Fjernmåling. Jordobservasjoner - Meteosat

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Forelesning i FY3020 Romteknologi 1
20.10.2005

Meteorological satellites

- History
- Examples
- Methods
- References

Meteorology satelittes History

1940 – Rockets with cameras

1957 – First weather satelitte Sputnik 1 USSR

1958 – First American weather satelitte, Explorer 1 U.S.A

1958 – Space organisation NASA established

1959 – First optical instrument for environmental studies on a satelitte (photodetector + lens) Vanguard 2

1960 – First weather satelitte for meteorology, only (Tiros1 NASA)

(observation of weather patterns)

1977 – Meteosat 1 (ESA) First European geostationary satelitte

1981 – Meteosat 2 the first fully operational Meteosat launched

1995 - Meteosat transition programme – current operational system for weather operations

Meteosat 7 is in operation, same technology

Se i G. Stette kap. 6, s. 152 for satellitt teknologi

2003 – Meteosat second generation satelitte

MSG 1 launced 28 August

(calibration and validation still going on)

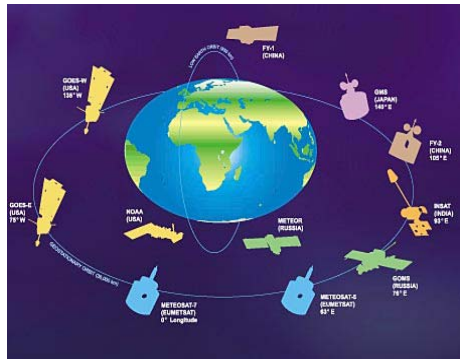
2015 ?? - Meteosat third generation

needs to start planning now.... (increase resolution, more channels, ...

Meteorological satellites

- Several geostationary satellites (36000km)
- Eumetsat (European collaboration) http://www.eumetsat.de/
- Provide images, wind fields, temperatures, assimilated products.

Global satellite update

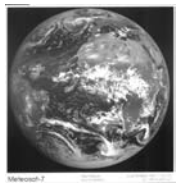


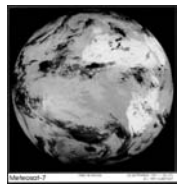
Meteosat history

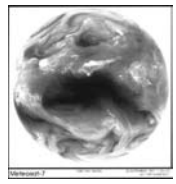
- http://www.eumetsat.de/en/index.html?area=left6.html&body=/en/mtp/background/meteosat_history.html&a=612&b=2&c=610&d=600&e=0
- European collaboration
  - 3 satelittes covering Europe and Asia
  - Less coverage in the polar regions

Meteosat 1-7
Pictures 3 wavelength bands

- At operational service: visible(0.5-0.7 m), IR (10.5-12.5 m) and far IR(5.7-7.1 m)
- See image service at:
- http://www.eumetsat.de/en/index.html?area=left7.html&body=/en/dps/helpdesk/faq_general.html&a=760&b=1&c=700&d=700&e=0


VIS


IR


Wv

New generation meteo satelittes

- **Meteorological products**

- The EUMETSAT central processing facility in Darmstadt will produce a range of meteorological products derived from satellite data:
- • Atmospheric wind vectors at various altitudes, derived from the motion of clouds and other tracers such as water vapour and ozone
- • Cloud Analysis providing identification of cloud layers with coverage, height and type for weather forecasting, Numerical Weather Prediction and climate research

•• Tropospheric Humidity at medium and upper levels for weather forecasting, Numerical Weather Prediction and climate research

•• High Resolution Precipitation Index

•• Cloud Top Height images for aviation meteorology

•• Clear Sky Radiances, for Numerical Weather Prediction models

•• Global airmass instability, for Nowcasting

•• International Satellite Cloud Climatology Project (ISCCP) data set

•• Total Ozone Product

•• Calibration Monitoring

MSG 1
Meteosat second generation

http://www.eumetsat.de/en/index.html?area=left7.html&body=/en/dps/dcs.html&a=750&b=1&c=700&d=700&e=0

Regular service since 12 January 2004
Named Meteosat 8

Payload Meteosat 8

- **Spinning Enhanced Visible and Infrared Imager (SEVIRI)**
  - imaging radiometer main element, 12 spectral channels
- **Mission Communication Payload (MCP)**
- **Geostationary Earth Radiation Budget (GERB)**
- **Search and Rescue transponder (S&R)**

- **MSG-1 Launched 28 august 2002**
- **First image:**
- **12 February 2003**
- **http://www.eumetsat.de/en/index.html?area=left7.html&body=/en/dps/dcs.html&a=750&b=1&c=700&d=700&e=0**

SEVIRI instrument:
Increased number of spectral bands:

Visible 0.6 and 0.8 for cloud detection
NearIR 1.6 for discriminate between snow and clouds
IR 3.9 low clouds and fog
water vapor at 6.2 and 7.3
IR 8.7 cirrus clouds
IR 9.7 ozone
IR 10.8 and 12 temperature on clouds
IR 13.4 CO2
High resolution visible (1 km)

TABLE 1. Spectral channel characteristics of **SEVIRI** providing central, minimum, and maximum wavelength of the channels and whether the channel is an absorption or a window channel. A concise summary of the use of the spectral channels is given in the section titled "**SEVERI** spectral channels."

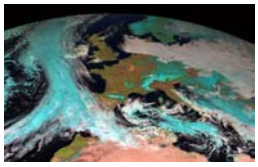
Channel no.		Characteristics of spectral band (μm)			Main gaseous absorber or window
		λ_{cen}	λ_{min}	λ_{max}	
1	VIS0.6	0.635	0.56	0.71	Window
2	VIS0.8	0.81	0.74	0.88	Window
3	NIR1.6	1.64	1.50	1.78	Window
4	IR3.9	3.90	3.48	4.36	Window
5	WV6.2	6.25	5.35	7.15	Water vapor
6	WV7.3	7.35	6.85	7.85	Water vapor
7	IR8.7	8.70	8.30	9.10	Window
8	IR9.7	9.66	9.38	9.94	Ozone
9	IR10.8	10.80	9.80	11.80	Window
10	IR12.0	12.00	11.00	13.00	Window
11	IR13.4	13.40	12.40	14.40	Carbon dioxide
12	HRV	Broadband (about 0.4 – 1.1)			Window/water vapor

MSG-1 Level 1.5 Rectified Images

- Click on image, first set of images
- http://www.eumetsat.de/en/index.html?area=left7.html&body=/en/dps/dcs.html&a=750&b=1&c=700&d=700&e=0
- Download images from different channels.
- Composite image of 3 channels.
- High resolution image, 1 km resolution
- Pdf download: MSG introduction (lower right corner)

Composite MSG-1 Image

of Europe18.02.2003, 13:00 UTC



Red: 1.6 μm IR

Green: 0.8 μm visible channel,

Blue: 0.6 μm visible channel.

By radiative transfer theory one can retrieve:

Turquoise: cloud signals the presence of ice particles, whereas white cloud is liquid. Snow on the ground is turquoise.

The large white patch over north-eastearn Europe is fog or stratocumuli, sharply contrasting with snowed areas south of it. Channel 1.6 creates that contrast. Vegetated surface shows green, due to its absorption properties in the visible range. Sandy or granitic areas are pink.

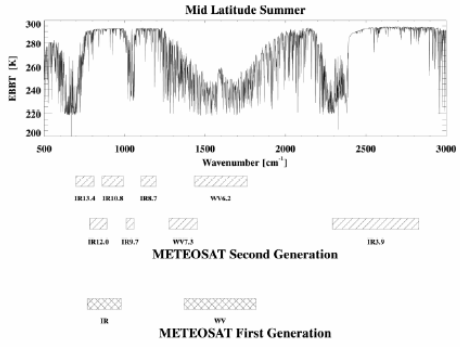


FIG. 5. Thermal infrared part of the spectrum emitted by the earth–atmosphere is shown in the top panel. Brightness temperatures are plotted as a function wavenumber. **MSG** imager channels are indicated below, as are the channels of the current **M**eteosat generation.

On line data from Meteosat 8

- http://oiswww.eumetsat.org/IDDS-cgi/listImages?a=0,m=5,f=1,c=2,o=0,s=2,n=6,d=1,v=400,p=0
- 4 channels available
  - VIS06,
  - IR3.9 (low clouds and fog),
  - WV6.2 (water vapor),
  - IR 10.8 (high clouds, temp)

Global satellite update

Europe: Meteosat-7 supports the primary service at 0° Longitude. Meteosat-6 performs the operational Rapid Scanning Service (and is the primary service back-up at 10°E). Meteosat-5 continues the Indian Ocean Data Coverage Service at 63°E. MSG-1 was launched on 28 August, 2002 and is currently undergoing commissioning. MSG-2 is currently planned for launch in January 2005 and Metop-1 in mid-2005.

USA: GOES-8 (East) is functioning at 75°W. GOES-12 is scheduled to replace GOES-8 as the GOES East operational spacecraft on 31 March 2003. GOES-9 is expected to act as back-up for the Japanese GMS-5 from Spring 2003. GOES-10 (West) is functioning at 135°W. GOES-11 acts as back-up at 105°W. On 1 October 2002 NOAA-17 was declared the primary polar orbiting morning satellite. NOAA-15 is the backup satellite. NOAA-16 is the primary polar satellite in the afternoon orbit with NOAA-14 as the backup.

Russia: Meteor-3M-N1 was successfully launched on 10 December 2001 into a polar sun-synchronous morning orbit, inclined at 99.7°. Meteor-3M-N2 is planned to be launched in 2005. GOMS-Electro-N2, which will be positioned at 76°E, is planned for launch in 2005. One satellite of the Meteor-3 series continues to operate beyond its designed lifetime with reduced capabilities in circular orbits inclined at approximately 82°.

China: Fengyun-1D (FY-1D), a polar-orbiting meteorological satellite to replace FY-1C, launched on 15 May, is fully operational. FY-2B is stationed at 105°E. FY-2A continues to act as back-up satellite at 86°E. FY-2C is planned for launch at the end of 2003 and will replace FY-2B. FY-3A, the first of the second generation of Chinese polar orbiting meteorological satellites, is planned for launch in 2004.

Japan: GMS-5, Japan's current operational geostationary meteorological satellite, continues to operate at 140°E. The US satellite GOES-9 is expected to act as back-up for GMS-5 at 155°E from Spring 2003 until MTSAT-1R becomes operational towards the end of 2003. MTSAT-1R is scheduled to be launched in the summer of 2003. MTSAT-2 will be launched in the summer of 2004.

India: METSAT, India's first exclusive meteorological satellite, was launched on
12 September 2002 and is positioned at 74°E, collocated with INSAT-3C. INSAT-2B and INSAT-2C are collocated at 93.5°E. INSAT-2DT is positioned at 55°E, INSAT-2E at 83°E. INSAT-3A is scheduled for launch in December 2002, INSAT-3D and -3E launches are planned in the 2003-2005 time-frame. INSAT-1D was deactivated on 14 May 2002.

Next generation: EUMETSAT POLAR SYSTEM

METOP

Meteorological Operational Polar satelitte

METOP satelitte

To be launched in 2005:

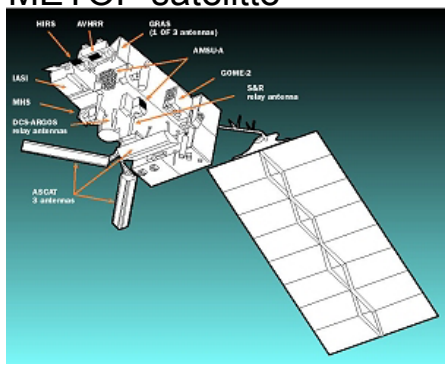
8 different

Instruments

Combinded meteorological and environmental

Applications

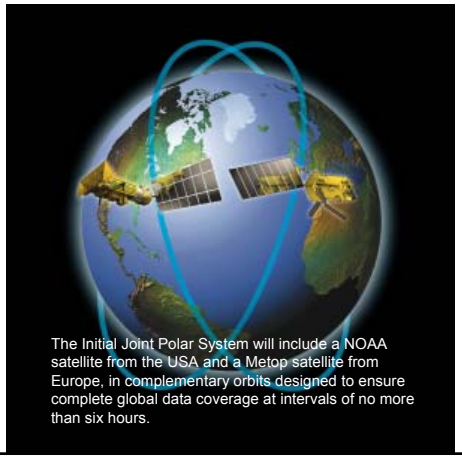
Combinded ESA and NASA project



INSTRUMENT	FULL NAME	PRIMARY FUNCTION
AVHRR/3*	Advanced Very High Resolution Radiometer	Global imagery of clouds, the ocean and land surface
HIRS/4	High Resolution Infrared Radiation Sounder	Temperature and humidity of the global atmosphere in cloud-free conditions
AMSU-A*	Advanced Microwave Sounding Unit-A	Temperature of the global atmosphere in all weather conditions
MHS	Microwave Humidity Sounder	Humidity of the global atmosphere
IASI	Infrared Atmospheric Sounding Interferometer	Enhanced atmospheric soundings
GRAS	Global Navigation Satellite System Receiver for Atmospheric Sounding	Temperature of the upper troposphere and in the stratosphere with high vertical resolution
ASCAT	Advanced Scatterometer	Near-surface wind speeds over the global oceans
GOME-2*	Global Ozone Experiment-2	Monitoring Profiles of ozone and other atmospheric constituents

Ground system at Svalbard

- Polar orbit
- combined global observations for meteorological applications and climate monitoring
- A completely new ground system is being developed at Svalbard
- http://www.svalsat.com



The Initial Joint Polar System will include a NOAA satellite from the USA and a Metop satellite from Europe, in complementary orbits designed to ensure complete global data coverage at intervals of no more than six hours.

•Tilleggslitteratur, fjernmåling:

•Atlas of satellite observations related to global change. (R.J.Gurney, J.L. Forster and C.L. Parkinson eds.) Cambridge University press, 1993, ISBN 0 521 43467.

•*En lettfattelig oversikt over hvilke klimafaktorer man kan observere, noen eksempler på resultater, lite om algoritmer og metoder for å gjøre dette.*

•Satellite Meteorolgy. S.Q.Kidder and T.H. Vonder Haar Academic Press, 1995, ISBN 0 12 406430 2.

•*Fokus på metrologi.*

•Introduction to Environmental Remote Sensing. (E.C. Barrett and L.F.Curtis ed.) 4th Edition 1999, Stanley Thornes (Publishers) Ltd, ISBN 0 7487 4006 6

•*Lettfoståelig, ikkedetaljer på metoder, oversikt over satelitter. Bredt spekter av miljøfaktorer.*

•Global change and remote sensing. (K.Ya. Kondratyev, A.A. Buznikov and O.M. Pokrovsky ed) Wiley-Praxis Series 1996 ISBN 0 471 96078