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GRUAN Technical Note 9

GRUAN Site Photographs Guide

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Abstract

This Technical Note outlines the generic steps required to ensure that a long term site photographic record is maintained in support of the documented reference-quality data. The aim is to establish a long-term visual record against which any unaccounted for variability in data measurement can be assessed.

Contacting GRUAN Lead Centre

Please contact the GRUAN Lead Centre (gruan.lc@dwd.de) if you have any questions or comments in relation to this document.

Revision history

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1 Introduction

This Technical Note outlines the generic steps required to instigate and maintain a long-term site photographic record. A photographic record of the site provides valuable metadata to both present and future users of GRUAN data. By initiating the agreed protocols described herein, a site's reliability can be assured over a significant temporal span, which is critical to the integrity of the reference quality data record.

The purpose of this Technical Note is to set guidelines for the provision of photographic evidence that:

- Provides a graphical record of the site environment over decades;
- Describes compounding factors;
- Provides intimate site-led knowledge of the local environment;
- Aids the certification and audit process.

By following the guidelines described hereunder, a valuable resource for assessing changes in the environment at the site will be provided that will help contextualise measurements taken over the long term and provide a rich metadata-set.

2 Site photography guidelines

Scope

A comprehensive set of photographs providing a horizon-wide view of the site, taken from various reference locations, should be provided at an appropriate refresh frequency. There are two components to the site photographic record:

1. Site overview: provides an overall assessment of the site's environment;
2. Instrument view: details relevant site features pertaining to each individual instrument.

For site overview photographs it is anticipated that the refresh frequency will be every five years. This should ensure that any significant site-wide environmental changes are captured. For instrument-specific photographs, and for most sites, the refresh frequency should be approximately four times throughout the year to reflect seasonal variation. Such frequency should capture evidence pertaining to potential anomalies; for example, systematic errors attributable to signal multipath effects of slow growing vegetation, and environmental electromagnetic variation due to changes in soil moisture (*Larson et al.*, 2010; *Pierdicca et al.*, 2014).

If seasonal variation is not significant, for example in sub-tropical desert zones, photographic frequency can be adapted appropriately at the discretion of the station but with agreement of the Lead Centre. Constant vigilance however is required to proactively detect compounding factors which may require additional 'upon exception' photographs to be lodged and perhaps an adaptation to the photographical scheduling and / or locations. Such factors may include:

- Unplanned changes; for instance trees being planted or removed that may alter the site environment in a step-like fashion.
- Changes that occur to the site itself; for example, the construction of new buildings.
- Changes in the location or configuration of measurement systems.
- Any change in the instrument system itself.

It is imperative that all such change events be recorded in the metadata associated with the site and that these events be specifically identified.

Template overview

There are two templates for recording site photograph details (see Appendix A):

i) Site Overview
ii) Instrument View

The Site Overview template is to provide an overall assessment of the site's environment. Aspects such as location, general topography and climate will be captured by these photographs. This will aid in establishing constraining factors that may impact all or a large number of the instruments at the site and provide necessary context.

The Instrument View template encompasses features pertaining to each individual instrument. Aspects such as instrument type, site location, photograph direction and date will be captured.

Different measurement techniques have different dependencies, so what is appropriate to photograph is necessarily instrument dependent. For example, lidar is upward looking only, whereas GNSS-PW relies upon signal attenuation across multiple lines of sight. Having instrument-specific photos ensures that users interested in only one or a subset of instrumental series can easily access only those photos relevant for contextualisation.

Each site should use its expertise to assess photographic requirements for its instruments, ensuring that the relevant aspects of instrumentation and environment are captured. Relevant aspects will necessarily differ between instruments. For this reason, it is essential that sites enter appropriate detail to describe the rationale for each photograph (see Appendix A, *ii*) *Instrument View:* Instrument Details and Agreed Photo Rationale). For example, for GNSS-PW it is clear that a record of monumentation and its changes would be useful, whilst this is not likely to be necessary for a lidar instrument.

It is envisaged that the Site Overview refresh frequency be five-yearly, associated with certification and / or periodic audit, or at the occurrence of a significant site change. Conversely, Instrument View photos should be taken seasonally throughout the year, as appropriate. As an example, after five years at a mid-latitude temperate climate site the photographic record would be one Site Overview plus twenty seasonally recurring sets of Instrument View photographs.

Specific guidelines

For each instrument, a panoramic photograph should be constructed with measurement technique dependencies such as rising ground, buildings and vegetation annotated. Images taken in the direction of compass points N, E, S, and W will give a comprehensive panoramic view in a repeatable manner. The instrument should be at an appropriate location when taking photographs so as not to mask detail and ideally photos should be taken from repeatable features such as corners of buildings or instrument monumentation. If an instrument is present at two or more locations, site photos for each instrument location should be taken.

Sites should adjudge on a case-by-case basis, and on known issues, whether additional instrument positioning photographs are required to provide further context. Details should be captured in Appendix A, *ii*) *Instrument View:* Instrument Details and Agreed Photo Rationale.

To contextualise the photography, the site's configuration and instrument locations should be outlined on a sketch map / aerial photograph that includes:

- Layout of site, with North indicated, with relevant instrument locations indicated;
- Vegetation type and seasonal considerations.

Where instruments are spread over a wide area, it may be necessary to provide supplemental photos to illustrate more accurately the instruments' positions within the overall layout of the site.

Each photo file name should include searchable terms for ease of interrogation in an automated fashion. Appendix A contains the Site Overview and Instrument View templates to be used for site photography. Appendix B contains a worked example.

3 Upload protocol

Metadata and photographs can be uploaded via the GRUAN Data Portal (https://dp.gruan.info). Separate access to the portal is set up for each GRUAN site. In case the account information is required or if there are any questions regarding contents of the presented guidelines, please contact the GRUAN Lead Centre at gruan.lc@dwd.de.

Relevant facts about the data portal are listed below:

```
Host:       dp.gruan.info
Account:    <user-name>    ... provided by Lead Centre
            <password>     ... initial password provided by Lead Centre,
                               changeable via the Web UI
            <public-keys> ... can be added via the Web UI
Path:       /upload/SiteEnvironment
Web UI:     https://dp.gruan.info  [/web/client/login]
            (port 443)
SFTP:       port 22
FTP:        port 21
            TLS explicit required
            passive port range is 50000-50100
WebDAV:     port 10443
            protocol is HTTPS
```

1. Folders for all GRUAN sites are named thus: *<site-code>_<site-name>*
   e.g. *"LIN_Lindenberg"*
2. Each "Site overview" or "Instrument view" should be stored as a packed file (e.g. *"*.zip"*) within the correct site folder using the following file naming protocol:
   - Site overview:
     *<site-code>*_site-overview_*<date>*.zip,
     e.g. *"LIN_site-overview_2018-05-24.zip"*
   - Instrument view:
     *<instrument-code>*_instrument-view_*<date>*.zip,
     e.g. *"LIN-RS-01_instrument-view_2018-06-30.zip"*
3. Content of each zip file should be:
   - Site overview:
     - ASCII text file (*"*.txt"*) with all details,
       file name e.g. *"LIN_site-overview_2018-05-24.txt"*
     - image file (*"*.png"* or *"*.jpg"*),
       file name e.g. *"LIN_site-overview_aerial-photo_2018-05-24.png"*
   - Instrument view:
     - ASCII text file (*"*.txt"*) with all details,
       file name e.g. *"LIN-RS-01_instrument-view_2018-06-30.txt"*
     - several image files (*"*.png"* or *"*.jpg"*),
       file name e.g. *"LIN-RS-01_instrument-view_North_2018-06-30.jpg"*

Three example files are available in subfolder *"_example"*. Please check and compare.

Appendix

A Site Photography templates

i) Site Overview

Site Details	Note: These entries need only be updated on exception
Name & Affiliation	
Address	
WIGOS ID	
Location	
Date	
General topography	
Climate	
Sketch map / aerial overview (indicating instrument locations)	

ii) Instrument View

Instrument Details (n)	Note: These entries need only be updated on exception
Description	{*Include any relevant measurement geometry and site-specific considerations*}
Repeat photo schedule / rationale	
Photograph Details	Note: These details should be updated with each new submission
Date	
N	{*insert digital image*}
E	{*insert digital image*}
S	{*insert digital image*}
W	{*insert digital image*}
Remarks (e.g. photo was taken in snow, but snow only lay on ground 3 days this season)	

B Worked example: Lindenberg (LIN), Germany

i) Site Overview

Site Details	Note: These entries need only be updated on exception
Name & Affiliation	Lindenberg
Address	Am Observatorium 12, 15848 Tauche OT Lindenberg, Germany
WIGOS ID	10393 LINDENBERG
Location	Latitude: 52.21°N, Longitude: 14.12°E, Altitude: 98 m
Date	2018-05-24
General topography	The land use in this area is dominated by forest and agricultural fields, lakes, villages and traffic. Embedded in the countryside are small and medium-sized lakes and the river Spree. Around Lindenberg are sandy soils and small hills.
Climate	Moderate mid-latitude climate at the transition between marine and continental influences.
Sketch map / aerial overview (indicating instrument locations)	

ii) Instrument View

Instrument Details 1	Note: These entries need only be updated on exception
Description	{*Include any relevant measurement geometry and site-specific considerations*} GNSS receiver
Repeat photo schedule / rationale	3 months / Photos of seasonal variation of surrounding vegetation, capturing Summer, Autumn, Winter and Spring seasons.
Photograph Details	Note: These details should be updated with each new submission
Date	2018-06-30
N	
E	
S	
W	
Remarks (e.g. photo was taken in snow, but snow only lay on ground 3 days this season)	

Instrument Details 2	Note: These entries need only be updated on exception
Description	{*Include any relevant measurement geometry and site-specific considerations*} Radiosonde launch site
Repeat photo schedule / rationale	1/year. Seasonal variation of surrounding vegetation. Instrument not dependent upon field of view.
Photograph Details	Note: These details should be updated with each new submission
Date	2018-06-30
N	
E	
S	
W	
Remarks (e.g. photo was taken in snow, but snow only lay on ground 3 days this season)	

Acronyms

GNSS	Global Navigation Satellite System
GNSS-PW	Global Navigation Satellite System - Precipitable Water
GRUAN	GCOS Reference Upper-Air Network

Bibliography

Larson, K. M., *et al.*, Gps multipath and its relation to near-surface soil moisture content, *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, **3**(1), 91–99, 2010, URL https://doi.org/10.1109/JSTARS.2009.2033612.

Pierdicca, N., L. Guerriero, R. Giusto, M. Brogioni, and A. Egido, Savers: A simulator of gnss reflections from bare and vegetated soils, *IEEE Transactions on Geoscience and Remote Sensing*, **52**(10), 6542–6554, 2014, URL https://doi.org/10.1109/TGRS.2013.2297572.