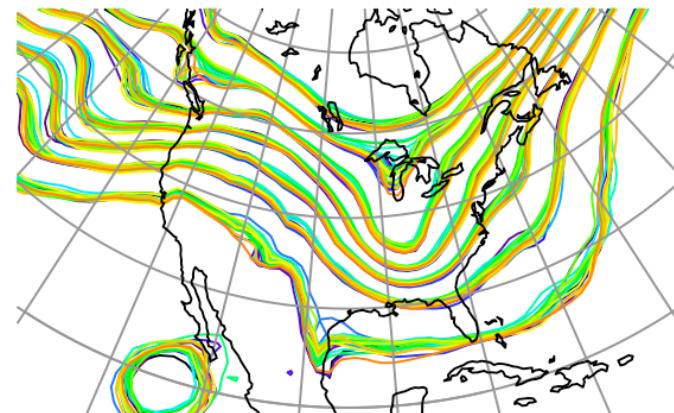


# Hydro-DART: Ensemble Streamflow Assimilations with WRF-Hydro and the Data Assimilation Research Testbed.



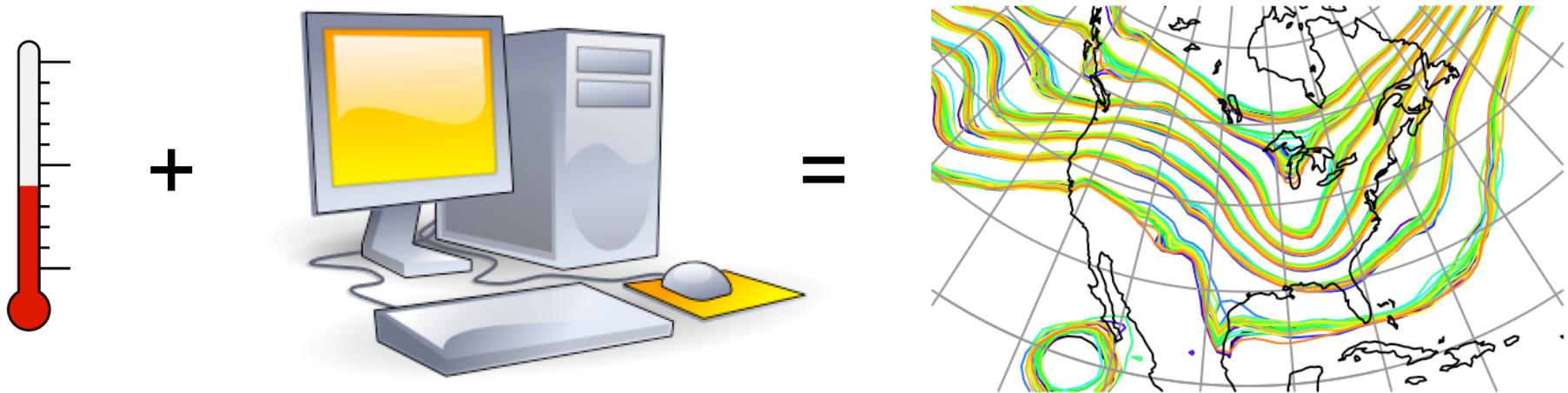
The National Center for Atmospheric Research is sponsored by the National Science Foundation. Any opinions, findings and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

©UCAR 2018

NCAR | National Center for  
UCAR Atmospheric Research

# What is Data Assimilation?

Observations combined with a Model forecast...



... to produce an analysis.

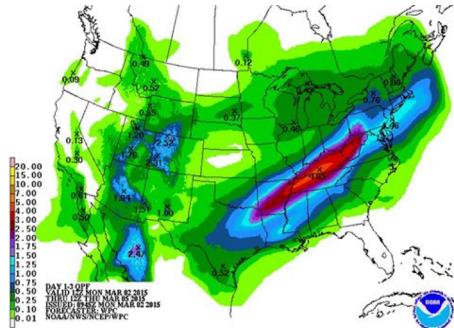
Overview article of the Data Assimilation Research Testbed (DART):

Anderson, Jeffrey, T. Hoar, K. Raeder, H. Liu, N. Collins, R. Torn, A. Arellano, 2009:  
The Data Assimilation Research Testbed: A Community Facility.  
*Bull. Amer. Meteor. Soc.*, **90**, 1283–1296. [doi:10.1175/2009BAMS2618.1](https://doi.org/10.1175/2009BAMS2618.1)



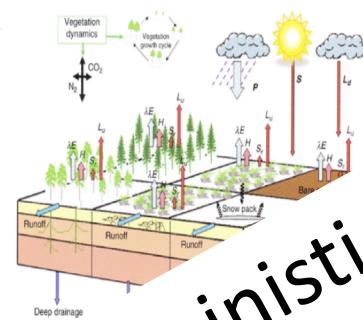
# The Big Picture

Weather Forcing Engine



*WRF-Hydro: <https://www.ral.ucar.edu/projects/wrf-hydro>*

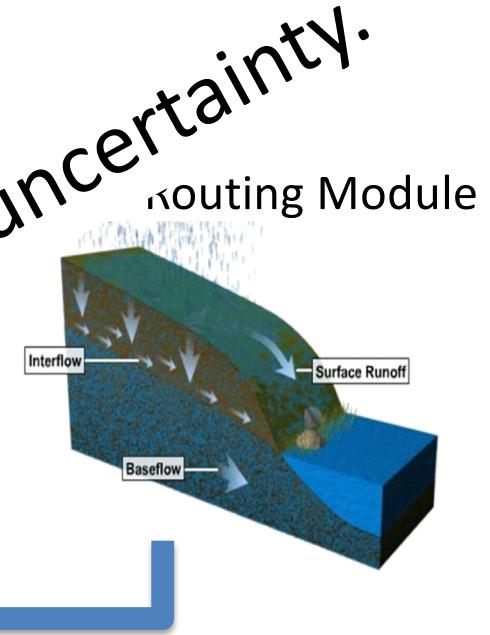
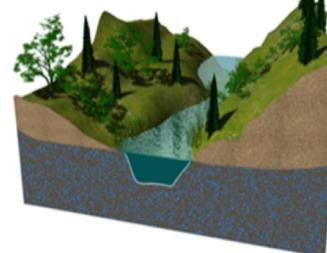
NoahMP LSM



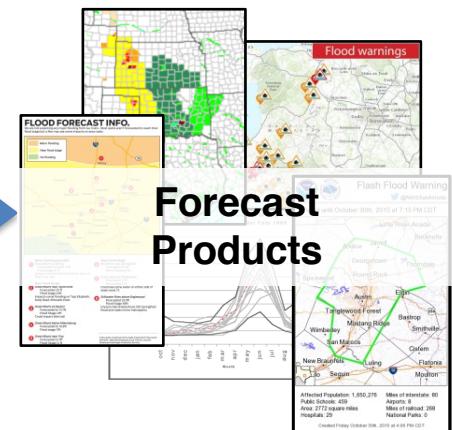
This is all deterministic. There is no uncertainty.  
NHD+ Channel Routing



Channel & Reservoir  
Routing Module

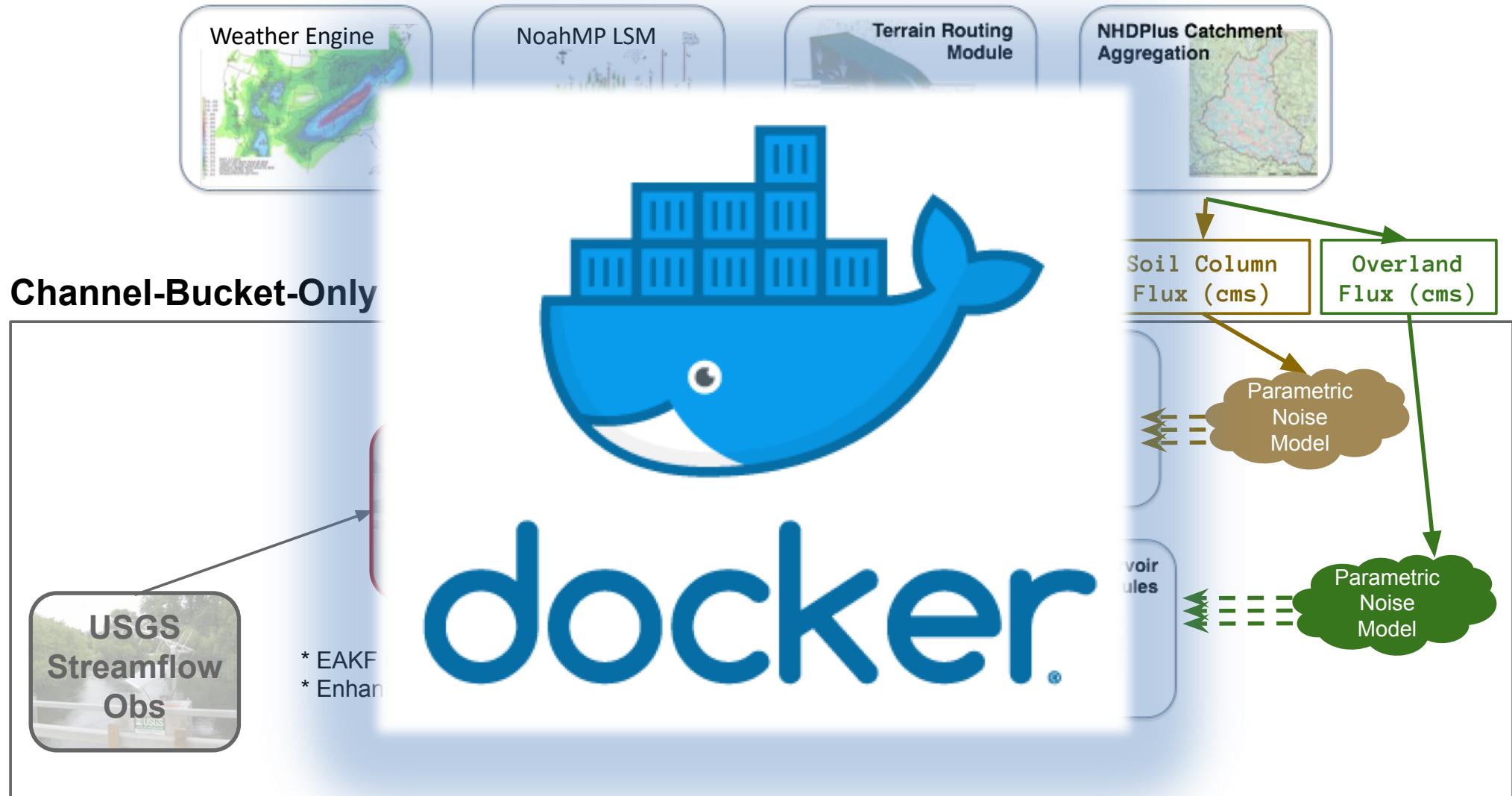


Forecast Products



Data  
Assimilation  
Research  
Testbed

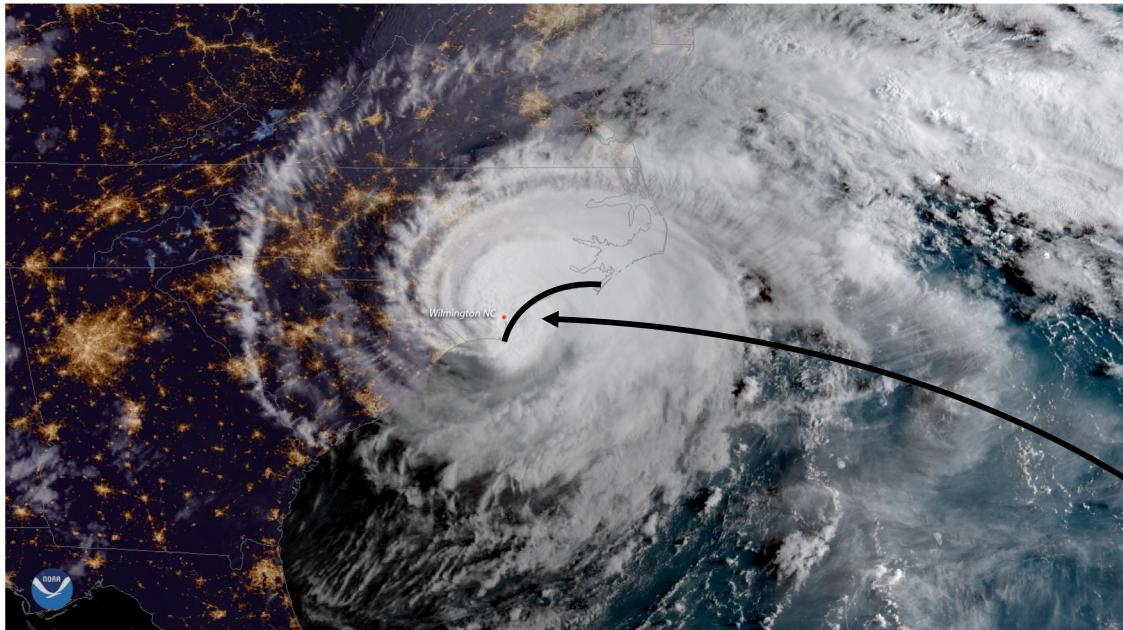
# WRF-Hydro & DART .... HydroDART



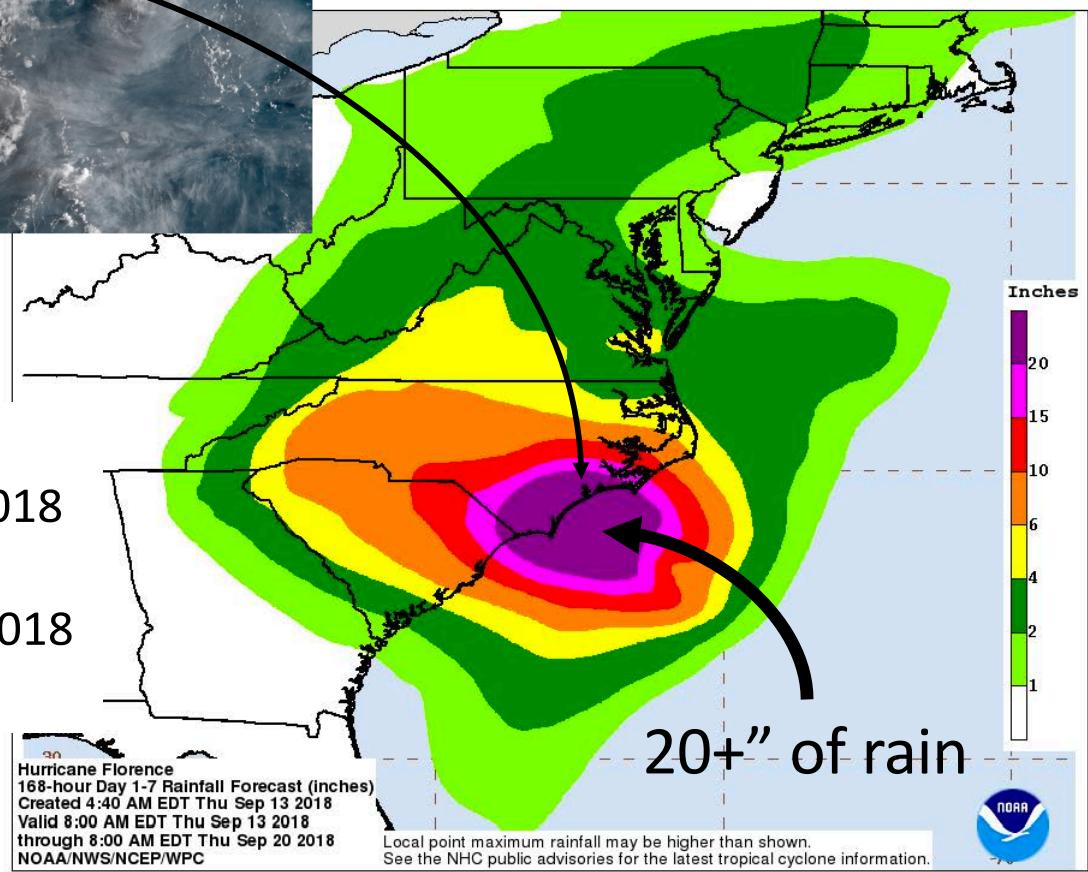
Python  
environment

[github.com/NCAR/wrf\\_hydro\\_py.git](https://github.com/NCAR/wrf_hydro_py.git)

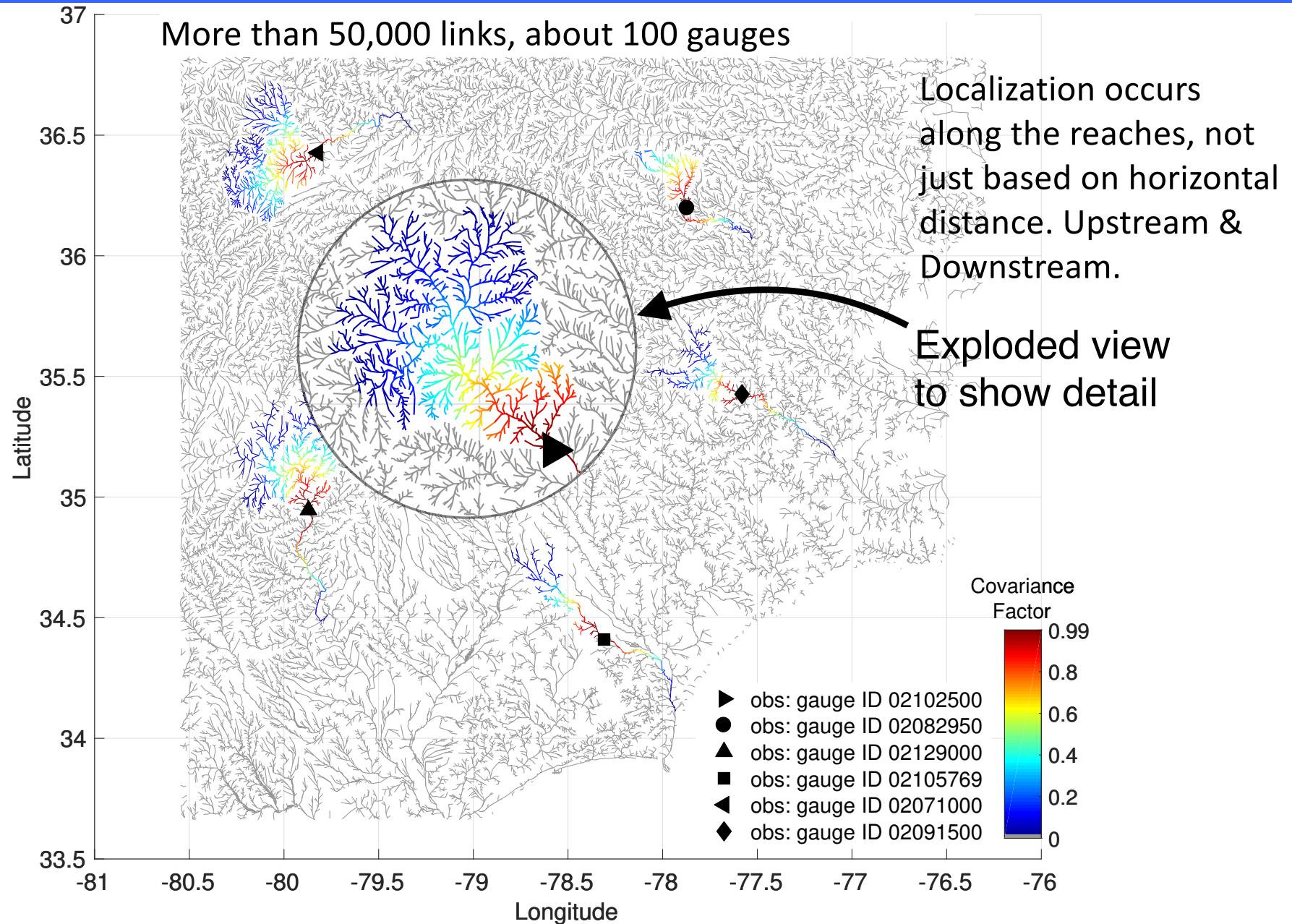
# Hurricane Florence



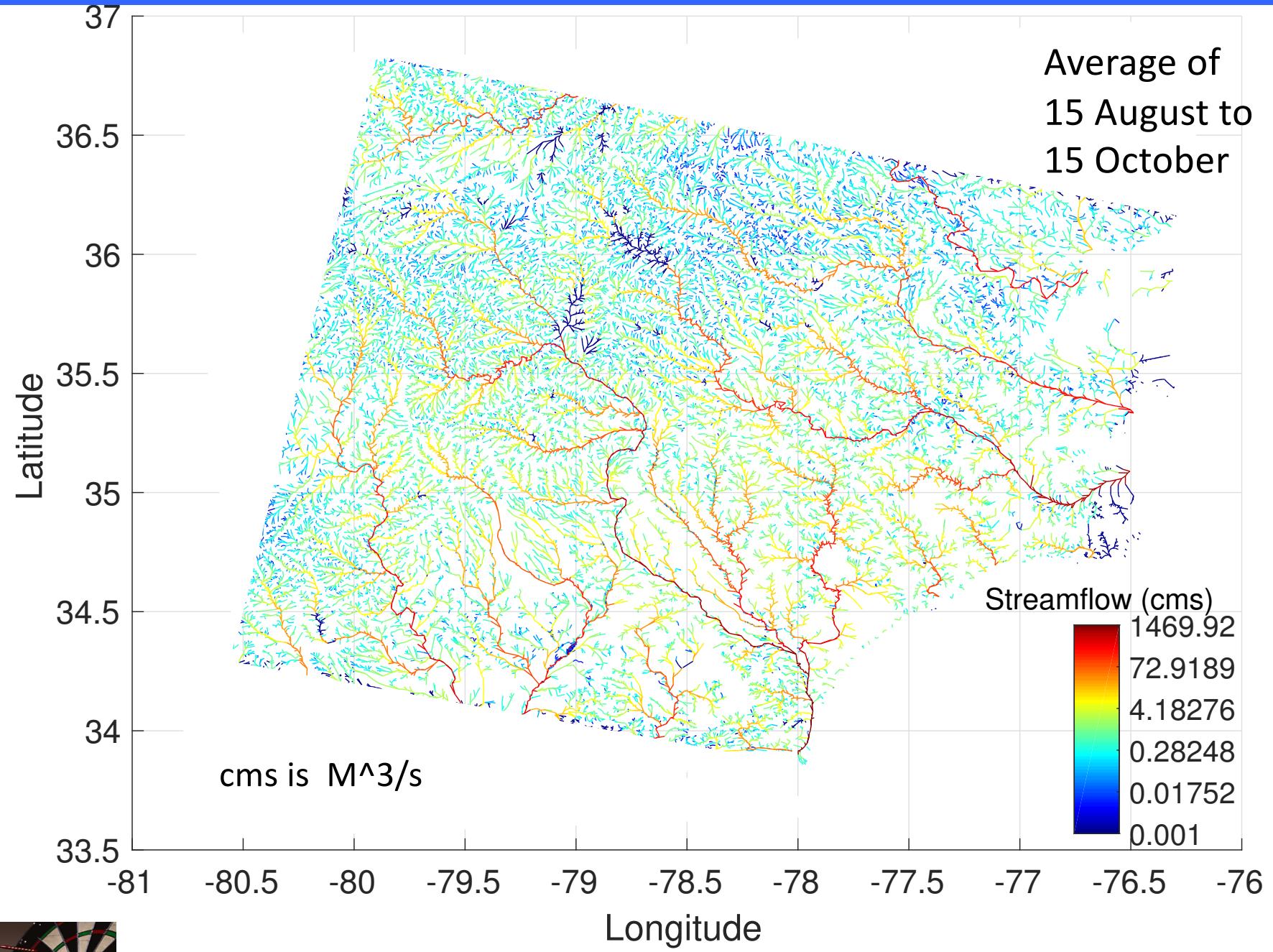
Hurricane Florence made landfall near Wrightsville Beach, North Carolina at **7:15 a.m. ET September 14**, as a Category 1 storm. The GOES East satellite captured this geocolor image at 7:45 a.m. ET



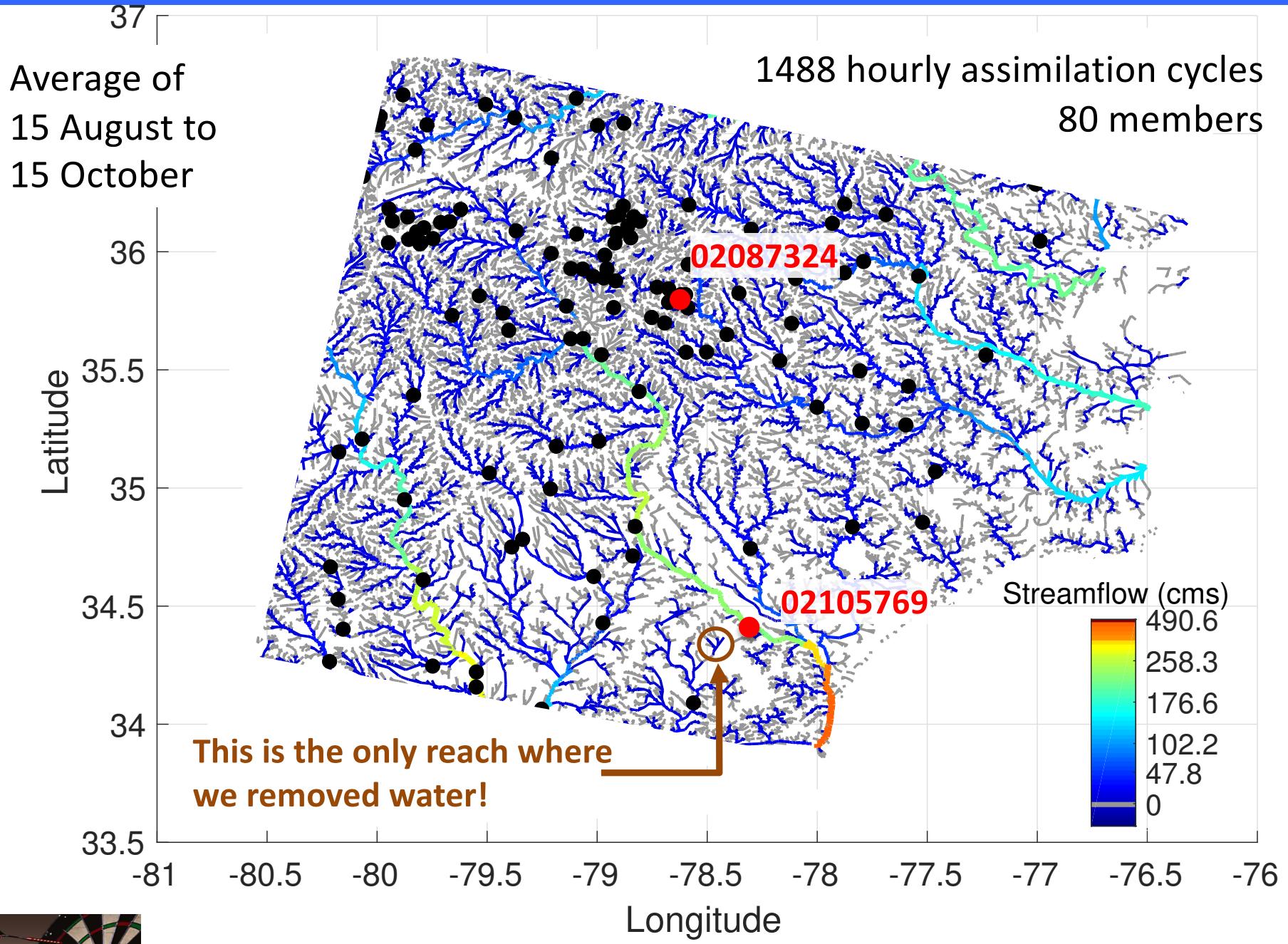
# Florence Domain : localization



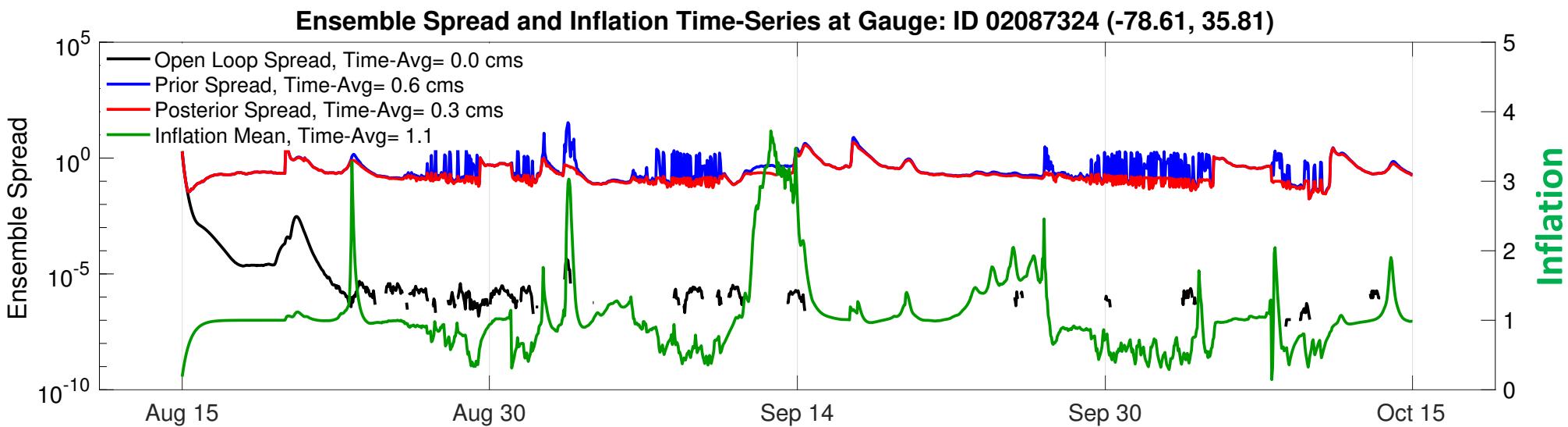
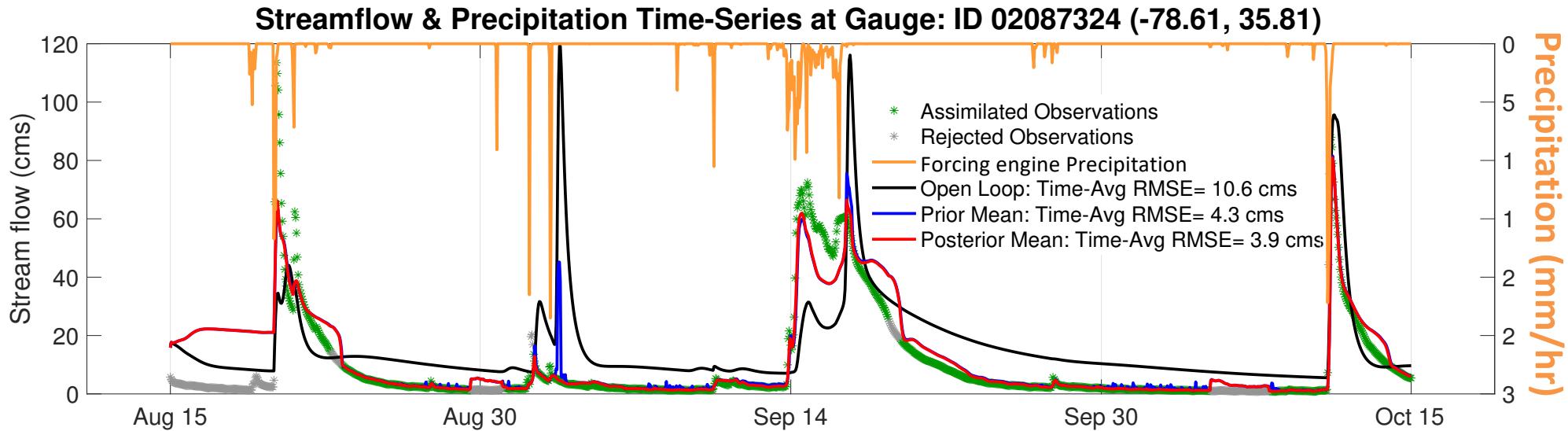
# Time-Averaged Streamflow: Open Loop Mean



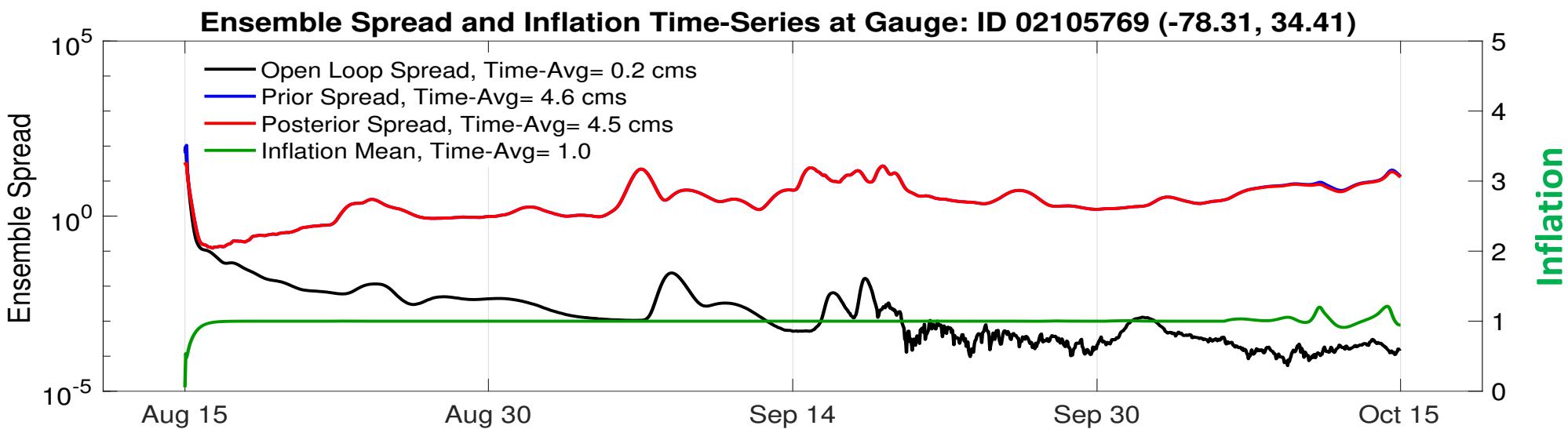
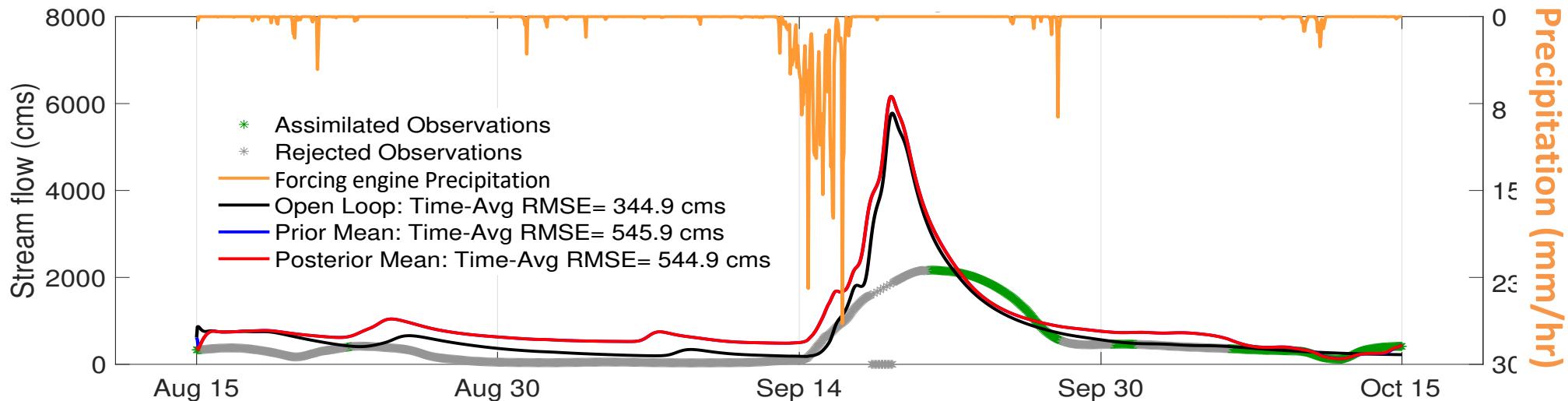
# Posterior Mean – Open Loop Mean



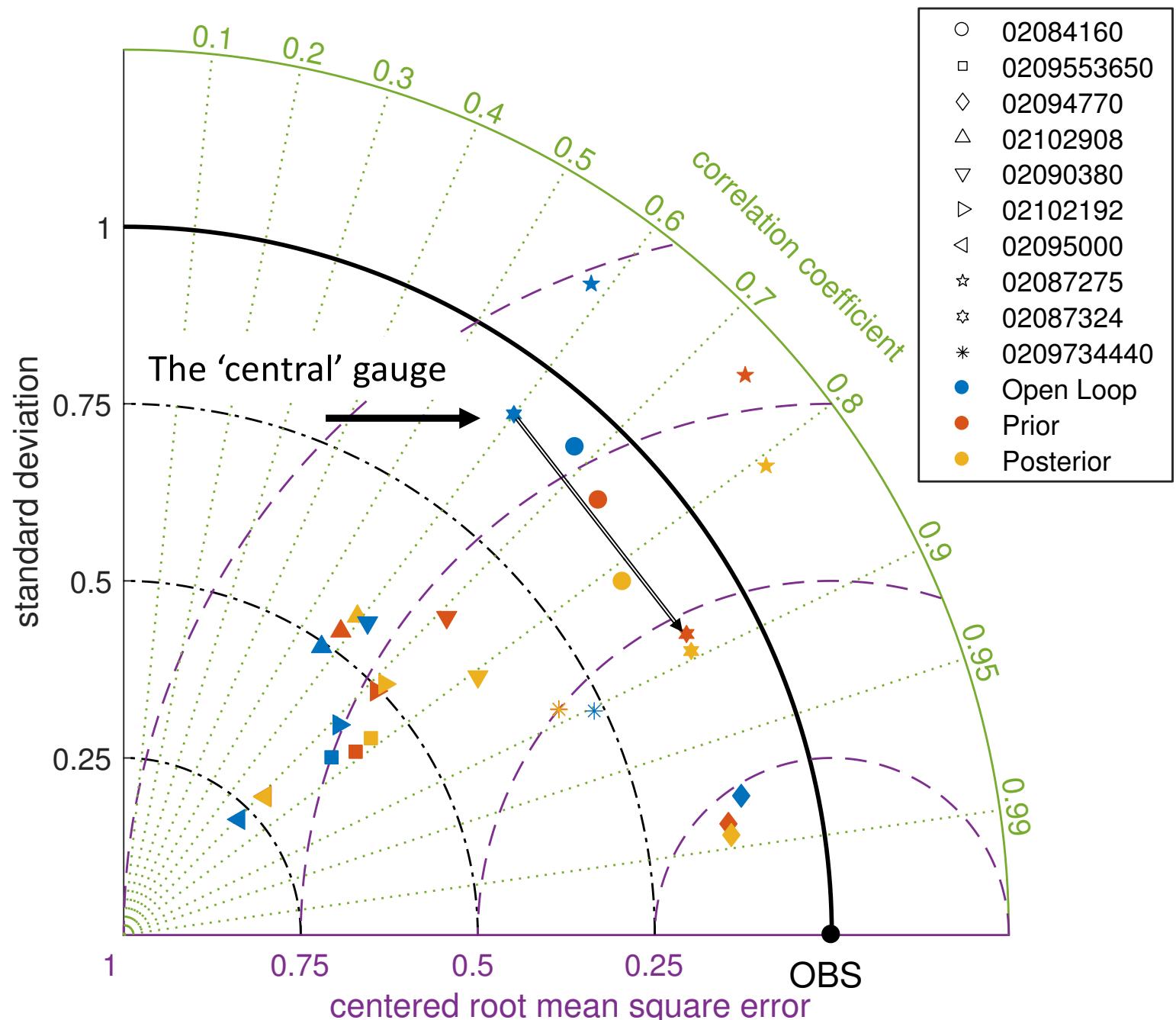
# Gauge 02087324 ... central



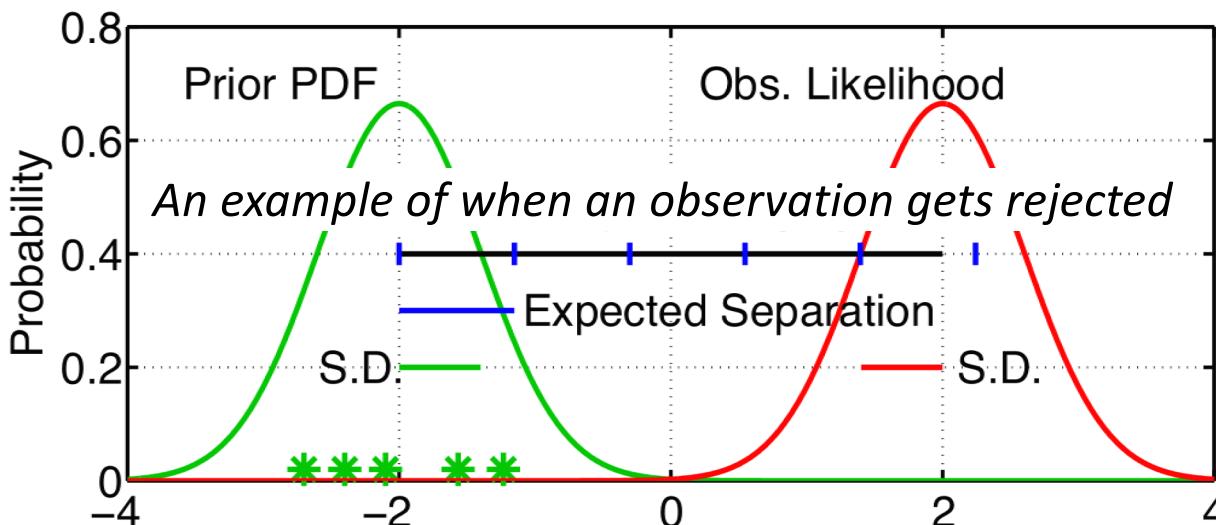
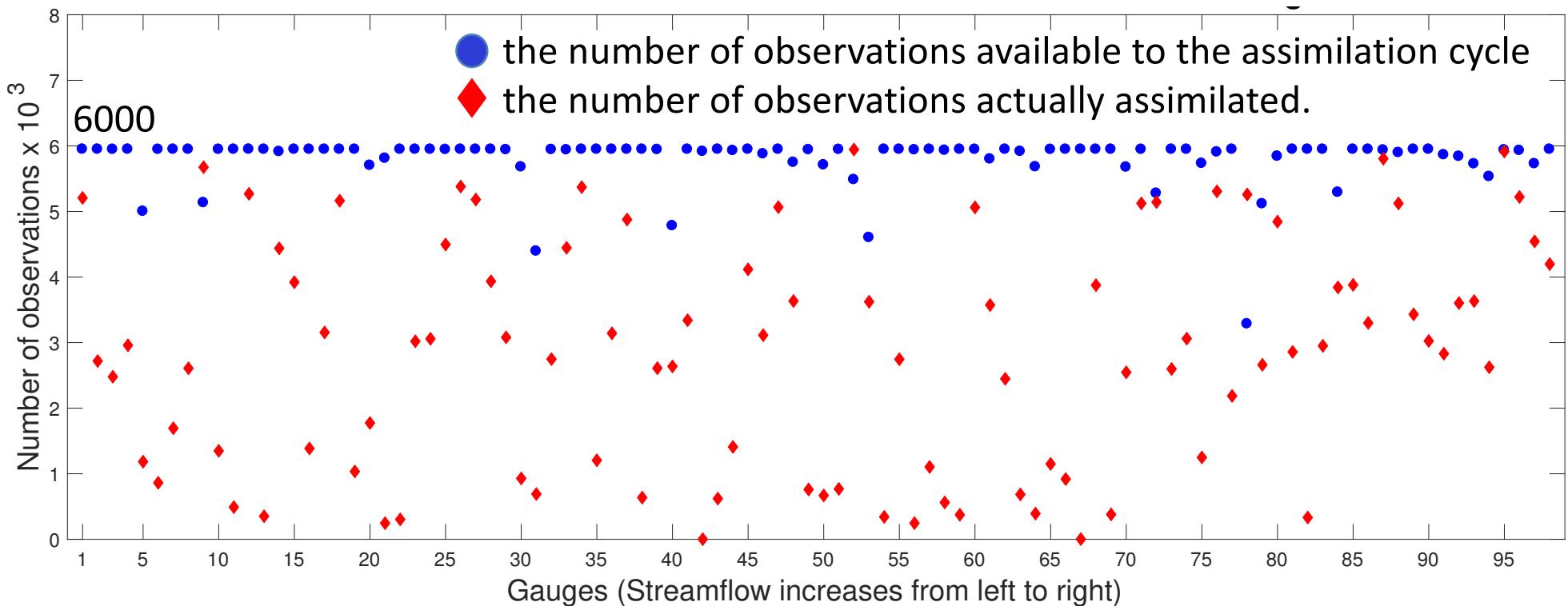
# Gauge 02105769 ... downstream



# 10 gauges from the middle of the domain



# Observation Rejection is (*currently*) a problem.



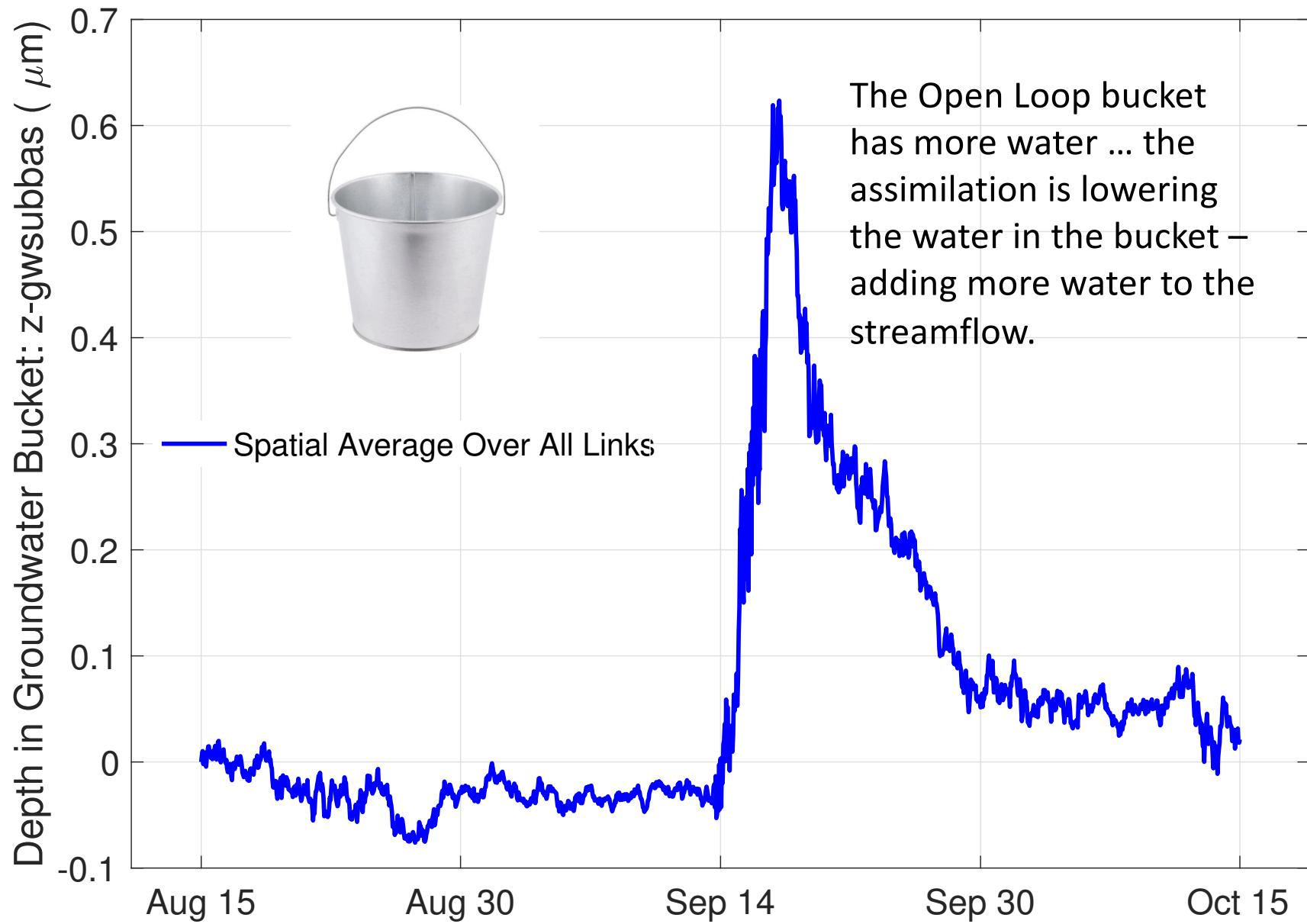
The observation error variance  $\sigma_{obs}$  is key, and is being explored.

$$\sigma_{obs} = \max [\sigma_{\min}, \mathcal{N}(0, 0.2x)]$$

$$\sigma_{\min} = 0.2 \text{ cms}$$

$$x = \text{streamflow}$$

# Open Loop – Prior Mean



# For more information:

<i>CAM</i>	<i>GCOM</i>	<i>CAM-Chem</i>	<i>PBL_1d</i>	<i>ROMS</i>	<i>NOAH-MP</i>
	<i>GITM</i>		<i>WRF-Hydro</i>		<i>CICE</i>
<i>CLM</i>					<i>WACCM</i>
<i>AM2</i>					<i>POP</i>
<i>SQG</i>	D A R T	Data Assimilation Research Testbed			<i>BGRID</i>
<i>COAMPS</i>					<i>WRF</i>
<i>MITgcm_ocean</i>		<a href="http://www.image.ucar.edu/DARes/DART"><u>www.image.ucar.edu/DARes/DART</u></a>			
		<i>dart@ucar.edu</i>			
<i>NCOMMAS</i>					<i>MPAS_ATM</i>
<i>WRF-Chem</i>	<i>NAAPS</i>	<i>MPAS_OCN</i>	<i>TIEGCM</i>	<i>COAMPS_nest</i>	<i>WACCM-X</i>
			<i>PE2LYR</i>	<i>CABLE</i>	<i>CM1</i>