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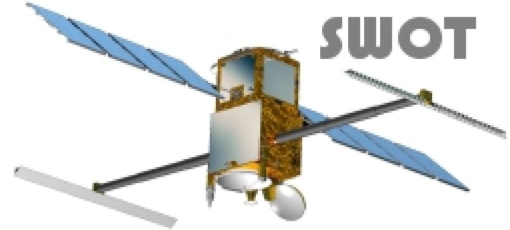

SWOT

SWOT Science Team

PIXEL CLOUD POLYGONIZATION AND FLOODPLAIN DEM GENERATION

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PIXC_VEC PRODUCT

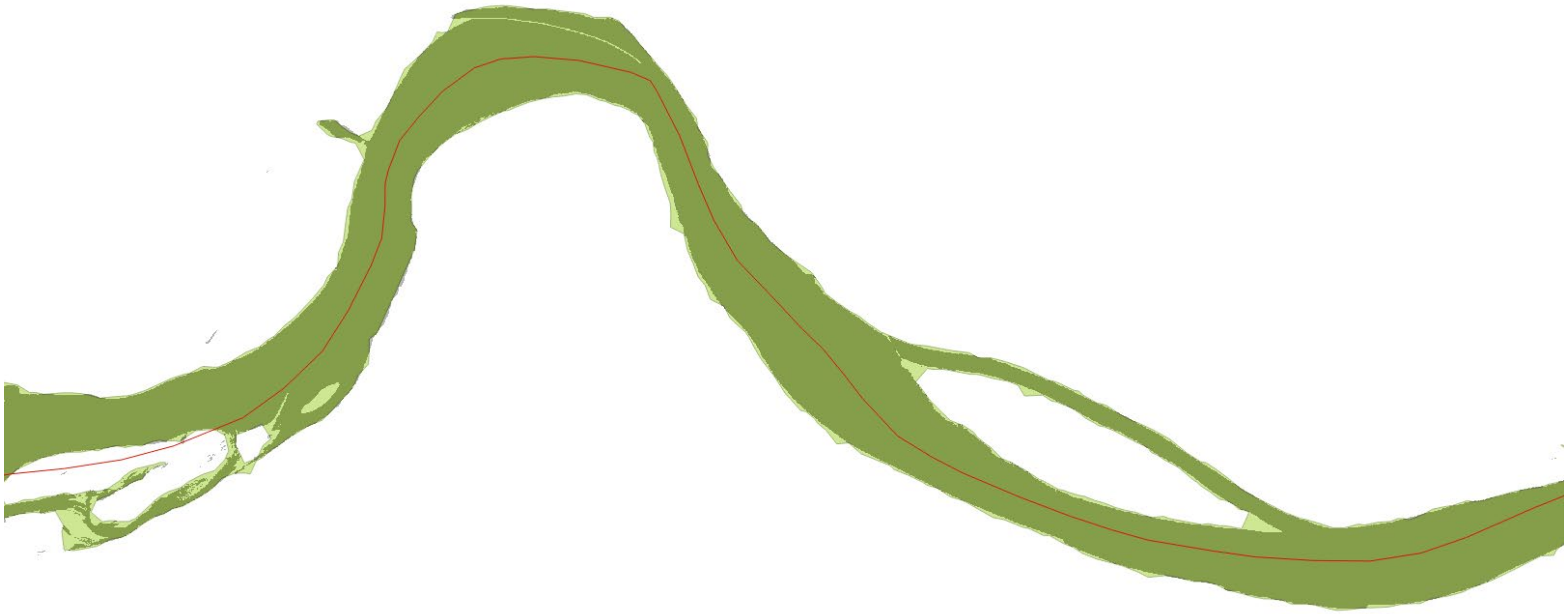
KaRIn phase noise leads to geolocation errors

- Pixel cloud height and geolocation is relatively noisy
- Impacts processing and products
  - Width estimation
  - Flood-plain DEM prediction very sensitive to geolocation errors
  - Raster product and river characteristics could be impacted
- Need for more smoothing ⇨ PIXC_VEC add-on to PIXC product

Methodology

- River and lake processing will estimate average height (and slope) along each water body
- The pixel cloud geolocation can be constrained using these heights instead of using the noisy phase
- Possibility to iterate the river/lake processing to improve slope/height prediction using the new geolocation

EXAMPLE OF IMPROVED GEOLOCATION ON THE PO RIVER



Input Pixel cloud simulated on the Po river by the OSU team

Lat/Lon : [11,13 /45,06]
River width about 500m (main branch)

Centerline
True water mask
Example of noisy pixel cloud
Improved geolocation pixel cloud
Estimated shape

APPLICATIONS

Polygonization

- For both rivers and lakes
- In SAR or ground geometry
- « Concave-hull » approach to create polygons from pixel cloud
- Not actually included in standard products

Width estimation

- Precise and local estimation of river width according to the regularized pixel cloud
- Using similar method to RiverObs (point to point) but on shape-file polygon

Flood-plain DEM estimation

- Bathtub ring method using improved geolocation/polygonization
- Preliminary results

FLOODPLAIN DEM

Floodplain DEM requirement & goal:

Requirement 2.6.4 (“cross-section map”)

- A DEM of land elevations near the boundary of water bodies shall be derived from water elevations and extent [… after the first year of data]

Goal 2.6.3i (DEM from land elevations, but only over floodplain)

- A Level-2 standard data product will be a topographic map of all land elevations. This global digital elevation model (DEM) will be constructed from many SWOT orbits.

Two concepts

Bathtub ring: use water heights for edge pixels to estimate floodplain DEM elevations (limited to observed min/max water heights/extent) ➔ current baseline

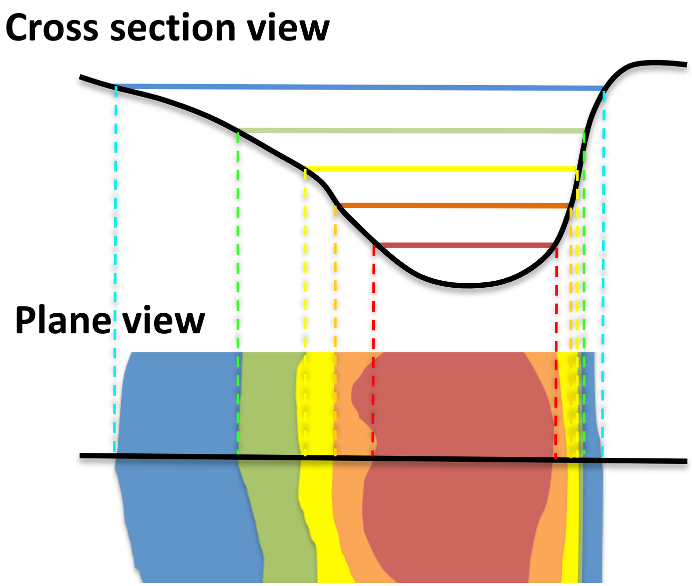
Interferogram stacking: use land heights, but need to beat down noise for height/geolocation by temporal averaging (takes a lot of passes) ➔ Very sensitive to thermal noise / phase unwrapping

BATHTUB RING METHOD

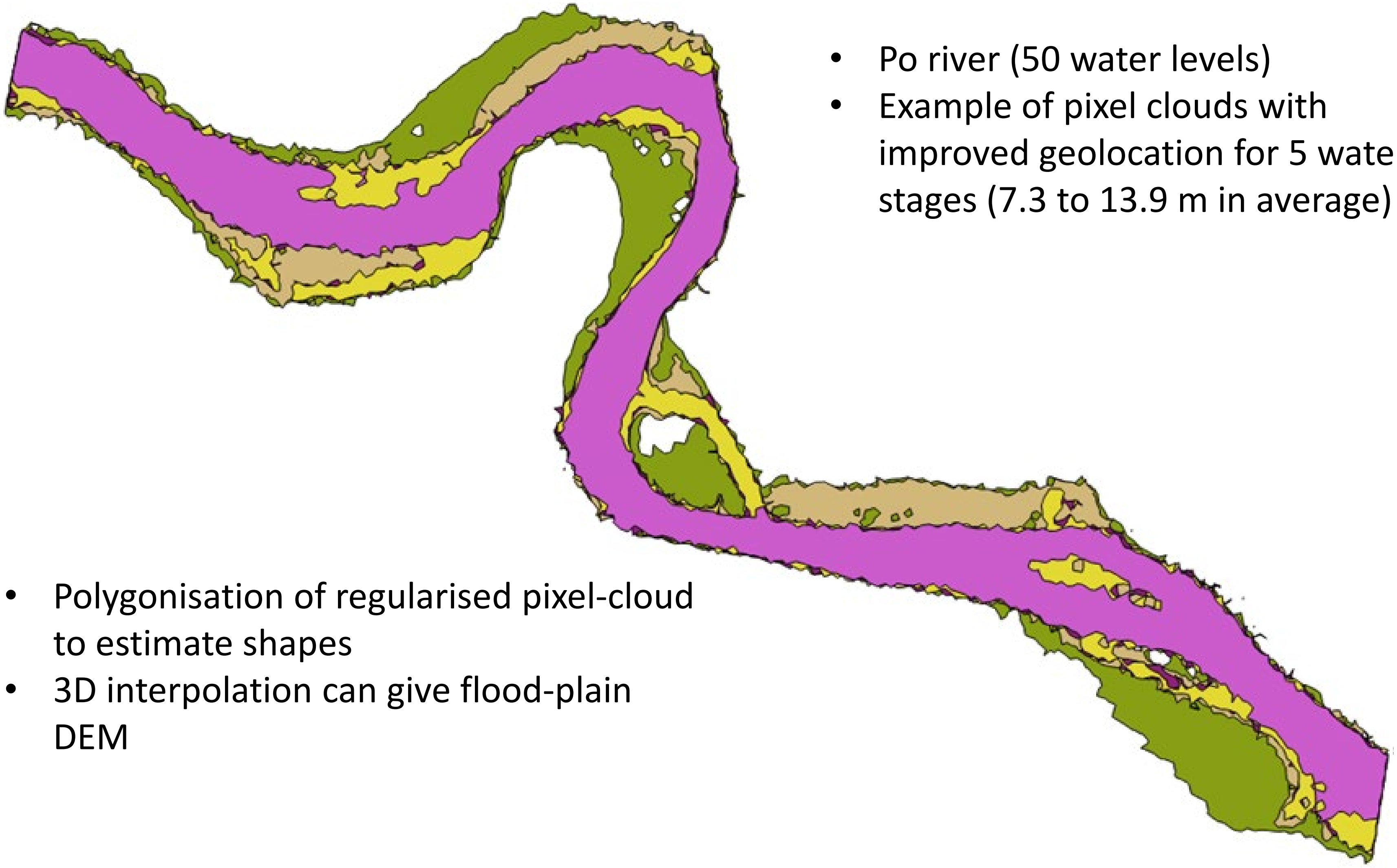
On geo-referenced grid (similar to water probability maps)

Average the heights of water pixels (weighted by height errors)

- Edge pixels are assumed to be approximately the same height as the land underneath
- Edge pixels may have larger height errors due to mixed pixels and classification errors. Edge heights are improved using spatial regularization to extend interior water heights.
- Therefore use improved geolocation and corresponding smoothed heights
- Multitemporal averaging/regularization weighted by height errors, layover flag etc.
- After enough accumulation converges to the floodplain DEM, between observed min and max stages
- Interpolation over holes between contours from the different observed water heights



PRELIMINARY RESULTS ISSUED FROM HR SIMULATOR



- Po river (50 water levels)
- Example of pixel clouds with improved geolocation for 5 water stages (7.3 to 13.9 m in average)

- Polygonisation of regularised pixel-cloud to estimate shapes
- 3D interpolation can give flood-plain DEM

DISCUSSIONS AND LIMITATIONS

What is the best way to generate the flood-plain DEM using this approach?

- For small lakes: could use level lines for « constant » height areas
- Interpolation between different passes
- For rivers, big lakes and wetlands (general case): 3D interpolation using improved geolocation and associated heights along the water bodies
  - ⇨ Interpolation using polygons or directly on PIX_VEC point cloud?
  - ⇨ SAR or ground geometry?

Some limitations to deal with

- Water detection errors (overestimation due to azimuth smearing, mixed pixels…)
- Approach for polygonization: in SAR geometry to reduce artefacts?
- Final coverage limited by water level dynamics: min/max water level observations
- The spatial precision/resolution of the flood-plain DEM will depend on the frequency of the observed water level