Air Quality Management

at Urban, Regional and Global Scales

Editors :

S.Topçu, M.F.Yardım, A.Bayram,
T.Elbir, C.Kahya

Proceedings of the Third International Symposium
on

AIR QUALITY MANAGEMENT

at Urban, Regional and Global Scales
&
14th IUAPPA Regional Conference

26-30 September 2005
Mövenpick Hotel - Istanbul, Turkey

organized by

Turkish National Committee for
Air Pollution Research and Control (TUNCAP)
and
Korean Environmental Sciences Society (KENSS)

in collaboration with

ITU – Istanbul Technical University
DEU – Dokuz Eylul University
IUAPPA - The International Union of Air Pollution Prevention and Environmental Protection Associations
EFCA - The European Federation of Clean Air and Environmental Protection Associations
and
TUBITAK – The Scientific and Technical Research Council of Turkey

Editors:

S. Topcu, M. F. Yardım, A. Bayram,
T. Elbir, C. Kahya

Proceedings of the Third International Symposium on Air Quality Management at Urban, Regional and Global Scales. 26-30 September 2005, Istanbul – Turkey

THE IMPORTANCE OF BLOCKING EVENTS IN AIR POLLUTION IN TURKEY

Ali Deniz[1], Fevzi Erdoğmuş[2] and Hüseyin Toros[1]

[1] Istanbul Technical University, Aeronautics and Astronautics Faculty, Department of Meteorology, 34469, Maslak, İstanbul, TURKEY.
[2] İstanbul university, Faculty of Engineering, Department of Maritime Transport and Management Engineering 34850, Avcılar, İstanbul, TURKEY.

ABSTRACT

The main sources of air pollution are automobiles, industry, and central heating systems in winter months and so on. Apart from these, there are a number of meteorological elements or atmospheric events with great significance in the development of air pollution. One of these is "Blocking Events" which occurs when baroclinic westerly flows do not go forward to all latitudes. During the blocking events, zonal movements of short-waves are locked effectively and as a result of the movement to upper level systems the basic mechanism of vorticity advection can be neglected. Blocking patterns oblige many people to live under bad weather or poor environmental conditions.

In this study frequencies and durations of blocking events that cause air pollution in Turkey are investigated using by surface and 500 mb maps obtained from Germany Meteorological Bulletins. The frequencies and the durations of blocking events are determined for a period 5 or over 5 days. Therefore we tried to find a connection between air pollutant (SO_2) and blocking event in some selected cities in Turkey with a population over 200000.

Key Words: Frequency, Blocking event, Air Pollutant.

INTRODUCTION

The definition of a blocking event is rather subjective, and various indices have been derived to quantify the blocking intensity. Blocking highs were first studied by D.F. Rex in 1950 and later by Austin in 1980. To be called blocking, the high must split the mid-latitude jet stream meridionally into winds at least 45 degrees of latitude apart, and persist for 5 days or more. In the case of blocking, the same pattern repeats for several days to even weeks. This can lead to flooding, drought, above normal temperatures, below normal temperatures, air pollution and other weather extremes. It is synoptically important to recognize a blocking pattern in its initial development. Atmospheric blocking is best seen on upper air analysis and forecast charts. Blocking over large regions is most common with high-pressure since high pressure covers a large spatial area and tends to move slower than low pressure. Blocking has been studied extensively over the last several decades, largely for the Northern Hemisphere (Rex 1950; Lejenas and Økland 1983; Dole 1986; Colucci and Alberta 1996; Sinclair 1996; Lupo 1997; Lupo and Bosart 1999; Lupo and Smith 1995a,b).

Blocking situations occur most frequently in April and least frequently in August and September in the Northern Hemisphere. There are three types of blocking patterns in general. They are (Bluestein, 1993):

1. High-over-low block;
2. Omega block;
3. Stationary, high-amplitude ridge.

The "high-over-low" blocking type occurs frequently over the west of Europe and North America (Fig. 1). Because of the geographical structure for this type of block, horizontal variations in surface heating and/or topography probably play an important role in occurring the block. In the omega block the flow pattern has the shape of the capital Greek letter Ω (Fig. 2). It is zonally oriented in between two lows. The third type of block the stationary, high-amplitude ridge (Fig. 3) is associated with hot, dry, dull weather.

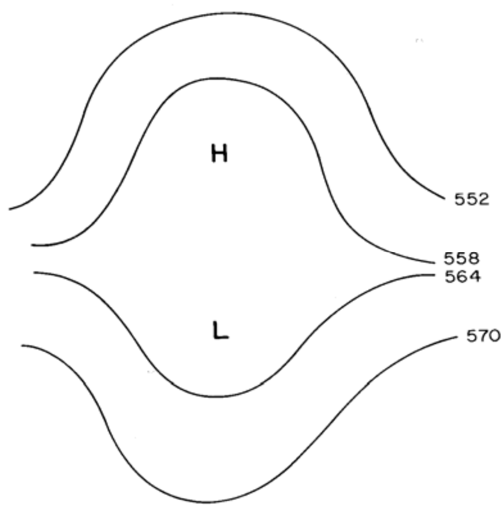


Fig. 1: Idealized illustration of a high-over-low block in the Northern Hemisphere. 500-mb height contours in dam (solid lines). North is toward the top of the figure (Bluestein, 1993).

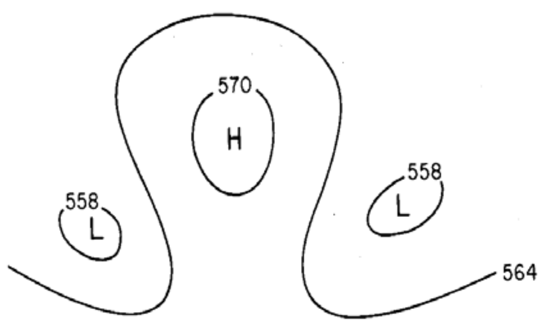


Fig. 2: Idealized illustration of an omega block in the Northern Hemisphere. 500-mb height contours in dam (solid lines). North is toward the top of the figure (Bluestein, 1993).

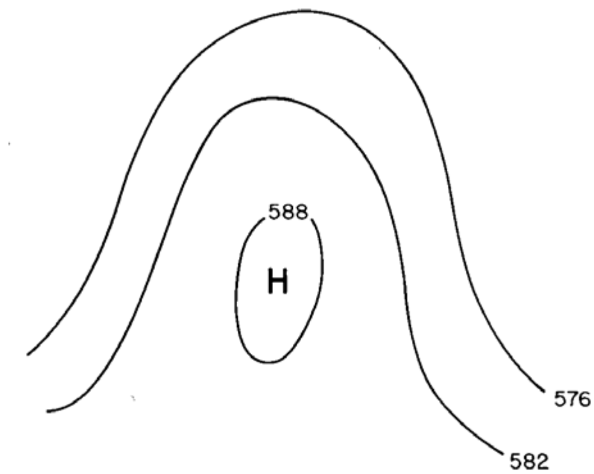


Fig. 3: Idealized illustration of a stationary, high amplitude ridge in the Northern Hemisphere. 500-mb height contours in dam (solid lines). North is toward the top of the figure (Bluestein, 1993).

DATA AND METHODOLOGY

In this study synoptic maps are used to determine blocking numbers and their durations observed in Turkey subjectively. Blocking durations are defined according to the 5 or more days by analysis of daily maps of 500 mb geopotential and surface maps at 00 GMT for the period of 1995-2004 (http://wetterzentrale.de, 2005). SO_2 data are used to compare air pollution with blocking events. Monthly mean values of SO_2 are obtained from Turkish Bulletin of Environmental Statistics (2005) for five selected stations (İstanbul, Ankara, Erzincan, Bursa and İzmir) for all season. The map of Turkey and selected stations are shown in Fig. 4.

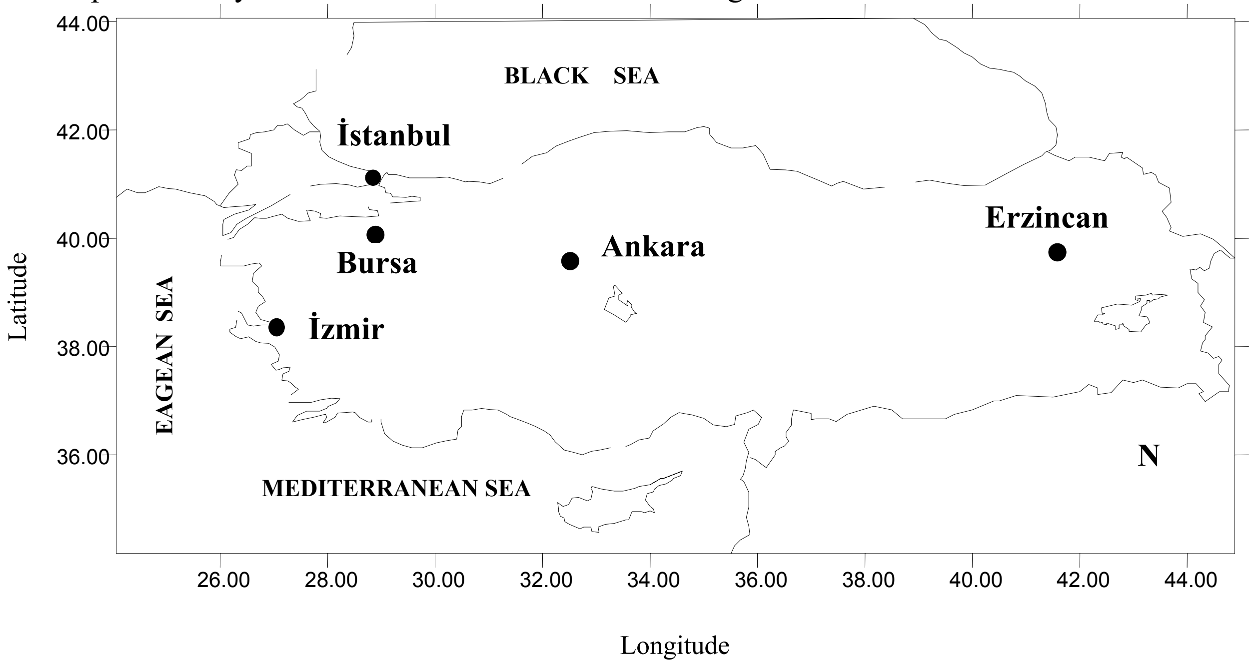
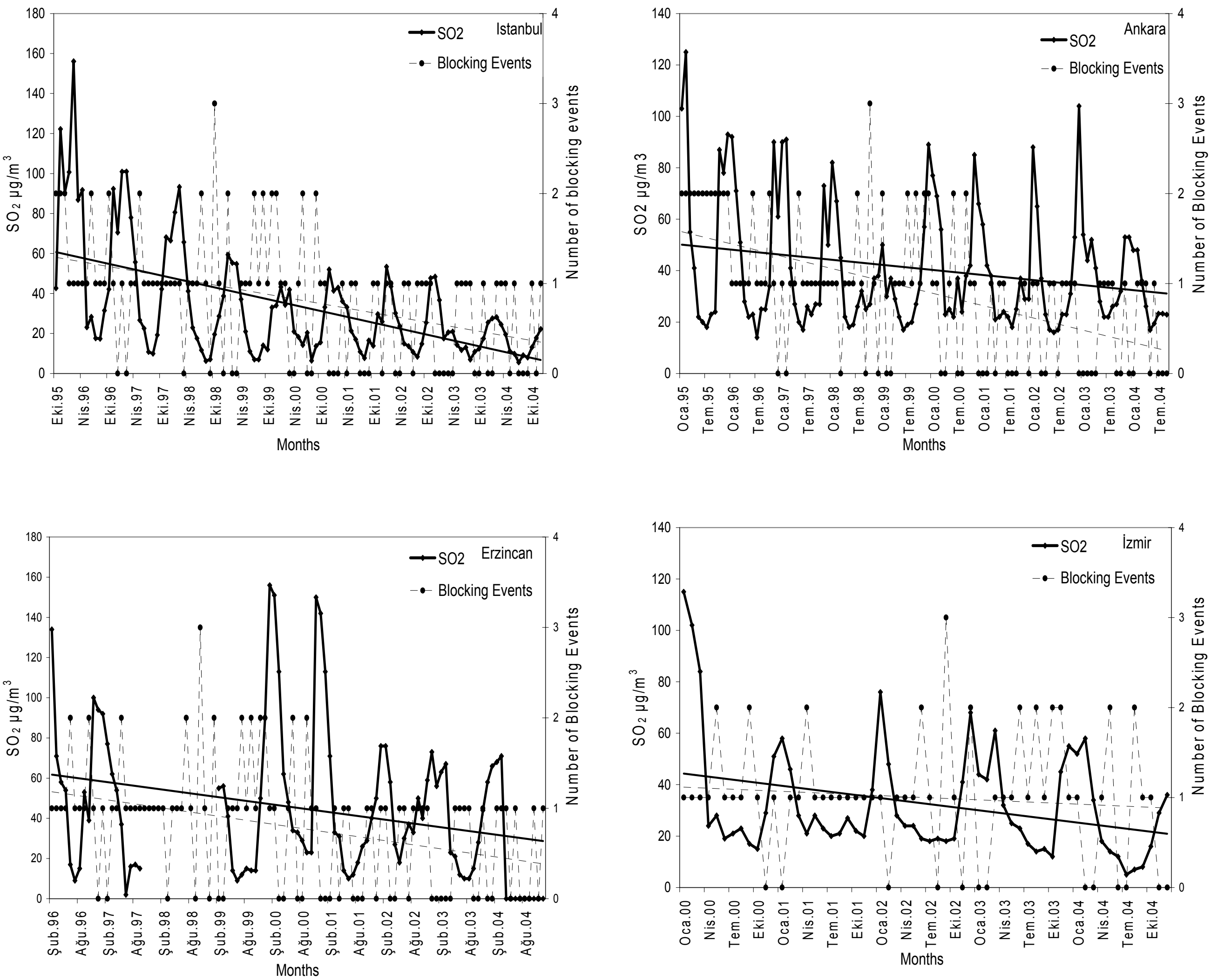


Fig. 4: Map of Turkey and five selected stations.

Turkey is located at the eastern corner of Southern Europe (36 °N and 42 °N latitudes, 26 °E and 45 °E longitudes) and its surface area is 77.106 km^2 with about 70 million population. Approximately 50 % of the population lives in the sea cost areas.

ANALYSES AND RESULTS

In this study it is tried to find a relationship between air pollution and blocking events in some selected cities in Turkey. For this, the variations of the number of blocking events and SO_2 can be seen from Fig. 5. It is thought that the blocking durations are important as well as their numbers in the air pollution studies. Therefore both of them are associated with environmental problems. Fig. 6 shows also the variations of European blocking durations (5 or over 5 days) and SO_2 in İstanbul, İzmir, Bursa, Erzincan and Ankara. When we compare all of the figures (see Fig. 5 and Fig. 6) it is found that there are decreasing trends in the number of blocking events and their durations in general for all cities (except for Bursa) for the period of 1995-2004. Recently, because of intense industry and its topography air pollution has been increasing in Bursa. On the other hand it is possible to say that decreasing trends are approximately valid for SO_2 variations. This means that there is a strict relationship between air pollution and blocking events in Turkey. To verify and generalize this result it must be increased the data period.



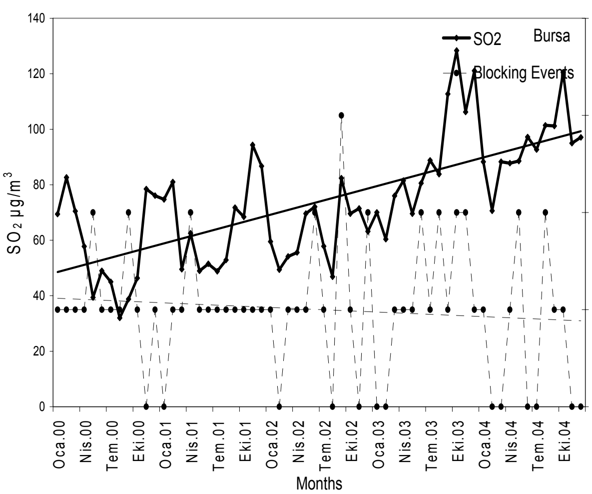


Fig. 5: Monthly variations of number of blocking events and SO_2 in İstanbul, Ankara, Erzincan, İzmir and Bursa for the period of 1995-2004.

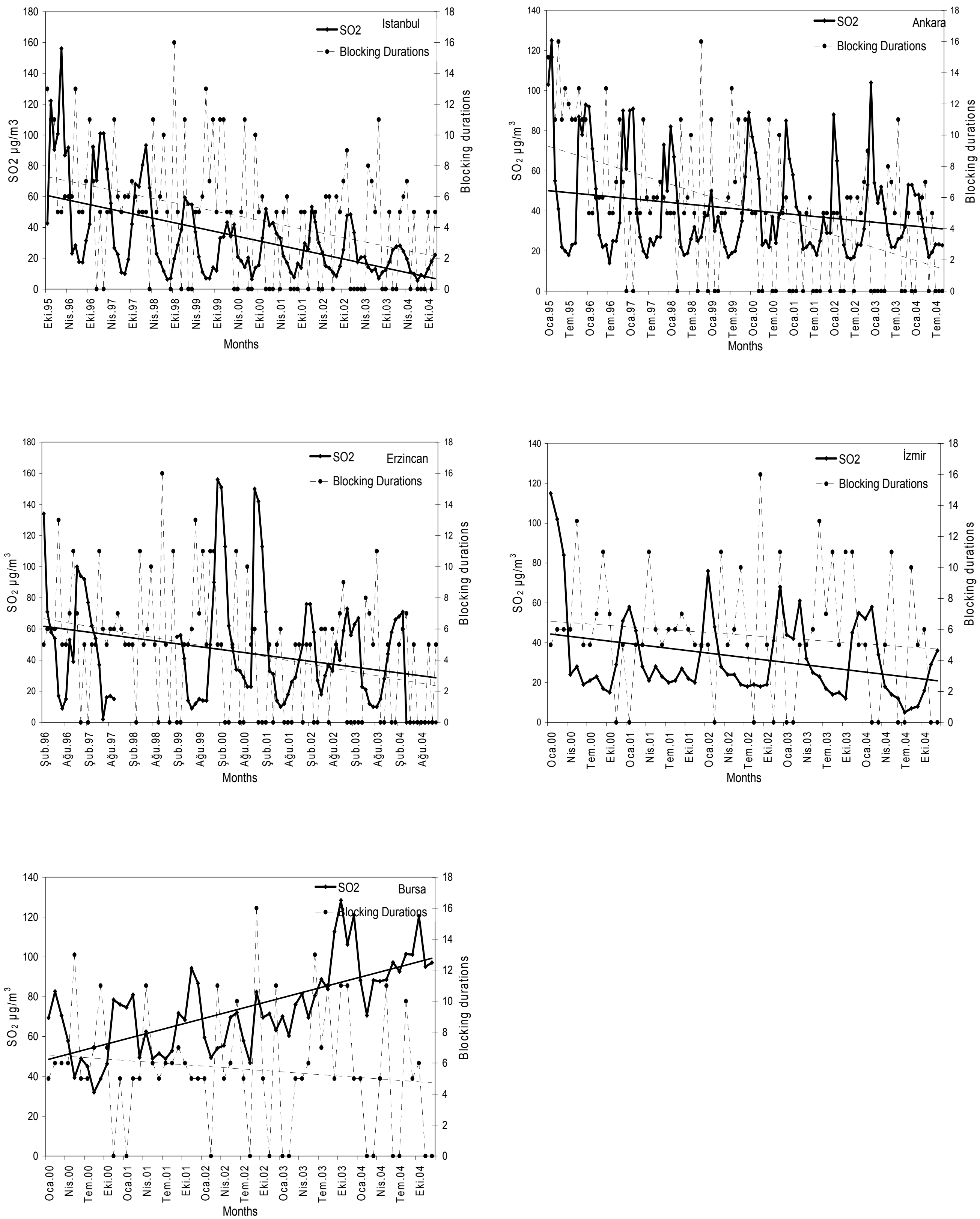


Fig. 6: Monthly variations of blocking durations and SO_2 in İstanbul, Ankara, Erzincan, İzmir and Bursa for the period of 1995-2004.

REFERENCES

Austin, J.F. 1980. The blocking of middle latitude westerly winds by planetary waves. *Quart. J. Roy. Meteor. Soc.,*106, 327-50.

Colucci, S. J., and T. L. Alberta, 1996: Planetary-scale climatology of explosive cyclogenesis and blocking. *Mon. Wea. Rev.,* **124,** 2509–2520.

Dole, R. M., 1986: The life cycles of persistent anomalies and blocking over the North Pacific. *Advances in Geophysics,* Vol. 29, 31–69.

http://wetterzentrale.de/topkarten/fsreaeur.html

Lejenas and H. Økland, 1983: Characteristics of Northern Hemisphere blocking as determined from a long time series of observational data. *Tellus,* **35A,** 350–362.

Lupo, A.R., and P.J. Smith, 1995a: Climatological features of blocking anticyclones in the Northern Hemisphere. *Tellus*, **47A**, 439 – 456.

Lupo, A.R., and P.J. Smith, 1995b: Planetary and synopticscale interactions during the life cycle of a mid-latitude blocking anticyclone over the North Atlantic. *Tellus*, **47A**: *Tellus Special Issue: The life cycles of extratropical cyclones*, 575 – 596.

Lupo, A.R., 1997: A diagnosis of two blocking events that occurred simultaneously over the mid-latitude Northern Hemisphere. *Mon. Wea. Rev.*, **125**, 1801 – 1823.

Lupo, A.R., and L.F. Bosart, 1999: An analysis of a relatively rare case of continental blocking. *Quart. J. Roy. Meteor. Soc.,* **125***,* 107 - 138.

Rex, D. P., 1950: Blocking action in the middle troposphere and its effect upon regional climate (II). The climatology of blocking actions. Tellus, 2, 275–301.

Sinclair, M. R., 1996: A climatology of anticyclones and blocking for the Southern Hemisphere. Mon. Wea. Rev., 124, 245–263.

Turkish State Statistics Institute Bulletin, (2005) Environmental Statistics.