Intra-year distribution of water discharge in global rivers

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Global water-sediment database

- Large rivers with drainage area larger than 1,000 km²

So far the largest database

- Water: 4307 large rivers, 8089 stations
- Sediment: 309 large rivers, 495 stations
- Including six continents
- 88% of the world total drainage area
- 62% data length longer than 30 years
- 50% extended to 2000s
Climate change and human activities

Climate Change
- Higher Mean Air Temperature
- Shrinking Ice Cap
- Extreme Climate events

Human Activities
- Increasing demand for water resources
- More dams
- Land cover changes
Homogenization and polarization

(a) 
Homogenization

(b) 
Polarization
Global intra-year discharge data

GRanD, http://globaldamwatch.org/grand/

5668 hydrological stations, 2/3 of total land area.
Division of dry and flood seasons

Flood season: Consecutive six months with the highest sum of runoff

Dry season: The remaining six months.
TFPW-MK Method to test trends

Trend free pre-whitening MK method
Global trends of intra-year discharge

Homogenization Phenomenon: 22.7% of the hydrological stations (1287 stations);

Polarization Phenomenon: 8.3% of the hydrological stations (470 stations)

*Confidence level exceeding 90%.
Global trends of intra-year discharge

**Homogenization Phenomenon:**
181 of the 314 independent basins, 62.6% of the total area studied;

**Polarization Phenomenon:**
39 independent basins, 25.6% of the total area studied.
Reasoning the changes.

**CLIMATE**
- Precipitation & Evaporation
- Glacial Runoff

**Human Activities**
- Dam construction
Reasoning the changes.
Reasoning the changes.
Reasoning the changes.
Contributions of the major factors

Homogenization phenomenon
dominated by dam operations in GDEP and DEP river basins,
primarily affected by homogenized precipitation in GEP and EP river basins.
Contributions of the major factors

Polarization phenomenon
Evaporation and precipitation are primary factors contributing 56% and 41.2%, respectively
Conclusions

- **Homogenization phenomenon** occurred in 181 independent river catchments occupying 62.6% (5532.6 km\(^2\)) of the study area.

- **Polarization phenomenon** occurred in 39 independent basins taking up 25.6% (2262.5 km\(^2\)) of the study area.

- Dam operations (D) make a major contribution (41.9%) to the **homogenization phenomenon** of seasonal water discharge in GDEP and DEP river basins.

- In GEP and EP river basins, changes in seasonal precipitation are the dominant factor behind the **homogenization phenomenon** of the intra-year water discharge distribution.

- Dam operation has no effect on the **polarization phenomenon** of water discharge.
Conclusions

• However, evaporation (E) and precipitation (P) generally account for the polarization phenomenon, contributing 56.0% and 41.2% respectively.

• Premature glacial runoff (G) also had a significant effect on the seasonal water discharge homogenization and polarization phenomena, especially in GEP river basins, with contributions of 30% and 21% respectively.

• This paper provides basis both for controlling flood and drought disasters, and for preventing ecological damages induced by the redistribution of the intra-year water discharge in hot spot regions.
Main References


Thank you for attention!