

# Supplementary material for "Calibrating a process-based forest model with a rich observational dataset at 22 European forest sites."

David Cameron, Christophe Flechard, Marcel van Oijen

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## Contents

1	Forest site map	1
2	Generic prior parameter ranges	2
3	Site specific priors for rooting depth and soil water retention	2
4	Historic N deposition timeseries	2
5	RMS deviation plots	2

## 1 Forest site map

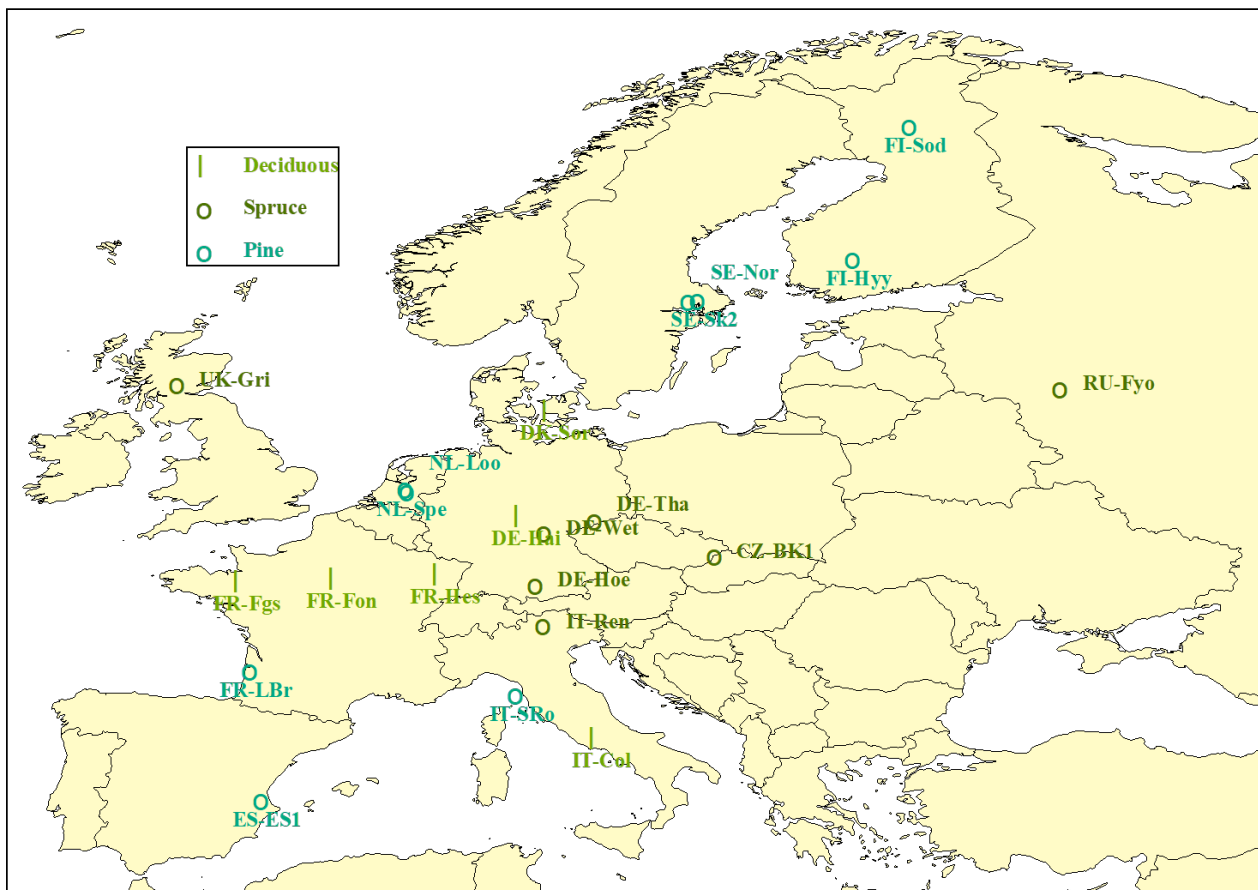


Figure 1: Geographic distribution of calibrated forest sites. Site abbreviations follow the FLUXNET convention.

## 2 Generic prior parameter ranges

parameter	pine or spruce			deciduous		
	min	mode	max	min	mode	max
BETA	0.3	0.5	0.7	0.3	0.5	0.7
CBTREE0	0.00025	5e-04	0.001	0.00025	5e-04	0.001
CLTREE0	5e-05	1e-04	2e-04	5e-05	1e-04	2e-04
CRTREE0	5e-05	1e-04	2e-04	5e-05	1e-04	2e-04
CSTREE0	0.00025	5e-04	0.001	0.00025	5e-04	0.001
FB	0.25	0.285	0.3	0.275	0.31	0.325
FLMAX	0.27	0.3	0.37	0.25	0.28	0.35
FNCLMIN	0.3	0.5	0.7	0.3	0.5	0.7
FS	0.25	0.285	0.3	0.275	0.31	0.325
FTCCLMIN	0.5	0.9	1	0.4	0.55	1
GAMMA	0.4	0.5	0.6	0.4	0.5	0.6
KAC	3	8	15	3	9.5	15
KACEXP	0.3	0.375	0.45	0.3	0.375	0.45
KBA	1	2	3	1	2	3
KEXT	0.35	0.5	0.65	0.35	0.5	0.65
KH	3	8	20	3	8	20
KHEXP	0.2	0.25	0.3	0.2	0.25	0.3
KNMIN	5e-04	0.001	0.002	5e-04	0.001	0.002
KNUPT	5e-04	0.001	0.002	5e-04	0.001	0.002
KRAININT	0.15	0.25	0.4	0.15	0.25	0.4
LUEMAX	0.001	0.002	0.003	0.001	0.002	0.003
NCLMAX	0.02	0.04	0.05	0.03	0.06	0.075
NCR	0.02	0.03	0.04	0.02	0.03	0.04
NCW	5e-04	0.001	0.002	5e-04	0.001	0.002
SLA	2.5	5	10	15	30	50
TCCB	3103	6205	12410	3103	6205	12410
TCCLMAX	720	1440	2160	2	3	10
TCCR	1825	5000	7300	1825	4000	7300
TOPT	12	20	28	12	20	28
TTOL	5	10	50	5	10	50
TRANCO	4	6	8	4	6	8
WOODDENS	170	205	250	250	320	400
CNLITTO	25	35	45	25	35	45
CNSOMF0	15	25	40	10	15	25
CNSOMS0	15	25	40	10	15	25
FCOMF0	0.1	0.18	0.3	0.2	0.32	0.4
FLITTSOMF	0.4	0.6	0.8	0.4	0.6	0.8
FSOMFSOMS	0.01	0.03	0.06	0.01	0.03	0.06
RNLEACH	0.1	0.9	1	0.1	0.6	1
KNEMIT	3e-04	6e-04	0.001	2e-04	3e-04	0.001
TCLITT	300	730	1000	300	530	1000
TCSOMF	10000	18250	30000	6500	12250	25000
TCSOMS	1e+05	182500	3e+05	65000	122500	250000
TMAXF	35	50	65	35	50	65
TSIGMAF	15	19	23	15	19	23
RFN2O	5	8.73	13	5	8.5	13
WFPS50N2O	0.5	0.72	0.9	0.5	0.62	0.9
LAIMAX				5	7	9
CLITT	0.5	1.0	2.0	0.5	0.8	1.5
CSOM	5.0	10.	20.	5.0	8.0	15.0

## 3 Site specific priors for rooting depth and soil water retention

## 4 Historic N deposition timeseries

## 5 RMS deviation plots

Table 1: Prior parameter ranges for pine sites

parameter name	min	mode	max	units	site
ROOTD	1.9	2	2.1	m	ES-ES1
ROOTD	0.41	0.61	0.92	m	FI-Hyy
ROOTD	1	1.5	2.25	m	FI-Sod
ROOTD	0.8	1.2	1.8	m	FR-LBr
ROOTD	0.5	1.5	3	m	IT-SRo
ROOTD	0.33	0.5	0.75	m	NL-Loo
ROOTD	0.67	1	1.5	m	NL-Spe
ROOTD	0.47	0.7	1.05	m	SE-Nor
ROOTD	0.67	1	1.5	m	SE-Sk2
WCST	0.26	0.37	0.48	m <sup>3</sup> m <sup>-3</sup>	ES-ES1
WCST	0.4	0.573	0.74	m <sup>3</sup> m <sup>-3</sup>	FI-Hyy
WCST	0.33	0.47	0.61	m <sup>3</sup> m <sup>-3</sup>	FI-Sod
WCST	0.31	0.44	0.58	m <sup>3</sup> m <sup>-3</sup>	FR-LBr
WCST	0.27	0.38	0.5	m <sup>3</sup> m <sup>-3</sup>	IT-SRo
WCST	0.17	0.25	0.33	m <sup>3</sup> m <sup>-3</sup>	NL-Loo
WCST	0.26	0.37	0.48	m <sup>3</sup> m <sup>-3</sup>	NL-Spe
WCST	0.28	0.39	0.51	m <sup>3</sup> m <sup>-3</sup>	SE-Nor
WCST	0.26	0.37	0.48	m <sup>3</sup> m <sup>-3</sup>	SE-Sk2
FWCWP	0.06	0.23	0.3	-	ES-ES1
FWCWP	0.11	0.14	0.17	-	FI-Hyy
FWCWP	0.01	0.22	0.31	-	FI-Sod
FWCWP	0.05	0.07	0.08	-	FR-LBr
FWCWP	0.1	0.12	0.15	-	IT-SRo
FWCWP	0.08	0.1	0.12	-	NL-Loo
FWCWP	0.14	0.23	0.3	-	NL-Spe
FWCWP	0.1	0.13	0.15	-	SE-Nor
FWCWP	0.09	0.15	0.21	-	SE-Sk2
FWCFC	0.32	0.53	0.74	-	ES-ES1
FWCFC	0.76	0.955	0.96	-	FI-Hyy
FWCFC	0.33	0.55	0.88	-	FI-Sod
FWCFC	0.3	0.38	0.93	-	FR-LBr
FWCFC	0.19	0.242	0.82	-	IT-SRo
FWCFC	0.39	0.49	0.59	-	NL-Loo
FWCFC	0.32	0.53	0.76	-	NL-Spe
FWCFC	0.34	0.43	0.66	-	SE-Nor
FWCFC	0.28	0.47	0.98	-	SE-Sk2

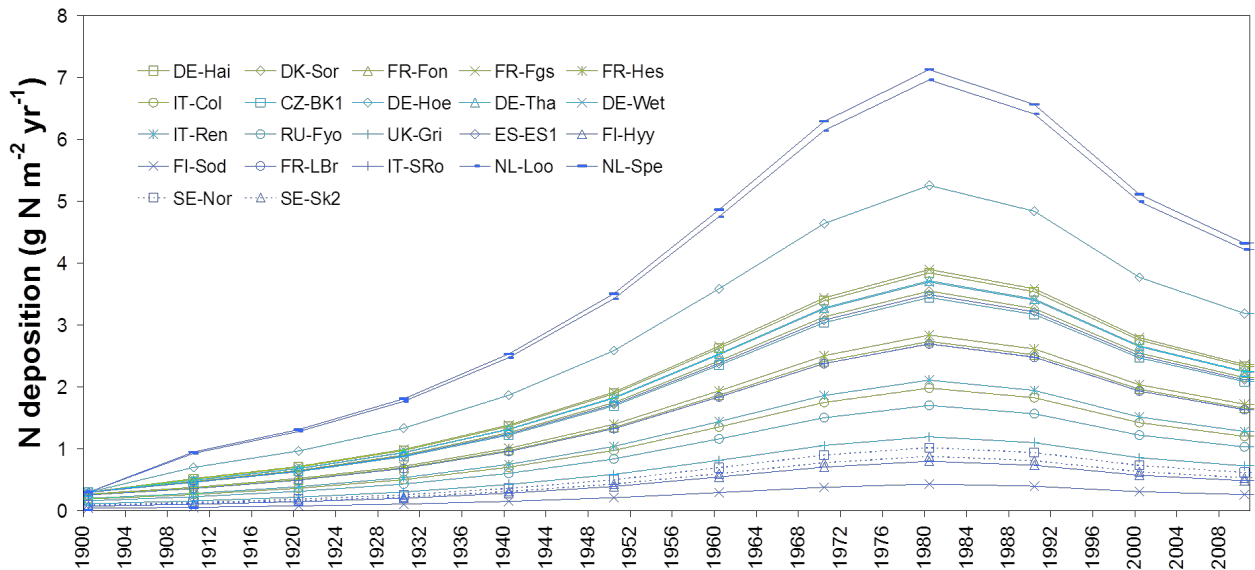


Figure 2: Historical N deposition over the 20th century used as inputs to the BASFOR model. The relative temporal evolution of Ndep was assumed to be identical for all sites and was derived from Fig.3, p72, in van Oijen et al. (2008).

Table 2: Prior parameter ranges for deciduous sites

parameter name	min	mode	max	unit	site
ROOTD	0.48	0.65	0.71	m	DE-Hai
ROOTD	0.7	0.77	0.85	m	DK-Sor
ROOTD	0.53	0.8	1.2	m	FR-Fon
ROOTD	0.97	1.45	2.18	m	FR-Hes
ROOTD	0.6	0.9	1.35	m	IT-Col
ROOTD	0.53	0.8	1.2	m	FR-Fgs
WCST	0.41	0.589	0.76	m <sup>3</sup> m <sup>-3</sup>	DE-Hai
WCST	0.32	0.457	0.59	m <sup>3</sup> m <sup>-3</sup>	DK-Sor
WCST	0.21	0.3	0.39	m <sup>3</sup> m <sup>-3</sup>	FR-Fon
WCST	0.42	0.6	0.78	m <sup>3</sup> m <sup>-3</sup>	FR-Hes
WCST	0.42	0.6	0.78	m <sup>3</sup> m <sup>-3</sup>	IT-Col
WCST	0.39	0.56	0.73	m <sup>3</sup> m <sup>-3</sup>	FR-Fgs
FWCWP	0.21	0.263	0.32	-	DE-Hai
FWCWP	0.11	0.186	0.25	-	DK-Sor
FWCWP	0.17	0.285	0.39	-	FR-Fon
FWCWP	0.13	0.167	0.2	-	FR-Hes
FWCWP	0.24	0.31	0.37	-	IT-Col
FWCWP	0.16	0.27	0.37	-	FR-Fgs
FWCFC	0.33	0.413	0.97	-	DE-Hai
FWCFC	0.26	0.427	0.9	-	DK-Sor
FWCFC	0.4	0.655	0.95	-	FR-Fon
FWCFC	0.53	0.667	0.8	-	FR-Hes
FWCFC	0.38	0.48	0.95	-	IT-Col
FWCFC	0.43	0.72	0.95	-	FR-Fgs

Table 3: Prior parameter ranges for spruce sites

parameter name	min	mode	max	unit	site
ROOTD	0.37	0.55	0.83	m	CZ-BK1
ROOTD	0.67	1	1.5	m	DE-Hoe
ROOTD	0.77	1.15	1.73	m	DE-Tha
ROOTD	0.29	0.44	0.66	m	DE-Wet
ROOTD	0.33	0.5	0.75	m	IT-Ren
ROOTD	0.2	0.3	0.45	m	RU-Fyo
ROOTD	0.67	1	1.5	m	UK-Gri
WCST	0.26	0.37	0.48	m <sup>3</sup> m <sup>-3</sup>	CZ-BK1
WCST	0.26	0.366	0.47	m <sup>3</sup> m <sup>-3</sup>	DE-Hoe
WCST	0.3	0.43	0.56	m <sup>3</sup> m <sup>-3</sup>	DE-Tha
WCST	0.33	0.47	0.61	m <sup>3</sup> m <sup>-3</sup>	DE-Wet
WCST	0.43	0.61	0.8	m <sup>3</sup> m <sup>-3</sup>	IT-Ren
WCST	0.43	0.61	0.8	m <sup>3</sup> m <sup>-3</sup>	RU-Fyo
WCST	0.43	0.62	0.8	m <sup>3</sup> m <sup>-3</sup>	UK-Gri
FWCWP	0.14	0.23	0.31	-	CZ-BK1
FWCWP	0.29	0.48	0.6	-	DE-Hoe
FWCWP	0.13	0.161	0.19	-	DE-Tha
FWCWP	0.22	0.369	0.42	-	DE-Wet
FWCWP	0.13	0.22	0.31	-	IT-Ren
FWCWP	0.1	0.2	0.35	-	RU-Fyo
FWCWP	0.32	0.54	0.65	-	UK-Gri
FWCFC	0.32	0.53	0.74	-	CZ-BK1
FWCFC	0.65	0.72	0.95	-	DE-Hoe
FWCFC	0.29	0.368	0.93	-	DE-Tha
FWCFC	0.45	0.56	0.91	-	DE-Wet
FWCFC	0.33	0.55	0.96	-	IT-Ren
FWCFC	0.67	0.9	0.95	-	RU-Fyo
FWCFC	0.66	0.702	0.98	-	UK-Gri

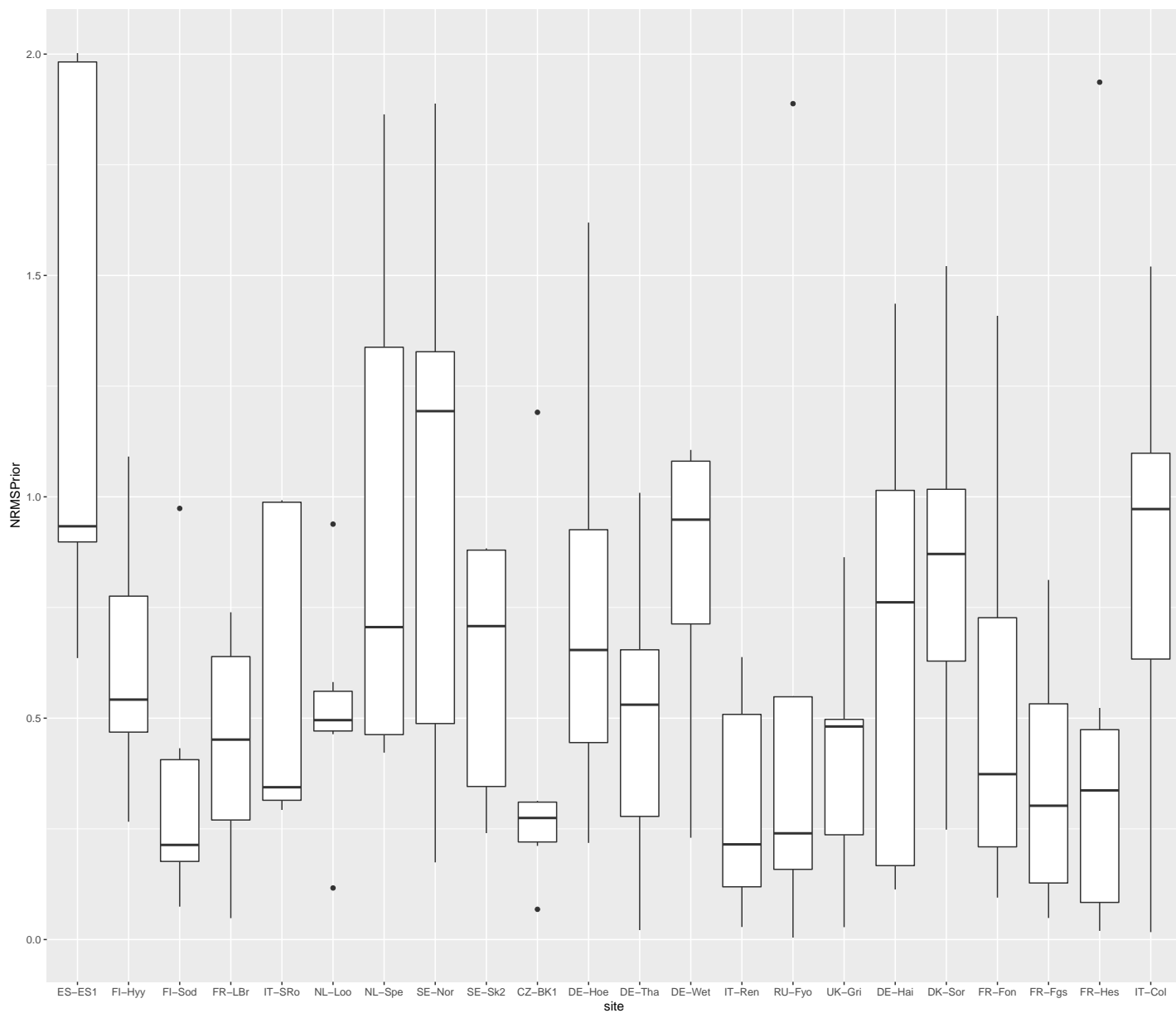


Figure 3: Box and whisker plot of normalised RMS deviation against ancillary observations of BASFOR run with the prior mode parameter vector.

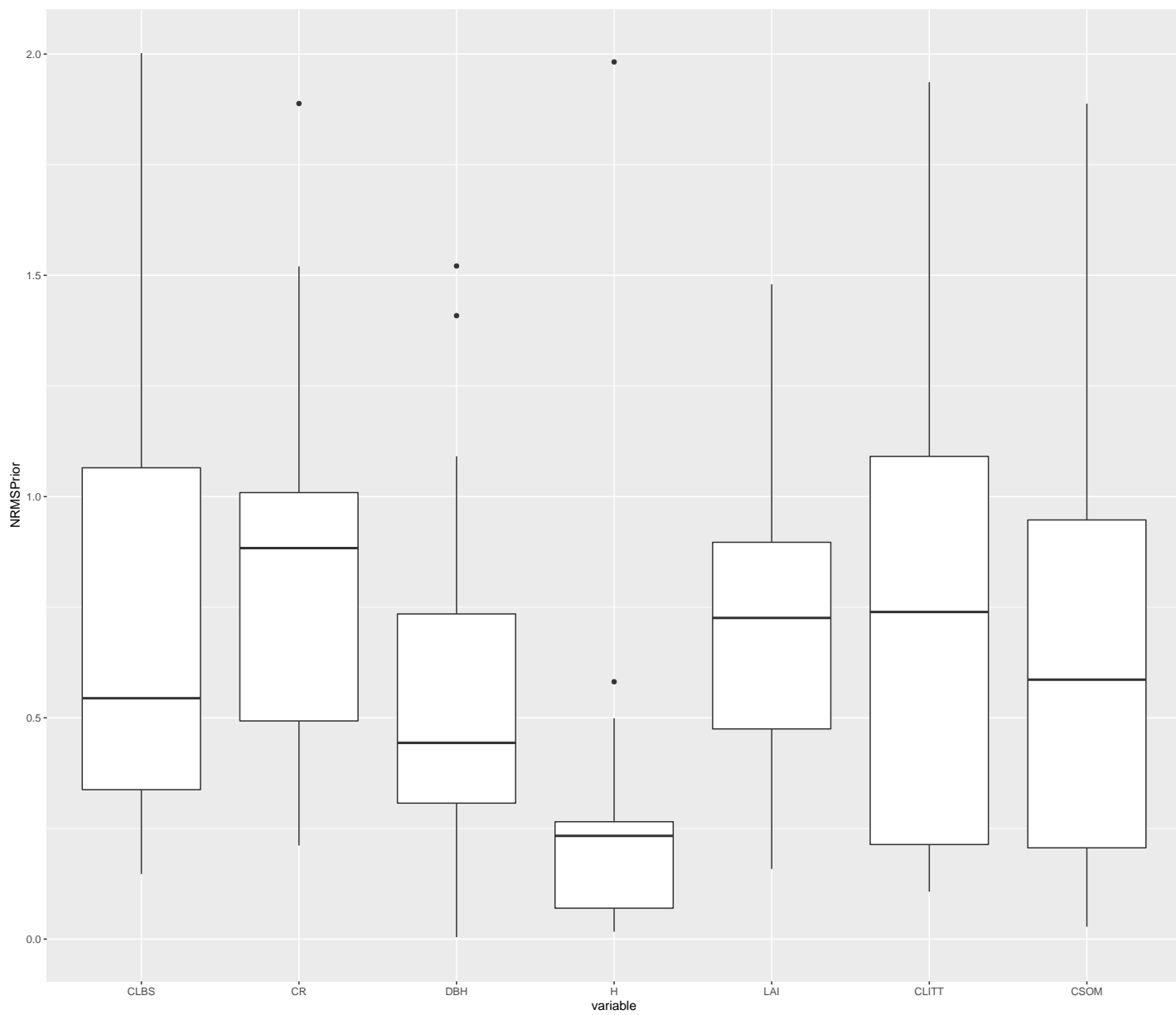


Figure 4: Box and whisker plot of normalised RMS deviation against observations of BASFOR run with the prior mode parameter vector.

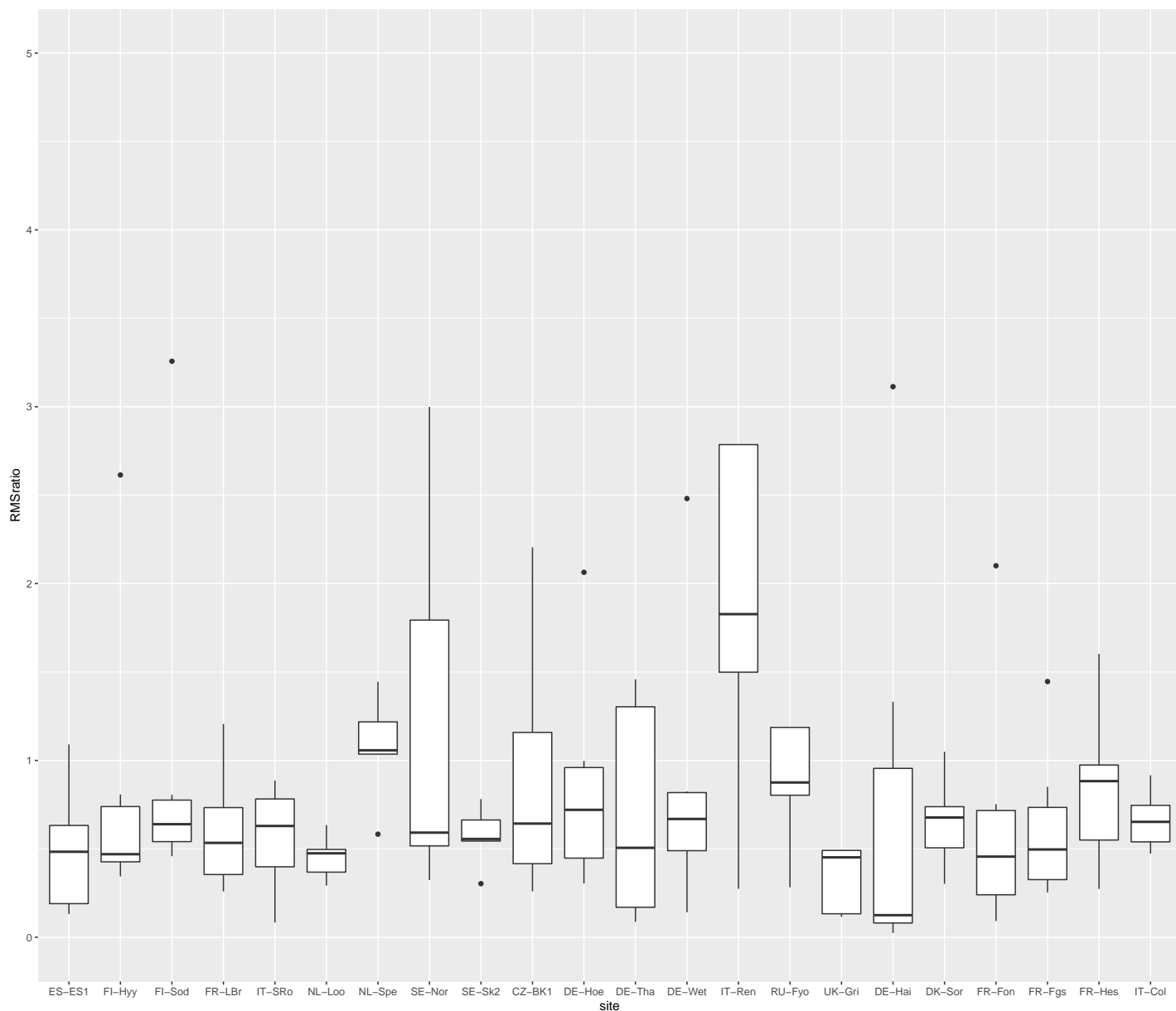


Figure 5: Box and whisker plot of the ratio of RMS deviation against ancillary observations of BASFOR run with the MAP parameter vector over BASFOR run with the prior mode parameter vector.

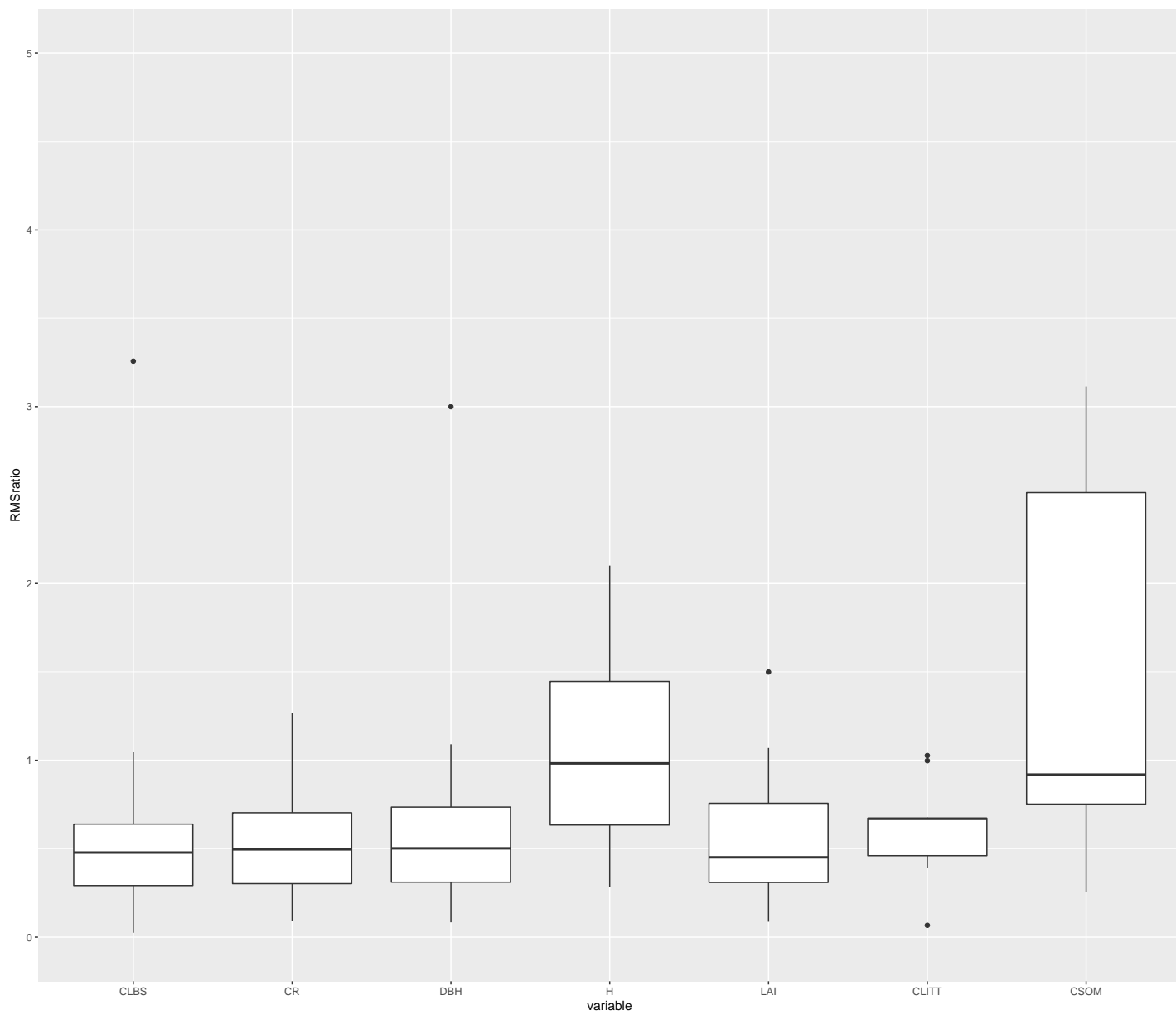


Figure 6: Box and whisker plot of the ratio of RMS deviation against ancillary observations of BASFOR run with the MAP parameter vector over BASFOR run with the prior mode parameter vector.



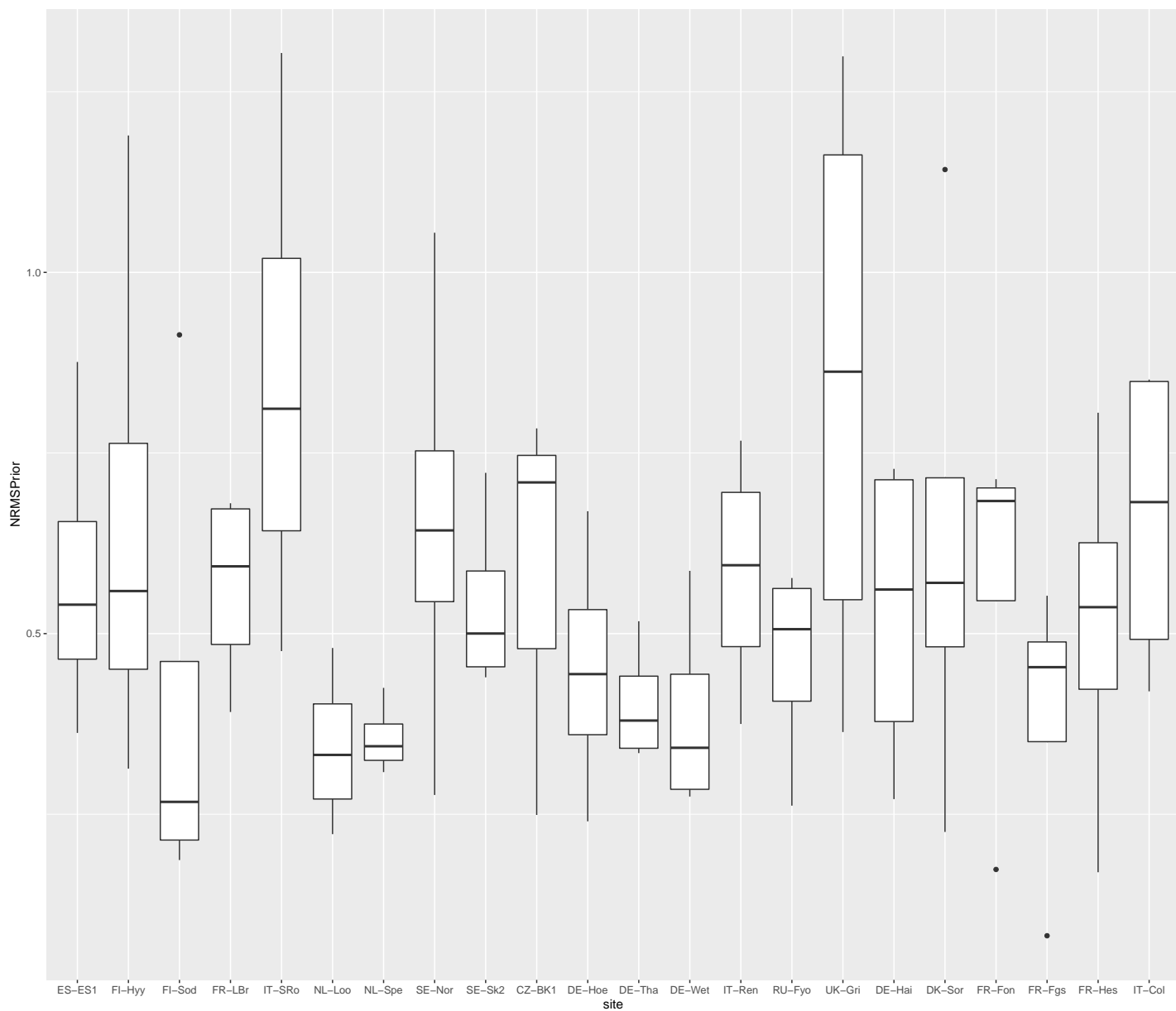


Figure 7: Box and whisker plot of normalised RMS deviation against NEE, GPP, evapotranspiration and soil water content observations of BASFOR run with the prior mode parameter vector.

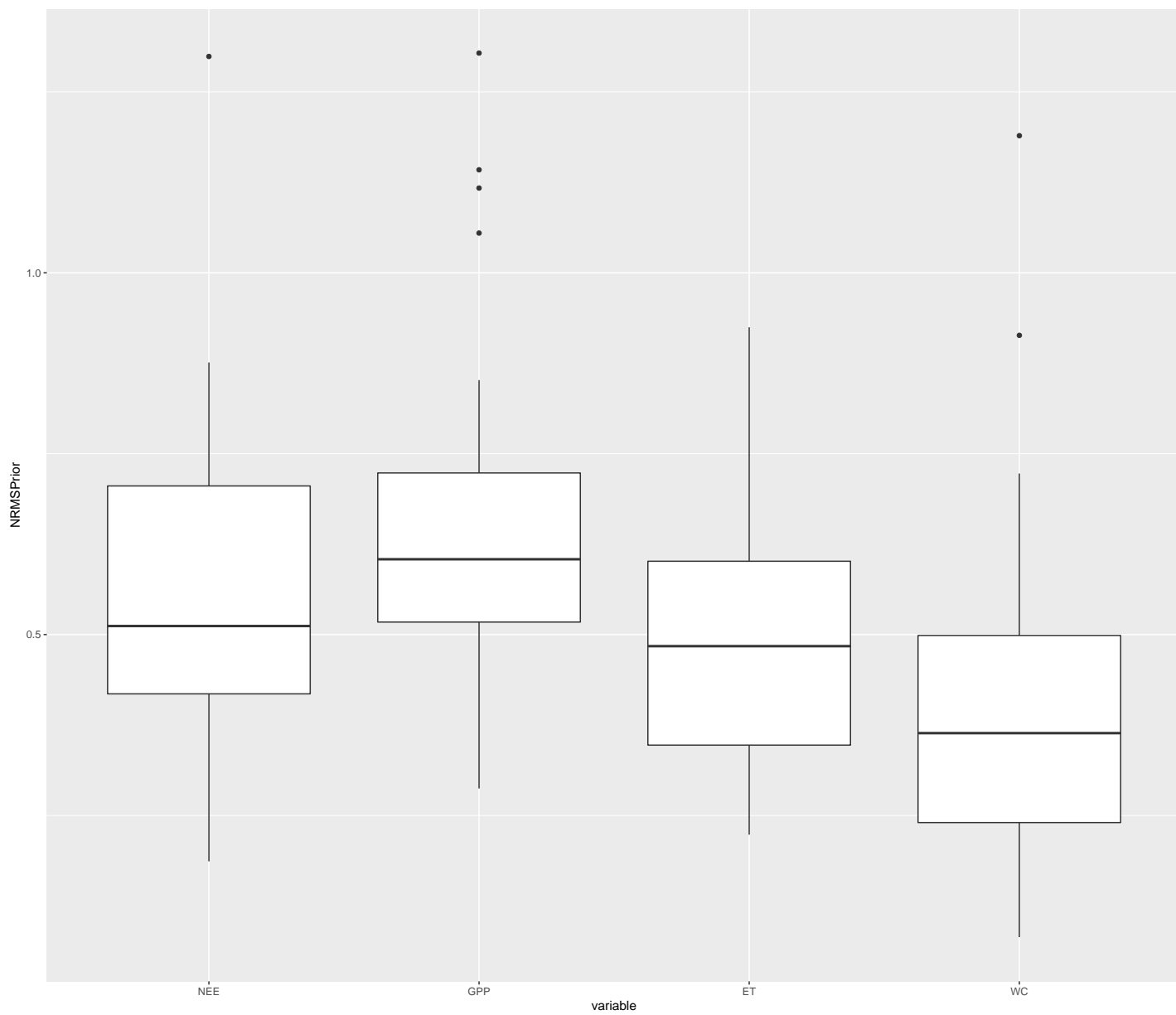


Figure 8: Box and whisker plot of normalised RMS deviation against NEE, GPP, evapotranspiration and soil water content observations of BASFOR run with the prior mode parameter vector.

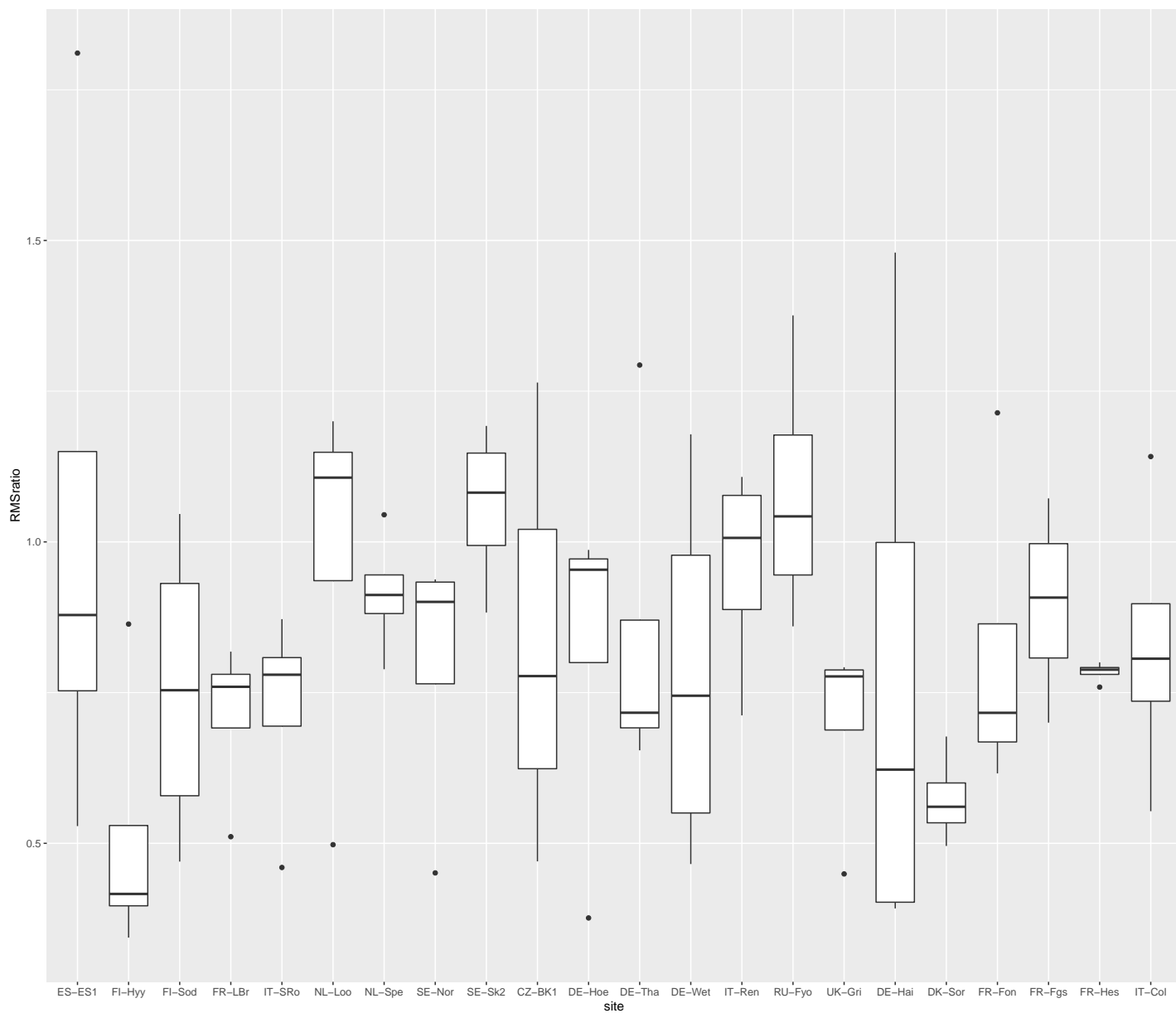


Figure 9: Box and whisker plot of the ratio of RMS deviation against NEE, GPP, evapotranspiration and soil water content observations of BASFOR run with the MAP parameter vector over BASFOR run with the prior mode parameter vector.

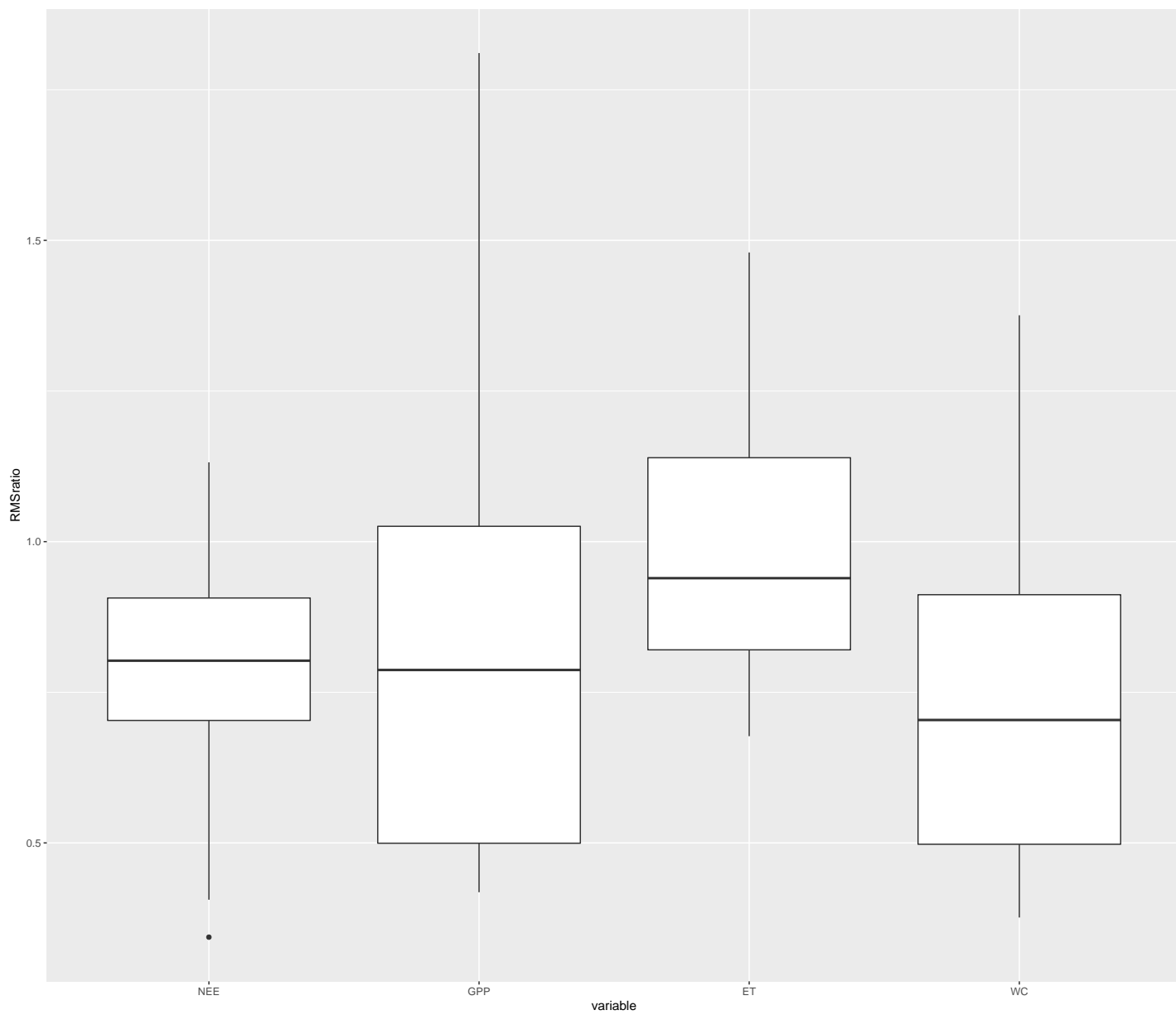


Figure 10: Box and whisker plot of the ratio of RMS deviation against NEE, GPP, evapotranspiration and soil water content observations of BASFOR run with the MAP parameter vector over BASFOR run with the prior mode parameter vector.