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Hydrologic research in small basins in Belgium

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Hydrologic research in small basins has a long history in Belgium, dating back more than 50 years. Data collection and scientific investigation occurs in a number of catchment. Below two catchments and their ongoing research are described.

(1) Transport of dissolved organic carbon, dissolved organic phosphorus and silicon from the soil to surface water

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Researchers from the Belgian university KULeuven are working on the transport of dissolved organic carbon, dissolved organic phosphorus and silicon from the soil to surface water. The aim of the study is to understand how this transport varies from one land use to another. Therefore six small upstream catchments were selected (Figure 1). Lithologies of the catchments are comparable as they are all located in the Belgian loess belt. Two of the catchments are covered by forest, two by croplands and two by grasslands.

Fig. 1: Test basins of university KULeuven.

All streams are provided with a V-notch and a flow proportional sampler to measure discharge and collect river samples. In the catchments covered by forest and grassland, baseflow is sampled every 84h. In the croplands streams flow only through the catchment after heavy rain events. To get better insights in the transport of dissolved elements during peak flow regimes, sampling during rain events is proportional to the discharge in all catchments.

In all catchments 15 suction cups have been installed on the catchment slope (perpendicular to the stream) to collect soil water once or twice a month. The suction cups are installed downslope, in the middle of the slope and upslope of two catenas. One catena is located in a topographical depression: these suction cups take soil water at 30 cm and 90 cm depth. The suction cups of the other catena, installed on topographical

crest, take water at 30 cm, 60 cm and 90 cm depth. Soil moisture is measured at the same depth with TDR-probes.

In the catchments covered by forest and in one of those covered by grassland, piezometers have been installed. In those catchments groundwater is undeep (<3m). The groundwater is sampled monthly. The level is measured each 30 minutes with a diver and corrected for the barometric pressure.
To understand the transport of the dissolved elements with natural waters, the hydrologic characteristics of the catchments need to be known. Three of the six catchments are studied in more detail. The catchment Meerdaal covered by forest has an average run-off coefficient of $6{,}41*10^{-4}$. In this catchment the river is constantly fed by groundwater and surface run-off is negligible. The run-off coefficients of the two other catchments are 2 orders of magnitude higher: $3.81*10^{-2}$ for the cropland in Velm, and $2.13*10^{-2}$ for the grassland in Blégny. In Velm the temporary stream is only fed by surface run-off. The groundwater table is much deeper and does not interact with the surface water. In Blégny the hydraulic river regime is currently not well understood and is still being studied. The contribution of the different end-members feeding the river will be quantified by reservoir models with lumped parameters. These water flux models will be calibrated with oxygen and hydrogen isotopes measured in the rain and in the river water. In a later stage, transport of dissolved elements will be integrated in the model.

(2) The Bellebeek catchment

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Site Description

The study site is the Dender catchment in Belgium. A Large Aperture Scintillometer was installed in the subcatchment of the Bellebeek (102.3 km2). For the calibration and validation of hydrologic models, data from the neighboring subcatchment of the Wolfputbeek (48.6 km2) are used as well. Figure 1 shows the location of the catchments together with a digital elevation model (DEM) of the area. The elevation in the subcatchments ranges between 10 and 110 m. Soil texture is predominantly loam (74%), and the land use (shown in Figure 2) is predominantly agriculture (63.6%) and pasture (22.9%). 8.6% of the surface consists of urban land cover and the rest of the area consists of forest (4.8%) and open water (0.1%).

Data Sets

Meteorological Station and Discharge Observations

Figure 2 shows the location of the different stations. Discharge observations are available with an hourly time step at the outlet of the Bellebeek subcatchment. Measurements of wind speed and wind direction at 10 m height, as well as precipitation rates, air pressure, and air and dew point temperature at a height of 2 m are available at 10 min intervals at the meteorological station of Liedekerke, situated near the outlet of the catchment. Furthermore, net radiation and ground heat flux observations are also available at this site.

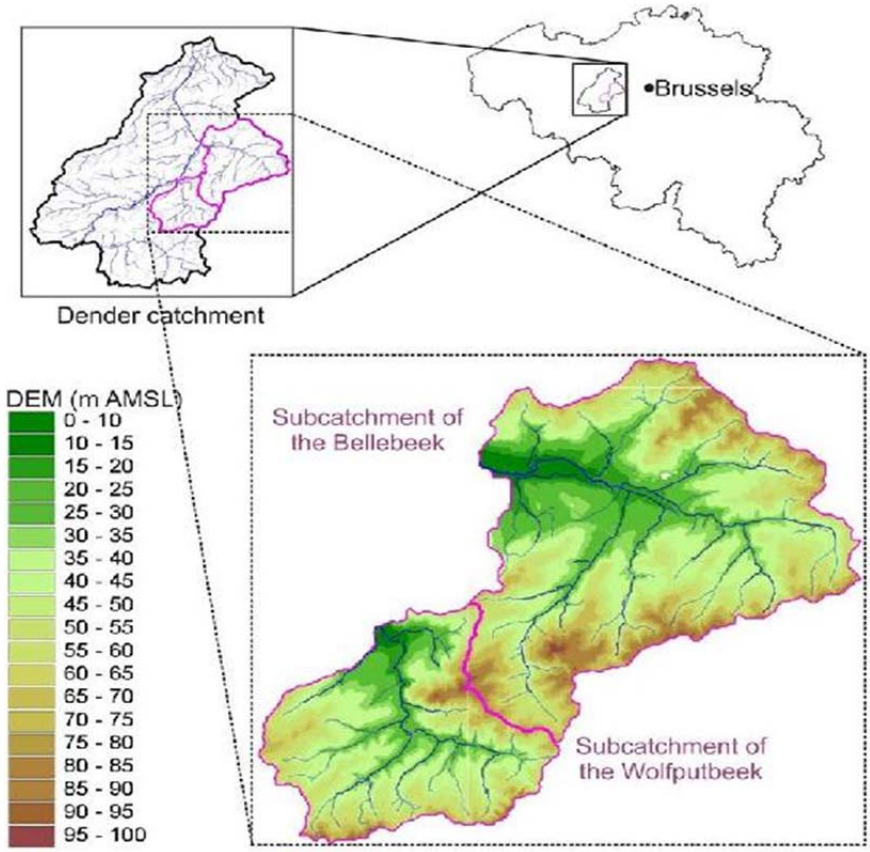

Fig. 2. The location of the study site in Belgium and a DEM of the study area (m AMSL ¼ meter above mean sea level).

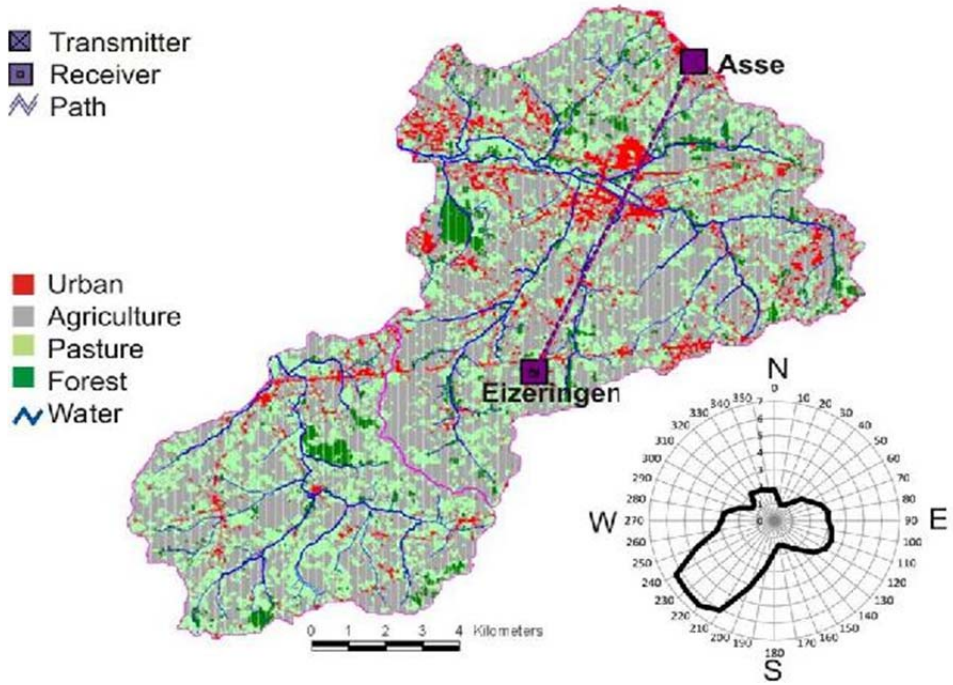

Fig. 3: The location of the meteorologic stations and scintillometer, land use, and the distribution of the wind direction.

Bowen-Ratio Energy Balance (BREB) and LAS Installations

From 15 August 2007 through 15 July 2008, a Bowen-ratio station was installed on a pasture field in Gooik in the subcatchment of the Wolfputbeek. From 3 September 2008 through present, this BREB station was installed in Ternat on a grassland approximately in the middle of the scintillometer path. The BREB station consists of two HMP45C capacitive probes with radiation shield (Vaisala, Woburn, Massachusetts) for measuring air temperature and relative humidity at two different heights (1 and 2 m), a CMP3 pyranometer (Kipp and Zonen, Delft, Netherlands), and a NR-Lite net radiometer (Kipp and Zonen, Delft, Netherlands) at 2 m height, and two HFP01SC soil heat flux sensors (Hukseflux, Delft, Netherlands) installed just below the surface. No correction has been made for the heat storage in the soil (5 cm) above the soil heat flux sensors as this can be assumed very small. All measurements are registered at 10 min intervals and are averaged to 1 h intervals from which Bowen ratios and fluxes were calculated.

Large Aperture Scintillometer measurements are avaiable from 21 February 2008 through present. Due to logging problems, no data were available for three periods: from 1 August 2008 through 25 September 2008, from 3 March 2009 through 1 April 2009, and from 9 June 2009 through 2 July 2009.

Geographical Information

A digital elevation model (DEM) with an accuracy of 0.07 m and soil texture and land cover maps of the Dender catchment are available through the Flanders Geo- graphical Information Agency. These data were converted to grids with a resolution of 50 m for the subcatchments of the Bellebeek and the Wolfputbeek.