How do hurricanes form?

Sea surface ocean temperature is an important ingredient in tropical cyclone formation.

How does tropical cyclone form in the Northern Atlantic basin?

The surface water in the ocean needs to warm to about 30°C and a deep enough layer of water of this temperature is necessary for it to upwell to the surface.
The surface water in the ocean needs to warm to over 30ºC. Prevailing winds off West Africa. Unstable air masses (thunderstorms) release stored heat and moisture from the ocean into the atmosphere. If the mid levels of the atmosphere are dry, the storms will not have enough energy to grow. If the thunderstorms release ocean heat and humidity into already humid levels of the atmosphere, the storms gain energy and can form a tropical storm.
This region is known as the tropical storm formation zone. The tropical storm ingredients are specific, so the formation zone is rather narrow as illustrated in the pathways of all recorded major hurricanes in the Northern Atlantic.

Very poor representation of NOAA spaghetti map.

What happens after a tropical storm forms?

A tropical storm will typically over warmer water (about 30°C). If the layer of warm water is deep enough, the storm will continue to gain energy. If not, the storm will lose energy and dissipate.
Wind shear must be low, otherwise circulation in the cyclone will be disrupted and the storm will dissipate.

- The water remains about 30ºC
- Wind shear remains low
- Atmospheric pressure continues to decrease

The storm eyewall will strengthen and storm intensity will increase to hurricane strength (category 1 – 5) will depend on the above main ingredients

If ingredients are missing, the storm will lose energy and dissipate.

Tropical Storm Intensification Zone

Storm de-intensification is caused by:

- Interaction with land
- Interactions with subtropical air masses
- Encounters with colder ocean temperatures
How are tropical storm ingredients measured?

- **Historically**
  - Satellites provide Sea Surface Temperature (SST) data (for the thin ocean surface layer).
  - Weather stations and buoys data.

**Maracoc Additions**

- HF radar – coastal high frequency radar which is positioned to look out over the water to the ocean and reports data on surface currents (direction and speed) and wave height and frequency.

What other sources of data should be considered to better understand the impact of the coastal ocean on storm intensity?
MARACOOS ADDITIONS

Gliders – ocean robots deployed from ships which can move vertically in the water column and equipped with a suite of sensors to report back data.

Pros of MARACOOS data:
- Robots continue to collect data during storms
- Ocean water temperature measurements from surface to bottom
- Real-time surface current direction and speed