



# **The GRAS SAF project and its Role in the European Polar System**

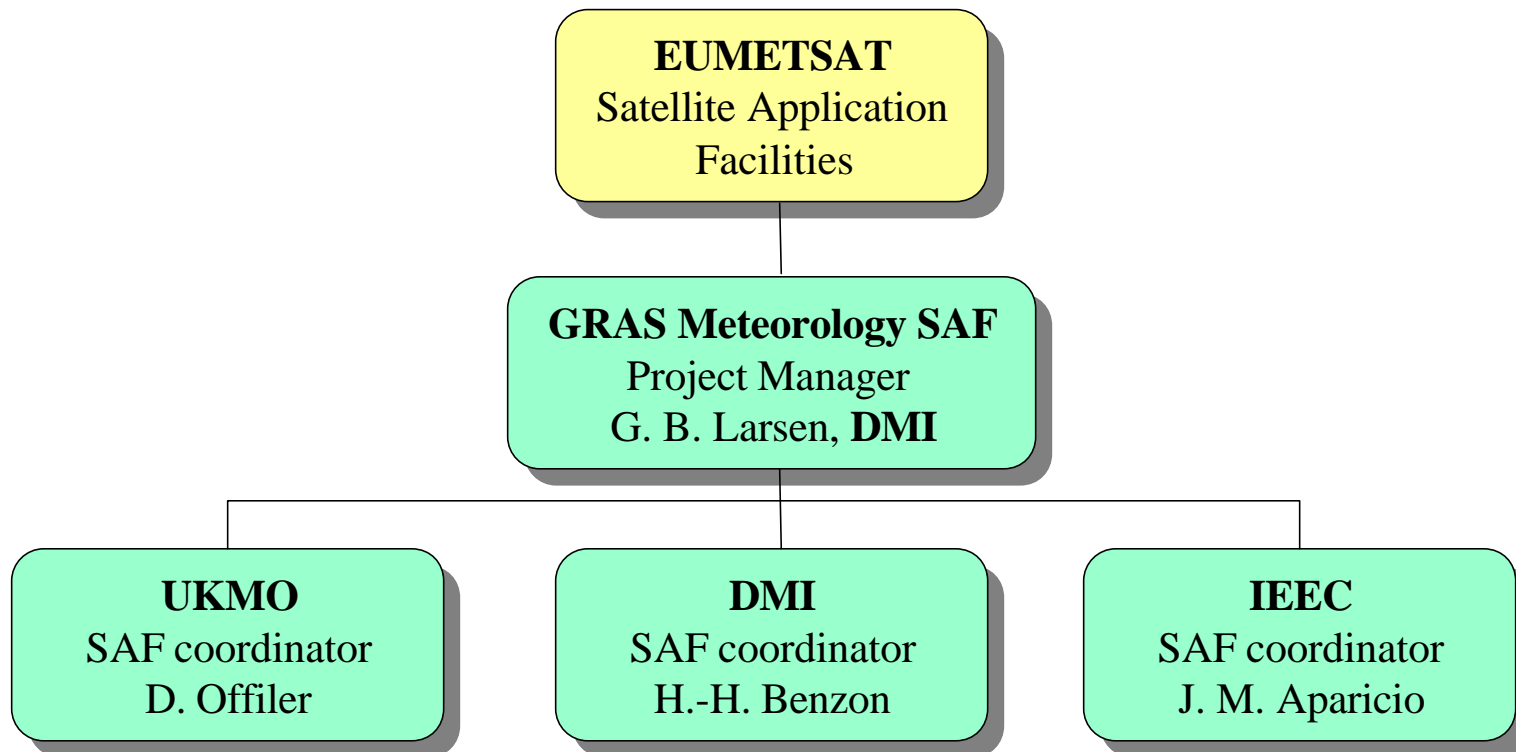
By

**Georg Bergeton Larsen**

Danish Meteorological Institute

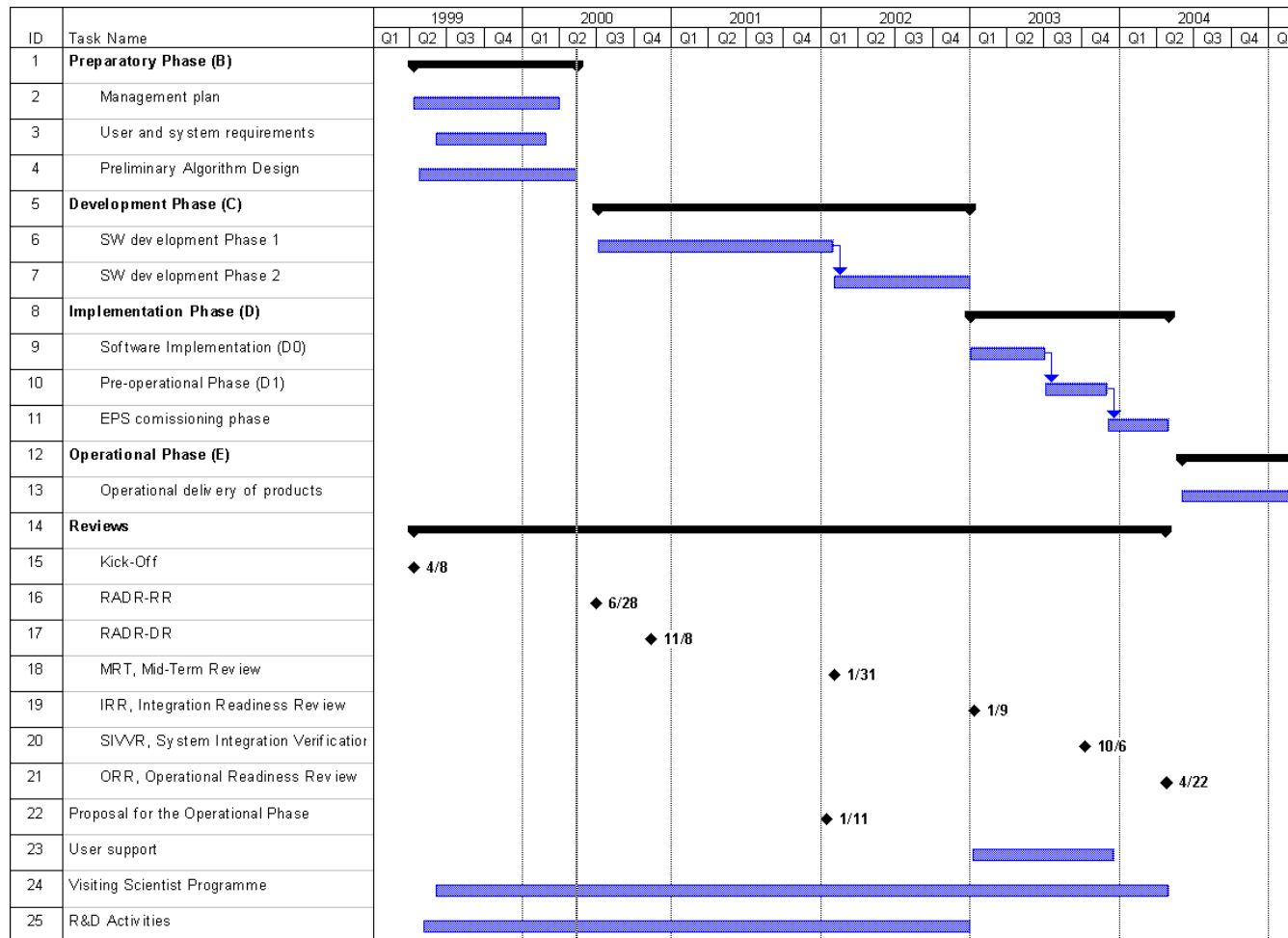


# GRAS SAF Organisation

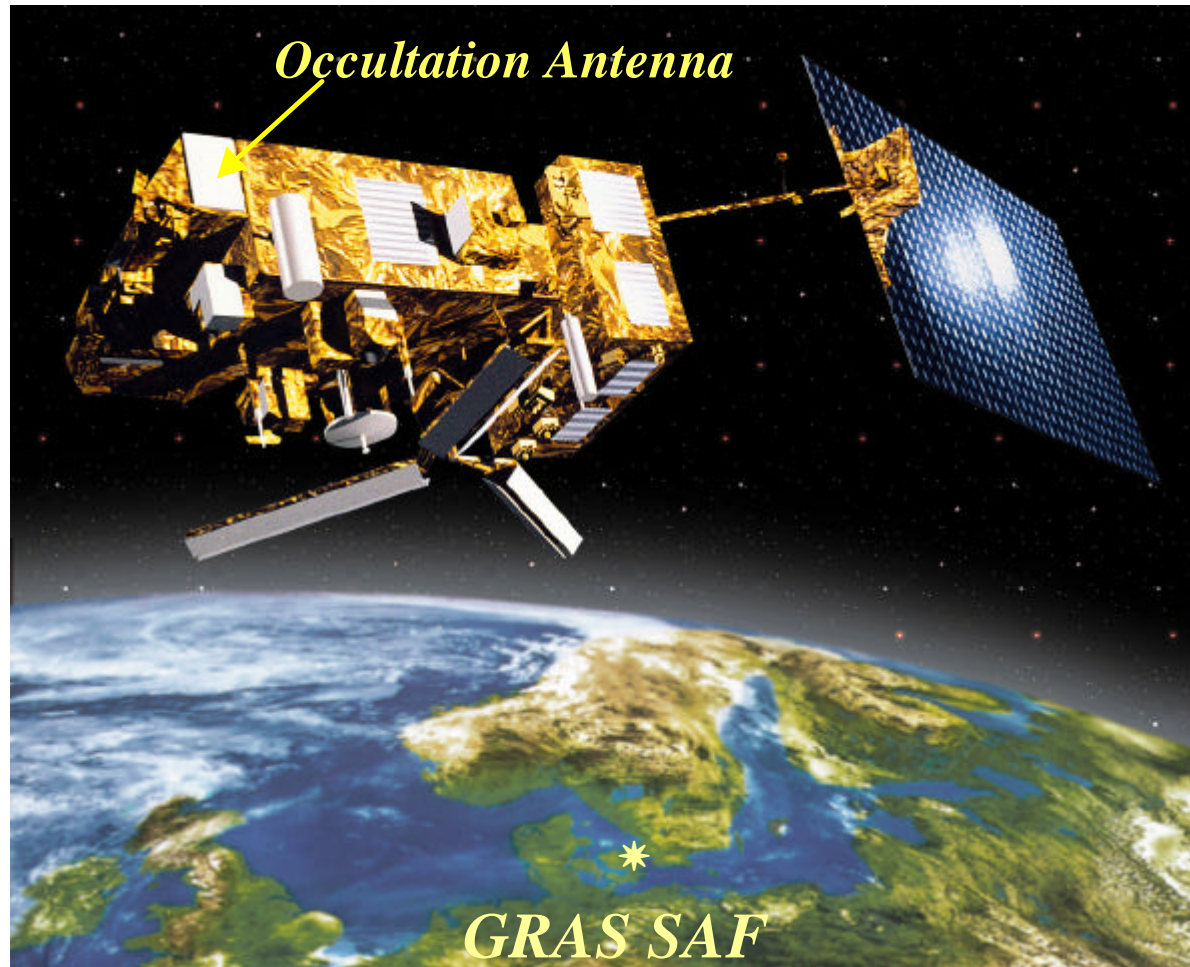




# Project Schedule

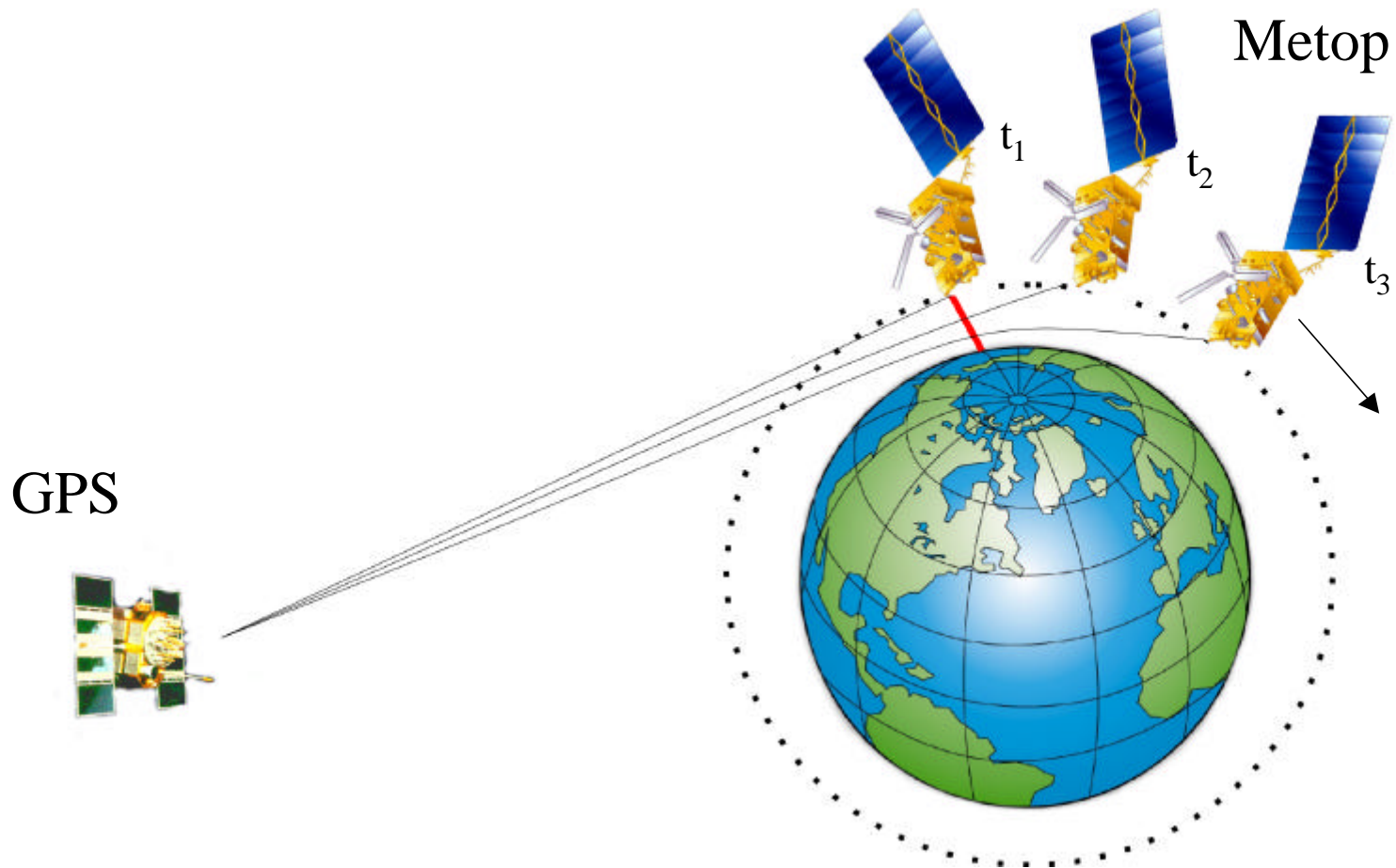


# The GRAS instrument on EPS

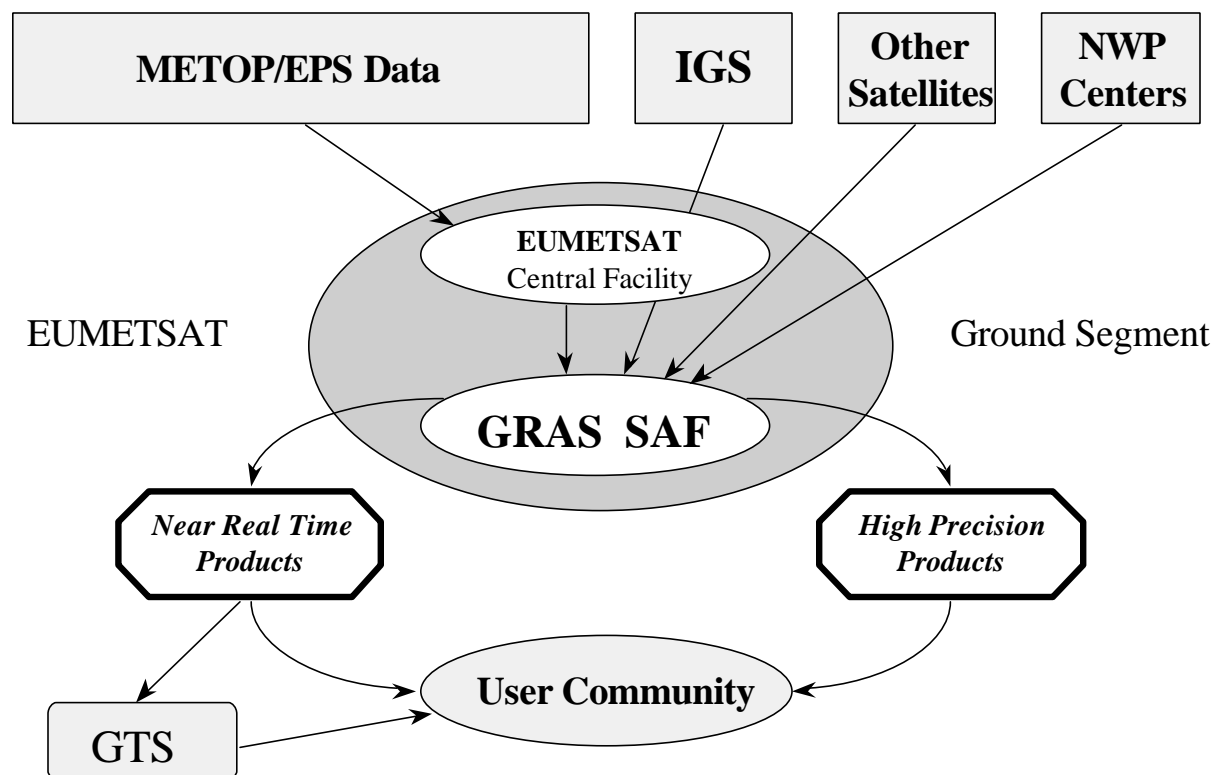


Workshop on GPS/RO Remote Sensing of the Atmosphere, Washington D.C. 16-17 May 2000

# GRAS Atmosphere profiling

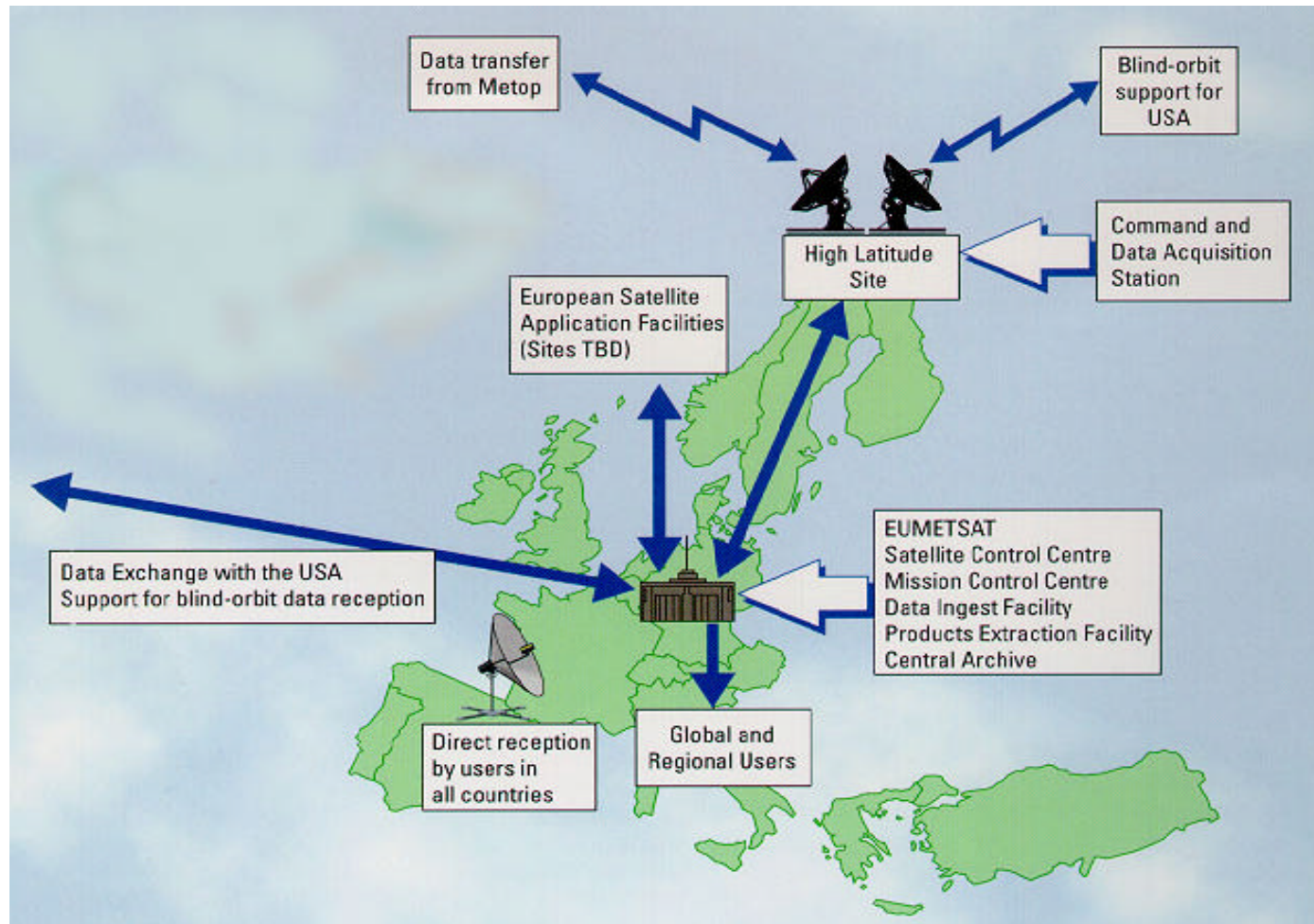


# Data flow real time system



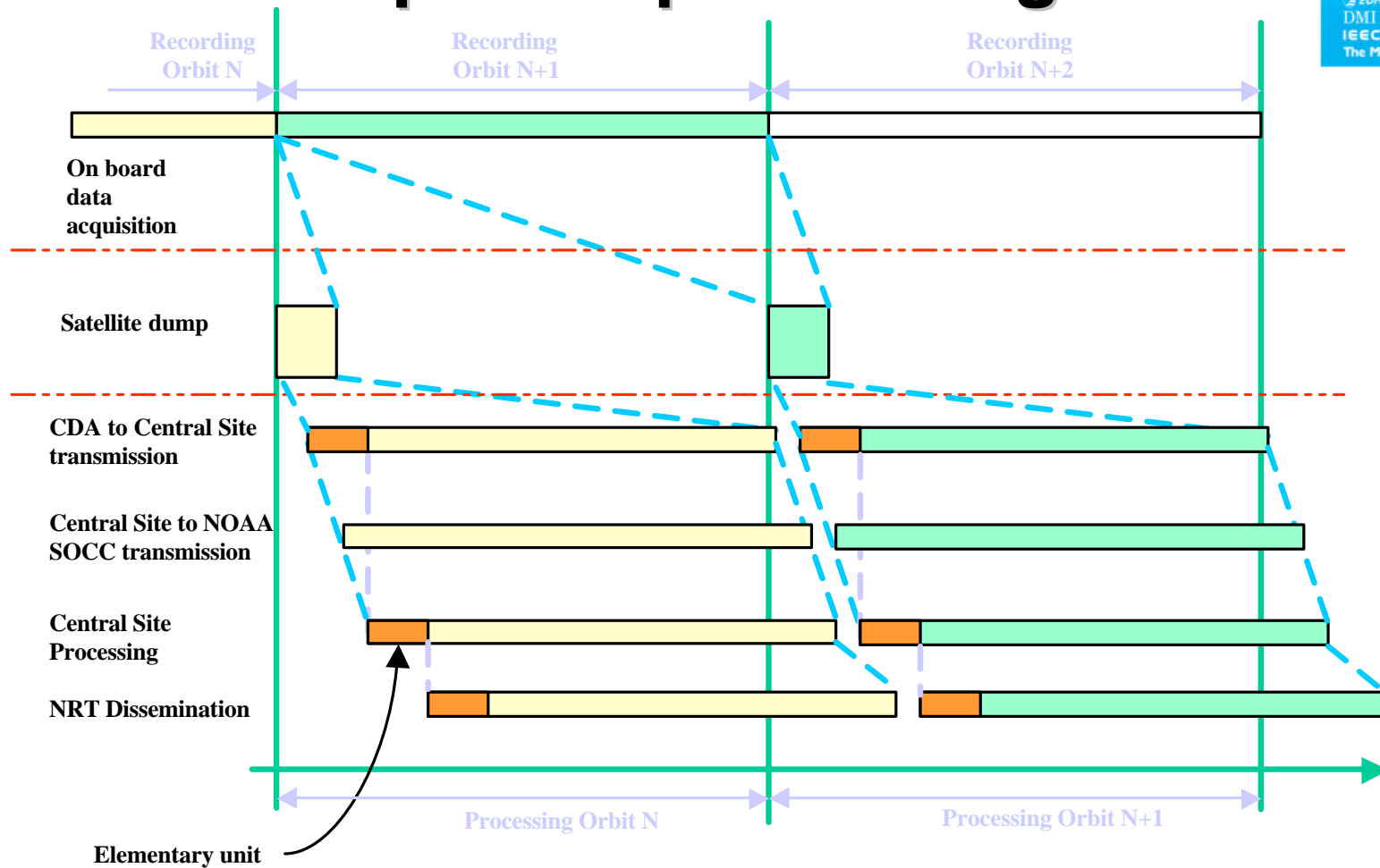


# European Polar System (EPS)





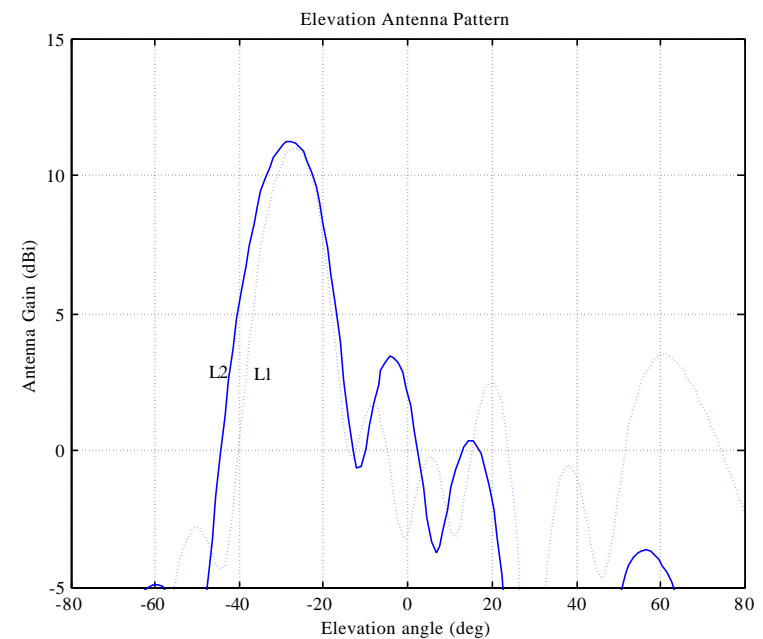
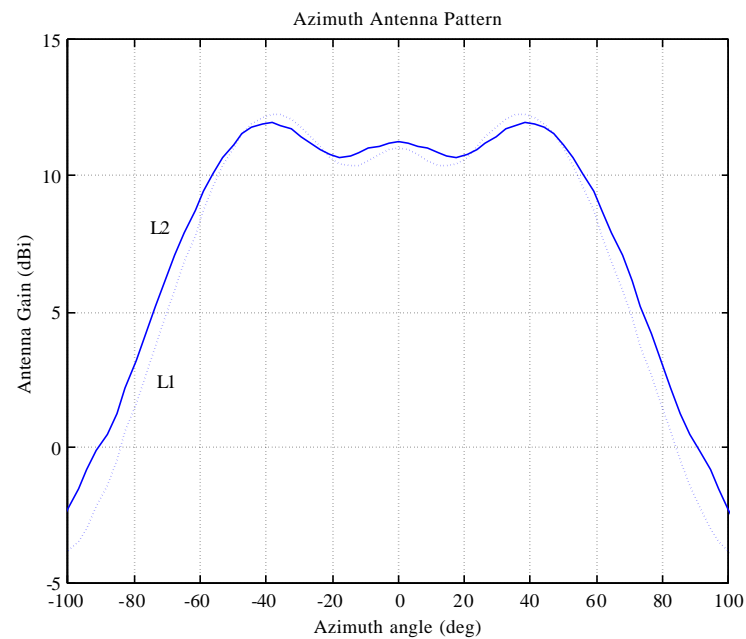
# Pipe line processing



EUMETSAT SAF Technical Coordination Meeting June 1999

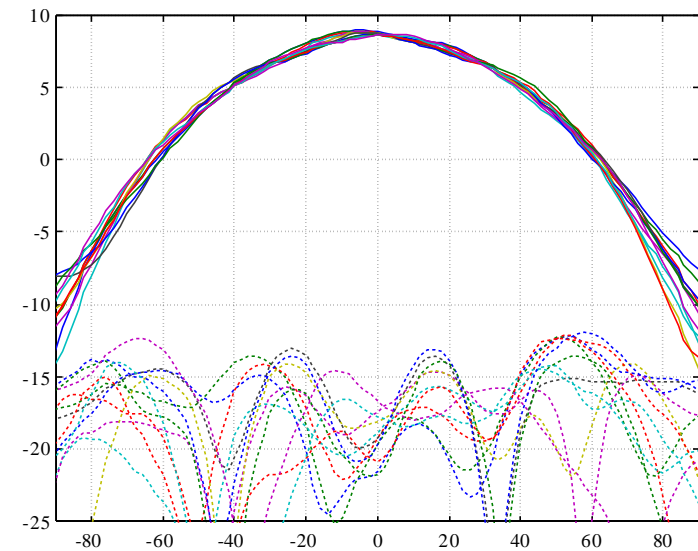
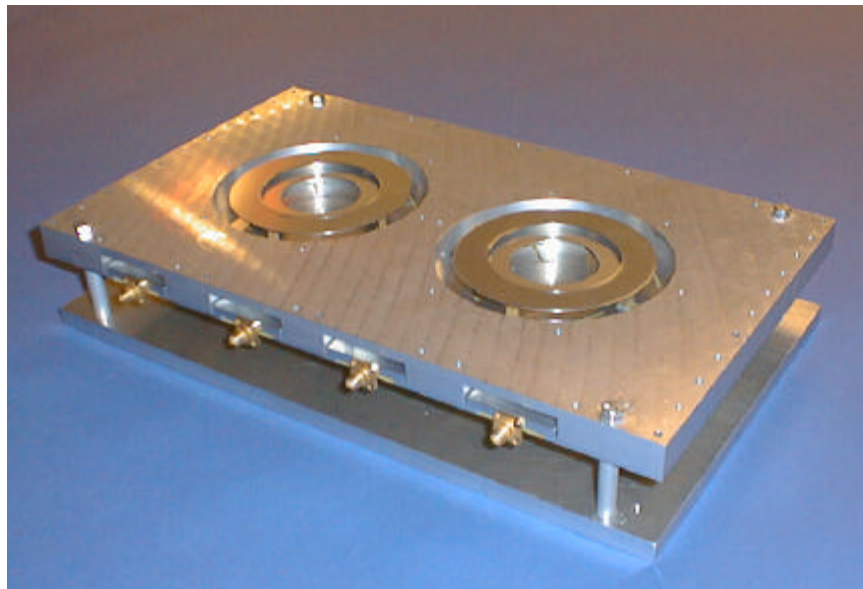


# GAVA/GVA Performance

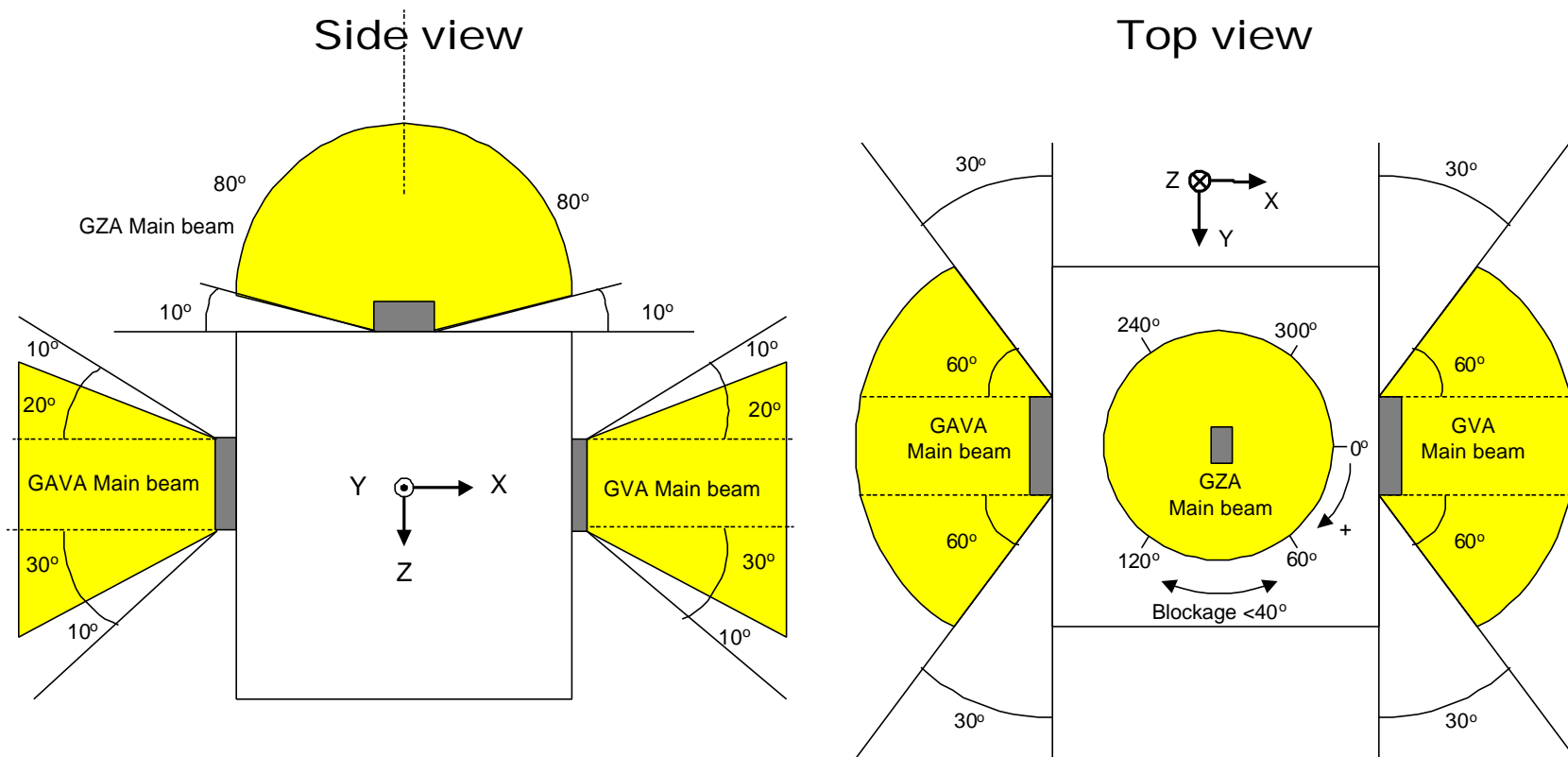


# GRAS Zenith Antenna GZA

Two element antenna, L1 and L2



# Antenna Field of View





# Software Deliverables for NRT Products

DMI, IEEC

- **Data products (B) and (C)**
  - ◆ Refractivity profiles
  - ◆ Temperature profiles
  - ◆ Pressure profiles
  - ◆ Water vapor profiles
  - ◆ Geographical location

UKMO

- **4DVAR Assimilation Software**
  - ◆ Forward operators
  - ◆ Error covariance matrix



# Generic User requirements

		Temperature	Specific Humidity	Integrated WV	Surface Pressure
<b>Horizontal Domain</b>		Global	Global	Global	Global
<b>Horizontal Resolution</b> <sup>1)</sup>		50–500 km	50–250 km	50–500 km	50–250km
<b>Vertical Domain</b>		Sfc to 1 hPa	Sfc to 100 hPa	Column	Sfc (msl)
<b>Vertical Resolution</b> <sup>2)</sup>	LT	0.3–3 km	0.4–2 km	–	–
	HT	1–3 km	1–3 km	–	–
	LS	1–3 km	–	–	–
	HS	1–3 km	–	–	–
<b>Time Resolution</b> <sup>3)</sup>		1–12 hrs	1–12 hrs	1–12 hrs	1–12hrs
<b>RMS Accuracy</b> <sup>4)</sup>	LT	0.5–3 K	0.25–1 g/kg <sup>5)</sup>	1–5 kg/m <sup>2</sup>	0.5–2 hPa
	HT	0.5–3 K	0.025–0.1 g/kg <sup>5)</sup>	–	–
	LS	0.5–3 K	–	–	–
	HS	0.5–5 K	–	–	–
<b>Timeliness</b>		1–4 hrs	1–4 hrs	1–4 hrs	1–4hrs

Table 1. Generic User Requirements for global NWP  
(Source: WMO TD No. 913, SAT-21, 28/9/1998)



# GRAS Metop User Requirements

		Temp	Specific Humidity	IWV	Surface Pressure	Refractivity	Bending Angle
<b>Horizontal Domain</b>		Global	Global	Global	Global	Global	Global
<b>Horizontal Sampling</b>		100–2000km	100 – 2000km	100–2000km	100–2000km	100–2000km	100–2000km
<b>Vertical Domain</b>		Sfc–1 hPa	Sfc–100 hPa	Column	Sfc (msl)	Sfc–1 hPa	Sfc–80 km
<b>Vertical Sampling</b>	LT	0.3–3km	0.4–2 km	–	–	0.3–3 km	⋮
	HT	1–3 km	1–3 km	–	–	1–3 km	⋮
	LS	1–3 km	–	–	–	1–3 km	⋮ 2–5 Hz
	HS	1–3 km	–	–	–	1–3 km	⋮
<b>Time Window</b>		1–12 hrs	1–12 hrs	1–12 hrs	1–12 hrs	1–12 hrs	1–12 hrs
<b>RMS Accuracy</b> <sup>4)</sup>	LT	0.5–3 K	0.25–1 g/kg <sup>5)</sup>	1–5 kg/m <sup>2</sup>	0.5–2 hPa	0.1–0.5%	⋮ 1 μrad
	HT	0.5–3 K	0.025–0.1g/kg <sup>5)</sup>	–	–	0.1–0.2%	⋮ or
	LS	0.5–3 K	–	–	–	0.1–0.2%	⋮ 0.4% <sup>7)</sup>
	HS	0.5–5 K	–	–	–	0.2–2%	⋮
<b>Timeliness</b>		1–3 hrs	1–3 hrs	1–3 hrs	1–3 hrs	1–3 hrs	1–3 hrs

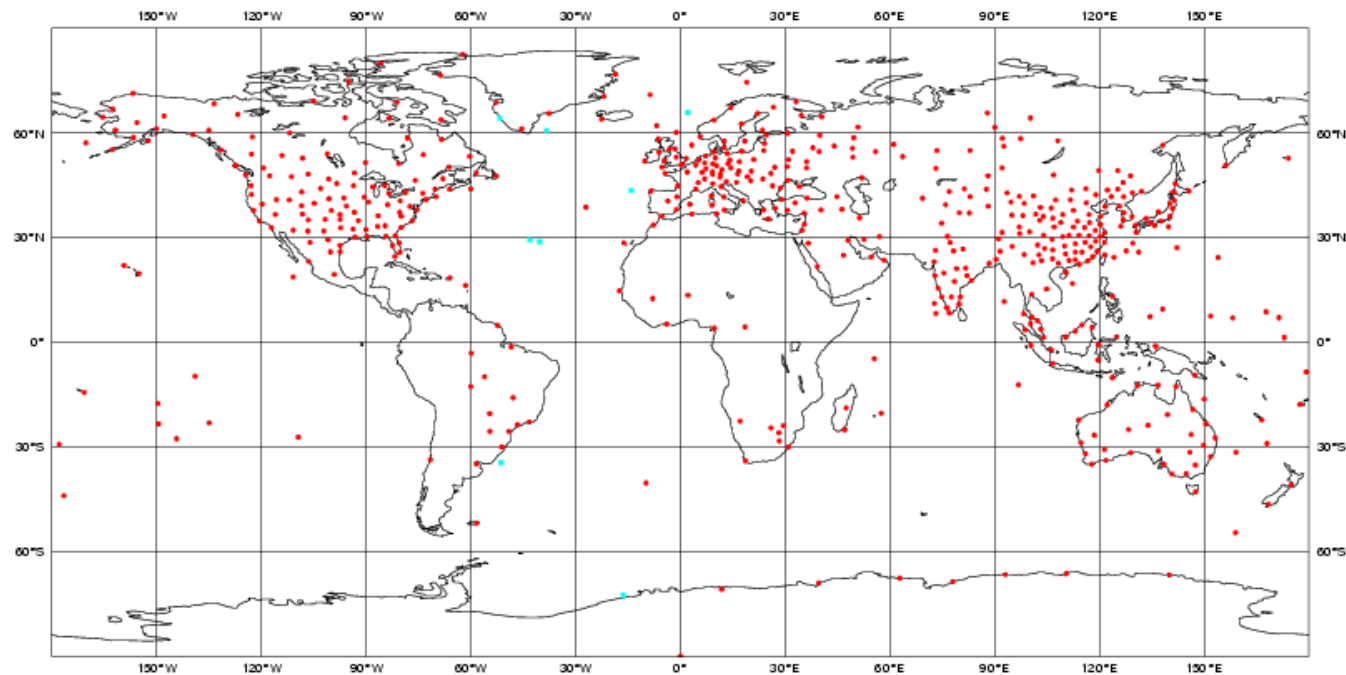
Table 1. GRAS/Metop User Requirements for Operational Meteorology



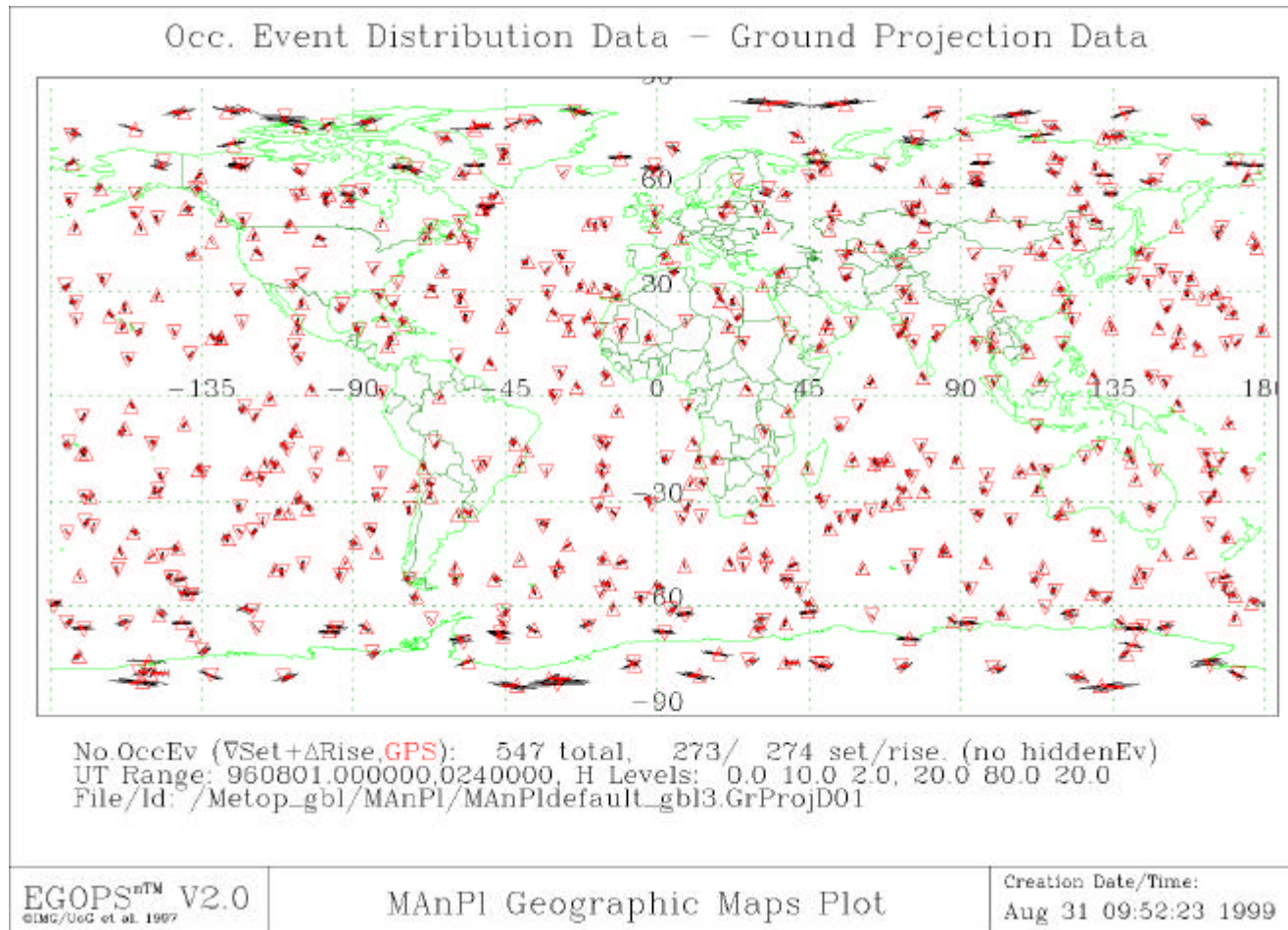
# Distribution of NWP radiosondes

ECMWF Data Coverage  
15/DEC/1999 00 UTC

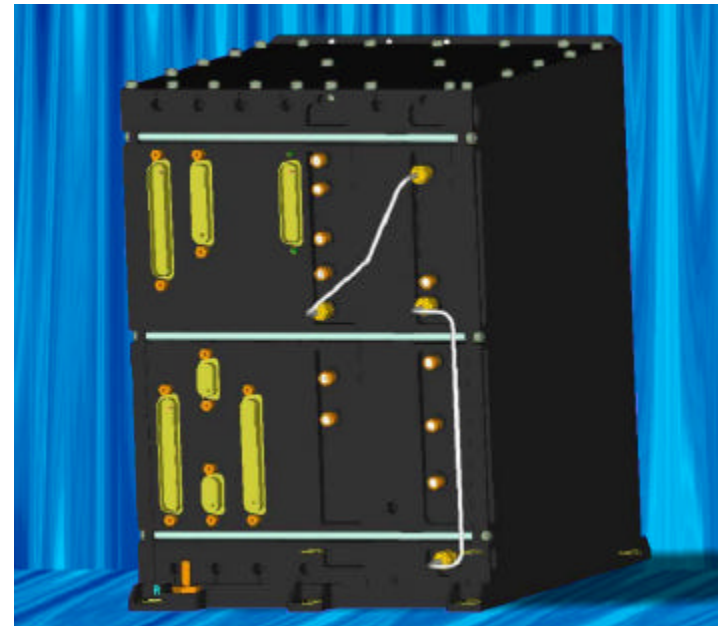
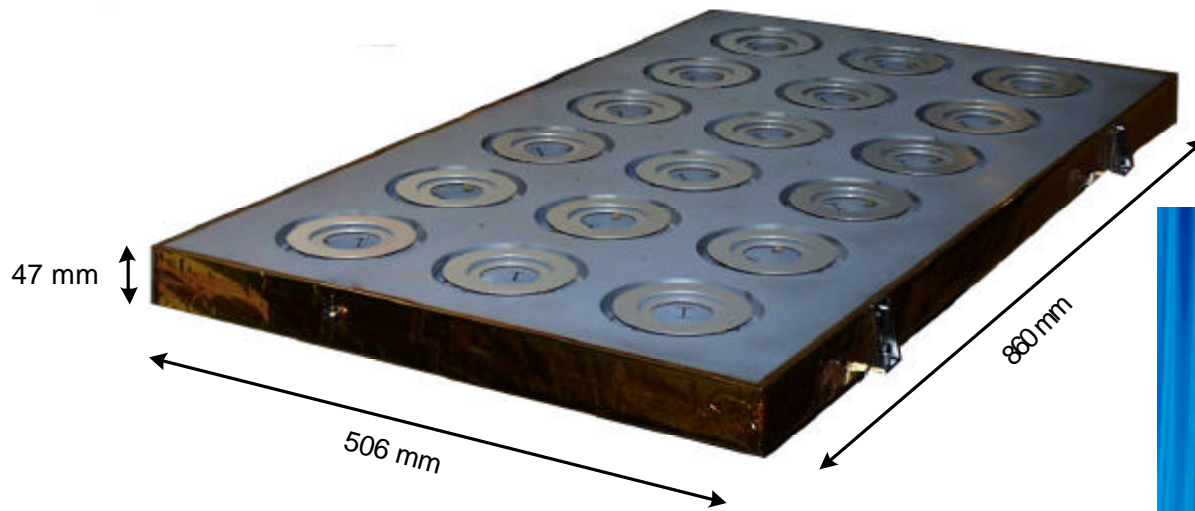
• 543 LAND  
• 8 SHIP



# Global distribution of occultations



# GRAS instrument



# Temperature profile from GPS/MET

