**Open R-code to communicate the impact of co-occurring natural hazards**

**README (i.e. guide to files in Supplementary Material)**

**Cor\_Tool\_GC\_1.1.R**

* Open R script that is the subject of the paper. Designed in RStudio version Version 2023.06.2+561, and last checked 25th Sept 2023.
* A ‘User Guide’ is provided at the top of the script, and it should only be necessary to change ‘User set quantities’ at the top of the script and input file locations.
* For use with sample input files provided, listed below.
* The calculations performed (e.g. reinsurance structure) are briefly described in Hillier et al (2023), but are presented here for full inspection.

**Sample input event data (Events\_TS1\_F\_r1.txt, Events\_TS1\_S\_r1.txt)**

Illustrative dates and severities of events (i.e. *SI*) are based on the UCKP climate projections by the UK's Met Office. Severity Indices are as in Bloomfield et al (2023), specifically the versions of the formulae that are not population weighted. Events defined as in Griffin et al (2022) for flooding (i.e. their events are used), and for wind the events mirror the methodology used there. The full derivation of these events is beyond the scope of this paper, which is to illustrate a method of combining event sets, but the intention is to publish both the method and full data as part of a companion paper in preparation.

* Based on UKCP18 events during winters (i.e. Oct-Mar) 1981-1999
* 12 Ensembles [1,4,5,6,7,8,9,10,11,12,13,15]
* 12\*19 = 224 years in total, numbered sequentially i.e. ENS 1 is 1-19, ENS 2 is 20-38 etc ...
* Losses with a log-Normal size distribution were assigned according to (i.e. correlated with) hazard severity, and this was done 50 times, giving an overall time-series length of 224\*50 = 11200 simulated years.
* Day is 'start day' [1-180] with 1 being 1st Oct, noting that all months are 30 days.
* Severity is FSI or SSI .... where SI is 'Severity Index' a metric allegedly related to £ loss.
* The largest events are selected to match the number per year in the commercial models used (see paper's text)
* A log-Normal distribution of losses and a Gaussian copula are assumed in order to add a distribution losses.

These are large assumptions. They are suitable for illustrative purposes but should not be interpreted further. In reality, whilst this has not been explicitly investigated, there will be differences that critically affect tail behaviour (i.e. impact on 1-in-200 year co-occurrence). Illustratively, commercial models’ loss distributions are not exactly log-Normal, and it seems unlikely that randomly assigning loss according to severity is appropriate since it was necessary to assume *r* = 1.0 between severity and loss to get outputs similar to the commercial risk models.

**Other sample input files**

* CompanyX\_format\_losses\_ALL\_numbers\_changed.txt
  + Selected return period values for modelled losses from a company. In the last part of the script this allows you to, if you wish, replicate the analysis using loss distributions of the same shape but scaled in magnitude to the size of two perils for a particular firm.
* RPs\_selected.txt
  + Selected return period values

**/Run1/ and files therein**

* The output files that should be obtained after running the R-script with the sample input files provided. These are described in the script.

**Bibliography**

Bloomfield, H., Hillier, J. K., Griffin, A., Kay, A. L., Shaffrey, L., Pianosi, F., James, R., Kumar, D., Champion, A. J., and Bates, P. D.: Co-occurring wintertime flooding and extreme wind over Europe, from daily to seasonal timescales, Weather Clim. Extremes, 2023.

Griffin, A., Kay, A. L., Sayers, P., Bell, E., and Carr, S.: Widespread flooding dynamics changing under climate change: characterising floods using ukcp18, Hydrol. Earth Syst. Sci. Discussions, 1–18, https://doi.org/10.5194/hess-2022-243, 2022.