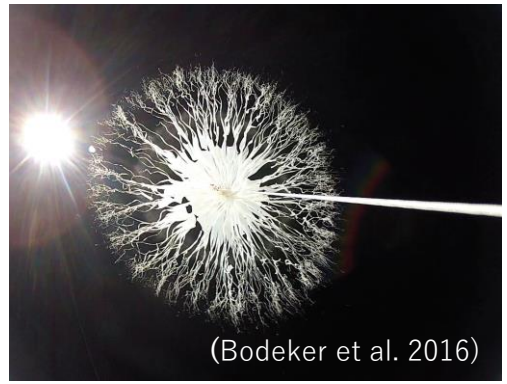


Justification for high altitude attainment (HP4)

Masatomo Fujiwara (Hokkaido Univ., Japan)
on behalf of Task Team Radiosondes, IPET-OSDE(*)

(*)IPET-OSDE: WMO CBS (Commission for Basic Systems) Inter-Programme Expert Team on Observing System Design and Evolution

GRUAN ICM-15, Bern, Switzerland, 11-15 March 2024

Task: Justification for high ascent attainment (for balloon soundings at GRUAN and other sites)

- Main Contact: TT Radiosondes, IPET-OSDE (since ICM-11)
- Milestone: Publication in the peer reviewed literature
- "High": Higher than 10 hPa level, 5 hPa level. . . (compared to 30 hPa)
- Criteria to include not only climate monitoring, but also: NWP impact; seasonal predictability; importance of monitoring LS winds; radiative transfer calculations; satellite validation; climatology, etc. [The "user needs"!]

- **Progress since ICM-14:**
  - **Draft paper manuscript "version 0.8" has been prepared (contact MF if you want to take a look/read through)**
  - **Extensive internal review process has already been started!**
  - **One of the major comments is, "you should acknowledge GNSS RO temperature measurements more"**

Current structure of the paper

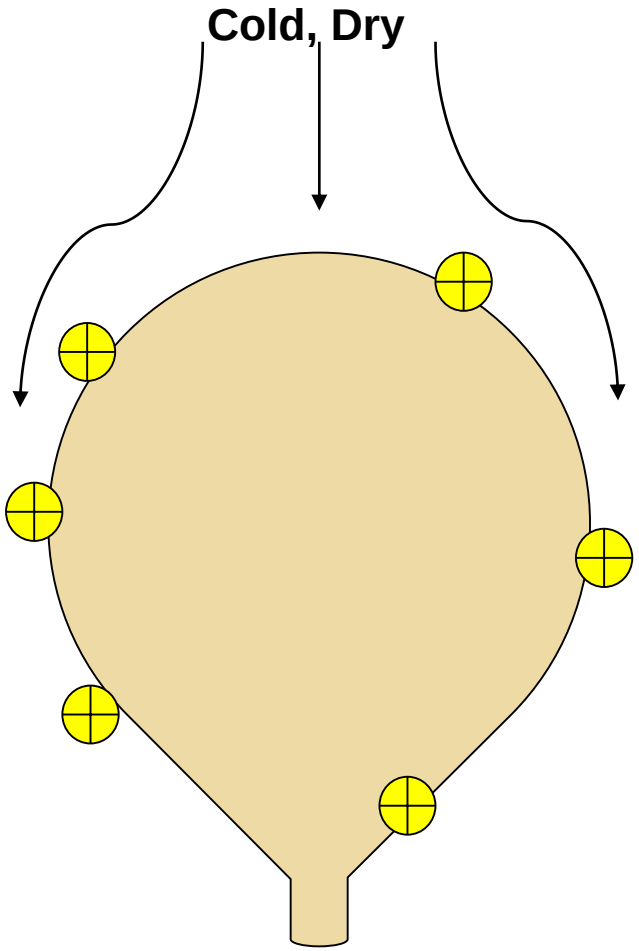
1. **Introduction**
2. **Technical issues for balloon soundings**
   2.1 Balloons
   2.2 Radiosonde sensors
3. **Climate monitoring and process studies**
4. **Satellite calibration and validation**
   (an overview)
   4.1 Radiative transfer calculations for microwave and infrared sounders
   4.2 Comparison of various GNSS temperature retrieval data sets with GRUAN radiosonde data
5. **Impacts on numerical weather forecast and sub-seasonal to seasonal predictability**
   (an overview)
   5.1 Value of high-ascent radiosondes in NWP data assimilation and forecast system
6. **Summary and Conclusions**

Notes:
- Both review and new studies
- New studies are in sub-sections
- **Sections 1-3 are largely completed**
- **Sections 4 needs revision / review**
- **Section 5 waits for inputs**

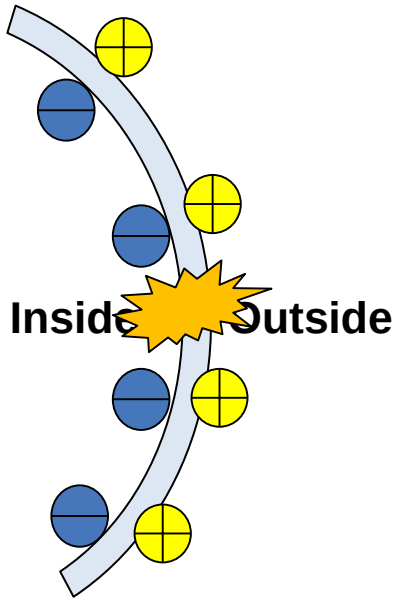
Hypothesis: Accumulated static electricity may be triggering earlier bursts?

IHI GROUP

As balloon ascends in cold and dry air, friction may result in static electricity accumulating on the balloon outer surface



The electric charge accumulated on the rubber surface does not go anywhere.



When the balloon expands at high altitudes, the rubber becomes thinner

Dielectric strength voltage decreases & spark may occur, resulting in “premature” bursts

Provided by Kensaku Shimizu

MEISEI

“Balloon discharger”

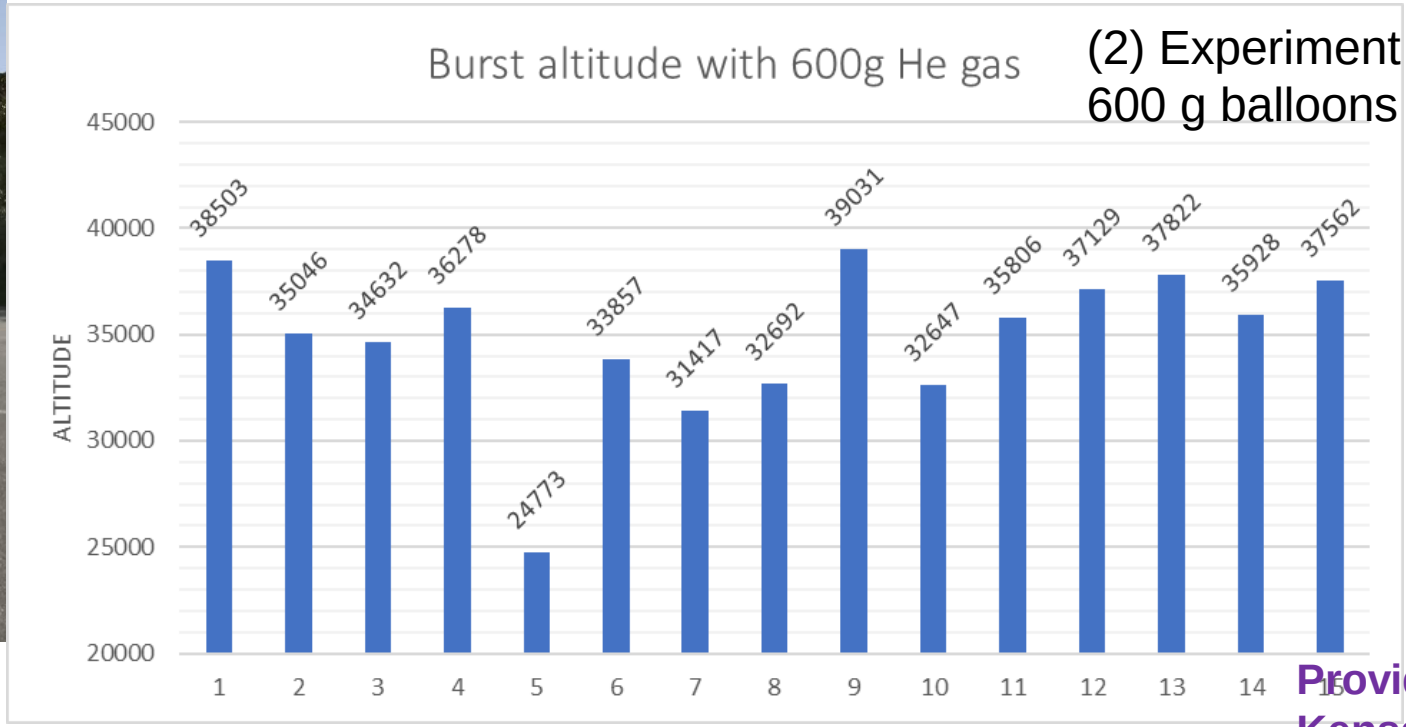
IHI GROUP

(1) Experiment for 2000 g balloons

A stick-like material (created with 3D printer, made of plastic) is attached at the balloon neck, which may act as a discharger

Balloon flights with this discharger resulted in a few km more altitudes than those without, suggesting that this may be working

(2) Experiment results with 600 g balloons



~36 km on average

(~32 km for those without)

Provided by Kensaku Shimizu

MEISEI

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4. Satellite calibration and validation

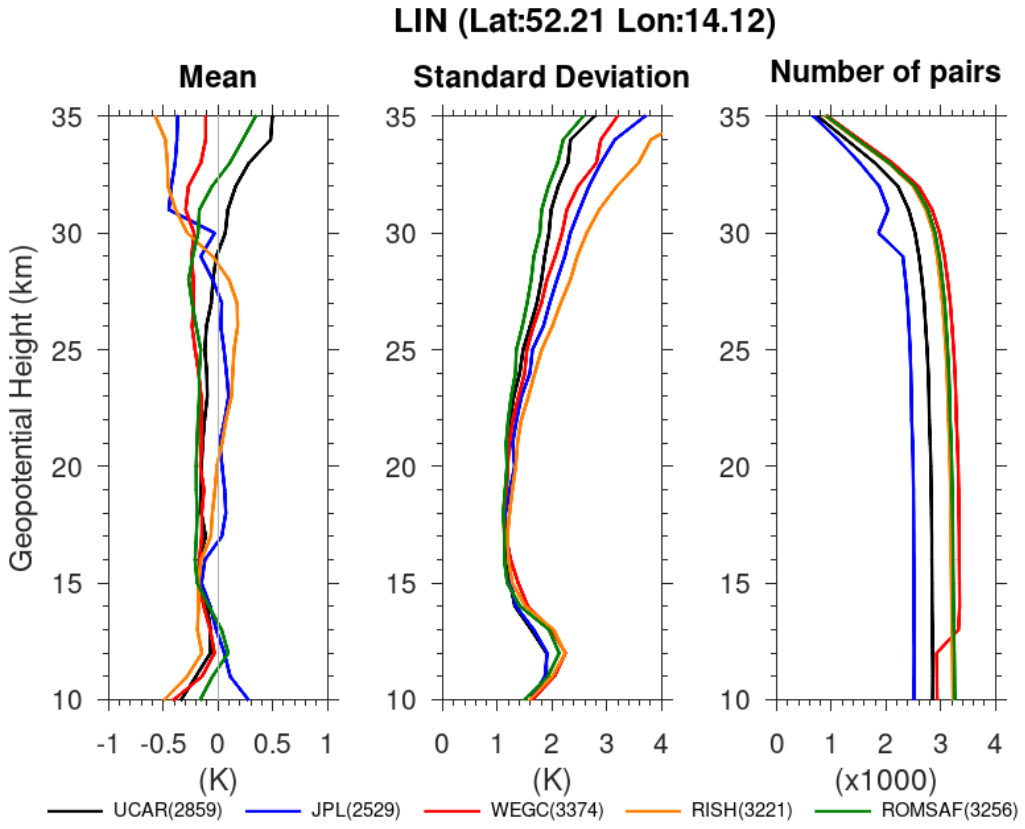
- (The introductory paragraphs need to be finalized)

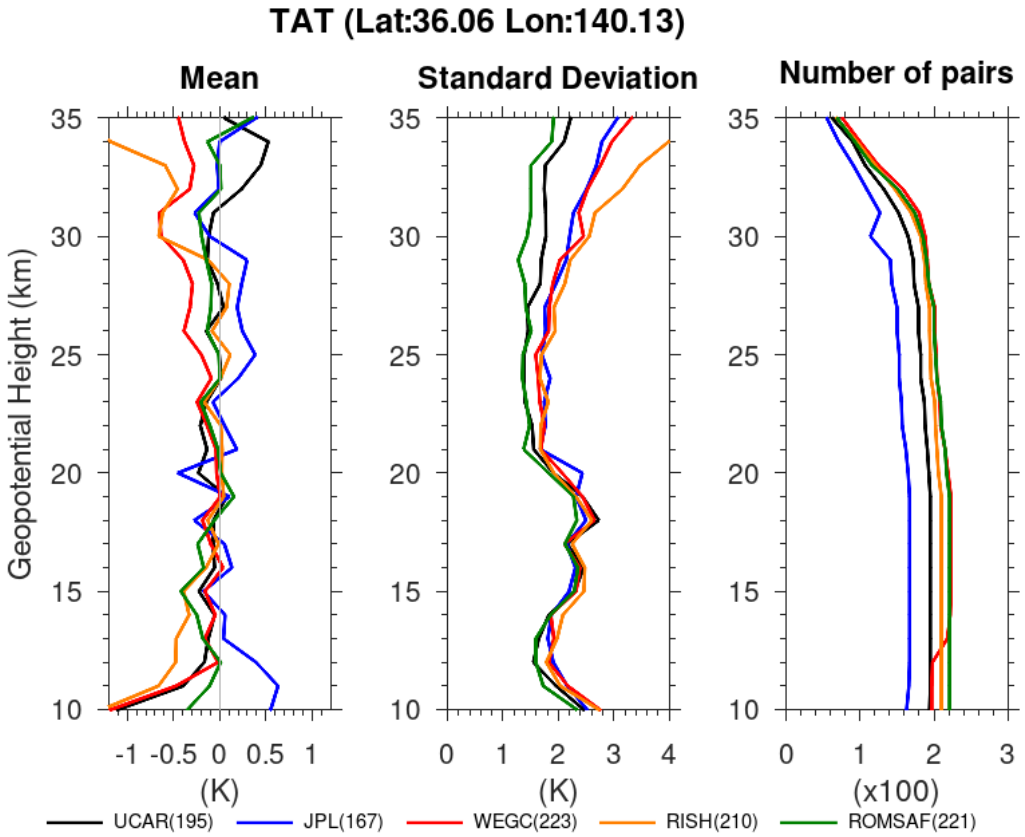
- 4.1 Radiative transfer calculations for microwave and infrared sounders
  - Sensitivity study for the impact on line-by-line radiative transfer calculations, for microwave (MW) by Nico Cimini and infrared (IR) by Lori Borg, comparing radiosonde data up to 30 hPa and 5 hPa level
  - (above 30/5 hPa, we still need profiles from models/reanalyses for the calculations)
  - Following very recent comments regarding the choice of upper stratosphere-mesosphere profiles, we are currently thinking about redoing the calculations

- 4.2 Comparison of various GNSS temperature retrieval data sets with GRUAN radiosonde data [new addition by Dr. Noersomadi (BRIN, Indonesia) and MF]
  - “There are several institutions that provide GNSS RO temperature retrievals (see e.g. Steiner et al., 2020a), which show differences in particular above ~25 km due to differences in the processing algorithms, e.g. treatments of the ionospheric effects (Danzer et al., 2015).”
  - We investigate differences between GNSS RO temperature retrievals from 5 institutions and GRUAN radiosonde products RS92-GDP at Lindenberg, Germany and Tateno, Japan.

4.2 Comparison of various GNSS temperature retrieval data sets with GRUAN radiosonde data

- For the COSMIC-1 project; during 2007–2017
- 5 data products from: UCAR, JPL, WEGC, RISH (Kyoto Univ.), and ROMSAF
- The collocation conditions are set as within 3° longitude/latitude and ±3 hours





5. Impacts on numerical weather forecast and sub-seasonal to seasonal predictability

- Waiting for inputs based on very recent studies from
- **Fabien Carminati: High altitude sonde NWP experiment**
- **Bruce Ingleby: Radiosonde data denial studies and implications for height attainment**

- (Introductory paragraphs will be rewritten in relation to these new inputs)

- 5.1. Value of high-ascent radiosondes in NWP data assimilation and forecast system: By Bomin Sun and Tony Reale

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