Supplementary Material S1:
Input data for the PESERA model as used in this study:

Table S1: Monthly ground cover estimates for permanent crops / land uses

Land use	**Month**											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Artificial, water	100	100	100	100	100	100	100	100	100	100	100	100
Bare land	0	0	0	0	0	0	0	0	0	0	0	0
Grassland	100	100	100	100	100	100	100	100	100	100	100	100
Shrubs	30	30	30	30	30	30	30	30	30	30	30	30
Vineyards	10	10	10	20	25	30	30	30	30	20	15	15
Fruit trees	10	10	10	20	25	30	30	30	30	20	15	15
Olive groves	10	10	10	20	25	30	30	30	30	20	15	15
Forest (all types)	100	100	100	100	100	100	100	100	100	100	100	100

Table S2: Crop calendar and water use efficiency values per crop and agroclimatic zone

		Y1												Y2							
Crop	**Region**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Spring cereal	Continental					0.3	0.6	1.15	1.15	0.3											
	Mediterranean				0.3	0.6	1.15	1.15	0.3												
	Oceanic				0.3	0.6	1.15	1.15	0.3												
	Subartic					0.3	0.6	1.15	1.15	0.3											
Winter cereal	Continental										0.3	0.3	0.4	0.6	0.8	1	1.15	0.6	0.4	0.3	
	Mediterranean											0.3	0.5	0.7	0.9	1	1.15	0.5	0.3		
	Oceanic										0.3	0.3	0.4	0.6	0.8	1	1.15	0.6	0.4	0.3	
	Subartic										0.3	0.3	0.3	0.3	0.4	0.6	0.8	1.1	0.6	0.3	0.3
Maize	Continental				0.4	0.7	0.95	1.15	1.15	0.7	0.2										
	Mediterranean				0.4	0.8	1.15	1.15	0.7												
	Oceanic				0.4	0.7	0.95	1.15	1.15	0.7	0.2										
	Subartic																				
Pulses	Continental			0.4	0.8	1.15	0.35														
	Mediterranean												0.4	0.8	1.15	0.35					
	Oceanic			0.4	0.8	1.15	0.35														
	Subartic																				
Sugarbeet	Continental				0.4	0.6	0.9	1.2	1.2	0.7	0.5										
	Mediterranean			0.4	0.5	0.7	0.95	1.2	1.2	0.7	0.5										
	Oceanic				0.4	0.6	0.9	1.2	1.2	0.7	0.5										
	Subartic																				
Potato	Continental				0.5	0.8	1.15	1.15	0.5	0.3	0.1										
	Mediterranean				0.5	0.8	1.15	1.15	0.5	0.3											
	Oceanic				0.5	0.8	1.15	1.15	0.5	0.3	0.1										
	Subartic				0.5	0.8	1.15	1.15	0.5	0.3											
Oilseed	Continental									0.7	1	1	1	1	1	1	1.15	0.8	0.5		
	Mediterranean											0.7	1	1	1	1	1.15	0.8	0.5		
	Oceanic									0.7	1	1	1	1	1	1	1.15	0.8	0.5	0.5	
	Subartic										0.7	1	1	1	1	1	1.15	0.8	0.5		
Veg & Flowers (sunflowers)	Continental					0.45	0.9	1	0.7												
	Mediterranean				0.5	0.8	1	1	0.7												
	Oceanic					0.45	0.9	1	0.7												
	Subartic																				
Rice	Continental					1.1	1.1	1.15	1.2	1.2	0.9										
	Mediterranean					1.1	1.1	1.15	1.2	1.2	0.9										
	Oceanic					1.1	1.1	1.15	1.2	1.2	0.9										
	Subartic																				
Forage	Continental			0.4	0.8	0.8	0.8	0.9	0.9	0.8	0.6										
	Mediterranean												0.4	0.8	0.8	0.9	0.6				
	Oceanic			0.4	0.8	0.8	0.8	0.9	0.9	0.8	0.6										
	Subartic																				

Table S3: Rooting depth, initial surface storage and reduction of surface storage per land use and crop type as used in SoilCare PESERA modelling

Land use / crop	**Rooting depth (mm)**	**Initial surface storage (mm)**	**Reduction of surface roughness (%)**
Artificial	10	0	0
Bare land	10	5	0
Grassland	500	5	0
Shrubs	600	5	0
Vineyards	800	5	0
Fruit trees	800	5	0
Olive groves	800	5	0
Broadleaf Forest	1000	5	0
Coniferous Forest	1000	5	0
Mixed Forest	1000	5	0
Water	10	0	0
Winter cereals	400	10	50
Spring cereals	400	10	50
Consumption maize	600	10	50
Fodder maize	600	10	50
Pulses	400	10	50
Rice	500	10	50
Sugarbeet	500	10	50
Potato	500	10	50
Oilseed	400	10	50
Vegetables & Flowers	600	10	50
Forage	400	10	50
Fallow	10	10	50

Erodibility calculation for Norway, Sweden and Iceland

Table S4: Erodibility classes used in the SoilCare erodibility map

Erodibility class	K-factor values
1	< 0.02
2	0.02 – 0.028
3	0.028 - 0.038
4	0.038 – 0.046
5	> 0.046

For three countries, exceptions were made: Norway, Sweden and Iceland. In large parts of Iceland, and mountainous parts of Norway and northern Sweden, erodibility was classified as 5 (highest class) using the classification above and K-factor data. Except for bare rock and glacier areas, which were excluded, these areas consist of sparsely vegetated land cover and heather, usually on very thin soils and underlain by granite bedrock closely at the surface. As this bedrock is hardly erodible, combined with our Norwegian partner’s observation that these areas produce very clean water (i.e. hardly any erosion), the erodibility classes for these areas were adapted by making two different maps and taking the minimum of both as follows:

Map 1:
The RUSLE K-factor was recalculated using equation 1 (Panagos et al., 2014):

$$K = \left[2.1 \cdot 10^{-4} * M^{1.14} * (12 - OM) + 3.25 \cdot (s - 2) + 2.5 \cdot (p - 3)\right)/100] * 0.1317 \quad (1)$$

With *M* the textural factor (equation 2):

$$M = (m_{silt} + m_{sand}) * (100 - m_{clay}) \quad (2)$$

With m_{silt} = silt fraction (%), m_{sand} = sand fraction (%) and m_{clay} = clay fraction (%).
OM = the organic matter content (%), *s* = the soil structure class (1 = very fine granular, 2 = fine granular, 3 = medium or coarse granular, 4 = blocky, platy or massive), *p* = the permeability class, ranging from 1 = very rapid to 6 = very slow.

Texture (clay, silt, sand fraction) and organic carbon data was derived from SoilGrids. Data on the permeability and structure was obtained from the ESDAC database. For soil structure, the topsoil structure data was used; for permeability the WR data (dominant annual average soil water regime class of the soil profile). Soil structure was converted from Good, Normal, Poor and Humic or Peaty to structure classes 1, 2, 3 and 4 respectively following Panagos et al. (2015). Water regime (WR) classes 0 – 4 were converted to permeability classes 2-5 respectively.
This resulted in a new K-factor map that was classified into erodibility classes 1 to 3

Map 2:
Based on the Corine Land Classification 2018 map, land use class ‘sparsely vegetated areas’ (CLC value 32) was given an erodibility value of 1 – these areas were observed to be very close to / bordering the bare rock areas. Land use class ‘heathland’ (CLC value 27) was given an erodibility of 2, as these areas were in turn bordering the sparsely vegetated areas. Any remaining areas with erodibility classes 4 or 5 were set to a maximum erodibility class 3.

These two maps were finally combined, taking the minimum of both maps (Fig. 5). According to feedback from local Norwegian partners, the resulting map would better represent the erodibility in the mountainous areas in Norway and test runs with the PESERA model indeed showed much lower, and more realistic erosion values for these areas.

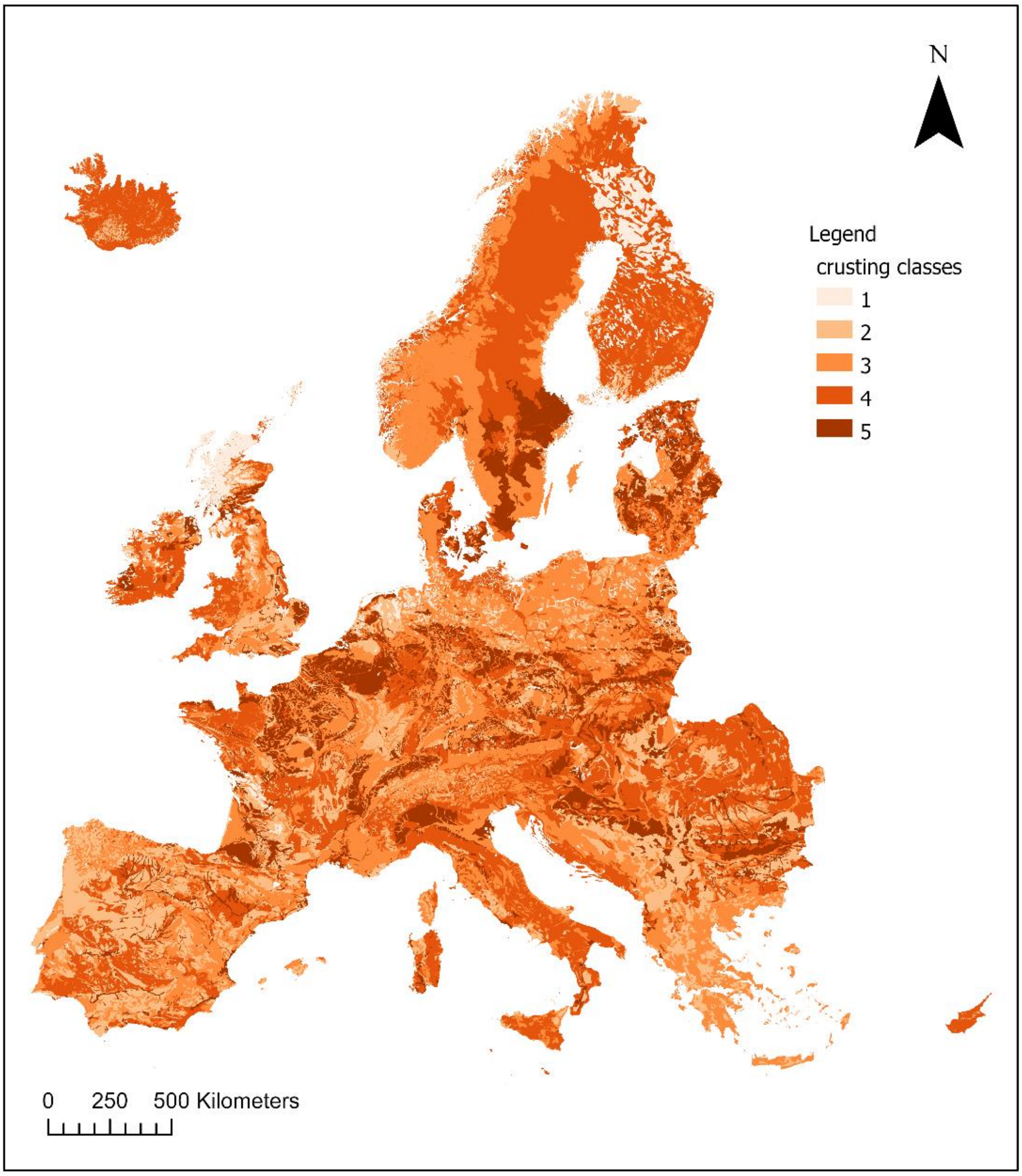

Figure S1: Input crusting map for Europe

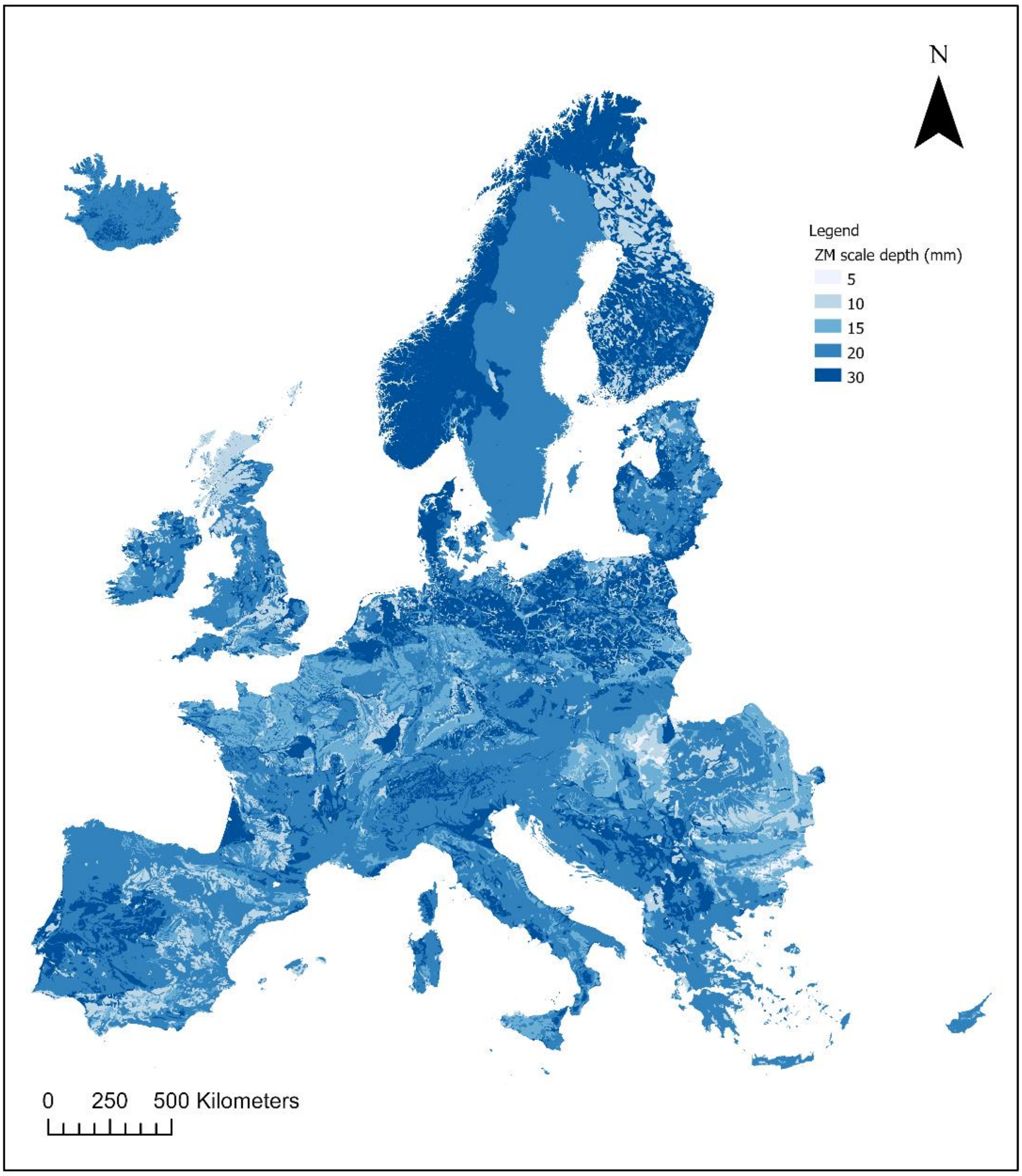

Figure S2: Scaling depth input map for Europe

Table S5: Soil Texture and corresponding scale depth values (mm)

Soil Texture		Scale depth (mm)
Coarse	C	30
Fine	F	10
Medium	M	20
Medium Fine	MF	15
Organic Soils	O	10
Very fine	VF	5

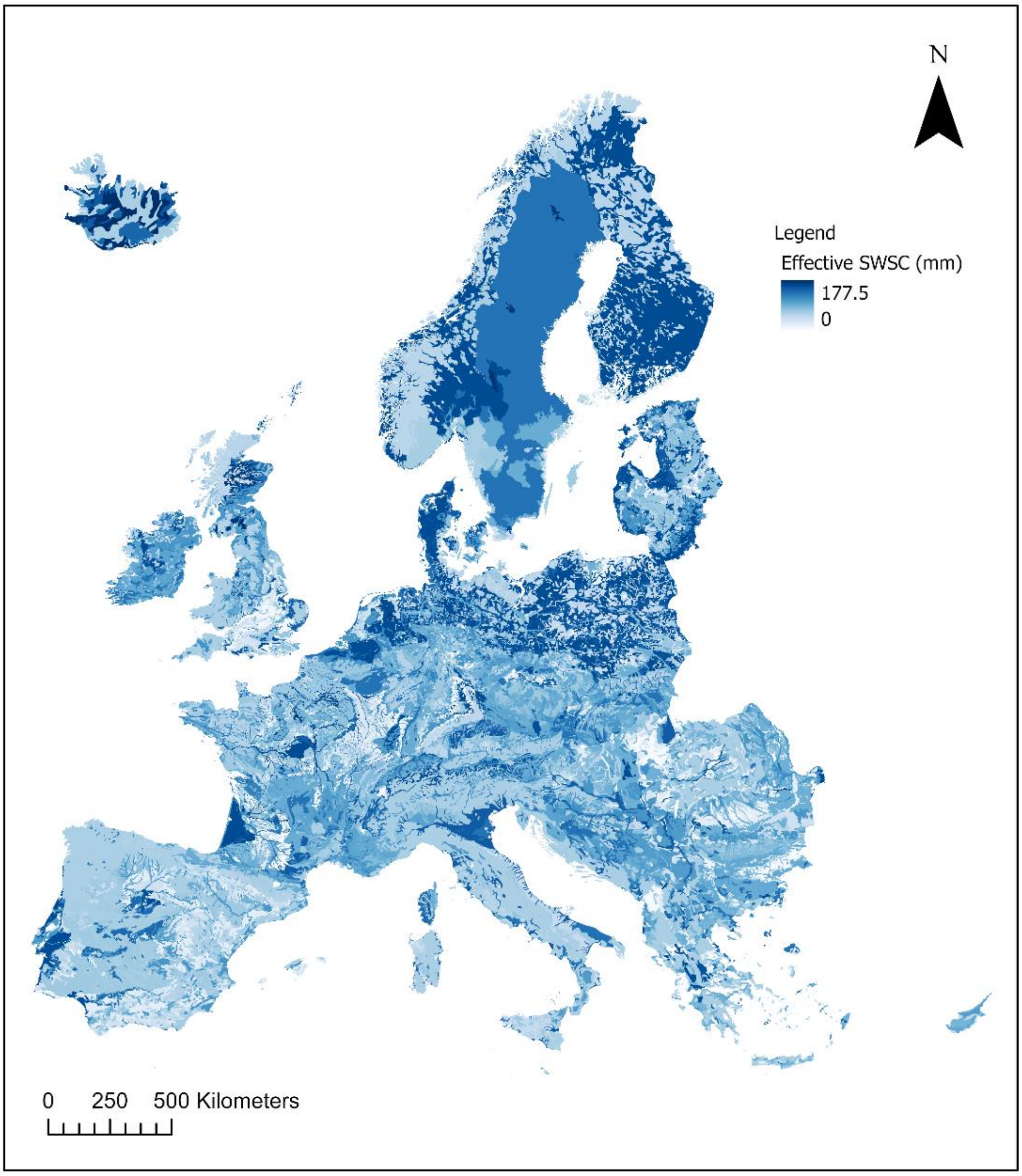

Figure S3: Effective soil water storage capacity or Europe

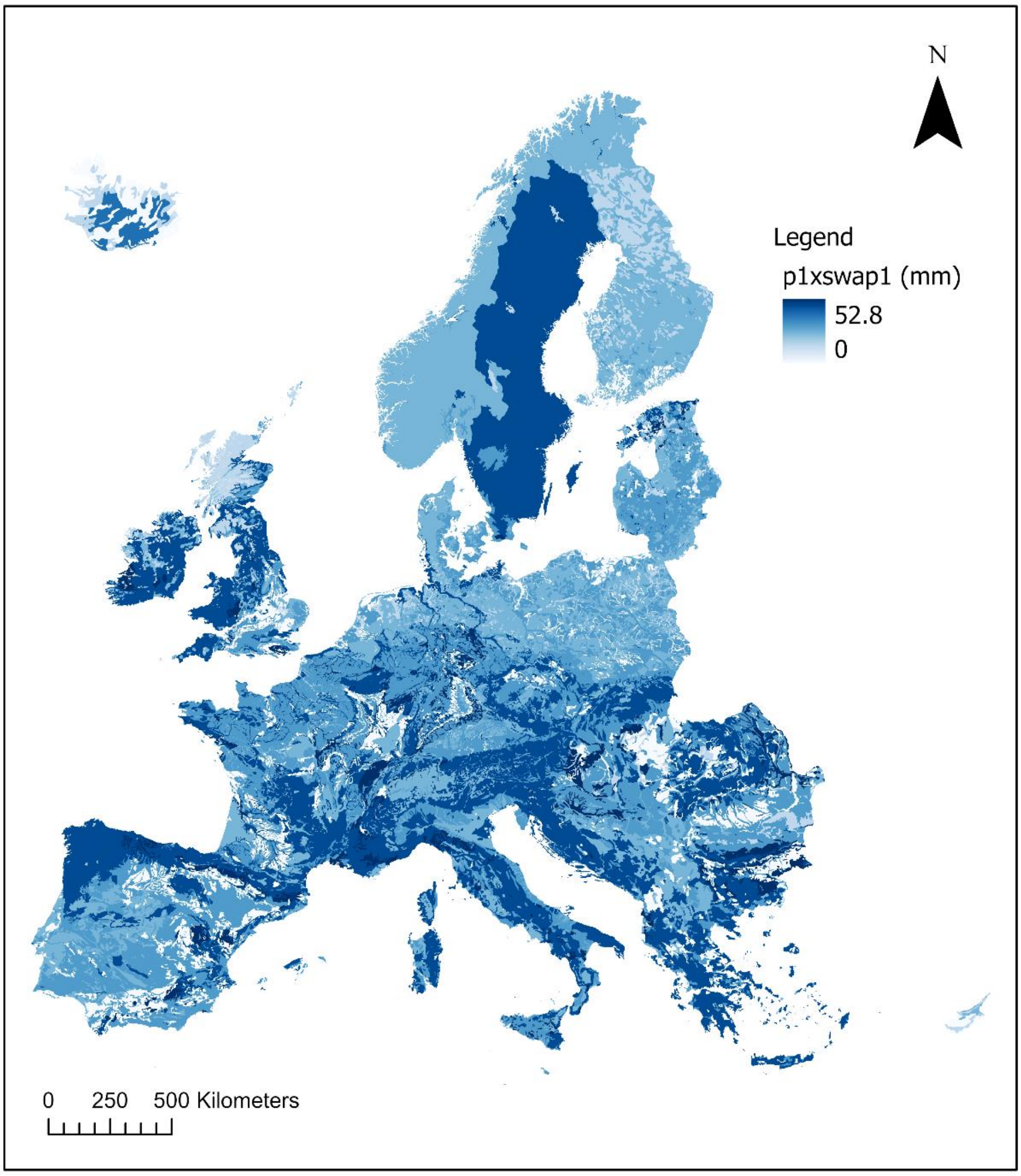

Figure S4: Soil water available to plants (0-300mm)

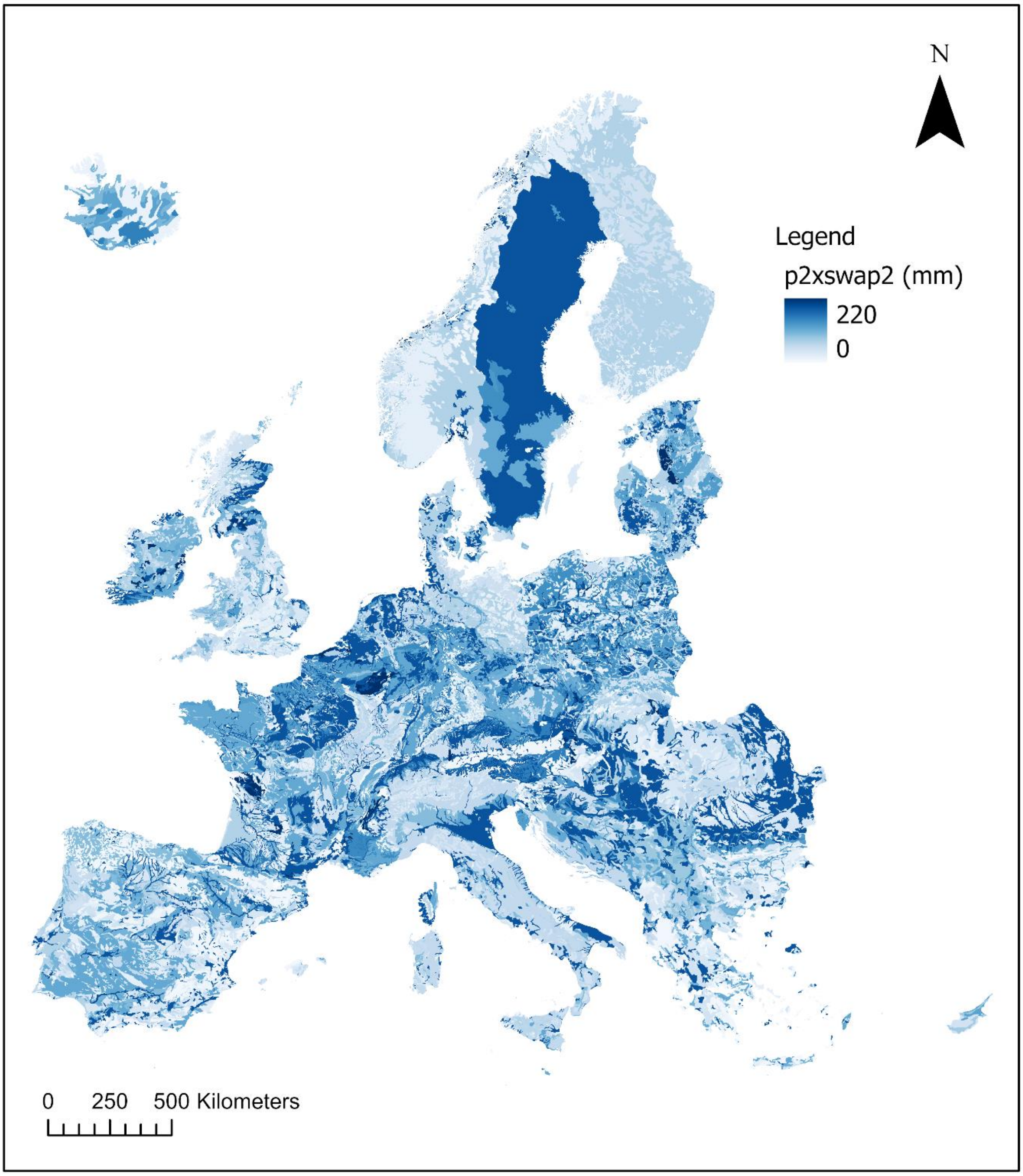

Figure S5: Soil water available to plants (300-1000mm)

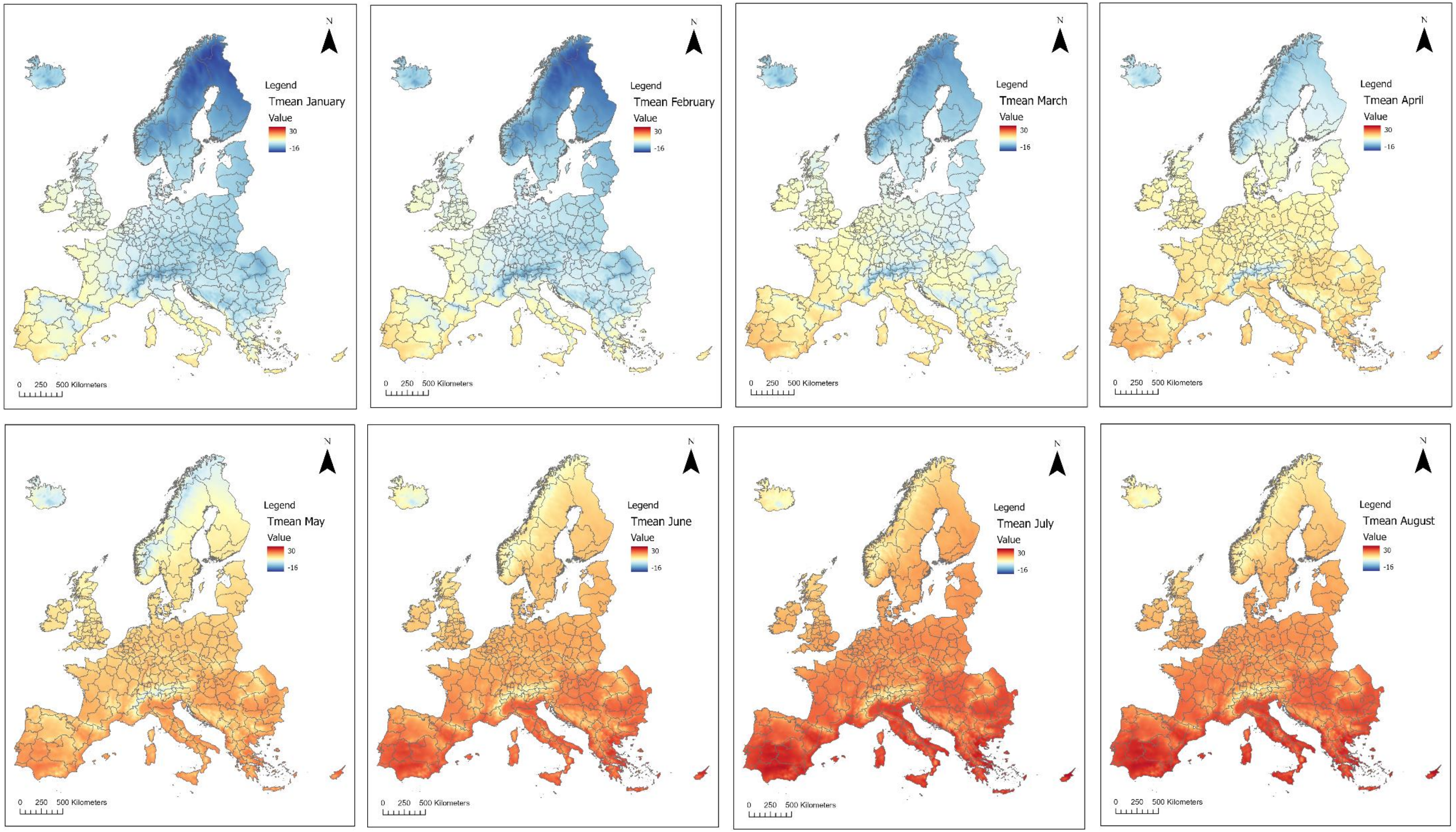

Figure S6: Mean temperature input maps (equilibrium version; average for 1981-2020) for each month

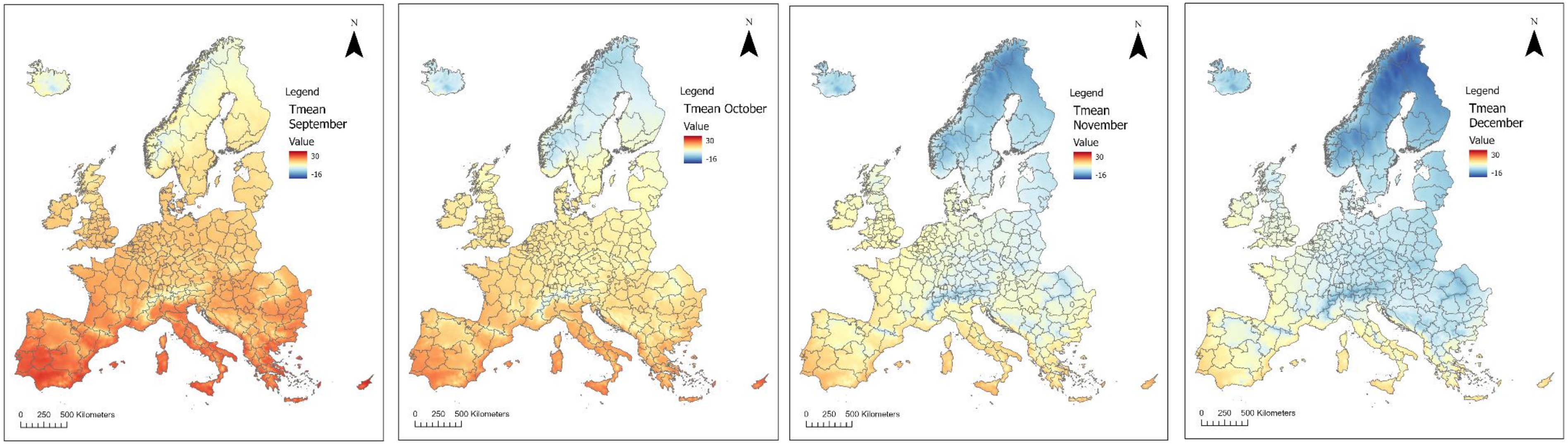

Figure S6 (continued): Mean temperature input maps (equilibrium version; average for 1981-2020) for each month

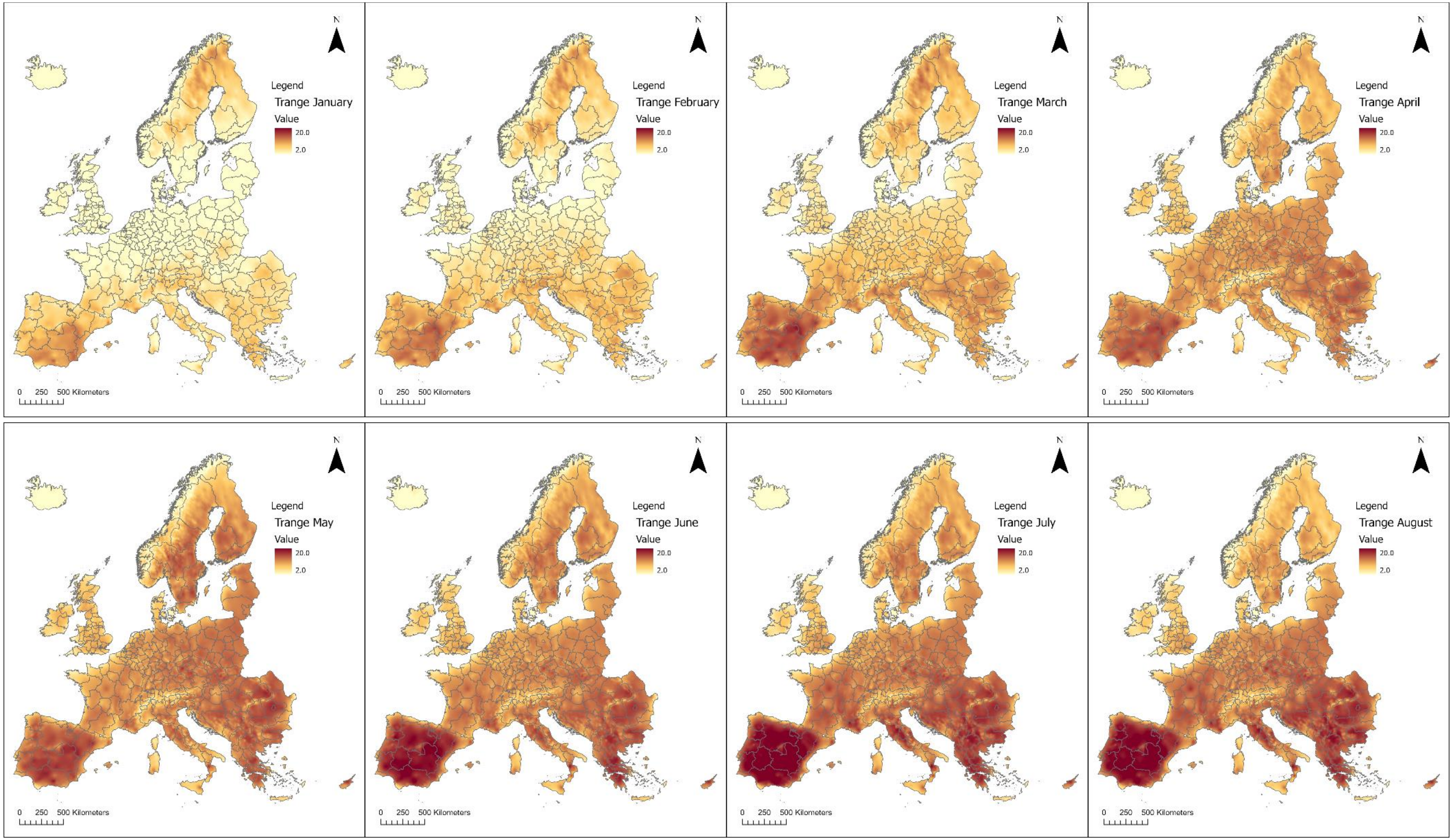

Figure S7: Temperature range input maps (equilibrium version; average for 1981-2020) for each month

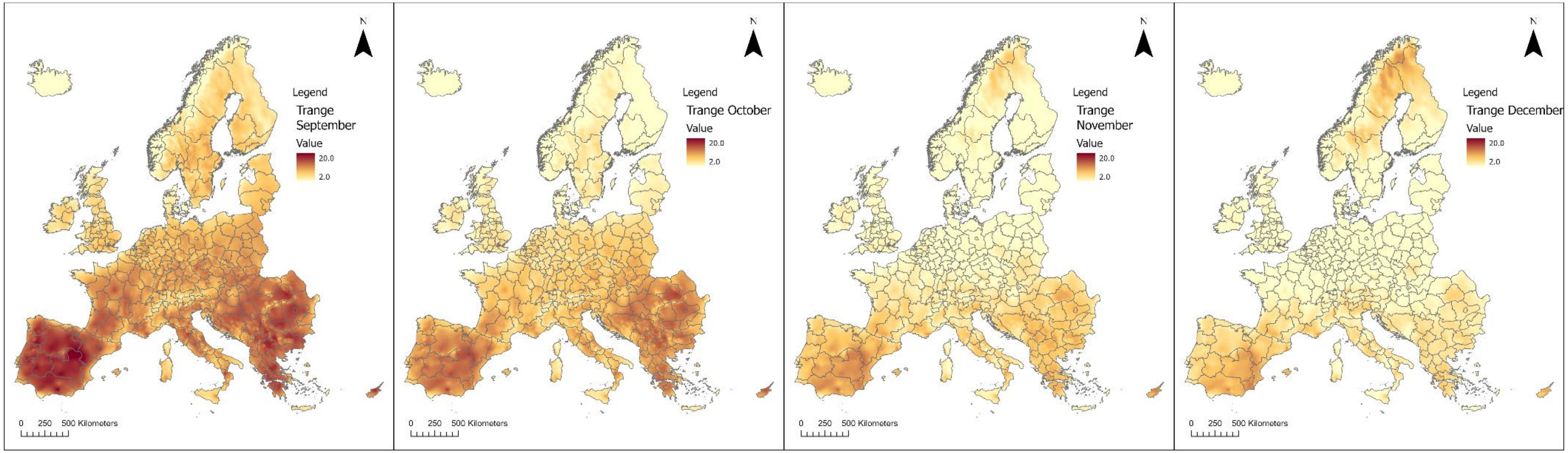

Figure S7 (continued): Temperature range input maps (equilibrium version; average for 1981-2020) for each month

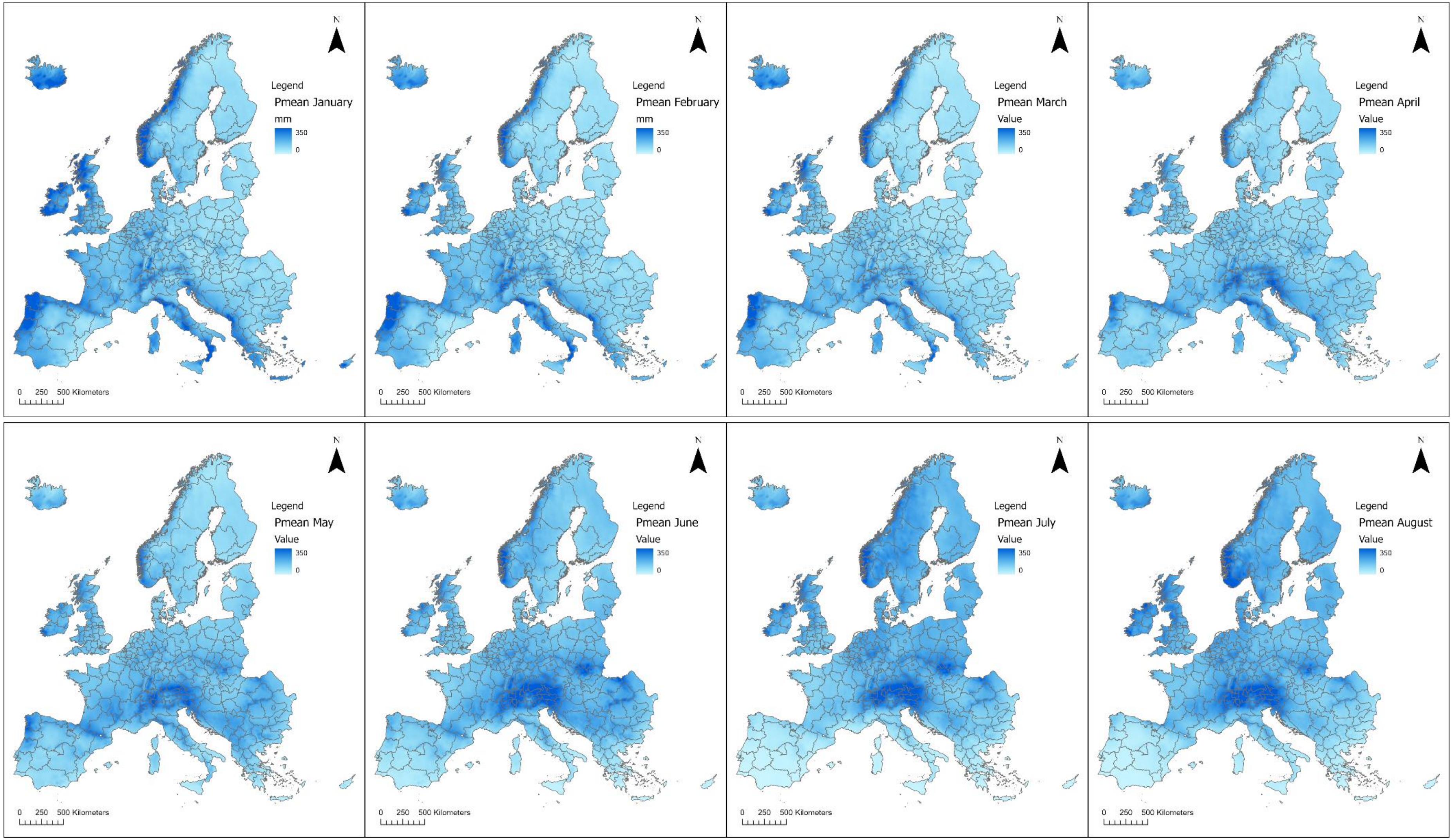

Figure S8: Mean rainfall input maps (equilibrium version; average for 1981-2020) for each month

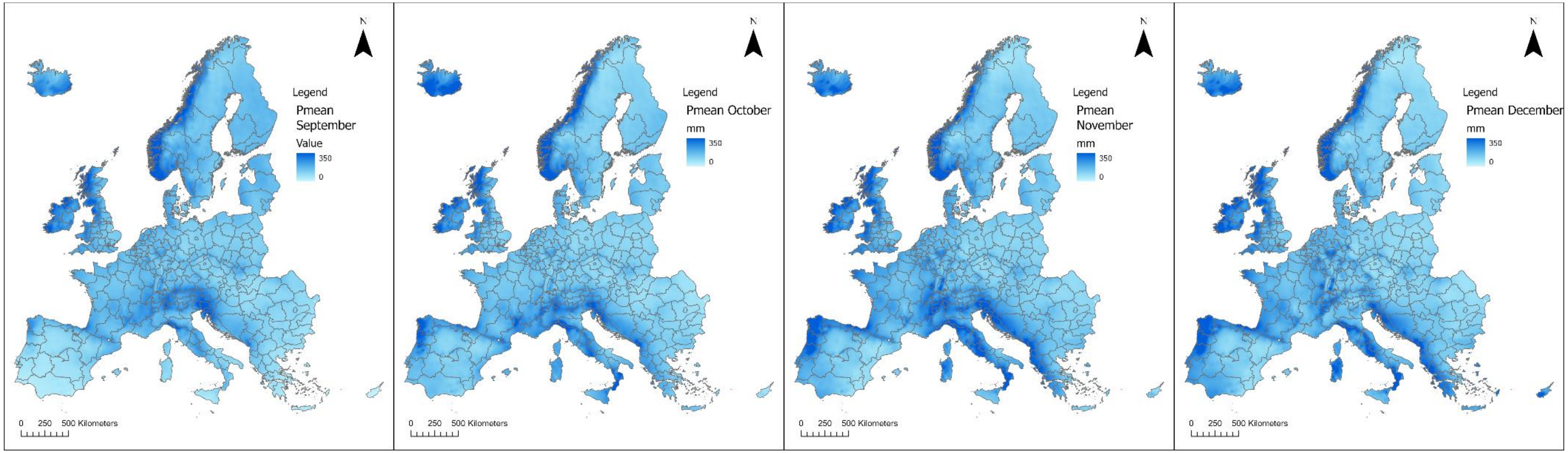

Figure S8 (continued): Mean rainfall input maps (equilibrium version; average for 1981-2020) for each month

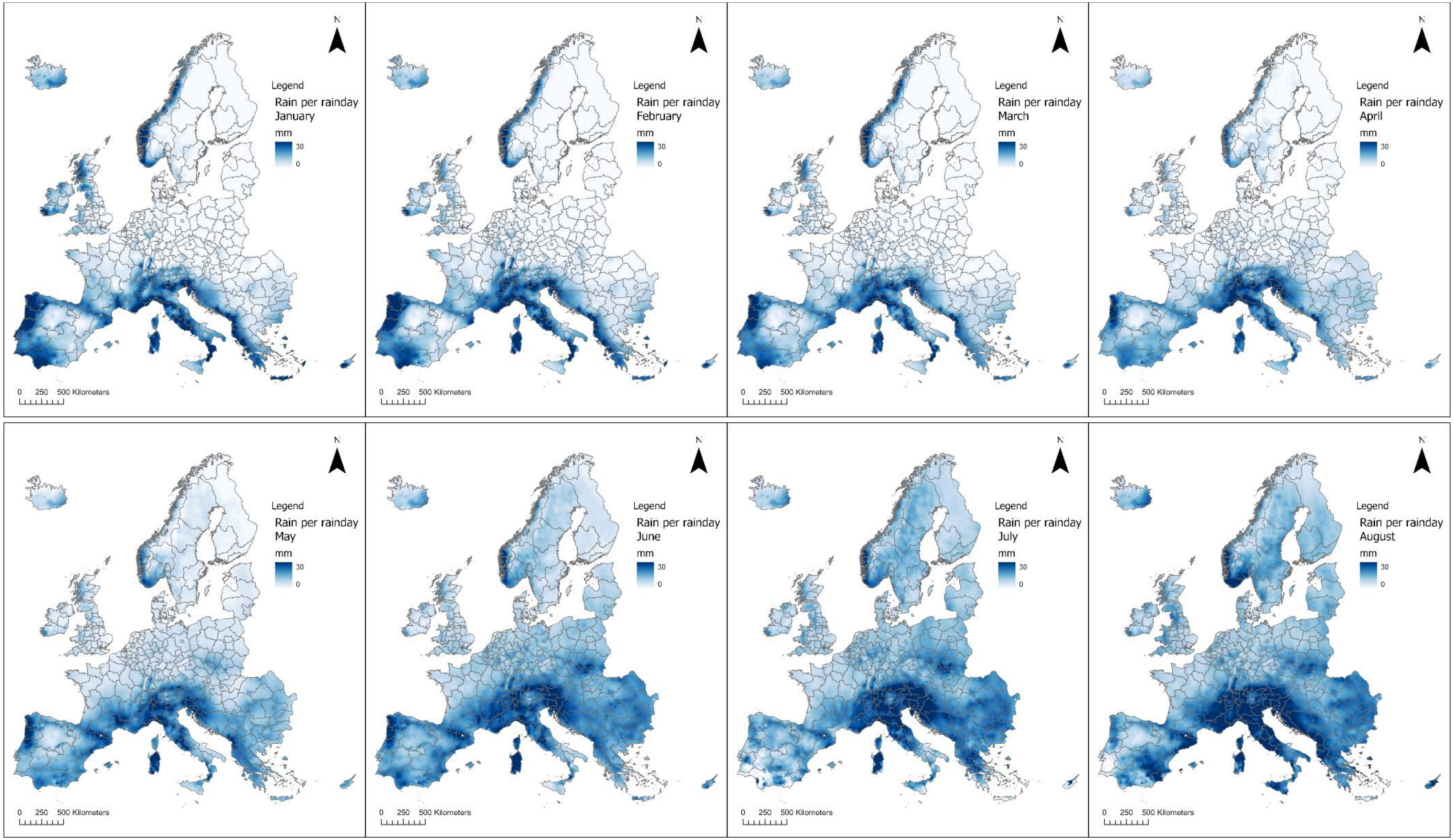

Figure S9: Rainfall per rain day input maps (equilibrium version; average for 1981-2020) for each month

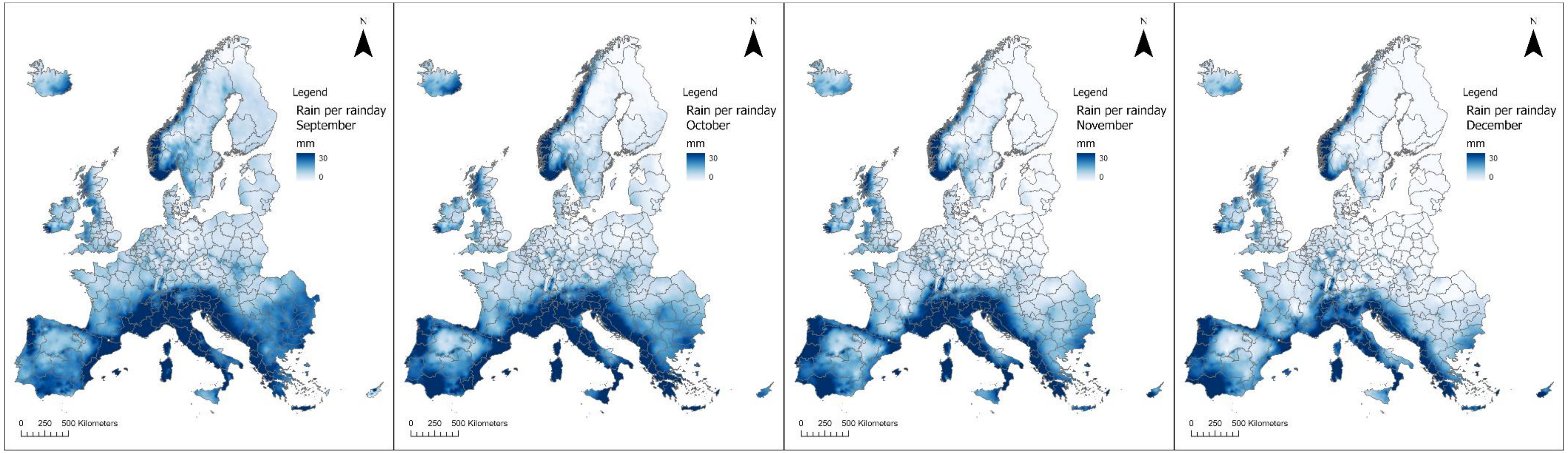

Figure S9 (continued): Rainfall per rain day input maps (equilibrium version; average for 1981-2020) for each month

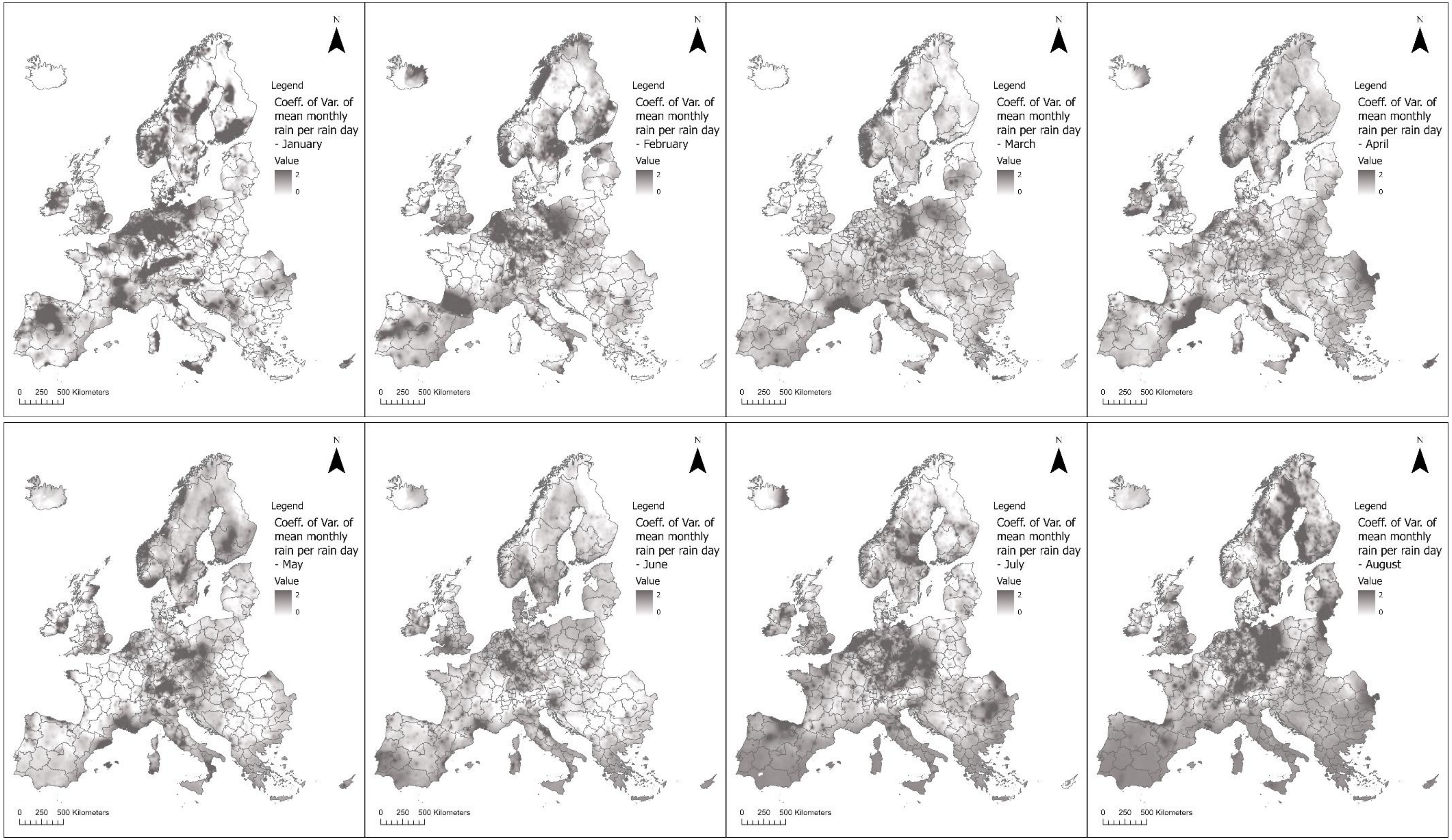

Figure S10: Coefficient of variation of mean monthly rainfall per rain day input maps (equilibrium version; average for 1981-2020)

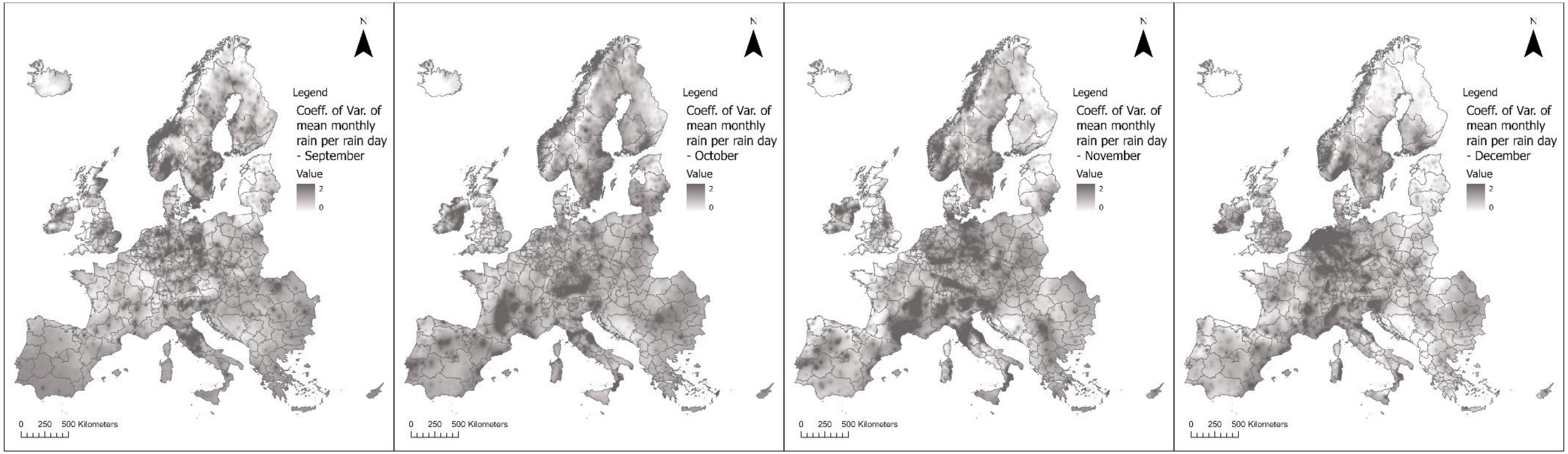

Figure S10 (continued): Coefficient of variation of mean monthly rainfall per rain day input maps (equilibrium version; average for 1981-2020)

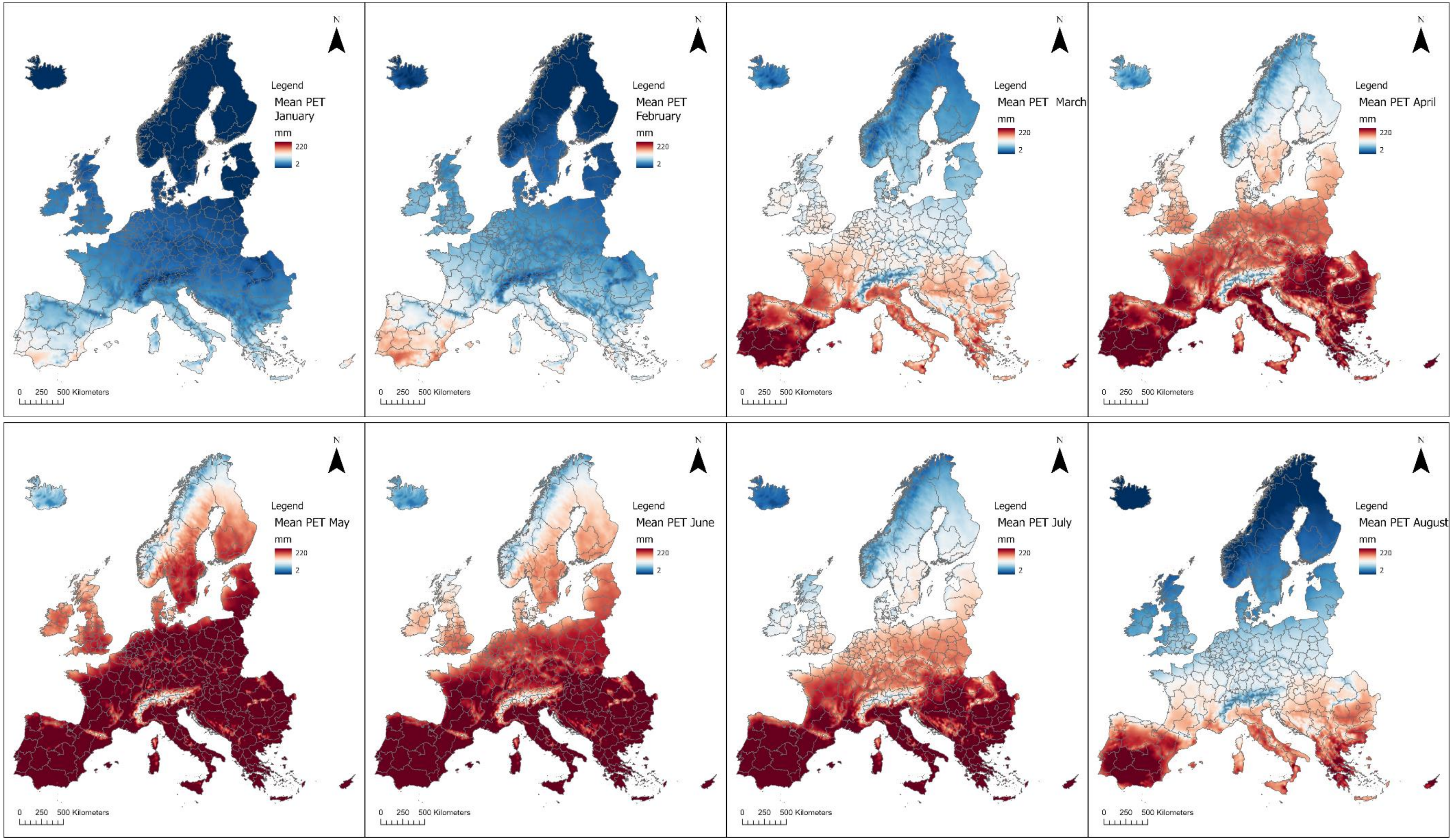

Figure S11: Mean PET input maps (equilibrium version; average for 1981-2020)

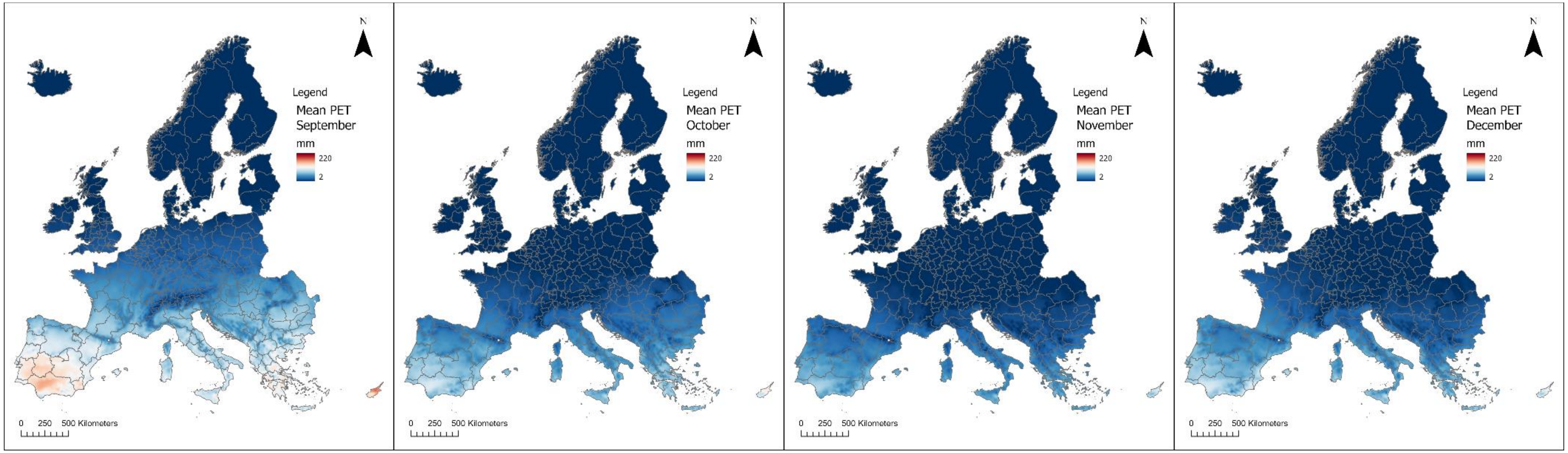

Figure S11 (continued): Mean PET input maps (equilibrium version; average for 1981-2020)