Data description document for

soil moisture measurements

Cabauw Experimental Site for Atmospheric Research (CESAR)

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1 Measurement

Volumetric soil moisture contents have been measured daily between 6 November 2003 and 19 August 2010 with a TDR set-up developed by Heimovaara and Bouten (1990) (see also Heimovaara and de Water, 1993), consisting of six arrays of six sensors between 5 and 73 cm below the soil surface. The six arrays were positioned on the perimeter of a circle with a diameter of 9 m with equal distances. The TDR was calibrated by taking 6 undisturbed soil samples (diameter: 20 cm; height: 20 cm) into the lab and comparing independently measured volumetric soil moisture contents to the TDR measurements.

Measurements were performed at midnight local time, without taking daylight savings time into account. For example, the measurements listed behind 6 Nov. 2003, was at 5 Nov. 2003 23:00 UTC. For more information, see Brauer et al. (2014a,b); Brauer (2014).

Note that next to these soil moisture measurements performed by Wageningen University, soil moisture has been measured by KNMI. These data are also available through the CESAR database.

2 Dataset

There are data files for each year:

- `cesar_tdr_soilmoisture_la1_t1d_v1.0_yyyy.nc`

Two of the arrays contained too many errors and were removed from the data set, leading to a total dataset of 24 sensors (4 arrays with sensors at 6 depths).

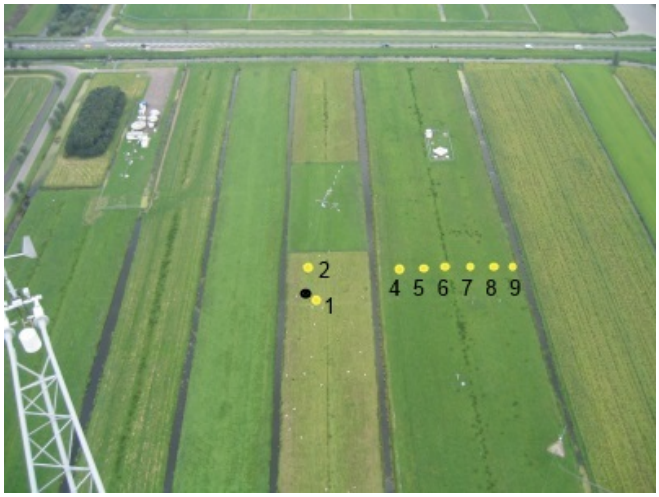

Figure 1: Location of the soil moisture sensors (black dot) and piezometers (yellow dots) as seen from the tower (looking southward).

3 Gap filling

Measurements have been corrected and gaps have been filled. A quality code is supplied with every measurement:

1 Original measurement.

0 Value obtained with gap filling.

Gaps in the time series of a certain sensor are filled with data from the other sensors at the same depth. This procedure is as follows (using a gap in the time series of sensor number 1 as example):

1. Compute, for every time step with data available for sensors 1, 7, 13 and 19, the ratio between the measurement of sensor 1 and

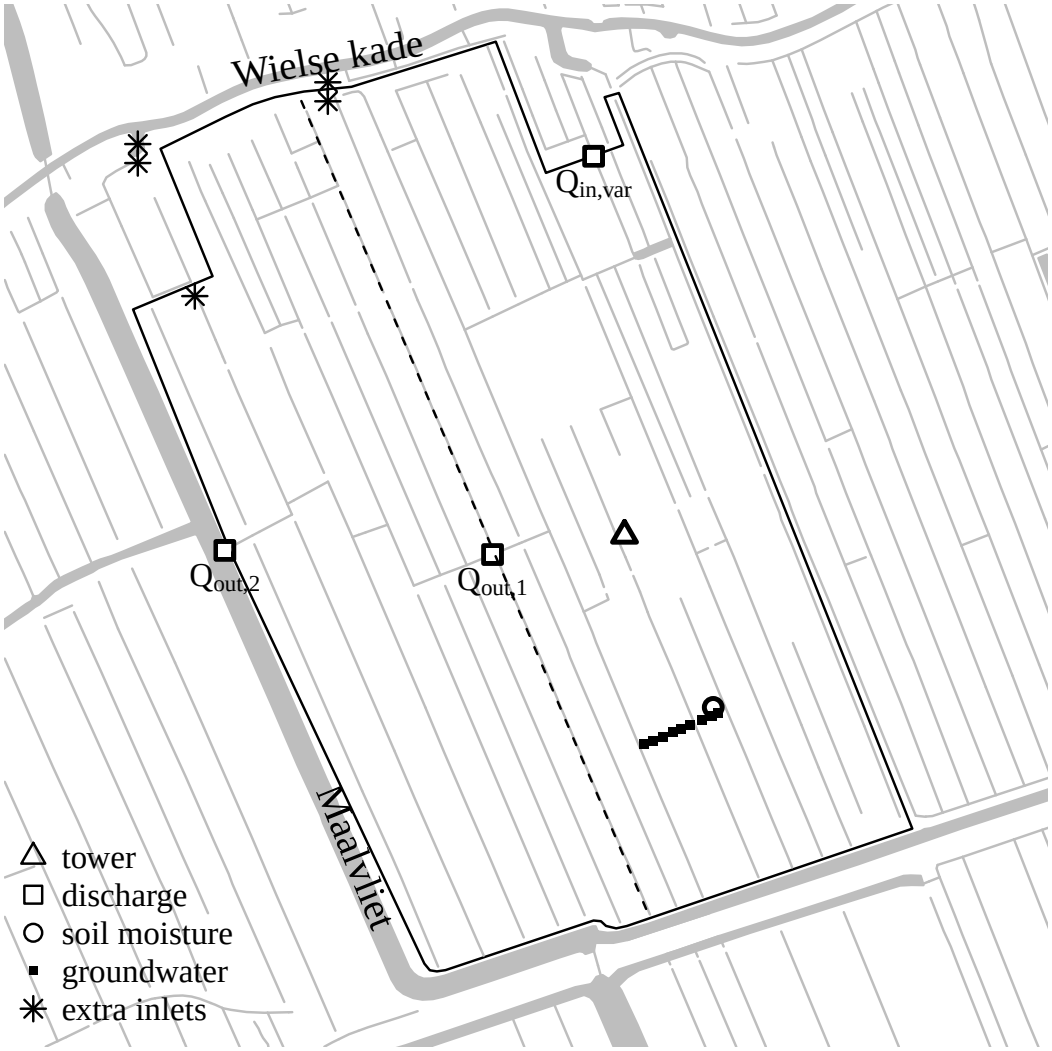

Figure 2: Location of the soil moisture and other hydrological measurements.

those of the other sensors:

$$\text{ratio} = \frac{3\ \theta_1}{\theta_7 + \theta_{13} + \theta_{19}}$$

and take the mean.

2. Use this ratio to fill gaps in the time series of sensor 1:

$$\theta_1 = \text{ratio} \cdot \frac{\theta_7 + \theta_{13} + \theta_{19}}{3}\ .$$

Table 1: Specifications (depth and array number) of each sensor (numbers 1–24).

Array number	Depth [cm]					
	5	15	30	45	60	73
1	1	2	3	4	5	6
2	7	8	9	10	11	12
3	13	14	15	16	17	18
4	19	20	21	22	23	24

4 Set-up NetCDF files

The NetCDF files contain the following columns:

- `date`: date (as yyyymmdd)
- `SM1`, `SM2`, ..., `SM24`: soil moisture content for each sensor
- `code1`, `code2`, ..., `code24`: data quality code for each sensor
- `DOY`: all days in the year in question (belongs to `valid_dates`)
- `valid_dates`: vector with 1 and 0 indicating if data for that day are available

Figure 3: Location of the sensors (under the iron wickets) and the rest of the instrumentation (in the wooden box).

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