



ESA Missions

CryoSat and Future Satellite Oceanography Mission in the context of GMES & GODAE

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- Satellite Ocean Monitoring forms one of the key elements of Global Monitoring for Environment and Security (GMES)
 - Satellite systems are a unique, globally available data source and facilitate local, regional and global applications and related services.
 - GMES will establish operational capabilities providing information to the user community as specified in the EC Action Plan^[1] (2001-2003).
- The economic and environmental importance of the oceans dictate that oceans and marine GMES applications are initially focused on:
 - fisheries and vessel monitoring
 - maritime traffic and security
 - coastal zones and open ocean environment monitoring
 - ice monitoring.
- The general objective of the GMES programme is to realise the benefits of EO data for markets and society.

^[1] COM(2001) 609 final GMES: Outline EC GMES Action Plan

- The primary actors in GMES ocean-related projects need to have existing access to the "tools" needed to establish operational services.
- Since these tools must (in most cases) include operational ocean forecasting capability, these groups are logically also participants in the Global Ocean Data Assimilation Experiment (GODAE). Ocean modelling efforts are: TOPAZ, MERCATOR, FOAM, MFS, HICOM-US, NLOM.
- There is an important overlap, in terms of capacity building, between GODAE and GMES, and thus ESA needs to serve the primary data requirements of these established users (operational and scientific)

NWP Forcing Data

Surface Fluxes

ECMWF
UKMetO
FNMOC
NCEP

Op. Sat. Data

>L2 Products

ESA/
Eumetsat
OSI-SAF
SSALTO/DUACS (F)
NOAA

In Situ Data

Moorings,
Floats, Ships

Coriolis (F)
CERSAT (F)

01100111010...

GODAE Operational Forecast Models

MERSEA (Strand1) FP6 LIP
> 40 Partner Institutions

TOPAZ (N)

MERCATOR (F)

FOAM (UKMO)

Mediterranean
Forecast System
(MFS) (I)

Operational Ice Services

DMI (via OSI-SAF),
FIMR, SMHI, etc
(EU)

CIS (Can)

ESA GMES Services

Gridding & Data Projection

Live Access Server - OR
other Product Distribution Services
e.g. Bulletins <http://bulletin.mercator.com.fr>

Policy
Customers

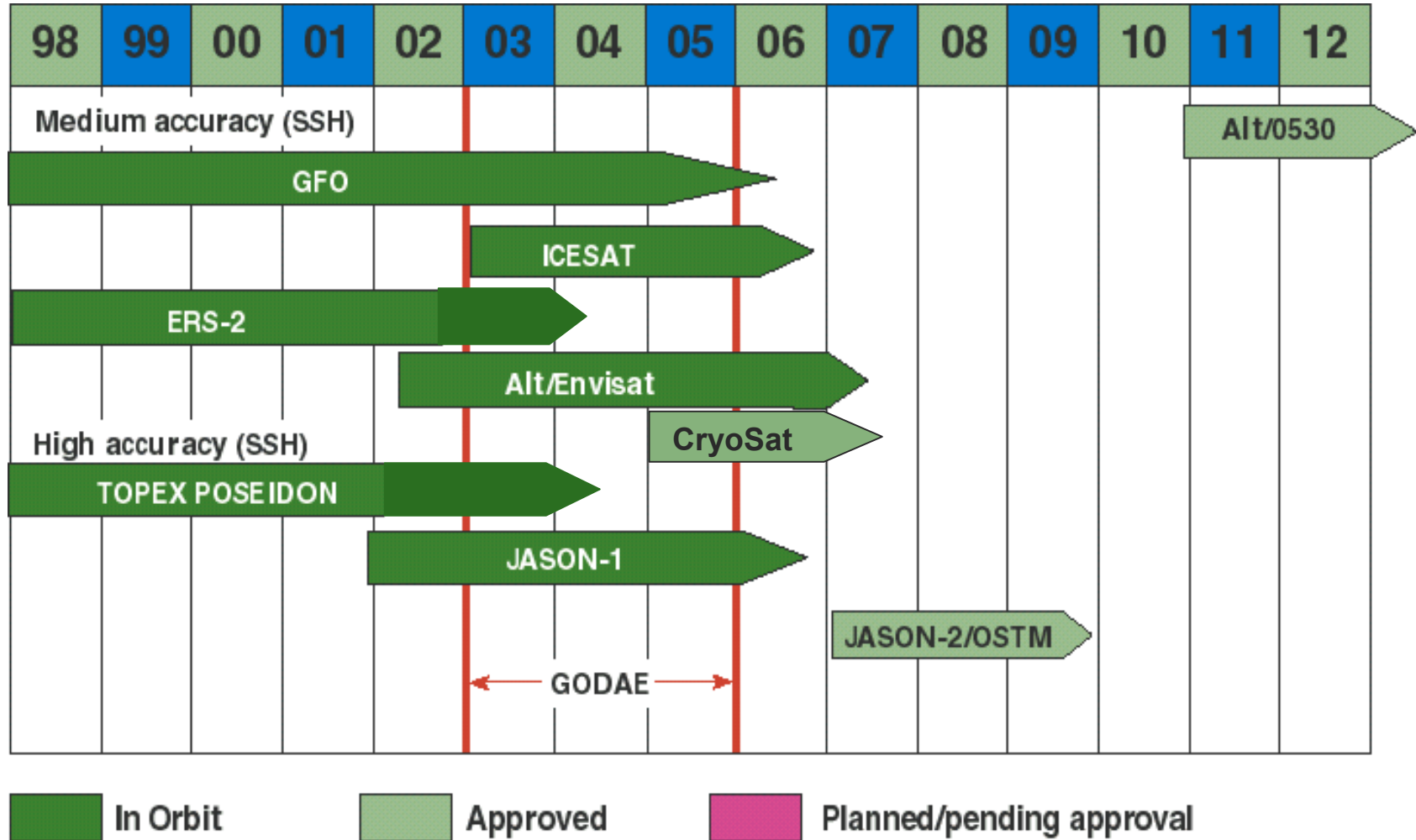
Govts.
*Environment
Agencies, etc.*

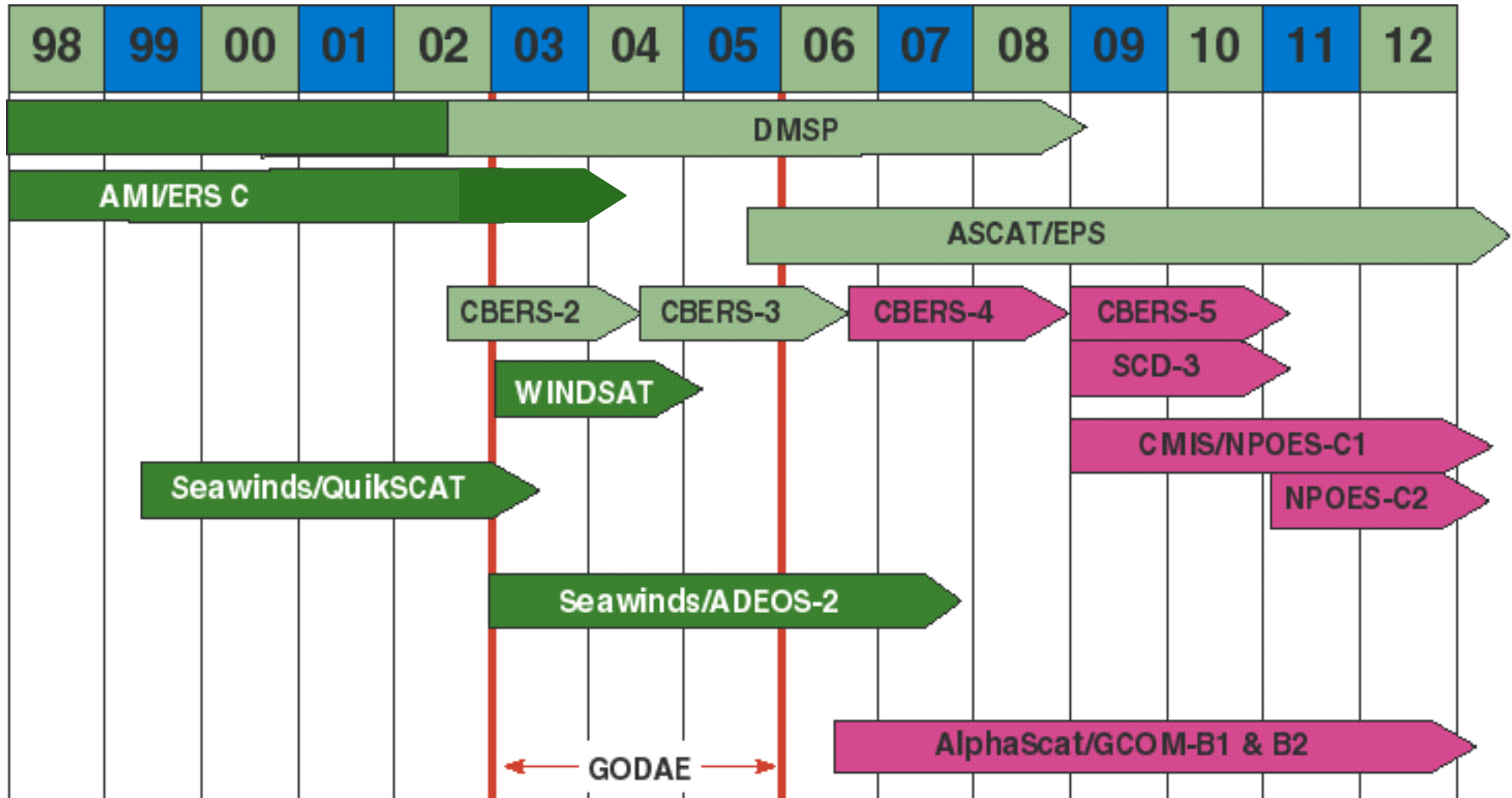
Commercial
Customers

*Shipping
Fishing
Offshore
Marine Survey
Drilling
Forecasters,
etc..*

Scientists

General
Public



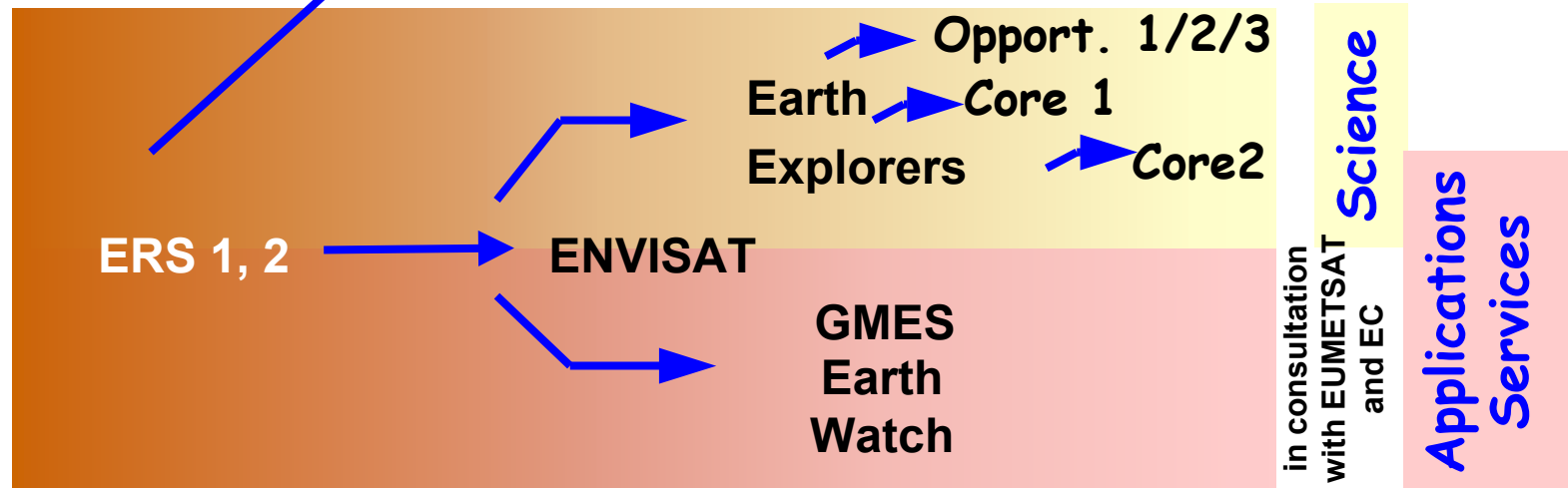
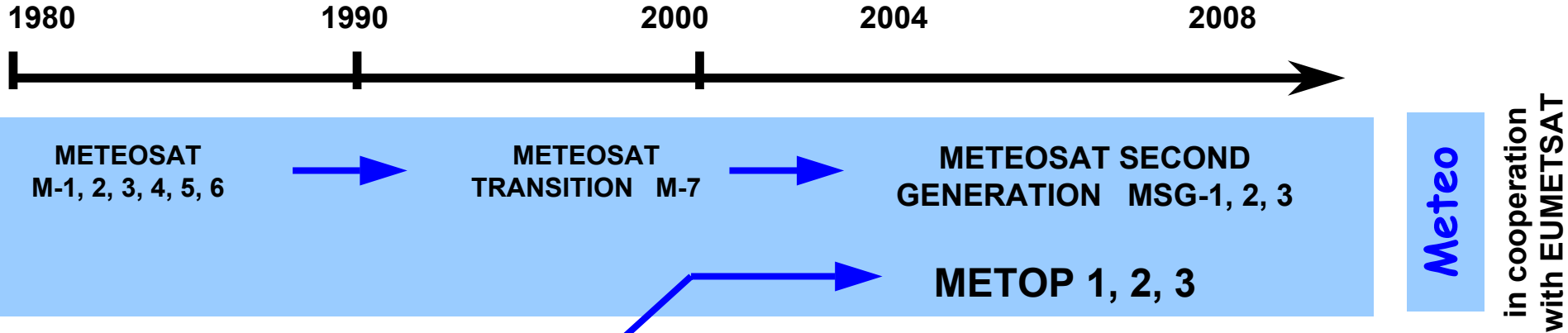


In Orbit

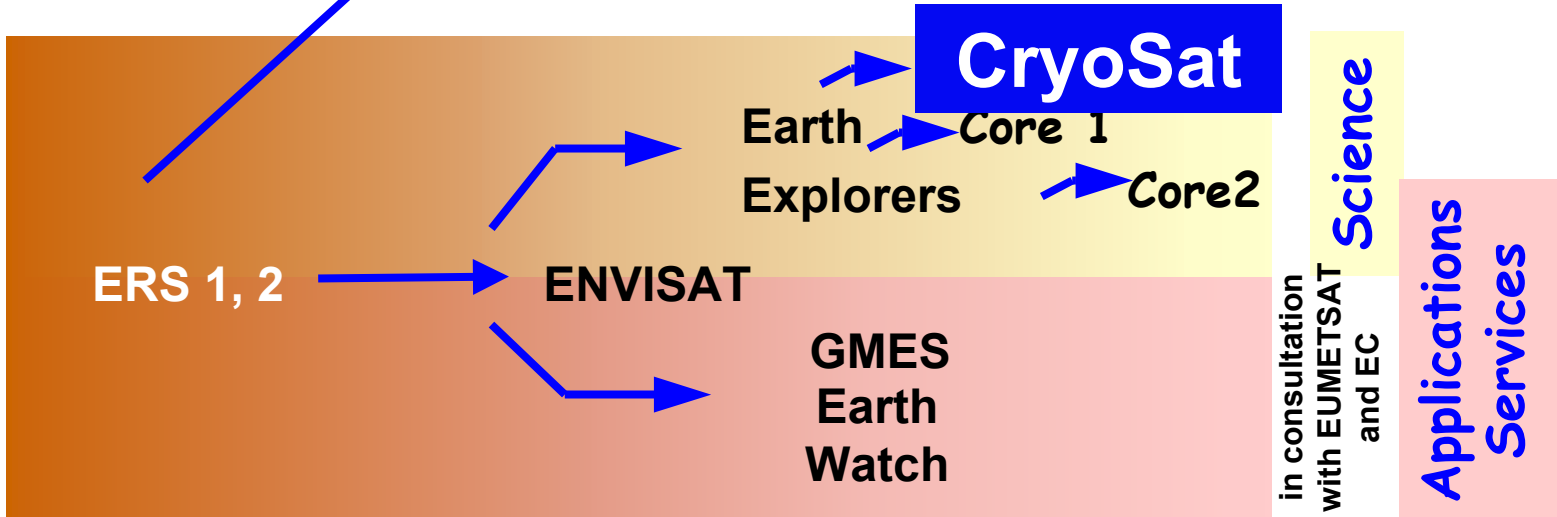
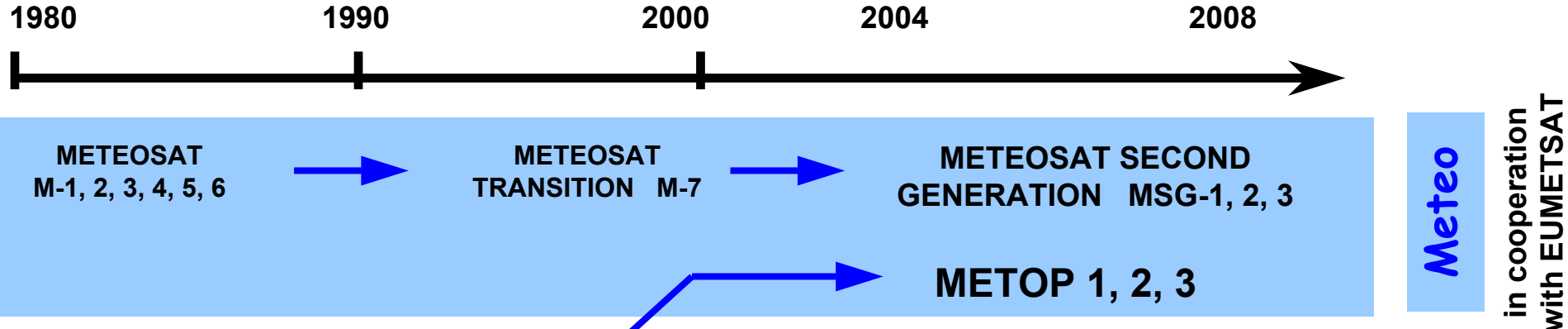
Approved

Planned/pending approval

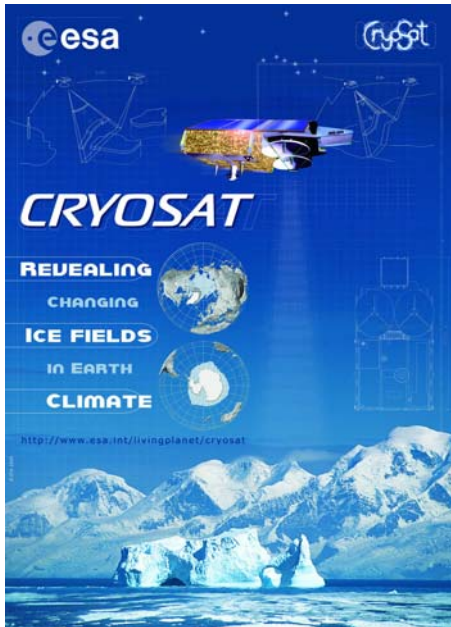
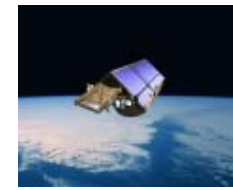
- ESA's Living Planet Programme contains two types of missions:
 - Earth Explorers
 - Earth Watch
- Earth Watch missions are operational service-oriented missions of ESA's dual mission strategy
- Earth Watch Missions shall complement the more research-driven Explorers, and provide continuity in observations



Earthnet: European access to non-ESA missions (JERS, LANDSAT, SeaWifs, MODIS, ALOS, ADEOS...)



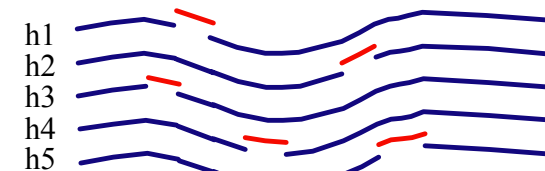
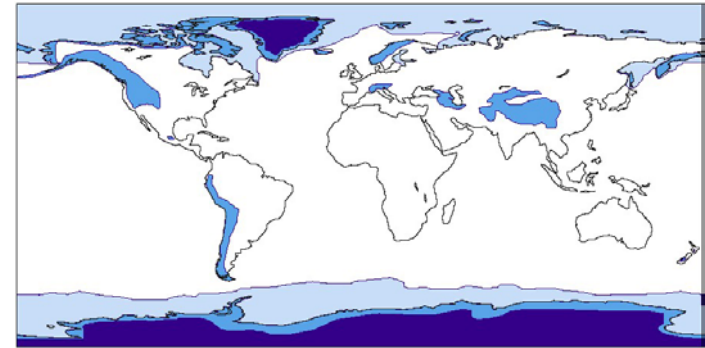
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CRYOSAT (Launch end 2004)
Status: Phase C/D ongoing

Ku-band Altimeter
SAR/Interferometric Capability
Along-track res. 250 m (SAR mode)

Sea-ice objective:
To characterise trends/variations in sea-ice thickness/mass to an accuracy of:
1.6cm/year - on a space scale of 100,000 km² (~320 x 320 km)

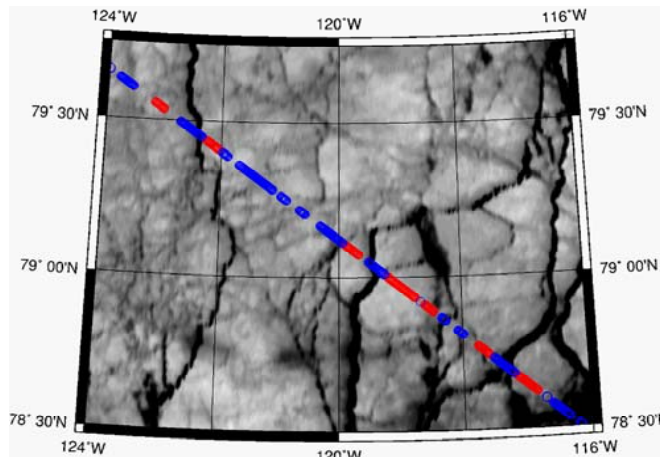


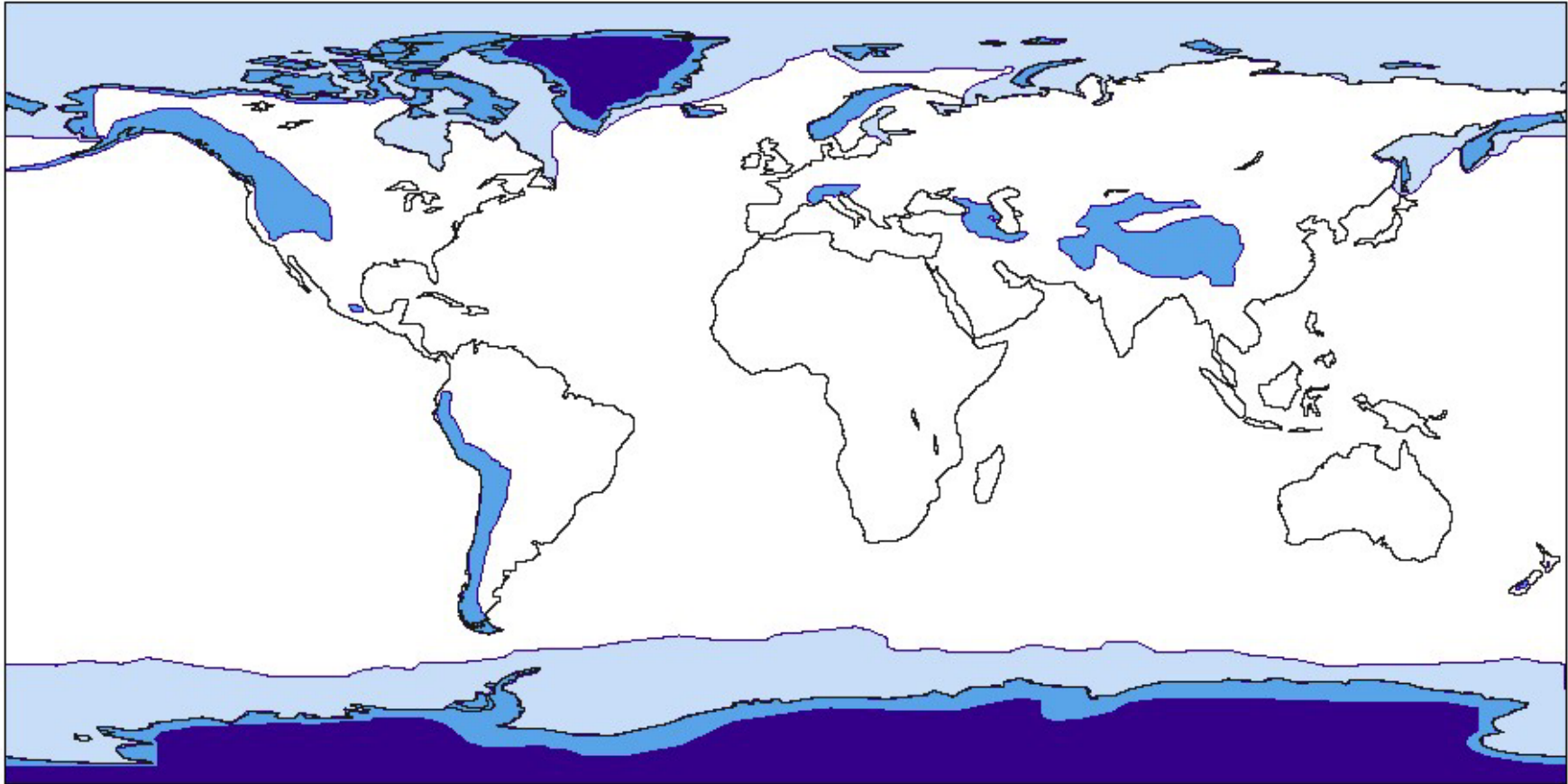
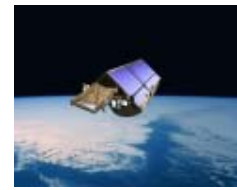
$$\Sigma$$



$$\Delta h = h - \bar{h}$$

after Laxon





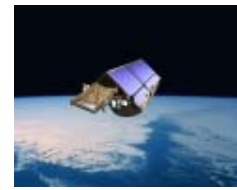
High resolution altimetry SARIn and SAR



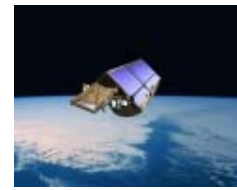
Low Resolution mode



Not required by CryoSat mission objectives, but will be operated in Low Resolution mode



- Conventional Altimetry will be operated over ocean and non-cryosphere land
- A development and validation of a Near Real Time product similar to the ENVISAT FDMAR is foreseen
 - Significant Wave Height
 - Wind Speed
 - Range, DORIS Navigator altitude
 - 10 orbit/day in < 3 h
 - 14 orbit/day in < 7 h (due to Kiruna data dump scenario)



- A CryoSat data AO will be issued before end of year
- It will also call for oceanographic science and applications
- CryoSat has some spare system resources (power, data memory) to acquire some samples of SAR and SARin over ocean, coastal zones, lakes, rivers, land
- AO Proposals should request small samples of SAR and SARin over non-cryospheric surfaces to be used in scientific experiments for demonstration purposes.

- An Earth Watch ocean mission would provide remote sensing data required to provide operational services for applications related to ocean, coastal zones and ice.
- Was formulated for a phase A in 2001 but not given a high enough priority
- The GMES Initial Period report requires, among other, operational satellite ocean mission, in the context a world-wide global ocean observing system.....

- The human need for global ocean observations
 - better understanding of ocean processes to increase predictability of processes, e.g. NWP, hurricanes, coastal erosion, alga blooms, etc.

- The economic importance of the oceans
 - Commercial, Economic and Social Value
 - 2-5 BEURO /year estimated by EuroGOOS

 - The Environmental Value
 - air, forests, rivers, ocean, soil, represents capital! It is necessary to understand role of the sea better to perceive its true value

 - Sustainable Development
 - Conventions, Kyoto Protocol, Framework Climate Convention, Biodiversity Convention, etc.

- The capability to observe the ocean and to deliver useful ocean data products is well established
 - Altimetry and ocean topography, ocean colour and biology, wind vector measurements at ocean surface, sea ice, ocean waves
 - Observation techniques and top class instruments: altimeters in ERS, ENVISAT, CRYOSAT, T/P, JASON, ocean colour on IRS and ENVISAT, SST on ERS and ENVISAT, Wind Scatterometers on ERS and MetOp, SAR on ERS, ENVISAT, Radarsat and future EarthWatch missions
- The policy justification for a global ocean observing system is well established:
 - GMES, convention monitoring,
 - Support by operational entities in particular Eumetsat (Darmstadt declaration October 2000)
 - Desire to go operational in many federating bodies: WMO, CEOS/ IGOS, EuroGOOS
- Improved knowledge of the ocean is essential for further development of a global ocean observing system
- It is economically, environmentally, strategically and scientifically important, it is mature and politically opportune, it is affordable, it is time to do it operationally.

- The European shelf “environment and food” operational community sectors regard biogeochemical variables as highest priority (also input to ecosystem modelling) - (ROSES - GMES Service Element Study)
- Accurate NWP requires operational, satellite-derived sea-surface topography, wind-speed, sea-surface temperature data for model data assimilation
- Coastal variables (e.g. sediment transport/biological productivity/sea-level of considerable importance to shipping, waterway and coastal/estuarine resource management)
- Offshore operational community (shipping and platforms) regard wind speed, wave height, mesoscale ocean circulation, SST, and sea-level as high priorities.
- Activity in sea ice (ICEMON & Northern View - GMES SE Studies)

Taking into account the present and planned missions, it was proposed to implement an Earth Watch Operational Ocean Mission exploiting two lines of heritage:

- Altimeter element:
 - Based on ERS-1/2 RA/ENVISAT RA-2/SIRAL heritage and continuation of altimeter development
 - MWR (water vapour content - and tropospheric correction) and a GPS and / or DORIS / Laser reflector (precise positioning for cm accuracy)
- Optical Element (VIS-IR)
 - Combination of Ocean Colour and SST capabilities, extension to coastal and land applications

- ESA has provided a high inclination altimetry service since 1991: ERS-1 (1991-2000), ERS-2 (1995 -), ENVISAT (2002 - 2007), will continue with CryoSat (2004 - 2007)
- Europe has developed new concepts, CryoSat, Altika, GANDER, MANOLO, PARIS, SWIMSAT, etc.
- Concepts of “Report of High-Resolution Ocean Topography Science Working Group meeting” March 2001, addressed (incl. WSOA, WITTEX, WITTEX-Wide etc..)
- The Ocean Earth Watch should be conceived in cooperation taking into account the European position for JPS (i.e. NOAA+Eumetsat) and planning for post-EPS (i.e. post METOP)

- An Earth Watch ocean mission should be a GMES/Operational Oceanography user-driven mission that would be developed with interagency partnerships.
- ESA would capitalise on its experience in development of ERS-1/2 (*RA*, *ATSR*), ENVISAT (*RA-2*, *AATSR*; *MERIS*) and CryoSat (*SIRAL*); and ongoing instrument studies
- A future mission concept should meet the goal of long-term provision of:
 - High-inclination, high-quality altimeter (SSH, SWH, Wind speed, ice thickness)
 - High-quality SST in continuity of AATSR
 - Ocean Colour data in continuity of MERIS

And meet the stringent data delivery timeliness and measurement accuracy requirements

- The present study identifies the need of a launch in the 2008 time frame, but the concept is not approved yet...

- We are at an important crossroad of the history of Earth Observation from Space, with converging efforts:
- GMES Initiative end of the 2001-2003 Initial Period implemented according to a shared EC/ESA Action Plan producing requirements and way forward for operational EO services in 2004-2008 time frame.
- New ESA Director General with his “AGENDA 2007”
- White Paper from the COMMISSION OF THE EUROPEAN COMMUNITIES, presented by European Research Commissioner
 - “Space: a new European frontier for an expanding Union -
An action plan for implementing the European Space policy”