FEH changes for Peak Flows V15

Overview of changes based on current methods and descriptors

Adam Griffin, Hadush Meresa, Gianni Vesuviano

Issue number 1
2026-08-24

UK Centre for Ecology & Hydrology

Contents

1. Executive Summary

This report serves as an appendix to the Peak Flows V15 release note, expanding on the differences between Version 14 and Version 15 in the context of FEH methods: single-site analysis, donor adjustment to *QMED* estimates, and pooled flood frequency estimates (Robson and Reed, 1999; Kjeldsen et al., 2008; Vesuviano et al., 2025). This includes an analysis of the new data at a selection of approximately 1500 ungauged locations across Great Britain.

It does not include or discuss the new catchment descriptors introduced in V14 and included with V15: $FARL_{2015}$, $SAAR_{9120}$, $URBEXT_{2015}$, $BFIHOST19_{SCALED}$. These are discussed in a separate report, available through the FEH website (Vesuviano et al., 2025).

Overall, there were some small changes across the UK in growth curves and pooling-groups due to longer records on average, 24 new stations and the reclassifying of the FEH Indicative Suitability of a small number of stations. Single-site analysis was typically impacted most by new peak flow values above AMAX3, significant rating changes, or the inclusion or rejection of a large number of AMAX values as part of the period of record review.

The ungauged locations selected are representative of the gridded river network across Great Britain (covering all combinations of *AREA*, $BFIHOST_{19}$, *SAAR*, *FARL* and *FPEXT*), and as such predominantly consists of very small catchments, unlike the NRFA Peak Flow dataset. This leads to very different patterns in the differences between the results using V14 and V15 as potential donors and pooling-group members on the ungauged dataset. This is to be expected.

2. Differences in catchment descriptors

Between V15 and V14, there were no unexpected changes found in FEH catchment descriptors. As such, there are essentially no changes in the catchment-descriptor estimates of *QMED*, or any urban adjustments.

3. Differences in single-site analysis

This section documents changes in single-site (not Enhanced single-site) analysis of FEH statistics.

Between V14 and V15, most stations gained one extra year of record (as expected), though a small number of stations had some periods excluded or re-included from AMAX analysis due to a period of record review or similar. These are documented in the main NRFA V15 release note.

3.1 Changes in record length

Very little changed between V14 and V15 in terms of record length (most stations gained one extra year of record as expected). Stations with larger changes in record length are shown in Figure 1, with more details provided in the NRFA V15 release note (NRFA, 2026).

Average pooling group size is similar between the two versions (Figure 1). A small number of cases have seen a decrease in pooling group size, but this this expected given group size depends on a fixed total of station-years.

Due to changes in record length and the introduction and removal of stations flagged as 'Suitable for Pooling', the average number of stations in pooling groups (using FEH 2025 Statistical Method for v14 and v15) has changed from 17.17 to 16.92 (mean difference -0.24). The median record length change is +1 year (range of -24 to +20) as shown in Figure 1 and Figure 2.

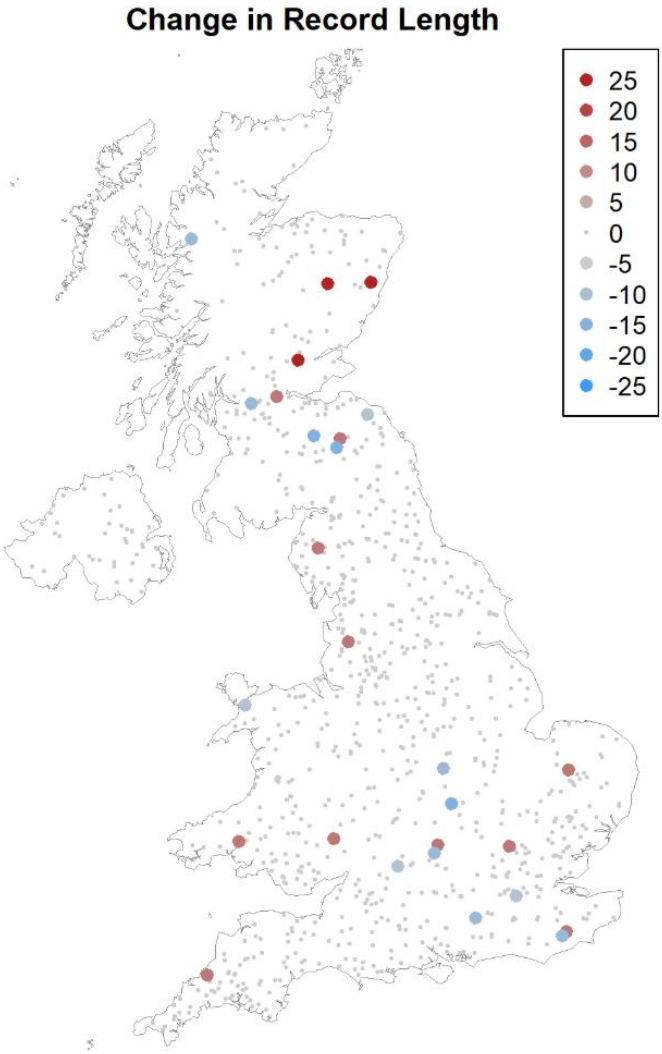


Figure 1: Change in record length (years) across NRFA stations.

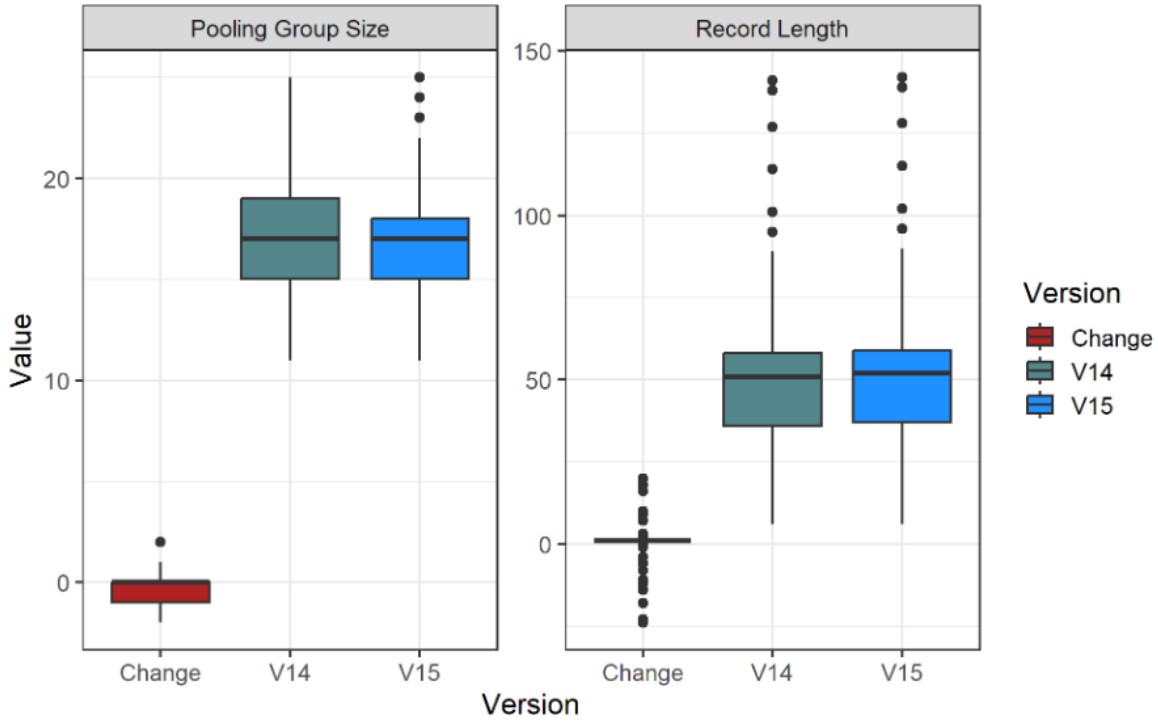


Figure 2: Boxplots showing pooling-group size and record length, and percentage change in these, split by NRFA version.

3.2 Changes in gauged *QMED*

See Figure 3 for changes in gauged *QMED* between V14 and V15. Specific changes (greater than 10%) are shown in Figure 5. A small number of stations saw a significant change in QMED due to rating changes, large AMAX or record length changes, but overall changes were small across the country.

There were no changes in $QMED_{CD}$, the estimate of *QMED* derived from catchment descriptors, because there were no changes in the underlying datasets from which the catchment descriptors were derived.

3.3 Changes in gauged (single-site) growth curve

The following figures show changes in the FEH growth curve, XT, which is equal to the flood frequency curve, QT, divided by QMED, based just on the scale and shape parameters of the fitted GLO distribution. They are linked by $\boldsymbol{Q_T = QMED \times X_T}$.

Changes in the growth curve are shown summarised in boxplots in Figure 3 and illustrated spatially (for changes above 10%) in Figure 4. A small number of stations saw a large change in growth curve, at the most extreme return period. The gauged changes in growth curve are mostly down to notable new AMAX values (above

AMAX3) which can affect the tails of the distribution, as well as rejections or introductions of periods of station records. Thirdly, rating changes enacted on the whole AMAX series can lead to notable changes in the flood frequency curve, especially if flow derivations increase in the upper tail under the new rating. These major changes are justified in the main NRFA V15 release note (NRFA, 2026).

Changes in at-site Q_T exceeding 10% can be seen across the network in Figure 5. Big changes in the gauged flood frequency curves are all a combination of the changes already documented with regards to changes in gauged *QMED* and changes in the growth curve. There is no obvious spatial pattern of compounding changes in both *QMED* and X_T.

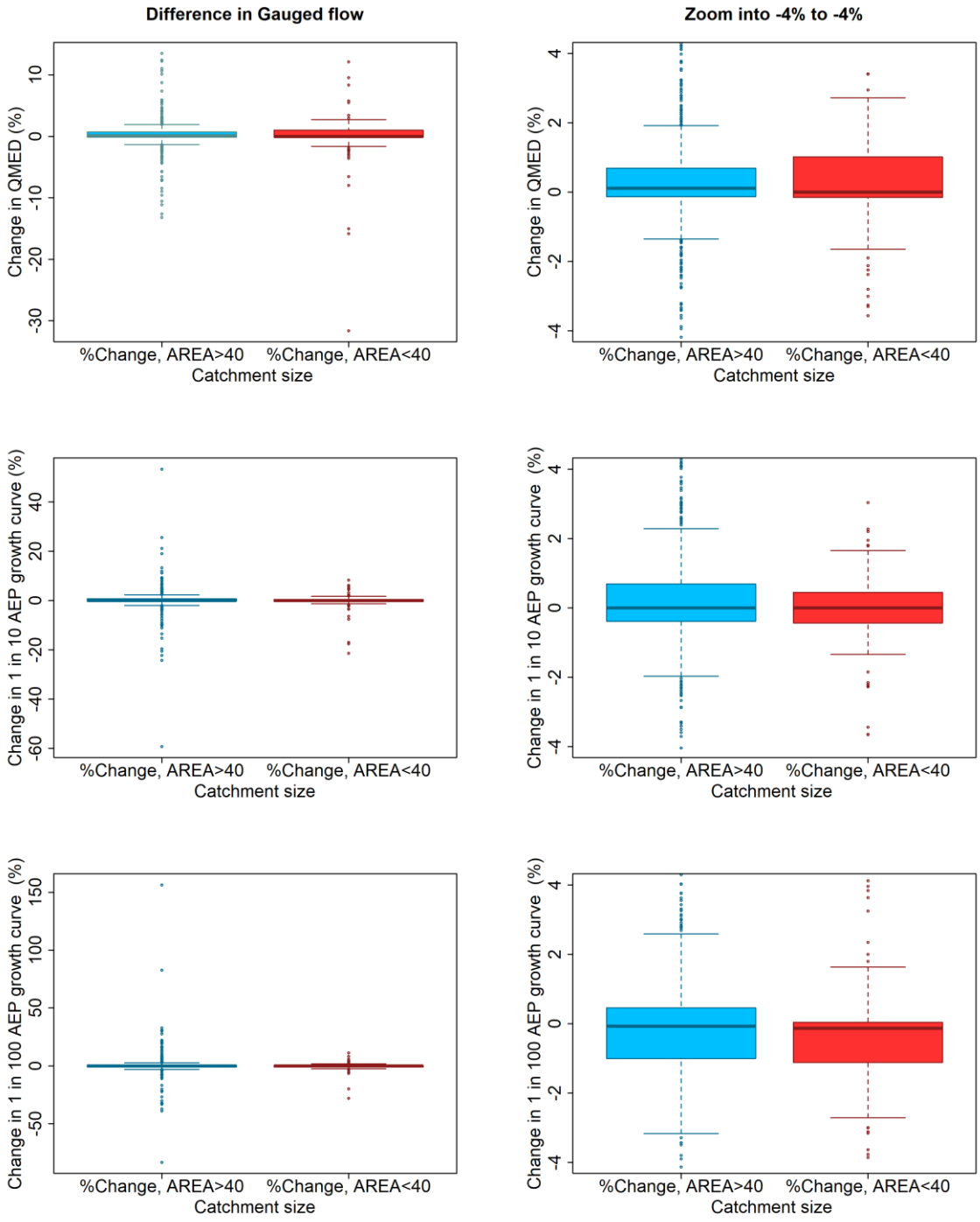


Figure 3: Box plots of differences in gauged *QMED* and growth curves (10% and 1% AEP), split by catchment size (Small < 40 km^2).

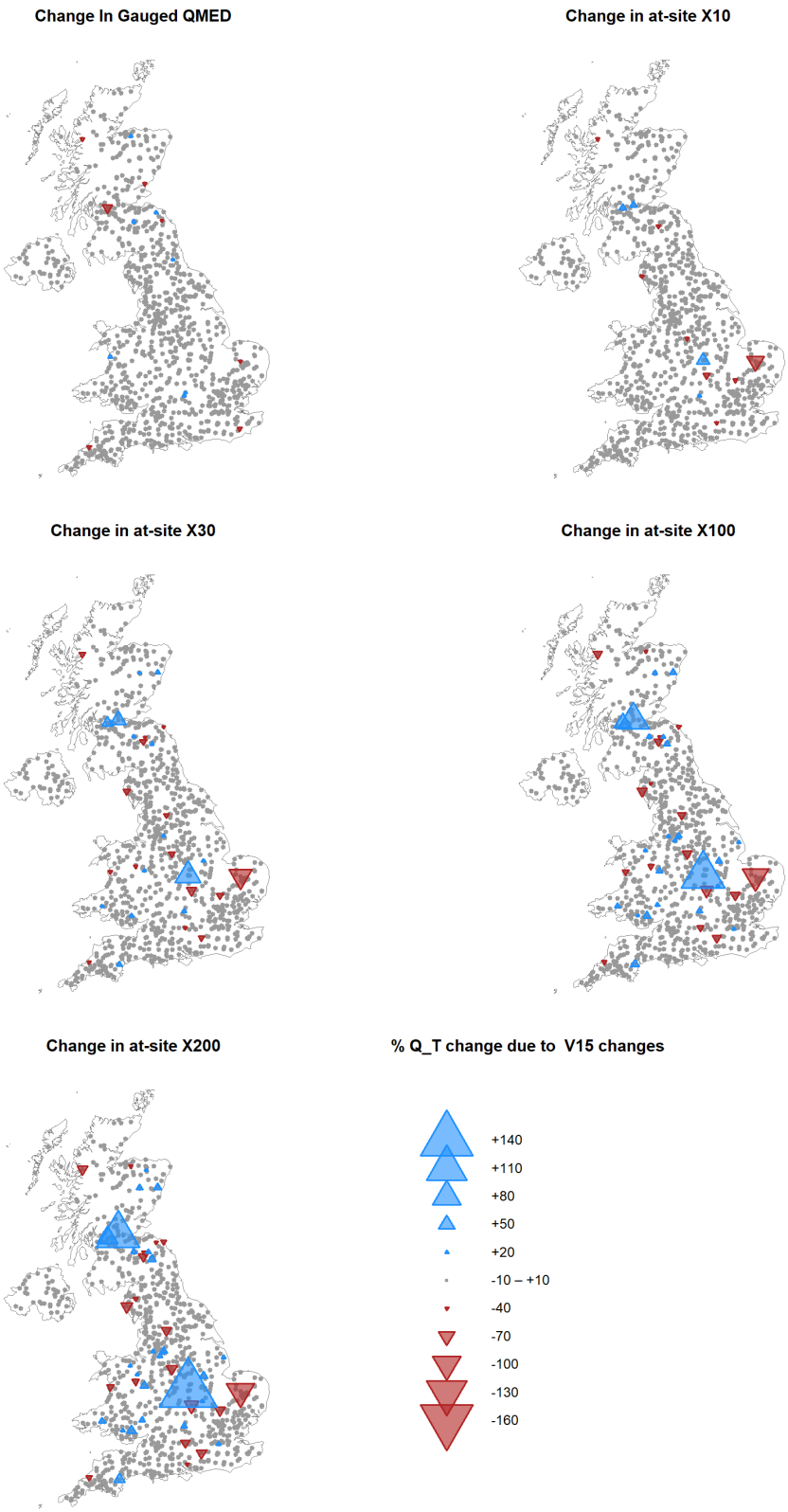


Figure 4: Changes in at-site (single-site) estimates of flood frequency growth factors at NRFA stations (50%, 10%, 3.33%, 1% and 0.5% AEP).

3.4 Changes in flood frequency curve

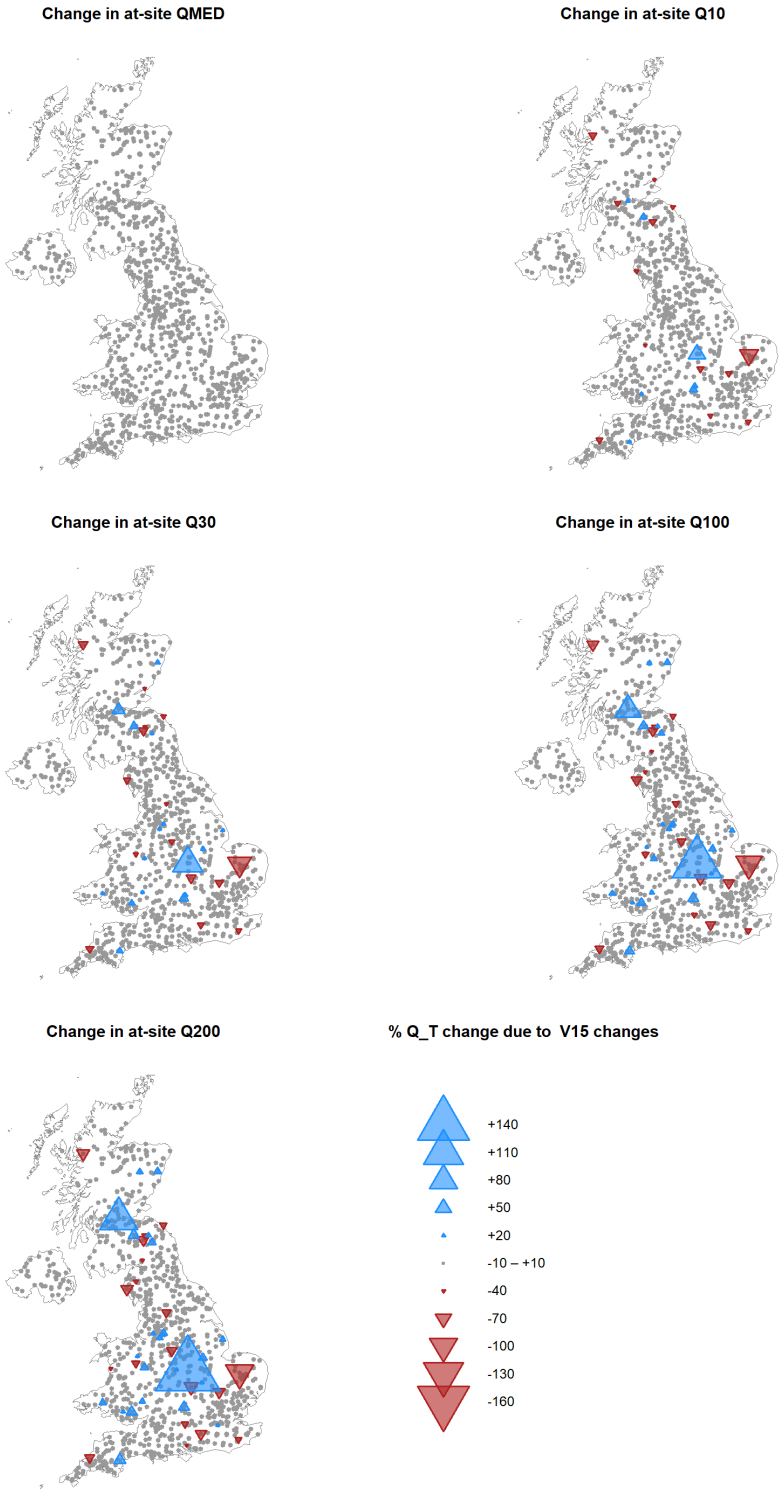


Figure 5: Changes in at-site (single-site) estimates of flood frequency return levels (50%, 10%, 3.33%, 1% and 0.5% AEP) at NRFA stations.

4. Differences in Donor adjustment

Donor-adjustment, as developed by Vesuviano and Griffin (2025) and implemented in WINFAP 5.3 and, uses the eight nearest "suitable for *QMED*" (including "suitable for pooling") stations to improve the $QMED_{CD}$ estimate assuming spatially consistent errors between gauged *QMED* and $QMED_{CD}$. In this report, donors are always those chosen as in WINFAP 5.3, without changes.

The main changes between V14 and V15 donor-adjusted *QMED* at NRFA stations are due to:

- the addition of 9 new "Suitable for pooling" stations,
- 15 new "Suitable for *QMED*" stations,
- the removal of one "Suitable for *QMED*" station,
- 2 stations downgraded from "Suitable for QMED" to "Suitable for Neither",
- 4 stations downgraded from "Suitable for Pooling" to "Suitable for QMED"
- 1 station upgraded from "Suitable for QMED" to "Suitable for Pooling"
- 1 station upgraded from "Suitable for Neither" to "Suitable for QMED"
- changes in gauged *QMED* at existing stations.

27 stations exhibited a change of more than 10% in donor-adjusted QMED (Figures 6 and 7). The majority of these 27 changes are due to the addition of new stations to the Peak Flow Dataset. Some of these new stations, particularly in hydrometric areas 38 and 39, have small catchment areas (< 40 km^2) and high baseflow (> 0.7 $BFIHOST19_{SCALED}$). In these cases, the catchment-descriptor QMED underestimates significantly, and this impacts all the stations in the nearby area.

In the sample of representative ungauged sites (see Appendix), the predominantly small catchments lead to overall small changes in donor-adjusted *QMED*, with no changes above 10% in donor-adjusted *QMED*. Similar overall patterns were seen in the ungauged and gauged data (Figure 7).

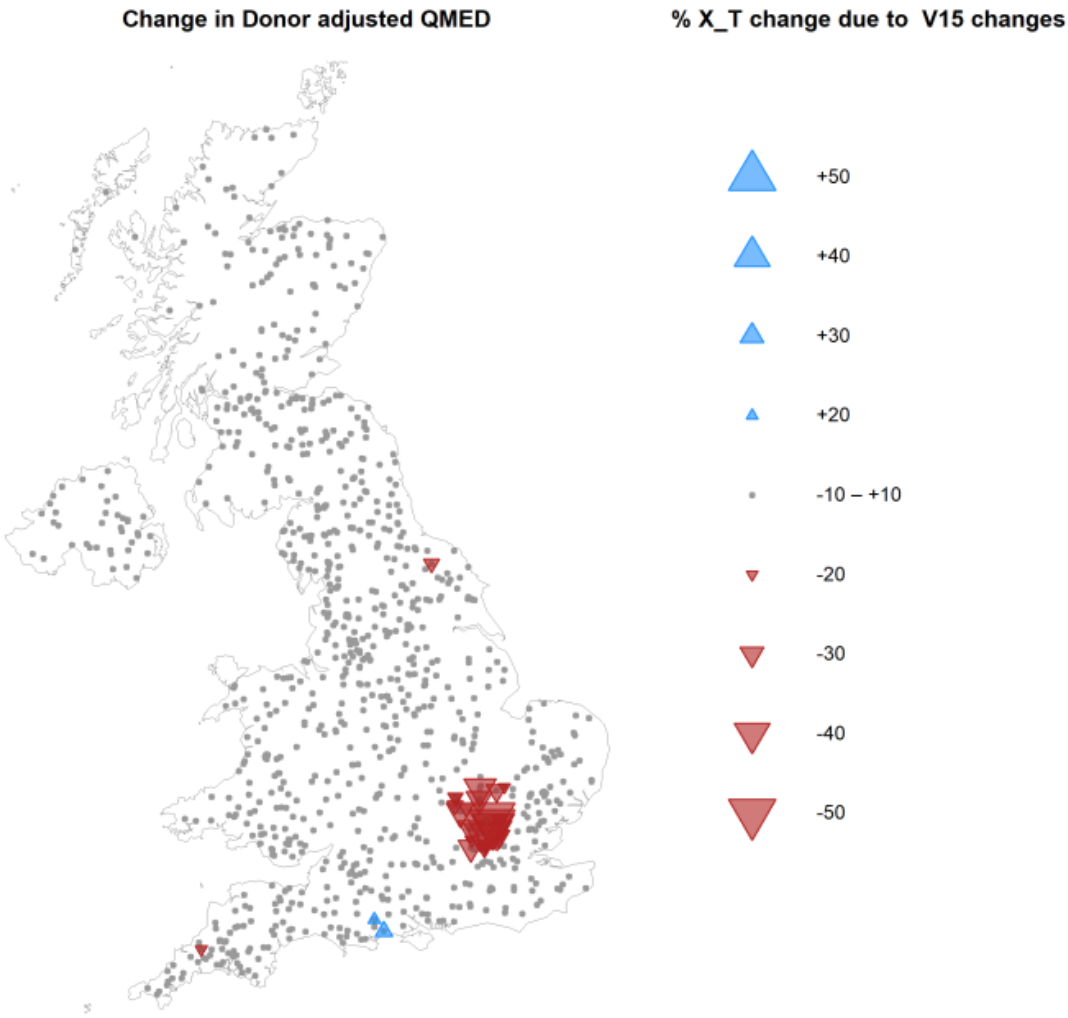


Figure 6: Change in donor adjusted QMED at NRFA gauging stations.

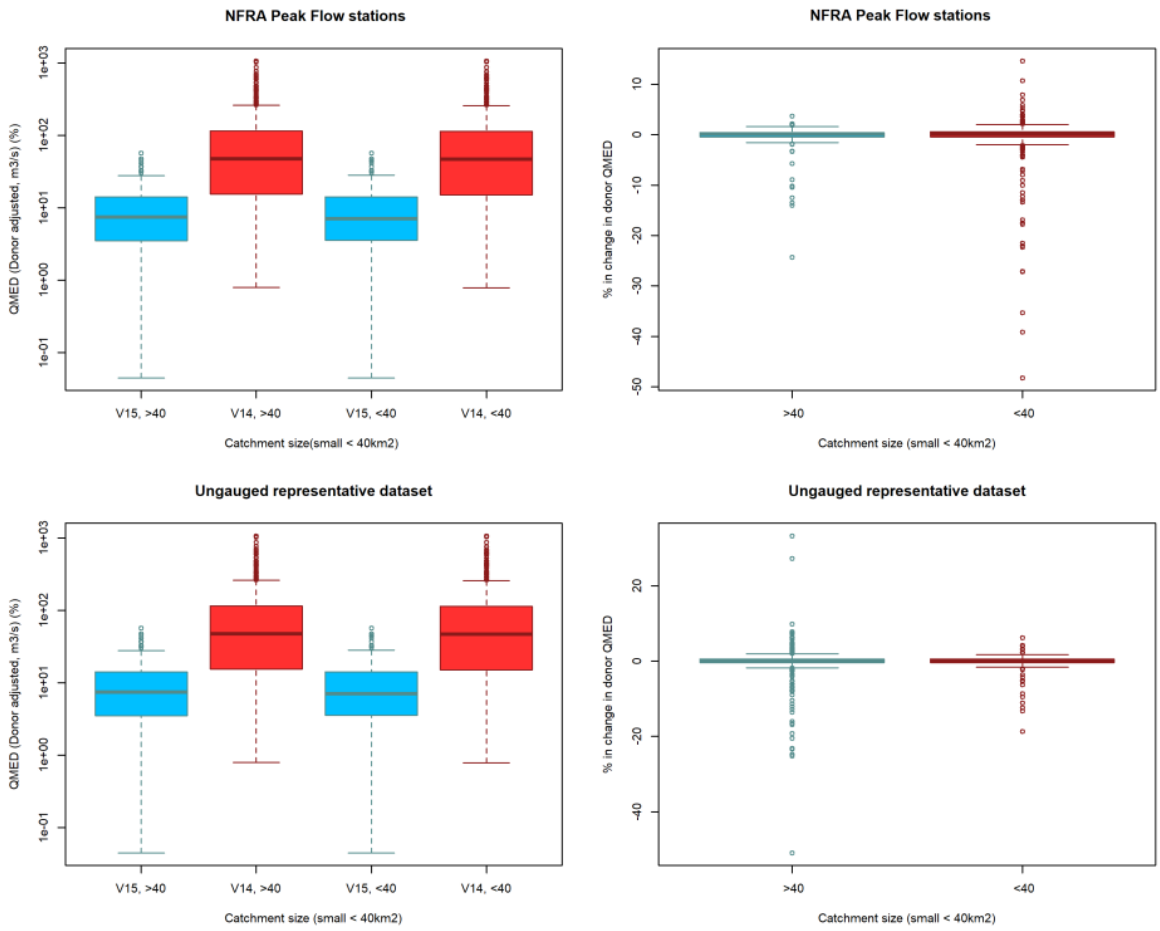


Figure 7: Boxplots highlighting differences between donor-adjusted *QMED* in NRFA stations and ungauged locations.

5. Differences in pooled flood frequency

Pooling uses hydrologically similar catchments to generate a set of at least 800 station-years, which is used to generate weighted average estimates of *L*-moment ratios for parameterising a Generalised Logistic distribution for calculating return levels of specified exceedance probabilities. Other distributions are available, but need justification to use.

In the following, default pooling-groups are used as derived using the FEH 2025 Statistical Method in WINFAP 5.3 (Wallingford HydroSolutions, 2025).

Nearly all major changes in pooled flood frequency at NRFA stations are due to the addition of 10 stations which are now “Suitable for Pooling” (new or change in suitability).

5.1 Changes in pooling-groups

Tables 1 to 4 show the most commonly pooled stations in V14 and in V15 for the NRFA stations and for the ungauged dataset. Percentages indicate the number of pooling groups a listed station is part of (e.g. 21026 is in 7.99% of pooling groups of NRFA stations). The changes between the most common pooling-group members are either due to the addition of new NRFA “Suitable for pooling” catchments, or to the overall increase in average record length leading to small adjustments of pooling-group size.
Note that the FEH 2025 Statistical method puts less emphasis on area, due to emphasis on other descriptors, and so the smaller catchments align less strongly than under older approaches.

Table 1: Most commonly "pooled" stations in V14 and V15 for gauged NRFA stations. Small indicates catchment area < 40km^2. Percentages indicate fraction of pooling groups of NRFA stations the listed station is included in.

V15	% pools	notes	V14	% pools	notes
21026	7.99	Small	21026	7.80	Small
84020	7.13	Not Small	84020	6.85	Not Small
54025	6.70	Not Small	54025	6.53	Not Small
57014	6.70	Not Small	57014	6.53	Not Small
72007	6.70	Small	76014	6.32	Not Small
76014	6.48	Not Small	28053	6.22	Not Small
28053	6.37	Not Small	27095	6.01	Not Small
83010	6.26	Not Small	7011	6.01	Small
28082	6.16	Not Small	72007	6.01	Small
7012	6.16	Small	83010	6.01	Not Small
71013	6.16	Small	28082	5.90	Not Small
21017	5.94	Small	53017	5.90	Not Small
48004	5.94	Small	7012	5.90	Small
53017	5.94	Not Small	71013	5.90	Small
27095	5.83	Not Small	44003	5.80	Not Small
69044	5.83	Not Small	48004	5.80	Small
84035	5.83	Small	69044	5.80	Not Small
28035	5.72	Not Small	84035	5.80	Small
44003	5.72	Not Small	28035	5.69	Not Small
44011	5.72	Not Small	39028	5.69	Not Small
48011	5.72	Not Small	44011	5.69	Not Small
39028	5.62	Not Small	48011	5.69	Not Small
54011	5.62	Not Small	49004	5.58	Not Small
63001	5.62	Not Small	63001	5.58	Not Small
7011	5.62	Small	21017	5.48	Small

Table 2: Most commonly "pooled" stations in V14 and V15 for NRFA stations with area above 40 km^2.

V15	% pools	notes	V14	% pools	notes
21026	8.21	Small	28053	7.43	Not Small
84020	7.31	Not Small	28082	7.05	Not Small
72007	6.92	Small	69044	6.93	Not Small
76014	6.79	Not Small	28035	6.8	Not Small
28053	6.54	Not Small	48011	6.8	Not Small
57014	6.28	Not Small	39028	6.68	Not Small
28082	6.15	Not Small	63001	6.68	Not Small
54025	6.15	Not Small	54011	6.42	Not Small
7012	6.15	Small	68005	6.42	Not Small
21017	5.9	Small	83010	6.3	Not Small
71013	5.9	Small	13012	6.3	Not Small
84014	5.9	Not Small	76014	6.17	Not Small
25012	5.77	Small	25020	6.17	Not Small
83010	5.64	Not Small	53013	6.17	Not Small
48011	5.64	Not Small	84014	6.17	Not Small
37016	5.64	Not Small	15013	6.17	Not Small
48004	5.64	Small	43014	6.05	Not Small
55004	5.64	Not Small	54004	6.05	Not Small
28035	5.51	Not Small	57014	5.92	Not Small
39028	5.51	Not Small	71008	5.92	Not Small
63001	5.51	Not Small	7010	5.92	Not Small
84035	5.51	Small	84020	5.79	Not Small
46005	5.51	Small	3002	5.79	Not Small
68005	5.51	Not Small	47004	5.79	Not Small
25020	5.38	Not Small	25004	5.67	Not Small

Table 3: List of most commonly "pooled" stations in V14 and V15 for ungauged locations.

V15	% pools	notes	V14	% pools	notes
21026	8.21	Small	28053	7.43	Not Small
84020	7.31	Not Small	28082	7.05	Not Small
72007	6.92	Small	69044	6.93	Not Small
76014	6.79	Not Small	28035	6.8	Not Small
28053	6.54	Not Small	48011	6.8	Not Small
57014	6.28	Not Small	39028	6.68	Not Small
28082	6.15	Not Small	63001	6.68	Not Small
54025	6.15	Not Small	54011	6.42	Not Small
7012	6.15	Small	68005	6.42	Not Small
21017	5.9	Small	13012	6.3	Not Small
71013	5.9	Small	83010	6.3	Not Small
84014	5.9	Not Small	15013	6.17	Not Small
25012	5.77	Small	25020	6.17	Not Small
37016	5.64	Not Small	53013	6.17	Not Small
48004	5.64	Small	76014	6.17	Not Small
48011	5.64	Not Small	84014	6.17	Not Small
55004	5.64	Not Small	43014	6.05	Not Small
83010	5.64	Not Small	54004	6.05	Not Small
28035	5.51	Not Small	57014	5.92	Not Small
39028	5.51	Not Small	7010	5.92	Not Small
46005	5.51	Small	71008	5.92	Not Small
63001	5.51	Not Small	3002	5.79	Not Small
68005	5.51	Not Small	47004	5.79	Not Small
84035	5.51	Small	84020	5.79	Not Small
25020	5.38	Not Small	25004	5.67	Not Small

Table 4: List of most commonly "pooled" stations in V14 and V15 for ungauged locations with catchment area above 40 km^2.

V15	% pools	notes	V14	% pools	notes
84020	7.31	Not Small	28082	7.05	Not Small
76014	6.79	Not Small	28035	6.8	Not Small
28053	6.54	Not Small	48011	6.8	Not Small
57014	6.28	Not Small	39028	6.68	Not Small
28082	6.15	Not Small	63001	6.68	Not Small
54025	6.15	Not Small	54011	6.42	Not Small
84014	5.9	Not Small	15013	6.17	Not Small
37016	5.64	Not Small	53013	6.17	Not Small
48011	5.64	Not Small	84014	6.17	Not Small
55004	5.64	Not Small	43014	6.05	Not Small
83010	5.64	Not Small	54004	6.05	Not Small
28035	5.51	Not Small	57014	5.92	Not Small
39028	5.51	Not Small	7010	5.92	Not Small
63001	5.51	Not Small	3002	5.79	Not Small
68005	5.51	Not Small	47004	5.79	Not Small
25020	5.38	Not Small	25004	5.67	Not Small

5.2 Changes in pooled growth curves

Figure 8 and Figure 9 show changes in pooled growth curve (and donor-adjusted *QMED* for reference) for the NRFA stations (Figure 8) and the ungauged dataset (Figure 9). The overall differences between versions V14 and V15 are very small due to the high similarity between the two datasets.

These changes are mapped in Figure 10, showing large changes in pooled growth curves for NRFA stations (differences above 10%). Figure 11 shows the same for ungauged catchments: note there were no large changes in this dataset. The biggest differences are only seen for the more extreme growth curve values, incurred due to very large AMAX values (above AMAX3) at a small number of stations across the network, highlighted in the main NRFA V15 release note. These large values only impact the upper tail of the flood frequency distribution.

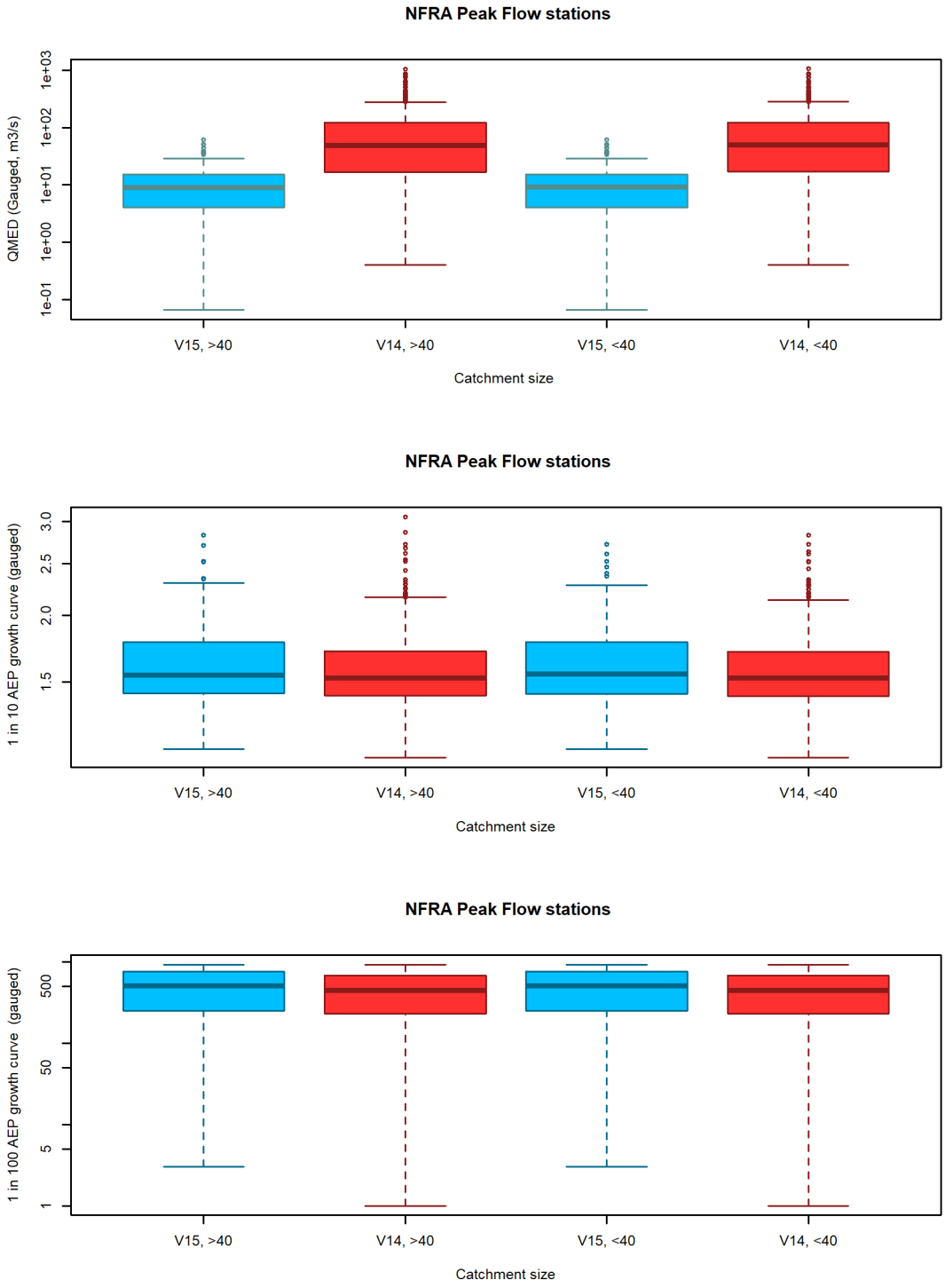


Figure 8: Boxplots of changes in pooled flood frequency growth curves (QMED, 10% and 1% AEP) between NRFA Peak Flow versions for NRFA stations, split by catchment size (Small < 40 km^2).

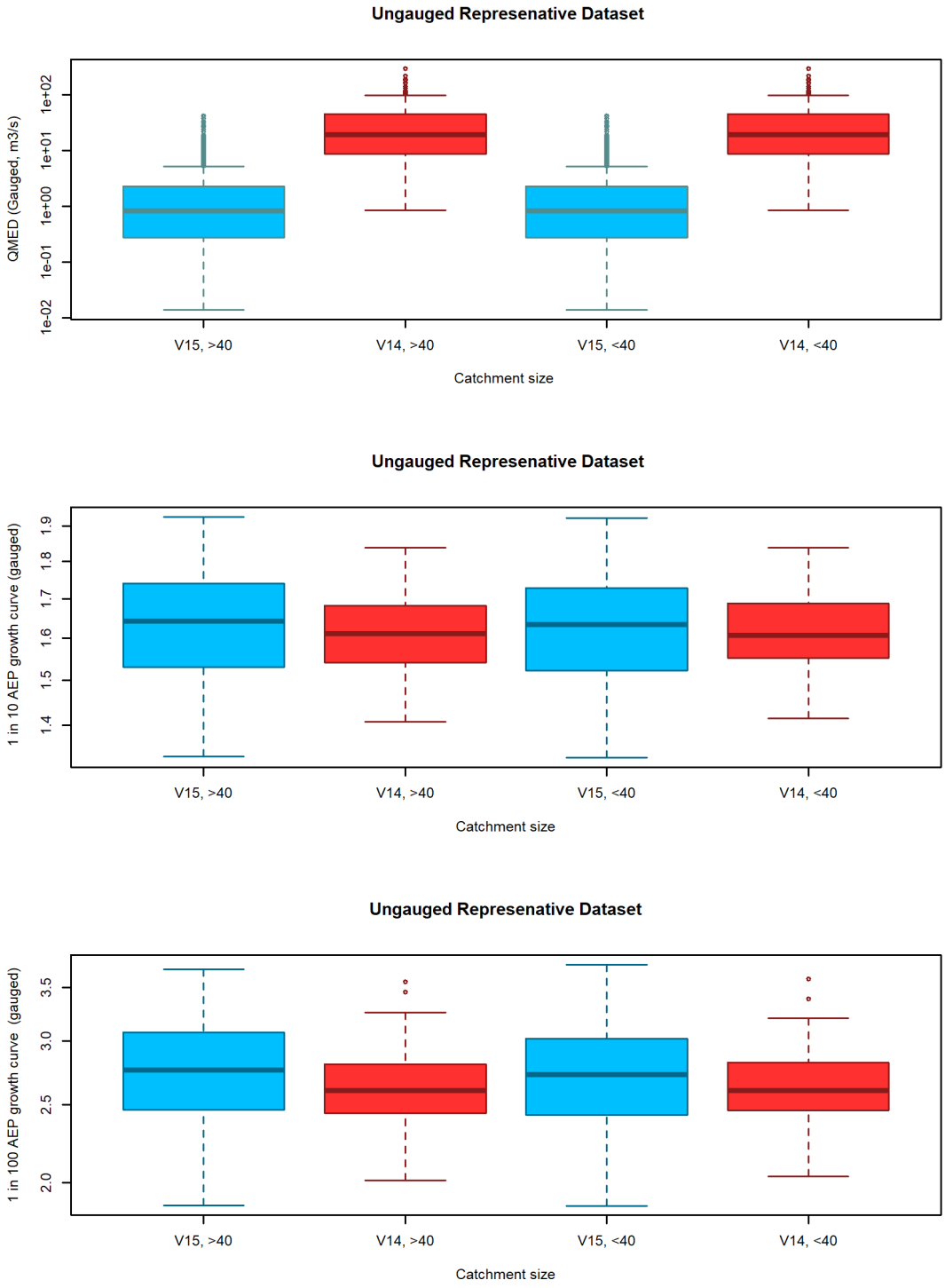


Figure 9: Boxplots of changes in pooled flood frequency growth curves (QMED, 10% and 1% AEP) between NRFA Peak Flow versions for ungauged stations, split by catchment size (Small < 40 km^2).

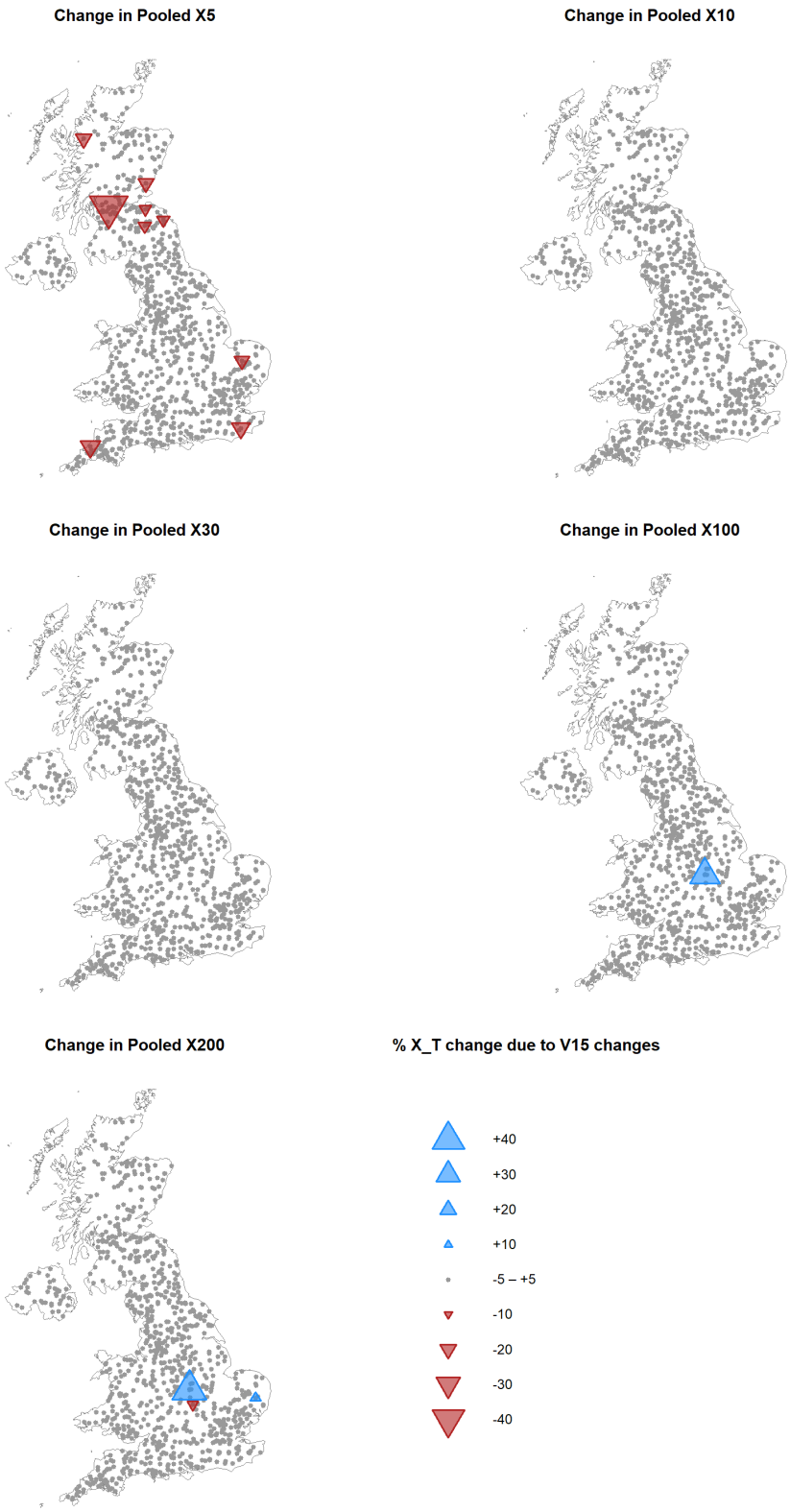


Figure 10: Changes in pooled estimates of flood frequency growth curves (20%, 10%, 3.33% 1%, 0.5% AEP) at NRFA stations.

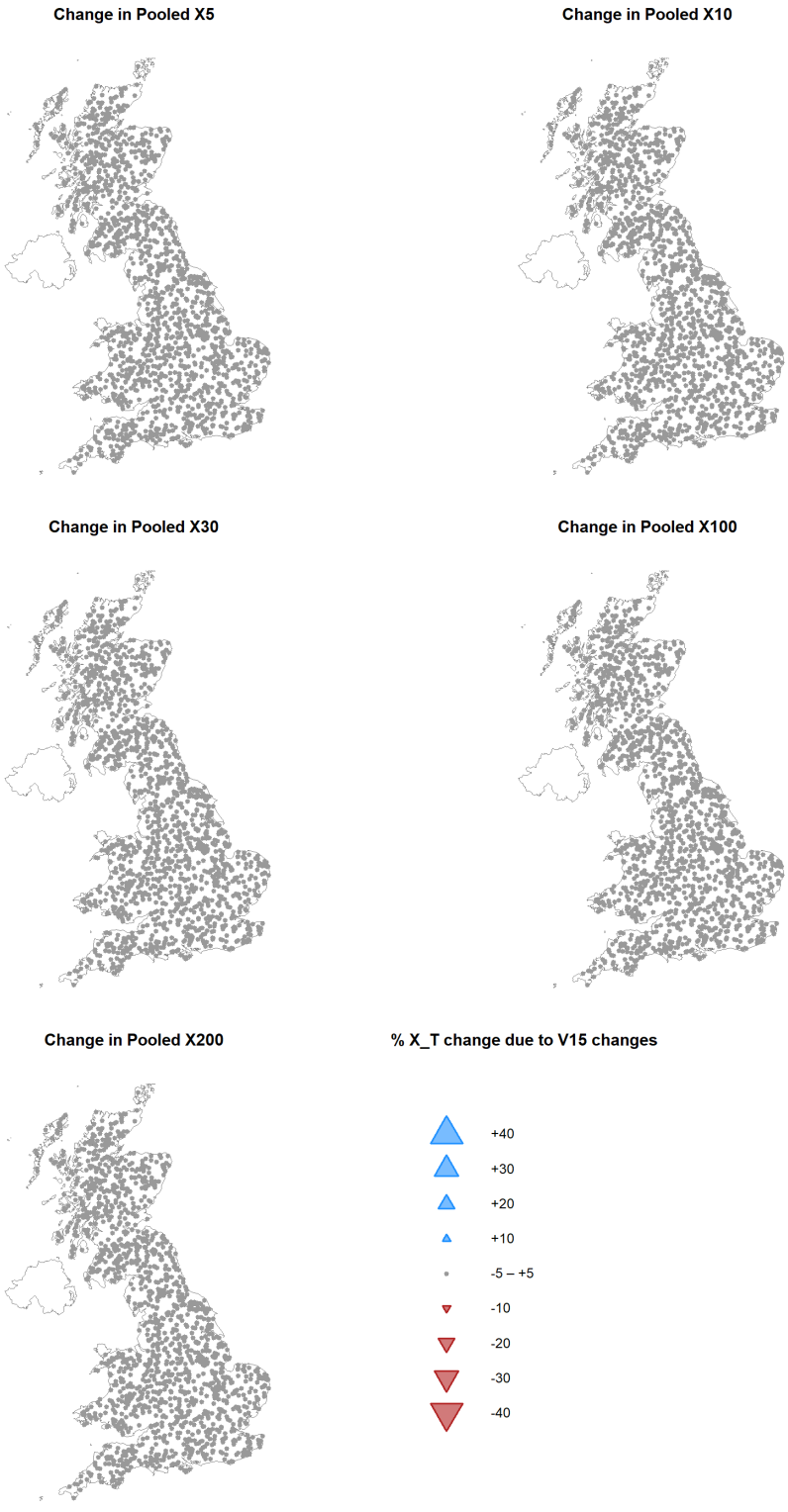
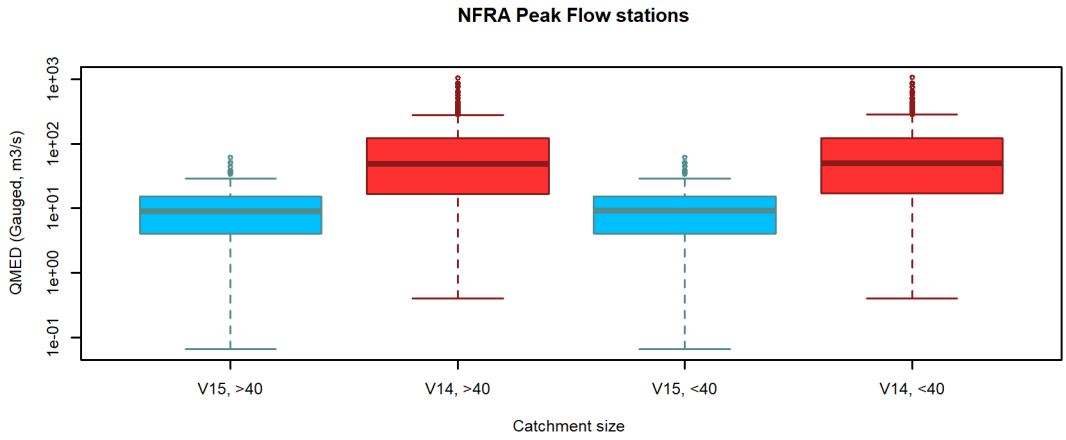
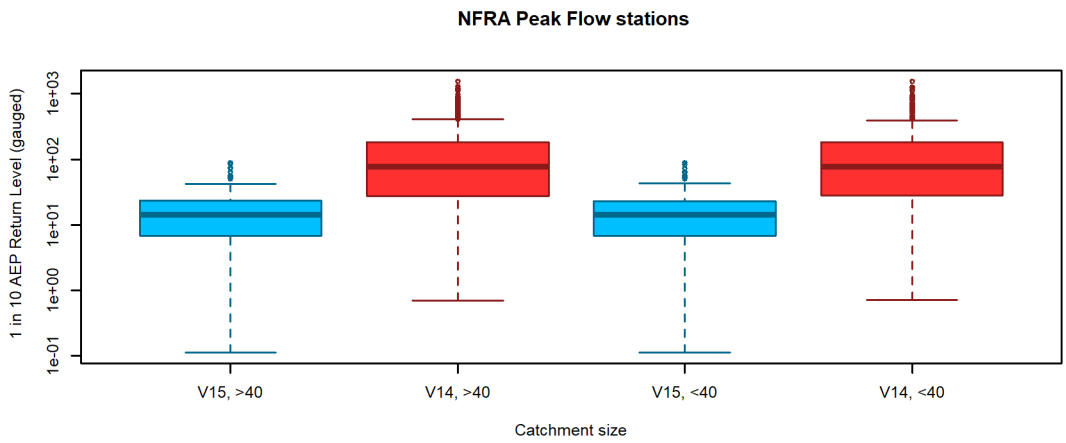


Figure 11: Changes in pooled estimates of flood frequency growth curves at ungauged locations. (20%, 10%, 3.33% 1%, 0.5% AEP) All the changes are under + 10 and above -10%.

5.3 Changes in flood frequency curves

Figure 12 and Figure 13 show changes in pooled return levels (Q_T) (and donor-adjusted *QMED* for reference) for the NRFA stations (Figure 12) and the ungauged dataset (Figure 13). The overall differences between versions V14 and V15 are very small due to the overall high similarity between the two datasets. Figure 14 shows large changes in pooled return levels for NRFA stations (differences above 10%). Figure 15 shows the same for ungauged catchments. The patterns fit with the previous sections regarding the different effects of the growth curve and the estimates of *QMED*, since the final pooled estimates are the product of donor-adjusted QMED and pooled growth curves.





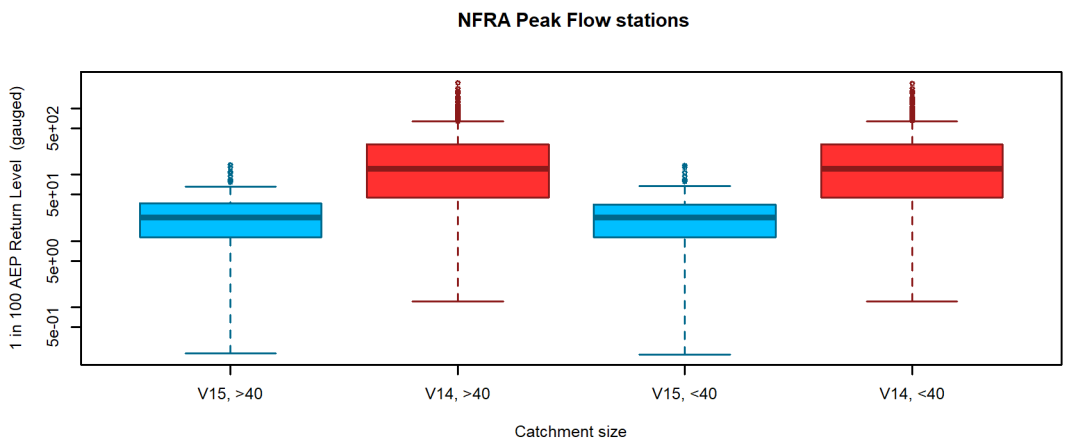


Figure 12: Boxplots of changes in pooled flood frequency return levels (QMED, 10%, 1% AEP) between NRFA Peak Flow versions for NRFA stations, split by catchment size (Small < 40 km^2).

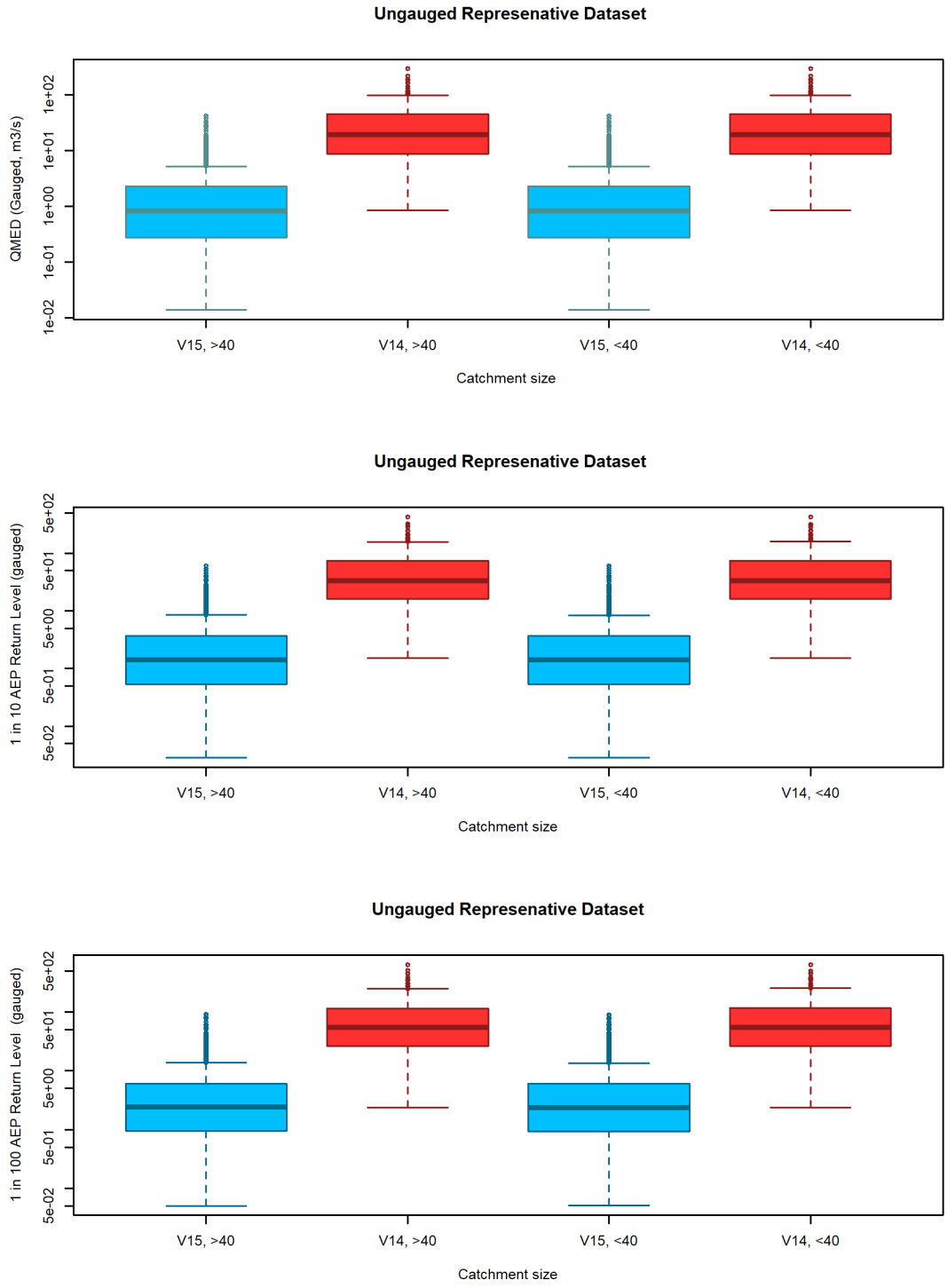


Figure 13: Boxplots of changes in pooled flood frequency return levels (QMED, 10%, 1%, AEP) between NRFA Peak Flow versions for ungauged locations, split by catchment size (Small < 40 km^2).

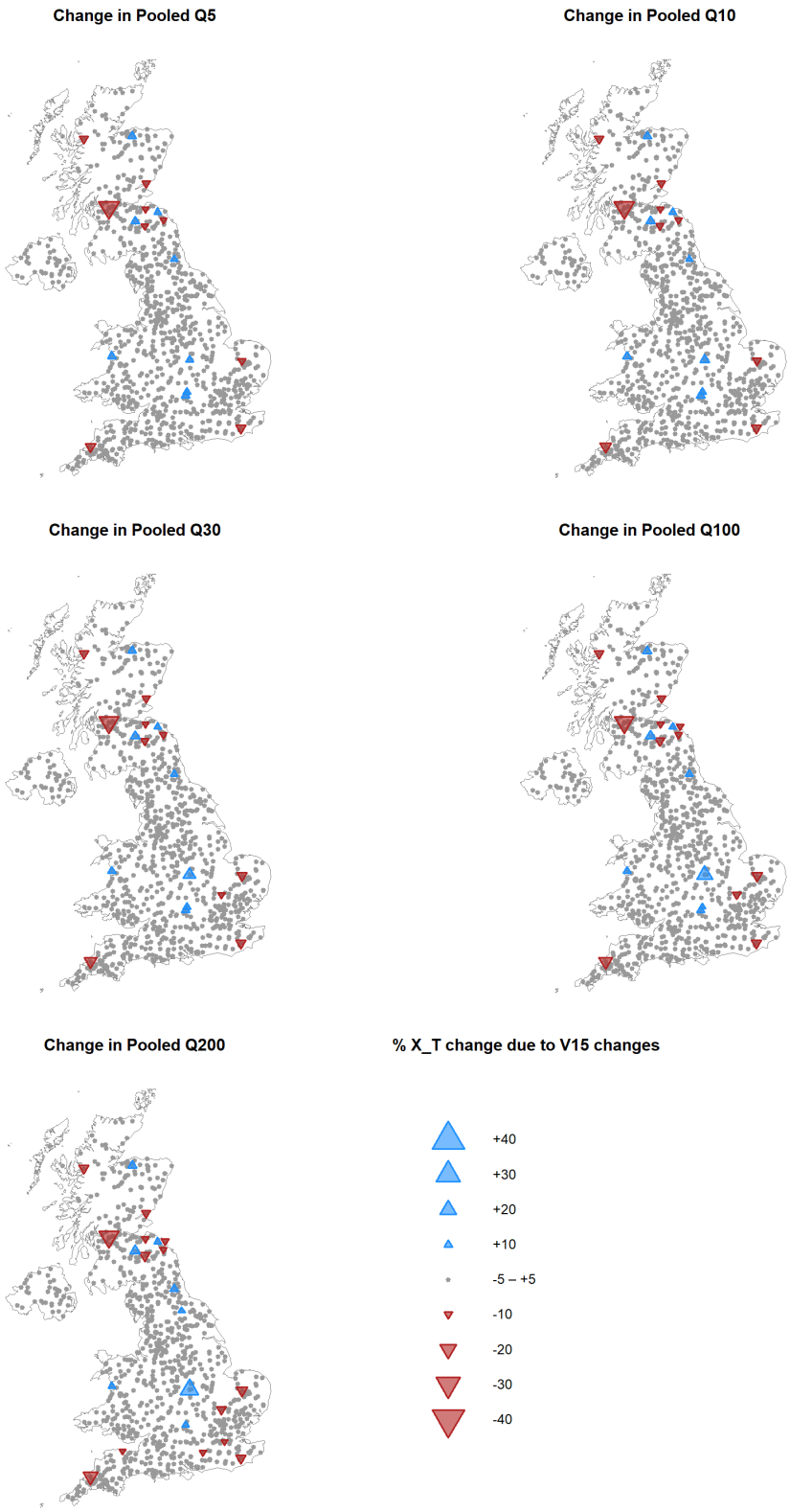


Figure 14: Changes in pooled estimates of flood frequency return levels at NRFA stations.

Figure 15: Changes in pooled estimates of flood frequency return levels at ungauged locations.

6. Conclusions

Overall, there were no unexpected or inexplicable changes between the two datasets in terms of flood frequency estimation. There were a small number of large changes in the 10-year and rarer return period estimates at places that either experienced large AMAX events, or had pooling-group members that experienced such events.

References

Kjeldsen, T. R., Jones, D. A. & Bayliss, A. C. (2008). Improving the FEH statistical procedures for flood frequency estimation (Science Report SC050050). Joint Defra/ Environment Agency Flood and Coastal Erosion Risk Management R&D Programme. Environment Agency, Bristol.

Kjeldsen, T. R., Jones, D. A. & Morris, D. G. (2014). Using multiple donor sites for enhanced flood estimation in ungauged catchments. Water Resources Research, 50(8), 6646–6657. doi:10.1002/2013WR015203

NRFA Peak Flow Dataset – Version 14 (2026) https://nrfa.ceh.ac.uk/peak-flow-dataset [Last Accessed 2026-07-20]. National River Flow Archive, Wallingford.

NRFA Peak Flow Dataset – Version 15 (2026) https://nrfa.ceh.ac.uk/peak-flow-dataset [Last Accessed 2026-07-20]. National River Flow Archive, Wallingford.

Robson, A. & Reed, D. (1999). Statistical procedures for flood frequency estimation (Vol. 3). Institute of Hydrology, Wallingford.

Vesuviano, G., Wallbank, J., Griffin, A., Miller, J. 2025. New FEH Catchment Descriptors 2025: Updates to FARL, SAAR, URBEXT and BFIHOST. UK Centre for Ecology & Hydrology, Wallingford, UK. Available from: https://www.ceh.ac.uk/services/feh-2025-statistical-updates

Vesuviano, G., Griffin, A. 2025. The FEH 2025 Statistical Method Update. UK Centre for Ecology & Hydrology, Wallingford, UK. Available from: https://www.ceh.ac.uk/services/feh-2025-statistical-updates

Vesuviano, G., Griffin, A. & Stewart, E. (2024) Estimating flood peaks and hydrographs for small catchments: R5 – pooling-group formation for small catchments (SC090031/R5). FCERM Research and Development Programme. https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/review-of-methodology-for-estimating-flood-peaks-and-hydrographs-for-small-catchments [Last Accessed: 2024-08-16]. Environment Agency, Bristol.

Wallingford HydroSolutions (2024). WINFAP 5.3 Documentation. https://winfapdocs.hydrosolutions.co.uk/Introduction/ [Last Accessed: 2024-08-14]. Wallingford HydroSolutions, Wallingford.

Distribution of catchment descriptors in ungauged dataset

Although this report does not go into the derivation of the ungauged dataset in-depth (this can be requested from the FEH team), Figure 16 shows the distribution several catchment descriptors for the IHDTM river network in Great Britain.

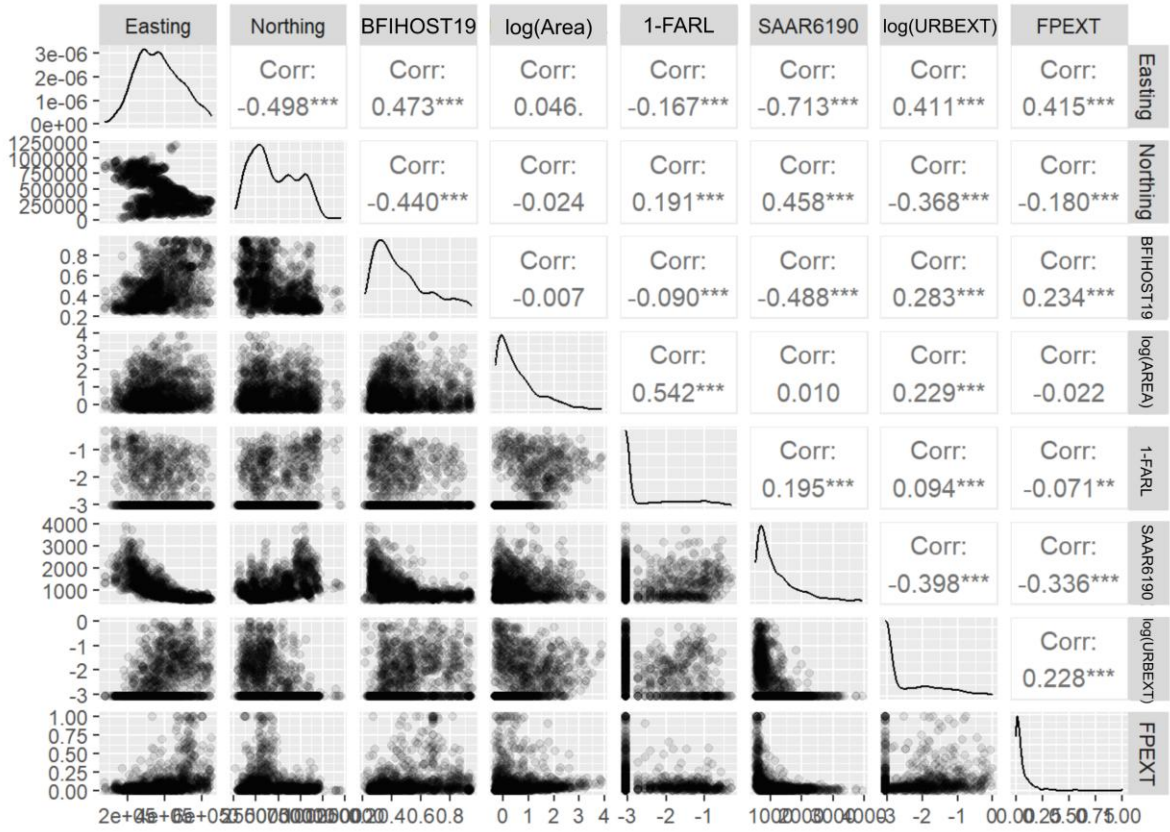


Figure 16: Distribution of catchment descriptors across the IHDTM river network in Great Britain.

Contact

enquiries@ceh.ac.uk

@UK_CEH

ceh.ac.uk

Bangor

UK Centre for Ecology & Hydrology
Environment Centre Wales
Deiniol Road
Bangor
Gwynedd
LL57 2UW

+44 (0)1248 374500

Edinburgh

UK Centre for Ecology & Hydrology
Bush Estate
Penicuik
Midlothian
EH26 0QB

+44 (0)131 4454343

Lancaster

UK Centre for Ecology & Hydrology
Lancaster Environment Centre
Library Avenue
Bailrigg
Lancaster
LA1 4AP

+44 (0)1524 595800

Wallingford (Headquarters)

UK Centre for Ecology & Hydrology
Maclean Building
Benson Lane
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

+44 (0)1491 838800

UK Centre for Ecology & Hydrology