RWaater – A Cyber-enabled Data-driven Tool for Enhancing Hydrology Education

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**Motivation**

How can we enhance students’ ability to analyze the *cause-and-effect* relations in hydrologic processes?

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**Bridging the gap in idealized classroom hydrology education**

**Interpreting real-time events from real locations**

- Data extraction
  - Not emphasizing on data post-processing
- Visualization
  - Not concentrating on how to create a plot
- Interpretation
  - Focus on the *science* part

**User-friendly tool-kit**

- Platform independent
- Scalable
  - 32-bit
  - 64-bit

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*It doesn’t work on my machine!*

*New version... Reinstall*
Introducing **RWater**

[Image of the RWater tool interface]

**RWater tool**

RWater - A cyber enabled analysis and visualization tool for hydrologic data.

- Runs in a self contained environment on Purdue’s cyber-infrastructure (WaterHUB)
  - Does not require any installation of RWater software
  - Does not store anything in user’s computer
  - All you need is a browser

[Link to the RWater tool: https://mygeohub.org/tools/rwater]
RWater: Design for Classroom Teaching

- It pulls streamflow data directly from the USGS website
  - Only required information: time period and location ID
  - Does not require any data post-processing
- Following the data-driven modules, students can write/modify R scripts to create visualizations
- Those visualizations allow users to understand the cause and effect in real world rivers
  - Making it interesting and practical
- Total 7 learning modules
  - Contained both hypothetical and real-time examples
  - Each module has a short quiz, that helps testing the lessons learnt
RWater Interface and Online Modules

https://mygeohub.org/tools/rwater
Science from RWater

Understanding Rainfall-Streamflow Relationship

Example for Cedar Creek, IN

Event 1

- Hypothetical Example
- High rainfall intensity
  - Higher peak discharge
  - Shorter Lag Time
- Low rainfall intensity
  - Lower peak discharge
  - Longer Lag Time

Event 2

RWater Example
Real-time data for Cedar Creek, IN
More frequent extreme event in recent times!

Higher Peak Discharge and shorter Lag Time!
Science from RWater
Trending Urbanization by Flow Duration Curve
Example for Chicago area

Two adjacent watersheds near Chicago area

Objective: Analyze streamflow data and comment on possible trend of LU change

Method: Flow Duration Curve?

1971-1990

1991-2010

Blackberry Creek

Indian Creek

‘higher’ high flows

‘lower’ low flows
Student-Teacher Evaluation

- **Summer Residential Program,**
  College of Education, Purdue University
  29 June – 12 July, 2014
  Total 7 High School Students (9-12 Grade)

- **RWater Teacher’s Workshop,**
  Lyles School of Civil Engineering, Purdue University
  17 – 18 July, 2014
  Total 20 Middle and High School Teachers
Student-Teacher Evaluation
Survey Results

- Testing the improvement in users’ hydrologic perception
- Pre/Post Assessment

**Student**

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<th>Pre-Assessment</th>
<th>Post-Assessment</th>
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<tr>
<td>Avg</td>
<td>66.9</td>
<td>82.3</td>
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<tr>
<td>Min</td>
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<td>Max</td>
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<td>92.3</td>
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**Teacher**

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<th>Pre-Assessment</th>
<th>Post-Assessment</th>
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<td>86.7</td>
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<tr>
<td>Min</td>
<td>50.0</td>
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<tr>
<td>Max</td>
<td>91.7</td>
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Student-Teacher Evaluation
Survey Results

- User opinion on **RWater’s Utility**
- Post Assessment

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Student</th>
<th>Teacher</th>
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<tbody>
<tr>
<td>Overall Utility</td>
<td>3.3</td>
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<td>Module Organization</td>
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<td>3.3</td>
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<td>Conceptual Development</td>
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<td>Appropriateness for Classroom</td>
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<td>2.9</td>
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<thead>
<tr>
<th>Response</th>
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<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Undecided</th>
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<td>3</td>
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Future Work

• Addition of a conceptual rainfall-runoff model with opportunities of high performance calibration
  • Making RWater a comprehensive modeling and analysis tool

• Testing RWater for upper undergraduate/graduate class
  • Making RWater applicable from K-12 to the graduate level

• Creating a database with RWater class projects from participating schools/universities all over United States.
  • This will record hydrologic assessments over the real locations across the country, being done by the students.
Thank You!

Questions?

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