



Trends in global radiation between 1950 and 2100

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The knowledge of the means, variations and trends of global radiation is important for planning solar applications. This analysis is focused on long time series of global radiation with a duration of at least 40 years within the period 1950 - 2009. Like this work lies in-between the analysis for worldwide (satellite) data with approx. 20 years of duration and those for some few sites with very long measurements. A total of 25 sites based on Global Energy Balance Archive (GEBA, <http://proto-geba.ethz.ch>) have been used. These 25 sites have been grouped to 10 regional clusters including 2 – 13 stations. The trends of the time series of monthly data of the full period and several sub periods have been investigated.

Additionally the results of the fourth report of IPCC [Meehl et al., 2007] has been analysed to get an idea about the future changes till 2100.

For the total period of 1950 - 2009 and all sites a negative and statistically significant trend of -1.4 W/m^2 per decade could be found. For most grouped sites no significant trend is visible. Nevertheless for Germany / Austria a slightly positive trend can be seen and for Switzerland, Asia, India and Canada a negative trend. For the two sub periods 1950 – 1985 and 1985 – 2009 a significant trend could be found for most groups and stations. For the first period 1950-1985 only negative trends were found. For the second period 1985-2009 (including data for most sites up to 2005) all regions except India and Canada showed a positive trend.

The phenomenon of global dimming and brightening [Wild et al., 2005] could be approved. For the mean of all sites the dimming for the period 1950 – 85 and the brightening for the period 1985 – 2009 is statistically significant. The negative trend during the dimming period is clearly stronger (approx. factor 2) than the positive trend during the brightening phase. The individual regions and groups show a great variety of different trends for the analyzed sub periods. The negative trend found in [Hinkelman et al., 2009] for the period after 2000 could be found only at 2 stations out of the 25.

From IPCC results we took the average of all 18 available models. We used the three scenarios B1 (low), A1B (mid) and A2 (high). The forecasted changes of global radiation till 2100 with all scenarios are relatively small compared to temperature changes. They are in the range of one tenth of a percent till some percents. The differences between the three scenarios are also relatively small. On an average the global radiation will decrease slightly. However, in the Mediterranean region the trend is positive (+ 2 – 3 % till 2100). The changes of the last 25 years go in the same direction but are already bigger than the forecasted anomalies for the period till 2030.