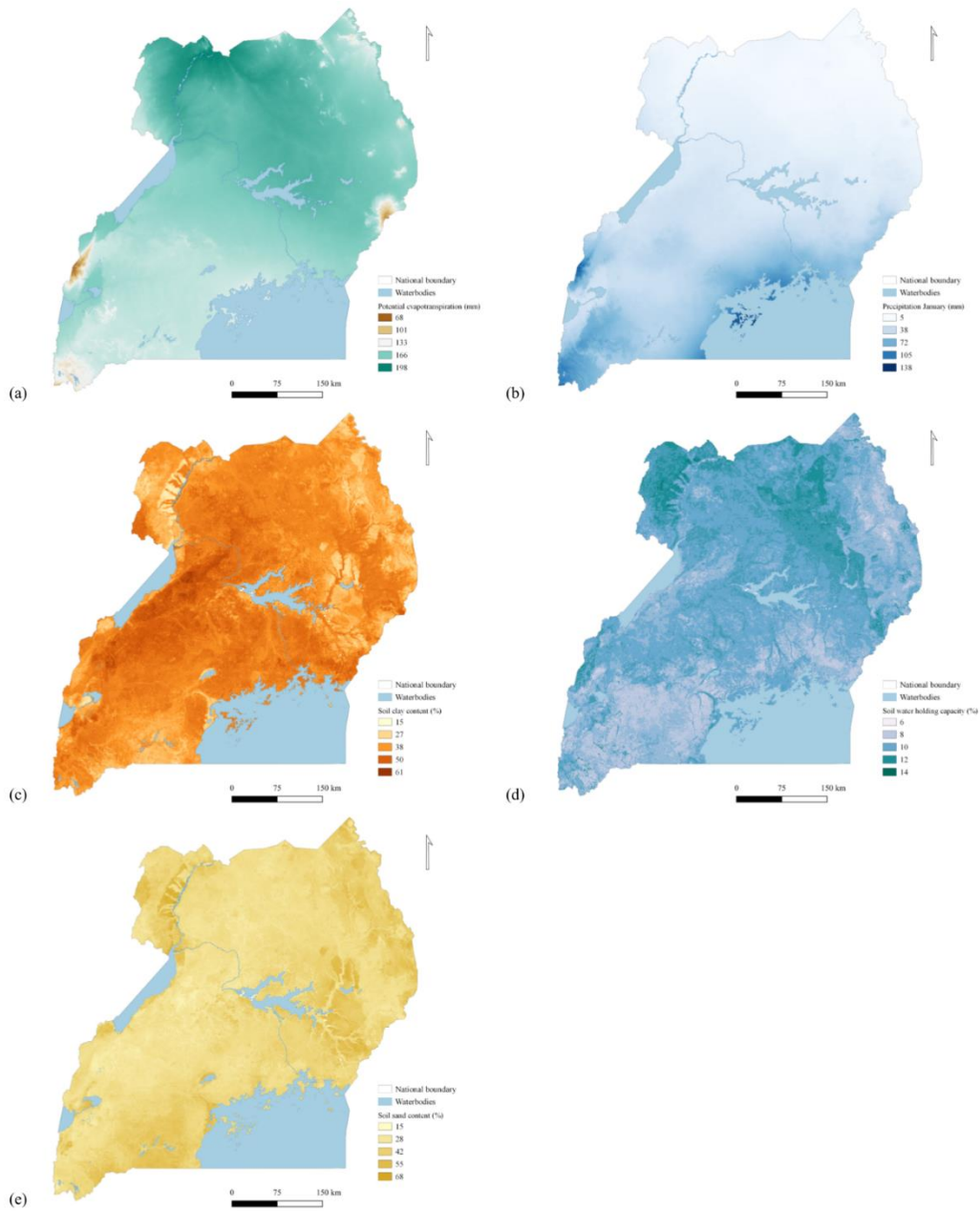


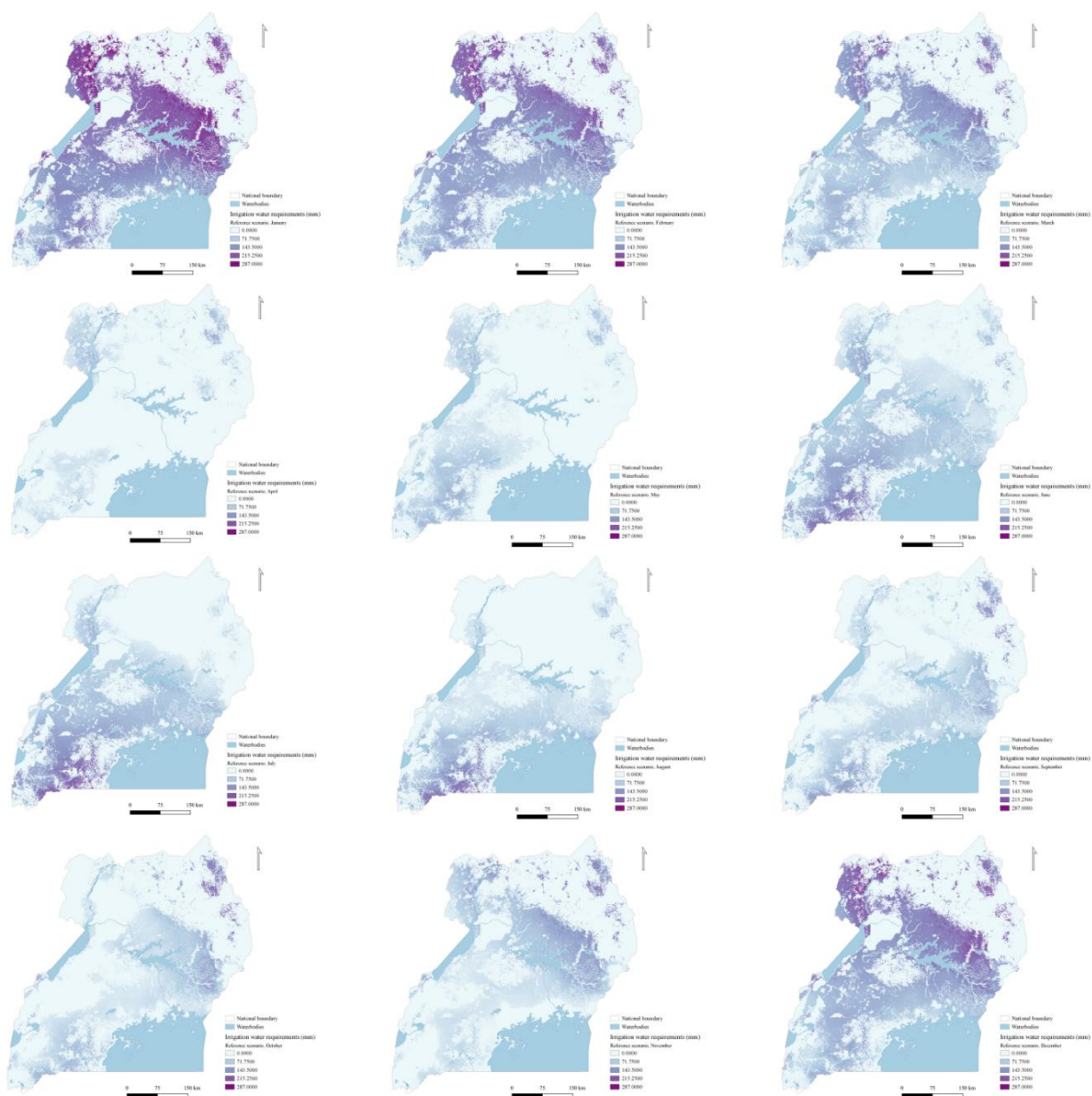
## Supplementary materials

### Geospatial input data



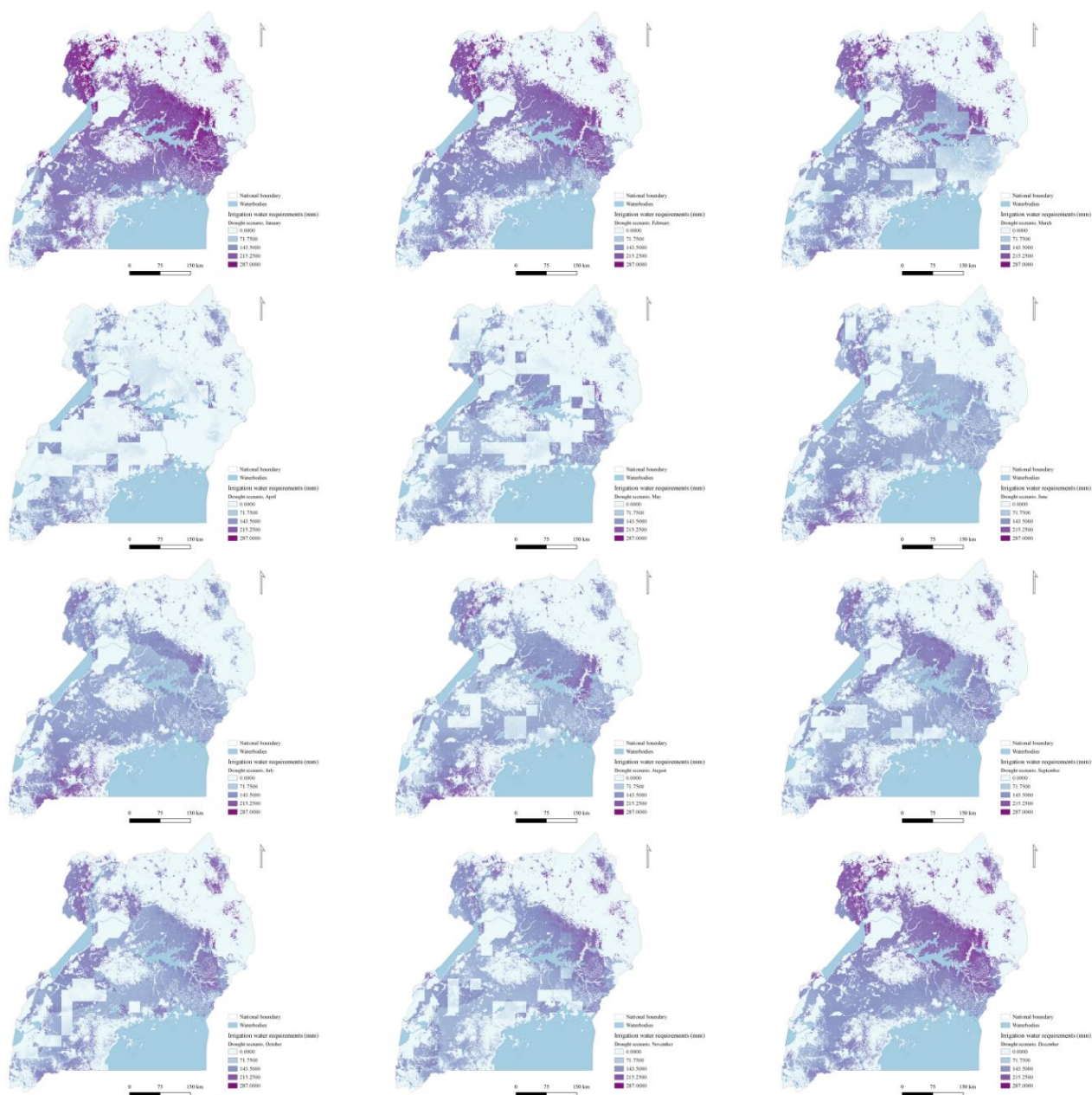
**Figure S1.** Key spatial datasets applied for the estimation of the irrigation water requirements. The datasets are presented in the following order: (a) Potential evapotranspiration (mm), (b) Precipitation in January (mm) (January is presented as an example, although data for all months of the year are applied in the calculations), (c) Soil clay content (%), (d) Soil water holding capacity (%), and (e) Soil sand content (%).

*Irrigation water requirements, reference scenario*



**Figure S2.** Irrigation water requirements (mm) in the reference scenario, January through December.

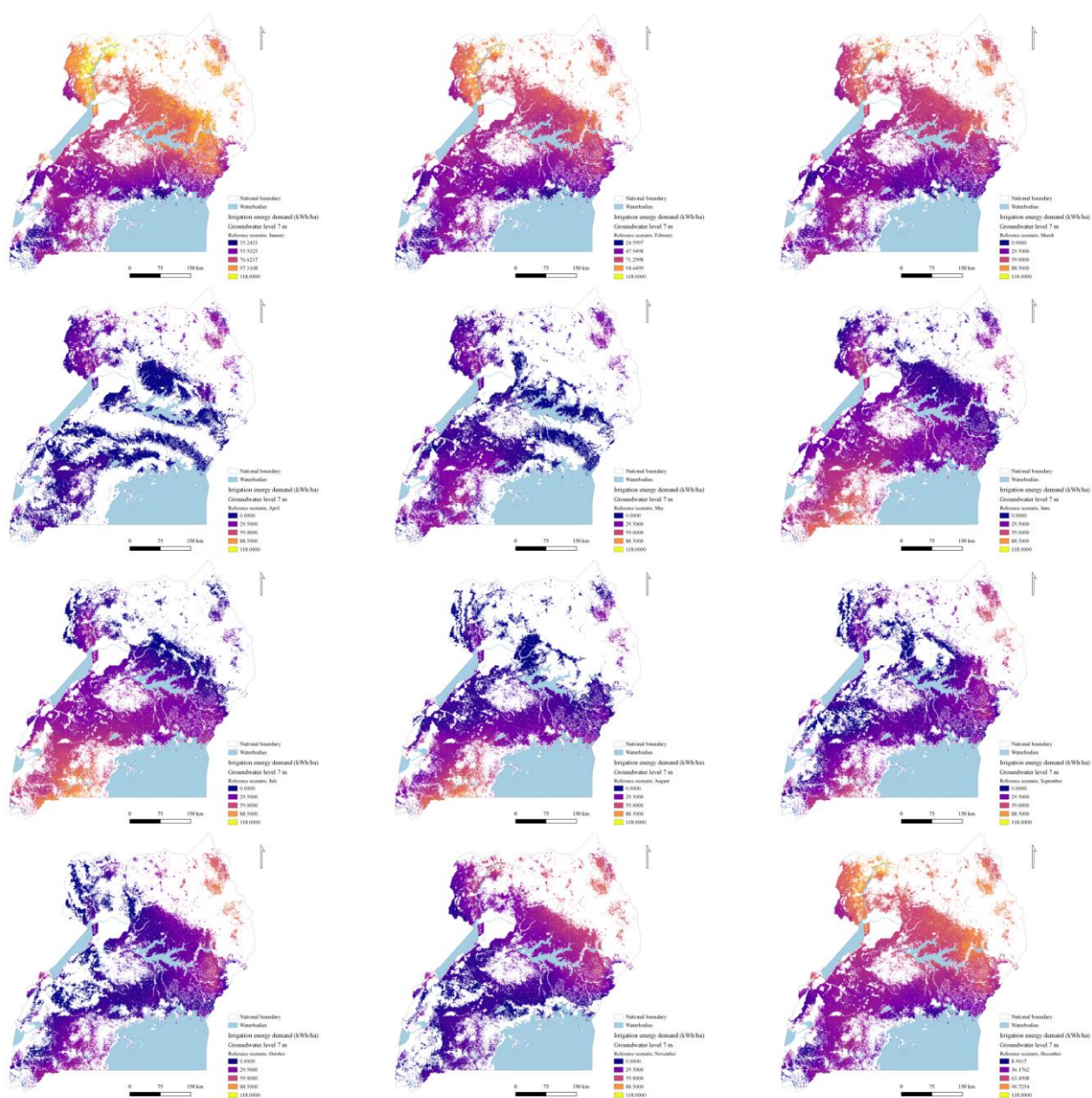
*Irrigation water requirements, drought scenario*



**Figure S3.** Irrigation water requirements (mm) in the drought scenario, January through December.

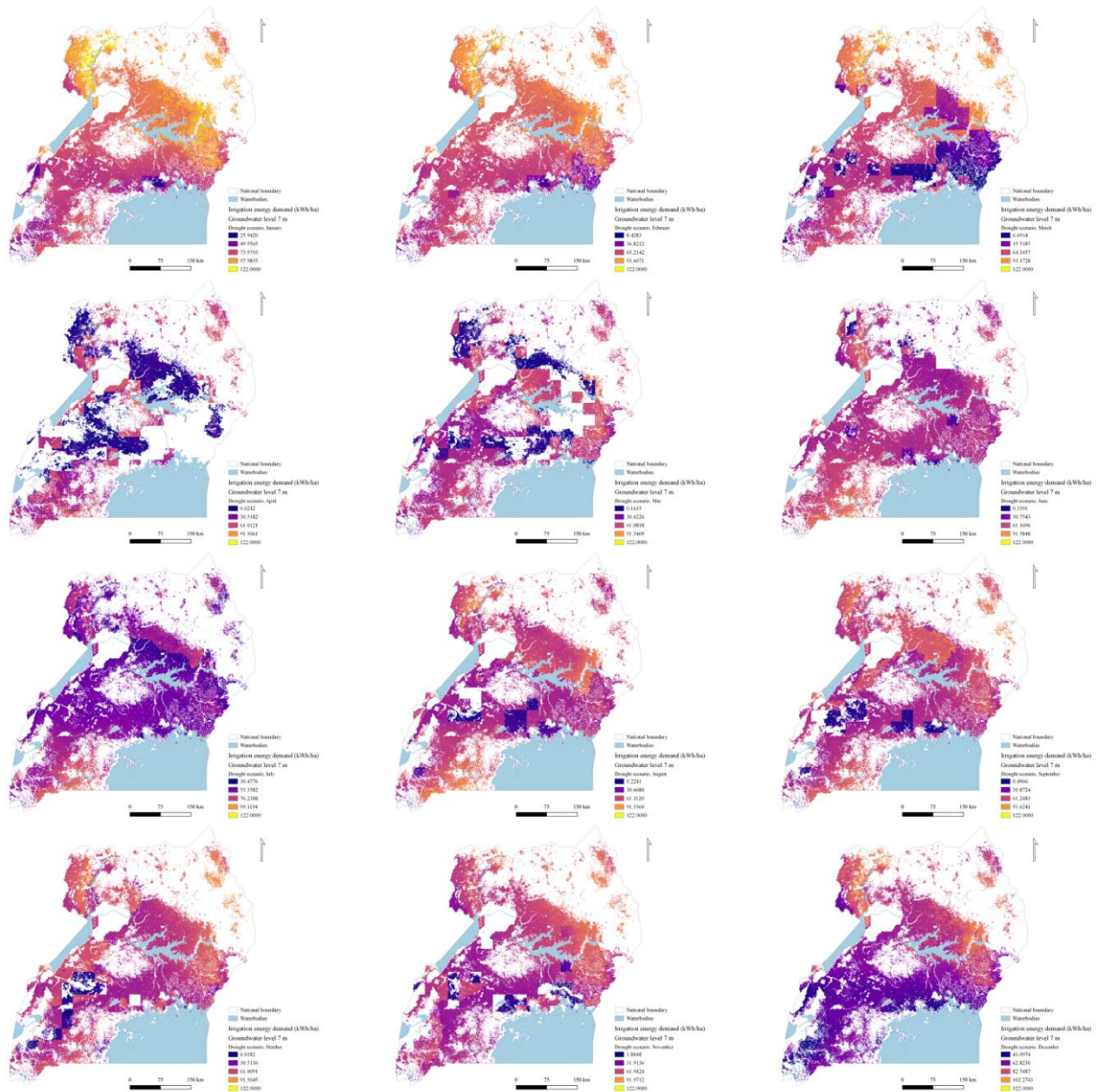


# Energy demand, reference scenario



**Figure S4.** Energy demand (kWh/ha) in the reference scenario, January through December.

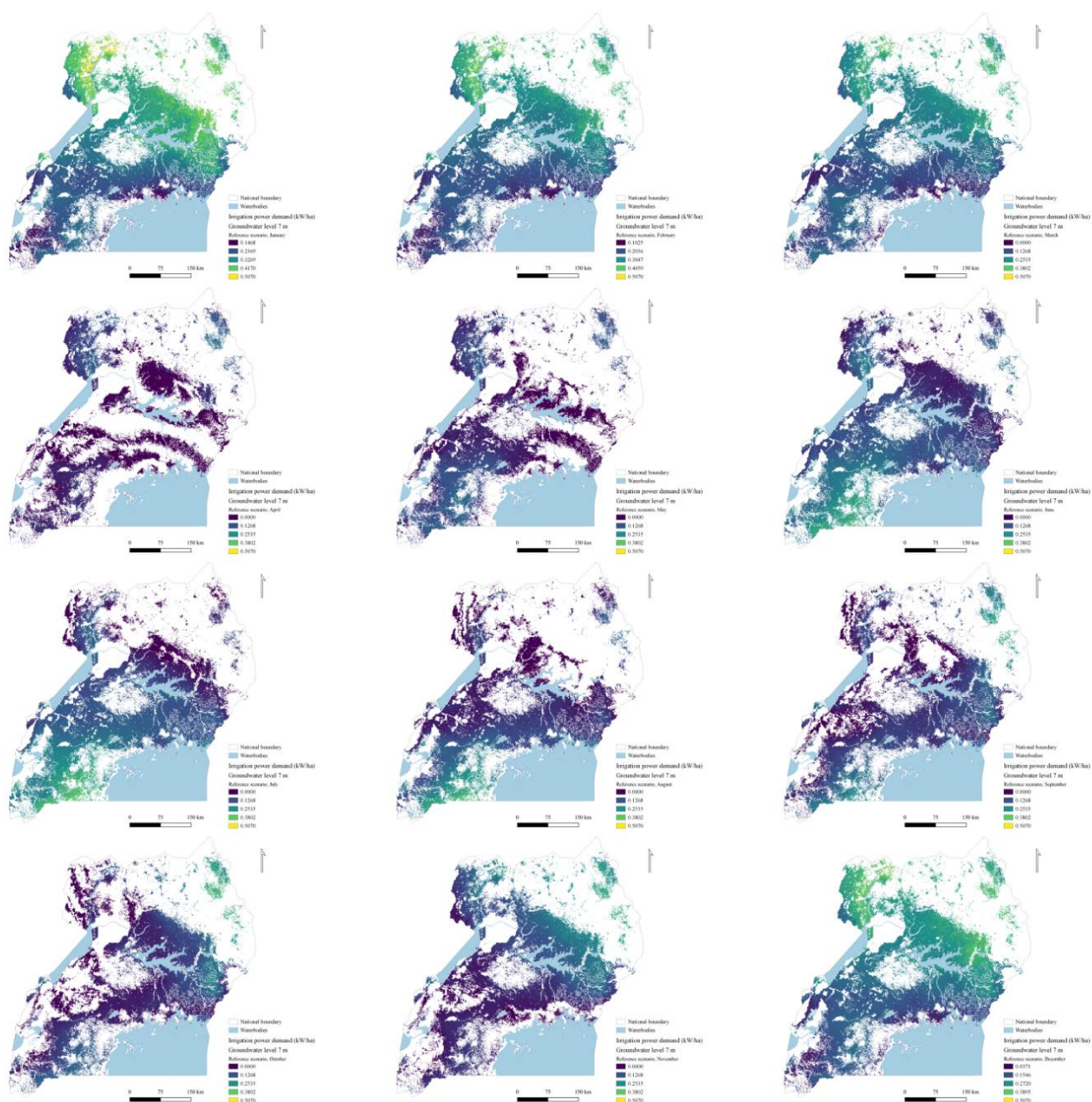
# Energy demand, drought scenario



**Figure S5.** Energy demand (kWh/ha) in the drought scenario, January through December.

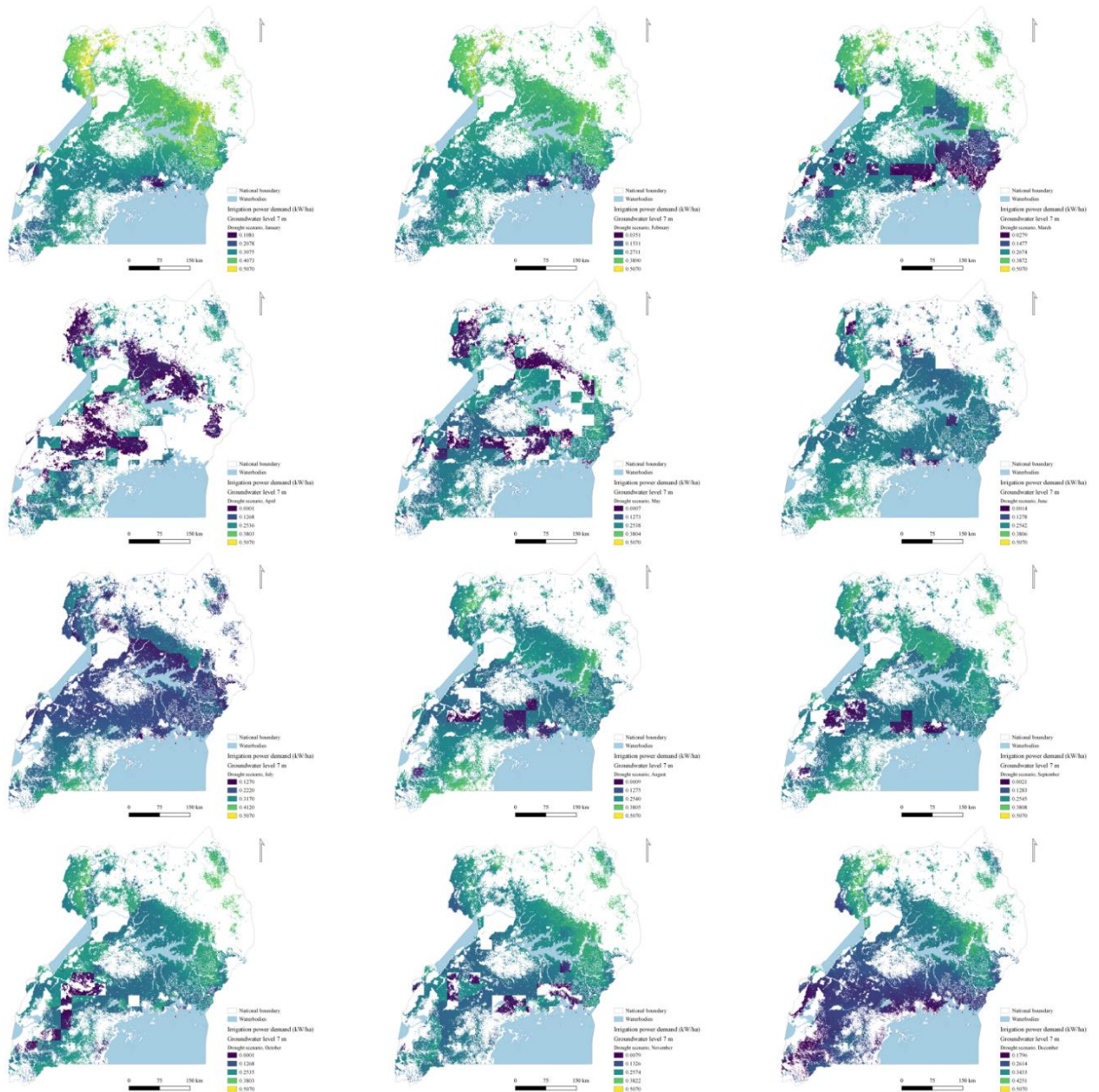


*Power demand, reference scenario*



**Figure S6.** Peak power demand (kW/ha) in the reference scenario, January through December.

*Power demand, drought scenario*



**Figure S7.** Peak power demand (kW/ha) in the drought scenario, January through December.

#### *Sensitivity analyses*

The results from the reference scenario are analysed through (a) a sensitivity analysis on the daily time of operation of the irrigation pumping system, (b) a sensitivity analysis on the groundwater level and (c) a scenario analysis simulating an abnormally dry year based on historic drought severity data. A rather simple approach is applied for both sensitivity analyses by modifying the respective parameters  $H$  and  $t_{Op}$  in equations 8-10.

#### *Sensitivity to the groundwater level*

The relationship between the energy demand and the groundwater level is linear, resulting in a doubled energy demand when the groundwater level is doubled. Considering the uncertainties with regard

to the potential variations in the groundwater level across the study area, this could therefore have a significant impact on the energy demand. The peak annual energy demand per hectare for each groundwater level in the study is presented in Table S1.

**Table S1.** Annual energy demand (MWh/ha) by groundwater level.

| Groundwater level (m) | Peak $E_{\text{Annual}}$ (MWh/ha) |
|-----------------------|-----------------------------------|
| 7                     | 0.77                              |
| 10                    | 1.09                              |
| 15                    | 1.60                              |
| 20                    | 2.19                              |

#### Sensitivity to the daily time of operation

In a second sensitivity analysis, the significance of the time of operation on the peak power demand is assessed. The results show that halving the time of operation would require a twice as high power capacity in order to deliver the same amount of water. The effects on the peak power demand in the wettest and driest months (January and April) are presented in Table S2. As can be observed in Table S2 the peak power demand in January would hence rise from 0.49 kW/ha to 0.99 kW/ha if the time of operation would be decreased from 8 to 4 hours per day. Similarly, the same measure would result in an increase from 0.20 kW/ha to 0.40 kW/ha in April. The time of operation could therefore have significant effects on the required power capacity and should be considered in power supply planning. For instance, the daily profile of the potential of variable renewable energies could affect the possible daily time of operation, including other factors such as availability of energy storage.

**Table S2.** Peak power demand (kW/ha) in January and April, by time of operation ( $t_{\text{op}}$ ).

| $t_{\text{op}}$<br>(hours/day) | $P_{\text{Peak, max}}$ (kW/ha) |       |
|--------------------------------|--------------------------------|-------|
|                                | January                        | April |
| 8                              | 0.49                           | 0.20  |
| 6                              | 0.66                           | 0.27  |
| 4                              | 0.99                           | 0.40  |