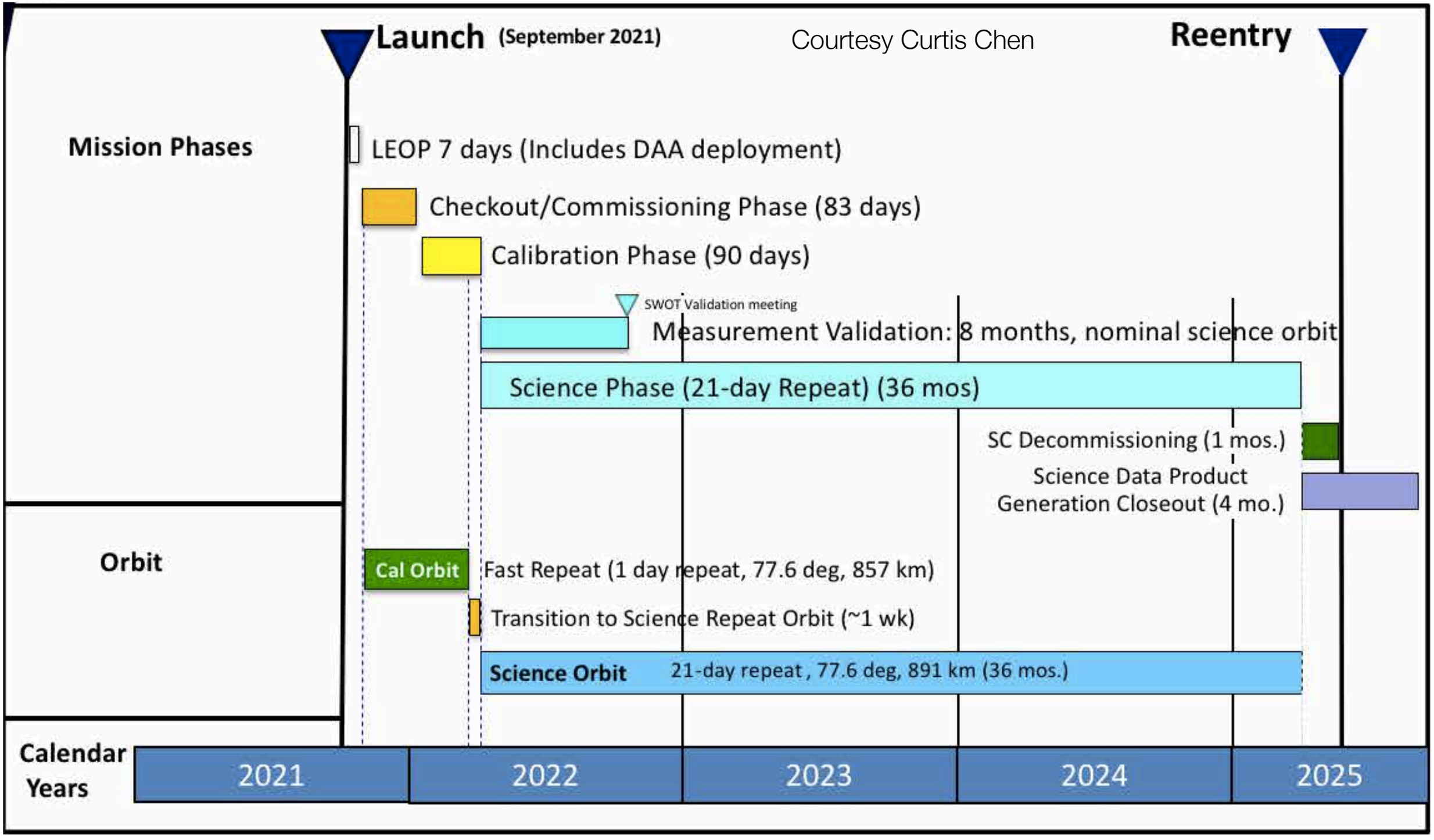
Discharge Data Products and Mission Operations

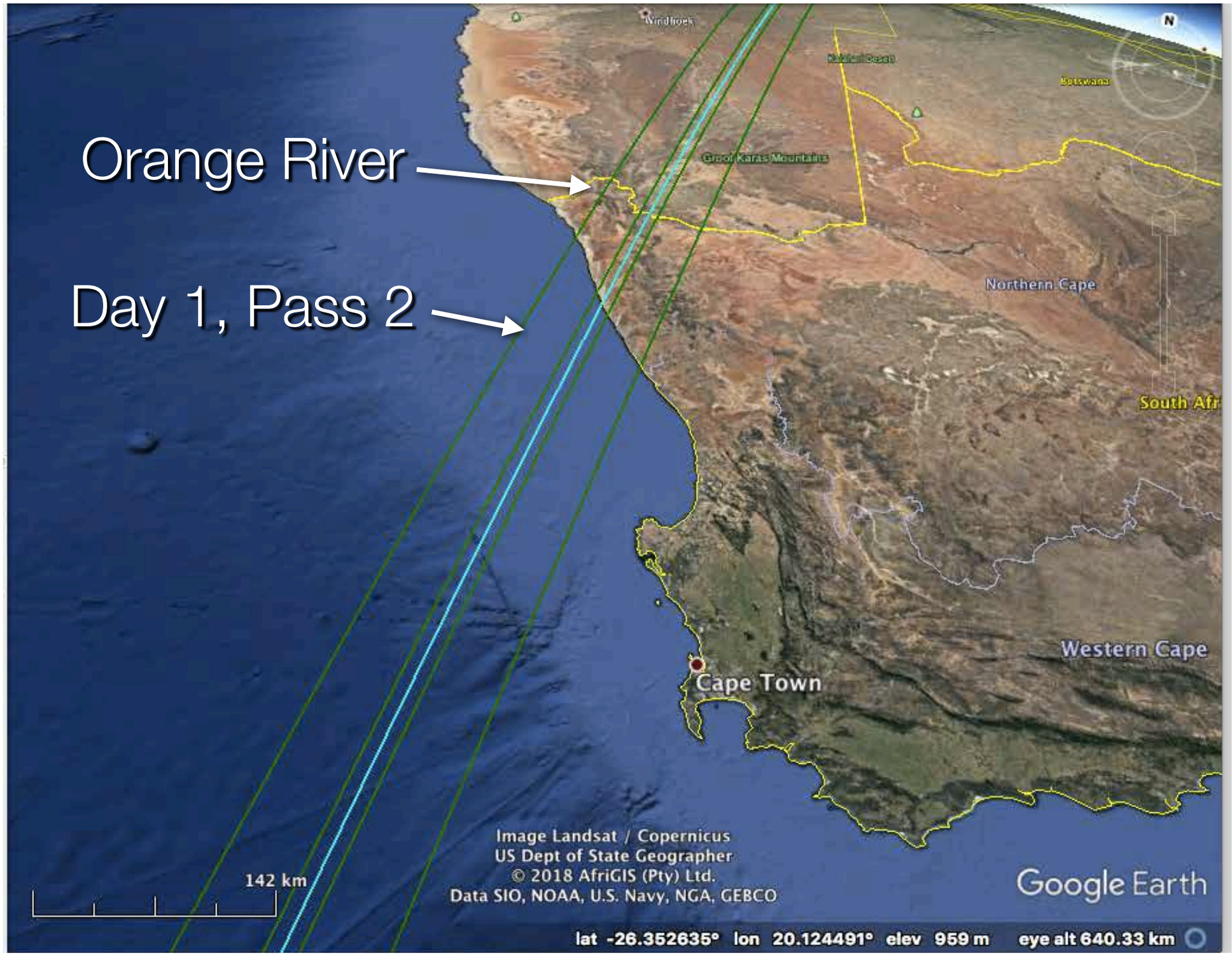
Michael Durand



Courtesy Curtis Chen

Mission Timeline

Launch is now only 39 months away.
What do we need to do to get ready?



~April 2022, the first day and (2nd) pass of river height, width and slope is measured* in science orbit

How will we use these to compute discharge parameters? What will we all be doing? What resources are needed?

Current ***proposal***

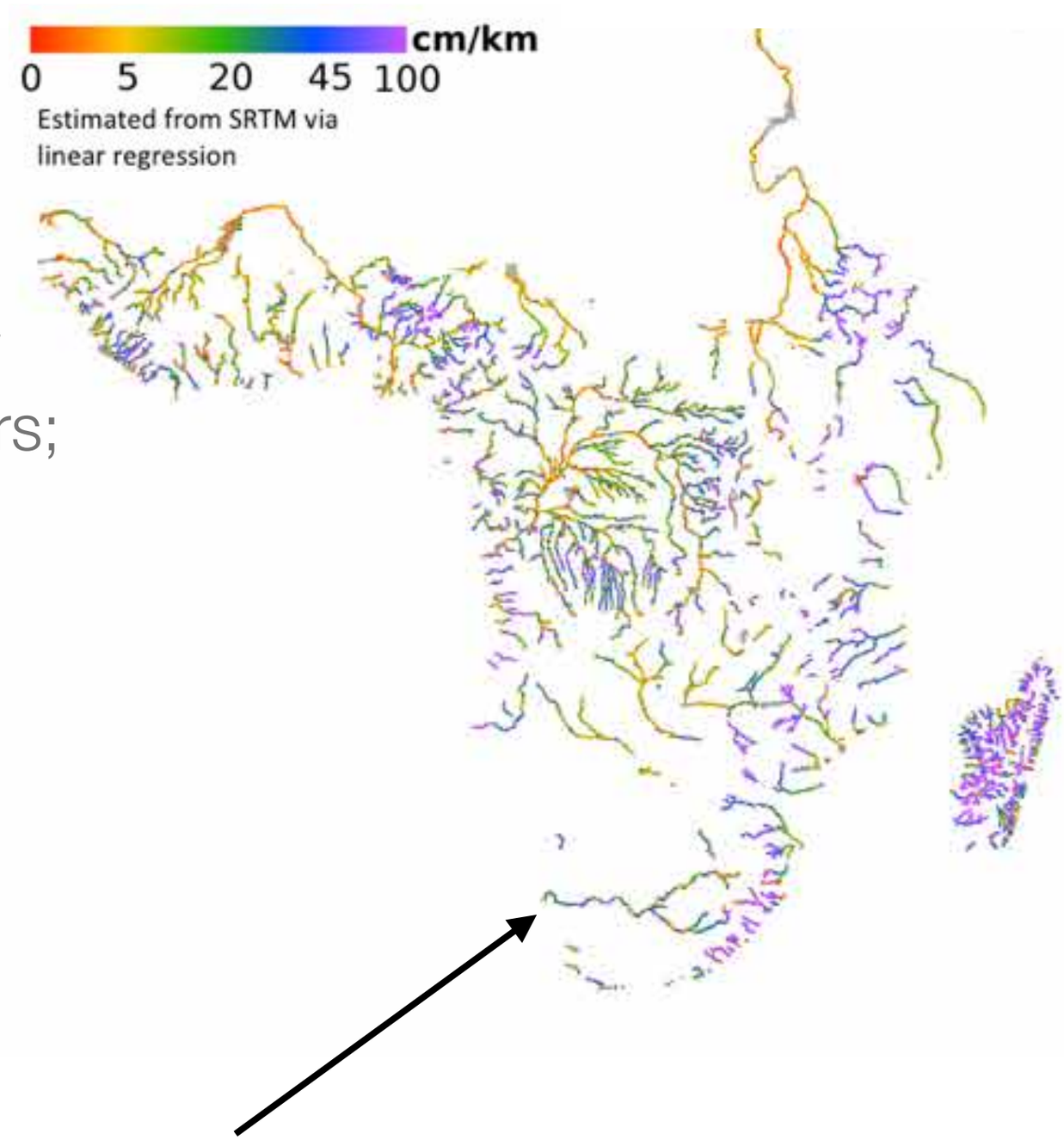
- Science team provides parameters; Project computes discharge e.g.:

$$Q = \frac{1}{n}\left(\bar{A} + A'\right)^{5/3} W^{-2/3} S^{1/2}$$

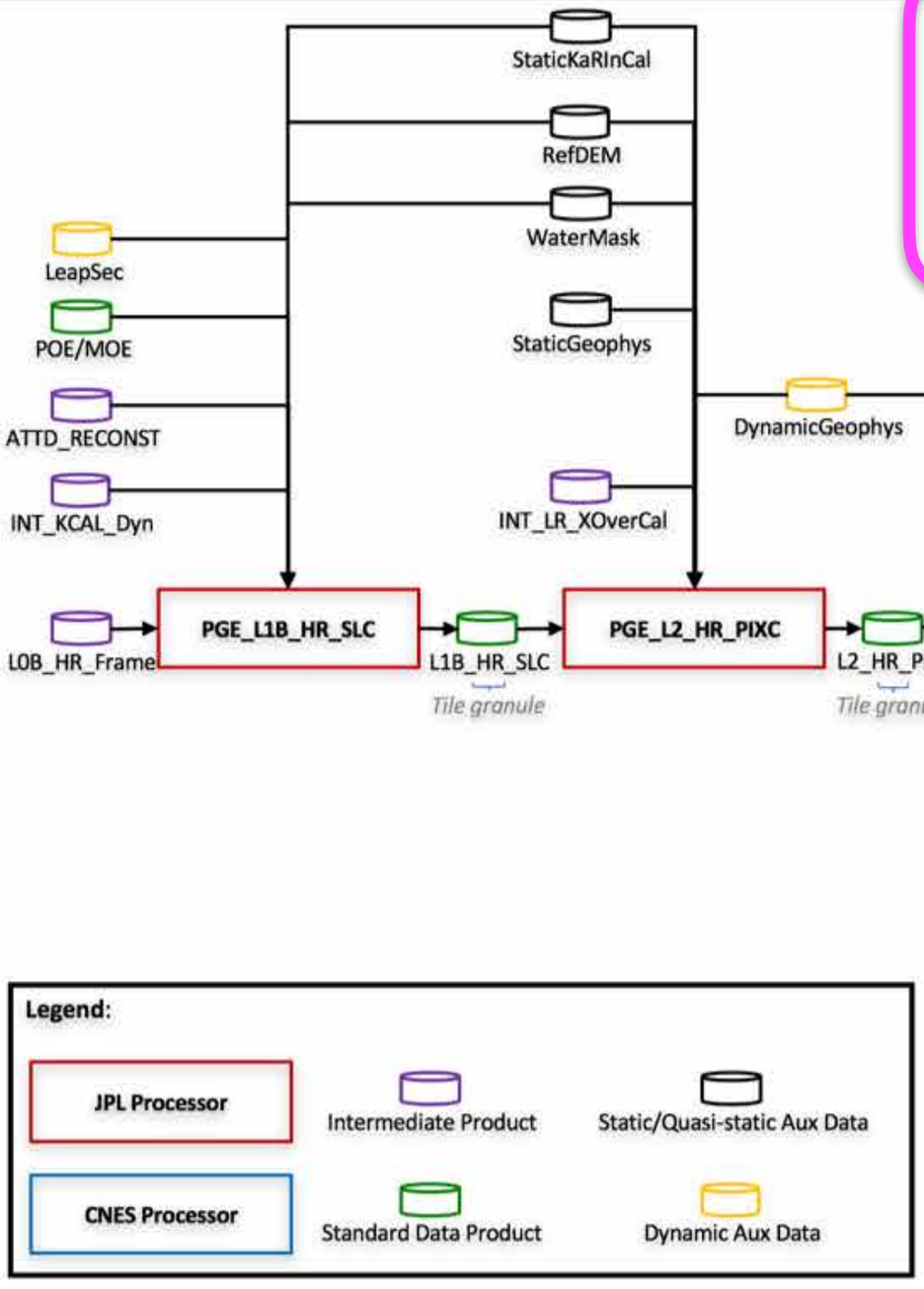
- As data come in, Science Team members will feverishly begin computing parameters.

- There will be multiple algorithms and a consensus algorithm

- We must QA/QC parameters and add them to the a priori river database



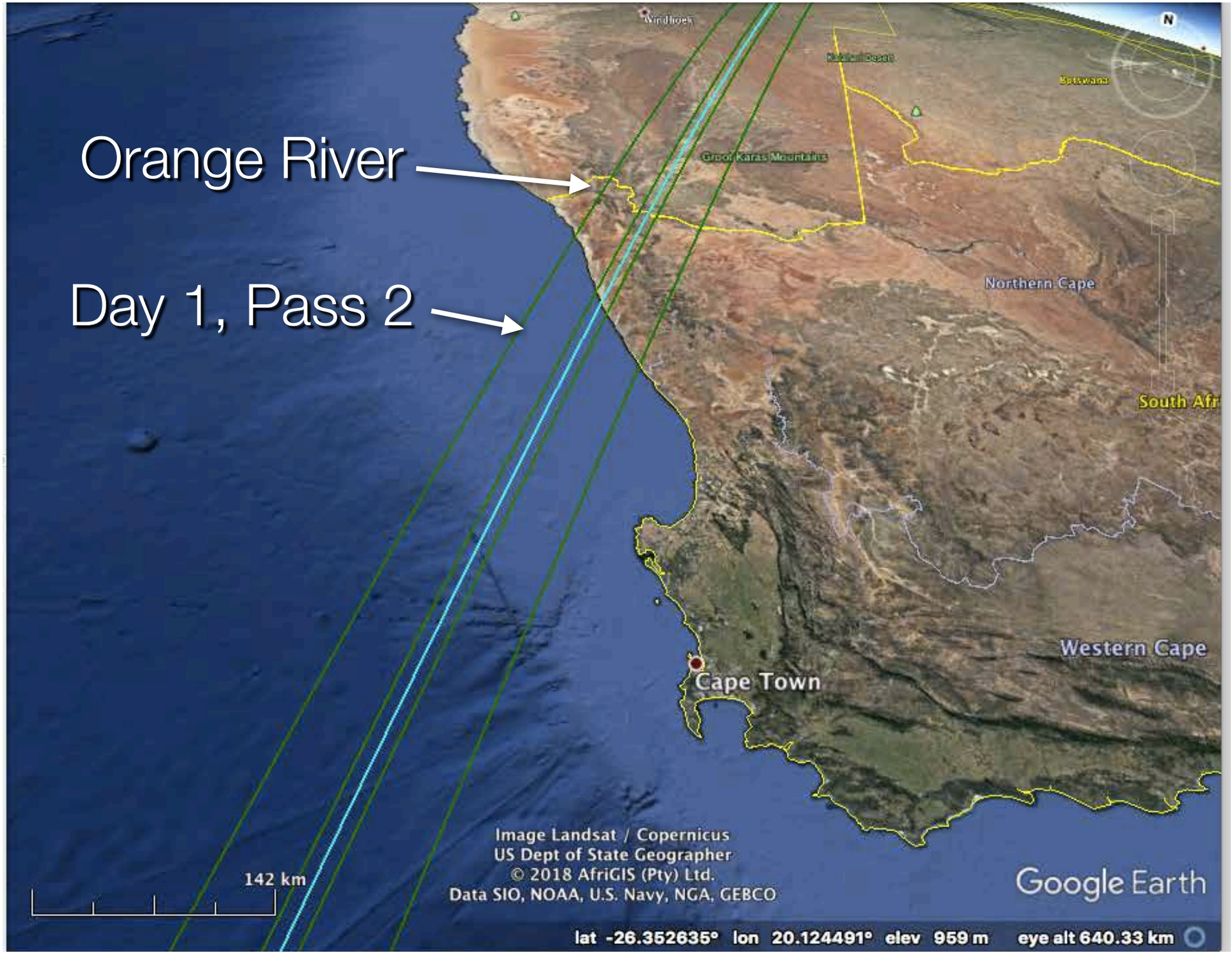
	n	$\bar{A}$
Reach 1		
Reach 2		
…		
Reach *n*		



Courtesy Curtis Chen

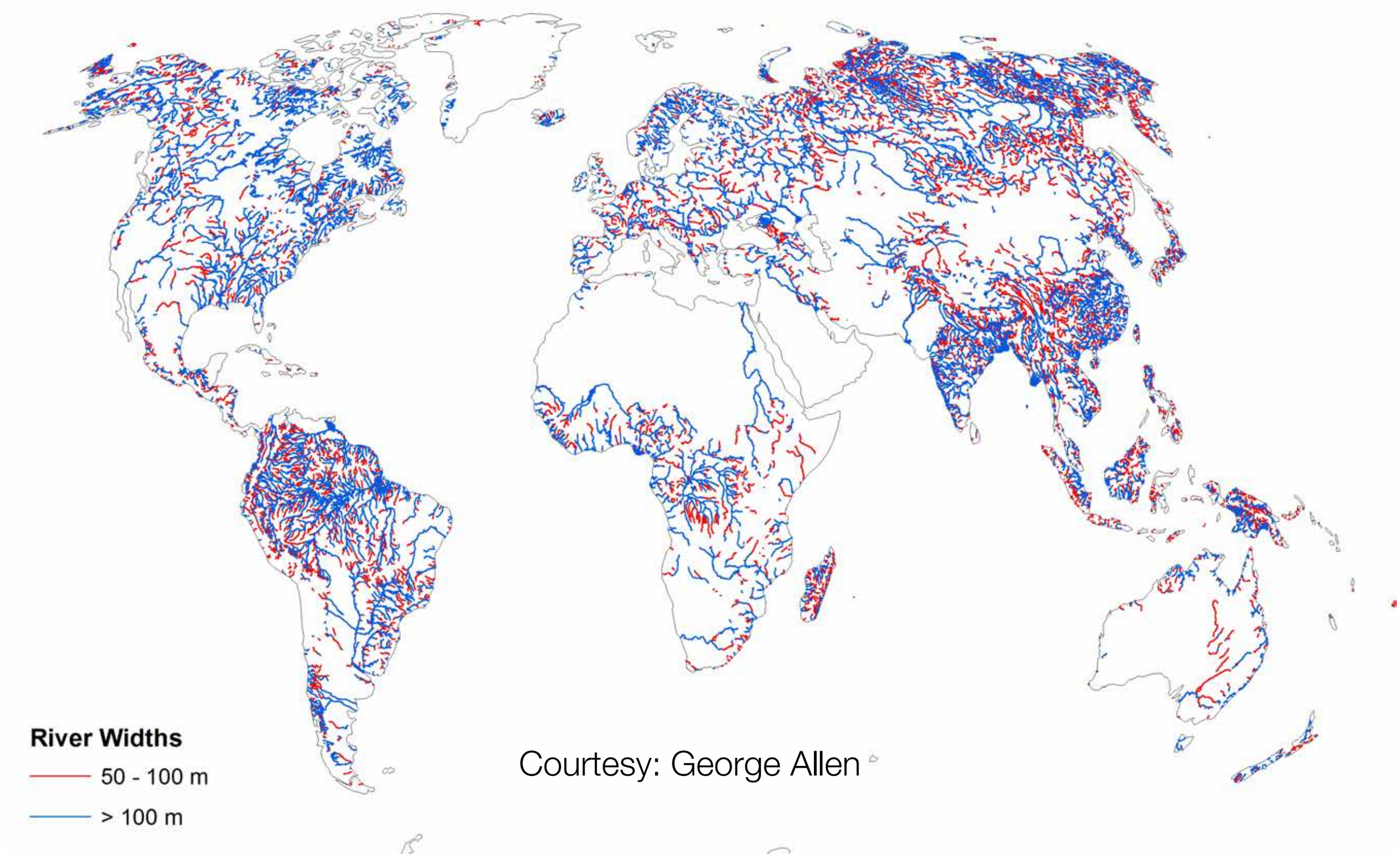
Hydrology Flow Chart

The River Tile Processor (core of RiverObs) will produce discharge, drawing from a priori database of parameters



~July 2023, the first day and (2nd) pass* river discharge will be produced

What will it look like? How good or bad will it be? What is our evaluation process?



Courtesy: George Allen

SWOT observable reaches

There are ~200,000 global reaches. We want to do the best job we can with all of them.

Timeline. Drawn to scale. Sobering!

- **2014**-2015: AMHG, MetroMan, and GaMo papers
- **2016**: Pepsi Challenge 1 paper
- **2018**: You are here. SIC4DVar, MFG papers.
- **2020**: Next Science Team grants launch
- April **2022**: First height, width and slope measurement

First discharge produced July 2023

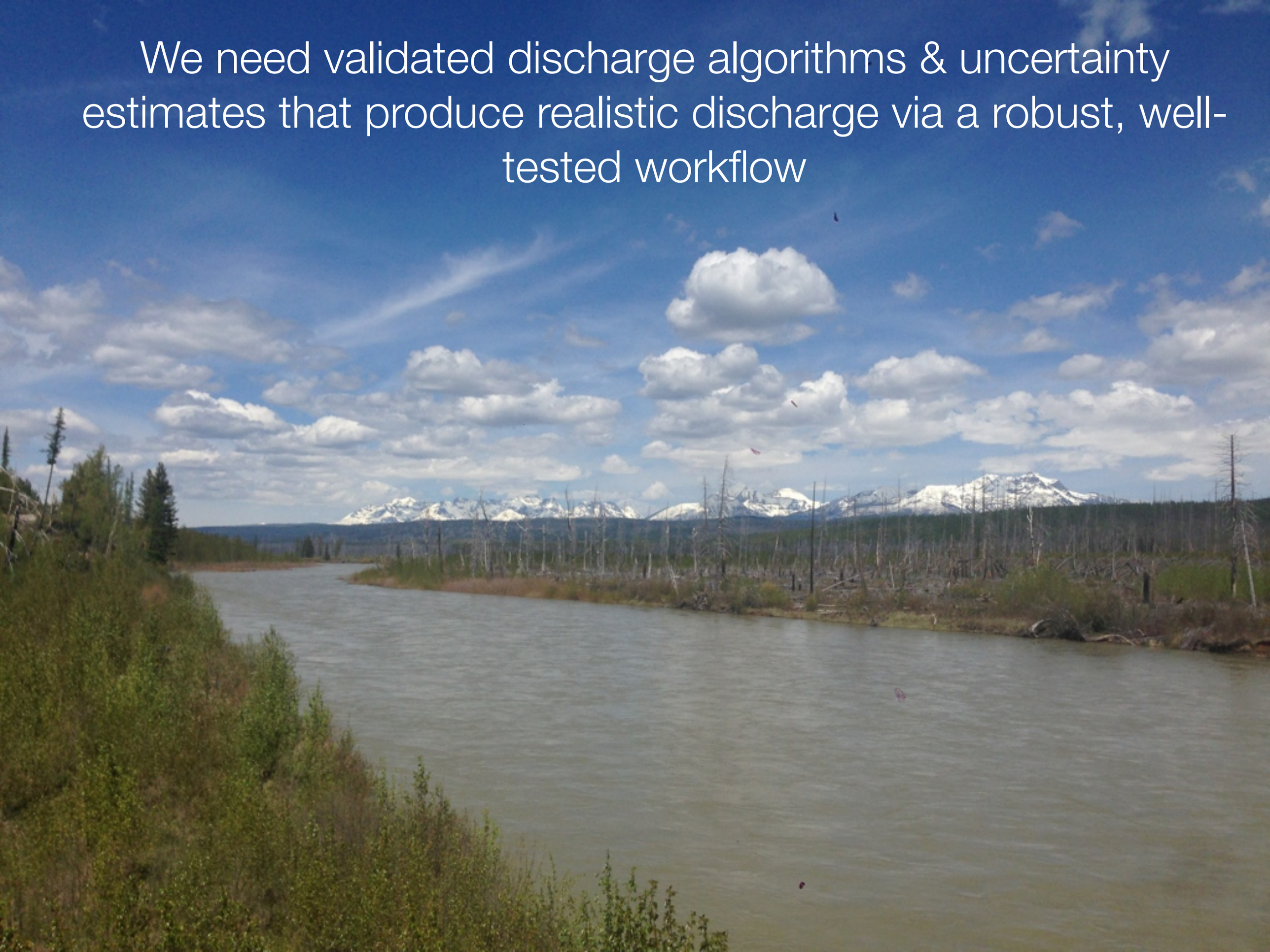
via Durand-Gleason March 2018 Summit

What do we need to do to be ready?

What does “ready” look like?

. . .

We need validated discharge algorithms & uncertainty estimates that produce realistic discharge via a robust, well-tested workflow



Validated algorithms…

- … wait, what **are** our algorithms?

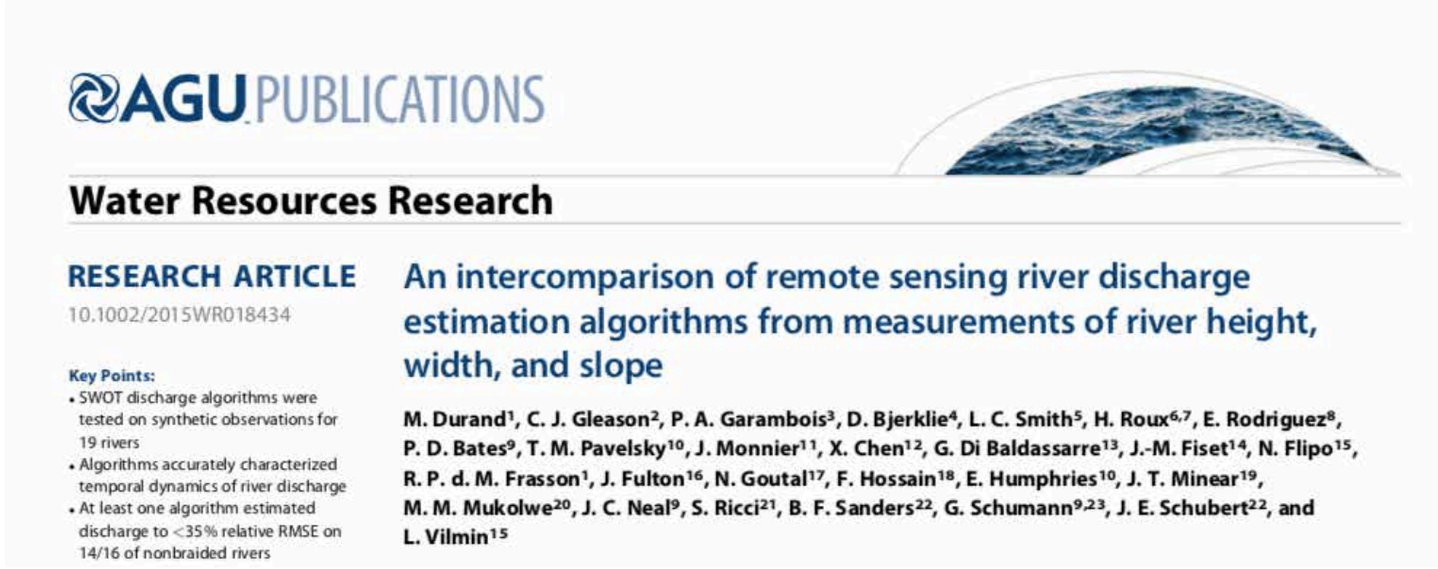
- Proposal: A preliminary selection of algorithms to be included in the SWOT data products ought to be done by the end of this Science Team cycle. As PAG has pointed out, this should be done by scientific criteria.

- Proposal: Why don’t we **baseline** inclusion of all algorithms currently participating in the Pepsi Challenge? Then in example data products etc. we will simply add parameters for however it is envisioned for each algorithm to be run? This can always be changed.

- If accepted, OSU can take the lead to develop instrument simulator test cases for everyone that include **actual inverted parameters** from each algorithm, and include in example data products.

Validated algorithms…

- We must continue to test and test our algorithms on new datasets
- I felt very happy with Pepsi1: I was not happy with MetroMan performance. But I learned what broke it, and I fixed it as best as I could. It works better now.
- The great success of Pepsi1 was to wind up algorithms and run them blind, without turning knobs after running them to get better results
- I believe some of our algorithms have more knobs than we have datasets to test on…



AGU PUBLICATIONS

Water Resources Research

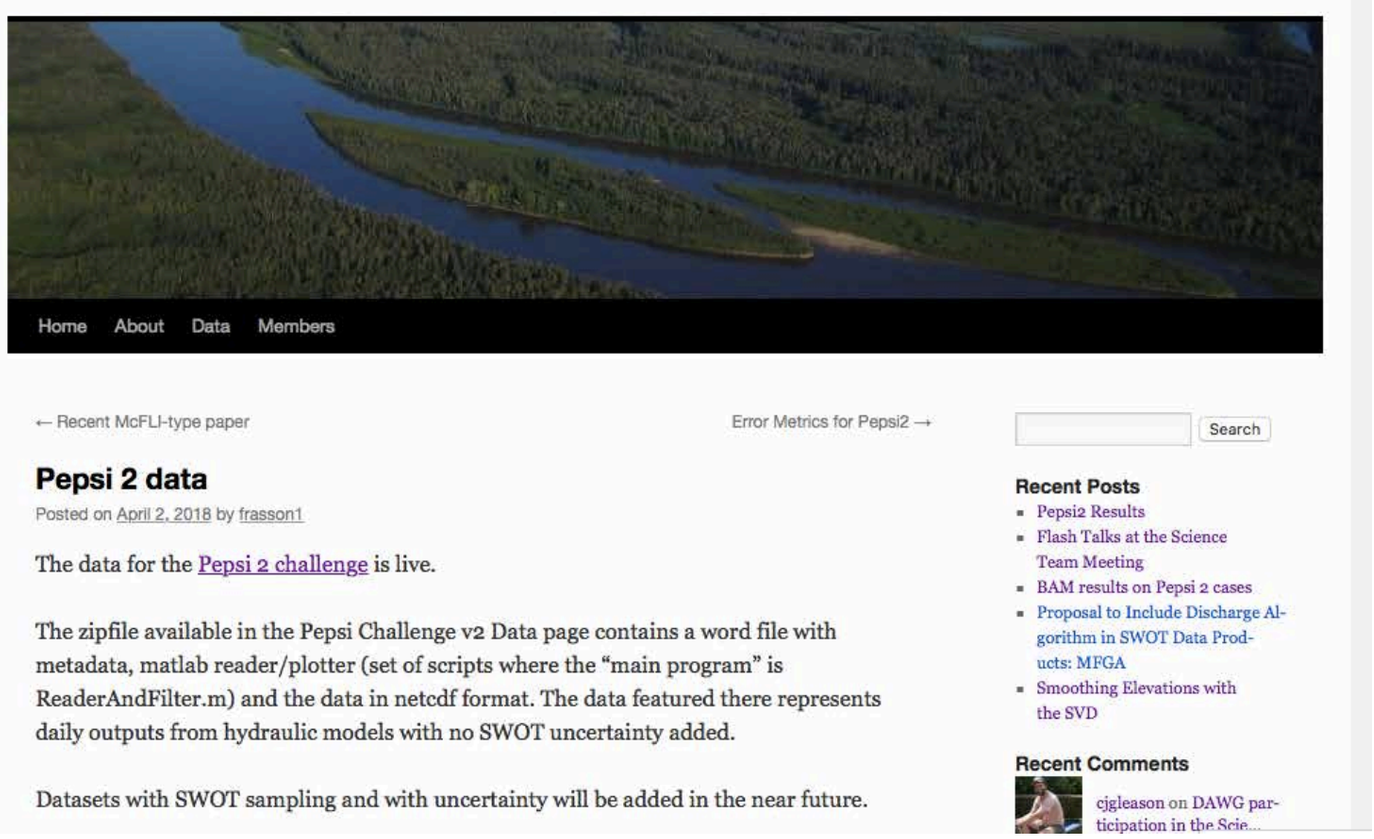
RESEARCH ARTICLE

10.1002/2015WR018434

Key Points:
- SWOT discharge algorithms were tested on synthetic observations for 19 rivers
- Algorithms accurately characterized temporal dynamics of river discharge
- At least one algorithm estimated discharge to <35% relative RMSE on 14/16 of nonbraided rivers

An intercomparison of remote sensing river discharge estimation algorithms from measurements of river height, width, and slope

M. Durand[1], C. J. Gleason[2], P. A. Garambois[3], D. Bjerklie[4], L. C. Smith[5], H. Roux[6,7], E. Rodriguez[8], P. D. Bates[9], T. M. Pavelsky[10], J. Monnier[11], X. Chen[12], G. Di Baldassarre[13], J.-M. Fiset[14], N. Flipo[15], R. P. d. M. Frasson[1], J. Fulton[16], N. Goutal[17], F. Hossain[18], E. Humphries[10], J. T. Minear[19], M. M. Mukolwe[20], J. C. Neal[9], S. Ricci[21], B. F. Sanders[22], G. Schumann[9,23], J. E. Schubert[22], and L. Vilmin[15]



SWOT Discharge Algorithm Working Group

Home About Data Members

← Recent McFLI-type paper

Error Metrics for Pepsi2 →

Pepsi 2 data

Posted on April 2, 2018 by frasson1

The data for the Pepsi 2 challenge is live.

The zipfile available in the Pepsi Challenge v2 Data page contains a word file with metadata, matlab reader/plotter (set of scripts where the "main program" is ReaderAndFilter.m) and the data in netcdf format. The data featured there represents daily outputs from hydraulic models with no SWOT uncertainty added.

Datasets with SWOT sampling and with uncertainty will be added in the near future.

Search

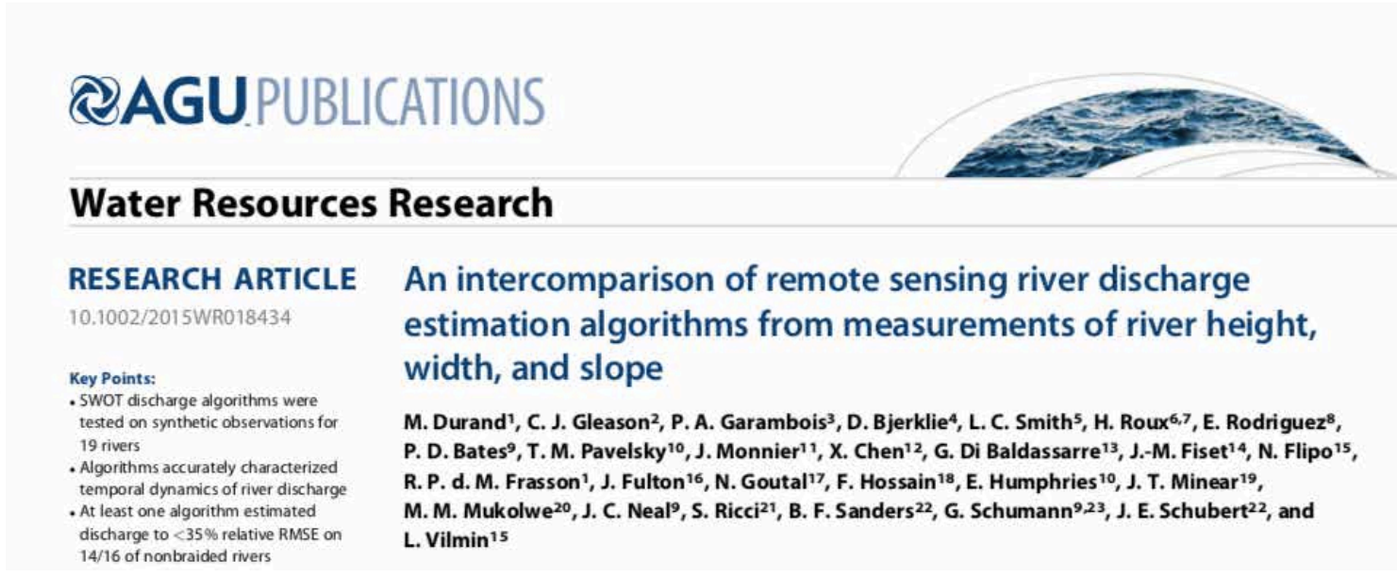
Recent Posts
- Pepsi2 Results
- Flash Talks at the Science Team Meeting
- BAM results on Pepsi 2 cases
- Proposal to Include Discharge Algorithm in SWOT Data Products: MFGA
- Smoothing Elevations with the SVD

Recent Comments

cjgleason on DAWG participation in the Scie...

Validated algorithms…

- We must continue to find models, generate data, test algorithms. PAG has some ideas for post-Pepsi2
- We need to make scenarios more like “real” SWOT cases, thinking about transferring parameters outside inversion periods
- We need to talk more about uncertainty estimates. Stephane Calmant: “A good algorithm is one with a known uncertainty”.
- We need to figure out how to optimize and speed up the testing process
- We must finish Pepsi2: this included other phases: SWOT-type scenarios, instrument simulator, AirSWOT, in situ data.



AGU PUBLICATIONS

Water Resources Research

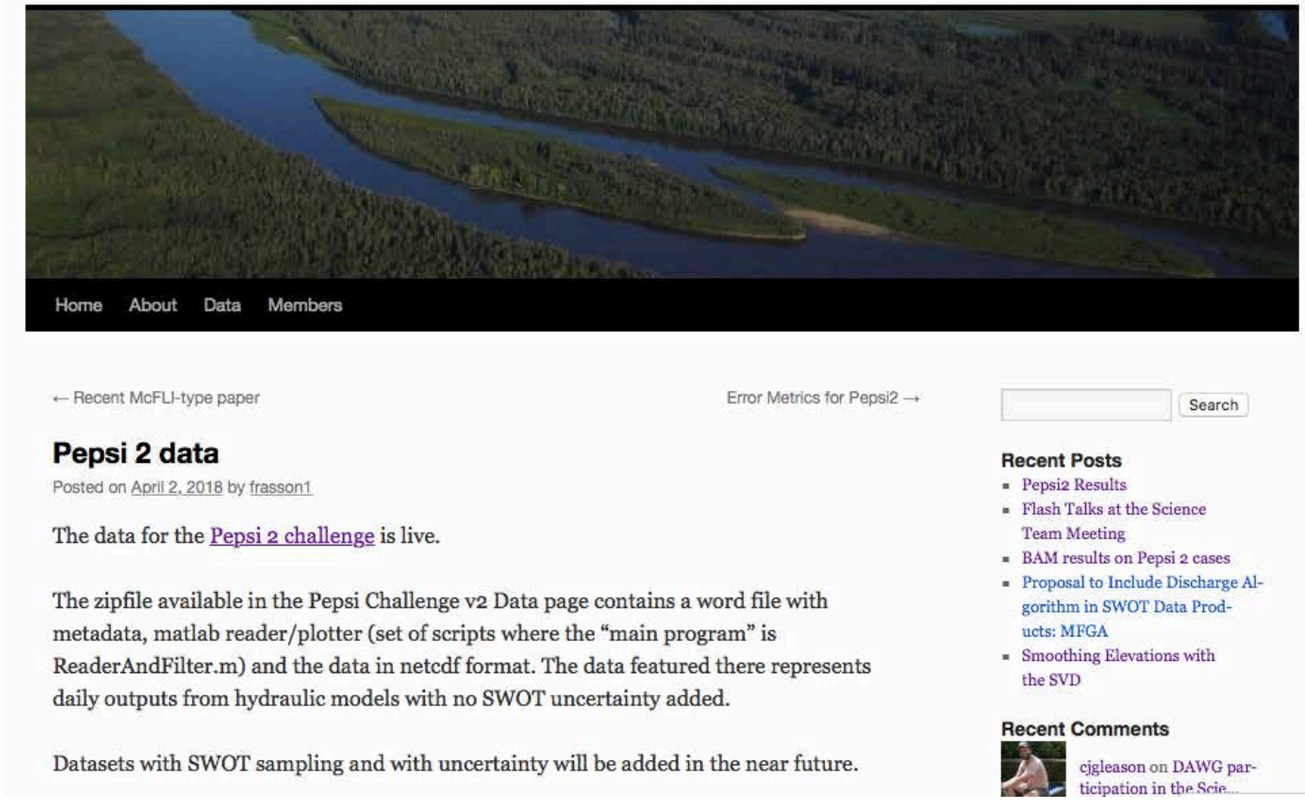
RESEARCH ARTICLE

10.1002/2015WR018434

Key Points:
- SWOT discharge algorithms were tested on synthetic observations for 19 rivers
- Algorithms accurately characterized temporal dynamics of river discharge
- At least one algorithm estimated discharge to <35% relative RMSE on 14/16 of nonbraided rivers

An intercomparison of remote sensing river discharge estimation algorithms from measurements of river height, width, and slope

M. Durand[1], C. J. Gleason[2], P. A. Garambois[3], D. Bjerklie[4], L. C. Smith[5], H. Roux[6,7], E. Rodriguez[8], P. D. Bates[9], T. M. Pavelsky[10], J. Monnier[11], X. Chen[12], G. Di Baldassarre[13], J.-M. Fiset[14], N. Flipo[15], R. P. d. M. Frasson[1], J. Fulton[16], N. Goutal[17], F. Hossain[18], E. Humphries[10], J. T. Minear[19], M. M. Mukolwe[20], J. C. Neal[9], S. Ricci[21], B. F. Sanders[22], G. Schumann[9,23], J. E. Schubert[22], and L. Vilmin[15]



SWOT Discharge Algorithm Working Group

Home About Data Members

← Recent McFLI-type paper

Error Metrics for Pepsi2 →

Search

Pepsi 2 data

Posted on April 2, 2018 by frasson1

The data for the Pepsi 2 challenge is live.

The zipfile available in the Pepsi Challenge v2 Data page contains a word file with metadata, matlab reader/plotter (set of scripts where the “main program” is ReaderAndFilter.m) and the data in netcdf format. The data featured there represents daily outputs from hydraulic models with no SWOT uncertainty added.

Datasets with SWOT sampling and with uncertainty will be added in the near future.

Recent Posts
- Pepsi2 Results
- Flash Talks at the Science Team Meeting
- BAM results on Pepsi 2 cases
- Proposal to Include Discharge Algorithm in SWOT Data Products: MFGA
- Smoothing Elevations with the SVD

Recent Comments

cjgleason on DAWG participation in the Scie…

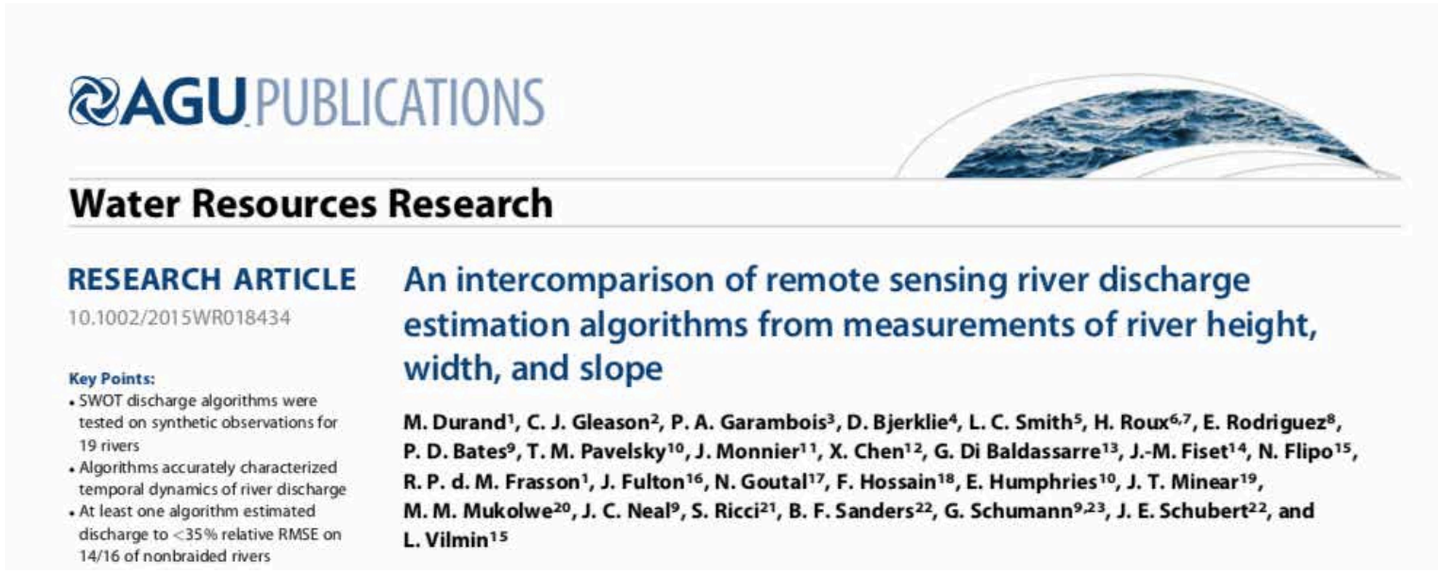
What is running blind?

- It means you show your first result. If you get a weird result, you **don't** tweak the algorithm, even if it's clear what went wrong.

- That is what we agreed on for Pepsi2 runs. That is what I'm assuming everyone did. If you didn't please be up front about it when you present results.

- The only exception is for **bugs**: we found a "+" that should have been a "-": not an *algorithm issue* but a code issue.

- When you present your results, please state whether you ran blind or not



AGU PUBLICATIONS

Water Resources Research

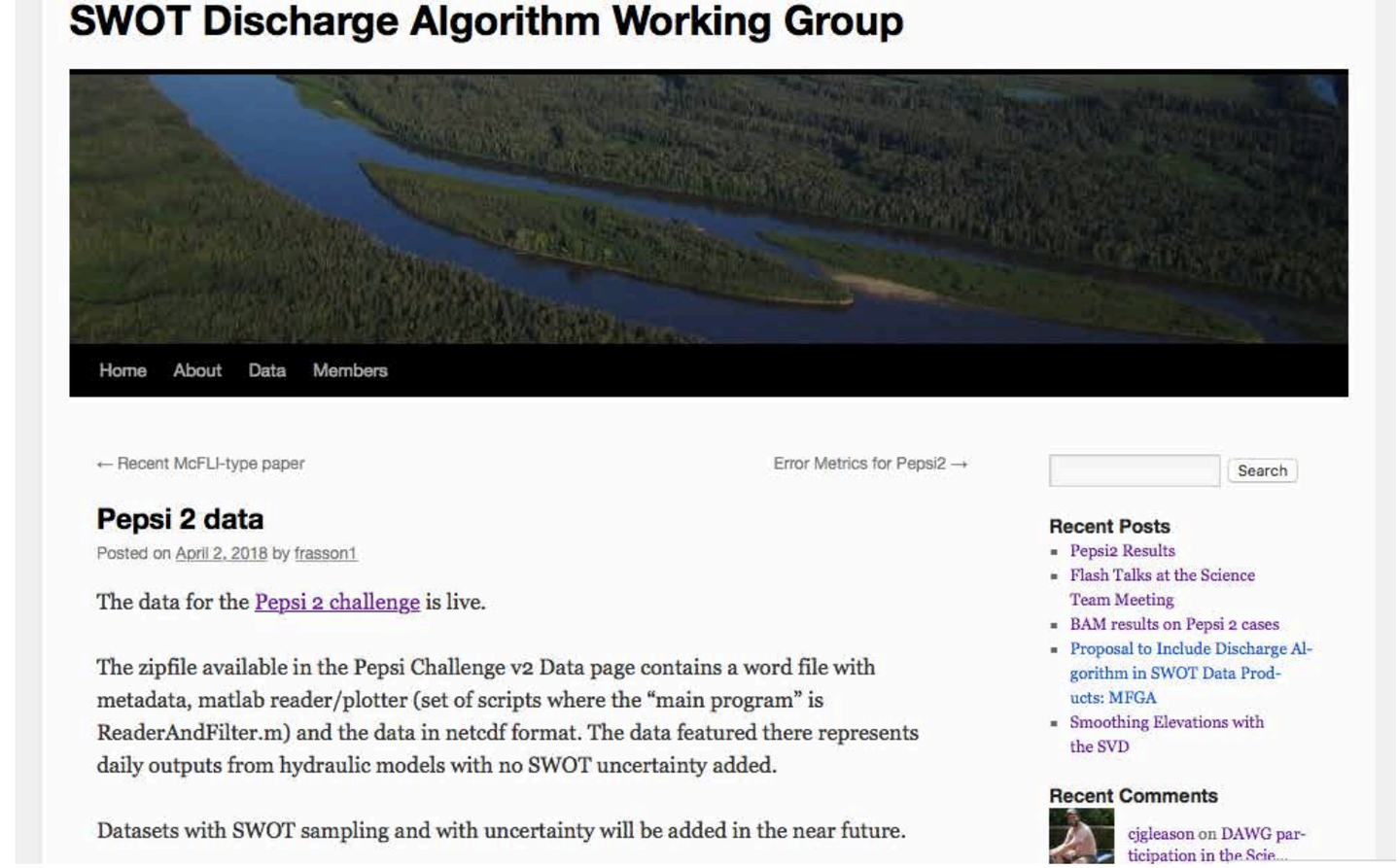
RESEARCH ARTICLE

10.1002/2015WR018434

Key Points:
- SWOT discharge algorithms were tested on synthetic observations for 19 rivers
- Algorithms accurately characterized temporal dynamics of river discharge
- At least one algorithm estimated discharge to <35% relative RMSE on 14/16 of nonbraided rivers

An intercomparison of remote sensing river discharge estimation algorithms from measurements of river height, width, and slope

M. Durand[1], C. J. Gleason[2], P. A. Garambois[3], D. Bjerklie[4], L. C. Smith[5], H. Roux[6,7], E. Rodriguez[8], P. D. Bates[9], T. M. Pavelsky[10], J. Monnier[11], X. Chen[12], G. Di Baldassarre[13], J.-M. Fiset[14], N. Flipo[15], R. P. d. M. Frasson[1], J. Fulton[16], N. Goutal[17], F. Hossain[18], E. Humphries[10], J. T. Minear[19], M. M. Mukolwe[20], J. C. Neal[9], S. Ricci[21], B. F. Sanders[22], G. Schumann[9,23], J. E. Schubert[22], and L. Vilmin[15]



SWOT Discharge Algorithm Working Group

Home About Data Members

← Recent McFLI-type paper

Error Metrics for Pepsi2 →

Pepsi 2 data

Posted on April 2, 2018 by frasson1

The data for the Pepsi 2 challenge is live.

The zipfile available in the Pepsi Challenge v2 Data page contains a word file with metadata, matlab reader/plotter (set of scripts where the "main program" is ReaderAndFilter.m) and the data in netcdf format. The data featured there represents daily outputs from hydraulic models with no SWOT uncertainty added.

Datasets with SWOT sampling and with uncertainty will be added in the near future.

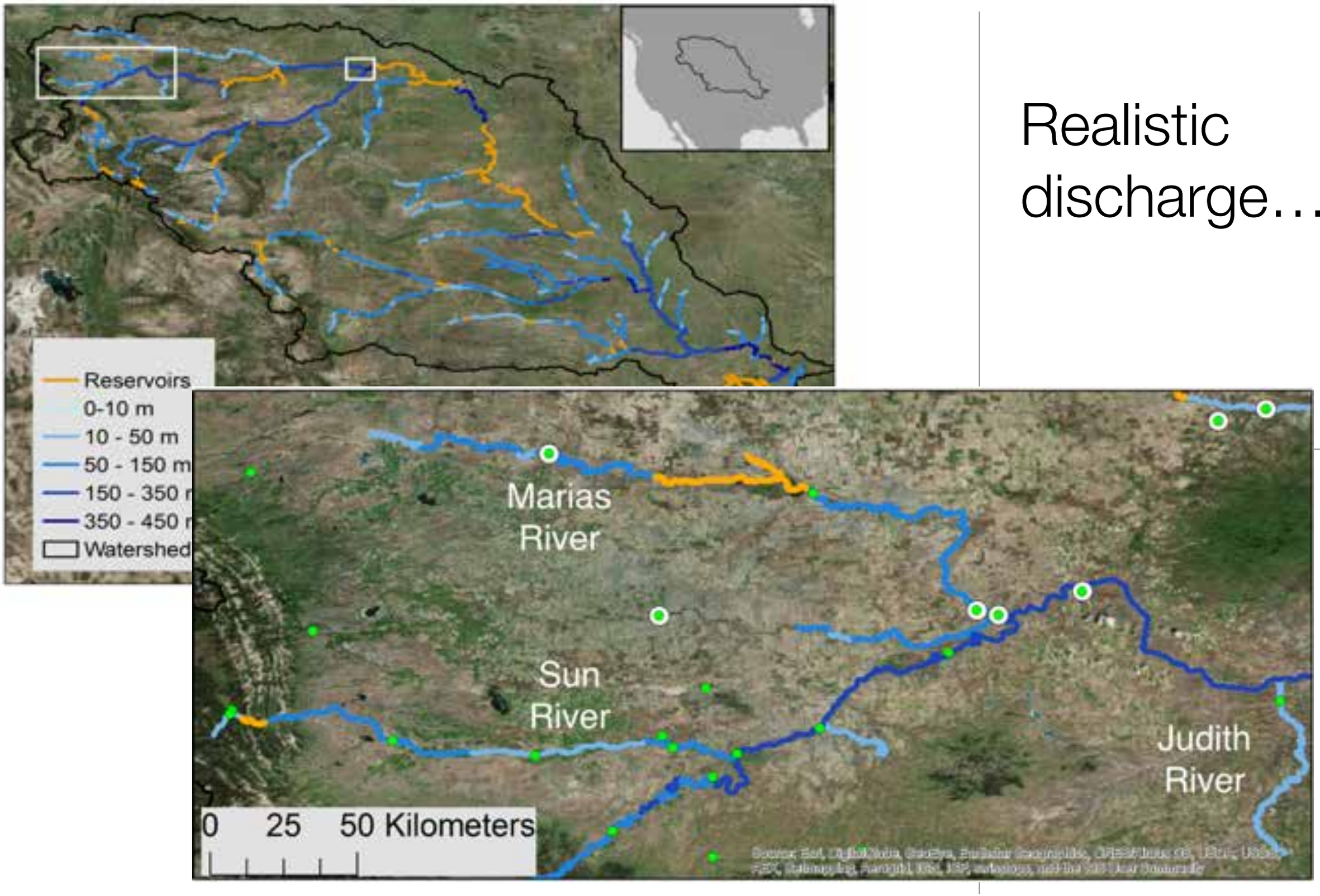
Search

Recent Posts
- Pepsi2 Results
- Flash Talks at the Science Team Meeting
- BAM results on Pepsi 2 cases
- Proposal to Include Discharge Algorithm in SWOT Data Products: MFGA
- Smoothing Elevations with the SVD

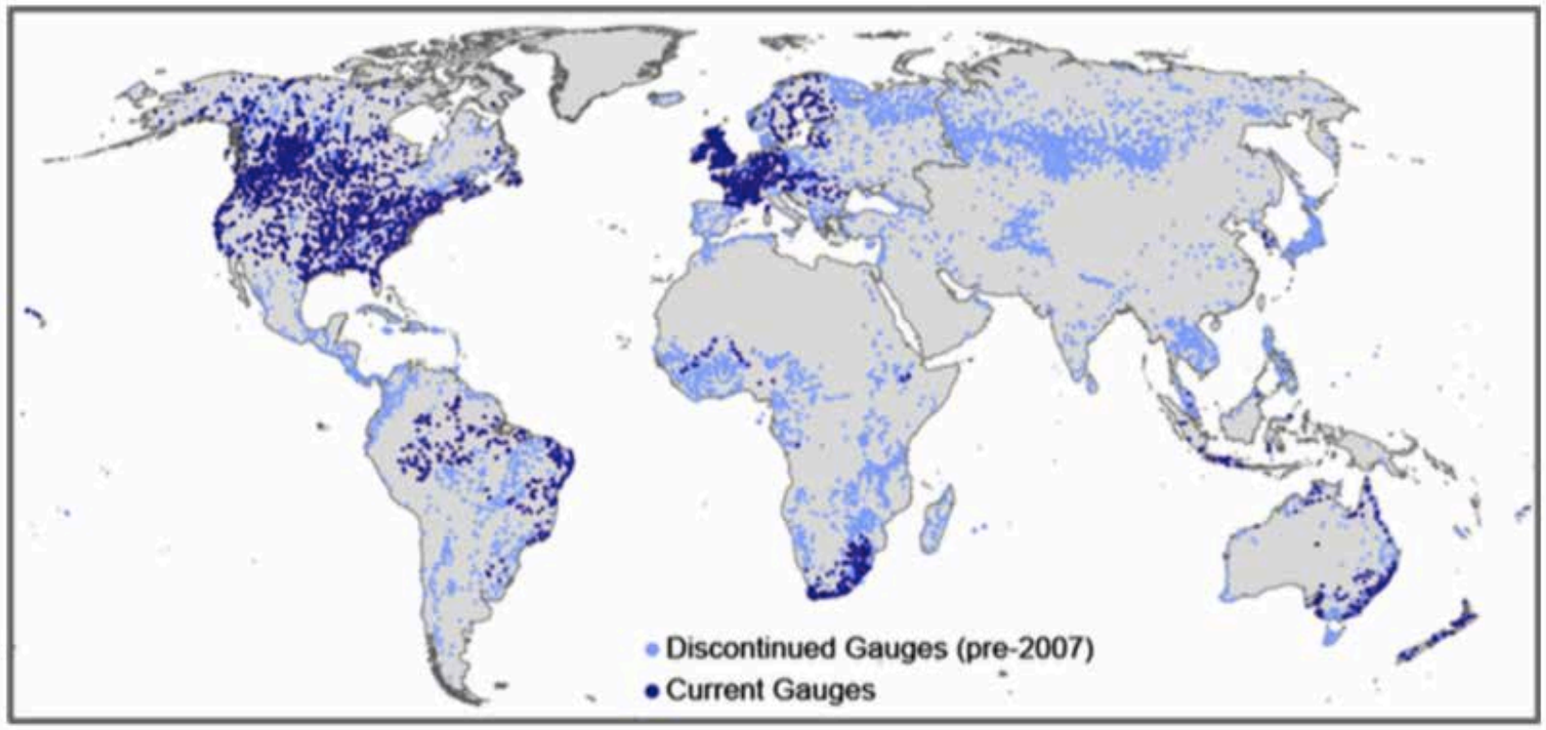
Recent Comments

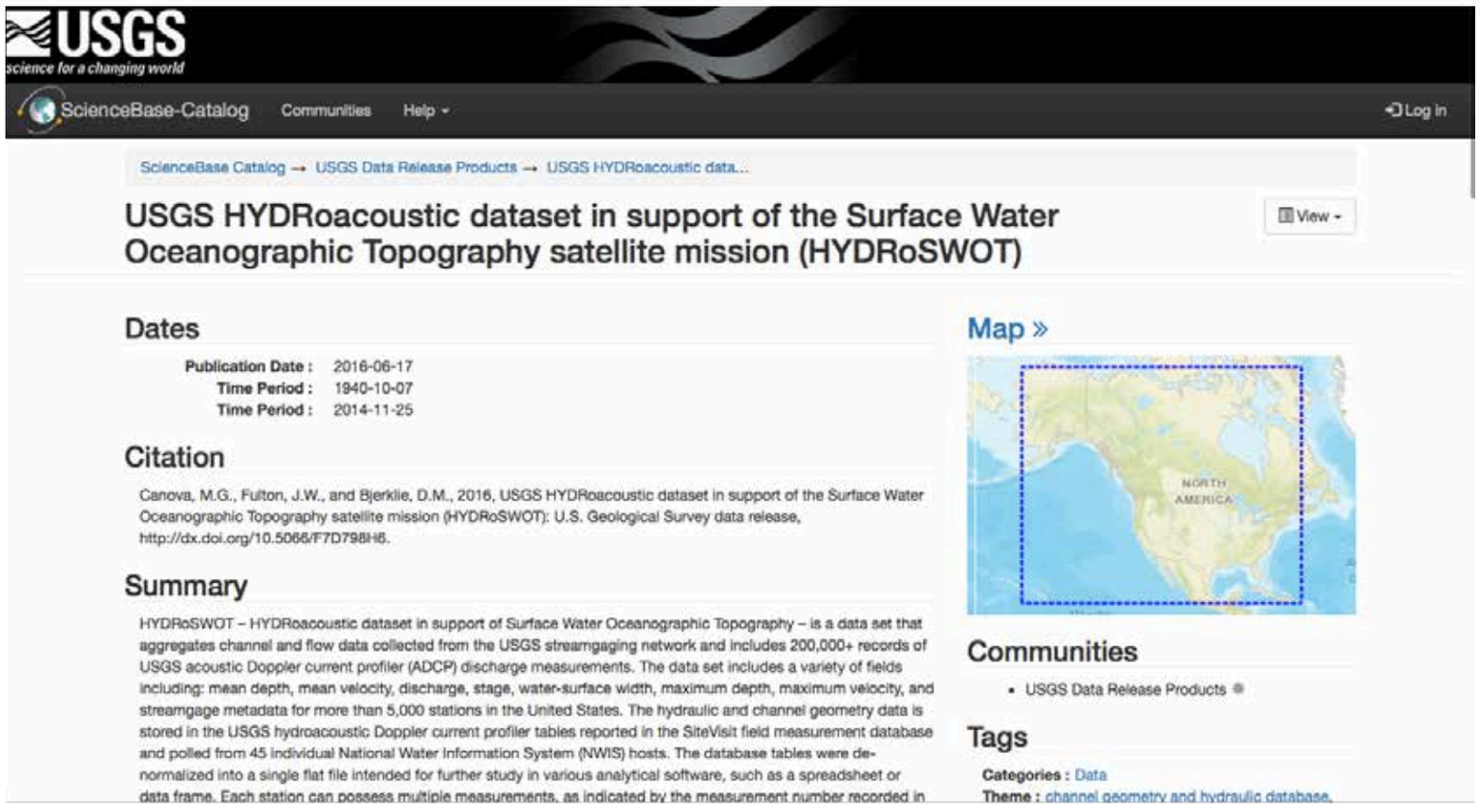
cjgleason on DAWG participation in the Scie...

Realistic discharge…



Discharge integrators: Discussed in detail by Colin Gleason (next talk). Goals: Formal ways of incorporating a priori and topological information



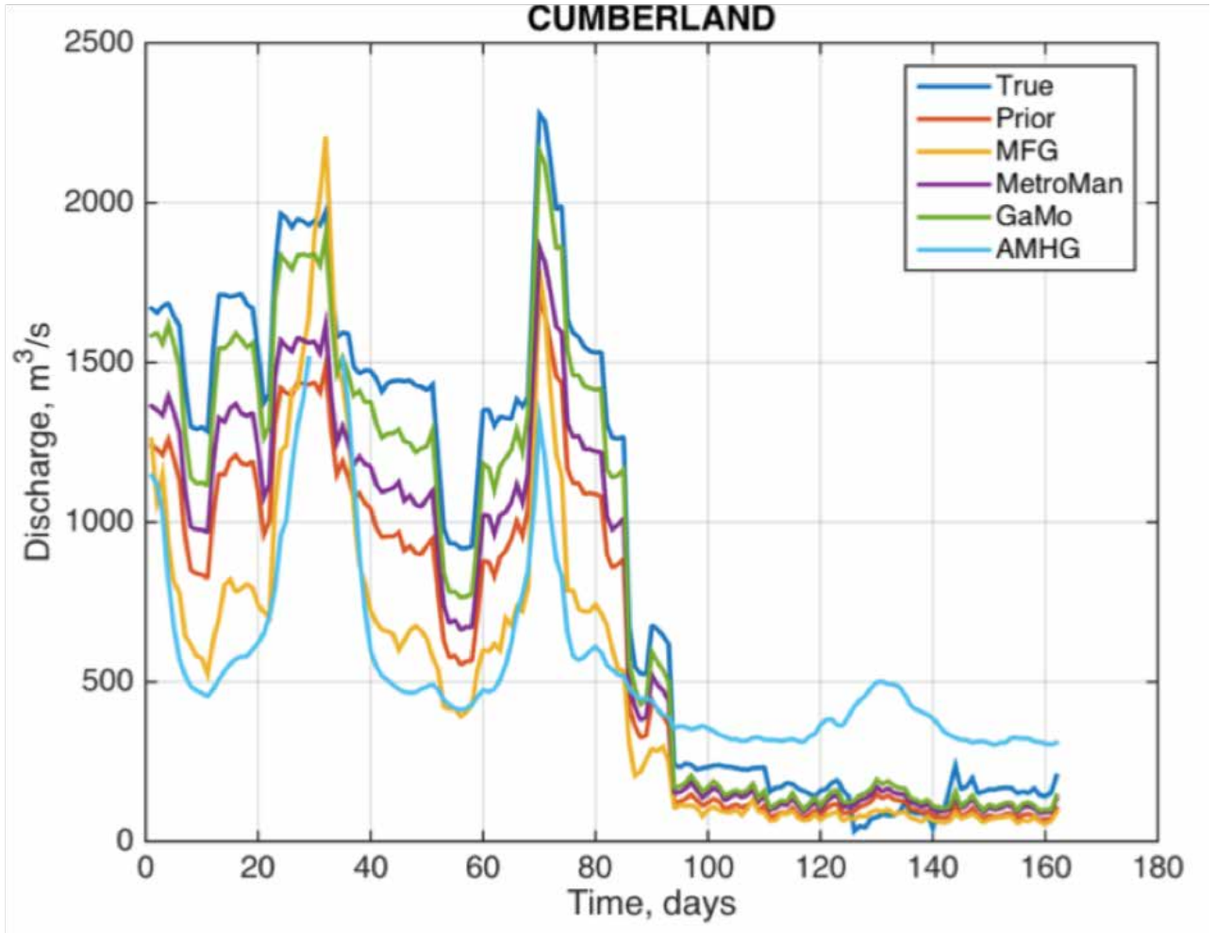


Realistic discharge…

Discharge integrators: Discussed in detail by Colin Gleason (next talk). Goals: Need to move towards ways of better using in situ data: real-time, historical, satellite rating curves, etc.

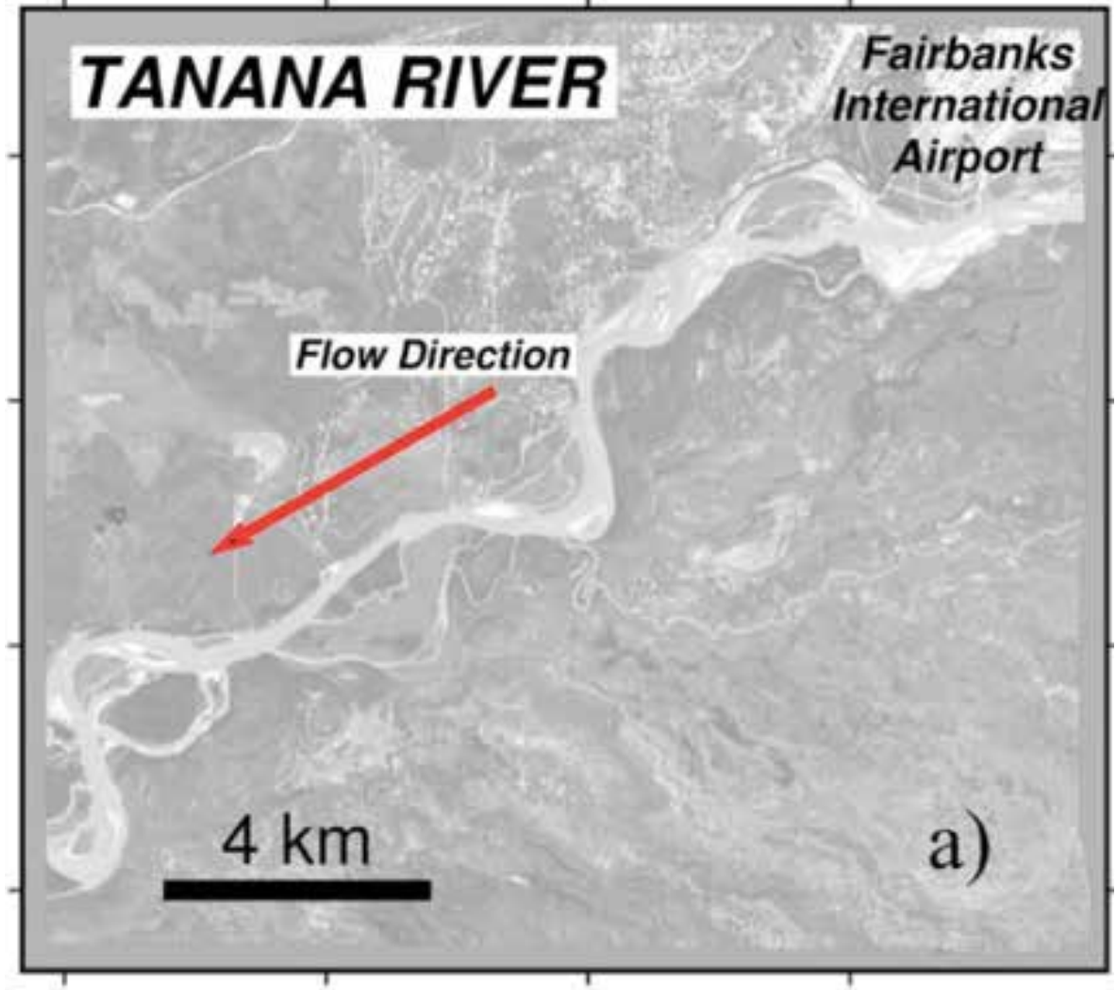
Realistic discharge: The need for consensus algorithm development

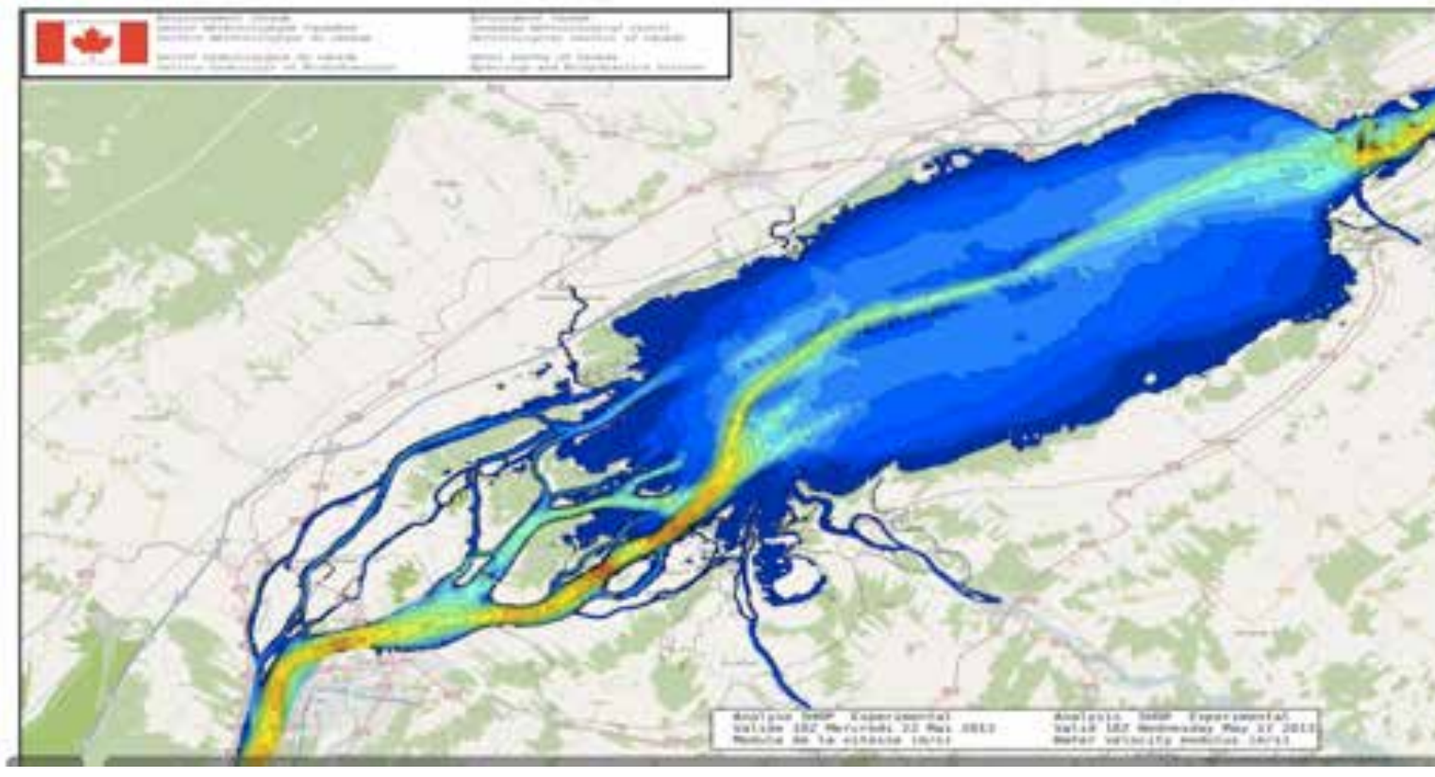
The algorithm for “consensus” discharge has not been developed. Taking median of all algorithms is a start, used in Durand et al. [2016]. Who is going to take charge of this?



Realistic discharge: Adapting algorithms for special cases

Braided rivers, flat rivers, floodplains, dams, gaining and losing reaches. Some of this is ongoing… I propose that after we develop integrators and conquer a priori data, a focused effort on special cases is the next step.





Robust, well-tested workflow: We need a discharge integrator environment

- Mark Hagemann has pointed out that often we are not running in a context that is “like” how algorithms will be run with SWOT data

- Parameters will be inverted on one time period, then applied on a different time period. In fact, some algorithms do this, while others do not. But this should be systematized.

- Making future tests conform to this idea will likely involve validating parameters, consideration of equifinality, and longer discharge timeseries

Robust, well-tested workflow: We need a discharge integrator environment

- Many of the operations, routines, etc. to do this operationally will require MANY commonalities

- I.e. BAM, DassFlow, MetroMan, MFG, SAD, and SIC all require massive data I/O, checking the same kinds of flags.

- We have much to gain from supporting the development of common libraries (source, or binary), comparing against in situ, cal/val sites, etc.

- In an ideal world, there would be a massive, scalable, HPC-enabled “integrator” environment, common across the Atlantic. It could run on Amazon Web Services. Any of us could launch 75,000 McFLI runs and compare to real-time Qs…

- … given adequate computational resources, which we may also want to start thinking about

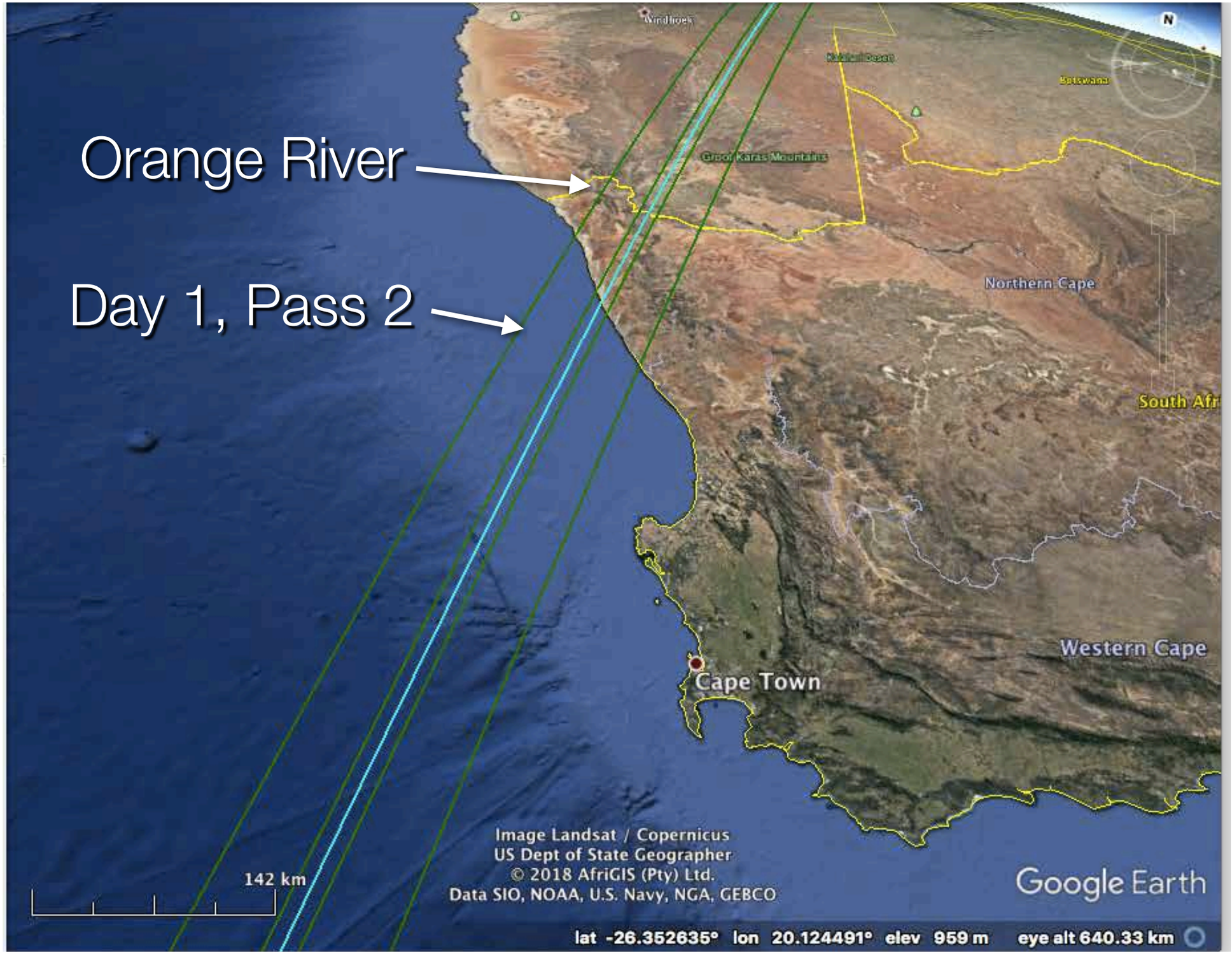
Timeline. We need to fill in the blanks between now and launch. I will propose something, for discussion on telecons

---

- **2014**-2015: AMHG, MetroMan, and GaMo papers
- **2016**: Pepsi Challenge 1 paper
- **2018**: You are here. SIC4DVar, MFG papers.
- **2020**: Next Science Team grants launch
- April **2022**: First height, width and slope measurement

First discharge produced July 2023

via Durand-Gleason March 2018 Summit



~July 2023, the first day and (2nd) pass* of river discharge will be produced

This room includes people with tremendous and diverse capabilities. We need **everyone** in order to produce successful discharge