



TRANSPONDER CASE STUDY

WP 6500

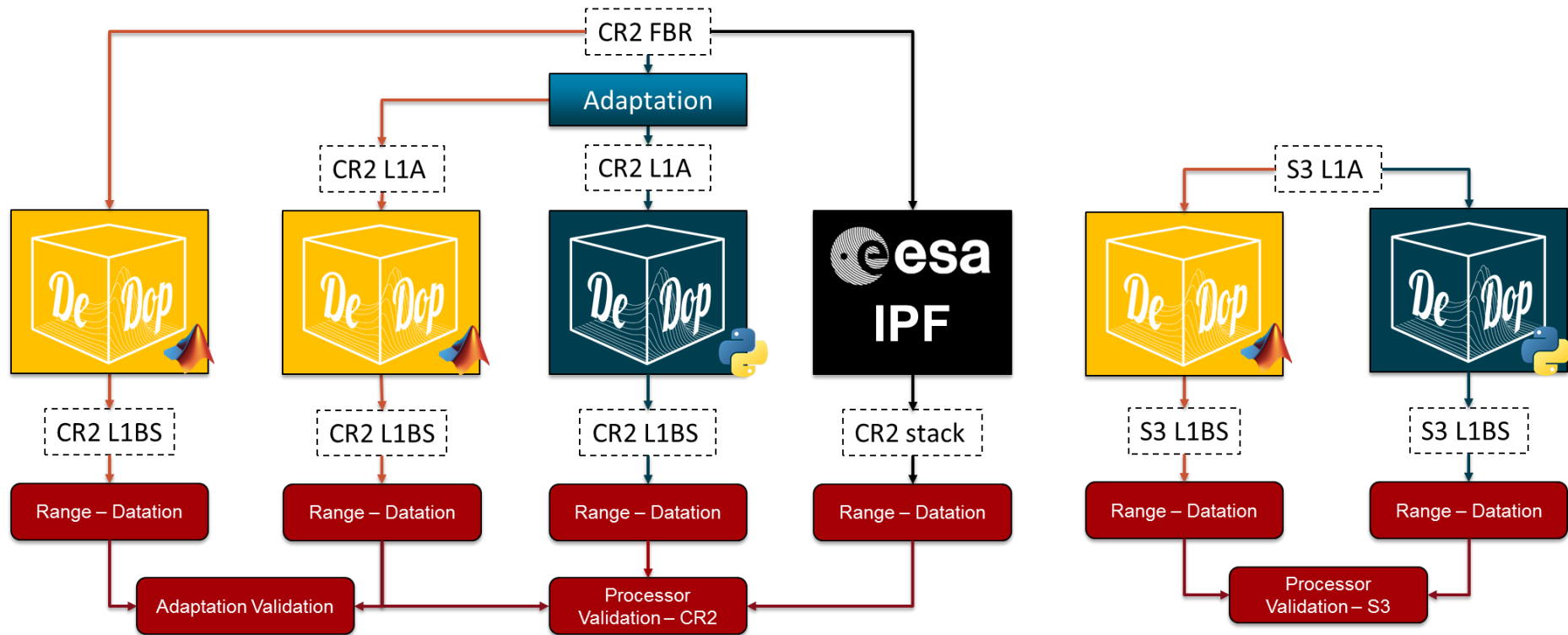


Introduction

- The particularities of the transponder case make it ideal for cross comparison with internal validation purposes.
- Three different exercises has been set up in order to validate the different modules that have been implemented in the DeDop project.
- The **first** comparison validates the first part of the chain, **the adaptation**. For that reason, we use our Matlab development code that is able to process data directly from CR2-FBR and CR2 data adapted to S3 L1A format.
- The second comparison validates the **DeDop processor**. It consists on a triple comparison between the results retrieved from L1BS file generated with the ESA IPF processor, the results from the Matlab development code and the results from the Python DeDop released code with adapted data.
- Finally, DeDop is used to process S3 L1A data and the results between the Python DeDop and the Matlab development versions is compared.



Introduction





Data Sets

- CryoSat-2 data adapted to Sentinel-3 format for the first two comparison exercises
- Data directly from Sentinel-3 for the third exercise.
- Additionally, the location of the transponder is needed during the surface generation.
- The L1BS data generated by DeDop is analysed and the range and datation biases are computed.
- The geophysical corrections needed in the absolute computation of the range are extracted from the CR2 products, as the adapted ones do not contain them (nor at L1A neither at L1BS/L1B). In the S3 case, they are extracted from the corresponding L2 product.

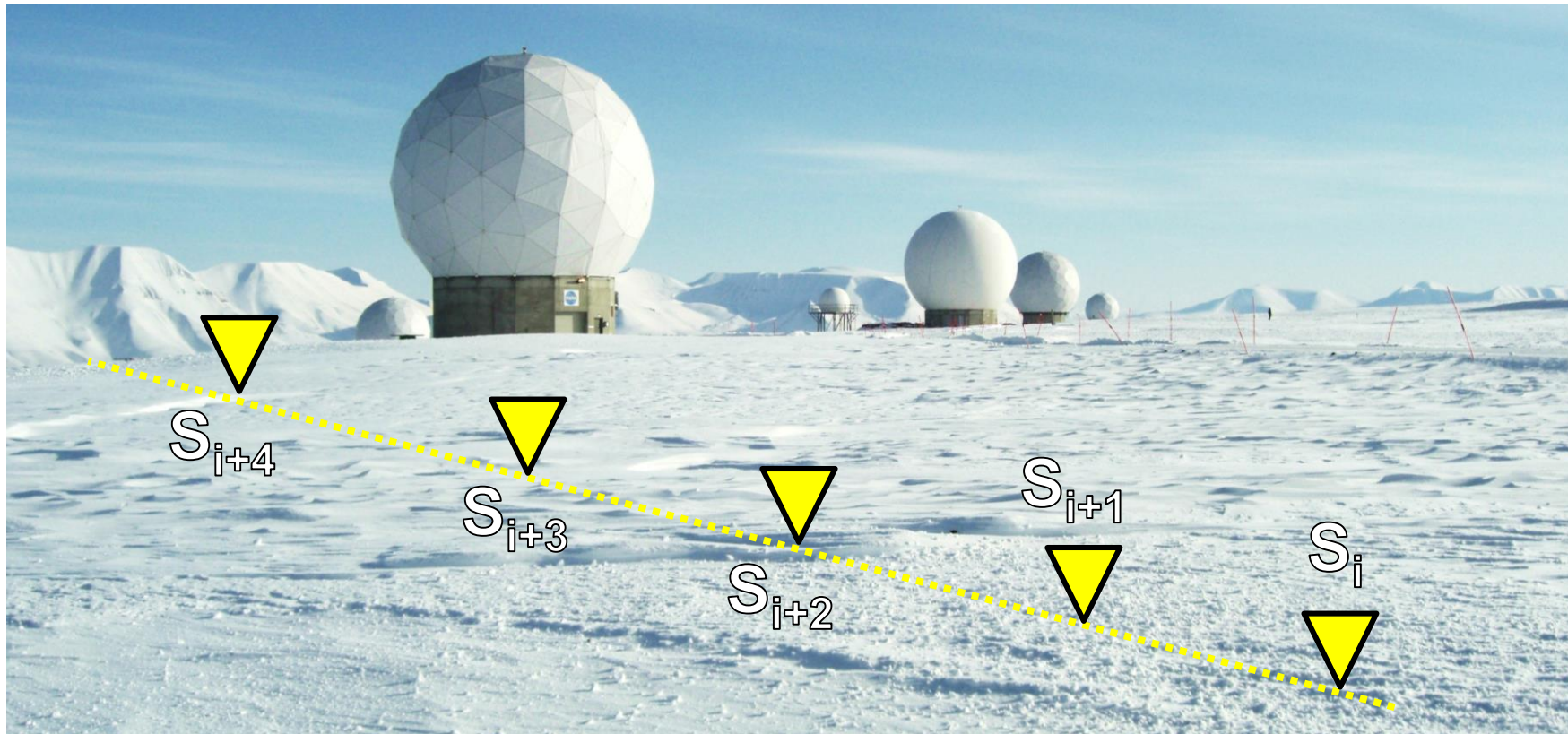


Configuration parameters involved in the TRP processing

- Forced surface location
- Exact azimuth processing
- Range zero padding

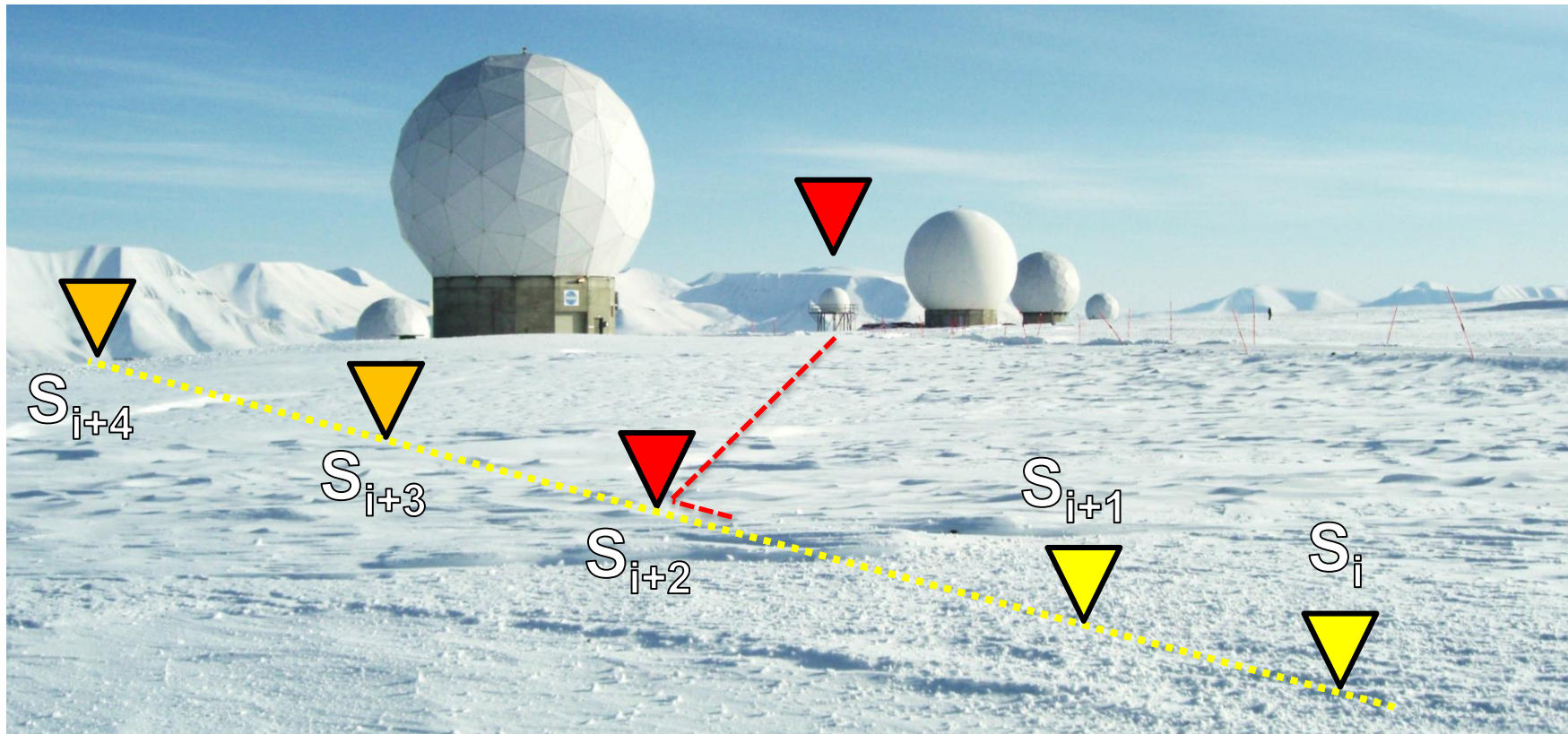
Configuration parameters involved in the TRP processing

- Forced surface location



Configuration parameters involved in the TRP processing

- Forced surface location





Configuration parameters involved in the TRP processing

- Forced surface location
 - *Additional inputs*: TRP location
 - *Explanation*: Force the steering process to a defined location.
 - *Algorithms involved*: Surface location
 - *Expected results*: Surface moved to a new location along the ground track in the closest point to the specified location. The `surface_flag` parameter should include a value to indicate TRP type.

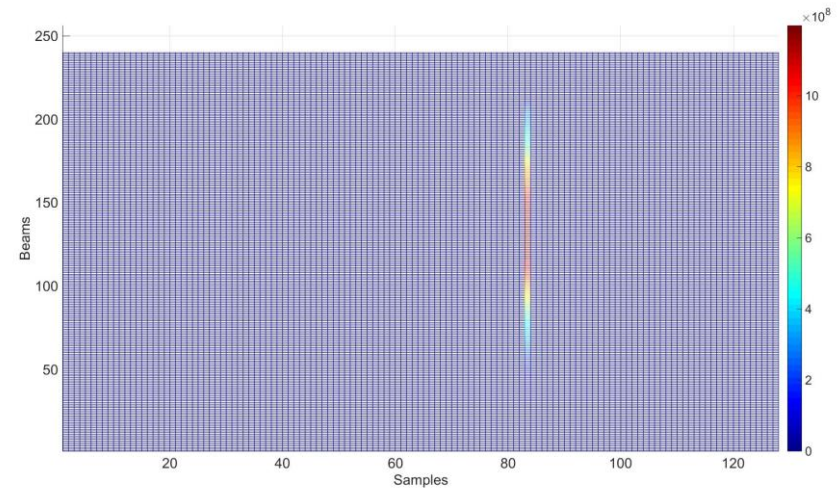
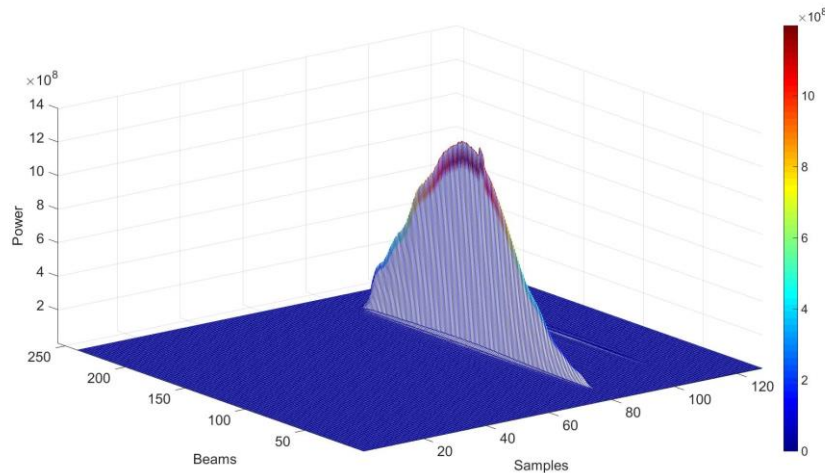


Configuration parameters involved in the TRP processing

- Forced surface location
- Exact azimuth processing
 - *Additional inputs:* -
 - *Explanation:* Use the “exact phase shift” to properly steer the beams to the forced location.
 - *Algorithms involved:* Azimuth processing.
 - *Expected results:* Stack properly steered. It will be aligned after the geometry corrections. The L1b waveform width

Configuration parameters involved in the TRP processing

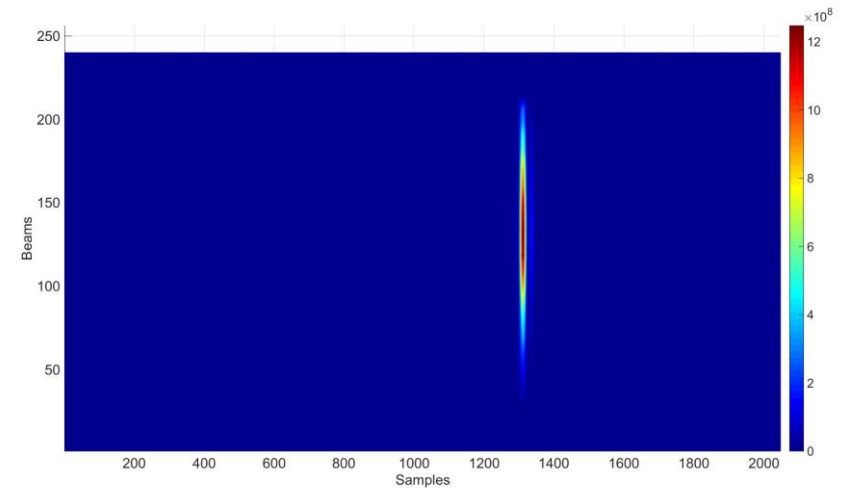
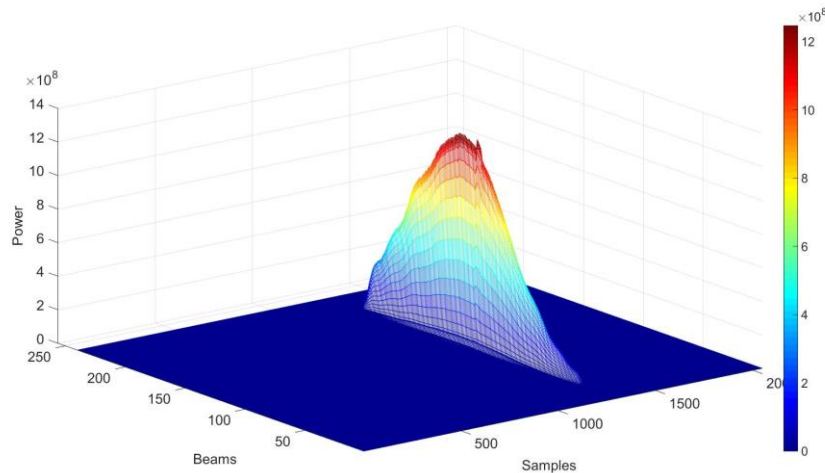
- Forced surface location
- Exact azimuth processing
- Oversampling factor (n)





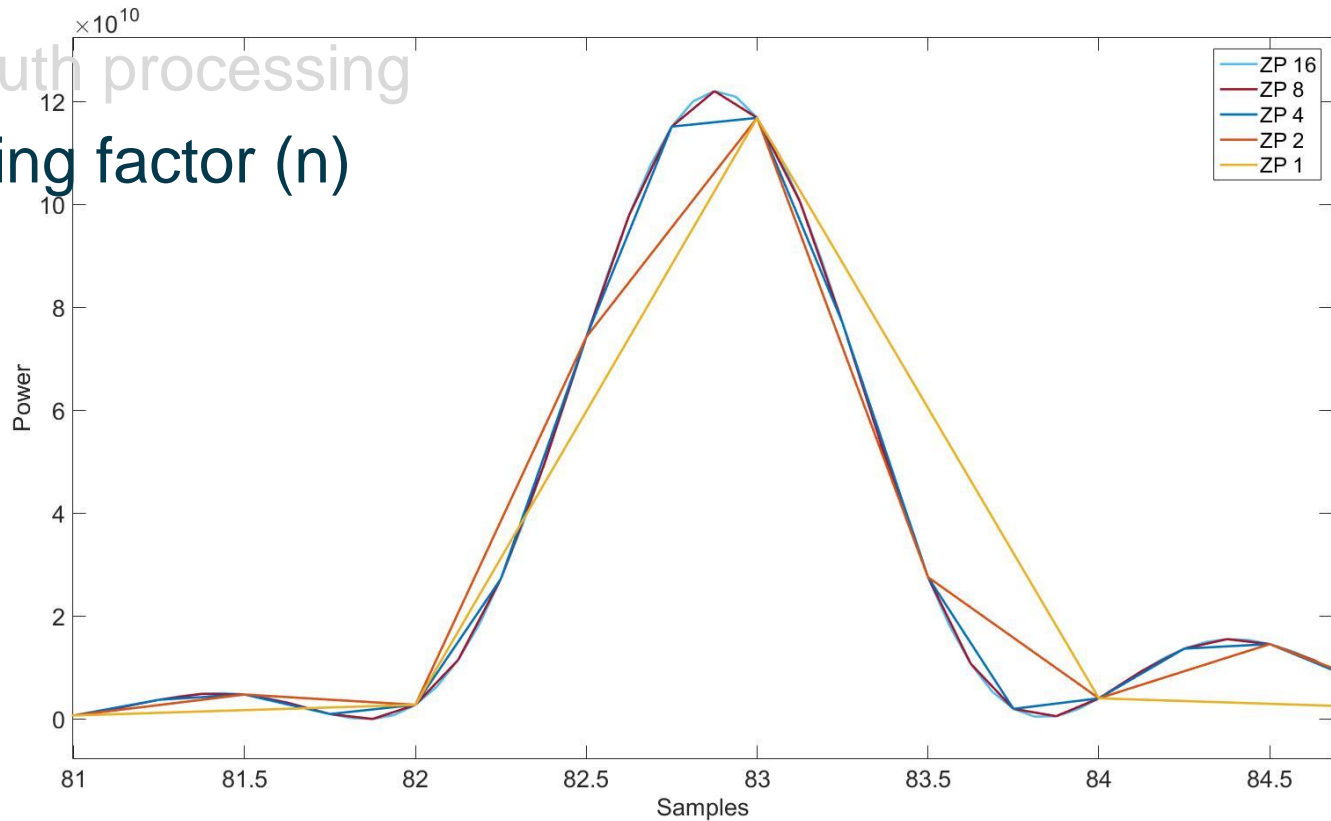
Configuration parameters involved in the TRP processing

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Configuration parameters involved in the TRP processing

- Forced surface location
- Exact azimuth processing
- **Oversampling factor (n)**





Configuration parameters involved in the TRP processing

- Forced surface location
- Exact azimuth processing
- Oversampling factor (n)
 - *Additional inputs:* -
 - *Explanation:* Perform the Range Compression FFT using an oversampling factor.
 - *Algorithms involved:* Range compression.
 - *Expected results:* The resulting number of samples is 2^n over the same range window.



Range, Datation, and Sigma-0 computation.

- Retrievals from L1Bs:

1. Retrack each beam
2. Convert samples to range
3. Read and remove the slant and Doppler range corrections
4. Apply the instrumental and geophysical corrections
5. Apply Sigma0 scaling factor to each beam

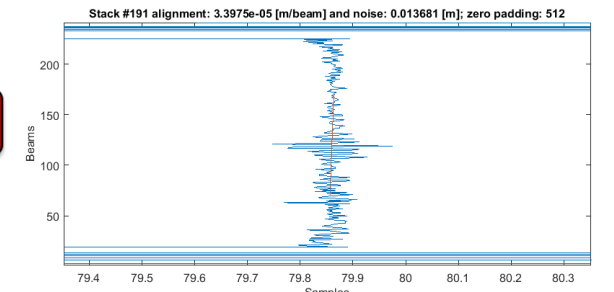
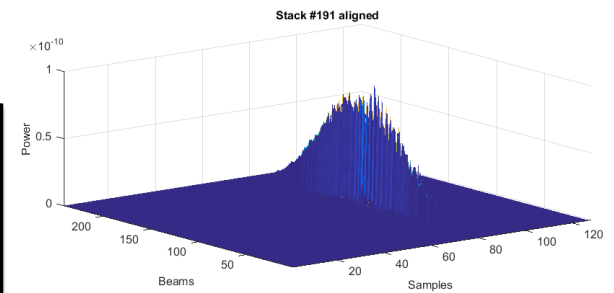
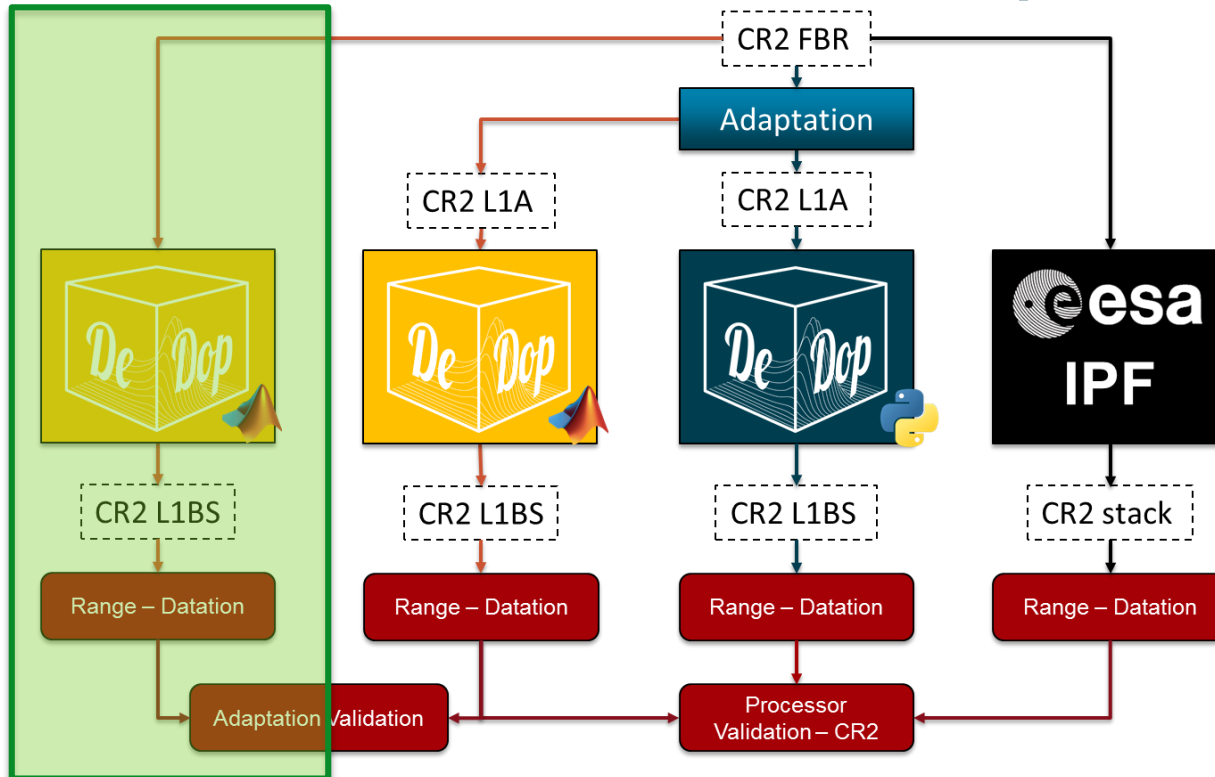
- Theoretical values

1. Read TRP coordinates and convert them to ECEF
2. Read L1A record times and satellite positions
3. Subtract the CoG
4. Convert coordinates in ECEF
5. Compute the theoretical Range as:

$$Range_{th} = \sqrt{(x_{SAT} - x_{TRP})^2 + (y_{SAT} - y_{TRP})^2 + (z_{SAT} - z_{TRP})^2}$$



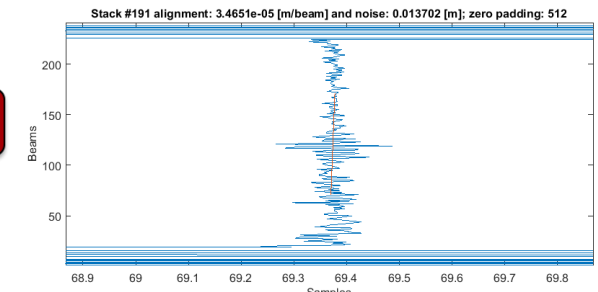
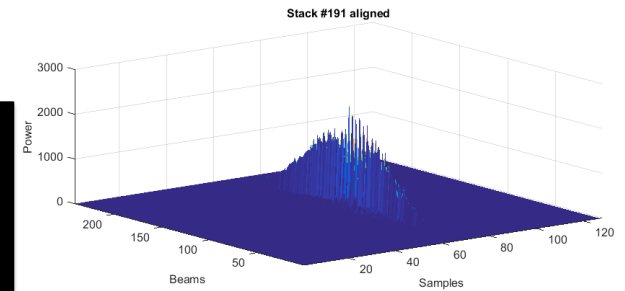
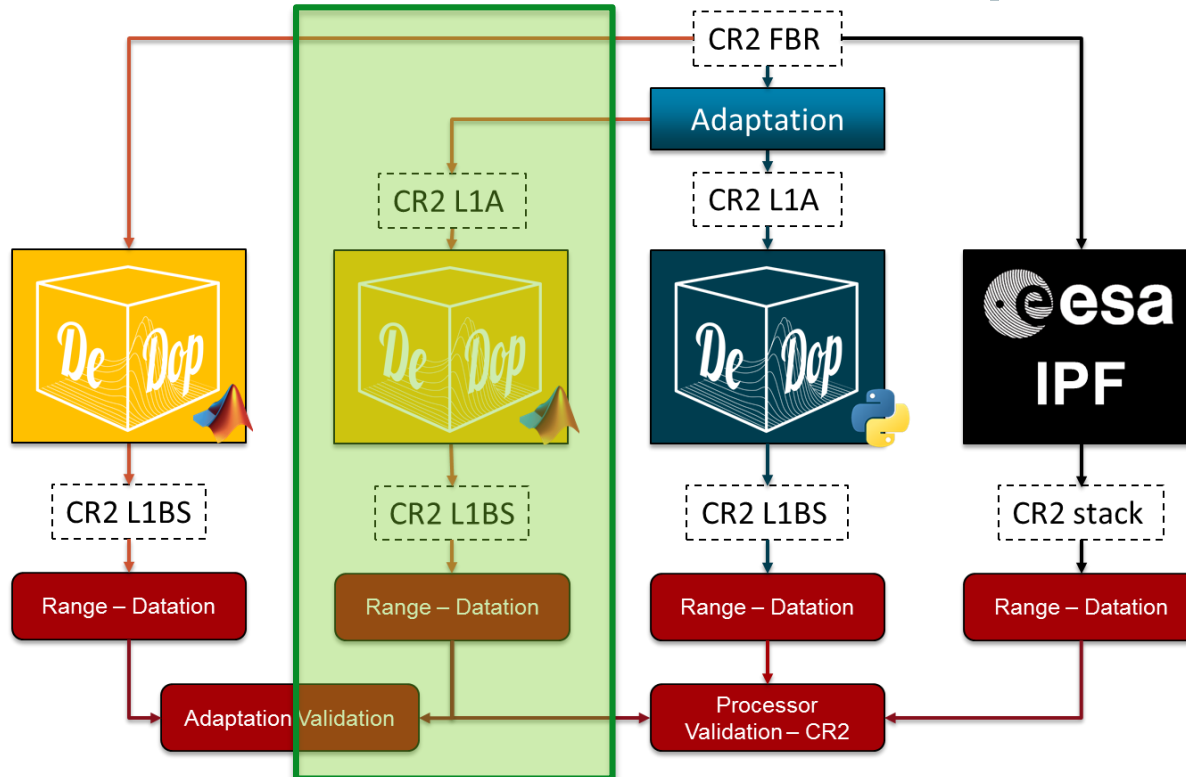
- Technical Results: Cross Comparison



Test	Range Bias [mm]	Datation bias [microseconds]	Range noise within stack [mm]	Range alignment within stack [mm/beam]
1.CR2 + Matlab	55.76	-47.17	13.68	0.0339
2.CR2 + Adaptor + Matlab	-4856.10	-47.17	13.70	0.0346
3.CR2+ Adaptor + DeDop	-4846.75	-11.79	11.17	0.0075
4.CR2+ ESA IPF	30.54	-54.24	13.43	0.0365

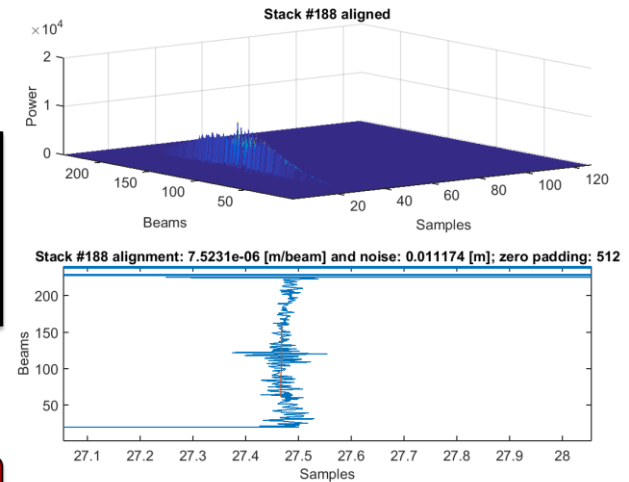
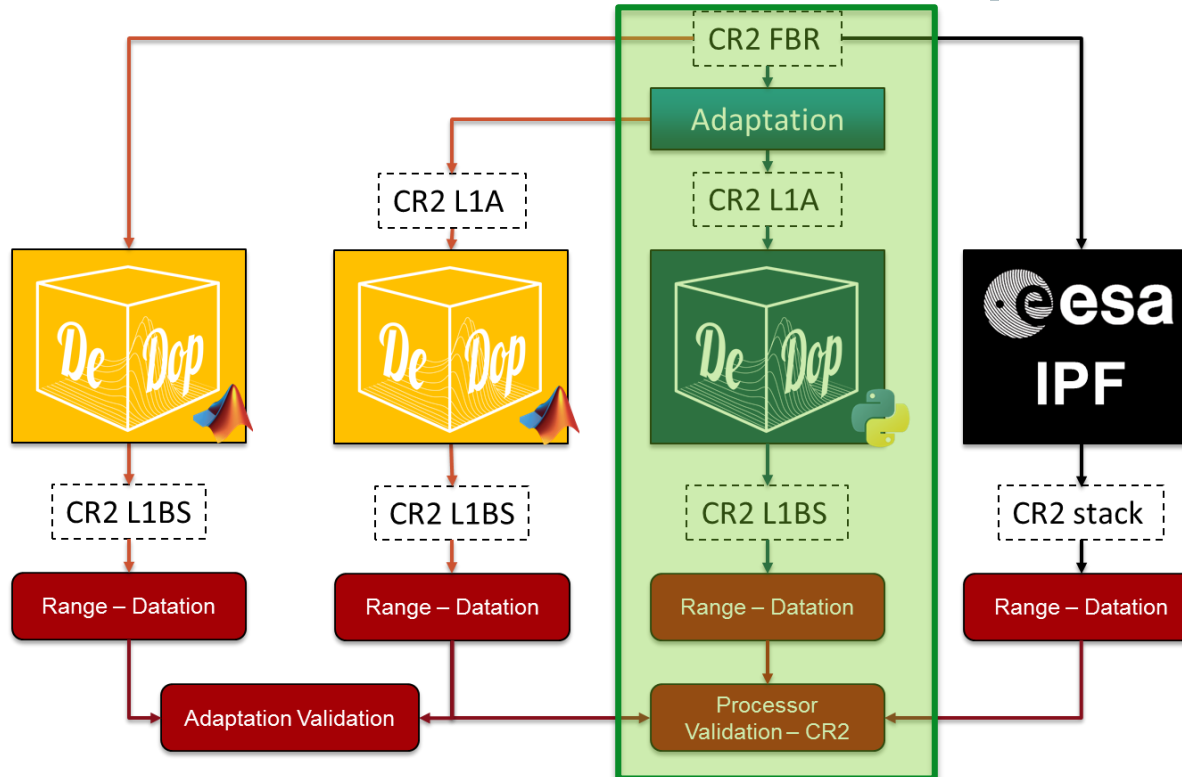


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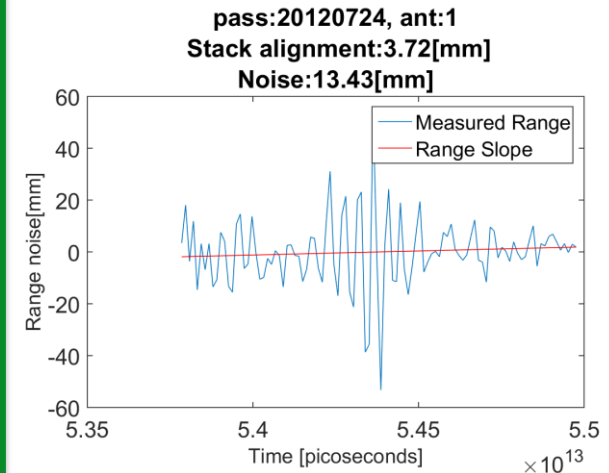
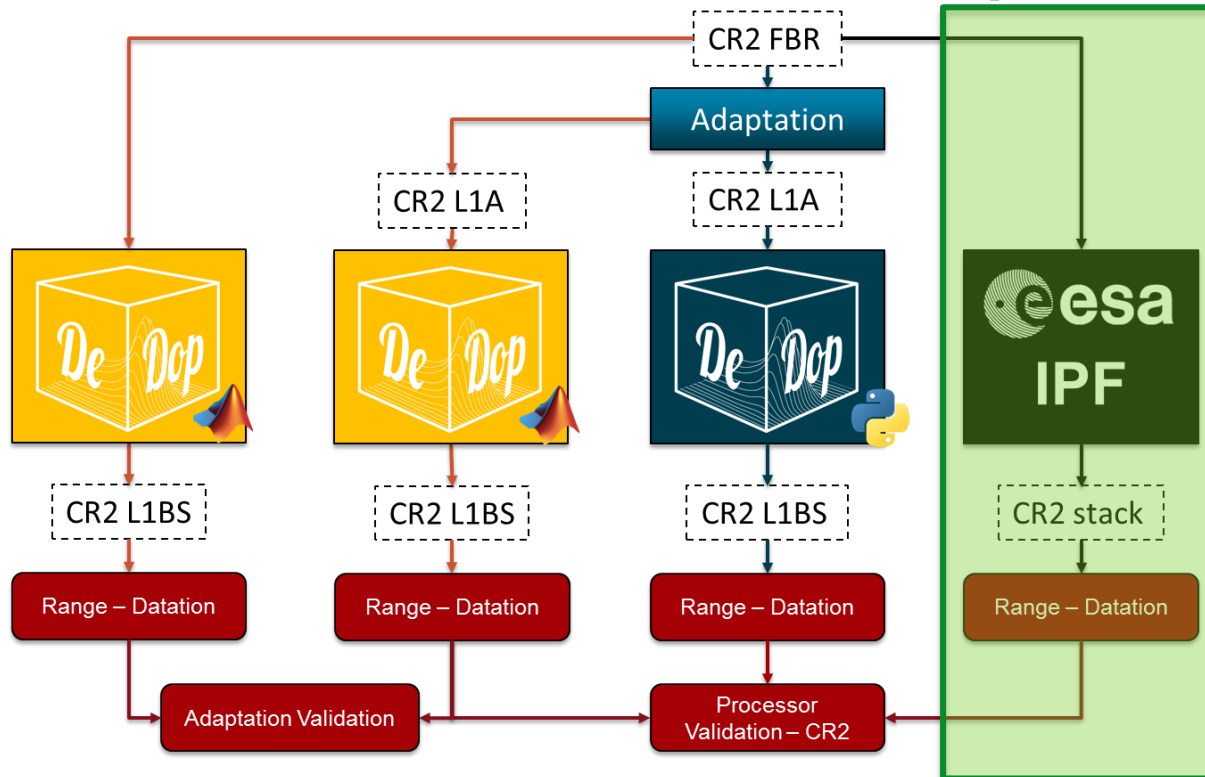
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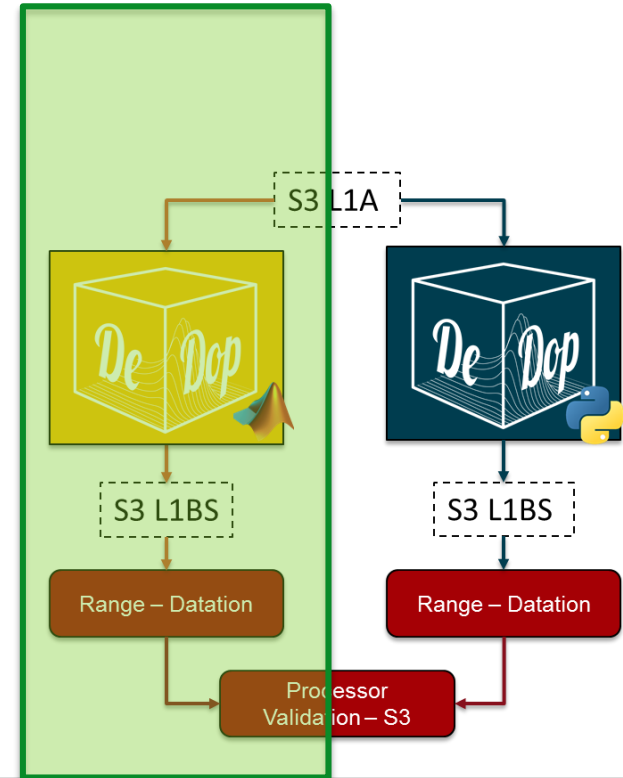
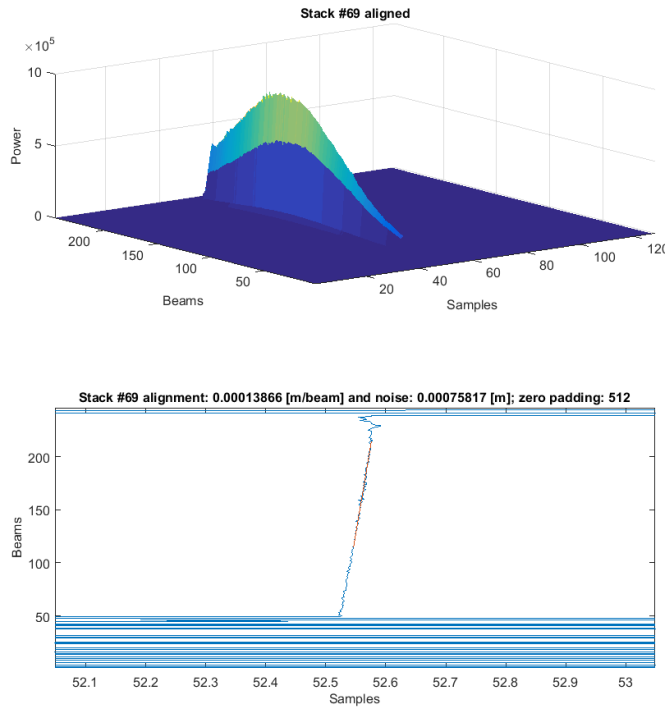
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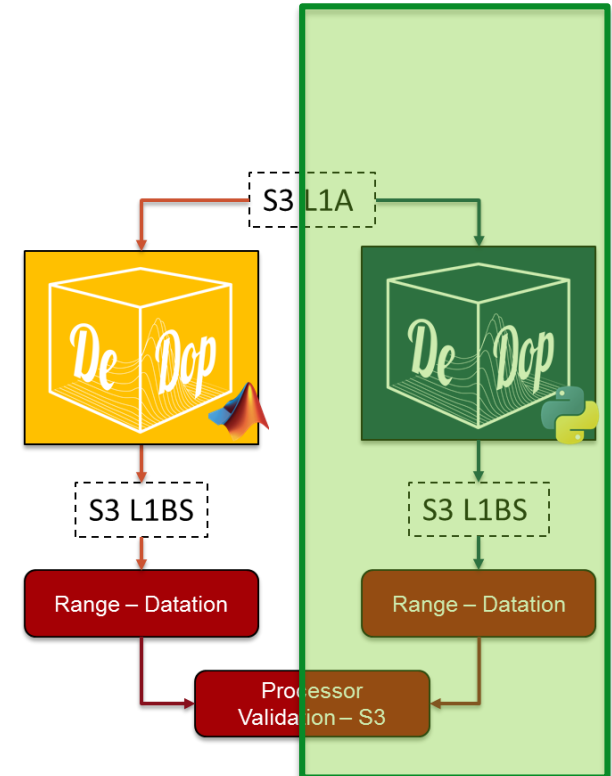
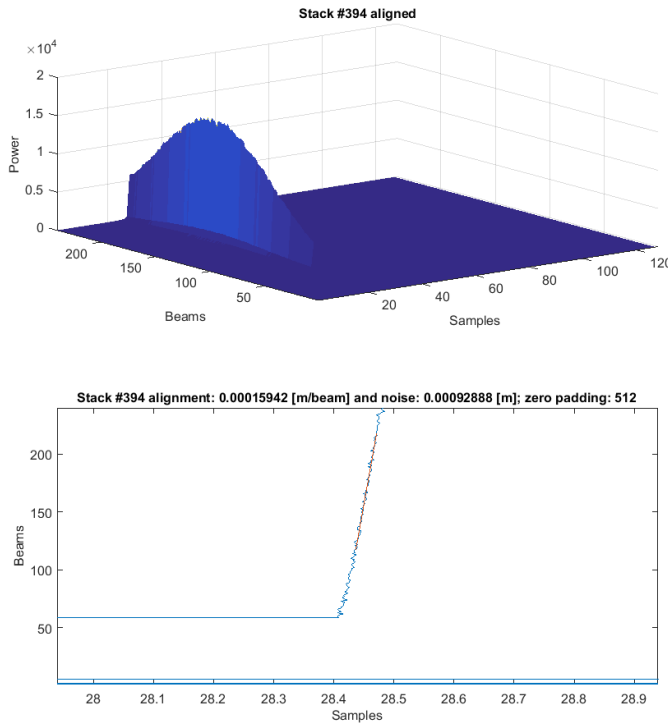
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6.S3 + DeDop	-4.32	-203.73	0.92	0.1594



- Technical Results: Cross Comparison



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Conclusions

- The Transponder case study is a very useful validation activity to analyse the performances of the instrument and ground processing. In the case of DeDop, it has helped to identify issues in the implementation that have been corrected and are not present in the current release.
- Apart from the bias introduced in the adaptation block, the results show a very good agreement between the CR2 ESA IPF and the Matlab development code, validating the use of DeDop for processing S3 L1A data and CR2 FBR adapted.

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