



Long Term Monitoring of Hydrology and Water Quality in Red River Delta, Vietnam

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Site Selection Criteria

- **Strategic location** (e.g. up=down of confluences of main tributaries, up-downstream large metropolitan or main industries, reservoir outlet)
- Easily accessible throughout the year
- Historical monitoring data available
- Existing sampling and monitoring facilities

Identification of **Impacts** to the System

- Hydrology (reservoirs, diking)
- Land use changes (deforestation, aqua-agricultural practices, urbanization, ..)
- Point sources, non-point sources of pollutants (industry, agriculture)
- Climate changes (salinity intrusion, sea water level rise, desertation)

Selection of Monitoring Parameters

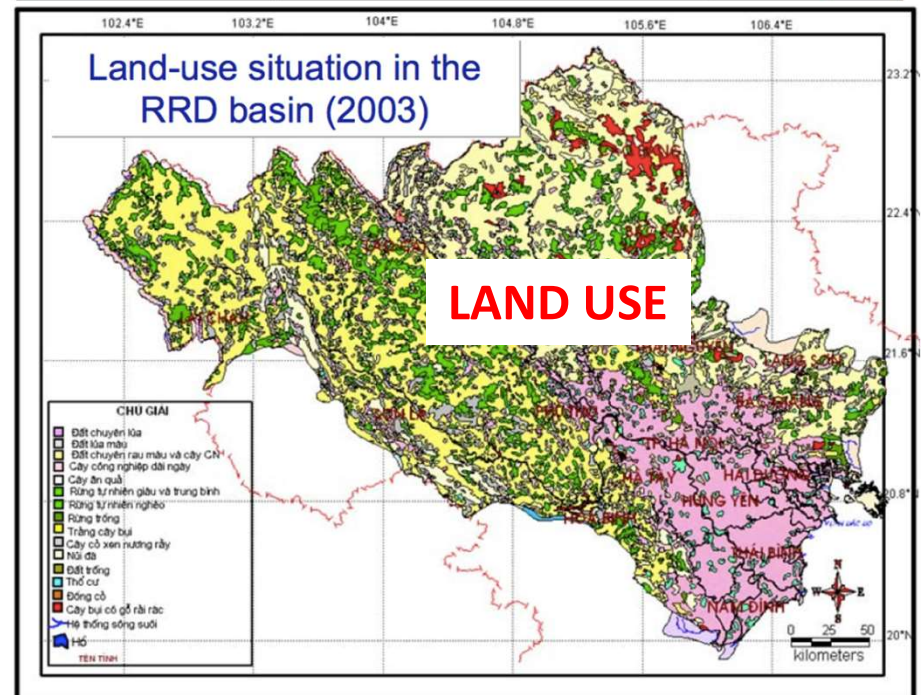
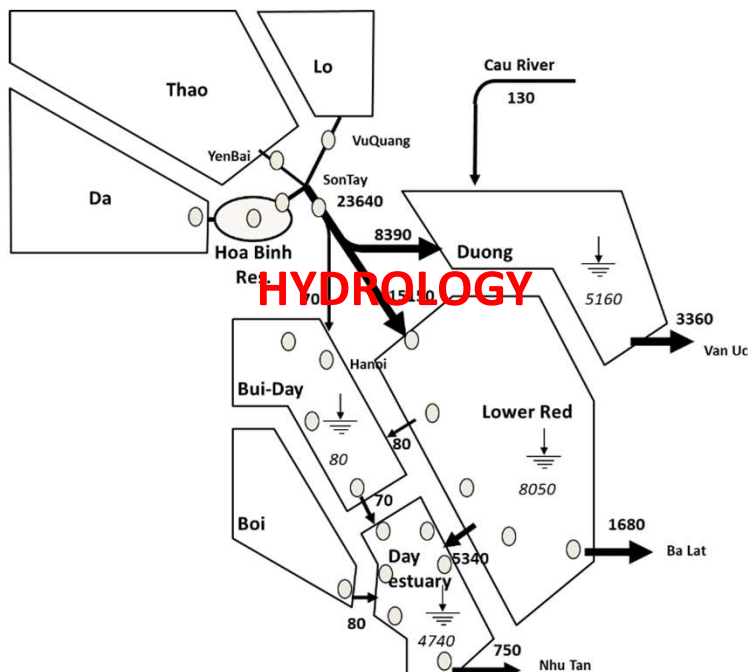
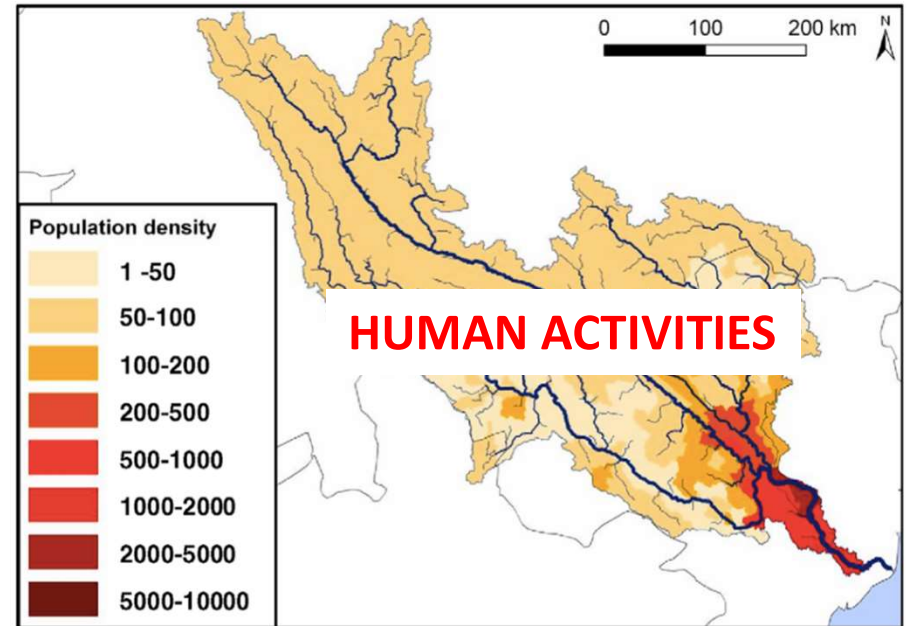
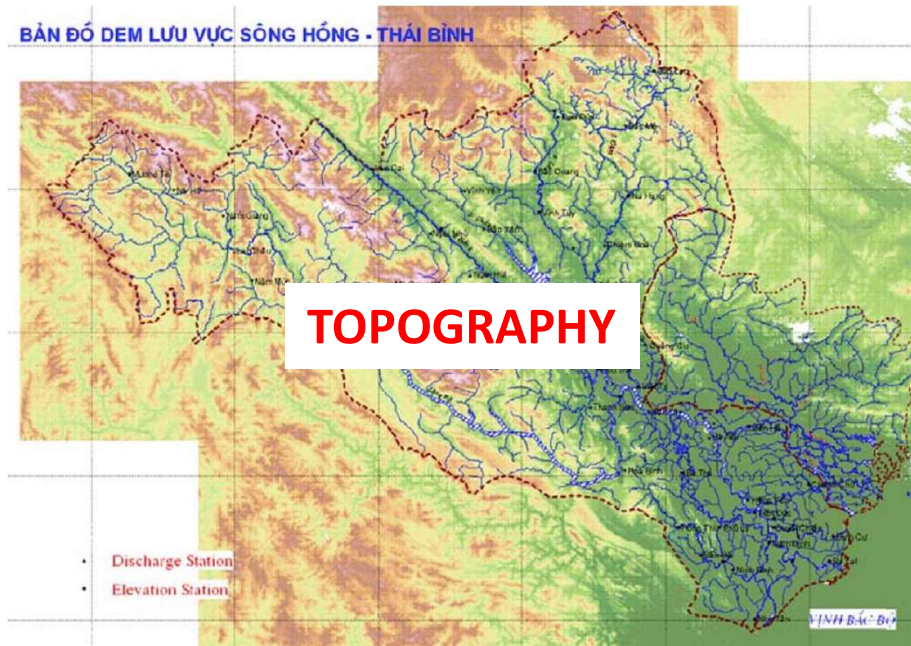
- Primary parameters indicating the impacts
- Gathering of monitoring team who have the same research interests/objectives with diverse expertise
- Collectable and/or doable parameters
 - Coordinating data of monitoring parameters
 - Self-conduct or collaborating

 **Monitoring parameters**

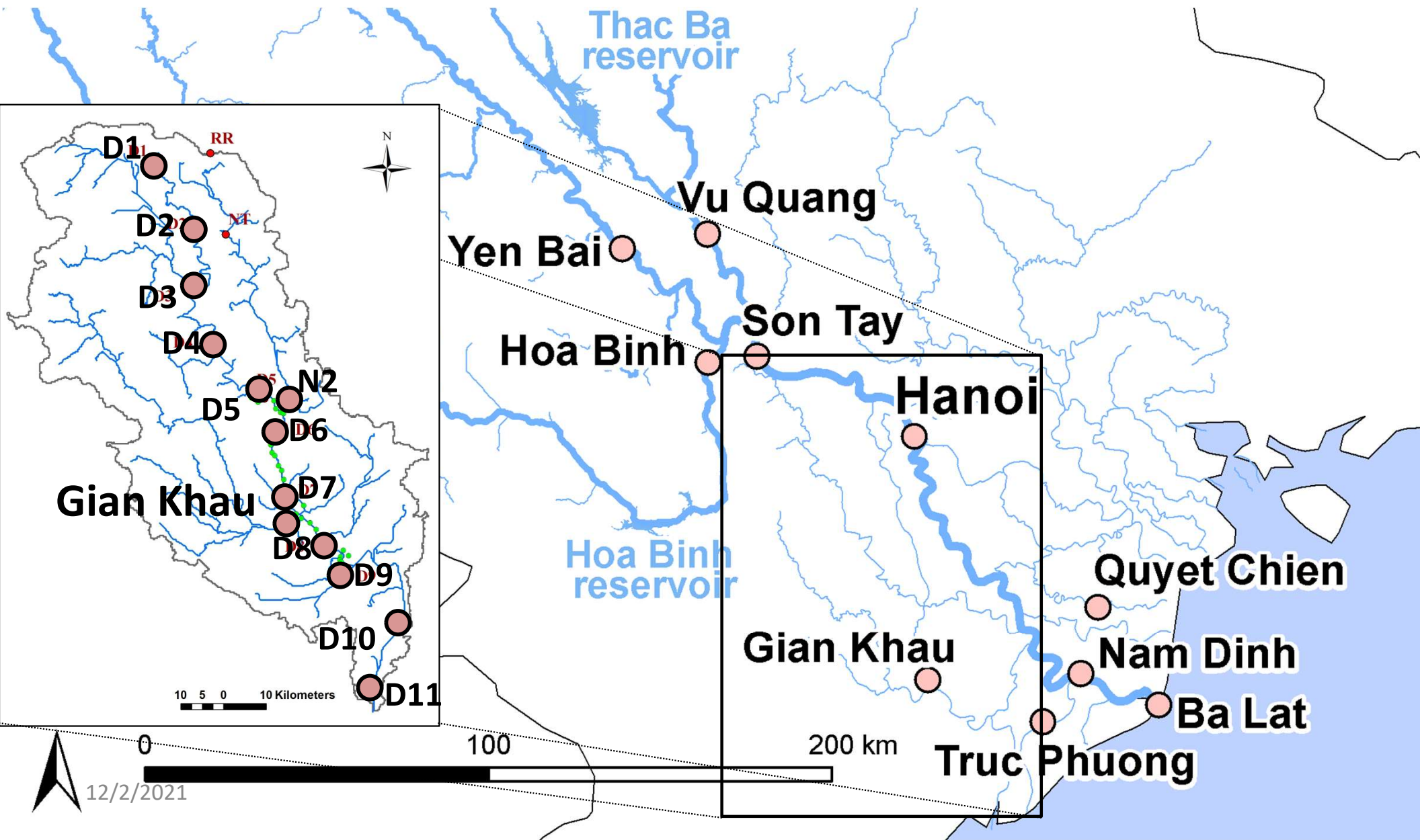
Team Setup and Organization

- Chemistry
- Biology
- Hydrology
- Limnology
- Geology
- Geography and GIS

Monitoring in Red River Delta



Monitoring Sites in Red River Delta



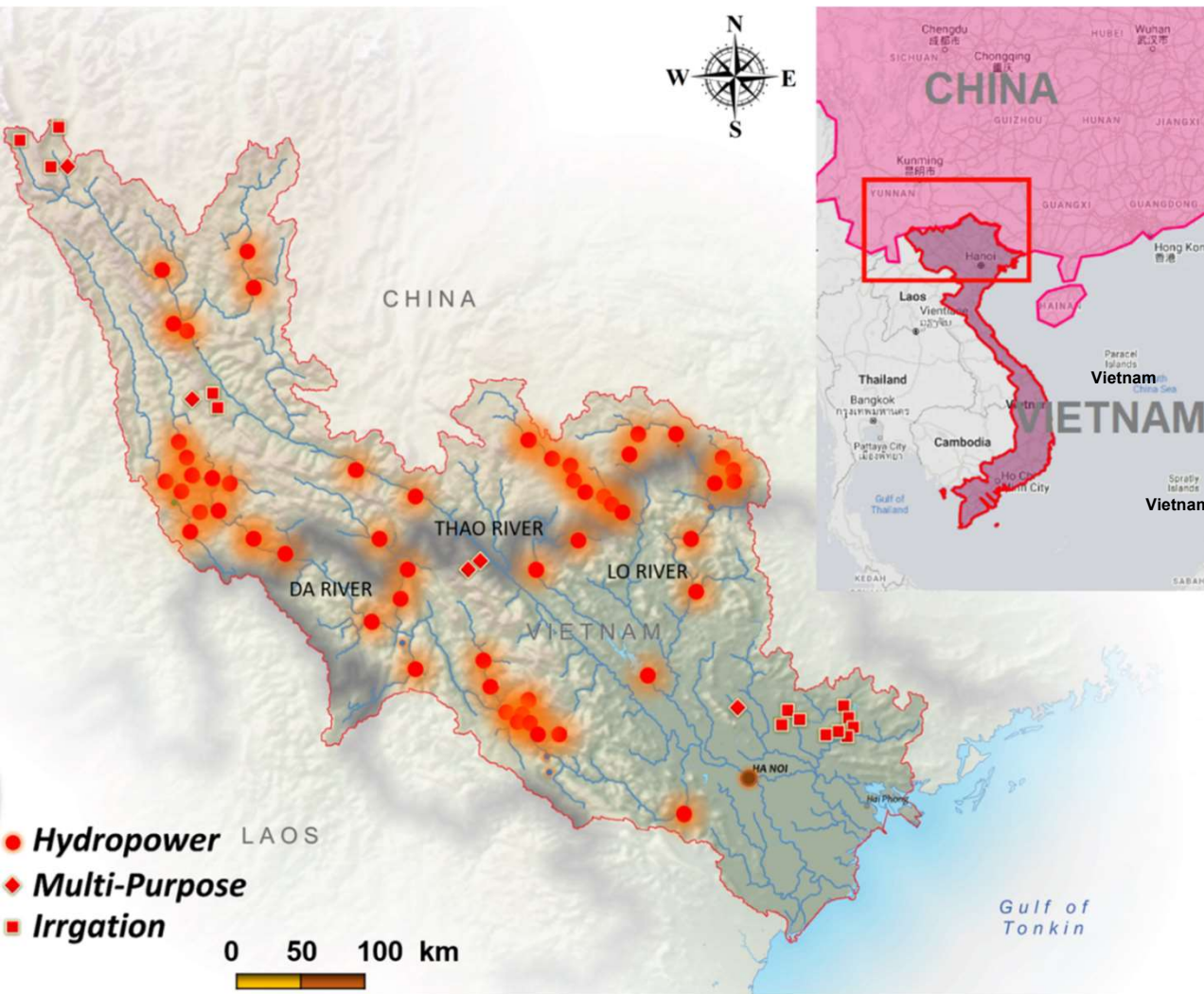
Monitoring in Red River Delta

- Duration and frequency: 3 year and monthly
- Monitoring data collection:
 - Meteo-hydrology (daily)
 - Statistics
 - Interviewing
- Monitoring parameters:
 - *In situ* physical chemistry: DO, temp, pH, turbidity, conductivity, TSS..
 - Nutrients: N, P, Si,...
 - Carbon: COD, Alkalinity/DIC, TOC (DOC, POC)
 - Biology: BOD, chlorophyll a, taxonomy,
 - Isotopes: water, nutrients (occasionally), and C (occasionally)
 - Chemistry: Major cations, anions, trace elements, organic pollutants (occasionally),...

Monitoring Evaluation and Validation

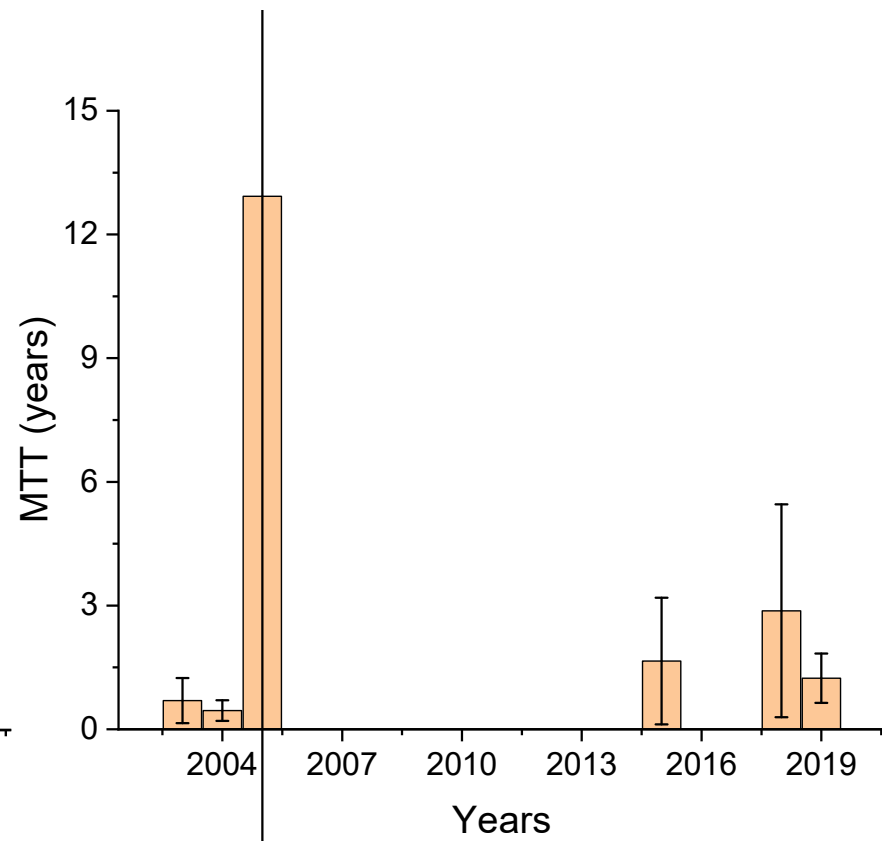
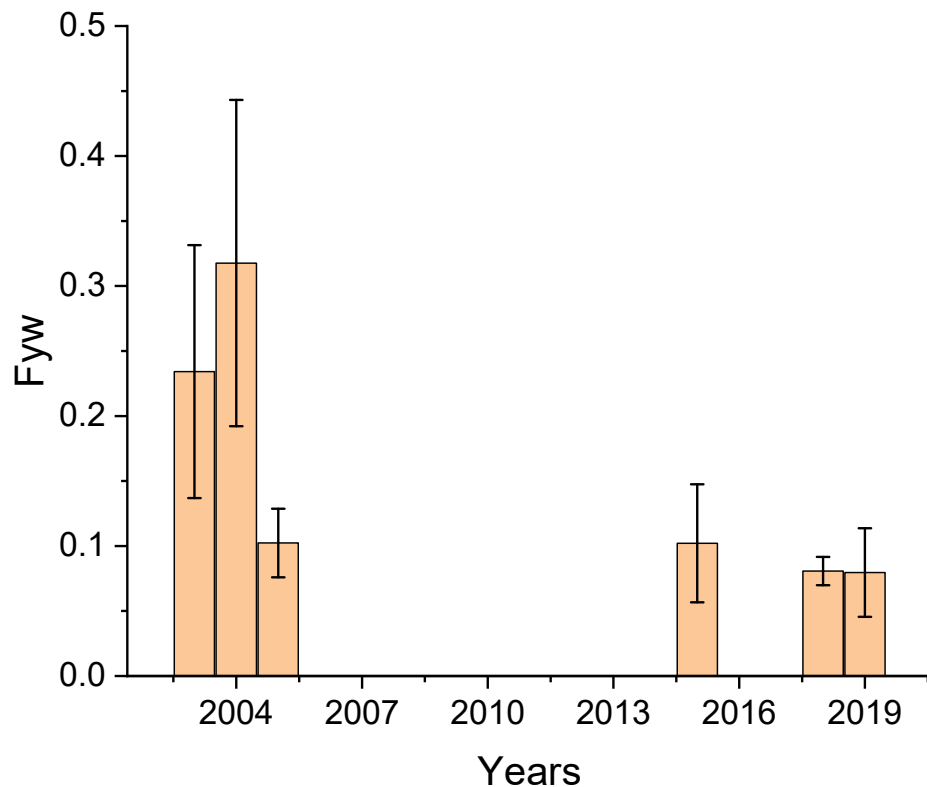
- Quality test, statistical test
- Visualization
- Simulation/modeling
- Reports and publications

Reservoirs in RRS



| Name | Country | Volume (million m ³) | Commision Year |
|------------|---------|-------------------------------------|-------------------|
| Thác Bà | Vietnam | 2940 | 1972 |
| Hòa Bình | Vietnam | 9862 | 1989 |
| Longma | China | 590 | 2007 |
| Jufudu | China | 174 | 2008 |
| Gelantan | China | 409 | 2008 |
| Tukahe | China | 88 | 2008 |
| Sinanjiang | China | 270 | 2008 |
| Malutang | China | 546 | 2018 |
| Sơn La | Vietnam | 9260 | 2010 |
| Shimenkan | China | 197 | 2010 |
| Madushan | China | 551 | 2011 |
| Lai Châu | Vietnam | 1215 | 2016 |
| Huổi Quảng | Vietnam | 184.2 | 2016 |
| Bản Chát | Vietnam | 162.7 | 2016 |
| Puxiqiao | China | 531 | 2016 |

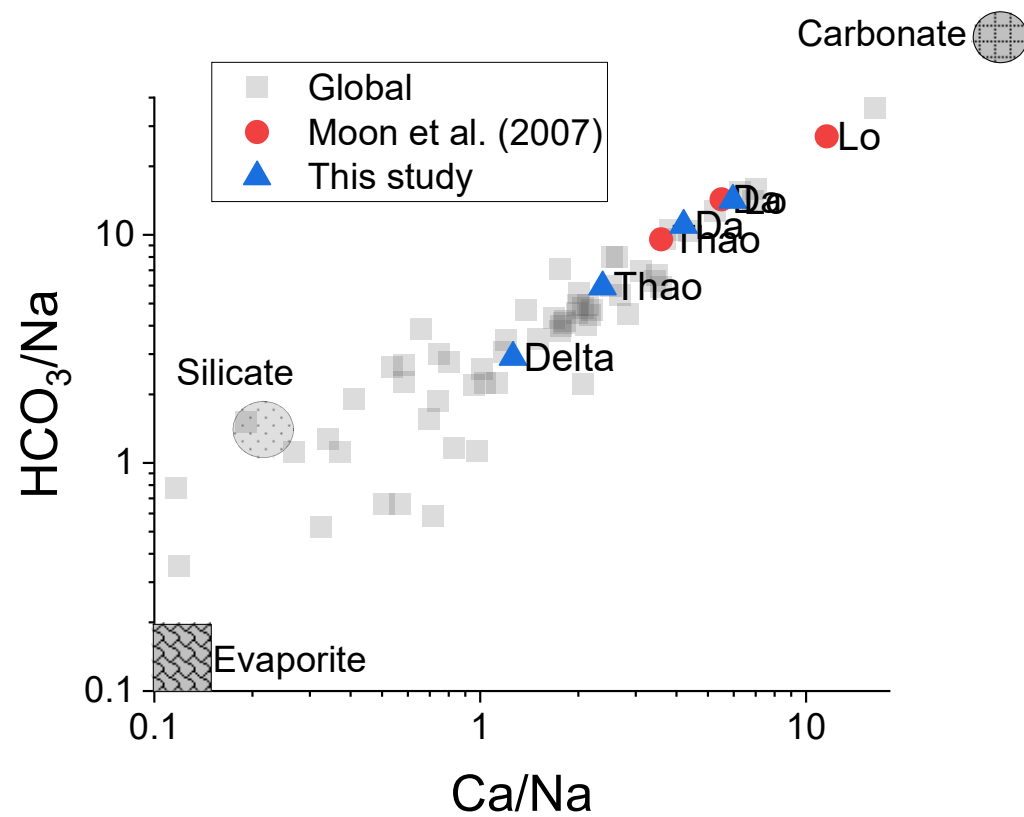
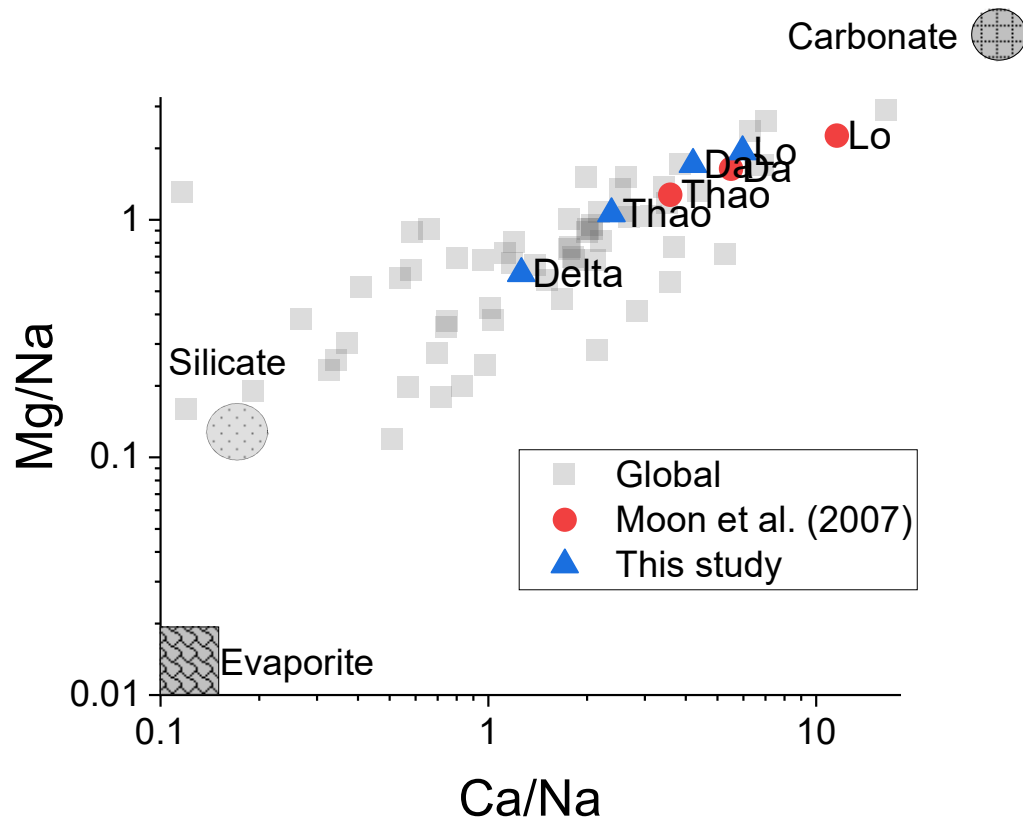
Hydrological Characteristics



Fyw - Fraction of water younger than 3 months since precipitation

MTT - Mean transit time of water in the basin

Water Chemistry



Major challenges of RRD Monitoring Management

- Trans-boundary water utilization; water resource sharing among stakeholders
- Quality degradation; water disasters
- Management challenges: lack of co- and adaptive management, coordination, cooperation both in Central and Provincial levels in the field of water resource; water management institutional changes
- Sharing - database for all the water-related activities in international river basins as well as monitoring network
- Lack of Comprehensive collaboration with various related academic fields and research institutions
- The capacity of institutions on all levels to monitor, control and sanction water use, land use or water pollution remains weak