

Temperature Trends

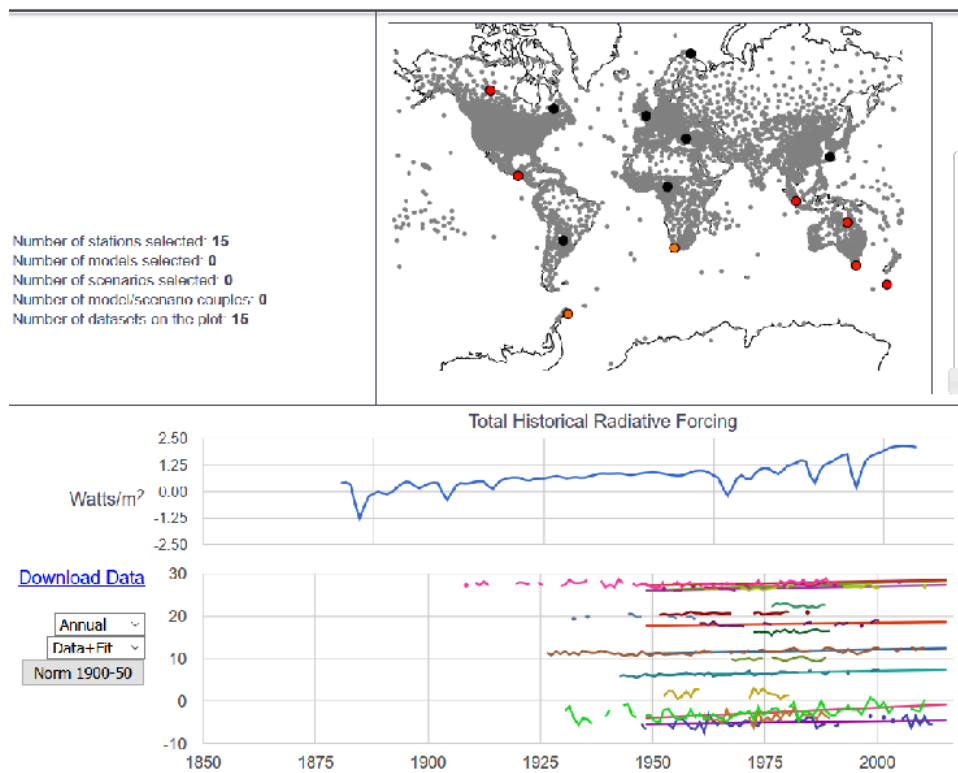
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29 October 2016

Introduction

Idea

My project started with the idea of showing trends in temperatures from randomly selected stations. I downloaded the list of station names from the [Time Series Browser](#), and wrote a short Python script to select station names at random. I then manually selected stations, see link [here](#). However, there is a problem as the figure makes clear: *stations are not distributed uniformly, so the selection will also be skewed.*



I therefore decided to sample uniformly across the globe: select positions at random, and take the readings from the nearest stations with adequate data. See Methodology Section below.

References

- Code is stored in [my Github repository](#) - user name ‘weka11’
- The algorithm for uniformly sampling points on the surface of a globe is documented in [Statistical Mechanics: Algorithms and Computations](#), Werner Krauth, PDF [here](#) - *algorithm 1-22, direct-surface*.
- [Time Series Browser](#)
- [NOAA National Climatic Data Center](#)

Methodology

I decided against using the Time Series Browser, as it was designed for accessing data by station name, not latitude and longitude. I could have written a script to generate random locations, and then screen scrape the data, but past experience with other websites has taught me that this is fraught with difficulty (typically this requires the exploitation of undocumented features in the website: *here be Dragons!*). I decided to use the *data behind the Time Series Browser* instead. The analyses are performed in [R](#), and this document has been generated by [R Markdown](#) - see References above. **NB: as the R code uses a random number generator, the results of each run will be different.**

- Download stations and monthly average temperature readings from [NOAA National Climatic Data Center](#)
- Randomly sample 25 locations, uniformly distributed distributed on the surface of the Globe, using the algorithm from Werner Karuth’s book, above.
- Filter the list of stations so they are restricted to those with readings in the time interval of interest (currently 1950 to the present)
- For each of the 25 locations, find the nearest station.
- Tabulate the stations, and plot the time annual average temperatures, along with a regression line

Results

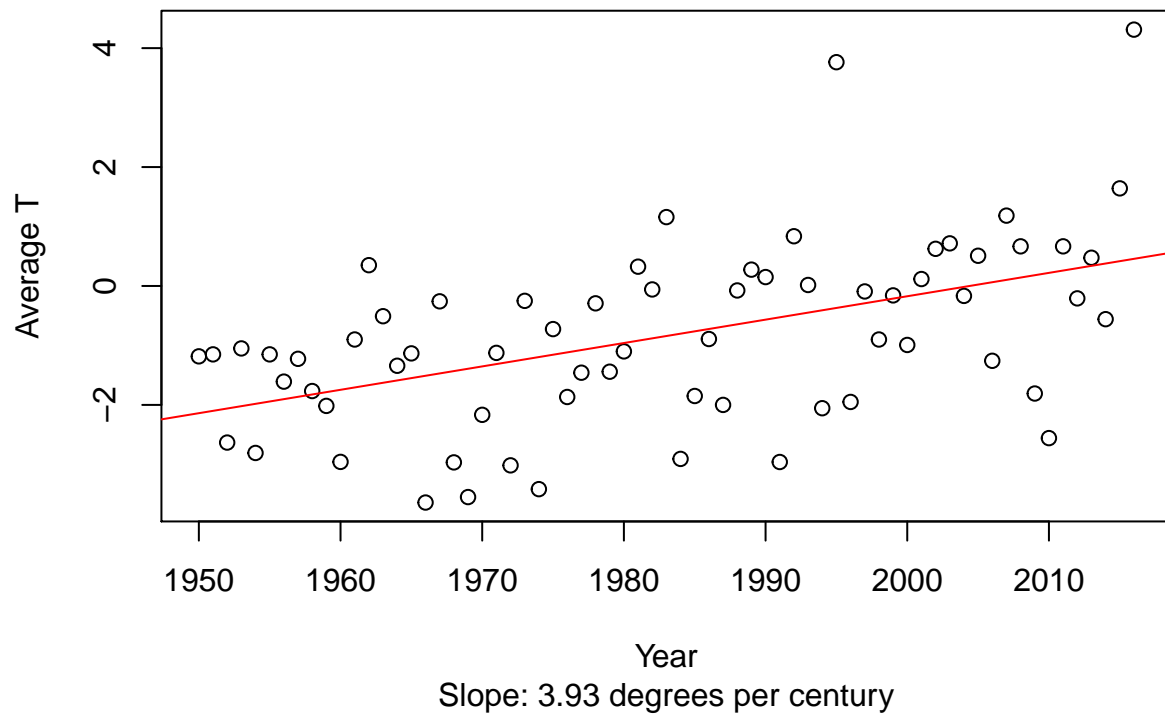
Stations and their locations

ID	NAME	LATITUDE	LONGITUDE
22229231000	KOLPASEVO	58.32	82.95
80099905001	SHIP E	35.00	-48.00
44078543002	CHAR. AMALIE, ST. THOMAS V	18.40	-64.90
20840879000	IRANSHAHR	27.20	60.70
10160571000	BECHAR	31.62	-2.23
12961986000	ST. BRANDON	-16.45	59.62
15567413001	ABERCORN	-8.87	31.37
15464222000	KIKWIT	-5.03	18.80
20742314000	DIBRUGARH /MO	27.48	95.02
10808589000	PRAIA	14.90	-23.52
15464235000	KANANGA	-5.88	22.42
22235121000	ORENBURG	51.68	55.10
16161967000	DIEGO GARCIA	-7.30	72.40
20558944000	PINGTAN	25.52	119.78
20743279000	MADRAS/MINAMB	13.00	80.18
21047405001	OMU	44.58	142.97
22341036000	TAIF	21.48	40.55

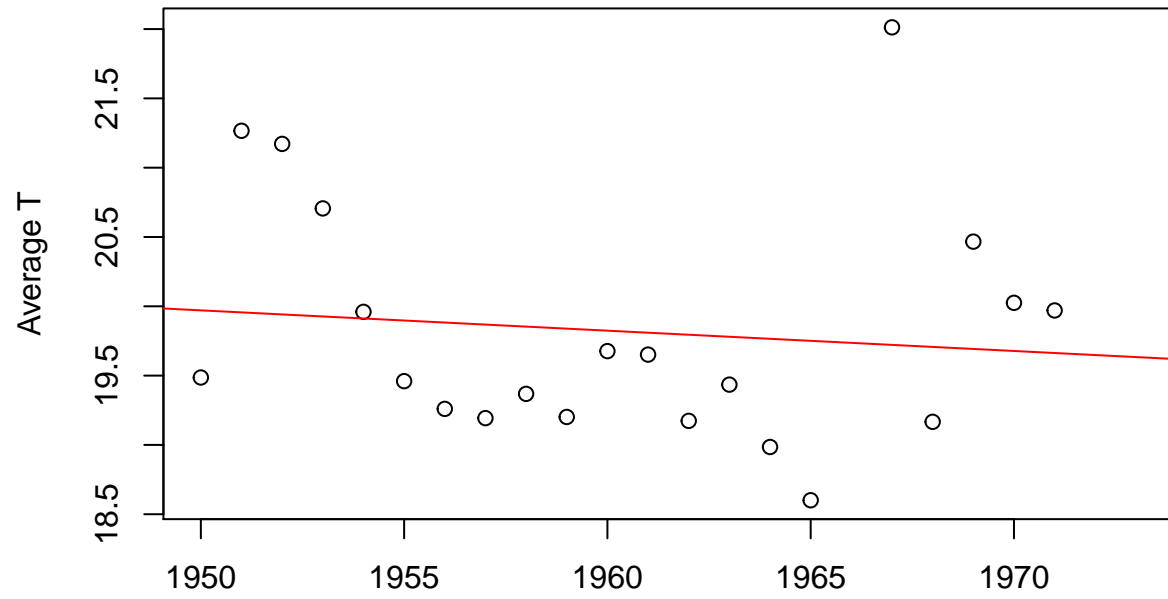
ID	NAME	LATITUDE	LONGITUDE
14063230000	GALCAYO	6.85	47.27
21841256000	SEEB, INTERNA	23.58	58.28
22224125000	OLENEK	68.50	112.43
22938763000	KIZYL-ARVAT	38.98	56.28
10565503000	OUAGADOUGOU	12.35	-1.52
63837031000	ARMAVIR	44.98	41.12
40371094003	BROUGHTON ISLAND,NW	67.53	-63.78
22340438000	RIYADH	24.72	46.73

Details from each Station

22229231000: KOLPASEVO

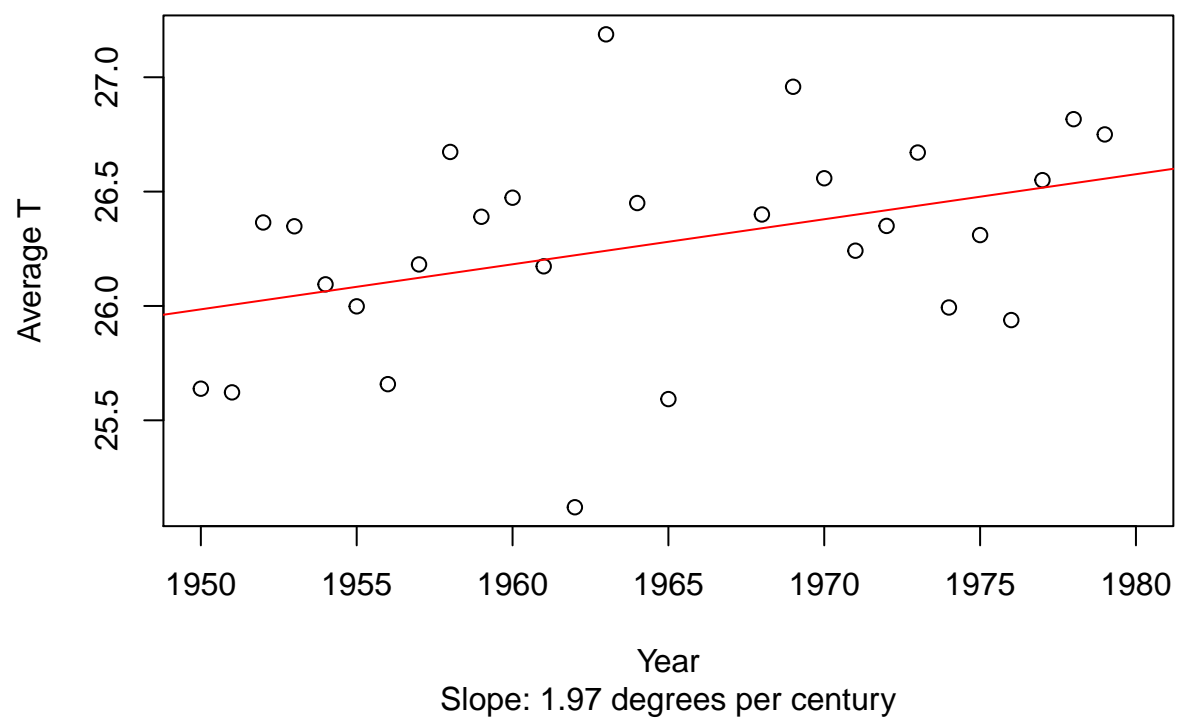


80099905001: SHIP E

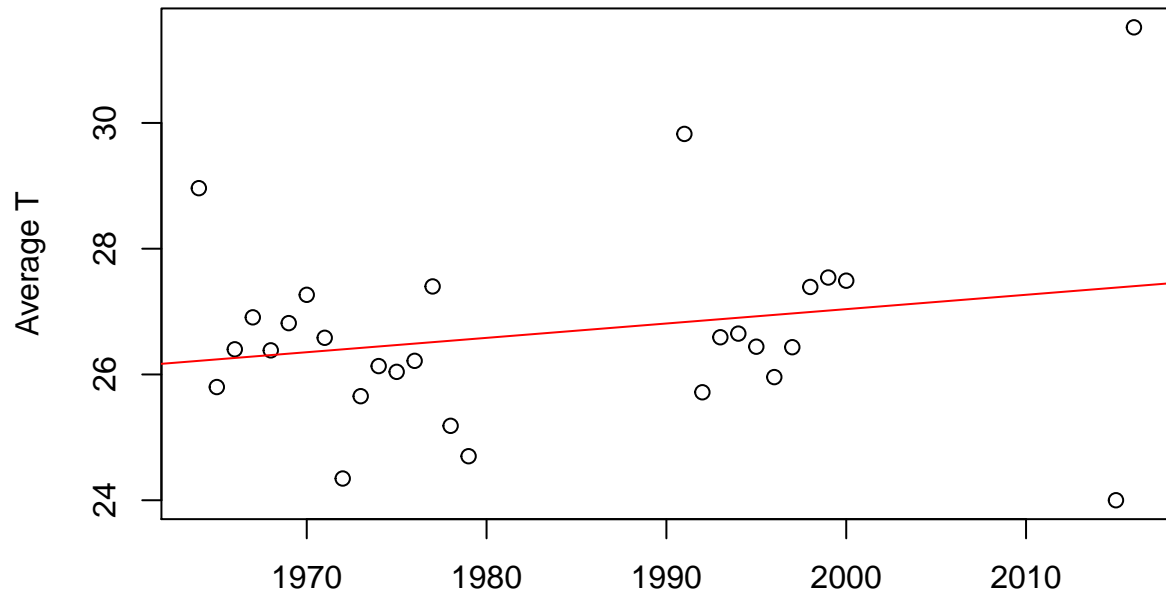


Year
Slope: -1.47 degrees per century

44078543002: CHAR. AMALIE, ST. THOMAS V

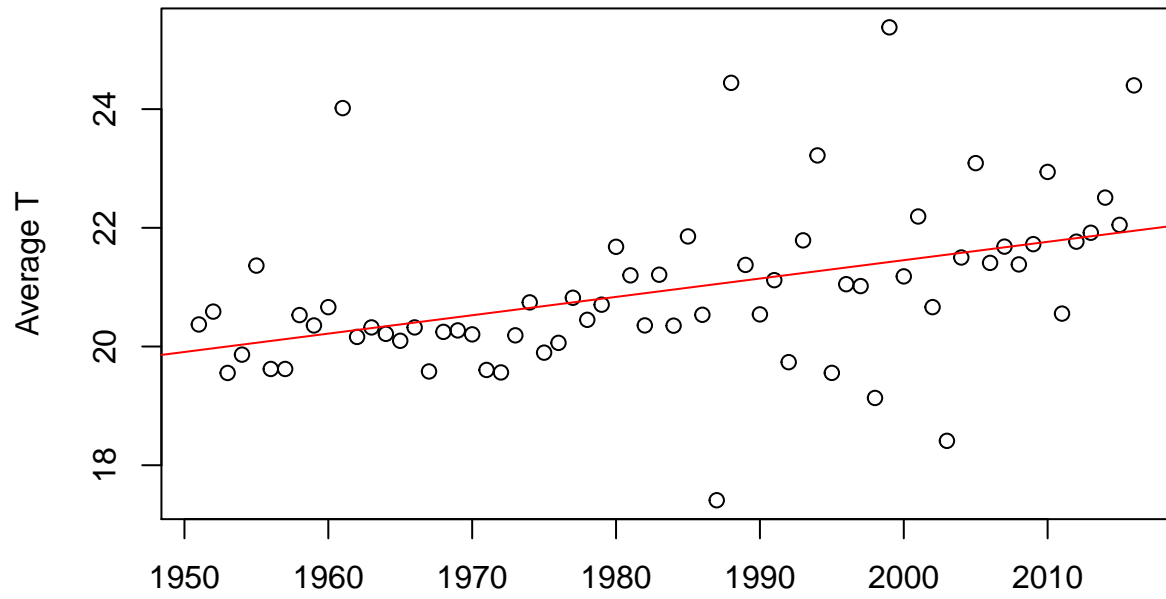


20840879000: IRAN SHAHR



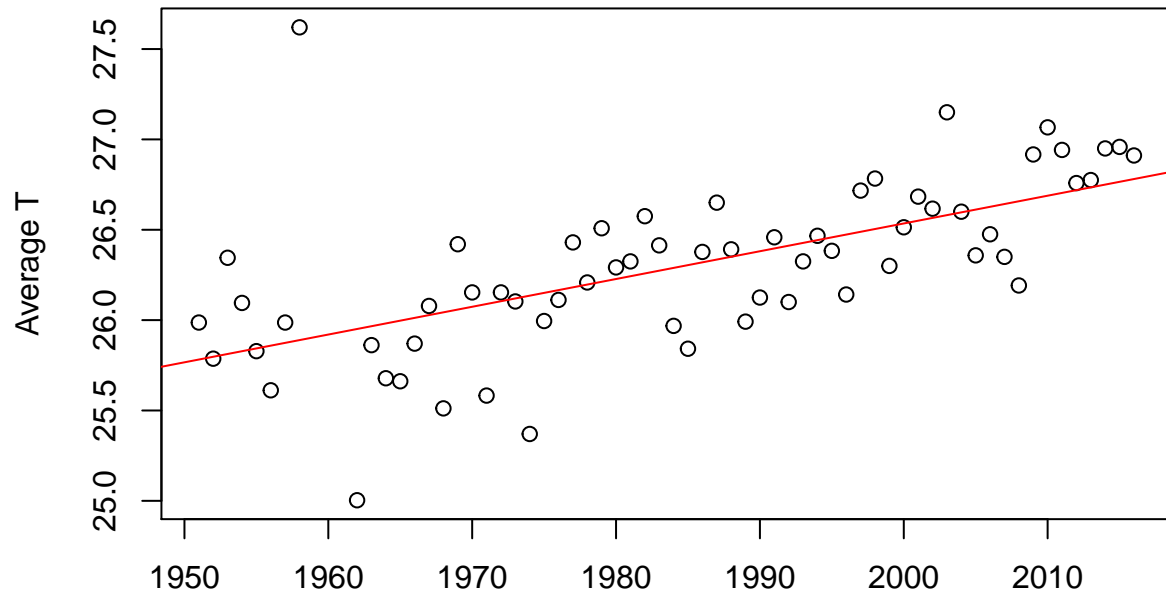
Year
Slope: 2.28 degrees per century

10160571000: BECHAR



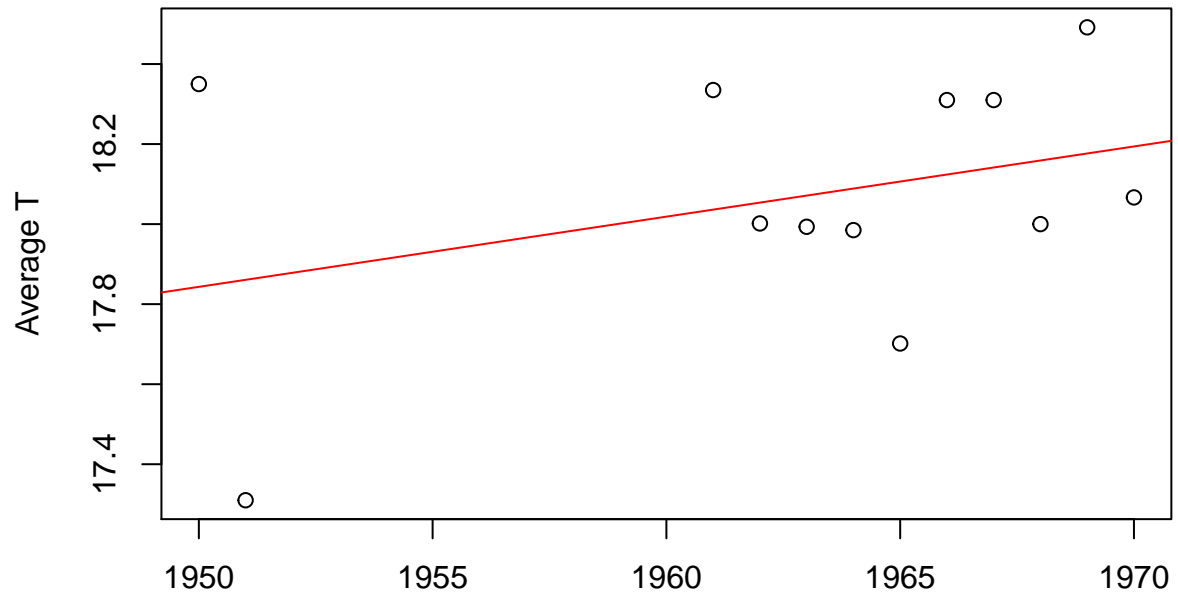
Year
Slope: 3.09 degrees per century

12961986000: ST. BRANDON



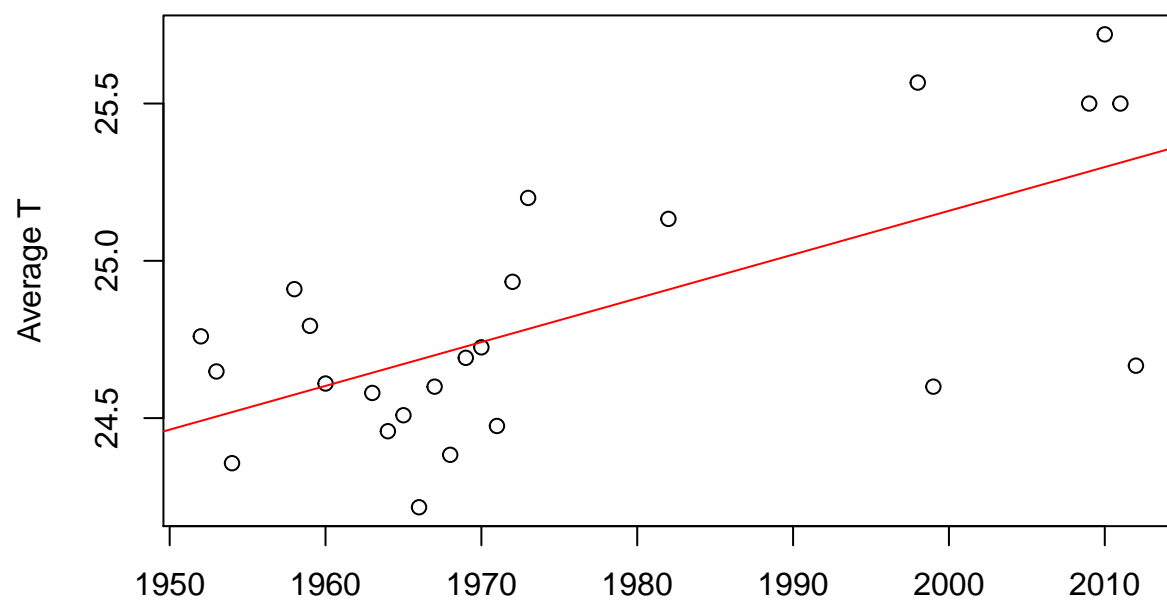
Year
Slope: 1.54 degrees per century

15567413001: ABERCORN



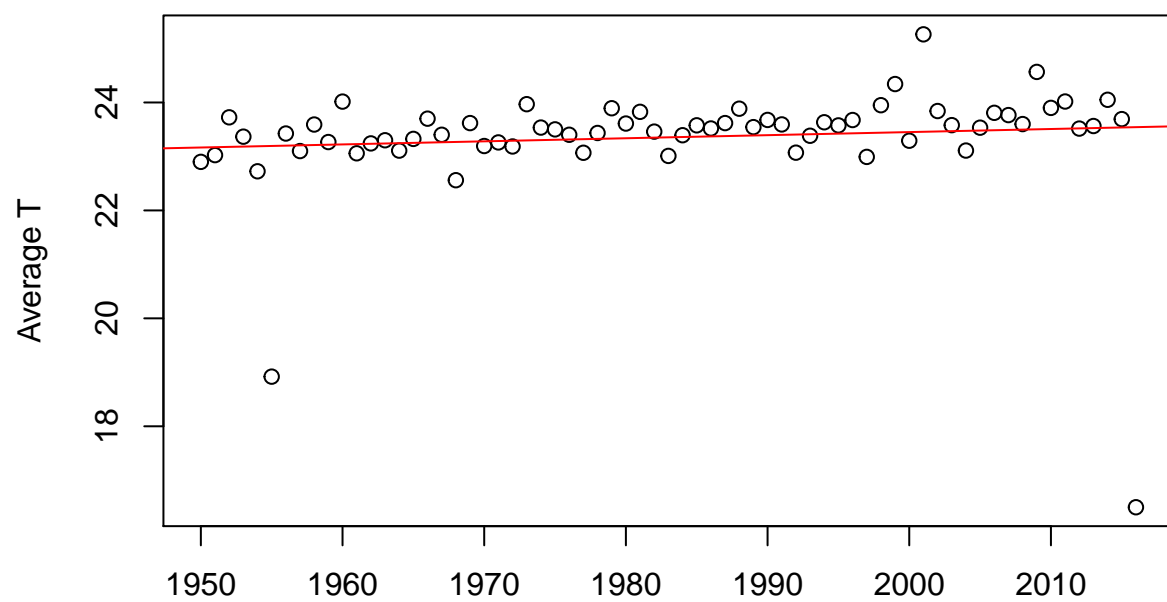
Year
Slope: 1.75 degrees per century

15464222000: KIKWIT



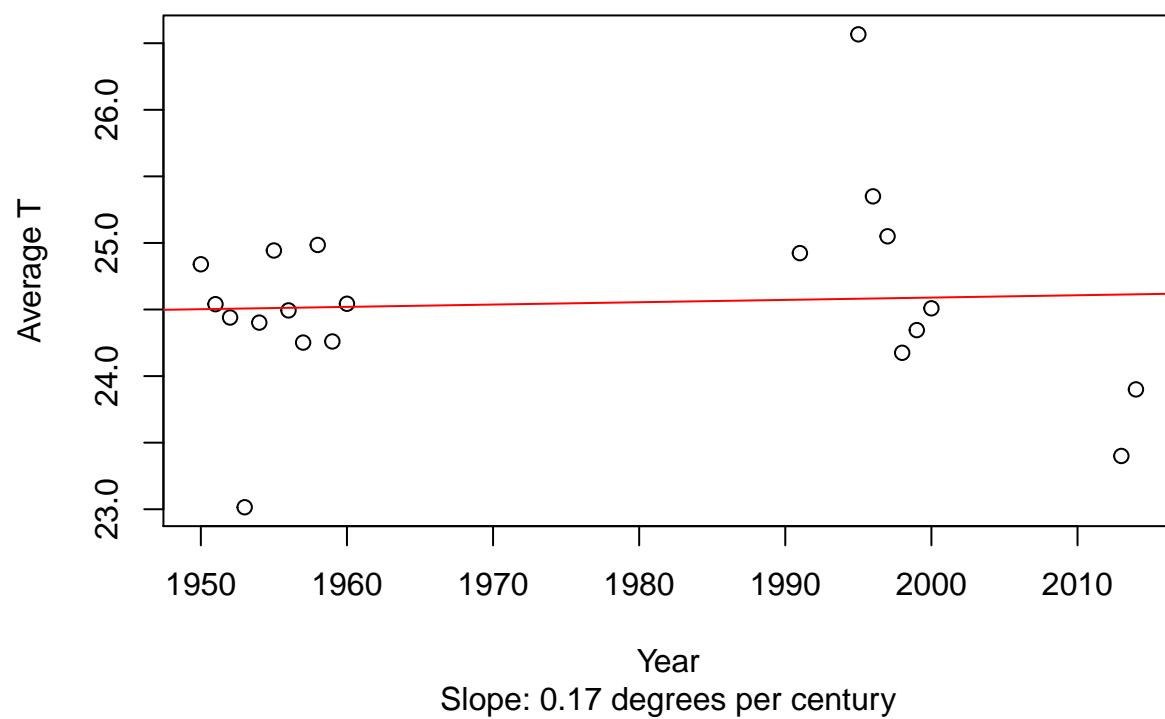
Year
Slope: 1.39 degrees per century

20742314000: DIBRUGARH /MO

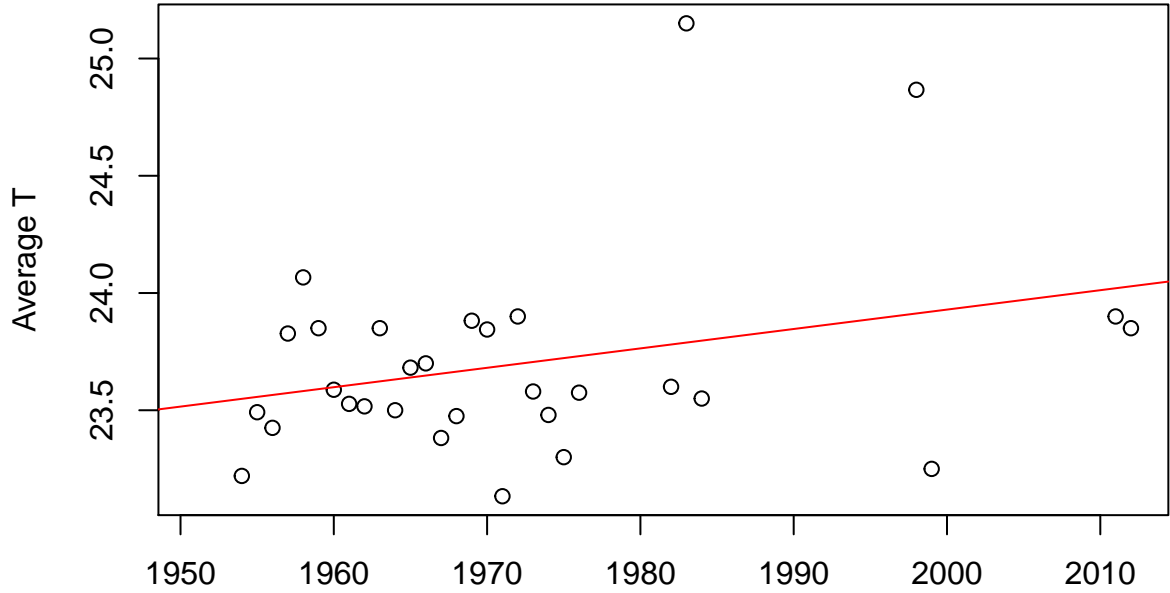


Year
Slope: 0.57 degrees per century

10808589000: PRAIA

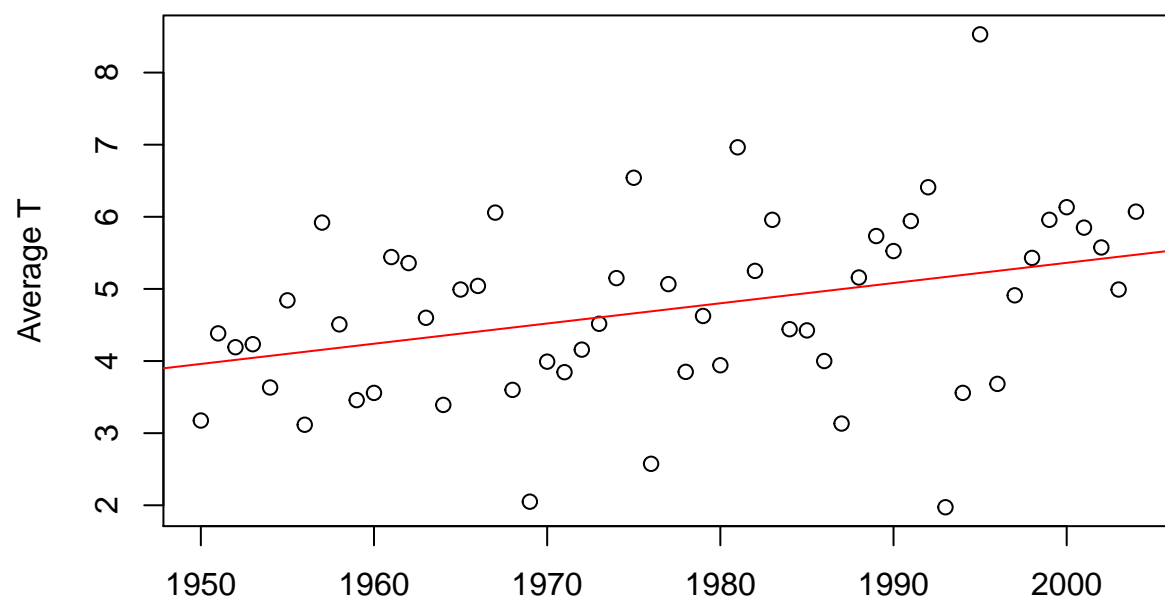


15464235000: KANANGA



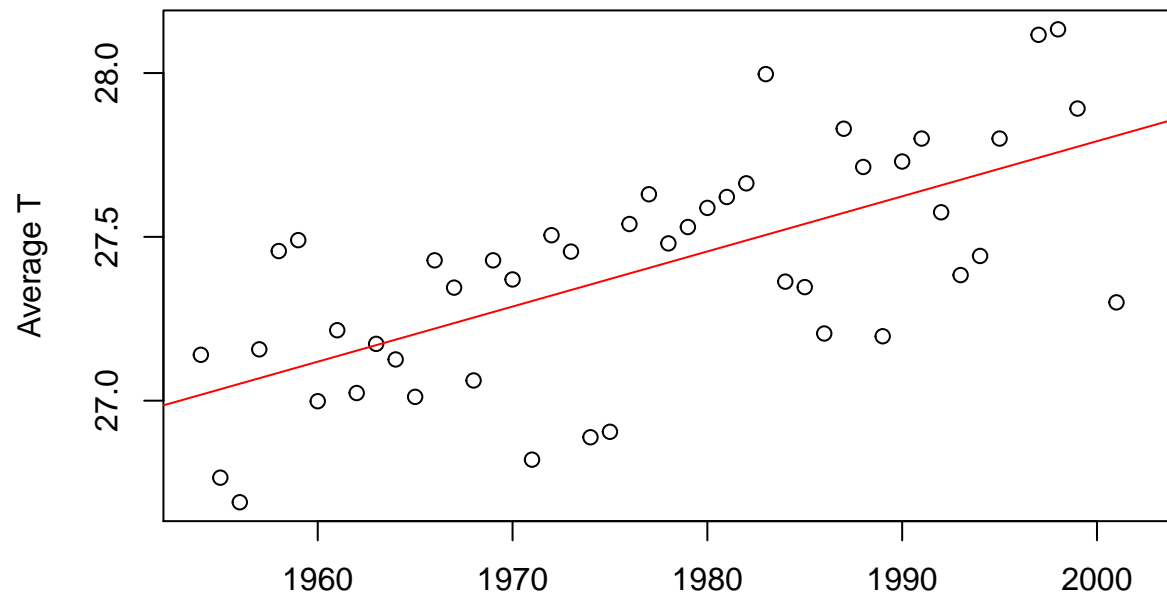
Year
Slope: 0.83 degrees per century

22235121000: ORENBURG



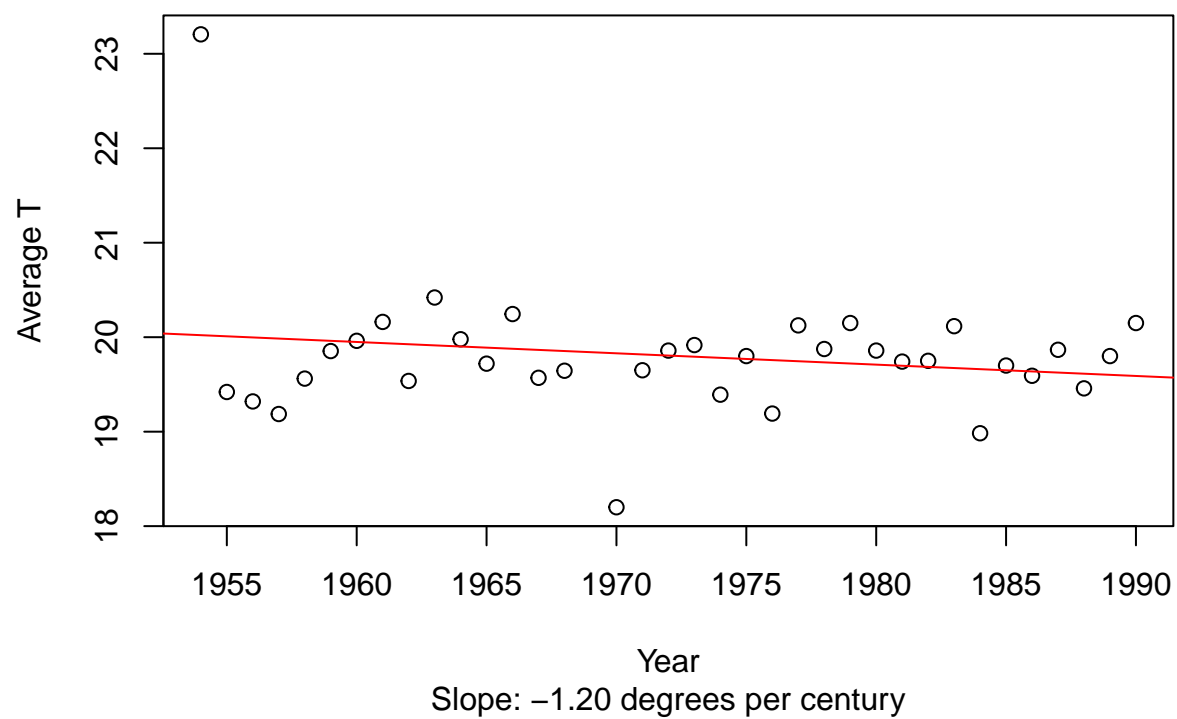
Year
Slope: 2.80 degrees per century

16161967000: DIEGO GARCIA

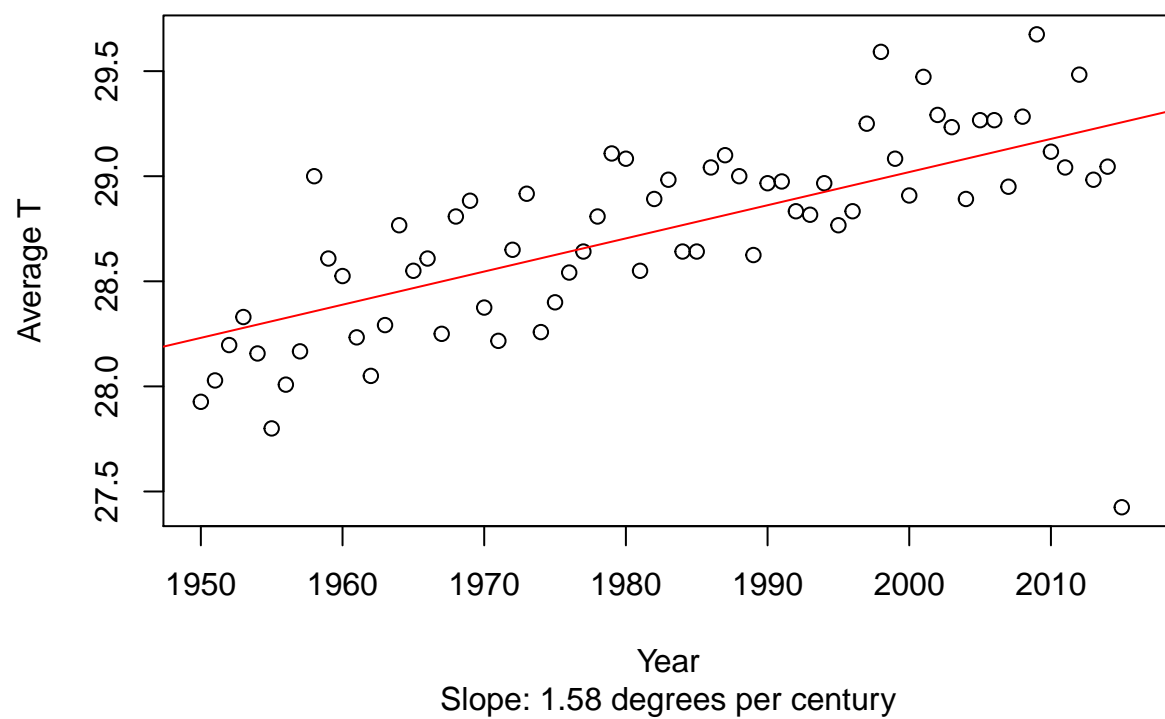


Year
Slope: 1.68 degrees per century

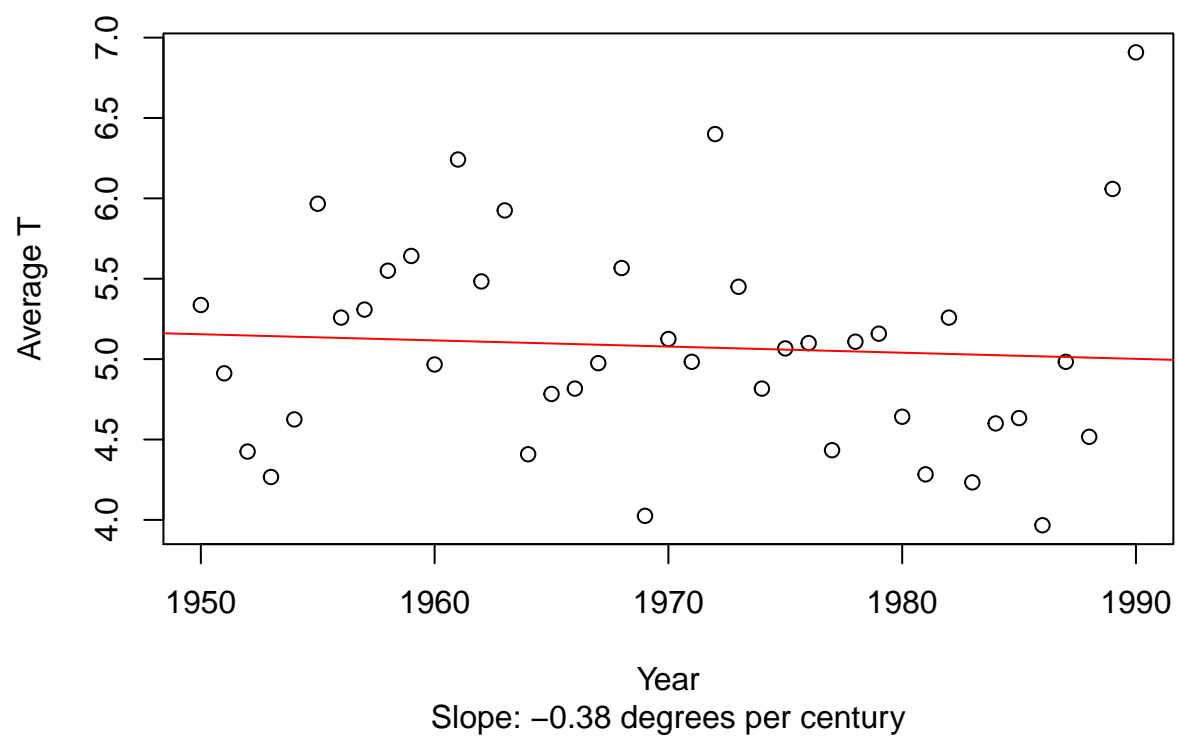
20558944000: PINGTAN



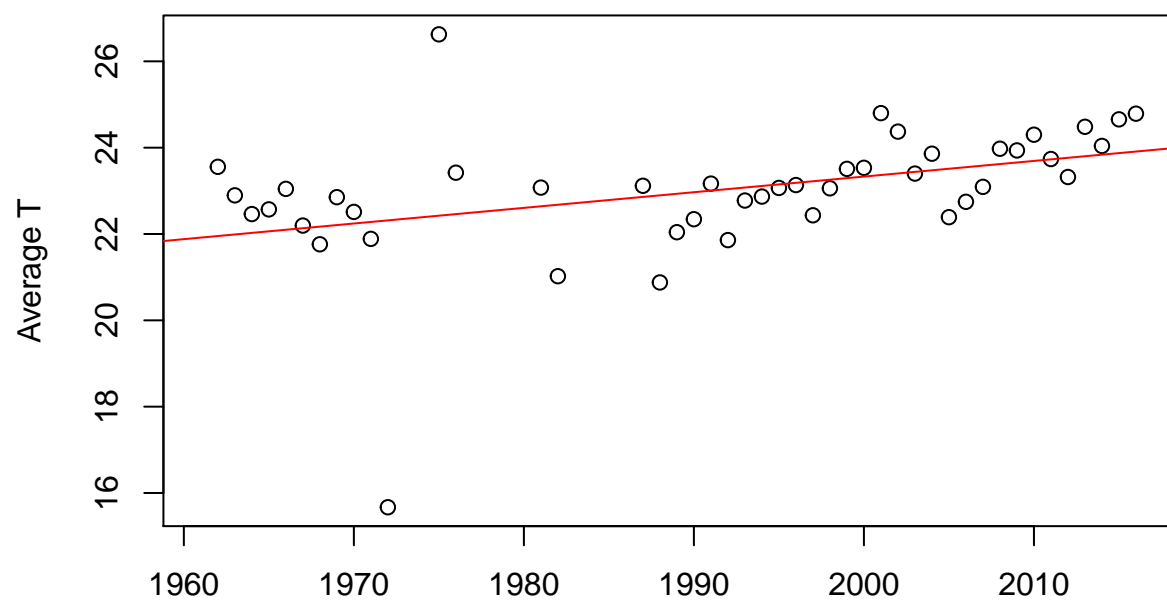
20743279000: MADRAS/MINAMB



21047405001: OMU

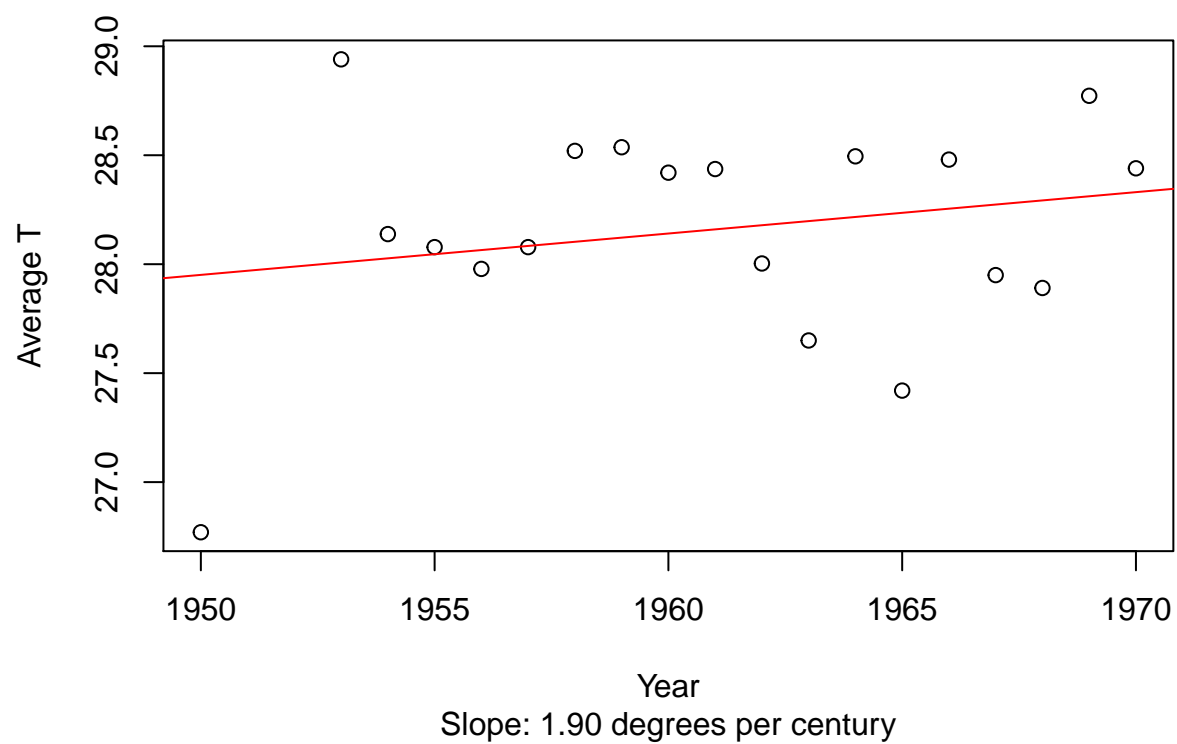


22341036000: TAIF

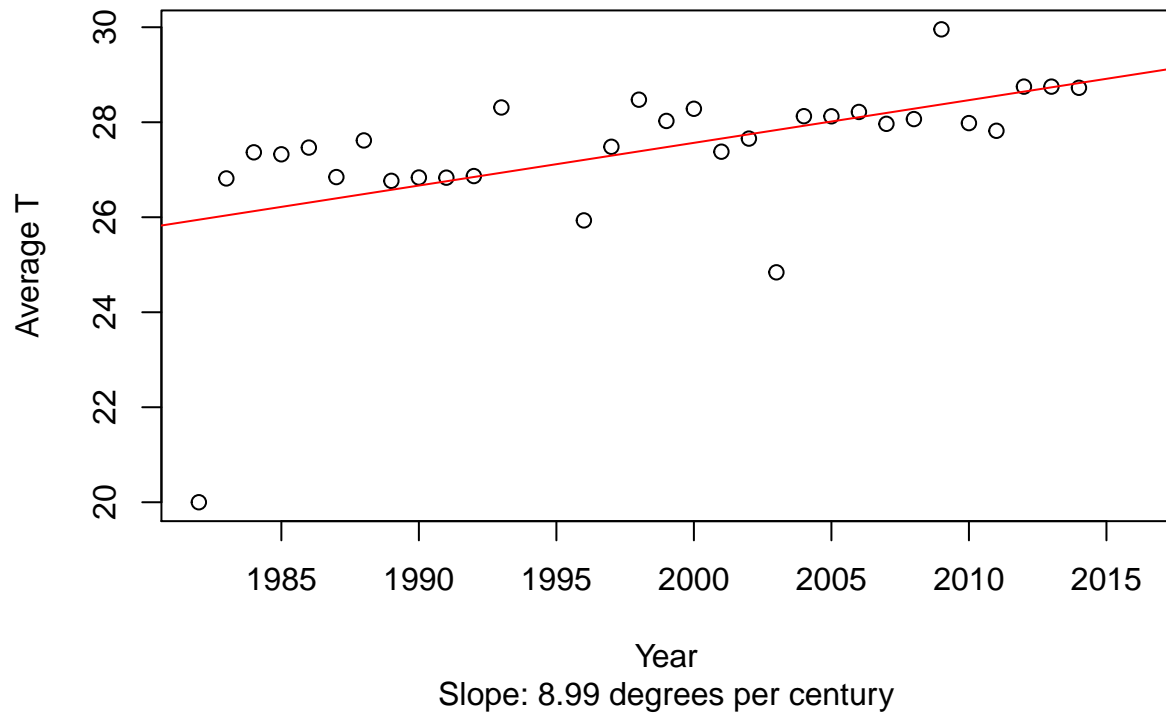


Year
Slope: 3.62 degrees per century

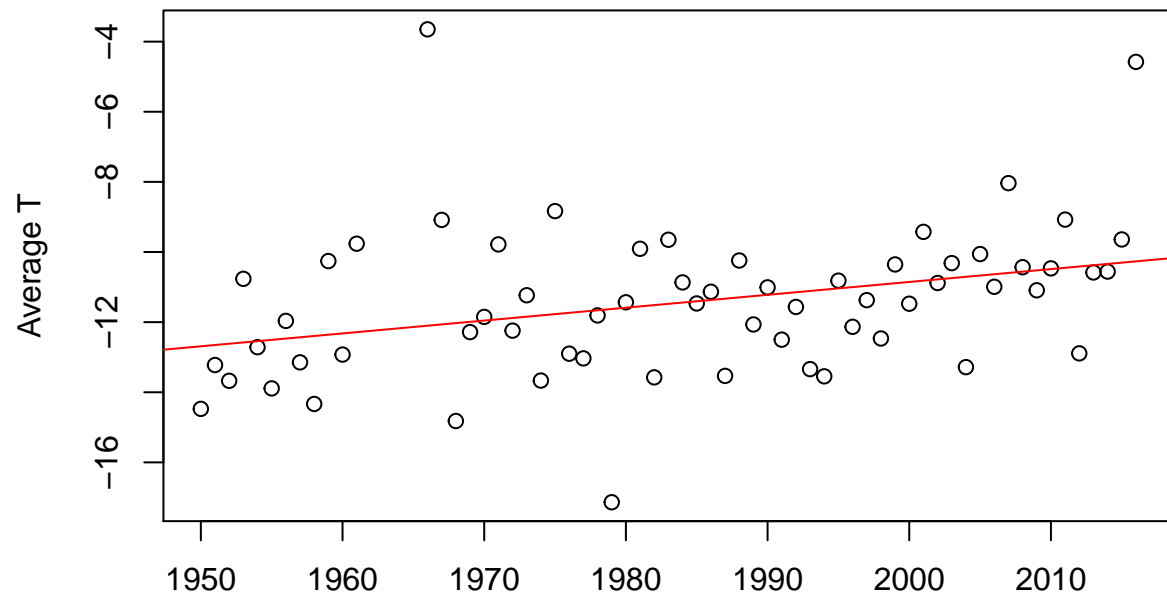
14063230000: GALCAYO



21841256000: SEEB, INTERNA

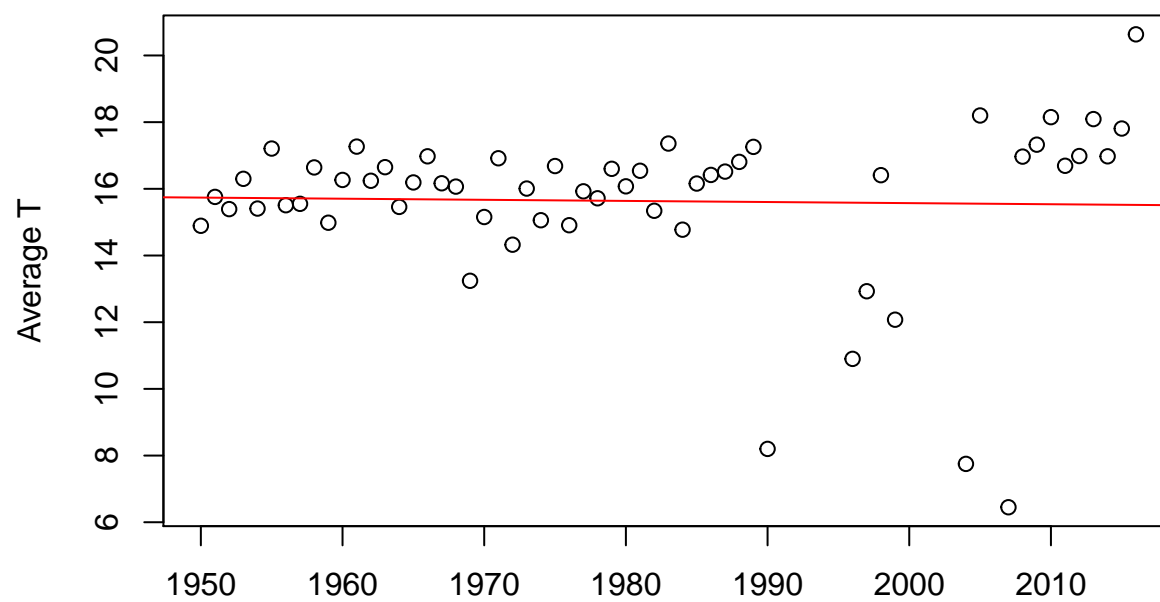


22224125000: OLENEK



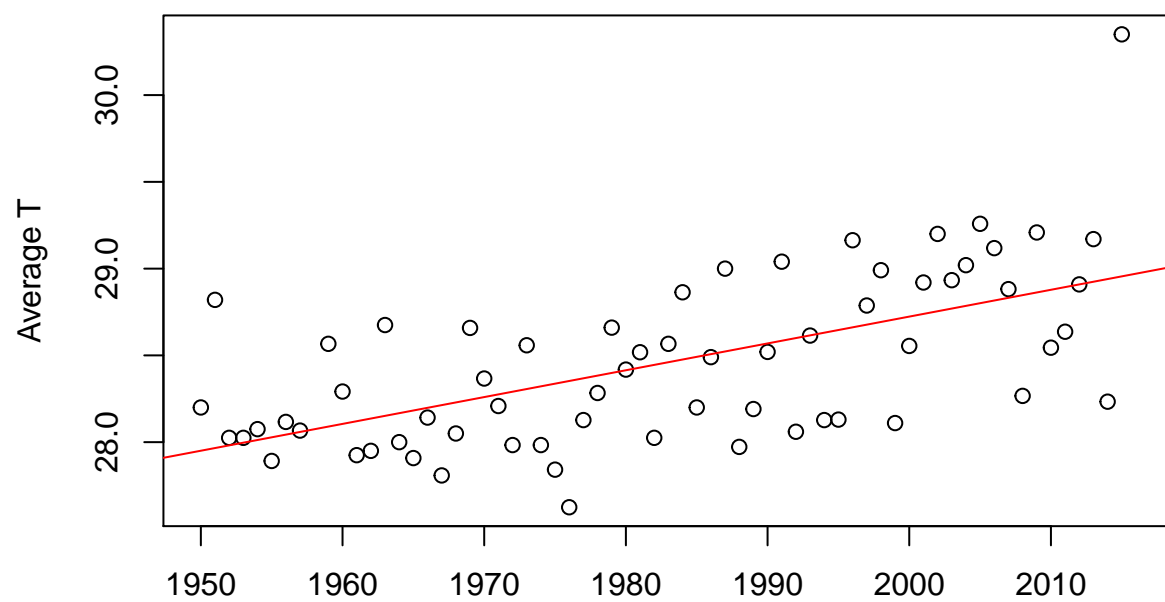
Year
Slope: 3.67 degrees per century

22938763000: KIZYL-ARVAT



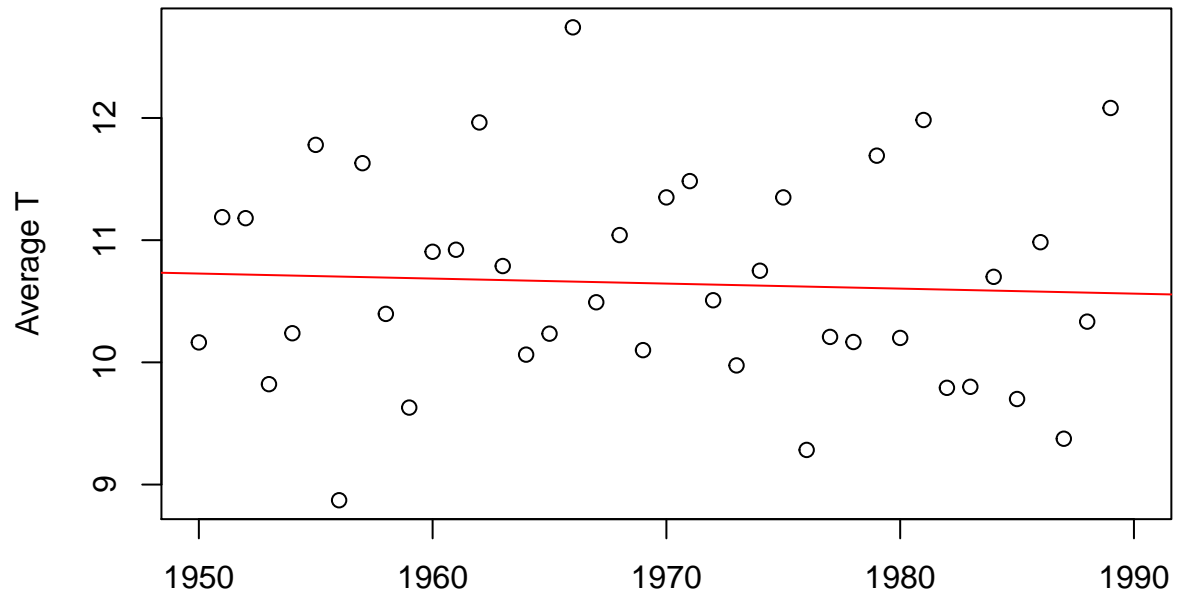
Year
Slope: -0.33 degrees per century

10565503000: OUAGADOUGOU



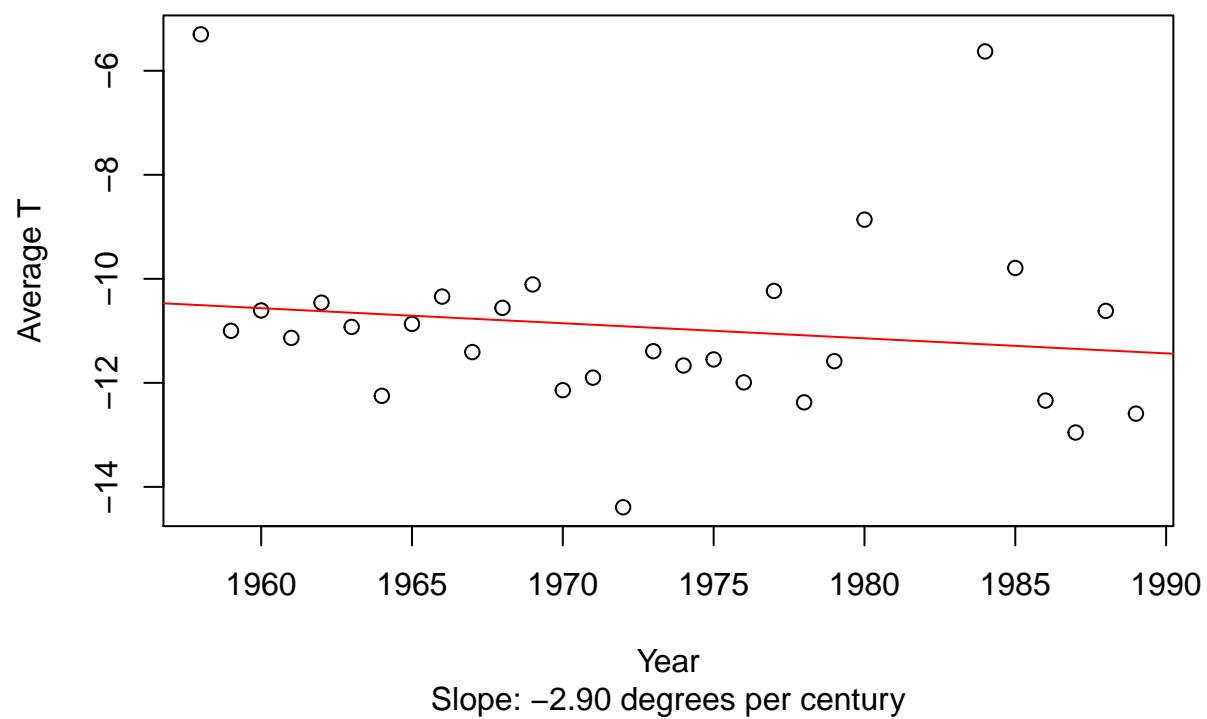
Year
Slope: 1.55 degrees per century

63837031000: ARMAVIR

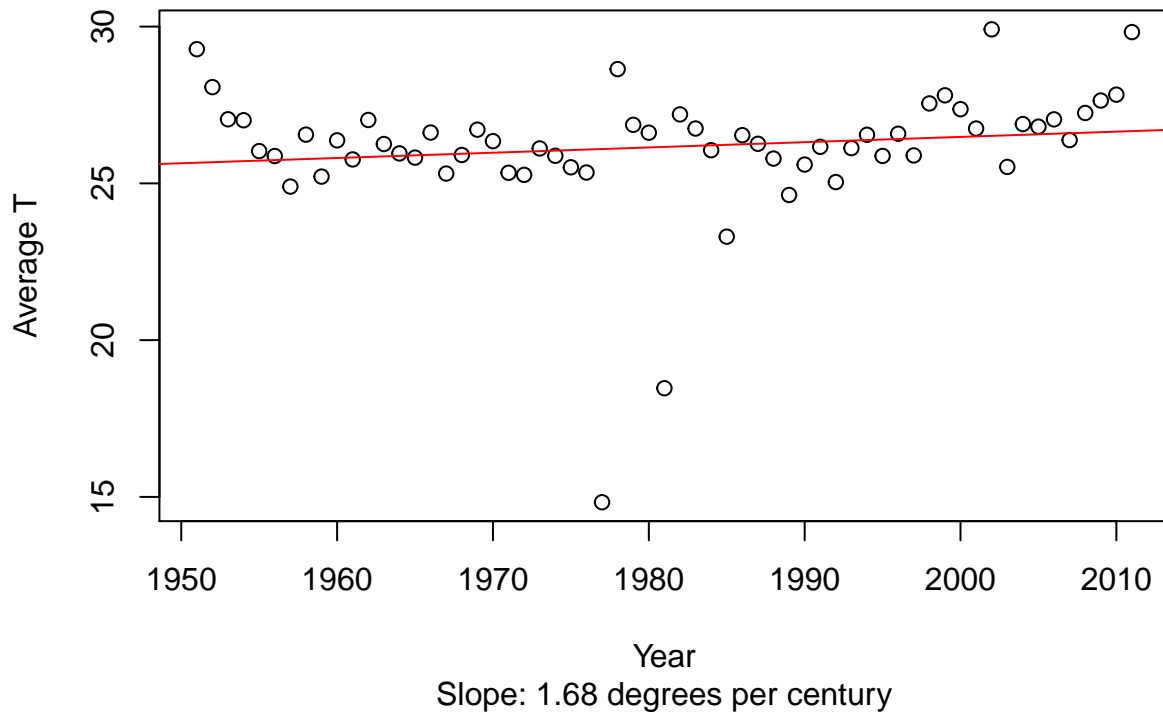


Year
Slope: -0.41 degrees per century

40371094003: BROUGHTON ISLAND,NW



22340438000: RIYADH



Conclusion

The temperature increased at 19 stations and decreased at 6 stations. This is in line with the results I have seen each time I have generated this report for a new random selection: there are far more stations with increases than decreases.

Future work

- Allow user to specify number of results needed since 1950 (currently script just requires some results).
- Allow user to specify a threshold for increases, so we would only consider temperature to be increasing if the slope exceeded some value - say 0.5 degrees per century.
- Include a summary plot for all stations.
- Allow program to download latest data from NOAA, instead of using canned data.