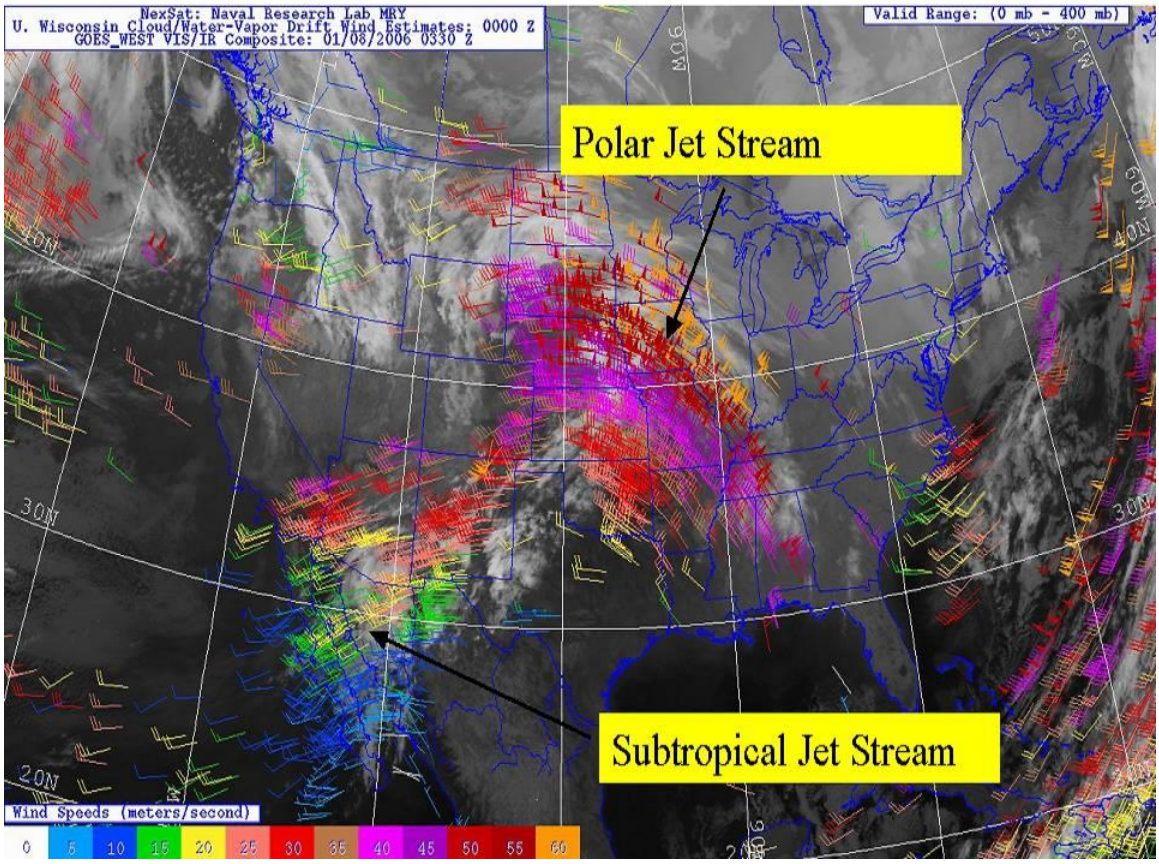
Satellite Product Tutorials:

Cloud Drift Winds



Above: The example above shows a geostationary wind product for the 0 to 400 mb atmospheric layer (22,000 ft and up). Barbs show wind speed and direction, color-coded for different speeds. Examples of two kinds of jet streams are shown: the polar jet stream which defines storm tracks, and the subtropical jet stream which sometimes appears over the southern United States and Mexico in the winter. These winds are derived by tracking cloud and water vapor features on successive geostationary images from the geostationary satellites. The winds are estimated by an automated algorithm developed at the Cooperative Institute of Meteorological Satellite Studies (CIMSS), University of Wisconsin-Madison.

The quest for quantitative and qualitative wind information over oceanic regions lacking in conventional observations was the prime motivation for the development of methods to track cloud motion in sequential satellite images. For forecasters, possible applications are a) analysis of tropical cyclones, b) the estimation of wind shear, c) the location of jet streams, and d) the analysis of coastal winds. Perhaps the greatest advantage of these wind data is their coverage of enormous areas of the earth far removed from ground station observations. Large and complex wind systems can be followed easily over huge portions of the globe.

Why We're Interested…

A key to understanding and predicting the weather is knowledge of the winds. Storms, which bring havoc to the earth, are carried by the wind. Air pollution moves from place to place based on the winds. Winds transport the moisture that nourishes crops. However, wind data are very limited. Weather balloons can send back accurate vertical profiles of wind, but only at one spot every twelve hours or so. Satellites are therefore an important source of wind information. Unfortunately, winds cannot be observed directly from most satellite sensors. However, through the tracking of clouds and water vapor gradients, which are features that can be observed from satellite, winds can be inferred. In one of their most important applications, winds data are assimilated into numerical weather prediction models to improve forecast skill.

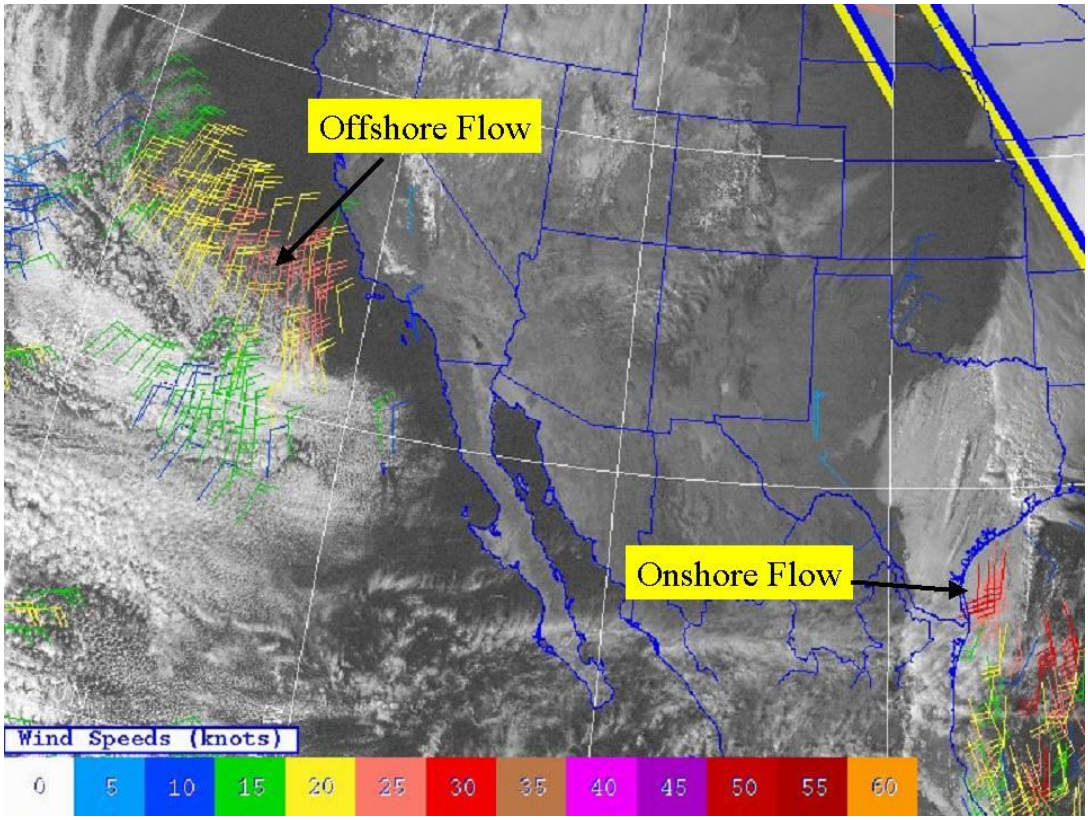
How This Product is created

Three kinds of geostationary data channels are used to produce winds, visible, infrared, and water vapor. On visible and infrared images cloud elements are identified and then tracked. The displacement of the cloud position from one image to the next per unit time interval gives an estimate of the cloud speed and direction, and hence the wind vector. Based on the infrared temperature of the cloud, an assignment of height is made. The lower the temperature, the higher the cloud.

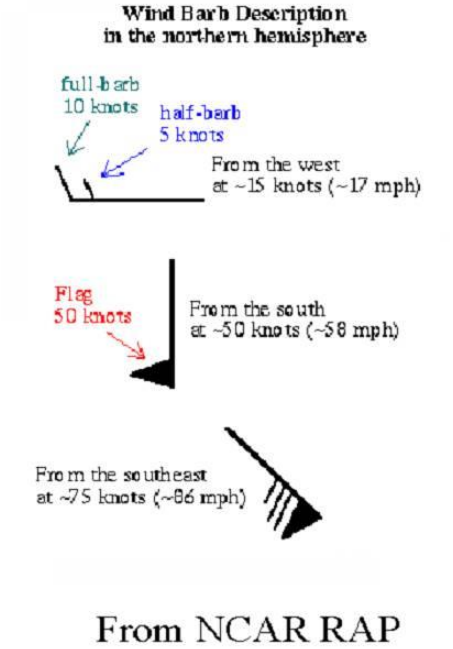
Winds can not be derived where clouds do not lend themselves to tracking or no water vapor gradients are present. In these areas there are large

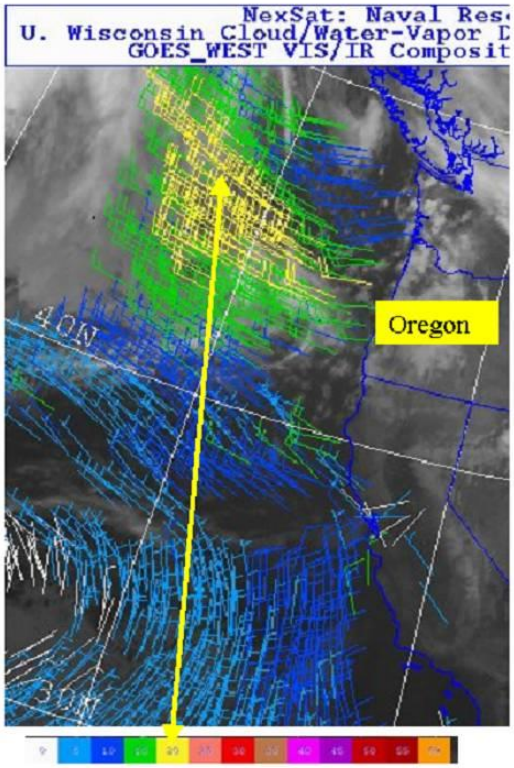
"blank" regions devoid of wind vectors. Winds are not available at the surface of the earth because of the difficulties related to tracking very low clouds and fog. Geostationary winds are limited to tropical and mid-latitude regions. Visible cloud drift winds are only available during the daytime. Polar orbiting satellites (such as the future NPOESS constellation), which cross the poles frequently, can supplement geostationary data here.

How to Interpret



In the image above you can observe offshore winds (north and northeasterly) off the west coast and onshore (southerly) flow off Texas. The product here shows winds at low levels (about 0 to 10,000 feet), based on the tracking of stratocumulus clouds. We also provide winds at mid levels (10,000 to 22,000 feet), and high levels (22,000 feet on up.)





Notice that the image above has a large number of "vectors" with barbs on the end. See the diagram on the left above for explanation. The vectors tell you both speed and direction. In addition, we color code the speeds by the colors shown at the bottom of the image.

Did You Know…?

The highest wind ever recorded at a land station was a whopping 231 miles per hour (103 meters per second; 200 knots). Location: Mount Washington New Hampshire, USA.

Want to Learn More?

1. Geostationary winds from NOAA-NESDIS: Geostationary Satellite Server.
2. Description of CIMSS Water vapor winds: Analysis from GOES Water Vapor Winds.
3. Tutorial from the VISIT program: GOES High Density Winds.
4. Journal article for AMS Subscribers in the Bulletin of the American Meteorological Society.

Author: NRL Monterey (webmaster@nrlmry.navy.mil)