SCRM: Eduardo Frei Montalva Airport

Geography

In particular, the topography of the Antarctic Peninsula is a mountainous barrier that extends from the base of the continent and narrows northward reaching latitude 63º S. It has an extension of about 1300 km and an average width 70 km north of the 69º S (Figure 2.1). The mountain peaks have an elevation above 2000 m and even at the northern end of the peninsula they reach 800 m. On average, the peninsula is a formidable mountain barrier to air flow, with an average height of 1500 m that extends almost longitudinally separating the southern Pacific and Atlantic oceans. King George Island is part of the South Shetland Islands located north of the Antarctic Peninsula, separated by the Bransfield Strait (Figure 2.1). Several countries have installed Bases in different sectors of the island or in other nearby. In March 1969, Chile began operating the President Eduardo Frei Montalva Base as a successor to the station located on Deception Island which was destroyed by a volcanic eruption in December 1967. In 1979, a track was built next to the Base. landing to which he was later incorporated radio-aids and aeronautical facilities thus constituting the Lieutenant Rodolfo Marsh airfield. The Antarctic Meteorological Center (CMA) was also named Eduardo Frei Montalva and was established as one of the three Meteorological Collection Centers (CCA) in the Antarctic continent. This is in accordance with the resolution of the First Meeting of the Antarctic Meteorology Working Group of

the Executive Council of the World Meteorological Organization (WMO), held in Australia in 1966. The CMA technically depends on the Meteorological Directorate of Chile and has a weather station with a synoptic observation program every 3 hours (00, 03, 06, 09, 12, 15, 18, 21 TUC: coordinated universal time) of the main atmospheric parameters such as temperature, humidity, precipitation, wind (direction and intensity), pressure, cloudiness (type, quantity and height) and others.

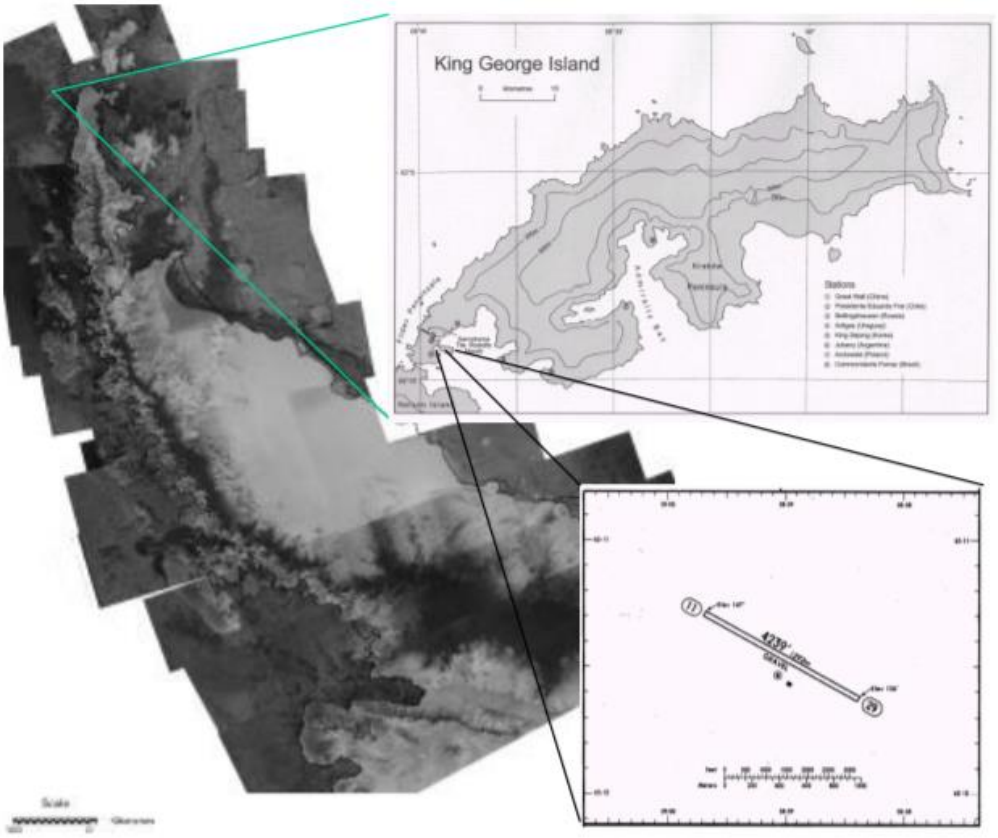


Figure 3.1 Location of King George Island on the Peninsula Antarctic and Airfield Lieutenant Rodolfo Marsh.

King George Island is the largest of the South Shetland Islands. It has a length of about 80 km and its widest part is no more than 28 km. The southernmost region of the island is the narrowest with no more than 2 km wide. It is at this end, next to the Bay of Fildes that the CMA is located and the airfield that crosses the sector in a northwest-southeast orientation with its north end facing the Drake Pass and the south of Fildes Bay. Due to its location it has a maritime climate in the summer but in winter it has a polar climate.

Temperature

The monthly average and the interannual variability (given by ± 1 standard deviation) of the average air temperature at the Frei station is shown in Figure 2.2. Positive values take place in the summer months (December, January and February) and near zero degrees in March. The annual cycle does not show the characteristic of "winter without minimum" like the seasons inside the continent (Figure 1.5). Greater variability is observed in the winter months. The average monthly hourly percentage distribution is plotted in Figures 2.3a and 2.3b for temperatures greater than 0º C for temperatures between -10 and 0º C, respectively. Results indicate the annual behavior of the temperature where the months from June to September 90 to 95% of the time the temperatures do not exceed 0º C and do not present a defined daily oscillation, instead the months of January and February a maximum temperature between 18 and 21 UTC. Table 1 also shows the average monthly temperatures and the temperatures of the warmest day (MAX. ABS.) And coldest (MIN. ABS.) Of the respective month.

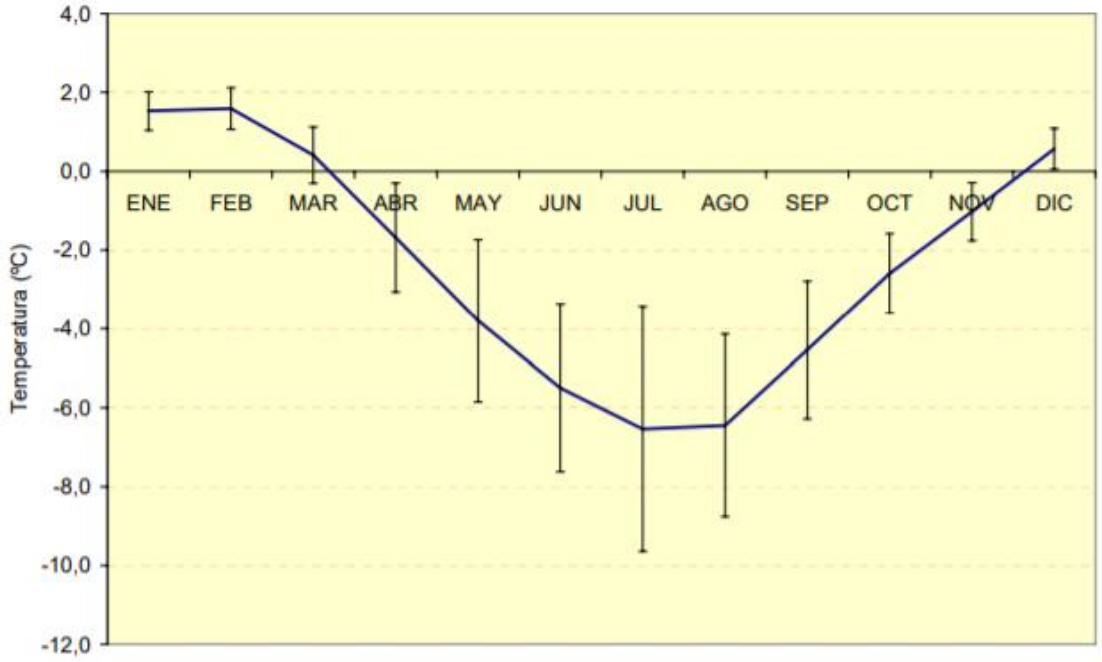
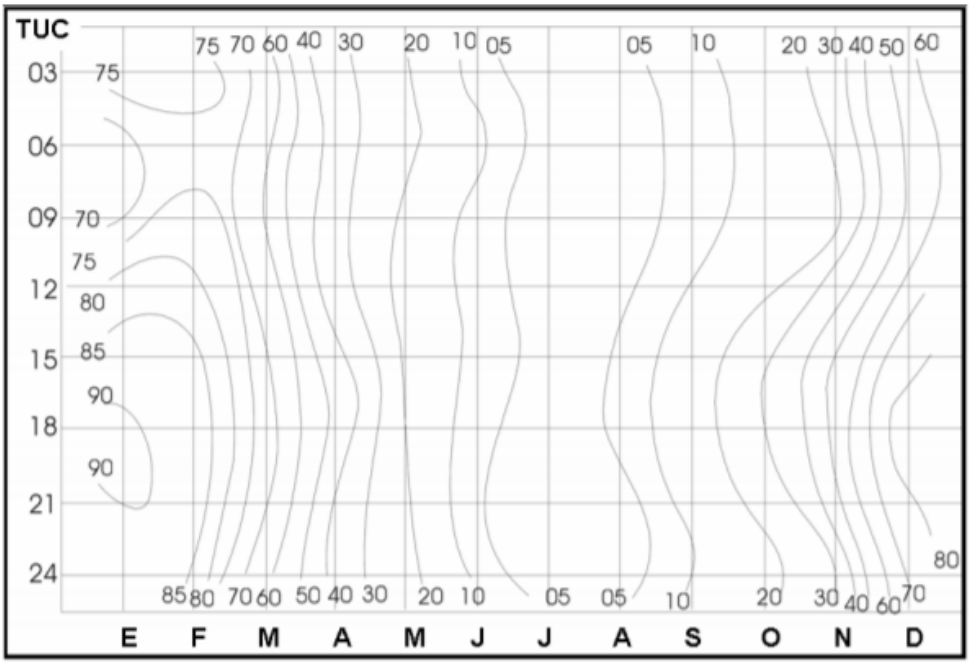


Figure 2.2 Annual oscillation of the average air temperature (1970-2000) in Frei Base. Vertical bars indicate ± 1 standard deviation.

Table 2.1 Average monthly air temperature along with its standard deviation and absolute maximum and minimum monthly average for the period 1970 - 2004 in Base Frei

MES	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC
MEDIA	1,5	1,6	0,4	-1,7	-3,8	-5,5	-6,5	-6,5	-4,5	-2,6	-1,0	0,6
DESV.EST.	0,5	0,5	0,7	1,4	2,1	2,1	3,1	2,3	1,7	1,0	0,7	0,5
MAX. MEDIA	2,7	2,9	2,2	0,6	-0,8	-1,5	-0,9	-2,2	-1,3	-0,8	0,0	2,1
MIN. MEDIA	0,3	0,6	-1,2	-4,8	-8,2	-9,4	-13,2	-11,3	-8,0	-5,6	-2,8	-0,3
MAX. ABS.	13,0	9,2	8,3	5,9	4,6	4,2	5,0	3,8	4,4	4,4	6,0	8,2
MIN. ABS.	-5,1	-5,8	-9,9	-16,8	-23,6	-24,2	-28,5	-28,7	-23,0	-17,0	-10,7	-6,8



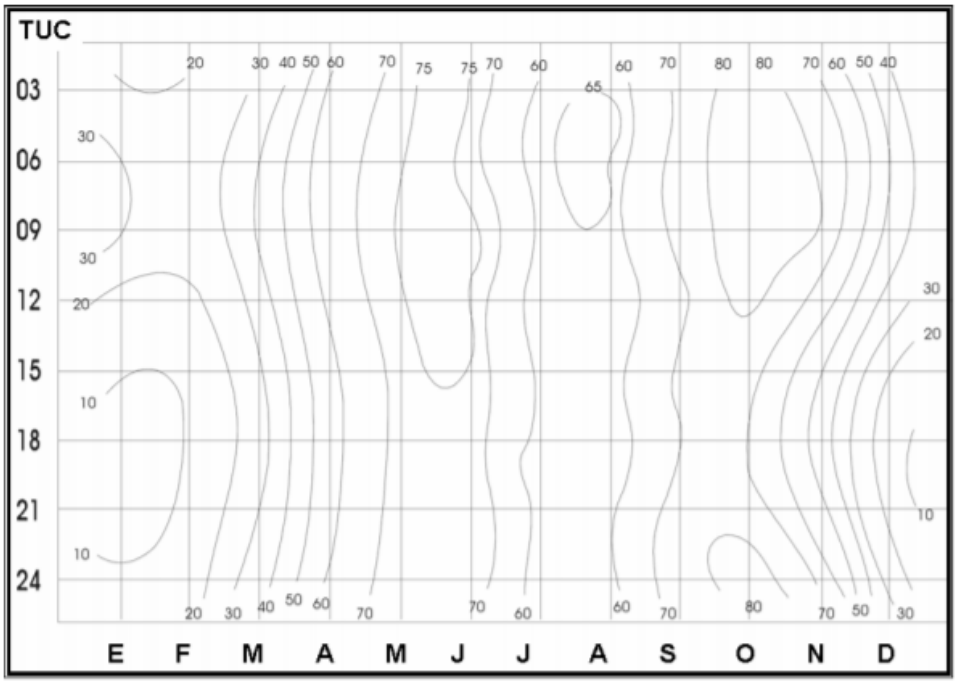


Figure 2.3. (a) Monthly temperature distribution greater than 0º C and (b) monthly temperature distribution less than 0º C and greater than -10º C.

Atmospheric Pressure

The northern end of the Antarctic Peninsula is within the circumpolar trough that surrounds the continent. This low pressure band results from the relative highest frequency of cyclonic activity in the southern oceans. The frontal systems that are formed in the middle latitudes by the encounter of relatively colder air masses of polar origin with relatively warmer masses of tropical origin and traveling southwestward reaching the vicinity of the Antarctic continent in its state of dissipation. The climatic average of this activity is reflected as a zone of low pressures around the continent in the meteorological charts of the field of surface air pressure.

The average annual behavior of pressure at sea level at Frei station shows two maximums, one in autumn and the other in spring and two minimum (Figure 2.4, Table 2.2) revealing the semi-annual oscillation due to the north-south displacement of the circumpolar trough.

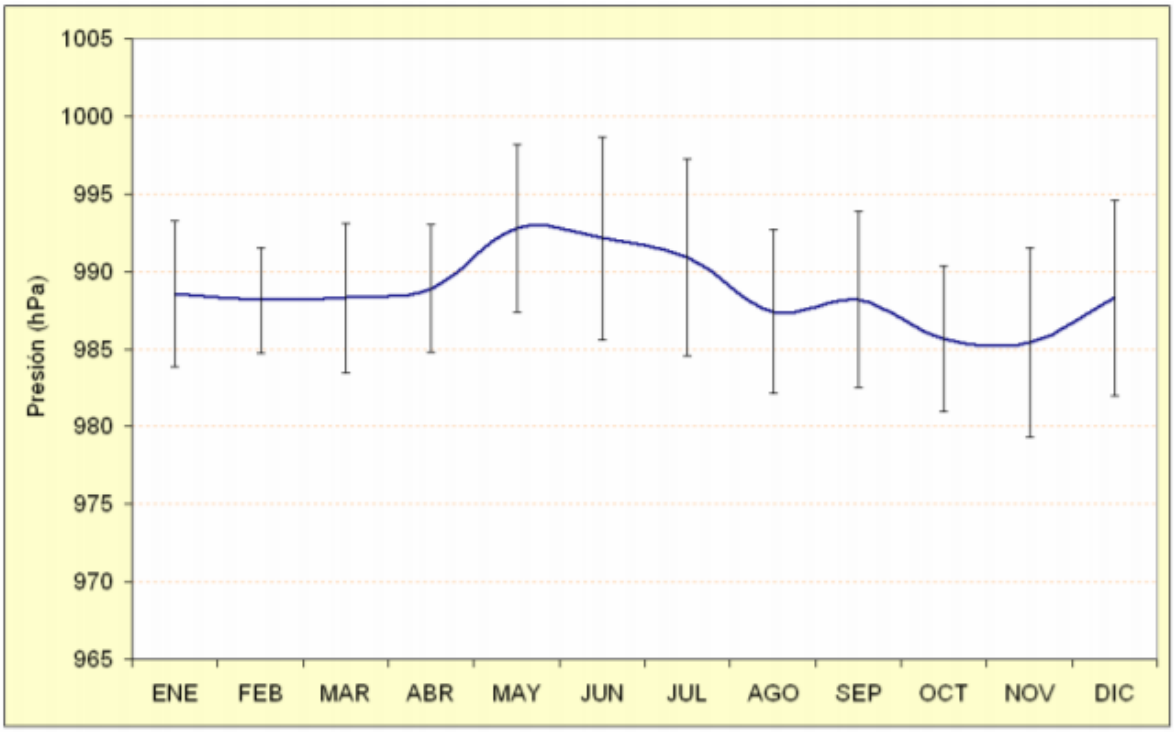


Figure 2.4. Average monthly behavior of atmospheric pressure at Frei, Prat and O'Higgins stations.

Table 2.2 Average monthly values (1971-2004) of atmospheric pressure at the Frei station

MES	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC
MEDIA	987,9	988,1	988,0	988,5	992,1	991,3	990,8	988,3	988,7	985,9	985,2	988,1
DESV. EST.	5,7	4,1	5,4	4,5	5,4	8,0	6,8	6,1	5,7	5,6	6,0	6,5
MAX. MEDIA	995,3	998,9	1000,2	999,3	1002,3	1006,6	1001,9	1000,2	998,4	999,7	996,3	1000,7
MIN. MEDIA	967,8	980,0	974,0	979,7	981,1	961,6	973,3	977,2	974,3	975,0	972,4	977,0

Wind Direction & Wind Speed

The weather pattern of sea-level pressure in the vicinity of the Antarctic Peninsula indicates the prevailing wind regime of its southern component on its east side over the Weddell Sea, and its north / northwest component on its west side over the Bellingshausen Sea. In particular, Figure 2.5 shows the frequency of the annual distribution of the wind direction at the Frei station. It can be seen that the wind prevails with a west and northwest direction. In second place it is observed an east-southeast wind. Table 2.3 shows the monthly distribution (%) of wind speed for certain given intervals, while Figure 2.6 graphs the percentage of wind occurrence greater than certain

values. Clearly the semi-annual oscillation of wind intensity can be observed in the maximums that take place in April and October for values greater than 10 knots (Figure 2.6). In general, the wind intensity increases during the equinoxes and is on average higher in winter.

Table 2.3 Monthly percentage distribution of wind direction at Eduardo Frei station.

Dirección/ Month	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC
360 N	10,9	10,6	10,6	8	8,8	10,4	8,3	12,2	13,9	12,4	13,6	12,9
030	7,1	7,6	6,4	6,3	6,5	6,5	6	5,8	7,5	5	5,9	5,9
060	2,4	2	2,5	2,1	2,4	2,4	1,5	1,1	0,5	0,8	2	1,8
090 E	12,2	7,4	8,6	9,3	7,5	8,9	5,6	8,2	5	4,3	6,4	9
120	17,8	16,5	13,3	14,6	15	14,9	13,7	12	9,7	7,5	10,6	15,9
150	5,1	3,6	3,3	3,9	5,9	7,1	4,8	6,8	5,2	1,5	2,5	4,1
180 S	1,2	1	0,9	1,5	2,7	2,1	2,4	1,9	1	1,1	0,9	0,8
210	1,5	1,6	1,5	2,6	3,5	1,8	2,1	3,5	2,4	2,5	1,8	1
240	3,7	5,5	4,4	6	9,2	6,2	8,1	7	8,3	8,1	5,7	4,3
270 W	1,7	14,5	17,1	13,6	9,7	10,8	10,9	9,7	12,7	17,9	16,2	12,6
300	9,6	10,8	12,5	9,7	7,1	7	8	9	9,7	13,4	11	3,4
330	11,5	14,4	14,9	16,6	12,2	10	12,1	12,3	16,8	19,8	16,9	13,6
CALMA	5,4	4,4	4,5	5,8	9,6	12	16,5	10,6	7,4	5,7	6,5	4,8

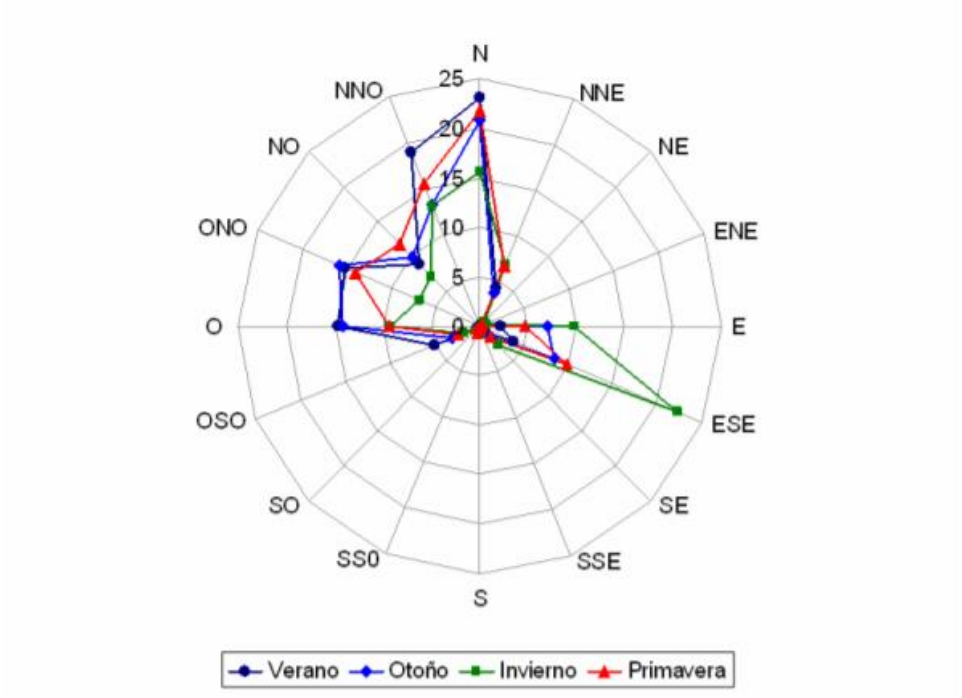


Figure 2.5 Seasonal average of wind direction at Eduardo Frei station

Clouds

The Frei Base is permanently affected and is exposed to the passage of cloud masses associated with frontal and depressing systems that pass through the sector. Hence, the station and in general the area of the South Shetland Islands are generally cloudy, in fact more than 70% of the days of the month the skies are covered with 6 (octa) or more clouds (Figure 2.7). Masses of cold air moving northward become unstable by interacting with relatively warmer surface sea waters. This means that the cloudiness associated with these air masses is of the cluster and stratocumulus type. The colder the air, the stronger the temperature contrast with the ocean and the greater the instability, generating conditions for the formation of mesoscale cyclones and / or clusters of strong development that cause storms with strong winds and snowfall In contrast, relatively warmer air masses that travel from the mid-latitudes to the south interact with a relatively cooler sea surface, so the air mass tends to stability. The characteristic cloudiness associated with these air masses is of the stratiform type, mainly low strata based on the near-surface cloudiness (low ceilings) and which can eventually cause mists.

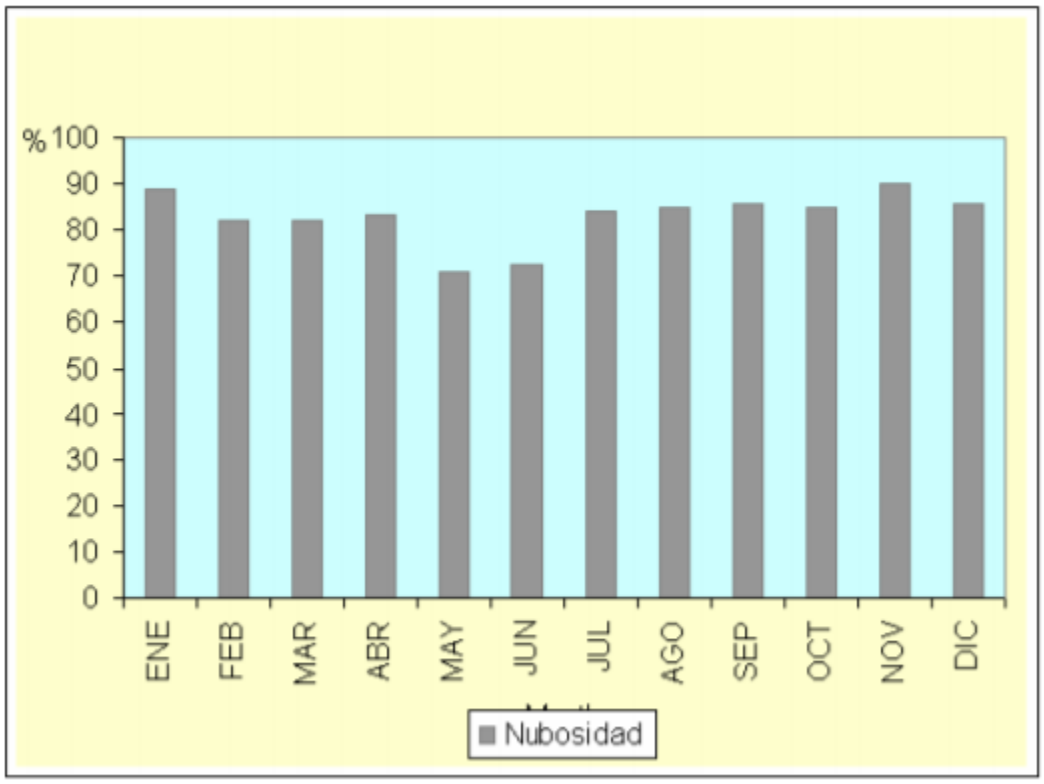


Figure 2.7 Amount of average monthly cloudiness observed at Frei station

King George Island and in general the entire Antarctic Peninsula sector is, on the one hand, exposed to the northwest flow associated with frontal systems and already weakened cyclonic depressions that dissipate west of the peninsula, and on the other hand to the passage of these same disturbances that in its trajectory towards Atlantic Ocean affect the sector. In the first case, warm and humid air is advected on the island and with it frequently the low cloud type strata and stratocumulus, and occasionally fog, reaches the Frei base. Eventually there may also be rainfall associated with the rest of the frontal cloudiness that is projected on the peninsula. In the second case, the passage of a frontal system through the region is first accompanied by warm advection in front of the front, rather stable cloudiness associated with the front and rainfall; then when the front and this depression is located east of the peninsula, the island is affected rather by cold air advection, instability and rainfall of water or snow showers depending on the time of year and the intensity of the frontal system that affected it.

Visibility

Figure 2.8 shows the frequency of days with horizontal visibility less than 1600 m, 5000 m and 10000 m, respectively. Between 20 to 30% of the days of the month the visibility is less than 1600 m. These reductions are mainly due to mists and precipitation. On the other hand, the Frei station reveals that more than 70% of the time is met by a cloud cover greater than 6 octas. The visibility and height of the cloud base are important parameters for air operations, so these two variables are analyzed in combination: when visibility is less than 1600 m and the cloud cover is less than 150 m. Results indicate that about 7% of the time these two conditions occur simultaneously, being more frequent during the summer and winter, and that their daily behavior indicates greater frequency between the hours of the night and mid-morning.

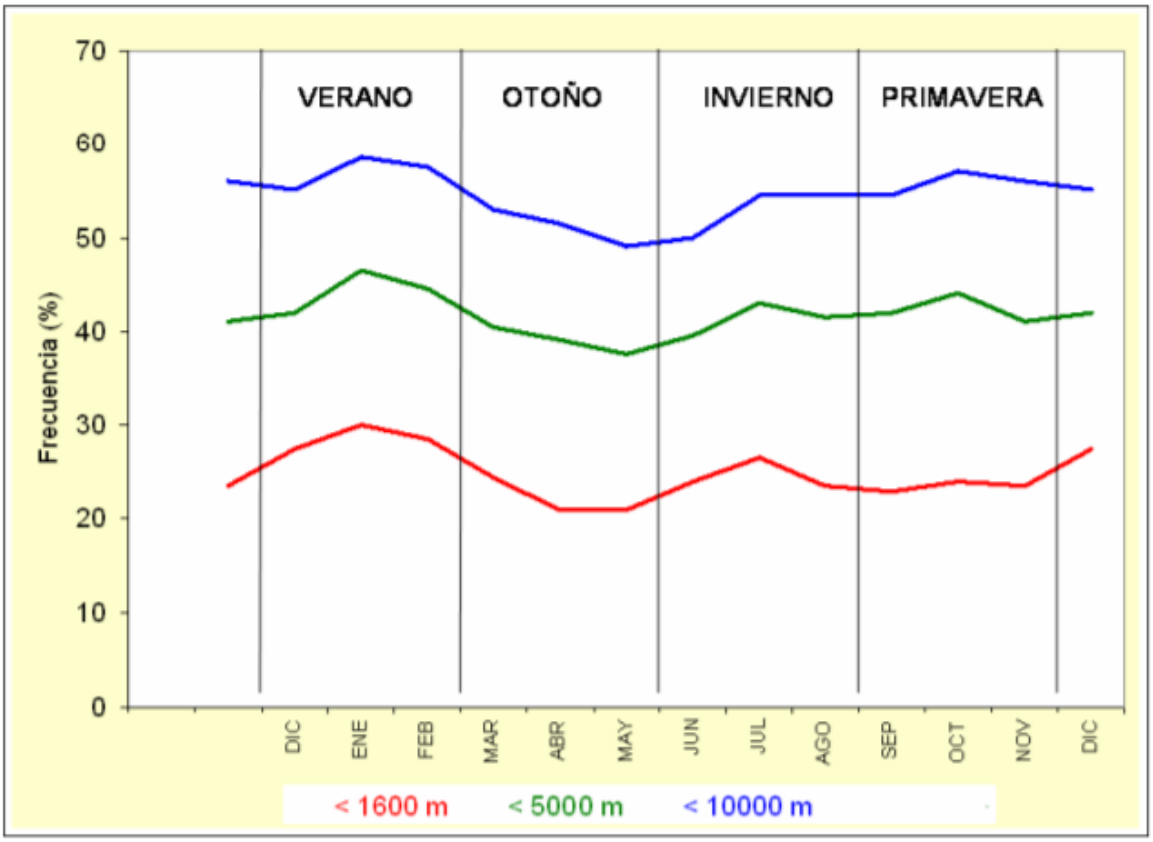


Figure 2.8 Visibility frequency under 1600 m, 5000 m and 10,000 m during the year at Eduardo Frei station.

An analysis of the days with wind direction and visibility less than 1600 m indicate that mostly the reduction in visibility occurs with wind from the northwest quadrant and to a lesser extent with an east-southeast component. Visibility reduction under 1600 m does not occur with winds from the southwest and south as well as from the northeast. Figure 2.9 illustrates these results through the distribution of the seasonal frequency of the wind direction.

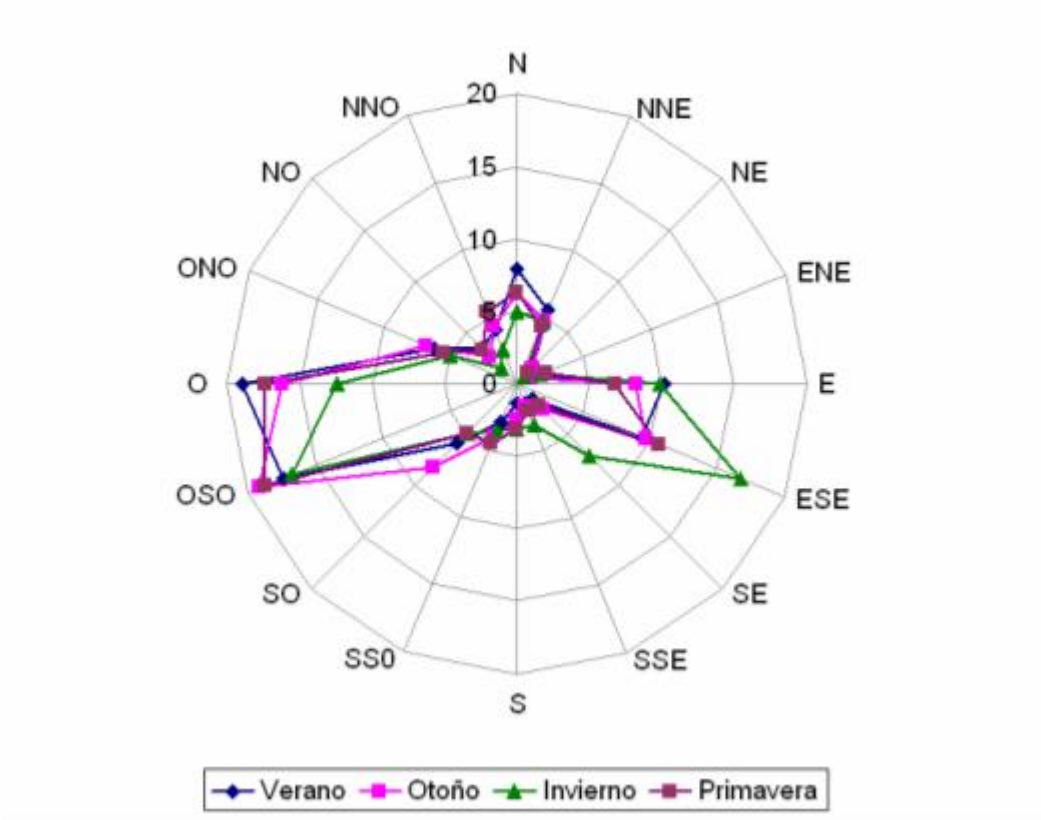


Figure 2.9 Prevailing wind direction for visibility less than 5000 m, and (b) for visibility greater than 10,000 m.

Precipitation

Precipitation in Antarctica is difficult to measure, especially snow due to wind. The general precipitation decreases towards the interior of the continent and is higher on the coastal edge. In particular, the average annual rainfall is higher on the West side of the Antarctic Peninsula than on the East side. Precipitation is mainly of frontal origin and postfrontal instability including the activity of cyclones at mesoscale. The orographic effect of the Antarctic Peninsula introduces an additional mechanism for the air ascent movement which favors precipitation on its west side, while downward flow on the leeward side precipitation is inhibited along the east side of the peninsula.

In particular, the Frei station is under the influence of the west flow and the topography of the island has a minimal influence on the amount of rainfall recorded annually, at least in comparison to the influence exerted by the mountains along the west coast of the peninsula. Figures 2.10 and 2.11 show respectively the amount of monthly precipitation

and the monthly average of the number of days with liquid and solid precipitation. Clearly, precipitation presents a semi-annual behavior with two highs in autumn and spring and two minimums in summer and winter. Although snow-like precipitation predominates in winter, liquid precipitation events (rain, water showers, drizzle) also occur, and snowfall also occurs in the summer months.

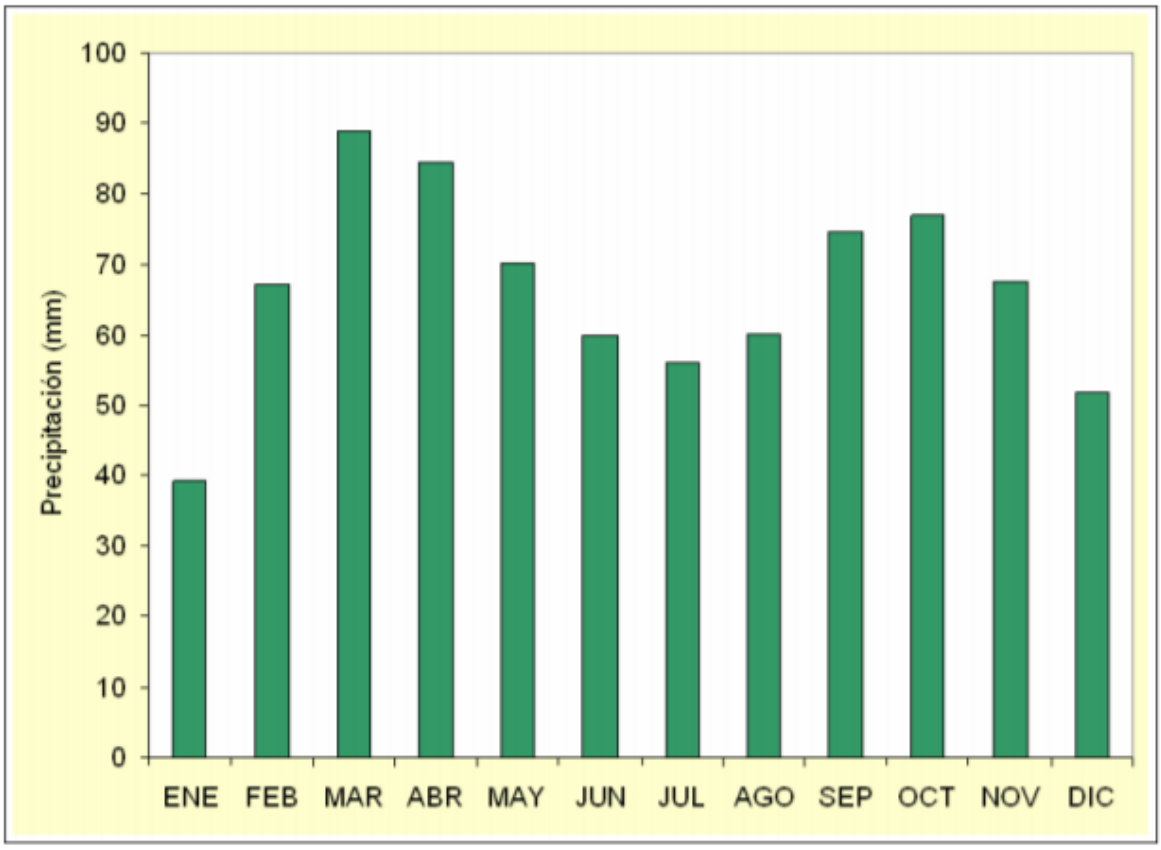


Figure 2.10 Average monthly total rainfall at Eduardo station Frei

Figure 2.12 shows the cumulative frequency of the maximum daily rainfall at the Frei station. About 27% of precipitation events accumulate a daily total between 6 and 8.9 mm and less than 5% exceed a daily accumulation above 21 mm. Around 60% the accumulated rainfall in 24 hours is less than 9 mm.

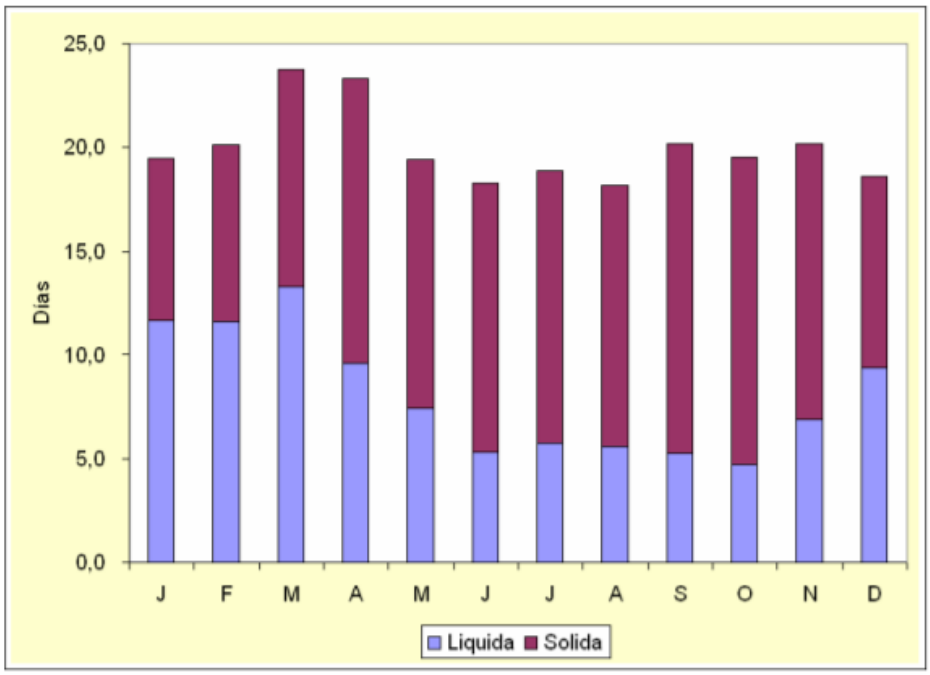


Figure 2.11 Monthly average of days with solid (snow) and liquid (rain) precipitation recorded at Eduardo Frei station

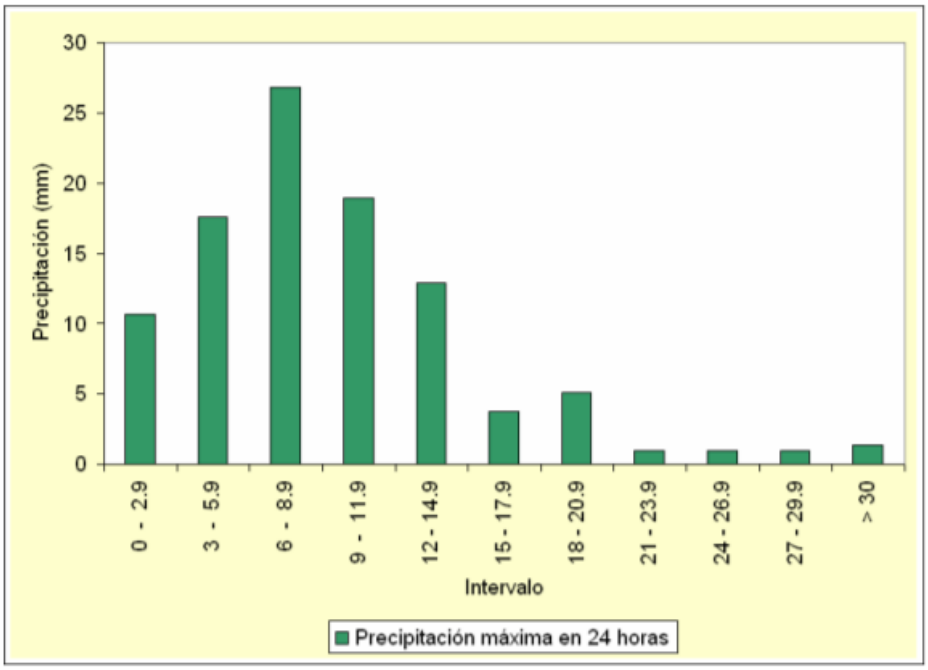


Figure 2.12 Cumulative frequency of maximum daily rainfall at Frei station