# GFZ magnetometers: relocating Wingst observatory

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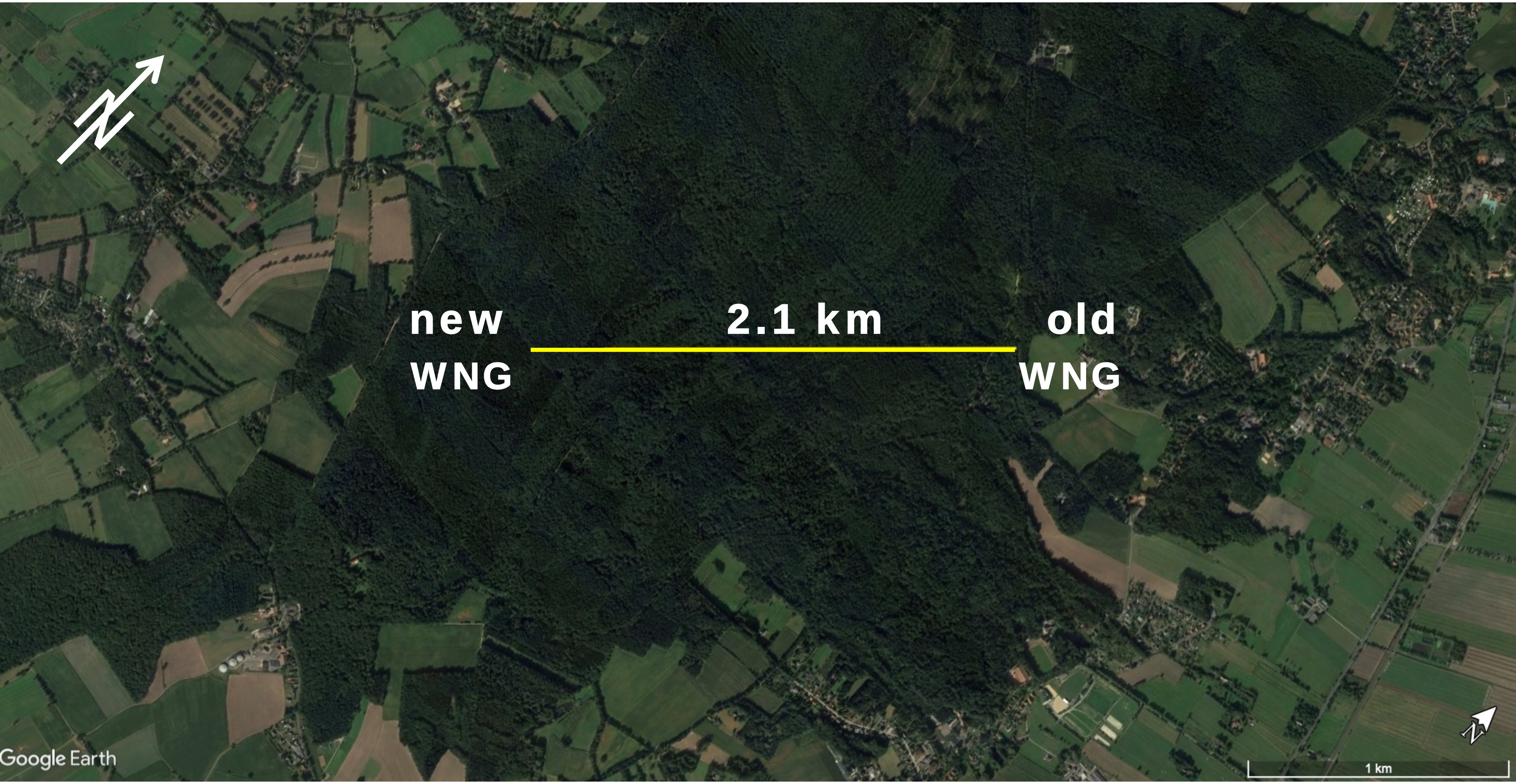
# Wingst old and new location



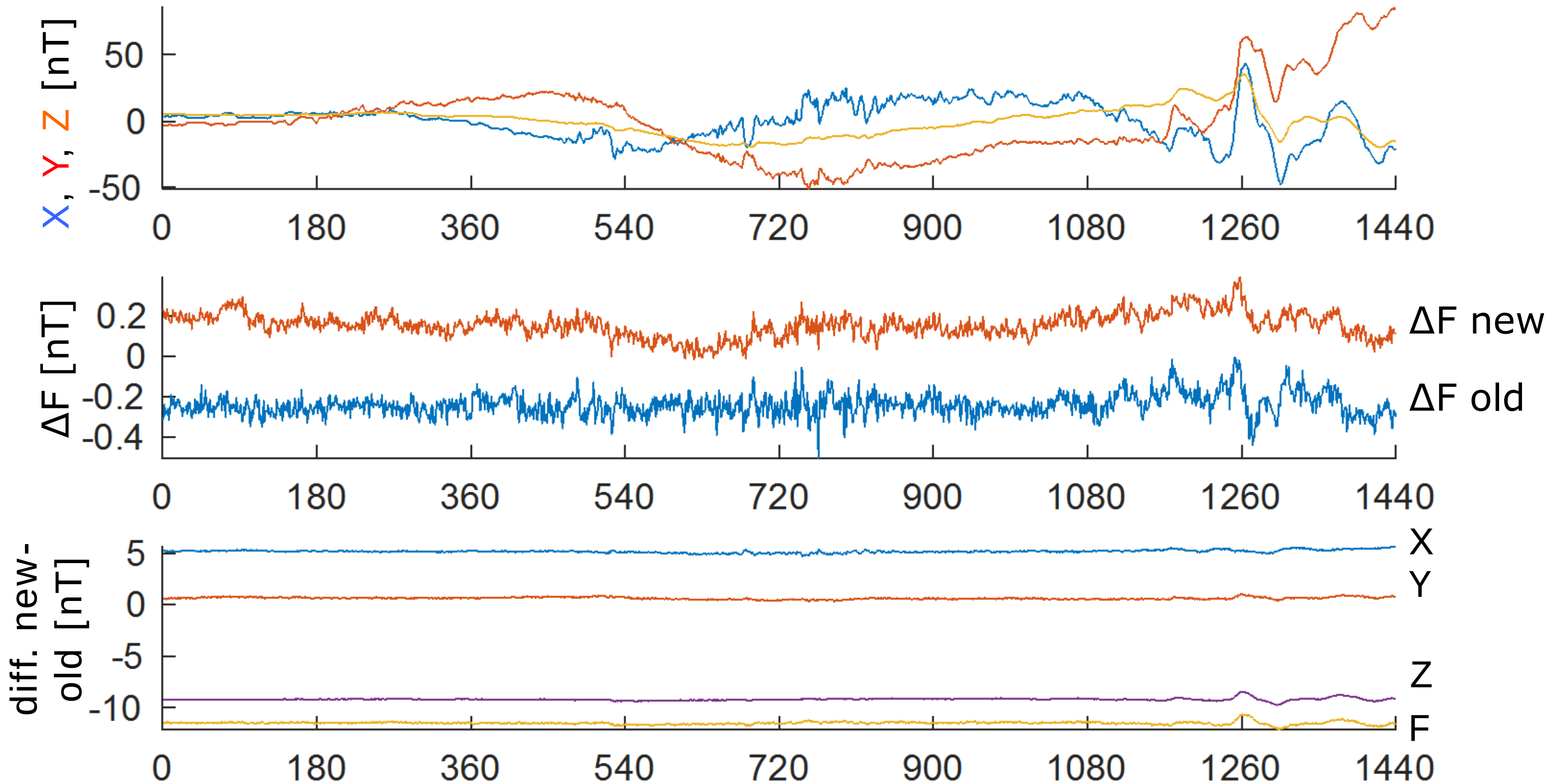

New WNG: securing long term operation, deep in the woods

# WNG new observatory buildings


**Relocation-related activity:**

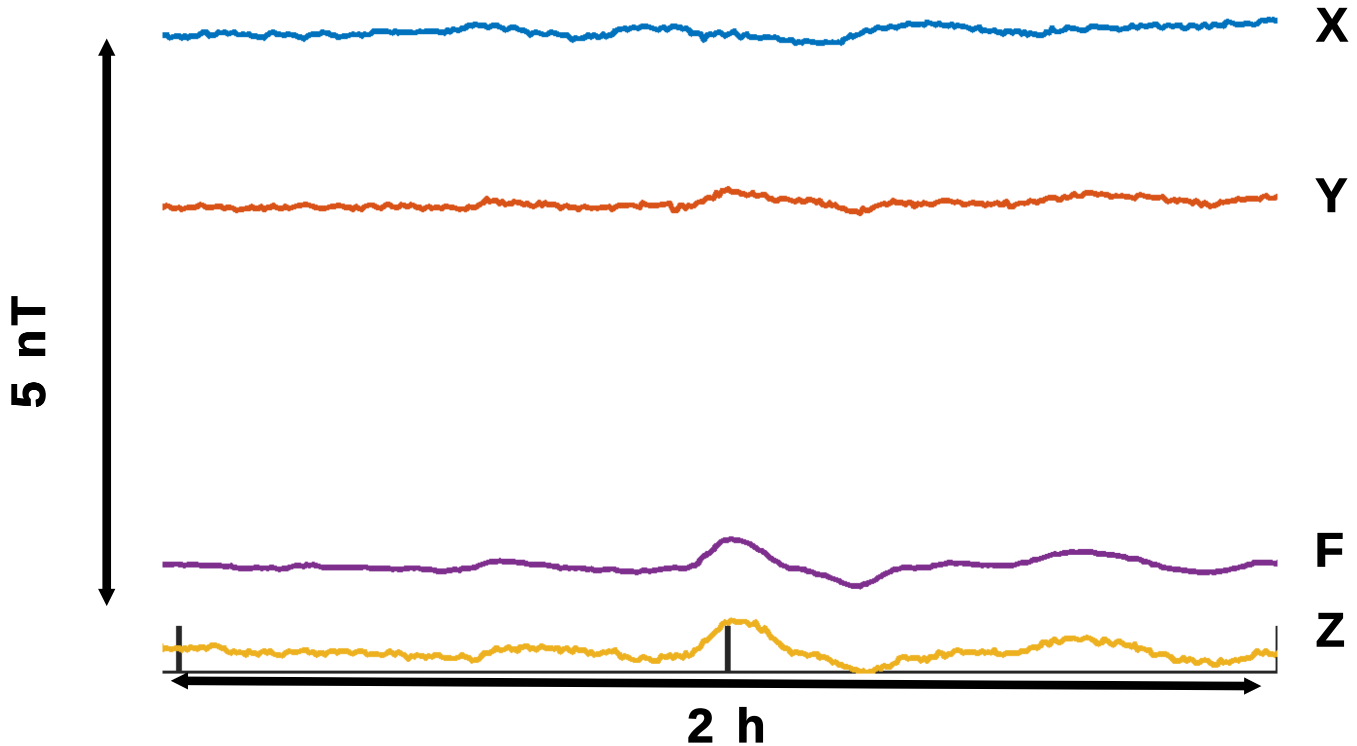
- parallel measurements from July 2018 to April 2019
  - variable conditions (warm, raining, **freezing**)
  - -> test heating systems, minor improvements to absolute hut
- azimuth determined by highly accurate gyro -> to be repeated

# WNG differences between new and old site




- Example: increased geomagnetic activity August 25, 2018
- ΔF for both old and new site <0.4 nT-> good quality
- Old and new site differ by up to 9 nT (Z component) and 11 nT (F), are differences constant? -> closer look

# WNG differences – a closer look




- Differences in X and Y are smooth (might become smoother after improvement of scale values and declination baseline)
- Differences in Z and F vary identically: no instrumental effect (also supported by 2 backup systems at new location), it is an actual difference in the variation of the Z component between the old and new site -> induction effect?

# WNG differences – a closer look

- Tipper calculated for old and new site
- good discussion with Gerhard during IUGG (salt domes?)
- will follow up on this later

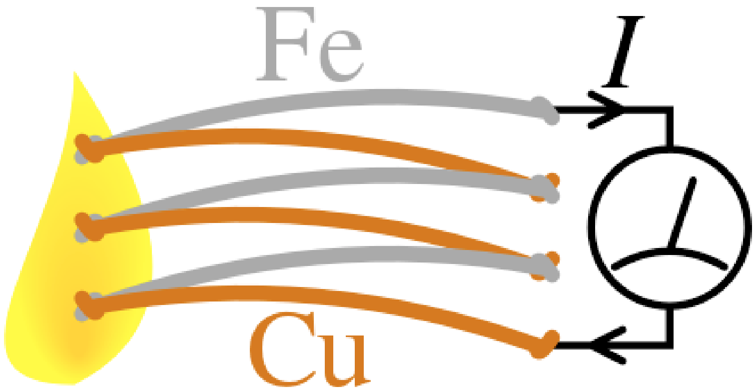
- data transfer by 3G, miniseed is a lean enough protocol to work even under adverse connectivity conditions
- power through 300 m cable (horizontal drilling, 50 kEUR)

- More info on the new observatory technology will be given elsewhere.

# Bonus story: thermoelectric currents

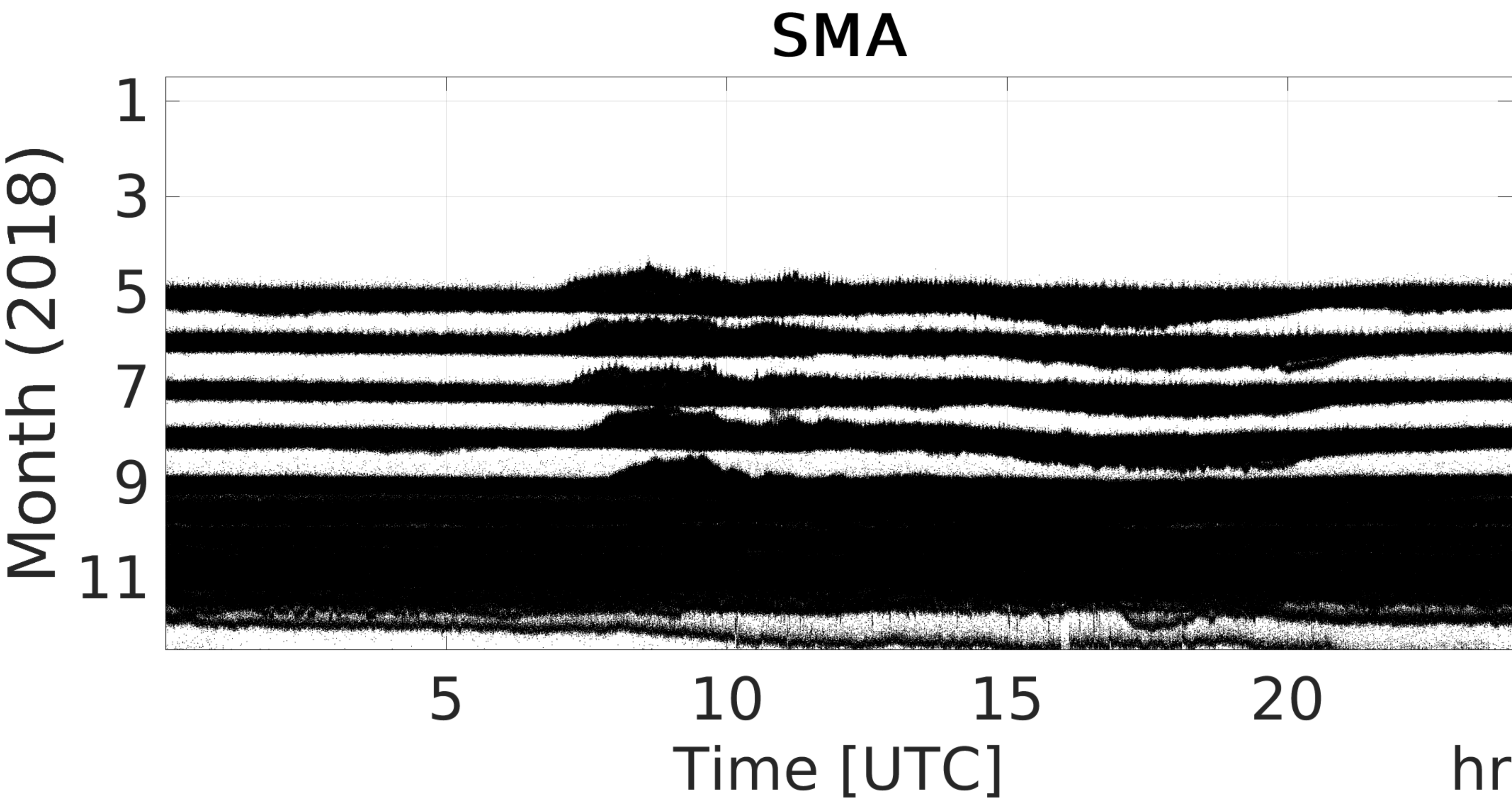
# Thermoelectric currents

- Thermoelectricity: Seebeck-effect
- In 1821, Seebeck observed that a **compass needle** would be deflected by a closed loop formed by two different metals joined in two places, with a temperature difference between the joints.
- Seebeck did not recognize that there was an electric current involved, so he called the phenomenon "**thermomagnetic effect**". Danish physicist Hans Christian Ørsted rectified this and coined the term "**thermoelectricity**".

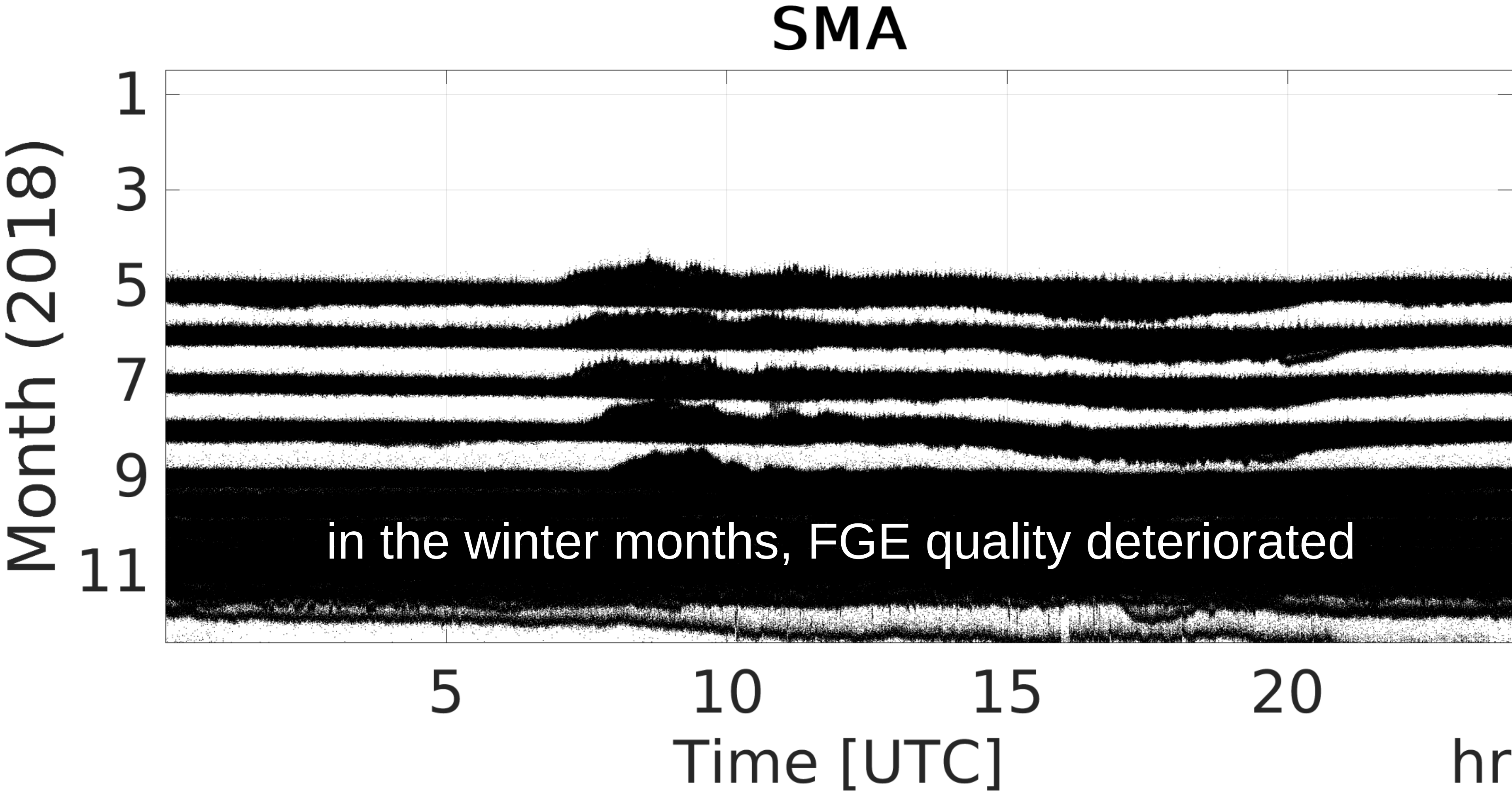



- it is a thermocouple
- source: Wikipedia

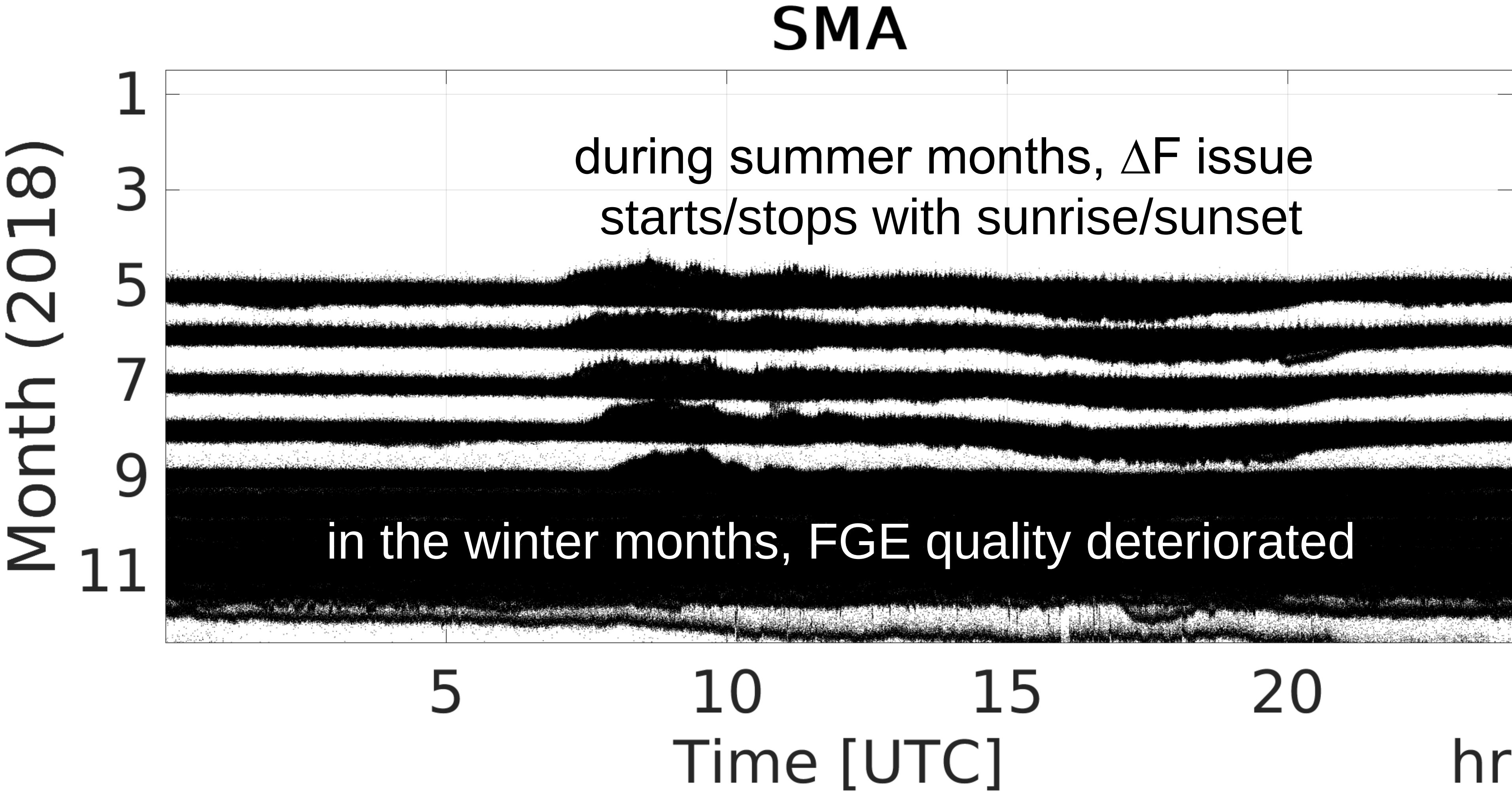
# ΔF at SMA, Azores



# ΔF at SMA, Azores



# ΔF at SMA, Azores



# Bonus story: thermoelectric currents

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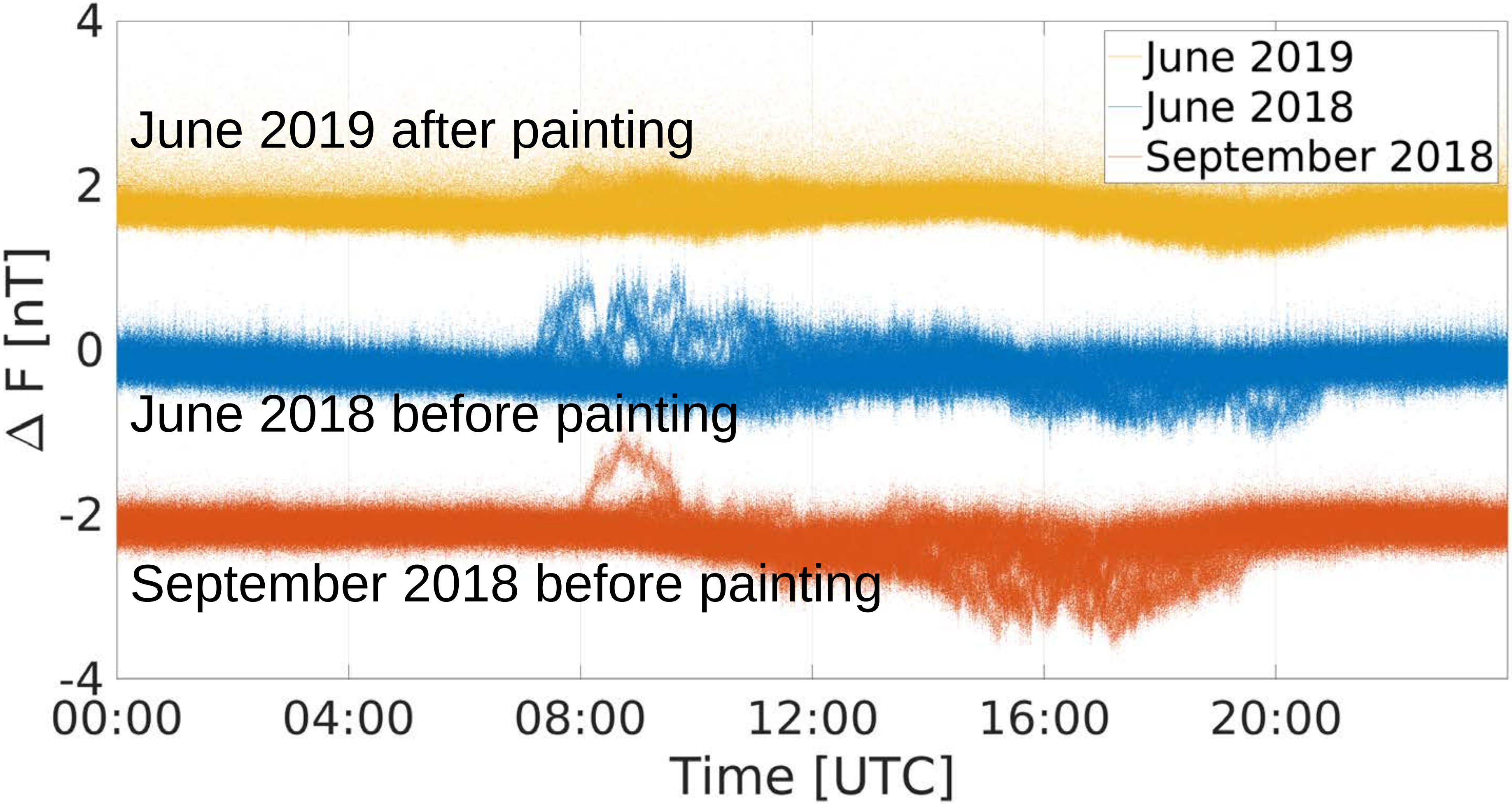


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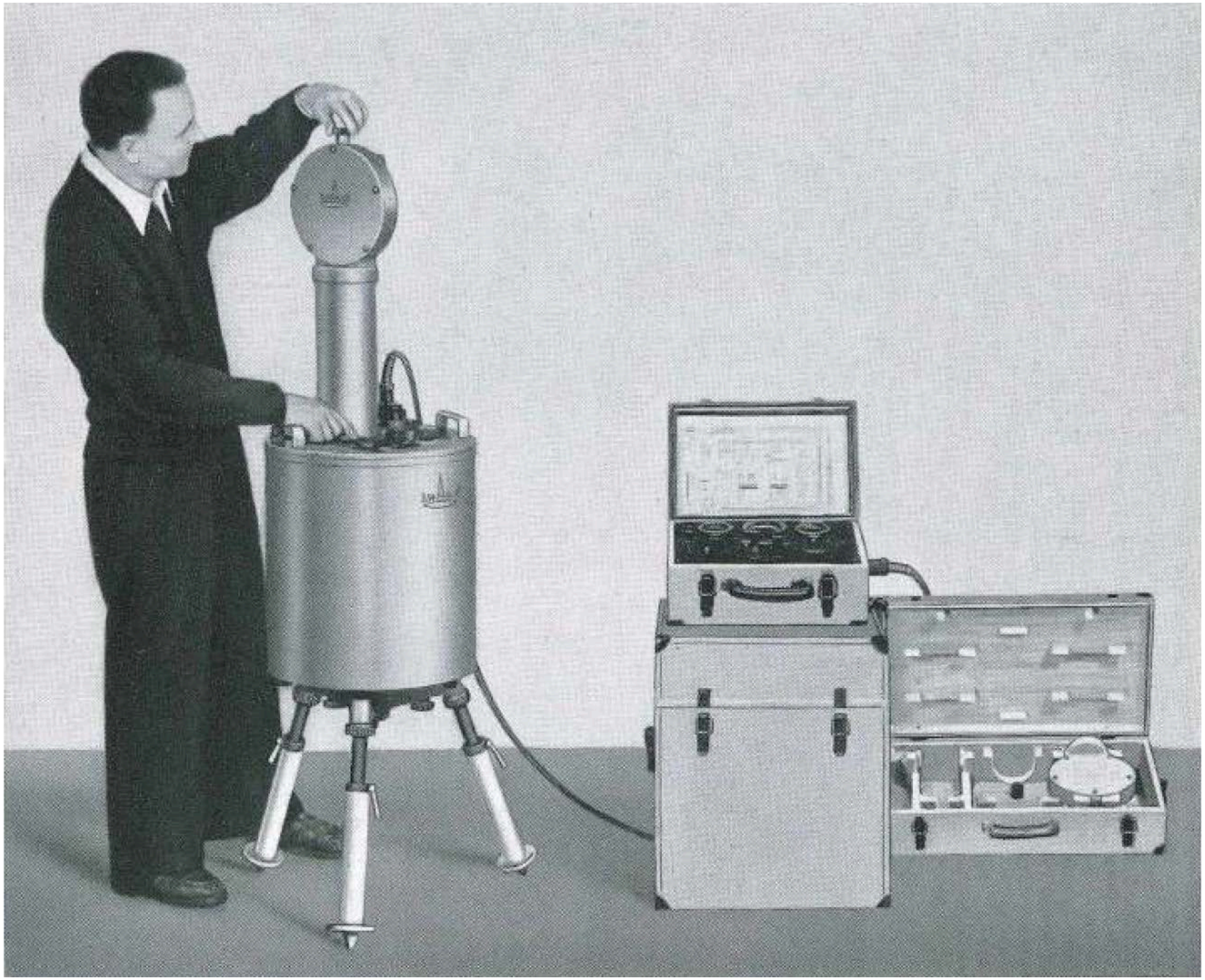
# Effekt on data quality

- During very quiet days, we saw the problem in ΔF and in the H component, not in the Z component, for symmetry reasons (sun goes around 180°, the box is symmetric, we expect that D is affected in a similar way as H
- a problem of ±0.5 nT in ΔF translates into **±0.8 nT in H** (ΔH = ΔF/cos(I), I = 52°) (**and D?**). Should we accept this? Or do we need to do more than painting the box?

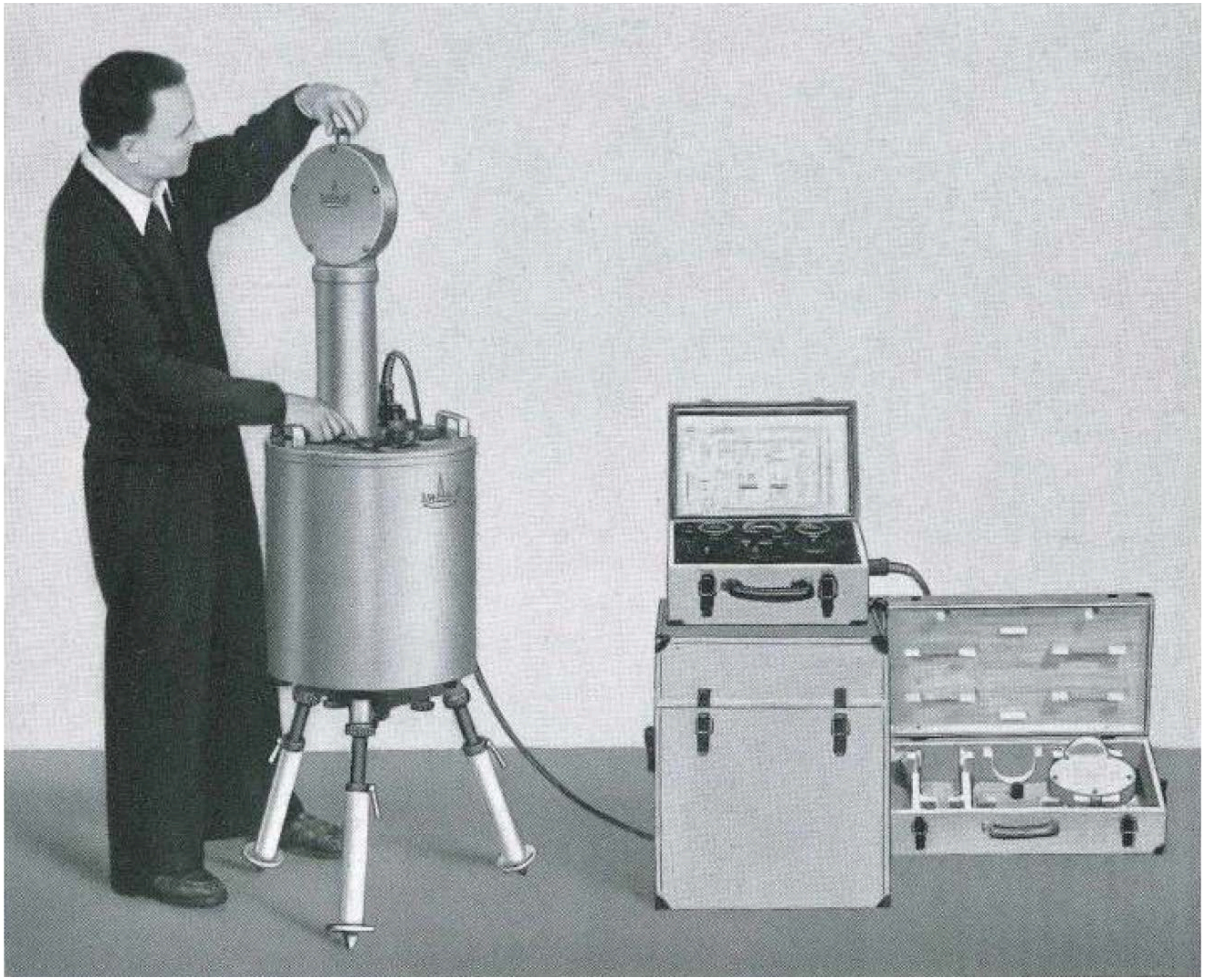
# Are thermoelectric currents a good explanation?

- How strong are they? We don't know.
- Where do they flow? We don't know.
- Would be nice to know to prove that the problem in ΔF is caused by thermoelectric currents.

# What is that?



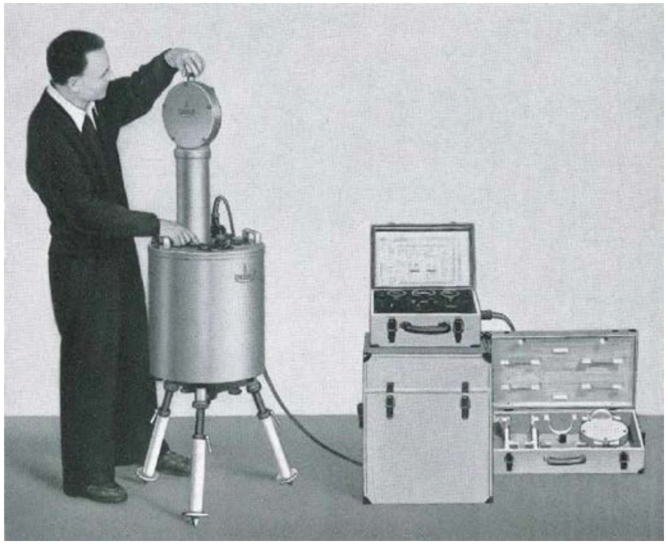
# Askania geomagnetic variograph Gv 3



source: Askania

# Experience Askania Gv 3

## Entwicklung von der 2. zur 3. Serie



Äußerlich bekam der Variograph eine zylinderische Form, in erster Linie aus fertigungstechnischen Gründen. Verbessert wurde damit auch die Wärmeisolierung. Allerdings handelte man sich Anfangsschwierigkeiten mit dem inneren Alublech-Mantel ein, an dessen Nietstellen Thermoelemente entstanden, deren Stromfluß im Rhythmus der Heizung Temperaturwellen auf der Z-Komponente erzeugten. Die Nietung wurde schließlich durch Klebung der Bleche ersetzt. Geblieben war die Thermoelementbildung aus gleichem Grunde in der Außenhaut, die z.B. durch Sonnenbestrahlung aktiviert werden konnte.

Voppel, D., 1998. Der erdmagnetische Askaniavariograph 1952 bis 1970. DGG-Mitteilung 3, 1998.

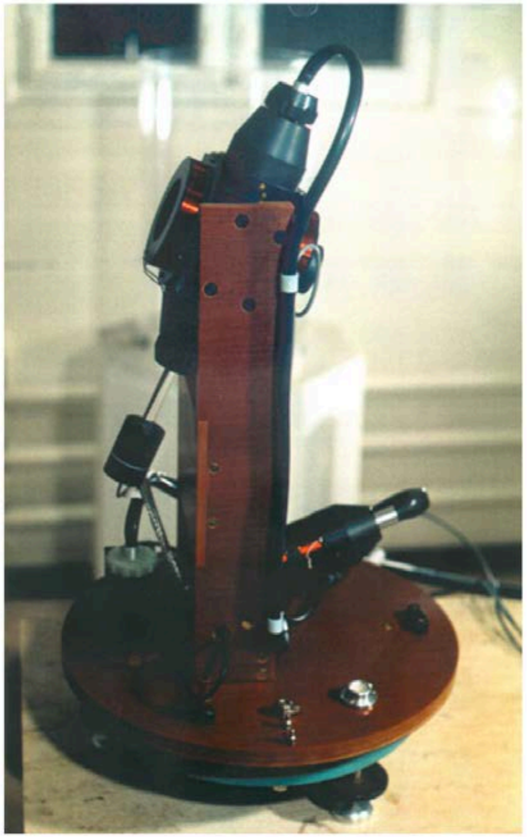
**-> Thermocouples emerge at the riveting of the aluminum cylinder, problem for the Z-component**

**-> rivets and problem partly replaced by gluing**

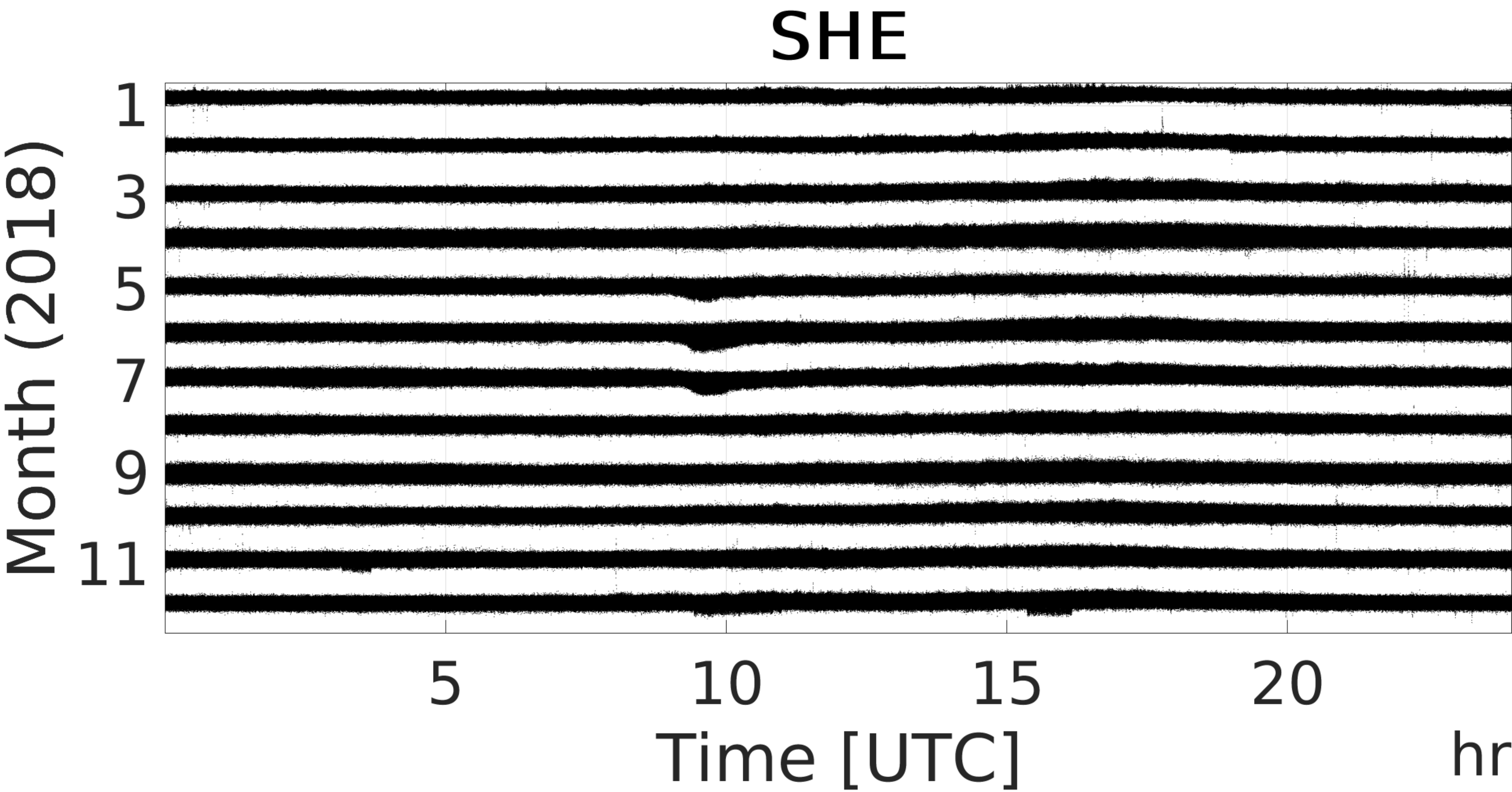
**-> remaining riveting: problems emerge with sunshine**

# Niemegk experience

Eberhard Pulz developed sensitive optically pumped magnetometers* and **magnetic effects from electric currents** in the **lightning rods to the copper roofs** were measured during **sunshine period**s.



*Pulz, E., Jäckel, K.-H. and Linthe, H.-J., 1999. A new optically pumped tandem magnetometer: principles and experiences. Meas. Sci. Technol. 10 (1999) 1025–1031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