ERS and ENVISAT missions status

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Envisat Mission Manager

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ERS Mission Manager
ESA missions embarking SAR instruments: a lot of progress since last Fringe workshop in November 2005

- **ERS-2**: approved mission (1995)
- **Envisat**: approved mission (2002)

**Status in Nov. 2005**
ESA missions embarking SAR instruments:
a lot of progress since last Fringe workshop in November 2005

<table>
<thead>
<tr>
<th>Year</th>
<th>Mission</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>ERS-2</td>
<td>approved 3-years extension</td>
</tr>
<tr>
<td>2002</td>
<td>Envisat</td>
<td>envisaged 3-years extension</td>
</tr>
<tr>
<td></td>
<td>ALOS (ESA 3rd party mission)</td>
<td>Status today</td>
</tr>
<tr>
<td></td>
<td>Sentinel-1</td>
<td></td>
</tr>
</tbody>
</table>
ERS-2 mission

- 16 years of ERS-1/2 SAR data in the archive
- ERS-2 achieved 12 years in orbit in April 2007
  \ ERS-2 was designed for 3 years nominal lifetime!
- Ample hydrazine \ ~ 50% left after 12 years
- Platform
  \ preventive measures are implemented on the power system to compensate for ageing
- Instruments
  \ all instruments work satisfactorily and provides useful data

( Good prospect to operate ERS-2 mission until 2011 )
ERS-2 mission status

Life-limiting items (gyros & recorders) compensated through workaround solutions:

- SAR interferometry revived: zero-gyro data are being Doppler screened removing the attitude uncertainty,
- Network of SAR data acquisition stations provides a good coverage

Fast ERS-2 SAR instrument tasking \ 13 hours
ERS-2 / ERS-2 SAR interferogram of the Peru Pisco earthquake (15 August 2007 - Magnitude 7.9)

ERS-2 interferometry pair:
18 February 2005
&
17 August 2007

Courtesy of F. Amelung, J. Biggs, M. Pritchard (Univ. of Miami)
Exploitation of the synergy between ERS-2 and Envisat

(same ground track with 30 minutes time difference)

Relation with Envisat:
- Mitigation of ASAR mode conflicts
- Operational complementarity
- Synergetic exploitation of 30 min. time difference
- Partial backup
Synergy ERS-2 / Envisat

Exploiting SAR mode differences

Relation with Envisat:
- Mitigation of ASAR mode conflicts
- Operational complementarity
- Synergetic exploitation of 30 min. time difference

ERS-2 (e.g. for InSAR)

ASAR Wide Swath
(e.g. for oil slick monitoring)
Exploitation of the synergy between ERS-2 and Envisat

**Etna volcano**: mean deformation velocity maps relevant to the 1992-2006 time interval, generated from both ascending and descending orbits by merging ERS and Envisat data.

**ERS/Envisat**: Longest consistent C-Band SAR data archive permanently updated \ more than 1PByte of data

**Relation with Envisat**:  
- Partial backup  
- Mitigation of ASAR mode conflicts  
- Operational complementarity

**Courtesy**: R. Lanari (CNR, Italy)
InSAR exploitation of the synergy between ERS-2 and Envisat

The ERS-2 / Envisat constellation (30 min. difference) has the potential to:

• measure velocity of fast moving Arctic glaciers (> 200 m/year). ERS/Envisat SAR data should be suited to map velocities of 1 cm between the two 30-minutes passes with interferometry (assuming coherence and attitude stability are sufficient).

• generate accurate low relief Digital Elevation Models. This is of particular interest for many low elevation delta regions.

• improve the general understanding of interferometry and coherence.

However the InSAR exploitation of Envisat and ERS data is complicated by the difference of 31 MHz between the radar central frequencies and can be performed under certain geometry (baseline) conditions.

\ to compensate for the frequencies difference, ERS-2 orbit was shifted by about 2 km at end-September 2007, for a campaign of about 4 months.
ERS-2 - ENVISAT SAR Interferometry

Low relief DEM
Siberia
Ob river estuary
[70.2 N, 75.5 E]

ERS-2 / Envisat
3 October 2007

High coherence!

No SRTM DEM at high latitudes

Ambiguity height: 5.3 m

Courtesy:
U. Wegmueller, M. Santoro
(Gamma Remote Sensing, CH)
ERS-2 - ENVISAT SAR Interferometry

Fast moving glacier
Greenland
Kangerdlugssuaq
Glacier

ERS-2 / Envisat
2 October 2007

High coherence on ice

Fringes were not visible in ERS-1/2 tandem 1-day data on this glacier (too fast)

Courtesy: E. Rignot (JPL, USA)

Preliminary result - Next step: Retrieval of glacier velocity once precision baselines are available
ENVISAT mission: 5 years!

- First images
- Global air pollution
- Ozone hole 2003
- Prestige tanker oil slick
- Bam earthquake
- Tectonic uplift (Andaman)
- Envisat Symposium Salzburg (A)
- Hurricane Katrina
- B-15A iceberg
- Chlorophyll concentration
- CO2 map
- Arctic 2007

- Calibration Review
- Validation Workshop
- MERIS Workshop
- InSAR Workshop
- Envisat Symposium Salzburg (A)
- MERIS (A)ATSR Workshop
- InSAR Workshop
- Altimetry Conference
- Atmospheric Science Conference
- Envisat Symposium Montreux (CH)

- Launch Mar 02
- Cal Dec 02
- Val Nov 03
- MERIS Dec 03
- InSAR Sep 04
- Envis Sep 05
- InSAR Dec 05
- Alt May 06
- Atmospheric Science Conference
- Envis Apr 07

- ~1400 scientific projects
- + several GMES pre-operational projects

ENVISAT mission: 5 years!
## Envisat satellite status - Overview

<table>
<thead>
<tr>
<th>Mission elements</th>
<th>Current performances</th>
<th>Expected evolution</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>MERIS</td>
<td>Excellent</td>
<td>Excellent</td>
<td></td>
</tr>
<tr>
<td>AATSR</td>
<td>Excellent</td>
<td>Excellent</td>
<td></td>
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<tr>
<td>ASAR</td>
<td>Good</td>
<td>Fair</td>
<td>Sub-system on redundant side</td>
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<tr>
<td>RA-2</td>
<td>Good</td>
<td>Good</td>
<td>S-band redundant side failure</td>
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<td>MWR</td>
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<td>DORIS</td>
<td>Excellent</td>
<td>Fair</td>
<td>Instrument on redundant side</td>
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<tr>
<td>SCIAMACHY</td>
<td>Excellent</td>
<td>Good</td>
<td></td>
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<tr>
<td>MIPAS</td>
<td>Good</td>
<td>Fair</td>
<td>Mechanical degradation in non redundant part (currently stopped)</td>
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<tr>
<td>GOMOS</td>
<td>Fair</td>
<td>Fair</td>
<td>Instrument on redundant side</td>
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<tr>
<td>Service Module</td>
<td>Excellent</td>
<td>Excellent</td>
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<tr>
<td>Payload Equip. Bay</td>
<td>Excellent</td>
<td>Excellent</td>
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<tr>
<td>Hydrazine</td>
<td>Excellent</td>
<td>Fair then Bad</td>
<td>Main limiting factor of the mission</td>
</tr>
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</table>
Hydrazine consumption: very good performances, but ...

Current orbit control (+/- 1km) means about 35 kg / year

Very good performances (and improved InSAR baselines thanks to new strategy implemented in 2007)

Fringe 05 (65 %)

Today (45 %)

optimistic

typical

worse case
Envisat 3-years extension [2011-2013]: the context

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<thead>
<tr>
<th>Year</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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<td>Sentinel-5 ?</td>
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</tbody>
</table>

Risk of data gap & Need of back-up
The following criteria were used to find a solution for extending Envisat beyond 2010:

- to keep the current nominal mission for as long as possible (i.e. until 2010),
- to extend the mission well beyond 2010,
- to ensure the continuity of the max. number of Envisat applications beyond 2010,
- to follow the mitigation rules for space debris risk at end of mission.

The Envisat 3-years extension requests a modification of the orbital parameters in 2010 as the on-board hydrazine will be almost completely consumed by 2010.
Arctic sea ice extent
Worldwide acquisition thanks to on-board recorders and to ESA data relay satellite Artemis (60% of ASAR High Bit Rate data transmitted through Artemis).

Envisat ASAR use: some 18 minutes /orbit (i.e. about 7200 km per orbit in average)

Remaining acquisitions in Low Bit Rate:
Global Monitoring Mode over land and sea ice, Wave Mode over oceans.
The ASAR Background Regional Mission

- Defines planning of ASAR when there is no specific user acquisition request
- Acquisition priorities defined by the High Level Operation Plan

Background Regional Mission (BRM)
(implemented with the aim to minimize conflicts with existing user requests)

Archive built by specific user acquisition requests
Data acquisition confirmed to users

Archive built by BRM
Data acquisition NOT confirmed to any user group

ENVISAT ASAR archive

All Fringe 05 recommendations for ASAR Background Mission are implemented
Yellowstone caldera uplift

Yellowstone caldera accelerated uplift: up to 7 cm / year

Science, 9 Nov. 2007: “Accelerated Uplift and Magmatic Intrusion of the Yellowstone Caldera, 2004 to 2006”, Wu-Lung Chang, et al., Univ. of Utah (ESA Cat-1 project #2765)
### Archived data

<table>
<thead>
<tr>
<th>Archived data</th>
<th>availability</th>
<th>period</th>
<th>coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envisat ASAR</td>
<td>On request (CD-Rom or DVD-Rom)</td>
<td>Whole mission since 2002</td>
<td>Worldwide coverage</td>
</tr>
<tr>
<td>ERS-1/2 SAR</td>
<td></td>
<td>Whole mission since 1991</td>
<td>Within ERS station masks</td>
</tr>
</tbody>
</table>

**FTP distribution service for archived data, priority to emergency and Cat.2 requests**

### Near Real Time data

<table>
<thead>
<tr>
<th>NRT data</th>
<th>availability</th>
<th>period</th>
<th>coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Envisat ASAR</strong></td>
<td><strong>Systematic</strong></td>
<td>Rolling archive of last 7 days</td>
<td>Worldwide coverage</td>
</tr>
<tr>
<td>Medium Resolution (75 m)</td>
<td>(i.e. processing of all data)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[e.g. Wide Swath Mode image]</td>
<td>Product available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global Monitoring (1000 m)</td>
<td>3 hours after acquisition</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Envisat ASAR</strong></td>
<td><strong>On request</strong></td>
<td>Few hours after acq.</td>
<td>Worldwide coverage</td>
</tr>
<tr>
<td>Full Resolution (12.5 m)</td>
<td>(i.e. limited number, priority to emergency and Cat.2 requests)</td>
<td></td>
<td></td>
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<tr>
<td>[e.g. IMS, APS]</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>ERS-2 SAR</strong></td>
<td><strong>On request</strong></td>
<td>Few hours after acq.</td>
<td>Southern Europe</td>
</tr>
<tr>
<td>Full Resolution (12.5 m)</td>
<td>(i.e. limited number)</td>
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</tbody>
</table>
Conclusions

ESA is committed to continue supporting SAR Interferometry:

- ERS-2 mission extended until 2011
- New opportunity with ERS-2 / Envisat 30-minutes tandem
- Envisat large acquisition capability (dedicated to InSAR)
- Overall 16 years C-band SAR data archive (ERS-1/ERS-2/Envisat)
- C-band Sentinel-1 satellite under development
- Access to L-band ALOS PALSAR data
- Coordination with other European / Canadian SAR missions