

SKYDEW status

IHI GROUP

17.11.2021

Kensaku Shimizu*1, Takuji Sugidachi*1
Junko Suzuki*2, Shinya Ogino*2

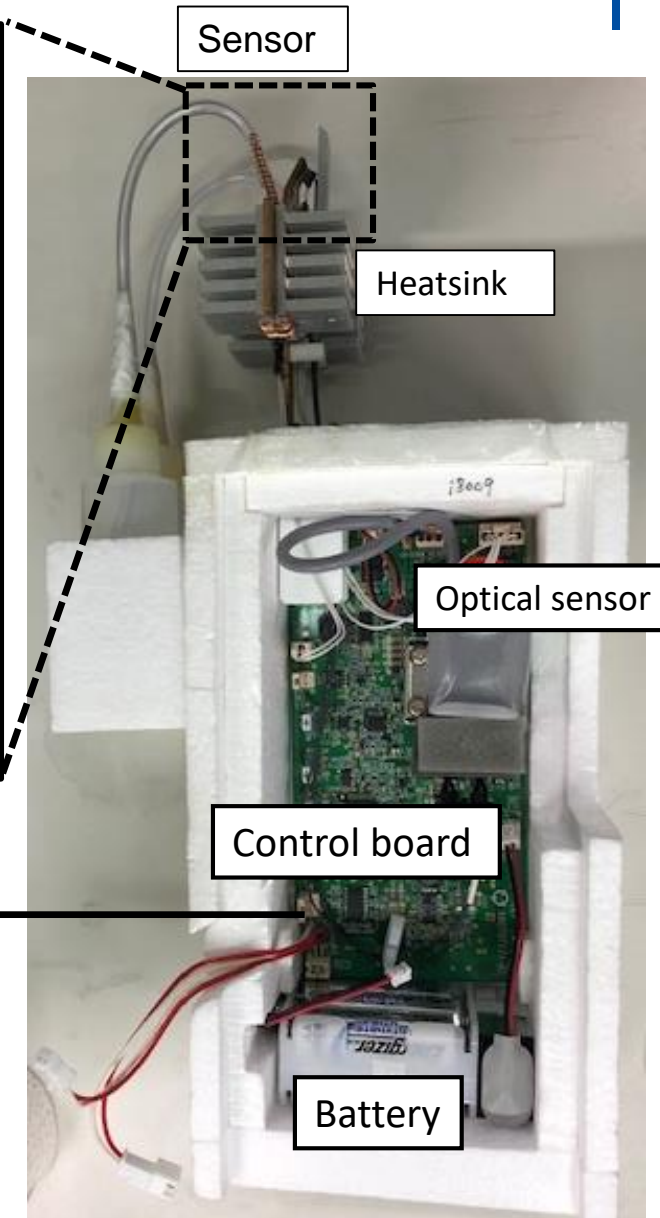
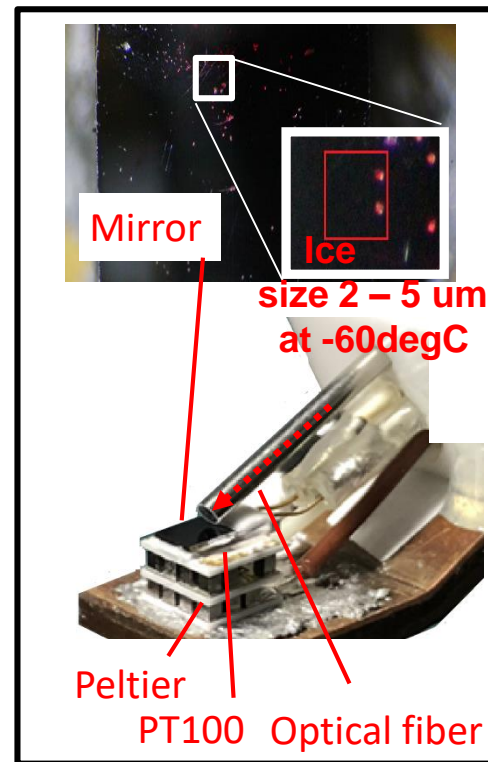
*1: Meisei Electric Co., Ltd. , Japan

*2: JAMSTEC, Japan

SKYDEW has been developed since 2009 by Meisei and Hokkaido university.

Features of SKYDEW hygrometer

1. Two-stage Peltier device
No need to use cryogen material (CHF3)
2. Dew/frost detection by scattered light using an electronically modulated light
3. Digital controller (PID controller, gain scheduling depending on dewpoint)
4. Supports Meisei original data format and XDATA format for other radiosonde

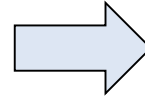


Output data to
Meisei Radiosonde
or
Other radiosonde
(XDATA)

History of SKYDEW development

2009 – 2014 Phase 1:

Several types of prototype
Lab tests and 9 test soundings

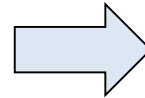


These results are described in
Sugidachi, 2014, Ph. D paper at
Hokkaido Univ.

(https://eprints.lib.hokudai.ac.jp/dspace/bitstream/2115/55416/1/Takuji_Sugidachi.pdf)

2016 – 2019 Phase 2:

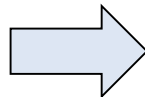
Design of product model
20 test soundings including the
comparison sounding with CFH



Issues on product model were
identified by testing in the
laboratory and in the field (Japan,
Indonesia and Lindenberg).

2019 – 2021 Phase 3:

Test of 2nd product model
Product release for domestic
(in Japan)

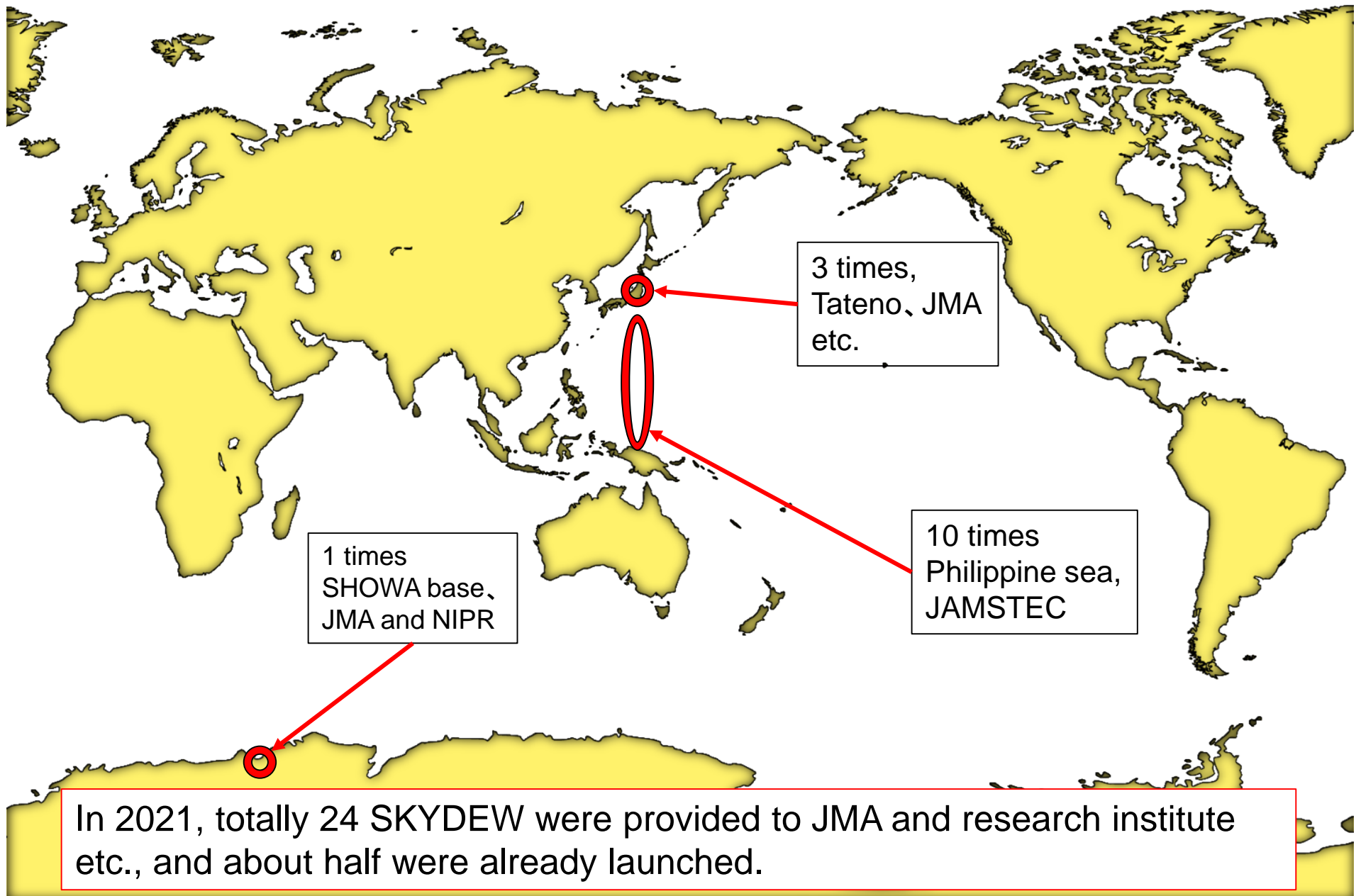


Started supplying to domestic
pilot users(JMA、JAMSTEC、NIPR
and Universities).

2022 – Phase 4:

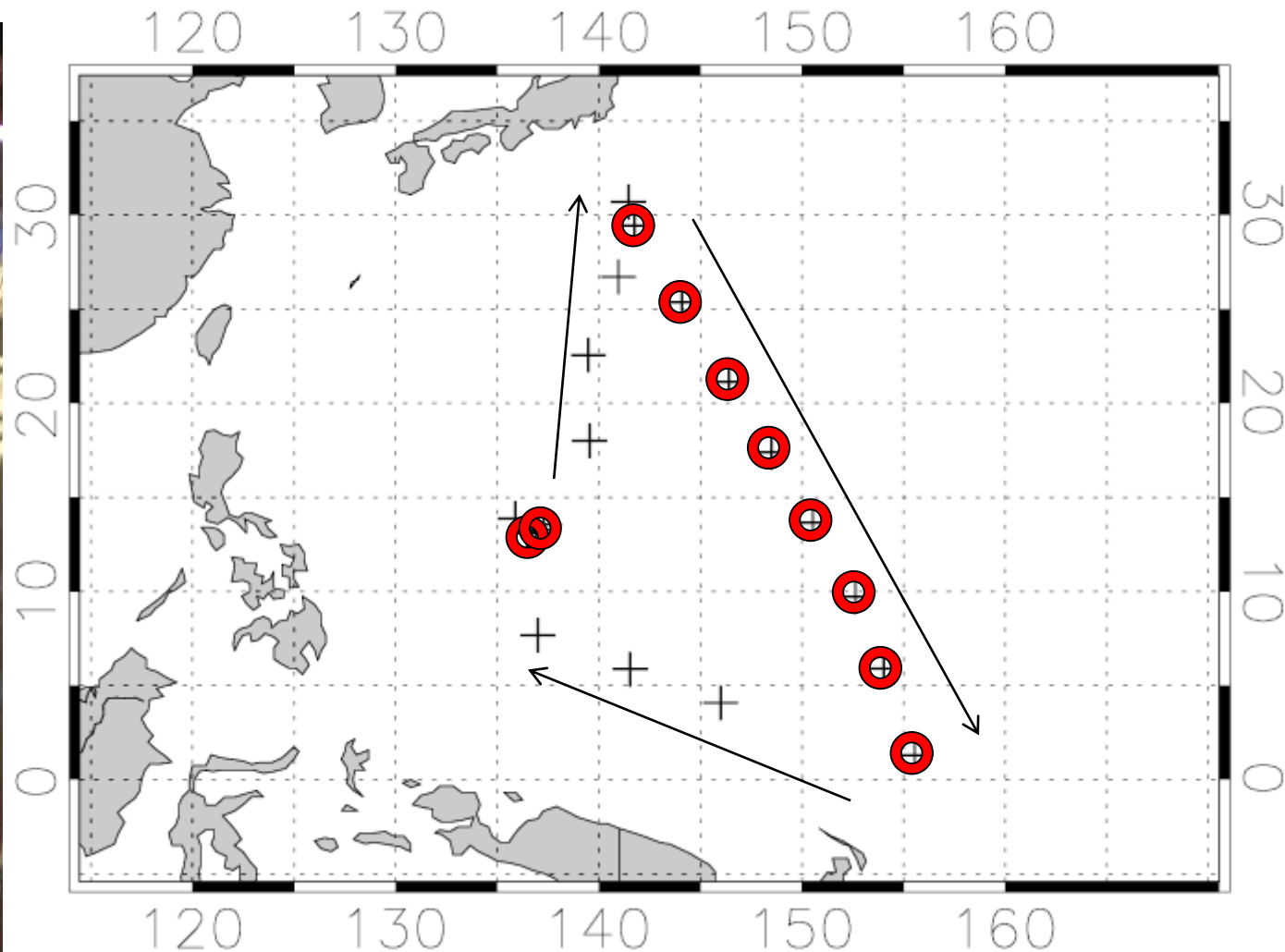
Scheduled to start providing 2nd
product model to all users including
overseas

In this presentation, we will
explain the performance and
observable conditions that
currently known through phase 3.



Observation results in 2021

| FL No. | Operated by | Date | Lat. | Lon. | Day / Night | Reached height (km) | Cooling limit (km) | Measured height (km) | Remark |
|--------|-------------|---------------|-------|-------|-------------|---------------------|--------------------|----------------------|--------------------------------|
| 36 | JAMSTEC | 27 May, 2021 | 29.8 | 141.5 | N | 32 | 30 | 30 | ○ |
| 37 | JAMSTEC | 28 May, 2021 | 25.7 | 143.9 | N | 30 | 28 | 28 | ○ |
| 38 | JAMSTEC | 29 May, 2021 | 21.6 | 146.2 | N | 31 | 30 | 30 | ○ |
| 39 | JAMSTEC | 30 May, 2021 | 17.8 | 148.3 | N | 32 | 29 | 29 | ○ |
| 40 | JAMSTEC | 31 May, 2021 | 14.0 | 150.4 | N | 30 | 30 | 20 | Contaminated by cloud? |
| 41 | JAMSTEC | 1 June, 2021 | 10.0 | 152.5 | N | 32 | 30 | 30 | ○ |
| 42 | JAMSTEC | 2 June, 2021 | 5.8 | 154.0 | N | 23 | UNK | 14 | Contamination on Fiber head? |
| 43 | JAMSETC | 3 June, 2021 | 1.5 | 155.5 | N | 31 | 30 | 24 | Oscillation on scattered light |
| 44 | JAMSTEC | 17 June, 2021 | 13.1 | 136.5 | N | 29 | 29 | 24 | Contaminated by cloud? |
| 45 | JAMSTEC | 25 June, 2021 | 13.1 | 136.5 | N | 30 | UNK | 14 | Contaminated by cloud? |
| 46 | JMA | 5 July, 2021 | -69.0 | 39.6 | N | 29 | UNK | 19 | Contaminated by cloud? |
| 47 | NIPR | 21 Sep., 2021 | 36.3 | 140.4 | D | 25 | 23 | 23 | ○ |



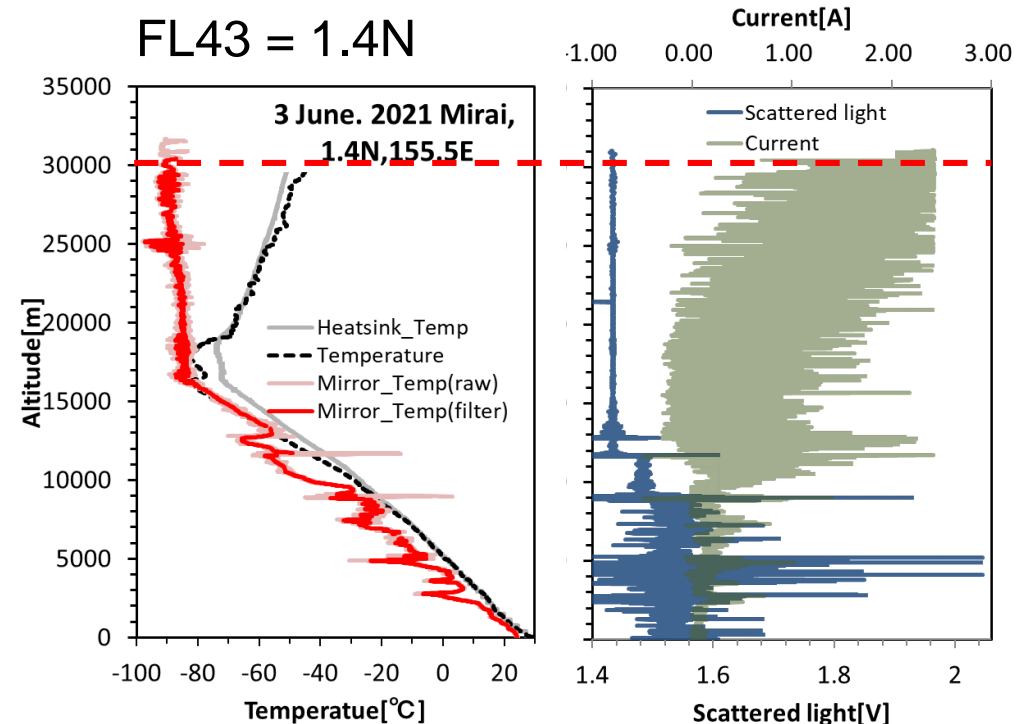
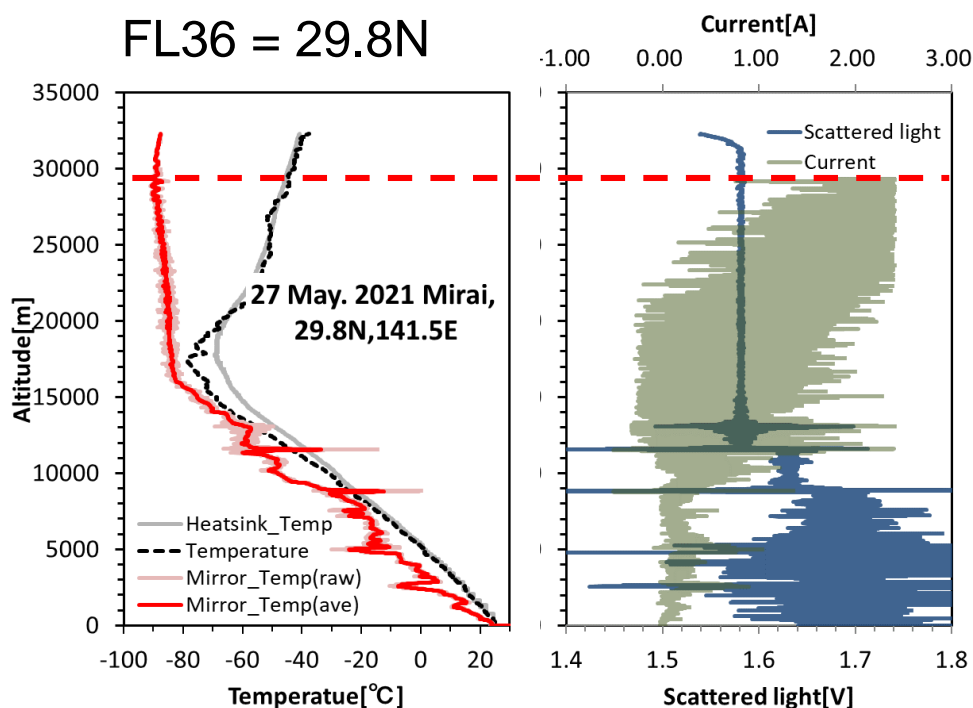
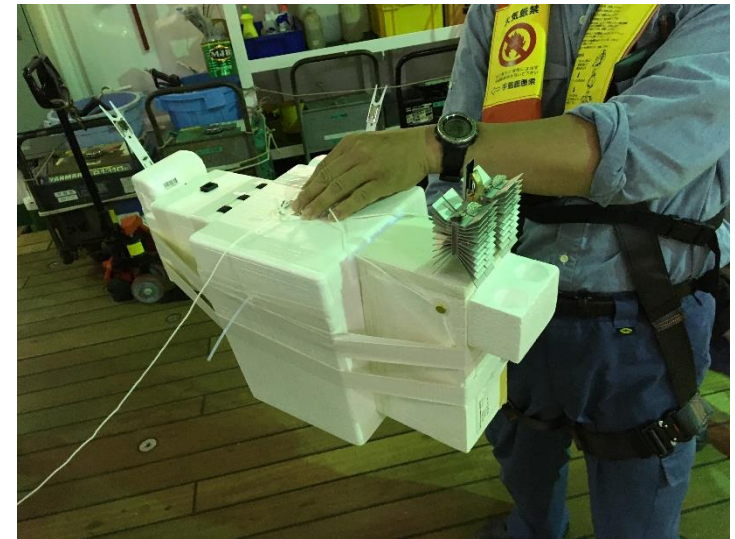
⊙ = SKYDEW launch point

Observations at various latitudes were carried out during JAMSTEC campaign.

Results between tropical and mid-latitude

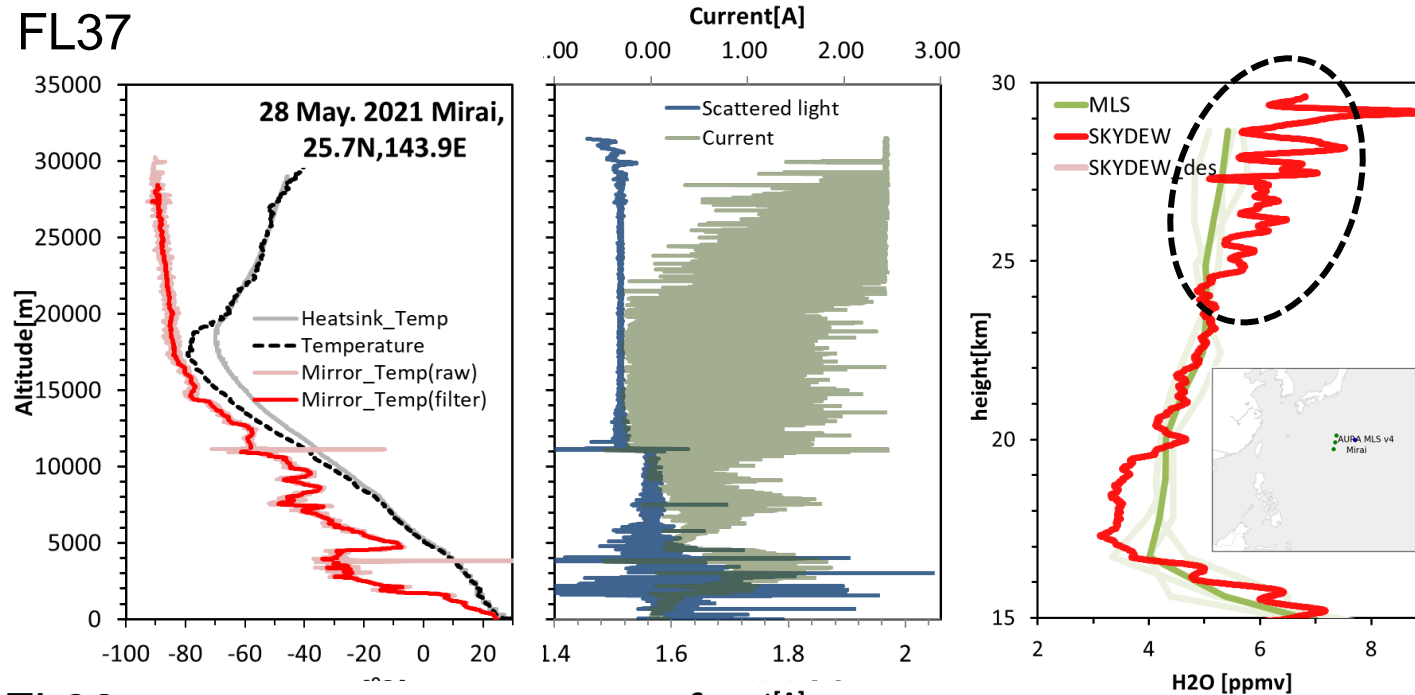
Observations from mid-latitudes to the tropics were made at night.
These cooling limits were about 30 km height.
T-Td is 40 K or more at 30km.

--- = Cooling limit



Contamination from flight equipments?

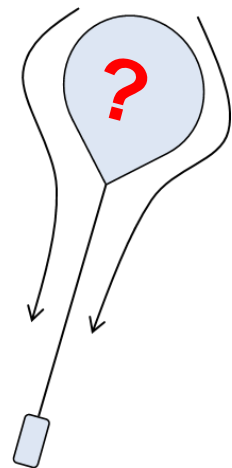
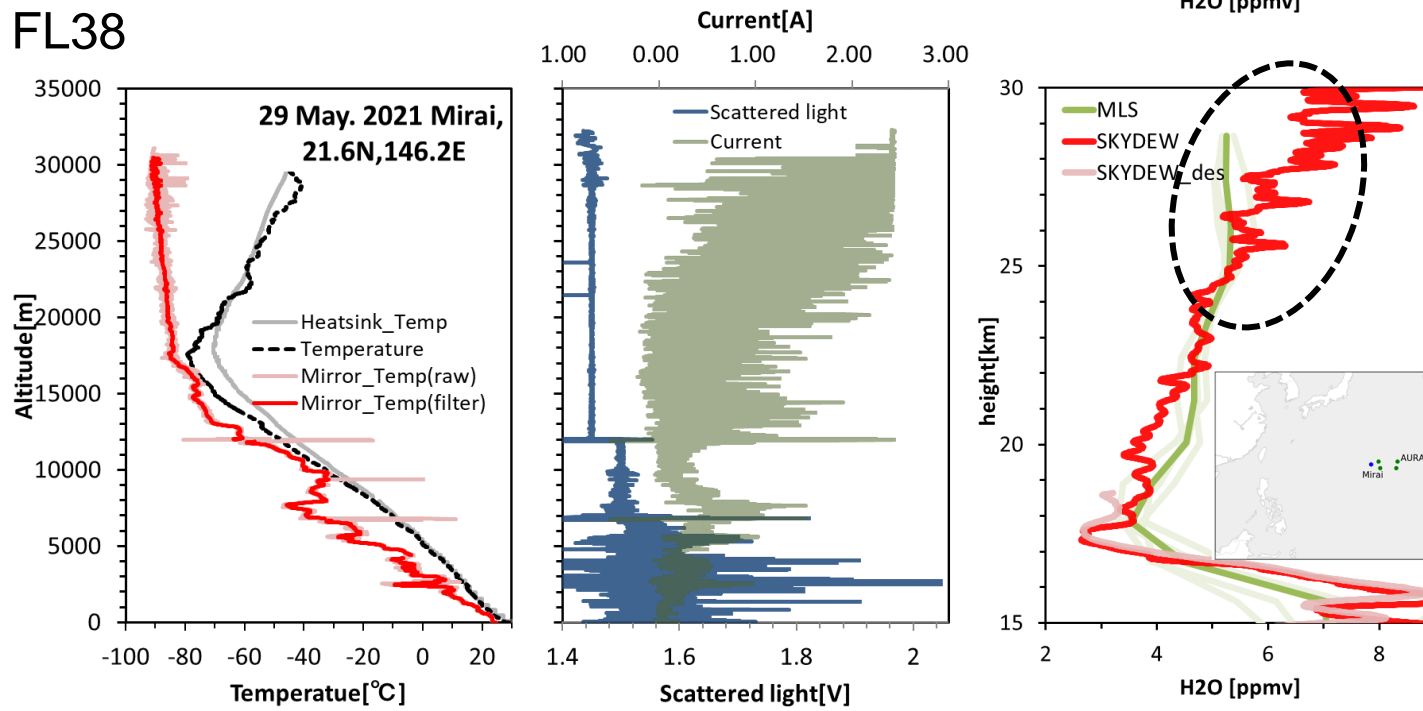
FL37



MLS and SKYDEW do not match over 25km. As one of the possibilities, It might be the evaporation of water vapor contained in the balloon.

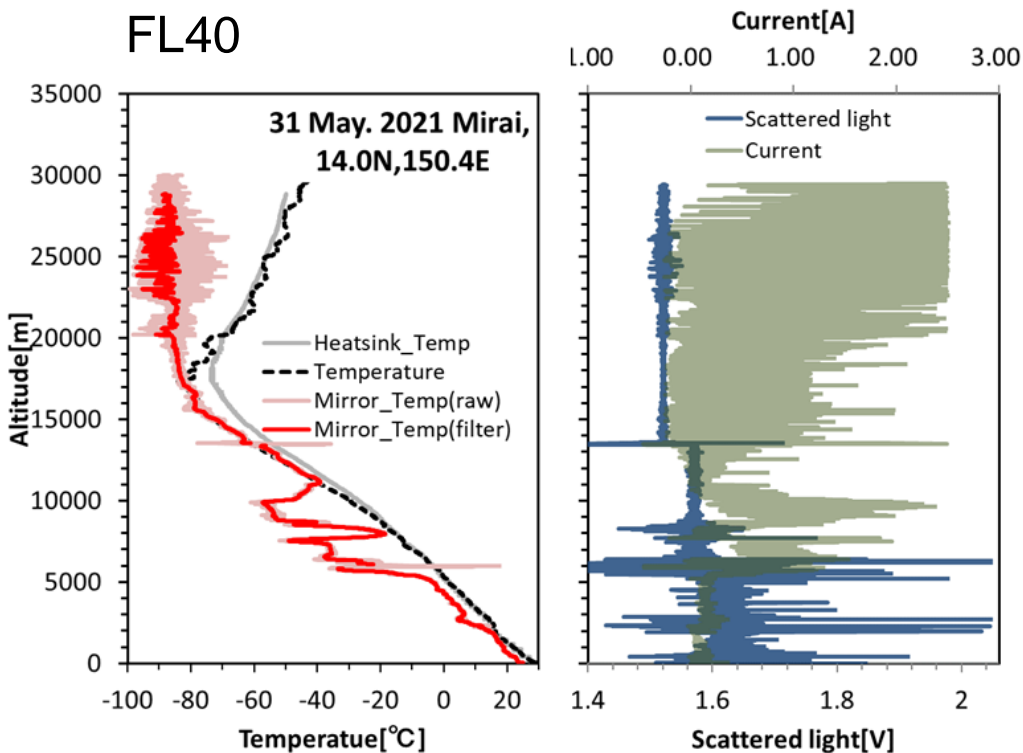
For more detail, under investigation.

FL38

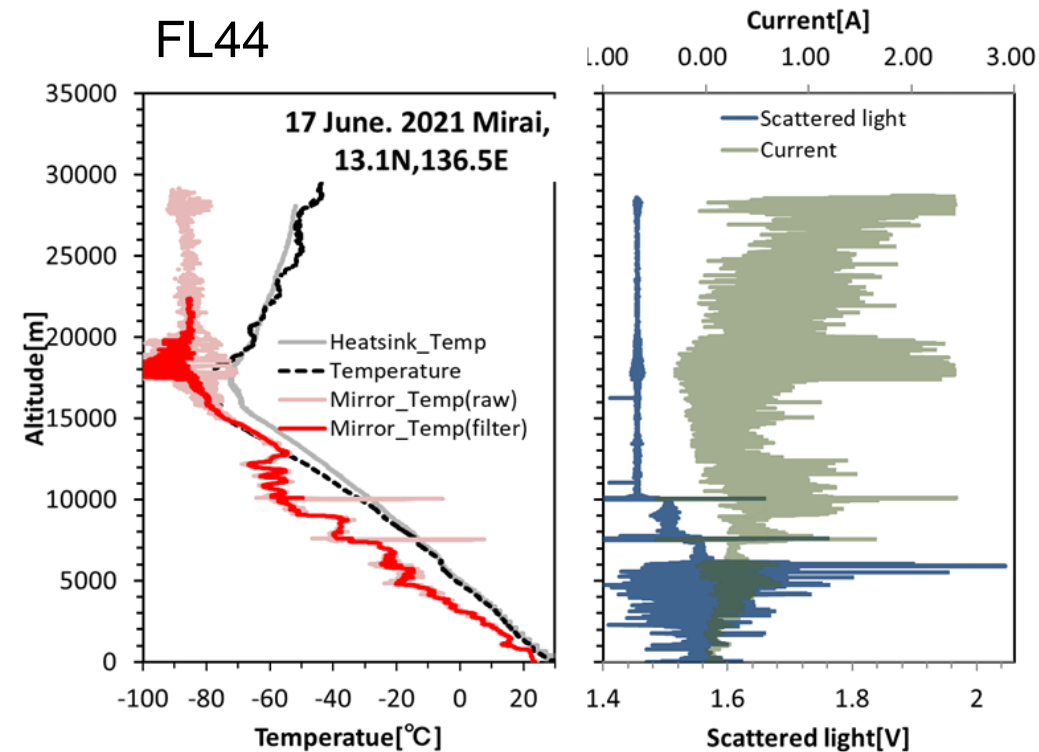


When SKYDEW passes through saturated clouds in the troposphere, the mirror temperature often oscillates in the stratosphere.

FL40

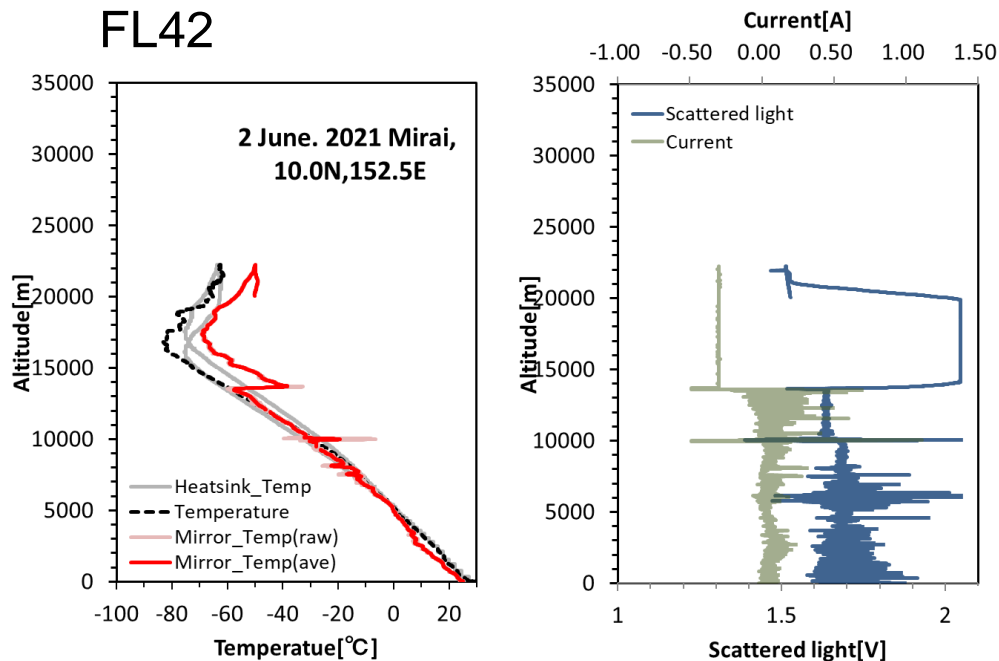


FL44



It is unknown whether the clouds was contaminated the SKYDEW body or the balloon, but SKYDEW observation recommended under cloudless weather.

FL42



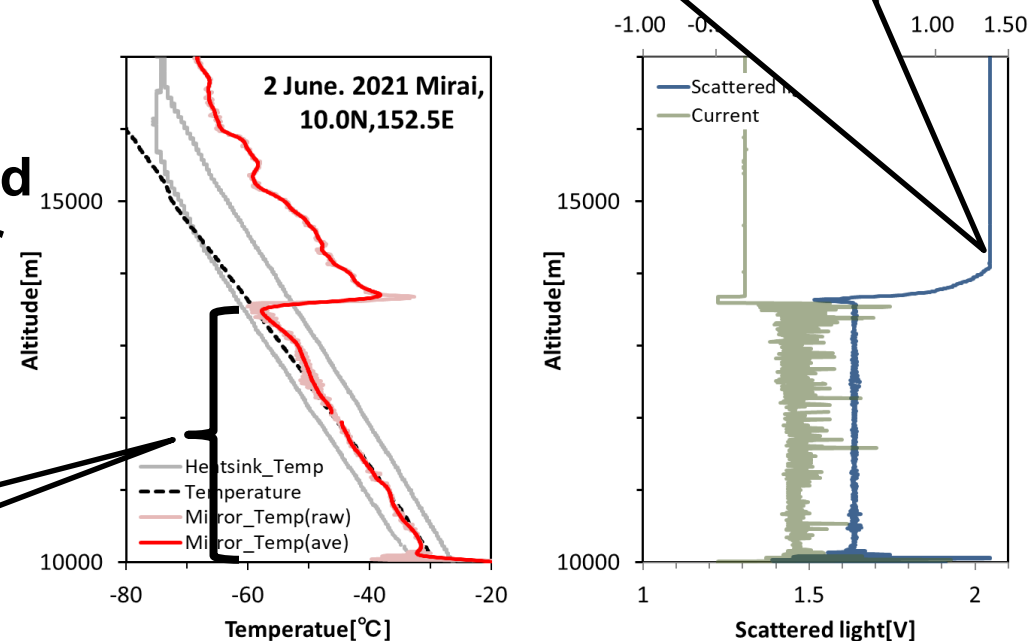
In FL42, the scattered light did not decrease even under heating control.

As the scattered light became large, the mirror was warmed by Peltier heating.

It is considered that clouds or dust attached to the head of the fiber that does not have a heating mechanism.



It was in the clouds until the problem occurred.



- In 2021, Meisei started supplying to domestic pilot users (JMA, JAMSTEC, NIPR and Universities).
- By JAMSTEC observations, SKYDEW was tested under the conditions from 30 degrees north to the equator.
- The cooling limit of SKYDEW is more than 40K in T-TD at night.
- In the observation that clouds exist in the troposphere, the mirror temperature often oscillated in the stratosphere. Cloudless conditions are recommended for SKYDEW observations.
- GDP development of SKYDEW is underway.
- Observations in many areas, including Antarctica, are planned in 2022.
- It is scheduled to start providing product model SKYDEW to all users including overseas in 2022.

IHI GROUP
Realize your dreams