

dem Abfall der entsprechenden Strahlungs-dichte-Verteilung des bedeckten Himmels in Abb. 8. Interessant ist der Vergleich dieser Werte mit solchen, die unter blauem Himmel gewonnen wurden (zweite Zeile von Tab. 2). Während die Albeden im Blau, Grün und Rot auch hier gleich 1 sind, sind sie sowohl im nahen Ultraviolett als auch im nahen Infrarot niedriger als unter bedecktem Himmel. Die Abweichung im Ultraviolett beruht darauf, daß die Kurve des spektralen Reflexionsvermögens des Schnees (nach Messungen von Dirmhirn 1957) zum Ultraviolett hin bereits absinkt; das macht sich bei grauem, dicht bedecktem Himmel nicht bemerkbar, wohl aber bei blauem, dessen Einstrahlung einen starken kurzwelligen Anteil besitzt. Die Unterschiede der Albedo im nahen Infrarot kön-

nen auf den von Kasten (1962) näher beschriebenen Effekt zurückgeführt werden, daß die Infrarot-Albedo um so höher ausfällt, je größer der Wassergehalt der Luft ist.

*

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Pelagic distribution of birds at the Weddell Sea

By Ricardo Novatti, Buenos Aires *

Zusammenfassung: Pelagische Verbreitung von Vögeln in der Weddell-See. Die Arbeit ist eine Aufzeichnung über Vogel-Beobachtungen in der Weddell-See (24 Arten). Die Beobachtungen wurden auf zwei Expeditionen im Südsommer 1955/56 und 1959/60 an Bord des argentinischen Eisbrechers „General San Martin“ gemacht. Nach einer Einleitung über die Weddell-See und die Arbeitsmethoden sind die Arten mit ihrem Beobachtungsgebiet und ergänzenden Bemerkungen beschrieben. Zwei Tabellen geben eine Übersicht über die an den einzelnen Expeditionstagen und in den durchfahrenen Gebieten gesehenen Vögel.

*

Abstract: Pelagic distribution of birds at the Weddell Sea. The essay contains the notes taken of the observation of birds at the Weddell Sea (24 species). The observations were made on two expeditions in the southern summer of 1955/56 and 1959/60 on board the Argentine icebreaker „General San Martin“. After an introduction dealing with the Weddell Sea and the methods of research the species are represented together with the territory of observation and supplementary annotations. Two tables give a survey of the birds seen on each day of the expedition and in the territories they sailed through.

I — Introduction

The present work offers the observations of the author on the pelagic distribution of birds at the Weddell Sea, Antarctica.

These observations were made during two polar argentine campaigns in the summers

1955—56 and 1959—60. The author participated of both of them as biologist of the Instituto Antártico Argentino aboard the icebreaker „General San Martin“ of the National Navy. His work was done always from aboard and he recorded the observed birds with ecological and ethological notes on them.

II — General features of the Weddell Sea

The Weddell Sea is one of the most important geographic accidents of the Antarctica. Its physical description is not satisfactorily known due to its extension as much as to the difficulties it presented and presents to exploration, in spite of the icebreaker-ships and special aircrafts, but it must be outlined that it remains frozen over its greater area during the whole year. A large part of the eastern and western coasts of the Weddell Sea bear the addition of large floating ice-barriers that unfasten masses of great extent that invade the Weddell and some other adjacent areas in lower latitudes. The great ice-fields and icebergs are important elements in the landscape — and

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Table I
Record of the birds observed at the Weddell Sea during the period: 6 december, 1955—19 january, 1956 between the following positions: 59° 09' S., 26° 45' W. and 77° 58' S., 38° 48' W.

Position of the ship at noon.
** Stay of the ship off Laurie Island — South Orkneys Islands.
° Ship unloading supplies for the argentine base „General Belgrano“, at the Filchner's Ice-barrier. The position belongs to the argentine base „General Belgrano“.
The numbers of the horizontal lines show individuals observed by species, for each day and position of the ship at noon.

Spezies	19. Phalacrocorax atriceps	18. Sterna vittata	17. Larus dominicanus	16. Catharacta skua	15. Chionis alba	14. Oceanites Oceanicus	13. Halobaena caerulea	12. Pachyptila desolata	11. Pagodroma nivea	10. Daption capensis	9. Thalassoica antarctica	8. Fulmarus glacialisoides	7. Macronectes giganteus	6. Diomedea exulans exulans	5. Eudyptes chrysolophus	4. Pygoscelis papua	3. Pygoscelis antarctica	2. Pygoscelis adeliae	1. Aptenodytes forsteri
6-XII-955 63°59'S. 55°04'W.	—	—	—	—	—	2	—	—	14	1	30	—	—	—	—	—	—	—	—
7-XII- 61°14'S. 46°15'W.	—	—	—	—	—	6	—	—	19	35	2	4	—	—	—	—	—	32	—
8-XII** 60°45'S. 44°43'W.	—	—	—	—	—	7	—	—	—	4	—	—	—	—	—	—	—	—	—
9-XII** 60°45'S. 44°43' W.	2	8	8	8	—	9	—	—	—	12	—	—	—	—	—	—	—	—	—
10-XII** 60°45'S. 44°43'W.	22	2	8	8	—	20	—	—	—	31	—	—	—	—	—	—	—	—	—
11-XII** 60°45'S. 44°43'W.	7	1	—	8	—	4	—	—	11	50	—	—	1	—	—	—	—	7	—
12-XII 60°08'S. 37°16' W.	—	—	—	—	1	3	—	8	—	24	6	—	1	—	—	—	—	—	—
13-XII 59°30'S. 28°08'W.	—	—	—	—	—	—	—	12	8	5	6	—	2	—	30	8	8	8	—
14-XII 59°27'S. 27°15'W.	—	—	—	—	—	1	—	—	4	15	14	—	—	—	—	—	—	—	—
15-XII 64°19'S. 36°28'W.	—	—	—	—	—	—	—	—	1	—	6	—	—	—	—	—	34	—	—
16-XII 63°28'S. 40°50'W.	—	—	—	—	—	—	—	3	11	6	7	—	—	—	—	—	31	3	—
17-XII** 60°45'S. 44°43'W.	—	8	20	—	—	8	—	—	—	8	—	—	—	—	—	—	—	—	—
18-XII** 60°45'S. 44°43'W.	6	8	8	8	—	8	—	—	—	8	—	—	—	—	—	—	—	—	—
19-XII** 60°45'S. 44°43'W.	12	8	8	12	—	8	—	—	—	8	—	—	—	—	—	—	—	—	—
20-XII** 60°45'S. 44°43'W.	2	8	—	60	—	8	—	—	—	8	—	—	—	—	—	—	—	—	—
21-XII 62°30'S. 44°40'W.	—	8	—	8	—	8	—	—	—	8	—	—	—	—	—	—	—	—	—
22-XII 66°10'S. 43°40'W.	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—	7	1
23-XII 68°09'S. 40°23'W.	—	—	—	—	—	1	—	4	17	—	23	1	—	—	—	—	—	5	—
24-XII 68°45'S. 39°39'W.	—	—	—	—	—	—	—	13	8	—	7	3	—	—	—	—	—	4	—
25-XII 69°09'S. 37°09'W.	—	—	—	—	—	—	—	—	—	—	180	—	—	—	—	—	—	—	6
26-XII 70°13'S. 34°17'W.	—	—	—	—	—	2	—	—	8	—	79	—	—	—	—	—	—	—	13
27-XII 69°55'S. 32°48'W.	—	—	—	—	—	—	—	—	4	—	13	—	—	—	—	—	—	3	2
28-XII 69°33'S. 31°15'W.	—	—	—	—	—	—	—	—	10	—	24	—	—	—	—	—	—	47	4
29-XII 69°26'S. 28°22'W.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20
30-XII 69°54'S. 27°18'W.	—	—	—	—	—	3	—	6	10	—	10	—	—	—	—	—	—	5	11
31-XII 70°28'S. 23°43'W.	—	—	—	—	—	—	—	—	5	—	7	—	—	—	—	—	—	—	—
1-I-956 71°41'S. 23°50'W.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2-I 71°53'S. 22°01'W.	—	—	—	—	—	1	—	7	31	—	41	—	—	—	—	—	—	5	12
3-I 75°25'S. 25°44'W.	—	—	—	—	—	—	—	—	10	—	8	—	—	—	—	—	—	—	60
4-I 77°44'S. 35°55'W.	—	—	—	—	—	—	—	—	3	—	32	—	—	—	—	—	—	—	34
5-I* 77°58'S. 38°48'W.	—	—	—	—	—	—	—	—	3	—	8	—	2	—	—	—	—	18	4
6-I* 77°58'S. 38°48'W.	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7-I 77°56'S. 38°35'W.	—	—	—	—	—	—	—	—	1	—	2	—	—	—	—	—	—	—	—
8-I 77°31'S. 35°09'W.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9-I 74°33'S. 24°39'W.	—	—	3	—	1	—	—	—	—	—	41	—	—	—	—	—	—	—	8
10-I 71°32'S. 19°01'W.	—	—	—	—	—	—	—	—	6	—	10	—	—	—	—	—	—	—	3
11-I 69°00'S. 14°23'W.	—	—	—	—	—	—	—	—	12	4	—	4	—	—	—	—	—	—	2
12-I 65°56'S. 18°08'W.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13-I 61°24'S. 24°20'W.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14-I 59°09'S. 26°45'W.	—	—	2	—	—	10	±50	—	8	8	—	8	—	—	—	—	—	—	—
15-I 59°45'S. 33°56'W.	—	—	—	—	—	—	—	—	—	22	—	—	—	—	—	—	—	—	—
16-I 59°38'S. 41°57'W.	—	—	—	—	—	3	8	—	8	—	8	—	2	2	—	—	—	—	—
17-I 60°45'S. 44°43'W.	—	—	—	—	—	15	—	—	—	8	—	—	—	—	—	—	—	—	—
18-I 63°14'S. 51°00'W.	—	—	—	—	—	5	8	—	43	—	8	—	—	—	—	—	2	2	—
19-I 64°47'S. 55°29'W.	—	8	—	—	1	13	—	—	12	1	113	—	—	—	—	—	—	—	—

though less parts of the barrier itself also — that often present difficulties to navigation.

III — Method of Work

The system followed consisted in a record of all the birds observed during almost all the day-hours and occasionally part of the night-hours. The author's task was done from the bridge, from the deck and from the crow's nest, using field glasses of excellent treated optics. The work by Murphy (1936) and the Bierman & Voous (1950) one were very useful. The observations record consisted on the number of the individuals of each species, date and hour of observation, surface temperature of sea-water, notes on the ice-conditions and behaviour of the birds.

The lack of the surface temperature of sea-water is mostly due to the existence of the ice that surrounded the ship preventing its observations.

The tables added detail the recorded birds according to the systematic order. Attending to the time for the exposition to the congressmen, some aspects of the observations are not commented with the desirable extension. The maps show the areas of the Weddel Sea visited during the observations period.

IV — Pelagic distribution of species according to its systematic order

1. *Aptenodytes forsteri* G. R. Gray, 1844. Antarctica latitude 64°, 77° S. **Emperor Penguin.** (Kaiserpinguin).

a) Northernmost record: Dezember 22, 1959 63° 30' S., 56° 11' W.
Sea-water temperature:
— 1,2° C.

b) Southernmost record: January 5, 1956. 77° 58' S., 38° 48' W.

The most remarkable concentration of these animals was recorded by the author on January 9, 1956 at dawn around 0100 o'clock on the return voyage from base "General Belgrano". It was observed a concentration of young and adults emperors in an estimated number of 3000, latitude 75° 40' S., longitude 25° 30' W. (Novatti, 1959). The norwegian ship "Tottan" was in that location unloading supplies for the base of the

Royal Society (Royal Society Base), in Halley Bay.

2. *Pygoscelis adeliae* (Hombron & Jacquinot), 1841. Adélie Land. **Adélie Penguin.** (Adéliepinguin).

a) Northernmost record: December 13, 1955. 59° 30' S., 28° 08' W.
Sea-water temperature:
1,6° C.

b) Southernmost record: January 5, 1956. 77° 58' S., 38° 48' W.

The record a) was done in the close vicinity of the Morrel Island of the Southern Thule Group (South Sandwich Arch.)

3. *Pygoscelis antarctica* (Forster), 1781. South Shetland. **Antarctic Penguin. Ringed Penguin. Adélie Penguin.** (Kehl-streifpinguin).

a) Northernmost record: Dezember 13, 1955. 59° 30' S., 28° 08' W.
Sea-water temperature:
1,6° C.

b) Southernmost record: Dezember 15, 1955. 64° 19' S., 36° 28' W.
Sea-water temperature:
— 0,2° C.

The record a) was done in the close vicinity of Morrell Island of the South Thule Group (South Sandwich Archipelago).

The record b) dealing with some dozens of individuals swimming around the ship and some on floes, situated these birds at an equal distance from the South Orkneys Islands and from the Thule Group (600 km approximately).

4. *Pygoscelis papua* (Forster), 1781. Malvinas Islands. **Gentoo Penguin.** (Eselspinguin).

This species was observed only during the campaign 1955-56, in the water near the coasts of Morrel Islands (South Thule Group) on which they nest, on December 13, 1955, 59° 30' S., 28° 08' W., being the sea-water temperature 1,6° C.

5. *Eudyptes chrysolophus* (Brandt), 1837. Malvinas Islands. **Yellow-forehead Penguin. Macaroni Penguin.** (Goldschopfpinguin).

This species as the preceding one was observed only in the waters near Morrell

- a) Northernmost record: 25. December, 1959. $62^{\circ} 14' S.$, $54^{\circ} 10' W.$ aprox.
Sea-water temperature:
— $1,1^{\circ} C.$
- b) Southernmost record: 22. December 1959. $63^{\circ} 40' S.$, $56^{\circ} 11' W.$
Sea-water temperature:
— $1,3^{\circ} C.$

8. *Diomedea malanophris* (Temminck), 1828. Cape of Good Hope. **Black-browed Albatross.** (Mollymauk).

Murphy (1936) notes that the distribution of this species covers in general the Southern Oceans, from the Tropic of Capricorn to the 60° of Southern latitude and sometimes more.

Biermann & Voous (1950) note too, that "though this species has been recorded in the literature from all over the South Atlantic Ocean, and stragglers are even known from the Northern Hemisphere, Bierman & van der Lee observed it *only in Antarctic and Subantarctic waters, northward to a little beyond Subtropical Convergence*".

- a) Northernmost record: 25. December, 1959. $60^{\circ} 11' S.$, $38^{\circ} 00'$ aprox.
Sea-water temperature:
— $1,3^{\circ} C.$
- b) Southernmost record: 26. December, 1959. $60^{\circ} 45' S.$, $28^{\circ} 20' W.$
Sea-water temperature:
— $1,3^{\circ} C.$
9. *Diomedea chrysostoma* Forster, 1785. No type locality. **Gray-headed Albatross.** (Graukopfalbatros).

This Albatross has a distribution area practically super posed with the one of the *Diomedea melanophris*.

- a) Northernmost record: 25. December 1959. $59^{\circ} 58' S.$, $36^{\circ} 47' W.$
Sea-water temperature:
— $1,3^{\circ} C.$
- b) Southernmost record: 24. December, 1959. $61^{\circ} 01' S.$, $43^{\circ} 05' W.$
Sea-water temperature:
— $1,1^{\circ} C.$
10. *Diomedea exulans exulans* Linne, 1758. Cape of Good Hope. **Wandering Albatross.** (Wanderalbatros, Kapschaf).

- a) Northernmost record: 16. January, 1956. $59^{\circ} 38' S.$, $41^{\circ} 57' W.$
Sea-water temperature:
— $1,1^{\circ} C.$
- b) Southernmost record: 22. December, 1959. $63^{\circ} 15' S.$, $54^{\circ} 17' W.$
Sea-water temperature:
— $1,2^{\circ} C.$

The record a) ist of two individuals over flying, among other species, a small fleet of norwegian whale catchers.

11. *Macronectes giganteus* (Gmelin), 1789. Staten Island. **Giant Fulmar. Giant Petrel.** (Riesensturmvogel).

- a) Northernmost record: 16. January, 1956. $59^{\circ} 38' S.$, $41^{\circ} 57' W.$
Sea-water temperature:
 $1,1^{\circ} C.$
- b) Southernmost record: 5. January, 1956. $77^{\circ} 58' S.$, $38^{\circ} 48' W.$

The individuals recorded in a) were, too, overflying the fleet of norwegian whale catchers.

The b) record of this species was done by gentle cooperation of Dr. Z. Popovici.

12. *Fulmarus glacialisoides* (Smith), 1840. Cape Seas. **Silver Grey Petrel. Antarctic Fulmar.** (Silbermöwensturmvogel).

- a) Northernmost record: 25. December, 1959. $59^{\circ} 00' S.$, $37^{\circ} 00' W.$ aprox.
Sea-water temperature:
— $1,0^{\circ} C.$

b) Southernmost record: 13. January, 1960. $76^{\circ} 27' S$ (*), $29^{\circ} 11' W.$

The latitude recorded in b) (*) is right. It was a single individual.

13. *Thalassoica antarctica* (Gmelin), 1789. $31^{\circ} - 61^{\circ} S.$, **Antarctic Petrel, Antarctic Fulmar.** (Grauer Sturmvogel).

This Petrel is a *peculiar* antarctic species, of the large ice-fields, and abounded singularly in both campaigns, greatly distributed.

- a) Northernmost record: 14. December, 1955. $59^{\circ} 27' S.$, $27^{\circ} 15' W.$

Sea-water temperature:
— 1,0° C.

- b) Southernmost record: 5. January, 1956. 75° 58' S., 38° 48' W.

14. **Daption capensis** (Linne), 1758. Cape of Good Hope. **Cape Petrel. Cape Pigeon.** (Kaptaube, Kapsturmvogel).

- a) Northernmost record: 14. January, 1956. 59° 09' S., 26° 45' W.
Sea-water temperature:
1,0° C.
- b) Southernmost record: 19. January 1956. 64° 47' S., 55° 29' W.
Sea-water temperature:
— 1,2° C.

The daily record of this species showed marked irregularities in the occurrence.

15. **Pagodroma nivea** (Forster), 1777. 52° S., 20° E. **Snow Petrel.** (Schneesturmvogel).

Undoubtedly, it is a bird close and unvariedly associated to the ice-fields and big icebergs, of which it is a good indicator.

- a) Northernmost record: 14. January, 1956. 59° 09' S., 26° 45' W approx.
Sea-water temperature:
1,0° C.

- b) Southernmost record: 5. January, 1956. 77° 58' S., 38° 48' W.

16. **Pachyptila desolata** (Gmelin), 1789. Kerguelen Island. **Antarctic Whale-Bird.** (Taubensturmvogel).

- a) Northernmost record: 14. January, 1956. 59° 09' S., 26° 45' W.
Sea-water temperature:
1,0° C.

- b) Southernmost record: 12. January, 1960. 75° 30' S., 27° 35' approx.

Though this species is singularly abundant, the author had no occasion of observing great concentrations of it, except in the chance of the presence of the norwegian whale catchers (59° 38' S., 41° 57' W.) when over the ships there were hundreds of whale-birds flying.

17. **Pterodroma macroptera macroptera** (Smith), 1840. Seas off Cape of Good

Hope. **Great-winged Petrel.** (Langflügelsturmvogel).

This Petrel was recorded only one day and it was during the 1959—60 campaign, on December 26th., as follows:

- a) 60° 12' S., 31° 20' W.
Sea-water temperature:
— 1,2° C.
- b) 60° 20' S., 30° 00' W.
Sea-water temperature:
— 1,3° C.
- c) 60° 30' S., 28° 50' W.
Sea-water temperature:
— 1,1° C.

18. **Halobaena caerulea** (Gmelin), 1789. Southern Oceans, 48° — 58° S. **Blue Petrel.** (Blauer Sturmvogel).

- a) Northernmost record: 14. January, 1956. 59° 09' S., 26° 45' W.
Sea-water temperature:
1,0° C.

- b) Southernmost record: 9. January, 1960. 68° 35' S., 13° 43' W.
Sea-water temperature:
— 1,2° C.

19. **Oceanites oceanicus oceanicus** (Kuhl), 1820. South Georgia (Murphy). **Wilson's Petrel.** (Buntfüßige Sturmschwalbe).

- a) Northernmost record: 14. December, 1955. 59° 27' S., 27° 15' W approx.

Sea-water temperature:
— 1,5° C.

- b) Southernmost record: 9. January, 1956. 74° 33' S., 24° 39' W.
Sea-water temperature:
— 0,5° C.

Occasionally little flocks of 8—10 individuals were seen following the ship even in the worst storm conditions.

20. **Chionis alba** (Gmelin), 1789. New Zealand (errore) Malvinas Islands. **Sheath-bill** (Scheidenschnabel).

- a) Northernmost record: 12. December, 1955. 60° 08' S., 37° 16' W.
Sea-water temperature:
1,4° C.

b) Southernmost record: 19. January, 1956. $64^{\circ} 47' S.$, $55^{\circ} 29' W.$
Sea-water temperature:
— $1,2^{\circ} C.$

21. *Catharacta skua* and subspecies (Große Raubmöwe).

a) Northernmost record: 9-11-18-19-20-21 December, 1955. $60^{\circ} 45' S.$, $44^{\circ} 43' W.$

b) Southernmost record: 6. January, 1956. $77^{\circ} 58' S.$, $38^{\circ} 48' W.$
Sea-water temperature:
— $1,6^{\circ} C.$

The records in a) correspond to the stays of the ship off Laurie Island (South Orkneys Islands).

22. *Larus dominicanus* Lichtenstein, 1823. Coast of Brazil. **Southern black-backed Gull.** (Dominikanermöwe, Südliche Heringsmöwe).

a) Northernmost record: 14. January, 1956. $59^{\circ} 09' S.$, $26^{\circ} 45' W.$ aprox.
Sea-water temperature:
 $1,1^{\circ} C.$

b) Southernmost record: 8-9-10-18-19-20-21 December, 1955. $60^{\circ} 45' S.$, $44^{\circ} 43' W.$

The records in b) correspond to the stays of the ship off Laurie Island (South Orkneys Islands).

23. *Sterna vittata* and subspecies. (Gabelschwanzseeschwalbe).

a) Northernmost record: 8-9-10-11-17-18-20 December, 1955. $60^{\circ} 45' S.$, $44^{\circ} 43' W.$

b) Southernmost record: 19. January, 1956. $65^{\circ} 10' S.$, $60^{\circ} 15' W.$
Sea-water temperature:
— $1,0^{\circ} C.$

The records in a) correspond to the stays of the ship off Laurie Island (South Orkneys Islands). The record in b) was done off Robertson Island, on the Larsen Iceshelf.

24. *Phalacrocorax atriceps* and subspecies. (Blauaugenkormoran).

The only records of this shag were done in the following dates and position:

9-10-11-18-19-20 December, 1955. $60^{\circ} 45' S.$, $44^{\circ} 43' W.$, off Laurie Island (South Orkneys Islands).

It is necessary to remark that during the summer campaign 1959-60, the ice-conditions in the Antarctic were particularly severe. The maximum latitude reached by the icebreaker "General San Martin" in the Weddell Sea was approximately $76^{\circ} 30' S.$ That is the reason why the records do not show satisfactorily what the author would like to, although with them some gaps filled with the hope that many more will be completed in the near future.

Der Rhythmus der Veränderungen des antarktischen Inlandeises unter dem Einfluß der Klimaschwankungen

Von Stefan Zbigniew Różycki, Warschau *

Das Inlandeis der östlichen Antarktis bedeckt ein großes Tiefland, das wie Grönland von drei Seiten von hohen Gebirgsketten — das Gebirge des Victoria-Landes, des Königin-Maud-Landes, Enderby's und MacRobertson-Landes — umgeben ist, wodurch das Eis nur an einigen Stellen Aus-

gänge hat. Dagegen fließt es im Sektor zwischen dem $68^{\circ} E$ und dem $154^{\circ} E$ frei zum Meer und trifft dabei nur verhältnismäßig kleine und wenige Geländehindernisse. Aus diesem Grund kann man am besten das durch andere morphologische Faktoren nicht gestörte Regime der Eiskalotte erkennen,

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