Small scale surface heterogeneities and impact on station relocations

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9th Seminar for homogenization and quality control in climatological databases and 4th conference on spatial interpolation techniques in climatology and meteorology (Budapest, 3-7 April 2017)

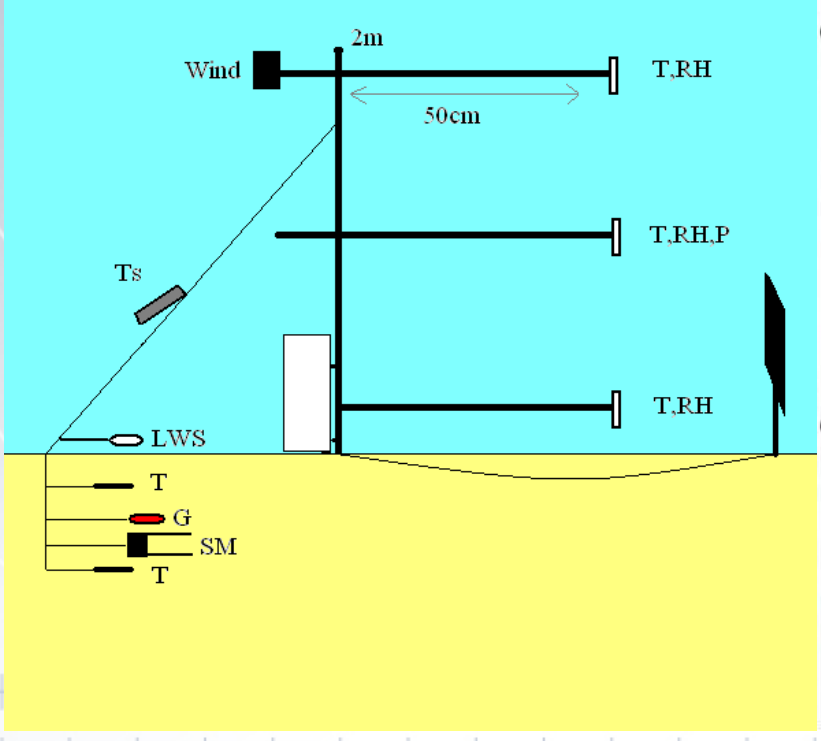
Introduction

- Relocations of the stations, changes in their instrumentation or in their surroundings and other events introduce inhomogeneities in the climatic series
- But we want our series to represent the climate variations only!
- $\Rightarrow$ Need to homogenize the series for a proper analysis of climate variability and trends

Related activities

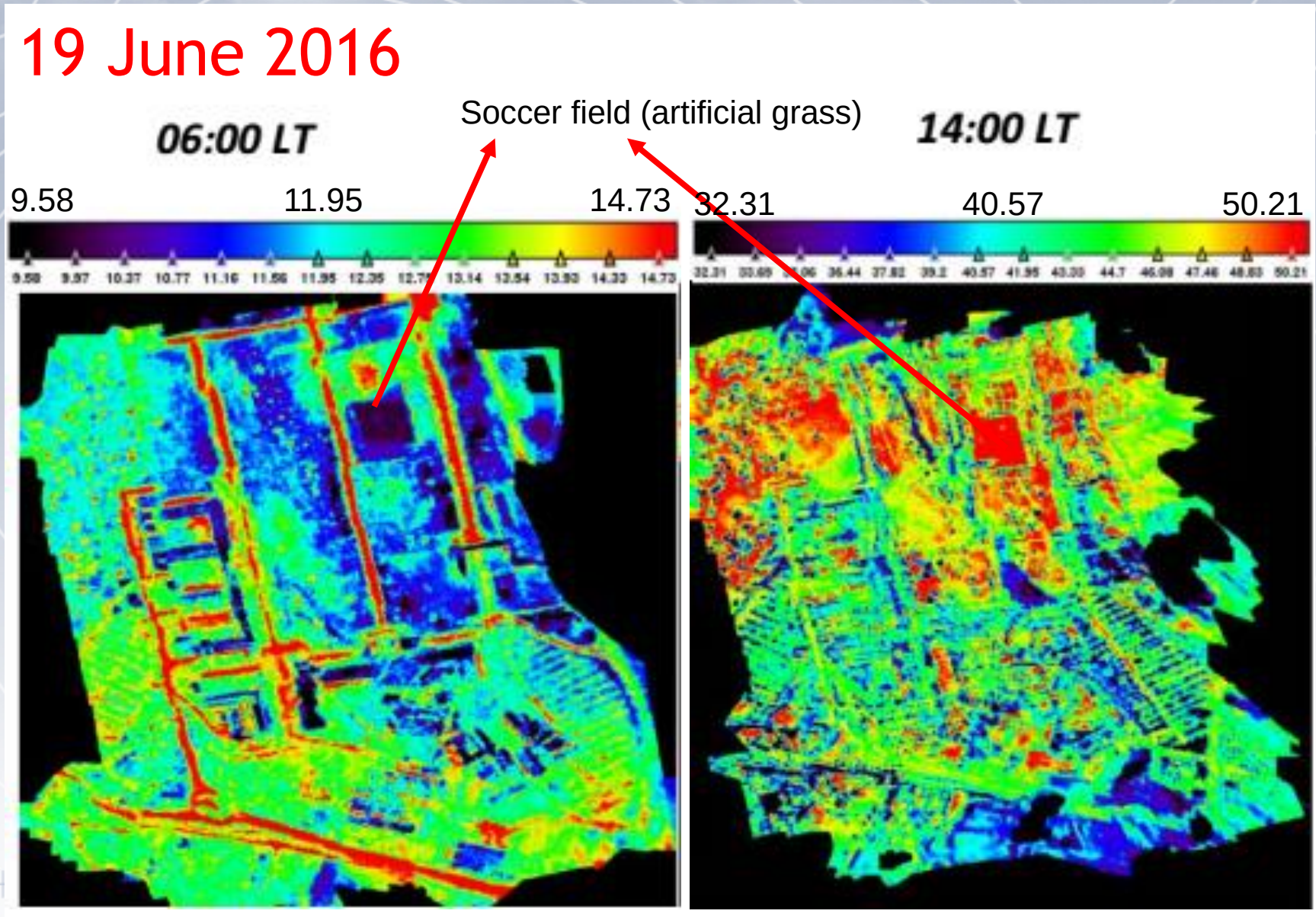
- Past COST Action ES 0601 comparing methodologies
- International Surface Temperature Initiative <http://www.surfacetemperatures.org/> and Parallel Observations Science Team <http://www.surfacetemperatures.org/databank/parallel_measurements>
- MULTITEST project comparing updated methods that can run automatically
- IMPACTRON research network studying the impact of changes in themometric screens, manual to automatic observations, and urban to airport relocations
- WMO CCI TT-HOM preparing homogenization guidelines for member states

UIB measuring sites (ATMOUNT project)



Thermal image

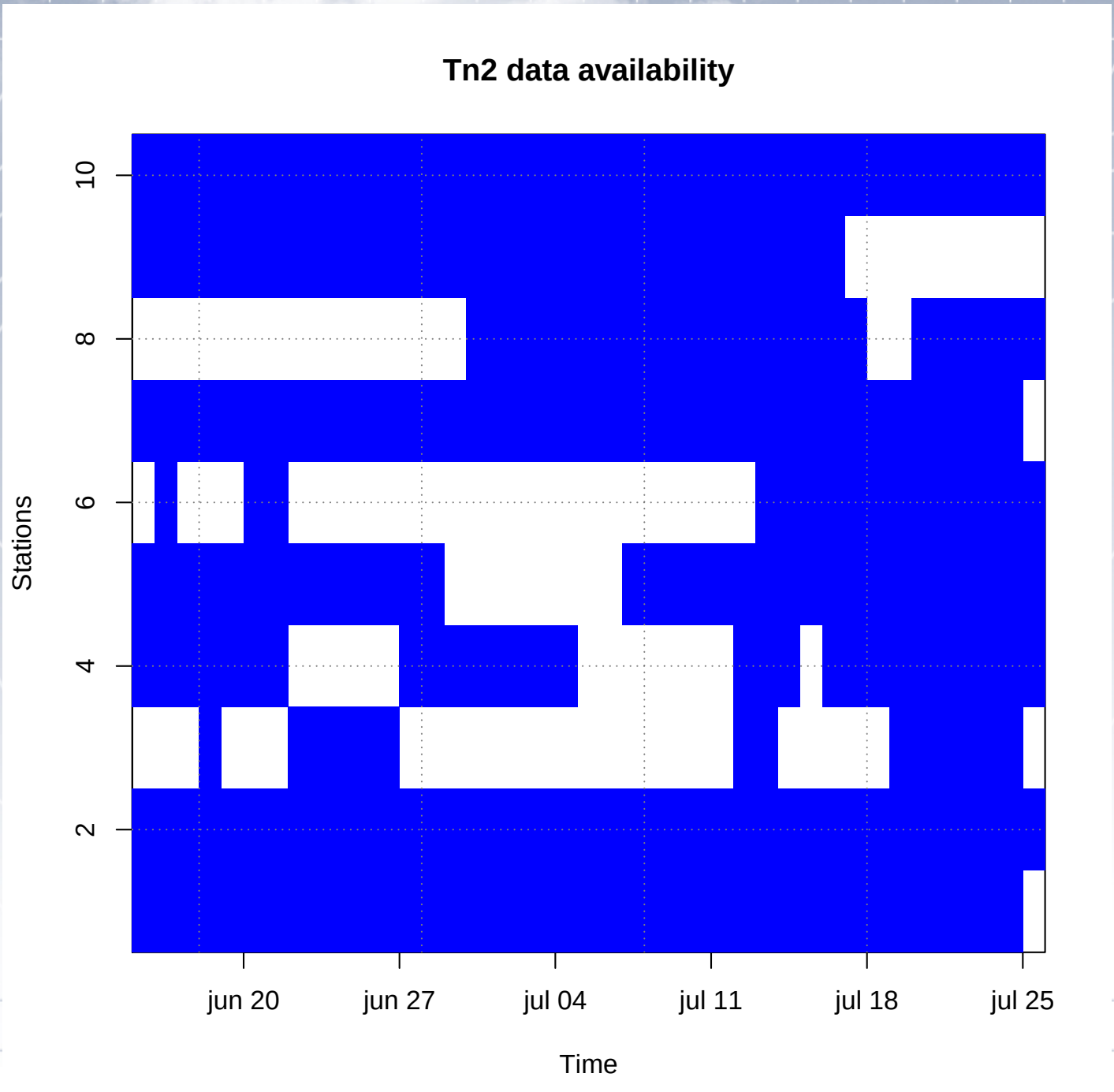
19 June 2016

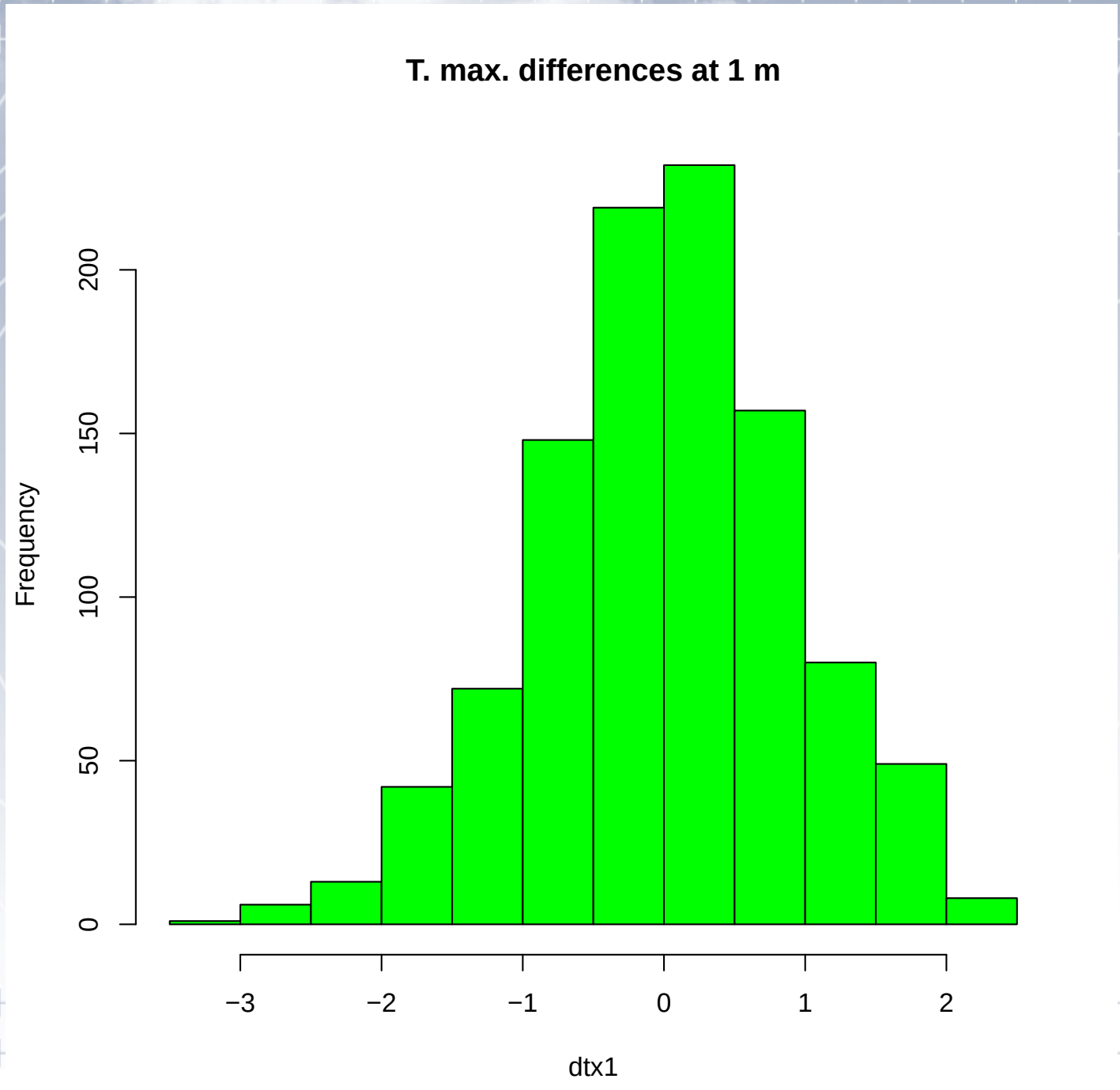


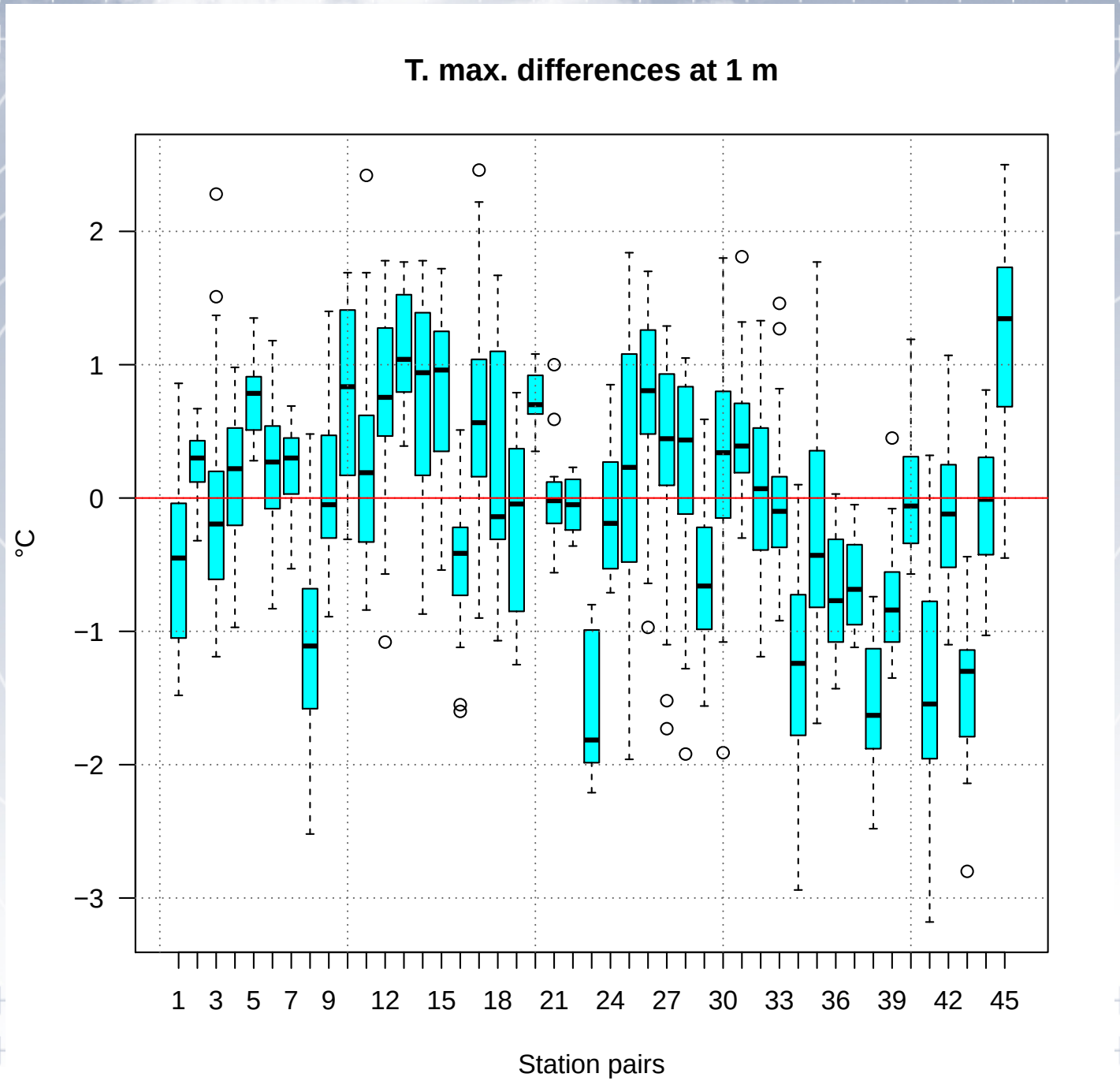
Great role of the Soil-vegetation system in regulating the temperature of the interface

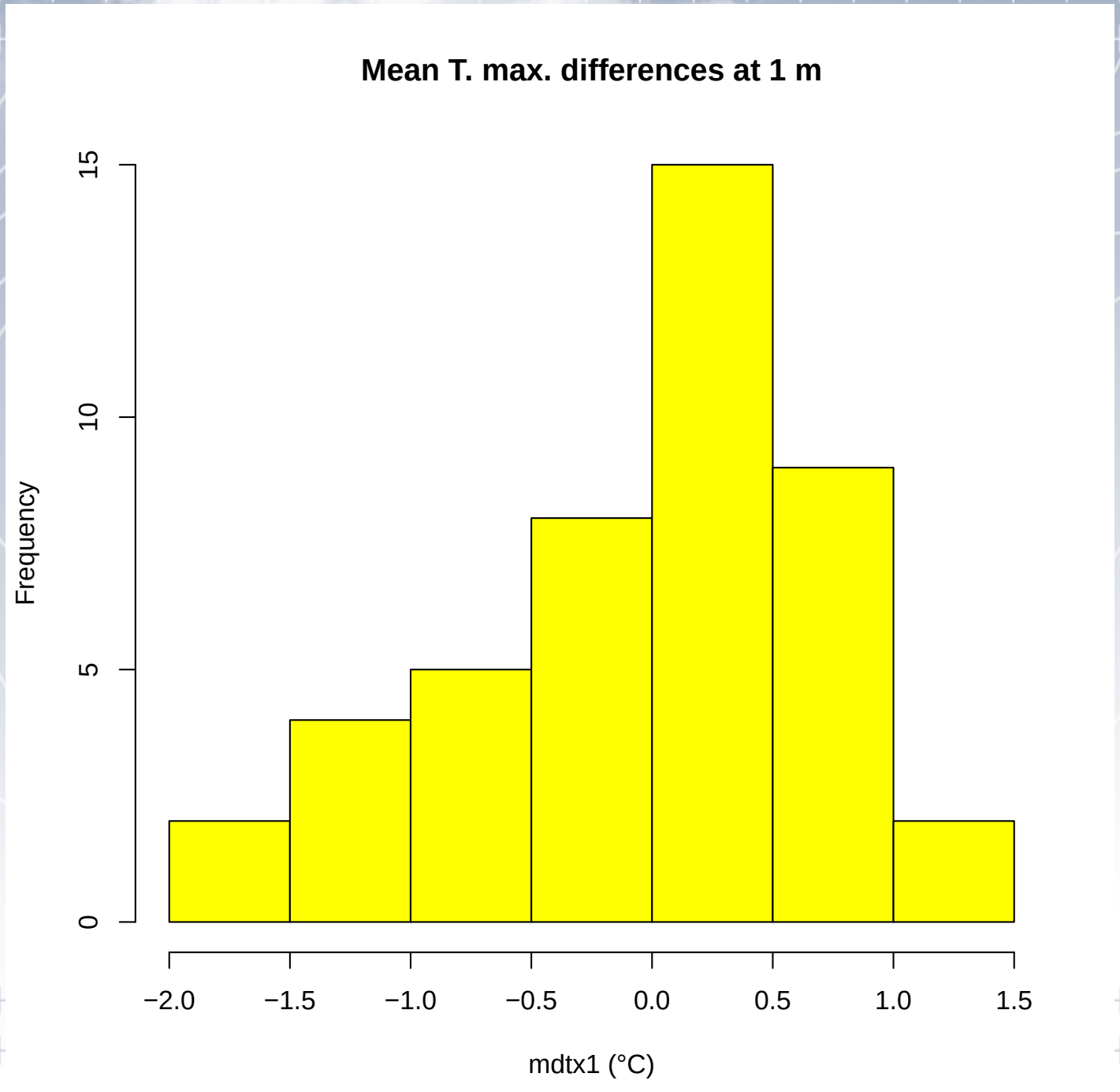
Data processing

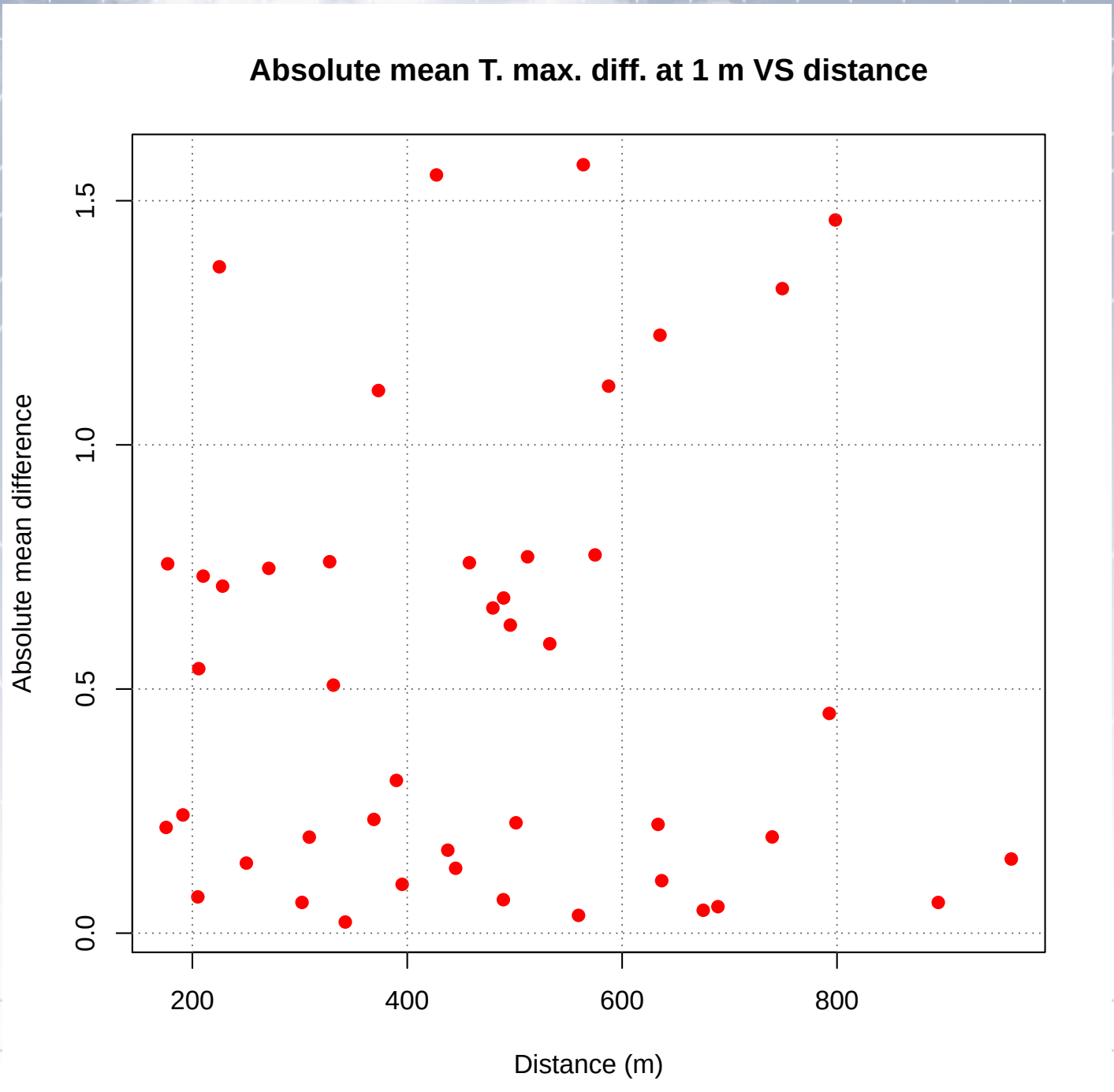
- All poles working only from June 16 to July 26 of 2016 (42 days, but with high insolation and low to moderate wind)
- Data in the observing poles every 5'
- Quality controled with the R package Climatol (deletion of bad data)
- Extraction of the extreme daily temperatures
- Adition of the extreme daily temperatures of the AEMET AWS, and analysis of the maximum and minimum temperatures

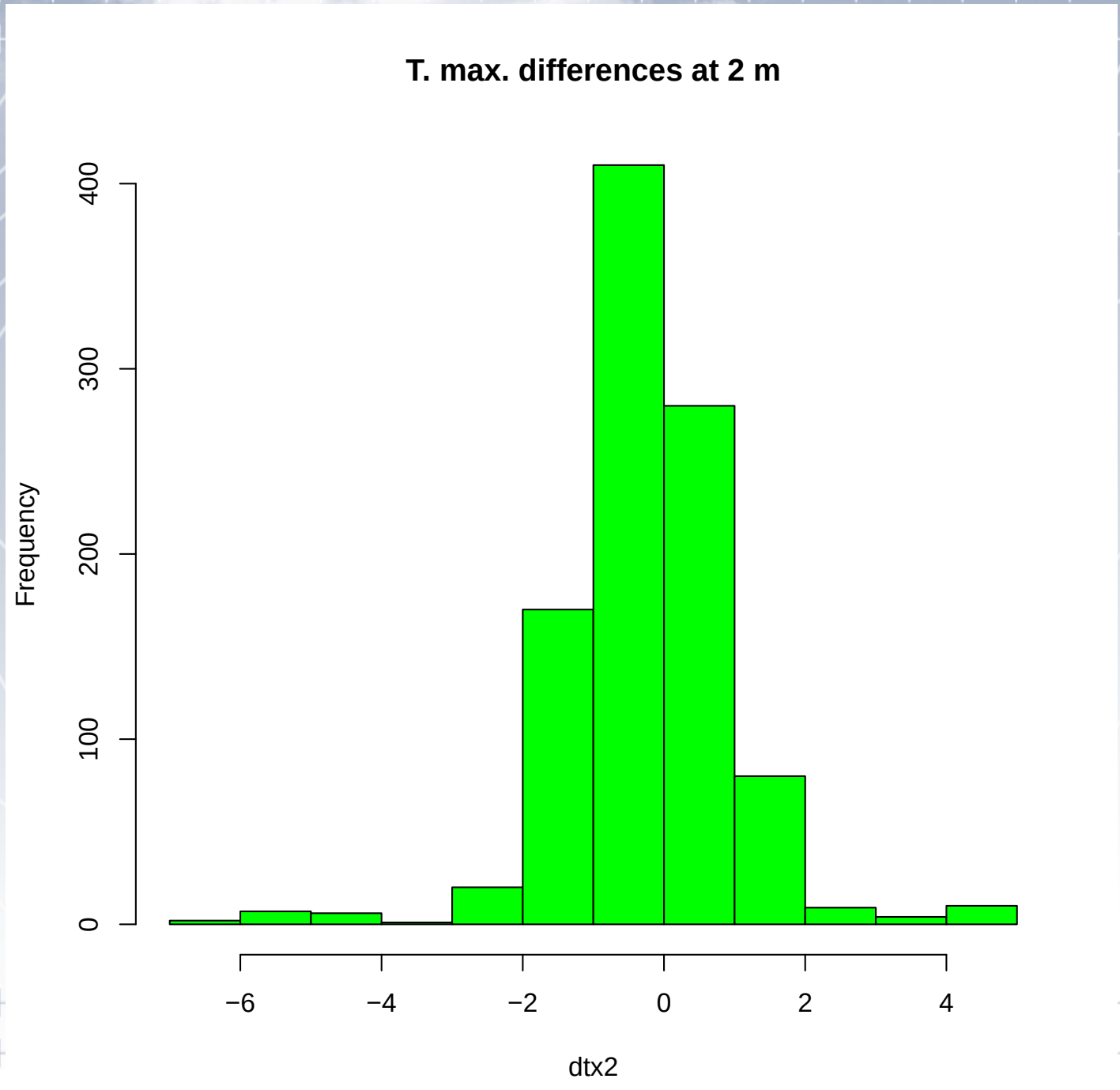

Tn2 data availability
Stations
10
8
6
4
2
jun 20
jun 27
jul 04
jul 11
jul 18
jul 25
Time

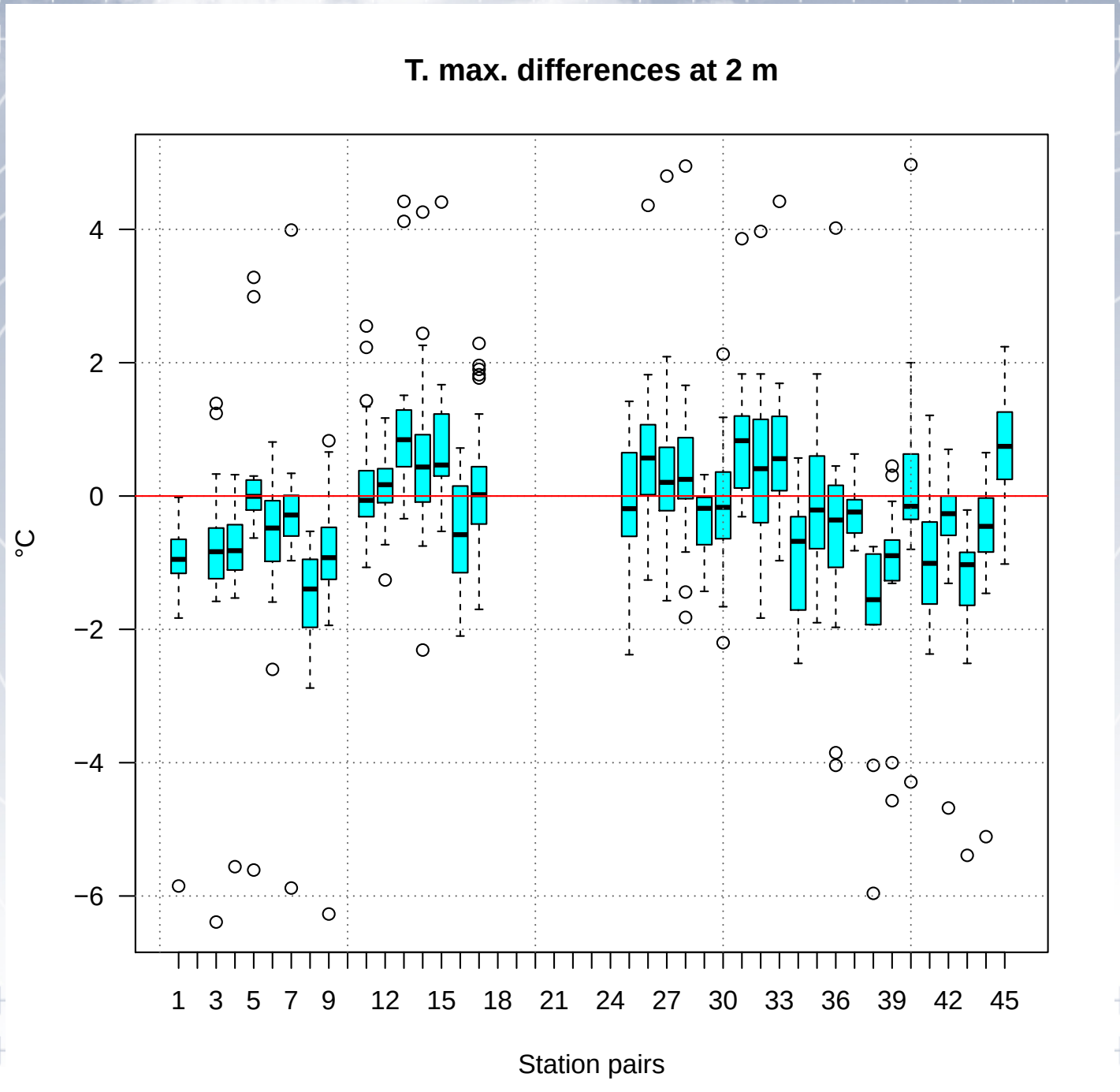

T. max. differences at 1 m
Frequency
0
50
100
150
200
−3
−2
−1
0
1
2
dtx1

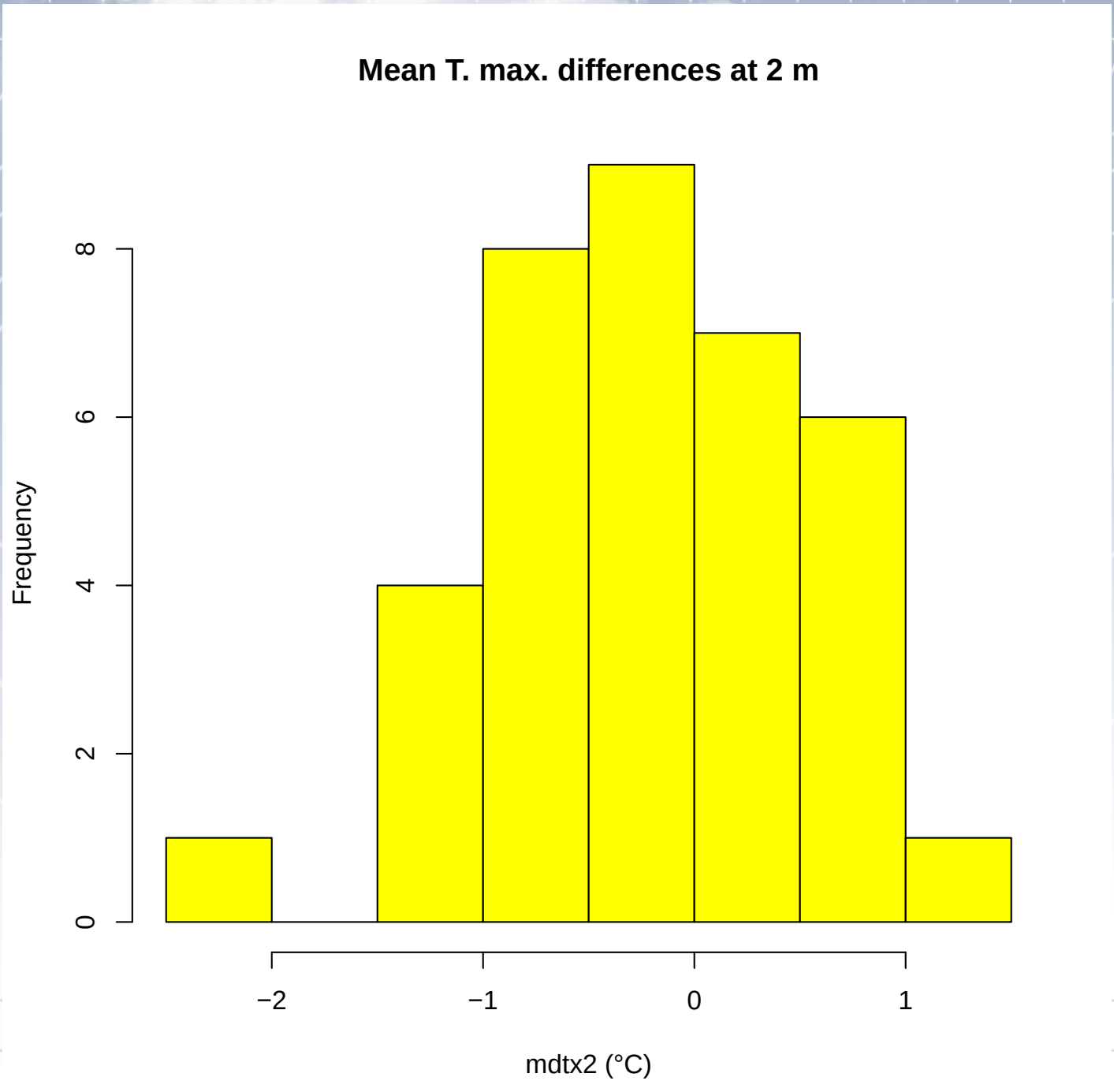

T. max. differences at 1 m
°C
2
1
0
−1
−2
−3
1
3
5
7
9
12
15
18
21
24
27
30
33
36
39
42
45
Station pairs

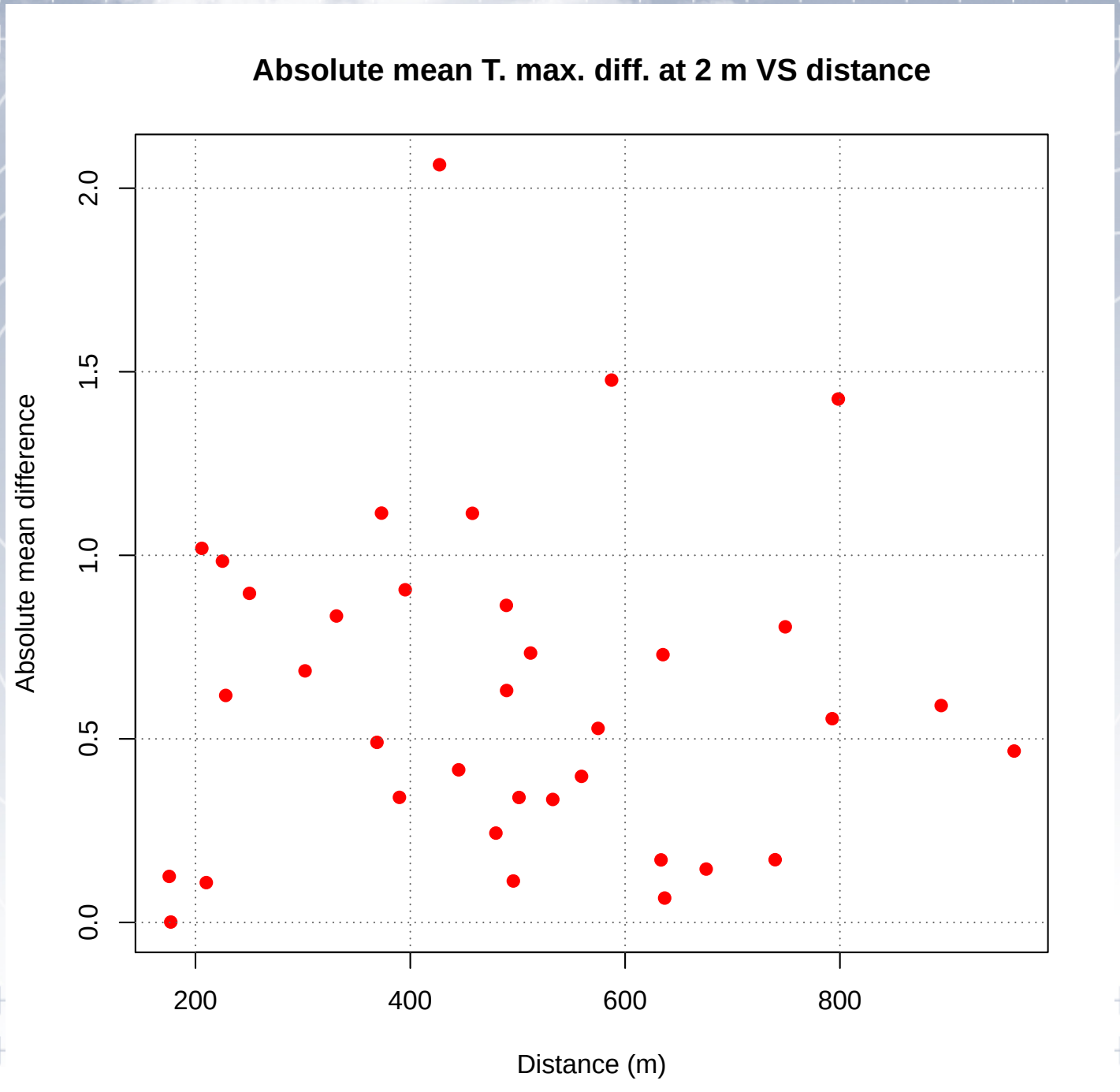

Mean T. max. differences at 1 m
Frequency
0
5
10
15
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
mdtx1 (°C)

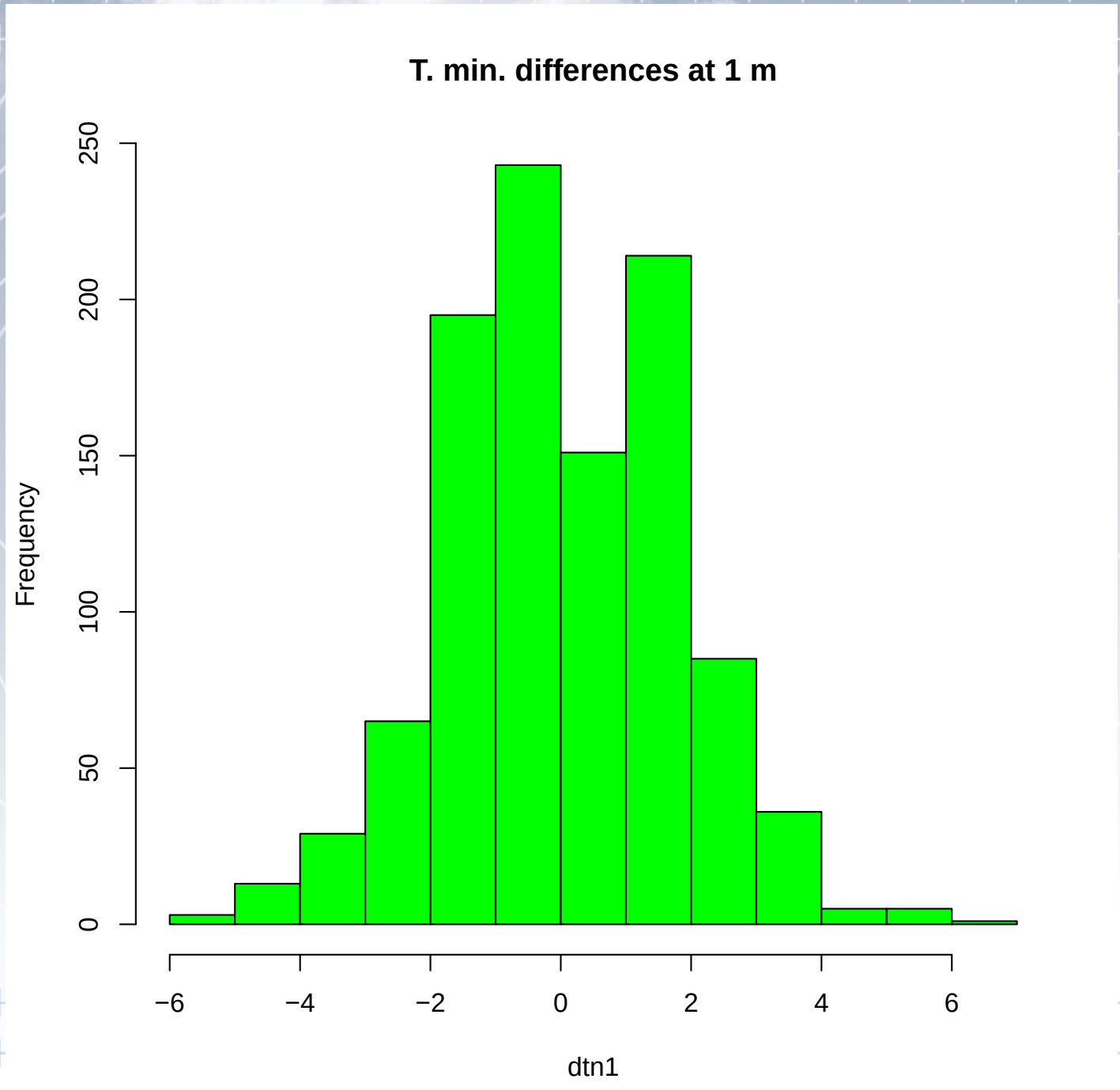

Absolute mean T. max. diff. at 1 m VS distance
Absolute mean difference
0.0
0.5
1.0
1.5
200
400
600
800
Distance (m)

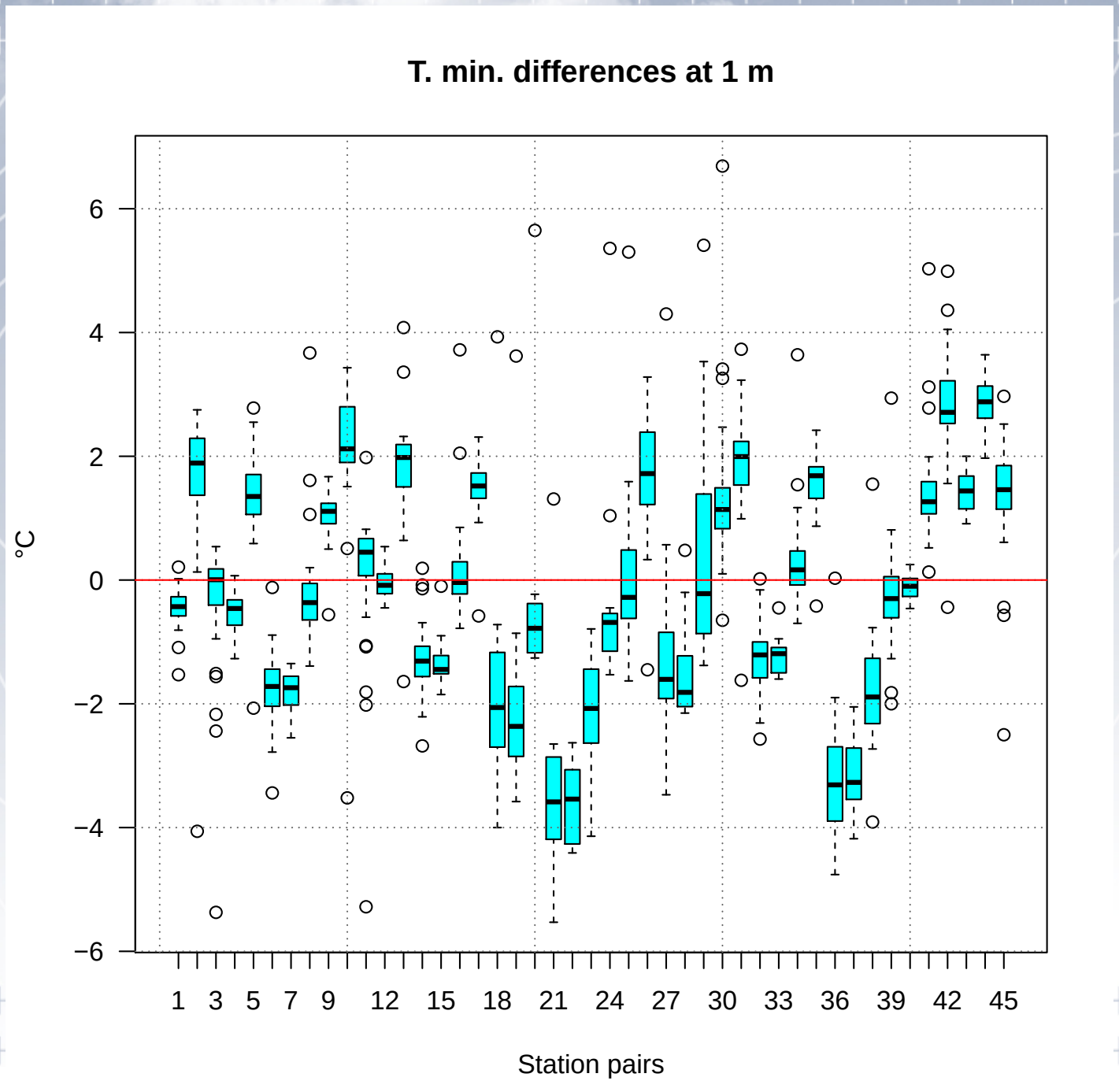

T. max. differences at 2 m
Frequency
0
100
200
300
400
−6
−4
−2
0
2
4
dtx2

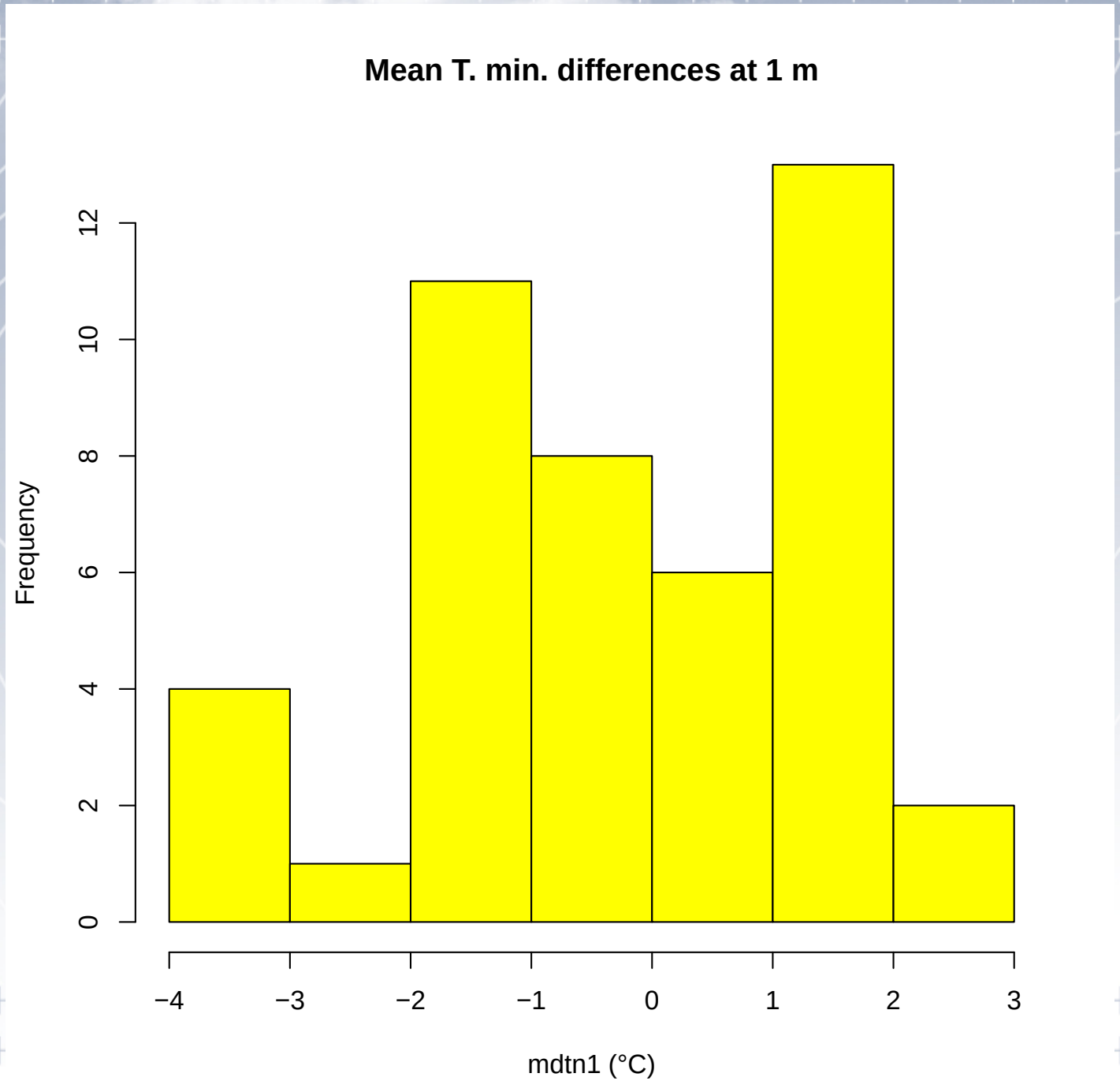

T. max. differences at 2 m
°C
4
2
0
−2
−4
−6
1
3
5
7
9
12
15
18
21
24
27
30
33
36
39
42
45
Station pairs

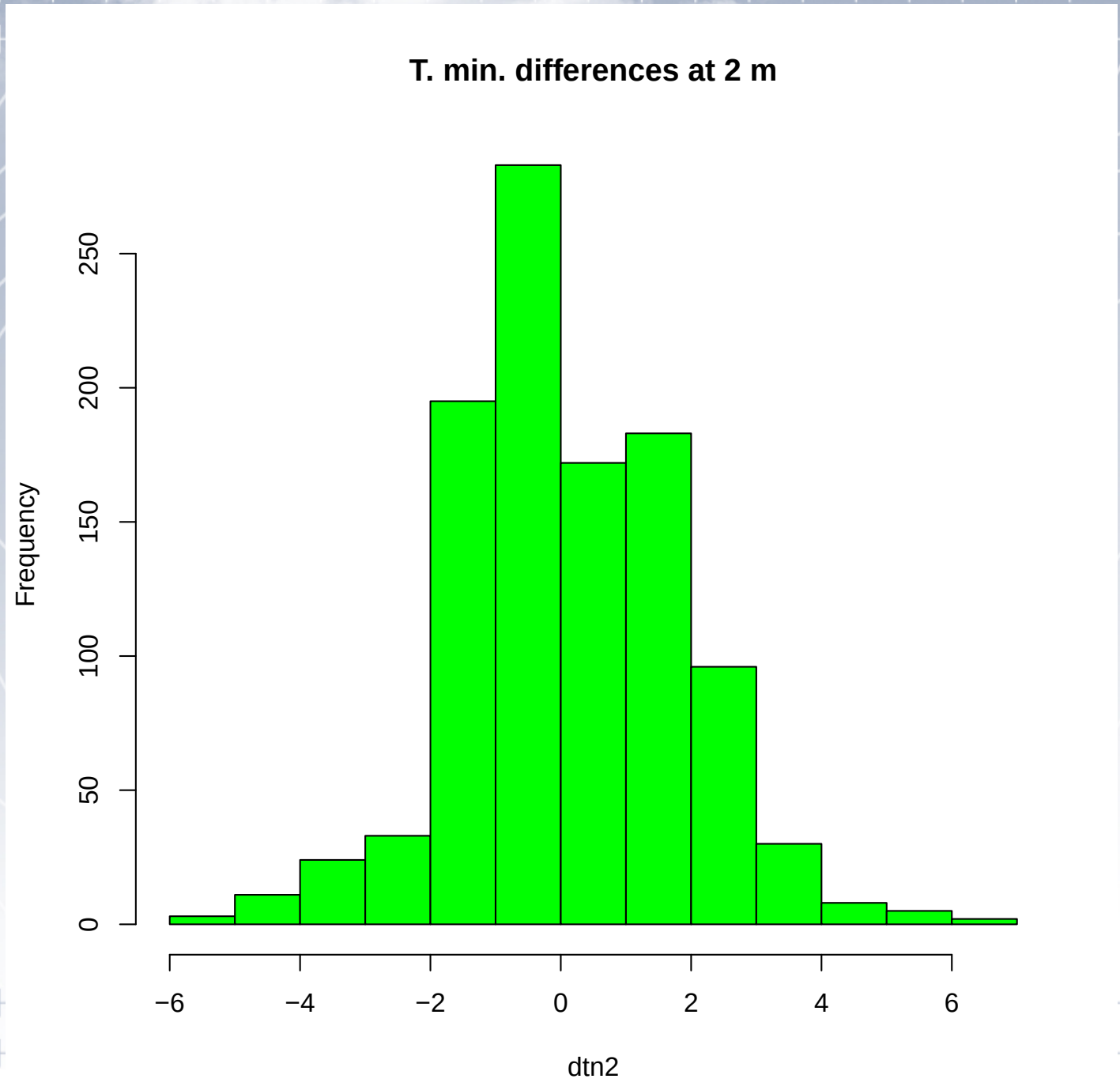

Mean T. max. differences at 2 m
Frequency
0
2
4
6
8
−2
−1
0
1
mdtx2 (°C)

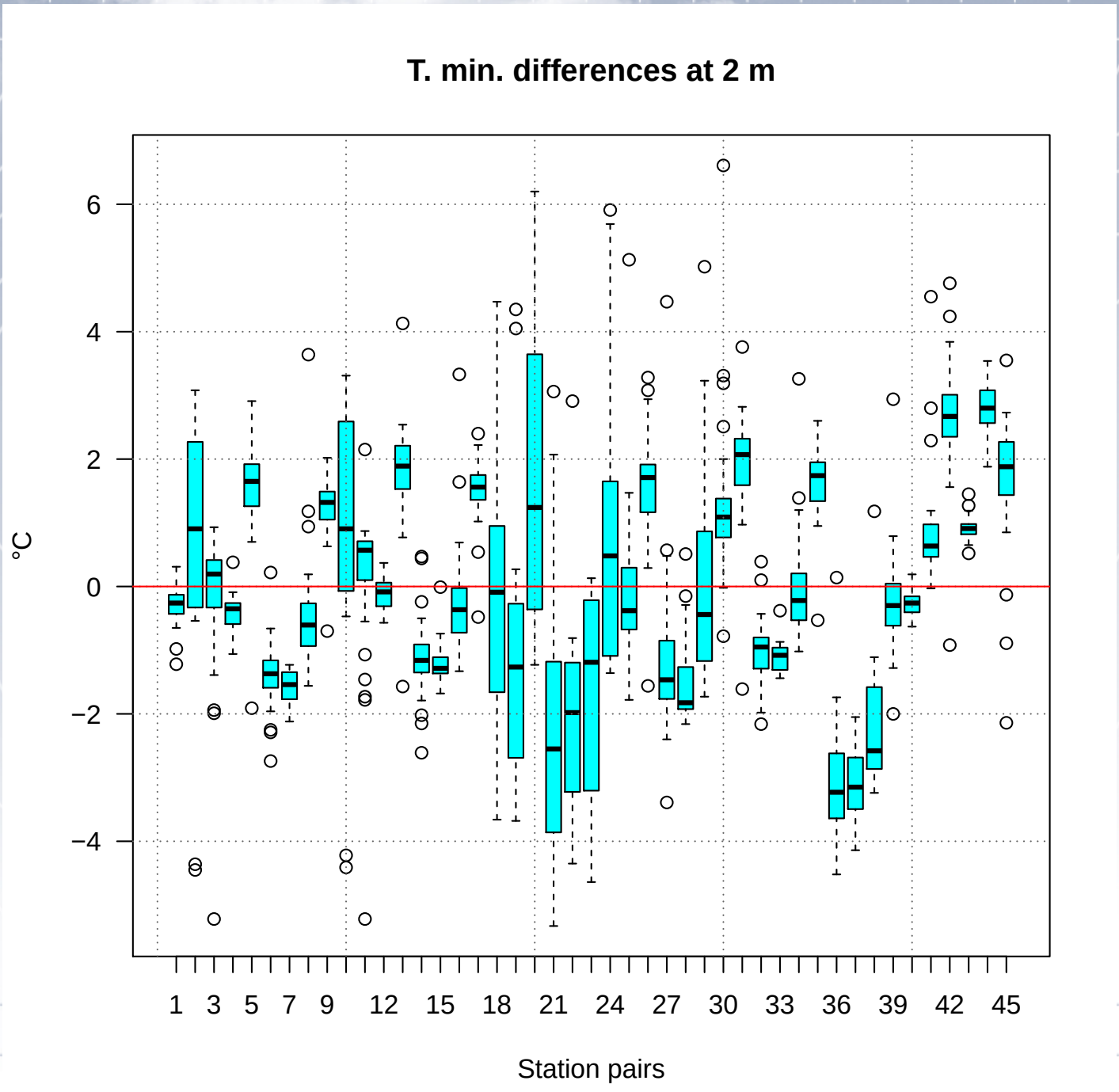

Absolute mean T. max. diff. at 2 m VS distance
Absolute mean difference
0.0
0.5
1.0
1.5
2.0
200
400
600
800
Distance (m)

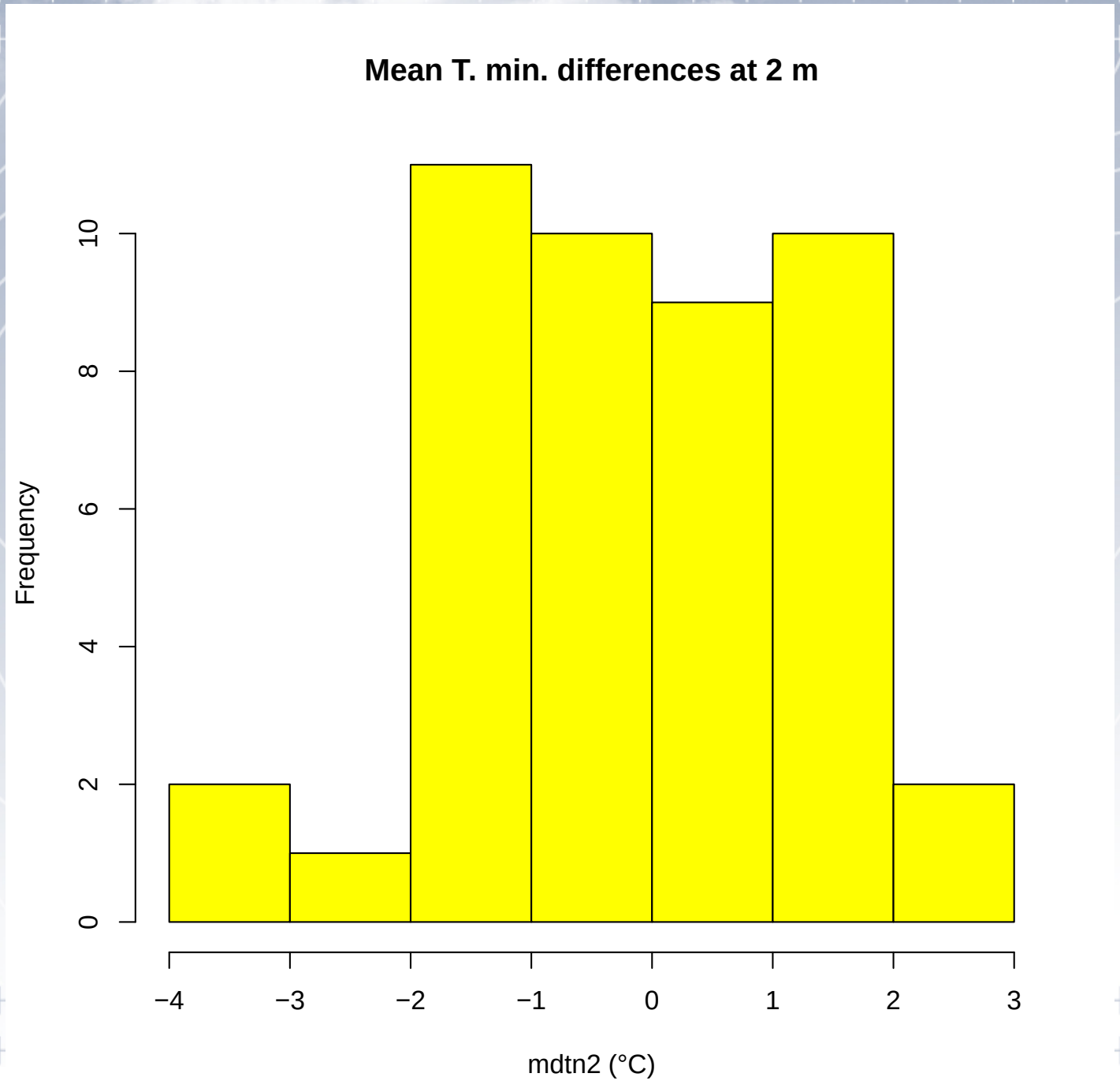

T. min. differences at 1 m
Frequency
0
50
100
150
200
250
−6
−4
−2
0
2
4
6
dtn1

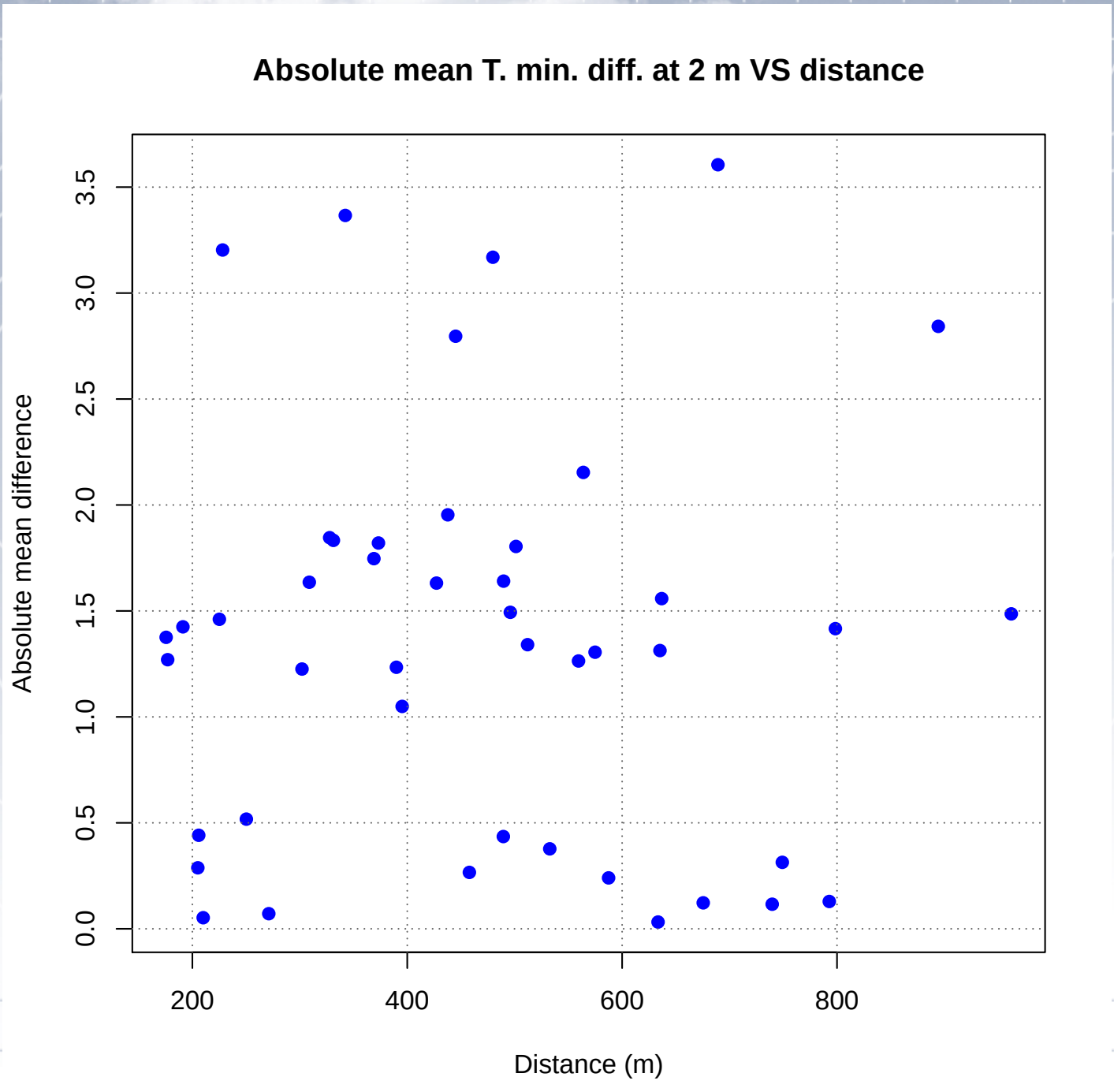

T. min. differences at 1 m
°C
6
4
2
0
−2
−4
−6
1
3
5
7
9
12
15
18
21
24
27
30
33
36
39
42
45
Station pairs

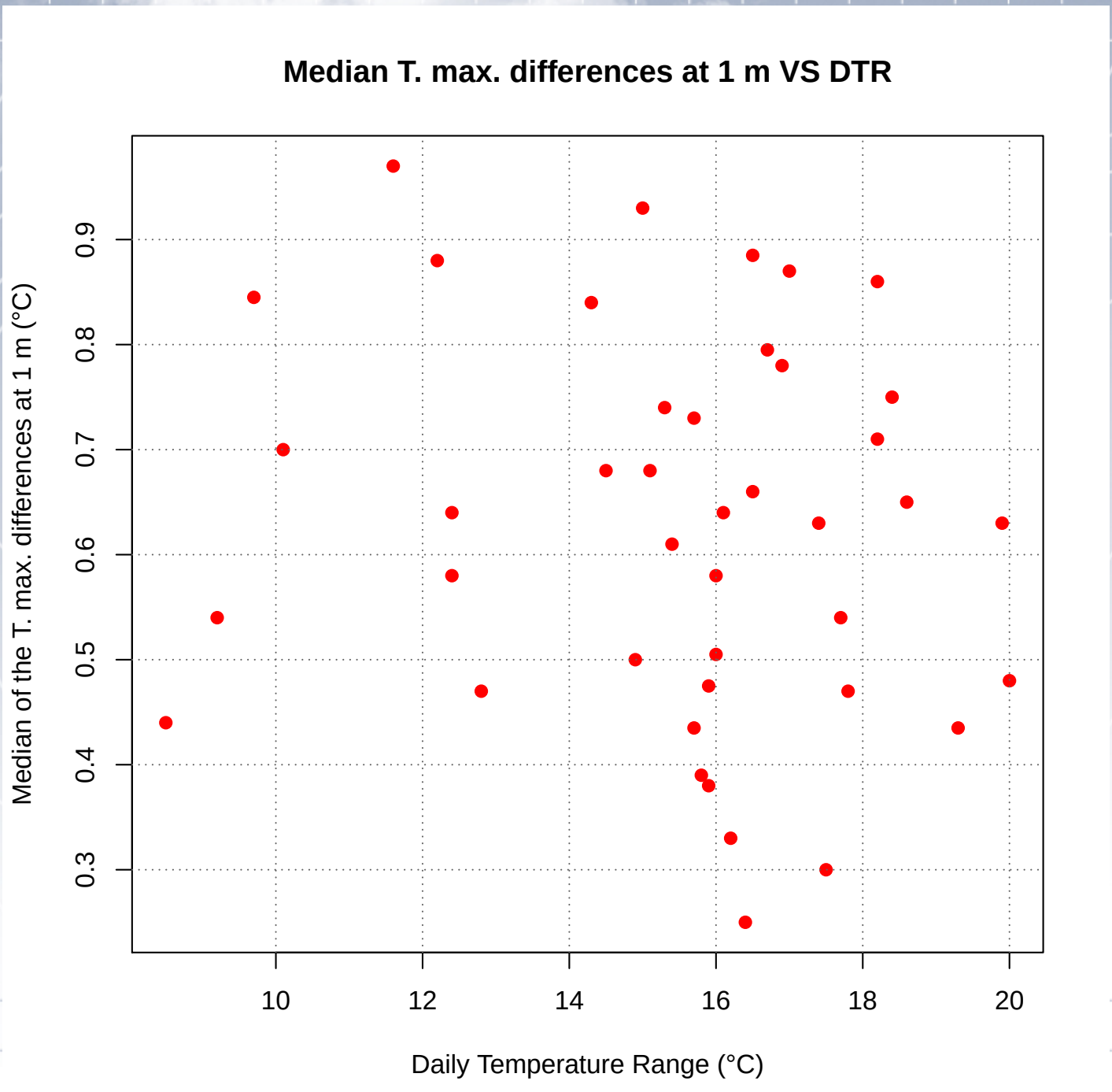

Mean T. min. differences at 1 m
Frequency
0
2
4
6
8
10
12
−4
−3
−2
−1
0
1
2
3
mdtn1 (°C)

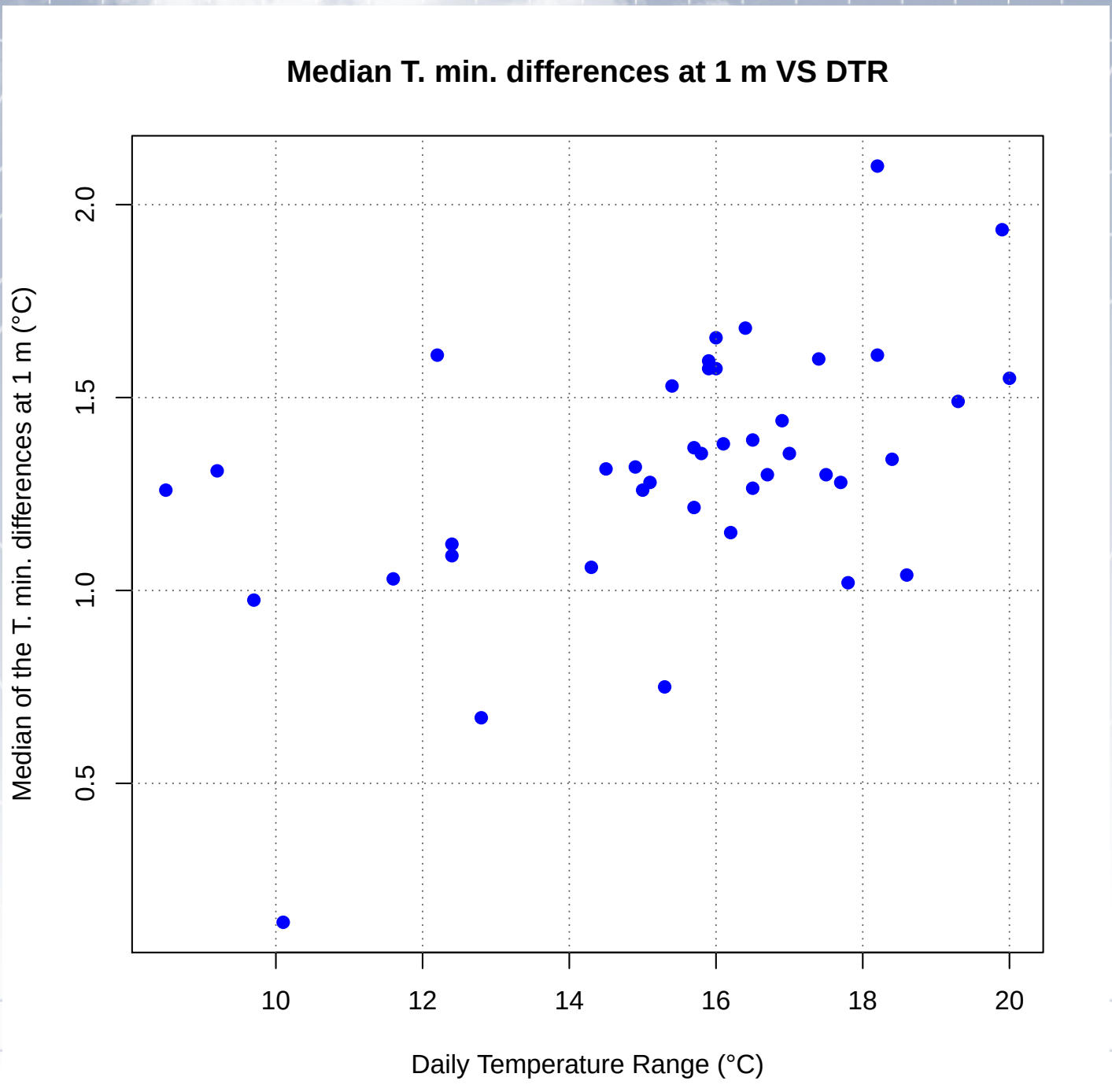

T. min. differences at 2 m
Frequency
0
50
100
150
200
250
−6
−4
−2
0
2
4
6
dtn2

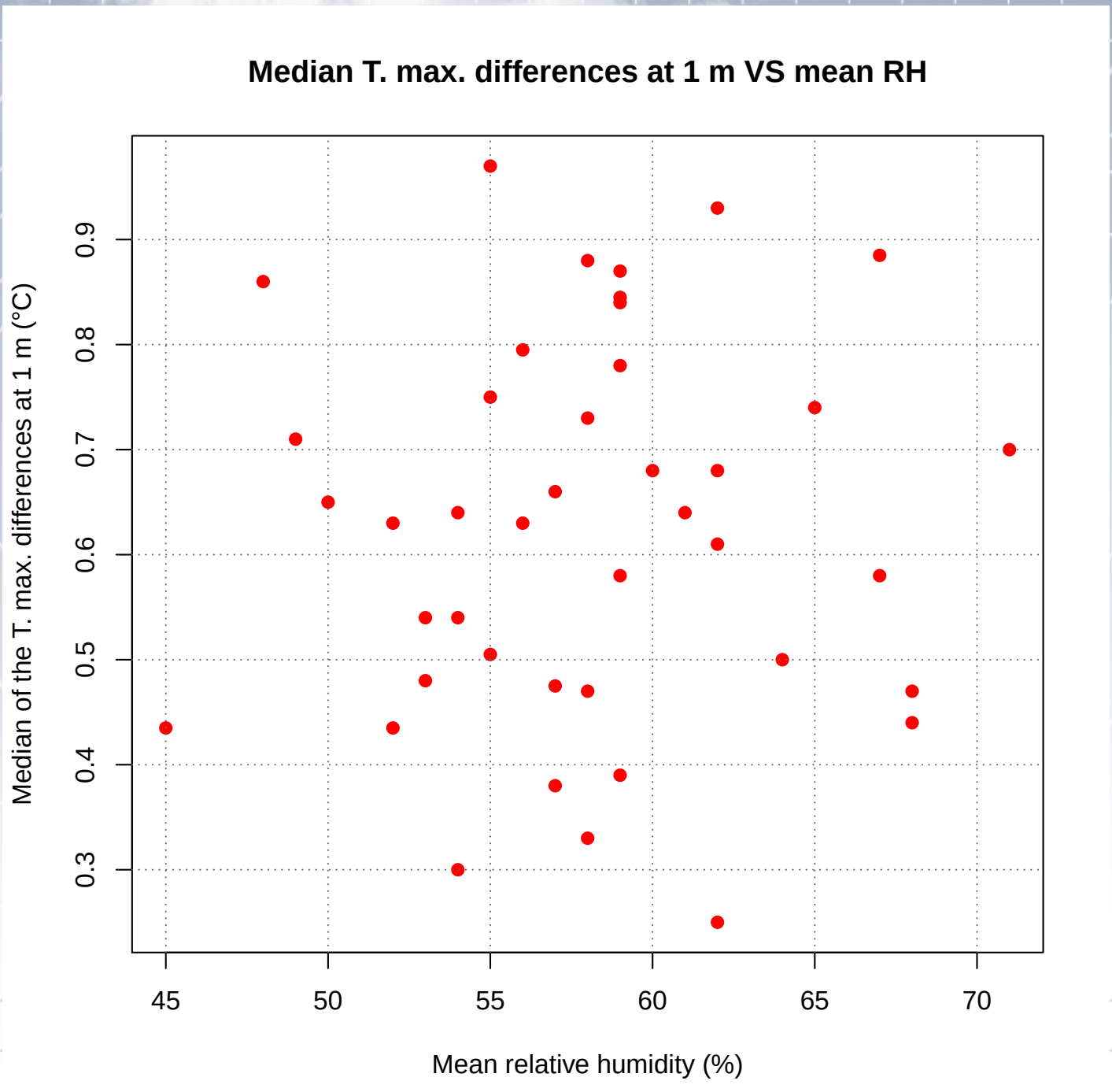

T. min. differences at 2 m
°C
6
4
2
0
−2
−4
1
3
5
7
9
12
15
18
21
24
27
30
33
36
39
42
45
Station pairs

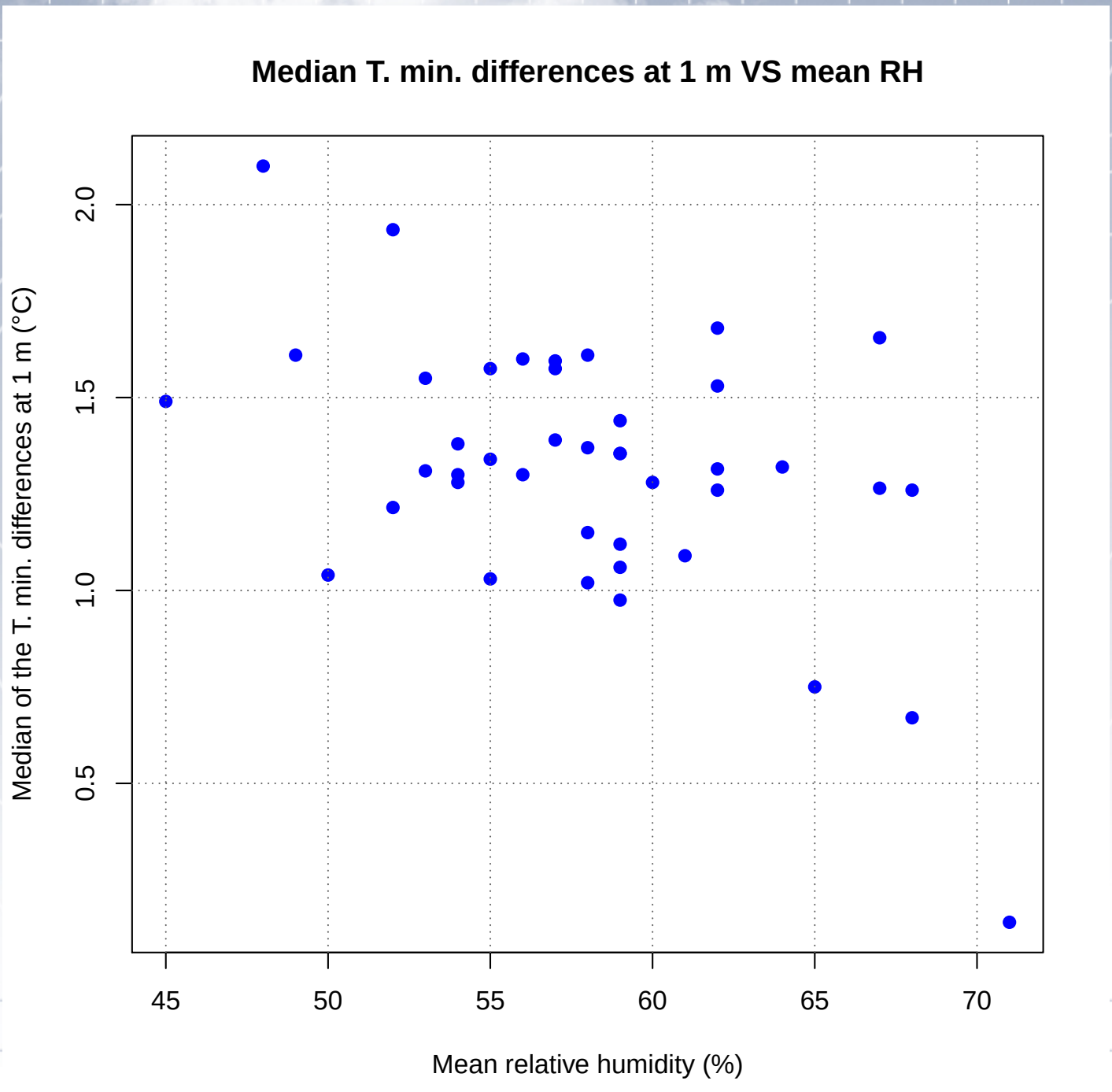

Mean T. min. differences at 2 m
Frequency
0
2
4
6
8
10
−4
−3
−2
−1
0
1
2
3
mdtn2 (°C)

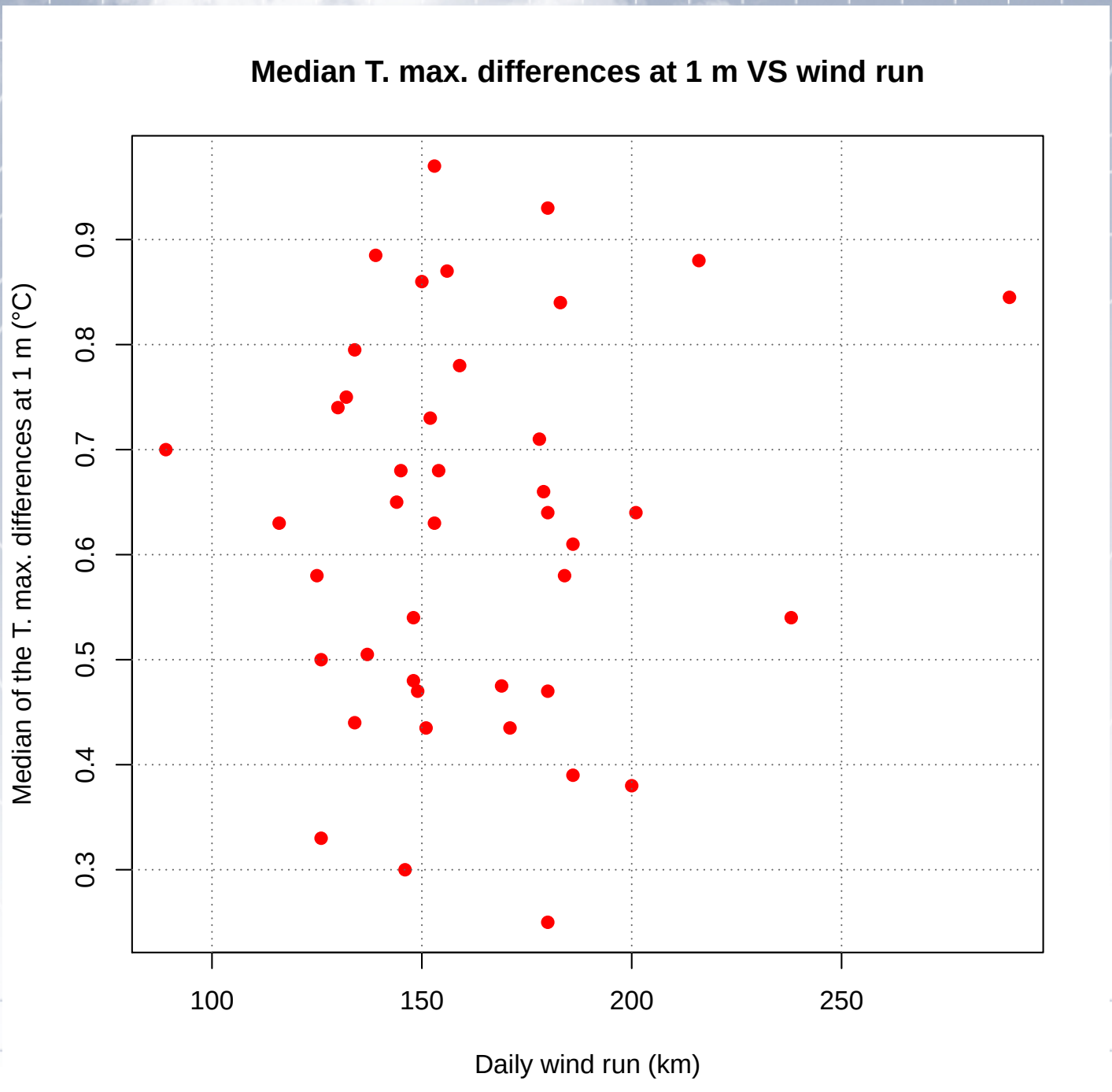

Absolute mean T. min. diff. at 2 m VS distance
Absolute mean difference
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
200
400
600
800
Distance (m)

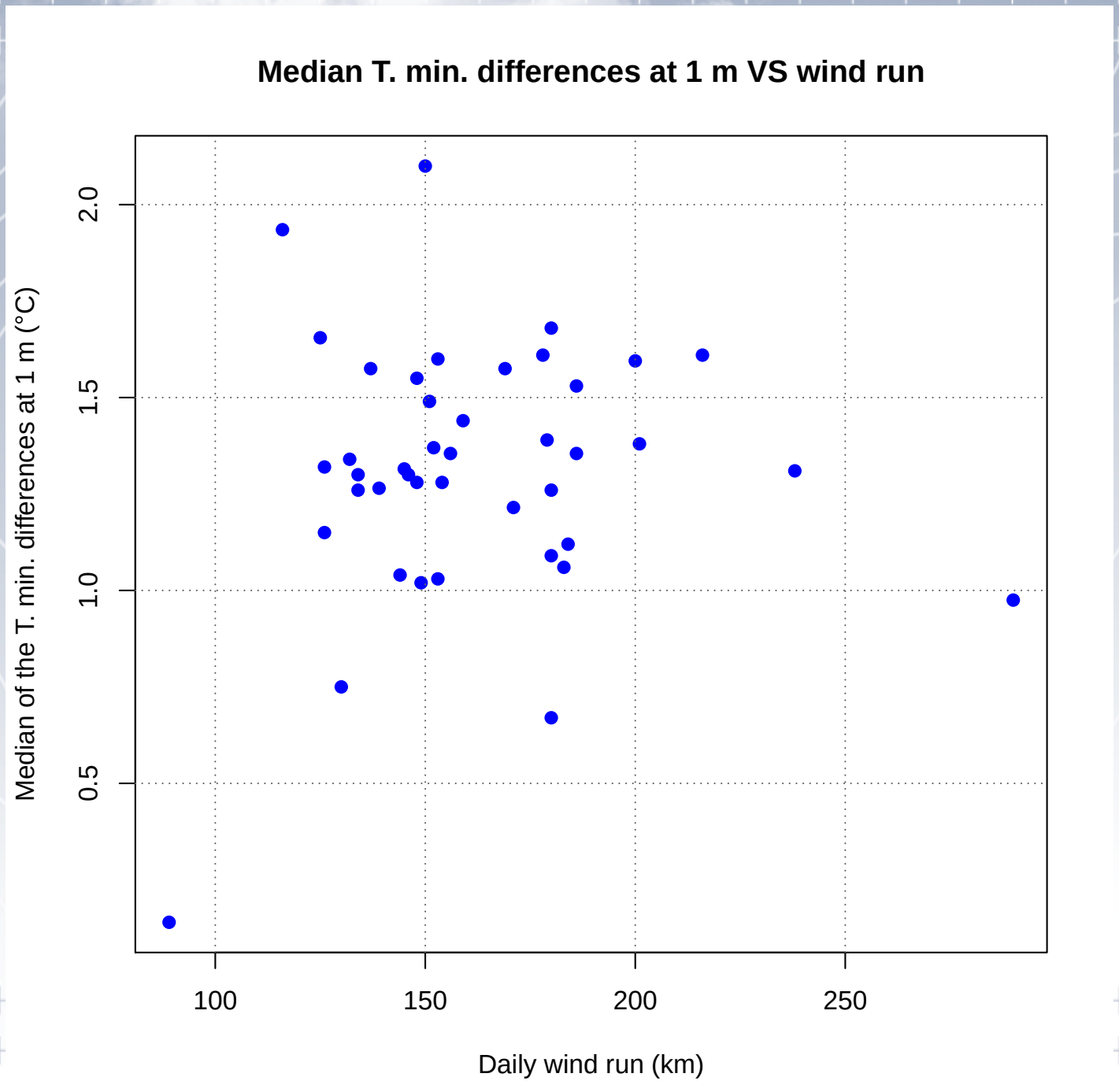

Median T. max. differences at 1 m VS DTR
Median of the T. max. differences at 1 m (°C)
0.3
0.4
0.5
0.6
0.7
0.8
0.9
10
12
14
16
18
20
Daily Temperature Range (°C)


Median T. min. differences at 1 m VS DTR
Median of the T. min. differences at 1 m (°C)
0.5
1.0
1.5
2.0
10
12
14
16
18
20
Daily Temperature Range (°C)


Median T. max. differences at 1 m VS mean RH
Median of the T. max. differences at 1 m (°C)
0.3
0.4
0.5
0.6
0.7
0.8
0.9
45
50
55
60
65
70
Mean relative humidity (%)


Median T. min. differences at 1 m VS mean RH
Median of the T. min. differences at 1 m (°C)
0.5
1.0
1.5
2.0
45
50
55
60
65
70
Mean relative humidity (%)


Median T. max. differences at 1 m VS wind run
Median of the T. max. differences at 1 m (°C)
0.3
0.4
0.5
0.6
0.7
0.8
0.9
100
150
200
250
Daily wind run (km)


Median T. min. differences at 1 m VS wind run
Median of the T. min. differences at 1 m (°C)
0.5
1.0
1.5
2.0
100
150
200
250
Daily wind run (km)

Conclusions

- Small scale surface heterogeneities generate micro-climatic variability that can produce significant changes in the series of observations in case of station relocations.
- Therefore, it is highly desirable to avoid changing the location of an observatory even by only tenths of meters, and to keep the surroundings unchanged.
- As the previous requirements are very difficult to achieve along the history of an observatory, it is of paramount importance to document any of those changes, and to store these metadata in the same climate database, to assure an easy way to provide them to the climate researchers.

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