2.6 Wind measurement

Fact sheet objectives

- To describe wind flow in the on-farm environment
- To discuss measurement of wind speed and direction
- To discuss applications of wind data

A cup anemometer used for measuring wind speed

A windvane used for measuring wind direction

A sonic anemometer used by researchers to measure wind speed in three dimensions

Why record wind?

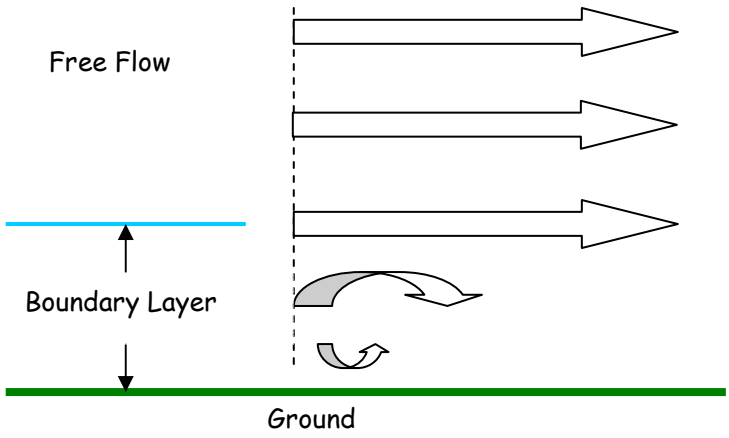
- As an aid to managing spray application.
- To document compliance with local authority requirements.
- As an input to some evapotranspiration models used in irrigation scheduling.
- To assess the adequacy of shelter.

Air Flow near the Ground

Air flowing over the earth's surface encounters friction from uneven ground, trees and buildings, which slows it down.

The interaction of the wind with obstacles means wind speed and direction can vary considerably from place to place over short distances.

The depth of the surface boundary layer can vary from a few metres during the nighttime up to 100's of metres during the middle of the day.



From NASA / Glenn Research Centre

Wind Measurement

Wind **velocity** is a vector quantity, with two components: **speed,** and the **direction** the wind is coming from. The two components are generally measured separately using a cup anemometer and a wind vane respectively.

For meteorological purposes wind sensors are mounted on a mast clear of immediate obstacles. Standard mast heights are 10m and

6m, and there are rules about the distance the mast should be from obstructions.

Diurnal windspeeds on a sheltered site usually follow the radiation with the strongest winds around the middle of the day and in the afternoon, and little wind at night. Typical windspeeds in a sheltered orchard are 0.5-1 m/s.

The **Beaufort Wind Scale (below)** is an older indication of "wind force" where speed is estimated from the effects of the wind. It assumes the availability of a simple wind vane. The first column is the Beaufort Number.

			M/s	Kts
0	Calm	Calm; smoke rises vertically	<0.5	<1
1	Light Air	Direction denoted by smoke drift, but not by wind vane	0.5-1.5	1-3
2	Slight breeze	Wind felt on face; vane moved by wind	2.0-3.0	4-6
3	Gentle breeze	Leaves and twigs in constant motion, wind extends light flag	3.6-5.1	7-10
4	Moderate breeze	Raises dust and loose paper; small branches moved	5.6-8.2	11-16
5	Fresh breeze	Small trees in leaf begin to sway; wavelets form on inland waters	8.7-10.8	17-21
6	Strong breeze	Large branches in motion; whistling heard in overhead wires; umbrellas used with difficulty	11-14	22-27
7	Near Gale	Whole trees in motion; inconvenience felt when walking against wind	14-17	28-33
8	Gale	Breaks twigs off trees; generally impedes progress	17-21	34-40
9	Strong gale	Slight structural damage (Chimney pots and slates removed)	21-24	41-47
10	Storm	Seldom experienced inland; trees uprooted; considerable structural damage occurs	25-28	48-55

Conversion Factors

In additional to standard measurements of speed such as Km/h and m/s, wind speed is sometimes measured in knots as in the Beaufort scale.

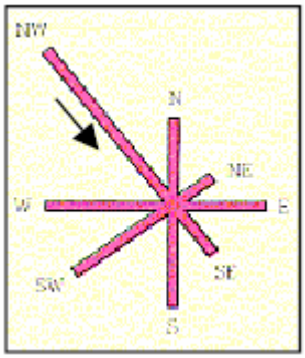
1 knot (Kt)	=	0.514 m/s
	=	1.85 Km/h
1 m/s	=	1.94 Kt
	=	3.6 Km/h
1 Km/h	=	0.28 m/s
	=	0.54 Kt

A relatively low cost desk top weather station showing wind speed and direction information.

Davis

http://www.weatherstations.co.uk/vp_display.htm

The Wind Rose is a way of summarising a long period of wind recording, by showing the distribution of wind speeds and the frequency of the varying wind directions. In the example shown, the prevailing wind is from the south west.



Wind Run over a period of time is calculated as mean wind speed x time, in units of distance. For example wind of 1 m/s blowing for an hour (=60 x 60 seconds) produces a wind run of 1 x 3600 m or 3.6Km.

Wind Zones The likelihood of strong winds affecting an area is presented in the building code Wind Zone data.

This map is from the Gib website:
http://www.gib.co.nz/literature/attachments/Bracing_Mar2002.pdf

Points	Wind Zone	
0	Low	(L)
1	Medium	(M)
2	High	(H)
3	Very High	(VH)
4 or more	Specific Design	(SD)

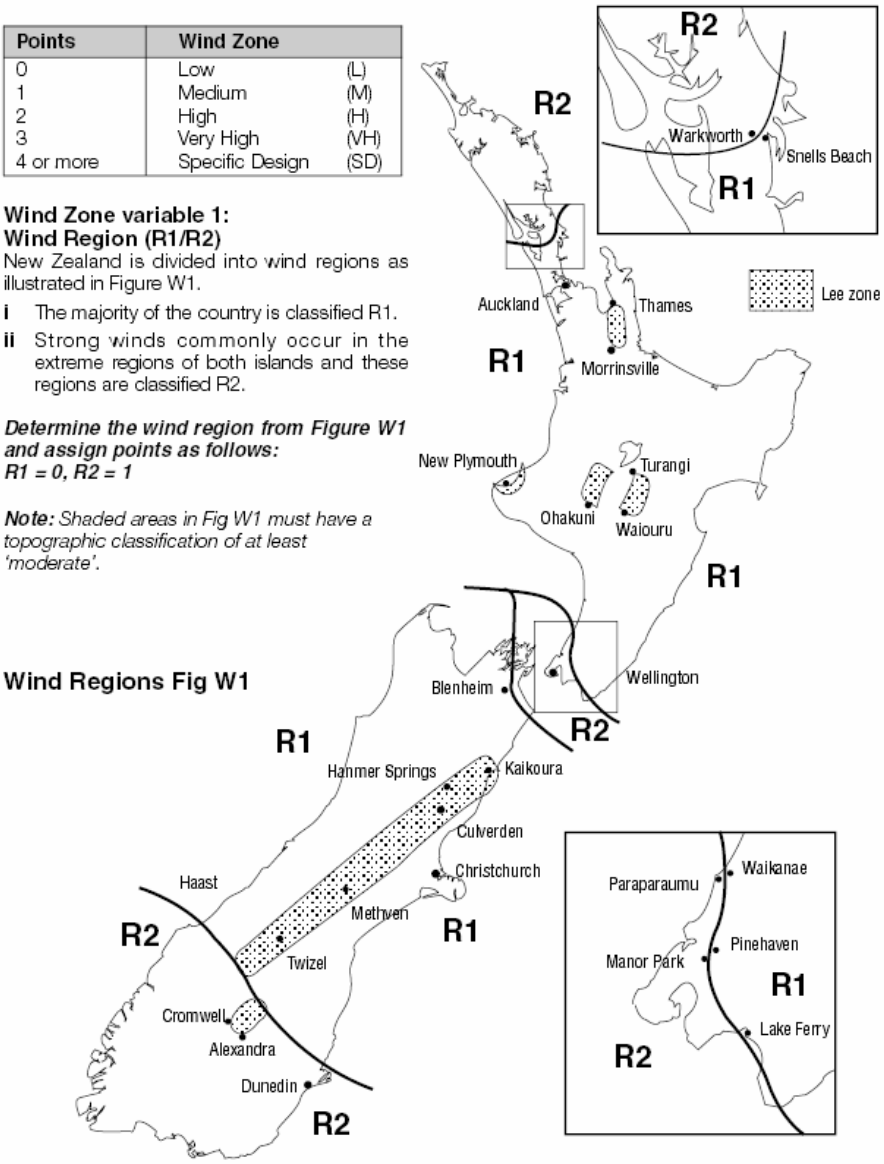
Wind Zone variable 1:
Wind Region (R1/R2)
New Zealand is divided into wind regions as illustrated in Figure W1.

i The majority of the country is classified R1.

ii Strong winds commonly occur in the extreme regions of both islands and these regions are classified R2.

Determine the wind region from Figure W1 and assign points as follows:
R1 = 0, R2 = 1

Note: *Shaded areas in Fig W1 must have a topographic classification of at least 'moderate'.*



Wind Regions Fig W1

Summary Information

Wind is an important factor in determining the risk to crops of physical damage, in estimating water use and the ability to apply sprays.
The key measurements are speed and direction, both of which can change over time and height above ground. A number of different scales can be used to describe wind.
A wind rose shows the amount of wind blowing from each direction over a certain time period. This knowledge can help determine best locations for shelter belts.

Useful Websites

WeatherBase: Records and averages for New Zealand
http://www.weatherbase.com/weather/city.php3?c=NZ&refer=

Met Service: Climate of New Zealand.
http://www.metservice.co.nz/learning/weather_climate_of_nz.asp

NIWA Educational Resources
http://www.niwa.co.nz/edu/resources/climate/

Further reading and other sources of information