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Biogeosciences Discussions

Interactive comment on "The variability of radiative balance elements and air temperature on the Asian region of Russia" *by* E. V. Kharyutkina et al.

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The authors wish to thank the reviewer for valuable comments and suggestions, which were very helpful for improving the manuscript.

Comment 1: The confidence in the results presented depends on the quality of the model outputs for the region under investigation. It is well known that most models have problems at high latitudes. For instance, in the study of Sorteberg et al. (2007) for the Arctic (70-90ï′CËĞrN) annual SW down and upward radiation from four observational estimates and IPCC AR4 models over 1980-1999 were used to show a spread of values over that region. Therefore, there is a need to first establish confidence in

the data used. The authors mention results of evaluation against ground observations as described in two independent papers however, the reader does not get a clear view what exactly was done there and to what extent those studies credibly evaluate the model results used. Moreover, on page 4338 the authors claim: "It is found that radiation unit in JRA reanalysis data, like radiation unit in reanalysis data NCEP/DOE AMIP-II, impartial characterizes the distribution of total radiation over Western Siberia, including mountain regions, although the annual averaged values of total radiation derived by reanalysis JRA should be reduced by 10–15 %." Whys should it be reduced? Based on what? If it is reduced, how will it impact the findings of this study? Usually, independent data are used to test if observed trends in one product are consistent with trends in other products.

Response 1 (this par was added to the text): For ten actinometrical stations, located in West Siberia and Altai, there were analyzed monthly sums of solar radiation from NCEP/DOE AMIP-II reanalysis, its intra-annual variability, and also correlation analysis was carried out. It was shown that NCEP/DOE AMIP-II reanalysis data represents seasonal variability of monthly sums of solar radiation with error 15%, also over mountain regions. For mountain regions basins in the south of Siberia total radiation from reanalysis data was slightly different (no more 4%) than that from data of actinometrical stations. Annual average values of total radiation, determined by reanalysis data, were higher than values, determined by observational data. For flatland regions of West Siberia annual average values of total radiation, determined by reanalysis data, were overestimated on 12-15%. Trend tendencies were not changed. The validation of JRA-25 reanalysis data and data from actinometrical stations has the same results with the validation by NCEP/DOE AMIP-II reanalysis: representation of intra-annual variability, systematical overestimation of total downward radiation values by models and the constancy of trend sign, interannual variability.

Comment 2. Since clouds control the magnitude of radiative fluxes reflected to space and reaching the surface, an inner consistency should be expected when looking at

cloud distributions and reflected and transmitted shortwave radiation. Therefore, as stated in the Conclusion section: “Regional variations of solar radiation flux obtained by reanalysis data are mainly conformed to total cloudiness and air temperature changes. In general, anomalies of shortwave and longwave radiation play a major role in the air temperature variability during the whole year.” This is kind of obvious.

Response 2: The remark is correct. We changed the sentence in the manuscript: Table 4 shows that ïĄd’TC and ïĄd’Eg anomalies have the dominant influence (>50%) on temperature variability ïĄd’T in November. In this month the areas of cloudiness influence are situated zonally over the mountain regions in southern part of ATR and in the northern part from Taimyr peninsula to Chukotka peninsula. In the region of Stanovoye Highlands ïĄd’TC anomaly describes up to 50-60% of temperature variability. The regions with increased influence of ïĄd’Eg anomaly are situated along coastal areas and river systems. Changes in the section “Conclusion”: In general, besides November, shortwave and longwave radiation play a major role in temperature variability (they describe 50% of this variability).

Comment 3: The paper is not clearly written. At places, it is not possible to understand what the authors wanted to say. For instance: a) p. 4333- “The downward solar irradiative fluxes of ISCCP-FD, NCEP AMIP/DOE and ERA-40 show similar spatial variability, while the downward longwave irradiative fluxes of CASPR, NCAP AMIP/DOE and ERA-40 show similar spatial variability”. b) “However, downward shortwave radiation at the top of atmosphere, as compared with satellite data, and the net surface flux, contribute to large energy budget residuals in ERA-40.” c) “Estimation of sensible heat flux variability from the types of relief was executed by Foken (2008).” d) p. 4334- “It is used opto-acoustic method in the long and short ranges.” e) Even the title: “The variability of radiative balance elements and air temperature on the Asian region of Russia” has a problem. Perhaps the authors meant:” The variability of radiative balance elements and air temperature over the Asian region of Russia”.

Response 3: a) Corresponding changes have been done in the text.

p. 4333. Changed sentence: “ISCCP-FD, NCEP AMIP/DOE and ERA-40 show similar spatial variability of downward shortwave irradiative fluxes, while CASPR, NCAR AMIP/DOE and ERA-40 show similar spatial variability of downward longwave irradiative fluxes”.

b) Corresponding changes have been done in the text. p. 4333. Changed sentence: “However, shortcomings in top of atmosphere radiation, as compared to satellite data, and the net surface flux, contribute to large energy budget residuals in ERA-40 (Serreze et al., 2007).”

c) Corresponding changes have been done in the text. p. 4333. Changed sentence: “Estimation of sensible heat flux variability for different types of relief was relized by Foken (2008).”

d) Corresponding changes have been done in the text. p. 4334. Changed sentence: “It is used opto-acoustic method in the long-wave and short-wave ranges.”

e) Corresponding changes have been done in the text. “The variability of radiative balance elements and air temperature over the Asian region of Russia”.

Comment 4: In the discussion, there is no transparency. It is not clear when the authors switch from one set of results to the other. The Introduction is also confusing, merging several topics that do not seem to be relevant to this study. For instance, there is the following statement: “Calculation accuracy for the territory of Romania was 20 %.” Why is it important here? On page 4341 it is stated: “For surface air sensible and latent heat fluxes can be calculated as (Budyko, 1958):” If the analyzed heat fluxes come from the two referenced models, why does the reader need to know how Budyko did the computations? On page 4341 it is stated: “For surface air sensible and latent heat fluxes can be calculated as (Budyko, 1958):” If the analyzed heat fluxes come from the two referenced models, why does the reader need to know how Budyko did the computations?

Response 4: Corresponding changes have been done in the section “Introduction” of the manuscript, according to the comment (page 4335). Calculation accuracy is important, because we use the same description of temperature variability over ATR due to heat balance elements variability. Therefore, it seems to be necessary to apply this approach to the territory with different forms of relief, which is similar with the relief in the southern part of West and East Siberia.

The expression, proposed by Budyko, allows to represent latent and sensible heat fluxes in convenient way for the analysis of their variability. These fluxes are determined by the difference between meteoparameters at two levels. Therefore, the investigation of value variability at each level allows to explain the flux variability. The result of this analysis is shown on the page 4342.

Interactive comment on Biogeosciences Discuss., 8, 4331, 2011.