

## Hurricane Forecasting

### *Hurricane Formation*

There are two distinct phases in hurricane formation:

**Genesis Stage.** This stage includes tropical disturbances and tropical depressions. Several conditions must be met for a disturbance to form a tropical depression. First, the disturbance must be in a **trough** containing a weak, partial cyclonic rotation. In general, all troughs are located at least  $10^\circ$  from the equator will obtain a partial cyclonic spin due to the earth's rotation. Second, **water temperature** must be at least  $80^\circ\text{F}$  ( $26.67^\circ\text{C}$ ). Energy from the ocean is transferred to the hurricane system by **condensation** of water vapor. Third, **vertical wind shear** must be weak in the region. Vertical wind shear is defined as the difference between wind speed and wind direction at 40,000 feet (12,192 meters) and at the surface. This is an important factor because it allows for vertical orientation of thunderstorms and maintains the low-level inflow.

**Intensification Stage.** All requirements mentioned in the genesis stage are prerequisites for a tropical depression to strengthen. As the energy transfer from water vapor continues, it creates faster wind, which in turn enhances the rate of energy transfer and so forth. This is a **feedback mechanism** that faster cyclonic winds breed more potent thunderstorms, which drop central surface pressure more and create stronger inflow to breed faster cyclonic winds. If the tropical depression has a sustained wind speed of at least 74 mph, it is classified as a hurricane.

### *Factors Affecting Hurricane Motion*

A strong hurricane can internally change its course. Other times, a hurricane is affected by external factors. **Beta effect** is the steering effect caused by the earth's rotation. This effect induces a weak poleward and westward drift of 2-3 mph. **Fujiwhara effect** is the effect describing two tropical cyclone systems interacting with each other. The two systems should have a distance within 850 miles from each other. Under the Fujiwhara effect, one of the following three situations may occur: the stronger system will lead the weaker system (e.g. super typhoon Saomai and tropical storm Bopha in the West Pacific in 2000); or they may combine into one system, but it rarely happens; they may rotate around a common midpoint (e.g. typhoon Prapiroon and tropical storm Maria in West Pacific in 2000). The Fujiwhara effect can cause a hurricane to take an unusual path (e.g. Typhoon Wayne in West Pacific in 1986).

### *Factors Affecting Hurricane Strength*

**Water temperature.** If a hurricane moves over water where its temperature is below  $80^\circ\text{F}$ , it will weaken dramatically since there is not enough energy to sustain its life. Cold water has another weakening effect, that is, it stabilizes the atmosphere. Thunderstorms are unlikely to develop under stable environments.

**Depth of ocean.** A deep, warm ocean has an abundance of energy stored in it. If the ocean only has warm water on the surface, warm water will soon be replaced by cold water since hurricanes mix the warm surface water and the cooler water from greater depths.

**Land.** Land creates more friction for the hurricane than water. Air from land is mostly dry and cooler (especially at night). This will rapidly weaken a hurricane.

### ***Hurricane Observation and Forecasting***

#### **Observation Platforms**

The most important data platform is **reconnaissance planes**. The planes will fly into the hurricane's eye and take critical meteorological measurements. Such information is extremely important for forecasting and evacuation procedures.

#### **Forecasting Annual Hurricane Activity**

Dr. William Gray, from Colorado State University, and his research students have discovered several global signals that may affect Atlantic hurricane activity:

1. The El Nino-Southern Oscillation (ENSO).
2. African rainfall.
3. Pressure and temperature difference between the western African coast and the Sahel region during the previous February-May period.
4. Caribbean sea surface pressure.
5. Quasi-Biennial Oscillation (QBO).
6. Caribbean wind shear.
7. Atlantic Ocean water temperature.
8. Strength of Azores High Pressure System.

### ***Hurricane Videos***

See the National Aeronautics and Space Administration (NASA) website ([www.nasa.gov/mission\\_pages/hurricanes/main/index.html](http://www.nasa.gov/mission_pages/hurricanes/main/index.html)) for informative videos about hurricanes.

*Source:* Fitzpatrick, P. J. 1999. *Natural disasters: a reference handbook*. Santa Barbara: ABC-CLIO, Inc.