A validation suite for texmex

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Contents

1 Introduction

The texmex [1] package for R provides a suite of test routines These tests include comparisons of parameter estimates with published versions – particulary values published in works by Coles [2] and Heffernan and Tawn [3] – as well as many comparisons with values produced by independently written code, and many logical checks and checks for routine failure in the context of inappropriate usage.

Many graphs are produced by the test suite and these can be visually compared with published versions, or evaluated against known plausible output.

The testthat [4] package is used to provide the testing environment.

In total, over 1000 tests are performed providing a reasonable degree of confidence that texmex produces the output expected of it.

1.1 Software

R version 3.1.1 (2014-07-10) [5] was used in the construction of this vignette. Versions of texmex, sombrero, test that and other packages can be found in the Appendix.

1.2 Acknowledgements

Some of the independently written code that is used for validation is borrowed from the ismev [2] and evd [7] packages. Other code has been provided by Yiannis Papastathopoulos [8] and by Paul Metcalfe of AstraZeneca.

The development of the the texmex package, including its test suite, was partially funded by AstraZeneca.

2 Using the validation suite

To install the test suite, it is necessary to install the package with the option `--install-tests`. For example, if installing version 2.3 at the command line from the package source (the .tar.gz file), the command would be

```
R CMD INSTALL --install-tests texmex_2.3.tar.gz
```

The test suite depends upon the testthat [4] package, so it is necessary to load that package before attempting to run any tests.

```
library(texmex)

## Loading required package:  mvtnorm

library(testthat)
```

The test scripts are located under the package directory in `tests/testthat`. To run a specific test script, you can use

```
test_file("texmex/tests/testthat/test.revTransform.R")
```

for example. To run all test scripts (which will take a while), the command is as follows, and the output consists of the majority of the remainder of this document.

```
test_package("texmex")

## bootmex :

## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5

## ............

## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5

## ........
```

```
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5

## .......
## chi : .......
## closures : ..........................................................................
## copula : ....
## dgpd : .....
## egp3 : ..
## endPoint : ...

## Fitted values of xi < -0.5

## ........

## Fitted values of xi < -0.5

## .

## Fitted values of xi < -0.5

## .

## Fitted values of xi < -0.5

## ..................
## evm : ...............................

## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5

## ..............................................
## evmBoot :

## Ratio of bias to standard error is high

## .....

## Ratio of bias to standard error is high

## ..

## Ratio of bias to standard error is high

## .....

## Ratio of bias to standard error is high

## ..
## exprel : ..
## extremalIndex : ....................................
```

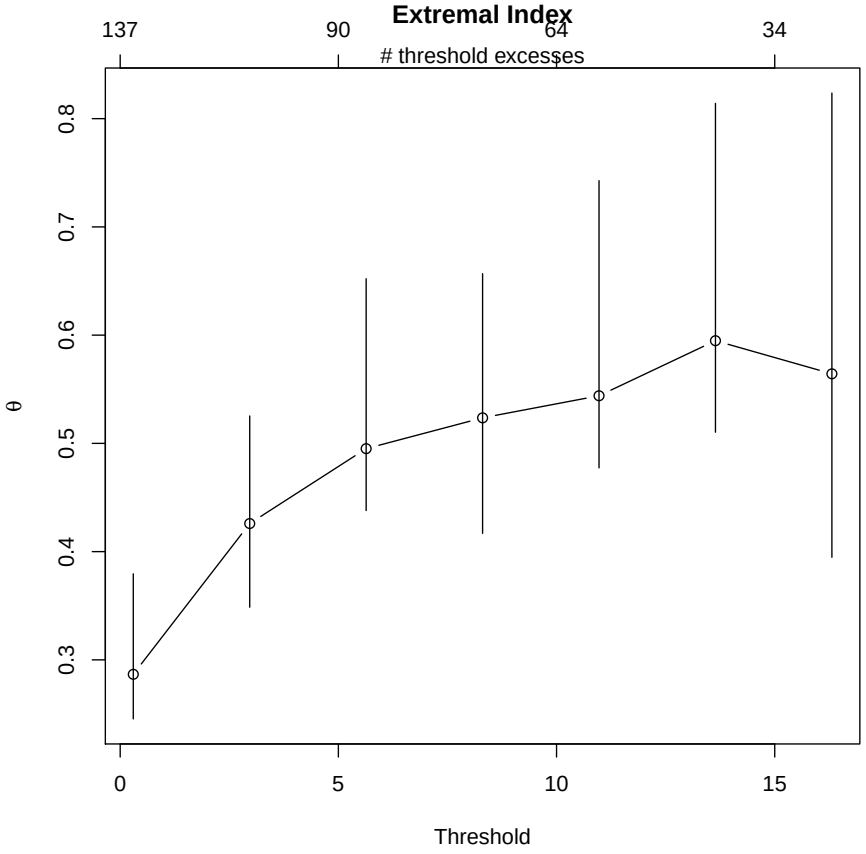

Figure 1: Output from running the validation suite.

```
## ..........
## gpd.info : .....

## Fitted values of xi < -0.5
## Fitted values of xi < -0.5

## ........................

## Fitted values of xi < -0.5
## Fitted values of xi < -0.5

## .....

## Fitted values of xi < -0.5
## Fitted values of xi < -0.5

## ..........

## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
```

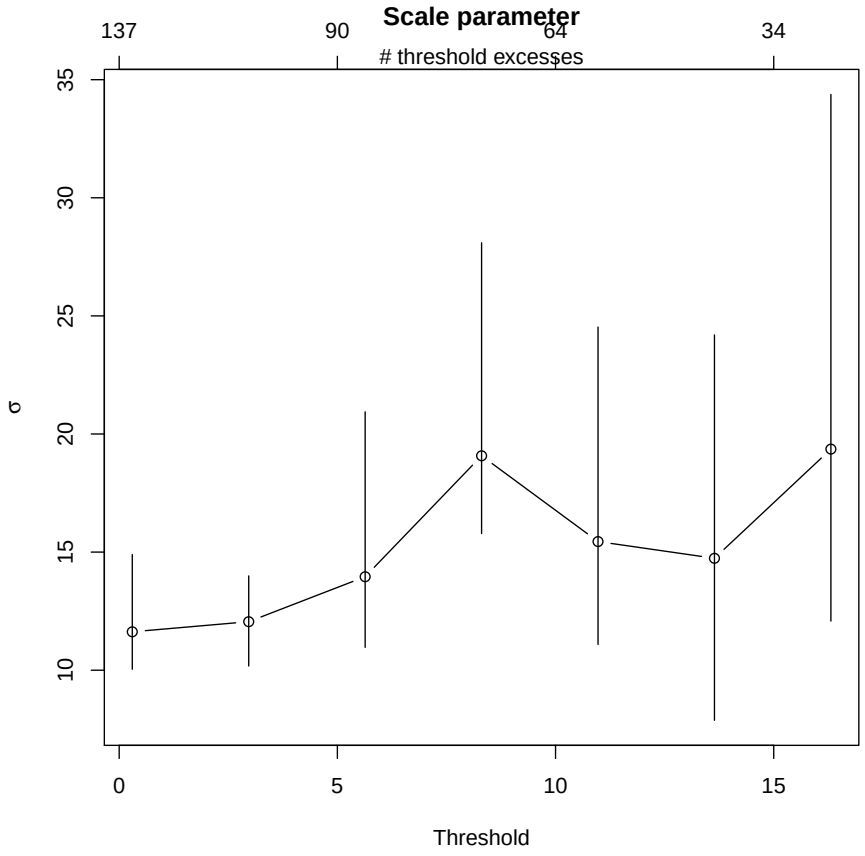

Figure 2: Output from running the validation suite.

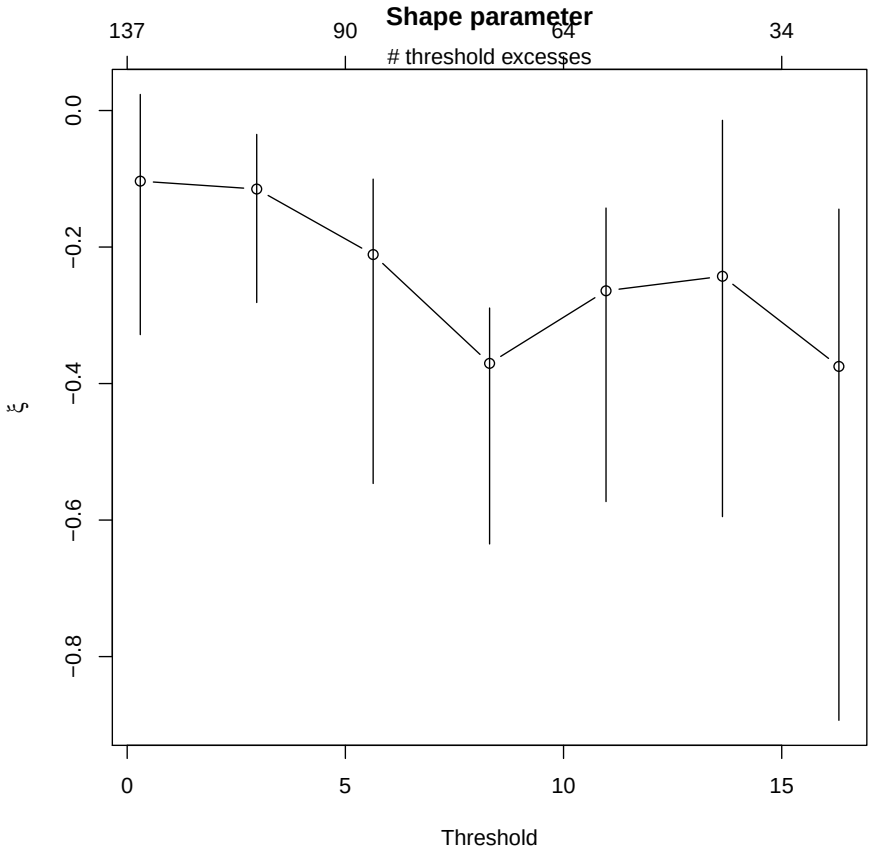

Figure 3: Output from running the validation suite.

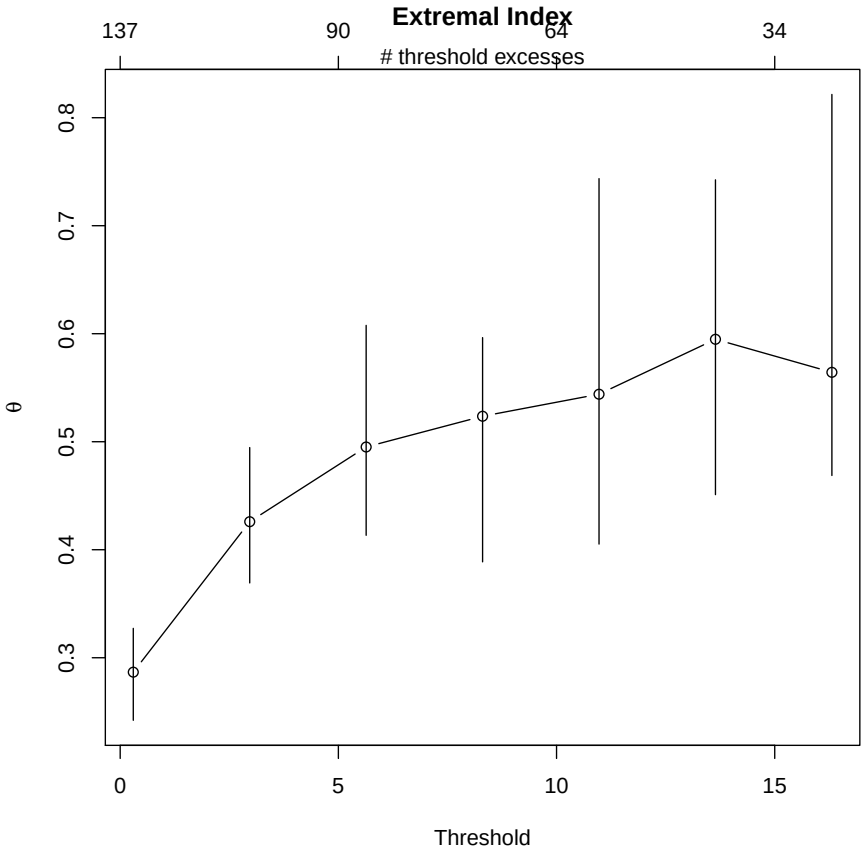

Figure 4: Output from running the validation suite.

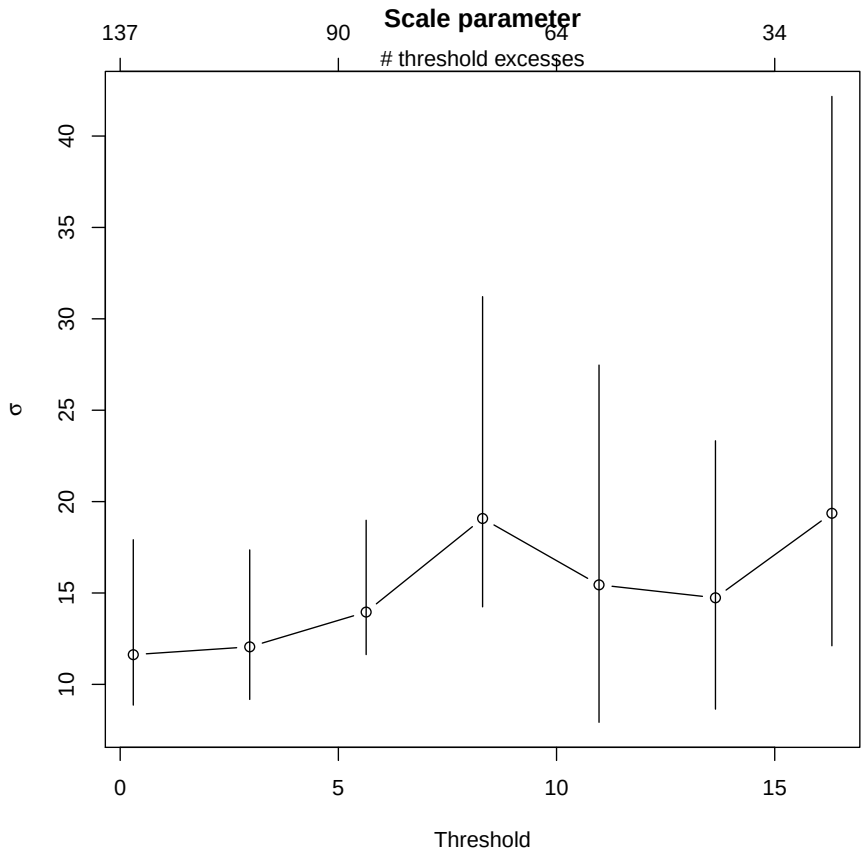

Figure 5: Output from running the validation suite.

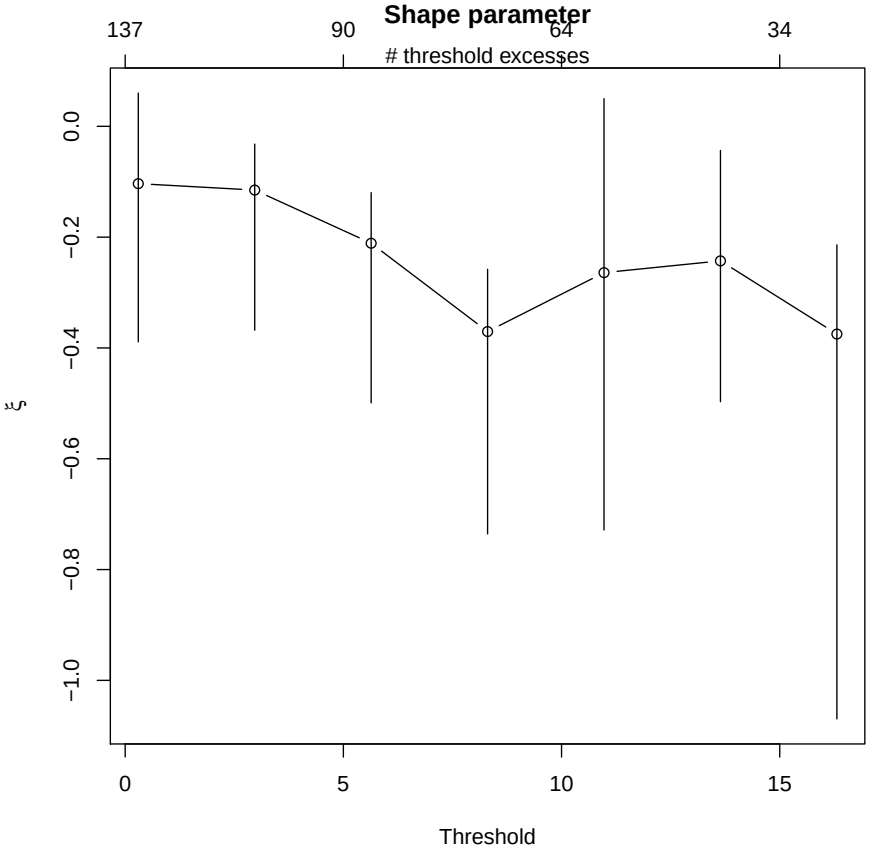

Figure 6: Output from running the validation suite.

```
## ......
## gpdRangeFit :
## .
## log1prel : ...
## MCS : ....
## mexDependence : ............................
## mexRangeFit :

## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
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## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
```

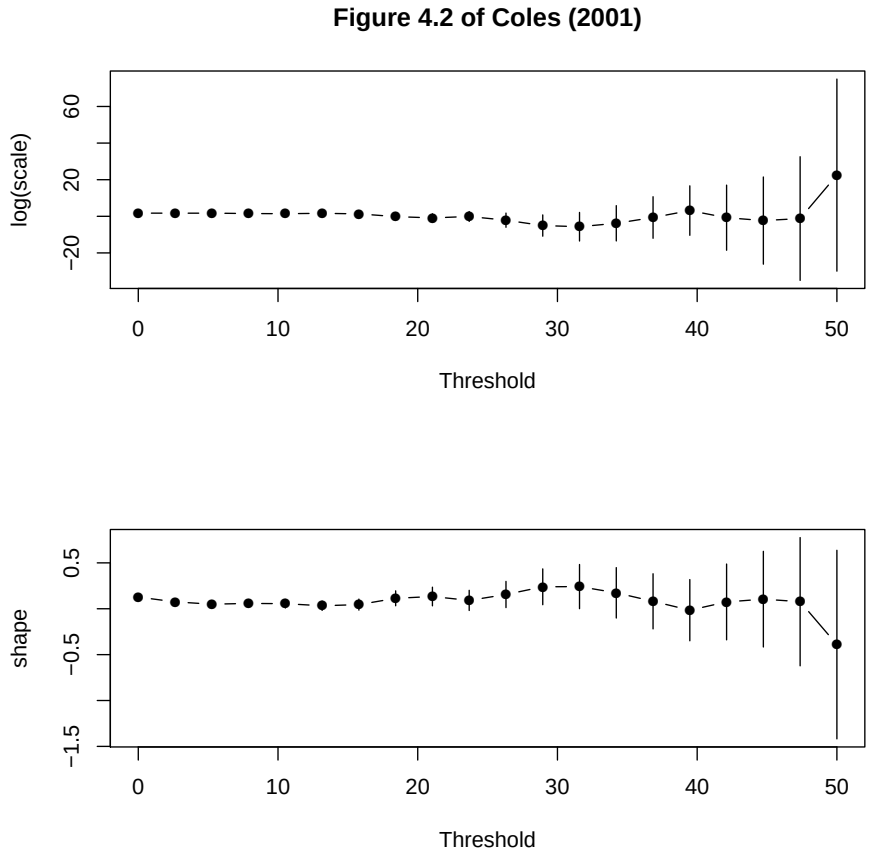

Figure 7: Output from running the validation suite.

```
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
```

```
## ......
```

```
##
## migpd : .........
## migpdCoefs : ....
## mrl :
```

```
## .
## pgev : ..........................................................................
## pgpd : ..........
## plot.bootmex :
```

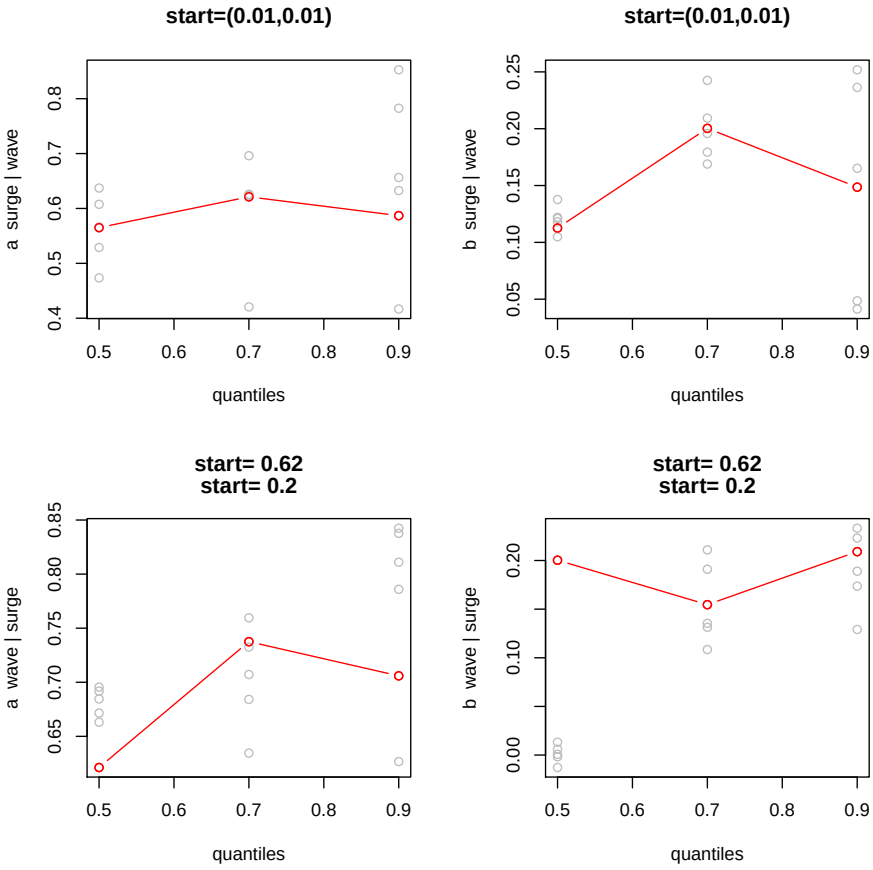

Figure 8: Output from running the validation suite.

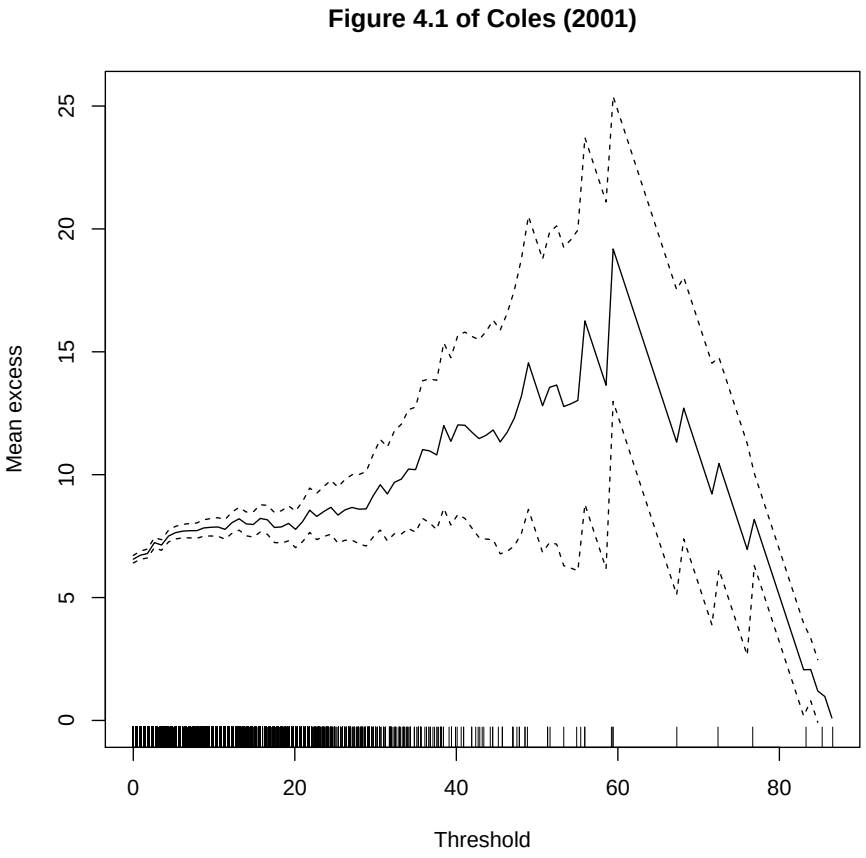

Figure 9: Output from running the validation suite.

```
## Fitted values of xi < -0.5
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## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
```

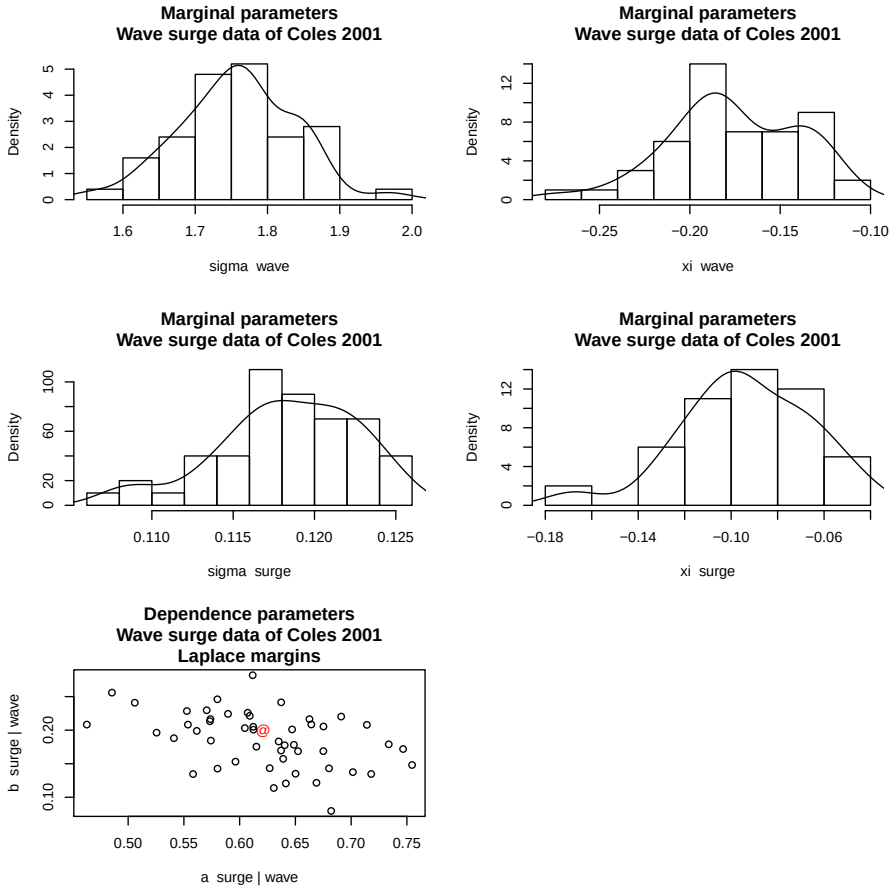

Figure 10: Output from running the validation suite.

```
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
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## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
```

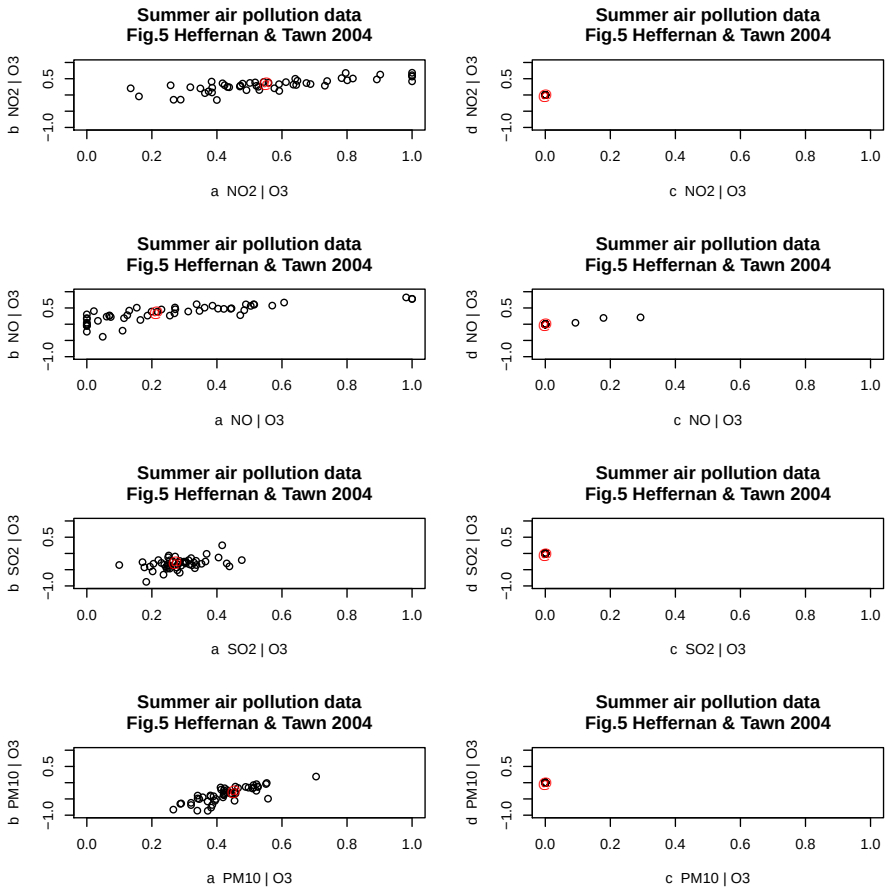

Figure 11: Output from running the validation suite.

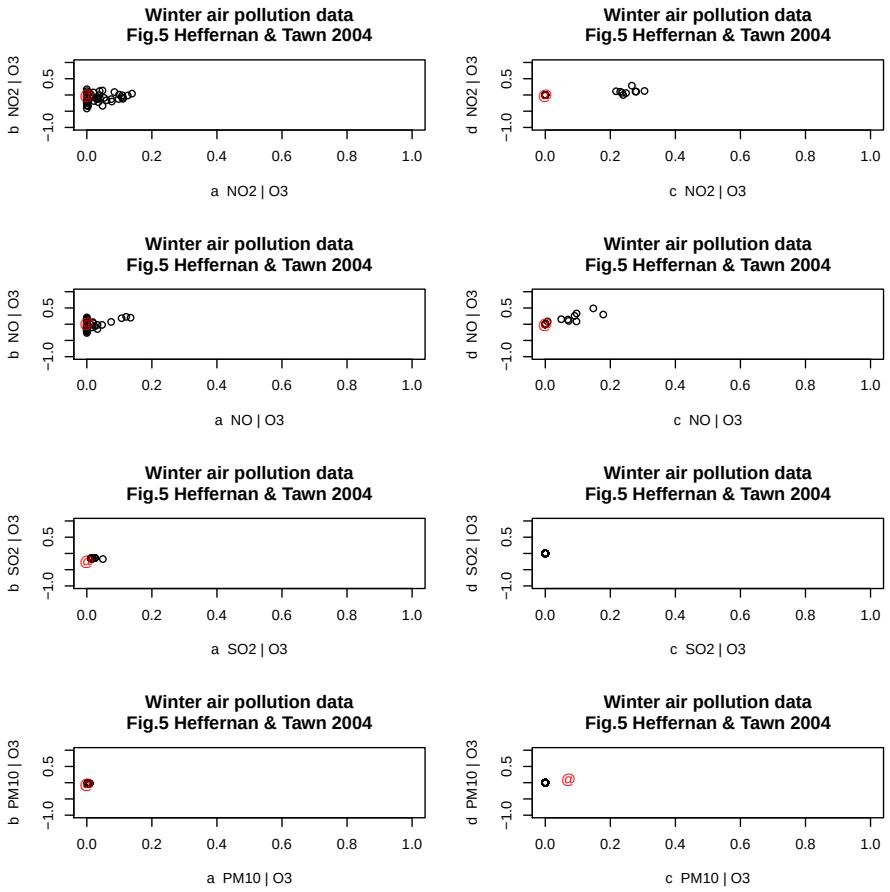

Figure 12: Output from running the validation suite.

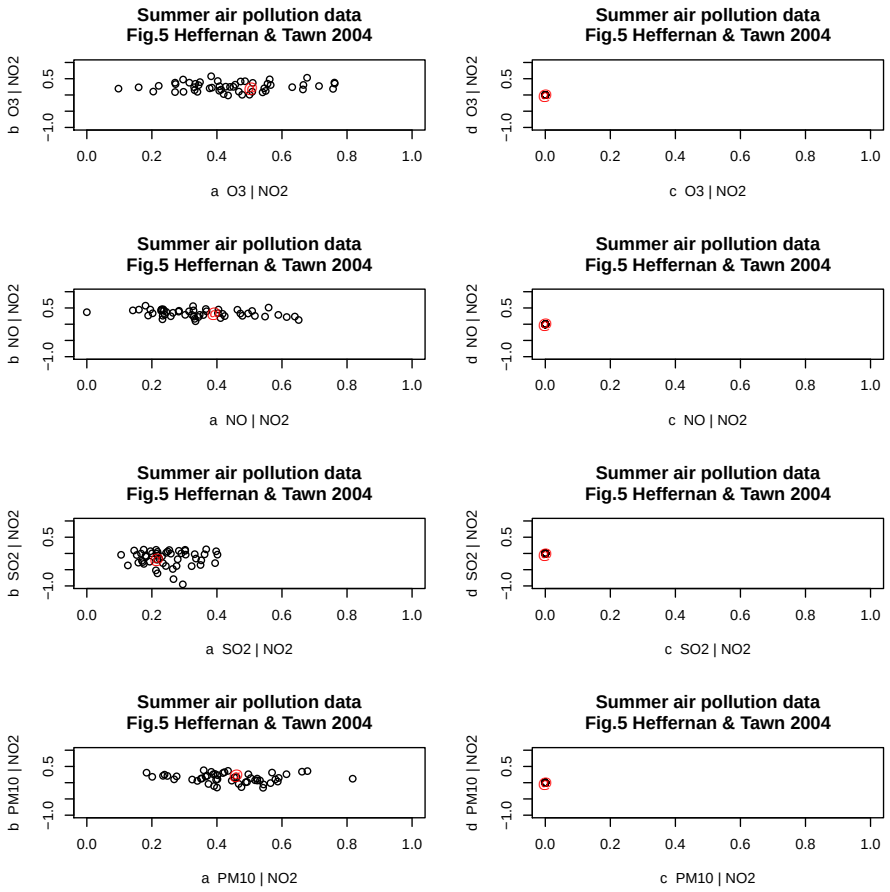

Figure 13: Output from running the validation suite.

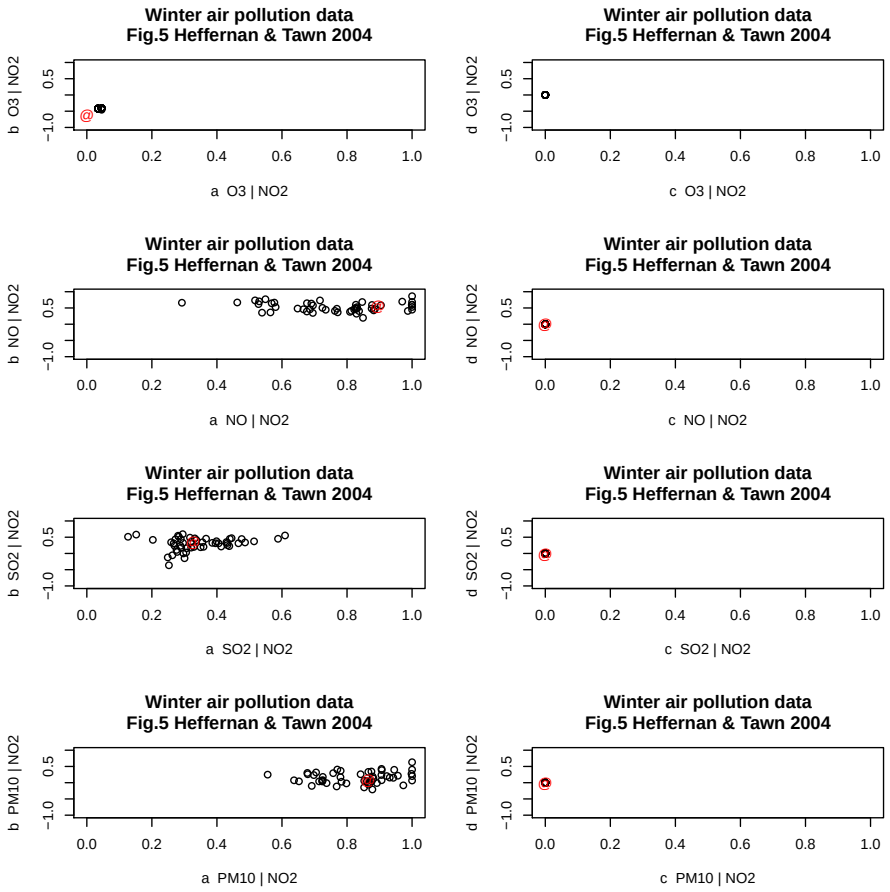

Figure 14: Output from running the validation suite.

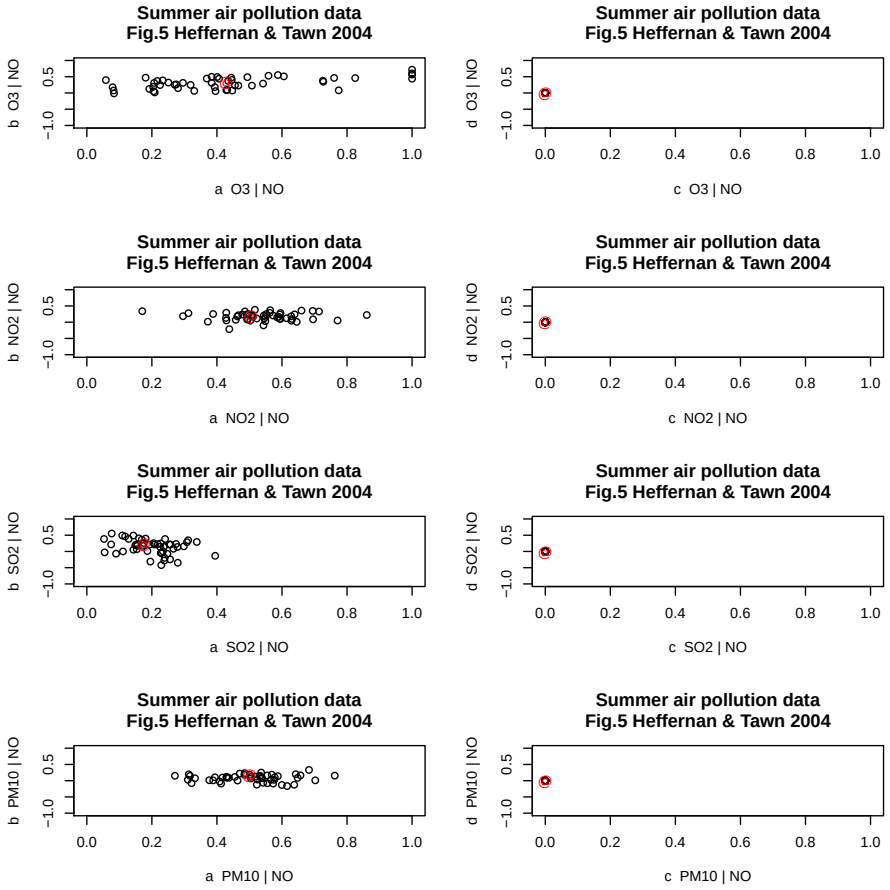

Figure 15: Output from running the validation suite.

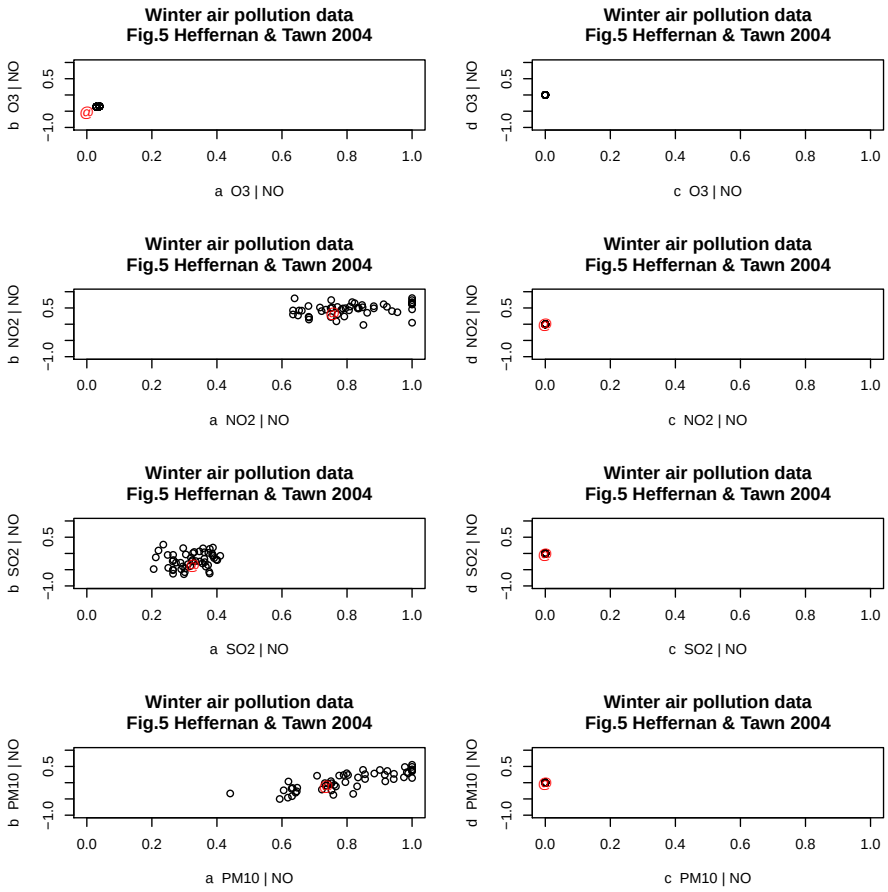

Figure 16: Output from running the validation suite.

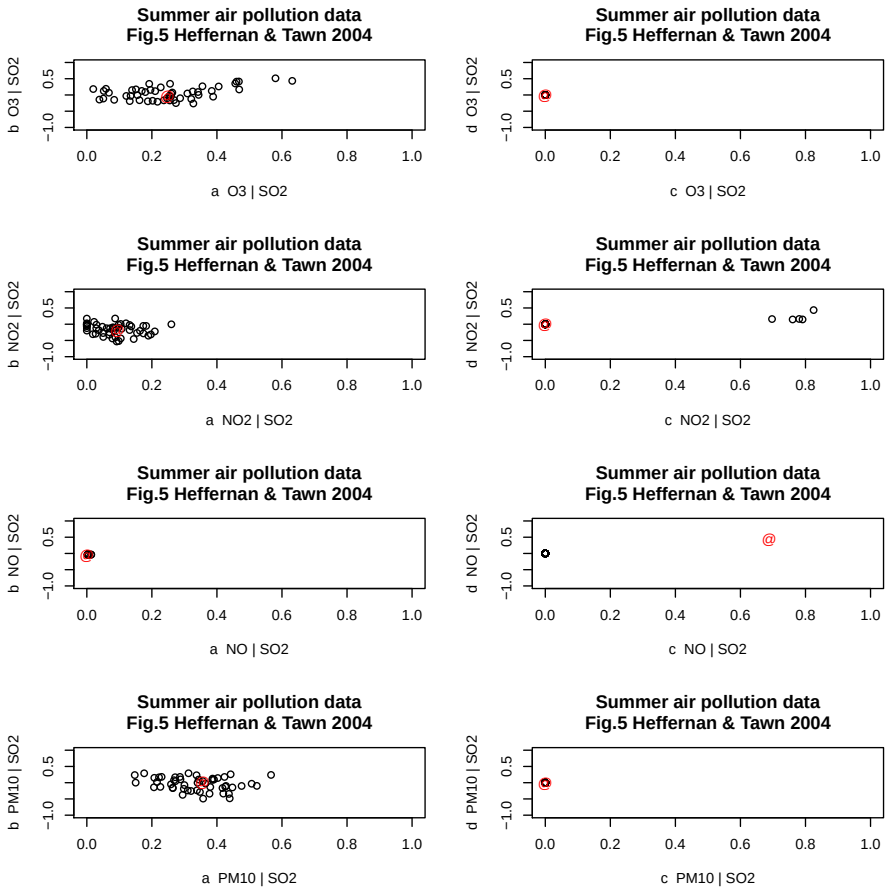

Figure 17: Output from running the validation suite.

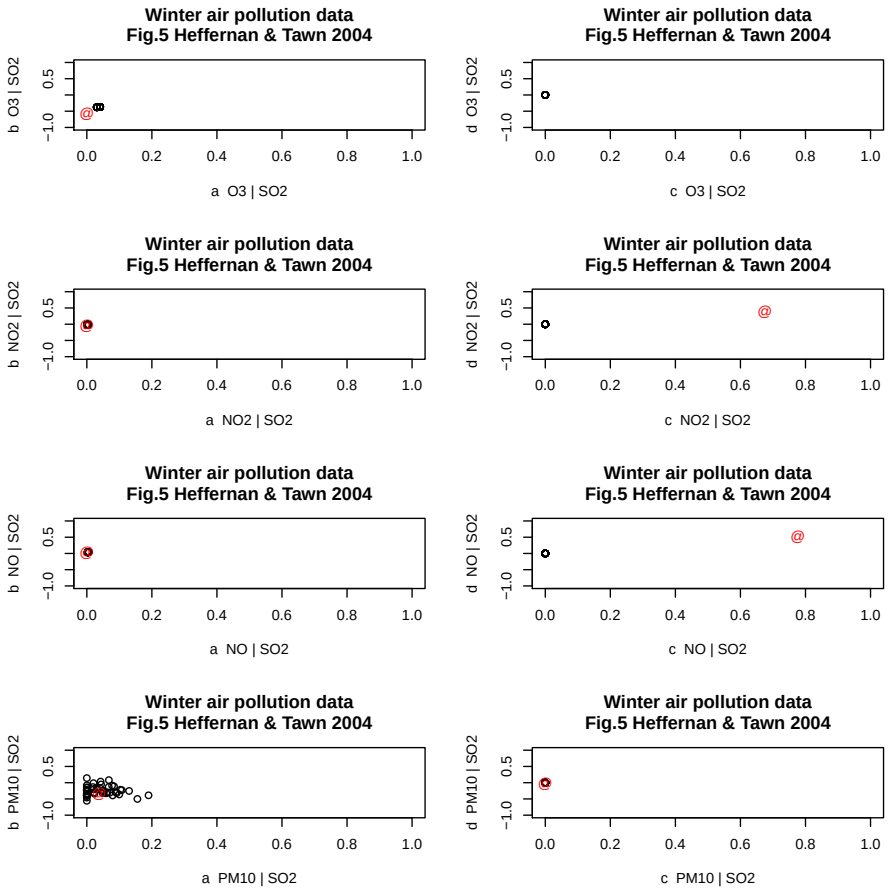

Figure 18: Output from running the validation suite.

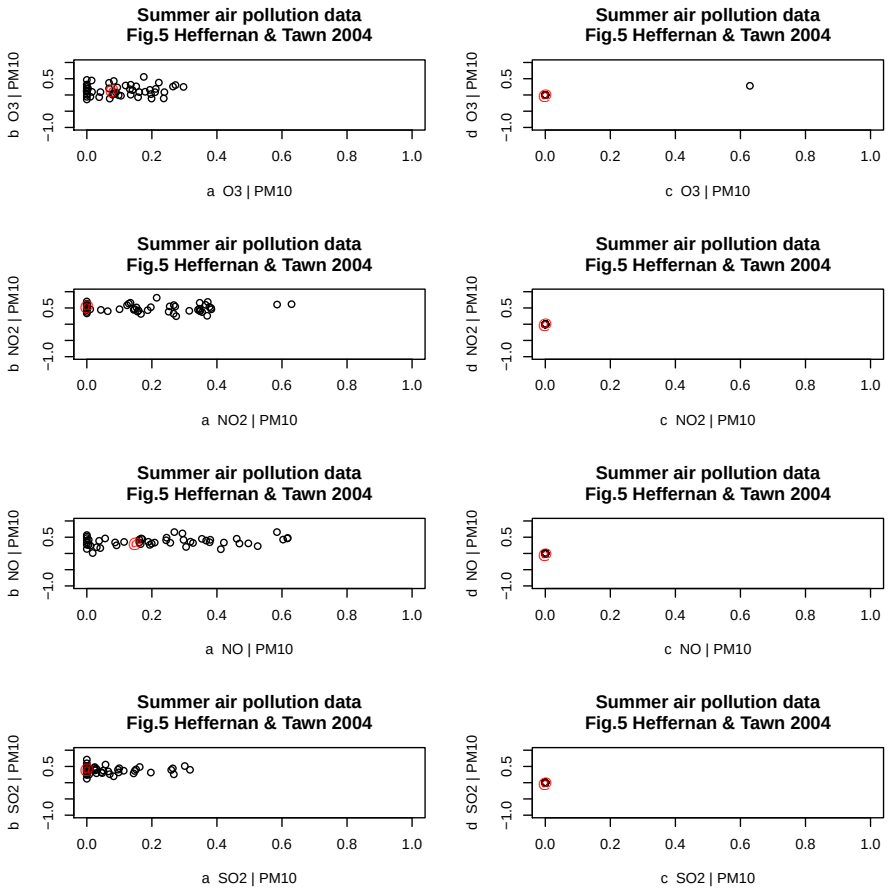

Figure 19: Output from running the validation suite.

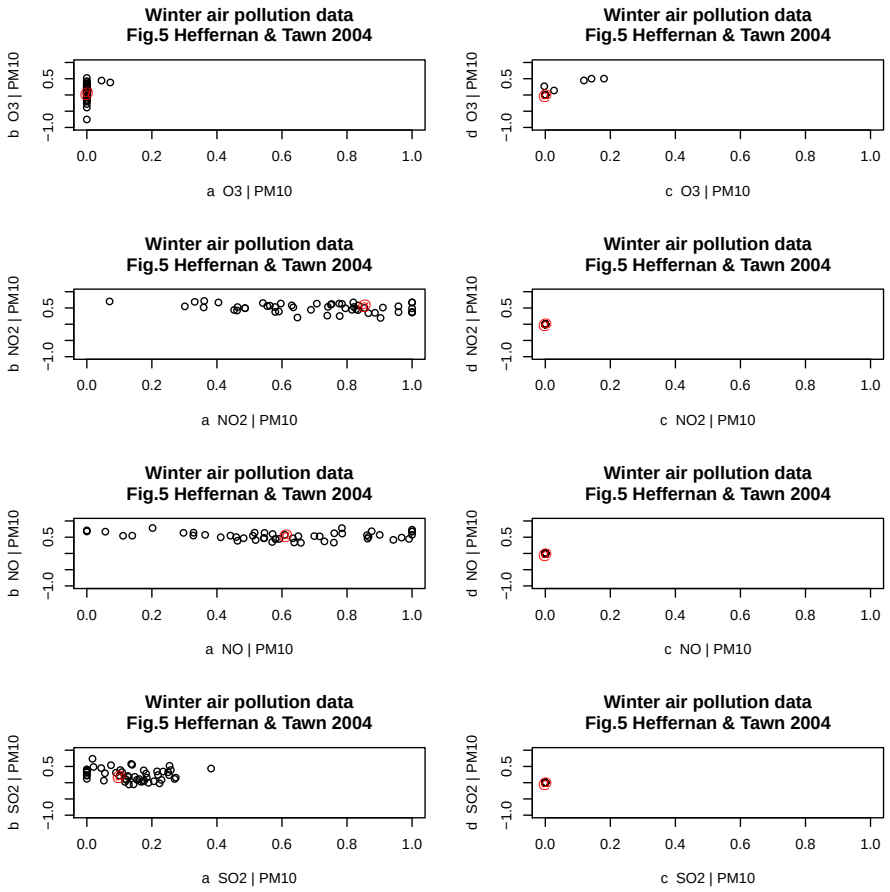

Figure 20: Output from running the validation suite.

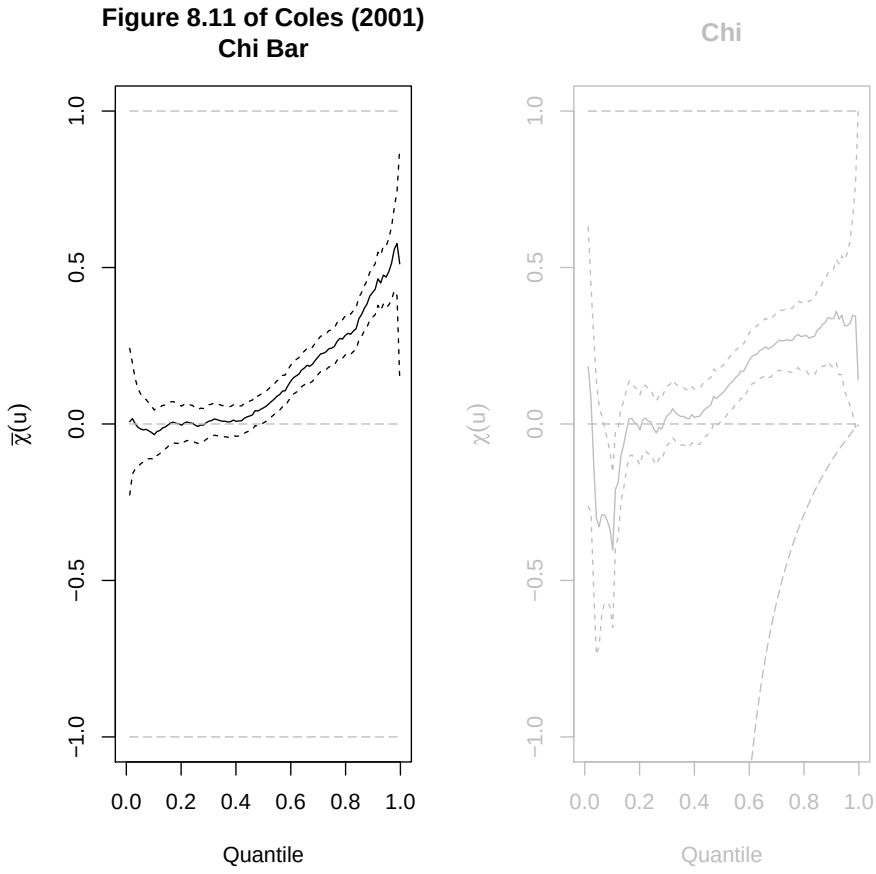

Figure 21: Output from running the validation suite.

```
## ...
## plot.chi :
```

```
## .
## plot.evmOpt :
```

```
## .
```

```
## .
```

```
## .
```

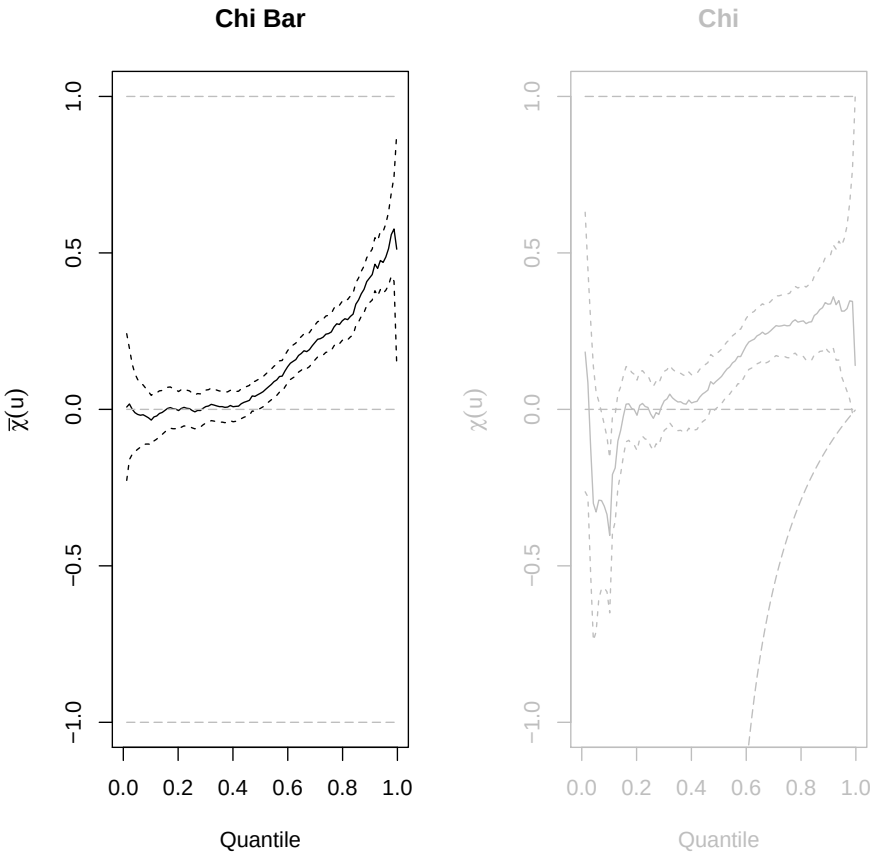

Figure 22: Output from running the validation suite.

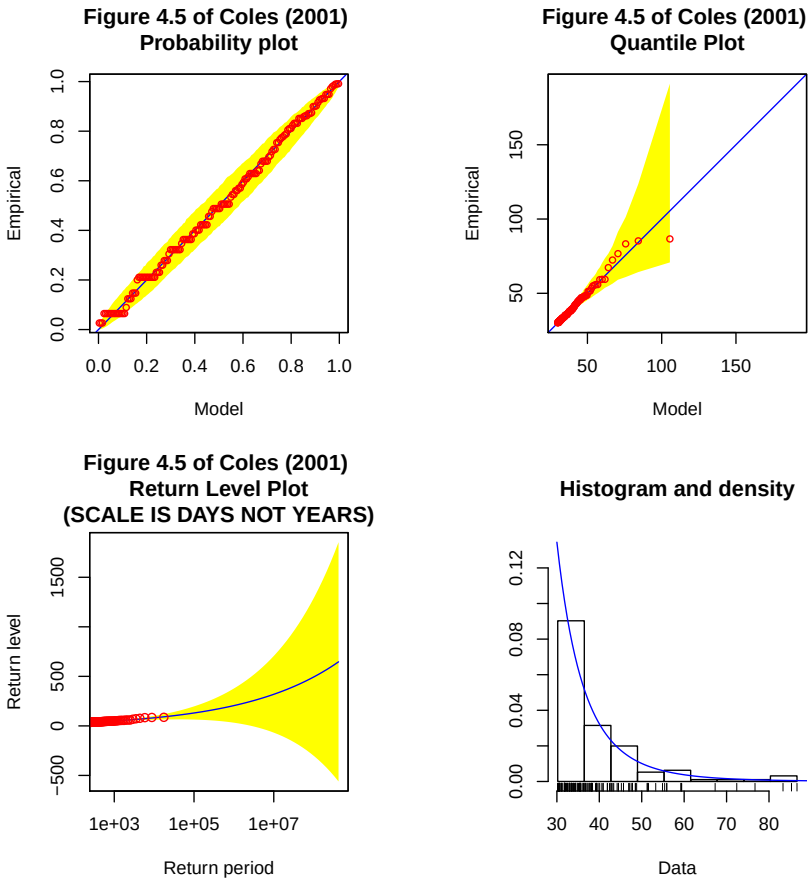

Figure 23: Output from running the validation suite.

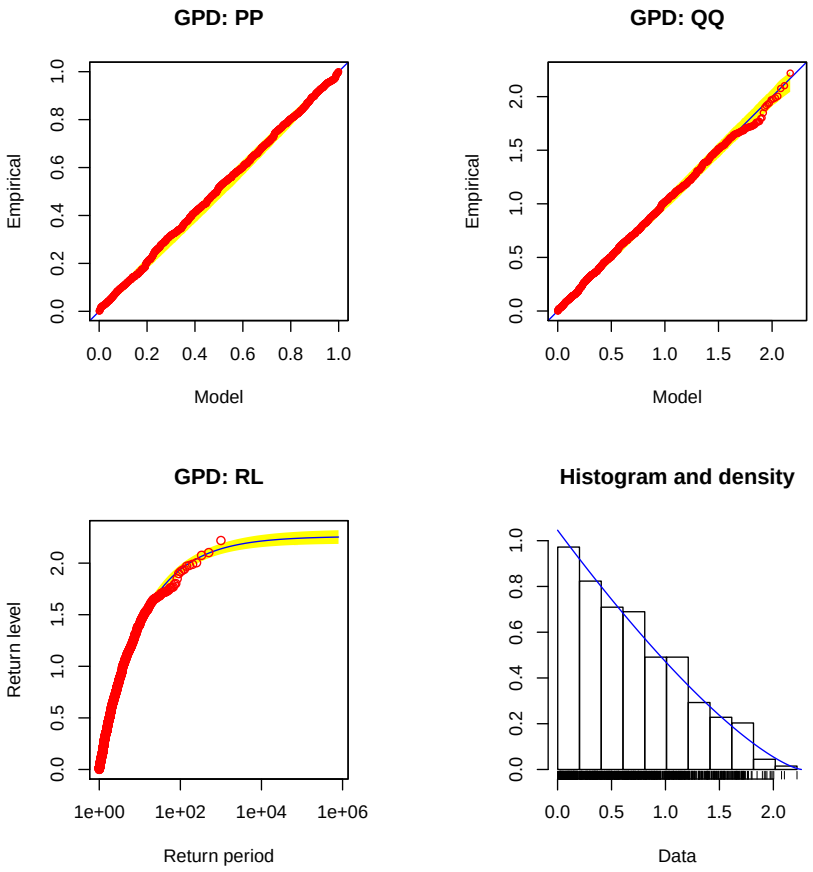

Figure 24: Output from running the validation suite.

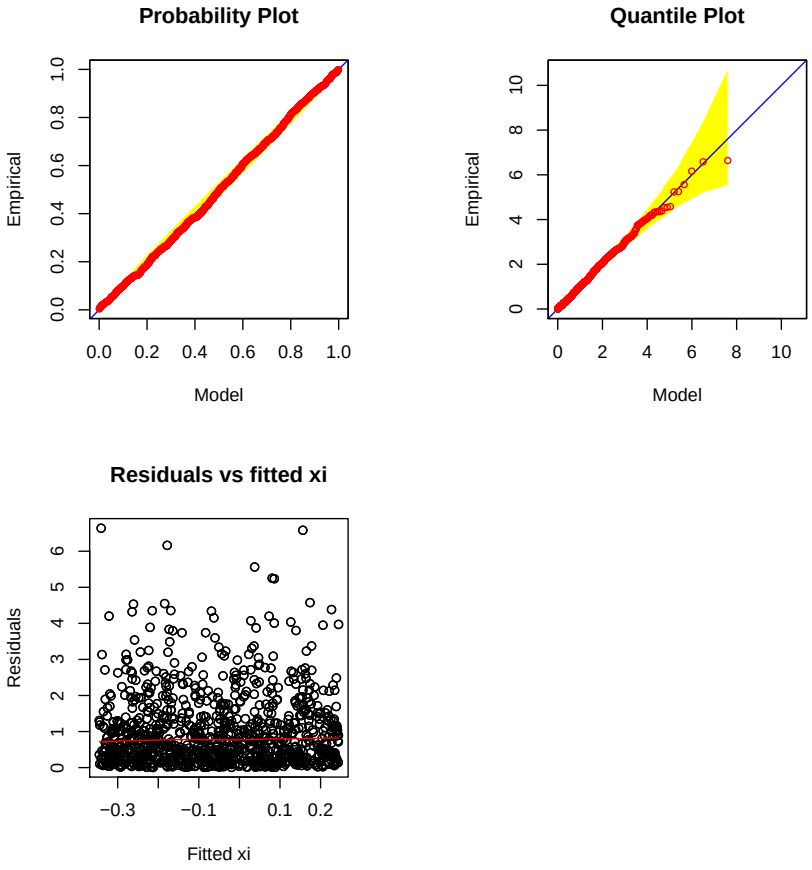

Figure 25: Output from running the validation suite.

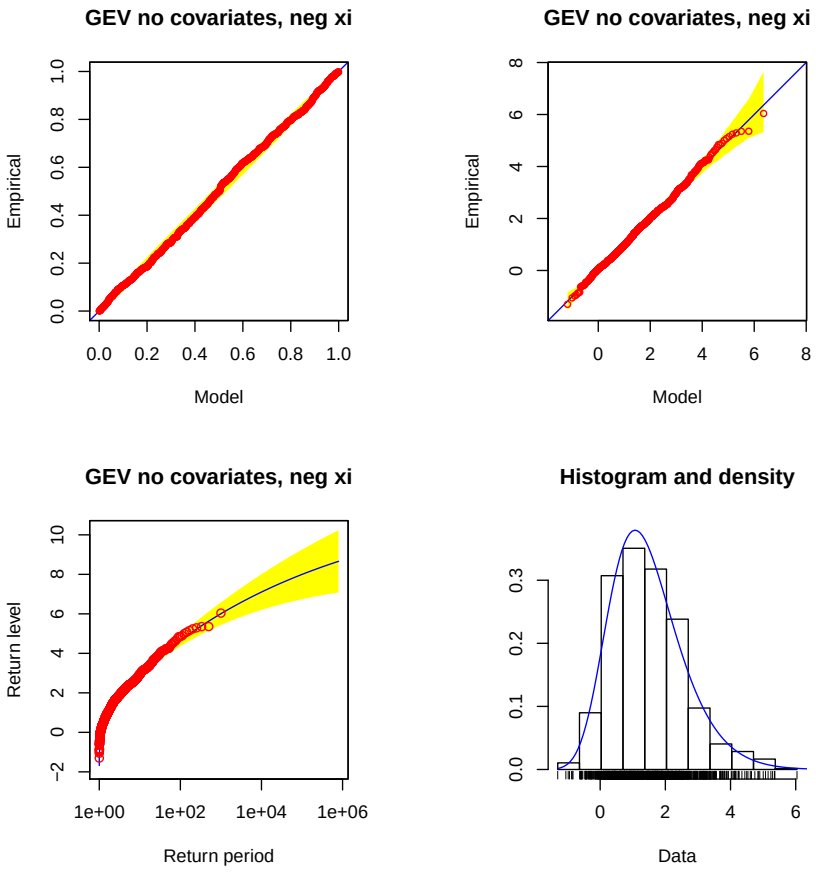

Figure 26: Output from running the validation suite.

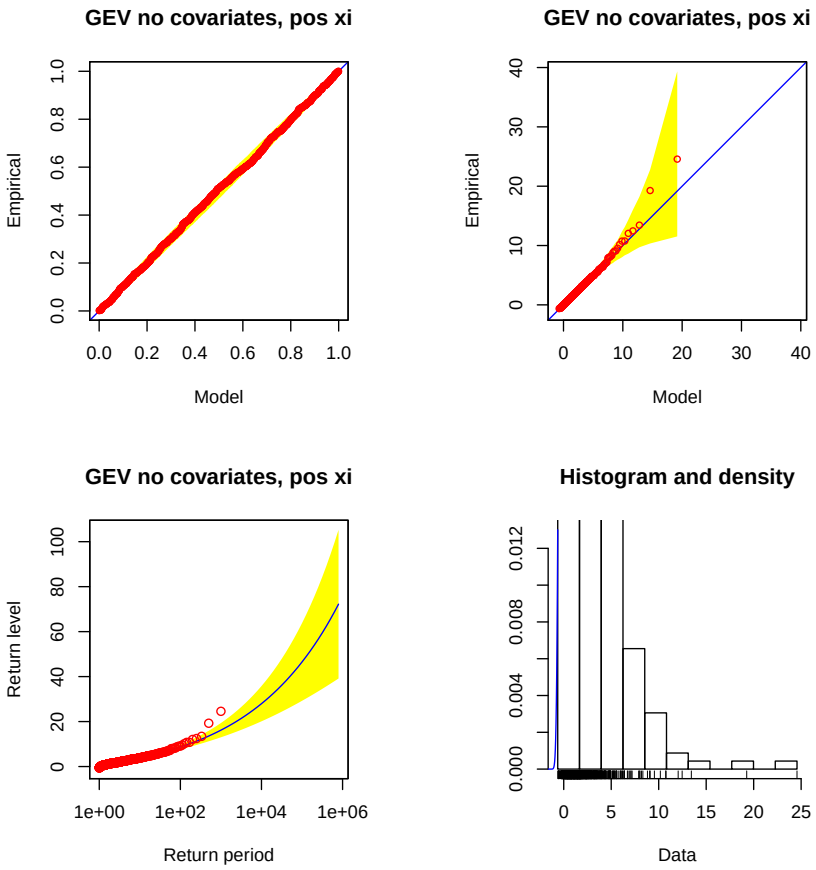

Figure 27: Output from running the validation suite.

```
## .
```

```
## .
```

```
## .
```

```
## .
## plot.mex :
```

```
## ..
```

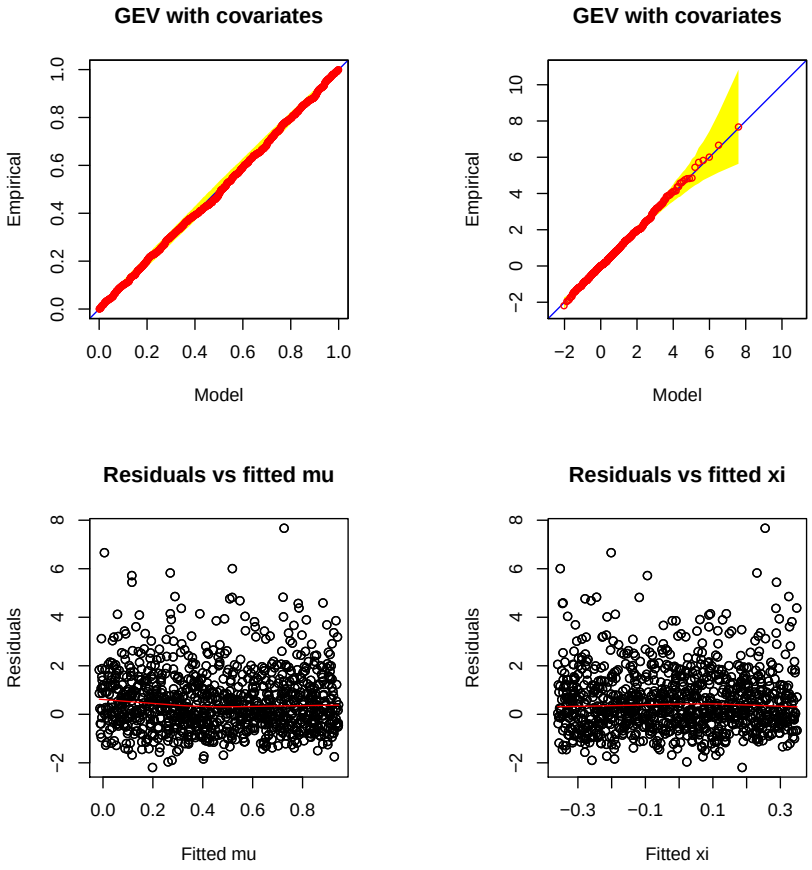

Figure 28: Output from running the validation suite.

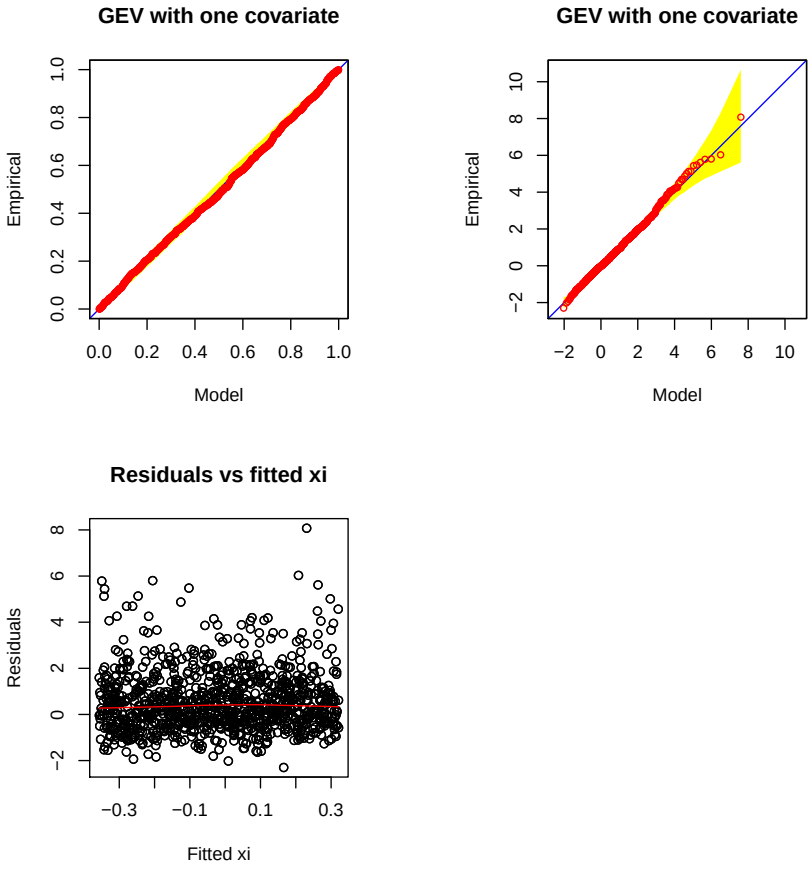

Figure 29: Output from running the validation suite.

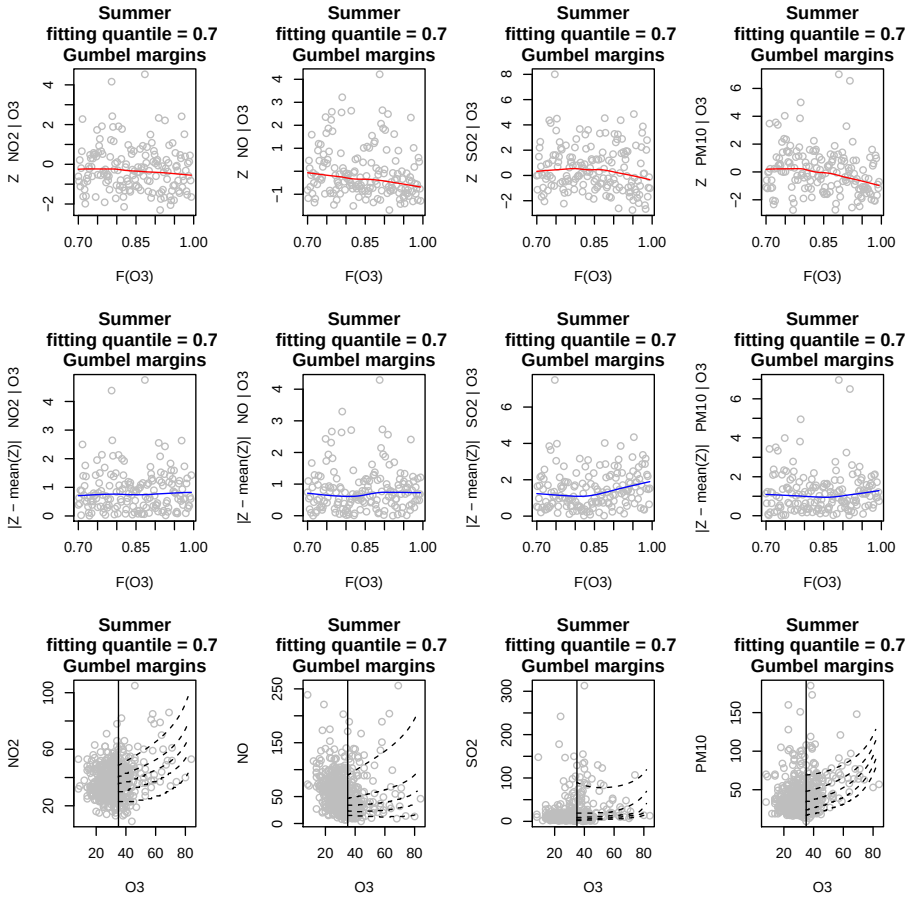

Figure 30: Output from running the validation suite.

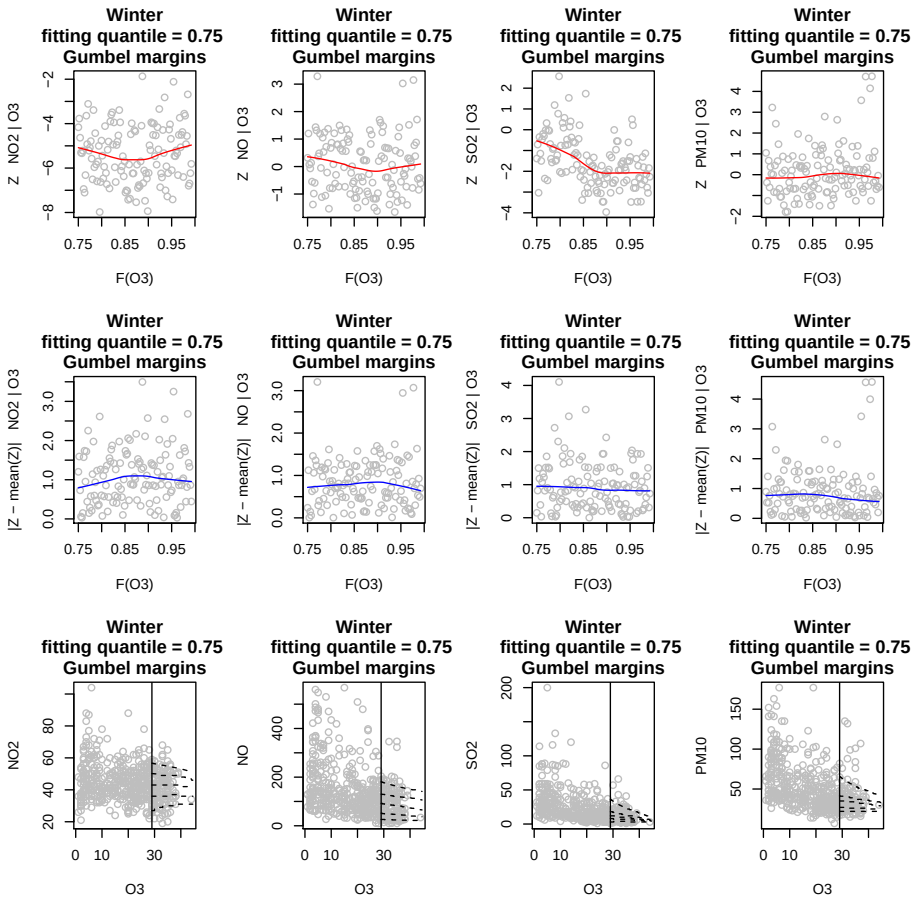

Figure 31: Output from running the validation suite.

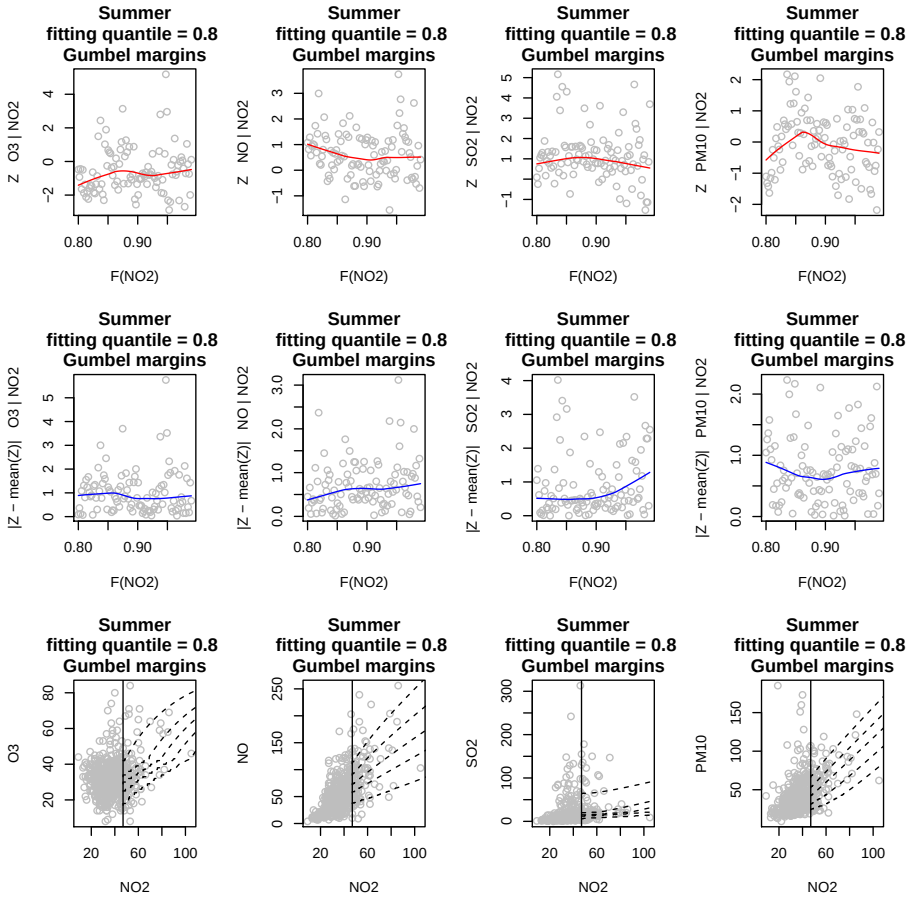

Figure 32: Output from running the validation suite.

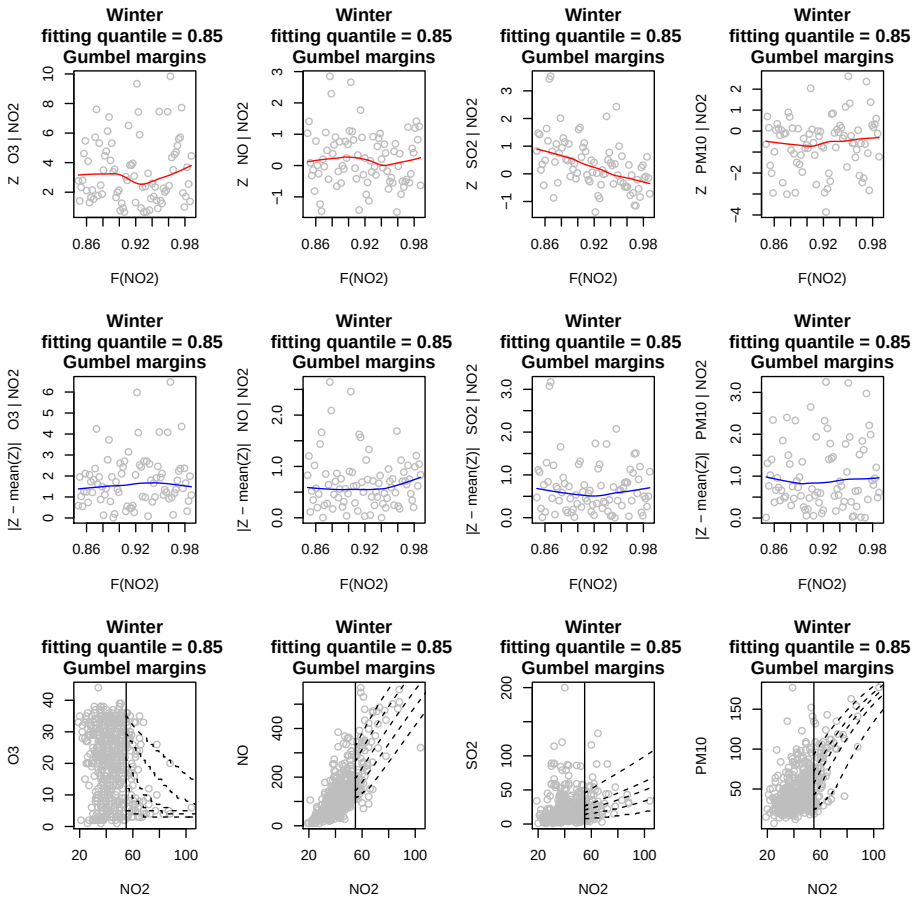

Figure 33: Output from running the validation suite.

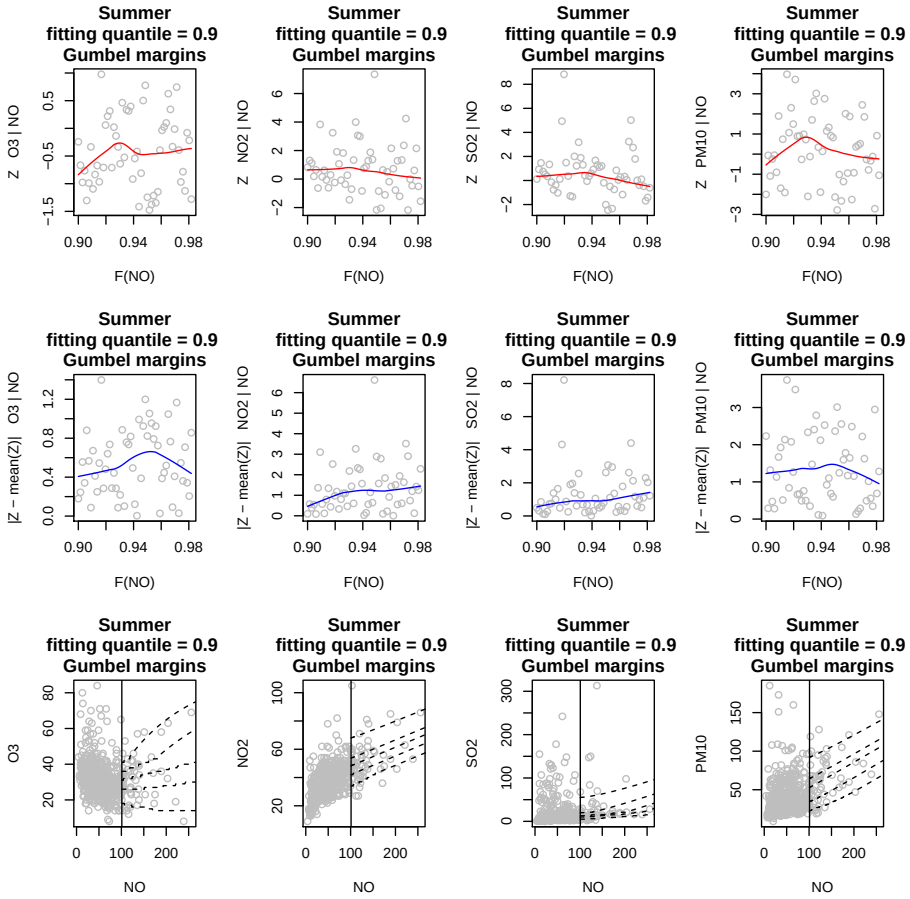

Figure 34: Output from running the validation suite.

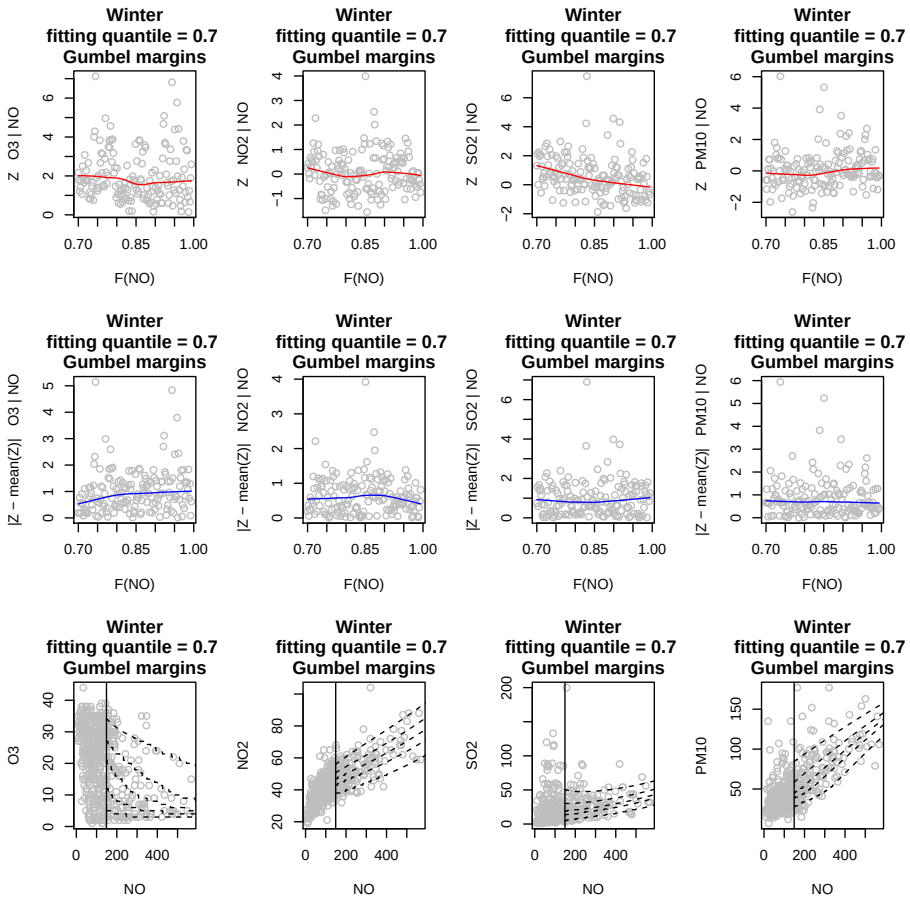

Figure 35: Output from running the validation suite.

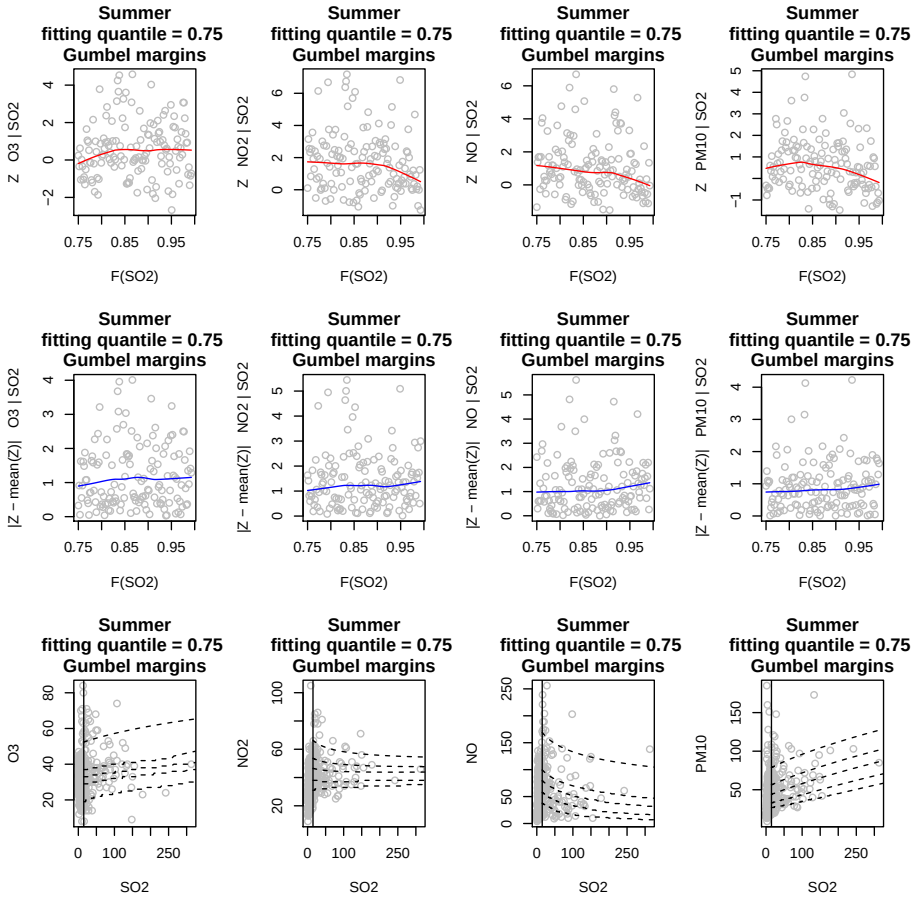

Figure 36: Output from running the validation suite.

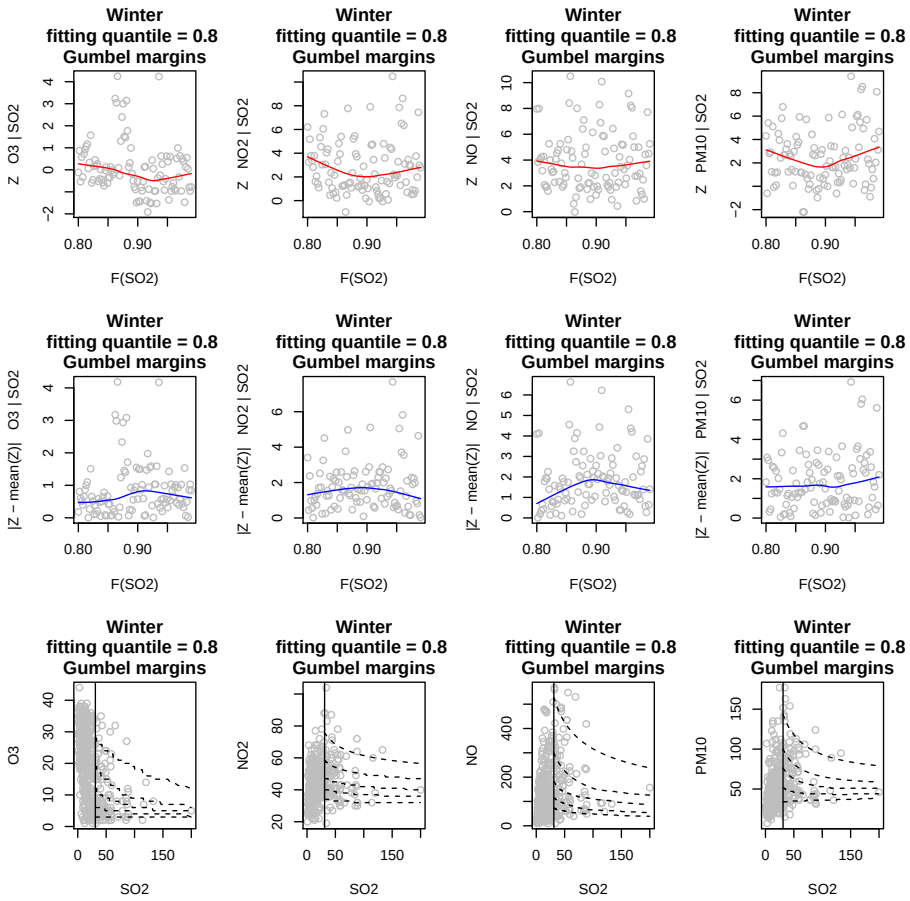

Figure 37: Output from running the validation suite.

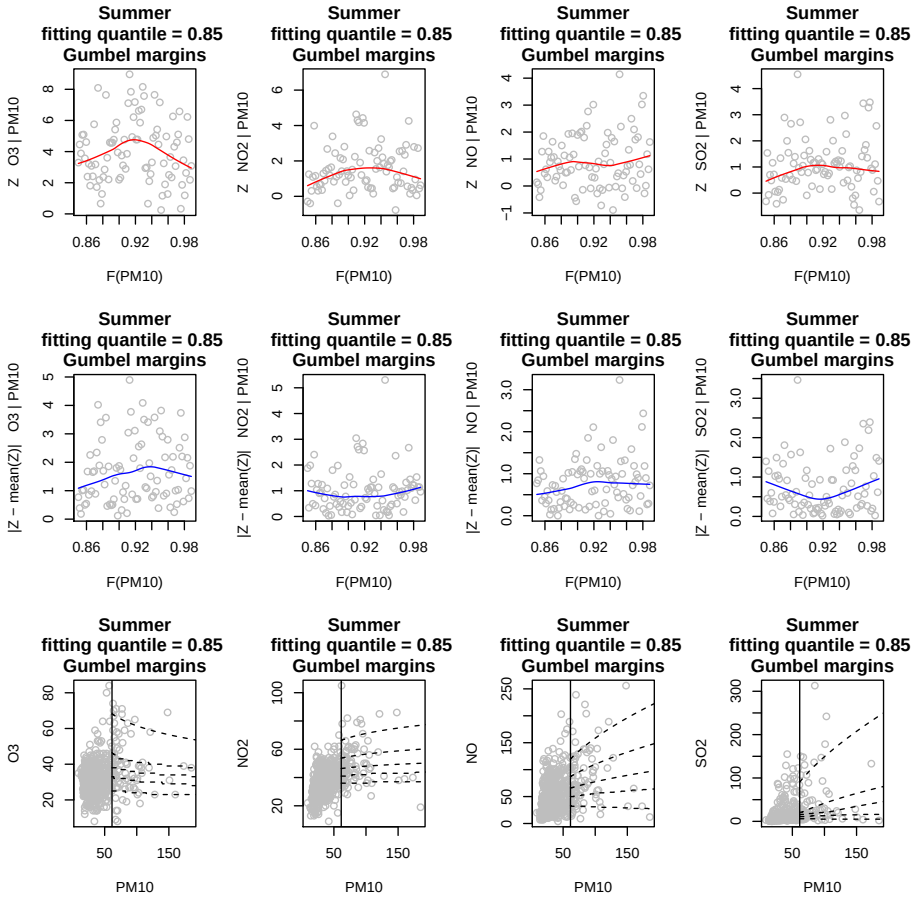

Figure 38: Output from running the validation suite.

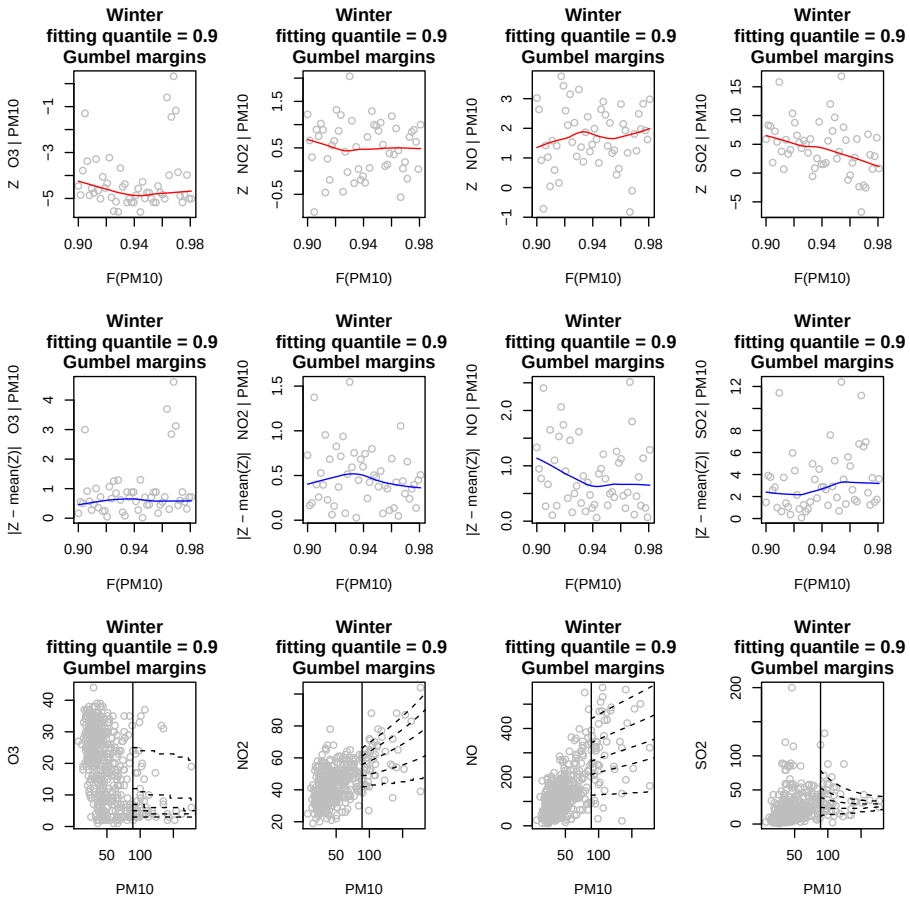

Figure 39: Output from running the validation suite.

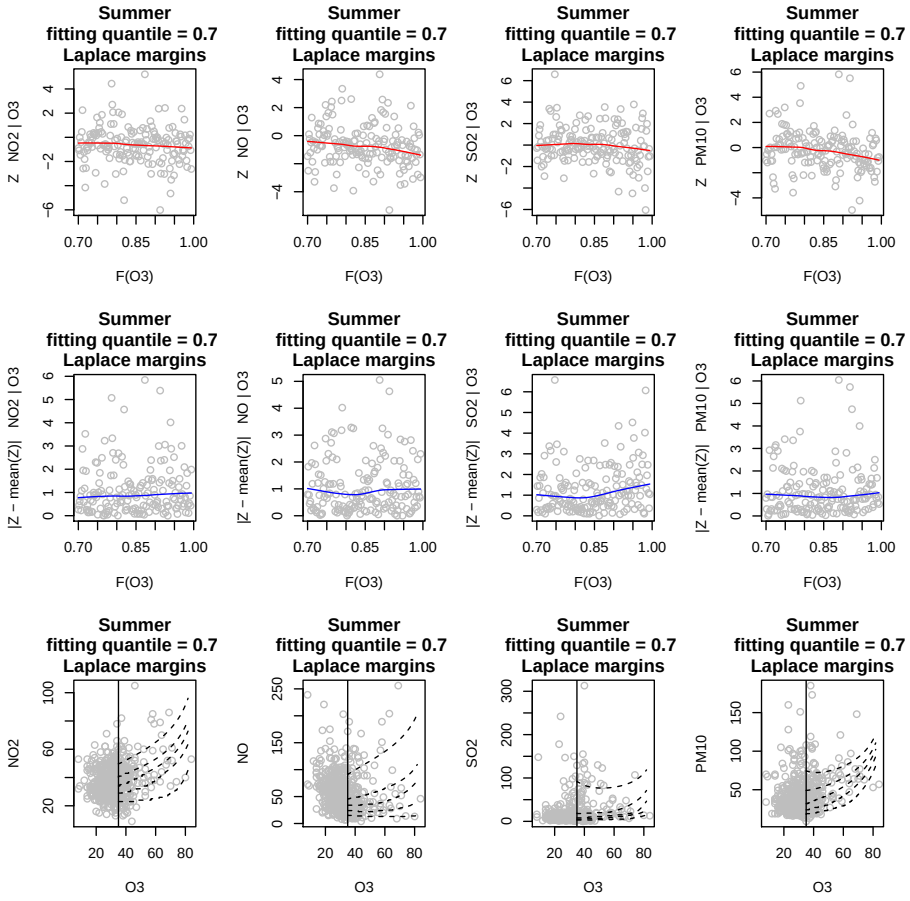

Figure 40: Output from running the validation suite.

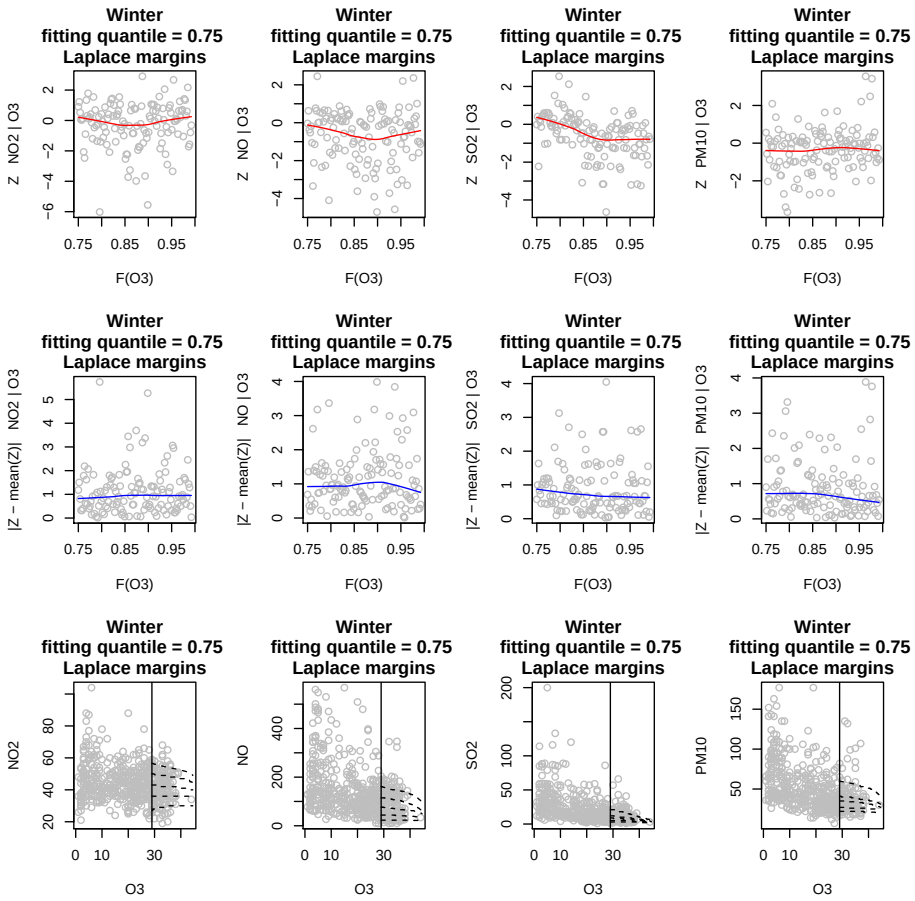

Figure 41: Output from running the validation suite.

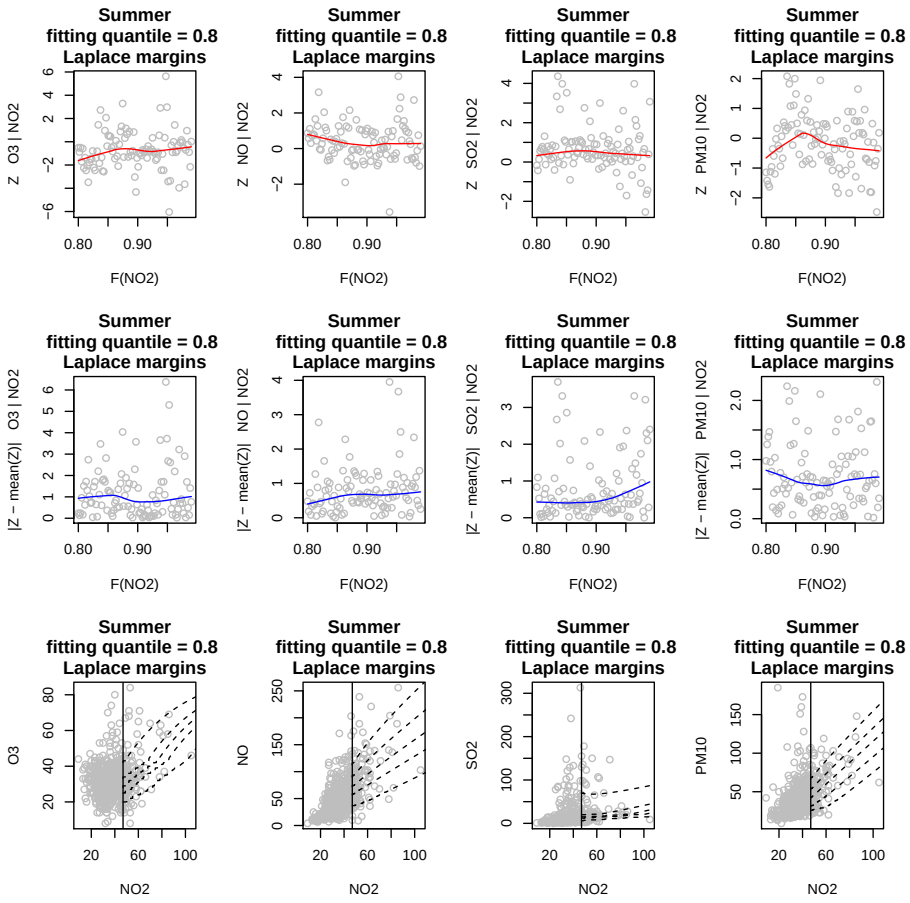

Figure 42: Output from running the validation suite.

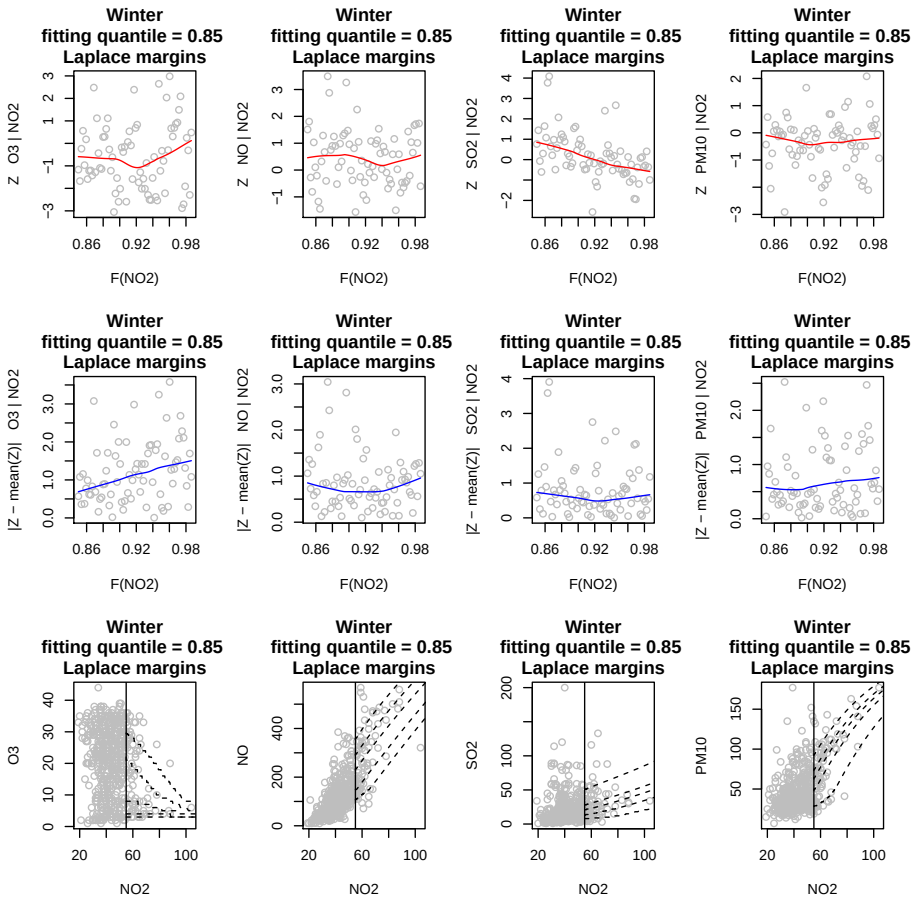

Figure 43: Output from running the validation suite.

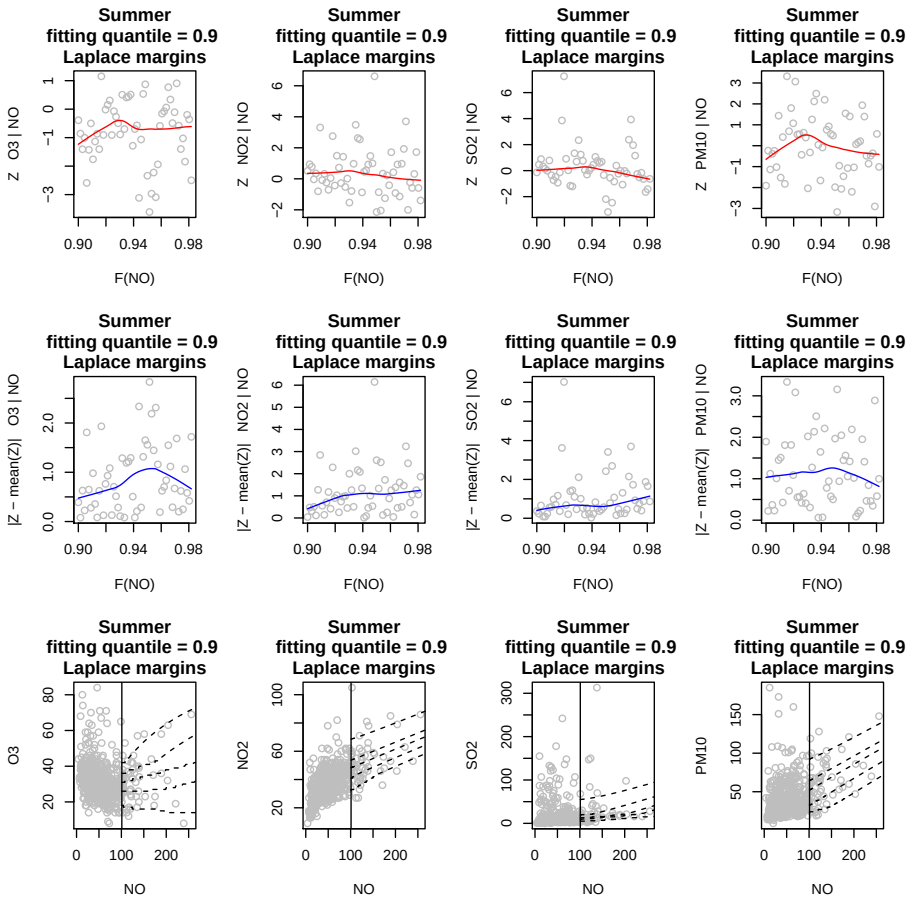

Figure 44: Output from running the validation suite.

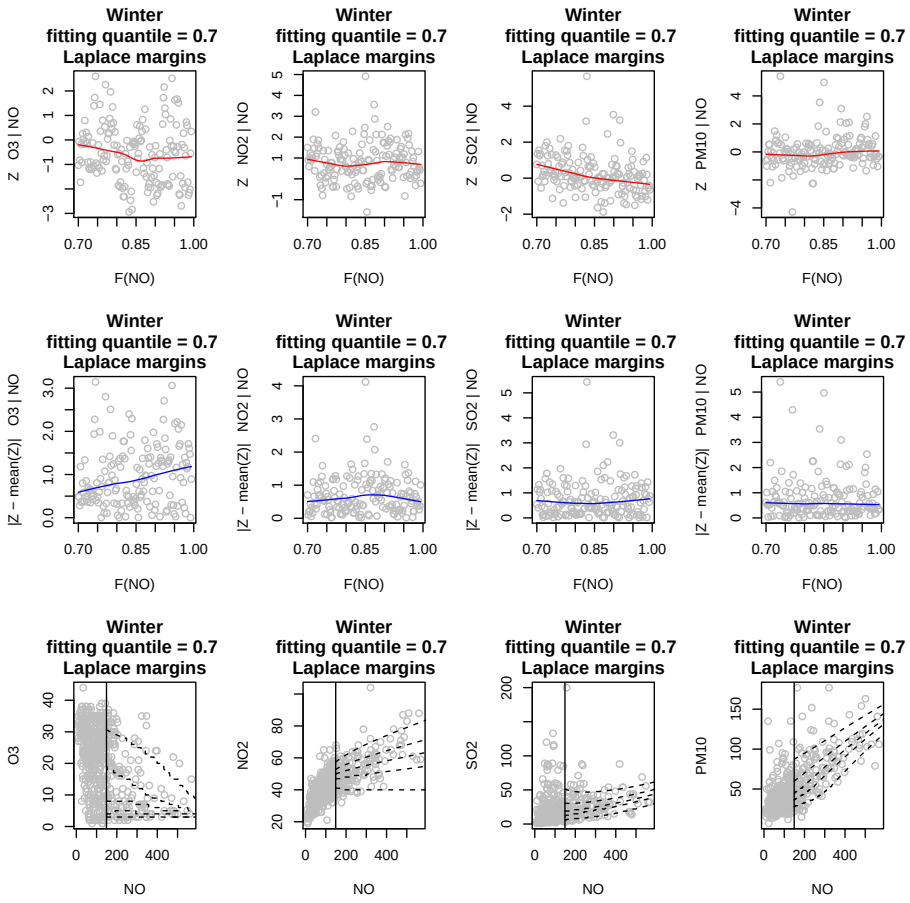

Figure 45: Output from running the validation suite.

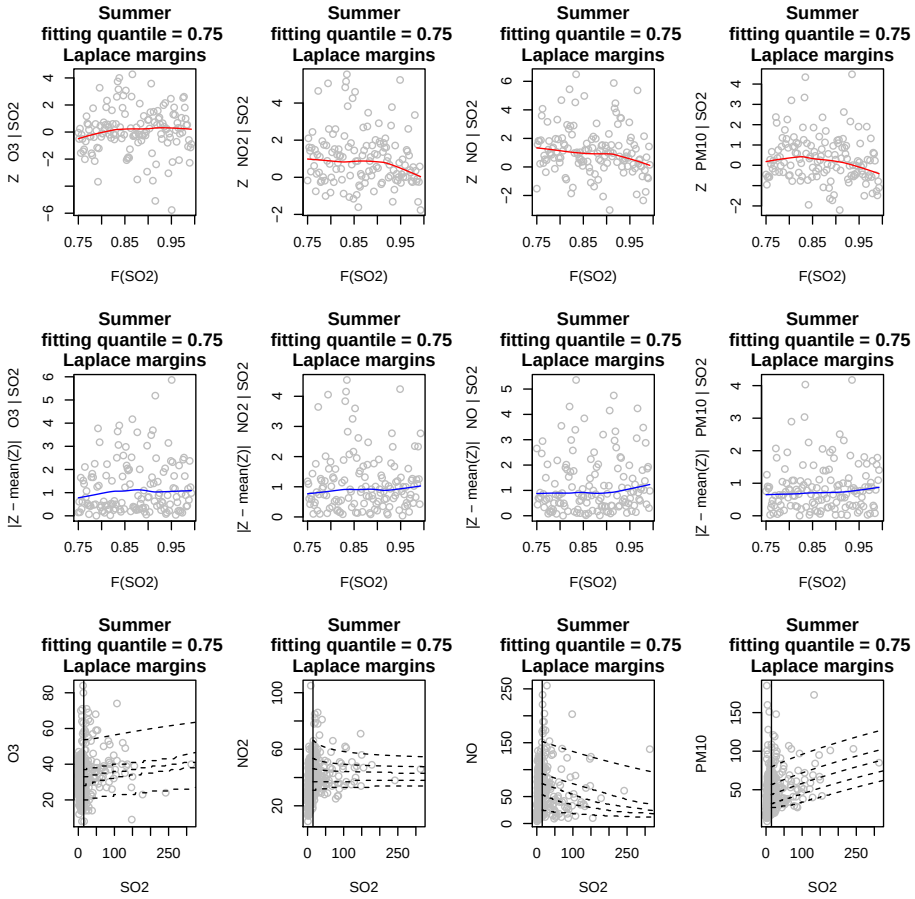

Figure 46: Output from running the validation suite.

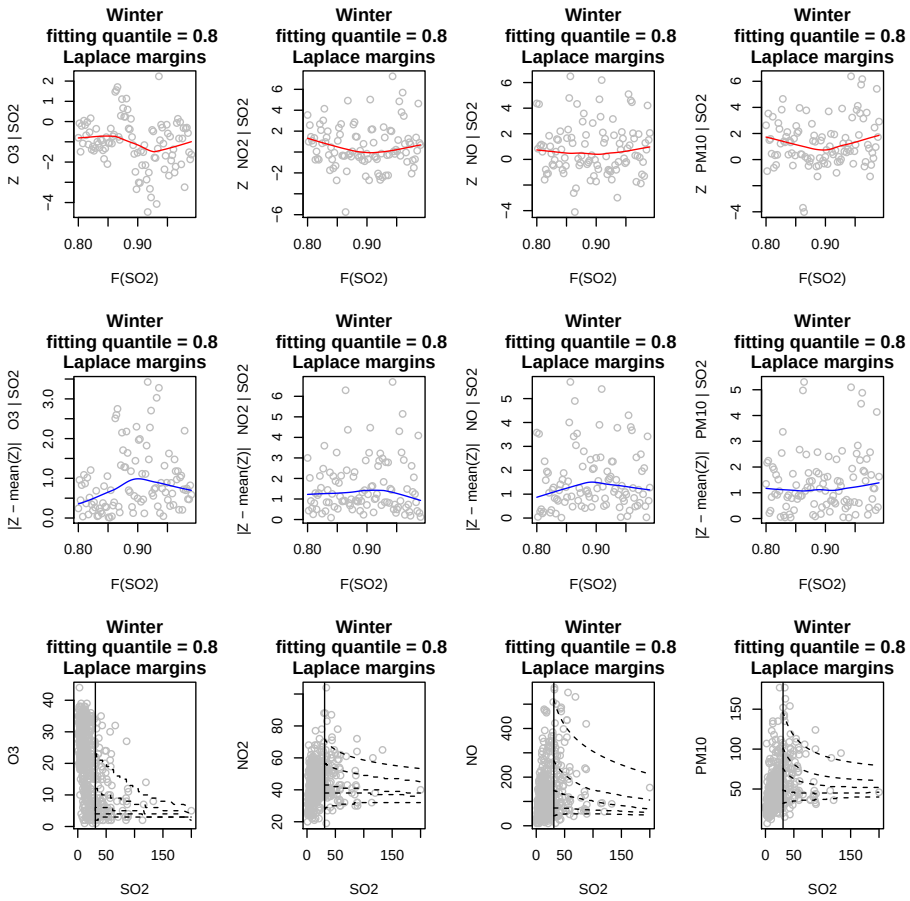

Figure 47: Output from running the validation suite.

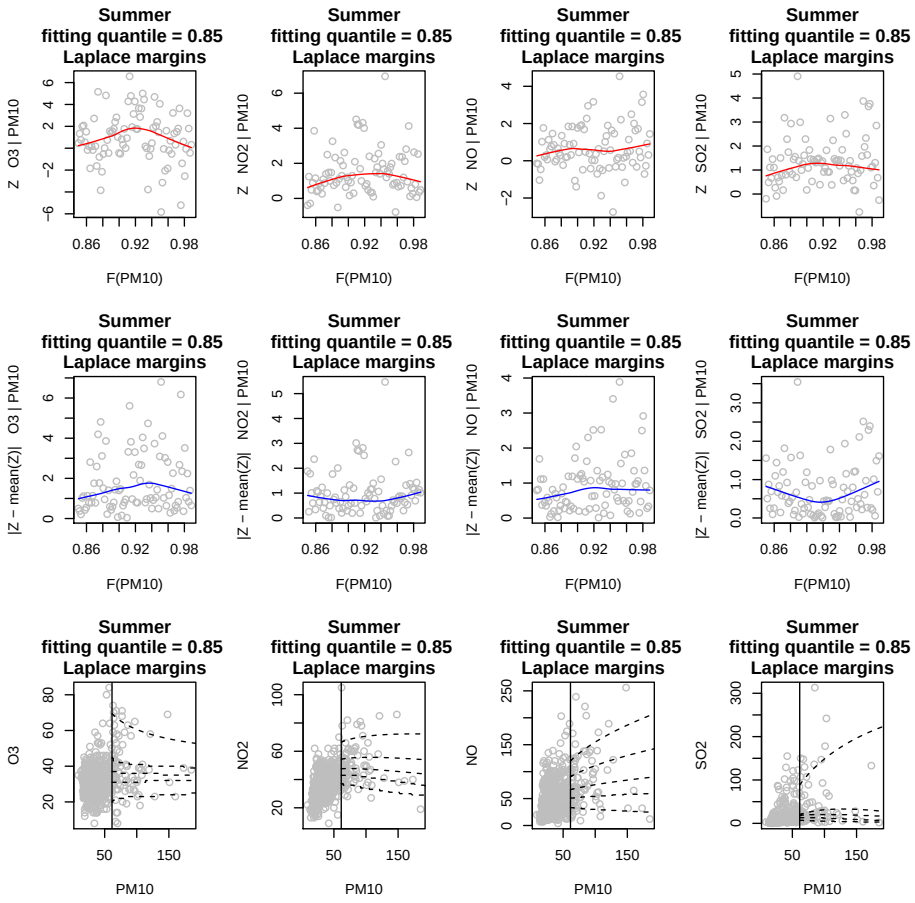

Figure 48: Output from running the validation suite.

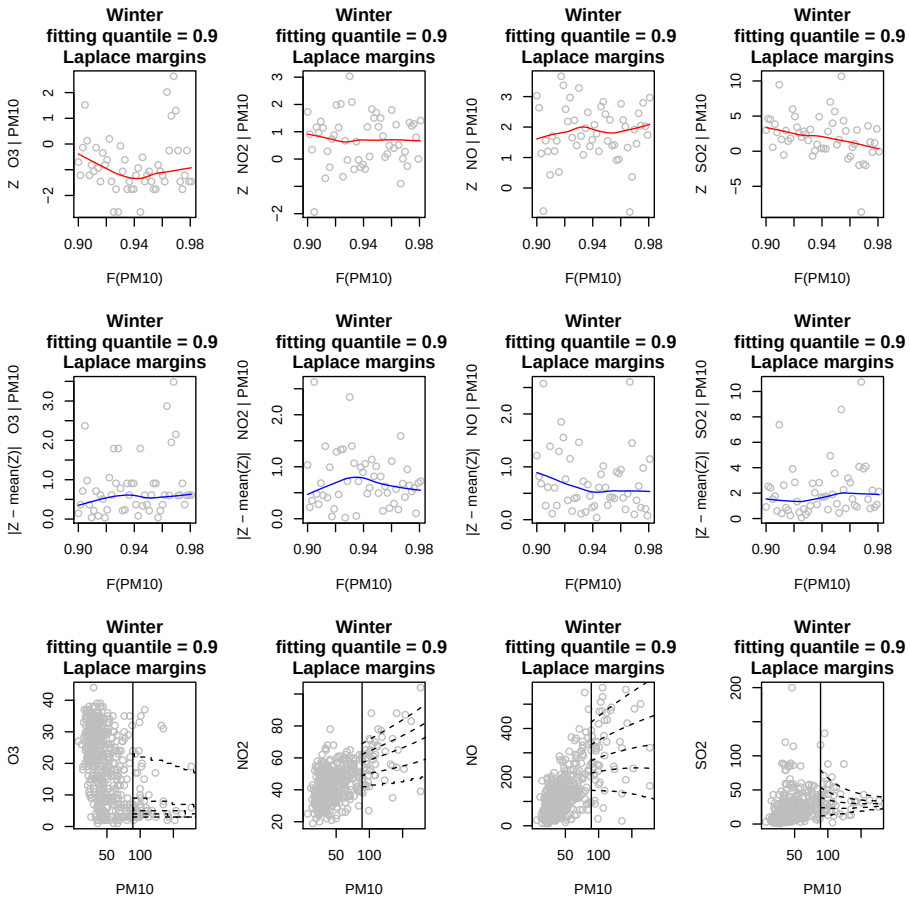

Figure 49: Output from running the validation suite.

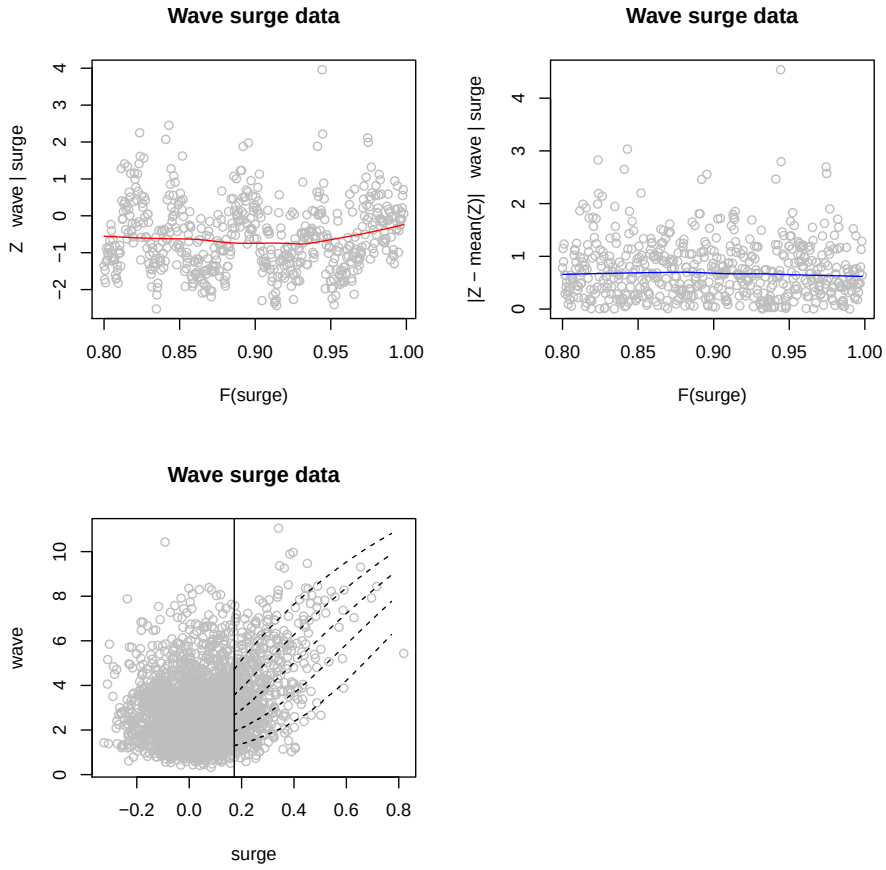

Figure 50: Output from running the validation suite.

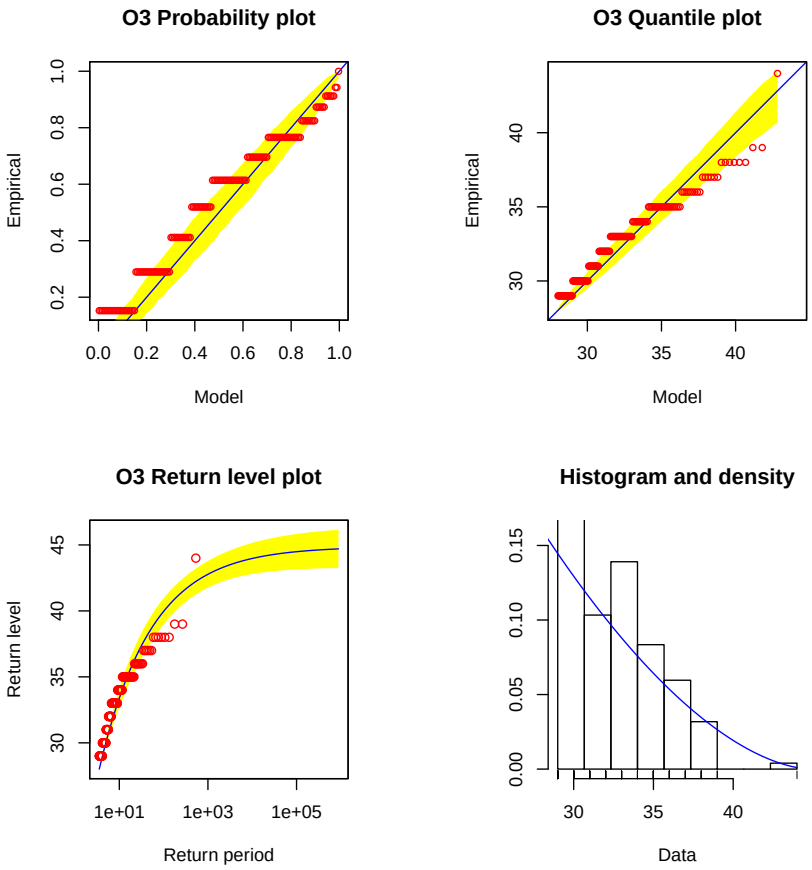

Figure 51: Output from running the validation suite.

```
## .
## plot.migpd :
```

```
## .
## plot.predict.evm :
## ...

## Ratio of bias to standard error is high
```

```
## Ratio of bias to standard error is high
```

```
## ...

## Ratio of bias to standard error is high
```

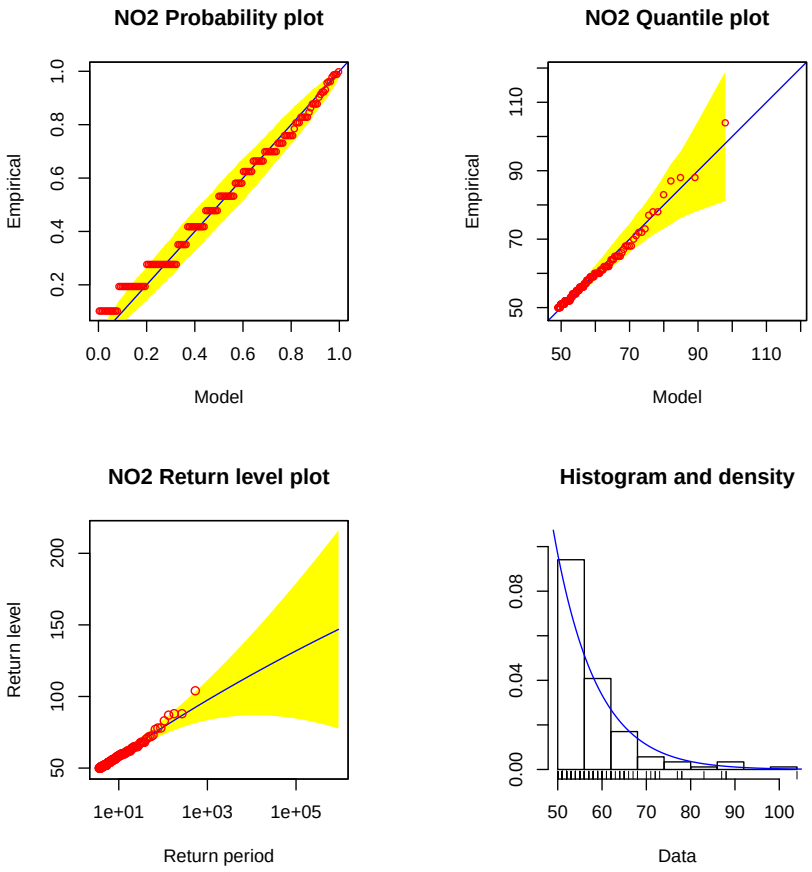

Figure 52: Output from running the validation suite.

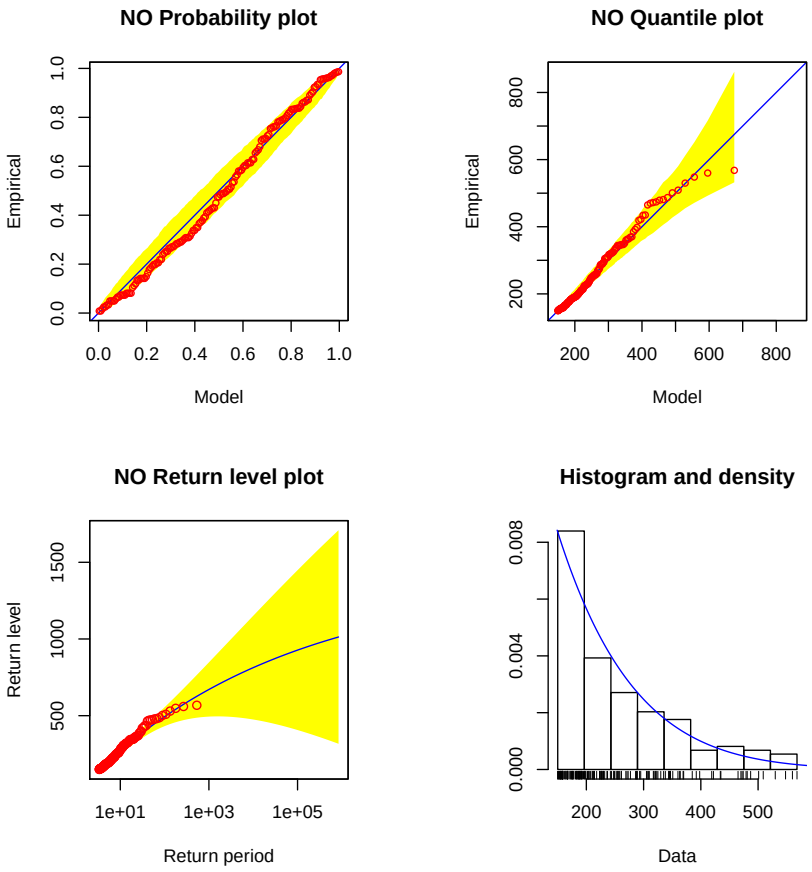

Figure 53: Output from running the validation suite.

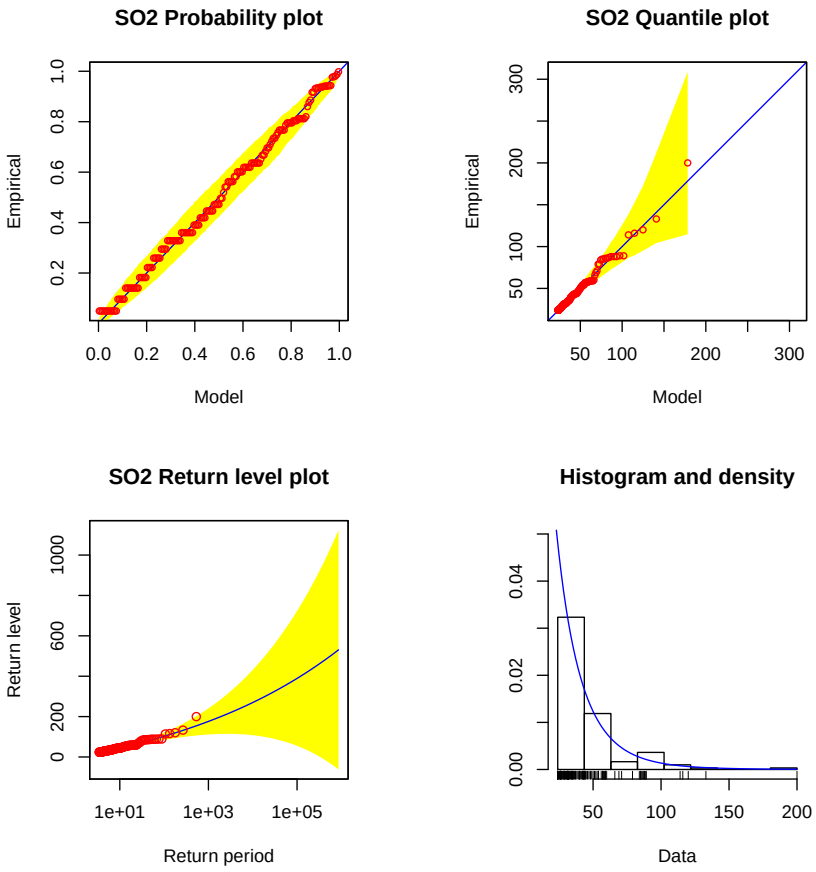

Figure 54: Output from running the validation suite.

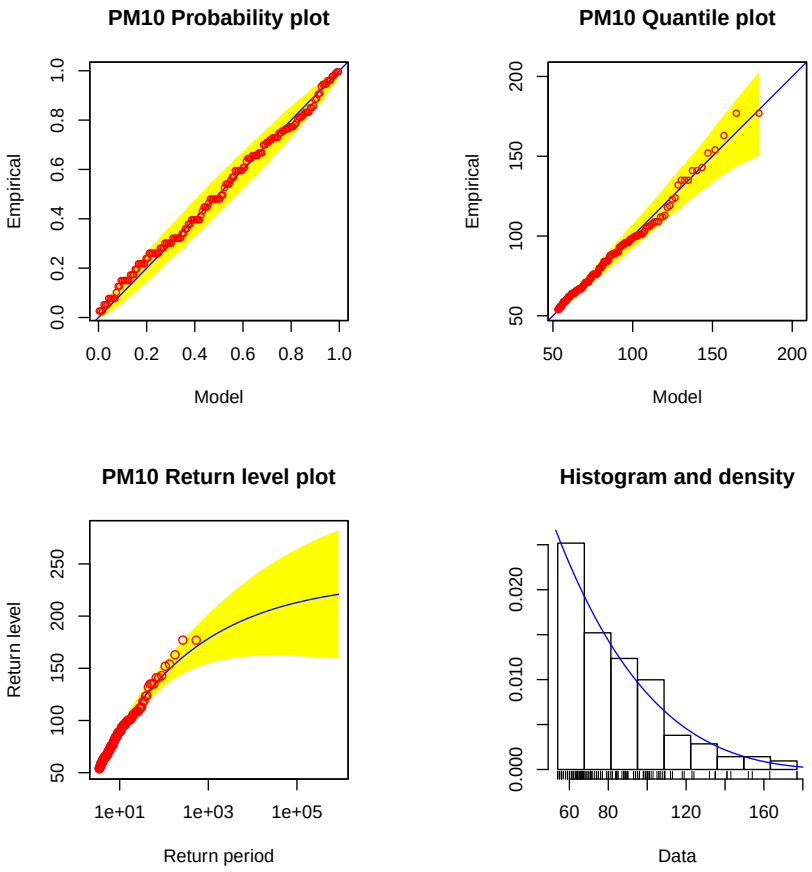

Figure 55: Output from running the validation suite.

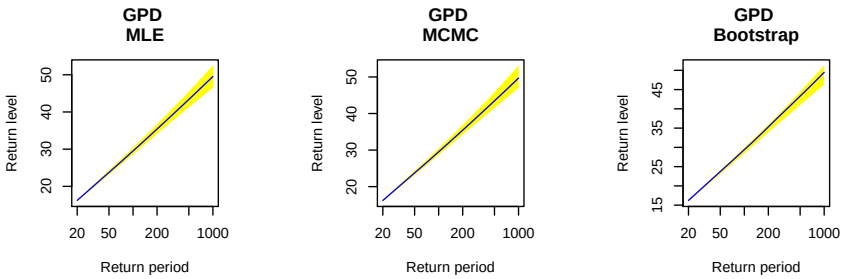

Figure 56: Output from running the validation suite.

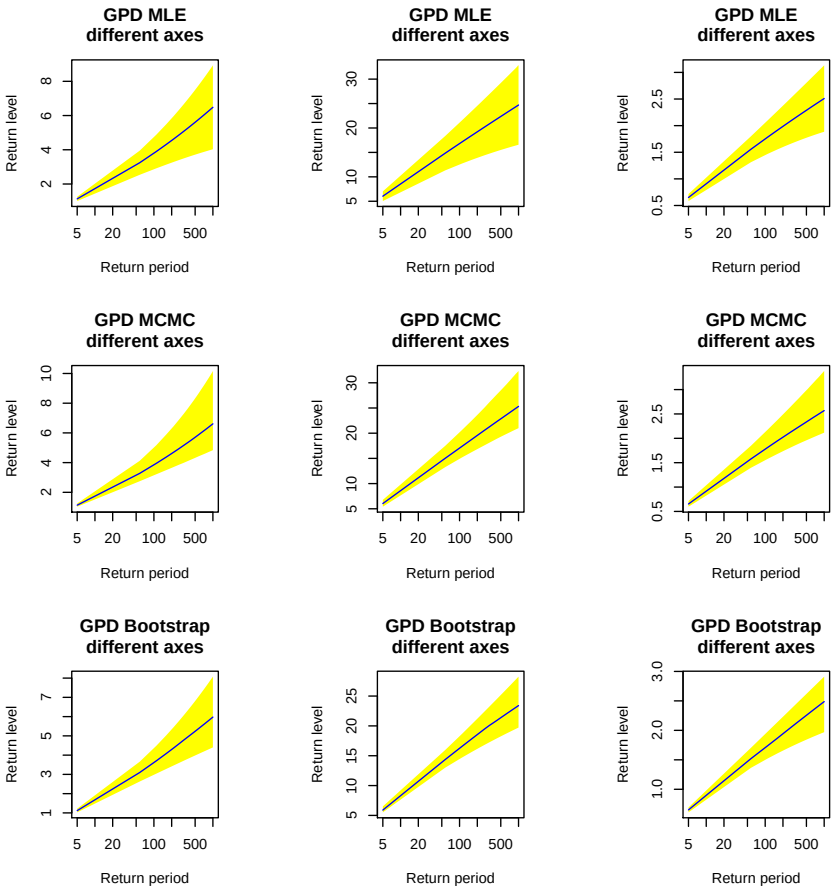

Figure 57: Output from running the validation suite.

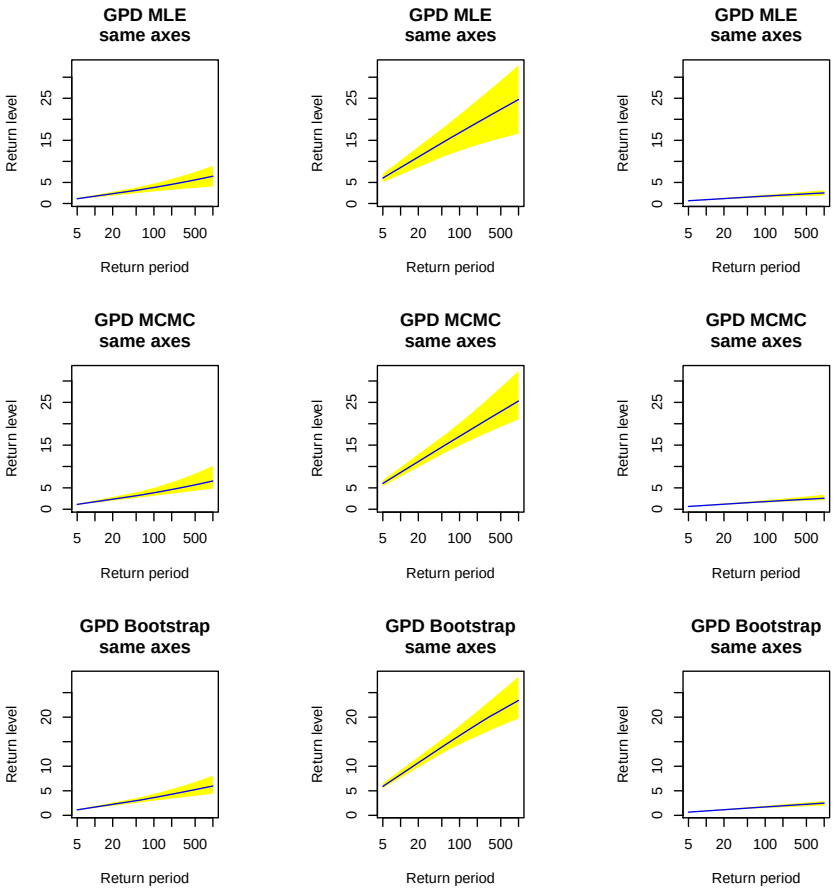

Figure 58: Output from running the validation suite.

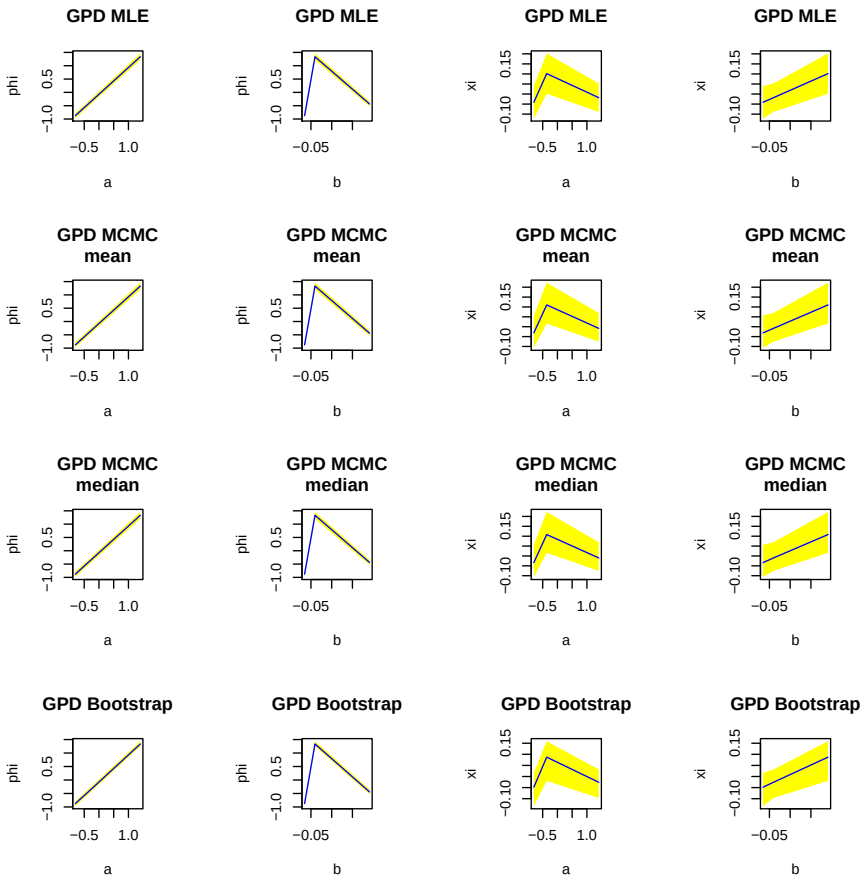

Figure 59: Output from running the validation suite.

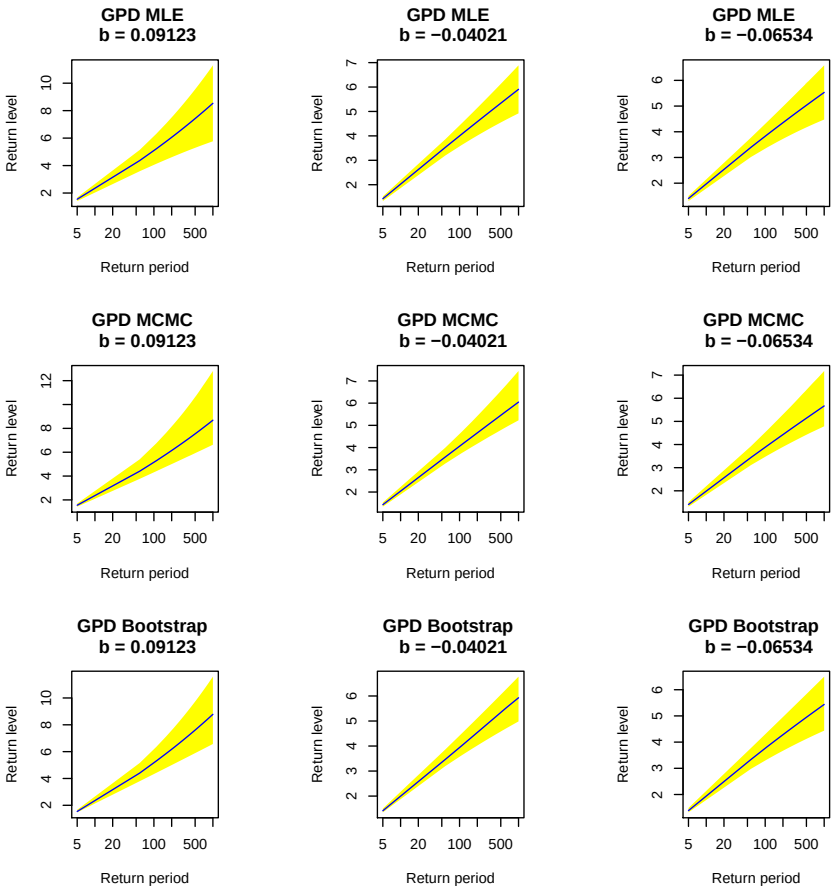

Figure 60: Output from running the validation suite.

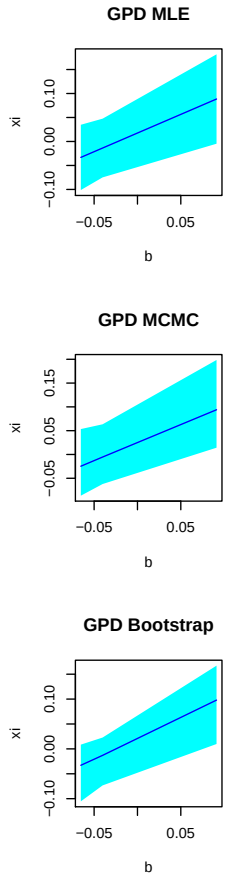

Figure 61: Output from running the validation suite.

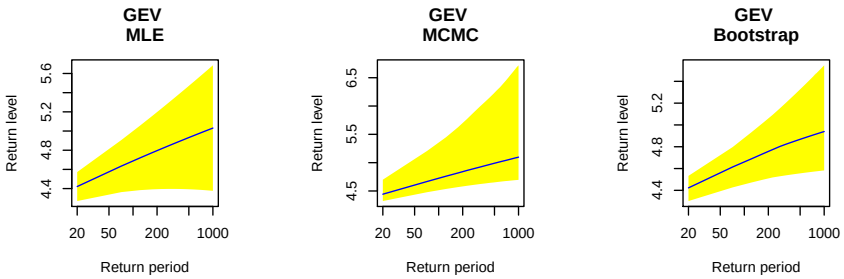

Figure 62: Output from running the validation suite.

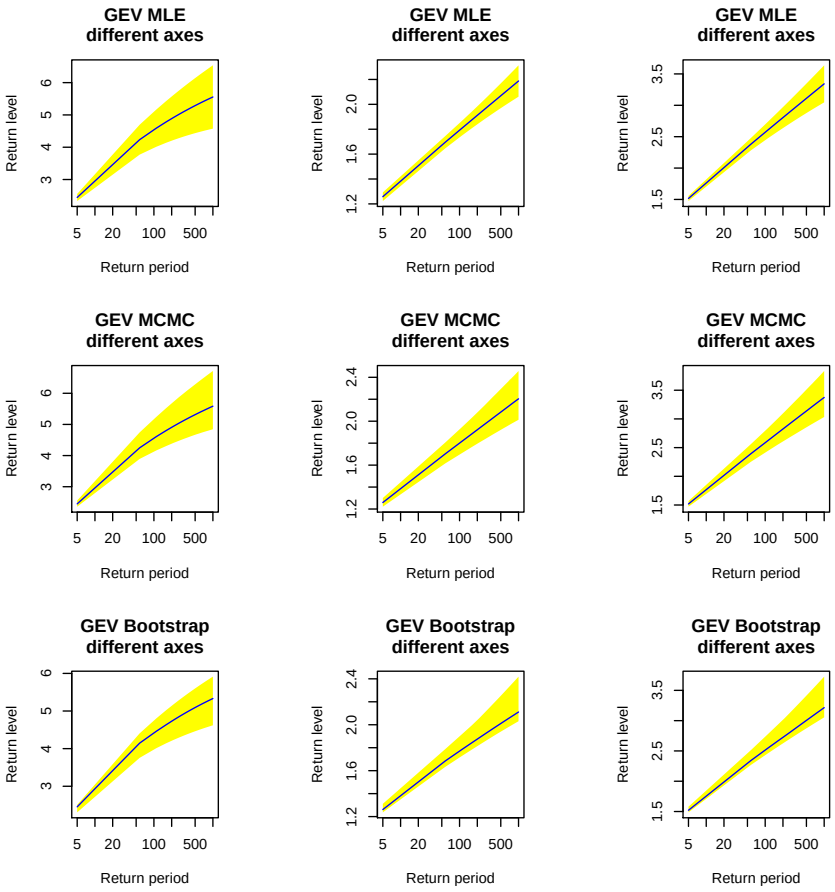

Figure 63: Output from running the validation suite.

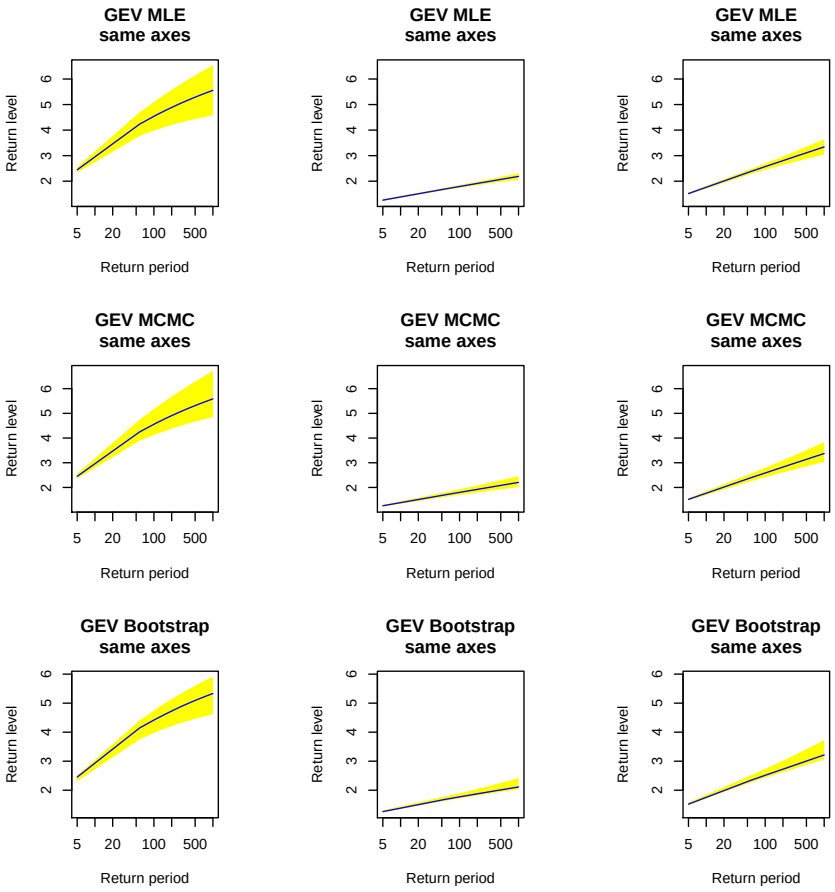

Figure 64: Output from running the validation suite.

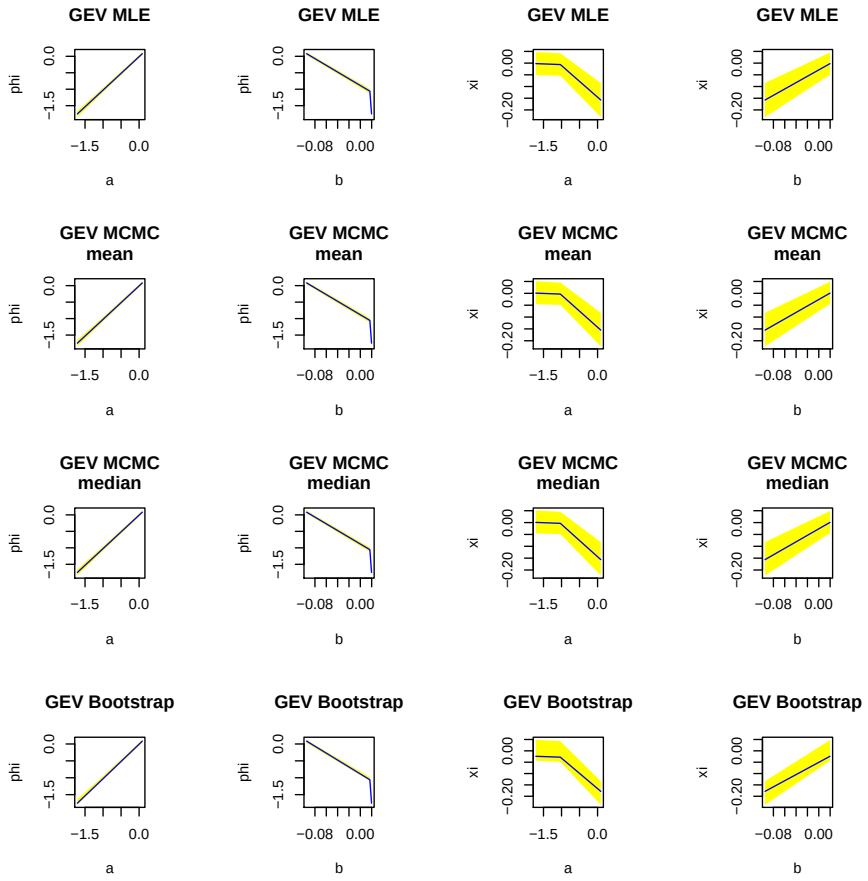

Figure 65: Output from running the validation suite.

```
## Ratio of bias to standard error is high
```

```
##
## plot.predict.mex :

## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
```

```
## .
```

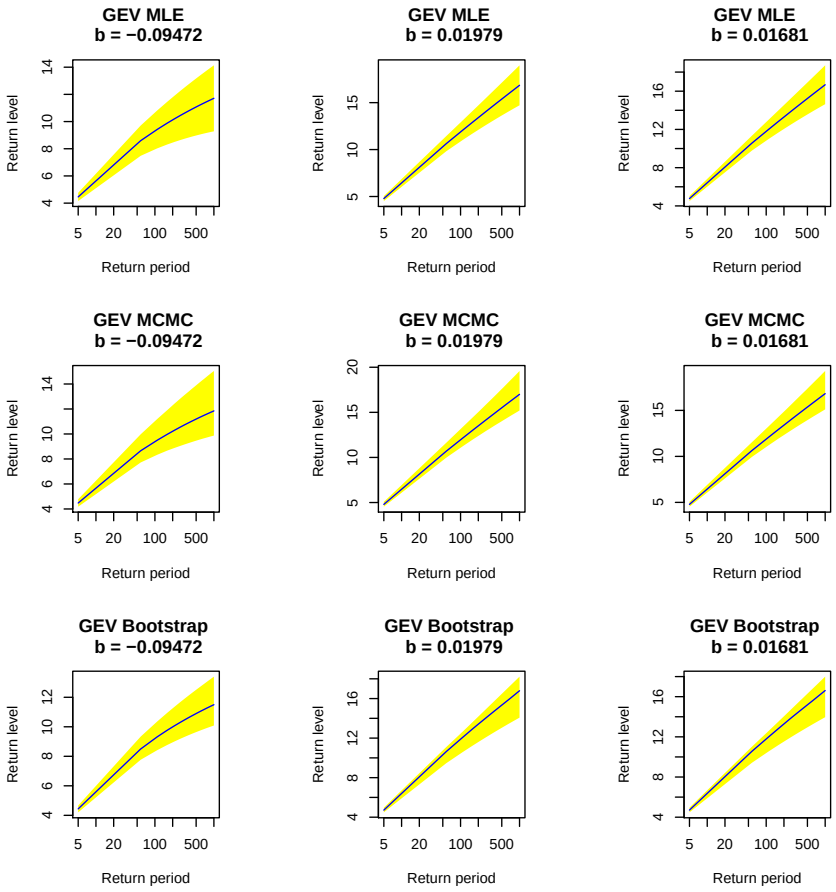

Figure 66: Output from running the validation suite.

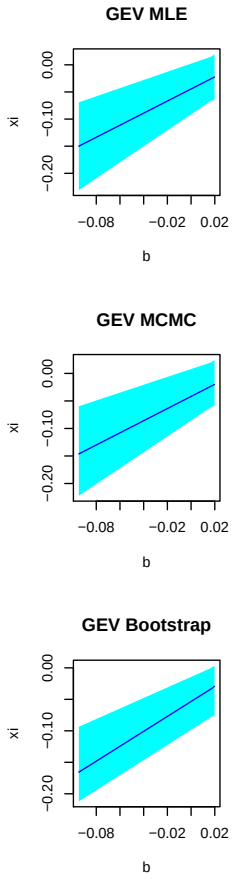

Figure 67: Output from running the validation suite.

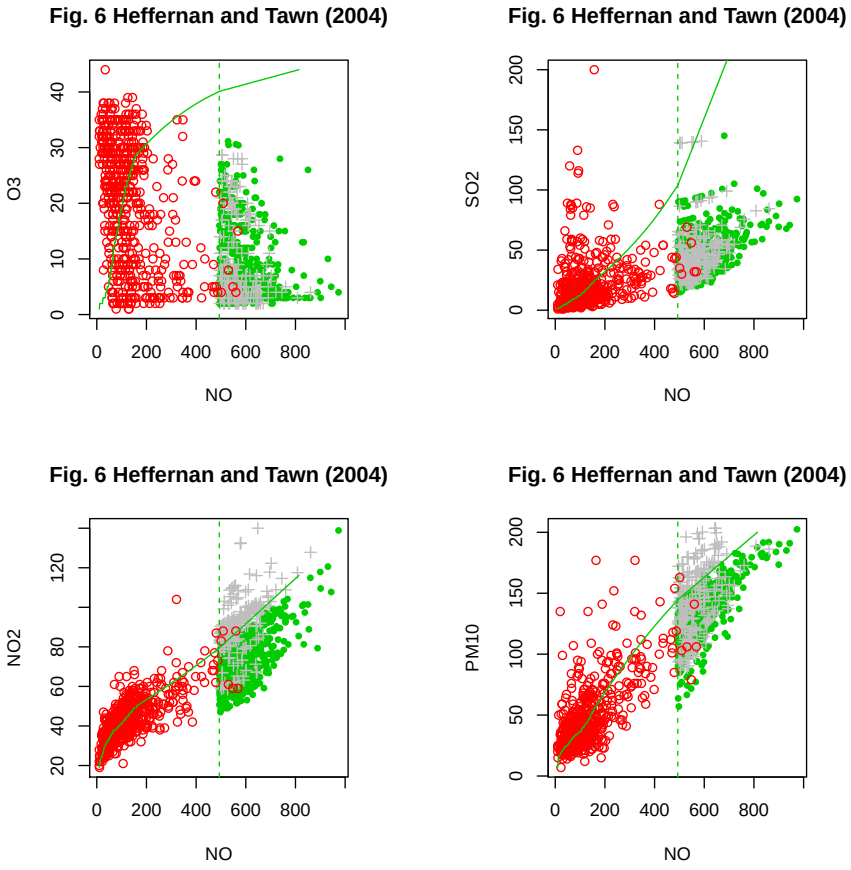

Figure 68: Output from running the validation suite.

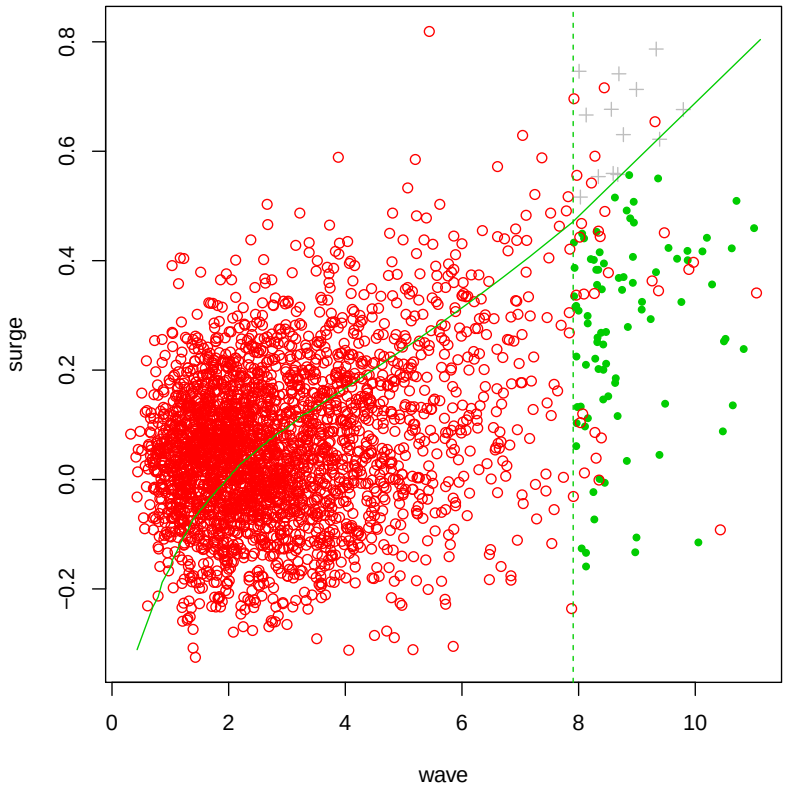

Figure 69: Output from running the validation suite.

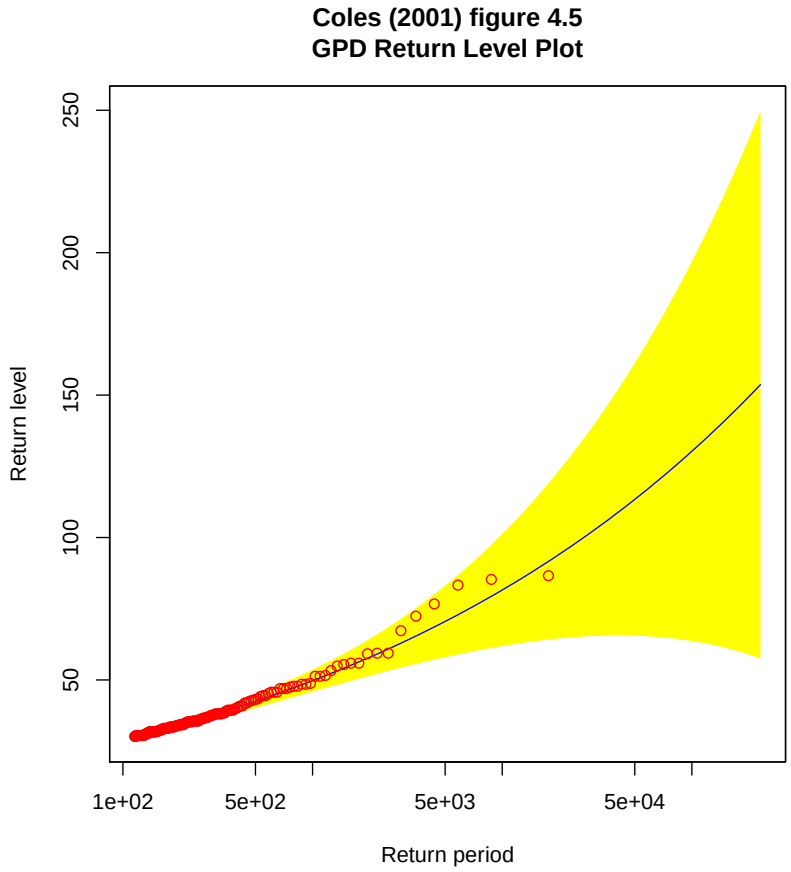

Figure 70: Output from running the validation suite.

```
## .
## plotrl.evm :
```

```
## ..
## predict.evmBoot :

## Ratio of bias to standard error is high
```

```
## ..........................................
```

```
## Ratio of bias to standard error is high
```

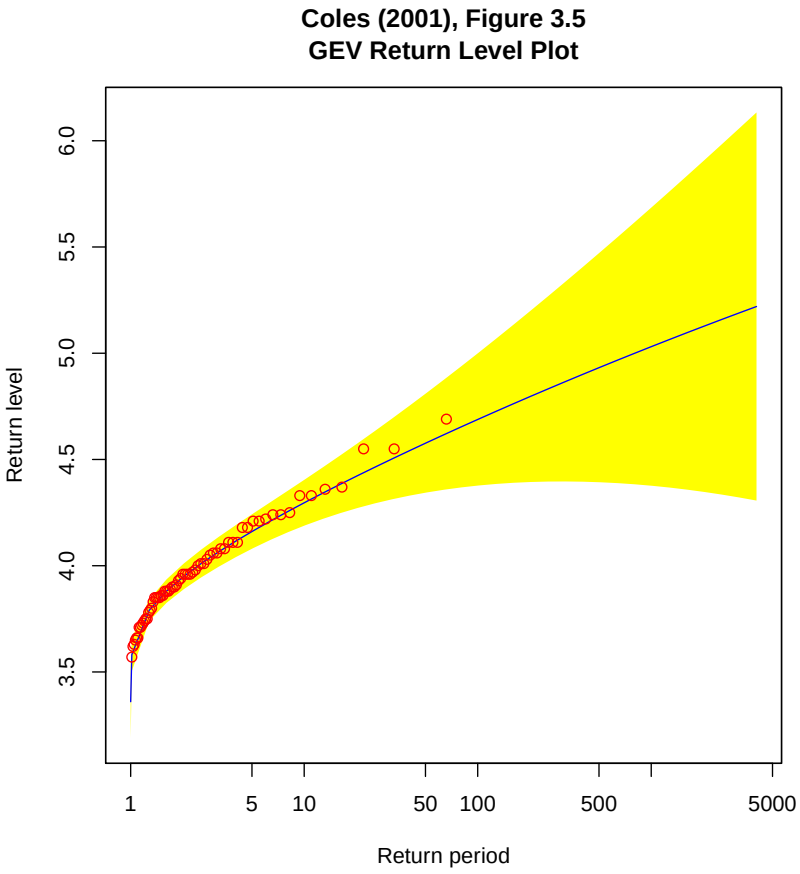

Figure 71: Output from running the validation suite.

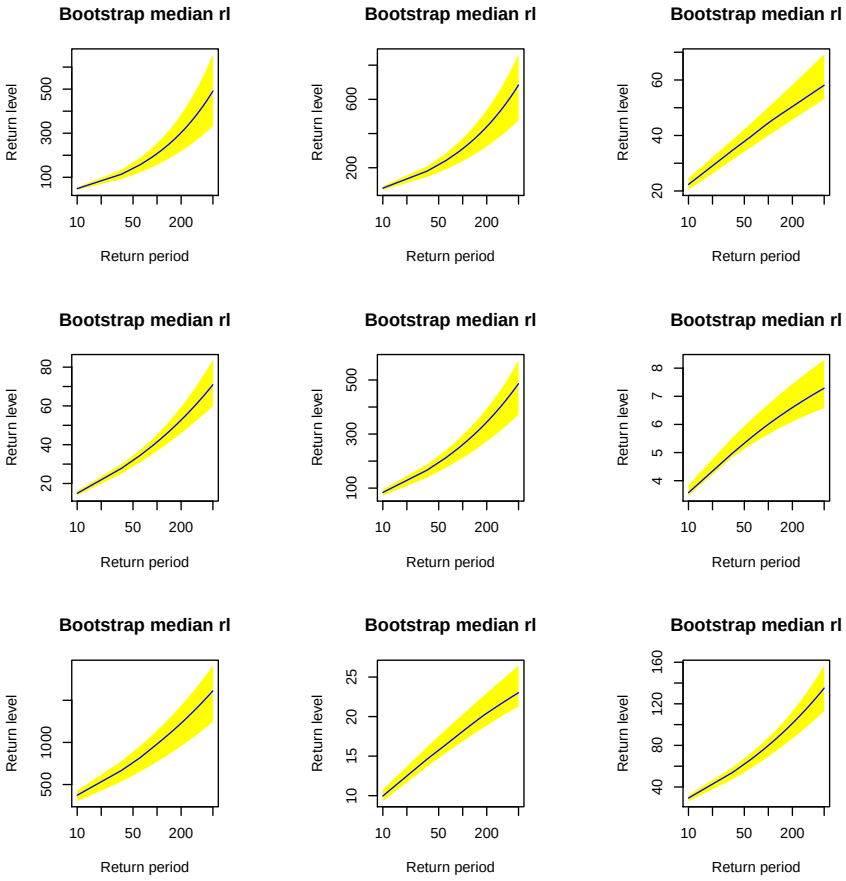

Figure 72: Output from running the validation suite.

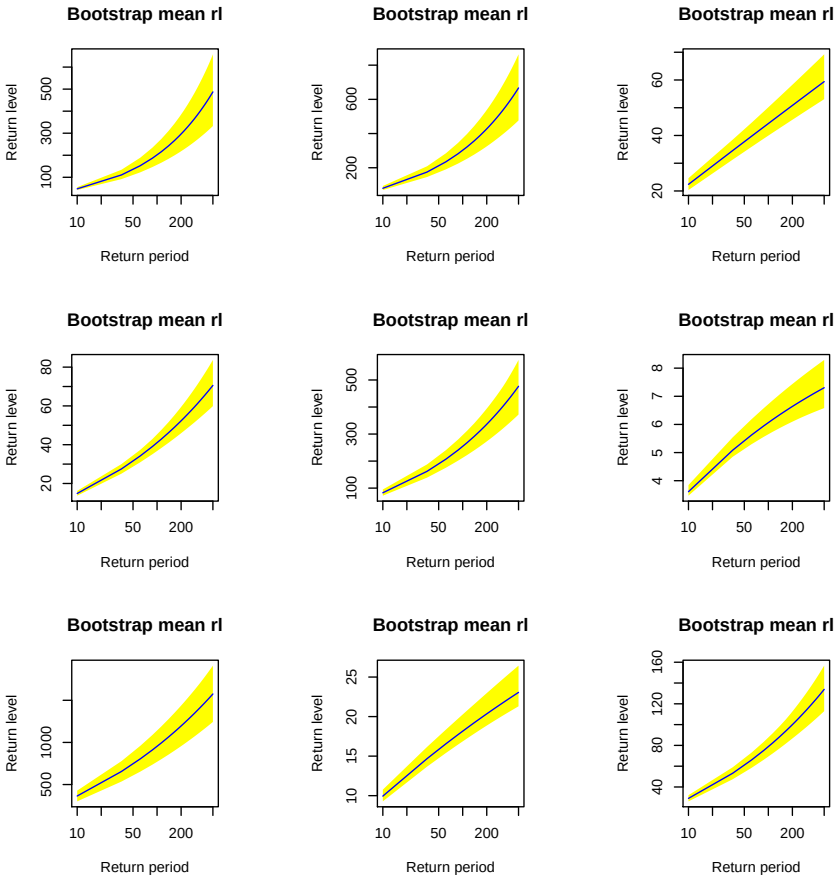

Figure 73: Output from running the validation suite.

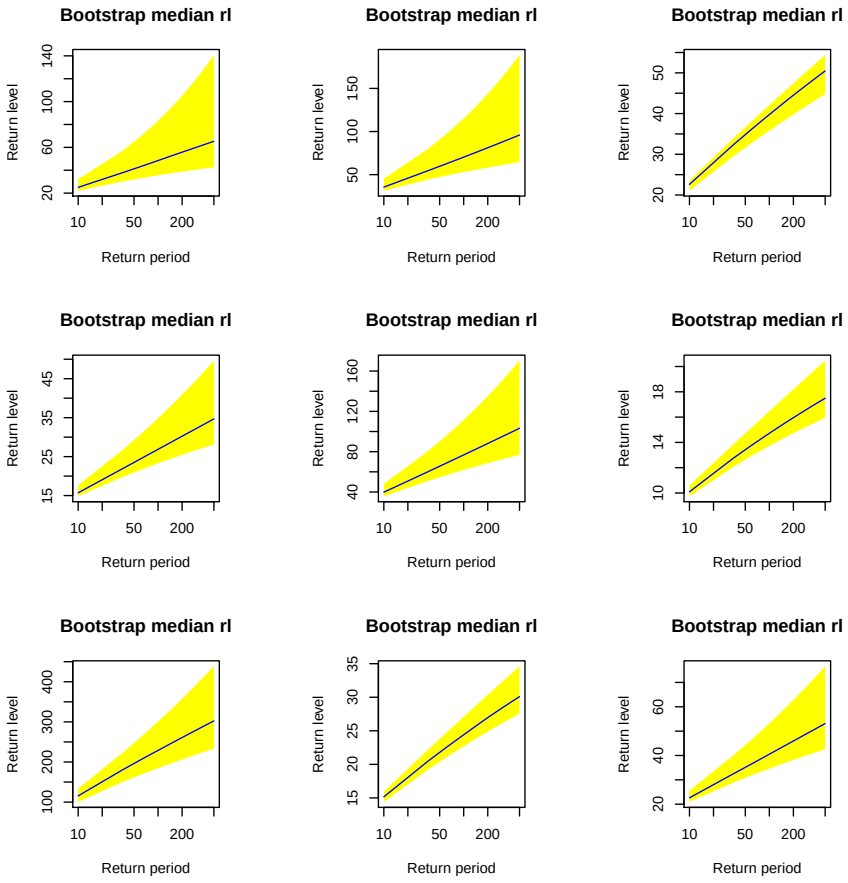

Figure 74: Output from running the validation suite.

```
## ..............................................
```

```
##
## predict.evmOpt : ..................................................................................
## predict.evmSim : ..................................................................
## predict.mex :

## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
```

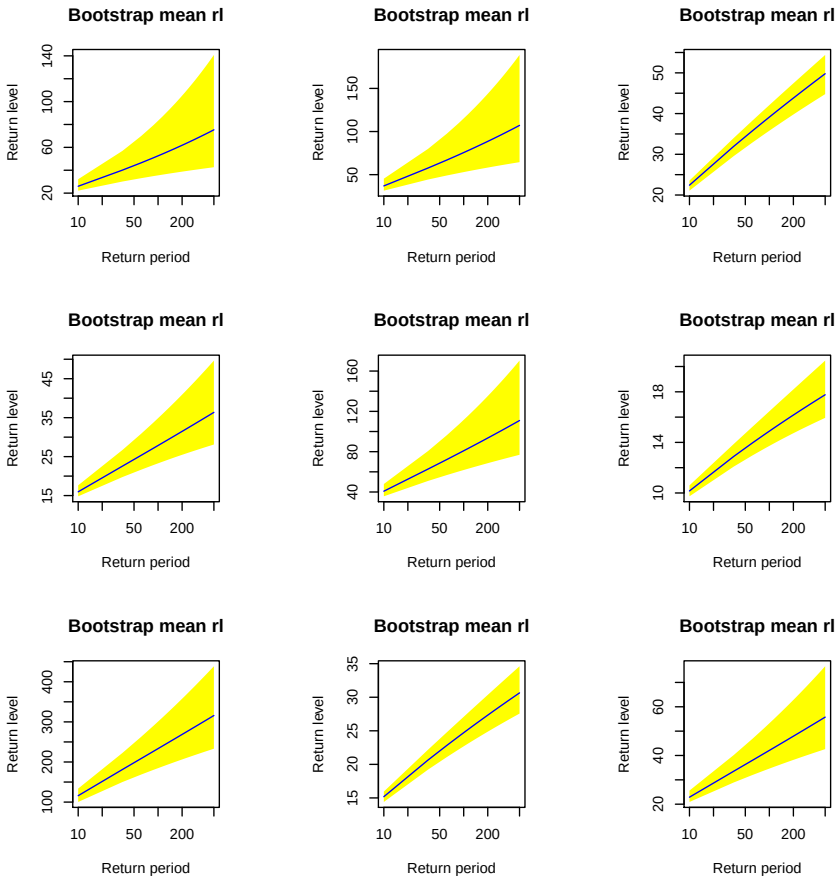

Figure 75: Output from running the validation suite.

```
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
## Fitted values of xi < -0.5
```

```
## ............
## qgev :
## qgpd : ...........
## revTransform : ....
## rgev :
## rgpd : ............................
## specfun.safe.product :
```

```
## thinAndBurn.evmSim : ..........
```

3 Appendix

3.1 Information on the R session

Information on the R session, in the interests of reproducibility.

```
## R version 3.1.1 (2014-07-10)
## Platform: i386-w64-mingw32/i386 (32-bit)
##
## locale:
## [1] LC_COLLATE=English_United Kingdom.1252
## [2] LC_CTYPE=English_United Kingdom.1252
## [3] LC_MONETARY=English_United Kingdom.1252
## [4] LC_NUMERIC=C
## [5] LC_TIME=English_United Kingdom.1252
##
## attached base packages:
## [1] parallel  stats     graphics  grDevices utils     datasets  methods
## [8] base
##
## other attached packages:
## [1] MASS_7.3-33    testthat_0.9.1 texmex_2.3     mvtnorm_1.0-0
## [5] knitr_1.6
##
## loaded via a namespace (and not attached):
## [1] evaluate_0.5.5 formatR_1.0    highr_0.3      stringr_0.6.2
## [5] tools_3.1.1
```

References

[1] Harry Southworth and Janet E. Heffernan, texmex: Statistical modelling of extreme values, 2014

[2] Stuart Coles, An Introduction to the Statistical Modeling of Extreme Values, Springer, 2001

[3] Janet E. Heffernan and Jonathan A. Tawn, A conditional approach for multivariate extreme values, Journal of the Royal Statistical Society, Series B, 66, 497 – 546, 2004

[4] Hadley Wickham, testthat: Get Started with Testing. The R Journal, vol. 3, no. 1, pp. 5–10, 2011

[5] R Core Team, R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, 2013

[6] Stuart Coles, Janet E. Heffernan and Alec G. Stephenson, ismev: An Introduction to Statistical Modeling of Extreme Values, 2012

[7] A. G. Stephenson, evd: Extreme Value Distributions. R News, 2(2):31-32, June 2002.

[8] Ioannis Papastathopoulos, Statistical Models for Pharmaceutical Extremes, PhD Thesis, Lancaster University, 2013