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Propagation of GDP uncertainties with DVAS - Data Visualization and Analysis Software

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with many thanks to

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for numerous enlightening discussions.

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ICM-12 | 5-7 | 20.11.2020

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Upper-Air Instrument Intercomparison – UAI2021

What: international comparison of upper-air instruments.

When:

August 2021* (field campaign)

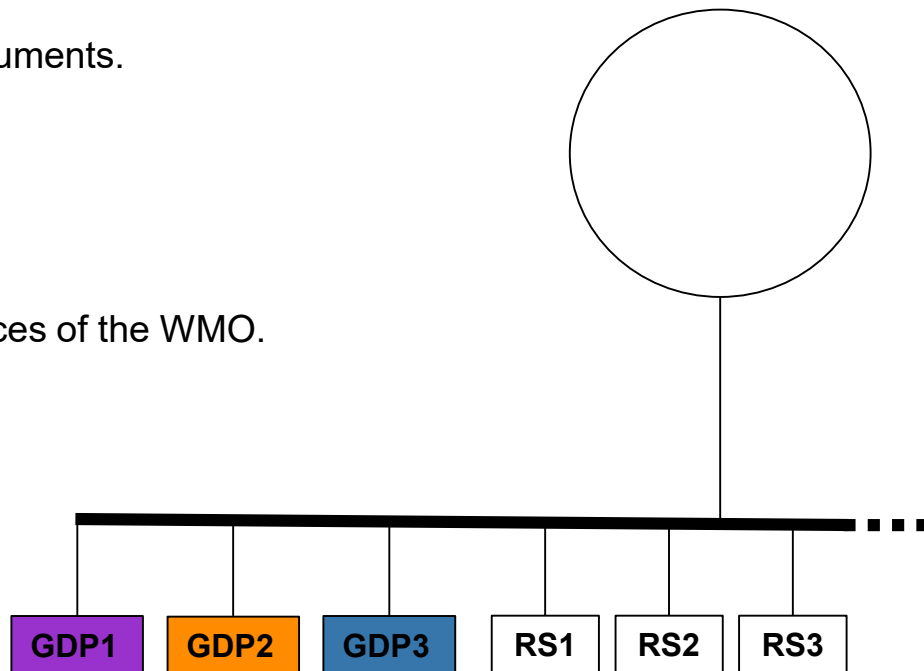
December 2021* (lab campaign)

*: to be confirmed

Where: Lindenberg, Germany.

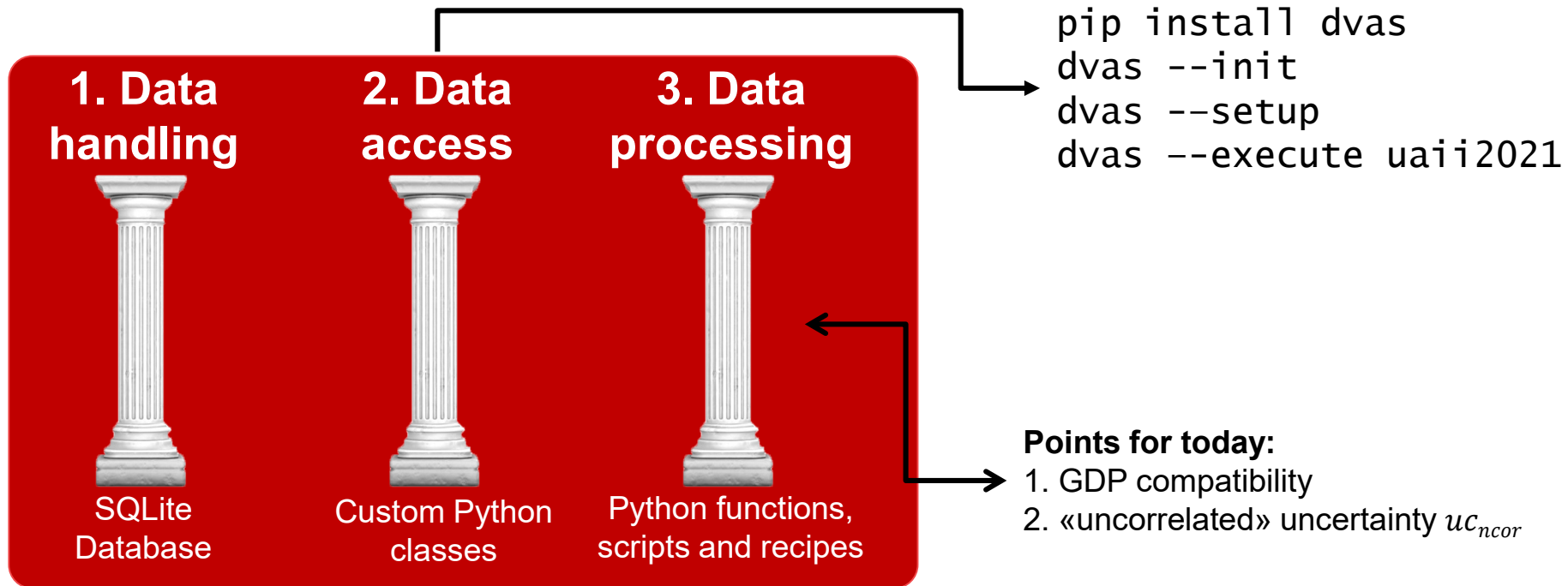
Who: DWD (lead), MeteoSwiss, under the auspices of the WMO.

Field campaign concept:
GRUAN Data Products (GDPs) used as
working measurement standards
in multi-payload flights



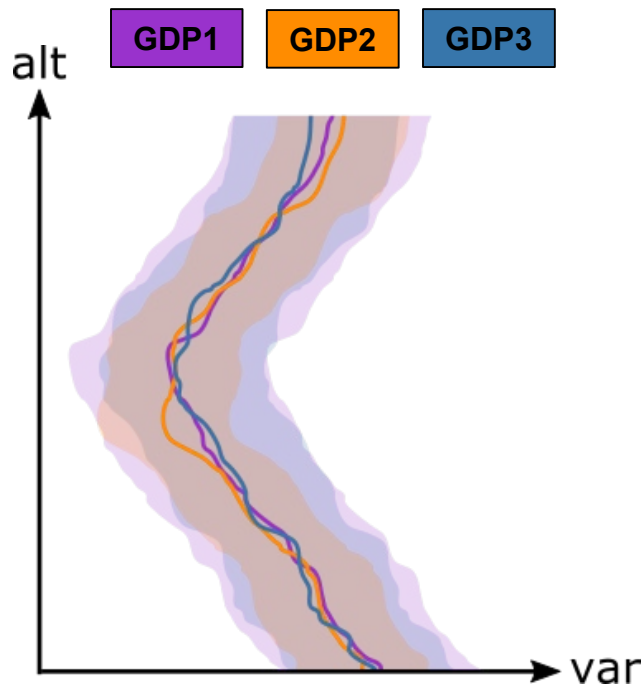


DVAS – Data Visualization and Analysis Software

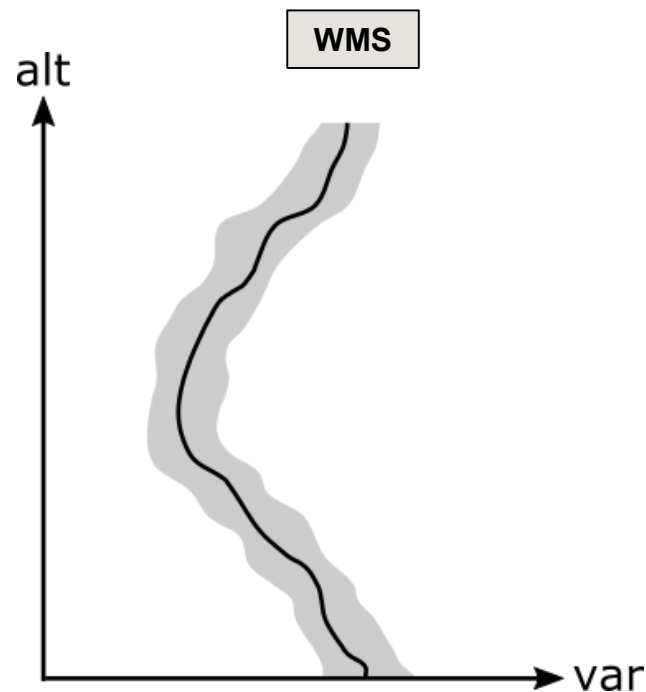




The key challenge of pillar 3

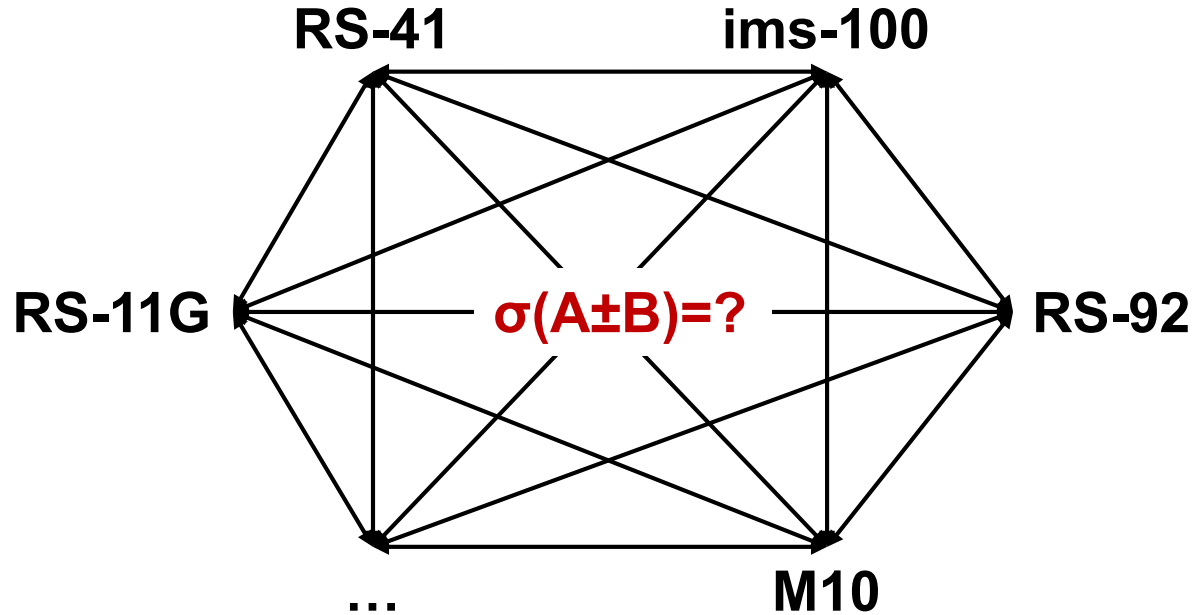


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1. Are GDPs compatible in their uncertainties ?





DVAS statistical formalism

Example (RS-11g temperature):

$$u_temp^2 = u_std_temp^2 + u_cor_temp^2$$

(uncorrelated) (correlated)


Goal(one of them): full propagation of correlated and uncorrelated uncertainties.

Requirement:

All GDP uncertainties can be *uniquely mapped to a common set* of uncertainty families.



So ... are GDP uncertainties compatible ?

GDP	σ_1	σ_2	σ_3
RS-92	u_std_ 	u_cor_	-
RS-11G	u_std_	u_cor_	-



So ... are GDP uncertainties compatible ?

GDP	σ_1	σ_2	σ_3
RS-92	u_std_ ⚠	u_cor_	-
RS-11G	u_std_	u_cor_	-
RS-41	_uc_ncor	_uc_tcor	_uc_scor
...	?	?	?

$$\mathbf{uc}_{scor} = \mathbf{0}$$

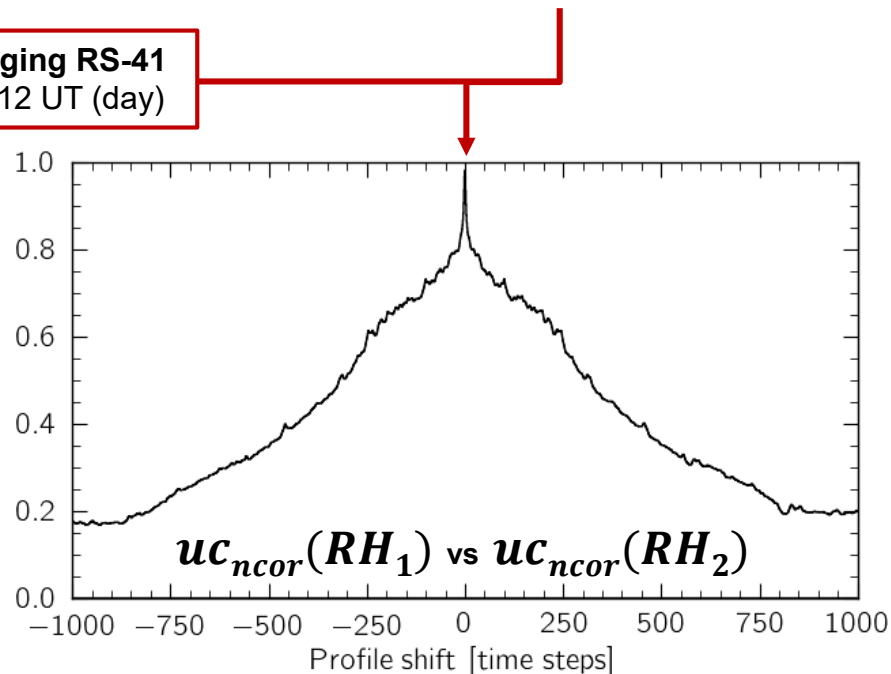
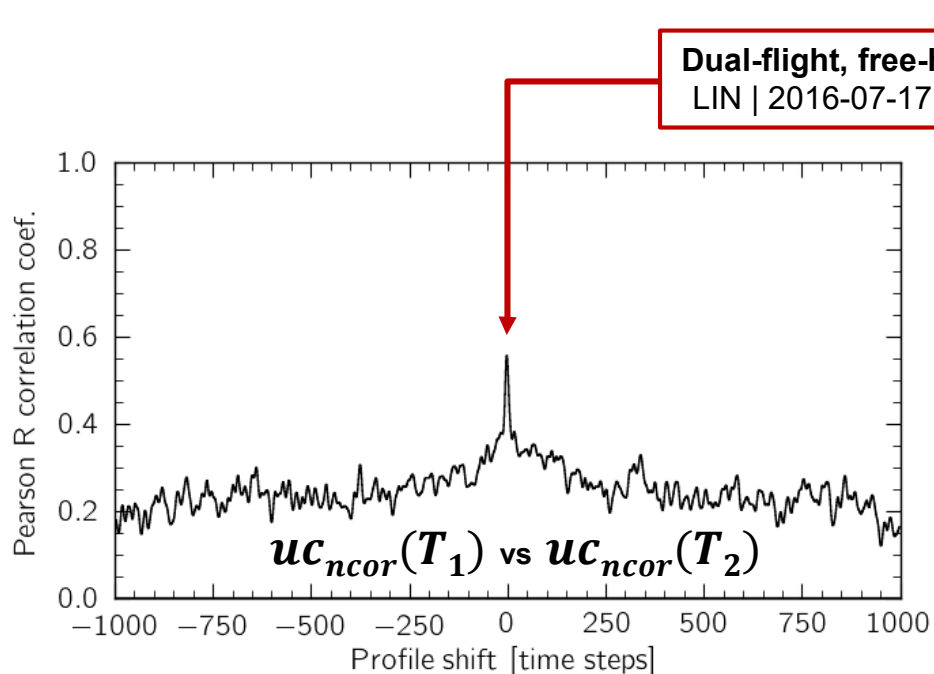
$\forall var \neq T_{day}$



2. The «uncorrelated» uncertainty uc_{ncor}

uc_{ncor} is called «uncorrelated» (e.g. Dirksen et al., 2014)

... but is it (always) the case ?



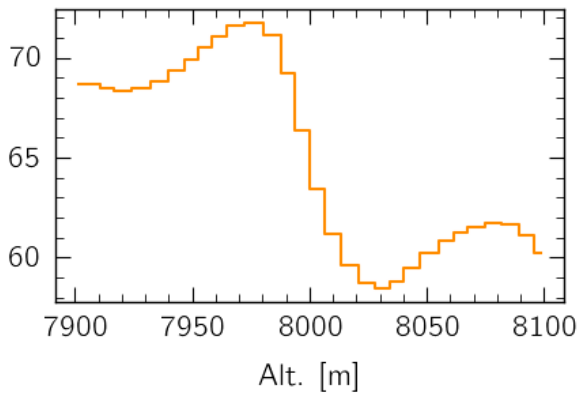
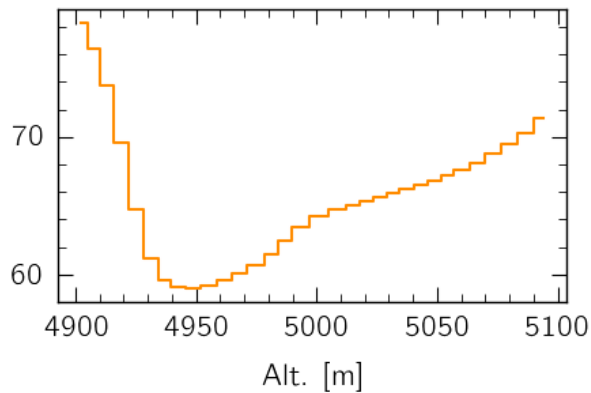
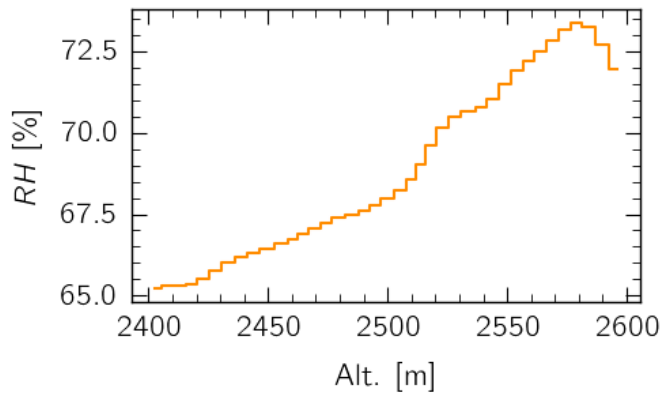
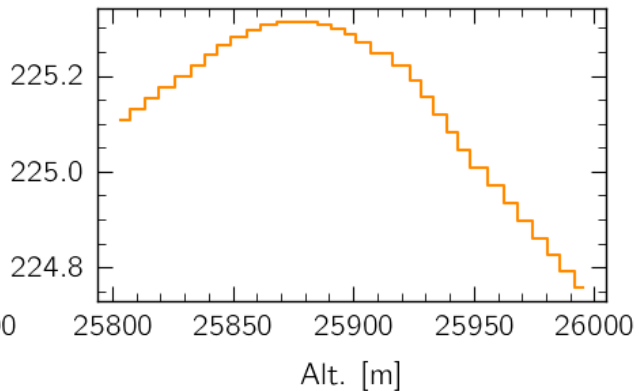
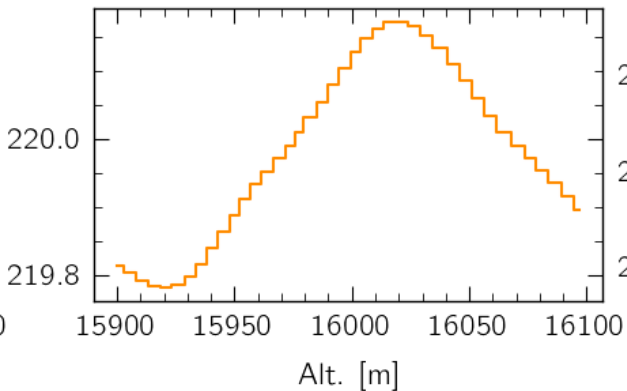
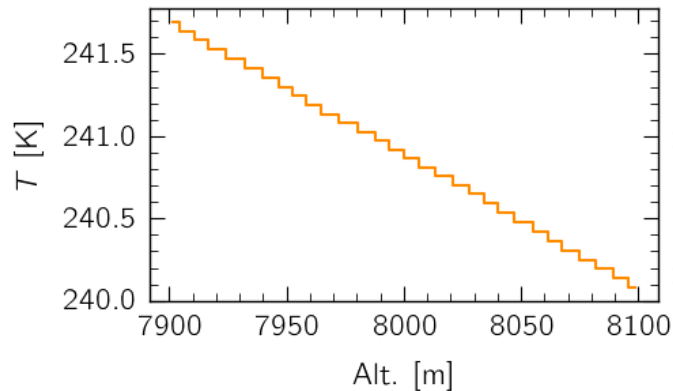
Dual-flight, free-hanging RS-41
LIN | 2016-07-17 @ 12 UT (day)



Where does uc_{ncor} come from ?

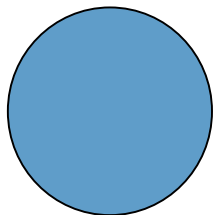
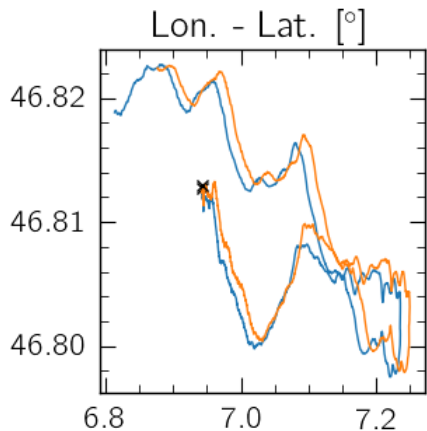
← ~40 sec →

RS-41 | PAY | 2020-07-14 @ 12 UT



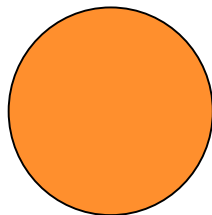


This was no typical flight ...

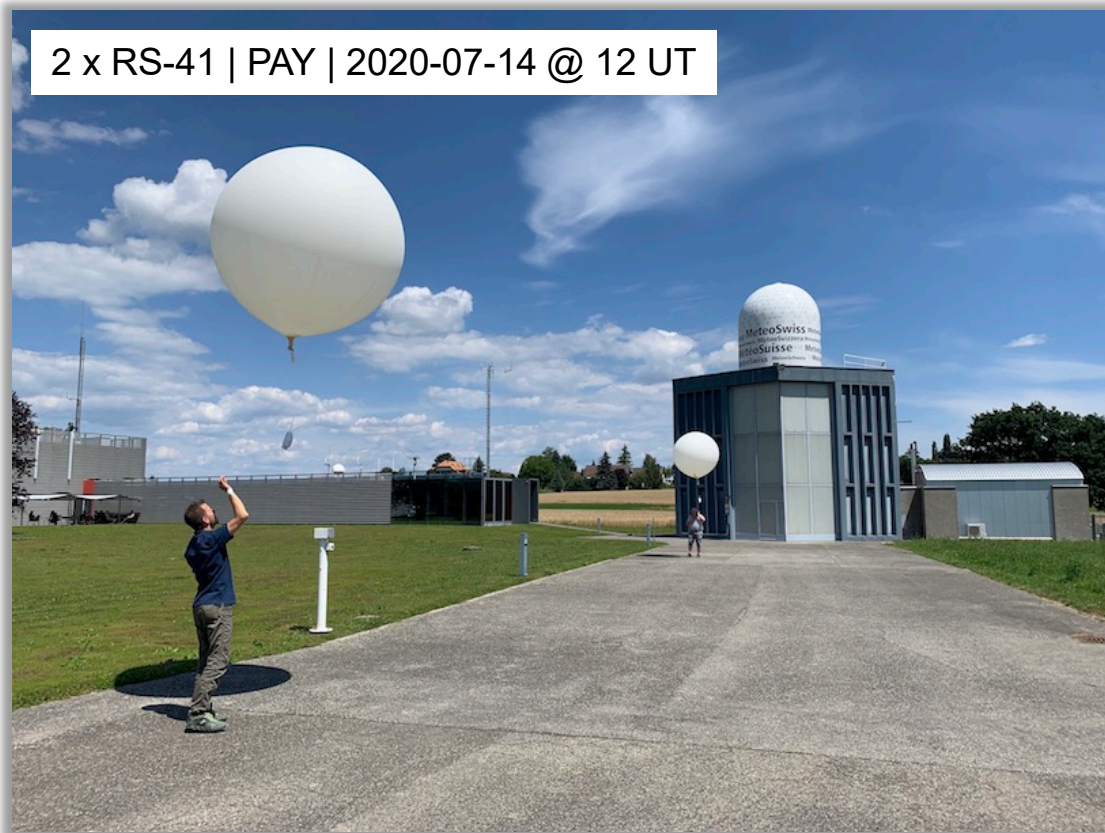


RS41

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RS41

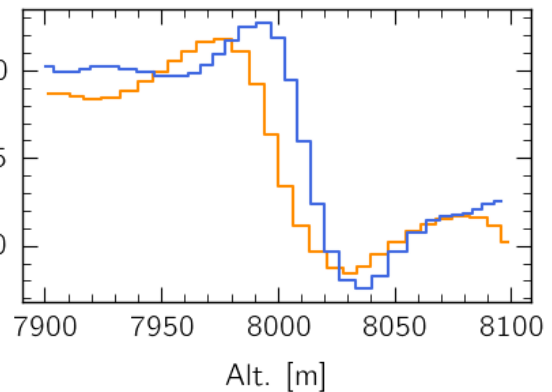
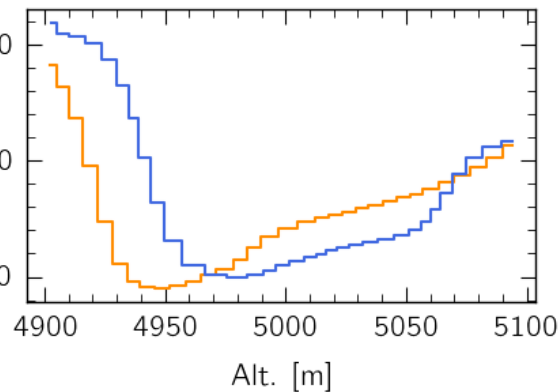
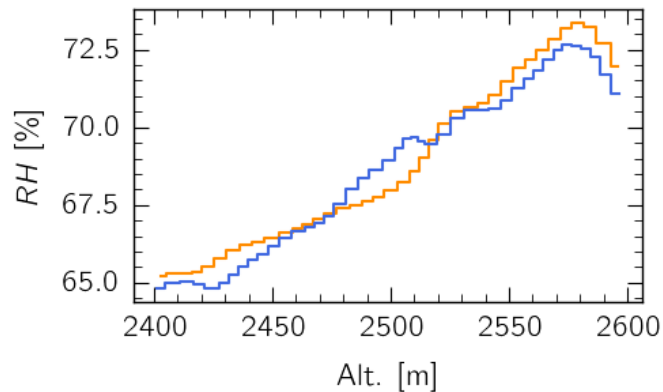
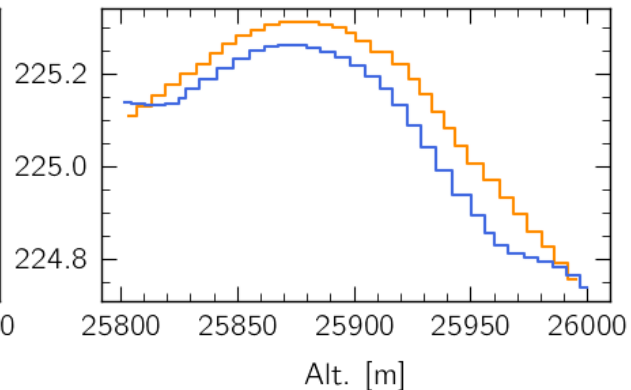
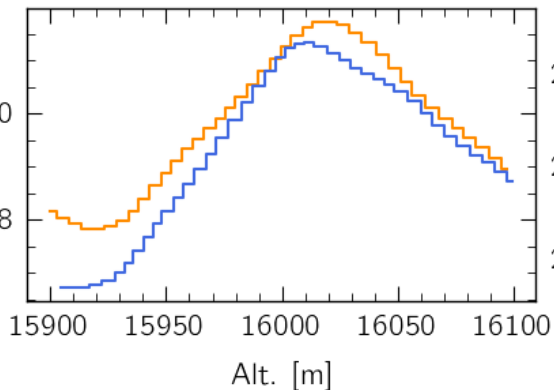
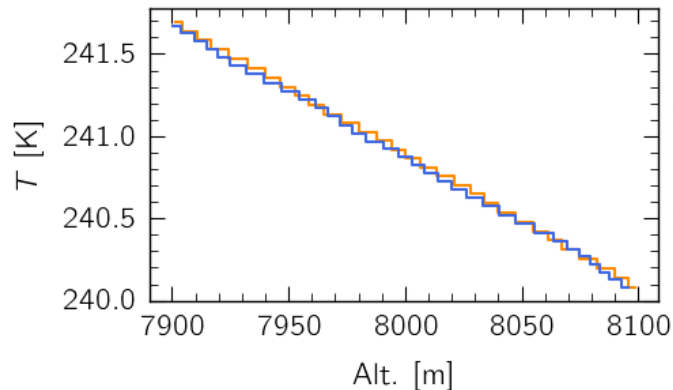




uc_{ncor} is affected by real atmospheric fluctuations!

2 x RS-41 | PAY | 2020-07-14 @ 12 UT

← ~40 sec →





Our conclusions for uc_{ncor}

- **Current algorithm is sensitive to real atmospheric fluctuations**
 - uc_{ncor} is correlated for multi-payload flights
 - uc_{ncor} is overestimated
- **Can this be improved ?**
Probably (e.g. detrending, etc...)
- **Can this be improved before the UAI2021 ?**
Probably not.



The current plan for uc_{ncor} in dvas

uc_{ncor} in dvas will be treated as **uncorrelated**.

1. Atmospheric fluctuations
→ **correlation & overestimation** of uc_{ncor} for multi-payload flights
2. Ignoring correlation
↔ minimizing overestimation of uc_{ncor} in the propagation of uncertainties



Summary

dvas: new Python code to analyze upper-air instrument intercomparison data

↳ **Goal**^(one of them): «best-possible» handling of GDP uncertainties.

Challenges:

1. Consistency/compatibility of GDP uncertainty schemes
2. uc_{ncor} algorithm is sensitive to real atmospheric fluctuations
 - correlation
 - over-estimation



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