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Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a Confirmed

- ☒ ☐ The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement
- ☒ ☐ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
- ☒ ☐ The statistical test(s) used AND whether they are one- or two-sided
Only common tests should be described solely by name; describe more complex techniques in the Methods section.
- ☒ ☐ A description of all covariates tested
- ☒ ☐ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
- ☐ ☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
- ☒ ☐ For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
Give P values as exact values whenever suitable.
- ☒ ☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
- ☒ ☐ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
- ☒ ☐ Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection	All necessary data were collected without using specific software
Data analysis	Hydrological simulations were performed using the open-source Lisflood model. Hydraulic simulations were performed using the open-source LISFLOOD-FP model. Data analysis was performed using custom scripts and algorithms developed in R (version 3.6.0 with packages ggplot2, ncd4, raster, rgdal, sp) and GNU Bash (version 4.2.46(2)). The Bash and R codes used to generate the results reported in the paper are available from the JRC Data Catalogue at https://jeodpp.jrc.ec.europa.eu/ftp/public/JRC-OpenData/PESETAIV/Paper_floods/scripts_HPC.zip . The open-source of the LISFLOOD hydrological model used in this work is available in Github at https://ec-jrc.github.io/lisflood/ . The source code of LISFLOOD-FP8.0 is available in Zenodo under a GNU General Public License v3.0 for any non-commercial use and can be downloaded at https://doi.org/10.5281/zenodo.4073011 .

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

The maps of river flow extremes for the global warming scenarios considered in this work are available at the JRC Data Catalogue: <https://data.jrc.ec.europa.eu/dataset/20247f06-469c-4607-8af1-a5a670082471>. The full dataset of river flood discharges considered in this work is available at the JRC Data Catalogue at <https://data.jrc.ec.europa.eu/dataset/1019a72f-7b98-4318-8baf-fd9e2c00a92c>

The flood hazard maps are available at the JRC Data Catalogue: <https://data.jrc.ec.europa.eu/dataset/1d128b6c-a4ee-4858-9e34-6210707f3c81>

The European population density map used to represent present-day population is available as supplementary information of the work by Rosina et al. (2018) at the following address: <https://doi.org/10.6084/m9.figshare.6210392>

The land cover map and all the spatial projections of population and land cover are available at the JRC Data Catalogue: <https://data.jrc.ec.europa.eu/collection/luisa>

The flood damage functions and related data are available as supplementary information of the report by Huizinga et al. (2017) at the JRC Publications Repository: <https://publications.jrc.ec.europa.eu/repository/handle/JRC105688>

The flood protection dataset and the dataset of adaptation measures developed for this work are available at the JRC Data Catalogue at <https://data.jrc.ec.europa.eu/dataset/1019a72f-7b98-4318-8baf-fd9e2c00a92c>.

All the datasets used as input or generated during the current study to assess river flood risk and appraise costs and benefits of adaptation are available at the JRC Data Catalogue at <https://data.jrc.ec.europa.eu/dataset/1019a72f-7b98-4318-8baf-fd9e2c00a92c>. The dataset available online include the minimum data that are necessary to interpret, verify and extend the research in the article. Additional datasets from the current studies are available from the corresponding authors on reasonable request

Human research participants

Policy information about [studies involving human research participants and Sex and Gender in Research](#).

Reporting on sex and gender	Not relevant
Population characteristics	Not relevant
Recruitment	Not relevant
Ethics oversight	Not relevant

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

- ☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	The study is based on software simulations and analysis of software results
Research sample	Not relevant
Sampling strategy	No sample-size calculation was performed
Data collection	Data collection was performed using the most recent databases available in literature. Where necessary, we carried out a manual literature review to collect additional data (e.g. to produce the map of flood protection standards and the database of adaptation measures)
Timing and spatial scale	The manual literature review (to collect data on flood protection standards and adaptation measures) was carried out between September 2018 and October 2019.
Data exclusions	All data collected and relevant for the spatial scope of the present work were used

Reproducibility	All findings are based on software simulations and therefore are fully reproducible using the same data and software
Randomization	Not relevant
Blinding	Not relevant

Did the study involve field work? ☐ Yes ☒ No

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging