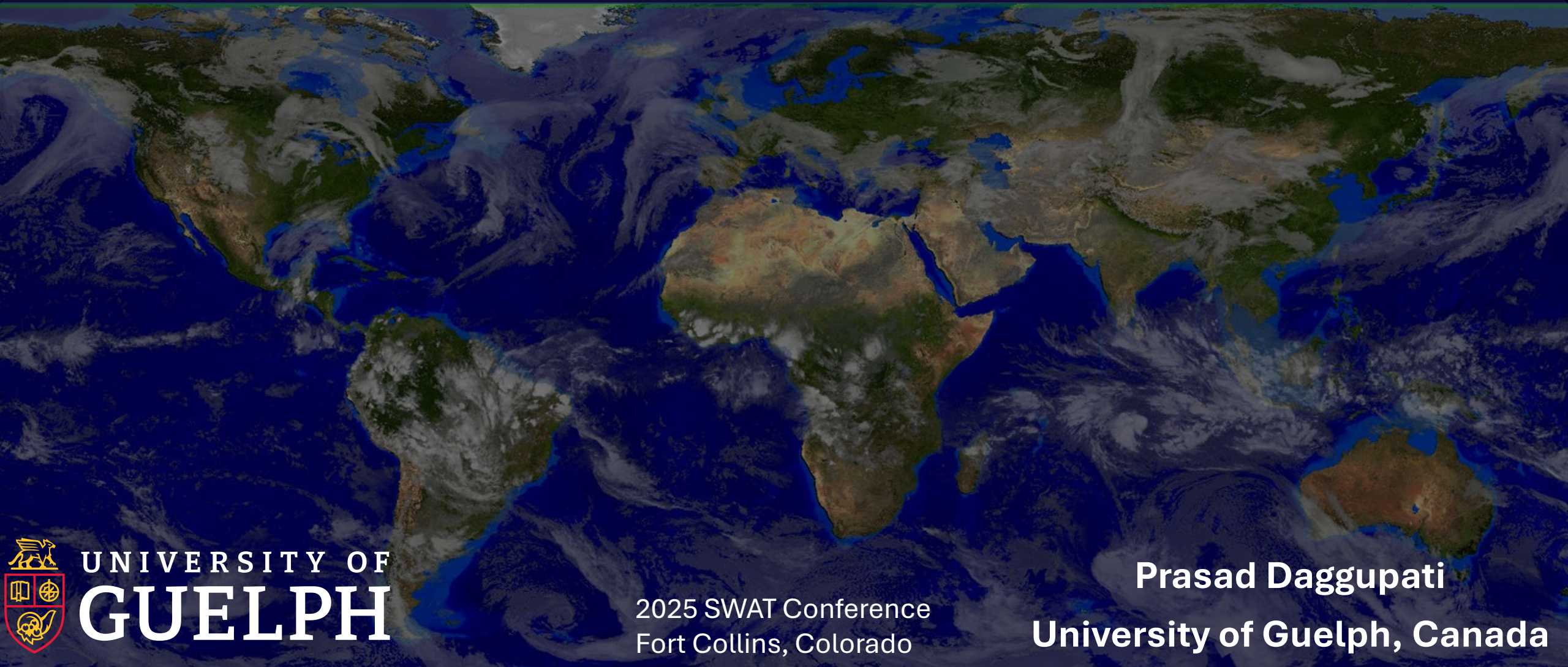
W3s: Global weather data platform, development and application



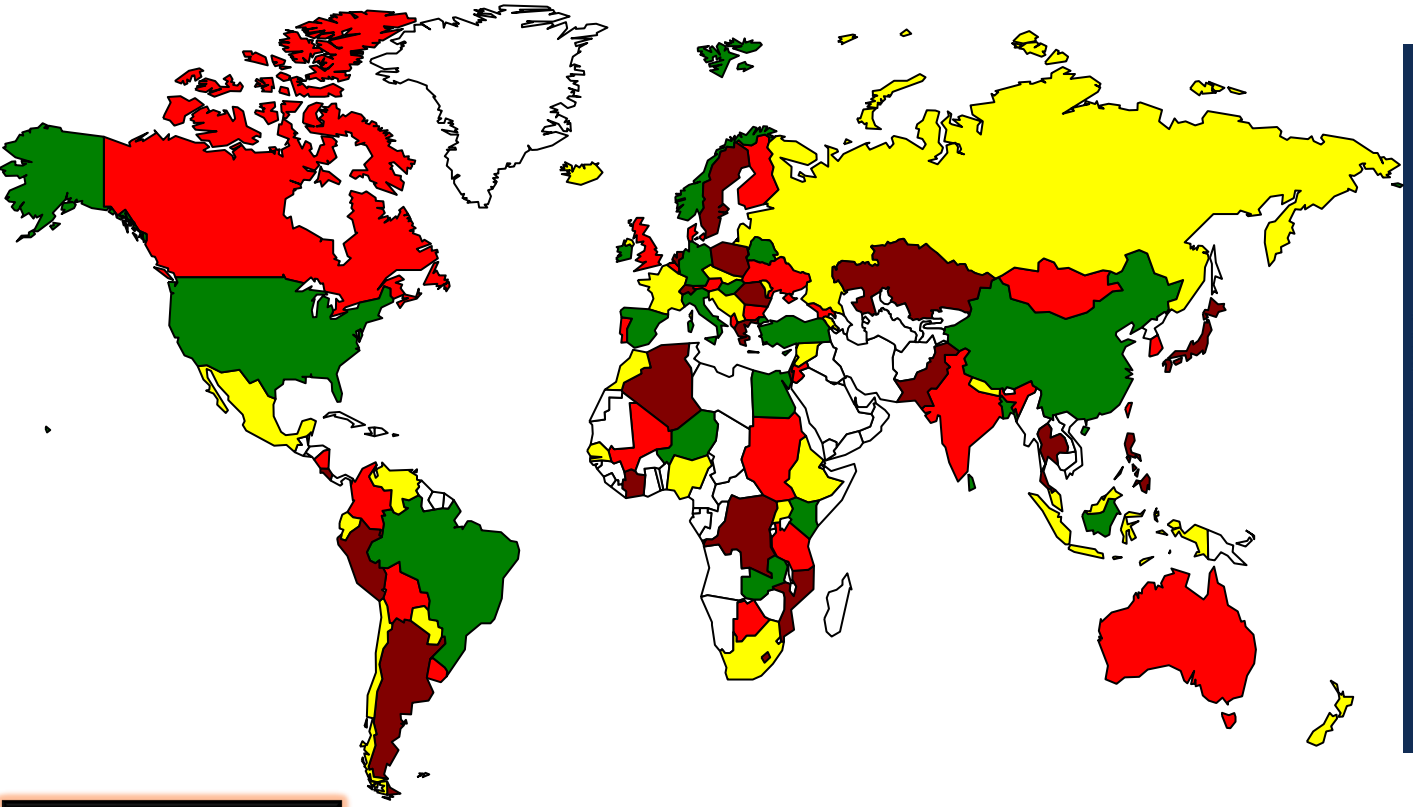
UNIVERSITY OF GUELPH

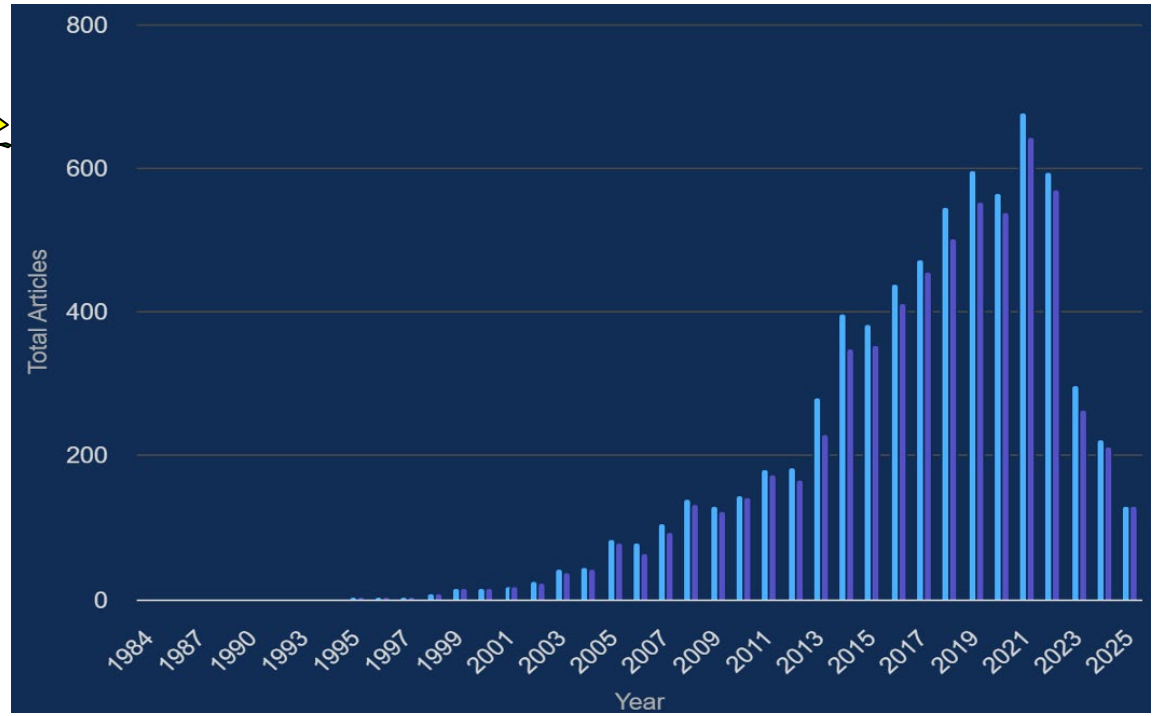
2025 SWAT Conference
Fort Collins, Colorado

Prasad Daggupati
University of Guelph, Canada

Background

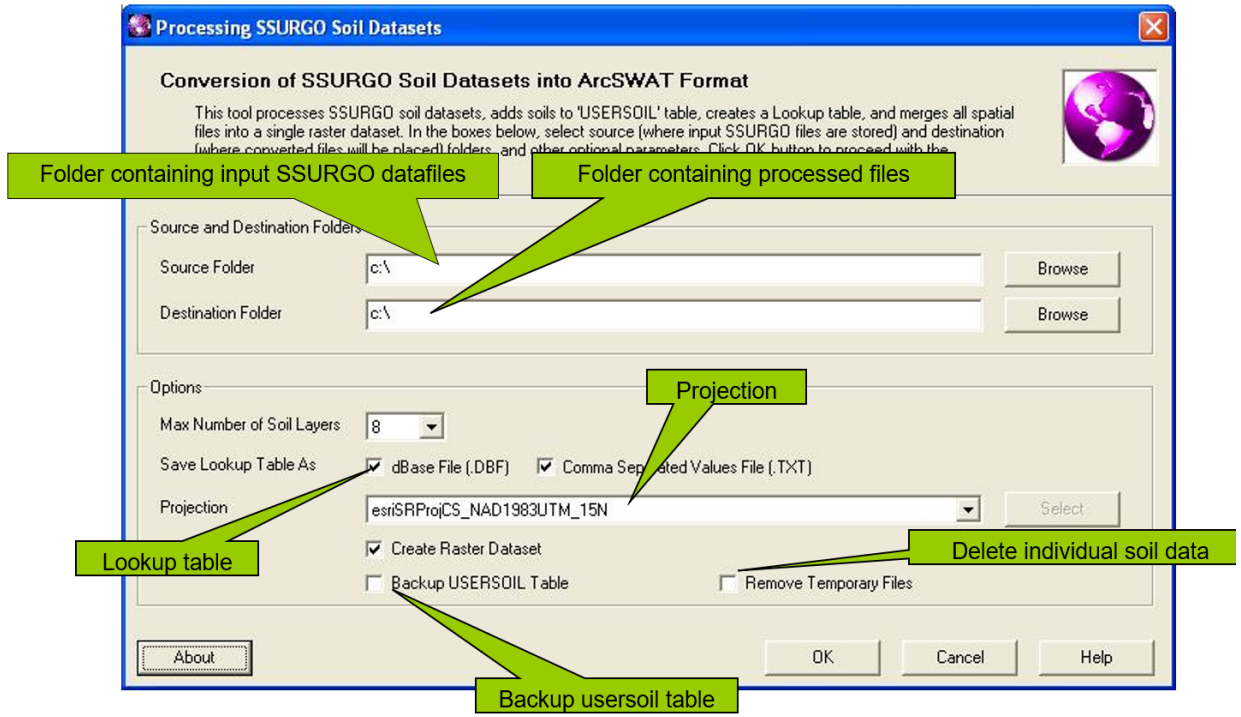
- Wanted to always develop tools that is being used by audiences/users
  - Inspired by the SWAT model and its applications globally





Background

- Developed **SSURGO Processing Tool for ArcSWAT** – 2008/2009
  - Convert the SSURGO soil datasets into ArcSWAT compatible format
    - Read SSURGO tabular and spatial files downloaded for multiple counties
    - Prepare user soil dBase data file and append it to the 'usersoil' table
    - Create a soil dataset lookup table
    - Export SSURGO spatial files into a single shapefile and optionally into a raster dataset



1.Sheshukov, A.Y., P. Daggupati, K.R. Douglas-Mankin, and M.-C. Lee. (2011) High Spatial Resolution Soil Data for Watershed Modeling: 1. Development of a SSURGO-ArcSWAT Utility. *Journal of Natural and Environmental Sciences* 2(2), 15-24.

2.Sheshukov, A.Y., P. Daggupati, and K.R. Douglas-Mankin. (2011) High Spatial Resolution Soil Data for Watershed Modeling: 2. Assessing Impacts on Watershed Hydrologic Response. *Journal of Natural and Environmental Sciences* 2(2), 32-41.

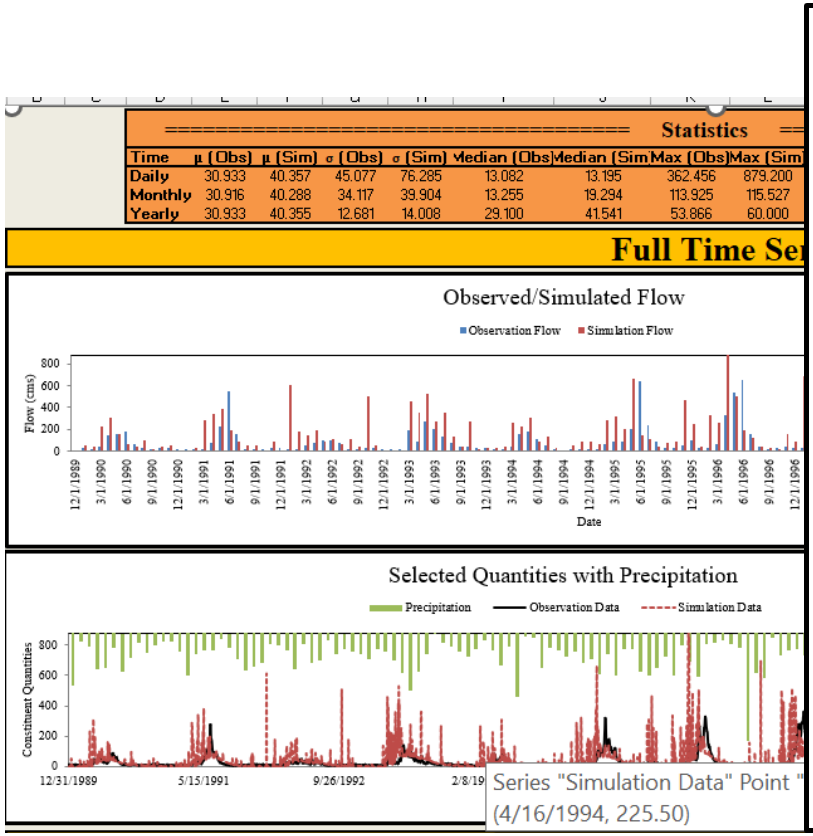
3.Sheshukov, A.Y., P. Daggupati, M.-C. Lee, and K. Douglas-Mankin (2009) ArcMap Tool for Pre-processing SSURGO Soil Database for ArcSWAT, *Proceedings of the 5th International SWAT Conference*, Boulder, CO, Aug 5-7, 2009, 8 p .

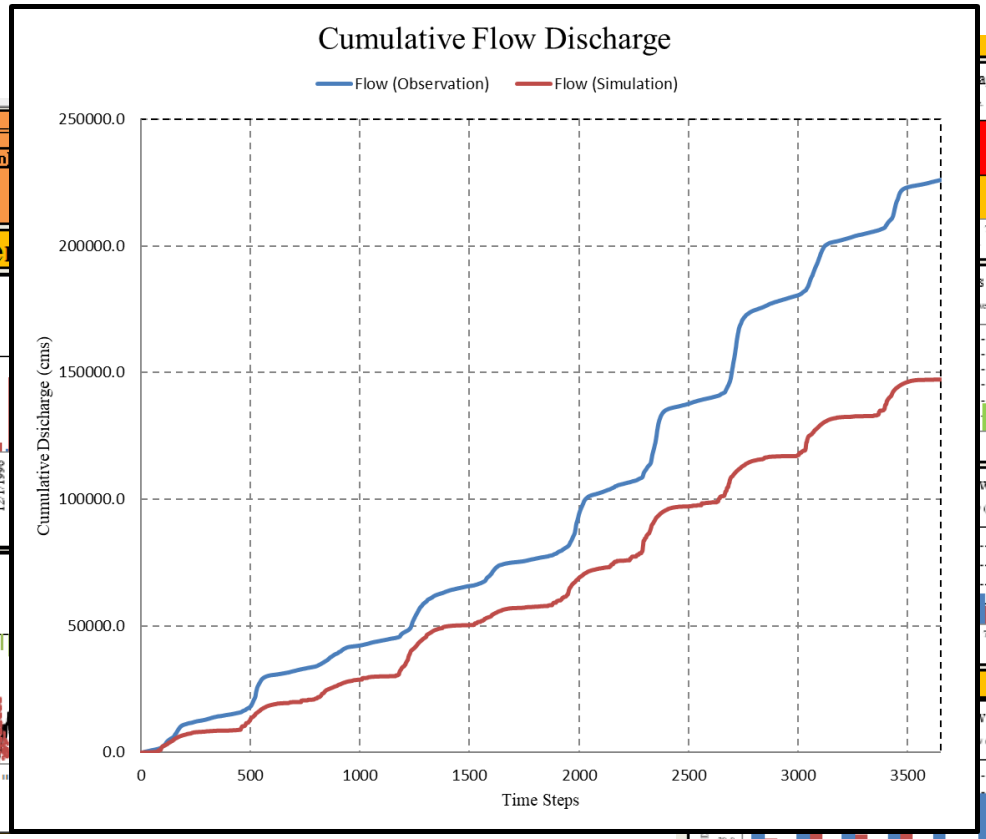
Download files:

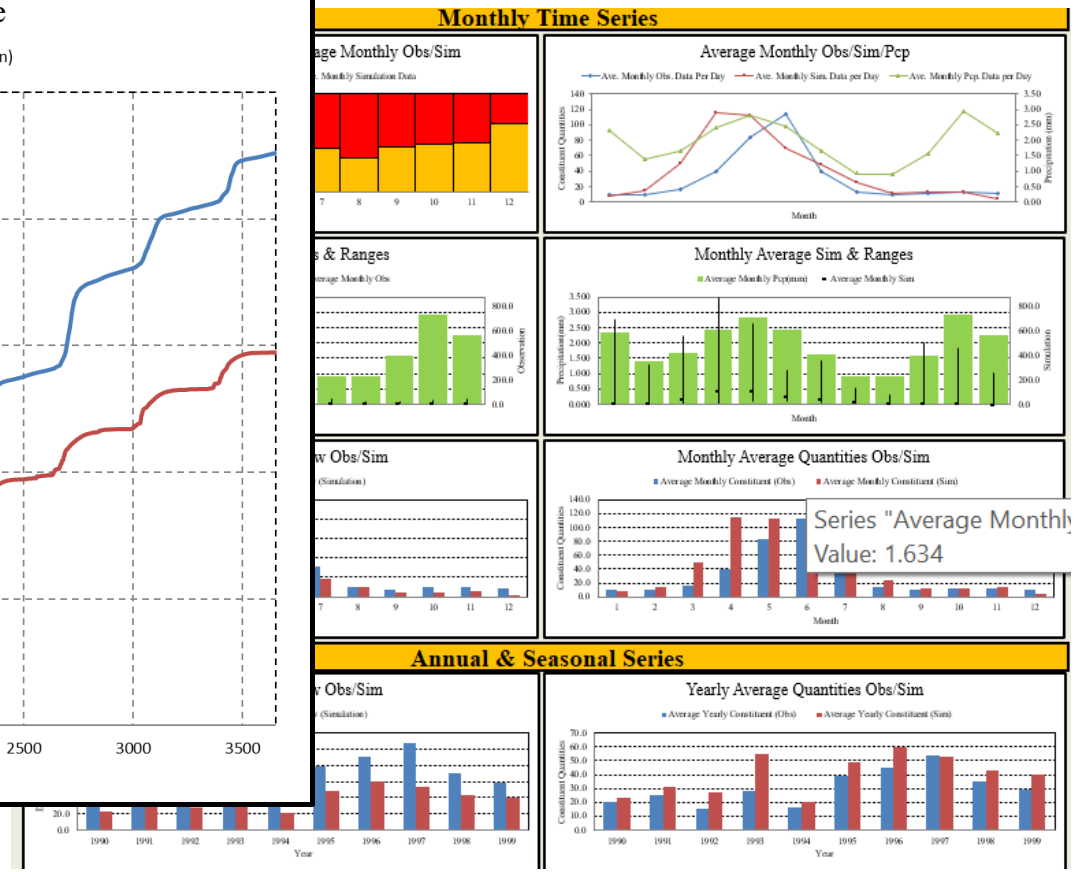
Files:	Version	Date	Description
EXE file	0.9.c	04/06/2010	Single installation file. Standard Windows installation wizard.
User guide		5/31/2010	Quick and brief user guide on installation and use of the tool.

Background

- **SWAT calibration results interface** – EXCEL – 2013/2014





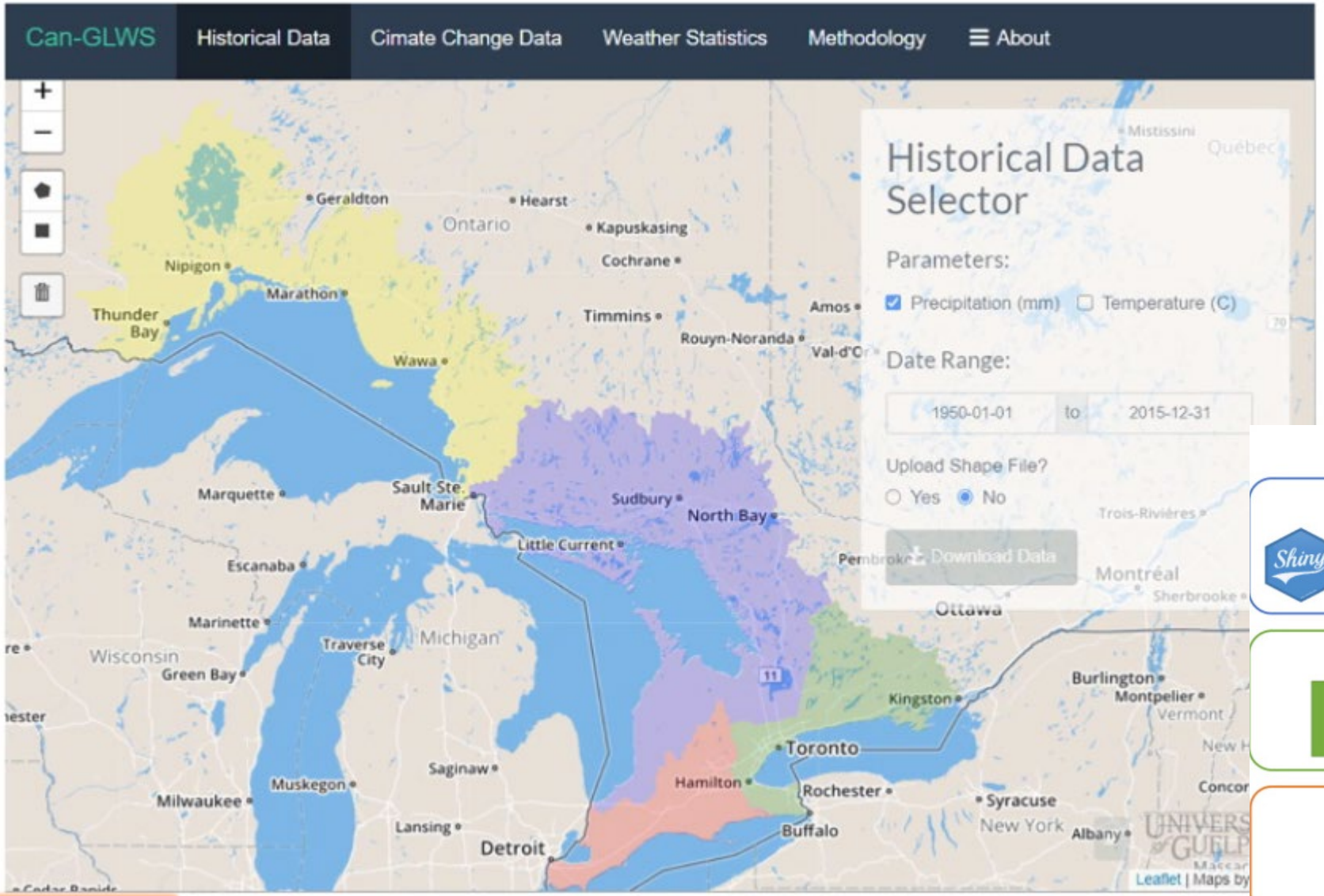


Still being used by out group but did not go public

Background

- **Can- GLWS – Canadian Great lakes Weather Service (2018)**
  - **Historical Precipitation and Temperature – NRCAN climate reanalyzed data (1980 to 2020)**
    - This dataset (300-arc-second resolution) was generated by interpolating quality-controlled gauge data using the ANUSPLIN thin-plate spline method
  - **Climate change data (2020 to 2099) – Pacific Climate Impact Consortium (PCIC)**
    - statistically downscaled at 300 arc seconds (~10 km)
  - **Weather Generator database**

Background



Can-GLWS Web Service Platform

Web Application Framework

Shiny · docker · R · mapbox · Leaflet

Data Processing and Storage

- NetCDF + Python
- GDAL
- SWAT-ready Weather Data

External Data Repositories

- NRCan Repository
- PCIC Data Portal

Background

- Meteorological data (precipitation and temperature) is vital for climate variability studies, water resource assessment, ecological modeling, and flood forecasting.
- Declining surface weather stations observed globally:
  - Colombia: rainfall stations reduced from ~1500 (1980s) to ~1000 (2010s).
  - Similar trends in the Sahel, tropics due to budget cuts and uneven network coverage.
- Remote and mountanious regions often remain ungauged or poorly monitored.
- Existing gridded reanalysis datasets (APHRODITE, CFSR, TRMM, AgMERRA, CHIRPS) help fill data gaps
  - They use **satellite observations and models** to estimate rainfall and temperature at fine spatial resolutions (10km by 10km)

Background

- Reanalysis Data are often stored in formats like NetCDF, ASCII, or binary, which are not directly compatible with the formats used by SWAT or other hydrological models.
- Reanalysis data comes at different spatial and temporal resolutions
- Reanalysis data must be **converted** to a compatible format
- Many users donot have the technical capability of converting reanalysis data to SWAT format and is also time consuming

Goal

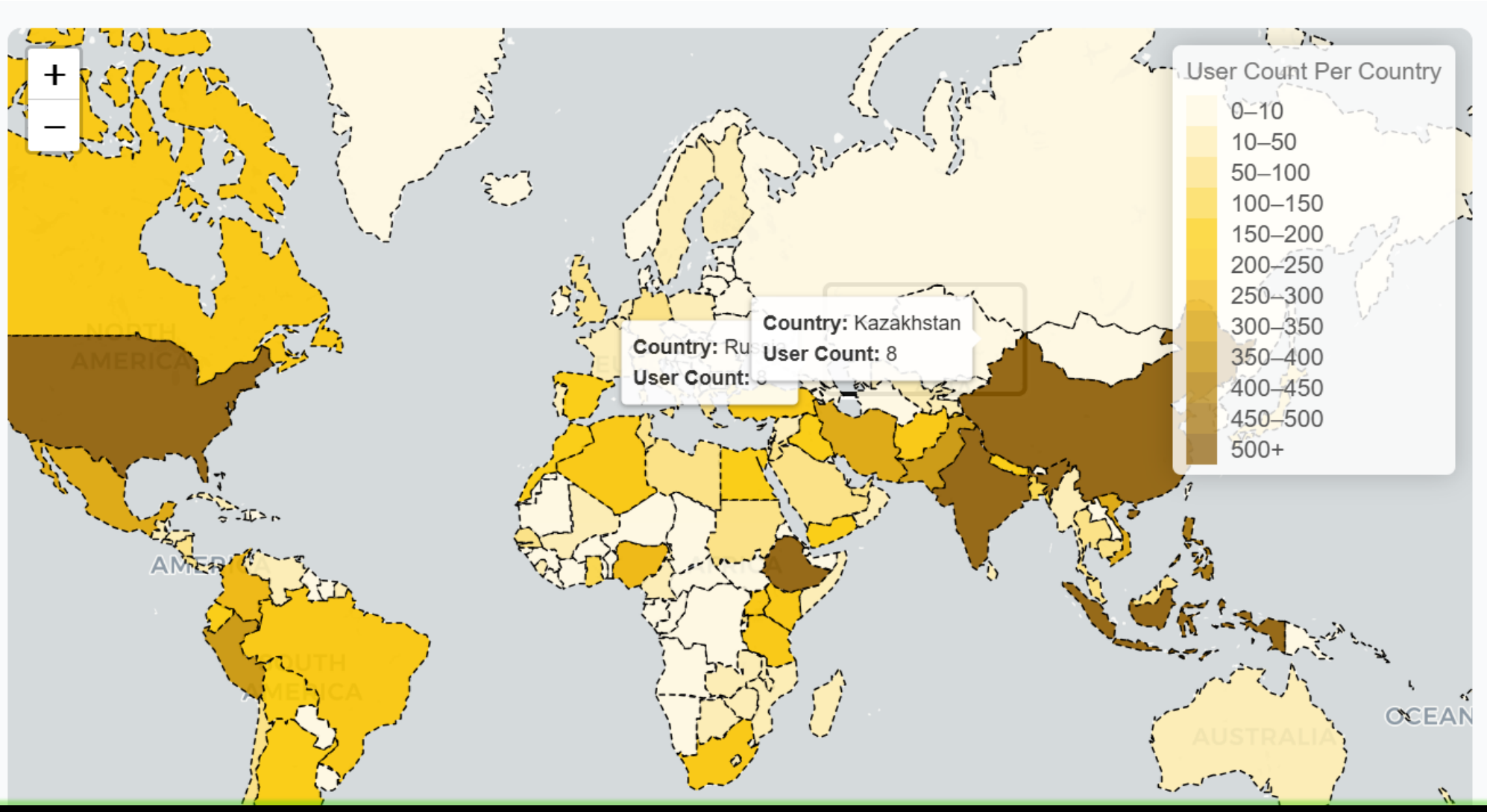
- Develop an **easy-to-use GUI platform** providing **near real-time, high-resolution weather data** (rainfall, max/min temperature)
  - Users can download weather data for region of interest
  - Use in hydrological models

W3s – Weather Platform

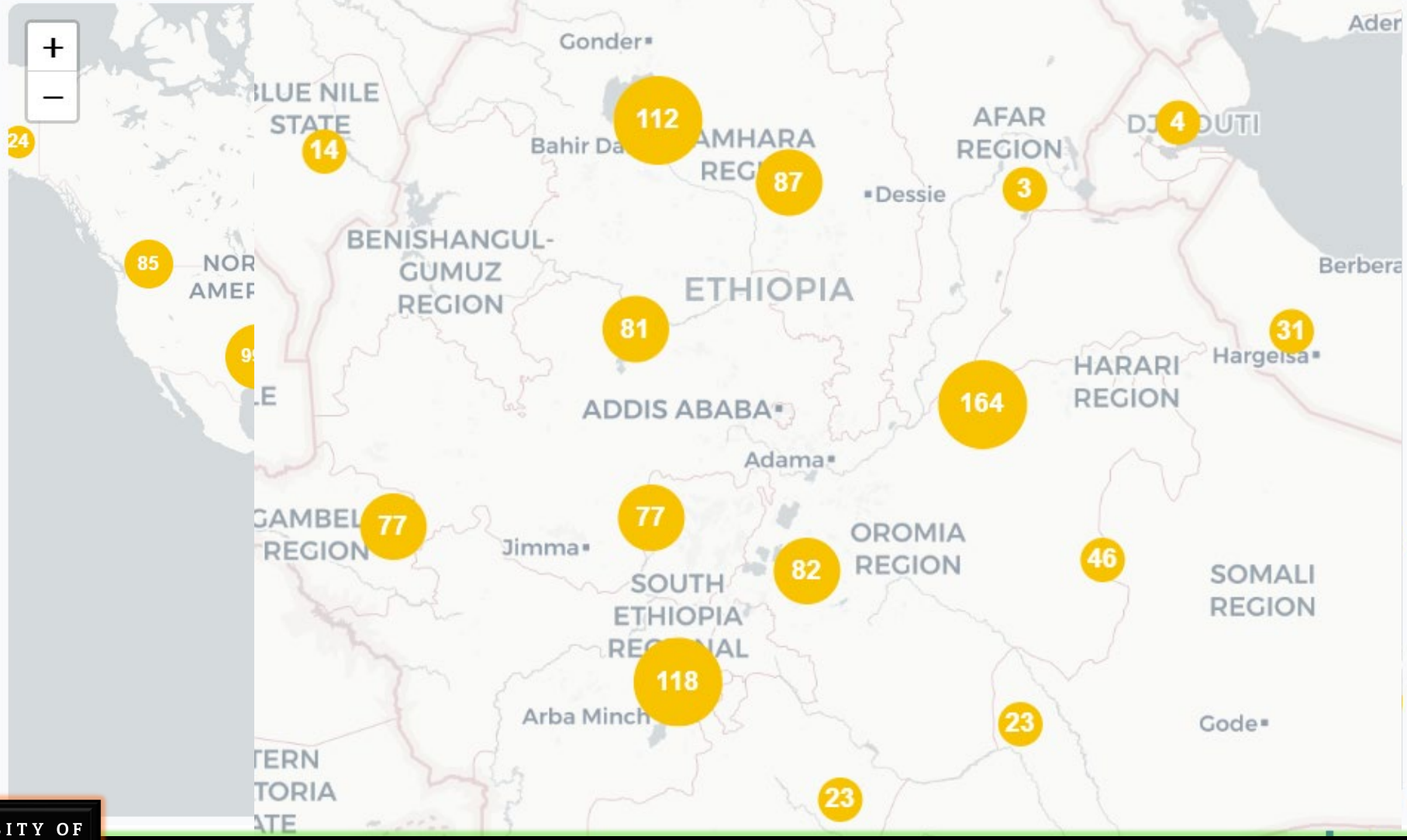
- The World Weather for Water Data Service (W3S) is a Data as a Service (DaaS) platform that enables users to download various climate data products, such as precipitation, maximum temperature, and minimum temperature, from popular sources.
  - Data source
    - IMERG, CPC
    - CHIRPS, CHIRTS
    - MSWEP
  - Users can define their region of interest within any watershed globally. The weather data is available in multiple formats compatible with hydrologic models like SWAT, as well as in generic CSV format for other models.
- Essentially, W3S serves as a global weather data hub, designed to help users quickly develop both conceptual and data-driven rainfall-runoff and hydro-ecological models.

DEMONSTRATION

W3s – Weather Platform



W3s – V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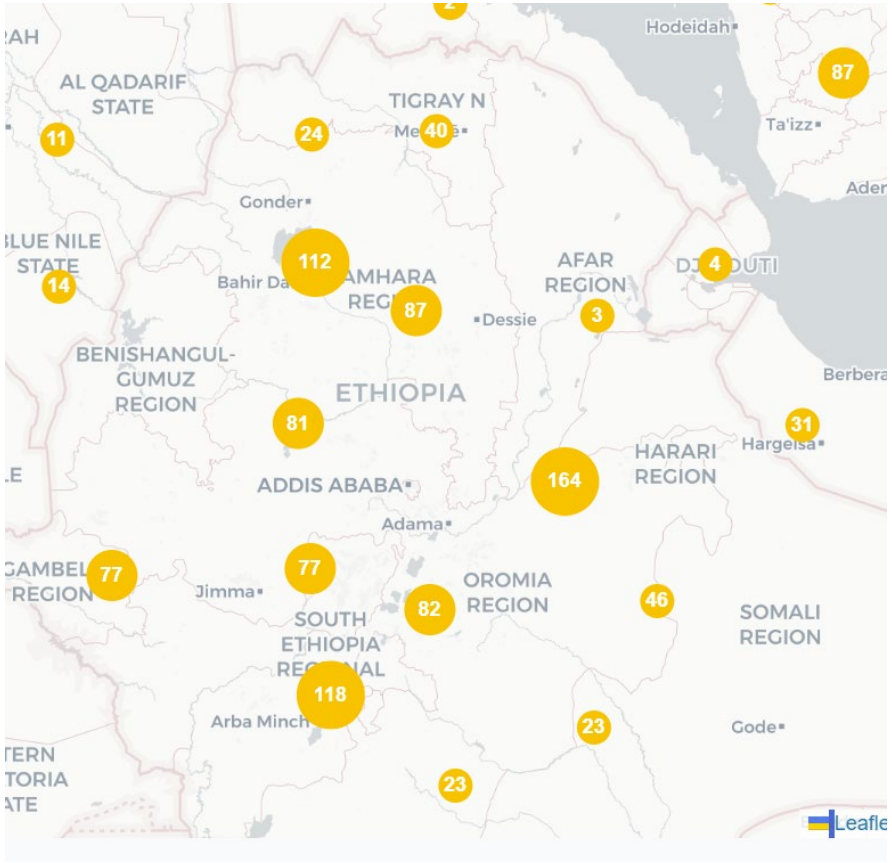
W3s – Weather Platform



Contributors and Collaborators

Faculty and Staff

- **Prasad Daggupati**, University of Guelph - Overall management and direction of the project and oversees the development and implementation of the platform
- **Asim Biswas**, University of Guelph - Contributes invaluable ideas, support, and direction
- **Raghavan Srinivasan**, Texas A&M University - Playing a key role in the global reach and innovation of our climate data portal
- **Matthew Kent, Joel Best, Bogdan Bunescu**, University of Guelph - Overall management and maintenance of the servers, coding new features, and ensuring the safety and security of our climate data portal

Developers

- **Taimoor Akhtar**, University of Guelph - Lead developer: Developed the core functionalities of the application.
- **Steven Mugisha Mizero**, University of Guelph - Lead developer, Active maintainer, Developed data processing modules
- **Leo Bantolino**, University of Guelph - Lead developer, Developed data automation modules, Managed networking, Built and managed CI pipelines, Implemented test suite
- **Mugesh Raj Krishnamoorthy**, SRM College, India - Developer & Data analysist, Developed MSWEP processing modules, Implemented MSWEP UI features

Data Analysis

- **Uttam Ghimire**, University of Guelph, ON and Stockholm Environment Institute Asia Center, Bangkok, Thailand - Data analysist: Analyzed and processed the climate data.
- **Narayan K. Shrestha**, University of Guelph - Data analysist: Analyzed and processed the climate data.
- **Pranesh Kumar Paul**, University of Guelph - Strategic consultant: Supported the project by providing critical insights and support

Collaborators

- Greenland International Consulting Ltd
- Texas A&M University

THANK YOU

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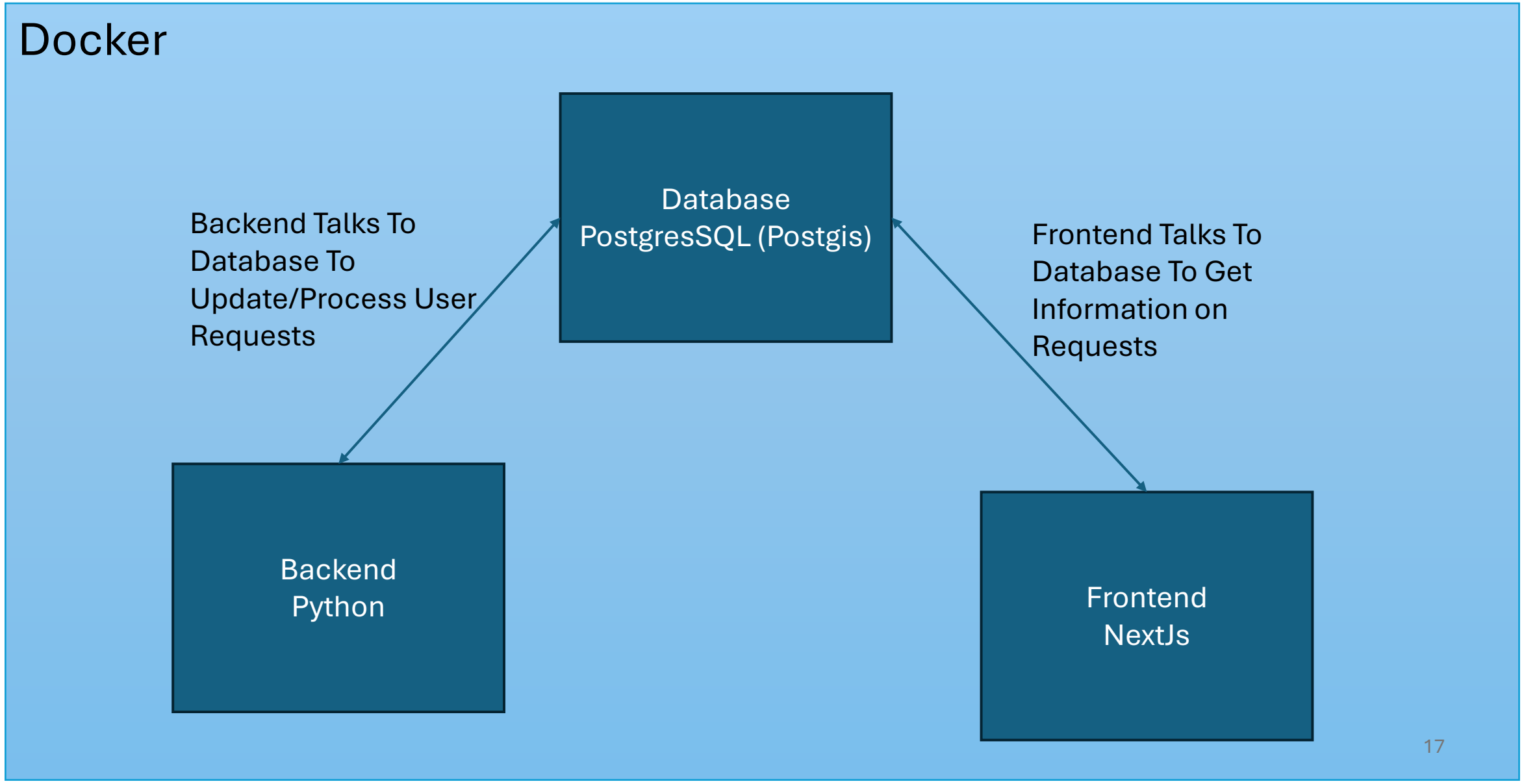
Technologies



Request Workflow