# About Negative Correlations of Surface Temperature and Clouds Parameters for Antarctic Region

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In previous study it was detected, that climatic changes of air surface temperature T in eastern and western part of Antarctica have different tendencies: warming was detected for some stations at the West and cooling was detected for some stations of the East [Comiso, 2000; Marshall et al. 2002, Turner et al., 2004 Chernykh and Alduchov, 2003a, 2003b, Jagovkina et al., 2004]. Clouds play very important role in distribution of solar radiation at the earth surface. But dependence of climate changes of surface temperature and clouds is not very pore. These changes can take place in different layers of the atmosphere. It is known, that distributions of cloud parameters, such as cloud amount, frequencies of cloud types are different for these regions [Warren, et al. 1986]. Increasing of cloud amount (up to 15-20%) at the South Pole, detected by Neff in 1999, was described in the documents of Intergovernmental Panel on Climate Change as “dramatic” [Climate Change, 2001].

Are exist any parameters of clouds which have negative correlations with air surface temperature for stations placed in both eastern and western and central parts of Antarctica, or for one of this part?

These researches are made on base Aerological dataset CARDS [Eskridge et al. 1995] for period 1964-2001 years. The present study is focused on the Eastern Antarctic coastal stations: Novolazarevskaya (89512); Syowa (89532); Molodezhnaya (89542); Mawson (89564); Davis (89571); Mirny (89592); Casey (89611); Dumont D’Urville (89642); Macquarie Island (94998); McMurdo (89002); Western Antarctic coastal stations: Bellingshausen (89050); Base Marambio (89055), Halley Bay (89022); Newmayer (89002); continental Antarctic stations: Amundsen Scott (89009); Vostok (89006).

CE-method was used to determine cloud boundaries and amount from temperature and humidity profiles [Chernykh and Eskridge 1996, Chernykh and Alduchov, 2004]. Correlations $\mu^{ta}{}_i$ for time series of monthly averaged means anomalies of cloud parameters and surface temperature for every station were calculated.

Monthly averaged mean values were calculated for five parameters of cloud vertical macrostructure: frequency of cloud layers (Freq), number (NLay) and total thickness (Thic) of cloud layers, base of lowest cloud layer (Base) и top of highest cloud layer (Top). All these parameters were determined for six atmospheric layers: 0-2 km, 2-6 km, 6-10 km (for L - low, M - middle and H – high level of clouds accordingly), and for layers 0-6 km, 2-10 km и 0-10 km about ground level (LM, MH, LMH, соответственно). Calculations were made for five following gradations of cloud amount. Symbols for these gradations present below:

1) 0-20%! – 0-20% of sky coverage independently of presence of any other cloud layers;
2) 20-60%! –20-60% of sky coverage independently of presence of any other cloud layers;
3) 60-80%! – 60-80% of sky coverage independently of presence of any other cloud layers;
4) 80-100%! – 80-100% of sky coverage independently of presence of any other cloud layers;
5) 0-100% – 0-100% of sky coverage (any clouds independently of amount).

So, totally we have 150 (5x6x5) cloud parameters to check correlations with surface temperature.

Calculations have shown that there is no exists any cloud parameter with negative correlations with respect T for all sixteenth. Frequency of middle cloud is one cloud parameter with negative correlations with respect T for all studied Eastern Antarctic coastal stations (see Table 1).

Table 1. Cloud parameter with negative correlations with respect T
for Eastern Antarctic coastal stations (and for fourteenth Antarctic Stations also).

| Atmos. layer | Cloud amount | Param. of cloud | Eastern Antarctic coastal stations | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 89512 | 89532 | 89542 | 89564 | 89571 | 89592 | 89611 | 89642 | 94998 | 89664 |
| | | | Correlations $\mu^{ta}{}_i$ | | | | | | | | | |
| M | 0-100% | Freq | -.002 | -.256 | -.015 | -.064 | -.027 | -.060 | -.082 | -.246 | -.028 | -.139 |

| Atmoos. layer | Cloud amount | Param. of cloud | Western Antarctic coastal stations | | | | Continental Antarctic stations | |
|---|---|---|---|---|---|---|---|---|
| | | | 89050 | 89055 | 89022 | 89002 | 89009 | 89606 |
| | | | Correlations $\mu^{ta}{}_i$ | | | | | |
| M | 0-100% | Freq | .014 | -.157 | -.019 | -.084 | .107 | -.221 |

Most important cloud parameter with negative correlations with respect T for Western Antarctic coastal stations is cloud number (see Table 2).

Most important cloud parameter with negative correlations with respect T for continental Antarctic stations is cloud number also (see Table 3).

Table 2. Cloud parameter with negative correlations $\mu^{ta}_{i}$ with respect T for four Western Antarctic coastal stations

| Atmospheric layer | Cloud amount | Parameter of cloud | Correlations $\mu^{ta}_{i}$ | | | |
|---|---|---|---|---|---|---|
| | | | 89050 | 89055 | 89022 | 89002 |
| H | 20-60%! | NLay | -.036 | -.183 | -.275 | -.105 |
| M | 0-100% | NLay | -.141 | -.082 | -.343 | -.157 |
| LMH | 0-100% | NLay | -.101 | -.188 | -.480 | -.169 |
| H | 0-100% | NLay | -.145 | -.057 | -.539 | -.164 |
| LM | 0-100% | NLay | -.160 | -.136 | -.336 | -.166 |
| MH | 0-20%! | NLay | -.070 | -.086 | -.253 | -.296 |

Table 3. Cloud parameter with negative correlations with respect T for two continental Antarctic stations

| Atmospheric layer | Cloud amount | Parameters of cloud | Correlations $\mu^{ta}_{i}$ | |
|---|---|---|---|---|
| | | | 89009 | 89606 |
| H | 20-60%! | NLay | -.410 | -.571 |
| M | 0-100% | NLay | -.455 | -.337 |
| MH | 20-60%! | NLay | -.504 | -.137 |
| M | 80-100%! | NLay | -.402 | -.385 |
| MH | 60-80%! | NLay | -.006 | -.500 |

This study is useful to gain insight into climate and climate change in Antarctica and for aviation. Further joint international researches should be very useful. The research was partly supported by RBRF, Project 04-05-64681 and Russian “Study and Investigation of Antarctic” Sub-Program.

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