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Supplement of

An observation-constrained multi-physics WRF ensemble for simulating European mega heat waves

A. I. Stegehuis et al.

Correspondence to: A. I. Stegehuis (annemiek.stegehuis@lsce.ipsl.fr)

Supplementary material

Table S1: Final ranks.

Final rank	Physic combinations					
	MP	PBL	SF	RA	CU	SU
1	10	1	1	4	6	2
2	6	5	5	4	3	2
3	6	7	1	5	6	2
4	8	5	5	4	14	2
5	8	7	1	4	6	2
6	8	7	1	5	6	2
7	10	5	2	4	6	2
8	6	1	1	3	6	2
9	10	2	2	4	6	2
10	10	5	5	4	6	2
11	8	4	4	4	6	2
12	8	5	5	4	3	2
13	6	7	1	4	6	2
14	8	5	2	4	14	2
15	6	7	1	3	6	2
16	6	4	4	4	6	2
17	6	7	1	4	3	2
18	6	5	5	4	14	2
19	8	5	5	5	6	2
20	8	1	1	5	6	2
21	8	2	2	4	14	2
22	6	2	2	5	6	2
23	8	5	2	5	6	2
24	6	5	2	4	14	2
25	8	2	2	5	6	2
26	8	5	2	3	6	2
27	6	5	5	5	6	2
28	8	1	1	5	3	2
29	8	5	5	3	6	2
30	6	5	2	3	6	2
31	8	7	1	4	14	2
32	8	1	1	4	14	2
33	6	2	2	3	6	2
34	6	7	1	4	14	2
35	6	5	5	3	6	2
36	6	2	2	4	14	2
37	8	2	2	3	6	2
38	10	5	5	4	1	2
39	6	1	1	5	14	2
40	10	5	2	4	1	2
41	6	1	1	4	14	2
42	10	1	1	4	1	2
43	6	7	1	4	1	2
44	6	5	5	5	1	2
45	8	7	1	4	1	2
46	8	2	2	4	1	2
47	6	5	5	4	1	2
48	8	5	2	4	1	2
49	8	5	5	4	1	2
50	8	6	6	4	1	2
51	8	5	2	4	1	2
52	6	5	2	5	1	2
53	6	1	1	4	1	2
54	8	1	1	4	1	2
55	8	2	2	5	1	2

Figure S1a-d: Timeseries over France 2003 (a,b) and 2007 (c,d) and Russia (e,f) with maximum (a,c,e) and minimum (b,d,f) daily temperatures. Every simulation is shown in gray and observations of E-OBS in black. The blue and red lines are the coldest and the warmest simulations over France during the heatwave. These lines have the same set of physics in all the figures.

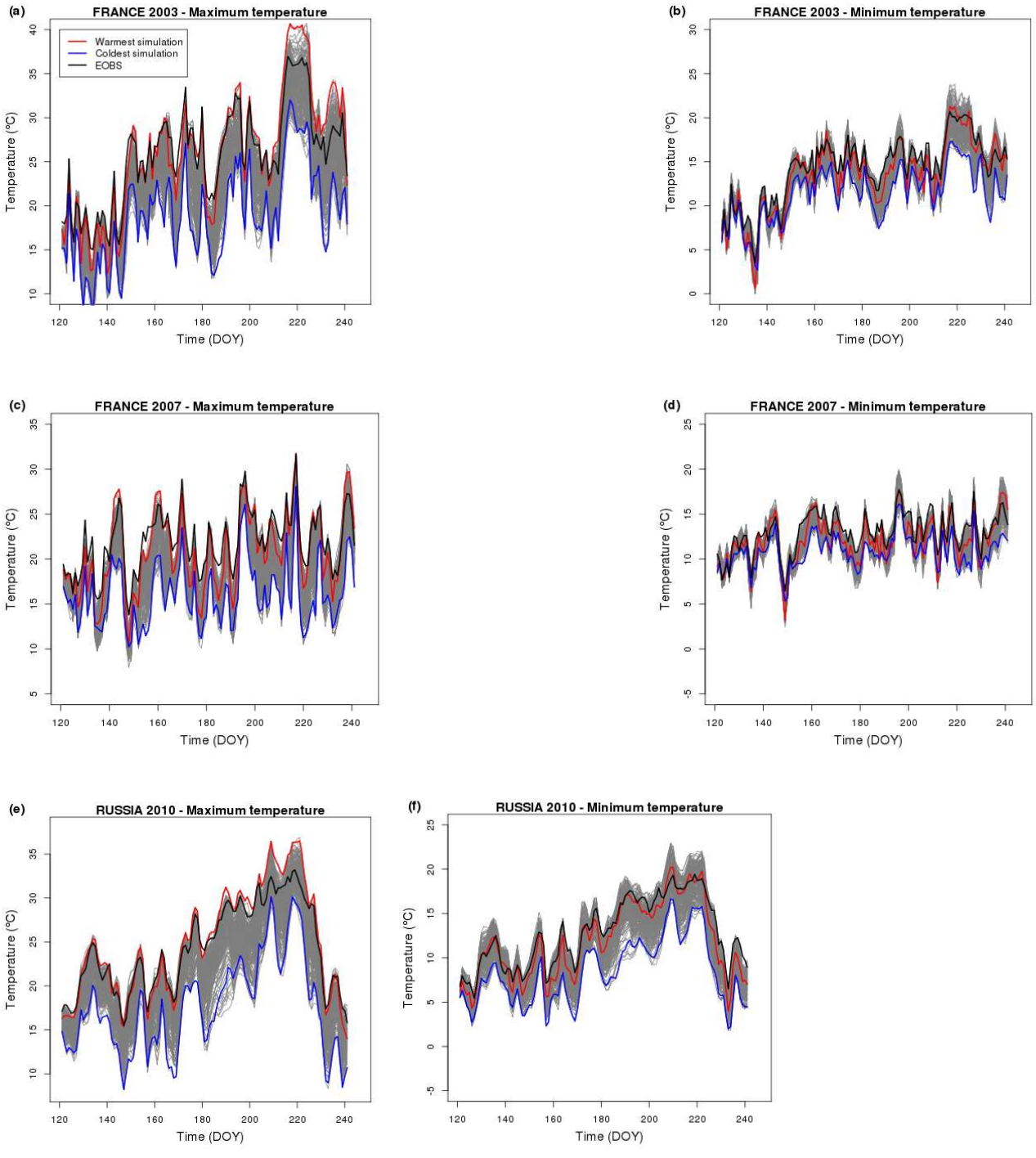


Figure S2a-d: Scatter plot with soil moisture content at July 31st and precipitation in the preceding months of June-July. Every point is one simulation. Different colors and symbols represent different physics for convection (CU) (a), microphysics (MP) (b), radiation (RA) (c) and planet boundary layer-surface (PBL-SF) (d).

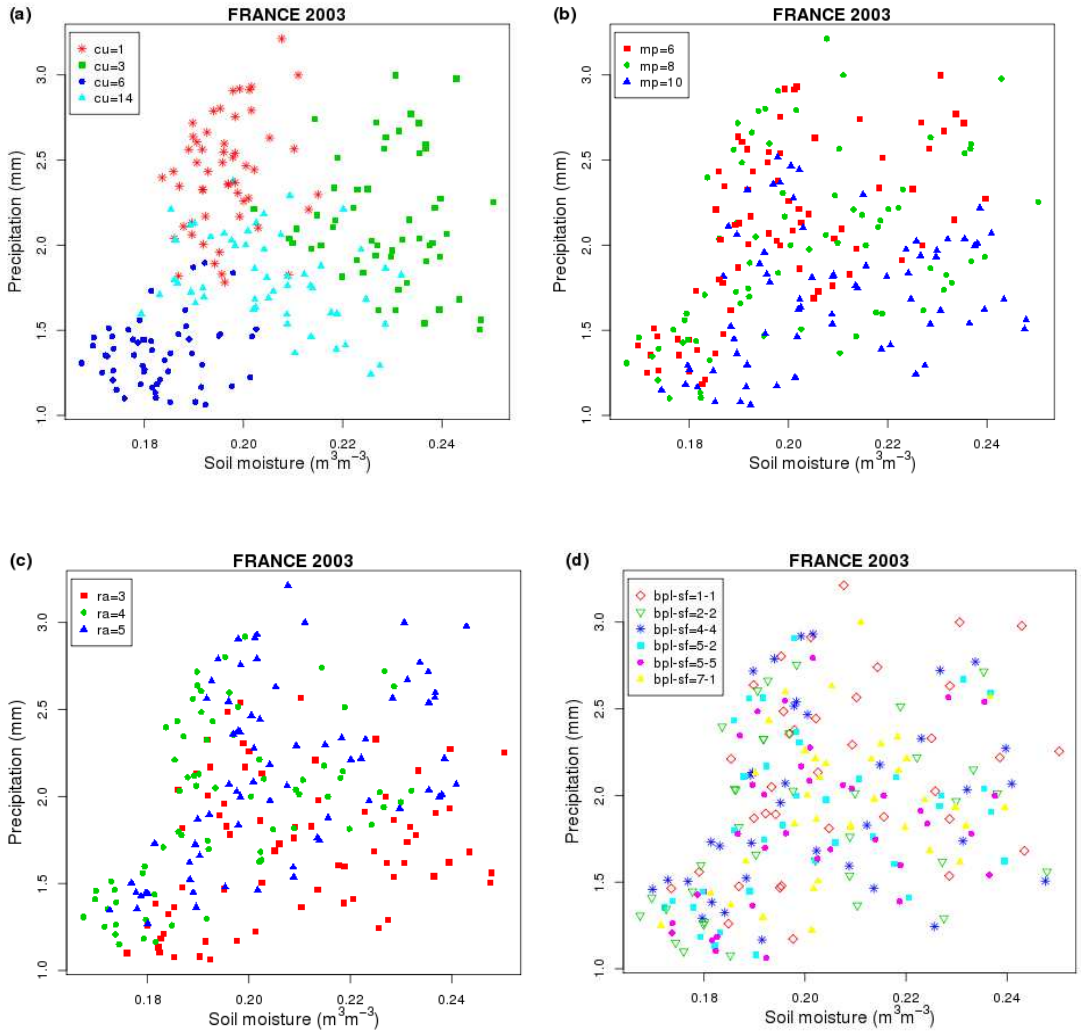
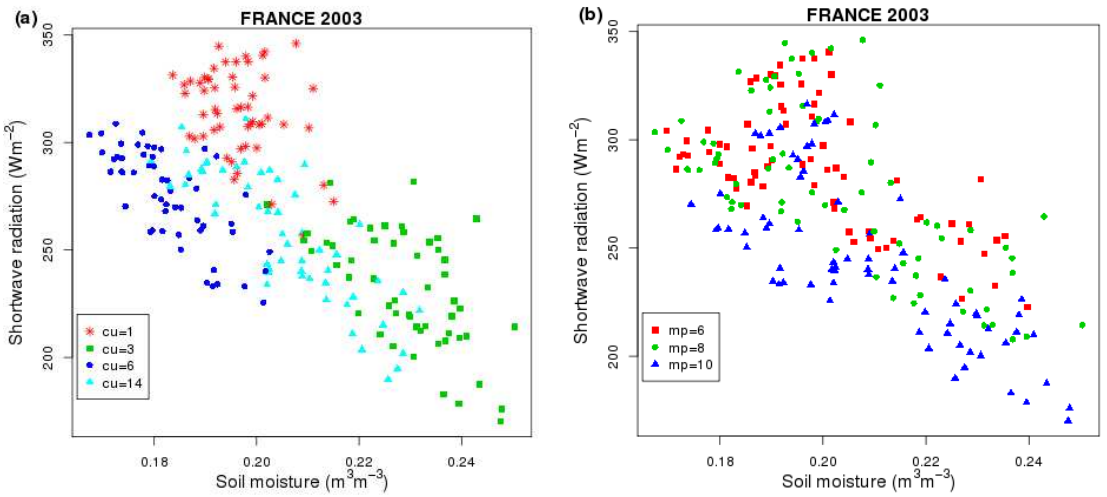


Figure S3a-d: Scatter plot with soil moisture content at the end of July and shortwave radiation during the preceding months of June-July. Every point is one simulation. Different colors and symbols represent different physics for convection (a), microphysics (b), radiation (c) and planet boundary layer-surface (d).



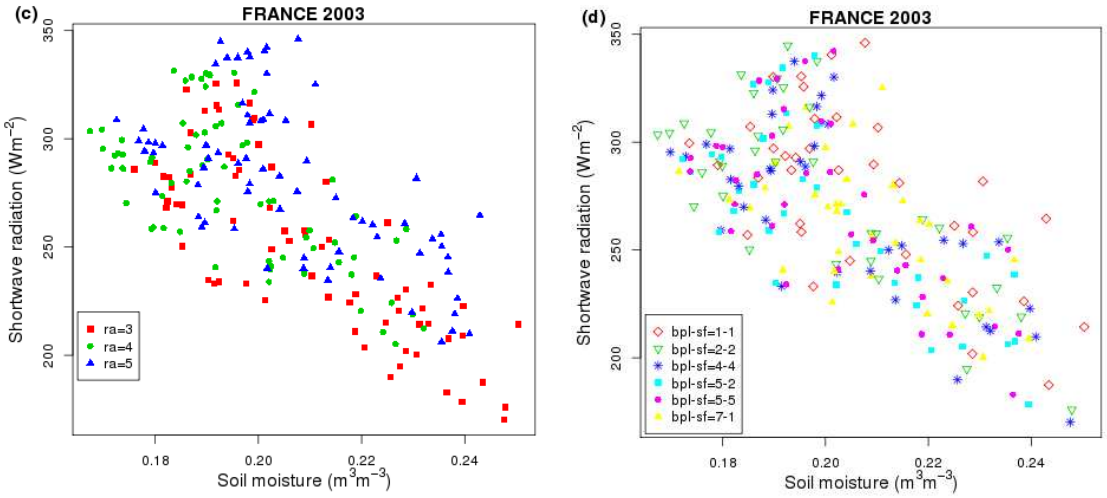
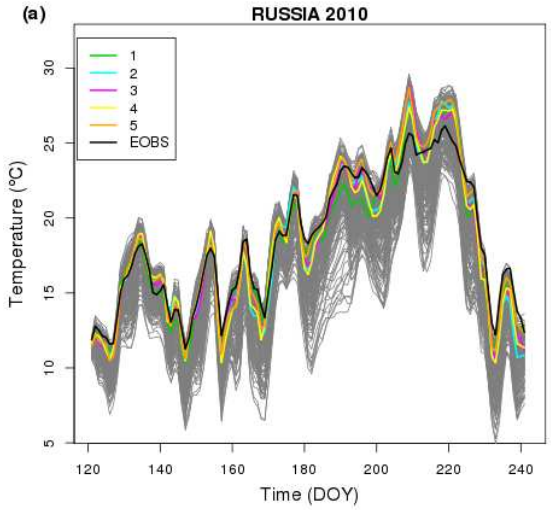
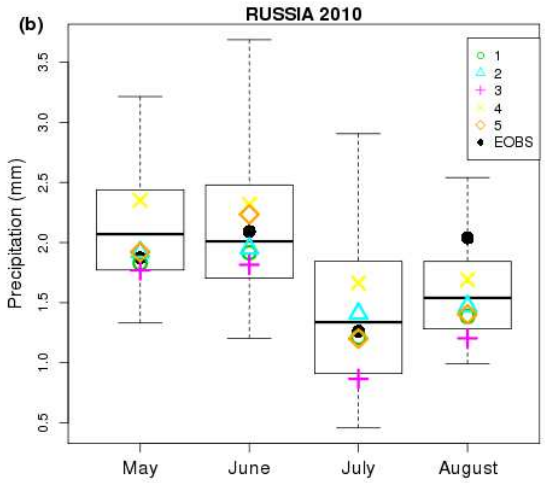


Figure S4a-c: Timeseries of temperature (a), precipitation (b) and latent heatflux (c) over Russia 2010.





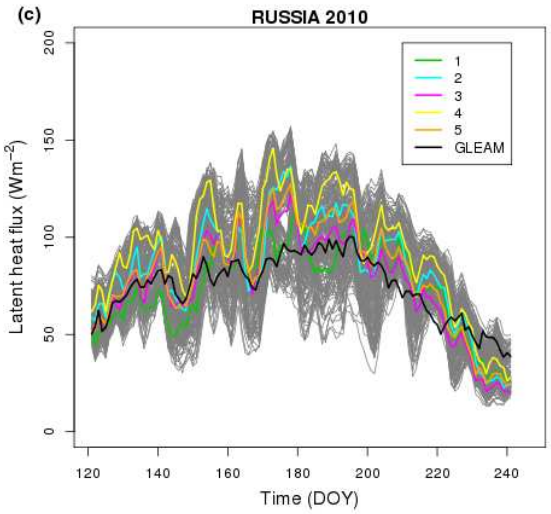


Figure S5a-d: Timeseries of temperature (a), precipitation (b), radiation (c) and latent heatflux (d) over France 2007.

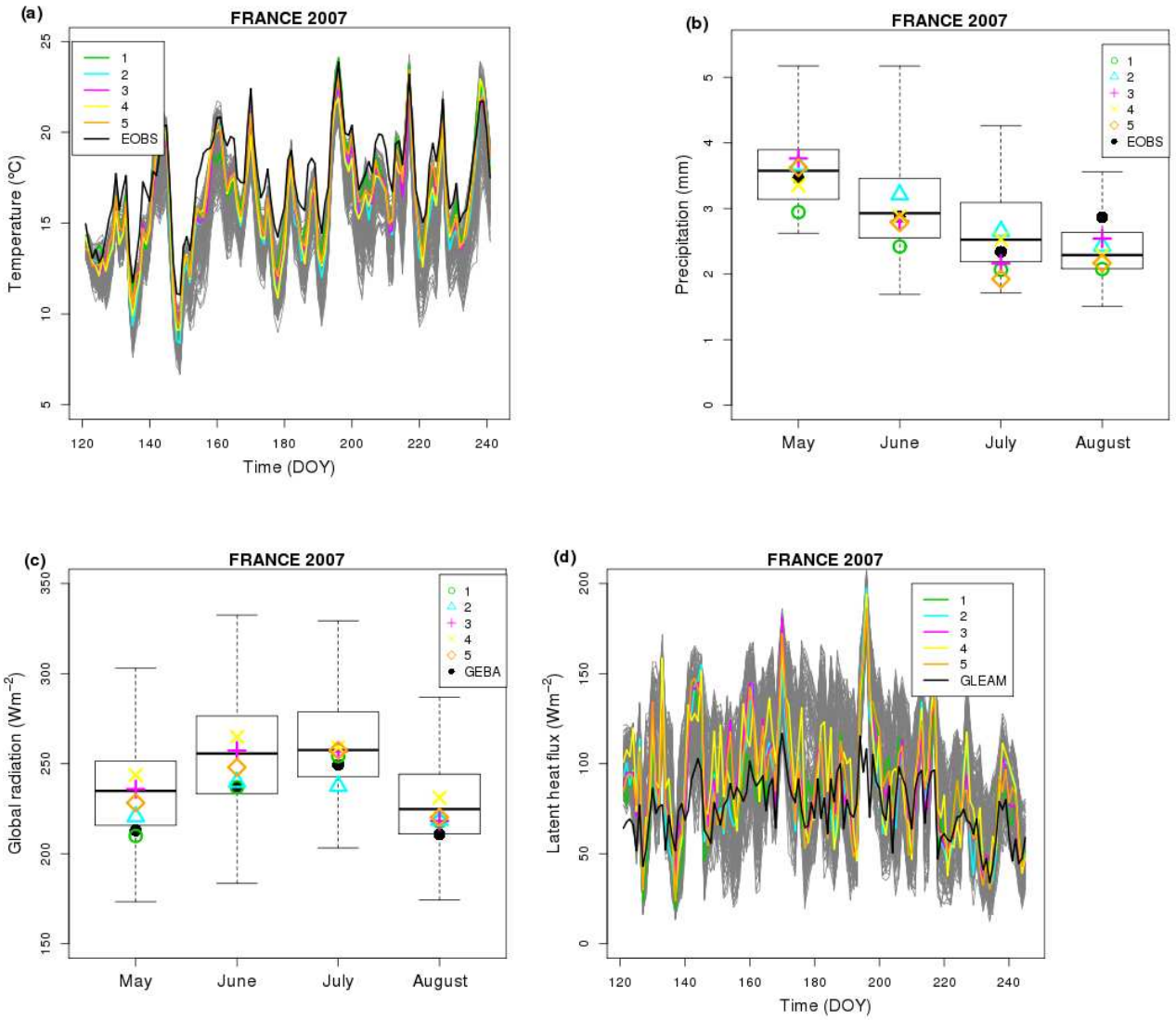
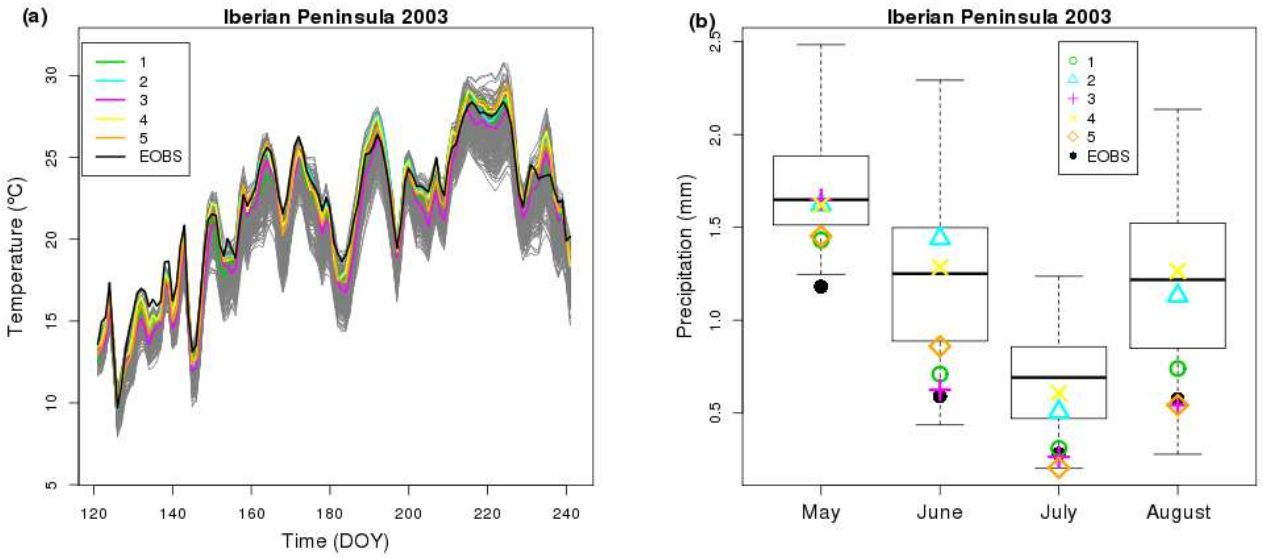
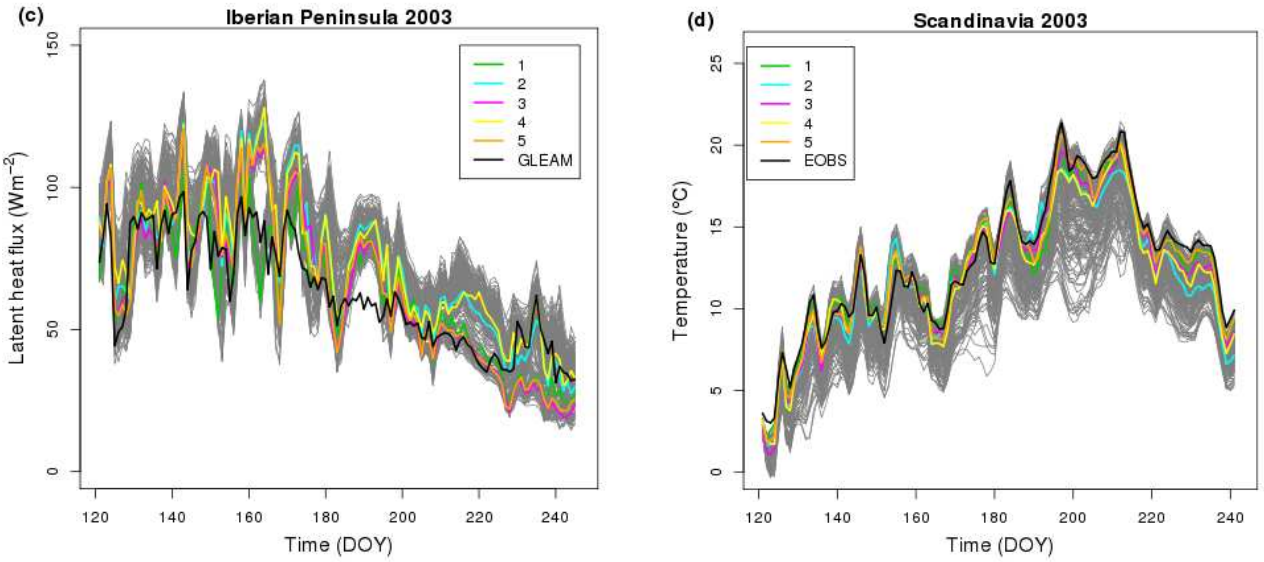
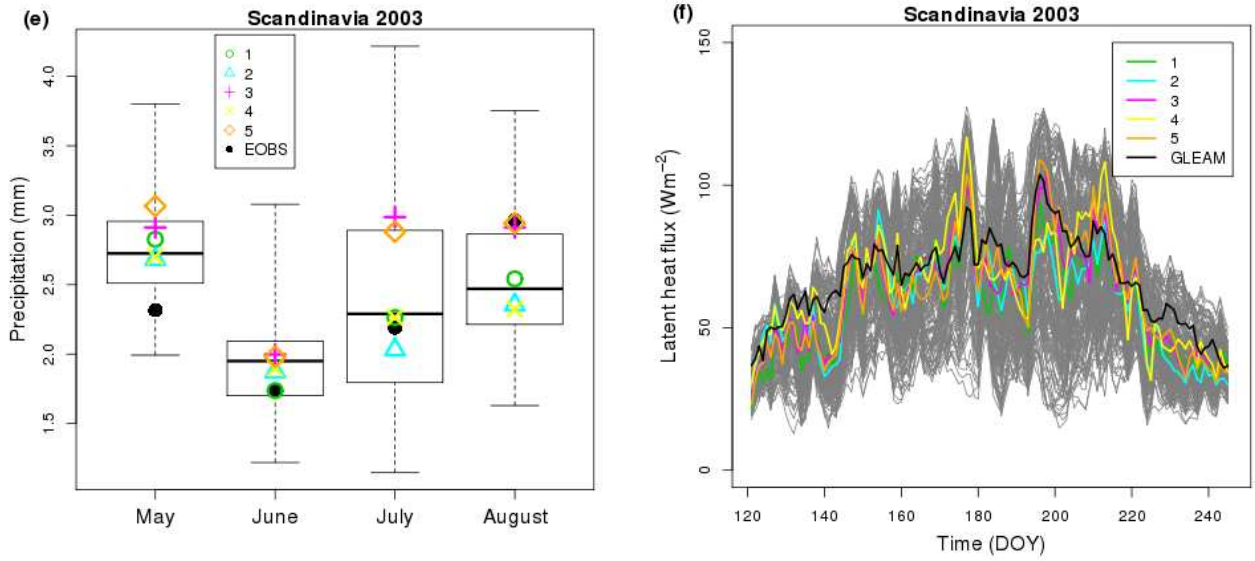


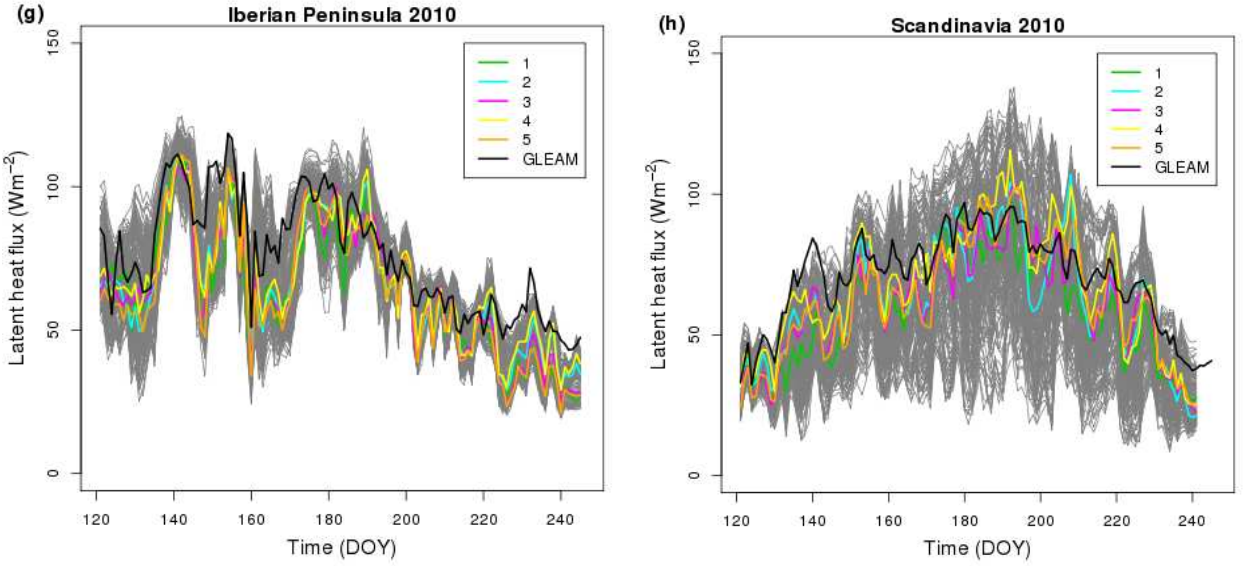
Figure S6a-h: Timeseries of temperature (a,d), precipitation (b,e) and latent heatflux (c,f,g,h) over the Iberian Peninsula 2003 (a,b,c), Scandinavia 2003 (d,e,f), the Iberian Peninsula 2010 (g) and Scandinavia 2010 (h).






(e)
Scandinavia 2003
Precipitation (mm)
1.5
2.0
2.5
3.0
3.5
4.0
1
2
3
4
5
EOBS
May
June
July
August
(f)
Scandinavia 2003
Latent heat flux (Wm^{-2})
0
50
100
150
1
2
3
4
5
GLEAM
120
140
160
180
200
220
240
Time (DOY)

40


(g)
Iberian Peninsula 2010
Latent heat flux (Wm^{-2})
0
50
100
150
1
2
3
4
5
GLEAM
120
140
160
180
200
220
240
Time (DOY)
(h)
Scandinavia 2010
Latent heat flux (Wm^{-2})
0
50
100
150
1
2
3
4
5
GLEAM
120
140
160
180
200
220
240
Time (DOY)

41

42