Analysis of soil at Casa de las Aguilas

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Here we compare the outcome of a classical kriging against a cost-based kriging which takes into account the presence of a semi-barrier.

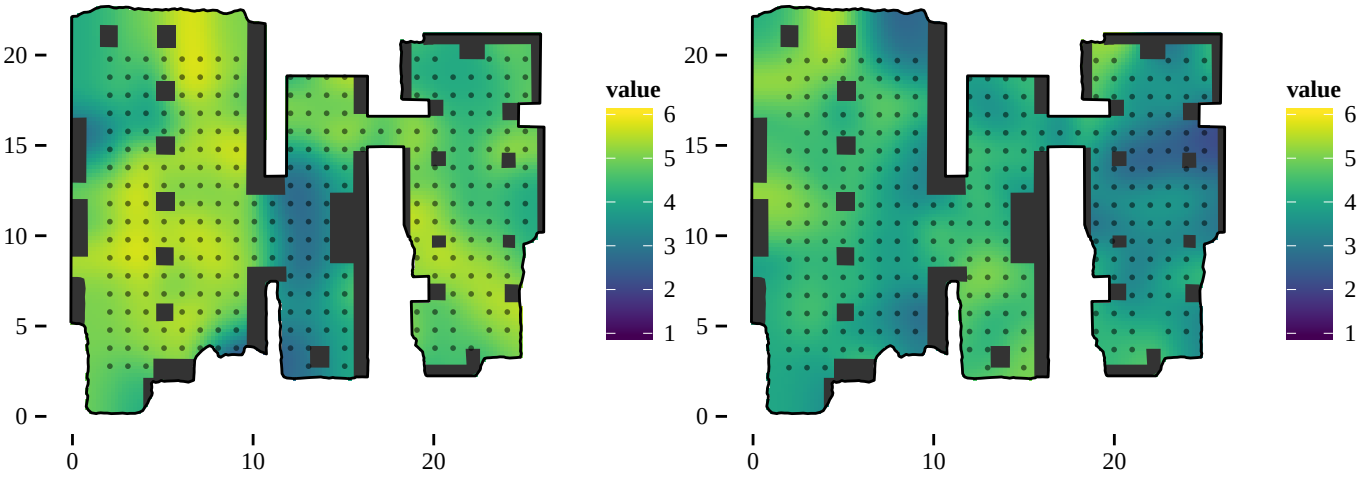
Data description

Figures 1 and 2 display the raw data, and an exploratory smoothed surface.

Data description

```
'data.frame':   598 obs. of  4 variables:
 $ x  : num  1.99 1.99 1.99 1.99 1.99 ...
 $ y  : num  2.7 3.7 4.7 5.7 6.7 ...
 $ pc : num  NA NA NA NA NA NA NA NA NA NA ...
 $ po4: num  4 4 4 4 4 4 3 5 5 5 ...
```

```
       x                y                pc             po4       
 Min.   : 1.987   Min.   : 2.697   Min.   :1.000   Min.   :2.00  
 1st Qu.: 6.070   1st Qu.: 7.779   1st Qu.:4.000   1st Qu.:3.00  
 Median :12.070   Median :11.779   Median :5.000   Median :4.00  
 Mean   :12.535   Mean   :11.772   Mean   :4.691   Mean   :4.02  
 3rd Qu.:19.987   3rd Qu.:15.779   3rd Qu.:5.000   3rd Qu.:5.00  
 Max.   :25.070   Max.   :19.779   Max.   :6.000   Max.   :6.00  
                                   NA's   :297     NA's   :301   
```



For the kriging predictions (both Euclidean and cost-based), we are using a prediction grid with a resolution of 0.2, clipped by the structure of the temple.

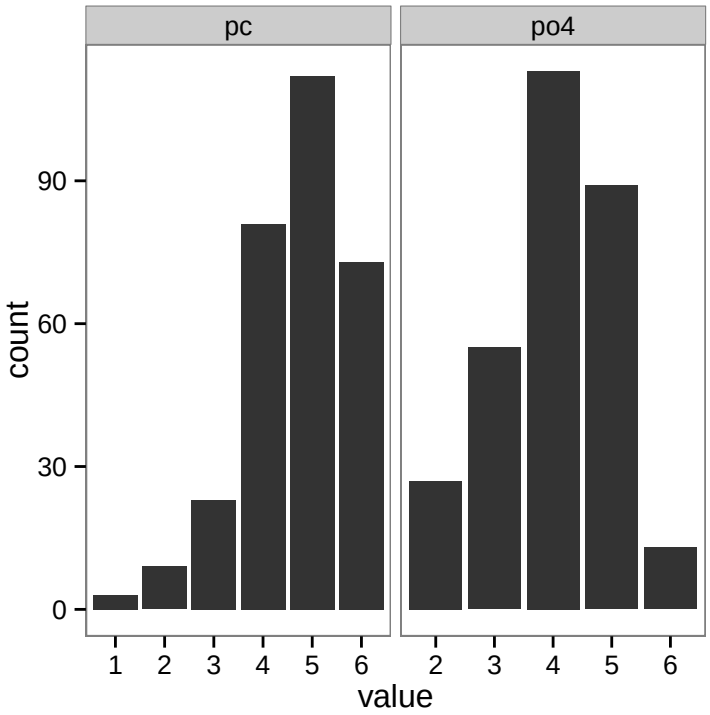


Figure 1:

Percent of Carbonates

Euclidean kriging

It may make sense to use the *room* as a covariate in this model (Universal kriging). For the moment, we just perform an ordinary kriging.

The variogram model is Matérn. We choose to estimate the nugget effect, which may account for measurement error, for example.

Cost-based kriging

Watch out! the cost surface can be derived either: - from a SpatialPolygon of the working area - from the SpatialPolygons of the border and of the inner structures

The results from both methods are not the same. In the first case, the cost of non-conductive inner areas is NA, while in the second is 0. This has an effect on one-pixel transitions (? this requires further inverstigation).

Some cost-based maps, for verification purposes.

Comparison of method outcomes

	Euclidean	Cost-based
Intercept	4.55	4.55
Nugget	0.30	0.26
Partial sill	0.92	0.95
kappa	0.51	0.51

	Euclidean	Cost-based
phi	2.45	2.24
Pract. range	7.32	6.70

The estimated variogram models are very similar in this case, with log-likelihoods of -386.5595983 and -386.5170783 respectively. This yields very similar kriging predictions as well.

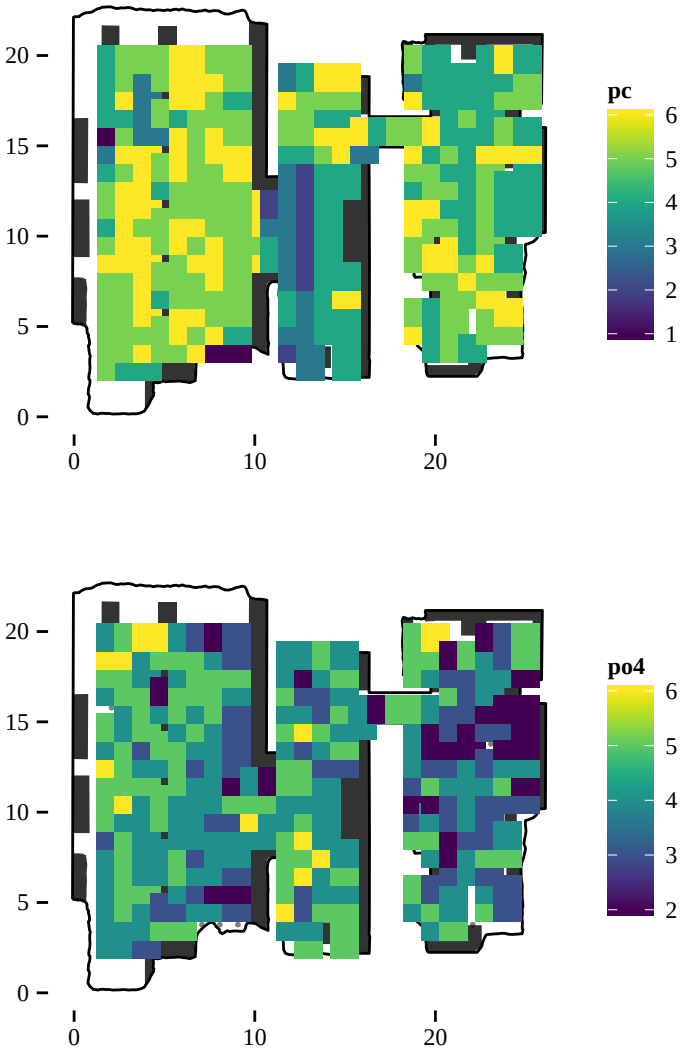


Figure 2: Measurement locations and observed values

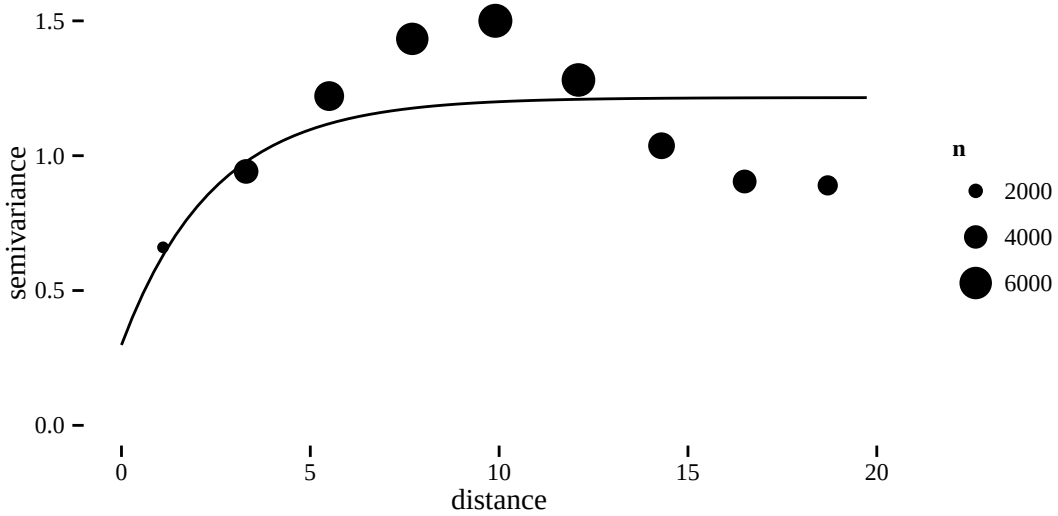


Figure 3: Empirical variogram and fitted model.

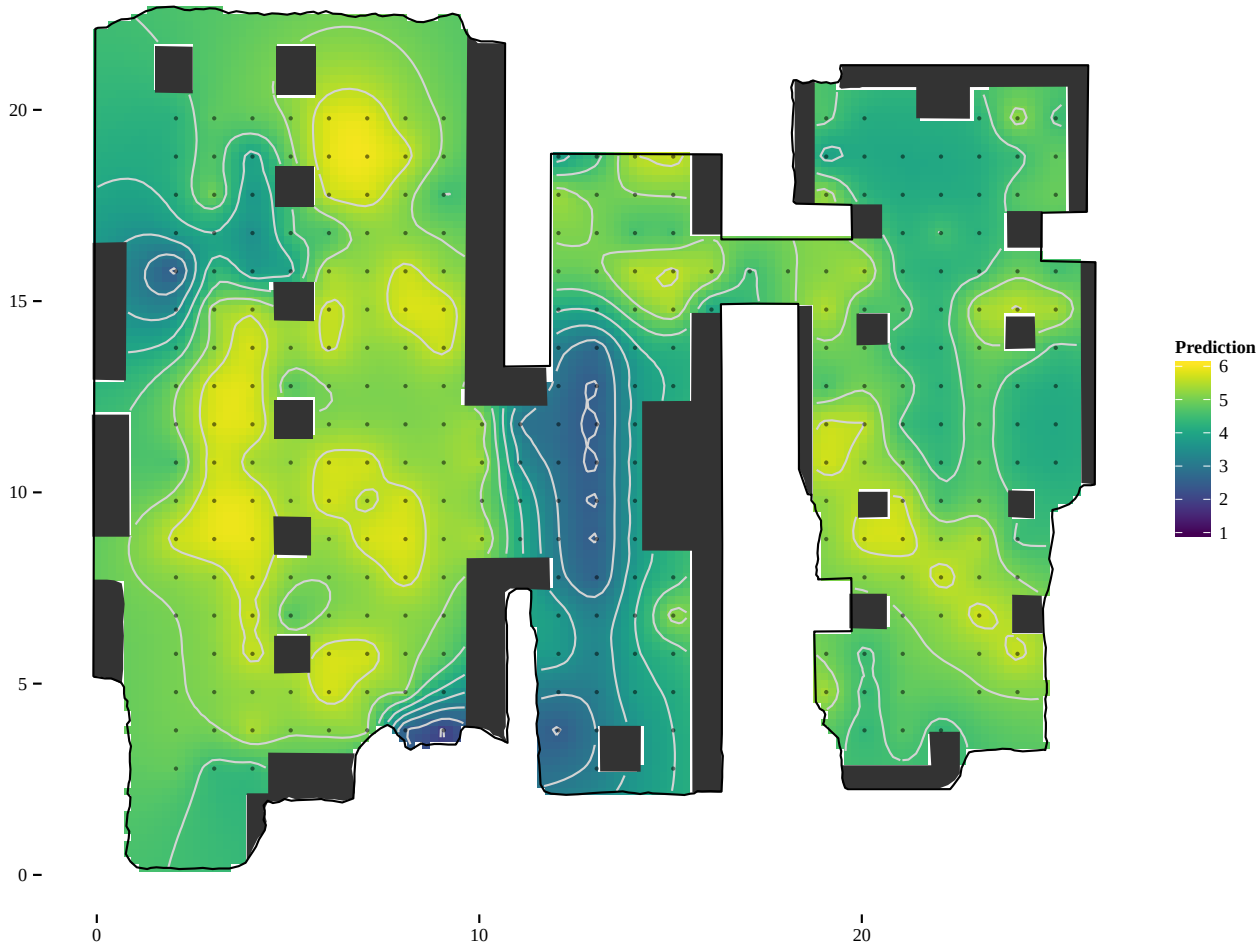


Figure 4: Euclidean kriging prediction

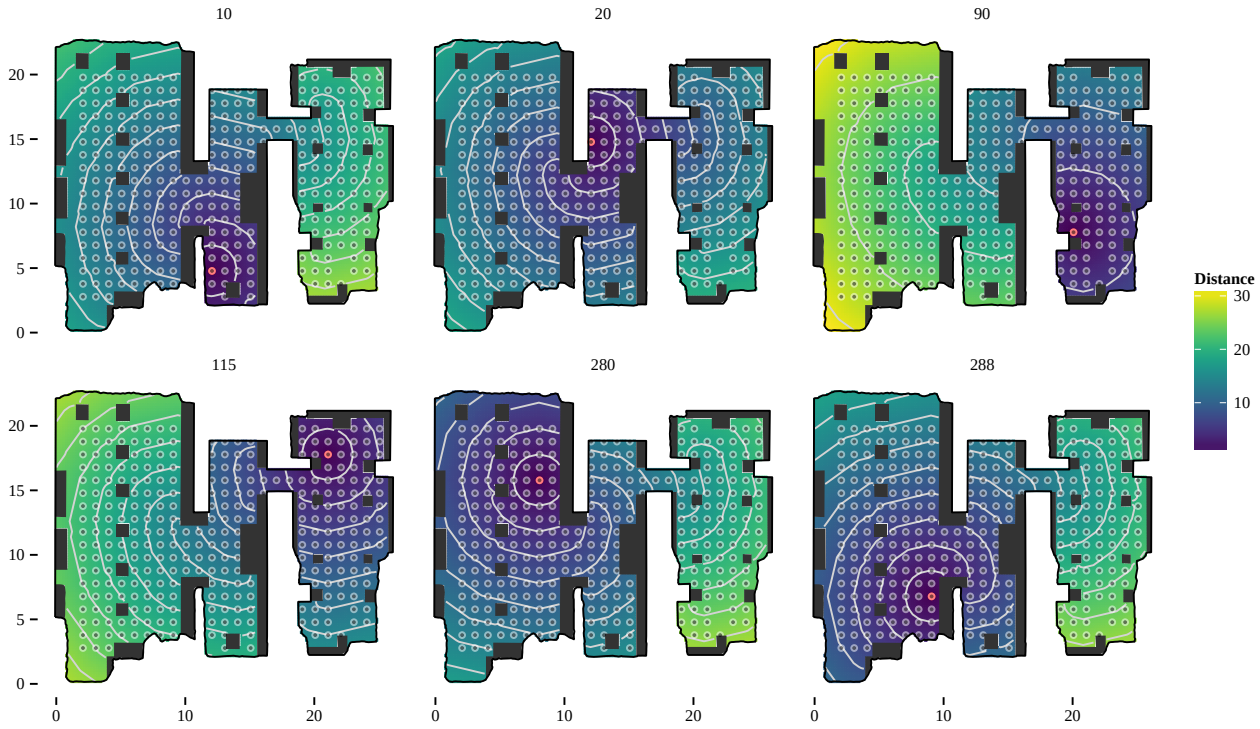


Figure 5:

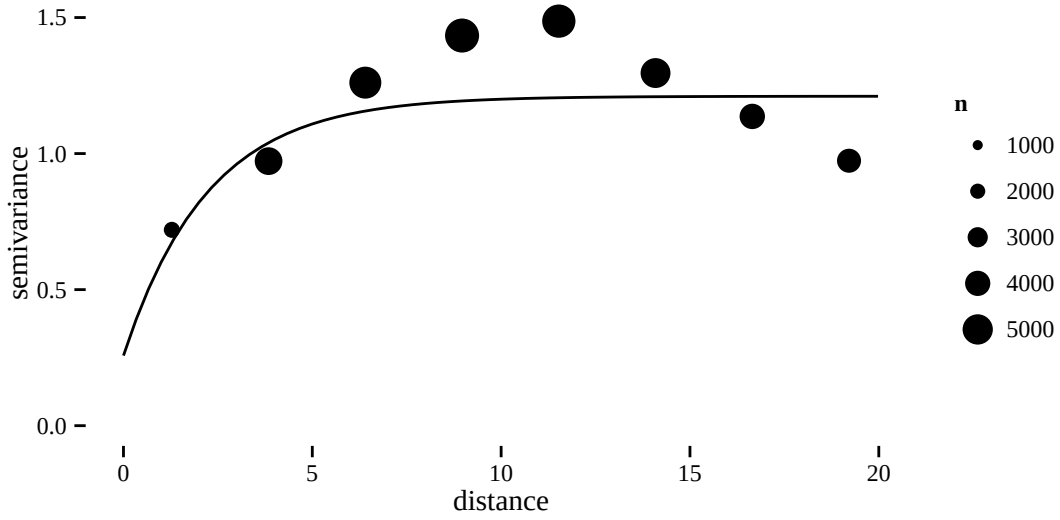


Figure 6: Empirical variogram and fitted model.

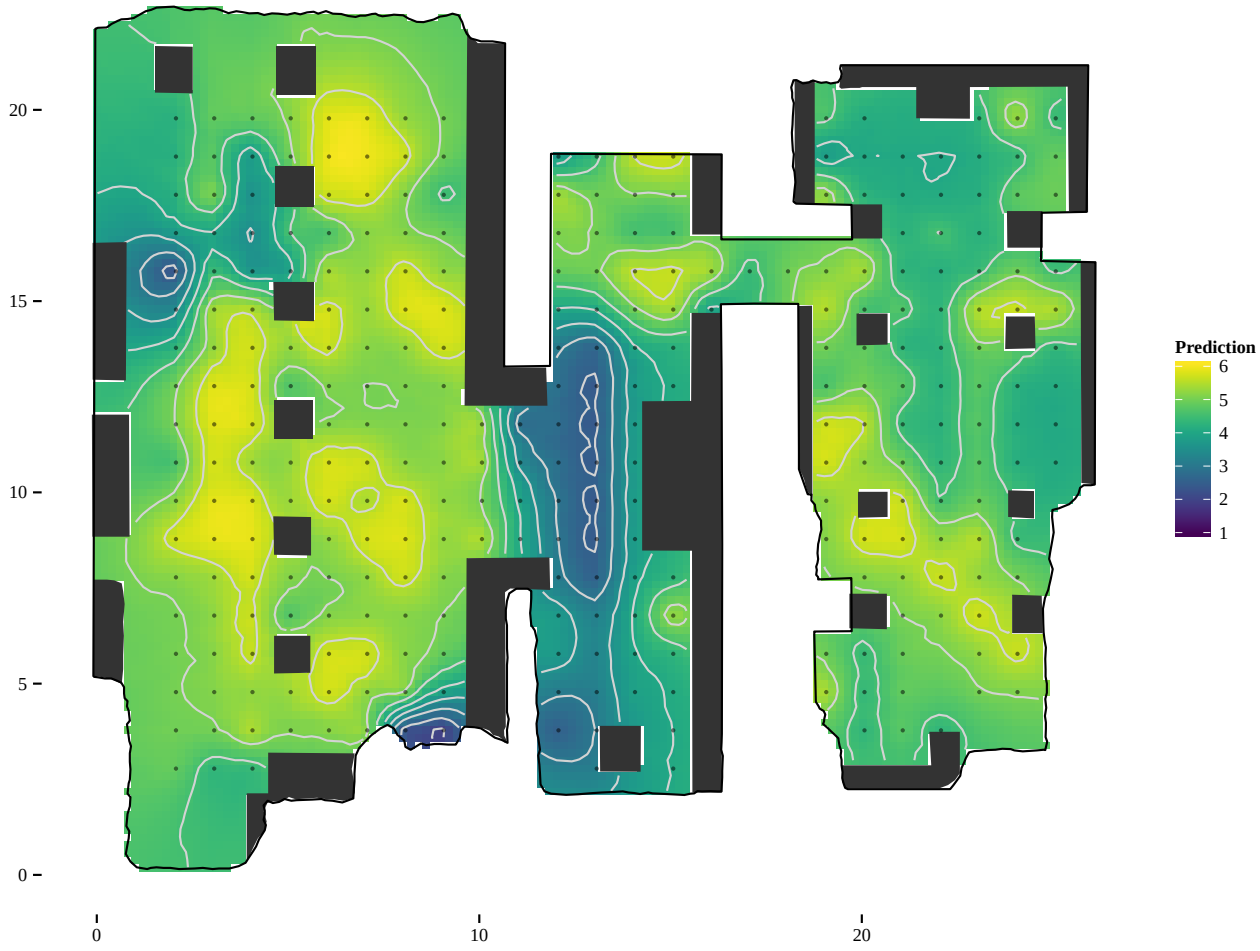


Figure 7: Cost-based kriging prediction

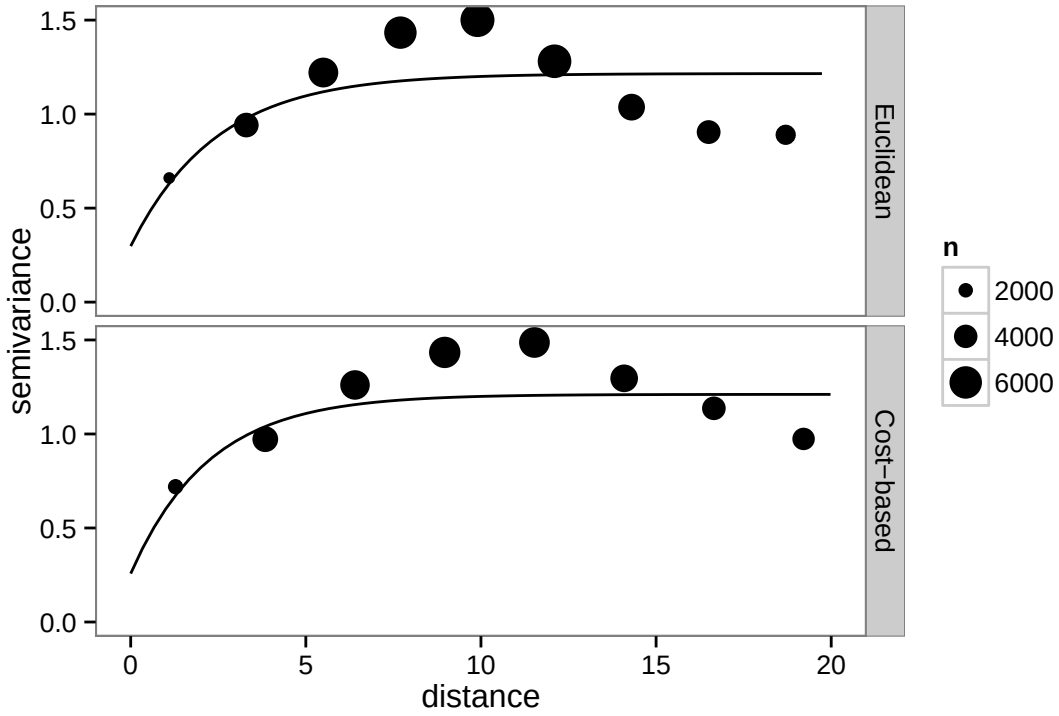


Figure 8: Empirical variogram and fitted models by method.

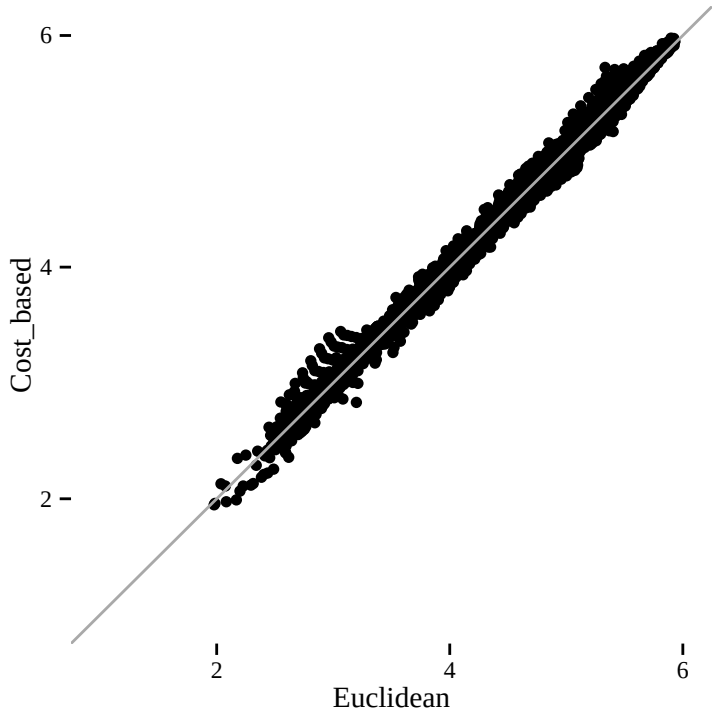


Figure 9:

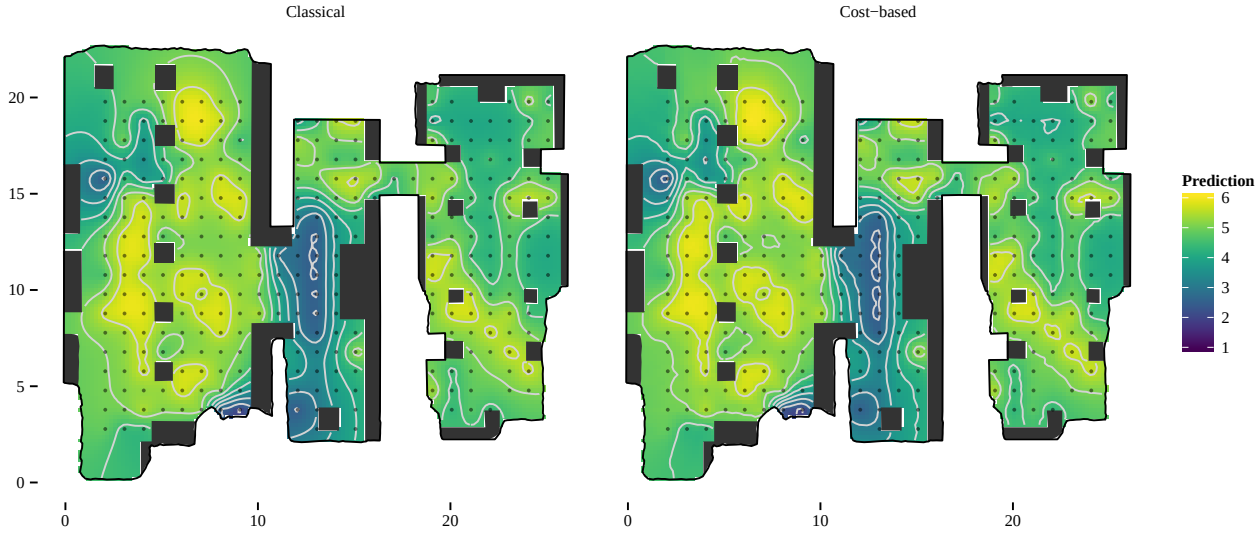


Figure 10: Comparison of Kriging estimates.

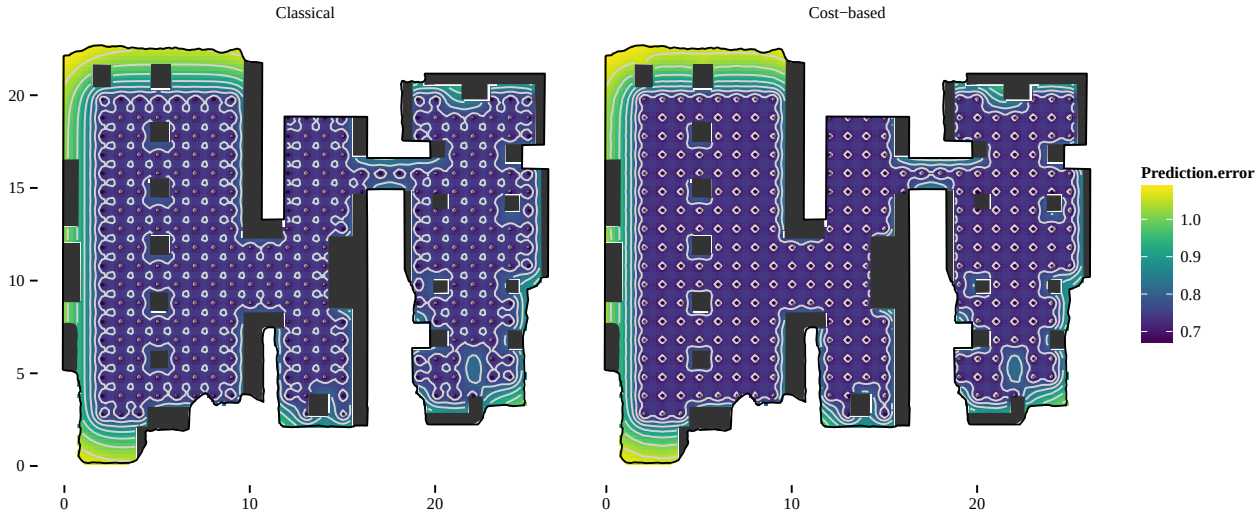


Figure 11: Comparison of Kriging estimates.

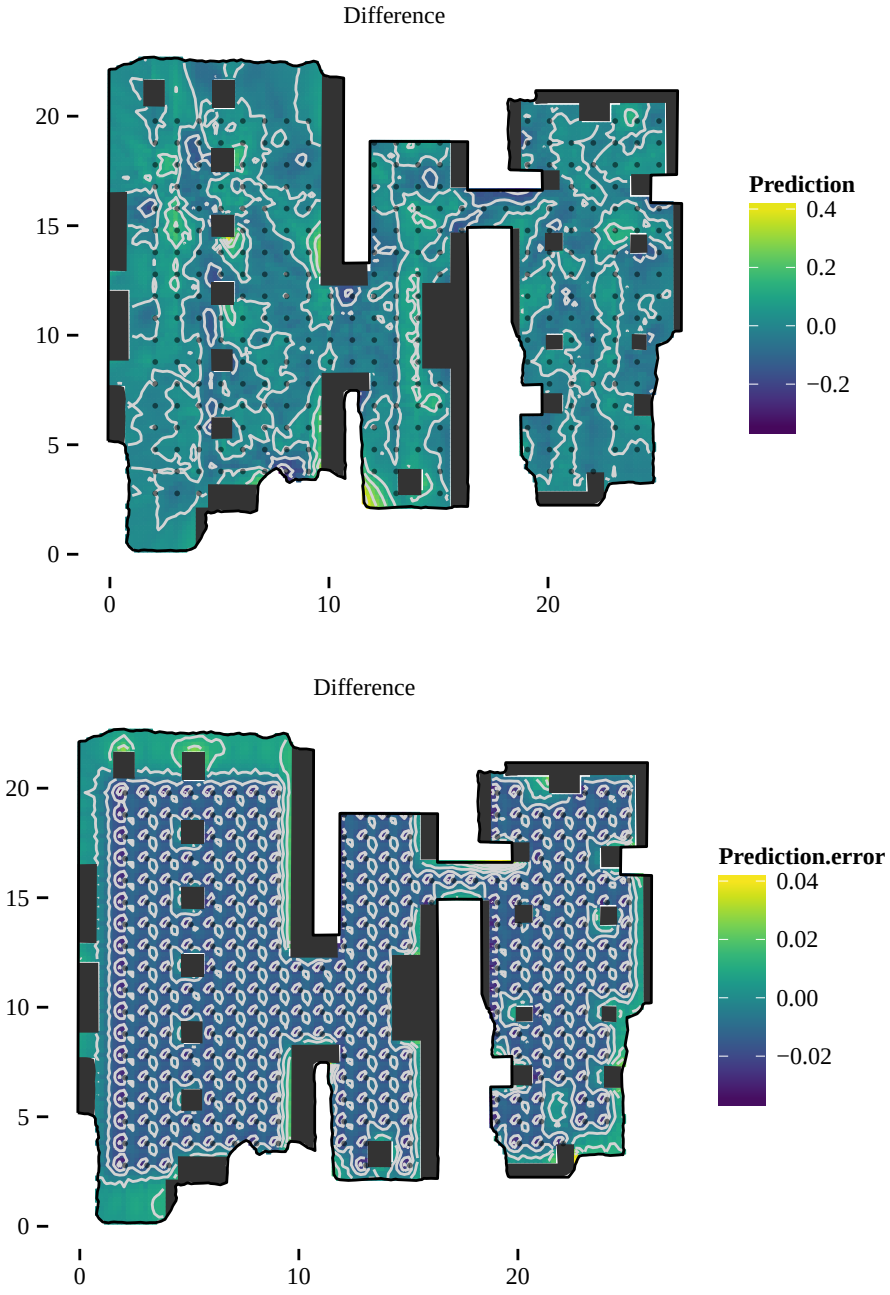


Figure 12: Difference between the cost-based and the Euclidean predictions

Percent of Phosphates

Euclidean kriging

It may make sense to use the *room* as a covariate in this model (Universal kriging). For the moment, we just perform an ordinary kriging.

The variogram model is Matérn. We choose to estimate the nugget effect, which may account for measurement error, for example.

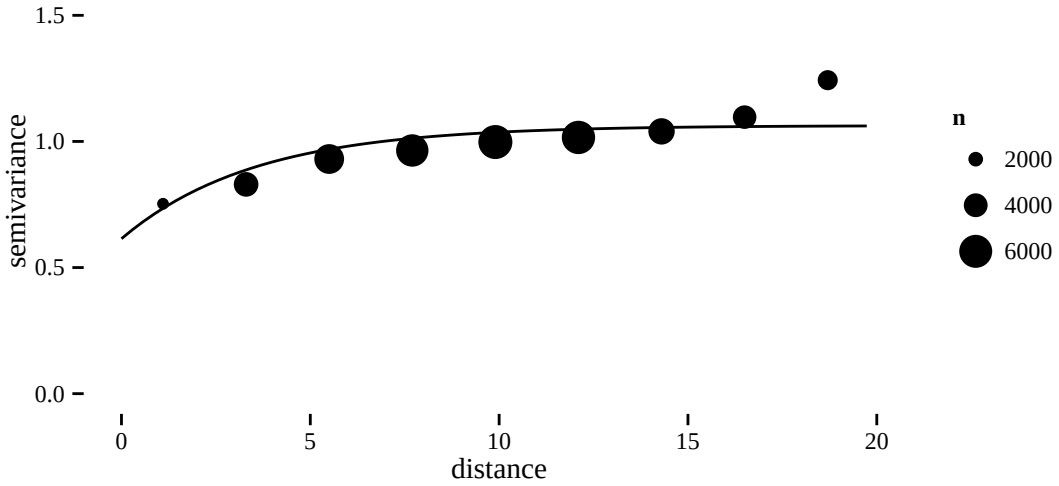


Figure 13: Empirical variogram and fitted model.

Cost-based kriging

Watch out! the cost surface can be derived either: - from a SpatialPolygon of the working area - from the SpatialPolygons of the border and of the inner structures

The results from both methods are not the same. In the first case, the cost of non-conductive inner areas is NA, while in the second is 0. This has an effect on one-pixel transitions (? this requires further inverstigation).

Comparison of method outcomes

	Euclidean	Cost-based
Intercept	4.07	4.09
Nugget	0.61	0.64
Partial sill	0.45	0.43
kappa	0.51	0.51
phi	3.52	4.39
Pract. range	10.56	13.14

The estimated variogram models are very similar in this case, with log-likelihoods of -394.8361536 and -394.6420113 respectively. This yields very similar kriging predictions as well.

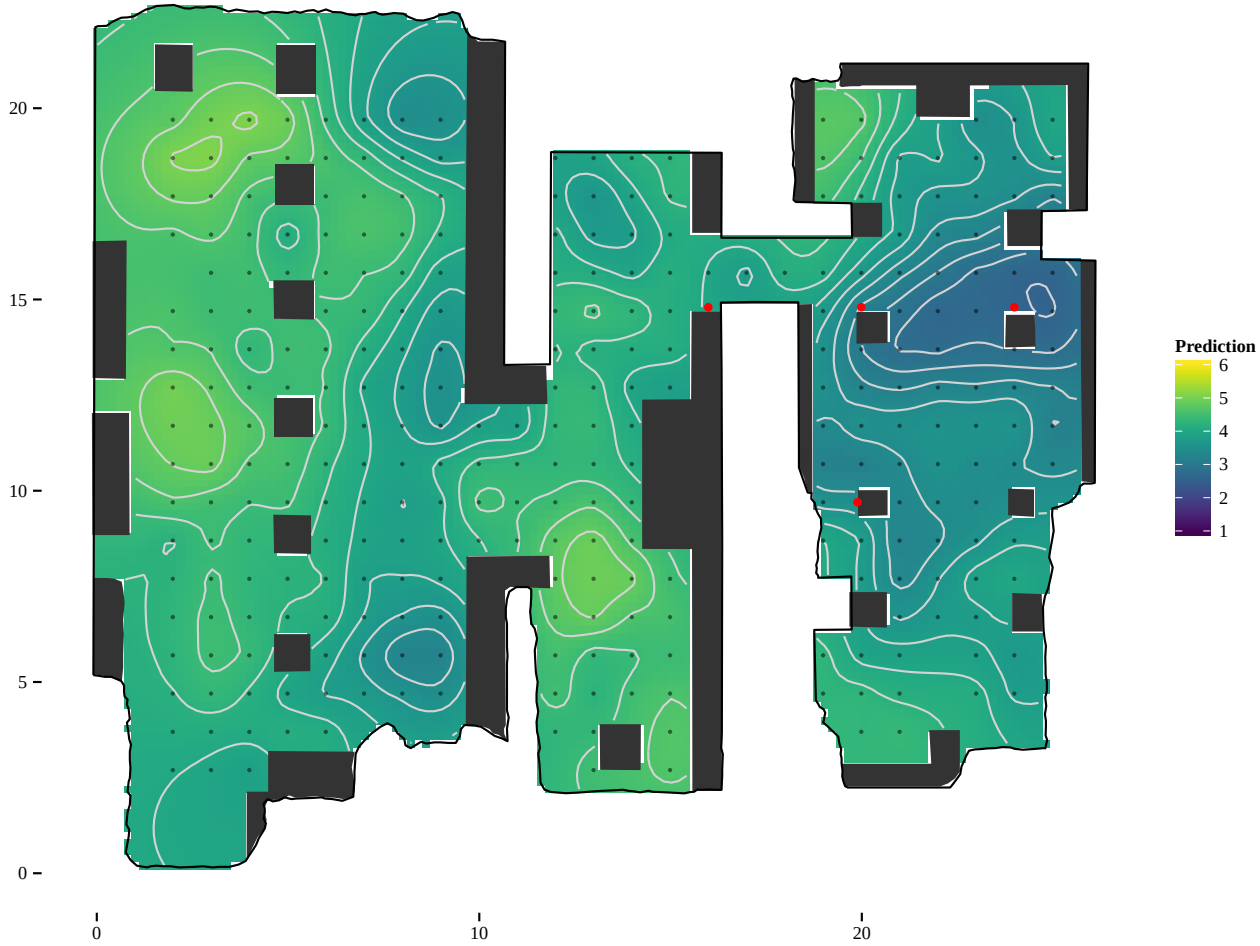


Figure 14: Euclidean kriging prediction

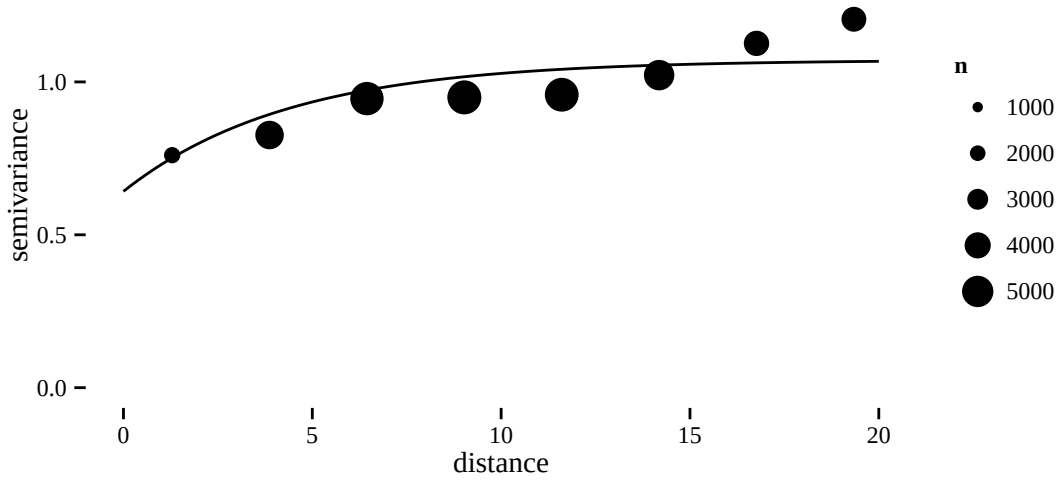


Figure 15: Empirical variogram and fitted model.

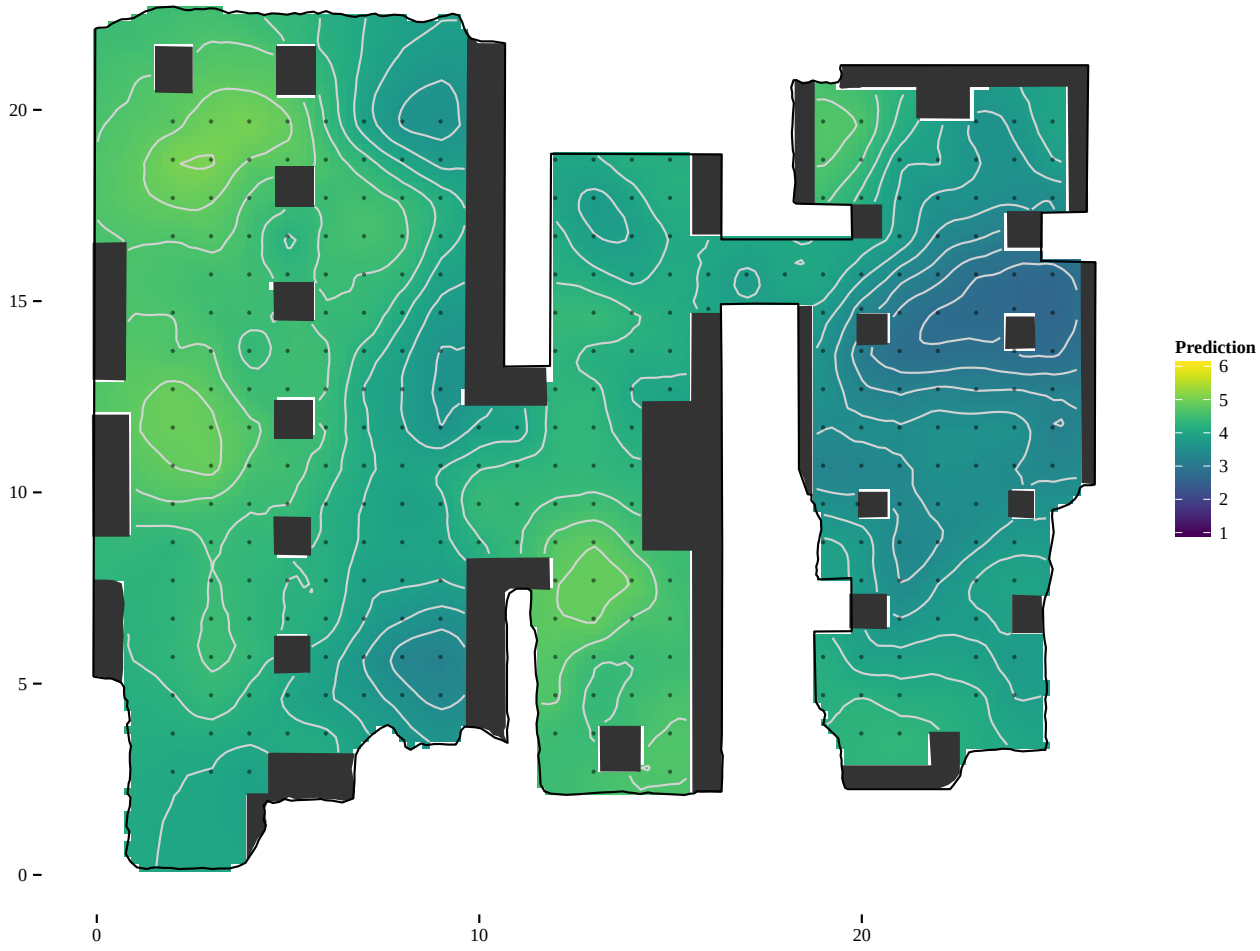


Figure 16: Cost-based kriging prediction

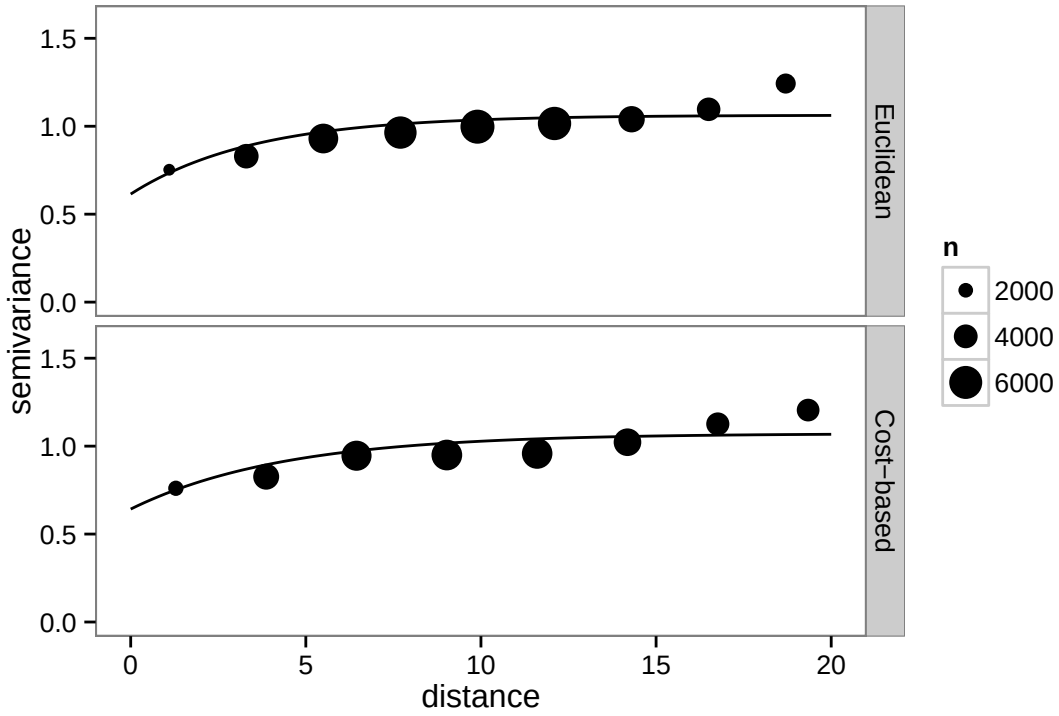


Figure 17: Empirical variogram and fitted models by method.

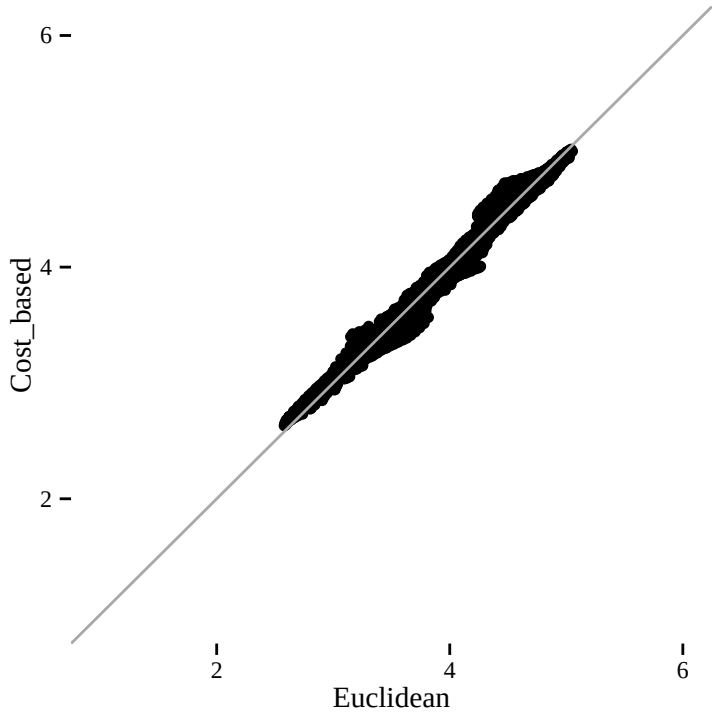


Figure 18:

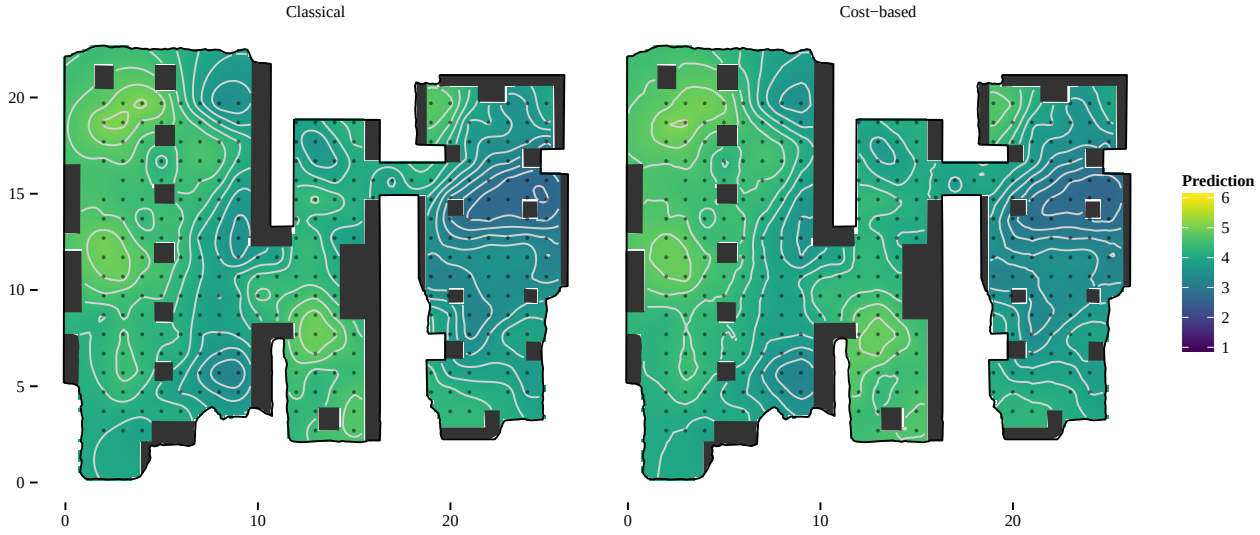


Figure 19: Comparison of Kriging estimates.

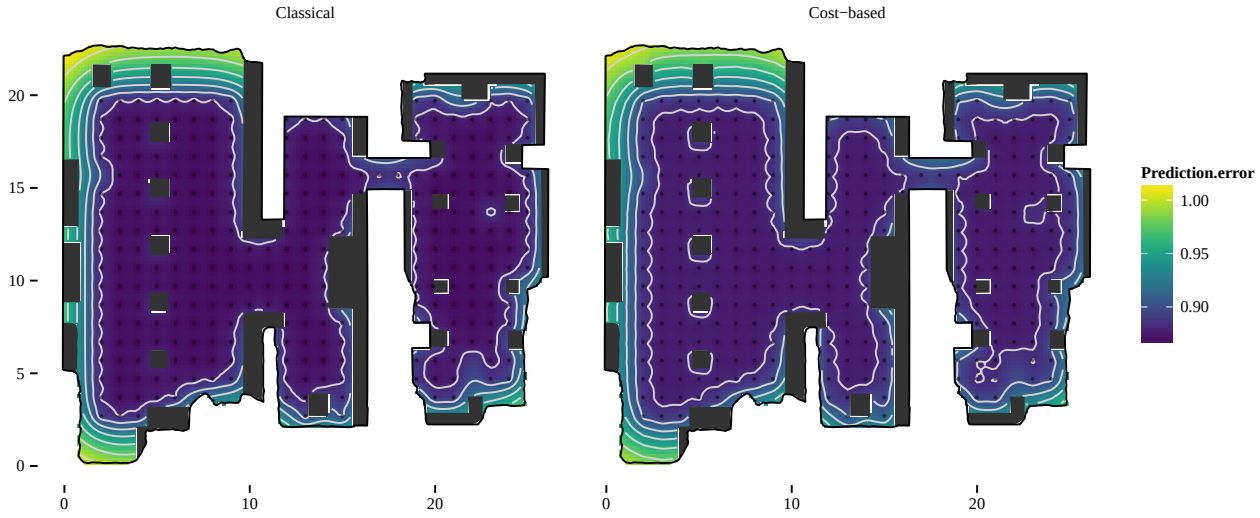


Figure 20: Comparison of Kriging estimates.

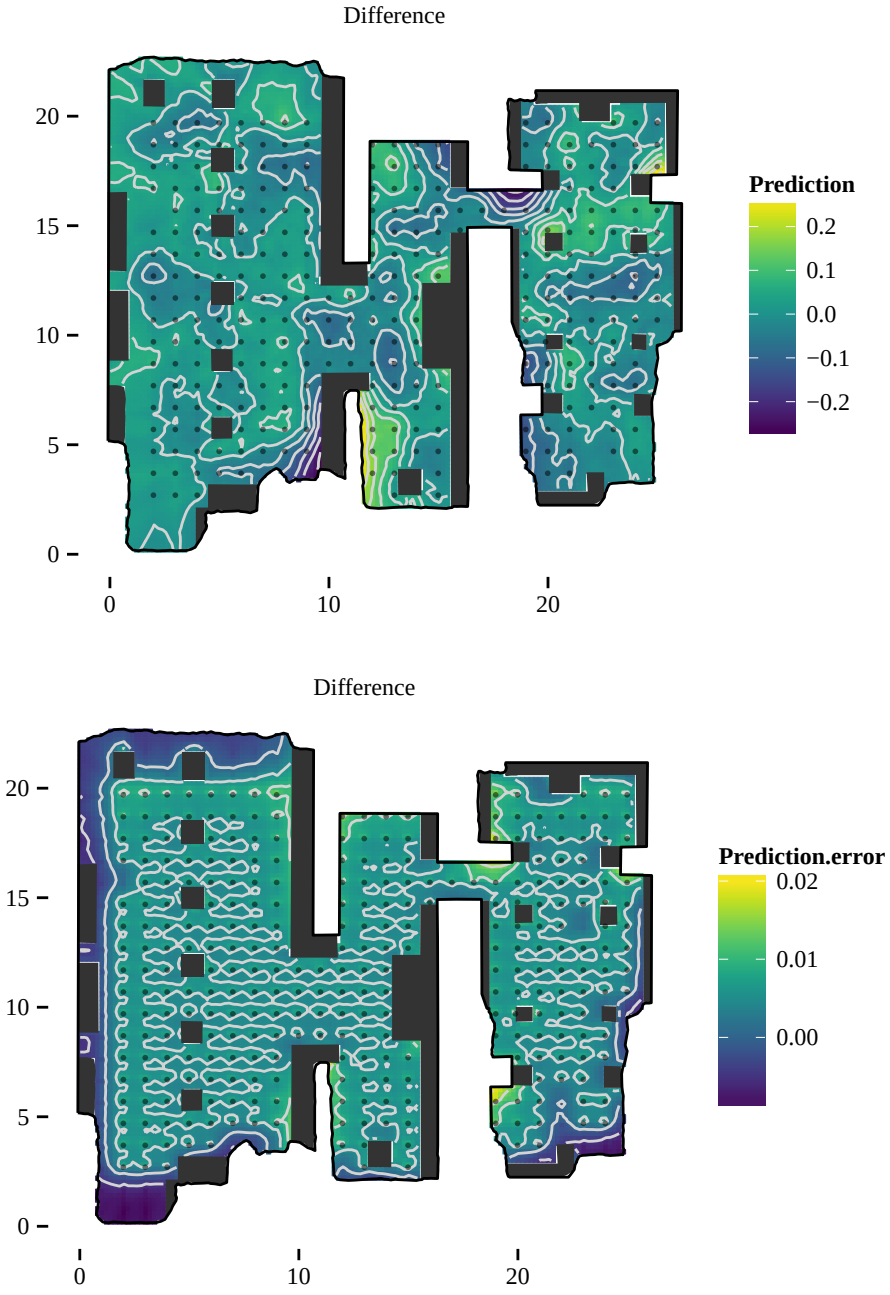


Figure 21: Difference between the cost-based and the Euclidean predictions