Contribution of natural and anthropogenic causes in regions with large temperature changes during XX century

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Global annual-mean surface air temperature (SAT) has been increasing during last three decades of 20th century at about 0.2 K/decade (Stott et al., 2000). Comparisons of observations with the climate model simulations show that both natural and anthropogenic factors have contributed significantly to 20th century temperature changes. According to model simulations the global warming during last decades cannot be explained by natural externally forced or internal variability (Stott et al., 2000; Climate Change 2001; Stott, 2003).

Maximum values of regional SAT trends during last decades are several times larger than that for global-scale SAT (Stott et al., 2000). Figure 1 shows an example of the annual-mean SAT trends from observations (RIHMI data - see (Razuvaev et al., 1993)) over the 30-year running intervals for Irkutsk (52N,104E) in Siberia. During last three decades of 20th century the SAT trend in this region was larger than 0.8 K/decade. Similar trends about 0.8 K/decade have been noted in the Northern Hemisphere during last decades at other Siberian sites and in Alaska. The largest SAT trend in the Southern Hemisphere was noted for the Antarctic Peninsula (up to 0.5 K/decade).

Figure 1 shows the annual-mean SAT trends and corresponding coefficients of correlation r over the 30-year running intervals from observations and HadCM3 simulations (ensemble of four model runs and ensemble mean) for region near Irkutsk with natural, anthropogenic and all forcings (see (Tett et al., 2002; Stott, 2003)). According to Fig.1 local SAT trends from observations at some sites are even larger than simulated regional (over model grid) trends for last decades of 20th century. This difference can be related partly with a general underestimation of regional Siberian warming due to both anthropogenic and natural forcings during last three decades. In particular, analysis of Stott (2003) indicates that HadCM3 appears to overestimate aerosol cooling in Asia. It can be also important the difference between local (observations) and regional (over model grid 2.5^{o}x3.75^{o}) trends.

The corresponding analysis for region in Alaska (for instance, about 60-65N, 135-140W) also shows a larger positive trend during last three decades from observations (CRUTEM2(v) - see (Jones and Moberg, 2003)) in comparison with model simulations except one model run. Analysis for Antarctic Peninsula shows less statistically significant trend of SAT during last decades than that for Siberia and Alaska both from observations and model simulations. The SAT trend in Antarctic Peninsula for last decades from observations (in particular, for Bellingshausen station about 62S, 59W) is found in the range of model estimates from different numerical runs.

This work has been partly supported by the RFBR and RAS Program.

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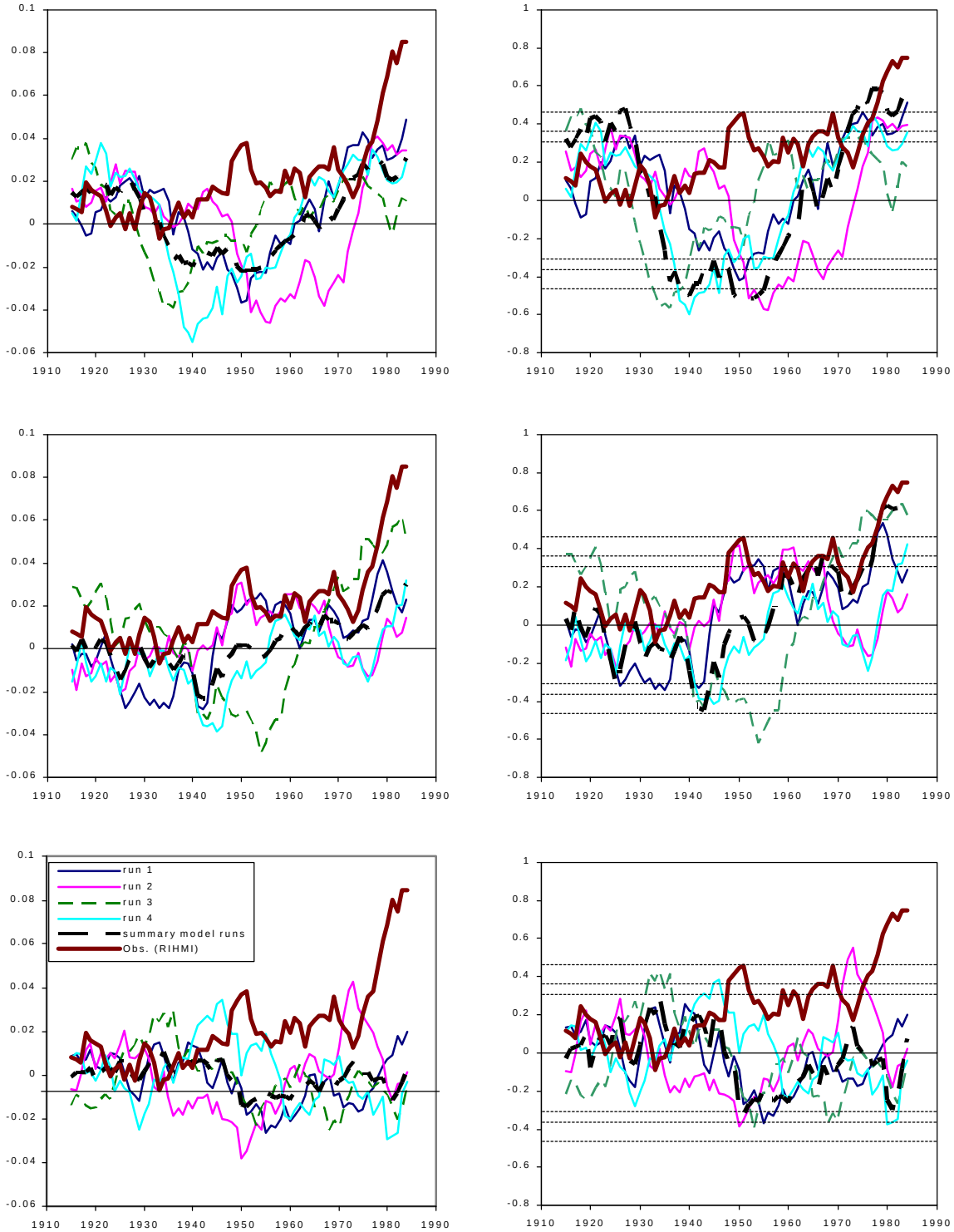

Fig.1. The annual-mean SAT trends (K/year, left panels) and corresponding coefficients of correlation r (right panels) from observations and model simulations over the 30-year running intervals for region near Irkutsk: all forcings (top panels), anthropogenic forcing (middle panels) and natural forcing (bottom panels). Dotted lines show minimum values of r for statistical significance of trends at the 90%, 95% and 99% level. The 30 year trends are centred on the year marked on the horizontal axis.