**Contract for the Open access to the FLIS Infrastructure**

**2303**

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**User**

|  |  |
| --- | --- |
| Name | **Bavarian Forest National Park** |
| Registered office |  |
| VAT No. | DE355687497 |
| Represented by | Prof. Dr. Marco Heurich, Head of Department of National Park Monitoring  and Animal Management |

**And**

**Provider**

|  |  |  |  |
| --- | --- | --- | --- |
| Name | **Ústav výzkumu globální změny AV ČR, v. v. i. (Global Change Research Institute, public research institute)** | | |
| Registered office | Bělidla 986/4a, 603 00 Brno | | |
| ID No. | 86652079 | VAT No. | CZ86652079 |
| Registered in | Register of Public Research Institutes | | |
| Represented by | Prof. RNDr. Ing. Michal V. Marek, DrSc., dr. h. c., Director | | |

Pursuant to Section 1746 (2) of the Civil Code, conclude a contract as follows:

**Preamble**

* 1. The Provider has obtained funds from the Operational Programme of Research and Development for Innovations (hereinafter only as the “OP RDI”), Priority Axis 1 – European Centres of Excellence for Project Implementation CZ.1.05/1.1.00/02.0073, CzechGlobe – Centre for the Study of Global Climate Impact (hereinafter only as the “CG Project”).
  2. Using the funds of the OP RDI, the Provider, among other things, has purchased elements of specialised infrastructure. One element is FLIS – Flying laboratory of imaging systems (hereinafter only as the “FLIS”).
  3. The FLIS includes the following equipment: hyperspectral imaging spectroradiometers CASI 1500, SASI 600 and TASI 600, laser scanner Riegl Q780, air carrier Cessna C208B, and additional equipment required for data collection and processing (IMU/GNSS units, gyrostabilization platform, navigation system, etc.).
  4. According to Chapter 5.3 of the technical description of the CzechGlobe Project, the specialised infrastructure may be used at three basic levels: a) Open access, b) Project cooperation, and c) Cooperation in contractual research.
  5. The Provider has published an Open Access Call for Submitting Projects on its website. The User has submitted the project entitled “Data Acquisition over the Territory of Data Acquisition over the Territory of Bavarian Forest National Park” (project) to the Provider. The Project forms an annex to this Contract.
  6. Due to the nature of the Provider (a legal entity governed by public law whose main purpose is research) and the User (a legal entity governed by public law whose main purpose is research and dissemination of knowledge) and due to the research nature of the Project, the Provider has decided to make the FLIS available for the Project purposes.
  7. CzechGlobe performs regular maintenance and repairs of the FLIS according to plans, conditions of the manufacturers of infrastructure elements, and as needed.

1. **Purpose and the Facility of the Contract**
   1. The purpose of the Contract is to use the FLIS for Open Access science and research needs.
   2. The facility of this Contract is the Provider’s obligation to provide access to the FLIS infrastructure, including its service. The facility of this Contract is the User’s obligation to provide the Provider with cooperation (e.g. in obtaining the necessary permits, etc.) and to comply with the conditions for handling the access outputs specified in this Contract.
   3. Under this Contract, flights of a total duration exceeding 7 hours may not be conducted.
2. **Financial Arrangements on the Access Costs**
   1. No price or remuneration shall be paid in return for the access to the infrastructure. The User shall pay only the direct costs of the access to the infrastructure according to the actual scope of access on the basis of the calculation units specified in Annex No. 1 hereto.
   2. The direct costs will be paid on the basis of an invoice.
   3. VAT at statutory rate will be added to the direct costs.
   4. Bank fees related to payments shall be paid by the User.
   5. The invoice shall comply with the requirements of a tax document; the maturity will be 30 days from the date of issuing the invoice.
3. **Access to the Infrastructure**
   1. The data will be collected between 01/06/2023 and 31/10/2023.
   2. The outcomes shall be accessible to both Parties by 31/12/2023 at the latest.
   3. The outcome means raw non-georeferenced data captured over the User’s interest area defined in the Project.
   4. The scope of the outcomes is determined in the Project.
   5. The minimum accuracy of the outcomes necessary to fulfil the purpose of this Contract is specified in the Project.
   6. The User shall receive the data in the form and quality in which they will be collected.
4. **Handling the Outcomes**
   1. The outcomes may only be used for scientific and teaching purposes. Under no circumstances may the outcomes be used for commercial use. Under no circumstances may the outcomes be used for the User’s economic activity.
   2. The outcomes may be further processed using any method.
   3. The User shall not publish the outcomes in a form allowing further processing.
   4. The User may transmit the outcomes to a third party within the scope of the licence referred to in paragraph 1 of this Article.
   5. If the User publishes the outputs, the User shall indicate that the outcomes were made owing to the Provider.
   6. Both the User and the Provider shall receive the outcomes.
5. **Representatives of the Parties**
   1. The Provider’s representative is xxxxxxxxxx. This Provider’s representative may act on behalf of the Provider in association with this Contract, but may not modify or terminate the Contract.
   2. The User’s representative is xxxxxxxxxxxxxx. This User’s representative may act on behalf of the User in association with this Contract, but may not modify or terminate the Contract.
6. **Contractual Penalties and Liability for Damage**
   1. The Provider shall claim the User to pay **a contractual penalty** of **EUR 1,000** for each case of breach of this Contract by the User.
   2. A separate invoice with a maturity of 30 days will be issued for the contractual penalty; the day of taxable supply shall be deemed to be the date of issue of the invoice.
   3. The obligation to pay the contractual penalty shall not exclude the right to compensation for damage in the amount exceeding the contractual penalty. If the contractual penalty is reduced by the court, the right to compensation for damage shall remain in the amount in which the damage exceeds the amount determined by the court as reasonable without any further limitation.
   4. In association with the possible amount of potential future damage, the User acknowledges that the damage in association with unauthorized handling of the outcomes may reach up to twice the acquisition price of the FLIS.
   5. The aggregate liability of User shall in all cases be restricted to the amount paid by it under the Contract, however, it shall not in any event exceed fifty thousand euro (EUR 50,000). The parties shall not be liable for indirect or consequential damages or losses.
   6. The limitations of liability defined herein shall not apply when the damage is caused wilfully or by gross negligence.

The limitations of liability defined herein shall not apply when the damage is caused wilfully or by gross negligence.

1. **Contract Termination**
   1. The Contract may be terminated by written agreement.
   2. Unless the data are not collected by 31/10/2023 due to the unfavourable weather conditions, due to safety reasons, due to the aircraft failure, or failure to obtain the required permits, the Contract shall set aside in its entirety.
      1. The Contract may be terminated by withdrawal from the Contract. The withdrawal shall be made in writing and efficiently served onto the other party. The Provider may withdraw from the Contract in cases stipulated by law and in the case of breach of the terms of this Contract.
      2. The User may withdraw from the Contract in cases stipulated by law.
2. **Common and Final Provisions**
   1. Neither Party may assign a claim or debt from this Contract or this Contract to a third party without the written consent of the other Party.
   2. Should any of the provisions of this Contract prove to be unenforceable (non-existent), the effect of this defect on other provisions of the Contract shall be assessed by analogy with Section 576 of the Civil Code.
   3. This Contract shall be governed by Czech law, with the exception of conflict of laws. All discussions about the Work and its performance shall take place in English.
   4. This Contract may only be amended in writing, by means of a mutually signed numbered amendment to this Contract.
   5. The following annexes form an integral part of this Contract:
      * 1. Annex No. 1: Calculation Units for the Quantification of Direct Costs
        2. Annex No. 2: Project of “Data Acquisition over the Territory of BFNP”
   6. This Contract has been drawn up in 4 copies, out of which each Party shall receive 2 copies.
   7. The Parties agree unconditionally to the publication of the full wording of the Contract so that this Contract may be the subject of the information provided in accordance with Act No. 106/1999 Coll., on Free Access to Information, as amended, and Act No. 340/2015 Coll., on Special Conditions for the Effectiveness of Certain Contracts, Publication of these Contracts and on the Register of Contracts (Act on Register of Contracts), as amended
   8. The Parties hereby declare that prior to its signature, they have read the Contract and agree with its content without reservation. The Contract is an expression of their true, actual, free and serious will, in witness whereof the authorised representatives of the Parties attach their own signatures.
   9. This Contract becomes effective upon its publication in the Register of Contracts.

|  |  |
| --- | --- |
| In Grafenau on 16.06.2023 | In Brno on |
|  |  |
| Prof. Dr. Marco Heurich | Prof. RNDr. Ing. Michal V. Marek, DrSc., dr. h. c. |
| Head of Department of National Park  Monitoring and Animal Management | Director |
| Bavarian Forest National Park | Global Change Research Institute AS CR, public research institute |

**Annex No. 1: Calculation Units for the Quantification of Direct Costs**

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| --- | --- | --- | --- |
|  | Unit price | Estimated number of units per OA | Estimated price per OA (excl. VAT) |
| **Aircraft lease and operation** |  |  |  |
| FLIS lease | 0 EUR | 5.5 | 0 EUR |
|  |  |  |  |
| **Direct operational costs** |  |  |  |
| Direct operational costs of the aircraft per 1 hour of flight | 1 720 EUR | 5.5 | 9 460 EUR |
| Direct operational costs of the aircraft crew per 1 day standby | 100 EUR | 0 | 0 EUR |
| Direct operational costs for air campaign preparation | 420 EUR | 1 | 420 EUR |
|  |  |  |  |
|  |  |  |  |
| **Total estimated costs of Open Access** |  |  | **9 880 EUR** |

**Annex No. 2: Project of “Data Acquisition over the Territory of Bavarian Forest National Park”**

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**Application Form for Open Access of the Flying Laboratory of Imaging Systems (FLIS)**

**Part 1 : General Information**

|  |  |
| --- | --- |
| **Project title** (characterising the scope of application) | **Data Acquisition over the Territory of** **Bavarian Forest National Park** |
| **Project acronym** (optional) | **Bavarian Forest** |
| **Start date** (expected) | **1.6.2023** |
| **End date** (expected) | **31.10.2023** |

**Project leader**

|  |  |
| --- | --- |
| **Title** | Prof. |
| **First name** | xxxxxxxxxx |
| **Last name** | xxxxxxxxxxxx |
| **Job title** | Head of Department |
| **Organisation name** | Bavarian Forest National Park |
| **Department** | National Park Monitoring and Animal Management |
| **E-mail** | xxxxxxxxxxxxxxxxx |
| **Phone number** |  |
| **Address** | xxxxxxxxxxx |
| **City** | Grafenau |
| **Postal code** | 94481 |
| **Country** | Germany |
| **WWW** | https://www.nationalpark-bayerischer-wald.bayern.de/ |

**Contact person for all correspondence (if different)**

|  |  |
| --- | --- |
| **Title** |  |
| **First name** | xxxxxxxx |
| **Last name** | xxxxxxxxxx |
| **Job title** | Research assistant |
| **Organisation name** | Bavarian Forest National Park |
| **Department** | National Park Monitoring and Animal Management |
| **E-mail** | xxxxxxxxxxxxxxxx |
| **Phone number** | +xxxxxxxxxxxxxxxxxx |
| **Address** | Freyunger Straße 2 |
| **City** | Grafenau |
| **Postal code** | 94481 |
| **Country** | Germany |
| **WWW** | https://www.nationalpark-bayerischer-wald.bayern.de/ |

**Collaborators (if different)**

|  |  |
| --- | --- |
| **Title** |  |
| **First name** |  |
| **Last name** |  |
| **Job title** |  |
| **Organisation name** |  |
| **Department** |  |
| **E-mail** |  |
| **Phone number** |  |
| **Address** |  |
| **City** |  |
| **Postal code** |  |
| **Country** |  |
| **WWW** |  |

**Part 2: Instrument**

**1) What type of instrument would you like to use for data acquisition?**

(In case of more types of instruments please copy the following paragraph)

Specify the instrument: CASI-1500; SASI-600; TASI-600

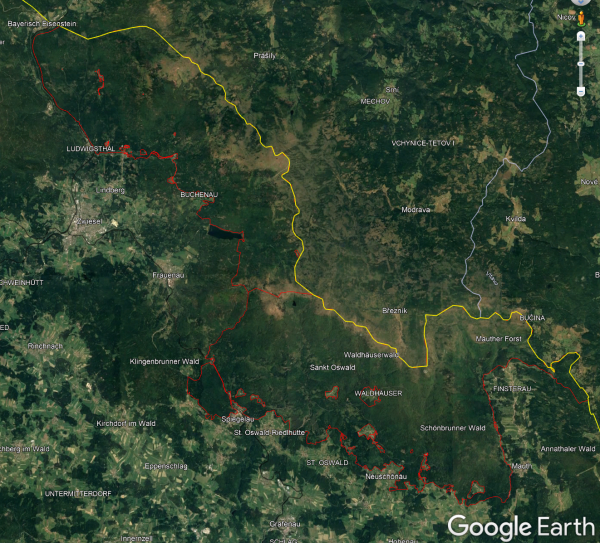
Specify desired spatial resolution:1,5m; 3,75m; 3,75m

Specify desired spectral resolution: 5nm; 15nm; 110nm;

Specify area for data acquisition:

BFNP – borders are highlighted by red color

*BFNP research site*



**2) What kind of assistance by technical staff of CzechGlobe or related services (e.g. additional corrections) is needed? Data are not georeferenced and pre-processed to level of at-sensor radiance (L1).***(Please specify not only technical features but outline also the financial aspects).*

1. *Radiometric corrections*
2. *Atmospheric corrections*
3. *Georeferencing*

**Part 3: Access to Data**

**If you need any CzechGlobe data acquired previously by FLIS, please specify** (e.g. area, type of data). Basic information about already acquired data is available on http://mapserver.czechglobe.cz/.

**Part 4: Project description (narrative)**

**4.1 Abstract of the project:** *If the project is accepted, it will be published on the CzechGlobe website. Please make this summary understandable to a general and non-scientific audience. (max. 400 words)*

Remote sensing-based forest ecosystem monitoring in the Bavarian Forest National Park:

In recent years the effects of climate change have become evident in Germany due to numerous dry summers. Forest ecosystems hereby experienced extensive and rapid transformations, that are expected to get more significant in the future. Therefore, continuous, and frequent monitoring of forest ecosystems is of great importance to get information on their conditions and developments.

National parks are an ideal study area for forest monitoring since the ecosystem is allowed to develop naturally. Long time series of forest structure data from permanent ground observation plots and inventories are available as surveying the developments is one of their core tasks. The Bavarian Forest National Park is Germany’s most important research site for remote sensing-based forest monitoring, having a long history of acquiring specialized remote sensing datasets. It was found, that remote sensing-based forest inventories are much cheaper to conduct, superior in information content for some parameters and can be performed more often.

Therefore, this project aims to develop concepts to link the remote sensing and ground datasets to detect characteristics on forest structure and biodiversity, that cannot be derived from one of those exclusively. These include information on single trees (e.g., height, species, condition, etc.) and different habitats (productivity, biomass, regrowth, etc.) on the scale of the full national park. To do so, innovative methods and algorithms using machine learning and artificial intelligence are used. The parameters are not only modelled at present time but in retrospective as well using the already present database. This allows to derive trends and detect changes in the ecosystem.

The already existing database of remote sensing and ground data on will be brought up to date by conducting new surveys. From the remote sensing perspective, new data from a variety of sensors will be acquired: Airborne laser scanning, multispectral, and hyperspectral data of high resolution will be acquired to get detailed information on single tree level. Satellite data will be used to implement a long-term and temporally dense monitoring of the stands and on the full scale by filling the gaps between the airborne acquisitions.

The acquired data will be analyzed in the context of current forest ecosystem changes caused by climate change. The results can be used to develop management strategies aiming to protect and conserve the national park forests. Also, the management of commercial forests can benefit, as the project provides essential knowledge supporting silvicultural practices.

**4.2 Description of the project** (aims, methodology, outcomes; max. 1000 words)**:**

Motivation

In recent years the effects of climate change on German forests have become evident due to numerous dry summers. These changes also apply to the Bavarian Forest National Park. For example, the average temperature in March has increased by more than 3 °C and instead of one summer day per year during the 1970s, up to 40 are recorded at present. These rapid changes also lead to the extensive transformation of forests. Therefore, it is of great importance to monitor forest condition and development continuously and more frequently.

National parks are very important when it comes to long-term monitoring of the environment, as these protected zones are allowed to develop naturally without human influence over large areas. This makes them suitable for detecting changes resulting from climate change only. The Bavarian Forest National Park hereby represents an ideal study area for the long-term monitoring of forest ecosystems, as many high-resolution remote sensing datasets were acquired in recent years within the framework of the "Remote Sensing Data Pool". Concomitant to this, extensive ground data on forest structure was recorded at continuous observation plots and trough inventories since the establishment of the national park to address a wide range of research questions.

Based on the analysis and results of this project, management strategies can be developed aiming to protect and conserve the forests. This also makes the project important for the management of commercial forests, as it provides essential knowledge supporting forest science and silvicultural practices.

Objectives

This project aims to develop concepts for linking remote sensing data techniques with ground data from forest inventories and monitoring sites, enabling the detection of characteristics, that cannot be derived from remote sensing data exclusively. These include metrics on biodiversity such as vegetation density, biomass, phenology, photosynthetic activity, as well as forest structural parameters (e.g., tree height, diameter and age, tree species distribution, wood volume and forest regeneration). All these metrics will be modelled at present time as well as in retrospective. For referencing purposes, new ground data are generated in addition to the one available through past projects. The resulting datasets are then evaluated regarding forest development in the context of current forest damage issues and the needs of the national park management. The generated products on biodiversity and forest structure are managed to be easily accessible to users and will also support further research projects of the national park.

Methods

The already existing extensive ground data on forest structure and biodiversity will be extended and brought up to date by conducting new surveys. To be most efficient in terms of time and costs, the implementation of forest inventories using classical methods will be avoided as far as possible. Instead, the 3-D structure of the forest will be recorded with high precision on representative points and areas using a mobile laser scanning system.

These data will be merged with airborne laser scanning, multi- and hyperspectral data acquired using UAVs and aircrafts, enabling extrapolation to the entire area of the national park while maintaining high resolution. The BFNP has a large base of such data already available and to bring it up to date, these will be re-recorded. This way, the current forest condition can be detected and compared to the past. The focus of the airborne remote sensing datasets will be the delineation of single trees and their conditions. While LiDAR and multispectral data can be used to assess the 3D structure of the forests and generate different structural metrics (e.g., tree height, volume, vegetation density, etc.), they only can delineate between coniferous, deciduous, and dead trees successfully. However, this is not accurate enough for the demands of the national park administration and forest management. Hyperspectral data on the other hand generates much more precise information on the spectral signature of each respective tree than multispectral data. Therefore, it can be used to distinguish more species and detect their condition much better.

To implement a long-term and temporally dense monitoring, data originating from the ground and airborne surveys will be fused with data from various satellite-based systems featuring multispectral, thermal, hyperspectral, RaDAR, and LiDAR sensors. In particular, the freely available satellite data of the European and American space agencies ESA and NASA will be used. In addition, high-resolution satellite images will be acquired to be able to observe parameters on smaller scales, like the phenology of different tree species. Concerning long-term observations, the satellites of the Landsat program can be used, which offer continuous data since 1972 - almost since the founding of the national park. Here, the already existing, extensive historical ground data can serve as a reference.

For all data analysis and modeling the target parameters, innovative methods and algorithms using machine learning and artificial intelligence will be utilized.

**4.3 Is the project connected with / (co-)financed from a grant** *(e.g. EU grant, public subsidy)***?**

No

**4.4 Do you see a potential for financing this proposed research cooperation from any research or similar funding and would you be interested in this kind of project cooperation with CzechGlobe?**

Yes

**4.4.1 If yes, please specify: Bavarian Forest National Park**

**4.5 Is any part of the project covered by confidentiality?**

~~Yes~~ / No

**4.5.1 If yes, please specify and give the reasons for confidentiality:**