

## CHAPTER 8 – Lectures 21 & 22

### Weather Systems

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**I. Air Masses:** Air masses are large bodies of air with fairly uniform temperature and moisture characteristics. They are classified on the basis of their latitudinal position and the nature of the underlying surface of their source regions.

*A. North American Air Masses* - The air masses that form in and near North America have a strong influence on North American weather. Continental polar (cP), arctic (cA), maritime polar (mP), maritime tropical (mT), and continental tropical (cT) air masses are the most common.

*B. Cold, Warm, and Occluded Fronts* - The sharply defined boundary between air masses is called a front. Fronts are named by the invading air mass (e.g. when a cold air mass invades a warm air mass a cold front develops.) At a cold front, a cold air mass lifts a warm air mass aloft. If the warm air is unstable, thunderstorms may develop. In a warm front, warm air advances toward cold air and rides up and over the cold air. If the warm air is stable, the precipitation will be steady. If unstable, convection cells can develop producing cumulonimbus clouds with heavy showers or thunderstorms. In an occluded front, a warm front is overtaken by a cold front. The warm air is pushed aloft, and it no longer contacts the ground.

**II. Traveling Cyclones and Anticyclones:** are large features that move slowly across the Earth's surface bringing changes in the weather.

*A. Wave Cyclones* - These exist at middle and high latitudes. Because of the contact between two large anticyclones at the polar front, one cold and dry, the other warm and moist, a wave cyclone will form in the low pressure trough between them. A wave motion begins at a polar front. The wave along the cold and warm fronts deepens and intensifies. The cold front overtakes the warm front in the centre of the cyclone. Later, the polar front is reestablished with a mass of warm air isolated aloft.

*B. Weather Changes within a Wave Cyclone* - Wind direction changes abruptly as the cold front passes. As they travel, at rates of about forty miles per hour, the weather changes as the cyclone approaches, as it crosses, and as it departs. Each type of frontal activity has a different pattern of weather.

*C. Cyclone Tracks and Cyclone Families* - Wave cyclones tend to form in certain areas and travel common paths until they dissolve. In the northern hemisphere, wave cyclones are heavily concentrated in the neighborhood of the Aleutian and Icelandic lows. These cyclones commonly form in succession, traveling as a chain across the North Atlantic and North Pacific Oceans. In the southern hemisphere, storm tracks generally form along a single lane, following the parallels of latitude due to the uniform pattern of ocean circulation at these latitudes.

*D. The Tornado* - A small but intense cyclonic vortex in which air spirals at tremendous speed. A tornado is associated with thunderstorms spawned by fronts in midlatitudes of North America, they can also occur inside tropical cyclones. They can vary from 90 to 450 meters in diameter and have wind speeds of approximately 350 kilometers per hour. They are most common in the spring and summer. They are most frequent and violent in the United States, but also occur in Australia and other midlatitude locations.

### **III. Tropical and Equatorial Weather Systems:** Weather systems of the tropical and equatorial zones show some basic differences from those of the midlatitudes.

*A. Easterly Wave and Weak Equatorial Lows* - An easterly wave is a slowly moving trough of low pressure within the belt of tropical easterlies (trade winds). Occur in latitudes  $5^{\circ}$  to  $30^{\circ}$  N and S over oceans. They travel westward at a rate of 300 to 500 km per day. A related system is the weak equatorial low, a disturbance that forms near the centre of the equatorial trough.

*B. Polar Outbreaks* - These are powerful tongues of cold polar air that penetrate into the low latitudes. The leading edge is a cold front with squalls, which is followed by unusually cool, clear weather with strong steady winds.

*C. Tropical Cyclones* - Known as a hurricane in the western hemisphere, a typhoon in the western pacific off the coast of Asia, and a cyclone in the Indian Ocean. They develop over oceans in a range between  $8^{\circ}$  and  $15^{\circ}$  N and S latitude. They typically originate as easterly waves or weak lows, which intensify into deep circular lows which require sea surface temperatures in excess of  $27^{\circ}\text{C}$ . Once formed, the storm moves westward through the trade-wind belt, often intensifying. Steered by westerly winds aloft, it can curve northwest, north and northeast. Tropical cyclones occur during certain seasons, and can penetrate well into the midlatitudes. A characteristic feature is its central eye, in which clear skies and calm winds prevail. The eye is a cloud free vortex produced by the intense spiraling of the storm. Wind speeds are highest along the cloud wall of the eye. Their intensity is rated on the Simpson-Saffir scale.

*D. Impact of Tropical Cyclones* - Tropical cyclones can be tremendously destructive storms. The most serious effect is usually coastal destruction by storm waves and high tides (a storm surge).