



## **METEOROLOGY DEPARTMENT**

### **AMUNDSEN-SCOTT SOUTH POLE STATION, ANTARCTICA**

The Meteorology staff's primary function is year-round collection and distribution of meteorological data. Temperature, wind, and pressure data from both the surface and the upper levels of the atmosphere are used to support scientific research based at Amundsen-Scott South Pole Station as well as various international research projects. Researchers investigating issues of global climate change routinely use the climatological database, which spans almost fifty years.

During the austral summer season (October-February), the South Pole staff also supports aircraft operations of the U.S. Antarctic Program. Hourly observations and twice-daily upper air soundings are transmitted via e-mail and over high frequency radio to McMurdo Station, where they are used to produce Terminal Aerodrome Forecasts (TAF's) for the various landing sites on the continent. In addition, observational data from the South Pole are used to initialize computer forecast models twice daily. The McMurdo Weather department receives the observations and transmits them to the World Meteorological Organization (WMO) for dissemination to the global meteorological community. Since the Southern Hemisphere is relatively data-sparse, Antarctic observations and upper air reports are especially valuable for the initialization of computer forecast models worldwide.

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## 90° South



While the Arctic is a frozen ocean surrounded by land, Antarctica is a continent surrounded by oceans. Over 97% of Antarctica is covered with ice—an estimated 90% of Earth’s supply of fresh water. South Pole Station lies on the continent’s interior plateau at an elevation of 2,836 meters/9,306 feet above sea level (ASL).

The grid system is used to define directions in Antarctica, with the prime meridian (0° longitude) corresponding to grid north. Toward grid north to grid east of the Pole, the East Antarctic Plateau climbs to over 4,000 meters/13,000 feet. Toward grid west to grid south, the Transantarctic Mountains rise from the ice, separating East Antarctica from West Antarctica.

### Temperature:

Surface temperatures at the South Pole have a typical annual range between  $-18^{\circ}\text{C}/0^{\circ}\text{F}$  and  $-76^{\circ}\text{C}/-105^{\circ}\text{F}$ , with an average annual temperature of  $-49.5^{\circ}\text{C}/-57.1^{\circ}\text{F}$ . The coldest temperature ever recorded at the South Pole was  $-82.8^{\circ}\text{C}/-117.0^{\circ}\text{F}$ , while the warmest was  $-13.6^{\circ}\text{C}/+7.5^{\circ}\text{F}$ . During the summer months of November-February, temperatures usually remain above  $-50^{\circ}\text{C}/-58^{\circ}\text{F}$ , and may even exceed  $-18^{\circ}\text{C}/0^{\circ}\text{F}$  during the warmest weeks of late December and early January. With the loss of incident solar radiation in March, temperatures cool rapidly, usually dipping below  $-73^{\circ}\text{C}/-100^{\circ}\text{F}$  at least once during the austral winter. Temperatures climb rapidly after the return of the Sun in September. In addition to the Sun’s elevation, changes in cloud cover immediately change the surface radiation balance, and therefore can have a rapid and significant effect on the surface temperature. Increasing cloud cover leads to warming temperatures, and a clearing sky brings falling temperatures.

One of the most pronounced features of the vertical temperature structure at South Pole is a strong surface inversion, especially during the winter. The temperature often increases by over  $25^{\circ}\text{C}$  in the lowest few hundred meters of the atmosphere, and then steadily declines again to the tropopause at 7-10,000 meters ASL. Stratospheric temperatures exhibit a strong annual cycle, with the minimum slightly below  $-90^{\circ}\text{C}$  during July and August and a maximum near  $0^{\circ}\text{C}$  in the summer.

### Precipitation:

Precipitation over Antarctica’s interior is very light, and due to the nearly constant wind, very difficult to measure. Ice crystals (“diamond dust”) are the most common form of precipitation at South Pole, and are observed on the majority of days. Unlike other forms of precipitation, ice crystals often fall out of a clear sky, glittering in the sunshine or moonlight and sometimes creating spectacular halos, arcs, and sundogs. Observation of snow grains is common at South Pole during storms, while actual snowflakes (branched crystals) are much less common, usually only rarely occurring in the summer months. The intensity of precipitation, almost without exception, is light. Snow accumulation as measured via an array of snow stakes averages about 9 inches annually.





## Wind:

Compared to the coastal areas, surface winds at South Pole are relatively light. Averaging about 11 knots annually, wind speeds rarely exceed 40 knots. The prevailing direction is from grid north. When wind speeds exceed 15 knots, blowing snow begins to significantly reduce visibility. Dangerous whiteout conditions (zero visibility with total loss of the horizon) usually occur when sustained winds exceed about 25 knots. The strongest gust ever recorded at South Pole is 48 knots. Orographically forced clouds and precipitation are common when the wind blows from the grid north or grid northwest, while down-slope conditions prevail when winds are from the grid northeast through grid southeast. Winds from the grid south and grid southwest are rarely observed.

## The Sun:

South Pole experiences six months of continuous sunshine and six months without sunshine, with the equinoxes approximately marking sunrise and sunset. During the summer solstice in December, the sun reaches a maximum elevation of 23.5 degrees above the horizon. Contrary to popular belief, complete darkness only envelopes South Pole for about three months. While the Sun is below the horizon for six months, astronomical, nautical and civil twilight are observed for several weeks after sunset and before sunrise. Extreme refraction also delays sunset and hastens sunrise by several days. For computational purposes, however, the U.S. Naval Observatory defines sunrise and sunset to occur when the center of the Sun's disk is 50 arc minutes below a level horizon.



## Clouds:

The Earth's atmosphere is substantially more compact at cold, high latitudes. This fact combined with the high elevation of the South Pole Station results in the observation of clouds at much lower altitudes above the surface than in the lower latitudes. Most clouds are composed of ice crystals, except during the warmest periods, when super-cooled water droplets may also be present. Cirroform clouds, typically categorized as high clouds, are observed at 3,500-12,000 feet above the snow surface.

The Antarctic continent has a major influence on the world's climate and is an important region for the study of global climate change. Since the South Pole is one of the few year-round stations in the interior of Antarctica (and the one with the longest continuous occupation), collection and study of meteorological data is an important part of the U.S. Antarctic Program's contribution to science.

## **General Information**

Elevation: 9,306 feet (2,836 meters) above mean sea level  
Distance from McMurdo Station: 847 statute miles  
Start of weather observation program: January 1957

## **Snow and Ice**

Average Annual Snow Accumulation: 9 inches (23 cm)  
Average Annual Liquid Equivalent: 3.4 inches (8.6 cm)  
Ice Movement: 33 feet/year (10 meters/year)

## **Temperature**

Record Maximum: +7.5°F (-13.6°C), Dec 1978  
Record Minimum: -117.0°F (-82.8°C), Jun 1982  
Average Annual: -57.1°F (-49.5°C)

## **Station Pressure**

Highest: 719.0 millibars (Aug 1996)  
Lowest: 641.7 millibars (Jul 1985)  
Average: 681.4 millibars

## **Wind**

Average Speed: 10.7 knots (12.3 mph)  
Prevailing Direction: 020 degrees (grid northeast)  
Peak Wind Speed: 48 knots (55 mph), Aug 89

## **Pressure Altitude**

Highest: 12,107 feet (3,690 meters)  
Lowest: 9,190 feet (2,801 meters)  
Average: 10,576 feet (3,223 meters)

