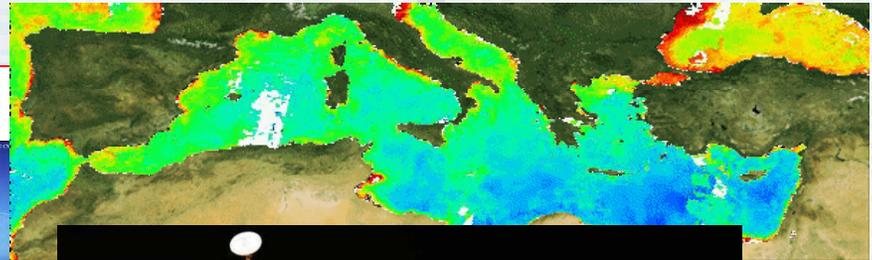
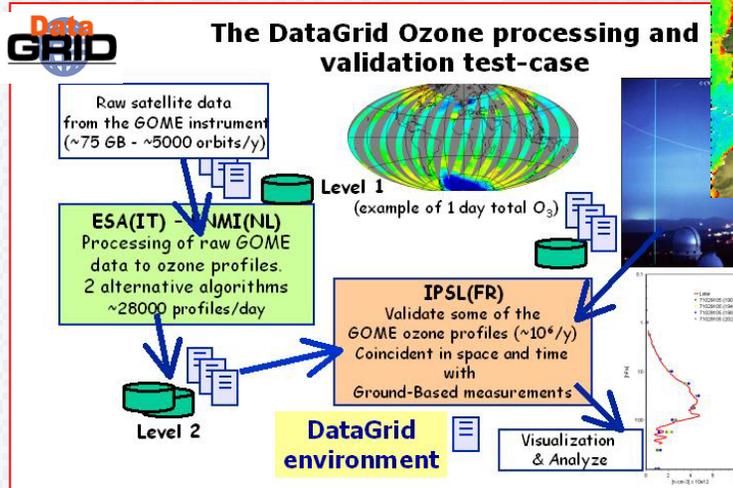


Low cost software for interpretation of satellite data

Is this in line with e-science?



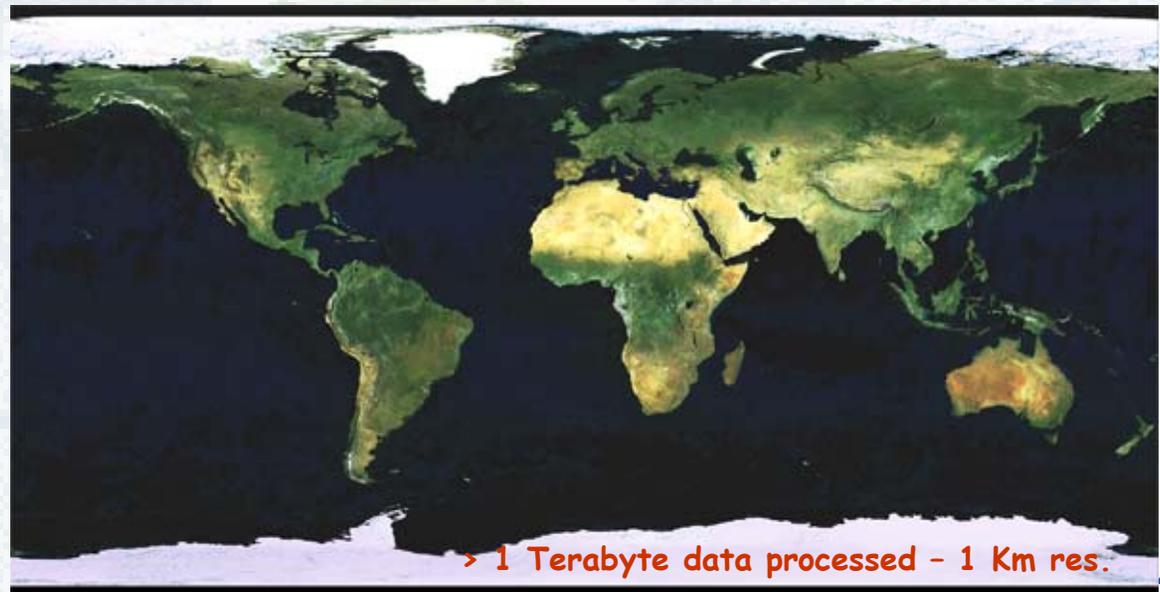
luigi.fusco@esa.int

Space Systems: protecting and restoring water resources
 Graz, Sept 2005

✓ ESA - European Space Agency

- Observer in the UN-COPUOS
- Active in the Committee and Subcommittee work
- Promote UN Programme on Space Application

- ✓ From the traditional way...
 - ...Support to learning (EDUSPACE, LEOWORKS)...
 - ... Software tools (BEAM, BEST, BEAT... BILKO...
- ✓ ...To a new **e-collaboration** paradigm
 - access to data, tools and resources
 - Earth Science GRID on Demand



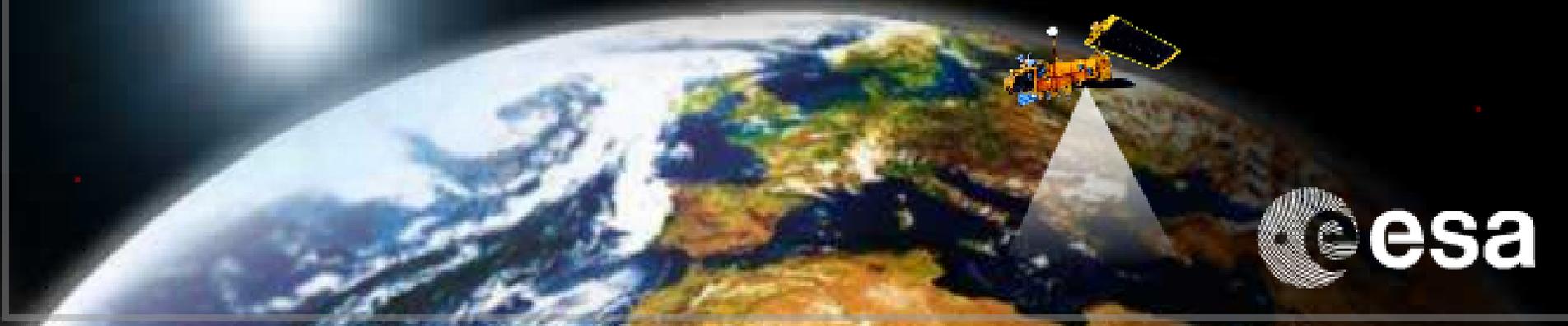
> 1 Terabyte data processed - 1 Km res.



Learning with Earth Observation

Europe from Space

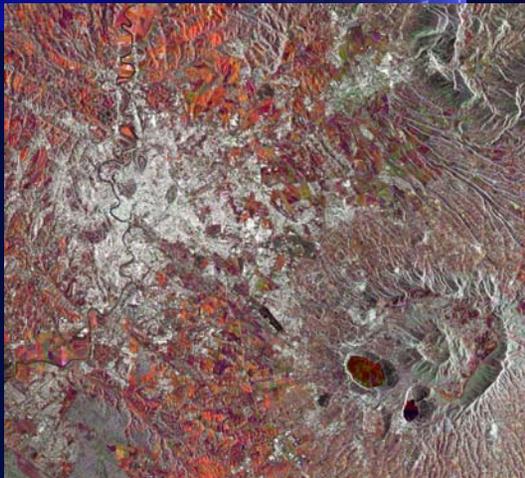
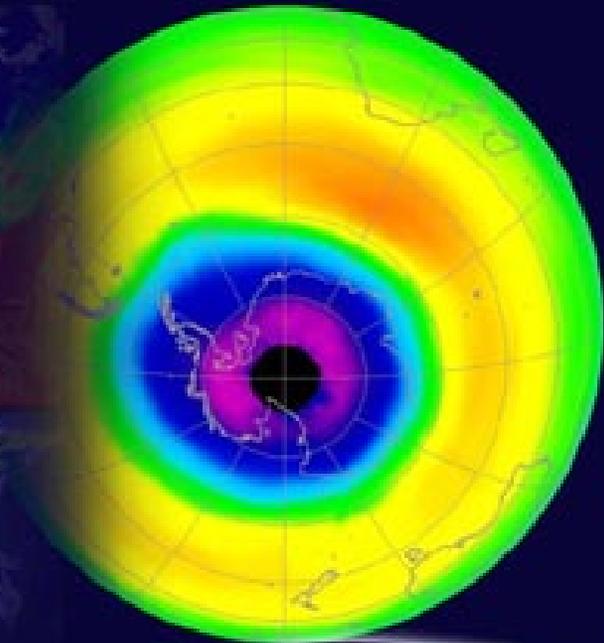
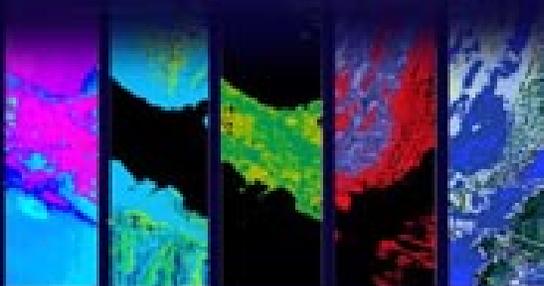
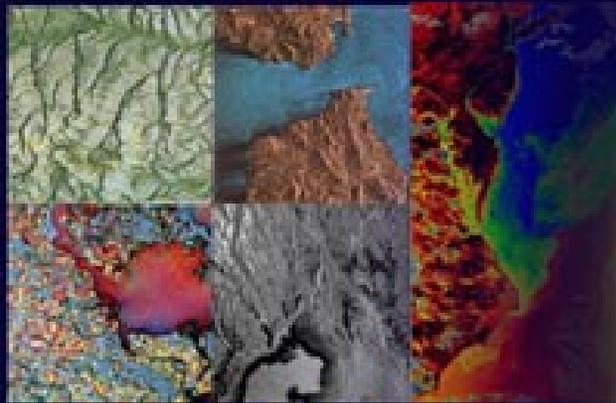
www.esa.int/education/eduspace



Context: Earth Observation @ ESA



© ESA - 2003



Eduspace and the Geography Curriculum

The Geography Coordination Group

**GCSE
Geography**

The Revision Guide

First Edition — for 1999 and beyond

Edited by Richard Parsons

Contents

Section One

Tectonics and Rock Types

The Tectonic Jigsaw	1
Earthquakes	2
Volcanoes	3
Surviving Tectonic Hazards	4
When the Disaster is Over	5
Rocks and Landscapes	6
Weathering	7
Revision Summary for Section One	8

Section Two

Drainage and Rivers

The Hydrological Cycle	9
Drainage Basins	10
Drainage Basins and People	11
Rivers and Valleys	12
Erosion, Transportation and Deposition	13
River Features of the Upper Stage	14
River Features of Middle and Lower Stages	15
Measuring River Floods	16
Flood Prevention	17
Flood Control	18
Water Supply and Management	19
Revision Summary for Section Two	20

Section Three

Glaciation and Coasts

The Work of Ice	21
Glacial Erosion	22
Glacial Deposits	23
Glaciated Landscapes and People	24
The Power of the Sea	25
Coastal Landforms from Erosion	26
Coastal Landforms from Deposition	27
The Coast and People	28
Revision Summary for Section Three	29

Section Four

Weather and Climate

World Climate Zones	30
The Question of Rain	31
Synoptic Charts	32
Lows and Highs	33
Weather Hazards — Hurricanes	34
Weather Hazards — Hurricanes and Fog	35
Local Weather and Microclimates	36
Revision Summary for Section Four	37

Section Five

Ecosystems and Soils

World Biomes	38
Biome Vegetation Types	39
Soils and their Processes	40
Ecosystem Cycles and the Human Effect	41
Deforestation and Conservation	42
Revision Summary for Section Five	43

Section Six

Population

Population Distribution	44
Population Density	45
Population Growth	46
Population Structure	47
Population Structure and Dependency	48
Managing Population Growth	49
Migration	50
Revision Summary for Section Six	51

Section Seven

Settlement

Settlement Site and Situation	52
The Settlement Hierarchy	53
The Function of Settlements	54
Urban Land Use In MEDCs	55
Urbanisation	56
Counter-Urbanisation	57
Urban Problems in MEDCs	58
Urban Problems in LEDCs	59
Planning and the Rural Urban Fringe	60
Revision Summary for Section Seven	61

Section Eight

Economic Activity

Classification of Industry	62
Industry as a system	63
Location of Industry	64
Influences on Location	65
Changing Industry — MEDCs	66
Industry in LEDCs	67
Multinationals	68
The Problems of Transport	69
Energy and Power	70
Revision Summary for Section Eight	71

Section Nine

Agriculture & Food Supply

The Farm as a System	72
Classifying Farming	73
Distribution of Farming Types	74
Farming in the EU	75
Diversification and Efficiency	76
Farming in LEDCs	77
The Green Revolution	78
Farming and the Environment	79
More Environmental Questions	80
Revision Summary for Section Nine	81

Section Ten

Development

Contrasts in Development	82
Measuring Development	83
Environmental Problems and Development ..	84
Dependency and the Colonial Past	85
International Trade	86
The Question of Aid	87
Development Projects	88
Revision Summary for Section Ten	89

Section Eleven

Responsibility & Stewardship

The Leisure Industry	90
National Parks	91
Tourism in LEDCs	92
Tourism and Conflict	93
The Use and Abuse of Resources	94
Acid Rain	95
Global Warming	96
Pollution	97
Revision Summary for Section Eleven	98

Section Twelve

Exam Resources

Ordnance Survey Maps	99
More on Ordnance Survey Maps	100
Other Maps and Photographs	10
Using Graphs	102
Graphs and Statistics	103
Revision Summary for Section Twelve	104
Index	102

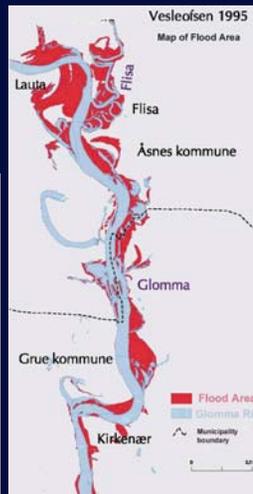
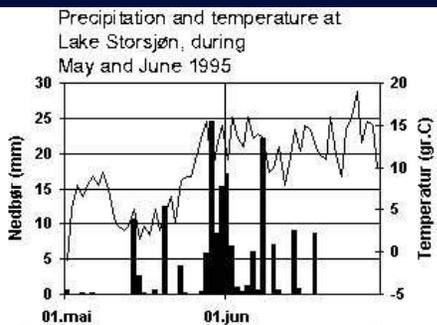
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Section Two

Drainage and Rivers

The Hydrological Cycle	9
Drainage Basins	10
Drainage Basins and People	11
Rivers and Valleys	12
Erosion, Transportation and Deposition	13
River Features of the Upper Stage	14
River Features of Middle and Lower Stages	15
Measuring River Floods	16
Flood Prevention	17
Flood Control	18
Water Supply and Management	19
Revision Summary for Section Two	20

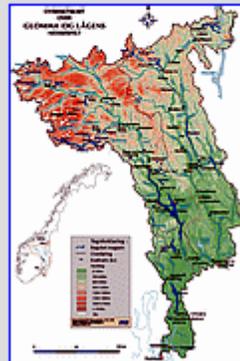
Case study, graphics, images, ...



Disaster Monitoring | Floods | The Floods in Østlandet 1995

Introduction | [eduspace Home](#)

The Floods in Østlandet 1995 [[de](#) [dk](#) [es](#) [fr](#) [it](#)]



Precipitation catchment area for Glomma/Norway and the Lågen River Basin

Source: GLB, Flommen 1995 / Glomma og Lågen



In May and June 1995 not only were Norway (Østlandet, Trysil, Glomma and Gudbrandsdalen) extensively flooded, but also Northern and Central Sweden experienced record-breaking floods.

The total damage from the floods were estimated at 1.3 to 1.5 billion NKK (Norwegian Crowns), of which damage to property constituted approximately 800 million NKK.

This should be compared to the normal average annual cost of flood damage in Norway of approximately 200 million NKK.

- Which principal causes contributed to the alarming proportions of the 1995 floods?

- Did the population of the area through their actions, inadvertently, cause the floods?

The project will also explore how GIS and Remote Sensing data can help analyse the conditions that caused the floods.

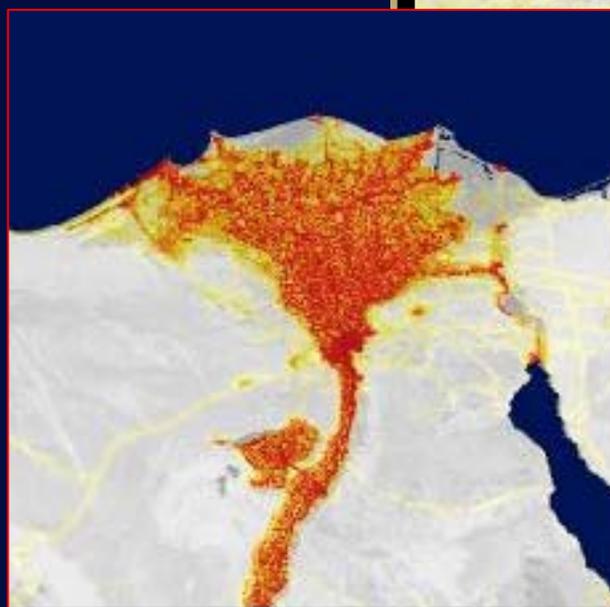
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Section Six

<u>Population</u>	
Population Distribution	44
Population Density	45
Population Growth	46
Population Structure	47
Population Structure and Dependency	48
Managing Population Growth	49
Migration	50
Revision Summary for Section Six	51

New continent, more information, more images, more data,...

IN DEVELOPMENT!



AFRICA - The Continent

Satellite Image Mosaic
Population Density
Topography
Download Tile

[Zoom Out](#)

Pixel Size:
[32 km](#)
[16 km](#)
[8 km](#)
[4 km](#)
[2 km](#)
[1 km](#)

Center Coordinates

17.428 d E
13.286 d N

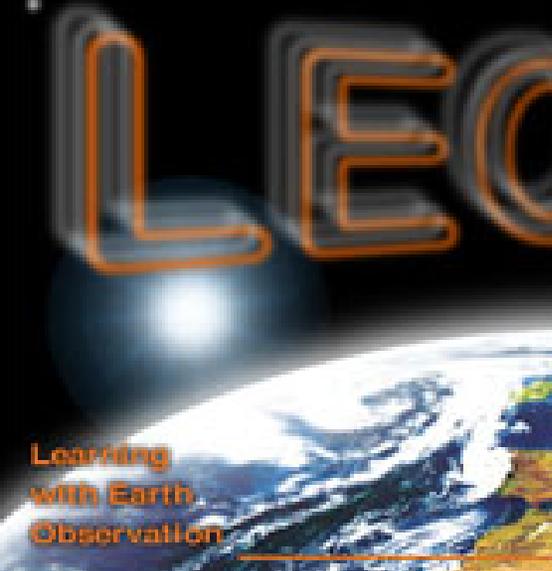
6-25	26-50	51-500	501-2500	>2500
------	-------	--------	----------	-------

Population Density (Inh./km²)

Projection: Geographic, Ellipsoid WGS84
 Data: LandScan 2000, Oak Ridge National Laboratory

Eduspace is also: The tools – LEOWorks: an Image processing software

Image processing software



LEOWorks
File Edit View Image Classification Tools Help

cast97_432.tif [1:1]

cast97_432[Blue Channel] [1:1]

cast97_432[Red Channel] [1:1]

Histogram for cast97_432
Options Properties Help
Green Channel

Min: 0	Std Dev: 57.4841	Level: 255
Max: 255	Median: 120	Count: 413647
Bins Used: 39	Pixels: 413647	Percent: 100.0000
Mean: 125.144		Std Dev: 57.4841

LUT Editor

Brightness

Contrast

0 255 255 0

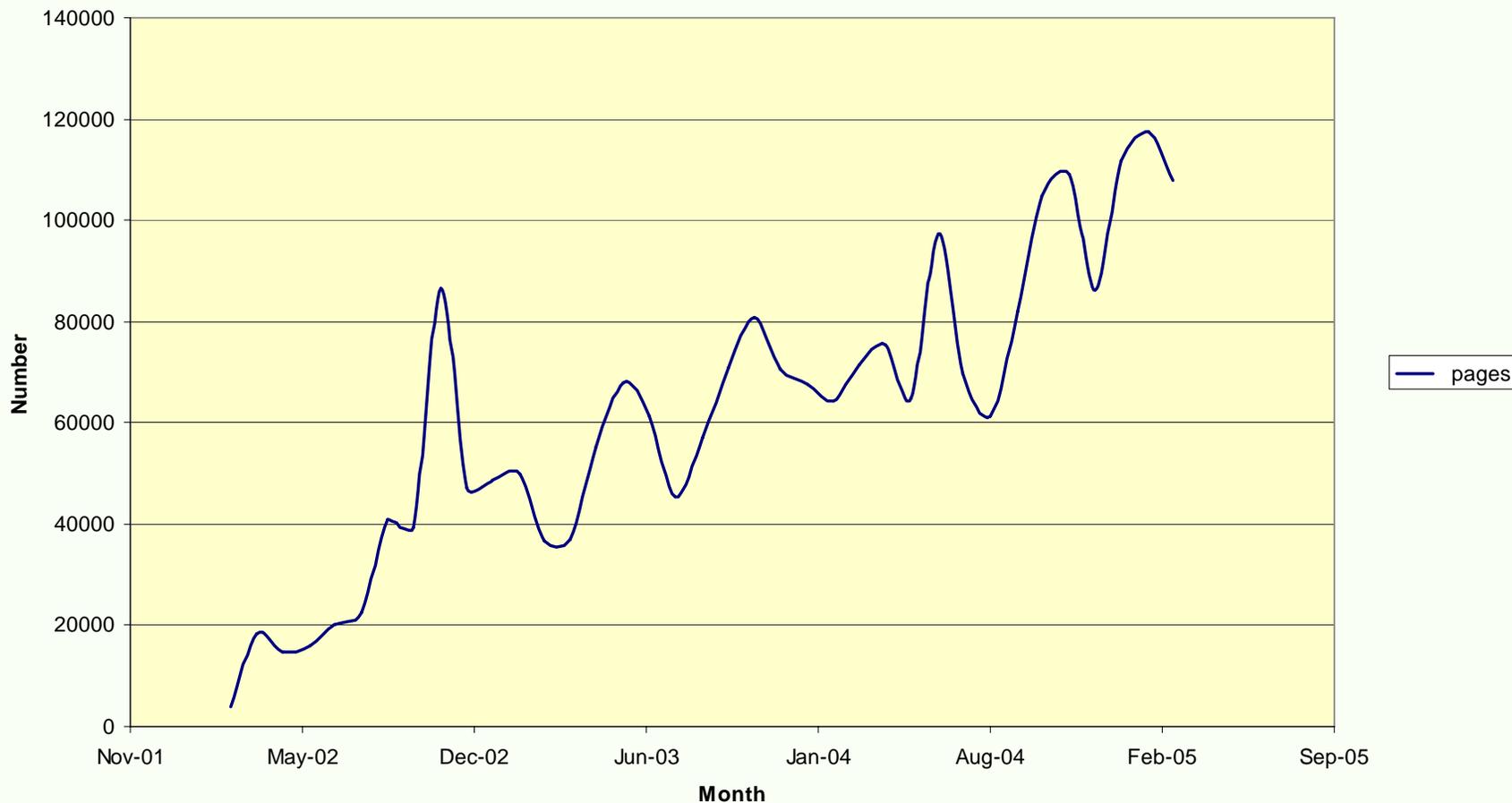
Red

Green

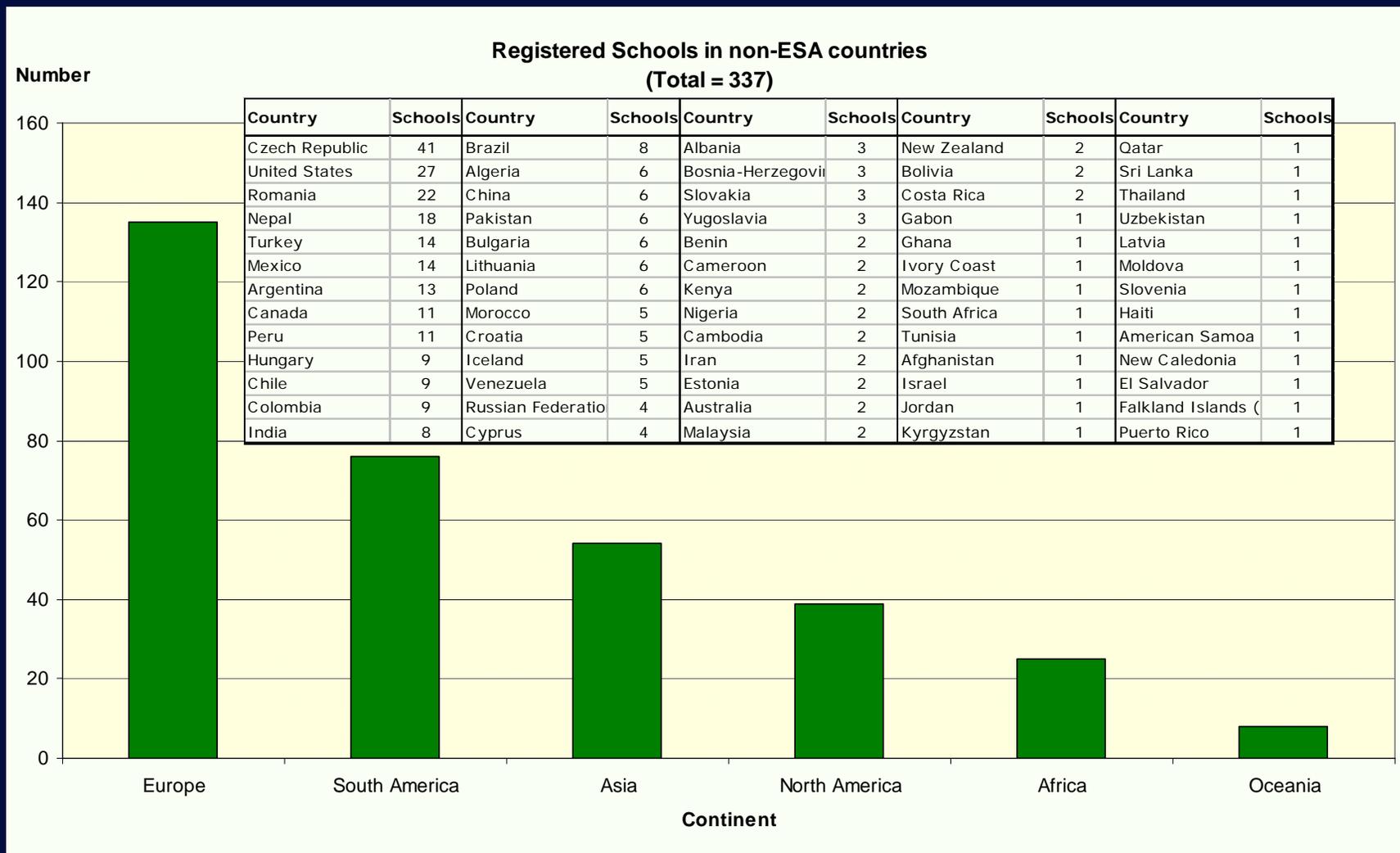
Blue

Eduspace: some statistics

Average requested pages per month



Eduspace: some statistics



✓ From the traditional way...

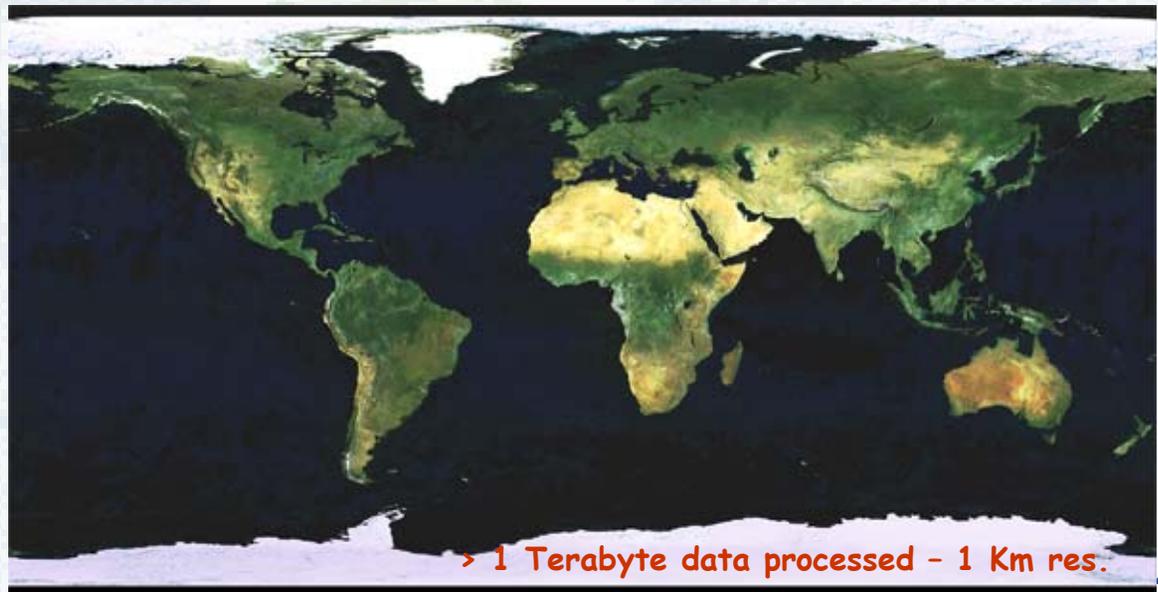
...Support to learning (EDUSPACE, LEOWORKS)...

... **Software tools (BEAM, BEST, BEAT... BILKO...**

✓ ...To a new e-collaboration paradigm

- access to data, tools and resources

- Earth Science GRID on Demand



> 1 Terabyte data processed - 1 Km res.

INTRODUCTION

- Each Toolbox is a collection of software tools under development to help the remote sensing community to use ESA data.
- New generation to contain Scientific tutorials prepared with Universities and practical case studies using real EO data



Basic ERS
& Envisat
(A)ATSR
and MERIS
Toolbox
(BEAM)



Basic ERS
& Envisat
SAR
Toolbox
(BEST)



Basic ERS
& Envisat
Atmospheric
Toolbox
(BEAT)



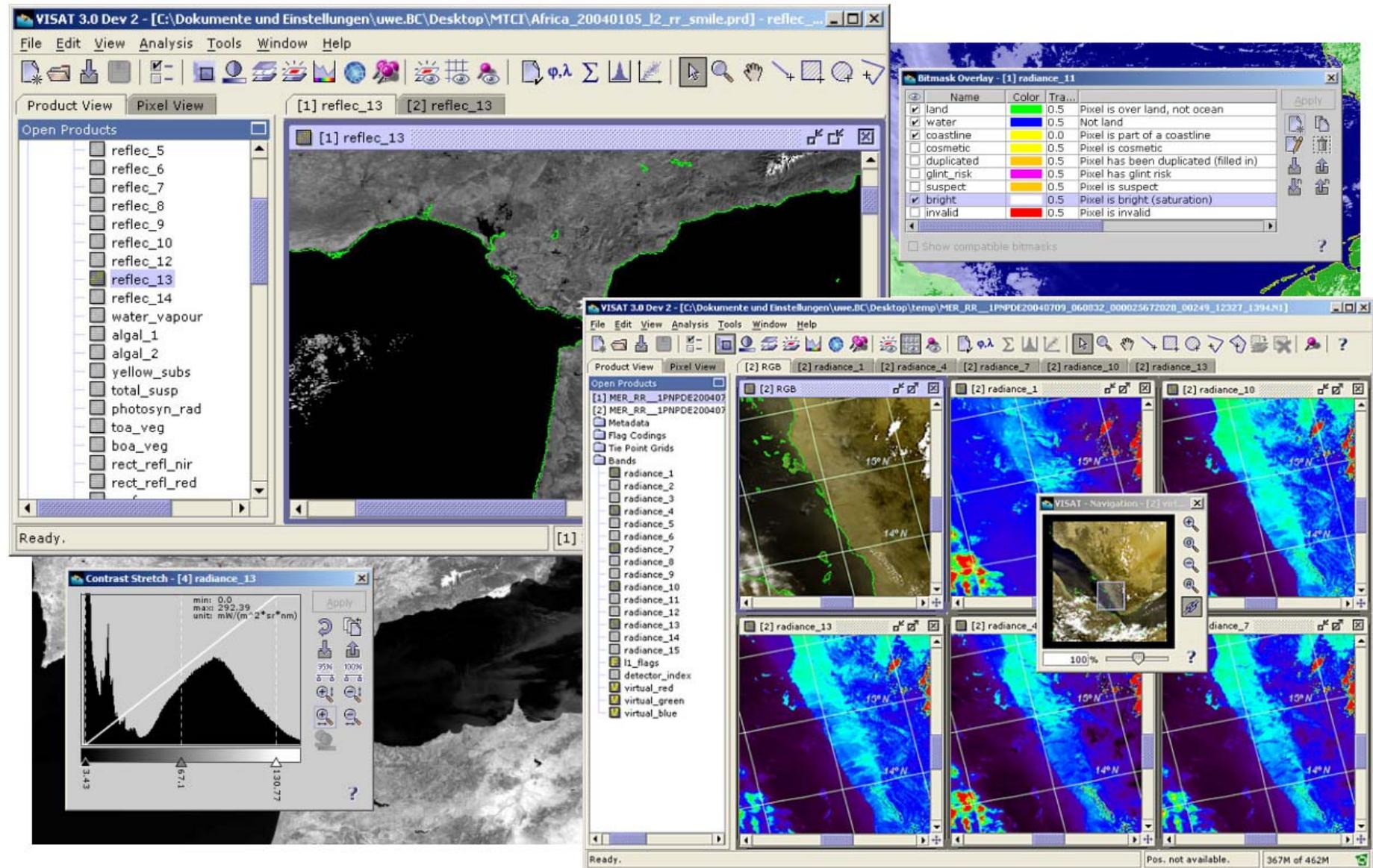
Polarimetric
SAR Data
Processing
and
Educational
Tool
(POLSARPRO)

Mission Compatibility

	 BEAM Basic SAR & ENVISAT (AATSR and MERIS) Toolbox V2.0 http://www.esa.int/nanoscience/beam	 BEST The Basic ENVISAT SAR Toolbox V4.0 http://best.esa.int/best	 BEAT The Basic ENVISAT Atmospheric Toolbox V2.2 http://beat.esa.int/beat	 POL/SARPRO The Polarimetric SAR Data Processing and Educational Tool v2.0 http://earth.esa.int/polarpro	Satellite Altimetry Toolbox	GUT
	MERIS AATSR ASAR	ASAR	MIPAS GOMOS SCIAMACHY	ASAR AP	RA2 MWR	RA2
	ATSR	AMI	GOME		RA MWR	RA
					Cryosat	GOCE
				AIRSAR EMISAR E-SAR PISAR SAR580 RAMSES		
TPM	MODIS		TOMS OMI GOME2 TES MLS	RADARSAT2 PALSAR TerraSAR-L TerraSAR-X SIR-C	Jason-1 Topex/Poseidon	



- **Data Import/Export Tools**
- **Visualisation and Analysis Tool: VISAT**
- **Scientific Data Processors**
 - Fluorescence Line Height processor
 - Smile effect correction processor
 - (A)ATSR Sea Surface Temperature Processor (with flexible coefficients)
 - SMAC Atmospheric Correction Processor
 - Level 3 Binning Processor
 - L3 Mosaicking Processor
- **Orthorectification and Map Projection**
- **Application Programming Interface API**
 - Comfortable product readers for C and IDL
 - JAVA API
- **Teaching material**
 - none





- **Data Import and Quick Look Tools**
- **Data Export Tools**
- **Data Conversion Tools**
- **Statistical Tools**
- **Resampling Tools**
- **Co-registration Tools and Support for Interferometry**
 - Coherence Image
 - Geometric correction of ASAR medium resolution imagery
- **Radiometric Resolution Enhancement**
- **Calibration Tools**
 - Backscattering Coefficient Image
 - ASAR Retro-calibration
 - ASAR Wide-swath imagery enhancement
- **Teaching material**
 - none

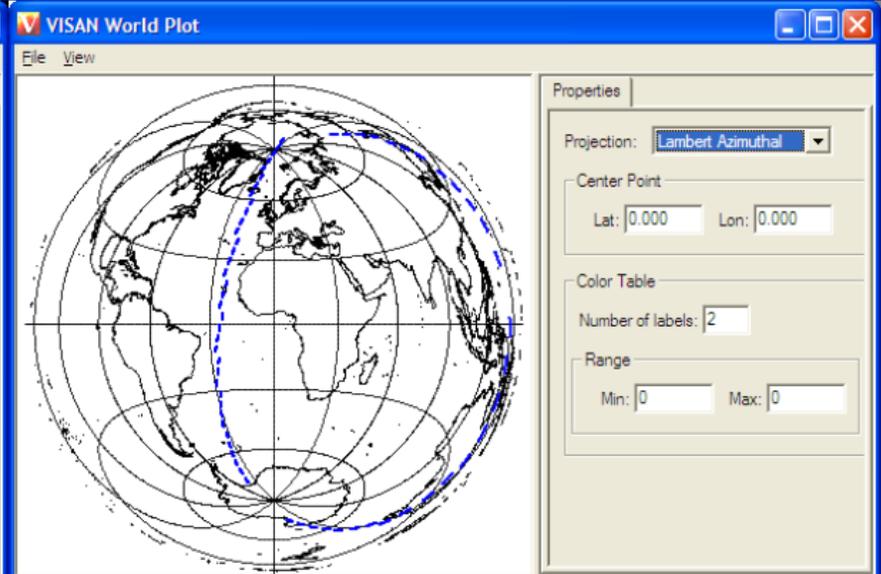
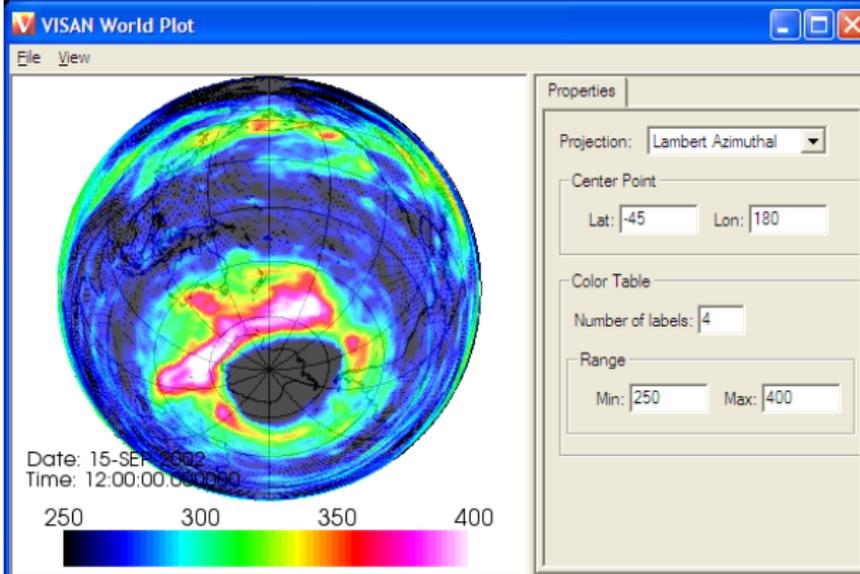
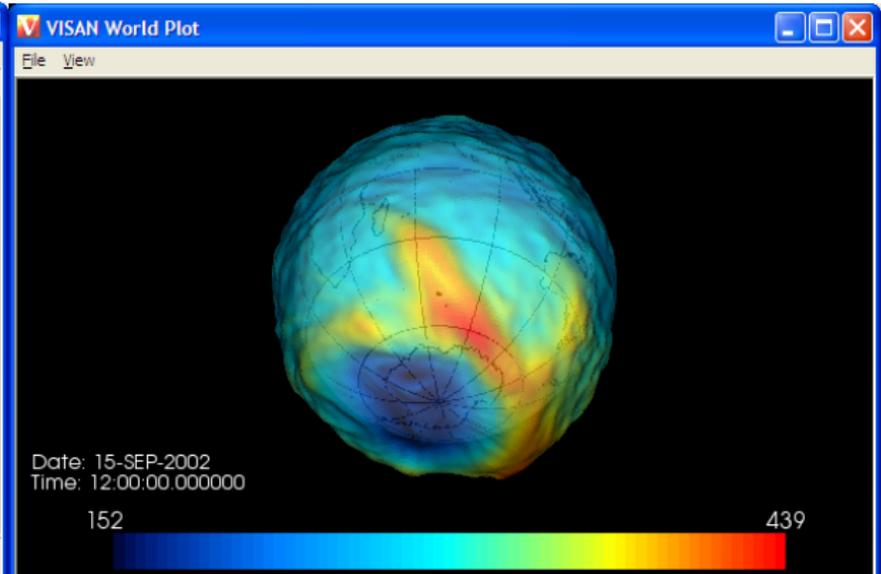
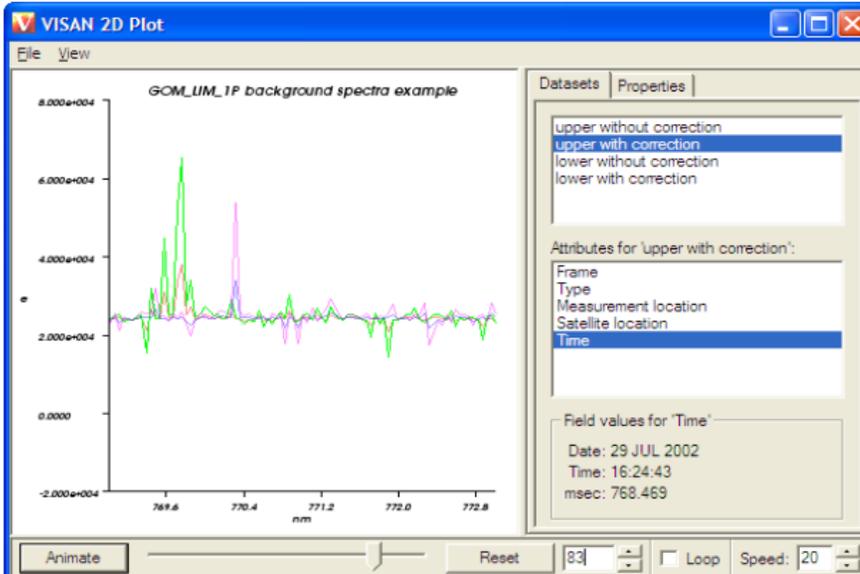
The screenshot displays the BEST software interface with several windows open:

- bestW - BestW - Header Analysis:** Shows input media type (CDR, Tape, Hard Disk), input product (d:\), and a list of files including 'ASA_IMS_1PNJPA:20021017_213630_00000162010_00244_03304_0008.N1'.
- bestW - Area Of Interest:** Configures the region of interest with coordinates: Top Left Row (0), Top Left Col (3000), Bottom Right Row (7000), and Bottom Right Col (5177).
- bestW - Image Under-sampling:** Sets input image (C:\Best_example\SLC_to_PFI), filter size (3x3), and output image ratio (0.166 Row, 0.5 Col).
- bestW - Image Coregistration Parameters:** Defines baseline file name, BCPs number, and transformation degree (1, 1.5, 2, 3).
- bestW - Image Coregistration Parameters (continued):** Shows interpolation window sizes (512 Row, 512 Column) and interpolation mode (Nearest Neighbour, Bilinear, Cubic Convolution, etc.).
- bestW - Image Coregistration Parameters (continued):** Includes options for interpolation inverse precision, sinc width, and overlapping mode.
- bestW - Image Coregistration Parameters (continued):** Shows quick look presentation options like normal, number of grid lines, and output image size (900).
- bestW - Image Coregistration Parameters (continued):** Displays window sizes, grid type, and grid drawing mode.

On the right, a satellite image of a coastal region is overlaid with a grid. The grid lines are labeled with latitude and longitude values, such as 44.94, 44.42, 43.90, 43.39, 42.86, 42.34, 41.82, -5.86, -6.55, -7.24, -7.92, -8.61, -9.29, -9.98, and -10.66.

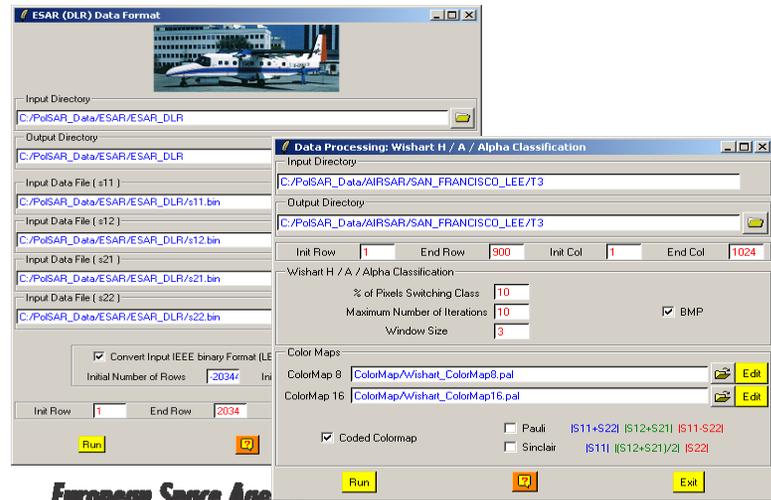
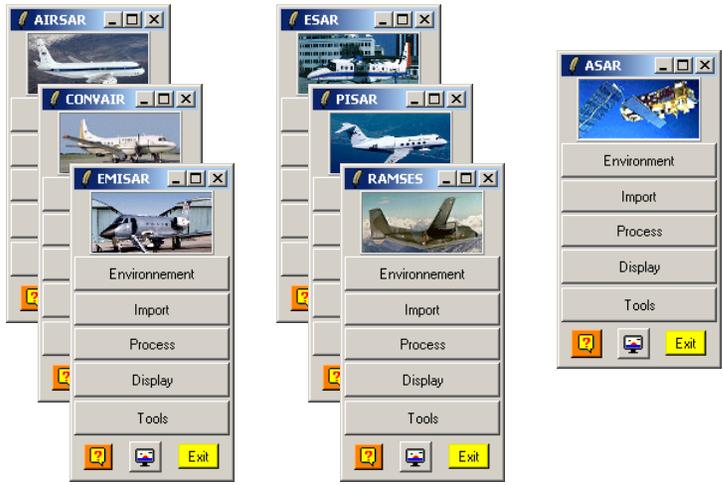


- **BEAT-I**
 - Direct access to GOMOS, MIPAS, SCIAMACHY and GOME products (Level-0, Level-1b, Level-2, and Auxiliary).
 - Interfaces including Fortran, IDL, and MATLAB.
 - Command line tools.
- **BEAT-II**
 - Data extraction, ingestion into predefined flexible data types for spectral readout data, profile data, ground pixel data, etc.
 - Comparison of similar data from different instruments.
 - Simplifies creation of general visualisation routines.
 - Interfaces for Fortran, IDL, MATLAB, and Python, plus a command line tool.
- **VISAN**
 - Cross-platform visualization and analysis application for atmospheric data.
- **GeoFit**
 - MIPAS Special Modes processor.
- **GOME and SCIAMACHY Reference Spectra Database**
- **GOME data calibration tool**
- **Teaching material**
 - Scientific Tutorial provides an introduction to BEAT and its capabilities for atmospheric science.
 - Case studies show how the BEAT tools can be used to answer scientifically interesting questions.



- **Data Import**
- **Fully Polarimetric Data Format Conversion**
- **Basis Change**
- **Speckle Filters**
- **Data Processing**
 - Sinclair (S2), Coherency (T3 or T4) or Covariance (C3 or C4) parameters processing.
 - Polarimetric Whitening Filter (PWF), Optimal Polarimetric Contrast Enhancement (OPCE).
 - Polarisation Synthesis, Polarimetric Signatures.
 - Polarimetric Decompositions (Huynen, Barnes, Holm, Cloude, Krogager, Freeman, Cameron).
 - H / A / α decomposition (Polarisation Fraction, Combinations, Helicity).
 - Supervised Wishart classification.
 - Unsupervised (H / α), (A / α), (H/A) and Wishart H / A / α classifications.
- **BMP Processing**
- **Teaching material**
 - Wide-ranging tutorial provides the grounding necessary to stimulate research and development of scientific applications that exploit polarimetric data and techniques.
 - Slide shows explain the basics of polarimetry.





[HH-VV], [HV], [HH+VV]



SAN FRANCISCO BAY JPL - AIRSAR L-band

Statistical indicators about Toolbox user communities and levels of uptake



Period	Dec 2002 – Apr 2005	Jan 2003 – Apr 2005		May 2004 – Apr 2005
Website visits [†]		18,434		1,937*
Website hits	161,000	60,482		41,943*
Downloads	2,400	2,462**		369
Registered users	~1,000	1,188	104	196

[†] unique IP addresses within a 30-minute time-out period

* since October 2004

** since August 2003

✓ From the traditional way...

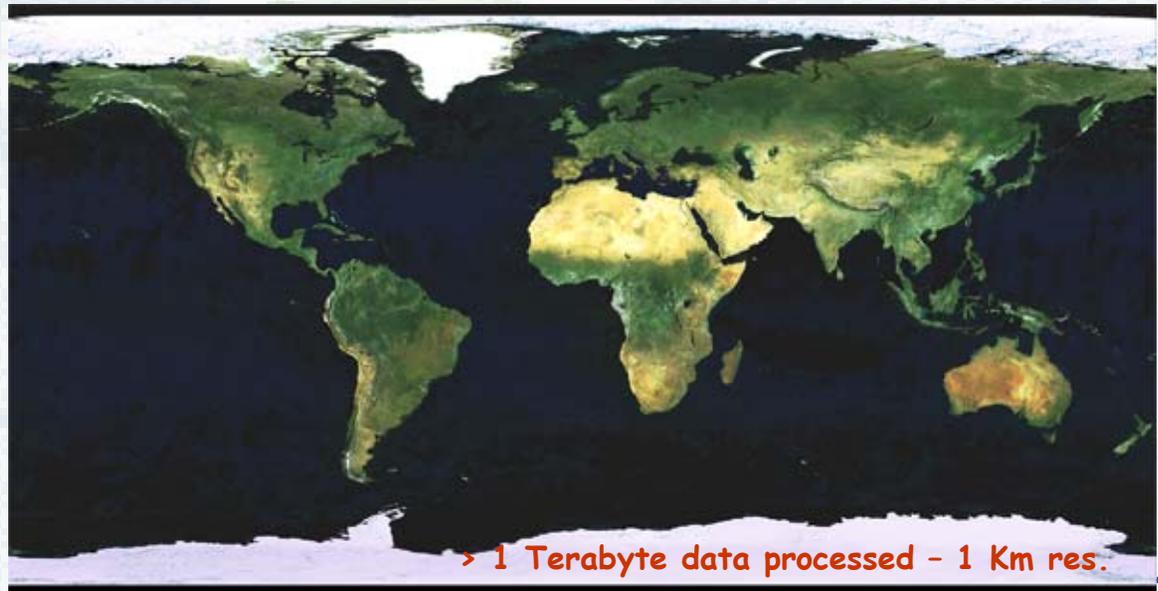
...Support to learning (EDUSPACE, LEOWORKS)...

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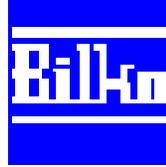
- Earth Science GRID on Demand



> 1 Terabyte data processed - 1 Km res.



The UNESCO-Bilko project



Dr. Valborg BYFIELD

James Rennell Division for Ocean Circulation and Climate
Southampton Oceanography Centre Tel: +44 2380 596405
SOUTHAMPTON, SO14 3ZH, UK

<http://www.oceans4school.com>

F.Sarti and P.P.Mathieu

ESA/ESRIN Earth Observation Program

Application Department

V.G.Galilei, C.P.64

I-00044 Frascati, Italy

mail: Francesco.Sarti@esa.int



Initiated in 1987 under UNESCO's Marine Sciences Training and Education Programme to develop training capability in coastal and marine remote sensing.

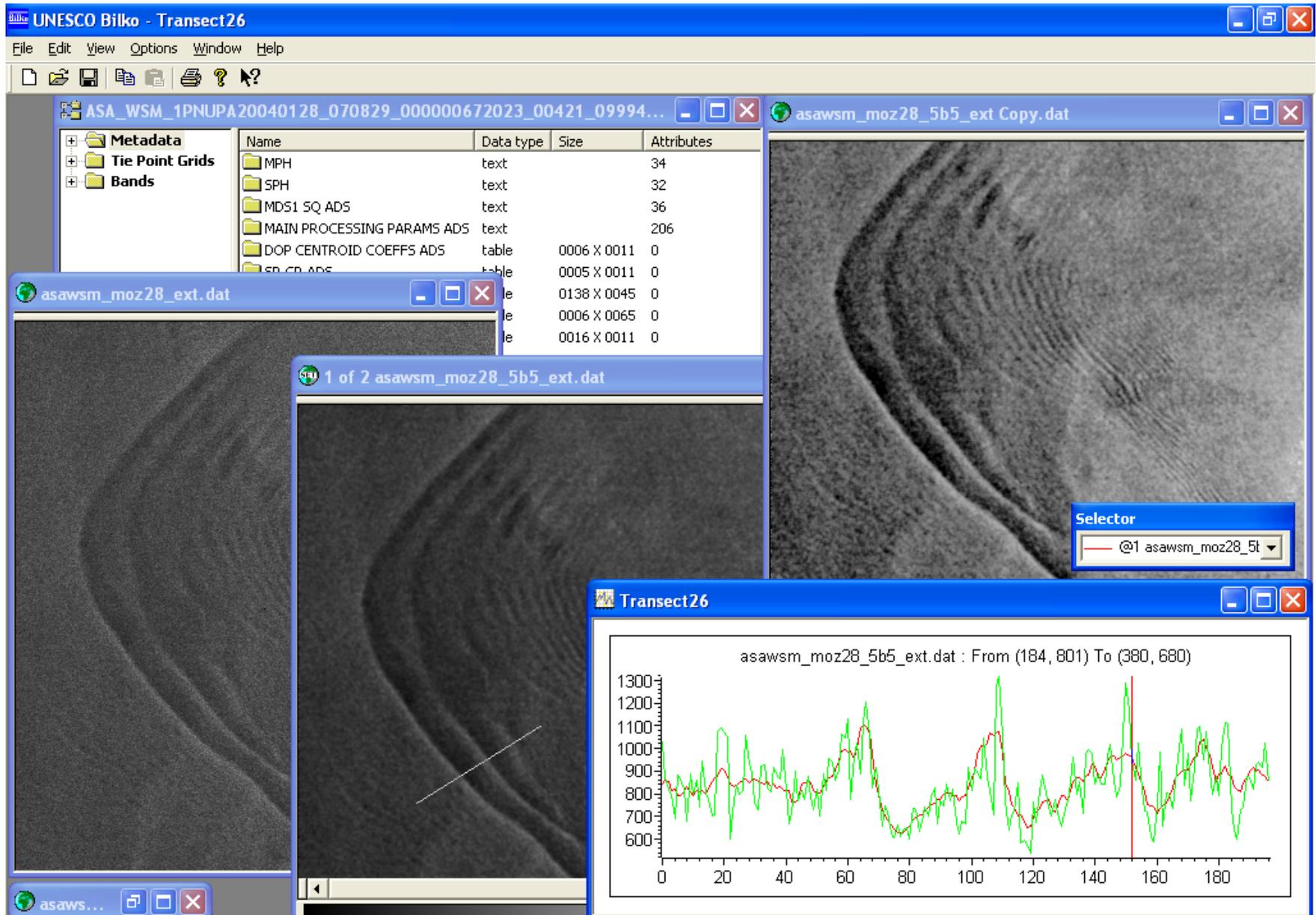
Designed to operate on PC, the project has provided 7 modules of computer-based lessons. Each module is a self-contained package of:

- (i) the image processing software (Bilko),
- (ii) a tutorial on how to use the software,
- (iii) lessons on the applications of remote sensing to oceanography and coastal management,
- (iv) satellite and airborne remotely sensed images to accompany the lessons.

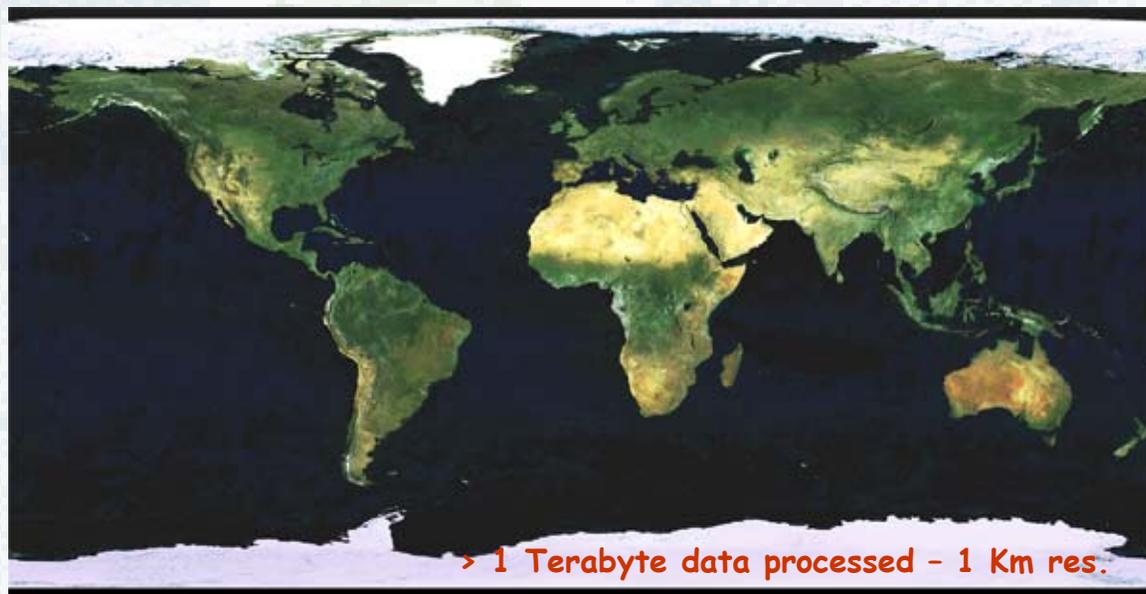
Used by ESA and upgraded with 7 lessons on oceanography based on ENVISAT data (available in autumn 2004).

The software and the modules can be downloaded from the web.

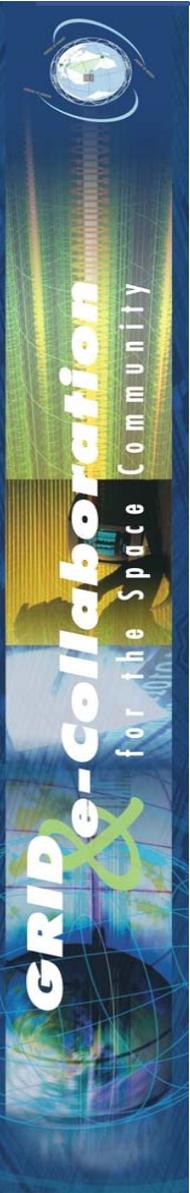
Using Bilko to study **internal waves** in data from **Envisat ASAR** - filtering, stretches and the use of transects to derive important wave parameters such as wavelength



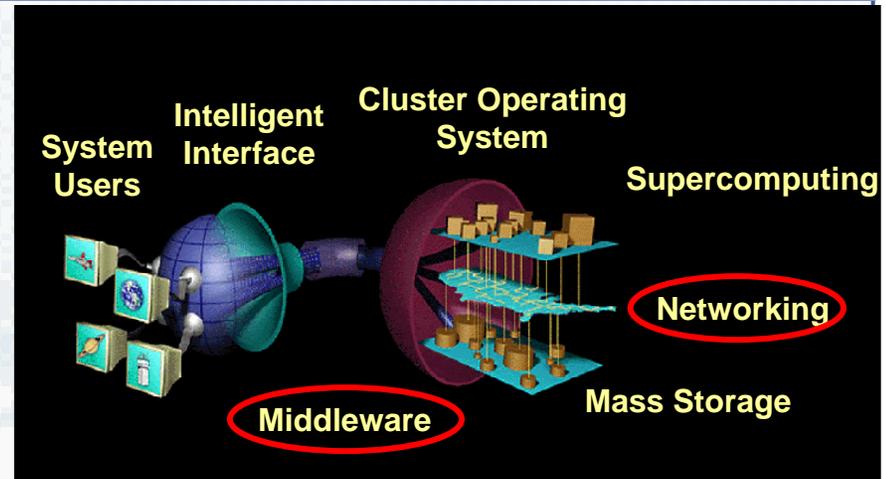
- ✓ From the traditional way...
 - ...Support to learning (EDUSPACE, LEOWORKS)...
 - ... Software tools (BEAM, BEST, BEAT... BILKO...)
- ✓ ...To a new **e-collaboration** paradigm
 - access to data, tools and resources
 - Earth Science GRID on Demand



> 1 Terabyte data processed - 1 Km res.



- ✓ Enhance the ability to create high level products
- ✓ Single stop shop for data access and processing
- ✓ Support PIs in new science developments
- ✓ Allow processing of large historical archives
- ✓ e-collaboration,
 - e.g. sharing of data sources, tools, means, models, algorithms ...
 - improve Earth science complex applications (data fusion, data mining, modeling ...)





Enabling Grids for
E-science in Europe

The EGEE project and the objectives ...

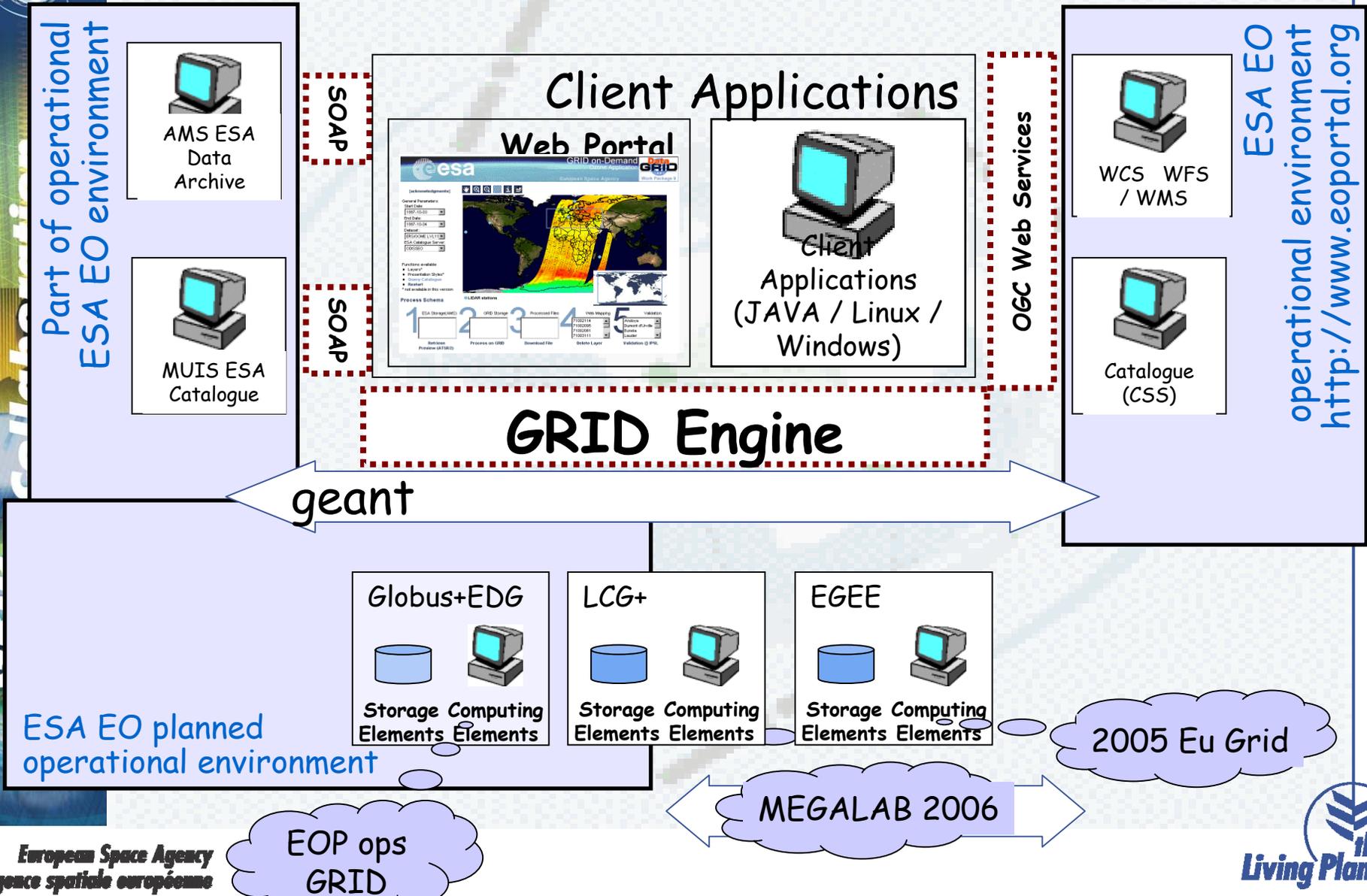
www.eu-egee.org

F.Gagliardi
Project Director

- More than 14000 PC cooperating in the world
- GEANT network provides very high connectivity
- dedicated Earth Science Virtual Organisation
- ...
- very substantial funding from EC



GRID & EO Web Services @ ESA



✓ Infrastructure

- Computing and Storage Elements:

- One GRID LAN for ops and dev environment
- 2 clusters (64, 16), ~20 PCs, 20+10+5 TB
- Link to external CE and SE

- Data access:

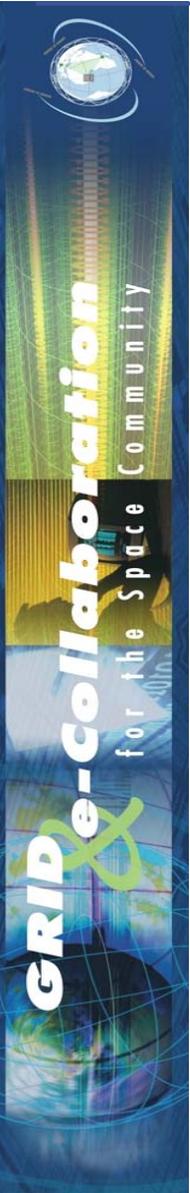
- ENVISAT Archive
- Access to NASA and other external data providers

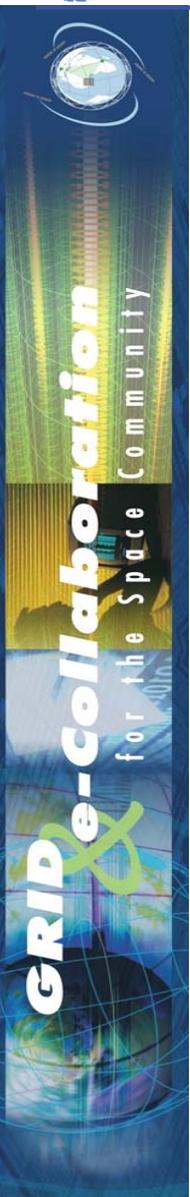
- Network:

- From Research Networks - internet

- Security:

- Based on User Certification





✓ MERIS

- MERIS Level 2: 2003- to date ~6Tb
- MERIS FR (samples) ~100Gb
- MERIS Level 3

✓ AATSR

- AATSR Level 1: 2003-2005 ~9Tb
- AATSR Level 2: last 6 months ~300Gb

✓ Atmospheric

- GOME Level 1 + Ozone profiles: 1996-2003 ~1Tb
- GOMOS: June 2003 - April 2004 ~300Gb

✓ Radar

- ASAR GM: Feb 2004 - to date ~300Gb
- ASAR High and Medium Resolution (samples) ~700Gb

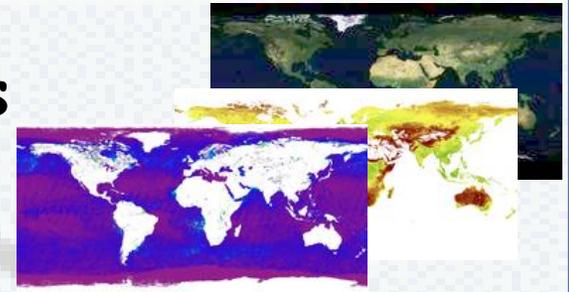
✓ MSG

- SEVIRI: Just started (last 6 months) ~3TB (planned)

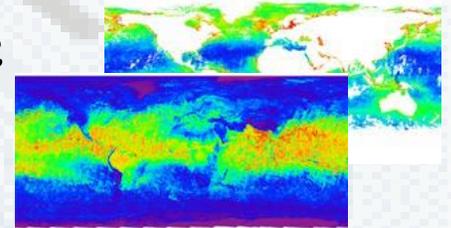
✓ AVHRR, SeaWiFS

- Under discussion @ CNR ~ 2TB (planned)

✓ Web Mapping MERIS L3 Layers for Promotion



✓ NRT MERIS L3 Ocean/Atmosphere
- Under final validation (end Oct)

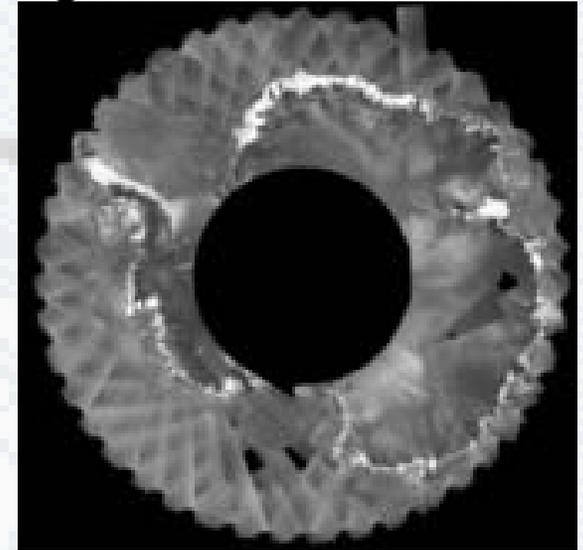


✓ NRT MERIS L3 Vegetation (MGVI)
- Joint collaboration with JRC (N Gabron)
- Ready for operation (end Sept)
- Processed historical archive of Europe for validation (article in MERIS/AATSR WS)



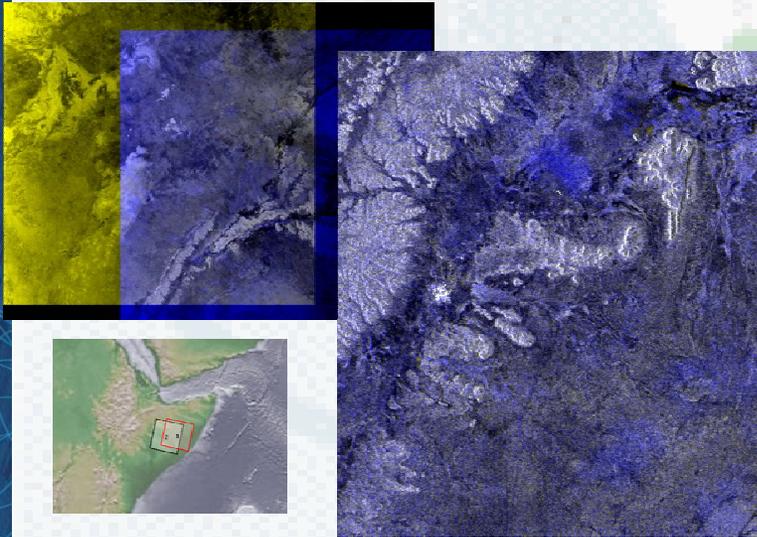
✓ NRT Antarctica ASAR GM mapping

- Daily Generation of 400-m Mosaic
- Automatic publish in ESAWeb Map
- Retrieval of NASA ice concentration contour (end Sept)
- Ready for operation



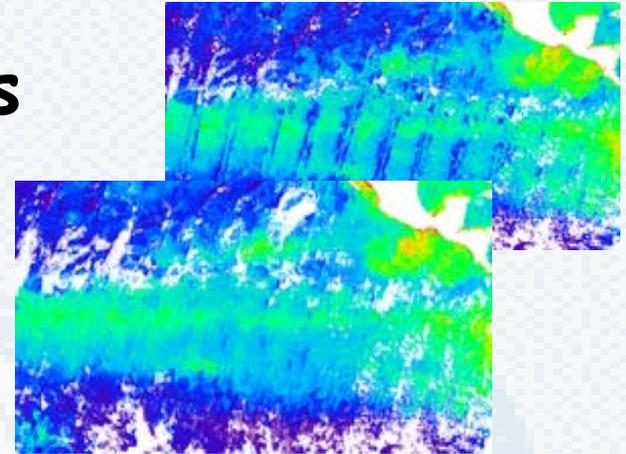
✓ Large scale ASAR/SAR mapping

- Reuse of BEST functions
- To be developed in coming months
- RESPOND interest for Systematic Flood Monitoring
- Compatible with MERIS mapping on GRID



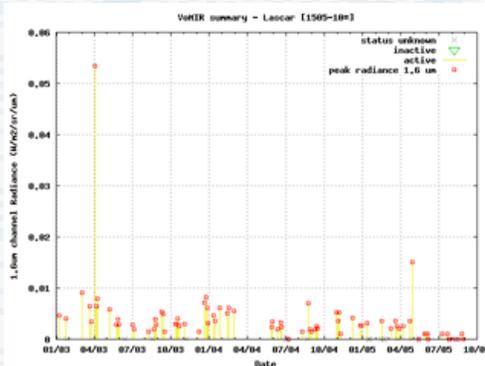
✓ MERIS L3 Quality checks

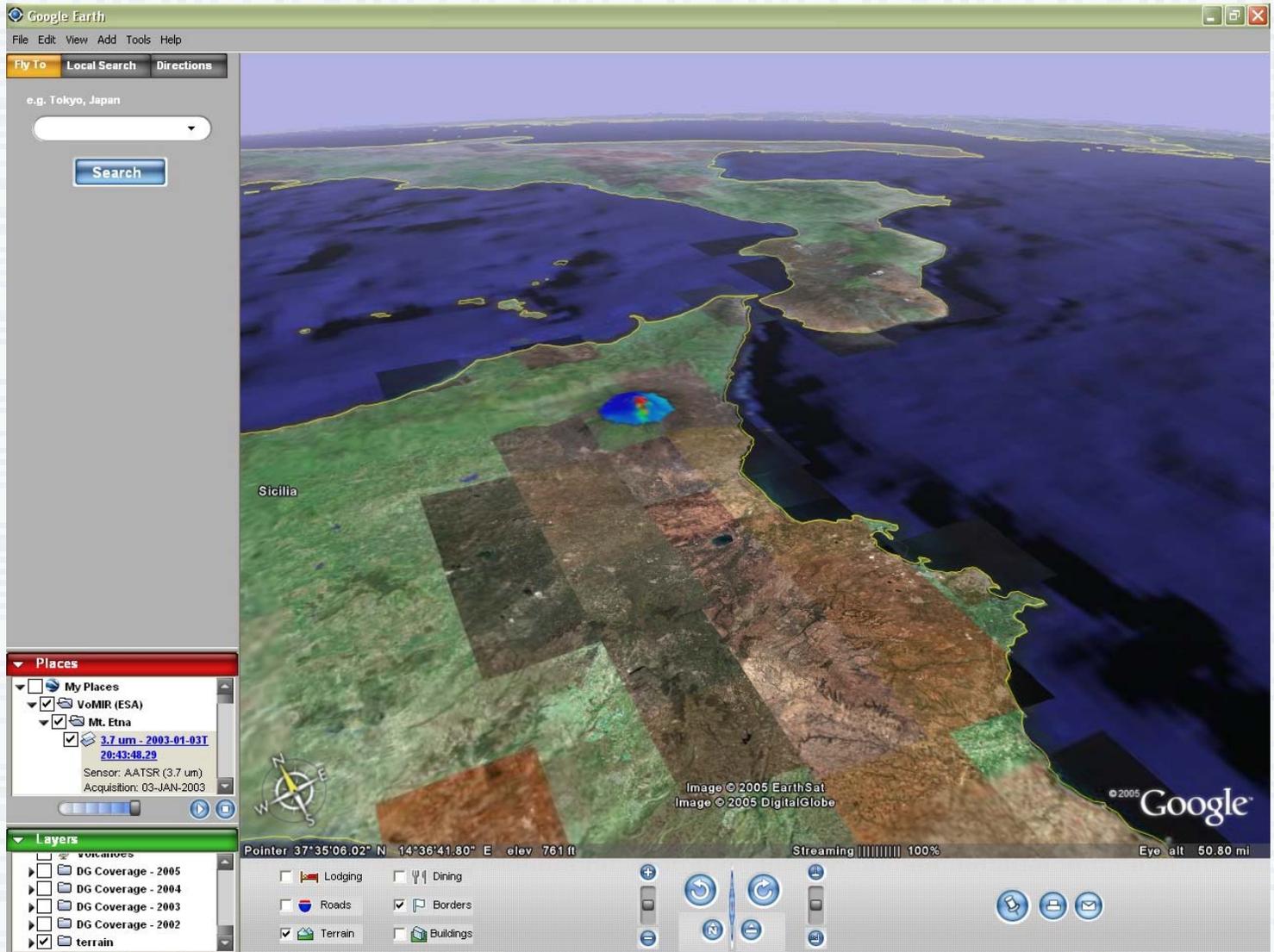
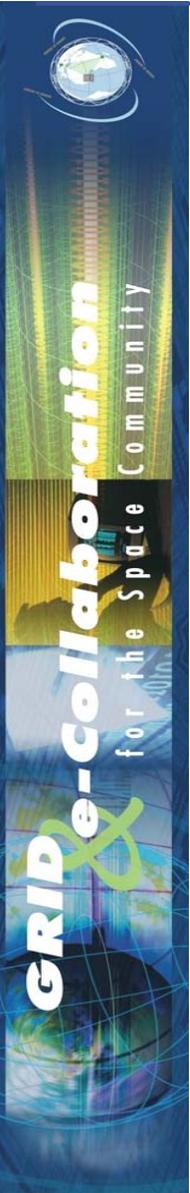
- Flags and aggregation methods
- Effect of Solar Angle and Glint for Algal-1



✓ VOMIR-Volcano monitoring by InfraRed

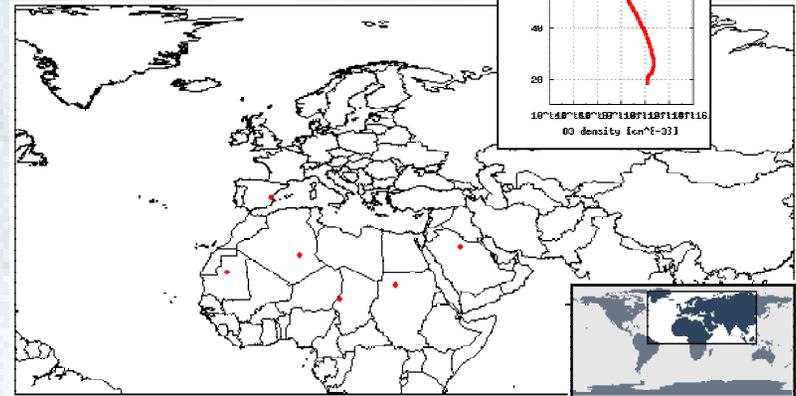
- Enables fast validation procedures (1 volcano -> 3 years of data in dispersed Storages -> 1 hour processing in 20 CPU)
- Collaboration w/ Kings College (M. Wooster)





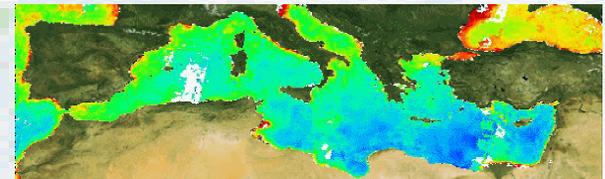
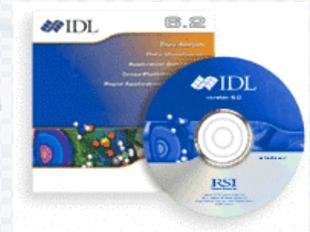
✓ Atmospheric chemistry (K Zehner, R Kopman)

- Stratospheric aerosol density processing (BIRA-IASB, Belgium)
- 3D data assimilation system
- Water Vapor and Temperature (DMI, DK)
- Based on BEAT



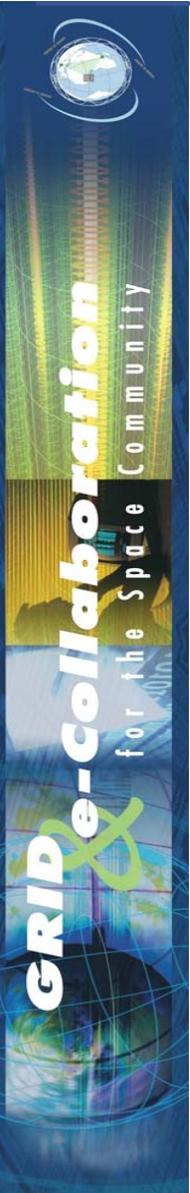
✓ Some 40+ applications supported by GRID at ESRIN

- Integration of ESA developed toolboxes (BEAM, BEST, BEAT...)
- Supports IDL library
- More Earth Science applications in collaboration with EGEE infrastructure (EC)
- Mainly based on CAT-1 project approval
- Compatibility with large applications



✓ Grid on Demand service approach

- is appreciated by internal and external users
- has reached operational maturity



✓ Operational Opportunities

- Routine generation of "standard" high level products
- Increase exploitation of available data/resources
- Enable new classes of large-scale, high-power applications

✓ More explicit support to science

- Extend initial collaboration experience
- Move more tools (BEAT, BEST...) in the grid environment
- Consider next EO missions

✓ Prepare the future

- Prepare a dedicated **GRID AO** - support additional key users
- Participation of Earth Science to the **EC e-infrastructure initiative**
- Contribution to the **GEOSS** architecture / implementation



**GRID should be promoted as glue
for integrating data, tools for
wide e-collaboration in the
Earth Science community**

Thank You!!!