

Supplementary Plots for Colorado Forest Analysis

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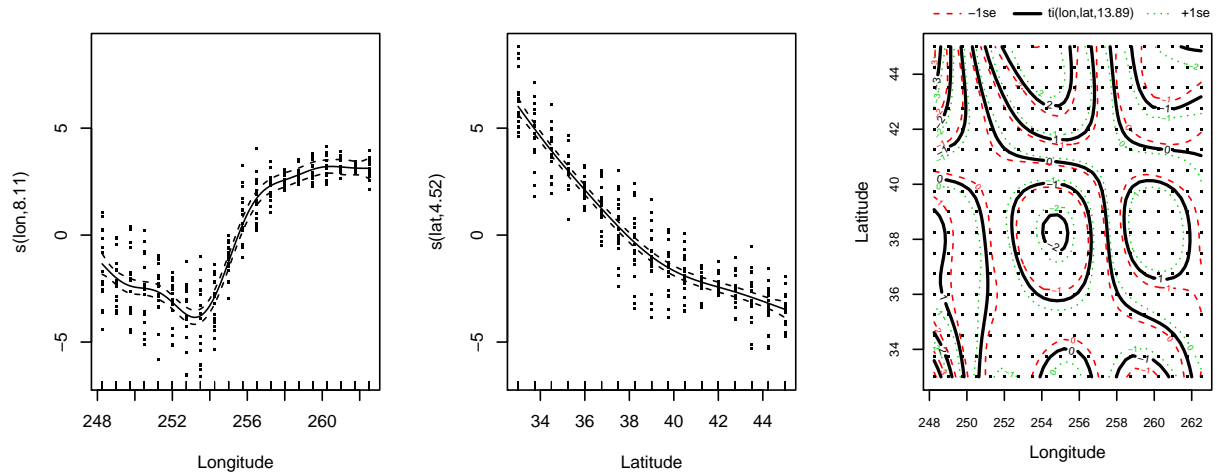
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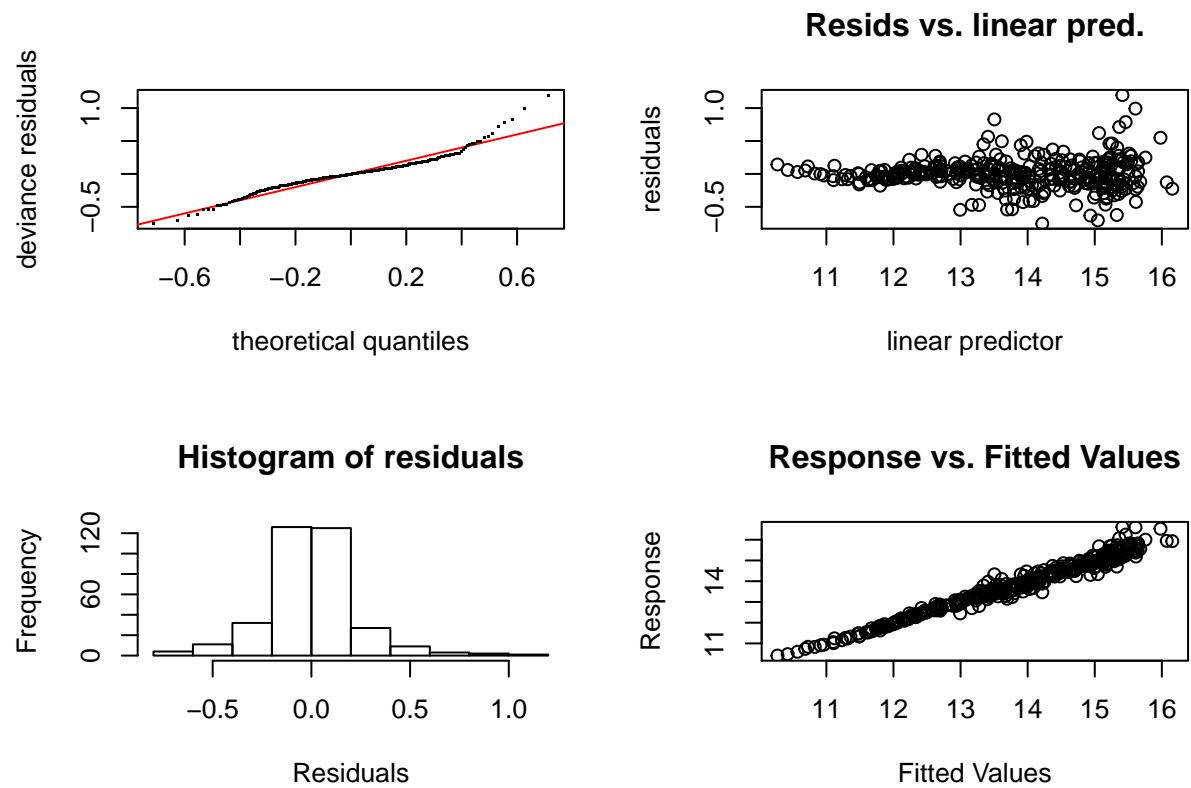
This document provides some supplementary information and plots to accompany the analysis of Colorado Forests. The GAM model marginal effects and residual diagnostics for climate related variables are produced here, along with the additional spatial distribution plots, like the predictions for gambel oak.

Climate GAM Models

AVGT Marginal Effects Plots



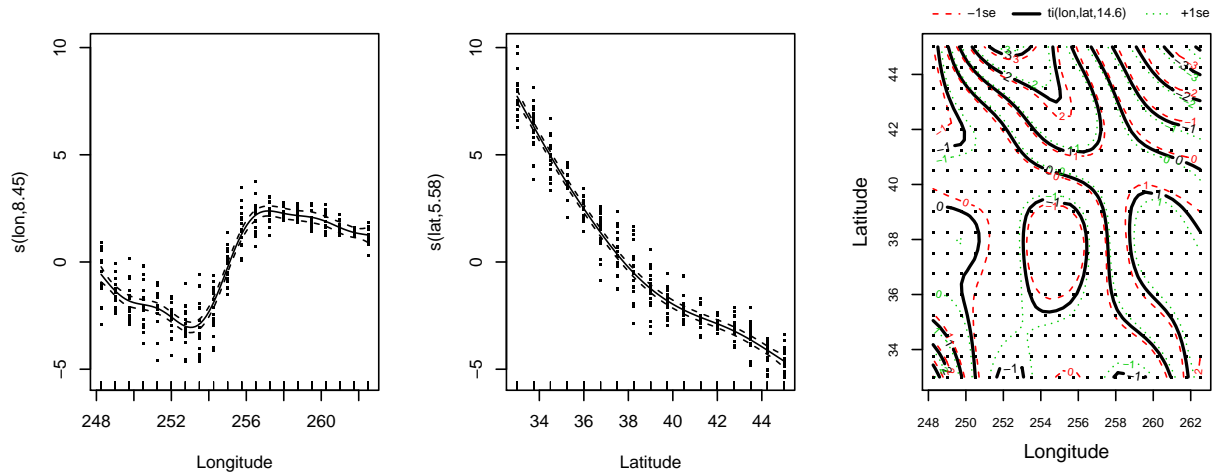
AVGT Model Residuals



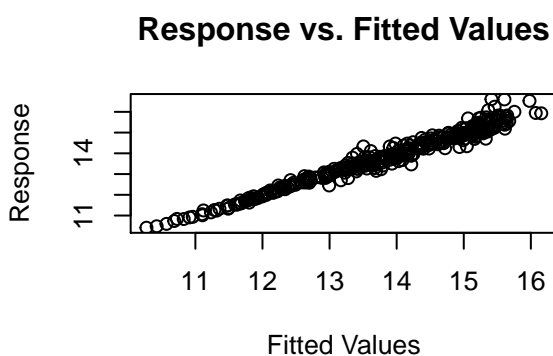
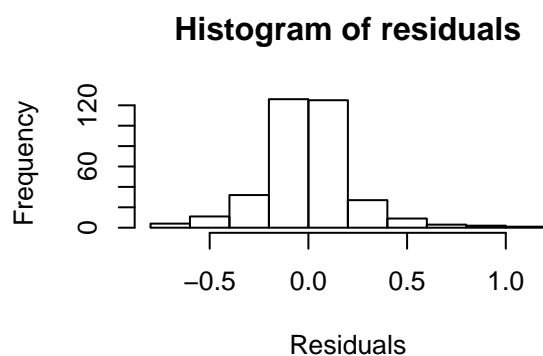
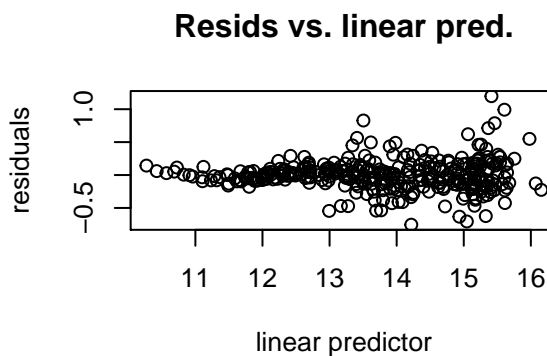
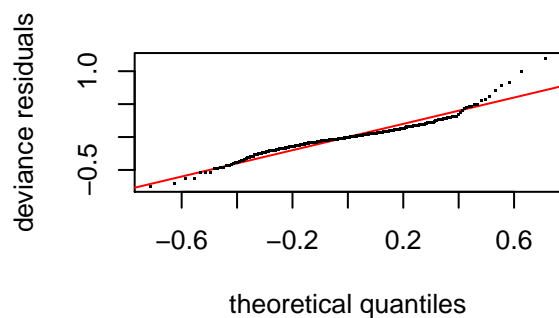
```
##
## Method: REML   Optimizer: outer newton
```

```
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##          k'    edf k-index p-value
## s(lon)      9.00  8.25   0.65 <2e-16 ***
## s(lat)      9.00  6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

JANT Marginal Effects Plots

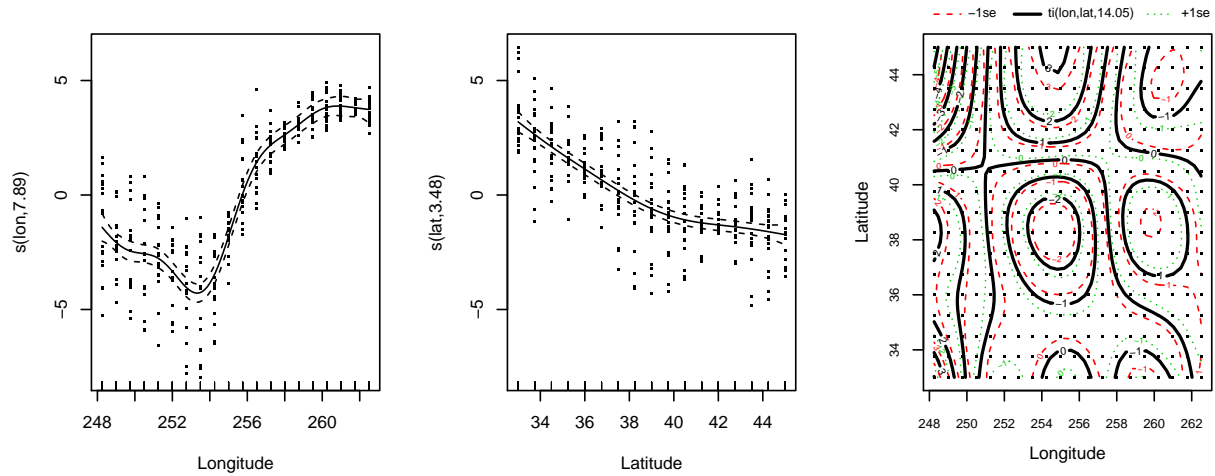


JANT Model Residuals

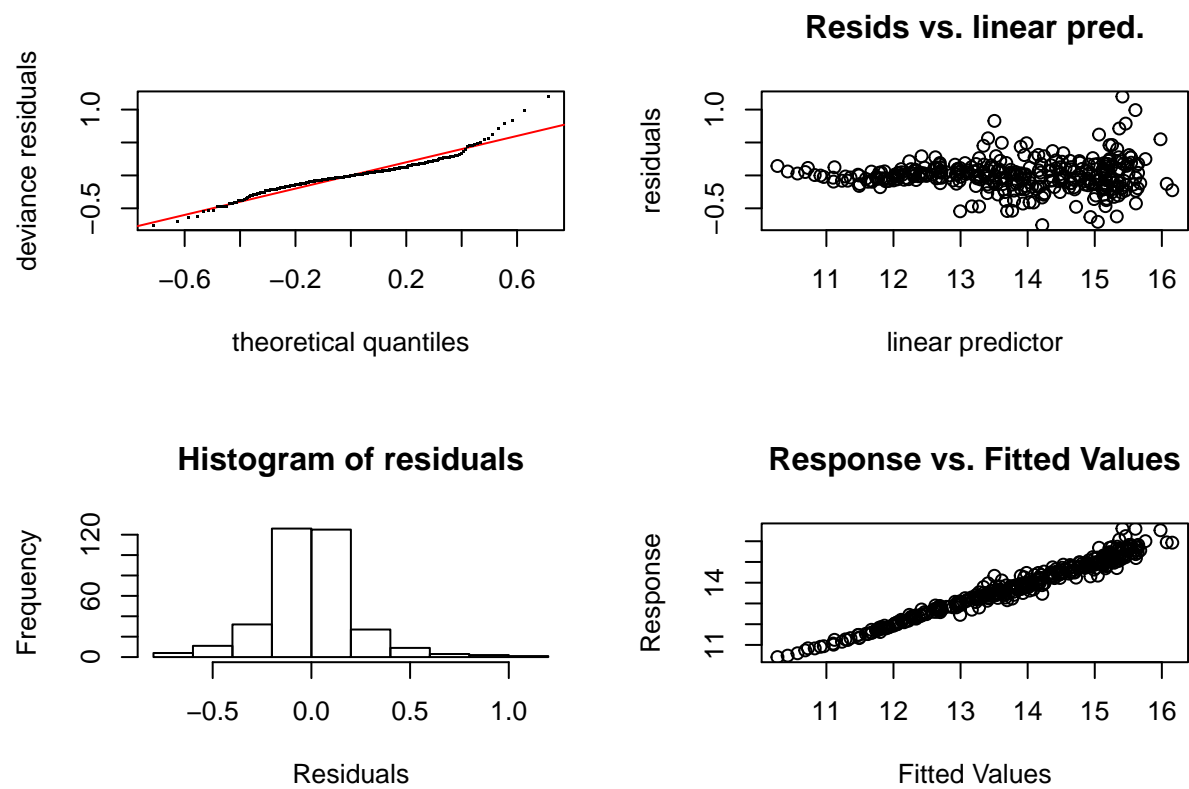


```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
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##
##          k'   edf k-index p-value
## s(lon)      9.00  8.25   0.65 <2e-16 ***
## s(lat)      9.00  6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

JULT Marginal Effects Plots



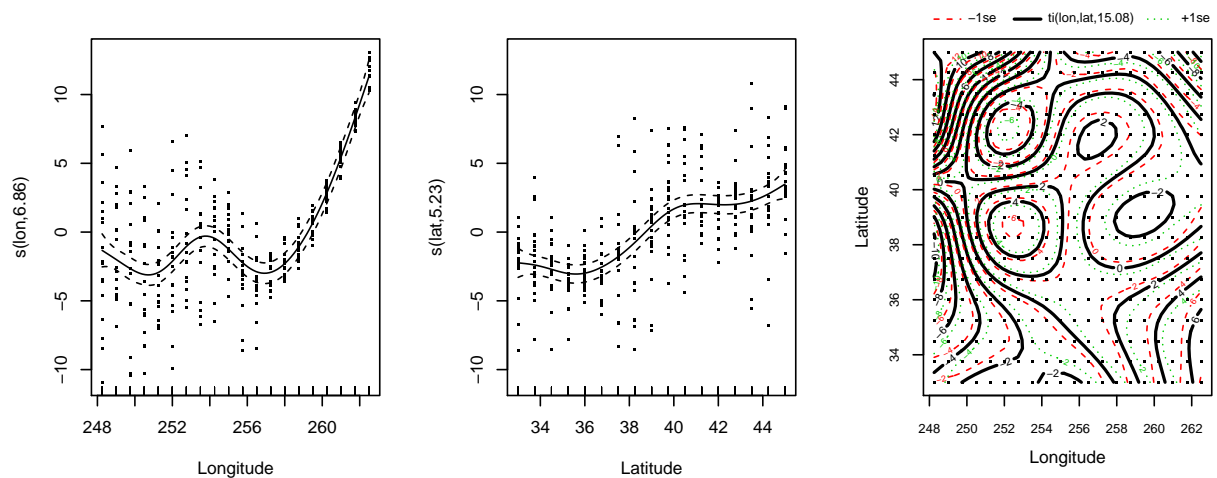
JULT Model Residuals



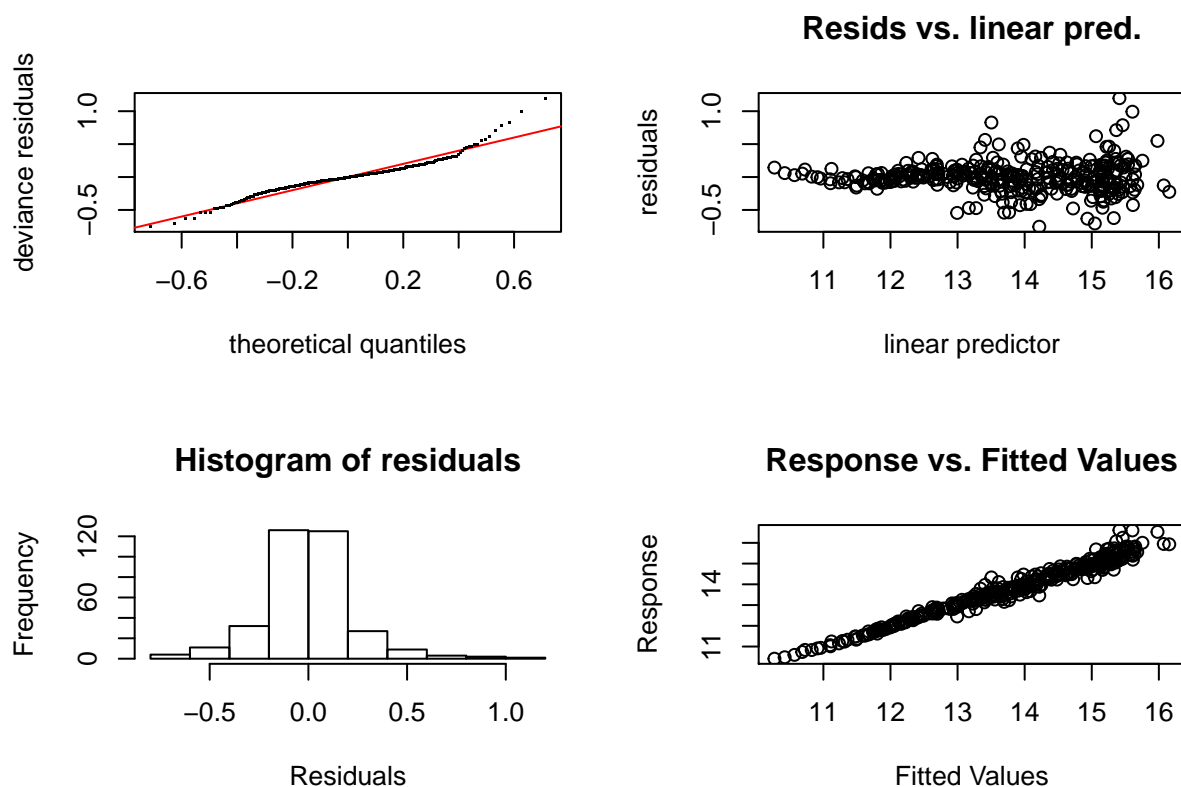
```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
```

```
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##          k'   edf k-index p-value
## s(lon)      9.00 8.25   0.65 <2e-16 ***
## s(lat)      9.00 6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

PPT Marginal Effects Plots

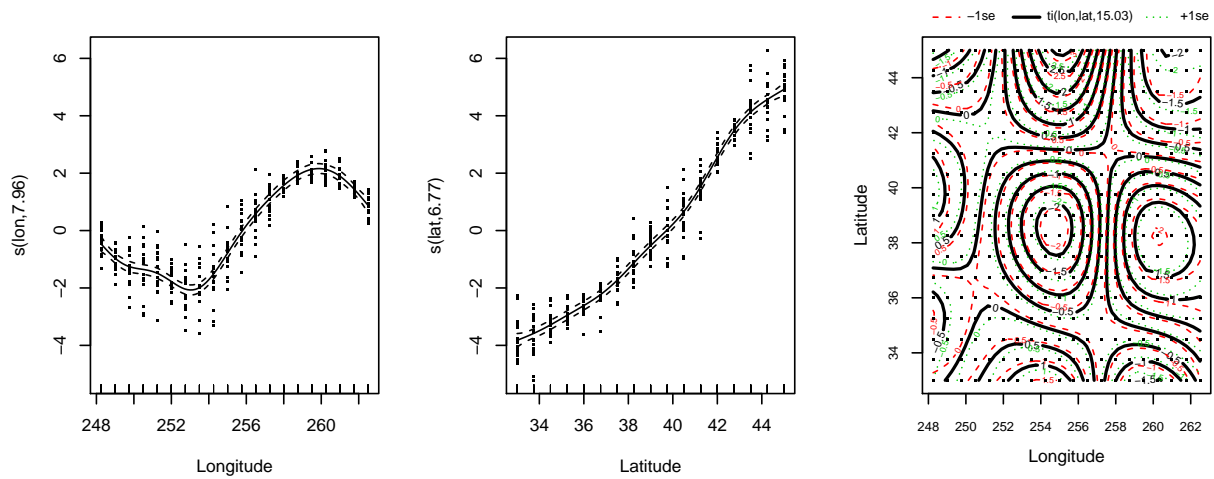


PPT Model Residuals

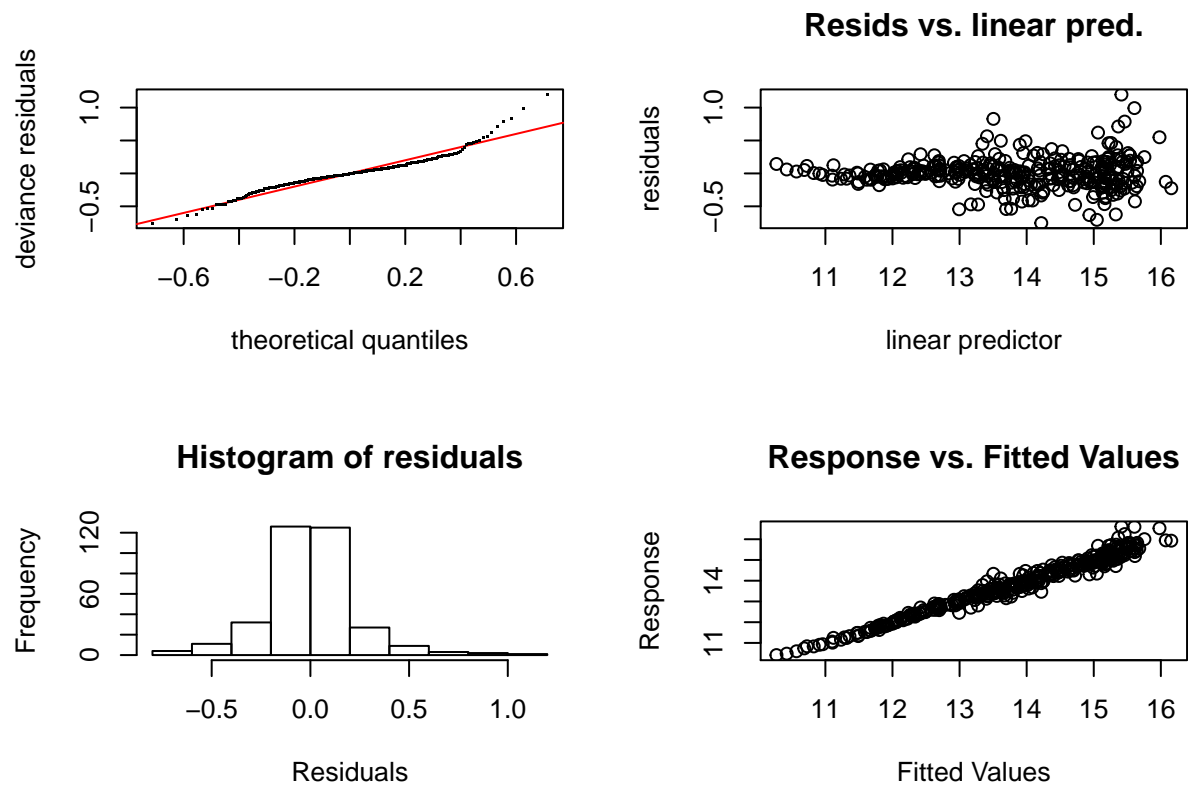


```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##          k'   edf k-index p-value
## s(lon)      9.00  8.25   0.65 <2e-16 ***
## s(lat)      9.00  6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

VARS Marginal Effects Plots



VARS Model Residuals

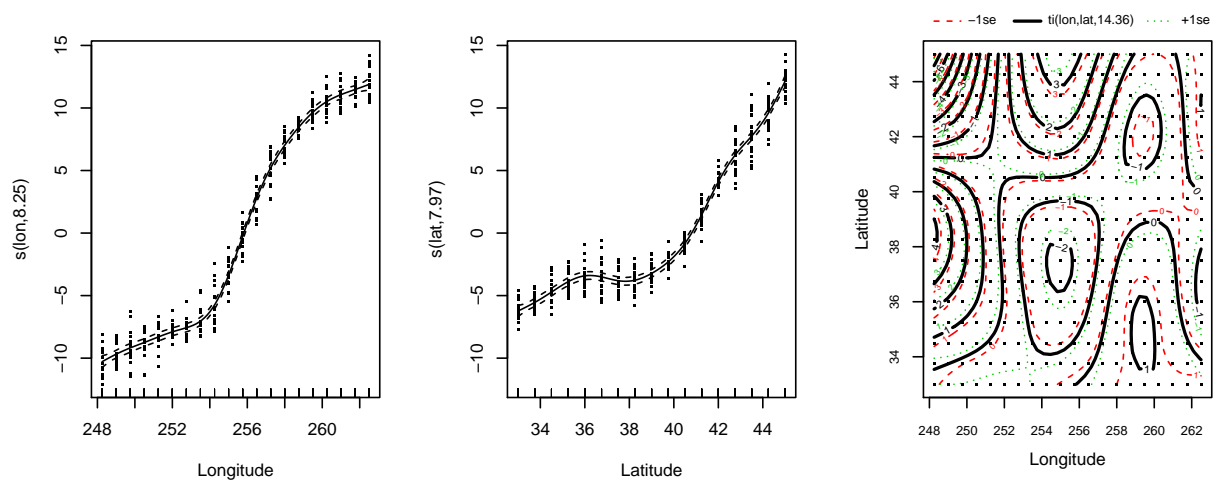


```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
```

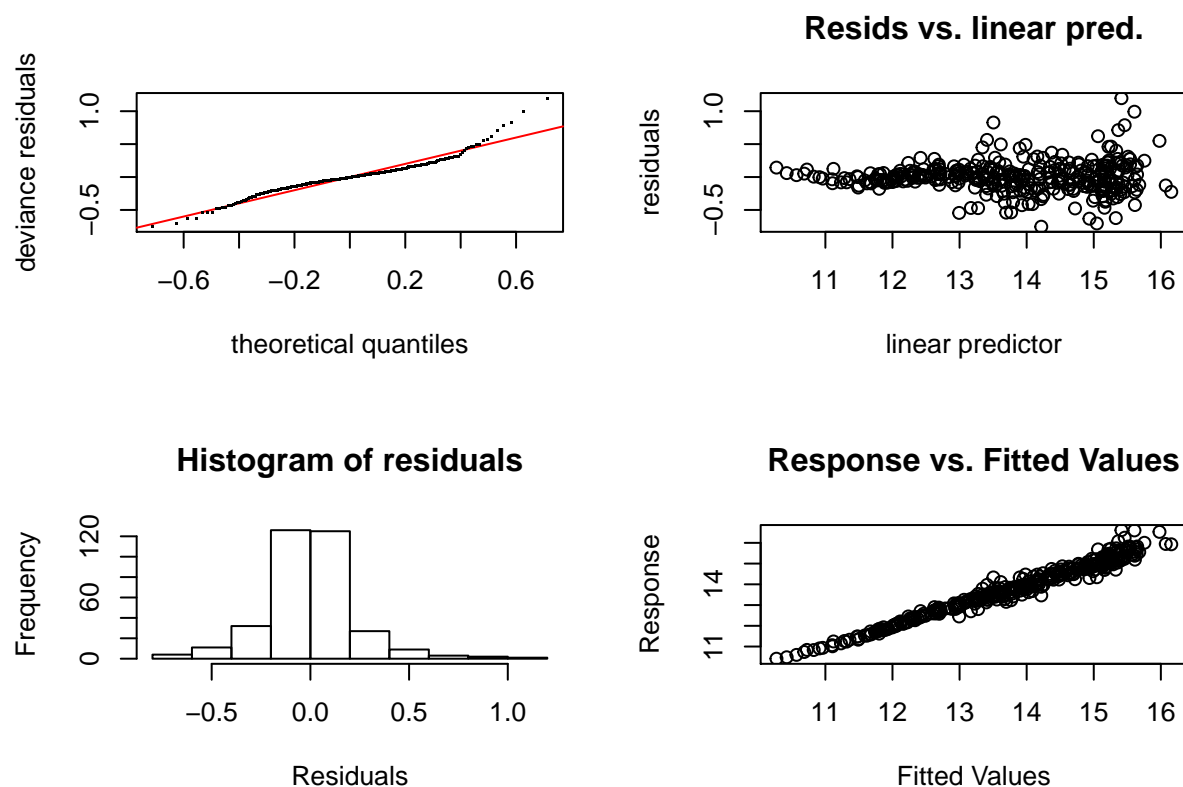


```
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##           k'   edf k-index p-value
## s(lon)      9.00 8.25   0.65 <2e-16 ***
## s(lat)      9.00 6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

VARW Marginal Effects Plots

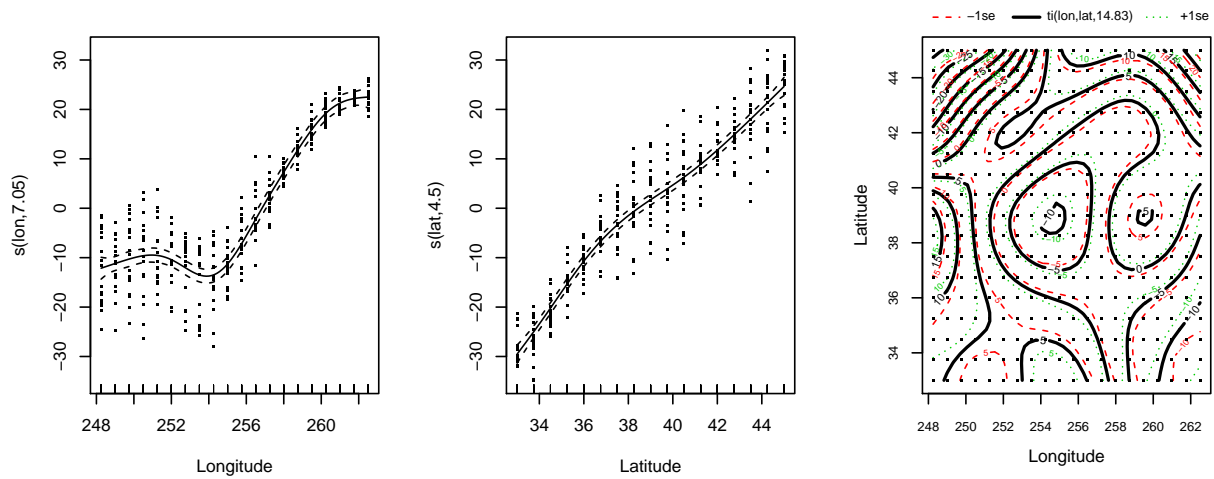


VARW Model Residuals

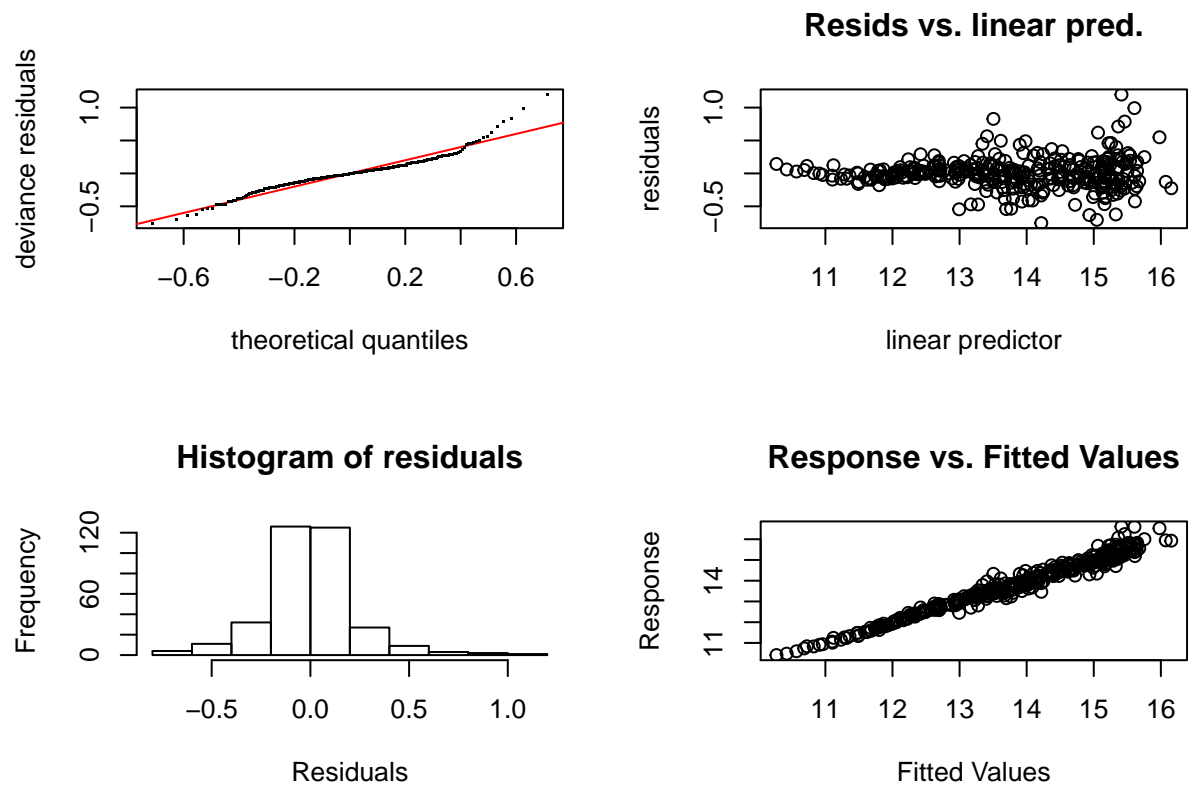


```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##          k'   edf k-index p-value
## s(lon)      9.00  8.25   0.65 <2e-16 ***
## s(lat)      9.00  6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

VARA Marginal Effects Plots



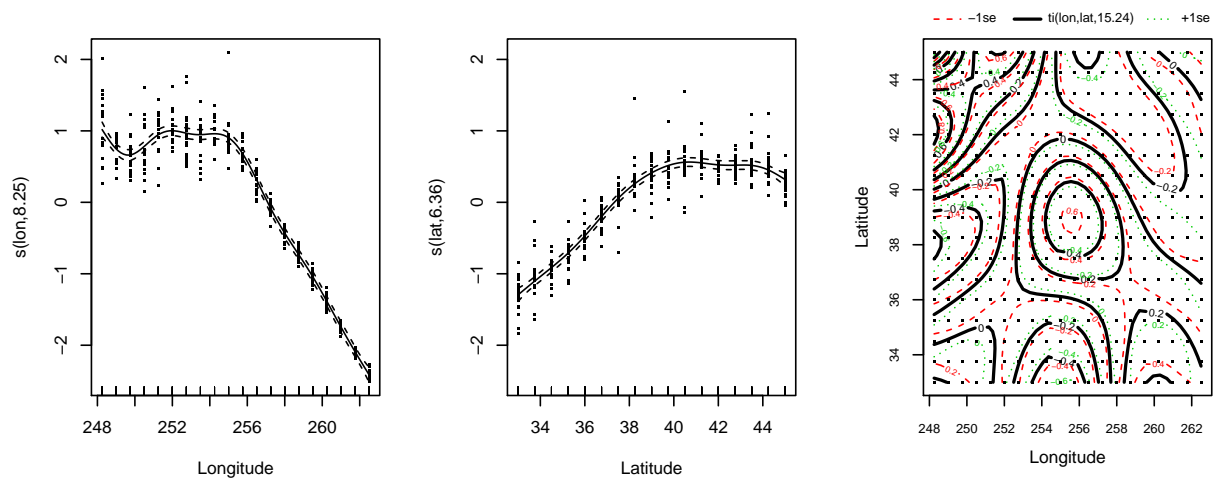
VARA Model Residuals



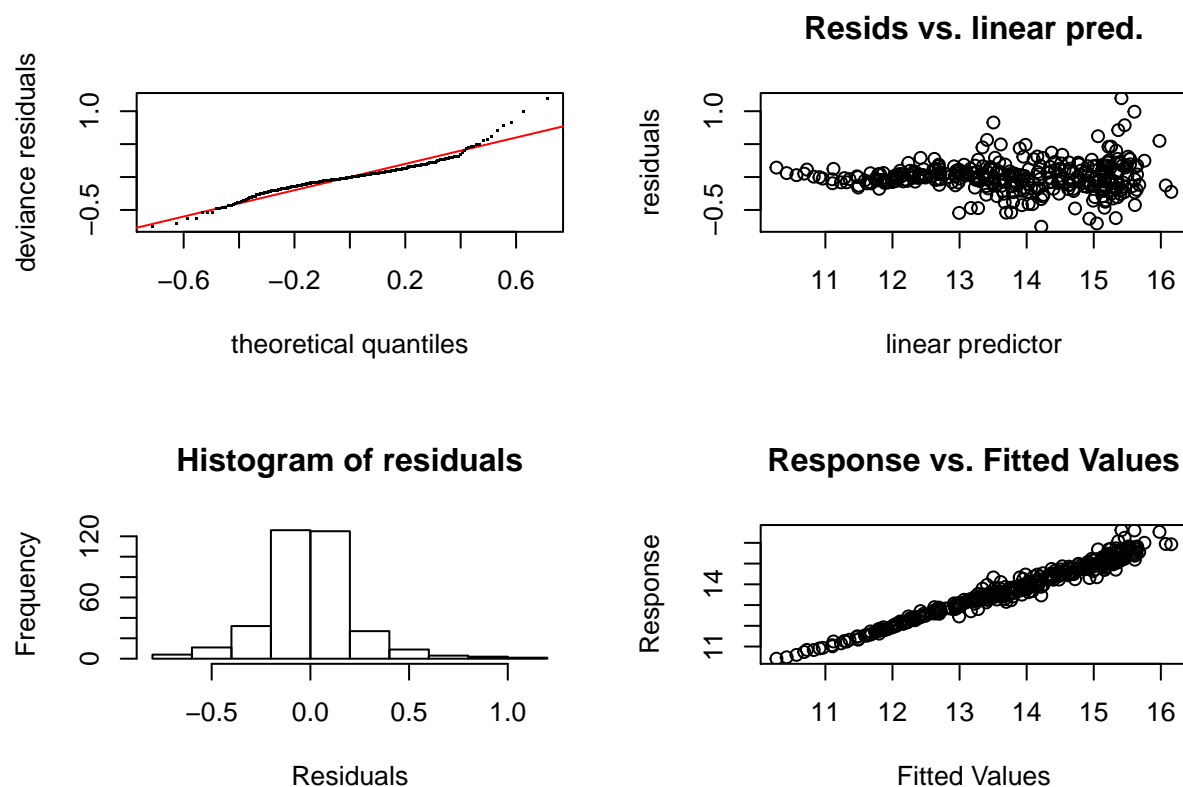
```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
```

```
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##          k'   edf k-index p-value
## s(lon)      9.00 8.25   0.65 <2e-16 ***
## s(lat)      9.00 6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

DIFS Marginal Effects Plots

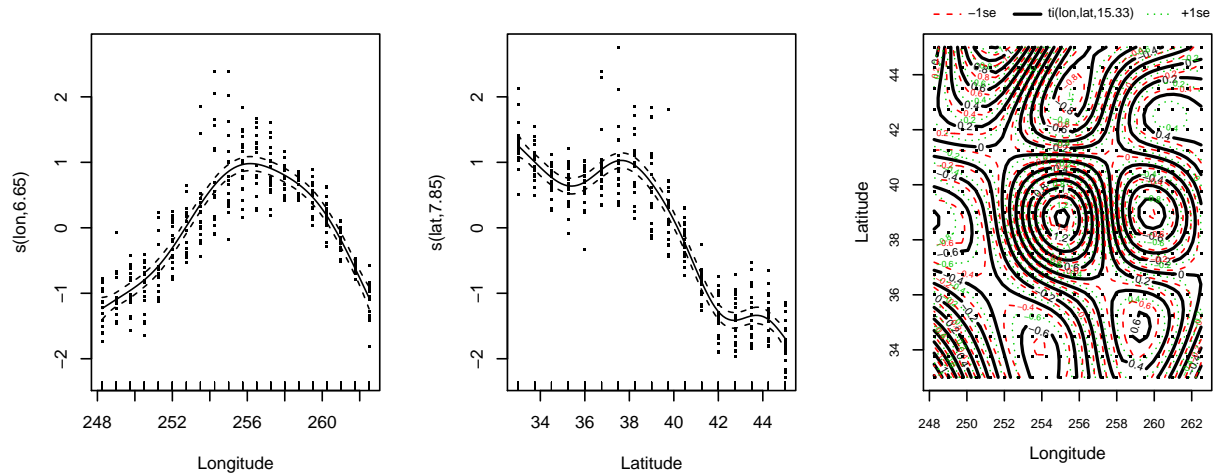


DIFS Model Residuals

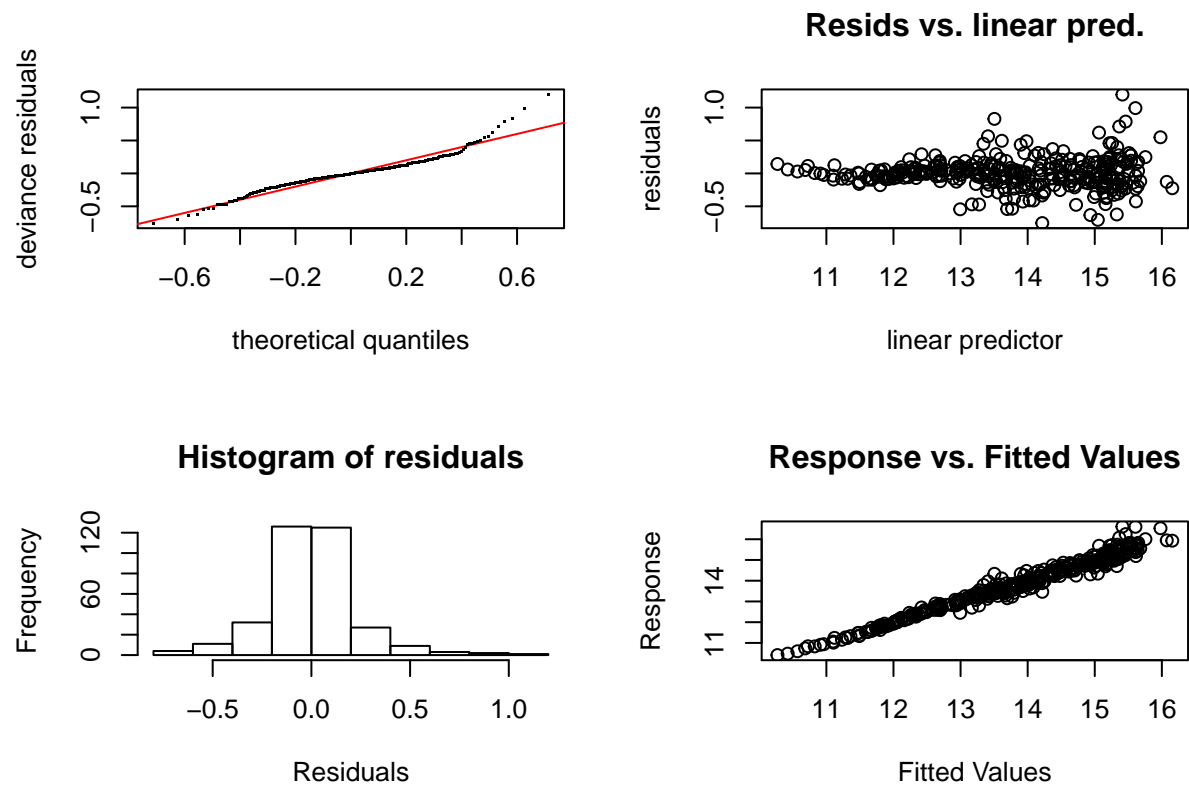


```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
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##
##          k'   edf k-index p-value
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## s(lat)      9.00  6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

DIFW Marginal Effects Plots



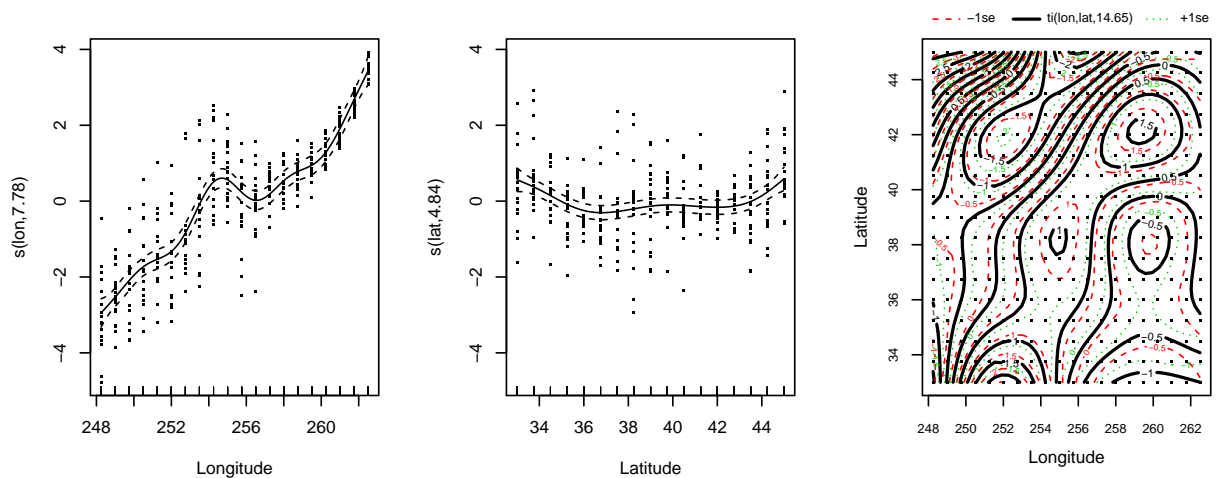
DIFW Model Residuals



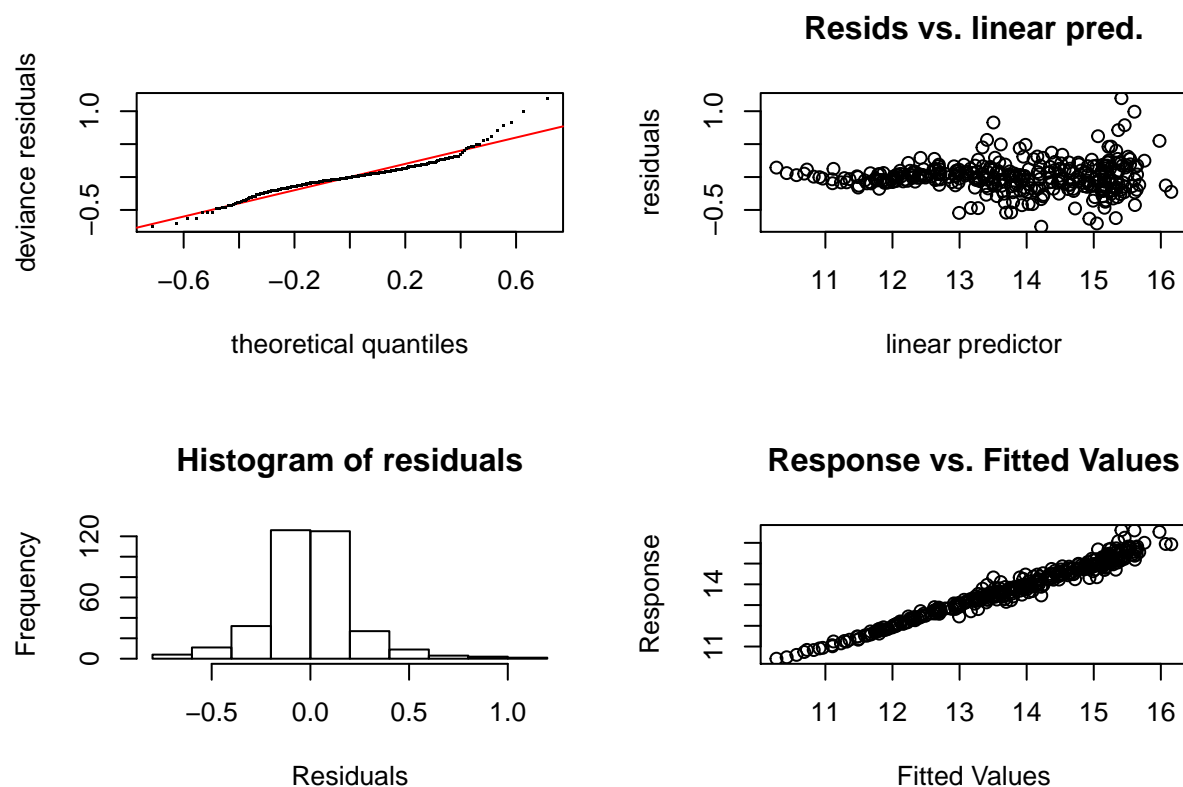
```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
```

```
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
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##
##          k'   edf k-index p-value
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## s(lat)      9.00  6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

PPTS Marginal Effects Plots

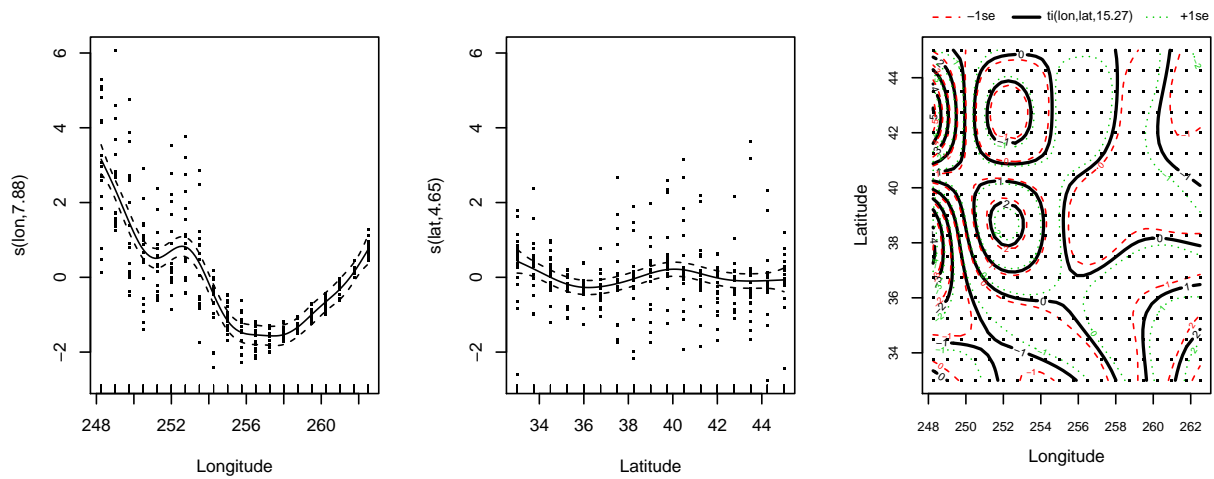


PPTS Model Residuals

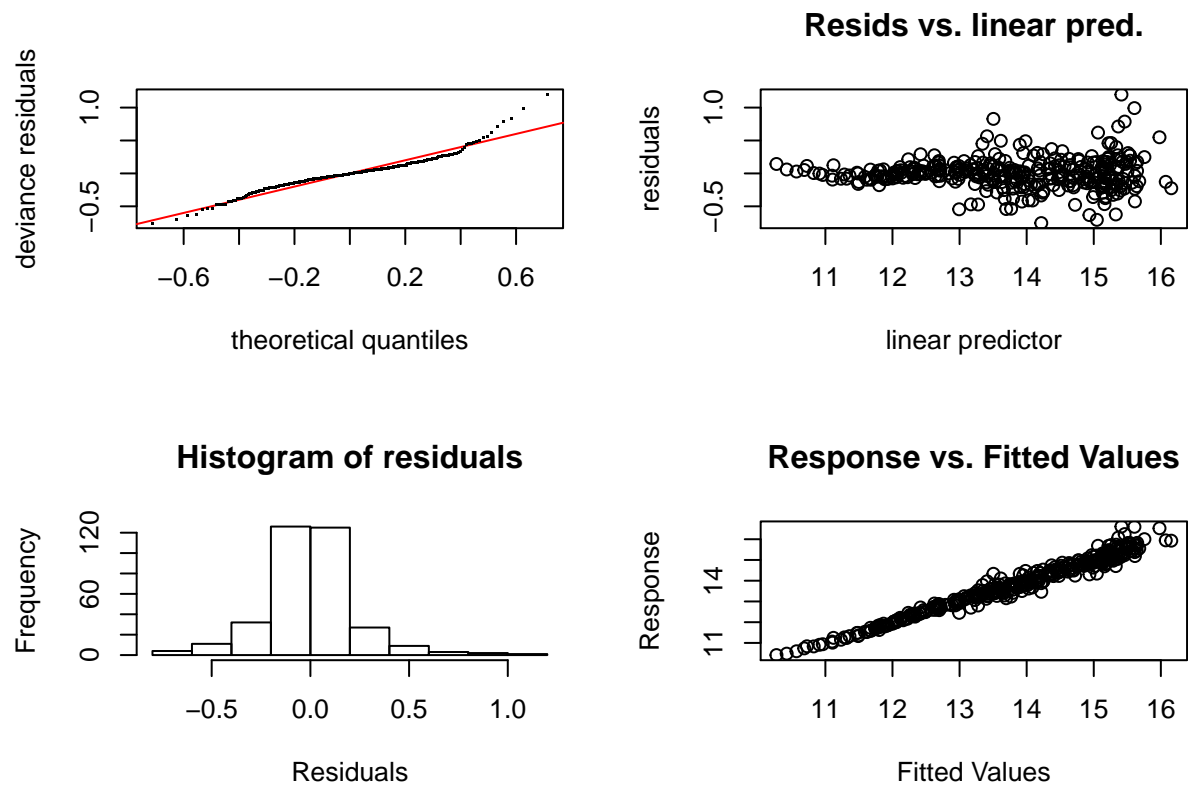


```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
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## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
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##          k'   edf k-index p-value
## s(lon)      9.00  8.25   0.65 <2e-16 ***
## s(lat)      9.00  6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```


PPTW Marginal Effects Plots



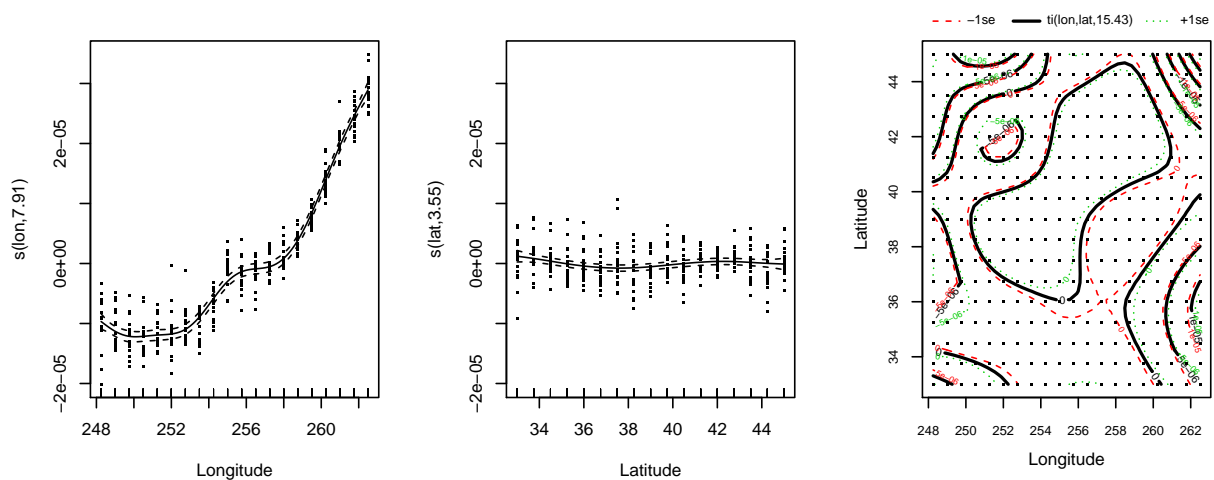
PPTW Model Residuals



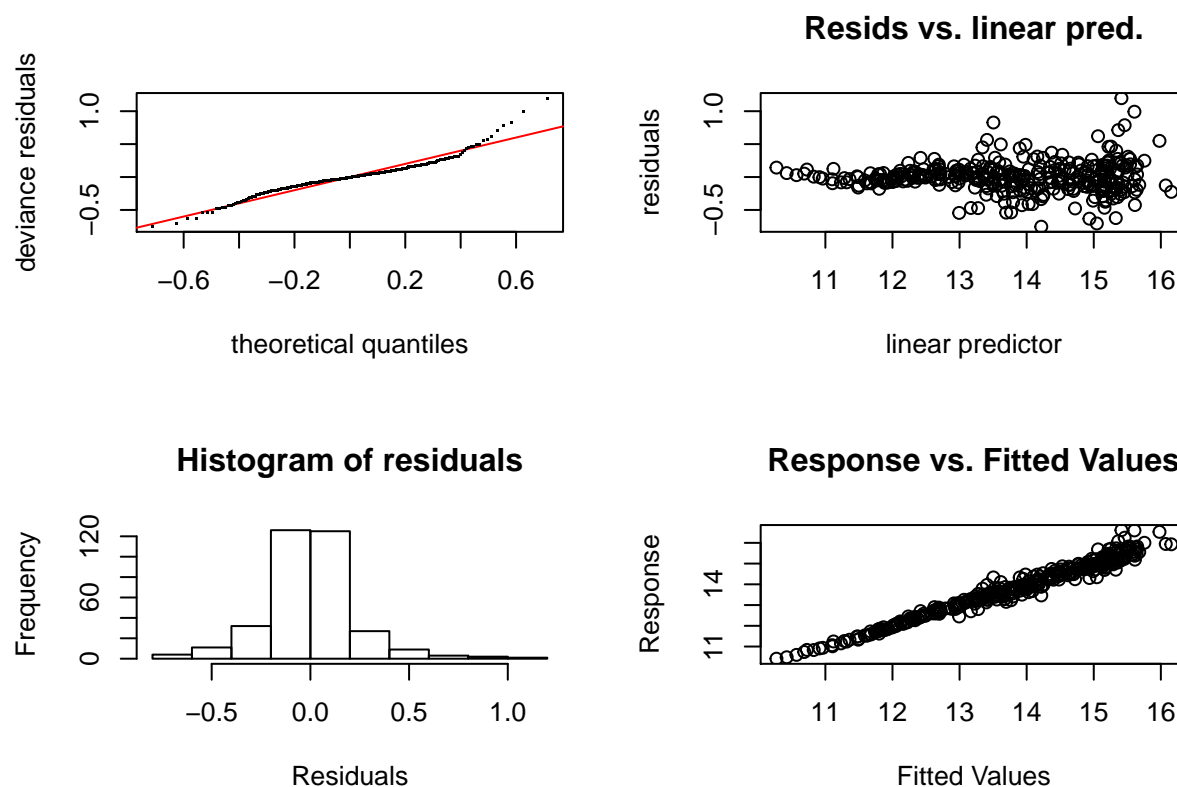
```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
```

```
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
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## Basis dimension (k) checking results. Low p-value (k-index<1) may
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##
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## s(lon)      9.00  8.25   0.65 <2e-16 ***
## s(lat)      9.00  6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

VARP Marginal Effects Plots



VARP Model Residuals



```
##
## Method: REML   Optimizer: outer newton
## full convergence after 7 iterations.
## Gradient range [-2.969321e-06,2.271718e-06]
## (score 56.11425 & scale 0.05742201).
## Hessian positive definite, eigenvalue range [1.657357,168.2762].
## Model rank = 35 / 35
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##          k'   edf k-index p-value
## s(lon)      9.00  8.25   0.65 <2e-16 ***
## s(lat)      9.00  6.36   0.64 <2e-16 ***
## ti(lon,lat) 16.00 15.24   0.60 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Prediced Spatial Distribution of Oak Trees

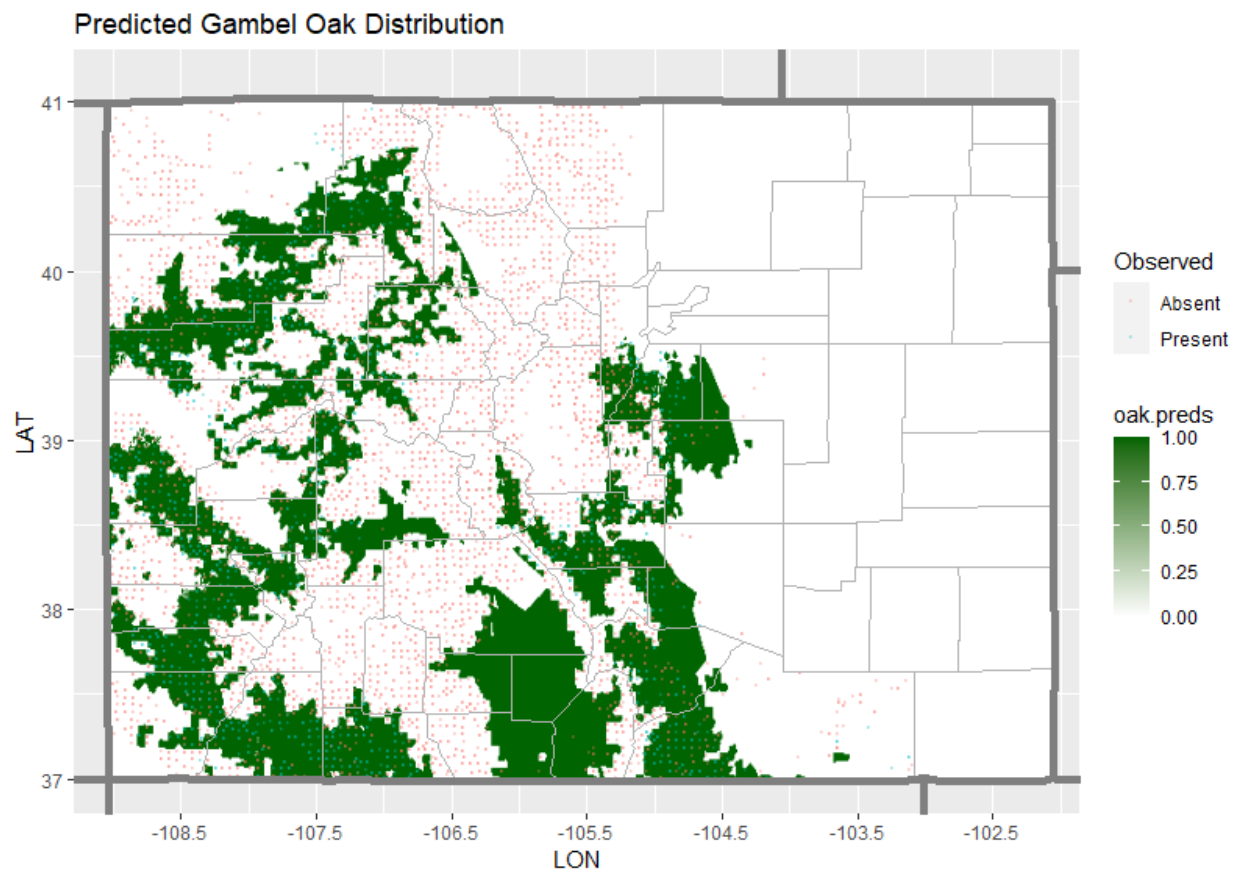


Figure 1: Predicted Gambel Oak Distribution. Note the extrapolation issues in the San Luis valley where no observations are present, but the elevation is favorable for oak growth.