SWOT Raster: Update

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Current Status of the SWOT Raster Product

- Raster will be produced systematically at 100 m and 250 m resolutions over all regions where the pixel cloud is produced and there is water.

- We will use a fixed grid with fixed boundaries, divided into tiles of ~120 x 120 km, for raster storage and distribution.

- Raster will be produced in netCDF format, with on-demand processing to geoTIFF, JPEG2000, etc. to be discussed with data distribution centers.

- Raster will be provided in UTM coordinates, but we will aim to have on-demand processing from pixel cloud direct to lat/lon.

- Prototype software for producing the raster product has been developed at UNC (in python) and has been evaluated and added to by JPL (B. Williams).

Current Raster Data Fields

Identifying Information

- Cycle Number
- Tile ID
- Time
- Projection Information

Data Fields

- Height (m)
- **Height Uncertainty (m)**
- Inundated Area (m^2 or %)
- **Inund. Area Uncert. (m^2)**
- Cross-track Distance (m)
- Average Sigma0 (dB)
- Sigma0 Uncertainty (dB)

Flags

- Data quality flag
- Low SNR
- Ice Cover
- Layover
- Geoid: geoid height above reference ellipsoid
- Geoid Slope
- Solid Earth tide model
- Pole tide model
- Orbit quality flag
- Instrument flags
- Wet tropospheric correction
- Dry tropospheric correction
- Ionospheric correction

Implemented (**New**)
Not implemented, simple
Not implemented, requires work

Examples of Raster Product

Sacramento River

- Built using output from the SWOT SLC Simulator
- Same case shown earlier for river data products

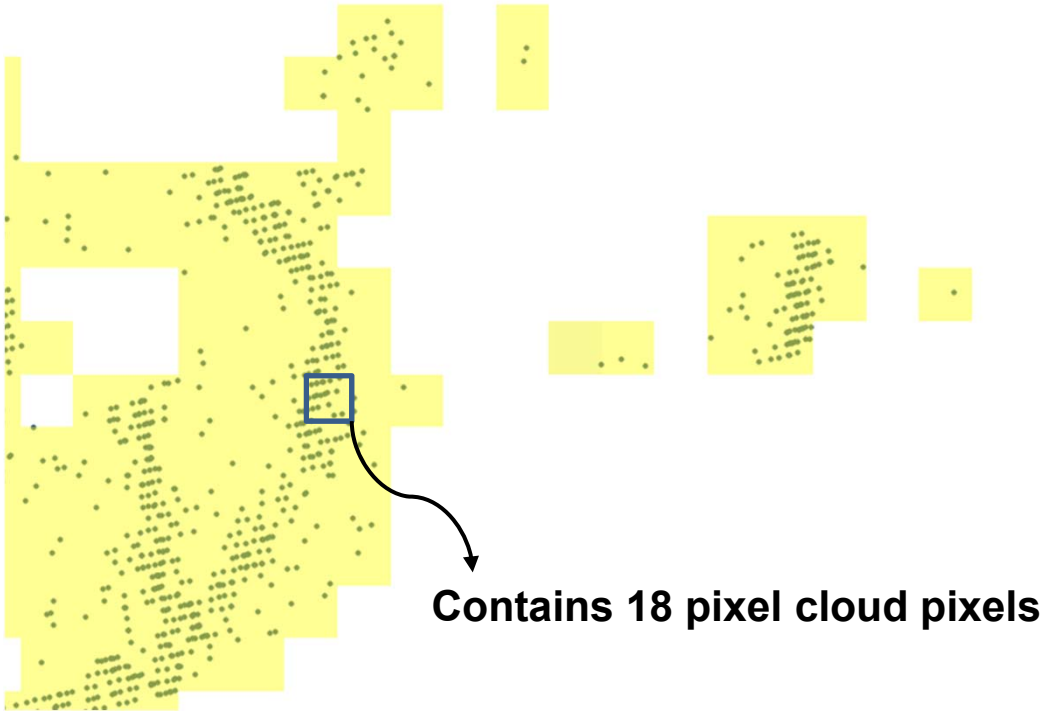
Severn River

- Built using the 1051 Simulator
- Simulates a significant flood event
- Built using Lisflood output developed at U. Bristol
- Can’t calculate error terms
- Aim to rerun with latest SWOT processor soon

Water Surface Elevation

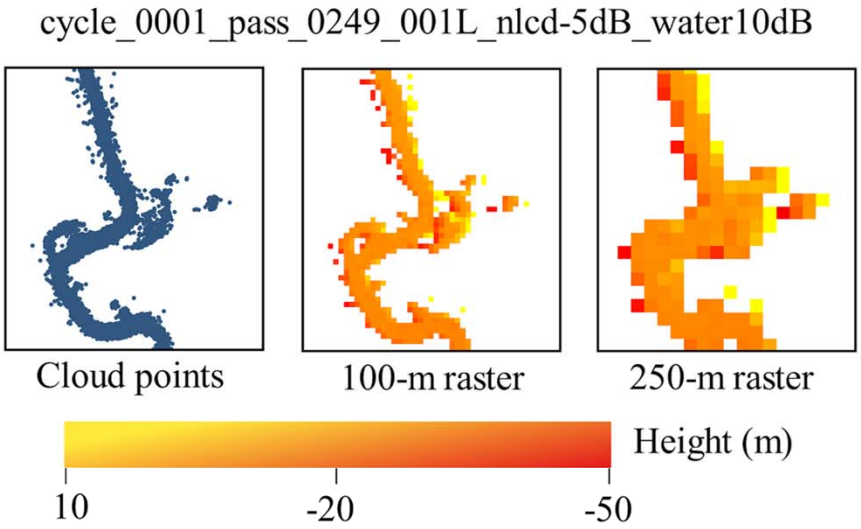
Mean elevation of all pixel cloud pixels with centers falling inside the raster grid cell.

Example of pixel cloud pixels overlaid on raster coverage

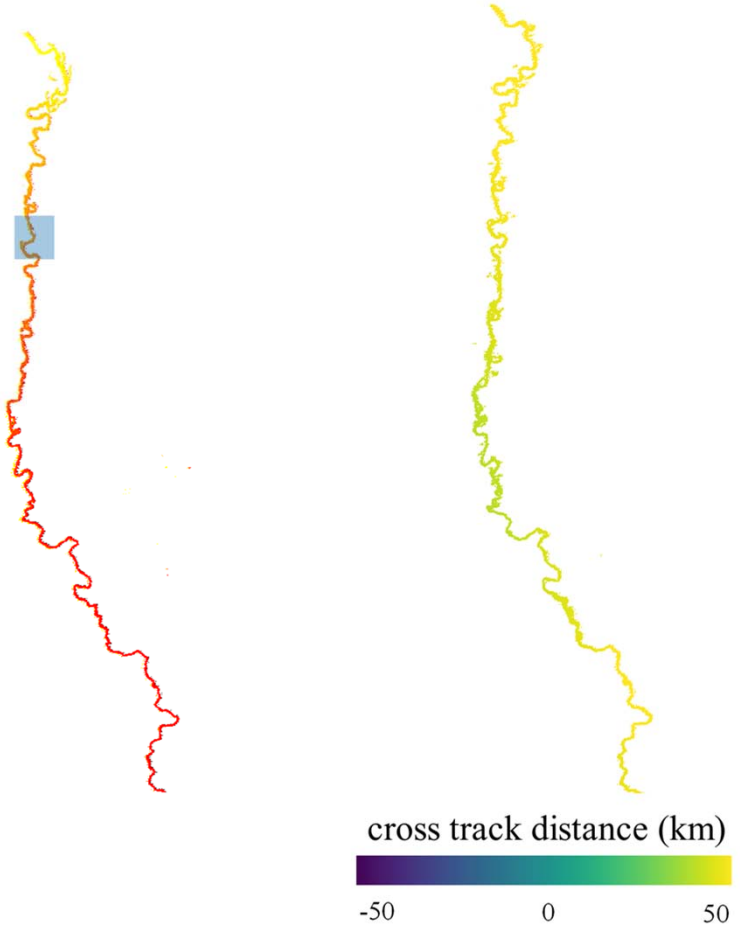


Sacramento Example 1: Mid-Swath Case

Water Surface Elevation

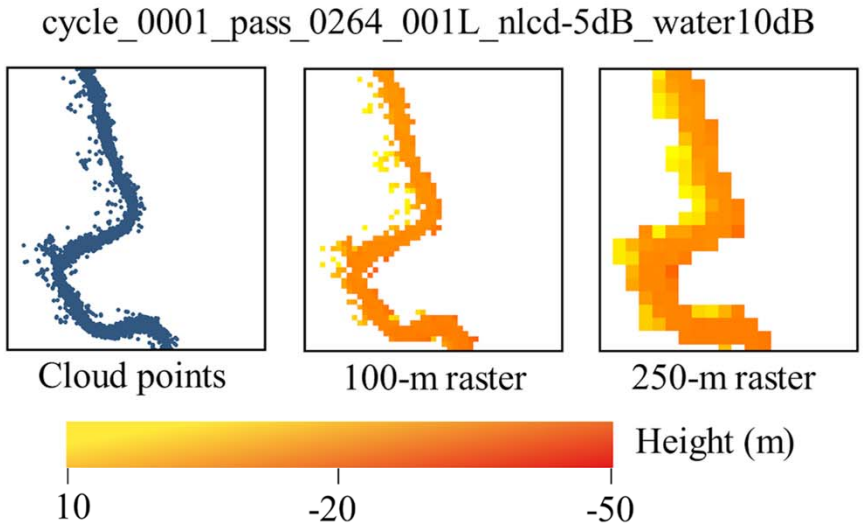


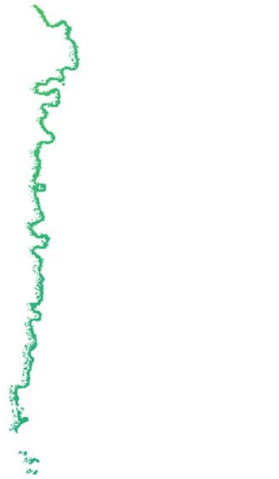
	Mean elev (m)	Std elev (m)
Point	-2.88	2.83
100-m raster	-2.41	6.69
250-m raster	-1.95	8.03



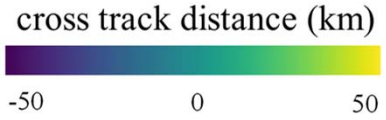
Sacramento Example 2: Near-Nadir Case

Water Surface Elevation



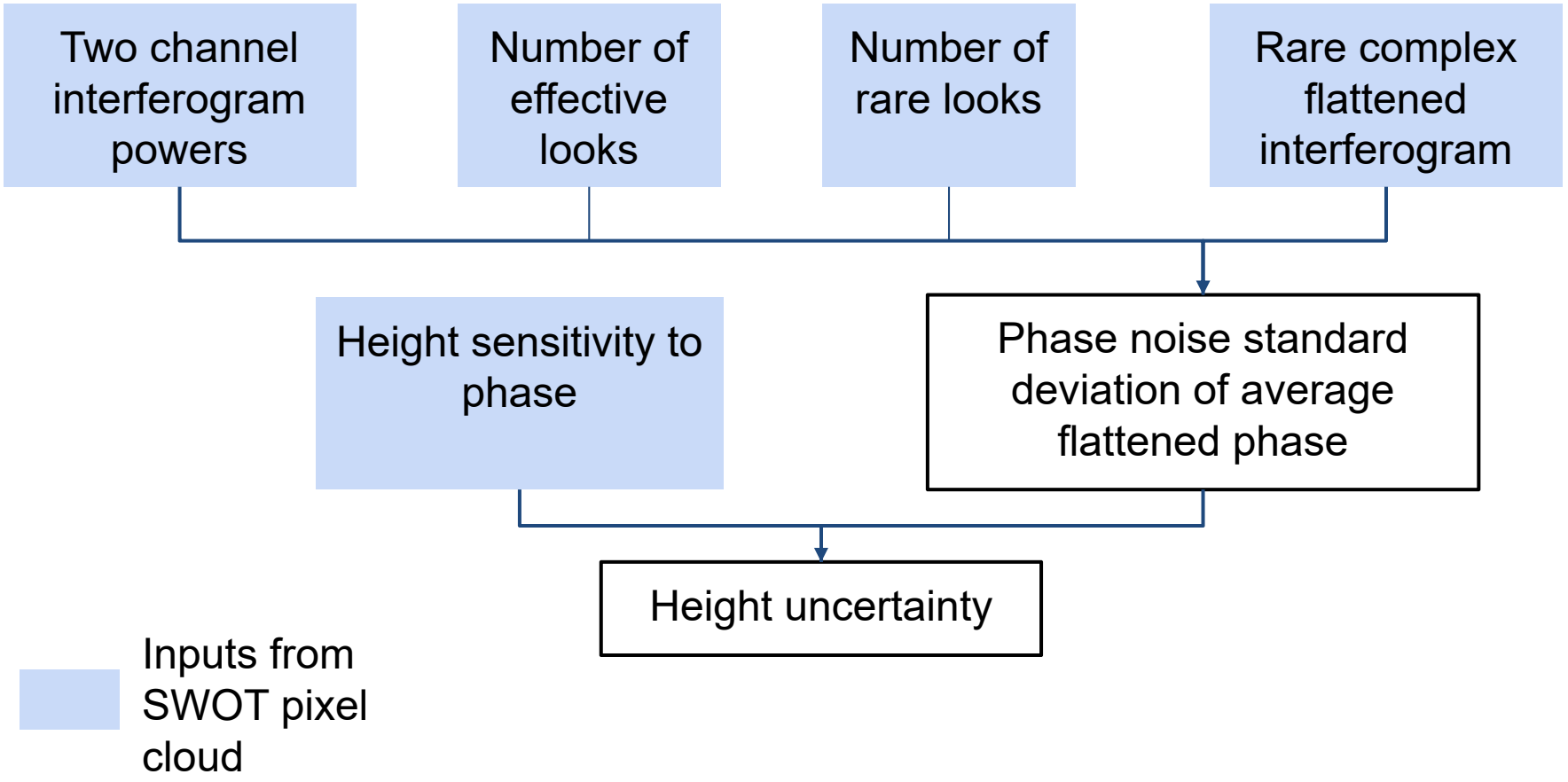


	Mean elev (m)	Std elev (m)
Point	-2.98	2.16
100-m raster	-1.63	3.91
250-m raster	-0.33	4.86



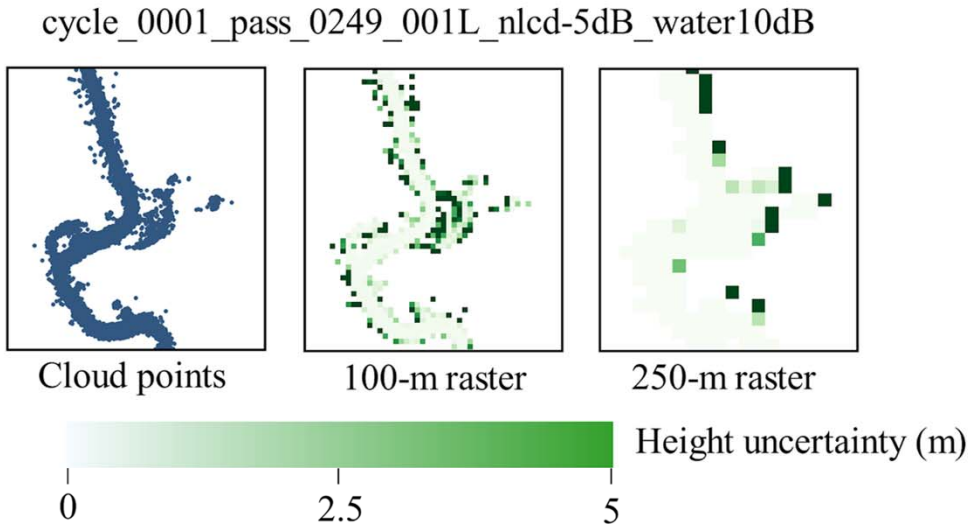
Height uncertainty estimation

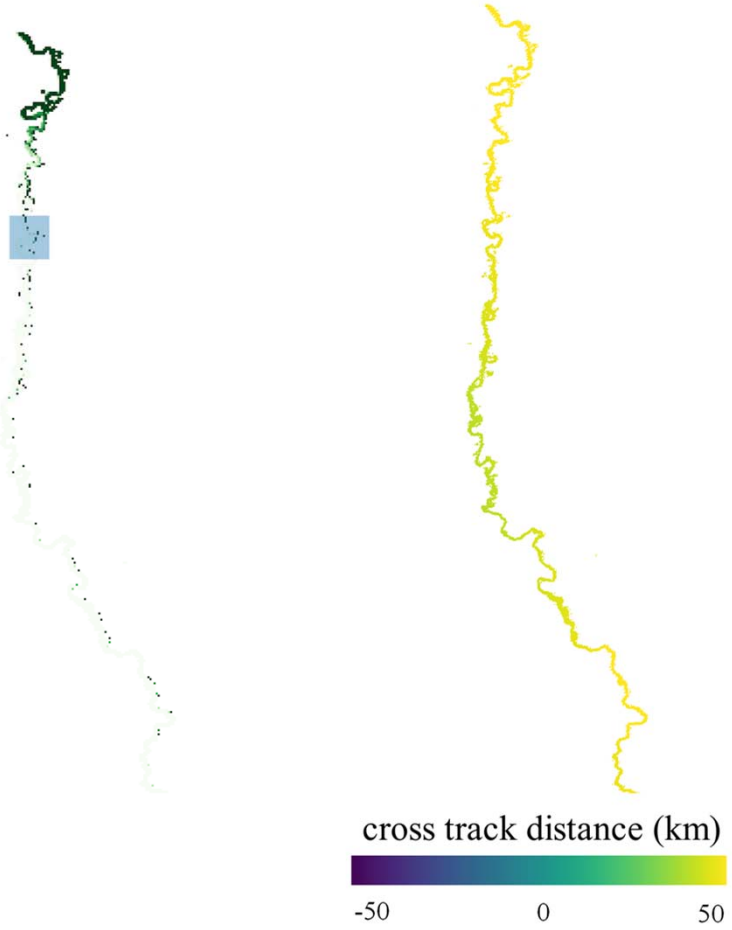
Height uncertainty is estimated from the height sensitivity to phase and the phase uncertainty.



Note: uncertainty does not contain all systematic errors

Sacramento Example 1: Mid-Swath Case
Water Surface Elevation Uncertainty



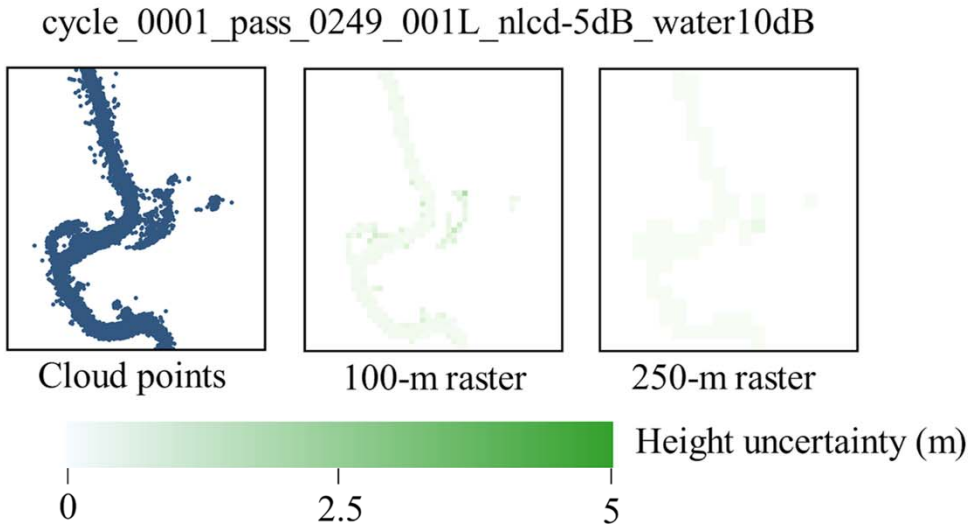


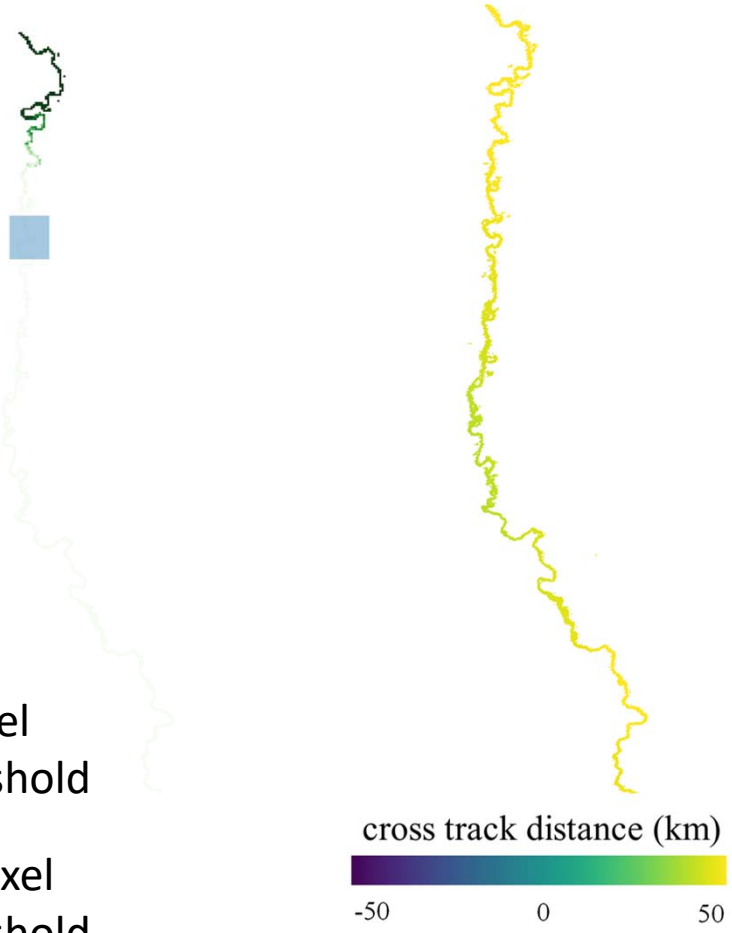
	Mean unc. (m)	Std unc. (m)
100-m raster	6.90	30.17
250-m raster	3.31	6.92

Note: uncertainty does not contain all systematic errors

Sacramento Example 1: Mid-Swath Case

Water Surface Elevation Uncertainty (Threshold)



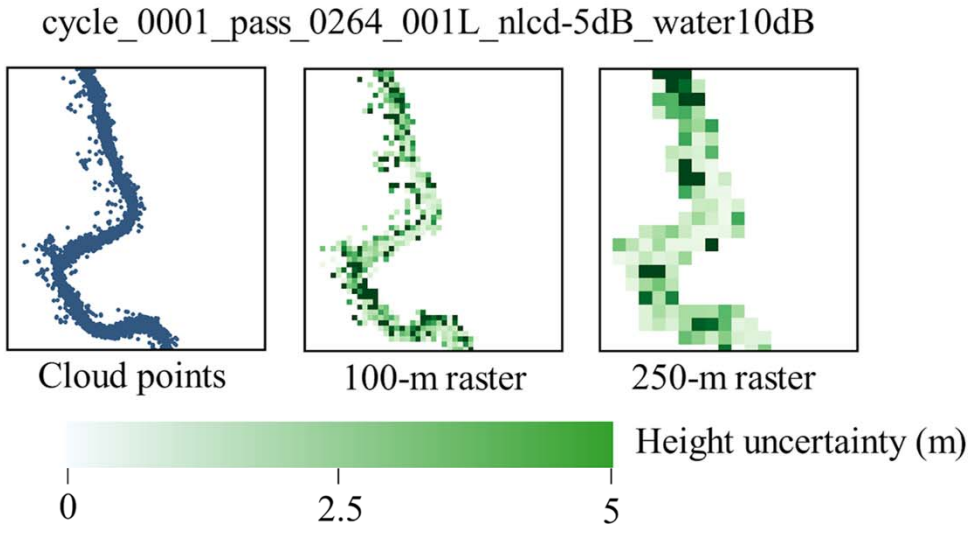


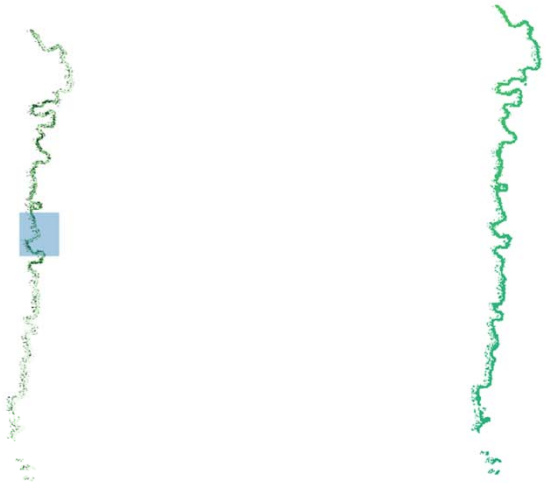
	Mean unc. (m)	Std unc. (m)	
100-m raster	0.26	0.24	8 pixel threshold
250-m raster	0.09	0.07	50 pixel threshold

Note: uncertainty does not contain all systematic errors

Sacramento Example 2: Near-Nadir Case

Water Surface Elevation Uncertainty



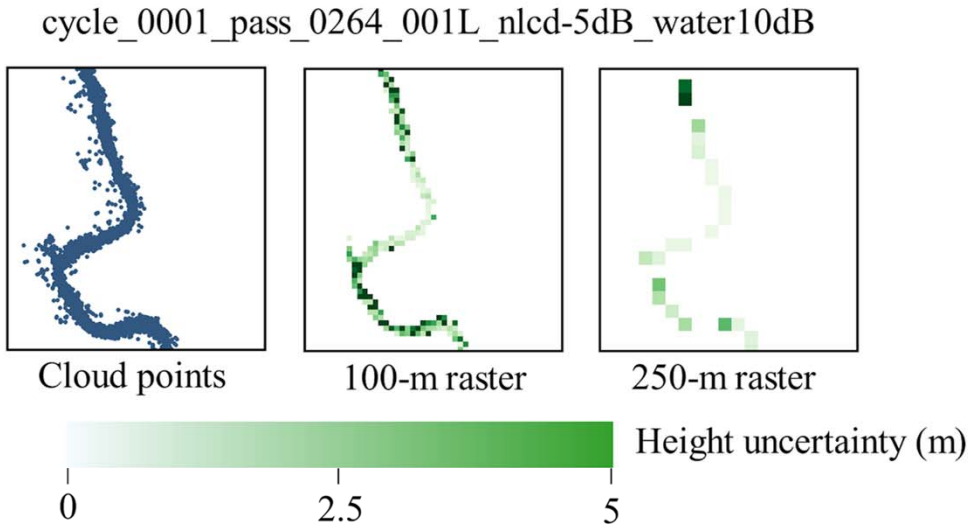


	Mean unc. (m)	Std unc. (m)
100-m raster	9.45	33.83
250-m raster	7.15	25.94

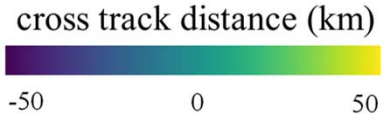
Note: uncertainty does not contain all systematic errors

Sacramento Example 2: Near-Nadir Case

Water Surface Elevation Uncertainty (Threshold)



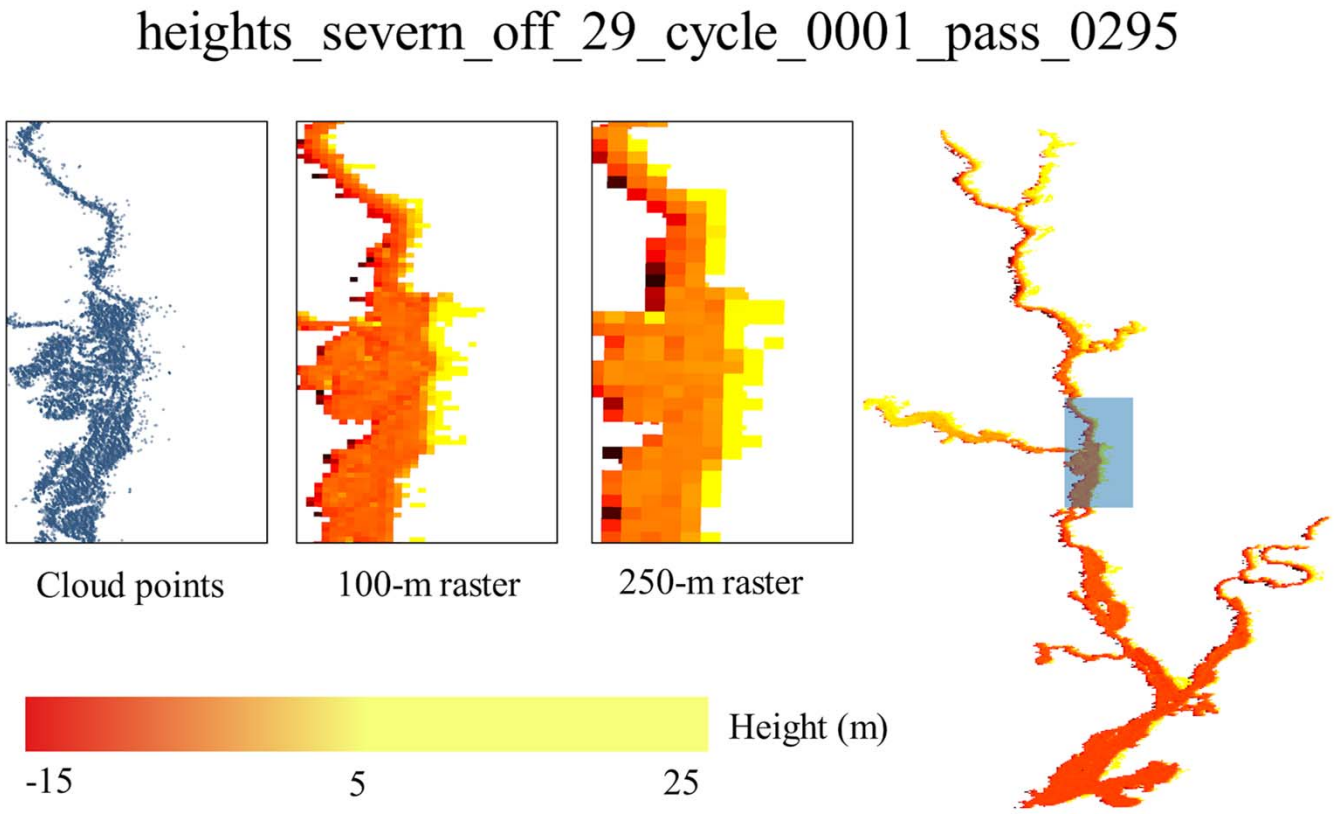
	Mean unc. (m)	Std unc. (m)	
100-m raster	6.46	25.84	8 pixel threshold
250-m raster	2.27	3.42	50 pixel threshold



Note: uncertainty does not contain all systematic errors

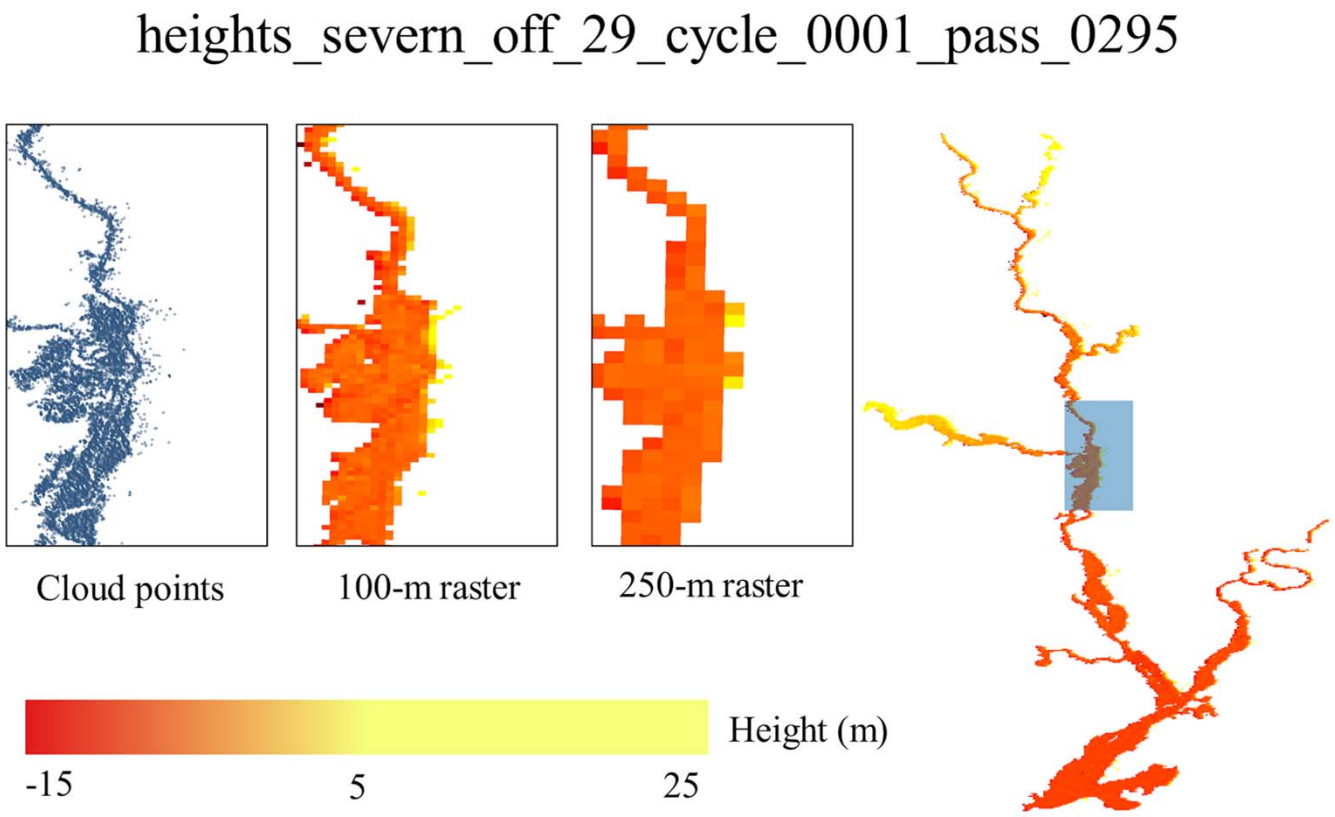
Severn Example

Water Surface Elevation (Raw)



Note the elevation ramp from right (high) to left (low)

Severn Example
Water Surface Elevation (Threshold)



Applying an area threshold to pixels that are retained largely addresses the unrealistic cross-channel slope problem.

Inundation Extent

For Interior Water Grid Cells

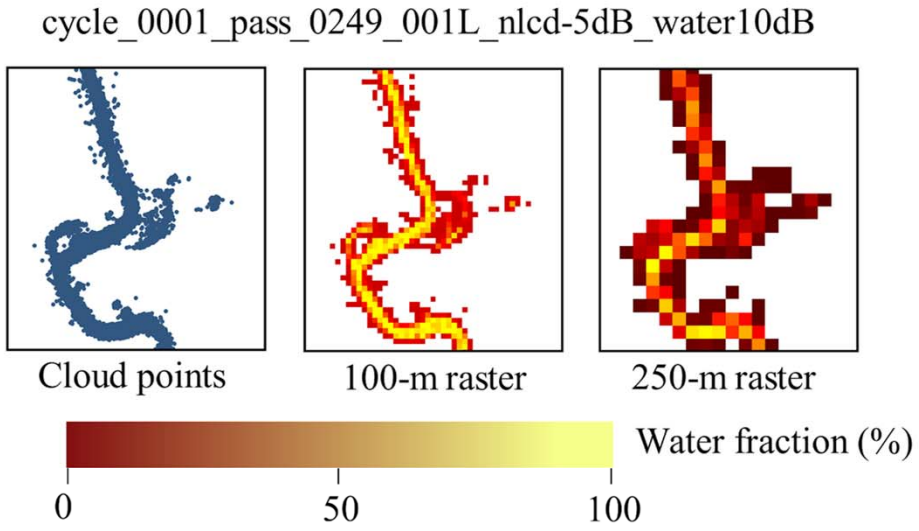
Sum inundation extent of all pixel cloud pixels, divide by total area of raster grid cell.

For Grid Cells Containing Water Near Land/Land Near Water:

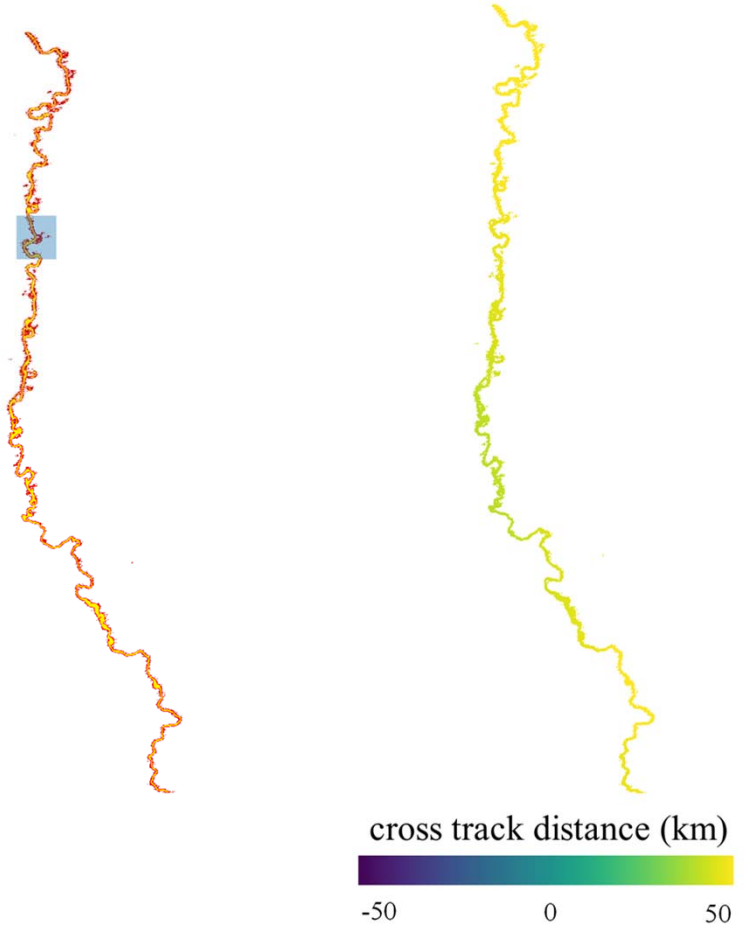
Sum inundation extent of all interior water pixels, weight WNL/LNW grid cells according to their estimated fractional water extent, divide by total area of raster grid cell.

Sacramento Example 1: Mid-Swath Case

Inundation Extent (% of Pixel Area)

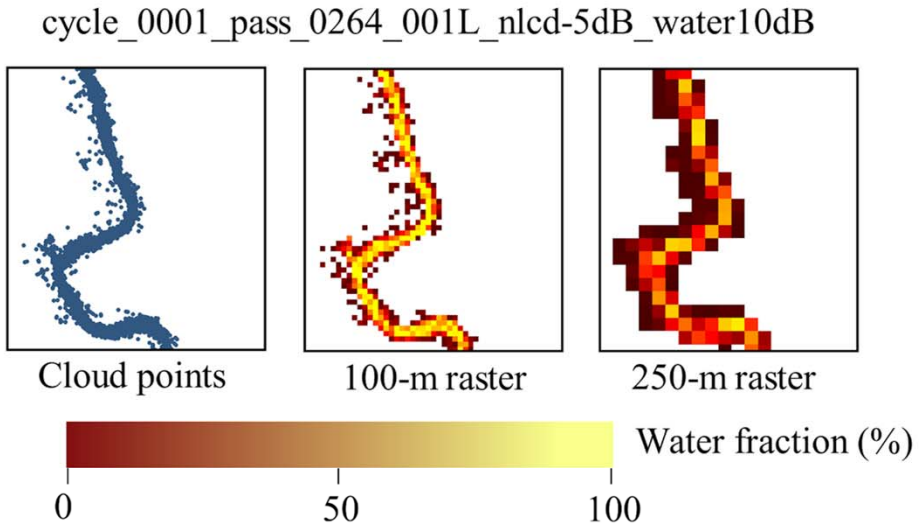


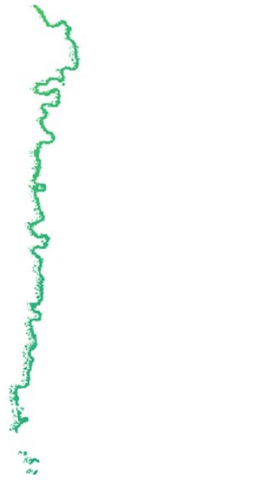
	Mean area (%)	Std area (%)
100-m raster	40.64	40.28
250-m raster	24.31	28.82

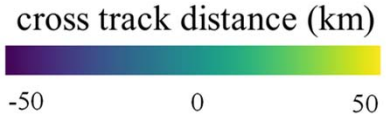


Sacramento Example 2: Near-Nadir Case

Inundation Extent (% of Pixel Area)



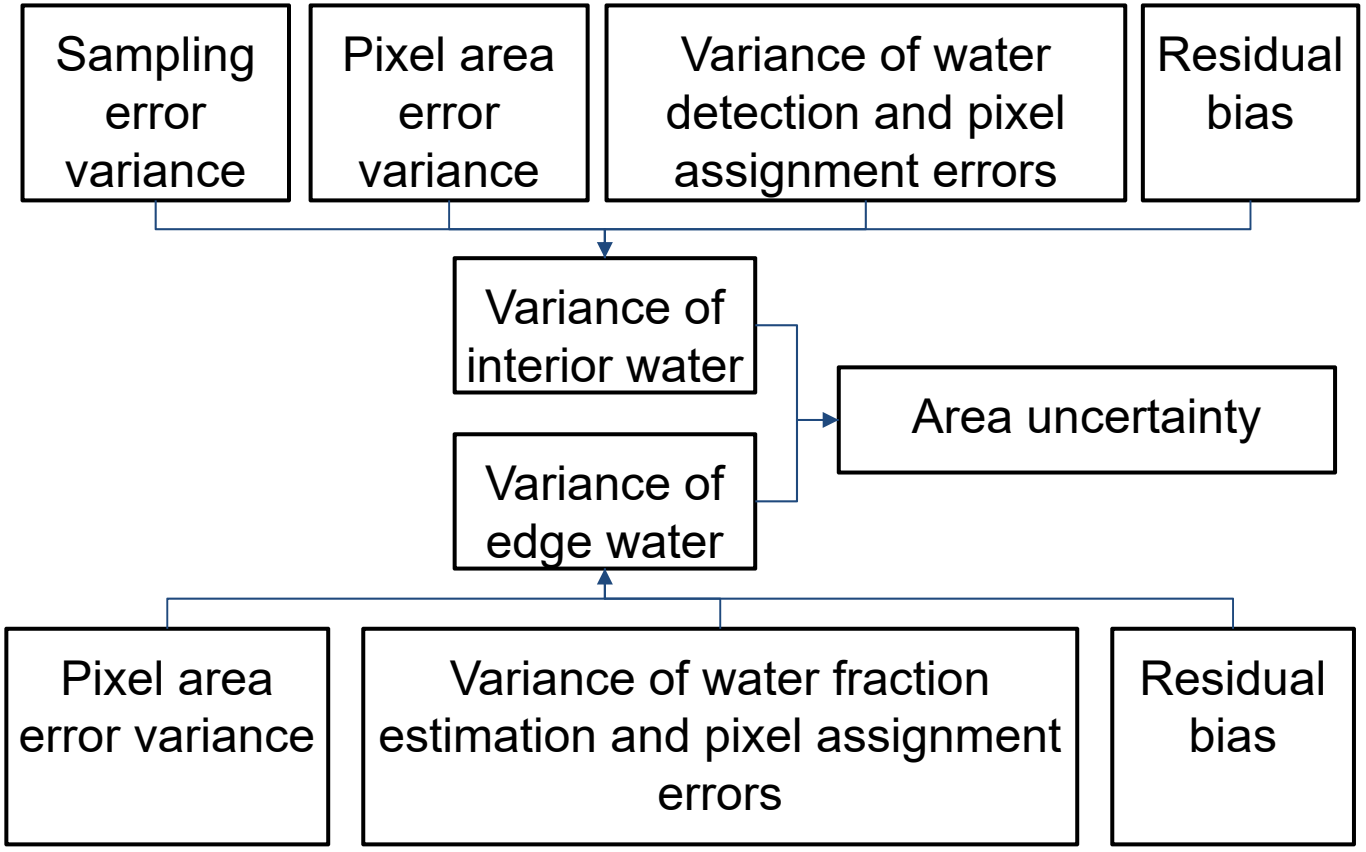




	Mean area (%)	Std area (%)
100-m raster	52.83	42.17
250-m raster	28.04	31.2

Area uncertainty estimation

Area uncertainty is estimated by calculating the variance of area estimation.



Inputs from SWOT:

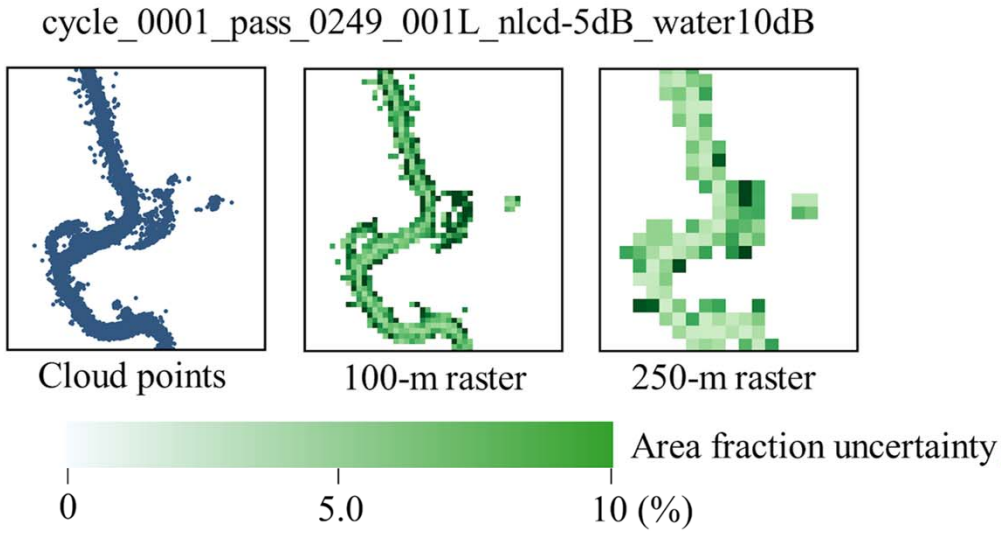
- Pixel area
- Pixel water fraction
- Classification

Assigned Parameters:

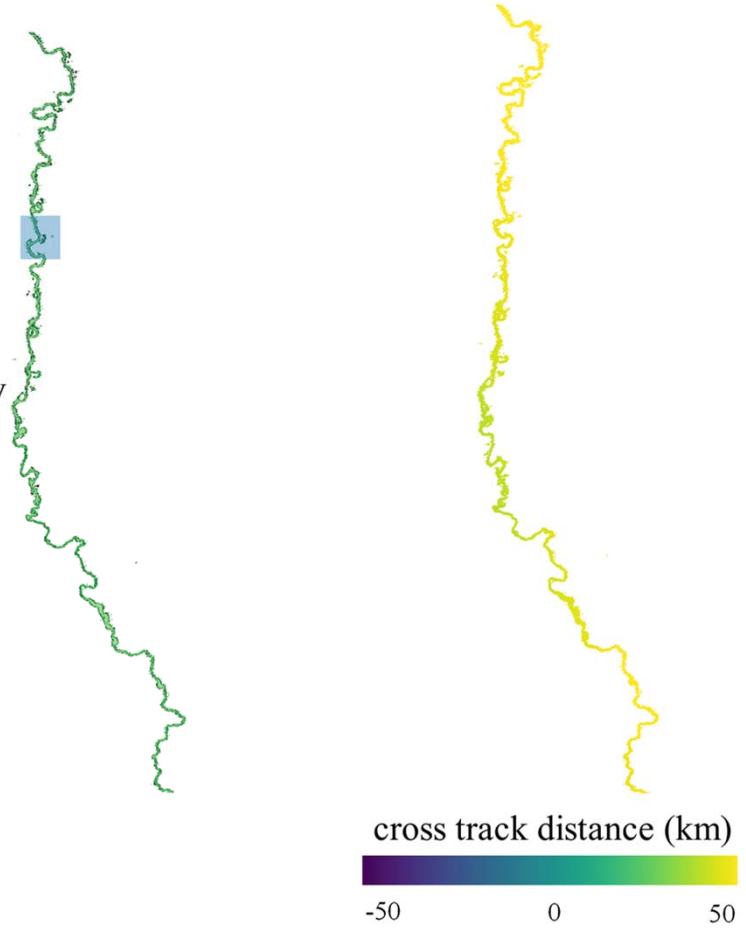
- Probability of correct assignment
- Probability of water (prior)
- Truth probability of pixel assignment

Sacramento Example 1: Mid-Swath Case

Inundation Extent Uncertainty

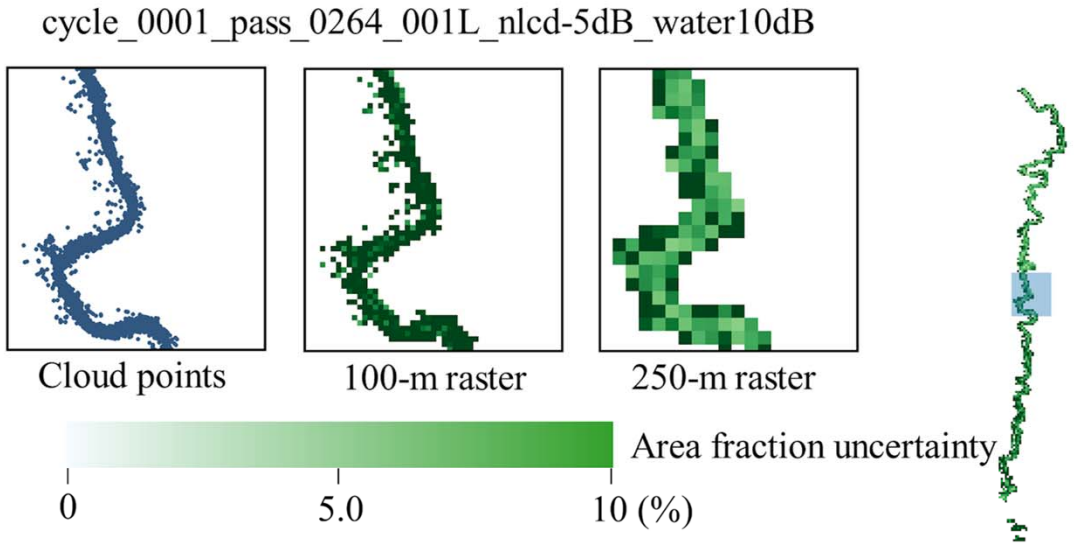


	Mean unc. (%)	Std unc. (%)
100-m raster	7.48	3.21
250-m raster	4.89	2.37

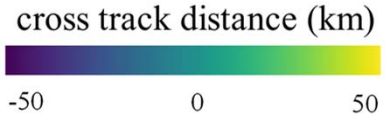


Sacramento Example 2: Near-Nadir Case

Inundation Extent Uncertainty



	Mean unc. (%)	Std unc. (%)
100-m raster	13.2	5.81
250-m raster	8.84	4.57



Current Status Summary

- We can successfully compute WSE, WSE uncertainty, Inundated Area Fraction, and Inundated Area Uncertainty in a raster context

- Water Surface Elevations in the raster should not be interpreted in isolation from inundated area fraction.
  - Option 1: apply a threshold before data is distributed
  - Option 2: include this information in the data quality flag decision tree
  - Option 3: simply allow users to make their own decisions.

- Inundation extent does not have the same issues as water surface elevation.

Plan Going Forward

- Work to incorporate variables not currently included.
- Incorporate PixCVec geolocations into raster processing.
- Give code, example data products to CNES for evaluation/modification.
- Implement Severn Case in new simulator (hoping to write journal article on this case).
- Test prototypes on a wider range of simulator output
  - Need input of existing simulator cases from ADT/ST (contact Shuai Zhang, zshuai@email.unc.edu)
- Provide code, examples, PDD, ATBD to Science Team (especially SMEs) for evaluation.