IDS AWG

Meeting minutes

Minutes of IDS AWG @DGFI-TUM, Munich - April 4, 2019

May.29, 2019

Participants:

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Distribution:

Participants and AWG IDS list

Written by:
Hugues Capdeville and Petr Štěpánek

1. Introduction

The last International DORIS Service Analysis Working Group (IDS-AWG) was hosted in Munich @DGFI-TUM on April 4, 2019 thanks to our hosts Denise Dettmering and Mathis Bloßfeld.
As usual, IDS ACs and CC gave their processing status. The new DORIS groups as DGFI-TUM and Copernicus POD service presented results of their DORIS satellite data processing. The CNES POD team presented studies on the update of the HY-2A SRP model, on the progress on CNES mascon solutions and on the preprocessing of DORIS phase data for Doppler solutions. The main objective of this meeting was the IDS contribution to the ITRF2020. Zuheir Altamimi introduced the subject by giving the roadmap for ITRF2020. In the following part, we discussed the main DORIS items for the preparation for the next ITRF as the South Atlantic Anomaly compensation, the attempt to mitigate the non-conservative force model errors on satellites, the implementation of DORIS RINEX processing and the implementation of the new standards/models recommended by IERS for the next ITRF. After, an IDS processing schedule proposal for the next ITRF was given. The formation of a working group on the observation of geocenter motion was proposed by Alexandre Couhert. Finally, we gave the list of actions in progress.
All the slides displayed during this meeting are available at:
https://ids-doris.org/ids/reports-mails/meeting-presentations.html#ids-awg-04-2019

2. Oral presentations abstracts

First, an abstract with the main conclusions of each oral presentation is given.

2.1. IDS news (L. Soudarin)

Two positions have been renewed within the Governing Board for 2019-2022:
- Analysis coordinator: new tandem: Hugues Capdeville & Petr Stepanek
- Member-at-large: Claudio Abbondanza succeeds to Marek Ziebart

A new IAG representative (previously Petr who resigned for the Analysis Coordination) will designed by IAG Executive Committee in July.
The IDS retreat was held on June 13 & 14, 2018. A debriefing meeting with GB members was organized in September 2018 in Paris to finalize the minutes and discuss about the strategic plan. The strategic plan will be written with medium and long term actions.
About AWG meetings: +1 in 2019 (Paris, France, Sep. 30 and Oct.1); 1 or 2 in 2020 --> TBD
IDS Workshop 2020 in conjunction with OSTST meeting, October 12-16, Darmstadt, Germany organized by EUMETSAT in the frame of Jason-CS launch preparation.
CNES/SSALTO POD processing is switching to new standards named POE-F. The standards are described in ftp://ftp.ids-doris.org/pub/ids/data/POD_configuration_POEF.pdf
CNES/SSALTO POE orbit files are made available in sp3c format on the IDS DCs with acronym « ssa ».
New archive folders have been created at IDS DCs for DORIS 2.2 SAA-corrected data of Jason-1 and SPOT-5and are in *pub/doris/data/ja1/saacorrection/* and *pub/doris/data/sp5/saacorrection/*
Several novelties of Data/products/information since last AWG meeting: Version #3 of DPOD2014, new DORIS SINEX Master file (including codes, DOMES and geographic positions of all the DORIS stations, type and eccentricity of the antennas (recommended by CC to ACs for headers of SINEX solutions), new version of the file tie vectors from DORIS to other techniques, new document "Jason-3 characteristics for POD processing", an updated version of the document satellite macromodels implemented in CNES POE processing:

Several novelties on the website since last AWG meeting: new sitelogs (MLAC, RISC, ROXC, SJUC, SVAC, WEUC), new maps, new pictures, new references in the list of articles related to DORIS in international peer-reviewed journals, new page "IDS > Documentation > Outreach material" (videos, leaflets, newsletters).
A new set of features has been brought to the tools (Webservice, https://ids-doris.org/webservice). For the network viewer: list of local events; vertical velocity vectors from the DPOD2014 solution; velocity values displayed on mouse-over. For the plottools: statistics update for displayed points for all the plottools; additional data: Pos./Vel. discontinuities, number of satellites. A list of possible

evolutions has been set up by the Central Bureau (here below), but only a part will be developed in 2019. Participants of the Analysis Working Group are invited to express their need.
Network viewer: Co-locations with SLR, VLBI, tide-gauges, Visibility circles (for one or two cut-off angles and one or two altitudes), Satellite tracks (only repetitive orbits), SAA contour line.
Plottools: Orbit residuals: add dates of switch to new standards, New data? (eg. solar activity: flux, Kp).
IDS Newsletter #6 was issued in February 2019. It is available on IDS web site at
https://ids-doris.org/images/documents/newsletters/IDS-Newsletter6.pdf
7 DORIS/IDS related presentations will be given at EGU, 1 oral and 6 posters.

2.2. **DORIS System Status (P. Ferrage)**

Currently 7 satellites contribute to IDS. Many futures missions are planned (7 to 10). 2 new batches of STAREC antennas (type D) will be deployed from mid 2019. These antennas have new center of phase positions and new phase law. The 4thgeneration of beacons (B4G) schedule is on time, they will be deployed from mid-2019. About on-board DORIS receivers, 2 R&T studies have started: 1) to reduce USO radiation sensitivity & better characterization, and 2) to design and build the prototype for a small receiver using both DORIS and GNSS signals.

2.3. **DORIS Network Status (J. Saunier)**

The current permanent network has 60 stations including 3 decommissioned stations pending replacement (Yuzhno, Port-Moresby and Easter). The main concerns are persistent coverage gaps in the Pacific and the deactivation of the Russian DORIS stations for over a year due to frequency clearance issues. Notwithstanding these difficulties, the network provides a good overall performance with always at least 80% of active stations throughout the period 2018-2019.
The main network events of the past year are: relocation of the station at Rothera (Antarctica) following site refurbishment; new site at Mangilao (Guam Islands, USA); new site in San Juan (Argentina); relocation at Ny-Alesund II (Svalbard, Norway); restarting at Mahé after a 3-years outage.
Several on-site operations are planned in 2019: equipment replacement at St-John's (Canada); restarting at Santa-Cruz (Ecuador); equipment replacements. Other ongoing projects will continue at Easter Island (Chile), Changchun (China), Dionysos (Greece), Reykjavik (Iceland), Katherine (Australia) and Papenoo (French Polynesia). Regarding the equipment, the deployment of the 4th generation beacon will start from mid 2019 (the production models are under manufacturing) and the deployment of the improved DORIS ground antenna "Starec C" (with phase center position controlled to +/- 1mm) is still under way: 16 stations are now equipped. Finally, co-location of DORIS with the other techniques is steadily increasing with an additional co-location with SLR at San-Juan and another with VLBI at Ny-Alesund II.

2.4. **Status of the ITRF2020 call for participation (Z. Altamimi)**

The roadmap for ITRF2010 was presented by Z. Altamimi. He gave the current status per Technique Center, the call for participation and the schedule & time-line (as on April 4, 2019):

Date	Action
January 10, 2019	Dissemination of the Call for Participation
February 10, 2021	Deadline for solution submissions by Technique Centers. Earlier submissions are welcome
April 2021	First and early results to be shared and discussed with the TCs.
Until end of May, 2021	Inter comparisons of the ITRF CCs solutions
~June, 2021	Preliminary ITRF2020 solution available for evaluation by TCs
Sep-Oct, 2021	Final ITRF2020 solution released by the ITRS Center

2.5. **Status of the DORIS satellite data processing at DGFI-TUM (M. Bloßfeld)**

The main motivation to implement DORIS satellite in the DGFI Orbit and Geodetic parameter estimation Software (DOGS) was to improve gravity field determination using an SLR multi-satellite constellation. In addition to all available spherical satellites, most-tracked satellite Jason-2 was logical. Initial work on DORIS analysis during a research stay at NASA GSFC in early 2018 thanks to F. Lemoine, N. Zelensky and the GSFC team. After a major software revision in 2018, we focus on DORIS implementation again in 2019, especially work of J. Zeitlhoefler and S. Rudenko led to an error-free and refined satellite attitude handling.
We implemented satellites/models Jason-1/-2/-3 in DOGS-OC and reprocessed (3.5 day arcs) for full mission period (until Jan. 2019) using SLR data. DORIS implementation is now successful (mean RMS values around 0.46 mm/s). Pre-processed attitude observations might be valuable for the POD community. DGFI-TUM now starts to intensively analyze DORIS data. Any hints for us how to proceed (e.g., IDS software comparison campaigns planned, etc.?).
Here the list of future work:

- Estimation of tropospheric corrections (scaling factors, gradients)
- Account for frequency shift of 3rd generation beacons
- Implementation of SAA correction (model/corrected observations)
- Analysis of DORIS-only TRF, EOP, and gravity field time series
- Combination of SLR and DORIS
- More satellites
- Implementation of RINEX data forma

2.6. **Current status of the DORIS processing at the Copernicus POD Service (H. Peter)**

The Sentinel-3A & -3B DORIS processing is running in parallel to the operational GPS processing. DORIS-only and combined GPS+DORIS orbits are generated with 72h arc length and apart from that similar orbit parametrization as for the GPS-derived orbits is used. The results of the DORIS-only orbits are compared to CLS DORIS-only orbits and to a combined Copernicus POD QWG orbit.

Due to a recent bug correction in the computation of the ionospheric correction the results are more consistent with other orbit solutions. The 3D RMS of the orbit comparisons dropped from more than 4 cm to approx. 3.5 cm.

The quality of the S-3B orbit solutions is equivalent to that of the S-3A orbit solutions. External validation with SLR measurements give a mean of 0.71 cm and an RMS of 2.14 cm for S-3A and a mean of 0.40 cm and an RMS of 2.19 cm for S-3B. First tests using updated background models (EIGEN.GRGS RL03 => RL04, atm_geosfpit from massloading.net => GFZ AOD L1B) reveal an improvement to SLR RMS values of 2.01 cm and 2.07 cm for S-3A and S-3B, respectively.

In accordance to all other CPOD processing chains further background model updates are planned in the future. Additionally, a closer look will be given to "problematic" days in the processing.

2.7. **Analysis of the tie vector residuals at the DORIS sites (G. Moreaux)**

That study deals with the analysis of the ITRF2014 DORIS-to-DORIS tie vector discrepancies (difference between the measured tie and the station coordinate differences). After removing the discrepancies smaller than either the tie measurement errors or the coordinate errors, we focused on the six sites with the largest discrepancies to understand/explain these differences. Then, we showed that the tie vector discrepancies could have different origins such as:
- site localization in the South Atlantic Anomaly region,
- very long distance (>1km) between the two DORIS stations,
- variation of the relative position between the 2GHz phase center (DORIS system measurement point) and the antenna reference point (surveying point),
- use of the wrong period in the ITRF2014 residual processing.

2.8. **Identification of satellite DORIS antenna phase maps, and performances of POE-F DORIS-only orbits (H. Ait Lakbir)**

The first part of the presentation is focused on the analysis of the DORIS receiver antenna phase maps. For that, phase maps modeled by an expansion in Zernike polynomials, whose coefficients are adjusted while determining dynamic orbits solutions, are identified for 4 missions (Cryosat-2, Jason-3, Saral and Sentinel-3A). The study shows significant phase center offsets for Jason3 (~2 cm in the X-antenna direction) and for Saral (1 cm in the Y-antenna direction), as well as the reduction of the radial offset due to the improvement of the scale factor in the DPOD2014 solution. Once these phase center offsets corrected, the remaining phase maps are flat as stated by the constructor and have little impact on the Doppler-based orbits and residuals. Still, the DORIS phase residuals are slightly improved, in particular in the Z-antenna direction.
For Saral, a 1cm radial offset in the center of mass location is observed through the DORIS measurements, and confirmed by comparison with Sentinel-3A, assumed to be well calibrated, and the analysis of the high elevation SLR residuals.
Finally, we assess the performances of the POE-F DORIS-only orbits through the independent SLR measurements. The precision of the POE-F DORIS-only orbits approaches the performances of Jason-3 GPS-based orbits with 9 to 12 mm RMS in 3D, and 5 to 7 mm RMS in radial.

2.9. **Update of the HY-2A SRP model (C. Masson)**

This presentation focuses on the estimation of a new value of the SRP coefficient of HY-2A, in preparation for a more in-depth update of its SRP model. The estimation of the SRP coefficient on GPS-only dynamic orbits with fixed ambiguities gave a new value of 0.88, with the most stable behavior during eclipses. New values for the DORIS and GPS centers of phase were then estimated with this new value.
In the radial direction, the offsets are relatively stable, but the normal offsets still exhibit a dependency with the betaprime angle. A further study of the empirical accelerations showed a strong correlation between the sine components of the along-track and cross-track components and the betaprime angle. The new value of the SRP coefficient removes the dependency of the along-track accelerations with the betaprime angle, but the normal accelerations are left virtually unchanged. Furthermore, the cross-track accelerations do not have a linear dependency with the betaprime angle, and thus cannot be represented by a SRP model alone. More accurate estimates of the cross-track offsets for the DORIS and GPS centers of phase will be possible once this behavior is explained.

2.10. **Progress on CNES mascon solutions (J. Moyard)**

A new approach using 36 parameters models, 4 terms by mascon, gives interesting results. The model seems to be well defined, i.e. there is no significant problem of observability. The Equatorial regions are correctly observed by SLR for this model. And the DORIS missions give interesting results for the high latitudes regions. Some ways are identified to improve the model:

- Integrate all available DORIS missions
- Force the coherency of the annual phase term
- Evaluate the impact of the reduced dynamic orbits

2.11. **Preprocessing of Doris phase data for Doppler solutions, and for low elevation measurements (F. Mercier)**

The general objective is to determine the valid measurements to be used in the Doris processing, specifically to include low elevation measurements (minimum 5 degrees). Using the phase measurements, and a processing using 10 s phase variations (Doppler type processing), it is first shown that removing a Doppler measurement leads usually to poorer estimates than using all measurements, if there is no cycle slip in the data set. Or equivalently, it is better to use the longest series of 10 s phase variations without intermediate interruption or cycle slip instead of removing some

measurements which were removed up to now. Thus, the threshold for the wrong phase measurements variations has been increased to be mainly sensitive to the 2 GH cycle slips (up to 2 cm or 4 cm variation over 10 s). The 2 GHz cycle slip which may occur at high elevation (during low Doppler measurements) has been also systematically reconstructed. Using this approach and using datasets of minimal duration 600 s (10 samples) without a cycle slip, the achieved orbit performance for Saral and Cryosat is equivalent (checked using SLR). Much more measurements are used at low elevation (minimal elevation 5 degrees, less than 5% of the total measurements are removed). The drawback is that the residuals rms value is much higher than for the current practice (here, for example, 5.6 mm for Saral, and 6 mm for Cryosat, instead of ~4 mm). The corresponding orbits have less than 2 mm rms difference in radial when compared to the current POD solutions. For the future, this allows for example checking directly the phase residuals on long passes to study the USO behaviour (for the receiver USO and also for ground USOs), and it is for example possible to reconstruct efficiently the receiver antenna phase map. Also, this is probably interesting for the station positioning accuracy, due to the important number of new measurements present at low elevations.

2.12. **Update on Time-Variable-Gravity models for POD applications (J.M. Lemoine)**

We present the new mean gravity field model "EIGEN-GRGS.RL04.MEAN-FIELD", that is proposed for POD applications and in particular ITRF2020 processing. It contains a time-variable part up to degree and order 90 and a static part coming from the model GOCE-DIR5 up to degree and order 300. This model is based on 14 years of GRACE range-rate and GPS data (2002-2016), 3 years of GOCE data for the static part and 26 years of SLR data (1993/01 –2019/02) from 5 SLR satellites. For the coefficients of degree 1 and 2, the time-variable gravity part is based on 26 years of data and is extrapolated only before 1993 and after 2019. For the coefficients between degree 3 and 90, the extrapolation concerns the years before 2002 and after 2016. The model is provided in both the quadratic and linear mean pole conventions and the importance of being coherent between the gravity model and the mean pole convention is stressed in this presentation. A quality assessment of this new model is also presented.

2.13. **ACs and CC Status**

GOP AC (By P. Stepanek)

Analysis center GOP processed the DORIS data until October 2018 and delivered to the corresponding weekly SIENX files to the IDS analysis centers. The major improvement in the processing strategy is the implementation of DORIS/RINEX processing capabilities, including the processing of the observations on both frequencies and the onboard clock estimation. We introduced the new satellites Sentinel-3A, Sentinel-3B and Jason-3 in the processing. We continue in the experiments with the elevation dependent data downweighting. The implementation of the linear frequency modeling during the satellite pass, particularly useful for the South Atlantic Anomaly effect reduction, is recently under the development.

GSC AC (By F. Lemoine)

An upgrade of GEODYN to new version (1810) has been done. The new version has many changes. Its objective was to remove “difficult-to-follow” parts of the code, implement processing improvements for GNSS, make subtle changes to the background tidal modeling (Earth & Ocean tides), implement the IERS2014 linear mean pole in GEODYN, as well as other satellite-specific changes. The new GEODYN version 1810 completely reconfigures how we process DORIS data in GEODYN. The specification of biases is now explicit, rather than “implicit”. In the previous “implicit” processing it was possible that data at the start & end of passes were deleted because the implicit definition of the time span of the biases did not always include all the data. In addition, badly determined troposphere and range-rate parameters (e.g. < 5 observations) were included when they should have been deleted. This would have been invisible to us in most instances, but probably means that a small percentage of data was systematically deleted for every satellite, or conversely in the second case, data were included that weakened the satellite solution. This means with the new GEODYN version,

we must modify all our setups, remove all the deletes accumulated from previous runs, and completely reprocess the data, re-converge the orbits, and regenerate all the deletes.

In preparation for ITRF2020 re-processing the new version of GEODYN was created but we also adopt the following items: new offset for HY-2A, new background gravity model (GOCO05s) and 3-hr de-aliasing models for atmosphere & oceans from GFZ (Includes new modeling of air tides), updated troposphere refraction model & corrections (e.g. VMF1) and more recent ocean tide model (e.g. GOT4p10c), IERS2014 Linear mean pole, new (2017) Alcatel phase law for DORIS antennae. We are reprocessing all DORIS Data for current satellites with new background models and new GEODYN version 1810, removing all previously-generated deletes. We are testing new USO models for Jason-2 & Jason-3 based on Results from T2L2.Further improve non-conservative force modeling for DORIS satellites. We plan to adopt new IERS model for diurnal/sub-diurnal tidally-driven variations in Earth rotation. We have to switch to RINEX processing for all RINEX-compatible DORIS satellites (other than J2 & J3) and add new satellites (Sentinel-3A, 3B).

The GSC Analysis Center is making progress on the ITRF2020 reprocessing preparations. In addition to the work items on slide (2) we plan to adjust a background low-degree gravity model from SLR & DORIS data to different satellites (1993-2018), using ITRF2014/DPOD2014/SLRF2014, GOCO05s and the new linear mean pole. A preliminary solution will be available by the time of the IUGG. Other changes in the processing can be implemented as long as they do not have a big impact on the modeling or require lots of changes to the GEODYN processing (e.g. improved interpolation for the quaternions in GEODYN or a better background model for planetary radiation pressure), since we are severely bandwidth limited.

GRG AC (By H. Capdeville)

GRG AC is currently preparing the processing configuration for our IDS contribution to the next ITRF realization. We will adopt the last standards and models recommended by IERS and IDS. We now use body and solar array quaternions for Jason-2 and 3 satellites. A Precise Orbit Determination status for DORIS satellites has been presented.

We processed DORIS2.2 and RINEX data from July 2017 to January 2019. For Jason and Sentinel satellites, there is a good agreement between the GRG orbits and other orbits (DORIS+GPS from CNES POD team and GPS-only orbits from JPL and CPOD). For Jason satellites, there is a ~59 days periodic signal visible in DORIS RMS and in the radial differences with other orbits for both satellites, even when we use quaternions. We plan to make a reduced dynamic orbit for Jason-3 satellite. We will continue our preparation to the next ITRF by the implementation and tests of models recommended by IERS and IDS as HF EOP model, TVG, ocean tidal model …

The improvement of the GRG IDS AC solution by analyzing Geocenter and Scale factor from single satellite solutions is still in progress. The estimation of the distance between the satellite CoG and DORIS CoP has be done for Sentinel satellites and Envisat. Same analysis have to be done for the other DORIS satellites. We continue also the GRG orbits evaluation by orbit comparison and by external validations as SLR measurements processing as well as through the use of altimeter crossovers.

IGN AC (By F. Lemoine on behalf of P. Willis)

About the legacy Gipsy/Oasis (GOA), AC will continue to submit SINEX Solutions every three months until a complete solution is provided by GipysX. No new code development or updates for Legacy software: the only updates to be applied will be addition of stations, and updates of satellite ancillary information (e.g. mass, maneuvers, attitude).

About the new software GipsyX. Full year processed with SPOT-5 (2014). Results appear to be correct, but the orbit overlaps are worse for GipsyX than for the legacy Gipsy. This may be due to different models or processing strategies (e.g. gravity field, atmospheric drag). We processed a full year of Jason-2 RINEX data, processing it as a Doppler measurement. The external independent test (comparison with GPS orbit) shows excellent consistency. For the present the GipsyX uses the clock model provided by CNES in the data file. The next step would be to estimate it using the DORIS pseudorange. One day of data has been processed using DORIS phase only. The current limitation is that we estimate the ground station clock per pass as a constant parameter and not as a clock

parameter. The required modification will probably be done in June. Residuals are good and comparisons with Doppler orbits are within the expected error bars. As presented by Flavien, DORIS phase processing is the same as GPS processing.

We implemented satellite models for all DORIS satellites (old and new) but only SPOT5 and Jason2 were tested.

IDS CC (By G. Moreaux)

That presentation is devoted to the status of the evaluation of the IDS AC individual solutions as well as of the IDS weekly combined solution as routinely performed by the IDS Combination Center. The evaluation consists in the estimation and analysis of the Helmert parameters wrt DPOD2014 and and of the EOP differences wrt to the IERS C04 series. The time window is 2016.0-2018.75. A focus is given on the latest series from the GOP and GSC ACs

3. Discussions

3.1. Preparation for the next ITRF

Modeling improvement
Attempt to mitigate the non-conservative force model error on satellites (draconitic signals)
The analyses associated with ITRF2014 as well as subsequent work have demonstrated that the DORIS products contain signals at distinct tidal, TOPEX/Jason-draconitic, semi-annual, and annual periods. These signals point to potential problems in force and measurement modeling, potentially associated with the tidal EOP modeling and with the modeling of non-conservative forces on some satellites. ACs have to improve SRP modeling to reduce draconitics, in particular for Topex/Jasons satellites by using solar angle panels, by estimating SRP coefficient, by improving the macromodels.
To mitigate the non-conservative force model error on Topex/Jasons serie (draconitic signal at 59/118 days) some ACs have used quaternions for both the s/c body and solar array. The 59d signal was reduced but is still present in particular in the radial differences with GPS-only orbits from JPL.

Adopt and evaluate the new Models&Standards recommended by IERS
ACs have to implement the new linear mean pole model but not until reprocessing has started, otherwise a velocity discontinuity will be introduced into their time series. They have to adopt a Time-Variable Gravity (TVG) model (using GRACE + SLR + GOCE + geophysical fluid models for full space geodetic era) compatible with the linear pole model. They are awaiting the High Frequency (diurnal-subdiurnal) tidal EOP model recommended by the IERS working group leaded by J. Gipson. They also have to use the last ocean tidal as FES2014.

South Atlantic Anomaly compensation
The objective is to mitigate the SAA effect on DORIS USOs for Spot-5 and Jason series. For Spot-5 and Jason-1, ACs can use the DORIS2.2 data corrected by the models available at CDDIS and IGN Data Centers. Note, for Jason-1 the corrective model is also available. For Jason-2 and Jason-3, ACs can adjust at least a bias+drift by pass for SAA stations in their POD processing. We could use better corrected frequency model for Jason-2 and Jason-3 USO when Belli et al. will demonstrate their efficiency and will be made them available.
We can also use the strategy to add single satellite solution affected by the SAA in the multi-satellite solution. This method was tested and adopted for Jason-1 for the ITRF2014. Before combining single satellite solution affected by SAA to the other single satellite solutions, we rename the SAA stations (and all their adjusted parameters) so these SAA stations from this single satellite do not contribute to the realization of the combined solution. A note which describes all these solutions will soon be available.

Scale, Data downweighting and elevation cut off
For the ITRF 2014 reprocessing, different elevation cut off and data downweighting were used by individual ACs. Elevation cut off and elevation downweighting affects the scale (confirmed result). According to GOP AC results, the downweighting improves the station repeatability (Štěpánek and Filler, 2018, GOP AC report, this meeting). IDS could drive experiment before the ITRF 2020 data reprocessing recommendation for data downweighting and elevation cut off.
About the Hy-2A scale, Analysis coordinators recommend to ACs to use the initial position of the CoM for Hy-2A from Chinese project (ftp://ftp.ids-doris.org/pub/ids/satellites/DORISSatelliteModels.pdf) and to do their own preprocessing if they use DORIS2.2 data (true for all satellites).
The SPOT-5-only scale clearly showed a pattern with sawtooth breaks. The discontinuities are of the order of -20 mm, so they are significant. Although no obvious cause has been found, efforts to understand these variations should continue, in particular to understand if something intrinsic to the SPOT-5 DORIS USO might be the cause.

DORIS RINEX data processing and introduction of the new satellites in the IDS combined solution for All ACs. And priority to RINEX if both formats available?

The Jason-3, Sentinel-3A and Sentinel-3B satellites have to be added in the DORIS processing chain of IDS ACs. Currently, only 4 ACs (ESA, GSC, GOP and GRG) could do that because they are able to process RINEX data format. The others ACs have to complete their DORIS/RINEX data processing implementation in order to take into account the data from these new satellites. About the priority to RINEX if both formats available, ACs have to use necessary the same format for the same satellite.

3.2. **IDS processing schedule proposal for the next ITRF**

The first phase will be devoted to the preparation of individual ACs and CC. When all the new standards/models will be validated and proposed by IERS (end May 2019), it will take at least several months for ACs to implement and test.
After this test phase ACs could start their reprocessing. We could divide the IDS reprocessing in 4 periods: [1992-2001], [2002-2008] (+sp5+env+ja1), [2008-2015] (+ja2), [2016-2020] (+ ja3+s3a+s3b).
ACs could start their reprocessing end 2019 (November) by the first period [1992-2002]. IDS Combination Center could start its combination of the first period at the beginning of the year 2020.
IDS ACs could continue at the beginning of year 2020 their reprocessing with the second period and provide their solution to IDS CC, …
A roadmap written by Analysis coordination will be sent to ACs and CC for IDS preparation for the next ITRF. ACs and CC have to work on 4 following essential items:

- Adopt and evaluate the new models/standards (TVG, HF-EOP model, ocean tides, …).
- SAA compensation.
- Elevation cut off and data downweighting.
- Modeling improvement. Attempt to mitigate the non-conservative force model error on satellites (draconitic signals).

Each topic will be leaded by one IDS with one of the analysis coordinator. The leader will follow the work made by the ACs and CC and will present a synthesis at the next IDS AWG in Paris planed on 30th September and 1th October in Paris.

3.3. **Geocenter product (A. Couhert)**

Alexandre proposes to create an IDS working group on the observation of geocenter motion.

The space-geodetic observation of geocenter motion is still in its infancy. Independent solutions have systematic differences as large as the signal level. The ITRF origin is only sensed by SLR observations of the LAGEOS-1 and 2 satellites. There are other techniques than SLR (DORIS, GPS-LEO satellites). The DORIS and GNSS tracking networks are stable and uniquely well distributed geographically and other missions than the LAGEOS satellites (other spherical satellites, Jason-2/3) which can observe geocenter motion, in both competitive and independent manner. The number of laser range normal point data for Jason-2/3 is two to three times higher than for the LAGEOS satellites.

DORIS can play a role because the tracking network is stable and well-distributed (reduces network effects). The sun-synchronous satellites should be disregarded (β'≈365 days). Solar Radiation Pressure (SRP) modeling deficiencies primarily affects the Z geocenter (TZ) derived from non-spherical satellites. The collinearity of TZ with residual SRP modeling errors can be mitigated well for Jason-like satellites since their 118-day draconitic period is not close to one solar year. So, the Jason-2/3 satellites are appealing for geodetic DORIS-based geocenter motion determination. The upcoming launches of future DORIS satellites HY-2C (inclination of 66°), Jason-CS/Sentinel-6 (66°), and SWOT (inclination of 78°), should also permit the same type of geocenter solutions.

First, we have to identify a list of IDS members. At least two to three groups should be able to produce similar results so that a combination could be performed. Spacecraft attitude data (quaternions) have to be processed. We could also solicit participation from non-IDS members. From IDS volunteers to process a DORIS Jason-2/3 geocenter motion time series in the frame of the ITRF2020 reprocessing, a combined DORIS solution could thus be available by that time.
IDS GB will evaluate the formation of Working Group on the Geocenter where non-IDS participation would be encouraged.

4. Actions review

Here, we give the list of the open actions:

Action	Title	Description	who	status
AWG_01	SPOT5 scale issue	Effort to understand the scale variation pattern with sawtooth breaks.	Volunteer ACs	open
AWG_02	Mitigate the SAA effect on DORIS USOs	Write a document which will consider the different possibilities (corrective models (for Jason-1, SPOT-5), …)	Analysis Coordinators	open
AWG_03	DORIS scale HY-2A high scale	Use the last spacecraft CoM position provided by the Chinese Project	All ACs	open
AWG_04	DORIS Scale Increase in 2012	Each analysis center should do its data editing with its own standards when using all DORIS2.2 data.	All ACs	open
AWG_05	Scale Data down-weighting Elevation cut off	We could analyze the impact of the cutoff angle/ data down-weighting law at low elevation / mapping function of the tropospheric correction on the scale factor and vertical positioning.	Volunteer ACs and associated	open
AWG_06	Mitigate the non-conservative force model error	Inter-comparison of the 2 or 3 time series of quaternions and solar panel angles available among the groups who have pre-processed them.	CNES, GFZ, GSFC	open
AWG_07	Implement DORIS RINEX processing	Creating a "cook-book" explaining step by step the implementation process. It is recommended in particular to explain clearly which data fields in the RINEX files have to be used as they are, and which ones need to be discarded or filtered before use.	GRG AC, CNES POD team	open
AWG_08	Implement DORIS RINEX processing	Providing to the IDS ACs for reference a set of the different data corrections (i.e. iono, tropo, CoM/CoP, etc.) computed for 2 satellites over one week: Cryosat-2 and Jason-2.	GRG AC, CNES POD team, GSFC	open
AWG_09	New standards/models recommended by IERS	Adopt and evaluate the new standards/models recommended by IERS	All ACs	open
AWG_10	Orbit comparison	On voluntary basis and for test purpose (maybe not on regular basis), ACs and associated may deliver their sp3 orbit to the CDDIS/IGN data centers in the appropriate directory: **ftp://cddis.gsfc.nasa.gov/pub/doris/products/orbits/**	Volunteer ACs and associated	open

5. Next Meeting

The next IDS AWG will be held in Paris, France, on September 30 and October 1 2019. The next IDS Workshop 2020 in conjunction with OSTST meeting, October 12-16, Darmstadt, Germany organized by EUMETSAT in the frame of Jason-CS launch preparation.