National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

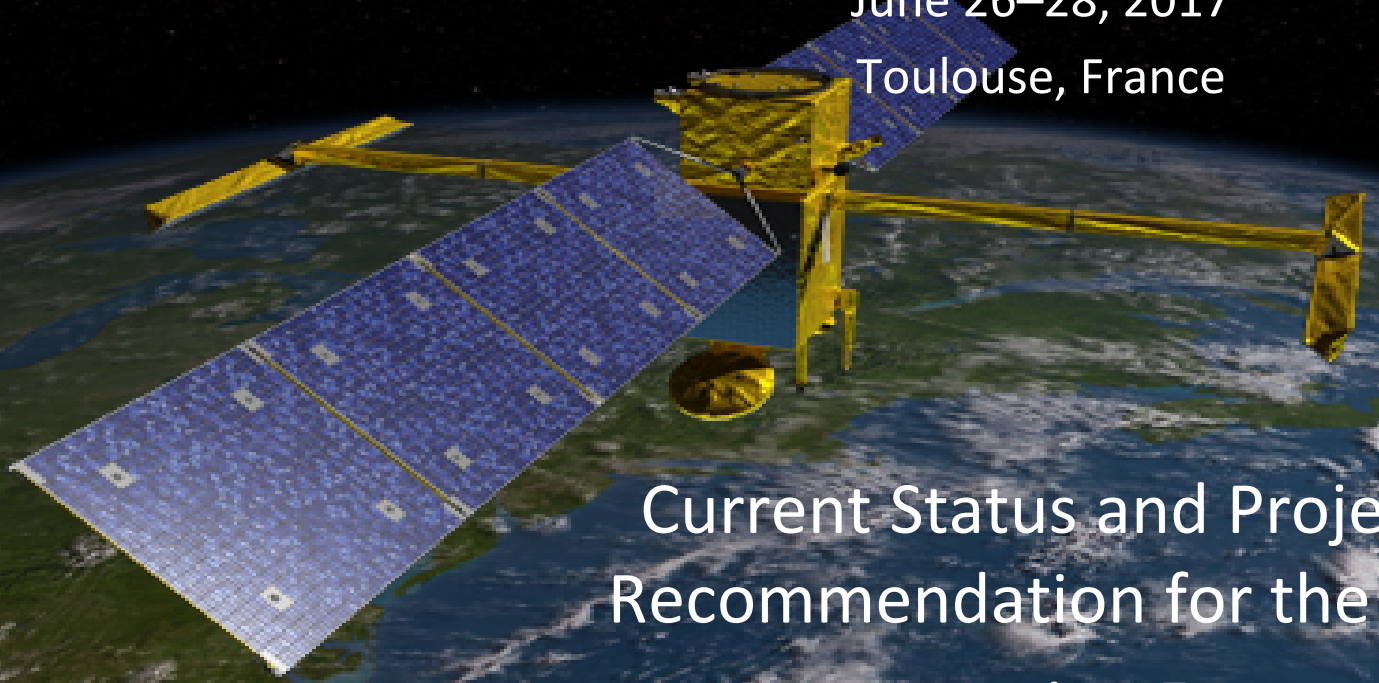
Surface Water and Ocean Topography (SWOT) Mission

SWOT Science Team Meeting

June 26–28, 2017

Toulouse, France

http://swot.jpl.nasa.gov

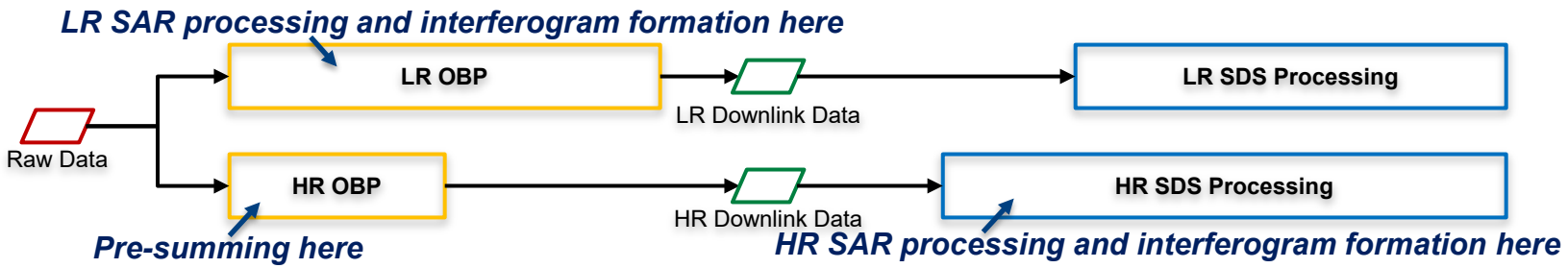


Current Status and Project Recommendation for the HR Pre-summing Factor

Curtis Chen

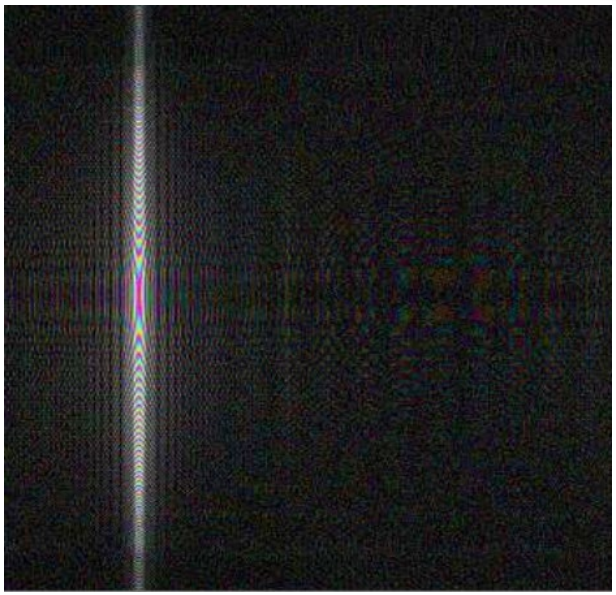
Pre-summing and HR Mask

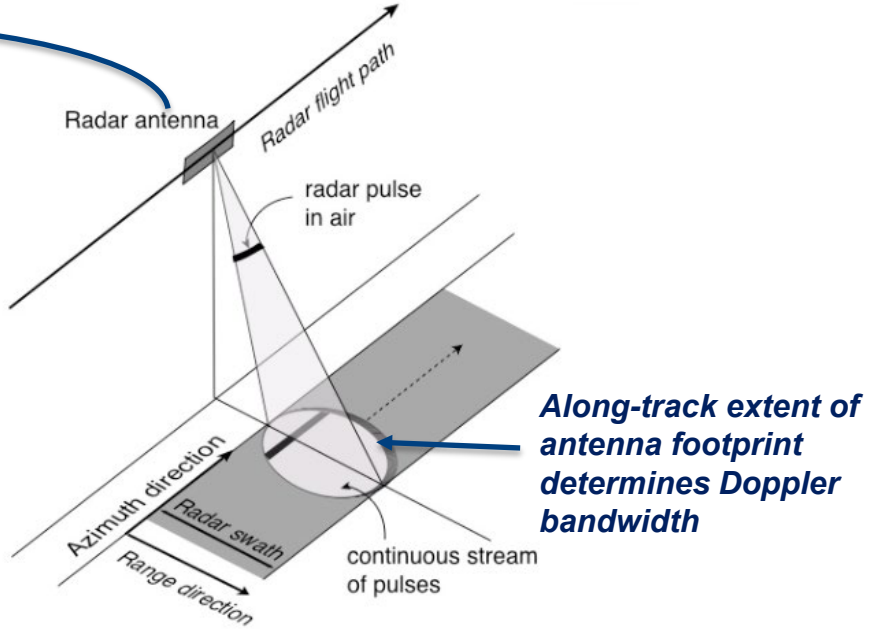
- Pre-summing is done by OBP for HR data in order to reduce data downlink volume at expense of resolution and number of looks
  - Pre-summing is irreversible process; cannot recover original raw data
  - Pre-summing only occurs for HR data stream (LR data rate reduction comes from averaging interferograms after SAR image formation on board)



- Presum factor is adjustable parameter in current OBP design
  - Baseline value of 2.125 has been used for performance analyses, coverage and downlink volume analyses, etc.
  - Higher presum factor reduces downlink volume per unit area of HR coverage but also reduces resolution and increases height/slope error
  - Higher presum factor also make data less robust to unforeseen problems
- While possible to sacrifice data quality/robustness to get more HR coverage by using higher presum factor, project recommends committing to current 2.125 baseline value (rationale described in following slides)

Pre-summing Background





- SAR pulse rate (pulse repetition frequency or PRF) must be fast enough to Nyquist sample Doppler bandwidth illuminated by antenna beamwidth
- Wider Doppler bandwidth allows for finer azimuth resolution, but requires more pulses and hence higher data volume to sample
- On-board pre-summing involves filtering Doppler spectrum and decimating in OBP to reduce downlink data volume

Presum Factor History

- Presum factor was raised from 2.0 to 2.125 with SDT concurrence in 2015 in order to enable downlink of 250 m posting/500 m resolution LR data
- Study on impact of raising pre-sum factor beyond 2.125 was inconclusive due to lack of reliable data for characterizing phenomenology of hydrology targets (E. Rodriguez et al.)
  - Included AirSWOT and ground-based data
  - Mainly addressed decorrelation time of hydro targets
    - If decorrelation time limits resolution and ability to classify water/land, raising presum factor may be somewhat more acceptable
    - However, even if resolution is limited by decorrelation of water surfaces, raising presum factor still degrades height/slope error due to loss of looks
    - Blurring of point target response due to target decorrelation does not imply loss of looks (different mechanism than resolution loss due to pre-summing)
  - No plan or opportunity to collect better data before launch

Changing Presum Factor After Launch

- Changing presum factor in-flight would force re-calibration of KaRIn data (big deal) and likely delay validation
  - Ground processing of AirSWOT data has shown significant changes in calibration with changing aperture width
    - Changing synthetic aperture beamwidth in AirSWOT processor is equivalent to changing presum factor for SWOT
    - AirSWOT data are not pre-summed in radar hardware
  - Keeping presum factor fixed reduces degrees of freedom in SWOT Cal/Val
  - Keeping the presum factor fixed eases comparisons over long time scales by making data homogenous in time.

Conclusions

- **Project recommendation is to fix presum factor at 2.125 (consistent with baseline concurred to by SDT in 2015)**
  - SWOT is new, challenging mission, so should get as much data as possible per unit area on ground to ensure robust, accurate measurement
  - Better to make sure we get good data for areas that we cover than to spread our coverage too thin since any extra coverage from higher presum factor affects all HR data globally
  - Do not expect to collect better phenomenology data before launch that could provide firm evidence that higher presum factor is tolerable, so keeping presum factor as low as possible gives lowest risk of failing to achieve performance objectives
  - Fixed value provides a homogenous time series and eases Cal/Val