While hurricanes and other extreme weather elements are often in the news, people in general are more interested in the day-to-day weather. Predicting the weather with a fair degree of accuracy has become vital in our daily lives, but in order to understand weather and weather predictions it is necessary to have some knowledge of basic behaviour of gases, especially the air in our atmosphere, heating processes as a result of solar insolation, heat transfer and heat exchange through moving air, or wind, and ocean currents, the behaviour of water vapor, or moisture.

Discussion

Why are people interested in weather?
Which kinds of people have a special interest and why?
What is the difference between weather and climate?
How does weather and climate affect and shape our behaviour and our daily lives?
Describe the atmosphere of the earth and its characteristics? How did the atmosphere come to be what it is today?
Where in our atmosphere are weather phenomena found?

Essay research project

Imagine yourself living in a different country or region, e.g. in the Himalayas or the Sahel zone south of the Sahara desert, or imagine you are a pilot flying a regular run between Singapore and Vancouver, or you are an Inuit living up north near the Arctic Ocean where you have learned traditional hunting techniques from your forefathers and are now experiencing some of the effects of global warming, slow melting of the permafrost that has led to shifting foundations of many homes in your village, how would you look at weather and climate on a personal level and on a global level? How would you describe your daily and yearly experiences as you move through the seasons?

Overview

The goal of this unit is to understand weather and how weather changes, how it can be predicted and how weather and climate are different even though they are connected in some way.

In order to understand weather phenomena, we need to start with the idea that air is a fluid or a gaseous fluid which envelops the earth as an atmosphere. Because air contains molecules, these molecules are pulled toward the earth by the force of gravity. In other words, air is more dense the closer it gets to the surface of the earth, or, in other words, as we move away from the earth the density of air decreases as the number of molecules decreases.
Density is connected to temperature. As air molecules collide with one another, friction causes heat. The less collision the less friction and heat. In other words, as we move into higher altitudes, temperature declines. This is known as environmental lapse rate.
Air also contains moisture in the form of water vapor. Warm air has a high capacity to “hold” water vapor, colder air has less capacity. In other words, as a parcel of air is warmed to a

temperature that is higher than its surrounding temperature (see environmental lapse rate), it will rise. As it ascends, it will begin to cool as the number of air molecules surrounding it is reduced. The rising air can cover a larger area but now that it has cooled it can not “hold” as much water vapor. This stage is called saturation. Once saturation has reached 100%, moisture may condense and form clouds.
Now how does heating of air take place so that the air can begin to rise? The first thing to consider is the fact that the sun sends radiation to the earth. The degree of insolation changes with the seasons as the earth is curved and tilted and revolves around the sun. The earth also rotates once in a twenty four hour time period. This means that there are many daily and seasonal variations that can affect the level of insolation. In addition, land and water respond to solar insolation differently.
In general terms it can be said that the tropics receive more solar insolation than the polar regions. In other words, the tropics have a heat surplus and the polar regions have a deficit. If this imbalance was not corrected in some way, the tropics would overheat and the polar regions would cool off too much. Therefore, wind and ocean currents act as exchange mechanisms that allow heat from the tropics to be moved to the poles and cold temperatures be moved from the poles to the tropics. These heat exchanges follow the coriolis force, however, as the earth spins counter-clockwise and air moves from the faster moving equator to the slower moving polar regions in a deflected way.
From this description it becomes clear that weather and climates in the tropics and in the polar regions tend to be steady. Weather in the transition zone, however, is marked by great seasonal differences.
Keep this brief overview in mind as we examine the various phenomena in more detail.

Understanding the atmosphere
The Atmosphere
Historical Changes of the atmosphere
Atmospheric Circulation
Lab-Layers of the Atmosphere
Atmosphere: Energy Balance Assignment

Impact of seasons on airflow and heat transfer
ITCZ Animation (Intertropical Convergence Zone)
Seasons Simulation
Solar Radiation and Seasons
Planetary Circulation Patterns

Rising air and cloud formation
Clouds
Clouds and air stability
Stability Simulation
Stability

HO 2.2 Earth's Atmosphere, weather and climate

Local Phenomena

Land and Sea Breezes

Moisture and Humidity

Atmospheric moisture and humidity Assignment

Water Vapor Capacity

Atmospheric Stability

Relative Humidity

Temperature Moisture Relationship

El Nino Simulation

Clouds in a glass of beer

Weather

Mid-latitude cyclone

Weather Maps for students

High and Low Pressure

Fair Skies and dark skies

Why do clouds stay up?

How to read synoptic charts

Atmospheric Circulation

Jet Streams

Virtual Skies NASA

Isotherms Drawing online

Isobars Drawing online

Jetstream

Jetstream Animation

Jetstream Lab

Rising Air Animation

Water Vapor Calculator

Orographic Lift

Orographic Lift animation

Weather Animations

MeteoEarth

Predicting Weather

Canadian Weather Analysis chart

Surface Wind Analysis

Ocean Currents

Climate Animations

Koeppen Climate Classification

Snowball Earth

Summary

HO 2.2 Earth's Atmosphere, weather and climate

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