

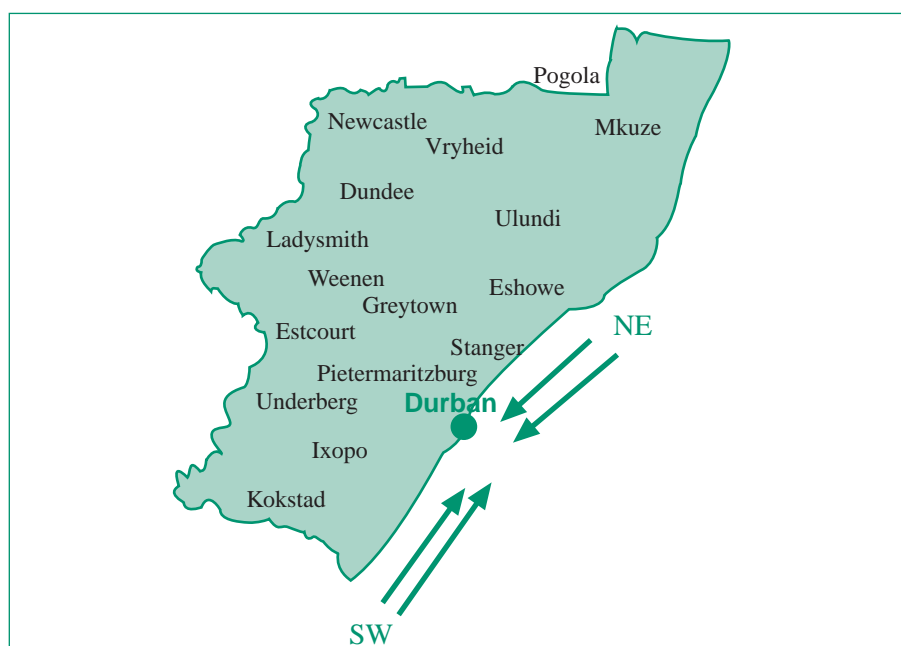
## CHAPTER FOUR

### FACTORS AFFECTING AIR POLLUTION IN SOUTH DURBAN

#### 4.1 Winds, Local Winds and Pollution

How would the existence of a North-Easterly, Westerly wind or its absence affect pollutants emitted into the atmosphere by industries? What effect do mountain, valley and plain winds or land and sea breezes or their absence have on existing air pollutants?

North-easterly winds are strongest in summer, the season in which their cooling effect is most welcomed. Northeast and Southwest are regarded as being the most frequent wind directions. May, June and July are the calmer months and August is the beginning of the windy season.



**Figure 4.1:** Dominant wind direction in Durban

The prevailing wind directions, which blow approximately parallel to the coastline and occur with almost equal frequency, are North-Northeast, Northeast, South-Southwest and Southwest. With a high located off the coast of Natal, winds blow northeast.

This assertion is confirmed by records from ambient air quality monitoring stations in the South Durban basin also obtainable from Engen, Sapref and SDCEA. Table 4.1 below showing the average wind direction from 1998 – 2003 was extracted from the above sources.

Table 4.1: Prevalent wind direction in the South Durban basin from 1998-2003  
(Source: SDCEA-GIS database)

WIND DIRECTION	OCCURRENCES
N	663
NNE	453
NE	131
ENE	48
E	35
ESE	38
SE	36
SSE	174
S	251
SSW	260
SW	234
WSW	192
W	27
WNW	38
NW	11
NNW	109

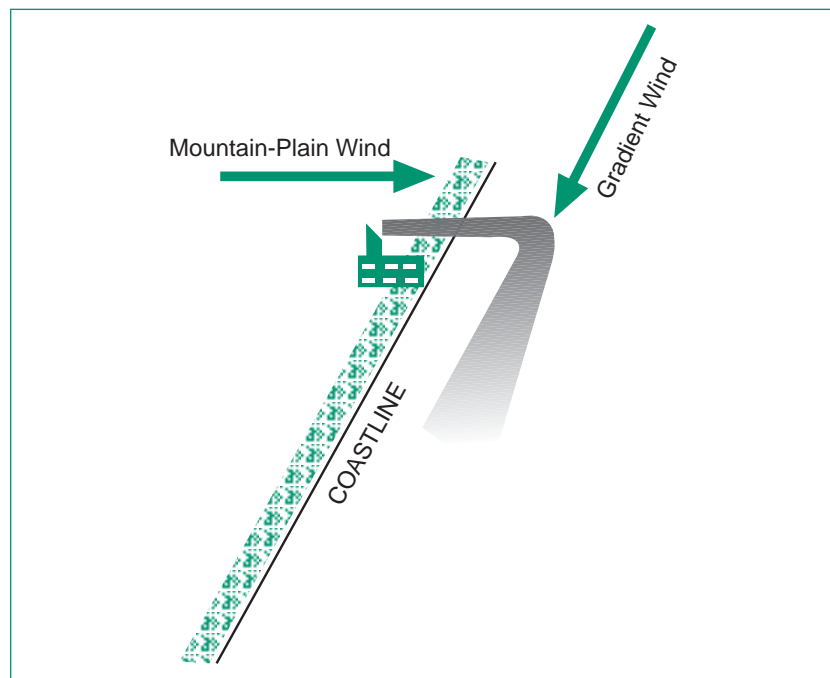


Figure 4.2: Effect of NE winds on pollution (Source: Preston-Whyte, 1980)

Figure 4.2 illustrates a pollution plume blown into the Indian Ocean by mountain-plain wind and re-diverted southward along the coastline by a NNE-NE gradient wind.

## 4.2 The Effect of Topography

The South Durban basin lies between two ridges, the Bluff to the seaward east and the Berea ridge inland. The Berea ridge descends to the basin through a number of valleys, including the Umhlatuzana to the south, the Umbilo in the middle and the Umgeni to the north. Together with the ridges, they play a significant role in controlling local wind flows, with the valleys acting as wind channels into and out of the basin.

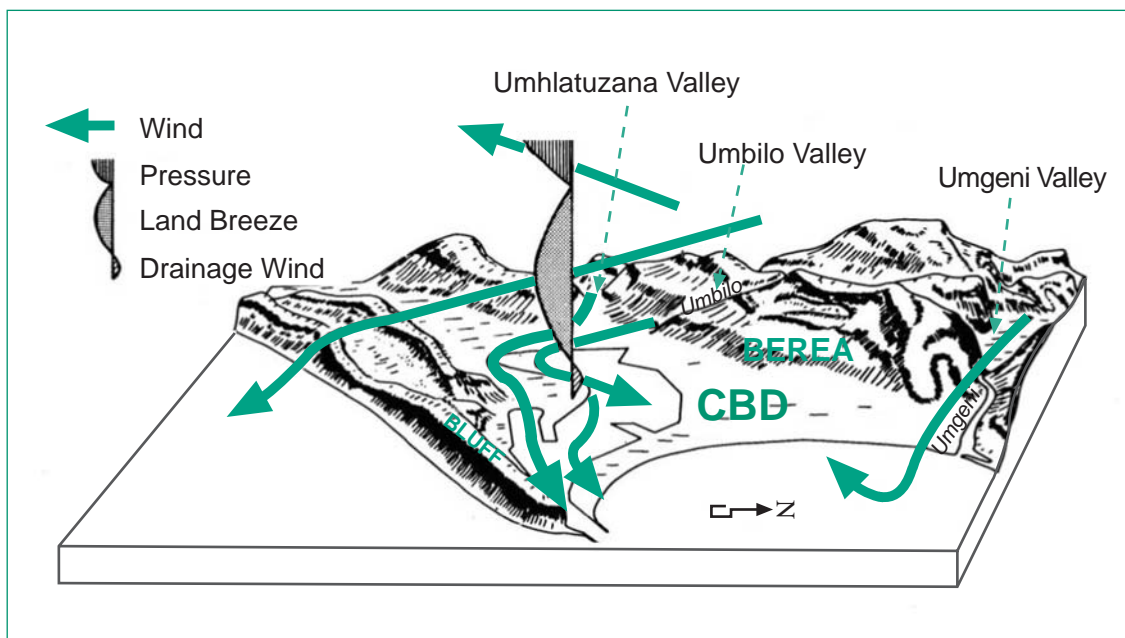


Figure 4.3: The Topography of the South Durban basin (Modified from: Preston-Whyte, 1968)

On a very local scale, during calm and clear winter nights, the ridges radiates or emits heat faster and thus gets colder faster than the valleys. This leads to high pressure developing on the ridge tops. As a general rule, air flows from regions of high pressure to regions of low pressure. Because of low pressure in the valleys cool air drains down the slope through the Umhlatuzana and Umbilo river valleys into the South Durban basin (see Figure 4.3 above). The Bluff ridge acts like a barrier damming the cold air from the mountains and obstructing its effective transportation of pollutants into the Indian Ocean, hence the concentration of air pollutants in South Durban corridor (Preston-Whyte, 1968a). However, when re-enforced by land breezes, they eventually blow pollutants into the sea especially in summer. During the day when the elevations are warmer, air flows from the sea as sea breezes upslope. However, most pollution in South Durban occurs at night, so that daytime sea breezes have little effect on the transport of pollutants. Land and sea breezes are discussed in detail in the sections below.

## 4.3 Land Breezes

Preston-Whyte, (1980) defines land breeze as a cool nocturnal wind that blows in the night in an offshore direction (that is towards the sea), with a speed not exceeding 4.5m/sec. The land

breeze starts when the land surface cools below that of the sea surface leading to high pressure on land and low pressure on sea. Air then flows from land to sea as land breeze. Tyson and Preston-Whyte, (1974) indicated that the average land breeze duration over Durban is 13 hours in summer and 16 hours in winter. It usually starts at 21h00 and prevail up to 07h00. It is now generally accepted that land breezes are re-enforced by mountain-plain winds. The effectiveness of these winds in dispersing air pollutants depends on their speed. The higher the speed, the more effective its ability to disperse air pollutants. If land breezes speeds do not exceed 4.5m/sec as indicated above then their role in blowing air pollution away from the basin is very limited. This could be true because for dispersion to take place, Holzeworth (1972) suggests that the wind speed should be above 6m/sec. However, since mountain-plain winds occur when atmospheric conditions in the basin are calm and stable, they blow pollution plumes seawards.

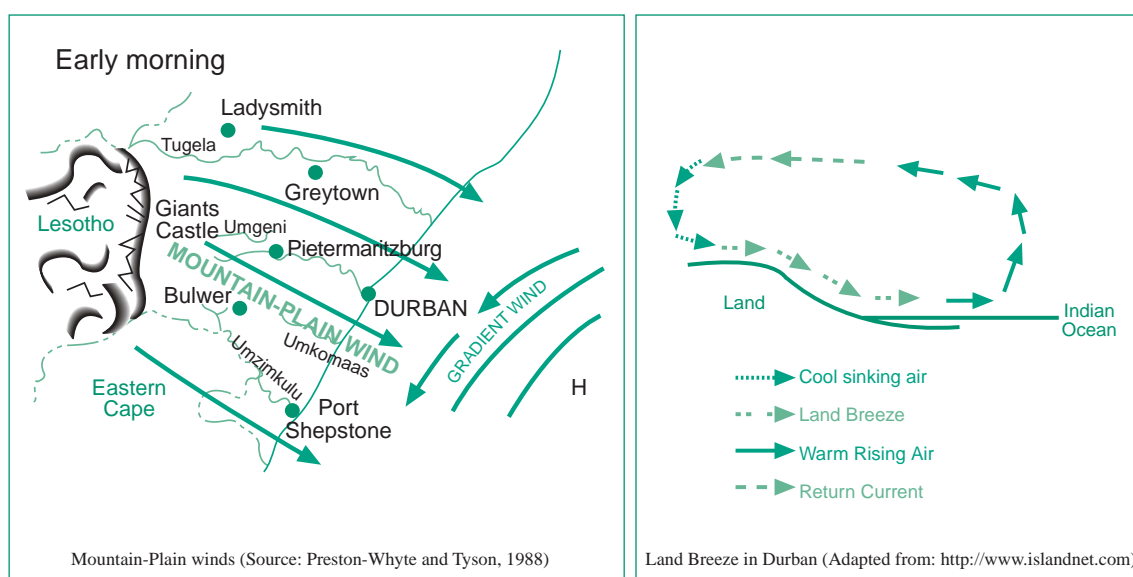


Figure 4.4: Land breezes (Source: Preston-Whyte and Tyson, 1988)

#### 4.4 Sea Breezes

Sea breezes are winds blowing from sea to land. They occur during the day for about 11 hours beginning at 9h00 and prevailing to 20h00 during summer. It is at a maximum in the afternoons when land temperature is highest resulting in strongest wind flow from the sea to the land as indicated by the figures in the table below. Sea breeze studies in Durban were conducted by Preston-Whyte in 1968 and the following details were recorded.

Table 4.2: Mean hourly wind velocity recorded at Durban in February 1968  
(Source: Preston-Whyte, 1968b)

Time (hrs)	8	9	10	11	12	13	14	15	16	17	18
Velocity(m/s)	2.7	3.3	3.9	4.5	4.9	5.1	5.3	5.2	5	4.7	4.5

Sea breezes are influenced by gradient winds, which divert the sea breezes to follow their north-easterly path blowing pollutants onto land towards the Umbogintwini and Amanzimtoti areas. The 20 complaints recorded in these areas from 1998-2002 (SDCEA, 2002) may have been as a consequence of sea breeze-transported pollutants.

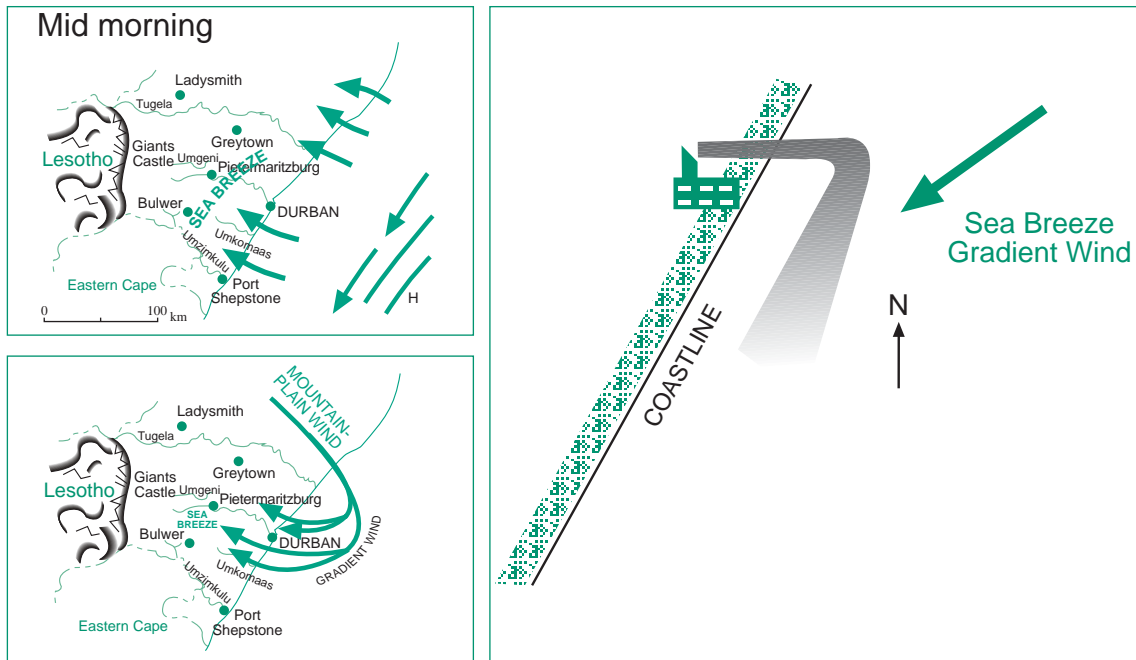


Figure 4.5: Sea breezes (Source: Modified from Preston-Whyte and Tyson, 1988 & Preston-Whyte, 1980)

### Exercises

The topographical map provided shows the location of two major refineries in South Durban.

- Draw the following 2 cross sections marked by lines AA and BB.
- Identify the roads, industries, communities and rivers along the cross sections.
- Comment on the location of industries.
- The frequent wind directions recorded by ambient air monitoring stations in the basin is NNW/SSW. Which communities are likely to be most affected by air pollutants?
- Name two major refineries located on the NNW/SSW wind path located close to the Indian Ocean.
- What is the name of the steep ridge adjacent to the Indian Ocean?
- What is the effect of this ridge on land and sea breezes?
- When do land breezes blow in Durban?
- When do sea breezes blow in Durban?
- Write short notes on the microclimate generated by the topography presented in south Durban.
- The figure below shows the diversion of a plume over the Indian Ocean back to land further from its source. Which two winds are responsible for this?



- Which communities are likely to be affected on the far side of South Durban if this diverted polluted air mass was to settle on land?
- What can we learn from this transportation about the effect of air pollution?

