Exploitation of Remote Sensing Techniques by the DWD for Early Warning of Natural Hazards

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Legislative + legal framework, organizational role

- **DWD is the governmental national meteorological service (NMS) of Germany**
  under responsibility of the Federal Ministry for Transport, Housing and Urban Development

§ Statutory tasks of DWD

… … …

- **Meteorological safeguarding of aviation and shipping**
- **Issue of official warnings about dangerous weather phenomena**

… … …

- **Monitoring of the atmosphere for radioactive trace elements and forecasting of their spreading**

- **DWD co-operates with the German Committee for Disaster Reduction within the International Strategy for Disaster Reduction (ISDR)**

- **DWD represents Germany at international organizations, e.g. the World Meteorological Organization (WMO), EUMETSAT etc.**

Natural hazards caused by meteorological events
some examples:

flood

courtesy:http://www.ur.ch/dateimanager/thumb/unwetter

drought
courtesy: Bundesanstalt für Gewässerkunde

tornado

tropical storms
courtesy**: NASA**

sandstorm
courtesy: NASA

wildfire
Courtesy: http://www.guttet.ch/pics/waldbrand2

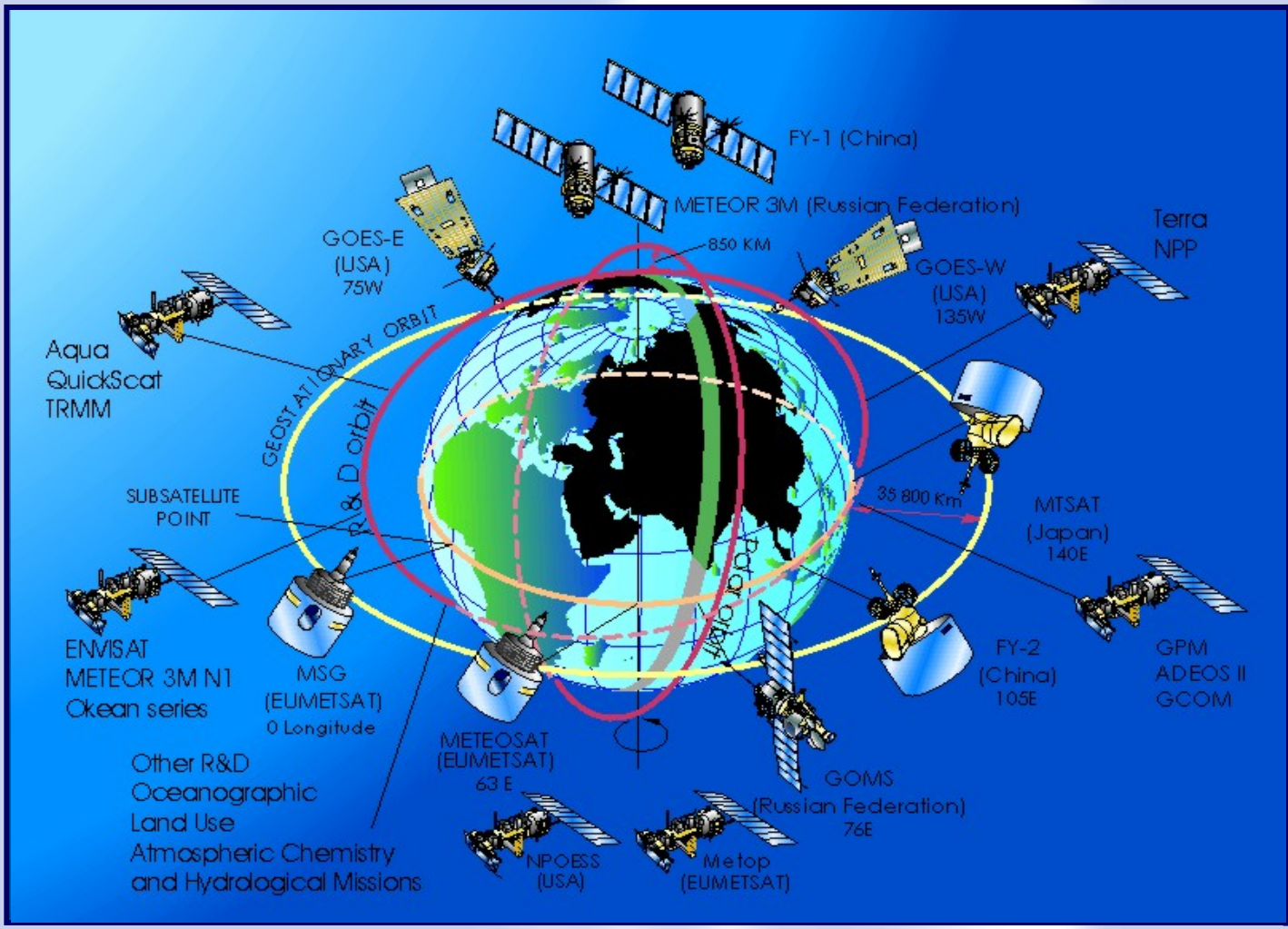
landslide
courtesy: „Südharzbahn“

severe storm
courtesy: heli-service-triet

snow impact
courtesy: „Welt am Sonntag“

ice impact
courtesy: „www.wetter.com“

The space-based component of the Global Observing System of the World Meteorological Organization (WMO)



Operational meteorological satellites in:

- **geostationary orbit,**
- **polar orbit**

+

research satellites

with relevance for environmental monitoring

courtesy:

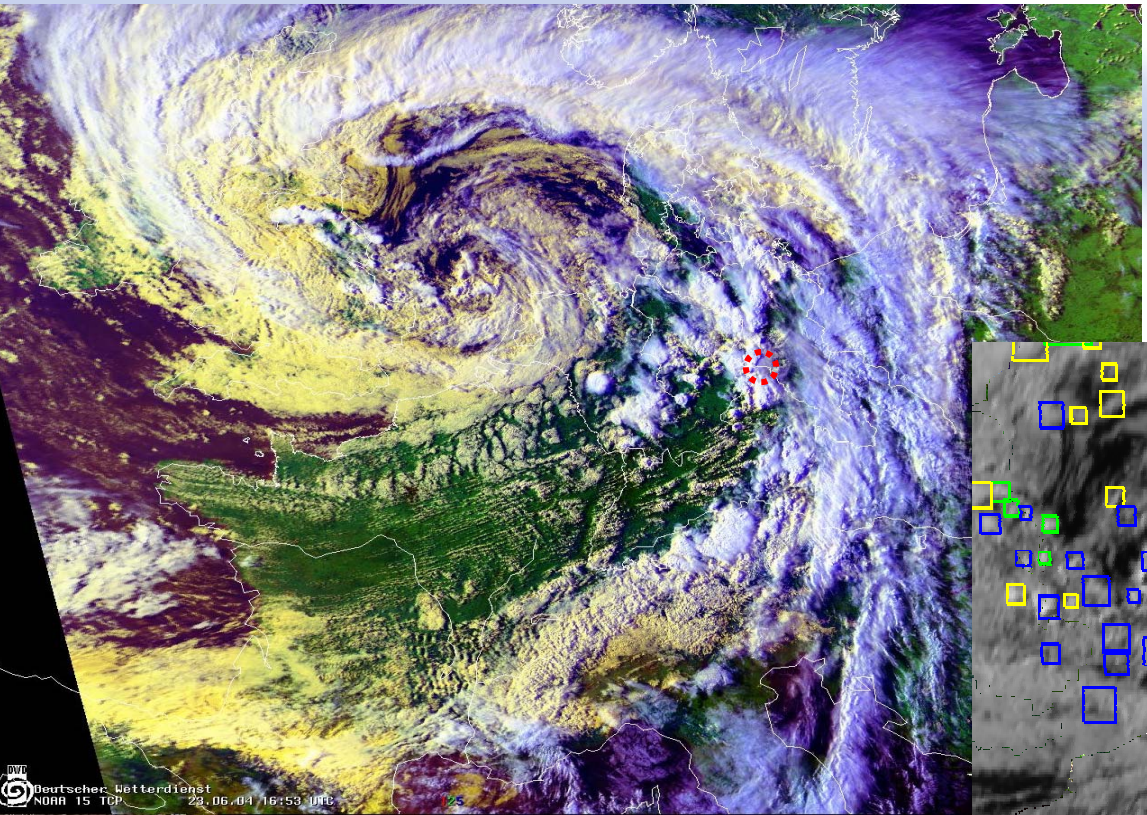
World Meteorological Organization (WMO)

Advantages of meteorological and environmental satellites

Benefits in comparison to other observing systems:

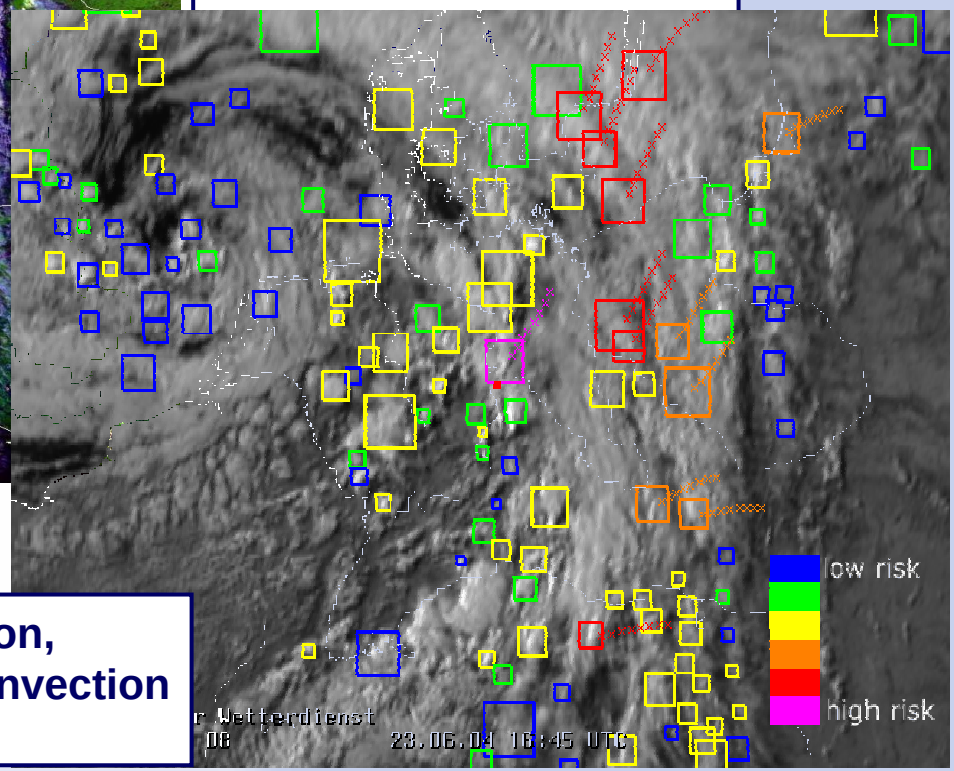
- a global system
- spatial coherent information
  (area covering, nearly without gaps)
- data from otherwise data-sparse areas
- same observing system for different parts of the globe
- nearly continuous observations
- data generally available, at least for official duty use

An example of natural hazards as seen by operational meteorological satellites



Depression with thunderstorms and tornadoes

NOAA-15
22.06.04 16:53 UTC

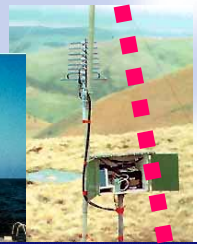


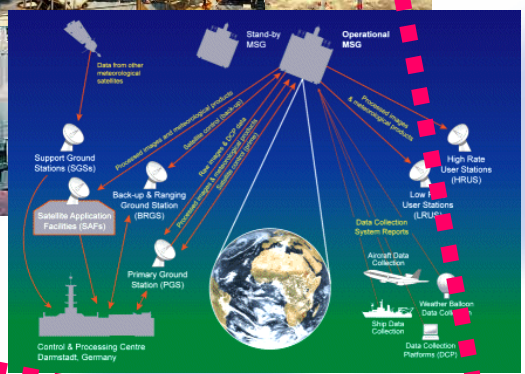
severe convection index = automatic detection, classification and extrapolation of severe convection
(for the time being experimental at DWD)

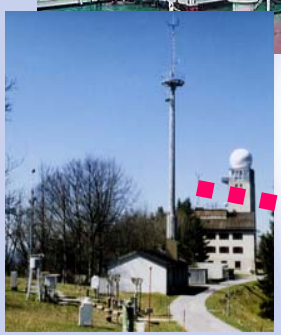
The role of remote sensing for support to risk management:

I. Early Warning

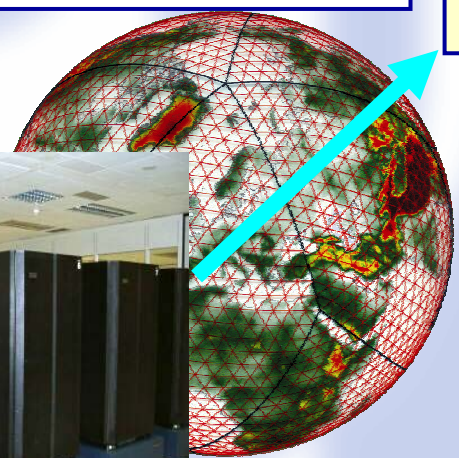
Weather forecast up to 10 days ahead: numerical weather prediction (NWP) model dominate







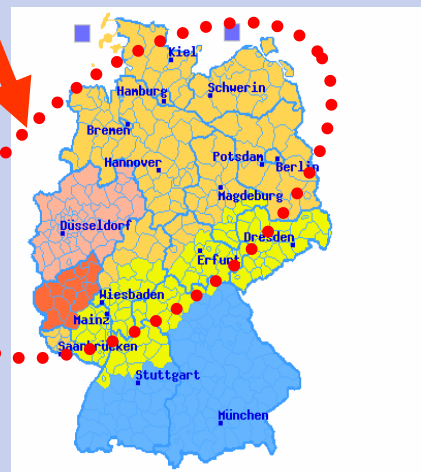
global + regional weather forecasting models of DWD + other centres



based on several day numerical weather prediction (NWP) model forecast:

indications on severe weather,

e.g. for a wider region

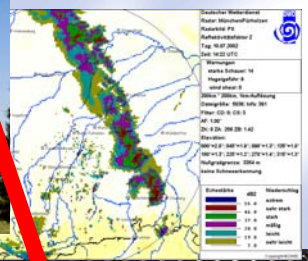


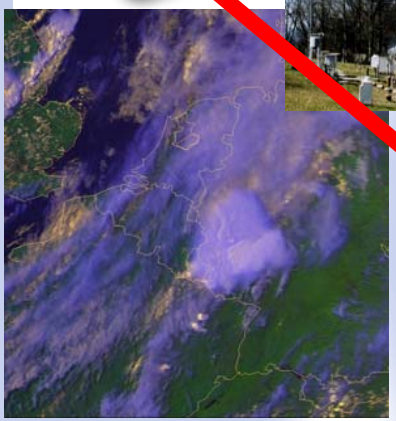
forecaster issues warnings and provides advises primarily based on computer model forecasts

The role of remote sensing for support to risk management:

II. Monitoring of severe weather events - support to risk reduction

Support to risk reduction management, 2-3 hours ahead of a severe event: "nowcasting"





continuously new observations,
<u>in particular remote sensing data</u>:
satellite + ground-based precipitation radar + lightning location

specific warnings on district level

"supervisor": applies nowcasting tools

nowcasting: mixed method: forecaster (specific nowcasting techniques) + latest computer runs

Availability of Warnings

Warnings via Internet to the General Public, freely available to everybody

WARNING OF SEVER WEATHER:
SEVERE THUNDERSTORMS WITH HEAVY RAIN, HAIL AND INTENSIVE GUSTS

for district Bernkastel Wittlich

valid from Tuesday, 10 June 2003, 16:30 hrs
until Tuesday, 10 June 2003, 24:00 hrs

issued by Deutscher Wetterdienst, 10/06/03, 16:00

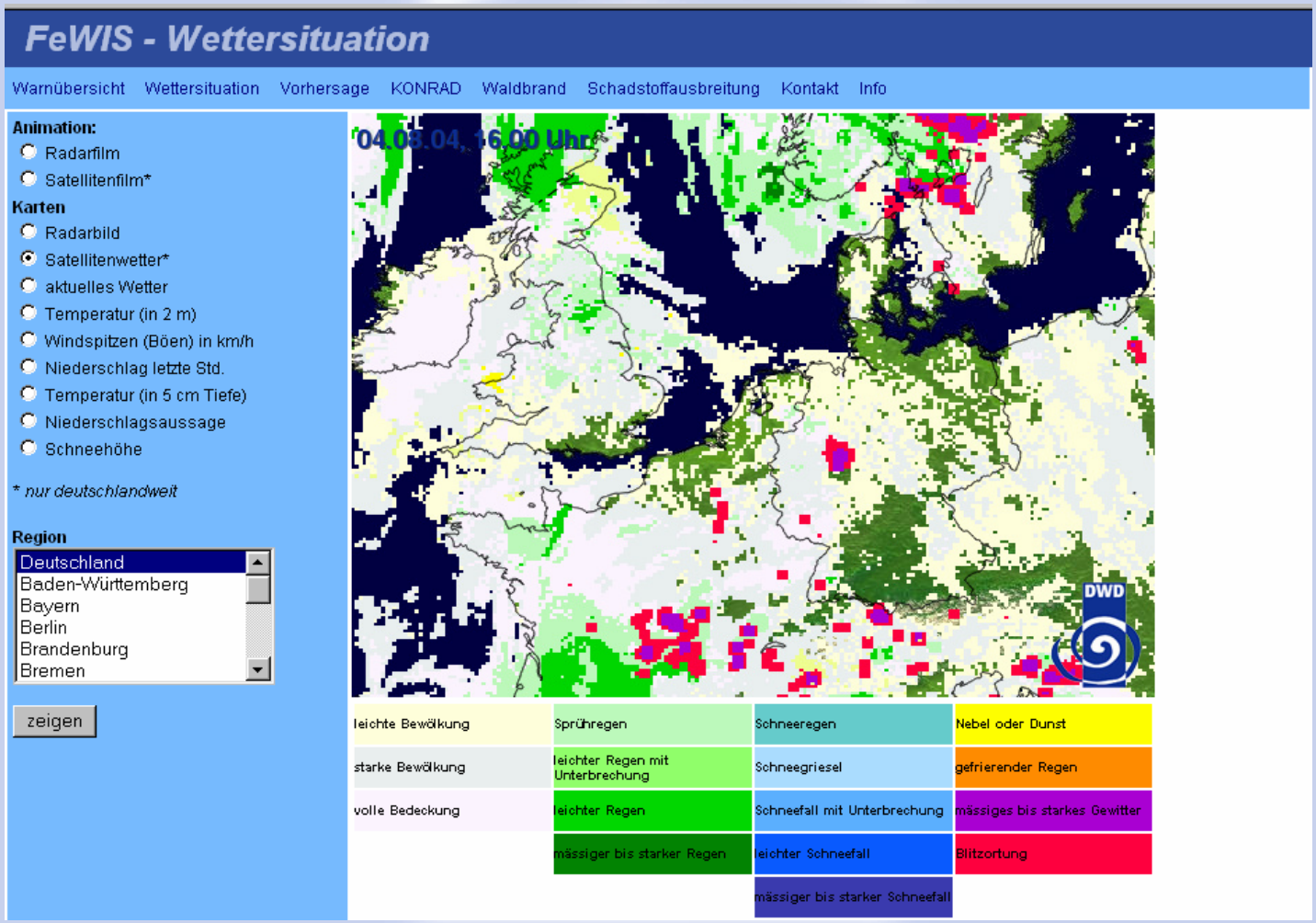
Locally sever thunderstorms with intensive gusts up to 100 km/h and rain with more than 25 mm within short time.

Potential impact of the expected severe weather:

- *locally flashes with danger*
- *sudden flooding of streets and cellars*
- *overrunning brooks and small rivers*
- *locally landslides*
- *locally severe damage from hail*
- *isolated falling trees and damage of roofs*
- *crashing down of tiles, branches and others*

Availability of Warnings

to disaster reduction services, e.g. via Internet to special user groups



International exchange of warnings

- **bilateral exchange of warnings of severe weather**

  with regional meteorological services

  of neighboring countries

- **EUMETNET Programme “EMMA”**

  (European Multi-service Meteoriological Awareness Programme)

Other important use of space technology

➢ Data relay function of meteorological satellites:

geostationary satellites: - transmission of data of automatic weather stations e.g. from isolated areas, ships, buoys, aircraft, etc

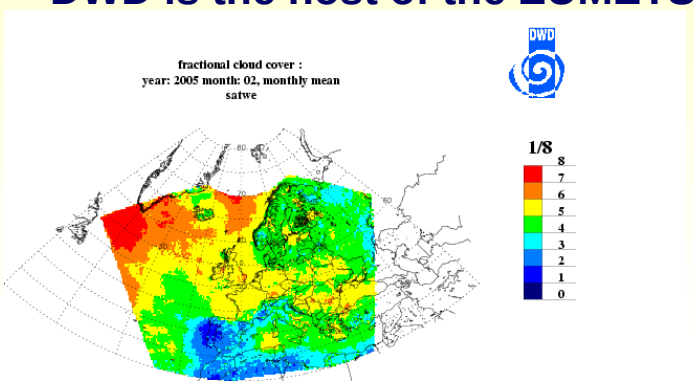
- Search and Rescue (S&R) signals

polar orbiting satellites: - location and transmission of crash signals

➢ Climatology:

(GPCC: Global Precipitation Climatology Centre)

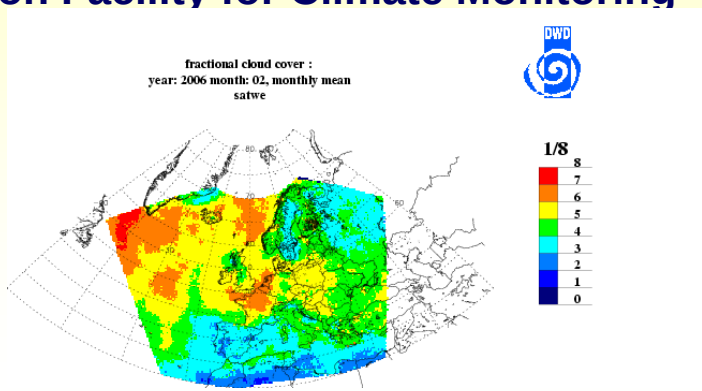
- global monthly means of precipitation (DWD contributes to the GPCC)
- DWD is the host of the EUMETSAT "Satellite Application Facility for Climate Monitoring"



fractional cloud cover

monthly means

← Feb. 05 Feb. 06 →



Note: also data of navigation satellites (GPS) are used for meteorological purposes

Outlook

Satellite programmes of EUMETSAT

➢ **fully approved programmes:**

geostationary:

Meteosat Second Generation (MSG)

(4 satellites in total): up to ~ 2019

polar orbiting:

EUMETSAT Polar System (EPS)
complementary with the NOAA systems

(METOP- A, - B, - C): 2006 - ~ 2020

Jason-2 : 2008 - ~ 2013
(25% EUMETSAT contribution)

➢ **under preparation:**

Meteosat Third Generation (MTG)

~ 2015 up to ~ 2030

➢ **first planning has started:**

Post-EPS:

from ~ 2018/19 onwards

Jason: oceanographic altimeter mission

Summary

- ~ 85 % of natural hazards are caused by meteorological events
  (according to WMO)

- meteorological satellites play an unique role in support to early warning and natural hazard risk reduction management:

  - as input data for numerical forecasts up to 10 days for early warning
  - for specific warnings on precise location, time and intensity of high-impact weather events some hours ahead
  - for monitoring of climate conditions and climate variability

Conclusions (I)

- **the global system of meteorological satellites is co-ordinated by WMO (a specialised agency of the United Nations)**

  in co-operation with other international institutions

- **this global satellite system (+ extensions) will be the backbone of a *G*lobal *E*arth *O*bservation *S*ystem of *S*ystems *(GEOSS)***

  continuous benefit for early warning of natural hazards and risk reduction

- **essential:**
  - **the resulting data / products**
  - **the communication capabilities of the operat. met. satellite operators (e.g. EUMETCast of EUMETSAT → cornerstone for GEONetcast)**

Conclusions (II)

- the operational meteorological satellite systems provide support to:
  - multi-hazard events
  - early warning and monitoring
  - global, regional and global multi-disciplinary purposes

- taking all these advantages into account:
  - all efforts have to be undertaken by political decision takers that the global satellite system will be secured in the future
  - with all the required future improvements

Hurricane KATRINA, 28 June.2005, 17 UTC, NASA EOS Terra, MODIS
(courtesy: MODIS Rapid Response Project NASA/GSFC)

Thanks for your attention