Status of
GRUAN data product development for Modem M10
ICM-11 Singapore
20th – 24th May 2019

D. Vignelles(1*), J.-C. Dupont(2), F. Marin(3) M. Haeffelin(2)

(1) Meteomodem (2) IPSL (3) MétéoFrance

dvignelles@meteomodem.com

Outline

1. **Introduction** :
   - Recent internal changes within Modem and with GRUAN Fr community
2. **MétéoFrance**:
   - Gruan RS at Trappes since 2018
3. **IPSL**:
   - State of data stream in Trappes
4. **Modem**:
   - Status and advancement of M10 uncertainties

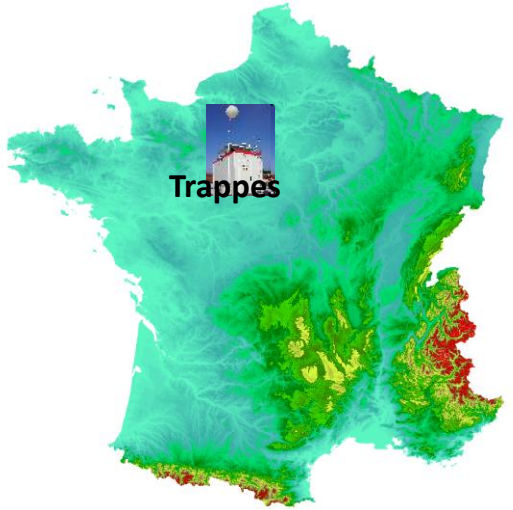
1. Introduction – recent changes

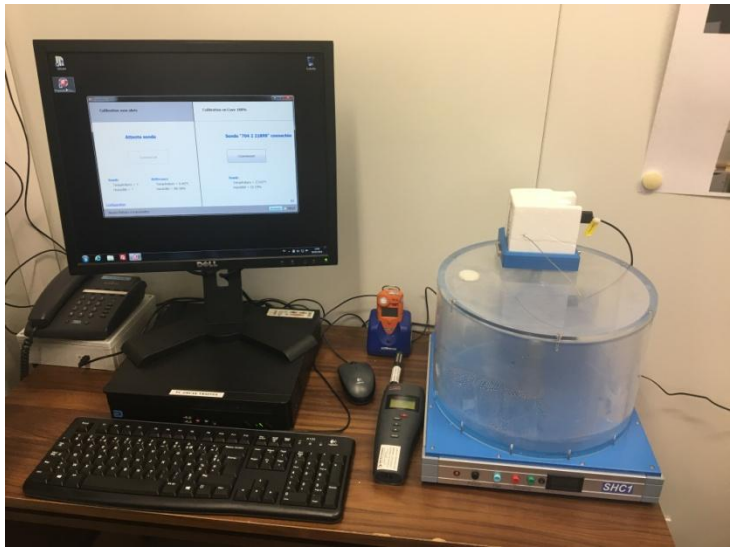
- Gaëlle Clain departure June 2018
- Damien Vignelles arrival September 2018
  - Research engineer
    - PhD in climatology and physico-chemistry of Earth atmosphere oriented in instrumentation and metrology
      - 50 % on GRUAN
      - 25% on BASTA – Cloud radar W band (2 PhD on calibration process (ACTRIS-Fr) and cloud classification)
      - 25% on LOAC stratospheric aerosol counter (involved in STRATEOL Phase 2 for cirrus characteristics and distributions)

- Reorganization of GRUAN-Fr M10
  - MétéoFrance - operational (F. Marin)
  - IPSL - data flux & GRUAN relations (J-C Dupont & M. Haeffelin)
  - Meteomodem - metrological tests (D. Vignelles)

2. Operational Trappes site MétéoFrance

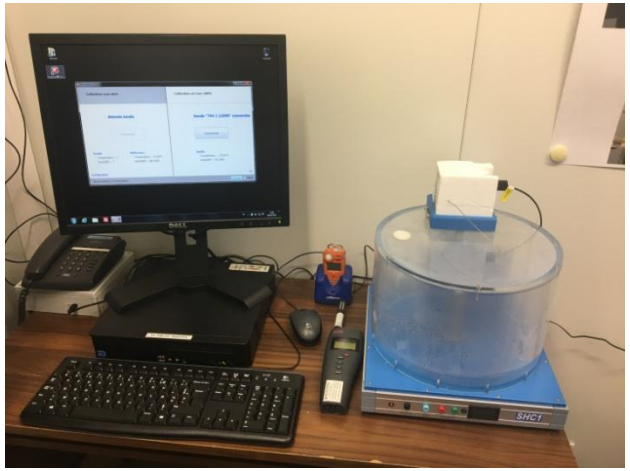
- Trappes site : historic RS station (1927)
- GRUAN procedures for all RS since 2018 twice a day





2. Trappes MétéoFrance GRUAN procedure

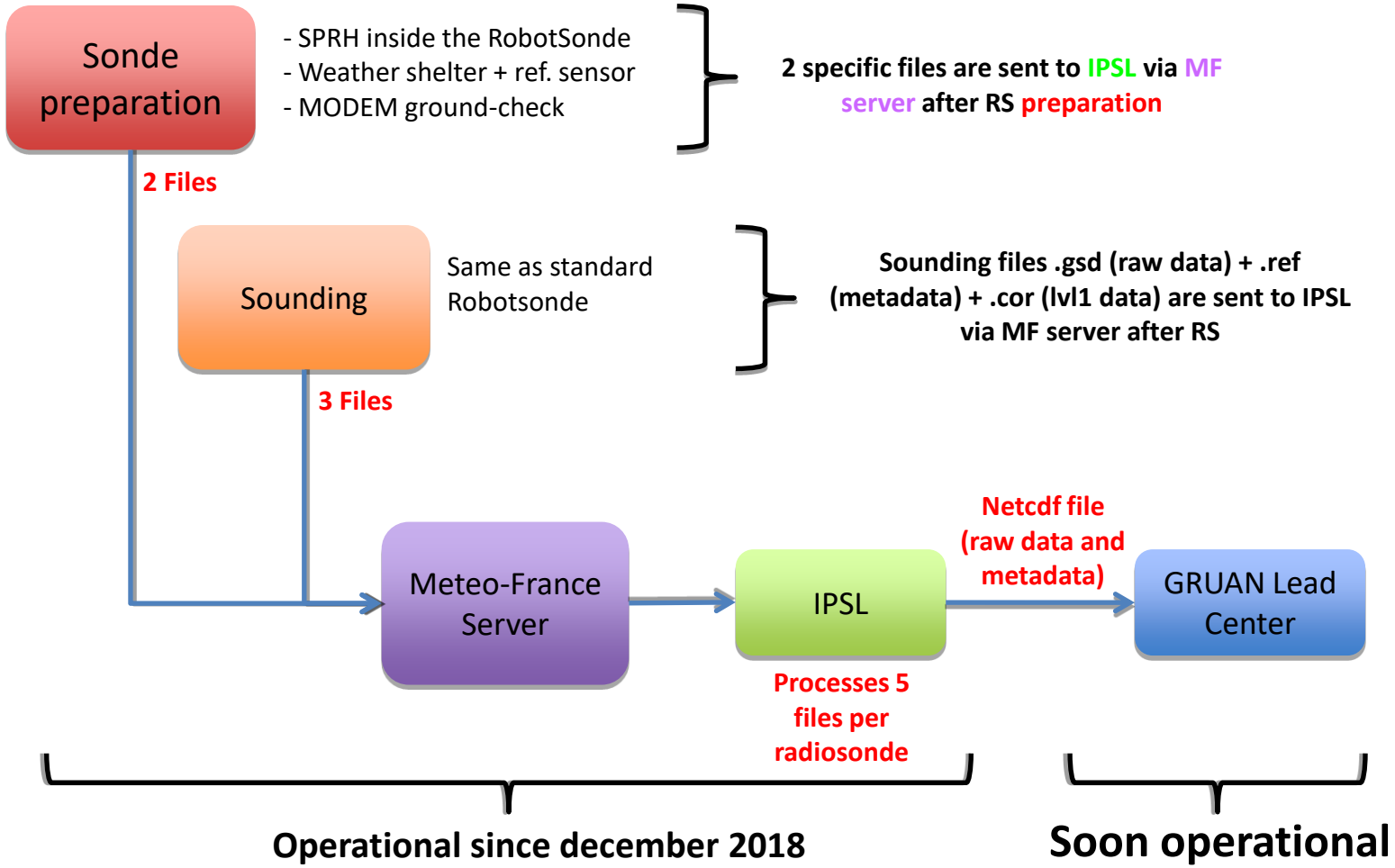
- Calibration of 100% humidity
  - GRUAN humidity chamber to produce a saturated environment
  - Data acquisition with a M10 radiosonde for 5 minutes
  - M10 data sent to the IPSL server with the serial number of the probe tested
- Calibration of ambient conditions
  - Stevenson screen with small van
  - Data acquisition of the M10 and a reference HMP110 sensor (Vaisala) for 5 minutes
  - M10 and HMP110 sent to the IPSL with the serial number of the probe tested



2. Trappes MétéoFrance GRUAN procedure

- After the calibrations
  - M10 is loaded into the Robotsonde according to the procedure (which include the ground check calibration)
  - Trappes Robotsonde is loaded twice a week, M10 loaded remains in the Robotsonde for a maximum of a few days before the flight
- M10 data and metadata are sent to the IPSL server after the flight

3. Status of the data stream



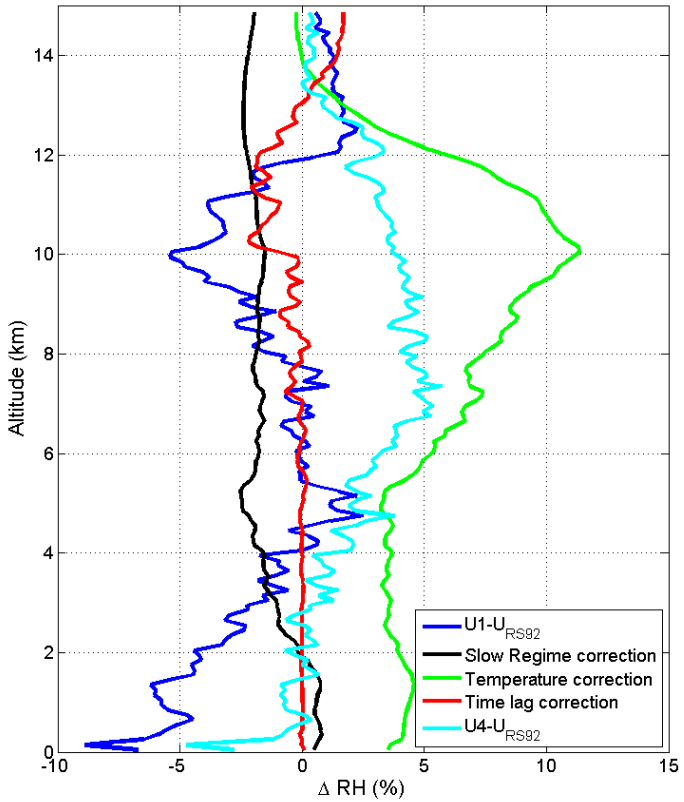
3. Status of the data stream

- Current status
  - Discussion with M. Sommer to finalize the automatic way to send the measurement data to GRUAN:
    - Configuration of the RSlaunch client,
    - First set of data/metadata already in processing
    - Tools need to be configured to this new french site
  - Processing of a complete dataset (2003-2018) available for future improvement related to GRUAN methodology
- Perspectives
  - Apply the automatic transfer of Trappes raw M10 dataset to the GRUAN LeadCenter
  - Develop methodology to produce L1 data following the GRUAN recommendations

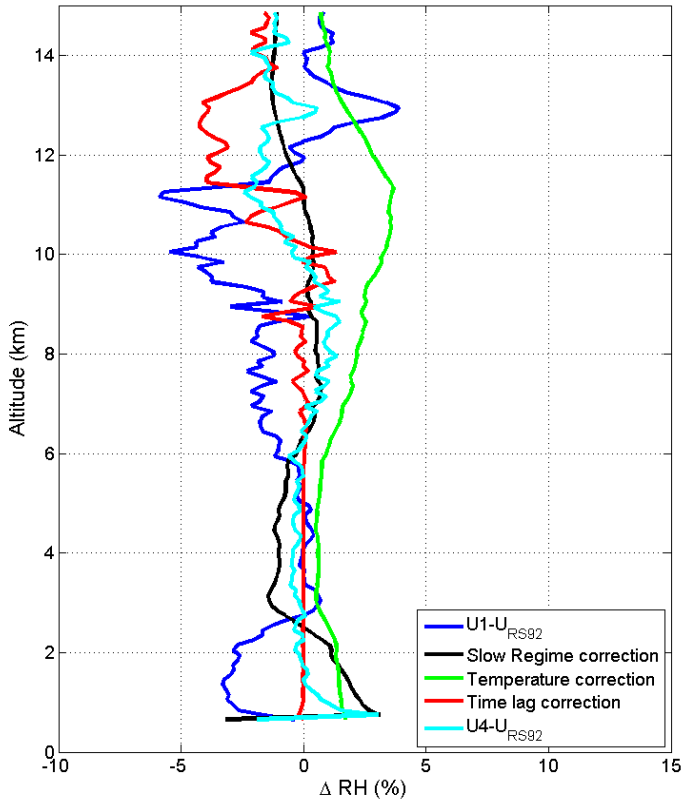
3. Status of the data stream

- Production of a M10 IPSL algorithm and a comparative study with RS92 (51 dual flights)
  - 4 steps of post-traitments
    - Calibration correction
    - Slow regime due to the slow diffusion of molecules in the sensor
    - Relative humidity sensor dependence on the gradient of temperature
    - Time lag at cold temperatures which affects measurements in regions of strong relative humidity gradients
  - Comparisons M10 / RS92 (accepted in JAOT Journal)
    - Mean differences better than 2%RH for nighttime launches
    - Better than 5%RH during daytime

3. Status of the data stream



BEFORE, AFTER



BEFORE, AFTER

Journal of Atmospheric and Oceanic Technology

Characterization and corrections of relative humidity measurement from MODEM M10 radiosondes at mid-latitude stations

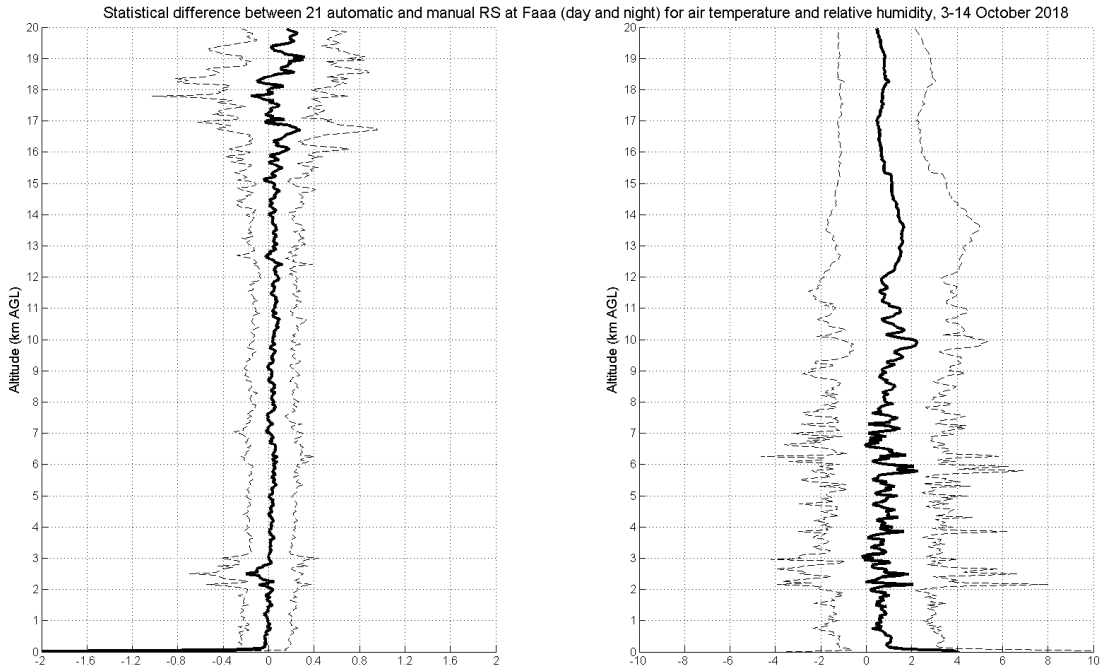
--Manuscript Draft--

3. Field experiment of dual sounding

- 21 dual soundings at Faa'a (October 2018)
- M10 raw dataset available and analysed by Fabio Madonna for the current article on automatic sounding systems
- A new campaign will be done at Trappes site need to be scheduled (before the end of 2019)

3. Field experiment of dual sounding

- Similar methodology to compar Vaisala, Meisei and Modem automatic systems
- Same figure for T and RH difference at each altitude with 50 m vertical grid
- Same equation to process the distance between the two sondes (automatic and automatic)



T_{auto} - T_{manual}

RH_{auto} - RH_{manual}

4. Status and advancement of M10 performances

RH

- **Calibration**
  - Sensor calibration
    - (done : U_c = 2.18 %RH k =2 based 2018 dataset – Type A)
    - Based on factory production check before shipping from Modem
      Compared to a calibrated Rotronic HC2A-S +/- 0.8 %RH (k =2)
  - Sensor adjustment (SPRH 100 and/or Groundcheck)
    - (need to be determined – first tests done on SPRH100 related to reproducibility but problem on the SPRH100 we have – Type A probably)
    - First test on repeatability and reproducibility
    - Need to discuss the need of a reference and so considered its uncertainty
- **Time-lag fast response**
  - Fast response time determination
    - (First estimation using the tropopause level – need laboratory experiment) Lindenberg ? Type A ?
  - Time-lag correction
    - (correlated and uncorrelated U. // Dirken et al. 2014) type B ?

4. Status and advancement of M10 performances

ICM-11 Singapore 2019

RH

- **Time-lag slow response**
  - Slow response time determination
    - (need to determine a protocol, certainly type A)
    - We could use the double pressure chamber to address the second time lag
  - Time-lag correction
    - (correlated and uncorrelated // Dirken et al. 2014 – in progress)
- **Temperature dependency**
  - Temperature uncertainties (Ta & Tu)
    - (need to be done // Dirksen et al. 2014)
  - Temperature dependency correction
    - (need to be done // Dirksen et al. 2014)
- **Others uncertainties needed to be considered**
  - Hysteresis ?
    - (need to be discussed – need to do in Lindenberg – type A ?)

4. Status and advancement of M10 performances

Air temperature

- Sensor calibration
  - (need to be done – type A)
- Radiation effect
  - (experiment done in 2013 - need a redaction – type B)

GPS geopotential altitude

- Manufacturer uncertainty
  - (Need a redaction – type B)
- Variability of altitude at ground
  - (in progress – following the Meisei methodology – type A)
- Transformation from geometrical to geopotential altitude
  - (need to be done – type B)

Zonal and meridional wind

- Variability of doppler speed data
  - (in progress – type A)
- Effect of the low-pass filter
  - (need to be done – type B ?)

Summary

- Gruan RS at Trappes since 2018
- Data stream operational soon
- RH characterization and corrections under review JAOT
- M10 uncertainties is in progress
  - Perhaps needs for methods and requirements

Thank you