

# Temperature Trends

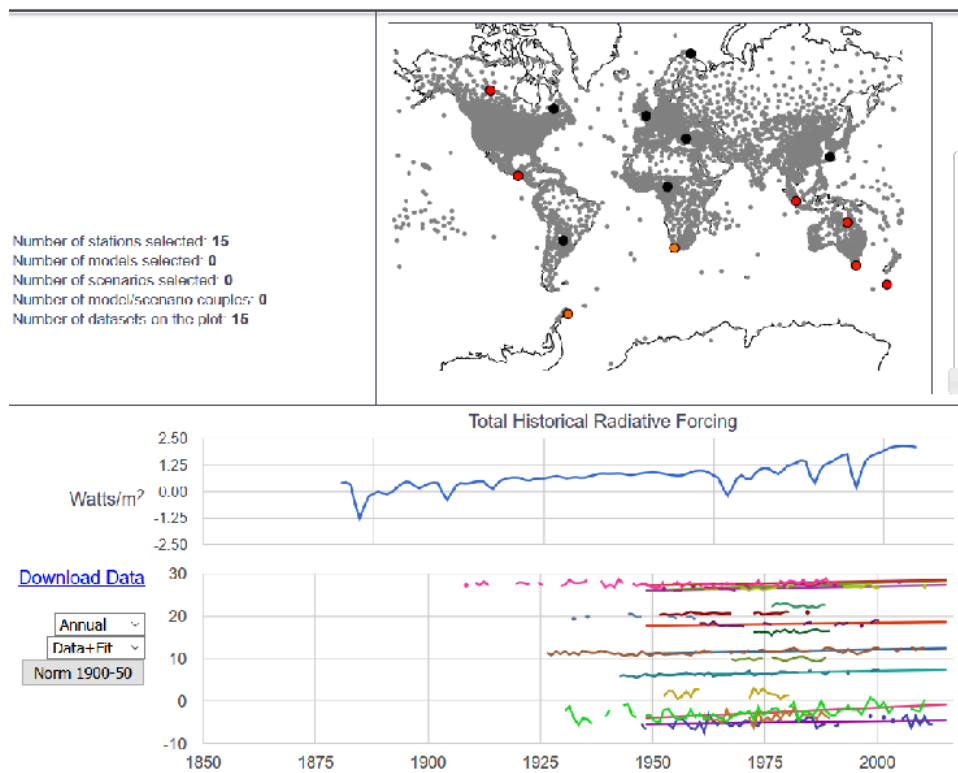
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*29 October 2016*

## 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

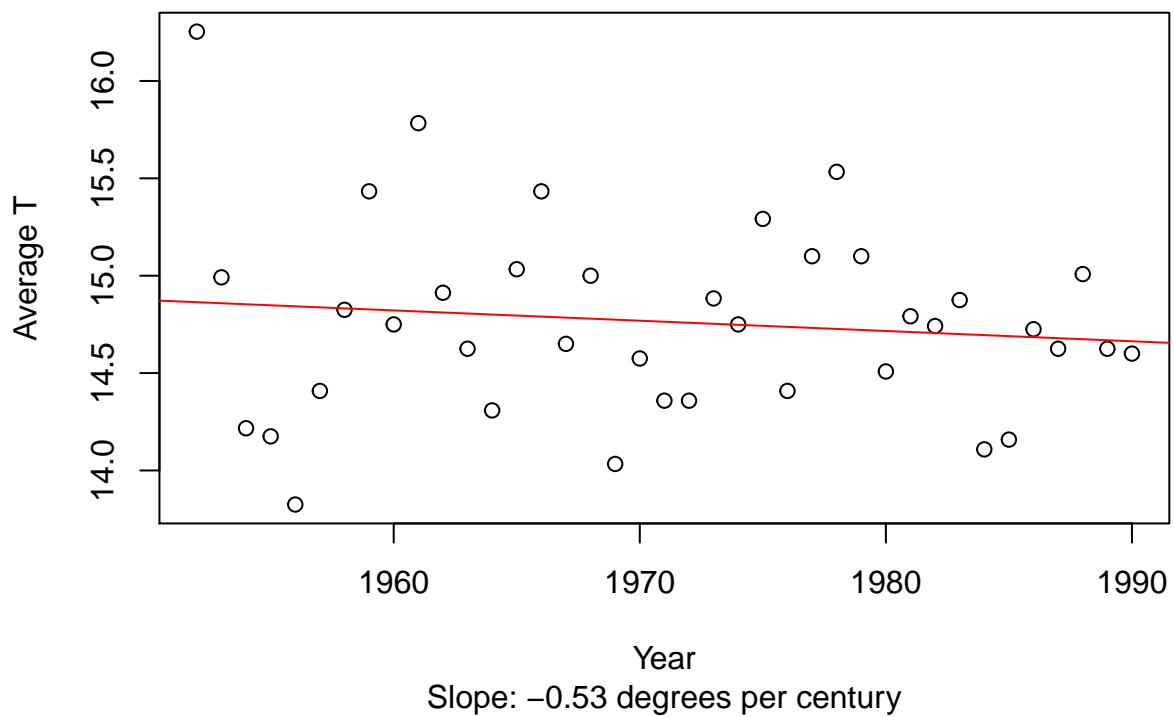
### Stations and their locations

ID	NAME	LATITUDE	LONGITUDE
20557178000	NANYANG	33.03	112.58
31480405000	LA ORCHILA	11.80	-66.18
42778016001	BOTANICAL GRDNS. BERMUDA	32.30	-64.70
13761695000	ZIGUINCHOR	12.55	-16.27
10160611000	IN AMENAS	28.05	9.63
50291660000	YASAWA-I-RARA	-16.70	177.58
11365578000	ABIDJAN	5.25	-3.93
12263612000	LODWAR	3.12	35.62
22221647000	MYS SALAUROVA	73.18	143.23
10365319000	NATITINGOU	10.32	1.38
40371926001	ENNADAI LAKE,NW	61.13	-100.90
62316350000	CROTONE	39.00	17.07
64502128001	STENSELE	65.10	17.20
10808589000	PRAIA	14.90	-23.52
10266325000	BIE (SILVA PO	-12.38	16.95
50396781000	BANDUNG/HUSEI	-6.90	107.58
22738954000	KHOROG	37.50	71.50

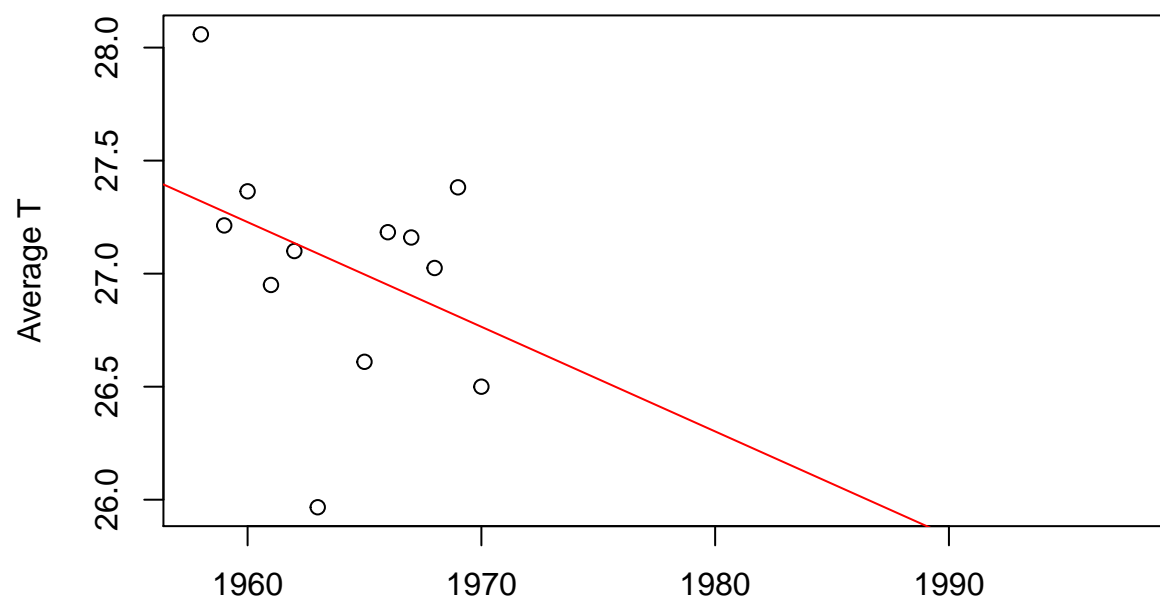
ID	NAME	LATITUDE	LONGITUDE
80099906001	SHIP I	59.00	-19.00
20742867000	NAGPUR SONEGA	21.10	79.05
12761226000	GAO	16.27	-0.05
43104330001	MYGGBUKTA	73.50	-21.60
50397900000	SAUMLAKI	-7.98	131.30
10764870000	NGAOUNDERE	7.35	13.57
50194974001	CAPE SORELL (AWS)	-42.20	145.17
14168902000	TRISTAN DA CU	-37.05	-12.32

## Details from each Station

### 20557178000: NANYANG

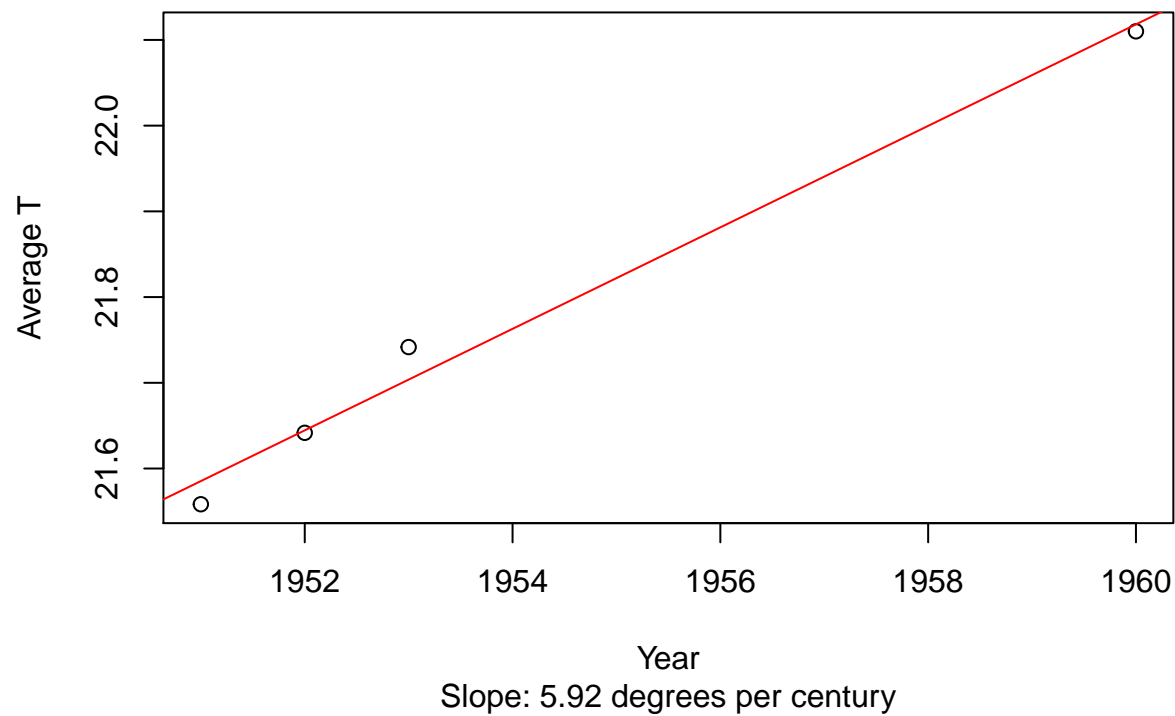


### 31480405000: LA ORCHILA

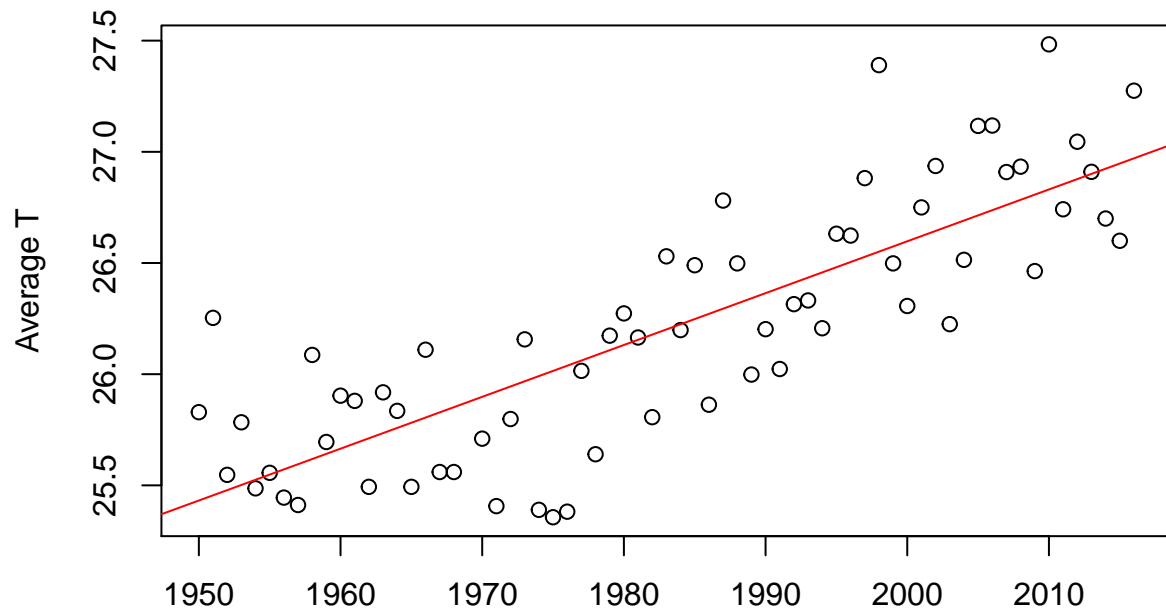


Year  
Slope:  $-4.63$  degrees per century

42778016001: BOTANICAL GRDNS. BERMUDA

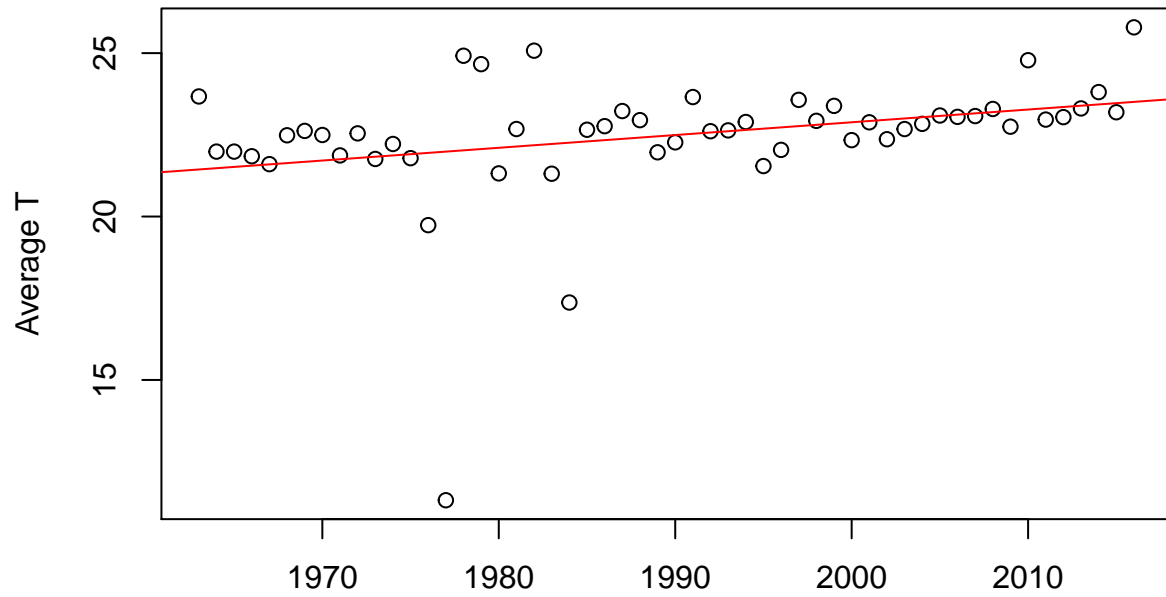


# 13761695000: ZIGUINCHOR



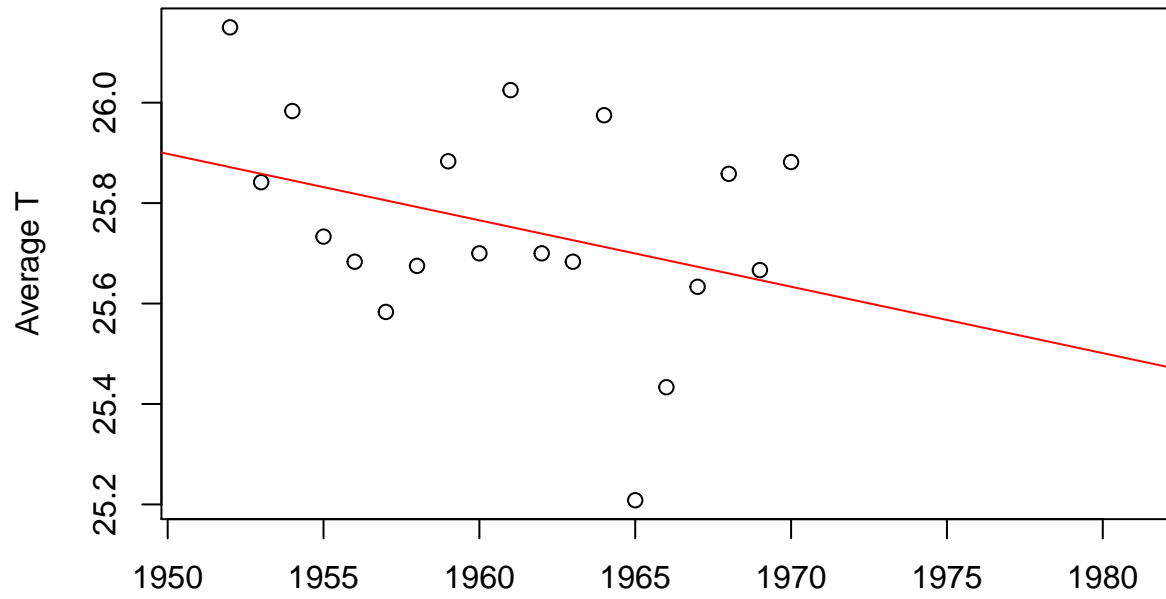
Year  
Slope: 2.33 degrees per century

# 10160611000: IN AMENAS



Year  
Slope: 3.90 degrees per century

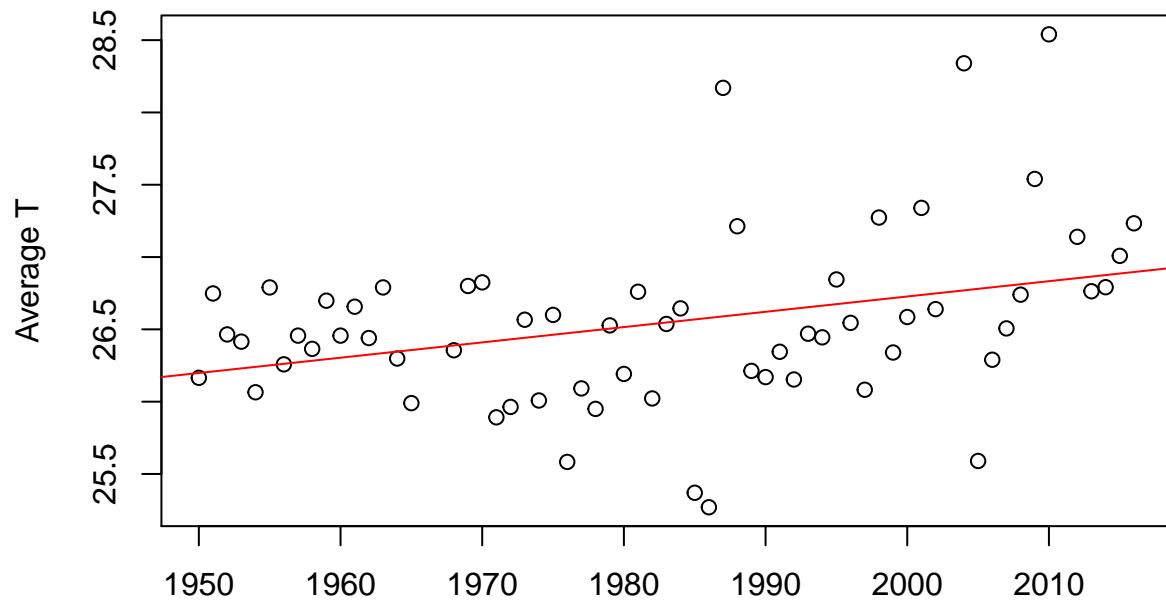
# 50291660000: YASAWA-I-RARA



Year  
Slope:  $-1.32$  degrees per century

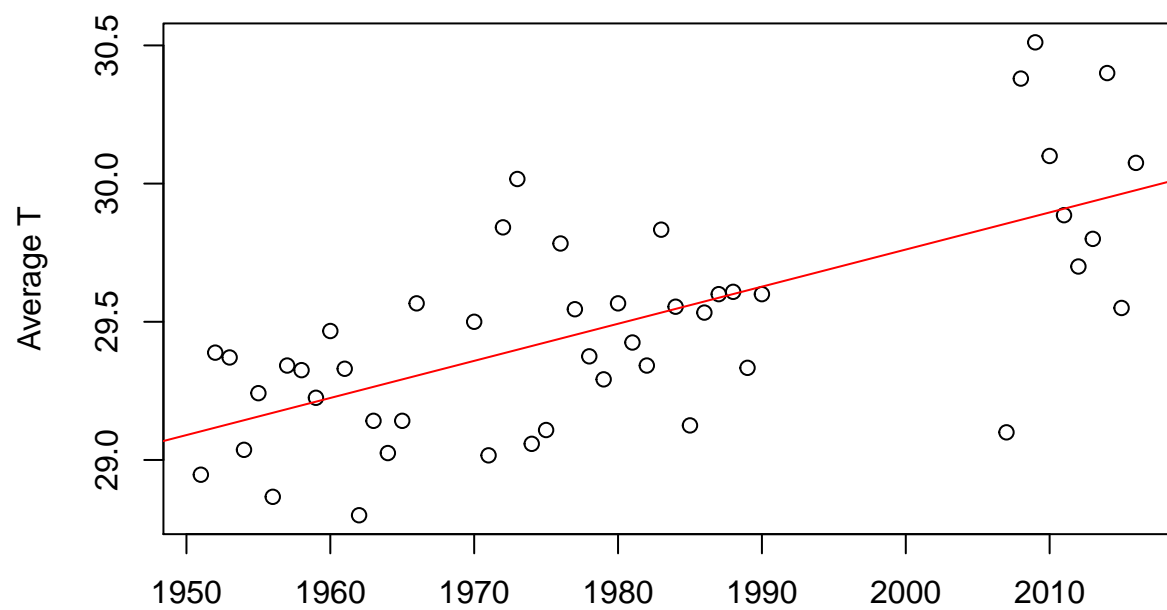


# 11365578000: ABIDJAN



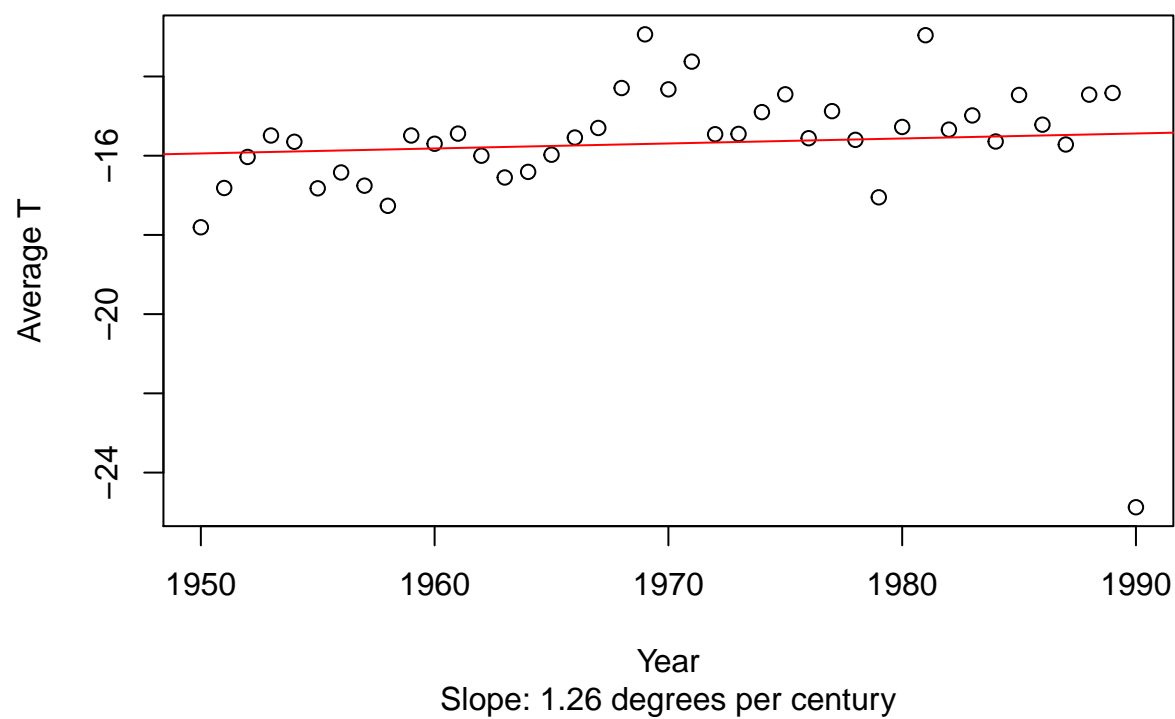
Year  
Slope: 1.06 degrees per century

# 12263612000: LODWAR

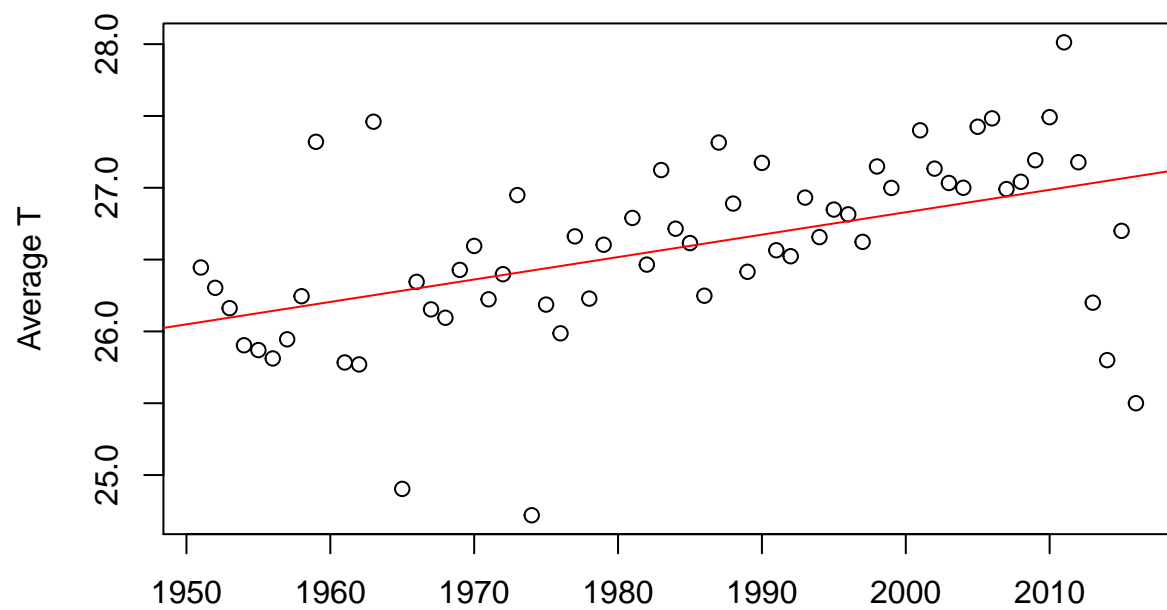


Year  
Slope: 1.34 degrees per century

# 22221647000: MYS SALAUROVA

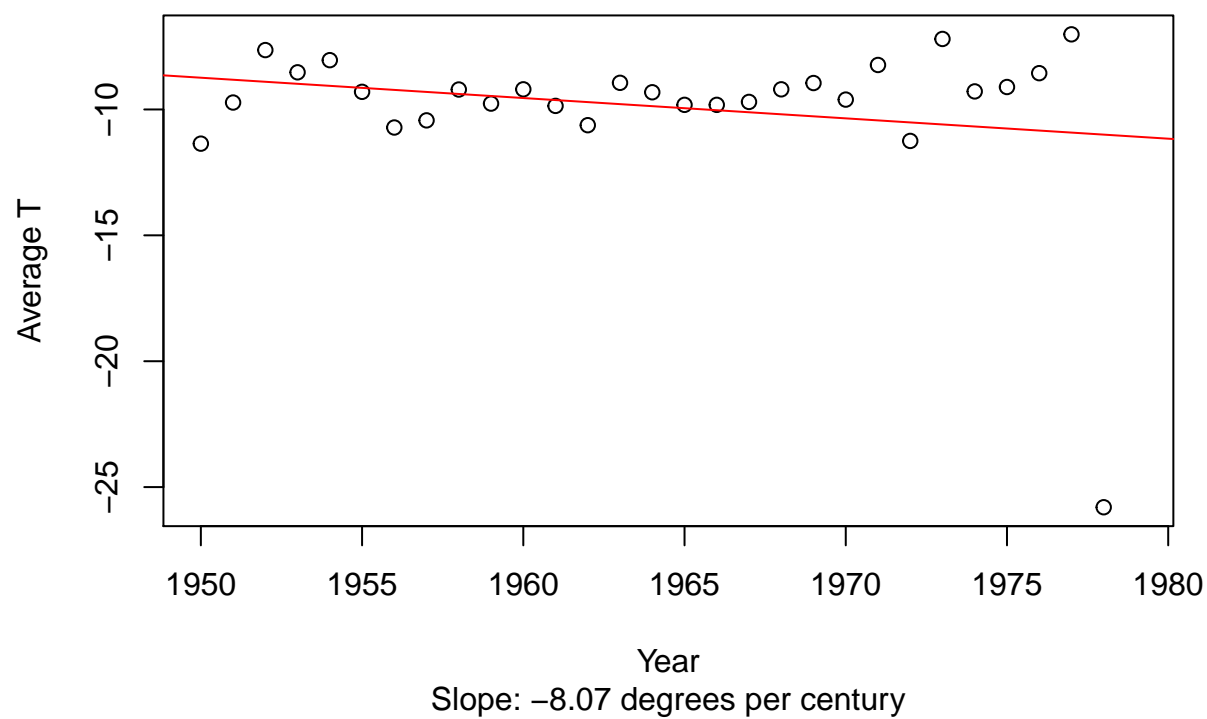


# 10365319000: NATITINGOU

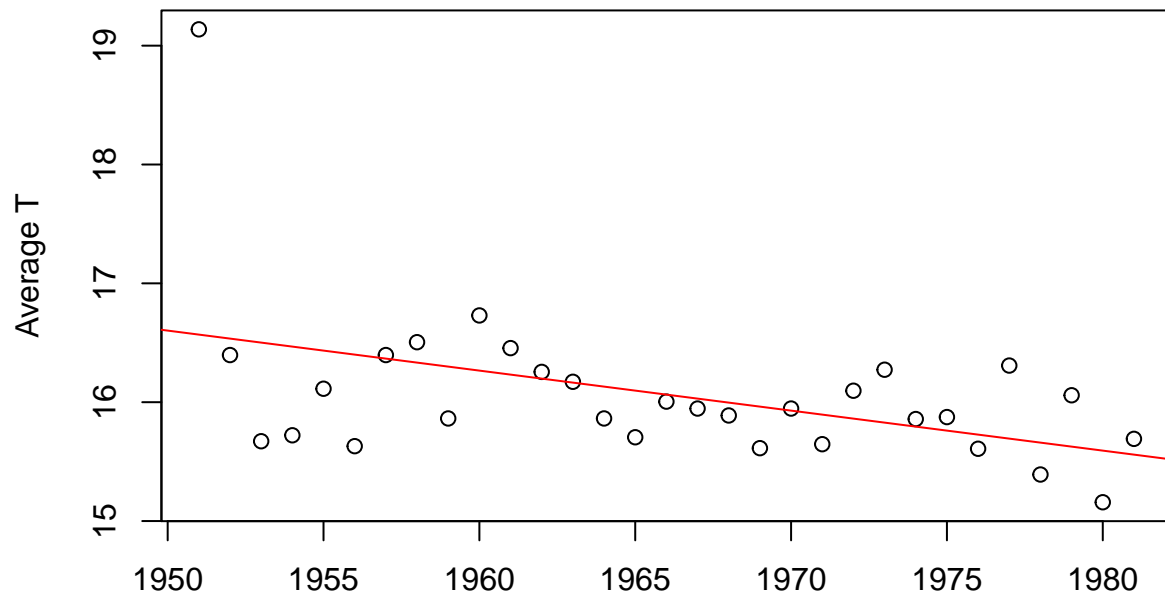


Year  
Slope: 1.56 degrees per century

### 40371926001: ENNADAI LAKE,NW

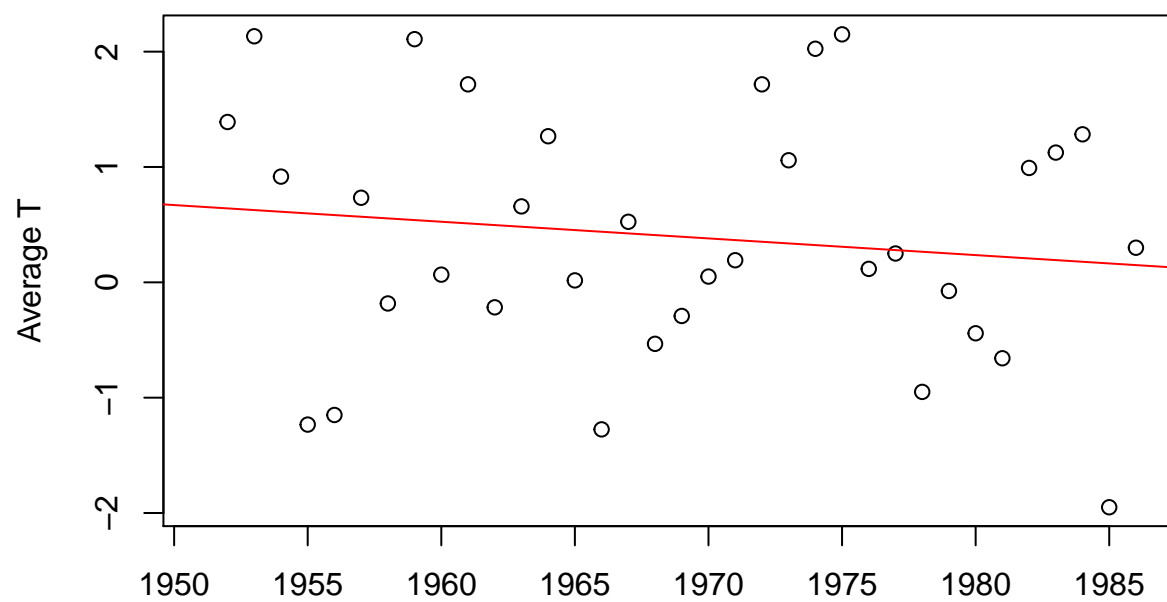


# 62316350000: CROTONE



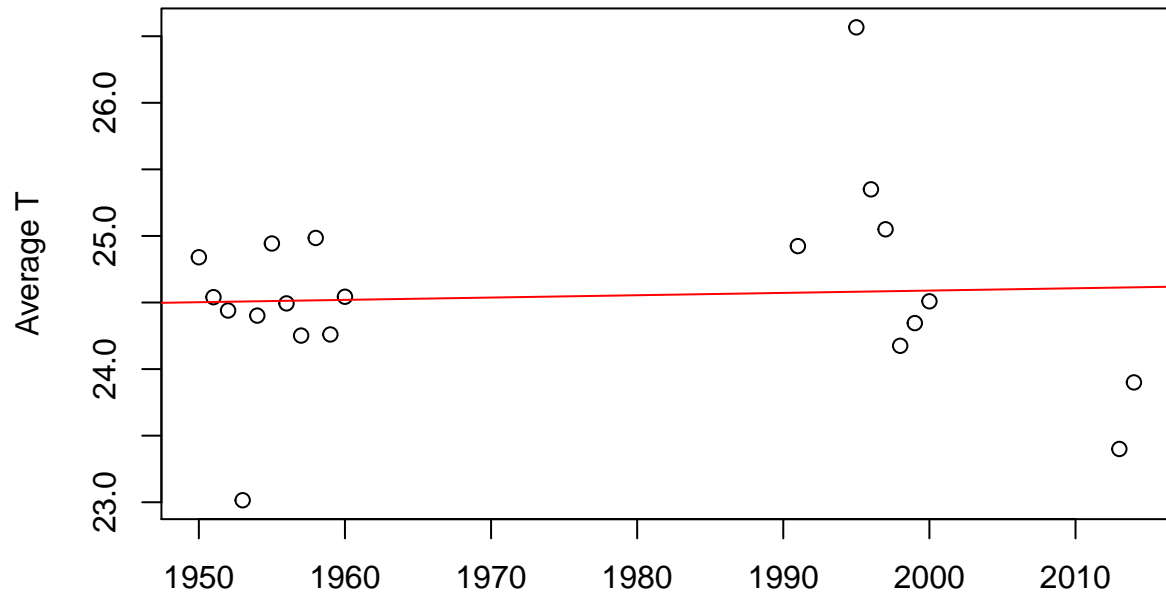
Year  
Slope:  $-3.37$  degrees per century

# 64502128001: STENSELE



Year  
Slope: -1.45 degrees per century

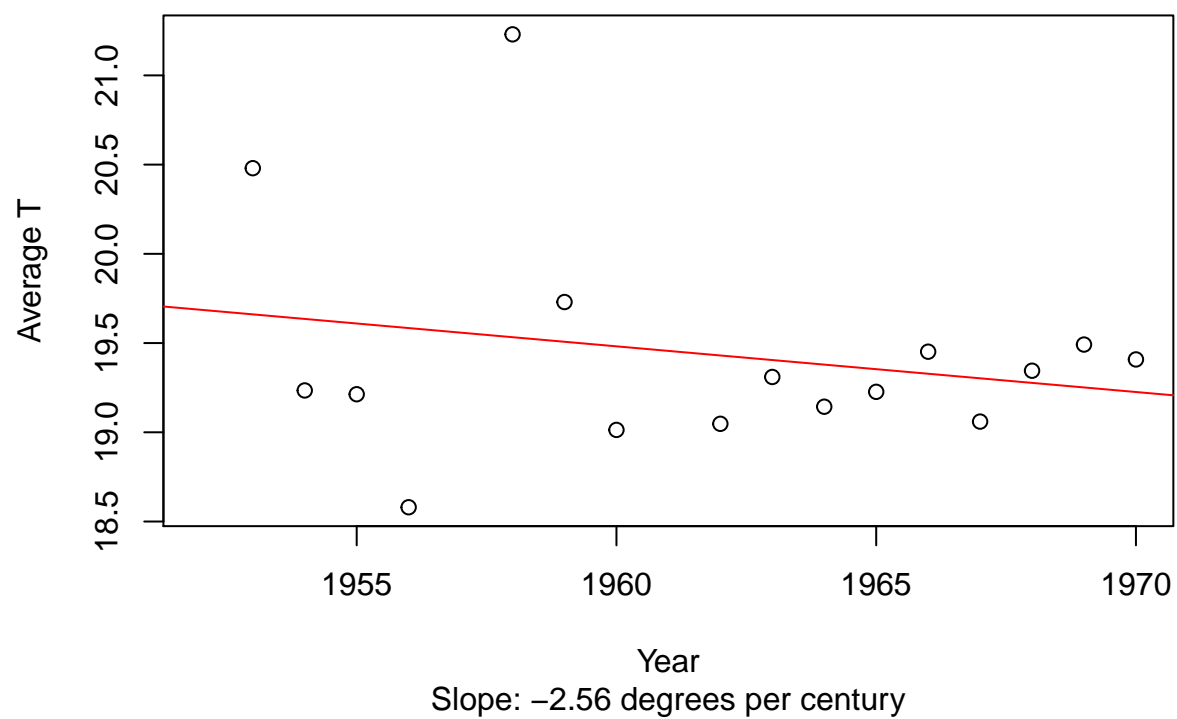
### 10808589000: PRAIA



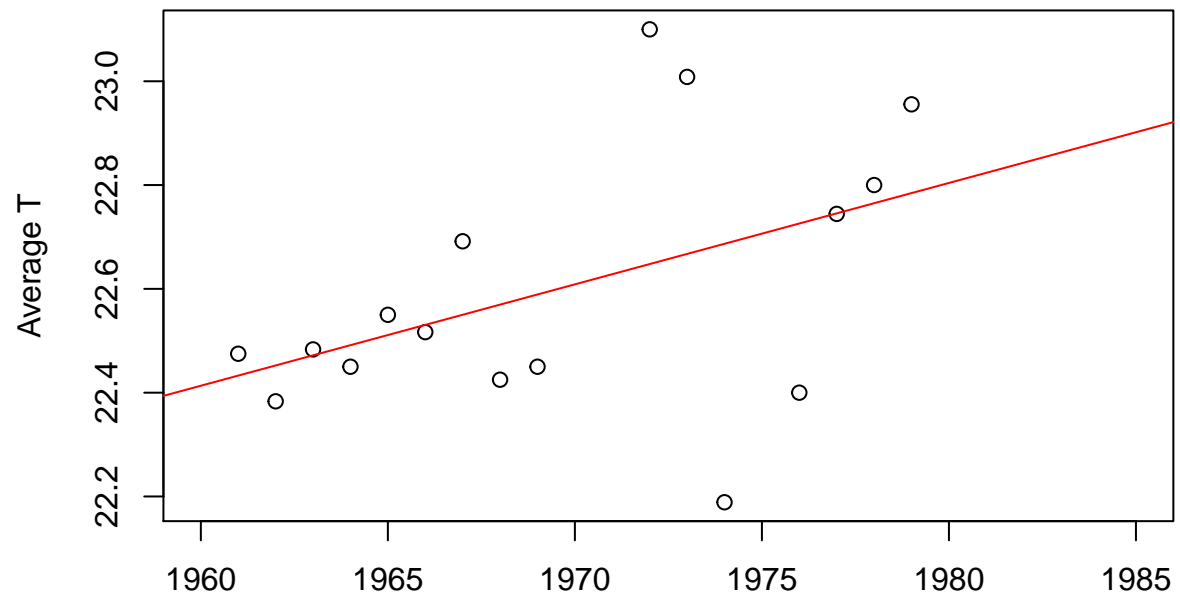
Year  
Slope: 0.17 degrees per century



# 10266325000: BIE (SILVA PO

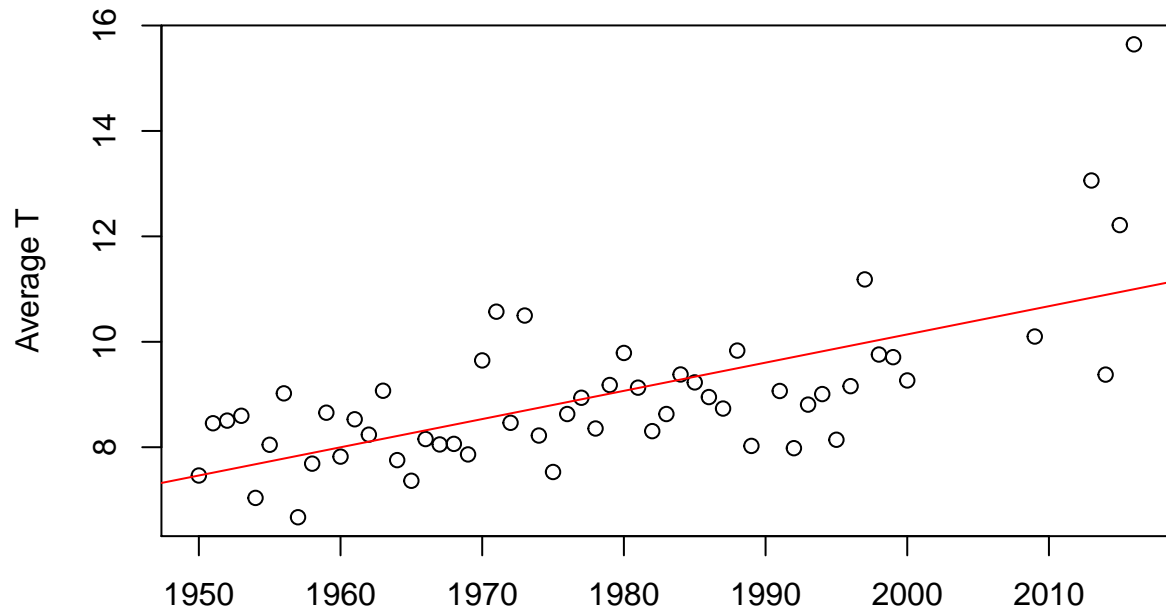


### 50396781000: BANDUNG/HUSEI



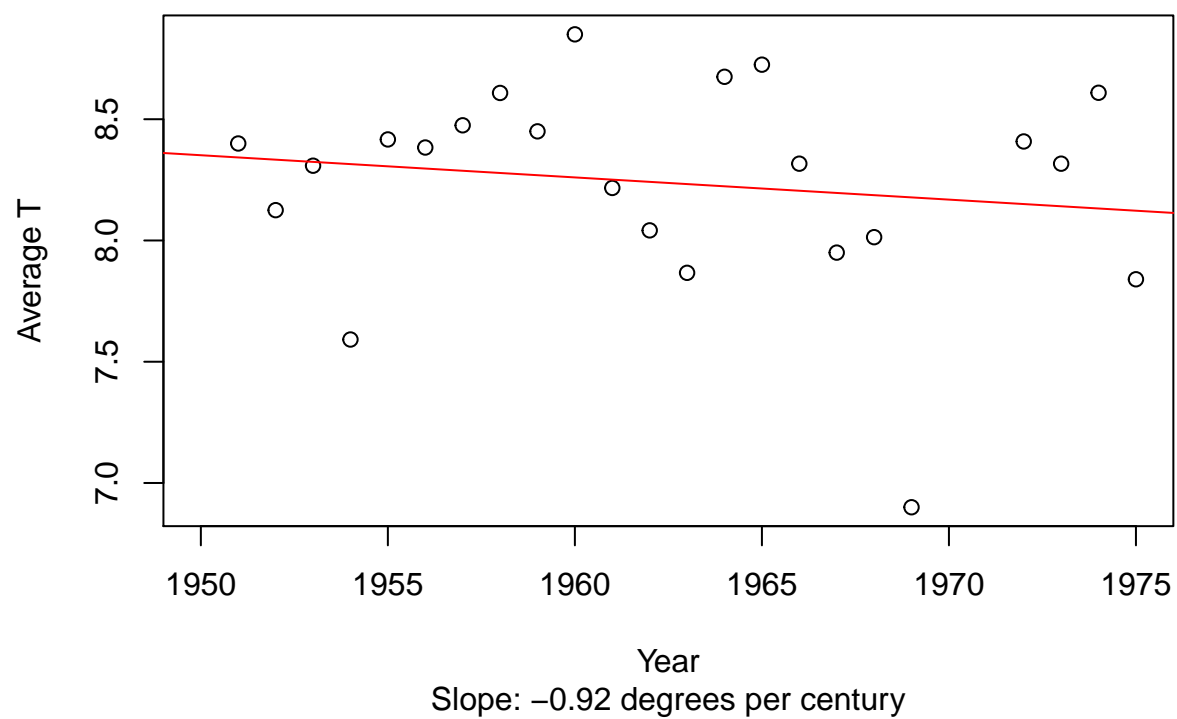
Year  
Slope: 1.95 degrees per century

## 22738954000: KHOROG

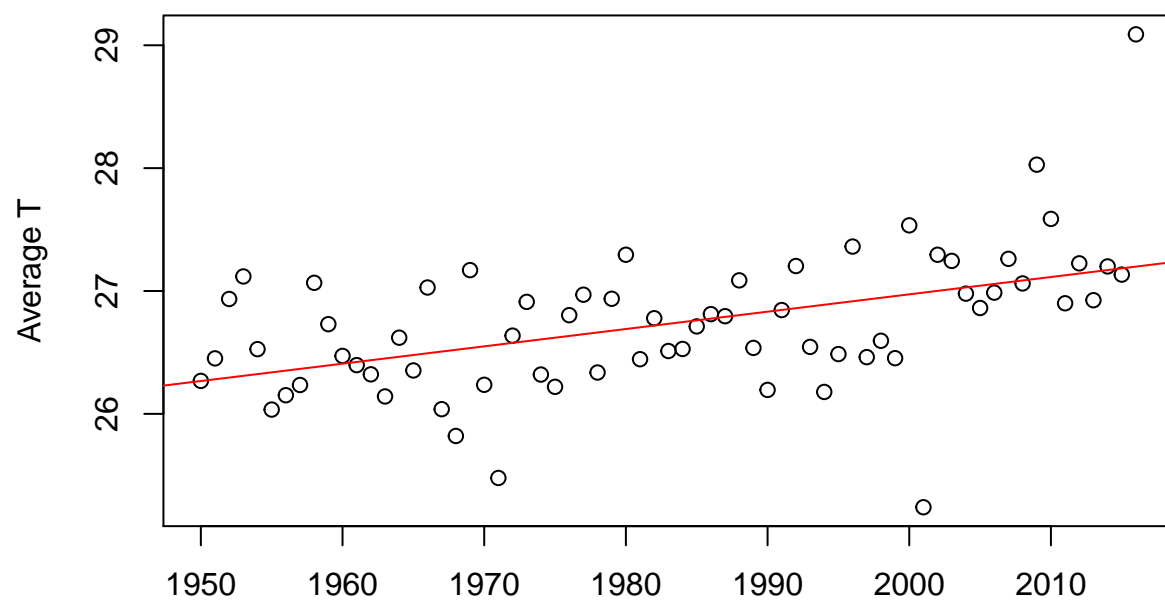


Year  
Slope: 5.35 degrees per century

# 80099906001: SHIP I

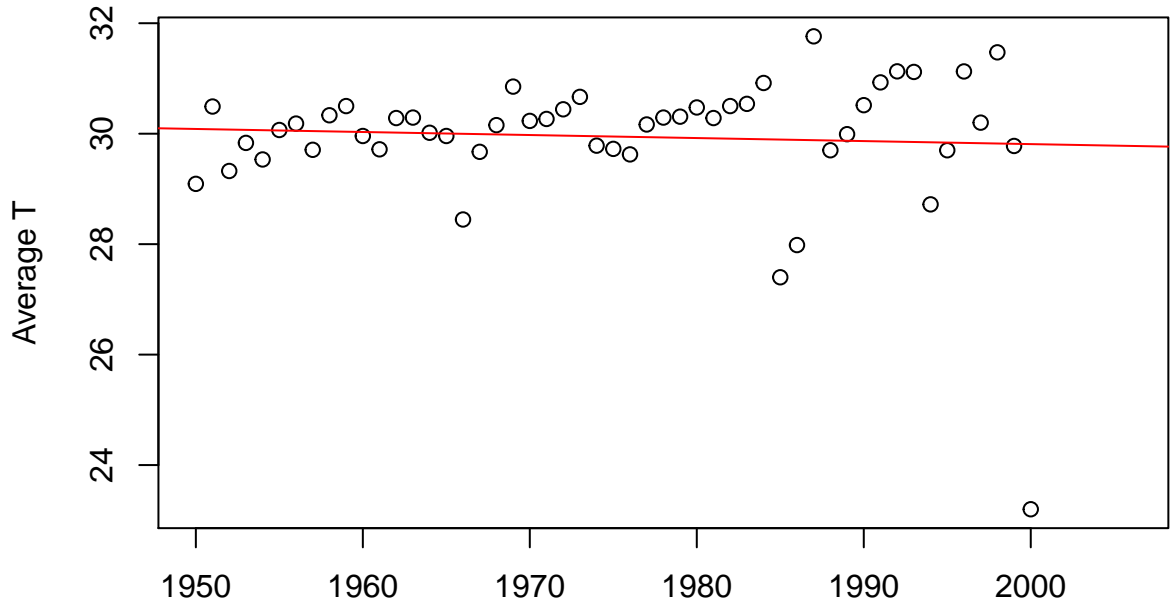


# 20742867000: NAGPUR SONEGA



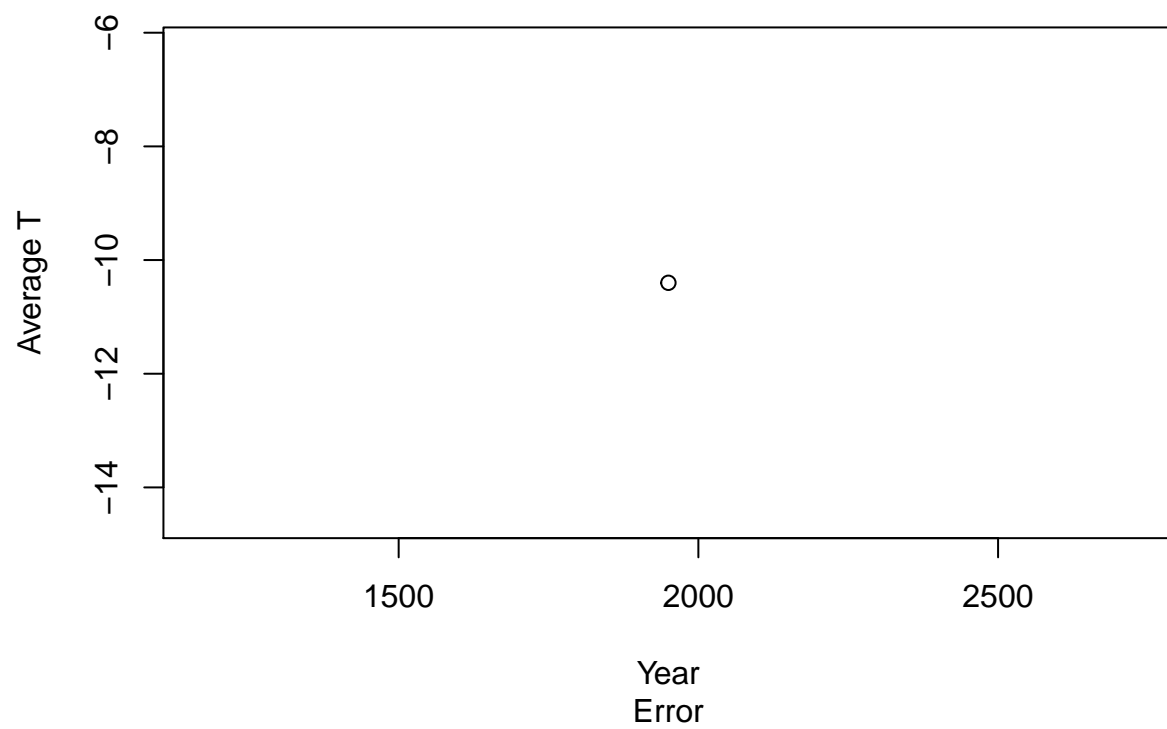
Year  
Slope: 1.41 degrees per century

**12761226000: GAO**

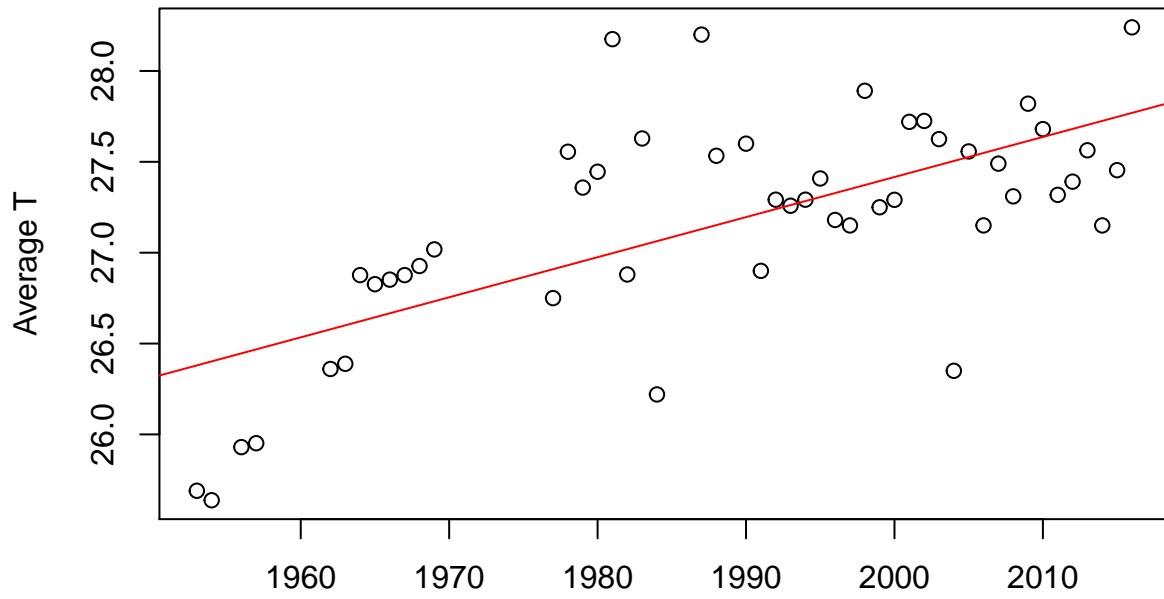


Year  
Slope: -0.55 degrees per century

# 43104330001: MYGGBUKTA



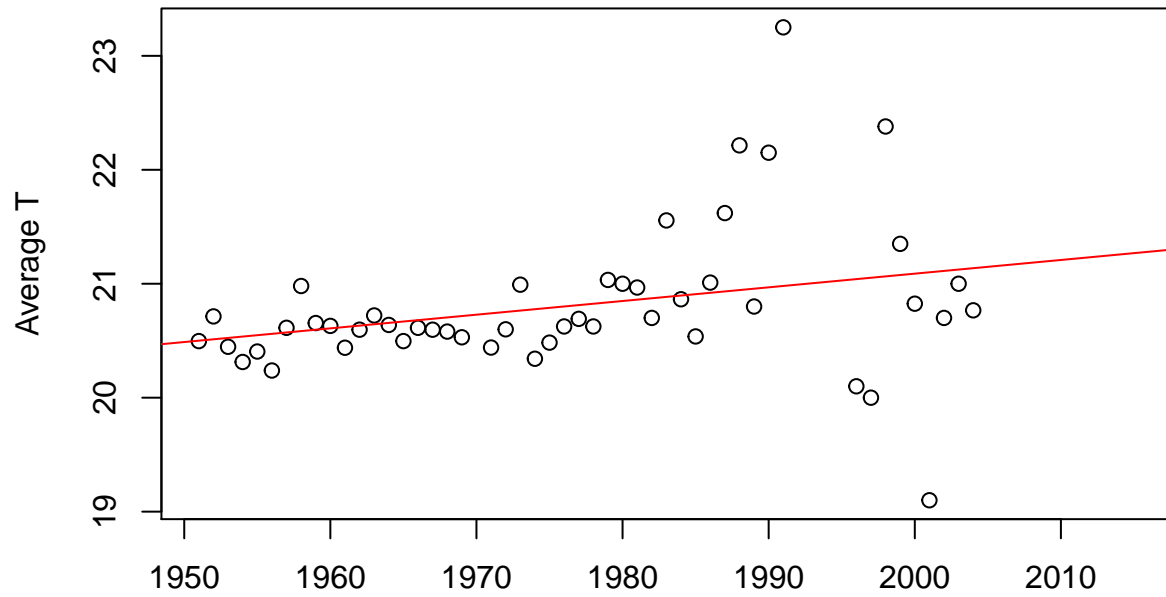
# 50397900000: SAUMLAKI



Year  
Slope: 2.21 degrees per century

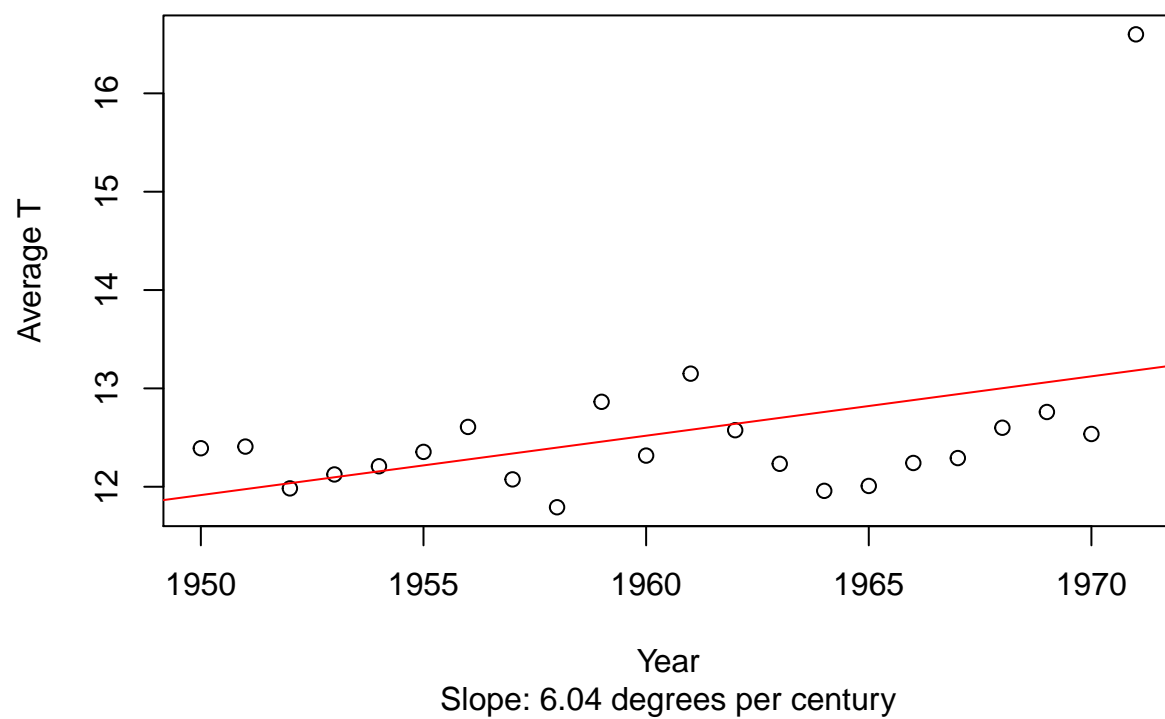


# 10764870000: NGAOUNDERE

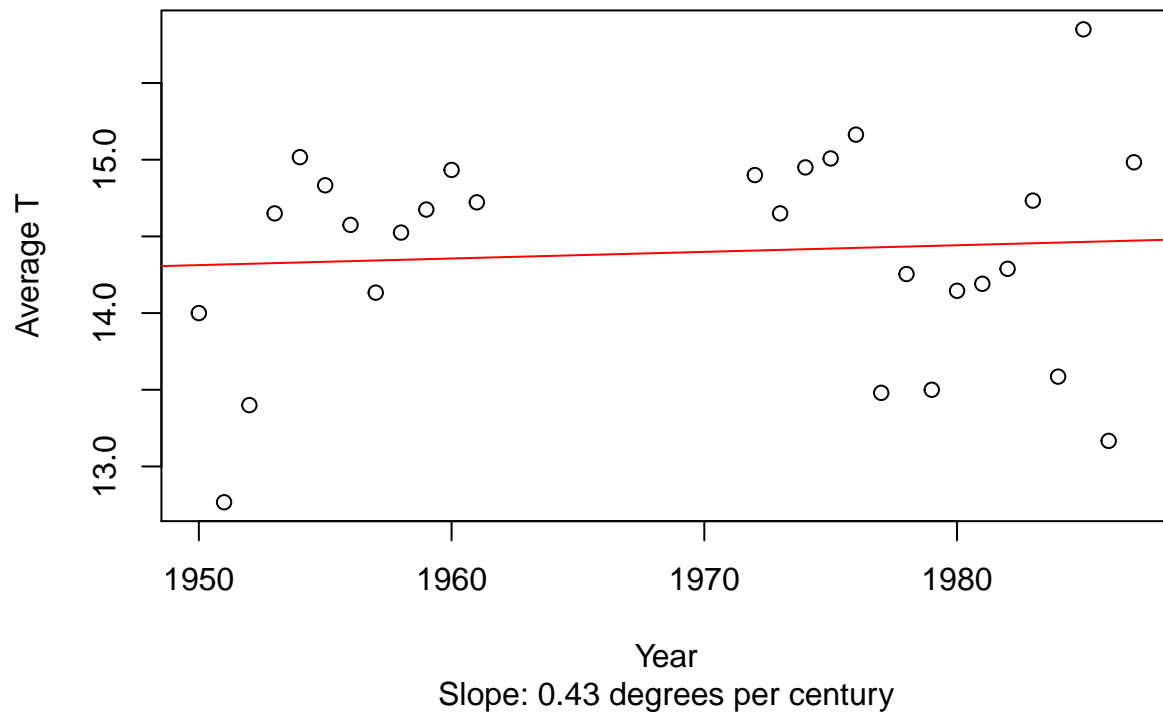


Year  
Slope: 1.20 degrees per century

### 50194974001: CAPE SORELL (AWS)



## 14168902000: TRISTAN DA CU



### Conclusion

The temperature increased at 15 stations and decreased at 9 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. Average increase is 0.0001 degrees/century.

### 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.