Users NEWSLETTER #2 July 2016

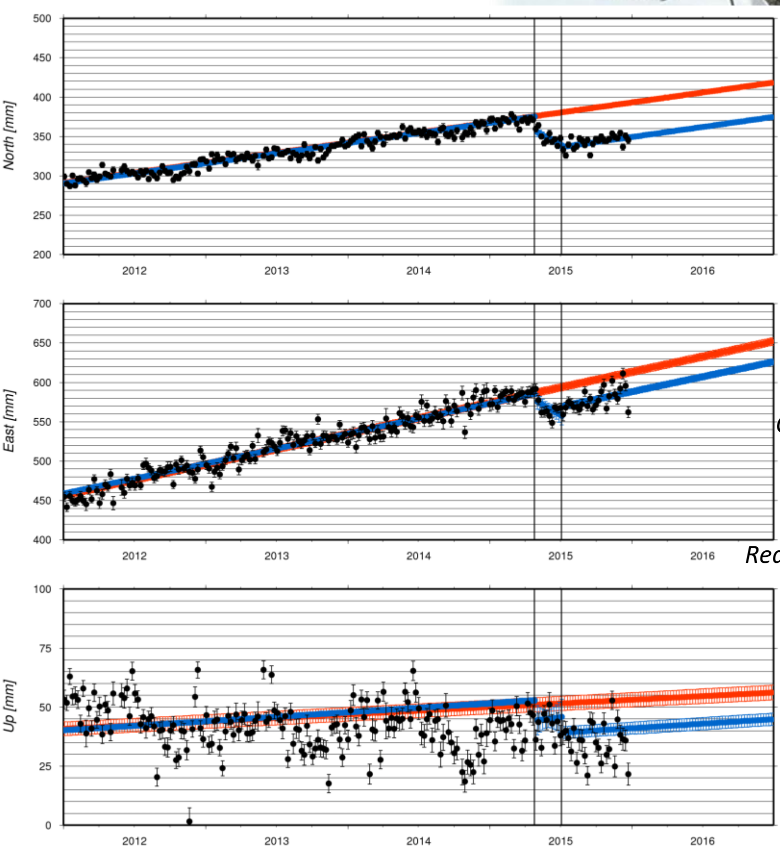
2015 Nepal Earthquakes moved the DORIS station on Everest by a few centimeters

Guilhem Moreaux (CLS)

On 25 April, 2015, an earthquake with a magnitude of 7.8 on the Richter scale struck central Nepal approximately 80 km northwest of the city of Kathmandu. The Gorkha earthquake, as it was named, was followed by a large number of aftershocks, including one that measured 7.3 on 12 May. Seismicity in the Himalaya Mountains is due to the collision of the India and Eurasia plates, which are converging at a relative rate of 40-50 mm/yr. All these events were also recorded by the DORIS station "EVEB" located at the Everest base camp (70-90 km from the epicenters). Monitoring of the position of the DORIS antenna revealed a sudden change as of 15 April 2015. The offsets of positions resulting from the earthquakes, in the directions north and east and along the up/down axis are estimated from the updated linear displacement model based on the DORIS time series and by comparing them with those produced by the ITRF2014 model.

The offsets showed that the successive earthquakes in Nepal moved the DORIS Everest station 44 mm southwards, 26 mm westwards and 11 mm downwards. Analysis of a longer time series after mid-2015 will enable us to determine how the earthquakes also changed the velocity of the DORIS Everest station.

"EVEB" DORIS antenna at the Everest base camp



Coordinate time series of the DORIS Everest antenna (black dots)

Red line: ITRF2014 model
Blue line: IDS model

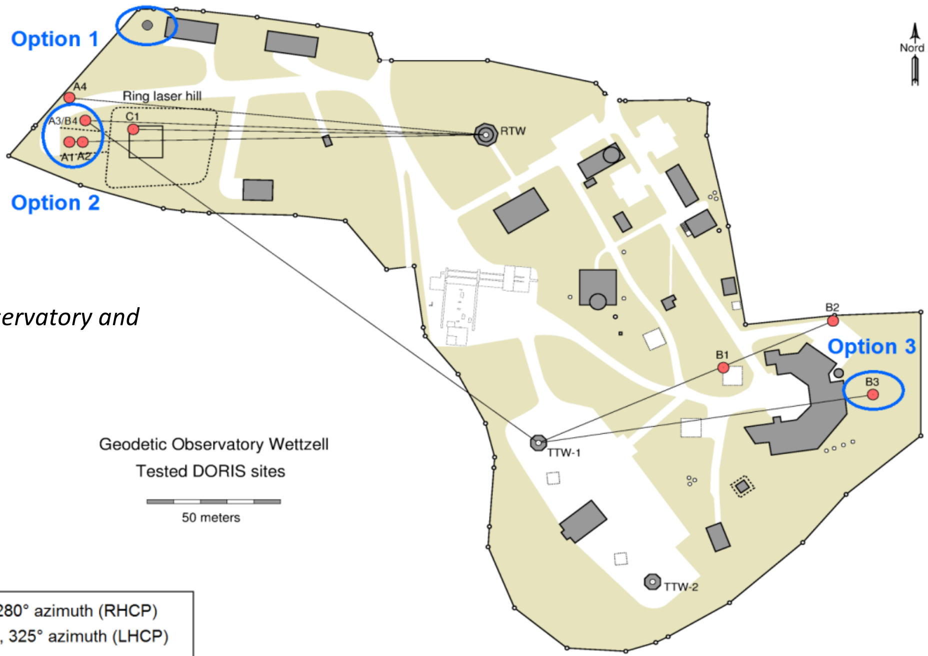
DORIS-VLBI compatibility tests at the Geodetic Observatory Wettzell

Thomas Klügel (BKG)

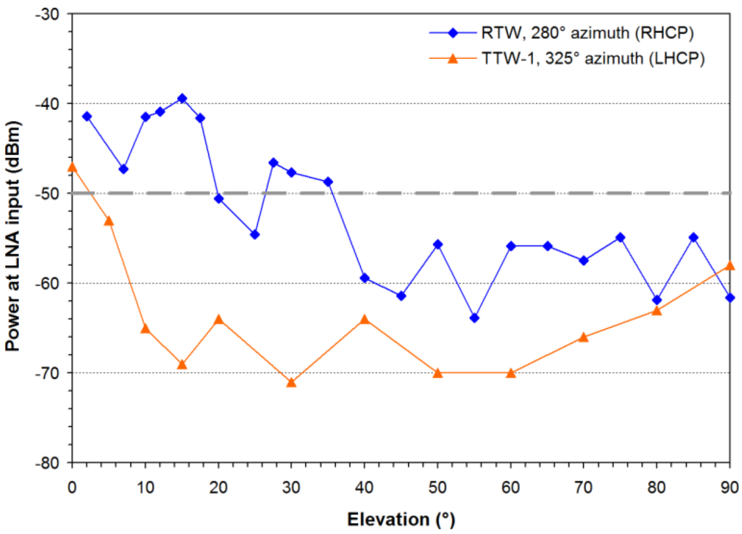
The co-location of DORIS with other geodetic space techniques is of special interest for determining and maintaining global reference frames such as the ITRF. While GNSS receivers are often operated together with DORIS beacons, co-locations with Very Long Baseline Interferometry (VLBI) or Satellite Laser Ranging (SLR) are less frequent. The Geodetic Observatory Wettzell in Germany, which includes 3 VLBI radio telescopes, two laser ranging systems, several GNSS receivers and a dense local tie network are present, is therefore an interesting co-location site for the IDS. On the other hand a DORIS beacon completes the instrumentation and shifts Wettzell towards a 4-techniques GGOS core site.

However, the common operation of VLBI and DORIS at one site generates Electromagnetic Compatibility (EMC) problems. While the VLBI system is designed to receive extreme weak signals down to –110 dBm, the DORIS beacon emits on a 2036 MHz frequency of +40 dBm. There is a high risk of coupling DORIS signals into the VLBI S-band receiving chain generating spurious signal and, in the worst case, overloading the Low Noise Amplifier (LNA) and risking it being damaged.

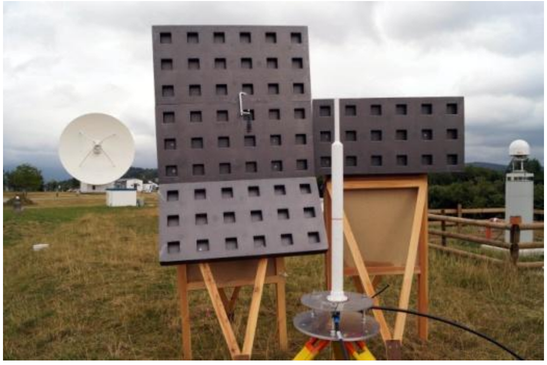
The recorded frequency band itself between 2.1 and 2.4 GHz is not expected to be influenced. In order to find a solution for a common operation, RF interferences at the LNA inputs of the 20 m radio telescope (RTW) and the classical S-/X-/Ka-band TWIN telescope (TTW-1) were investigated by varying the telescope azimuths and elevations and testing different locations and RF blocking structures. During a first survey in December 2014 three different location options were evaluated.



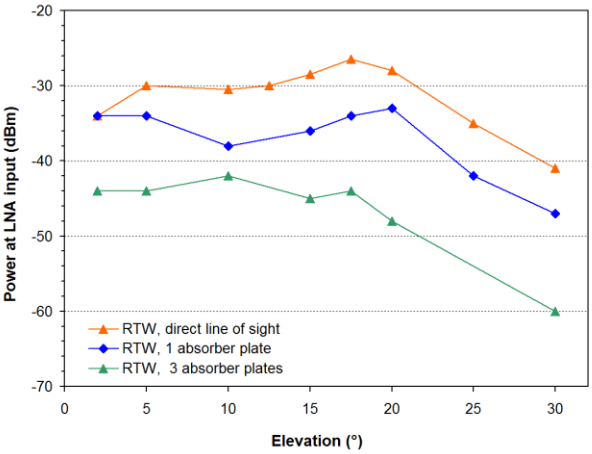
Map of the Wettzell observatory and tested DORIS locations



Elevation dependence of the received power at RTW and TTW-1 LNA inputs, from A3/B4 location. Both telescopes were pointing towards the DORIS antenna.
RHCP = Right Hand circular Polarization
LHCP = Left Hand Circular Polarization



3 plates (type COMTEST MT65) reduce the signal by 12-20 dB



Attenuation effect of absorber plates at location C1 on RTW

The received power strongly depends on the orientation of the telescope. It reaches a maximum when pointing towards the DORIS antenna at elevations below 15°. However, also at high elevations an increased power is noticeable due to spillover or reflections at the sub-reflector, in particular at the TWIN telescope. We found that in direct line of sight, the received power at the VLBI system may exceed the LNA saturation point everywhere on the station, which is in the order of –50 dBm. In these cases the original polarization (RHCP – Right Hand Circular Polarization) dominates. The introduction of RF barriers like absorber plates or obstacles such as buildings or hills reduce the received power up to 20 dB, however, at dedicated orientations the power is still at the upper limit. In these cases the fraction of left- and right-hand circular polarization is equal indicating that the signal is reflected many times before entering the receiver.

Tests under real conditions from the preferred location A3/B4

On the basis of these results the following principles for any site layout have been defined:

- Maximum distance between DORIS and VLBI antenna, ideally 300-400 m
- At a shorter distance, no direct visibility between DORIS and any VLBI antenna (by using local topography or RF blocking structures)
- If possible install the DORIS antenna clearly above the VLBI antenna (lower emission at low/negative elevations)
- Ensure that the maximum gain lobe of the VLBI antenna never points towards the DORIS antenna (since the LNA could be destroyed)
- Integration in a local survey network to achieve good local ties

In the case of Wettzell, option 2 (A3/B4) was the preferred choice as it enables the best compromise to meet the different demands:

- Ground installation into the observatory (good local ties, low installation costs, atomic clock option)
- Use of the ring laser hill as an existing RF blocking structure
- DORIS antenna significantly below the VLBI antenna horizon
- Operation on demand, i.e. the beacon should be kept in stand-by mode when no satellite is visible

An ongoing long-term test will show whether this location yields satisfying results given that the DORIS installation requirements are not strictly fulfilled (minimum elevation exceeds 5° in most directions). On the other hand the operation of the DORIS beacon has not resulted in any impact on the VLBI correlation results so far.

If everything goes well, the DORIS station installation could be scheduled for the end of 2016.

DORIS in Managua

Jérôme Saunier (IGN)

A new DORIS station has appeared on the network map in the heart of Central America at Managua, Nicaragua. INETER, the National Institute for Territorial Studies, has been hosting this new DORIS station, “MNAC”, in its premises since April 2016. This government agency, in charge of the description and characterization of the Nicaraguan territory, is particularly sensitive to the risks from natural hazards. Due to the country’s tectonic setting, volcanic eruptions, earthquakes, and tsunamis are permanent threats to Nicaragua. With extensive coastlines on two oceans, Nicaragua also pays particular attention to ocean evolution and global sea-level change.

“MNAC“ DORIS antenna with “MANA” GNSS antenna in the background

The DORIS beacon at INETER headquarters

Consequently, INETER was very keen on having a DORIS station in Nicaragua to better contribute to ocean observation, climate research, hurricane forecasting and further knowledge of local phenomena.

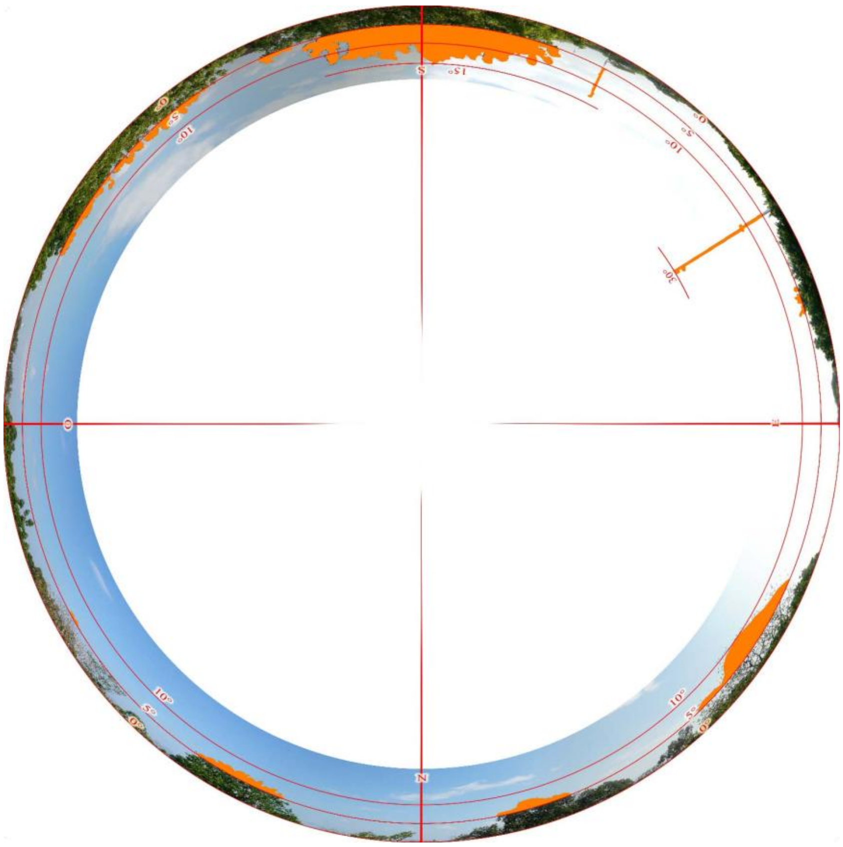
The DORIS station has been installed at the INETER headquarters in the centre of Managua and is co-located with the GNSS station “MANA”, part of the IGS network. The DORIS antenna was mounted on the terrace roof of a tall building thus offering a clear view of the sky for the DORIS signal transmission.

The co-location with another space geodetic technique (GNSS) will allow adding tie vectors in the reference frames combination for the determination of the International Terrestrial Reference Frame (ITRF). During the installation, IGN personnel undertook a high-precision local tie survey to determine the relative spatial positions of the two antenna reference points with extreme accuracy (to within 1 millimeter).

This new station is fully integrated within the DORIS data coverage map to improve the network's robustness, since it is strategically located right in the middle of its four neighboring stations: Socorro, Miami, Le Lamentin and Santa-Cruz. This is an important consideration for the DIODE system on board spacecraft with DORIS receivers, since DIODE processes DORIS data on-board to provide real time knowledge of the spacecraft position for applications that require rapid delivery of altimeter products.

Finally, at geophysical level, Managua is the second DORIS station located on the Caribbean tectonic plate following the installation of Le Lamentin in 2013. DORIS data acquired from the two stations should soon be yielding reliable information about the Caribbean plate motion.

Visibility circle around Managua station for Low Earth Orbit (800km) satellite with 12° cut-off angle over the horizon



360° aerial panorama from the antenna base

The DORIS data from the Managua station, in addition to contributing to precise orbit determination, will surely bring advances in many applications to the Earth sciences considering the study area. Our best wishes to the Managua DORIS station for successful continuation of its mission!

IDS life

IDS Analysis Working Group (AWG) meeting at the Technical University of Delft, May 26-27, 2016.

Twenty-one experts from CNES, Côte d'Azur Observatory, TU Delft, Geodetic Observatory Pecny, GFZ, IGN, NASA, Norwegian Mapping Authority, UCL, and CLS met at the Faculty of Aerospace Engineering of the TU Delft to share their respective evaluations of the new realization of the International Terrestrial Reference Frame and the estimation of the frequency sensitivity of DORIS Ultra Stable Oscillators (USO) when crossing the high radiation area known as South Atlantic Anomaly (SAA).

The solutions produced by the three ITRS Combination Centers (DGFI, IGN, JPL) have been evaluated in terms of DORIS observation residuals, orbit overlaps and transformation parameters of the DORIS network. All of the solutions lead to a clear improvement in comparison to ITRF2008. But, it was concluded that IGN's solution (ITRF2014) achieved the best overall performance and will henceforth be used for processing DORIS data.

The USOs carried by the new Jason-3 and Sentinel-3A satellites were estimated to be more sensitive than Jason-2's, but less sensitive than Jason-1's. This sensitivity has no impact on altimetry measurements and almost no impact on orbit computation, but leads to a degradation of positioning for stations in the vicinity of the SAA. The IDS community will now pursue the development of accurate models of frequency variations in response to the SAA.

Many thanks to Ernst Schrama for hosting the AWG!

IDS Workshop La Rochelle, France, 31 Oct - 1 Nov 2016

The workshop will be held in conjunction with the OSTST 2016 and a SAR altimetry workshop. The Governing Board will meet on this occasion. Visit the web page at http://ids-doris.org/meetings/ids-meetings.html

Deadline for abstract submission is 15 July

IDS component renewal

- Combination Center (CC)

The selection for 2017-2020 will take place as follows:
-June 2016: Call for Participation
-15 Oct. 2016: submission deadline of letter of intent
-1st Nov. 2016: selection of the new IDS CC
-1st Jan. 2017: start of the four-year term of the CC, overlap with current IDS CC and validation phase
-20 March 2017: delivery of first operational products by the new IDS CC

- Positions within the Governing Board

Three positions in the IDS Governing Board will be renewed for the term 2017-2020:
(1) Data Center representative,
(2) Analysis Center representative,
(3) Member at Large.
The elections will take place as follows:
-July - Sept. 2016: nomination process of candidates
-early Oct. 2016: vote by IDS associates
-1st Nov. 2016: elected candidates attend the GB meeting in La Rochelle (as observers)

IDS Newsletter

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