

Introduction

Background:

Scale issues in runoff and sediment delivery (SIRSD) is a hot and frontier topic in the fields pertinent to hydrology and soil erosion.

Objectives:

- present a clear global picture of state-of-the-art in SIRSD studies;
- provide a global view of spatial scale effect on sediment delivery ratio;
- address identified knowledge gaps and facilitate the future research.

Data and methods

Data collection:

- Publication data:** 1650 bibliographic records from Web of Science and Scopus databases.
- Sediment delivery ratio (SDR) data:** 1039 SDR records in 80 publications from over 20 countries or regions.

Bibliometric analysis of publication data:

- Word frequency analysis (WFA)
- Co-word analysis (CWA)
- Word cloud analysis (WCA)
- Social network analysis (SNA)

Integration of traditional literature review:

- clues for a robust search strategy;
- question-oriented bibliometric analysis;
- contextual and evidence support for quantitative results;
- direction for comprehensive and structural arrangement.

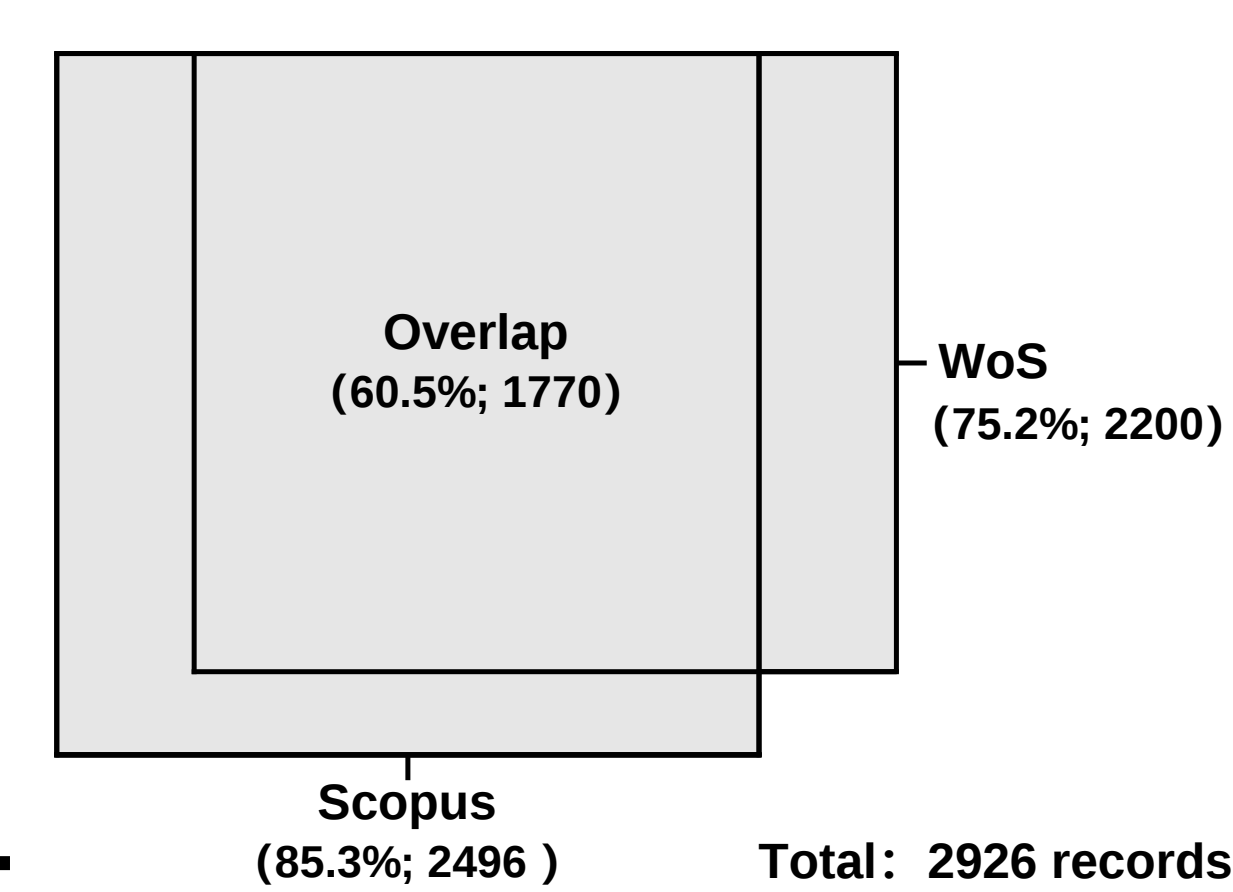


Fig. 1. Distribution of SIRSD studies in bibliographic databases.

Scale effect on sediment delivery ratio

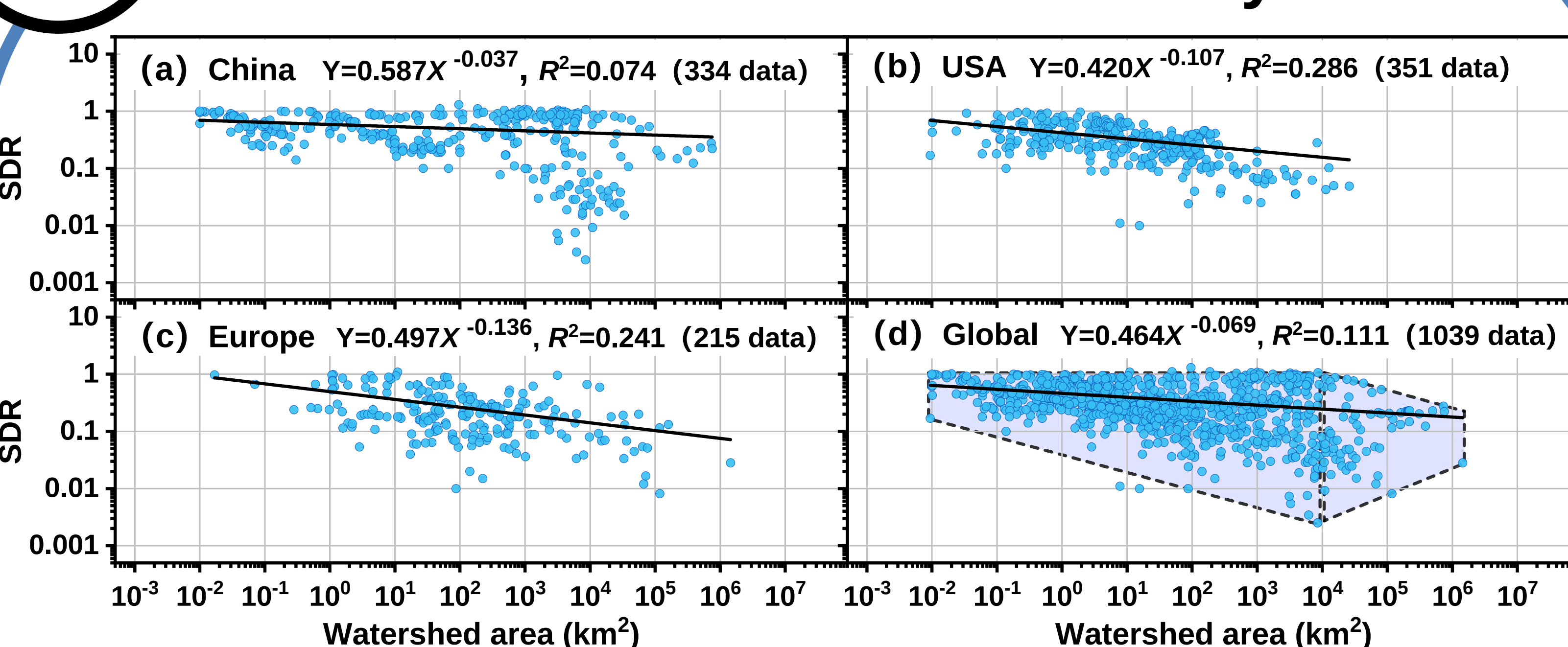


Fig. 10. The relationships of sediment delivery ratio (SDR) and watershed area in China (a), USA (b), Europe (c), and the world (d). All the regression coefficients are significantly different from zero at the 0.05 level.

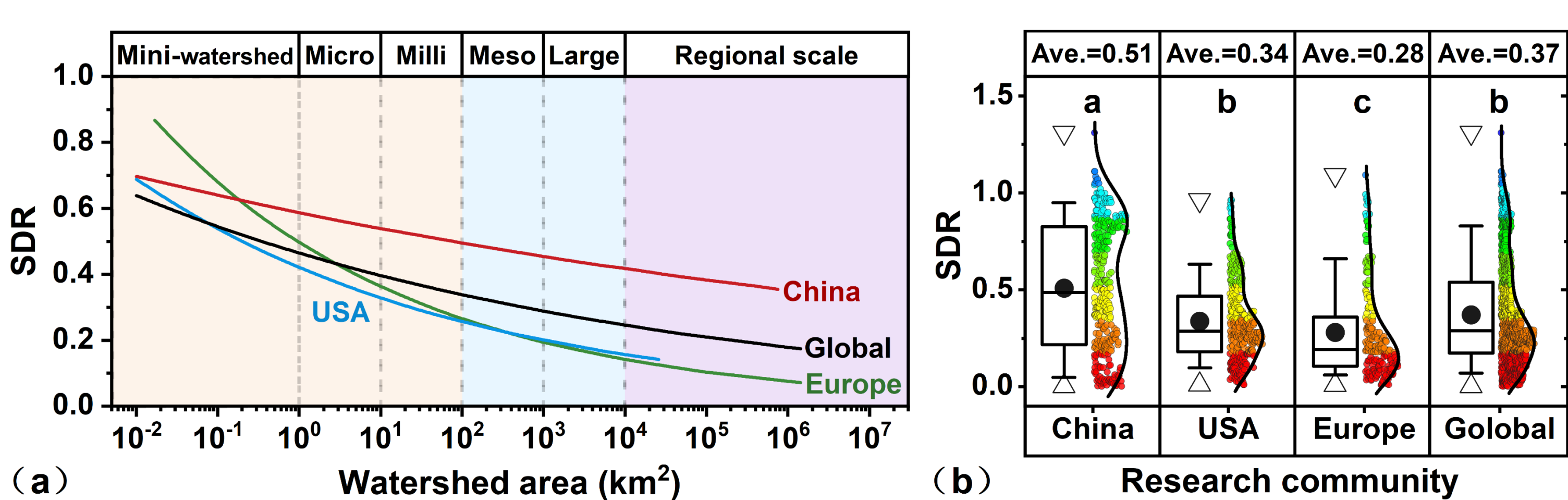


Fig. 11. Spatial scale effect on sediment delivery ratio (SDR) (a) and its value distribution (b) in China, USA, Europe, and the world. Different small letter above the curve denotes significant difference at the 0.05 level.

Conclusions

- SIRSD is a comprehensive and multidisciplinary issue that has been extensively investigated with a wide variety of methods by scientists from 93 countries since the 1928.
- SIRSD has attracted booming attention over the last three decades due to its great potentials for research and practice on various contemporary issues of environment and natural resources.
- SIRSD field is structurally consist of hydrological and erosion studies at slope, catchment, and river basin scales, in which the hydrological studies tend to discuss temporal scale issues at river basin scale, while the erosion studies tend to have more spatial scale relevant issues.
- Most studies cluster on the time scale from an event to 10 years and the spatial scale from a field (>10 m2) to a landscape scale (<10000 km2) and tend to appear in countries or regions with considerable river systems and high-intensity agriculture.
- Developing countries are in an increasing need to address environment issues pertaining to SIRSD and playing an increasingly greater role in the international co-operation.
- A country or a region with extensive mountainous or hilly areas tends to have a higher average SDR (a higher average slope gradient) and a smaller scale effect on SDR (a higher topographic variability).

1

Temporal trends

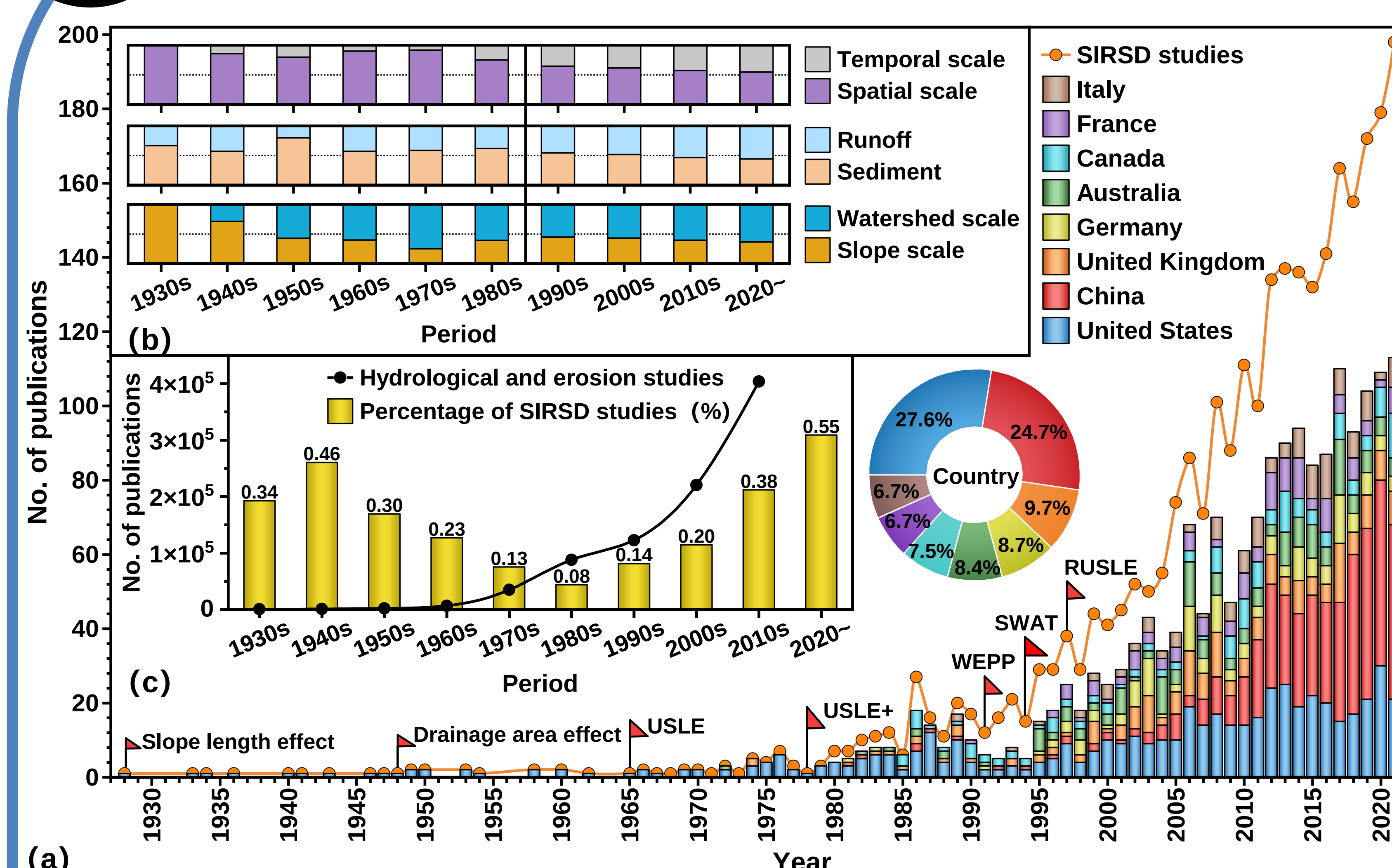


Fig. 2. Trend of published papers for SIRSD studies (a), its element comparison (b), and its percentage in hydrological and erosion studies (c) through time. Countries mentioned here are the top eight countries with over 100 publications.

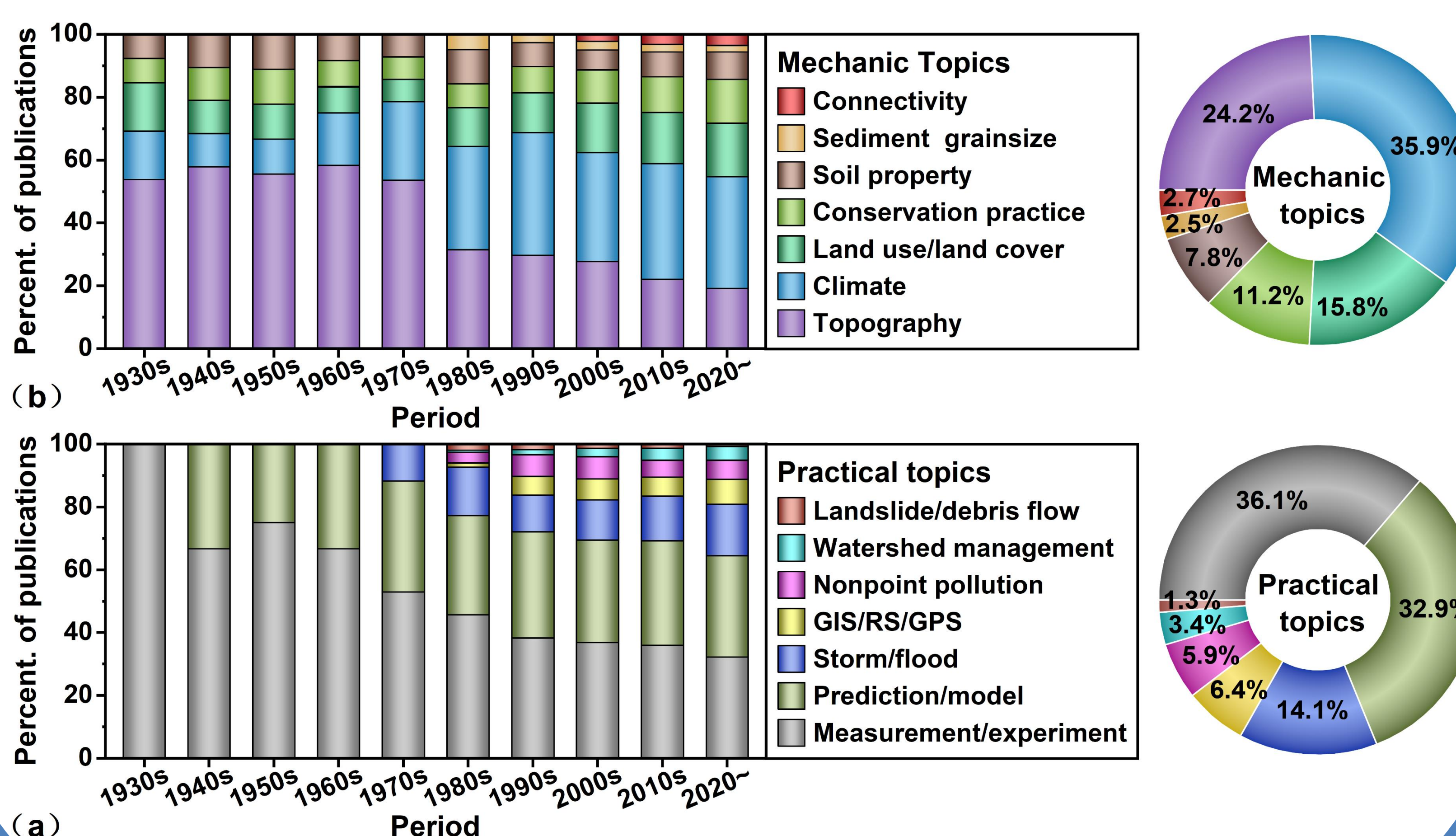


Fig. 3. Trend of research topics through time.

2

Thematic structure

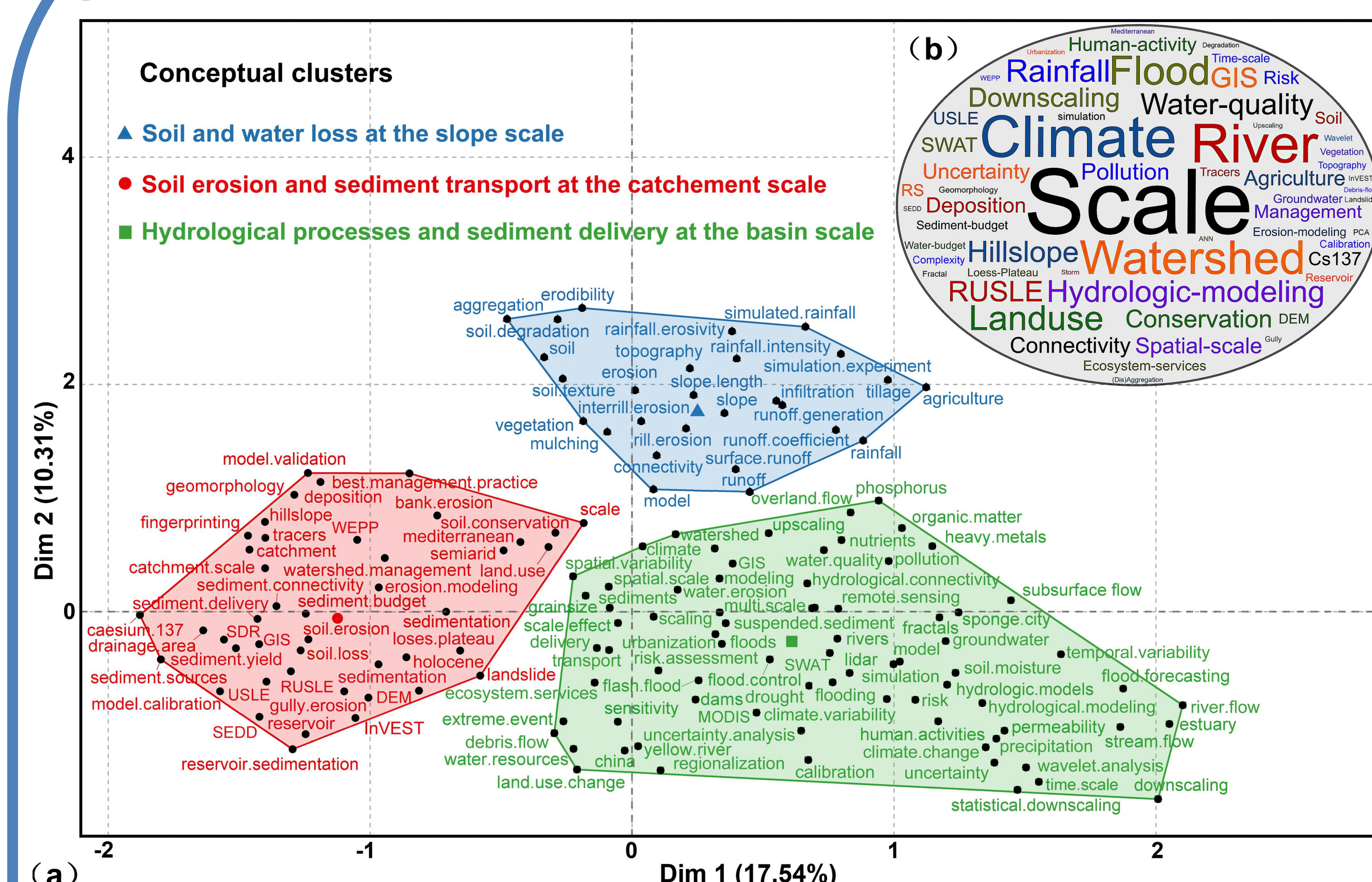


Fig. 4. Conceptual structure map with MCA (Multiple Correspondence Analysis) method (a) and a word cloud of the 70 most frequent keywords (b) pertaining to SIRSD studies.

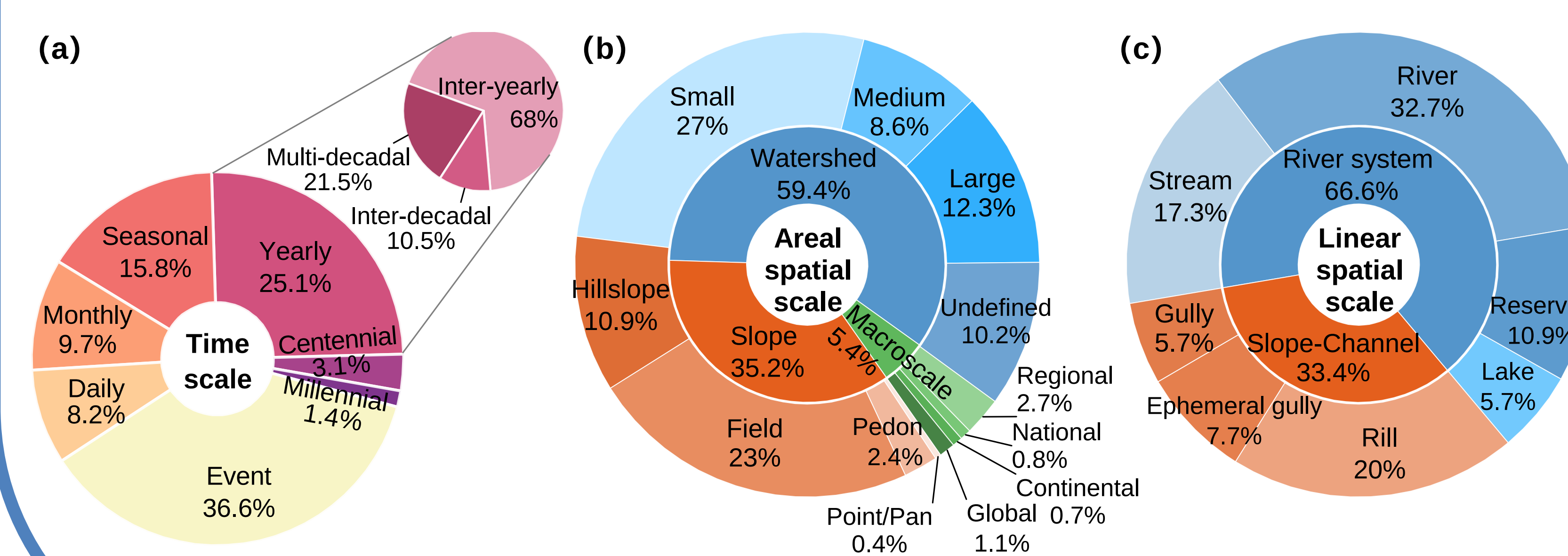


Fig. 5. Distributions of different temporal scales (a) and spatial scales (b-c).

3

International pattern

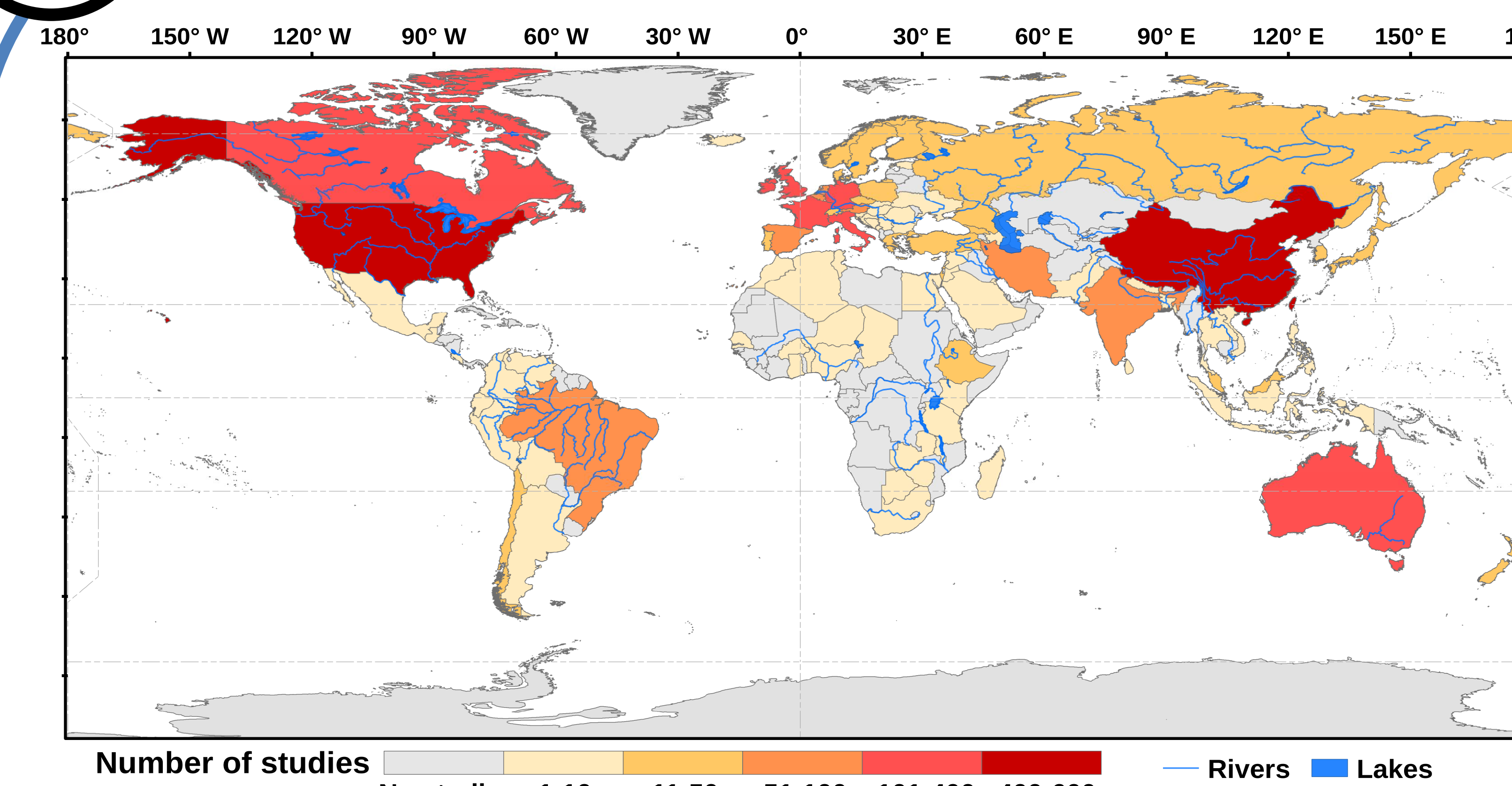


Fig. 6. Geographic distribution of SIRSD studies published in the English language.

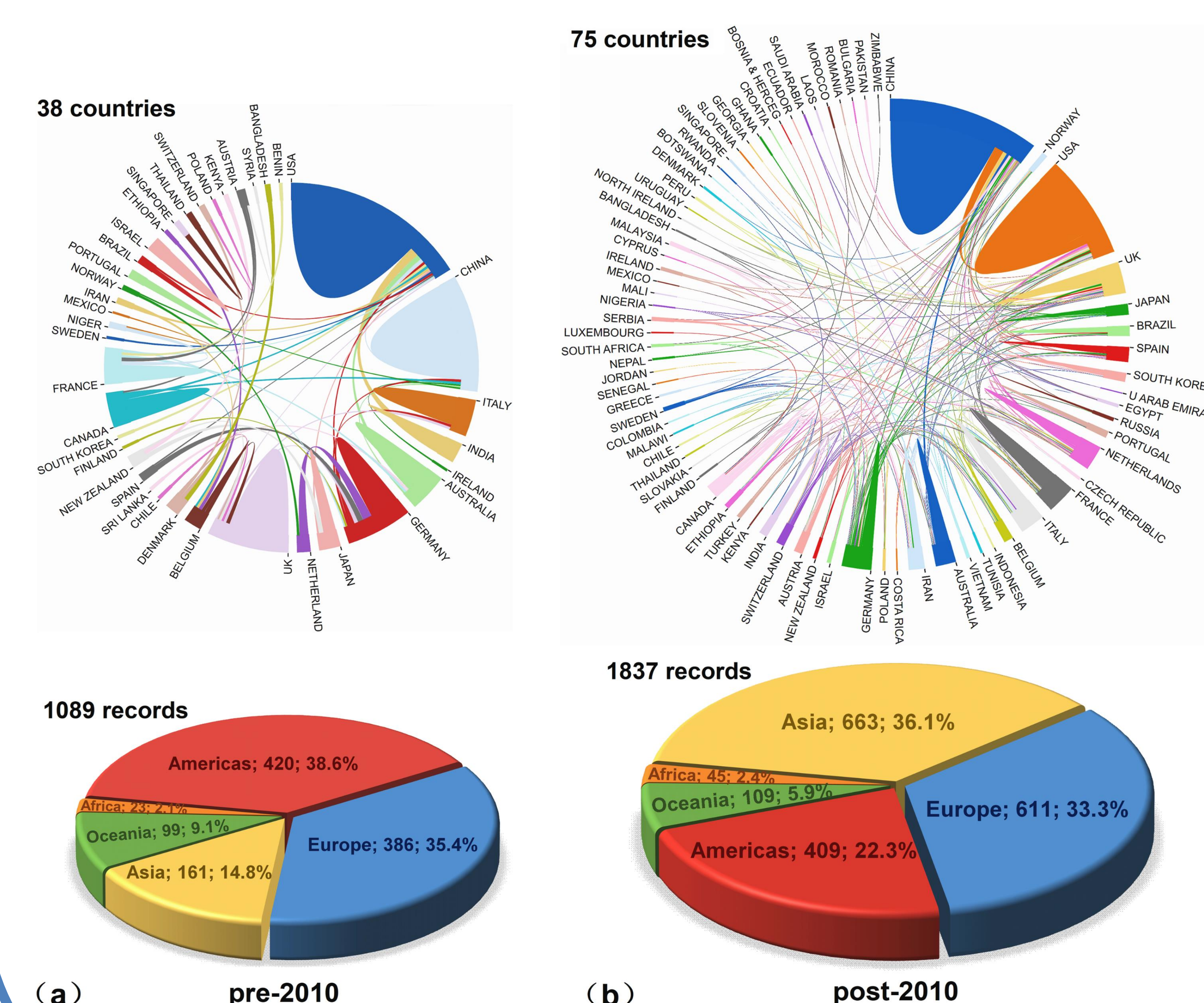


Fig. 7. International cooperation network (a) and number and percentage of studies published per continent in pre-2010 (a) and post-2010 (b).

4

Application of research methods

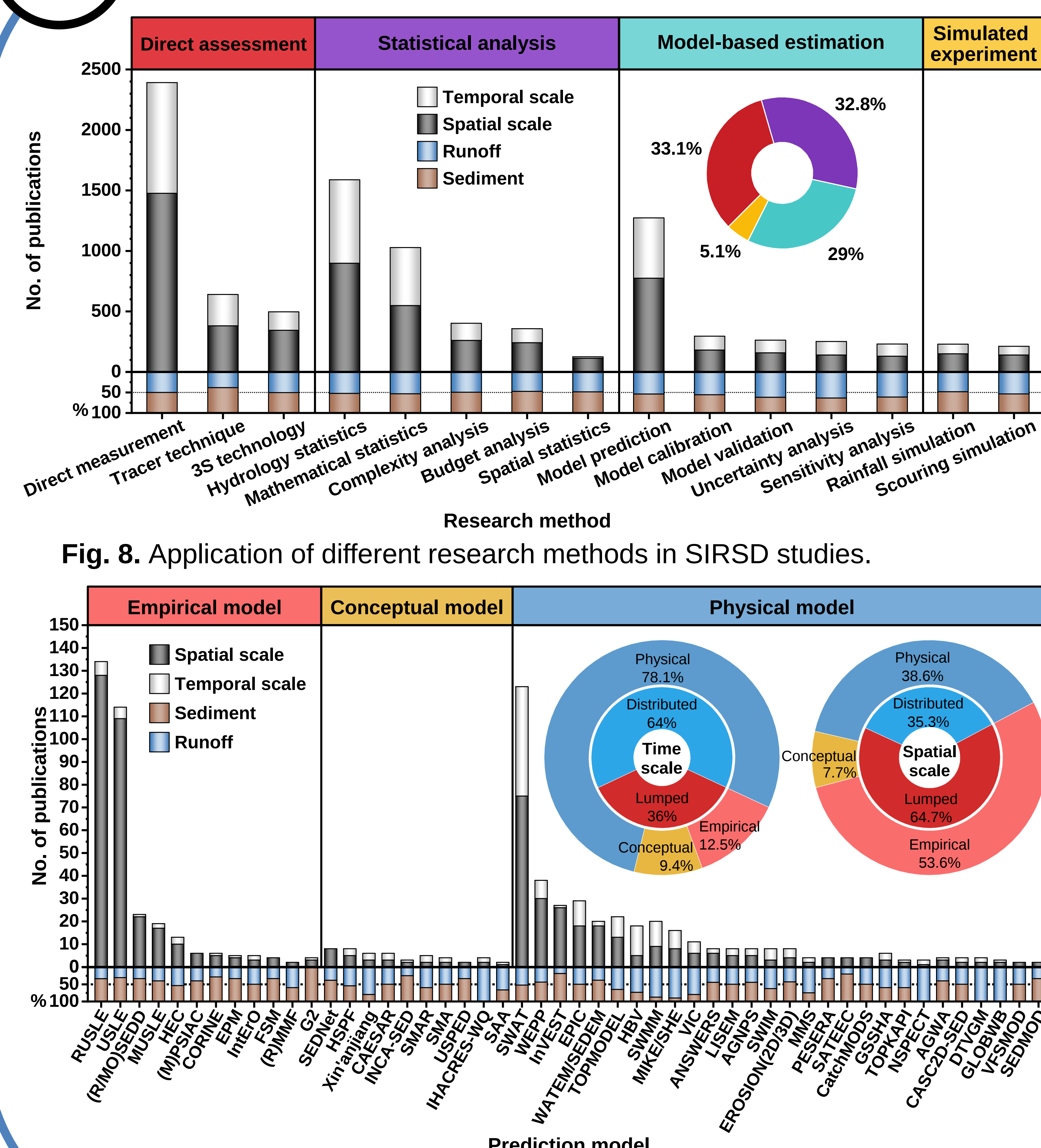


Fig. 9. Application of different numerical models in SIRSD studies. Models listed here are the top 50 most applied models.