

Satellite Communications in Support of Water Resource Management

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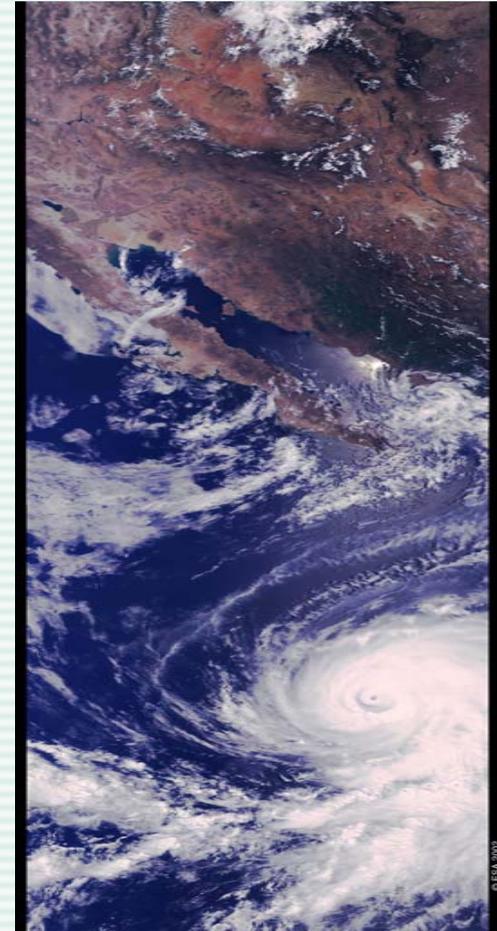
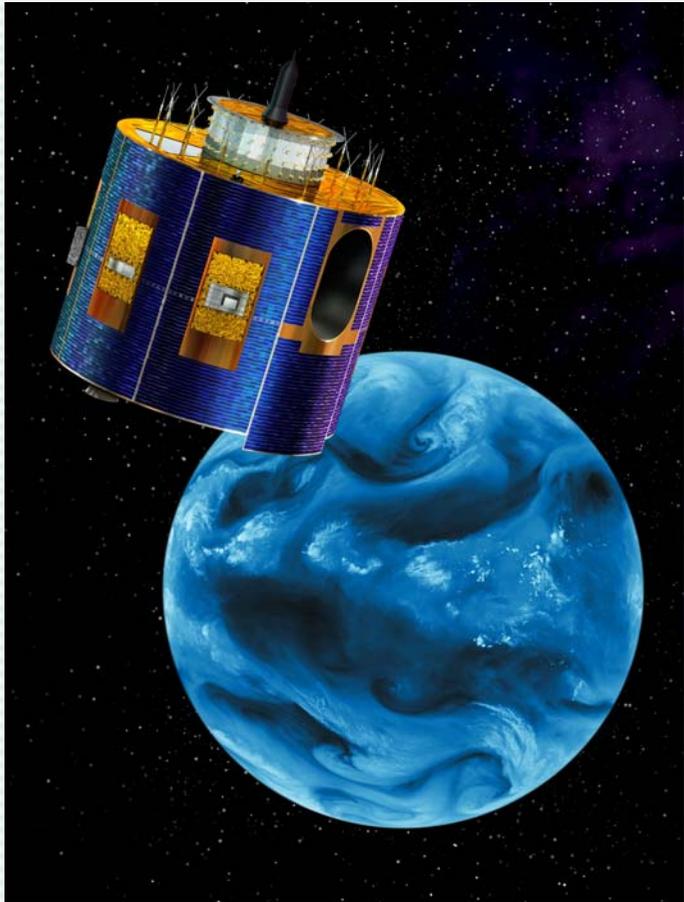
Contents

- **Introduction**
- **Advantages of satellite communications**
- **Solutions**
 - ➔ Data collection and dissemination
 - ➔ Internetworking
- **Decision support**
- **Summary and conclusion**

Question

- How can space technology support water resource management ?

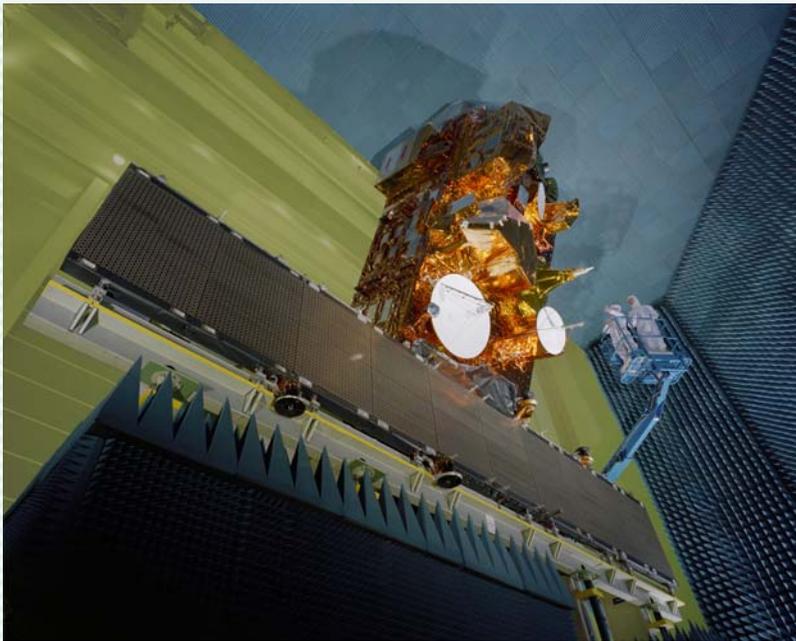
Meteorological Satellites



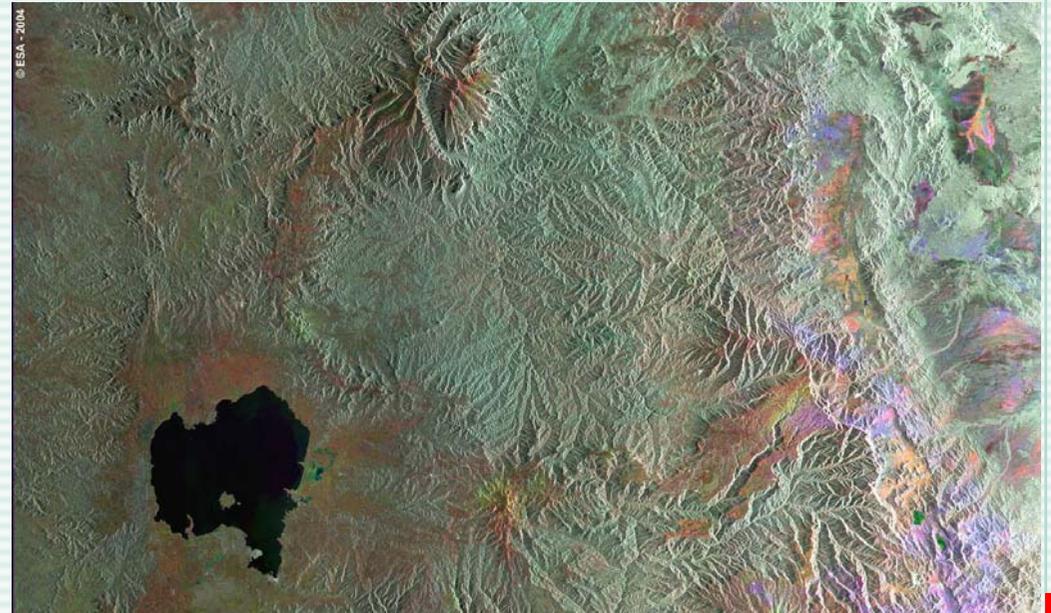
www.esa.int

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α TRADITION of INNOVATION

Remote Sensing Satellites



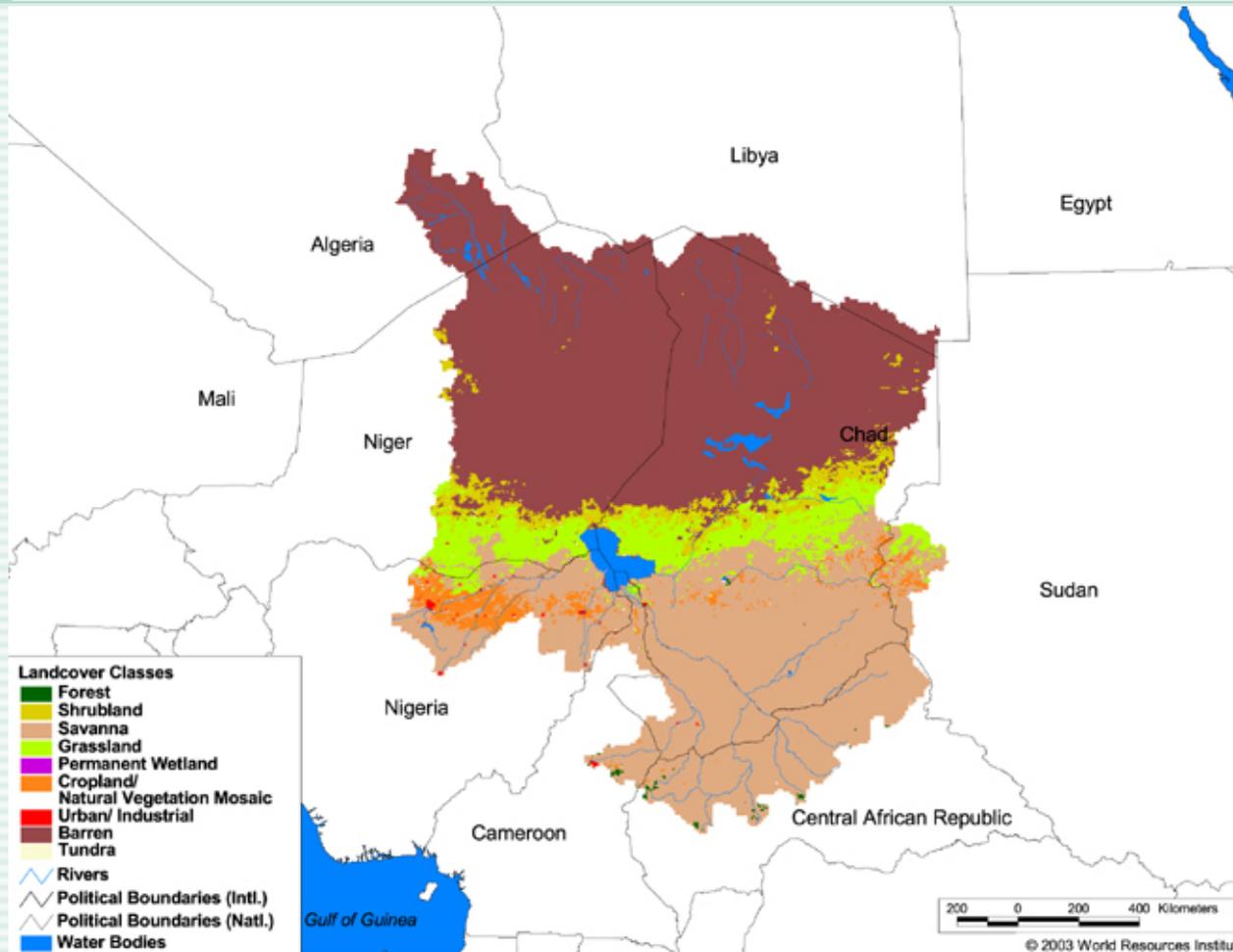
ENVISAT



Lake Tana, Ethiopia



Example Chad Basin

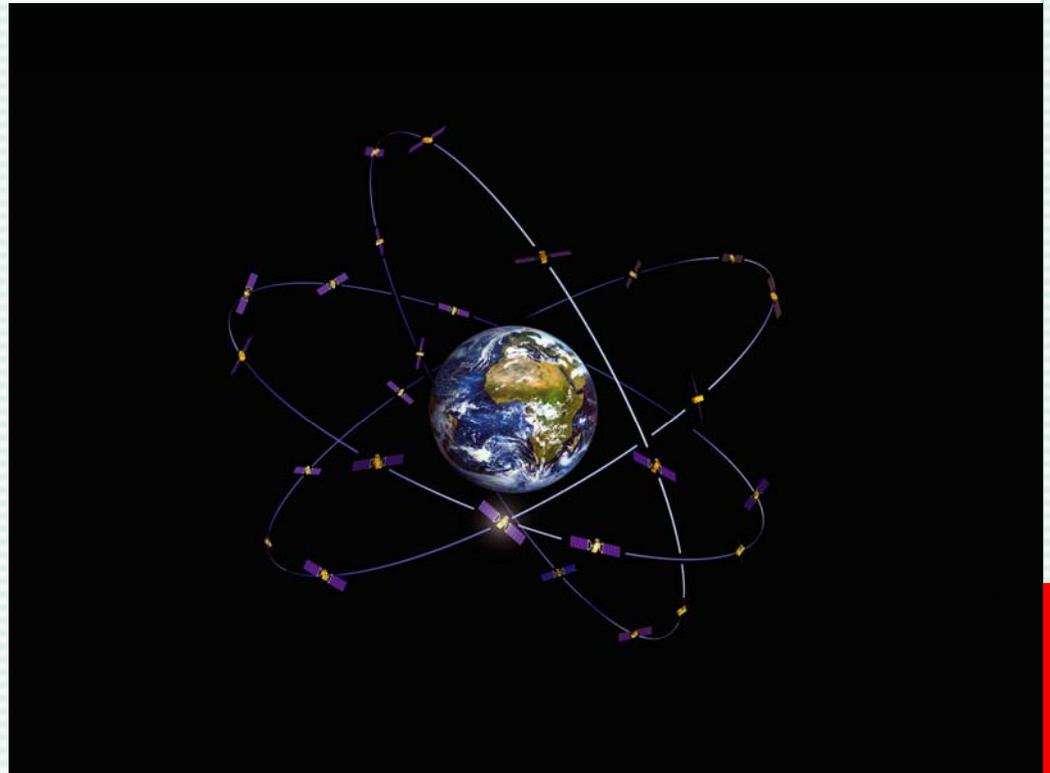




Navigation Satellites

- GPS
- GALILEO
- GLONASS

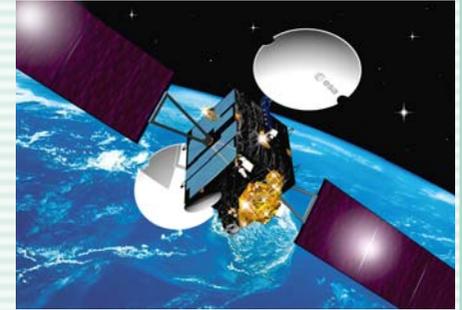
- Surveying
- Positioning
- Geocoding





Communications Satellites

- **Data collection**
- **Data dissemination**
- **Interconnection of remote areas with management centers**
 - Voice (telephony)
 - Video (video conference)
 - Data (Intranet/Internet, database access)





Satellite Advantages

- **Wide coverage**
- **Broadcast capability**
- **High communications capacity**
- **Flexibility in network set-up**
- **Mobility**
- **Rapid deployment**
- **Reliability**
- **Economic solutions available**





Data Collection

- **in remote areas**
- **Water level**
- **Water quality**
- **Meteorological data**
 - ➔ Rain gauge
 - ➔ Wind
 - ➔ Temperature
 - ➔ Humidity
 - ➔ Pressure



Data collection
and
processing



sensors



sensors



sensors

Solutions

- Data collection
- Data dissemination
- Interactive applications



THURAYA

- **Satellite phone technology**
- **2 geostationary satellites**
- **GSM-compatible**
- **L-band operations**
- **Data: 9.6 kbit/s**
- **Low-cost**
- **Coverage:**
 - ➔ Europe
 - ➔ Africa
 - ➔ Asia



THURAYA Coverage





GLOBALSTAR

- **Satellite phone technology**

- **LEO constellation**

- **L-band operations**

- **Services:**

- ➔ Voice

- ➔ Data: 8 kbit/s

- **Coverage:**

- ➔ „global“

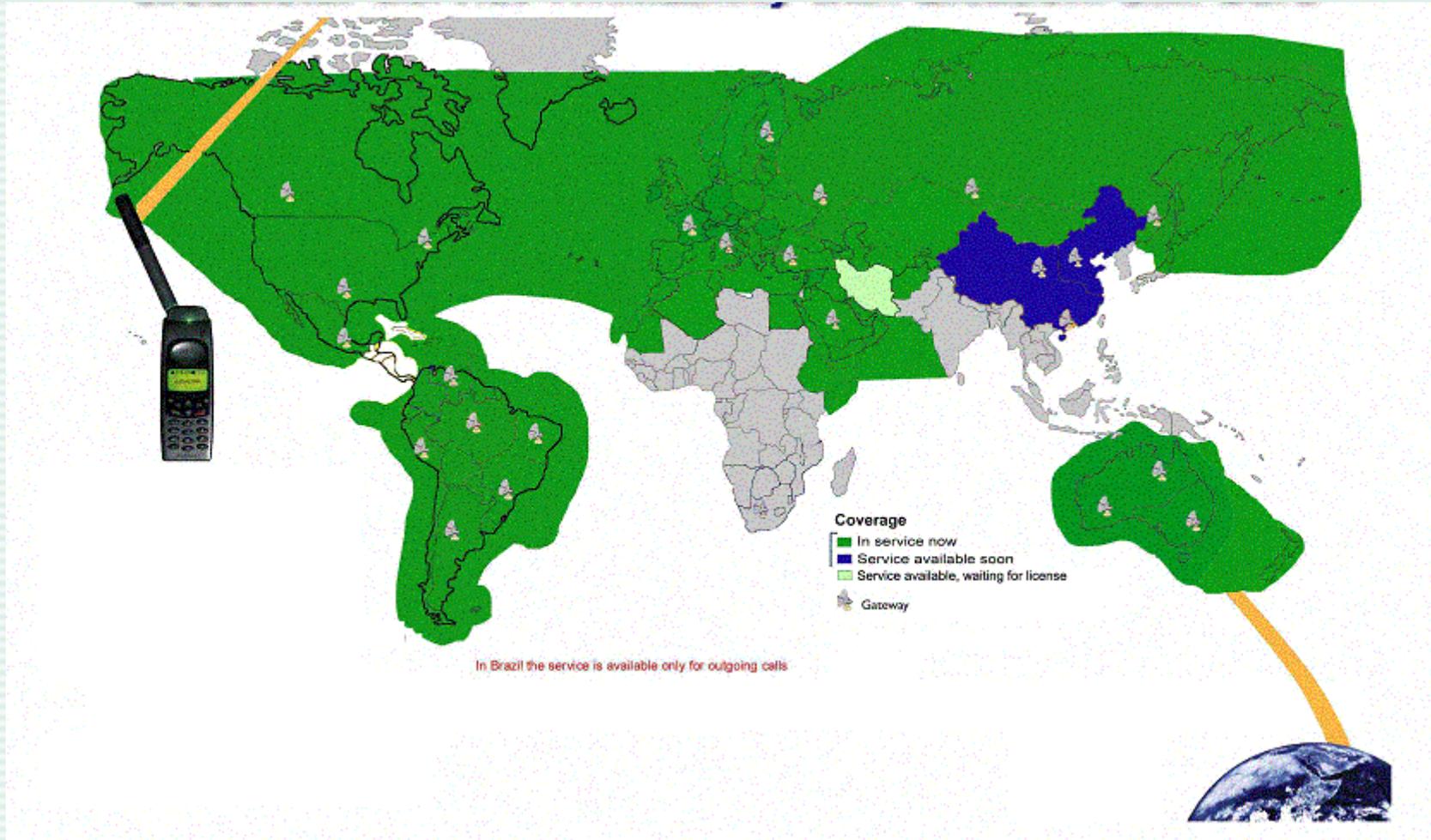
- ➔ Some parts not covered, ground gateways



www.globalstar.com



GLOBALSTAR Coverage



INMARSAT

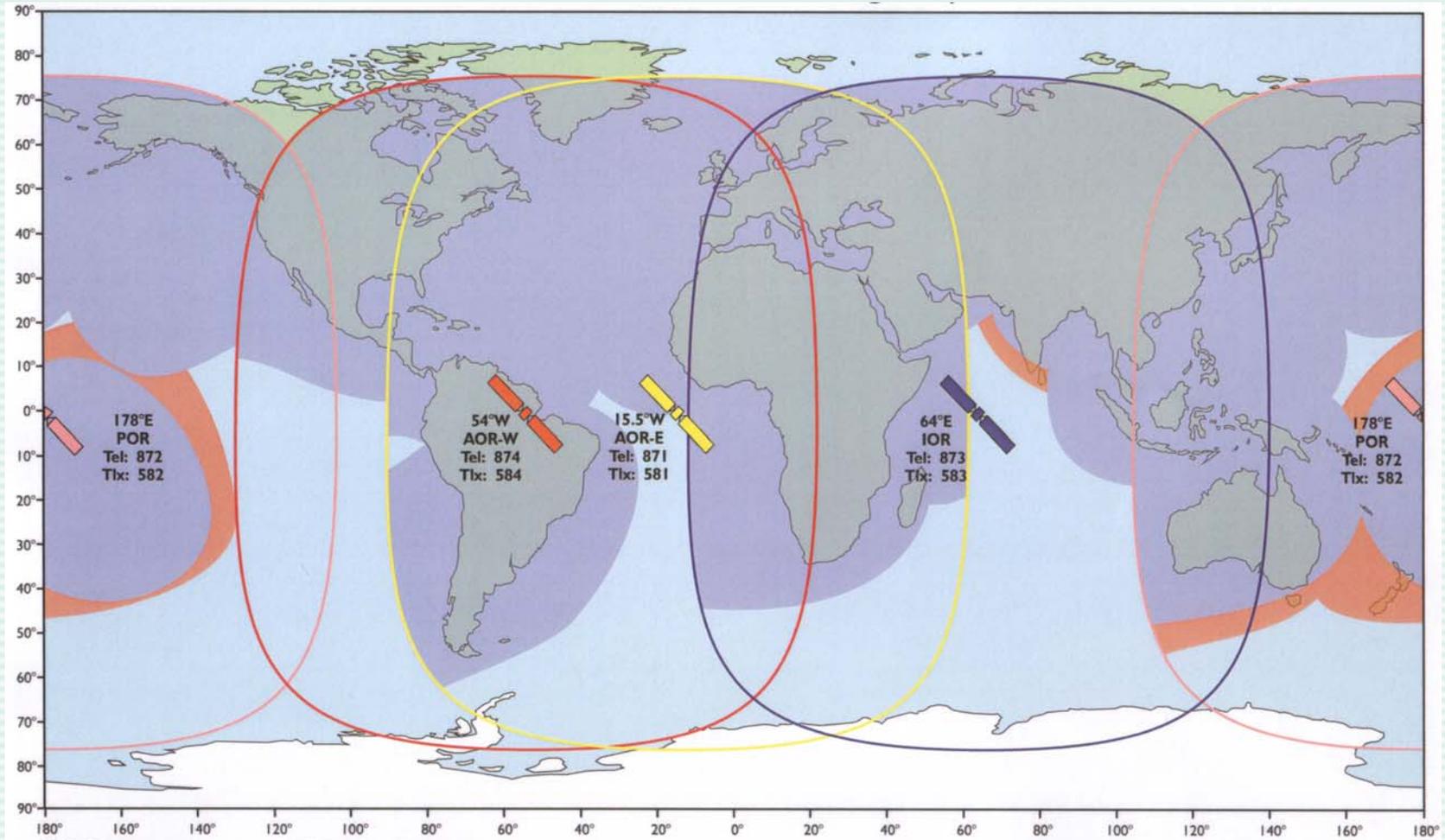
- **Global coverage**
- **Geostationary satellites**
- **L-band operations**
- **Data rates: up to 256 kbit/s**



www.inmarsat.com



INMARSAT Coverage





ORBCOMM

- **Low Earth Orbit (LEO) constellation**
- **Store- and forward principle**
- **VHF band (136 / 138 MHz)**
- **Not real-time**
- **Suitable for data collection**
- **Low cost**





VSAT Technology

- **Antenna sizes 1...3 m**
- **C-, Ku-, Ka- band**
- **High data rates: several Mbit/s**
- **Mesh and star networks**
- **Proven technology**





Services

- **File transfer**
 - ➔ Meteorological, remote sensing images
- **Intranet / Internet access from remote areas**
- **Videoconference services among experts and decision makers**
- **Integrated decision support system**



Networking Aspects

- Protocol family of Internet dominant
- State-of-the-art satellite systems support IP
- All standard local computer applications possible

Satellite



fixed station

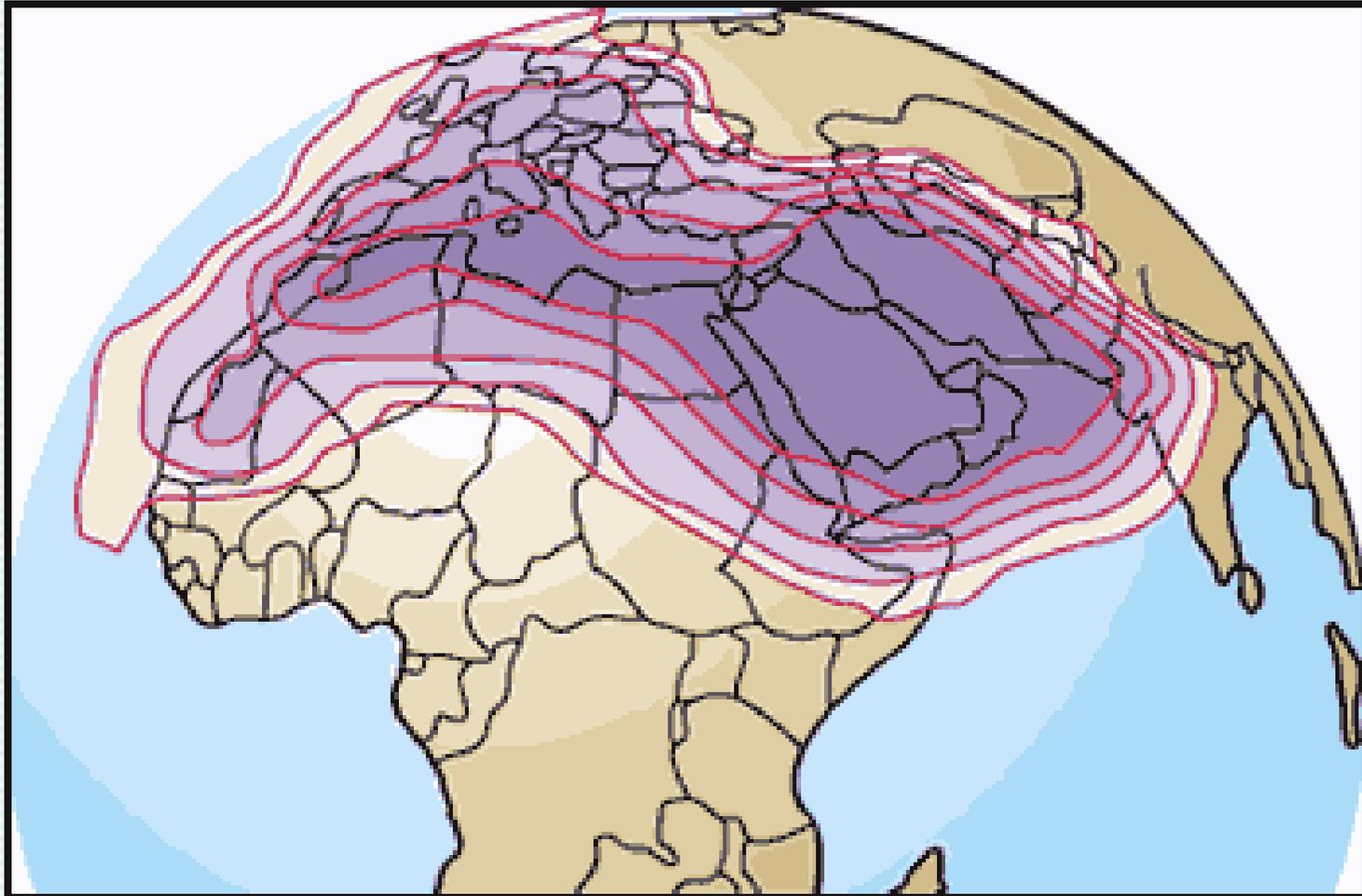
air-transportable
terminal

road-transportable
terminal

mobile
terminal

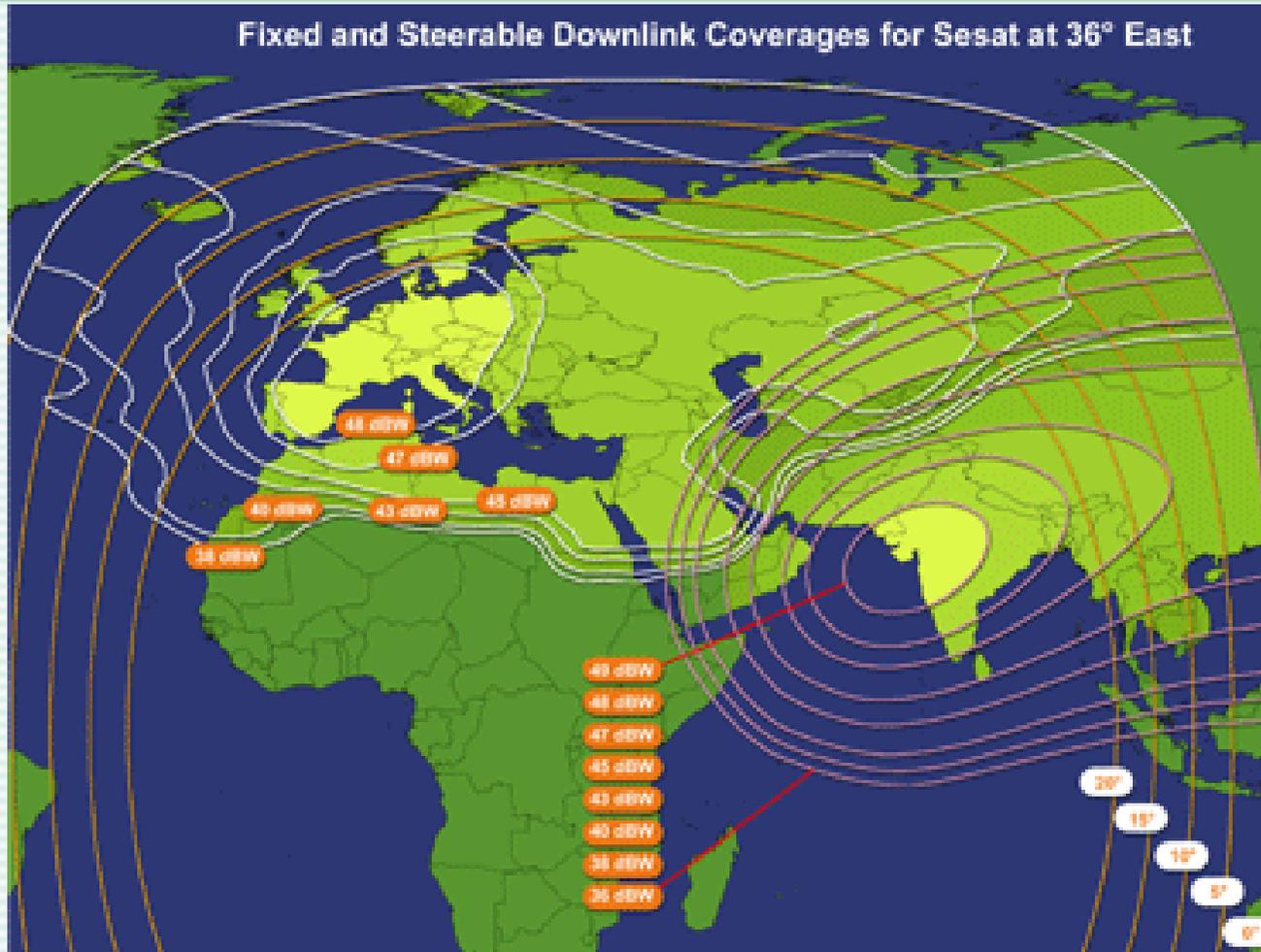


COVERAGE - ARABSAT





COVERAGE – EUTELSAT SESAT





SIT – Satellite Interactive Terminal

- **DVB – RCS (Return Channel System)**
- **Digital Video Broadcasting Technology (DVB-S,-S2)**
 - ➔ forward link Ku-, C-band
 - ➔ High bit rates: several Mbit/s
 - ➔ typ. in Ku-band (normally used for TV distribution)
- **Return link**
 - ➔ C-, Ku- or Ka-band
 - ➔ Data rates 144, 384, 2048 Mbit/s
- **Star network, large number of terminals**
- **Designed for high-speed Internet access in areas without DSL or cable connectivity**

SIT

- **Dish sizes: 75, 90, 120 cm**
- **Small transceiver front-end**
- **Small indoor equipment**
- **Lower cost compared to traditional VSATs**
 - ➔ **Terminal: around \$ 1500**



www.emssatnet.com

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SIT Networking Aspects

■ Suitable for

- High-speed data transmission (remote sensing images)
- Intranet / Internet access
- Data collection (larger volumes)

■ Direct terminal – terminal communications limited due to double hop

■ Solution: On-board processing

- „switching in the sky“
- HISPASAT AMAZONAS satellite (South American coverage)



Alternative solution

- **DVB forward link**
- **THURAYA / Globalstar / Inmarsat return link**
- **Suitable for asymmetric applications**
 - ➔ Downloading of large files



ENVISAT Data Dissemination

- **DVB technology to transfer ENVISAT processed images at high speed**
- **Satellite TV dish**
- **PC with DVB card**
- **Return link not required**
- **25 stations active in Europe**



Summary

■ **Satellite communications vital means for**

- Data collection
- Data dissemination
- Decision support

in water resource management

■ **Variety of solutions**

- Satellite phone technology
- Store and forward satellites
- VSATs
- SIT (DVB-RCS)
- DVB



Summary (2)

- **Provision of services in remote areas**
- **Rapid deployment**
- **Reliable systems**
- **Low-cost solutions available**