Supplements

S1. Model performance with respect to all discharge signatures

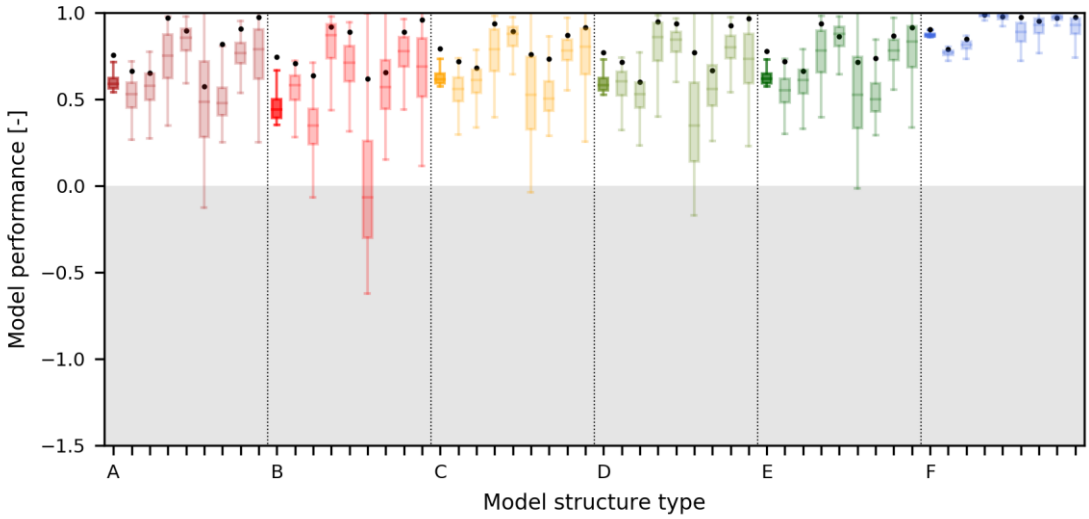

Figure S1: Calibrated model performance of all models with respect to discharge (2002 – 2012). The boxplots visualise the spread of the best 5% solutions according to $D_{E,Qcal}$ in the overall model performance $D_{E,Qcal}$ and the following individual signatures: 1) daily discharge ($E_{NS,Q}$), 2) its logarithm ($E_{NS,logQ}$), 3) flow duration curve ($E_{NS,FDC}$), 4) its logarithm ($E_{NS,logFDC}$), 5) average runoff coefficient during the dry season ($E_{R,RCdry}$), 6) average seasonal runoff coefficient during the wet season ($E_{R,RCwet}$), 7) autocorrelation function ($E_{NS,AC}$), and 8) rising limb density ($E_{R,RLD}$). The dots visualise the model performance with the "optimal" parameter set using the overall model performance metric ($D_{E,Qcalopt}$).

S2. Parameter sets selected based on discharge

S2.1 Time series: Discharge

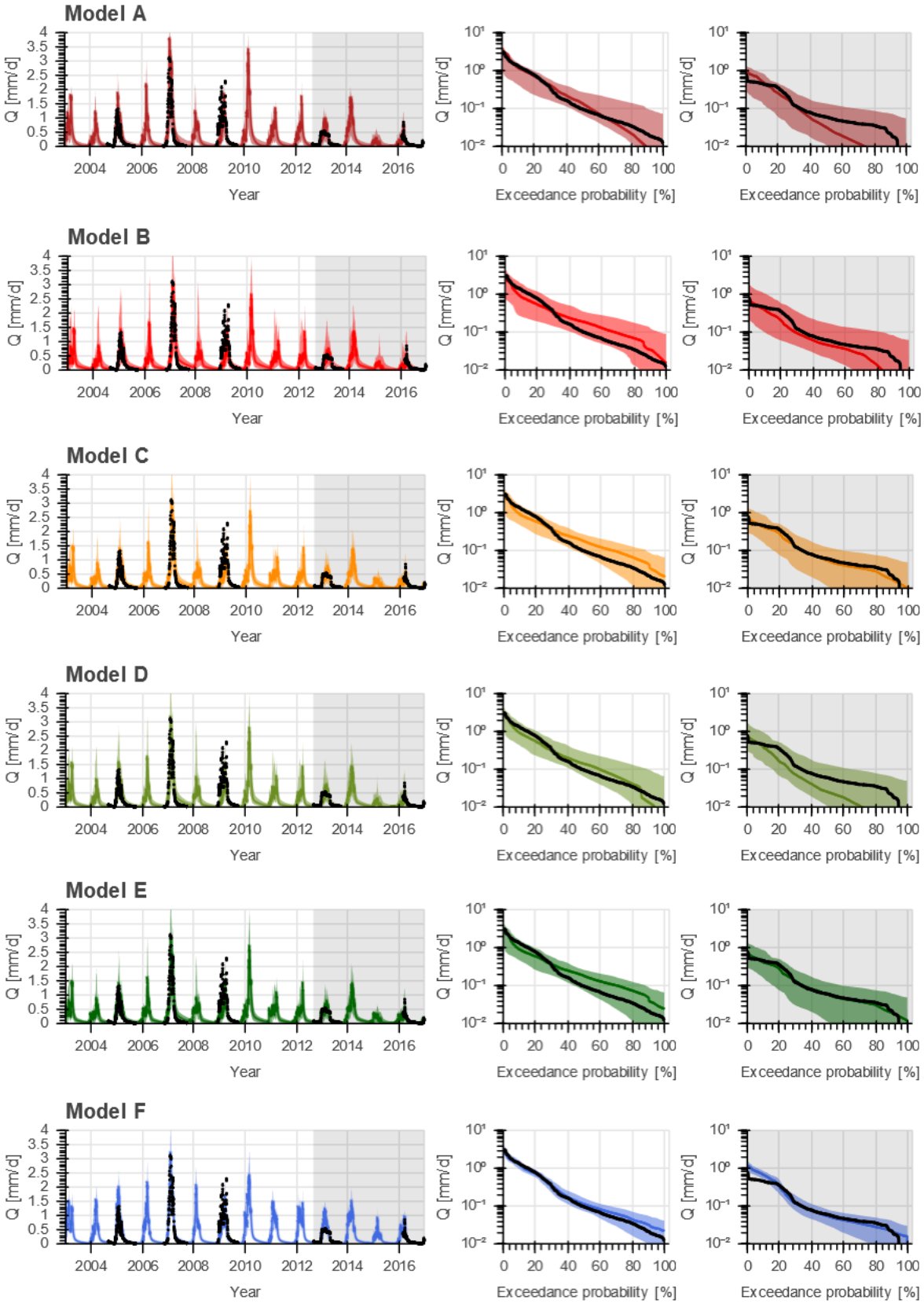

Figure S2: Range of model solutions for Models A to F. The left panel shows the hydrograph and the right panel the flow duration curve of the recorded (black) and modelled discharge: the line indicates the solution with the highest calibration objective function with respect to discharge ($D_{E,Qcal}$) and the shaded area the envelope of the solutions retained as feasible. The data in the white area were used for calibration and the grey shaded area for validation.

S2.2. Time series: Evaporation (Basin average)

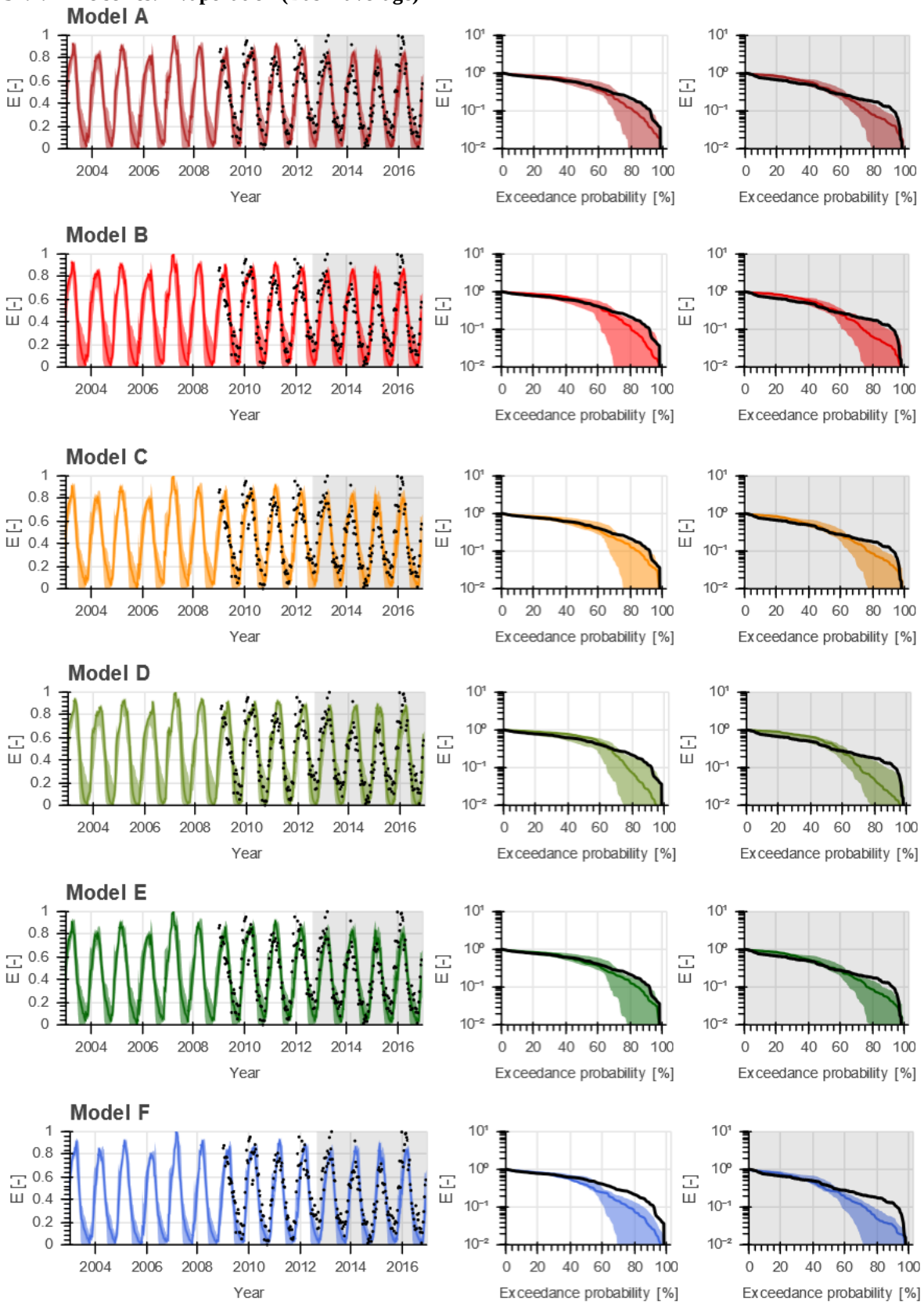

Figure S3: Range of model solutions for Models A to F. The left panel shows the time series and the right panel the duration curve of the recorded (black) and modelled normalised basin average evaporation: the line indicates the solution with the highest calibration objective function with respect to discharge ($D_{E,Qcal}$) and the shaded area the envelope of the solutions retained as feasible. The data in the grey shaded area were used for validation.

S2.3 Time series: Evaporation (Wetland dominated areas)

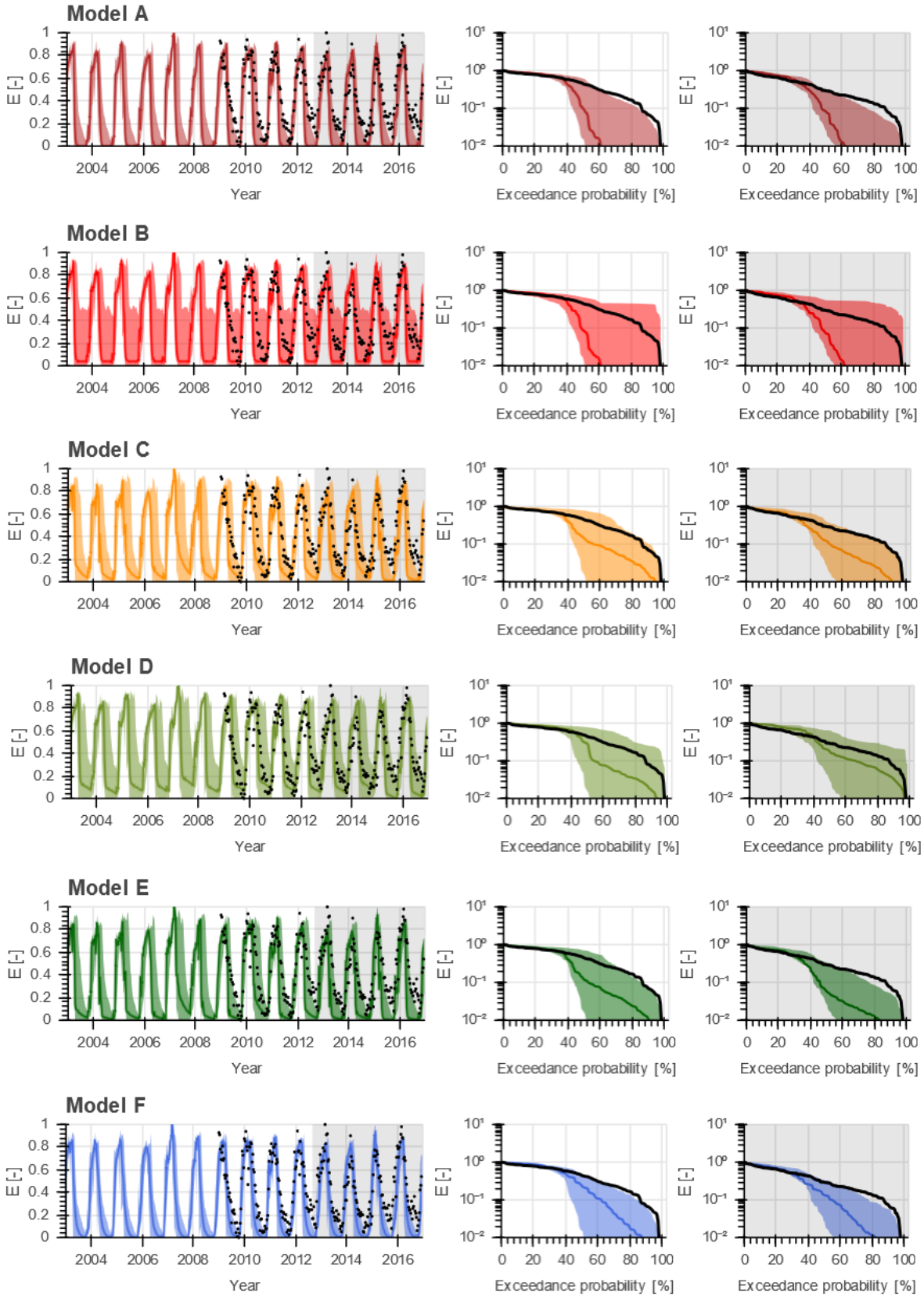

Figure S4: Range of model solutions for Models A to F. The left panel shows the time series and the right panel the duration curve of the recorded (black) and modelled normalised evaporation for wetland dominated areas: the line indicates the solution with the highest calibration objective function with respect to discharge ($D_{E,Qcal}$) and the shaded area the envelope of the solutions retained as feasible. The data in the grey shaded area were used for validation.

S2.4 Time series: Total water storage (Basin average)

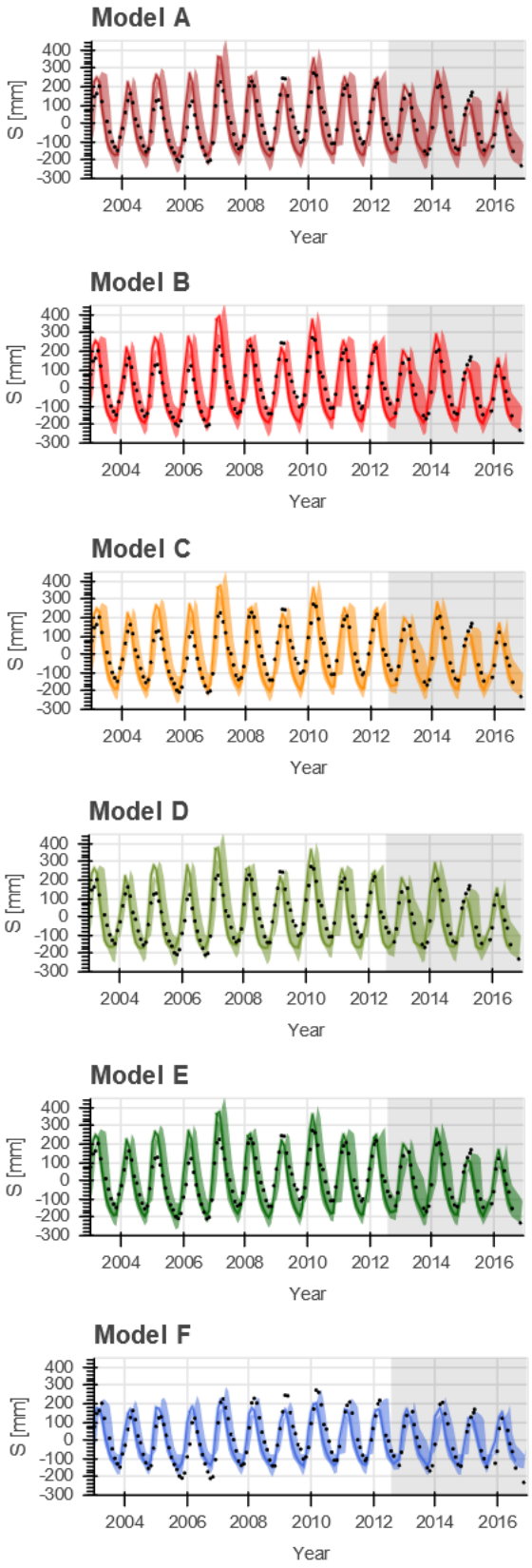

Figure S5: Range of model solutions for Models A to F. Each panel shows the time series of the recorded (black) and modelled basin average total water storage: the line indicates the solution with the highest calibration objective function with respect to discharge ($D_{E,Qcal}$) and the shaded area the envelope of the solutions retained as feasible. The data in the grey shaded area were used for validation.

S2.5. Spatial pattern: Evaporation (normalised, dry season)

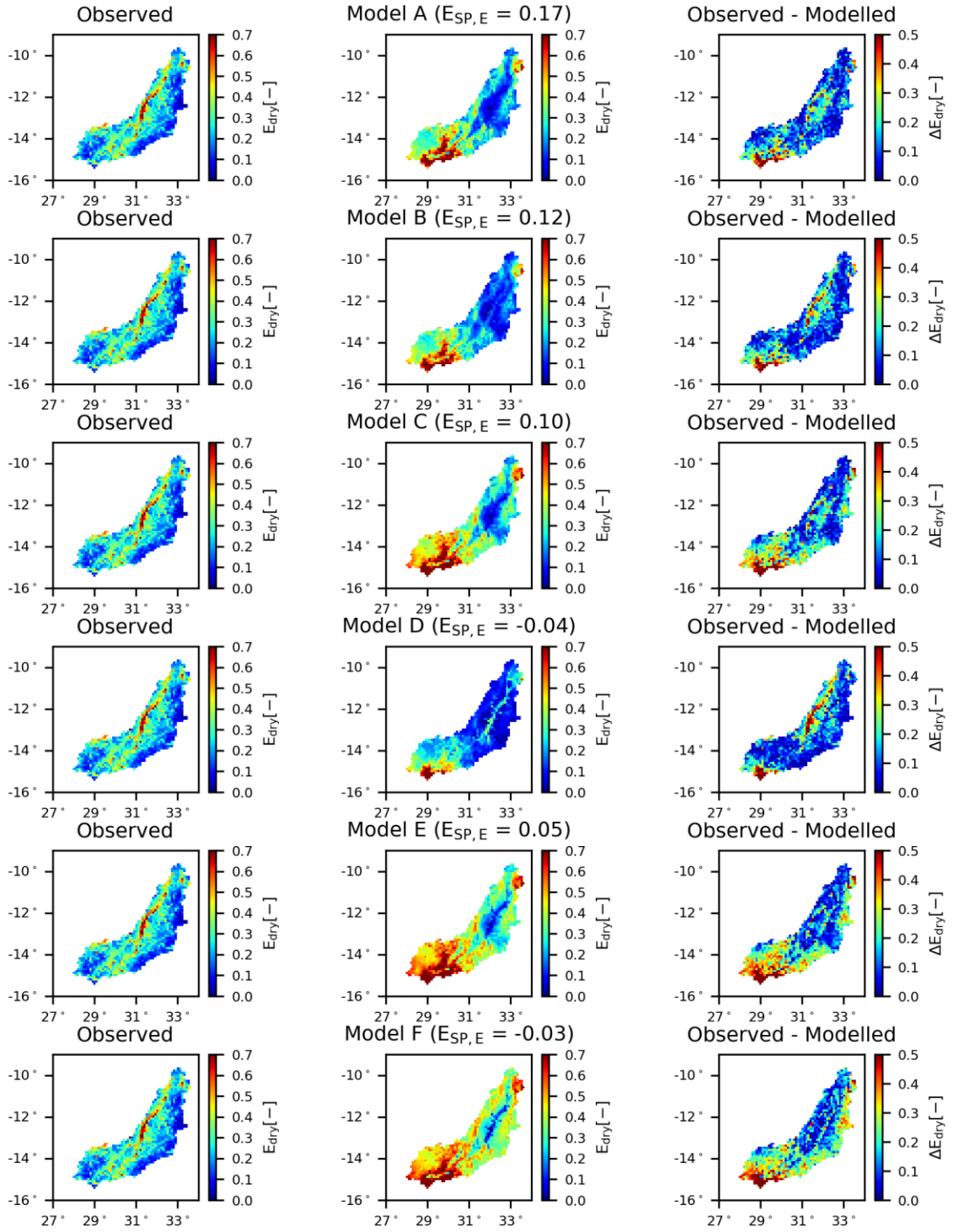

Figure S6: Spatial variability of the normalised total evaporation for Models A to F averaged over all dry seasons. The left panel shows the observation according to WaPOR data; the middle panel the model result using the "optimal" parameter set with respect to discharge ($D_{E,Qcal}$); and the right panel the difference between the observation and model.

S2.6. Spatial pattern: Total water storage (normalised, dry season)

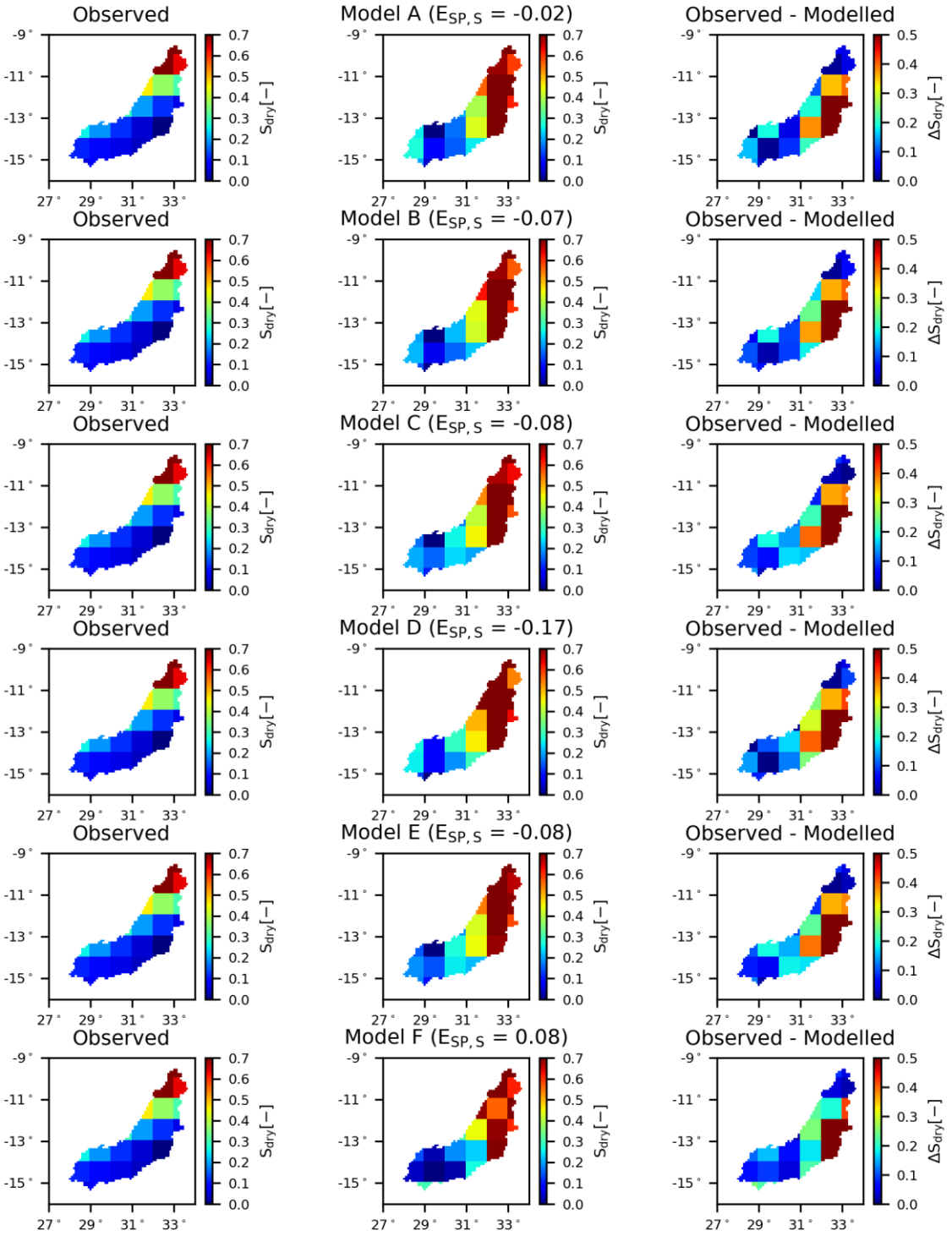

Figure S7: Spatial variability of the normalised total water storage for Models A to F averaged over all dry seasons. The left panel shows the observation according to GRACE data; the middle panel the model result using the "optimal" parameter set with respect to discharge ($D_{E,Qcal}$); and the right panel the difference between the observation and model.

S3. Parameter sets selected based on multiple variables

S3.1. Time series: Evaporation (Basin average)

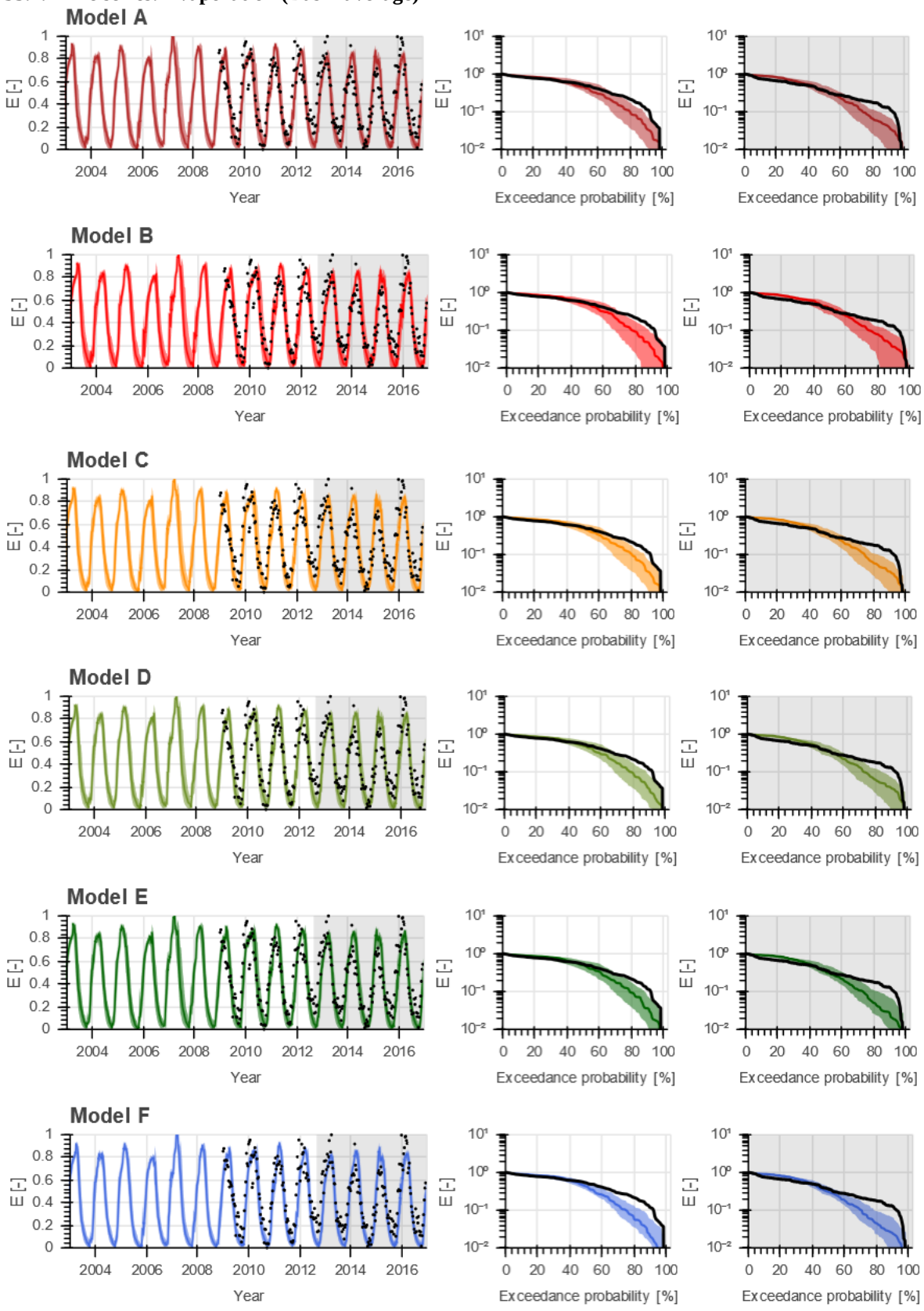

Figure S8: Range of model solutions for Models A to F. The left panel shows the time series and the right panel the duration curve of the recorded (black) and modelled normalised basin average evaporation: the line indicates the solution with the highest calibration objective function with respect to multiple variables ($D_{E,ESQ}$) and the shaded area the envelope of the solutions retained as feasible. The data in the grey shaded area were used for validation.

S3.2. Time series: Total water storage (Basin average)

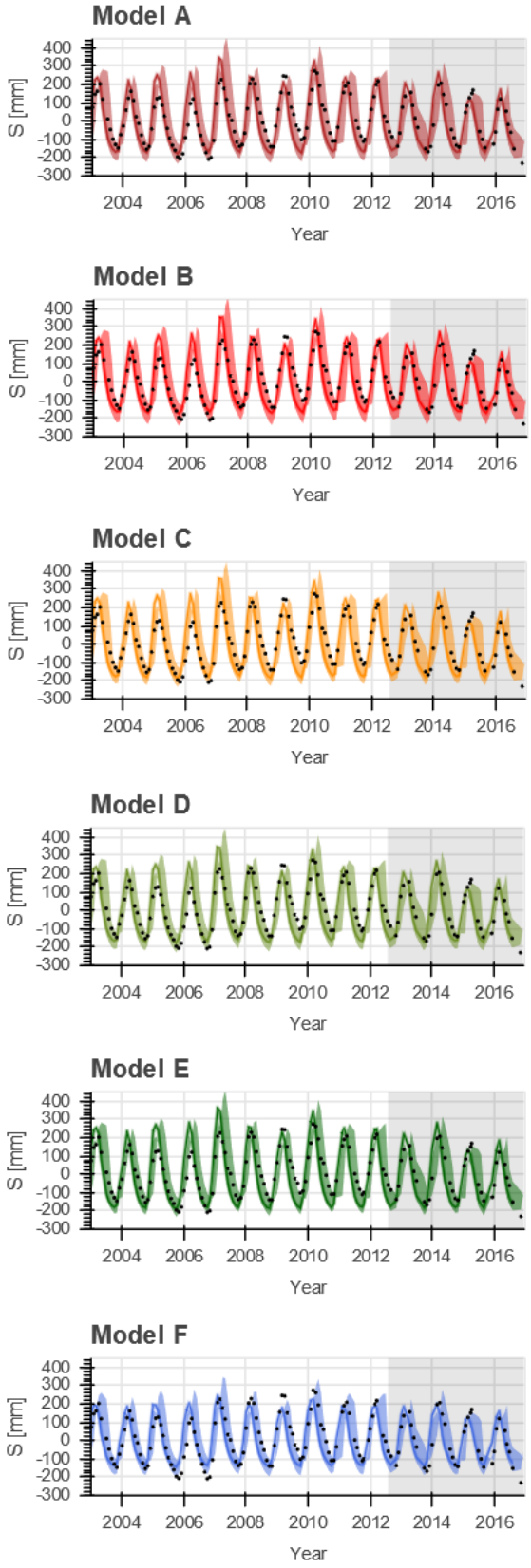

Figure S9: Range of model solutions for Models A to F. Each panel shows the time series of the recorded (black) and modelled basin average total water storage: the line indicates the solution with the highest calibration objective function with respect to multiple variables ($D_{E,ESQ}$) and the shaded area the envelope of the solutions retained as feasible. The data in the grey shaded area were used for validation

S3.3. Spatial pattern: Evaporation (normalised, dry season)

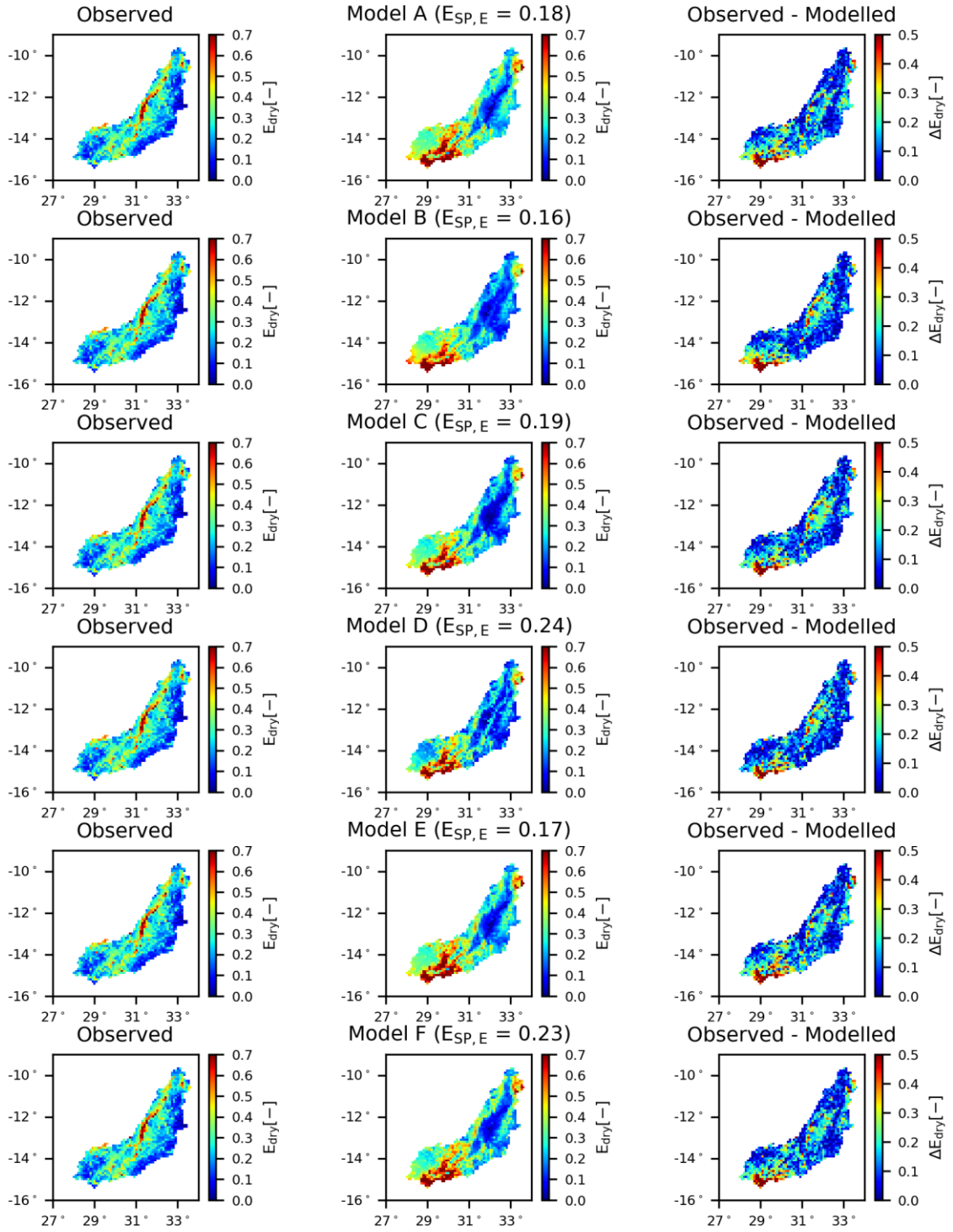

Figure S10: Spatial variability of the normalised total evaporation for Models A to F averaged over all dry seasons. The left panel shows the observation according to WaPOR data; the middle panel the model result using the "optimal" parameter set with respect to multiple variables ($D_{E,ESQ}$); and the right panel the difference between the observation and model.

S3.4. Spatial pattern: Total water storage (normalised, dry season)

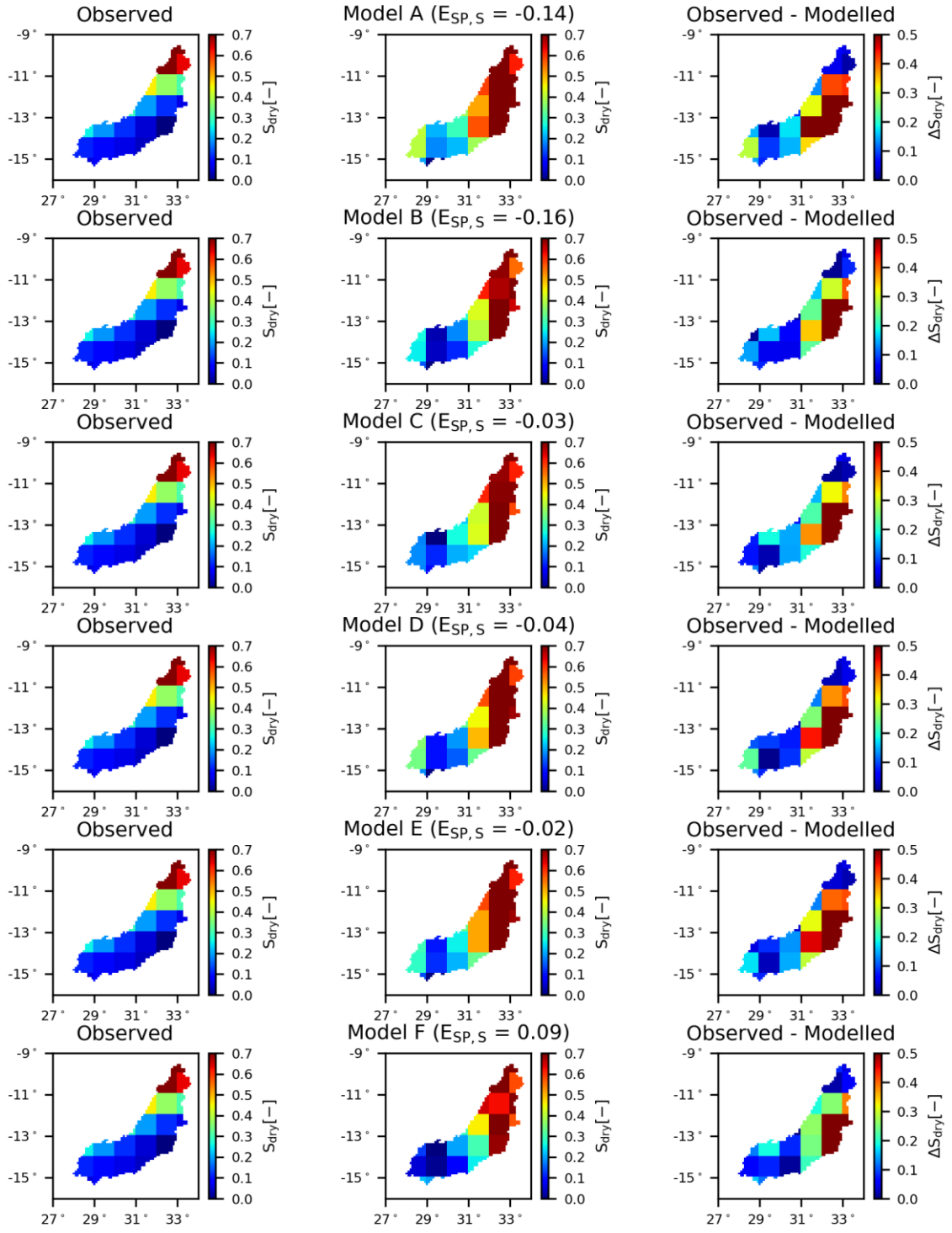

Figure S11: Spatial variability of the normalised total water storage for Models A to F averaged over all dry seasons. The left panel shows the observation according to GRACE data; the middle panel the model result using the "optimal" parameter set with respect to multiple variables ($D_{E,ESQ}$); and the right panel the difference between the observation and model.