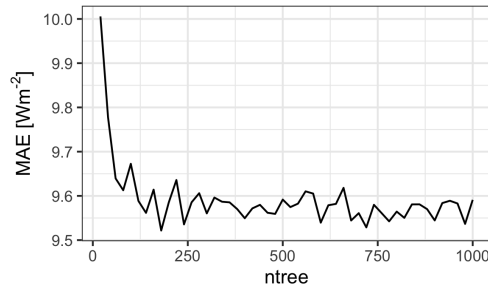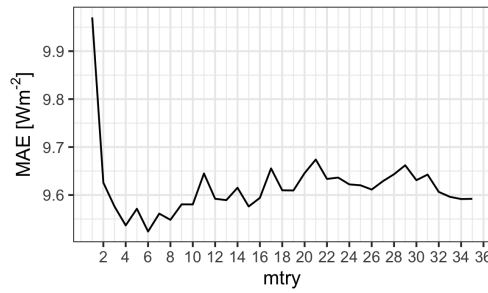# Supplementary Material

S1   RF model parameter tuning

Fig. S1 MAE changing with the number of decision trees

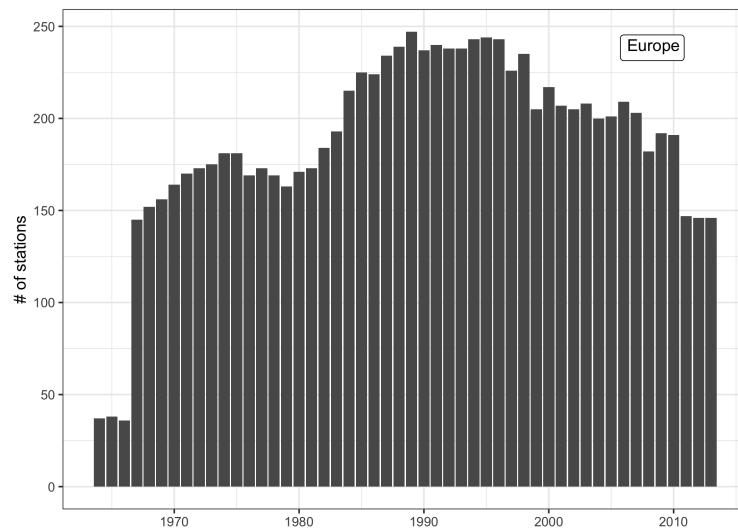**Fig. S2** MAE changing with the number of randomly preselected predictor variables
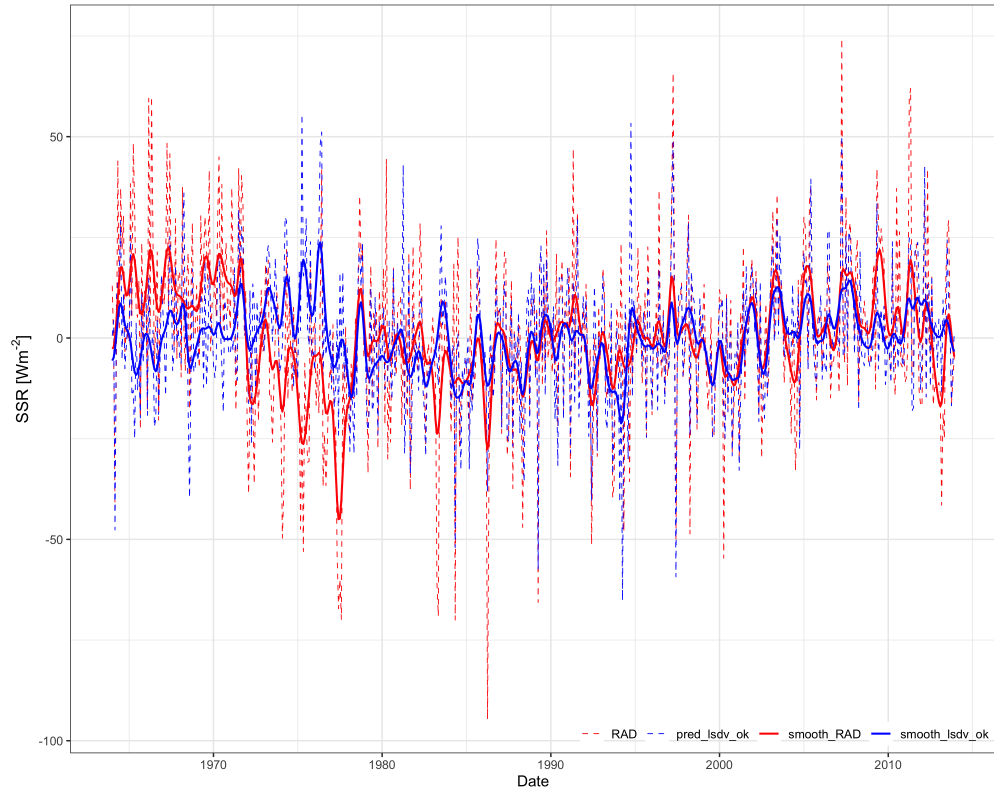
S2   Monthly anomalies

S2.1   Europe

Number of station Figure S3

Monthly anomalies for one station Figure S4
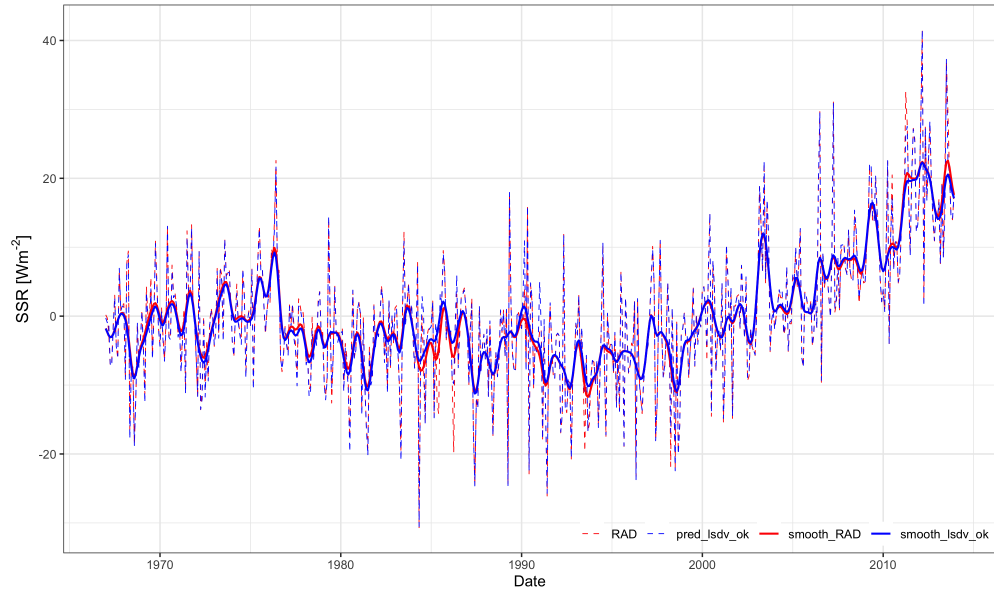
Monthly anomalies for LSDV+OK Figure S5

Fig. S3 Number of recorded stations in EU

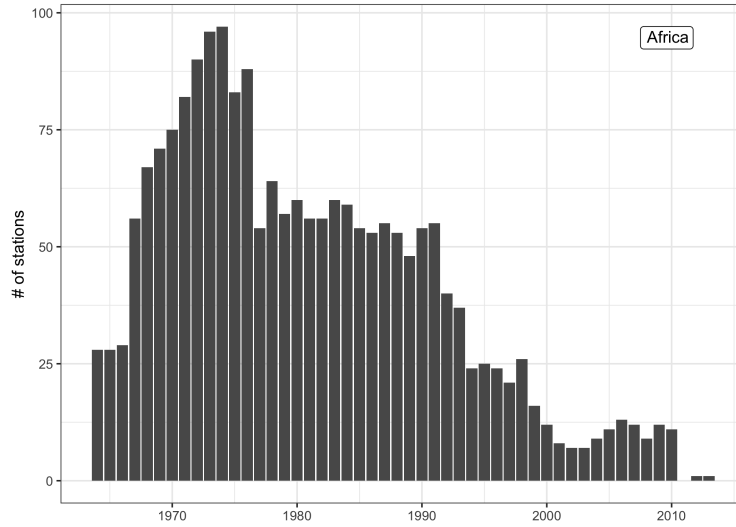**Fig. S4** Monthly SSR anomalies for observations and LSDV+OK simulations for one chosen station in Europe

Fig. S5 Monthly SSR anomalies for observations and LSDV+OK simulations for Europe
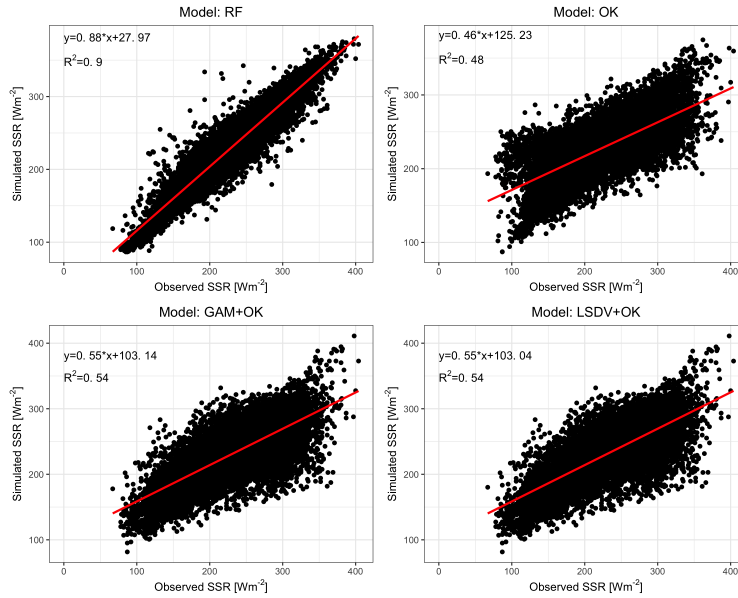
S2.2 Africa

Number of station

Prediction against observation plot
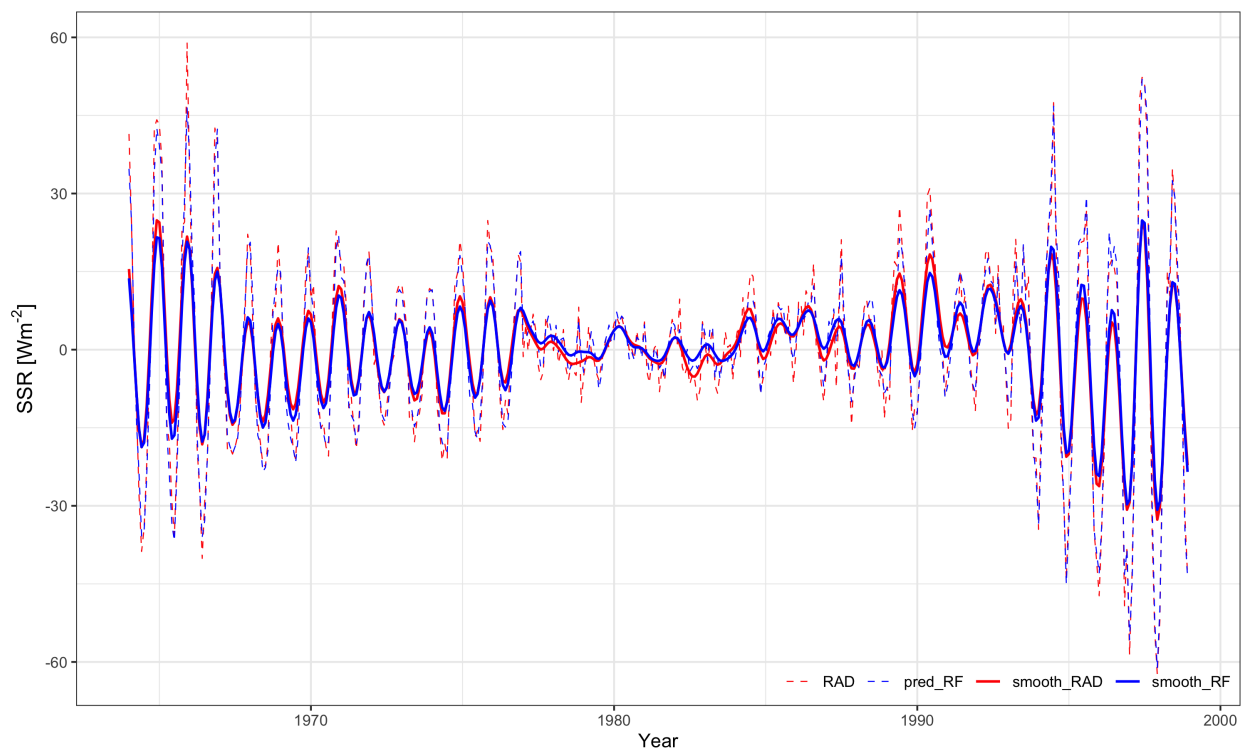
Monthly anomalies trend

Fig. S6 Number of recorded stations in AF

Fig. S7 Simulation v.s. observation values for AF

Fig. S8 Monthly anomalies for AF

S2.3 North America

Number of station Figure S9

Prediction against observation plot Figure S10

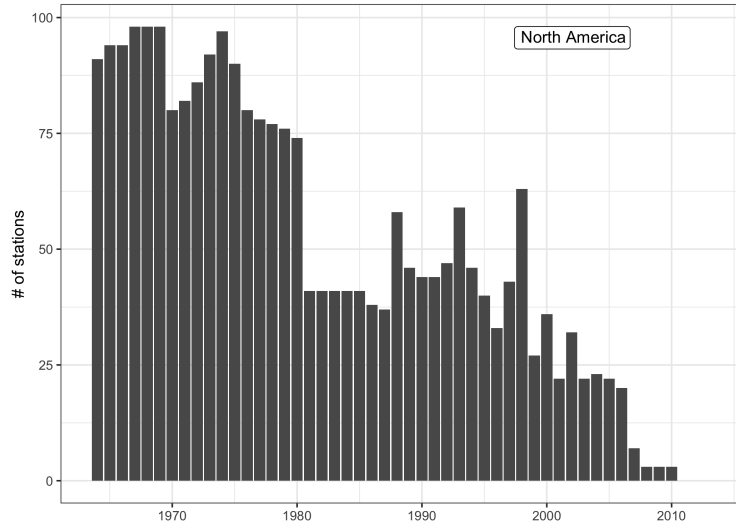**Monthly anomalies trend Figure S11**

Fig. S9 Number of recorded stations in NA

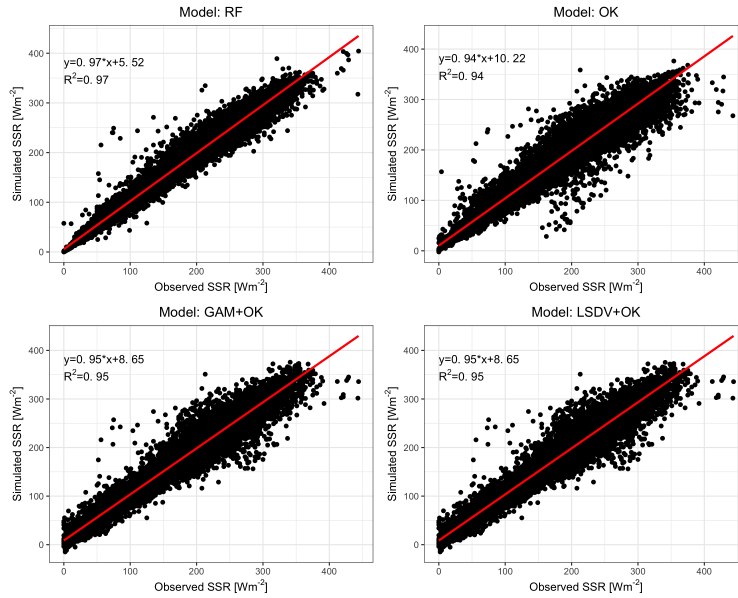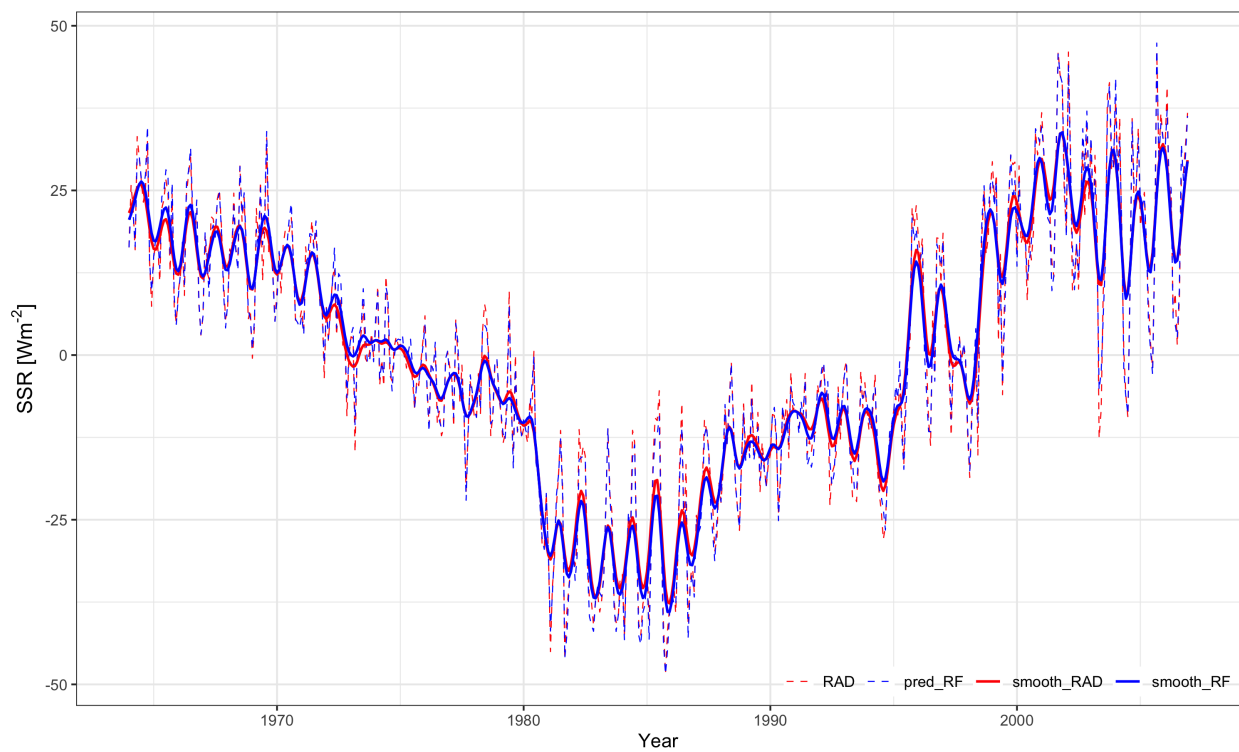**Fig. S10** Simulation v.s. observation values for NA

Fig. S11 Monthly anomalies for NA

S2.4   South America

Number of station

Prediction against observation plot
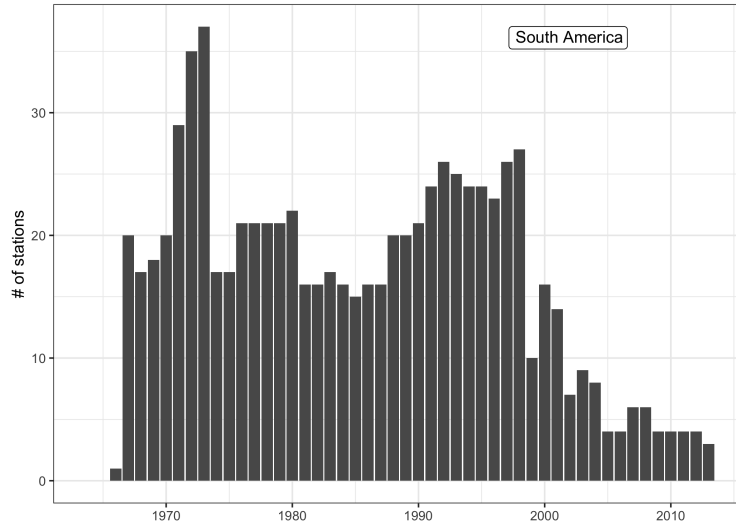
Monthly anomalies trend

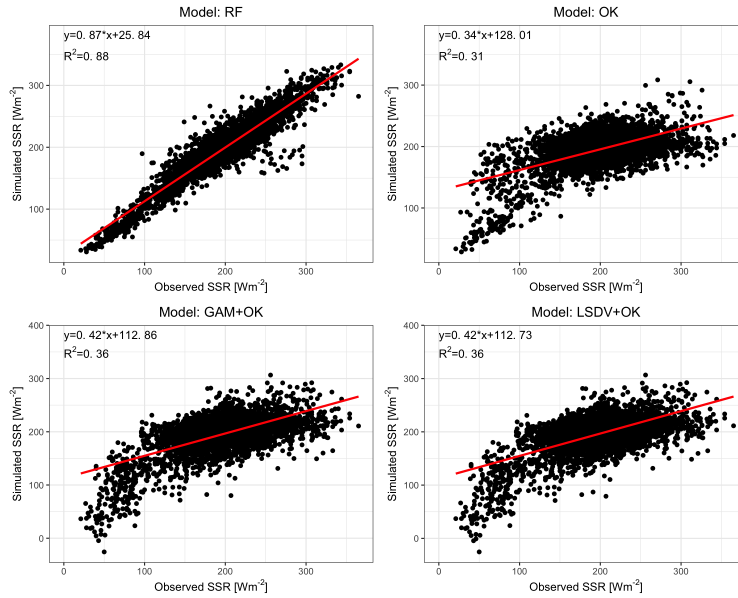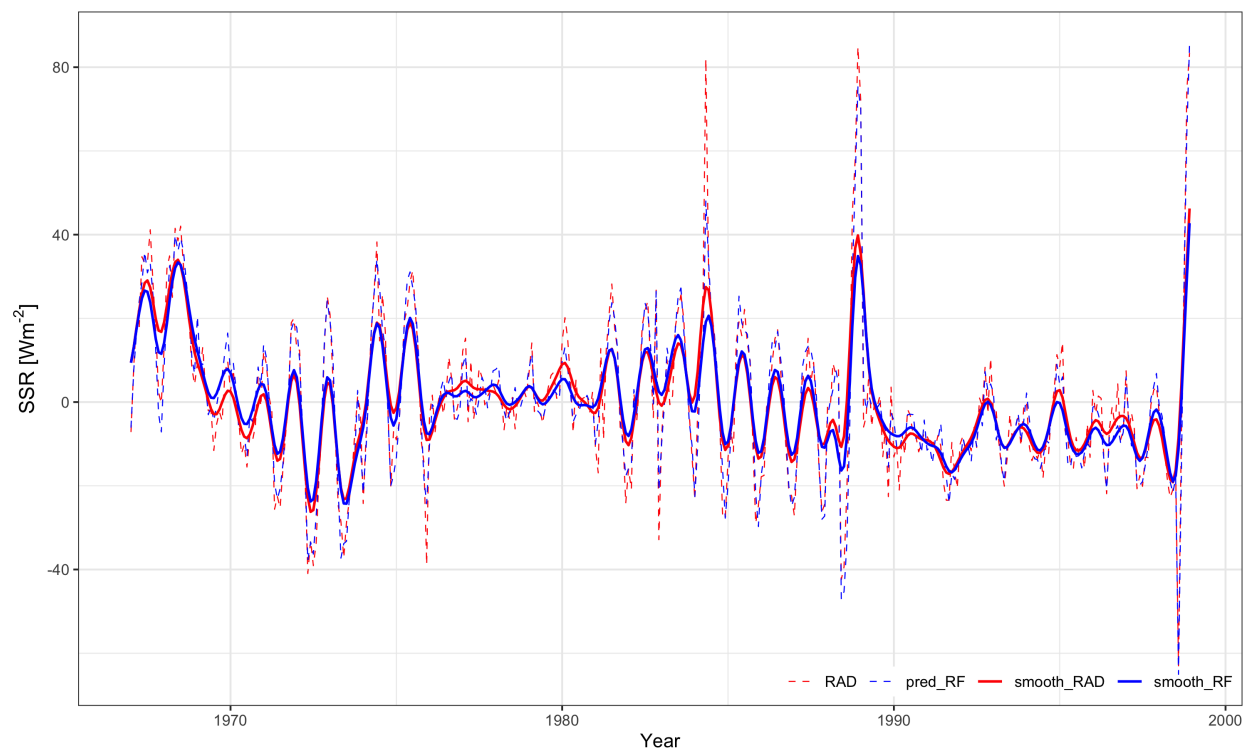**Fig. S12** Number of recorded stations in SA

Fig. S13 Simulation v.s. observation values for SA

Fig. S14 Monthly anomalies for SA

S2.5   Asia

Number of station **Figure S15**

Prediction against observation plot **Figure S16**

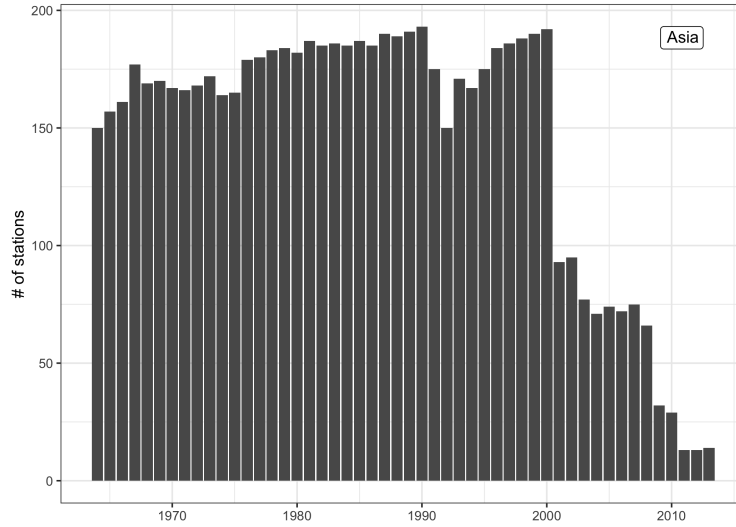Monthly anomalies trend **Figure S17**

Fig. S15 Number of recorded stations in AS
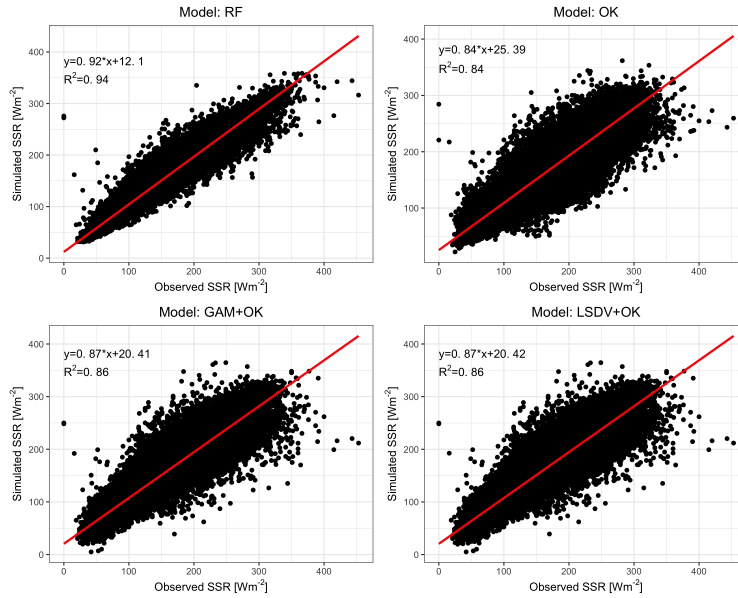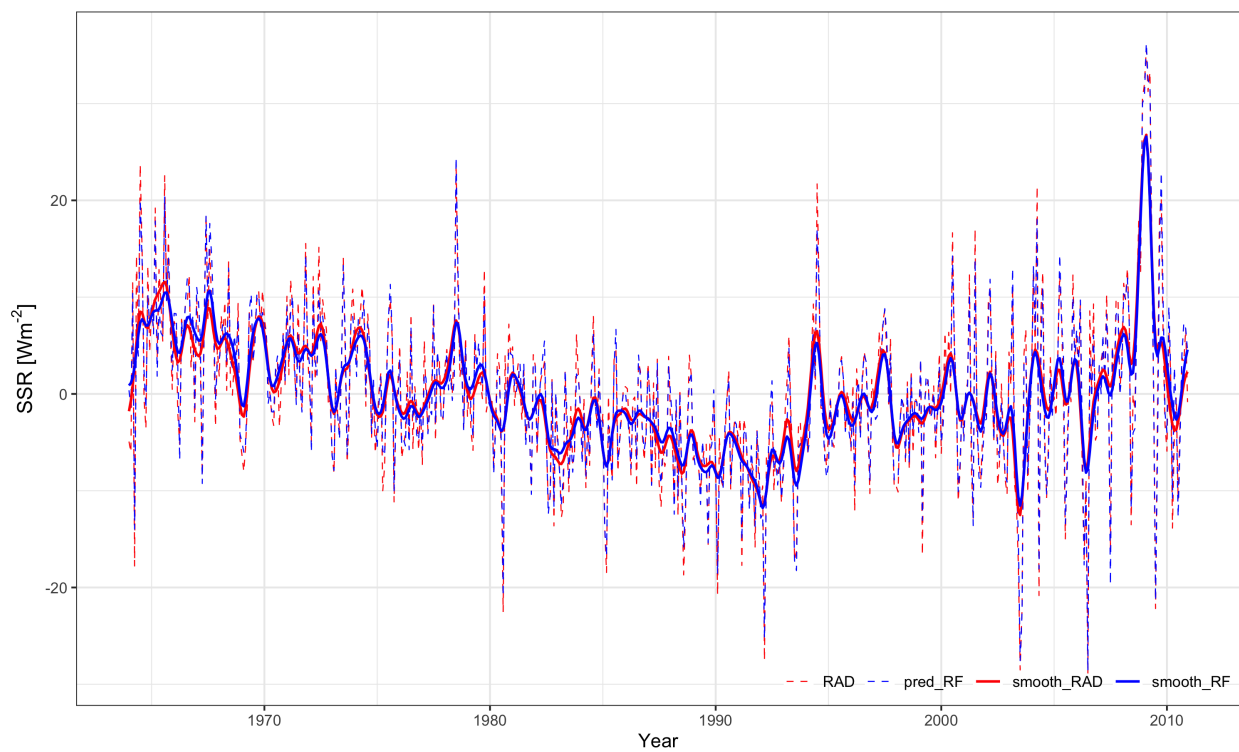

Fig. S16 Simulation v.s. observation values for AS

10

Fig. S17 Monthly anomalies for AS

S2.6 Oceania

Number of station **Figure S18**

Prediction against observation plot **Figure S19**

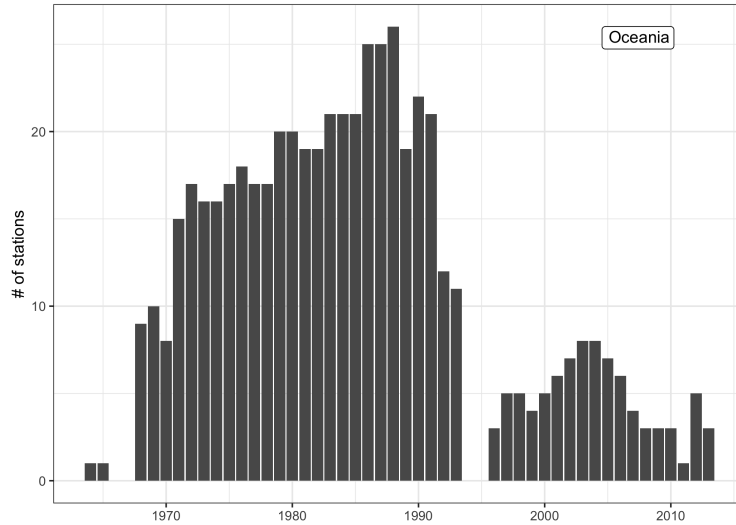Monthly anomalies trend **Figure S20**

Fig. S18 Number of recorded stations in OC

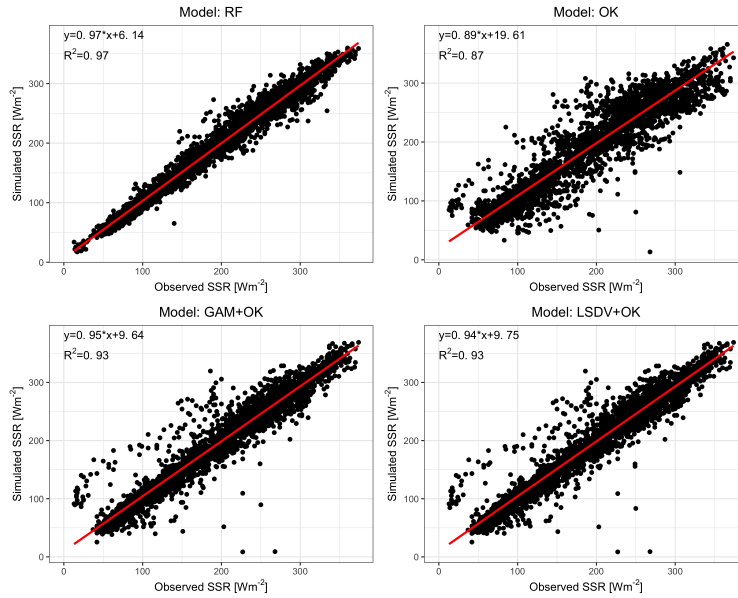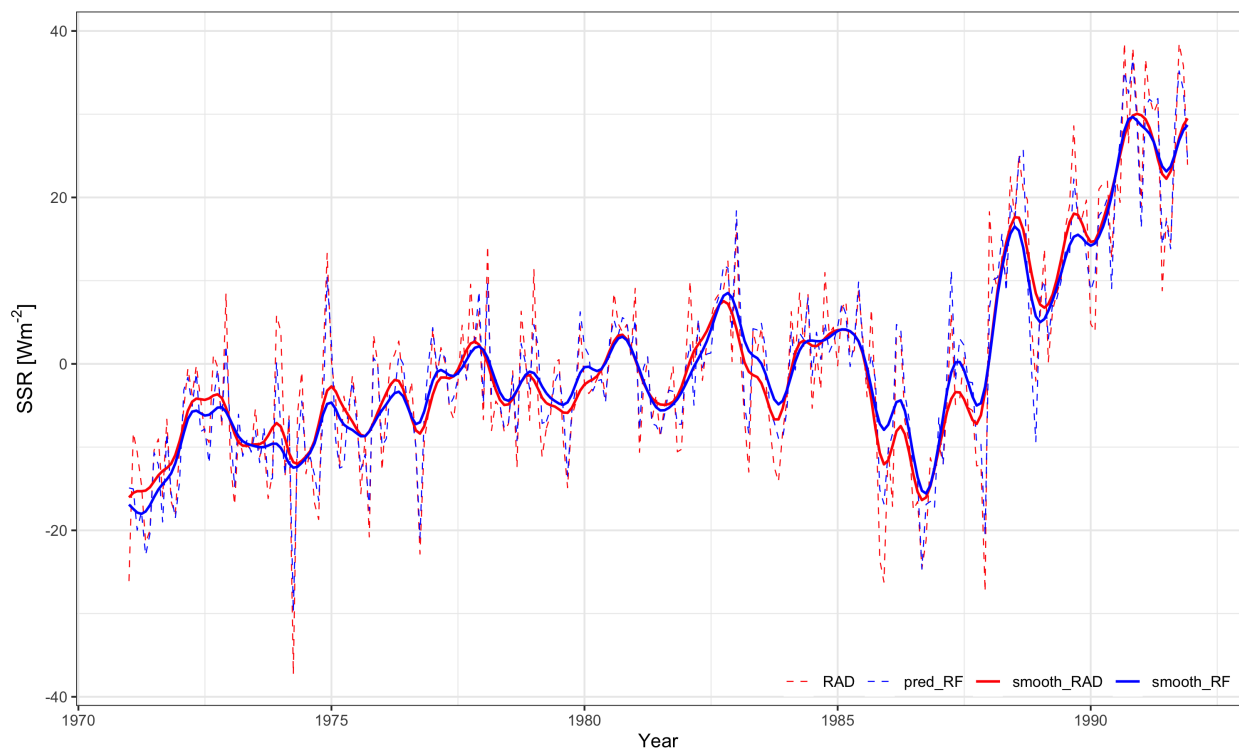**Fig. S19** Simulation v.s. observation values for OC

Fig. S20 Monthly anomalies for OC