Global warming – approaching my personal outlook

Term project for the *Coursera* **course** *Global Warming: The Science of Climate Change* **by**
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29 stations with similar geographic conditions as my hometown and a sufficient amount of available data were chosen and the combined trend for mean annual temperatures compared to model calculations. For the recent past (1970-2000) the more "optimistic" models seem to describe the data better. For the future (2000-2100), model trends for both a low-forcing (*rcp26*) and a high-forcing (*rcp85*) scenario were calculated. For the low-forcing scenario, most models predict a slight increase in temperature of between ∼0.5 and ∼1.5 °C compared to the present day value. For the high-forcing scenario, model predictions of temperature increase vary between ∼4 and ∼6 °C.

For this project, I wanted to explore model predictions for regions similar to where I live. I started by culling the available station data for the two geographical criteria given, i. e. latitude and altitude, selecting those bins my hometown of Frankfurt, Germany falls into. This gave me a selection of 94 stations in 50-60° Northern latitude at altitudes of 100-200m. I continued hand-filtering those for data quality/availability, selecting only those stations which a) had enough data between 1900 and 1950 that the time series browser offered normalizing, and b) had some data available after the year 2000. This approach left me with 29 stations [1] spread throughout Europe and Asia as shown in figure 1.

I next normalized the observed temperatures to the 1900-1950 mean and combined the station data to get one single curve to compare to models. To select which models to investigate further, I did a fit for the years 1970-2000, both for the experimental data and for the *historical* and *historicalNat* scenarios for all available models. I ranked the models by the difference in the calculated temperature trend between both scenarios, the reasoning being that how much an influence the selected scenario has is an indicator for the "pessimim" or "optimism" of a given model. I then selected the two models showing the greatest difference and the three models showing the least difference. Table 1 shows the calculated temperature trends as well as the anomalies in annual mean temperature for 2004 for the selected models. Note that both the observed temperature trend of 0.35 °C/decade and the observed mean temperature anomaly for 2004 of 1.42 °C lie between the second and the third most "pessimistic" models.

Next, I looked at the predicted temperature trend for the selected models for the years 2000-2100, both for the low-forcing *rcp26* and for the high-forcing *rcp85* scenario. Table 2 shows the linear fit parameters and the predicted annual mean temperatures for 2099 for all five models. A plot of the linear fits for both scenarios is shown in figure 2. Note that the values for T_{2099} shown in table 2 are the actual model values for that year and thus differ from the linear fit predictions shown in the figure.

As can be seen, even for the low-forcing scenario most models predict a further increase in temperature of between ∼0.5 and ∼1.5 °C compared to the present day value, with only one model
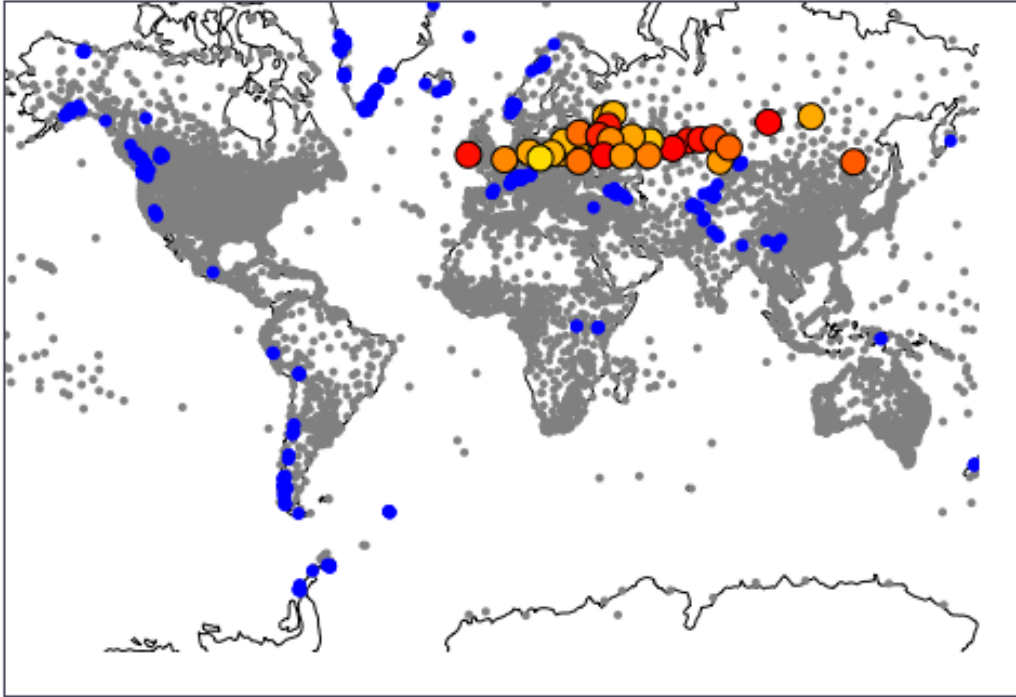
Figure 1: Geographical distribution of the stations selected for this project.

model	T trend, ℃/dec.		ΔT 2004, ℃	
scenario	historical	historicalNat	historical	historicalNat
data composite	0.35		1.42	
CNRM-CM5	0.71	0.03	2.43	−0.19
NorESM1-M	0.61	−0.03	2.93	0.90
GISS-E2-H	0.29	0.03	1.06	1.00
CSIRO Mk-3-6-0	0.39	0.16	1.72	0.15
MRI-CGCM3	−0.08	−0.18	0.78	0.4

Table 1: Fit parameters for 1970-2000 and mean temperature anomalies for 2004 for the selected models.

model	T trend, ℃/dec.		ΔT 2099, ℃	
scenario	rcp85	rcp26	rcp85	rcp26
CNRM-CM5	0.64	0.11	6.24	3.03
NorESM1-M	0.65	0.13	7.42	2.01
GISS-E2-H	0.47	−0.16	4.43	0.86
CSIRO Mk-3-6-0	0.61	0.12	5.65	1.77
MRI-CGCM3	0.51	0.11	4.96	1.71

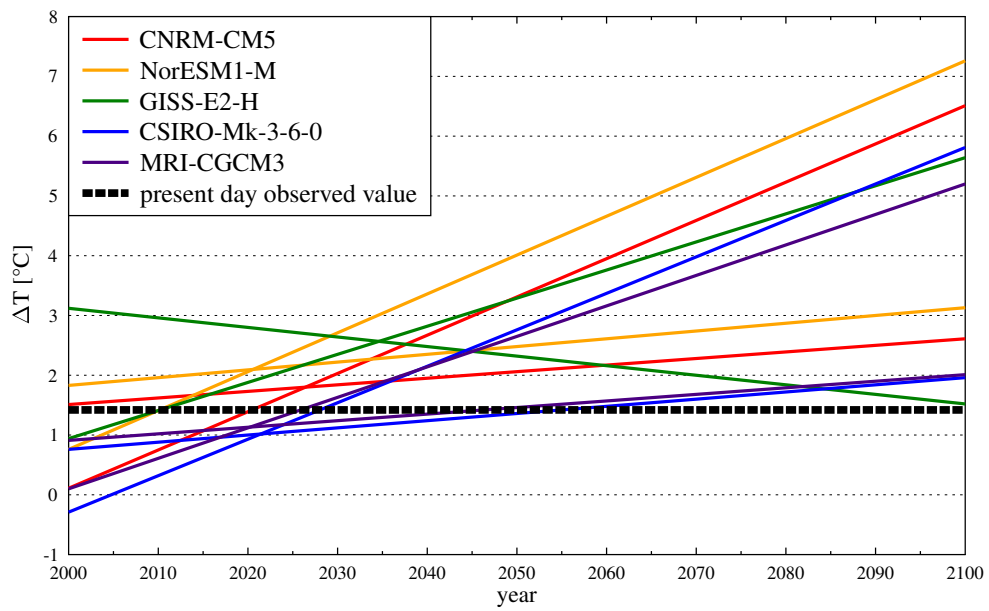Table 2: Fit parameters for 2000-2100 and mean temperature anomalies for 2099 for the selected models.

Figure 2: Linear fits of the normalized mean temperature in years 2000-2100 for the selected models for scenarios *rcp85* and *rcp26*.

(*GISS-E2-H*) showing a stabilization or even a slight decrease. For the high-forcing scenario, even the most "optimistic" models exhibit a further increase of ∼4 ℃ compared to today, with predictions of the more "pessimistic" models reaching up to ∼6 ℃ above today.

References

[1] http://climatemodels.uchicago.edu/timeseries/#CcyCRMdBEDDCBhBbGlhBBFxDmFjCyHDfFBCDBBFDOx