Evolution of EUMETSAT Satellite Programmes and the Cooperation with CIMSS

Johannes Schmetz

Programme Development Department

EUMETSAT

Or how CIMSS benfitted EUMETSAT satellites over more than two decades

- Meteosat First Generation

> *The evolution of water vapour winds*

- Meteosat-8: The Second Generation

> *Some results from Meteosat-8*

- EUMETSAT Polar System/Metop
- Toward Meteosat Third Generation

First image
Meteosat-1

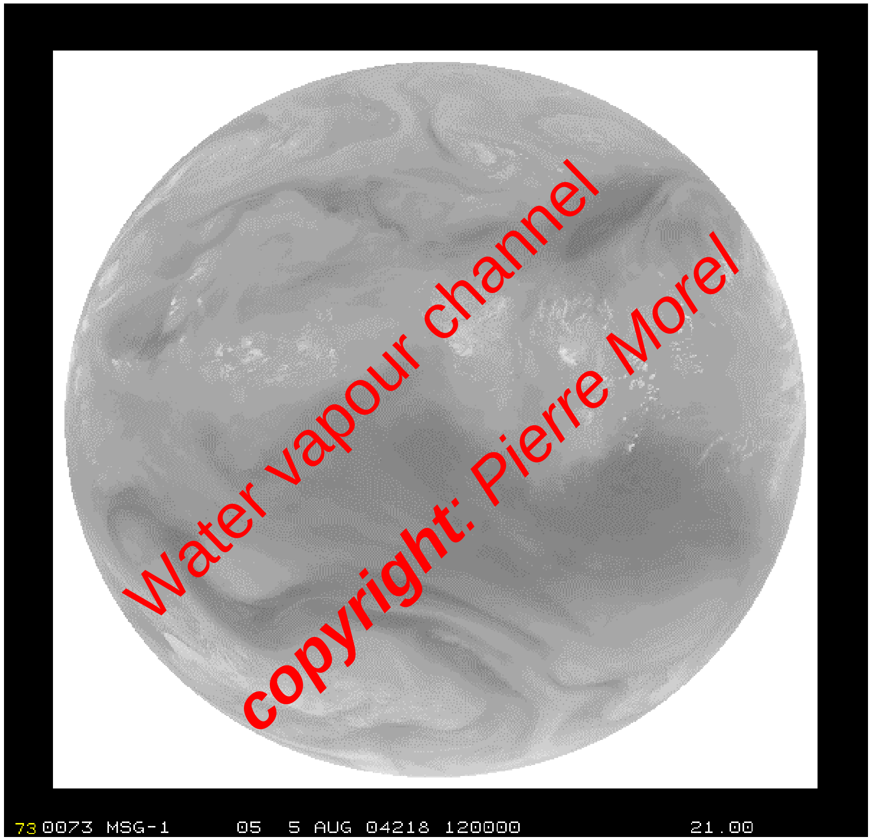
VIS Band

9 December 1977

- 3 channels: VIS, WV, IR
- every 30 Min. ‘full disk’
- first geostationary satellite with WV channel

How CIMSS/SSEC enabled Water Vapour Winds from Meteosat

A ‘true’ story about progress in science



correspondence

A New Insight into the Troposphere with the Water Vapor Channel of Meteosat

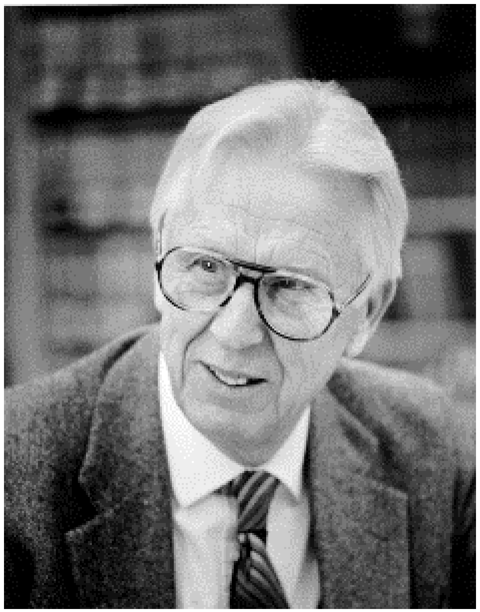
Pierre Morel, Michel Desbois, and Gérard Szejwach,
Laboratoire de Météorologie Dynamique, Centre National de la Recherche Scientifique, École Polytechnique, Palaiseau, France 91120

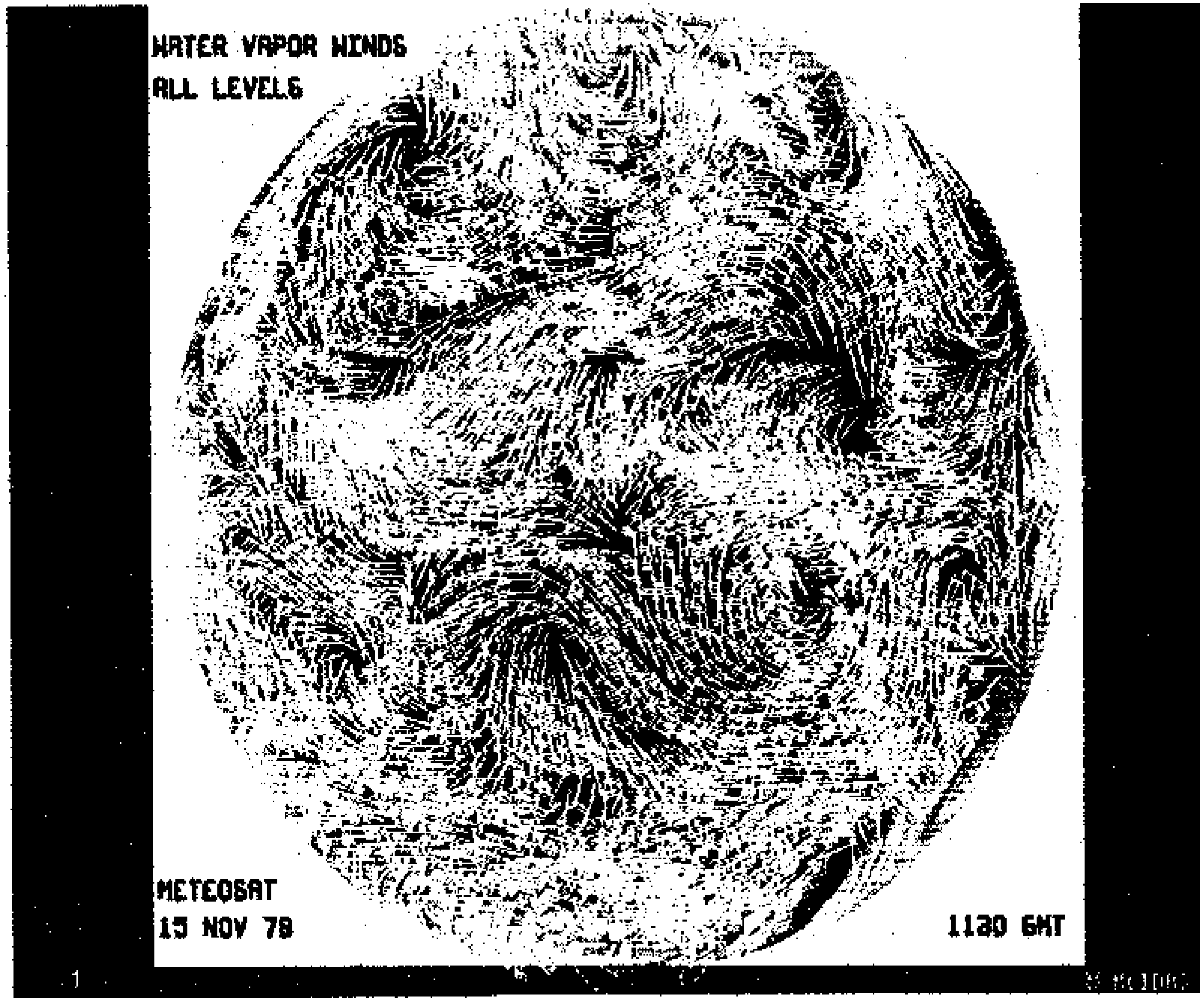
Abstract

Meteosat images in the three channels—visible (0.4–1.1 μm); thermal infrared (10.5–12.5 μm), and water vapor (5.7–7.1 μm)—are presented. The new possibilities offered by the water vapor channel on a geostationary satellite are outlined.

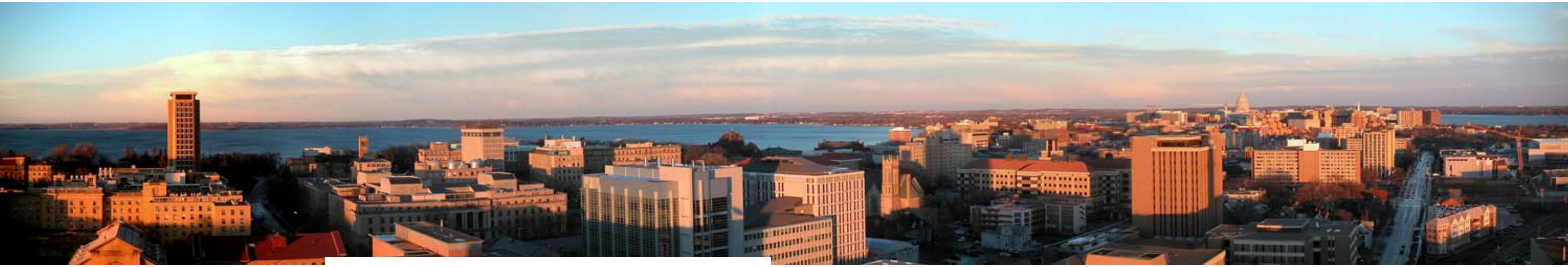
Water vapor winds from Meteosat:

Christmas Greetings from Verner Suomi to Pierre Morel





How do we get to know about WV winds?



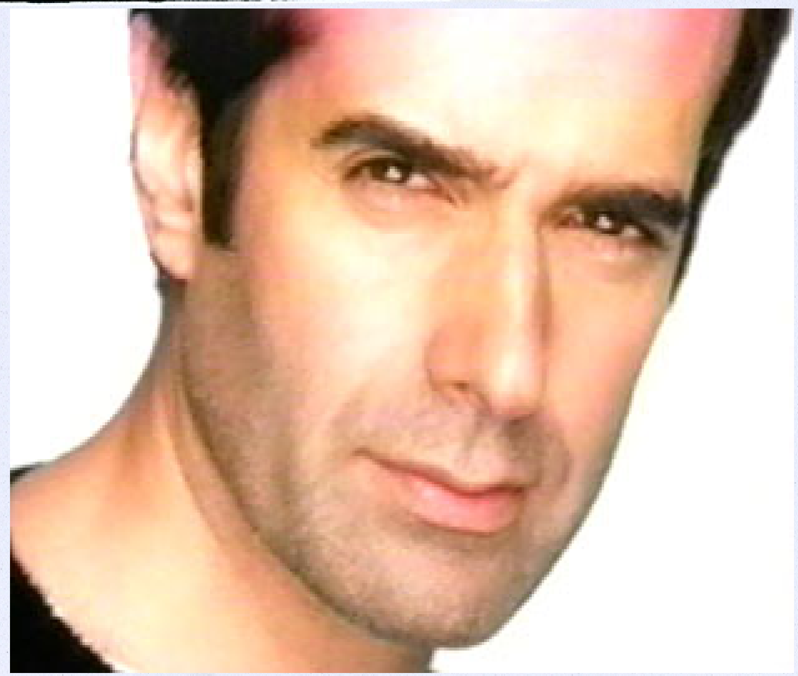
=> Pilgrimage to Madison …

… or the journey to enlightenment

The Magic World of Water Vapor Winds:
Tod Stewart outperforms David Copperfield

A Note on Water-Vapor Wind Tracking Using VAS Data on McIDAS

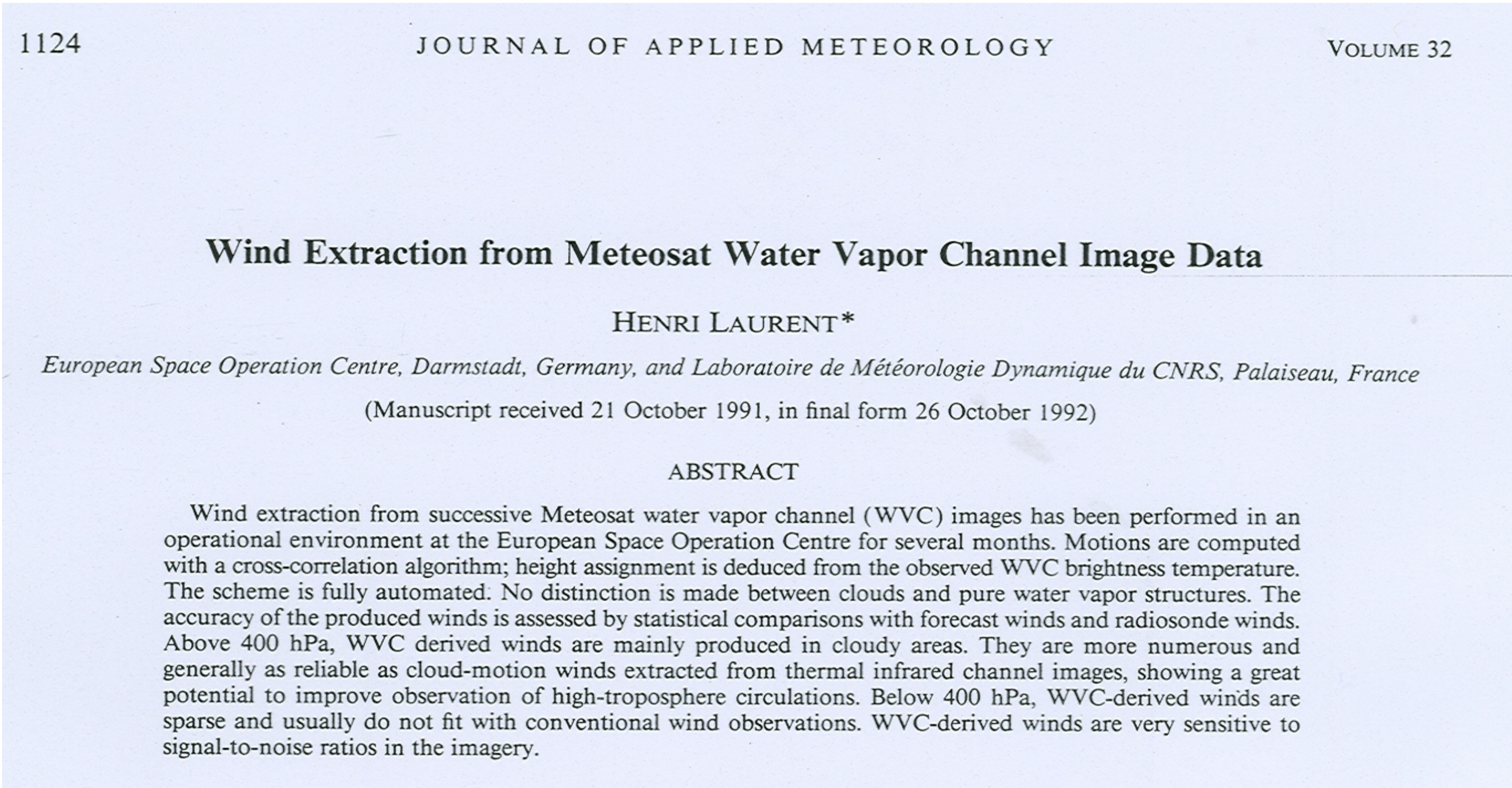
Tod R. Stewart,[1]
Christopher M. Hayden,[2]
and William L. Smith[1]



Abstract

Eleven data sets where water-vapor winds were obtained from the *GOES-5* 6.7-micrometer measurement over the United States are compared with rawinsondes. Over 2000 point comparisons are made for: a) an arbitrary height assignment of 400 mb; and b) a height assignment determined by matching the measured brightness temperature to the temperature structure represented in the LFM (Limited Area Fine Mesh) analysis. It is shown that the water vapor winds provide uniform horizontal coverage of midlevel flow with high accuracy (8 mps vector RMS). Furthermore, the radiometric height assignment significantly improves the accuracy.

Constraint with Meteosat: No way to derive WV winds manually => first automatic WV wind derivation



Wind Extraction from Meteosat Water Vapor Channel Image Data

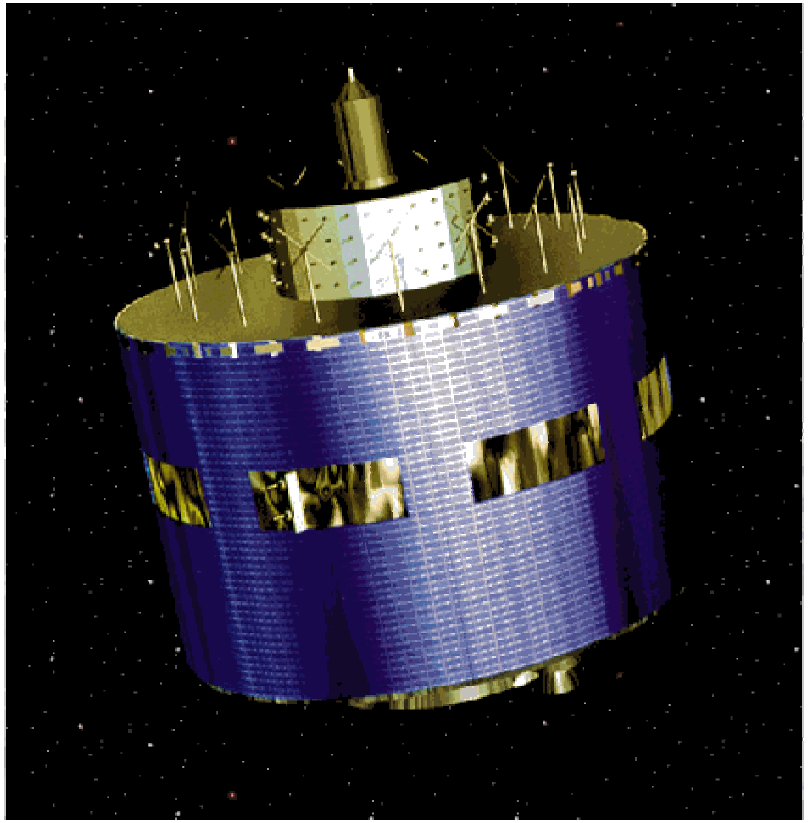
HENRI LAURENT*

European Space Operation Centre, Darmstadt, Germany, and Laboratoire de Météorologie Dynamique du CNRS, Palaiseau, France

(Manuscript received 21 October 1991, in final form 26 October 1992)

ABSTRACT

Wind extraction from successive Meteosat water vapor channel (WVC) images has been performed in an operational environment at the European Space Operation Centre for several months. Motions are computed with a cross-correlation algorithm; height assignment is deduced from the observed WVC brightness temperature. The scheme is fully automated. No distinction is made between clouds and pure water vapor structures. The accuracy of the produced winds is assessed by statistical comparisons with forecast winds and radiosonde winds. Above 400 hPa, WVC derived winds are mainly produced in cloudy areas. They are more numerous and generally as reliable as cloud-motion winds extracted from thermal infrared channel images, showing a great potential to improve observation of high-troposphere circulations. Below 400 hPa, WVC-derived winds are sparse and usually do not fit with conventional wind observations. WVC-derived winds are very sensitive to signal-to-noise ratios in the imagery.



Meteosat Second Generation

- Meteosat-8: operational since 29 Jan 2004

- 12 spectral channels

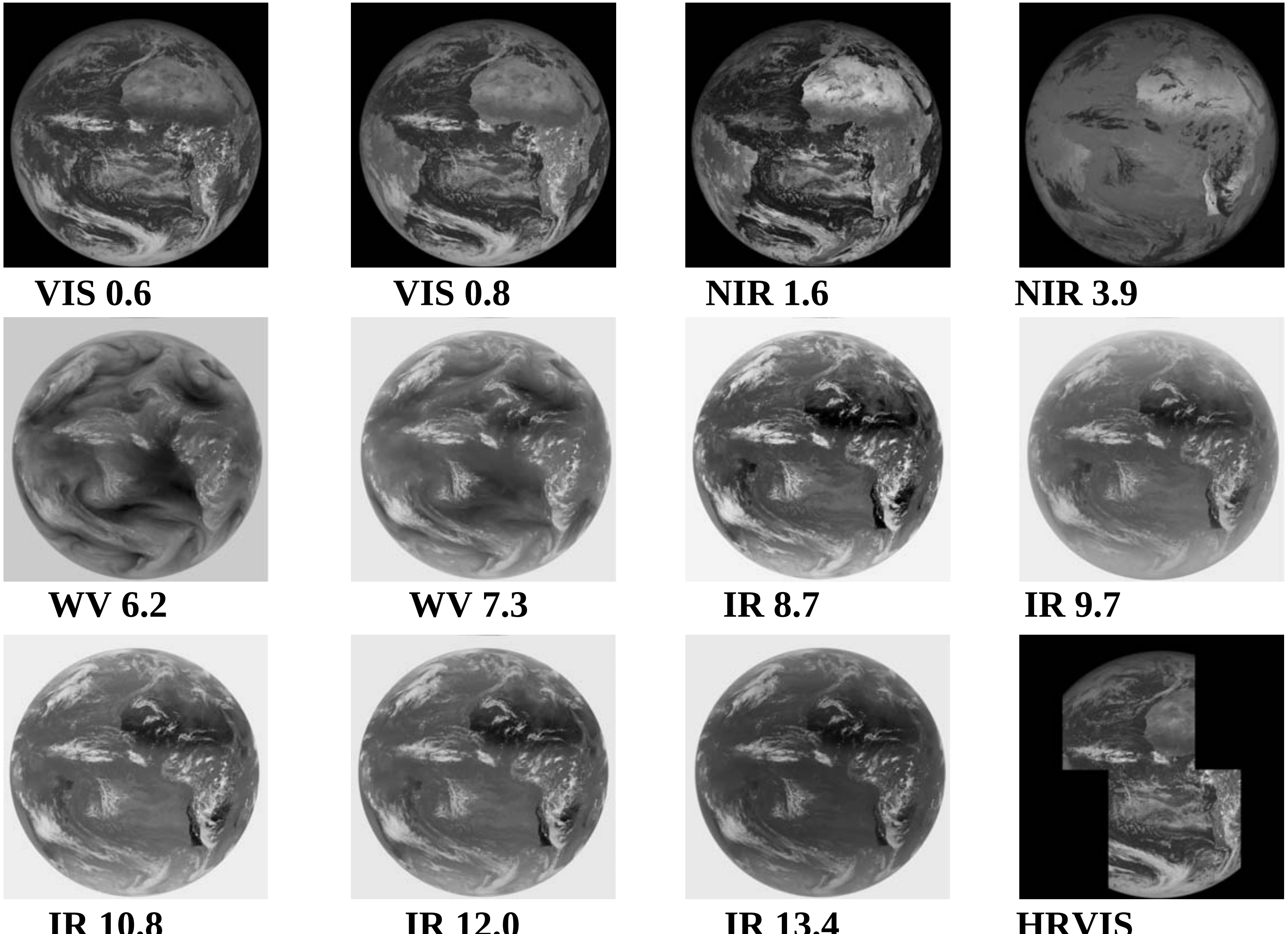
- imaging repeat cycle 15 minutes

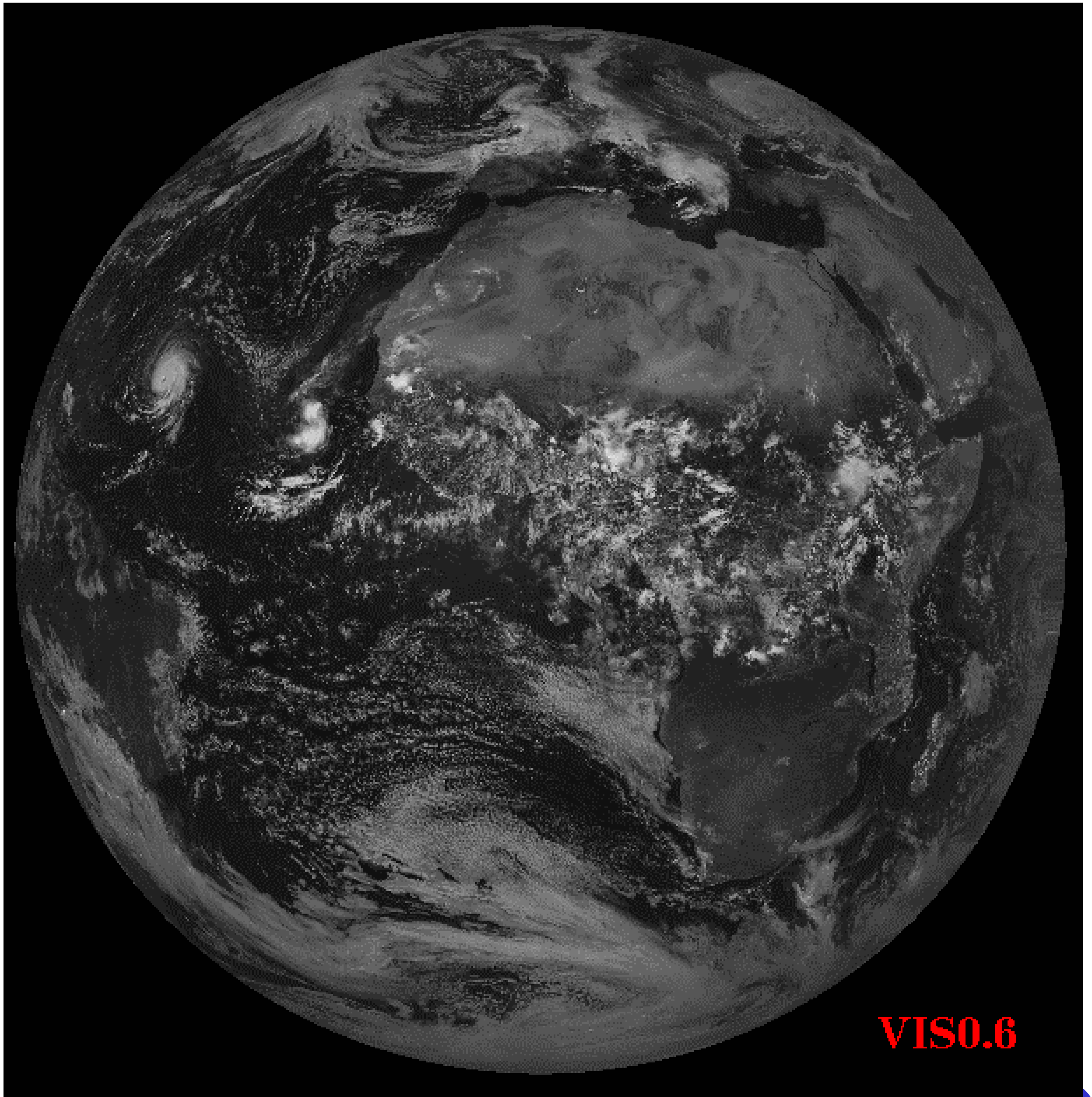
(ESSENTIAL SUPPORT
to CHANNEL DEFINITION from Bill Smith)

- Meteosat-9: autumn 2005

- two more MSG satellites will follow

Meteosat-8 observes the Earth with ‘12 Eyes’/spectral channels

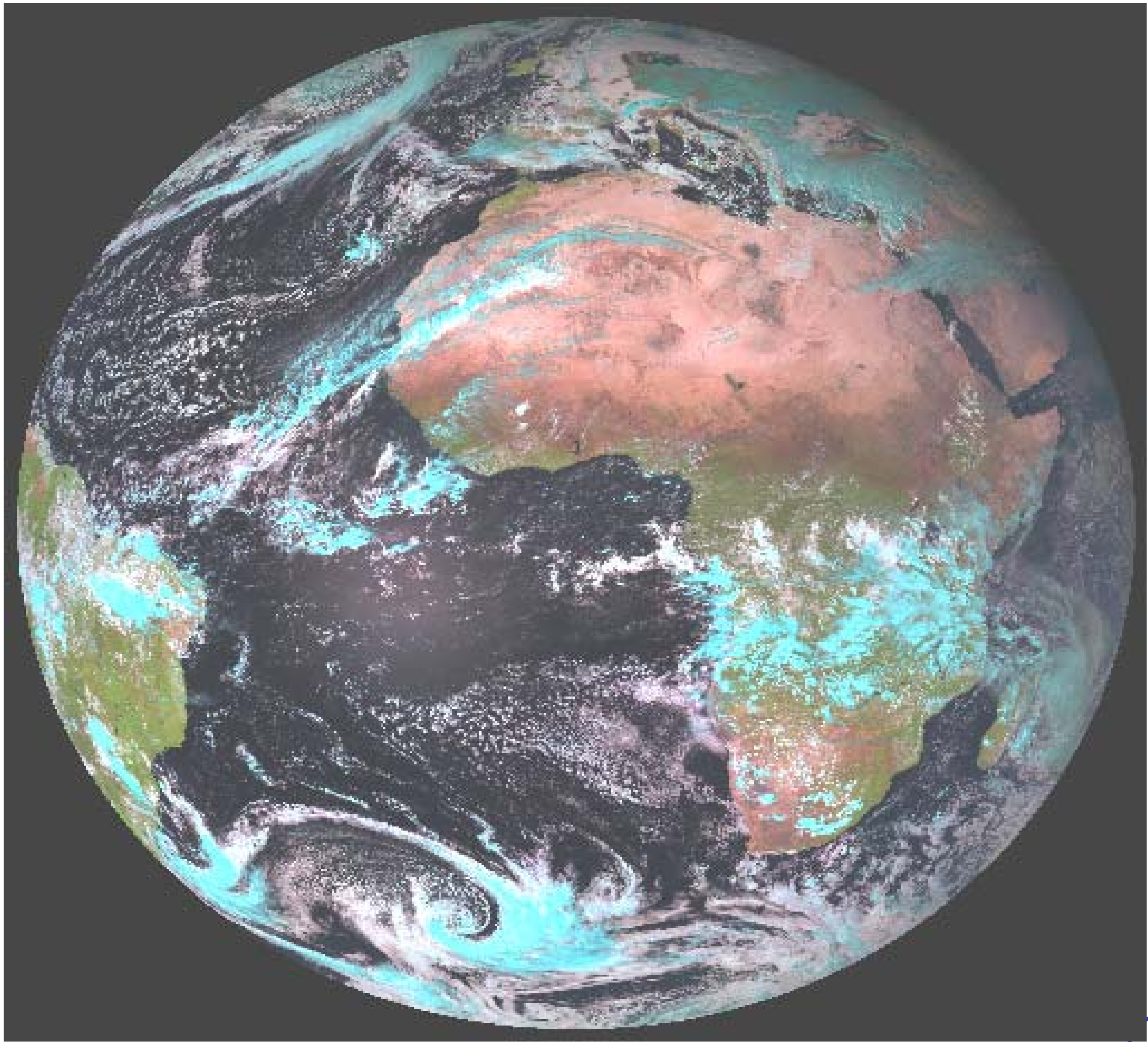




Meteosat-8 (MSG-1)
all channels

8. September 2003

Visualisation of Snow and Ice / Ice Clouds



RGB Image:

red = NIR1.6

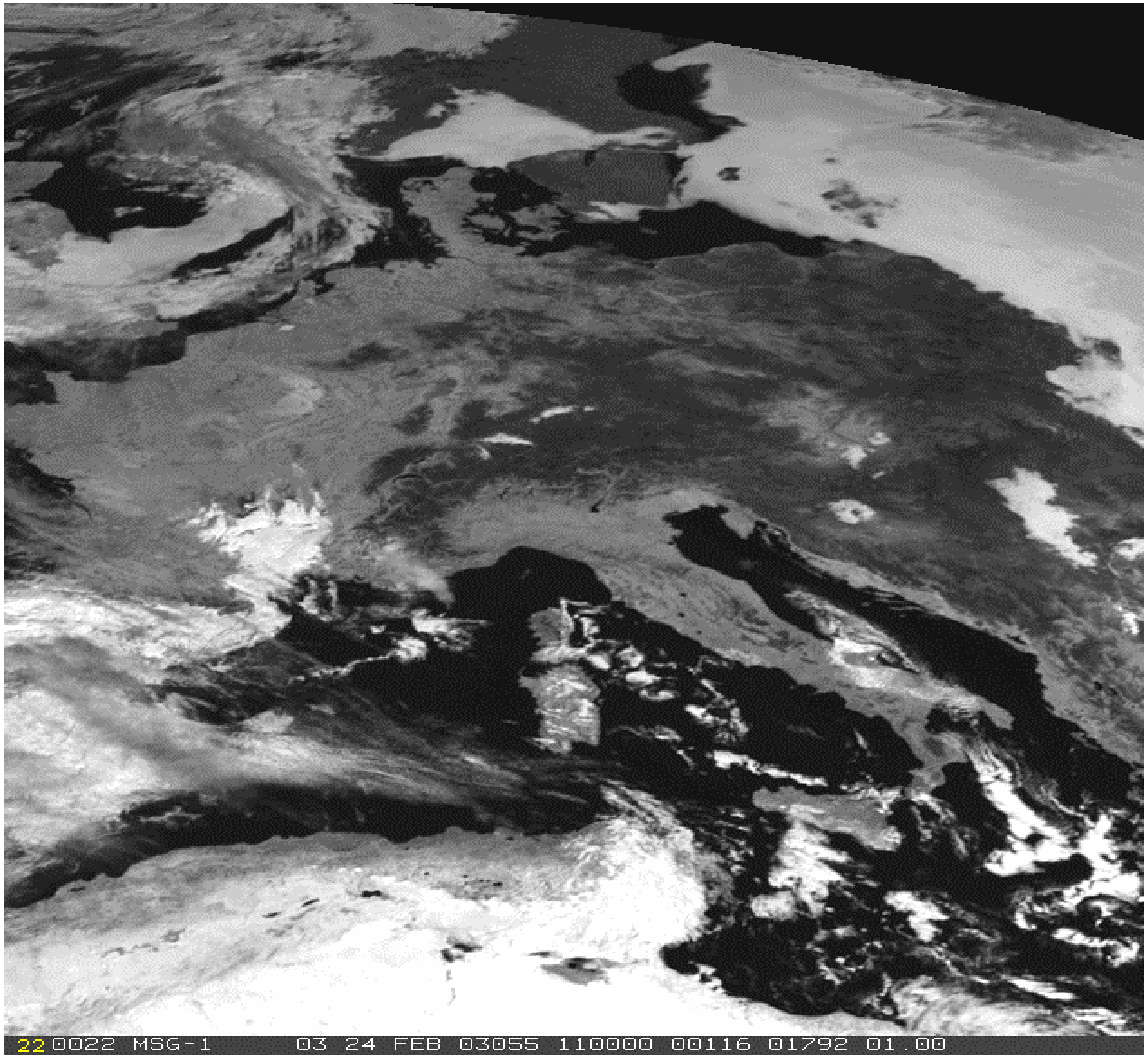
green = VIS0.8

blue = VIS0.6

snow/ice in cyan

Detection of supercooled water clouds => aircraft safety

EUMETSAT



Meteosat-8
Chl 3
24 February 2003

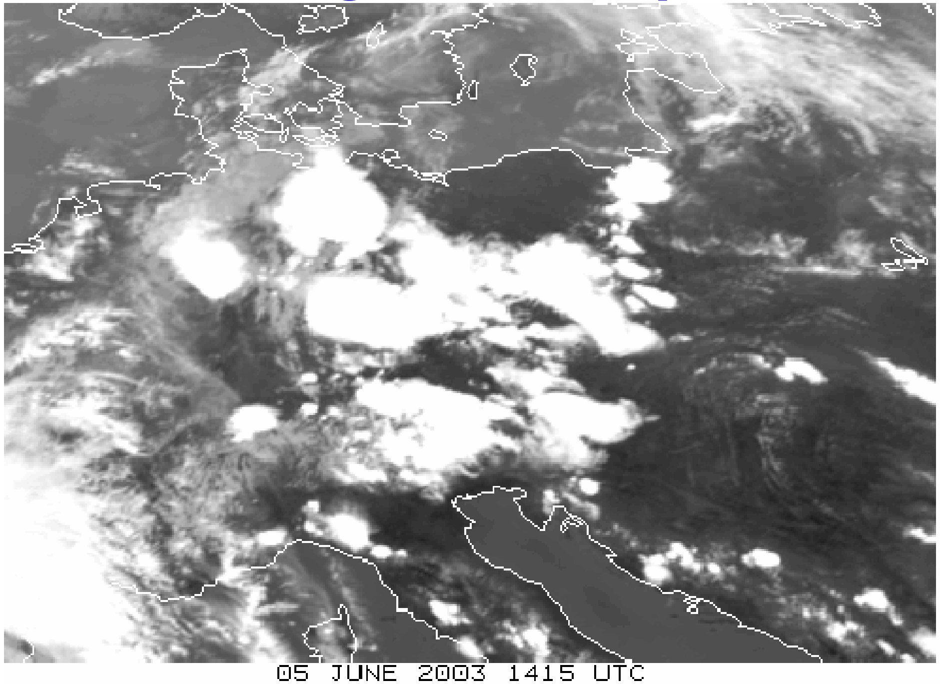
15 min imagery
1100 - 1245 UT

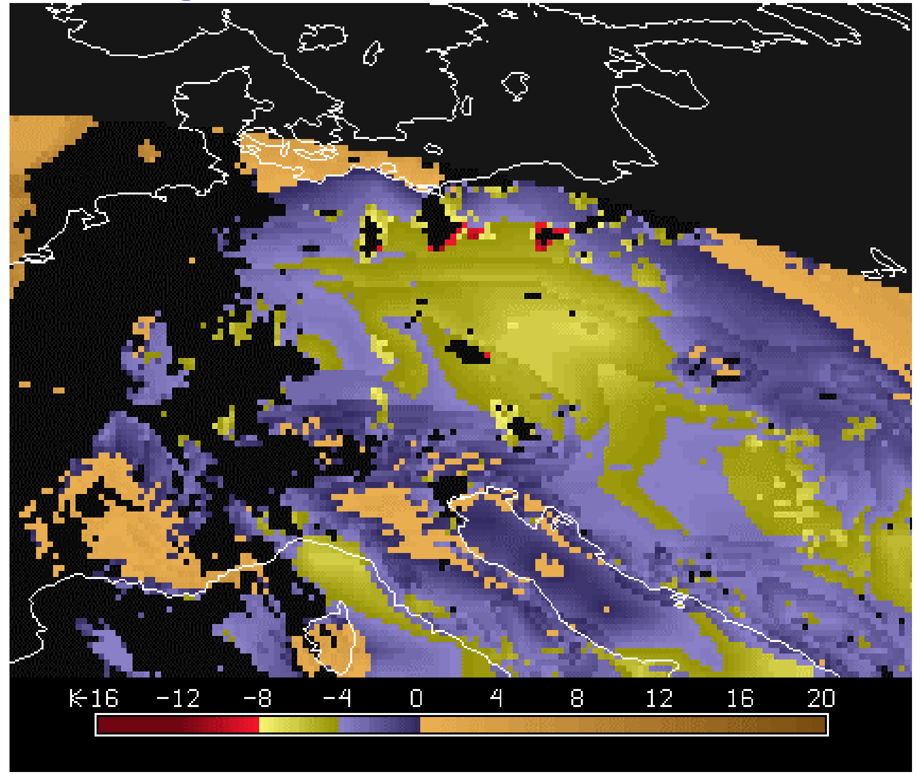
=>

*** fog dissipation**
*** water clouds move over water clouds**

EUMETSAT

Monitoring of atmospheric instability





Cloud image at 1415 UT on 5 June 2003 (left) and lifted index 5 hours earlier (right)

$LI = T^{obs} - T^{lifted\ from\ surface}$ at 500 hPa

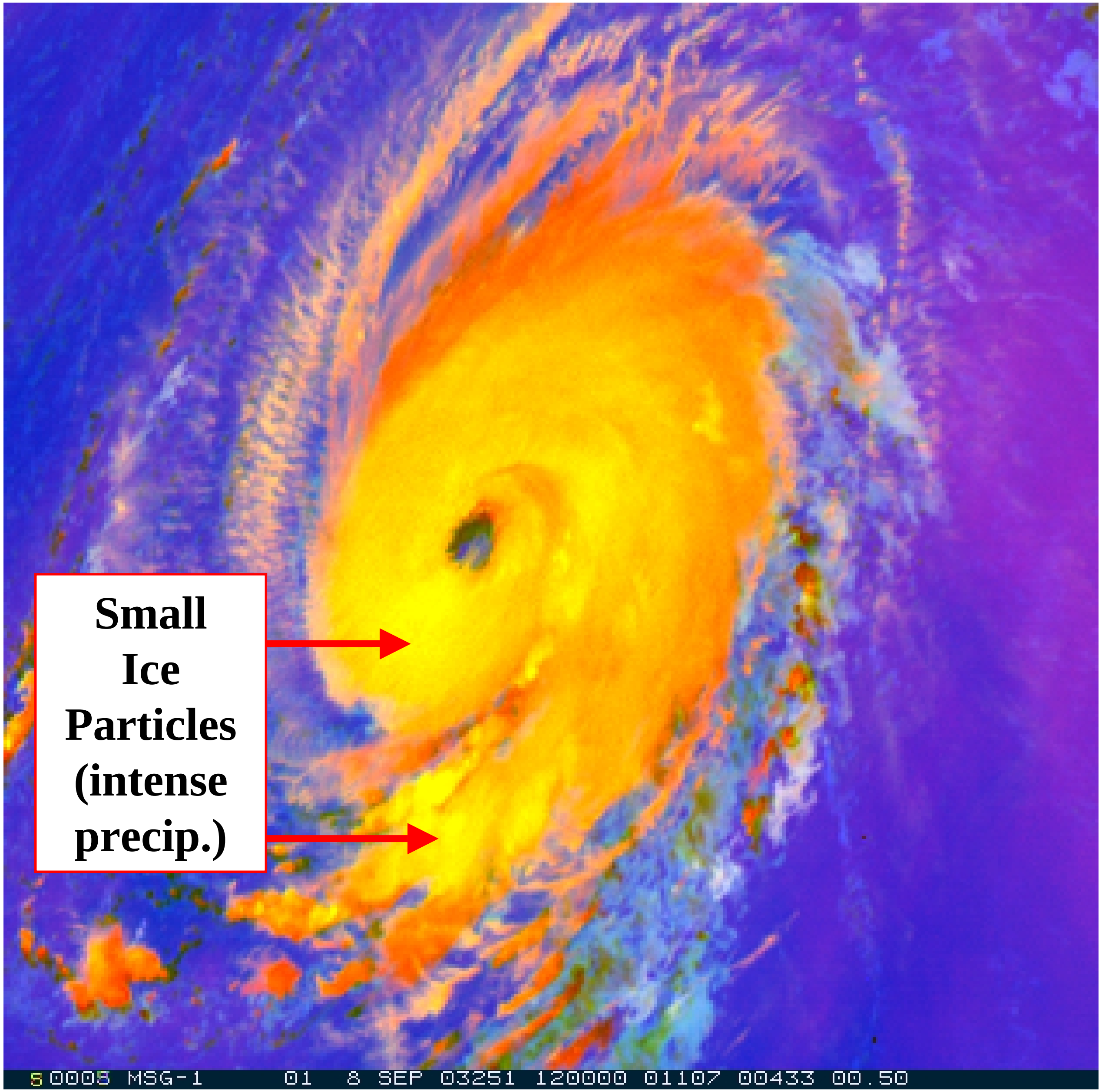
EUMETSAT

Cloud microphysics product:

- multispectral radiances allow retrieval of effective radius
- small ice particles indicative of areas of strongest convective activity and rainfall (=> every 15 minutes)

- (Note: $T_{WV} - T_{IR} > 0$ delineate those areas too

=> also possible with pre-MSG imagers)



Hurricane Isabel

MSG-1
8 September 2003
12:00 UTC
RGB Composite
R = WV6.2-WV7.3
G = IR3.9-IR10.8
B = NIR1.6-VIS0.6

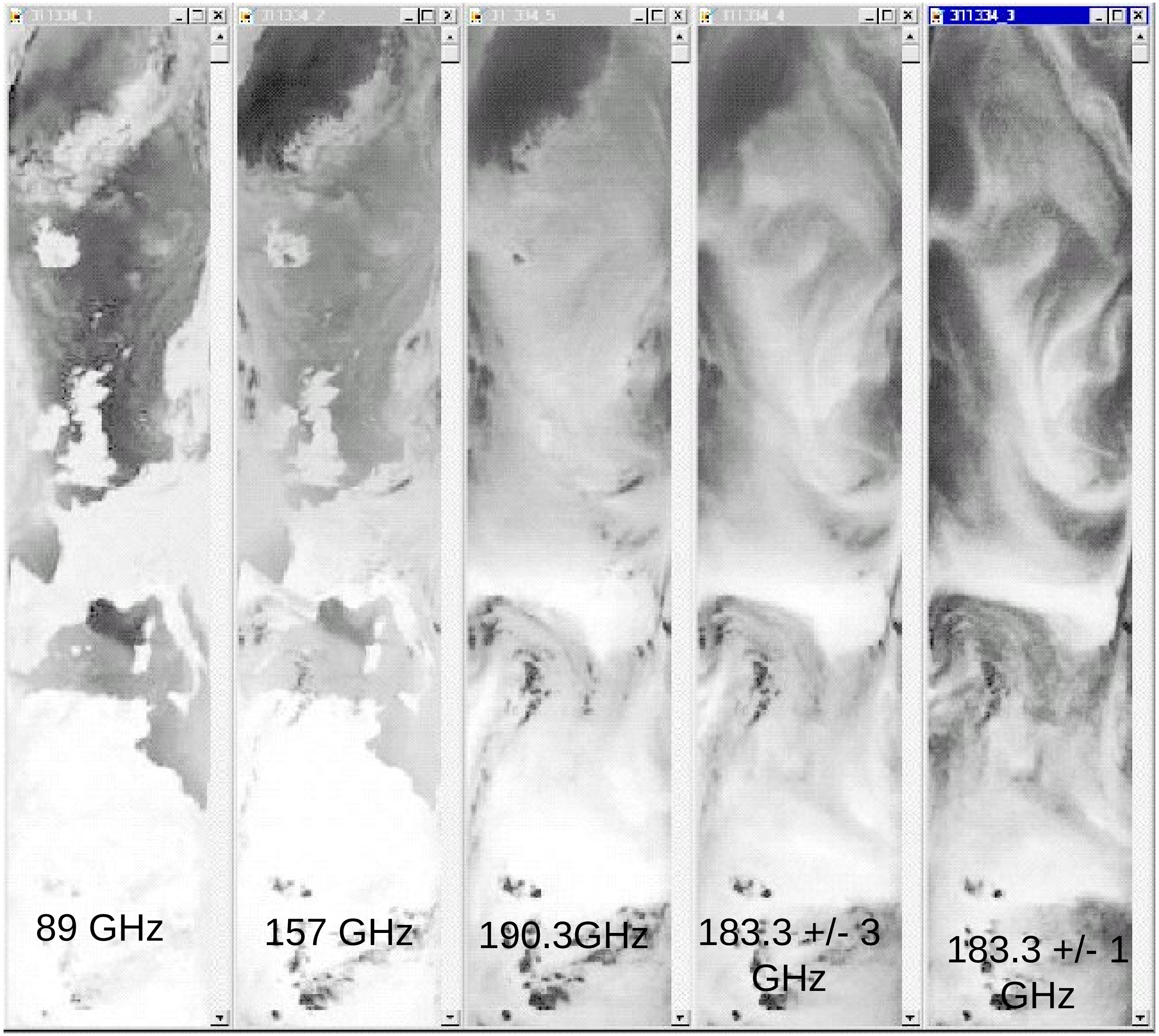
EUMETSAT

EUMETSAT POLAR SYSTEM

- Metop-2 Scheduled launch April - June 2006
- Metop-2 renamed Metop-A after launch
- Sun Synchronous orbit 820 km, 9h30 LST
- 14 years of operation
- Central and distributed Ground Segment components

- Metop-B and Metop-C recurrent models

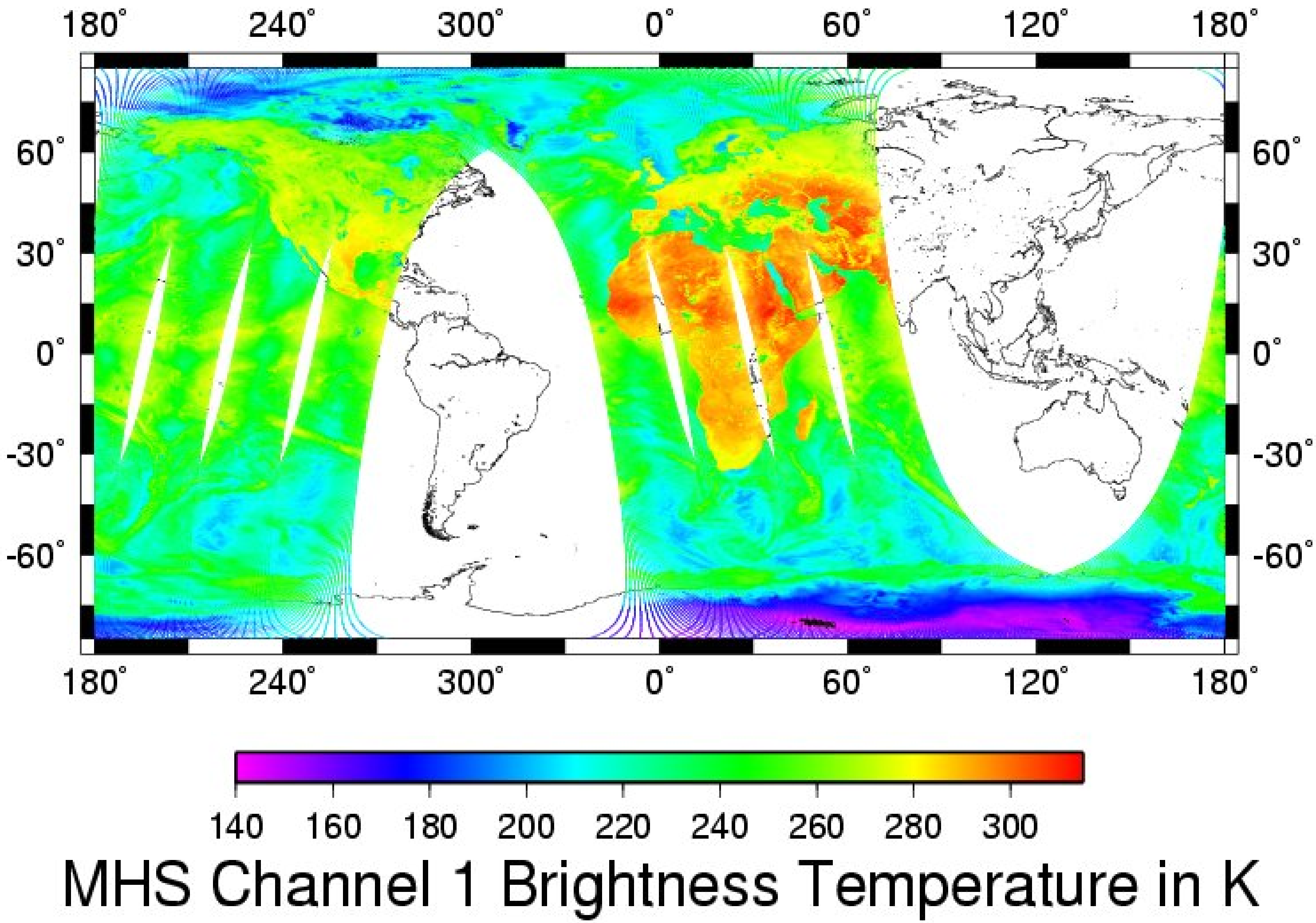
EUMETSAT



Images from MHS (Microwave Humidity Sounder) on NOAA-18

Orbit #155,

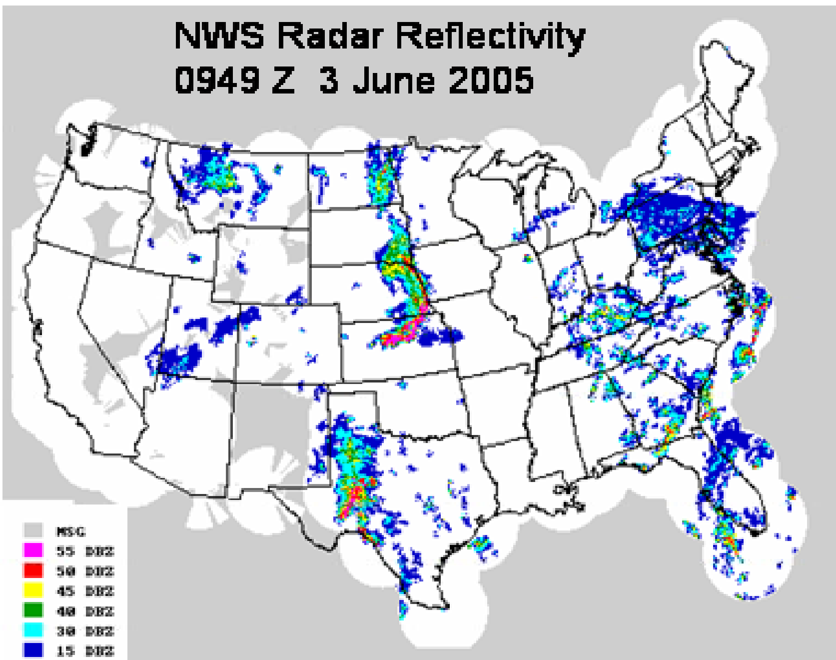
31 May 2005

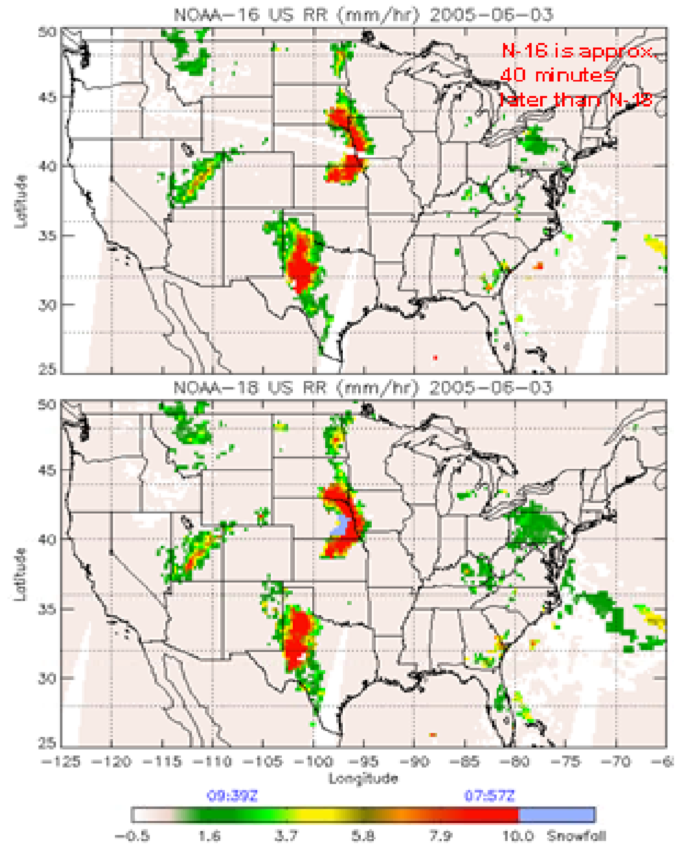


Orbits #153, #154, #155, #156,

31 May 2005

- Comparison between NOAA-16 AMSU-B and NOAA-18 MHS derived rain rates, as produced by NOAA.
- MHS appears to detect light precipitation better than AMSU-B due to lower noise.

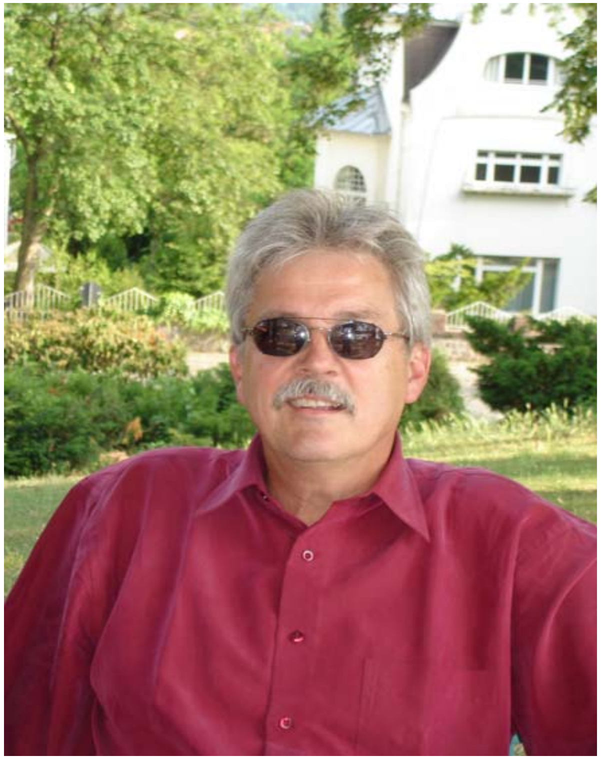




Scientific Cooperation between EUMETSAT and NESDIS/CIMSS

P. Menzel and J. Schmetz

June 2005



General Goals:

Coordination and formalization of mutual efforts

(a) to enhance utilization and impact of satellite data,

(b) to study evolution of the satellite instrument capabilities

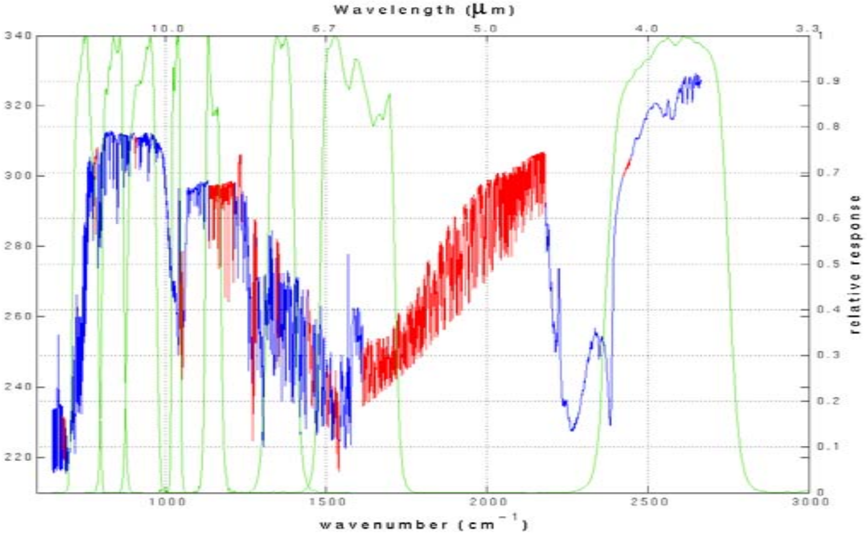
Three activity areas:

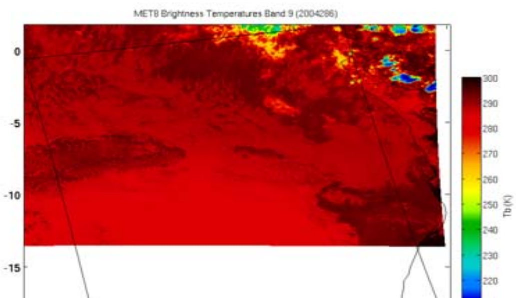
(1) conducting joint research projects on algorithm & product development plus validation (for nowcasting, weather forecasting, and climate monitoring),

(2) hosting briefings on evolution of respective satellite holdings, and inviting participation in instrument science teams as appropriate,

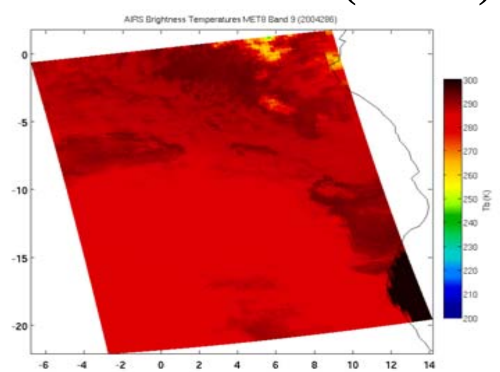
(3) extending virtual laboratory training and research activities.

EUMETSAT





IRW – MSG(top)
& convolved AIRS (bottom)



Meteosat-8 – AIRS Intercalibration

Between 12 April 2004 and 12 October 2004

	n	Mean ΔTbb (MET-8 minus AIRS)	Stand. Dev. (from mean)
4 (4.2 µm)	16	-2.3 K	0.49 K
5 (6.2 µm)	16	-7.0 K	0.16 K
6 (7.3 µm)	16	-0.9 K	0.15 K
7 (8.7 µm)	16	-0.2 K	0.72 K
8 (9.7 µm)	16	-0.3 K	0.10 K
9 (10.8 µm)	16	0.4 K	0.09 K
10 (12.1 µm)	16	0.6 K	0.11 K
11 (13.4 µm)	16	0.1 K	0.28 K

EUMETSAT

Meteosat Third Generation: Missions Considered in planning for the 2015 - 2025 Time Frame

- Improved imagery (full disk and a special high spatial resolution imager or a combination)
- Sounding of temperature and humidity and wind profiles
- Lightning detection
- Sounder for chemical constituents (very challenging for geostationary orbit)

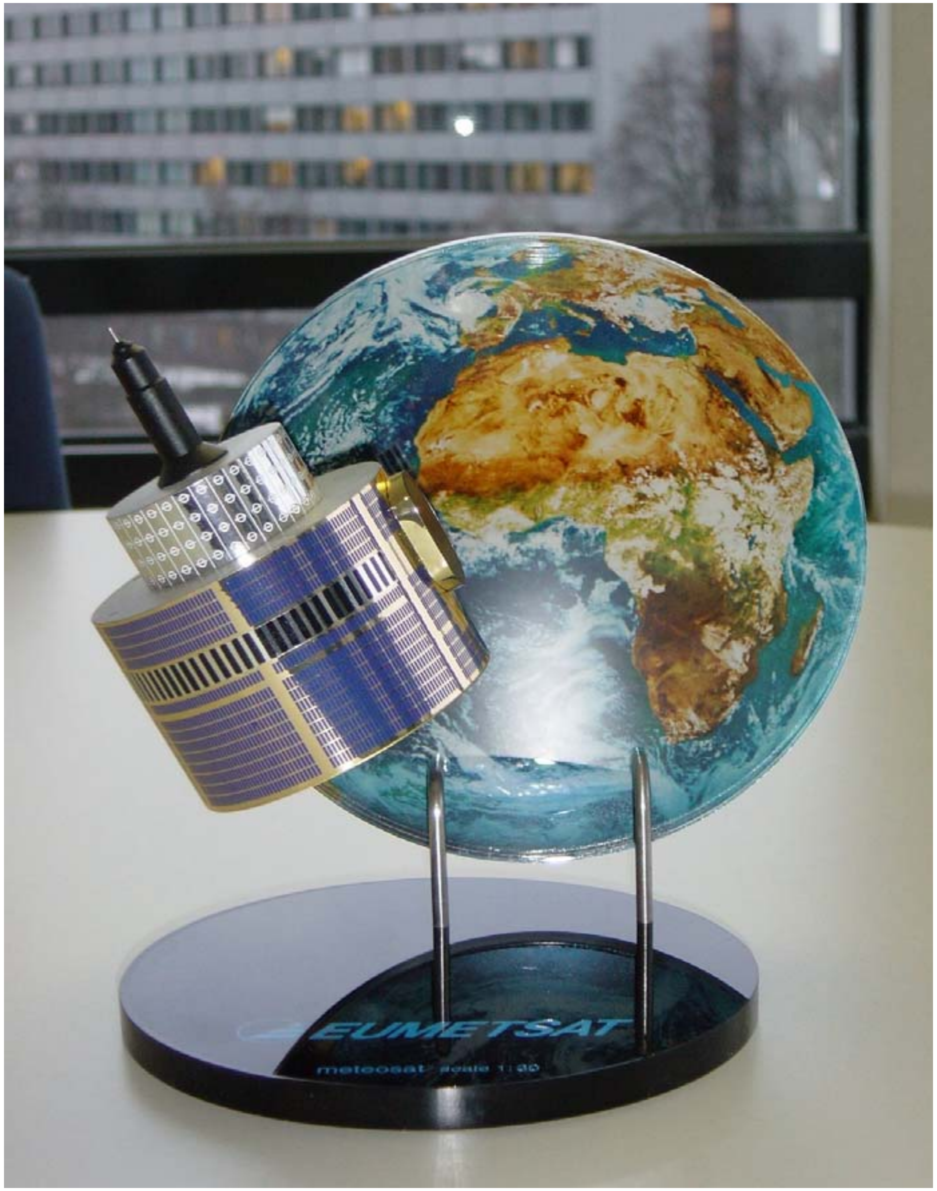
> *Parallel development of GOES-R => Cooperation with CIMSS scientist*

EUMETSAT

Working together to prepare for GOES-R & MTG

Software and data sharing includes:

- temperature/moisture/ozone sounding training data sets,
- information content of spectral measurements,
- high-spectral resolution radiative transfer,
- atmospheric motion vectors tracked in sounding retrievals.



Congratulations

to CIMSS

upon the 25th

Anniversary

Thanks for:

continuous scientific stimulus,

the excellent cooperation,

the sharing of progress,

and friendship

Best wishes for a bright future

from

EUMETSAT