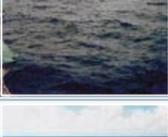
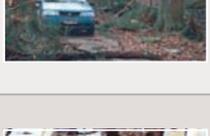
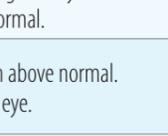
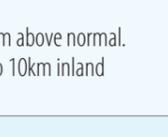
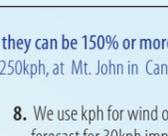


MEASURING THE WIND

WMO ¹ Saffir-Simpson ² Classification	Flags ¹⁰	Appearance of Wind Effects			Fujita Scale ⁴	Beaufort Force ⁵	Wind Speed ⁶		Pressure ⁹ kgf/m ²			
		On Water ³	On a tree	On Land			knots ⁷	kph ⁸				
Calm		Sea surface smooth and mirror-like. Sea calm and glassy.		Still			0	<1	<1			
Light Air		Scaly, no foam crests. Sea calm and rippled.		Still			1	1 - 3	1 - 6			
Light Breeze	None	Small wavelets, crests glassy, no breaking. Sea smooth.		Leaves rustle			2	4 - 6	7 - 11	1		
Gentle Breeze		Large wavelets, crests begin to break, scattered whitecaps. Sea smooth.		Leaves and small twigs move			3	7 - 10	12 - 19	2		
Moderate Breeze		Slight. Small waves about 1m, becoming longer, numerous whitecaps.		Small branches move			4	11 - 16	20 - 30	3 - 4		
Fresh Breeze		Moderate. Waves up to 2.5m taking longer form, many whitecaps, some spray.		Small trees in leaf begin to sway			5	17 - 21	31 - 39	5 - 7		
Strong Breeze		Rough. Larger waves 3 to 4m, whitecaps common, more spray.		Larger branches shake			6	22 - 27	40 - 50	8 - 12		
Near Gale		Very rough. Sea heaps up, 4-6m waves, white foam streaks off breakers.		Whole trees move			7	28 - 33	51 - 61	13 - 18		
Gale		Moderately high 5-7m waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks.		Whole trees shake, twigs break			8	34 - 40	62 - 74	19 - 27		
Strong Gale		High waves 7-9m, sea begins to roll, dense streaks of foam, spray may reduce visibility.		Branches start to break			9	41 - 47	75 - 87	28 - 37		
Storm		Very high waves 9-12m with long overhanging crests, sea white with densely blown foam, heavy shock-like rolling, lowered visibility.		Pushes over shallow-rooted trees, big branches break powerlines		Light damage: Some damage to chimneys; twisting damage to signs TV aerials + billboards; light-weight awnings and canopies damaged. Boats break free from moorings. Weak roofing lifts, windows may blow out, aircraft grounded	F0	10	48 - 55	88 - 102	38 - 51	
Violent Storm		Exceptionally high 12-14m waves, foam patches cover sea, visibility more reduced.		Broken branches big enough to cause structural damage		<i>Damage photos from: www.stormfax.com/fujita.htm</i>		11	56 - 63	103 - 117	52 - 67	
Category One Hurricane		Phenomenal. Waves over 14m, Air filled with foam and spray, sea completely white with driving spray, visibility seriously reduced, some minor pier damage. Storm surge generally 1-2m above normal.		Some mature trees uprooted. Can knock people over, 142kph has sideways push of 100kg/m ²		Moderate damage: House roofs lift, snaps power lines, home chimneys and garages may collapse; camper vans and billboards flipped, moving cars pushed off road; windows broken by flying debris.	F1	12	64 - 82	118 - 153	68 - 115	
Category Two Hurricane		Same as above, visibility severely reduced, small craft in unprotected anchorages break moorings. Coastal flooding near eye. Storm surge generally 2-3m above normal.		Defoliation of trees					83 - 95	154 - 177	116 - 154	
Category Three Hurricane		Same as above and storm surge generally 3-4m above normal. Coastal flooding 3-5 hours ahead of eye.		Trees & power poles snap		Considerable damage: Roofs peel off frame houses; mobile homes/camper vans tumble; boxcars pushed over; light-object missiles. Small cars roll in the wind. House cladding stripped.	F2	13	96 - 113	178 - 209	155 - 215	
Category Four Hurricane		Same as above and storm surge generally 4 to 6m above normal. Terrain to 3m above mean sea level flooded to 10km inland		Coconut trees stripped					114 - 135	210 - 249	216 - 305	
Category Five Hurricane		Same as above and storm surge generally greater than 6m above normal. Terrain to 3m above mean sea level flooded to 15km inland		Most trees in forest levelled		Severe damage: Roofs and some walls torn off well-constructed houses; internal walls fail; trains overturned; heavy cars lifted off the ground and thrown.	F3	14	136 - 179	250 - 332	306 - 542	
Notes						Devastating damage: Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.		F4	15	180 - 226	333 - 418	543 - 863
						Incredible damage: Strong frame houses lifted off foundations, carried considerable distances, and disintegrated; automobile-sized missiles fly through the air in excess of 160 kph for 100m or more; trees debarked; incredible phenomena will occur.		F5	16	227 - 276	419 - 512	864 - 1284

Usually gusts do the damage, and they can be 150% or more of the average wind. Strongest gust officially measured in NZ: 250kph, at Mt. John in Canterbury on 18 July 1970.

- MetService uses WMO (World Meteorological Organization) standards for wind reporting. Anemometers measure a ten-minute average at a height 10m above ground level in an open space. Forecasts give an average over the area for the duration of the forecast.
- Saffir-Simpson Hurricane Intensity scale (1969, Herbert Saffir + Dr. Bob Simpson) for tropical cyclones, technically uses US 1-minute average winds.
- This table just gives wind-waves in open water. Photos are from <http://www.crh.noaa.gov/lot/webpage/beaufort/>

4. Fujita Scale (Dr. Ted Fujita 1971) classifies tornadoes according to their damage. Damage photos from <http://www.stormfax.com/fujita.htm>.
5. Beaufort scale (1805, Sir Francis Beaufort, England) is based on observed impact of wind on sea and land.
6. Figures given here are approximate and have not been actually verified.
7. MetService Wind forecasts for marine areas give a direction the wind is from to the nearest octant and speed in knots to nearest 5.
8. We use kph for wind on land. So a land forecast for 30kph implies 45kph offshore, mentioned in a coastal forecast as 25 knots.
9. Doubling the wind speed increases its push (wind-force or dynamic pressure) four-fold. And wind power rises with the cube of the speed.
10. The (old) United States National Weather Service's Coastal warning flag system is used on the warning map on the website www.metservice.com