Progress of Graw DFM-09 & DFM-17 GRUAN Data Product development

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Graw Radiosondes in the GRUAN Network

- Graw Radiosondes has been a manufacturer in Germany for radiosondes since almost 90 years
- (historic) DFM-06 radiosonde was already used for the LUAMI campaign in 2008
- DFM-09 radiosonde (now superseded) was used in Singapore from 2012-2015
- DFM-17 radiosonde is being used on potential GRUAN candidate site in Dakar
- Regular comparison flights between GDP-Radiosondes and DFM-17 at Lindenberg and Potenza

Scope of GDP development

- Single GRUAN Data Product for
- some DFM-09 radiosondes
- heated DFM-17 radiosondes
- (unheated DFM-17 radiosondes)

Project Team

- **GRUAN-LC** Laboratory Characterization, Algorithm Implementation and Validation, peer-reviewed Paper
- **Graw Radiosondes** Calibration Uncertainties, Algorithm Implementation, Technical Document
- **Cologne University for Applied Sciences** Algorithm Implementation and Validation, peer-reviewed Paper

Common GDP Framework

- Pre-processing
- Data import & mapping
- Processing & quality control
- Quality assessment
- Data export

General & ground check	Pressure & altitude	Wind & ventilation	Temperature	Humidity
Make time axis steady	Calculate position (XYZ → LLA)	Pendulum analyse	Position of sun	Time-lag correction
Combine & grid data sources	Pressure calibration	Calculate ventilation	Estimate radiation (RTM simulations)	Smoothing (time-lag related)
Quality control of all input vars.	Recalculate alt. MSL, GPH	Calculate wind speed & direction	Radiation correction	Recalculation (internal T to air T)
Detect launch points	Calculate pressure using alt. (GNSS)	Smoothing (pendulum effects)	Smoothing (pendulum effects)	Estimate uncertainties
Detect & analyse SHC / shelter	Estimate uncertainties	Estimate uncertainties	Estimate uncertainties	Calculate further humidity variables
	Quality control of pressure & alt.	Quality control of wind	Quality control of temperature	Quality control of humidity

Common GDP Framework

- use the existing framework of the RS41 GDP
- new modules in Python, maybe port old modules to Python aswell
- new openly documented archive data format which can be created for old flights as well
- recalculate 1s interval data prior to processing as this is not native to the DFM data format
- make this data processing available to non-GRUAN users without sending data to the processing site

Main Challenges

- Reimplementation of IDL modules in Python and Integration with new modules
- Best practices for 1s interval data resampling
- Processing differences for different radiosonde models/archive formats
- "interesting" paper topic

What has been achieved since ICM-16

- 1) scope and general requirements (language, platform, supported sondes)
- 2) procedure regarding telemetry frames <> datasets
- 3) specific procedures for individual variables
- 4) completion of necessary laboratory tests, implementation
- 5) validation during ascents, publication of the beta GDP
- 6) finish writing the TD / paper
- 7) publication/certification of the GDP

Current Work Items

Python Reimplementation	DFM-17 Code Changes	Laboratory Measurements	Technical Document	Cal Traceability Whitepaper	Peer-Reviewed Paper
integrate altitude and humidity into common framework	Gridding, Merging and QC changes (import script)	U – Time Lag	instrumentation & measurement practice	collect information	collect ideas
location coordinates and wind	integrate laboratory measurements	(U – SHC for TD/Paper)	sensor characterization and evaluation of GDP variables	compile whitepaper	**GRUAN Website**
temperature	check for additional changes needed		traceability & uncertainties		update technical entries
flight phases			GDP documentation chapters		

Road Ahead

- 1) scope and general requirements (language, platform, supported sondes)
- 2) procedure regarding telemetry frames <> datasets
- 3) specific procedures for individual variables
- 4) completion of necessary laboratory tests, implementation
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ICM-17

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Questions for the community

- Is GRUAN ready for a GDP that follows open software principles?
- That can be computed by anyone
- Where fork versions can be created by anyone
- How to properly distinguish GRUAN data from data that uses an open-source GDP?