# Internet Browser for Ice, Weather and Ocean Information

Leif Toudal  and Roberto Saldo

Ørsted-DTU, Technical University of Denmark Building 348, DK-2800 Lyngby, Denmark – (ltp,rs)@oersted.dtu.dk

**Abstract** − **An Internet based distribution system for ice, weather and ocean information has been set up. The system provides near real time access to a large variety of data about the polar environment in a standard user environment.**
**The system is freely available at: http://www.seaice.dk**

**Keywords:** Satellite data, Microwave Radiometry, SAR, Information system, JAVA

## 1. INTRODUCTION

The amount of information available on the sea-ice, ocean and weather conditions for a particular region such as the Greenland Sea today is very large. However, the information is found in many different places, typically in  incompatible formats that makes the task of optimally combining data into the desired set of information for a particular application very difficult. The applications vary from near real time usage for navigation, to off-line browsing of ice information for climate studies.
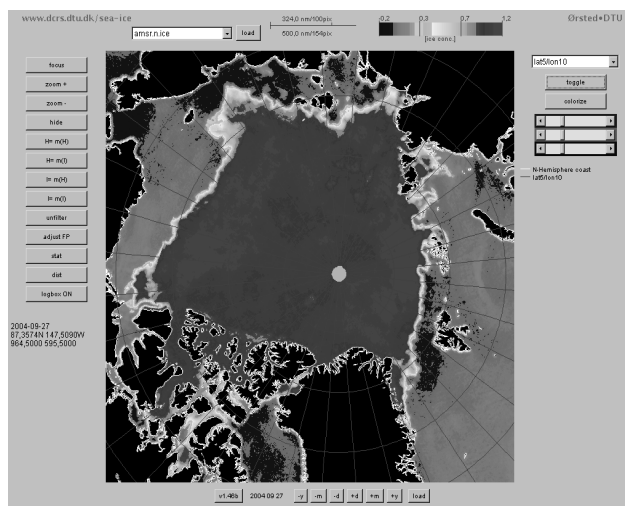


Figure 1.  Example of AMSR-E ice concentration product in the DTU JAVA ice system.

The task of this work thus was to process the information into common formats and build a browser that would allow user-defined views of the data. The Internet was the obvious data distribution medium and Java the programming language of choice because it allowed the generation of a tool that could be centrally maintained, and globally applied. Users will always get the latest version of the code. The JAVA run-time environment (Virtual Machine (VM)) is freely available for most platforms from Sun Microsystems (http://java.sun.com).

Specific target groups for the browser are companies involved in planning and/or carrying out navigation in ice frequented waters, ice services in the Northern and Southern hemisphere, scientific partners in various EC projects etc.

## 2. SPECIFICATION/REQUIREMENTS

The original purpose of the Java browser was to allow remote surveillance during off-hours and week-ends of the archive and product generation processes running at our central UNIX/Linux computer systems. The image visualization software we had at the UNIX computers was built on top of software libraries that allow easy handling of images in different geometries and with different scales (Bagger et. al, 1996). A simple conversion to GIF and/or JPEG format would allow us to check the images using a Web-browser such as Netscape, but lacked the geometrical referencing of the UNIX software. The development of the Java browser showed great potential, and we decided to build an application that benefited from the geometrical knowledge of the UNIX software, the data compression capabilities of the GIF and JPEG image formats, and the transmission capabilities of the World Wide Web. The requirements to the system included the following:

### ARCHIVE and PROCESSING

- Downloading and archiving of relevant data from the Internet

    o   ENVISAT ASAR GMM data from ESA
    o   AMSR-E data from NASA via the National Snow and Ice Data Center (US)
    o   SSM/I data from Marshall Space Flight Center (US)
    o   ERS-1/2 SAR data from ESA/ESRIN (not near real time)
    o   Ice charts from the National Ice Center (US)
    o   Wind and Wave forecasts from NCEP (US)
    o   QuickSCAT scatterometer data from NOAA via the Danish Meteorological Institute
    o   AUSU-A and AMSU-B data from the Cooperative Institute for Research in the Atmosphere (CIRA), Colorado State University (US)
    o   SST analysis data from NOAA (US)
    o   SST and ice data from the EUMETSAT Ocean and Sea-Ice Satellite Application Facility (OSI-SAF)
    o   MODIS data from NASA (US)
    o   ATSR and AATSR data from ESA
    o   Ice drift data from DTU, met.no, IFREMER and NCEP

- Processing of downloaded data into ice/weather/ocean relevant information

- o ENVISAT ASAR Global Monitoring mode data are converted to a polar stereographic grid. 1-day and 3-day mosaics are created, and 3-day ice drift fields are generated.
- o AMSR-E Processing for determination of ice, ocean and atmospheric fields (simple algorithms as well as the DTU optimal parameter estimation algorithm). Parameters are total ice concentration, multi-year ice fraction, atmospheric columnar water vapor, atmospheric columnar liquid water, SST, ice surface temperature, wind speed over the ocean.
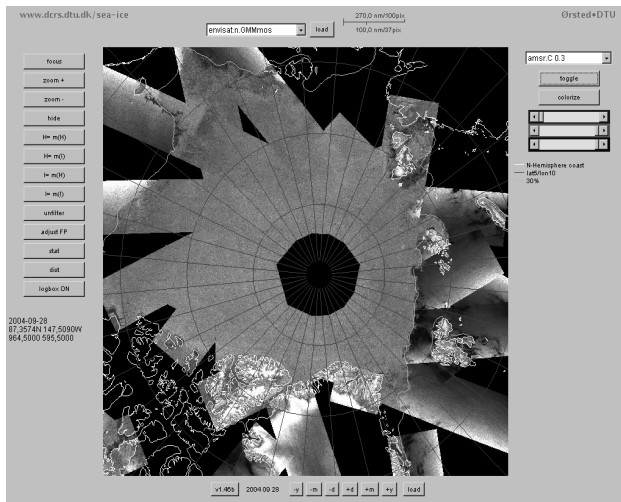- o Quickscat data are gridded into a polar stereographic projection.



Figure 2. Example of ENVISAT ASAR Global Monitoring Mode mosaic in the DTU JAVA system.

- o SSM/I data processing, generation of contours and ice maps
- o NIC icechart data are converted to DTU internal vector/polygon format
- o ERS SAR data mosaics of frames from same orbit etc.
- o MODIS data are converted to a polar stereographic projection
- o NOAA SST data are regridded into a polar stereographic projection
- o NCEP wind and wave forecasts are converted to the DTU internal vector format.

### BROWSER
- Access to data archive via the internet
- display of color and B&W satellite imagery
- display of color coded derived digital ice maps
- user controlled color & grayscale manipulation
- user controlled zooming in & out
- lat,lon co-ordinates of any point at the click of the mouse
- user controlled addition of (vector) overlays showing
  - o coastlines

- o lat/lon grids
- o bathymetry
- o contours of ice concentration
- o contours of ice concentration from past
- o contours of Ku-band (QuickSCAT) backscatter
- o other auxiliary data (cruise tracks, float tracks, SAR frames,.......)
- User controlled vector overlay coloring
- user controlled adjustment for simple registration errors
- combine data from different sensors
- combine data from different dates/times
- reasonable data transmission times e.g. data compression of large files
- Platform independence or something that would work with most potential customers!
- Parameter values (such as temperature or ice concentration) at the click of the mouse
- Easy shift (shortcut) to another date
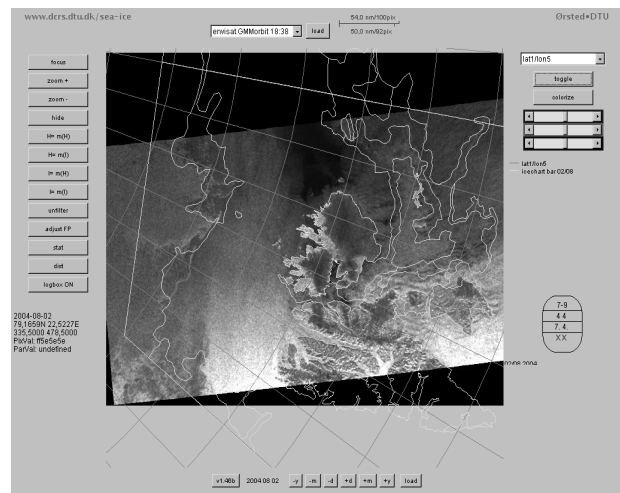


Figure 3. Example of clickable NIC ice chart overlaid an ENVISAT ASAR Global Monitoring mode image of the Svalbard area.

### 3. IMPLEMENTATION

**3.1 Downloading and data archiving facility**
Data from various sources are acquired via FTP or HTTP and stored in a 'date tree' directory structure. All in house processing is done using various scripts and utility programs.
Automatic download of AMSR-E, AMSU, ENVISAT ASAR GM and SSM/I data are carried out as data becomes available using automated FTP.
Offline, other types of data are added from CD-ROM (ERS SAR, ENVISAT ASAR WS, PRI, APP)

*3.2 Pre-processing*
To produce images, the AMSR-E, AMSU, SSM/I, ASAR-GM, QuickSCAT and MODIS data are gridded into a polar stereographic projection. Various ice concentration products and ice indexes as well as some of the original SSM/I channels

are created as images using default grayscale and pseudo color tables. All images in GIF or JPEG format for compression.

The SSM/I data are used to produce ice contour vectors at various concentrations ( at 5, 15, 30, 60 and 90%).

ERS1/2 SAR and ENVISAT ASAR data are re-sampled to the polar stereographic projection and a vector-overlay showing the border of the SAR scene(s) is produced for referencing. Grayscale JPEG images are created. Various mosaics are created from the SAR images, and ice drift data are derived from the swath data (Walker et al, 2005).

### 3.2 Interactivity – the JAVA browser

*User controlled selection and loading of images*
The browser defaults to the current day when loaded. It features a date control panel that allows the user to shift the date by one day, one month or one year. The available images from the day chosen are shown in a list, and the user can chose any image from the list for loading.

*User controlled color and grayscale manipulation*
To allow the user the possibility to enhance details in the image, four mapping filters are available. The user can adjust one parameter (either intensity or hue) as a function of another. Two of the filters maps from grey levels (black to white) (by adjusting intensity) and the other two maps from blue through green and yellow to red (by adjusting hue).
 This allows the user to e.g. colorize a range of values from a grayscale image with the colors from blue to red, thereby enhancing small changes.
The range for the manipulation is selected by the user by pointing at two pixel values specifying the boundaries of the interval to be mapped.

*Zooming and focusing*
The user can enlarge or shrink the image by zooming in or out. To examine part of a large image, it's possible to focus on any part of an image effectively centering that part of the image for later zooming.

*Lat/Lon co-ordinates*
For navigational purposes it is important to be able to get lat/lon co-ordinates of any desired point in the image. This was originally implemented by downloading a grid file containing lat/lon co-ordinates of a set of grid points. This grid was then used to linearly interpolate to the lat/lon co-ordinate of the desired point. However, it turned out that downloading the grid was rather time consuming and not as flexible as we wanted, so we ended up implementing a set of map projection conversion routines that allows conversion from image co-ordinates to lat/lon. The run-time performance of the Java code is easily capable of these calculations.
At any time the user can click on a point in an image to get the corresponding latitude/longitude co-ordinates. This is accomplished by the projection information contained in the ASCII metadata file that is downloaded with the image.

*Vector overlays*
The vector overlays are arranged in a list from which the user can select the 'actual overlay'. This overlay can then be toggled on and off and the RGB components of the overlay can be defined.

Current overlays available are:

- coastline,
- bathymetry (depth) curves at 200m, 500m, 1000m,1500m, 2000m, and 3000m etc.
- latitude/longitude grids at 1/1 1/5 5/10 degrees lat/lon spacing
- ice concentration curves derived from AMSR-E and SSM/I data at 5, 15, 30, 60 and 90% from this date, three days ago and 7 days ago.
- Ice drift data from DTU, met.no, IFREMER and NCEP
- NIC clickable ice charts with display of ice egg code.
- QuickSCAT Ku-band backscatter contours
- ENVISAT and ERS SAR scene boundaries

Originally the overlays were downloaded in image co-ordinates (for performance reasons), but the performance of the Java code, and the implementation of map-projection code allows us to download vector overlays in lat/lon co-ordinates directly. The vector data files are all in ASCII format for easy generation and editing. A special run-length encoding has been developed as an alternative for larger vector files.
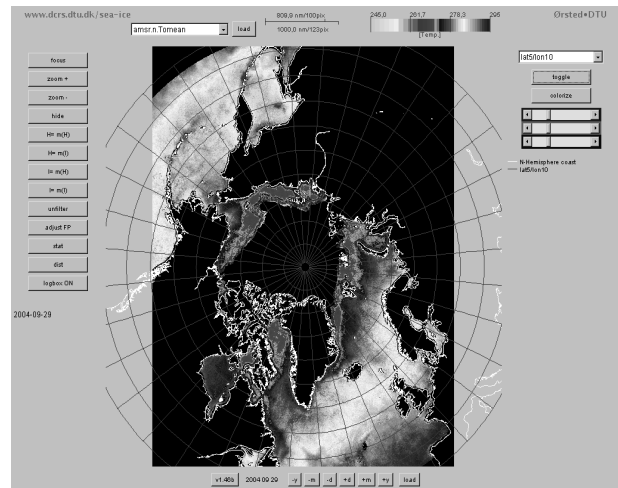


Figure 4. Example of a 7-day mean SST product derived from AMSR-E data.

## 4. PORTABILITY ISSUES

Java is a platform independent programming language, and very native to the Internet. This makes it a good choice for visualization of image data across the World Wide Web. The browser has been tested with Netscape/Mozilla on a variety of platforms as well as with Internet Explorer under Windows.
Minor differences in the look of various buttons, scrollbars etc. are observed but the application generally works in all these environments.
For some additional functionality of the applet, Sun Microsystems JAVA appletviewer (comes with the Java software development kit) can be used, since it allows seamless resizing of the browser window.

## 5. DATA TRANSMISSION ISSUES

By using GIF/JPEG/PNG images for representing visual data (images), a high compression ratio is obtained; also the images can be displayed on an ordinary web-page, for fast referencing. By use of a World Wide Web browser that caches frequently used files, data-transmission rates are kept low.

Response time is good on a system that runs locally (Java) as opposed to cgi scripts that is run on remote servers. With cgi-scripts, performance degrades with server-load whereas on a Java system there is almost no waiting time after the data is transferred.

## 6. CONCLUSIONS

*Advantages:*

The system provides a wealth of ice/weather and ocean information.

The archive (with the browser) can be copied to CD-ROM and work directly from there. This is a very useful feature for demonstrations.

Data transmission benefits from the caching of the www-browser. The structure of the data on our server means that the Java code only has to be downloaded once, and then will be readily available as long as it remains in the disk-cache of the client browser. The entire Java code that needs to be downloaded to run the browser is approx. 60 Kbytes (not including images etc.).

The entire system is free to use and can be found at http://www.seaice.dk

*Off-line use:*

In order to make full use of the capabilities of the system, the user has to stay on-line for quite a long time, which may be expensive at satellite telecommunication rates from ship to shore.

For navigational use, under the constraints of expensive low bandwidth satellite communication, we offer the possibility of running the browser locally (on-board); keeping a local database that is updated at the beginning of a session by downloading one or more compressed files with the data for a specified region and period. Compressed datafiles for most regions of the Arctic and the Southern Oceans are being produced automatically for download and off-line use.

## 7. ACKNOWLEDGEMENT

Figure 5. Example of a high resolution ice product for the Baltic Area.

## 8. REFERENCES

Walker, Nicholas P., Leif Toudal Pedersen, Roberto Saldo, David Simonin, Kim C. Partington, 2005, *Envisat ASAR Global Monitoring Mode Data for Polar Research and Applications*, manuscript TGRS-00488-2004, submitted to IEEE Transactions for Geoscience and Remote Sensing.