British Geological Survey

Eddleston groundwater and soil moisture monitoring

ECAR Programme

Internal Report IR/23/023

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Front Cover

Monitoring borehole at Cringletie hillslope observatory (photo ©UKRI)

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Eddleston groundwater and soil moisture monitoring

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1 Project scope

This report describes work undertaken to continue monitoring at two experimental sites on the Eddleston Water, a tributary of the River Tweed. The Eddleston experimental sites were set up as part of the wider Eddleston Water Project, which aims to reduce the impact of flooding in and downstream of the village of Eddleston.

The first experimental site is part of Darnhall Mains Farm, adjacent to the village of Eddleston (Ó Dochartaigh et al. 2019). It is approximately 0.2 km^2 (approximately 400 m by 500 m) and covers most of the width of the Eddleston Water floodplain on both sides of the river (Figure 1). The site is farmland predominately comprising mixed livestock farming on improved grassland, but part of the floodplain has been fenced off, which has allowed trees to be planted and vegetation to recover. The monitoring at this site comprises eight boreholes in which groundwater level is recorded. The data are stored with the National Geoscience Data Centre (https://www.bgs.ac.uk/geological-data/national-geoscience-data-centre/, ID 128585). A key objective of the experimental site is to improve understanding of the role of groundwater in floodplain environments and in flooding, and of how groundwater interacts with climate, rivers and soils.

The second experimental site is the Cringletie hillslope observatory (Figure 1, Peskett et al. 2020). The site is approximately 2500 m^2 (approximately 50 m by 50 m) and comprises two transects parallel to the slope: one through a narrow forest strip and one on improved grassland used for mixed livestock farming (see Peskett et al. 2020). The installed monitoring equipment comprises soil moisture sensors, rain gauges and piezometers fitted with pressure transducers. The site was set up by Dr Leo Peskett as part of his PhD and was handed over to the BGS in 2020. The aim of the experimental site is to determine whether forest strips planted perpendicular to a hillslope can reduce surface runoff during flood events. Further information about the observatory is available in Peskett et al, 2020 ().

In 2022/23, the BGS received funding from the Scottish Government to check the monitoring equipment; download all data and reset the loggers; replace broken equipment; and collate, process and quality check the data.

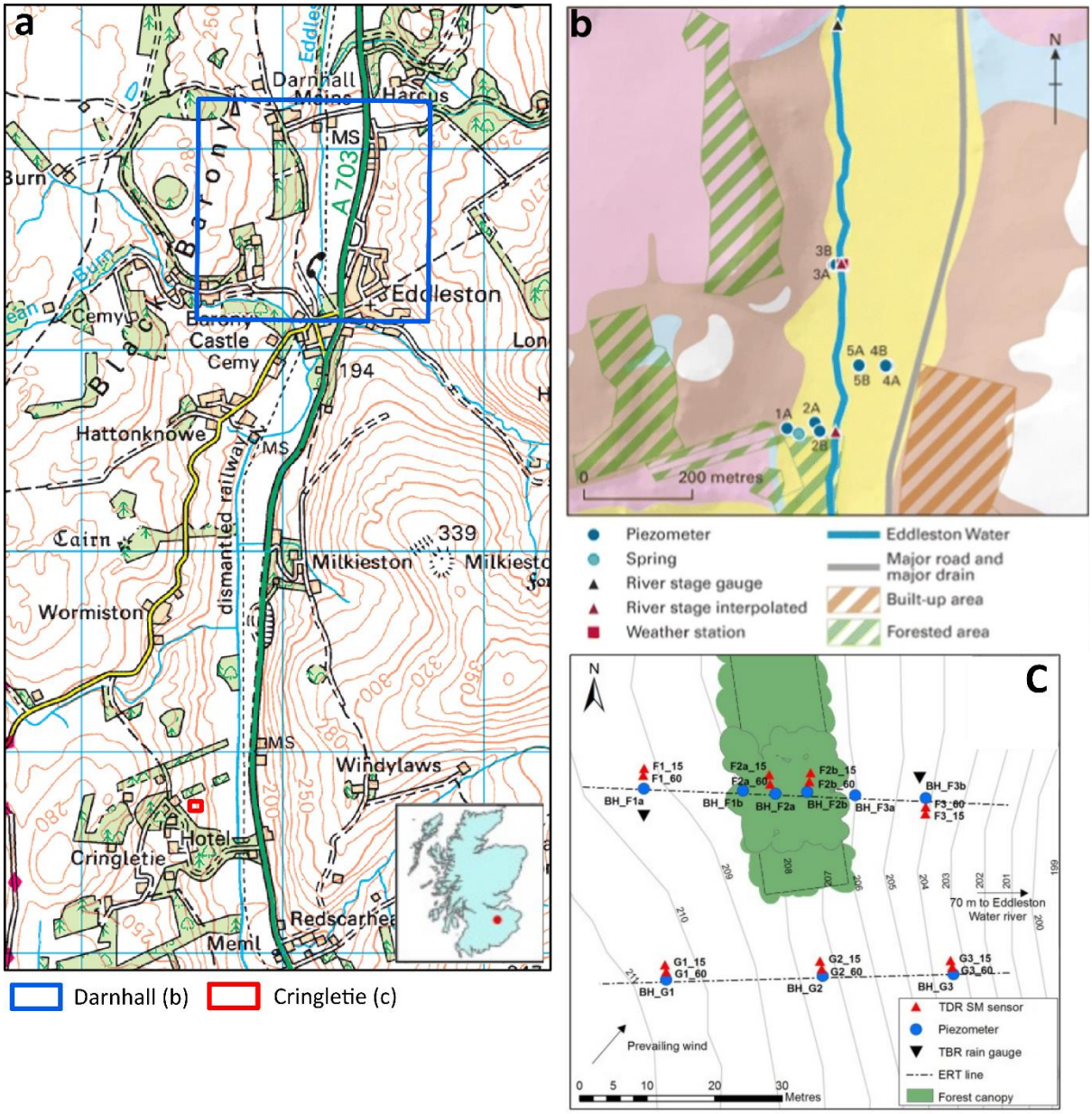


Figure 1 (a) Map of Eddleston experimental sites (© Crown Copyright and database rights 2023. Ordnance Survey Licence No. 100021290 EUL). (b) Monitoring boreholes at Darnhall (reproduced from Ó Dochartaigh et al. 2019 Available under License Creative Commons Attribution 4.0). (c) Soil moisture sensors and piezometers at Cringletie hillslop observatory (reproduced from Peskett et al. 2020 Available under License Creative Commons Attribution Non-commercial No Derivatives 4.0).

2 Darnhall floodplain monitoring

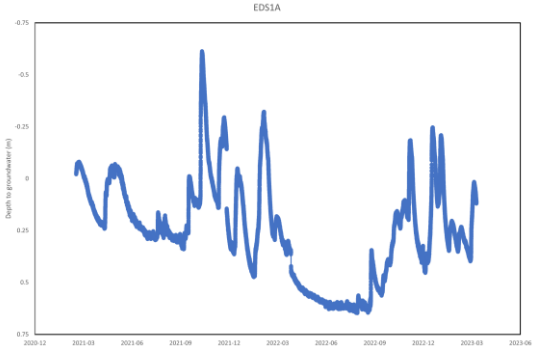
There are eight monitored boreholes at the Darnhall floodplain site (Ó Dochartaigh et al. 2019).

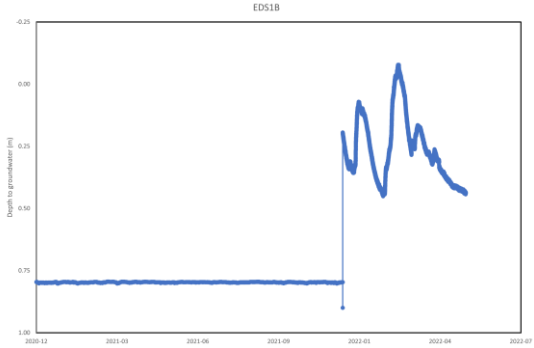
In December 2021, data from pressure transducers in seven of the eight boreholes was successfully downloaded. One borehole, EDS1B, had seized and was not able to be accessed.

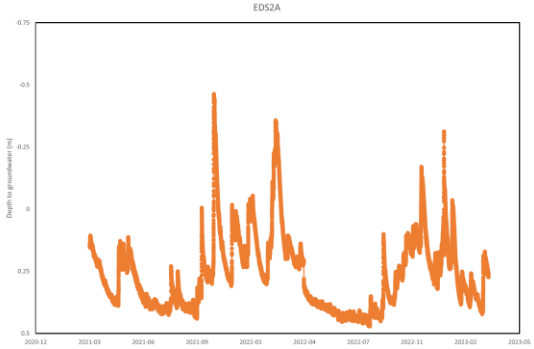
In March 2023, data from pressure transducers in all eight boreholes was successfully downloaded. It was found that the pressure transducer in one borehole, EDS1B, that was not able to be accessed in December 2021 had ceased recording data on 16 May 2022. This logger has since been replaced by another unit.

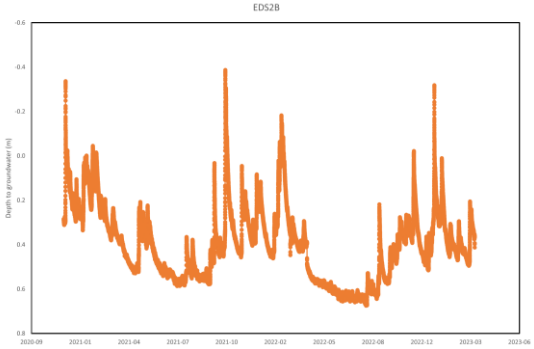
Data from an additional pressure transducer at the site that measures atmospheric pressure were also downloaded during both visits. The remaining transducers were wiped and reset at the end of each visit.

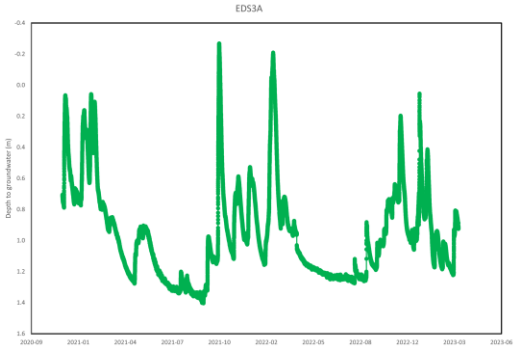
The groundwater level data were compensated for atmospheric pressure and quality checked. The processed groundwater level data for December 2020 to March 2023 can be found in Figure 2.

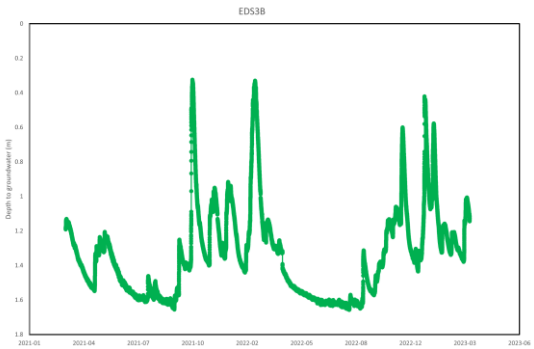


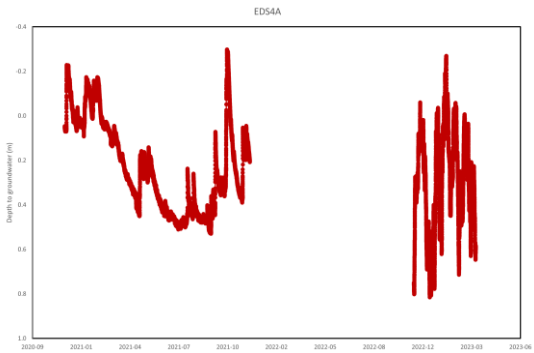


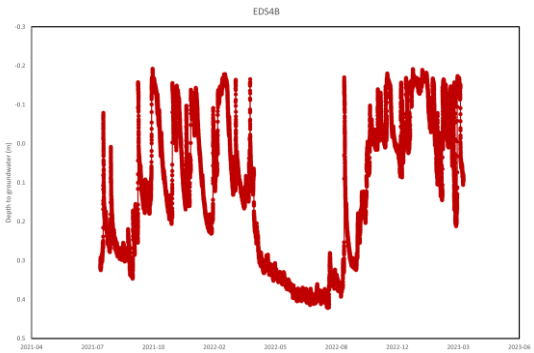












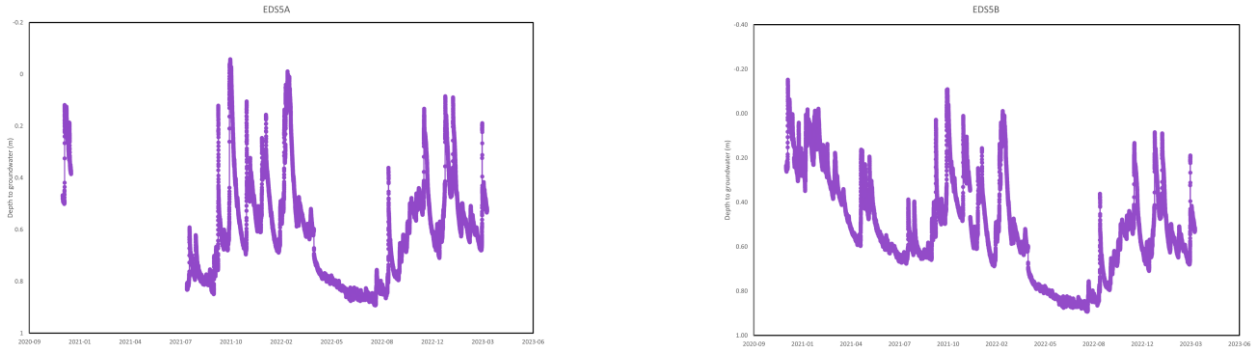


Figure 2 Groundwater levels at floodplain boreholes for period December 2020 to March 2023.

3 Cringletie hillslope monitoring

In 2020, Dr Leo Peskett stopped maintaining the Cringletie hillslope observatory installed during his PhD (Peskett et al. 2020). The site consists of 14 soil moisture sensors, 2 rain gauges and 7 piezometers fitted with pressure transducers. Although not part of this contract with Scottish Government, BGS decided to keep a low level of maintenance on the infrastructure and download the data.

3.1 Soil Moisture

The soil moisture gauges at the Cringletie hillslope appear to have reached the end of their functional life. Data was downloaded, batteries changed and the monitors given a basic service on 07 March 2023. After discussion with the wider project team, a decision was made to temporarily remove all soil moisture logger units from site in order to perform more comprehensive servicing and repair work. Data are presented below.

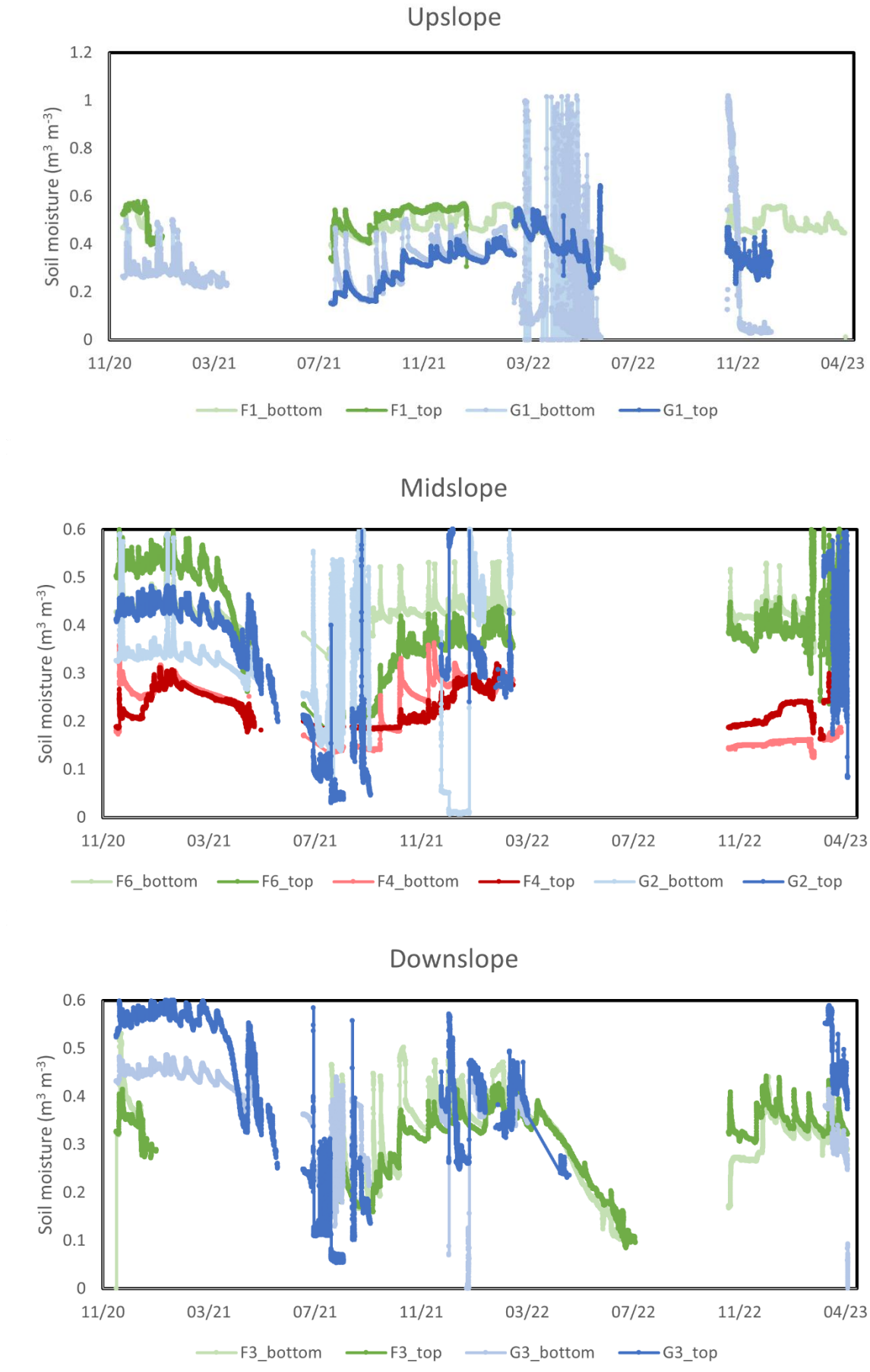


Figure 3 Measured soil moisture levels from December 2020 to April 2023.

3.2 RAINFALL

The two rain gauges – one is located above the forest strip and the other below – were found to be in poor condition. Both loggers had time periods where data remedial works were undertaken but the units are believed to be approaching their end of useable life. Available data collected is presented below.

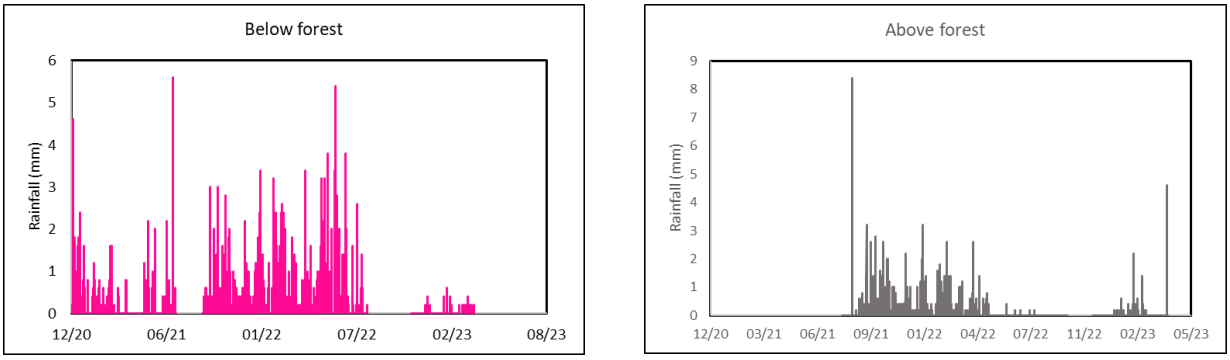


Figure 3 Measured rainfall above and below forest strip.

3.3 GROUNDWATER LEVELS

Most piezometers were dry for significant periods, as can be seen from the data (Figure 4), all piezometers were dry throughout the majority of summer months in 2021 and 2022. The midslope piezometers appear to have held small volume of groundwaters within them except for the summer months. Whereas the up and down slope piezometers were, on the whole, dry and appear to respond to small groundwater events.

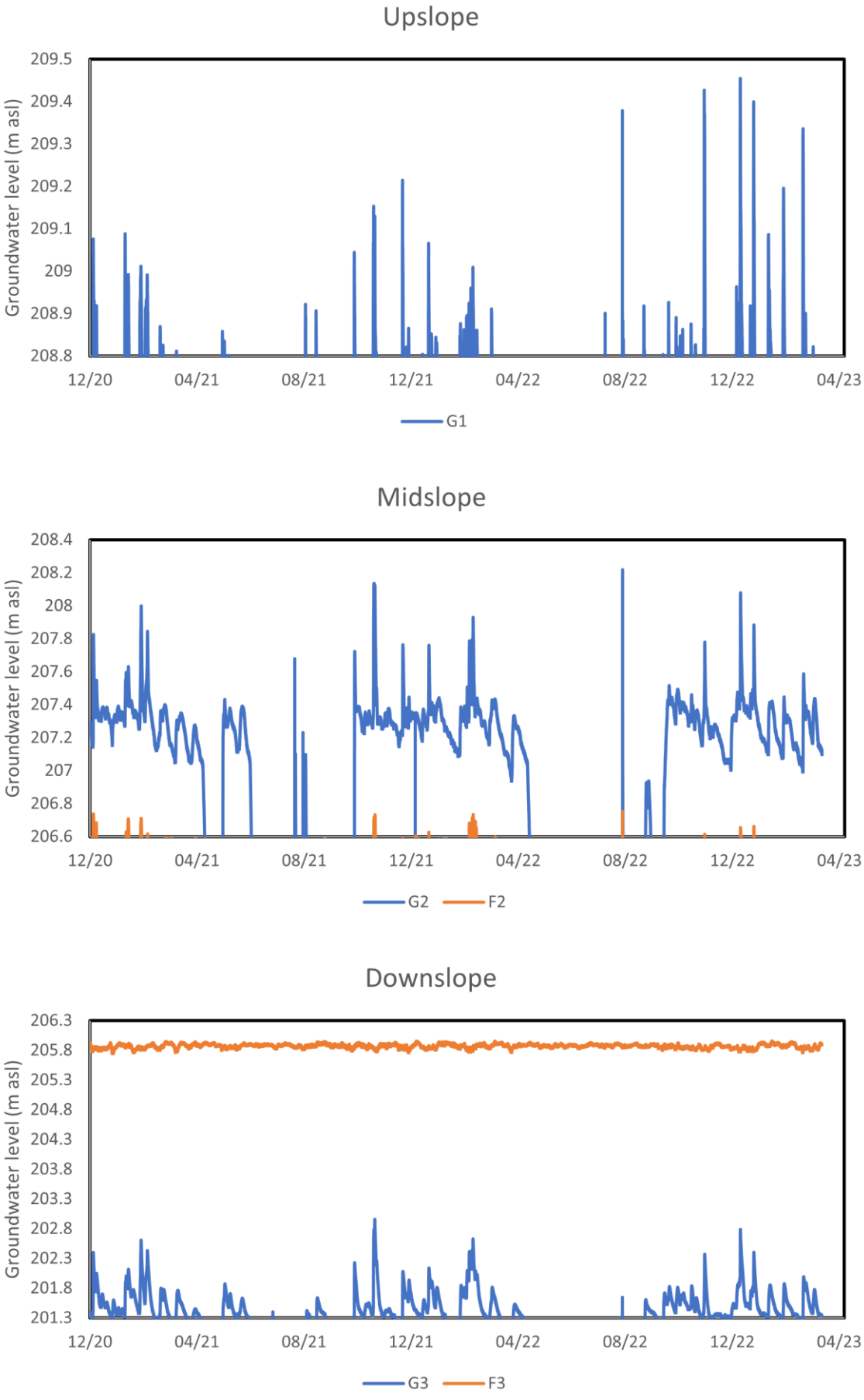


Figure 4 Groundwater levels after atmospheric pressure compensation, December 2020 to April 2023.

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