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*Supplement of*

## **Advancing land surface model development with satellite-based Earth observations**

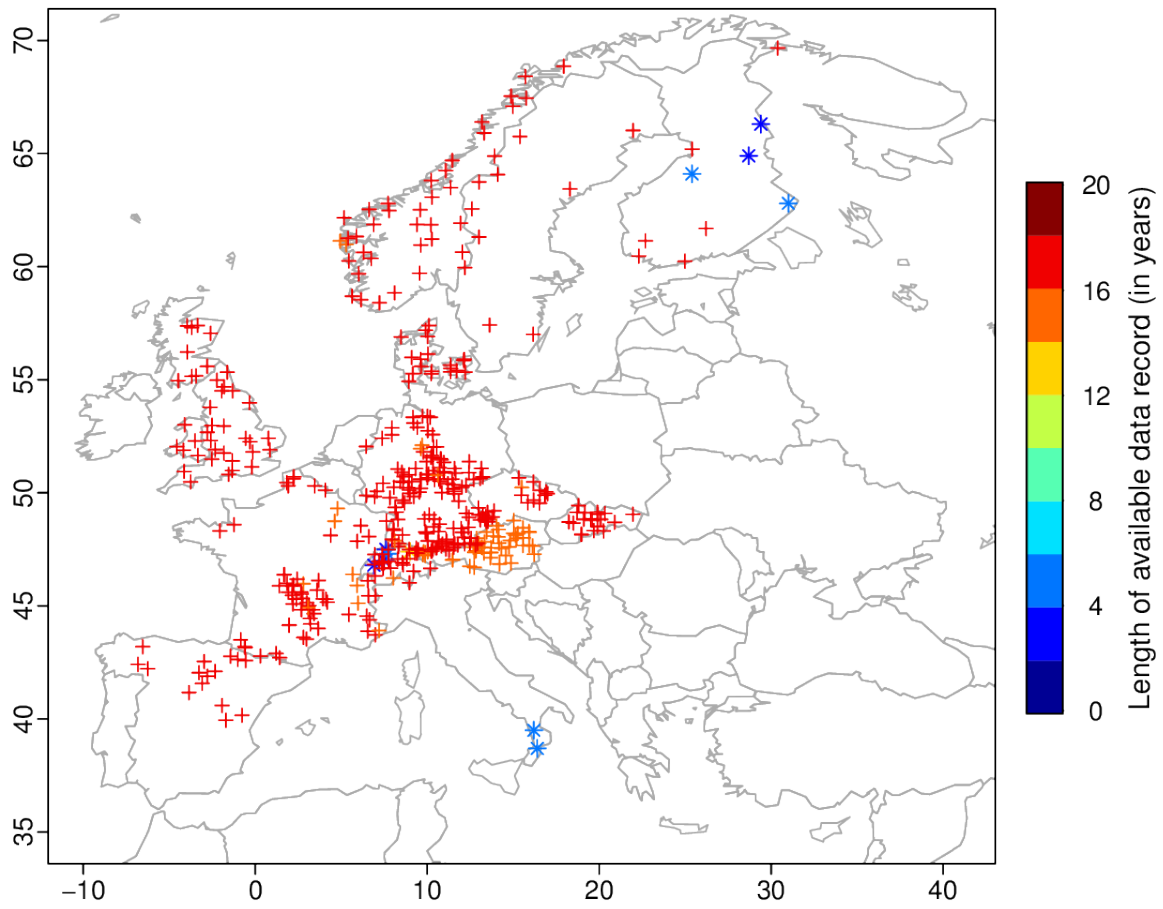
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*Table S1: Summary of soil moisture measurements. (from Orth and Seneviratne 2015)*

Country	Site	Latitude	Longitude	Validation time period	Depths (m)
Finland	Haapavesi	64.1	25.4	2001-2006	0.1, 0.3, 0.5, 0.7, 0.9
	Ilomantsil	62.8	31.0	2002-2007	0.1, 0.3, 0.5, 0.7, 0.9
	Kuusamo	66.3	29.4	2004-2007	0.1, 0.3, 0.5, 0.7, 0.9
	Suomussalmi	64.9	28.7	2004-2007	0.1, 0.3, 0.5, 0.7, 0.9
Switzerland	Basel	47.5	7.6	2009-2012	0.05, 0.1, 0.3, 0.5
	Bern	47.0	7.5	2009-2012	0.05, 0.1, 0.5, 0.8
	Oensingen	47.3	7.7	2002-2007	0.05, 0.1, 0.3, 0.5
	Payerne	46.8	6.9	2008-2012	0.05, 0.1, 0.3, 0.5, 0.8
	Rietholzbach	47.4	9.0	1999-2012	0.05, 0.15, 0.55, 0.8
Italy	Chiaravalle	38.7	16.4	2001-2007	0.3, 0.6, 0.9
	Mongrassano	39.5	16.2	2001-2007	0.3, 0.6, 0.9



*Figure S1: Location of the measurement stations from where we use soil moisture and runoff observations. The coloring denotes the length of the available data record.*

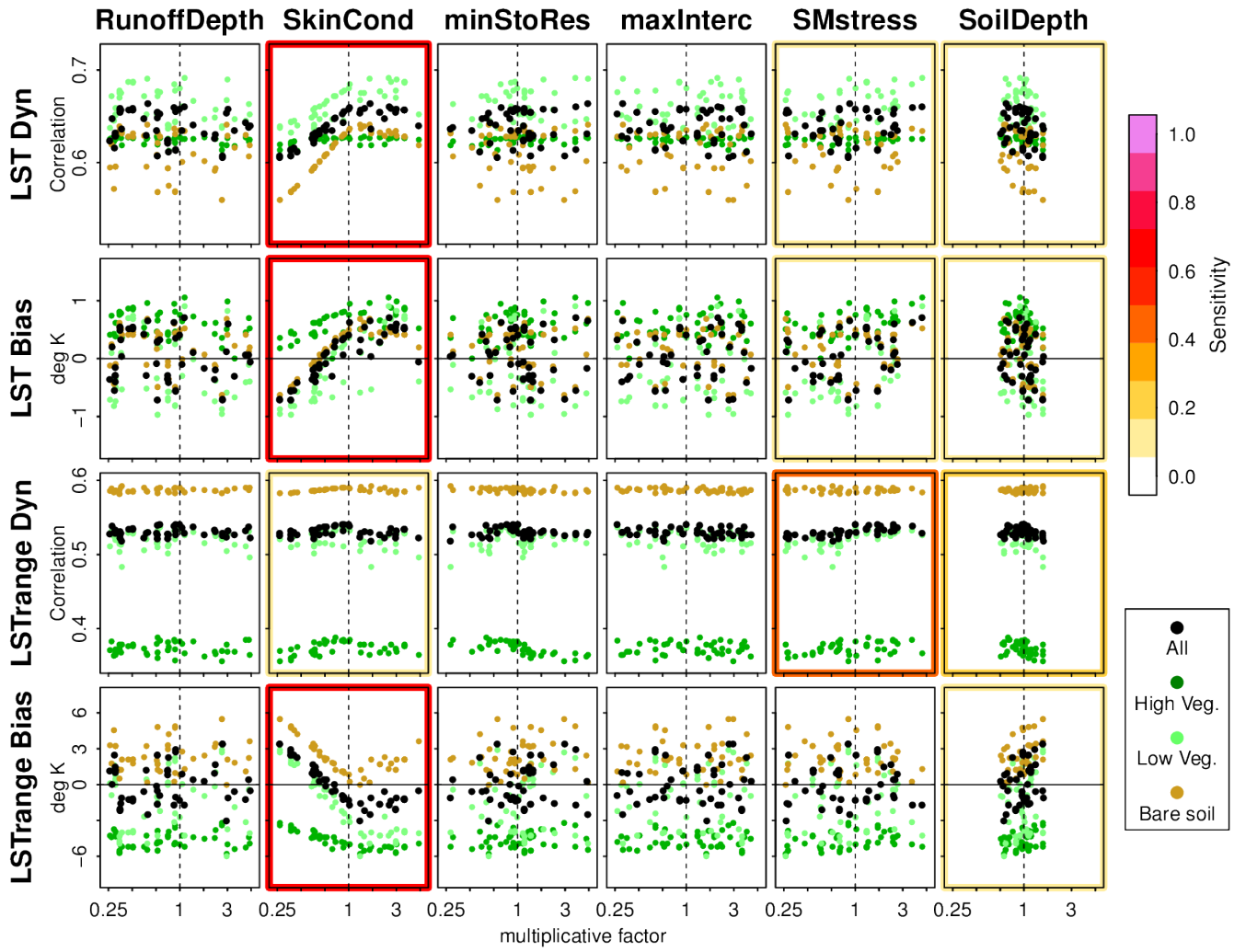


Figure S2: As in the lower part of Figure 2, but for the entire domain displayed in Figure 1, including the bare soil areas in Africa.

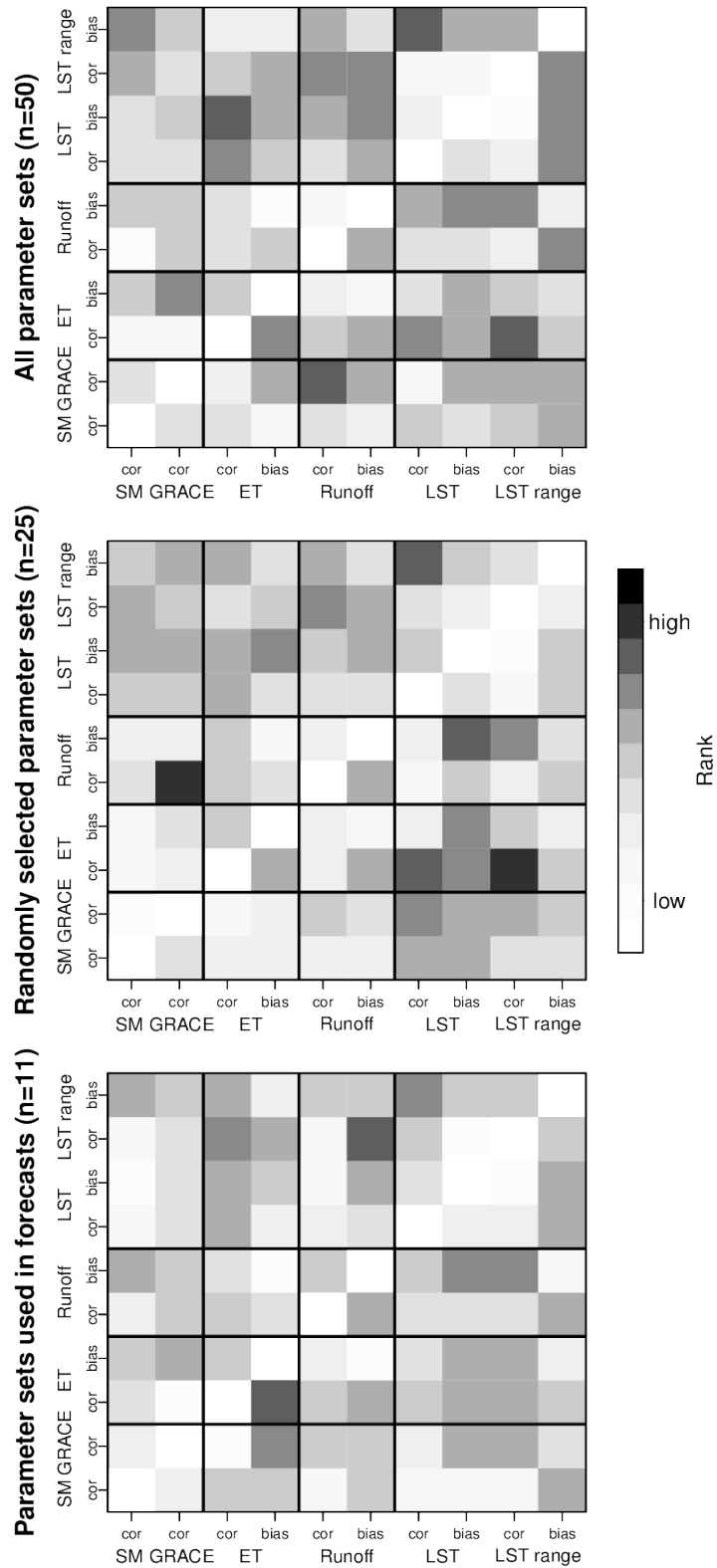


Figure S3: As in Figure 3, but for different sets of considered parameter sets.

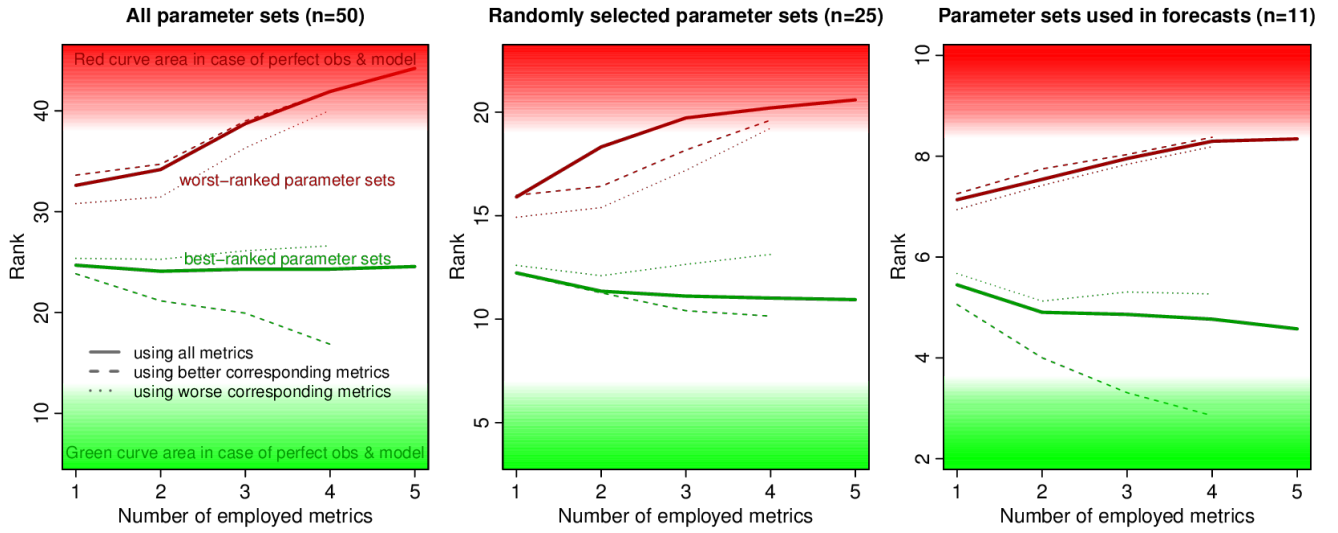


Figure S4: As in Figure 4 but for different sets of considered parameter sets.