



# 1 Sea-land breeze circulation and atmospheric pollution in Sfax (South-Eastern of Tunisia)

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Sfax is a coastal city located in south-eastern of Tunisia. This agglomeration is characterized by an important industrial activities and high urban density (600 000 habitants). The Mediterranean Sea has a significant impact on the weather and climate in this coastal plane. Sea breezes are known to be fairly frequents in the Mediterranean region (Colcino and Dell Oso, 1978; Dalu and Cima, 1983; Ramis and Romero, 1995). In sky clear days, contrast between sea and land diurnal surface temperature causes the breeze circulation. In this paper, thermal contrast is determined by simultaneous measures of air temperature over land and sea. Also, sea and land surface temperatures are estimated using NOAA-AVHRR data. During the day, land is hotter than sea; the mean difference between the two is about 4°C. In the night, this difference is in favor of sea but it's below 2°C. This fact explains why sea breeze (mean around 4m/s) is more speed than land breeze (1.5m/s).

Sea-land breeze climatologically studies, such us the present one, aim at determining one or more characteristics of this phenomenon (direction, speed, frequency of occurrence, duration, time of onset, cessation and daily evolution). This study is based on the analysis of a 33-years (1970-2002) archive of hourly continuous wind direction and speed records at Sfax. The method based on six filters used by Borne *et al.* (1998) was used to separate sea-land breeze days from non-sea-land breeze days. Sea breezes are most frequents in the summer months (May-September) when they appear on more then tow-third of days. The duration of sea breeze is the longest in hot season (11 hours in summer). Sea breeze hodographs show clockwise rotation with time,

but sometimes synoptic wind modifies its development. The impact of land-sea breeze on temperature and humidity are studied by meteorological observations, which were carried out during two years (2002 and 2004) near the shore with an automatic weather station (Davis). The sensors were fixed at a height of 10 m above a sea surface and 1 km from the coast.

When the sea breeze appears, the people living near the coast welcome its refreshing effects; however it may have damaging effects on the distribution of pollutants. Industrial factories within the urban area of Sfax are a considerable source of atmospheric pollution. The cluster of hourly record of air quality and meteorological parameters by the National Agency of Environment Protection shows that sea-land breeze and winter anticyclones situations are the most favorable to high concentration of pollutants. At Sfax, sea breeze diffuse air pollution from the two coastal industrial zones to some crowded quarters. The really serious problems of pollution happen just before the sea-breeze onset (6-8h) and after the sea-breeze cessation (19 to 21h). In these two periods, breeze speed is less than 2m/s and boundary layer level is reduced : quarters of "Sfax el Garbia" and "Badrani" are the most concerned. Other problems of pollution carried by the coastal breeze are related to land and sea breeze reversal. This gives a mechanism for a complete layer of polluted air to be maintained at high concentration and returned to the same locality 24 hours later. So, the maximum of pollutions are recorded in the end of a long sequence of sea-land breeze which are very frequent in the summer.