DUACS Release Notes & Status
April 2008

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1. INTRODUCTION

Email date: 2008-04-14

Dear DUACS users,

*The latest version of the DUACS-DT software (v2.0) has been deployed on the **production servers**. It was used for a complete re-analysis of past and present altimetry (from ERS1 to current missions) with the state-of-the-art corrections, models and references recommended for the next generation of Jason-1 & ENVISAT GDR, as well as Cal/Val and cross-calibration algorithms. The re-analysed products will be distributed next week on the AVISO ftp site.*

The latest version of the DUACS-NRT software (v8.1) has been deployed on the production servers. It is now running and all status and reports are nominal. The first NRT data were generated a couple of weeks ago in order to restore the availability of RT data for ENVISAT as soon as possible (see mission status below).

The new versions of both components add some significant changes in altimetry processing and data availability so you might want to look at the release notes below. I apologize for the length of this document if it contains more information than you need.

Best regards.

Gerald Dibarboure.

2. TABLE OF CONTENT

3. MISSION STATUS

Thanks to the dedication of the teams involved in the operations of Jason, ENVISAT and GFO, DUACS has been receiving a reliable amount of altimeter data over the past months. Although these missions are getting old, they keep delivering precious data for end-users.

The Jason-1 status is nominal at the time of this writing and the satellite will remain the reference mission for DUACS until Jason-2 is fully operational and ready to take over. After the Cal/Val phase needed to cross-calibrate both satellites at user-requirement level, a dual mission (optimized constellation) might be considered in 2009.

However Jason-1 might be temporarily unavailable in the coming weeks due to an avoidance manoeuvre. T/P is still in orbit albeit in a non controlled one and there is a significant risk of collision with nearby satellites such as Jason-1. This risk is actively monitored and due to a specific collision risk window, an avoidance manoeuvre may become necessary. The exact impact on data availability and end-user products is still not defined, but the objective is to resume nominal operations as soon as possible.

ENVISAT is (almost) fully operational, but it was temporarily unavailable, and especially in RT (experimental DUACS production with data delivery <24h). The origin of this problem is an important onboard anomaly: the failure of the S-Band of the Side-A altimeter.

This frequency is used to compute the mandatory ionospheric correction of the altimeter range. Alternative corrections (namely GIM-based ionosphere corrections) have been used since then. For the records, after the first USO anomalies in 2006, a tentative switch to the Side-B altimeter was decided and reverted after the loss of the same S-Band on the redundant altimeter. In short, ENVISAT is now in a degraded mono-frequency mode. This is an important loss and there are ongoing efforts from all actors to minimize the impact on end-users.

More than 10 years after launch, GFO is still in operations thanks to important efforts from the US Navy and NOAA. The satellite is still suffering from battery aging and the power consumption must be minimized when the satellite is in the eclipse phase of the orbit. This translates into partial ocean coverage (~50%) and hourly switches on/off of the altimeter (quite a brutal but mandatory treatment), with specific actions to optimize onboard power and temperature. Even with the current partial coverage, and the additional errors on the altimeter parameters, GFO provides more than 20% of the altimeter data used in DUACS, and more when another satellite is unavailable.

The launch of Jason-2 is scheduled for June 15, and the first data sets (Cal/Val phase) should be available in early July. Once the first assessment phase is over, the first integration experiments will start in DUACS (autumn) for a tentative operational use in early 2009 or sooner if needed (optimistic case: Jason-1 moved to a new orbit, pessimistic case: Jason-1 unavailable for a long period).

4. RELEASE NOTES

The Near Real Time and the Delayed Time (and Re-analysis) components of DUACS have been recently upgraded. Here is a short version of the release notes with the user-visible changes.

4.1. Delayed Time (DT, and reanalysis RAN) component: v2.0

- One of the most significant changes is the systematic activation of the regional production for the Black Sea. This product is in line with the demonstration datasets delivered in 2007. All anomaly products (no MDT available in the area) will be updated regularly when input GDR data become available.

- Another significant change with respect to the previous generation of DUACS data, is the recent availability of two datasets: ENVISAT Side-B and ERS1 Geodetic phase.

  When ENVISAT was temporarily switched to Side-B, a few weeks of data were delivered to a limited audience for validation purpose. Despite the experimental aspect of this production and some events observed on this dataset, it proved to be usable in DUACS with a few dedicated processes and tuning. Thanks to ESA's agreement, this 2006 data gap is now partly filled.

  Another very important data gap was the geodetic phase of ERS1 in 1994/1995. The drifting orbit used was not compatible with the repeat track analysis needed for high-accuracy SLA. Generally speaking, a Mean Profile (or local and precise MSS) along a repetitive ground track is mandatory to reach the accuracy needed for mesoscale observation. With a non-repetitive orbit, only a global MSS can be used to compute Sea Level Anomalies, and it translates into additional errors and a degraded observation. However recent studies carried out for ESA (CryoSat and Sentinel-3) showed that it was theoretically possible to perform the combination of a Jason-class mission and a mission on a new ground track (no Mean Profile available) despite the additional error from the new or drifting ground track. In 2007, DUACS carried out additional feasibility studies on ERS1. Although the mission is roughly 30 to 40% below its standard accuracy level, the sampling provided by this dataset proved to be an asset of most applications and the geodetic phase of ERS1 is now processed by DUACS. However a lot of work is still needed to improve the accuracy of the along-track data set, and this work will be mandatory for the use of opportunistic measurement of CryoSat on ocean.

- Various upgrades were added to the L3/L4 processing, starting with the use of a high-resolution Dynamic Atmospheric Correction (DAC) based on the high-resolution version of MOG2D. The HR version of this model and the complete HR DAC reanalysis since 1991 is the result of a contribution from CNES, LEGOS, Noveltis and CLS.

  Additionally, minor improvements were added to the L3/L4 processing in coastal areas. Various changes on the wet troposphere correction and on the editing process (and the computation of the corresponding Mean Profiles) allowed a better data coverage for some missions, and an better precision for others. These upgrades are applied on traditional input data sets (e.g: GDR 1 Hz) and do not benefit from the coastal pre-processing needed on Level 2 and high-resolution datasets. This coastal-specific processing will be tackled in the PISTACH initiative (see below).

- Lastly, the latest generation of DUACS ranalysed data (RAN v2.0) takes the latest reprocessed datasets (e.g: GDR-B) which benefit from additional improvements of altimeter corrections and orbit standards.

The new generation of DUACS DT products based on this reanalysis will replace the current DT data sets on the AVISO ftp site in the coming days. You might want to check it out, in order to benefit from the improvements from v2.0. Generally speaking, the v1.2 and the v2.0 product generations are compatible, but to minimize the transition discrepancies, you might want to update your entire historical dataset.

4.2. Near Real Time (NRT) component: v8.1

The main upgrade of the NRT component of DUACS v8.1 is that DUACS is now using the high-resolution version of the Dynamic Atmospheric Correction in order to be consistent with the global 15 year reanalysis and the new standards.

Another important change which sped up the operational deployment is the replacement of the instrumental dual frequency ionosphere correction by a GIM-based correction on ENVISAT (see mission status above). The strategy used is classical for mono-frequency altimeters: the correction is using TEC grids from JPL with minor adjustments to take into account the satellite altitude. For the RT processing (<24h) a stationary assumption is made: it creates an additional error taken into account and minimized in the RT-specific processing of DUACS. The performance is still better than when using static models such as IRI or Bent.

Lastly the monitoring and QC procedures have been upgraded. This should be transparent for most users.

5. UPCOMING VERSIONS

After the recent 15 year reanalysis, the DUACS-DT software should be stable until a significant amount of Level2 product reprocessing have been carried out upstream (tentative date: end of 2009). Such reprocessing activities have been scheduled or considered for the following missions: T/P, Jason-1, ENVISAT, ERS1 & ERS2. Conversely, the NRT and RT component of DUACS should evolve significantly in the coming months.

5.1. Real Time product: end of the experimental phase

Since v8.0, Real Time altimeter data sets (Jason OSDR, ENVISAT FDGDR) are merged to the NRT dataset in a dedicated and experimental daily production generation. Recent results showed that the output product provides a significant improvement of the L3+ data sets generated by DUACS. The system is able to provide along-track data sets (Sea Level Anomaly and Absolute Dynamic Topography) based on real time coverage. This translates into an additional 2 or 3 days of recent data available for assimilation in operational oceanography, and for real time applications (e.g: loop current monitoring in the Gulf of Mexico).

The improved coverage and the delay reduction (from measurement to application) prove useful for regional applications and/or real time applications on short time decorrelation scales events. Another practical but significant side effect is that this processing can smooth out temporary unavailabilities observed frequently in real time (onboard event, ground segment or network anomaly) by giving more data and a faster return to nominal status when the event is over.

So far this product was tagged as experimental due to the uncertainties and potential problems on real time data sets. These RT data were distributed in a dedicated FTP directory so as not to impact operational applications (see DUACS product handbook for more details). Thus in addition to the nightly operational NRT production, an experimental RT production has been running on a daily basis since last summer. Since no significant anomaly was detected, we're considering the end of the experimental phase, and only one nightly product generation merging NRT and RT datasets.

The main impact will be an additional 24h to 48h coverage for all regular users, with some disclaimers on the RT altimeter datasets. If you haven't checked out the experimental RT data produced over the past few months, you might want to get some samples and to run some tests before the operational change on DUACS.

5.2. New NRT Products, Indicators and Online status

As part of the GMES Marine Core Service work plan, the Black Sea product class is considered for a Near Real Time operations as a demonstration.

Similarly, there is an ongoing work to distribute and online and more user friendly status of DUACS and of the altimetry missions. So far the quality control reports contain rich but expert-oriented information. As a GMES MCS demonstration exercise, this material will be progressively completed by an online status available on the DUACS pages of the AVISO website, and by simple and trustworthy Key Performance Indicators (KPI) which can be considered as green to red flags associated to the various QC checks performed by DUACS experts twice a week.

5.3. Costal improvements on Level2 and impact on Level3 data

Over the past few months, a lot of effort has been put on the improvement of coastal altimetry and Level2 processing (e.g.: GDR). This topic involves various projects and teams worldwide. CNES and CLS will contribute through the PISTACH initiative which should bring significantly upgraded Jason-2 datasets in coastal areas. Similarly, the COASTALT project from ESA is focussing on ENVISAT with different algorithms. The first consolidated results should be available by late 2008 or early 2009. Although it's early to consider directly usable Level 3+ products (read: cross-calibrated and homogenized products for all missions), the need, the feasibility, and the content of such user products will be analysed.

5.4. Towards an orbit error reduction process without reference

An important cross-calibration algorithm used by DUACS is the so-called orbit error reduction (OER) process from [Le Traon 97]. A reference mission (T/P or Jason-1) is used to minimise globally the mono and multi-mission crossover differences. This method proved to be reliable in complex and degraded configurations, but it was originally developed to fit ERS data on T/P since the former had a much larger orbit error than the latter. However the most recent and future altimetry missions benefit from a much more accurate POD process and the order of magnitude of the orbit errors are similar. Considering residual artefacts (e.g.: geographically correlated patters) present on each mission including T/P or Jason, the use of a single mission to reference the others is somewhat arguable, especially in NRT where the reference mission can be temporarily unavailable.

Alternate solutions are being developed to use a global crossover minimisation with all crossovers from all missions and their respective error characterisations, in order to consolidate the OER process for the NRT processing. This will help minimize the global error patterns by giving an equivalent weight to each mission if they have the same level of accuracy (e.g.: Jason-1 & Jason-2).

However the downside is that merged NRT products will likely contain residual artefacts from *all* missions, especially in terms of local errors and long terms drifts (e.g.: MSL trend). This is problematic in that a temporarily degraded POD on any mission might in return affect Jason & Jason-2 and the merged L4 data. This limitation is precisely why similar solutions developed by other groups (albeit with much simpler algorithms) were not implemented in DUACS sooner, and why the reference mission approach will likely be kept in DT products where data availability from the reference mission is not so much a problem as in NRT.

5.5. Format upgrades & standards

In an effort to comply with classic and new standards and norms, the existing DUACS products may be slightly altered to integrate the information needed for compliancy. When the historical format used by DUACS needs more than minor tweaks, the main format will be completed by a second and entirely different product with a new format (still in netCDF, but with a new semantic) fully compliant with as many standards as possible.

This is notably true for the along-track datasets which are a legacy of historical formats designed to minimize the file size and network bandwidth. The side effect of this optimisation is the format complexity. A new simpler and standard compliant (e.g.: COARDs-CF) will be prototyped to ease data access with generic tools. However, the lack of optimisation and data compaction will translate into much larger data files (up to x10). Both the historical and the new format will be distributed.

6. FINAL NOTES

If your operational application or your research work requires a new upgrade or a specific product/processing, you are highly encouraged to contact the AVISO user service (aviso@cls.fr) and to give us more details. More generally user feedback is a very precious source of improvement of the user-driven DUACS system, whether it is negative (reporting of imperfections, limitations and errors on DUACS data) or positive (recent results or publications you might want to see highlighted on AVISO).