

Analysis of extreme European Summers and prior spring conditions

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Introduction

Hot and dry summers in mid and high latitudes as the ones in 1976 and 2003 in central Europe as well as 2010 in Russia have large negative socio-economic impacts. It would therefore be beneficial if such events could be forecasted ahead of time. To improve the understanding of the development of such events, the spring conditions prior to the heatwaves 1976 and 2003 are investigated.

Solar irradiation, soil water and precipitation during spring 1976 and 2003

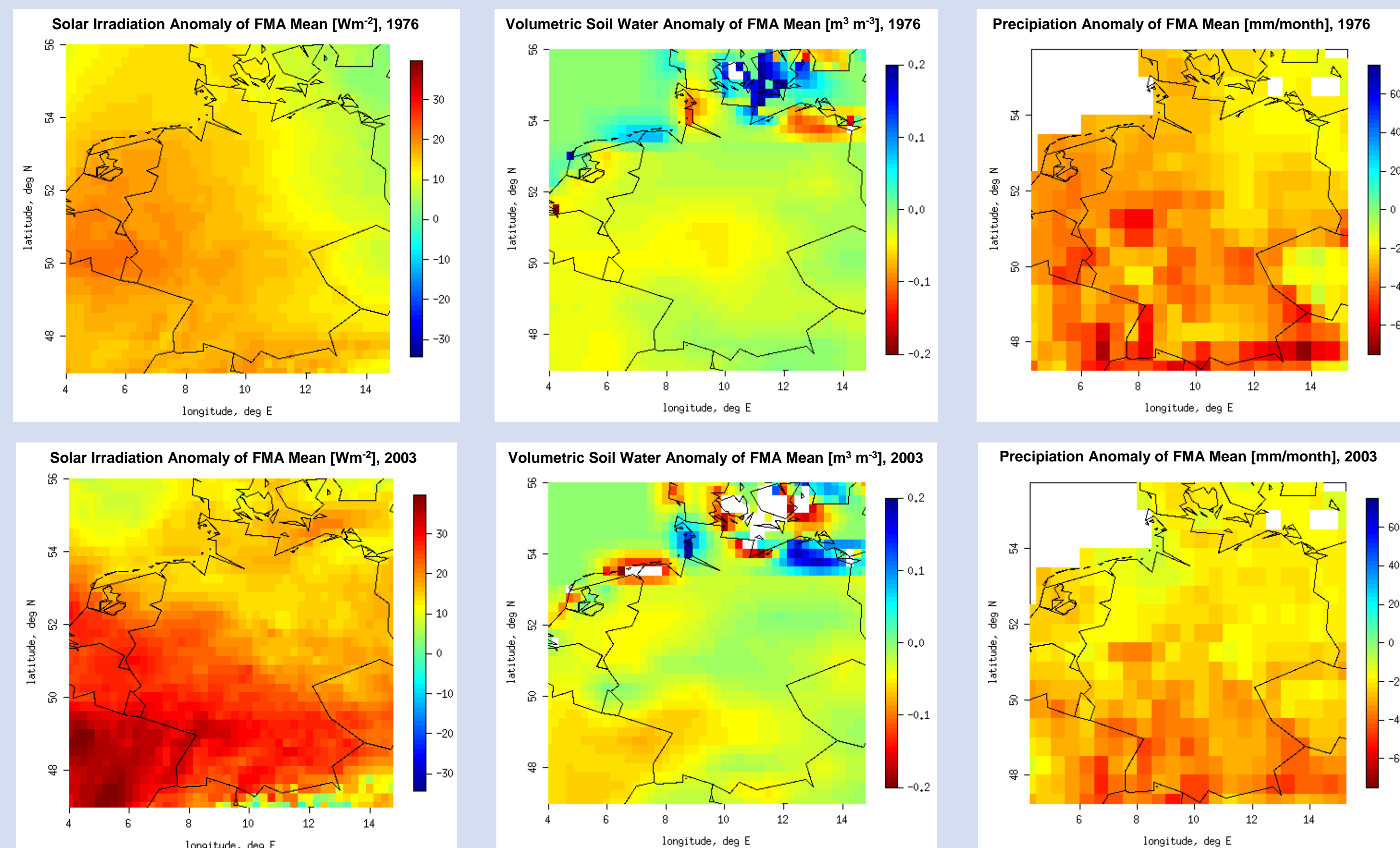


Fig.1: Anomalies of solar irradiation, soil water and precipitation during FMA in 1976 (upper row) and 2003 (lower row)

Solar irradiation data are taken from ERA40 (1958 – 1994) and Heliosat (1994 – 2005, **presentation EGU2011-2589 CL 2.6**), soil water data are from ERA40 (1958-1988) and ERAinterim (1989-2005) and precipitation data are from Global Precipitation Climatology Centre (GPCC, gpcc.dwd.de).

Already during the spring months FMA of 1976 and 2003 solar irradiation, soil water, and precipitation showed large positive / negative anomalies compared the longterm mean 1958 - 2005.

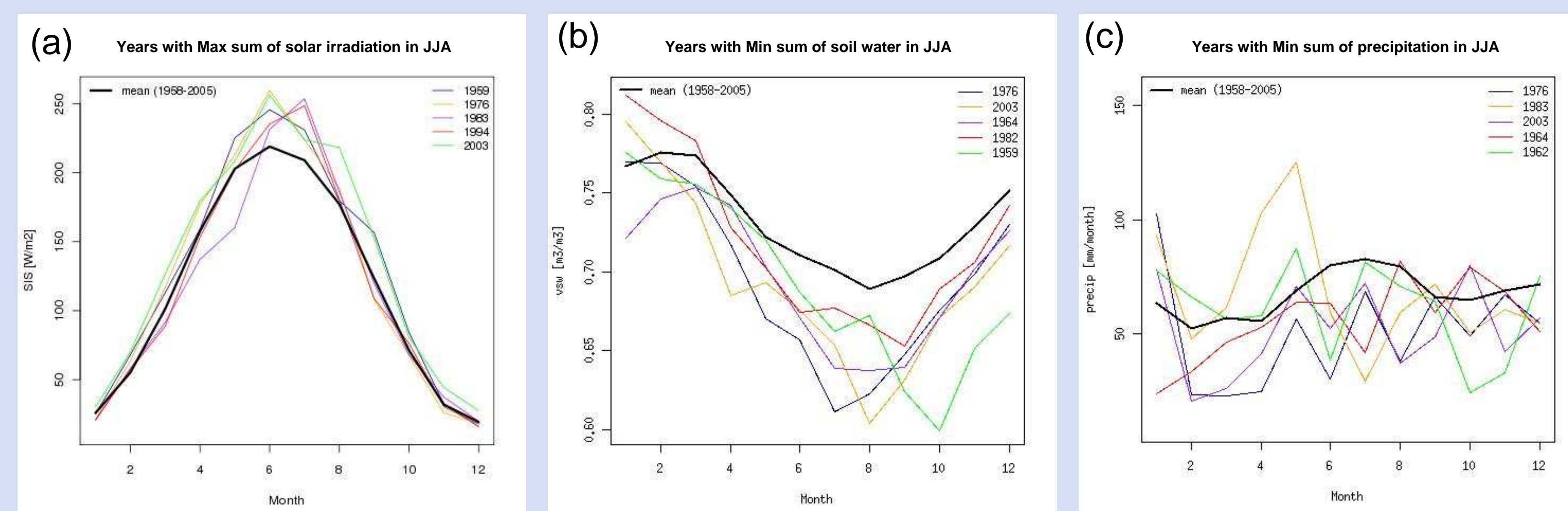


Fig.2: Annual cycle of solar irradiation (a), volumetric soil water (b), and precipitation (c) during the 5 years with max. / min. values in the time series 1958 - 2005

Using solar irradiation, soil water and precipitation together as predictands, the extremely hot and dry summers 1976 and 2003 would have been correctly forecasted for the study area (study area as shown in Fig.1).

Large Scale circulation during spring 1976 and 2003

To check for extremes in the large scale circulation the geopotential in different hights is analysed. Date were taken from the ERA40 (1958 – 1988) and ERAinterim (1989-2009) archive, respectively. Compared to the anomalies during years with an average summer in central Europe (e.g. 1984), in 1976 and 2003 the low pressure anomaly over eastern Canada / southern Greenland is shifted southward, as well as the high pressure anomaly over esatern US / eastern – central North Atlantic, which presumably results in a more meridional direction of flow over Europe.

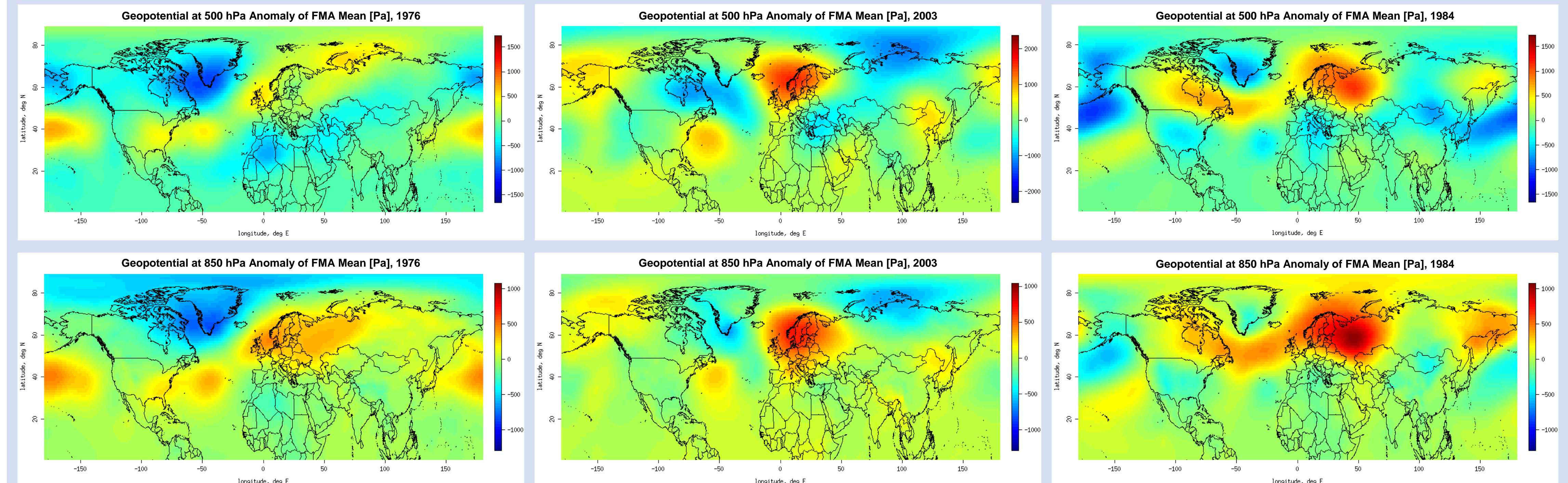


Fig.3: Anomalies of geopotential at 500hPa (upper row) and 850hPa (lower row) during FMA in 1976; 2003 and 1984

Also the position of the Hadley circulation was checked for extremes, using OLR as proporeased by Hu and Fu (2007). Also the OLR data were taken from the ERA40 (1958-1988) and ERAinterim (1989-2009) archive. No significant anomalies in the position of the Hadley circulation during FMA 1976 and 2003 were found.

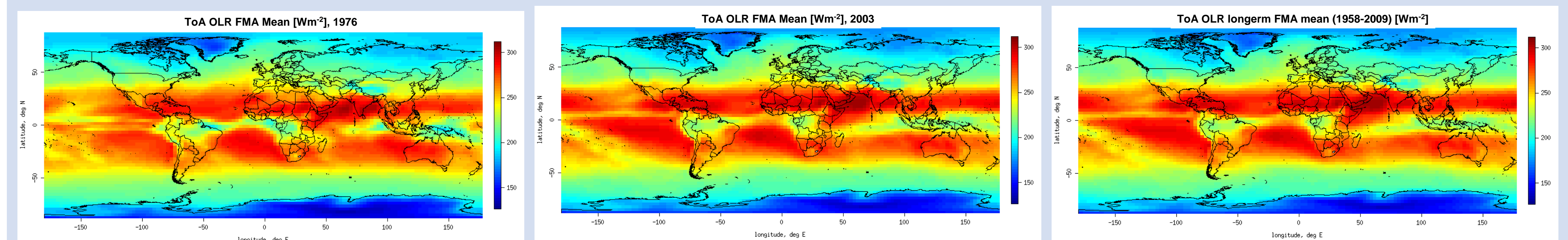


Fig.4: ToA OLR FMA mean in 1976 and 2003 and the longterm FMA mean (1958 – 2009)

Conclusions and Outlook

- The spring months FMA prior to the hot and dry summers of 1976 and 2003 show anomalies in the geopotential that presumably result in a more meridional direction of flow over Europe.
- No obvious connections found between hot and dry summers in central Europe and the position of the Hadley Cell in prior spring.
- Connections of extreme summer conditions in solar irradiation, soil water, and precipitation to prior spring conditions exist and have also been found by other authors (e.g. Rebetez et al. (2009))
- Solar irradiation, soil water and precipitation will be investigated for an enlarged study area and the predominant synoptic weather types during FMA and JJA will be analysed to see possible regional effects that might be the key for a successful method to forecast heatwaves and droughts in (central) Europe.

References

- Hu, Y. and Fu, Q. (2007): Observed poleward expansion of the Hadley circulation since 1979, in: Atmos. Chem. Phys., 7, 5229-5236
- Rebetez, M, Dupont, O., Giroud, M. (2009): An analysis of the July 2006 heatwave extend in Europe compared to the record year of 2003, in: Theor. Appl. Climatol., 95: 1-7