SO₂ LEVELS AT FORESTED MOUNTAINS AROUND IZMIR, TURKEY 
AND THEIR POSSIBLE SOURCES

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Abstract. Daily average SO₂ concentrations were measured during August 1999–September 2000
period in the mountains around Izmir. Sampling devices to collect integrated daily SO₂ samples were
located at four different sites. These sites were Yamanlar Mountain in the north, Tekketepe height of
Karabelen Mountain in the south, and two mountain villages (Kiziluzum and Bespinar) located east
of Izmir. Samples were analyzed by using standard methods. Maximum daily SO₂ concentrations
up to 433 µg m⁻³ were found with the average values ranging between 75–135 µg m⁻³ per day at
the four mountain stations. Annual mean values were above the threshold levels acceptable for the
health of trees. It is concluded that such high SO₂ pollution might have caused the noted decline in
the forests. In order to decide the sources of such high levels of pollution on the forested mountains,
trajectory analyses were carried out. Results obtained at Tekketepe station are given in this article
and they point to the fractional contributions of dense industrial areas around Izmir, to the forested
heights of Tekketepe. Local topography and location of industrial zones around the city are seen
to have a strong effect on the deteriorated air quality over the mountains. The annual and seasonal
averages and ten maximum daily measurements at the Tekketepe sampling site indicate that the
highest contribution to the deterioration of air quality is associated with the northerly wind sectors.

Keywords: air pollution in Izmir, back-trajectory analysis, forest damage due to SO₂, sulfur dioxide
pollution on mountains

1. Introduction

Air pollution is one of the most important environmental problems in Izmir, Turkey. This metropolitan city is the center of a highly industrialized area by the Aegean Sea shoreline of Turkey (Figure 1). The city with a population of 2.7 million and sizeable economic activities houses many industries that are emitting high quantities of air pollutants. One of the most important air pollutants with regard to its emission quantities and impacts is sulfur dioxide (SO₂). Annual emissions of 81 752 tons for year 2000 were estimated from the geographical scope shown in Figure 1. A predominant fraction (86%) of these emissions were contributed by industries (Elbir, 2002; Muezzinoglu et al., 2001).

The city of Izmir is located in a basin surrounded by a mountain range of approximately 1000–1500 m height with only the west end open to the Aegean Sea. Mountains are usually covered with carefully managed coniferous strands,
but recently damage was detected on the trees. This was attributed to SO2 impacts (Kantarci, 2001). From dispersion modeling (Elbir, 2002; Muezzinoglu et al., 2001) large sources of SO2 located upwind at about 45 km northwest were suspected to have strong impacts on mountains covered with coniferous forests.

This study was focused on the SO2 levels in the air at mountainous areas and their possible sources. For this reason air sampling stations were located at Tekketepe, Yamanlar, Bespinar and Kizilizum with the altitudes of 980, 970, 800 and 350 m, respectively (Figure 1). Two day back-trajectory analyses were carried out by using the SO2 data to determine the contribution from different wind sectors to the SO2 measured on the mountains. Results obtained at the Tekketepe site are reported here.

The annual SO2 regional emission inventory for the year 2000 indicated that fossil fuels burned in residential areas and regional industries have contributed 9 and 91%, respectively (Elbir, 2002). Fossil fuels in use in this part of the country have high sulfur content. Although at the city center, lignite coals of less than 1% and fuel oils with 2.2% sulfur contents are permitted for use in domestic heating and industrial sectors, residual oils containing 3.5% sulfur outside the city center are widely used in industrial facilities. In the Aliaga region, a petroleum refinery and connected petrochemical complex along with several auxiliary chemical and metallurgical industries are located (Muezzinoglu, 2000). Figure 1 shows the location of major industrial zones with their respective contributions to the emission.