Mediterranean intermittent rivers and ephemeral streams: temperature and water level responses to precipitation events

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December 12, 2022

Abstract

Despite continued interest in flow regime variability and its influence on stream dynamics in intermittent rivers and ephemeral streams, the link between different precipitation events and its control on water presence in hydrologically transient catchments with varying land cover and biophysical characteristics, has rarely been studied. This paper presents the results from high-resolution (30-min) precipitation data and streambed temperatures collected from a fifteen-month period from six different Mediterranean intermittent and ephemeral catchments. The monitoring timeframe proved to be one of the driest periods in the studied areas in the last 50 years and most recorded rain events were small, the majority of which not exceeding 0.4mm of rainfall in a single event. The results demonstrate the larger studied catchments had longer water level response lag times to precipitation episodes. In addition, reduced water level responses to autumn rain events in rural areas indicated that the soil water retention capacity due to the limited soil moisture content during the summer period and the empty water-retention infrastructure, play an important role in governing flow presence. The smaller and predominantly urban catchment, resulted with the second most rapid water presence response times and the highest average streambed temperature peaks following precipitation events. Conversely, rural catchments that have groundwater springs contributing to stream flows, showed more stable temperature variations. This research highlights the need for the improved understanding of the intrinsic landscape and basin properties that control the spatio-temporal patterns of transient flows and thermal responses to varying rain events, especially in a changing climate.

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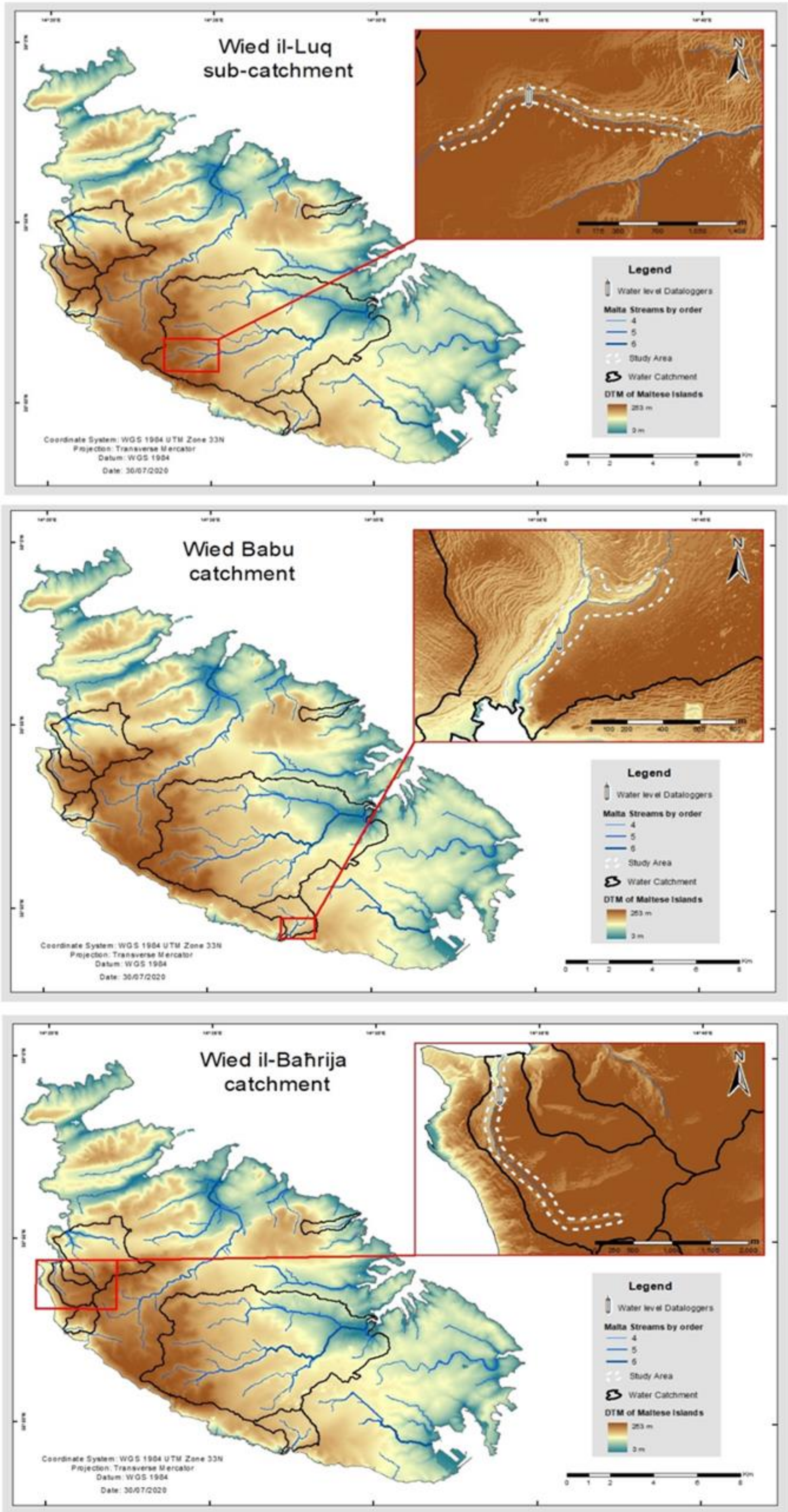
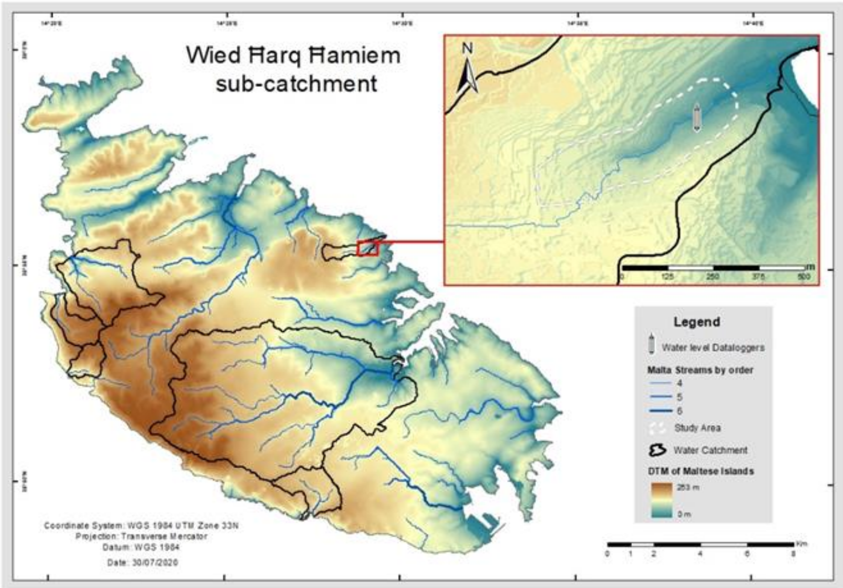
Figure 1. Map of the case study areas including location of the monitoring sites.

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Legend
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Malta Streams by order
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5
6
Study Area
Water Catchment
DTM of Maltese Islands
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0 m
Coordinate System: WGS 1984 UTM Zone 33N
Projection: Transverse Mercator
Datum: WGS 1984
Date: 30/07/2020
0 1 2 4 6 8
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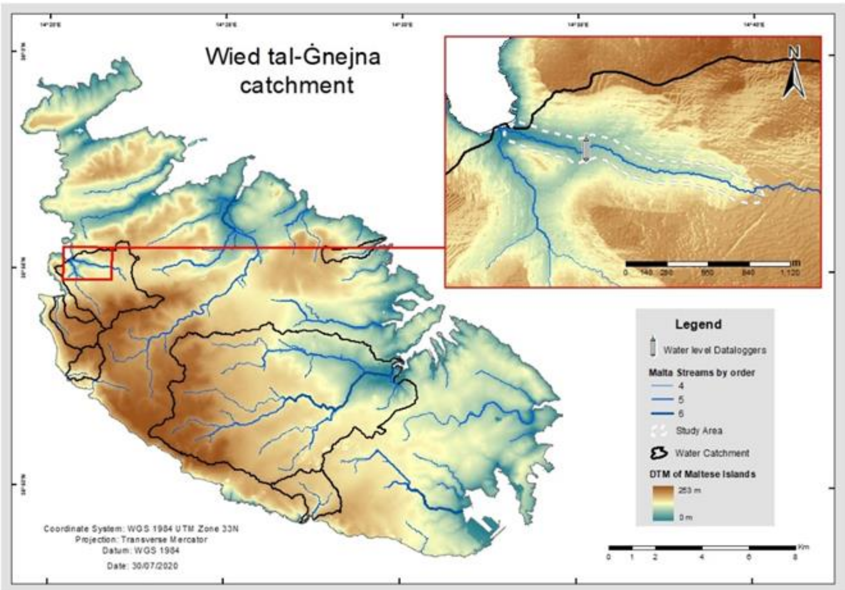
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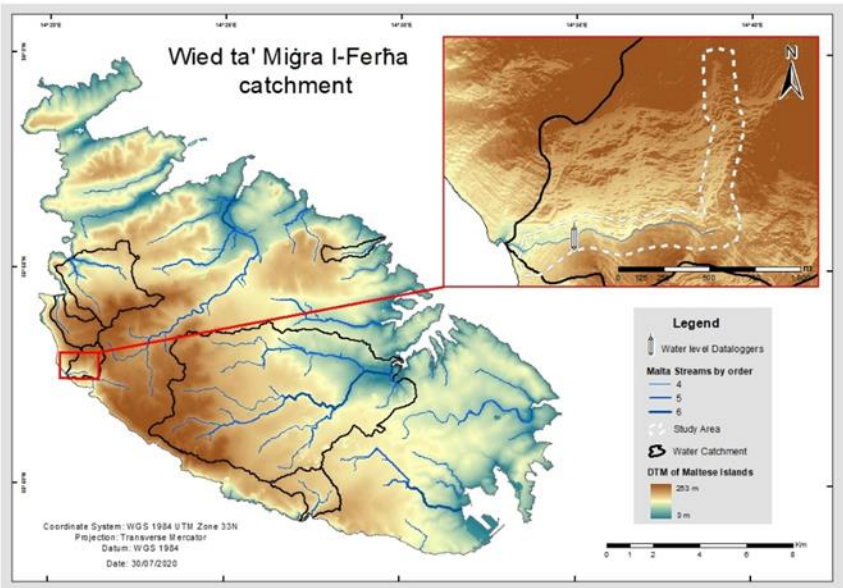
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Coordinate System: WGS 1984 UTM Zone 33N
Projection: Transverse Mercator
Datum: WGS 1984
Date: 30/07/2020
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Figure 2. Onset HOBO U20L-04 with HOBO U2X Protective Housing deployed at Wied ta' Miġra l-Ferħa case study site.

Figure 3. Precipitation event size histograms for the three weather stations used in this study.

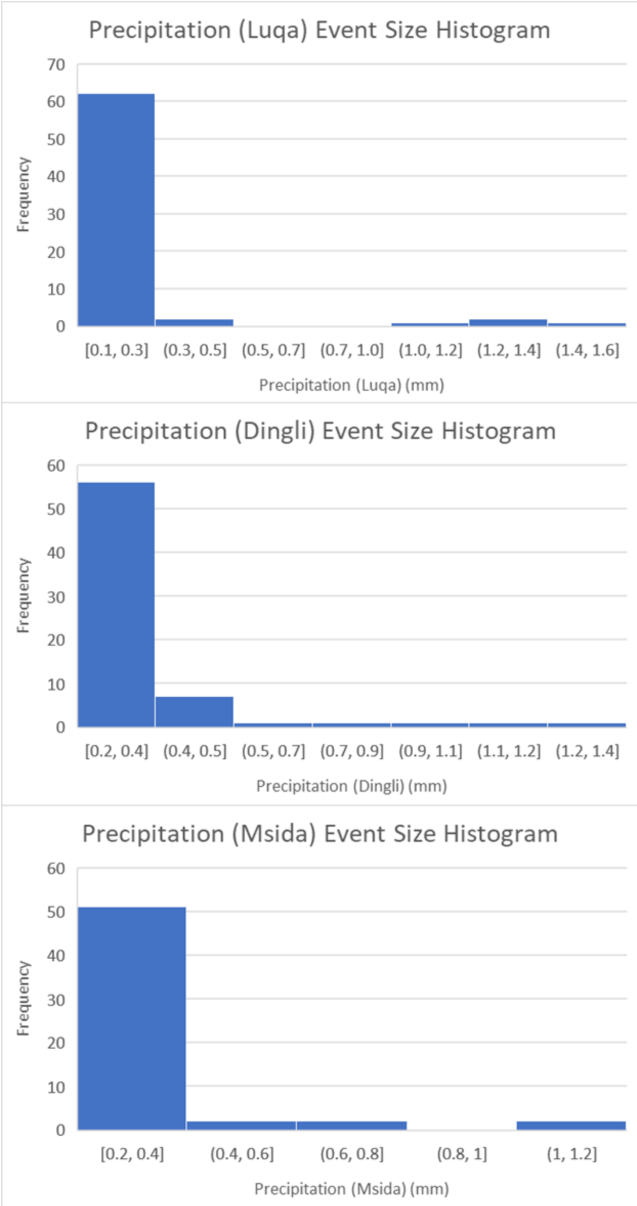
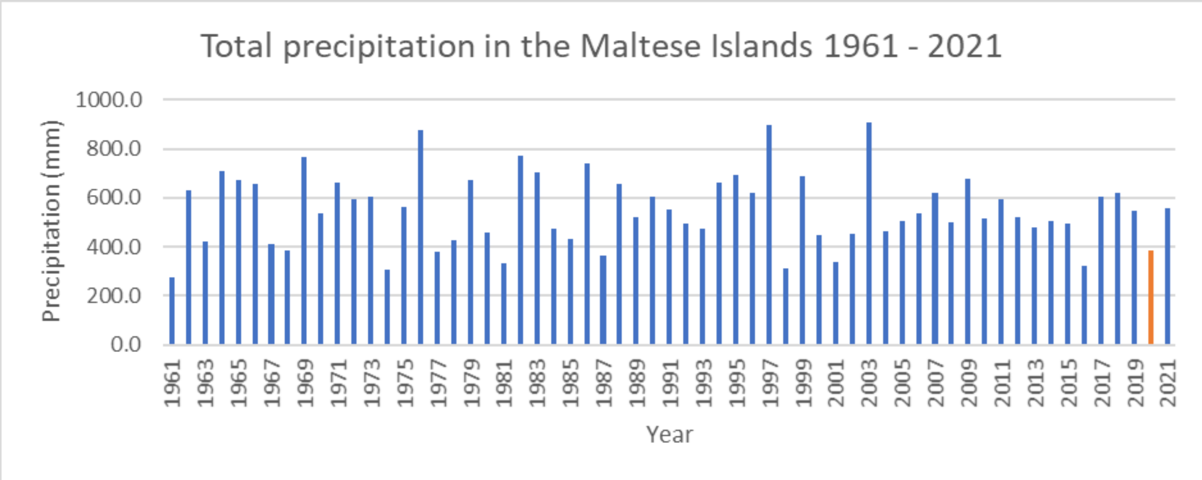
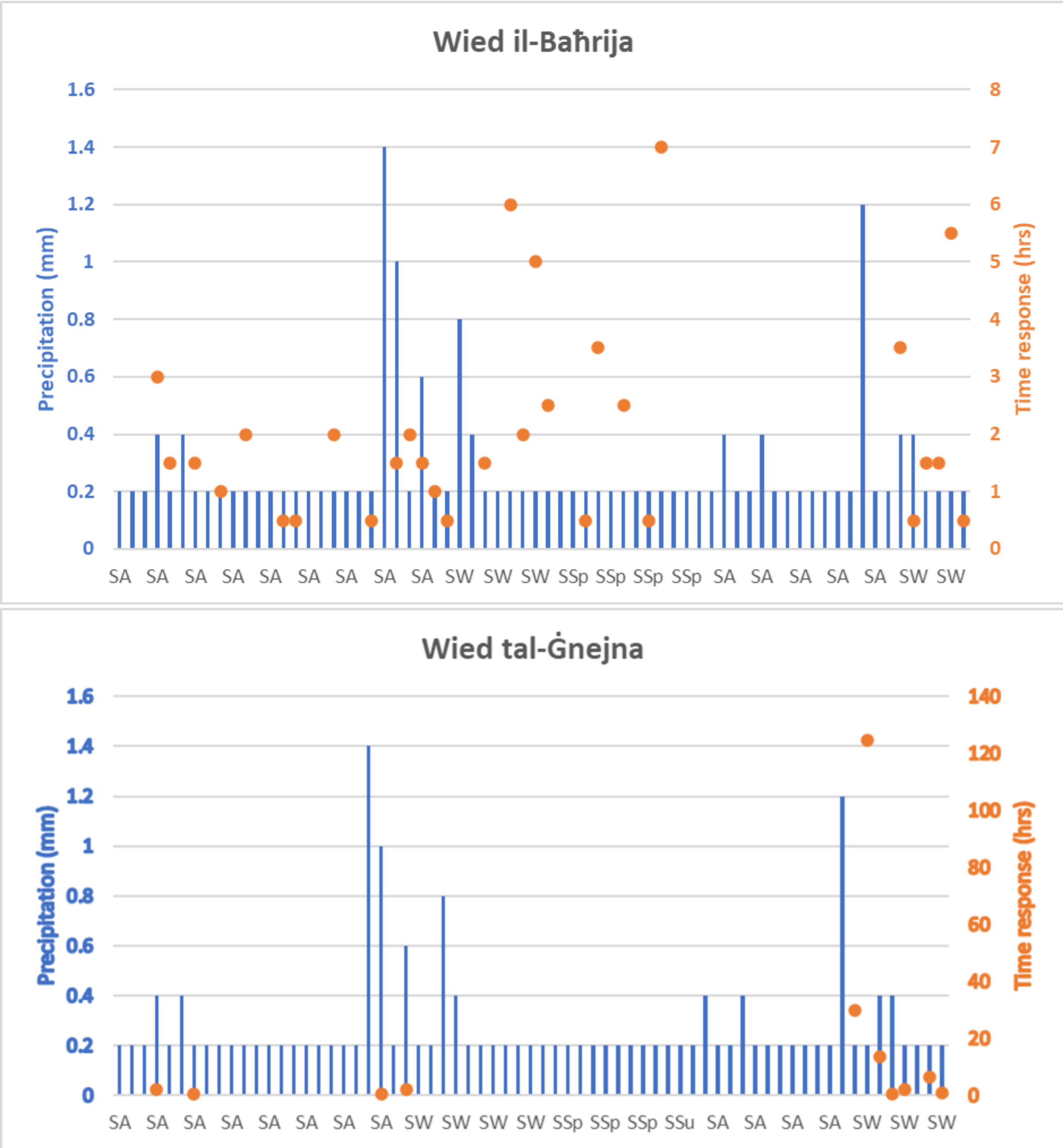


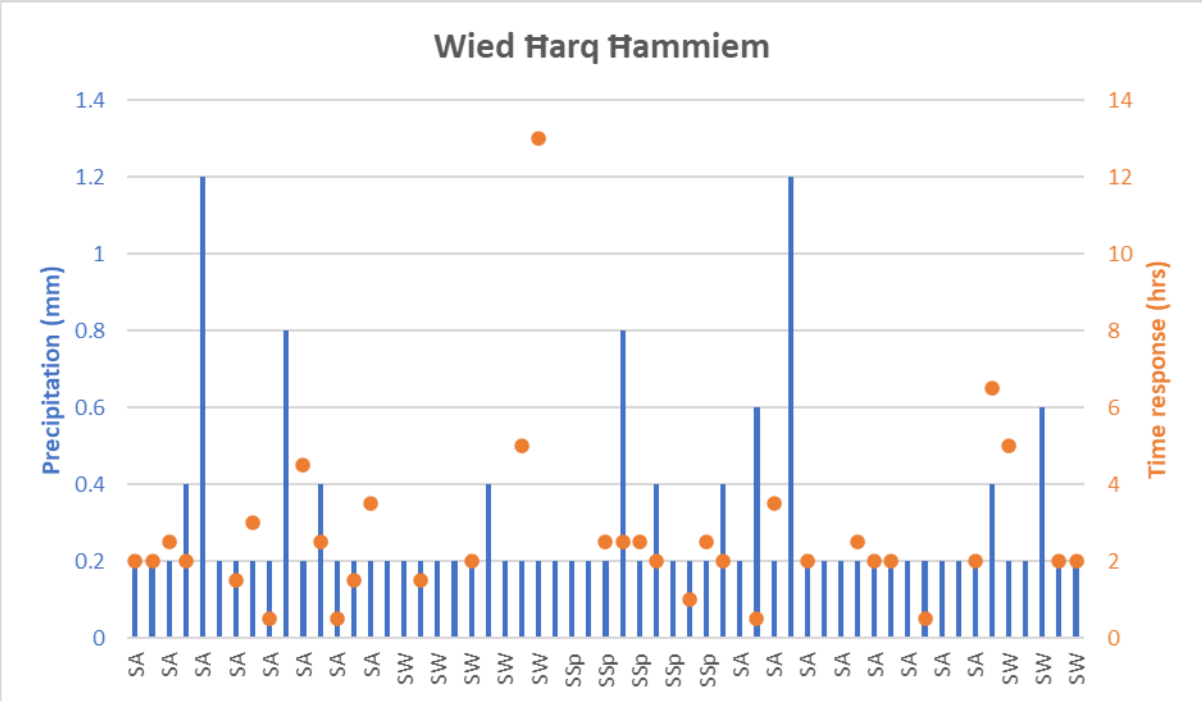
Figure 4. Annual precipitation total of the monitoring period in comparison with the last 50 years.



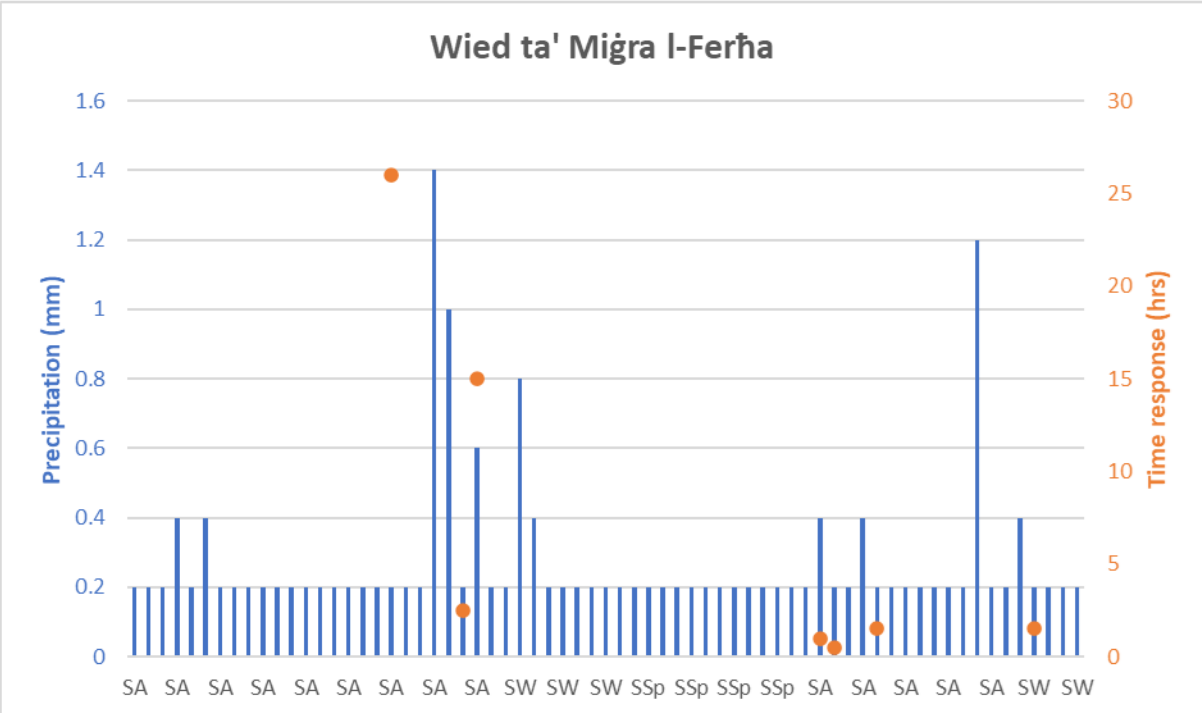
*data extracted from https://www.dwd.de/ for WMO Climate Station: 16597

Figure 5. Response times until peak water level following the occurrence of precipitation events.





Wied Ħarq Ħammiem
Precipitation (mm)
Time response (hrs)
SA SA SA SA SA SA SA SA SW SW SW SW SW SSp SSp SSp SSp SSp SA SA SA SA SA SA SA SA SW SW SW



Wied ta' Miġra l-Ferħa
Precipitation (mm)
Time response (hrs)
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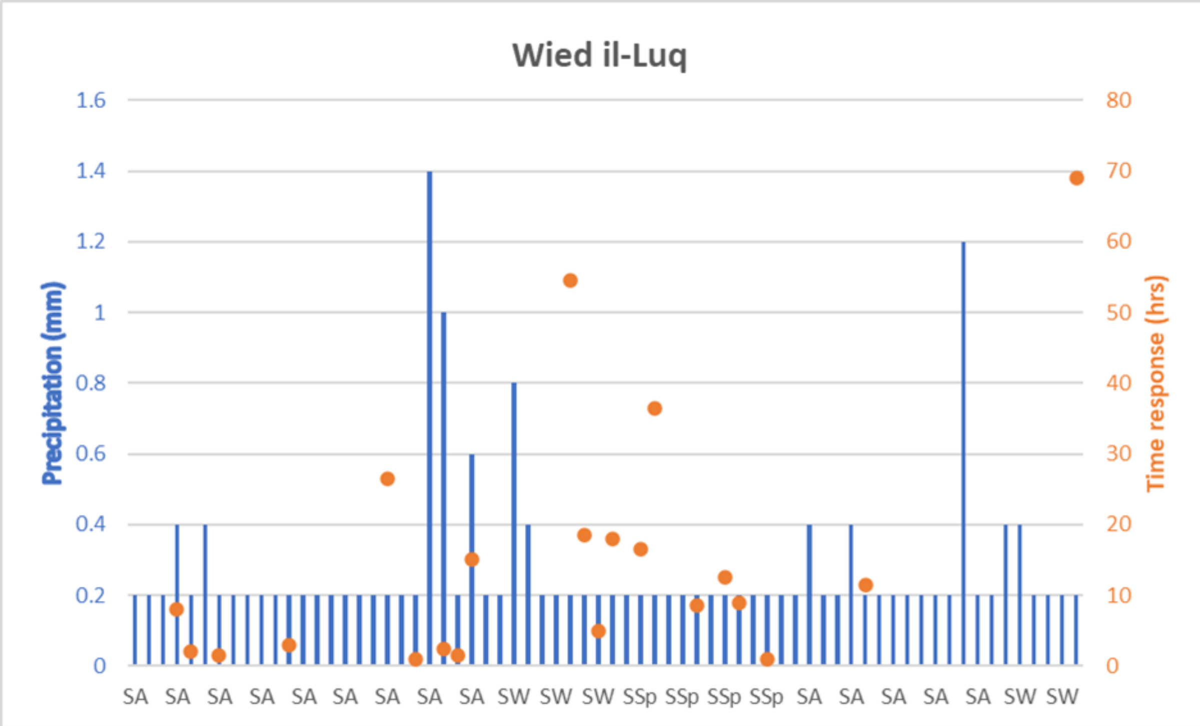

Wied il-Luq
Precipitation (mm)
Time response (hrs)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
80
70
60
50
40
30
20
10
0
SA SA SA SA SA SA SA SA SA SW SW SW SSp SSp SSp SSp SA SA SA SA SA SW SW

Figure 6. Temperature change response at streambed peak water level following precipitation events.