About Climatic Changes of Clouds and Precipitation over Antarctic Peninsula

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Antarctic Peninsula is a region with good known warming [Comiso, 2000; Marshall et al. 2002, Turner et al., 2004]. In previous study it was founded, that air surface warming over Antarctic Peninsula takes place together with changes in sea ice extent, changes in main atmospheric parameters in troposphere (warming in the troposphere, increasing of water vapor amount observed from 850 hPa, decreasing of wind speed at surface level and in troposphere), increasing of cyclone frequency and changes of cloudiness vertical macrostructure (in atmospheric layer 0-10 km for cloud layers with cloud amount 0-100% of the sky there was detected an increasing of total thickness; decreasing of cloud layers number; clouds high boundary is decreasing; low boundaries decrease) [Alduchov et al., 2003]. More detailed study of climatic changes of low boundary of cloudiness (LB) for atmospheric layers 0-2 km, 2-6 km, 6-10 km, 0-10 km for different cloud amount 0-20%. 0-60%, 0-80%, 0-100% of the sky was presented for all seasons and for year in paper [Chernykh et al., 2003]. It was founded that low boundaries for clouds with amount 0-100% of the sky in atmospheric layers 0-2 km and 0-10 km for Bellinsgshausen decrease with decadal changes of –35 m/decade and –66 m/decade accordingly. Researches was made for Russian station Bellinsgshausen, placed near Antarctic Peninsula, because warming for this station was detected by surface, sonde and satellite observations [Comiso J.C., 2000; Chernykh and Alduchov, 2003a, 2003b, Jagovkina et al., 2004]. Increasing of number of reports about precipitation over the coastal Antarctic Peninsula from synoptic observations was founded for Australian winter [Turner et al., 1997]. Existence of cloudiness with cloud amount 80-100% of the sky is necessary condition for exist of precipitation. Which kinds of climatic changes of vertical macrostructure parameters of cloud layers with cloud amount 80-100 % can be detected from data about temperature and humidity profiles obtained on base standard radiosounding of atmosphere ?

Researches are made on base Aerological dataset CARDS (Eskridge et al. 1995) for period 1970-1999 years. CE-method was used to determine cloud boundaries and amount from temperature and humidity profiles [Chernykh and Eskridge 1996, Chernykh and Alduchov, 2004]. Trends in anomalies for all parameters were calculated by linear regression with using measured values with provision for correlation dependence in time.

Trends in anomalies of the frequency and low boundary of cloud layers with cloud amount 80-100% of the sky for atmospheric layers 0-2 km, 2-6 km, 6-10 km, 0-6 km, 2-10 km and 0-10 km are shown on figure 1. Highest increasing (towards other months) of low clouds frequency with decadal changes of 11.8 %/decade is detected for June. Increasing of the frequency of clouds in atmospheric layers 0-6 km and 0-10 km are detected for June also with decadal changes of 7 %/decade and 2.2 %/decade accordingly. Highest increasing (towards other seasons) of frequency of low clouds and clouds in atmospheric layers 0-6 km is detected for summer (Australian winter) with decadal changes of 7.4 %/decade and 3 %/decade accordingly. The frequencies increasing of low clouds and clouds in atmospheric layers 0-6 km for year take place with decadal changes of 4.0 %/decade and 1.4 %/decade accordingly.

It was founded that for summer months low boundaries for clouds with amount 80-100% of the sky in atmospheric layers 0-2 km increase with decadal changes of 20 m/decade for July and decrease with decadal changes –18 m/decade for August. Figure 1 have shown decreasing of low boundaries for clouds in atmospheric layers 2-6 km for all summer month with decadal changes -214 m/decade, -25 m/decade and -60 m/decade for June, July and August accordingly.

These results, obtained on base aerological data, are in agreement with results about increasing of number of reports about precipitation during of Australian winter, obtained on base synoptic observations [Turner et al., 1997] and increasing of cyclone frequency, detected on base twice-daily NCEP/NCAR surface pressure re-analysis data for 1980-1999 [Alduchov et al., 2003].

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 (Turner et al, 2004). The research was partly supported by RBRF, Project 04-05-64681 and Russian “Study and Investigation of Antarctic” Sub-Program.

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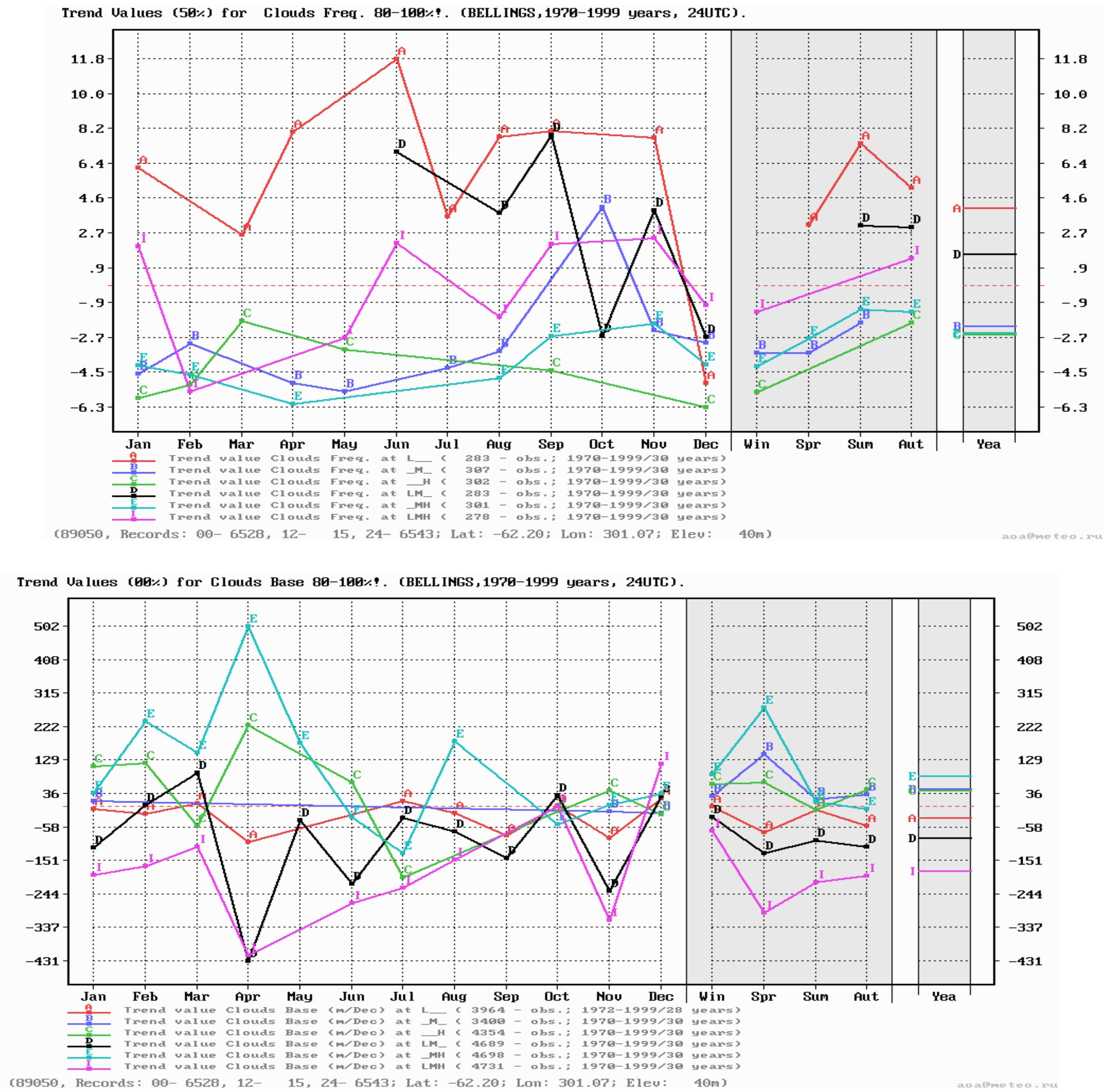

Figure 1. Trends in anomalies of the frequency (on the top of the figure) and low boundary (on the bottom of figure) of cloud layers with cloud amount 80-100% of the sky for atmospheric layers 0-2 km (A), 2-6 km (B), 6-10 km (C), 0-6 km (D), 2-10 km (E), 0-10 km (I) for all month (on the left) season (in centre) and year (on the right) for Bellingshausen. 1970-1999 years. Win – December-February. CARDS. Trends in anomalies were calculated by linear regression with using measured values with provision for correlation dependence in time. Trends were detected with significance level not less than 50%.