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Article

Importance of Flood Samples for Estimating Sediment and Nutrients Loads in Mediterranean Rivers

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In Figure S1, the 2010-2020 ranked flow curve is plot in blue and the sampled flows in red. These plots clearly show the differences in water conditions between the rivers. The Berre is the river with the widest range of high flows, over three orders of magnitude. In contrast, the Arc has a low range of variation in high flows (only one order of magni-tude). Several rivers have many zero flow values (i.e., no values in the right part of the curves in log scale).

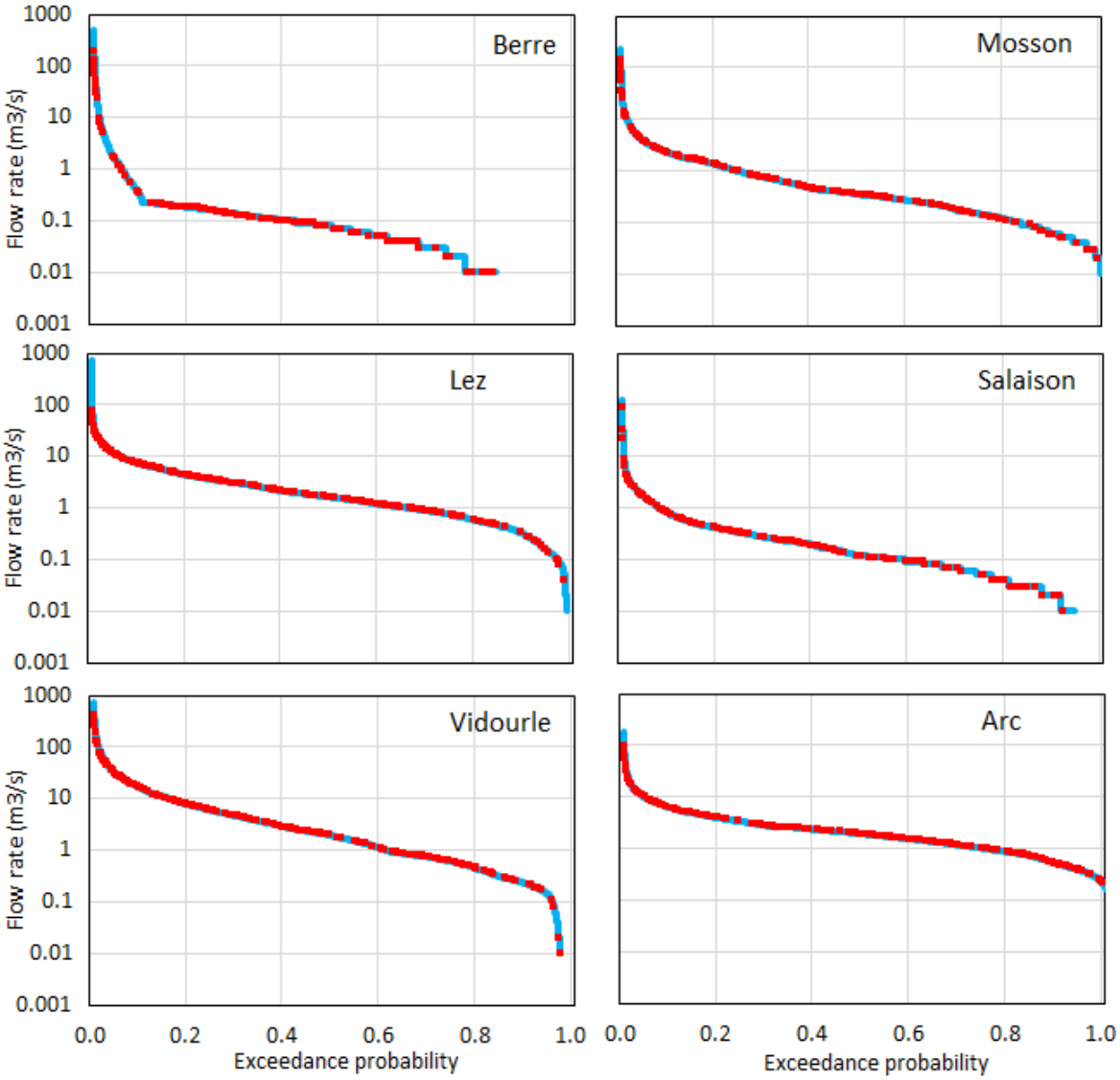

Figure S1. Comparison of the flows sampled during the quality monitoring (in red) with the flows observed during the last ten years (in blue).

The next figures show the annual specific fluxes (in tons/km²) of total suspended solids, total nitrogen and total phosphorus calculated with the Flow Weighted Mean Concentration (FWMC) method and the Flow Duration Rating Curves (FDRC) method. Figure S2 shows the sediment loads calculated with the FWMC method. The annual loads are very variable from one river to another and from one year to another. The annual specific loads are sometimes very high, exceeding 100 tons/km² in 8 cases out of 30. They are also sometimes very low, less than 20 tons/km² in 13 cases out of 30.

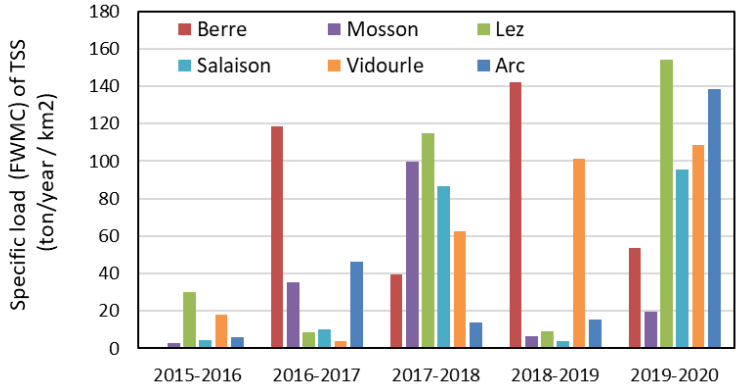

Figure S2. Specific load (ton/year / km²) of total suspended solids calculated on the six watersheds by the Flow Weighted Mean Concentration (FWMC) method.

Figure S3 shows the sediment loads calculated with the FDRC method. These annual loads are very different to those calculated with the FWMC method. The annual specific loads rarely exceed 20 tons/km². Only the Arc shows a high load during the 2019-2020 year reaching 80 tons/ km². This very high load calculated for the Arc in 2019-2020 is due to the important occurrence of floods which resulted in high effective rainfall too.

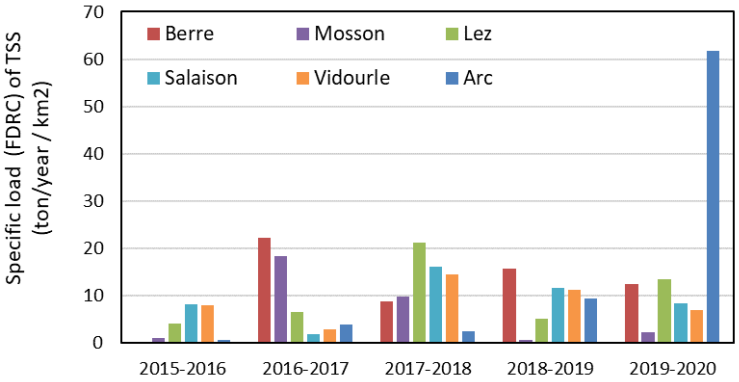

Figure S3. Specific load (ton/year / km²) of total suspended solids calculated on the six watersheds by the Flow Duration Rating Curves (FDRC) method.

Figures S4 and S5 show the total phosphorus loads calculated with both methods. Results of the total phosphorus are presented before those of the total nitrogen because of their similarity to the sediments loads. Indeed, patterns of Figure S4 and Figure S2 are close, as well between Figure S5 and Figure S3. Actually, particulate phosphorus accounts for a high fraction of phosphorus loads in rivers because of the strong affinity between orthophosphate (the major dissolved form of phosphorus) and particulates. Phosphorus annual loads calculated by FWMC exceed 0.1 ton/km² in four cases out of 30, and are between 0.05 and 0.1 ton/km² in seven cases.

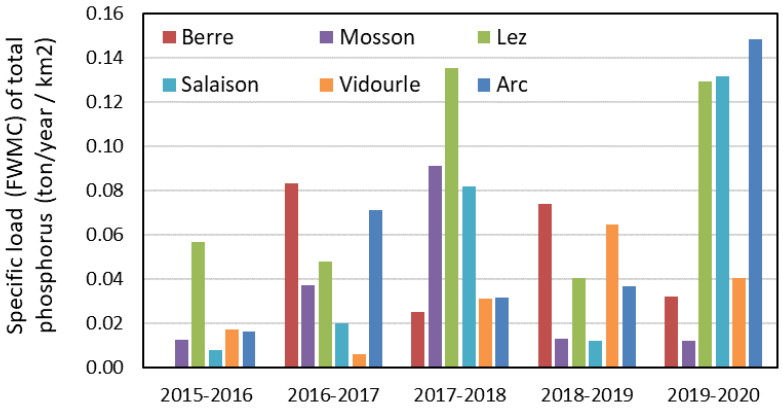

Figure S4. Specific load (ton/year / km²) of total phosphorus calculated on the six watersheds by the Flow Weighted Mean Concentration (FWMC) method.

As previously noted, the loads calculated with the FDRC method (Figure S5) are very different and considerably lower than those obtained from the FWMC method (Figure S3), except here again for the Arc in 2019-2020.

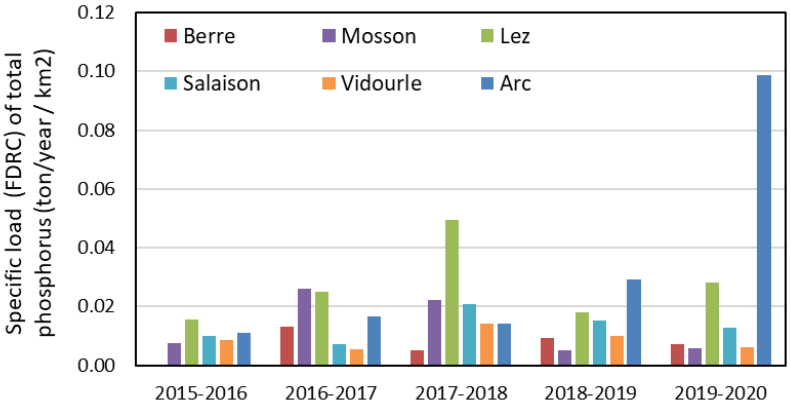

Figure S5. Specific load (ton/year / km²) of total phosphorus calculated on the six watersheds by the Flow Duration Rating Curves (FDRC) method.

Figure S6 shows the fairly good correlation between the specific load (ton/year / km²) of total suspended solids and total phosphorus calculated by the FWMC method, espe-cially when considering river-by-river results.

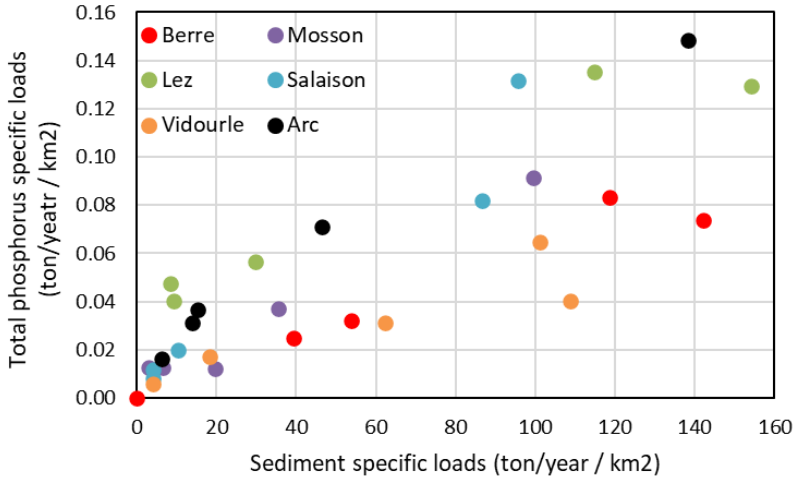

Figure S6. Correlation between specific load (ton/year / km²) of total suspended solids and total phosphorus calculated by the Flow-Weighted Mean Concentration (FWMC) method.

The correlation (Figure S7) between the specific load (ton/year / km²) of total suspended solids and total phosphorus calculated by the FDRC method is also very good when considered river by river.

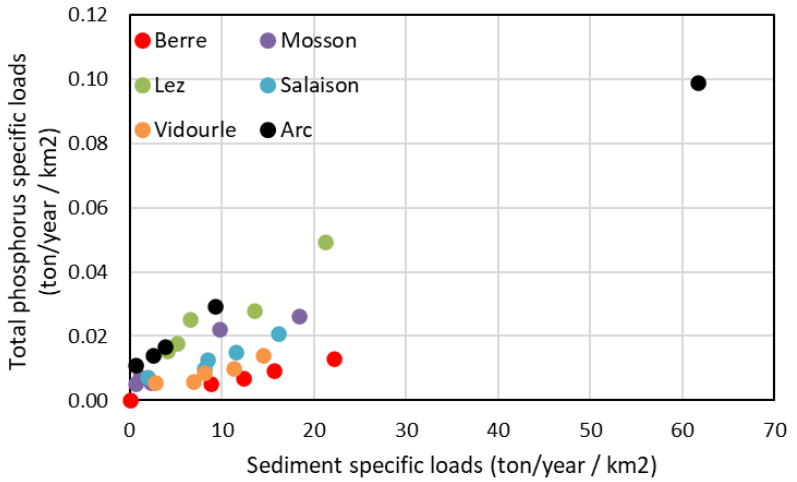

Figure S7. Correlation between specific load (ton/year / km²) of total suspended solids and total phosphorus calculated by the Flow Duration Rating Curves (FDRC) method.

Figures S8 and S9 show the specific loads (ton/year / km²) of total nitrogen calculated on the six watersheds by the two methods. The results are overall quite similar between the two methods and very different from the loads of total suspended solids and total phosphorus loads previously discussed.

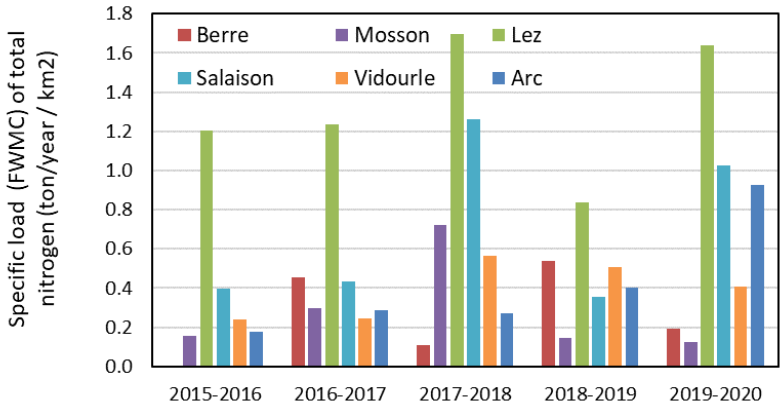

Figure S8. Specific load (ton/year / km²) of total nitrogen calculated on the six watersheds by the Flow-Weighted Mean Concentration (FWMC) method.

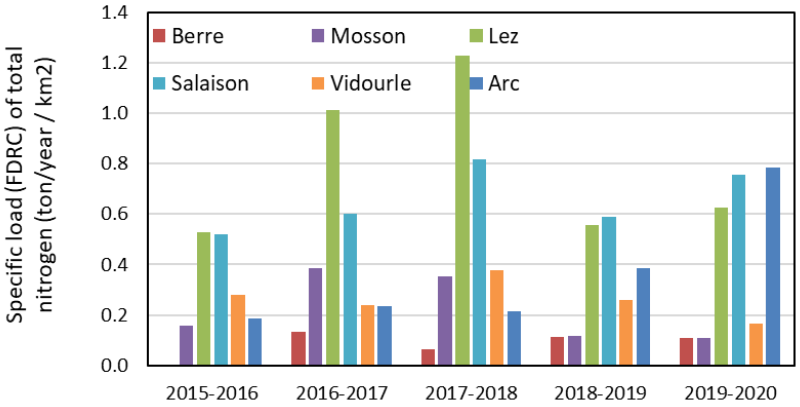

Figure S9. Specific load (ton/year / km²) of total nitrogen calculated on the six watersheds by the Flow Duration Rating Curves (FDRC) method.

The loads are slightly different (higher for the FWMC method) but of the same order of magnitude. The relatively good correlation between the results of the two methods is shown by Figure S10.

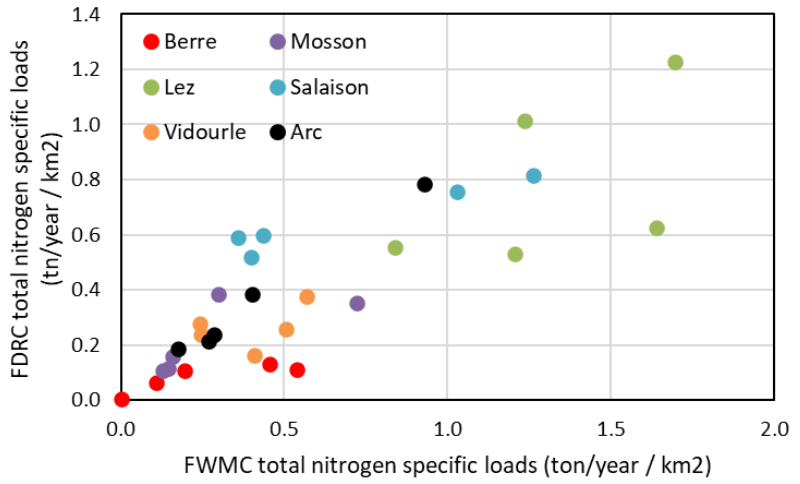

Figure S10. Correlation between specific load (ton/year / km²) of total nitrogen calculated by FWMC and FDRC methods.

Figure S11 compares the specific loads calculated by the FDRC method and by the FWMC method with all samples or excluding samples from flood period, i.e., those whose flow exceeds the threshold. Specific loads are used to compare the rivers. Loads calculated with the FWMC method without flood data are much lower than those calculated with FWMC method using flood data. They are also lower than those calculated with the FDRC method. For TSS and total phosphorus, the loads calculated with the FDRC method are systemically intermediate between those calculated by the FWMC method with and without the flood data. For total nitrogen, the differences between loads calculated by the methods are small, as already observed.

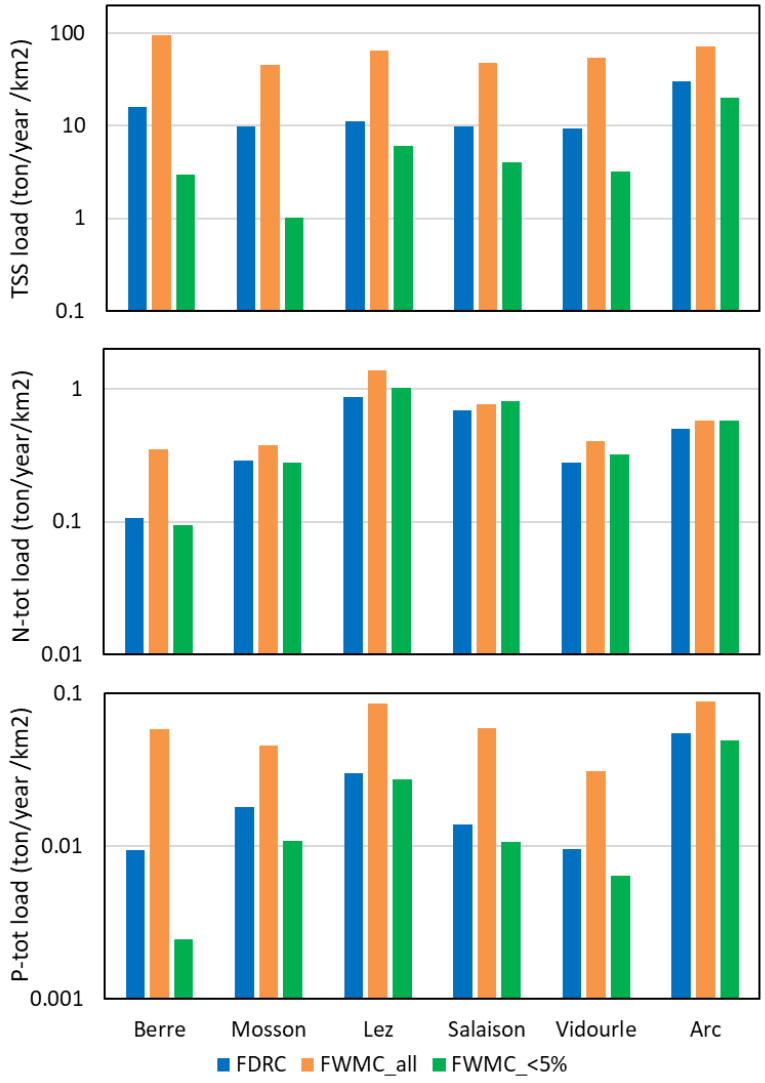

Figure S11. Specific mean loads calculated with the FDRC method and with the FWMC method considering or not the flood samples (TSS = total suspended solids; N-tot = total nitrogen, P-tot = total phosphorus; FWMC_all = with all samples; FWMC_<5% = without the flood samples for which flow exceeds the streamflow threshold.

Figures S12 to S14 show the ratios of loads calculated with the different approaches. The differences between the loads calculated with the FWMC method (Figure S12) using or not the flood data are very significant. In the case of TSS, the ratio between loads varies between 3 and 45. The ratios are less important for total phosphorus and little for total nitrogen. The ratios between FWMC loads considering flood samples and FDRC loads are important but less than 6.2 (Figure S13). The ratios between FDRC loads and FWMC loads

without flood samples (Figure S14) are also low, except for the TSS on the Mosson, and to a lesser extent for the Berre.

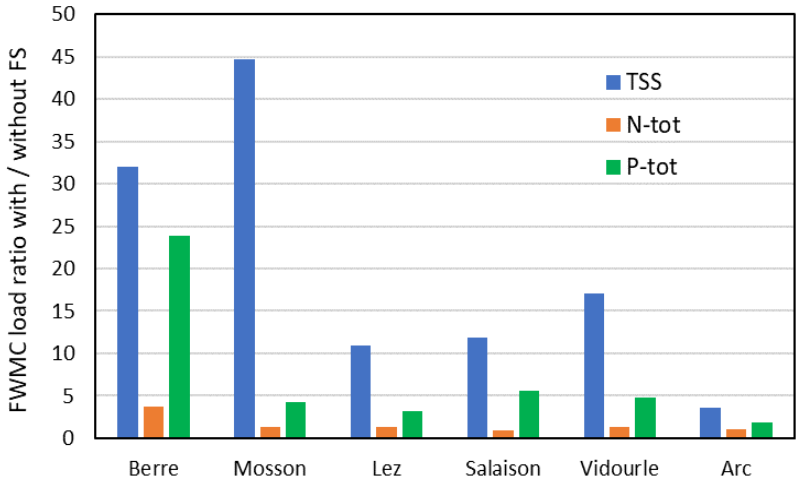

Figure S12. Ratio of loads calculated by the FWMC method considering or not the flood samples.

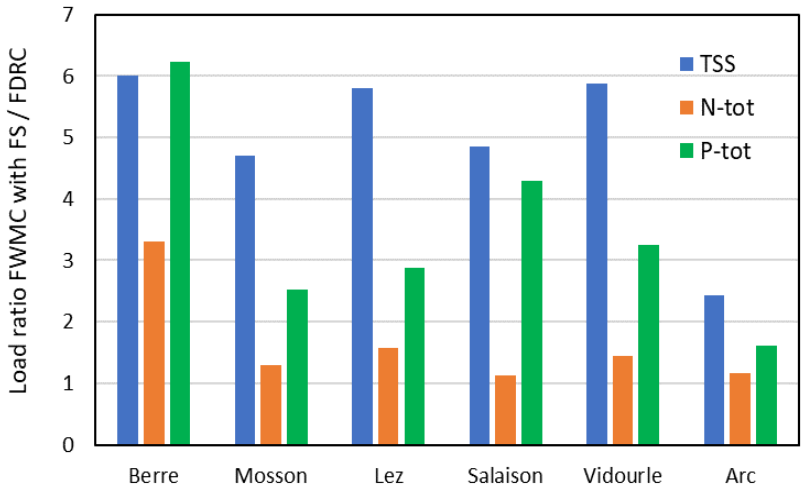

Figure S13. Ratio of loads calculated by the FWMC method considering the flood samples and the FDRC method.

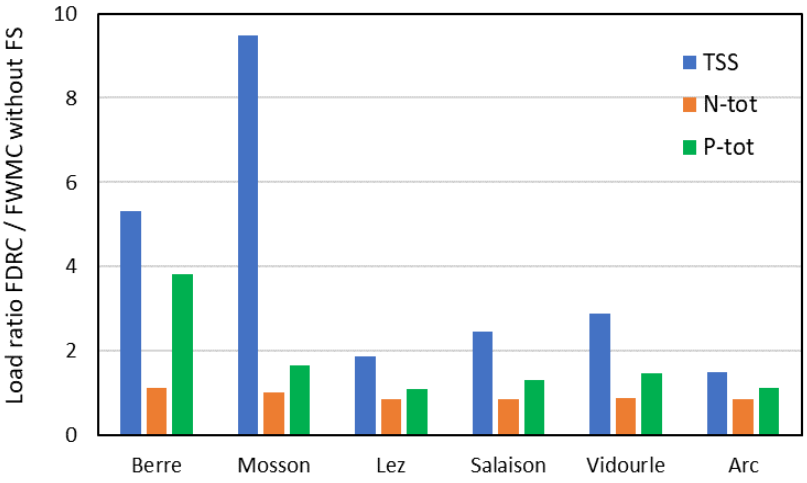

Figure S14. Ratio of loads calculated by the FDRC method and the FWMC method without the flood samples.