

ΣΥΝΕΔΡΙΑ ΤΗΣ 7ΗΣ ΜΑΪΟΥ 1992

ΠΡΟΕΔΡΙΑ ΜΙΧΑΗΛ ΣΑΚΕΛΛΑΡΙΟΥ

ΦΥΣΙΚΗ... **Stratospheric Ozone over Europe during the European Arctic Stratospheric Ozone Experiment (EASOE)**, υπό του Ἀντεπιστέλλοντος Μέλους *H. T. Mantis* μετὰ τῶν *C. Zerefos, C. Reppas, J. Ziomas, A. Bais, D. Balis**.

1. Introduction

The European Arctic Stratospheric Ozone Experiment (EASOE) has just concluded a five month campaign of intensive observations of the chemical and aerosol composition of the stratosphere. Over 200 scientists in laboratories in Europe participated in the research program sponsored by the Community and their respective governments. The experiment is directed toward obtaining an understanding of the seasonal and long-period variation in the concentration of stratospheric ozone. The Laboratory of Atmospheric Physics of the University of Thessaloniki operated ground based ozone measuring instruments at Iceland and at Thessaloniki during this experiment but their major role in EASOE was the preparation and distribution of daily maps of the ground based measurements. It is our purpose in this presentation of maps of the ozone distribution to illustrate its complex structure and thereby provide some appreciation of the difficulty in achieving the EASOE goal of understanding the causes of ozone fluctuations.

* Ο. ΜΑΝΤΗΣ, Χ. ΖΕΡΕΦΟΣ, Χ. ΡΕΠΑΠΗΣ, Ι. ΖΙΩΜΑΣ, Α. ΜΠΑΗΣ, Δ. ΜΠΑΛΗΣ, **Τὸ Στρατοσφαιρικό Ὄζον ὑπεράνω τῆς Εὐρώπης κατὰ τὴν διάρκεια τοῦ Εὐρωπαϊκοῦ Πειράματος γιὰ τὸ Ἀρκτικό Στρατοσφαιρικό Ὄζον (EASOE).**

2. Discussion and Results

The daily total ozone ground observations from almost all the stations of the EASOE network and from cooperating Canadian and Russian stations too, were transmitted every day to the Laboratory of Atmospheric Physics of the University of Thessaloniki. This Laboratory analysed the data and constructed daily ozone maps for each day during the EASOE. The ozone map analysis employed a statistical interpolation scheme developed in Central Aerological Observatory, Moscow Russia, by Fioletov (1989) and Fioletov et al (1990).

Fig. 1, shows the map of the ozone distribution for 28 January of this year. This example was chosen because it represents the very lowest values of ozone observed over Northern Europe during the experiment. The map for 19 February 1992, shown in Fig. 2, displays a similar appearing pattern as on 28 January but instead of low values they represent a center of high ozone. The central value in Fig. 2 is more than twice that in the low center on 28 January shown in Fig. 1. It can be recognized that the dimensions of the low and high ozone regions are similar scale to that of the wind systems in the upper troposphere. There is in fact a rough correspondence of a high ozone center to follow a surface low pressure system, a relation that was first observed more than 60 years ago by Professor Dobson, and his colleagues (Normand, 1953).

Ozone maps obtained from surface based measurements or from satellite observations unlike ordinary weather maps do not portray conditions at a single instant in time because both methods of observation depend upon illumination by the sun and a map for a given day shows observations made over a 24-hour interval. To overcome the lack of simultaneity of the two measuring systems we compare ozone concentration averaged over an area of similar size to these major ozone disturbances. Fig. 3 shows such a comparison of daily satellite (TOMS, Total Ozone Mapping Spectrometer) and ground based observations for Northern Europe averaged over the latitude belt 50°- 60° N. One notes there is satisfactory agreement between the two measurements verifying the magnitude of the fluctuation shown on our sample maps for 28 January and 19 February. Ozone levels over Northern Europe averaged almost 20% below normal during the month of January with day to day changes as large as 10%. Conditions over Central Europe in the latitude belt 40°- 50° N were similar to those in Northern Europe

as shown on Fig. 4. The average ozone departure in the latitude belt 40°-50° N during January, however, was just half that in 50°-60° latitude belt.

The day to day ozone fluctuations as well as the large disturbance shown in our 28 January example are clearly dominated by circulation effects as can be shown by a comparison of the daily record of ozone amount (Figs. 3 and 4) with the temperature in the ozone layer (15-30 km) shown in Figs. 5 and 6.

As one can imagine it is extremely difficult to verify a chemically produced ozone depletion with this highly variable background produced by transport. Isolation of the chemically produced ozone changes in the Northern Hemisphere may therefore require a quantitative evaluation of the ozone transport. At the Academy of Athens Research Center we are undertaking the detailed calculation of ozone transport over Europe during the period 21 January to 21 February, 1992. It is our hope to obtain a more quantitative measure of the contribution of transport versus chemically produced fluctuations in ozone.

REFERENCES

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- Fioletov, V. E., Dorohov, V. M. and Khatatov, V. U., 1990: Development of a Ground-Based Ozone Observing System for the Ozone Layer State Control. Unpublished Report, Central Aerological Observatory, Moscow Russia.
- Norman, Sir Charles, 1953: Atmospheric Ozone and the Upper-Air Conditions. Quart. J. R. Met. Soc., 79, 39-50.

WMO/GO3OS SYNOPTIC OZONE MAP
Compiled at I.A.P.-Univ. of Thessaloniki, GREECE in collaboration with CAO, RUSSIA.
Total ozone (D.U.) for January 28, 1992.

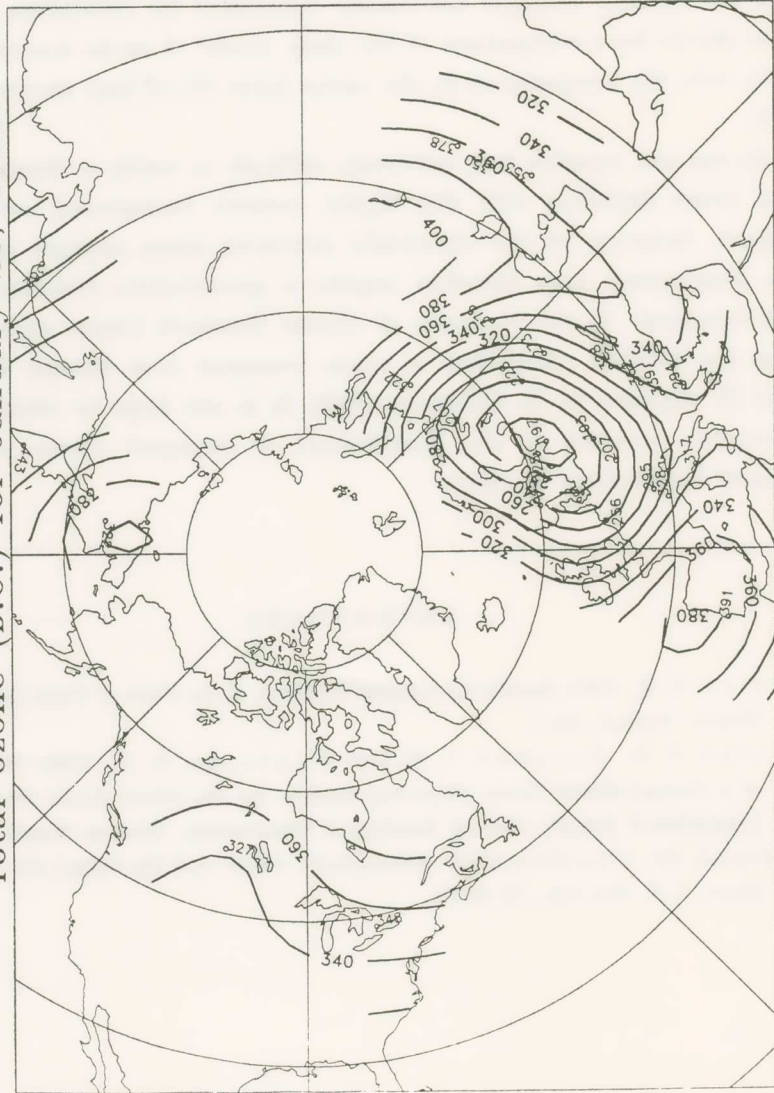


Fig. 1. Total ozone distribution (in D.U.) of the ground-based measurements for 28 January 1992.

WMO/GO3OS SYNOPTIC OZONE MAP
Compiled at LAP- Univ. of Thessaloniki, GREECE in collaboration with CAO, RUSSIA.
Total ozone (D.U.) for February 19, 1992.

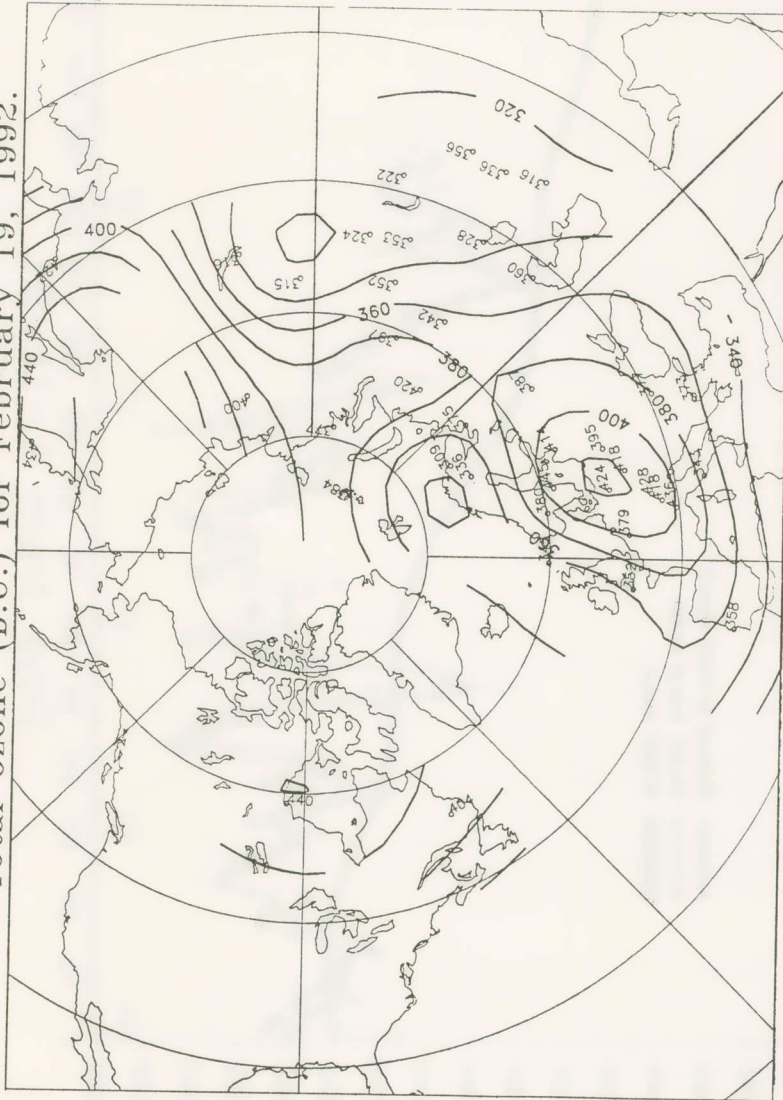


Fig. 2. Total ozone distribution (in D.U.) of the ground-based measurements for 19 February 1992.

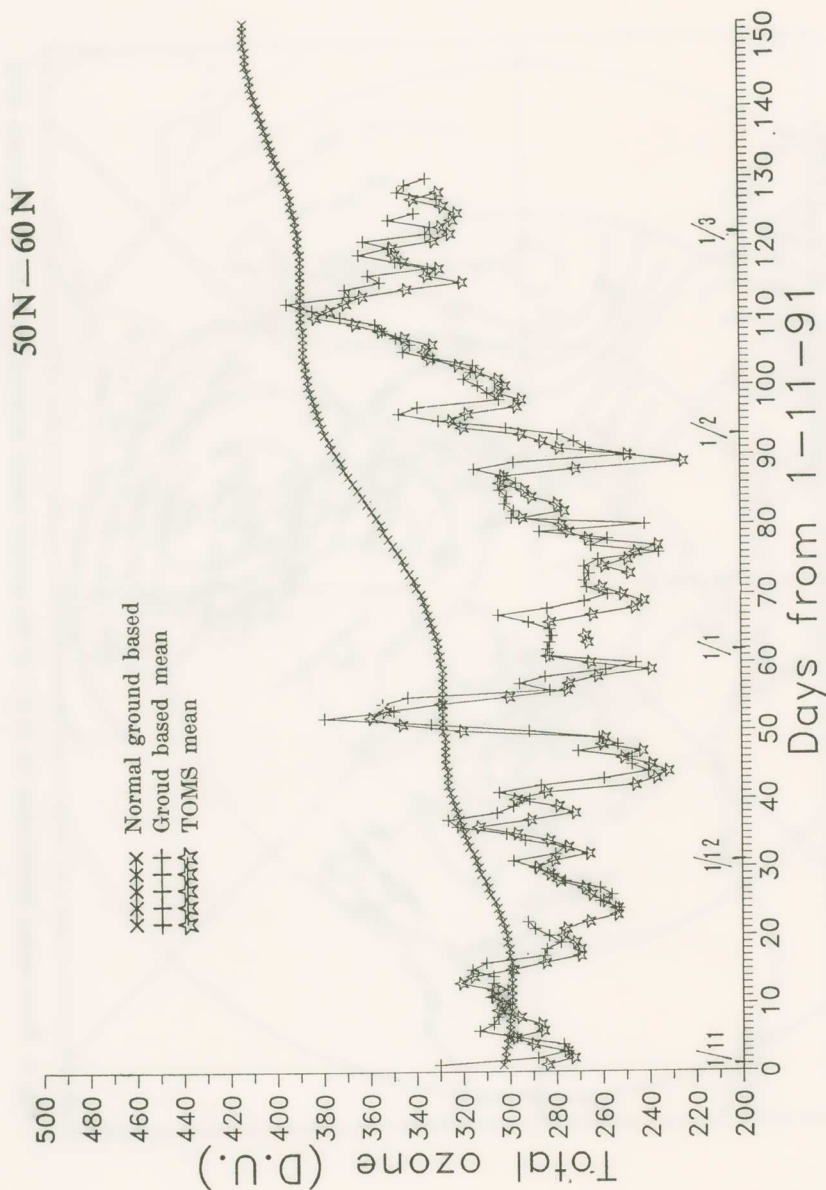


Fig. 3. Time series of total ozone from ground-based observations (++++) and from satellite (TOMS) observations (☆☆☆☆) for Central Europe averaged over the region 50°N - 60°N and 10°W - 40°E. The curve on top (xxxxx) is the time series of the normal daily values from ground-based observations.

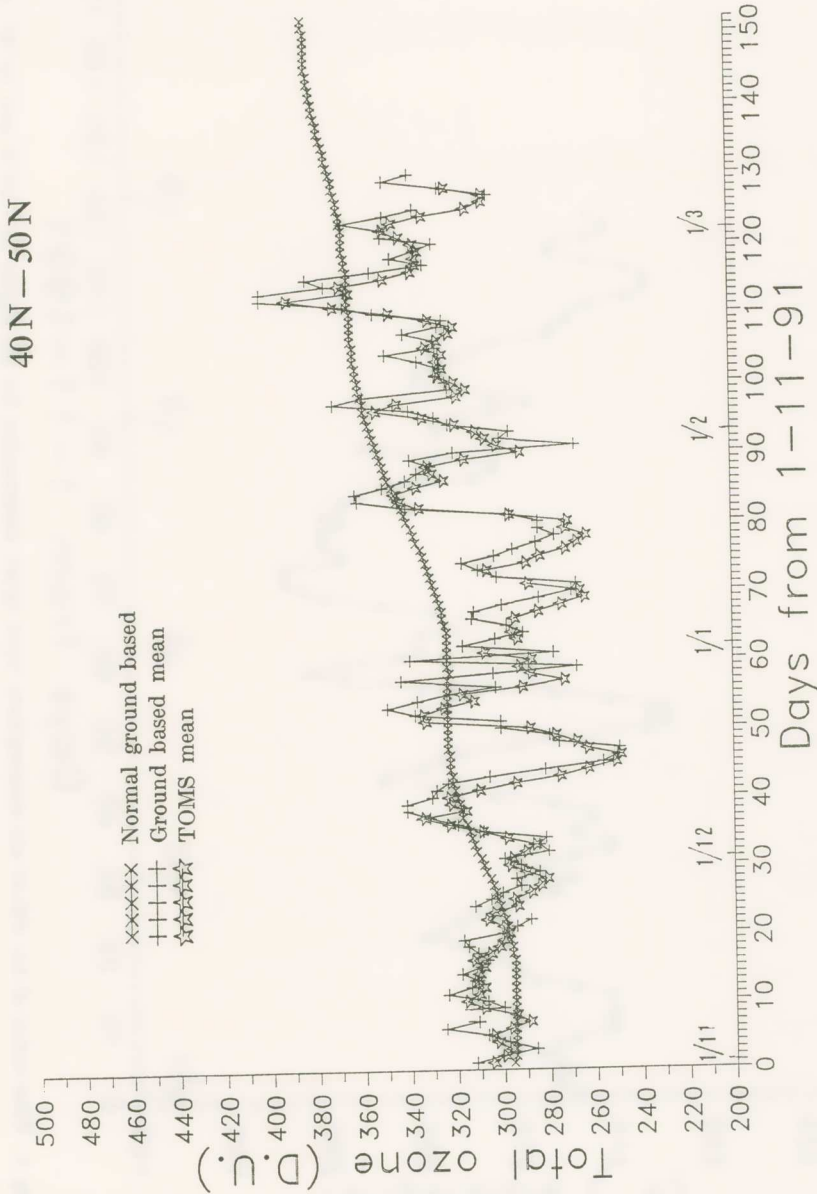


Fig. 4. Time series of total ozone from ground-based observations (+++++) and from satellite (TOMS) observations (☆☆☆☆☆) for Southcentral Europe averaged over the region 40°N - 50°N and 10°W - 30°E. The curve on top (xxxxx) is the time series of the normal daily values from ground-based observations.

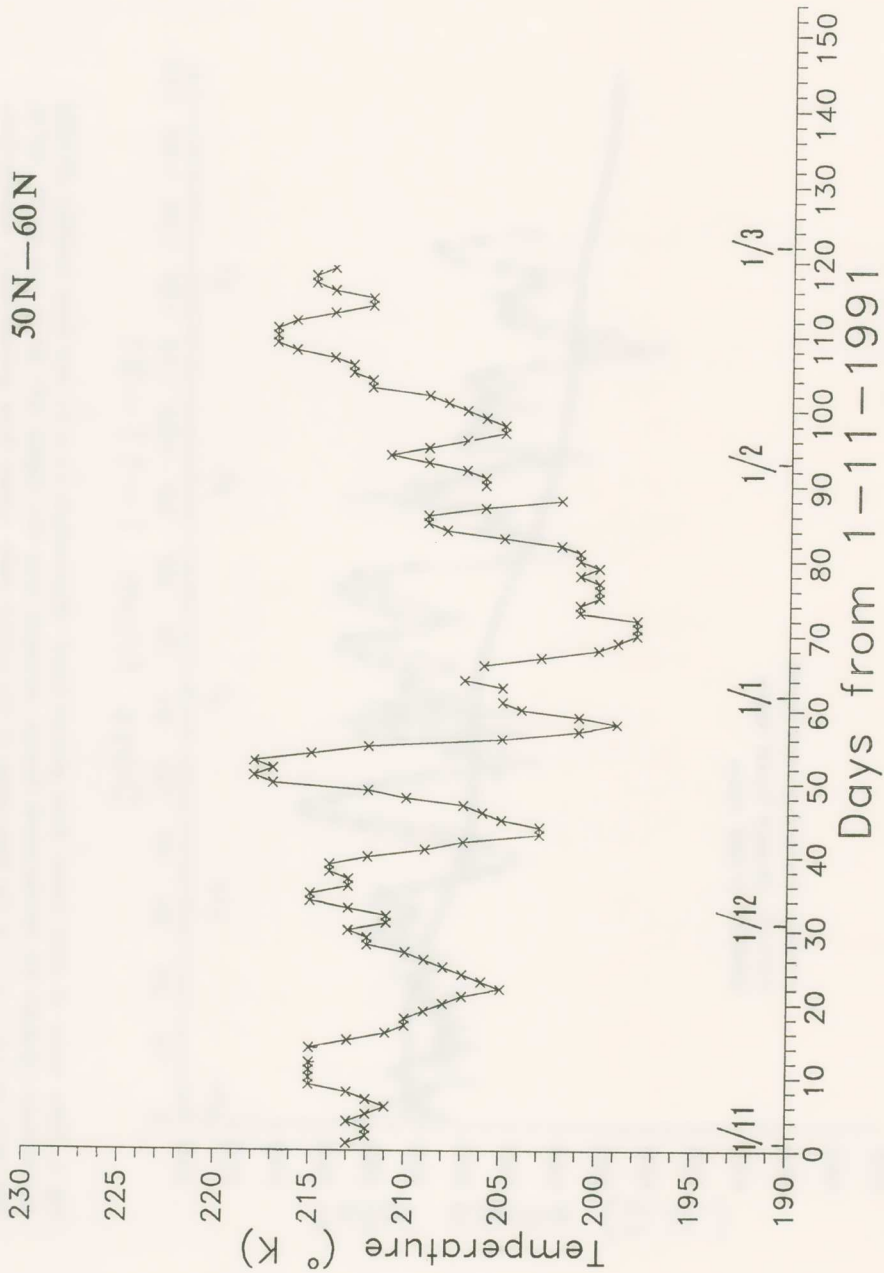


Fig. 5. Time series of the 100-30 mb stratospheric layer mean temperature for the region 50°-60°N and 10°W-40°E.

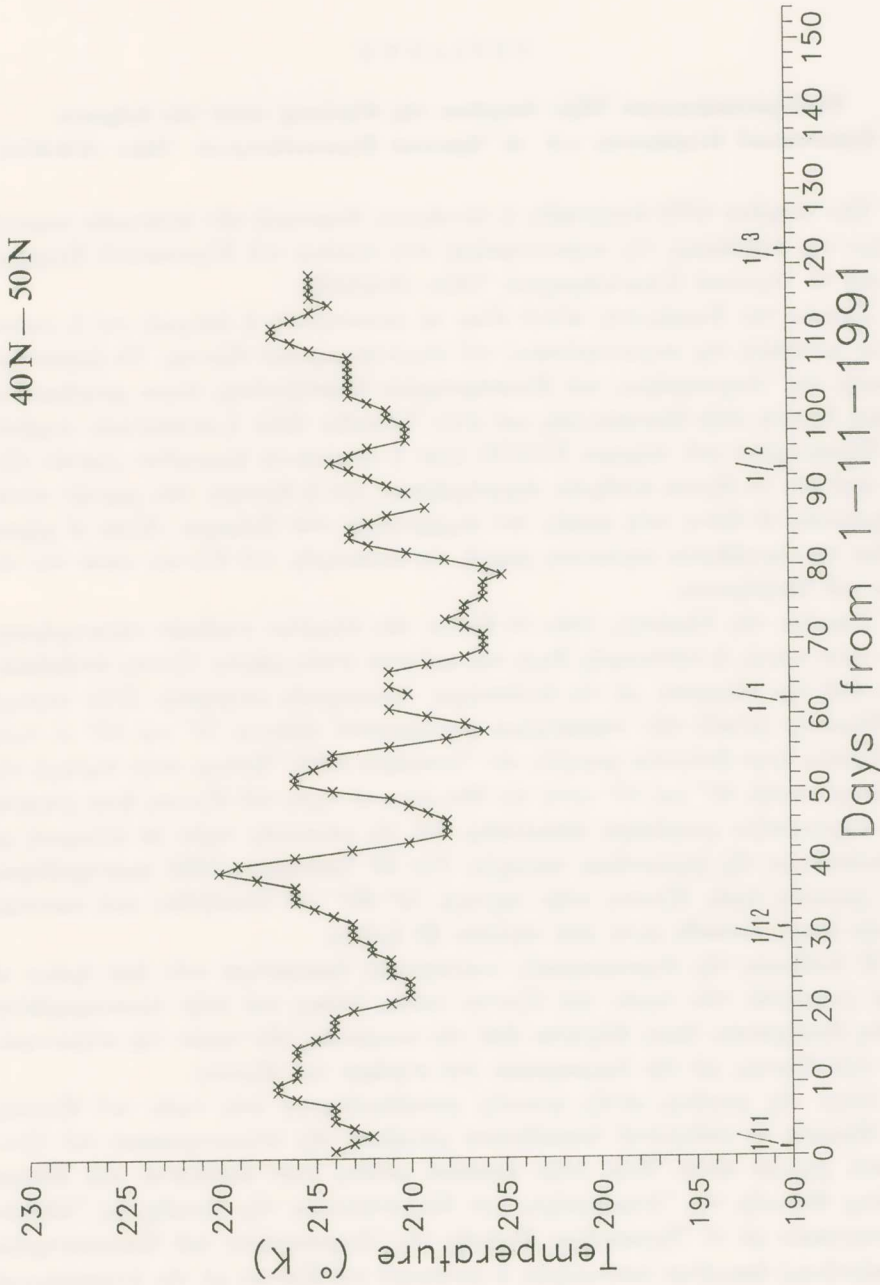


Fig. 6. Time series of the 100-30 mb stratospheric layer mean temperature for the region 40° - 50° N and 10° W - 30° E.

Π Ε Ρ Ι Λ Η Ψ Η

Τὸ Στρατοσφαιρικό Ὄζον ὑπεράνω τῆς Εὐρώπης κατὰ τὴν διάρκεια τοῦ Εὐρωπαϊκοῦ Πειράματος γιὰ τὸ Ἀρκτικό Στρατοσφαιρικό Ὄζον (EASOE).

Τὸν Ἀπρίλιο 1992 ἐπερατώθη ἡ πεντάμηνη ἀποστολὴ τῶν ἐντατικῶν παρατηρήσεων τῆς συστάσεως τῆς στρατοσφαιρας στὰ πλαίσια τοῦ Εὐρωπαϊκοῦ Πειράματος γιὰ τὸ Ἀρκτικό Στρατοσφαιρικό Ὄζον (EASOE).

Σκοπὸς τοῦ Πειράματος αὐτοῦ εἶναι νὰ κατανοηθοῦν ἡ ἐποχικὴ καὶ ἡ μακροχρόνια μεταβολὴ τῆς συγκεντρώσεως τοῦ στρατοσφαιρικοῦ ὄζοντος. Τὸ ἐργαστήριο Φυσικῆς τῆς Ἀτμοσφαιρας τοῦ Πανεπιστημίου Θεσσαλονίκης ἔκανε μετρήσεις μὲ ἐπίγεια ὄργανα στὴν Θεσσαλονικὴ καὶ στὴν Ἰσλανδία ἀλλὰ ἡ μεγαλύτερη συμβολὴ τοῦ Ἐργαστηρίου στὸ πείραμα EASOE ἦταν ἡ κατασκευὴ ἡμερησίων χαρτῶν ὄζοντος ἀπὸ ἕλο τὸ δίκτυο σταθμῶν παρατηρήσεων καὶ ἡ διανομὴ τῶν χαρτῶν αὐτῶν καθημερινῶς σὲ ἄλλους τοὺς φορεῖς ποὺ συμμετεῖχαν στὸ Πείραμα. Αὐτοὶ οἱ χάρτες ἔδειξαν τὴν ἀσυνήθιστα περίπλοκη μορφή τῆς κατανομῆς τοῦ ὄζοντος κατὰ τὴν περίοδο τοῦ Πειράματος.

Ἐπεράνω τῆς Εὐρώπης, ὅπου τὸ δίκτυο τῶν ἐπιγείων σταθμῶν παρατηρήσεως εἶναι πολὺ πυκνὸ, ἡ λεπτομερὴς δομὴ ποὺ φαίνεται στοὺς χάρτες ὄζοντος ἐπιβεβαιώνεται ἀπὸ τὴν σύγκριση μὲ τὶς ἀντίστοιχες δορυφορικὲς μετρήσεις. Στὴν περιοχὴ τῆς Εὐρώπης μεταξὺ τῶν παραλλήλων γεωγραφικοῦ πλάτους 50° καὶ 60° οἱ τιμὲς τοῦ ὄζοντος ἦταν ἀνώμαλα χαμηλὲς τὸν Ἰανουάριο 1992. Ἐπίσης στὴν περιοχὴ τῆς Εὐρώπης μεταξὺ 40° καὶ 50° κατὰ τὸν ἴδιο μῆνα οἱ τιμὲς τοῦ ὄζοντος ἦταν χαμηλὲς ἀλλὰ παρουσίαζαν μικρότερες ἀποκλίσεις ἀπὸ τὶς κανονικὲς τιμὲς σὲ σύγκριση μὲ τὶς ἀντίστοιχες τῆς βορειότερας περιοχῆς. Τὴν 28 Ἰανουαρίου 1992 παρατηρήθησαν πολὺ χαμηλὲς τιμὲς ὄζοντος στὴν περιοχὴ 50°-60° καὶ ἐπανῆλθαν στὰ κανονικὰ γιὰ τὴν ἐποχὴ ἐπίπεδα μετὰ ἀπὸ περίπου 20 ἡμέρες.

Ἡ ἐπίδραση τῆς ἀτμοσφαιρικῆς κυκλοφορίας ἐπεκράτησε στὶς ἀπὸ ἡμέρα σὲ ἡμέρα μεταβολὲς τῶν τιμῶν τοῦ ὄζοντος καθὼς ἐπίσης καὶ στὴν προαναφερθεῖσα μεγάλη διακύμανση, ὅπως δείχνεται ἀπὸ τὴν συσχέτιση τῶν τιμῶν τῆς συγκεντρώσεως τοῦ ὄζοντος, μὲ τὴν θερμοκρασία στὸ στρῶμα τοῦ ὄζοντος.

Λόγω τῆς μεγάλης αὐτῆς φυσικῆς μεταβλητότητας στὶς τιμὲς τοῦ ὄζοντος, εἶναι δύσκολο νὰ καθοριστεῖ ὁποιαδήποτε μεταβολὴ τῆς συγκεντρώσεως τοῦ ὄζοντος ἀπὸ χημικὰ αἷτια. Ἔτσι στὴν παρούσα μελέτη (ποὺ διεξάγεται στὸ Κέντρο Ἐρευνῆς Φυσικῆς τῆς Ἀτμοσφαιρας καὶ Κλιματολογίας τῆς Ἀκαδημίας Ἀθηνῶν σὲ συνεργασία μὲ τὸ Ἐργαστήριο Φυσικῆς τῆς Ἀτμοσφαιρας τοῦ Πανεπιστημίου Θεσσαλονίκης) ἐρευνᾶται λεπτομερῶς ἡ μεταφορὰ τοῦ ὄζοντος μὲ τὴν ἀτμοσφαιρικὴ κυκλοφορία, κατὰ τὴν περίοδο ποὺ διήρκεσε τὸ Πείραμα, γιὰ νὰ ἐκτιμηθεῖ ποσοτικὰ τὸ μέτρο τῆς συνεισφορᾶς τῆς μεταφορᾶς σὲ σχέση μὲ τὶς μεταβολὲς τοῦ ὄζοντος λόγω χημικῶν διεργασιῶν.