Surface Water and Ocean Topography (SWOT) Mission Science Team Meeting
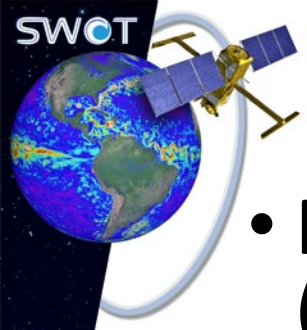
September 19, 2023

SWOT Algorithms and Products: Status and Plans

Shailen Desai[1], Nicolas Picot[2]

on behalf of JPL/CNES Algorithm Development Team
[1]Jet Propulsion Laboratory, California Institute of Technology
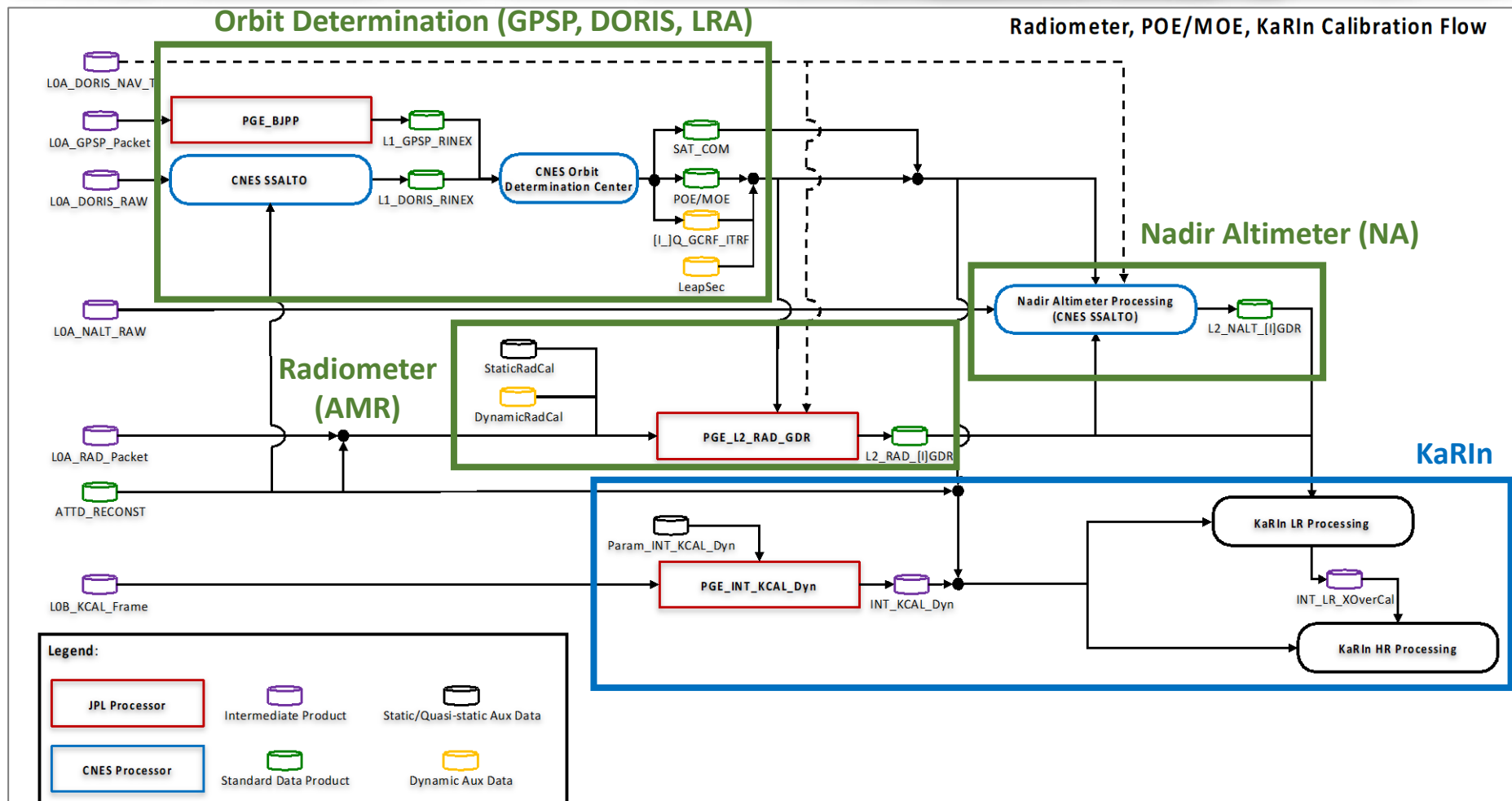[2]Centre National d'Etudes Spatiales

- Responsibilities of Joint JPL/CNES Algorithm Development Team (ADT):
  - 18 SWOT science data products.
    - 4 Oceans products.
    - 9 Hydrology products.
    - 5 tracking data, attitude and orbit determination public products.
  - Science Algorithm Software.
    - Generates science data products by processing downlinked instrument telemetry data.
  - User Documentation.
    - User Handbook.
    - Product Description Documents.
    - Algorithm Theoretical Basis Documents.
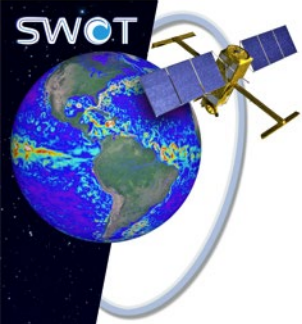 - Sample Data Products.
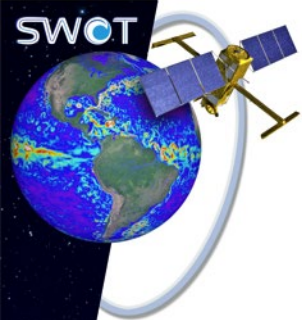
Top Level Processing Flow of SWOT Science Data Products

2023 SWOT Science Team Meeting
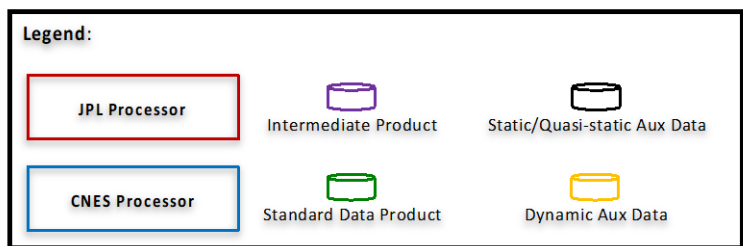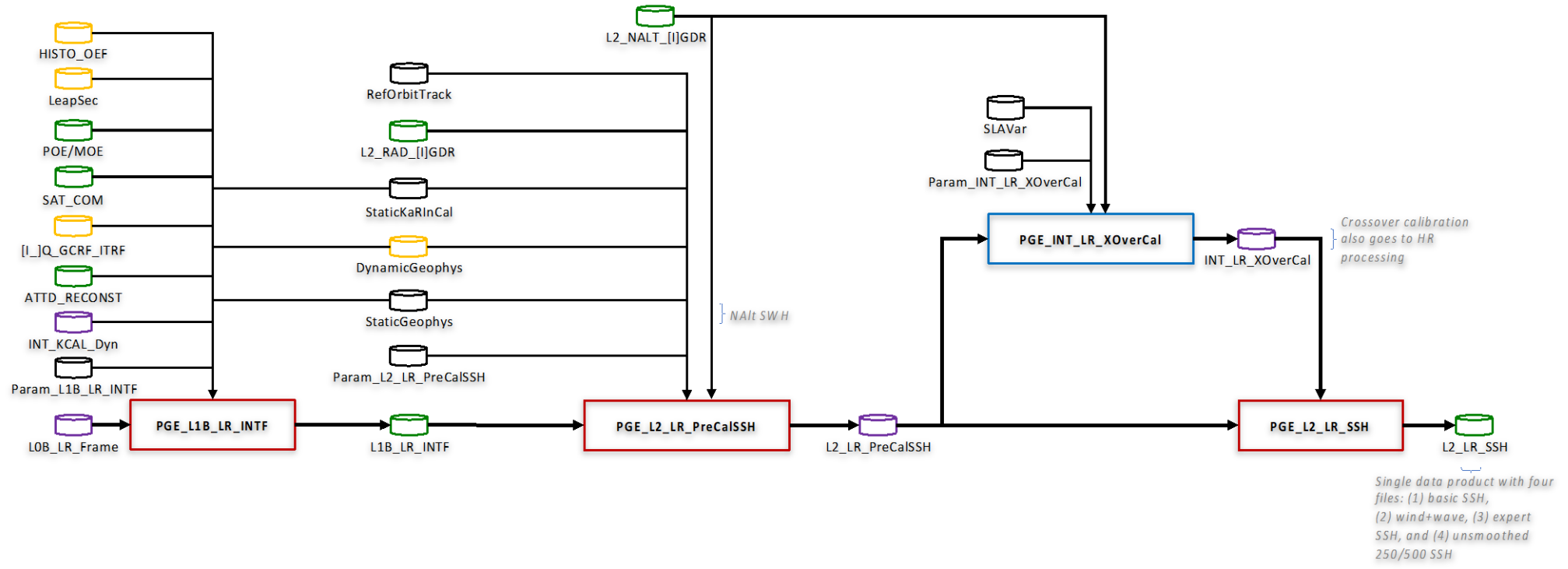
KaRIn Low-Rate (Oceans) Processing Flow

KaRIn LR Flow

Crossover calibration also goes to HR processing

NAlt SWH

Single data product with four files: (1) basic SSH, (2) wind+wave, (3) expert SSH, and (4) unsmoothed 250/500 SSH

Legend:

- JPL Processor
- CNES Processor
- Intermediate Product
- Standard Data Product
- Static/Quasi-static Aux Data
- Dynamic Aux Data

LR data processing suite designed for **ocean** surfaces
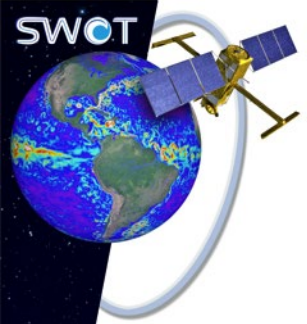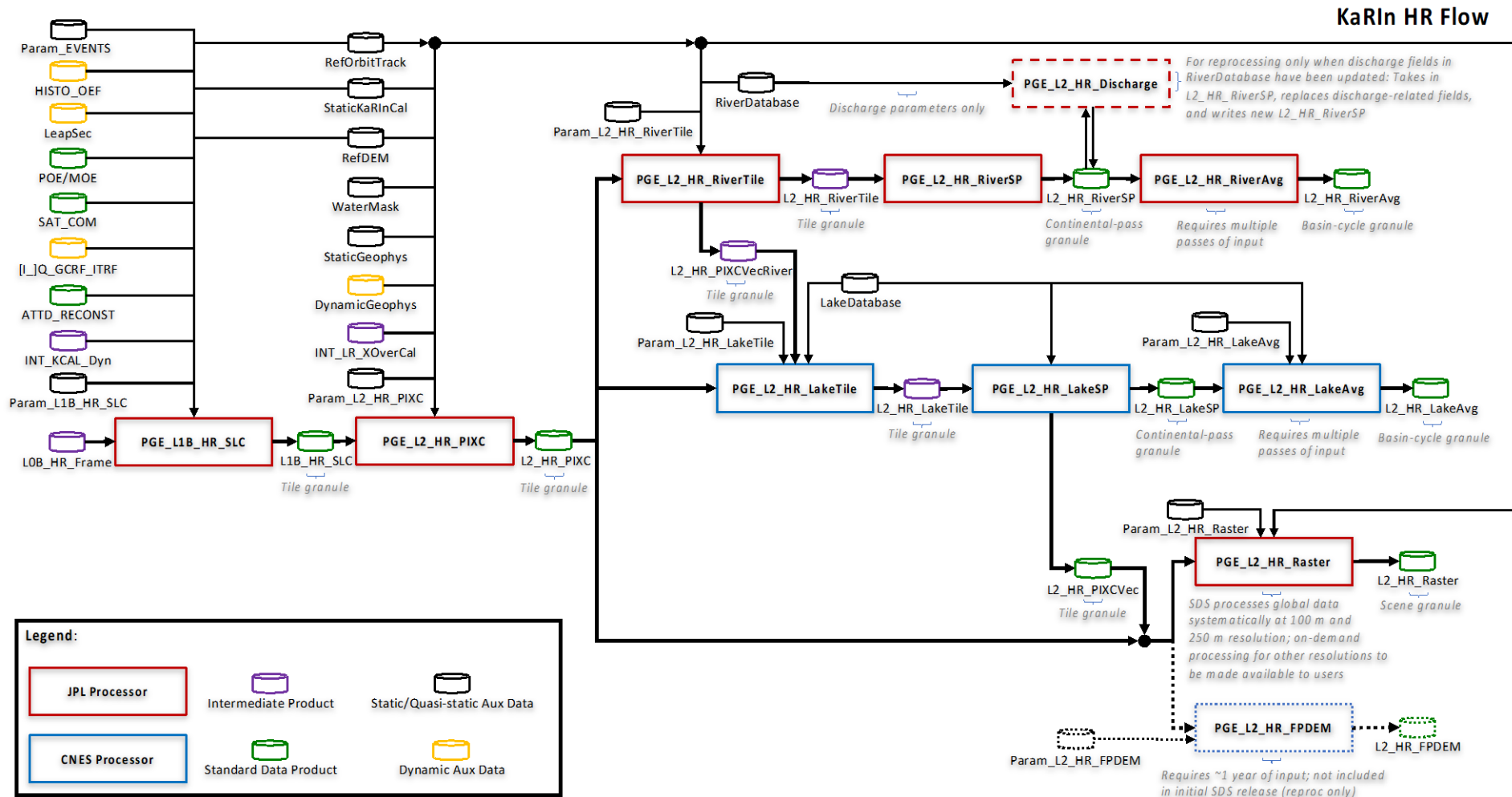
HR data processing suite designed for **inland water** surfaces (Rivers, Lakes, flood plain)
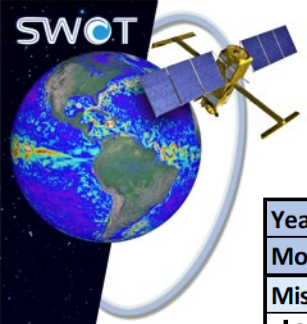
Science Algorithm Software (SAS) Status

Beta Pre-Validated Science Data Products

- **"Beta Pre-Validated" KaRIn science data products.**
  - **Added to plans due to better than expected maturity of KaRIn products (especially ocean).**
  - Aimed towards familiarizing users with novel KaRIn science data products.
  - Includes data from calibration phase:
    - ~100 days of global KaRIn ocean products spanning calibration phase.
      - ~2 weeks released September 1, 2023, with remainder released September 15, 2023.
    - ~2 weeks of ~6 passes of KaRIn hydro products covering project cal/val sites (Passes 13, 16, 9, 27, 4, 10).
      - Pass 13 released September 15, 2023, with remainder released September 18, 2023.
  - Corrects various anomalies in upstream products that impacted product quality.
    - Reconstructed attitude: algorithm improvements.
    - Medium-accuracy orbit determination: Account for improved satellite center of mass.
    - Radiometer: In-flight radiometer calibration and use of improved orbit and attitude products.
    - Nadir altimeter: Resolution of minor algorithm anomalies and use of improved orbit products.
    - **KaRIn: Use of improved orbit, attitude, radiometer, and nadir altimeter products**
   - **KaRIn: Use in-flight calibrations only available on June 29, 2023.**
    - **KaRIn: Enable consistent crossover calibrations across calibration phase.**
  - **Uses one version earlier than KaRIn algorithms that will be applied to pre-validated products.**
    - Known issues with beta products.

Science Data Products: Reprocessing Plans

- Full global reprocessing of all products from calibration phase up to date when forward processing uses same algorithms.
  - **Identified as "pre-validated" science data products.**
  - **Products are aimed towards the SWOT validation meeting.**
  - **Products to be made publicly available.**
  - Currently planned to start late October 2023.
  - Will use most recently released versions of science algorithm software from August/September 2023.
  - Will use best available in-flight instrument calibrations for KaRIn, radiometer, and nadir altimeter.
  - Will apply various lessons learned from August 2023 reprocessing.
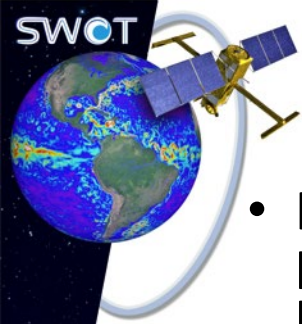
KaRIn HR Algorithm Computing Resources for Forward Processing

- Implemented KaRIn HR forward processing priority mask to mitigate computational resource constraints.
  - Defined with inputs from hydrology science leads.

- Mitigation approach:
  - Algorithm team continues to work on reducing processing time and memory usage.
  - Science data system incrementally expanding processing aiming towards 100% coverage.

- **Current best estimate is that 100% of all HR tiles can be processed in routine forward processing.**
  - Reduction in CPU usage from recent SAS deliveries.
  - Processing mask continues to be enforced should need arise.

- **100% of HR data processed during global reprocessing campaigns.**
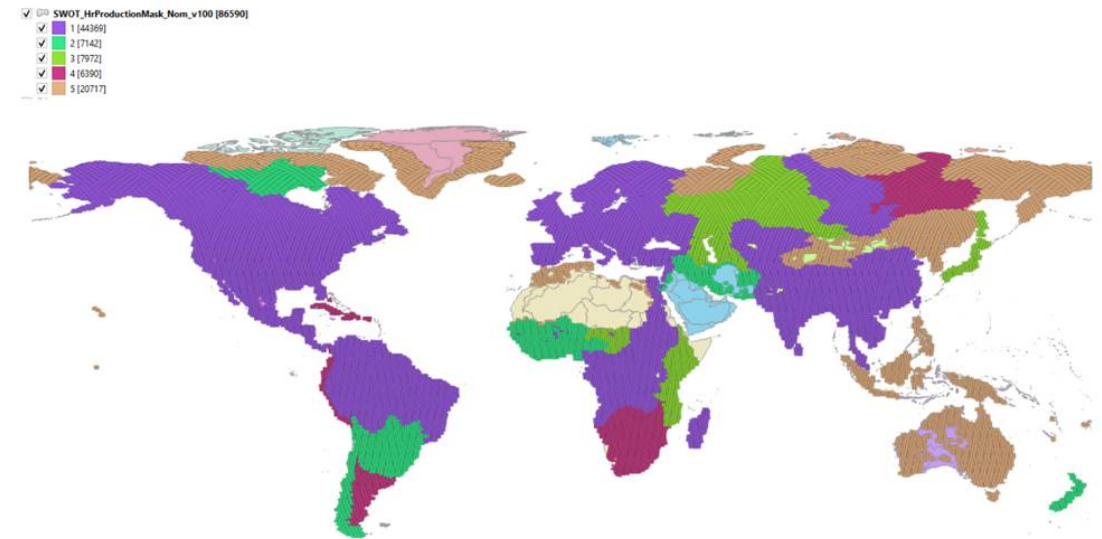
User Documentation Status and Plans
See: https://podaac.jpl.nasa.gov/swot?tab=datasets

User Handbook

- **Targeted to all SWOT product users.**
- Mission Overview, Terminology and Definitions
- Mission Design and Payload
- Basic Measurement Principles of Payload
- Radar phenomenology
- Geophysical contributors to measurements
- Processing flow

→ November 2023

Product Description Documents

- **Targeted to general user of specific product.**
- Separate document for each science data product
- Product-specific content
- Structure
- Qualitative description
- Detailed format and content
- Size and latency

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- **Completed SME Review**
- **Mature versions released November 2022**
- To be updated October 2023.
  - Accounts for in-flight experience (e.g., flags).
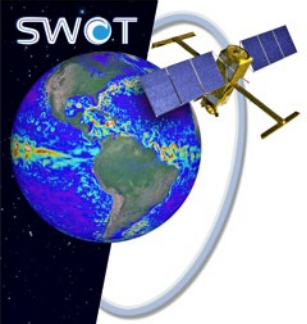
Algorithm Theoretical Basis Documents

- **Targeted to the more-expert user.**
- Separate document for each science data product
- Physical and mathematical basis of algorithms.
- Describes how variables in products are computed.
- Qualitative description of input and output data

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- **Completed SME Review**
- **7 of 8 released August 2023.**
  - L2_HR_Raster moving to formal signature cycle.
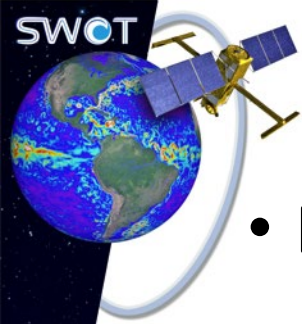
Summary

- Beta pre-validated products released to science team in Sep, 2023.
  - Instrument calibrations and algorithms have better than planned maturity.
  - Aimed towards familiarizing users with novel SWOT products using in-flight data.
    - Known issues with products, many of which resolved for pre-validated products.
- Software deliveries for pre-validated products delivered to science data system in Aug/Sep 2023.
- Pre-validated products will include:
  - Reprocessed data from calibration phase.
  - Reprocessed data from science phase up to date when forward processing uses same version of processing algorithms.
- Product description documents mature and publicly available.
- ATBDs mature and publicly available.

Backup