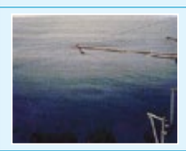
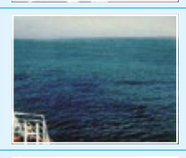
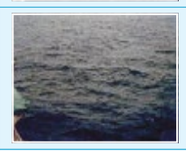
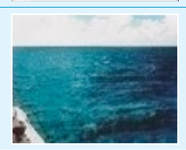
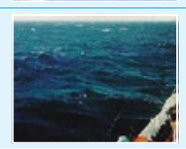
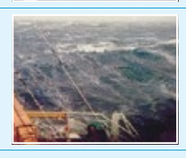
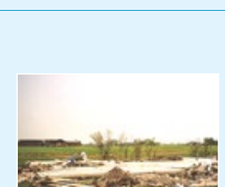
MEASURING THE WIND

MetService

WMO(1), Tropical(2) Classification	Appearance of Wind Effects					Tornado (4)	Beaufort Force (5)(6)	Wind Speed		Flags (10)
	On Water(3)		On a tree	On Land				knots (7)	kph (8)	
Calm	Sea surface smooth and mirror-like. Sea calm and glassy.		Still.	Calm, smoke rises vertically.			0	< 1	< 1	None
Light Air	Scaly, no foam crests. Sea calm and rippled.		Still.	Smoke drifts, wind vanes are still.			1	1-3	2-6	
Light Breeze	Small wavelets, crests glassy, no breaking. Sea smooth.		Leaves rustle.	Wind felt on face, vanes begin to move.			2	4-6	7-11	
Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps. Sea smooth.		Leaves and small twigs move.	Flags flap.			3	7-10	12-19	
Moderate Breeze	Small waves about 1m, becoming longer, numerous whitecaps. Sea slight.		Small branches move.	Dust and loose paper lifted.			4	11 -16	20-30	
Fresh Breeze	Waves up to 2.5m taking longer form, many whitecaps, some spray. Sea moderate.		Small trees in leaf begin to sway	Flags fully extend.			5	17-21	31-39	
Strong Breeze	Larger waves 3 to 4m, whitecaps common, more spray present. Sea rough.		Larger branches shake.	Whistling in wires, umbrellas become difficult to use.			6	22-27	40-50	
Near Gale	Sea heaps up, 4-6m waves, white foam streaks off breakers. Sea rough.		Whole trees move.	Wind impedes walking.			7	28-33	51-61	
Gale / Tropical Cyclone Category One	Moderately high 5-7m waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks. Sea very rough.		Whole trees shake, twigs and leaves break.	Wind blown dust and dirt.			8	34-40	62-74	
Strong Gale / Tropical Cyclone Category One	High waves 7-9m, sea begins to roll, dense streaks of foam, spray may reduce visibility. Sea high.		Branches start to break.	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.			9	41-47	75-87	
Storm/ Tropical Cyclone Category Two	Very high waves 9-12m with long overhanging crests, sea white with densely blown foam, heavy shock-like rolling, lowered visibility. Sea high.		Pushes over shallow rooted trees, big branches break powerlines.				10	48-55	88-102	
Violent Storm / Tropical Cyclone Category Two	Exceptionally high 12-14m waves, wave tops blown into a froth, visibility more reduced. Sea very high.		Broken branches big enough to cause structural damage.			EF0	11	56-63	103-117	
Hurricane / Severe Tropical Cyclone Category Three	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. Sea phenominal.		Some mature trees uprooted.				12	64-72	119-135	
	Same as above, visibility severely reduced, small craft in unprotected anchorages break moorings. Coastal flooding near eye. Storm surge generally 2-3m above normal.		Defoilage of trees. Can knock people over,142kph has a sideway push of 100 kgf/m2	Moderate damage. House roofs lift, power lines snap, home chimneys and garages may collapse, camper vans and billboards flipped, moving cars pushed off road; windows broken by flying debris.		EF1	13*	73-85	135-158	
Severe Tropical Cyclone Category Four	Same as above and storm surge generally 3-4m above normal. Coastal flooding 3-5 hours ahead of eye.		Trees + power poles snap.				14*	86-89	159-165	
							15*	90-95	166-178	
								96-99	179-183	
							16*	100-106	185-196	
Severe Tropical Cyclone Category Five	Same as above and storm surge generally 4 to 6m above normal. Terrain to 3m above mean sea level flooded to 10km inland.		Most trees in forest leveled, coconut trees stripped bare, internal walls fail.	Considerable (or Significant) damage. Roofs peel off frame houses; camper vans tumble; Large Trucks pushed over. Small cars roll in the wind.		EF2	17*	107-119	197-218	
				Severe damage. Roofs and some outer-walls torn off well-constructed houses; trains overturned; heavy cars lifted off the ground and thrown.		EF3		120-143	219-266	
				Devastating damage. Well-constructed houses leveled; structure with weak foundation blown off some distance; cars thrown and large missiles generated.		EF4		144-174	267-322	
			Trees debarked.	Incredible damage. Strong frame houses lifted off foundations, carried considerable distances, and disintegrated, automobile-sized missiles fly through the air in excess of 100 mph for several hundred feet or more.		EF5		>174	>322	
						Notes	Speed of sound	661 at 15C	1226 at 15C	Mach One

Notes

Usually it is the GUSTS that do the damage, and the gusts can be 50% higher than the average wind.

1. WMO is the World Meteorological Organization and MetService uses WMO standards for wind reporting. MetService Wind recordings from anenometers and refer to a ten-minute average at a height 10m above ground level in an open space. MetService Wind forecasts refer to an average over the area for the duration of the forecast.

2. The tropical cyclone classification shown here is used in South Pacific and is DIFFERENT from the Saffir-Simpson Hurricane Intensity scale (1969, Herbert Saffir + Dr. Bob Simpson) used in Atlantic.

3. Wind on water makes waves, called wind waves or “sea”. The sea state is combined effect of sea and swell.

Underlined words give the Douglas Sea Scale as used in coastal forecasts. Photos from http://en.wikipedia.org/wiki/Beaufort_scale

Height in metres is significant height, from trough-bottom to crest-top, average of top third of the larger well-formed waves in a fully developed sea.

Individual waves with less fetch are smaller, FETCH (force extent and time of wind over the sea combine to build wave height).

The occasional wave, 1-in-66 is 50% higher and maximum wave, 1-in-1000 or more, twice (actually 1.8 times) the significant height.

Swell has a longer period than 7 seconds (less slope), low swell is 0-2m, moderate swell 2-4m and heavy swell over 4m.

4. Enhanced Fujita EF Scale is a set of wind estimates (NOT measurements) for classifying tornadoes based on damage.

Started Feb 2007, based on Fujita Scale (Dr. Ted Fujita 1971). Photos of damage come from http://www.spc.noaa.gov/faq/tornado/

5. Beaufort force scale (1805, Sir Francis Beaufort, England) relates to logged observations of wind impact on sea and land.

6. *The extended Beaufort Scale from 13 to 17 is only used in China and Taiwan.

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. This helps users to spot the difference between land and sea forecasts. Wind at sea can be 50% stronger than over built-up land. So a land forecast for 30kph implies winds of 45kph offshore, mentioned in a COASTAL forecast as 25 knots.

9. Did you know: doubling the wind speed increases its punch (wind-force or dynamic pressure) four-fold. Wind power and wind energy go up with the cube of wind speed.

10. The United Stated National Weather Service’s Coastal Warning Flag system has been offically retired, but is used on the metservice.com website warning map. The strongest gust officially measured in New Zealand : 250kph, at Mt. John in Canterbury on 18 July 1970. During the “Wahine” storm in Wellington on 10 April 1968 gusts to 236kph were measured at Hawkins Hill (higher gusts taken at Oteranga Bay have since been discounted).

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