Jet Lag: What's Causing One of the Driest, Warmest Winters in History?

The jet stream controls winter weather, but strange forces are controlling the jet stream this season

By Mark Fischetti, Scientific American, January 12, 2012

A little snow and rain are falling in a few states today, but the 2011–12 winter has been extremely warm and dry across the continental U.S. Meteorologists think they have figured out why.

First, a few records: The initial week of January was the driest in history. And more than 95 percent of the U.S. had below-average snow cover—the greatest such percentage ever recorded—according to some intriguing data maps generated by the National Oceanic and Atmospheric Administration. During December, approximately half of the U.S. had temperatures at least 5 degrees Fahrenheit above average, and more than 1,500 daily record highs were set from January 2 to 8. Europe has seen similar extremes.

The chief suspect behind the mysterious weather is an atmospheric pressure pattern called the Arctic Oscillation, which circles the high Northern Hemisphere. Its lower edge is known as the North Atlantic Oscillation (NAO). Together, the related features influence the path and strength of the jet stream. The jet itself is an air current that flows west to east across the northern latitudes of the U.S., Europe and Asia, altering temperature and precipitation as portions of it dip southward or crest northward. A strong jet stream that flows in a somewhat straight line from west to east, with few southward dips, prevents cold arctic air from drifting south. "The cause of this warm first half of winter is the most extreme configuration of the jet stream ever recorded," according to Jeffrey Masters, a meteorologist who runs the Weather Underground, a Web site that analyzes severe weather data.

By "extreme," Masters means that the jet stream was far north and fairly straight, and stayed that way for an unusually long time. That position allowed warm southern air to prevail over the entire U.S., and prevented cold fronts from descending from the north and clashing with warm fronts, creating large snow- and rainstorms. The jet stream has been locked in that position by the NAO for most of the winter, and Masters says it has sustained the largest pressure gradient since tracking began in 1865.

Conversely, December 2010 set record snowfalls in many parts of the U.S. Sure enough, the NAO at that time had some of the lowest pressures ever observed, allowing the jet stream to move south and stay there. Arctic air descended, picked up moisture or interacted with warm fronts, and dropped snow. "The December Arctic Oscillation index has fluctuated wildly over the past six years," Masters notes, "with the two most extreme positive and two most extreme negative values on record." Data for the trends is available at the Weather Underground site.

Meteorologists are not certain what causes the oscillations to vary so dramatically. Some scientists say the loss of Arctic sea ice due to global warming is causing the Arctic Oscillation to drop in pressure. Others have noticed a correlation with sunspot activity, which was very low in December 2010 and very

Figure 1: WEATHER MAKER: An unusual region of atmospheric pressure over the Arctic has kept the polar jet stream (green) locked up at far northern latitudes, causing a warm, dry U.S. winter. Image: Courtesy of NOAA

high during December 2011, although they haven't proposed a mechanism whereby sunspots would directly alter the Arctic Oscillation.

Of course, winter has many weeks to go, so the oscillations, and U.S. weather, could shift. But if plentiful precipitation does not fall, complications could arise for many more people than ski resort owners and their patrons. A small snowpack often leads to spring droughts in the Midwest and summer water shortages in the West as well as a longer wildfire season in the latter because the soil dries out earlier than usual.

In the meantime if you want snow, hop a flight to Cordova or Valdez, two towns on Alaska's Pacific coast that are buried under 4.5 to 5.5 meters of snow—with more on the way. They, too, can thank the Arctic Oscillation because, being so high latitude, they lie within the band the jet stream has been stuck in, not south of it.