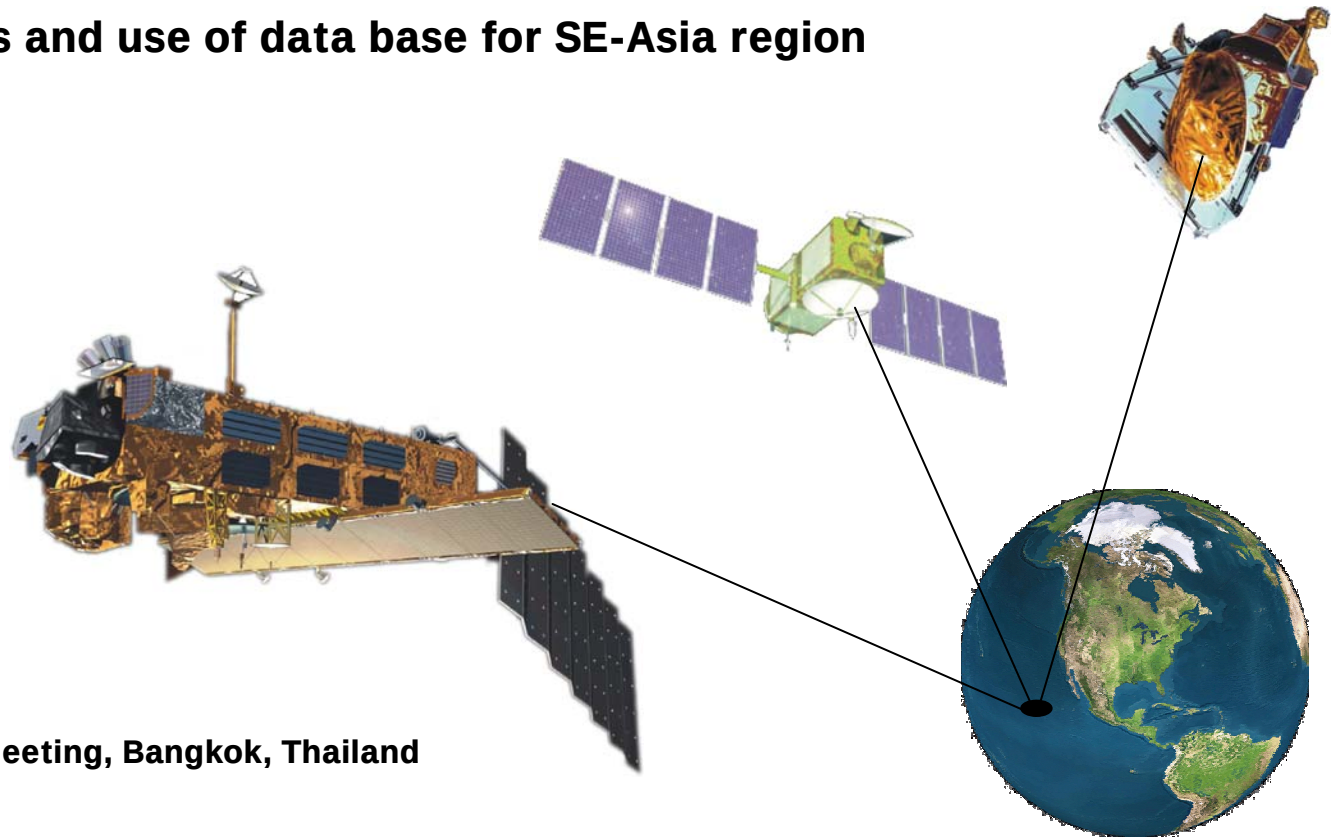
Satellite ALTimetry

SALT applications and use of data base for SE-Asia region



SEAMERGES kick-off meeting, Bangkok, Thailand

Marc Naeije

4 March 2004

Faculty of Aerospace Engineering – DEOS/AS

TU Delft
Delft University of Technology

SEAMERGES altimeter theme: summary

- The specific needs of the ASEAN partners in the SEAMERGES project are a dedicated HRD programme in 3 areas of high-precision space geodetic technology provided by skilled and experienced EC partners, as well as an introduction to the application of the acquired technology in a number of intra-ASEAN and EC common applied research projects. This theme covers Satellite ALTimetry (SALT) technology.

SEAMERGES altimeter theme: description (I)

- Though satellite altimetry may be based on the simple fact that time is distance, the processing and interpretation of the data is quite complex: you have to take into account the instrument design, calibration, validation, atmospheric path delays, geophysical corrections, reference system, precise orbit determination and space and time sampling characateristics.
- The result is very rewarding: the ability to observe relative and absolute sea level. Altimetric data helps monitoring sea level change and its coastal applications, regional geodetic datum realization and maintenance, research on geodynamics and mass transport and their consequence for regional and global climate, to name a few applications.

SEAMERGES altimeter theme: description (II)

- DEOS has a long-standing altimeter experience and is Principal Investigator in many missions.
- The SE-Asia region has been explored already for regional tide modelling, wave climate and internal waves.
- SEAMERGES brings in expertise and data that contributes to the development of local research groups and companies that support governments and industry in coastal management and off-shore activities.
- By initiating research cooperation, organising workshops and hands-on training with altimeter database tools, and the integration of the altimetry with GPS, InSAR and *in-situ* measurements, intra regional cooperative research can be stimulated and developed to an international standard and help in the advancement of altimetry based science, operations and commerce.

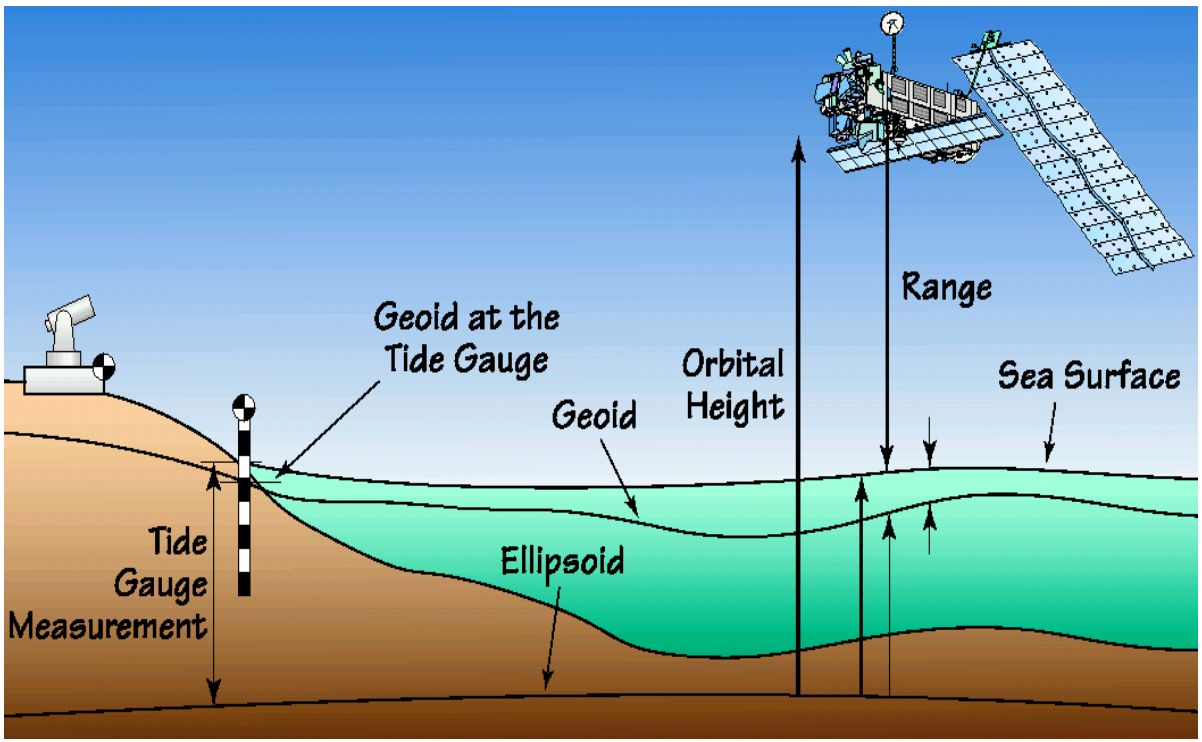
SEAMERGES altimeter programme: seminar

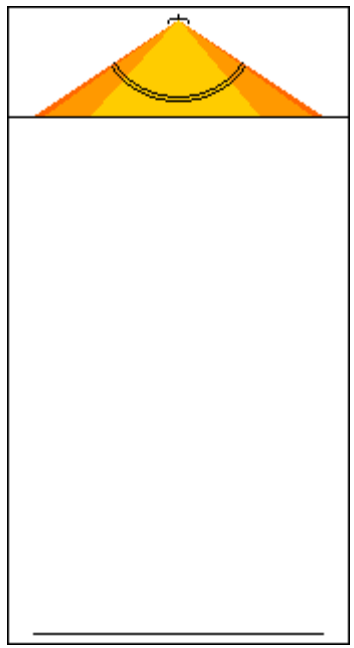
- The SALT technology and application courses will include the necessary theoretical background (introducing the space borne altimeter and its wide range of applications), the introduction to RADS (the DEOS/NOAA Radar Altimeter Database System) and altimeter processing, and the opportunity to get acquainted with the RADS database and tools by "hands-on" training.
- More details: *to be determined*.

Why Altimetry?

- All-weather round the globe monitoring system;
- Contributes to environmental studies, in particular ocean and ice;
- Allows effective monitoring and management of the Earth's resources;
- Enables better understanding of fluid and solid Earth processes.

Altimetry basics





Radar pulses Illuminating the sea surface.

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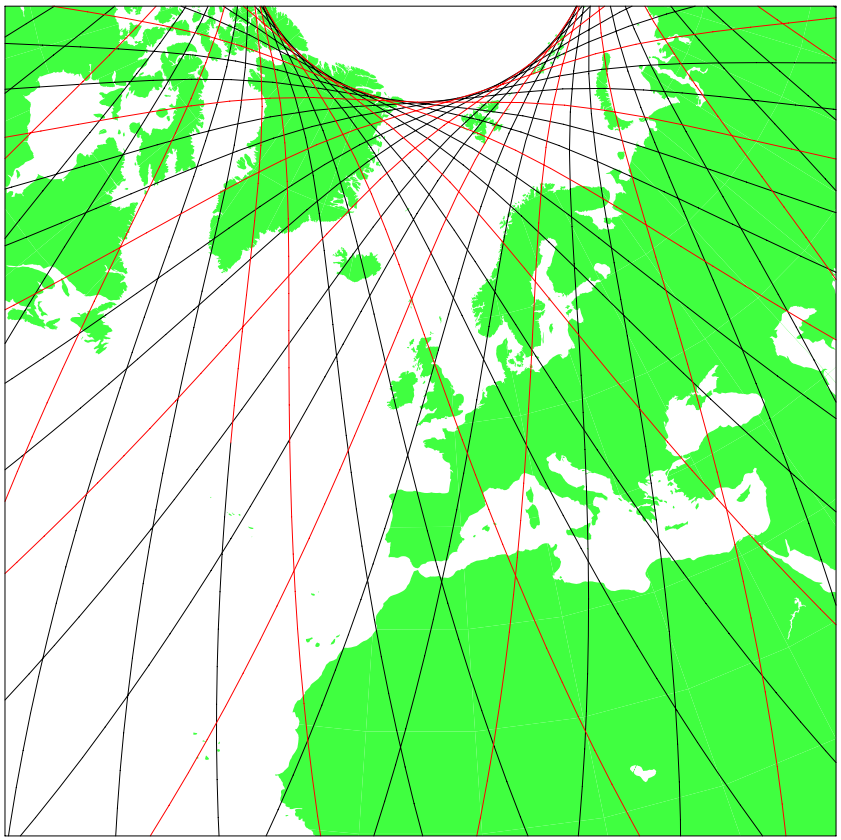
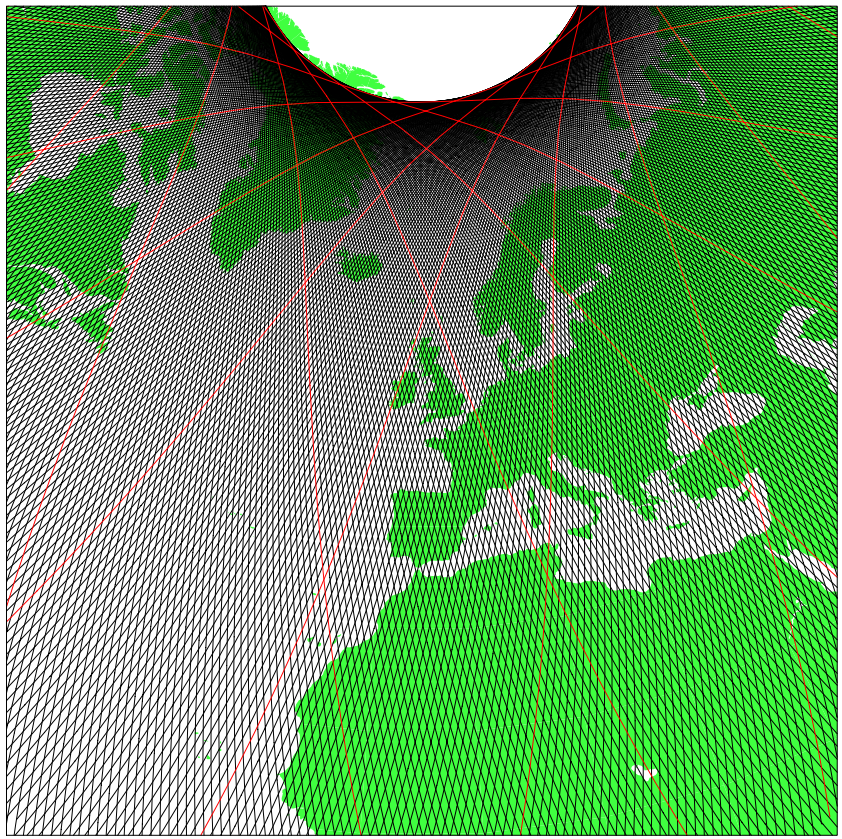
Ground track pattern



3-day repeat orbit



35-day repeat orbit

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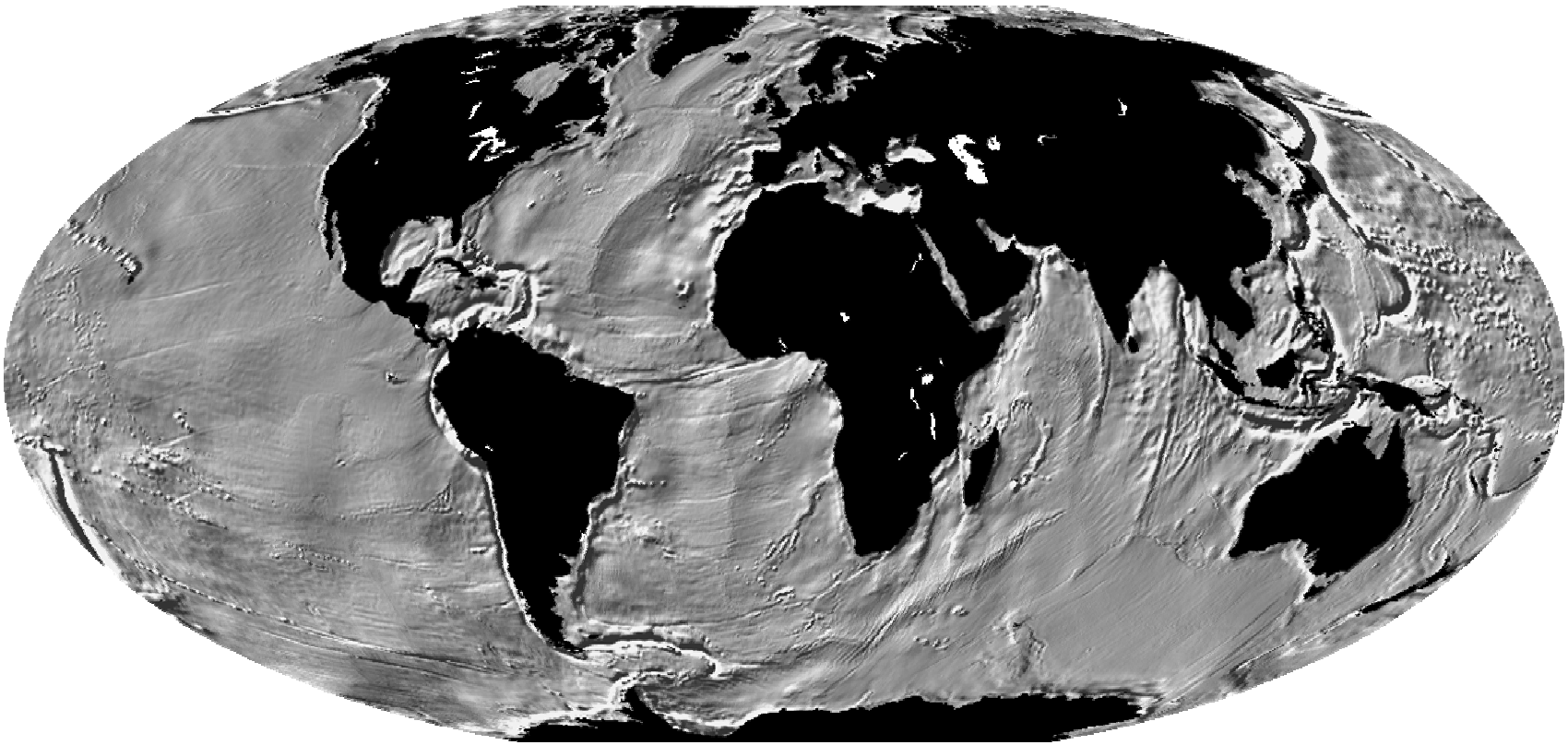
Mean sea surface



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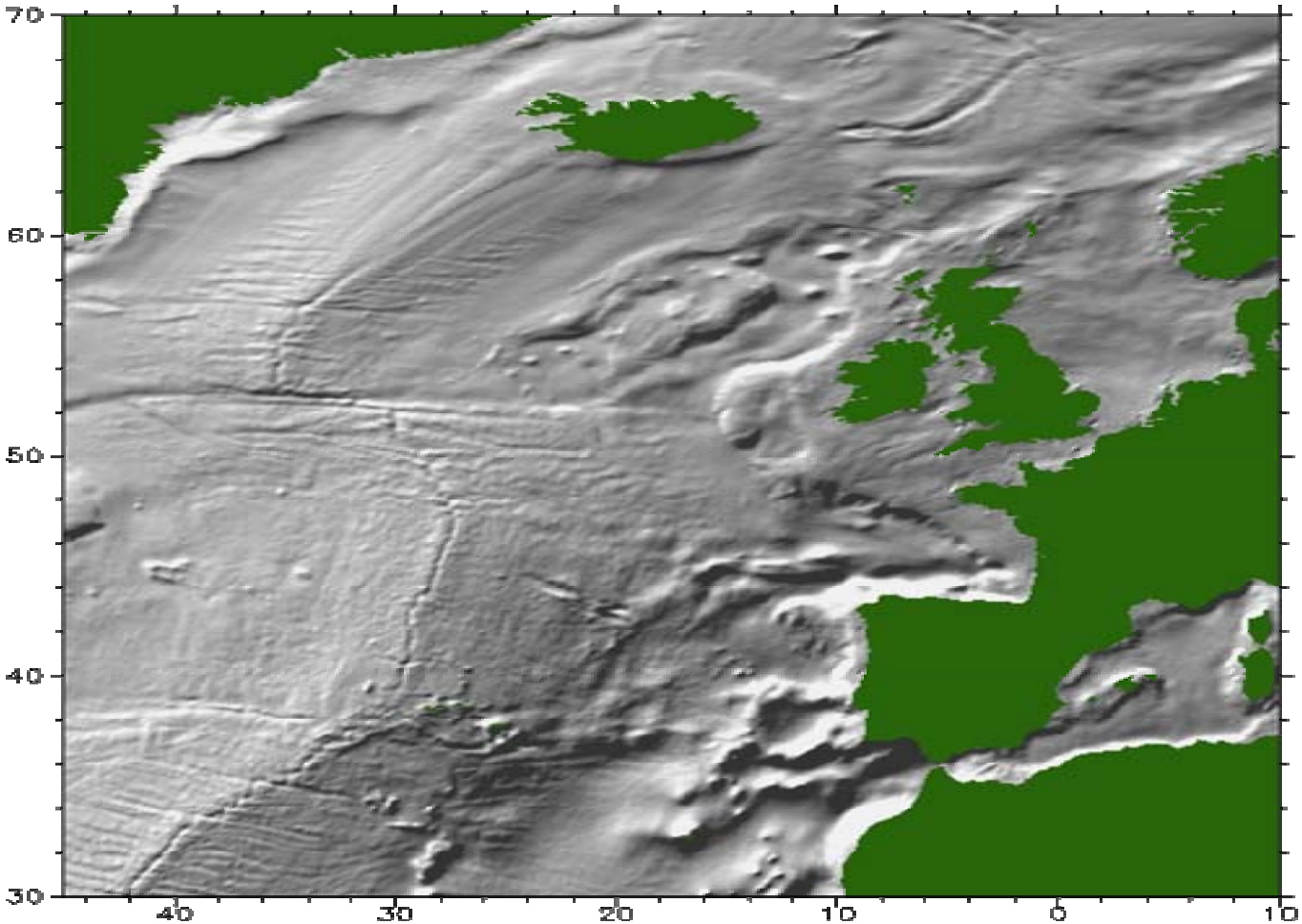
North Atlantic: Gibbs fracture zone



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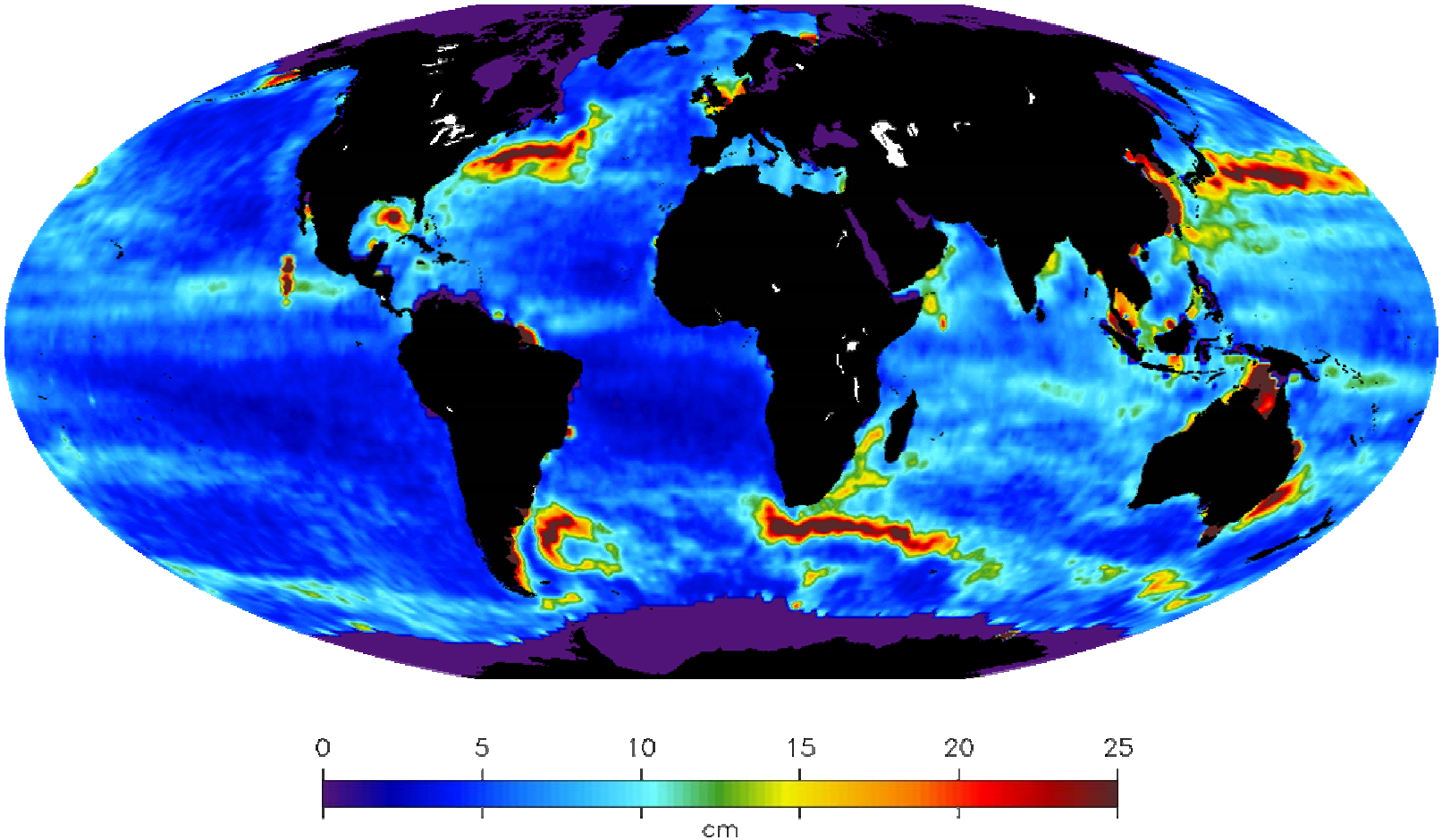
Sea surface variability



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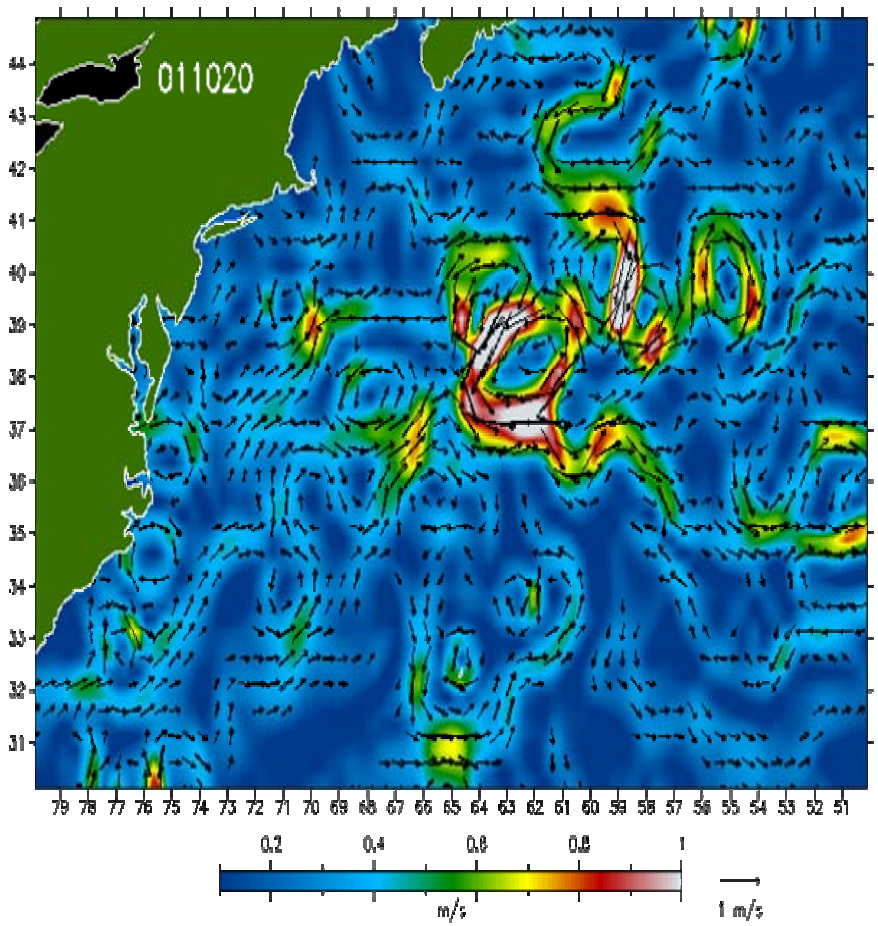
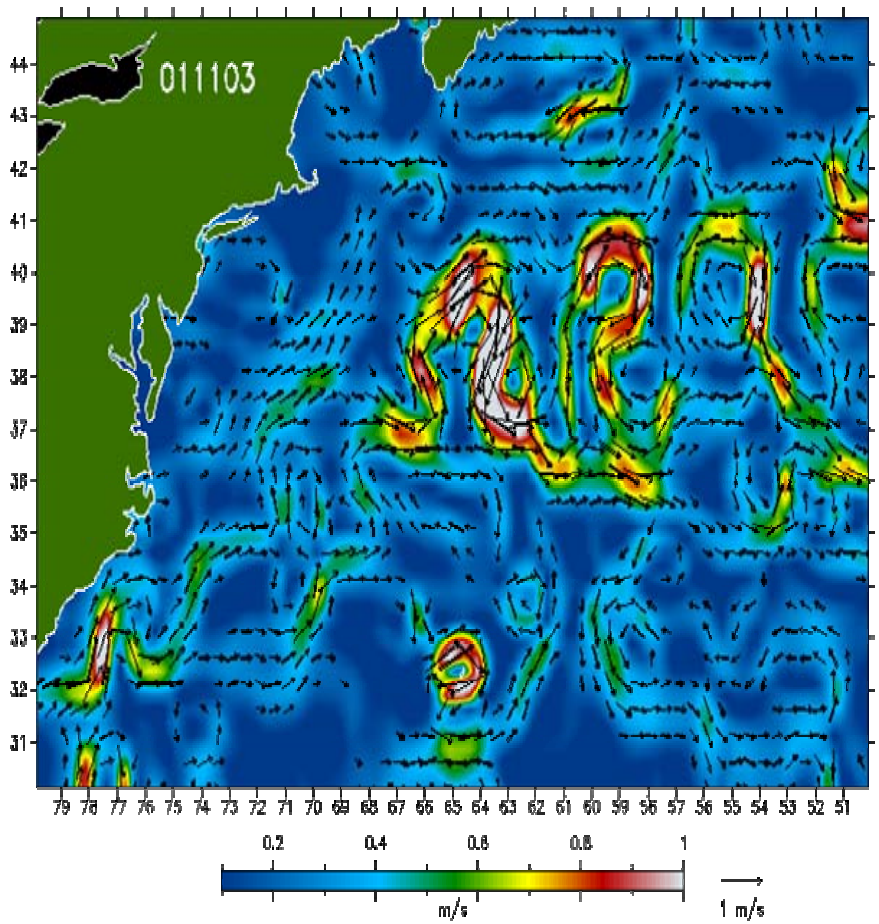
Gulf Stream velocities





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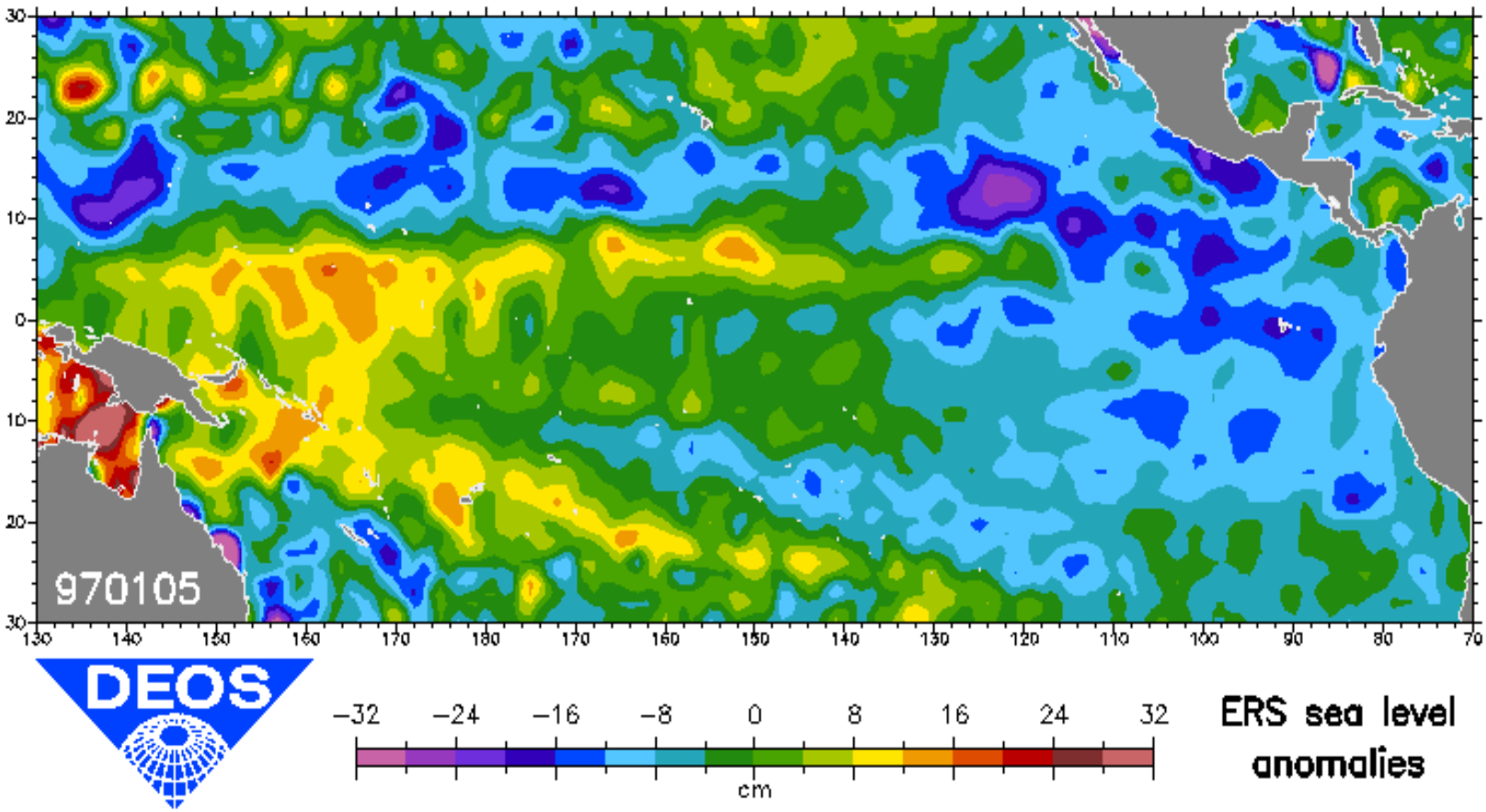
El Niño - southern oscillation



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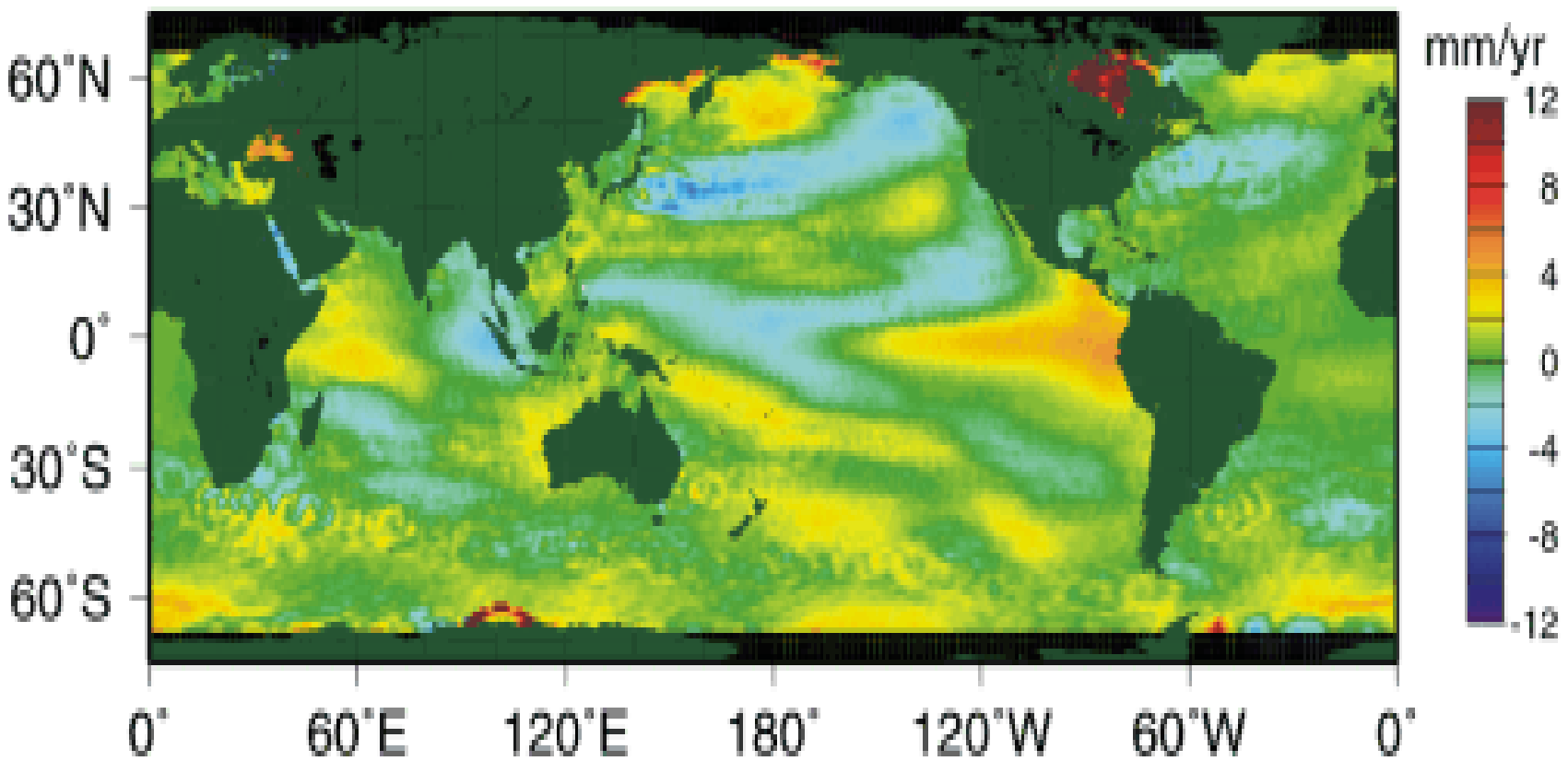
Sea level rise



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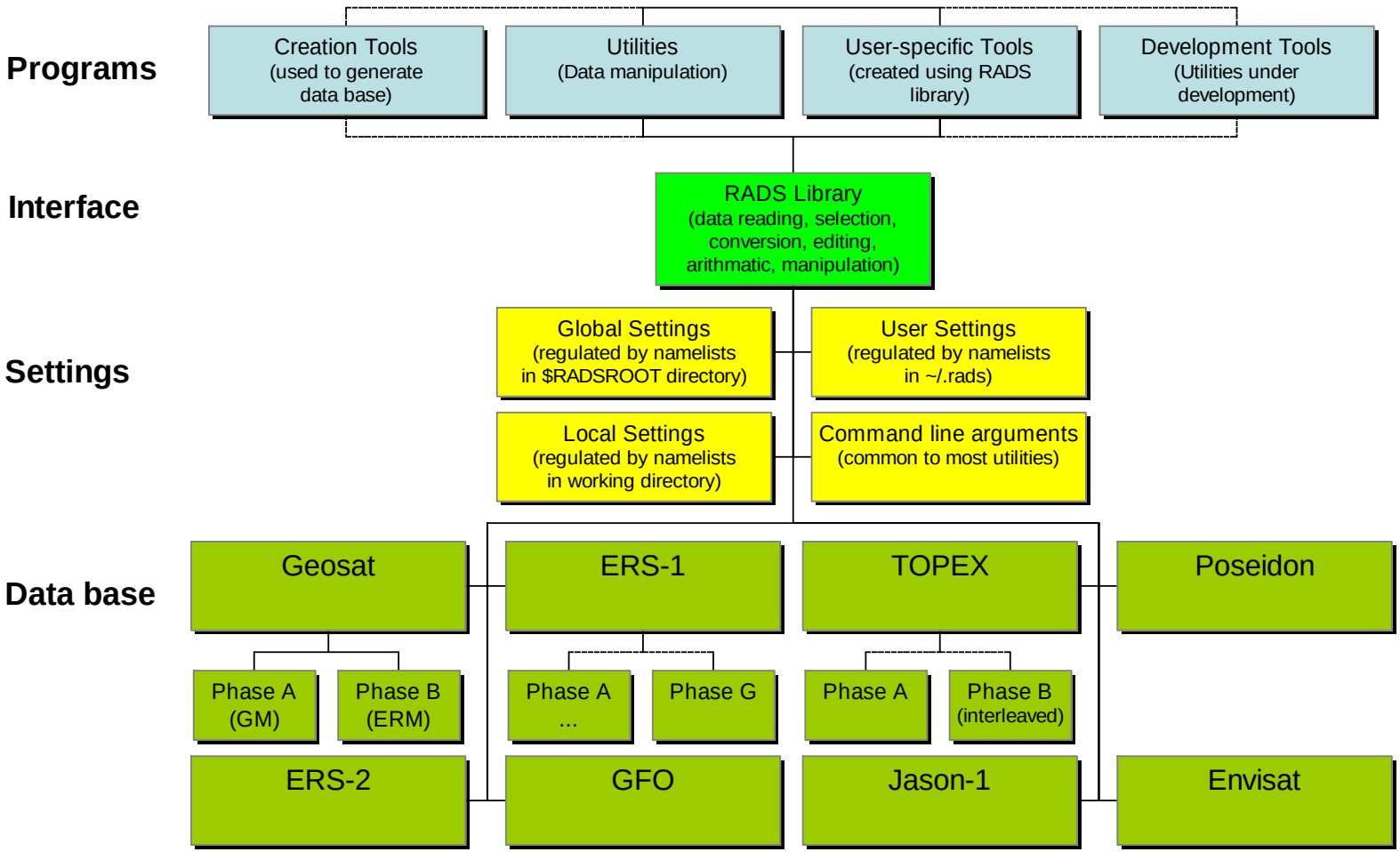
Altimetry as an international service

- DEOS' launched the Radar Altimeter Database System (RADS) in 2001 as a precursor to an International Altimeter Service. It is embedded in the Netherlands Earth Observation NETwork NEONET;
- RADS is a facility to easily manage and access calibrated and validated altimeter data that are consistent throughout the entire data base (e.g. reference frame);
- RADS contains altimeter and ancillary data from all available altimeter missions combined with the latest (correction) models: 20 years of valuable sea level, wave height and wind data;
- Whenever new data (including latest GFO, Jason-1 and Envisat), models or knowledge arrive, the data base is updated;
- Data organization: common data and meta file formats and ultra-flexible data augmentation;
- Web-interface http://www.deos.tudelft.nl/altim/rads provides access to (almost) raw, processed and value-added data, and also to other altimeter related information;
- Development of (RADS) data utilities like data extractors and converters, a collinear track analyzer and a multi-satellite crossover generator.

Radar Altimeter Database System



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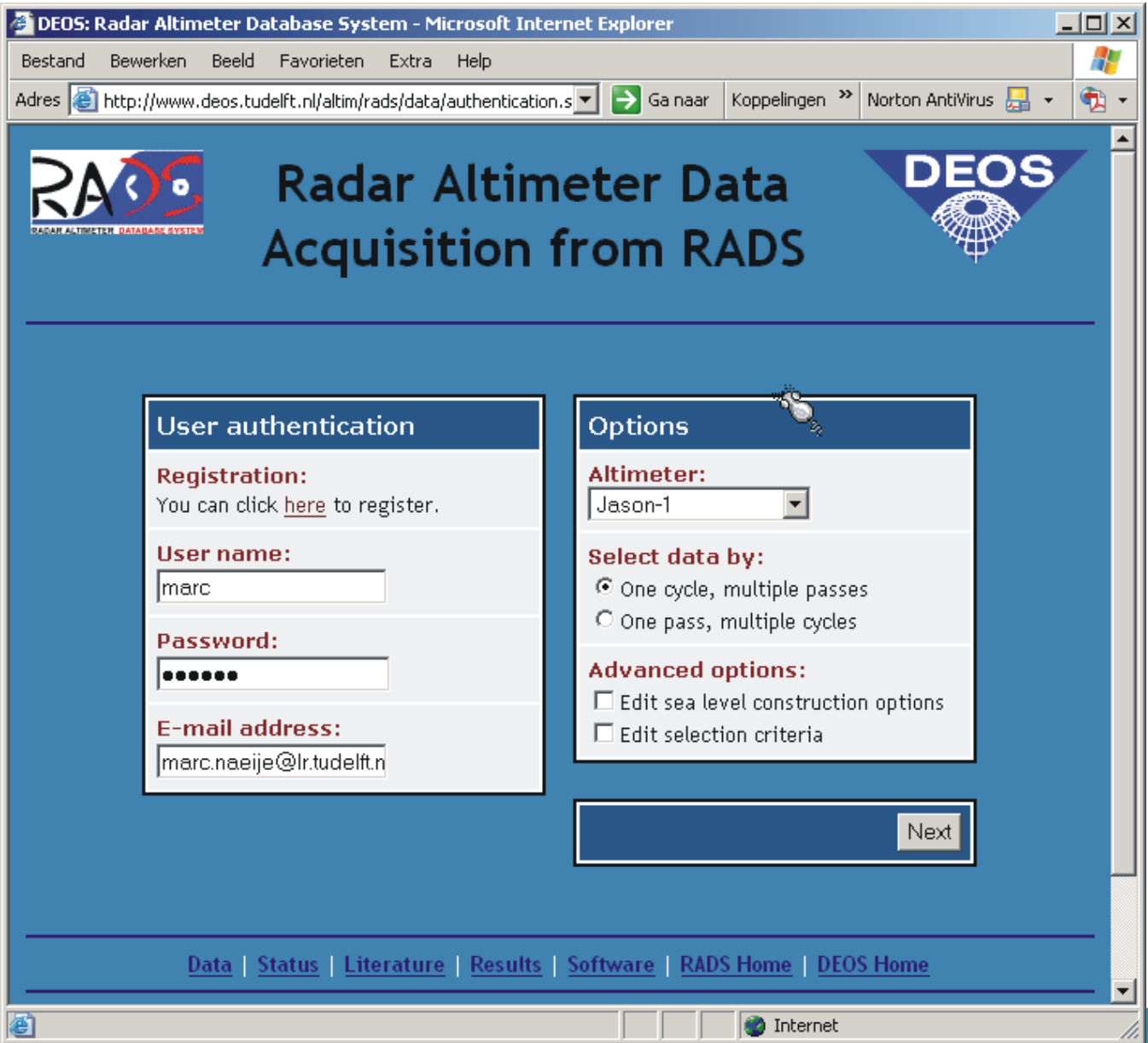
DEOS: Radar Altimeter Database System - Microsoft Internet Explorer
Bestand Bewerken Beeld Favorieten Extra Help
Adres http://www.deos.tudelft.nl/altim/rads/data/authentication.s
Ga naar
Koppelingen
Norton AntiVirus
Radar Altimeter Data Acquisition from RADS
DEOS
User authentication
Registration:
You can click here to register.
User name:
marc
Password:
E-mail address:
marc.naeije@lr.tudelft.n
Options
Altimeter:
Jason-1
Select data by:
One cycle, multiple passes
One pass, multiple cycles
Advanced options:
Edit sea level construction options
Edit selection criteria
Next
Data | Status | Literature | Results | Software | RADS Home | DEOS Home
Internet

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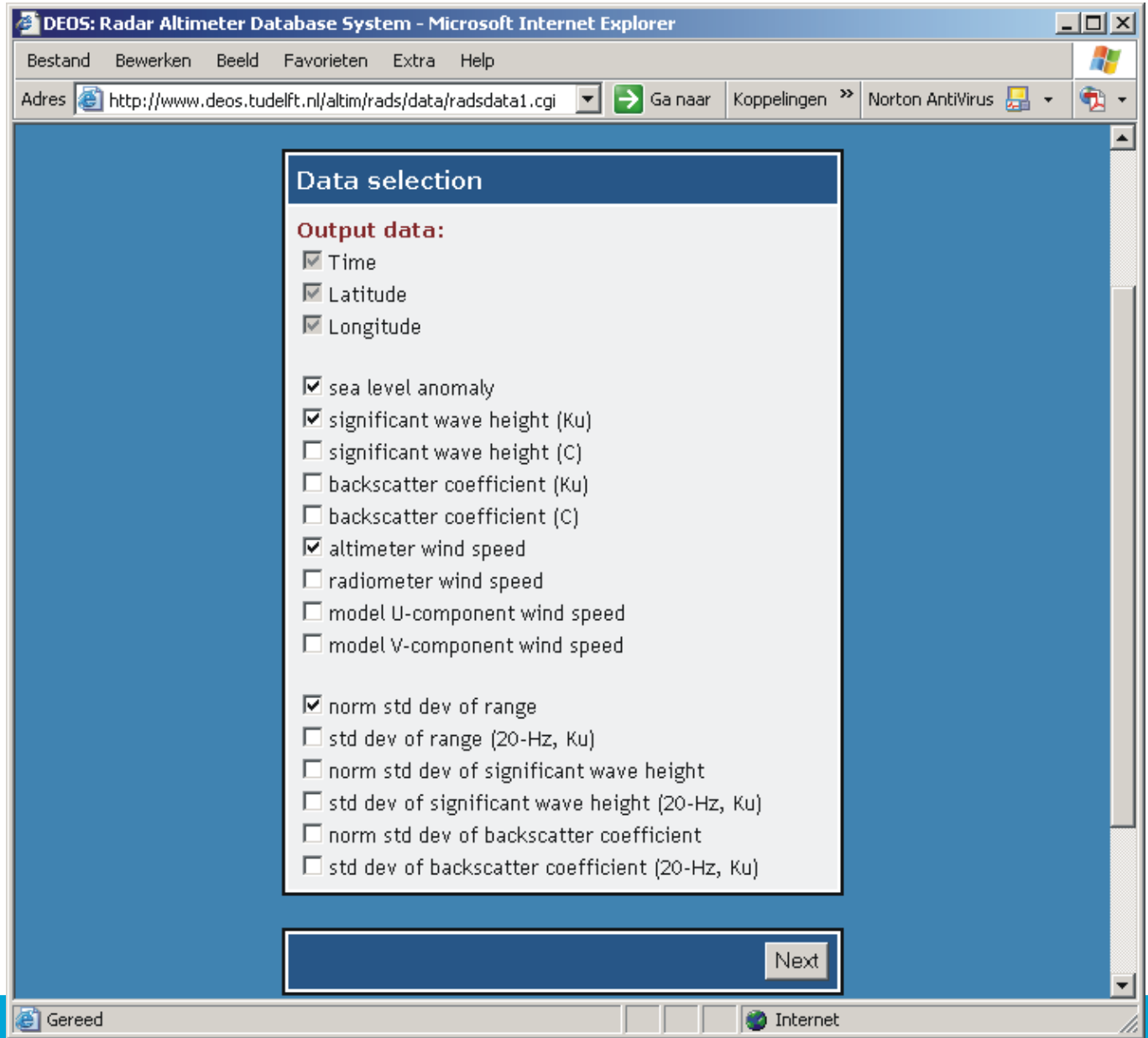
DEOS: Radar Altimeter Database System - Microsoft Internet Explorer
Bestand Bewerken Beeld Favorieten Extra Help
Adres http://www.deos.tudelft.nl/altim/rads/data/radsdata1.cgi
Ga naar
Koppelingen
Norton AntiVirus
Data selection
Output data:
Time
Latitude
Longitude
sea level anomaly
significant wave height (Ku)
significant wave height (C)
backscatter coefficient (Ku)
backscatter coefficient (C)
altimeter wind speed
radiometer wind speed
model U-component wind speed
model V-component wind speed
norm std dev of range
std dev of range (20-Hz, Ku)
norm std dev of significant wave height
std dev of significant wave height (20-Hz, Ku)
norm std dev of backscatter coefficient
std dev of backscatter coefficient (20-Hz, Ku)
Next
Gereed
Internet

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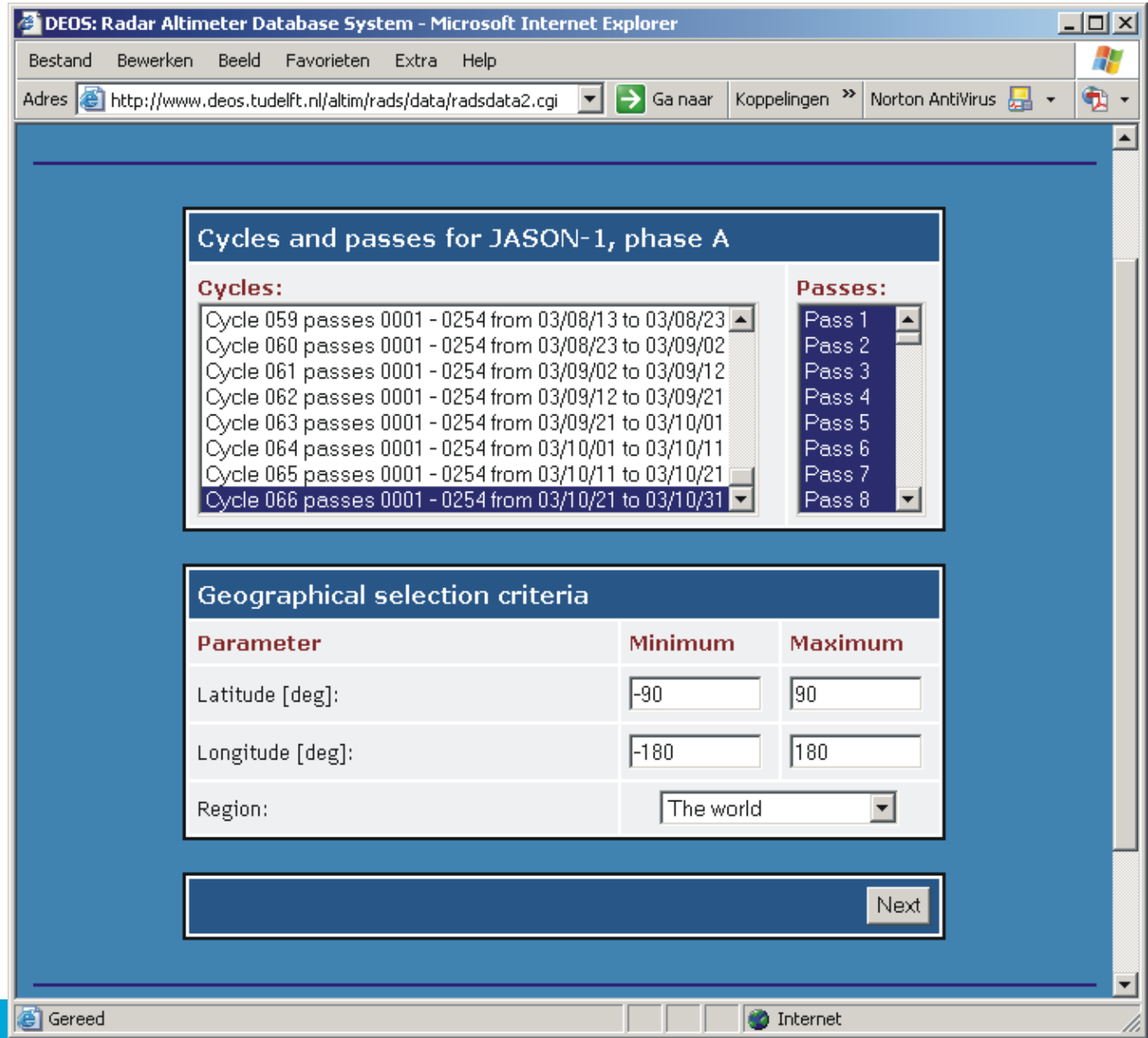
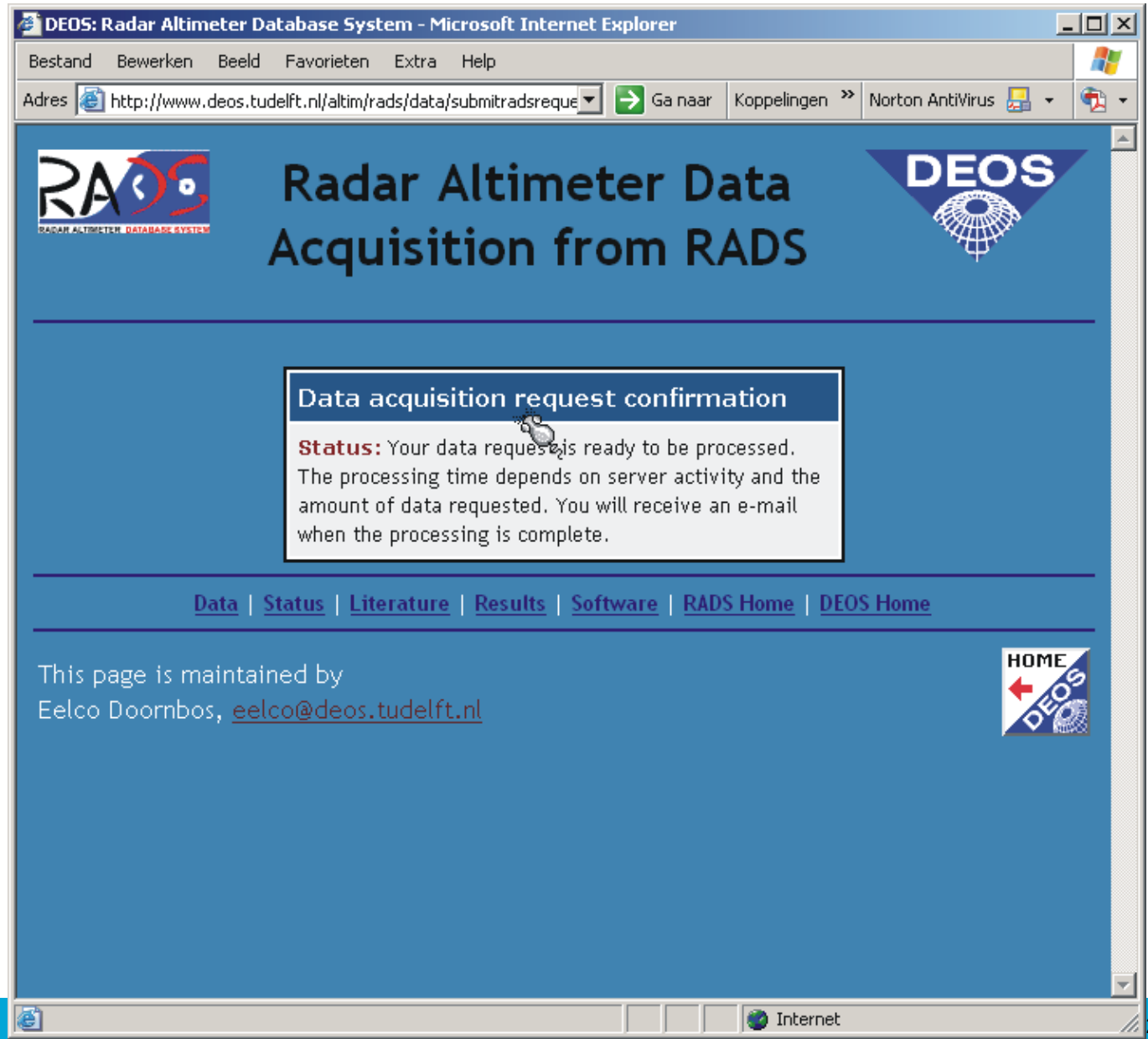

DEOS: Radar Altimeter Database System - Microsoft Internet Explorer
Bestand Bewerken Beeld Favorieten Extra Help
Adres http://www.deos.tudelft.nl/altim/rads/data/radsdata2.cgi
Ga naar
Koppelingen
Norton AntiVirus
Cycles and passes for JASON-1, phase A
Cycles:
Cycle 059 passes 0001 - 0254 from 03/08/13 to 03/08/23
Cycle 060 passes 0001 - 0254 from 03/08/23 to 03/09/02
Cycle 061 passes 0001 - 0254 from 03/09/02 to 03/09/12
Cycle 062 passes 0001 - 0254 from 03/09/12 to 03/09/21
Cycle 063 passes 0001 - 0254 from 03/09/21 to 03/10/01
Cycle 064 passes 0001 - 0254 from 03/10/01 to 03/10/11
Cycle 065 passes 0001 - 0254 from 03/10/11 to 03/10/21
Cycle 066 passes 0001 - 0254 from 03/10/21 to 03/10/31
Passes:
Pass 1
Pass 2
Pass 3
Pass 4
Pass 5
Pass 6
Pass 7
Pass 8
Geographical selection criteria
Parameter
Minimum
Maximum
Latitude [deg]:
-90
90
Longitude [deg]:
-180
180
Region:
The world
Next
Gereed
Internet


DEOS: Radar Altimeter Database System - Microsoft Internet Explorer
Bestand Bewerken Beeld Favorieten Extra Help
Adres http://www.deos.tudelft.nl/altim/rads/data/submitradsreque
Ga naar
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Norton AntiVirus
Radar Altimeter Data Acquisition from RADS
DEOS
Data acquisition request confirmation
Status: Your data request is ready to be processed. The processing time depends on server activity and the amount of data requested. You will receive an e-mail when the processing is complete.
Data | Status | Literature | Results | Software | RADS Home | DEOS Home
This page is maintained by
Eelco Doornbos, eelco@deos.tudelft.nl
HOME
Internet

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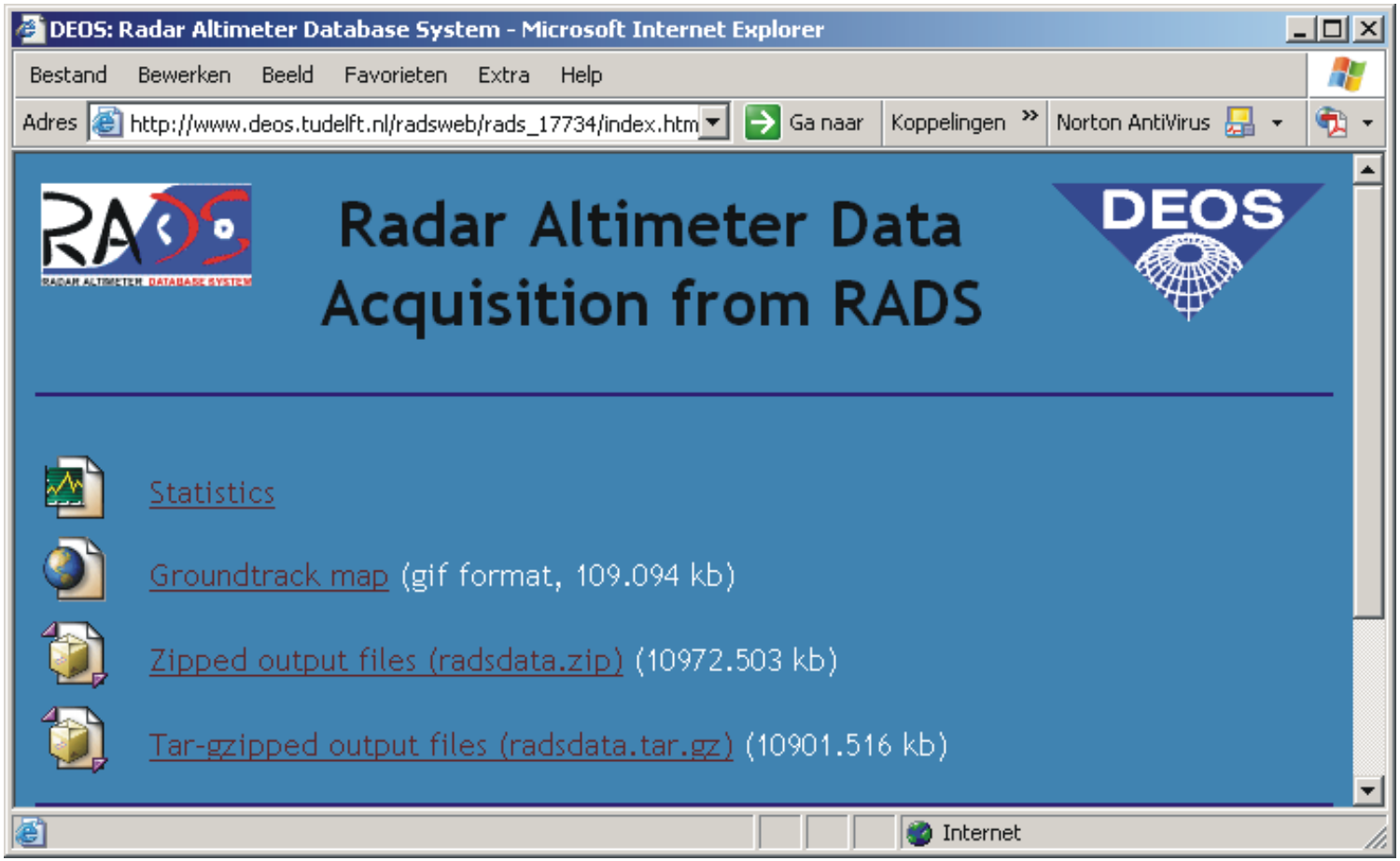
DEOS: Radar Altimeter Database System - Microsoft Internet Explorer
Bestand Bewerken Beeld Favorieten Extra Help
Adres http://www.deos.tudelft.nl/radsweb/rads_17734/index.htm
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Norton AntiVirus
Radar Altimeter Data Acquisition from RADS
DEOS
Statistics
Groundtrack map (gif format, 109.094 kb)
Zipped output files (radsdata.zip) (10972.503 kb)
Tar-gzipped output files (radsdata.tar.gz) (10901.516 kb)
Internet

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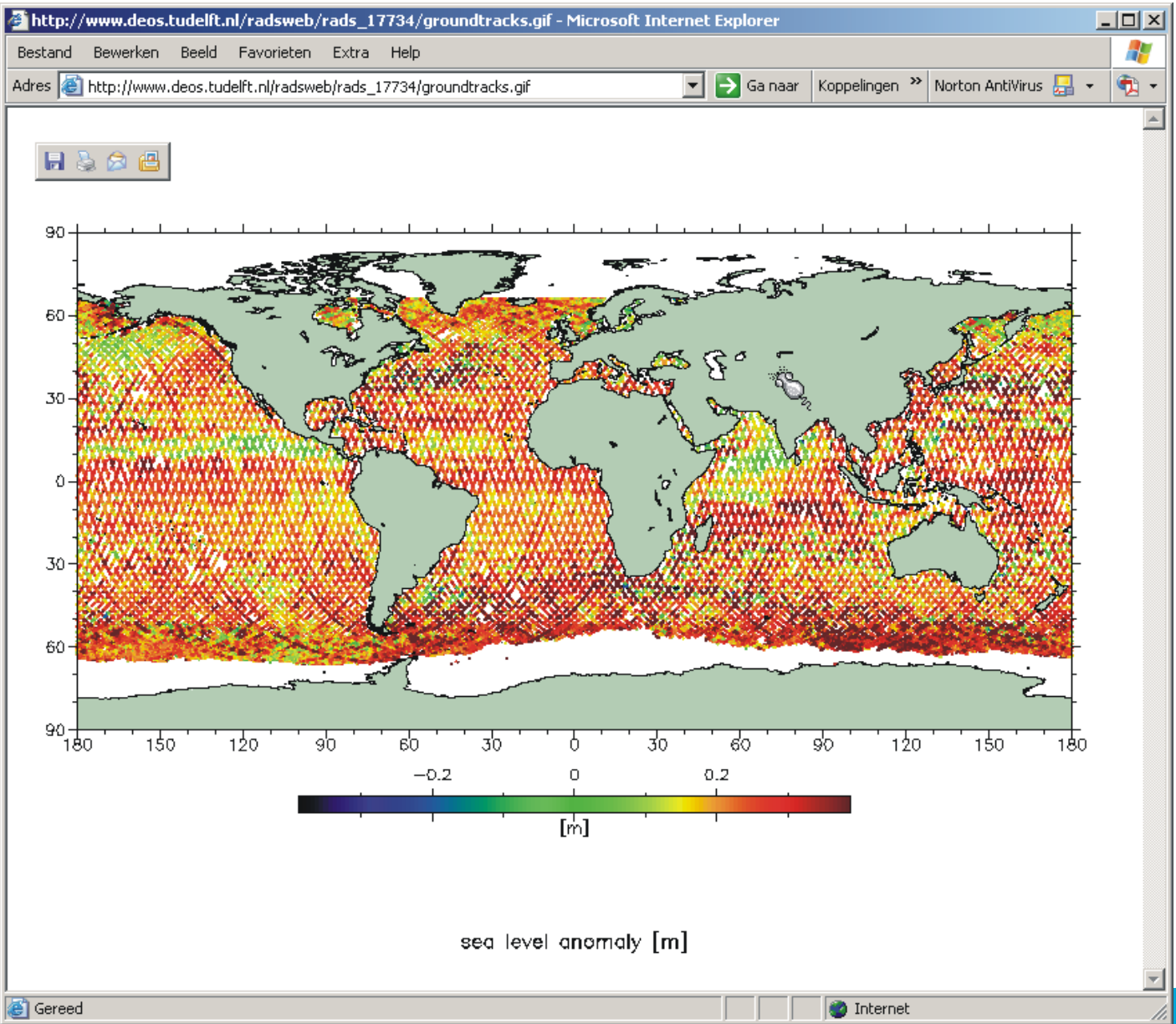
http://www.deos.tudelft.nl/radsweb/rads_17734/groundtracks.gif - Microsoft Internet Explorer
Bestand Bewerken Beeld Favorieten Extra Help
Adres http://www.deos.tudelft.nl/radsweb/rads_17734/groundtracks.gif
Ga naar Koppelingen Norton AntiVirus
90
60
30
0
30
60
90
180 150 120 90 60 30 0 30 60 90 120 150 180
−0.2 0 0.2
[m]
sea level anomaly [m]
Gereed
Internet

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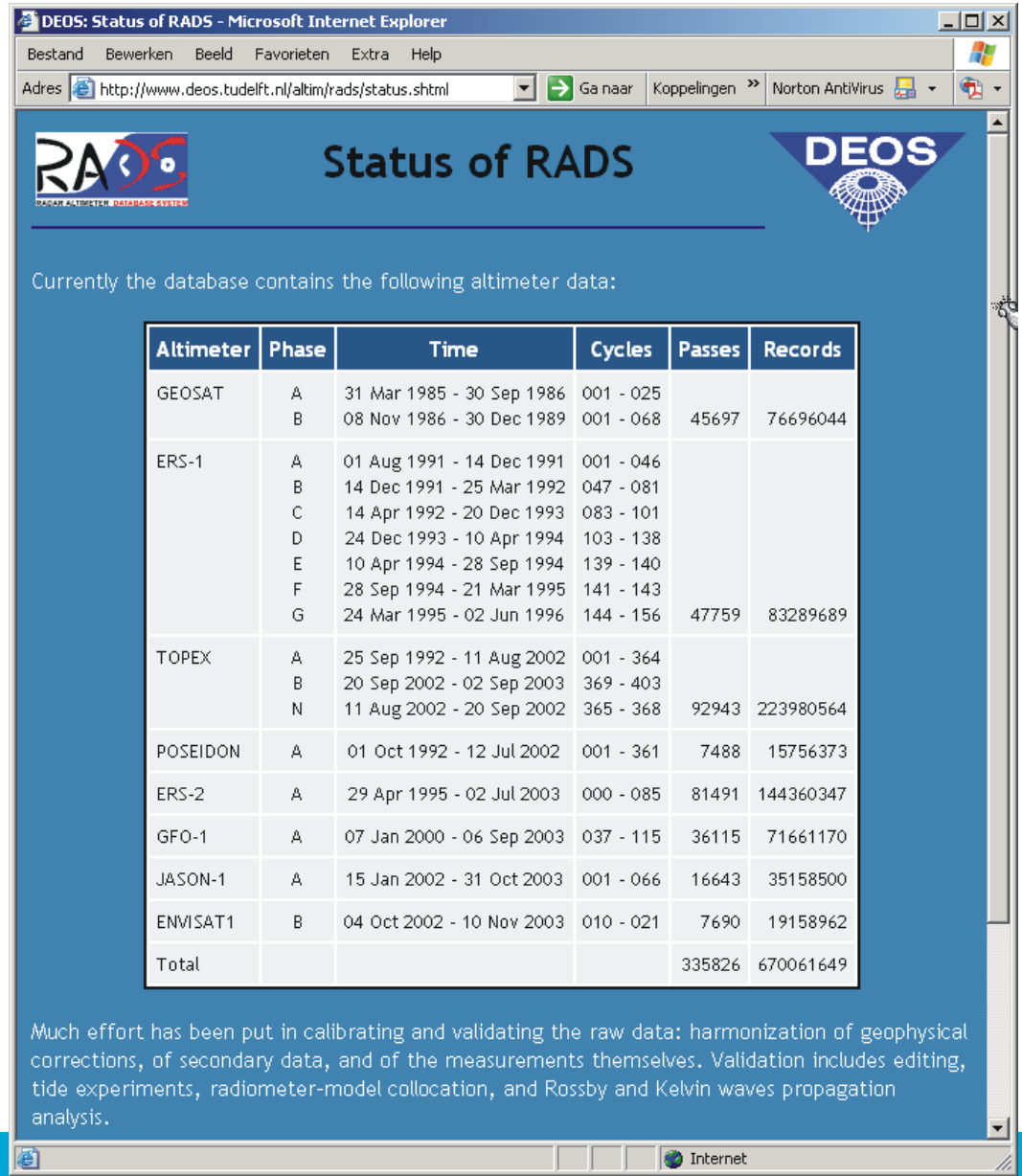

Altimeter	Phase	Time	Cycles	Passes	Records
GEOSAT	A	31 Mar 1985 - 30 Sep 1986	001 - 025		
	B	08 Nov 1986 - 30 Dec 1989	001 - 068	45697	76696044
ERS-1	A	01 Aug 1991 - 14 Dec 1991	001 - 046		
	B	14 Dec 1991 - 25 Mar 1992	047 - 081		
	C	14 Apr 1992 - 20 Dec 1993	083 - 101		
	D	24 Dec 1993 - 10 Apr 1994	103 - 138		
	E	10 Apr 1994 - 28 Sep 1994	139 - 140		
	F	28 Sep 1994 - 21 Mar 1995	141 - 143		
	G	24 Mar 1995 - 02 Jun 1996	144 - 156	47759	83289689
TOPEX	A	25 Sep 1992 - 11 Aug 2002	001 - 364		
	B	20 Sep 2002 - 02 Sep 2003	369 - 403		
	N	11 Aug 2002 - 20 Sep 2002	365 - 368	92943	223980564
POSEIDON	A	01 Oct 1992 - 12 Jul 2002	001 - 361	7488	15756373
ERS-2	A	29 Apr 1995 - 02 Jul 2003	000 - 085	81491	144360347
GFO-1	A	07 Jan 2000 - 06 Sep 2003	037 - 115	36115	71661170
JASON-1	A	15 Jan 2002 - 31 Oct 2003	001 - 066	16643	35158500
ENVISAT1	B	04 Oct 2002 - 10 Nov 2003	010 - 021	7690	19158962
Total				335826	670061649

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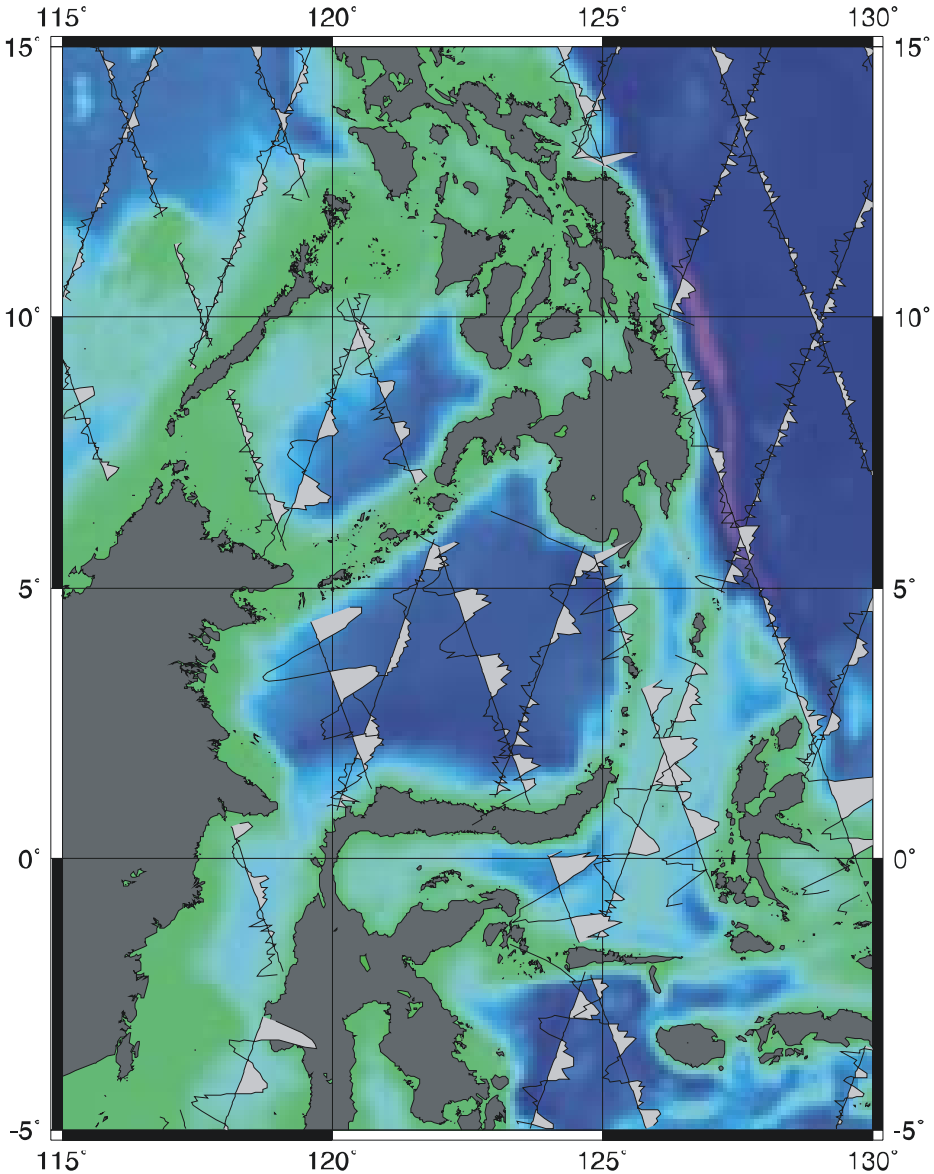

In the SAT2SEA project, Delft Hydraulics (WL|Delft) and DEOS investigated the application of altimetry in local sea level and storm surge predictions, by assimilating the data in a time stepping high resolution hydro-dynamic model. The area of interest is the Indonesian region which exhibits some complex bathymetry, consisting of several deep sub basins such as the Sulu, Celebes, Andaman and Banda seas, connected by barrier reefs and narrow channels.
Ocean tide modelling has also played an important role in this project. The image gives evidence for the presence of internal tides in the Sulu Celebes area shown as a surface rippling effect in the M2 field recovered using a response method along the TOPEX/ POSEIDON ground tracks on a 1-second interval. The surface ripples, obtained by high-pass filtering the results, perfectly reveal the internal baro-clinic tidal effects. This is related to the dissipation of tidal energy, partly occurring in shallow waters due to bottom friction, but also in parts in the deep ocean.

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