CASE STUDY

WP6400. Inland Water : Amazon River

N. Bercher, ALONG-TRACK S.A.S.

Demonstrate usefulness of the DeDop tool in terms of

- Usability & design
- Adequacy for the monitoring inland water
- Algorithms & Computational Performances
- Benefits of a configurable delay-Doppler processor
- Benefits of an open source code base

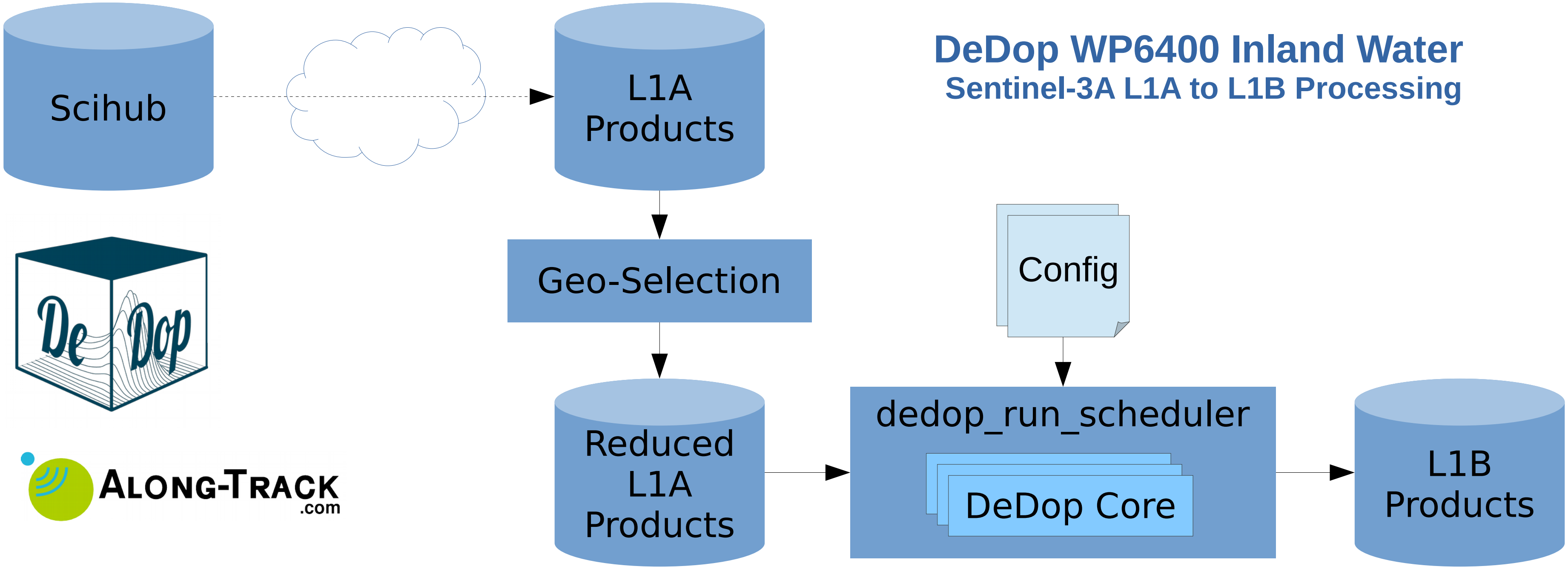
Regarding Inland Water

- Quantify accuracy of well-configured delay-Doppler processor vs. basic configuration

Secondary objectives

- Produce & examine Waveforms
- Elaborate L2 data despite the absence of:
  - L2 corrections: Wet/Dry tropo, Geoid model
  - Retracking algorithm
- Produce L3 data: River Water Level (RWL) time series
- Perform validation of the L3 RWL against gauging data
- Analyse and comment results, provide recommendations

- Input: Sentinel-3A L1A files from scihub
- Add-on tool from ALONG-TRACK: **`dedop_run_scheduler`**
- Output: L1B files



https://github.com/nbercher-atk/dedop_run_scheduler

DeDop Core: L1A to L1B Processing

- Input: Sentinel-3A L1A files from scihub
- Add-on tool from ALONG-TRACK: **`dedop_run_scheduler`**
- Output: L1B files for 2 different DeDop configurations

Parameter	Conf. #1: Basic	Conf. #2: Inland Water
Azimuth Windowing	None	Hamming
Azimuth Processing Method	Approx	Exact
Zero Padding Factor	1	2

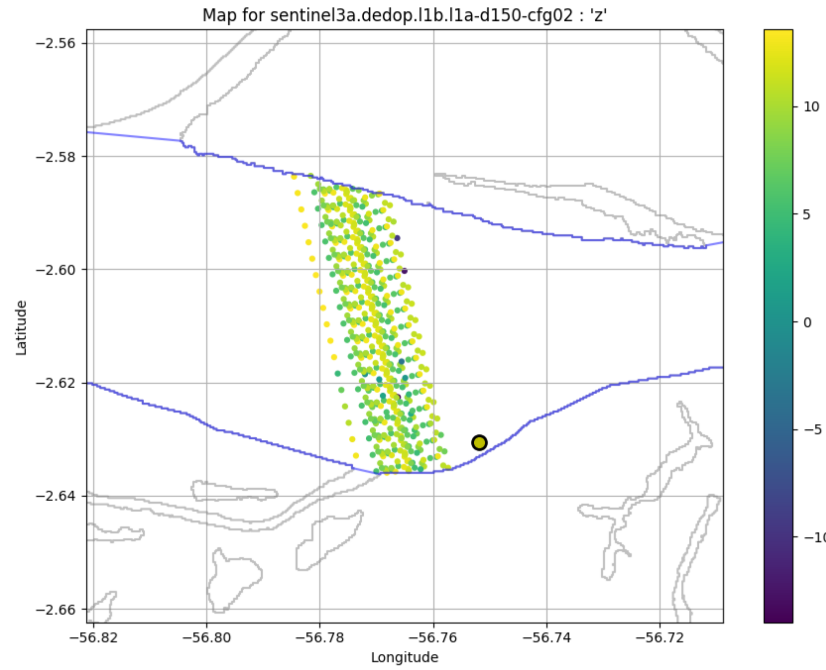
https://github.com/nbercher-atk/dedop_run_scheduler

Main steps of the L2 Processor

1. Read input netCDF L1B data files
2. Compute Waveforms alignment w.r.t. the on-board tracker
3. Compute Geoid undulation, add static correction value
4. Run Ice1 retracker on Waveforms

Main steps of the L3 Processor

1. Water masking (SWBD-Edited) → boolean flag variable
2. Compute surface height from Ice1 range & corrections:
   - Geoid undulations (EIGEN-6C4+DTU13)
   - Static range corrections (estimated from Jason-3 GDR-d data, same place, same time)
3. Outliers rejection
4. “One per Overflight” routines (remove high frequency in RWL time series)



INLAND WATER CASE STUDY

Additional L2 to L3 Processing

Main steps of the L3 Processor

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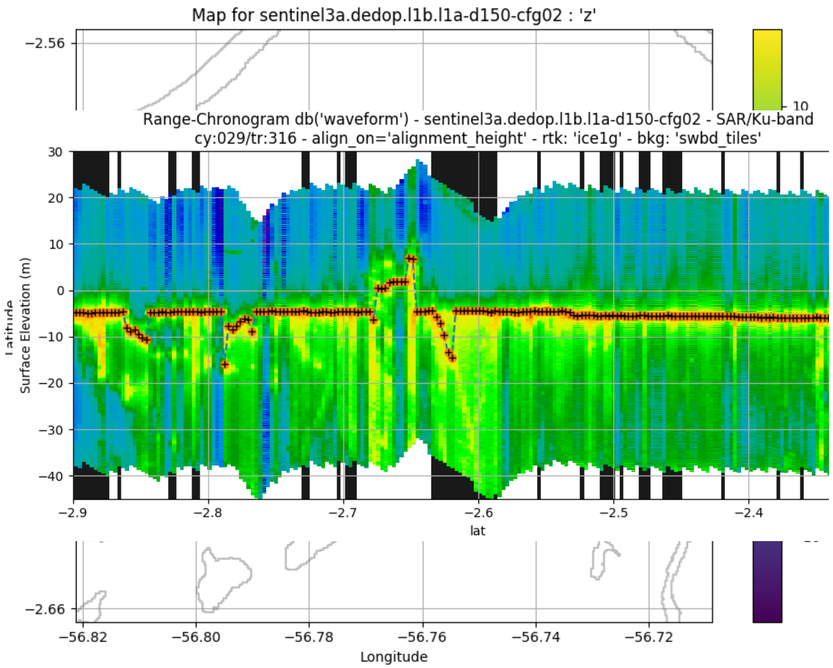

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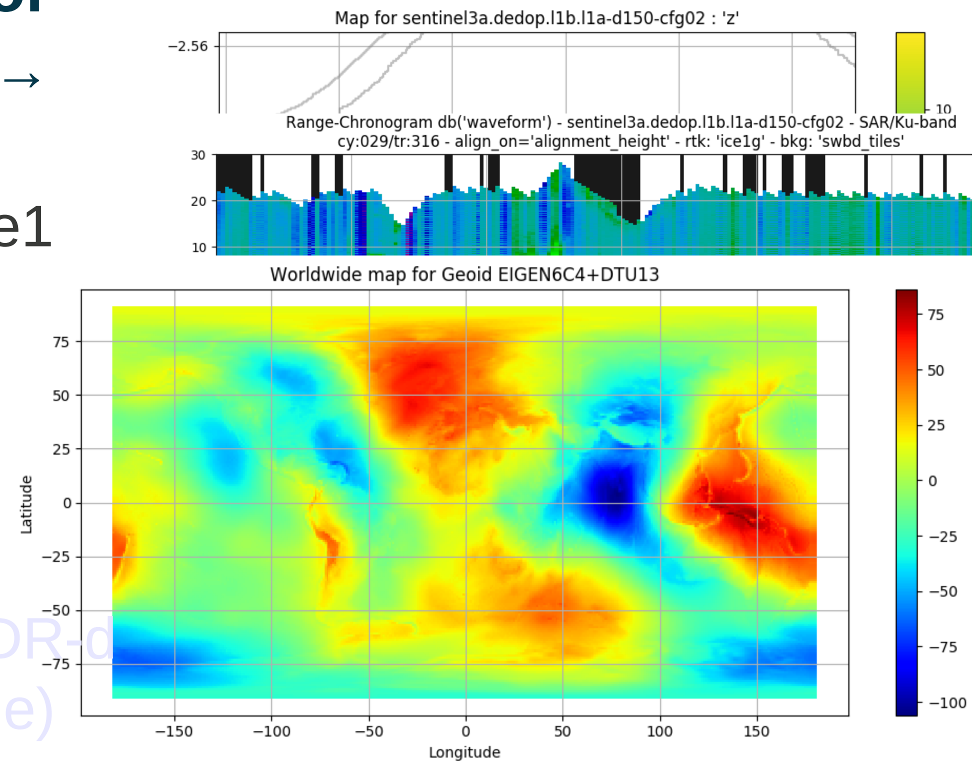

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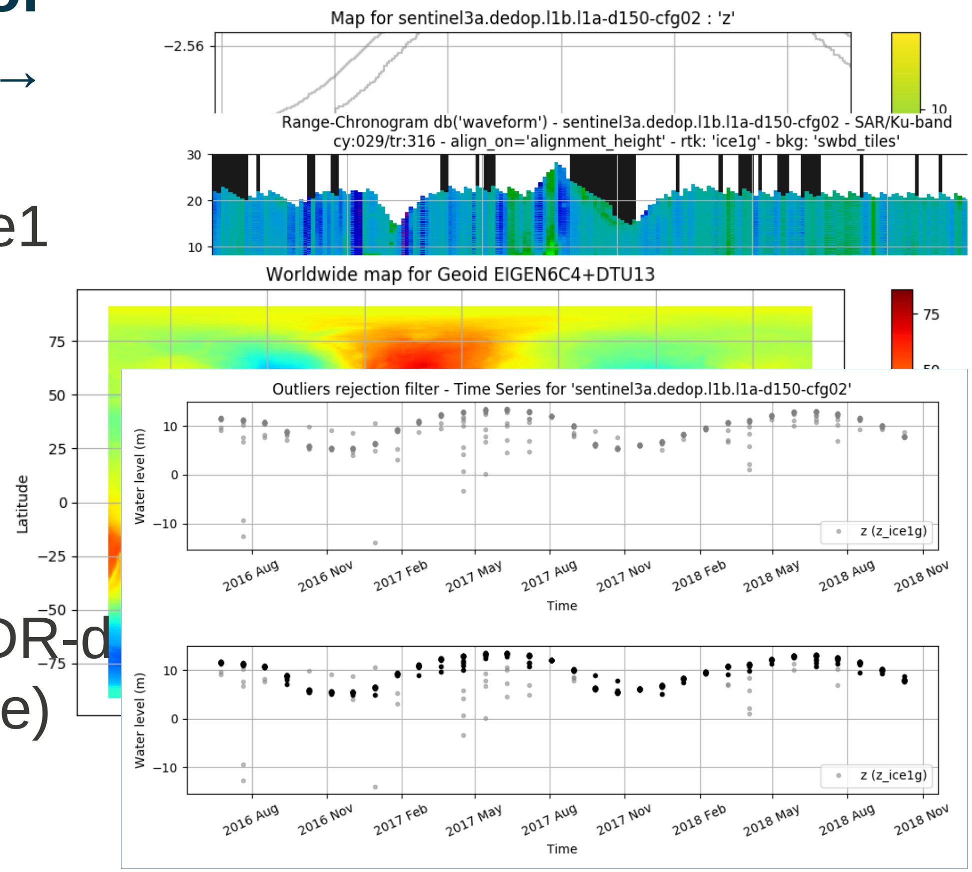

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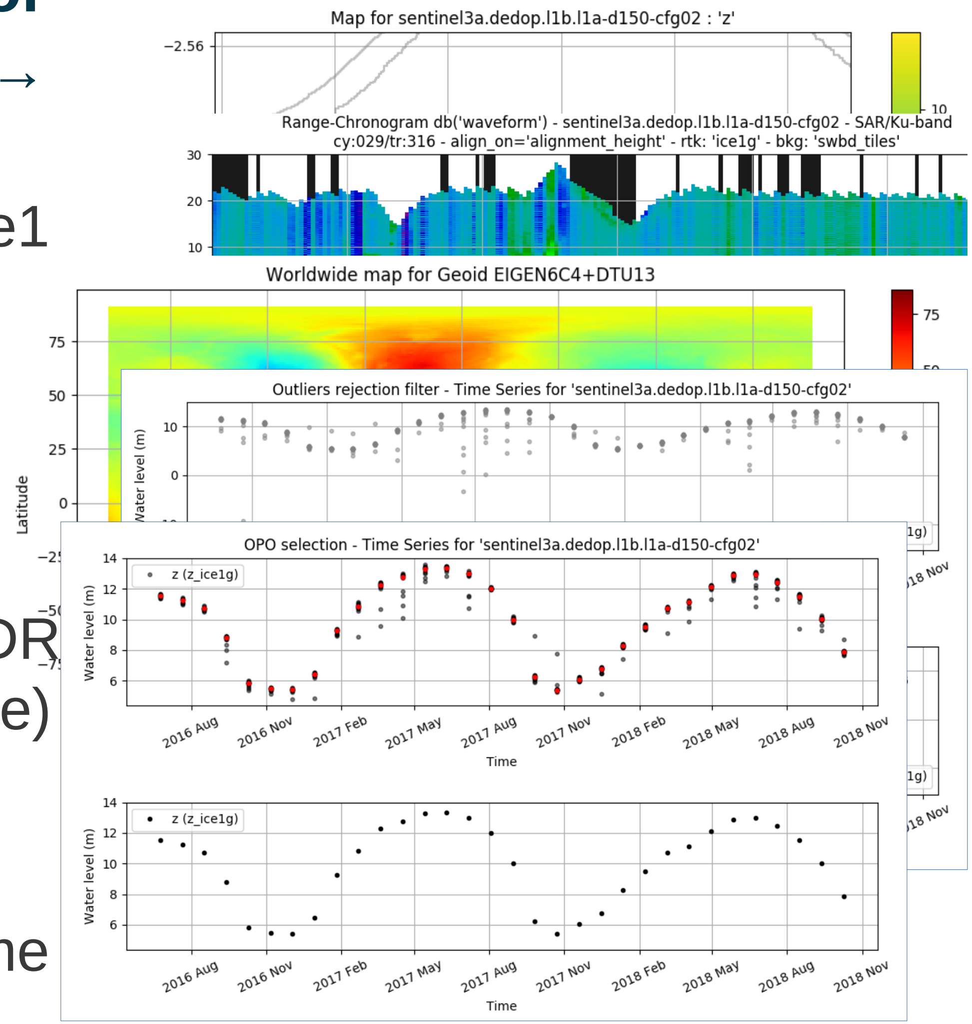
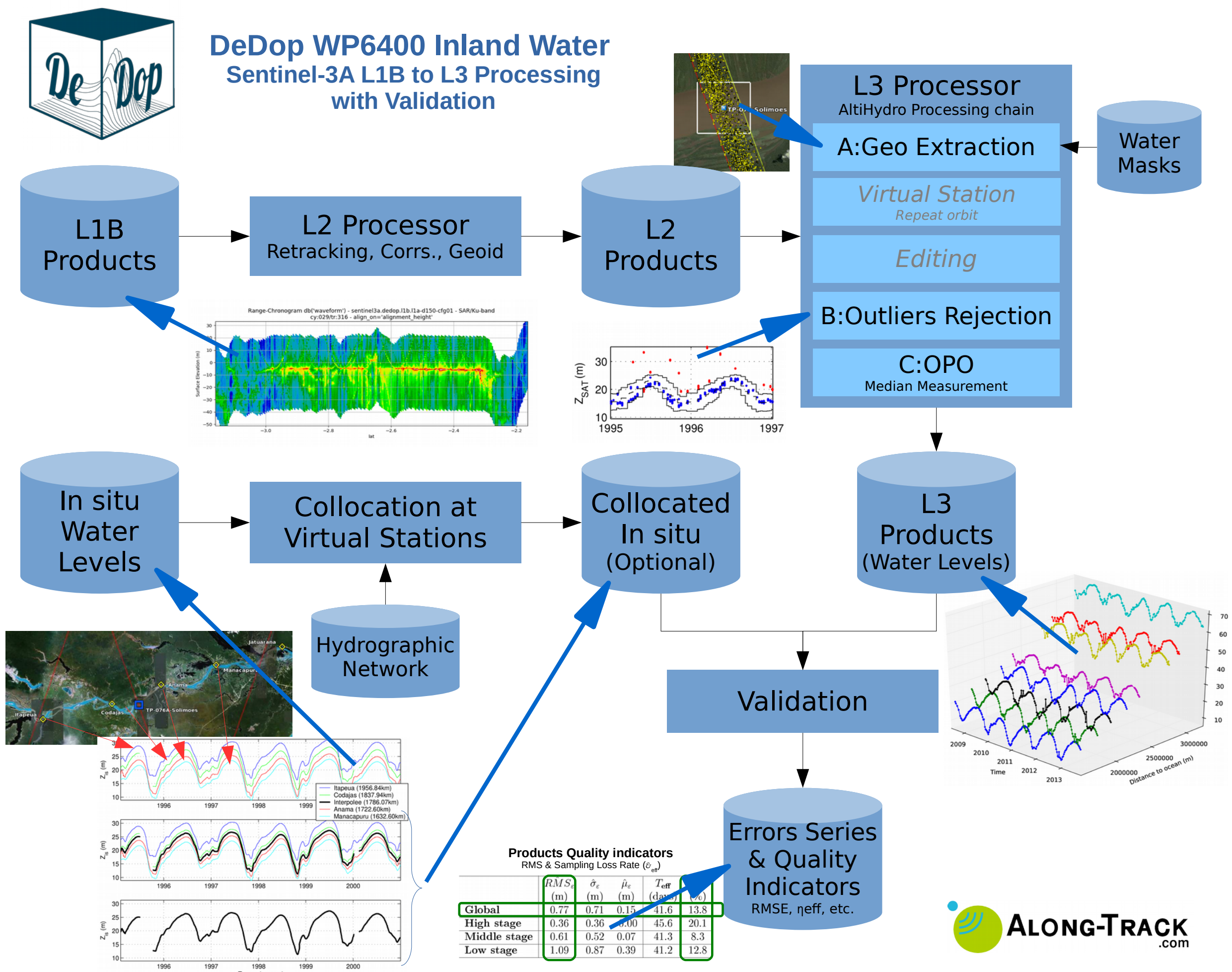


Overview : Add-on processing for L2, L3 & Validation



Products Quality indicators

RMS & Sampling Loss Rate (ε_{eff})

	$\hat{RMS}_\varepsilon$ (m)	$\hat{\sigma}_\varepsilon$ (m)	$\hat{\mu}_\varepsilon$ (m)	$T_{\mathbf{eff}}$ (days)	(%)
Global	0.77	0.71	0.15	41.6	13.8
High stage	0.36	0.36	0.00	45.6	20.1
Middle stage	0.61	0.52	0.07	41.3	8.3
Low stage	1.09	0.87	0.39	41.2	12.8

L1B Processor : Outputs analysis

Sentinel-3A

Cycle 29

Track #316

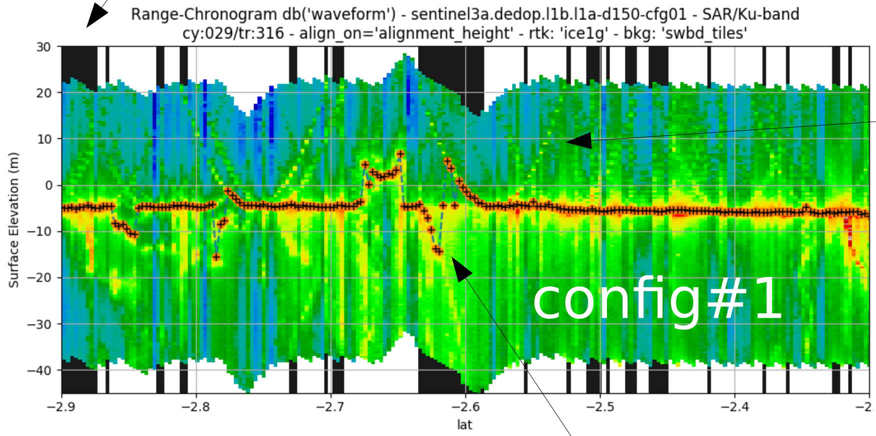
Amazon River

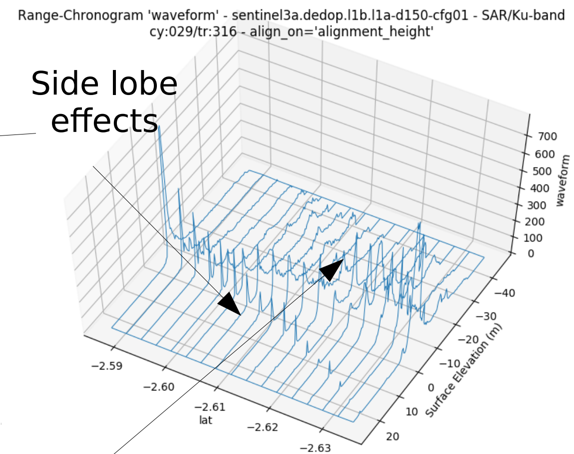
Parintins

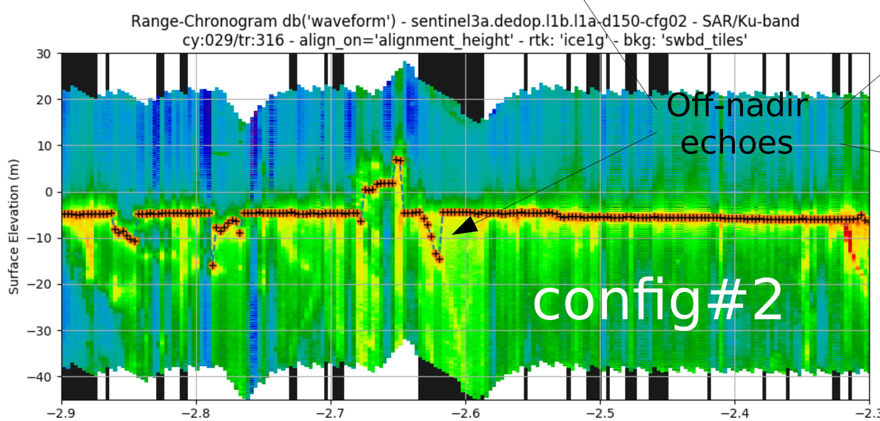
Records in SWBD water mask

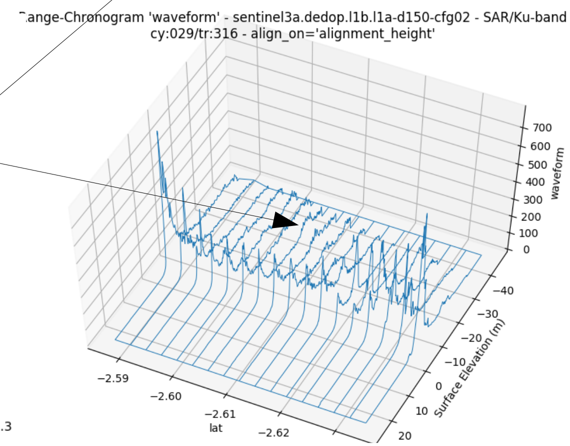
Amazon Crossing

L1B Waveforms extracted fr Amazon Crossing









L1B Processor : Outputs analysis

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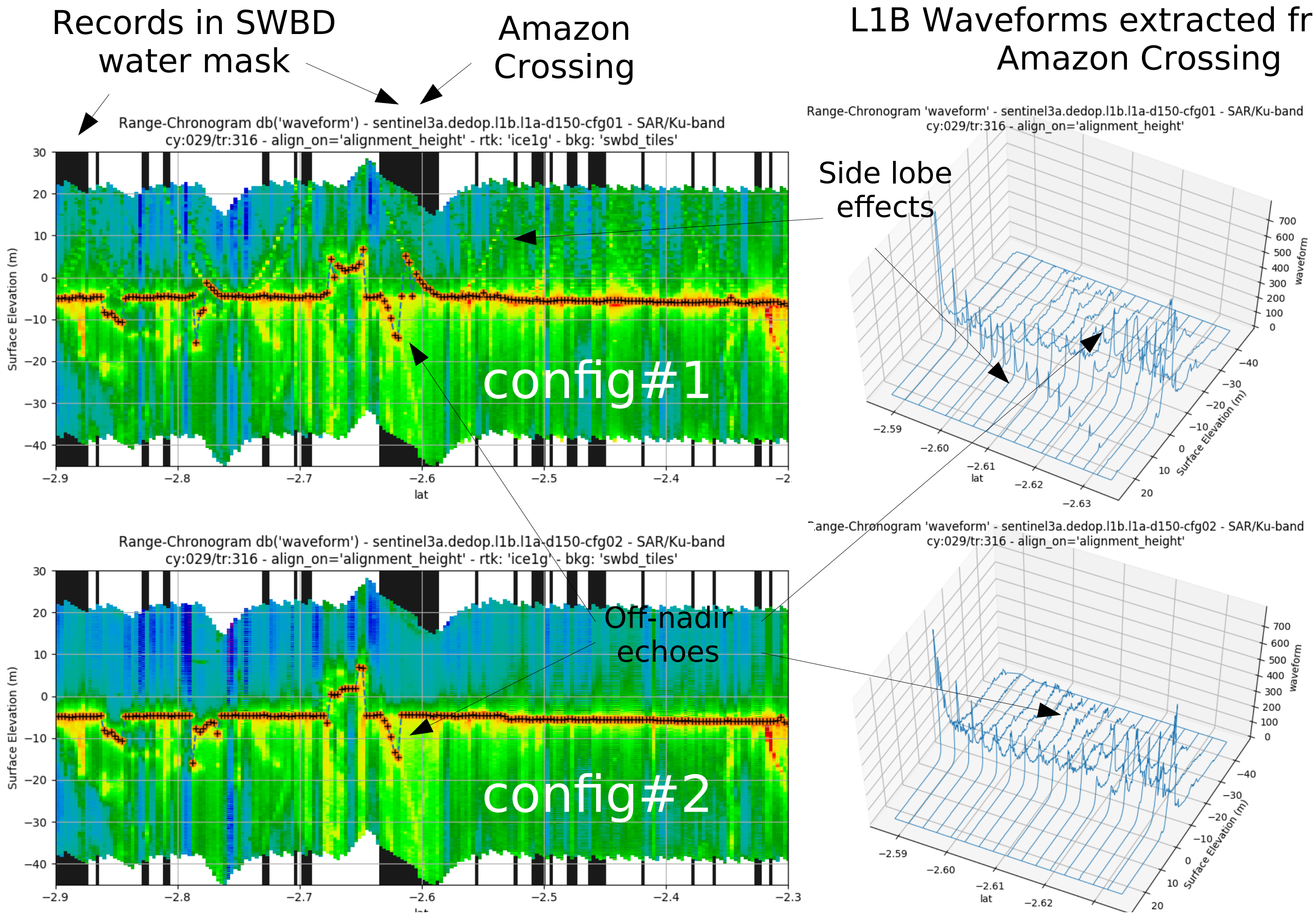
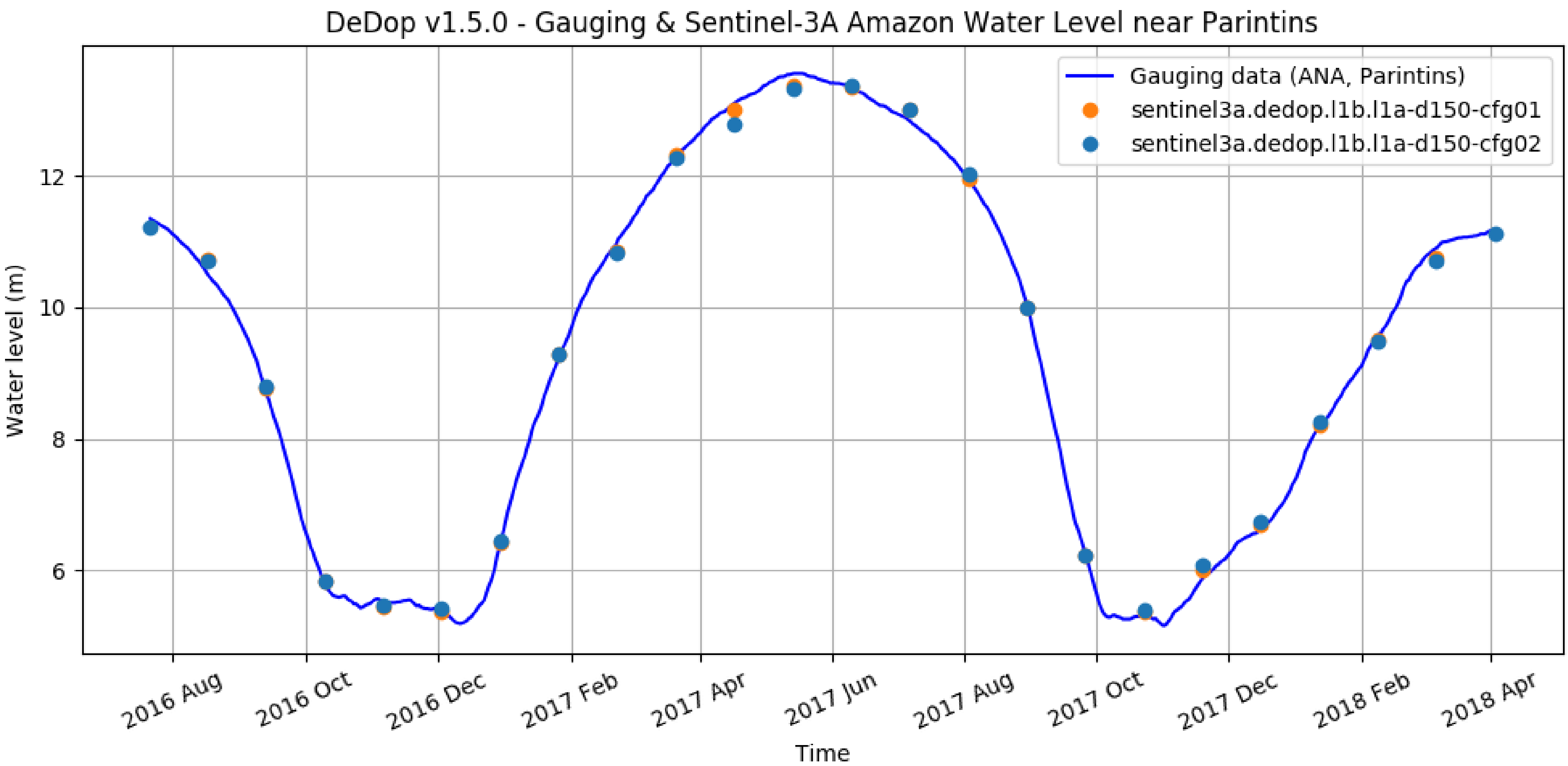


Main config impact

Hamming: removes side-lobe effects but alters original signal information

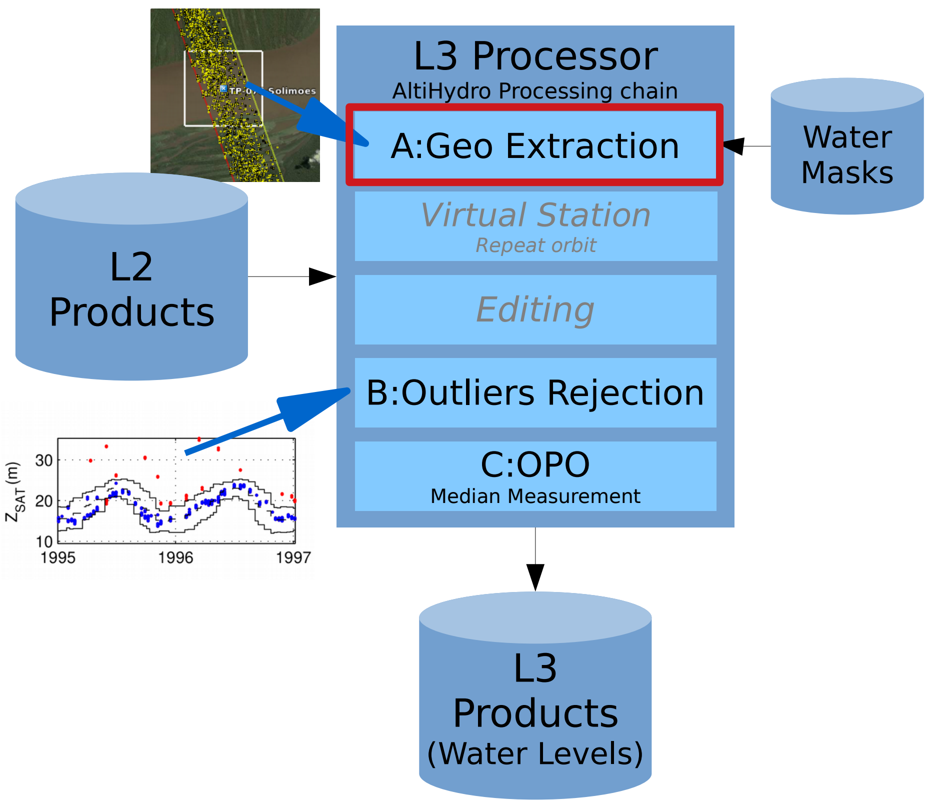
L3 Processor : Output RWL time series

Sentinel-3A Cycles 5–36 / Track #316 / Amazon River / Parintins



L3 Processor : Sensibility @internal steps A, B & C

Sentinel-3A Cycles 5–36 / Track #316 / Amazon River / Parintins



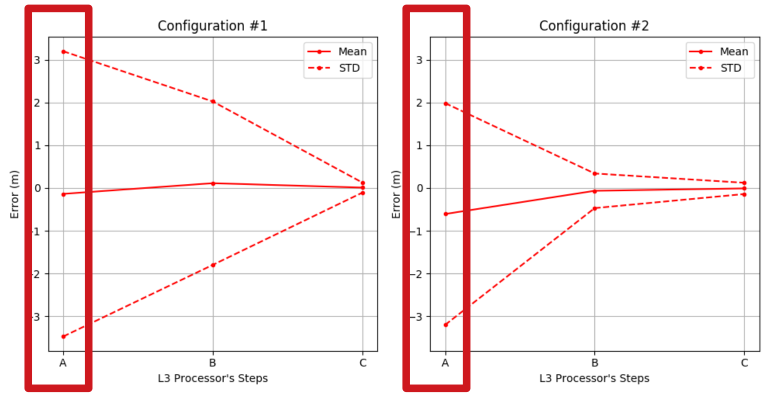


Table 3: Validation results for the L3 River Water Level time series.
Detailed results for all steps of the L3 Processor, including: (A) L2 in water mask, (B) Outlier rejection and (C) final L3 for the two configurations #1 and #2.

L3 Processing Step	DDP Config	Nb meas.	Mean±STD (m)	RMSE (m)	Sampling Loss Rate (%)
Step A. L2 – All records in Water Mask	#1	422	- 0.14±3.34	3.34	*N.A. (SLR defined for L3 data only)*
	#2	422	- 0.61±2.60	2.66	
Step B. L2 – After outliers rejection filter	#1	380	0.11±1.91	1.92	
	#2	377	- 0.07±0.40	0.41	
Step C. L3 – Final: After OPO routine (median meas.)	#1	24	0.01±0.12	0.12	0%
	#2	24	- 0.01±0.13	0.13	0%

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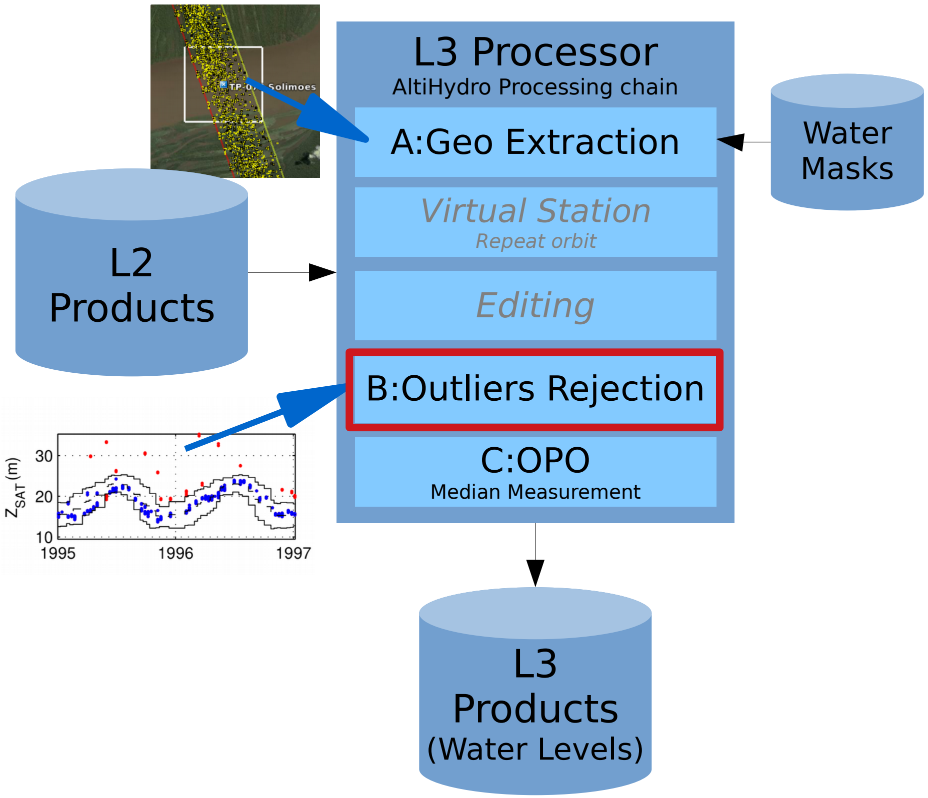
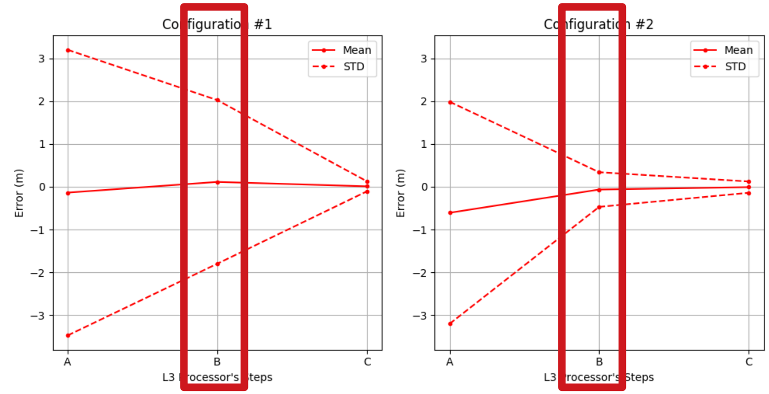
Sentinel-3A Cycles 5–36 / Track #316 / Amazon River / Parintins





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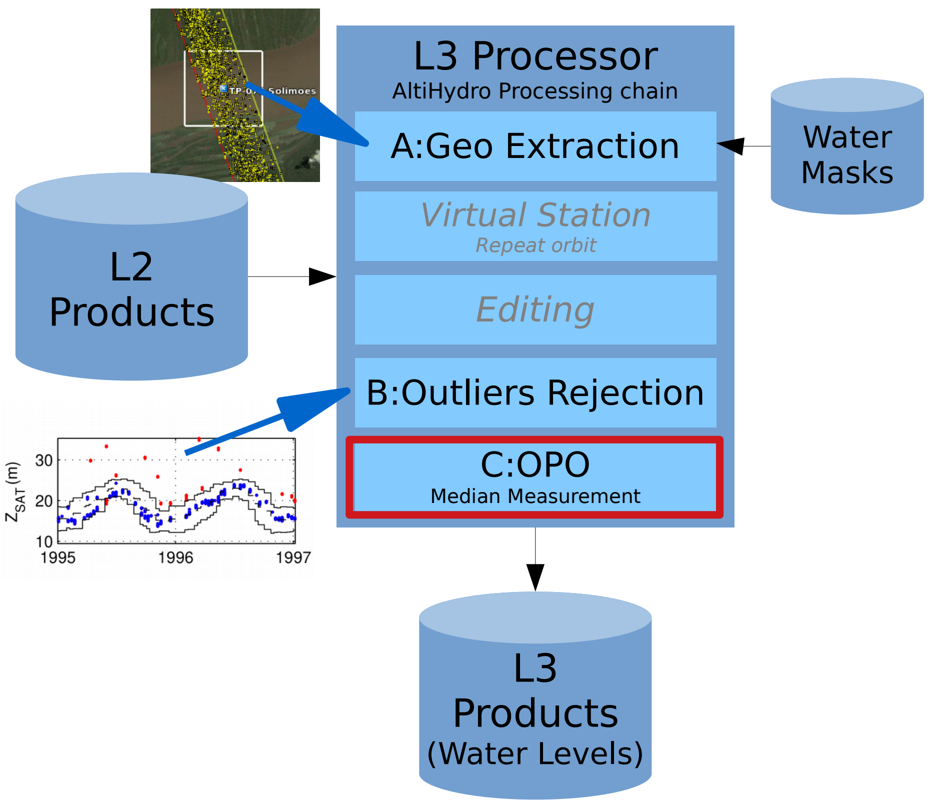

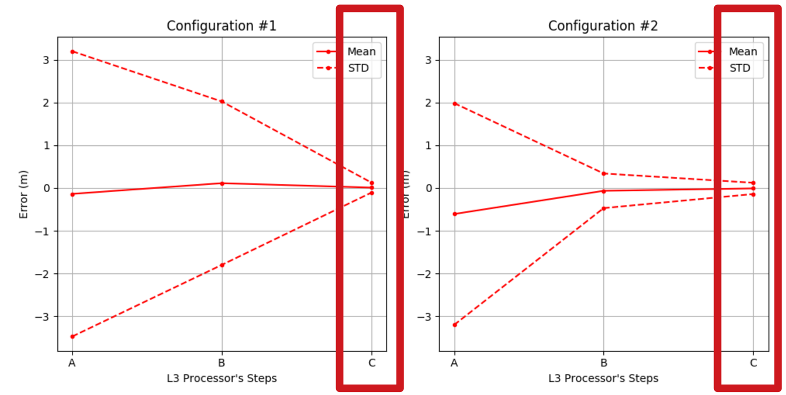

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Validation of L3 RWL

Sentinel-3A Cycles 5–36 / Track #316 / Amazon River / Parintins

- Config #1 “basic” RMSE = **0.12 m** (0.01±0.12 m)
- Config #2 “inland water” RMSE = **0.13 m** (-0.01±0.13 m)

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Conclusions

- **Very high quality!**
- No significant difference between configs #1 & #2
- No systematic bias!

Conclusions

- DeDop Core tool (v1.5.0) has been tested using Sentinel-3A L1A product files from Copernicus/Scihub to produce L1B data for two delay-Doppler configurations
- An add-on job scheduler has been developed in order to run several DeDop Core instances in parallel (along with improvement in DeDop source Code, solved GitHub Issue #31)
- A full L2 → L3 Processing stack has been added on top of DeDop Core in order to produce L3 River Water Level time series
- Validation of the L3 River Water Level has been done against gauging data and exhibits very high quality results!
- Internal L3 analysis demonstrates the benefits of a customised delay-Doppler configuration vs. a basic (ocean-like) configuration
- WARNING: Keep in mind that “Hamming windowing” alters information that might be useful indeed in the original waveforms...

- Most important recommendation: **To maintain a perennial development leadership on the DeDop open source code base after the end of the ACA-DDP project:**
  - Drive the vision for the future of DeDop
  - Maintain the various DeDop tools
  - Merge patches provided by users community
  - Continue to improve the tool
  - Communicate via ESA (and other agencies) about DeDop
  - Keep training the young (and old!) generations of potential users

Nicolas Bercher

nbercher@along-track.com
Along-Track S.A.S.