

Supplement of Geosci. Model Dev. Discuss., 7, 7861–7886, 2014
<http://www.geosci-model-dev-discuss.net/7/7861/2014/>
doi:10.5194/gmdd-7-7861-2014-supplement
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Supplement of

An observation-constrained multi-physics RCM ensemble for simulating European mega-heatwaves

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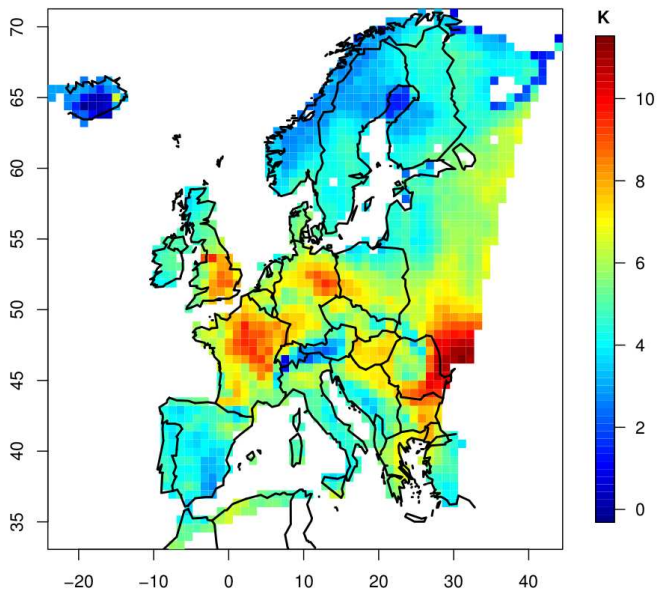
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1 Supplementary material

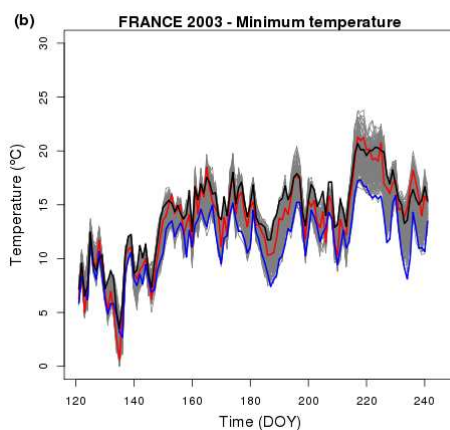
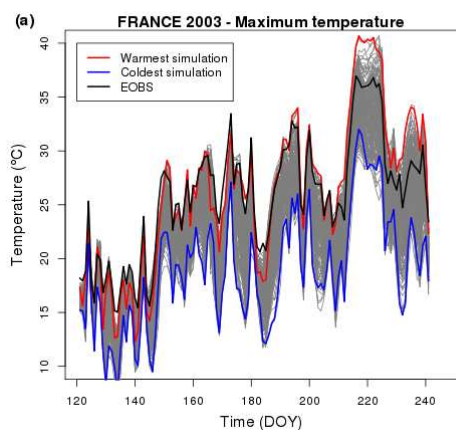
2 Table S1: Final ranks.

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

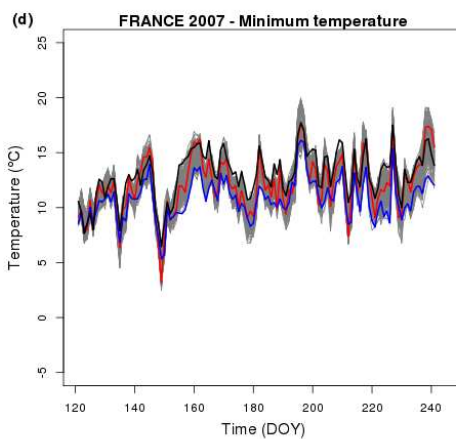
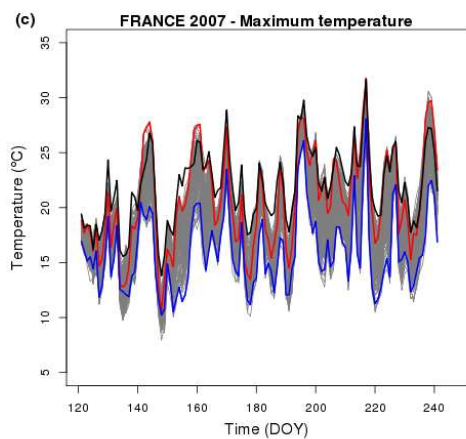
4 **Figure S1:** Simulated temperature min-max range during the heatwave of 2003 (1-15 August). The
5 range is calculated as the difference between the warmest and the coldest simulation during this period
6 between the 216 members of the ensemble.



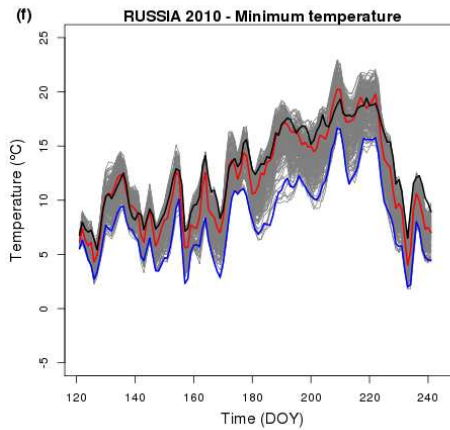
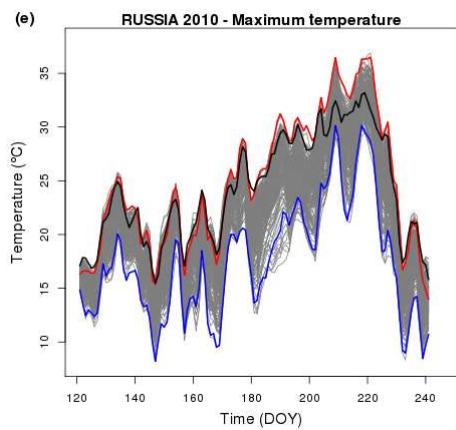
8 **Figure S2a-d:** Timeseries over France 2003 (a,b) and 2007 (c,d) and Russia (e,f) with maximum (a,c,e)
9 and minimum (b,d,f) daily temperatures. Every simulation is shown in gray and observations of E-OBS
10 in black. The blue and red lines are the coldest and the warmest simulations over France during the
11 heatwave. These lines have the same set of physics in all the figures.



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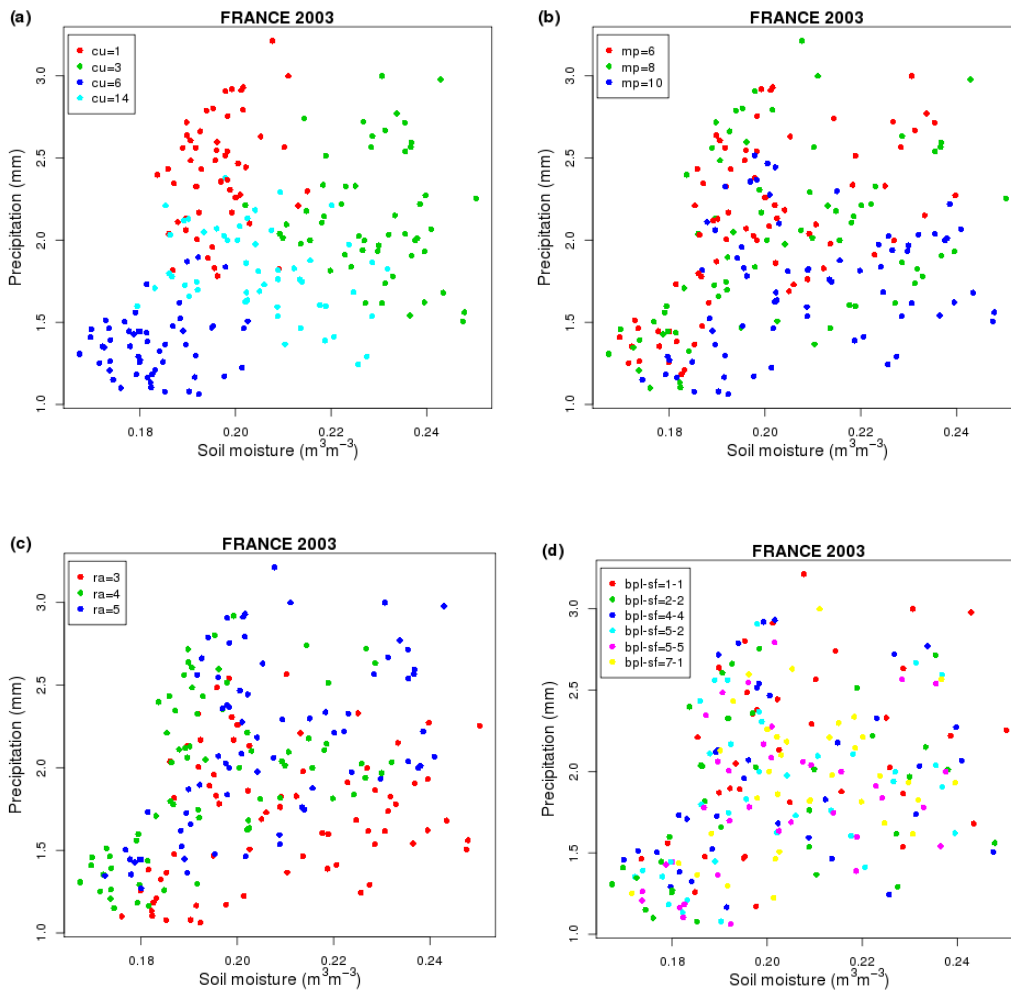


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15 **Figure S3a-d:** Correlation between soil moisture content at July 31st and precipitation in the preceding
16 months of June-July. Every point is one simulation. Different colors represent different physics for
17 convection (CU) (a), microphysics (MP) (b), radiation (RA) (c) and planet boundary layer-surface
18 (PBL-SF) (d).

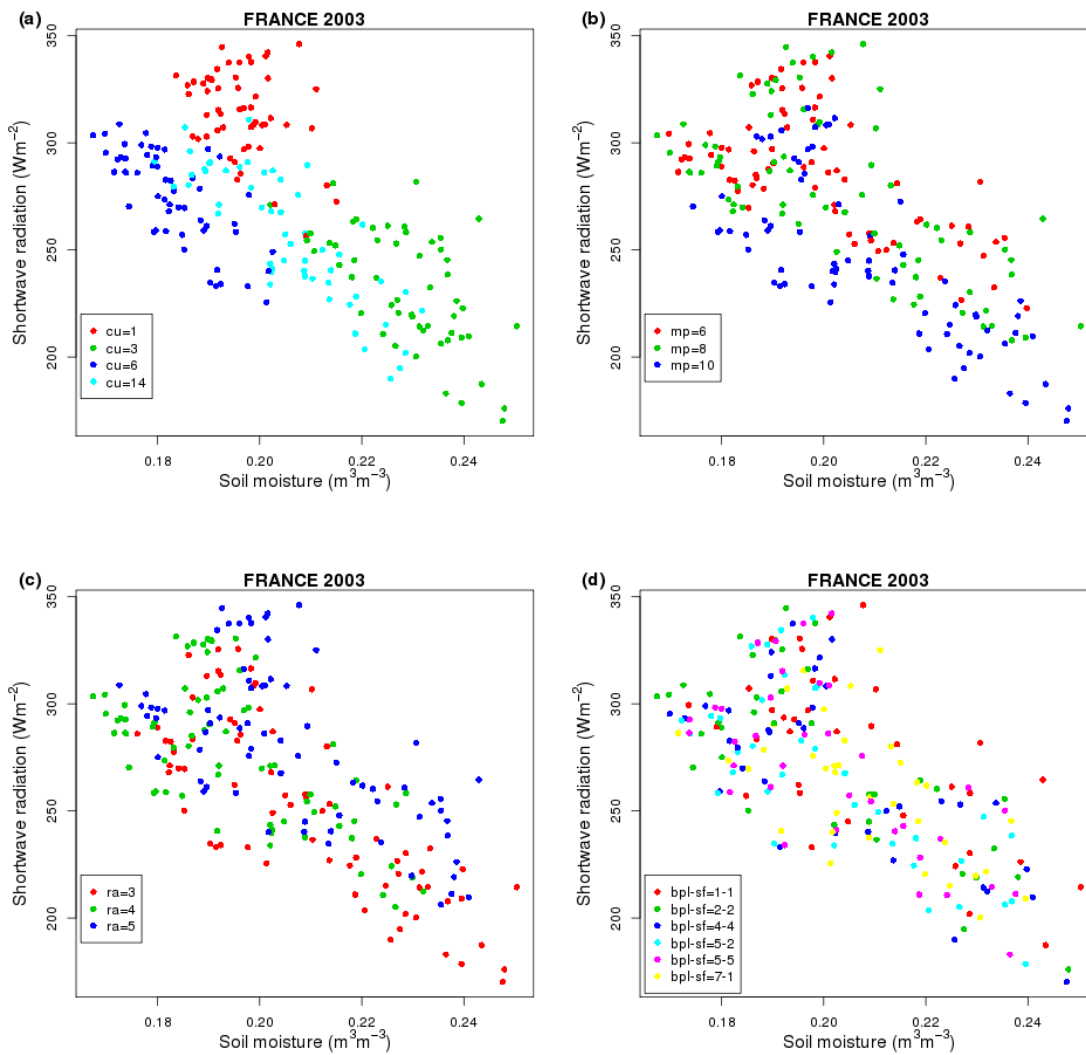


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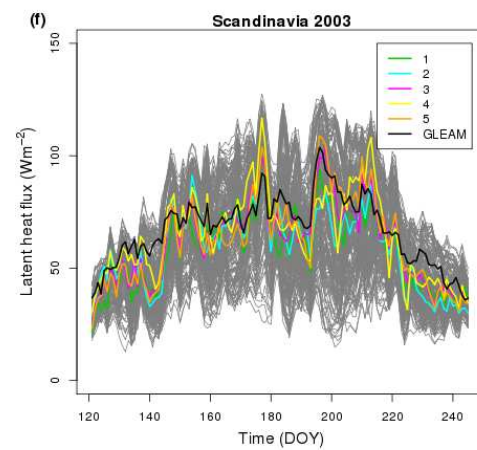
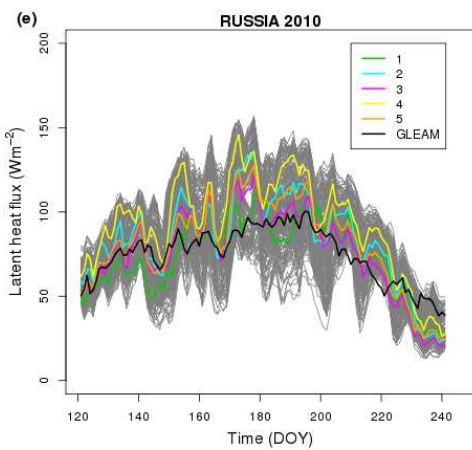
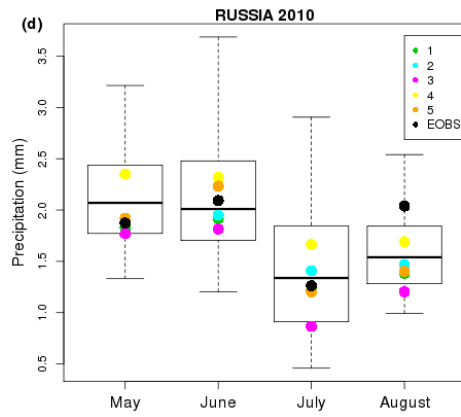
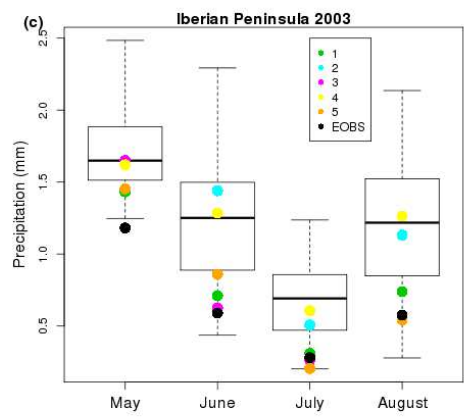
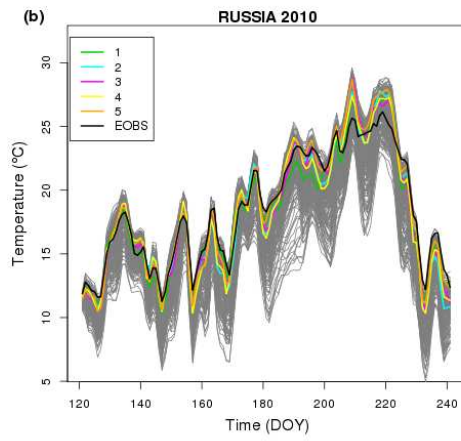
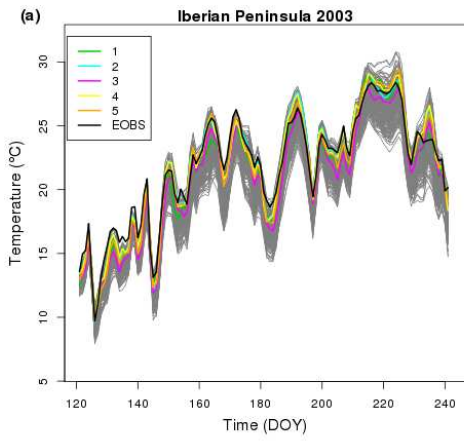
22 **Figure S4a-d:** Correlation between soil moisture content at the end of July and shortwave radiation
23 during the preceding months of June-July. Every point is one simulation. Different colors represent
24 different physics for convection (a), microphysics (b), radiation (c) and planet boundary layer-surface
25 (d).



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28 **Figure S5a-f:** Timeseries of temperature (a,b), precipitation (c,d) and latent heatflux (e,f) over the
 29 Iberian Peninsula 2003 (a,c), Russia 2010 (b,d,e) and Scandinavia 2003 (f).



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