THE MARINE ICE OF POLAR LATITUDES: ANNUAL AND INTERANNUAL EVOLUTION

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In this paper the intra-annual and interannual variability of the marine ice is analysed over the period 1979-2008 from the data and images facilitated by the «National Snow and Ice dates Center» (NSIDC). Special emphasis is placed on the annual extreme values, maximum and minimum marine ice surface areas.

From the monthly data of marine ice surface area during the period 1979-2008 the following statistical data are obtained:

— maximum, minimum, average, standard deviation and range
— analysis of tendency of the ice surface: annual average, maximum and minimum
— study of the surface temperatures in the polar meteorological stations with longer series.
— Relation of the temperature to the ice surface in the contemporary period: 1979-2008.

For the temporary analysis of the temperatures, we have selected the meteorological stations of the polar regions that are located in rural areas with populations of less than 10,000 inhabitants.

The series of temperatures have been obtained from Peterson & Vose (1997) and Peterson *et al*. (1998) of the Scientific Committee on Antarctic Research (SCAR) and the United States Historical Climatologic Network (USHCN).

The annual average surface area of the marine ice during the period 1979-2008 is very similar in the two polar zones: (11.94 mill km^2 in the Antarctic and 11.91 mill km^2 in the Artic).

When contrasting the intra-annual variations of the marine ice in the polar zones: greater extension is noticed during the six winter months in the Antarctic, with surface areas clearly superior to those of the Arctic Ocean. The greater development of the austral marine ice takes place due to the cold contributed by the great frozen continent. Thus, in the Oceans

that encircle the Antarctic, for five months of the year the marine ice occupies an extension superior to 16 mill km^2; a figure that has not been reached in the Arctic Ocean since 1988, and, has only occurred there for a maximum period of 2 months in the peak months of March and February. Further, the maximum monthly extension of the marine ice occurs in the South hemisphere, with an average value in September of 18.75 mill km^2, as opposed to the 15.58 mill km^2 in the month of March in the Arctic Ocean (1979-2008 period). The austral supremacy as far as the extension of the marine ice is concerned continues during the long polar winter and it is only during the polar summer season when there is a greater surface area in the Northern hemisphere.

When analysing the evolution of the annual averages over the period 1979-2008, the abrupt and progressive reduction of the extension of the ice in the Arctic Ocean is surprising. The minimum average extension is in 2007, with 10.70 mill km^2. Although the figures for the year 2008 indicate an inferior annual ice surface area in comparison to the average of the thirty year period, there is a considerable increase evident with respect to the two preceding years (with higher values in every month of the year, except in June). This means that the uninterrupted descendent tendency from 2003 has been reversed for the first time.

The linear tendencies of the arctic ice (annual ice surface, maximum and minimum parameters), are clearly significant and negative as far as extension and concentration in the summer are concerned. Although the period of sampling is reduced we can affirm that there is a clear tendency to the reduction of the frozen surface area of the Arctic and its concentration in summer, but the tendency of the concentration of the marine ice at the winter maximum is not significant.

On the contrary, the annual figures for the extension of the marine ice in the Antarctic during the last 30 years emphasize the considerable and progressive increase of the average surface area, with great interannual oscillations.

The increasing surface area of the austral ice in terms of monthly and annual maximum values of extension of the marine ice is evident from the year 2000, reaching a high for the year of 2008.

The spatial variations are small during the winter whereas they are large at the end of the polar summer. The greater development of the summer ice in the seas of Wedell and Ross gives rise to remarkable changes in these platforms. As opposed to the alarmist news of numerous mass media reports concerning the ice levels in the sea of Wedell, the analysis from 1979 to 2008 allows us to contradict this catastrophic theory, because there is an evident increase of the ice between the platforms of Larsen and Rüser-Larsen. Furthermore, the recent defrosting of the Plate of Wilkins, next to the islands Charcot and Latady in the west of the continent, had also taken place between the summers of 1989 and 1991. Although the extension of the marine ice in the final months of 2008 shows a clear decrease in the Plate of Wilkins, in other sectors of the coast there is a remarkable increase. For this reason the data must be analysed as a whole and not by the extrapolation of temporary variations of a particular plate, without taking into consideration what is happening with the remainder of the marine ice.

The linear tendency of the annual average surface area of the marine ice around the Antarctic for the period 1979-2008 is positive and significant to 99 % of confidence, although

the straight line regression only explains 30 % of the annual variability. On the contrary, the linear tendency of the extreme months is not statistically significant, because although their straight lines have positive slopes, the values are very small.

Of the series of temperatures in the Arctic with registries from the beginning of the nineteen thirties or even before, half of them have the same annual thermal maximums as today and, the other half have their maximums in 1937 and 1943. Of these most are located in the Siberian coast. As there are neither satellite images during those decades, nor cartographic documentation of the ice surface area of the Arctic Ocean, it´s impossible for us to know what influence those exceptionally warm years had, mainly in the decade of the 1940s.

In the Antarctic during the 1979-2008 period, contrasted tendencies can be observed between the series located in the Peninsula and the rest of the continental stations. In the first ones, there is a clear ascent of the central tendency, whereas in the second ones, there is either no tendency or a negative tendency.

Regarding the total of the marine ice surface area, the evolution from 1979 to 2008 has a clearly deficit balance between hemispheres, because the reduction of the Arctic ice is greater than the increase of the Antarctic ice. Therefore there has been no compensation between hemispheres. It is necessary to consider that in this balance the continental ice is not considered. Surely the data to be obtained by the new satellites of polar orbit (Cryosat, Icesat, etc.), equipped with specific sensors to measure the continental ice, will allow us to know more about the Antarctic and Greenland in the future. The dimension and volume of fresh water stored in these continental areas must be really significant in the global climatic system.