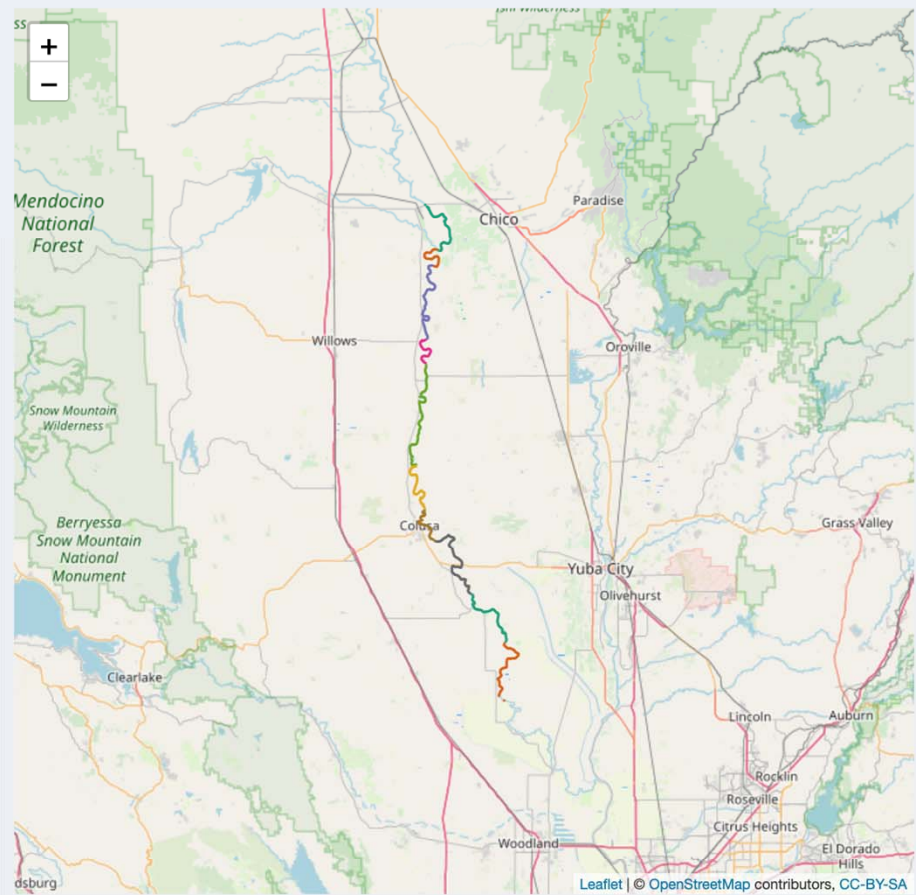# Summary: SWOT Hydrology Breakout Results

Reminders

- Session Chairs: You will be asked to write a brief summary of your session.

- Please make sure your session chairs have your presentation slides.

- Please look at the HR Swath Coverage discussed on Wednesday and provide feedback by August 1st.
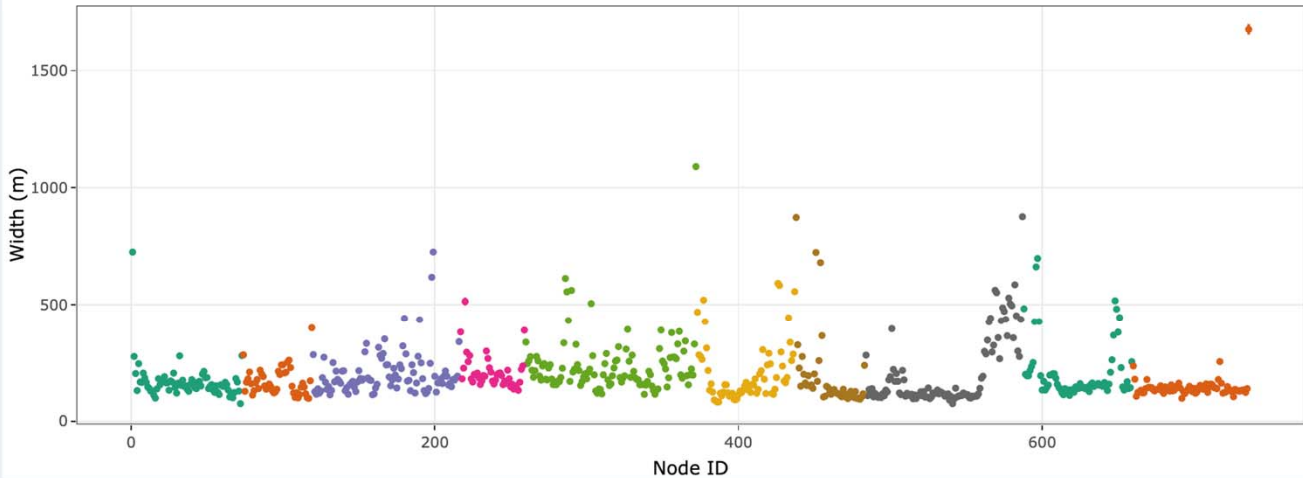
Data Products Workshop (1)

- Brought the Science Team up to speed on the key features of the pixel cloud product.
    - Multiple levels of spatial averaging
    - PixC vs. PixCVec products
    - Answered lots of questions
- Provided key examples of how the SWOT River Product will be produced
    - A Priori River Database under ongoing development
    - New web app presented by Mark Hagemann allows the Science Team to explore example river data products over the Sacramento River
        - Bit.ly/riverproducts
    - Agreed that the algorithm to convert from the pixel cloud to river products is largely in good shape.

Prior DB   Passes/Tiles   Pixels   **Nodes**   Reaches

Nodes

Node-level data for the selected tile are now shown in the map. The display size of each node corresponds to its area. Click a node to see some of its data; a full set of node-level data is shown in the table below.

Y-axis variable

◉ Width   ○ Height   ○ Area   ○ Custom (from table)

X-axis variable

◉ Node ID   ○ Cross-track Dist   ○ Width   ○ Height   ○ Area

Show [10 ⬍] entries   Search: [   ]

reach_id	node_id	time	time_tai	latitude	longitude	latitude_u	longitud_u
1	1	764832.744928134	764832.744928134	39.7515080675251	-121.997293336946	0.00000199899932340486	0.00001151249580289
1	2	764832.754494042	764832.754494042	39.7482697692157	-121.993356578006	0.00000356268833456852	0.0000205216419999488
1	3	764832.757396945	764832.757396945	39.7474140961029	-121.991851195502	0.00000352050255969516	0.0000202801820705645
1	4	764832.760351217	764832.760351217	39.7463161808806	-121.989663510699	0.00000432829119745293	0.000002493616011634

Data Products Workshop (2)

- Demonstrated the current capabilities and discussed future plans for SWOT lake products
  - The SWOT A Priori Lake Product is well on its way, with global input provided by Yongwei Sheng in next two months for processing by CNES.
  - Software for lake processing from the pixel cloud is advanced (demonstration cases shown).
  - Work is ongoing on harmonizing river/lake algorithms and products
- Most variables for Raster data product are currently producible; raster elevations should not be interpreted separately from uncertainties and/or inundation extents
- Long discussion on data quality flags: need both flags and uncertainties for different users.
- An algorithm exists for the floodplain DEM, but accuracy will be challenging in many cases.

Lake Science from SWOT

- Lakes are sentinels (proxies with ECVs), Regulators (they act on the local and global climate) and integrators (archives in the sediments) of climate changes.

- SWOT data on height, extent and storage changes are going to be assimilated in global models.
  - Work on coupling routing models, LSM, and lake models are under development
  - Sensitivity analysis of lake models to physical parameters have been performed and have shown the high value of SWOT, particularly for shallow lakes.

- SWOT regional studies presented on lakes in Sahel and Arctic lakes
  - HR simulator, external images analysis and AirSWOT data.
  - Capacity to monitor lakes and produce essential variables for understanding lakes In complex contexts demonstrated.

- Major efforts on the setup of the a priori database (lakes extent, lake height, MSL, separation between lakes and artificial reservoirs) to be ready before launch.

- The ST participates actively to the ADT for the development of the Lake products algorithm chain

Discharge Algorithms and Science

- The new paradigm of "hydraulic visibility" and its effects on river discharge was highlighted
- The Pepsi Challenge Part Deux results were unveiled
  - Discharge can be estimated from SWOT alone. Accuracy is acceptable
  - Neither measurement uncertainty nor frequency governed results
  - Prior discharge estimates play an important role in governing accuracy
- How SWOT algorithms will use prior data was discussed
  - Emerging consensus to have two discharge data products, one with no in situ data used, and one constrained by in situ data
  - This highlights the need to coordinate with the cal/val team to ensure discharge validation follows best practices

Hydrology Data Product Distribution

- High enthusiasm for APIs
  - Especially Reformatting, Reprojection, Regridding
- Choice of interoperability standards: science users trust data centers
  - Help introduce new standards, ways of doing things
- Use of ArcGIS cloud – not considered to be of very high interest
  - Note: user community might not be represented by the room (other agencies, applications)
- Interest in test processing on the cloud and other options in advance
- Don't worry, data download (including some transformations) will be free
  - But cost for users to do further processing in the cloud could be issue
- For HPC option, clarification of available resources needed

SWOT Data Assimilation and Hydrologic Modeling

- New understanding of discharge uncertainty (runoff/routing sources and propagation) used to advance SWOT data assimilation
    - Approach applicable to other models/methods

- Global scale hydrologic models are capable of providing "reasonable" a priori river discharges
    - Performance varies regionally; arid/semi-arid are most challenging

- Major advances underway on lake modeling in Earth System Models
    - Still a lot of work to do…

- SWOT derived baseflows likely to be better than event discharges
    - Potential to advance groundwater understanding and modeling capabilities

- End-to-end demo for SWOT-like discharges using McFLI and remote sensing alone
    - Coupled systems provides "better" & "network-wide" discharge estimates

Calibration and Validation

- Cal/Val is not strictly separated by ocean/hydrology, since hydrology needs ocean calibration.
- Cal/Val phases (calibration, error budget validation, data product validation) require different data, in some cases different sites.
  - Make sure algorithms do not use in situ data from validation sites!
- Inland Hydrology Cal/Val is well developed but some issues remain
  - Tier 1 and 2 sites mostly chosen and studied. Benefits could be gained by shifting sites under Fast-Repeat orbit.
  - Small issues with transducers identified, though error is small and is being understood / explored.
    - E.g. drift of 1cm / month in WSE due to wind or biofouling; also wind / wave effects
  - Water surface distributions are being studied to better compare gage stage to SWOT stage: "in-situ apples to SWOT apples"
  - GNSS processing needs more effort: Need standardization and processing workflow; could have some data pre-processed for launch. Small working group recommended to test processing with existing data.
  - Recommend 'Bright mud' / 'Radiant rooftops' working group, to come up with a plan to assess
  - Incorporation of remotely sensed inland altimetry (Jason altimeters, ICESat-2, etc)
  - Citizen Science for WSE measurements being explored
  - Cal/Val workshop and more integration across US and French Teams would be useful
- Inland Hydrology Cal/Val would benefit from prioritization and assessment of costs and risks.