Satellite sea surface thermic images of T-ECHO research project

FLAVIO PARMIGGIANI (1), JAIME RUCABADO (2) and PATRICK SCHNEIDER (2)

(1) Istituto per Metodologie Geofisiche de Ambientali (IMGA-CNR), Via Emilia Est 770, 41100 Modena, Italy
(2) Instituto de Ciencias del Mar (CSIC), Passeig Joan de Borbó s/n, 08039 Barcelona, Spain

SUMMARY : This report deals on the sea surface thermic satellite image files prepared for T-ECHO research project. No details on techniques are herewith supplied as suitable literature is world-wide available. Neither are we supplying any material justificative of the work carried out, considering them being specified in other papers and reports of the project for Adriatic Sea and Catalan Sea, as well. All the gathering and main processes have been done by first author (Parmiggiani), but extra processes, editing and printing have been done by the latest two (Rucabado and Schneider).

INTRODUCTION

The present is a general description of the data files and presentation of printings of thermic satellite image files for use in T-ECHO project. In fact, all "image files" were gathered and processed at IMGA-CNR, Modena Italy, by the first author (Parmiggiani).

The two main areas of interest of T-ECHO project are the Adriatic Sea and the Catalan Sea; thus the suffix (or prefix) "adr" or "a" for the Adriatic, and "cat" or "c" for the Catalan, will be widely used for identifying the data files through this report and for file naming.

Two main streams of image files have been produced during T-ECHO project: (i) the High Resolution Data Set (HRDS); and (ii) the Low Resolution Data Set (LRDS). The second stream (LRDS) is divided in three subsets : (i) the so called "binary" files, (ii) "raster" files, and (iii) the so called "imagettes"; in fact, the "binary" and "raster" files are two presentation formats of same information. Although the "imagettes" are also binary format files, they represent additional information to the "binary" and "raster" ones.

THE HRDS (SPATIAL RESOLUTION = 1 KM)

The HRDS was produced by processing the original HRPT data from the AVHRR (Advanced Very High Resolution Radiometer) mounted on the TIROS-N/NOAA satellite family. AVHRR has 5 channels in the visible, near-infrared, middle-infrared and thermal infrared, and has a spatial resolution of 1.1 Km. The processing of AVHRR data makes use of the commercial software package TeraScan (SeaSpace, San Diego, CA, USA).

HRDS consists of Sea Surface Temperature (SST) maps covering both the Adriatic and the Catalan Sea for the periods in conjunction with the surveys. The surveys interesting T-ECHO can be divided in two main sections: (i) the so-called Adriatic Historical Data Set regarding surveys performed in the Adriatic in the years from 1976 to 1992, with the exclusion of 1984 and 1986, by IRPEM-CNR (M. Azzali); and (ii) the surveys performed during T-ECHO in 1993, 1994 and 1995, both in the Adriatic and in the Catalan Sea.

The raw HRPT/AVHRR data for the Adriatic Historical Data Set were acquired from the historical archives of the University of Dundee which is the only historical archive of AVHRR data in Europe. Acquisition and archiving of AVHRR data started at the University of Dundee in November 1979; thus, AVHRR data were only available in conjunction with the surveys from 1980 to 1992.

The raw HRPT/AVHRR data for the recent surveys (1993-1995) were either acquired from the archive of the University of Dundee or kindly supplied by the following scientific Institutions: (i) the Federal Hydrographic Institute of Hamburg (Germany); (ii) DLR, the German Space Agency, at Oberpfaffenhofen (Germany), and (iii) IMAAA-CNR, Potenza (Italy).

The helpful collaboration of these Institutions is warmly acknowledged. Starting from February 1996, IMGA-CNR will have its own AVHRR

receiving and archiving facility; thus, there will be no need to request data to other institutions for future projects

Starting from the original AVHRR raw data, a specific procedure, utilising a sequence of TeraScan commands, provides the output product, i.e., an SST map. The final TeraScan command for SST computation, "nitpix", makes use of the standard MCSST (Multi-Channel SST) algorithm developed by NOAA; details of this algorithm can be found in the literature or requested from the first author (Parmiggiani).

A sequence of SST maps can be used to produce a Composite Sea Surface Temperature (CoSST) map. In the CoSST map, each pixel is obtained by taking the warmest pixel from all the SST maps being considered. Some CoSST maps have been produced, in conjunction with the recent T-ECHO surveys, by considering the "good quality" images of the daytime satellite passes over a period of 15 days (2 CoSST maps per month).

The NOAA satellites pass over Europe twice per day, once with ascending orbit and once with descending orbit. Normally there are two NOAA satellites in full operation at the same time; thus, in theory, we could have 4 satellite images per day for our areas of interest. In effect, this theoretical observation capability is greatly reduced by two main factors: (i) cloud cover, and (ii) viewing angle.

Regarding this second problem, one of the parameter of "nitpix" algorithm (cos-sat-zen, the cosine of the satellite zenith angle) rejects all the pixels whose cosine of the satellite zenith angle is below 0.6. This choice is very appropriate as the pixels below this zenith angle are greatly distorted, both geometrically and radiometrically.

A detailed description of the SST maps (geographical coordinates, temperature range, etc.) contained in the HRDS, and about the displaying of SST maps with the "public domain" software packages running on INTEL platforms (personal computers), EPODISP and TVSAT, is given later, in different subchapters, within this report.

Adriatic Sea HRDS file description

This chapter aims to supply some information about the contents and the handling of the SST maps produced at IMGA-CNR for T-ECHO Project. In particular, it refers to the SST maps of the Adriatic Sea.

The general name of the image file for SST maps is:

a|yymmdd|k.dat

where "a" stands for Adriatic, "yymmdd" indicates the date : "yy" for the year, "mm" for the month and "dd" for the day; "k" can be "n" for night, "m" for morning, "p" for afternoon or "e" for evening satellite pass.

On September 13, 1994, just in the middle of GIAS-2, the radiometer AVHRR on board of NOAA-11 broke down. NOAA-11, with its two passes per day (in the first afternoon and after mid-night) was at the time the main NOAA satellite. After Sept.13 and till the launch of NOAA-14 in Dec.94, only NOAA-12 was in operation. Thanks to the collaboration of DLR (the German Space Agency), it was possible to obtain a small set of SST maps of the Adriatic for the period Sept.12 - Oct.13, 1994. These maps are obtained as the daily composite (maximum) MCSST using all available passes of NOAA-12. They were produced by means of TeraScan software with the same size and in the same geographical reference used at IMGA.

The general name of the image files from DLR map (only for period Sep 12, 1994 to Oct 13, 1994) is:

d|yymmdd|c.dat

where "d" stands for DLR and "c" stays for composite MCSST.

For both SST and CoSST maps, the information about map size, geographical reference and temperature calibration, is provided in the following chapters.

a/ Map size

Map size is of 600 x 170 pixels. As SST maps are 1 byte per pixel images, the image file is a BINARY file whose size is 102,000 bytes.

b/ Geographical reference

The maps were produced in rotated UTM projection coordinates in order to match almost perfectly the basic map for pelagic fish population adopted by IRPeM-CNR. The basic map of IRPeM-CNR is a rectangle of : 360 x 100 nautical miles, equivalent to 660 x 180 Km, since the pixel of an AVHRR image is 1.1 Km.

The geographical coordinates of the four corners are:

Corner # 1 lat/lon 44.9885 N 11.5775 E
Corner # 2 lat/lon 46.2690 N 13.4220 E
Corner # 3 lat/lon 40.2690 N 16.3757 E
Corner # 4 lat/lon 41.2300 N 18.1575 E

c/ Temperature calibration

The "nitpix" command of TeraScan software produces an image file of 1 byte per pixel. This means that, with a temperature step of 0.1°C, the allowed temperature range of the image is 25.5°C. The surveys in the Adriatic Sea were mainly performed in summer, when the sea temperature often exceeds 25.5°C. For this reason, when this occurs the pixel temperature is obtained by the following relationship:

$$MCSST = 0.1 * (PV + 10)$$

where PV is the pixel value.

When the surveys extended later in autumn, i.e. for the years 1983, 1989, 1991 and 1993, for the SST maps of the months of October, November and December, the pixel temperature is obtained by the following relationship:

$$MCSST = 0.1 * PV$$

where PV is the pixel value.

For the image files of "dlr94" (that is Adriatic 1994 images, gathered from September 12 till October 13), the pixel temperature is obtained by the following relationship:

$$MCSST = 0.125 * PV$$

where PV is the pixel value.

Catalan Sea HRDS file description

This chapter aims to supply some information about the content and the handling of the SST maps produced at IMGA-CNR for T-ECHO Project. In particular, it refers to the SST maps of the Catalan Sea.

The general name of the image files for SST maps is:

c|yymmdd|k.dat

where "c" stands for Catalan; "yymmdd" indicates the date : "yy" for the year, "mm" for the month and "dd" for the day; "k" can be "n" for night, "m" for morning, "p" for afternoon or "e" for evening satellite pass.

CoSST maps were obtained for the year 1995 on the basis of keeping the maximum pixel value of the selected images (per half month and half daytime); the general name of the image file for CoSST maps is:

c|c|yymm|k|d.dat

where first "c" stands for Catalan Sea, second "c" stands for composite; "yymm" indicates the year and the month to which the CoSST refers, "k" can be either 1 or 2 thus referring to the first or to the second half of the month, and "d" stands for daytime.

For both SST and CoSST maps, the information about map size, geographical reference and temperature calibration, is provided in the following chapters.

a/ Map size

Map size is 600 x 600 pixels. As SST maps are 1 byte per pixel images, the image file is a BINARY file whose size is 360,000 bytes.

b/ Geographical reference

The maps were produced in rectangular projection coordinates.

The geographical coordinates of the central pixel are: (i) lat = 41N, (ii) lon = 03 E while those of the four corners are:

Corner # 1 lat/lon 43 59.7 N 00 58.11 W
Corner # 2 lat/lon 43 59.7 N 06 58.11 E
Corner # 3 lat/lon 38 00.3 N 00 58.11 W
Corner # 4 lat/lon 38 00.3 N 06 58.11 E

c/ Temperature calibration

The "nitpix" command of TeraScan software produces an image file of 1 byte per pixel. This means that, with a temperature step of 0.1 °C, the allowed temperature range of the image is 25.5°C. The surveys in the Catalan Sea were performed in spring, when the sea temperature never exceeds 25.5 °C. For this reason, the pixel temperature is obtained by the following relationship:

$$MCSST = 0.1 * PV$$

where PV is the pixel value.

THE LRDS (SPATIAL RESOLUTION=18 KM)

The LRDS was produced at IMGA-CNR by extracting sections of the NOAA/AVHRR MCSST data set produced by the University of Miami, Rosenstiel School of Marine and Atmospheric Science, and archived and distributed by JPL, California Institute of Technology, Pasadena, CA, USA.

As the tape containing the NOAA/AVHRR MCSST data set was received in January 1995,

the Data Set covers the period Nov. 1981 - Nov. 1994. A request for obtaining from JPL the data for the period Nov. 1994 - Dec. 1995 has already been submitted.

The NOAA/AVHRR MCSST data set contains in effect two data sets, one for daytime MCSSTs and one for nighttime MCSSTs. The MCSST product consists of the weekly composite at approx. 18 Km resolution. The weekly composite is produced by taking the average of the warmest pixels inside the grid point during the week.

Each weekly composite image consists of 512x512 pixels in rectangular projection coordinates. The geographical coordinates of the upper-left corner are:

(i) lat= 72.509765625

(ii) lon= 313.505859375

whereas the step from one pixel to the next is (in deg.): step=0.1757812.

By means of a simple procedure, two windows were extracted from each weekly MCSST composite, one for the Adriatic and one for the Catalan.

The geographical location window for the Adriatic Sea is: corner 146 326

Corner # 1 lat/lon 47.0215 N 10.6348 E
Corner # 2 lat/lon 47.0215 N 21.7090 E
Corner # 3 lat/lon 35.9473 N 21.7090 E
Corner # 4 lat/lon 35.9473 N 10.6348 E

The geographical location window for the Catalan Sea is: corner 161 251

Corner # 1 lat/lon 44.3848 N 02.5488 W
Corner # 2 lat/lon 44.3848 N 08.5254 E
Corner # 3 lat/lon 33.3106 N 08.5254 E
Corner # 4 lat/lon 33.3106 N 02.5488 W

The size of the extracted windows is 64x64 pixels, thus covering an area of approximately 1100x1100 Km. The general name of the window file (BINARY file) is:

dy|yyjjj.win for daytime MCSSTs, and

ut|yyjjj.win for nighttime MCSSTs

where yy indicates the year (e.g. 88 for 1988) and jjj indicates the julian day of the year.

Two subsets containing the low resolution MCSST windows were created: (i) "adlo" for the Adriatic Sea, and "catlo" for the Catalan Sea.

The format of the pixel in the original NOAA/AVHRR MCSST Data Set is 4 bytes per pixel. The first 2 bytes contain the relevant information about the temperature of the pixel, while the second 2 bytes contain a flag which indicates whether the pixel is land, ice or sea, and in the case of sea wheter it is an averaged or an interpolated value. During the extraction phase, the pixel format is reduced to 2 bytes, the first 2 bytes containing the temperature information; thus, each 64x64 window becomes a BINARY file whose size is 8192 bytes. The pixel temperature is obtained by the following relationship:

$$MCSST = 0.1 * PV$$

where PV is the pixel value read on 2 bytes, with a temperature resolution of 0.1 °C. The low resolution images can be displayed by software packages which are able to deal with 2 bytes/pixel images (which is not the case of EPODISP).

As an alternative, the low resolution image files can be delivered in SUNRASTER format. The name of the low resolution image in SUNRASTER format will be the same as that of the binary file but with the extension *.RAS (instead of *.WIN).

THE IMAGETTES

After a specific request by IRPeM-CNR, the LRDS for the Adriatic has been remapped in the traditional geographic reference used by IRPeM. As the IRPeM geographic reference is a box of 360 x 100 nm, and as the grid step of the LRDS is 10 nm (18 Km), the remapped LRDS consists of "imagettes" of 36 lines x 10 columns. We know (see above) that each pixel is expressed on 2 bytes, thus each imagette of the remapped LRDS consists of 720 bytes.

The general name of the imagette file (BINARY file) is:

dy|yyjjj.dar for day time MCSSTs, and

ut|yyjjj.dar for night time MCSSTs

where yy indicates the year (e.g. 88 for 1988) and jjj indicates the julian day of the year.

Again, the pixel temperature is obtained by the relationship:

$$MCSST = 0.1 * PV$$

where PV is the pixel value read on 2 bytes, with a temperature resolution of 0.1 °C.

SINGLE BINARY IMAGE DISPLAYING

There are many ways to display the high resolution image produced files. T-ECHO proposes two procedures by using EPODISP and/or TVSAT programs, both need an INTEL based personal computer equipped at least with a VGA graphic board. Both programs are of "public domain".

Anyway, many commercial software packages allow the viewing of the images, zooming the display and producing dynamic presentations (i.e. PaintShop Pro, etc.).

Epodisp

EPODISP was given to the first author (Parmiggiani) by its designer, Pascal Gilles, who was at the time working at ESA-ESRIN in Frascati, Italy. EPODISP is a general viewer of satellite images including seven different data formats, manual image sizing, manual screen viewing, colour editing, and for some technical reasons limited to screen plot for only 512*480 pixels. Thus in case of a larger image (those of Catalan Sea) the viewing is done by selecting sections.

By running EPODISP, the user is requested to supply a set of parameters. Below is reported an example for displaying the upper left part of an SST map of the Catalan Sea:

```
------------------------------------------------------
The Image File You Have selected is :
C:\FLAVIO\c950501p.dat
  Please enter number of file type to load :  0
  Please enter the number of pixels per line : 600
  Please enter the number of pixels for header : 0
  Please enter the number of lines to skip  : 0
  Please enter the number of pixels to skip : 0
  Please enter the number of pixels to display : 512
  Please enter the number of lines to display :  480
  Please enter the sampling rate : 0
  Are you satisfied  [ (Y)es, (N)o, (Q)uit] ?
------------------------------------------------------
```

If the user wishes to display the lower right part of an SST map of the Catalan Sea (600x600 pixels), he has to select the following parameters:

```
------------------------------------------------------
The Image File You Have selected is :
C:\FLAVIO\c950501p.dat
  Please enter number of file type to load :  0
  Please enter the number of pixels per line : 600
  Please enter the number of pixels for header : 0
  Please enter the number of lines to skip  : 120
  Please enter the number of pixels to skip : 88
  Please enter the number of pixels to display : 512
  Please enter the number of lines to display :  480
  Please enter the sampling rate : 0
  Are you satisfied  [ (Y)es, (N)o, (Q)uit] ?
------------------------------------------------------
```

Herewith, as an extra example, the screen parameters for displaying the upper part of an SST map of the Adriatic Sea (170x600 pixels):

```
------------------------------------------------------
The Image File You Have selected is :
C:\FLAVIO\c950501p.dat
  Please enter number of file type to load :  0
  Please enter the number of pixels per line : 170
  Please enter the number of pixels for header : 0
  Please enter the number of lines to skip  : 0
  Please enter the number of pixels to skip : 0
  Please enter the number of pixels to display : 512
  Please enter the number of lines to display :  480
  Please enter the sampling rate : 0
  Are you satisfied  [ (Y)es, (N)o, (Q)uit] ?
------------------------------------------------------
```

If the user wishes to display the lower part of an SST map of the Adriatic Sea, he has to select the following parameters:

```
------------------------------------------------------
The Image File You Have selected is :
C:\FLAVIO\c950501p.dat
  Please enter number of file type to load :  0
  Please enter the number of pixels per line : 170
  Please enter the number of pixels for header : 0
  Please enter the number of lines to skip  : 120
  Please enter the number of pixels to skip : 80
  Please enter the number of pixels to display : 512
  Please enter the number of lines to display :  480
  Please enter the sampling rate : 0
  Are you satisfied  [ (Y)es, (N)o, (Q)uit] ?
------------------------------------------------------
```

Tvsat

TVSAT (acronym for T-echo Viewer of high resolution SATellite images) has been developed by one of the authors (Rucabado) in FORTRAN language and using the graphic libraries of HALLO-PROF. This program is specific for T-ECHO satellite images (it accepts only two image formats: binary -one byte per datum- and *.GRD -from SURFER, and allows to display the whole image on the screen. It has only one restriction : all image files must be stored in hard-disk C:. It has full and clear on-line help messages. TVSAT is accompanied with a set of auxiliary programs for obtaining file temperature range and frequency tables (TESART), generation of composite files for maximum, minimum and average pixel value (COSAT), and filtering images and file format conversion from binary to GRD format (FIGIT).

WMF IMAGES AND PAPER PRINTOUTS

In order to assist the daily research of other scientists involved in T-ECHO project and to facilitate a comfortable access to such data, the HDRS thermic satellite images have been processed additionally to obtain image files that most usual office-like soft packages are able to import and/or view. This task has been done by two of the authors (Rucabado and Schneider), assisted by S. Conejero (ORSTOM, Montpellier).

The basic aim was to obtain a set of new files in WMF format (Windows Meta File) as this is a widely accepted format on Windows platforms and applications, allowing to resize the image without quality loss.

The process involved the following steps: i/ filtering of original image files in order to remove all pixel values over land; ii/

transforming binary into "grid" files; iii/ processing of grid files by the SURFER package; and iv/ export processed images as WMF format files.

Those WMF files (from individual original thermic files) have been stored individually, but have also been "combined" for printout purposes in groups of several of them producing a complete printing page.

Moreover, the programs built (see above) allow an easy preparation of "composite" images and also to extract selected areas from the general images. This has been done for the Catalan Sea, where the specific area covered by GICS cruises has been extracted from original files establishing a new set of individual binary, WMF, composite and combined files. The overall process is described in the following chapters.

Generating GRD files

The SURFER program allows the generation and edition of 2-D views from some data input, which are processed with an intermediate transformation adapting data input to a regular grid, or accepts the input of external regular grids, which was the selection done. Each of so called "grid" file consists of one header which contains information on the file contents, such as minimum and maximum values for x, y and z, followed by the actual data values.

In order to obtain consistent (with same colour scale) final output, the original binary files were processed by TESART to analyze the frequency value distribution tables and to evaluate the best parameters for the maximum and minimum limits to include in the grid files.

For the Catalan Sea the temperature values (pixel value) to be considered in the temperature distribution images have been limited to 101 as minimum and to 245 as maximum value. Missing values and all values below 101 were set to a default value of 100.

For the Adriatic Sea, the values (pixel value) to be considered in the thermic distribution images have been limited to 50 as minimum and to 250 as maximum value. Missing values and all values below 50 were set to a default value of 10, those on land being set to 0. See next chapter for a description of the colour assignment.

Further, the conversion process included the calculation of minimum, maximum and average pixel values from a set of single day SST, in order to provide SST composite images (only for Catalan Sea and GICS area). Further details on composite images are provided in the according chapter below.

Thus, files for individual SST images and for composite SST images (generated by means of COSAT) have been converted as described above to GRD files, by means of FIGIT.

For more details on the GRD file format please refer to the SURFER manual (SURFER for Windows, Version 6 User's Guide, Golden Software, Inc., Golden, Colorado, USA, 1995) or contact one of the authors (Schneider).

Creating SST Images in SURFER

In the next step, the GRD files were used in SURFER to create SST images. In this process, to each "real" temperature value (i.e., the original pixel value finally represented within the image) was assigned a specified colour, using a graded colour spectrum, ranging from magenta to red, as it is shown in the colour scale added to the images.

For the Catalan Sea and the GICS area, "grey" was assigned to all values ranging from 101 to 120; values above 120 and below 245 received the corresponding colour from the defined colour spectrum, while to those higher than 245 was assigned "black". Missing values and values below 101 were set to 100 as mentioned above, to this value of 100 being assigned the colour "white" in order to provide the "background" of the image.

The pixel values of the data of the Catalan Sea and the GICS area correspond exactly to the SST, i.e. these values have been calibrated and temperature in degree centigrade is achieved by dividing the pixel value by 10 (see also corresponding chapter in the HRDS file description above).

For the Adriatic Sea, to all values ranging from 10 to 50 was assigned "grey"; values above 50 and below 250 received the corresponding colour from the defined colour spectrum. To values higher than 250 was assigned "black". Missing values and values below 50 were set to 10 and to this was assigned "white" in order to provide the "background" for the image. Pixels on land were set to 0, as mentioned above, and received an earthy colour representing the coast.

To obtain pixel temperature from the pixel values of the data of the Adriatic Sea, please refer to the corresponding chapter in the HRDS file description for the Adriatic Sea above.

The geographic situation of the image frames is as follows:

Catalan Sea:
Corner # 1 lat/lon 44 00.0 N 01 00.0 W
Corner # 2 lat/lon 44 00.0 N 05 00.0 E
Corner # 3 lat/lon 38 00.0 N 01 00.0 W
Corner # 4 lat/lon 38 00.0 N 05 00.0 E

GICS area:
Corner # 1 lat/lon 41 15.0 N 00 19.6 W
Corner # 2 lat/lon 41 15.0 N 01 42.0 E
Corner # 3 lat/lon 39 15.0 N 00 19.6 W
Corner # 4 lat/lon 39 15.0 N 01 42.0 E

Adriatic Sea:
Corner # 1 lat/lon 44.9885 N 11.5775 E
Corner # 2 lat/lon 46.2690 N 13.4220 E
Corner # 3 lat/lon 40.2690 N 16.3757 E
Corner # 4 lat/lon 41.2300 N 18.1575 E

Please note that Adriatic Sea images represent a rotated UTM projection, for which reason they are not supplied with an axis scale. Thus geographical reference of the Adriatic Sea images are the same as described above under the HRDS file description.

Using GS SCRIPTER (a macro tool for use with SURFER) all images have been processed, formatted and finally saved in the WMF format. GS SCRIPTER uses a basic-like language and provides a set of SURFER specific macros. Macro scripts have been written to load and format the individual files, to add a coastline to the image and to assign specified colours to each pixel of the file within SURFER. In this way, it was possible to process all files in a fast and standardized manner.

SST Images

With the process described above, WMF files and printouts within the same area are comparable throughout all years, each image including a colour scale. Please note once more that for Adriatic Sea the colour scale refers to the pixel value and not to the temperature value. Consequently, different transformation criteria should be applied (refer above) to obtain temperature values, according to year and file name.

Image types

Different types of images are provided, according to the following description.

a/ Individual images

The term "individual" images applies to images which show the temperature (or pixel value for Adriatic) distribution at the moment of the satellite pass, which is specified in the filename and in the header of the respective image. Depending on the coverage and quality of the original image data, these images are provided for both the Catalan Sea and/or the GICS area as well as for the Adriatic Sea.

Individual images are available for morning, postmeridian, evening and night satellite passes. Information on this is also provided in the filename, which can be found in the header of each image. Please refer also to the file naming conventions given below.

b/ Composite images

"Composite" images are images, in which temperature data of several images have been composed within one single image map. Out of a set of images covering a certain period (i.e., through one year or one part of a year or through one month, as indicated in the filename), pixels of identical coordinates have been overlayed to get:

1. maximum pixel value, resulting in a maximum temperature composite image
2. minimum pixel value, resulting in a minimum temperature composite image
3. average pixel value, resulting in an average temperature composite image

These image sets have been created for the investigation area of the GICS cruises as well as for the whole Catalan Sea, each time depending on the coverage and quality of the original images. For the Adriatic there are no composite images available.

In the paper version, on each page you will find three images:

1. top left: maximum temperature composite image
2. top right: minimum temperature composite image
3. bottom: average temperature composite image

In this order, images also appear in the combined composite image files (i.e., load one

single file and see three images in this order), but only for Catalan Sea and GICS area. They are also available as single images (one image per file).

More information on the image is provided in the filename, which can be found in the header of each image. Please refer also to the file naming conventions given below.

Presentation modes

Further, it has to be distinguished between two presentation modes of the different image types described above:

a/ Single images

Single images are available only in the electronic form (files). As indicates the name, one single image file contains one single image. The term "single" refers to individual image (single individual image) and also to composite image (single composite image).

b/ Combined images

In electronic form as well as in the printouts, individual and composite images are also available as so called "combined" images. In contrast to the single images described above, this means that each image file contains up to four single images in the case of the Catalan Sea and the GICS area (three in the case of the composite images, see above) and up to 32 images in the case of the Adriatic Sea, i.e. load one file and see three (composite images), up to four (individual images) or 32 (Adriatic Sea) images on the screen. A quicker and more comfortable access to such kind of images was the reason to include this option in the electronic file access. In this arrangement the images are also made available as paper printouts.

Viewing the images

In order to view the provided images, any application supporting the WMF format could be used (Paint Shop Pro from JASC Inc., Word for Windows from Microsoft Corp., Corel from Corel Corp., Surfer from Golden Software Inc., etc.).

It is important to know that the WMF format is a vector type format, i.e. images can be scaled to each size that you wish (within the appropriate software, of course), without quality loss. When loading files from CD-ROM, please refer to the README.TXT files which will guide you through the subdirectory structure to help you find quickly the information you need.

File naming conventions

File naming convention for "single individual" satellite data files follows the generic name :

w|YYMMDD|k.nnn

where: w is "C" for Catalan Sea and GICS area or "A" for Adriatic Sea; YY stands for year; MM for month; DD for day; k can be "M" for morning, "P" for postmeridian, "E" for evening or "N" for night satellite pass; nnn refers to the extension: "DAT" for binary original files, "BDF" for filtered (from pixels over land) binary files and "WMF" for WMF files, as appropriate.

File naming convention for ICM "single composite" satellite data files follows the generic name:

wYYMMxyz.nnn

where w is "K" for composite on Catalan Sea, "G" for composite on GICS area; YY for year; "MM" for month; x can be "A", indicating all images available for YY year (then MM is 1st available month) or "M" only images of month indicated by MM; y is "1" for maximum temperature, "2" for minimum temperature or "3" for average temperature composite images; z is "A" for all day-partitions [M+P+E+N], "M" for morning, "P" for postmeridian, "E" for evening, and "N" for night satellite pass images matching YYMMxy parameters; nnn refers to the extension: "BDF" for filtered binary composite files and "WMF" for WMF files, as appropriate.

File naming convention for "combined" satellite data (only images) follows the generic name:

wYY_##.wmf

where w is "C" for the Catalan Sea and GICS area ("individual" satellite data), "A" for the Adriatic Sea ("individual" satellite data), "K" for the Catalan Sea ("composite" satellite data) and "G" for the GICS area ("composite" satellite data); YY stands for year; ## is an index for the sequential and continous numbering of "combined" files generated.

ANNEX A

To facilitate the access to the T-ECHO satellite data files and related files, Table 1 shows the directory structure of the satellite files stored in the CD-ROM; furthermore, the generic names for the files held in each subdirectory are also indicated. The respective file naming conventions are explained in detail in the corresponding chapter within this paper. Also in the CD-ROM subdirectories are provided README.TXT and other *.TXT files which contain a short version of Table 1 (subdirectory structure) and other relevant information.

TABLE 1- Subdirectory structure of satellite thermic data files and related files of T-ECHO project

subdirectory structure	generic file names	
SAT\DATA\ADR\HRDS\1980..1995	aYYMMDDk.dat	
SAT\DATA\ADR\LRDS\BINARY\1981..1994	dyYYJJJ.win	utYYJJJ.win
SAT\DATA\ADR\LRDS\RASTER\1981..1994	dyYYJJJ.ras	uyYYJJJ.ras
SAT\DATA\ADR\LRDS\IMAGETTE\1981..1994	dyYYJJJ.dar	utYYJJJ.dar
SAT\DATA\CAT\HRDS\INDIVID\DAT\1993..1995	cYYMMDDk.dat	
SAT\DATA\CAT\HRDS\INDIVID\BDF\1993..1995	cYYMMDDk.bdf	
SAT\DATA\CAT\HRDS\COMPOSIT\1993..1995	kYYMMxyz.bdf	
SAT\DATA\CAT\LRDS\BINARY\1981..1994	dyYYJJJ.win	utYYJJJ.win
SAT\DATA\CAT\LRDS\RASTER\1981..1994	dyYYJJJ.ras	utYYJJJ.ras
SAT\DATA\GICS\HRDS\INDIVID\1993..1995	cYYMMDDk.bdf	
SAT\DATA\GICS\HRDS\COMPOSIT\1993..1995	gYYMMxyz.bdf	
SAT\WMF\ADR\SINGLE	aYYMMDDk.wmf	
SAT\WMF\ADR\COMBINED	a_sat_##.wmf	
SAT\WMF\CAT\1993\INDIVID\SINGLE	c93MMDDk.wmf	
SAT\WMF\CAT\1993\INDIVID\COMBINED	c93_##.wmf	
SAT\WMF\CAT\1993\COMPOSIT\SINGLE	k93MMxyz.wmf	
SAT\WMF\CAT\1993\COMPOSIT\COMBINED	k93_##.wmf	
SAT\WMF\CAT\1994\INDIVID\SINGLE	c94MMDDk.wmf	
SAT\WMF\CAT\1994\INDIVID\COMBINED	c94_##.wmf	
SAT\WMF\CAT\1994\COMPOSIT\SINGLE	k94MMxyz.wmf	
SAT\WMF\CAT\1994\COMPOSIT\COMBINED	k94_##.wmf	
SAT\WMF\CAT\1995\INDIVID\SINGLE	c95MMDDk.wmf	
SAT\WMF\CAT\1995\INDIVID\COMBINED	c95_##.wmf	
SAT\WMF\CAT\1995\COMPOSIT\SINGLE	k95MMxyz.wmf	
SAT\WMF\CAT\1995\COMPOSIT\COMBINED	k95_##.wmf	
SAT\WMF\GICS\1993\INDIVID\SINGLE	c93MMDDk.wmf	
SAT\WMF\GICS\1993\INDIVID\COMBINED	c93_##.wmf	
SAT\WMF\GICS\1993\COMPOSIT\SINGLE	g93MMxyz.wmf	
SAT\WMF\GICS\1993\COMPOSIT\COMBINED	g93_##.wmf	
SAT\WMF\GICS\1994\INDIVID\SINGLE	c94MMDDk.wmf	
SAT\WMF\GICS\1994\INDIVID\COMBINED	c94_##.wmf	
SAT\WMF\GICS\1994\COMPOSIT\SINGLE	g94MMxyz.wmf	
SAT\WMF\GICS\1994\COMPOSIT\COMBINED	g94_##.wmf	
SAT\WMF\GICS\1995\INDIVID\SINGLE	c95MMDDk.wmf	
SAT\WMF\GICS\1995\INDIVID\COMBINED	c95_##.wmf	
SAT\WMF\GICS\1995\COMPOSIT\SINGLE	g95MMxyz.wmf	
SAT\WMF\GICS\1995\COMPOSIT\COMBINED	g95_##.wmf	
SAT\REPORT		
SAT\SOFT\EPODISP		
SAT\SOFT\TVSAT		

ANNEX B

The Annex B contains the printouts of all high resolution combined images (individual as well as composite images) in order to propitiate a visual approach to the file information. In former chapters it has been explained in detail the process for achieving the final combined files in WMF format. These combined files have been imported into six *.DOC files (for WORD 7 for WINDOWS-95) in order to not increase excessively the size of concerned files; finally these files have been printed.

Note that colour scale is identical for all printouts in Catalan Sea (Catalan Sea and GICS area) but different from the Adriatic Sea. For Catalan Sea and GICS area the colour scale refers directly to the temperature value of the original files, but in the Adriatic printouts colours refer to the pixel value, and, according to the original data set, adequate transformation criteria must be applied.

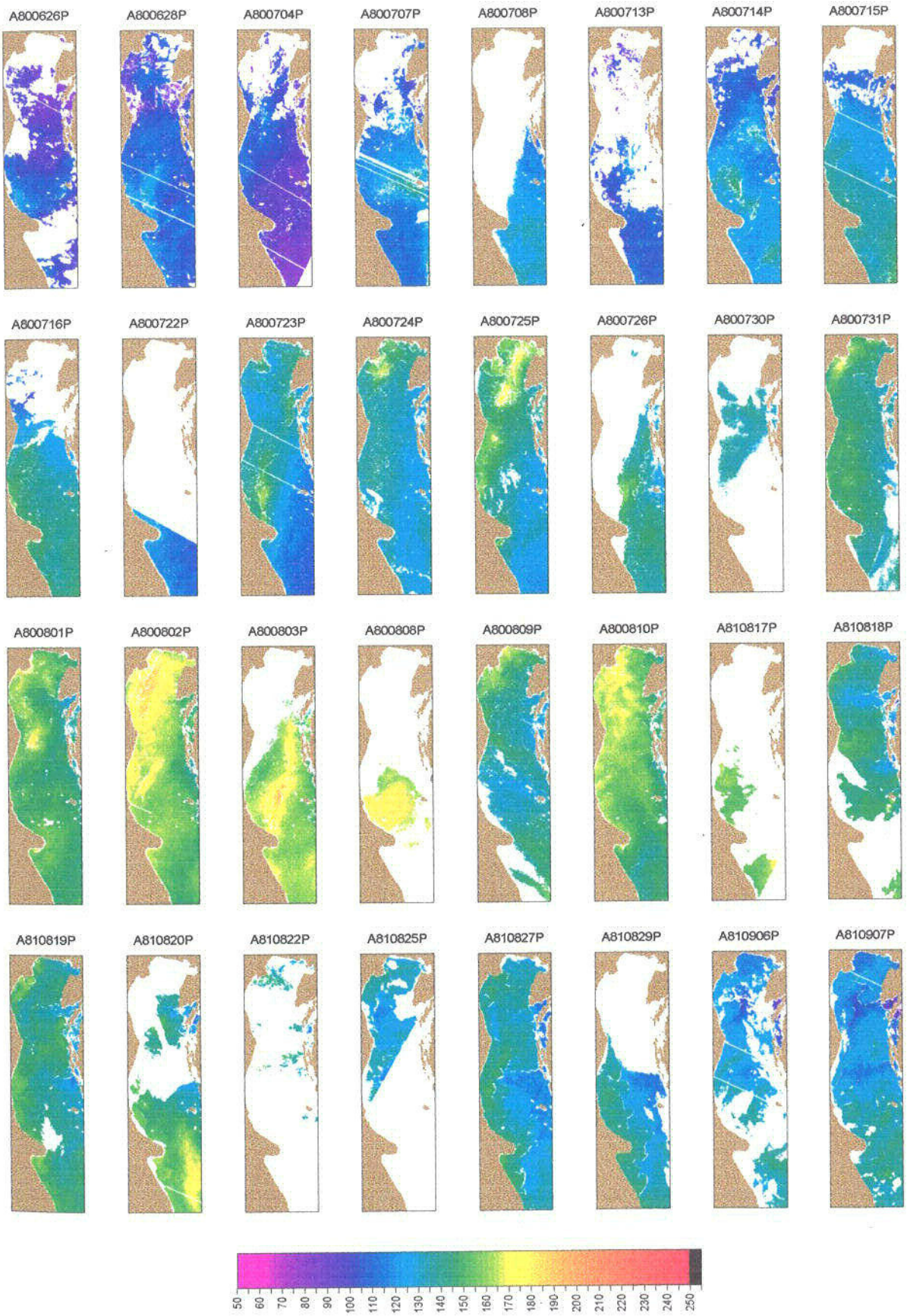
The pages for combined composite images show in top left position the "maximum" pixel value for all involved files, top right for "minimum" pixel value and the bottom image shows the "average" pixel value.

Table 2 shows the correspondence of different parts of the present annex with the *.DOC files and original *.WMF files.

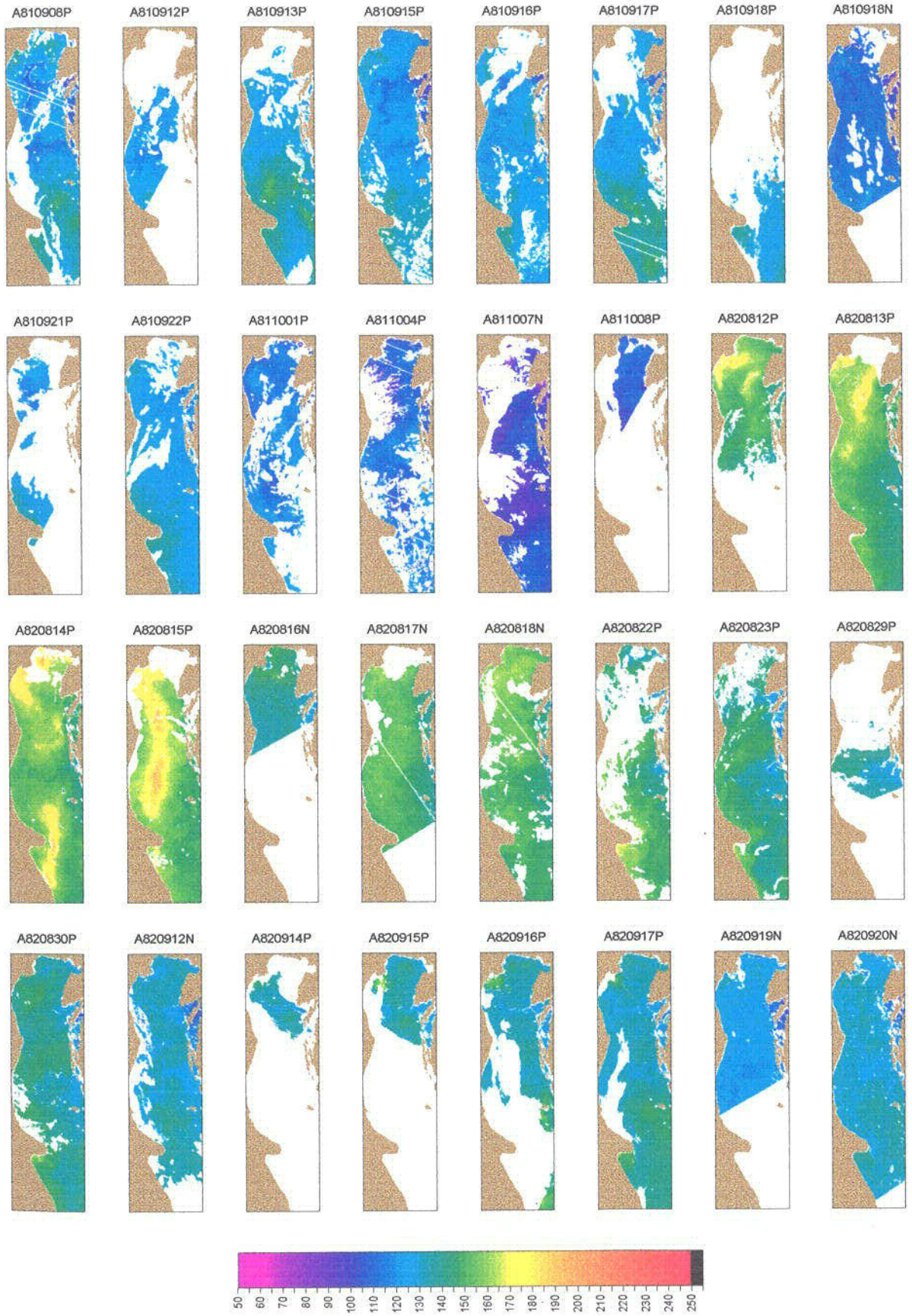
Table 2.- correspondence between the contents and pagination of Annex B, WORD version 7 for WINDOWS-95 files (*.DOC) and original *.WMF files

CONCEPT	PAGES IN ANNEX B	WORD 7 FILE NAME	GENERIC FILENAME *.WMF ORIGIN
Individual images of Adriatic Sea	11 to 18 19 to 26	SATANXB1 DOC SATANXB2 DOC	a_sat##.wmf
Individual images of Catalan Sea	27 to 50	SATANXB3 DOC	cYY_##.wmf
Composite images of Catalan Sea	51 to 73	SATANXB4 DOC	kYY_##.wmf
Individual images of GICS area	74 to 85	SATANXB5 DOC	cYY_##.wmf
Composite images of GICS area	86 to 104	SATANXB6 DOC	gYY_##.wmf

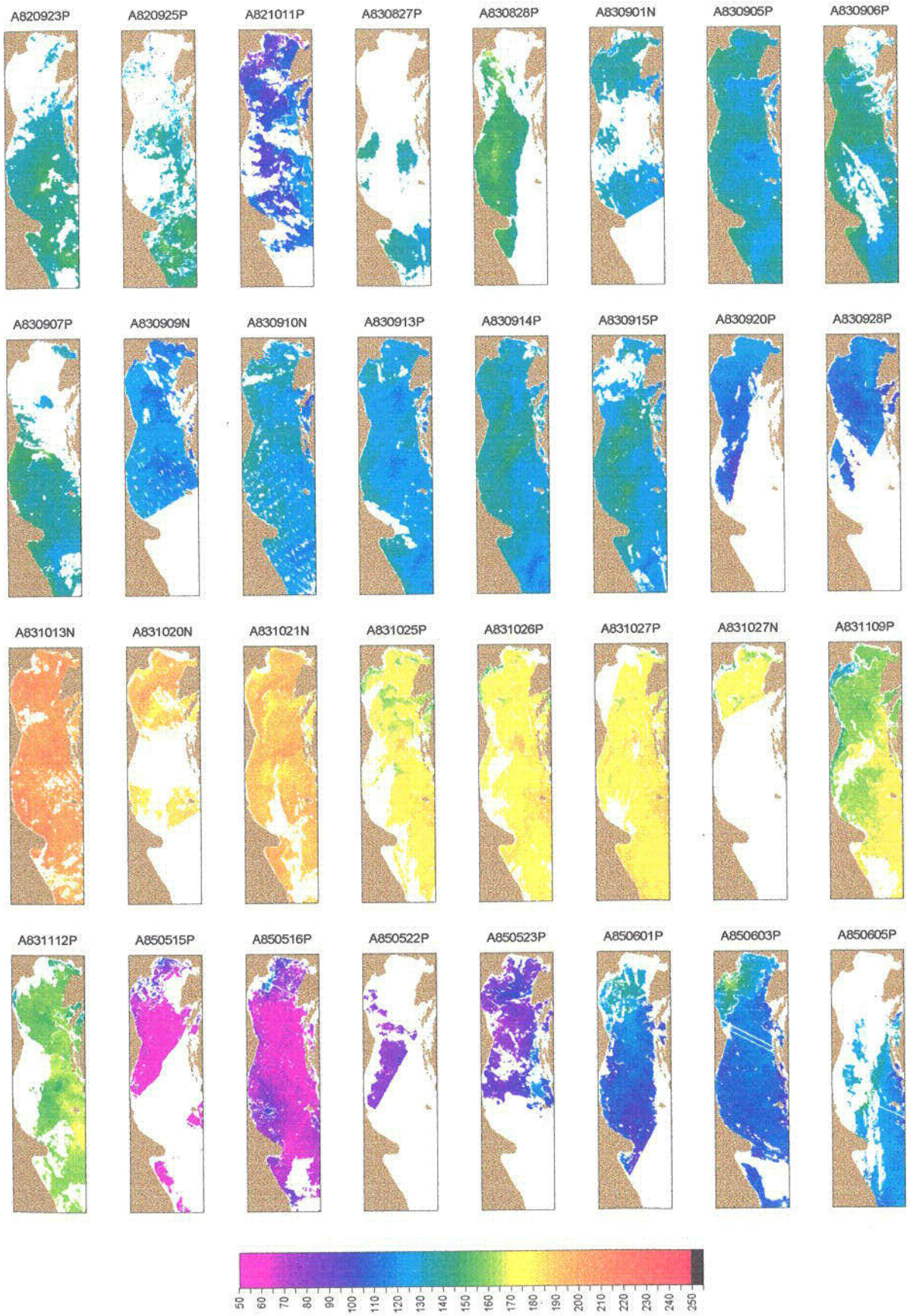
Satellite Images Adriatic Sea



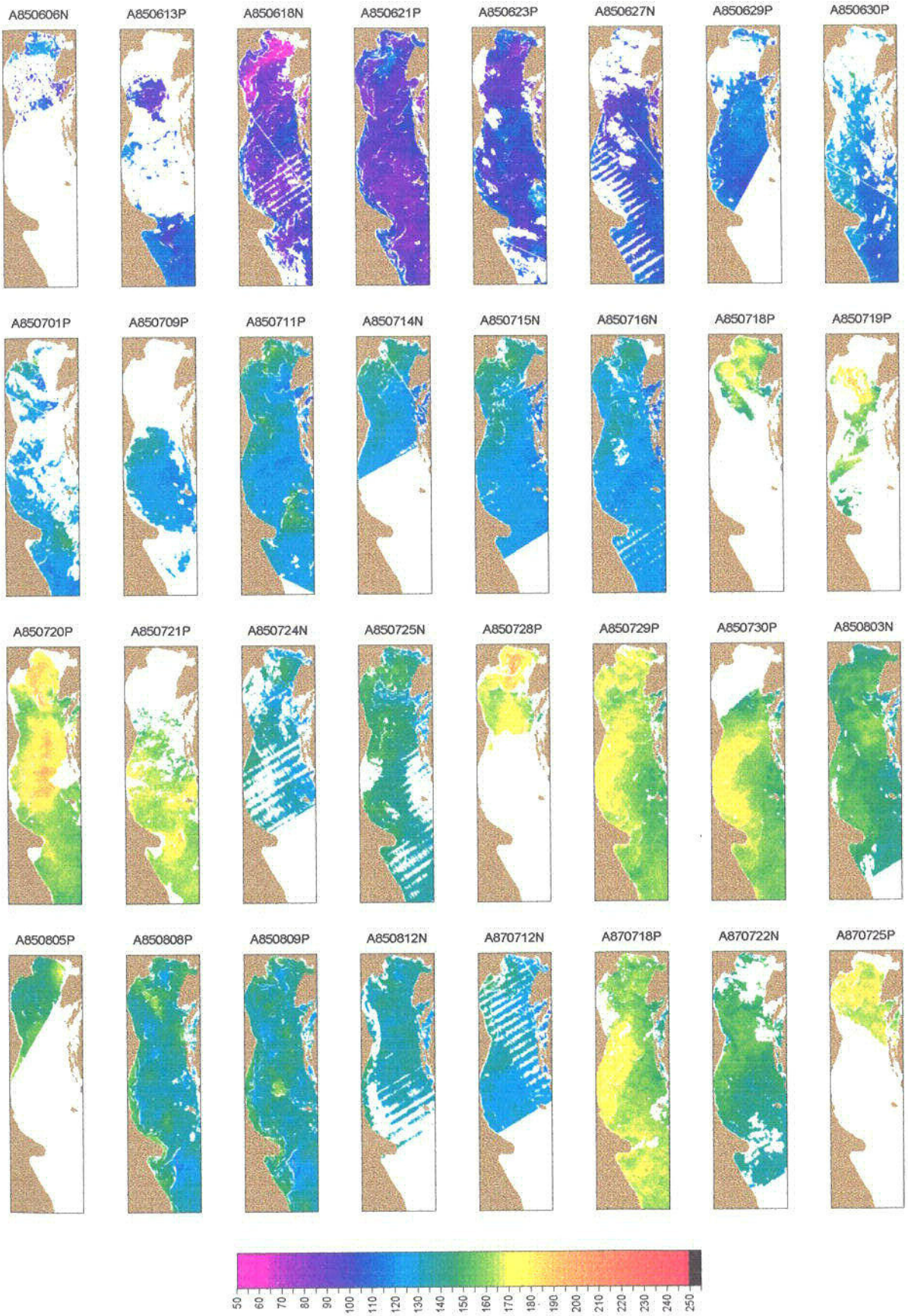
Satellite Images Adriatic Sea



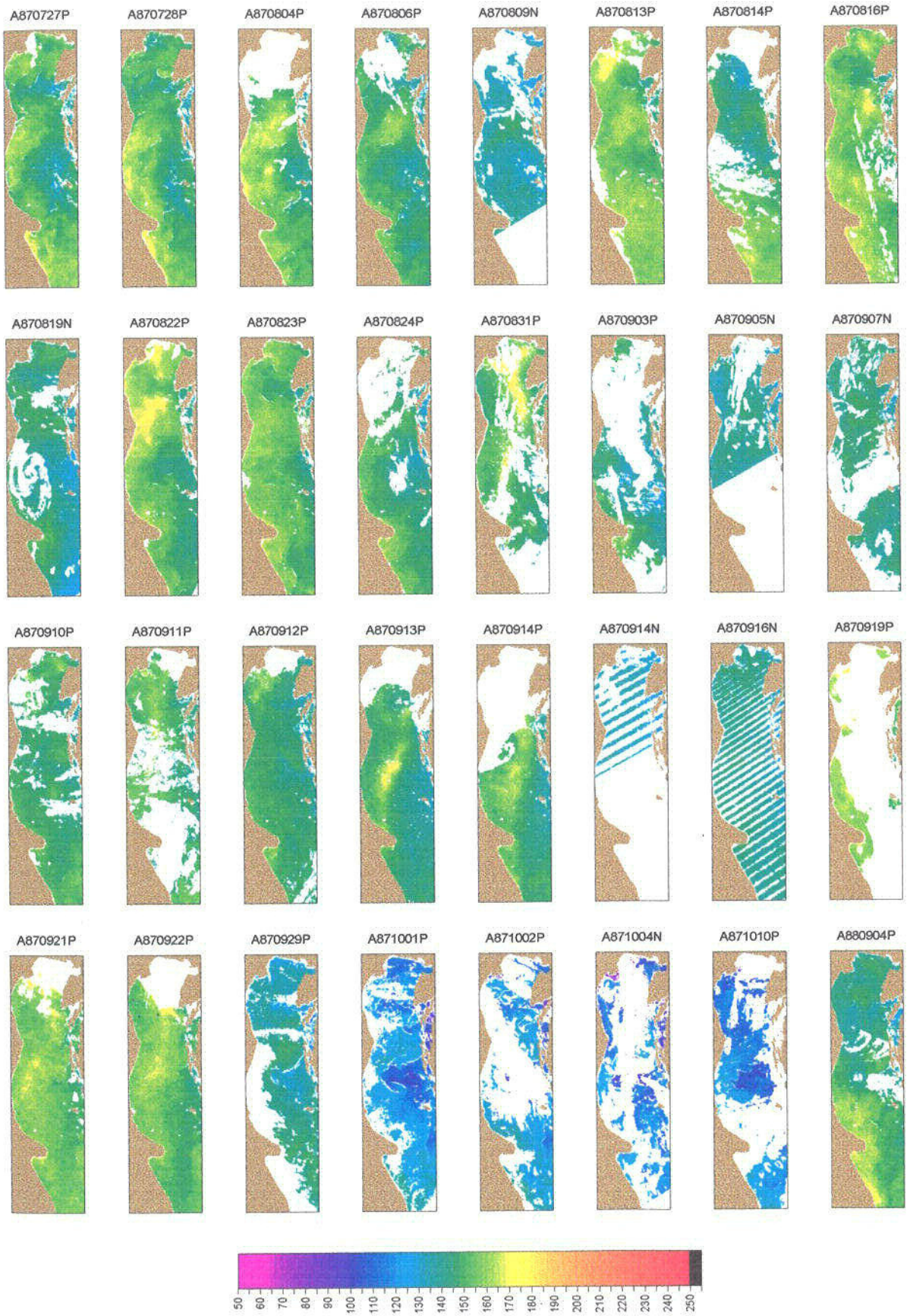
Satellite Images Adriatic Sea



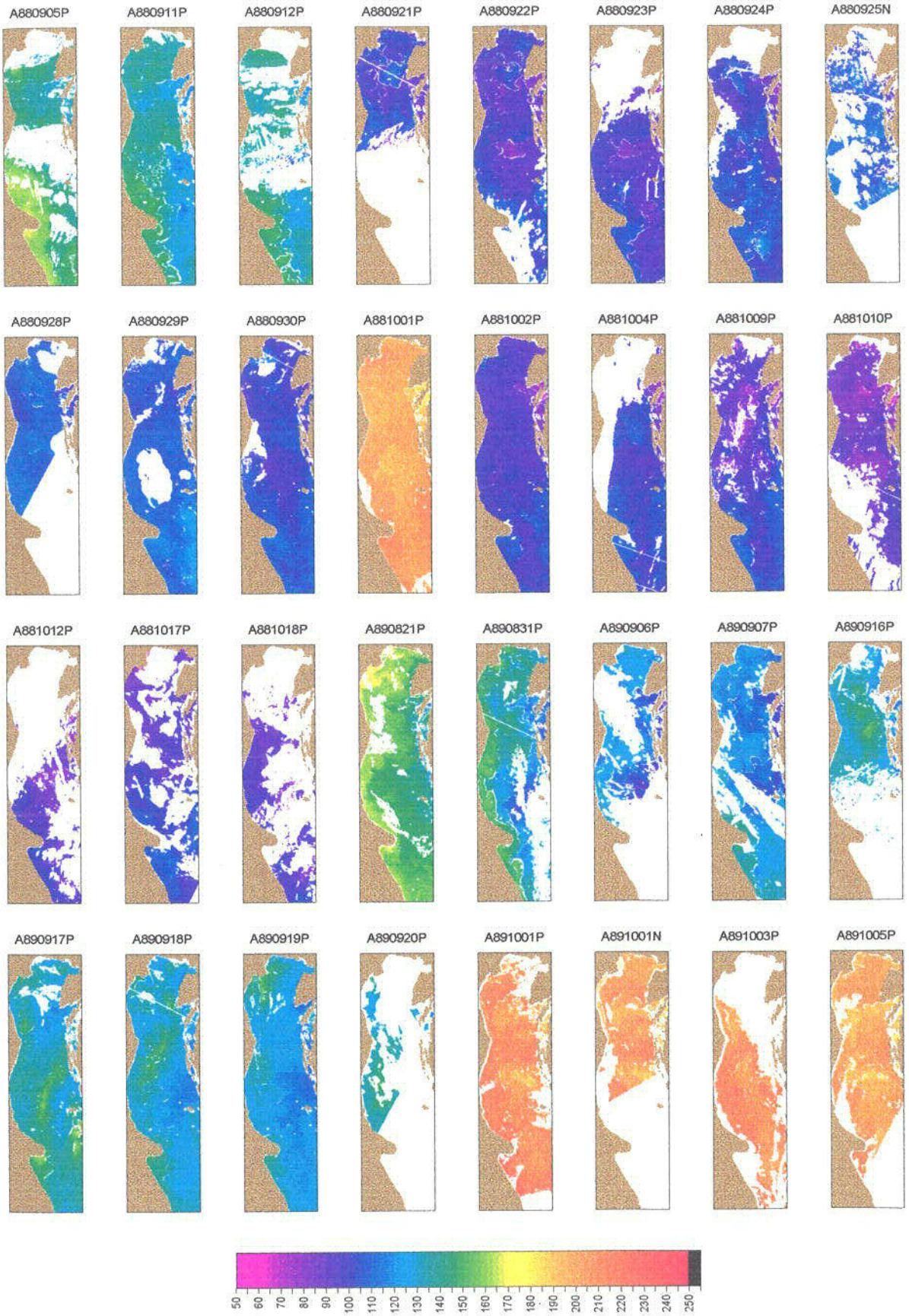
Satellite Images Adriatic Sea



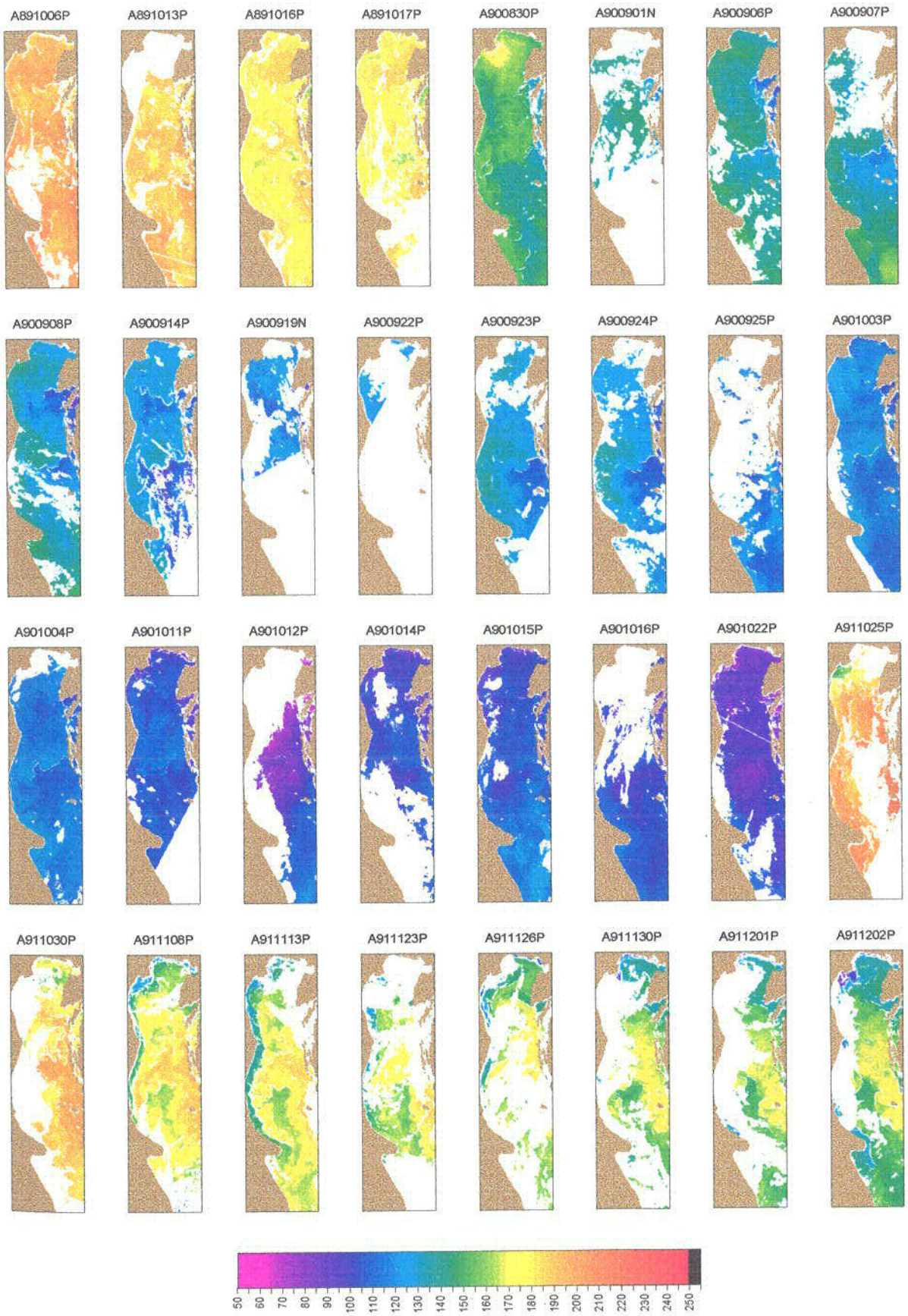
Satellite Images Adriatic Sea



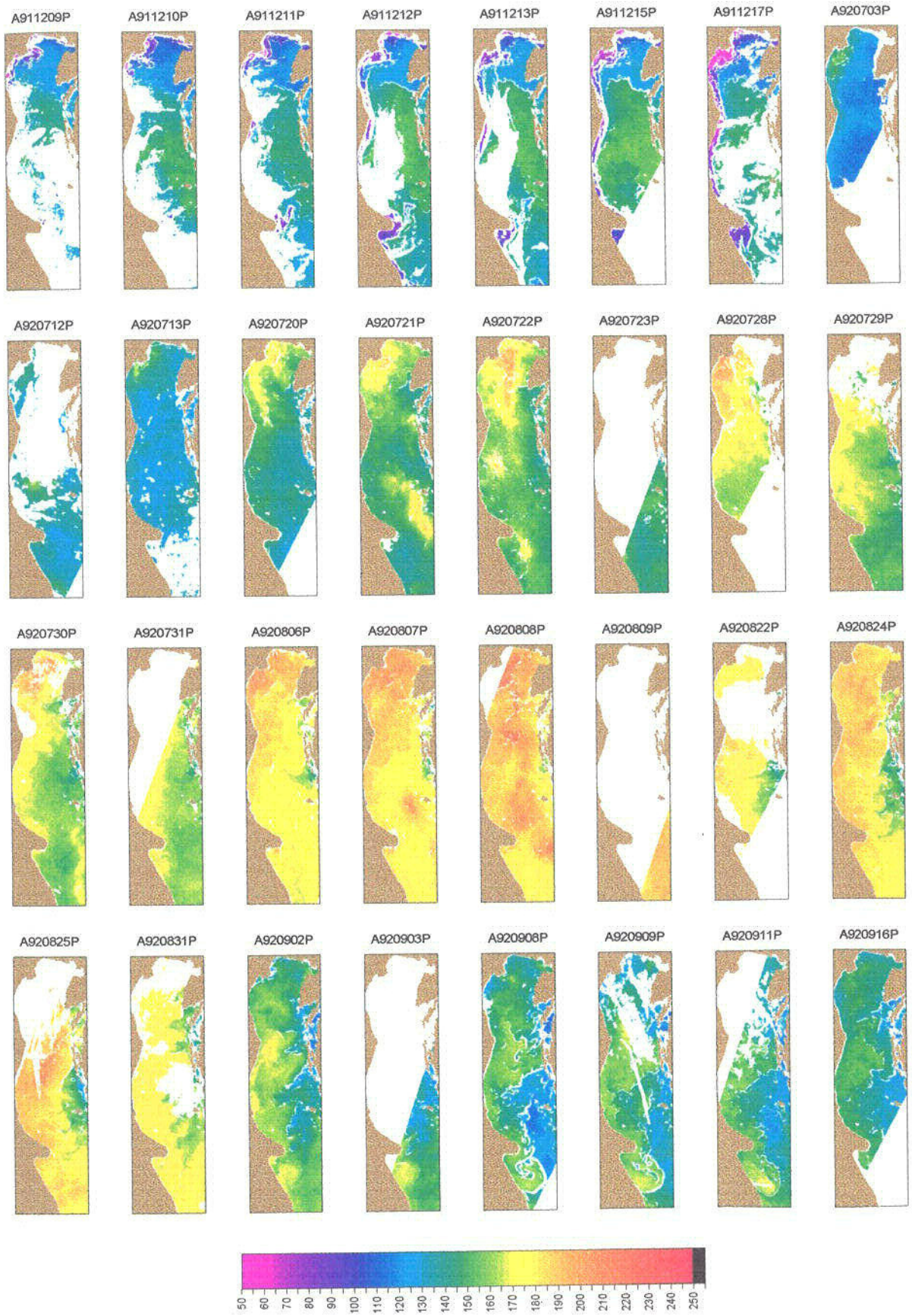
Satellite Images Adriatic Sea



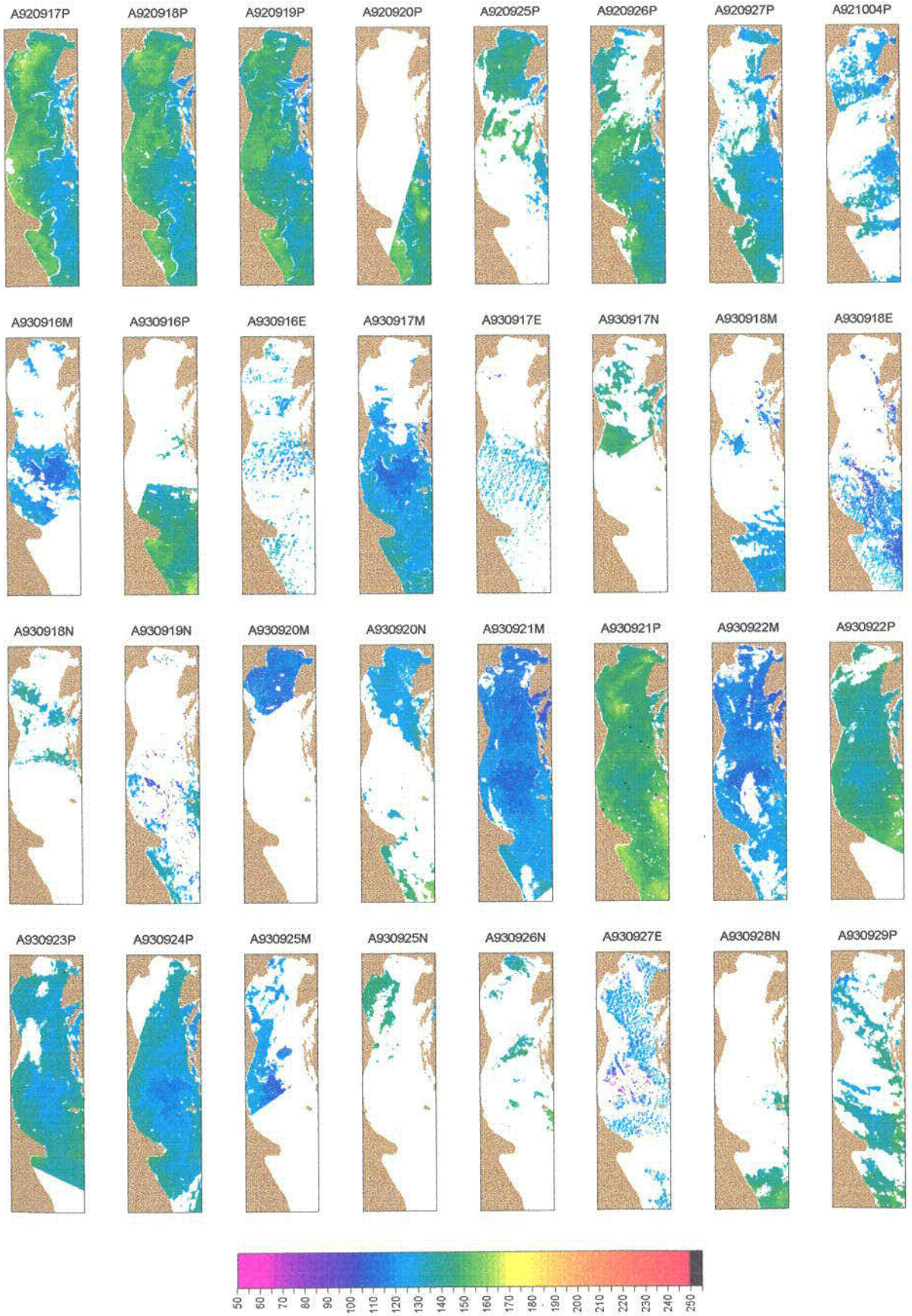
Satellite Images Adriatic Sea



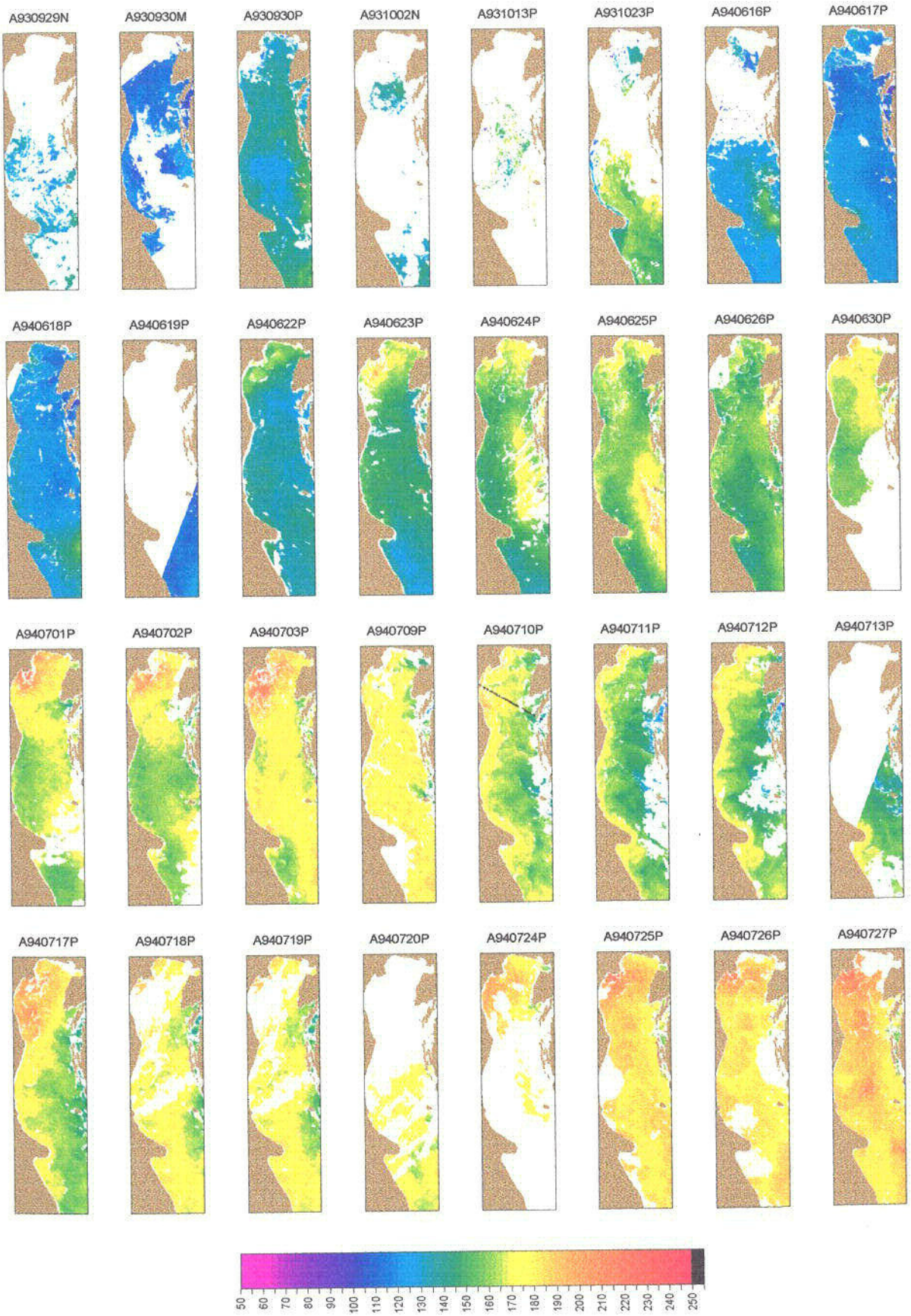
Satellite Images Adriatic Sea



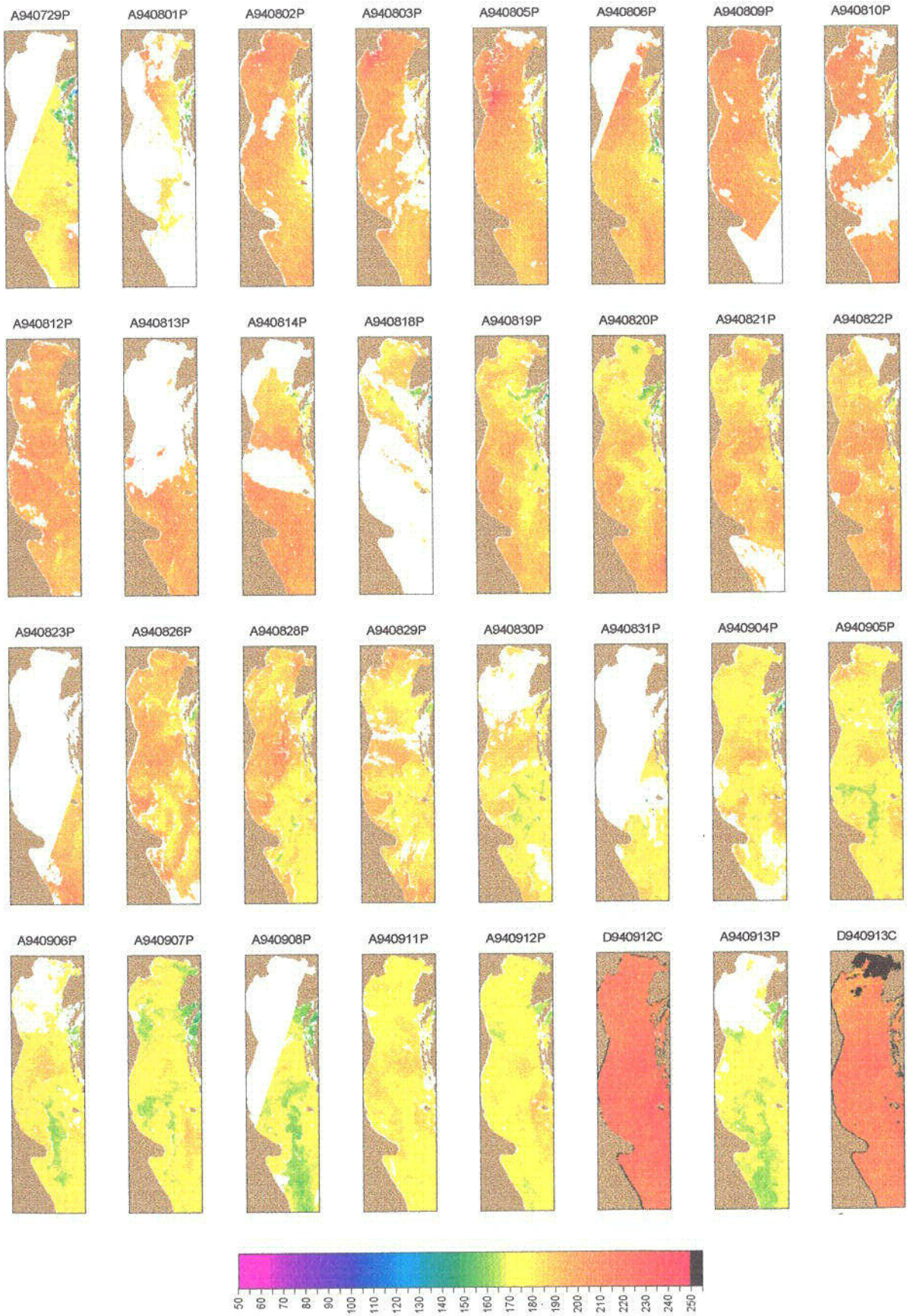
Satellite Images Adriatic Sea



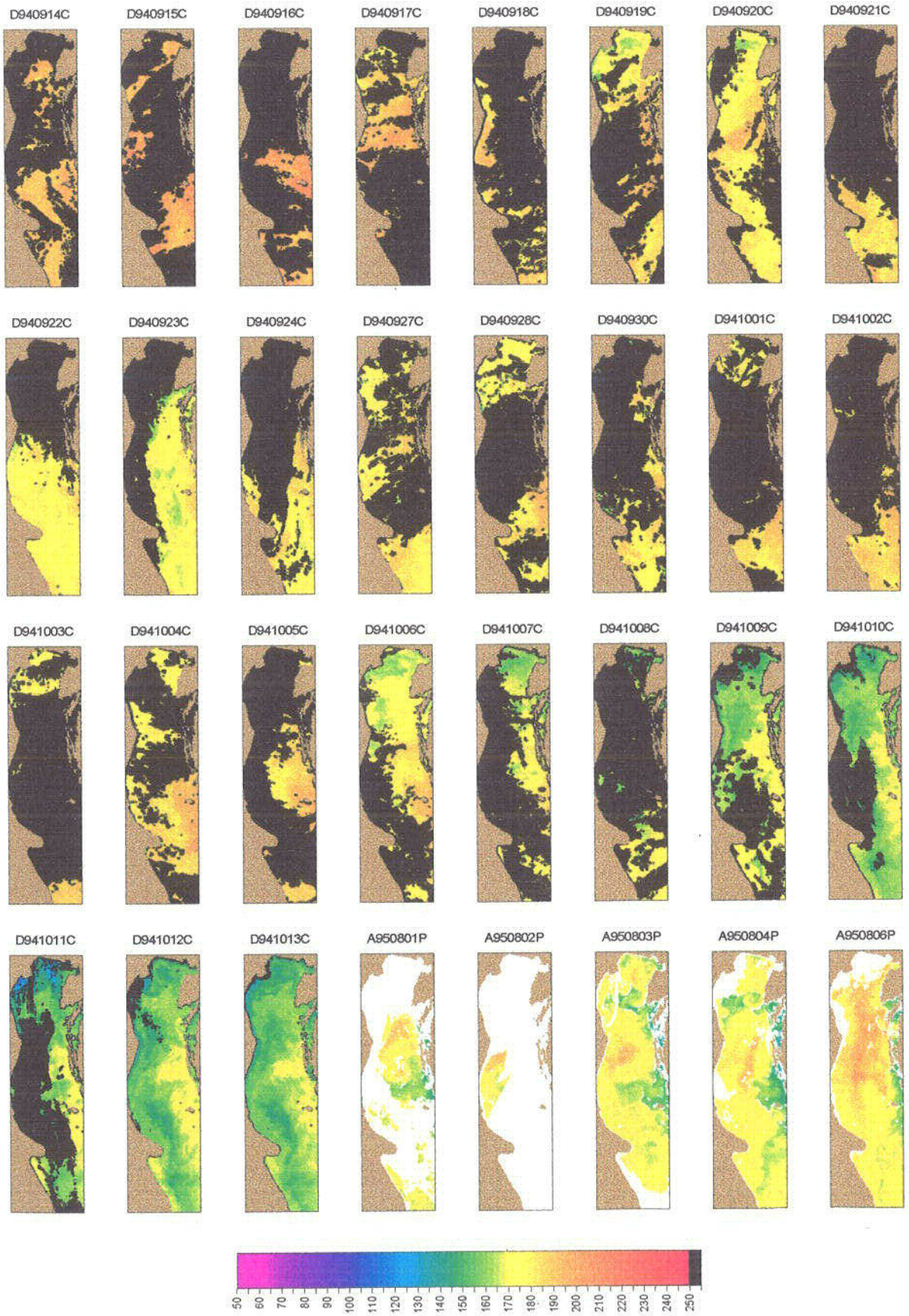
Satellite Images Adriatic Sea



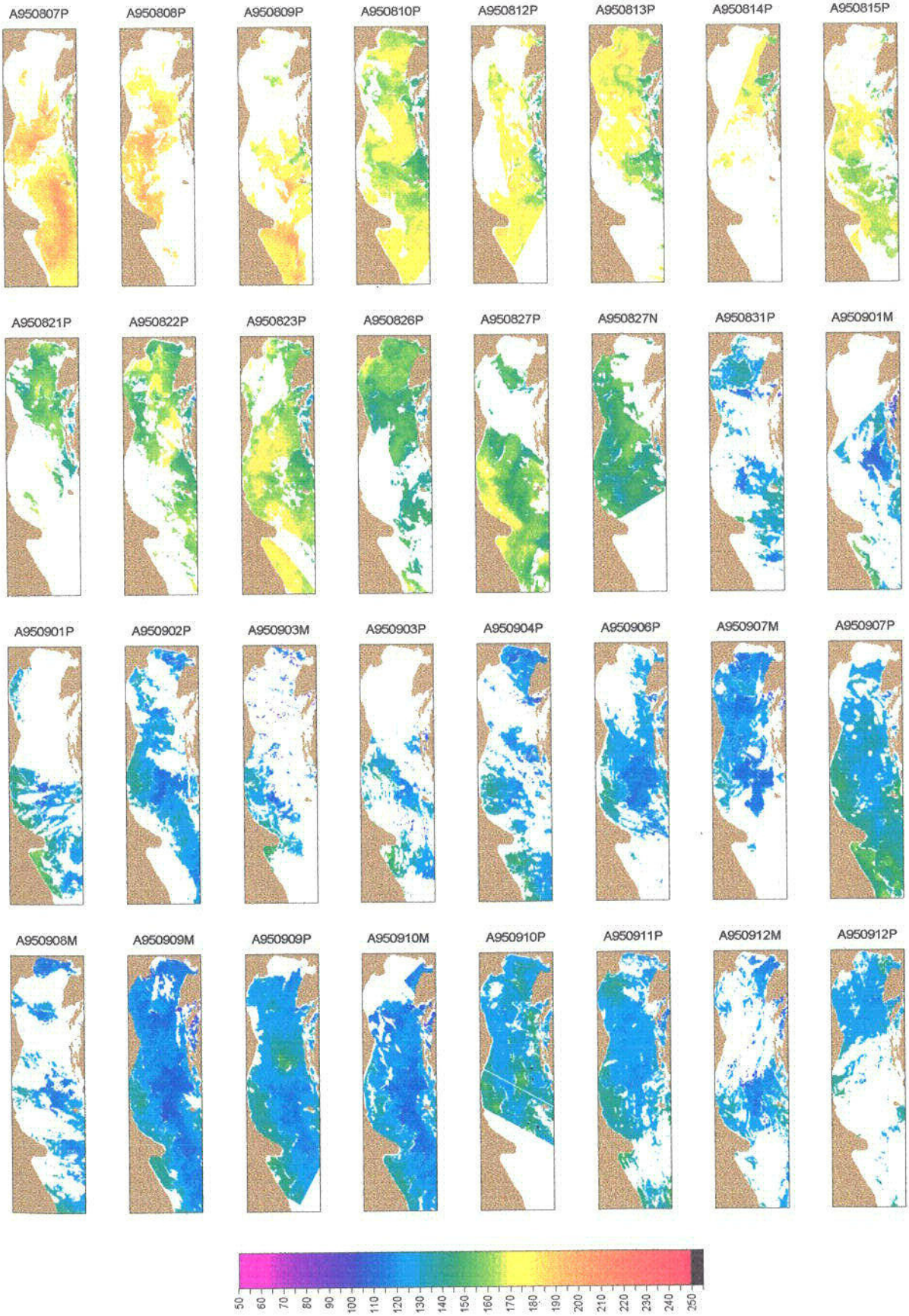
Satellite Images Adriatic Sea



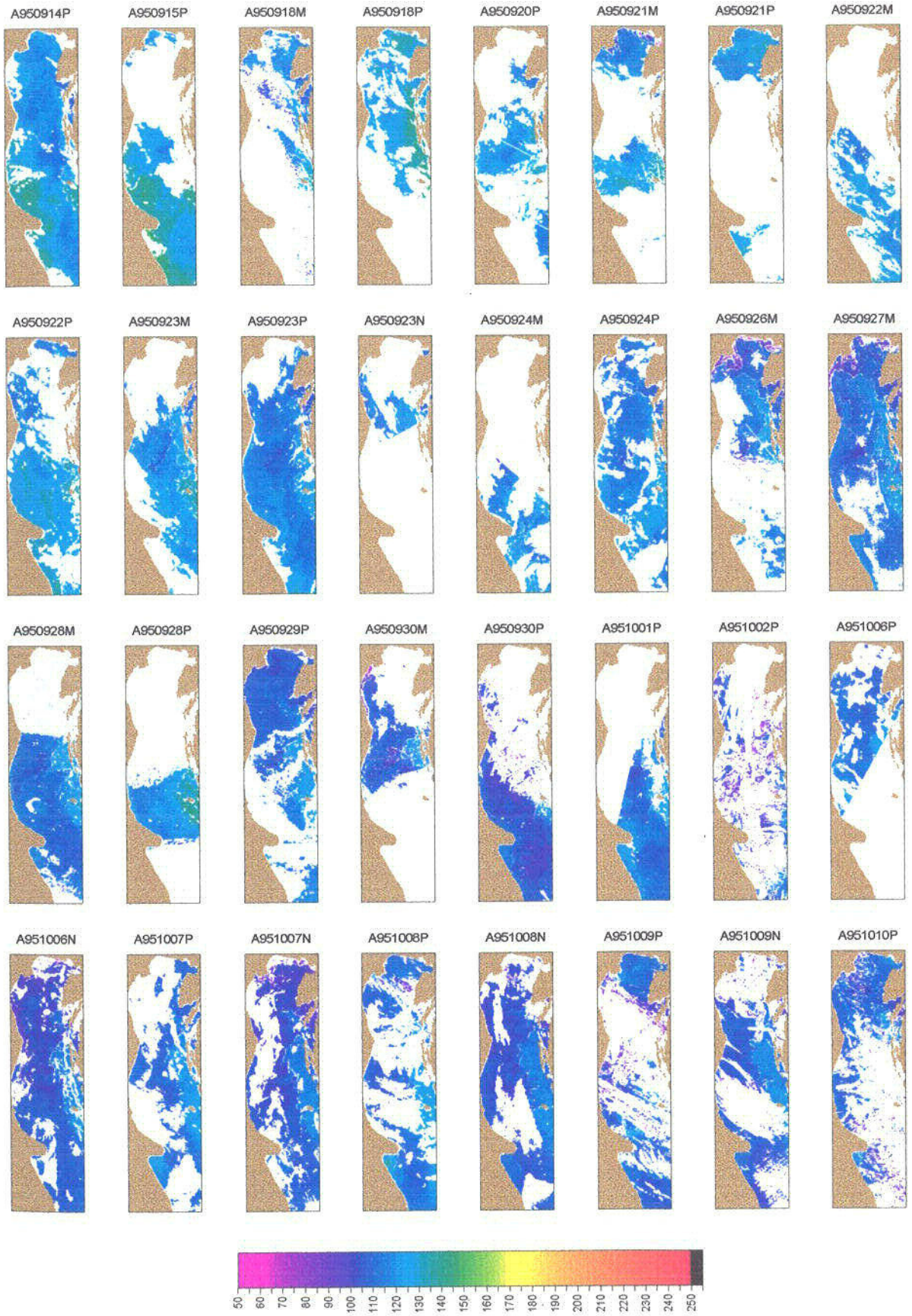
Satellite Images Adriatic Sea



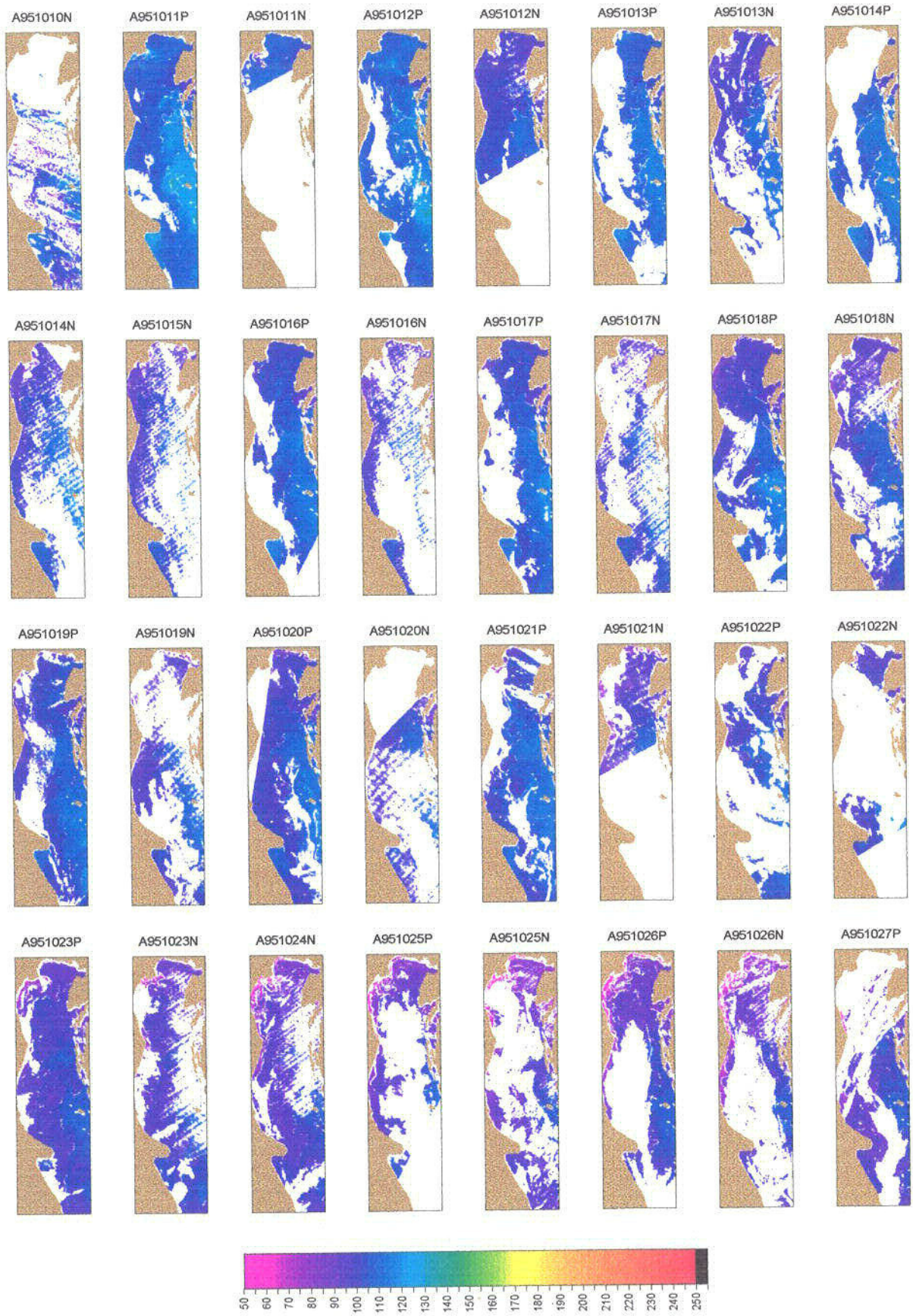
Satellite Images Adriatic Sea



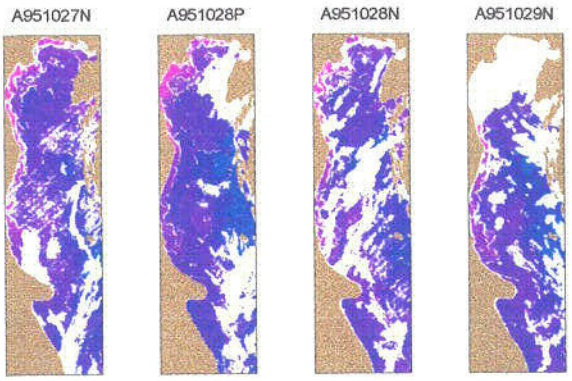
Satellite Images Adriatic Sea

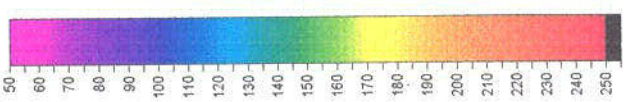


Satellite Images Adriatic Sea



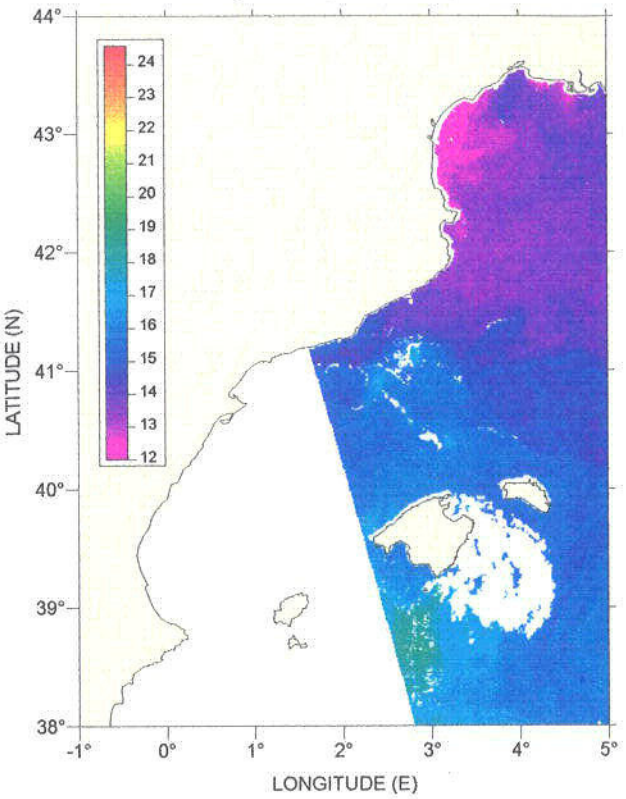
Satellite Images Adriatic Sea



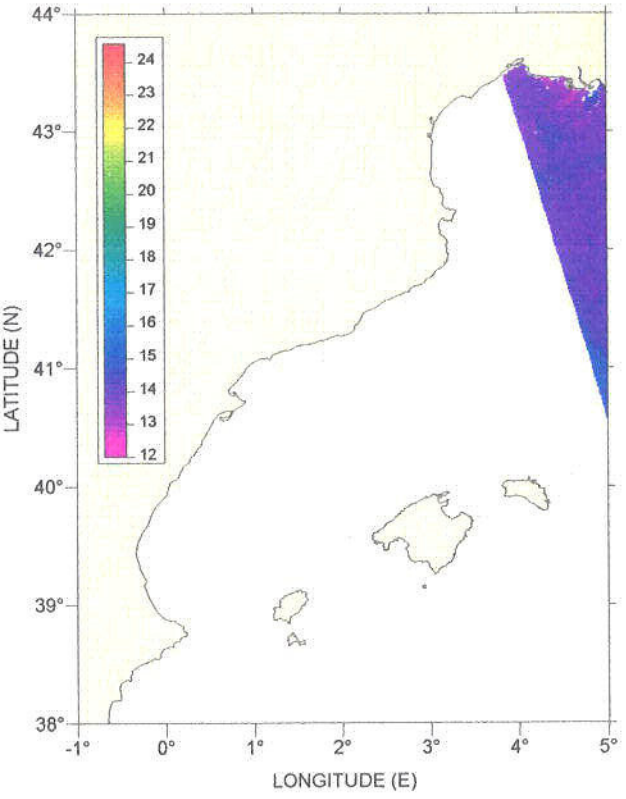


Temperature Satellite Individual Images
GICS-1 (1993) – Catalan Sea

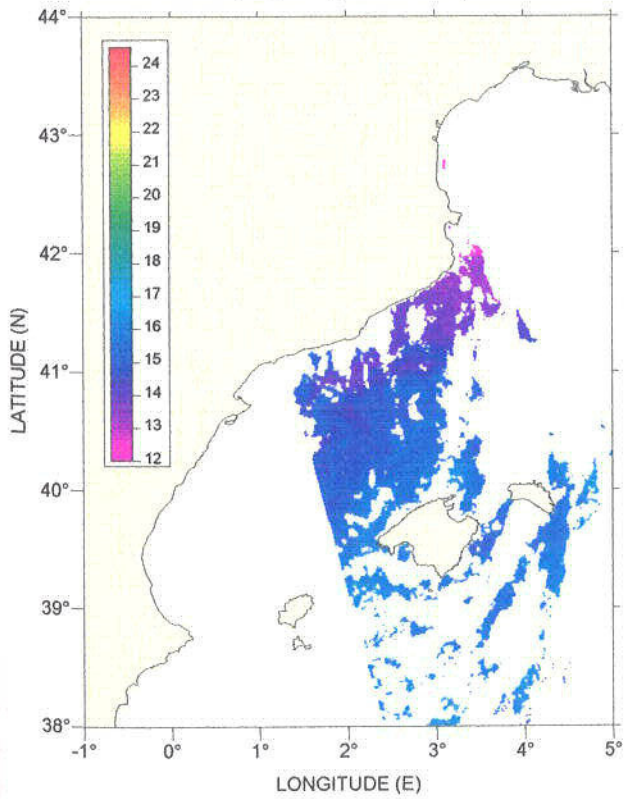
April, 17 (C930417P)



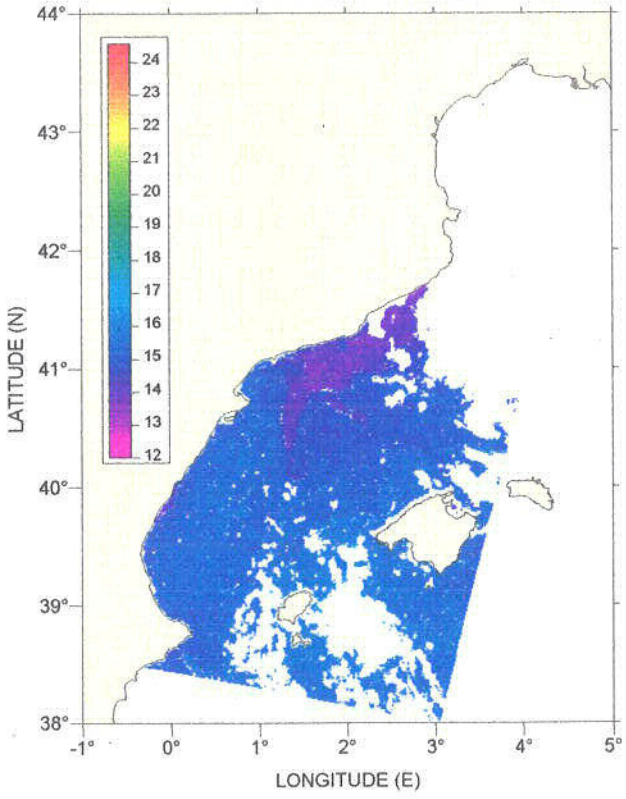
April, 18 (C930418P)



April, 25 (C930425P)

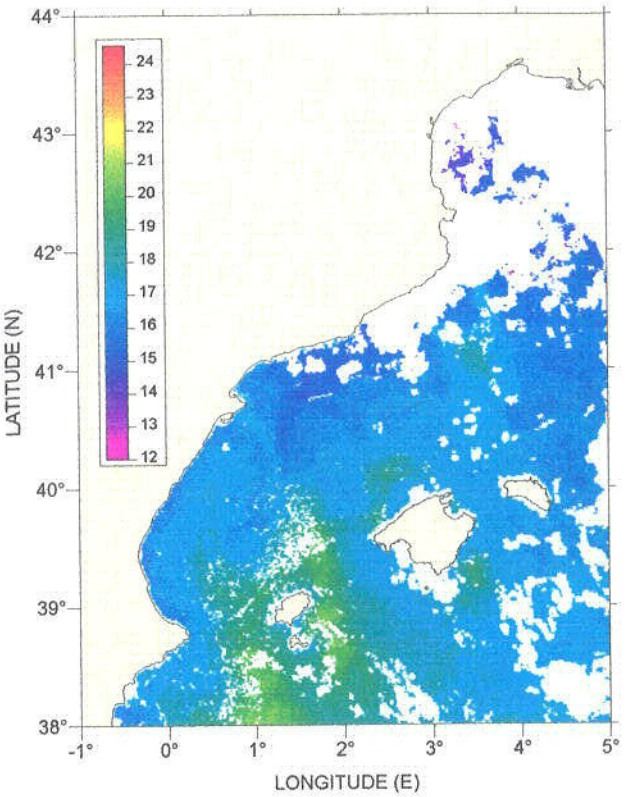


May, 02 (C930502M)

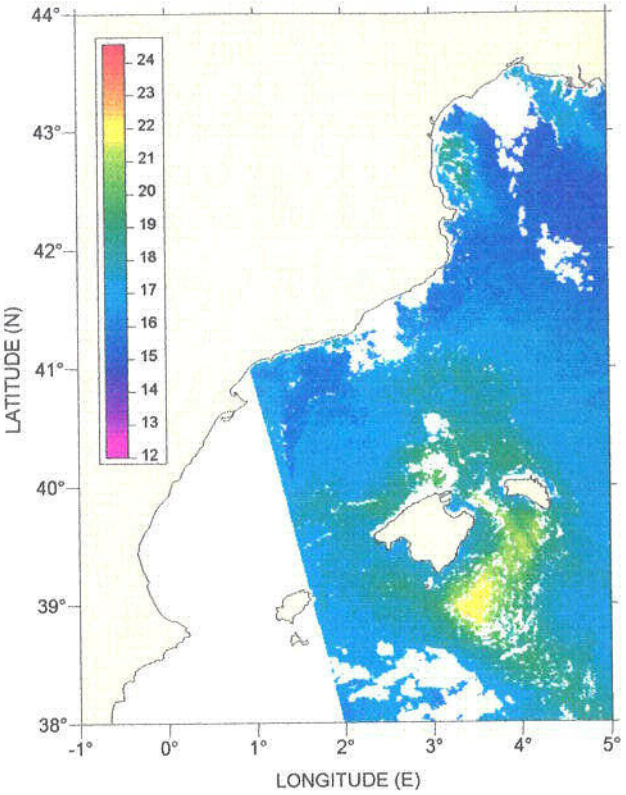


Temperature Satellite Individual Images
GICS-1 (1993) – Catalan Sea

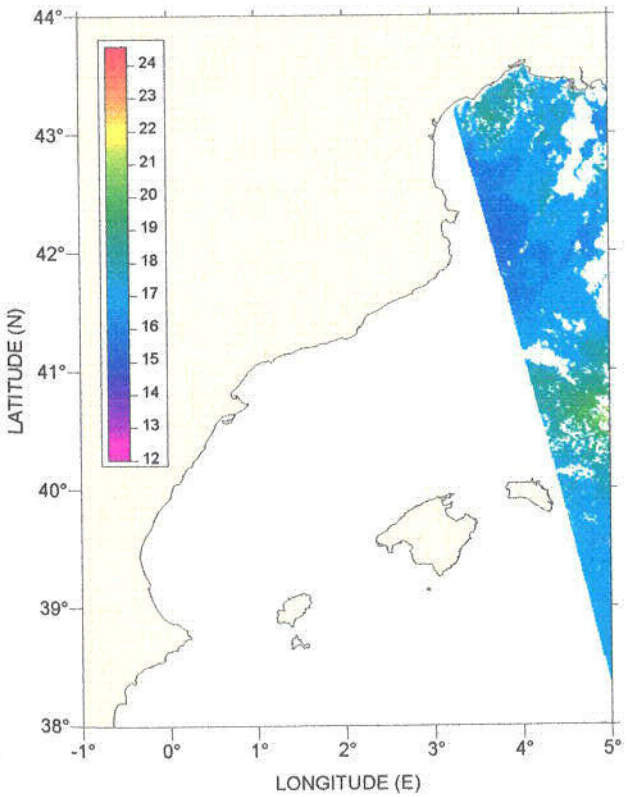
May, 02 (C930502P)



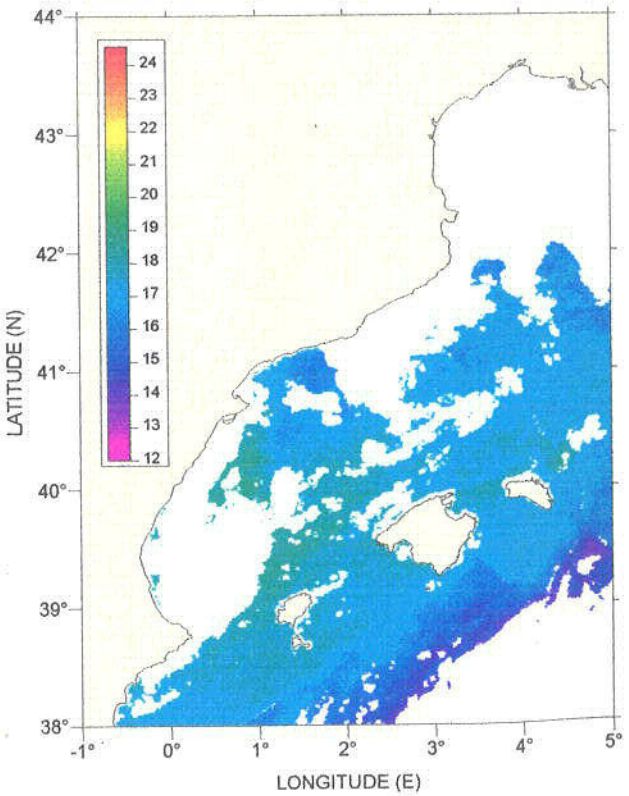
May, 03 (C930503P)



May, 04 (C930504P)

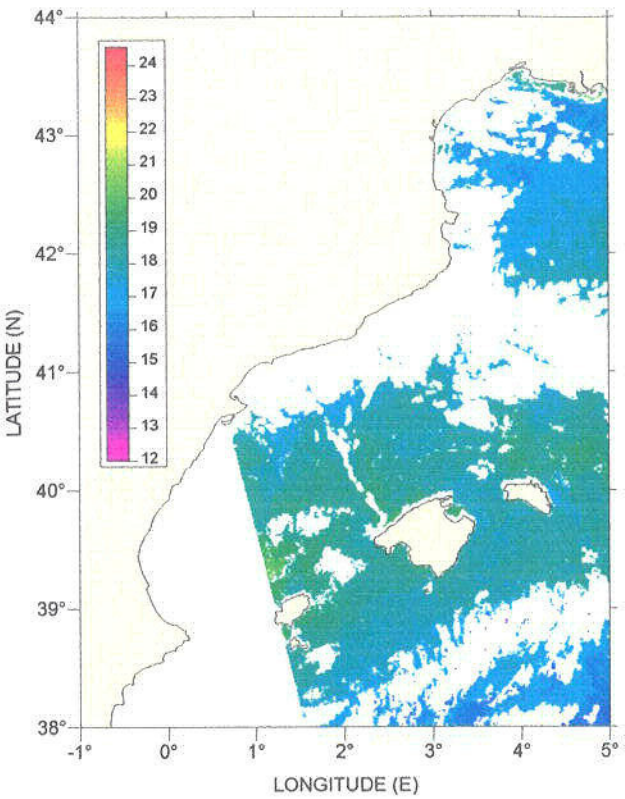


May, 10 (C930510P)

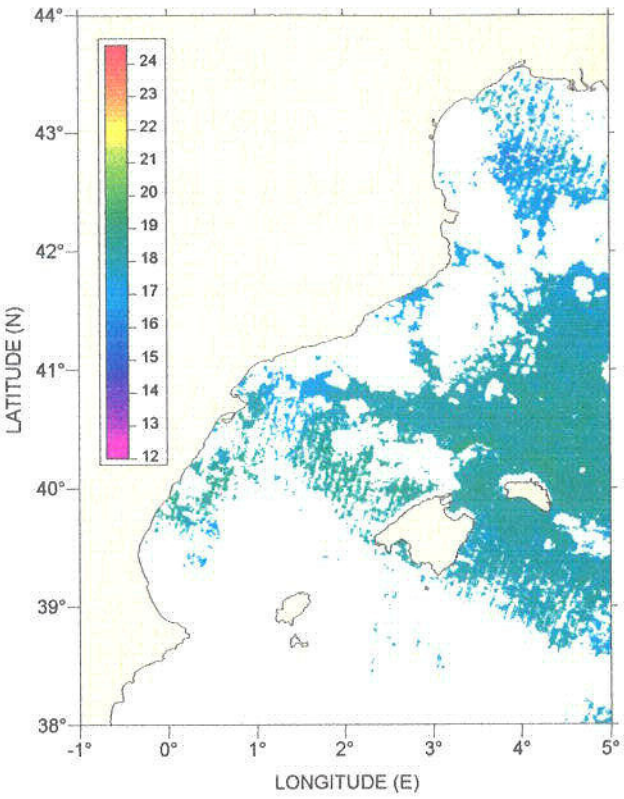


Temperature Satellite Individual Images
GICS-1 (1993) – Catalan Sea

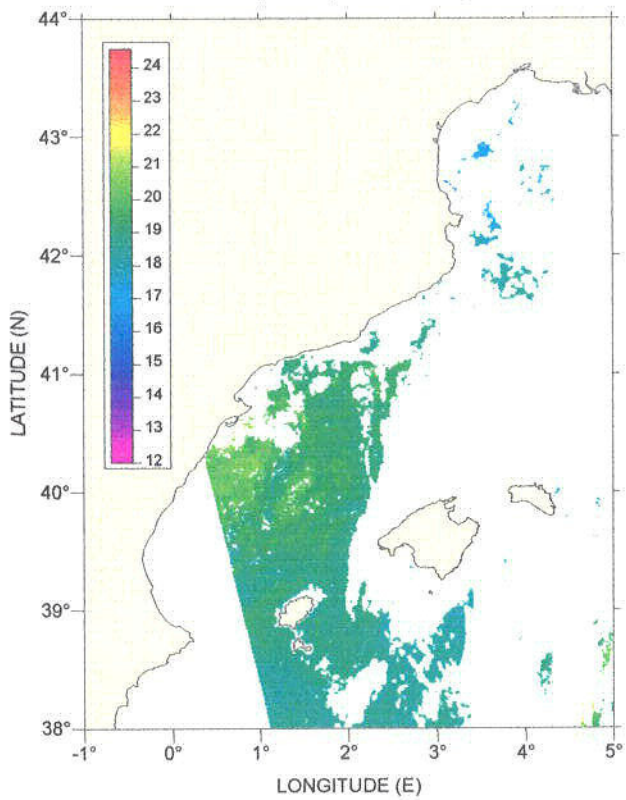
May, 11 (C930511P)



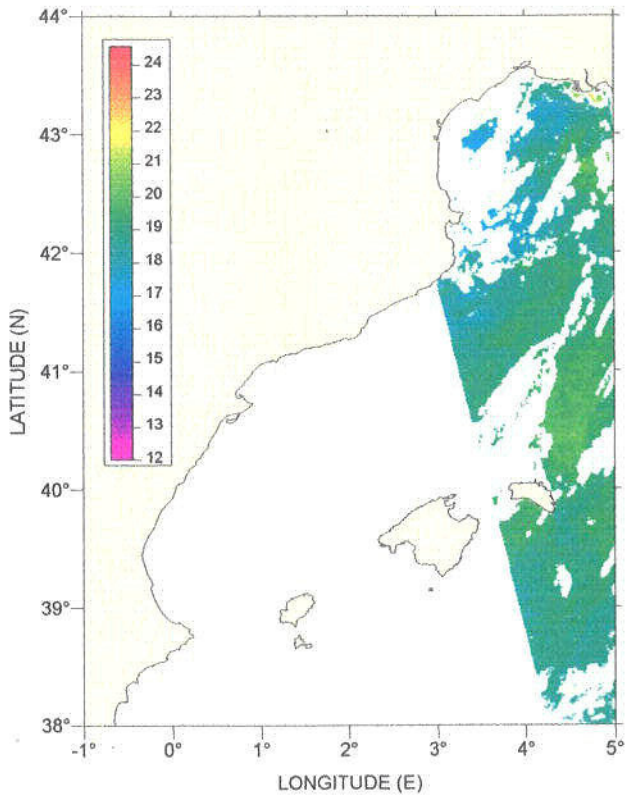
May, 16 (C930516N)



May, 19 (C930519P)

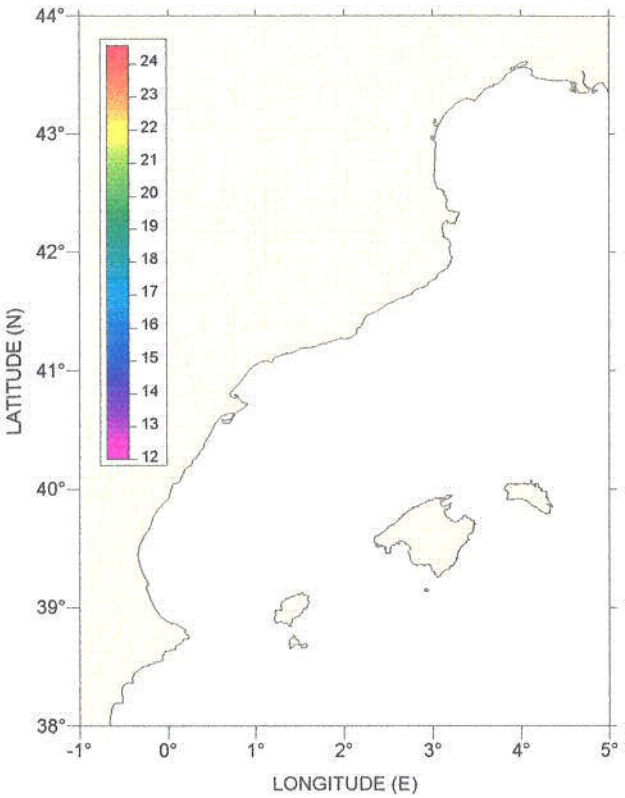


May, 20 (C930520P)

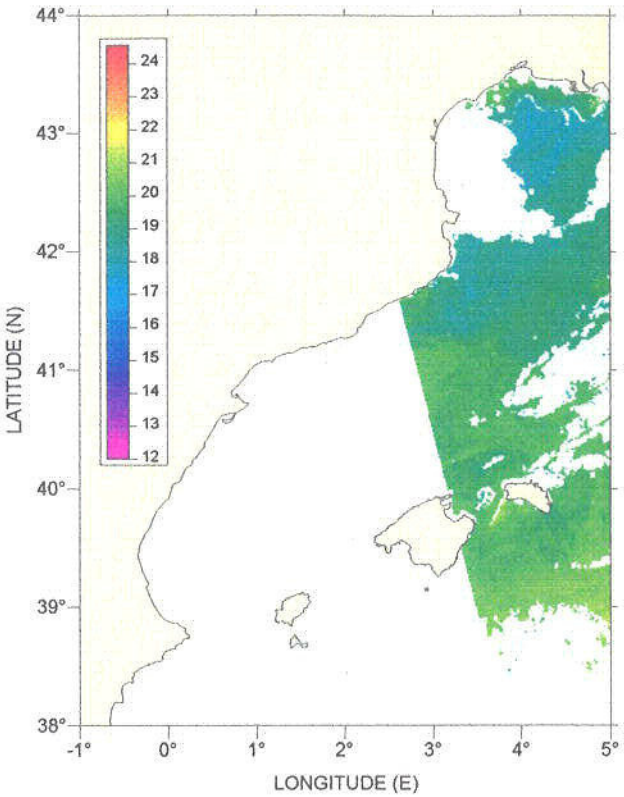


Temperature Satellite Individual Images
GICS-1 (1993) – Catalan Sea

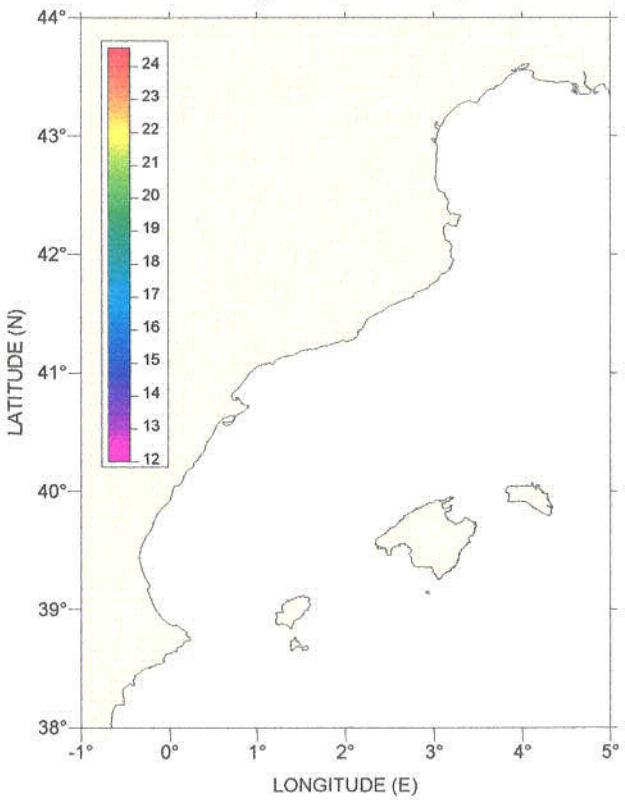
May, 21 (C930521P)



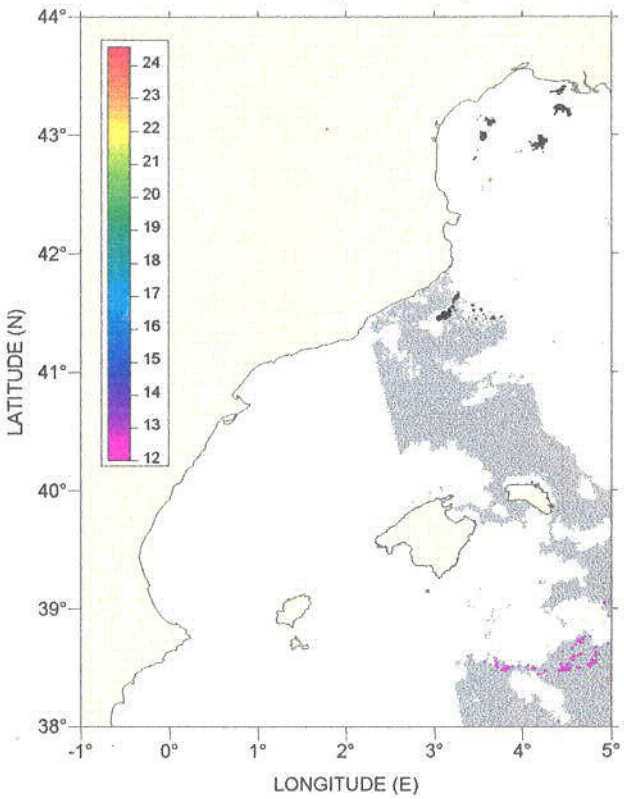
May, 28 (C930528P)



May, 29 (C930529P)

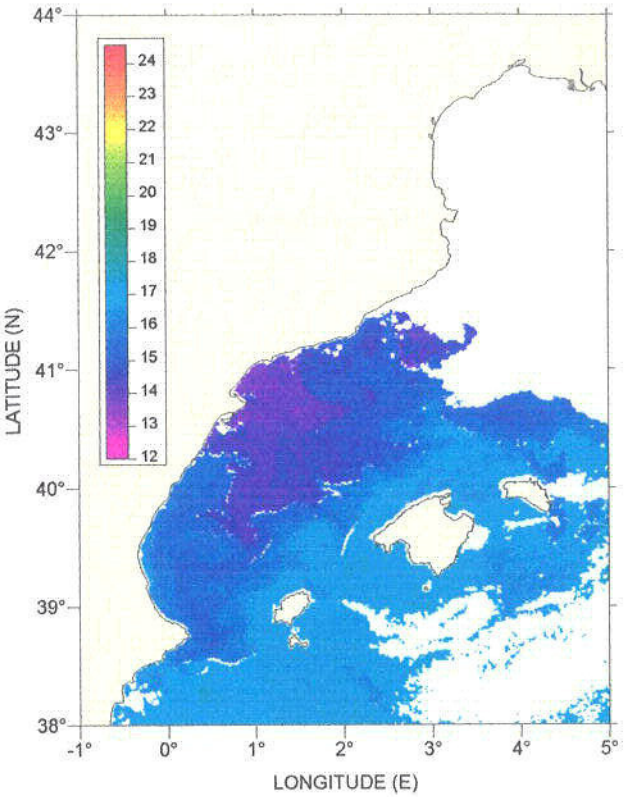


June, 05 (C930605P)

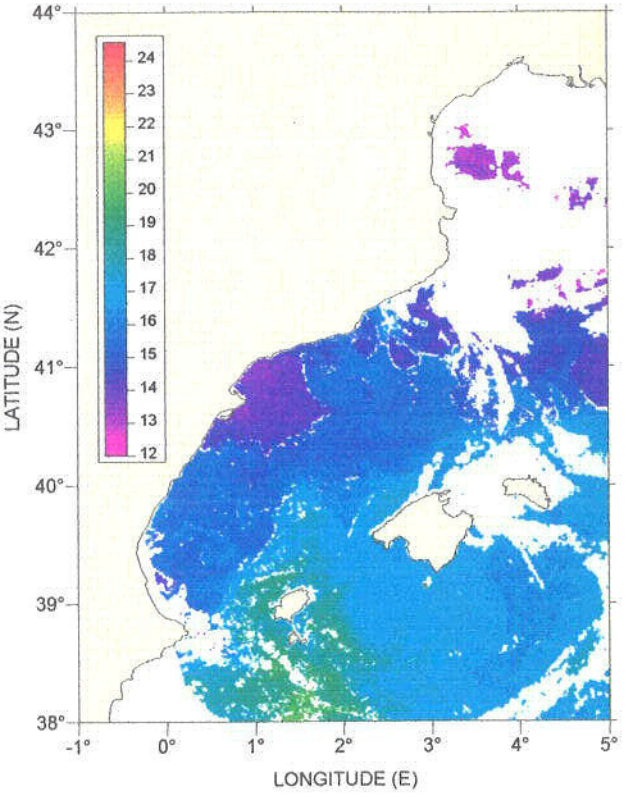


Temperature Satellite Individual Images
GICS-2 (1994) – Catalan Sea

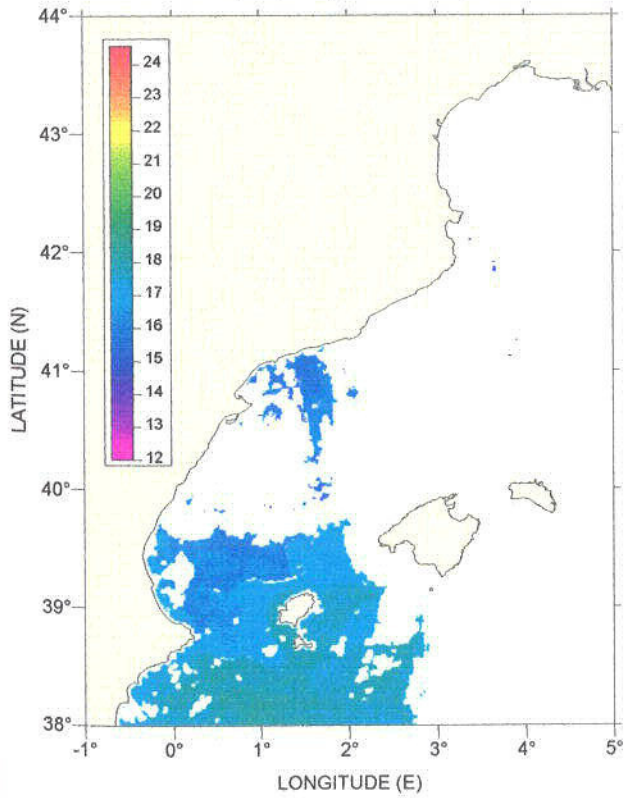
April, 17 (C940417P)



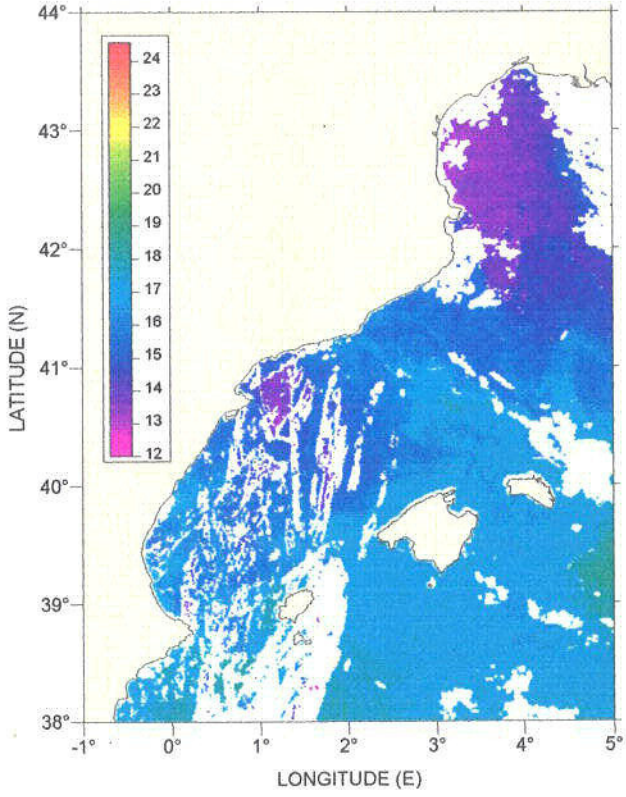
April, 18 (C940418P)



April, 24 (C940424P)

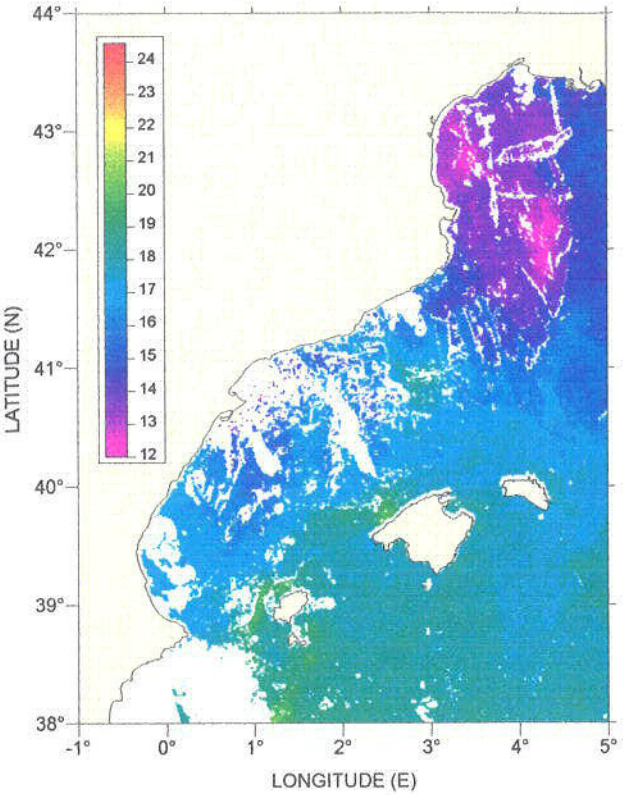


April, 25 (C940425P)

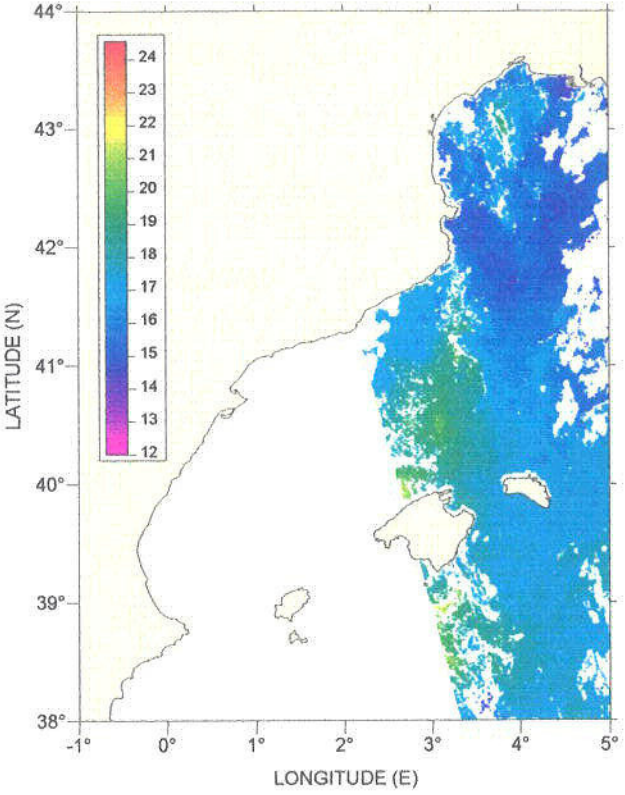


Temperature Satellite Individual Images
GICS-2 (1994) – Catalan Sea

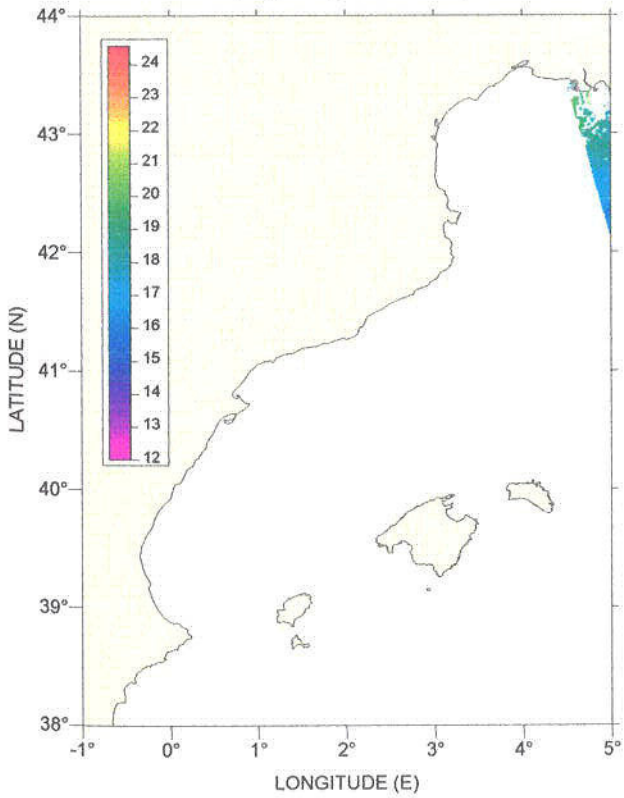
April, 26 (C940426P)



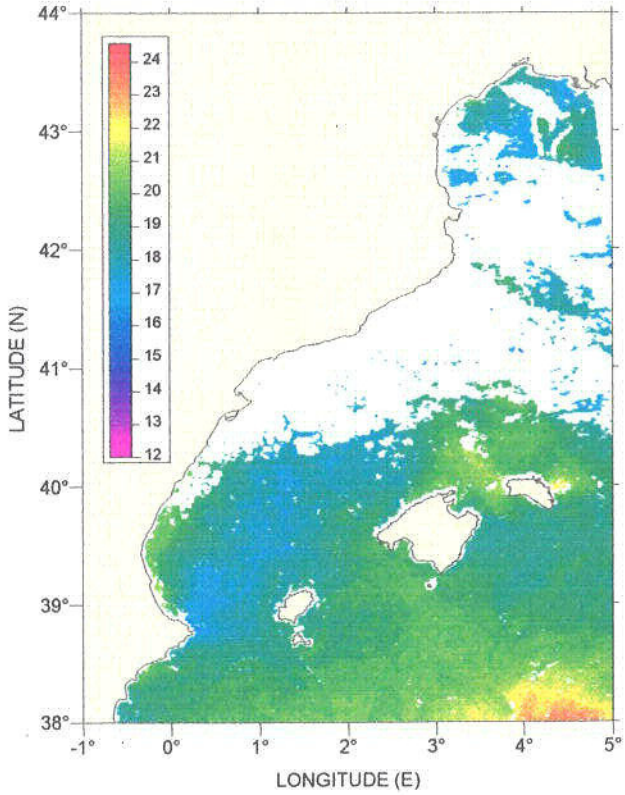
April, 27 (C940427P)



April, 28 (C940428P)

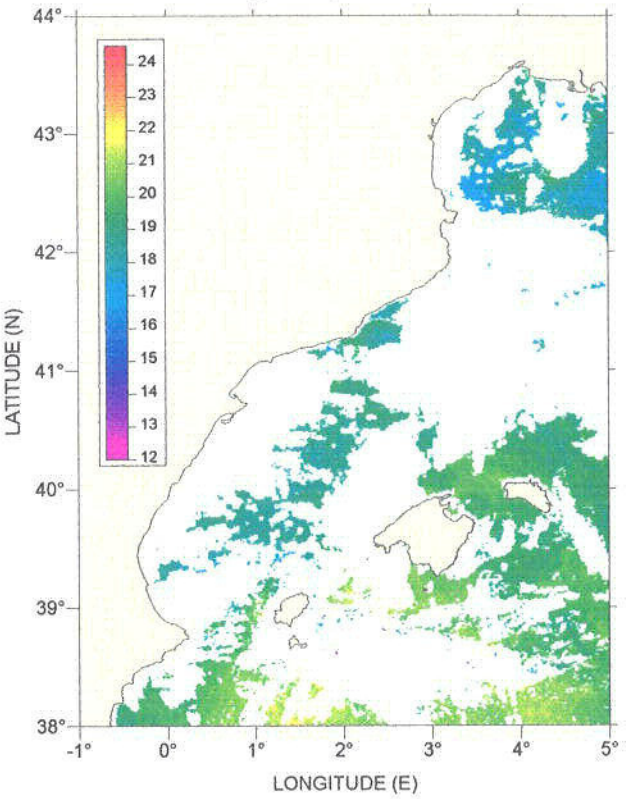


May, 02 (C940502P)

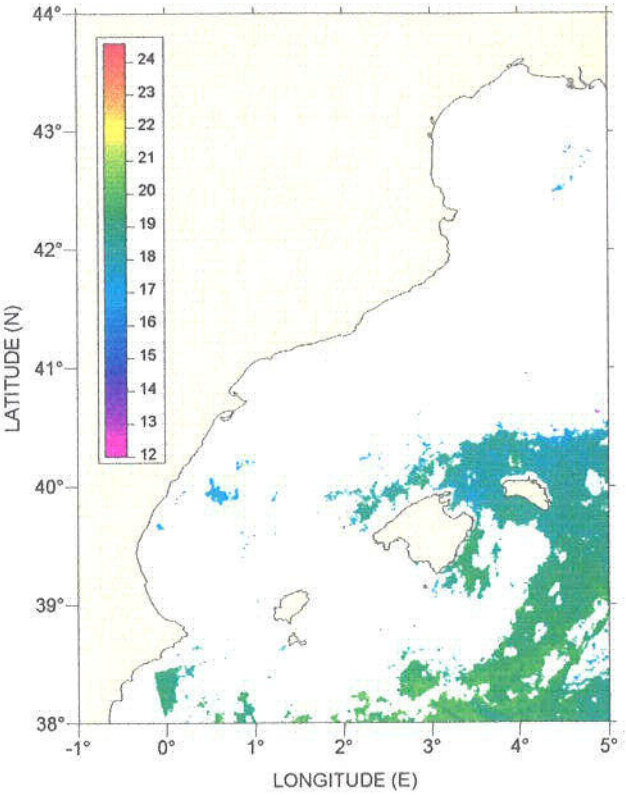


Temperature Satellite Individual Images
GICS-2 (1994) – Catalan Sea

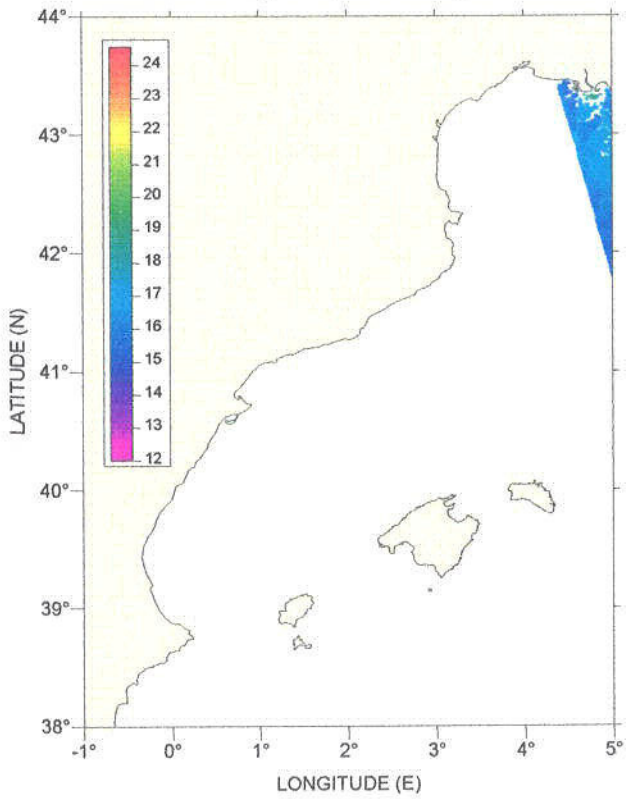
May, 03 (C940503P)



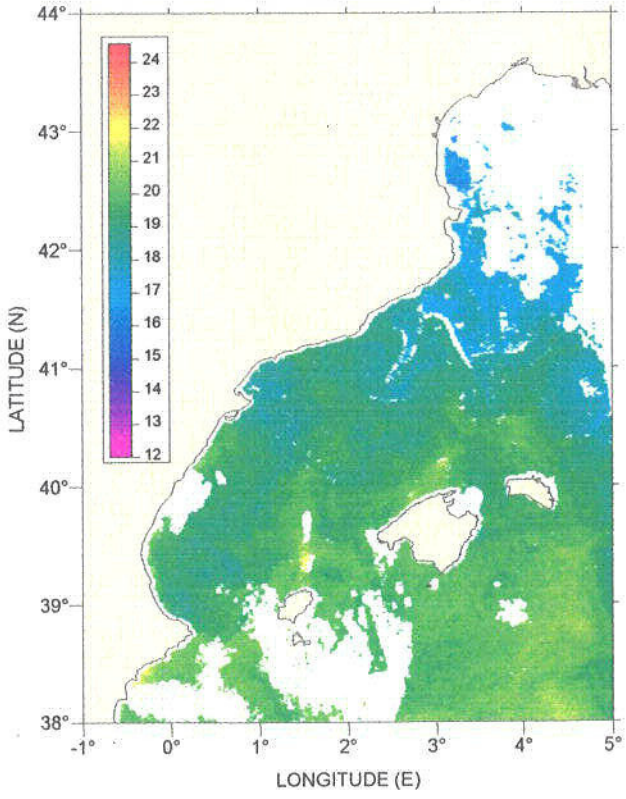
May, 04 (C940504P)



May, 06 (C940506P)

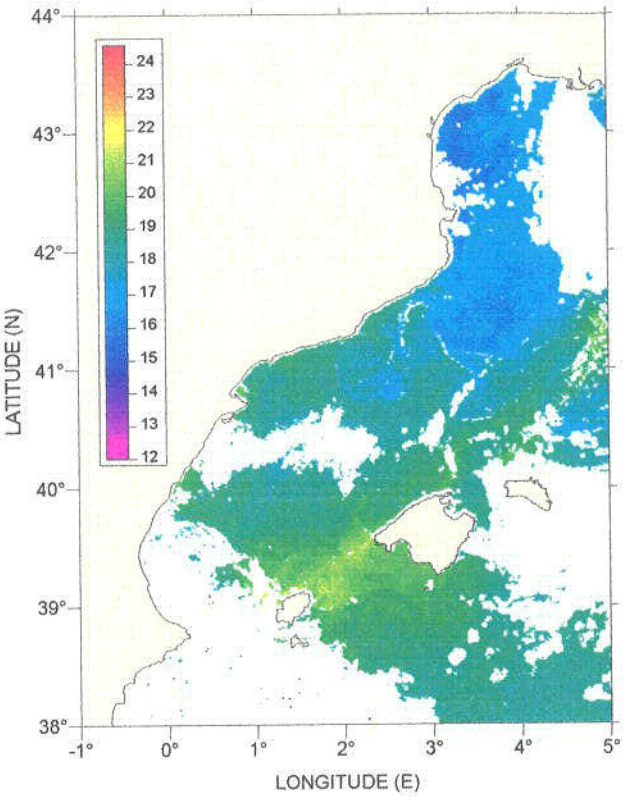


May, 10 (C940510P)

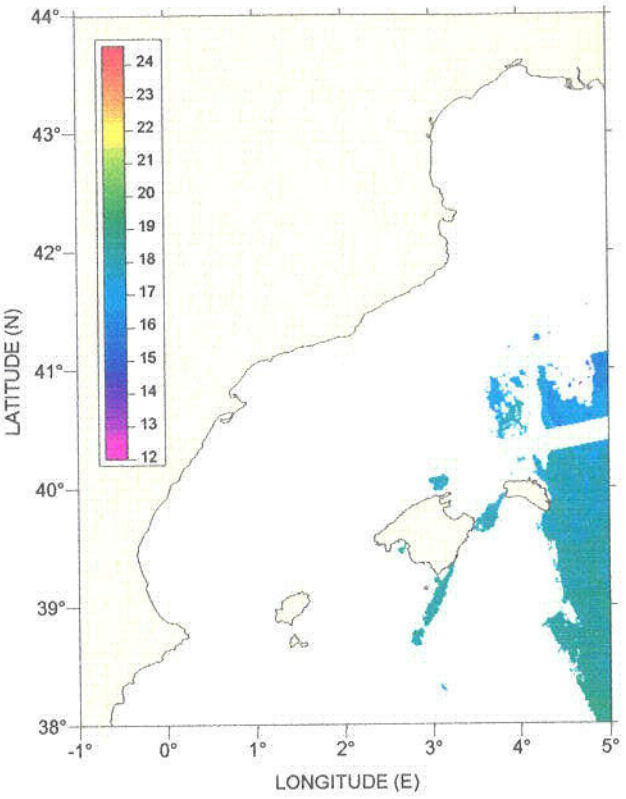


Temperature Satellite Individual Images
GICS-2 (1994) – Catalan Sea

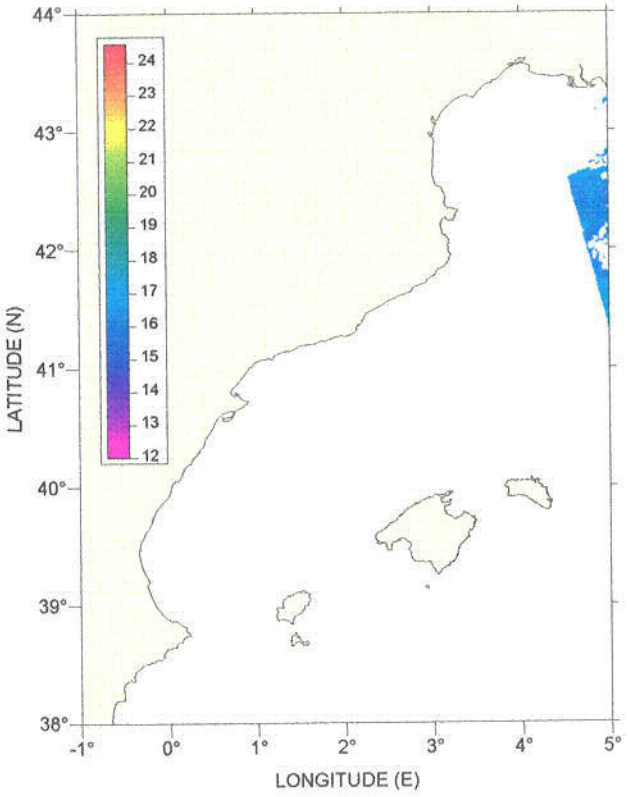
May, 12 (C940512P)



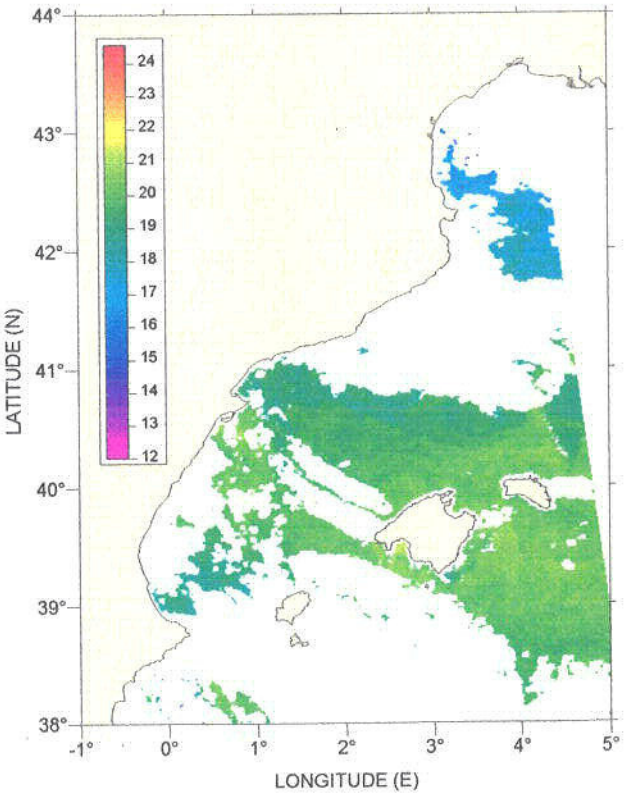
May, 13 (C940513P)



May, 14 (C940514P)

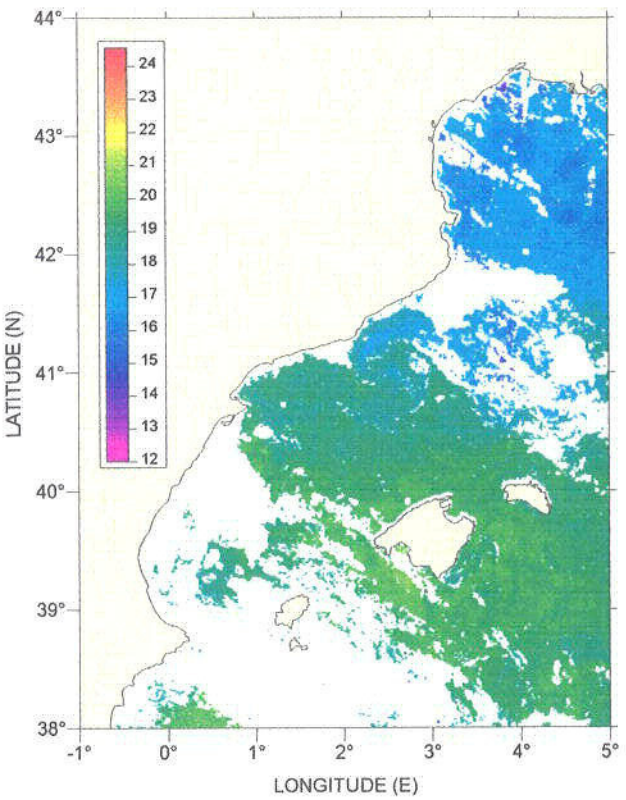


May, 18 (C940518P)

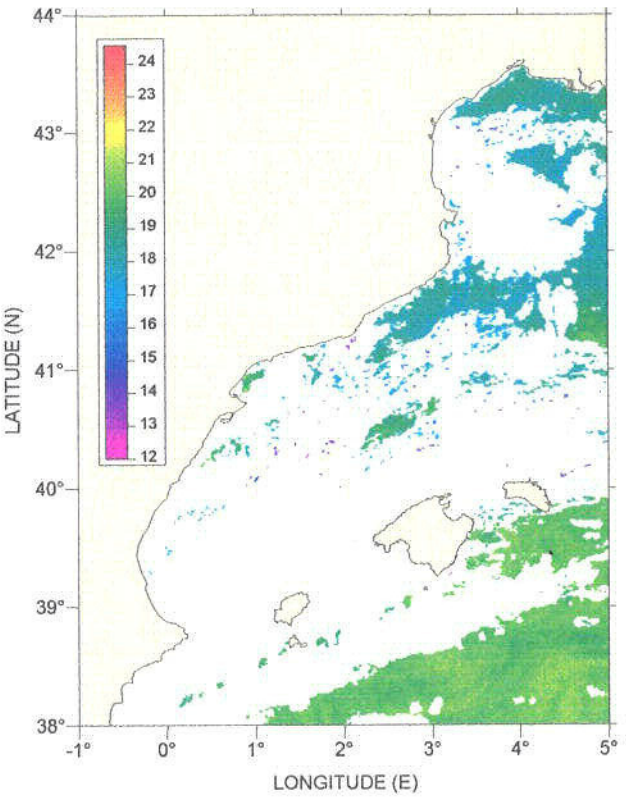


Temperature Satellite Individual Images
GICS-2 (1994) – Catalan Sea

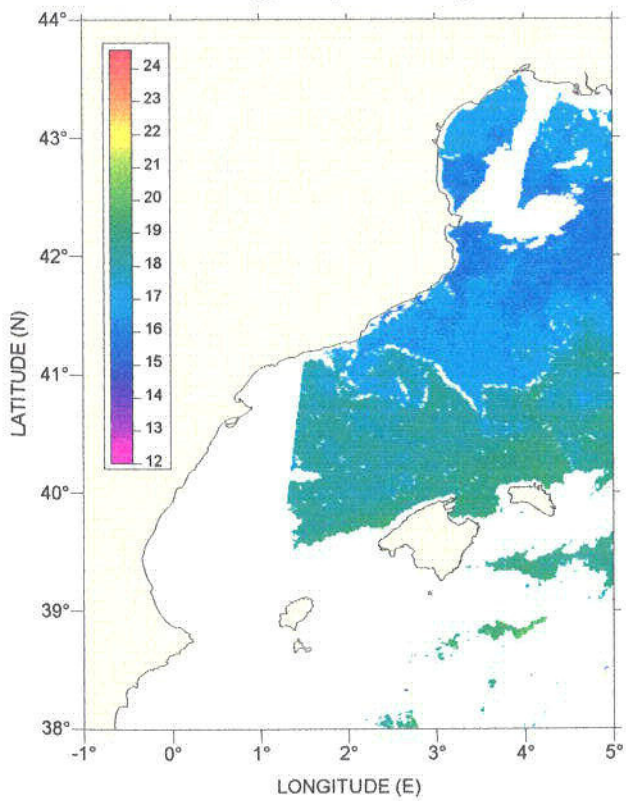
May, 19 (C940519M)



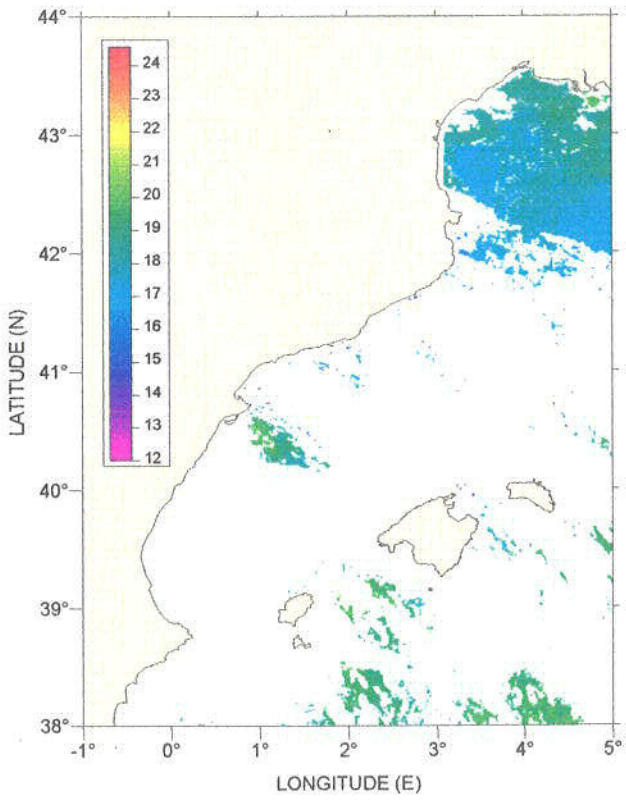
May, 19 (C940519P)



May, 20 (C940520M)

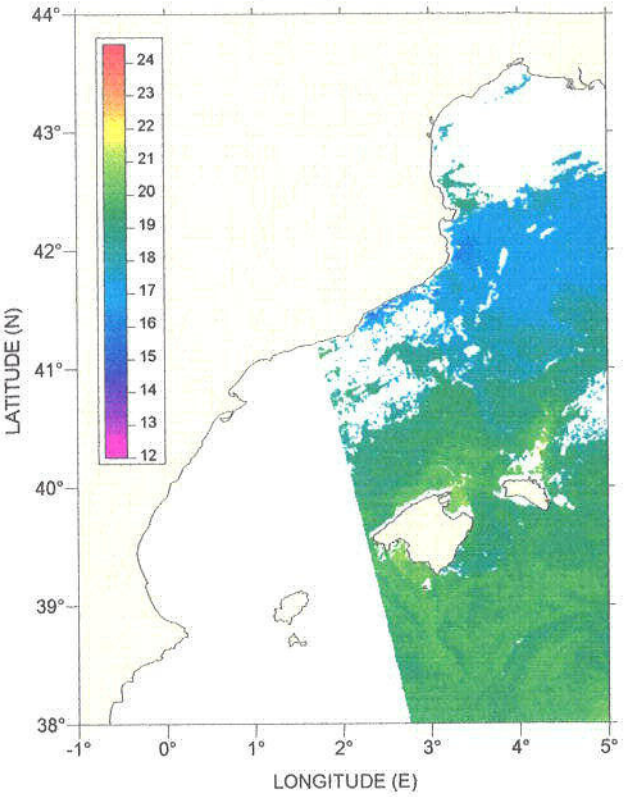


May, 20 (C940520P)

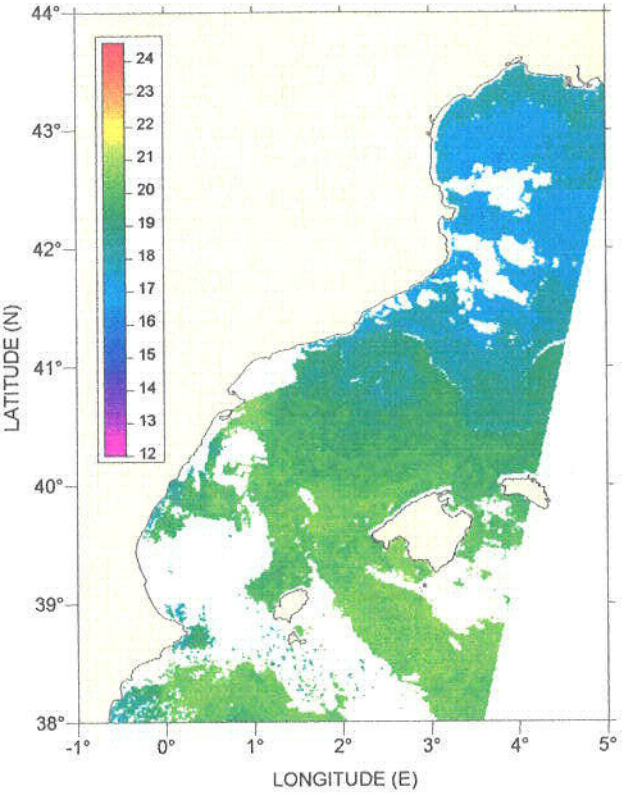


Temperature Satellite Individual Images
GICS-2 (1994) – Catalan Sea

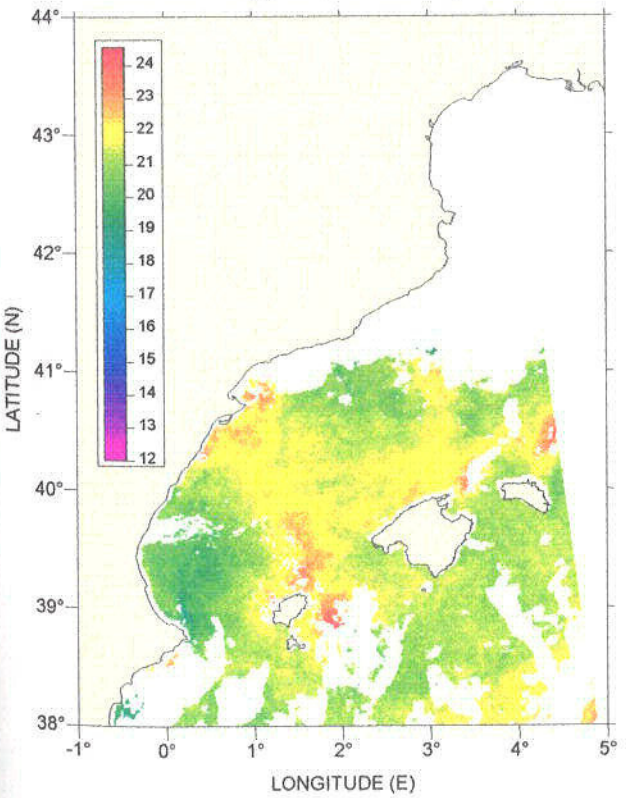
May, 21 (C940521P)



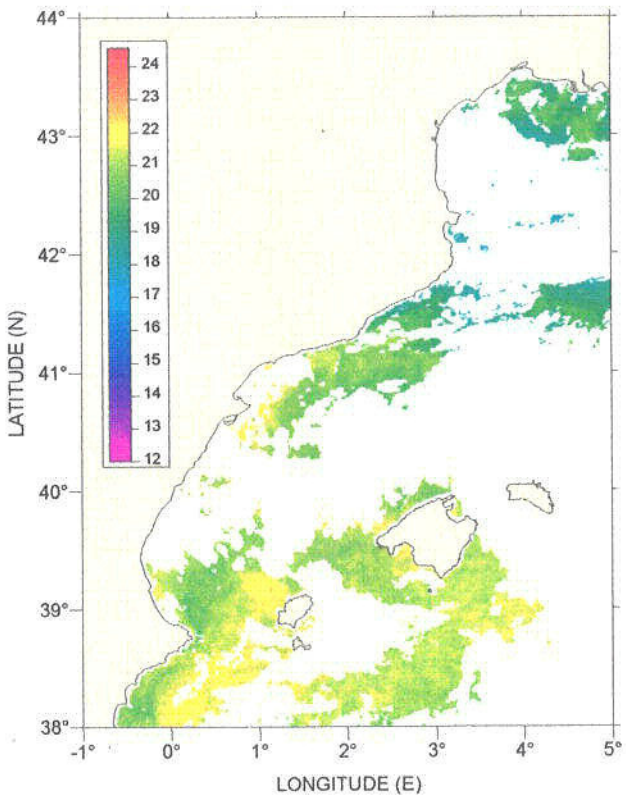
May, 25 (C940525N)



May, 26 (C940526P)

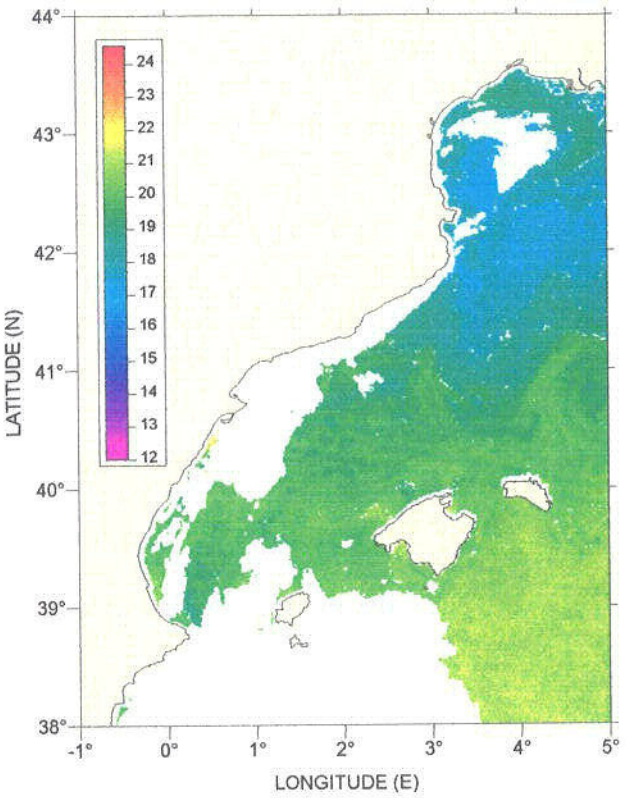


May, 27 (C940527P)

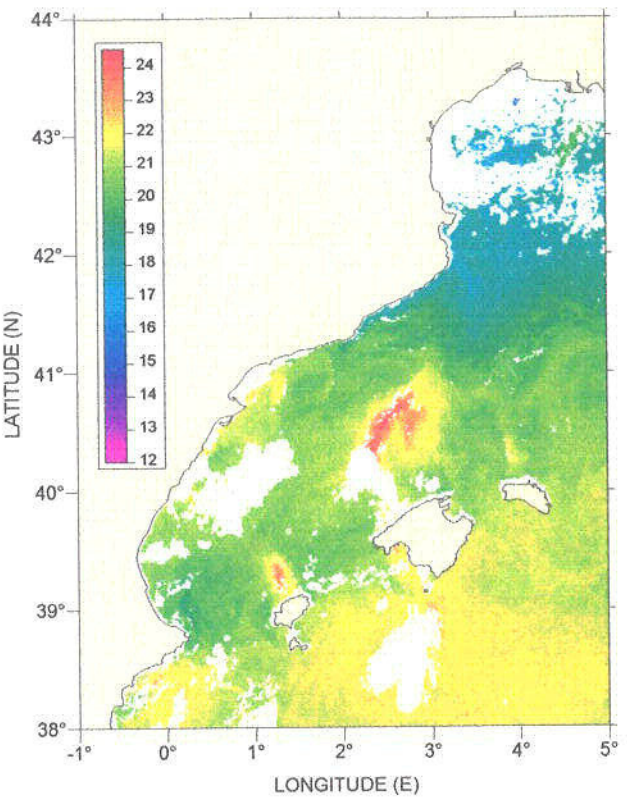


Temperature Satellite Individual Images
GICS-2 (1994) – Catalan Sea

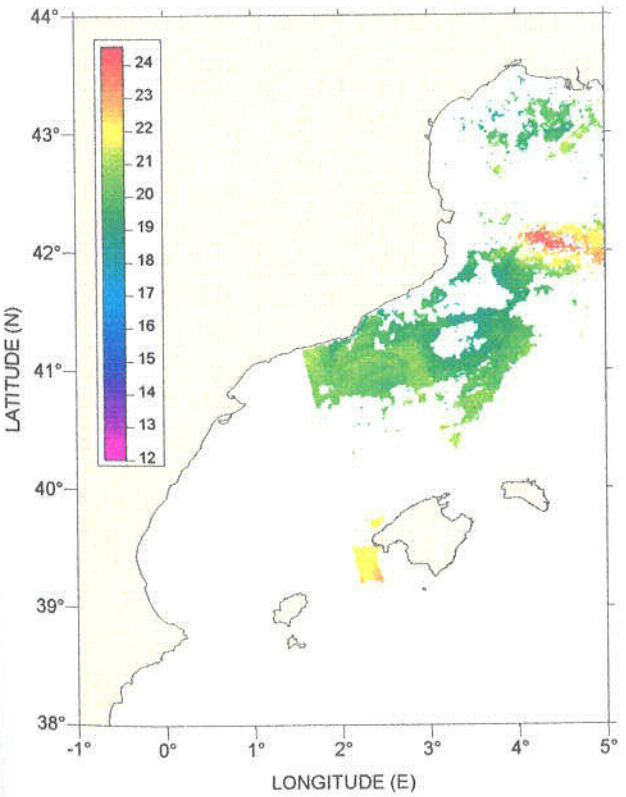
May, 28 (C940528M)



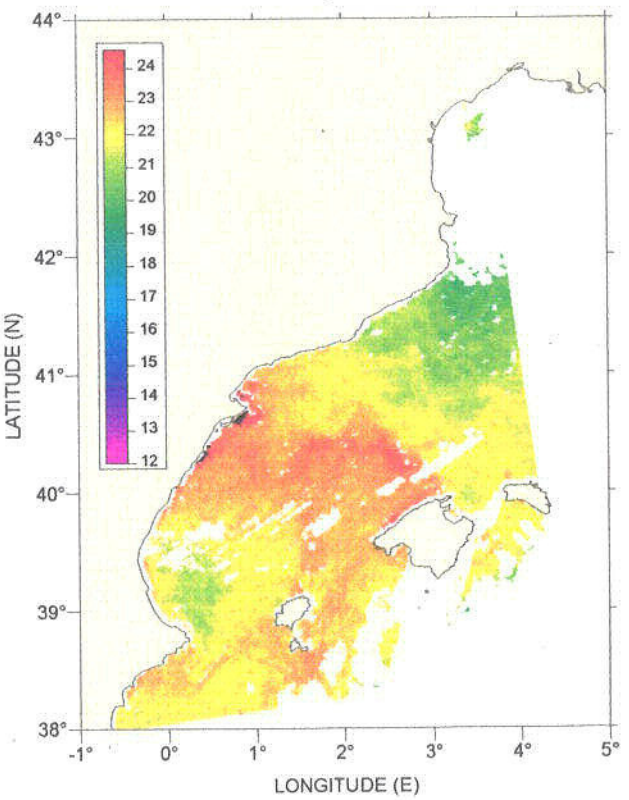
May, 28 (C940528P)



May, 29 (C940529P)

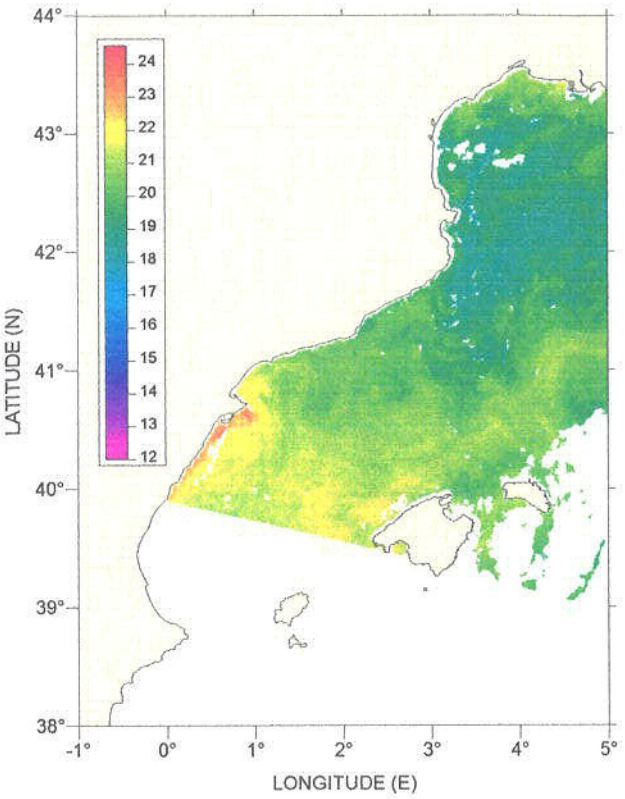


June, 03 (C940603P)

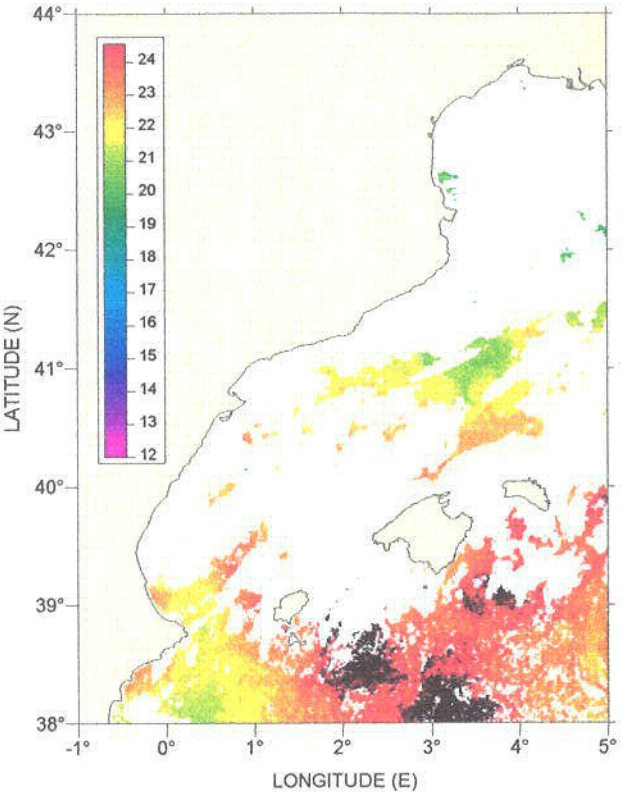


Temperature Satellite Individual Images
GICS-2 (1994) – Catalan Sea

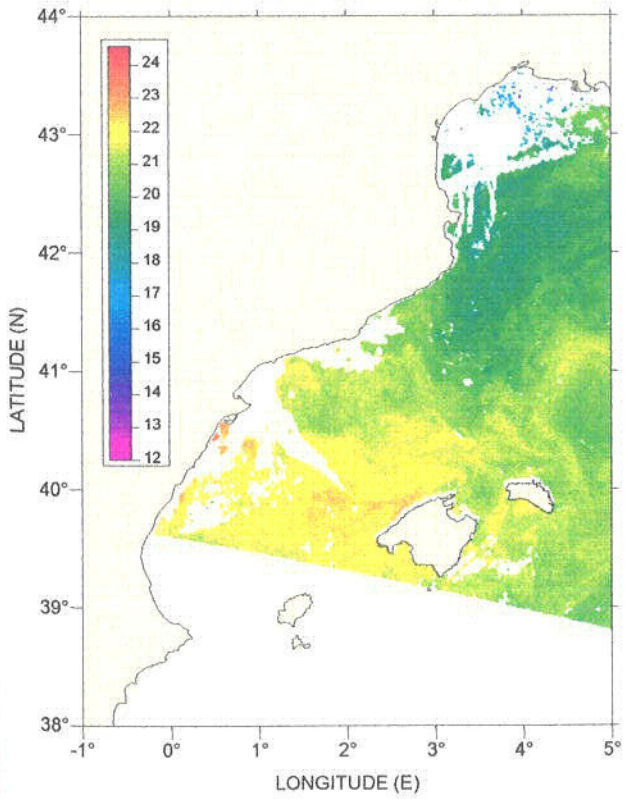
June, 03 (C940603N)



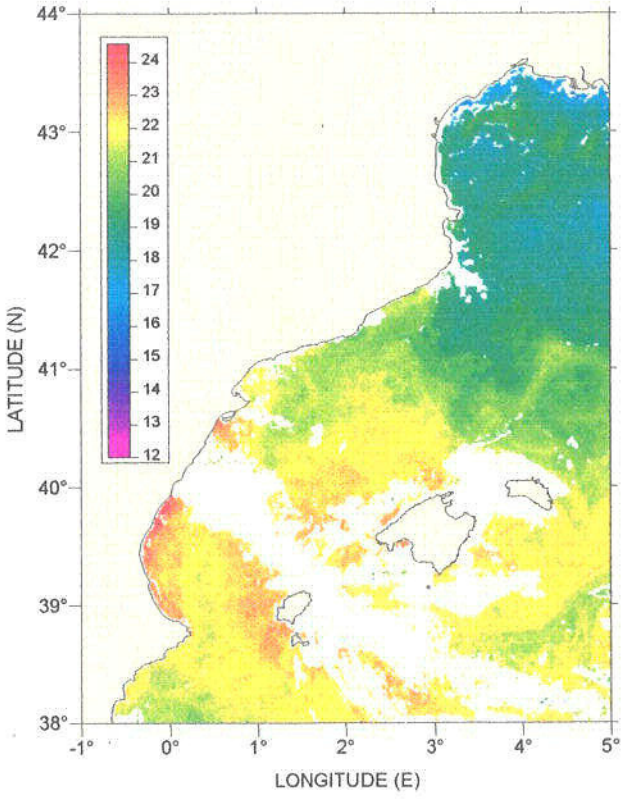
June, 04 (C940604P)



June, 04 (C940604N)

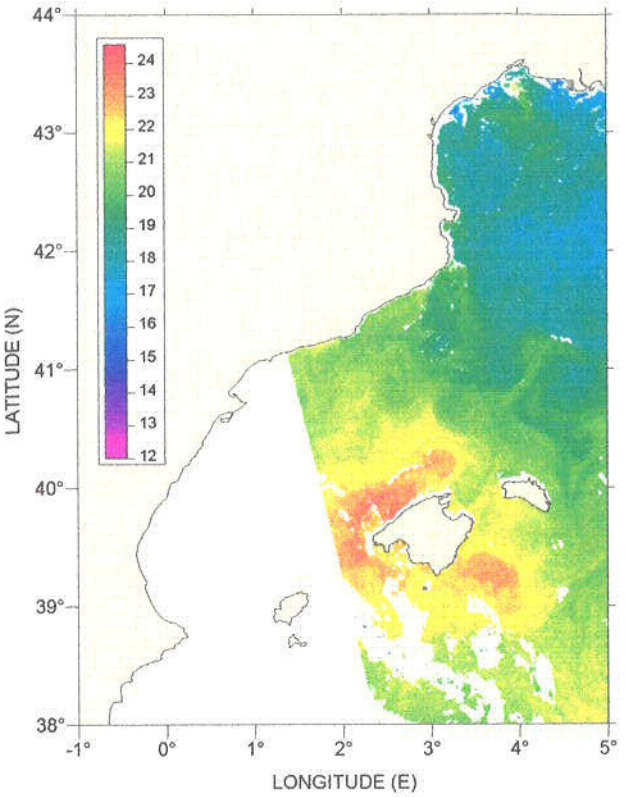


June, 05 (C940605P)

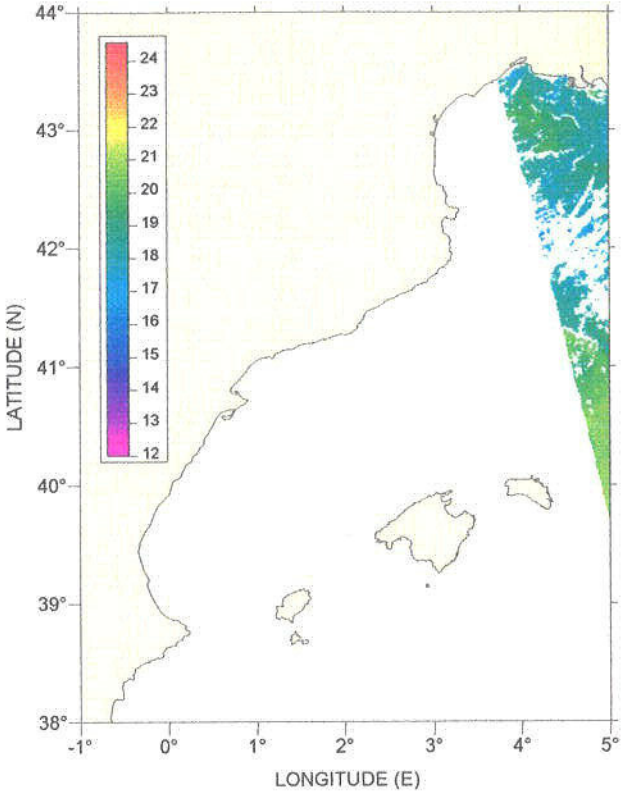


Temperature Satellite Individual Images
GICS-2 (1994) – Catalan Sea

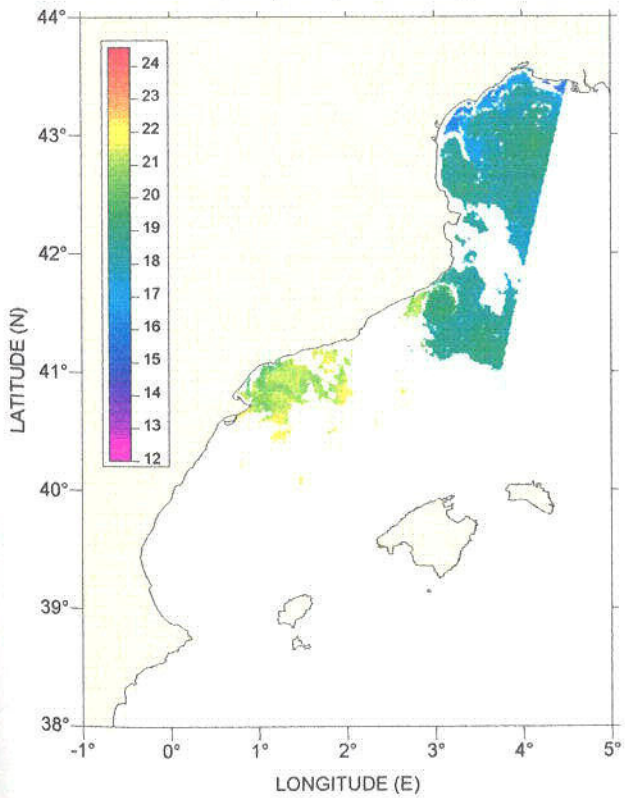
June, 06 (C940606P)



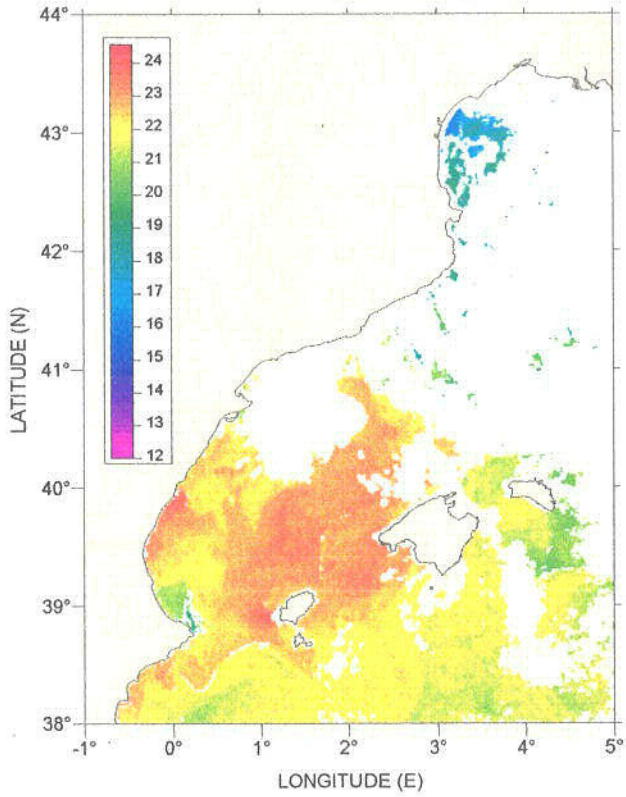
June, 07 (C940607P)



June, 10 (C940610N)

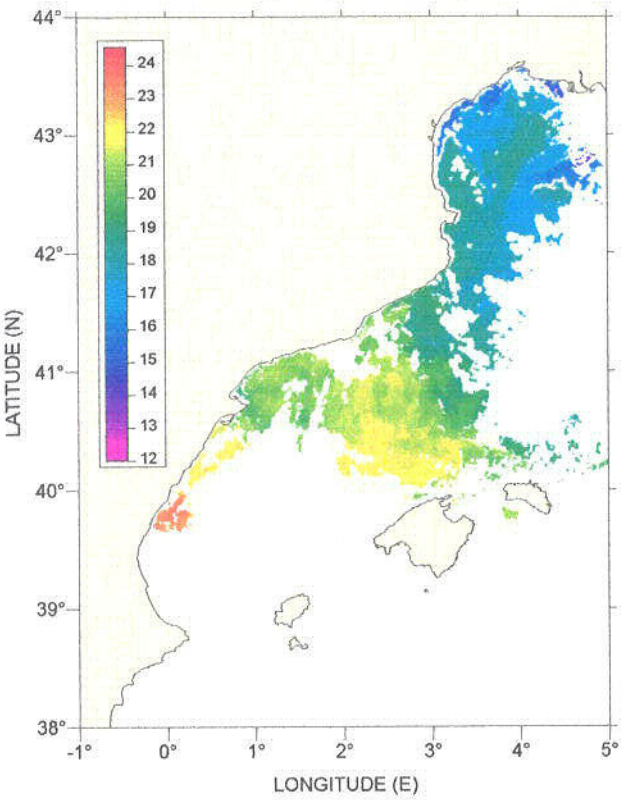


June, 12 (C940612P)

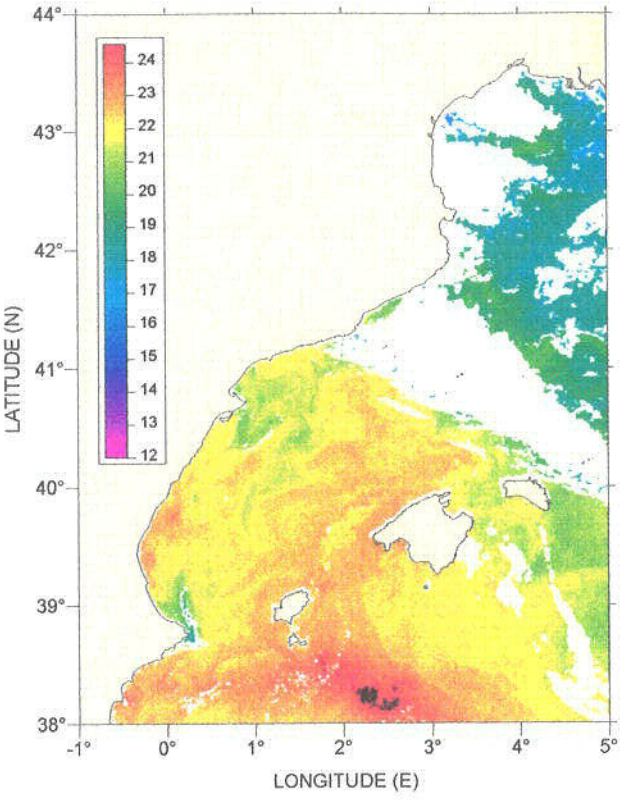


Temperature Satellite Individual Images
GICS-2 (1994) – Catalan Sea

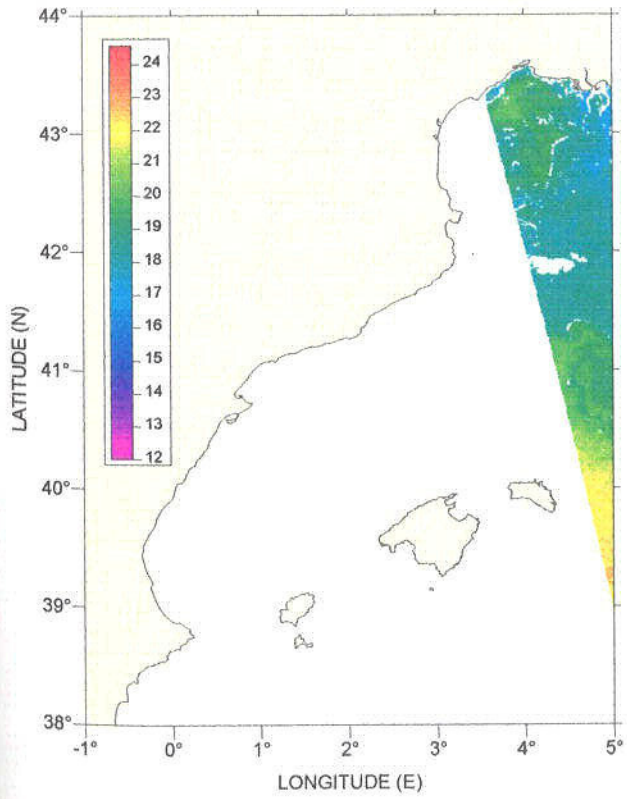
June, 12 (C940612N)



June, 13 (C940613P)

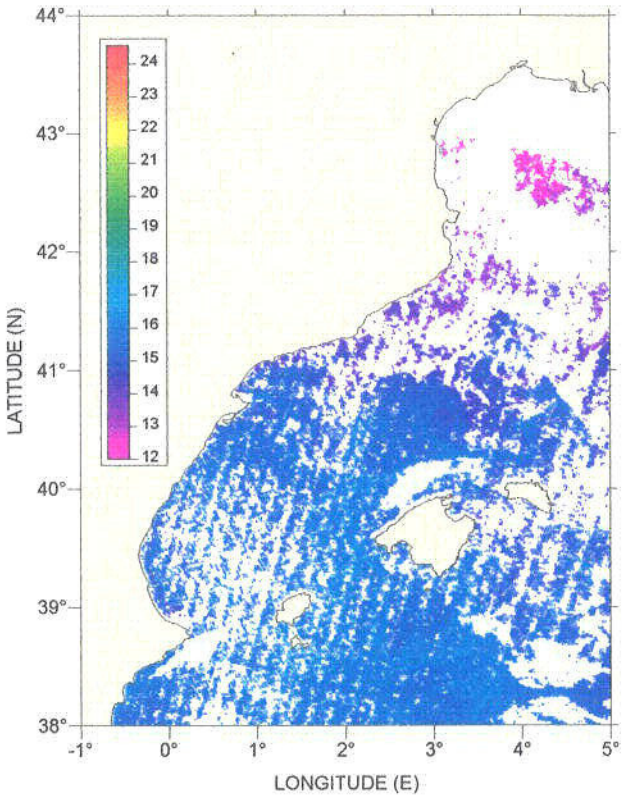


June, 15 (C940615P)

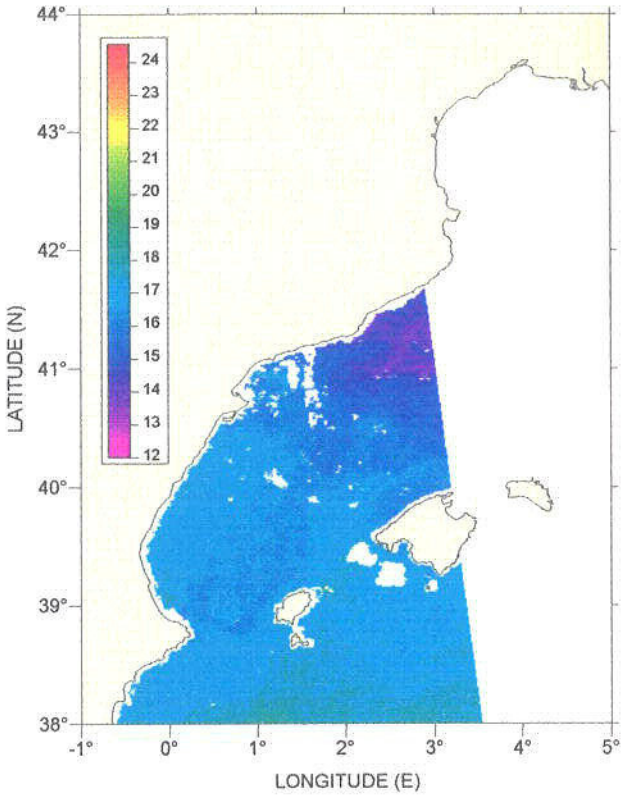


Temperature Satellite Individual Images
GICS-3 (1995) – Catalan Sea

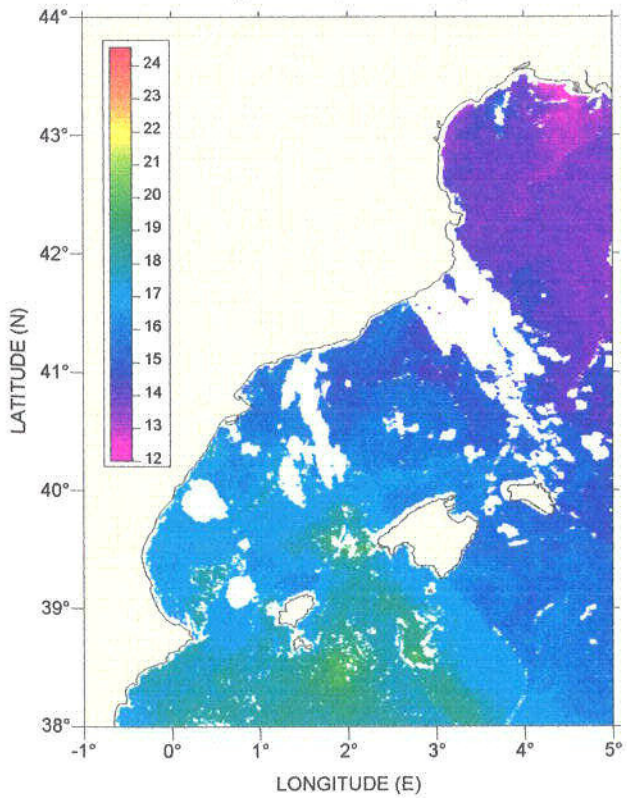
April, 04 (C950404N)



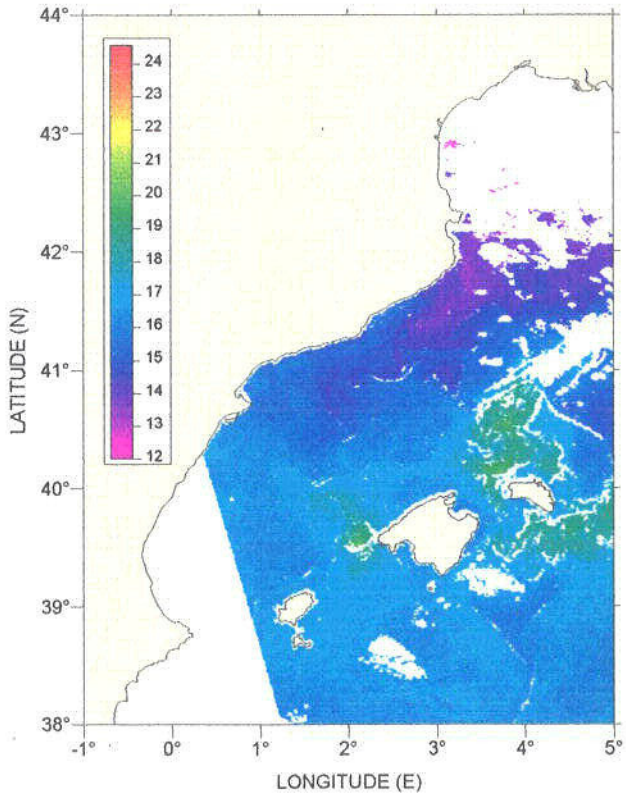
April, 08 (C950408P)



April, 09 (C950409P)

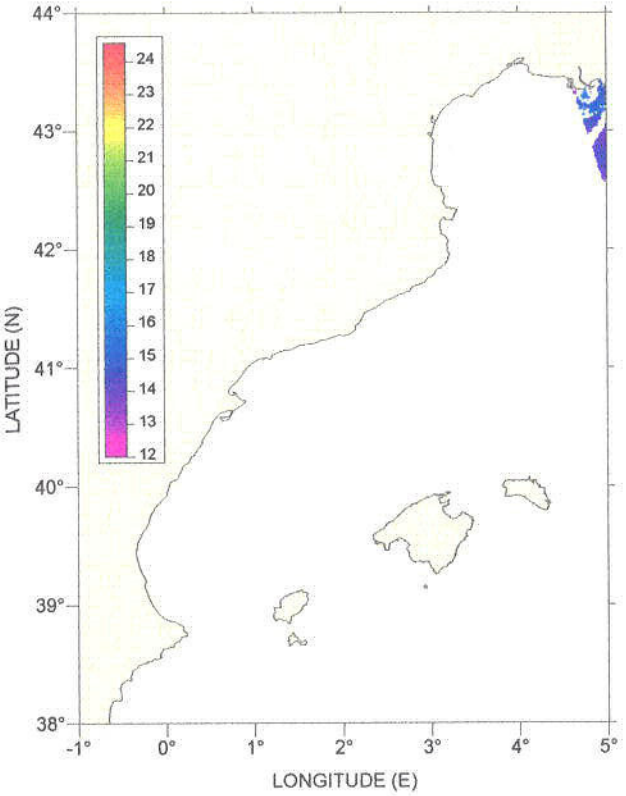


April, 10 (C950410P)

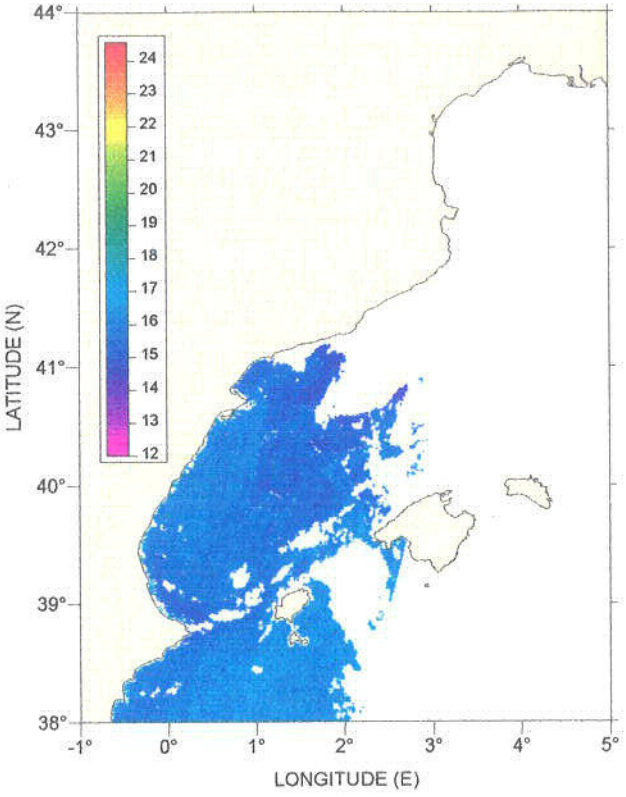


Temperature Satellite Individual Images
GICS-3 (1995) – Catalan Sea

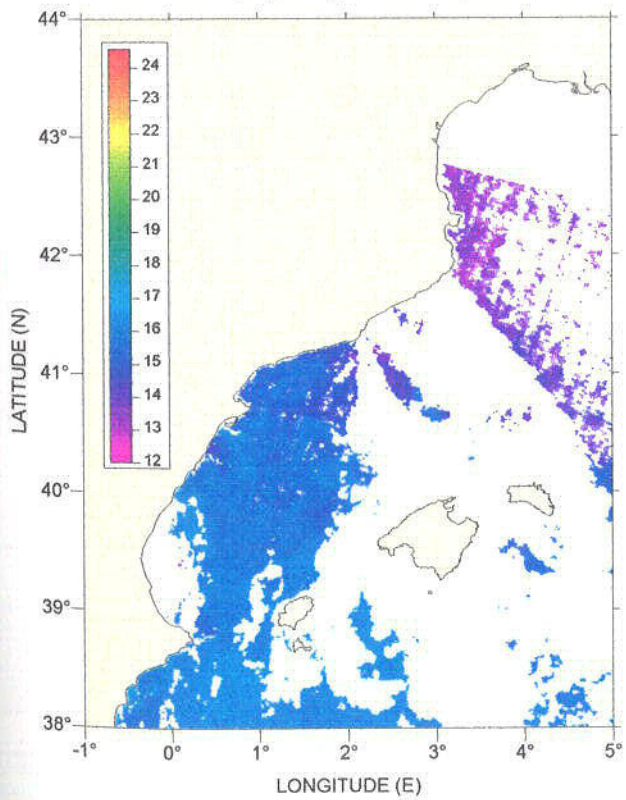
April, 12 (C950412P)



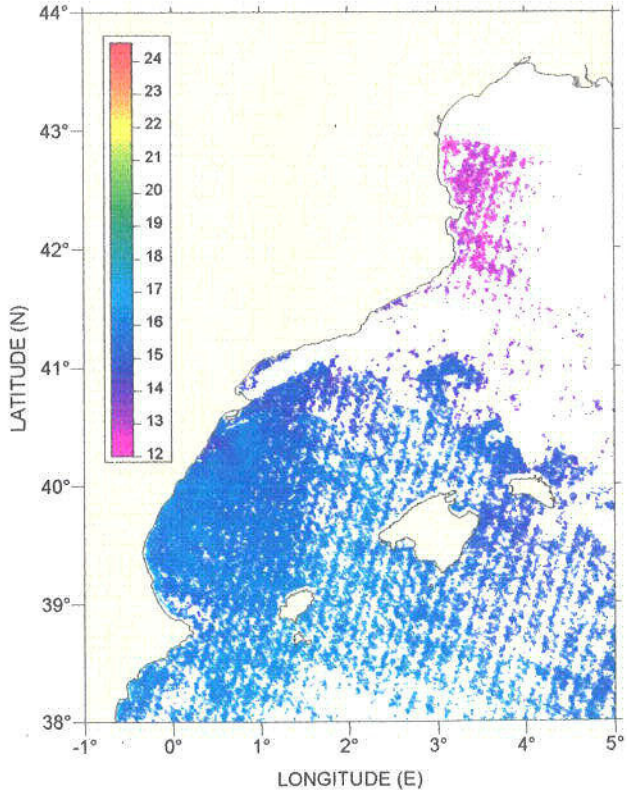
April, 16 (C950416M)



April, 17 (C950417N)

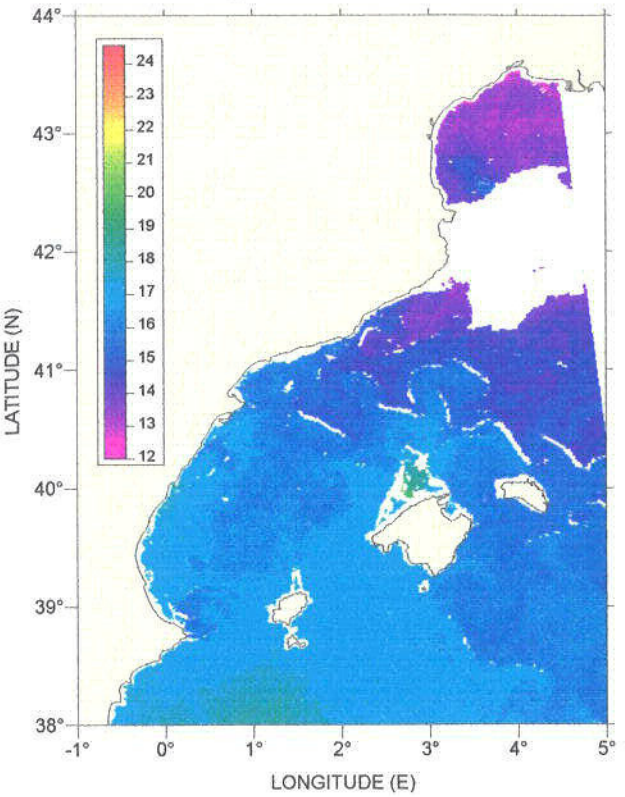


April, 18 (C950418N)

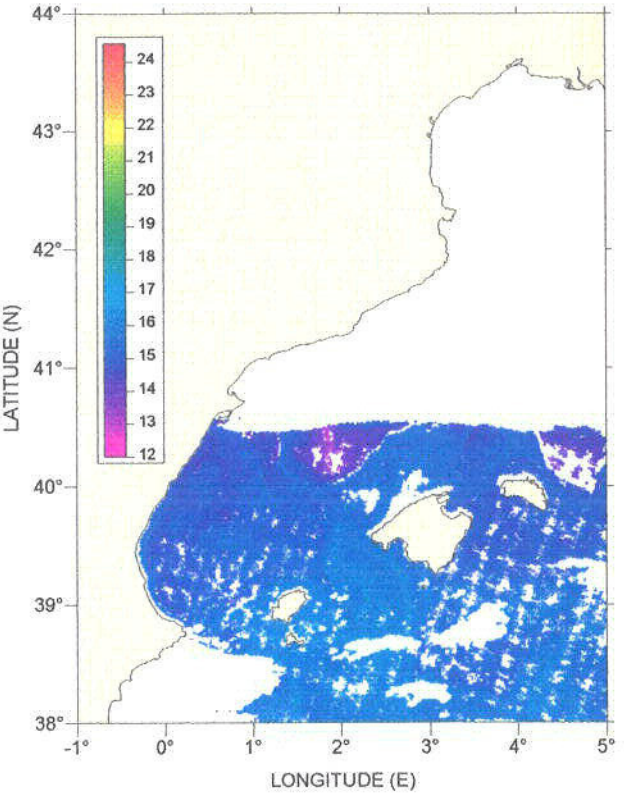


Temperature Satellite Individual Images
GICS-3 (1995) – Catalan Sea

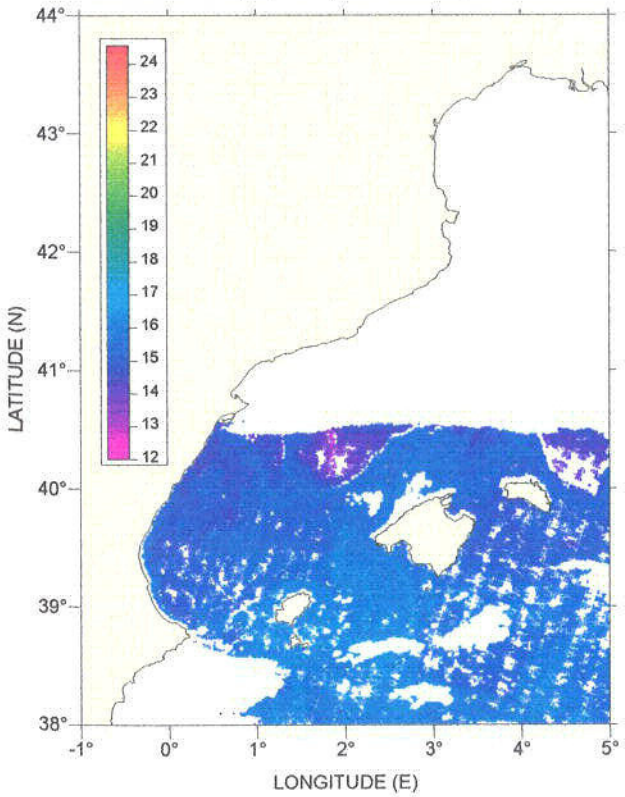
April, 18 (C950418P)



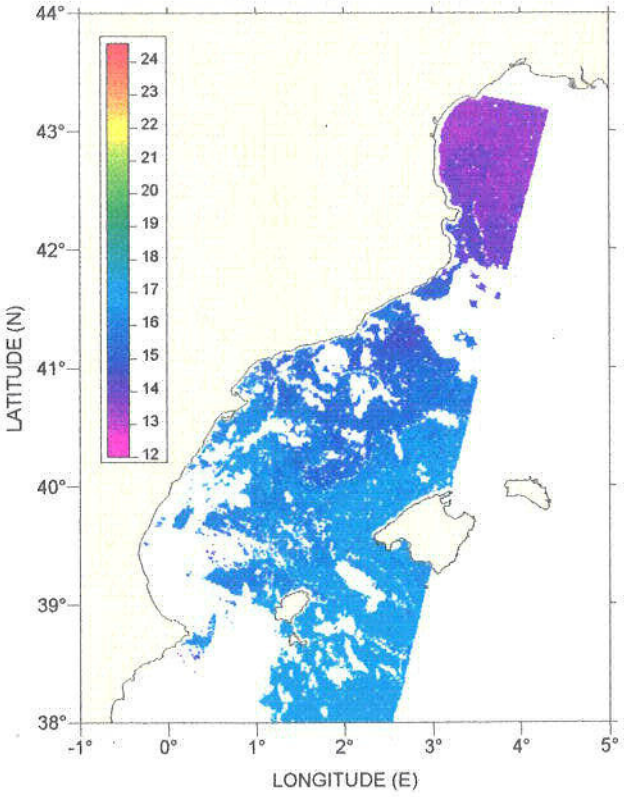
April, 26 (C950426N)



April, 27 (C950427N)

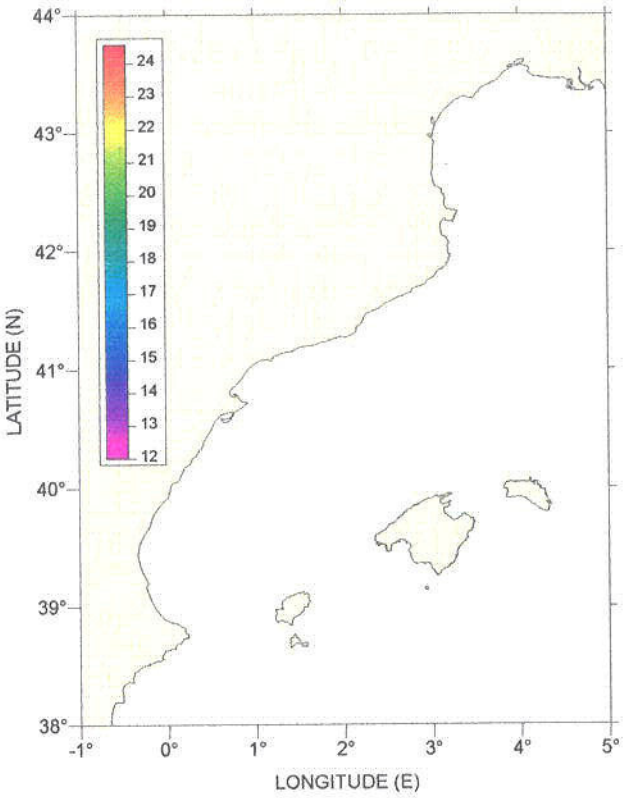


April, 30 (C950430M)

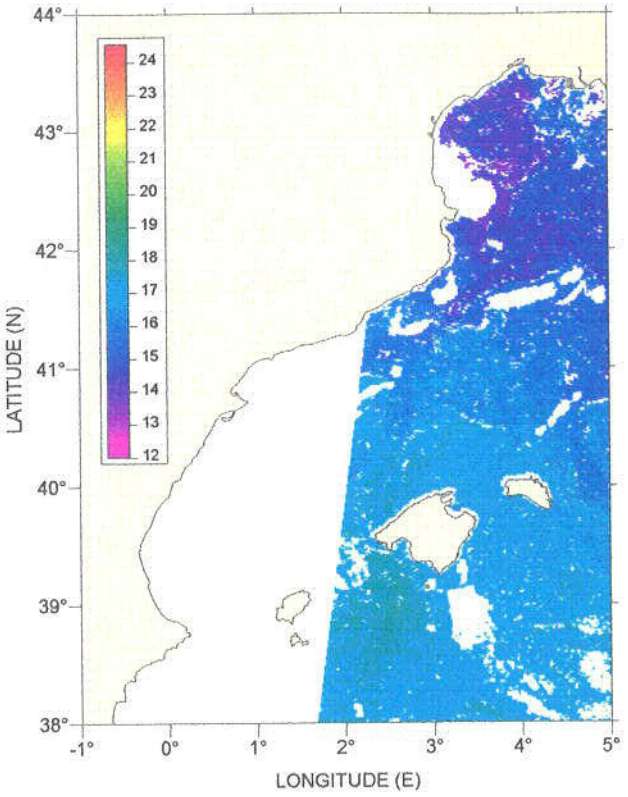


Temperature Satellite Individual Images
GICS-3 (1995) – Catalan Sea

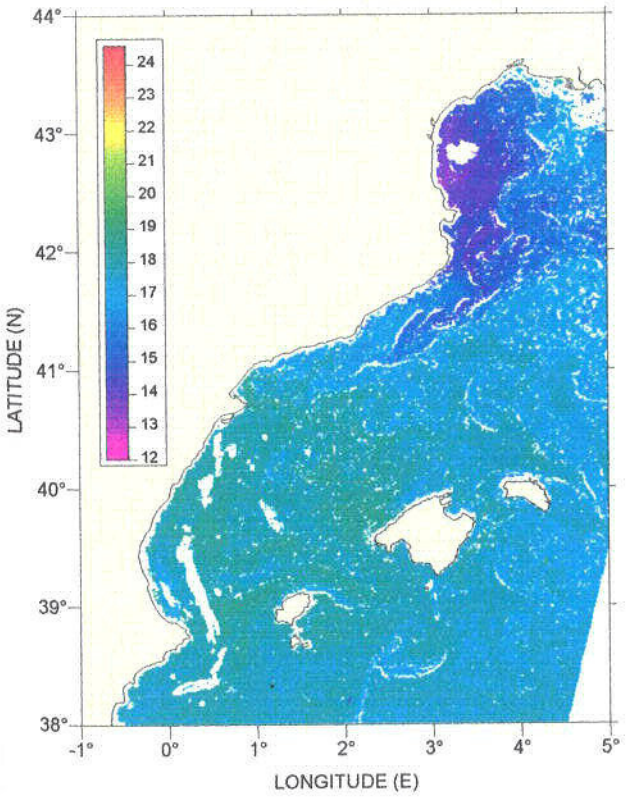
May, 01 (C950501M)



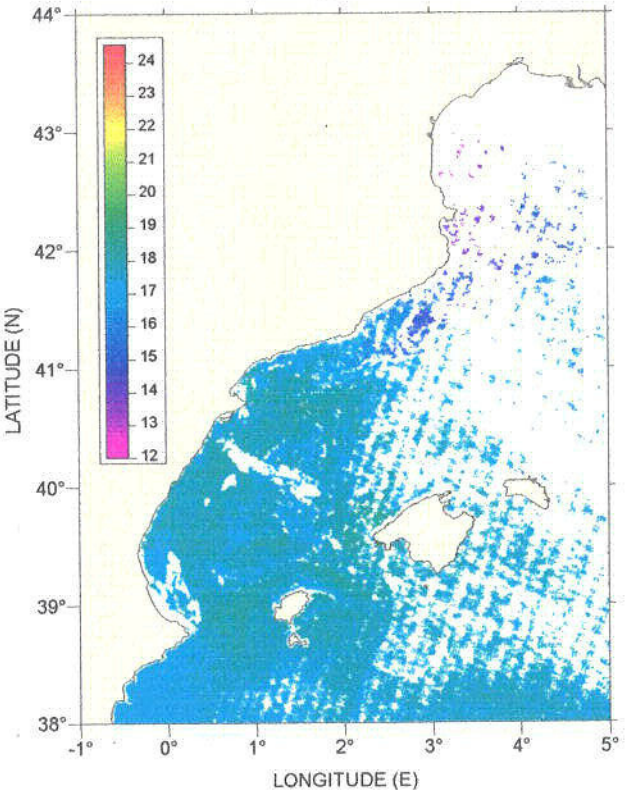
May, 02 (C950502M)



May, 05 (C950505M)

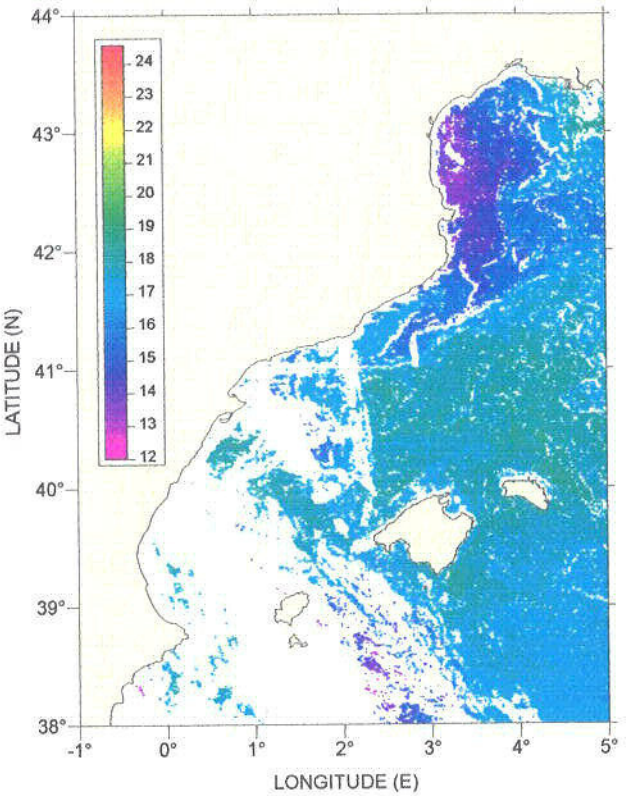


May, 05 (C950505N)

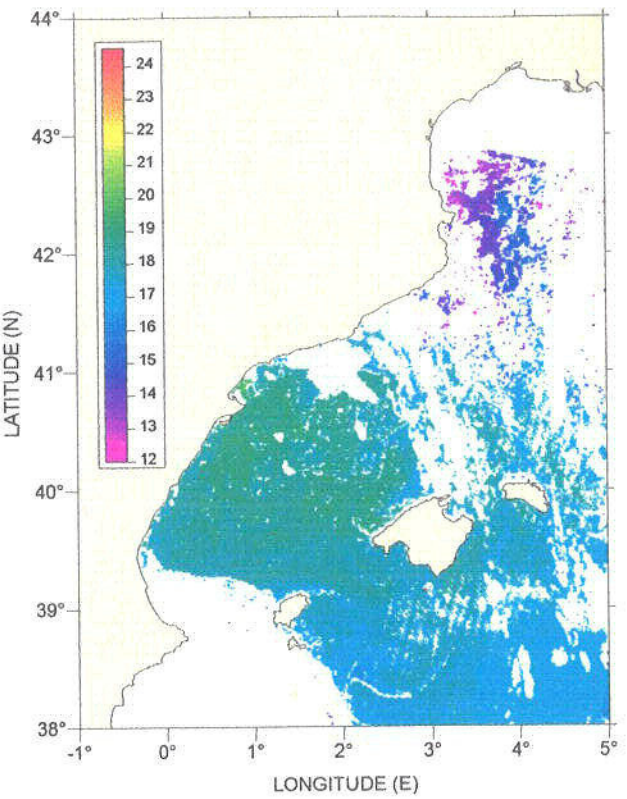


Temperature Satellite Individual Images
GICS-3 (1995) – Catalan Sea

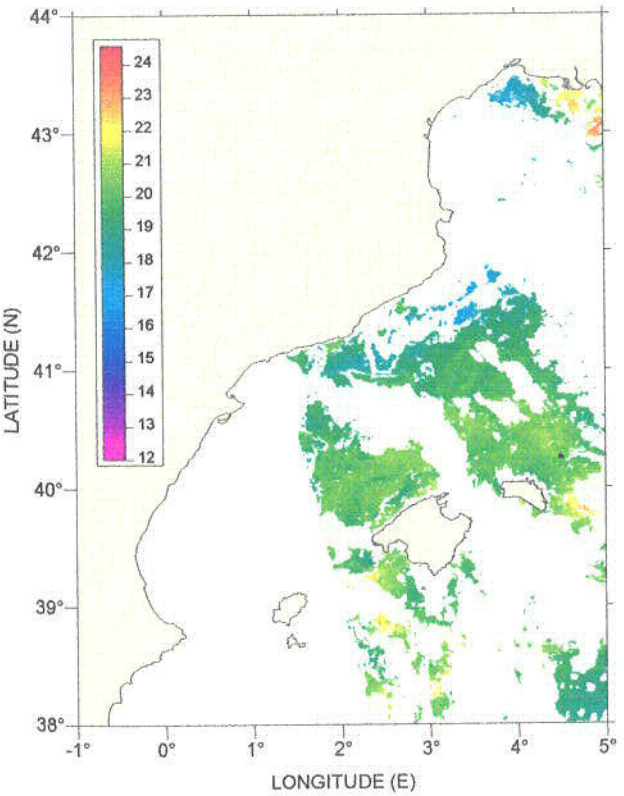
May, 06 (C950506M)



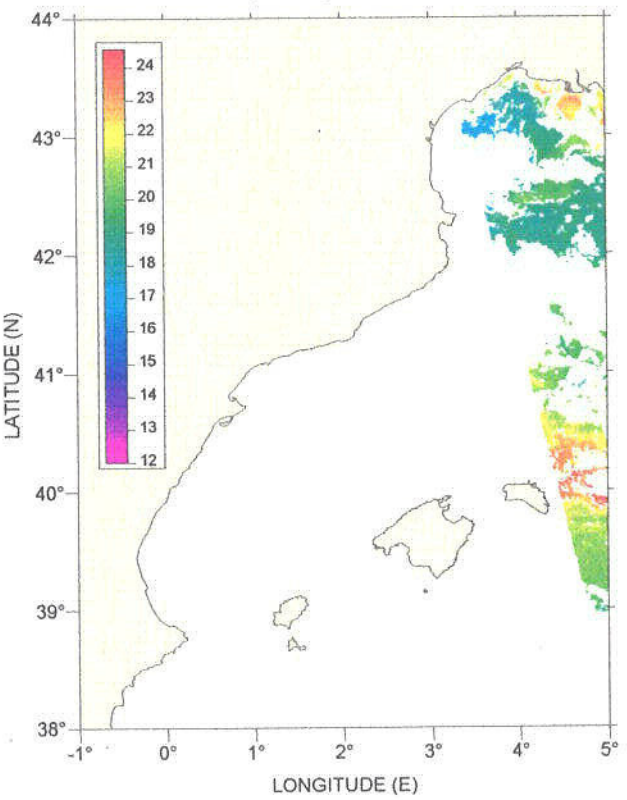
May, 07 (C950507N)



May, 08 (C950508P)

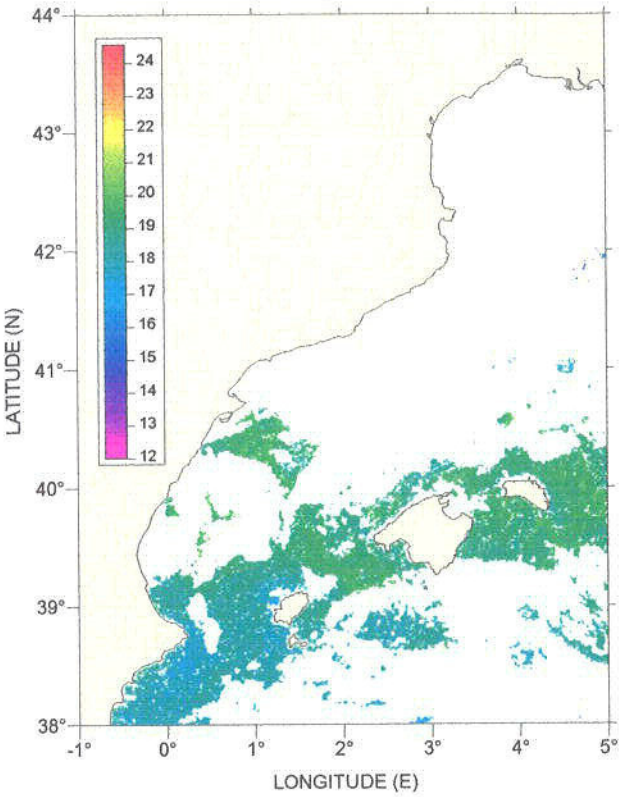


May, 09 (C950509P)

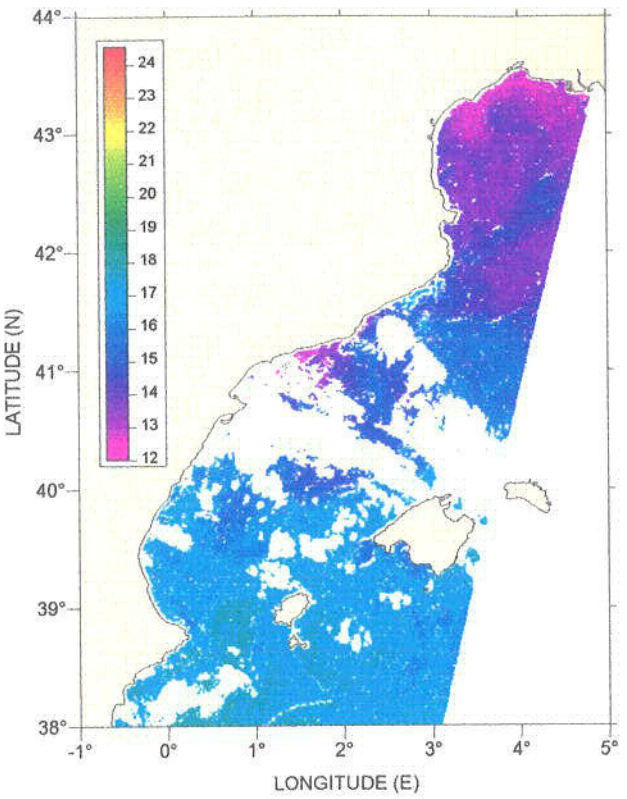


Temperature Satellite Individual Images
GICS-3 (1995) – Catalan Sea

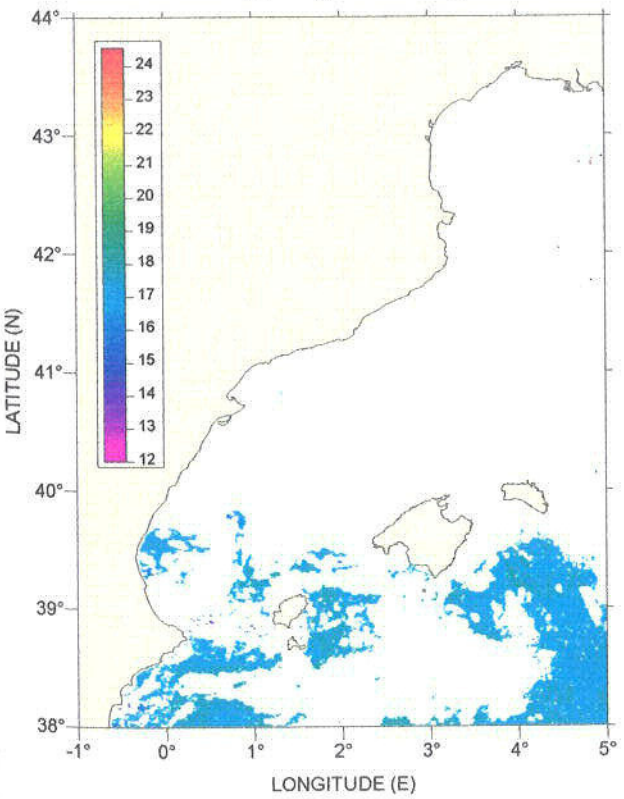
May, 10 (C950510M)



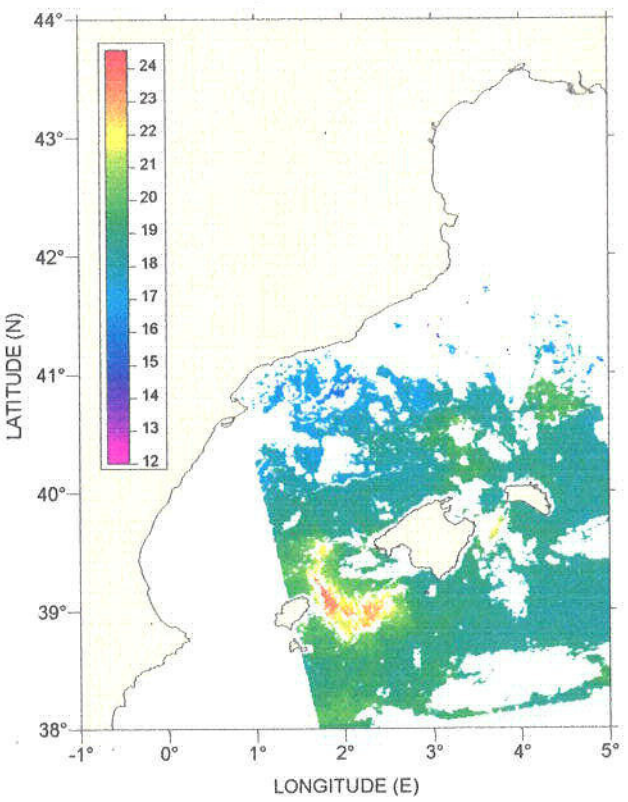
May, 14 (C950514M)



May, 15 (C950515M)

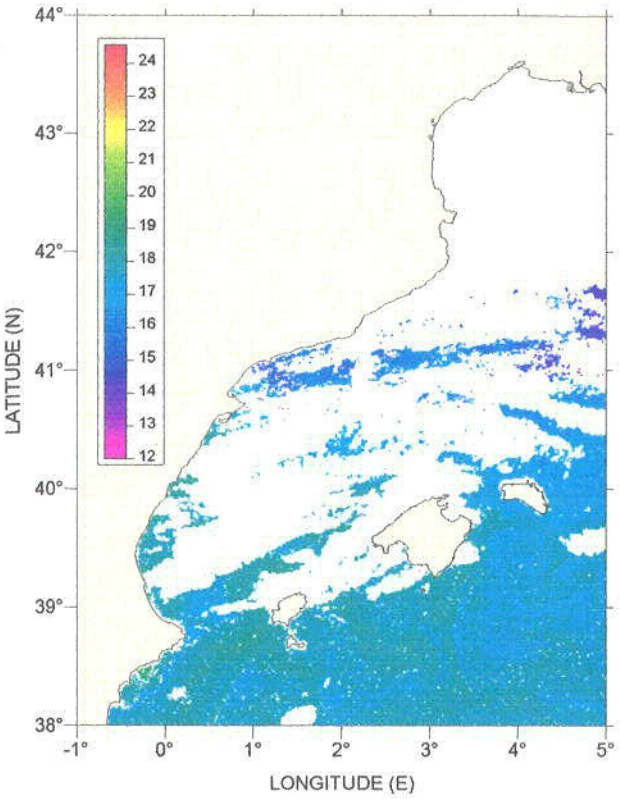


May, 17 (C950517P)

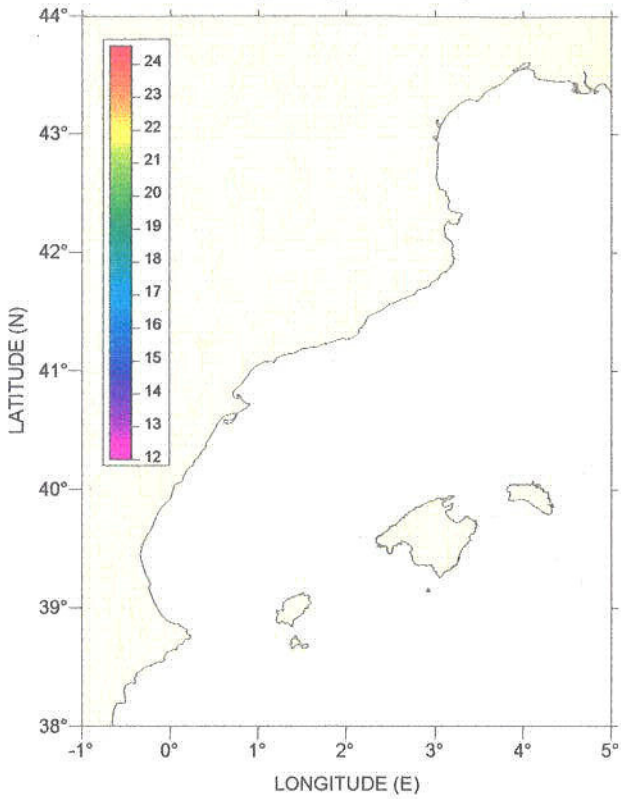


Temperature Satellite Individual Images
GICS-3 (1995) – Catalan Sea

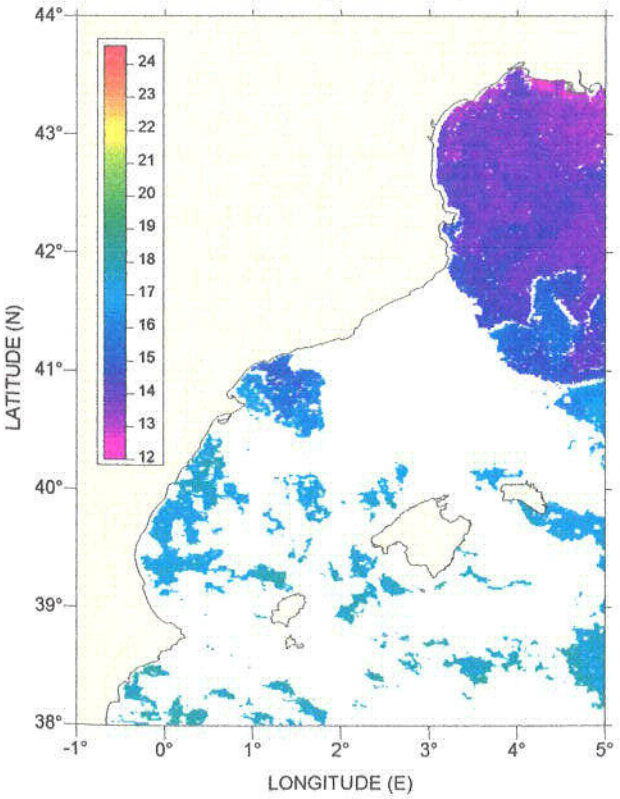
May, 19 (C950519M)



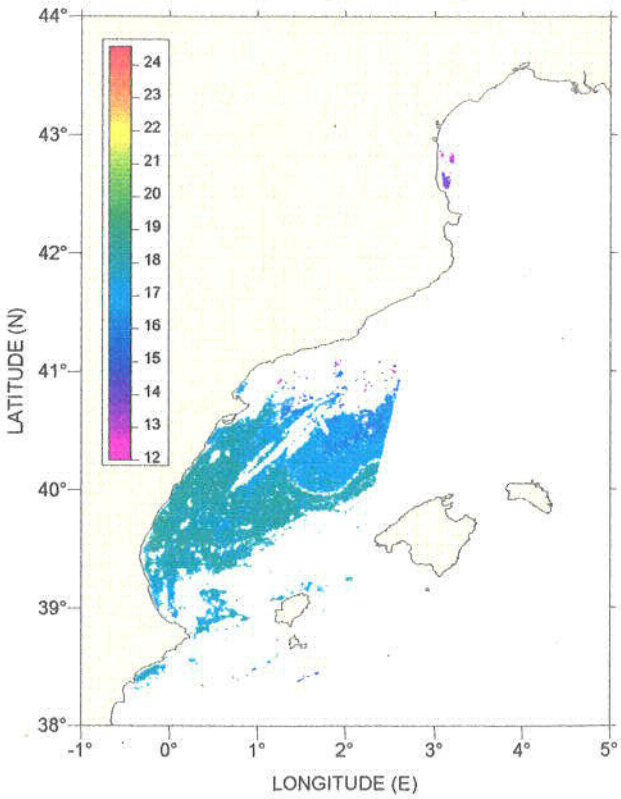
May, 19 (C950519P)



May, 20 (C950520M)

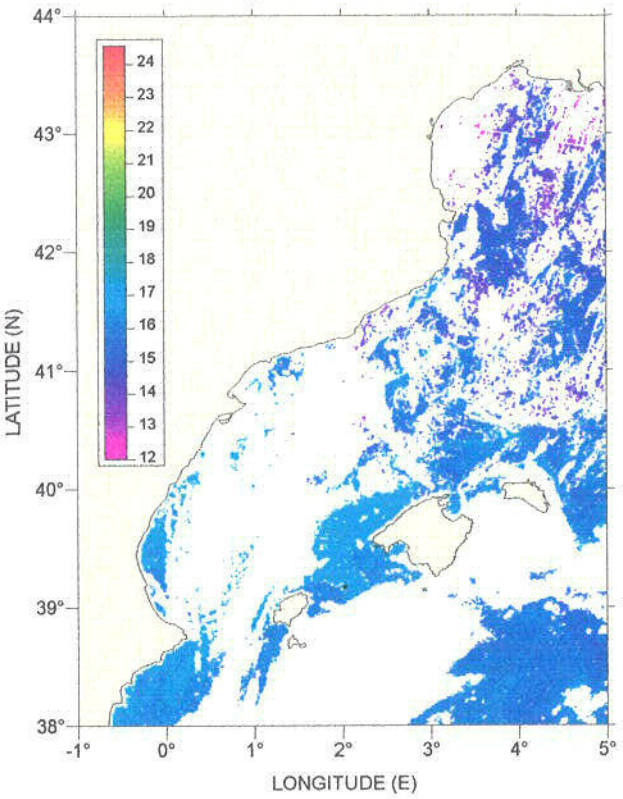


May, 23 (C950523M)

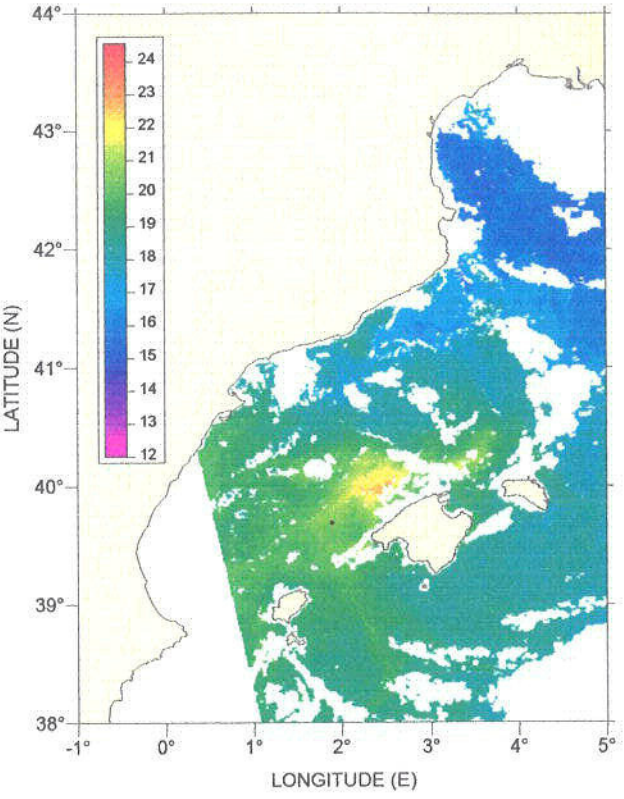


Temperature Satellite Individual Images
GICS-3 (1995) – Catalan Sea

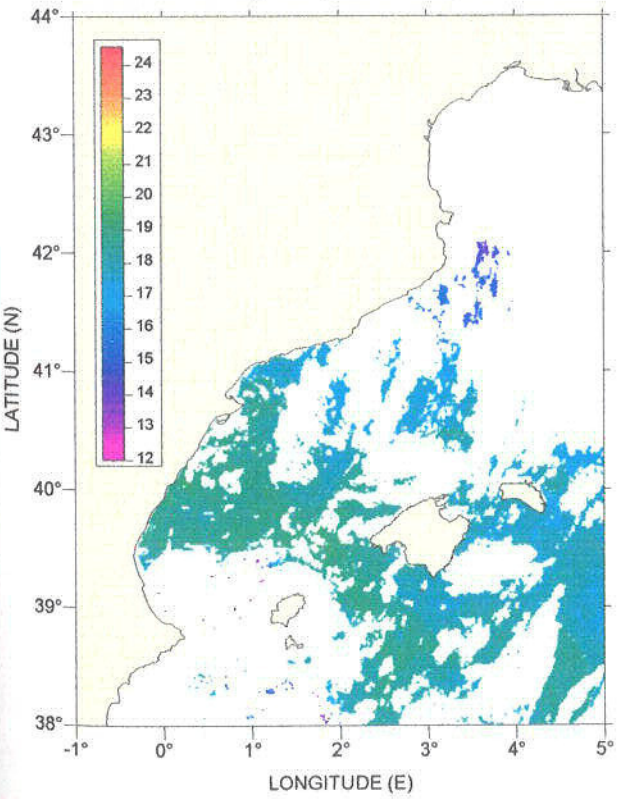
May, 24 (C950524M)



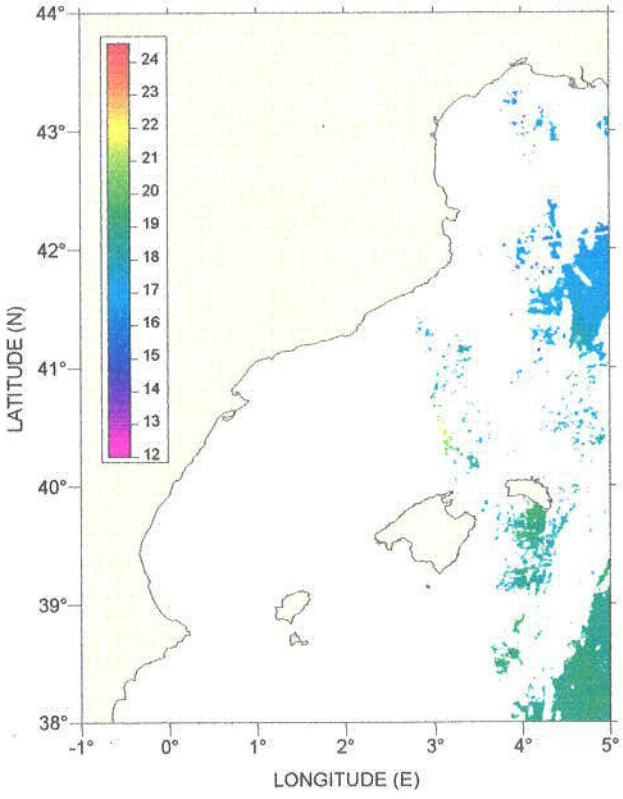
May, 26 (C950526P)



May, 26 (C950526N)

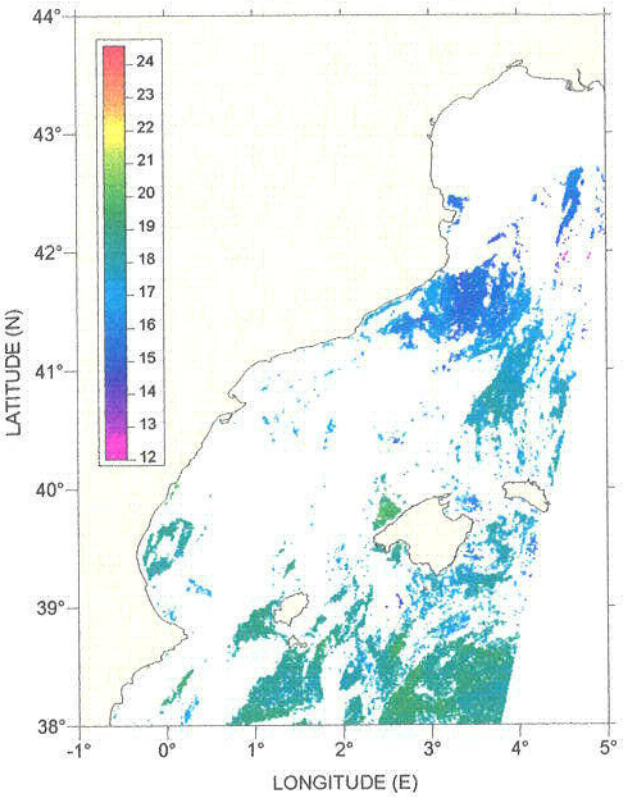


May, 27 (C950527P)

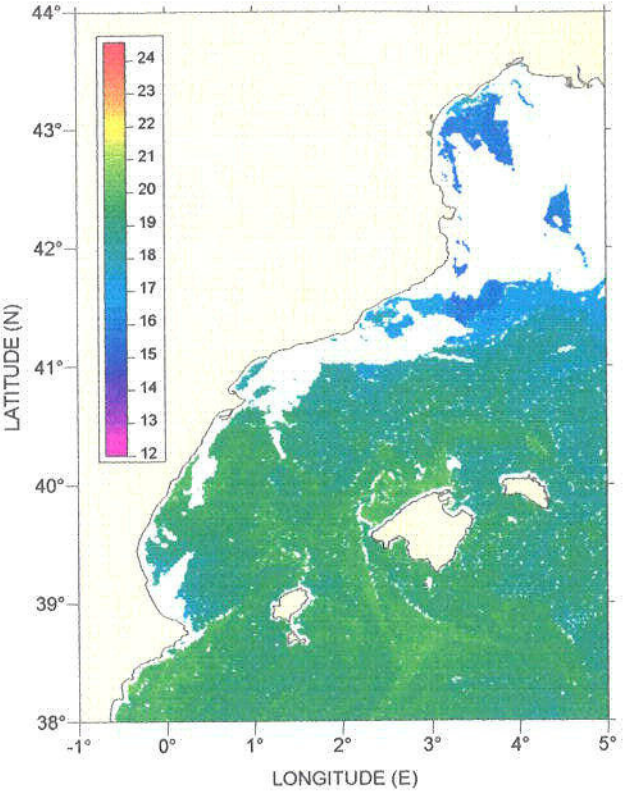


Temperature Satellite Individual Images
GICS-3 (1995) – Catalan Sea

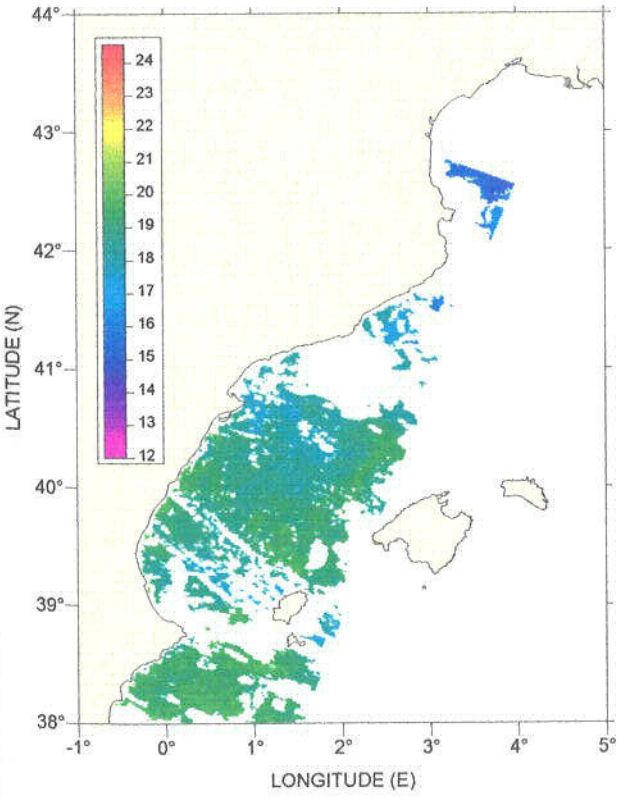
May, 28 (C950528M)



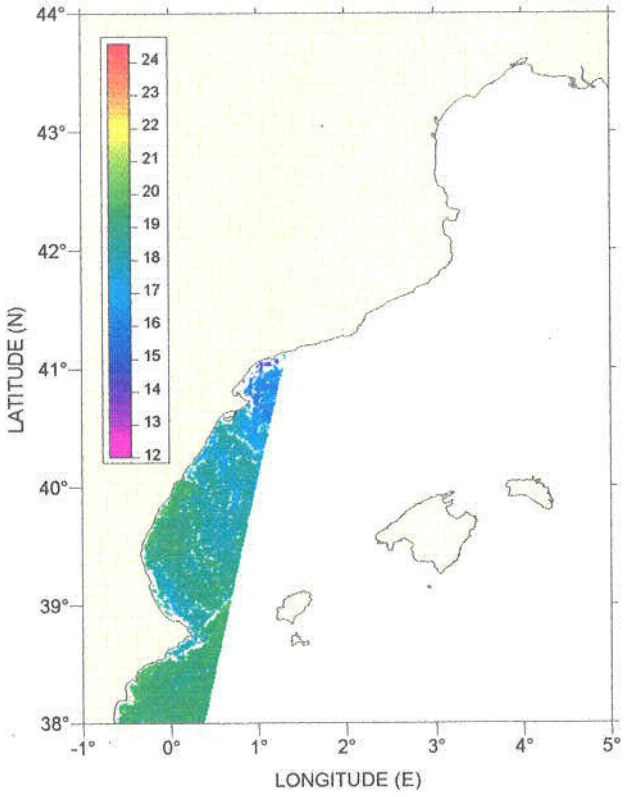
May, 29 (C950529M)



May, 31 (C950531N)

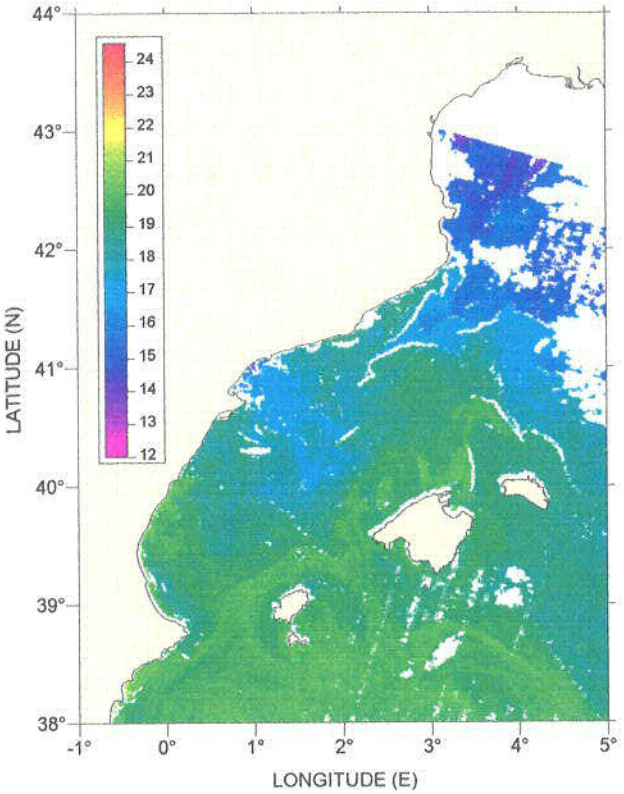


June, 01 (C950601M)

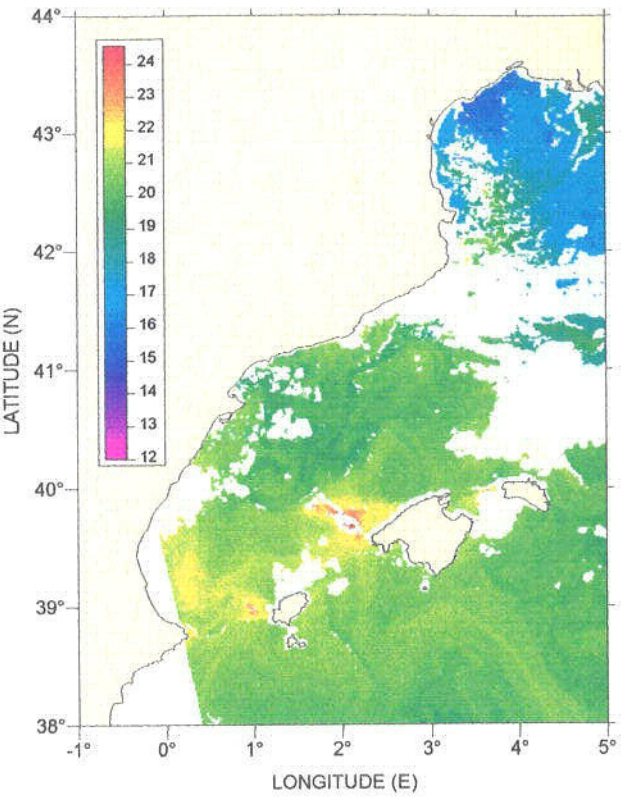


Temperature Satellite Individual Images
GICS-3 (1995) – Catalan Sea

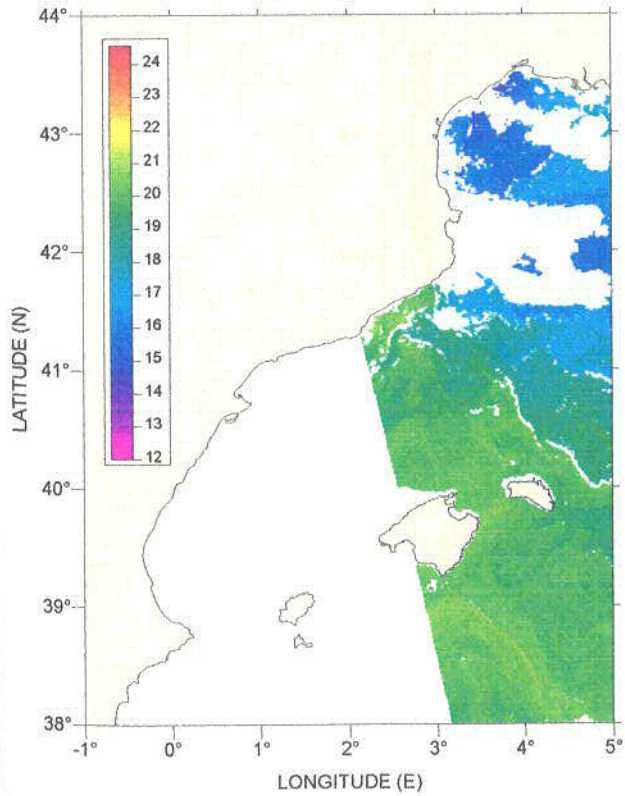
June, 02 (C950602N)



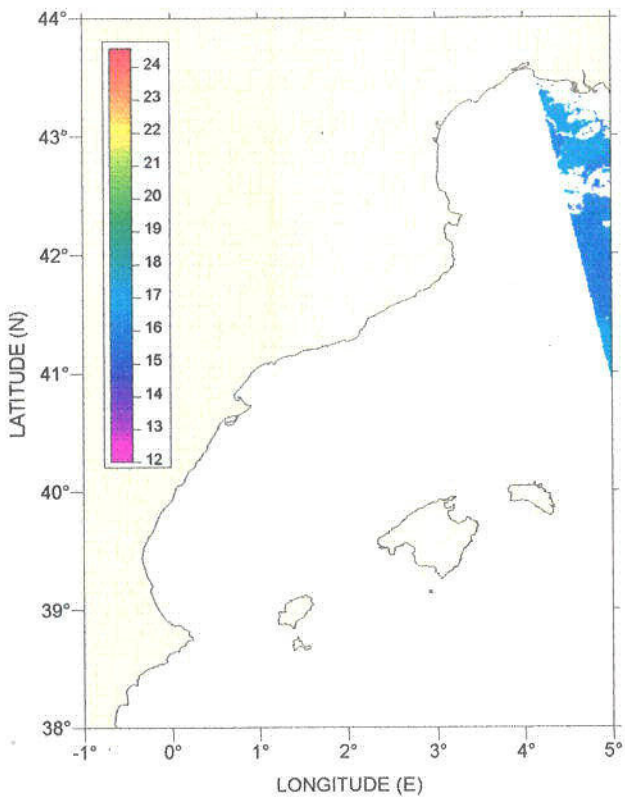
June, 04 (C950604P)



June, 05 (C950605P)

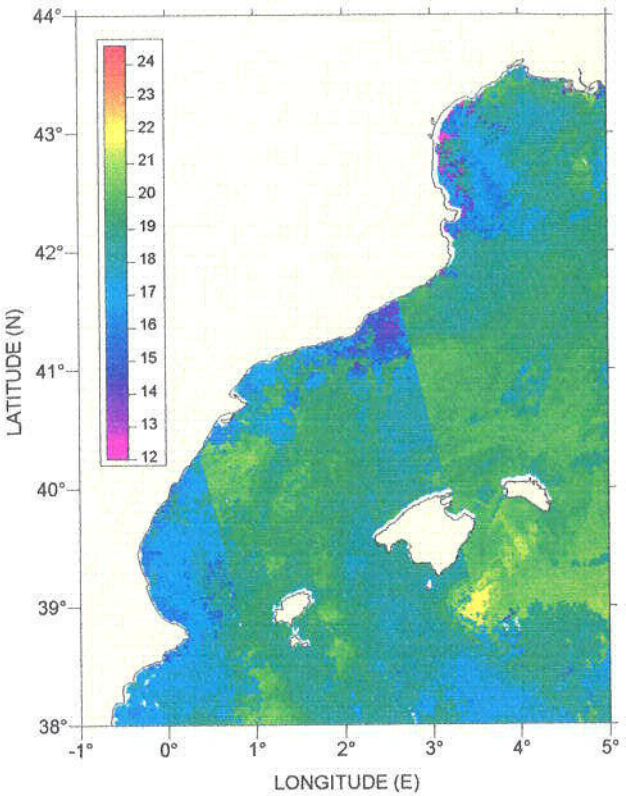


June, 06 (C950606P)

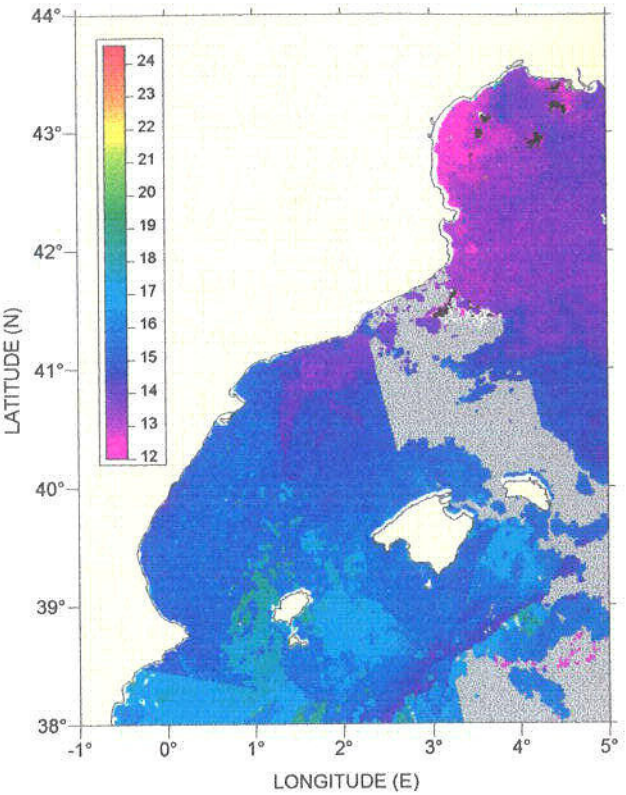


Temperature Satellite Composite Images
GICS-1 (1993) – Catalan Sea

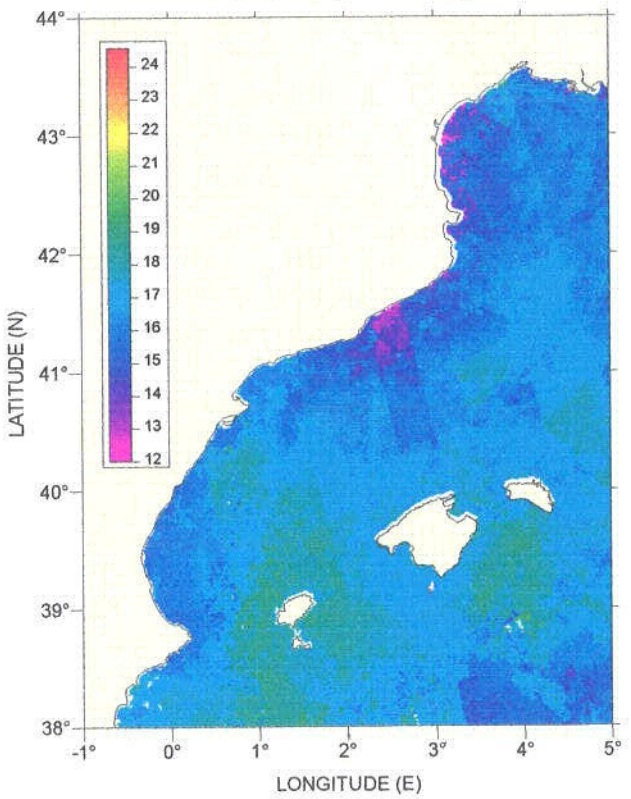
April, A1 (K9304A1A)



April, A2 (K9304A2A)

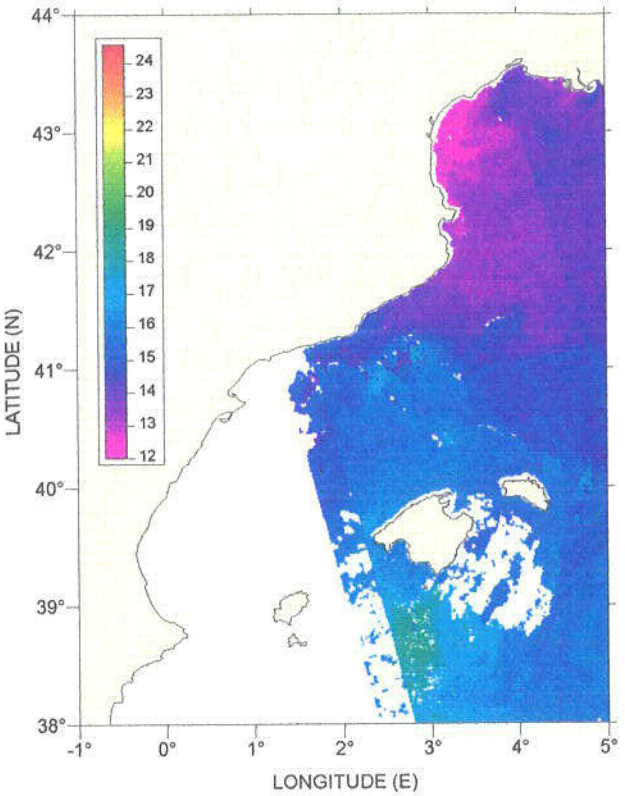


April, A3 (K9304A3A)

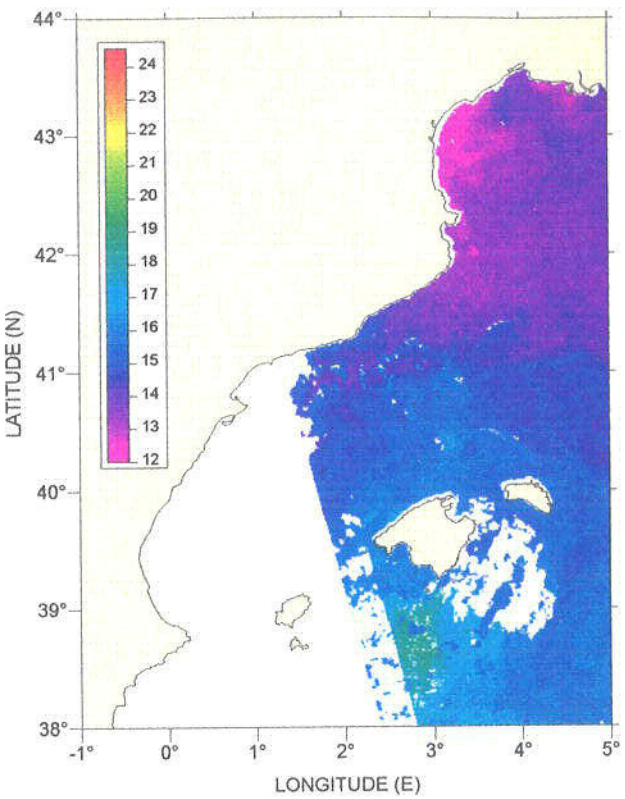


Temperature Satellite Composite Images
GICS-1 (1993) – Catalan Sea

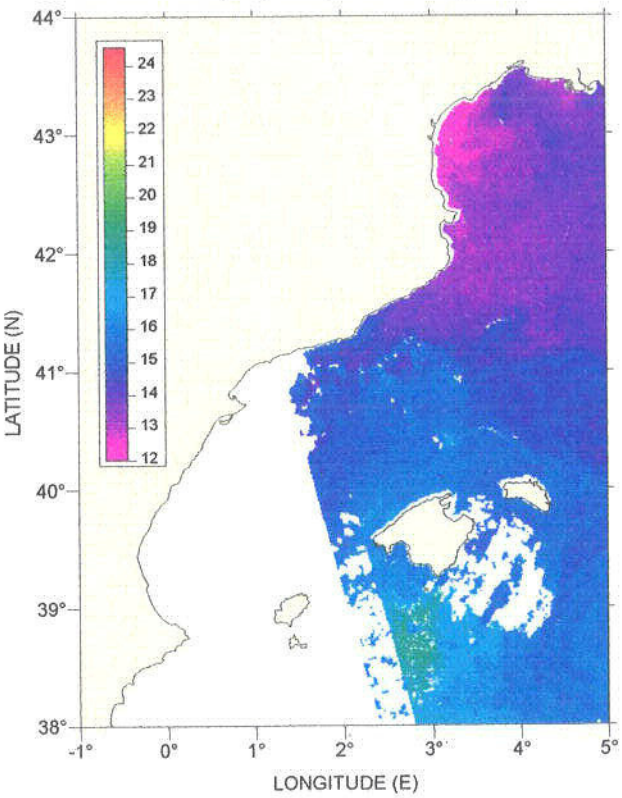
April, M1 (K9304M1A)



April, M2 (K9304M2A)

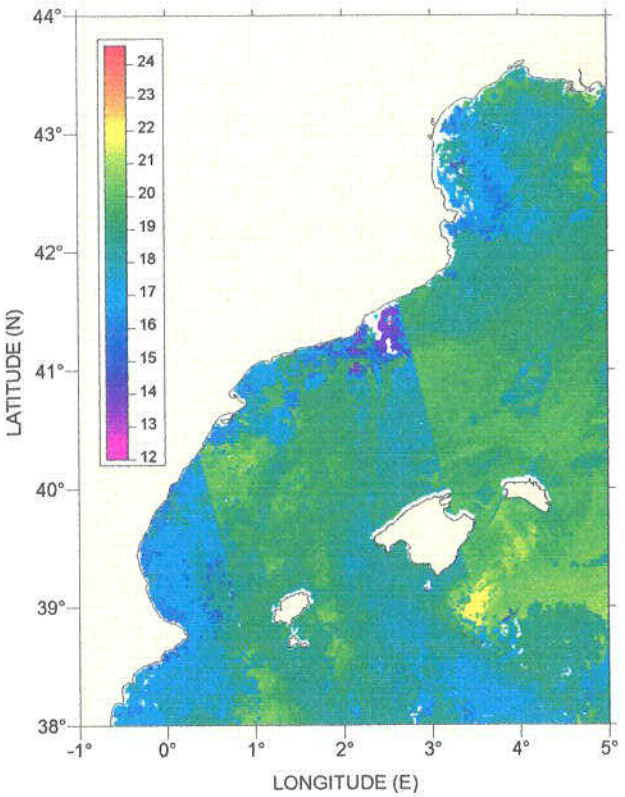


April, M3 (K9304M3A)

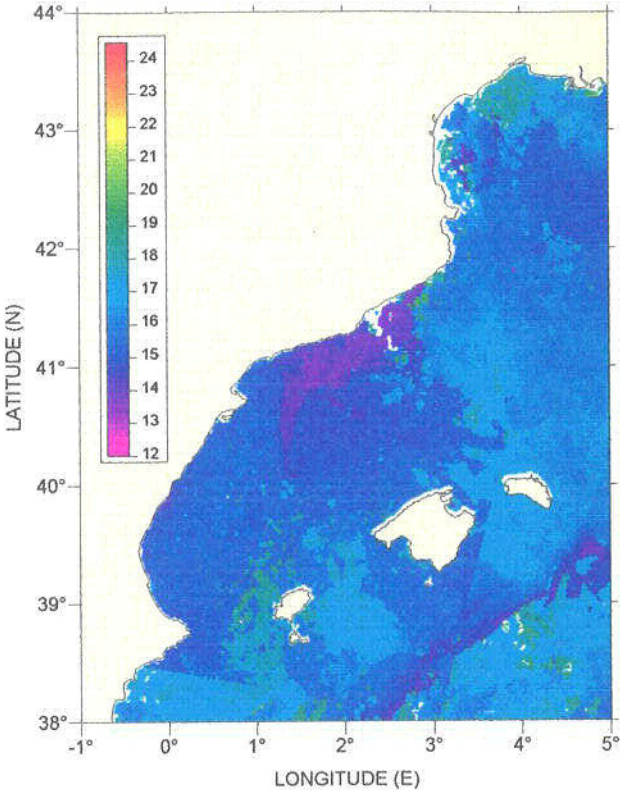


Temperature Satellite Composite Images
GICS-1 (1993) – Catalan Sea

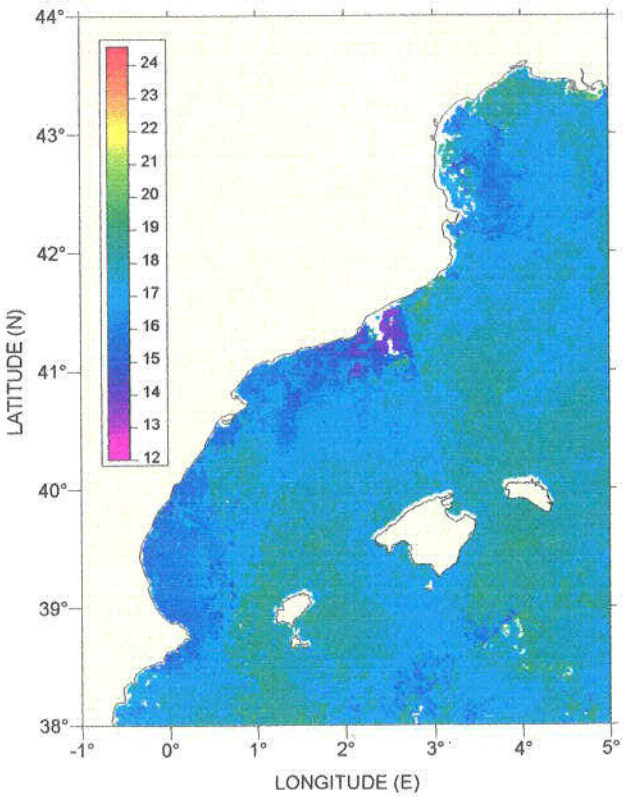
May, M1 (K9305M1A)



May, M2 (K9305M2A)

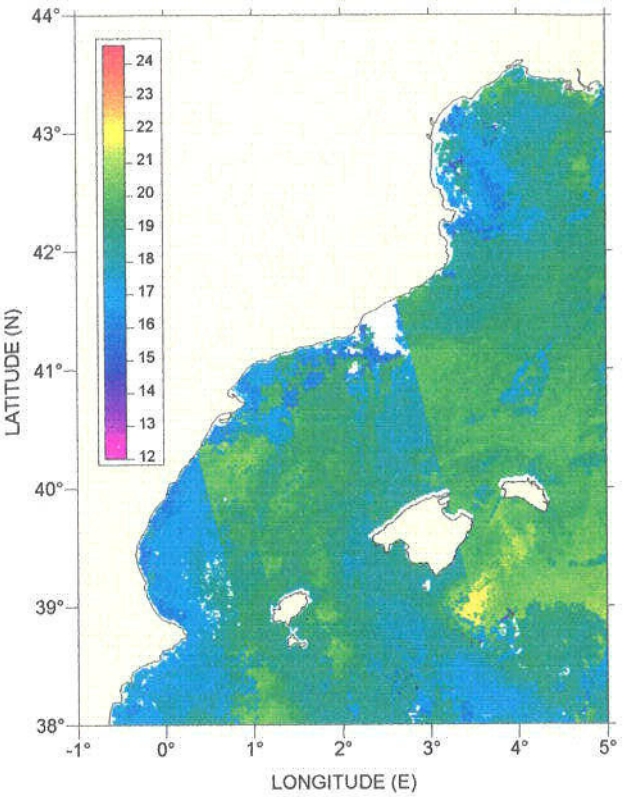


May, M3 (K9305M3A)

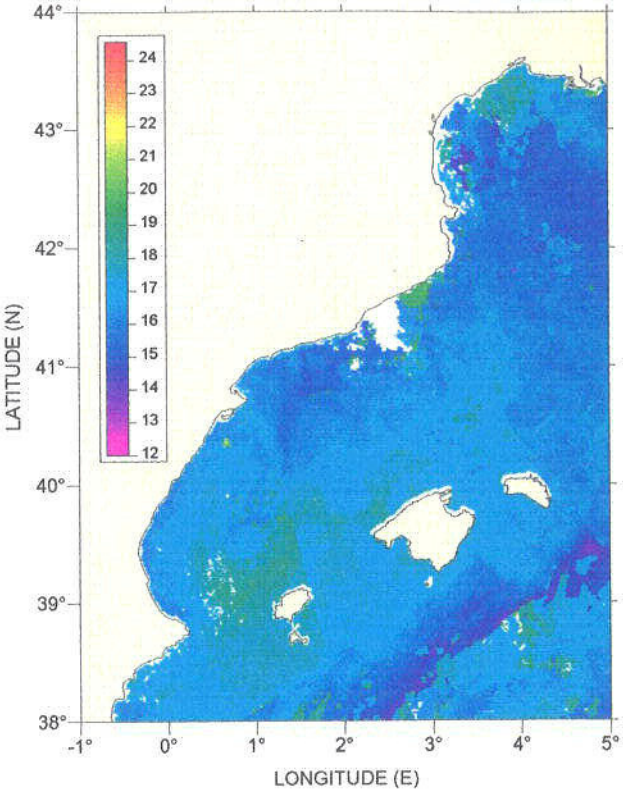


Temperature Satellite Composite Images
GICS-1 (1993) – Catalan Sea

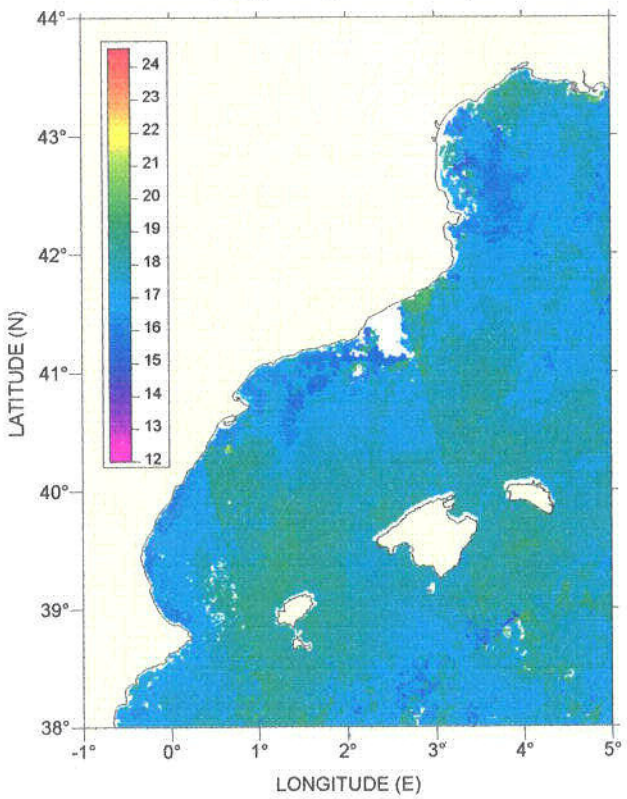
May, M1 (K9305M1P)



May, M2 (K9305M2P)

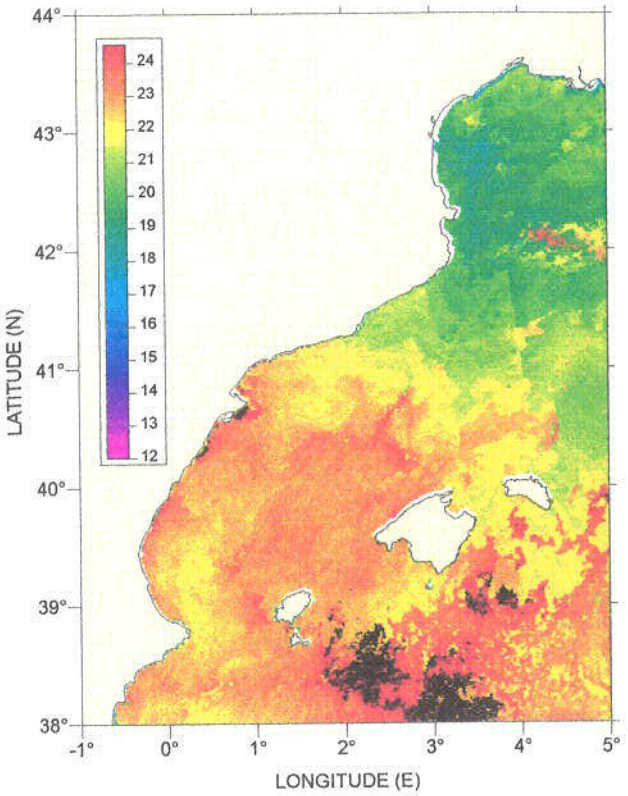


May, M3 (K9305M3P)

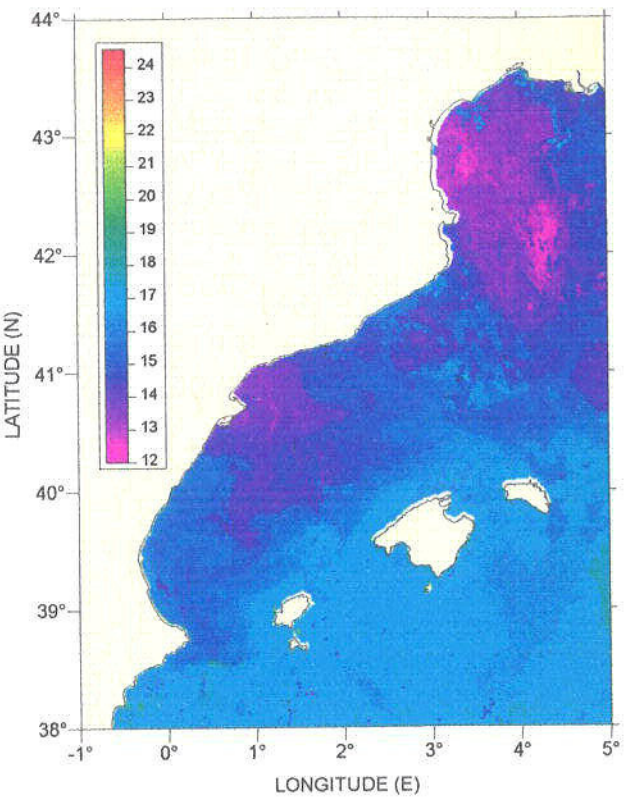


Temperature Satellite Composite Images
GICS-2 (1994) – Catalan Sea

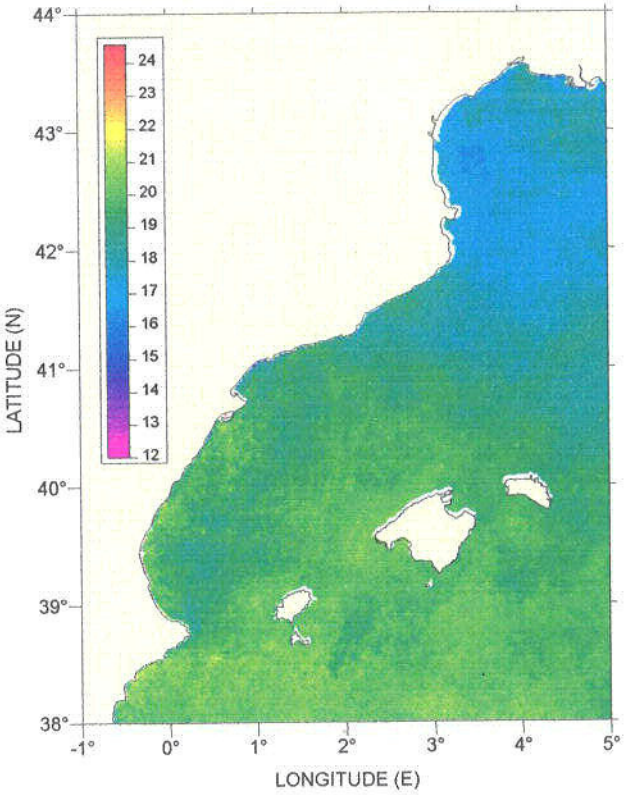
April, A1 (K9404A1A)



April, A2 (K9404A2A)

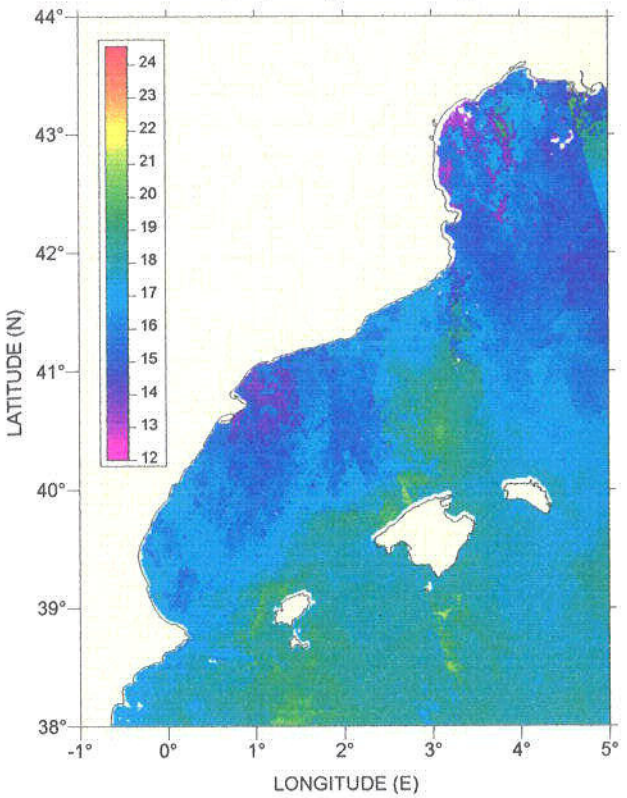


April, A3 (K9404A3A)

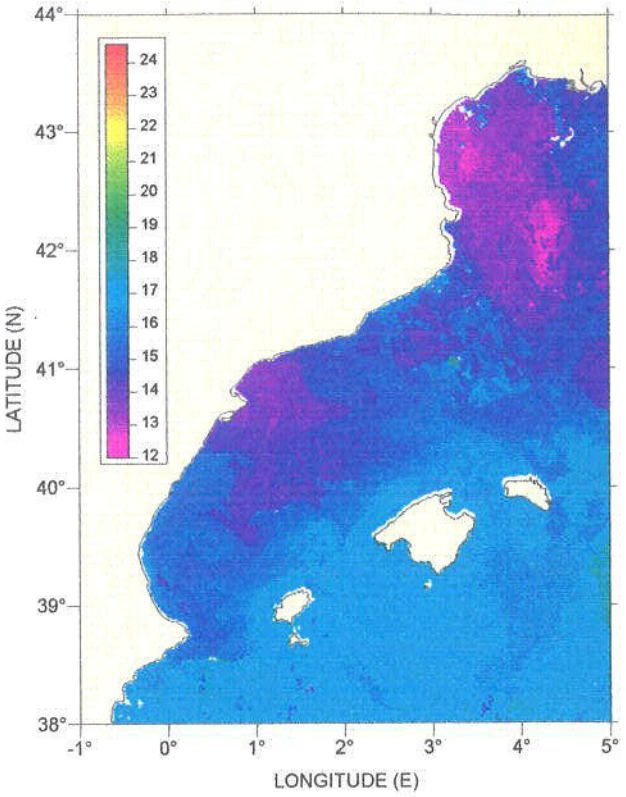


Temperature Satellite Composite Images
GICS-2 (1994) – Catalan Sea

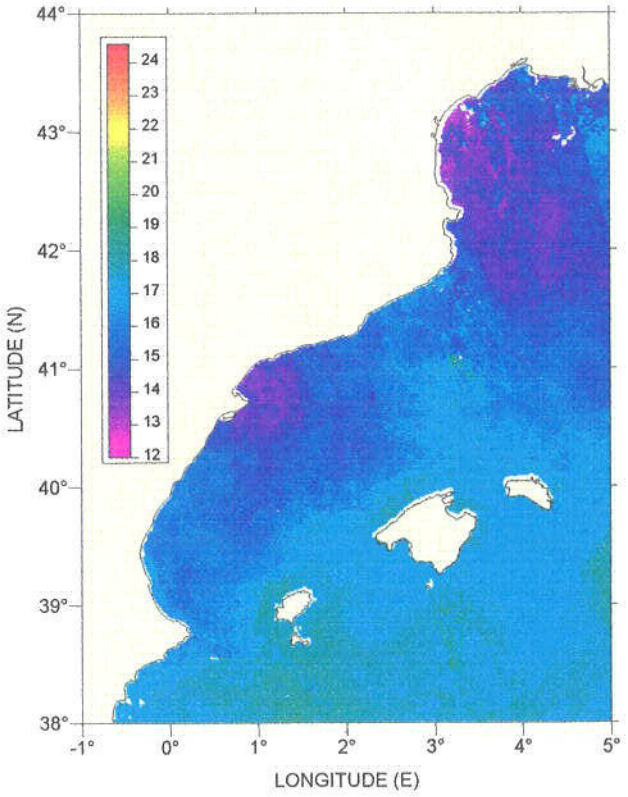
April, M1 (K9404M1A)



April, M2 (K9404M2A)

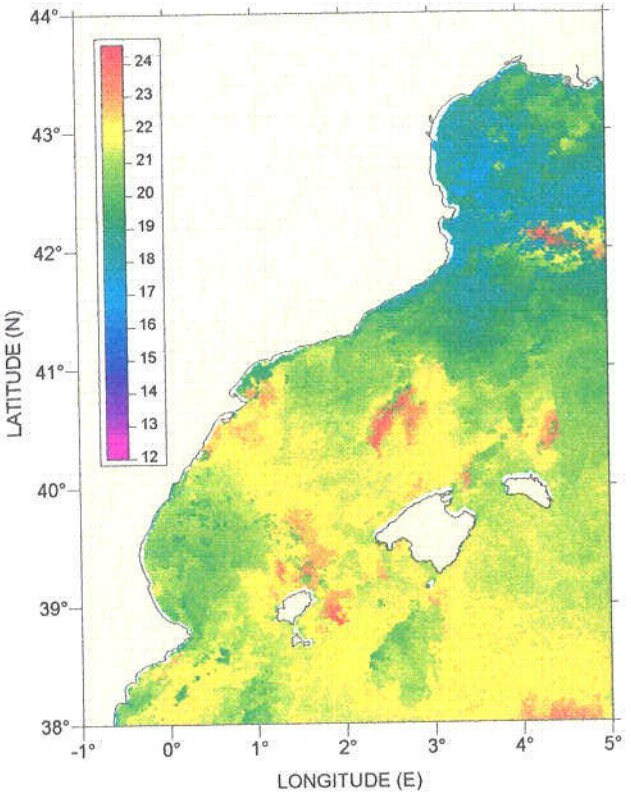


April, M3 (K9404M3A)

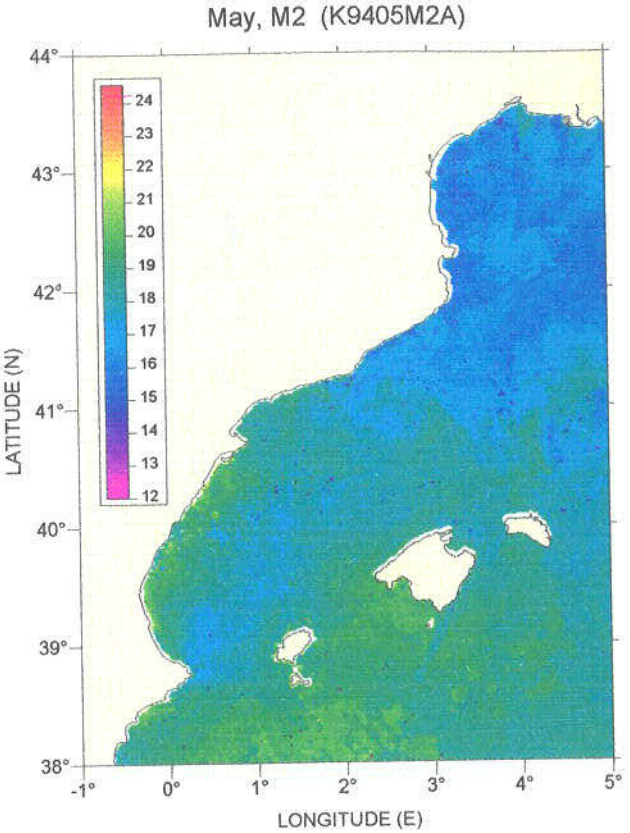


Temperature Satellite Composite Images
GICS-2 (1994) – Catalan Sea

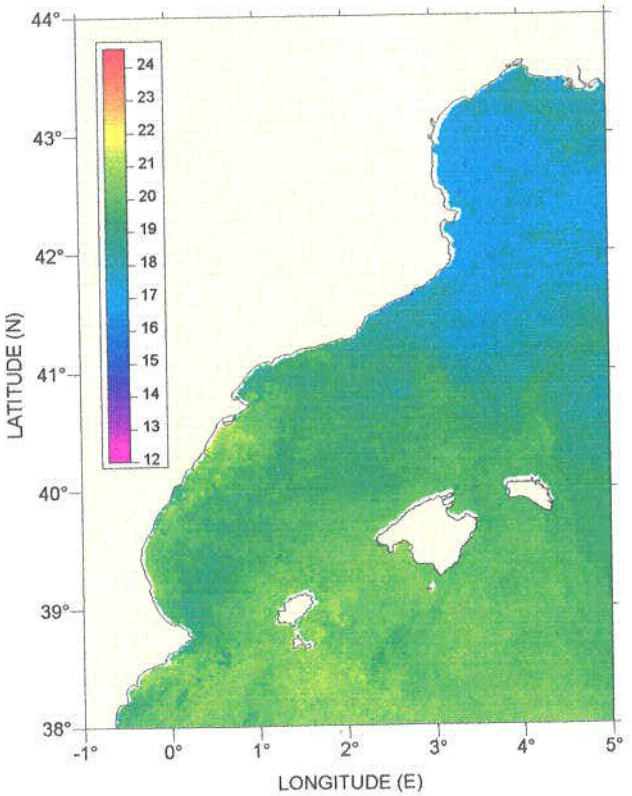
May, M1 (K9405M1A)



May, M2 (K9405M2A)

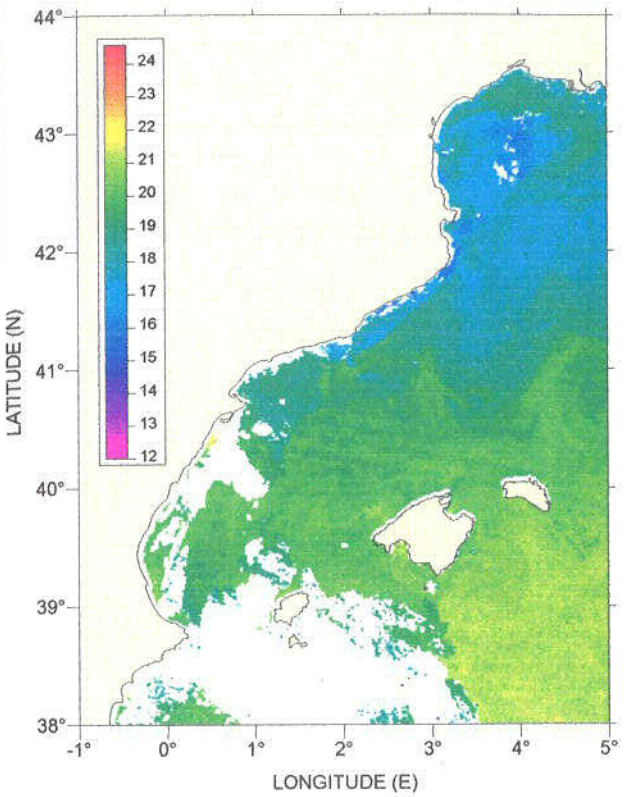


May, M3 (K9405M3A)

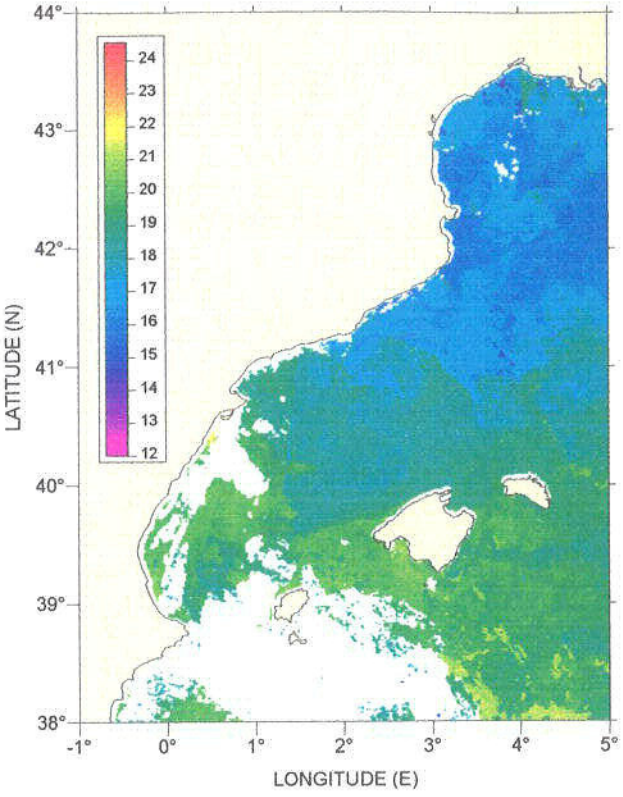


Temperature Satellite Composite Images
GICS-2 (1994) – Catalan Sea

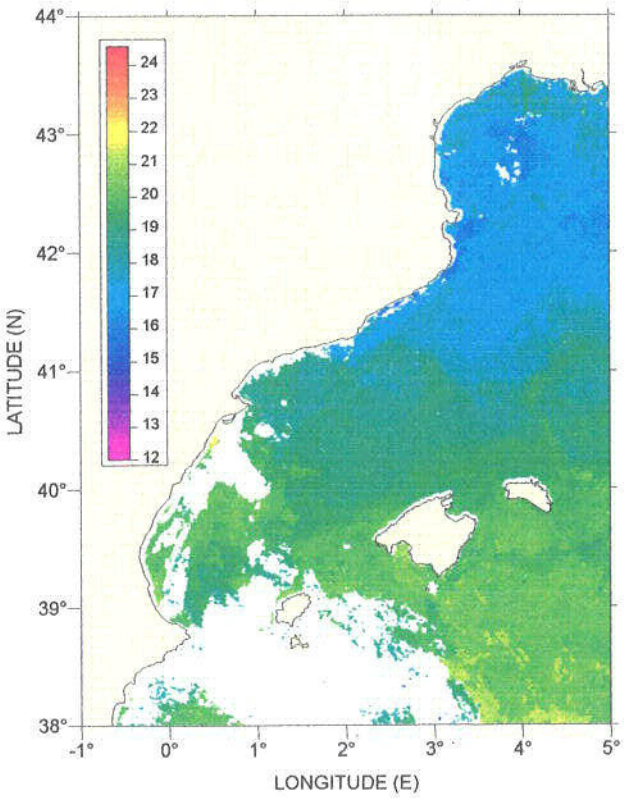
May, M1 (K9405M1M)



May, M2 (K9405M2M)

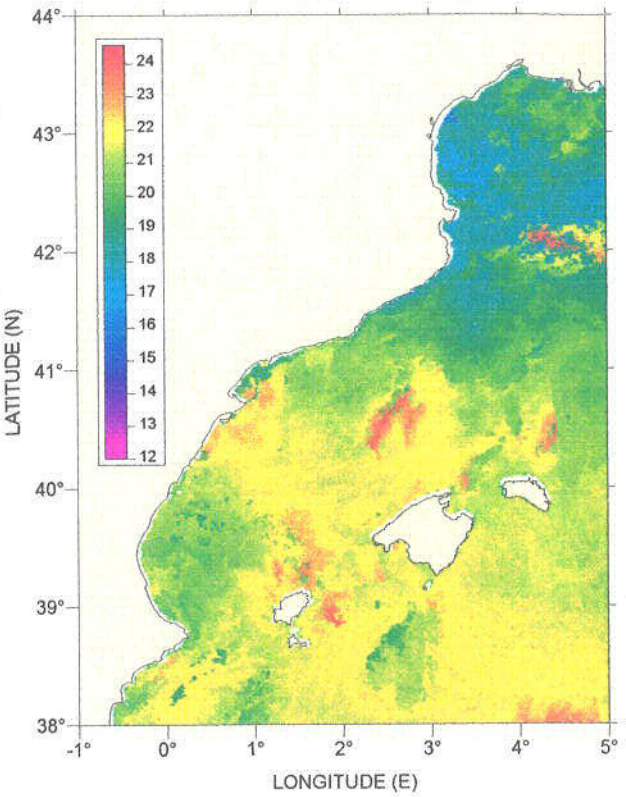


May, M3 (K9405M3M)

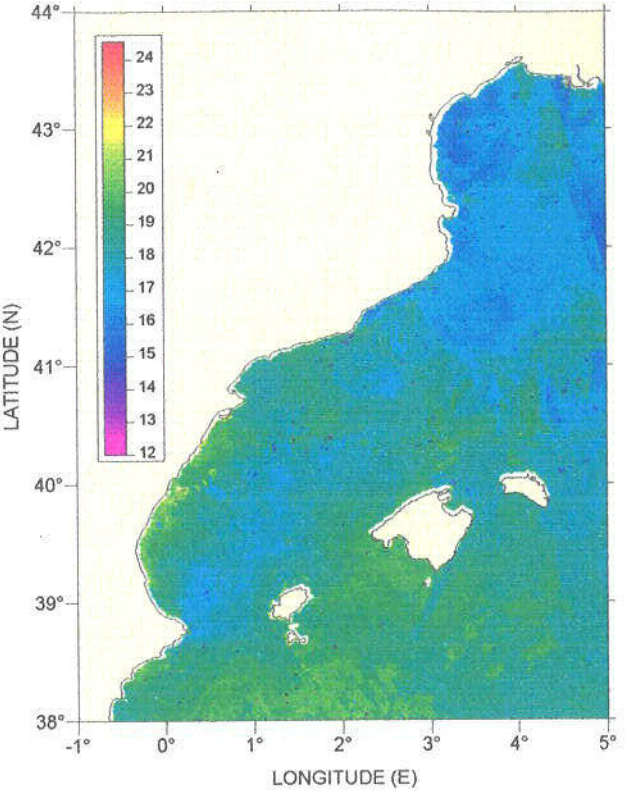


Temperature Satellite Composite Images
GICS-2 (1994) – Catalan Sea

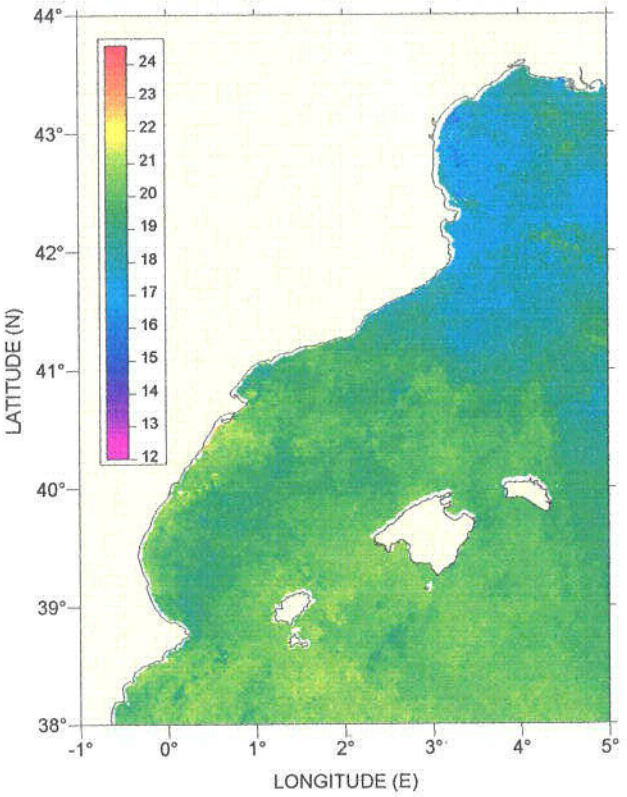
May, M1 (K9405M1P)



May, M2 (K9405M2P)

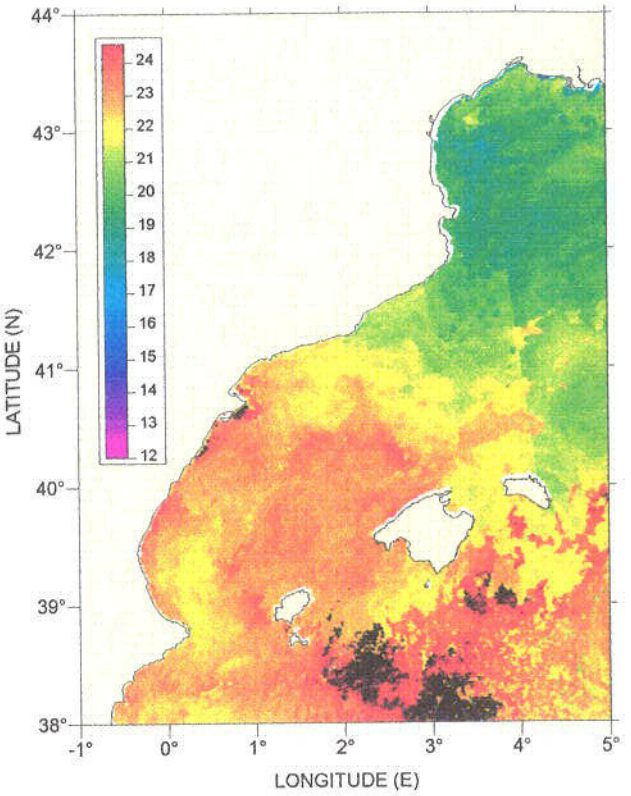


May, M3 (K9405M3P)

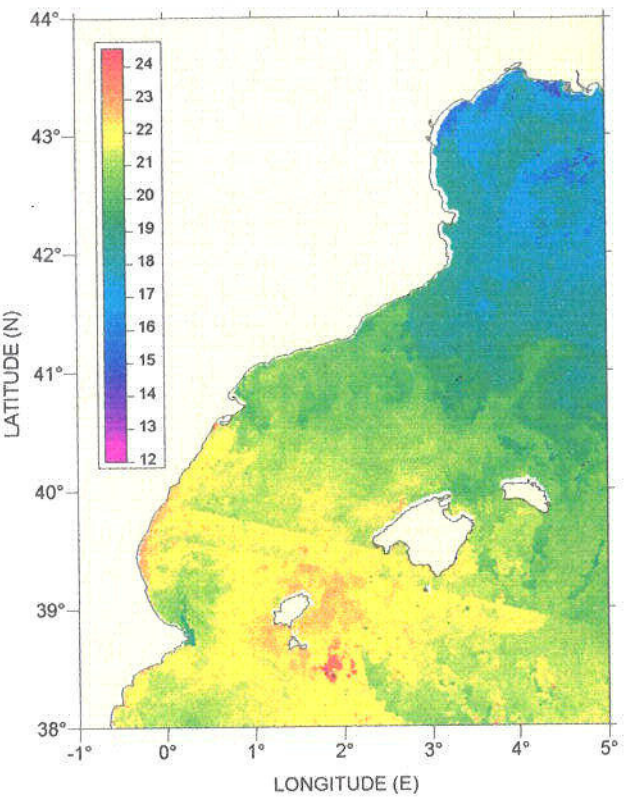


Temperature Satellite Composite Images
GICS-2 (1994) – Catalan Sea

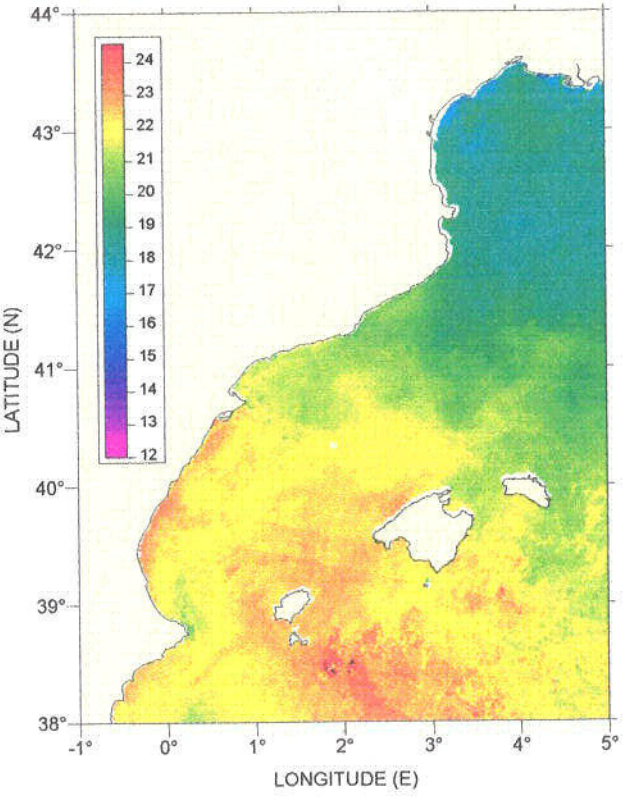
June, M1 (K9406M1A)



June, M2 (K9406M2A)

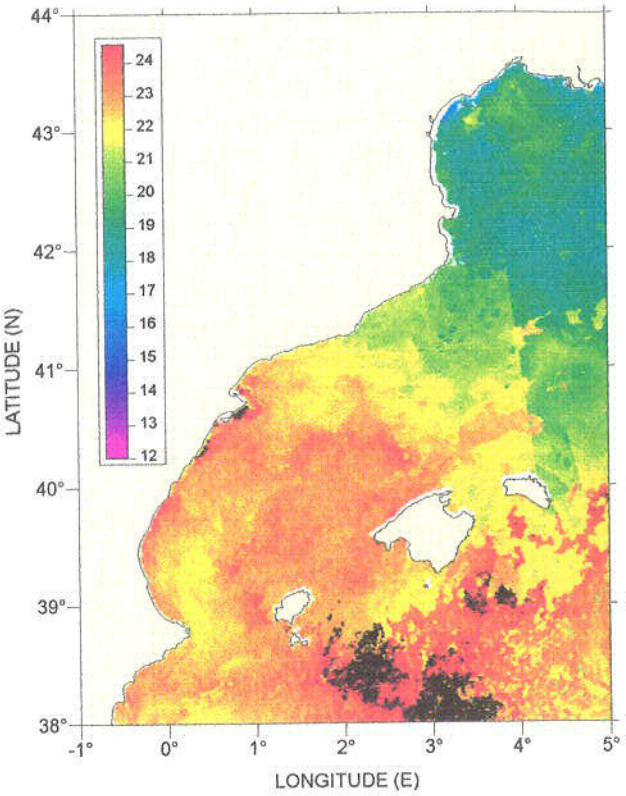


June, M3 (K9406M3A)

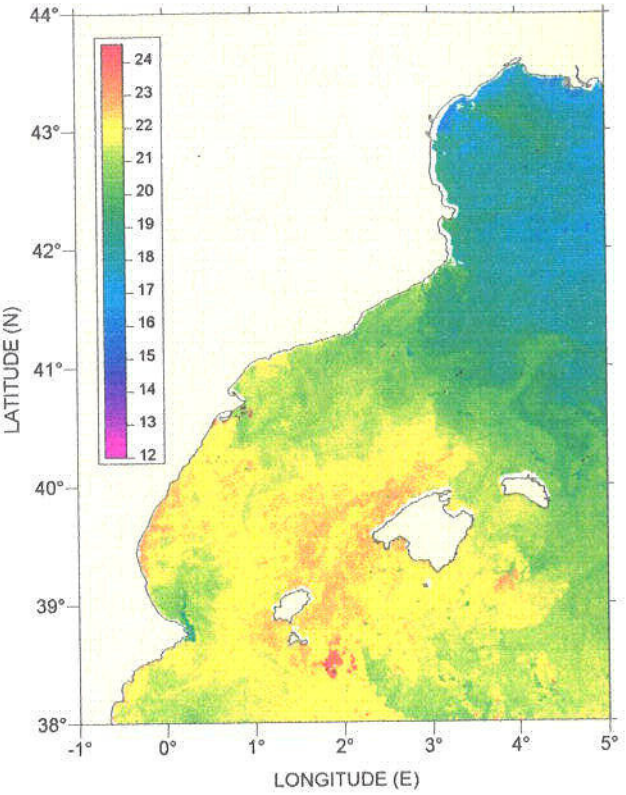


Temperature Satellite Composite Images
GICS-2 (1994) – Catalan Sea

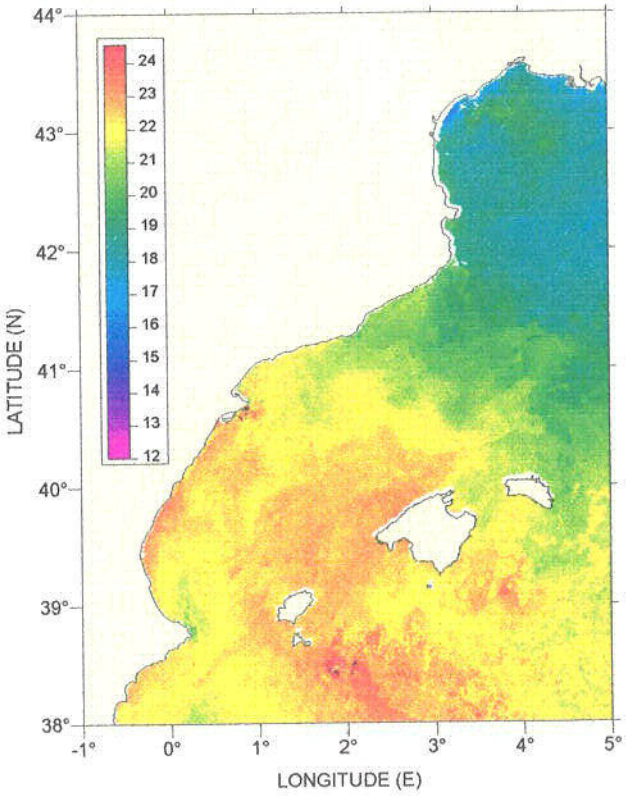
June, M1 (K9406M1P)



June, M2 (K9406M2P)

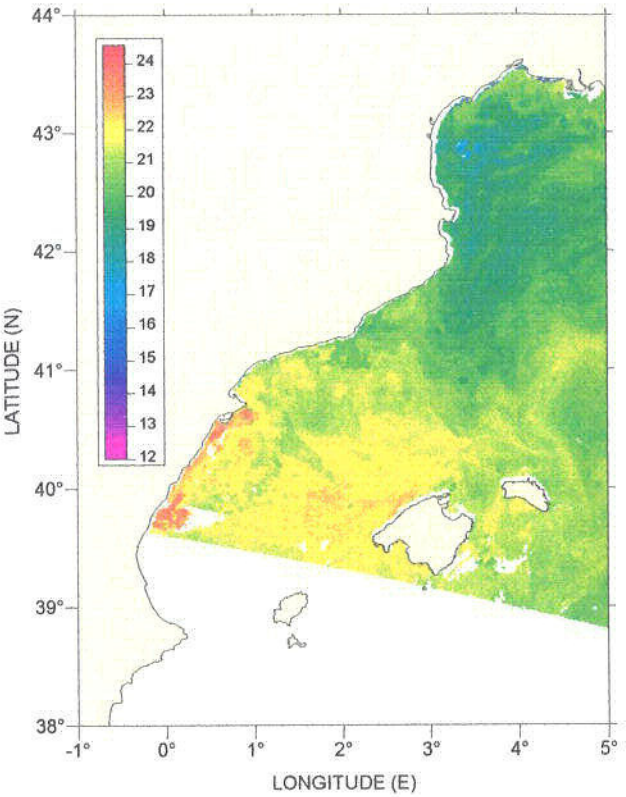


June, M3 (K9406M3P)

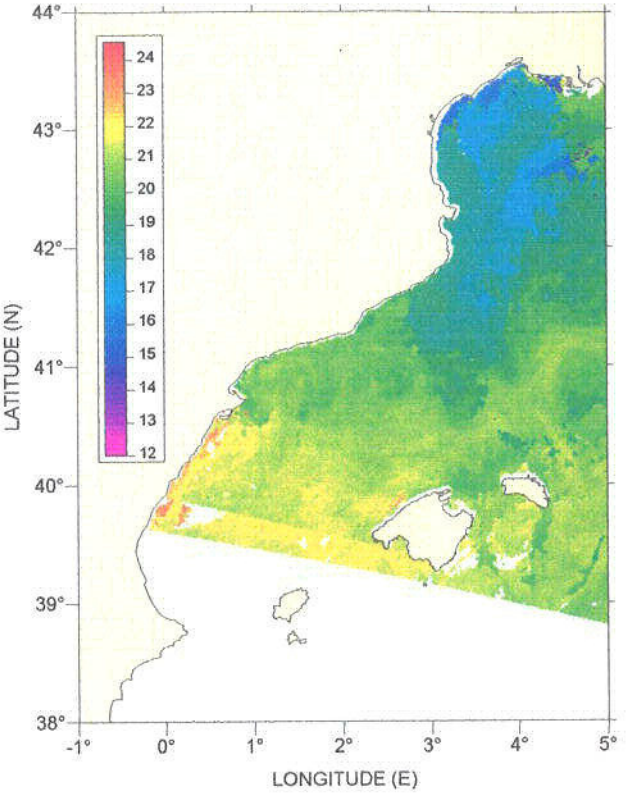


Temperature Satellite Composite Images
GICS-2 (1994) – Catalan Sea

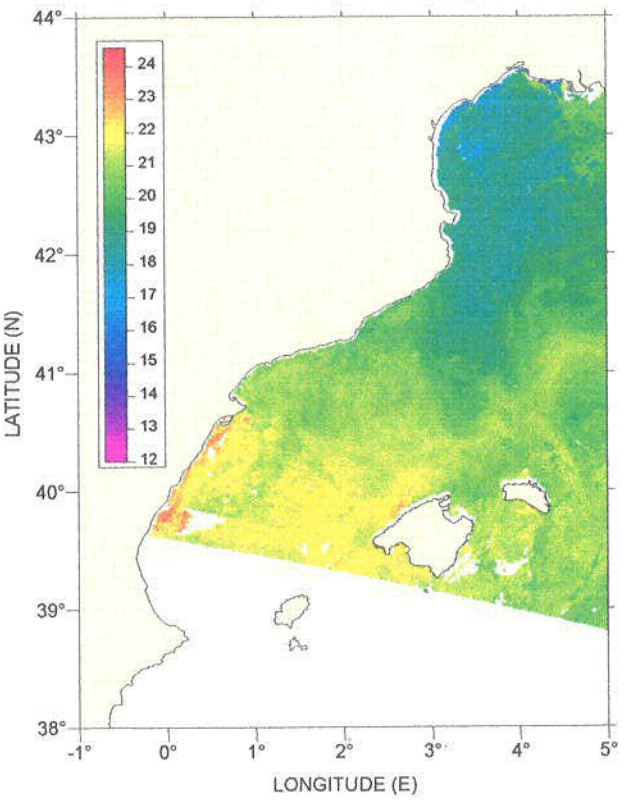
June, M1 (K9406M1N)



June, M2 (K9406M2N)

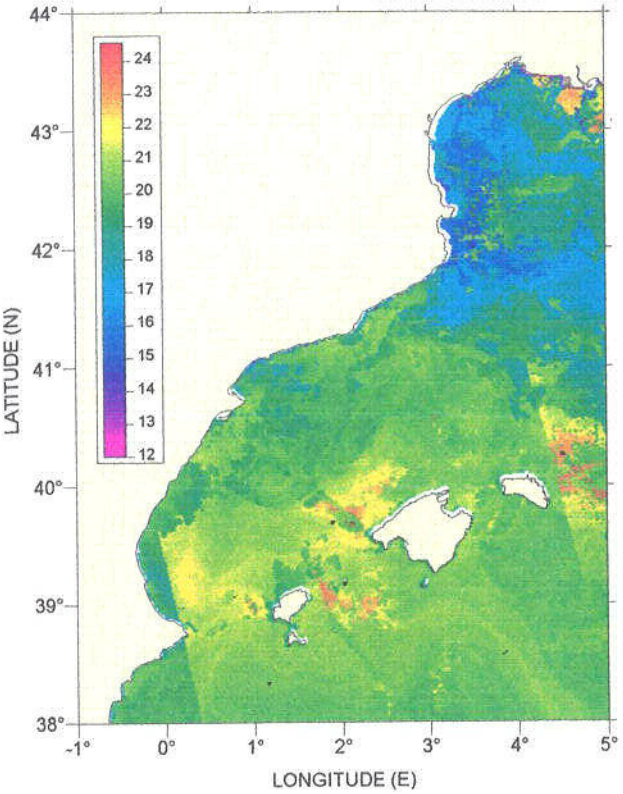


June, M3 (K9406M3N)

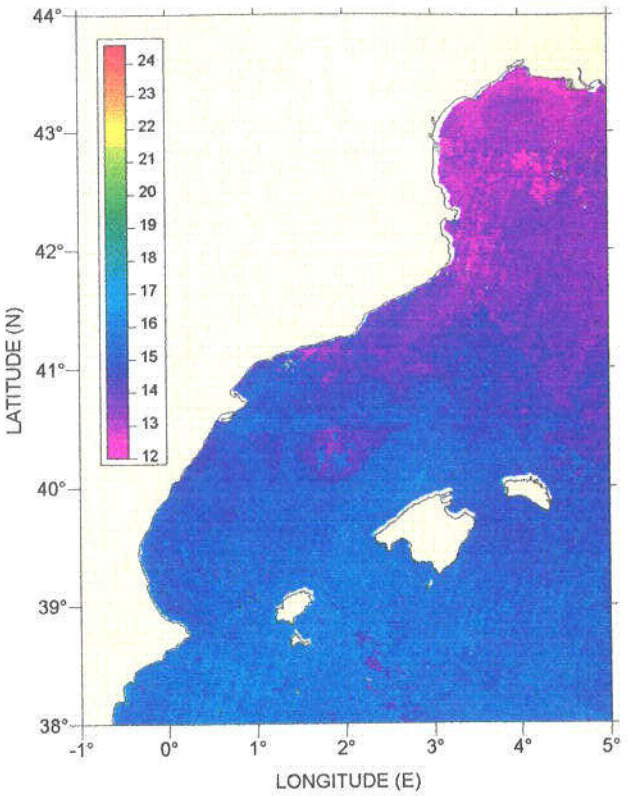


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

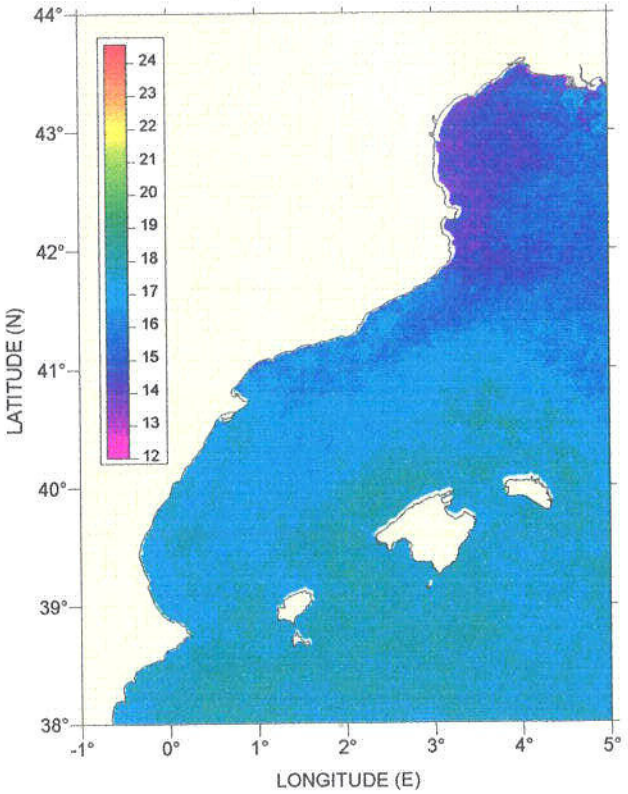
April, A1 (K9504A1A)



April, A2 (K9504A2A)

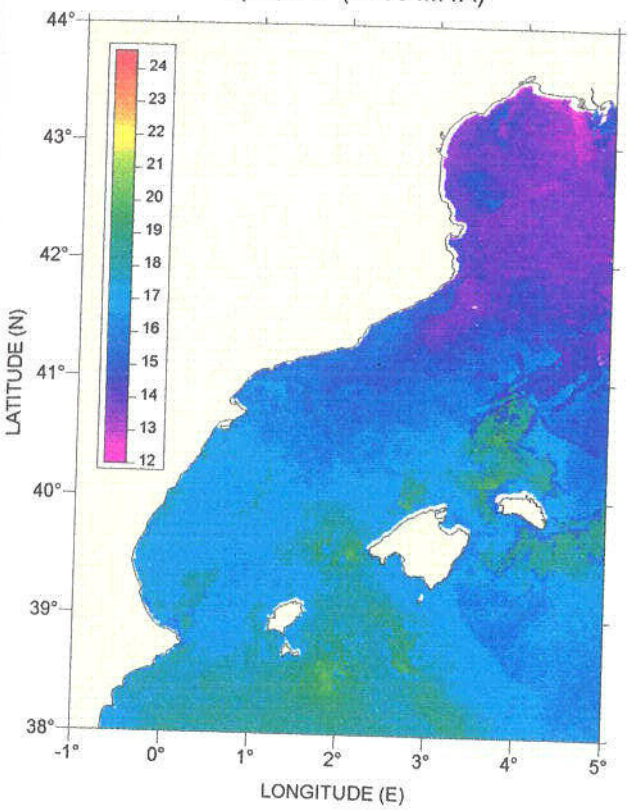


April, A3 (K9504A3A)

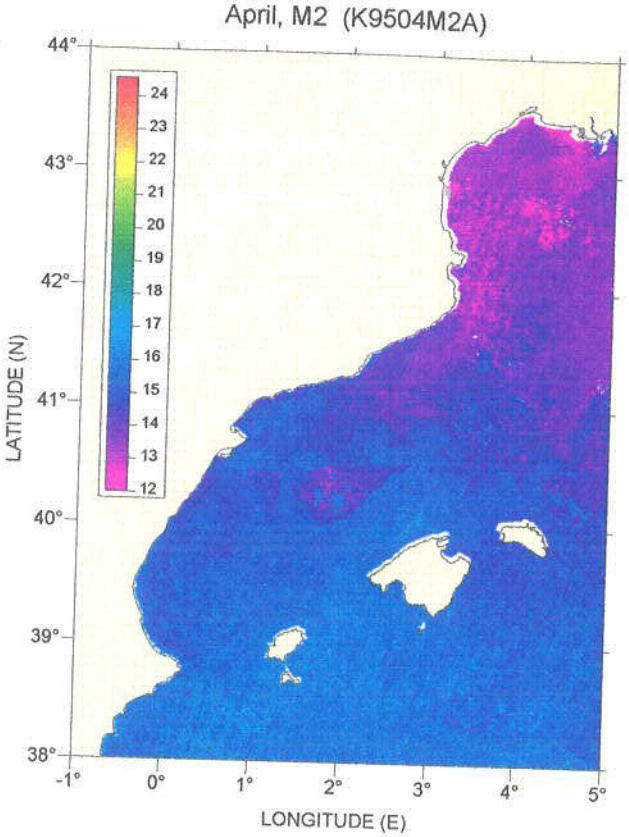


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

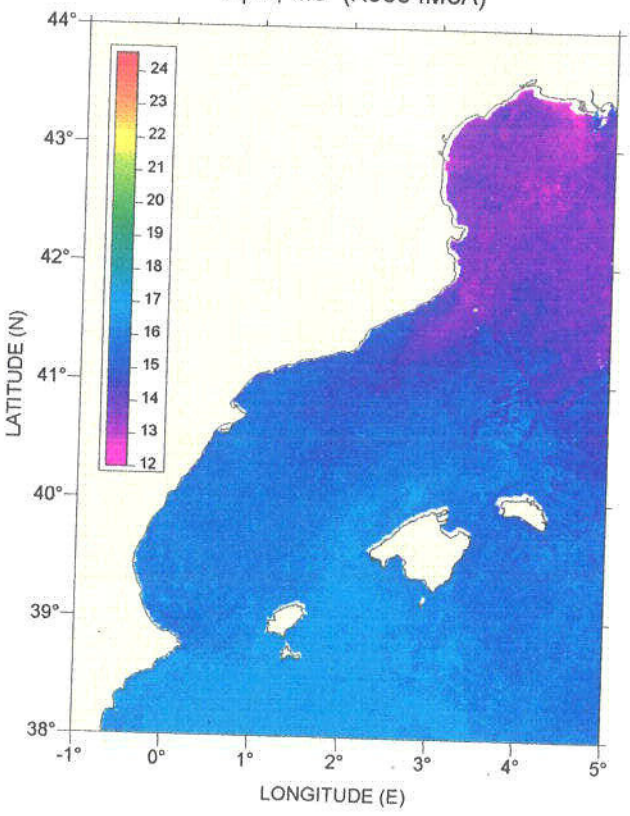
April, M1 (K9504M1A)



April, M2 (K9504M2A)

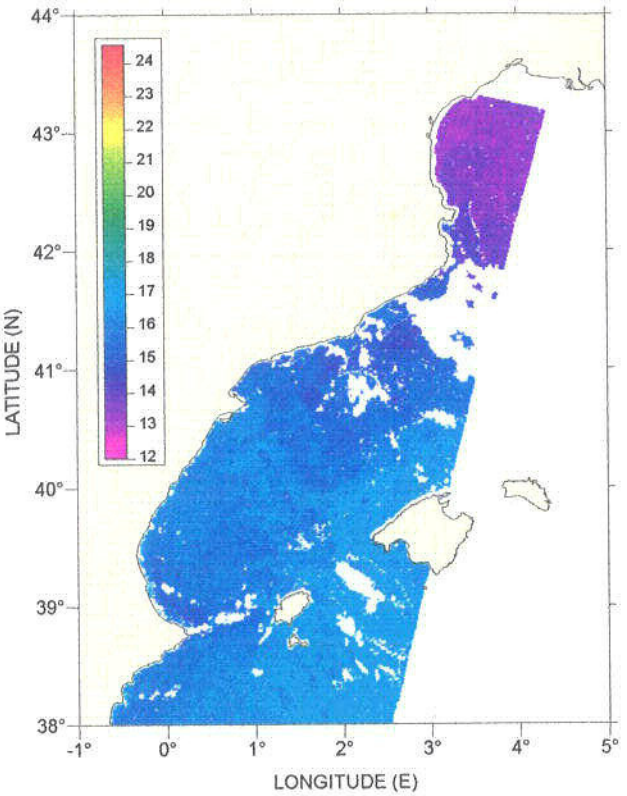


April, M3 (K9504M3A)

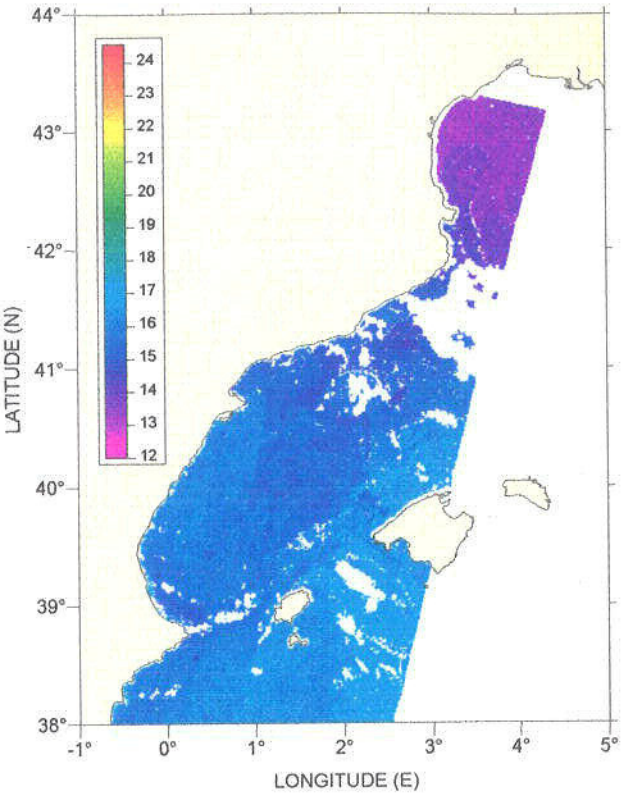


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

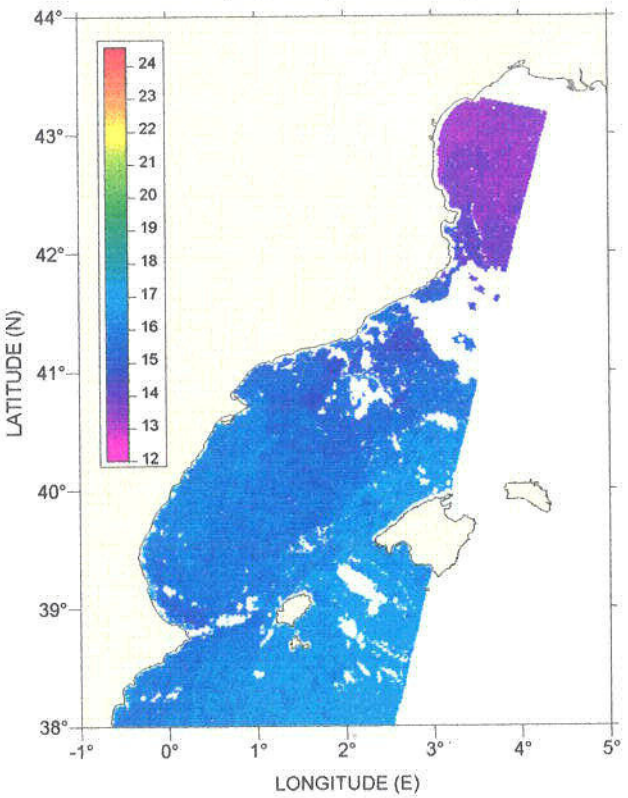
April, M1 (K9504M1M)



April, M2 (K9504M2M)

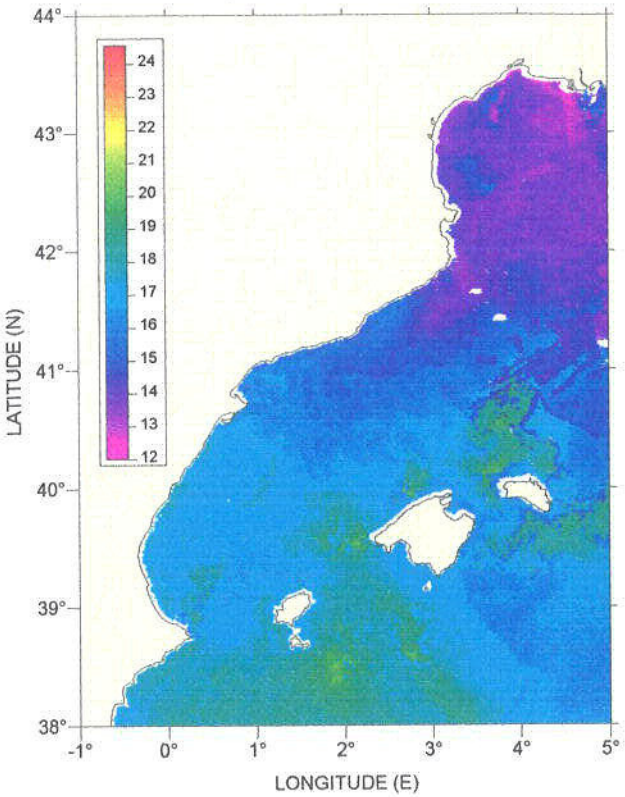


April, M3 (K9504M3M)

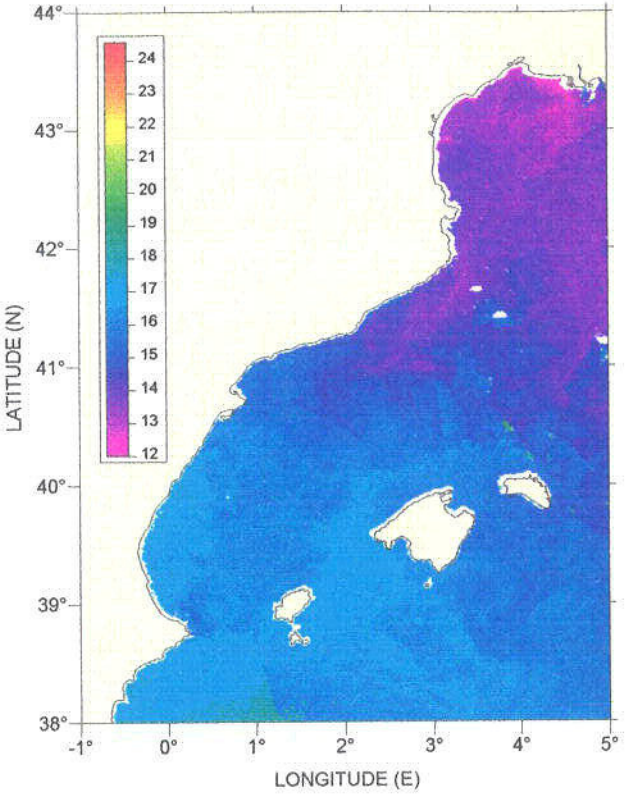


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

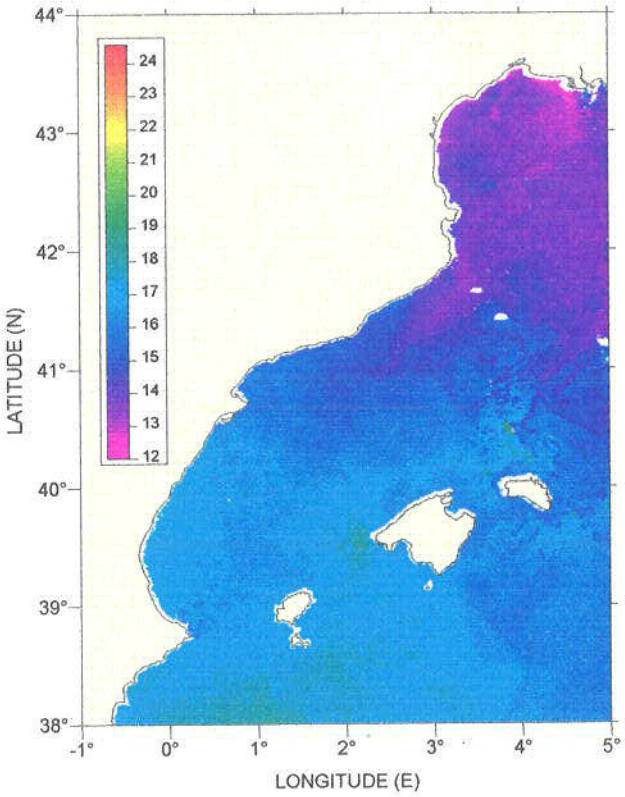
April, M1 (K9504M1P)



April, M2 (K9504M2P)

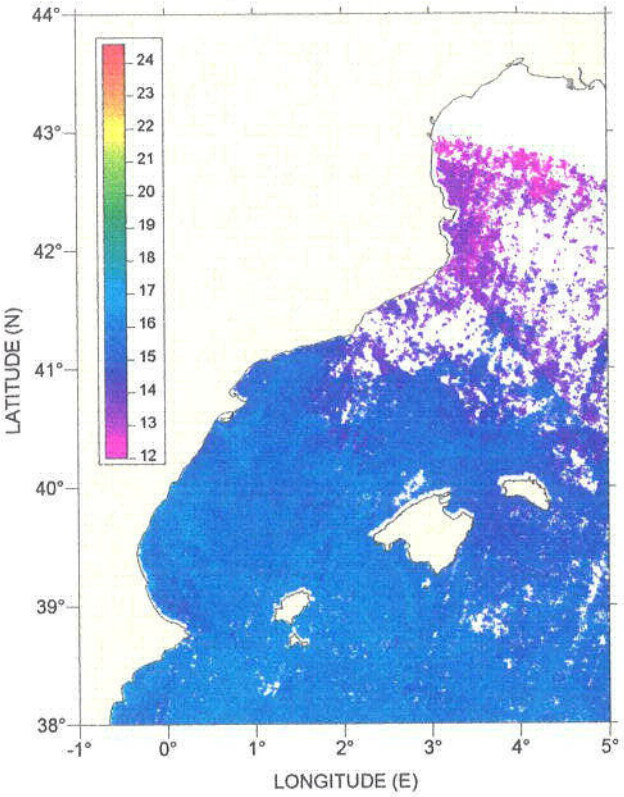


April, M3 (K9504M3P)

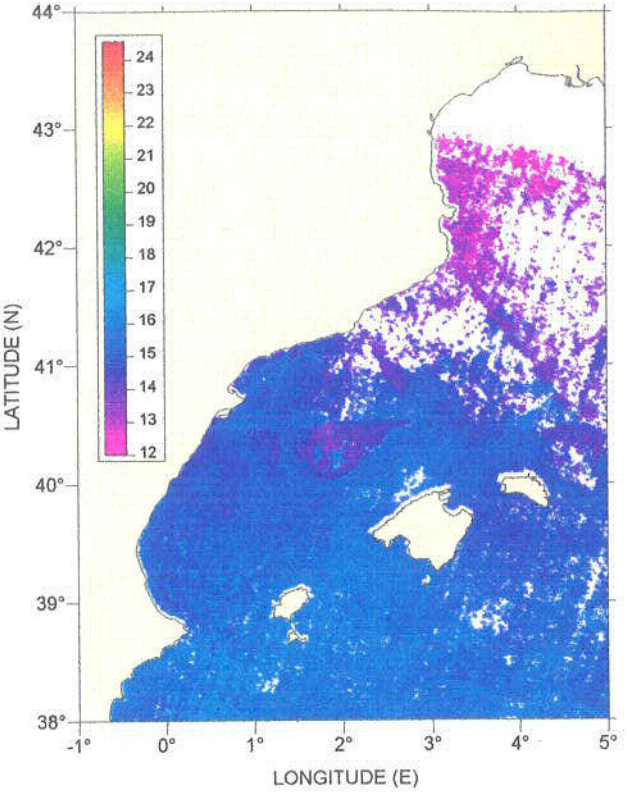


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

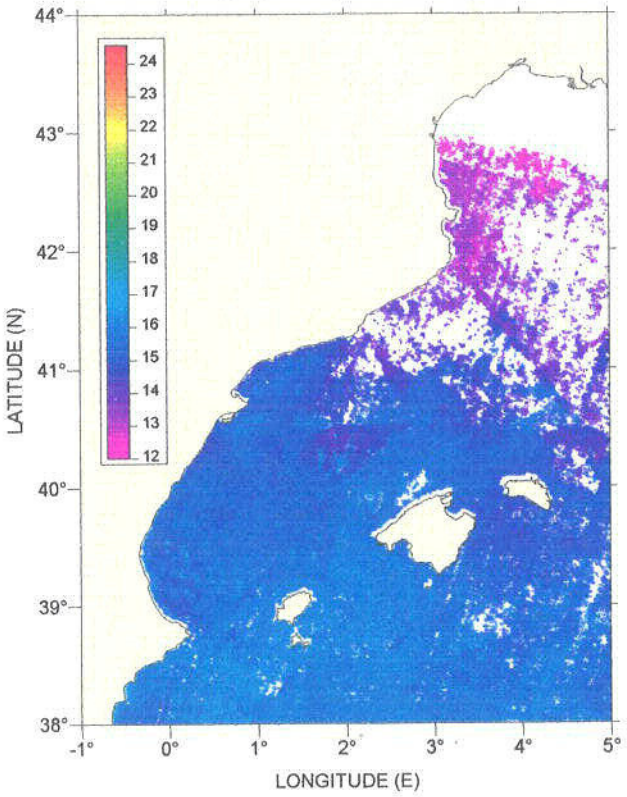
April, M1 (K9504M1N)



April, M2 (K9504M2N)

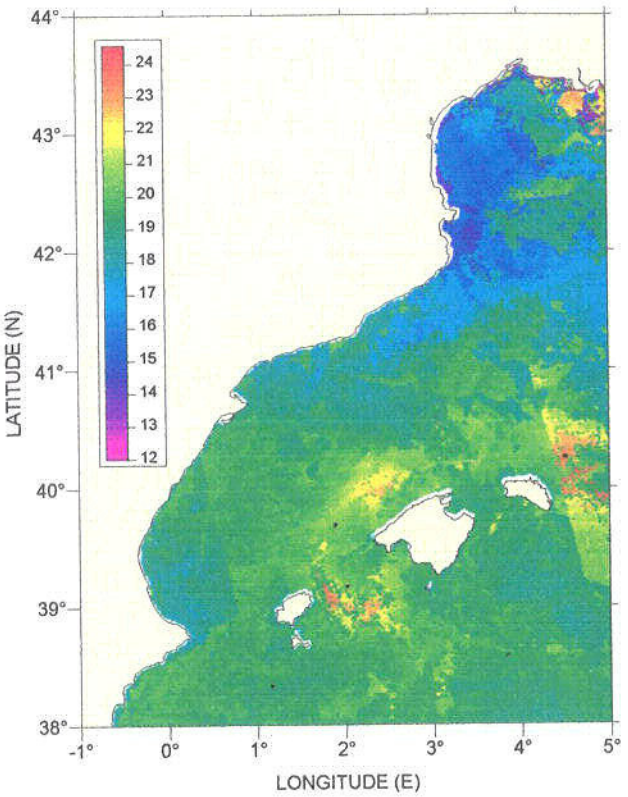


April, M3 (K9504M3N)

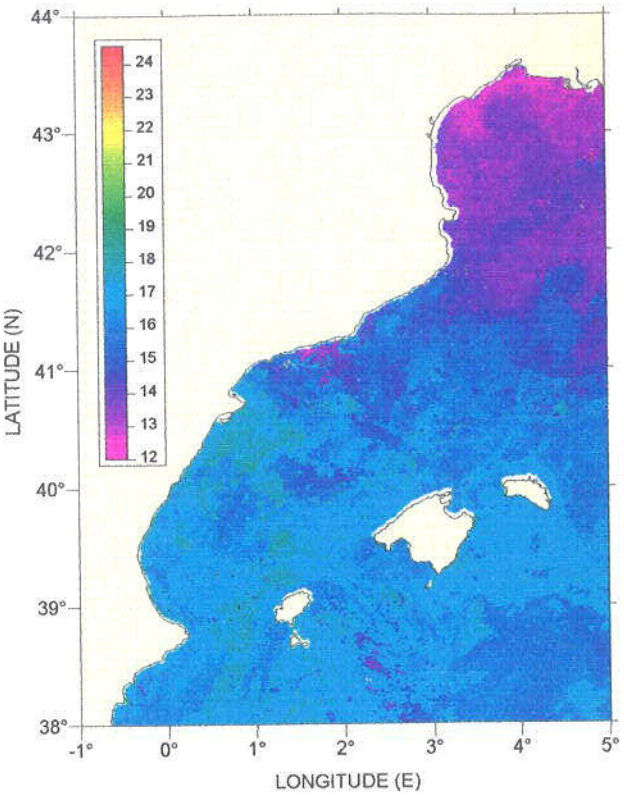


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

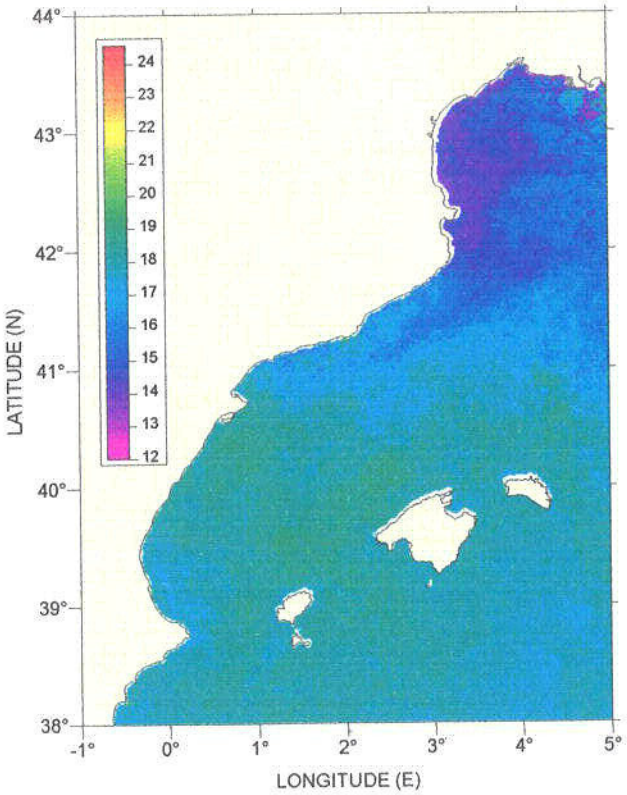
May, M1 (K9505M1A)



May, M2 (K9505M2A)

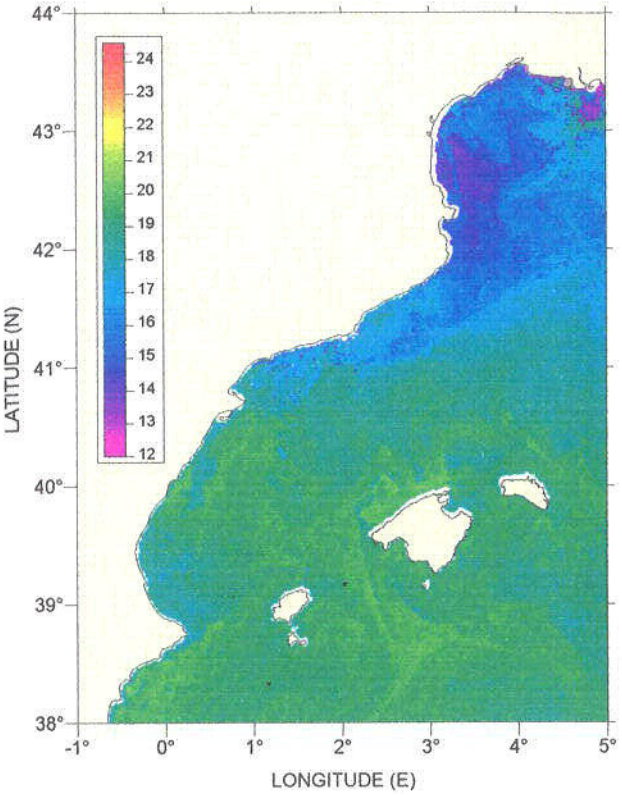


May, M3 (K9505M3A)

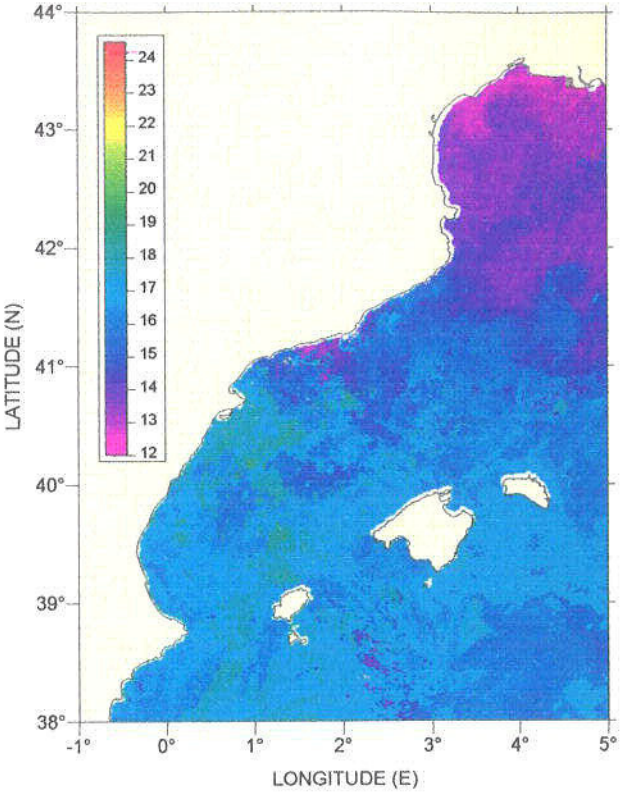


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

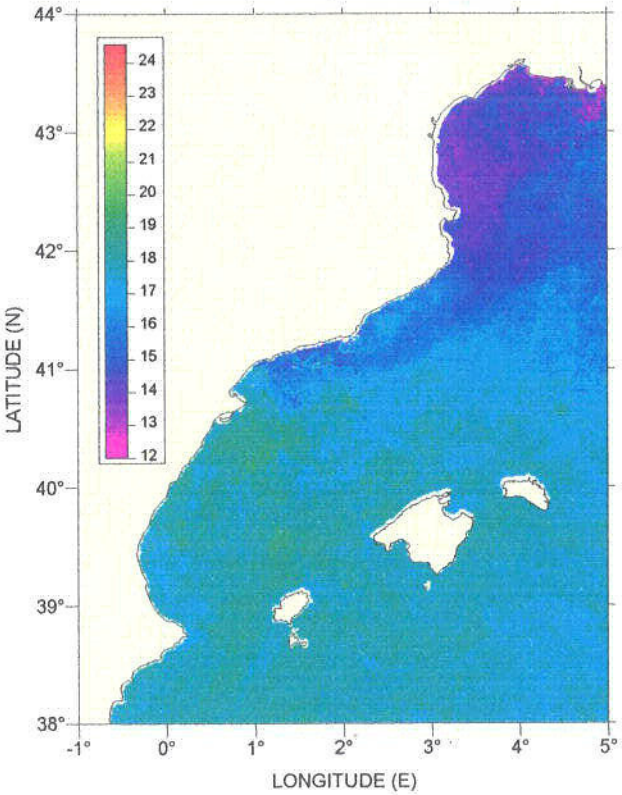
May, M1 (K9505M1M)



May, M2 (K9505M2M)

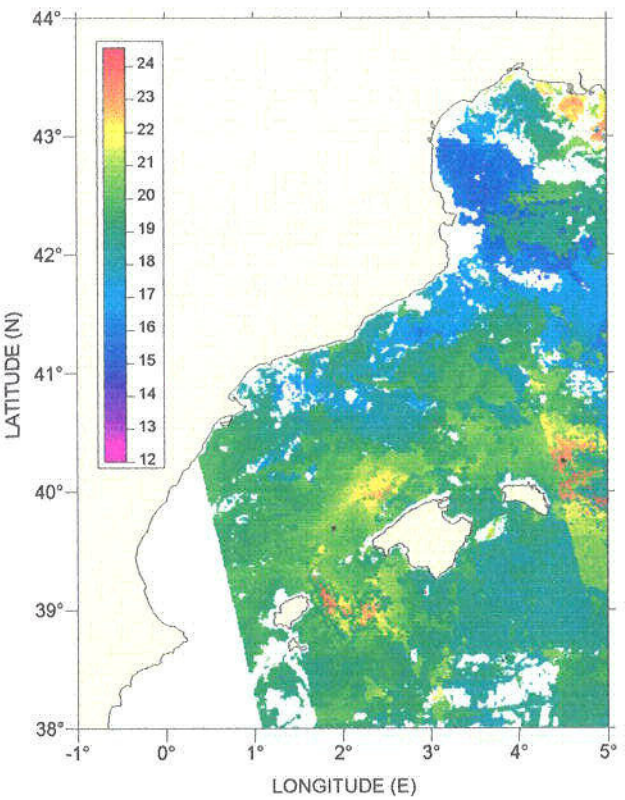


May, M3 (K9505M3M)

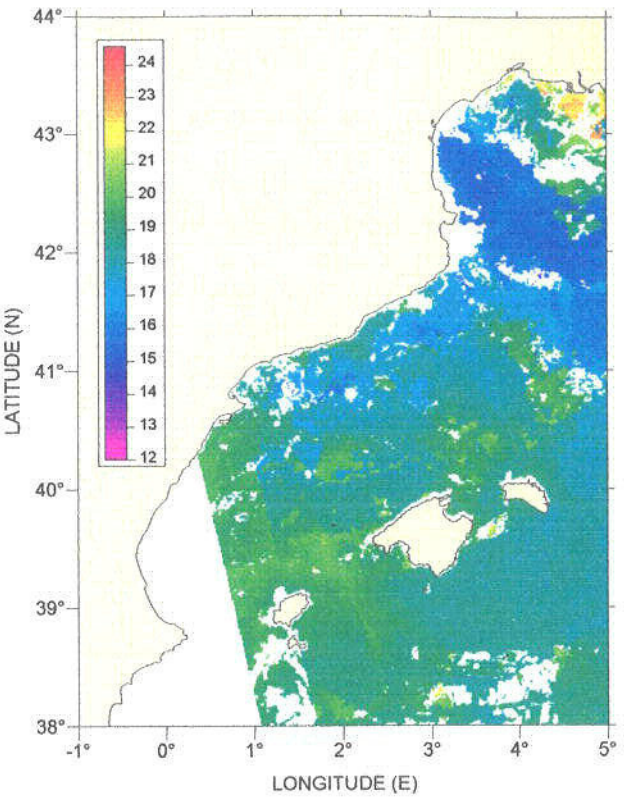


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

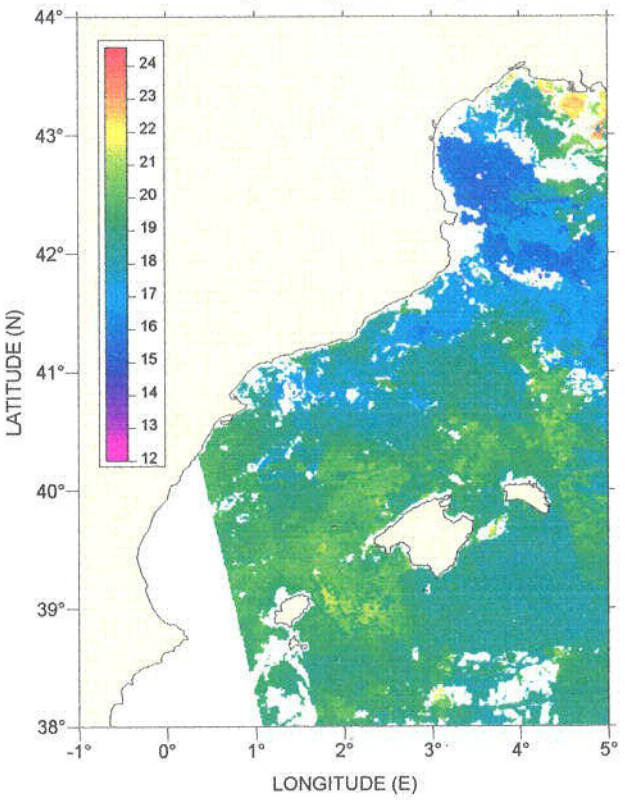
May, M1 (K9505M1P)



May, M2 (K9505M2P)

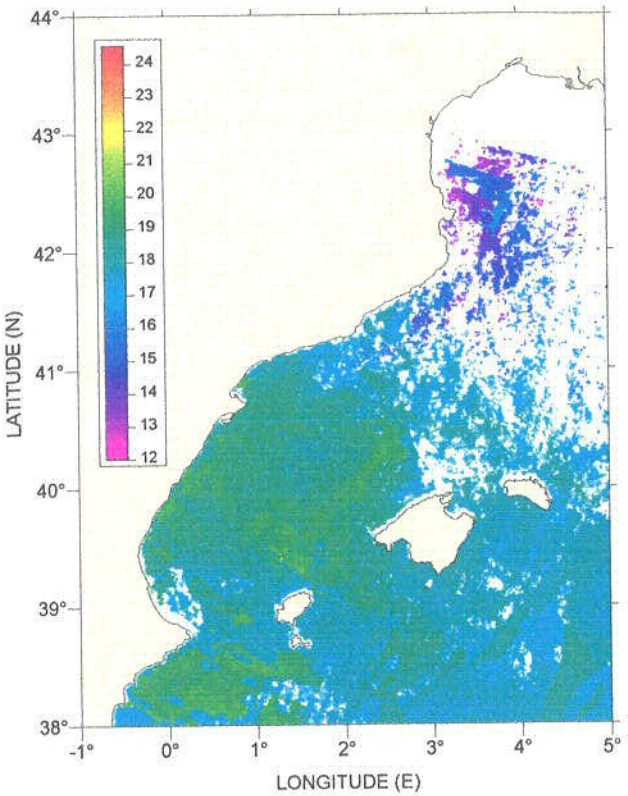


May, M3 (K9505M3P)

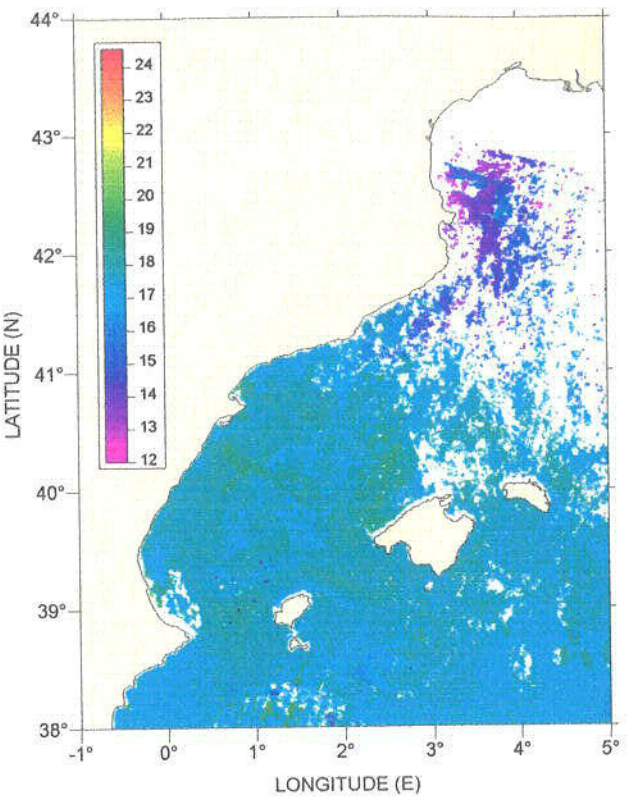


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

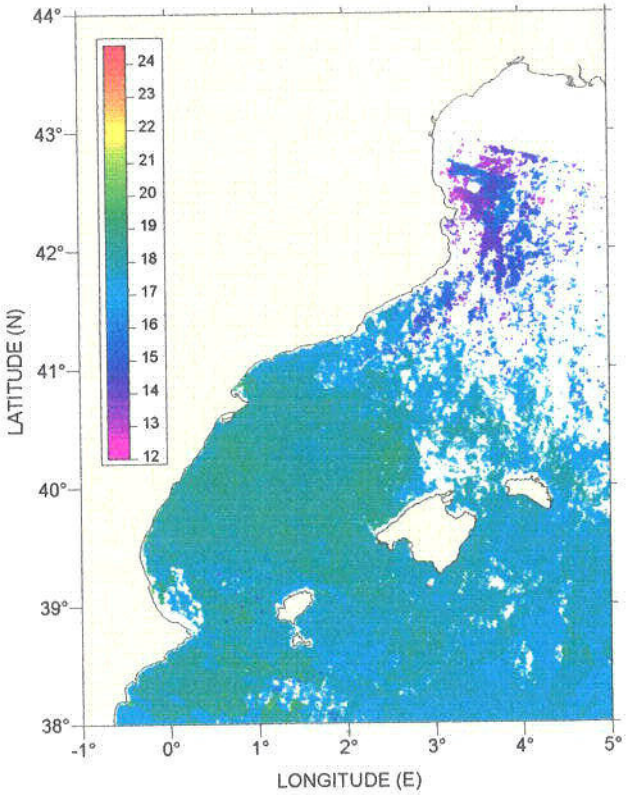
May, M1 (K9505M1N)



May, M2 (K9505M2N)

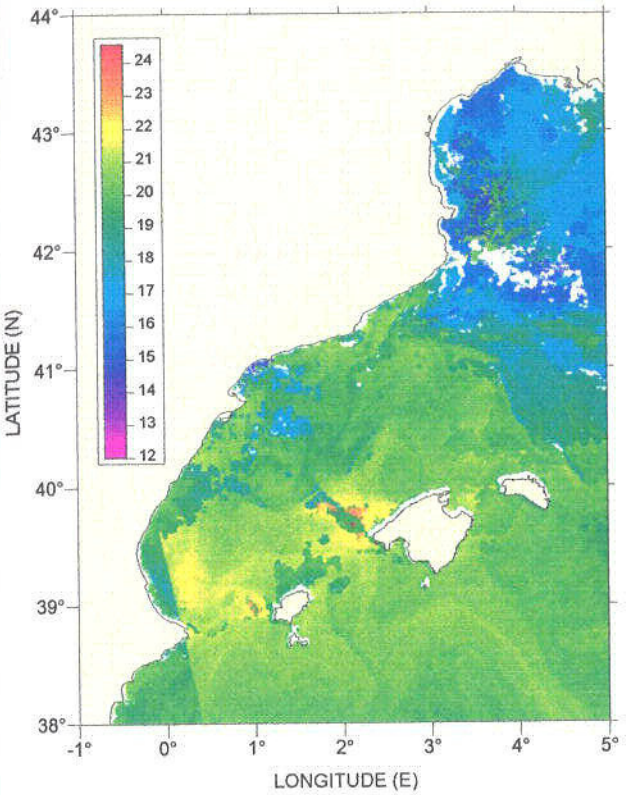


May, M3 (K9505M3N)

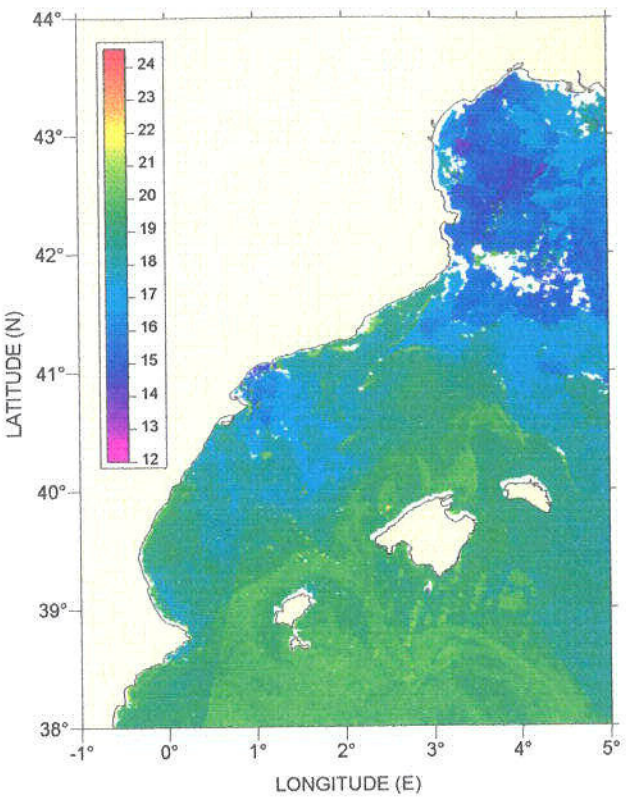


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

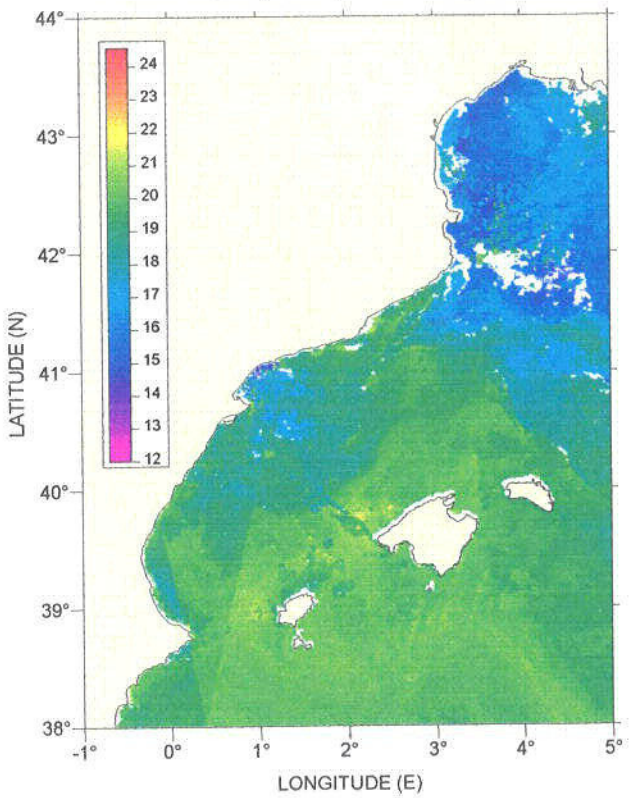
June, M1 (K9506M1A)



June, M2 (K9506M2A)

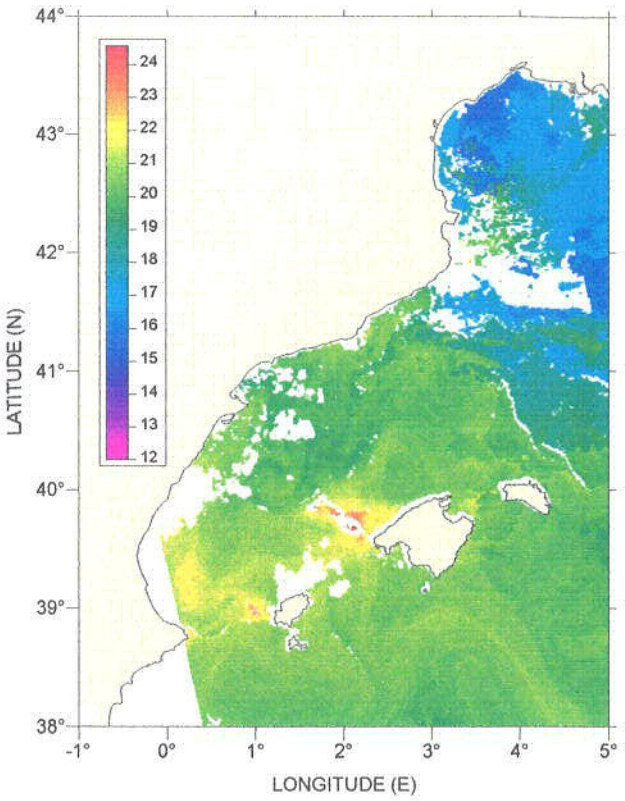


June, M3 (K9506M3A)

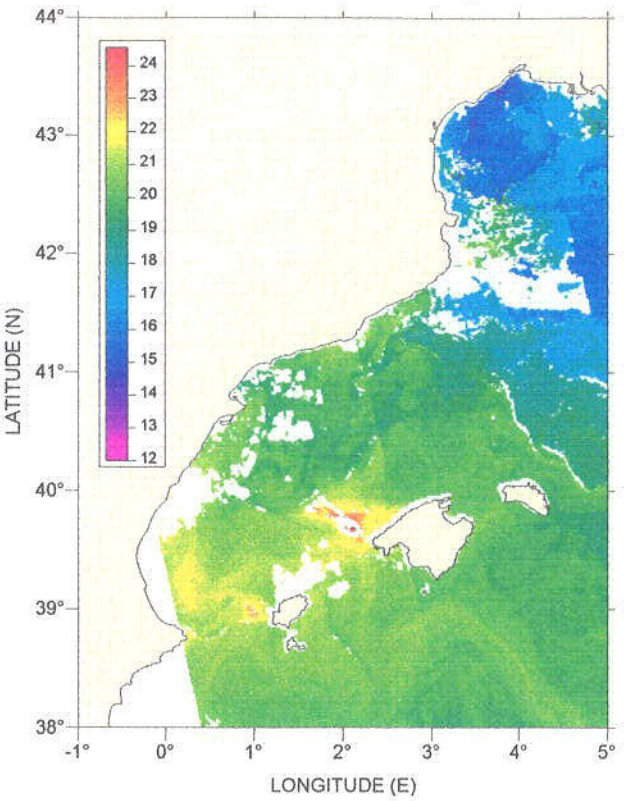


Temperature Satellite Composite Images
GICS-3 (1995) – Catalan Sea

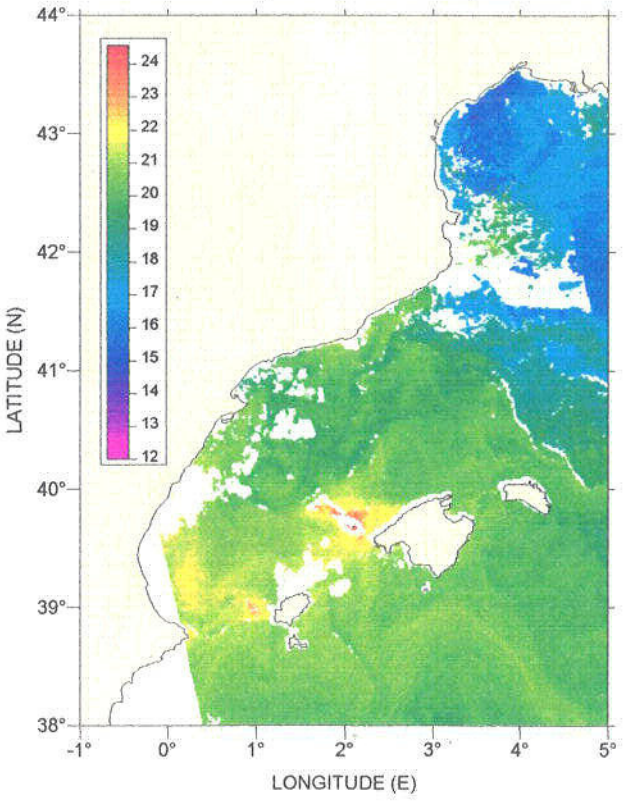
June, M1 (K9506M1P)



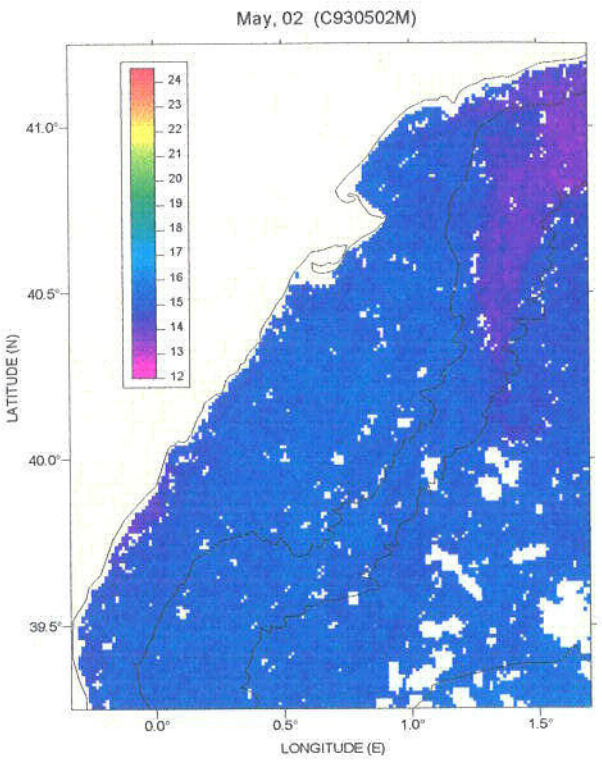
June, M2 (K9506M2P)

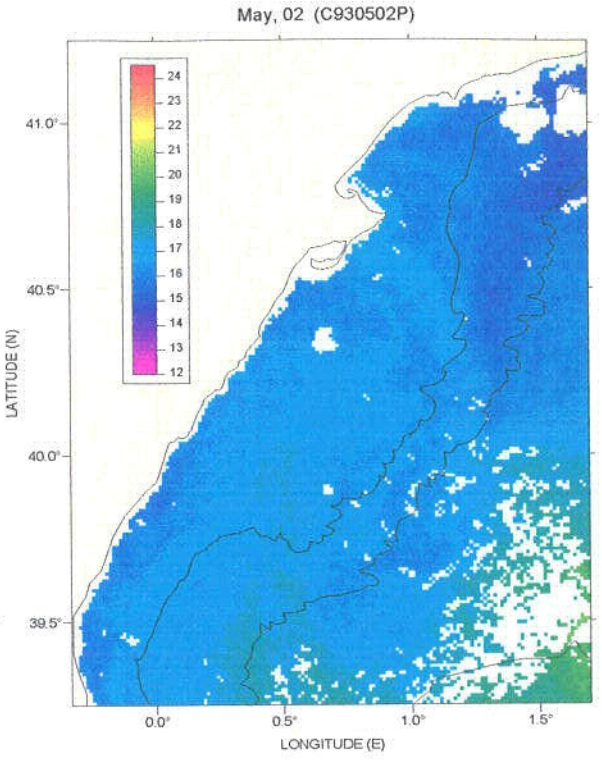


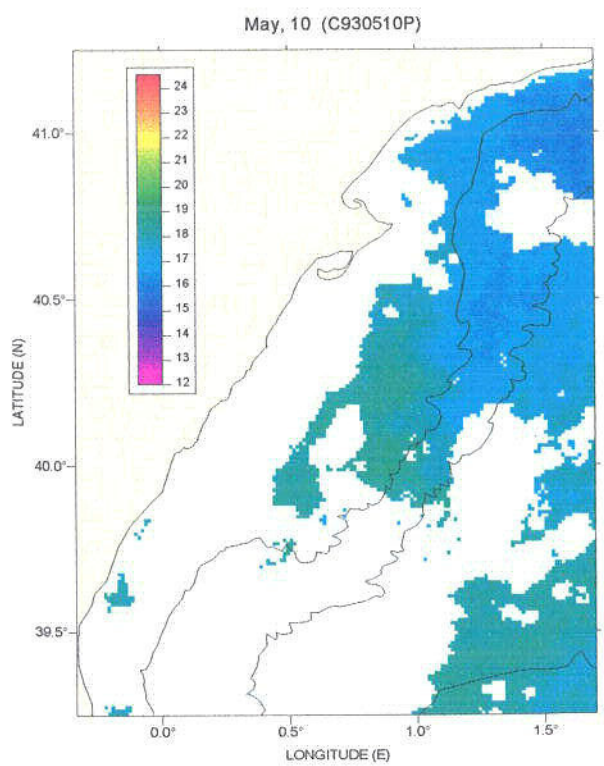
June, M3 (K9506M3P)

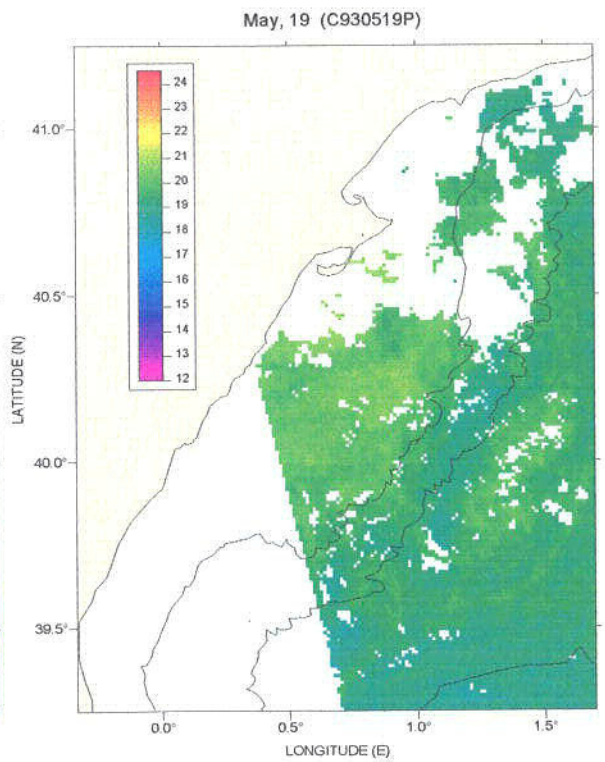


Temperature Satellite Individual Images
GICS-1 (1993) – GICS area



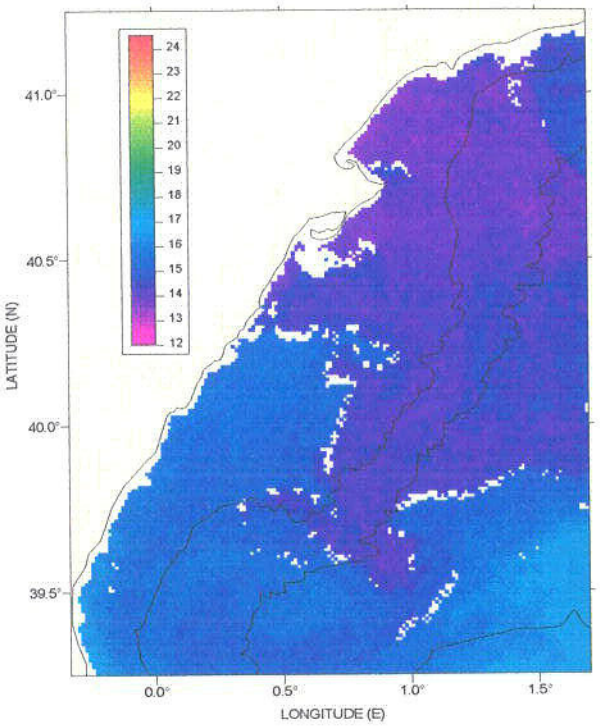




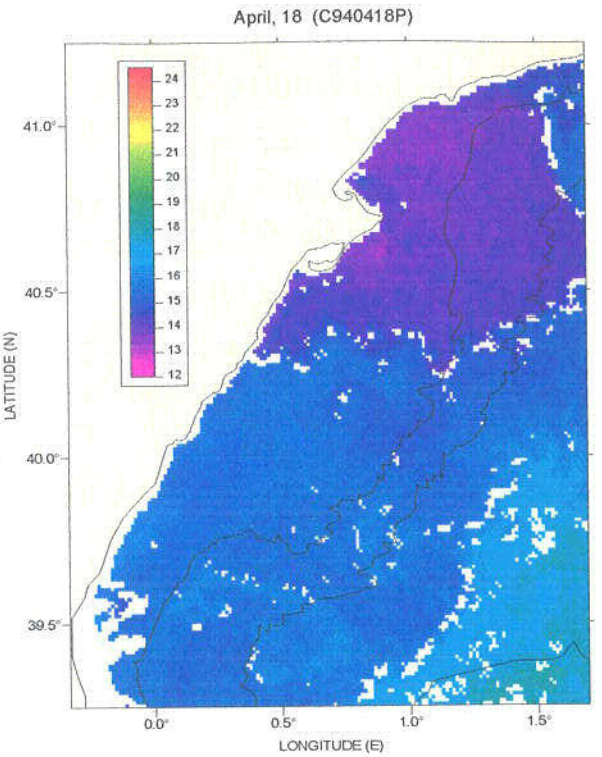


Temperature Satellite Individual Images
GICS-2 (1994) – GICS area

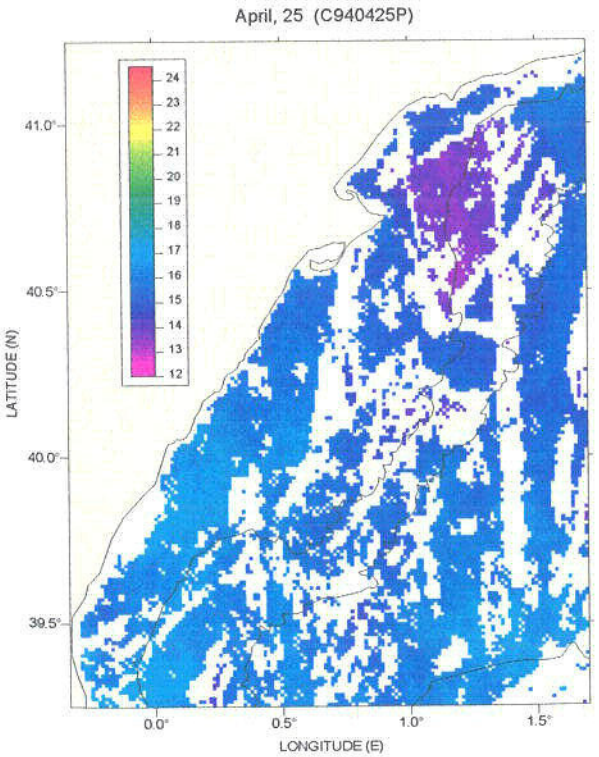
April, 17 (C940417P)



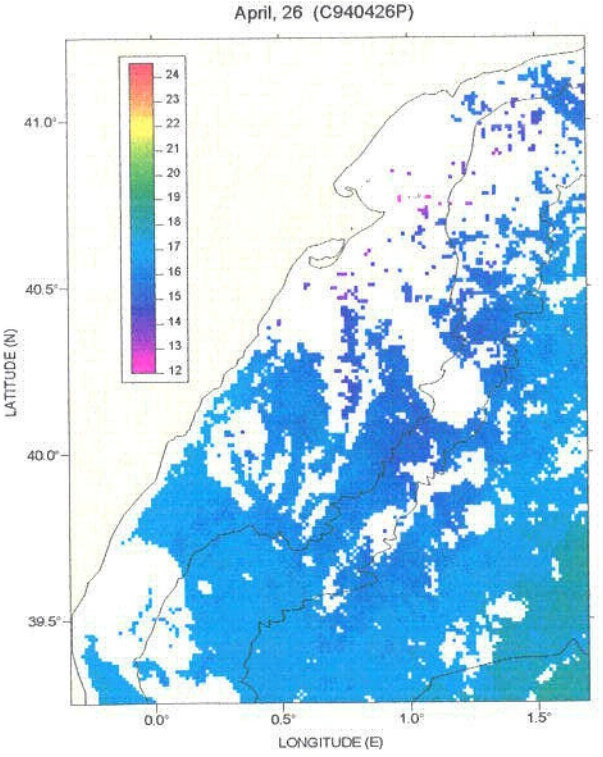
April, 18 (C940418P)



April, 25 (C940425P)

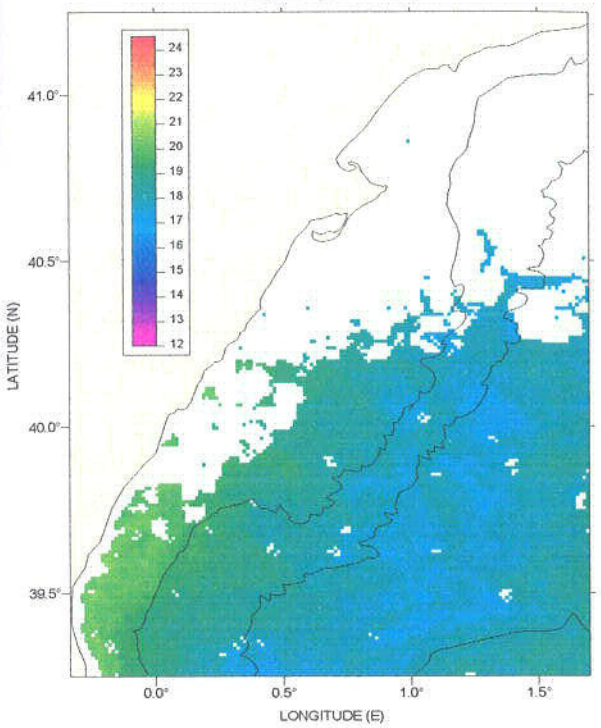


April, 26 (C940426P)

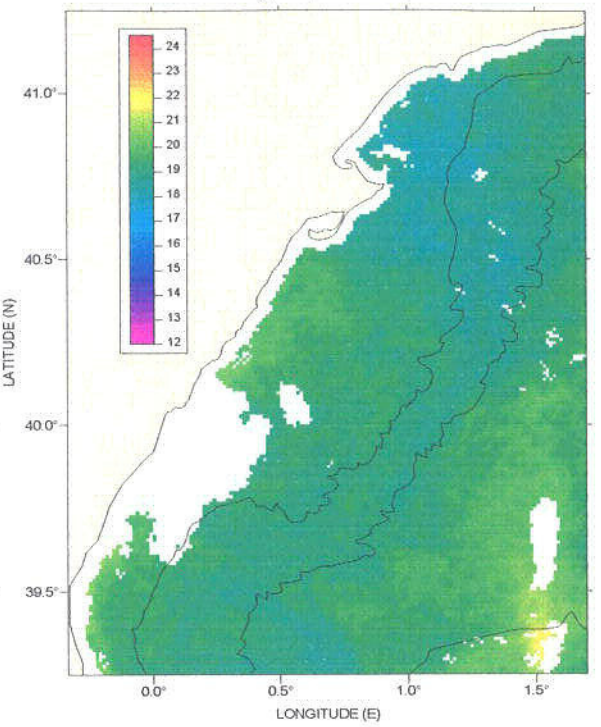


Temperature Satellite Individual Images
GICS-2 (1994) – GICS area

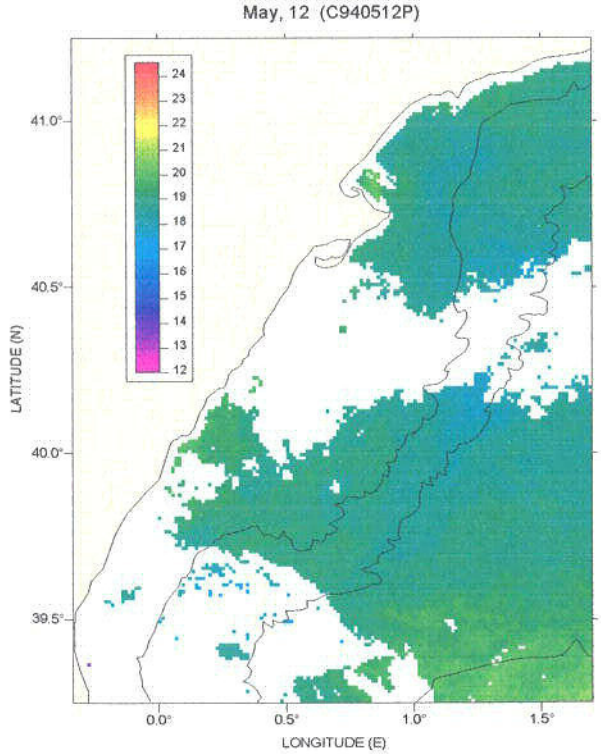
May, 02 (C940502P)



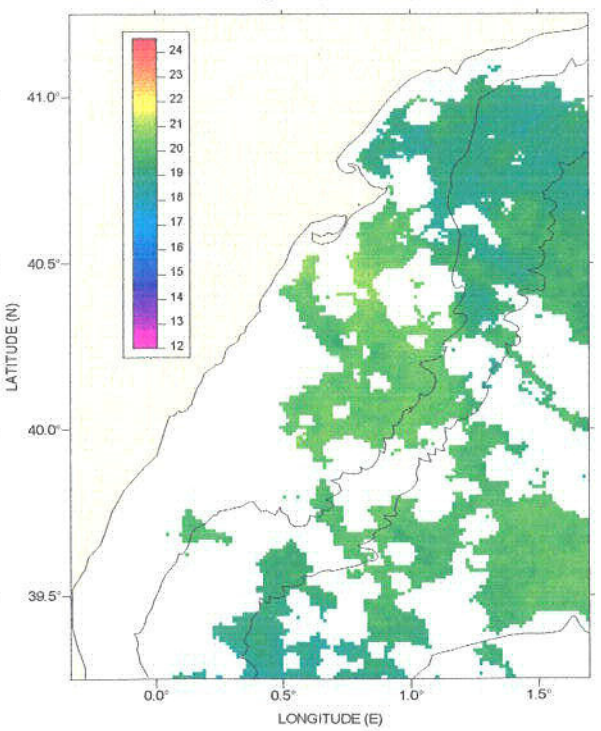
May, 10 (C940510P)



May, 12 (C940512P)

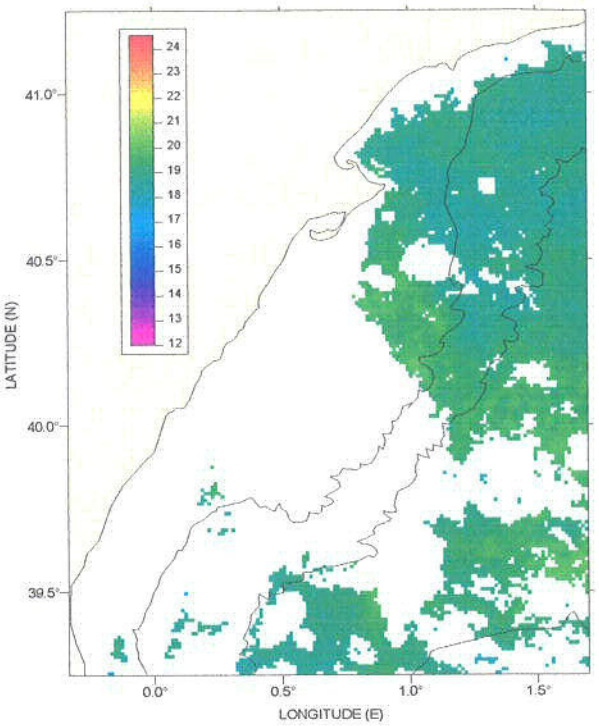


May, 18 (C940518P)

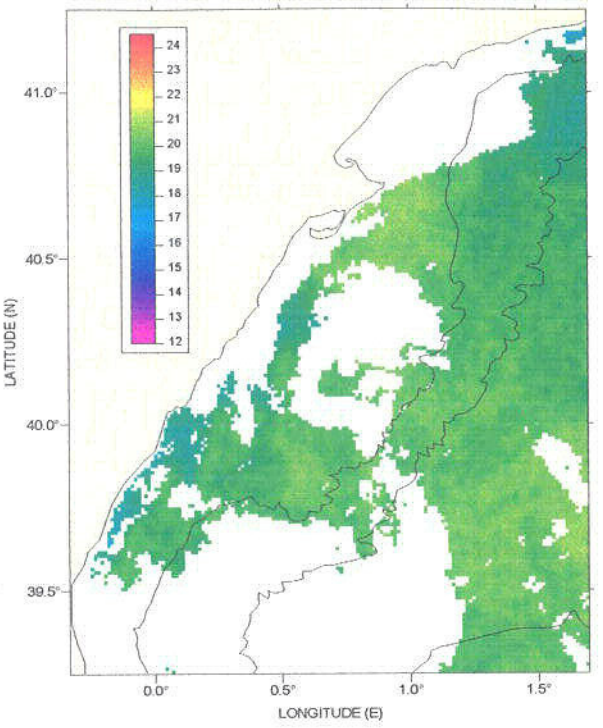


Temperature Satellite Individual Images
GICS-2 (1994) – GICS area

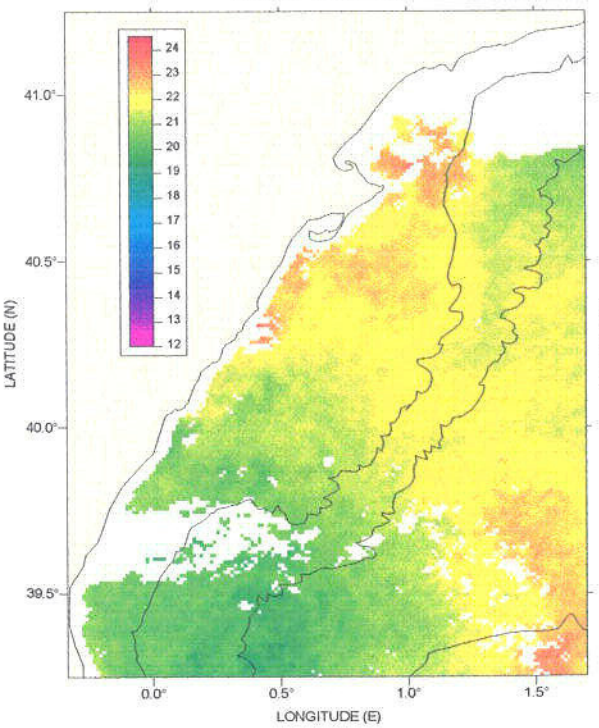
May, 19 (C940519M)



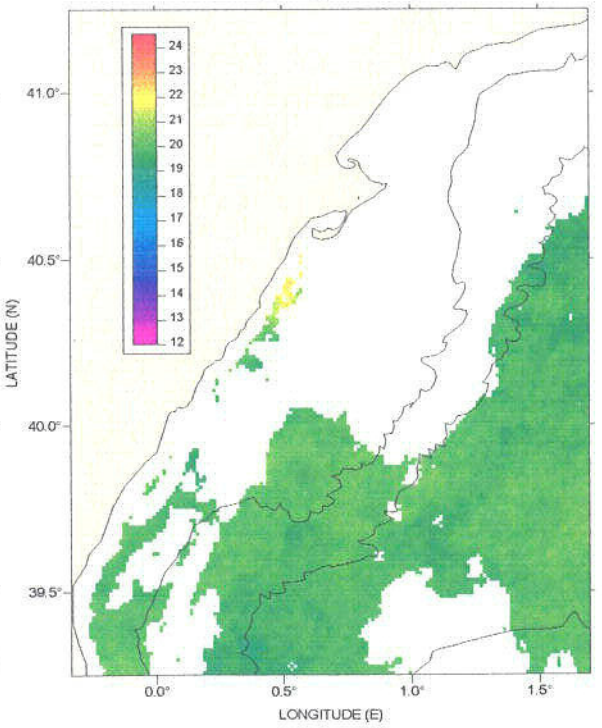
May, 25 (C940525N)



May, 26 (C940526P)

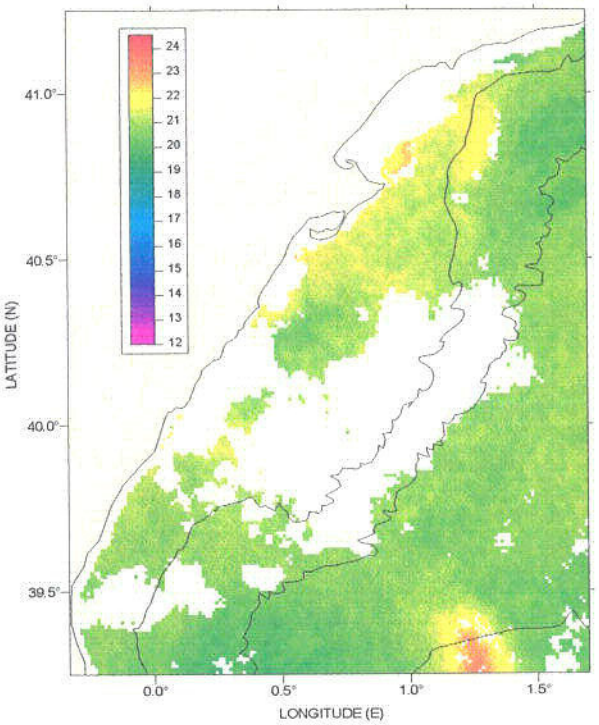


May, 28 (C940528M)

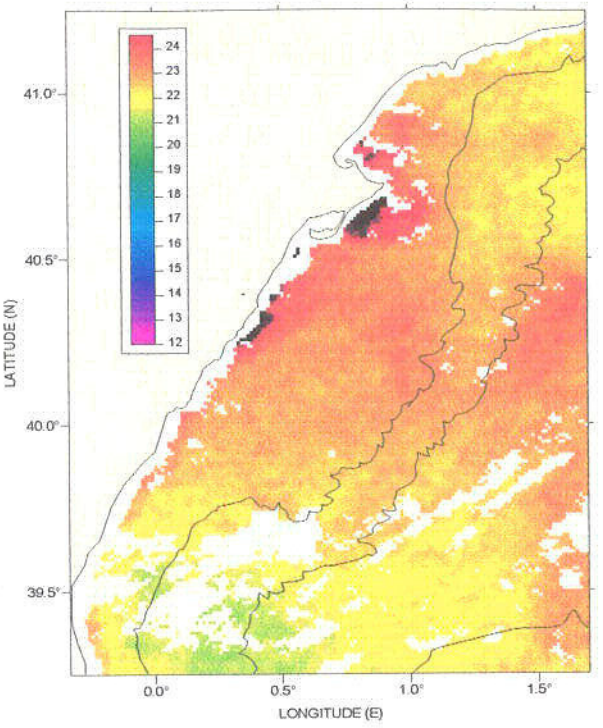


Temperature Satellite Individual Images
GICS-2 (1994) – GICS area

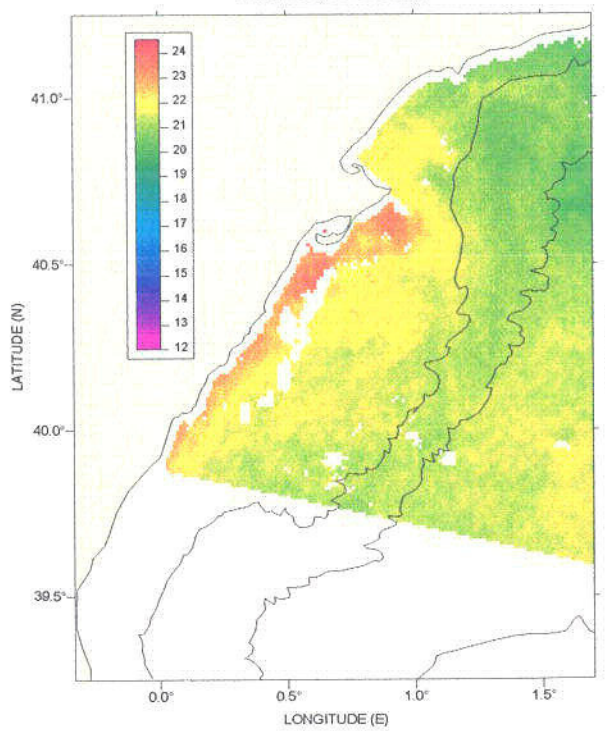
May, 28 (C940528P)



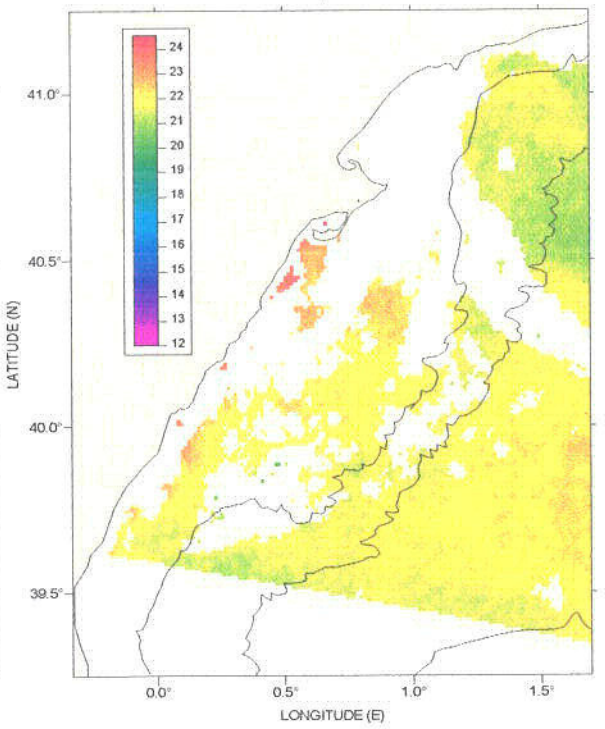
June, 03 (C940603P)



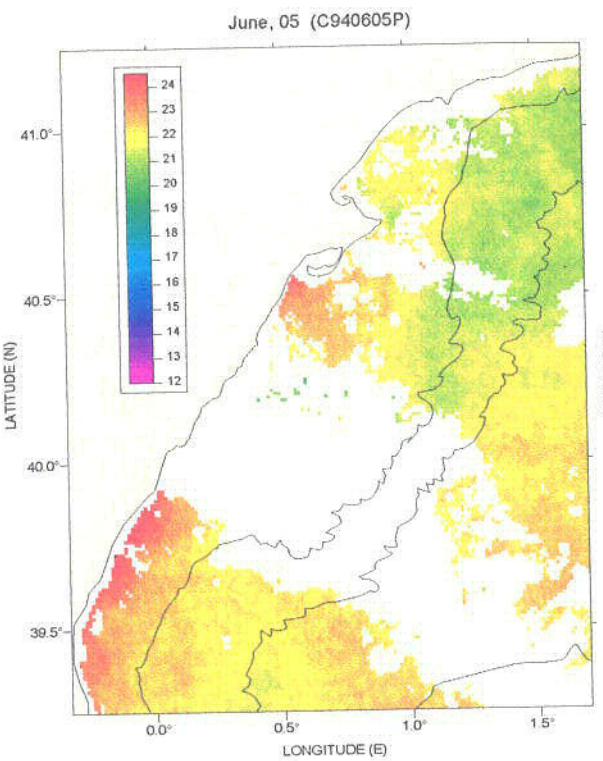
June, 03 (C940603N)

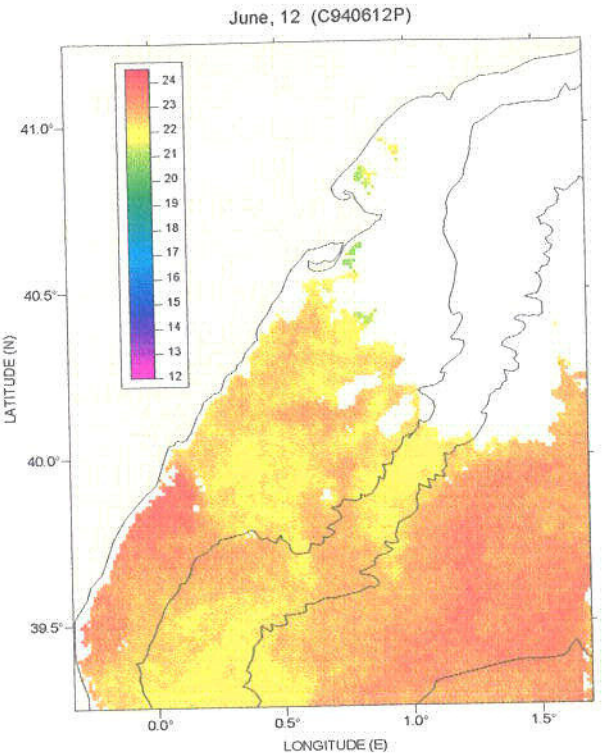


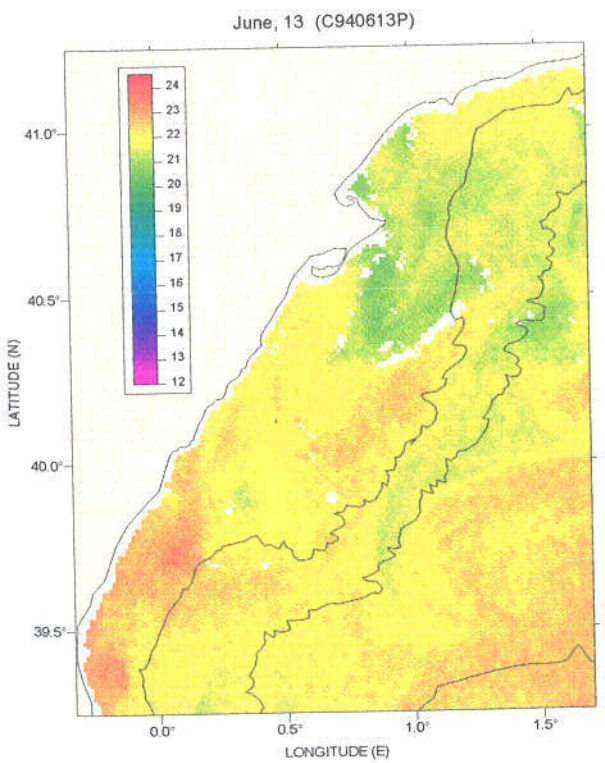
June, 04 (C940604N)



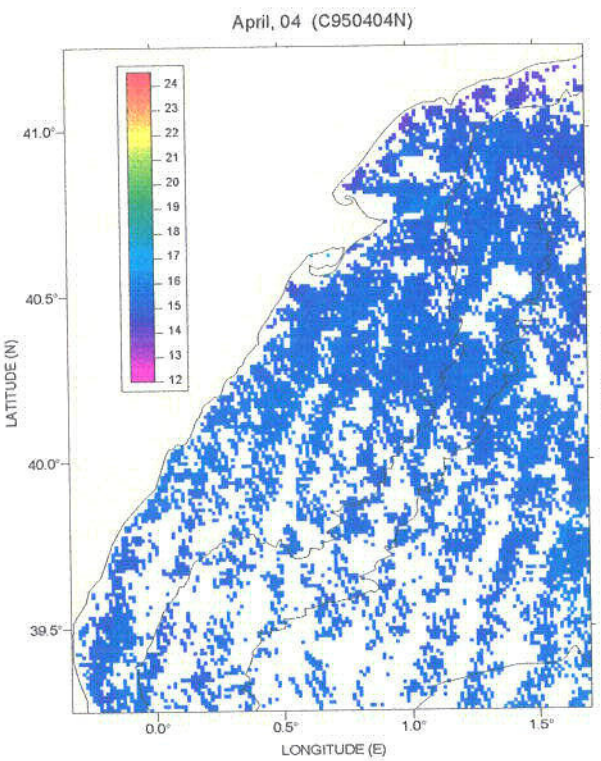
Temperature Satellite Individual Images
GICS-2 (1994) – GICS area

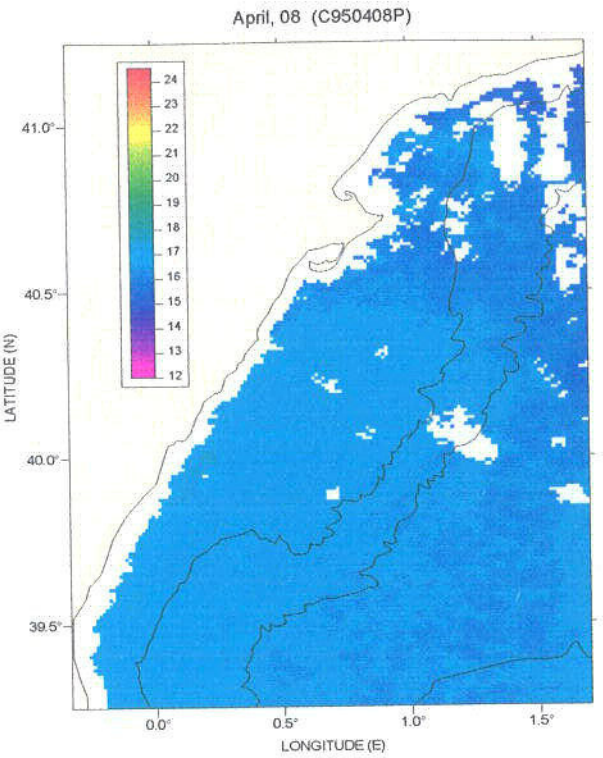


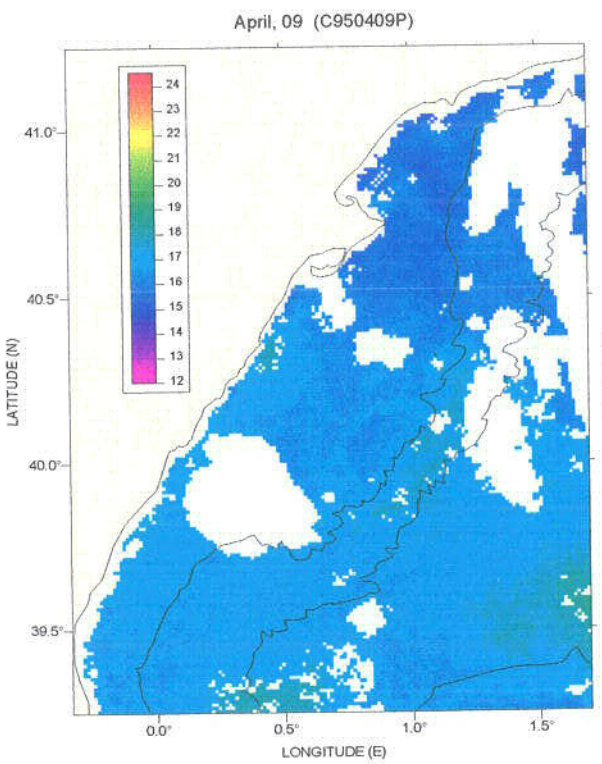


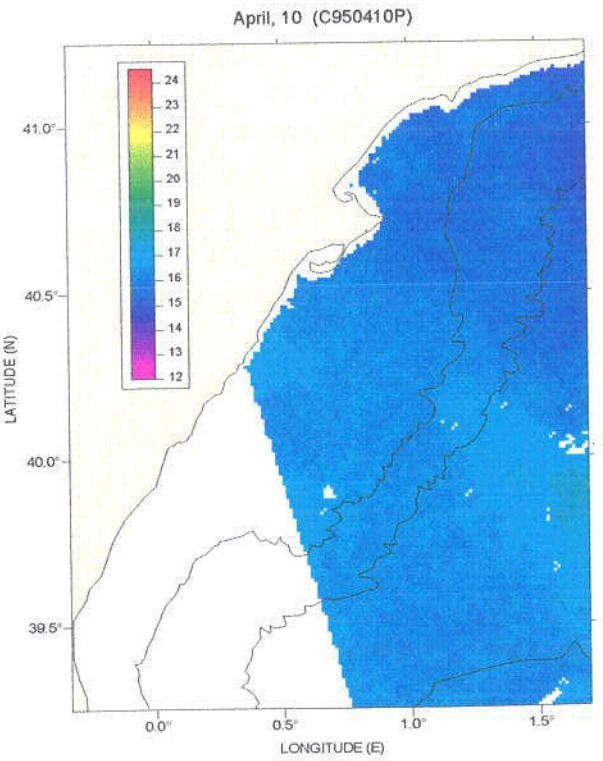


Temperature Satellite Individual Images
GICS-3 (1995) – GICS area



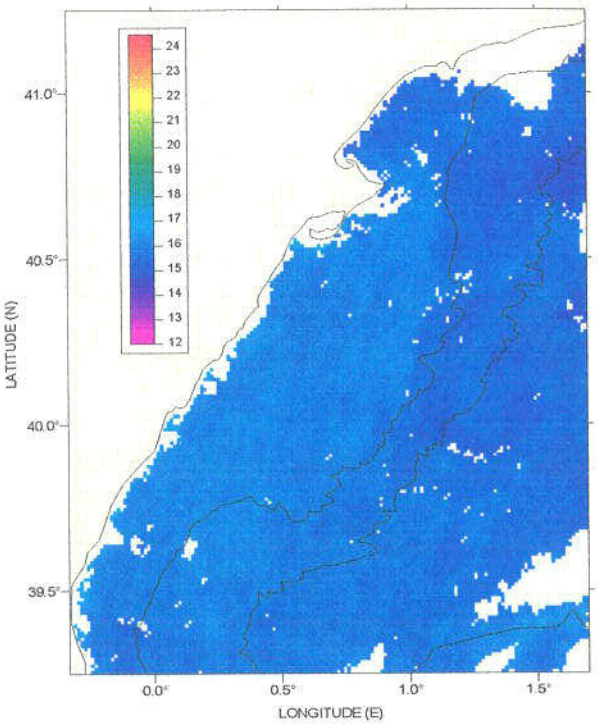




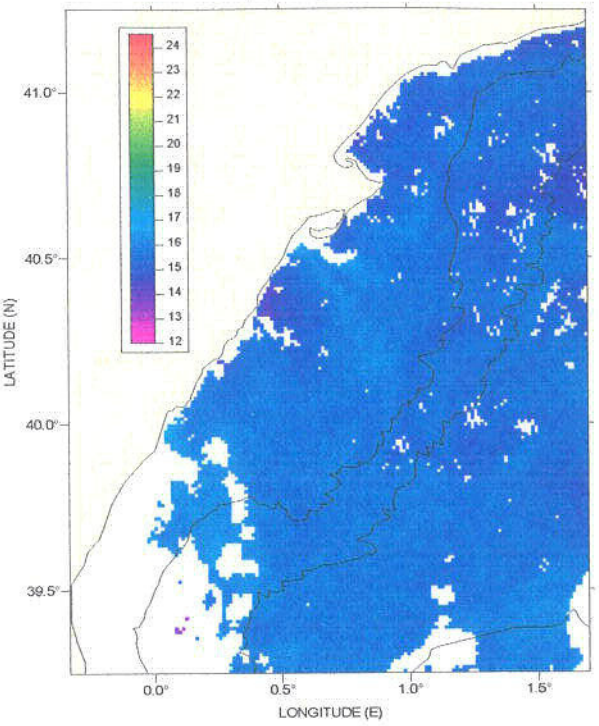


Temperature Satellite Individual Images
GICS-3 (1995) – GICS area

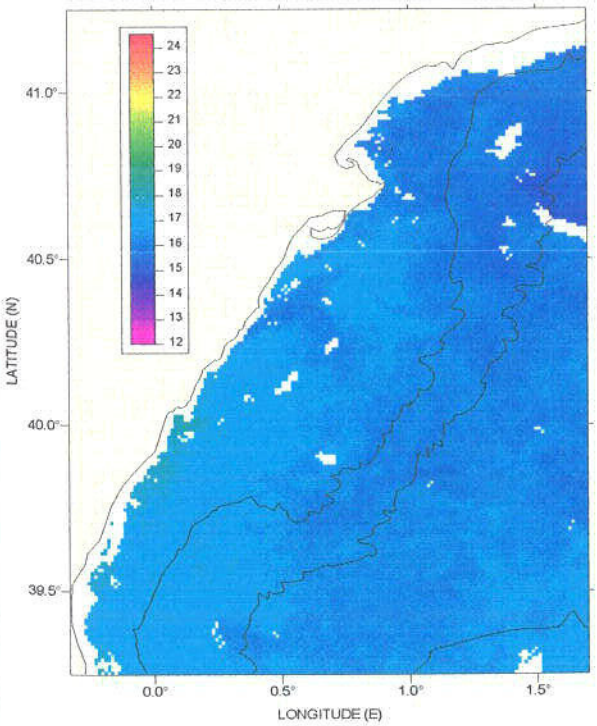
April, 16 (C950416M)



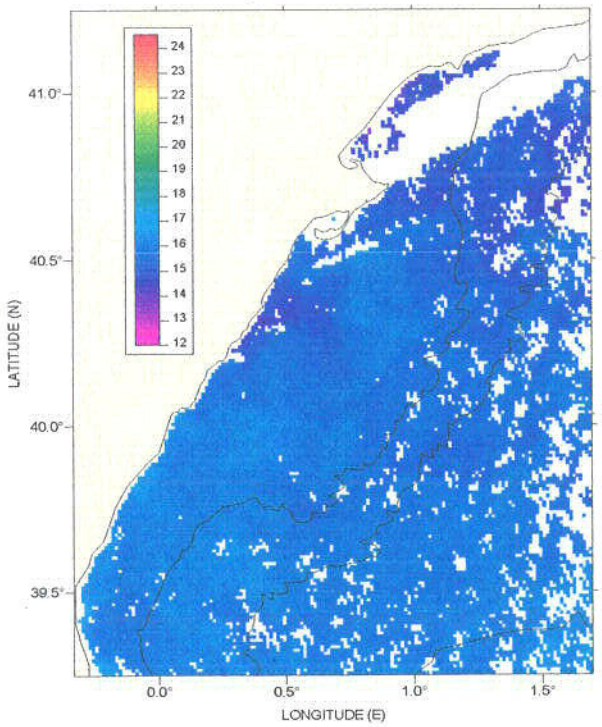
April, 17 (C950417N)



April, 18 (C950418P)

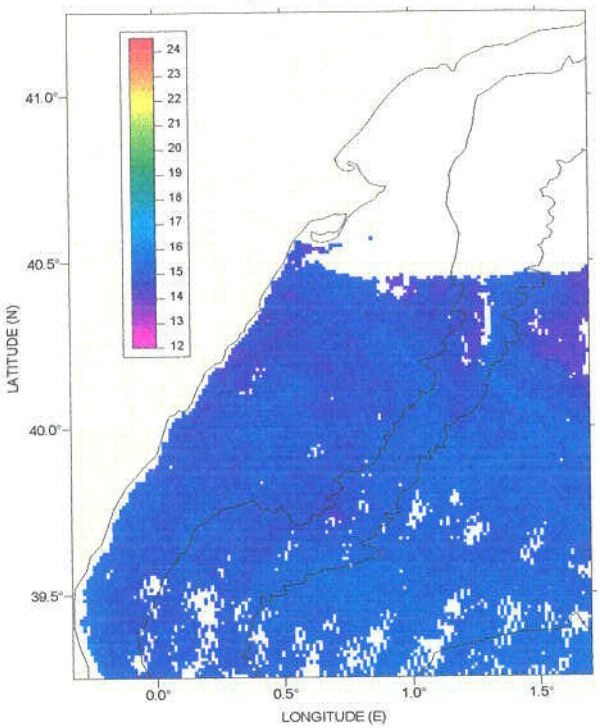


April, 18 (C950418N)

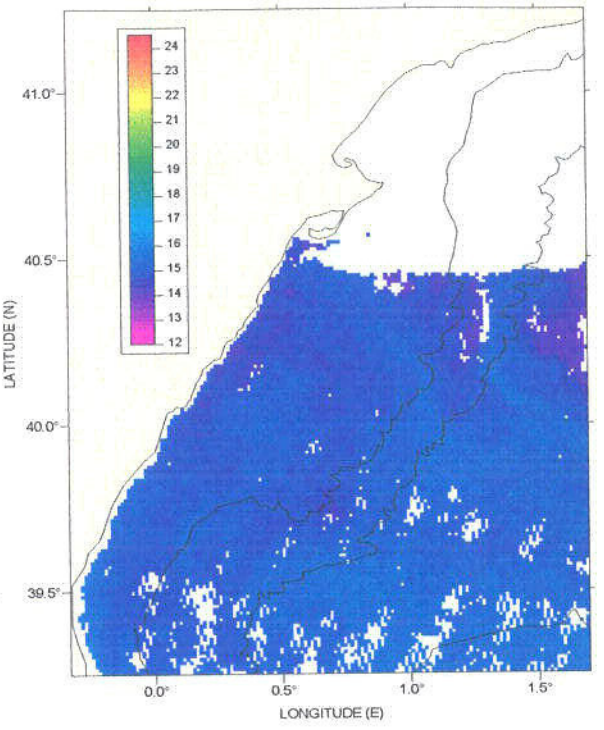


Temperature Satellite Individual Images
GICS-3 (1995) – GICS area

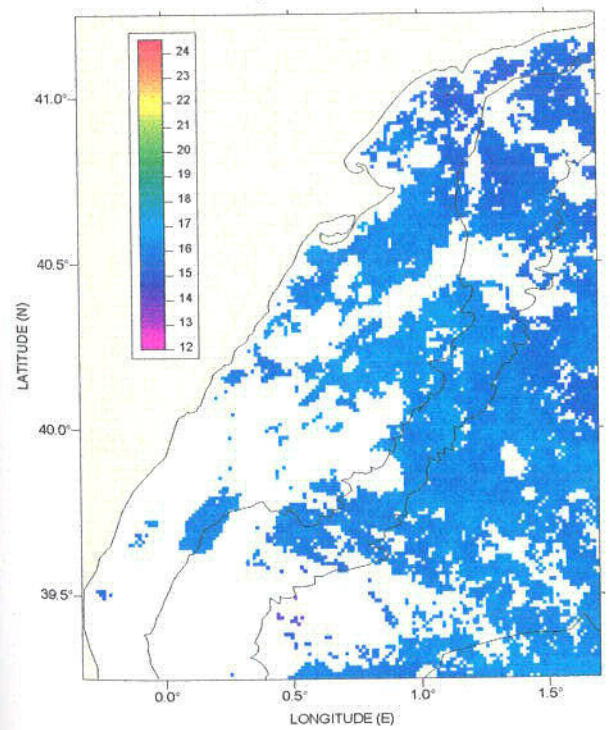
April, 26 (C950426N)



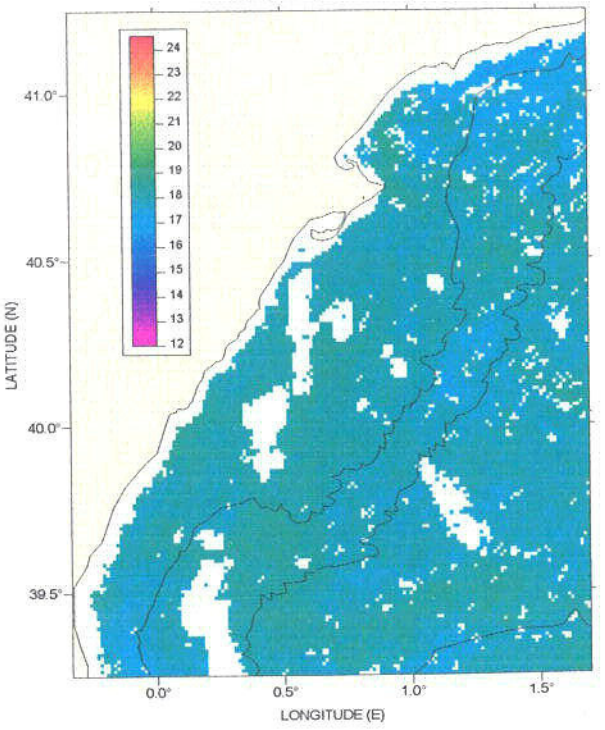
April, 27 (C950427N)



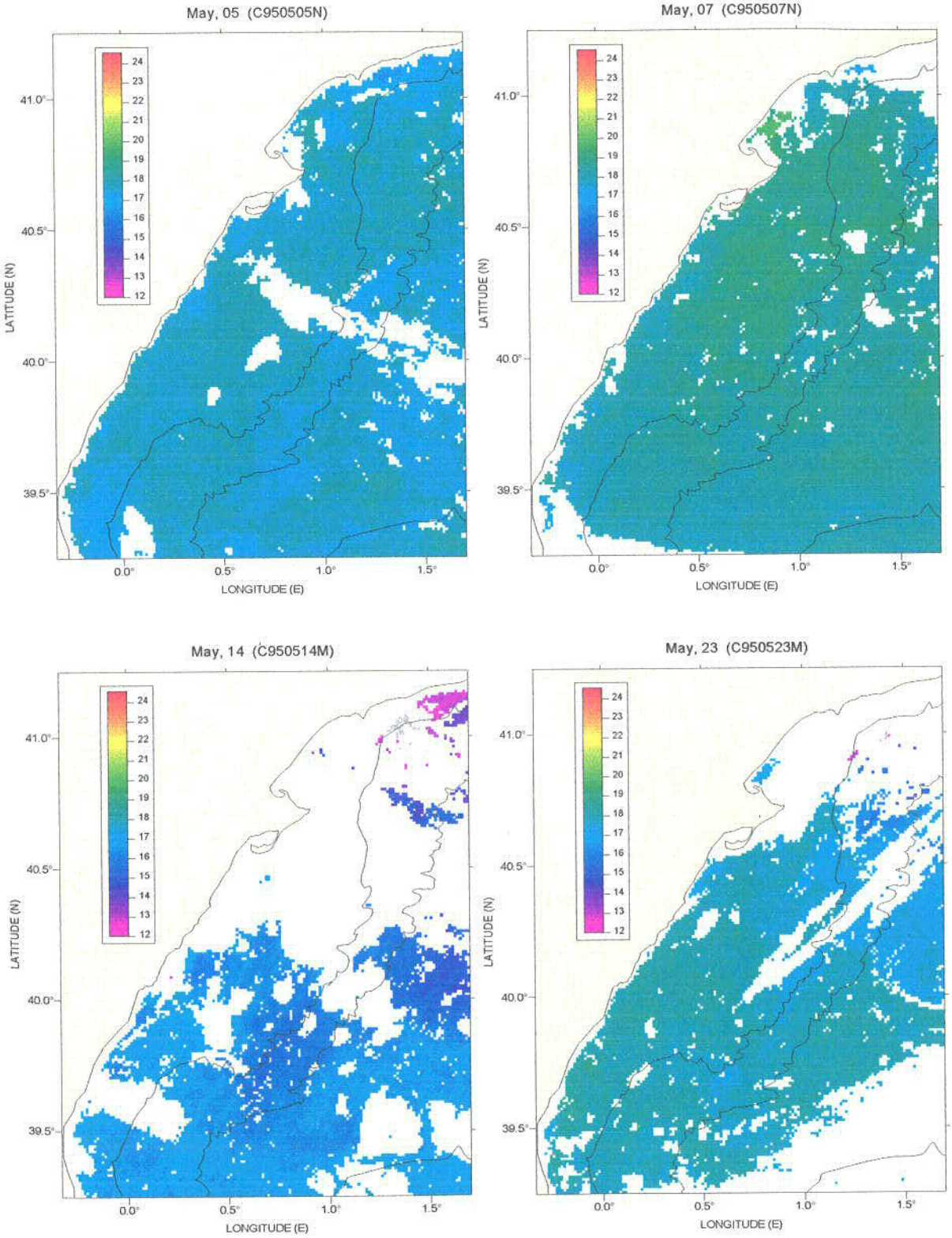
April, 30 (C950430M)



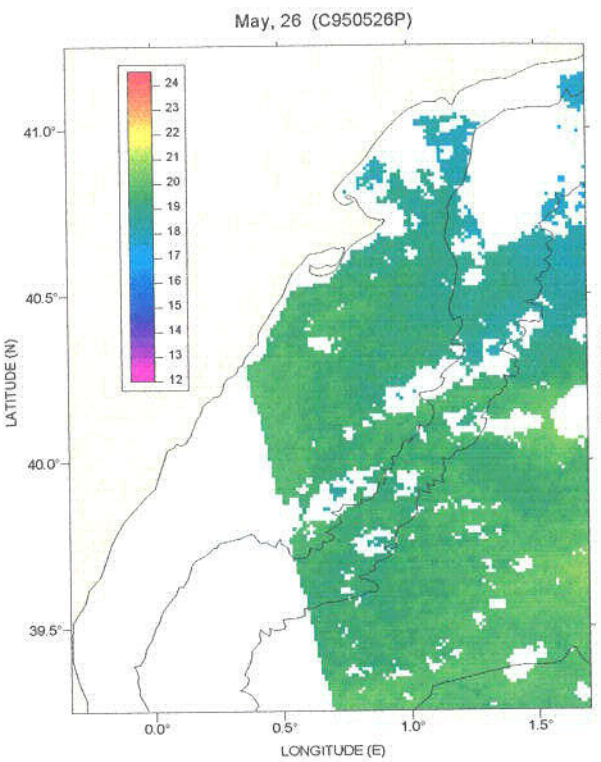
May, 05 (C950505M)

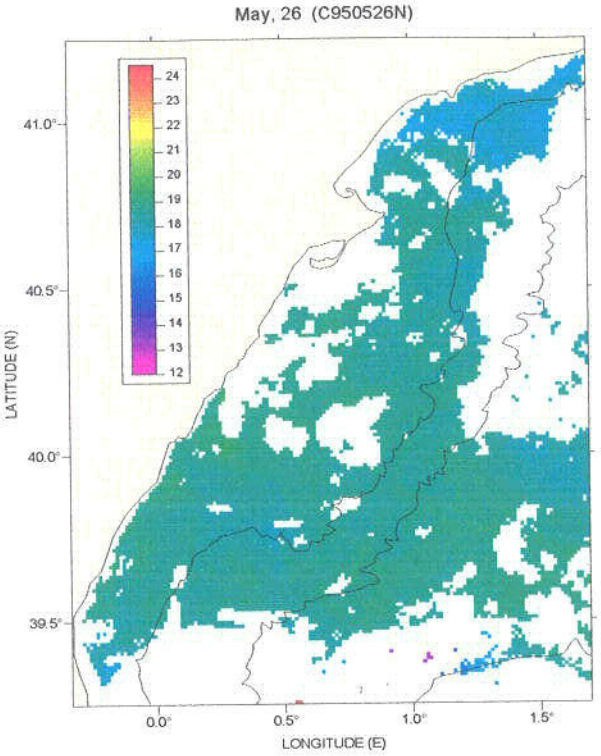


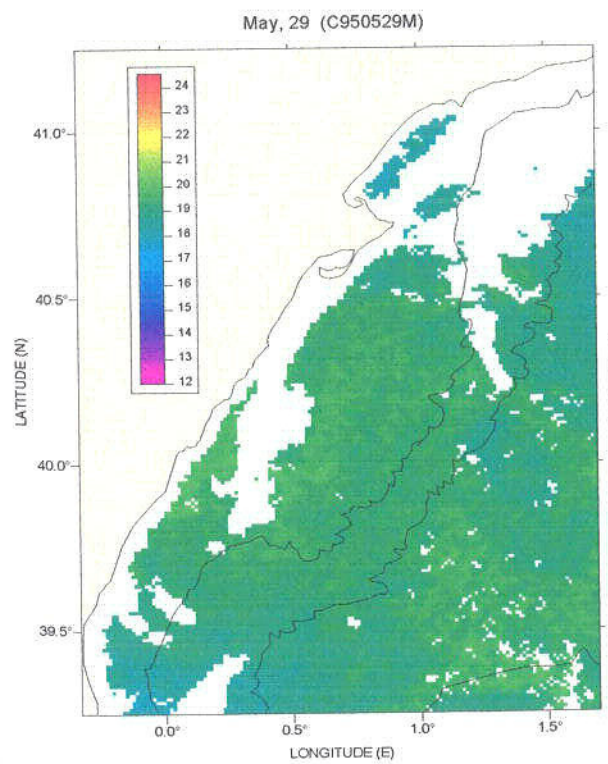
Temperature Satellite Individual Images
GICS-3 (1995) – GICS area

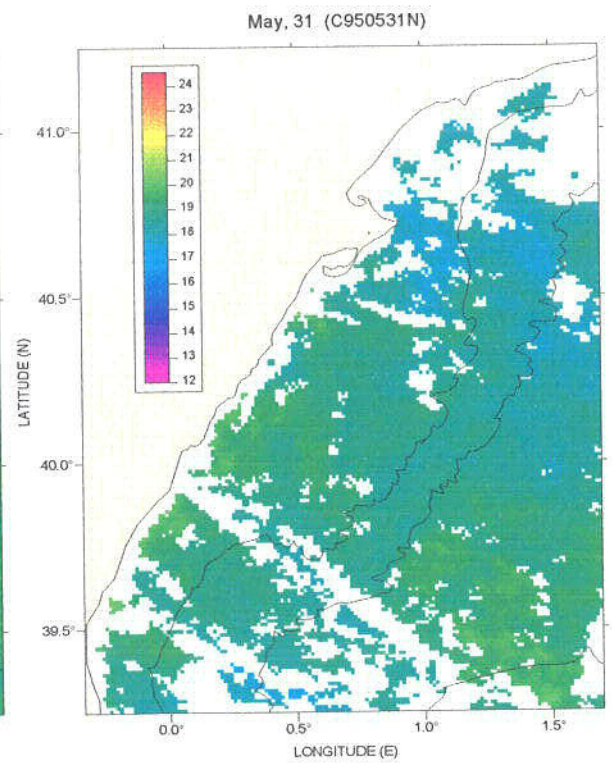


Temperature Satellite Individual Images
GICS-3 (1995) – GICS area



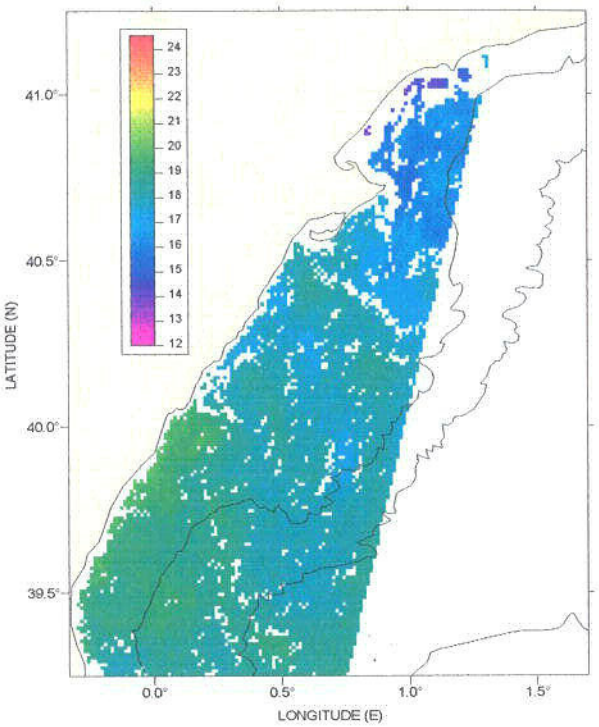




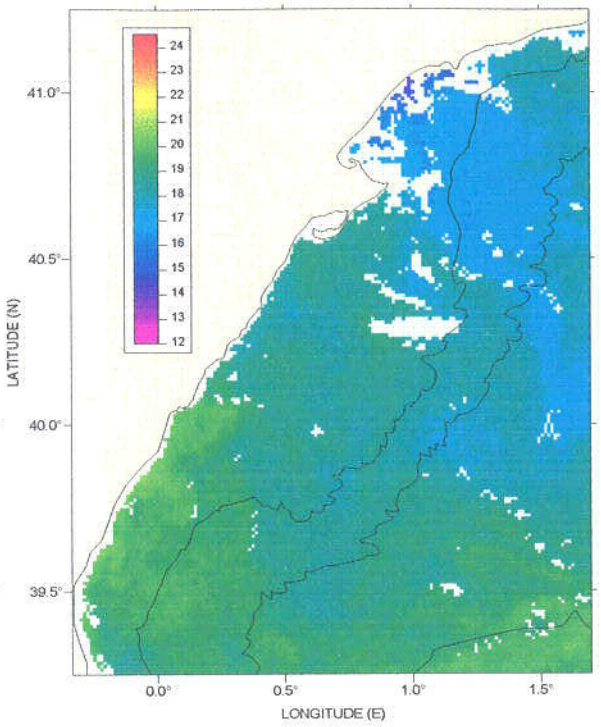


Temperature Satellite Individual Images
GICS-3 (1995) – GICS area

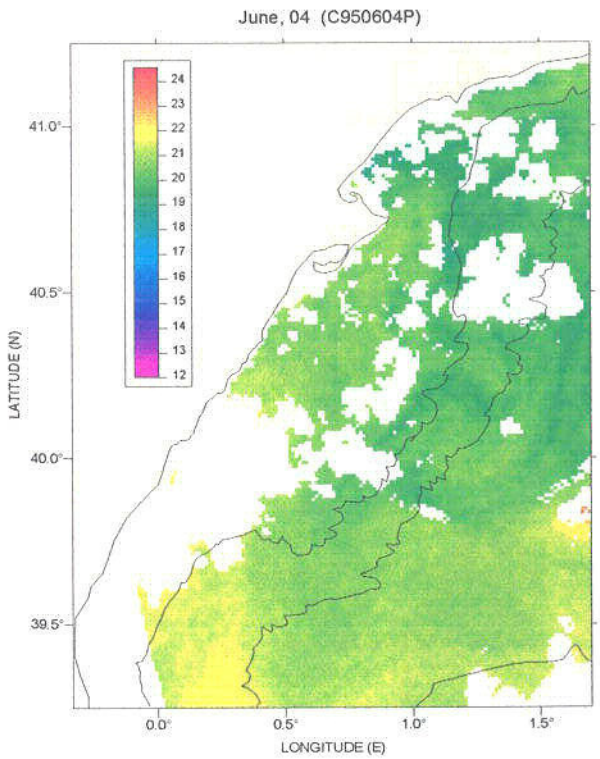
June, 01 (C950601M)



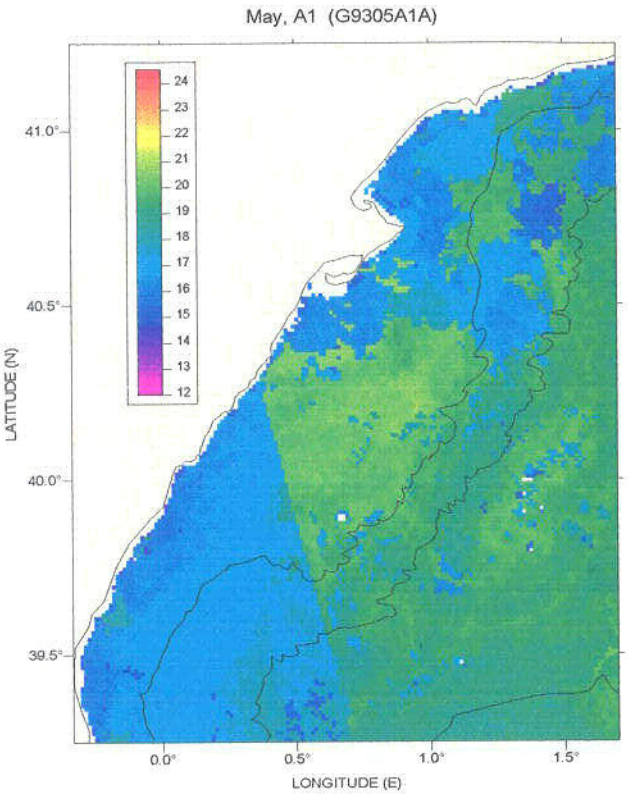
June, 02 (C950602N)

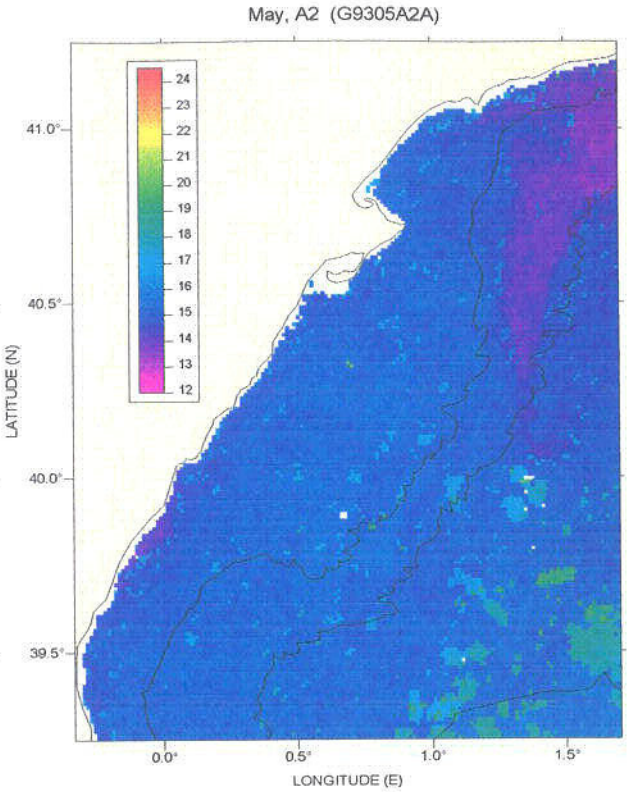


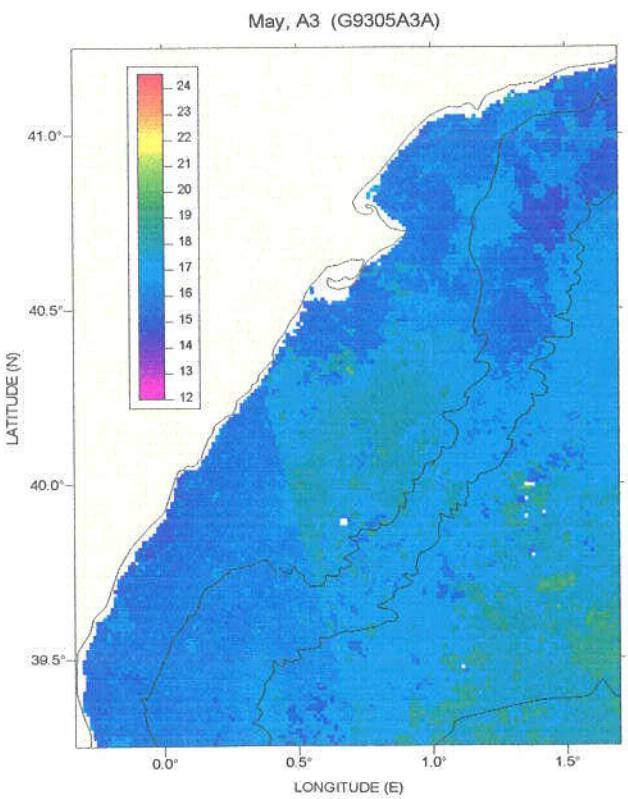
June, 04 (C950604P)



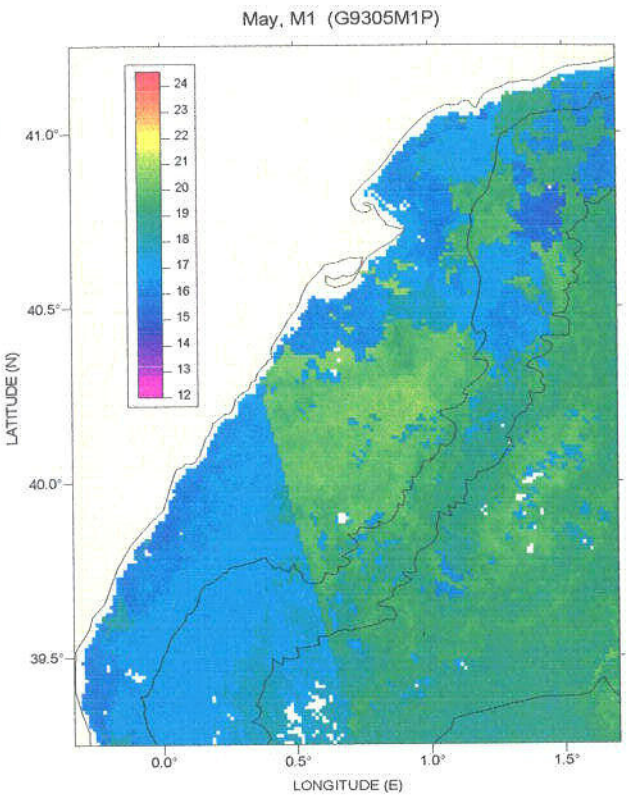
Temperature Satellite Composite Images
GICS-1 (1993) – GICS area

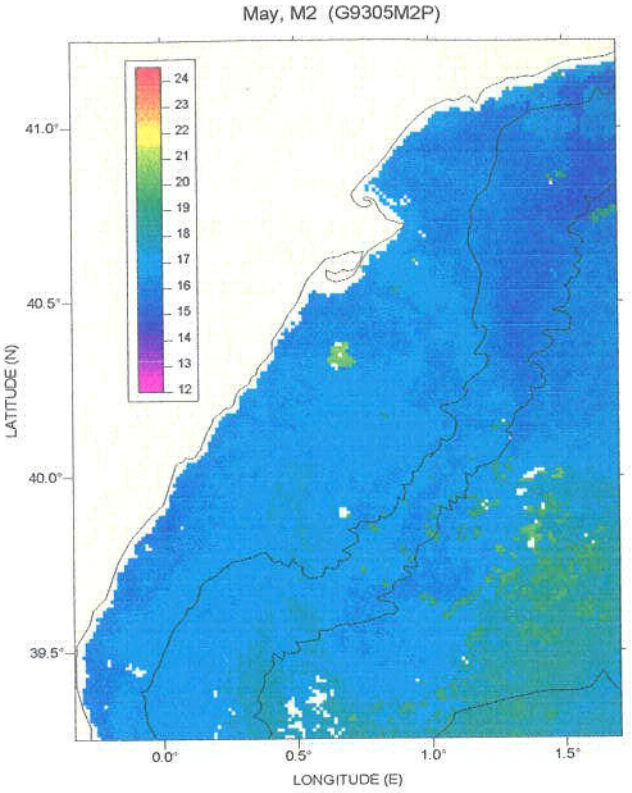


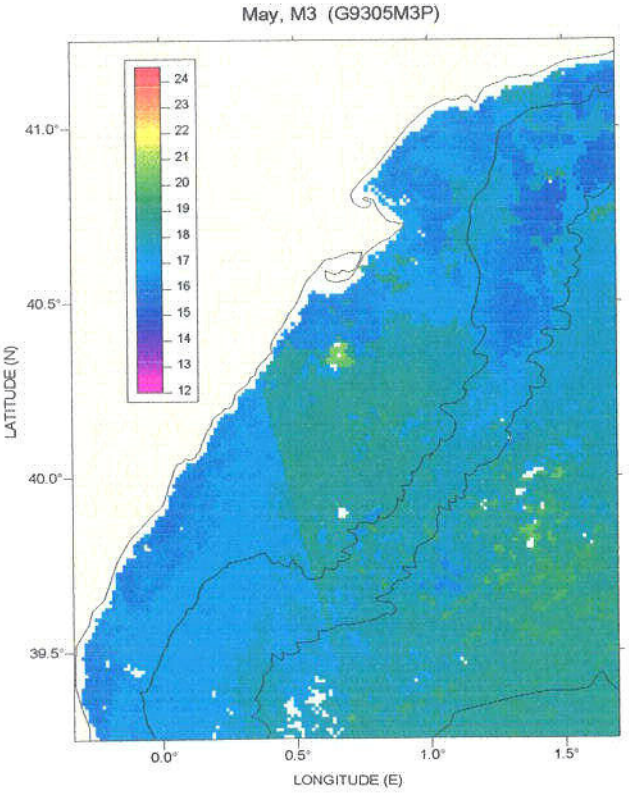




Temperature Satellite Composite Images
GICS-1 (1993) – GICS area

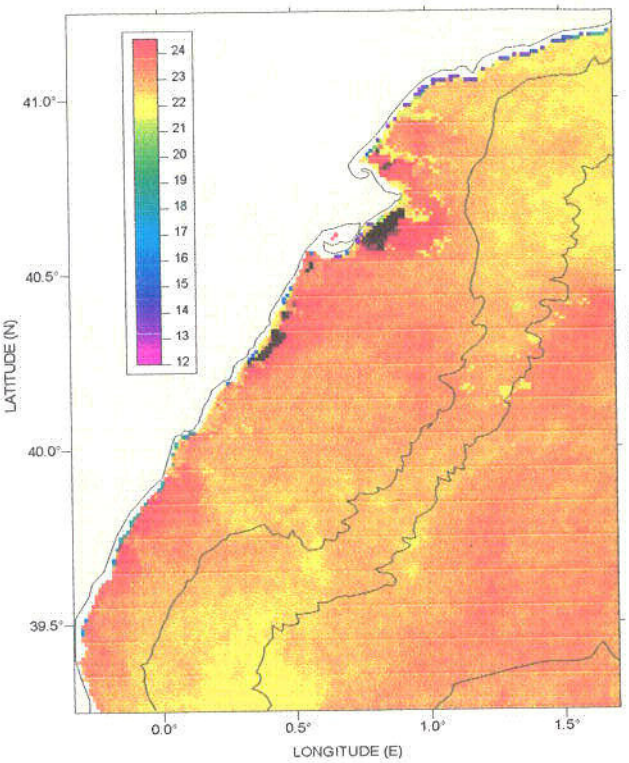




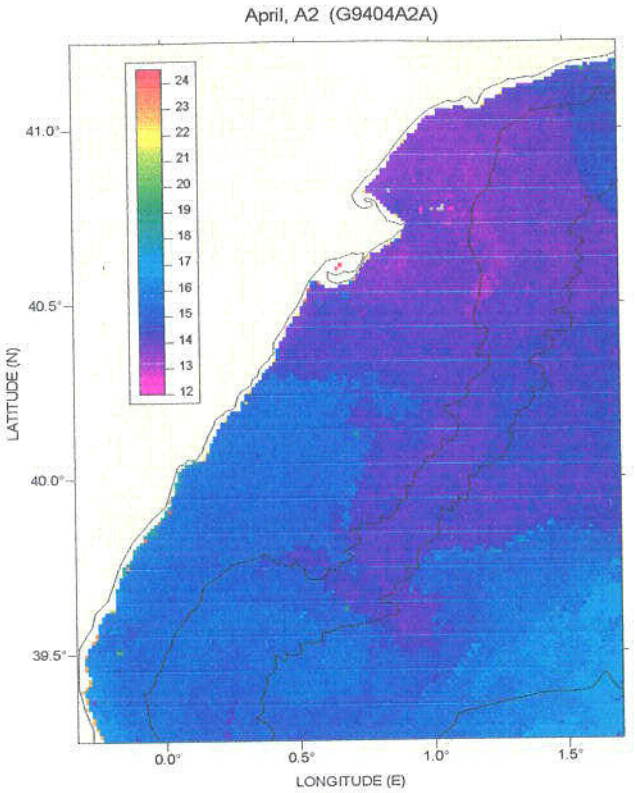


Temperature Satellite Composite Images
GICS-2 (1994) – GICS area

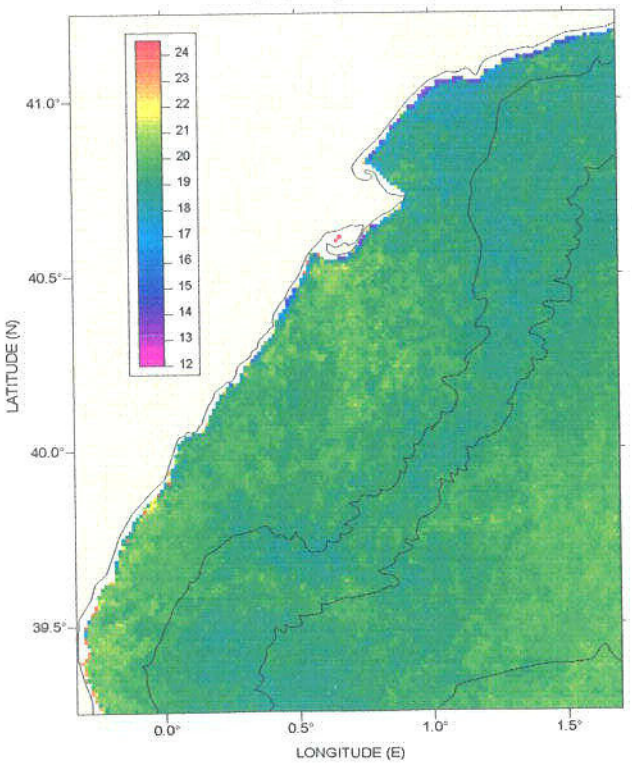
April, A1 (G9404A1A)



April, A2 (G9404A2A)

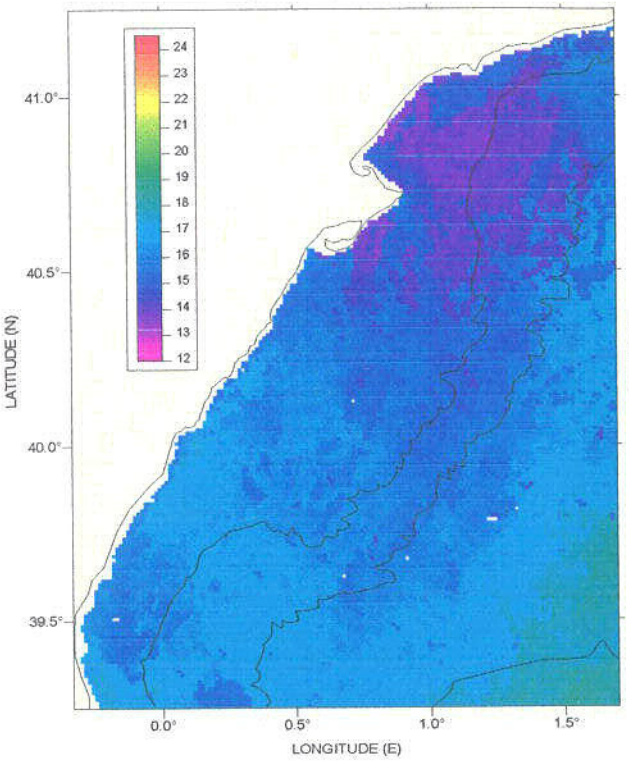


April, A3 (G9404A3A)

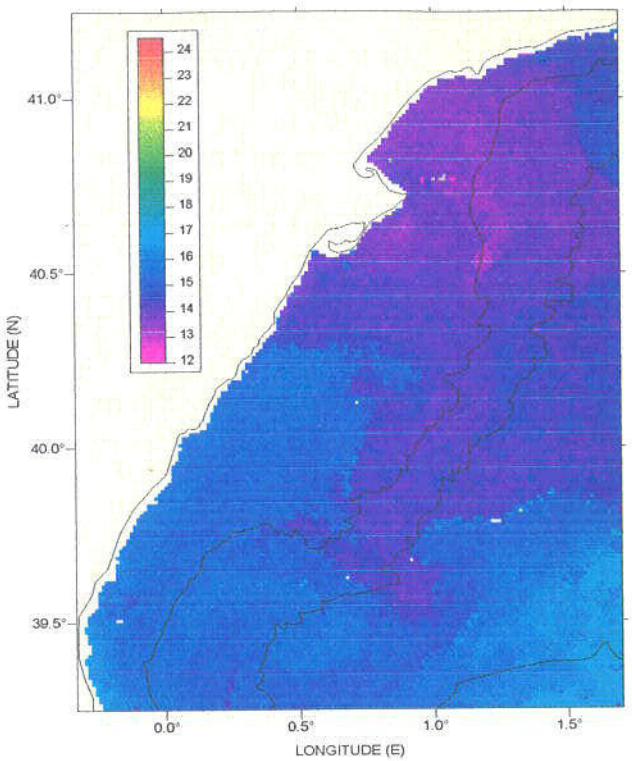


Temperature Satellite Composite Images
GICS-2 (1994) – GICS area

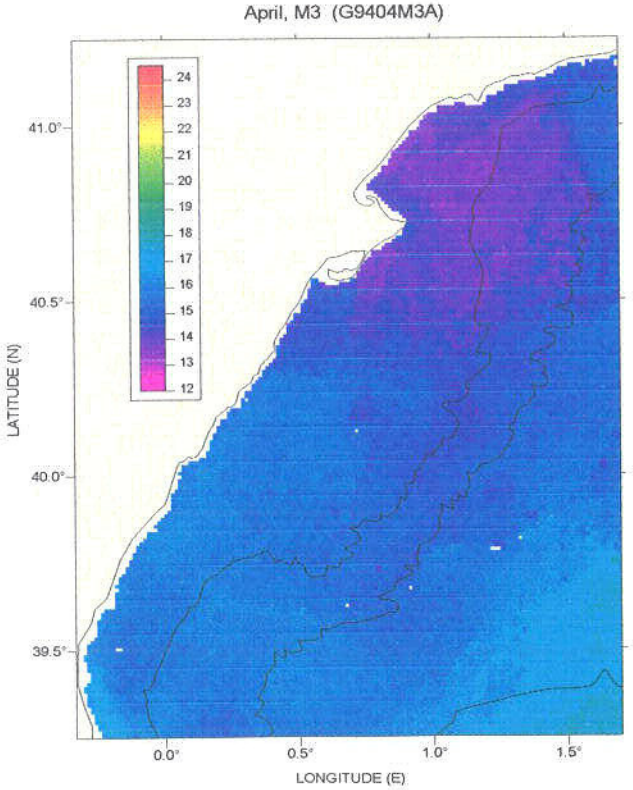
April, M1 (G9404M1A)



April, M2 (G9404M2A)

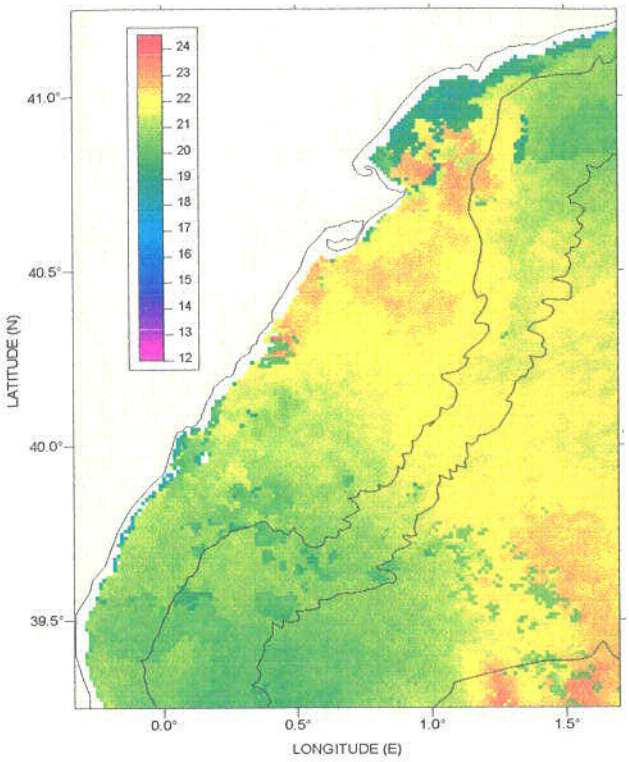


April, M3 (G9404M3A)

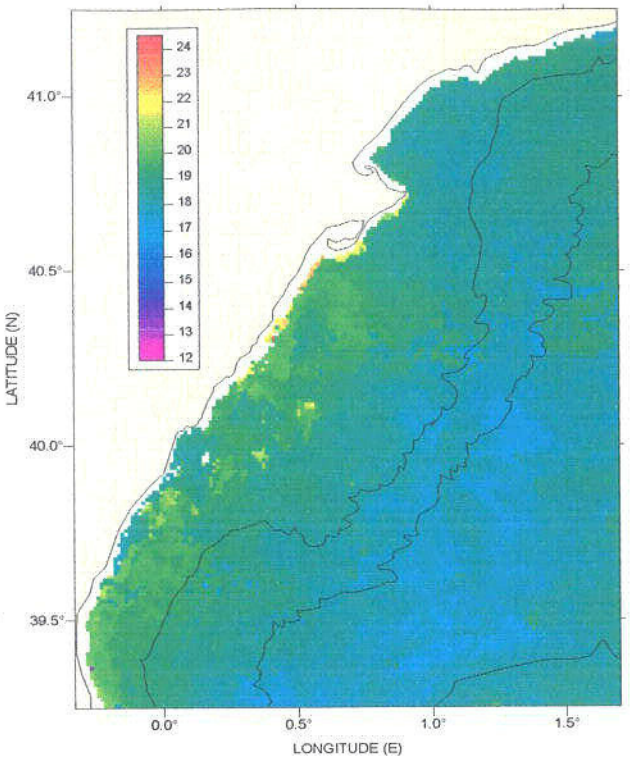


Temperature Satellite Composite Images
GICS-2 (1994) – GICS area

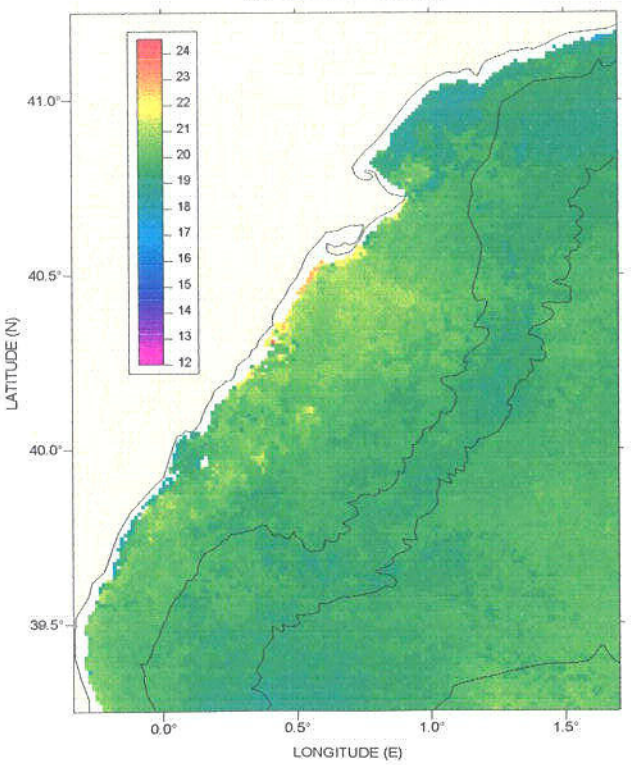
May, M1 (G9405M1A)



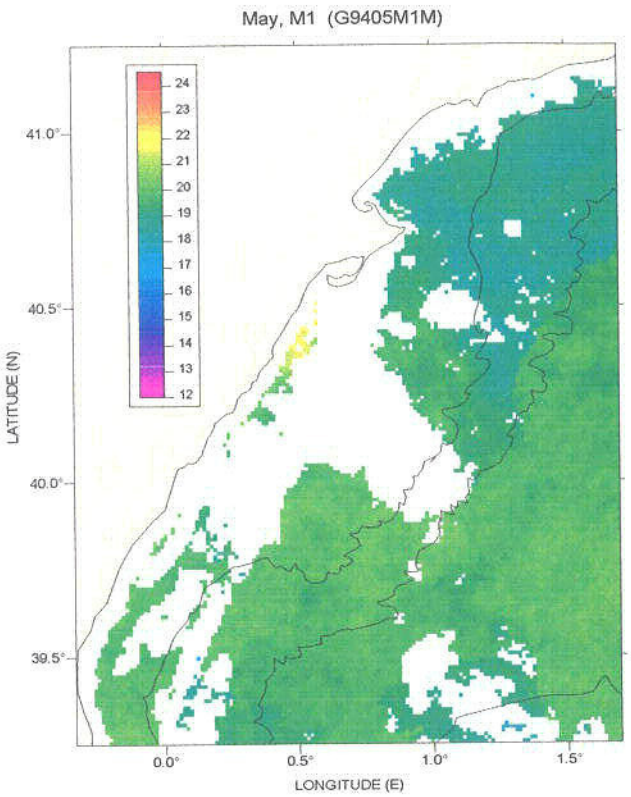
May, M2 (G9405M2A)

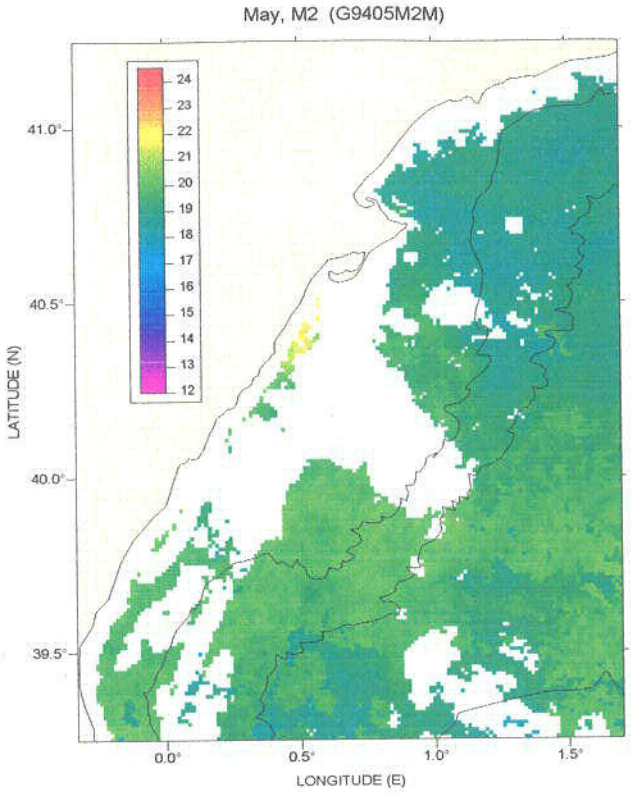


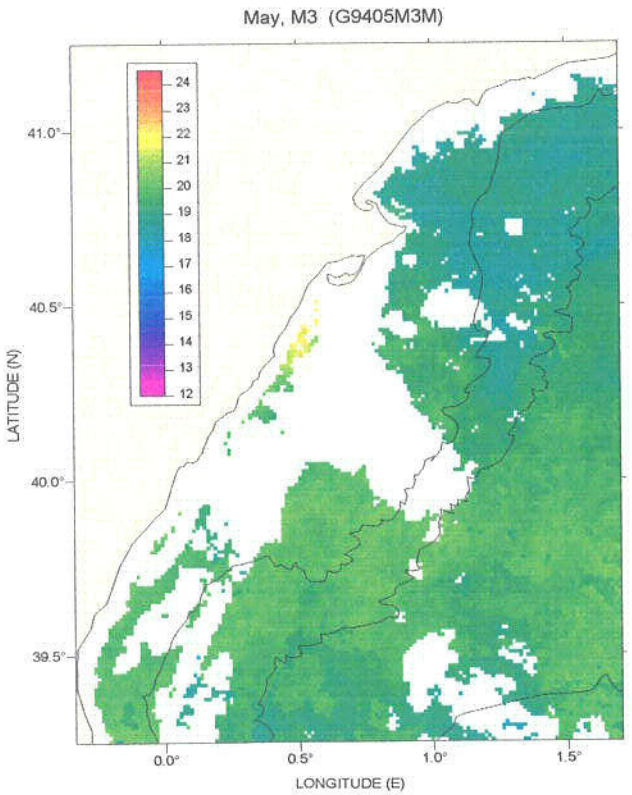
May, M3 (G9405M3A)



Temperature Satellite Composite Images
GICS-2 (1994) – GICS area

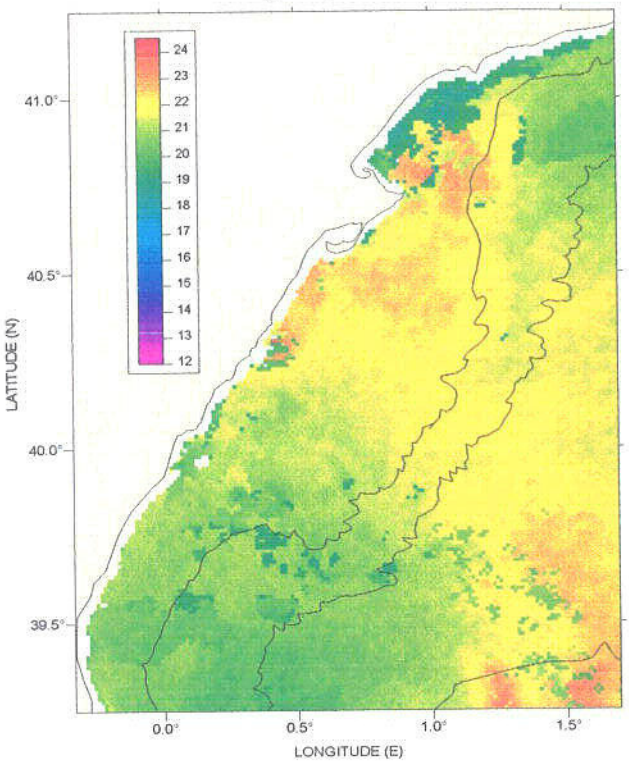




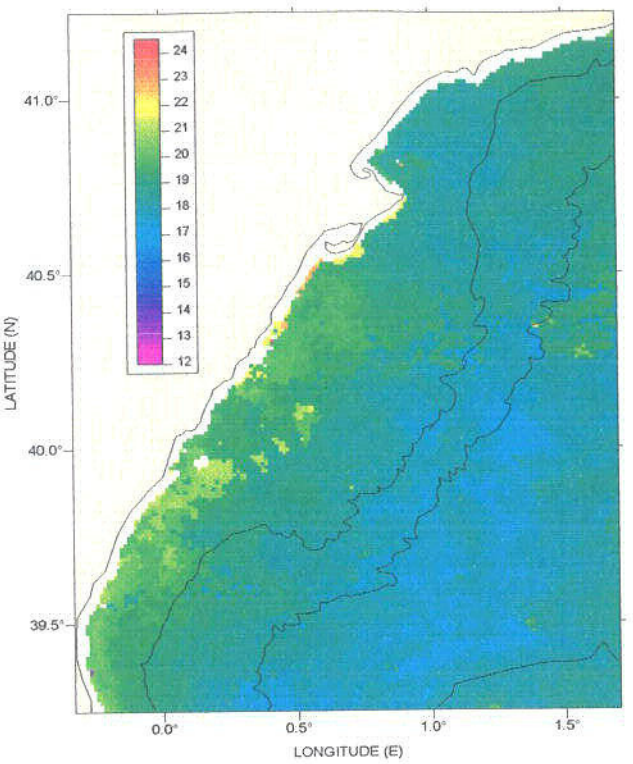


Temperature Satellite Composite Images
GICS-2 (1994) – GICS area

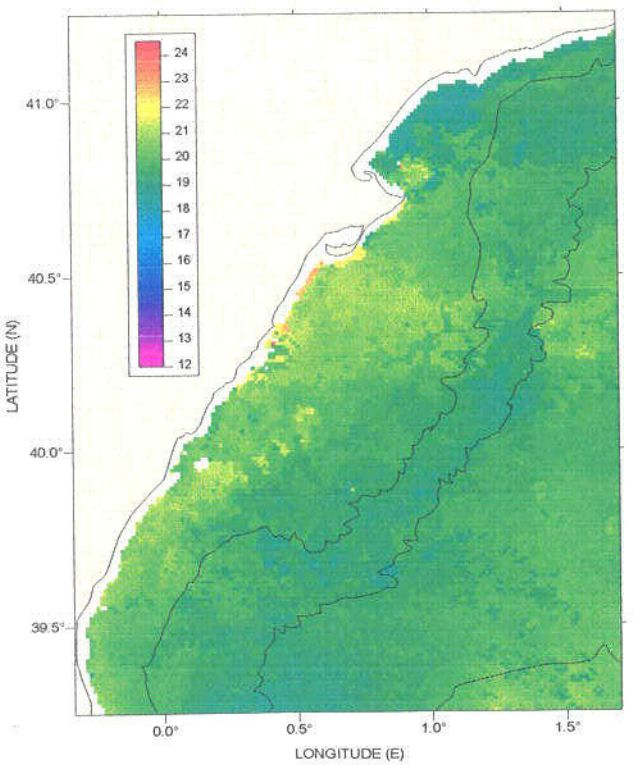
May, M1 (G9405M1P)



May, M2 (G9405M2P)

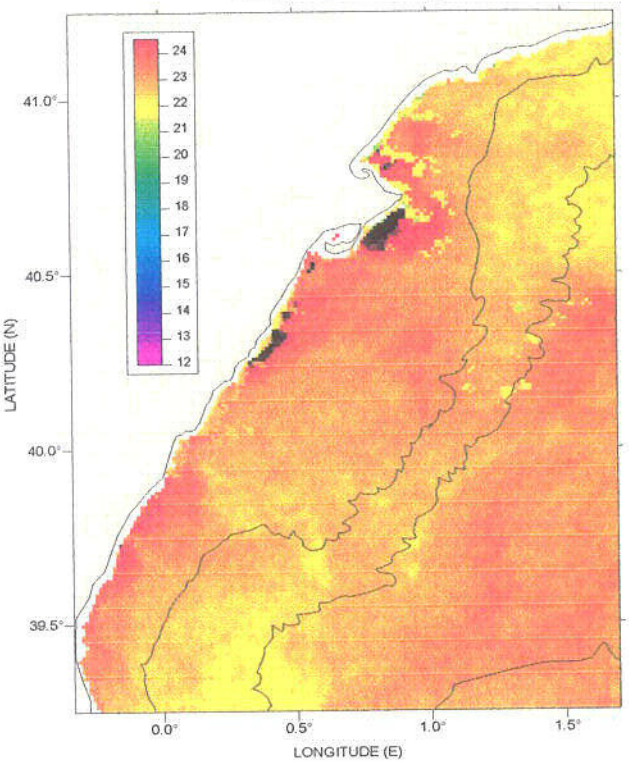


May, M3 (G9405M3P)

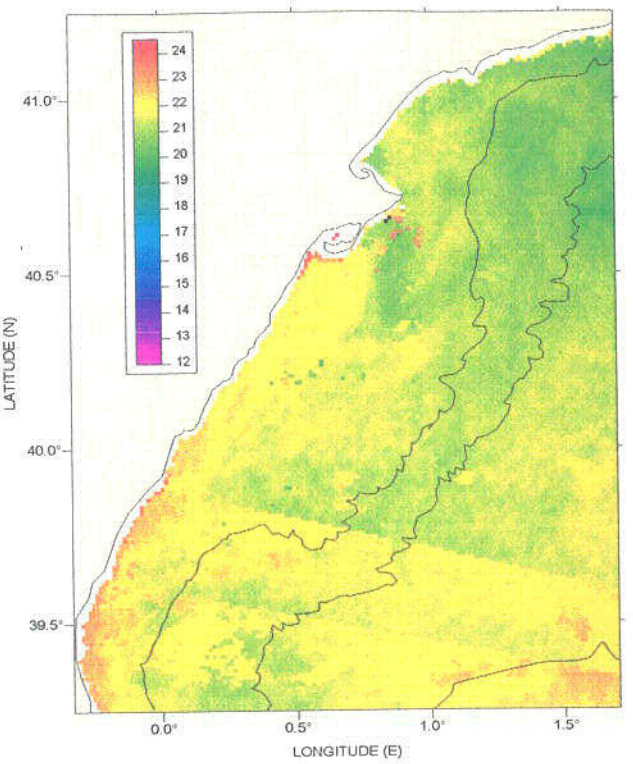


Temperature Satellite Composite Images
GICS-2 (1994) – GICS area

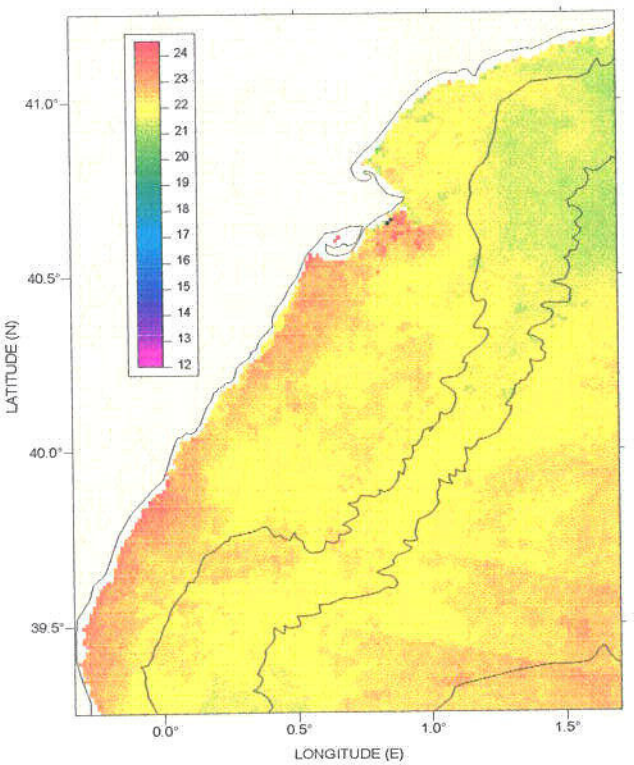
June, M1 (G9406M1A)



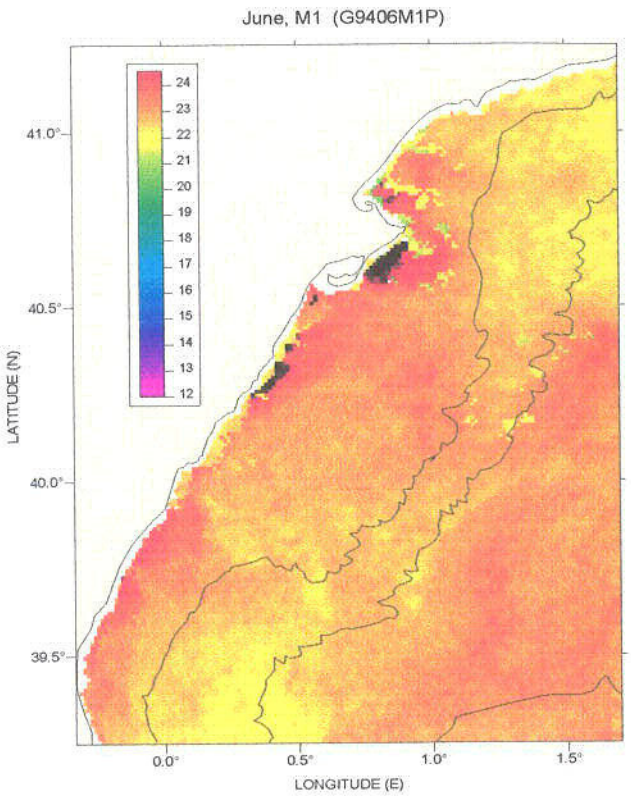
June, M2 (G9406M2A)

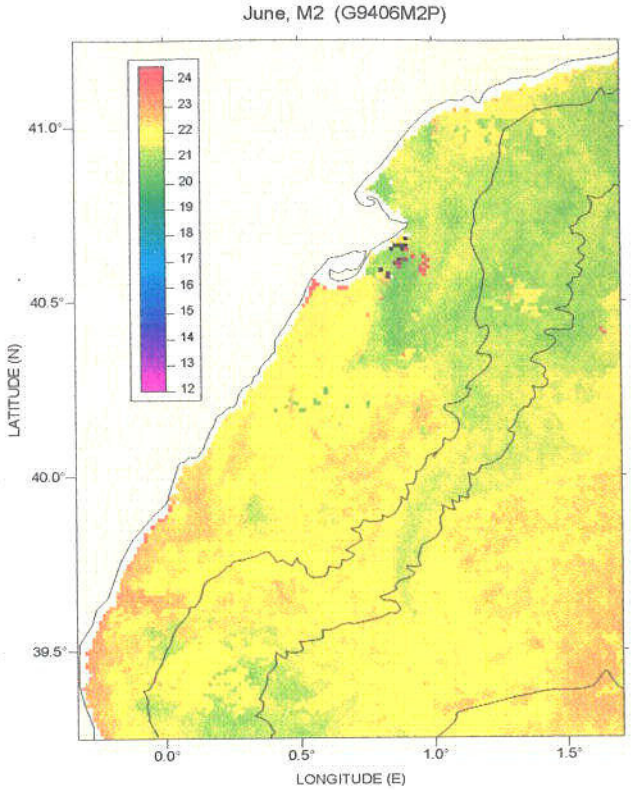


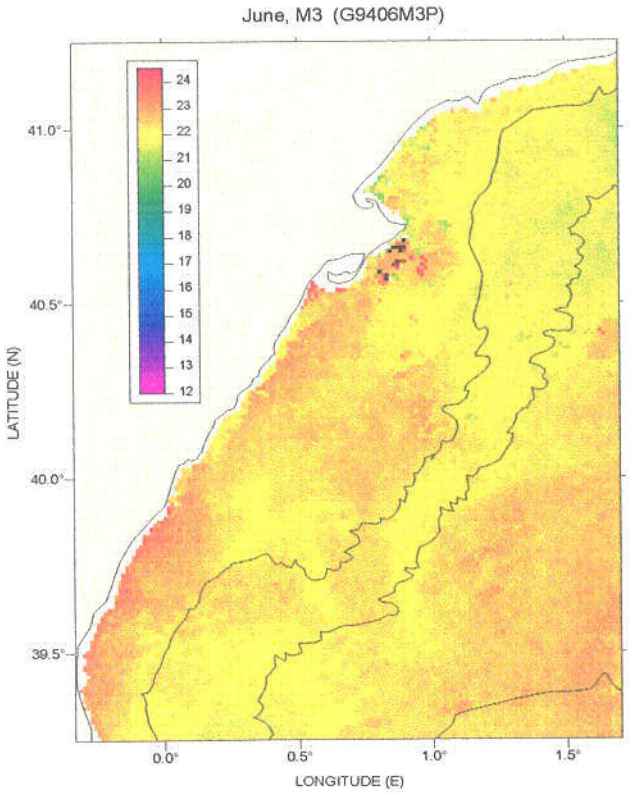
June, M3 (G9406M3A)



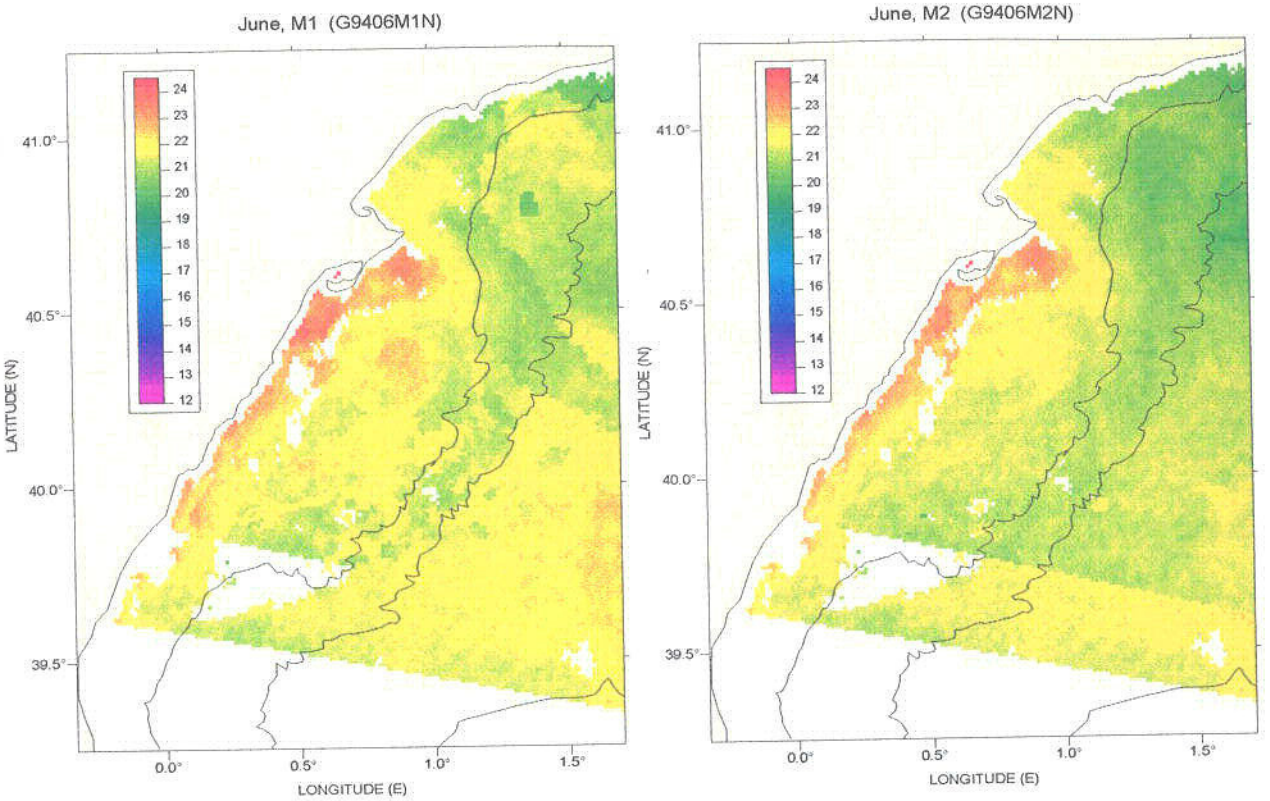
Temperature Satellite Composite Images
GICS-2 (1994) – GICS area

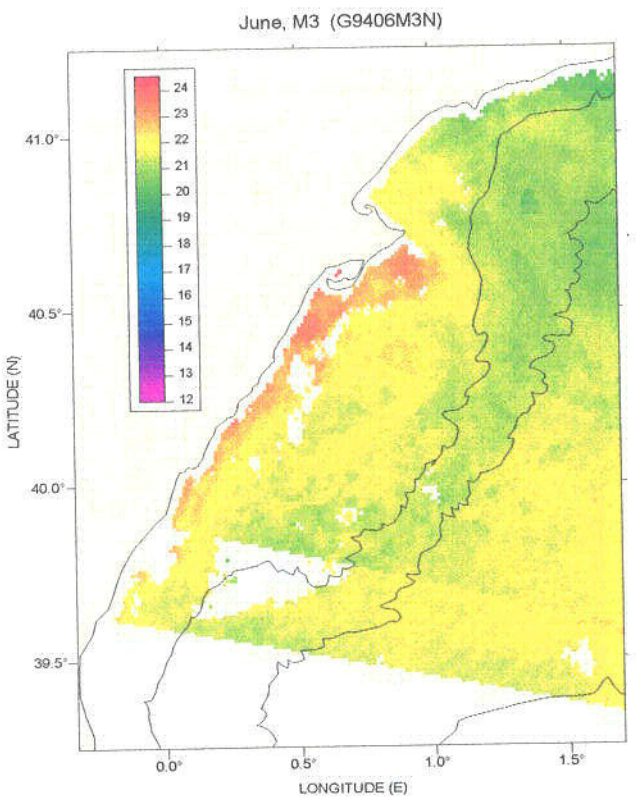






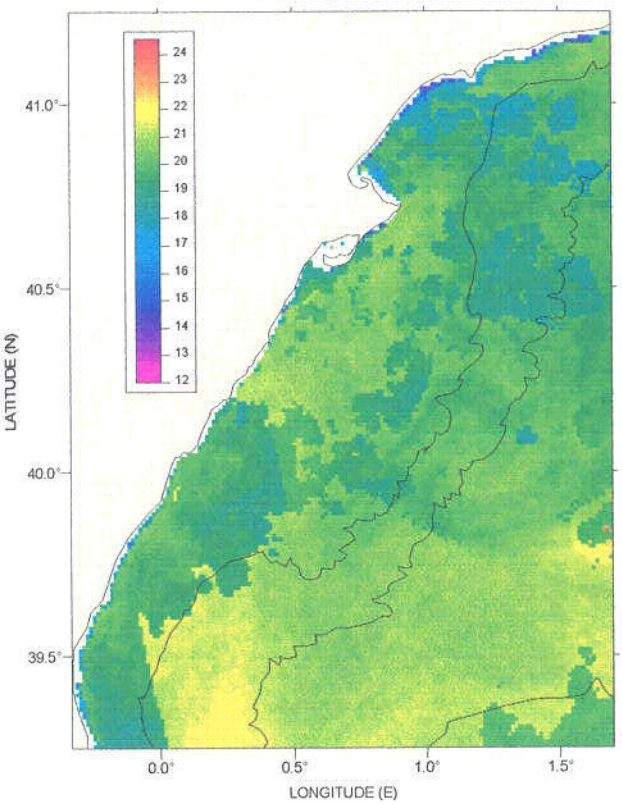
Temperature Satellite Composite Images
GICS-2 (1994) – GICS area



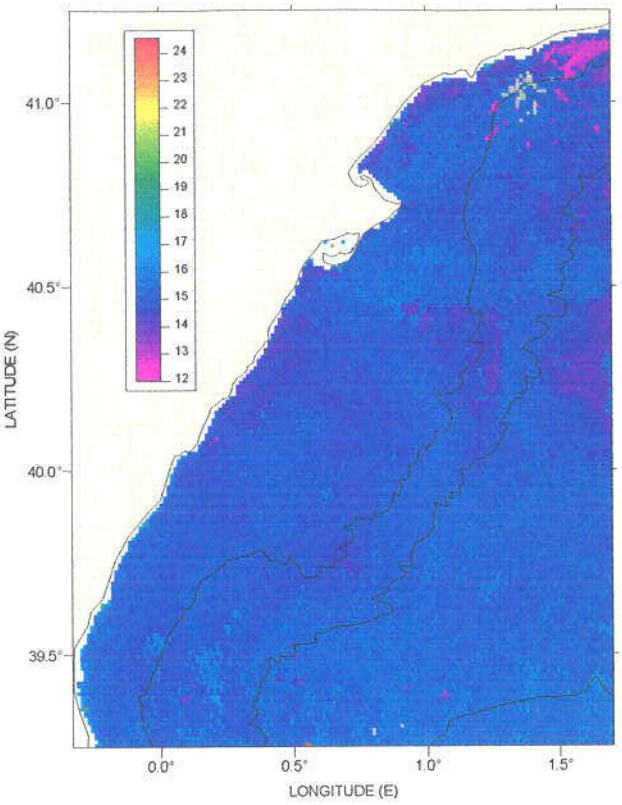


Temperature Satellite Composite Images
GICS-3 (1995) – GICS area

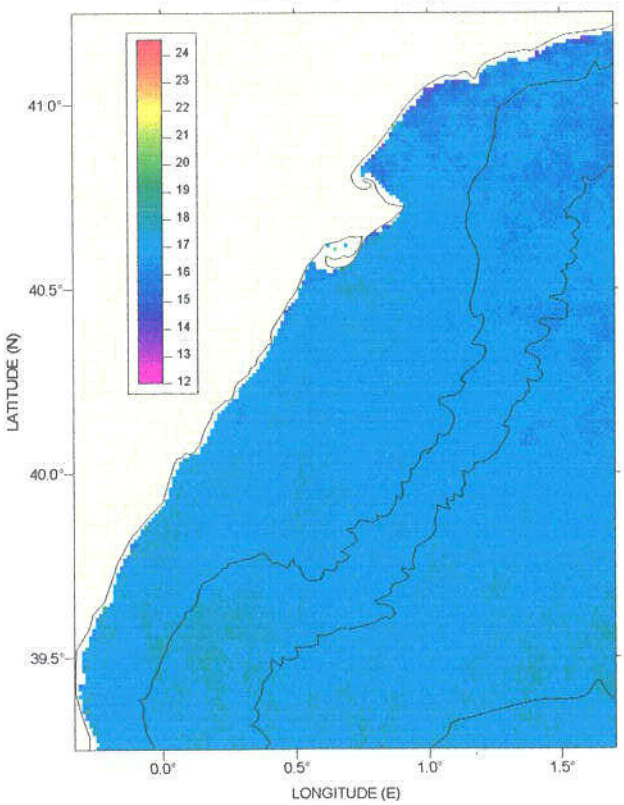
April, A1 (G9504A1A)



April, A2 (G9504A2A)

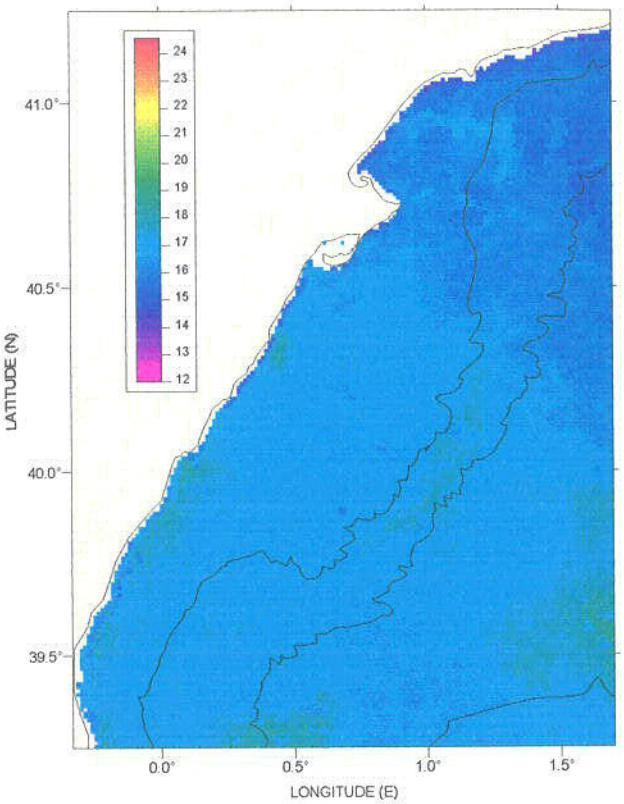


April, A3 (G9504A3A)

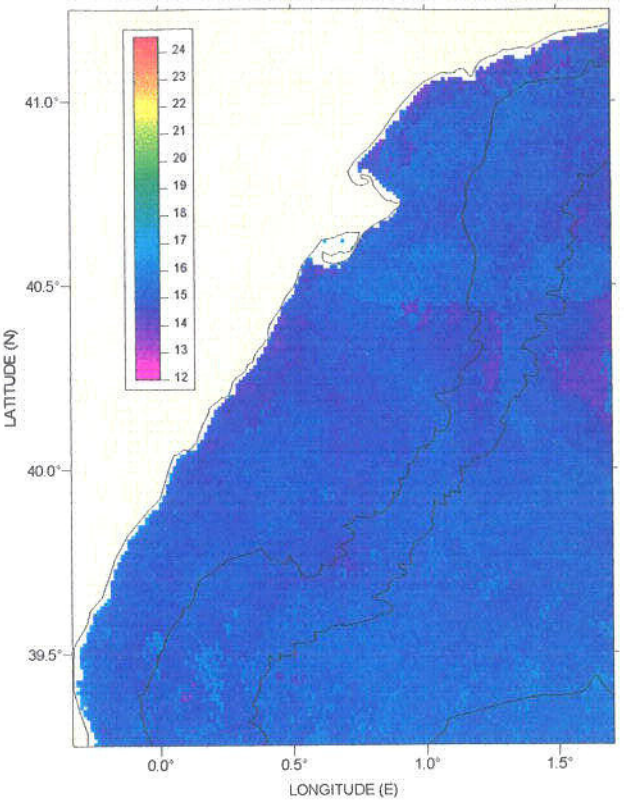


Temperature Satellite Composite Images
GICS-3 (1995) – GICS area

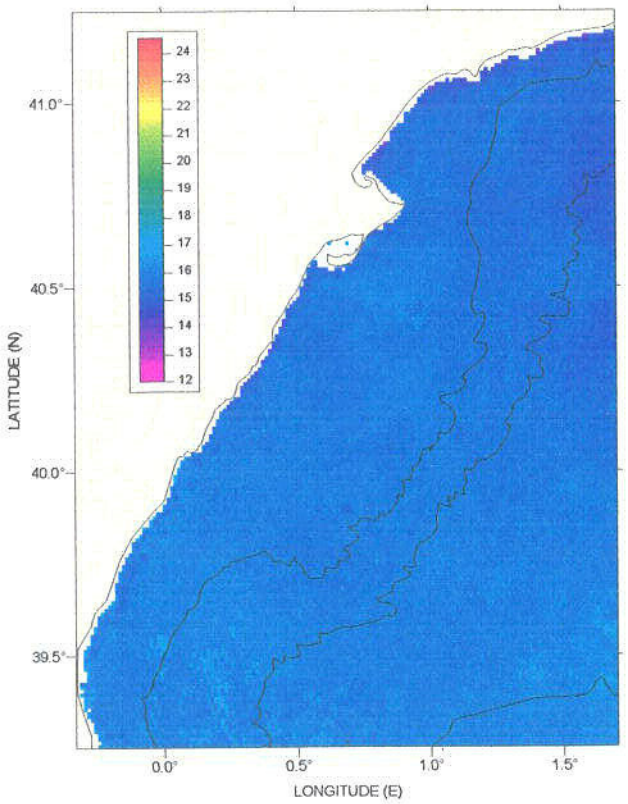
April, M1 (G9504M1A)



April, M2 (G9504M2A)

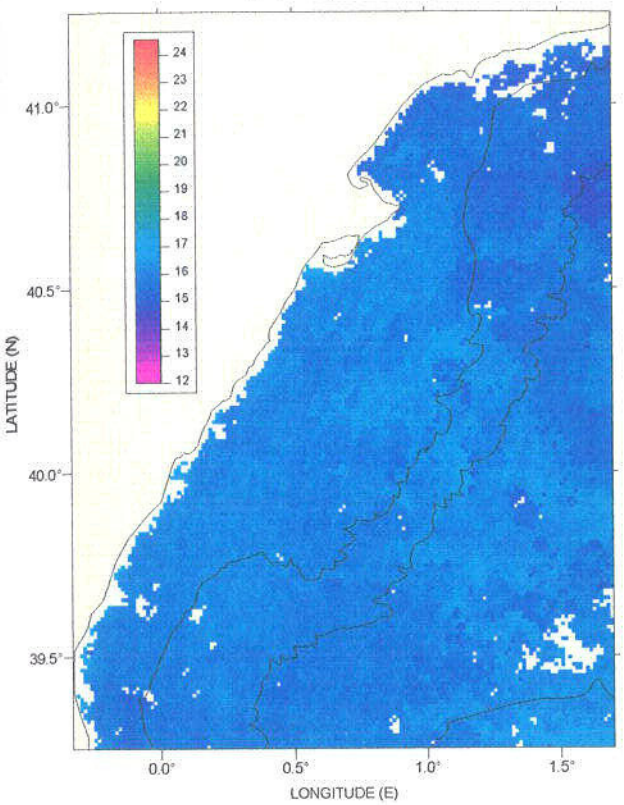


April, M3 (G9504M3A)

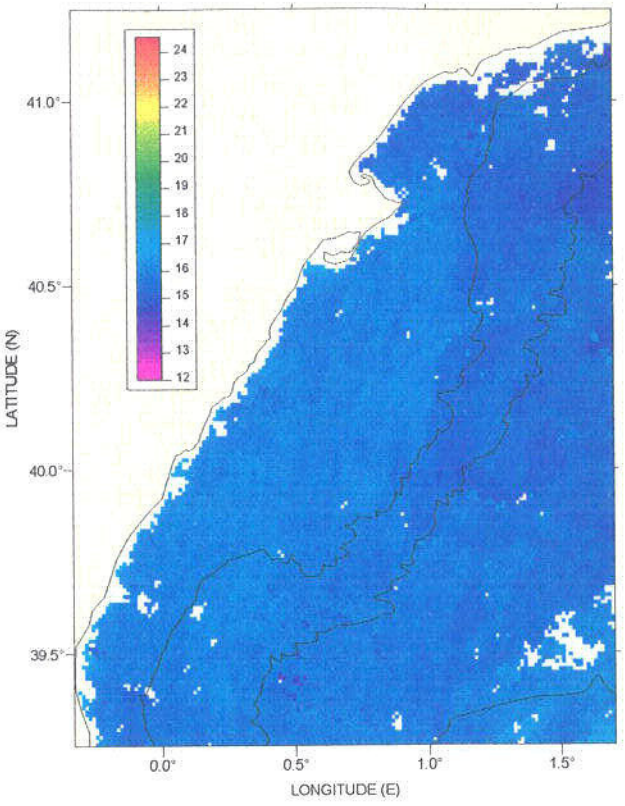


Temperature Satellite Composite Images
GICS-3 (1995) – GICS area

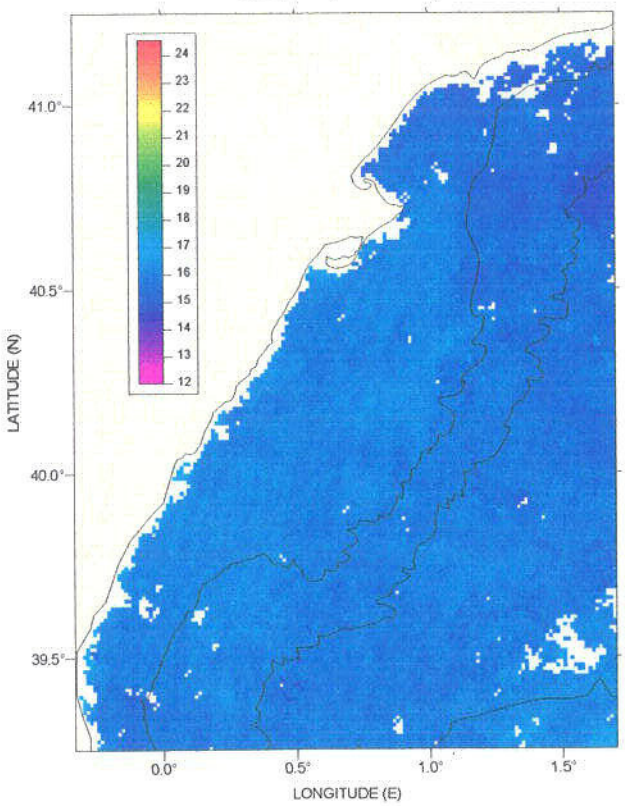
April, M1 (G9504M1M)



April, M2 (G9504M2M)

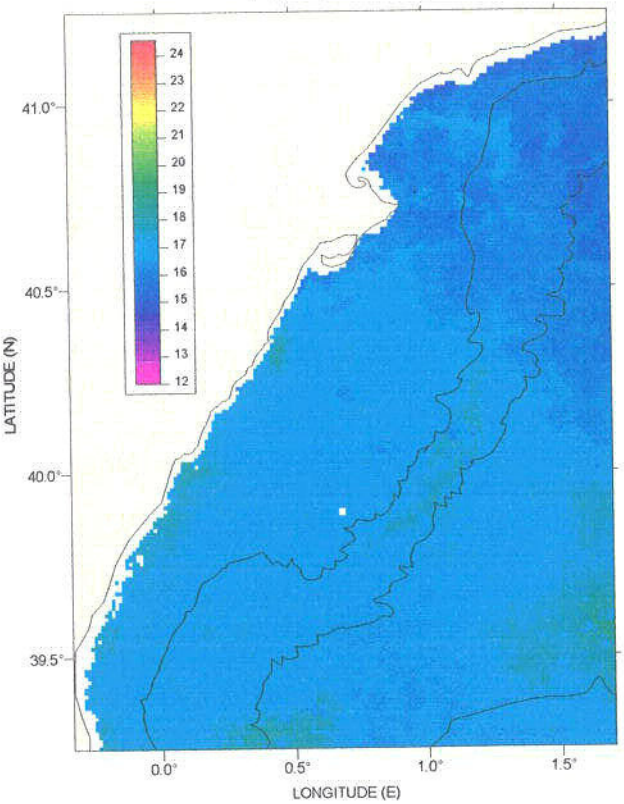


April, M3 (G9504M3M)

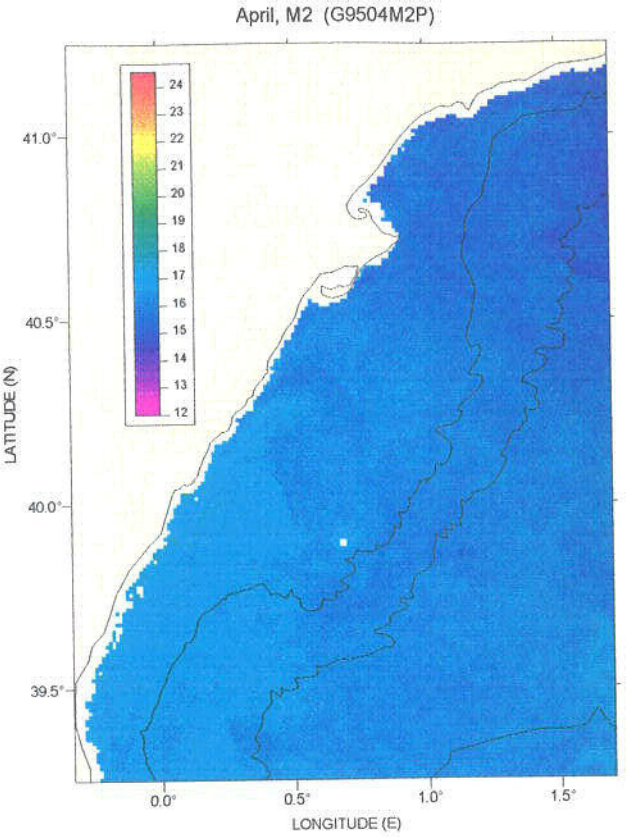


Temperature Satellite Composite Images
GICS-3 (1995) – GICS area

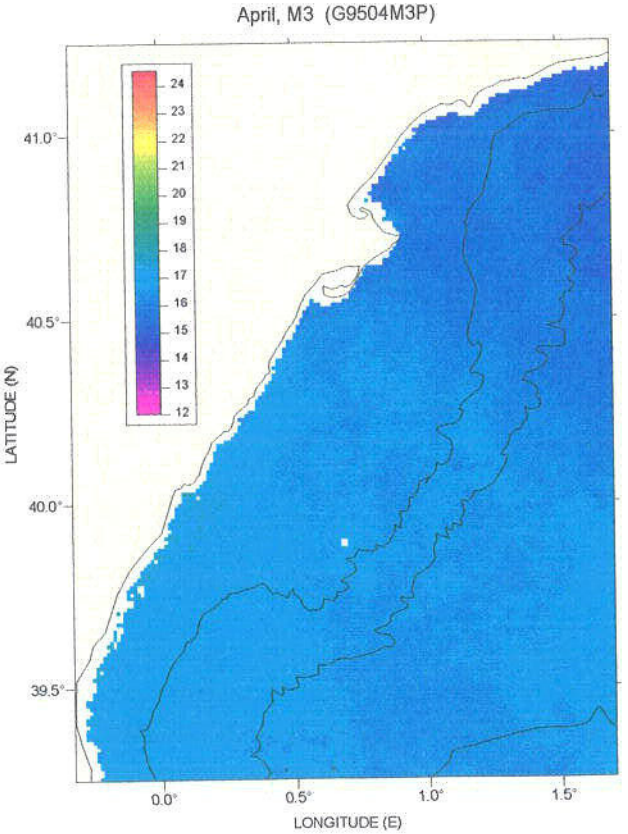
April, M1 (G9504M1P)



April, M2 (G9504M2P)

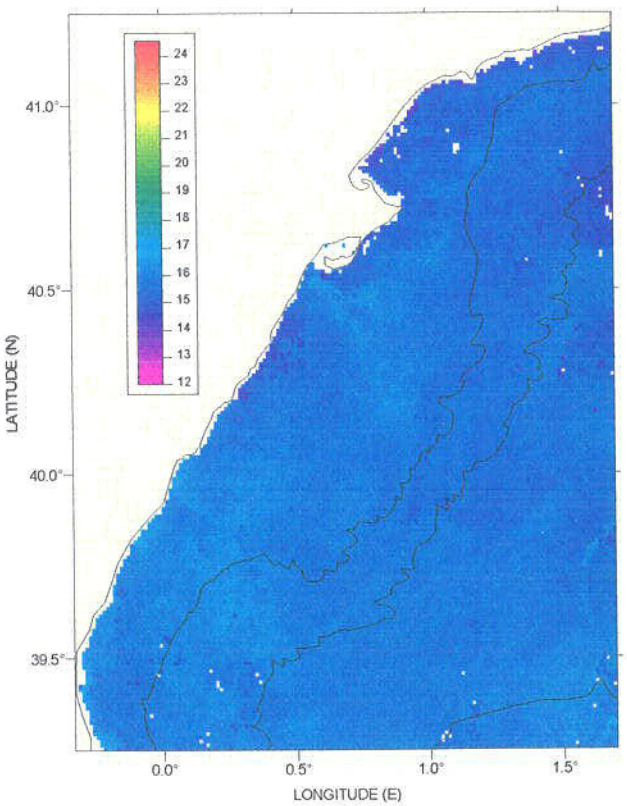


April, M3 (G9504M3P)

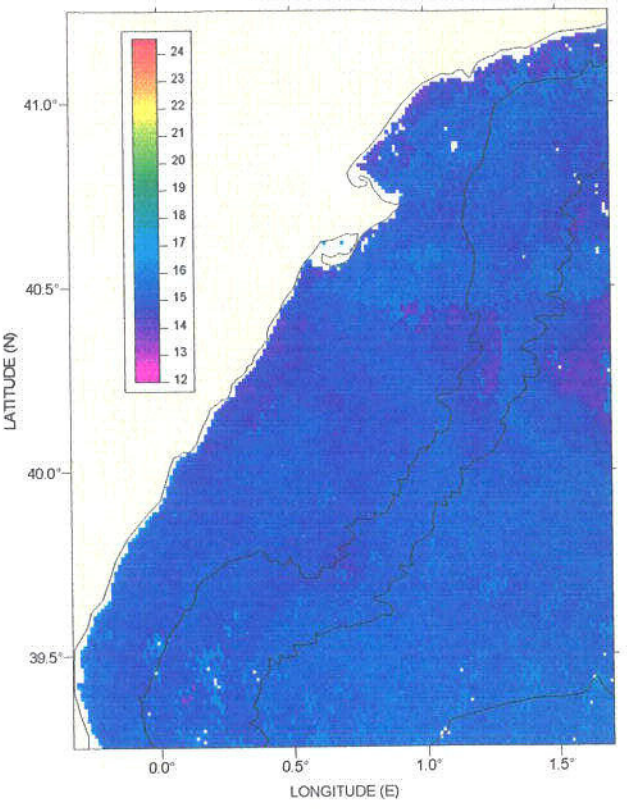


Temperature Satellite Composite Images
GICS-3 (1995) – GICS area

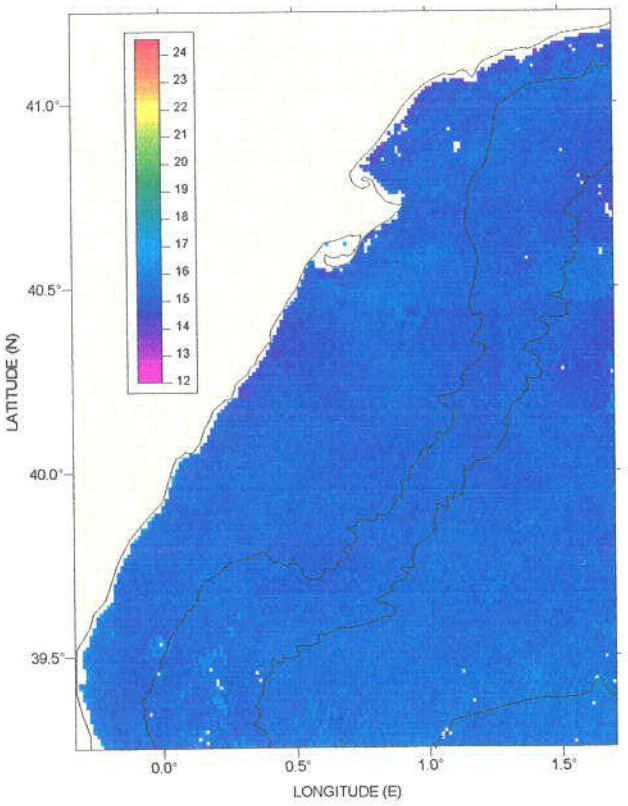
April, M1 (G9504M1N)



April, M2 (G9504M2N)

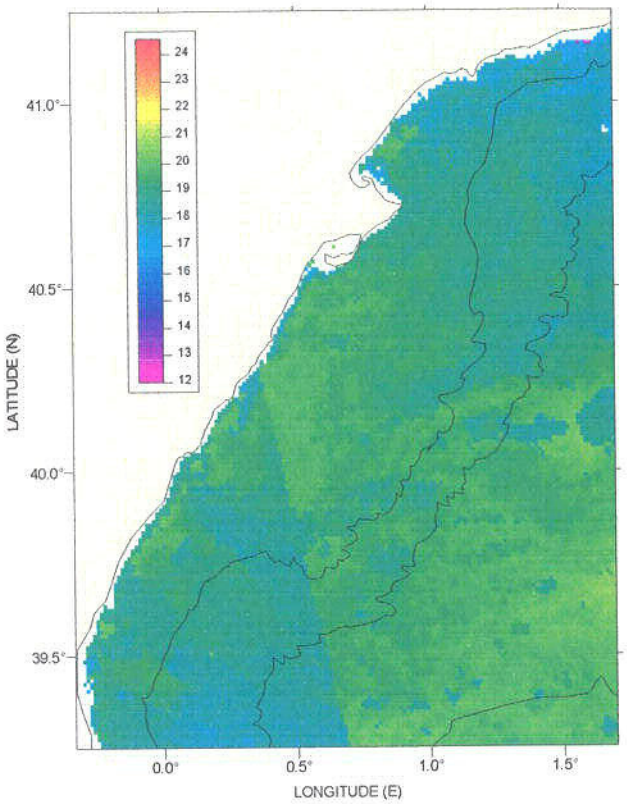


April, M3 (G9504M3N)

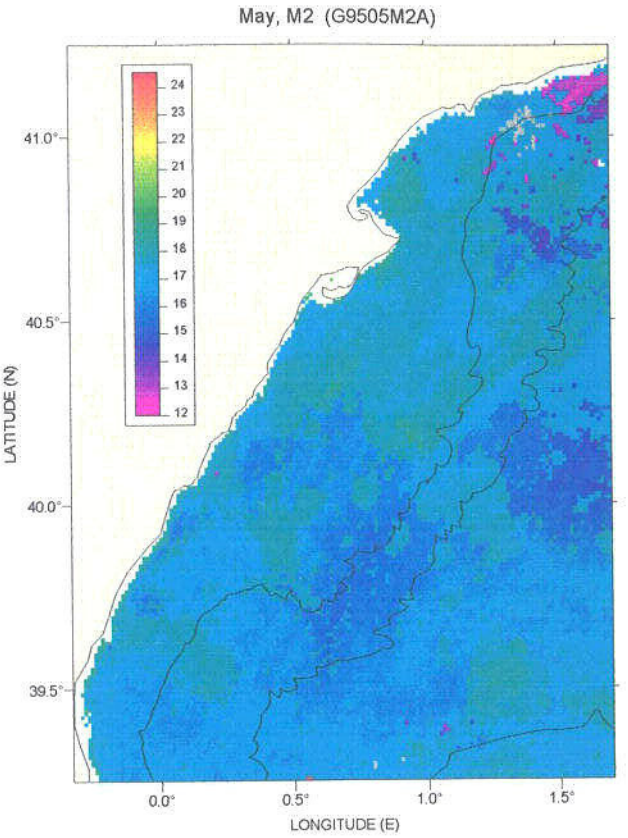


Temperature Satellite Composite Images
GICS-3 (1995) – GICS area

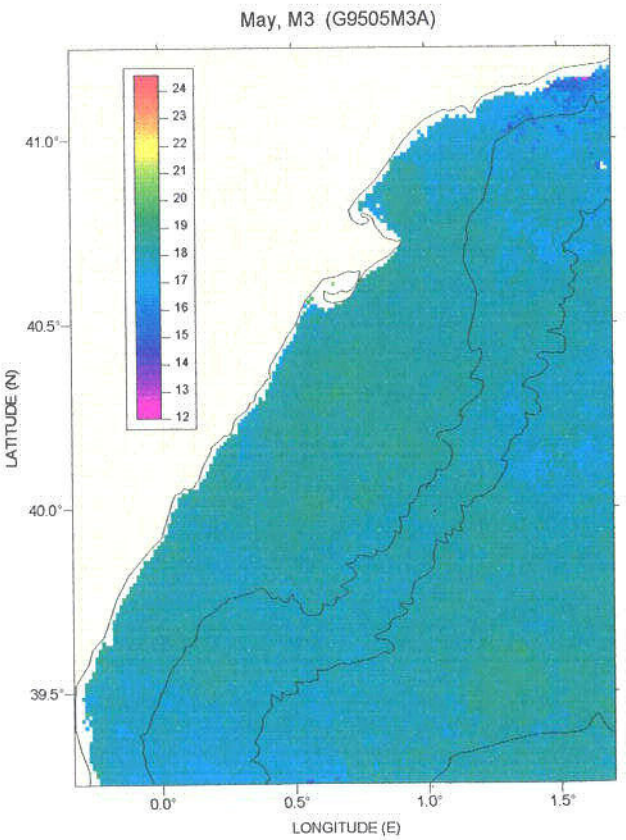
May, M1 (G9505M1A)



May, M2 (G9505M2A)

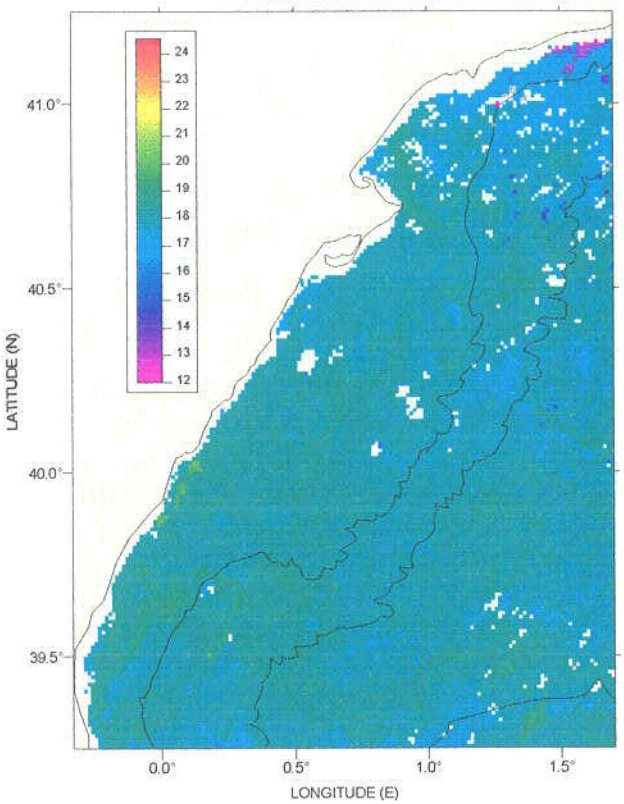


May, M3 (G9505M3A)

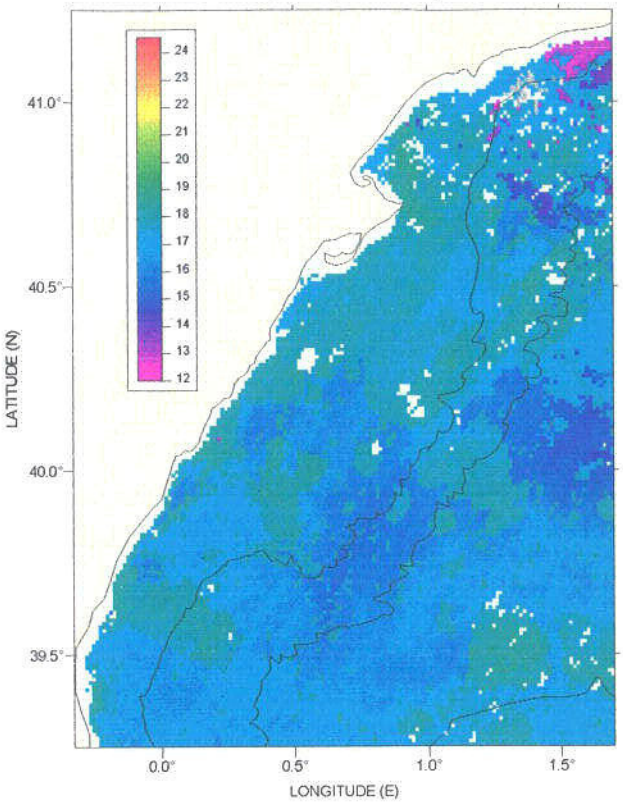


Temperature Satellite Composite Images
GICS-3 (1995) – GICS area

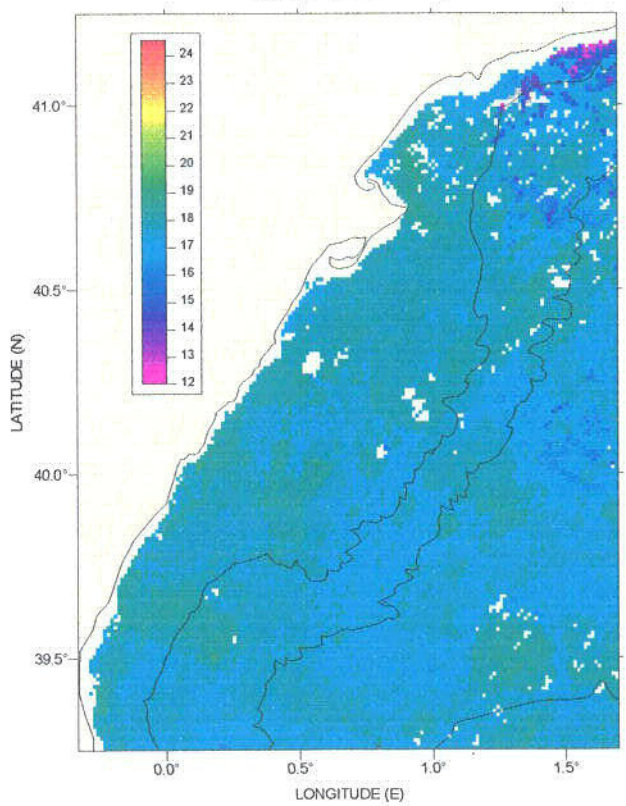
May, M1 (G9505M1M)



May, M2 (G9505M2M)

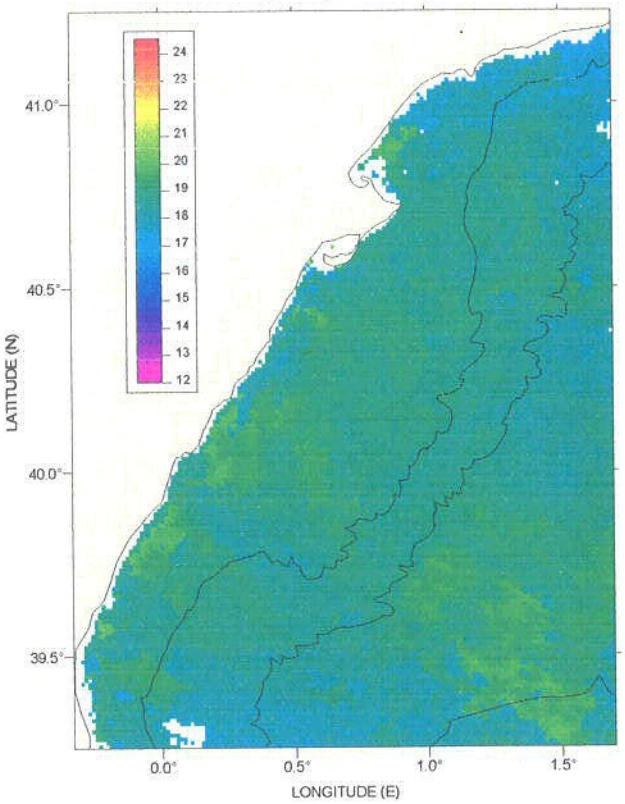


May, M3 (G9505M3M)

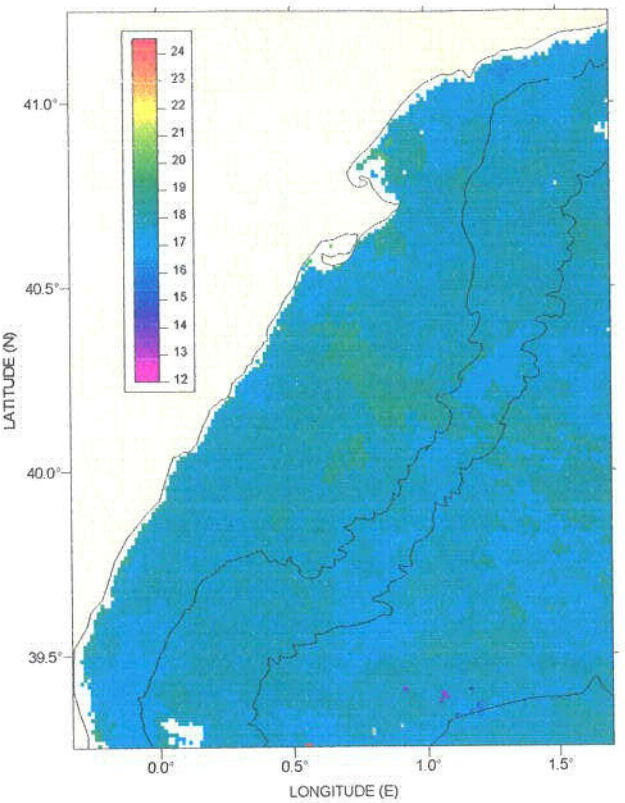


Temperature Satellite Composite Images
GICS-3 (1995) – GICS area

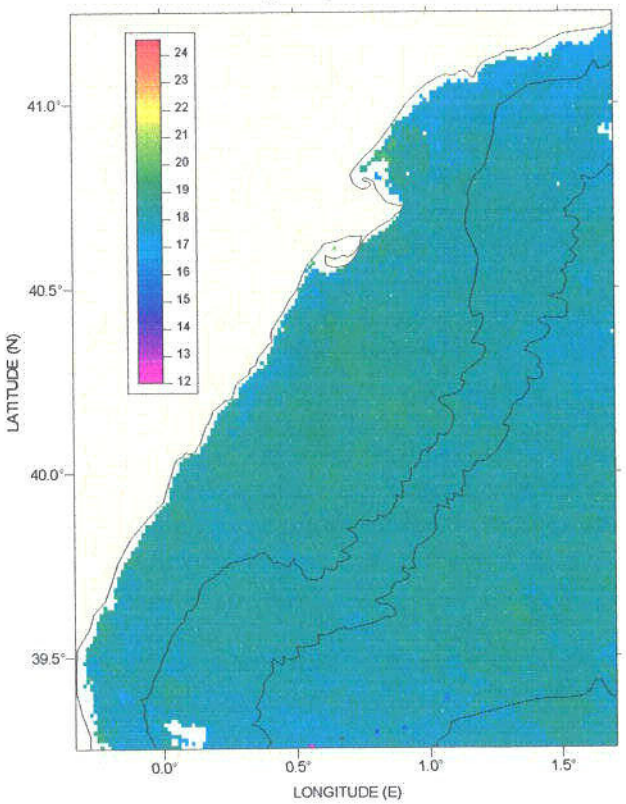
May, M1 (G9505M1N)



May, M2 (G9505M2N)

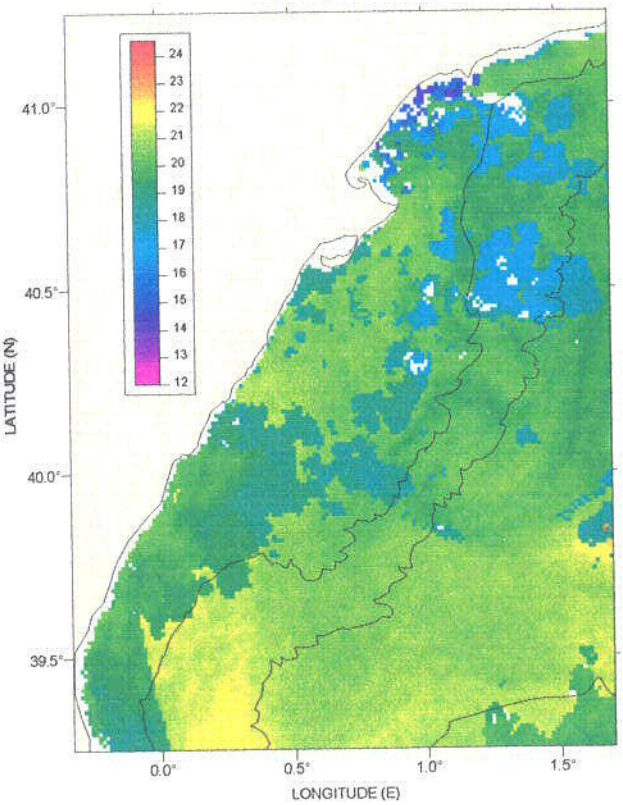


May, M3 (G9505M3N)

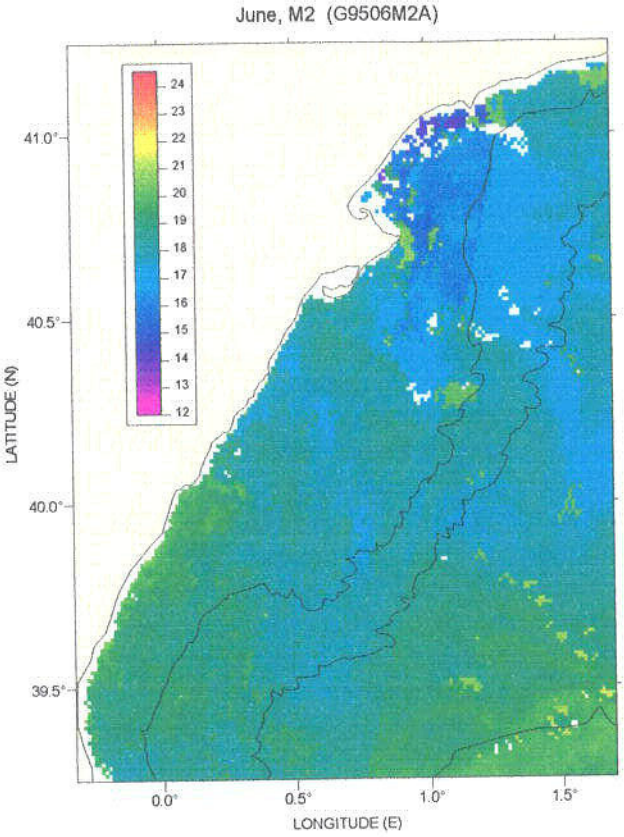


Temperature Satellite Composite Images
GICS-3 (1995) – GICS area

June, M1 (G9506M1A)



June, M2 (G9506M2A)



June, M3 (G9506M3A)