IDS
Users NEWSLETTER
#4 November 2017

Station re-location at Kitab (Uzbekistan) to get better visibility

Jérôme Saunier (IGN)

The good reception of DORIS signal requires an unobstructed path from the transmitting stations to the orbiting satellites. The visibility at the DORIS ground stations is a key element of how well they contribute to the precise orbit determination. The DORIS network performance is evaluated on an ongoing basis. A loss of performance for the DORIS station at Kitab has been observed for a number of years. The antenna environment has been getting progressively worse: nearby trees mask the view of the sky as seen from the DORIS antenna. It was decided in 2013 to relocate the station to get better visibility.

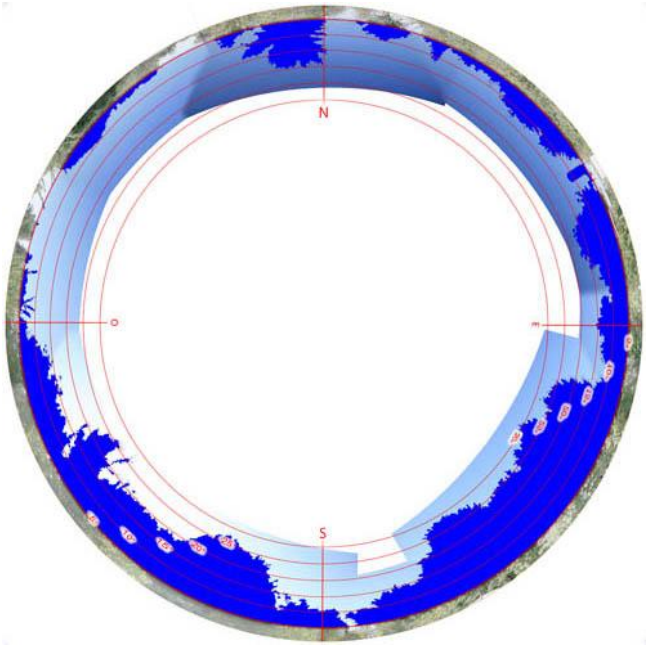
Kitab station "KIUB" before re-location

The new DORIS antenna "KIVC" and the new GNSS antenna "KITG"

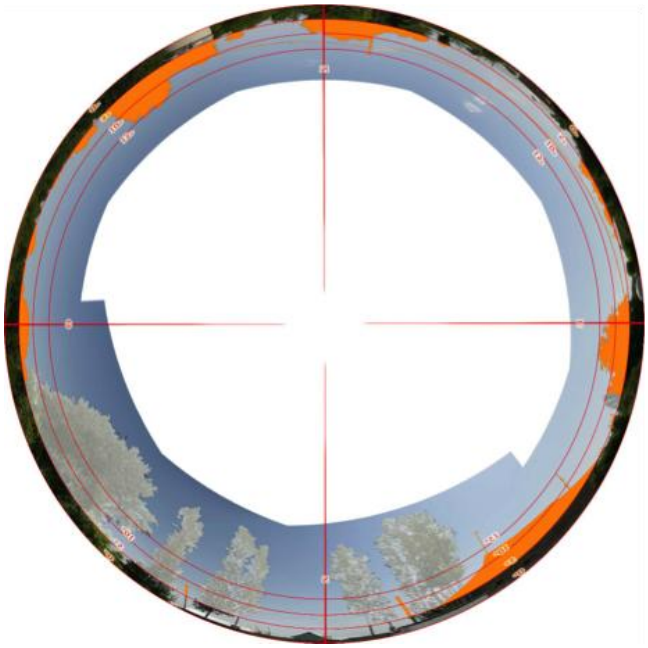
The DORIS station has been hosted at the Kitab observatory of the Ulugh Beg Astronomical Institute (see insert on page 3) since 1991. Originally installed on the roof of the main building, the DORIS station was moved in 2001 to a pillar to get better stability. But since then, the antenna environment has gradually deteriorated over the years causing disruption and loss of low-site measurements.

DORIS has been co-located with the GNSS station "KIT3", part of the IGS network, since 1994. During the reconnaissance, it was important to find a location close enough to the GNSS station in order to maintain a good co-location in the geodetic meaning of the term, but also sufficiently near the former DORIS location to be able to determine with high accuracy the tie vector between the two antenna reference points and thus allow the connection of the time series of station positions.

The new site is located at around 200 m southeast of the GNSS station that allows the carrying out of a high precision local tie survey. The relatively open ground offers a good antenna environment.



Aerial panorama from "KIUB" (before the re-location)



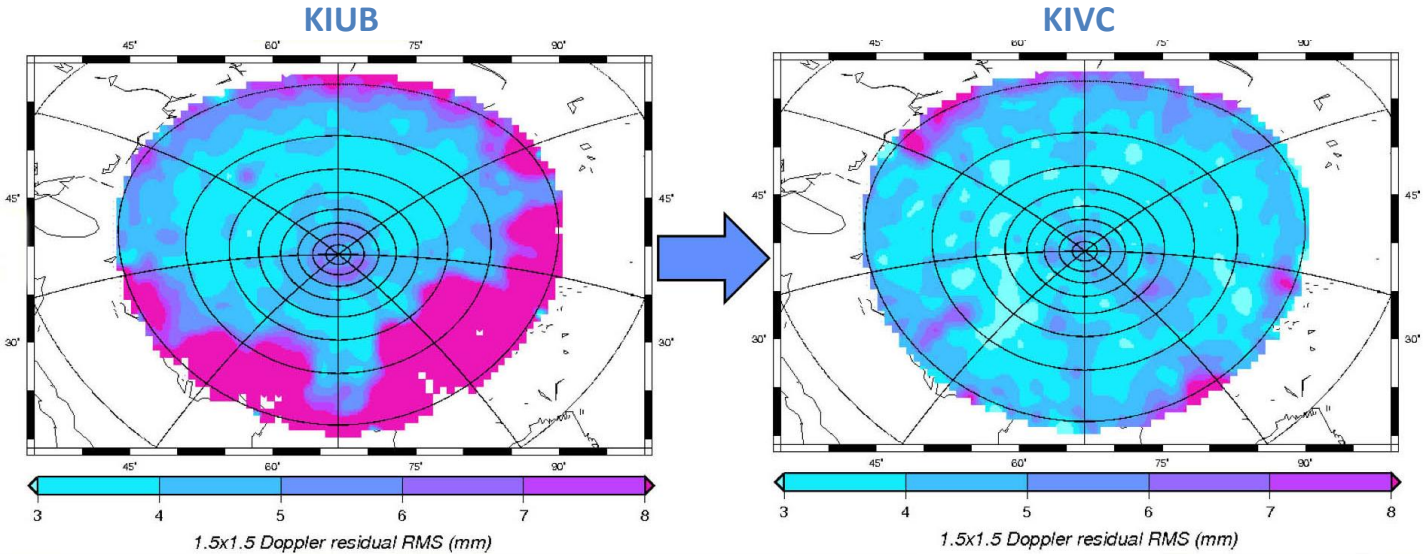
Aerial panorama from "KIVC"
Note: trees in grey were felled after the photo shooting date

Compared to the previous location, the spherical 360° panoramic view showing the blocked area has an obstruction rate of 3.6% vs. 16.9% before the re-location.

A little over one year after the station re-location (commissioned on June 15th, 2016), we are now in a position to properly assess the performance of the station. A dual approach is usually followed to analyze the impact of the antenna environment: first, comparisons between the theoretical and actual level of power received on-board the DORIS satellites, and second, study of the residuals of an orbit adjustment to the Doppler measurements. From statistics processed with the data from DORIS satellites over 2015, the mean of residuals of the least-square precise orbit adjustment for Kitab was well above the typical level of noise in the residuals: 6.1 mm instead of the usual 3-4 mm.

Today, after the re-location, Kitab now is included among the best stations in the DORIS network ranking with POE RMS of 4 mm. The measured power received on-board the satellites increased on the 2 GHz channel by 1.8 dB if we consider the mean in all directions.

The impact of the signal obstructions on power attenuation and Doppler residuals has clearly been highlighted even if other phenomenon (as multipath) can also cause degradations.



RMS POE map (Courtesy of Philippe Yaya, CLS)

The need for a clear environment surrounding the antenna at low elevation is one of the main requirements when considering a DORIS station installation. This requirement is important, especially since the general introduction of the DORIS DGXX instrument onboard has increased the number of measurements at lower elevation. We specified this DORIS system requirement by defining a "visibility cone" with an angle of 170° at the apex which is situated at the antenna base (corresponding to an elevation of 5°). Ideally, nothing must stand within the visibility cone. But it is often difficult to meet this requirement, especially with the proximity of the building housing the transmitting unit (the maximum cable length allowed to the antenna is 15 m). To overcome this limitation, a fourth generation DORIS beacon is under development that will allow installation of the antenna up to 50 m from the beacon. But, we will have a chance to talk about that a little later on…

The name of the institute honors Ulugh Beg, who in the 1420's founded what was for a time, one of the finest astronomical observatories in the Islamic world.

THE HOST AGENCY IN SHORT

Dilbar Fazilova and Shuhrat Ehgamberdiev
(UBAI, Uzbekistan)

The Tashkent Astronomical Observatory (Ulugh Beg Astronomical Institute of the Uzbek Academy of Sciences, UBAI, since 1966) was involved in the International Latitude Service (ILS) in 1899, when regular latitude measurements were started from several observatories along the parallel 39° 08' north latitude in order to study precession of the Earth's axis and its effect on measures of latitude. A new latitude station was established at Kitab at latitude +39°08'40" and longitude -66°53', in November 1930. The Kitab latitude station provided the ILS with more than 250000 instantaneous latitude measurements.

Since the independence of Uzbekistan in 1991, new activities have been developed, mainly based on international cooperation in the field of Earth's sciences. The "Kitab complex of high mountain astronomical observatories" hosted DORIS, CATS, PRARE, GPS, and lately GNSS stations. UBAI uses the data from these stations for the realization of national applied projects, the construction of National Geographical System of Uzbekistan and research of the local geodynamic phenomena.

Ulugh Beg Astronomical Institute
Uzbek Academy of sciences

DPOD2014: a new DORIS extension of ITRF2014 for Precise Orbit Determination

Guilhem Moreaux (CLS)

As one of the tracking systems used to determine orbits of the altimeter mission satellites (such as TOPEX/Poseidon, Envisat, Jason-1/2/3, Cryosat-2, HY-2A), the position of the DORIS tracking stations provides a fundamental reference for the estimation of the precise orbits and so, by extension is fundamental for the quality of the altimeter data and derived products. Therefore, the time evolution of the position of both the existing and the newest DORIS stations must be precisely modeled and regularly updated. To satisfy the operational requirements for precise orbit determination and routine delivery of geodetic products, the International DORIS Service maintains the so-called DPOD (DORIS extension of the ITRF[(1)] for Precise Orbit Determination) solutions which can be seen as DORIS extensions of the latest available ITRF solution from the IERS[(2)].

The DPOD solutions were initiated to overcome some intrinsic drawbacks while using the latest ITRF:

i) some stations of the current tracking network are not included in the ITRF solution;

ii) some stations may be affected by coordinate and/or velocity discontinuities that could happen after the realization of the ITRF;

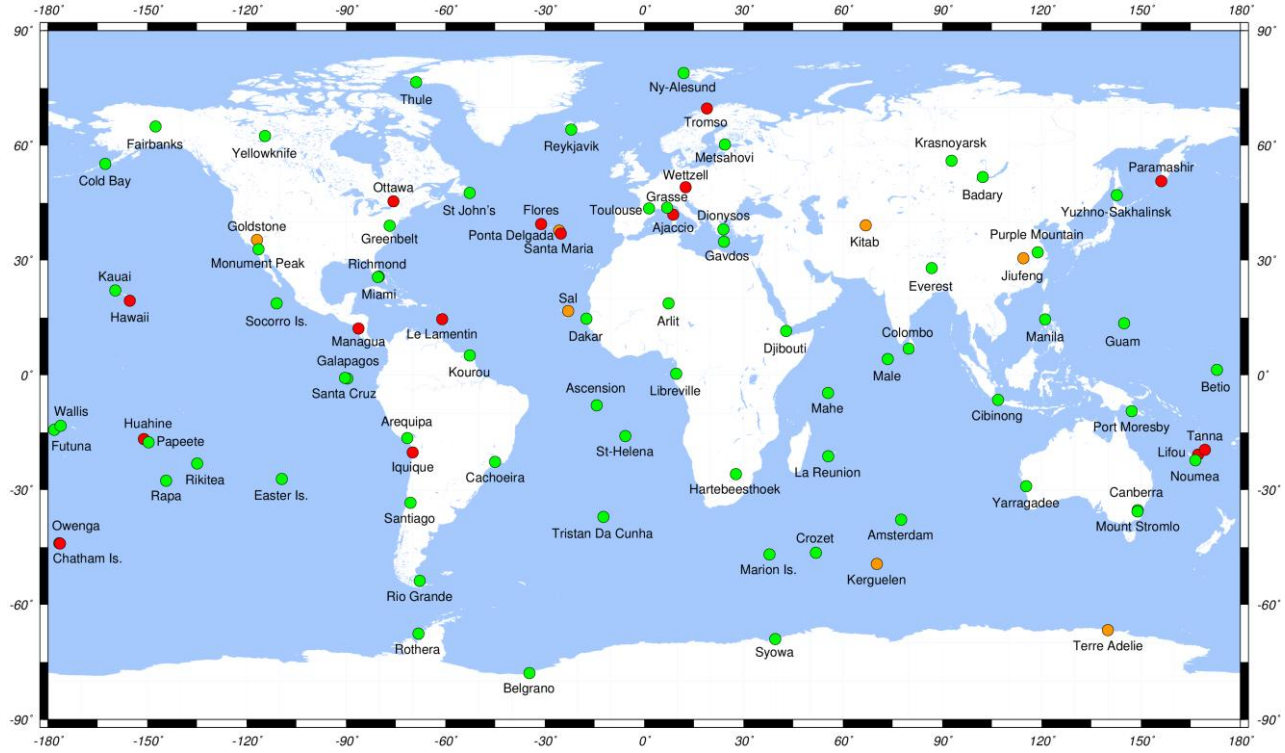
iii) the precision of the position and velocities of the stations with few observations at the time of the ITRF may be increased with longer data span and;

iv) problems in geodetic technique data processing may be found after the computation of the ITRF (e.g. sensibility of Spot-5's Ultra Stable Oscillator to the South Atlantic Anomaly).

Furthermore, the DPOD solutions for some stations give periods of time not to be considered while doing orbit determination so as to not degrade it.

In mid-2016, the IDS agreed to change the processing strategy of the DPOD solution *(construction steps and validation tests are described p. 5)*. The new solution from the IDS Combination Center is mostly based on the latest DORIS position and velocity cumulative solution (aligned to the ITRF2014) from the latest IDS combined weekly solutions. The cumulative solution will be augmented to include any new stations. Note that the DPOD2014 solution is still based on linear motions to facilitate its use, especially on board the DORIS satellite.

(1) International Terrestrial Reference Frame
(2) International Earth Rotation and Reference Systems Service



Network of the 86 DORIS sites included in the first release of the DPOD2014 solution.

Legend:

- *sites in ITRF2014*
- *sites in ITRF2014 but with new station(s) not in ITRF2014*
- *sites not included in ITRF2014*

Construction

The construction of the DPOD2014 can be divided in three main steps:

1. Construction of the IDS combined series from the six IDS Analysis Center multi-satellite weekly solutions starting in 1993.0.

2. Construction of the DORIS position and velocity cumulative solution. Includes update of the station position discontinuities related to Earthquakes or equipment change.

3. Inclusion of the most recent DORIS stations which are not already part of the cumulative solution. Positions and velocities will be either extracted from IGN mails distributed via the DORISmail mailing list or deduced from the IGN DORIS-to-DORIS tie vectors.

Validation process

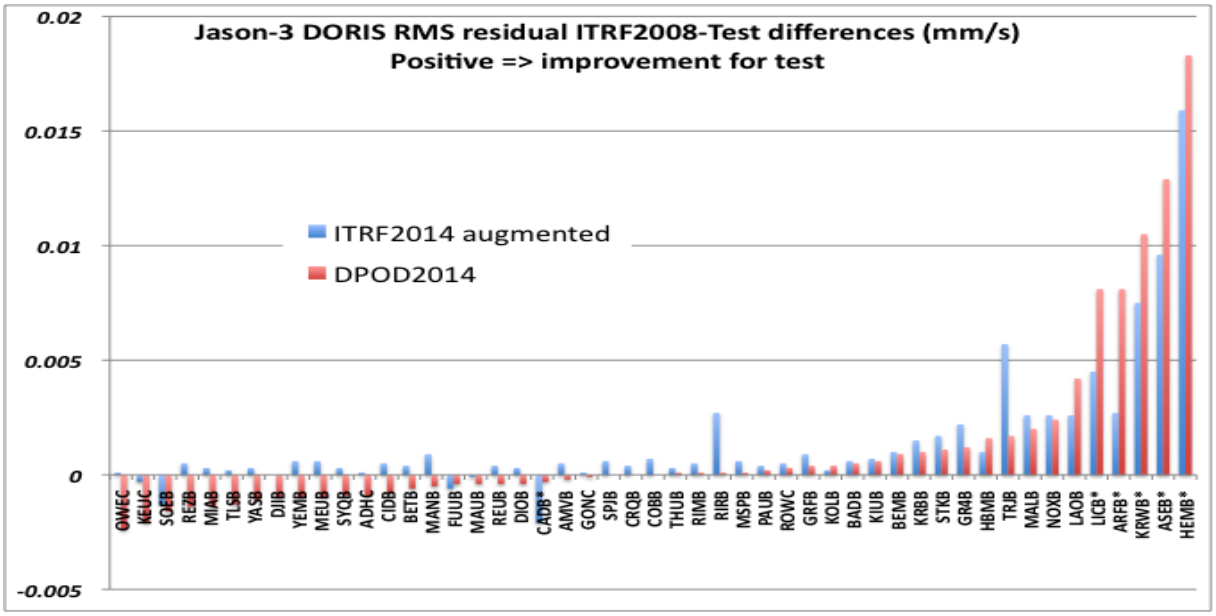
The DPOD2014 solution faces a two step validation process.
The first set of the validation tests realized by the IDS Combination Center consists of position and velocity comparisons with the ITRF2014, analysis of the DORIS-to-DORIS tie vector residuals (discrepancies between the DPOD2014 coordinate differences and the IGN tie vectors), estimation of the DORIS position formal errors at T+2 years (T being the DPOD2014 realization date), analysis of the differences between GNSS-to-DORIS tie vectors deduced from the DPOD2014 (DORIS) and ITRF2014 (GNSS) and the IGN tie vectors.
The second validation step is mostly devoted to some POD tests performed by the POD validation group composed by Pascal Willis (IGN, chair), Frank Lemoine (NASA), Nikita Zelensky (SGT), Alexandre Couhert (CNES) and Hanane Ait Lakbir (C-S).

The POD tests include:

- ❑ Verifying that all DORIS stations are provided in the DPOD solution.

- ❑ Verifying that the coordinates of the new stations are consistent with the latest available DORIS data.

- ❑ Verifying that POD solutions are not degraded by looking at:
  - DORIS residuals and comparisons with ITRF2014 and previous DPOD performances *(ex: DORIS residuals associated to Jason-3, see below)*.
  - SLR residuals and comparisons with ITRF2014 and previous DPOD performances.
  - Long term orbit drift as shown with the Mean Z ITRF2014 orbit differences.
  - Radial orbit differences.
  - …



Jason-3 DORIS RMS residuals with ITRF2014 and DPOD2014 v1.0

The DPOD2014 is updated twice a year. It is available and archived at the IDS Data Centers in both SINEX and text formats.

Two releases have been issued this year, in March and October.
The up-to-date solution is always named dpod2014_current.

Visit the dedicated page on the IDS website to find how to get the DPOD2014 releases:
https://ids-doris.org/analysis-coordination/combination/dpod.html

IDS life

Two new Associate Analysis Centers

At its meeting in May 2017, the IDS Governing Board recognized the CNES POD team and TU Delft as Associated Analysis Centers. Both groups actively contribute to DORIS data studies and provide specialized and derived products. Groups interested in accessing this status are invited to contact the Analysis Coordination. (*ids.analysis.coordination @ ids-doris.org*)

Creation of the Working Group "NRT DORIS data"

Following user requests for rapid dissemination of DORIS data for assimilation in ionospheric models, a Working Group has been set up to define the possible applications of Near Real Time data, identify potential users and define the test requirements. Based on the results of the Working Group, CNES will evaluate the possibility to establish a new NRT DORIS data production chain.
The WG is chaired by Denise Dettmering (DGFI/TUM).

IDS Retreat

IDS plans to organize a retreat in 2018 to define the activities of the service for the next 5-10 years. Inputs from both inside and outside the IDS community are needed in preparation for this event. A survey is in preparation to collect user expectations. IDS representatives attending the AGU Meeting in New Orleans will also be available to get feedback from experts.

IDS workshop 2018

The next IDS workshop will be organized in conjunction with an exceptional Symposium on "25 Years of Progress in Radar Altimetry" and the annual Ocean Surface Topography Science Team (OSTST) meeting. These events will be held over 6 days, from 24 to 29 of September 2018 in Ponta Delgada, São Miguel Island, Azores Archipelago (Portugal).
Additional information and call for contributions will be sent out, along with the details of a dedicated web site to submit your contributions. Please consider your participation at this exceptional event and reserve the last week of September 2018 in your agenda.

Doris antenna at Jiufeng (China)

IDS Newsletter

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