INTERNATIONAL POLAR YEAR

Above the Poles

Polar weather, with extreme cold, fierce winds, and constant wintertime darkness, remains a deterrent and a threat to modern researchers. The polar regions provide crucial cooling processes for our global climate system, and polar weather in both hemispheres has links to weather as far away as the tropics. The atmosphere over ice- and snow-covered surfaces has unique properties and a remarkable sequence of reactions in the snow and ice influence the chemistry of the polar air. Auroras in both hemispheres provide a glimpse of planetary-scale geomagnetic processes in the outer atmosphere.

Artic Weather and Climate

Arctic weather can have dramatic impacts on northern hemisphere weather and climate. Conversely, many Arctic storms develop from initial conditions in tropical latitudes. These hemispheric interactions, coupled with the properties of the underlying ocean, ice, and land surfaces, a complicated cloud environment, and extreme seasonal variations in heating and cooling, make the Arctic a challenge for predictions. Researchers use observations of clouds, precipitation, temperature, and winds together with numerical models to improve their skills at predicting extreme Arctic weather events such as abrupt spring thaws, rapid sea ice movements, and severe winter storms. The Arctic atmosphere also mediates emissions of greenhouse gases from degrading permafrost and influences the timing and type of precipitation. Already the Arctic climate shows strong warming, which will very likely impact the weather, chemical, and hydrological processes in the Arctic atmosphere.

Antarctic Weather and Climate

Dry stable conditions over the high Antarctic plateau, particularly in the winter, produce some of the coldest air on the planet, making Antarctica the primary heat sink of the global climate system. As cold air masses flow off the plateau toward the ocean, they produce very strong winds and interact with vigorous coastal storm systems. Conditions on the plateau, and complex connections to the tropics, determine the frequency and intensity of Antarctic coastal storms and the strength of the winds over the Southern Ocean. These Antarctic atmospheric circulations influence ocean processes such as sea ice formation and deep ocean currents. Processes in the Antarctic snowpack and in the surrounding sea ice control the chemistry of the lower atmosphere. Improved climate predictions require proper representation of Antarctic atmospheric processes.

Global Connections and Transport

Large scale atmospheric circulations that move warm moist air from

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the tropics toward the poles also transport a variety of particulate and gaseous materials. These materials, which include persistent organic pollutants and trace metals from local and distant sources, tend to deposit on polar terrestrial, aquatic, and snow surfaces. Some of the gaseous pollutants condense in the cold polar air. Due to their environmental persistence and potential toxicity, the pollutants, which often bioaccumulate through polar food chains, can significantly affect the health of wildlife and humans. Winds, temperature, and precipitation influence the amount of pollutants delivered to Arctic and Antarctic regions. The Antarctic environment has few local sources of pollutants, so it may serve as a global reference. Pollutant and toxicity data from the Arctic may allow prediction of current and future impacts in the Antarctic.

The Upper and Outer Atmospheres

Circumpolar vortices and associated polar ozone holes occur in the Arctic and Antarctic stratosphere, the layer above the air we live in. IPY occurs during the period of peak concentrations of man-made ozone depleting substances in the stratosphere. Depletion of stratospheric ozone in polar regions has greatly enhanced the amounts of harmful UV radiation reaching polar marine and terrestrial ecosystems. A variety of geoelectric and geomagnetic processes, strongly influenced by the sun, occur in the outermost atmospheric layers above the stratosphere. The auroras visible over both poles provide hints of the dynamic and turbulent processes occurring in these outer layers. Working in collaboration with the International Heliophysical Year, IPY researchers focus on interhemispheric linkages and on active and passive connections between processes in the outer atmospheres and weather at the Earth's surface.

View into Space

With their extremely dry, cold, clear, and stable atmospheric conditions, the polar plateaus provide the best sites on the Earth's surface for a wide range of astronomical observations. Polar astronomical observations include measurements of cosmic microwaves resulting from the Big Bang, the use of optical and infrared telescopes to examine the formation of galaxies, telescopes and interferometers at other frequencies to probe the dense molecular clouds where stars are born, and the measurement of the earthshine from the Moon to probe the variations in the Earth's reflectance primarily resulting from changing cloud cover. A unique one-cubic-kilometer neutrino observatory installed in the ice below the South Pole Station allows researchers to open unexplored bands for astronomy.

View from Space

Satellite observations provide essential high-resolution, frequent, and all-weather observations over large and often inaccessible polar regions, particularly of sea ice and ice sheets. The satellite-borne sensors include cameras, radars, thermal mappers, and ultrasensitive gravity detectors. An international team of researchers works to optimize the operations and data from these satellites and sensors to provide a comprehensive and unprecedented picture of the polar regions during IPY. Human-guided observations of clouds and the aurora from the International Space Station will complement ground and satellite observations.

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Weather Observation Activity

Each day, automated meteorological systems and human observers around the world produce and share weather data through a global network. Predictions centres use the observations to produce global, regional, and local forecasts. The quality of these forecasts depends on accurate weather observations from polar regions.

Observe the weather today where you live:

1. Air Temperature – warm, cold? Value in degrees Celsius?
2. Precipitation – do you currently experience rain or snow?
3. Wind – do you observe calm or windy conditions? Did you measure the wind, or observe its effects on trees or flags?
4. Visibility – how far can you see (in metres)?
5. Cloud cover – do you see clear sky, sky and cloud, or only clouds?

Activities:

1. Record your location (latitude, longitude) and your observations.
2. Using the WMO world weather map (http://www.worldweather.org/), compare your local weather to 'official' weather near your location and to weather in the Arctic and elsewhere on the planet. (Compare with data gathered by students at another school?)

Discussion:

- How do you react to your local weather? Do you wear different clothing? Do you choose certain types of transporation? Do you change the heating or cooling of your home?
- What do these observations tell you about seasonal effects? About local effects? About differences between your location and polar locations?
- For information about Antarctic weather, try: http://www.wunderground.com/global/AA.html. Can you find those locations on a map? How does weather at coastal stations around Antarctica differ from weather at the South Pole?

Find these and other educational materials in: Kaiser, 2010, Polar Science and Global Climate, An International Resource for Eduation and Outreach, ISBN 978 1 84959 593 3, www.pearson.co.uk.

www.ipy.org

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