

**Agreement on cooperation  
for the integration of DORIS software enhancements into  
the Bernese GNSS Software**

between

**Federal Agency for Cartography and Geodesy,**

**represented by its President Prof. Dr. Paul Becker,  
Richard-Strauss-Allee 11,  
D-60598 Frankfurt am Main**

**(referred to as "BKG")**

and the

**Research Institute of Geodesy, Cartography and Topography, Czech Republic  
Department of Geodesy and Geodynamics  
Represented by its Director Ing. Pavel Hánek, Ph.D.  
Ústecká 98, 250 66 Zdíby, CZ**

**(referred to as "VUGTK")**

and the

**University of Bern  
acting through the Astronomical Institute**

**Sidlerstraße 5  
CH-3012 Bern**

**Represented by its Co-Directors Prof. Dr. Adrian Jäggi and Prof. Dr. Lucia Kleint**

**(referred to as "AIUB")**

**Hereinafter jointly referred to as "Parties"**

## 1. Preamble

The Parties confirm their mutual interest to enhance the Bernese GNSS Software (BSW) for DORIS analysis capabilities in order to make the BSW a multi-technique analysis software, which is able to handle all four main geodetic observation techniques (GNSS, SLR, VLBI and DORIS) and to allow a combined analysis of all techniques. Eventually, the BSW will be able to process all the data from the European Space Agency's future Genesis mission, which will expand the possibilities of combining the space techniques by collocating all four techniques on one satellite.

The Bernese GNSS Software is a scientific analysis software, which allows to process geodetic observables and to generate geodetic reference frame products. The planned developments will enhance the software capabilities w.r.t this scientific usage, which is of public interest.

The Parties contribute to various services of the IAG (International Association of Geodesy), by providing geodetic products for public usage, and they use the BSW for these activities.

- AIUB is using the most recent BSW version for its activities as an official IGS analysis centre.
- BKG is using the most recent BSW version for its activities as an official ILRS analysis centre. In addition, BKG has already an agreement with AIUB for the enhancement of the BSW for VLBI processing capabilities to use it for its activities as IVS analysis centre.
- VUGTK is using an older version of BSW, which was enhanced for DORIS processing capabilities and is not maintained at AIUB, for its activities as an official IDS analysis centre.

The Parties have a common interest in the transfer of the DORIS processing capabilities into the main version of the BSW, which is maintained and updated at AIUB. This would ensure that

- the DORIS implementation will not get lost and get available to the Parties,
- the DORIS implementation is maintained and updated also in the future, to also benefit from upcoming model changes and processing standards,
- the BSW will be capable of processing all four geodetic techniques with the very same models ensuring highest consistency among the different techniques and allowing the combination of all techniques at the normal equation and observation level.

A BSW version, which is able to process all four techniques including DORIS will be used by all Parties, i.e. by

- AIUB for its activities as an official IGS analysis centre, but also for research and development activities in the area of combined data analysis, in particular for Genesis data processing
- BKG for its activities as an official ILRS analysis centre, for its VLBI data analysis, for the combined data analysis using all four techniques in particular for Genesis data processing
- VUGTK for its activities as an official IDS analysis and combination centre

Nevertheless, it should be noted that the BSW is also used commercially, although this mainly takes place on the GNSS application market. However, the focus of this cooperation is on the scientific use of the BSW in order to fulfil the respective public

law tasks of the Parties. Hence all Parties agree that the enhancements of the BSW for the DORIS technique has no significant value for commercial use.

## **2. Purpose and objective of the cooperation**

The purpose of this agreement is to cooperate in the common goal to enhance the BSW for DORIS processing capabilities.

VUGTK is using the BSW for its IDS activities and has implemented DORIS functionalities into the version 5.3, which is no longer maintained by AIUB. Under this agreement, the Parties aim to merge the existing DORIS functionalities into the development branch of the BSW (currently version 5.5). This will make the BSW a multi-technique analysis software, which is able to handle all four main geodetic observation techniques (GNSS, SLR, VLBI and DORIS) and to allow a combined analysis of all techniques at the normal equation level.

The term "DORIS development version" is used in the following to refer to the entire BSW software package (in its latest version) including the additional DORIS processing capabilities.

## **3. Contributions from the contracting Parties**

Each Party shall provide the resources necessary and appropriate for the implementation of the work plan. This includes human, technical and/or financial resources. None of the Parties shall derive any individually measurable advantage from this.

VUGTK shall provide one person to work half-time (50%) on the software implementations for the duration of the contract (1.5 years). AIUB shall support the activities as set forth in Section 3.2, hereunder. BKG shall provide personnel for the project management and software testing of the DORIS development version, as well as financial resources amounting to [REDACTED] Euro for the entire project.

## **4. Service provided by VUGTK**

(1) The project comprises the following work packages (WP) to be carried out by VUGTK:

WP1: Integration of DORIS enhancements into the DORIS development version

- Merge of the DORIS version at VUGTK
  - in a first step: with BSW version 5.5 from 02.02.2023 (cvs tag 20230202)
  - in a second step: with the latest version of the BSW development branch

WP2: Ensure normal equations (NEQ) compatibility between DORIS and GNSS solutions from the latest version of the BSW development branch

- Ensure full compatibility at NEQ level between DORIS and GNSS processing. This means in particular

- to adjust the parameterization of the DORIS-derived parameters to GNSS parameterization to allow for best possible consistency between DORIS and GNSS technique
- to make the following parameters accessible at NEQ level: station coordinates, satellite orbits, tropospheric parameters per station, clock parameter
- Implementation of residual analysis capabilities in DORIS development version for
  - residual screening and outlier detection
  - identification of non-symmetrical passes and passes with insufficient data

WP3: Development of a DORIS-GNSS processing procedure

- Setup of DORIS-GNSS procedure (BPE), which provides DORIS-GNSS processing examples based on different LEO satellites
- (2) VUGTK shall deliver the software changes to AIUB at regular intervals, but at least once per project milestones (as defined in Section 4).
- (3) At each project milestone (as defined in Section 4) VUGTK shall deliver a progress report to BKG summarising the software changes and the DORIS test results and enabling an assessment of the work already performed.

## 5. Service provided by AIUB

- (1) AIUB shall support the services provided by VUGTK by
- providing the latest version of the development branch of the BSW,
  - coordinating the software development at VUGTK with the inhouse changes of the software package,
  - carrying out regular online meetings with VUGTK (typically once a week),
  - introducing the employee at VUGTK into the software environment and latest developments at AIUB,
  - defining and supporting the necessary tests that the merged version of the software can be entered into the development version used for the operational processing.
- (2) AIUB shall provide the DORIS development version also to BKG in regular intervals, but at least at each project milestone (as defined in Section 4).
- (3) AIUB shall verify that the DORIS development version provided by VUGTK meets the WP requirements and shall submit a brief implementation evaluation report to BKG at each project milestone (as defined in Section 4).
- (4) AIUB shall deliver the final DORIS development version to BKG after reaching project milestone 3 (as defined in Section 4) by providing electronical access (internet).

## 6. Service provided by BKG

- (1) BKG shall coordinate the project and organizes monthly meetings between the Parties to discuss the progress of the project.
- (2) BKG shall perform software tests and analyses the combination of DORIS and GNSS solutions at the NEQ level for LEO satellites by using the DORIS development version.
- (3) Funds are provided by BKG upon achievement of the respective project milestone in accordance with the milestone plan based on the documented performance. For this purpose, VUGTK and AIUB shall submit progress reports and implementation evaluation reports. If a milestone cannot be reached on time, VUGTK shall submit an explanation to BKG, and the Parties undertake to agree on changes or postponements in the project plan and corresponding changes in payment. Further funds shall be provided upon achievement of each previous milestone. There shall be no peak compensation between the Parties.

## 7. Project Milestones

The Parties agree on the following project milestones (MS):

### (1) MS1: 30.06.2026

MS1 will be successfully achieved by

- completion of WP1
- provision of the DORIS development version to BKG
- delivery of a progress report (summarizing the software changes and the DORIS test results) by VUGTK to BKG
- delivery of a short implementation evaluation report by AIUB to BKG

### (2) MS2: 15.01.2027

MS2 will be successfully achieved by

- completion of WP2
- provision of the DORIS development version to BKG
- delivery of a progress report (summarizing the software changes and the combined DORIS + GNSS test results) by VUGTK to BKG
- delivery of a short implementation evaluation report by AIUB to BKG

### (3) MS3: 30.06.2027

MS3 will be successfully achieved by


- completion of all WPs, including WP3
- provision the final DORIS development version to BKG
- provision the LEO data set, PCF files, Input panels, reference solution, processing procedure (description) related to WP3
- delivery of a progress report (summarizing the software changes) by VUGTK to BKG
- delivery of a short implementation evaluation report by AIUB to BKG


## 8. Term of the agreement


The agreement shall enter into force on 01.01.2026 and shall end upon achievement of the final project milestone.


## 9. Financing

- (1) BKG shall provide the funds halfway to a milestone or after a milestone has been achieved.
- (2) The following funding allocations for VUGTK by BKG are agreed:

 Euro halfway to MS1 (31.03.2026) and upon request

 Euro after completion of MS1 (30.06.2026) and upon request

 Euro after completion of MS2 (15.01.2027) and upon request

 Euro halfway to MS3 (31.03.2027) and upon request.

## 10. Rights of use

- (1) The rights of AIUB to the BSW remain unaffected by the provisions of this agreement. AIUB is granted the right to sublicense the DORIS development version of the BSW to third parties for commercial and non-commercial purposes.
- (2) In this cooperation agreement, the DORIS development version will be used by the cooperation partners VUGTK, AIUB, and BKG exclusively for scientific and sovereign purposes within the scope of their research work, public law tasks and cooperation agreement. In the opinion of the Parties, this cooperation does not lead to a significant consumable advantage with regard to commercial use. The software enhancements related to DORIS are intended to enable processing functions for scientific purposes.
- (3) Within the first two years after the expiration of this cooperation agreement, AIUB grants VUGTK and BKG the exclusive right to use the DORIS development version of the BSW. During that period AIUB is only permitted to pass on the DORIS development of the BSW to third parties if it ensures that the DORIS developments are not used by third parties. In any other case, prior consent by BKG and VUGTK is required for the distribution of the DORIS development version of the BSW by AIUB.

## 11. Publications

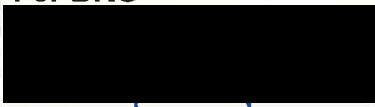

- (1) The scientific results achieved under this agreement shall be available to the Parties for their scientific and technical development work. Joint publications shall be sought.
- (2) The Parties undertake to refer to the participation of the other partner in all presentations and publications.

## 12. Miscellaneous

- (1) This agreement is governed exclusively by German law, excluding the UN Convention on Contracts for the International Sale of Goods (CISG).
- (2) Amendments or additions to this agreement must be made in writing in accordance with §§ 126, 127 BGB (German Civil Code).
- (3) The place of jurisdiction for all disputes arising from or in connection with this contract is Frankfurt am Main.

## 13. Signatures

This contract is signed in three copies, one for each of the Parties.

For BKG	For VUGTK	For AIUB
		
Date and Place	Date and Place	Date and Place
		
Signature	Signature	Signature

