WEATHER & SEA ICE

Weather Observations and Ice Assessment

Antarctic Weather

Weather in Antarctica is characterized by extremes: extreme temperatures, extreme winds, and extremely variable local conditions. All of this makes Antarctica a challenging place to work and live. The temperatures can vary from below -40°F (-40°C) to above freezing during the course of an austral summer. Moderate to strong winds are common. It's an unusual day when there is not at least a breeze blowing. The wind takes its toll on people, making camp chores, such as setting up tents, difficult. More importantly, wind chill increases the risk of hypothermia and frostbite. The wind chill chart in the reference section shows the effect of wind on perceived termperature.

McMurdo Area Weather

Storms arrive quickly and are sometimes fierce enough to halt all outside activity. Storms can also be very localized. Weather at McMurdo Station can produce near-zero visibility with blowing snow (halting flight operations), while the McMurdo Dry Valleys, which are 50 miles away from McMurdo, might be calm and sunny. Approaching storms are usually preceded by high, thin bands of cirrus clouds (mare's tails), followed by thicker layers of cirrus, which may cause a halo-like effect around the sun. The clouds grow progressively thicker and lower over the next six to 12 hours until the arrival of low cumulus clouds and the main front. Blizzards can happen any time of year and may last from several hours to several days.

Storms usually approach McMurdo Station from the south, through the gap between Black Island and White Island. They eventually obscure Minna Bluff with blowing snow or low clouds, at which point there is usually less than an hour before bad weather hits. Travel is difficult and dangerous during storms and should be avoided. Blowing snow can hide crevasses or sea-ice cracks. Even moderate winds can produce a layer of dense, blowing snow that may be as thin as a few feet or as thick as 1,000 feet. Whiteouts are equally dangerous phenomena. In a whiteout, thick, low clouds reduce surface definition, and the horizon is obscured. It's difficult or impossible to know if one is on a flat or sloping surface. It is also difficult to judge distances or the size of objects. Travel should only be attempted during a whiteout if there is an emergency. People caught unexpectedly in a whiteout should stop and wait for visibility to improve enough to reveal a recognizable landmark.

Antarctic Weather in Remote Locations

Weather conditions vary widely throughout the Antarctic continent, depending on a location's elevation, topography, and relative distance from the ocean. The polar plateau is very cold because of its higher altitudes and greater distance from the moderating effect of the sea. Areas near the coast can be subject to wet, heavy precipitation and warm days with intense sunlight. Winds at remote Antarctic sites range from calm and light to sustained hurricane force. Past reports and weather data can help parties plan for weather conditions at a given site. Still, it is best to expect the unexpected when it comes to weather.

Antarctic Weather Forecasting

Weather forecasting for U.S. Antarctic stations is done under the auspices of the National Science Foundation and is coordinated through the SPAWAR (Space and Naval Warfare) Systems Center in Charleston, South Carolina. SPAWAR also has a presence at McMurdo Station. Compared to most places in the world, Antarctic weather forecasters have fewer data collection sites upon which to base their forecasting models. Forecasters rely heavily on weather observations called in from remote field sites. They also use satellite imagery, data from automated weather stations, and a weather modeling system, the Antarctic Mesoscale Prediction System (AMPS), which produces twice daily forecasts for the Antarctic continent.

Terminal Aerodrome Forecasts (TAFs)

Weather forecasts for remote sites are called Terminal Aerodrome Forecasts (TAFs), and they are generated each day for sites scheduled to receive aircraft. A TAF is automatically generated for a given site based on the aircraft schedule; field personnel do not need to request one in advance. TAFs are usually issued every eight hours for a 24-hour period and are effective for 24 hours from the time they are issued.

Occasionally, an amended or corrected TAF will be issued between the standard issue times. Amended TAFs are issued when the current TAF no longer adequately describes the ongoing weather or the forecaster feels the TAF is not representative of the current or expected weather. Corrected TAFs are issued when there is misinformation on the original TAF.

USAP Field Party Weather Observing

Field parties must identify the person or persons responsible for making weather observations each day and reporting these observations to the McMurdo Weather Center (MacWeather). Weather observations made at remote field locations facilitate safe and timely aircraft operations to those locations. The data also support the continent-wide weather forecasting system.

When to Make Observations:

1. If no aircraft activity is planned:
   a. Make three daily weather observations and report them to MacWeather at 1800 Zulu (Z), 0000Z, and 0600Z.
   b. On holidays, only two observations need to be reported: morning (1800Z) and evening (0600Z).
   c. All observations should be recorded and called in to MacWeather within 15 minutes of the scheduled time.
   d. Begin the observation about 15 minutes before the top of the hour. (Weather observations should take 10 to 15 minutes to complete.)
   e. Call in the observation within five minutes of the hour.
2. If a fixed-wing aircraft is scheduled to arrive:
   a. Hourly observations begin six hours before an LC-130 and three hours before a Basler or Twin Otter aircraft is scheduled to depart from its original location en route to a remote camp.
   b. Hourly observations continue while the aircraft is on the ground at camp.
   c. If there is a change in the weather before an hour has passed since the last observation, a special observation is reported.
   d. Observations return to the normal daily schedule when the aircraft departs.
3. If a helicopter is scheduled to arrive, camp personnel should call the hangar Iridium with a weather update between 0715 and 0730 or between 0745 and 0800.

Setting Up a Weather Observation Site

Altitude and Grid North

Key information for setting up a weather observation station is available from the pilot of the aircraft. Upon arrival, the designated weather observer should ask the pilot for an exact altitude reading. This number is required to take accurate pressure readings with the handheld weather meter (Kestrel®). Also, the pilot should be able to identify grid north. This will assist in setting up the flagged weather-observation site.

Grid North Versus True North

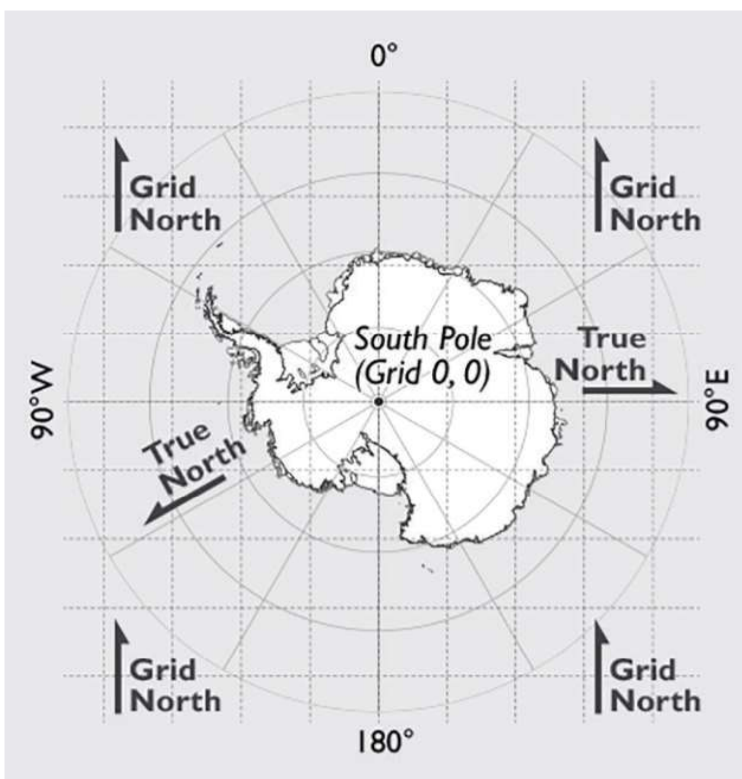
In order to avoid confusion, especially when traveling where lines of longitude converge near the South Pole, fixed-wing aircraft pilots navigate using directions based on an artificial grid pattern overlaying the continent, rather than on true compass directions. The designated weather observer in a fixed-wing supported camp should use these grid directions and not true or magnetic direction readings when observing and reporting the weather.

Helicopter pilots use true compass direction to navigate, and helicopter-supported groups should use that for reporting weather.

North has been conventionalized in two ways:

True North is defined as the direction of a line of longitude that ends at the North Pole.

Grid North is defined on the Antarctic Polar Stereographic Grid, with 0 degrees longitude acting as the reference (central) meridian and the South Pole as the origin (0, 0).



Determining Grid Directions

To determine grid north, face true north and treat your meridian as the prime meridian (0^0 or 360^0). For east longitude camps, grid north will be true north (360) minus the longitude of the camp.

For west longitude camps, grid north will be true north (0) plus the longitude of the camp. Once grid north has been identified, grid south, east, and west can be determined easily.

Examples: For a camp located at 167^0 E, subtract 167^0 from 360^0. Place the flag for grid north at 193^0 true (i.e. "true" to your subjective orientation, where 167^0 E is treated as 0^0).

For a camp located at 60^0 W, add 60^0 to 0^0 (true north). Place the flag representing grid north at 60^0 true.

Note: The declination between magnetic north and true north varies widely throughout the continent. Observers using a magnetic compass to determine direction must be sure to use an accurate declination for their location.

Grid Direction Flags

Upon arriving at a camp, team members should create a weather-observing site. Use four flags placed a few meters apart at the points representing grid north, grid south, grid east, and grid west. Label each flag with its grid direction. The observer should stand in the middle of this flag configuration when making weather observations. This will help determine the direction of the wind and provide a consistent point from which to observe sky and ground conditions.

Visibility Markers

To help determine visibility levels, team members should place a second layer of flags spaced 400 meters (1/4 mile) away, in line with each directional flag. If possible, additional flags should be placed at major intervals, such as 800 meters (1/2 mile), 1,600 meters (one mile), and/or 3,200 meters (two miles). The team members should measure and record distances to landmarks that can be seen from camp for additional help in determining visibility.

Setting Up the Handheld Weather Meter (Kestrel®)

Weather observers in remote locations often use a handheld weather meter to measure wind speed, temperature, dew point, and pressure. The handheld weather meter discussed in this manual is the Kestrel® 4000. Observers using a different meter should refer to the user instructions for that meter.

The Kestrel® 4000 is available through the Berg Field Center (BFC). The field team member picking it up should ensure the Kestrel® is set to measure temperature in Celsius, wind speed in knots, and altitude in feet. Extra batteries should also be procured at that time, in case the batteries in the Kestrel® lose power in the field. The Kestrel® must be returned to the BFC promptly at the end of the season.

The Kestrel® should be stored in an inside coat pocket or a warm area when not in use. The liquid crystal screen will function only at temperatures above -10°C (-14°F). At colder temperatures, the screen will be sluggish and eventually fade, although the device will still record data. The Kestrel® should be returned to a warm, inside coat pocket as soon as possible after use.

Setting a Reference Altitude and Barometric Pressure on the Kestrel®

Obtain the remote site's altitude in feet from the aircraft pilot. (Be sure to notify the pilot in advance so he or she knows to provide this information before departing.)

Navigate to the barometric pressure (BARO) screen and press the center COMMAND button to enter. On the screen, go to the reference altitude (Ref Alt) line. Use the left and right buttons to increase or decrease its value to equal the altitude (in feet) provided by the pilot. Be sure the Kestrel® is set with feet as its default altitude measurement. Notice that the barometric pressure reading changes in response to changes in the altitude number. Press the COMMAND button to save and exit the adjustment mode.

Next, go to the altitude screen and navigate to the reference pressure line. Enter the barometric pressure number now shown in the BARO screen. Since the Kestrel® is used to monitor barometric pressure for weather reporting, it should be kept in the same location (i.e., at the same altitude), because the pressure will change with changes in altitude. Read the pressure from the BARO screen.

Weather Reporting Sheet

Record weather observations on the Surface Weather Observations form (METAR/SPECI). MacWeather provides this form, which is too detailed to print here. Review how to fill it out at your weather briefing with MacWeather personnel before deploying to the field. Guidance is also provided in the following sections. **Note:** It is not necessary to maintain a written record of each observation. MacWeather will record and track the observations called in.

Camp Name/Location

List the latitude and longitude of the camp. If the camp has a name, provide that too. Example: Whillans Ice Plain Camp - Latitude: 83.65 S, Longitude: 167.4 W

Time in Zulu (GMT)

Weather observations should be reported using Zulu (GMT) Time. For example, if a weather observation is called in at 0700 New Zealand Daylight Time, it should be referred to as the "Eighteen Z Observation" since 0700 NZ time is 1800 Zulu (GMT).

Direction of Winds

The observer should stand in the middle of the flagged weather-observing site and use the feel of wind on the face and/or any visual cues, such as blowing flags and blowing snow, to determine the grid direction of the wind. Wind direction readings should be taken for at least two minutes. The average direction over that time should be reported. Wind direction is identified according to the following:

calm	no direction, report "winds calm"
northeast	023 to 067 degrees
east	068 to 112 degrees
southeast	113 to 157 degrees
south	158 to 202 degrees
southwest	203 to 247 degrees
west	248 to 292 degrees
northwest	293 to 337 degrees
north	338 to 022 degrees
variable	wind must be 6 knots or less

Speed of Winds

Confirm the Kestrel® is set to record wind in knots. Power it up and navigate to the wind speed screen. Expose the impeller (the small, revolving wheel at the top of the Kestrel®) by rotating open the plastic cover. While viewing the Min/Max/Avg screen, hold the unit into the wind (the screen facing the observer). When the screen displays "--average" press the button to begin collecting data. Press it again when the screen displays "--stop" to stop collecting data and hold the values on the display. Press the button when the screen displays "--clear" to clear the data. Collect enough data to calculate a two-minute average for all measurements.

Visibility at Surface

Visibility is the measure of how far an observer is able to see objects like flags or rock outcrops that are not obscured by weather, as viewed from ground level. Visibility should be recorded in meters and as an average of all quadrants.

Visibility distances are broken down to “Reportable Visibility Values.” Miles and feet are included in the Reportable Visibility Value chart for reference, but observers should call in observations using meters. For example, visibility estimated at 700 meters must be reported as either 600 or 800 meters since 700 is not a Reportable Value. The term “Unrestricted Visibility” refers to visibility that is 9,999 meters or greater. All visible distances 9,999 meters or greater are reported as “Unrestricted.”

Present Weather

This entry is a description of the weather effects that may or may not be restricting visibility, as seen at ground level. Examples include precipitation, such as snowfall or fog, and obstructions to visibility from blowing or drifting snow. It is possible to have two or three present-weather effects and obstructions to visibility in a given entry. For example: snow and drifting snow; or snow showers, fog and blowing snow.

Weather categories (with visibility obstruction):

No Weather	Visibility not obstructed by any weather condition
Snow	Visibility less than 9000m and precipitation steady
Snow Grains	Visibility is less than 9000m; steady precipitation of small, round, flat snow pieces
Ice Crystals	Can occur at any visibility, including unrestricted visibility
Fog	Only reported when visibility is less than 1200m
Mist	Looks like fog; reported when visibility is between 1200 and 9000m
Snow Showers	Visibility less than 9000m; precipitation intermittent
Ice Pellets	Visibility less than 9000m in steady precipitation of tiny hailstones <5mm (rare event)
Blowing Snow	Visibility less than 9000m
Drifting Snow	Visibility greater than 9000m

Reportable Visibility Values		
Meters	**Statue Miles**	**Feet**
0	0	0
100	1/16	328
200	1/8	656
300	3/16	984
400	1/4	1312
500	5/16	1640
600	3/8	1969
800	1/2	2625
1000	5/8	3281
1200	3/4	3937
1400	7/8	4593
1600	1	5249
1800	1 1/8	5906
2000	1 1/4	6562
2200	1 3/8	7218
2400	1 1/2	7874
2600	1 5/8	8530
2800	1 3/4	8858
3000	1 7/8	9843
3200	2	10500
3600	2 1/4	11810
4000	2 1/2	13120
4400	2 3/4	14440
4800	3	15750
6000	4	19690
8000	5	26250
9000	6	29530
Unrestriced 9999 or more	7 or more	

Amplification of Weather

This is a more detailed description of weather severity, such as “Light,” “Heavy,” or “Moderate.” Examples (including accompanying obstructions to visibility):

None	
Light Ice Pellets	Visibility not restricted
Moderate Ice Pellets	Visibility reduced to between 3 and 7 miles (4800 to 9000m)
Heavy Ice Pellets	Visibility reduced by ice pellets to less than 3 miles (4800 m)
Light Snow	Visibility greater than ½ mile (800m)
Moderate Snow	Visibility between ¼ and ½ mile (400-800m)
Heavy Snow	Visibility less than ¼ mile (400m)

Cloud Layers

Each cloud layer is usually reported using two entries: the first represents the amount of sky covered by a layer and the second represents the cloud layer height. At least one layer is reported (even if it's "sky clear"), and often two or three cloud layers are reported. The heights of cloud layers are reported in feet (not meters). If there is more than one layer, begin with the lowest layer. Examples:

Entry #6 – Cloud Layer 1, Few at 1,000
Entry #6a – Cloud Layer 2 (if needed), Scattered at 5,000
Entry #6b – Cloud Layer 3 (if needed), Broken at 10,000

To report cloud layers, always round to the nearest 100 feet for layers that are 5,000 feet or less. For layers between 5,000 feet and 10,000 feet, round to the nearest 500 feet. For layers 10,000 feet and above, round to the nearest 1,000 feet. Example: A cloud layer at 1,150 feet is rounded to 1,100. A cloud layer at 5,300 feet is rounded to 5,500 feet.

Summation Principle

A higher cloud layer cannot be reported as having less total area coverage than the area below it. The higher layer is considered to include the amount of sky coverage from all of the clouds below it. For example, if the lowest cloud layer is reported as "broken," the next higher layer must be reported as either "broken" or "overcast," even if there are only a few clouds in the higher layer.

Using Cloud Types to Estimate Layer Heights

A cloud's appearance or type will give clues as to how high it is. Following are some typical Antarctic cloud heights:

Cloud Type	Description	Typical Height
Stratus	Low, grey, shapeless sheet stretching wide	1,500 feet or less
Stratocumulus	Low, lumpy, rounded, with some blue sky visible	1,000 - 5,000 feet
Cumulus	Low, puffy, popcorn-like, vertical development	1,000 - 5,000 feet
Altostratus	Mid-level, uniform sheet of grey cloud	4,000 - 9,000 feet
Altocumulus*	Mid-level puffy clouds, sometimes in patterns. One part of the cloud is usually darker, "castles"	4,000 - 9,000 feet
Cirrus	High, whispy, feathery, see-through clouds	10,000 - up to 19,000 feet
Cirrostratus	A high, very thin sheet of see-through clouds	10,000 - up to 19,000 feet
Cirrocumulus	High, thin, wavy or rippled clouds in part of the sky	10,000 - up to 19,000 feet
** Altocumulus includes lenticular clouds. These are dangerous for air operations and must be reported in the Remarks section.*		

Additional Ways to Determine Cloud Layer Height

Ceiling Balloons Also called "weather balloons," ceiling balloons are helium-filled balloons released from ground level. Their ascent is timed and the balloons observed until clouds hide them from view. Cloud height is then determined based on a chart that shows how fast a given balloon will rise. Not all remote camps will have ceiling balloons, as they require the transport of compressed gas. Additional training is required for those using ceiling balloons to determine cloud height.

Pilot Report Observers may confirm the heights of cloud layers with pilots who fly into camp. The aircraft's instrumentation allows pilots to determine exact heights of cloud layers as they fly through them. A pilot report is called "PIREP" (pronounced "pie rep") and should be used only periodically, not for every single flight.

Total Sky Cover

This includes all of the layers of clouds taken as a whole. Sky cover is measured in "oktas" or eighths. If half of the sky is cloudy, that is described as 4/8 or four oktas. The oktas are grouped into the following categories:

Value	Amount of sky covered by cloud
Sky Clear	0/8 coverage Sky must be totally clear; do not encode a layer height.
Few	1/8 - 2/8 coverage Anything from one tiny cloud up to 25% of the sky covered.
Scattered	3/8 - 4/8 coverage
Broken	5/8 -7/8 coverage
Overcast	8/8 coverage If the cloud is “see-through,” it is still considered overcast.
Vertical Visibility	Sky view is obscured. Sky is entirely covered by fog and/or blowing snow; cloud layers cannot be discerned.

Temperature and Dew Point

Both of these readings should be recorded directly from the Kestrel®. Navigate to the correct screen by using the up and down arrows. Navigate to lines within a screen using the side to side arrows.

These data are reported in the nearest whole degree Celsius.

Negative temperatures and dew points are recorded with an “M” before the number (example: M06).

The dew point will never be higher than the temperature.

Sometimes the dew point will not register on the Kestrel® in extreme cold conditions. If this occurs, omit the dew point report from the weather observation.

Barometric Pressure

For this item, report the station pressure and not the altimeter. Station pressure is the atmospheric pressure at the station elevation. It should be read directly from the Kestrel® and reported in inches of mercury to the nearest five-thousandth of an inch.

Always round down. For example, 29.249 inches would be reported as 29.245 inches.

Surface/Horizon Data

These descriptions help pilots anticipate visual conditions for landing. The surface definition is relayed first, horizon definition second.

Surface Definition This entry describes how the contours of the ground and/or snow surface appear. Surface definition is judged by the relative distinctness of features like sastrugi or vehicle tracks in snow. Observers should notice how surfaces appear in good weather to use as comparison in changing weather.

This is a critical planning detail for helicopter pilots, as they are not allowed to fly over poor surface definition. Helicopter-supported groups on the ice shelf or sea ice must convey this information to the helo coordinator or helo supervisor if they are expecting a flight.

Surface Definition Levels

Good	Snow surface features such as sastrugi, drifts, and tracks are easily identified by a shadow. The sun is usually not obscured.
Fair	Snow surface features can be identified by contrast. No definite shadows exist. The sun is usually only dimly visible.
Poor	Snow surface features cannot be readily identified except from close up. The sun is usually totally obscured.
Nil	Snow surface features cannot be identified. No shadows or contrast exist. Dark objects appear to float in the air. The sun is totally obscured. The overcast may have considerable glare, which appears to be equally bright from surface reflection and from all directions.

Horizon Definition This is an observer's judgment as to the ease with which the sky can be distinguished from the land or snow surface.

Horizon Definition Levels

Good	The horizon is sharply defined by shadow or contrast. There is an obvious difference between land and sky (i.e., white surface and blue sky) and the horizon is distinct.
Fair	The horizon may be identified, though the contrast between sky and snow surface is not sharply defined. The sky distinguishable from land, and the horizon is visible. "Fair" horizon conditions are often observed when clouds are approaching or during light precipitation.
Poor	The horizon is barely discernible. Though it is difficult to distinguish the sky from the snow surface, there still seems to be a (hard to see) separation between the two. "Poor" is observed in conditions similar to those that cause "nil," only less severe.

Nil Total loss of horizon. The snow surface merges with the whiteness of the sky. No horizon is visible, which is common when there is a low stratus layer and blowing snow."

Examples:
Snow surface and horizon are both easily seen
= good and good
Surface contrast is seen in dim sun and the horizon is hard to discern
= fair and poor
Surface has no shadows or features and the horizon is not discernable
= nil and nil

If a poor or nil horizon is visible in one grid direction only and the rest of the horizon is more easily seen, report this condition in the remarks as, for example, "poor horizon grid south through west" or "nil horizon grid east."

Remarks

The remarks section should also be used to describe any significant weather-related phenomena that are not reflected elsewhere in the report. This could include weather seen in the distance, weather in a small quadrant (such as different surface or horizon definitions), or weather seen in the vicinity (such as fog, mist, or lenticular clouds at 2,000 feet grid northwest). Use plain language for remarks; no code is needed.

Calling in a Weather Observation

By Iridium (satellite) phone – dial MacWeather at 8816-763-20030.

By HF Radio – use the frequency that works best to contact MacOps. Provide MacOps with the observation and request it be passed to MacWeather.

Example weather observation call:

"Hello, this is Chris from Whillans Ice Plain Camp with the Six Z Observation." [Wait for affirmation between relaying bits of information.] "We are at 83.65 south latitude and 167.4 west longitude. Winds: Grid Northwest at 12 knots. Visibility: 1,600m. Present weather: snow and mist. Amplification of weather: light snow. Clouds: Broken at 1,000, Overcast at 5,000. Total sky cover: eight oktas. Temperature: negative ten. Dew point: negative fifteen. Barometric pressure: 28.245. Surface Definition poor, Horizon Definition poor. Remarks: all winds grid, mist in the vicinity at grid north. Thanks. Goodbye."

Calling for a TAF

To receive a TAF for a specific site, call MacWeather at 8816-763-20030. This call may be placed at any time on a day that an aircraft is scheduled for the site. Only the most recently generated TAF will be provided, regardless of the time of the call.

TAFs are relayed in an abbreviated format. The caller should have a pencil and paper ready at the start of each call. Below is an example of a typical TAF, followed by an explanation of how to interpret each section.

Example #1:

SDM TAF 0915/1015 (1004/1104NZDT) VRB04KT 1600 BR FEW010 BKN030 OVC050 QNH2855INS

BECMG 0917/0919 (1006/10008) VRB06KT 0400 SN FG OVC007 QNH2850INS

Translation:

The forecast (TAF) for Siple Dome (SDM) is in effect from 0400 NZ time on the 10th of the month to 0400 on the 11th of the month (0915/1015 (1004/1104NZDT)).

Winds will be Variable at 4 knots (VRB04KT).

Visibility will be 1,600 meters. (1600).

Mist will be present (BR).

The first layer of clouds will be Few at 1,000 feet (FEW010).

The second layer of clouds will be Broken at 3,000 feet (BKN030).

The third layer of clouds will be Overcast at 5,000 feet (OVO050).

Barometric pressure will be 28.55 inches (QNH2855INS).

Then, beginning at 0600 on the 10th day of the month NZ time (1006/10008), the weather will begin to transition from the previous forecast to a different one. By 0800 on the 10th day, the new forecast conditions should be in effect. (BECMG 0917/0919).

Winds will increase to Variable at 6 knots (VRB06KT).

Visibility will drop to 400 meters (0400).

There will be moderate snow and fog. (SN FG).

Skies will be Overcast at 700 feet (OVO007).

Barometric pressure will be 28.50 inches (QNH2850INS).

Example #2:

NBY TAF 0915/1015 (1004/1104NZDT) GRID08010KT 8000 -SN BR BKN010 OVC020 QNH2837INS

TEMPO 0920/0924 (1009/1013) 2400 -SN BR OVC010

BECMG 0923/1001 (1012/1014) VRB06KT 9999 NSW SCT010 BKN030 QNH2834INS AMD 1900

The following table explains how to interpret each section.

Terminal Aerodrome Forecast (TAF) Table

Abbreviation	Meaning	Translation for TAF Example #2	Notes/Examples
NBY	Station Identifier	Byrd Surface Camp (NBY is the abbreviation for the airstrip at Byrd Camp)	WSD – WAIS Divide NZSP – South Pole AGO3 – AGO Site # 3
TAF	Report Type	Terminal Aerodrome Forecast	
0915/1015	Forecast date and time	09 (9th day of the current month) 15 (1500, the time of issue in GMT/Z) 1015 (the forecast goes through the 10th day of the month at 1500 GMT/Z)	
(1004/1104NZDT)	Conversion to New Zealand time		Sometimes the New Zealand time will be included in parenthesis following Zulu time.
GRID08010KT	Wind Direction and Speed	GRID080 – Winds are forecast to come from Grid 80 degrees (grid east). 10KT – Wind speed forecast at 10 knots	Wind direction is always noted in three digits. 005 = 5 degrees. 040 = 40 degrees. Wind speed is always noted in two digits. 08 = 8 knots. 35 = 35 knots.
8000	Visibility in Meters	Visibility on the ground is 8000 meters (5 miles)	9999 represents unrestricted visibility. This is used for any visibility of 7 miles or greater.
-SN BR	Forecast Weather	-SN – light snow BR - mist *(a handy way to remember that BR equals mist is to think “Baby Rain”)*	SN - moderate snow -SN - light snow +SN - heavy snow FG - fog IC - ice crystals BLSN – blowing snow DRSN – drifting snow NSW -no significant weather

Terminal Aerodrome Forecast (TAF) Table (continued)

BKN010	Cloud Layer 1 height in feet	The lowest cloud layer is a broken layer (covers 5/8-7/8 of the sky) at a height of 1,000 feet.	Cloud heights are given as three digits and omit the last two zeros of the number. 005 = 500 feet. 010 =1,000 feet. 100 = 10,000 feet (just add two zeros to get the height number).
OVC020	Cloud Layer 2 height in feet	The next higher of clouds is an overcast layer (clouds cover the entire 8/8 of sky) at a height of 2,000 feet	
QNH2837INS	Barometric Pressure	Station pressure is forecast to be 28.37 inches.	
TEMPO 0920/0924 (1009/1013) 2400 -SN BR OVC010 Change to one hour long	Temporary Condition	A temporary condition (for no more than 30 minutes) will occur between the exact times of 2000 Zulu and 2400 Zulu on the 9th day of the month. Visibility will drop to 2400 meters and the cloud layer will become a single overcast layer at 1,000 feet.	Since wind direction, wind speed and pressure are not included in the TEMPO, it is assumed that they stay the same as in the original forecast.
BECMG 0923/1001 (1012/1014) VRB06KT 9999 NSW SCT010 BKN030 QNH2834INS	Becoming: The forecast conditions will change to a new one during the stated times. The new forecast will be in effect by the end of the BECMG period.	From 2300 on the 9th day of the month (Zulu) to 0100 on the 10th day of the month (Zulu) conditions will begin switching from the original forecast to a new one. By 0100 winds will be Variable at 6 knots. Visibility will be unrestricted. There will be No Significant Weather. Clouds will be Scattered at 1,000 feet and Broken at 3,000 feet. Pressure will be 28.34 inches.	New Zealand time is 12-13 hours ahead of Zulu time (depending on Daylight Savings Time). Therefore, the Zulu time forecast often appears to be for an earlier date. Be sure to check the Z versus the NZDT times.
AMD 1900	Time of amended forecast	This TAF is an amended forecast issued at 1900.	

Sea Ice Assessment

A McMurdo Sound Sea Ice Report is available bi-weekly while the sea ice is open for travel. The report consists of a satellite image with sea-ice routes overlaid and current conditions noted. Personnel should review the report before traveling on the sea ice and contact Field Safety and Training personnel with questions, if any.

Safe travel on the sea ice requires paying attention to weather conditions, ice thickness, ice color, ice temperature, and cracks.

Weather

Poor weather conditions will obscure surface definition, making it difficult or impossible to detect cracks. Use extra caution if surface definition or visibility is poor. Strong winds can be particularly dangerous, especially at the ice edge, where large chunks of the sea ice can break off and blow north with little warning.

Ice Thickness

Strong currents can erode the ice from below. This is hazardous because there may be no obvious indication of thinning from the surface. The currents typically occur later in the season and usually over underwater shoals. Land formations that indicate a potential shoal are long, low-angle ridges or peninsulas that descend into the sea. However, shoals can also occur offshore of steep slopes, such as the north side of Little Razorback Island. At McMurdo Station, the areas adjacent to Cape Armitage (at the base of Observation Hill), Hut Point, and Knob Point/Cinder Cones historically experience strong currents and thinning ice later in the season. In addition, as the air and sea temperature rise, the sea ice becomes progressively weaker and thinner everywhere.

Ice Color

The color of the sea ice is a good indication of its thickness and safety. In general, white or milky blue ice is the safest. In McMurdo Sound, these colors indicate solid ice 24 or more inches thick. Ice that is sky blue and has a slick, scalloped surface is multi-year ice that is several feet thick.

Ice of different ages and thickness will be marked by a thin line on the surface and, usually, slight differences in elevation. If the color of the ice changes abruptly, travelers should stop immediately and investigate. Darker ice indicates a hazard. Ice that is young or has thinned to six inches or less will appear grayish, even beneath a thin crust of snow. This ice may support an adult on skis but should never be traversed in a vehicle. Gray ice can also form as a result of surface flooding and subsequent freezing of the surface water, which often occurs at tidal cracks. It is always important to investigate areas of gray ice. Sea ice that appears black is very thin and should be avoided at all times.

When traveling off established routes, field team members should drill the sea ice every 100 meters if the ice surface is consistent, and much more frequently if there are variations in color or texture.

Ice Temperature

Colder ice is stronger. The colder the ambient air temperature, the more the ice grows. And the colder the sea ice, the stronger the overall structure. Just looking at the surface will not disclose the true strength of the ice. Sea ice strength is measured according to four temperature periods:

Period 1	Period 2	Period 3	Period 4
<14° F	14°- 23° F	23°- 27° F	27°- 28.5° F

Sea Ice Cracks

Cracks are fissures or fractures in the sea ice that form in response to environmental, geographical, and mechanical pressures, such as wind, waves, tidal action, and the pressure of ice shelves and glaciers pushing against the sea ice. Tidal cracks form along coastlines and around islands, grounded icebergs, and glacier tongues. Other cracks radiate out from the land, especially from headlands and glacier tongues, like the spokes of a wheel.

Cracks should be avoided whenever possible. If crossing one is unavoidable, cross it in a line perpendicular to the crack. Never cross a system of multiple, closely set cracks in a manner that places a vehicle on more than one crack at a time. Avoid sets of cracks that form triangular wedges. These could break off and turn over under the weight of a vehicle.

Snow cover on the sea ice can hide cracks. When traveling off established routes, look for continuous linear features and sagging areas of snow, sometimes of different color tones. Watch for areas where snow has drifted differently, especially if the drifted area is in a long, straight line. Good visibility and lighting are essential to seeing these features. Also, pay attention to seals or signs of seals, such as feces, urine, seal shadows, and breathing holes. Their presence anywhere on the sea ice indicates the presence of a crack.

Crack Types

There are four general types of sea-ice crack:

- Tidal
- Straight edge
- Working (active)
- Pressure ridge

Each is described and discussed during sea-ice training. Field party members working on the sea ice should learn to identify and evaluate each type.

Safe Ice Thickness Standards for Cracks

Effective crack width is the distance over which the sea ice in a crack is less than the minimum required for a vehicle, based on ice period. The effective width cannot exceed 1/3 of a vehicle track length or area of a tire in contact with the ice. Use the following Light Vehicle Sea Ice Guidelines to determine required ice thickness and effective width for the vehicle in use.

Light Vehicle Sea Ice Guidelines

Vehicle	Maximum Effective Crack Width (in)	Minimum Ice Thickness (inches)			
		Period 1	Period 2	Period 3	Period 4
Pisten Bully	36	12	12	17	17
Hägglunds	27	15	16	21	22
Snowmobile	20	5	5	6	7
Mattracks	15	12	13	17	18

** If towing a sled or trailer, different ice thickness requirements may apply. Please contact FS&T at X2345 for more information.*

How to Profile a Sea-Ice Crack

Stop the vehicle before reaching a crack and check for other cracks nearby.

1. Determine the nearest edge of the crack by removing snow down to bare ice.
2. Using an ice ax, probe for open water or weak spots to determine if it is safe to cross by foot.
3. If it is safe, shovel the snow out of the crack from edge to edge, clearing at least one shovel blade width.

4. Drill holes every 12 inches in a straight line, beginning outside one crack edge and ending outside the other, making certain to drill healed shelves and any visible fractures.
5. Drill each hole either to water level or to a full Kovaks drill flight length (>30 inches).
6. Measure the ice thickness in each hole.
7. Pay attention to the characteristics of the ice shavings (dry, moist, or slushy).

Sea Ice Crack Profile Example