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Monitoring environmental conditions during key comparison travelling standard transportation using a data logger

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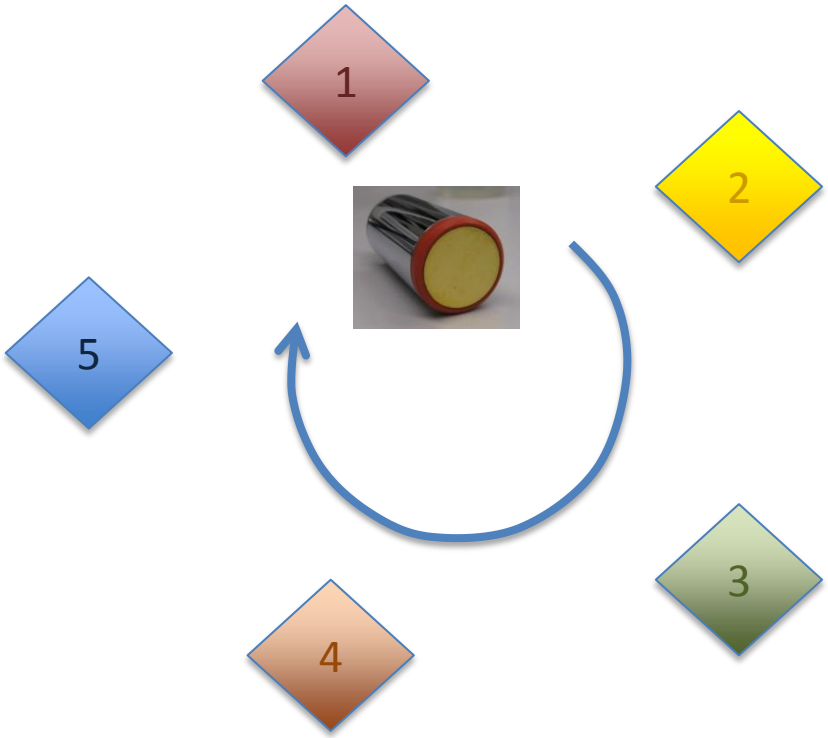
Key comparisons as basic element of MRA

Mutual Recognition Arrangement:

Participating national metrology institutes, […], recognize the degree of equivalence of national measurement standards, derived from the results of key comparisons



Preparation of a key comparison

Risk assessment of pilot laboratory

- Identification of critical environmental factors and conditions
- Definition of limits

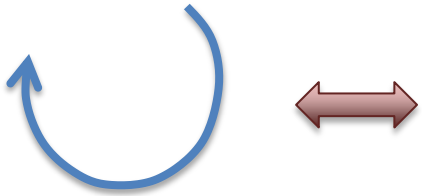
Choice of manufacturing of appropriate transport packaging

- Which package is appropriate?
- Does it fulfill the requirements?

Choice of transportation

- By hand or courier?
- Air-plane or surface transport?
- Courier or private car?
- Is “putting” critical?

Transport is critical



Transportation: stability

Key comparison rules:

…must be handled with care, i.e. only by qualified metrology personnel. It is desirable and in some cases essential that the transfer instruments be hand-carried.'

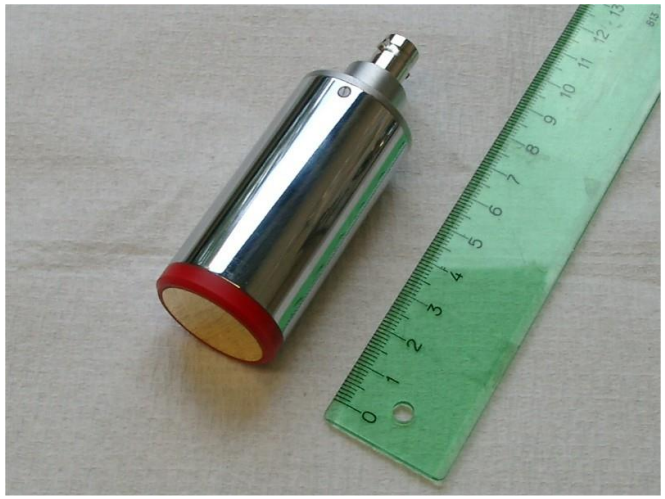
- Is this really the case?
- What happens during transport?

Example: CCAUV.U-K3.1 comparison

Planning for CCAUV.U-K3.1

Risk assessment of pilot laboratory

- Large pressures damage the $LiNbO_3$-crystal, risk for sealing
- Temperature range 5 – 25 °C
- Temperature gradients threat the sealing
- Humidity is not critically
- Shocks should be avoided



Appropriate transport packaging

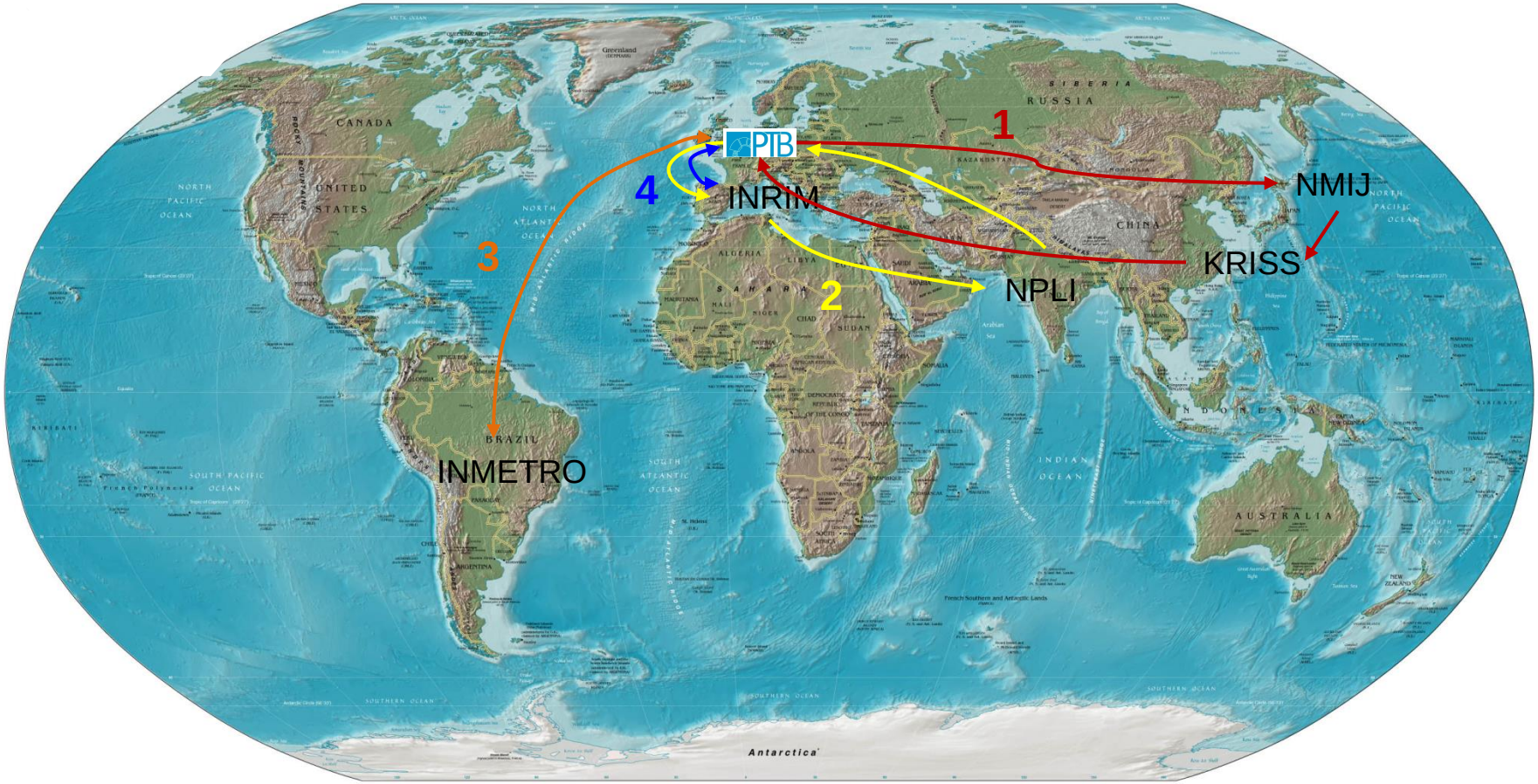
- Temperature isolated
- Tight volume

Is it effective?

Transportation

Choice of transportation

- Air-plane: by hand only if possible
- Surface: by hand in train and public transport



Measurement by data logger

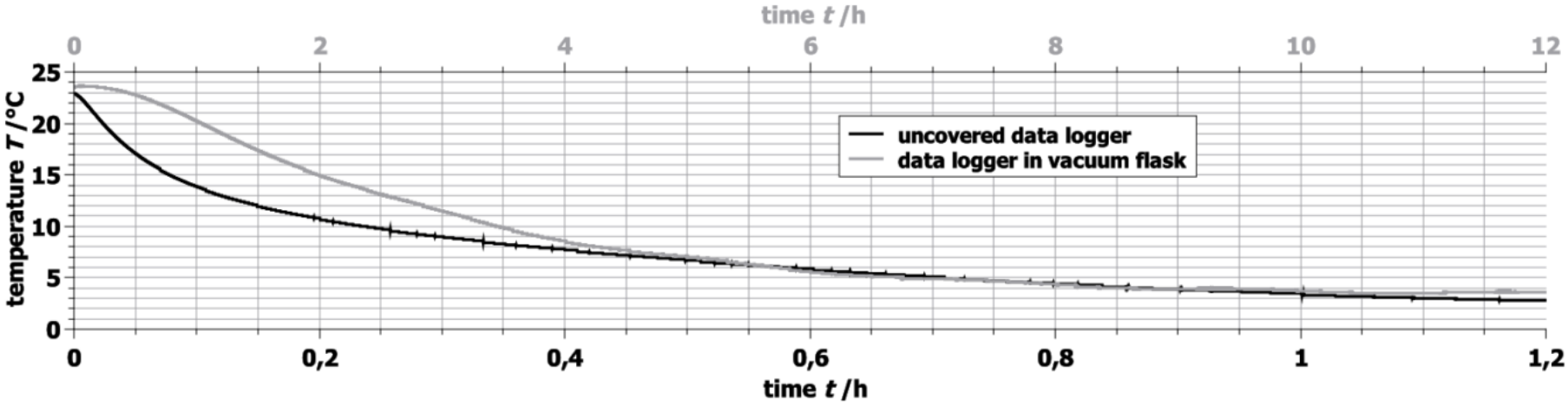
MSR 145

- Measurement on-line: rate 0.033 / s
- Battery lifetime: 108 d
- Memory: 92 d

Working range:	
Temperature:	-10 °C to +58 °C
Humidity:	0-100 % relative Humidity, -20 °C to +65 °C
Pressure:	0-2500 mbar absolute
Acceleration:	±10 G / ±2 G selectable
Accuracy:	
Temperature:	±0,1 °C (5 °C to 45 °C)
Humidity:	±2 % rel. humidity (10-85 % rel. humidity, 0 to 40 °C)
Pressure:	±2,5 mbar (750-1100 mbar absolute)
Acceleration:	±0,15 g (25 °C)

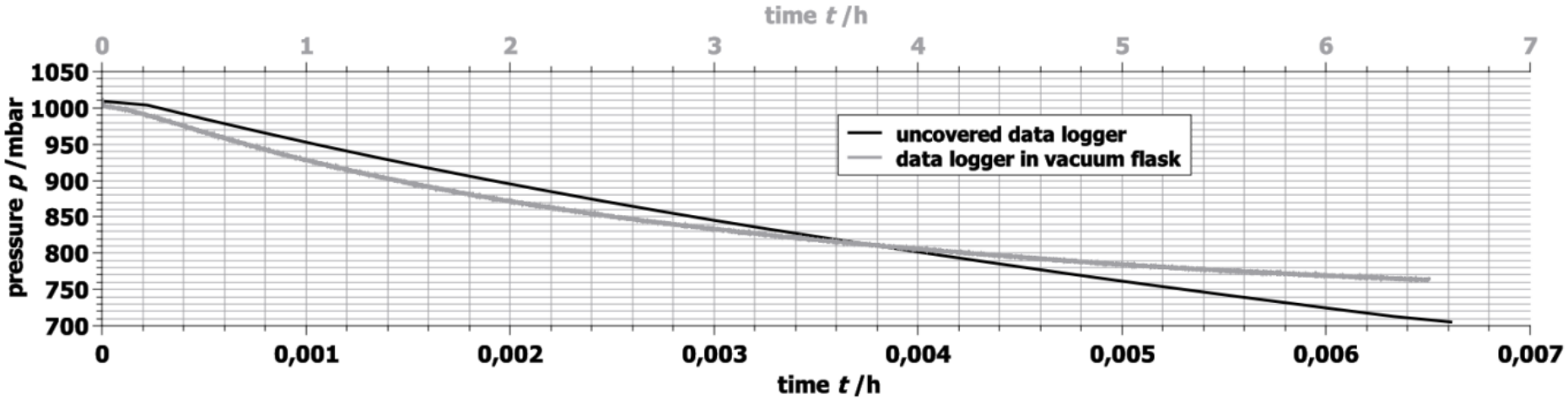
Is the vacuum flask efficient?

Flask in refrigerator: Temperature

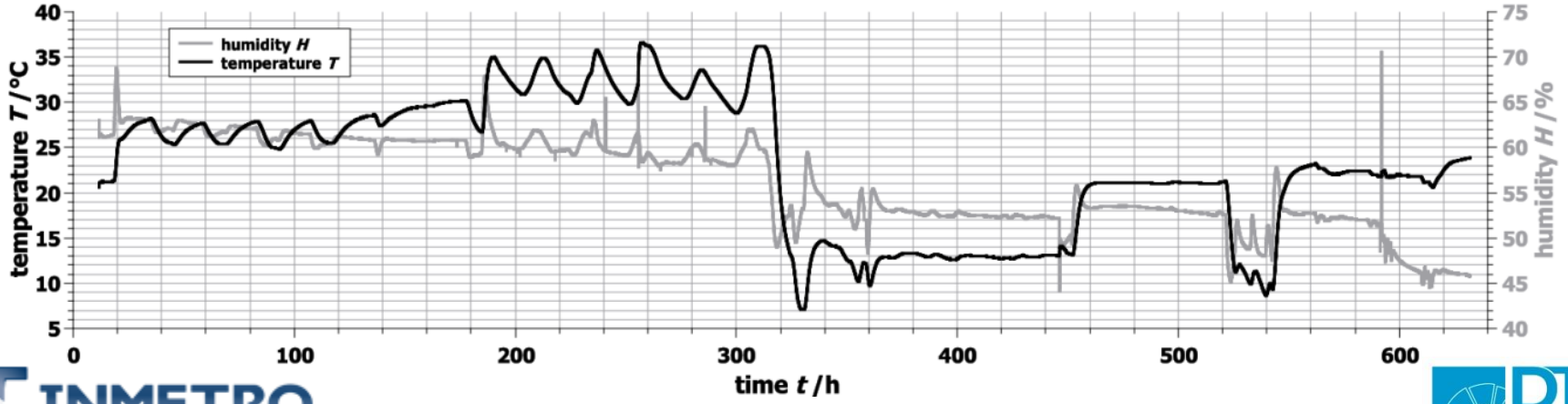


Is the vacuum flask efficient?

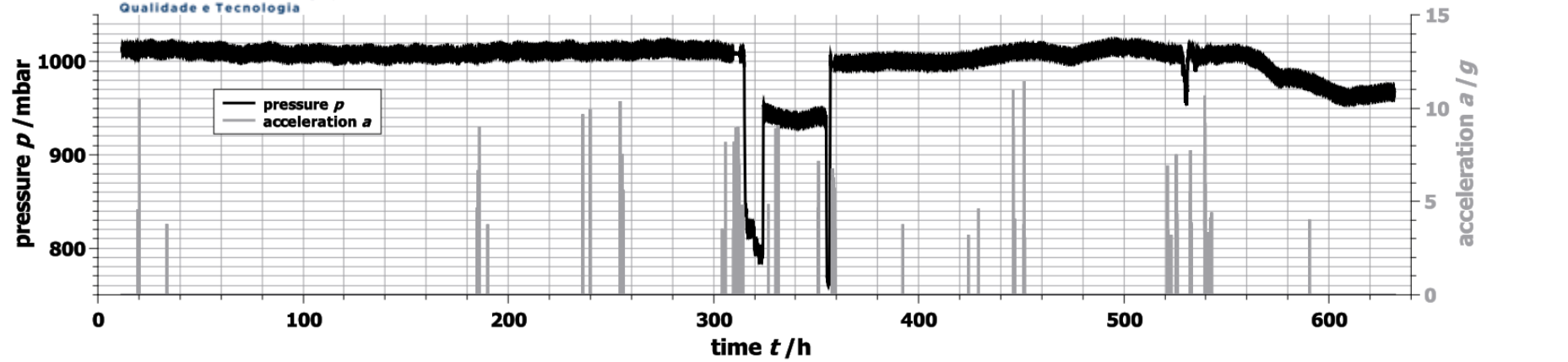
Flask in vacuum chamber: Pressure



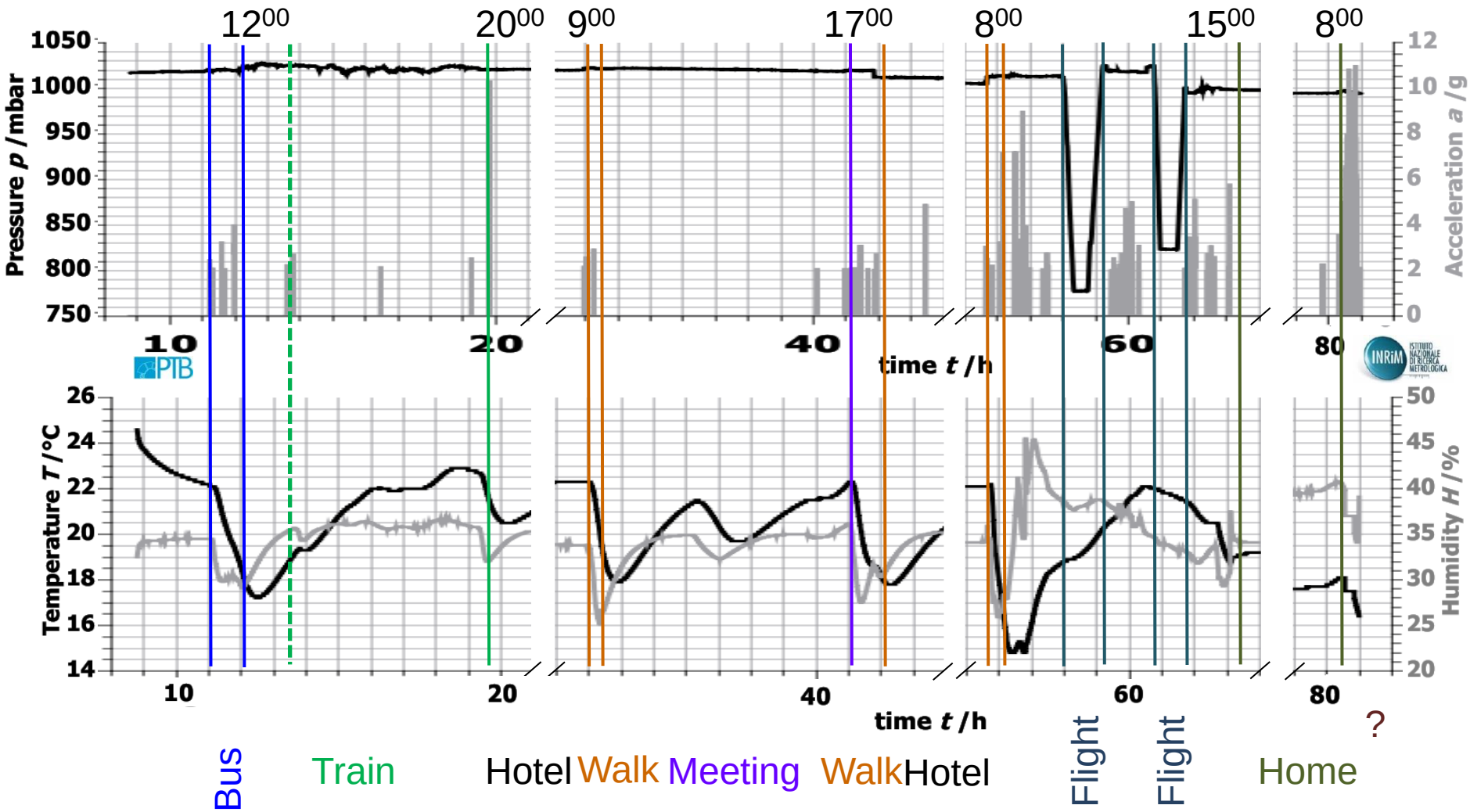
Transport from INMETRO to PTB



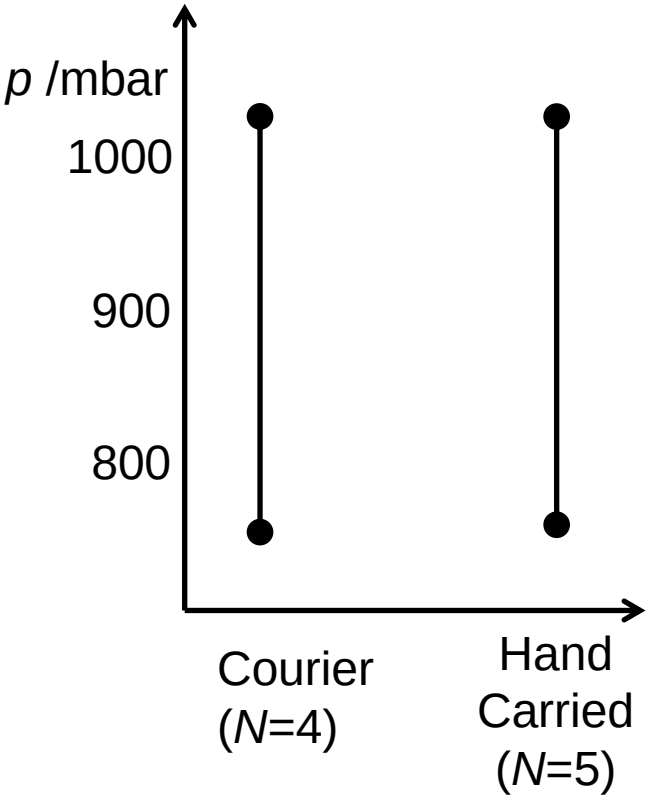
INMETRO
Instituto Nacional de Metrologia, Qualidade e Tecnologia

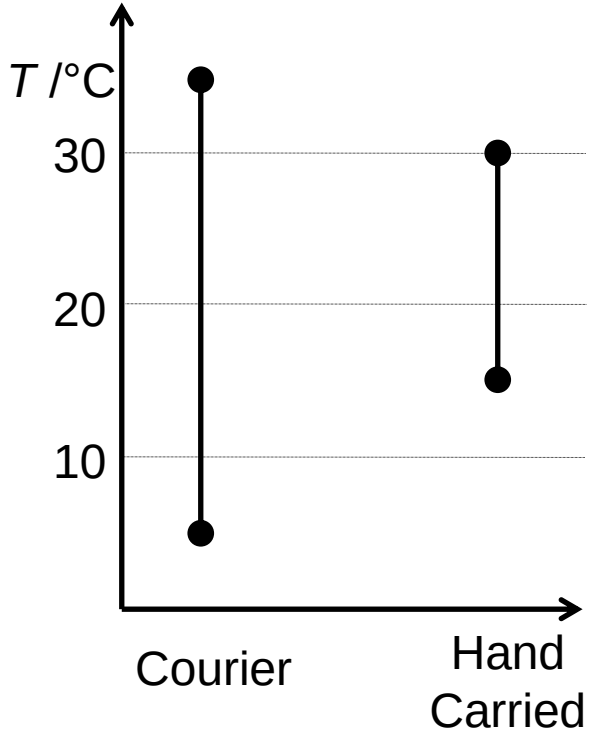


Mixed transport from PTB to INRIM



Comparison Courier – Hand carried





- Acceleration: luggage check in is critical
- But: Hand carrying itself makes comparable shocks!

Conclusions

- Simple and cheap data loggers are suitable for monitoring transport conditions
- Deliver information in case of damage
- Analysis of packaging possible: vacuum flask helps a lot
- Our data help in preparing risk analysis for an artifact:

- Hand carrying is recommended for temperature sensitive devices
- Air-tight packaging is necessary for pressure sensitive devices regardless of the kind of transportation
- Mechanical shocks are present also during careful hand carrying
- Shock isolating packaging is necessary: should be tested

J. Haller, C. Koch, Metrologia 52 (2015) 764–774