Information Shown on Jet Stream Maps: Northern Hemisphere, North America and Eastern Pacific Overviews

Jet Stream Analysis Maps

Jet stream analysis maps attempt to highlight the location and strength of the jet streams. The maps presented by the California Regional Weather Server (CRWS) show the pattern of winds in the upper troposphere, on the 300 millibar pressure surface (which corresponds roughly to an altitude of around 32,000 ft.). This is very roughly the level where winds in the atmosphere are typically strongest (with the exception of winds in tornadoes, strong hurricanes, and a few other unusual situations, all near the earth's surface).

In particular, the CRWS jet stream analysis maps show the following information:

1. **Contours** of **wind speed** (that is, **isotachs**). For the North American overviews, the jet stream analysis comes from the initialization of either the North American Model (NAM) or the Global Forecast System (GFS) model. For the Eastern Pacific, North Atlantic, and Northern and Southern Hemisphere overviews, the jet stream analyses comes only from the initialization of the GFS model. The GFS computer forecast model is run four times daily by the National Centers for Environmental Prediction (NCEP), while the NAM is run twice daily. The NAM results typically come several hours earlier than the corresponding GFS results do.

   Isotachs are color-filled in shades of gray, at intervals of 5 knots (or 10 knots on smaller-sized maps), starting at 60 knots. Superimposed on these color-filled contours are black, labeled, dashed-line contours at intervals of 20 knots, starting at 70 knots. Local maximum wind speeds ("jet streaks") are marked with "H" and labeled with the wind speed there.

2. **Wind vectors** (blue arrows), representing the direction and speed of the wind. These also come from NCEP's computer model initializations. Longer arrows represent faster winds.

Composite Maps: Jet Stream Analyses and Infrared Satellite Images

On composite maps of a jet stream analysis and infrared satellite images, a 300 mb jet stream analysis is superimposed on an infrared satellite image created by splicing together GOES-West and GOES-East infrared satellite images. The analyses are the same as described above, except that wind vectors are shown in cyan (rather than blue) and dashed contours of wind speed (isotachs) are shown in yellow.

Jet Stream Forecast Maps

The jet stream forecast maps show the 12, 24, 36, 48, 60, 72, 84, 96, 108, and 120-hour GFS-model forecasts of wind speed and direction on the 300 mb pressure surface (around 32,000 ft.). These maps display information using the same conventions as the jet stream analysis maps (see above).

The **time and date** appearing on these maps is in Universal Time Coordinated (UTC), formerly known as Greenwich Mean Time (GMT). (See comments about time labels for more information.)

General Meteorological Background on Jet Streams

At mid-latitudes (that is, roughly between 30° and 60° latitude), air in the upper troposphere and lower stratosphere tends to move in relatively narrow, fast-moving "streams" that wobble back and forth as they flow generally eastward. Often, two such jet streams might be visible on these maps: (1) a polar jet stream (generally within the mid-latitudes); and (2) a subtropical jet stream (generally within the subtropics, between roughly 23.5° and around 33° latitude). However, the atmosphere is a complicated place that often defies our attempts to make simple generalizations about it, and sometimes the polar jet stream splits into two branches or one or both jet streams fail to be continuous or well-defined.

The jet streams powerfully influence synoptic-scale weather patterns in the mid-latitudes. ("Synoptic-scale" patterns are typically around 1-2 thousand kilometers across and typically last from around a day up to a week; midlatitude wave cyclones are synoptic-scale patterns, for example.) As air races through the sinuous jet-stream pattern, there are some parts of the pattern where air tends to *converge*, thereby increasing the total weight of air above the earth's surface in those areas, which implies higher pressure at the earth's surface below. Moreover, convergence of air within the jet stream tends to force air beneath the jet stream downward. As air *descends* in the atmosphere, the pressure on it increases and *compresses* it, thereby *warming* the sinking air, which evaporates any existing clouds or prevents clouds from forming in the first place. Such areas generally experience clear weather.

However, air in other parts of the jet stream pattern tends to *diverge*, which reduces the total weight of air above the surface which implies *lower* surface pressure beneath those parts of the jet stream. Moreover, divergence of air within the jet stream tends to induce air below to *ascend* to replace the diverging air. Rising air encounters lower atmospheric pressure, so the rising air *expands* and *cools* by virtue of the expansion. If the rising air cools enough, *clouds* form in it and may eventually produce *precipitation*. Regions of the atmosphere where air within the jet stream aloft diverges, causing surface pressure to fall and forcing air within the troposphere below to rise and cool, leading to large-scale cloud formation and possibly precipitation, are associated with *mid-latitude wave cyclones* and their accompanying warm and cold fronts. These storms are often easy to spot on satellite images by their characteristic "comma"-shaped cloud pattern, often extending thousands of miles along the front(s).

As air races eastward through the jet stream at speeds often exceeding 150 m.p.h. (about 130 knots, or 65 meters/sec), the sinuous wobbles of the jet stream pattern tend to shift slowly eastward. The smaller of these wobbles generally propagate faster then the larger ones, which can sometimes stall completely. The regions of convergence and divergence within the jet stream pattern--and the patterns of clear and stormy weather associated with the regions of convergence and divergence--are strongly correlated with certain parts of the wobbles. Hence, since the wobbles tend to propagate eastward, so do both the mid-latitude cyclones and the regions of generally clear weather between the storms. The speed of these storms is typically around 20-30 m.p.h. (10-15 meters/second).

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