

ATMOSAT Interactive IBM PC/AT System for Processing of TOVS Data

L.A. Barański, K. Rozemski

The Satellite Data Receiving and Processing Center

The Institute of Meteorology and Water Management

Piotra Borowego Str. 14, 30-215 Kraków, Poland

1. Introduction.

In 1985 system for processing of TOVS data was developed in Poland by using MERA-60 microcomputer [L.A.Barański, 1983 ; L.A.Barański, K.Rozemski, 1984]. Not sufficient computing capacity of MERA-60 allowed to retrieve one profile within 40 minutes. This fact limited seriously operational use.

According to the ITOVS-II recommendation, the new interactive informatic system ATMOSAT has been established on the base of IBM PC/AT [L.A.Barański, K.Rozemski, 1988 ; L.A.Barański, K.Rozemski, 1988]. In above system the data base and partialy software from TOVS Export Package (version III) was applied [W.L.Smith, 1985].

In comparison to TOVS Export Package, the procedures for graphical presentation of final and indirect computing results was added. The graphical capabilities of IBM PC/AT with EGA color monitor were fully utilised.

2. ATMOSAT hardware.

The hardware of the ATMOSAT system (Fig.1) consist of :

- a/. bit & frame synchroniser,
- b/. interface to IBM PC main board,
- c/. IBM PC/AT

- main board, 10 MHz,
- RAM 7 MB,
- hard disc 40 MB,
- arithmetic coprocessor 80287,

- d/ EGA color monitor.
- e/ keyboard.
- f/ two magnetic tape drivers,
- g/ magnetic tape controller.
- h/ matrix printer.
- i/ plotter.
- j/ facsimile transmitter.

ATMOSAT system can be connected to the HRPT as well as to the DSB receiving stations [L.A.Baranski, 1985].

The TIP data are extracted from complete HRPT data transmission and then process by ATMOSAT software. However AVHRR data are initially selected and processed by TERRASAT system which allows also to process LANDSAT, SPOT, KOSMOS digital images [L.A.Baranski, P.Struzik, 1988].

3. ATMOSAT software.

The software of ATMOSAT system (Fig.2) consist of 7 programmes for preprocessing of TOVS data, retrieval of the atmospheric temperature, moisture and ozone profiles and graphical presentation of the results.

TIPEXT - the programme (written in TURBO C, v. 2.0) for extraction of TIP data from HRPT transmission.

TIPINS - the installation programme (in TURBO PASCAL, v. 5.0) creating the batch files for automatic control of running programmes. This programme allows also to enter the satellite orbital elements for geographical location of HIRS and MSU data. The orbital elements are extracted from APT/NOAA predict bulletin.

TIPPRE - the programme (in TURBO PASCAL, v. 5.0) for extraction of HIRS and MSU data from minor TIP frames, detection of errors, calibration of MSU data, computing HIRS calibration coefficients (slopes and intercepts). The results are displayed on line and/or optionally printed. The displaying results allow the full monitoring of transmission errors during the running time. The HIRS and MSU processing results are displayed on two pages of the screen memory which can be switch over manually. On the first

page the following informations are displayed [Fig.3]:

- major, minor frame and calibration cycle numeration,
- line and element numbers,
- HIRS encoder position,
- manually selected HIRS channel,
- mapping of HIRS data,
- temperature of the black-body targets.

On the second page counts of the MSU channels, MSU antenna temperatures and calibration data are displayed (Fig.4).

TIPLOC - the programme (in TURBO PASCAL, v. 5.0) for :

- calibration of HIRS data, calculated by using the slopes and intercepts obtained as an output of TIPPRE programme,
- geographical location of HIRS and MSU data,
- limb correction of MSU data,
- collocation of MSU data to HIRS scan position,
- correction of 18-th and 19-th HIRS channels with respect to reflected sun light,
- correction of 17-th HIRS channel with respect to fluorescence,
- calculation of Earth or clouds albedo from VIS 20-th HIRS channel.

For above calculations, all necessary coefficients are extracted from TOVS Export Package - magnetic tape.

Before processing, the TOVS scanning area is displayed on the map of the receiving antenna radiohorizone installed in Cracow (i.e.Europe). During location , the HIRS and MSU scan elements are also marked on this map (Fig.5). Since the programme terminated, the images of any selected TOVS channel can be optionally displayed (Fig.6). The effect of the limb correction can be observed too.

TIPRTV - the programme (in Professional FORTRAN v. 1.0) for retrieving of the temperature, moisture and ozone profiles, uses the simultaneous retrieval algorithm [W.L.Smith, 1985]. The programme FXTIRZ of TOVS Export Package treats ozone mixing ratio profile as an indirect result for computing the total ozone content. Ozone mixing ratio profile is not output. As opposed to above, in ATMOSAT system, the ozone mixing ratio profile is taking out for future research [L.A.Baranski, K.Rozemski, 1988].

In this programme, the subset of TOVS data can be selected on the following ways :

- manual setting of circle on the investigated area,
- manual pointing by cursor of the geographical region,
- selection of single sounding points by entering name of localities or manually by cursor.

Each position of cursor is converted to geographical coordinates which are displayed on the EGA monitor. After calculation of profiles, the sounding points are marked on the map of Europe (Fig.7).

During retrieving time at the most significant stages of retrieval algorithm, the results can be presented on diagrammes of the vertical temperature, moisture and ozone profiles (Fig.8). The real weighting functions including actual vertical temperature and moisture profiles can be optionally displayed for selected TOVS channels.

TIPISO - the programme (in TURBO PASCAL v. 5.0) for plotting of isolines for presentation of final retrieving results. The distribution of each of the calculated by TIPRTV physical parameters on selected isobaric surface can be displayed. The scale of map and size of investigated area can be selected. The procedures for making hard copies of the map with isolines on matrix printer are included in TIPISO programme (Fig.9).

TIPPLO - the programme (in TURBO PASCAL v. 5.0) for plotting diagrammes of vertical temperature, moisture and ozone profiles in selected points.

4. Conclusions.

Presented ATMOSAT system based on IBM PC/AT for TOVS data processing is working satisfactory in Poland since 1987. Computing times of each programme, assuming the transmission time 6.4 min. (60 scan lines of HIRS) is presented below :

TIPEXT -- 15 min.,
 TIPINS -- depends on operator,
 TIPPRE -- 1 min.,
 TIPLOC -- 5 min.,

TIPRTV -- 0.4 - 0.6 min.(depends on cloudiness) for one sounding.

TIPISO -- depends on number of isolines and sounding points.

TIPPLO -- immediately.

The intercomparison analysis was made for temperature and moisture vertical profiles retrieved from TOVS data by using ATMOSAT system versus radiosonde measurements obtained from 7 aerological stations placed in the Middle Europe [L.A.Barański, K.Rozemski, 1988 ; L.A.Barański, K.Rozemski, 1988]. The intercomparison analysis for total ozone content and especially ozone mixing ratio profiles are under preparation. The statistical material from TOVS transmission and time coincident aerological data will be used for calculation of the regression coefficients to establish the relationship between stratospheric HIRS channel and ozone mixing ratio profile. The determination of the regression coefficients representative for the Middle Europe climate conditions is the main goal of this work. The ATMOSAT software will be extended by including SSU data processing. The AVHRR data will also be used for research of the clear column radiance topics [T.Aoki, 1985].

5. References.

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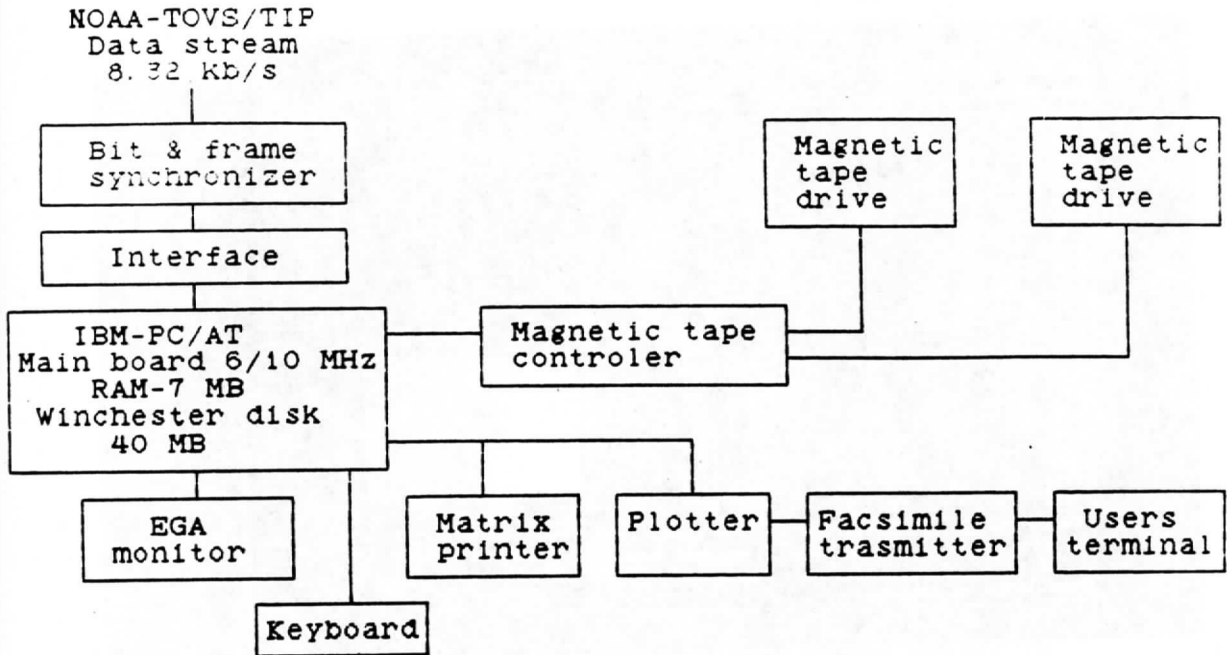


Fig. 1. ATMOSAT hardware configuration for TOVS data processing system

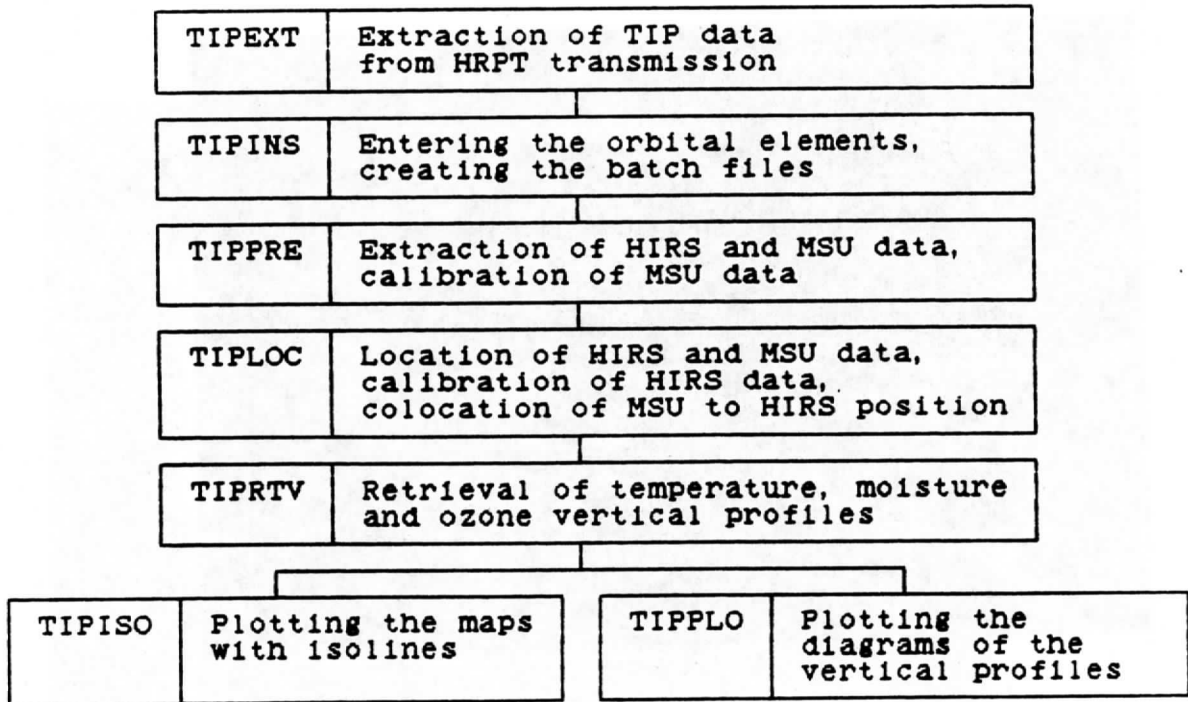


Fig. 2. ATMOSAT software for TOVS data processing system

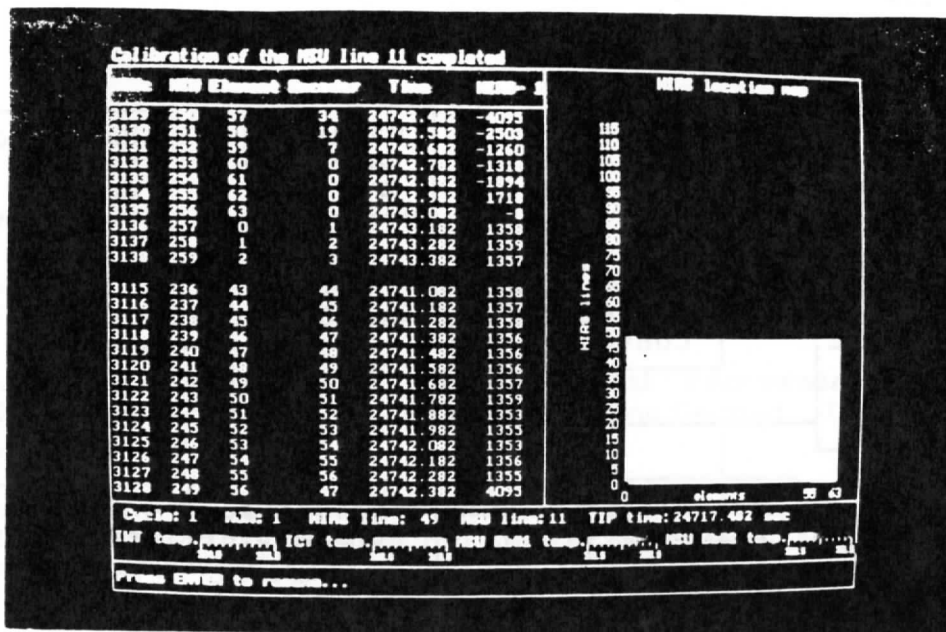


Fig. 3. Displaying of the HIRF preprocessing results (TIFFRE programme).

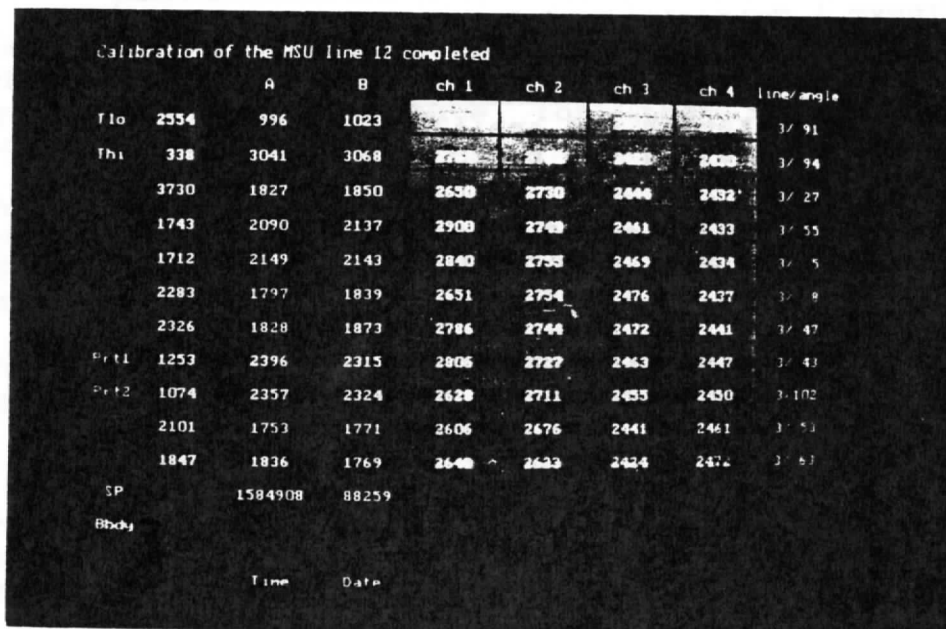


Fig. 4. Displaying of the MSU preprocessing results (TIFFRE programme).

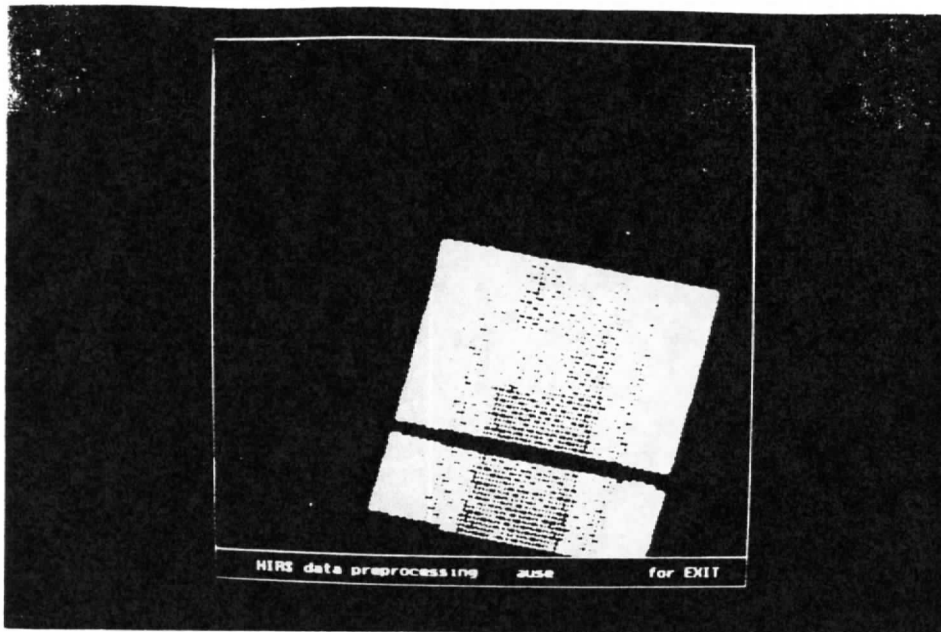


Fig. 2. Results of HIRS and MSW geographical location (TIPLOC programme).

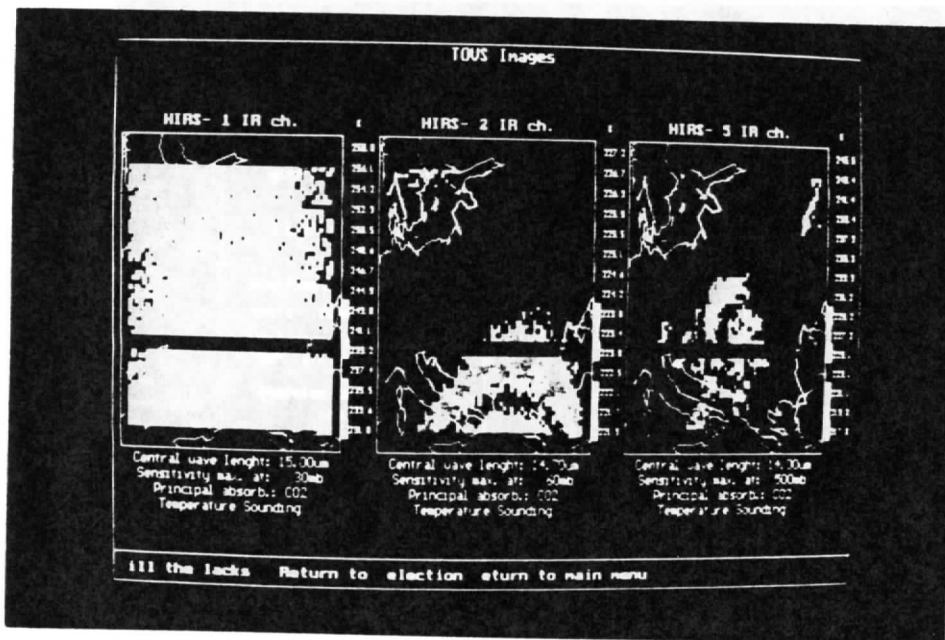


Fig. 3. Images of three calibrated TOVS channels data (TIPLOC programme).

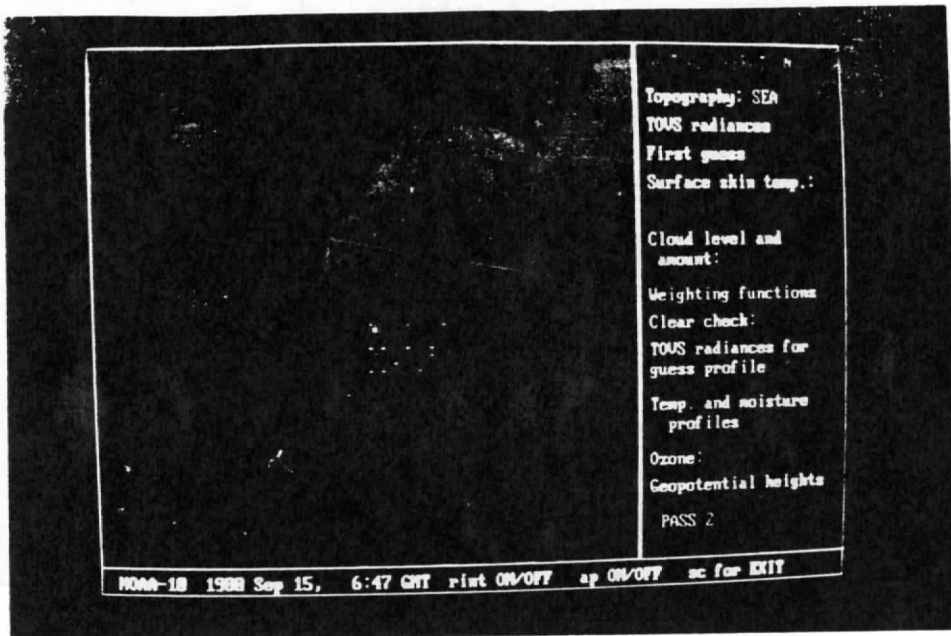


Fig. 1. TOUS radiances over the tropical Pacific Ocean. The data are from the TOUS instrument on the NOAA-10 satellite.

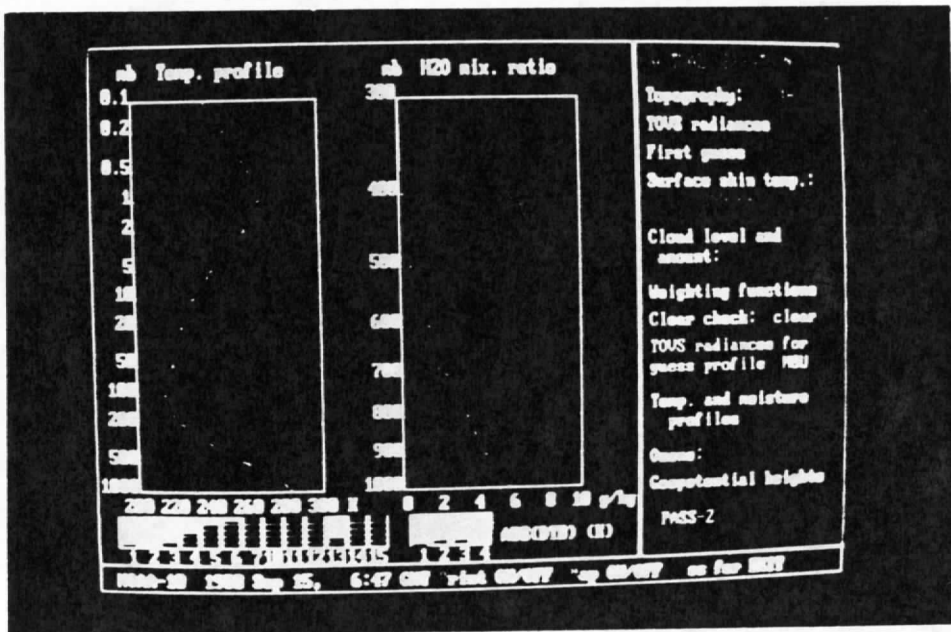


Fig. 2. Temperature and moisture profiles presented in diagram through vertical title in TOUS instrument.

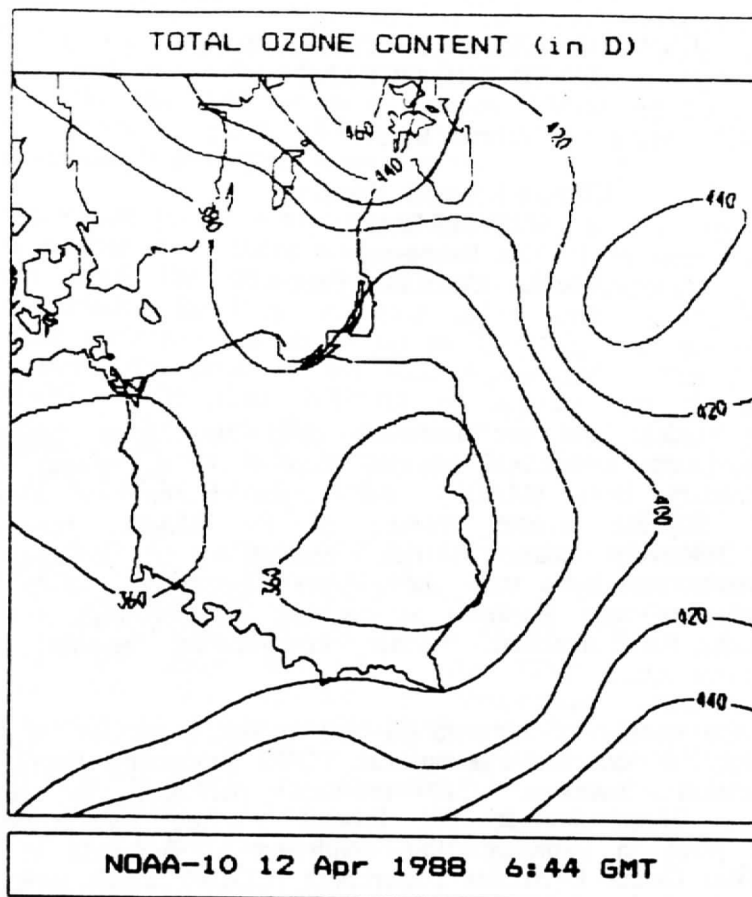


Fig. 9 Hard copy of the map with isolines for the total ozone content (TIPISO programme).

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July 24-28, 1989

Edited by A. CHEDIN

Laboratoire de Météorologie Dynamique (CNRS)
Ecole Polytechnique,
91128 Palaiseau Cedex
France

January 1990