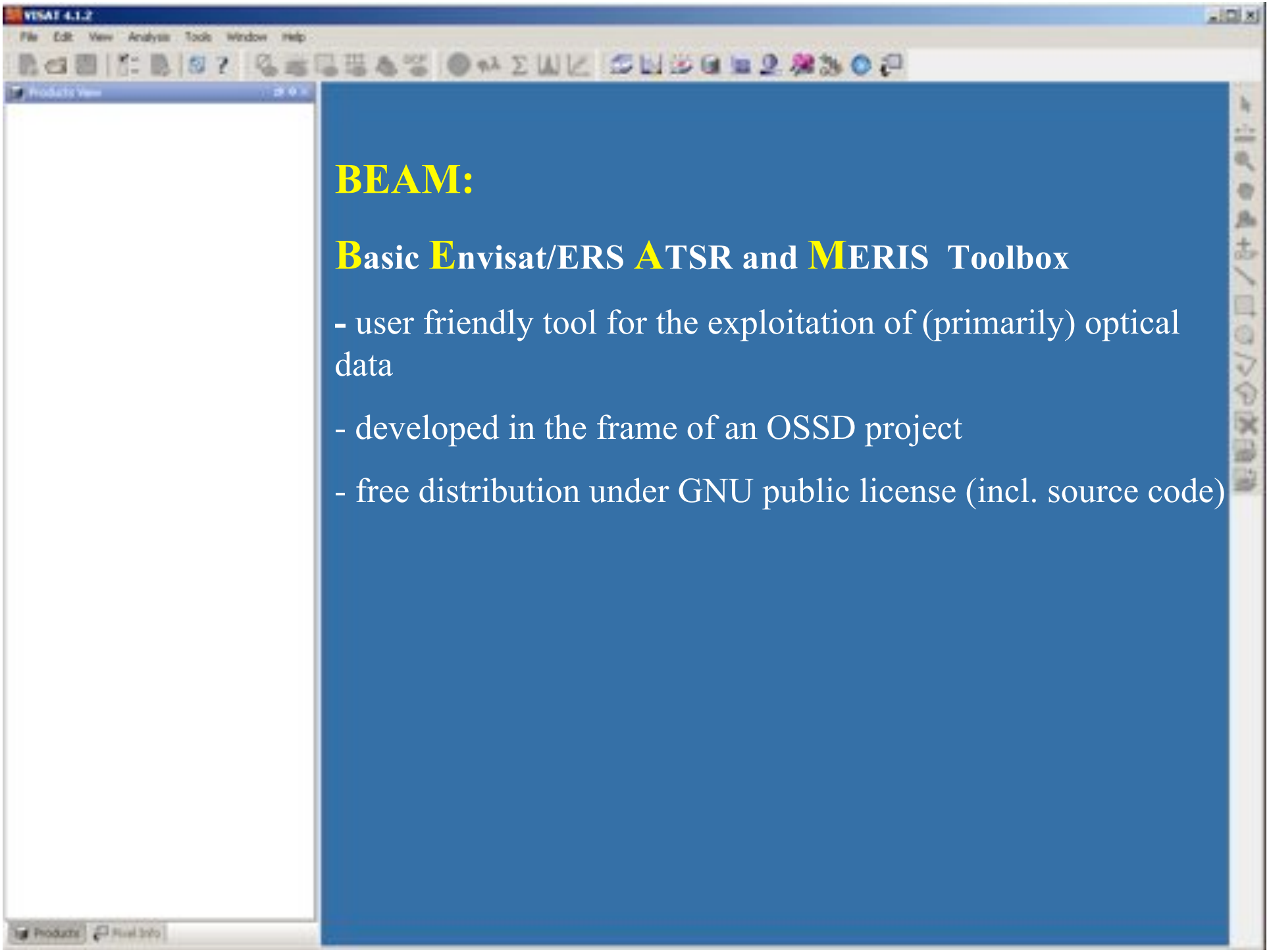
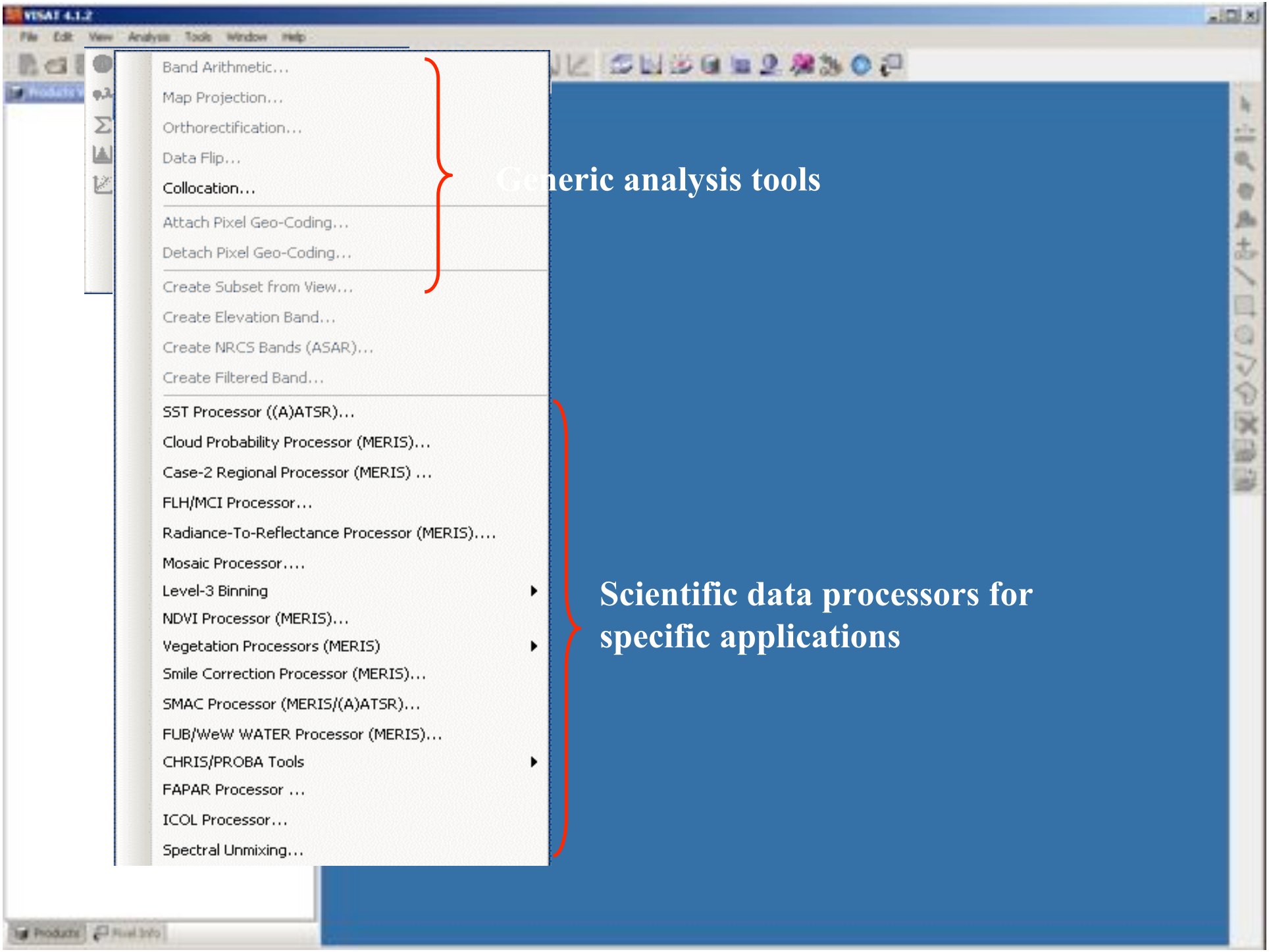
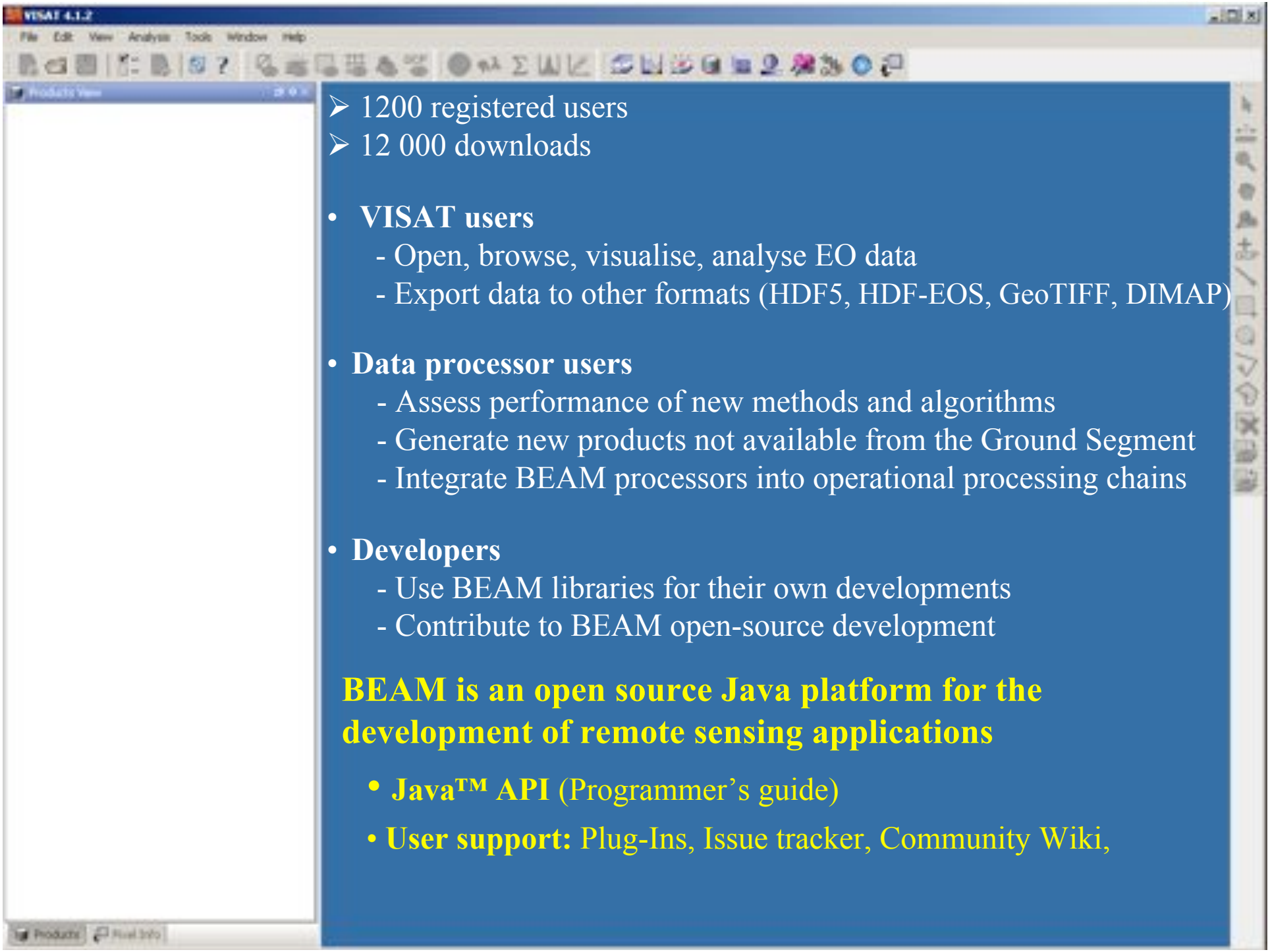

Peter Regner
ESA/ESRIN

Credit: BEAM Team


BEAM:
Basic Envisat/ERS ATSR and MERIS Toolbox
- user friendly tool for the exploitation of (primarily) optical data
- developed in the frame of an OSSD project
- free distribution under GNU public license (incl. source code)


Band Arithmetic...
Map Projection...
Orthorectification...
Data Flip...
Collocation...
Attach Pixel Geo-Coding...
Detach Pixel Geo-Coding...
Create Subset from View...
Create Elevation Band...
Create NRCS Bands (ASAR)...
Create Filtered Band...
SST Processor ((A)ATSR)...
Cloud Probability Processor (MERIS)...
Case-2 Regional Processor (MERIS) ...
FLH/MCI Processor...
Radiance-To-Reflectance Processor (MERIS)....
Mosaic Processor....
Level-3 Binning
NDVI Processor (MERIS)...
Vegetation Processors (MERIS)
Smile Correction Processor (MERIS)...
SMAC Processor (MERIS/(A)ATSR)...
FUB/WeW WATER Processor (MERIS)...
CHRIS/PROBA Tools
FAPAR Processor ...
ICOL Processor...
Spectral Unmixing...
Generic analysis tools
Scientific data processors for specific applications




- 1200 registered users
- 12 000 downloads

- **VISAT users**
  - Open, browse, visualise, analyse EO data
  - Export data to other formats (HDF5, HDF-EOS, GeoTIFF, DIMAP)

- **Data processor users**
  - Assess performance of new methods and algorithms
  - Generate new products not available from the Ground Segment
  - Integrate BEAM processors into operational processing chains

- **Developers**
  - Use BEAM libraries for their own developments
  - Contribute to BEAM open-source development

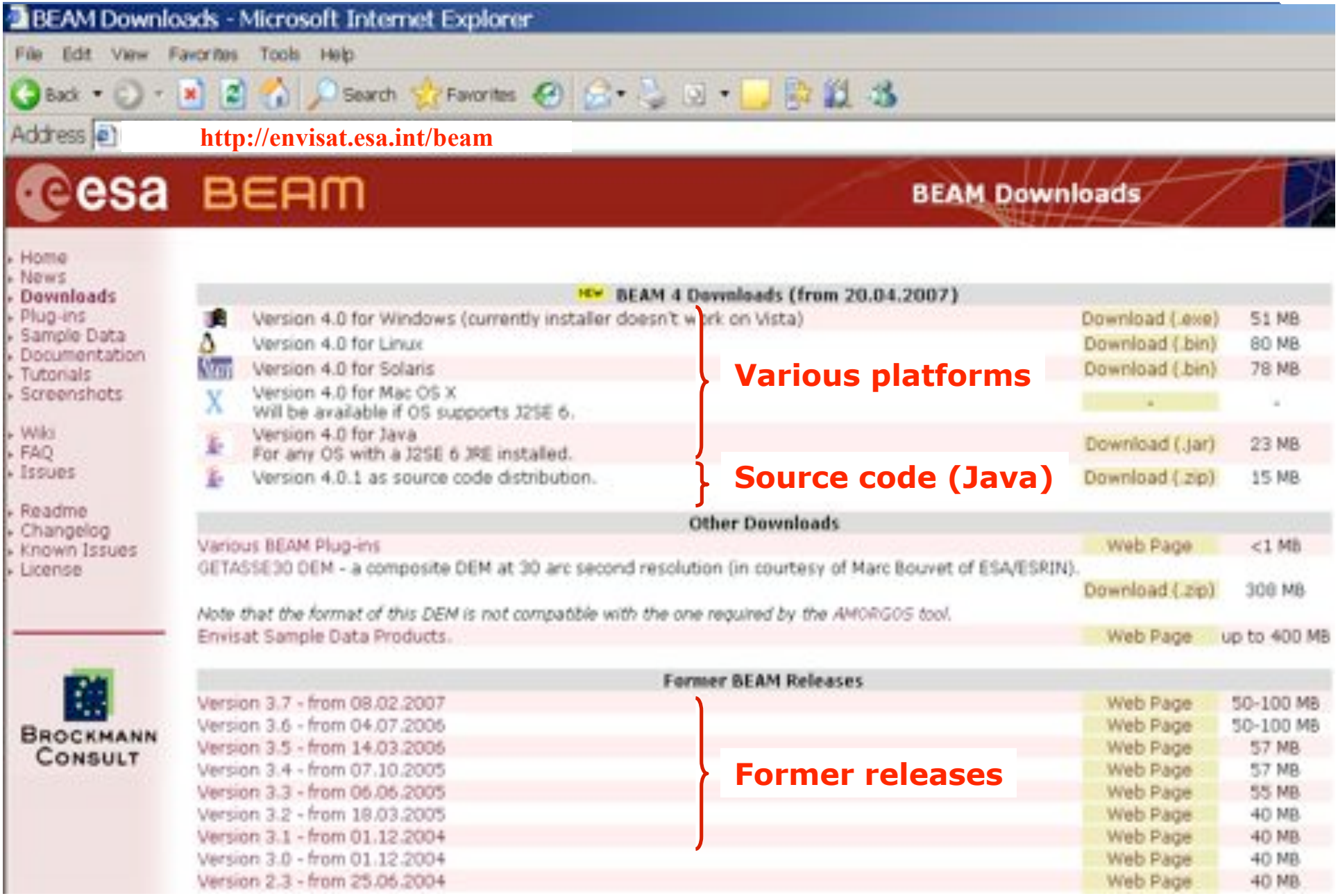
**BEAM is an open source Java platform for the development of remote sensing applications**

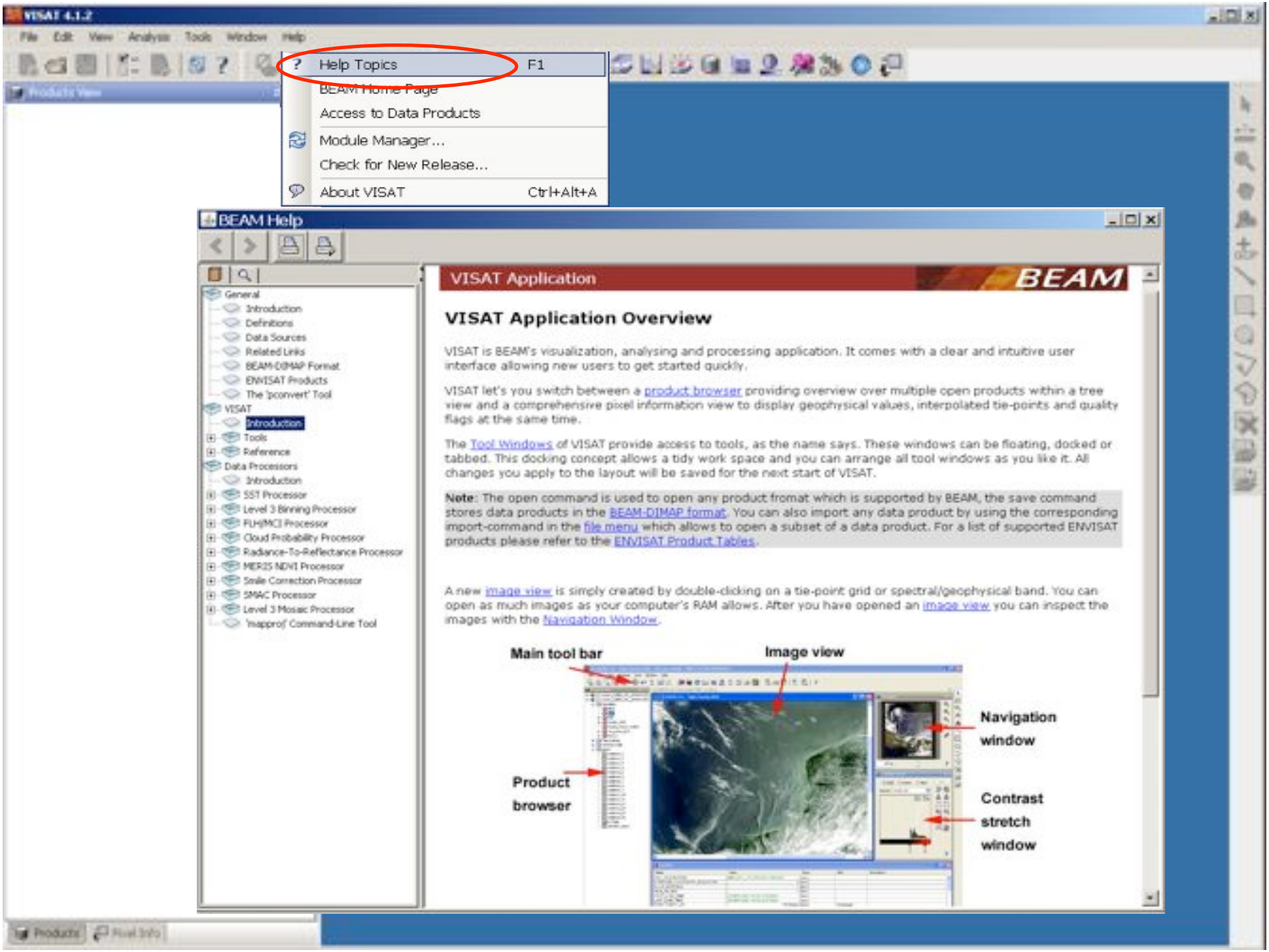
- **Java™ API** (Programmer's guide)
- **User support:** Plug-Ins, Issue tracker, Community Wiki,

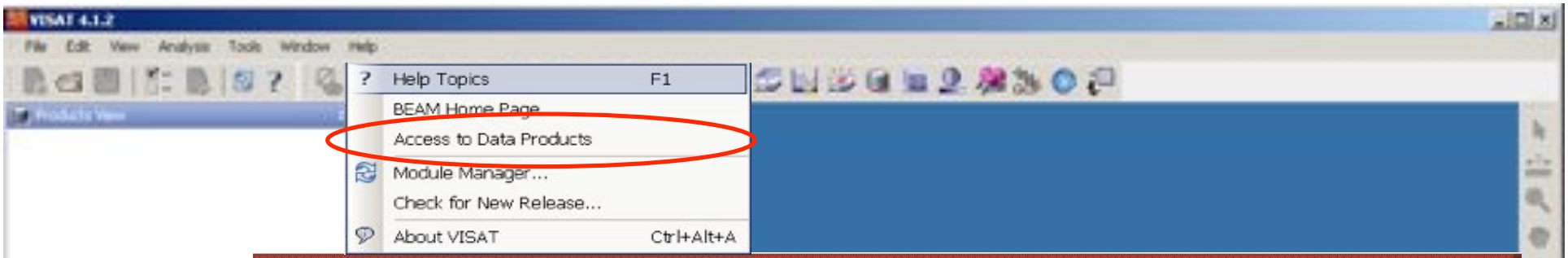
# Supported Missions/Instruments

- **Envisat:** MERIS, AATSR, ASAR
- **ERS:** ATSR, SAR
- **Terra & Aqua:** MODIS (OBPG Level-2)
- **Nimbus7:** CZCS
- **ADEOS:** OCTS
- **ALOS:** AVNIR2, PRISM
- **Metop & NOAA:** AVHRR/3
- **Landsat:** Thematic Mapper
- **Proba:** CHRIS
- **SMOS:** MIRAS (Microwave Imaging Radiometer using Aperture Synthesis)
- **Sentinel-3** (OLCI, SLST)

# Free download




VISAT 4.1.2
File Edit View Analysis Tools Window Help
Help Topics F1
BEAM Home Page
Access to Data Products
Module Manager...
Check for New Release...
About VISAT Ctrl+Alt+A
BEAM Help
General
Introduction
Definitions
Data Sources
Related Links
BEAM-DIMAP Format
ENVISAT Products
The 'pconvert' Tool
VISAT
Introduction
Tools
Reference
Data Processors
Introduction
SST Processor
Level 3 Binning Processor
FLH/MCI Processor
Cloud Probability Processor
Radiance-To-Reflectance Processor
MERIS NDVI Processor
Smile Correction Processor
SMAC Processor
Level 3 Mosaic Processor
'mapproj' Command-Line Tool
VISAT Application
BEAM
VISAT Application Overview
VISAT is BEAM's visualization, analysing and processing application. It comes with a clear and intuitive user interface allowing new users to get started quickly.
VISAT let's you switch between a product browser providing overview over multiple open products within a tree view and a comprehensive pixel information view to display geophysical values, interpolated tie-points and quality flags at the same time.
The Tool Windows of VISAT provide access to tools, as the name says. These windows can be floating, docked or tabbed. This docking concept allows a tidy work space and you can arrange all tool windows as you like it. All changes you apply to the layout will be saved for the next start of VISAT.
Note: The open command is used to open any product fromat which is supported by BEAM, the save command stores data products in the BEAM-DIMAP format. You can also import any data product by using the corresponding import-command in the file menu which allows to open a subset of a data product. For a list of supported ENVISAT products please refer to the ENVISAT Product Tables.
A new image view is simply created by double-clicking on a tie-point grid or spectral/geophysical band. You can open as much images as your computer's RAM allows. After you have opened an image view you can inspect the images with the Navigation Window.
Main tool bar
Image view
Navigation window
Product browser
Contrast stretch window




# Data Sources

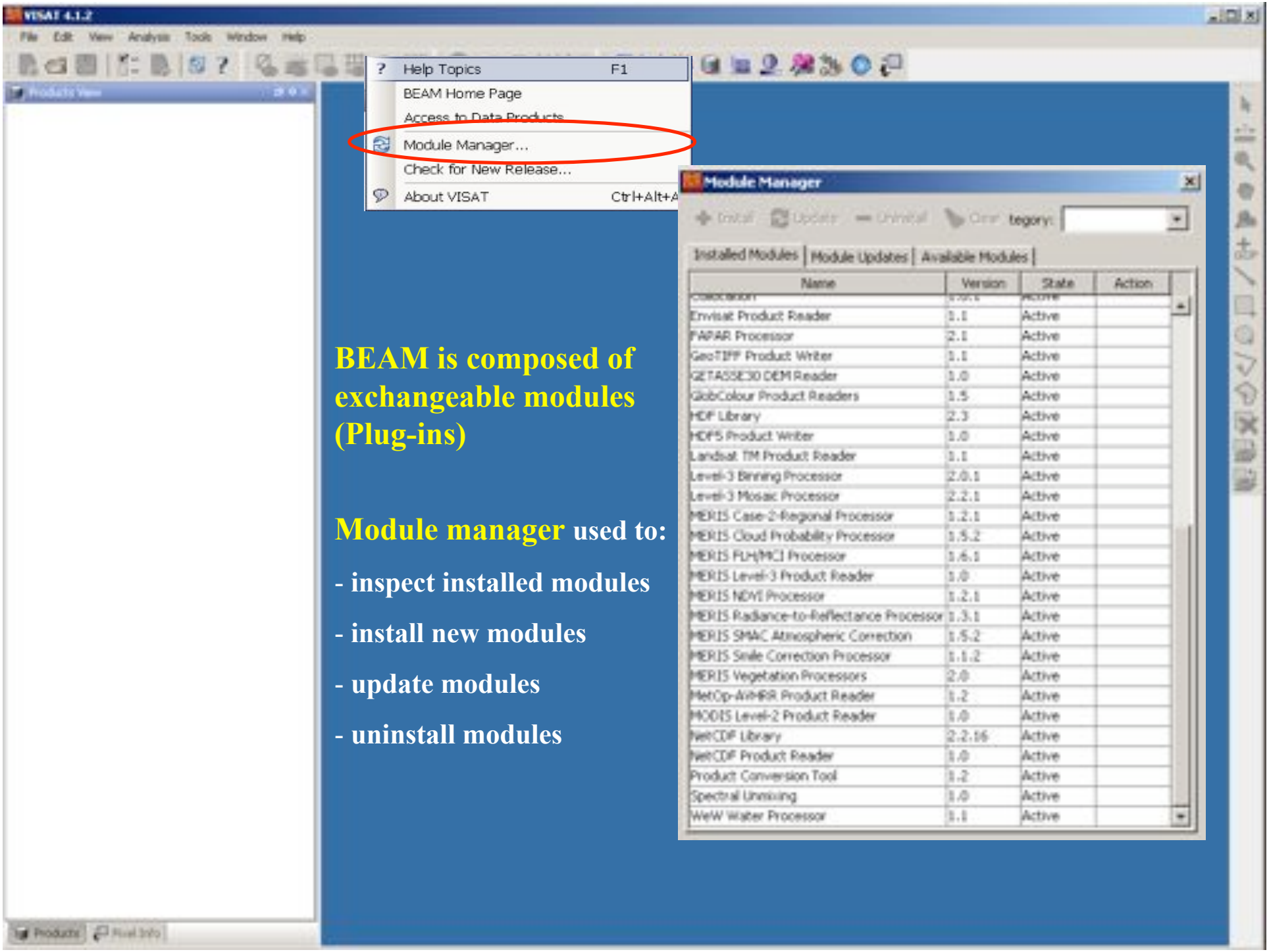
This page gives a brief description of access to the data products supported by the reader modules provided in the standard installation of BEAM.

## Data Sources Overview

| | Instrument | Platform | Format | Links |
|---|---|---|---|---|
| 1 | MERIS | Envisat | Envisat N1 | Rolling archive Kiruna: https://oa-ks.eo.esa.int/ra<br>Rolling archive ESRIN: https://oa-es.eo.esa.int/ra/<br>Envisat Web File Server: http://ewfs-ks.eo.esa.int/<br>MERCI: http://merci-srv.eo.esa.int/merci/welcome.do<br>EOLI-SA catalogue and ordering tool: http://eoli.esa.int/geteolisa/index.html |
| | MERIS Binned Level-3 | Envisat | netCDF | Level 3: http://envisat.esa.int/level3/meris/ |
| 2 | AATSR | Envisat | Envisat N1 | Rolling archive Kiruna: https://oa-ks.eo.esa.int/ra<br>Rolling archive ESRIN: https://oa-es.eo.esa.int/ra/<br>Envisat Web File Server: http://ewfs-ks.eo.esa.int/<br>EOLI-SA catalogue and ordering tool: http://eoli.esa.int/geteolisa/index.html<br>NERC data centre: http://www.neodc.rl.ac.uk/cgi-infrastructure/data_browser/data_browser/neodc/aatsr_multimission |
| 3 | ASAR | Envisat | Envisat N1 | Rolling archive Kiruna: https://oa-ks.eo.esa.int/ra<br>Rolling archive ESRIN: https://oa-es.eo.esa.int/ra/<br>Envisat Web File Server: http://ewfs-ks.eo.esa.int/<br>Rolling archive Matera: https://oa-ip.eo.esa.int/ra/<br>EOLI-SA catalogue and ordering tool: http://eoli.esa.int/geteolisa/index.html |
| 4 | ATSR | ERS | ERS | EOLI-SA catalogue and ordering tool: http://eoli.esa.int/geteolisa/index.html<br>NERC data centre: http://www.neodc.rl.ac.uk/cgi-infrastructure/data_browser/data_browser/neodc/aatsr_multimission |
| 5 | ATSR | ERS | Envisat N1 | These data will become available through a MERCI system in "specify a date". Contact EOHELP at eohelp@esa.int. |
| 6 | SAR | ERS | Envisat N1 | These data will become available soon. Contact EOHELP eohelp@esa.int. |
| 7 | Chris | Proba | HDF4 | EOLI-SA catalogue: http://eoli.esa.int/geteolisa/index.html<br>ESA on-line archive: https://oa-es.eo.esa.int/ra/ |
| 8 | AVNIR-2 | ALOS | CEOS | EOLI-SA catalogue and ordering tool: http://eoli.esa.int/geteolisa/index.html |
| 9 | PRISM | ALOS | CEOS | EOLI-SA catalogue and ordering tool: http://eoli.esa.int/geteolisa/index.html |
| 10 | MODIS | Aqua, Terra | HDF | MODIS data will be made available from ESRIN through a MERCI system. Please contact eohelp@esa.int.<br>Ocean data: http://oceancolor.gsfc.nasa.gov/cgi/browse.pl?sen=am<br>Land data: http://edcdaac.usgs.gov/datapool/datapool.asp |
| 11 | AVHRR/3 | NOAA-KLM | NOAA METOP | NOAA http://www.class.noaa.gov/<br>METOP: http://www.eumetsat.int/Home/Main/Access_to_Data/Metop__amp__NOAA_Services/index.htm?l=en |
| 12 | TM Thematic Mapper | Landsat 5 | Fast Format | EOLI-SA catalogue: http://eoli.esa.int/geteolisa/index.html (downloading functionality)<br>Eurimage: http://www.eurimage.com/einet/choose.html |
| 13 | GETASSE DEM | N/A | | http://www.brockmann-consult.de/beam/downloads.html |

## Data Access Details and Distribution Policy

| | Instrument | How to get data |
|---|---|---|
| 1 | MERIS | **Data Access**<br>MERIS data can be obtained by several means:<br>• - download of L1b and L2 RR data of the last 7 days from the rolling archive/EWFS<br>• - download of L1b and L2 RR data from 2002 until current from the Merci catalogue (one year of data missing) |




**BEAM is composed of exchangeable modules (Plug-ins)**

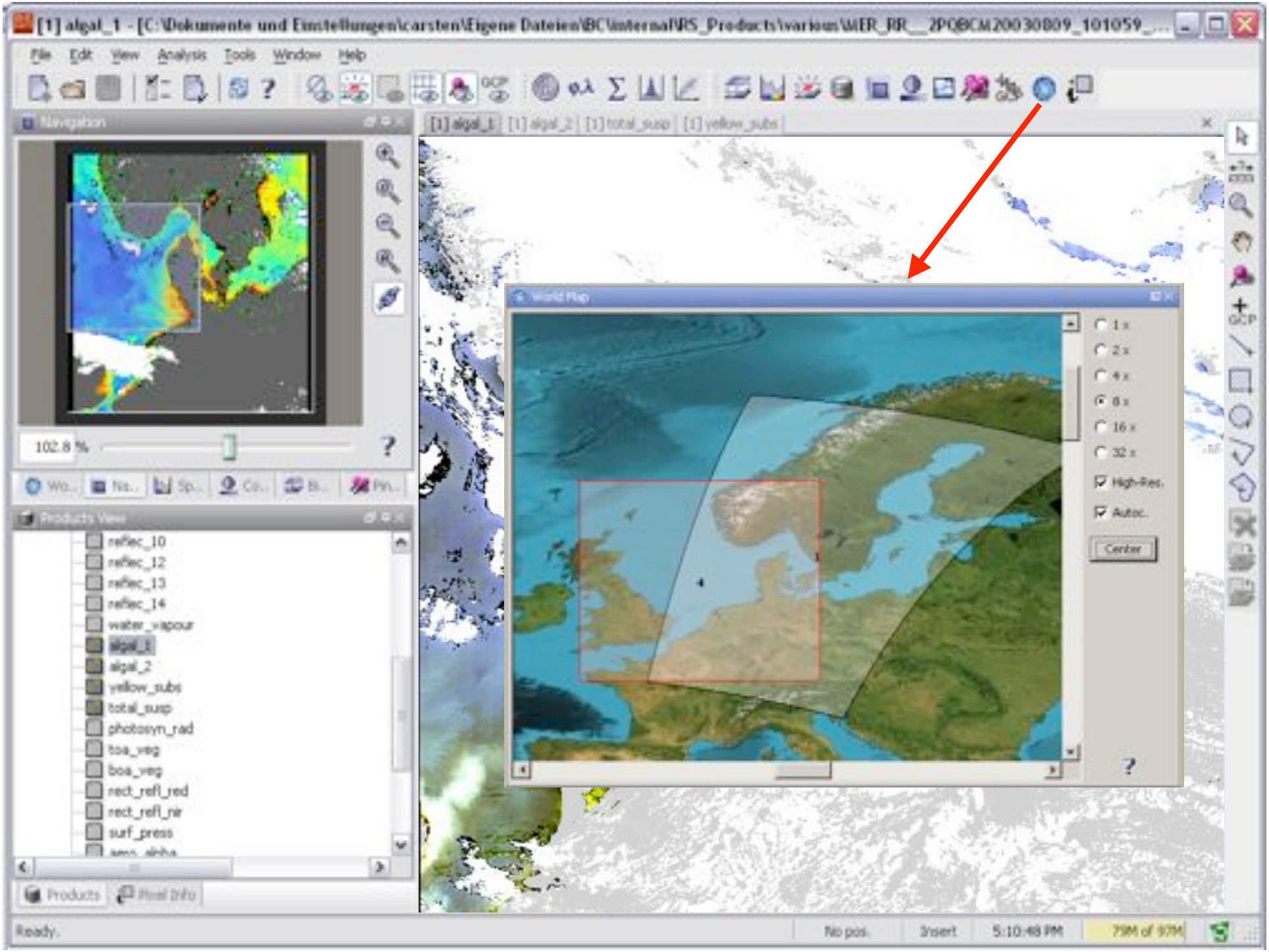
**Module manager used to:**

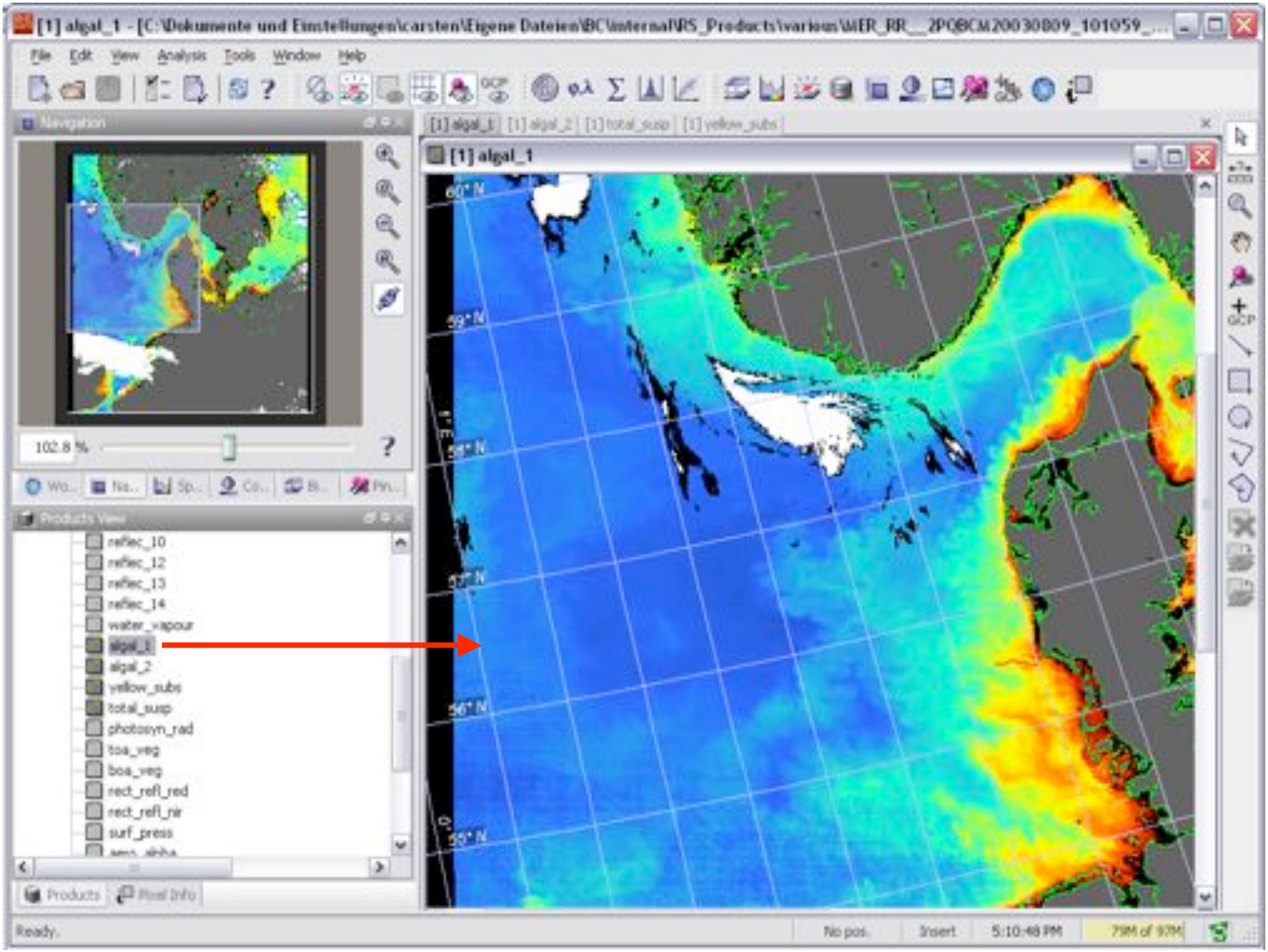
- **inspect installed modules**
- **install new modules**
- **update modules**
- **uninstall modules**

# A typical BEAM use case

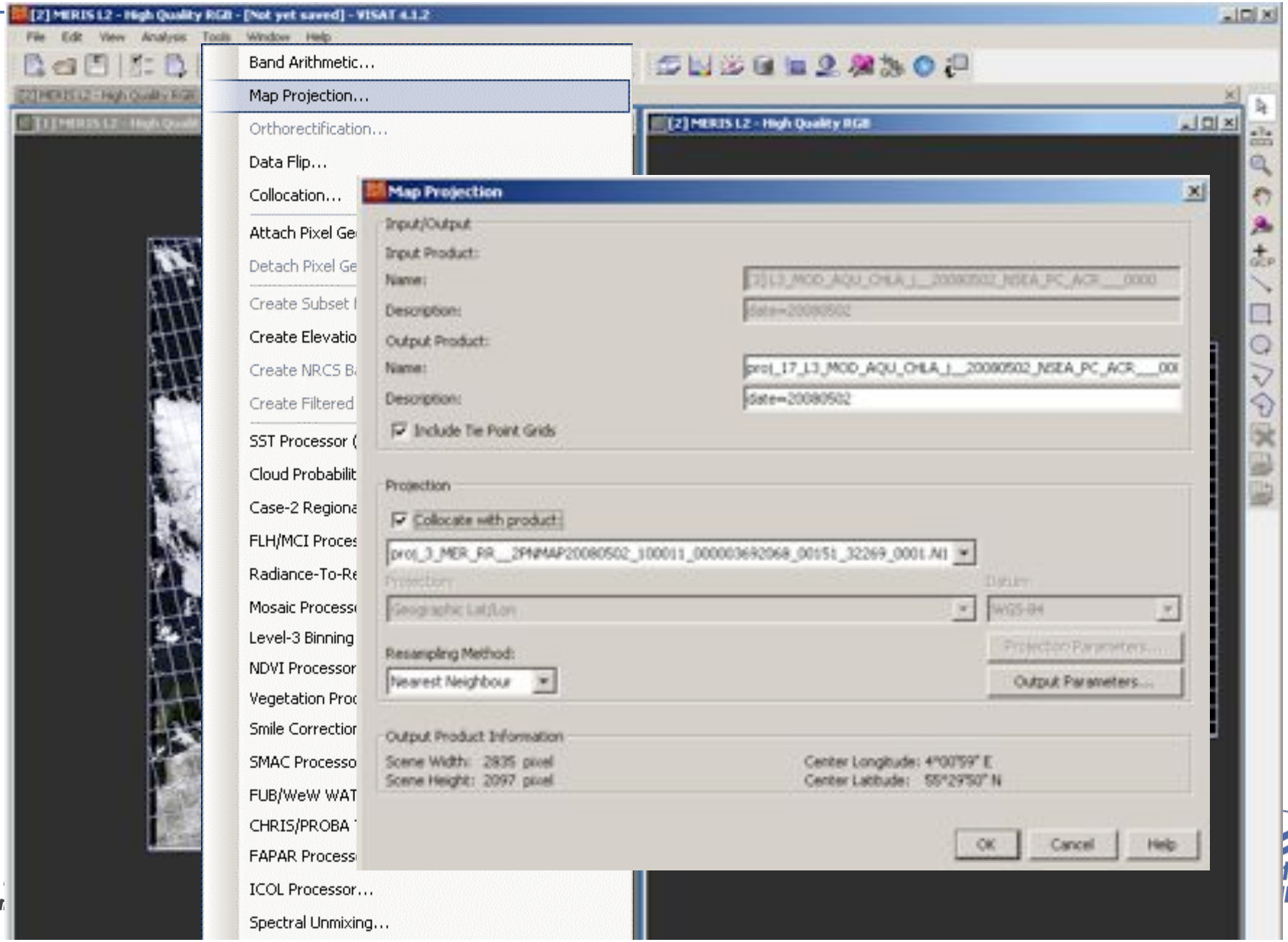
- Algal bloom (spring bloom 2008) in the North Sea shall be studied
- A MERIS and a MODIS product are available of this day
- A ship was at sea taking measurements

- **Tools for analysing the bloom:**
  - Map Projection Tool for co-locating MERIS and MODIS product
  - Colour palette tool for enhanced visual interpretation
  - Importing coordinates and display pixel values along the track
  - ROI manager for investigation of dedicated areas
  - PIN manager for investigating pixels at measurement stations

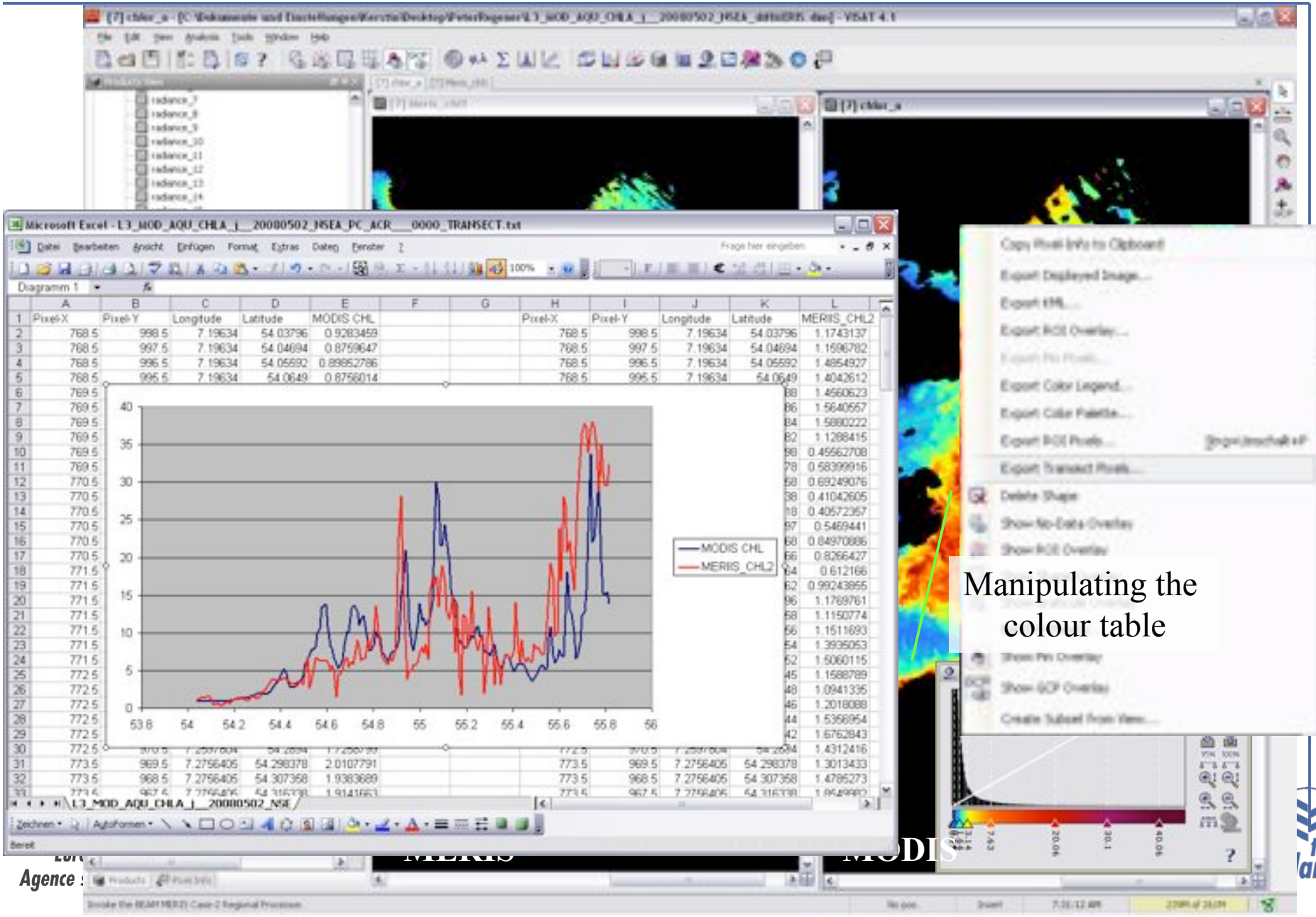

[1] algal_1 - [C:\Dokumente und Einstellungen\carsten\Eigene Dateien\BC\internal\RS_Products\various\MER_RR__2PQBCM20030809_101059_...
File Edit View Analysis Tools Window Help
Navigation
102.8 %
[1] algal_1 [1] algal_2 [1] total_susp [1] yellow_subs
World Map
1 x
2 x
4 x
8 x
16 x
32 x
High-Res.
Autoc.
Center
Products View
reflec_10
reflec_12
reflec_13
reflec_14
water_vapour
algal_1
algal_2
yellow_subs
total_susp
photosyn_rad
toa_veg
boa_veg
rect_refl_red
rect_refl_nir
surf_press
Products
Pixel Info
Ready.
No pos.
Insert
5:10:48 PM
79M of 97M


[1] algal_1 - [C:\Dokumente und Einstellungen\carsten\Eigene Dateien\BC\internal\RS_Products\various\MER_RR__2PQBCM20030809_101059_...
File Edit View Analysis Tools Window Help
Navigation
102.8 %
[1] algal_1
[1] algal_1 [1] algal_2 [1] total_susp [1] yellow_subs
Products View
reflec_10
reflec_12
reflec_13
reflec_14
water_vapour
algal_1
algal_2
yellow_subs
total_susp
photosyn_rad
toa_veg
boa_veg
rect_refl_red
rect_refl_nir
surf_press
Products
Pixel Info
60° N
59° N
58° N
57° N
56° N
55° N
Ready.
No pos.
Insert
5:10:48 PM

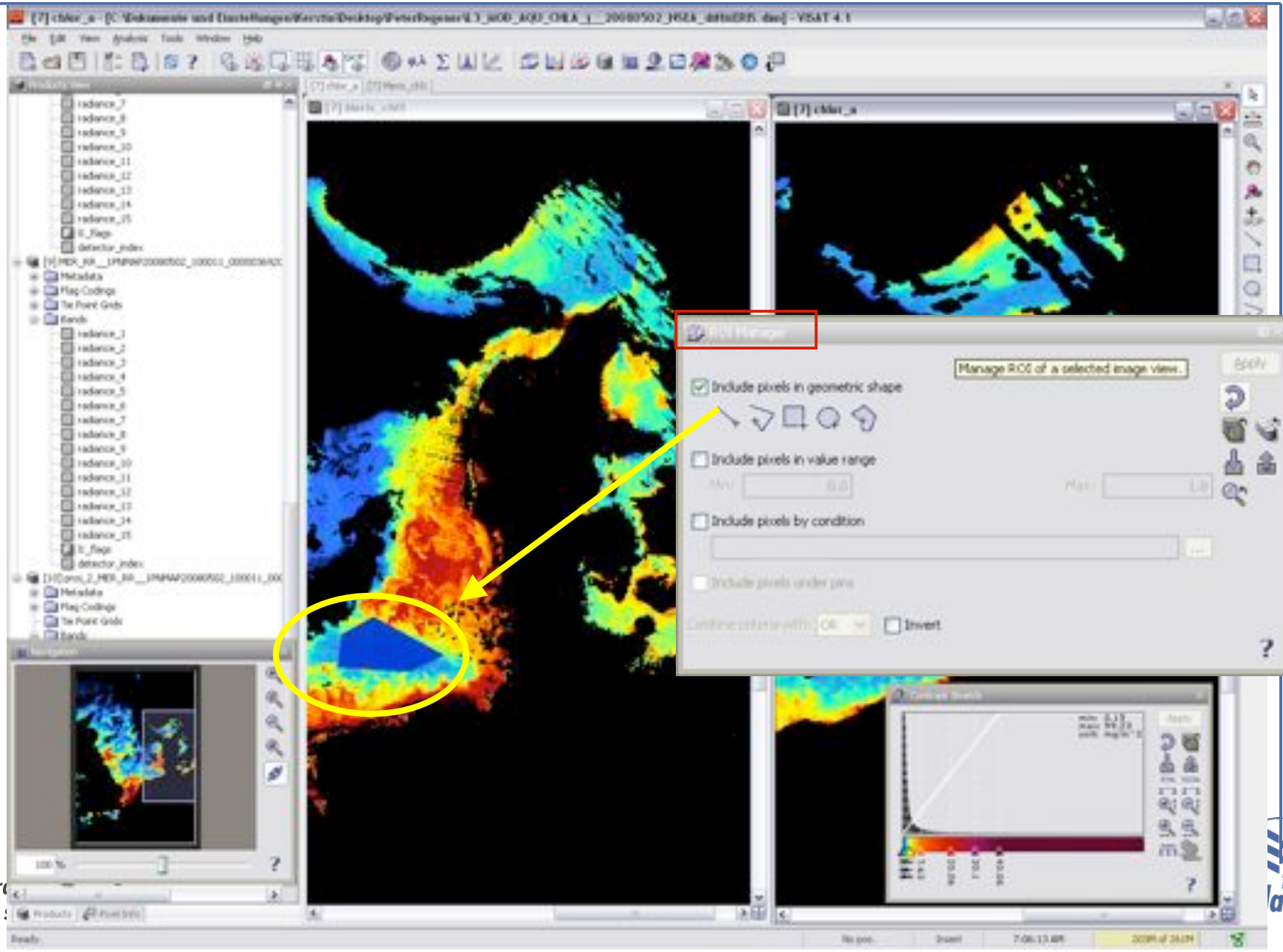
# Map projection



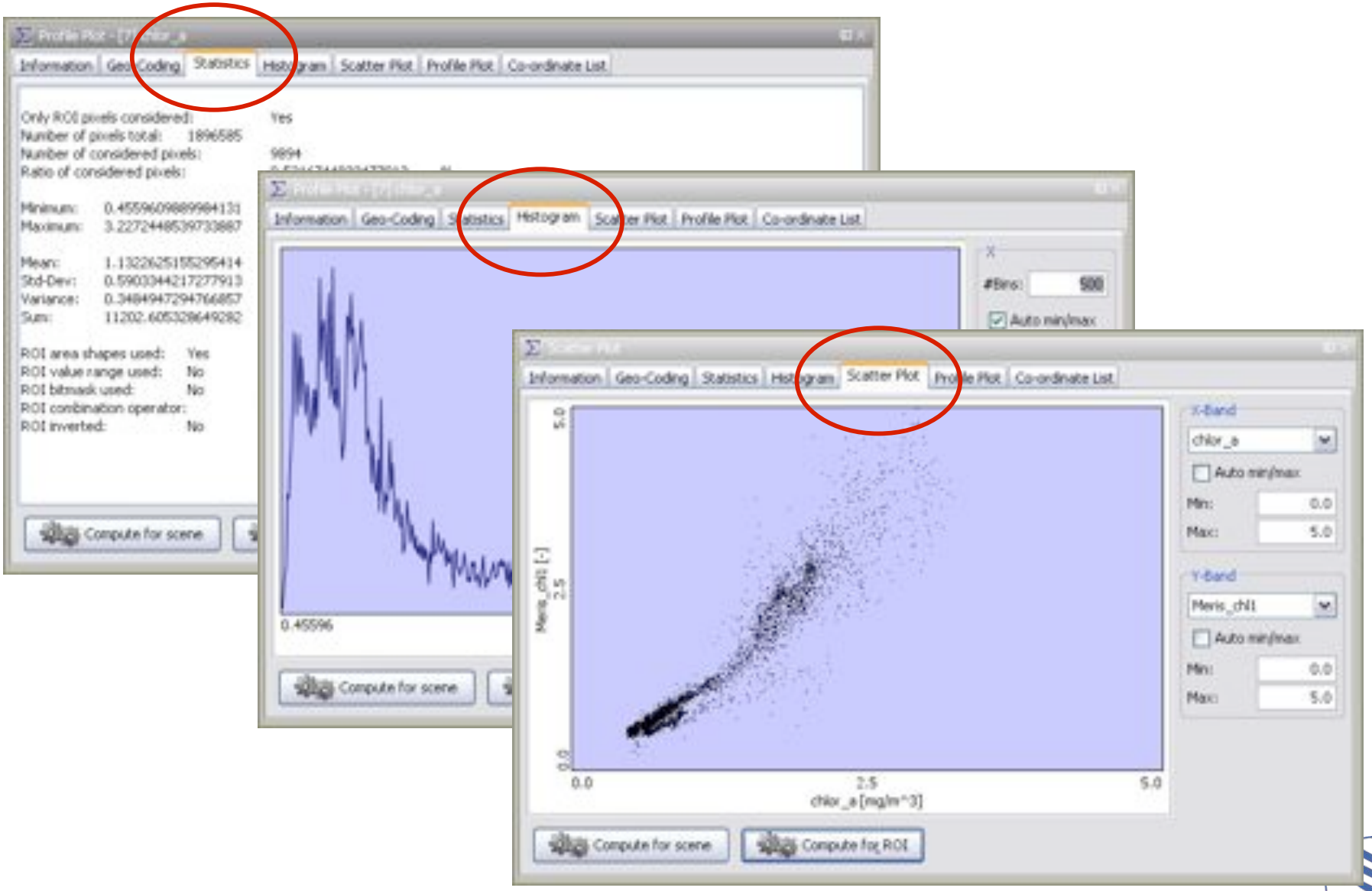
# Analysing Transects



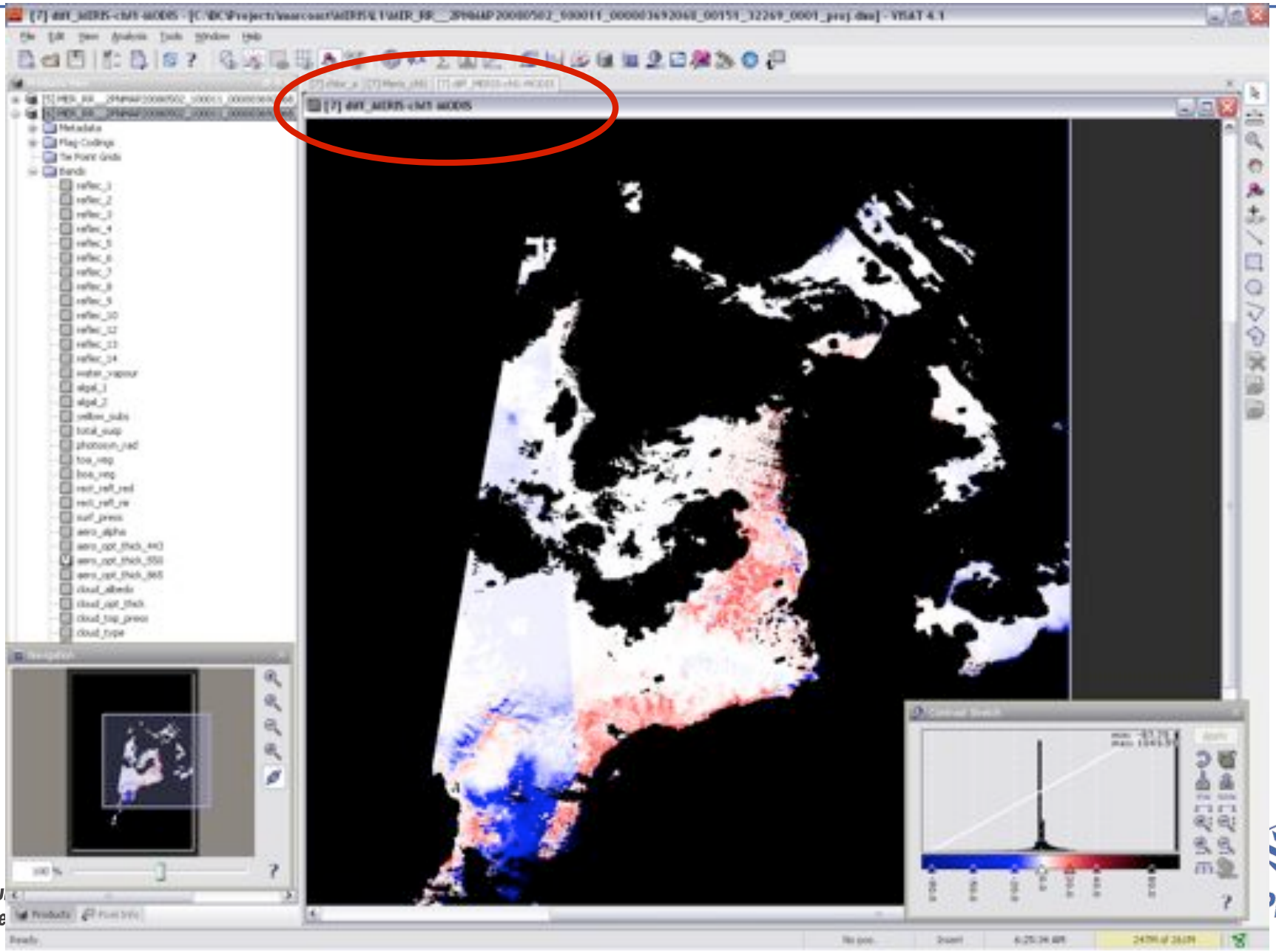
# Managing ROIs



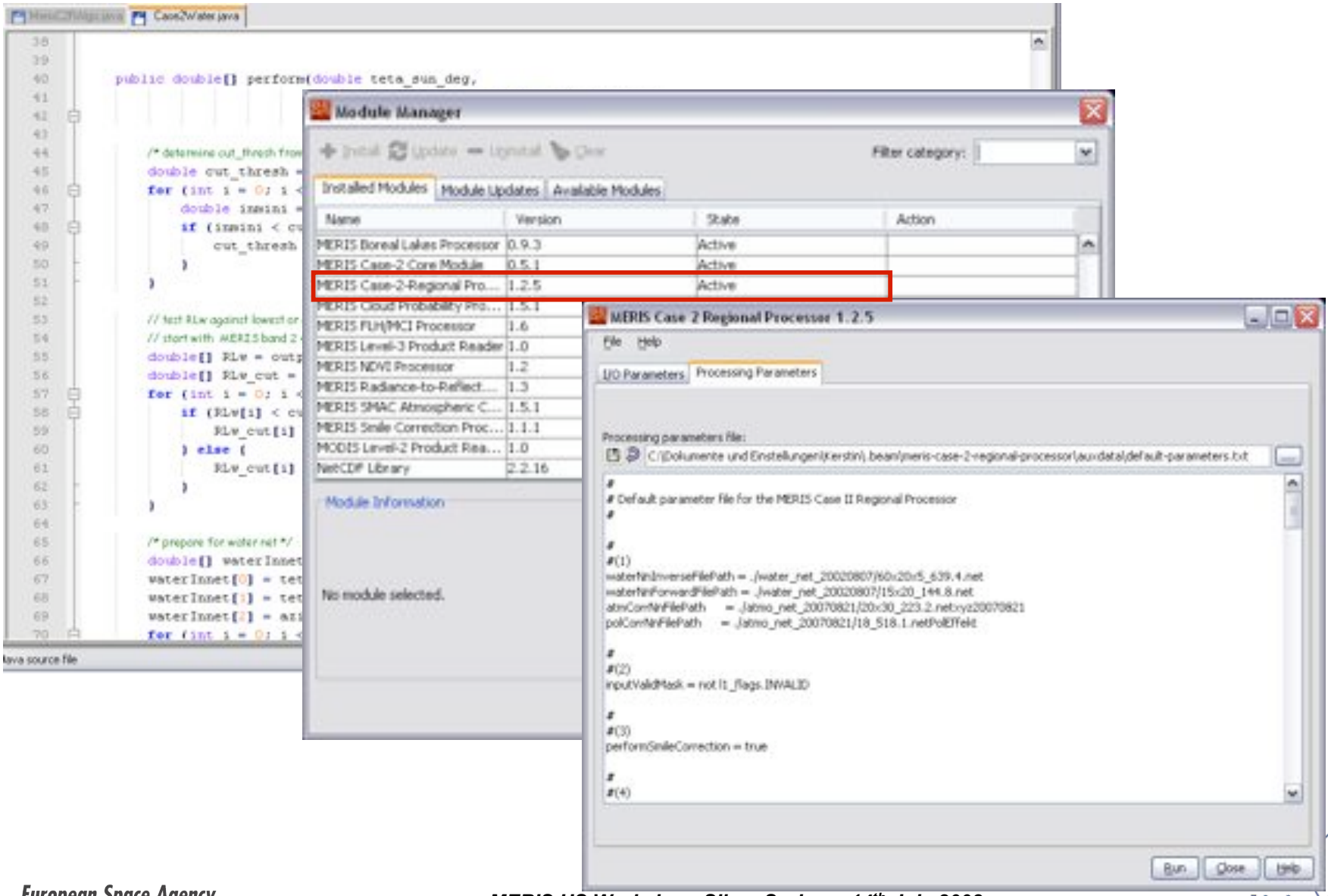
# Analsyis tools



# Band Arithmethic



# Plug-In Modules



# Case 2 Regional Processor

- Algorithm developed by R. Doerffer, GKSS Institute for Coastal Research, Germany
- Implemented as BEAM Processor by Brockmann Consult, Germany

- Processing of MERIS L1b data
- Adapted to coastal and inland waters (lakes in Spain, Finnland, Germany)
- Based on neural network inversion of bi-directional radiance reflectances

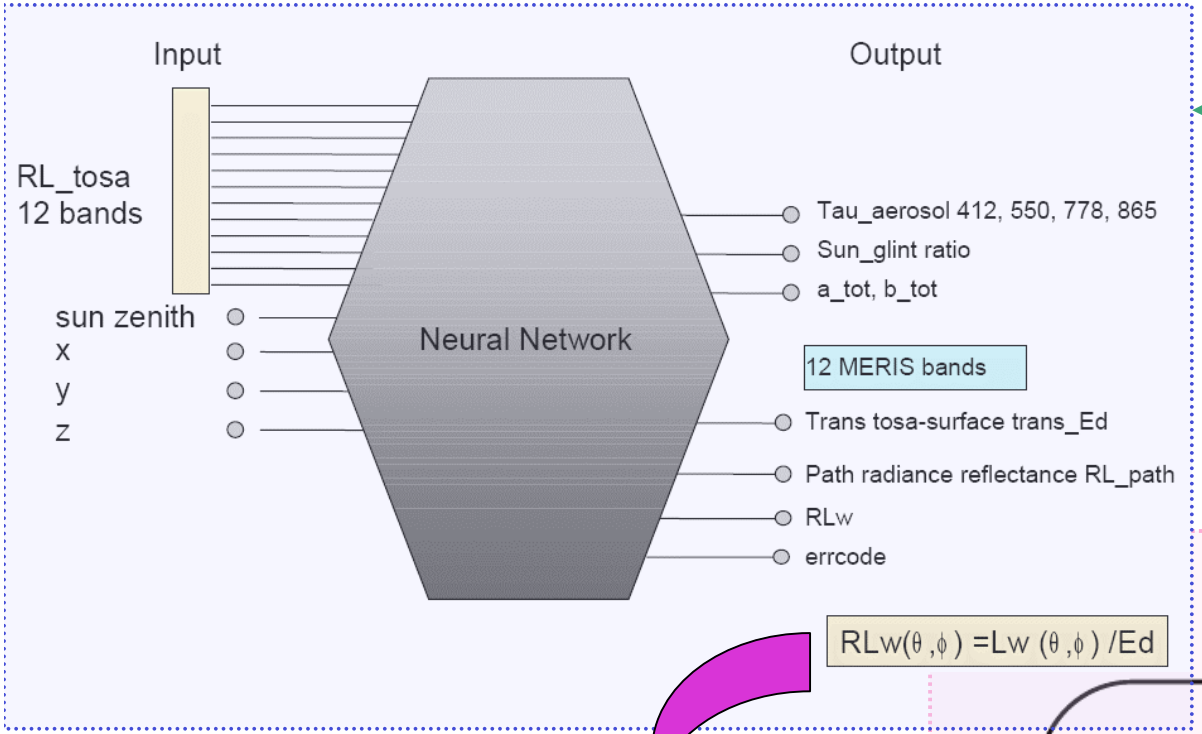
- **Atmospheric correction procedure generates:**
  - Water leaving radiance reflectances (12 bands)
  - Path radiance reflectances
  - Transmittance
  - Aerosol optical thickness

- **Water retrieval procedure generates:**
  - IOPs: total absorption & scattering
  - Absorption of CHL and YS

  } Concentrations of CHL & TSM dry weight

  - Downwelling irradiance attenuation koefficient k
  - z90 signal depth

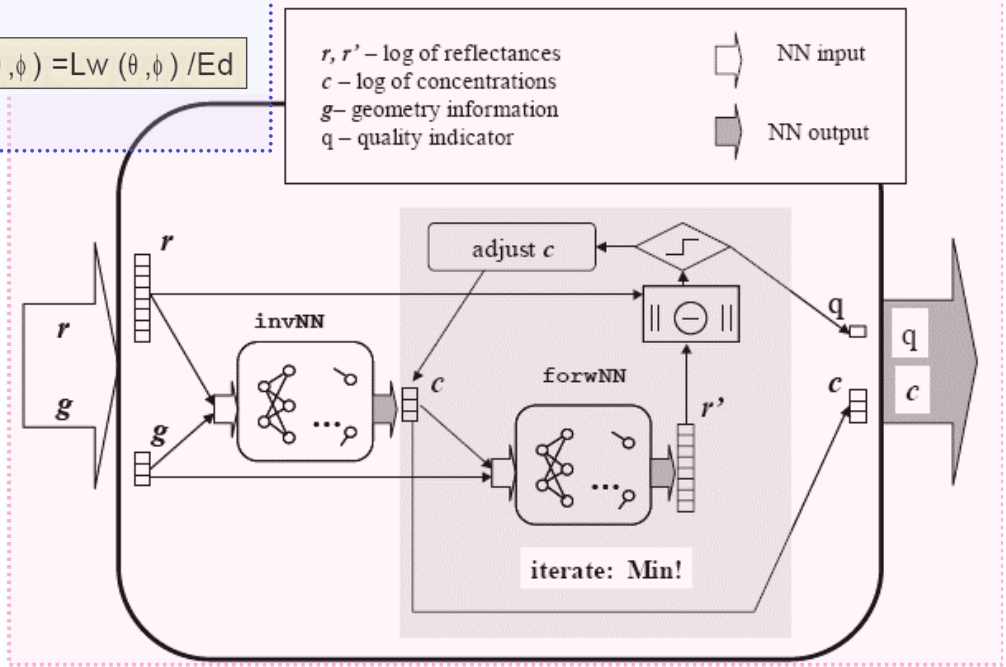
# Case2 Regional Processor




## Atmospheric correction

Neural networks trained with simulated spectra (Monte Carlo/Hydrolight)

## Water retrieval

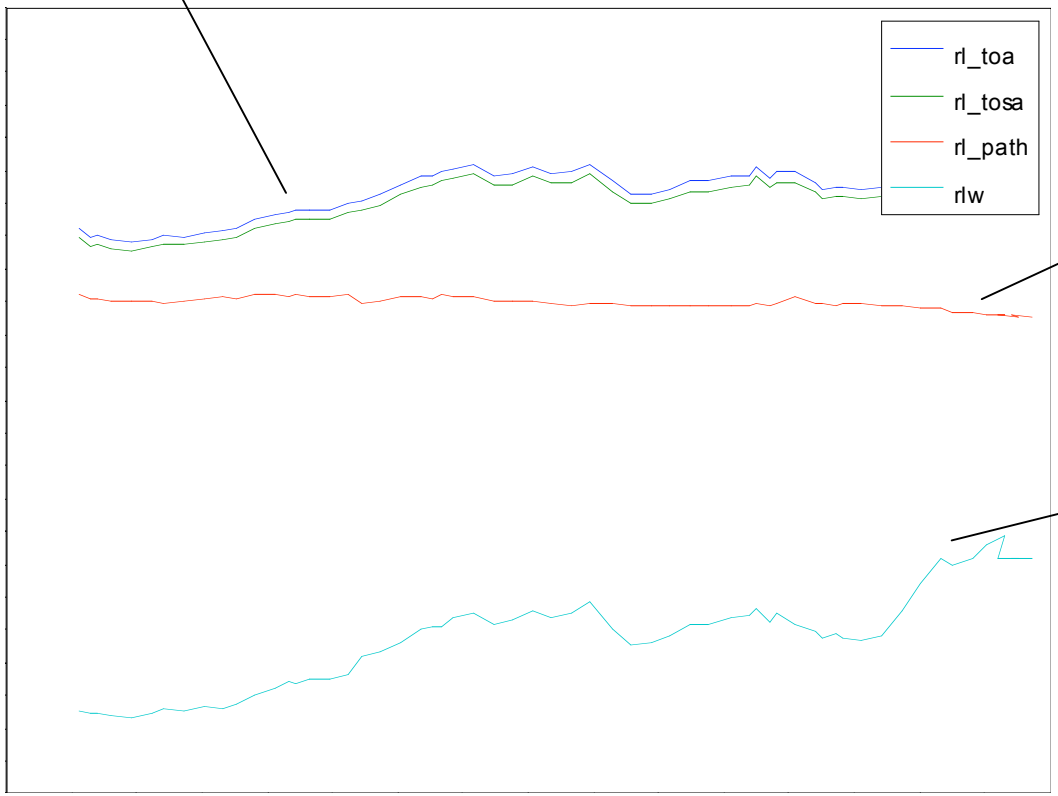



**H. Schiller and R. Doerffer,**
Improved Determination of Coastal Water Constituent Concentrations from MERIS Data.
*IEEE transactions on geoscience and remote sensing*, vol 43, pp. 1585-1591, 2005


TOA RL RGB
North Sea
German Bight
Helgoland
Elbe
100 km

# MERIS Radiance Reflectance along transect

Top of atmosphere
Top of standard atmosphere (1013 hPa, 350 DU)

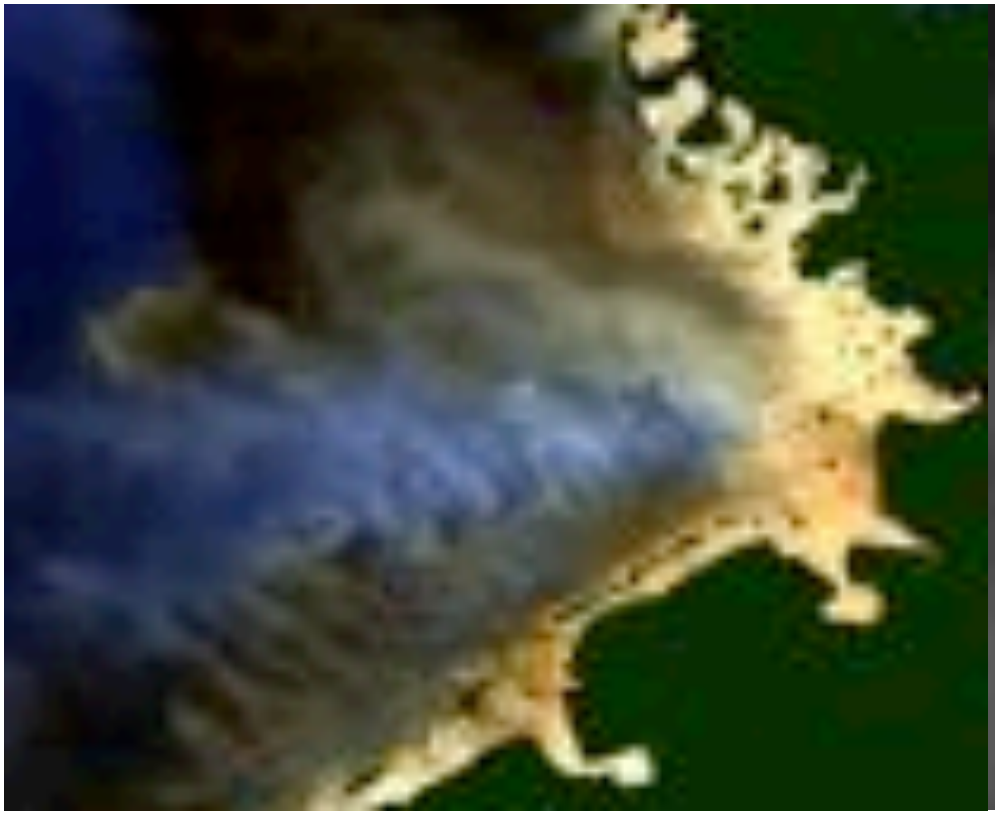



Path radiance

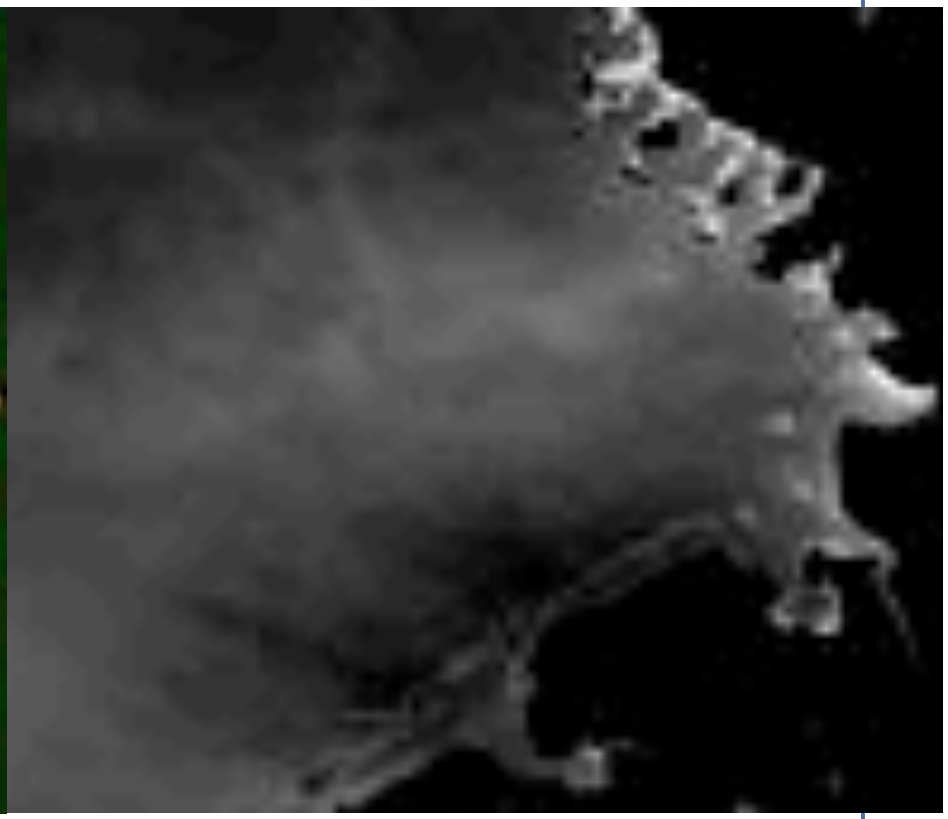
Water leaving radiance reflectance

RL [sr-1]

longitude



Water leaving radiance reflectance RLw RGB



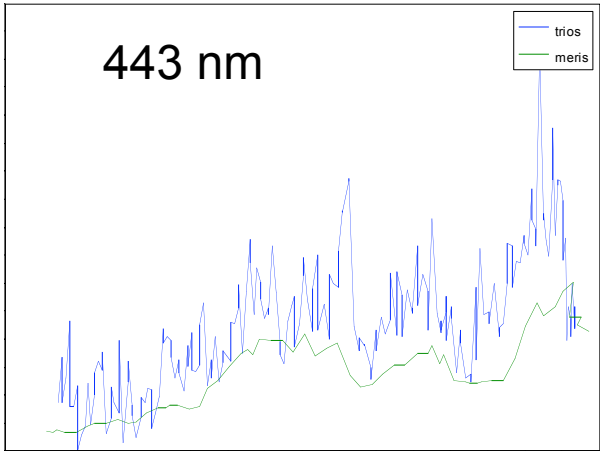
Path radiance reflectance 560 nm

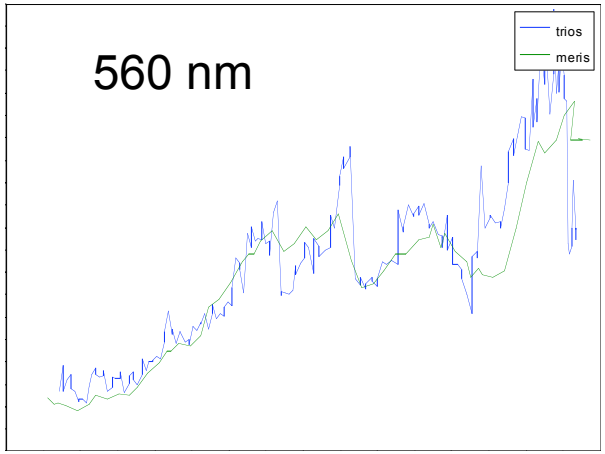
# RLw measurement with Trios spectrometer

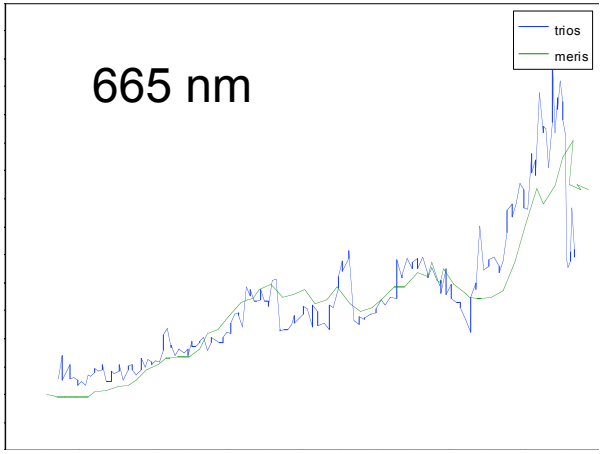
Trios spectrometer for measuring water surface radiance (RLs) and sky radiance (Lsky)
A further spectrometer measures downwelling irradiance, Ed.
Water leaving radiance reflectance is computed :

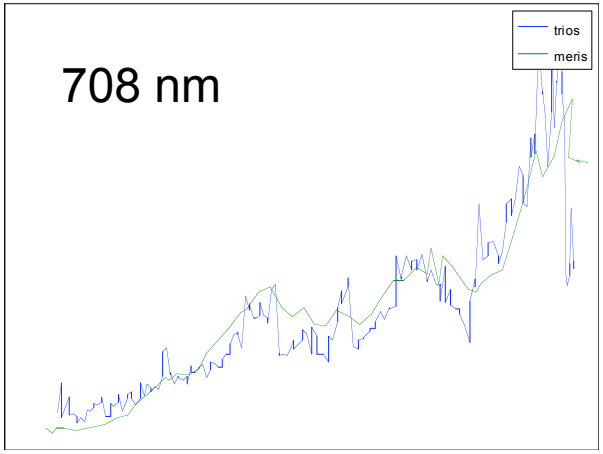
RLw = (RLs-Lsky*FR)/Ed (FR: Fresnel reflectance 0.025)

# Comparison RLw ship (Trios) – C2R Algorithm



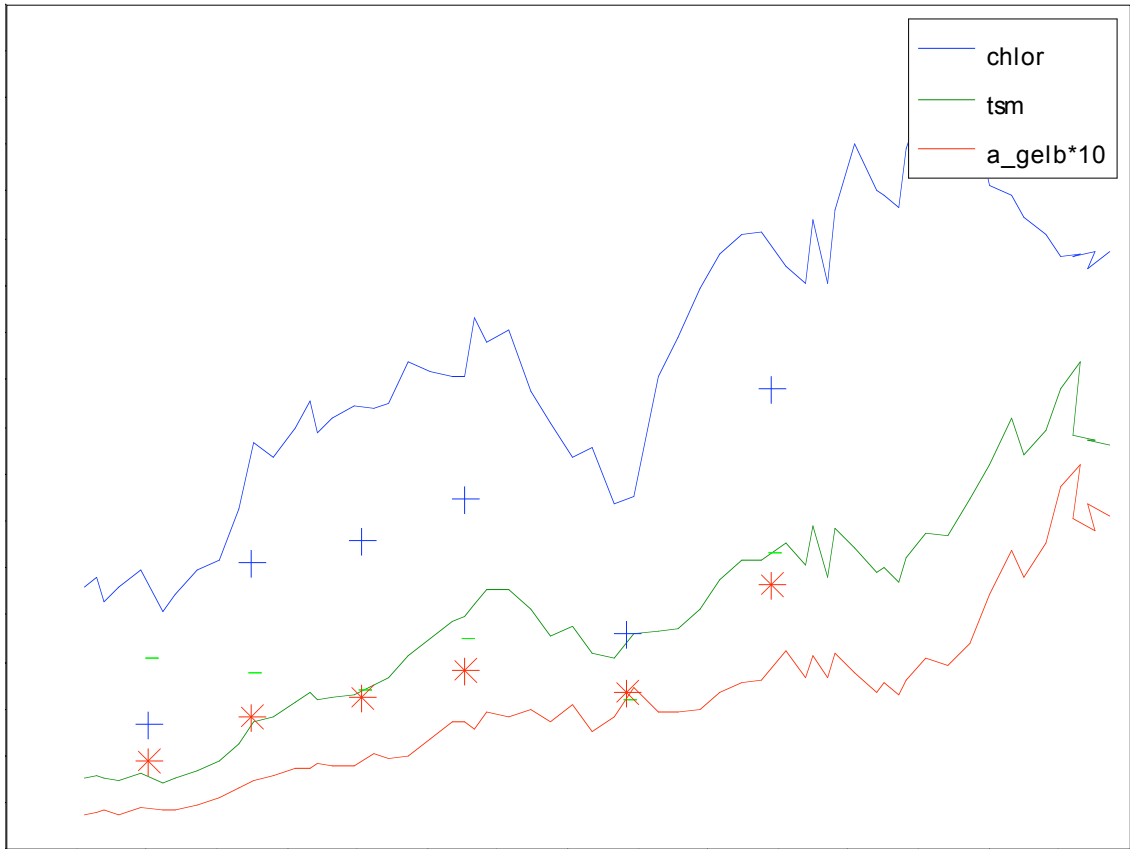



# Transect Cuxhaven – Helgoland (North Sea)

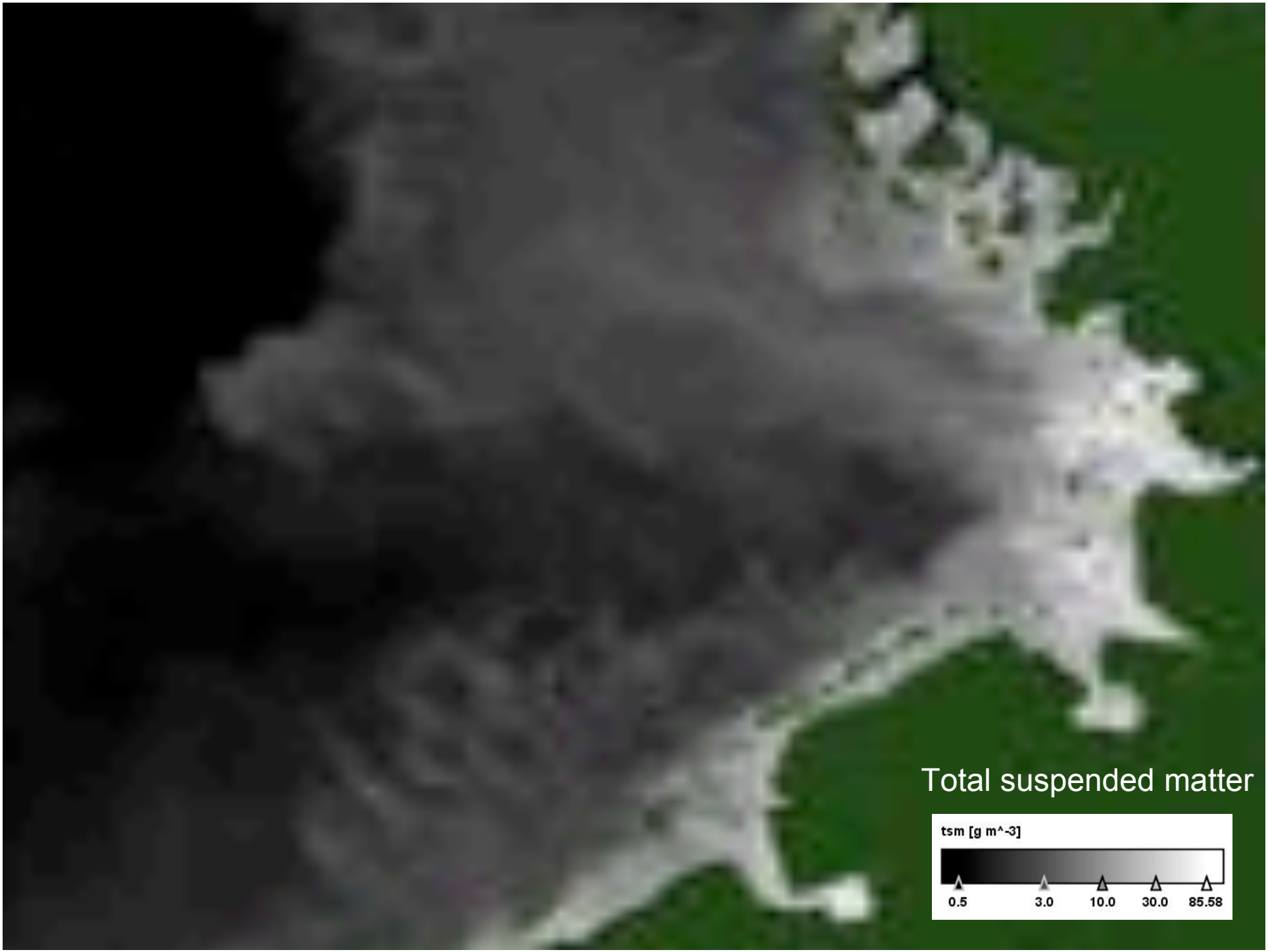
## with sample stations

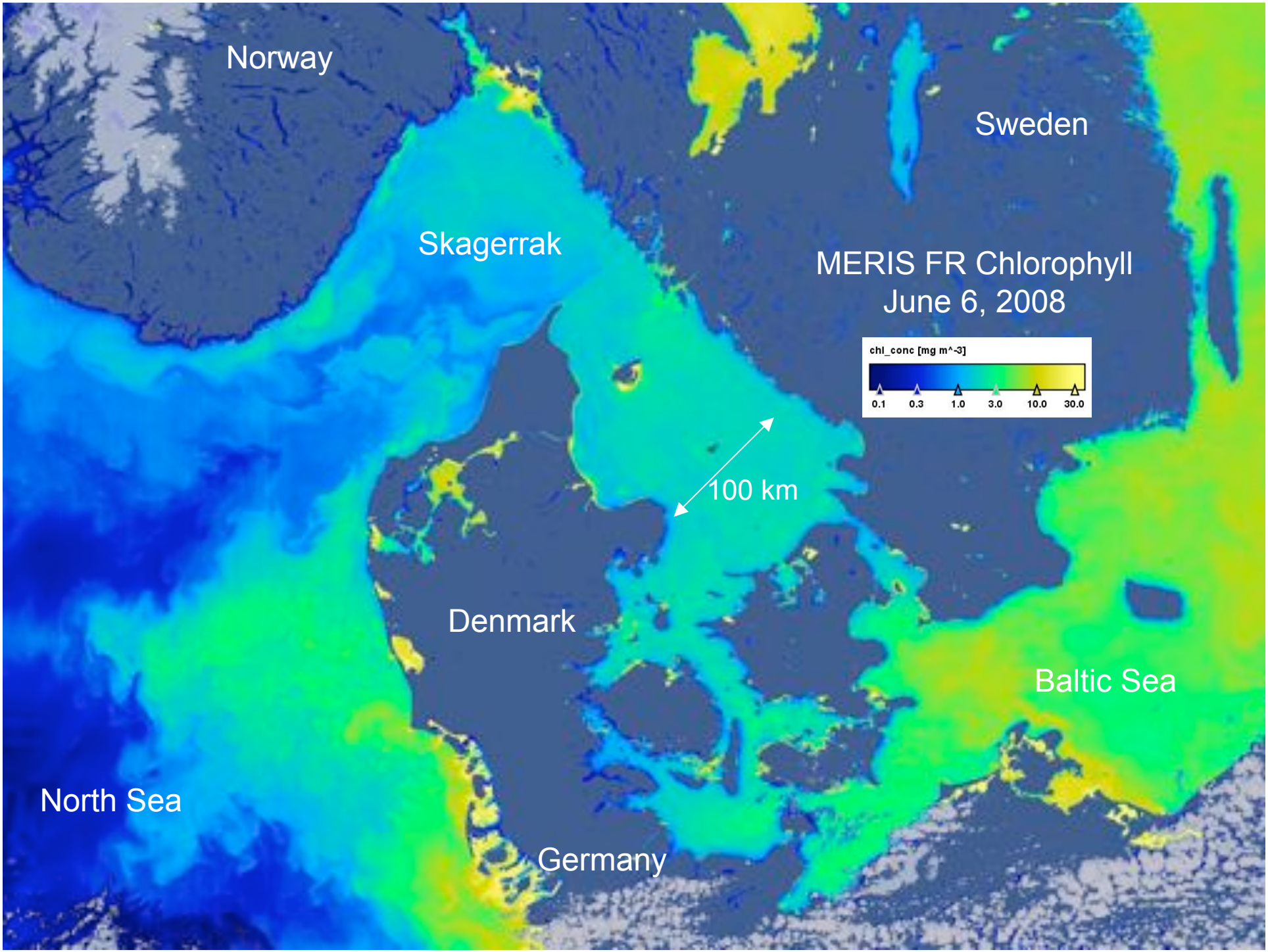
# Comparison MERIS C2R – water samples



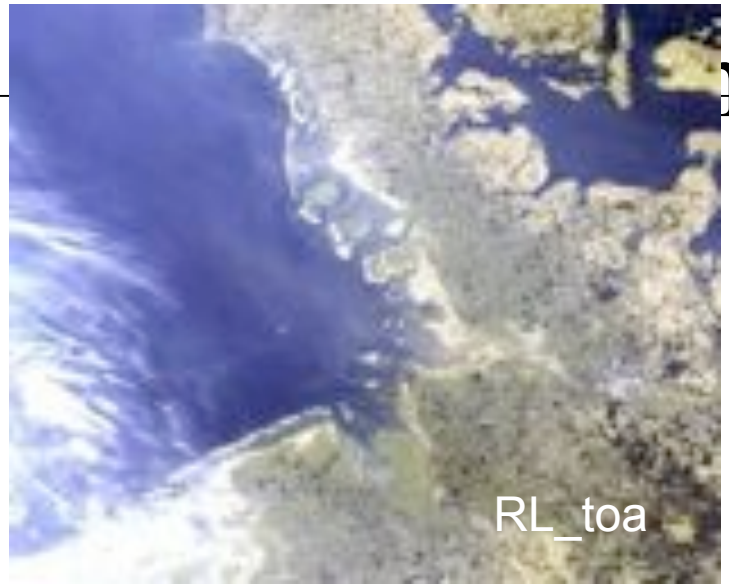
# Conclusion

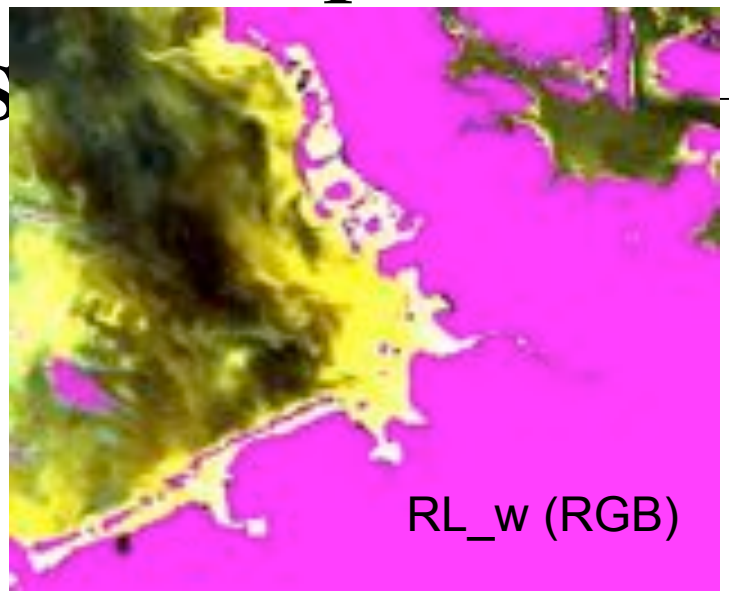
- **BEAM is very well received by users**
  - free SW - rich functionality - easy to use - openness - good user support
- **BEAM provides basis technology for EO data processing services**
- **General purpose Core API used for other toolboxes e.g. NEST (ASAR, Radarsat, TerraSAR-X), ➔ Sentinels**
- **BEAM used in multiple open source applications, e.g.**
  - UNESCO training software, various scientific processors, operational applications (e.g. Marcoast, G-POD)
- **ESA driving the development (in response to user needs)**
- **Further BEAM extensions in preparation**

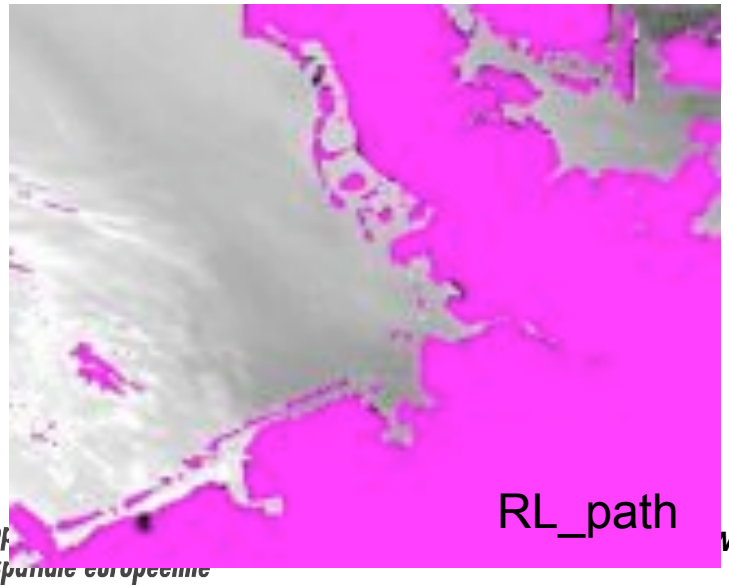

Total suspended matter
tsm [g m^-3]
0.5
3.0
10.0
30.0
85.58

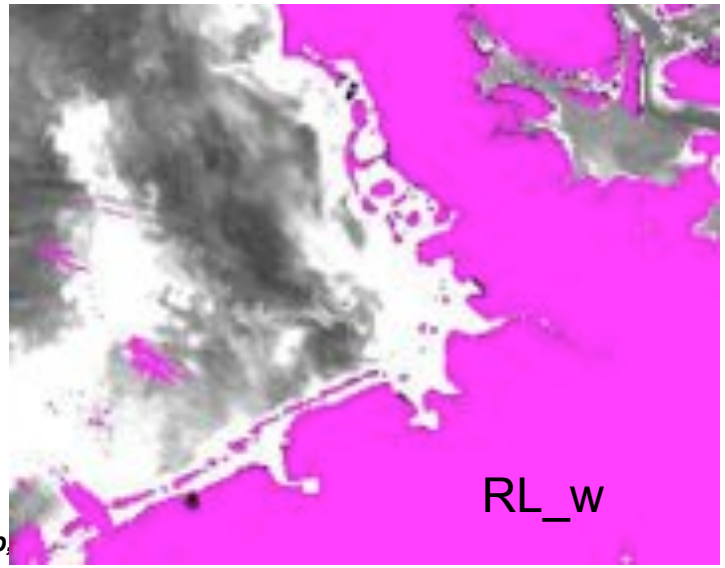

Norway
Sweden
Skagerrak
MERIS FR Chlorophyll
June 6, 2008
chl_conc [mg m^-3]
0.1
0.3
1.0
3.0
10.0
30.0
100 km
Denmark
Baltic Sea
North Sea
Germany

# Radiance reflectance: separation of

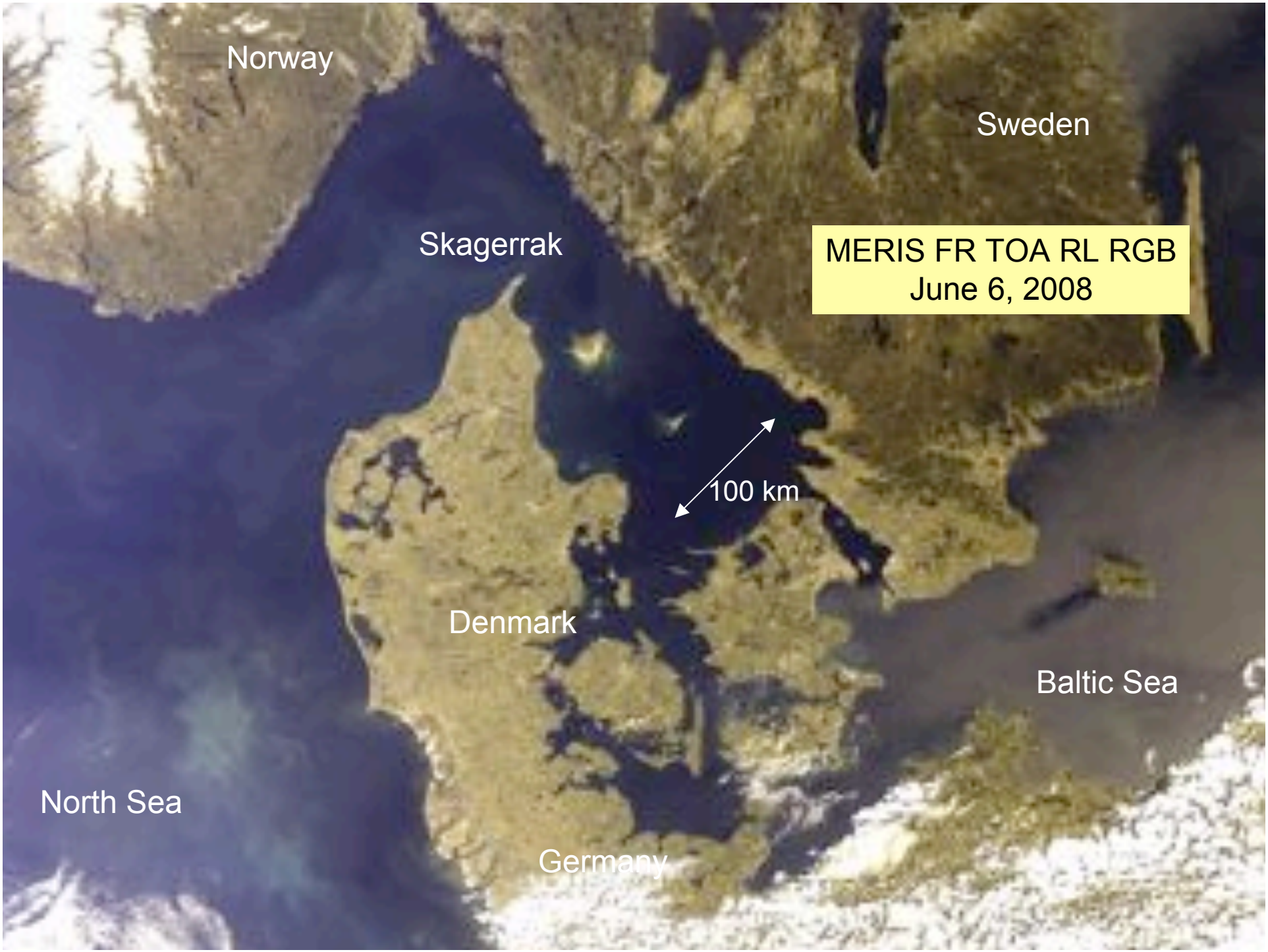


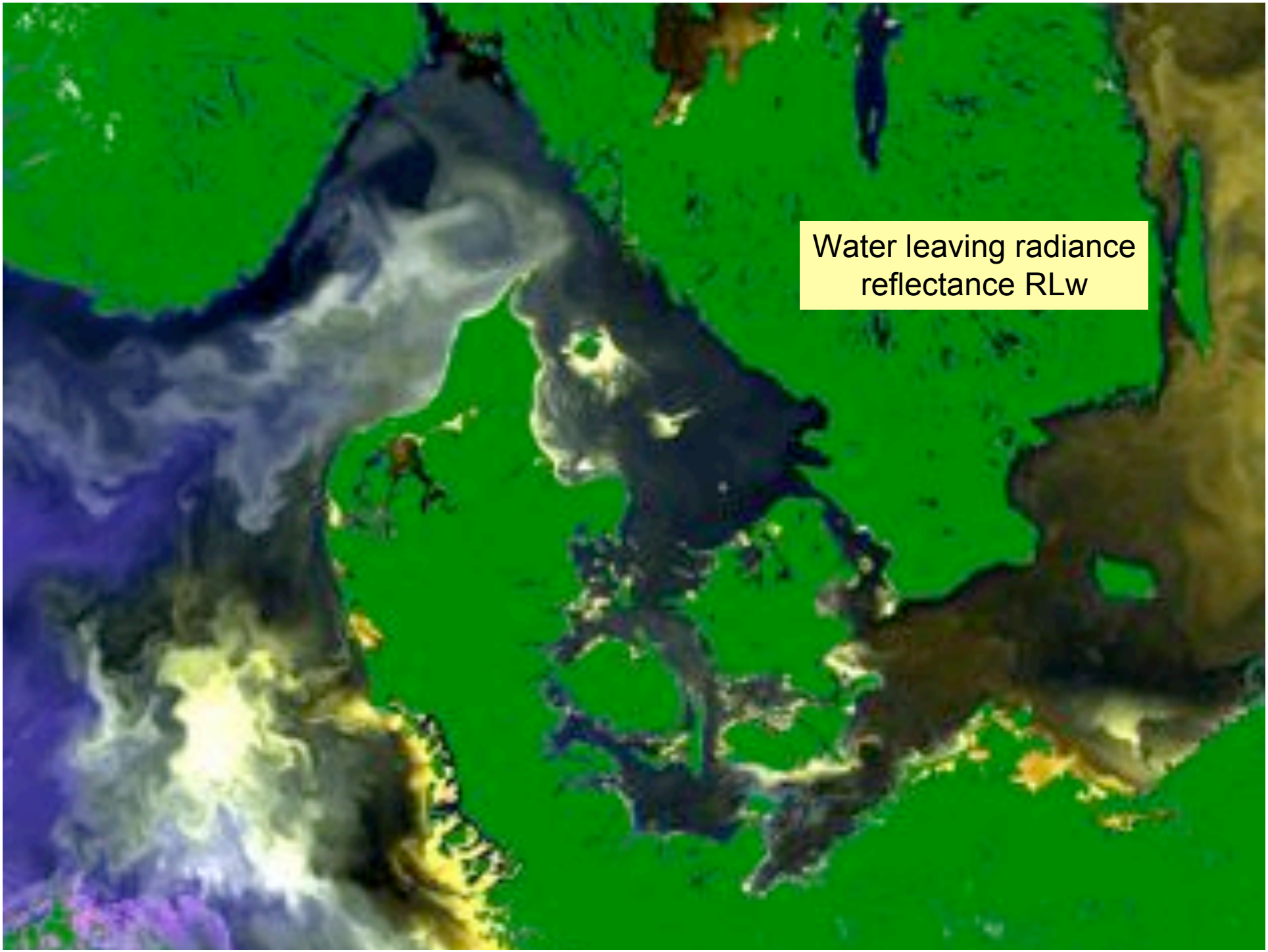



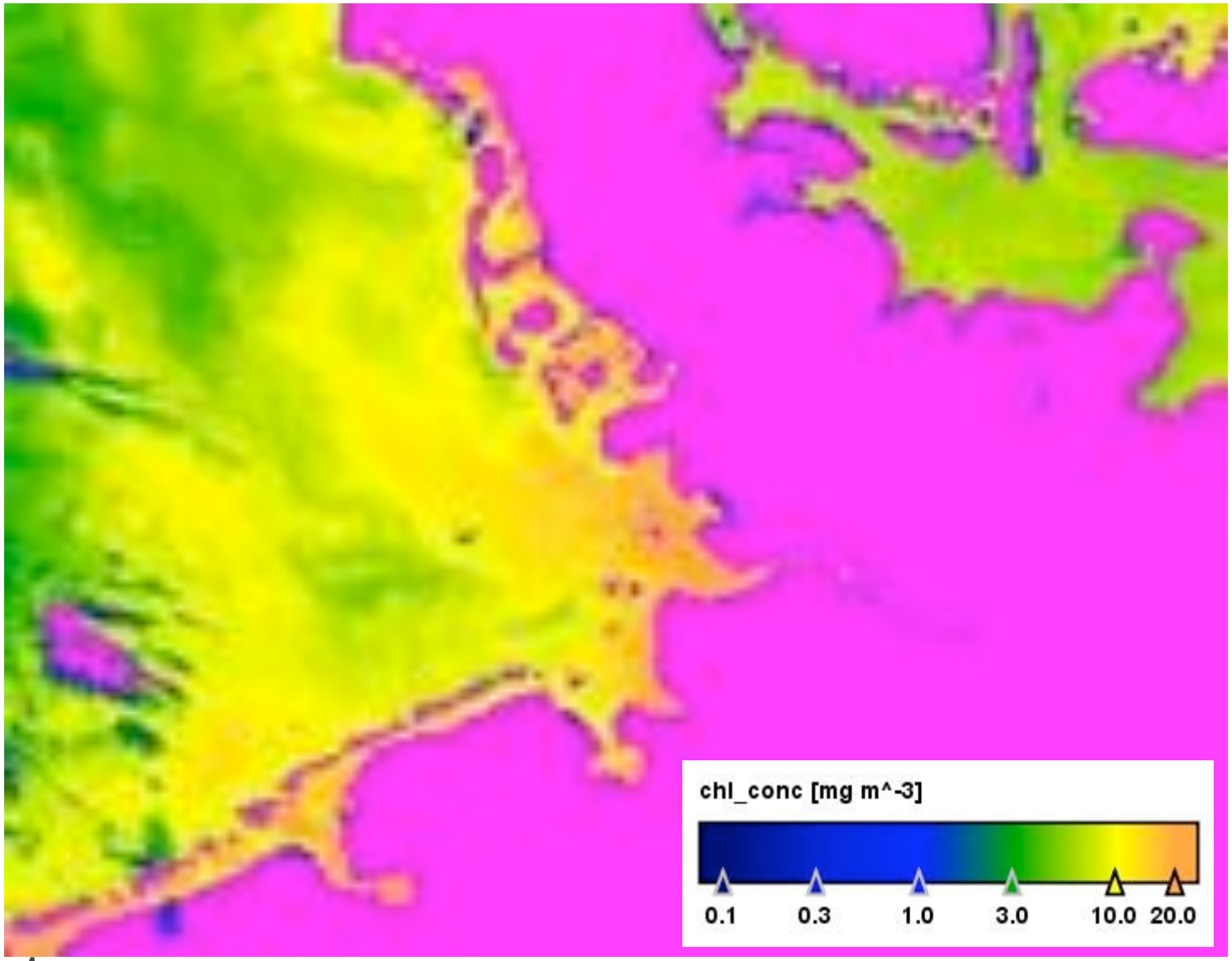



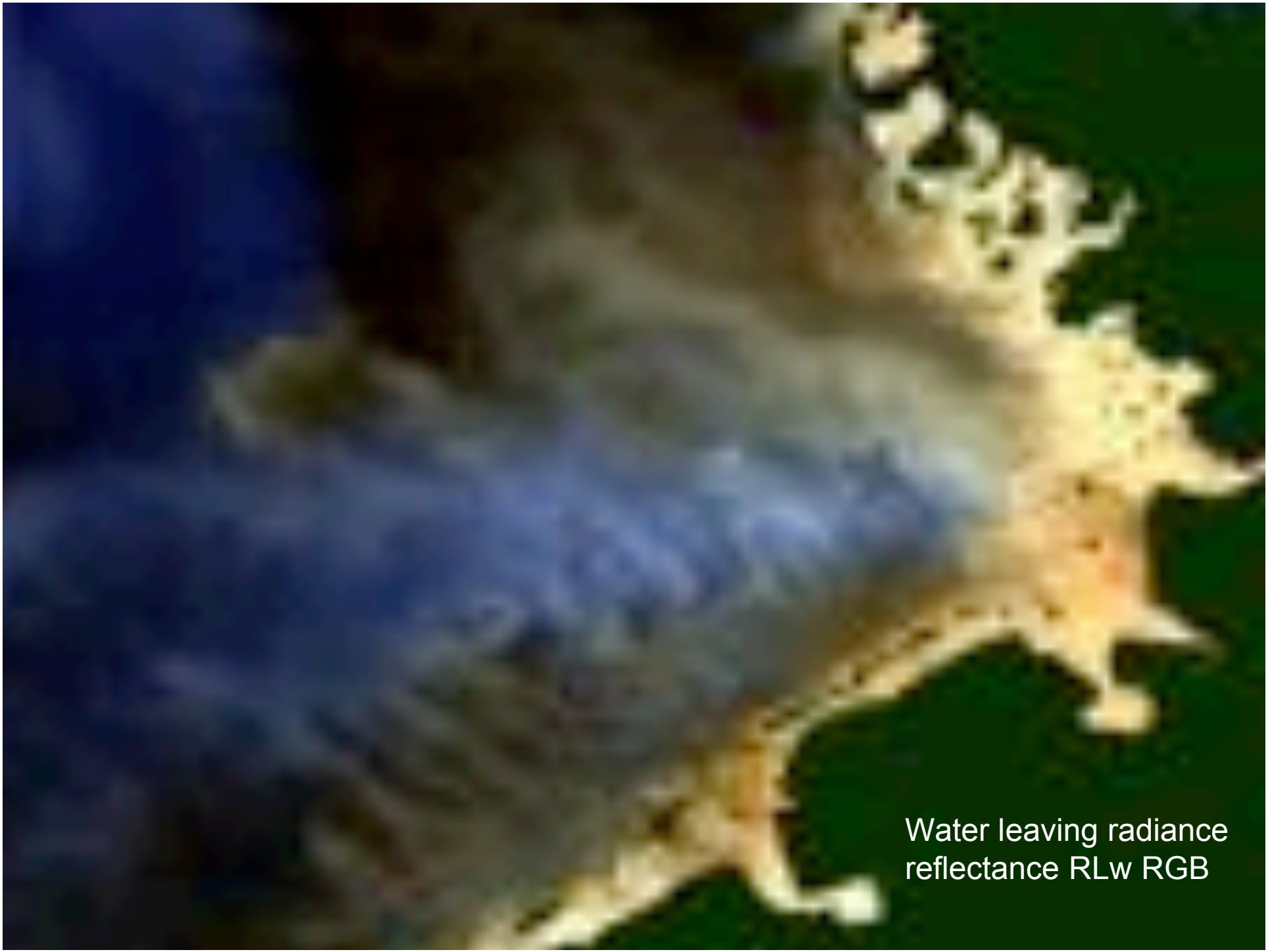

Band 5
560 nm

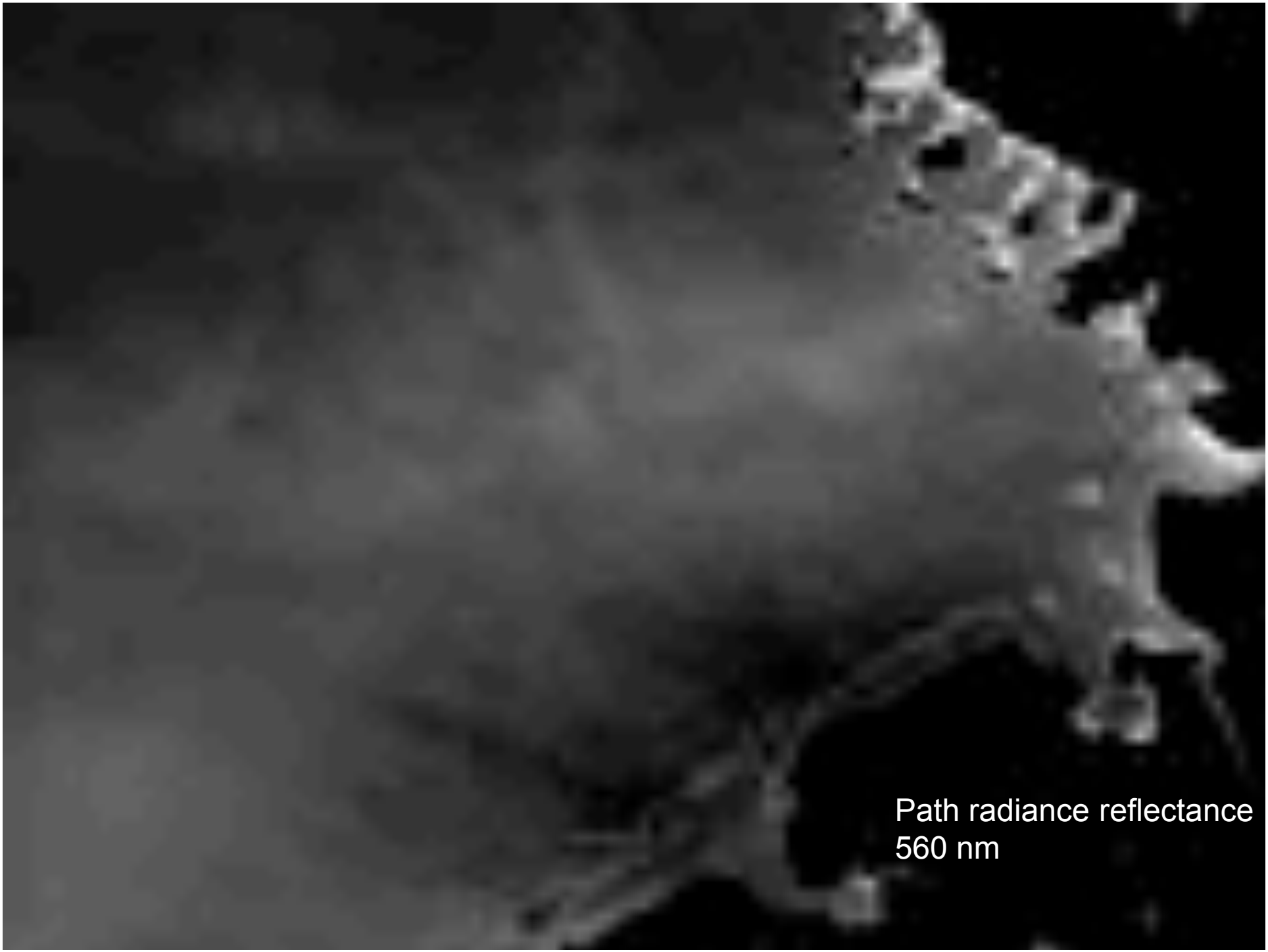

Norway
Sweden
Skagerrak
MERIS FR TOA RL RGB
June 6, 2008
100 km
Denmark
Baltic Sea
North Sea
Germany


Water leaving radiance
reflectance RLw

# MERIS 20050901 Chlorophyll




Water leaving radiance
reflectance RLw RGB


Path radiance reflectance
560 nm