OSTST 2016

1. Proposed splinters

This list will be used for the splinter selection in the abstract submission process

- Application development for Operations (previously NRT splinter)
- Instrument Processing
    1. Corrections (Troposphere and Ionosphere, Wind Speed and Sea State Bias)
    2. Measurement and retracking (SAR and LRM)
- Outreach, Education and Altimetric Data Services
- Precision Orbit Determination
- Quantifying Errors and Uncertainties in Altimetry data
- Regional and Global CAL/VAL for Assembling a Climate Data Record
- Science Results from Satellite Altimetry
    - Science I: Current and past mean sea level observations
    - Science II: From large-scale oceanography to coastal and shelf processes
    - Science III: Two decades of continental water's survey from satellite altimetry - From nadir low-resolution mode to SAR altimetry, new perspectives for hydrology
- The Geoid, Mean Sea Surfaces and Mean Dynamic Topography
- Tides, internal tides and high-frequency processes
- Others (poster only)

2. Splinters description

Application development for Operations (previously NRT splinter)

Hans Bonekamp, Emilie Bronner, Gregg Jacobs and John Lillibridge

Near Real-Time (NRT) Ocean Surface Topography products, and their incorporation into meteorology and oceanography forecast systems, have seen extensive development with the availability of NRT altimeter data. Many of these products have been recently drafted into service to provide information for applications ranging from search and rescue to environmental management. This session calls for abstracts that examine development and future challenges at all the steps along this chain from the satellite sensor, through the computation of NRT data sets, incorporation into numerical forecast models, to the final delivery of forecast information.

Several satellites now provide ocean surface topography, wave height, and wind speed measurements in near real time. Jason-3 (and soon Sentinel-3) will be added to the present constellation of Jason-2, AltiKa, CryoSat-2 and HY-2. The advancement in latency, accuracy and precision of NRT processing from all these data sets is of great interest. As the NRT data streams evolve, we look forward to new levels of accuracy and precision in ocean products based on the surface topography, wave height and wind speed, and results from the science community are sought to demonstrate these advances. The new NRT data streams will enable new and enhanced products and applications using the NRT observations to construct analyses, synoptic forecasts, and long term to climatological forecasts. The analyses considered include all the returned geophysical information from altimeters: surface topography, waves, and wind speed. In addition, the use within operational centers of expanded NRT products is a critical component to continued support for the observational capability, and thus we seek examples of observations in action and decision-making.

Ocean topography has been shown to be a critical observational component to enable oceanographic research and operational prediction. Other data sets certainly have complementary roles, and we invite participants to show how altimetry works with these additional data sets. These include in situ observations from ARGO, WOCE drifters, TOGA/TAU and Pirata, in addition to other satellite sensors providing sea surface temperature, salinity, visible imagery, biological activity, and synergistic observations such as wave field properties and surface winds.

Instrument Processing

Shannon Brown and Estelle Obligis / François Boy, Phil Callahan, Robert Cullen and Walter Smith

The Instrument Processing splinter addresses the key algorithms and processing steps that transform the raw instrument data from the altimeter system into science products with instrument calibrations.

The Instrument Processing splinter, will be divided into 2 parts:

Corrections (Troposphere and Ionosphere, Wind Speed and Sea State Bias): Shannon Brown and Estelle Obligis

Measurement and retracking (SAR and LRM): François Boy, Phil Callahan, Robert Cullen and Walter Smith

In both sessions, ideas for additional data elements, either directly derived from the instruments or from external sources, that will enhance the accuracy or utility of the data are encouraged.

As mentioned in the meeting call, initial characterization of Jason-3 processing and errors will be of great interest, particularly differences from previous missions.

For radiometer studies, contributions on higher frequencies as recommended during Venice OSTST for Jason-CS and on spatial variability are of particular interest.

Topics of particular interest for altimeter processing are continuing results from SARAL/AltiKa, development of SAR processing and comparison with LRM, and understanding the SSH spectrum.

Other instrument processing issues will be discussed as time allows or will be asked to do a poster. We will carefully review the abstracts and may ask some authors to adjust their presentations to have the most complete presentation and discussion.

Particular issues discussed recently include:

1. Radiometer:

- High frequency radiometer studies: is there anything further following the recommendation that a Jason-CS radiometer should operate at higher frequency?
- Any impacts of J-CS drift requirement on processing? Synergetic use of altimeter and radiometer measurements for surface and atmosphere characterization (ice and rain flags, ice classification/characterization…)
- Correction products for SWOT and understanding their spatial power spectra

2. Altimeter:

- How should non-Brown echoes be handled in processing (LRM and SAR), for example, those returned over a so-called Sigma 0 bloom?
- Characterizing differences between LRM and SAR for retrieved geophysical parameters (range, SWH, backscatter) and SSB
- Sensitivity of SAR altimetry retrievals as a function of platform mispointing and associated uncertainties.
- Improvements to SAR processing algorithms such as multi-look stack weighting, etc.

- Surface characterization from SAR stack data
- Impacts of swell on SAR retrievals
- Impacts of low SWH on:
    - Waveform aliasing and its magnitude
    - Conventional (“LRM” or pulse-width-limited echoes) on current and future missions
    - SAR mode on current and future missions
- [Included above] Improvement in algorithms for onboard tracking of future instruments, particularly SAR mode

Outreach, Education and Altimetric Data Services

Vinca Rosmorduc, Margaret Srinivasan and Jessica Hausman

The international collaborations in outreach, education, and applications have celebrated over 20 years of cooperation over the multi-mission lifetimes. A fruitful partnership has developed, and includes participation by NASA, CNES, Eumetsat, NOAA, and ESA. Joint products and activities have been fostered, and continue to be developed. In this session we wish to share our collective story and ideas, and to involve the scientists in the process of reaching educational and general public audiences. Our outreach team, reflecting the international science collaborations we represent, see the Outreach session as our opportunity to collaborate with each other, share our respective and joint activities and outcomes, and to involve the scientists in the education and public outreach (EPO) process.

Our overarching goal is to enhance understanding in the general population and across scientific disciplines of the value of ocean science research and, ultimately, public funding of space agencies. In order to maximize the 'reach' of altimetry outreach, a closer collaboration with the science teams, scientists from other disciplines, and other outreach professionals is necessary. The Outreach session at our annual OSTST is a key steppingstone on the path to achieving this goal as we meet and interact with scientists in the time leading up to and during the meeting.

The 'Showcase' element of our Outreach session has become a popular forum for members of the OSTST to share their outreach activities. It also provides a means to demonstrate the breadth of outreach being done to the larger OSTST, and perhaps spur ideas for more participation by team members.

Altimetric Data Services is an important element of this splinter. It provides a way for exchanging information and linking projects and users together so users can benefit from the wide variety of altimetry-derived data and services available. Exchanges between science team members are highly valuable, as experiences and solutions are shared in this splinter.

For the OSTST meeting we will focus the relevance of altimetric science to climate issues, support of training new users on the use of altimetry data, sharing resources and outreach products with a wide audience (and in multiple languages), focus on existing and potential collaborations between data centers to better serve users, and addressing long-term data management scenarios outside of project funds (and within data centers).

Precision Orbit Determination

Sean Bruinsma, Alexandre Couhert and Frank Lemoine

Precision orbit determination underpins the accuracy and quality of the data for all altimeter missions.

With a twenty-three-year long altimeter record from three missions on the reference orbit (TOPEX/Poseidon, Jason-1 and Jason-2/OSTM) and from several others on lower orbits (ERS, Envisat, CryoSat, HY2A, SARAL/AltiKa), the focus is now on the long term stability of the orbit solutions and on the impact of geographically correlated errors on both the global and regional Mean Sea Level estimates.

The most critical issues concern the stability of the reference frame for computing the orbits, the accuracy and fidelity of the force models that underpin the POD computations and the overall quality of the available tracking data. We monitor closely the performance of the tracking systems onboard the current flight missions (especially Jason-2, Jason-3) but we are also concerned with the general performance of the SLR, DORIS, and GNSS networks used for orbit determination.

The stability of the orbit in the North/South direction is estimated to be better than 1 mm/yr by comparison of orbits obtained using different tracking techniques and the ITRF2008 reference frame. Orbit quality is affected by the performance of the individual tracking systems (SLR, DORIS, GPS), and issues that are of a particular concern include the proper modeling of coordinates and biases for the SLR stations, the SAA effect on the Jason-1 DORIS receiver, and the performance of the GPS receiver on Jason-2 OSTM. While great strides have been made in the modeling of the static gravity and through other updates of the IERS standards, the fidelity with which time-variable gravity is modeled has emerged as an important limiting error source. Also, a precise orbit solution is the result of an estimation process involving some extent of arbitrariness in the parameterization: for instance, it is left to the POD analyst to decide how much weight should be given to tracking data with respect to dynamic models, and to one tracking technique with respect to the others. The comparison of different solutions obtained using a different parameterization (dynamic vs reduced dynamic) remains a fundamental tool to quantify the accuracy of the models and the tracking data on the long term. This type of comparison is typically achieved during the POD splinter, and raises issues that altimeter analysts should be aware of.

In addition, the accurate modeling of radiation-pressure related forces is essential to avoid the introduction of spurious beta-prime related signals into the orbits and thus into the long-term altimetric data records.

The POD splinter brings together POD specialists with altimetry users so that the two communities can interact. POD specialists gather during the splinter to discuss their latest results but they are also there to answer questions from the community. The goal of the POD splinter is to ensure that spurious orbit-related signals do not contaminate the altimetric products on medium-term or long-term time scales, and to help ensure that altimetric data across different missions from different orbits can be compared and combined in a seamless fashion.

Quantifying Errors and Uncertainties in Altimetry data

Michael Ablain, Joel Dorandeu and Remko Scharroo,

Although altimeter data provide an accurate estimation of sea-level over the last 20 years, they are impacted by errors at different time and spatial scales as any measurement system. Some are known to exist but have not been resolved, some are not even known to exist. This is the bane of our constantly expanding knowledge about a complex measurement system that does not only depend on the altimeter instrument, but also on radiometer data for the wet tropospheric delay correction, orbit determination and its associated reference frame, model data for atmospheric pressure, dynamic atmospheric correction, tides and alike. With a measurement system this complex it is often very difficult to identify even the cause of an error, like the 59-day signal observed between sea levels determined by Jason-1/2 and TOPEX.

Obviously, the identification and determination of new errors in altimeter data is an activity of crucial importance to improve and correct the whole altimeter datasets. This also allows us to provide users the error budget of altimeter data for a dedicated altimeter mission or for applications. However this activity makes sense only if the need of those applications is well defined. This means that the formulation of errors is as relevant as their identification. Thus the way of the error budget is presented (standards, classification of errors, wavelength, frequency, etc.) has to continue to be formalized better.

In this session we invite presentations and posters dealing with the two main following topics:

- new insights about errors in the altimeter system as a whole (all contributions are to be taken into account in a systemic approach). This is from altimeter specialists towards applications. Contributions on improvements and resolutions to long-lasting uncertainties, errors, and data anomalies are particularly encouraged. One topic of particular interest is the high frequency signals in the altimetry data in preparation to forthcoming higher resolution measurements.
- the needs from applications in terms of error formulation: what is lacking in the current situation? This is from applications towards altimeter specialists. Contributions from climate change experts, oceanographers, assimilators, etc., are encouraged.

Regional and Global CAL/VAL for Assembling a Climate Data Record

Pascal Bonnefond, Shailen Desai, Bruce Haines, Eric Leuliette and Nicolas Picot

Determining the random and systematic errors in the fundamental instrument observations and in the Level-2 geophysical data products is a continuing process that involves participation of both the project teams and the OSTST investigators. The principal objectives of joint verification are to: 1) assess the performance of the measurement system, including the altimeter and orbit-determination subsystems; 2) improve ground and on-board processing; and 3) enable a seamless and accurate connection between the current (OSTM/Jason-2 and Jason-3) and legacy (TOPEX/Poseidon and Jason-1) time series. To succeed in these objectives, the general approach is to pool the talents and resources of the project and science teams. Engaging the science team in the continuous CALVAL effort has been one of the hallmarks of success for the TOPEX/Poseidon and Jason altimeter programs. The CNES and NASA research announcements have consistently emphasized CALVAL, recognizing that the science investigators conducting research in some of the most demanding applications (e.g., mean sea level) are often positioned to offer the most innovative CALVAL solutions.

During the first 6 months of each new mission, an intensive verification effort is conducted by all members of the Verification Team in order to verify the integrity of the system—and to make adjustments where necessary—before starting the routine GDR production. However, the verification effort continues afterwards on a routine and permanent basis. These ongoing efforts are essential to ensure the integrity of the long-term climate record at the 1-mm/yr level.

CALVAL activities are conducted based on dedicated in-situ observations, statistics, cross comparisons between models, different algorithms and external satellite data. The studies go well beyond validation of the overarching error budget underlying the mission requirements. They focus in particular on the temporal and geographically correlated characteristics of the errors. Reduction of this class of errors is critical, since they are conspicuously damaging to estimates of ocean circulation and sea level. They also encompass issues related to data return, such as data editing and flagging. We also encourage CALVAL presentations on specific areas, for example on the Arctic ocean and on the impact of El Niño phenomena on data (editing in the case of rain, …)

Because of the usual large number of contributions the CALVAL splinter is separated into two parts: Local calibration/validation (focusing on in-situ bias estimates) and Global calibration/validation (focusing on corrections quality assessment and error budget assessment).

Since this will be our first OSTST after the successful launch of Jason-3, please indicate in your abstract submissions whether you plan to include any analysis of data from Jason-3. We realize that time will be short between the launch and the meeting and you may not know for certain whether there will be adequate time for analysis of Jason-3 data, but we ask that you make a guess and include your intention about this in your abstracts.

Science Results from Satellite Altimetry

Pascal Bonnefond, John Lillibridge, Remko Scharroo and Josh Willis

General science results based on data from satellite altimetry will be included in this session. Although this session will primarily focus on ocean surface topography observations, we also welcome science contributions that make use of the ancillary observations such as wet path delay, significant wave height, wind speed, or any results that do not fit into any of the other splinter sessions. This year 3 main themes have been selected that will correspond to dedicated oral sessions:

- Science I: Current and past mean sea level observations

Benjamin Hamlington and Guy Woppelmann

Tide gauges provide instrumental data that span the satellite altimetry era while also extending far beyond into the past. As a result, measurements of sea level from tide gauges provide a comparison to satellite altimeter measurements and also give historical context to the sea level change observed in recent years. In this session we seek for presentations that investigate current and past observations to improve our knowledge of long-term trends in mean sea level, or that study the differences in trends arising from various data analysis methods, in particular from sea level reconstructions that combine both instrumental records.

- Science II: From large-scale oceanography to coastal and shelf processes

Florence Birol and David Griffin

This session invites contributions on large-scale to coastal and shelf oceanographic processes, including studies that combine the use of altimetry, in-situ observations and numerical modeling. In particular, we welcome results that help to understand sea surface topography variations in terms of mesoscale, sub-mesoscale and coastal ocean dynamics (paving the way for high resolution altimetry missions) and studies that link large-scale dynamics with coastal impacts.

- Science III: Two decades of continental water's survey from satellite altimetry - From nadir low-resolution mode to SAR altimetry, new perspectives for hydrology

Charon Birkett and Jean-Francois Crétaux

Since the launch of TOPEX/Poseidon and ERS-1 in the early nineties, long term monitoring of water levels on lakes, reservoirs, rivers and floodplains, has been made possible thanks to the continued efforts of the space agencies and the success of the follow-on missions.

The new generation of higher resolution radar altimetry instruments will exploit techniques such as along track SAR altimetry (Sentinel-3) and interferometry (SWOT), permitting a breakthrough in the monitoring of surface hydrological parameters. With more than two decades of historical data (ERS-1/2, Topex/Poseidon, ENvisat, Jason-1/2, CryoSat, and AltiKa) the development and validation of river and lake level measurements is mature, and will be further enhanced by the new generation of sensors (Jason-3, Sentinel-3A , Sentinel-3B, Sentinel-6/Jason-CS, SWOT). The science and application communities are in "readiness" preparing for the change in technology and the inflow of new data.

New challenges include improving accuracy and breaking through water-body size limitations. Higher resolutions will require new and improved processing algorithms. The community also looks to significantly improve modeling and forecasting skills through assimilation of the altimetry observations within hydrological models.

The main objectives of this session are i) to present the most recent results and achievements in hydrology inferred from satellite altimetry, ii) to show data exploitation from the next generation of instruments, iii) to demonstrate new altimetry data processing techniques relevant to the enhanced instruments, and iv) to discuss future challenges in hydrology

The Geoid, Mean Sea Surfaces and Mean Dynamic Topography

Ole B. Andersen and Yannice Faugere

Geoid / MSS / MDT are key products for referencing altimetry. The quality of the altimetric sea level products (Sea Level anomaly, Absolute Dynamic topography) and the derived ocean surface currents directly depends on the quality of these surfaces. With the successful launch and availability of data from new satellites (CryoSat-2, AltiKa and Hy-2 and in the near future Sentinel-3 and SWOT) both SAR and Ka-band altimetry are becoming available for updated geoid, MSS and MDT products. This is a challenge for operational oceanographic application ingesting both new types of altimetry but also altimetry away from the “well revisited” ground tracks.

Both Cryosat-2 and Jason-1 have successfully provided new geodetic mission data to improve the resolution and accuracy of both the geoid and MSS. At the same time the availability of SAR and Ka-band altimetry opens for new challenges. One challenge being accurate MSS and geoid determination along the coast. Another challenge is to determine and enhance the accuracy of MSS along the new ground tracks for i.e Sentinel-3A/B and SWOT.

In this splinter we invite presentation in various aspects this research fields, both on developing new geoid/MSS/MDT, but also on the use of these for novel oceanographic and geophysical research .

Tides, internal tides and high-frequency processes

Loren Carrere, Florent Lyard, Richard Ray

Under the subject of tides, contributions are suggested on new global models and their accuracies, on comparisons and residual weaknesses of existing models (especially the two models on the GDRs), on radiational tides and interactions with the other High-Frequency corrections. Contributions are also suggested on internal tides signals and the ways to remove this signal from altimeter measurements.

Under the subject of High-Frequency aliases, a discussion is intended on (non-tidal) sea level variability at frequencies poorly sampled by the altimeter and on ways to "de-alias" the records. Of particular interest are contributions on the impact of current de-aliasing products on data analysis and interpretation and on possible improvements to those products (new model or data filtering developments, quality assessments of relevant atmospheric forcing fields, etc.).

Others (poster only)

Pascal Bonnefond, John Lillibridge, Remko Scharroo and Josh Willis

All other contributions that do not fit to any splinter: the form of contribution will be poster.