atmosphere

MDPI

Supplementary Materials:

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Table S1. v2 (20CRv3) reanalysis and observations seasonal mean MSLP series for 1806-1850. Red highlighted are cases where 20CRv3 is superior.

Correlation	DJF	MAM	JJA	SON
SW Iceland	0.876 (0.550)	0.902 (0.233)	0.852 (0.500)	0.805 (0.488)
Gibraltar	0.659 (0.375)	0.594 (0.051)	0.094 (0.544)	0.616 (0.634)
London	0.977 (0.890)	0.976 (0.758)	0.894 (0.503)	0.964 (0.871)
Paris	0.973 (0.885)	0.972 (0.673)	0.886 (0.464)	0.963 (0.886)

RMSE	DJF	MAM	JJA	SON
SW Iceland	3.79 (6.82)	2.97 (5.95)	2.32 (3.78)	2.40 (4.61)
Gibraltar	4.13 (3.54)	2.05 (2.41)	1.34 (3.15)	2.28 (2.74)
London	0.85 (1.44)	2.38 (1.88)	1.25 (1.82)	0.92 (1.27)
Paris	0.84 (1.65)	1.51 (1.76)	0.75 (1.22)	0.59 (1.01)

MAE	DJF	MAM	JJA	SON
SW Iceland	3.06 (5.57)	2.41 (5.17)	1.52 (3.06)	1.22 (3.62)
Gibraltar	3.39 (2.92)	1.57 (2.14)	1.18 (2.98)	1.86 (2.43)
London	0.67 (1.15)	2.28 (1.44)	1.04 (1.50)	0.75 (1.09)
Paris	0.66 (1.26)	1.41 (1.43)	0.61 (1.01)	0.48 (0.83)

Table S2. De-trended correlation coefficients between seasonal NAO_{Fixed} and NAO_{PC} indices for various periods. Both NAO indices are calculated from EKF400v2 and ERA5 reanalysis data spliced together, as discussed in the main text. The shaded value is *not* statistically significant at the $p \leq 0.05$ level.

Period	DJF	MAM	JJA	SON
1801-1850	0.95	0.92	0.82	0.91
1851-1900	0.95	0.86	0.70	0.82
1901-1950	0.91	0.92	0.74	0.78
1951-2000	0.92	0.84	0.49	0.77
1951-1980	0.91	0.86	0.54	0.91
1961-1990	0.93	0.81	0.56	0.84
1971-2000	0.94	0.83	0.33	0.65
1981-2010	0.94	0.88	0.52	0.63
1991-2020	0.93	0.91	0.65	0.61

Table S3. De-trended correlation coefficients between seasonal GB_1 and GB_2 indices for various periods.

Period	DJF	MAM	JJA	SON
1801-1850	0.96	0.97	0.84	0.95
1851-1900	0.96	0.95	0.88	0.95
1901-1950	0.94	0.97	0.94	0.94
1951-2000	0.93	0.88	0.90	0.90
1951-1980	0.92	0.83	0.92	0.94
1961-1990	0.92	0.90	0.95	0.92
1971-2000	0.93	0.92	0.91	0.88
1981-2010	0.91	0.93	0.92	0.86
1991-2020	0.91	0.96	0.93	0.85

Table S4. GB_2 means, standard deviations (stdev) and numbers of extreme values for selected periods. Means greater than 1σ and the highest frequencies for each period/season are emboldened.

	DJF	**MAM**	**JJA**	**SON**
1801-1850				
Mean	0.05	−0.19	0.31	−0.15
Stdev	0.77	1.10	0.88	0.66
ndays>2	0	1	0	0
ndays>1.5	2	3	4	0
ndays>1	5	7	13	4
ndays>0.5	**13**	15	**24**	5
ndays<-0.5	11	**18**	11	**14**
ndays<-1	5	11	4	6
ndays<-1.5	0	9	2	1
ndays<-2	0	3	0	0
1851-1900				
Mean	0.14	0.01	0.15	0.07
Stdev	0.94	1.05	0.88	0.89
ndays>2	2	1	0	0
ndays>1.5	4	6	2	2
ndays>1	10	8	7	9
ndays>0.5	**19**	**16**	**21**	**14**
ndays<-0.5	15	13	13	**14**
ndays<-1	6	8	6	6
ndays<-1.5	1	5	1	3
ndays<-2	0	2	1	0
1901-1950				
mean	0.06	0.07	−0.03	−0.05
stdev	0.82	1.23	1.10	0.75
ndays>2	0	2	1	1
ndays>1.5	2	8	5	1
ndays>1	8	11	10	3
ndays>0.5	**14**	**18**	12	13
ndays<-0.5	13	17	**16**	**14**
ndays<-1	6	11	12	4
ndays<-1.5	1	7	6	1
ndays<-2	0	2	1	1
1951-2000				
mean	0.00	0.00	0.00	0.00
stdev	1.00	1.00	1.00	1.00
ndays>2	2	0	0	2
ndays>1.5	3	2	2	4
ndays>1	8	10	9	7
ndays>0.5	14	**18**	**18**	**16**
ndays<-0.5	**19**	16	17	15
ndays<-1	10	9	10	8
ndays<-1.5	2	3	3	5
ndays<-	0	1	1	0
2000-2020				
mean	−0.34	−0.16	0.81	−0.31
stdev	0.99	1.30	1.46	0.98
ndays>2	0	0	4	0
ndays>1.5	1	2	9	2
ndays>1	1	5	10	3
ndays>0.5	4	6	**12**	4
ndays<-0.5	**10**	**8**	3	**9**
ndays<-1	6	4	2	6

ndays<-1.5	2	3	2	3
ndays<-2	0	2	1	0
2007-2020				
mean	−0.43	−0.40	**1.18**	−0.61
stdev	1.14	1.36	1.64	0.99
ndays>2	0	0	4	0
ndays>1.5	1	1	9	1
ndays>1	1	2	**10**	2
ndays>0.5	3	3	**10**	2
ndays<-0.5	**7**	**6**	2	**9**
ndays<-1	6	4	2	6
ndays<-1.5	2	3	2	3
ndays<-2	0	2	1	0

Table S5. NAO_{Fixed} means, standard deviations (stdev) and numbers of extreme values for selected periods. Means greater than 1σ and the highest frequencies for each period/season are emboldened.

	DJF	**MAM**	**JJA**	**SON**
1801-1850				
mean	−0.18	0.00	−0.71	−0.19
stdev	1.27	1.49	1.24	1.20
ndays>2	1	6	0	3
ndays>1.5	5	12	1	5
ndays>1	9	13	2	11
ndays>0.5	18	16	7	14
ndays<-0.5	**21**	**18**	**25**	**22**
ndays<-1	12	12	18	12
ndays<-1.5	7	9	9	6
ndays<-2	6	6	8	2
1851-1900				
mean	−0.36	−0.30	−0.26	−0.31
stdev	1.60	1.81	1.34	1.78
ndays>2	2	5	3	5
ndays>1.5	7	7	5	8
ndays>1	8	13	8	11
ndays>0.5	18	17	12	18
ndays<-0.5	**22**	**24**	**22**	**25**
ndays<-1	16	18	15	18
ndays<-1.5	12	13	10	12
ndays<-2	6	9	3	7
1901-1950				
mean	0.12	0.13	−0.17	−0.03
stdev	1.52	0.87	1.65	1.71
ndays>2	4	7	4	8
ndays>1.5	6	11	6	10
ndays>1	18	17	14	16
ndays>0.5	**26**	**22**	19	16
ndays<-0.5	15	16	**20**	**20**
ndays<-1	13	15	14	14
ndays<-1.5	10	13	9	11
ndays<-2	6	8	9	7
1951-2000				
mean	0.00	0.00	0.00	0.00
stdev	1.84	1.78	1.58	1.76
ndays>2	7	8	4	7
ndays>1.5	14	11	9	10
ndays>1	18	12	16	18

ndays>0.5	**23**	16	20	**24**
ndays<-0.5	22	**19**	**22**	20
ndays<-1	16	15	13	16
ndays<-1.5	11	11	8	12
ndays<-2	7	4	7	7
2000-2020				
mean	0.67	0.13	−0.71	0.21
stdev	2.00	2.11	1.73	1.50
ndays>2	5	6	1	4
ndays>1.5	7	6	4	5
ndays>1	10	8	4	5
ndays>0.5	**12**	**9**	4	**9**
ndays<-0.5	5	**9**	**13**	6
ndays<-1	4	6	9	4
ndays<-1.5	2	5	6	2
ndays<-2	1	3	5	1
2007-2020				
mean	0.98	0.41	−0.84	0.48
stdev	2.22	2.13	1.87	1.42
ndays>2	4	4	0	3
ndays>1.5	6	4	3	4
ndays>1	8	6	3	4
ndays>0.5	**10**	**7**	3	**7**
ndays<-0.5	2	5	**9**	3
ndays<-1	2	3	6	2
ndays<-1.5	2	3	5	1
ndays<-2	1	2	4	0

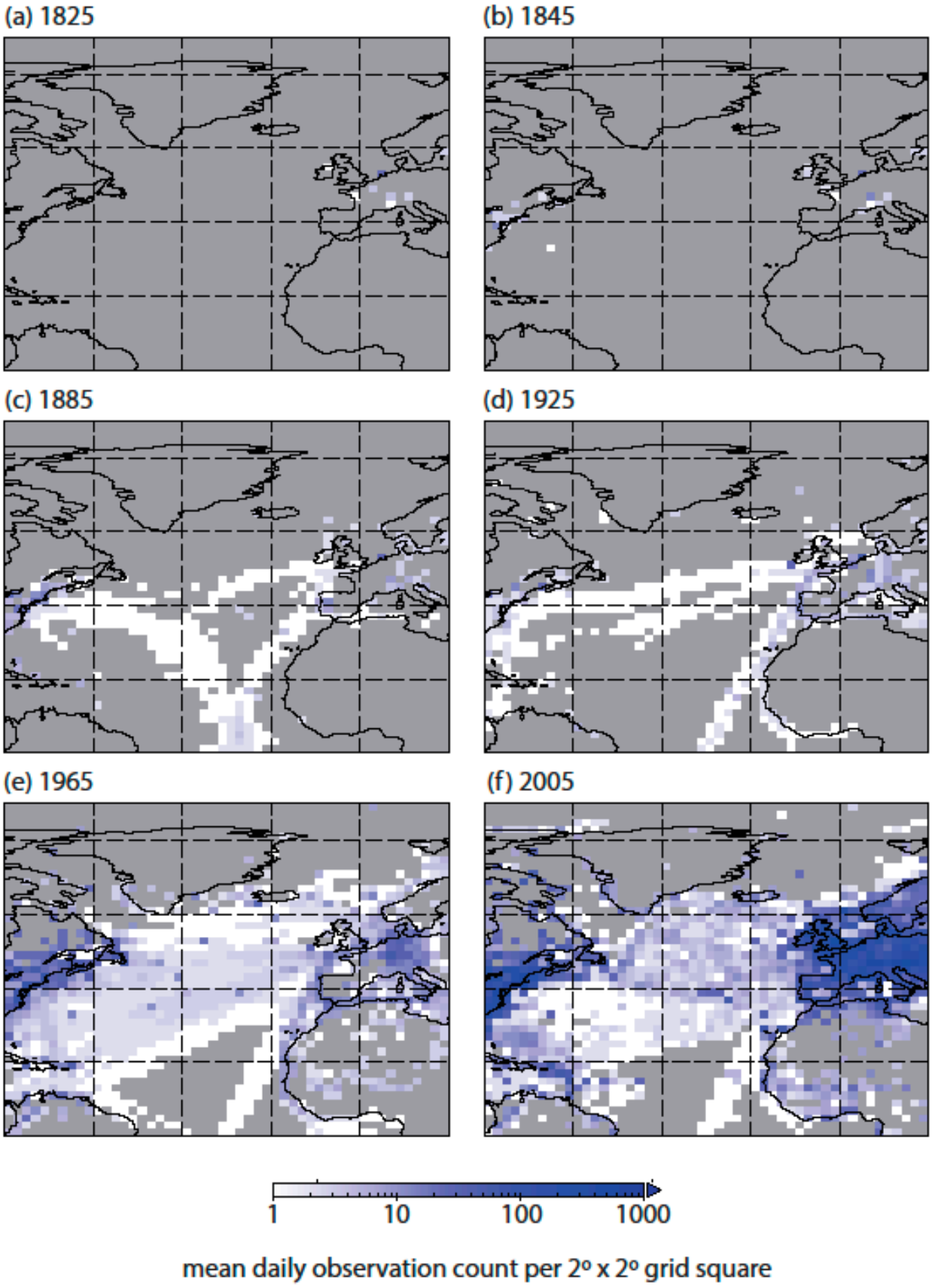
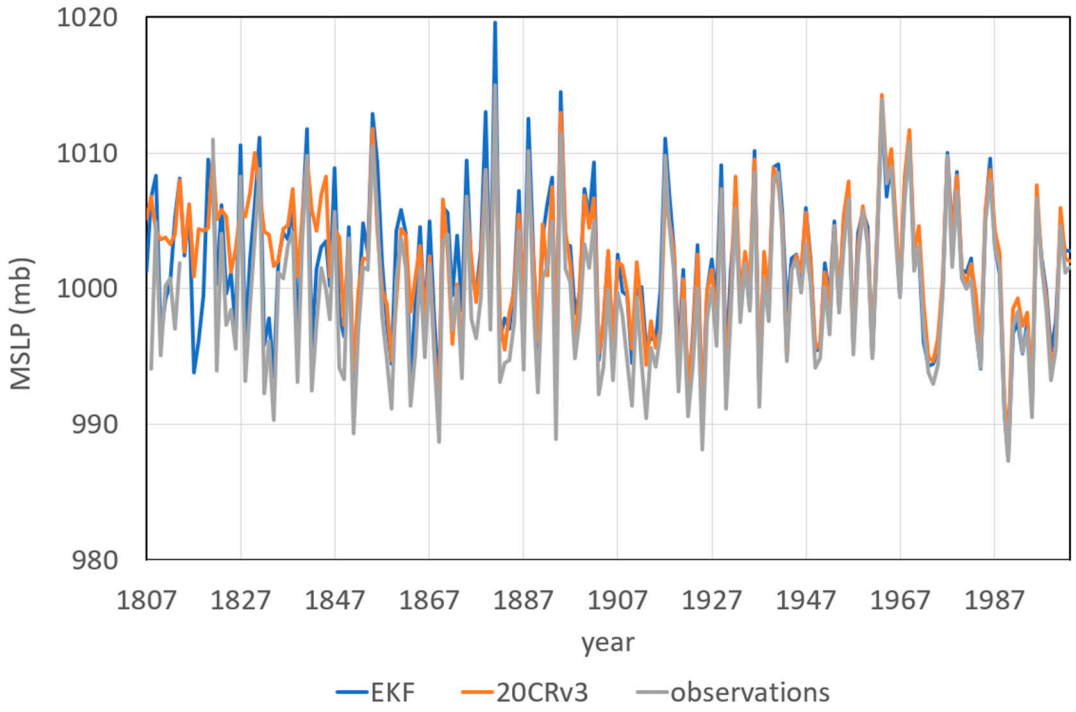
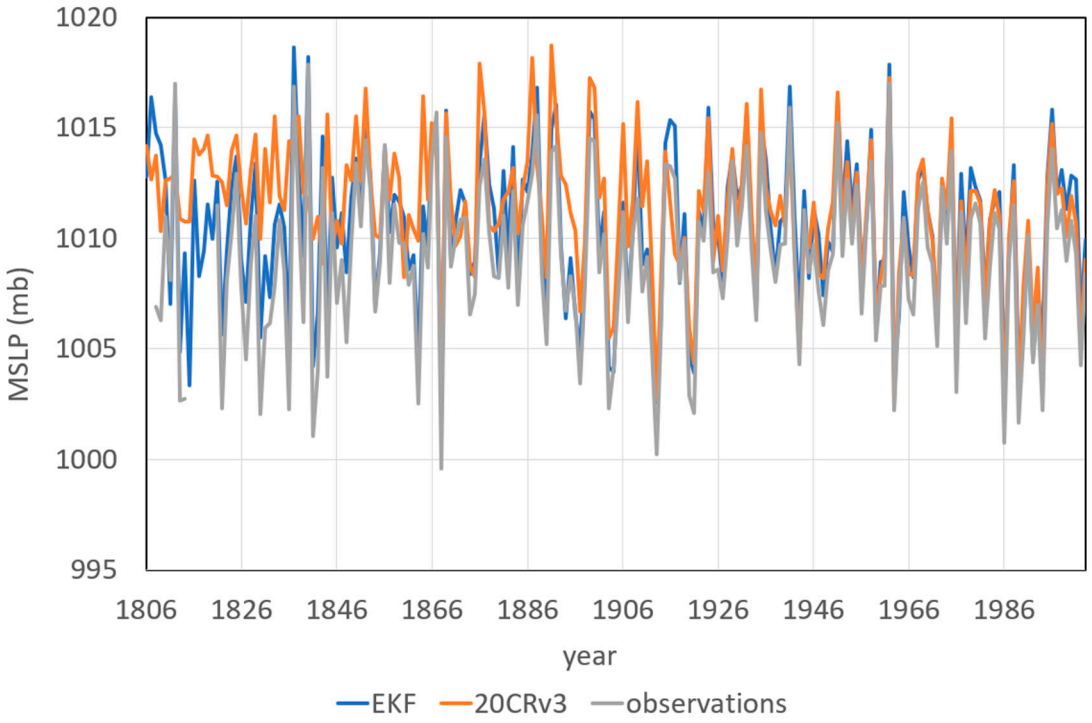


Figure S1. ISPD observational coverage for selected years in 20CRv3.

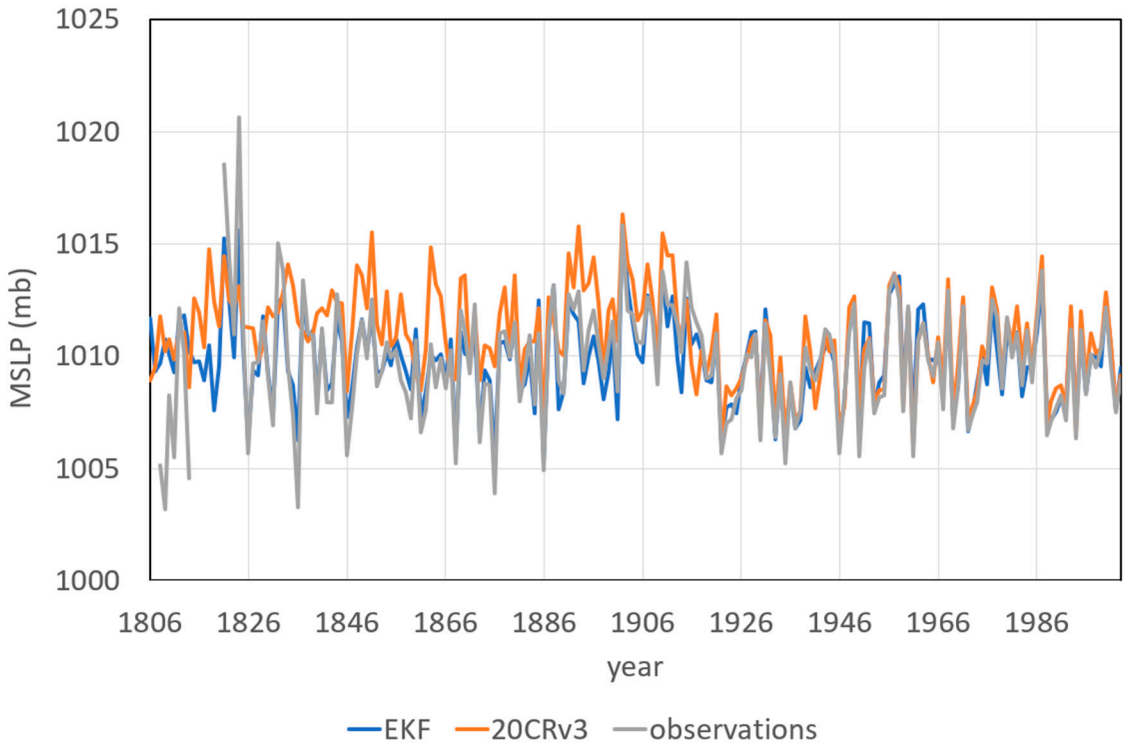
(a) DJF



(b) MAM



(c) JJA



(d) SON

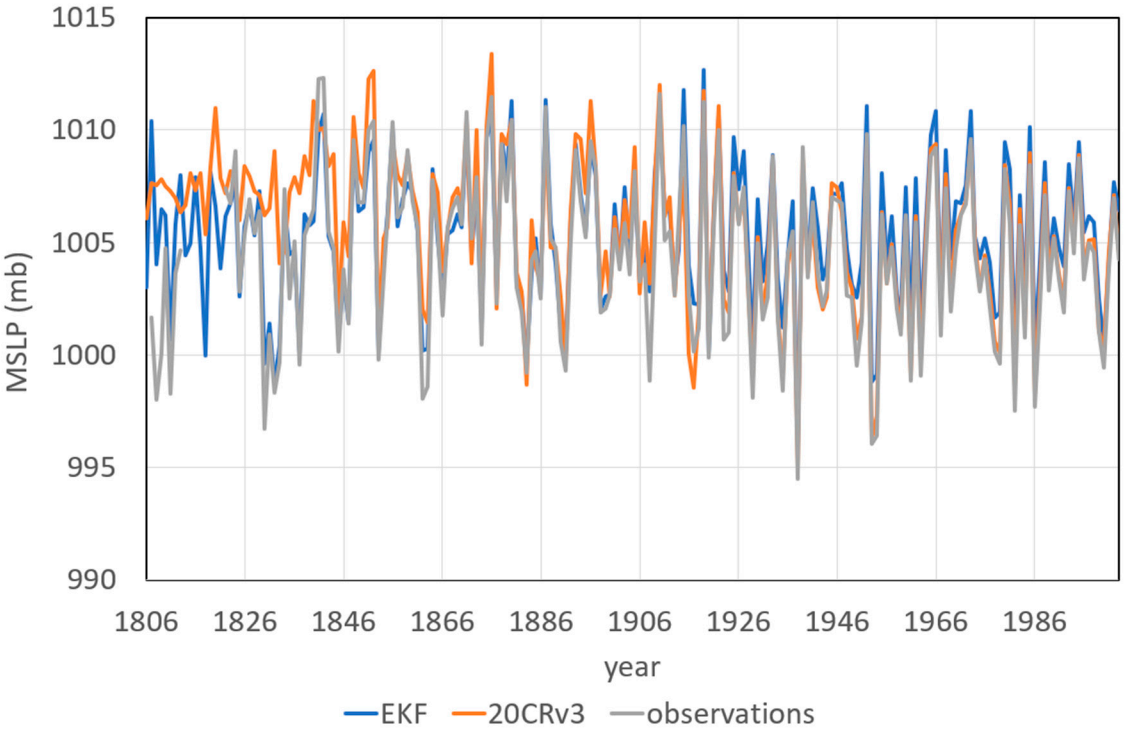
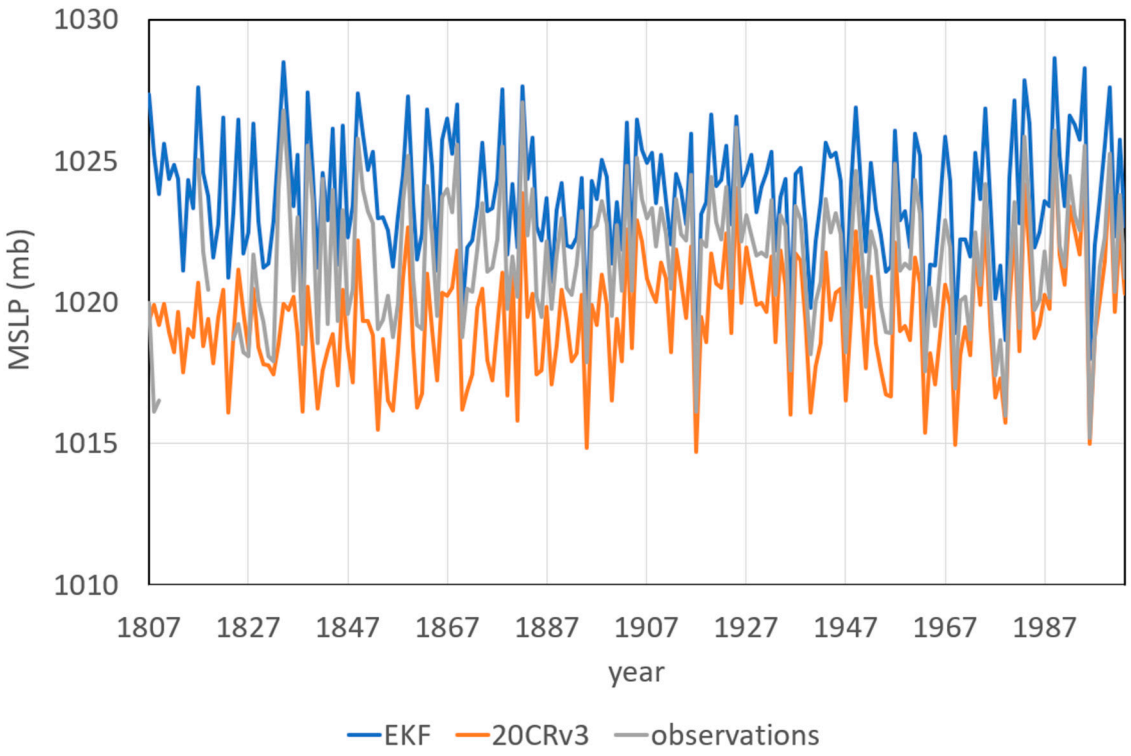
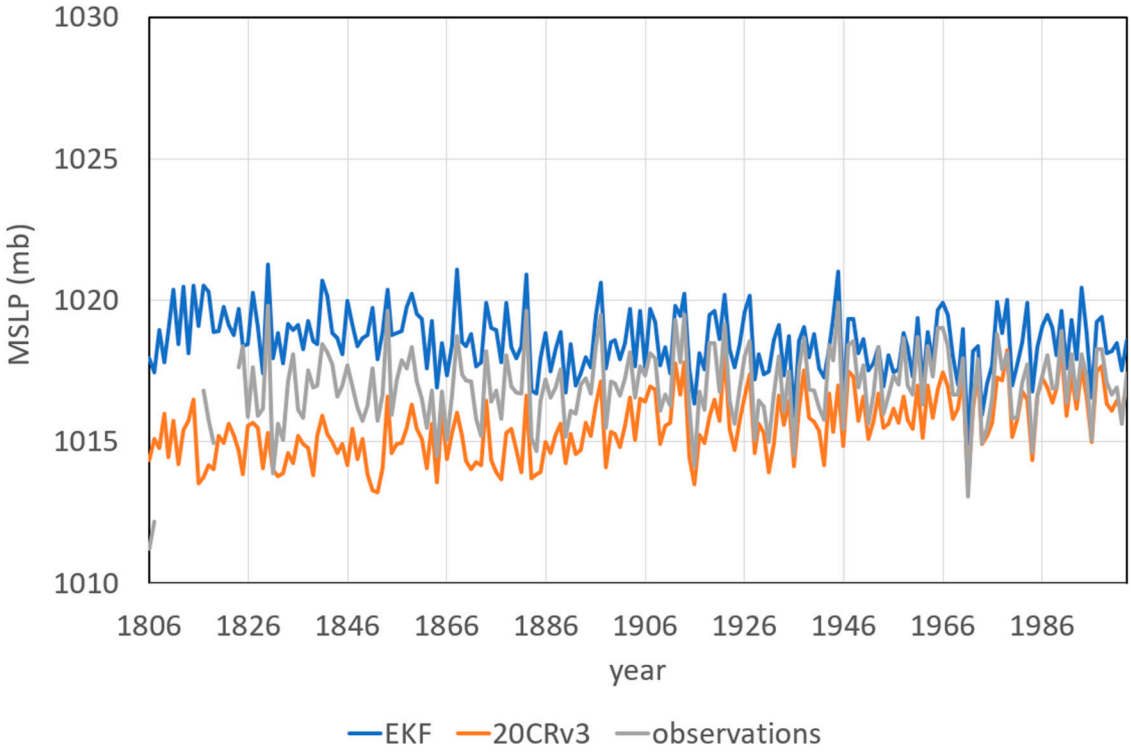


Figure S2. Seasonal time series of SW Iceland mean sea-level pressure (MSLP) from extended weather station record (grey) and 20CRv3 (orange) and EKF400v2 (blue) reanalyses: (a) winter; (b) spring; (c) summer; (d) autumn.

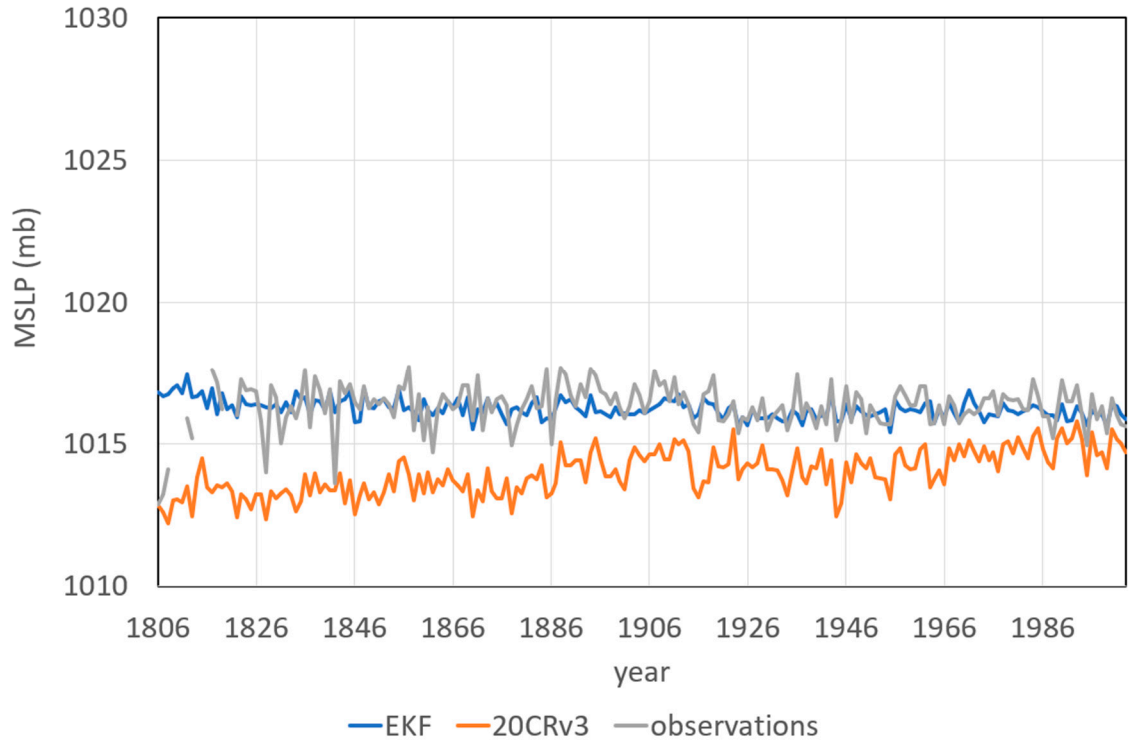
(a)DJF



(b) MAM



(c) JJA.



(d) SON

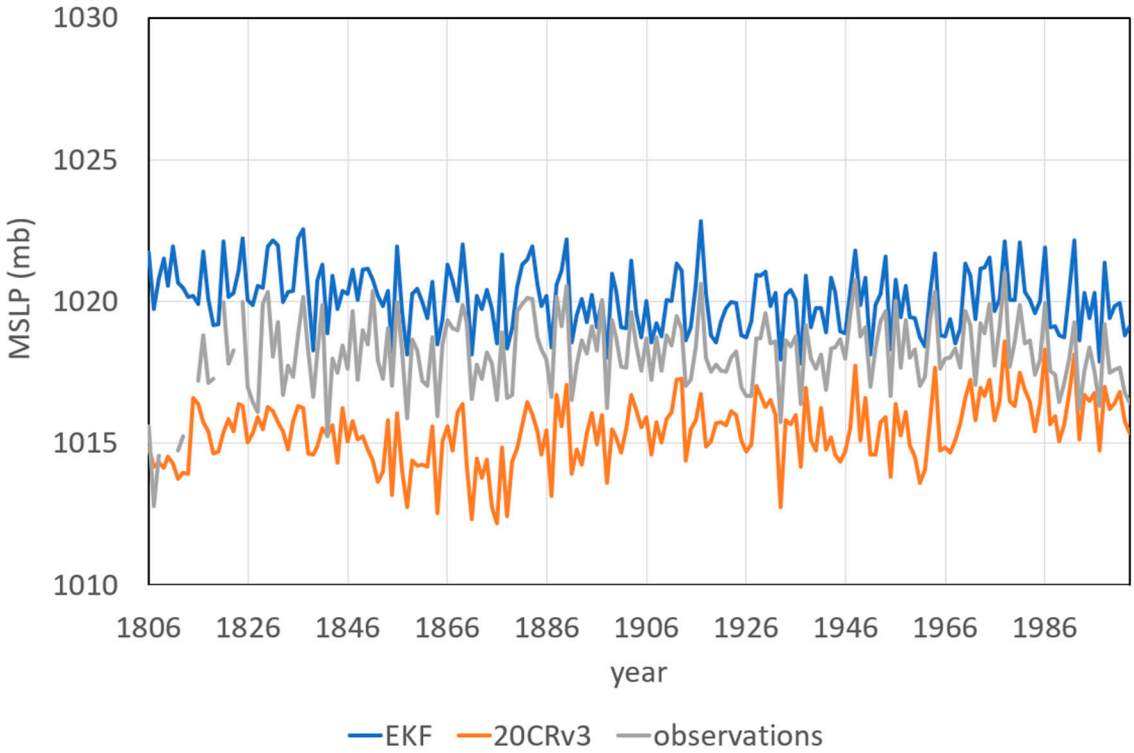
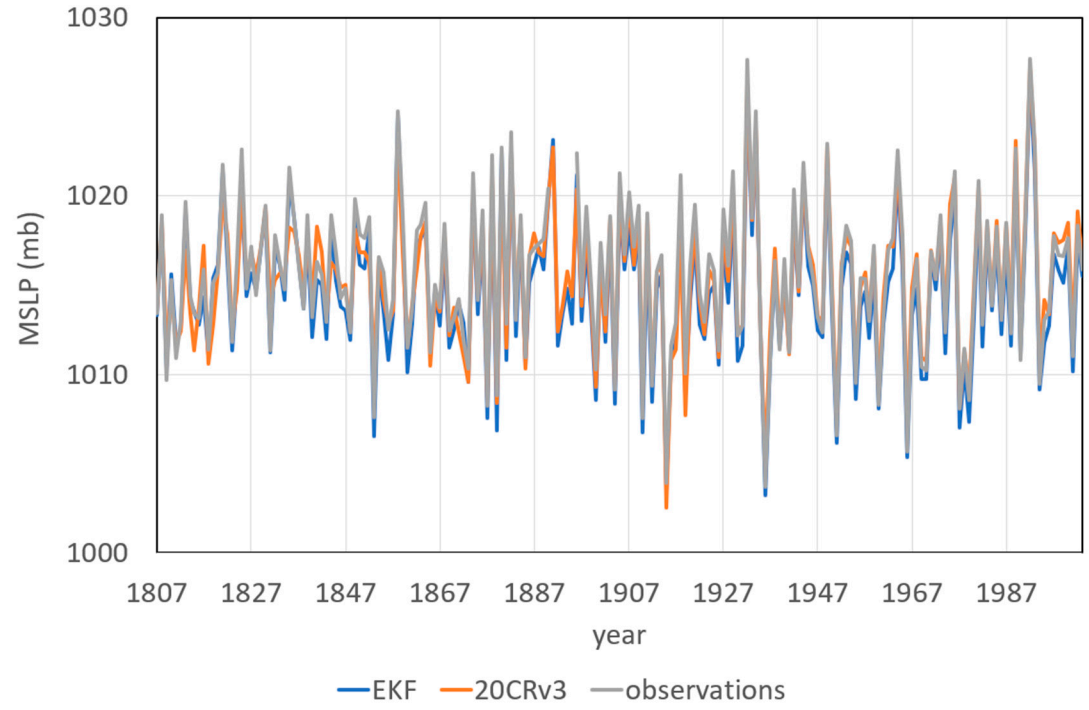
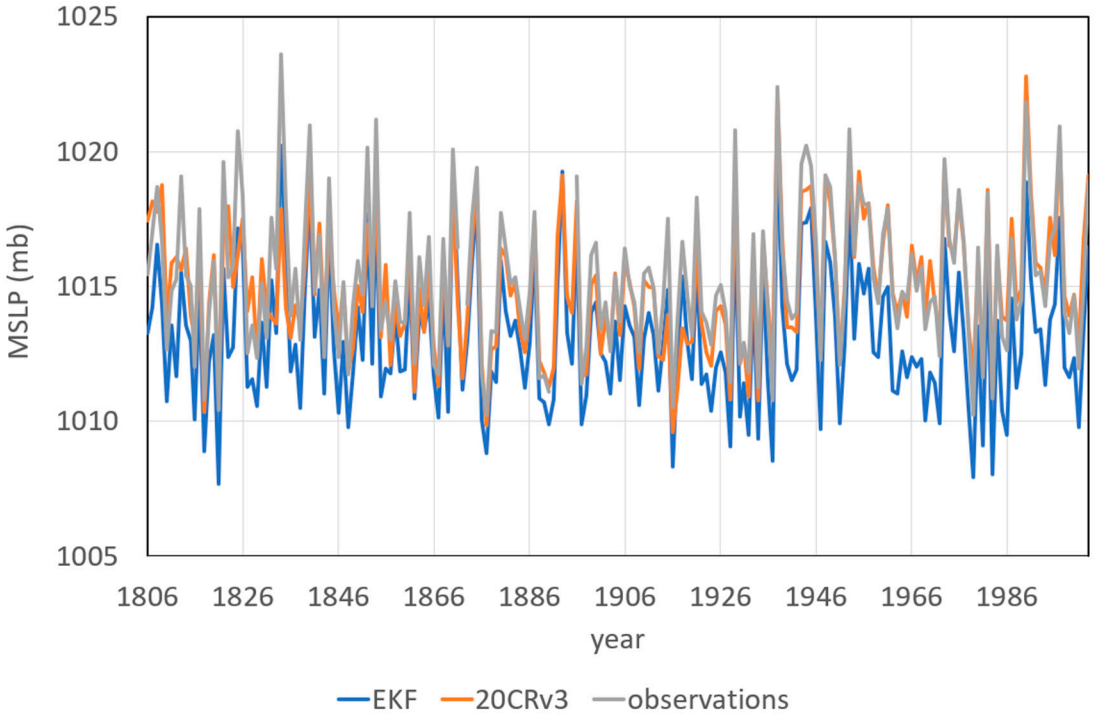


Figure S3. Seasonal time series of Gibraltar mean sea-level pressure (MSLP) from extended weather station record (grey) and 20CRv3 (orange) and EKF400v2 (blue) reanalyses: (a) winter; (b) spring; (c) summer; (d) autumn.

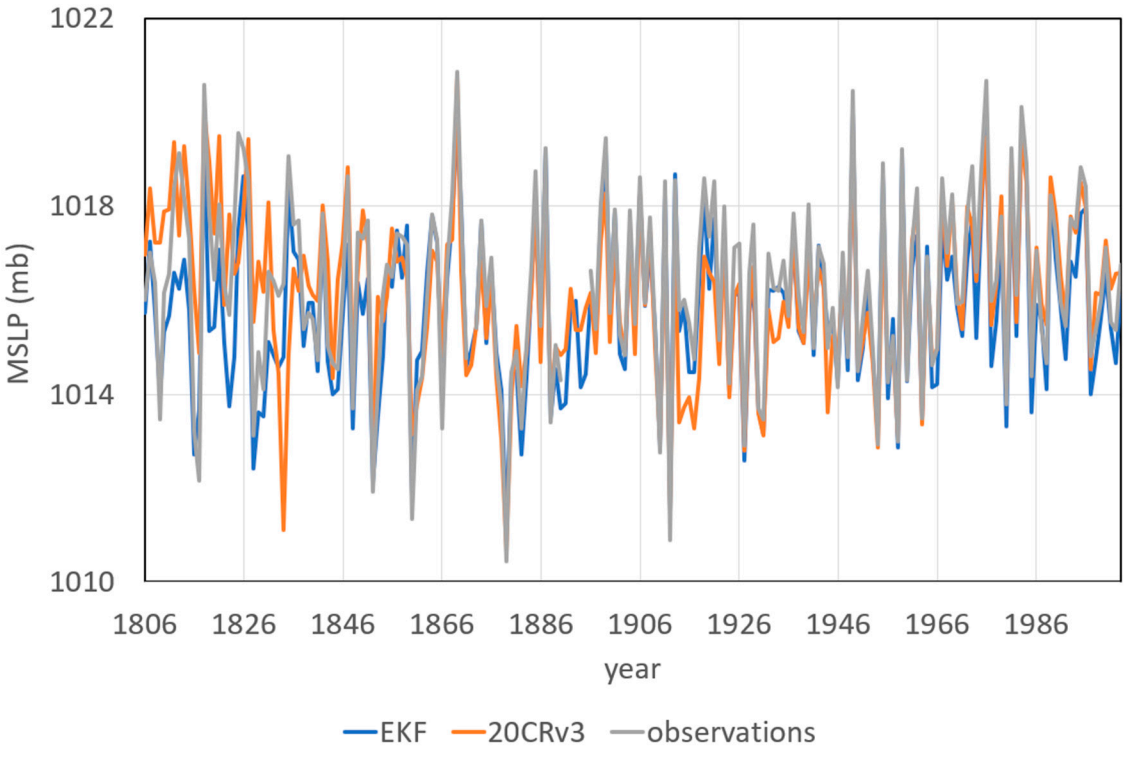
(a) DJF


1030
1020
1010
1000
MSLP (mb)
1807
1827
1847
1867
1887
1907
1927
1947
1967
1987
year
EKF
20CRv3
observations

(b) MAM


1025
1020
1015
1010
1005
MSLP (mb)
1806
1826
1846
1866
1886
1906
1926
1946
1966
1986
year
EKF
20CRv3
observations

(c) JJA



(d) SON

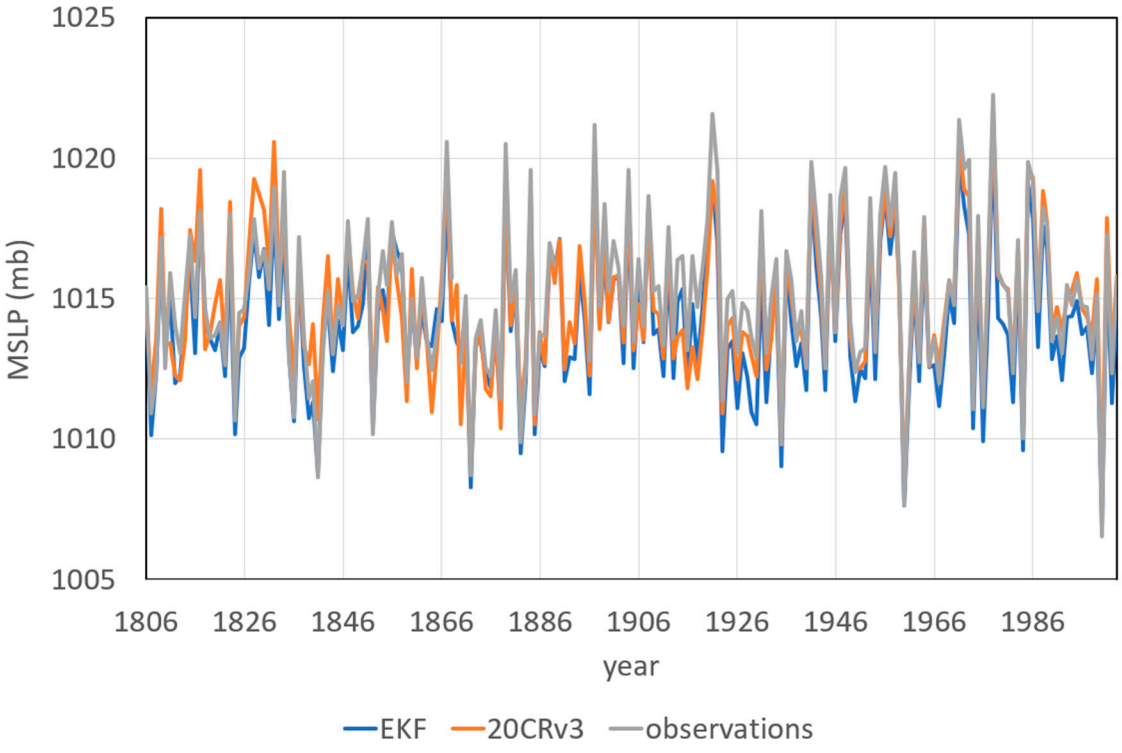
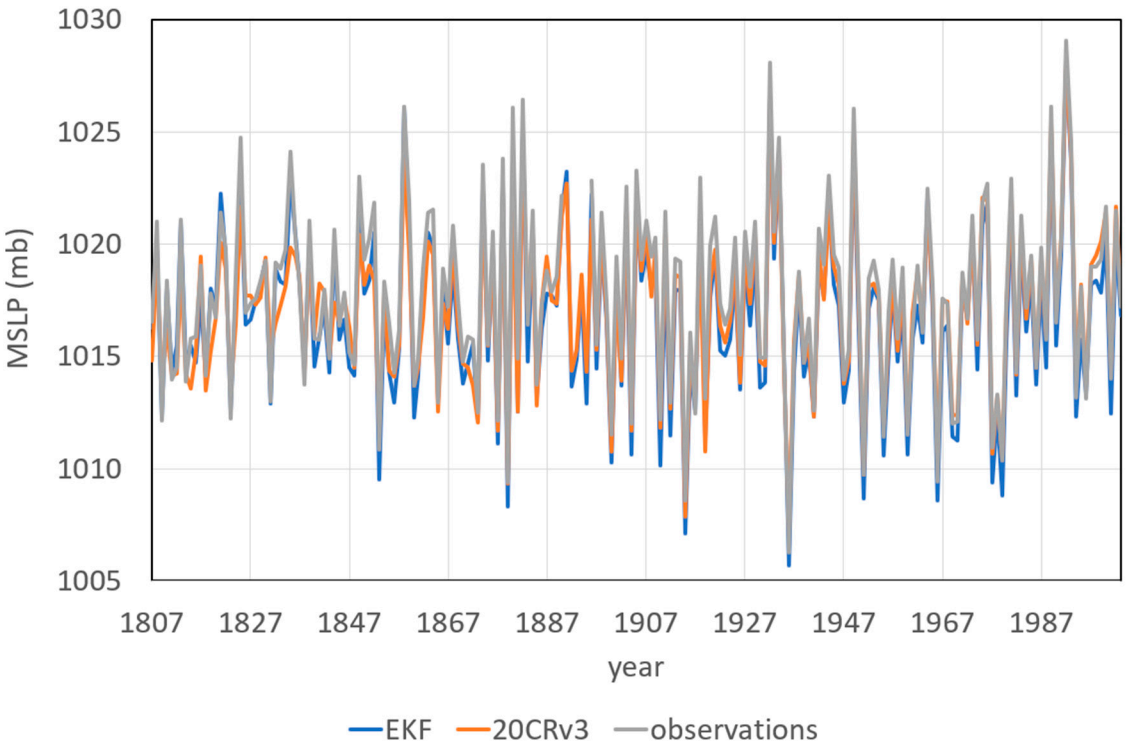


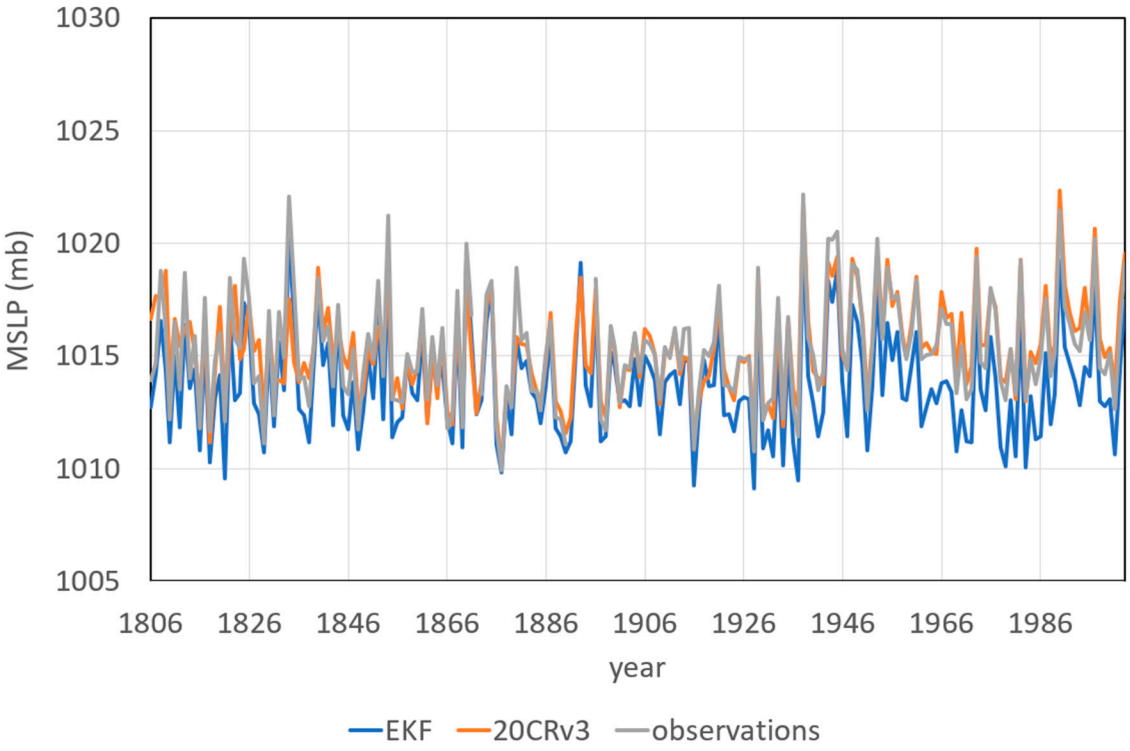
Figure S4. Seasonal time series of London mean sea-level pressure (MSLP) from extended weather station record (grey) and 20CRv3 (orange) and EKF400v2 (blue) reanalyses: (a) winter; (b) spring; (c) summer; (d) autumn.

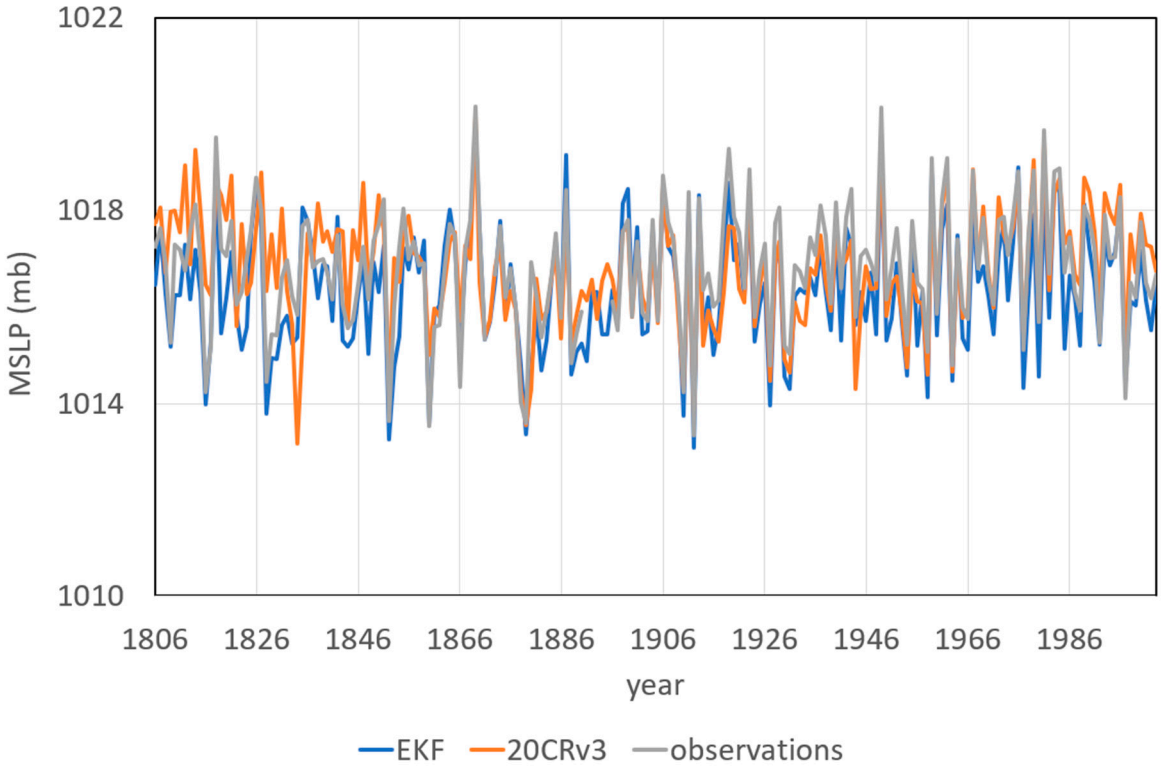
(a) DJF



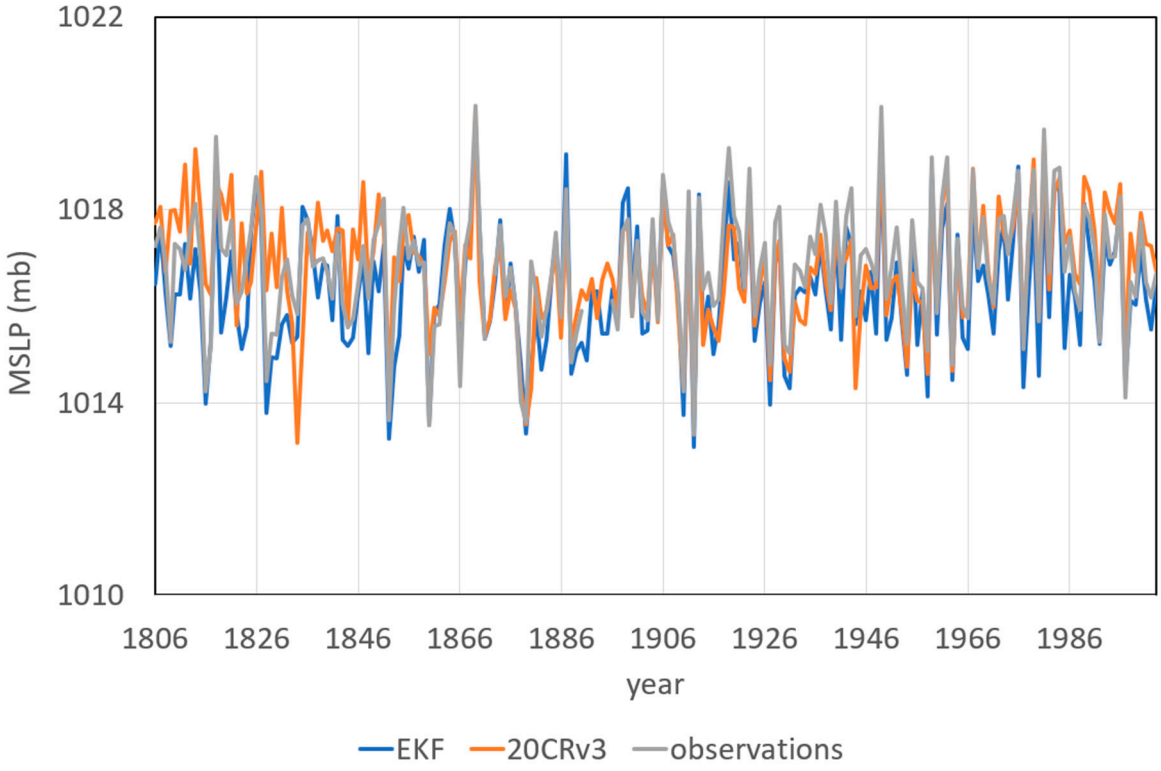
(b) MAM

(c) JJA




1022
1018
1014
1010
MSLP (mb)
1806
1826
1846
1866
1886
1906
1926
1946
1966
1986
year
EKF
20CRv3
observations

(c) JJA


1022
1018
1014
1010
MSLP (mb)
1806
1826
1846
1866
1886
1906
1926
1946
1966
1986
year
EKF
20CRv3
observations

(d) SON

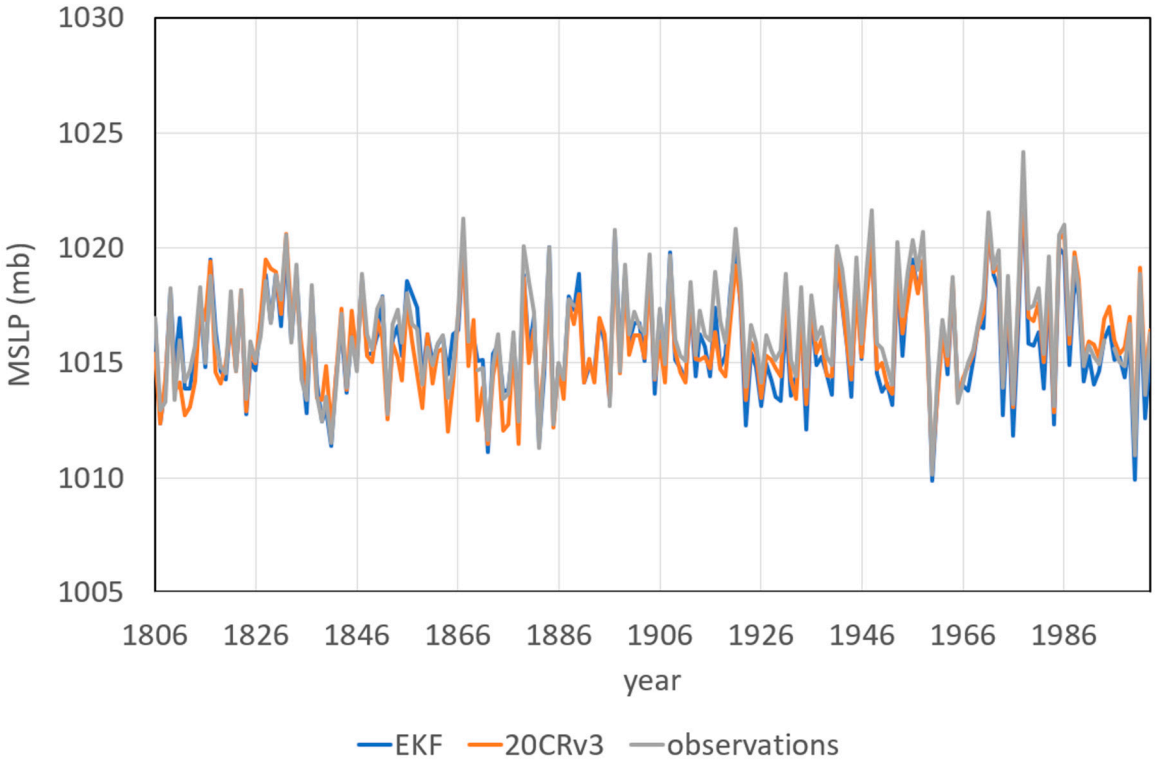


Figure S5. Seasonal time series of Paris mean sea-level pressure (MSLP) from extended weather station record (grey) and 20CRv3 (orange) and EKF400v2 (blue) reanalyses: (a) winter; (b) spring; (c) summer; (d) autumn.