

Challenge II: Spatial continuity and weather prediction

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Contents

1 Libraries	2
2 Data	2
3 Spatial continuity	3
3.1 First impressions of spatial variation	3
3.1.1 Winter before 1970	3
3.1.2 Summer before 1970	3
3.1.3 Winter after 1990	4
3.1.4 Summer after 1990	4
3.2 H - Scatterplots and autocovariance plots	5
3.2.1 Summer before 1970	5
3.2.2 Winter before 1970	6
3.2.3 Winter after 1990	7
3.2.4 Summer after 1990	8
3.3 Empirical Variogram	9
3.3.1 Winter before 1970	9
3.3.2 Summer before 1970	10
3.3.3 Winter before 2010	11
3.3.4 Summer before 2010	12
3.4 Fitted Semivariogram	13
3.4.1 Winter before 1970	13
3.4.2 Summer before 1970	14
3.4.3 Winter after 1990	15
3.4.4 Summer after 1990	16
3.5 Ordinary kriging cross-validation	17
3.5.1 Winter before 1970	17
3.5.2 Summer before 1970	17
3.5.3 Winter after 1990	17
3.5.4 Summer after 1990	18
3.6 Universal ordinary Kriging	19
3.6.1 Continentiality: Create distance to ocean layer	19
3.6.2 Winter before 1970	19
3.6.3 Summer before 1970	20
3.6.4 Winter after 1990	20
3.6.5 Summer after 1990	20
3.7 Ordinary Kriging	20
3.7.1 Winter before 1970	20
3.7.2 Summer before 1970	20
3.7.3 Winter after 1990	20
3.7.4 Summer after 1990	20

1 Libraries

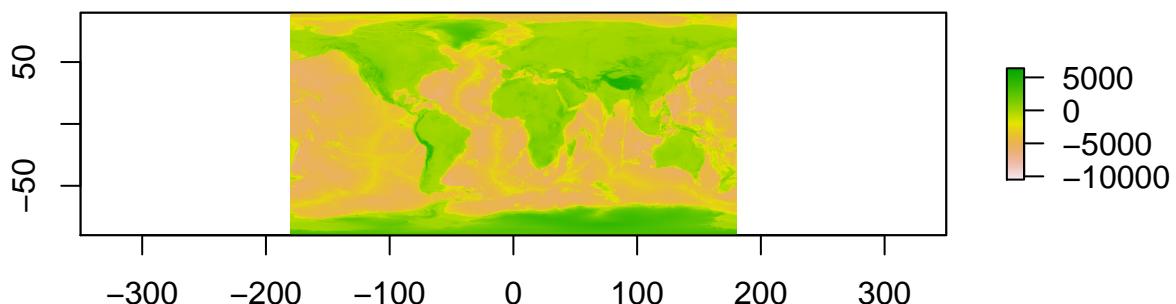
The following libraries are needed, to execute the code:

- **ggplot2** – Plots – [@ggplot2]
- **plyr** – Splitting, applying and combining data – [@plyr]
- **rgdal** – Open Shapefiles – [@rgdal]
- **sp** – Spatial datatypes – [@sp2; @sp1]
- **gstat** – Spatial statistics –[@gstat]
- **FNN** – Spatial statistics –[@FNN]

2 Data



id	meanWi_before1970	meanSu_before1970	meanWi_after1990	meanSu_after1990	elev
1	11.83	23.27	13.09	24.75	7
2	10.21	22.43	11.35	23.94	4
3	10.83	22.78	11.32	24.76	25
4	10.30	22.00	11.44	24.02	2
5	6.13	22.37	7.00	24.56	694
6	8.14	24.90	9.35	26.15	715



3 Spatial continuity

3.1 First impressions of spatial variation

3.1.1 Winter before 1970

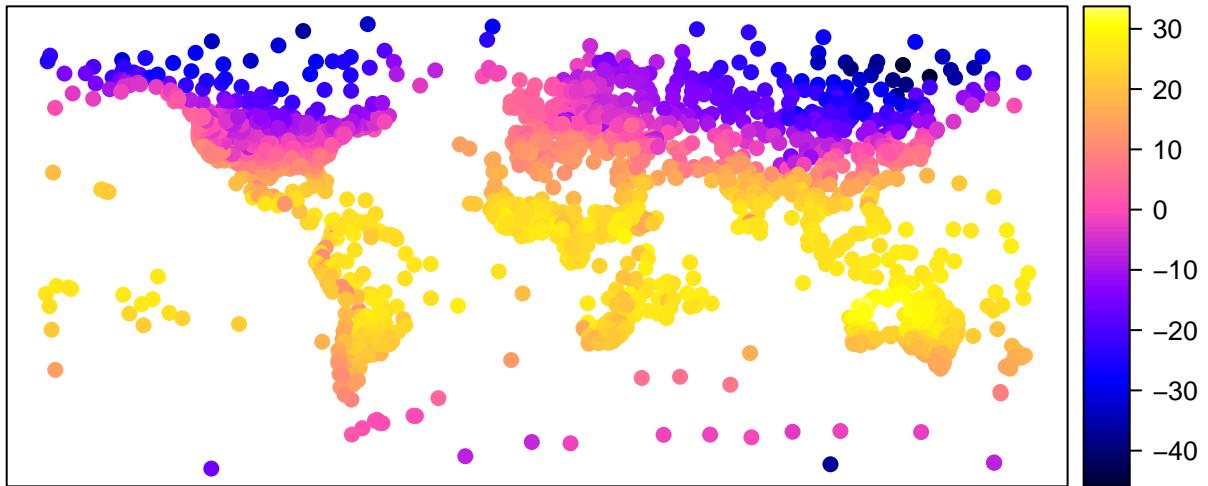


Figure 1: Mean temperature Winter from 1950 to 1970

3.1.2 Summer before 1970

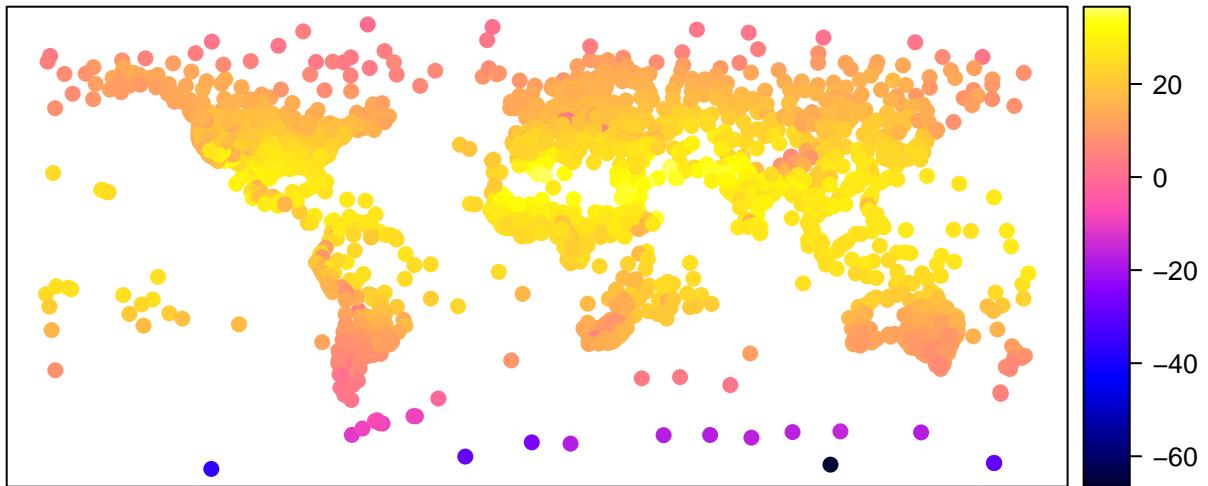


Figure 2: Mean temperature Winter from 1950 to 1970

3.1.3 Winter after 1990

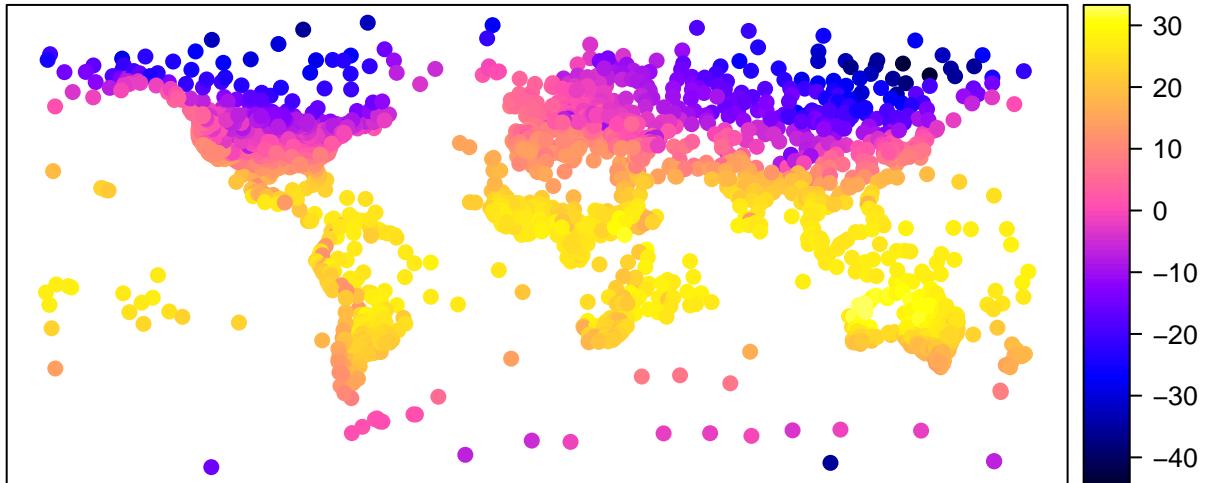


Figure 3: Mean temperature Winter from 1990 to 2010

3.1.4 Summer after 1990

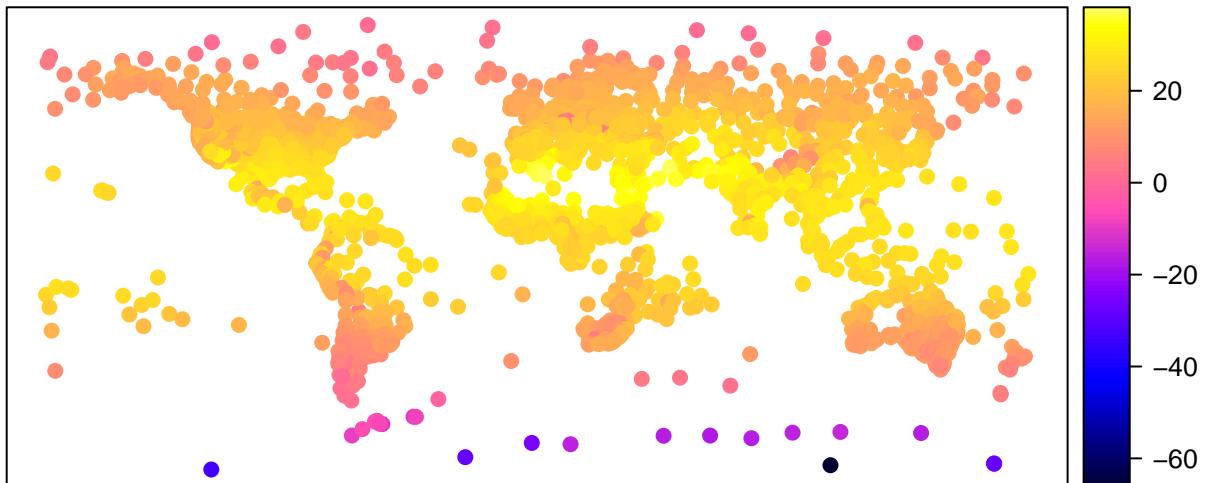
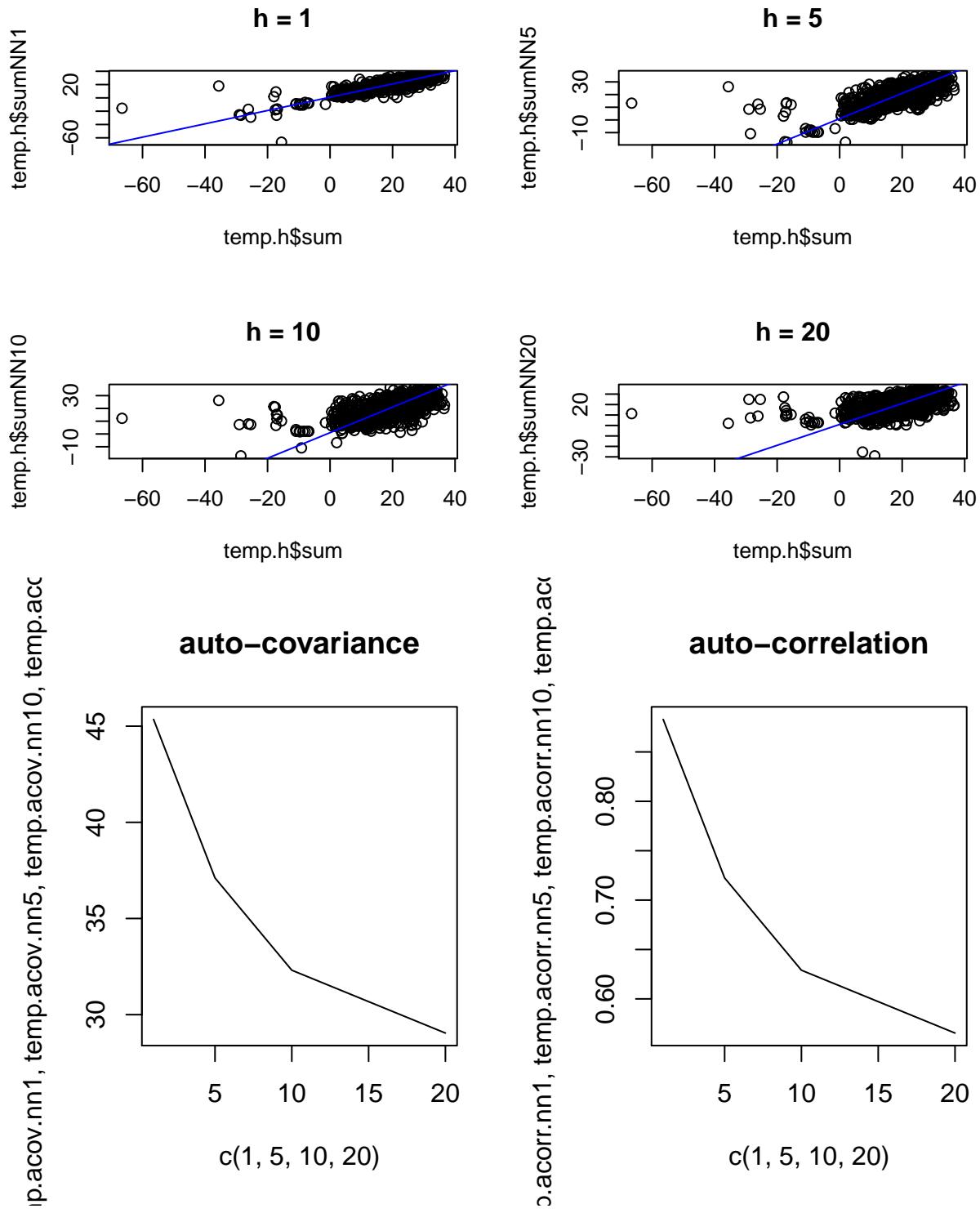


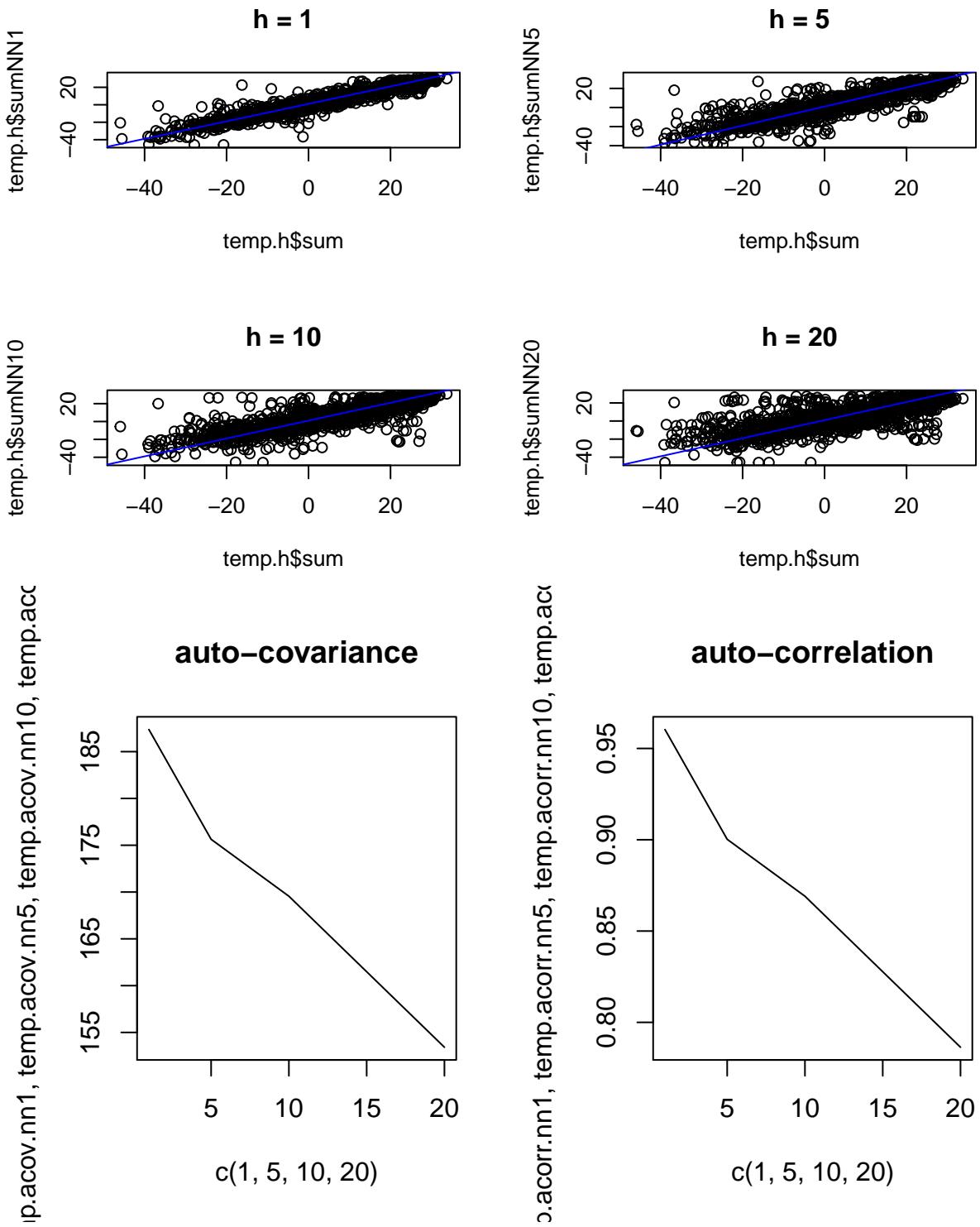
Figure 4: Mean temperature Winter from 1990 to 2010

3.2 H - Scatterplots and autocovariance plots

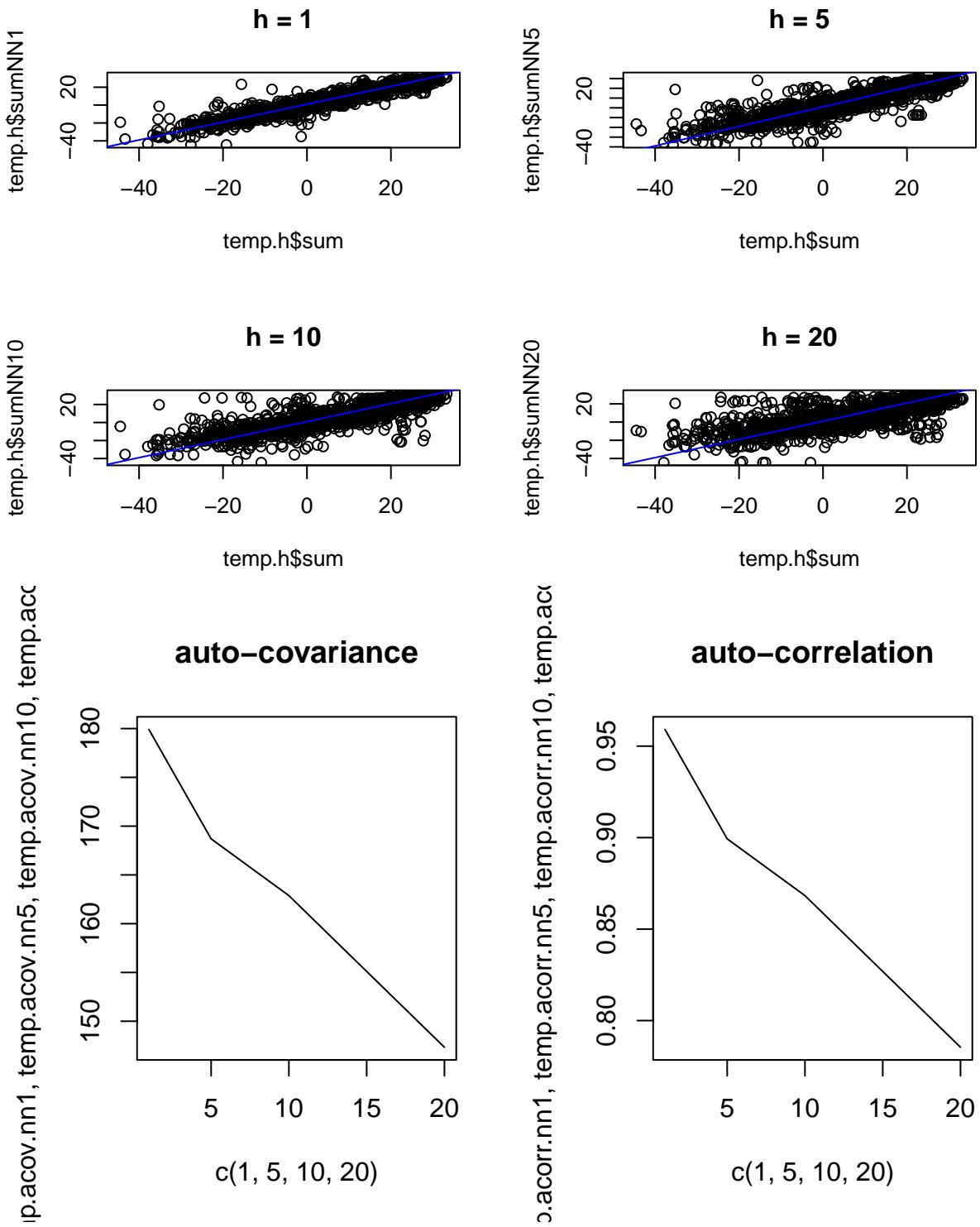
3.2.1 Summer before 1970



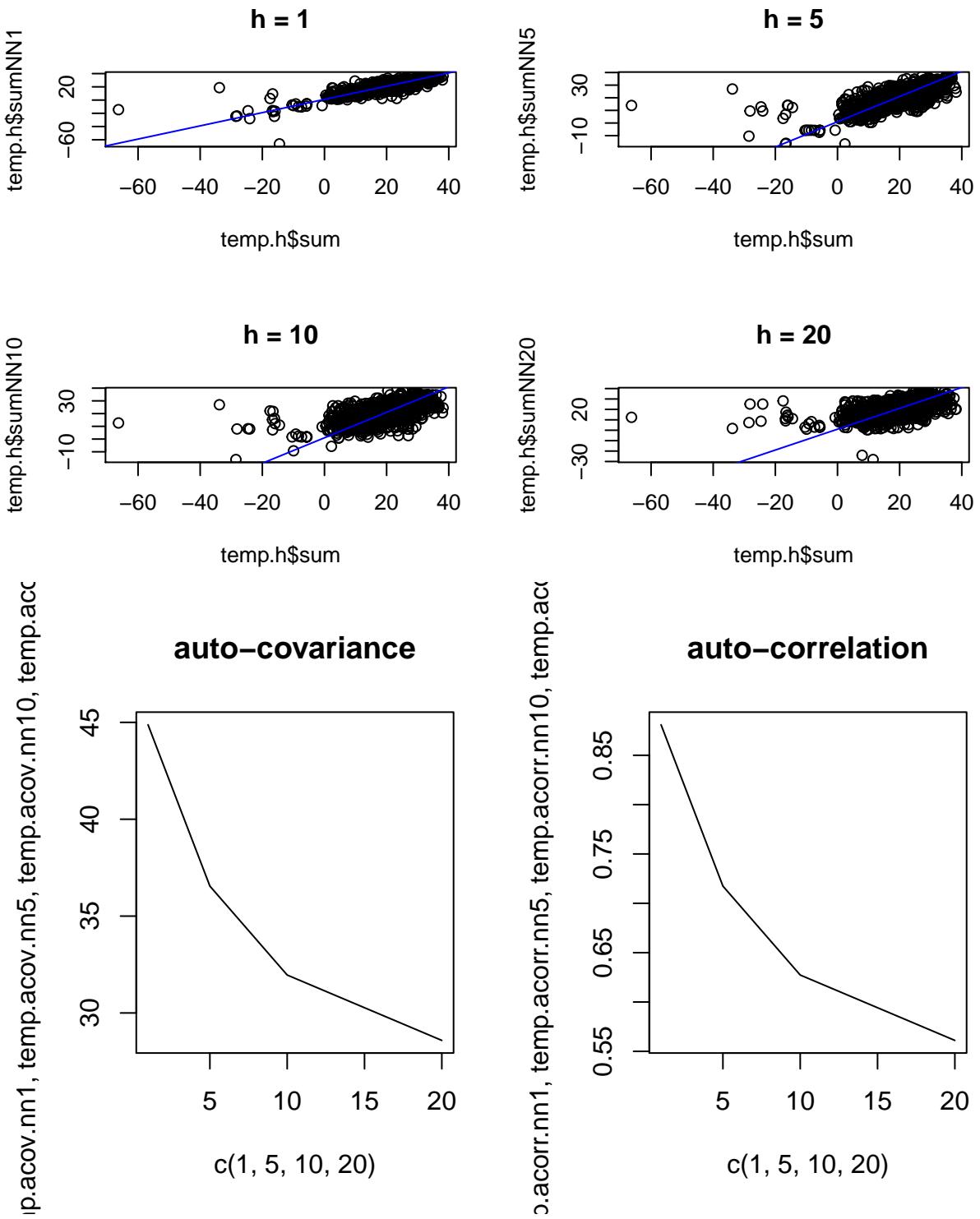
3.2.2 Winter before 1970



3.2.3 Winter after 1990

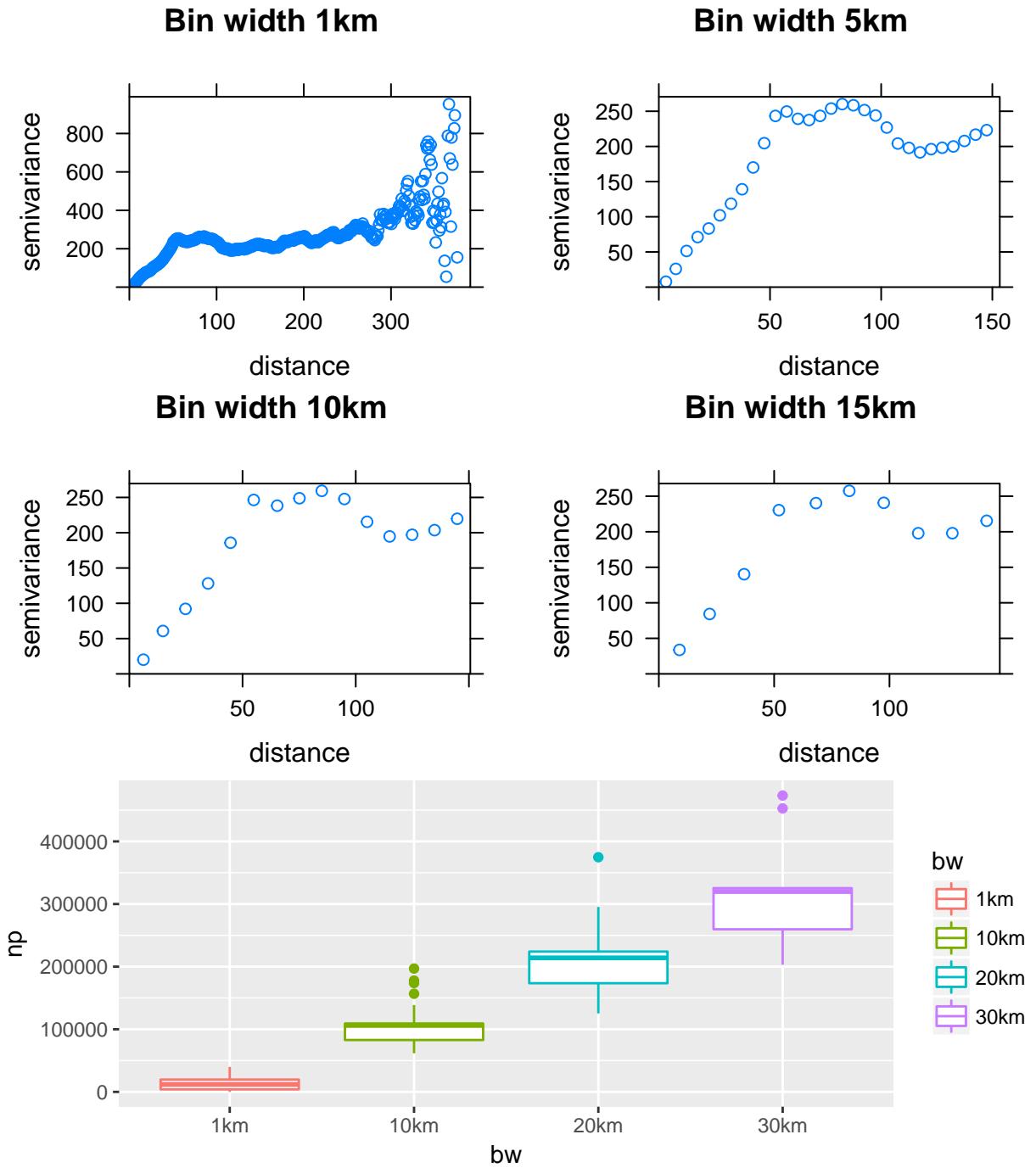


3.2.4 Summer after 1990

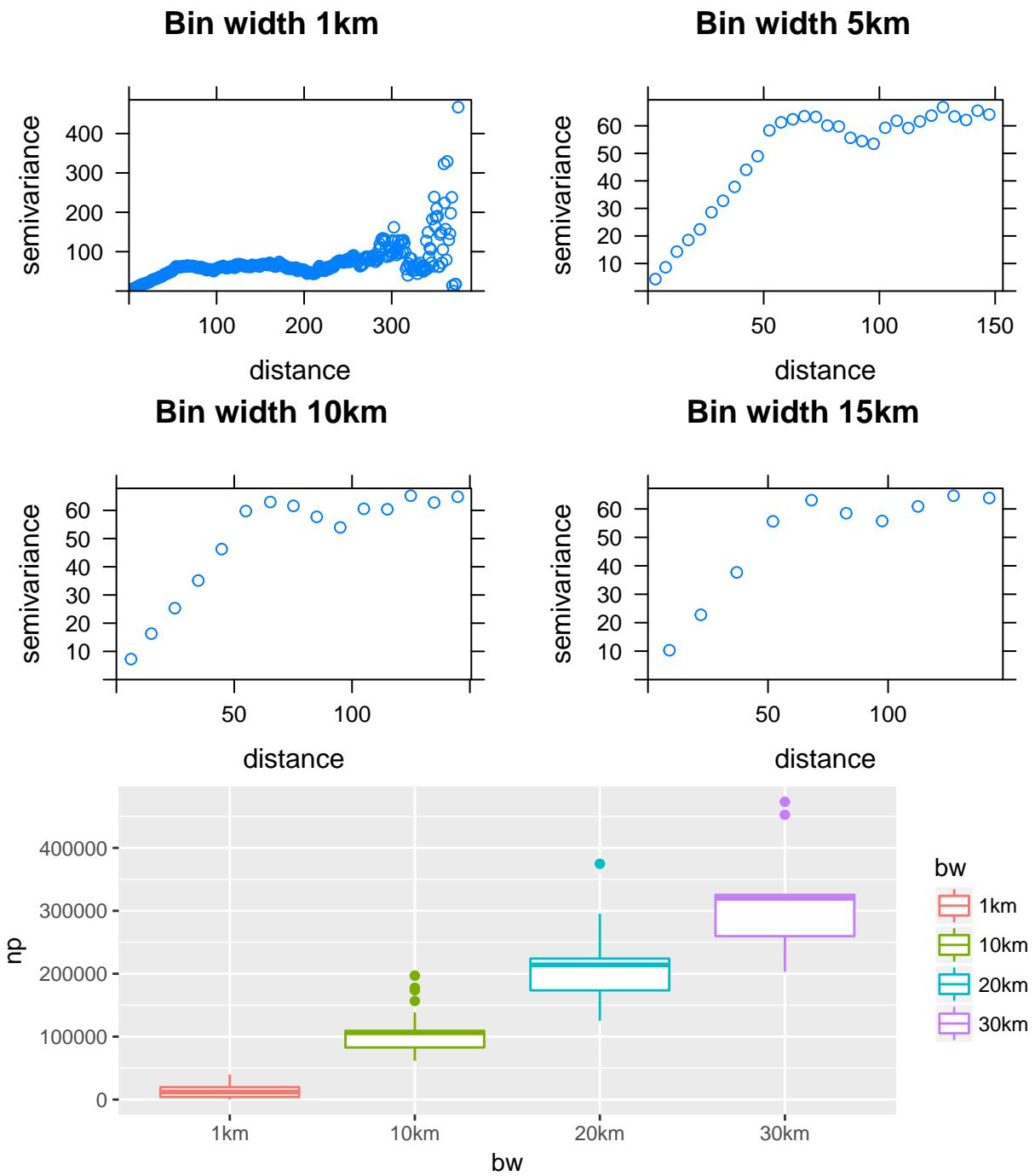


3.3 Empirical Variogram

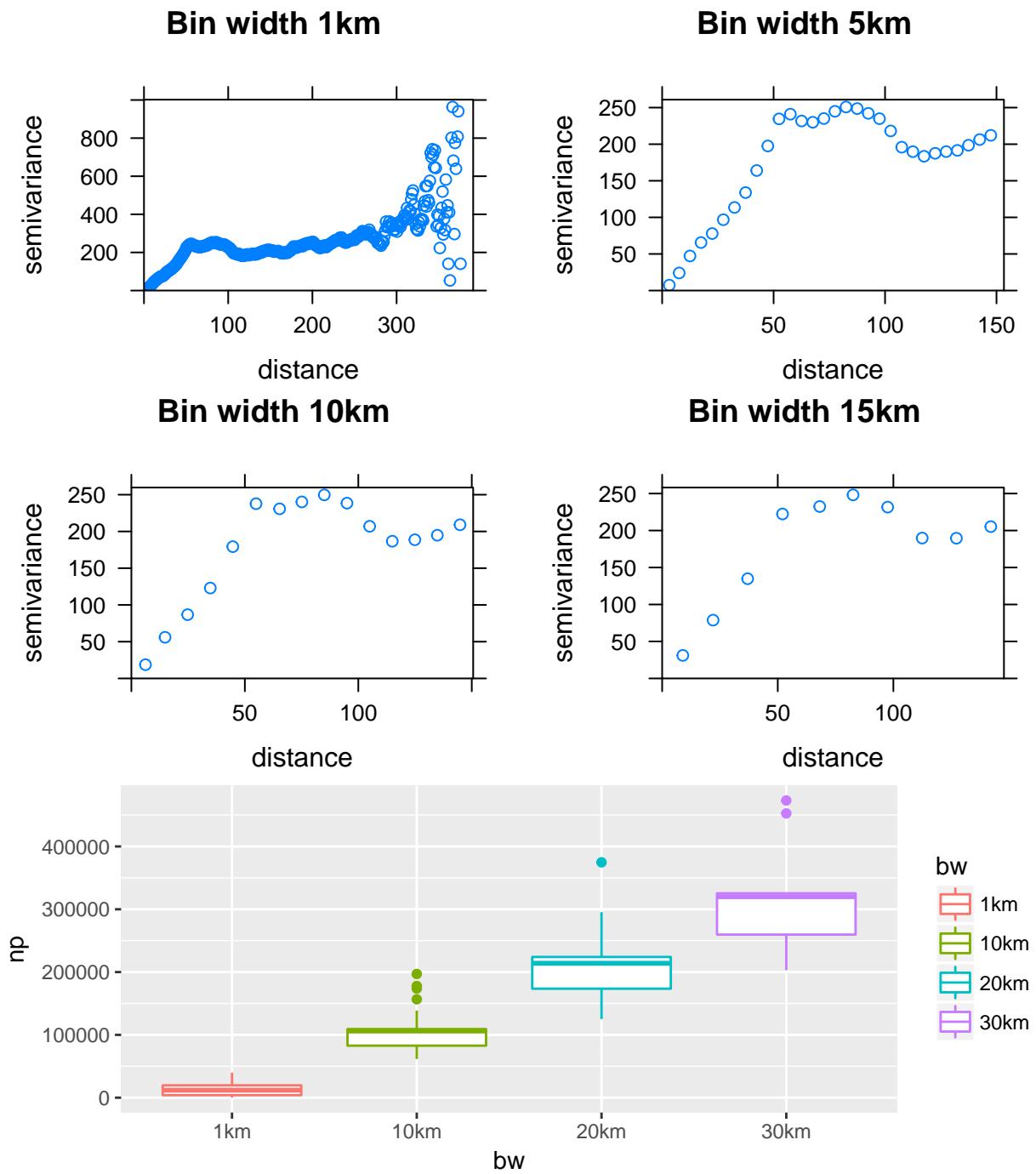
3.3.1 Winter before 1970



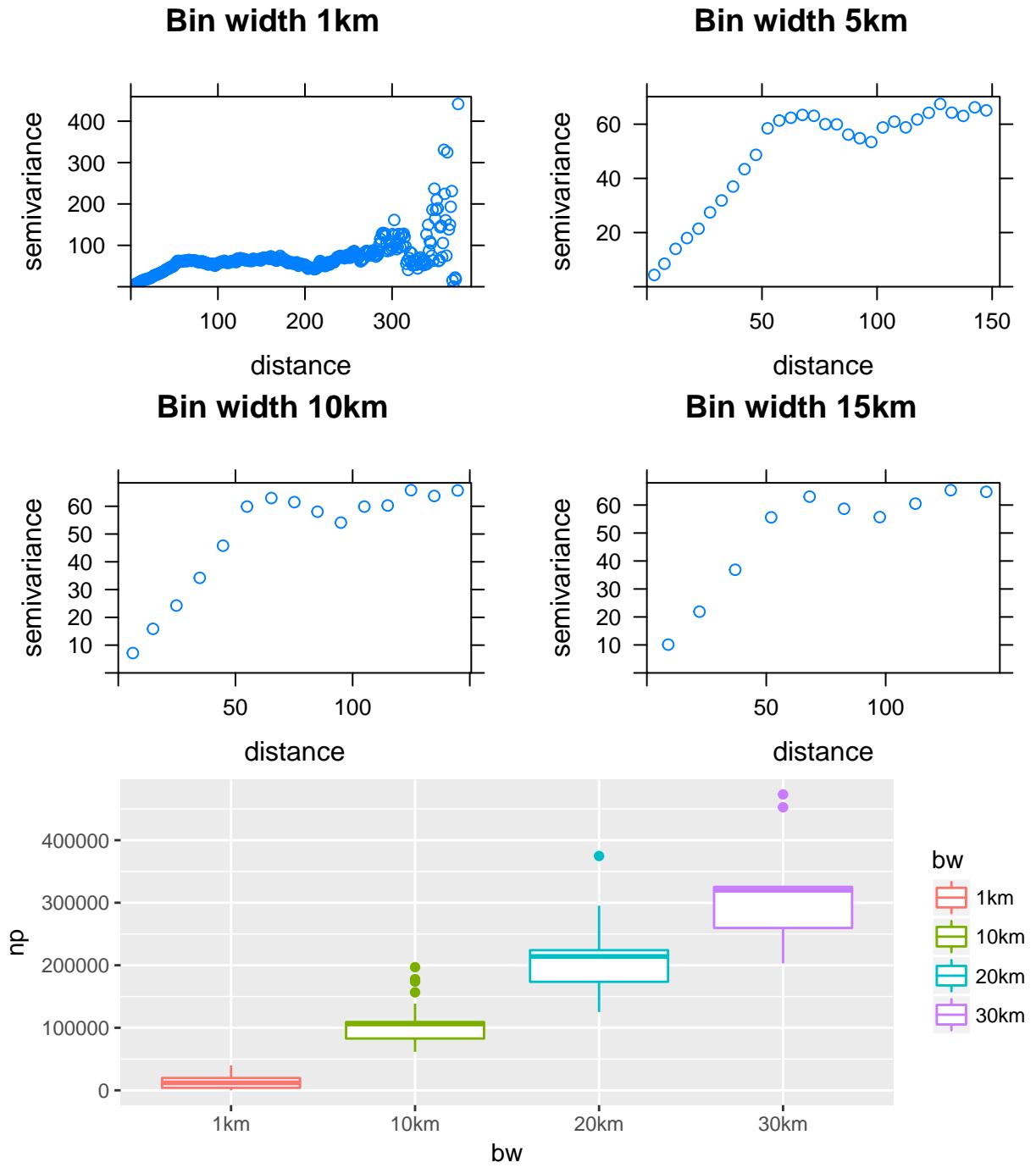
3.3.2 Summer before 1970



3.3.3 Winter before 2010



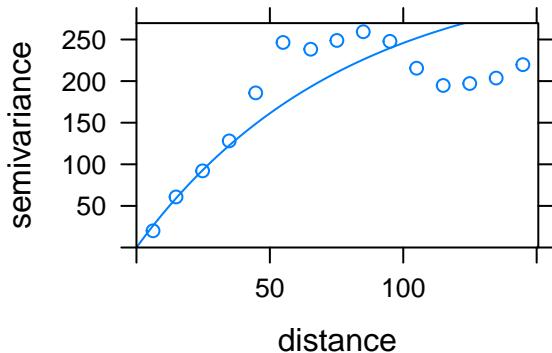
3.3.4 Summer before 2010



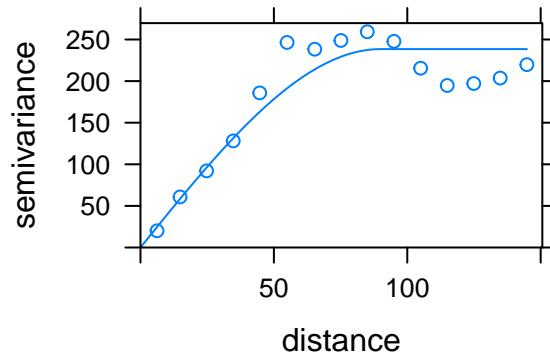
3.4 Fitted Semivariogram

3.4.1 Winter before 1970

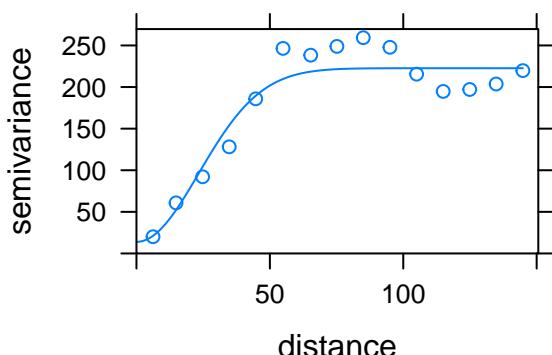
Exponential: 10km



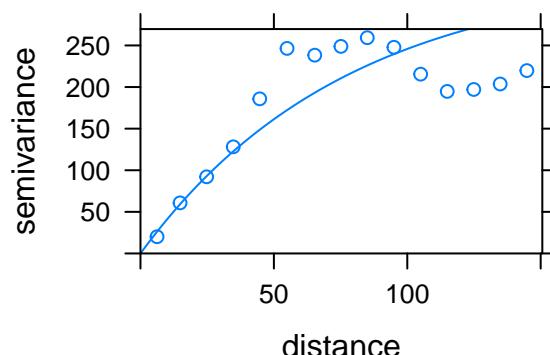
Spherical: 10km



Gaussian: 10km

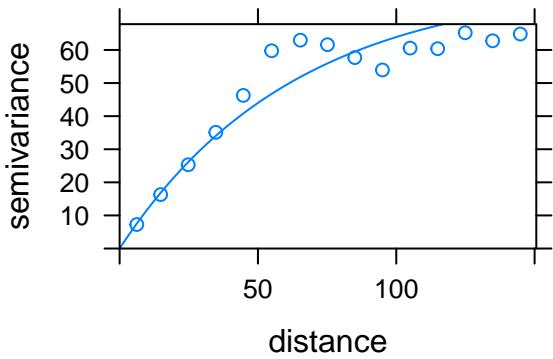


Mat: 10km

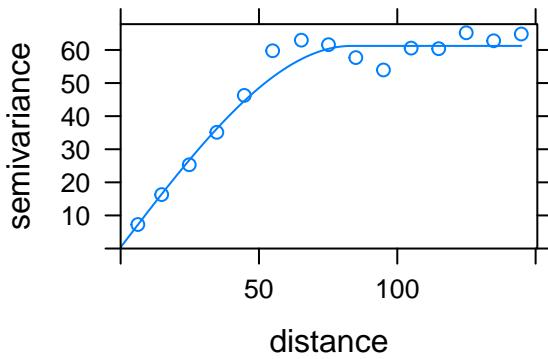


3.4.2 Summer before 1970

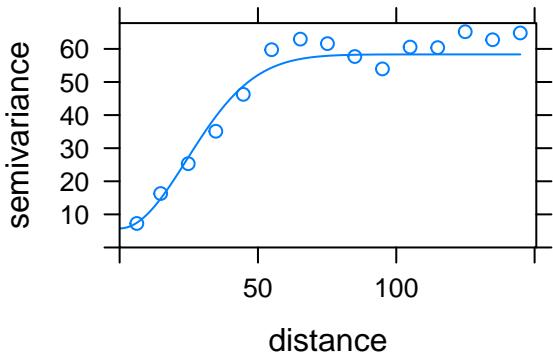
Exponential: 10km



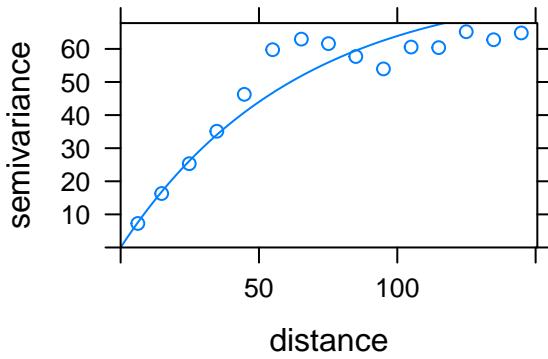
Spherical: 10km



Gaussian: 10km

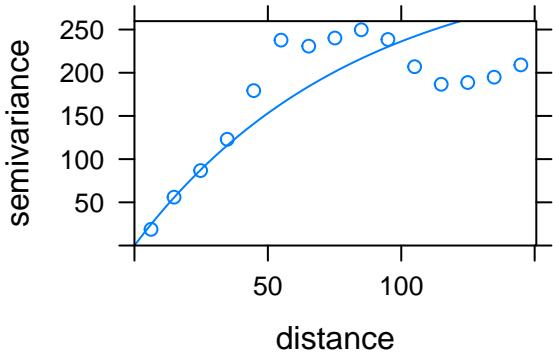


Mat: 10km

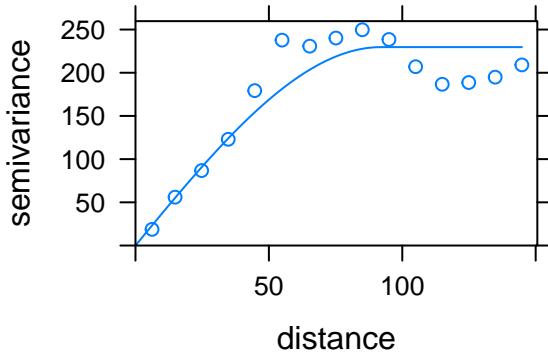


3.4.3 Winter after 1990

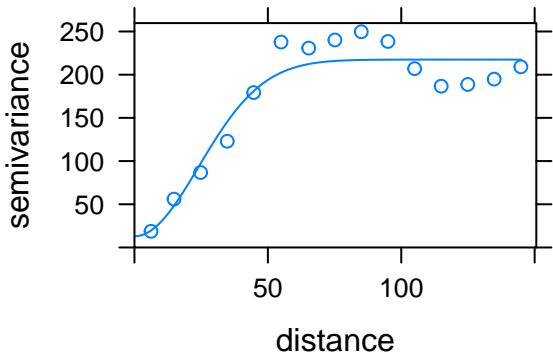
Exponential: 10km



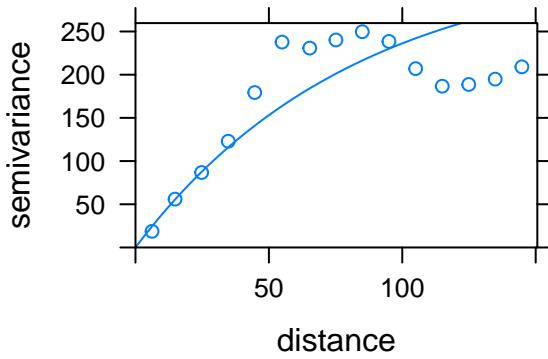
Spherical: 10km



Gaussian: 10km

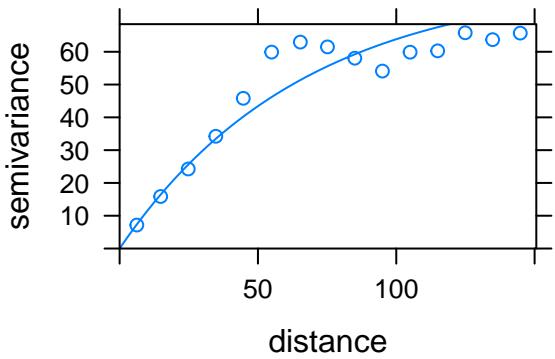


Mat: 10km

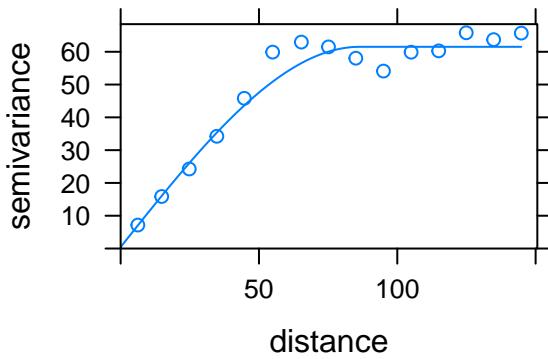


3.4.4 Summer after 1990

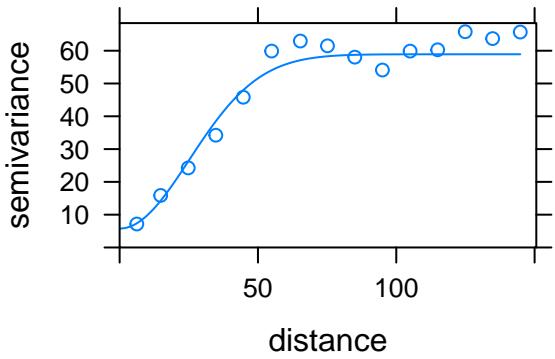
Exponential: 10km



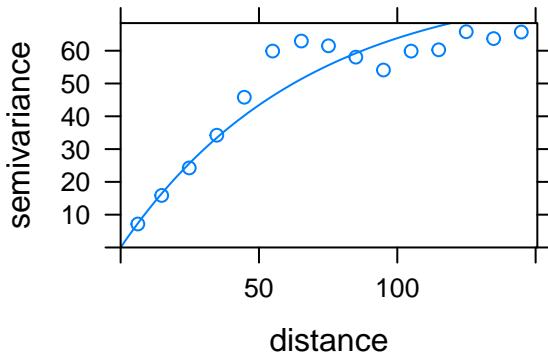
Spherical: 10km



Gaussian: 10km



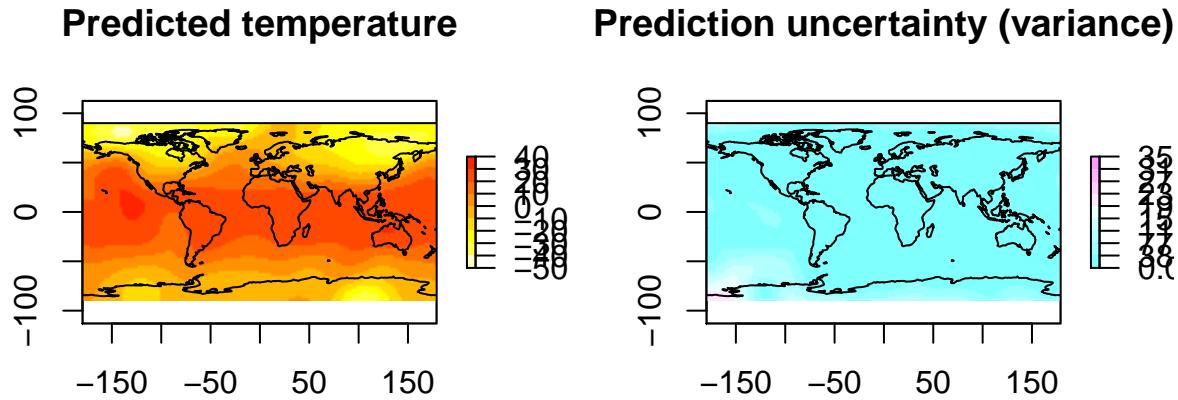
Mat: 10km



3.5 Ordinary krigin cross-validation

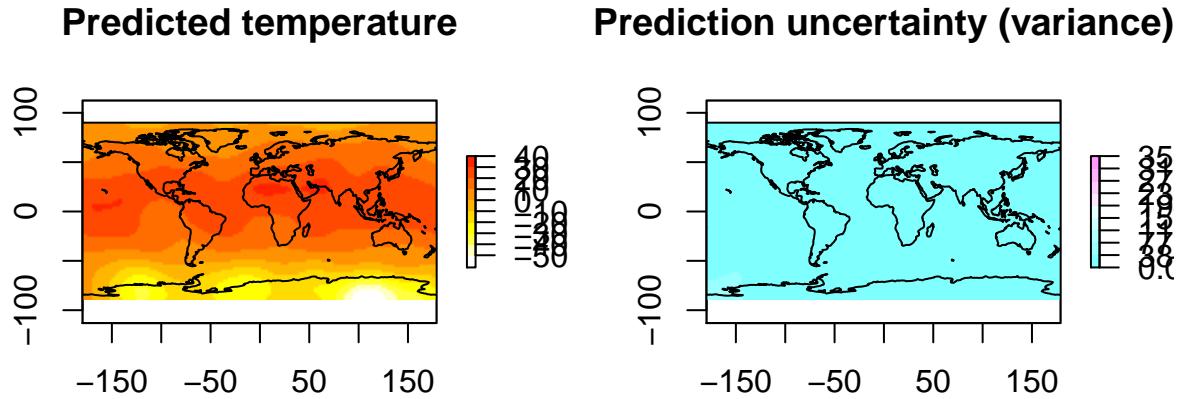
3.5.1 Winter before 1970

```
## [1] 3  
##   model      psill    range  
## 1   Nug  13.91332  0.000  
## 2   Gau 208.73520 32.963  
## [using ordinary kriging]
```



3.5.2 Summer before 1970

```
## [1] 3  
##   model      psill    range  
## 1   Nug  5.755207  0.00000  
## 2   Gau 52.584837 34.25292  
## [using ordinary kriging]
```

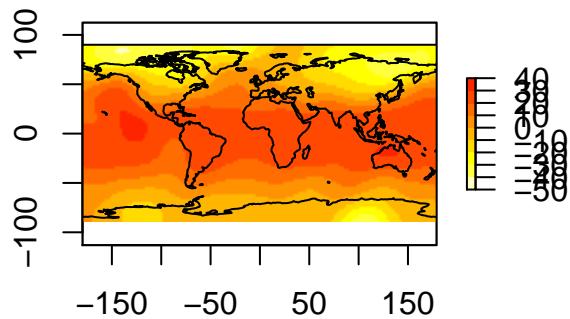


3.5.3 Winter after 1990

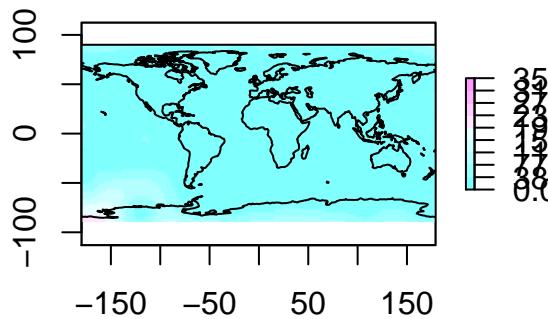
```
## [1] 3  
##   model      psill    range  
## 1   Nug  12.95515  0.00000  
## 2   Gau 204.49426 34.02119
```

```
## [using ordinary kriging]
```

Predicted temperature



Prediction uncertainty (variance)



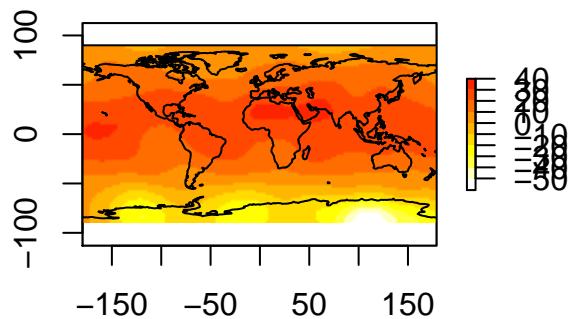
3.5.4 Summer after 1990

```
## [1] 3
```

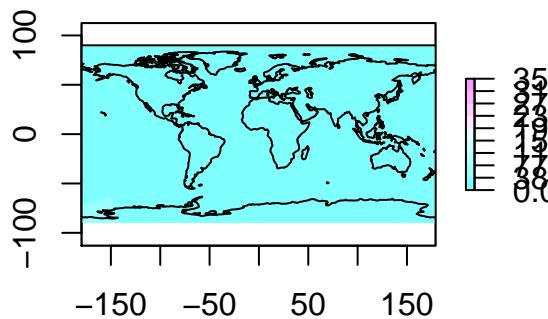
```
##   model    psill      range
## 1   Nug 5.76603 0.00000
## 2   Gau 53.14549 35.54324
```

```
## [using ordinary kriging]
```

Predicted temperature

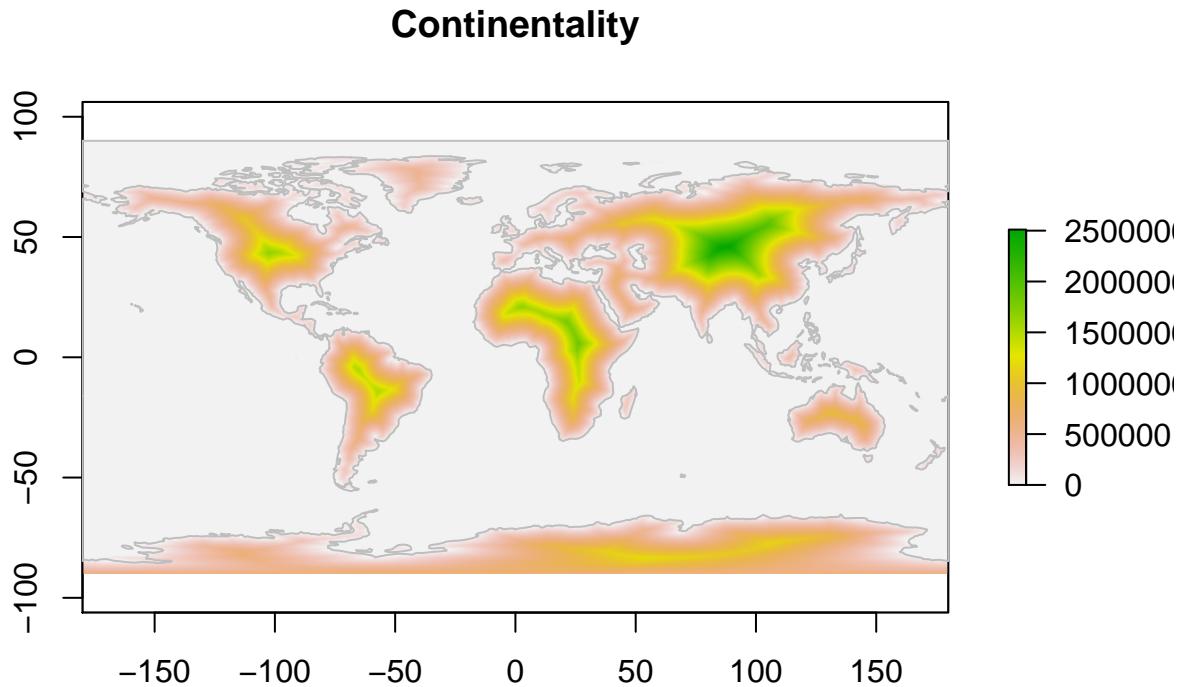


Prediction uncertainty (variance)



3.6 Universal ordinary Kriging

3.6.1 Continentiality: Create distance to ocean layer



3.6.2 Winter before 1970

```
##  
## Call:  
## lm(formula = meansum ~ elev + cont + lati, data = temp1970w@data)  
##  
## Residuals:  
##      Min       1Q   Median       3Q      Max  
## -68.228  -3.972    0.836    4.859   23.512  
##  
## Coefficients:  
##                 Estimate Std. Error t value Pr(>|t|)  
## (Intercept) 17.3425034642 0.2490925040 69.623 < 2e-16 ***  
## elev        -0.0016476819 0.0003036049 -5.427 0.0000000618 ***  
## cont        -0.0000055363 0.0000003967 -13.957 < 2e-16 ***  
## lati        -0.3294843671 0.0056557032 -58.257 < 2e-16 ***  
## ---  
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1  
##  
## Residual standard error: 8.796 on 3025 degrees of freedom  
## Multiple R-squared: 0.6038, Adjusted R-squared: 0.6034  
## F-statistic: 1537 on 3 and 3025 DF, p-value: < 2.2e-16
```

3.6.3 Summer before 1970

3.6.4 Winter after 1990

3.6.5 Summer after 1990

3.7 Ordinary Krigin

3.7.1 Winter before 1970

3.7.2 Summer before 1970

3.7.3 Winter after 1990

3.7.4 Summer after 1990