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WORLD METEOROLOGICAL ORGANIZATION

Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD

Life in a multi-GDP World

The UAII 2022 perspective

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with contributions from the UAII Task Team:

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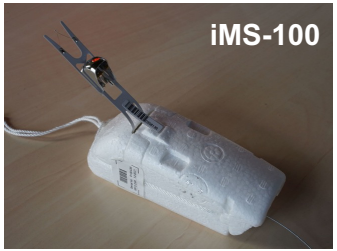
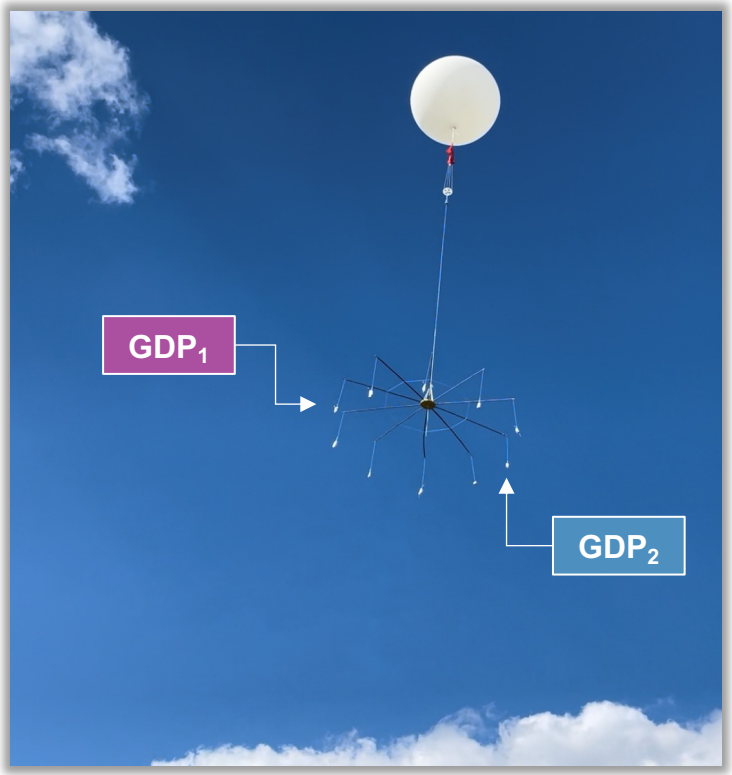
GDPs as working measurement standards

Motivation:

- SI-traceable measurements
- Comprehensive, altitude-resolved uncertainty estimation
- Open-source algorithms
- Documented, incl. metadata

UAII GDP selection:





Coming up next …

- Assessing GDPs compatibility
- iMS-100 & RS41 GDP surprises

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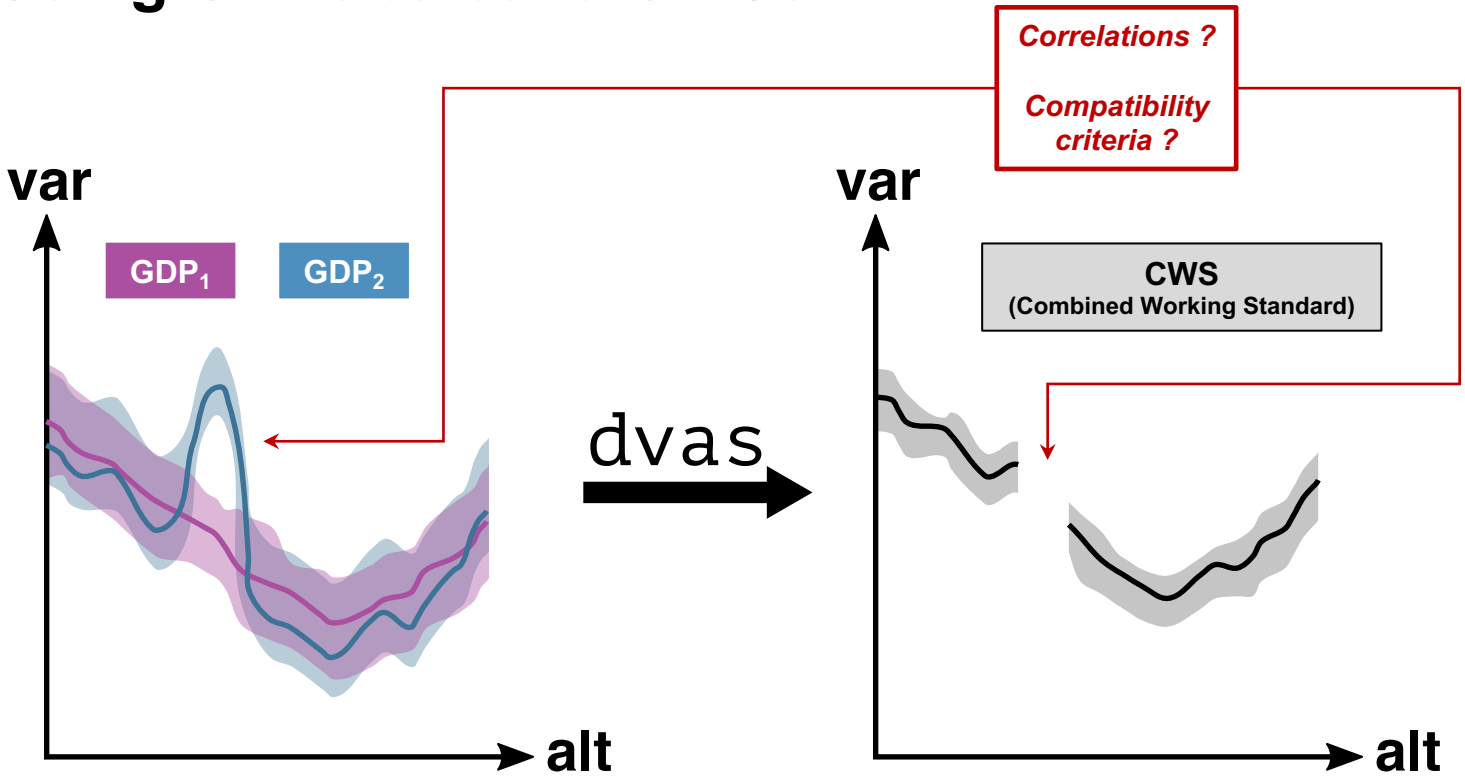
Using GDPs to build CWSs



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iMS-100 & RS41: correlations ?

GDP	σ_1	σ_2	σ_3
RS92	u_std_	u_cor_	-
RS-11G	u_std_	u_cor_	-
RS41	_uc_ucor	_uc_tcor	_uc_scor
iMS-100	_u_ucor	_u_cor	-

$\sigma(GDP_1 - GDP_2)$?

$\nexists$ GRUAN guidelines
… yet ?

UAII (dvas): NO correlation between RS41 and iMS-100

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GDP compatibility

GRUAN data processing:

- *corrects for all known errors and biases*
- *provides best estimate of the vertically-resolved measurement uncertainty*

$GDP_1 - GDP_2$

Normal distribution
⇔
Compatible

$$k = \frac{\Delta}{\sigma(\Delta)} \overset{?}{<} 2$$

Uncertainty($GDP_1 - GDP_2$)

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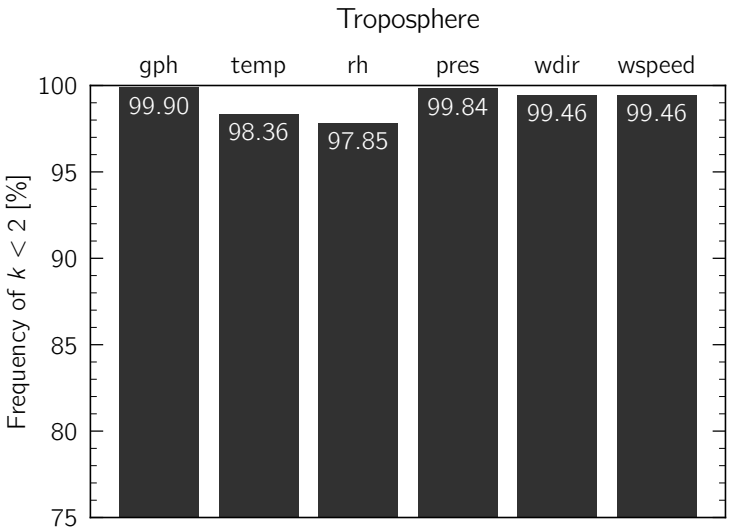
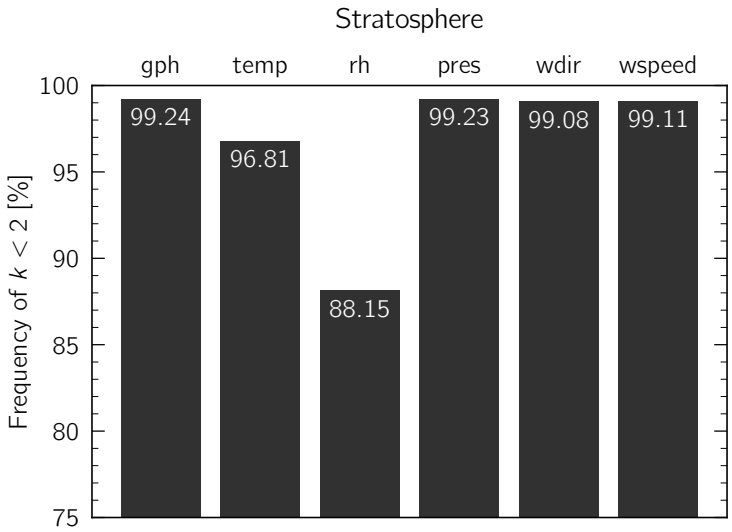
iMS-100 GDP vs RS41 GDP

$$k = \frac{\Delta}{\sigma(\Delta)} \overset{?}{<} 2$$





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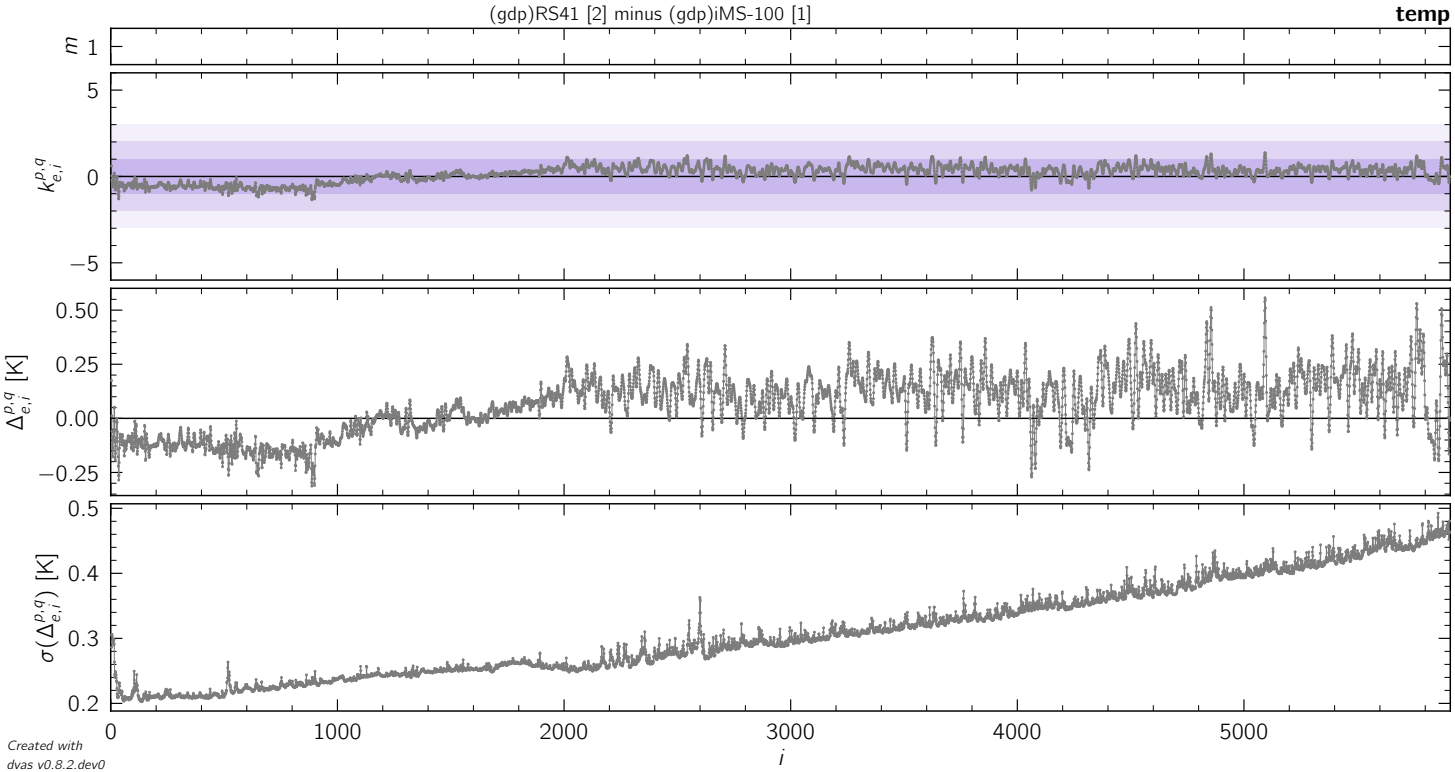
Profile deltas to test GDP compatibility

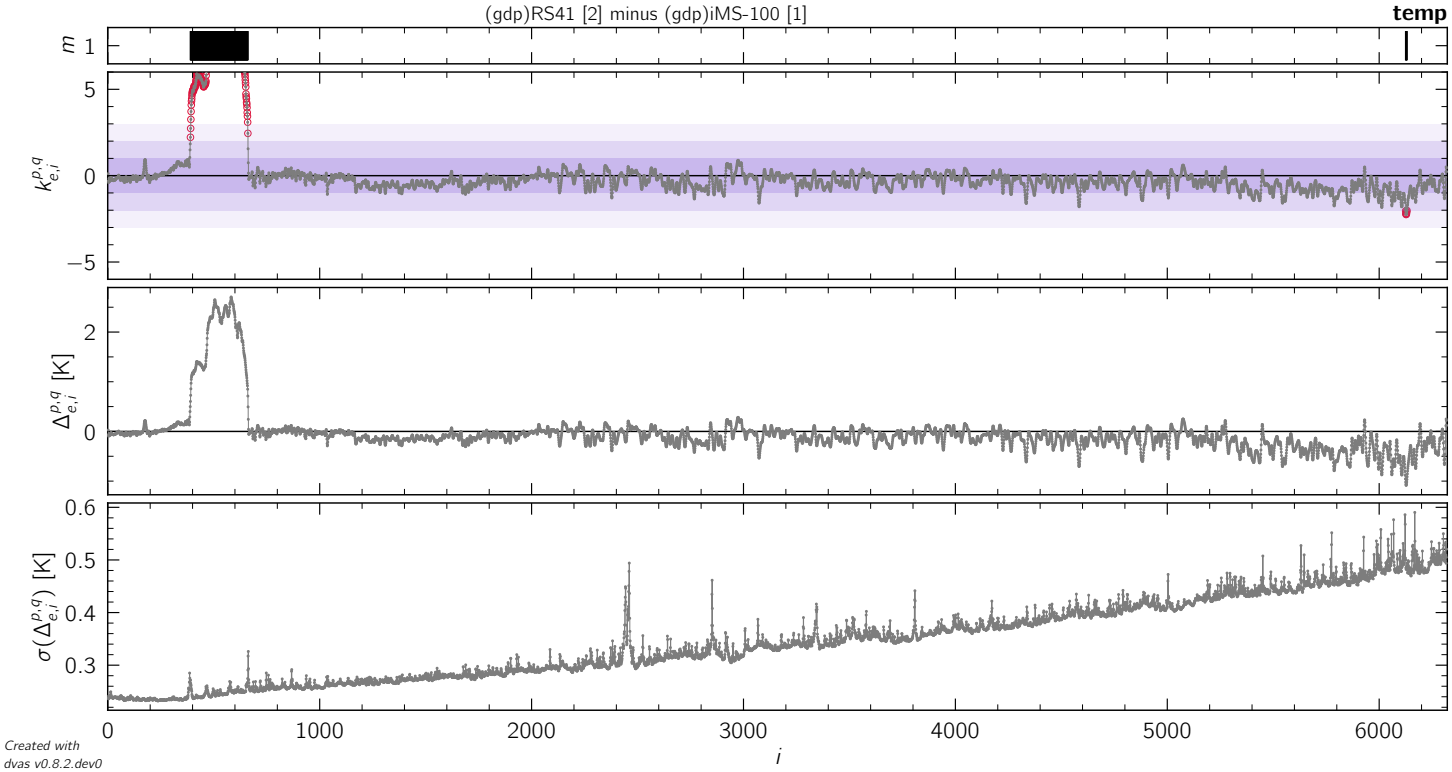


$$k = \frac{\Delta}{\sigma(\Delta)}$$

$$\Delta$$

$$\sigma(\Delta)$$

GDP mismatch example I: cloud exit

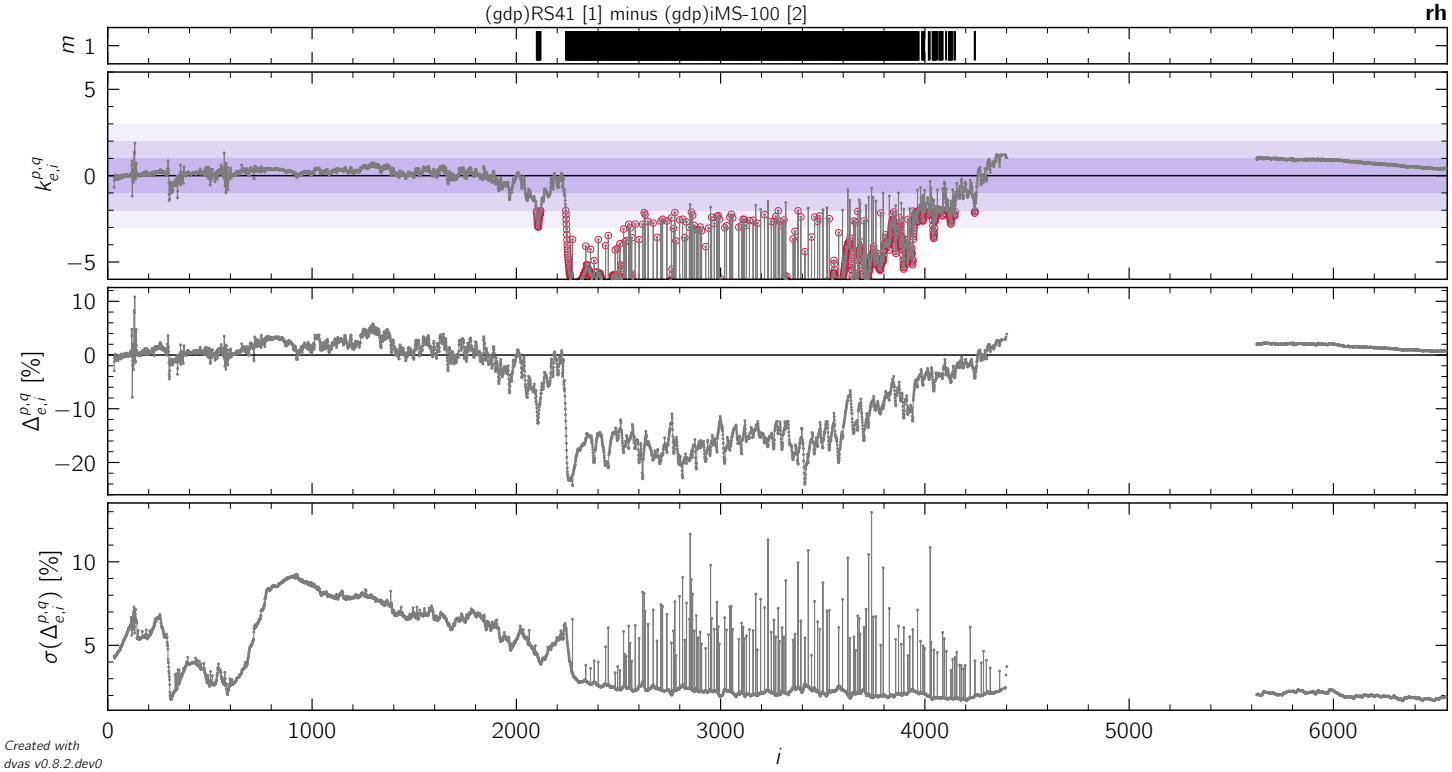


$$k = \frac{\Delta}{\sigma(\Delta)}$$

$$\Delta$$

$$\sigma(\Delta)$$

GDP mismatch example II: RH in LS



$$k = \frac{\Delta}{\sigma(\Delta)}$$

$$\Delta$$

$$\sigma(\Delta)$$

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Other GDP suprises …

Badness scale

Format/data inconsistency

Violation of GRUAN principles

Other GDP suprises …

Badness scale

Format/data inconsistency

- 😕 RS41: k=2 vs iMS-100: k=1
- 😖 iMS-100: lacks “**`g.Measurement.InternalKey`**”
- 😵 RS41: time as float(= **`float64`**) vs iMS-100: time as long (= **`int64`**)
- 😭 RS41: gph jumps of –(25-30)m

Violation of GRUAN principles

- 😨
- 😱
- 😱
- 😱
- 🤯
- 🤯

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Other GDP suprises …

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Violation of GRUAN principles

- 😨 RS41: GPS time offsets **[up to ~5 sec]**
- 😱
- 😱
- 😱
- 🤯
- 🤯

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Other GDP suprises …

Badness scale

Format/data inconsistency

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Violation of GRUAN principles

- 😨 RS41: GPS time offsets **[up to ~5 sec]**
- 😱 RS41: valid gph with no uncertainty **[up to 250/profile; see RS41 GDP user guide, Sec 5.1]**
- 😱 iMS-100: valid wdir/wspeed with no uncertainty **[up to 10/profile]**
- 😱 iMS-100: invalid rh with valid uncertainty **[up to 2500/profile]**
- 🤯
- 🤯

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Other GDP suprises …

Badness scale

Format/data inconsistency

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Violation of GRUAN principles

- 😨 RS41: GPS time offsets **[up to ~5 sec]**
- 😱 RS41: valid gph with no uncertainty **[up to 250/profile; see RS41 GDP user guide, Sec 5.1]**
- 😱 iMS-100: valid wdir/wspeed with no uncertainty **[up to 10/profile]**
- 😱 iMS-100: invalid rh with valid uncertainty **[up to 2500/profile]**
- 🤯 RS41 vs iMS-100: T mismatch at high altitude at night
- 🤯 RS41 and iMS-100: mis-estimation/mis-assignment of uncertainties

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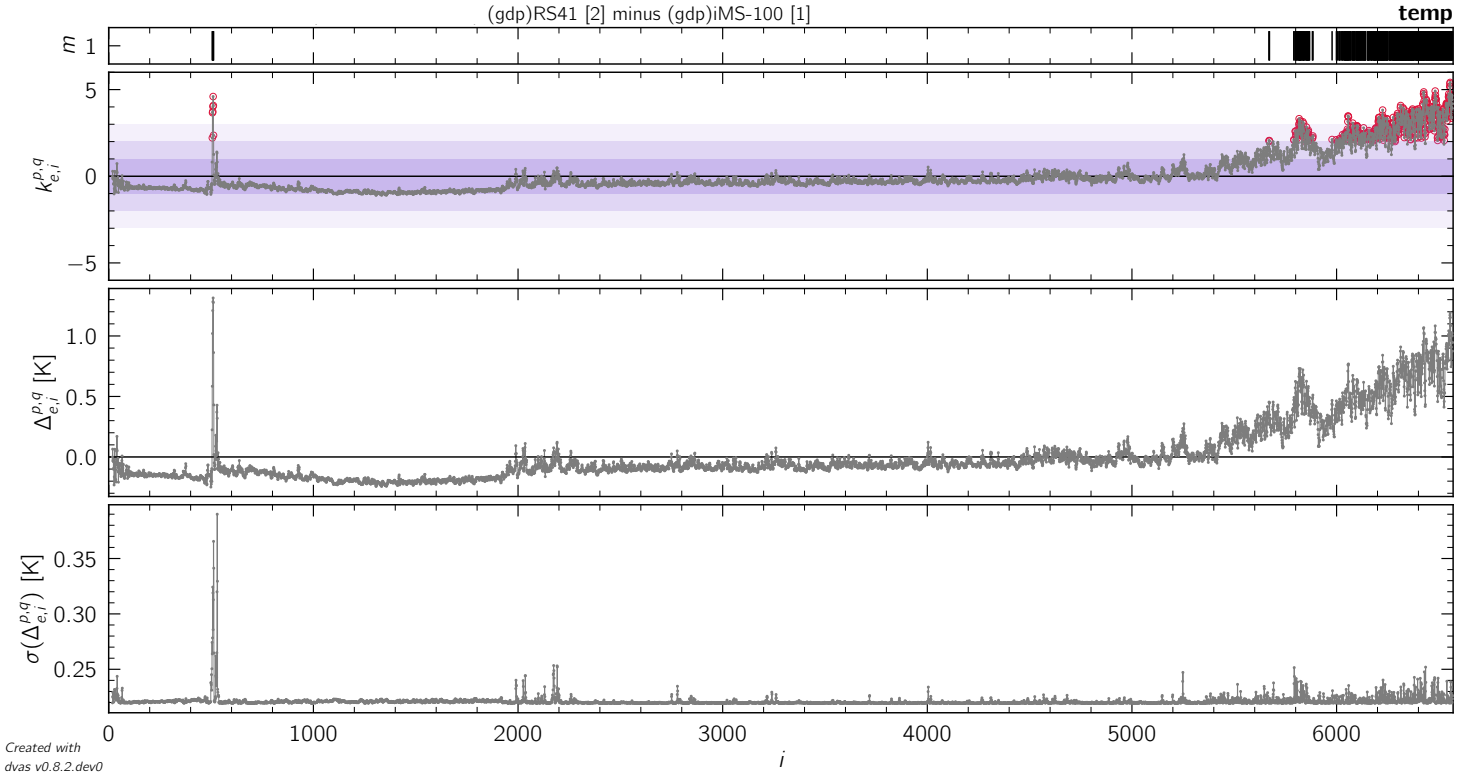
T mismatch @ high altitude @ nighttime



iMS-100 vs RS41
temp

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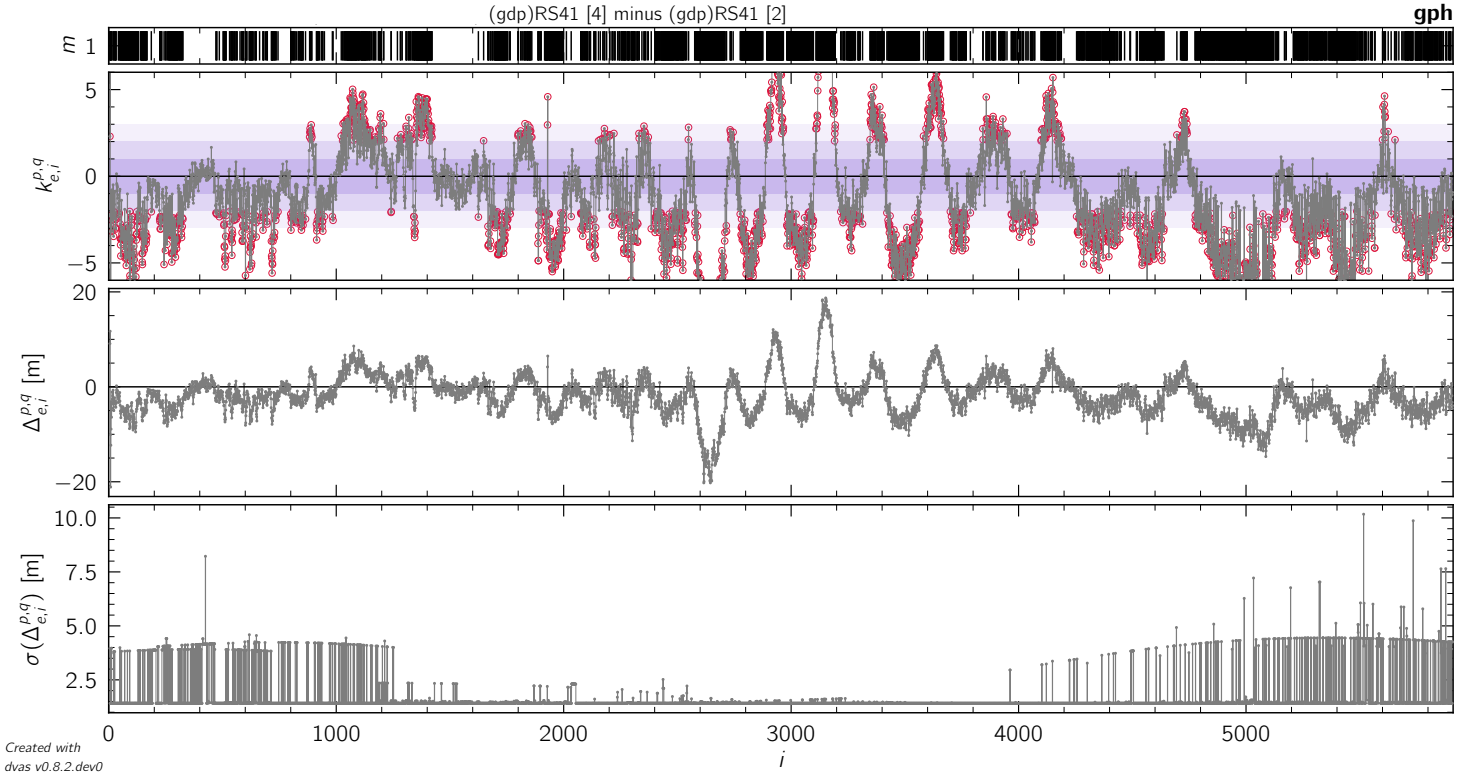
Mis-estimation/-assignment of uncertainties (I)



RS41 vs RS41
gph

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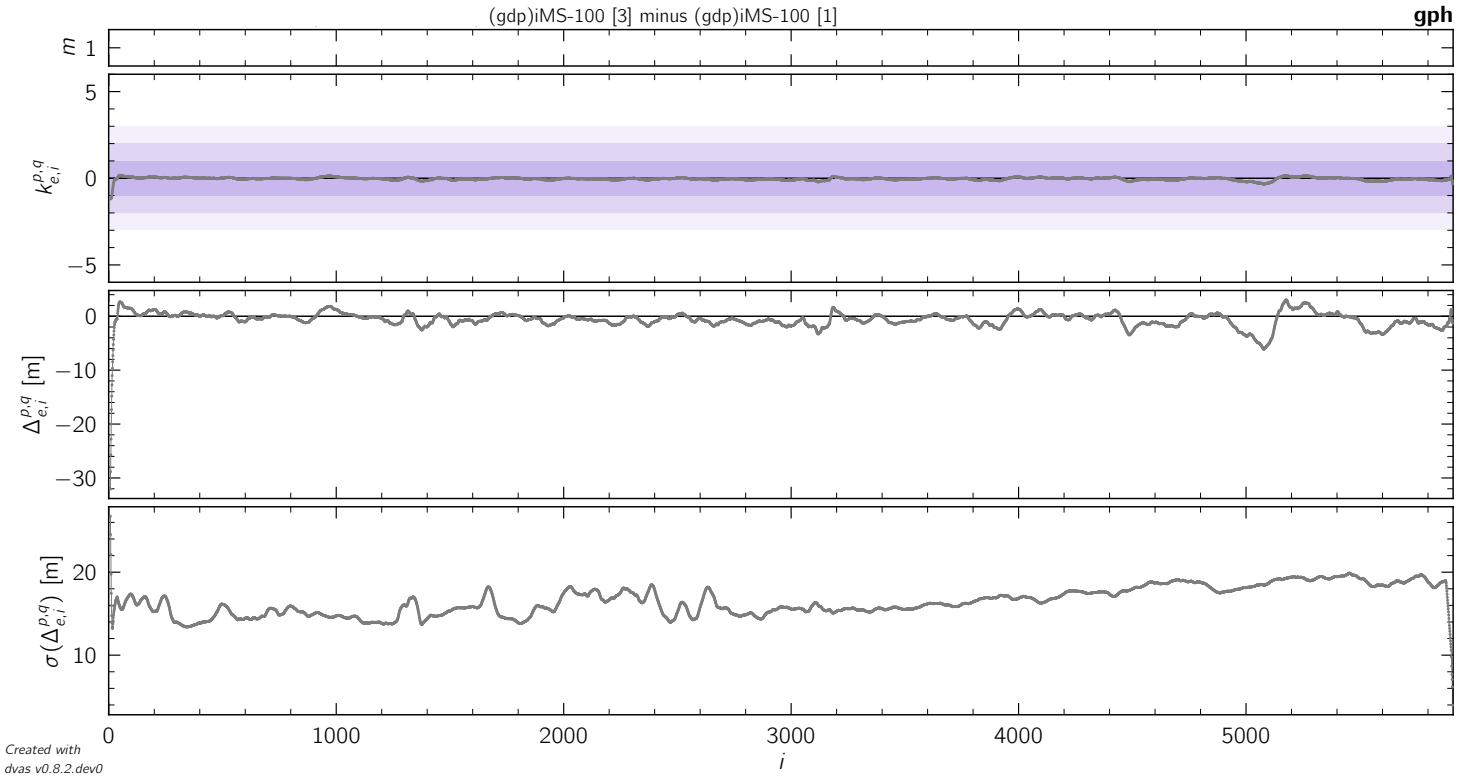
Mis-estimation/-assignment of uncertainties (II)

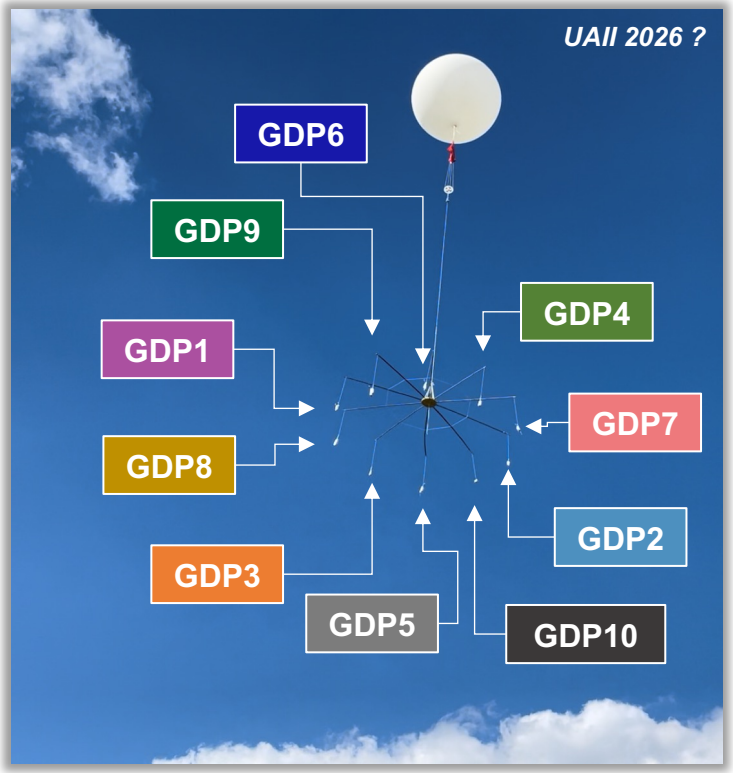


iMS-100 vs iMS-100
gph

Summary

- **Life in a multi-GDP World is great !**
- **GDP consistency is paramount for users**
  netCDF syntax & content, uc scheme, interpolation/smoothing, …
- **Cross-GDP GRUAN guidelines are needed**
- **GDP△: useful tool to validate uncertainties**

Thank you all for the GDP v1's.
We look forward to v2's and more v1's !



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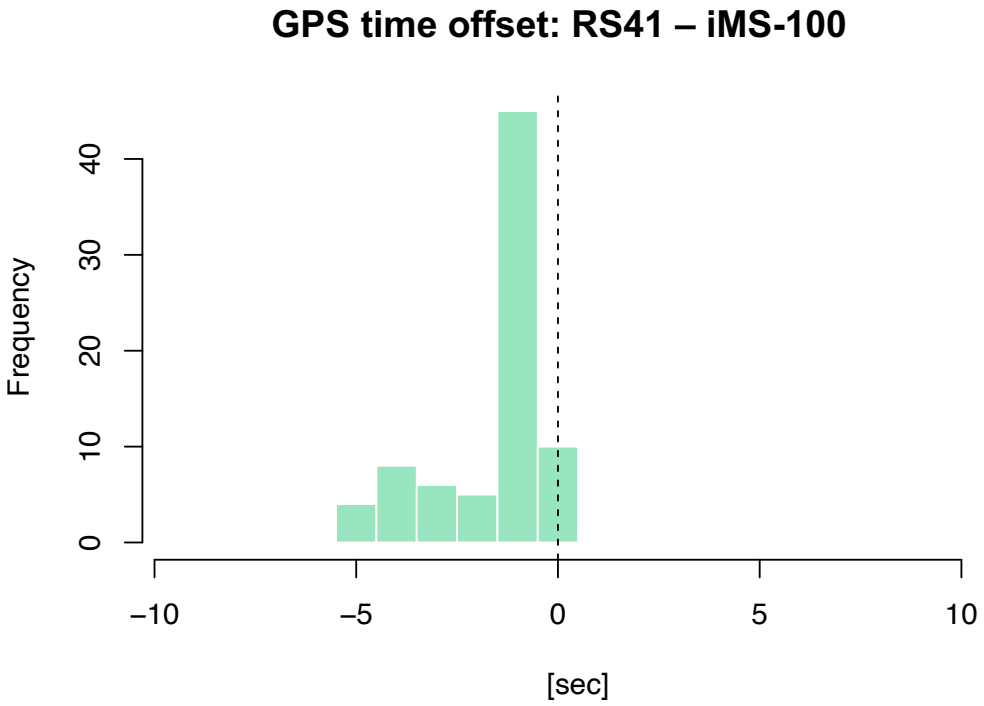
GPS absolute time offsets