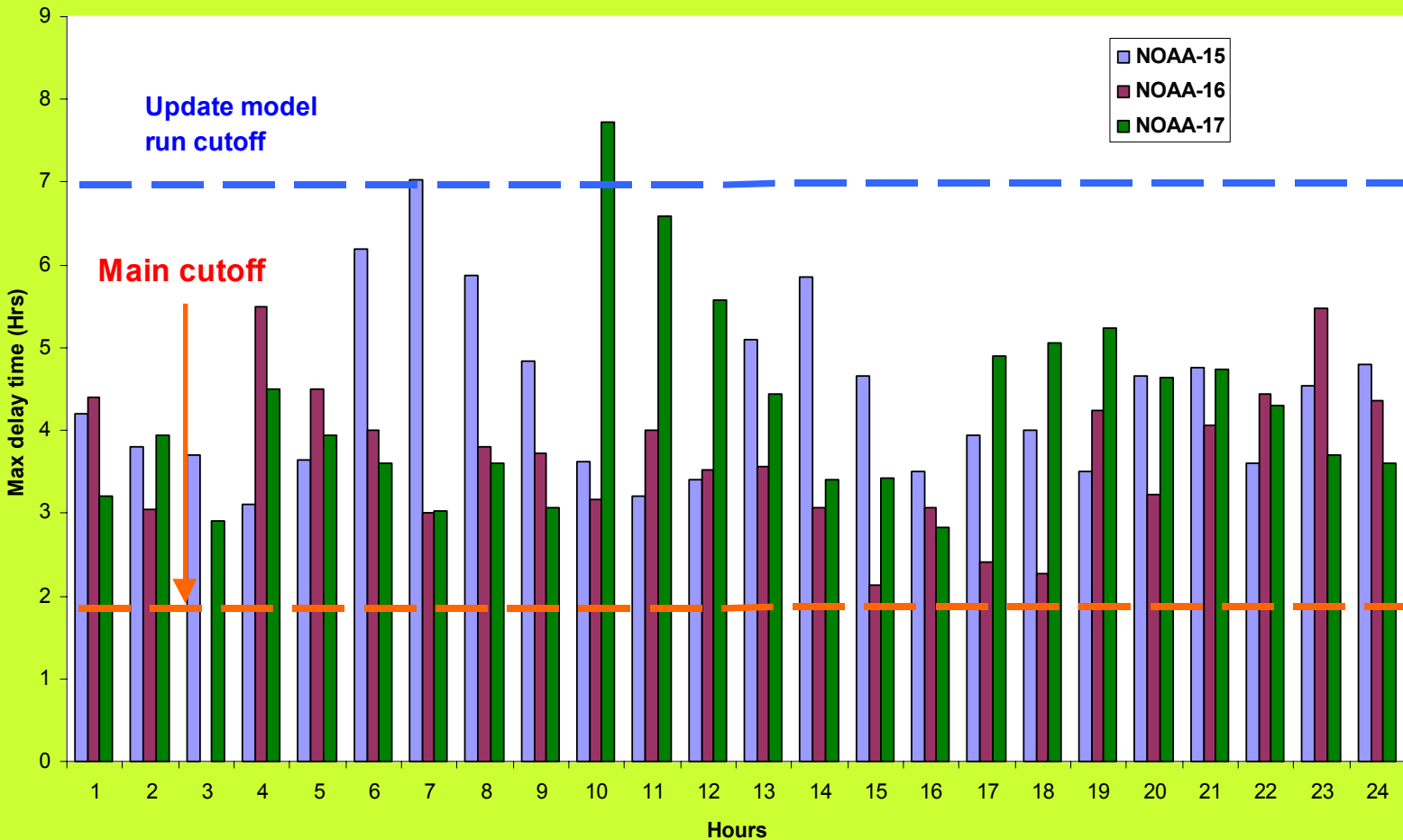


# Mean ATOVS delay times

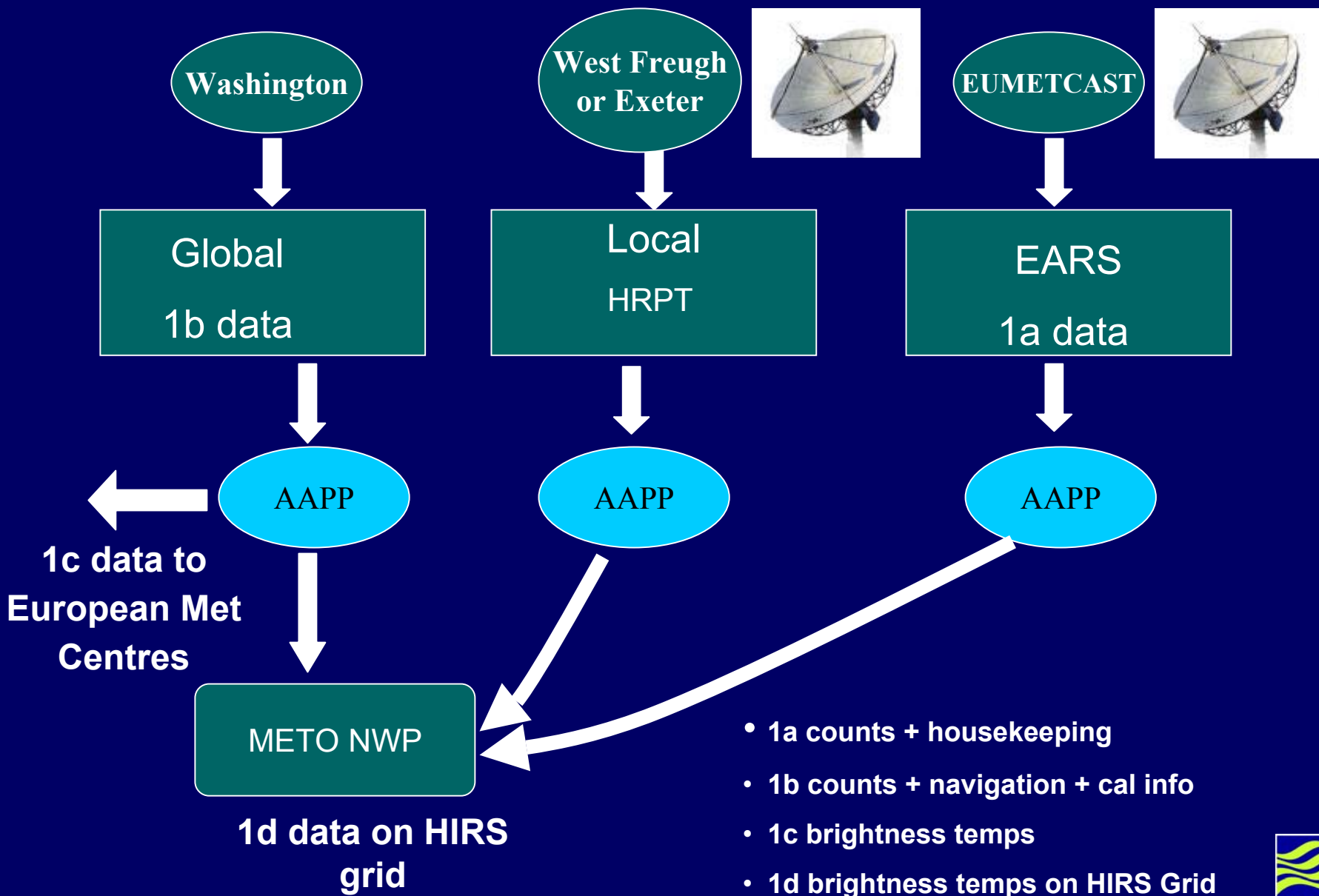


# Max ATOVS delay times

Max delay time 19-21 Oct 03



# Met Office NOAA Data Acquisition



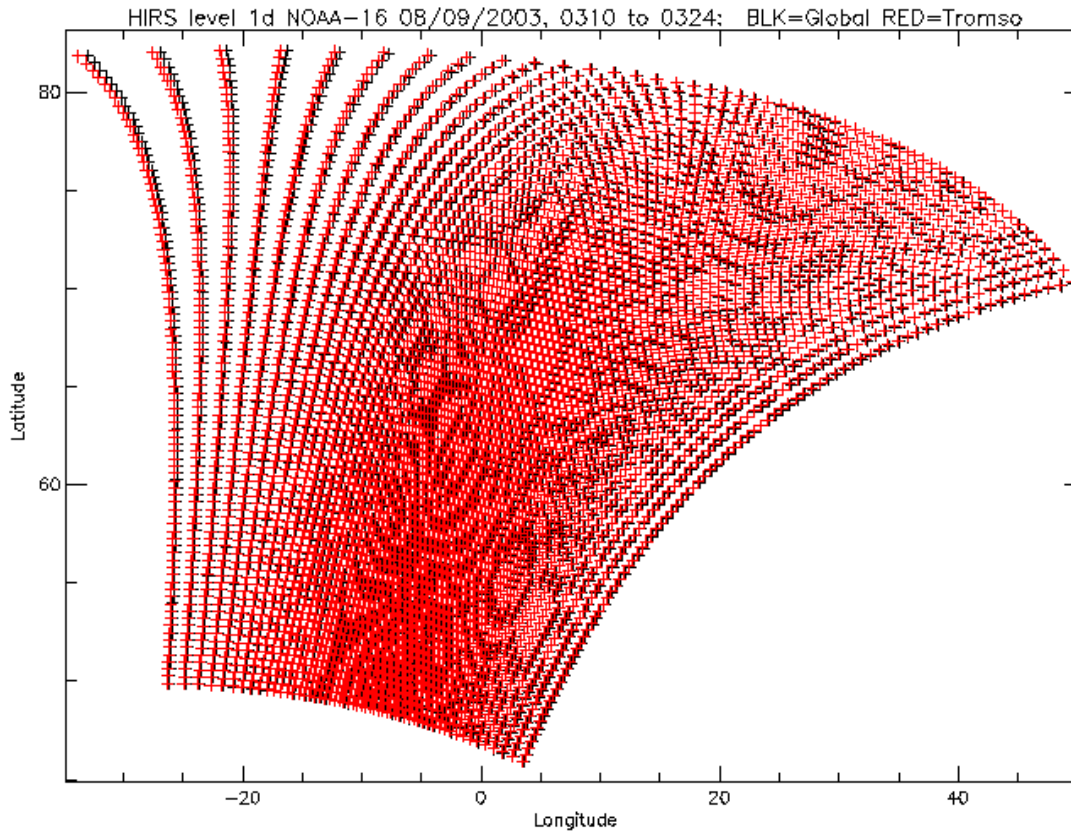
# Use of EARS ATOVS data

- Receiving ATOVS 1A data from Tromso, Maspalomas etc
- Routinely compare level 1B Global (from NESDIS) with EARS level 1B (using AAPP)
- Comparisons of:
  - Earth location
  - Brightness temperatures HIRS, AMSU
- Plan to use in EUROLAM model (and global?)

# Mapping Compared to Global

## Tromsø Data

Latitude

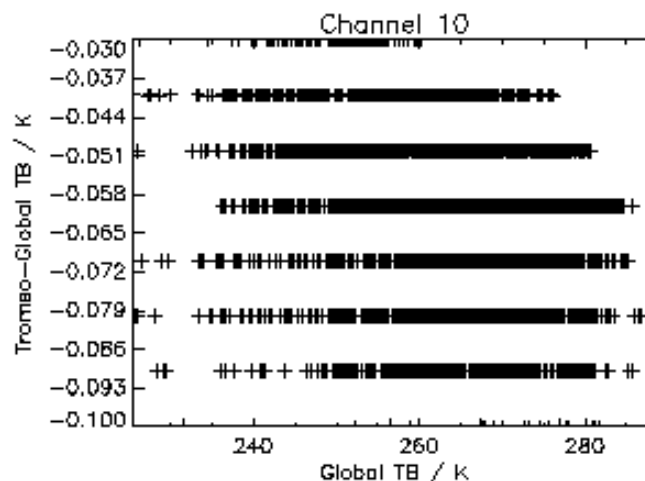
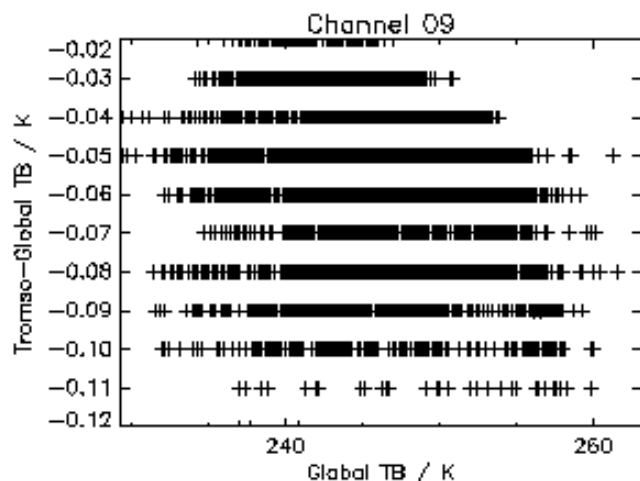


Black=Global

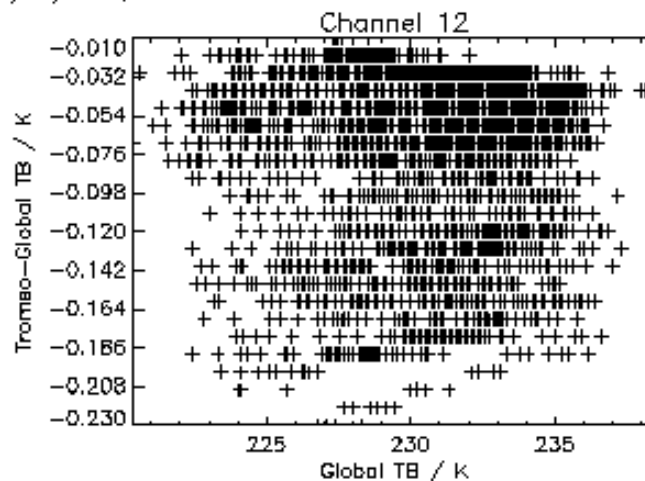
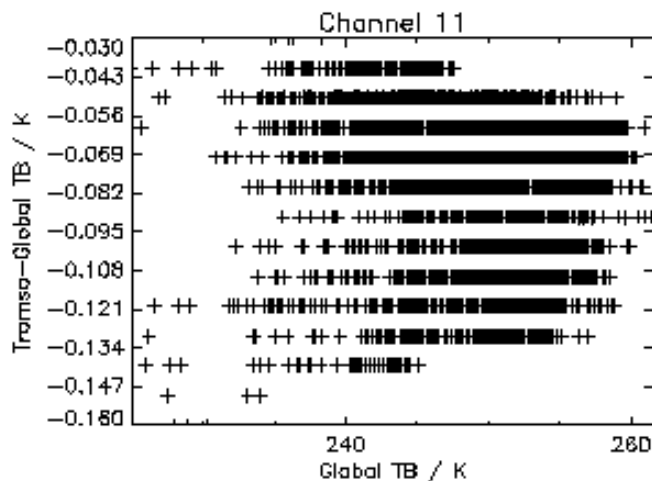
Red=EARS

Longitude

# Global – EARS (Tromso)



HIRS level 1d NOAA-16 14/05/2003, 1322 to 1335



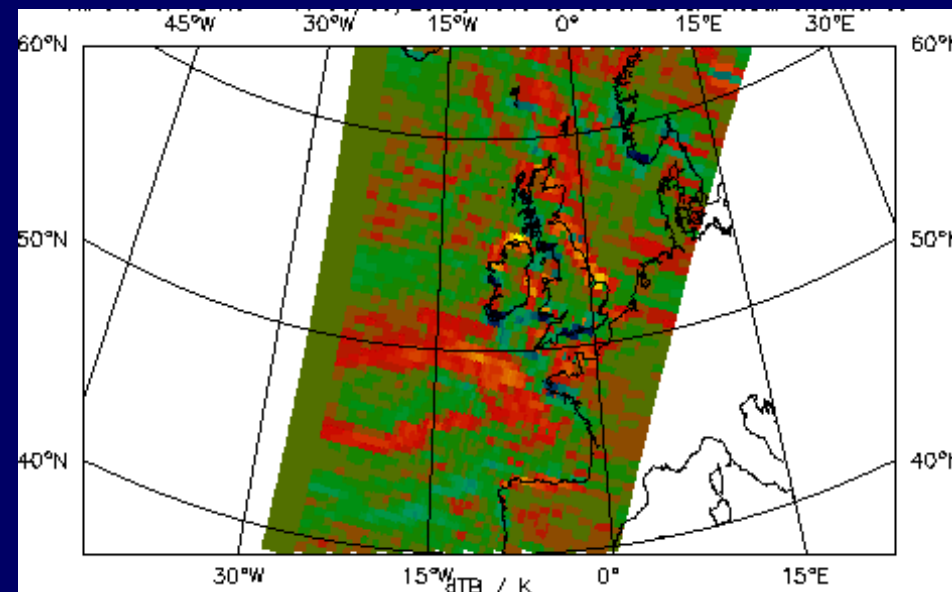
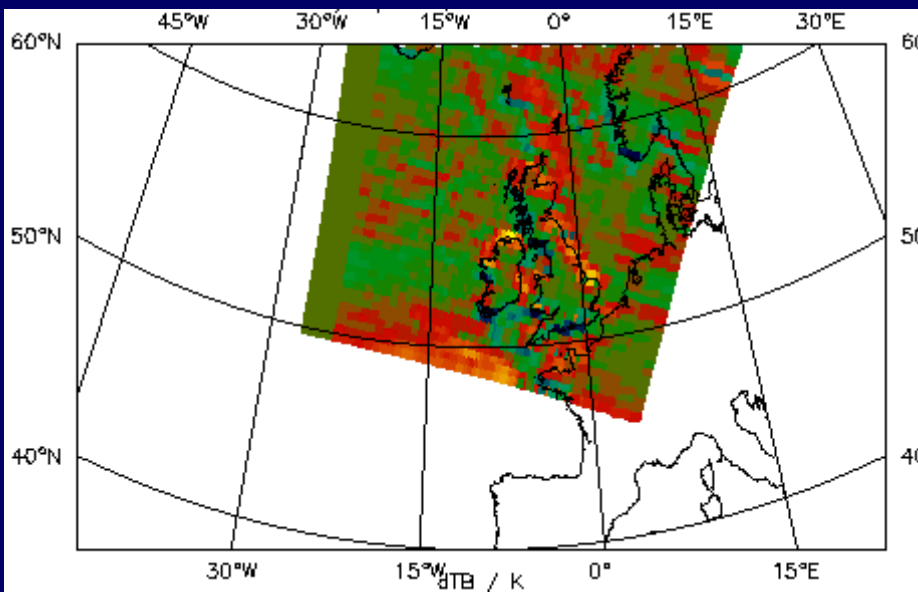


# Brightness Temperature Comparison

## AMSU-15

Global -Tromsø

Global -Local



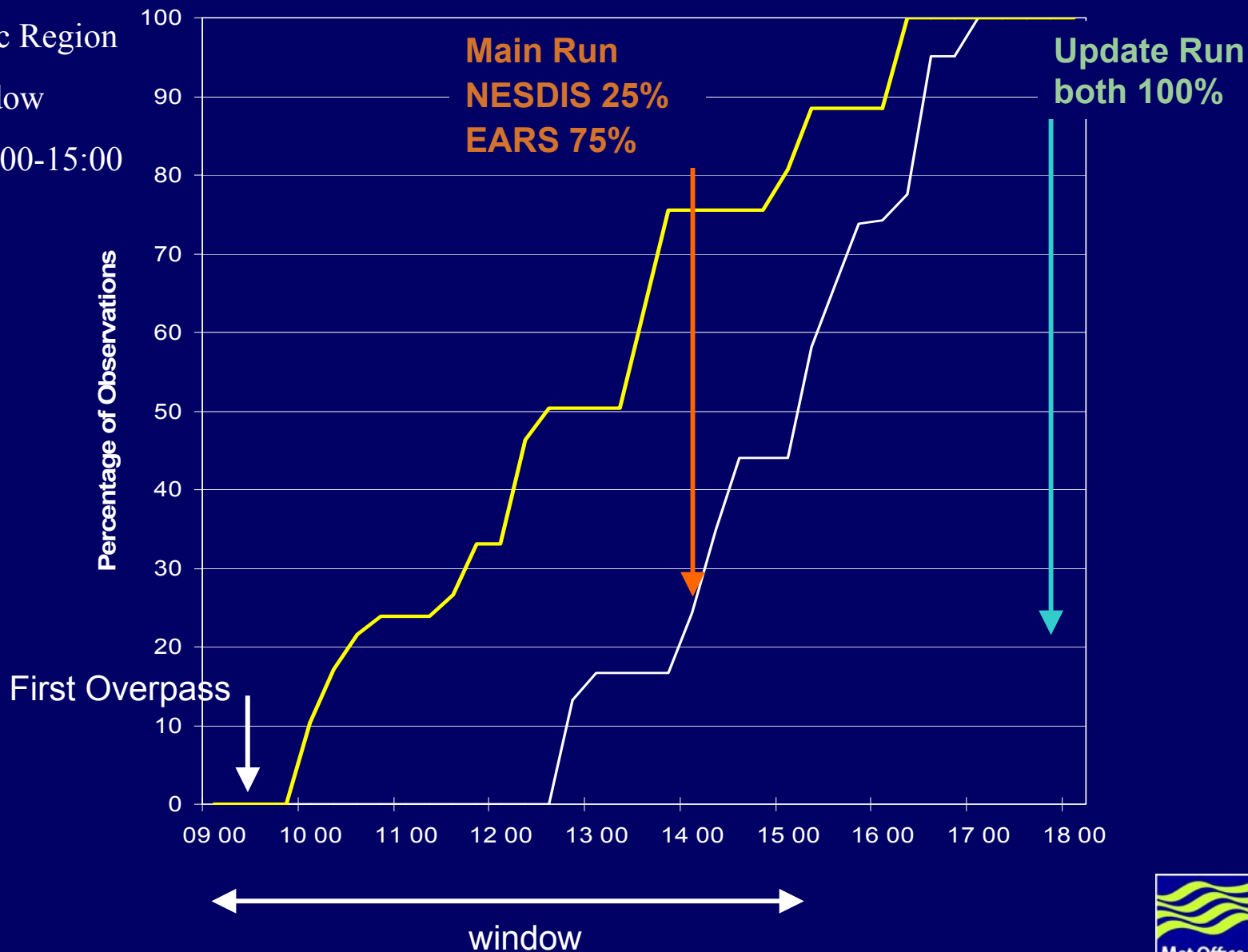
# Arrival Times of Data

— Global 109229 obs — EARS 93979 Obs

• North Atlantic Region

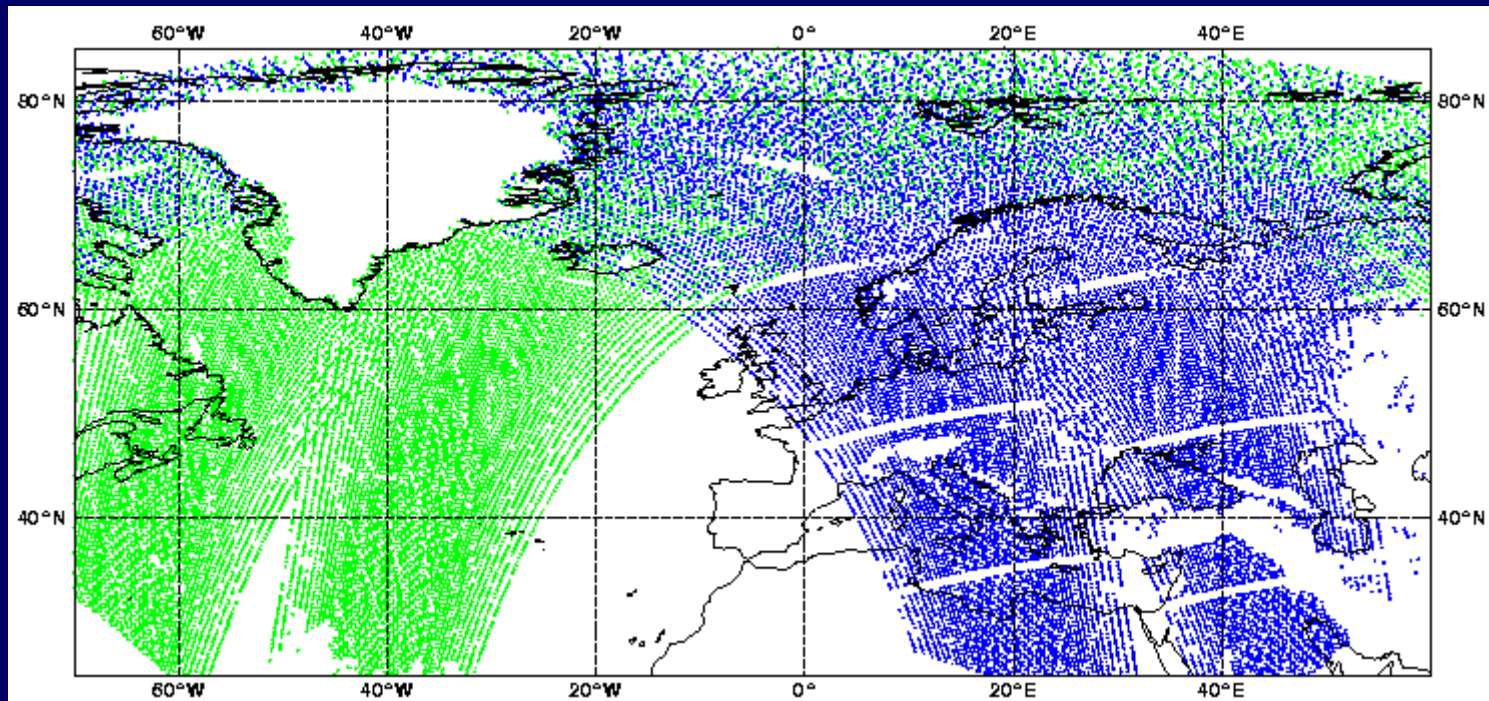
• six-hour window

09/09/2003 09:00-15:00



# Global AMSU Data Used in the Main Run

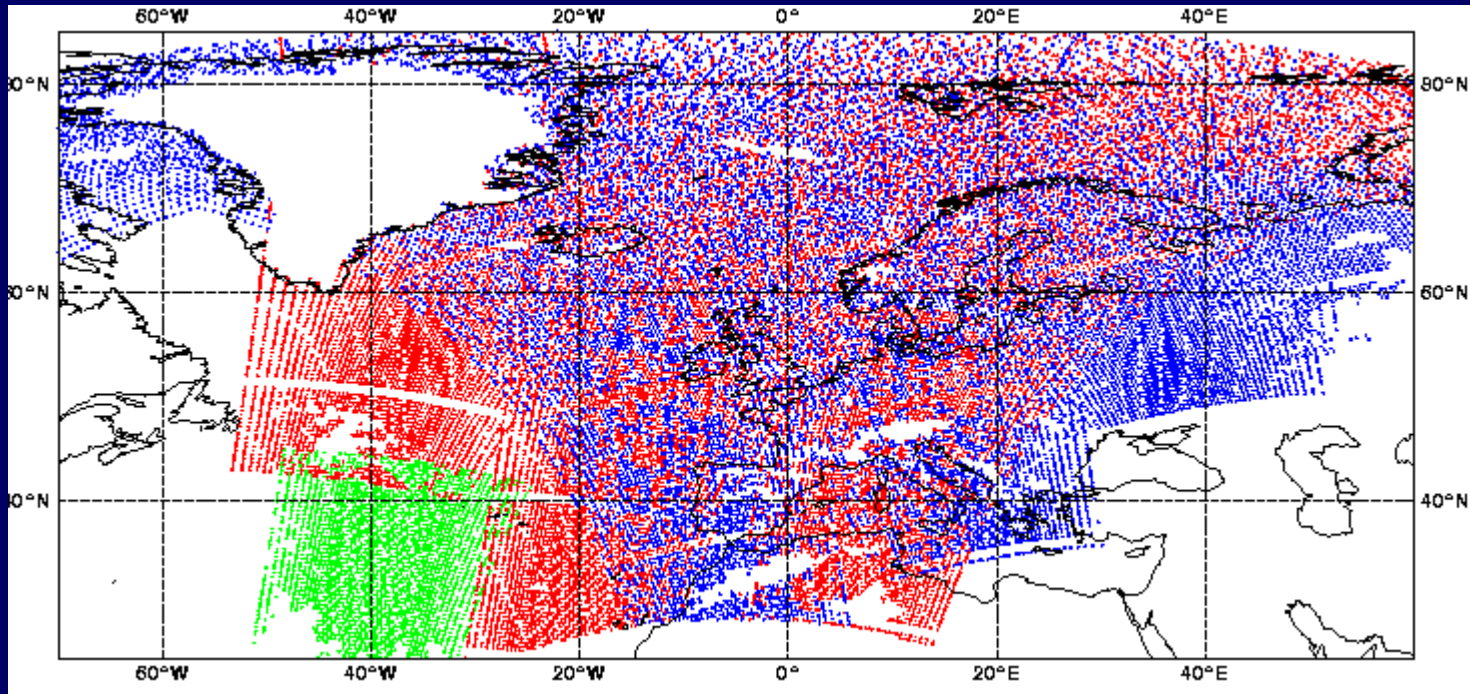
six-hour window 09/09/2003 09:00-15:00



Green: NOAA 15 Blue: NOAA 16 Red: NOAA 17

# Available EARS AMSU Data

six-hour window 09/09/2003 09:00-15:00



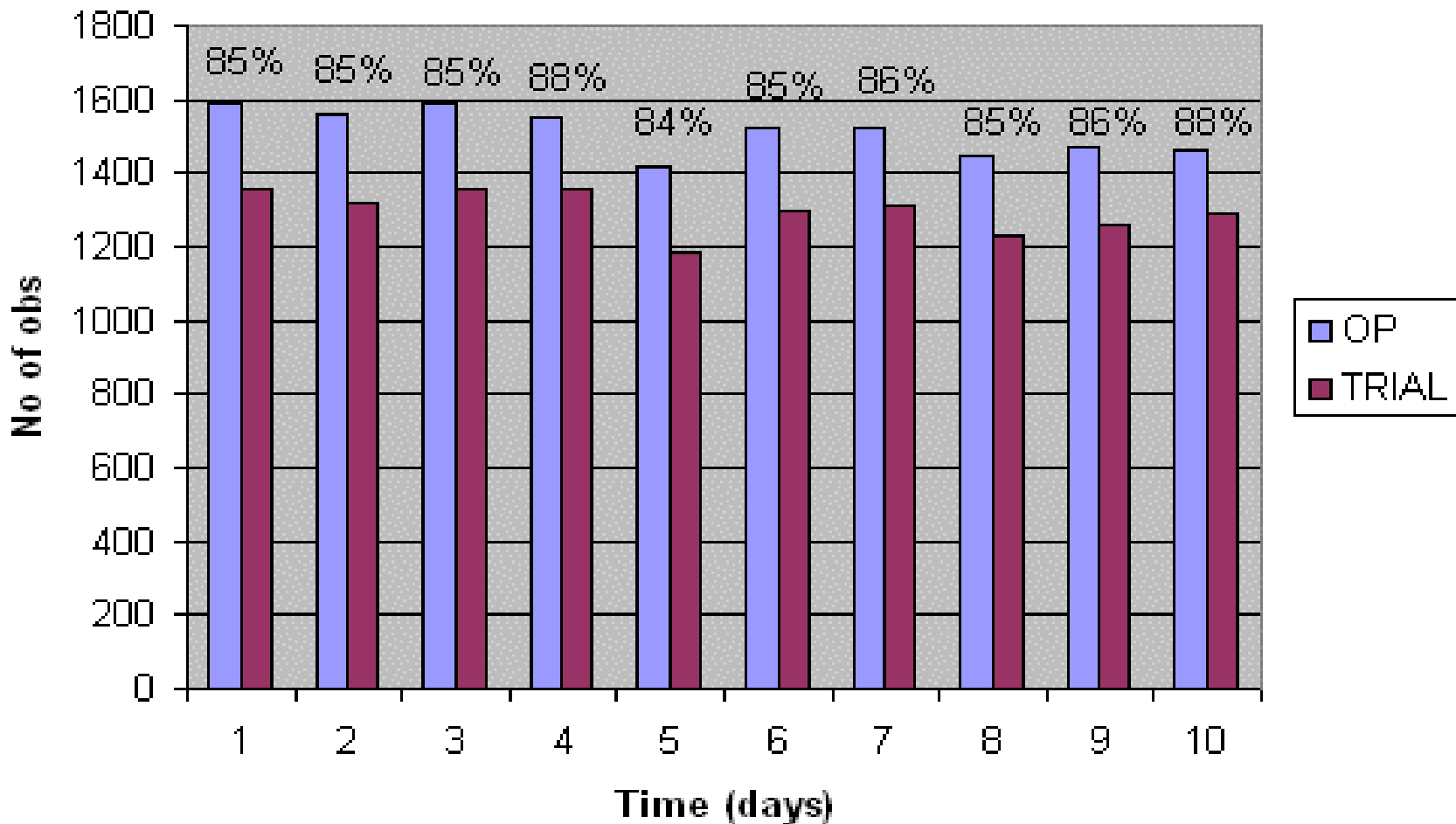
Green: NOAA 15 Blue: NOAA 16 Red: NOAA 17

# Timeliness of other data

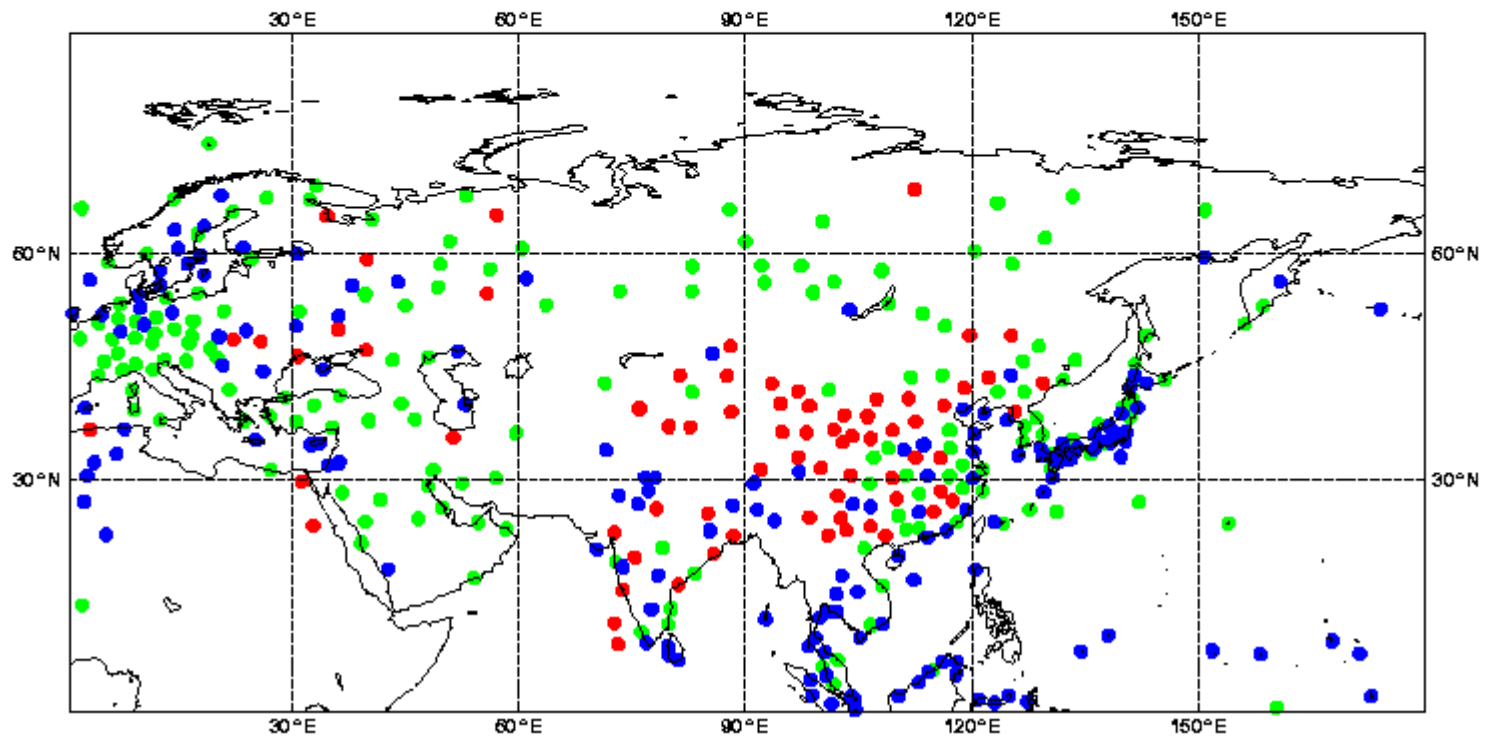
- Radiosondes
- Cloud track winds
- Aircraft (AMDARS)

# Radiosonde 3hr (blue) vs 1:50 (red)

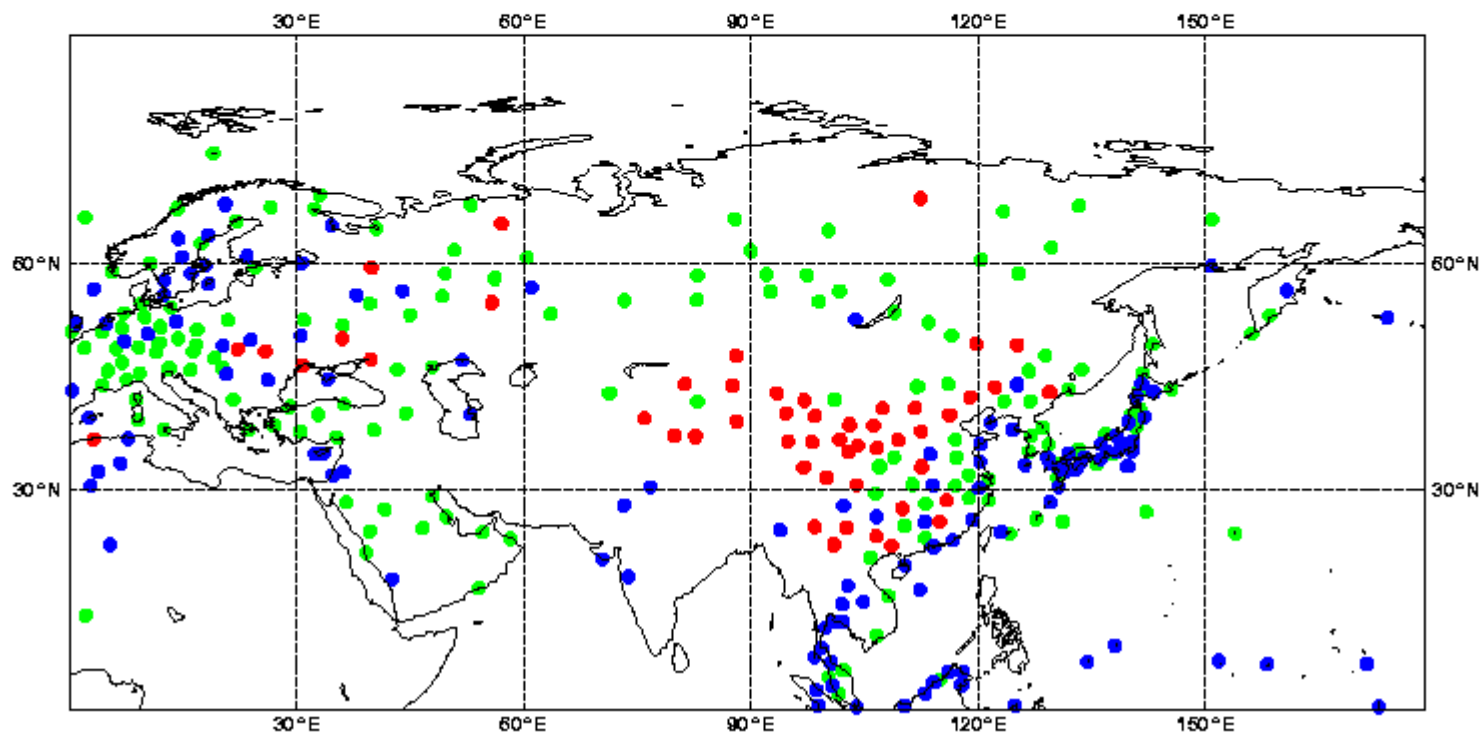
SONDE - 86%



# Radiosonde timeliness 3hr cut off



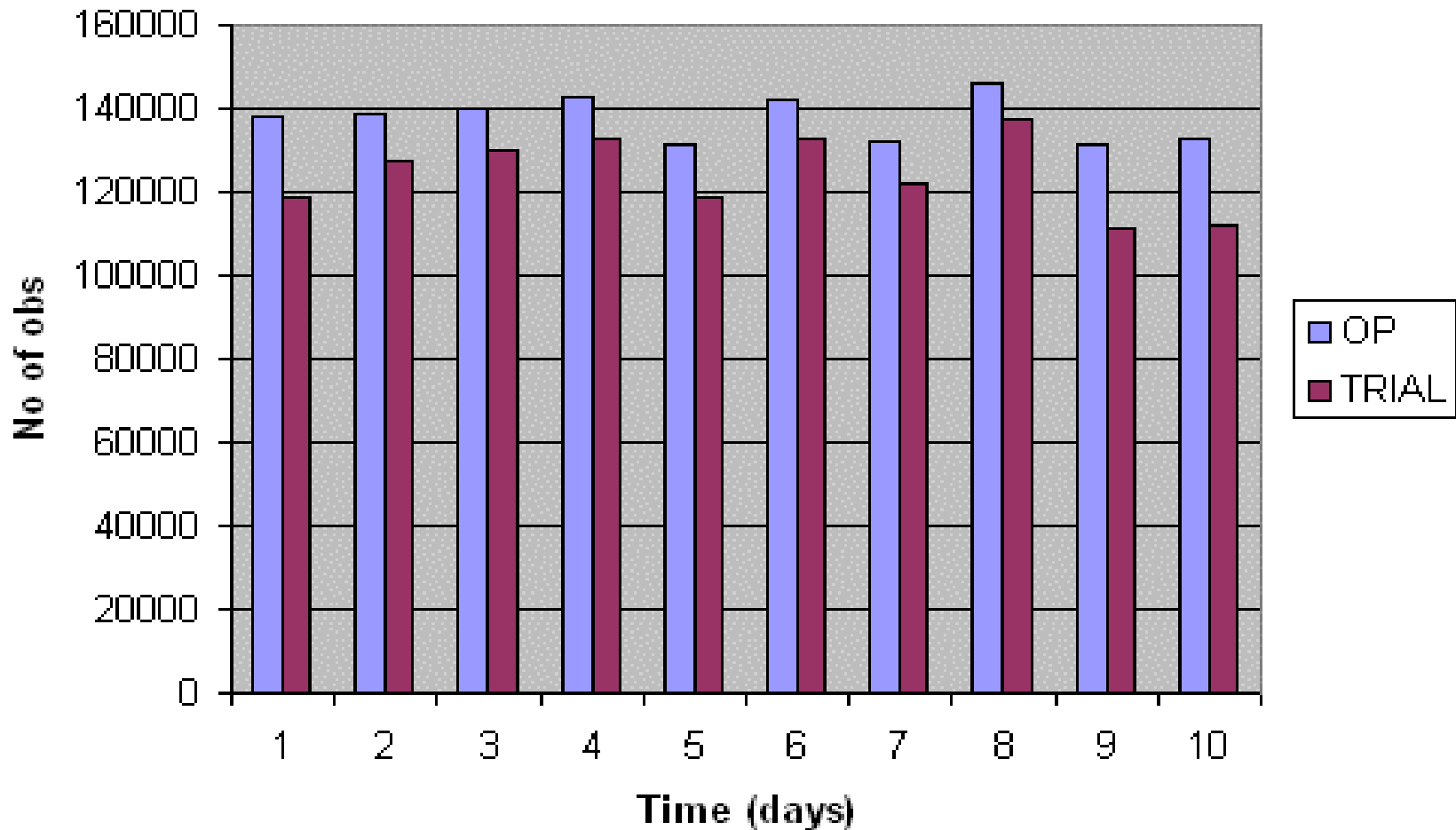
# Radiosonde timeliness cut-off 1:50





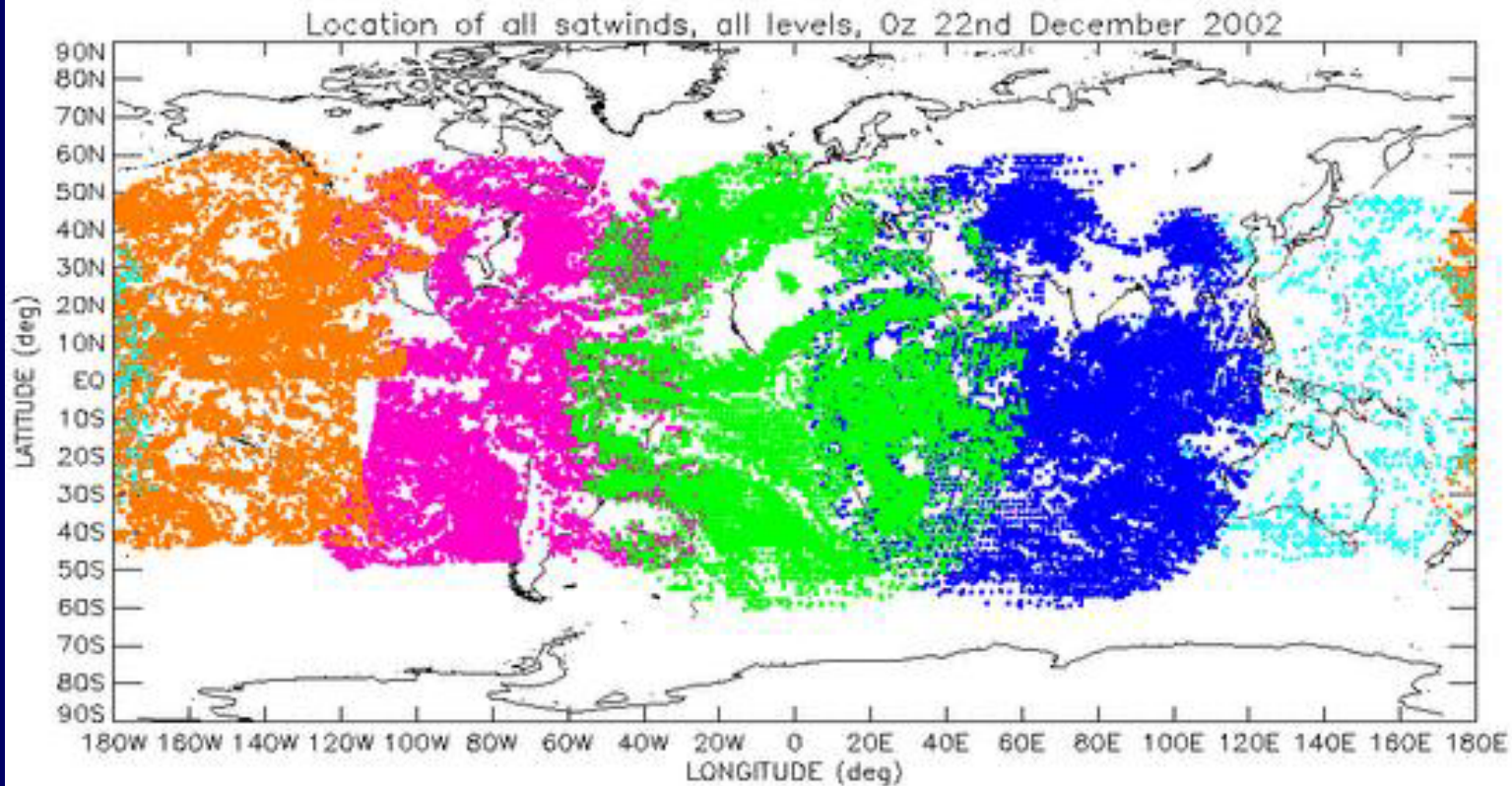
# Sat Winds 3hr (blue) vs 1:50 (red)

SATWIND



# All satwinds available for one global run

00Z 22 December, 2002 Number winds available = 84914



GOES-10

GOES-8

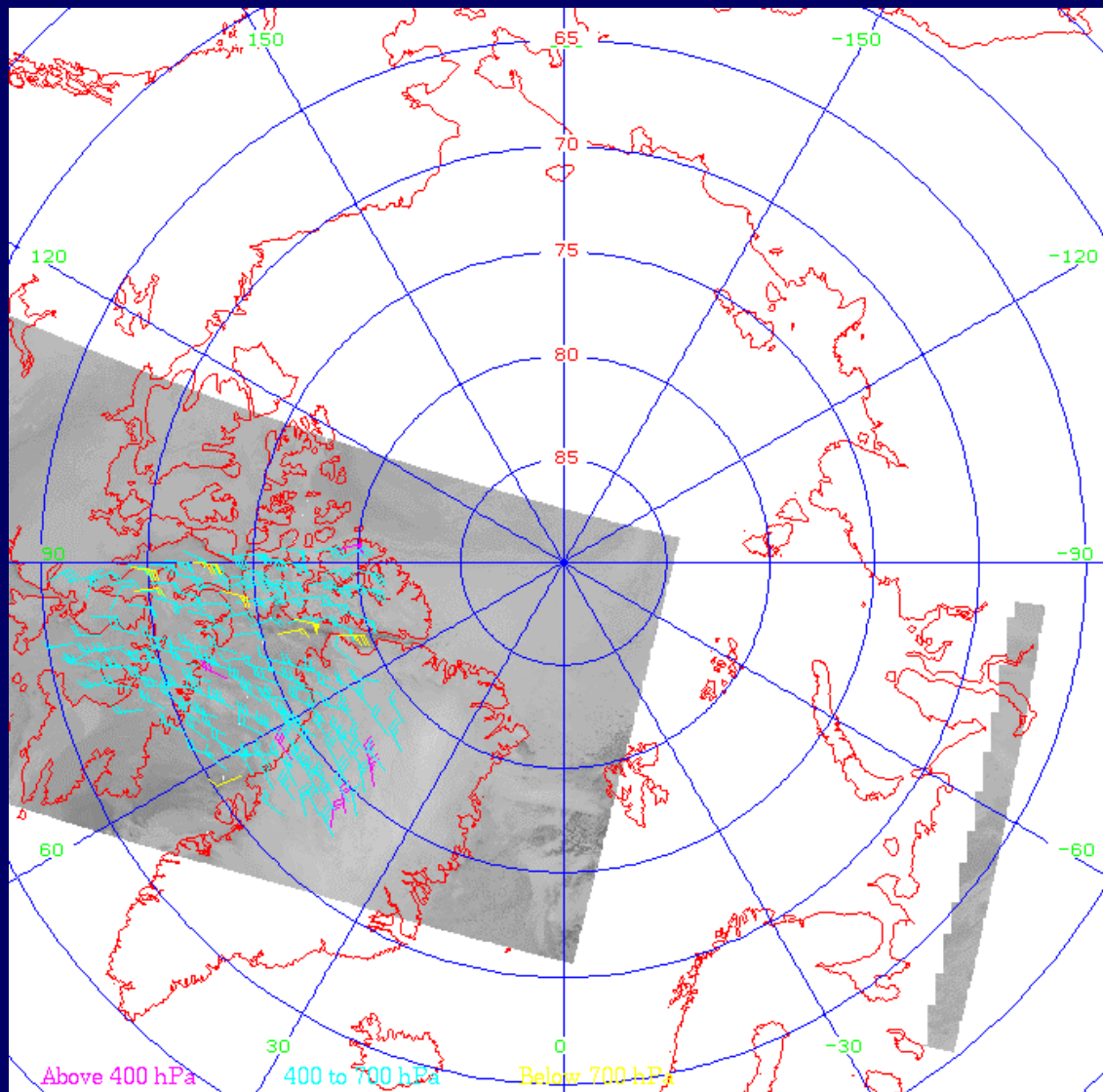
Meteosat-7

Meteosat-5

GMS-5

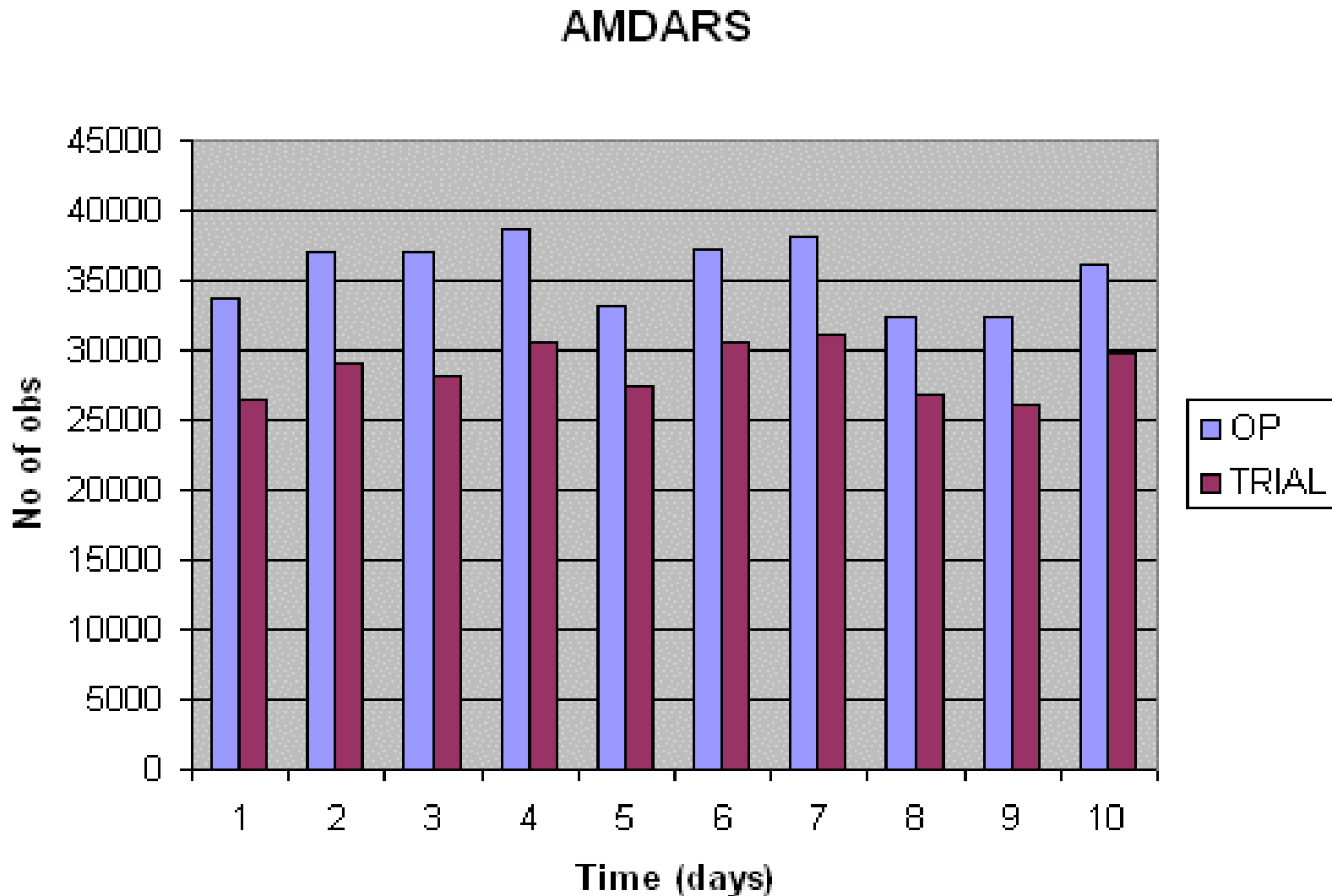


# MODIS polar winds



- MODIS imagery from Terra and Aqua used to generate winds.
- IR(11 $\mu$ m) and WV (6.7 $\mu$ m) channels
- 100 min between overlapping images.
- **Time delay of 5-6 hours after valid time before winds are available.**
- Still experimental. Met Office obtains them via ECMWF.

# AMDAR data 3hr (blue) vs 1:50 (red)

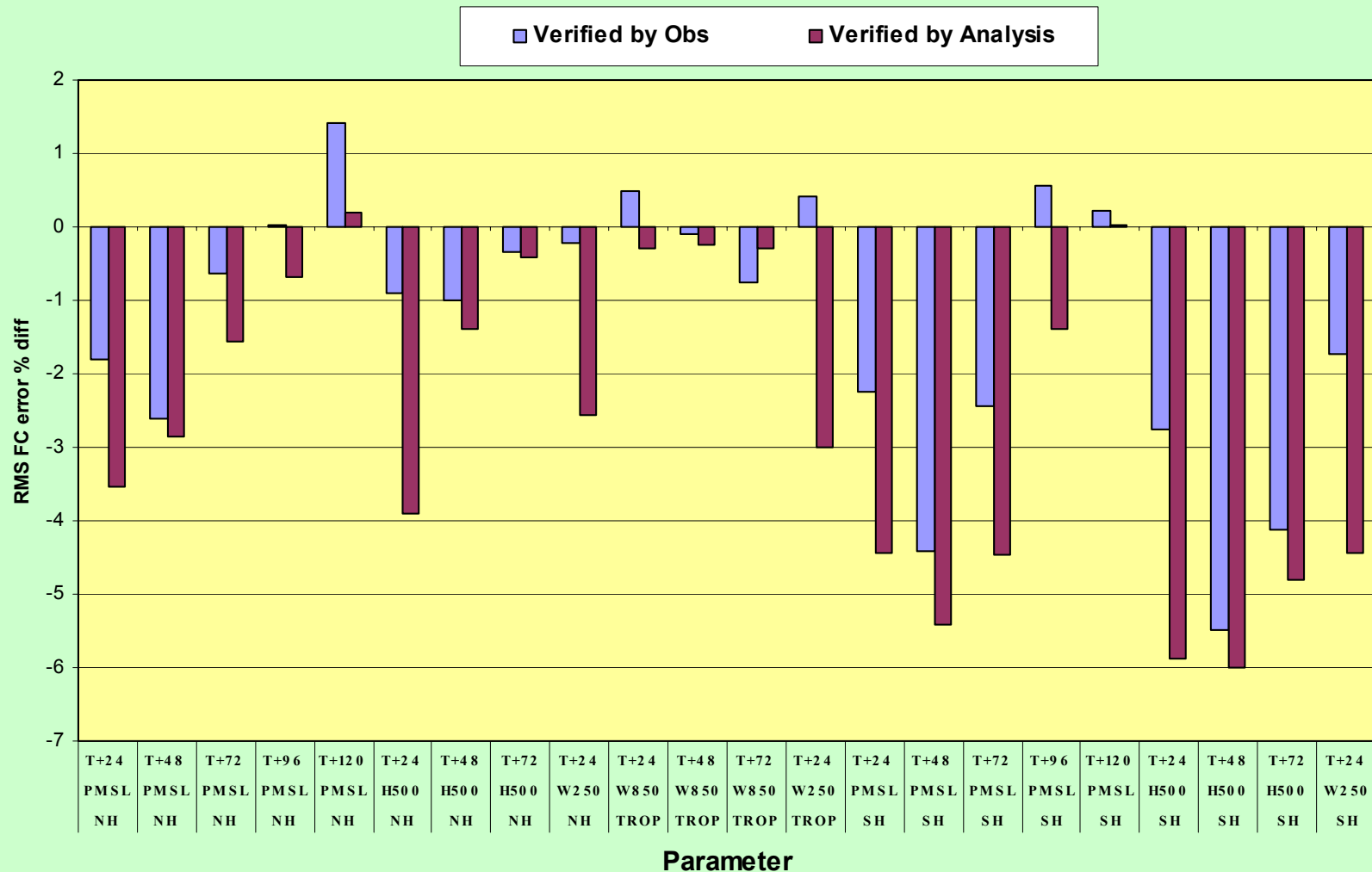


# Experiment to assess impact of early cut-off on forecasts

- Period 12 May – 4 June 2003
- NOAA level 1b radiances used:
  - NOAA-15 AMSU-A/AMSU-B
  - NOAA-16 HIRS/AMSU-A/AMSU-B
  - NOAA-17 HIRS/AMSU-A/AMSU-B
- **Control:** All data received before 1:50 (Ops) for main run and all late ATOVS used in update run
- **Experiment:** All data received before 1:50 + all late ATOVS received (up to 50% more data) used in main model run

# Forecast impacts

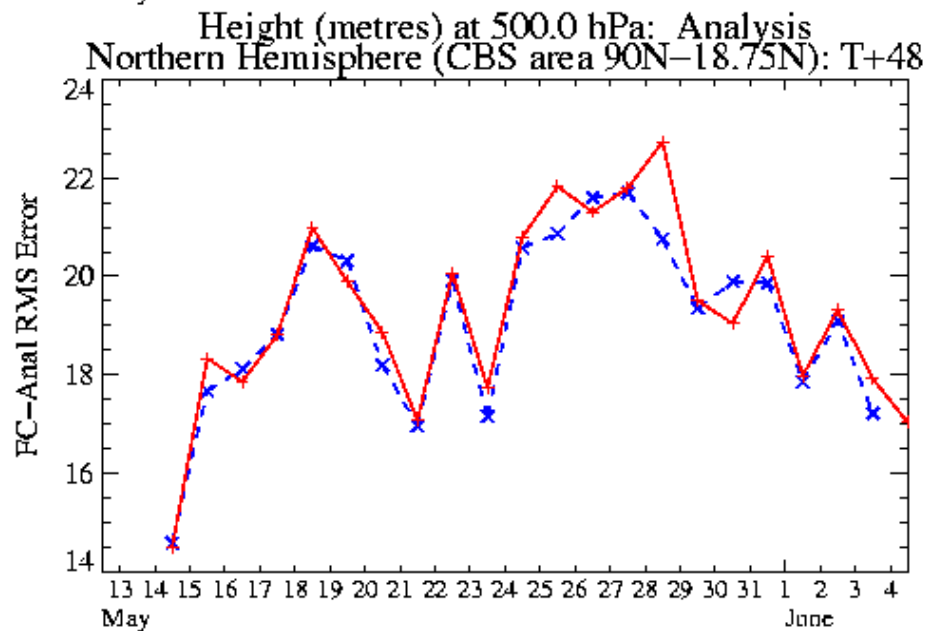
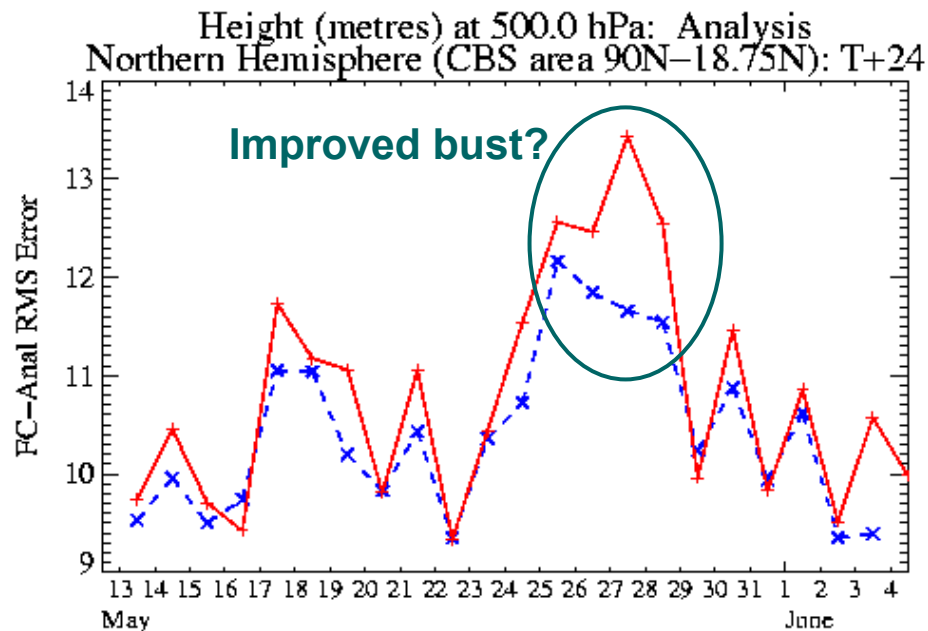
## Effect of including ALL ATOVS



# Forecast impacts

## N. Hem 500hPa

Cases:  $\text{---}\times\text{---}$  1:50 cut-off  $\text{---}\times\text{---}$  AllATOVS

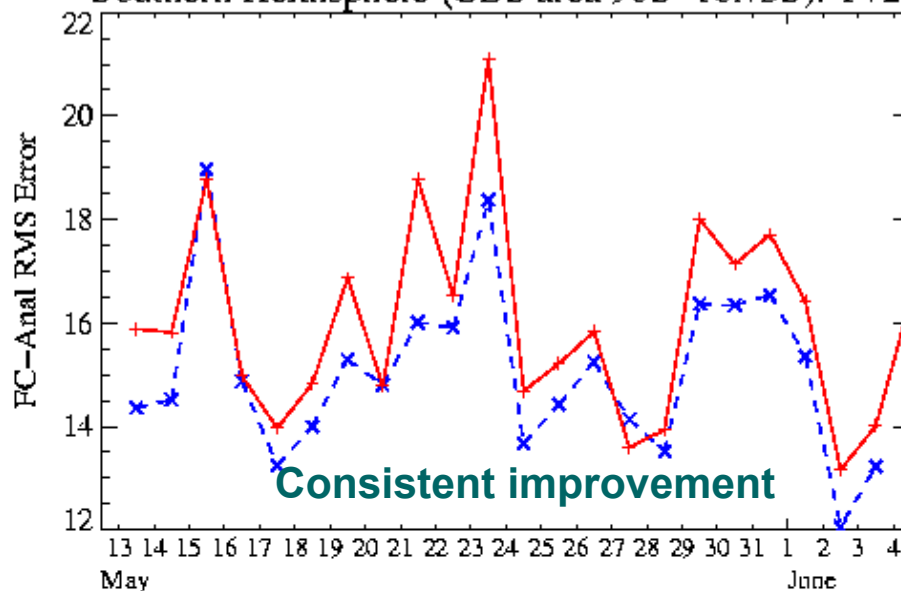


# Forecast impacts

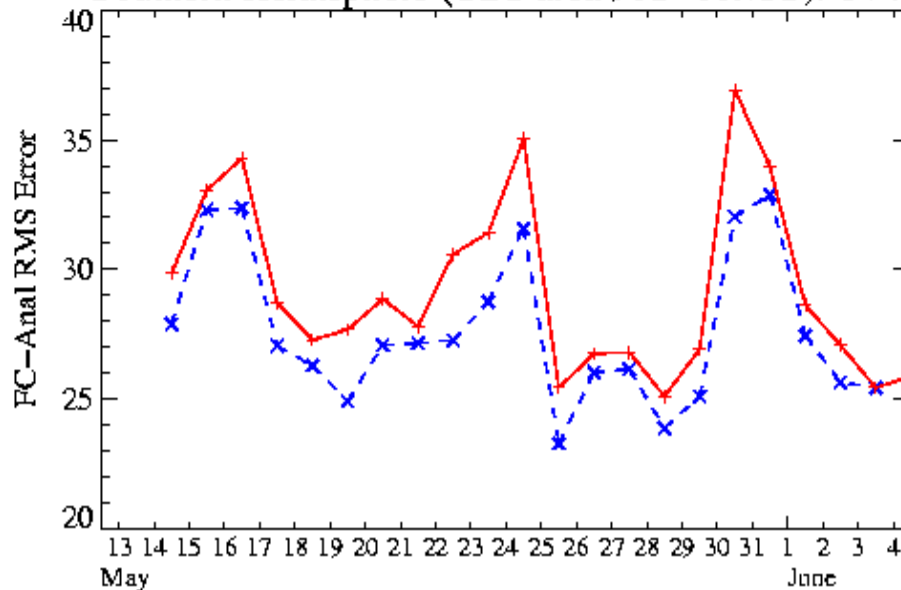
## S. Hem 500hPa

Cases: 1:50 cut-off \*-\* AllATOVS

Height (metres) at 500.0 hPa: Analysis  
Southern Hemisphere (CBS area 90S-18.75S): T+24

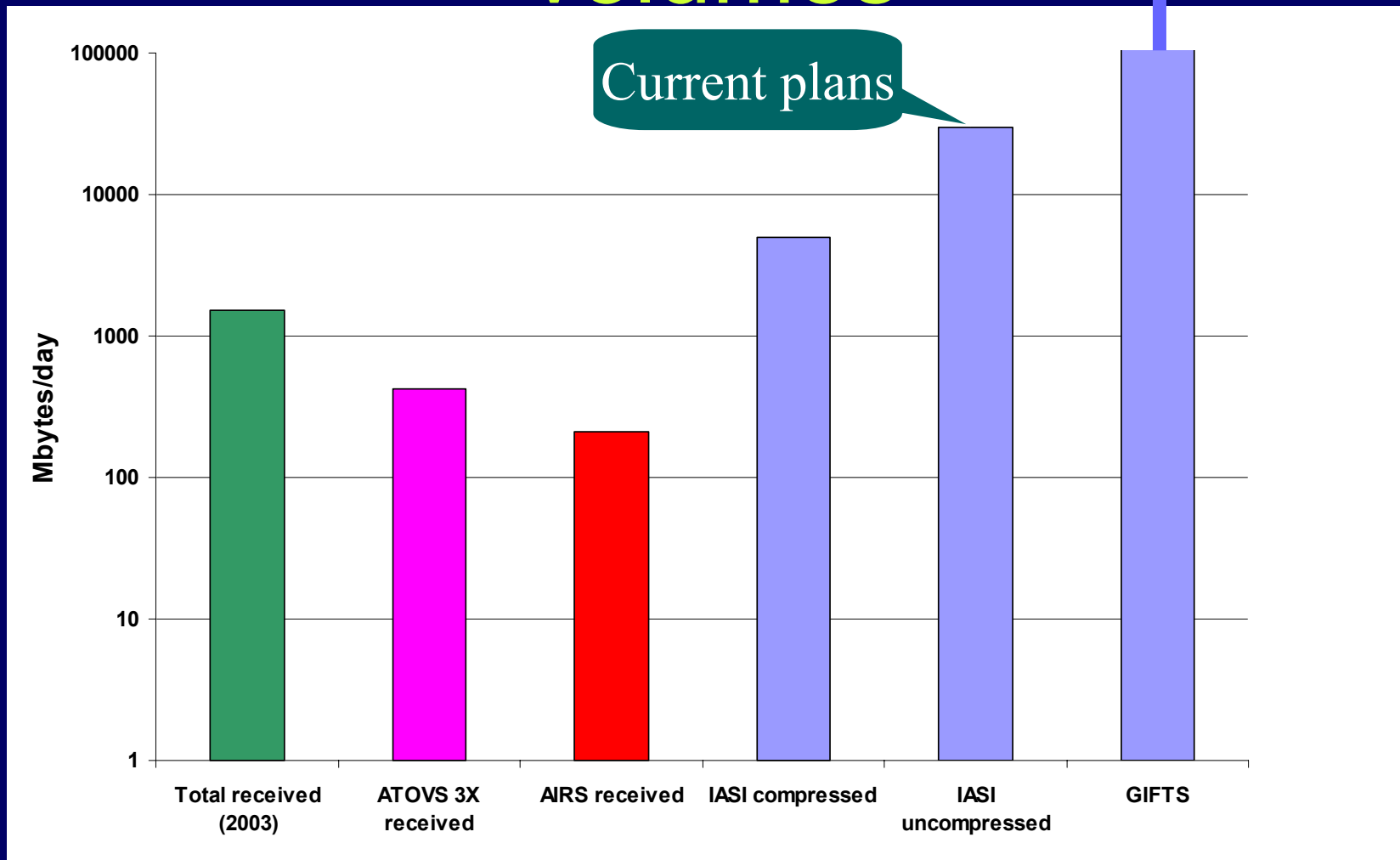


Height (metres) at 500.0 hPa: Analysis  
Southern Hemisphere (CBS area 90S-18.75S): T+48





# Advanced sounder data volumes



That's it!

Any questions?