Supplementary Information

Application, Adaption and Validation of the Thermal Urban Road Normalization Algorithm in a European City

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1 Reference Data (2.2)

Here we show the position of the 18 reference points at Richard-Wager Strasse, the mean temperatures measured with the handheld IR device at the sample points and the iButtons on asphalt at Richard-Wager Strasse and near Weilerstrasse:

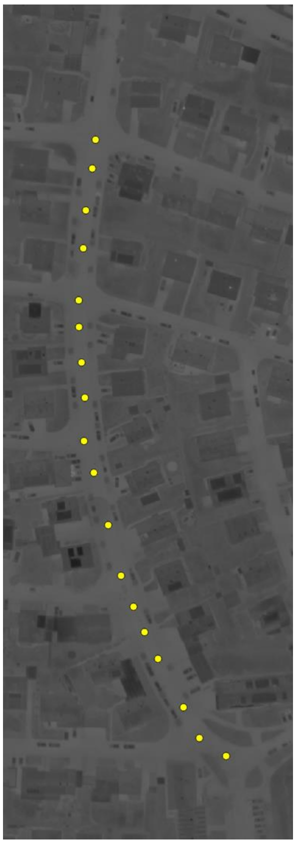

Figure 1 *Reference measurement points at Richard-Wagner Strasse with the TIR in the background.*

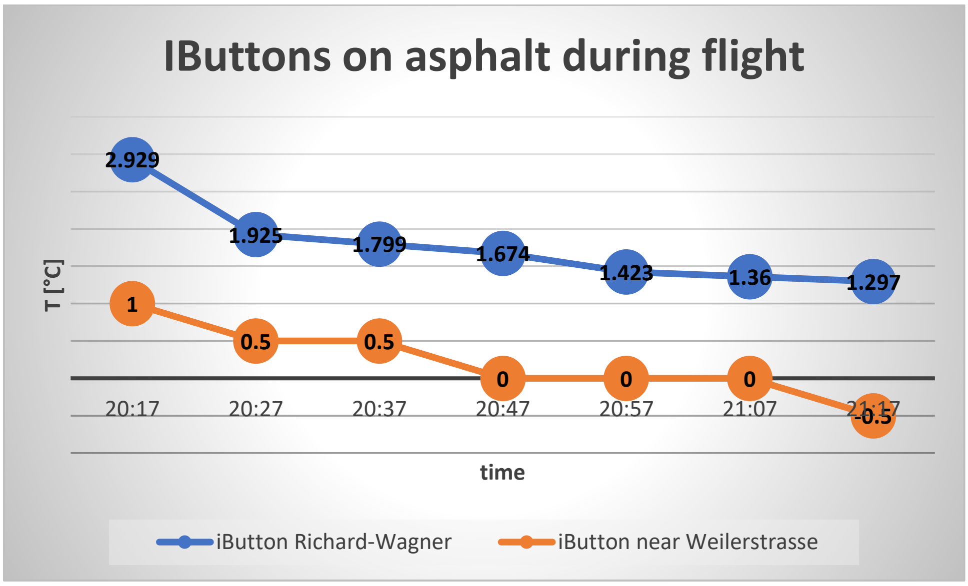

Figure 2 *iButton temperatures, placed on asphalt on Richard-Wager Strasse and Weilerstrasse.*

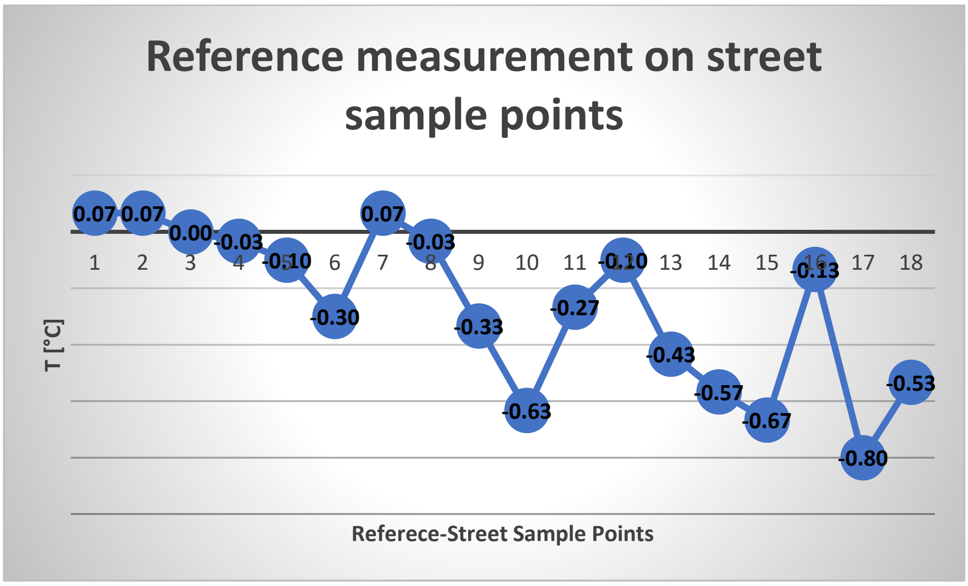

Figure 3 *Street samples measured at Richard-Wagner Strasse with handheld infrared measurement device from FLIR.*

2 Gaussian Smoothing of Road Mask (3.2)

To reduce the influence of outliers on the TURN calculations, the TIR-mosaic used for the calculation of the road mask median values was reduced from a resolution of 0.25 m/px to 1 m/px and a Gaussian smoothing filter was applied. Here we want to show the influence of these actions on the road mask.

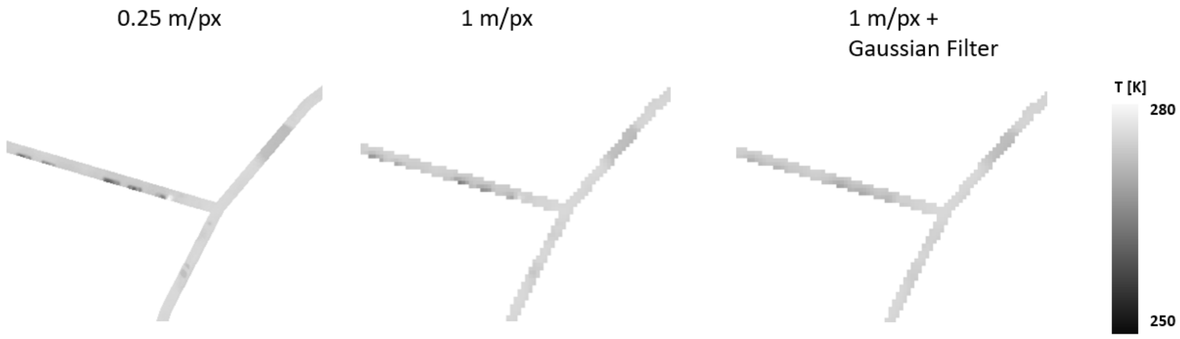

Figure 4 *Original 0.25 m road mask, 1 m road mask and 1 m road mask after Gaussian filtering.*

3 Road Mask Tiles, Median Point Sampling and RMSE with Different Tile Sizes (3.3)

Here we show an example of the 15x15 grid tiles, the street mask and the randomly placed median points on the street mask. The median value of the street temperature pixels inside a tile is stored inside the points and defines the value of a tile.

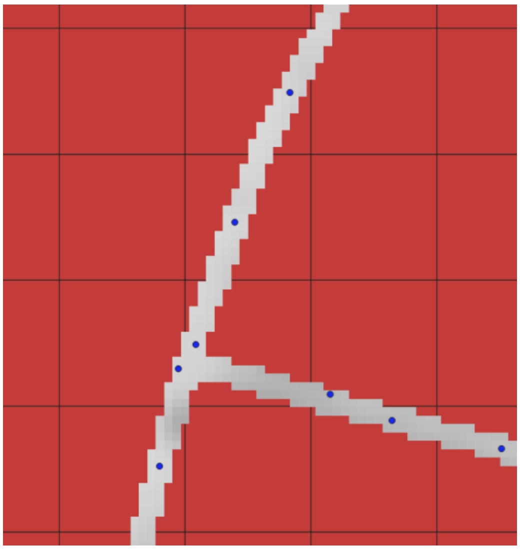

Figure 5 *Road mask, 15x15 m tiles and median road temperature points.*

4 IDW Interpolation Parameter Variation (3.5)

These are the results of an IDW parameter study that was carried out using data from a project area in Switzerland. The parameters power, smoothing and radius were varied in 12 configurations. Here we show the resulting RMSE and the visual appearance of the TURN-surface of the configurations.

Table 1 *Varied IDW interpolation parameters for TURN calculation.*

ID	Algorithm	Power	Smoothing	Radius 1 / 2
1	invdist	2	0	0.0 / 0.0
2	invdist	2	0	50.0 / 50.0
3	invdist	2	0	100.0 / 100.0
4	invdist	2	5	0.0 / 0.0
5	invdist	2	5	50.0 / 50.0
6	invdist	2	5	100.0 / 100.0
7	invdist	2	10	0.0 / 0.0
8	invdist	2	10	50.0 / 50.0
9	invdist	2	10	100.0 / 100.0
10	invdist	5	0	0.0 / 0.0
11	invdist	5	0	50.0 / 50.0
12	invdist	5	0	100.0 / 100.0

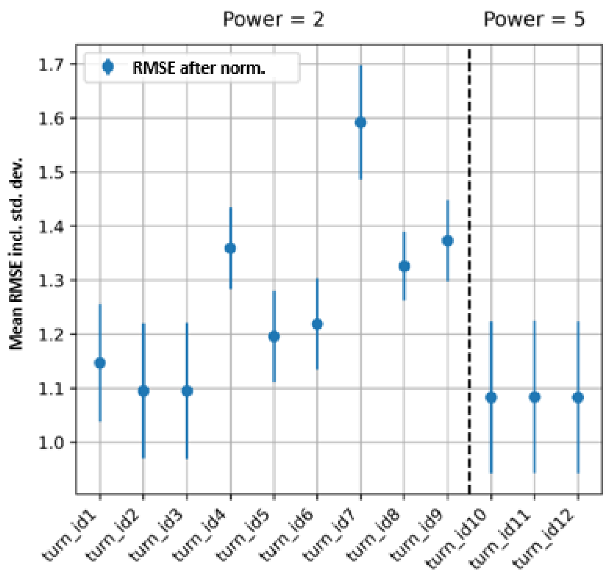

Figure 6 *Resulting RMSE after normalization for each parameter configuration.*

Figure 7 *Resulting TURN-surfaces for the different parameter configurations*.

5 iButton Comparison Richard-Wager vs. Weilerstrasse (4.4)

To compare the temperature of the iButtons with the TURN surface, we averaged the temperature in two polygons around the position of the two iButtons. Here we show the coordinates of the polygons and the resulting values. On average, the temperatures differ by approx. 1.3 K in the TURN-surface.

Table 2 *Polygon coordinates and resulting temperatures of the iButton locations.*

wkt_geom	id	_mean	_median	_majority
uMultiPolygon (((578834.02650788007304072 5409718.2594931535422802, 578836.98978337575681508 5409718.44469787180423737, 578836.80457865726202726 5409707.08547513838857412, 578834.02650788007304072 5409707.39414966851472855, 578834.02650788007304072 5409718.2594931535422802)))	1	0.95630	0.92373	0.76074
MultiPolygon (((578646.78453749150503427 5409274.57072257343679667, 578641.59880537400022149 5409273.212554638274014, 578639.37634875217918307 5409276.91664900816977024, 578644.68555068201385438 5409279.63298487942665815, 578646.78453749150503427 5409274.57072257343679667)))	2	-0.35013	-0.35212	-0.36543

6 Building Area Raster and Correlation Matrix (4.5)

We wanted to know how the building density and the sky-view factor are correlated with the TURN-surface. Here we show the building density grid and the resulting correlation/covariance matrices.

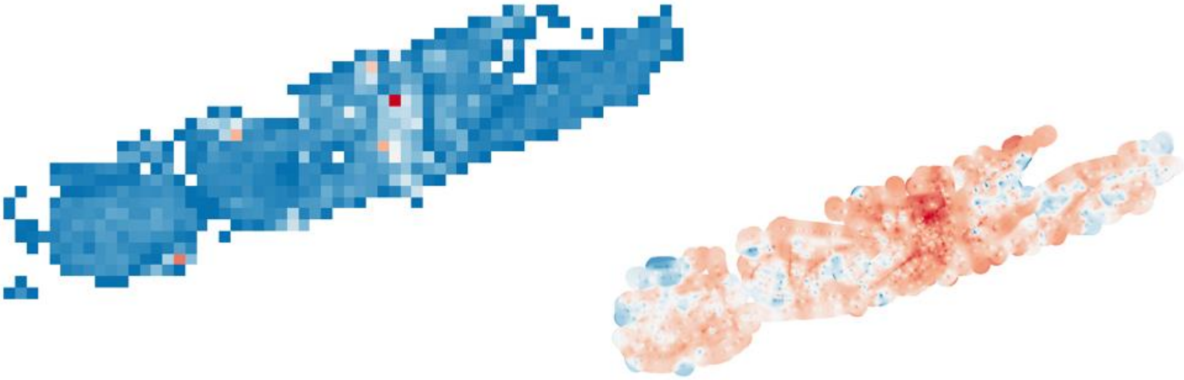

Figure 8 *Sum of building area on 100x100 m tiles (left) and TURN-surface (right) for visual comparison.*

N = 538
1.000000 0.358353
0.358353 1.000000 **Building area**

N = 91368444
1.000000 -0.126564
-0.126564 1.000000 **Sky-view factor**

Figure 9 *Resulting positive correlation for the building area and negative correlation for the sky-view factor.*