Strengthening Hydrological Modeling Curricula in CA Universities

Lessons Learned & Recommendations from two Years of Cooperation

Meeting of the Network of Academic Society,
3rd Dushanbe Water Action Decade Conference

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Schweizerische Eidgenossenschaft
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Swiss Agency for Development and Cooperation SDC

Blue Peace Central Asia

hydrosolutions

Background

Blue Peace CA (BPCA)

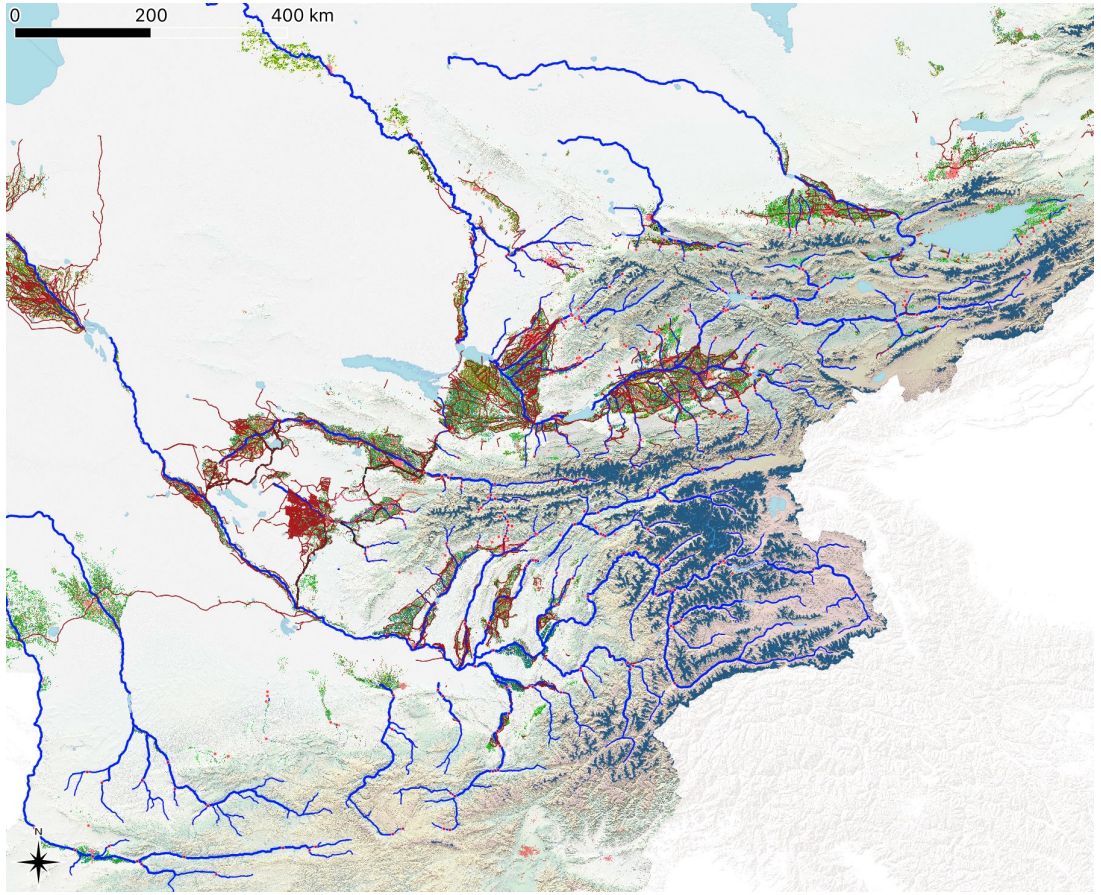
- Launched in 2010 by the Swiss Agency for Development and Cooperation
- BPCA Phase 1 (2017 – 2021) built on three pillars
  - Water diplomacy
  - Supporting action on the ground
  - Contribute to Educating future water leaders

Educational BPCA Pillar

- Support for the development of three tailored educational programs at the Masters level
  - WASH
  - **Applied Hydrological Modeling**
  - Hydrodiplomacy

MSc Course “Applied Modeling of Hydrological Systems in Central Asia”

- Educate on hydrological modeling specific to Central Asia, focusing on local hydrology and water challenges.
- Practical examples, covering fundamentals, data sources, and modeling approaches, focusing on hands-on learning.
- Open-source software and data with real-world examples encourage experimentation, replication, and adaptation to different local contexts.



Challenge: Wide Application Arena in Hydrological Modeling

Simulation of past/present conditions

- Filling of data gaps
- Resource management with elaboration of tradeoffs
- Basin planning
- Structure design

Forecasting

- Early warning (minutes/hourly time scales)
- Operational forecasting for sectors (daily/monthly/seasonal time scales)
- **Impact studies (decadal/centennial time scales)**

MSc Course Elements

- Hydrology and hydrological modeling primers
- Hydrological modeling scenarios and strategies for application
- Useful sources of relevant data and their access
- Data preparation and basin characterization
- Model implementation, calibration, and validation
- Analysis of results

MSc Course Elements

Effort

70 %
- Hydrology and hydrological modeling primers
- Hydrological modeling scenarios and strategies for application
- Useful sources of relevant data and their access
- Data preparation and basin characterization

20 %
- Model implementation, calibration, and validation

10 %
- Analysis of results

Required Knowledge & Skill Set

- Water balance analysis and understanding of key fluxes in specific contexts
- Elements of numerical modeling
- Programming
- GIS
- Writing and presentation skills

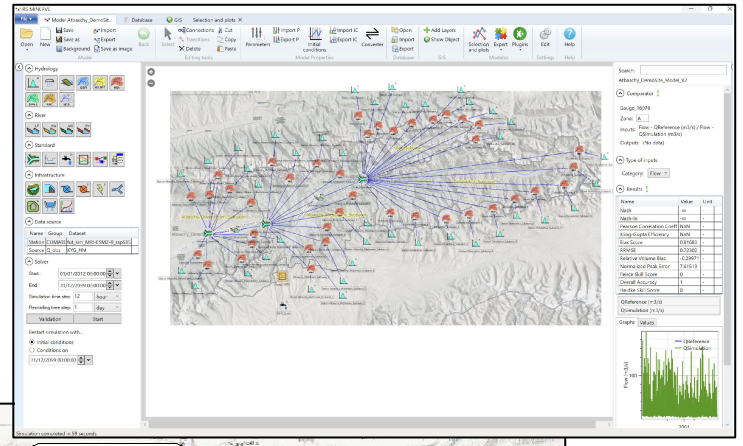
Open Access Data & Free Software

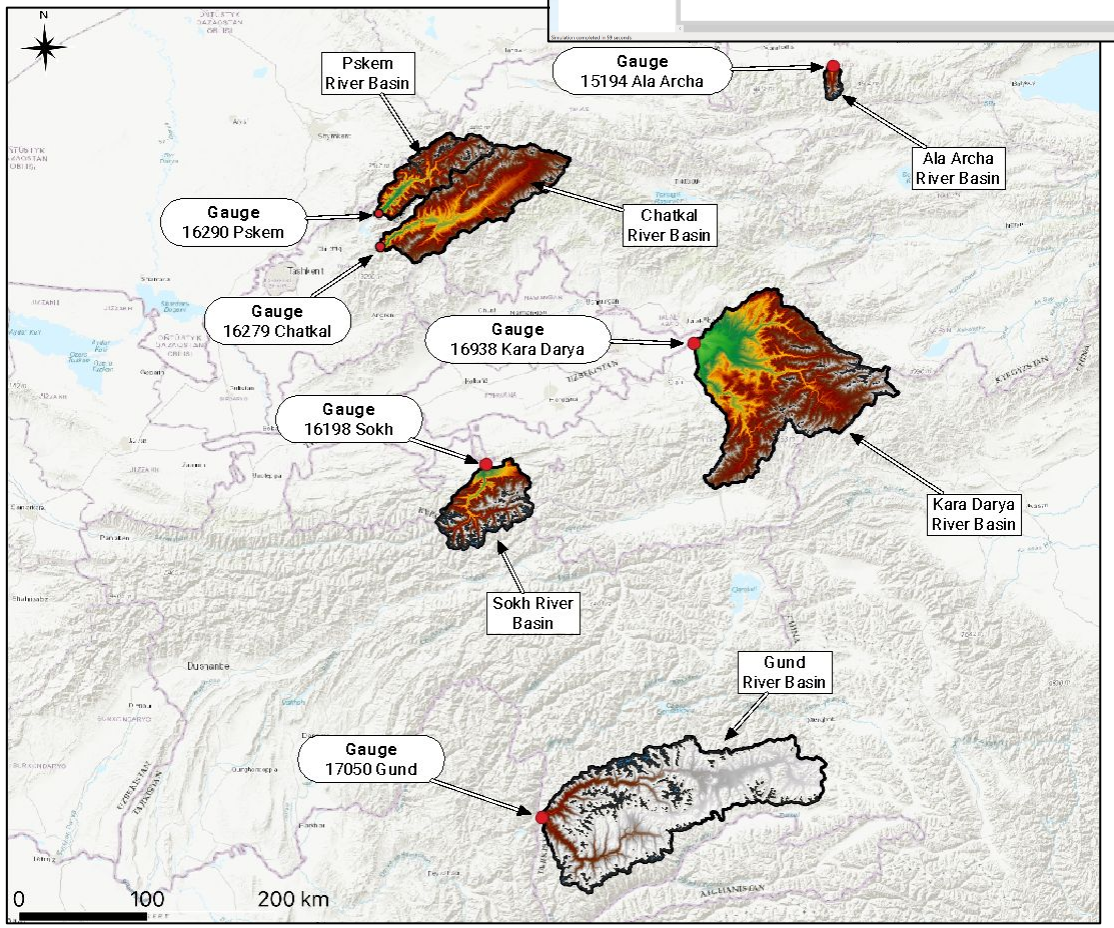
Data

- Geospatial data
- Climate and climate projections
- In-situ discharge data (where available)
- Cryosphere data

Software

- QGIS, R, RS Minerve
- R Package riversCentralAsia, hosted on GitHub

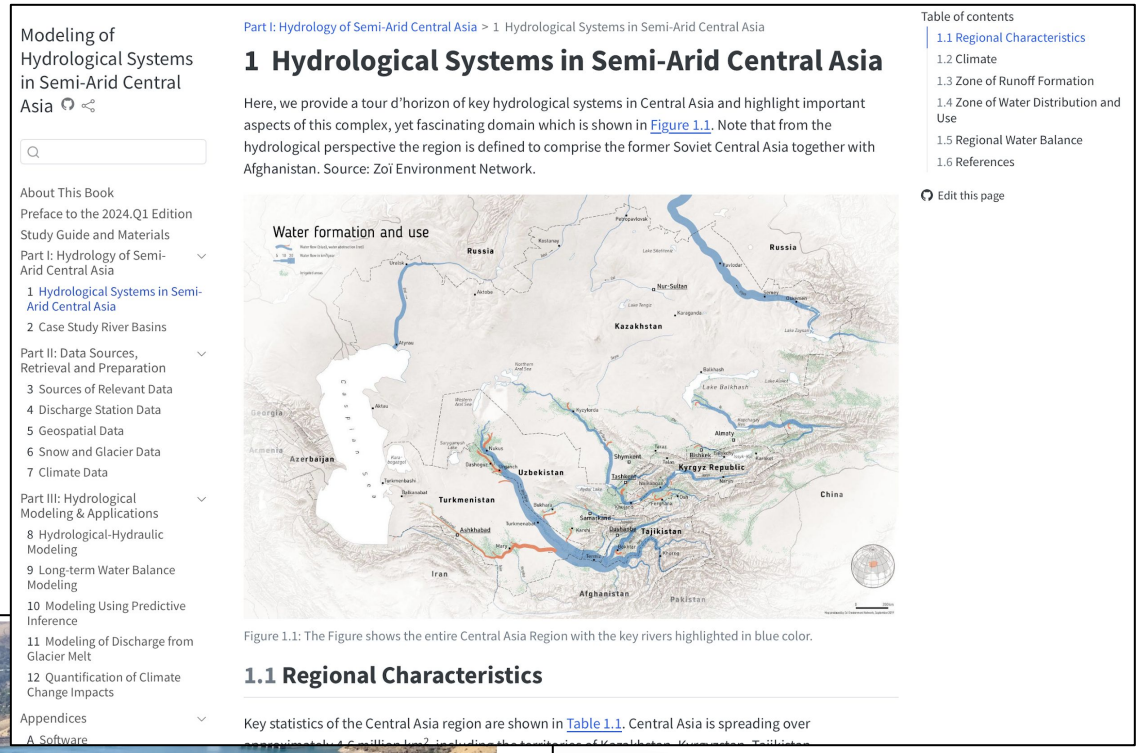


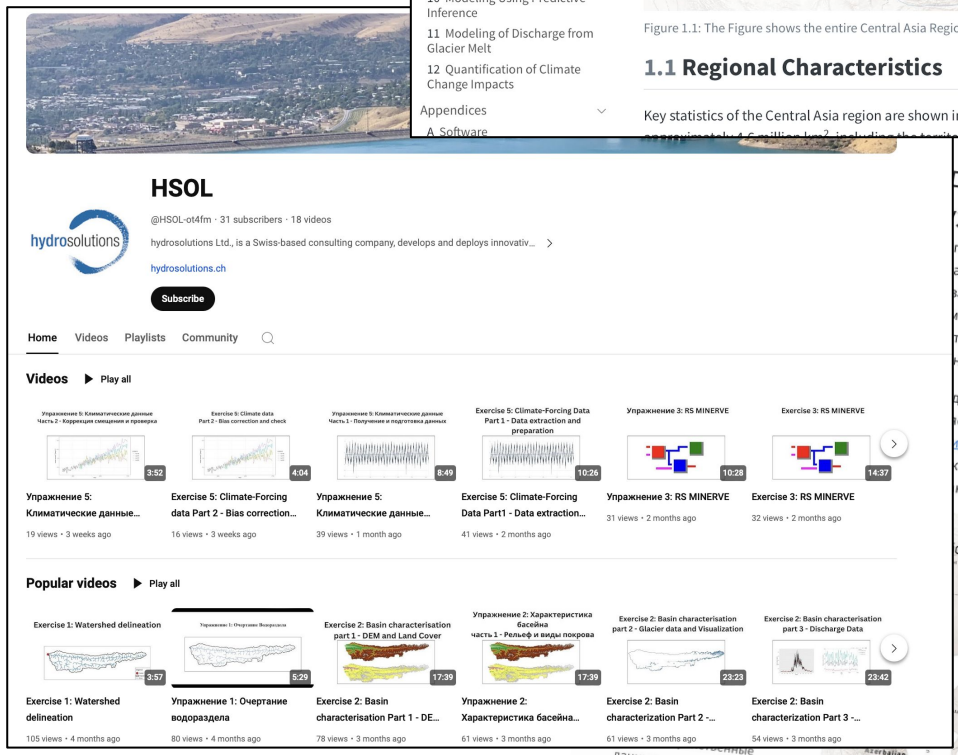


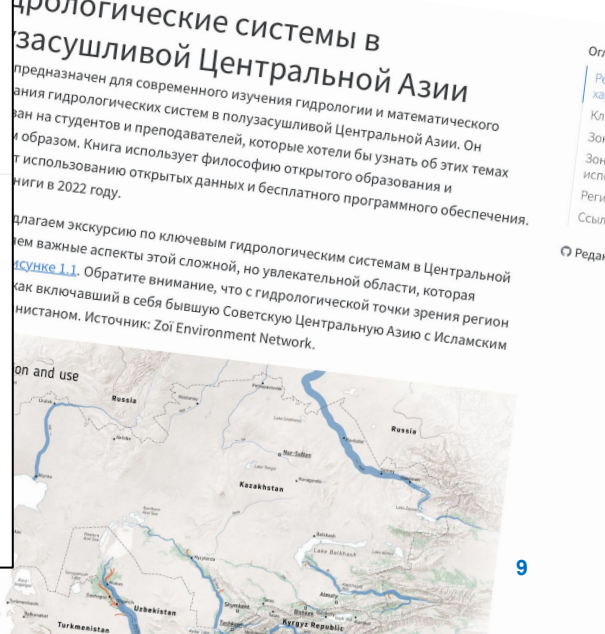
Online Coursebook, YouTube Channel

- Online, free, up-to-date with frequent improvements by hydrosolutions GmbH
- Easy online translation into local languages
- Accompanying YouTube channel Ru/En videos

Go and subscribe!

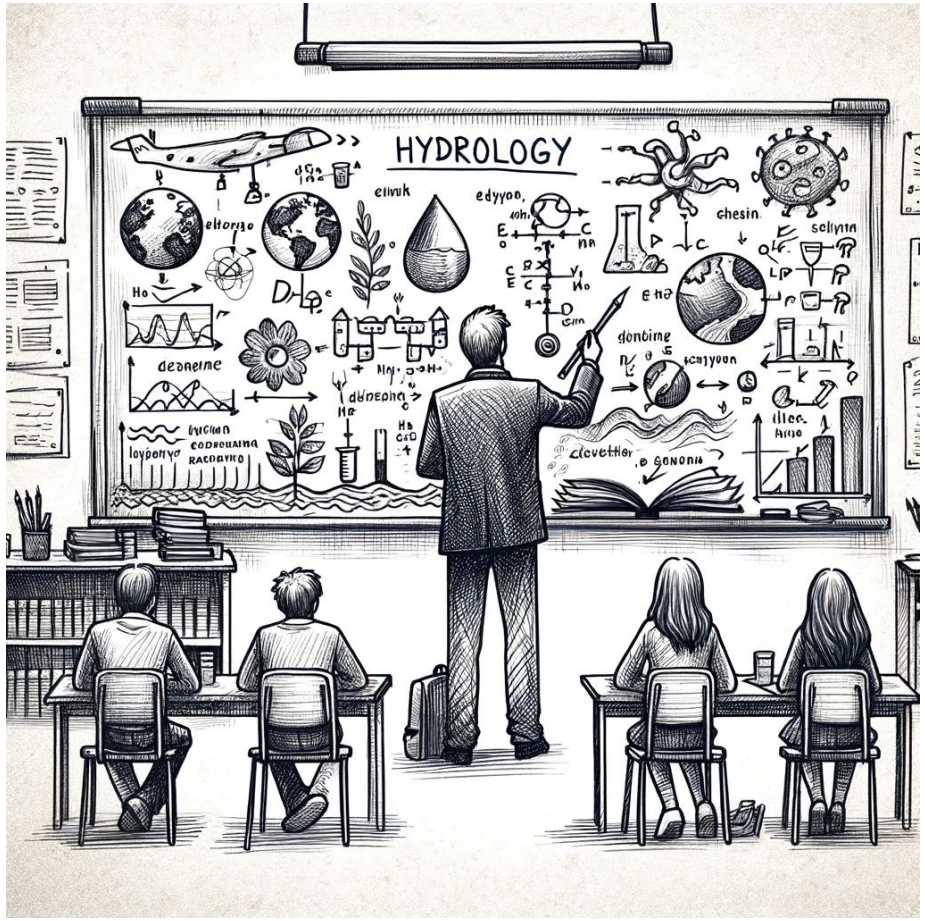






Execution

- Course integrated into German Kazakh University (DKU) Integrated Water Resources Management MSc program
- Two-week block courses at DKU 2021 – 2022 (extended to 2023) for 20 IWRM MSc students
- Two one-week training of trainers seminars in 2022. 25 teachers from 20 Universities attended
- Due to COVID-19 restrictions, all courses were held online only
- Following a subtopic-focused (modeling for climate impact), student-centered, inquiry-based collaborative learning approach



Results

- Training of 20 students and 25 professors and colleagues and friends gained
- DKU course continued for one more year despite a lack of funding
- Development of coursebook website, continued maintenance by hydrosolutions GmbH
- 2 peer-reviewed publications in international journals
- 1 scientific paper under review (MDPI Hydrology)
- 6-month visiting professor from KAZ in Zurich (additional financial support by ETH4D)
- Update of coursebook content at ETH Zurich (ETHZ) and Technical University Munich (TUM)

Learnings

Students

- Content delivery via a two-week block course format is not optimal (the topic is broad, and the required skill set is too wide-ranging).
- Learning via video lectures on YouTube is the most popular knowledge delivery format. Reading materials are rarely consulted.

Trainers

- Often unaware of opportunities for integrating open-source software and open data archives into teaching.
- Adapting existing courses requires extra work and commitment, which is critical with limited time and resources.

Recommendations

- **Embedding** Develop course in conjunction with dedicated GIS and programming courses
- **Timing** Recommendation to teach material over one semester-long course
- **Linking** Better link CA Universities with peers from Europe/US
- **Funding** Development of a local research funding stream, e.g., for research on transboundary water resources issues
- **Perspective** Donors should take a more long-term perspective when supporting education in the region (opportunity for SDC BPCA Phase 2)

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