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DOCUMENT TITLE
METEOROLOGY FOR AUSTRALIA

CHAPTER 10 – LOCAL WINDS

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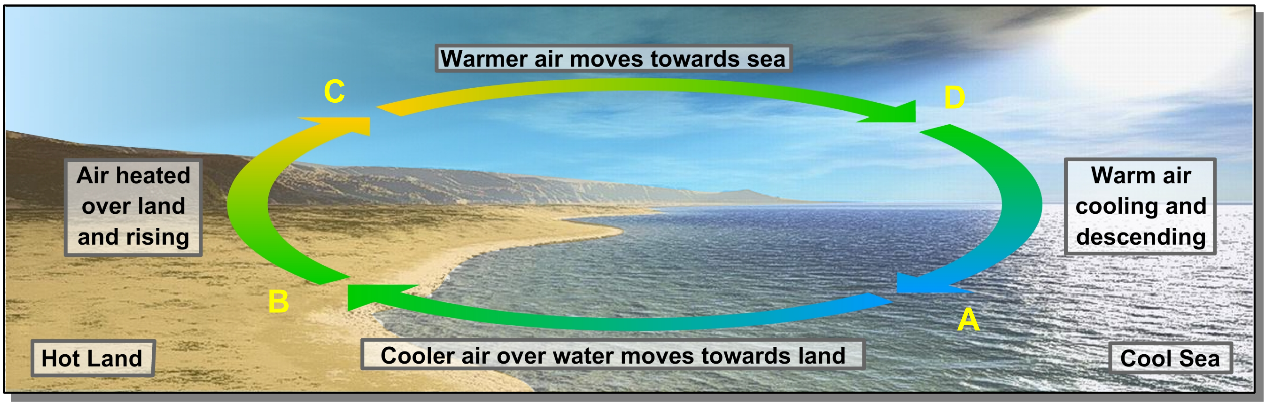
LOCAL WINDS

SEA BREEZES

Sea breezes show how winds are produced as a result of uneven heating of the Earth's surface. Consider two equal columns of air, one above land and one above the sea. For reasons discussed in Chapter 3, the land will heat up more readily than the sea. In the diagram below it can be seen that this warmer air will rise, causing both a reduction in pressure at B, and an increase in pressure at C. Conversely, the column of air over the sea will be cooler, causing a gentle subsidence. This will have the effect of increasing the pressure at A, and reducing the pressure at D. Now we have a closed circuit where air will move from B to C (convection), from C to D (higher to lower pressure and usually at about 500 ft.), from D to A (subsidence) and finally from A to B (higher to lower pressure). The movement of air from A to B is, of course, the **sea breeze**.



Sea breezes:

- Are common on most summer afternoons
- Blow up to 30 miles inland
- Blow at right angles to the coast <u>initially</u>
- Occur up to 500 - 1000 ft altitude
- Blow up to 20 kts.

The story doesn't end there though, as sea breezes, like any other wind, are subject to Coriolis force. As the wind strength increases throughout the afternoon, then the wind direction will change so that the land is on the left in the Northern Hemisphere, and on the **right** in the **Southern Hemisphere**.

Although it is not within the syllabus, a sea breeze and the prevailing (overland) wind may possibly be convergent, causing the air to meet and rise. This convergence and any associated weather, is known as a "sea breeze front ".

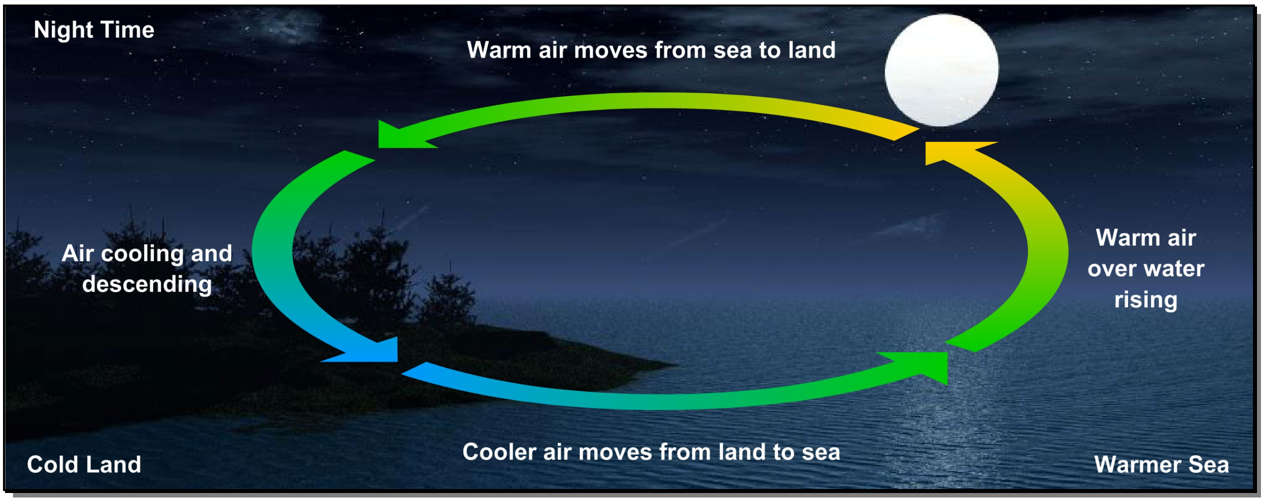
As mentioned before, sea breezes are common occurrences. This is well illustrated in the diagram below.

Place	Distance Inland: km	Percentage of days when a seabreeze occured											
		J	F	M	A	M	J	J	A	S	O	N	D
Mascot	7	60	60	60	59	27	19	37	37	37	47	57	57
Bankstown	20	54	48	48	50	26	11	24	24	28	34	41	47
Richmond	60	43	51	47	39	8	1	6	6	9	19	26	31

Frequency of Sea Breezes in the Sydney Region (month and distance inland)

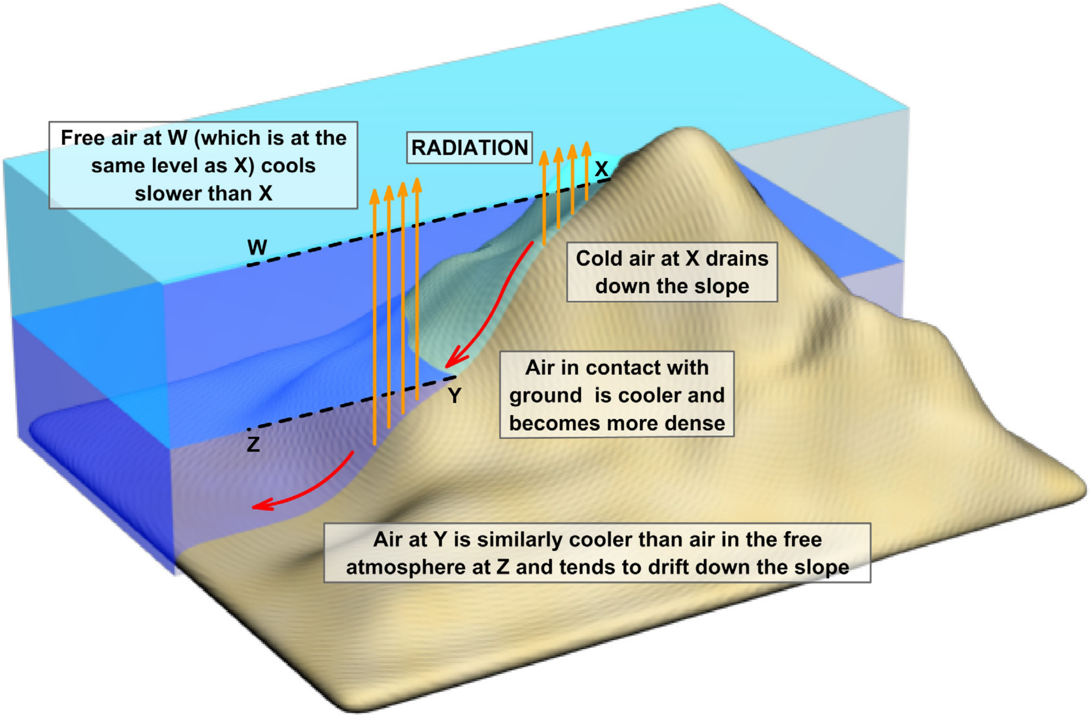
LAND BREEZE

At night, the land cools faster than the sea. The air in contact with the land cools whilst the air over the sea is warmer. The air over the sea therefore rises and the reverse of the sea breeze process takes place with air moving from the land to the sea. These are only gentle breezes starting during the evening and becoming strongest at dawn due to the greater temperature difference between the land and the sea. They rarely exceed 10 kts or 500 ft in height, and blow up to 10 miles either side of the coast.

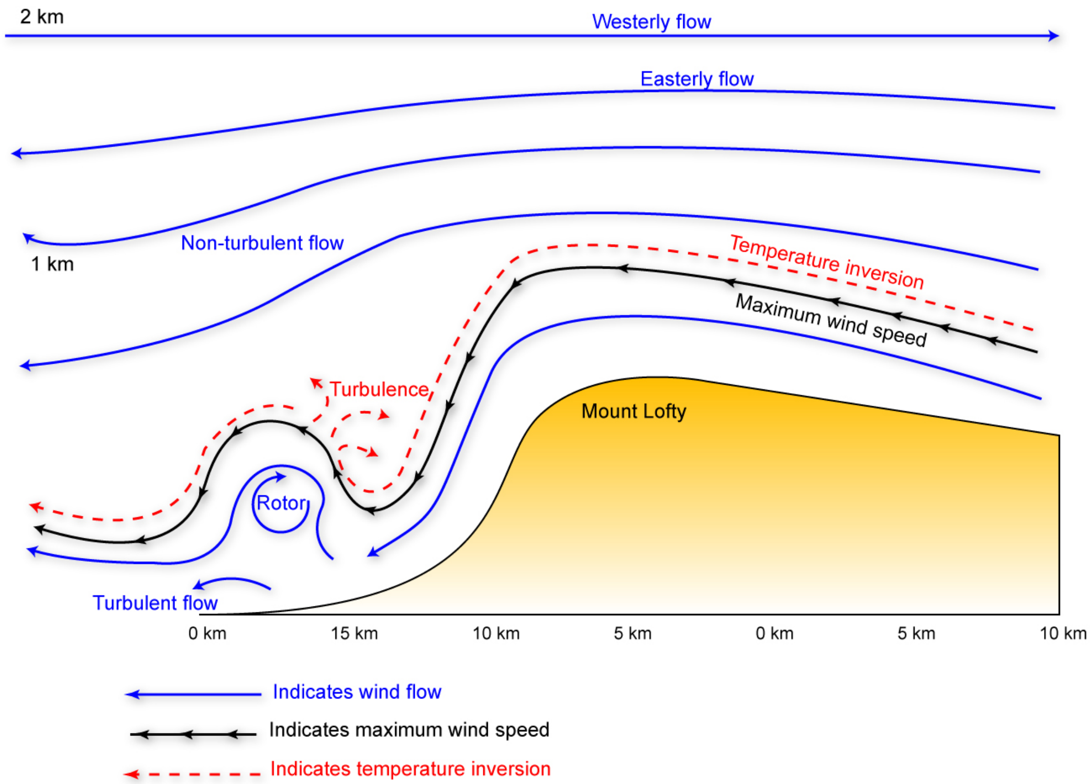


KATABATIC WIND

On clear nights, the tops and slopes of the hills cool and the air in contact with the surface also cools (conduction). This dense, cold air “falls” down the hillside and can be quite a strong wind. Often stratus clouds form on the slopes if the air temperature falls below dew point and fog may form at the base of the hills or in the valleys.



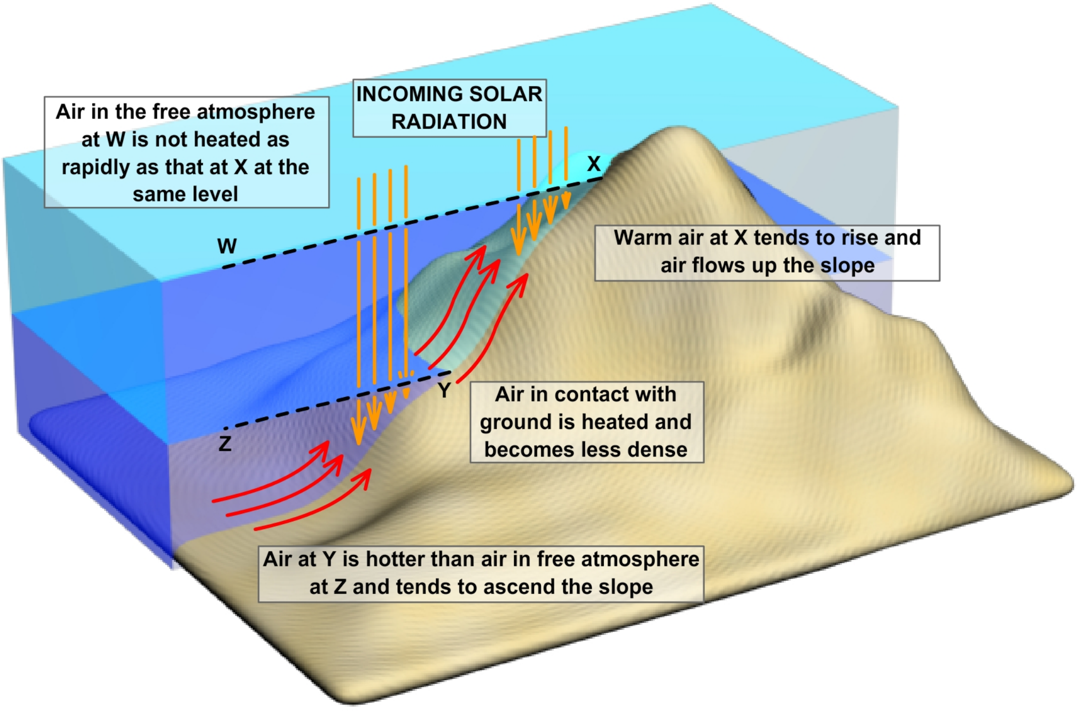
In the Adelaide area katabatic winds (or more correctly, 'Downslope Winds') are known as gully winds, and are common around the base of the Adelaide Hill region.



A Schematic Representation of the Adelaide Gully Wind

ANABATIC WIND

During the day, the land warms and heats the air in contact with it. This hotter air rises and flows up the hillside producing a warm, gentle up-slope breeze on a summer's afternoon.

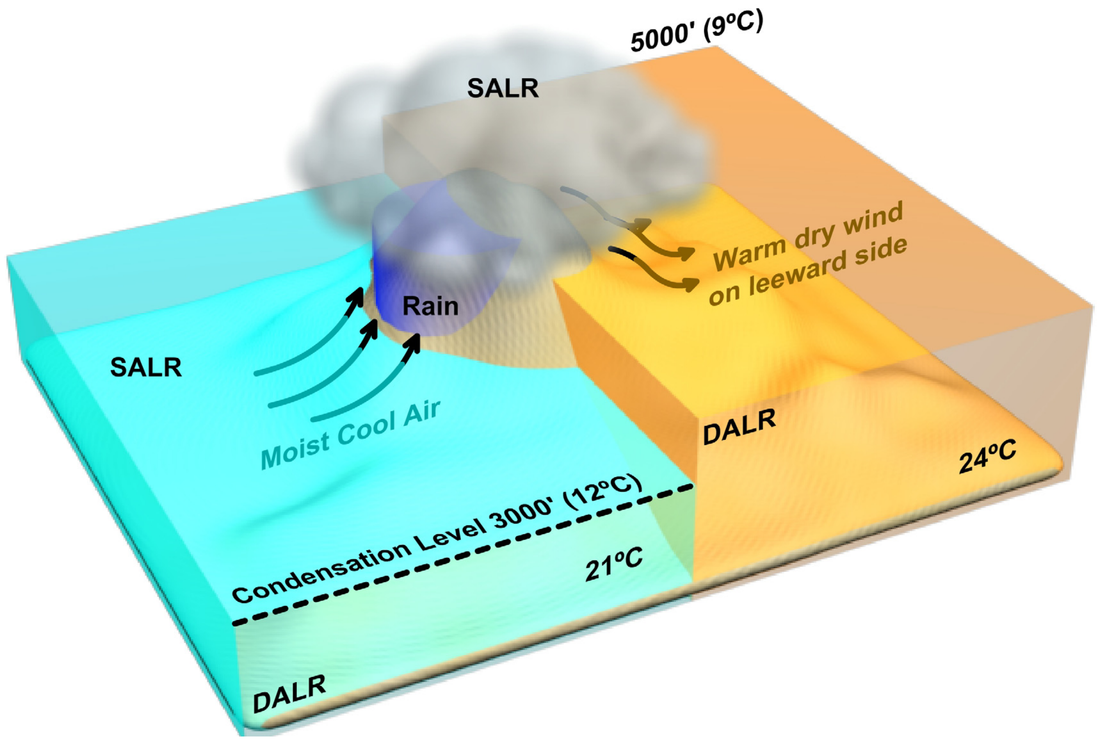


FOHN WIND

A Fohn wind is the warm, dry wind blowing down the leeward side of a mountain range. Air blowing up a mountain rises and cools at the DALR until condensation occurs and then it cools at the SALR.

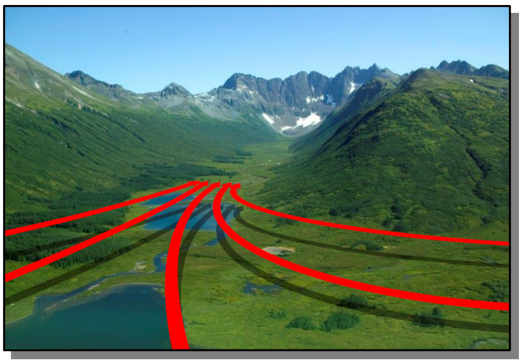
After losing much of its moisture on the windward slopes due to rain, the air begins to descend on the leeward side. The descending air warms at the SALR but it is now drier and so has a lower dew point and higher Condensation Level. Evaporation will be complete at a higher altitude, allowing the descending air to now heat up at the DALR, with the end result that the air is warmer and drier on the leeward side of the high ground.

Fohn is the name given to this wind in central Europe. In the USA it is called the Chinook in the Rockies and the Santa Ana in California; the Berg in South Africa, and the Bohorok in Indonesia.

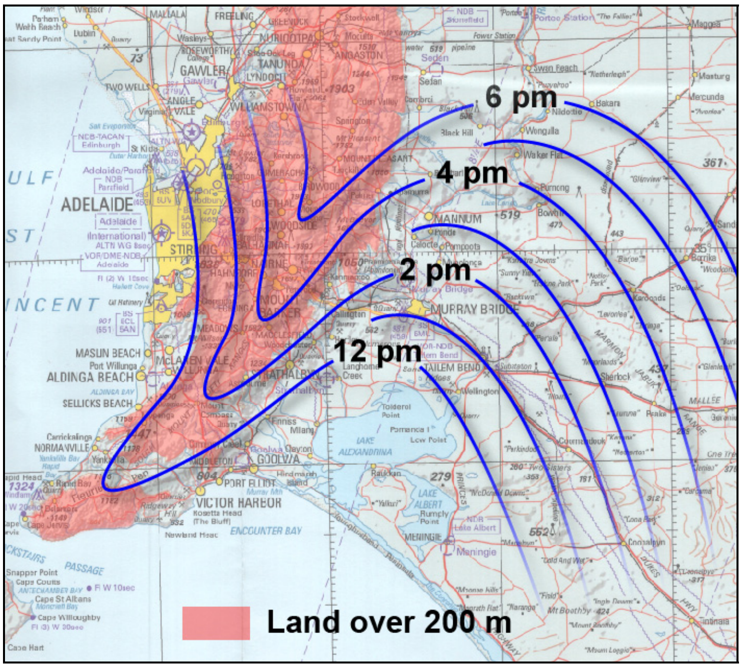


VALLEY (RAVINE) AND FUNNEL WINDS

Wind blowing against a mountain range tends to flow round the edges if possible rather than over, particularly if the lapse rate is stable. Where there is a route through the mountains, the wind will tend to follow the valley, even thought the valley may be lying at an angle to the required direction of circulation as given by the isobars.



Where the valley is narrow or converges, the wind will accelerate (think of a venturi and the principles of flight). This is known as the 'funnel effect'. The direction of the wind in narrow valleys need bear very little resemblance to the general wind direction, and in many cases the wind in the valley can change direction by 180° as a result of a change of only 20° - 30° in the general wind direction. The"Mistral" of the Rhone Valley in France is a good example of a valley wind.



The movement of a sea breeze front near Adelaide, showing the time of day in hours