Coupling the Short-Term Global Forecast System With Disturbed Watershed Models: Implication for Landscape Management

Andrew Sommerlot, Daniel Fuka, Moges Wagena, and Zachary Easton
Department of Biological Systems Engineering, Virginia Tech

Overview

Introduction – Why short-term?

Methods – forecast framework development

Results - Hindcast Validation

Application – Distributed Hydrology forecast

Future Work – Further development

Intro

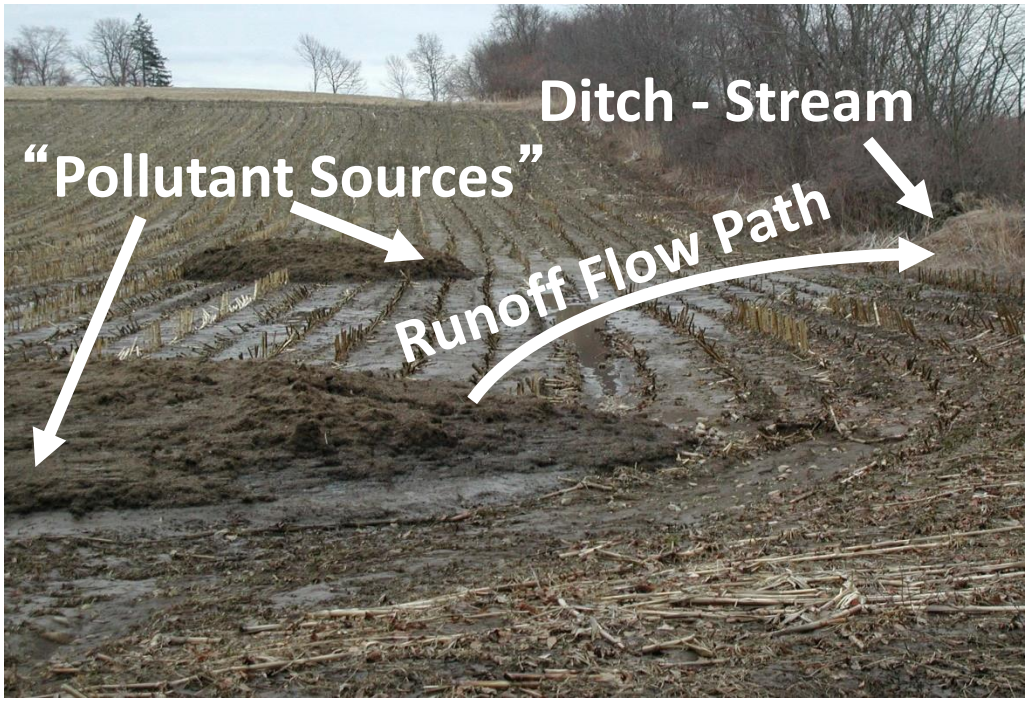
Studies exist incorporating long-term future climate projections into hydrologic models

These studies cannot accurately predict daily hydrology in the short-term

Why short-term?

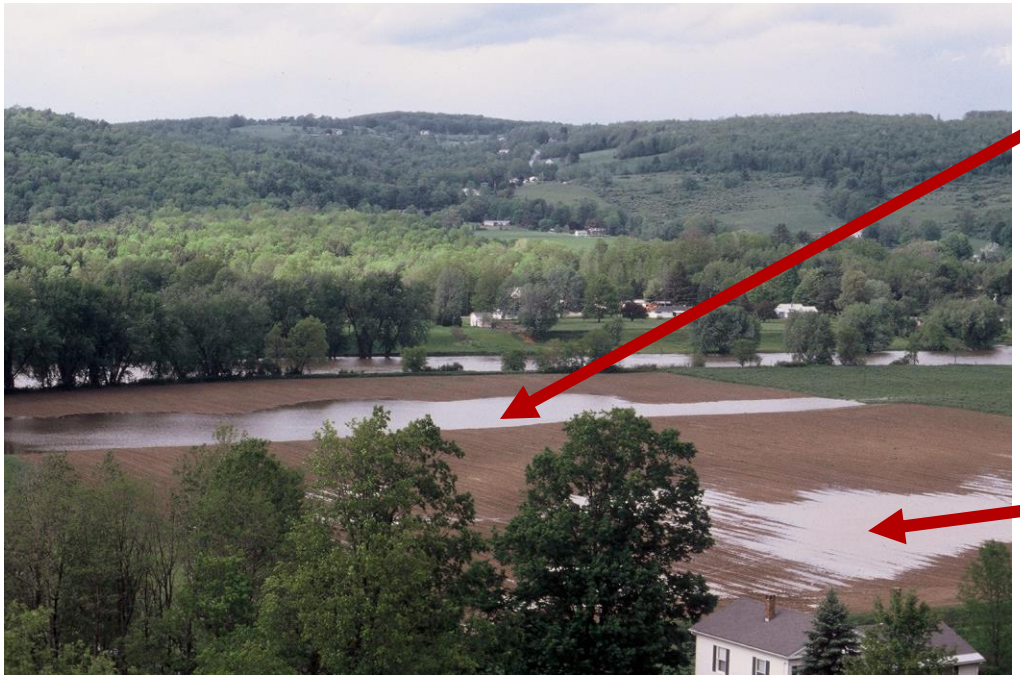
Intro

Variable Source Area (VSA) hydrology plays a major role in runoff and pollutant transport



Saturation-Excess driven runoff on agricultural land

Motivation



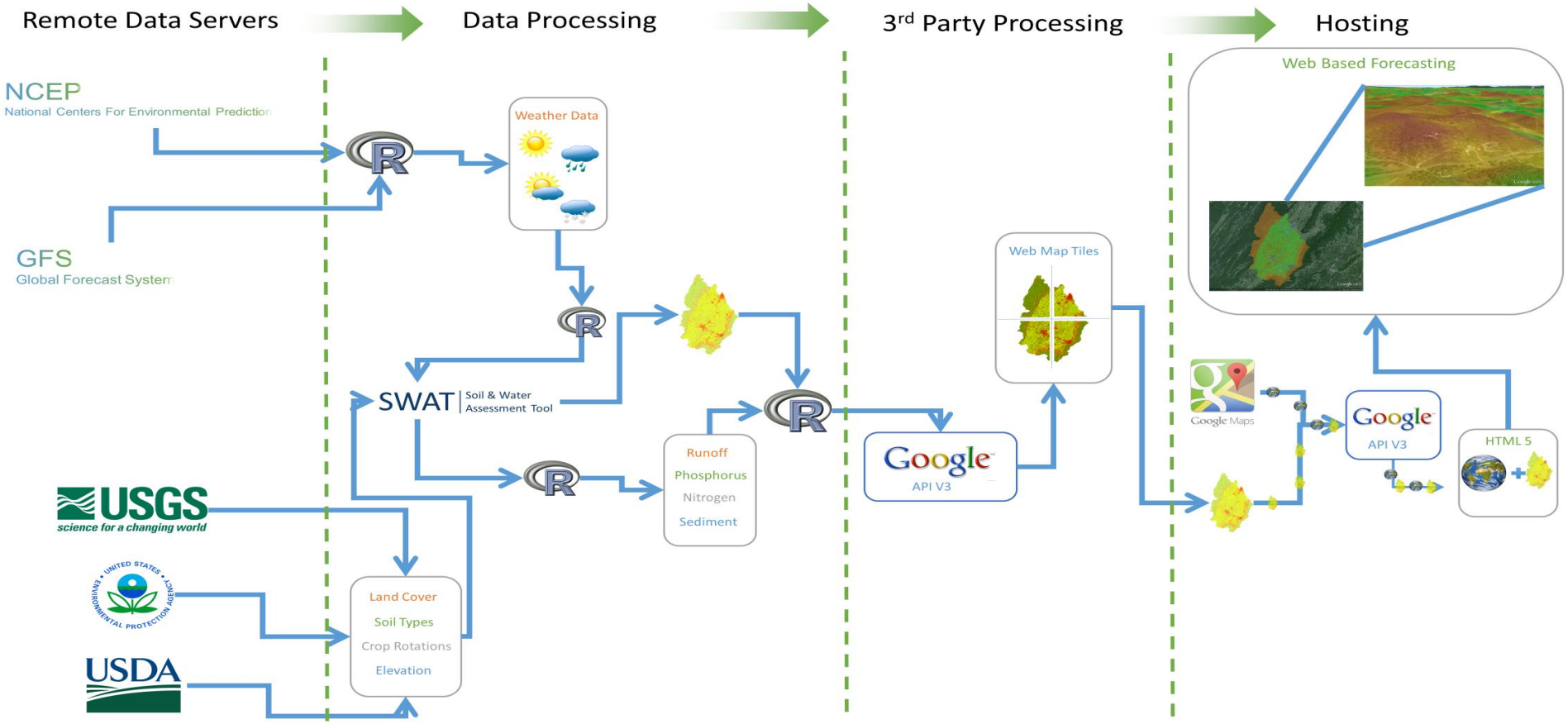
Identify short-term high risk areas to better inform management practices

Intro

When and where should we spread manure, fertilizers, etc?

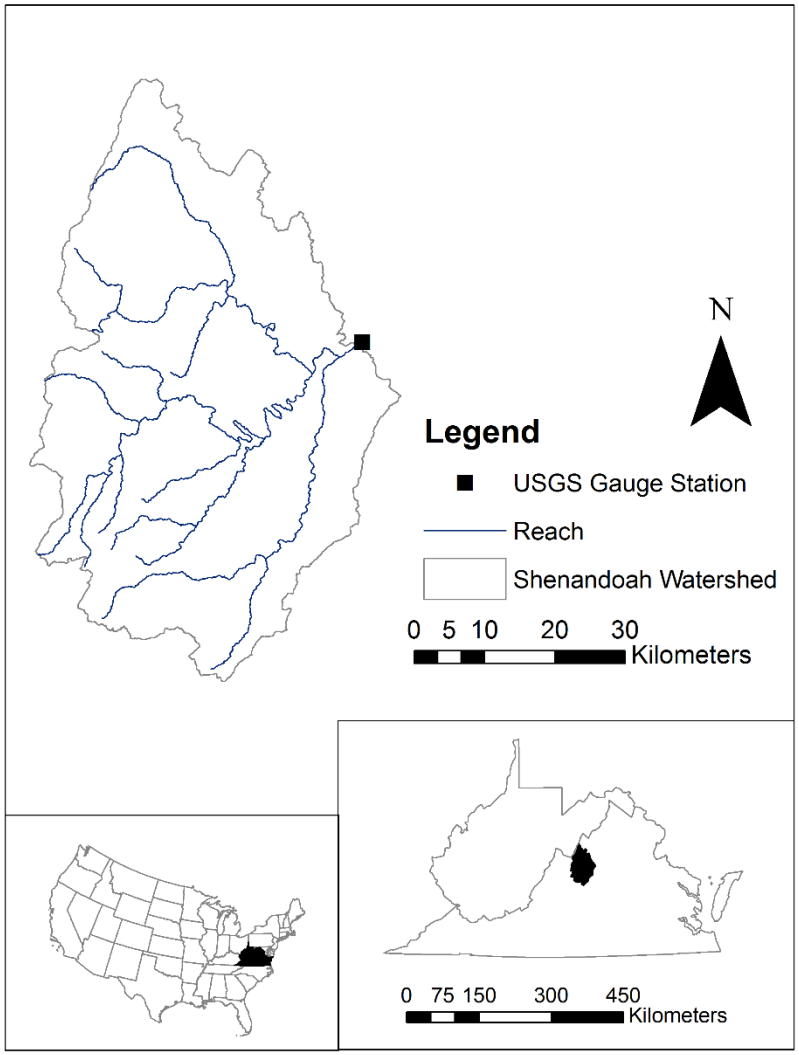
Objective: Provide sub-field scale short-term distributed hydrology forecast to inform landscape management decisions

Forecast Framework



Sommerlot et al., 2015

Study Area: SF Shenandoah



Identified by the EPA as a Critical Nitrogen and Phosphorus Source to the Chesapeake Bay

Landuse Profile

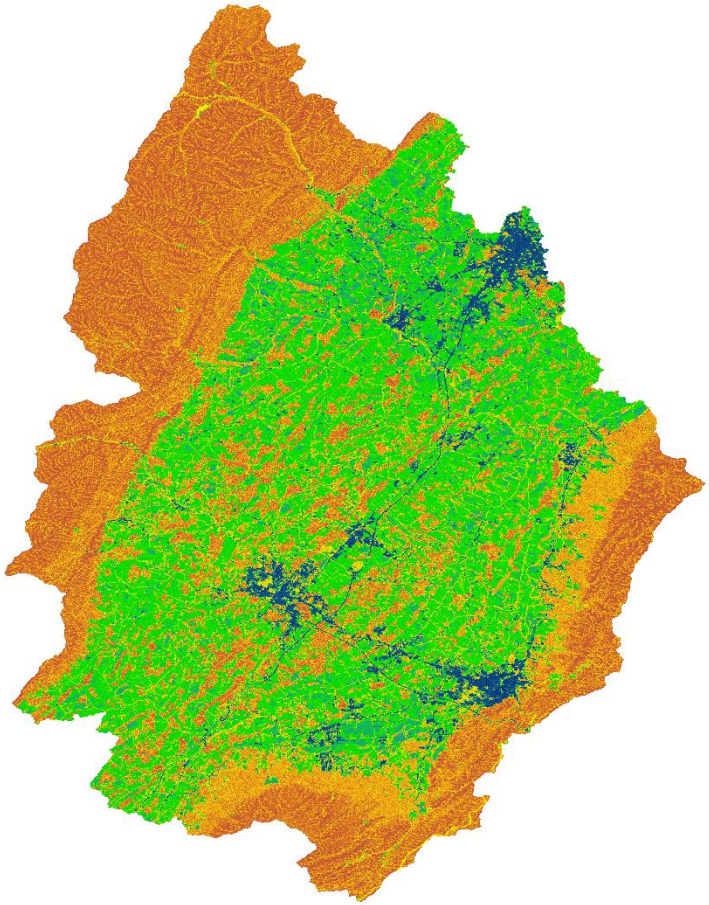
Area - 2600 km^2

Forest - 50%

Agriculture - 38%

Urban - 11%

Model initialization



We want detailed distributed hydrology

TopoSWAT used for SWAT-VSA initialization

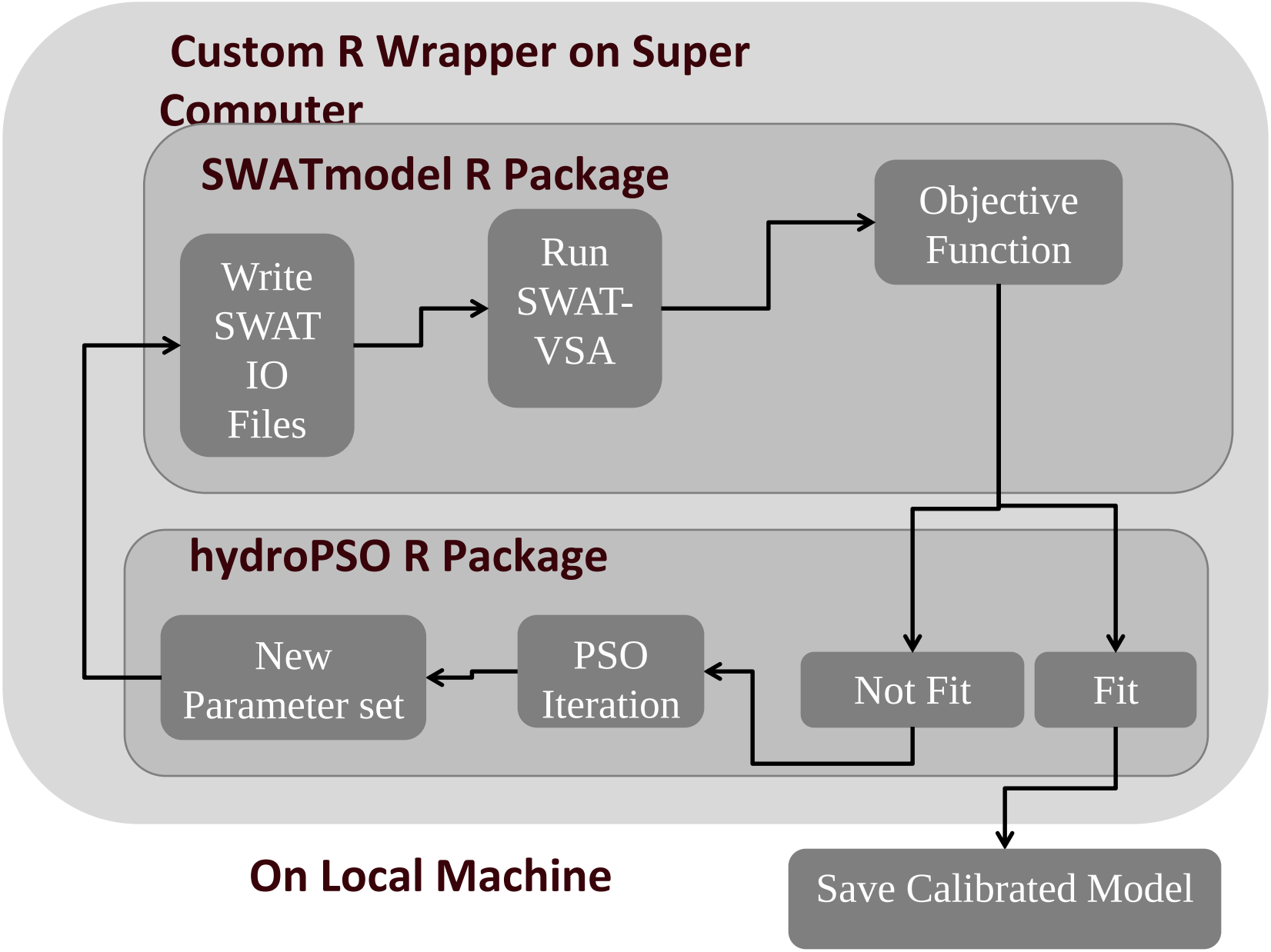
No HRU thresholds for full hru definition

Spatial Inputs:

- 3 m DEM
- FAO Soils
- NLCD 2011

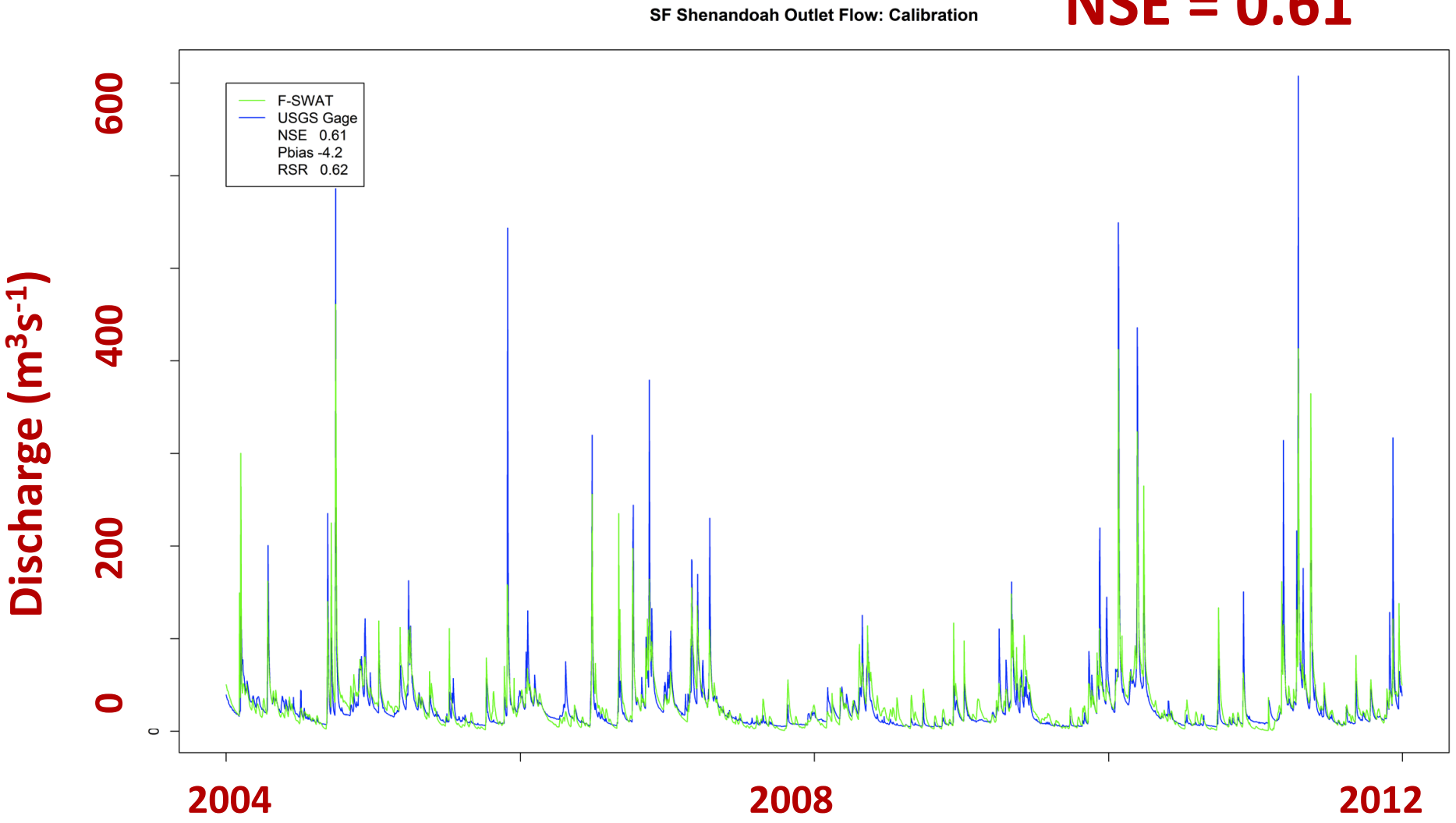
Calibration

1. Build R Wrapper
3. L-hoat Sensitivity Analysis
4. SWATmodel R package with Particle Swarm Optimization (PSO) on super computer framework


Custom R Wrapper on Super Computer
SWATmodel R Package
Write SWAT IO Files
Run SWAT-VSA
Objective Function
hydroPSO R Package
New Parameter set
PSO Iteration
Not Fit
Fit
On Local Machine
Save Calibrated Model

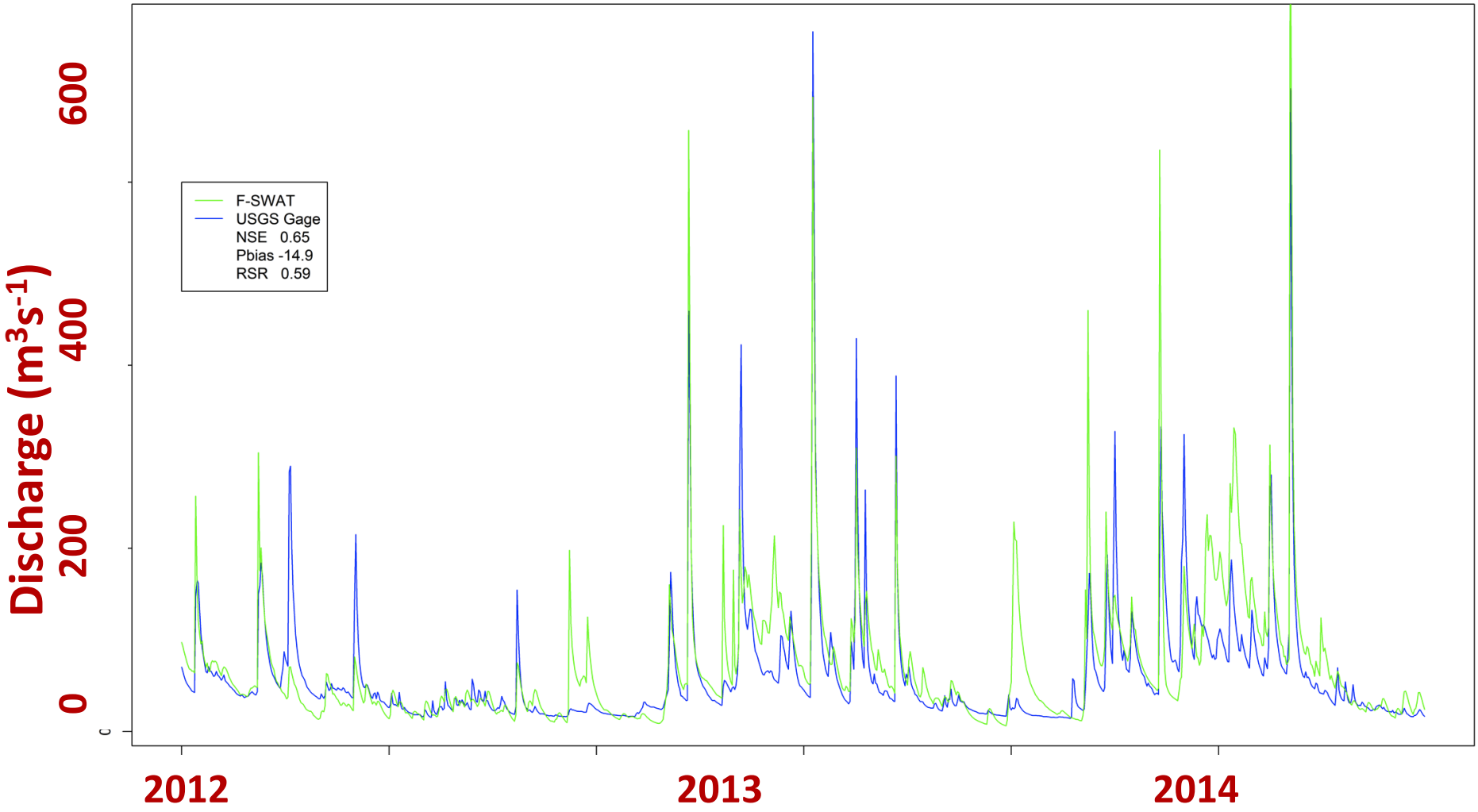
Calibration

2004 – 2011
NSE = 0.61



Validation

2012 – 2014
NSE = 0.85



Hindcast Data Set

~ 6 TB of Raw Forecast outputs in GRIB format

Thousands of Files – each a sub-daily worldwide grid

We Need to: Download and Parse the data into SWAT input files

Hindcast Preprocessing

1. Locate and catalog data sets
2. Download
3. Apply bounding box
4. Impute missing values
5. Interpolate
6. Bias Correct

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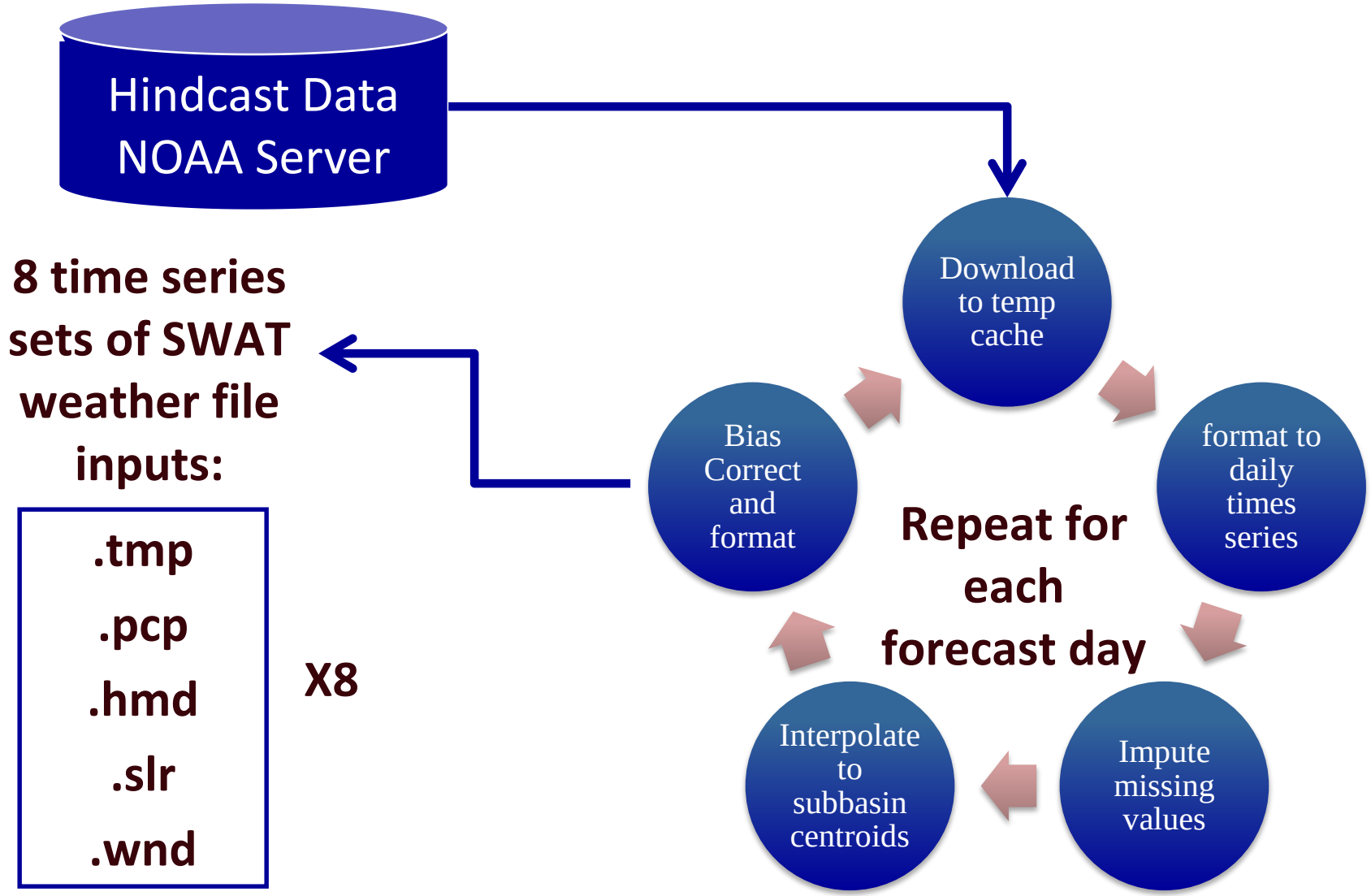
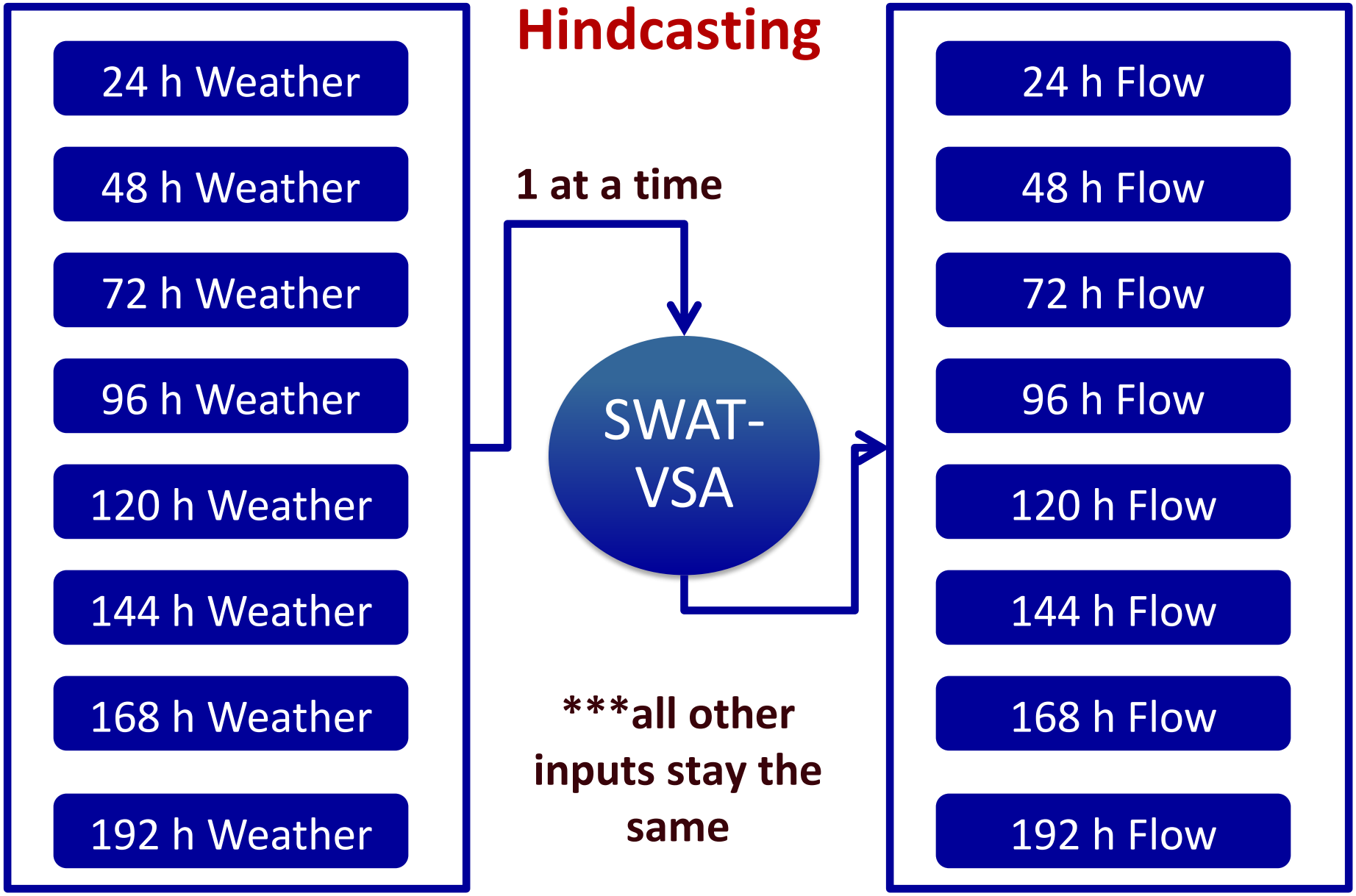
**Must be repeatable with live forecasts

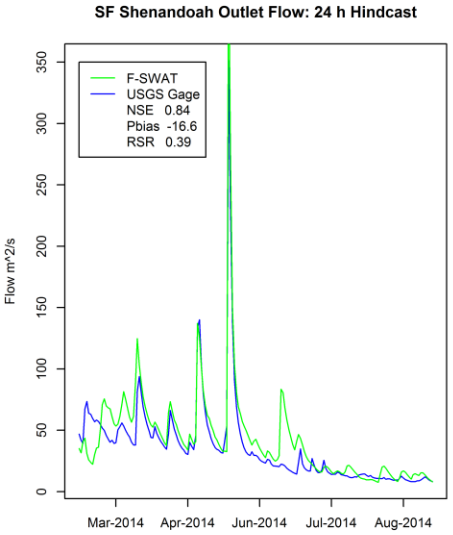
Hindcast Preprocessing

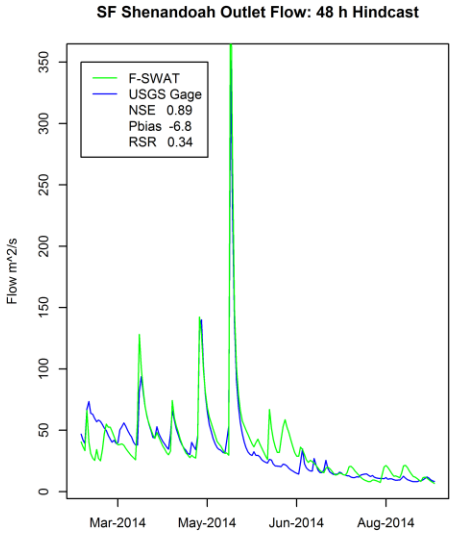


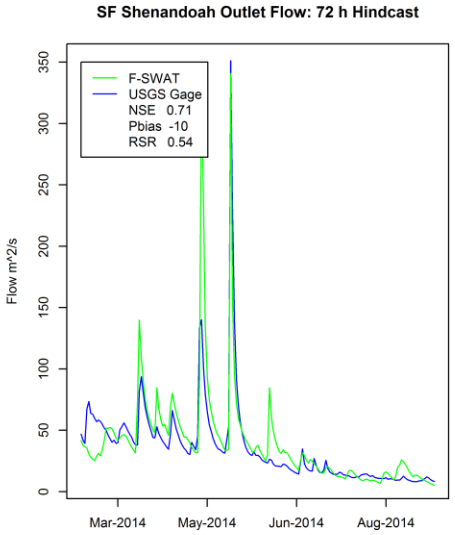
Hindcasting

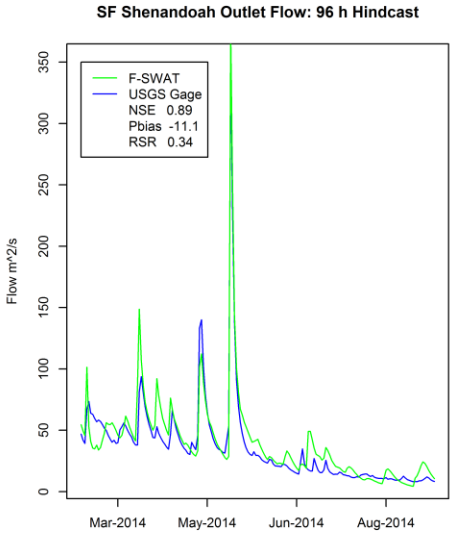


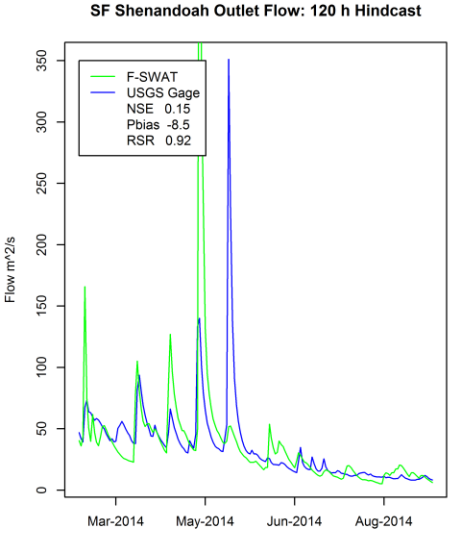
Hindcast Validation

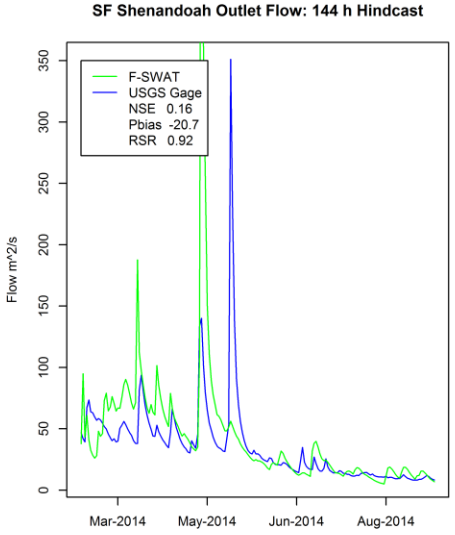


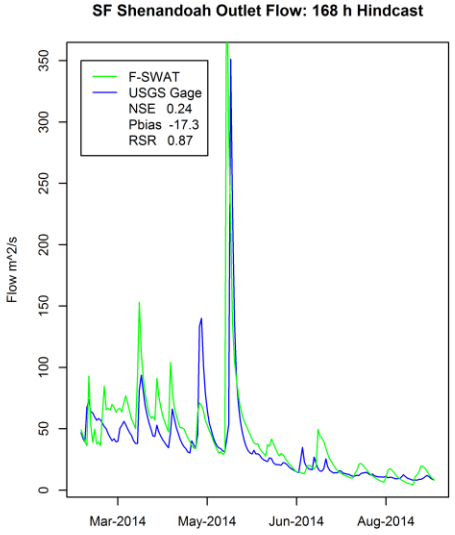


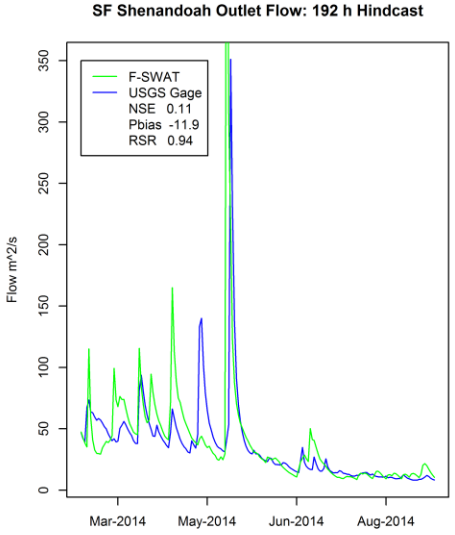












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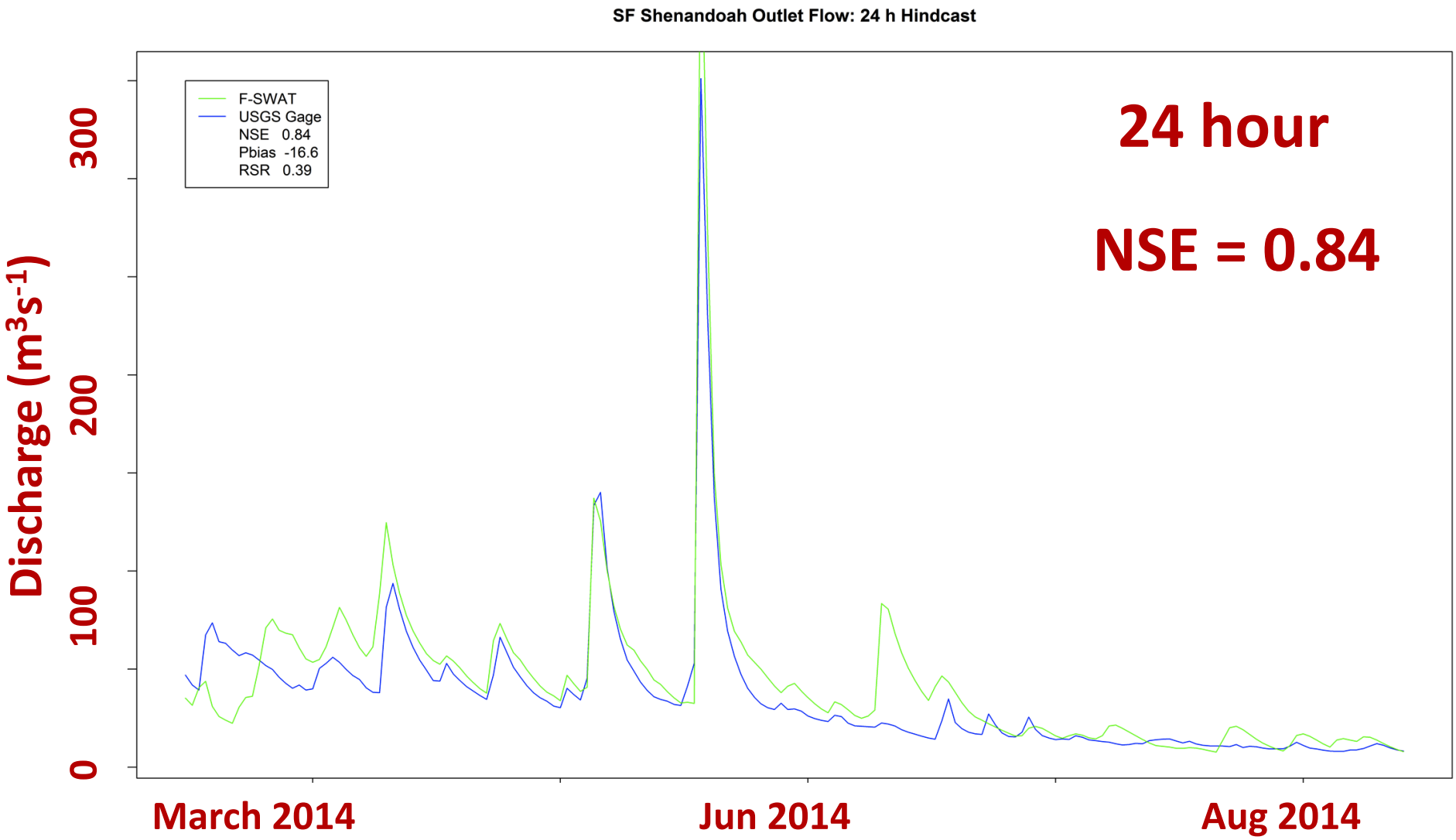

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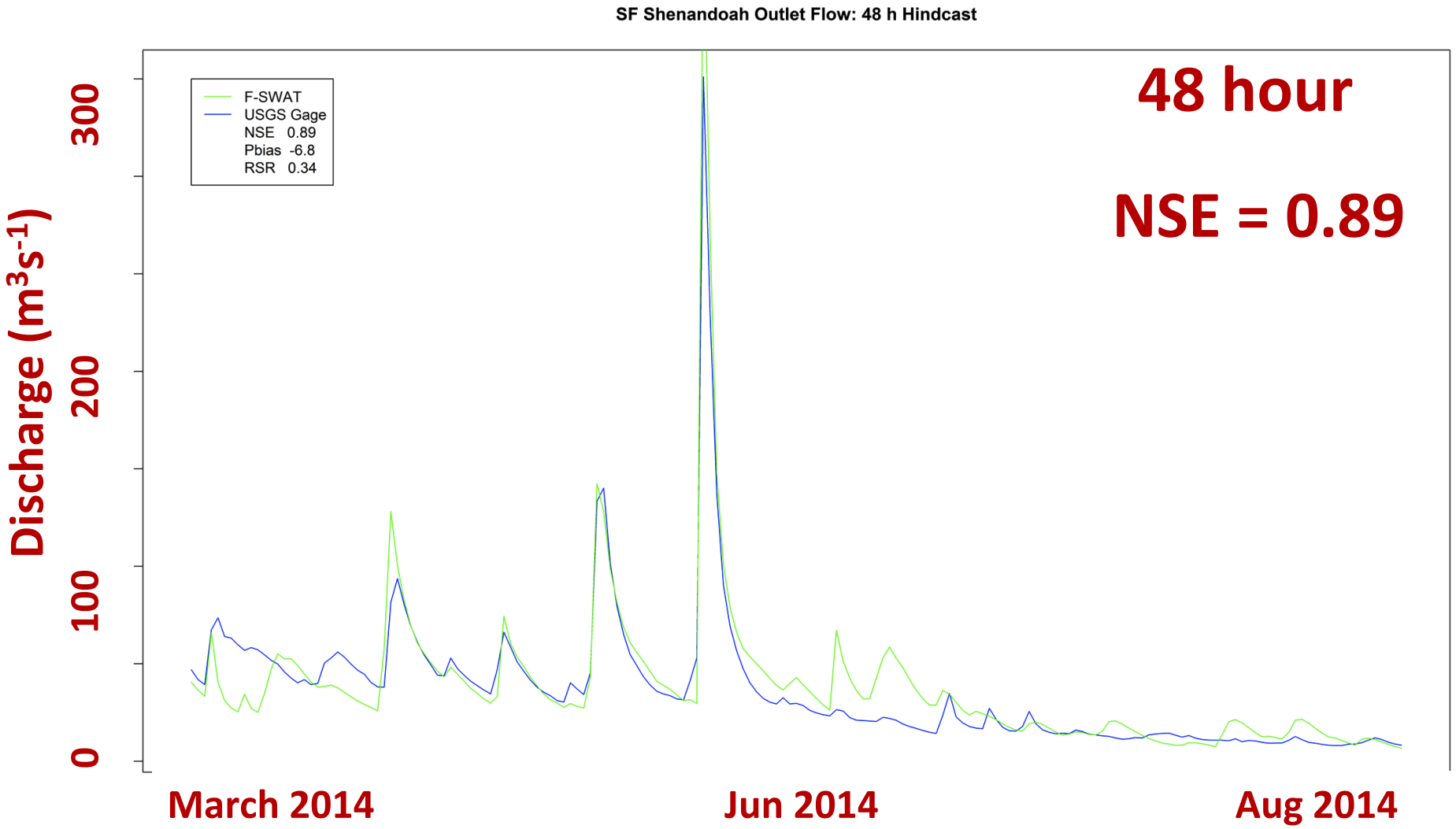

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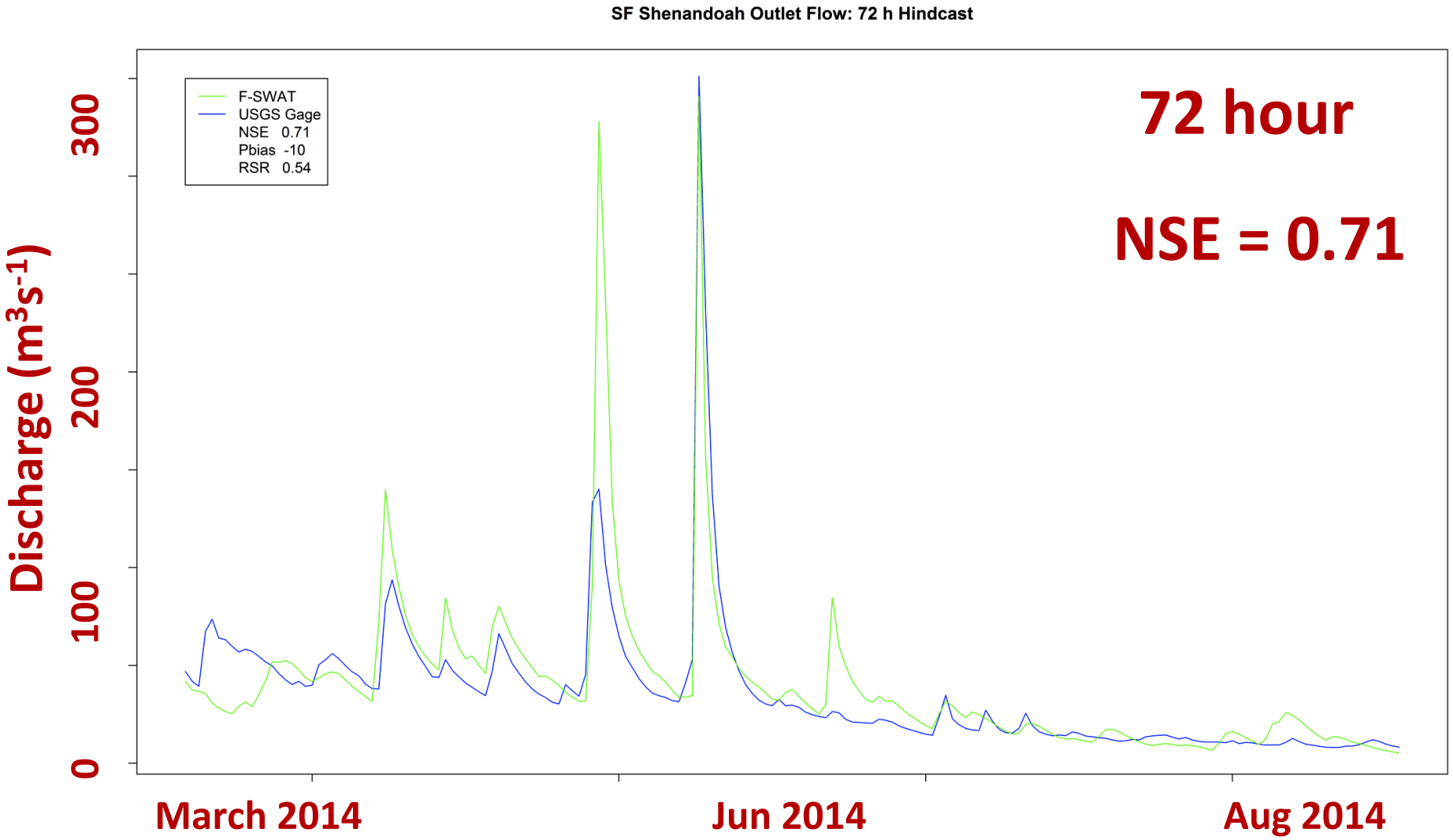

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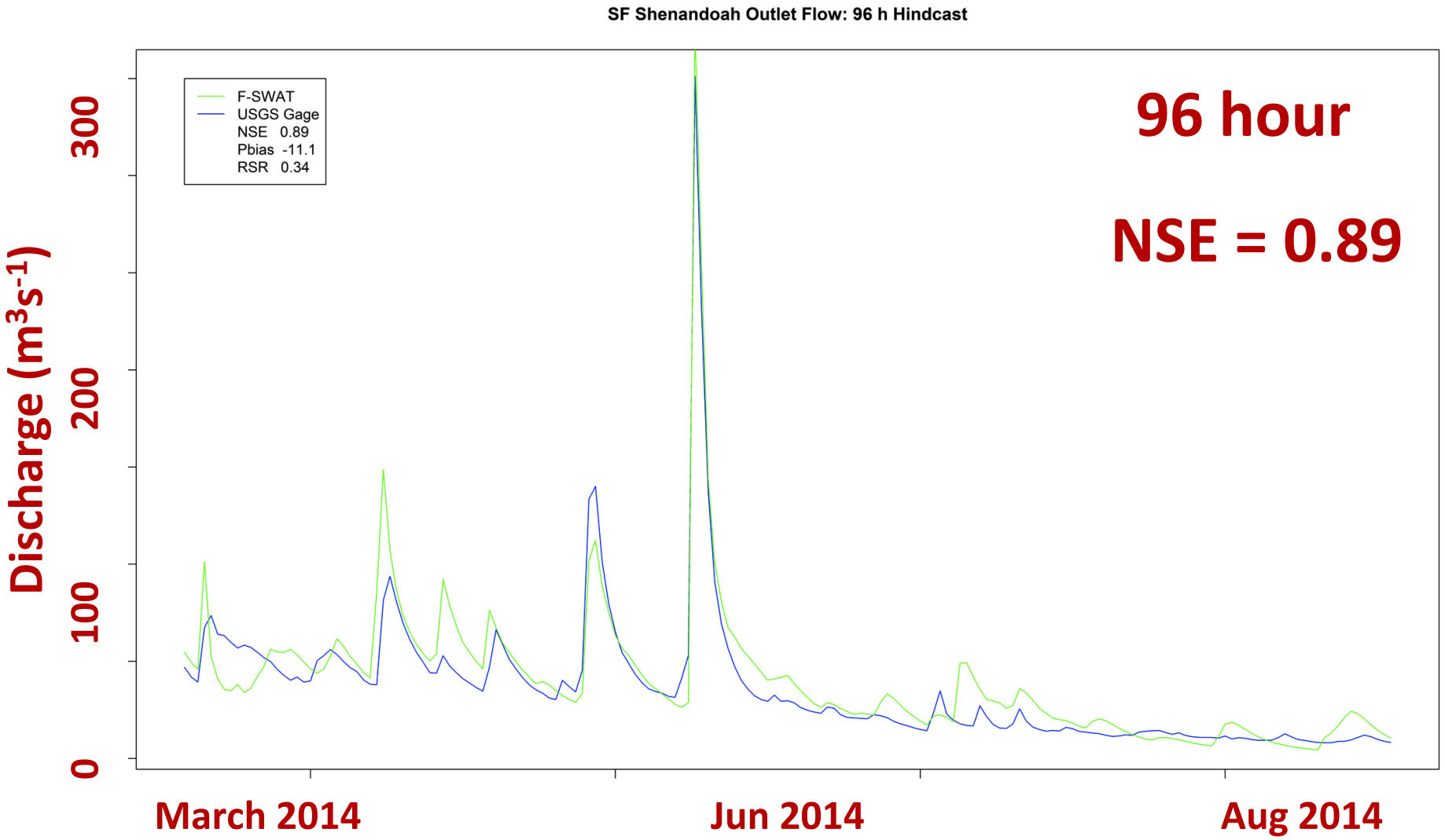


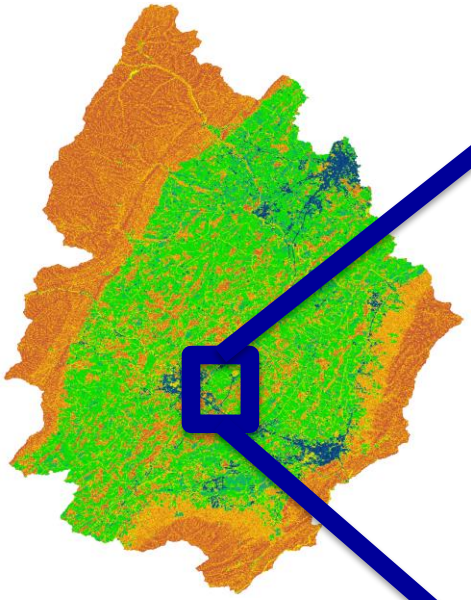
Hindcast Validation

Major Message: Short term forecasting with this framework is possible up through 4 days

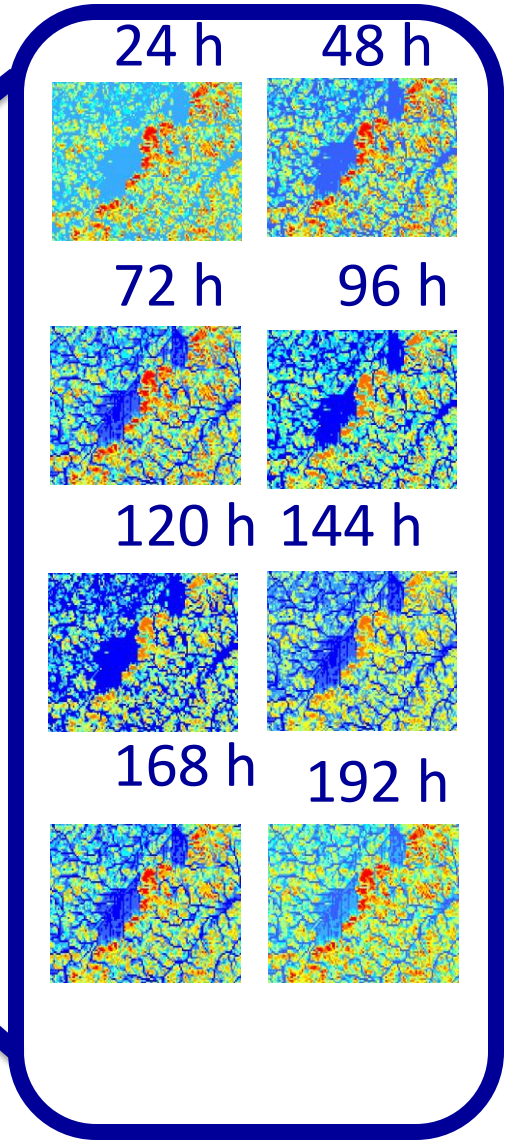
Sommerlot et al., 2015

Distributed Hydrology Forecast

HRU Runoff Output Raster



Runoff



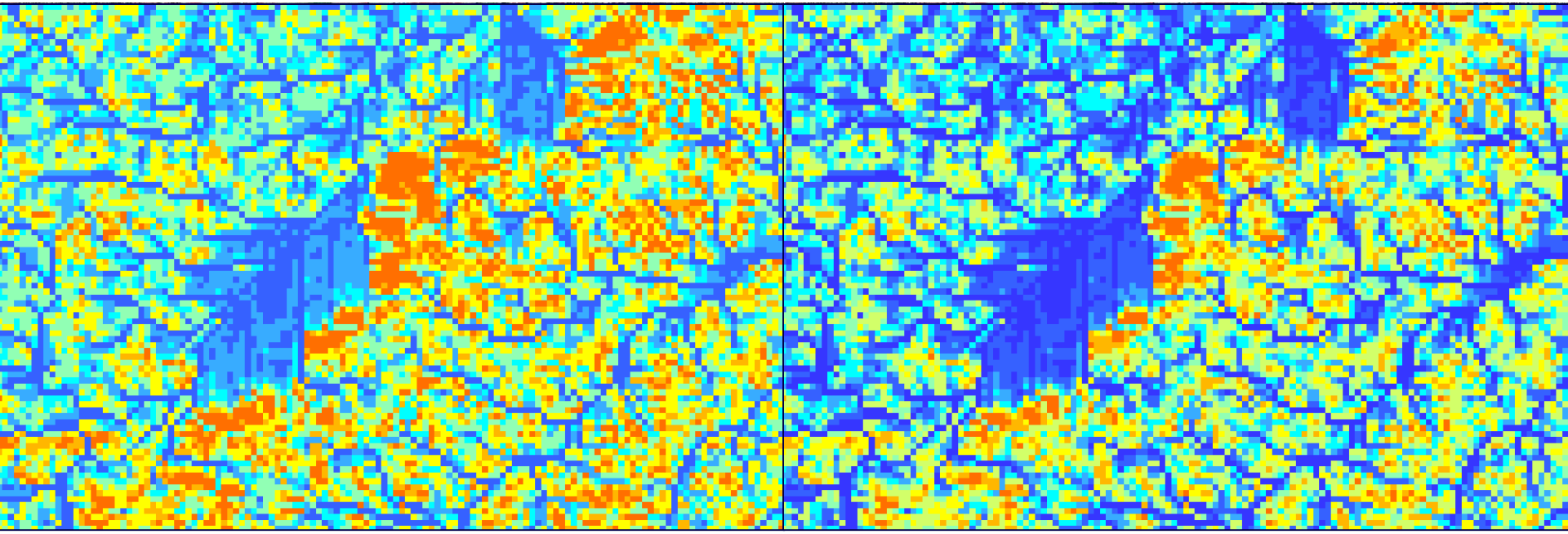
Sommerlot et al., 2015

Distributed Hydrology Forecast

Runoff
High
Low

24 Hour

48 hour



Conclusion

1. SWAT-VSA coupled with GFS can provide satisfactory hydrographic forecasts up to 4 days in advance
2. The forecast framework designed here can provide distributed hydrology forecasts

Future Work

1. Validation of Distributed Forecasts
2. Improvement of Weather Forecast inputs