SWOT SDT CALL SUBMISSION GUIDELINES

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This document aims at giving guidelines for proposal preparation, in response to the SWOT SDT 2015 call. Detailed scientific objectives of the call may be found in the NASA ROSES call document, (element A.10, pp 98-105, hereafter named ROSES document)

http://www.aviso.altimetry.fr/fileadmin/images/ScienceTeams/Full_ROSES_2015_amend2_clarify.pdf)

Please note that:

- US teams seeking NASA funding should submit through the ROSES call, following the ROSES rules, by May 15th, 2015.
- French teams seeking TOSCA financial support should in addition use the TOSCA "APR 2015" excel form to indicate requested funding http://www.aviso.altimetry.fr/fileadmin/documents/user_corner/SDT/Tosca_SWOT2016_excel_a_completer.doc.xls . The deadline is however extended to May 15th, 2015.
- Proposals from entities located outside the U.S. and France, (hereafter termed foreign entities) in response to this announcement, are encouraged. Other international team may submit proposals with no funding request, which would be jointly evaluated by CNES and NASA. Proposal should be submitted by e-mail before May 15th, 2015 at the following addresses:
    - surfac@cnes.fr for Hydrology proposals (Program manager: Selma Cherchali)
    - oceano@cnes.fr for Oceanography proposals (Program manager: Philippe Escudier)

The proposals may be written in French or English, but a full copy in English shall be made available at the time of submission.

The proposal format outlined below is merely a guide for the prospective proponent. Strict adherence to most of these guidelines is not absolutely necessary. However, page limits will be strictly enforced and proposals should provide information related to all items described below and as otherwise specified in this announcement.

Proposal format guidelines

1. COVER LETTER

A letter or cover page should be forwarded with the proposal (see Appendix). It should be signed by the proponent and an official of the proponent's organization who is authorized to commit the organization to the contents and implementation of the proposal.

2. TABLE OF CONTENTS

The proposal should contain a table of contents.

3. IDENTIFYING INFORMATION

The proposal should contain a short descriptive title for the investigation, the names of all investigators, the name of the organization or institution, the full name of the proposed principal investigator, his address with postal code, his telephone and fax numbers and E-mail and/or telex number.

4. INVESTIGATION AND TECHNICAL PLAN

The investigation and experimental plan should not exceed 15 to 20 single-spaced pages or printed text, including illustrations, tables, references, bibliographies and biographical information. Information concerning the education, training and relevant experience of the investigators involved in the proposed study should be provided on separate sheets attached to the technical plan. Biographical information of this nature should be limited to two pages or less for each investigator who will play a substantial role in the investigation. Proponents who wish to provide evidence of their experience and competence in particular disciplinary fields are encouraged to quote relevant publications in general scientific literature of which they are the author. References to earlier publications should be limited to major publications that are directly relevant to the proposed investigation. These citations should be included within the two pages allotted to each investigator for biographical information. Proponents should not include lengthy publication bibliographies or copies of specific publications in their proposal.

Information concerning specialized equipment or facilities that will be used during the course of the investigation should not be presented in the technical plan. Information of this nature should be included in the management and cost plans described in next sections.

It is anticipated that a large number of proposals will be received by CNES in response to this Announcement. To expedite the proposal evaluation process and assure fairness to all proponents, the length restrictions described above will be strictly enforced. If a prospective investigator fails to observe the restrictions on proposal length cited above, CNES reserves the right to return the proposal to the proponent upon receipt without further review or evaluation.

The investigation and technical plan will generally contain the following:

4.1. SUMMARY:

A simple, concise statement about the investigation, its conduct and the anticipated results. This summary should not exceed one single-spaced, typewritten pages.

4.2. EXPERIMENTAL OBJECTIVES:

Proposals are solicited in the fields indicated in the document provided by the ROSES call. The Proposal should identify and detail its contribution to each of its fields of relevance. For each contribution, a brief description of the technical objectives and their relationship to past research efforts and the current state of-the-art should be given. The scientific rationale for the proposed investigation should be clearly established through reference to existing scientific literature and other publications. The proposed investigation should be defined in relation to the current state-of-the-art and to the specific objectives of this call . Proponents are encouraged to define explicit hypotheses that will be tested and/or evaluated by the proposed project.

4.3. APPROACH:

The concept of the investigation should be clearly stated and the methods to be employed in data analysis and interpretation should be presented.

4.4. EXPERIMENTAL AND WORK PLAN:

The overall methodology and the sequence of key milestones of the investigation should be presented in some detail.

If the investigation requires accessing data that could be procured though the space agencies involved in SWOT (for example nadir altimetry data from current missions, AirSWOT campaigns data), the proposal should identify the data required and the desirable form in which it should be delivered to the proposed principal. The anticipated use of such data, as well as ancillary types of data or models to be employed in the analysis and interpretation should be clearly identified.

4.5. ANTICIPATED RESULTS:

As far as feasible, the expected outcome of the proposed project should be presented. The significance of these results should be discussed, if possible, in terms of:

- Their contribution towards the objectives of the current call (see ROSES document)
- Their scientific or real-time application interest and implications for future research and development.

4.6. SIGNIFICANCE OF THE INVESTIGATION:

The significance of the proposed study should be defined in terms of its relationship to earlier studies of a similar nature and/or to implications of the anticipated results. The proposal should attempt to characterize the relative degree of innovation associated with the objectives or approach of the proposed study. In addition, the proposal should attempt to characterize the importance of the anticipated results in relation to the current state of knowledge within particular disciplinary fields. The extent to which the anticipated results will influence the definition and conduct of future research and/or operational projects on similar or related topics should be discussed in the proposal.

5. MANAGEMENT PLAN AND COST PLAN

Management plans are required from all proponents submitting proposals to CNES.

Cost plans are required by CNES from French proponents and French participants in non-French proposals.

The investigation and technical plans and the management and cost plans will be reviewed independently during the various stages of the proposal evaluation process described in the last section of this appendix.

5.1. MANAGEMENT PLAN

The management plan should summarize the management approach and the facilities and equipment required.

Management

The management plan sets forth the investigator's approach for efficiently managing the work, the recognition of essential management functions and the effective overall integration of these functions. If ancillary data are needed, the method for obtaining these data should be detailed.

The management plan gives insight into the organization proposed for the work, including the internal operations and lines of authority with delegations, together with internal interfaces and relationships with CNES, major subcontractors and associated investigators. It also mention the link (if any) with other national or international programs. Likewise, the management plan usually reflects various schedules necessary for the logical and timely pursuit of the work, accompanied by a description of the Principal Investigator's work plan, the amount and responsibilities of the scientific collaborators (if any) and the amount and responsibilities of the technical collaborators (if any).

Facilities and Equipment

All major facilities and equipment essential to the proposed investigation should be indicated, including those of the investigator's proposed subcontractors and those of CNES and other French Government agencies (or foreign agencies in the case of non-French proposals or joint proposals). Existing equipment should be explicitly differentiated from facilities that will be developed to implement the investigation. Procurement schedules and lead times for the acquisition and installation of new equipment and facilities should also be indicated. Since these investigations will focus on Jason data analysis, the development of new equipment and facilities will be limited only to the support required for these analyses.

5.2. V.2. COST PLAN (FRENCH INVESTIGATORS ONLY)

The cost plan should summarize the total investigation cost by major categories of cost as well as by function.

Cost categories

- Materials: This should give the total cost of the bill of materials including estimated cost of each major item. Included lead time of critical items.
- Travel: This should give the estimated number of trips, destinations, duration, purpose, number of travelers and anticipated dates.

As a rule, direct labor and overhead costs will not be considered.

The cost born by the PI organization or the organization endorsing the proposal (and signing the cover letter) should be clearly identified as well as those for which support will be requested to other organizations.

Detailed cost schedule

Separate schedules for each year should be attached to show total cost allocable to the following

- Principal Investigator and scientific collaborators costs.
- Data reduction and analysis including the amount and cost of computer time.
- Cost of auxiliary data (if any) to be acquired by the investigator.
- Cost of field studies.

Specifics for foreign participation

Proposals from foreign entities should not include a cost plan. Foreign proposals or proposals that include foreign participation must be endorsed by the respective government agency or funding/sponsoring institution in the country from which the foreign participant is proposing. Such endorsement should indicate the following points: (1) The proposal merits careful consideration by NASA/CNES; and (2) If the proposal is selected, sufficient funds will be made available by the sponsoring foreign agency to undertake the activity as proposed.

All foreign proposals will undergo the same evaluation and selection process as those originating in U.S. or France. Foreign proposals or proposals that include foreign participation, must follow all other guidelines and requirements described in this announcement. Sponsoring non-U.S. non-French agencies may, in exceptional situations, forward a proposal without endorsement to the above addresses, if review and endorsement are not possible before the announced closing date. In such cases, however, NASA or CNES External Relation office should be advised when a decision on the endorsement is to be expected.

Successful and unsuccessful proposers will be contacted directly by NASA and/or CNES program offices. Copies of these letters will be sent to the sponsoring government agency. Formal arrangements for the participation of the selected investigators in the programme will be made by CNES and NASA External Relation Offices.

Appendix: proposal cover sheet

NASA/CNES SWOT SDT 2016-2019
Announcement

Proposal No. ______________________ (Leave Blank for NASA/CNES Use)

Title: ____

Principal Investigator:

Name: ____

Department:____

Institution: ____

Street/PO Box: ____

City: _____________________ State: ___________ Zip: ____________________

Country: __________________ E-mail: ____

Telephone: ________________________ Fax: ____________________________________

Co-Investigators:

Name	Institution	Telephone

Budget (for French Investigators only):

1st Year (2016):	2nd Year (2017):	3rd Year (2018):	4th Year (2018):	Total:

Authorizing Official: _____________________ _____________________

(Name) (Institution)

2019 SWOT ROSES TOSCA (Synergistic Sciences)

Coastal/estuary studies

The limitation of land contamination in conventional altimeter observations near coasts will be alleviated by the radar interferometry measurement. This improvement, plus the availability of high-resolution data (~ 50 m) in the region where the rivers meets the ocean, deltas and estuaries, will provide unprecedented opportunities to advance understanding of the complex water flow and its effect on this important environment. Understanding coastal and estuarine processes, as well as removing tidal signals, requires improved knowledge of coastal bathymetry. SWOT measurements of deviations from the vertical may be combined with specific coastal and estuarine tide models and independent bathymetric estimates for the development of better coastal tides and circulation models.

Cryospheric sciences

SWOT has the potential to be useful for observing several elements of the cryosphere, including sea ice, snow, and ice sheets. In the case of sea ice, fine-scale 250 m resolution SSH and SAR images will be available up to 78° in latitude and should enable the identification of open water and floating sea-ice. SWOT's SSH measurement may be useful to determine the freeboard of sea ice. The high-resolution observation at 250 m to 2 km everywhere, with limited patches of sea-ice data at resolution ~100 m, will allow better determination of ocean surface topography in the polar ocean in the midst of sea ice.

Additionally, it is possible that SWOT in Ka-band with a nadir altimeter in Ku band will provide useful measurements of snow surface elevation, especially during snowmelt when liquid water is present within the snowpack. Similarly, SWOT may provide some information on variations in elevation of glaciers and ice sheets, especially in low-slope regions. These measurements may provide useful information on variations in the cryosphere of importance to understanding of the terrestrial water cycle. Supraglacial rivers and lakes associated with melt processes on glaciers and ice sheets are also potentially fruitful subject of investigation.

Marine Geophysics

The SSH slope accuracy achieved by conventional altimetry is about 2 microradians, equivalent to 2 miligals in gravity anomaly. Every SWOT measurement promises to achieve 1 microradian slope accuracy at 15 km wavelength over two dimensions, as opposed to one-dimensional measurements from conventional altimetry. Over the lifetime of the mission, the precision of the measurement, as well as contamination due to mesoscale eddy slopes, will improve by an order of magnitude due to temporal averaging. Such global measurement is anticipated to result in an order of magnitude improvement in the accuracy of estimating seafloor depth at small scales. This would reveal the currently hidden abyssal hill fabric of the slow-spreading rate seafloor, as well as perhaps 10-20 thousand uncharted seamounts taller than 1000 m.

2019 SWOT ROSES TOSCA (Hydrology)

The primary objective of SWOT hydrology, described in the Science Requirements Document at https://swot.jpl.nasa.gov/docs/D-61923_SRD_Rev_A_20160318.pdf, is to "characterize the spatial and temporal variations in surface waters, globally." In particular, SWOT aims to measure variations in lake and wetland water storage and river height, slope and discharge at submonthly, seasonal, and annual timescales. SWOT will provide these measurements for rivers wider than 100 m, globally, and for lakes larger than $(250\ \mathrm{m})^2$. These measurements will constitute the first globally consistent database of surface water storage and fluxes from space and will substantially advance hydrologic science in several areas, as specified in the Science Description Document at https://swot.jpl.nasa.gov/docs/SWOT_MSD_1202012.pdf. We anticipate advances in three primary areas:

2.1.1 River, Lake, and Wetland Science

The storage of water in lakes and reservoirs, fluxes through rivers, and interactions with inland and coastal floodplains and wetlands are critical to understanding a broad range of science questions focused on hydrology, hydraulics, biogeochemistry, water resources engineering, etc. For example, the SWOT Science Definition Team identified the following core SWOT hydrology science questions:

- What is the spatial distribution of freshwater storages and runoff through rivers, lakes, and reservoirs? Does inclusion of the knowledge “close” water budgets of regional/global hydrology and climate models?
- What are the impacts of water impoundments in reservoirs and natural lakes, human water withdrawals, and trans-boundary rivers on the global water cycle, societal water supply, and global sea level rise?
- What are the regional-to-global-scale responses of lake volumes and river flows to climatic phenomena, e.g. droughts, floods, and a warming Arctic?
- What are the three-dimensional forms of waves propagating through natural river channels, and how may these be used to improve hydrodynamic models of flood hazard and risk?
- What are the spatial and temporal dynamics of water storage in millions of unmapped lakes and river floodplains, and how do they impact biogeochemical fluxes of carbon, nutrients, and greenhouse gases, waterborne diseases/public health, sediment transport, and ecosystem functioning?

There are also many other fruitful science questions related to SWOT hydrology, including in the areas of remote sensing science (e.g. radar phenomenology), the terrestrial cryosphere (e.g. snow processes), and the science of deltas and estuaries.

The SWOT Science Team projects focused in this category will finalize development of ways to address science questions before launch and then use the first SWOT data post-launch to begin addressing them. Science investigations may focus exclusively on SWOT data or may use a combination of SWOT measurements, other satellite or in situ data, and/or numerical models. All projects should make clear their plans for both pre-launch and post-launch activities.

2.2.2 SWOT Algorithms and Data Products

In order to effectively address science questions using SWOT, robust algorithms and high-quality data products are essential. The SWOT Science Team is integrally involved in development of such algorithms and data products. Key areas that are solicited here include:

- Development and implementation of algorithms to produce river discharge estimates from SWOT data globally. These may be based on so-called mass-conserved flow law inversion algorithms or other novel or established algorithms. Emphasis should be on global-scale implementation of algorithms rather than in only a few rivers. Proposals on discharge may also seek to integrate multiple existing or novel discharge algorithms into multimodel ensembles.
- Development and implementation of algorithms and data products based on assimilation of SWOT river, lake, and/or wetland data into hydrologic or hydrodynamic models
- Development of data products, led by the Science Team, that combine SWOT data with other remote sensing or in situ datasets to aid in addressing key SWOT science questions. Examples of other satellite instruments providing data that could be used in combination with SWOT data include nadir altimeters such as the JASON series, GRACE-FO, various Sentinel satellites, BIOMASS, ICE-Sat 2, MODIS/VIIRS, the Landsat suite, and NISAR.

All proposals in this category should demonstrate that it is possible to fully develop and distribute any proposed data products using proposed resources.

2.2.3 Key Areas in Calibration and Validation

The initial release of the SWOT calibration and validation plan, available at https://swot.jpl.nasa.gov/docs/D-75724_SWOT_Cal_Val_Plan_Initial_20180129u.pdf, describes two different tiers of validation sites. Tier 1 sites will be extensively instrumented in support of

SWOT, while Tier 2 sites will leverage existing infrastructure (e.g. networks of stream gauges). The SWOT Science Team will play a key role in acquiring and analyzing calibration and validation measurements. Two primary activities related to these sites are solicited here:

- Development and data collection at Tier 2 validation networks. These sites will be used to validate lake water surface elevation and inundation extent and river water surface elevation, width, slope, and discharge from SWOT. There is no upper limit on the number of suitable Tier 2 sites, and we anticipate that efforts to develop large Tier 2 networks in the United States and worldwide will substantially improve knowledge of SWOT performance and its geographic variability. Proposals to develop robust tier 2 networks should include partners who operate existing infrastructure as collaborators.
- Development and data collection at Tier 1 sites outside of the U.S. As described in the calibration and validation document, the core Tier 1 validation sites that NASA will lead are located in the United States. However, inclusion of additional sites outside the U.S. will help to ensure the quality of SWOT hydrology data around the world. Proposals to develop Tier 1 validation sites outside the U.S. should include partners in the relevant countries as collaborators.

Proposals in this category should plan to both develop calibration/validation sites prelaunch and to collect and analyze appropriate data after SWOT launch.

2019 SWOT ROSES TOSCA (Oceanography)

The oceanography science goals of SWOT are to observe the sea surface height (SSH) in two dimensions at scales not resolved by conventional altimetry for studying the role of ocean circulation in exchange of heat and ocean properties between the upper and deep ocean. The SSH measurement is to be made by the technique of radar interferometry that is fundamentally different from conventional altimetry. The observations are also expected to advance the understanding of the processes of the coastal oceans and interactions with the estuaries.

The mission's science requirements were developed with the participation of the mission's Science Definition Team (2013-2016). As the thrust of SWOT is to make SSH observations at previously unresolved scales, the observational requirements were specified in terms of wavenumber spectrum. Based on the prediction of signal strength and measurement errors, the spatial along-track resolution of SWOT is estimated to be 15 km for 2 m significant wave height. However, both signal strength and measurement errors are dependent on seasonal conditions, the actual resolved wavelengths vary from 15 km in the tropics to 30-50 km at high latitudes with the largest values in the Southern Ocean (Wang et al., 2018).

The mission's Science Team (2016-2019) has continued preparing the algorithms for open ocean and coastal processing, and contributed to the scientific understanding of the SWOT ocean signal, errors and applications. The mission has two phases with a 1-day repeat Validation orbit, and a 21-day repeat Science orbit (see the AVISO website for precise orbit groundtracks : (https://www.aviso.altimetry.fr/en/missions/future-missions/swot/orbit.html).

To aid in the preparation of ocean science studies, a SWOT ocean simulator has been developed to simulate the realistic SWOT swath groundtrack and errors. The simulator can be applied to most high-resolution model formats, and is freely available (https://github.com/SWOTsimulator/swotsimulator/blob/master/doc/source/science.rst).

The upcoming Science Team (2020-2023) will participate in the final preparations of the mission, will be engaged in post-launch validation of the first SWOT measurements, and will continue working on the main ocean issues as detailed below.

Mesoscale ocean dynamics

The scales noted above belong to the short end of the oceanic mesoscale, which has not been adequately resolved by the conventional altimeters. After mapping to two-dimensional gridded fields, the resolution of conventional altimeters is about 150 km in wavelength with on-going improvement owing to the increased number of altimeters on orbit. SWOT will also carry a nadir-looking conventional altimeter. With the constellation of conventional altimeters providing the global mesoscale field down to 150 km, the new high-resolution observations of SWOT will provide opportunities to study the interaction of the mesoscale variability within its wide range of scales from hundreds to tens of kilometers. The fine-scale swath observations will allow a better characterization of the anisotropic structure of the mesoscale field, its strain and vorticity, and local 2D energy fluxes. Studies are encouraged that will further our understanding of these smaller mesoscale processes, and their observability with SWOT.

Synergistic applications with other observations capable of revealing mesoscale variability such as in-situ or airborne data, or satellite sea surface temperature and salinity, ocean color and SAR images, are also encouraged.

Tides and high-frequency motions

SWOT's orbits have been specifically designed to resolve the major tidal constituents during its lifetime. SWOT is expected to provide unprecedented observations of the barotropic tides, especially in the coastal and high-latitude regions where current tidal models have the largest errors. The development of high-resolution barotropic tide models will be a high priority for SWOT, and these should be progressively improved during the mission lifetime. Science studies addressing the barotropic tide, its modification due to the baroclinic tide, and improved tidal models will be encouraged.

Internal tides and low-mode internal gravity waves have SSH signals comparable to mesoscale geostrophic motions. How to separate them is a challenge of the SWOT mission. There is a high degree of geographic and seasonal dependence of the problem, which is more severe at low latitudes. Development of predictive models for the internal tides from existing altimetry data is of high priority for the mission. The swath observations of SWOT will provide new opportunities to validate and improve the internal tide models. Understanding and improving the non phase-locked, incoherent part of the internal tide is a challenge for SWOT, but also an important scientific opportunity to learn more on this pathway to ocean mixing and dissipation. It is anticipated that ultimate internal tidal models will be developed by incorporating the SWOT data.

Internal gravity waves are not deterministic processes amenable to prediction. Their potential presence in the SWOT observations presents an unprecedented challenge and an opportunity for studying the interaction of these waves with the mesoscale geostrophic motions.

Ocean fronts and air-sea interactions

Horizontal gradients in SWOT's 2D SSH data can reveal the larger ocean fronts, with scales of tens of kms. SWOT will also provide collocated SAR images at 250 m resolution including power and variance, as well as SAR Doppler Centroid products providing higher resolution observations of the surface roughness changes across fronts. Studies are encouraged that use the collocated SSH and SAR images and other data or models to investigate frontal dynamics and upper-ocean wind-wave interactions across ocean fronts.

Calibration and validation (CalVal)

The interferometry measurement of SSH is fundamentally different from conventional altimetry. The approach to CalVal requires innovation and planning. First, we need to validate the measurement in terms of wavenumber spectrum, as opposed to previous point-wise validation. This geodetic objective is to be accomplished by both airborne and in-situ observations, via lidar and arrays of moorings of geodetic and oceanographic sensors. Second, we need to validate the utility of the SSH observations to the study of ocean circulation to meet the science goals. Specifically, we need to have an observing system that is able to provide information of the 3D ocean circulation, such as its vorticity and vertical velocity that allows studies of the vertical transport of heat and biogeochemical properties. Regions with internal tide activity will also require specific in-situ sampling for SSH validation. The in-situ observations will be used to test the performance of the SWOT-measured SSH for achieving the science goals.

Geophysical Corrections and Algorithms

There are anticipated contributions from the Science Team to better understanding of the measurement physics and the mission's algorithm development. Particular challenges include the correction for the electromagnetic bias at the Ka band frequency and its spatial variability across the measurement swath; the estimation of wind speed and significant wave height across the swath; the use of radar imagery to estimate surface current features; the detection of land, ice, and rain contamination; and, finally, the removal of errors due to the presence of ocean waves.

Ocean state estimation

The challenge of the separation of tides/waves from geostrophic motions is exacerbated by the deficiency of temporal sampling by SWOT. Owing to the limitation of near-nadir look angles to minimize the measurement errors, the swath of the observation is only 120 km wide with a 20-km nadir gap. It will take 21 days to complete the coverage of the world's oceans. The bursts of repeat overflights at a given location are separate in time by 10 days at mid and low latitudes. Apart from high latitudes, the repeat observations are most likely incoherent, presenting a challenge for estimating the continuously evolving state of the ocean. It is anticipated this challenge will motivate the development of creative approach to the problem, including but not limited to the application of high-resolution assimilative models.

High-level data products

The number of observations at a given location in a repeat cycle ranges from two near the equator to more than ten at the highest latitudes. To reconstruct regular 2D SSH fields from the irregularly sampled observations with complex error characteristics will pose a significant challenge for advancing the study of ocean circulation from this new type of observation. Development of methodology for producing optimally estimated products on regular space and time grids on both global and regional basis will be an important activity of the Science Team. The capacity to calculate derivatives of the SWOT gridded data (reconstruction of vorticity, strain, vertical velocities, and detection of fronts and filaments) should also be addressed.