



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

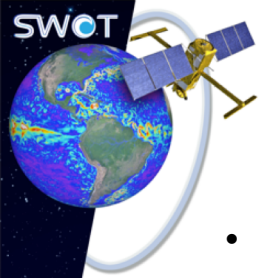
June 26-29, 2018

Montreal, Canada

Ocean Cal/Val Meeting
Introduction

Curtis Chen, Nicolas Picot

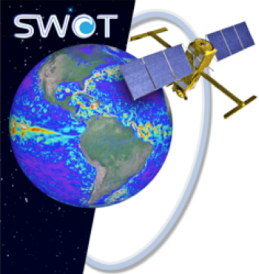
CL#18-3584



Cal/Val Objectives

- Basic objectives of Cal/Val¹:
 - Calibration: Estimate calibration parameters for ground processing based on flight data
 - Error budget validation: Validate measurement performance (“*Does system behave as expected, and if not, what can/should we do?*”)
 - Data product validation: Validate measurement with respect to high-level requirements (“*Does performance meet mission success criteria?*”)
- Different sources of data may be useful for different Cal/Val objectives
 - Direct measurements of quantities related to SWOT measurement physics may best demonstrate that measurement performance is as expected—or enable diagnosis of problems if measurement performance is not as expected
 - Direct measurements of quantities of oceanographic science interest may best establish link between SWOT measurements and science objectives underlying SWOT requirements

¹ SWOT Cal/Val Plan, Sects. 1.2-1.3



Mission Phases/Timeline

Primary Cal/Val Period

Long-term (low-level) validation



Launch (September 2021)

Reentry

Mission Phases

LEOP 7 days (Includes DAA deployment)

Checkout/Commissioning Phase (83 days)

Calibration Phase (90 days)

SWOT Validation meeting

Measurement Validation: 8 months, nominal science orbit

Science Phase (21-day Repeat) (36 mos)

SC Decommissioning (1 mos.)

Science Data Product
Generation Closeout (4 mo.)

Orbit

Cal Orbit Fast Repeat (1 day repeat, 77.6 deg, 857 km)

Transition to Science Repeat Orbit (~1 wk)

Science Orbit 21-day repeat, 77.6 deg, 891 km (36 mos.)

**Calendar
Years**

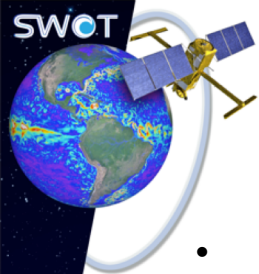
2021

2022

2023

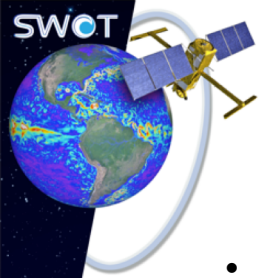
2024

2025



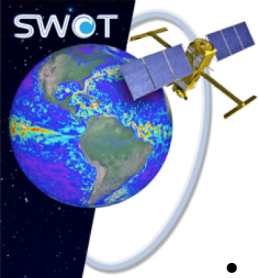
Status as of 2017 Toulouse Cal/Val Meeting

- Airborne lidar and hydrographic in situ concepts were proposed but needed to be matured and fully validated via pre-launch ocean experiments
 - Toulouse meeting occurred during Monterey Bay in situ experiment
 - Availability of suitable aircraft was major issue for airborne lidar
- GPS buoys were discussed and showed some promise; planning for US efforts on GPS buoys was to be folded into in situ activities
 - Due to cost uncertainty, were not proposed as stand-alone approach
 - Continue to leverage on-going development and test for other projects
- Global statistical approaches could likely validate wavelengths as short as 50-70 km, though validation to 150 km by local (in situ or airborne) approaches would still be preferred
- California Cal/Val site would be primary US project site
- Mediterranean activities were to continue
- Follow-on science activities were to be coordinated external to Cal/Val group



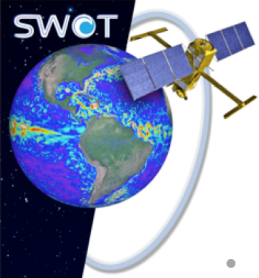
Programmatic Context

- Cal/Val plan released as JPL document (D-75724) in January 2018
 - Includes both airborne lidar and hydrographic in situ activities
- Cal/Val status and plans have been formally reviewed
 - Pre-PDR Measurement Review (Feb 2016)
 - Pre-CDR Measurement Review (Dec 2017)
 - Project CDR (Feb 2018)
 - ♦ Ocean Cal/Val received request for action (RFA) from board to complete glider and lidar validation
 - ♦ RFA did not take exception with plan, but action was to carry out plan



Meeting Objectives

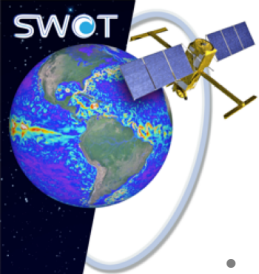
- Discuss big picture of how different Cal/Val approaches fit together in order to guide and prioritize future efforts:
 - Provide status on major ocean Cal/Val activities:
 - ♦ US in situ activities (hydrographic and GPS)
 - ♦ US lidar activities
 - ♦ French/European in situ activities & French lidar activities
 - ♦ Bass Strait absolute sea level in-situ activities
 - ♦ Global statistical approaches
 - Discuss additional approaches and sources of data (“adopt a crossover”)
- Discuss technical feasibility and risks associated with individual approaches and identify risk mitigations
 - Ability of proposed approaches to collect data of sufficient accuracy
 - Ability to interpret and inter-compare SWOT and other data sets
 - Robustness of approaches to launch date changes, logistical challenges, etc.



Timeline of US Cal/Val Plans

- Mid 2017: Monterey Bay experiment (in situ hydrographic, GPS collection)
- Mid 2018: Peer review of plans for pre-launch in situ campaign
- Early 2019: Execute pre-launch in situ campaign at California Cal/Val site
 - Date set to match season of Cal/Val phase given launch slip
- Mid 2019: Execute pre-launch lidar campaign on Gulfstream V aircraft
 - Date based on aircraft readiness
- Note: in situ and lidar plans have been decoupled to reduce logistical risk
 - Objectives of pre-launch lidar and in situ campaigns are sufficiently orthogonal
- Late 2019: Refine post-launch Cal/Val plans based on experience from pre-launch campaigns

- Early 2022 (L+3 months to L+6 months): Post launch Cal/Val at California crossover site



Timeline of French/European Cal/Val Plans

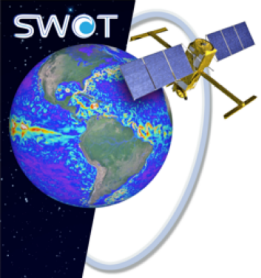
- May 2018 - Pre-SWOT Western Mediterranean cruise
- Fall 2018 - Lidar ocean flights along altimeter groundtracks (L. Froideval)
- Early 2022 (L+3 months to L+6 months): Post launch Cal/Val at chosen crossover sites (Mediterranean Sea, SW Pacific, ...)

Ongoing activities :

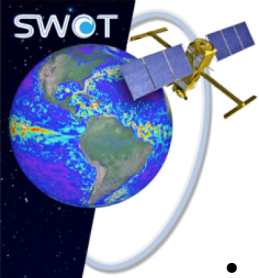
- Pre-launch preparation of global statistical CalVal activities
- Satellite product support for international « Adopt-a-crossover sites »

Future plans :

- Potential synergy with other satellite campaigns or Calval projects : e.g. CFOSAT, SKIM (in situ campaign in October 2018 off French coasts).
- 1day Xovers : assess SSH variability, SWH & Sigma0 mean values and variability, MSS/Tides/DAC quality, internal tides amplitudes; ...
- Continue working on LRM and SAR processing methods improvement to contribute to SWOT validation



Backup



SWOT CDR RFA 3: Cal/Val Plan

- Originators: Gregg Jacobs and Michael Dettinger (SWOT Project CDR Part I, 2018-02-15)
- Description:

“Not all measurement systems have been validated for cal / val, and there are plans for validate the systems. Any delays in validating the MASS lidar and underwater gliders as cal / val tools will inhibit progress in cal / val activities to support the missions.”
- Recommended Action:

“Ensure that the MASS and gliders instruments are validated as quickly and sufficiently as possible to not delay cal / val plans, activities, or other SWOT elements that may have derived requirements.”