

Predicting Storms 101

Predict a storm long before it is even visible to radar or satellite

The Lightning Threshold

Lightning occurs when the thunderstorm inflow rises through the cumulus cloud as an updraft that exceeds the **Lightning Threshold** speed of 7 m/s or 25 km/h. The updraft carries water droplets above the deep convective freezing level with some forming ice crystals or larger super cooled ice crystals joined together. They fall at different speeds producing lightning. The threshold cumulus updraft speed for the occurrence of lightning is 7 m/s or 25 km/h (Del Genio, 2007). This threshold is identical to that given for a storm with lightning by the Law of Storms (Ellis, 2014).

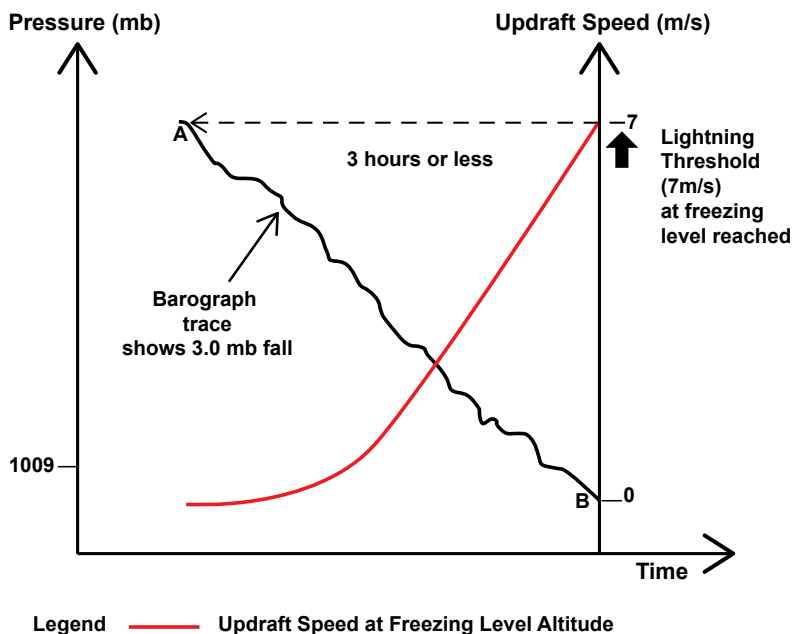


Figure 1. Lightning Threshold is reached when The Thunderstorm Rule is met

The Lightning Threshold is exceeded when the sea level **pressure falls more than 3.0 mb over 3 hours (or less) to below 1009 mb (The Thunderstorm Rule)**. We can rely on this Rule because of its link to the Lightning Threshold and the laws of Physics on which we all depend.

The Wind Speed Threshold for the smallest storm is **25 km / hour**.

The smallest storm ever recorded, with a 3 mb fall in barometric pressure over 3 hours (1009 mb to 1006 mb), was recorded at Middlebury, Vermont, US on 7 June 2011. Del Genio *ibid* showed that the Lightning Threshold will be reached sooner and the updraft speed will increase by about 1 m/s if the atmospheric CO₂ content doubles.



Thunderstorms can occur under certain conditions when the pressure is 1009 mb or above. This happens when localized areas of rising air reach the **Lightning Threshold** speed (7 m/s), near a Cold Front or a sea breeze. The lifting of the warm air by an advancing Cold Front causes intense and widespread thunderstorms. The storms occur in the localized areas of low pressure embedded in the Cold Front. This is a typical winter weather pattern.

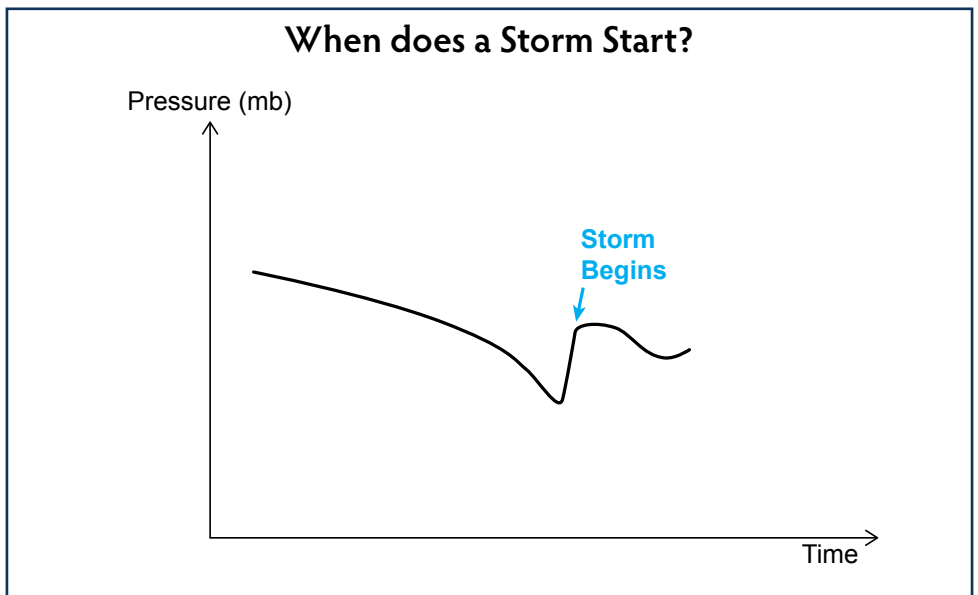


Figure 2. Storm will begin when the short steep rise or jump in pressure is completed after the pressure dip. The temperature makes a corresponding short steep fall when the storm begins.



Storm Early Warning

When the pressure starts falling at more than 1.0 mb / hour you have an Early Warning that a storm may be approaching.

Slowly Developing Thunderstorms

The barograph trace of some thunderstorms initially shows a slowly falling pressure (say, 1.0 mb / 3h) trend and will not exceed The Thunderstorm Rule's threshold (3 – 3 Rule) for 8 – 12 hours. Marine Navigation expert, David Burch, suggests that ***an even earlier wind warning occurs when the last 3 hours pressure fall is 2.0 mb or more.*** You now have at least 3 hours and possibly up to 5 hours Early Warning of an ordinary thunderstorm.

The Thunderstorm Rule

3 in 3

Pressure falls more than 3.0 mb to below 1009 mb

Within 3 hours or less

If there is no storm onset it means a Severe Thunderstorm is developing

The Thunderstorm Rule which relies entirely on the underlying laws of Physics will not be affected by Global Warming.

Storms that Exceed the Threshold from the Outset

The barograph of a Severe Thunderstorm will show the pressure falls steadily more than 8 mb for at least 8 hours to below 1005 mb. Typically, the pressure fall exceeds *The Thunderstorm Rule* threshold from the outset and wind shear contributes to the storm's longevity. You have at least 5 hours (and possibly up to 9 hours) ***Early Warning of a Severe Thunderstorm*** when the pressure falls 3.0 mb (or more) in 3 hours (or less) ***without*** any sign of storm onset and there is an ongoing steady pressure trend. It is easy to see on a barograph whether after 8 hours the pressure will eventually fall below 1005 mb.

References:

A.D. Del Genio, A. D., Yao, M.-S., and Jonas, J., (2007) Will moist convection be stronger in a warmer climate?, *Geophys. Res. Letters*, vol. 34, L16703, doi:10.1029/2007GL030525, page 2.

Burch, David (2009), *The Barometer Handbook*, Starpath, p98.

Ellis, Robert (2024) *Predicting Storms – The Adventure Begins*, Third Edition, Goldener-Parnell Publishing pp.21, 107-8.



Wind Warnings

You get a wind warning by monitoring the rate of change of pressure. Marine navigation gives further challenges as a wind speed greater than 15 knots (28 km/h) can capsize a small boat. A 6 mb rise or fall in barometric pressure over 3 hours will increase the wind speed to 54.2 km/h or 29.3 knots from dead calm. A 10 hPa rise or fall in barometric pressure over 3 hours will produce a gale. Also, a rise or fall in barometric pressure of more than 3 mb per hour will produce a gale at sea. Land winds are about 2/3 of the offshore wind strength.

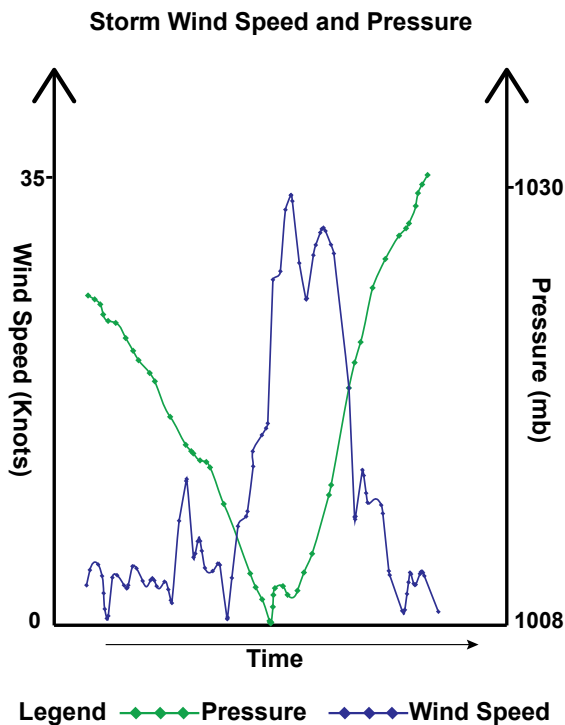


Figure 3. Storm Wind Speed and Pressure Traces

Get a Barograph and Get Started

Pressure is a key input to atmospheric computer models used to predict the weather. General weather is affected by many factors, including pressure, temperature, wind speed, and humidity. Fortunately, a storm's maximum wind speed (intensity) depends entirely on its central pressure. That is why the barograph is such a powerful instrument for predicting storms. You can know how storms are actually developing by watching the barograph trace on your smart phone.



The inclusion of a pressure sensor on good smart phones was a breakthrough in predicting storms and a real game changer. Apps such as Marine Barograph can now read accurate pressure values at your immediate location. Often forecasts from the various agencies are based pressure readings taken too far away from the storm's pressure centre and are consequently unable to reliably predict storms.

Getting started:

1. Open to page 5 of the book for the rules.
Predicting Storms – The Adventure Begins,
Third Edition 2024
Available: bestlittlebookshopintown.com
2. Download MARINE BAROGRAPH app.
(iPhone, iPad, iPod touch or Android).
App can be used on land or at sea.
3. In the app, enter your Elevation (height above sea level)
in metres or feet. Plenty of free apps give
your elevation e.g. *Current Altitude*.
4. Go to 'Graph' in the menu at the bottom then tap on
3h which is just above the graph itself.
You usually need the pressure change over 3 hours.

