

Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency 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
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☐ | ☒ 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
<i>Give P values as exact values whenever suitable.</i> |
| ☒ | ☐ 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	We used QGIS 3.6.0 to manually delineate the deltas extent. We used QGIS 3.10 to calculate average values of each ecosystem service indicator per delta, generally using the 'zonal statistics' tool, see supplementary information for exceptions. We also used Google Earth Engine to calculate average values of forest area using the 'mean reducer' tool, given the prohibitive size of the dataset for local analysis.
Data analysis	We used R 3.6.3 was used to conduct the analysis, using Base R unless stated. We used the 'ConsensusClusterPlus' package to assess how many clusters our cluster ensemble would resolve to. We used the 'cluster' and 'randomForest' packages to cluster our data. We used the 'strucchange' package to establish breakpoints within our population of deltas and identify shifts in the relationship between ecosystem service and modification. We used 'ggplot2', 'corrplot', and 'ggalluvial' packages to create the figures. We used Matlab R2016a to create a custom algorithm that relabeled the clusters created to maximise consistency between the results of the ensemble of clustering methods used.

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 delta shape files created for this project are available from DOI 10.5281/zenodo.6346472. The other data comes from public repositories detailed in SI Table 1 and SI Data 1. The processed dataset used to create Figures 2 and 3 and Tables 1, 2 and 3 is enclosed within SI Data 2.

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](https://www.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 aimed at understanding the ecosystem service supply and modification of global deltas. We conducted a clustering and correlation analysis of 49 ecosystem services indicators across the global population of 235 large deltas. We then assessed the response of these individual and clustered ecosystem services across four gradients of human modification. Each data point represents the average value of each indicator found in one delta area at one point in time.
Research sample	We included the entire population of 237 large (over 10 km ² in area) deltas with distributary networks (a split in the river channel typical of deltas) that were observed by the first author with satellite imagery along coastlines and lakesides worldwide.
Sampling strategy	No sampling was conducted, rather all deltas with a distributary network and an area above 10 km ² that we observed worldwide were included in the dataset, leaving 237 deltas, from which two were excluded (see exclusions)
Data collection	The first author manually created the dataset of delta areas by delineating their distributary networks using QGIS 3.6.0 (see supplementary information for protocol). The other data was downloaded by the corresponding author and processed for GIS analysis, as outlined in the supplementary information.
Timing and spatial scale	The delta dataset was constructed between February and March 2019. The ecosystem service and modification indicators taken from publicly available sources which varied in spatial scale and timing, each described in the supplementary information. We used the most recent available data to maximise comparability between datasets.
Data exclusions	We excluded two deltas - an unnamed Greenland delta for which very few of the indicators were available, and the Brahmani river in India, which substantially overlaps the watersheds of neighbouring rivers which form the same delta.
Reproducibility	We used several methods to ensure the robustness of the clustering process, outlined in the supplementary information. Firstly, we used an ensemble of clustering methods to both establish the number of clusters and perform the clustering. We chose this approach to minimize the influence of any one method, given that method selection heavily influences clusters formation. We repeated the clustering process for several numbers of clusters (four to seven), and found the number of clusters used (four) was logical. We then tested the methods on five artificial clusters created using a variance-covariance matrix with five blocks of positive covariance. Every method consistently clustered each variable together. Finally, we repeated our methods with random data, where on average each ecosystem service was assigned to a cluster 57% of the time, much lower than three of the four clusters our analysis produced.
Randomization	Randomisation was not relevant to the study as it involved the entire population of large deltas.
Blinding	The study involved analysis of existing datasets using a created spatial dataset, therefore blinding was 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 |
| ☒ | ☐ Human research participants |
| ☒ | ☐ Clinical data |
| ☒ | ☐ Dual use research of concern |

Methods

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