Review to the history and future of automatic upper air soundings

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VAISALA

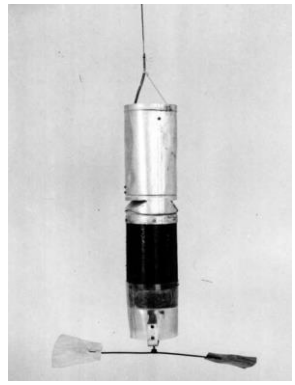
Contents of the presentation

- History
- Current status
- Future
- Best practices related to setting up automatic upper air sounding stations

History – data reception from the radiosonde

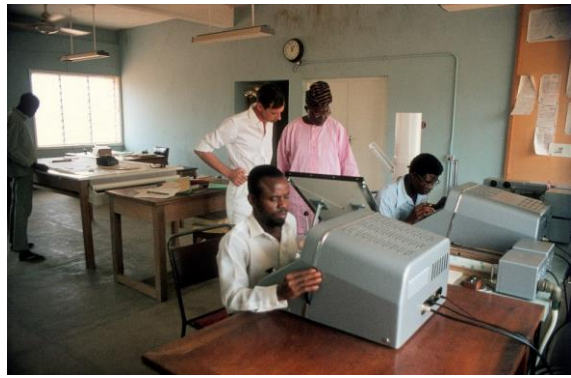
1930's-1950's

- Manual recording of pTU
- Optical theodolite for wind



1950's-1970's

- Radiotheodolite for wind
- Automatic radiosonde receiver



1970's-1990's

- NAVAID/Omega, Loran-C for wind
- All-weather pTUw without manual work after balloon launch

History – balloon filling and release

- Data reception and message creation is solved => how to fill the balloon automatically:
- Vaisala AUTOSONDE® 1992

PAPERS PRESENTED

AT THE

WMO TECHNICAL CONFERENCE ON

INSTRUMENTS AND METHODS OF OBSERVATION

(TECO-92)

Vienna, Austria, 11-15 May 1992

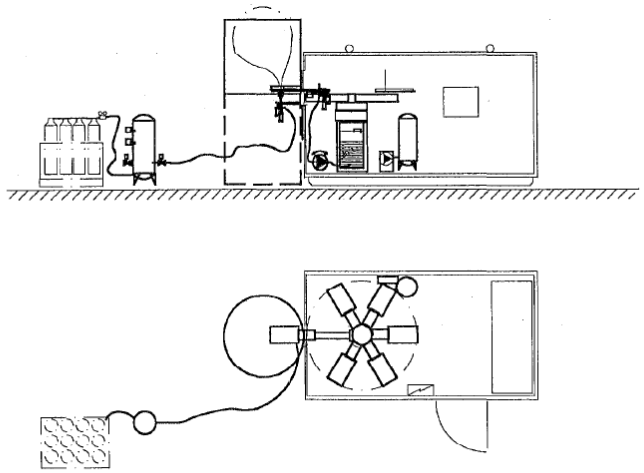


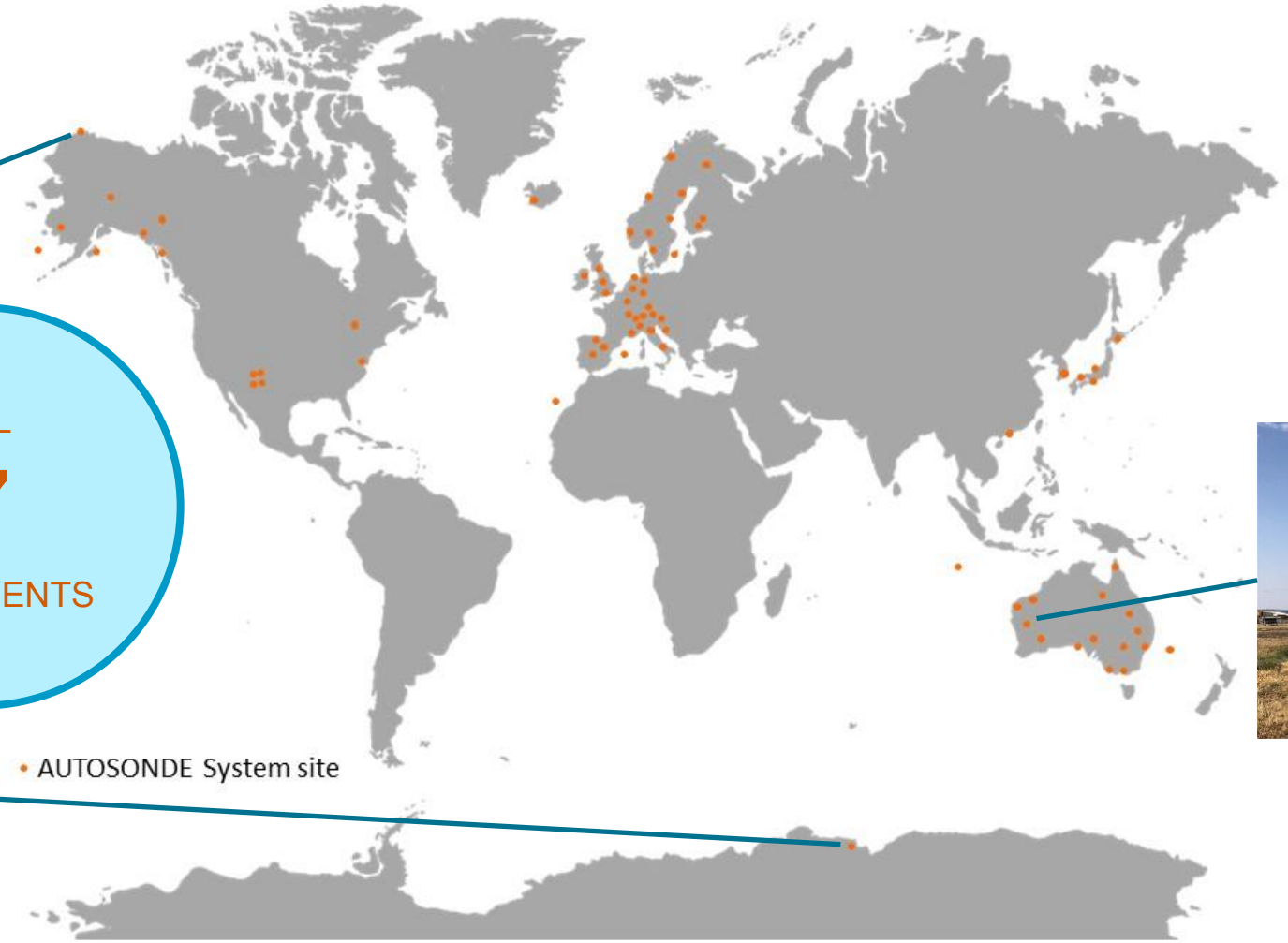
FIG. 2. Outline of a containerized automated radiosonde launcher (side view, view from above).

History - the first automatic synoptic upper air station

- Landvetter station, Sweden, SMHI since 1994

Year	RS model
1994-2006	RS80

Automatic upper air soundings today

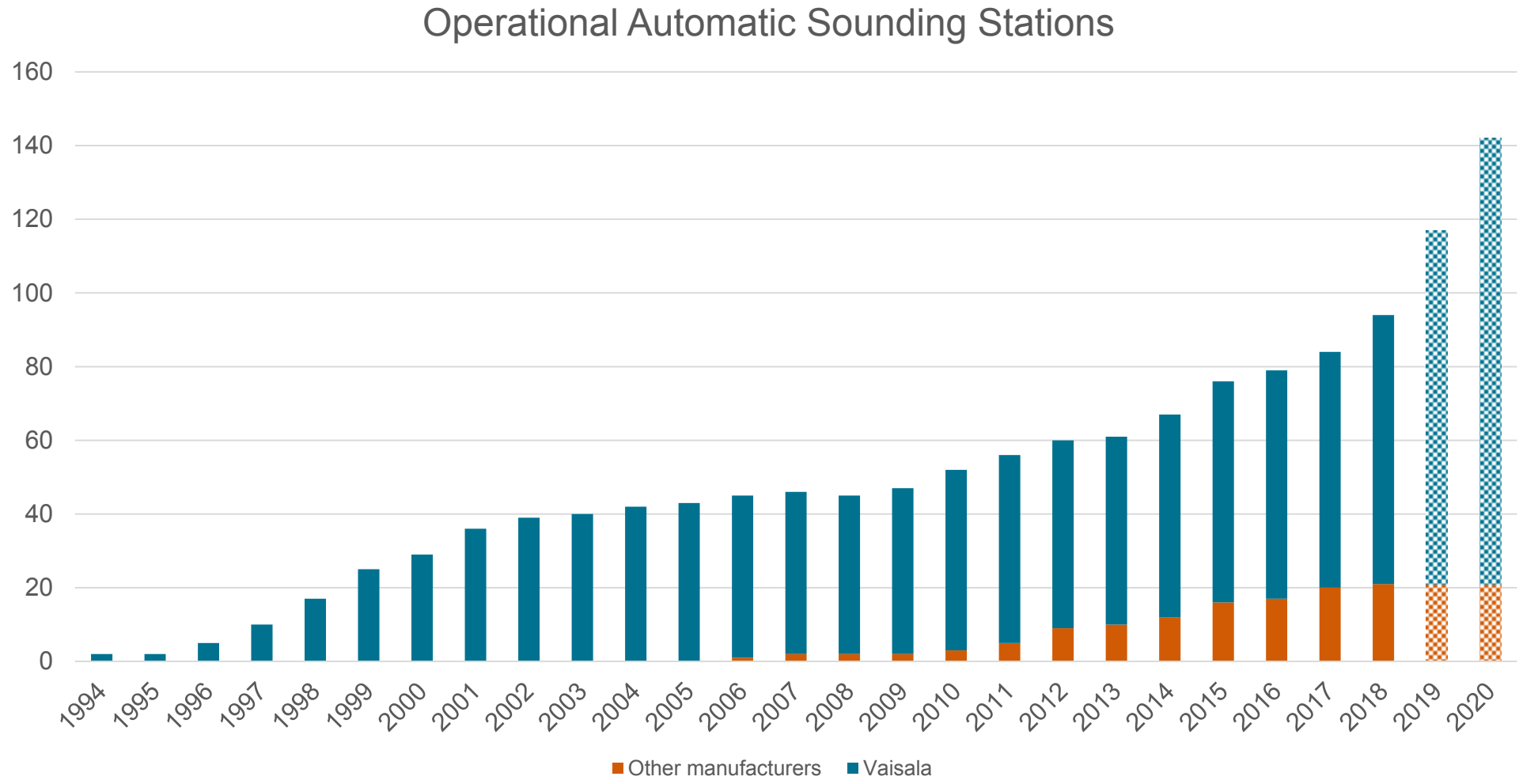


94
SYSTEMS

Vaisala AUTOSONDE® 73
Other manufacturers 21

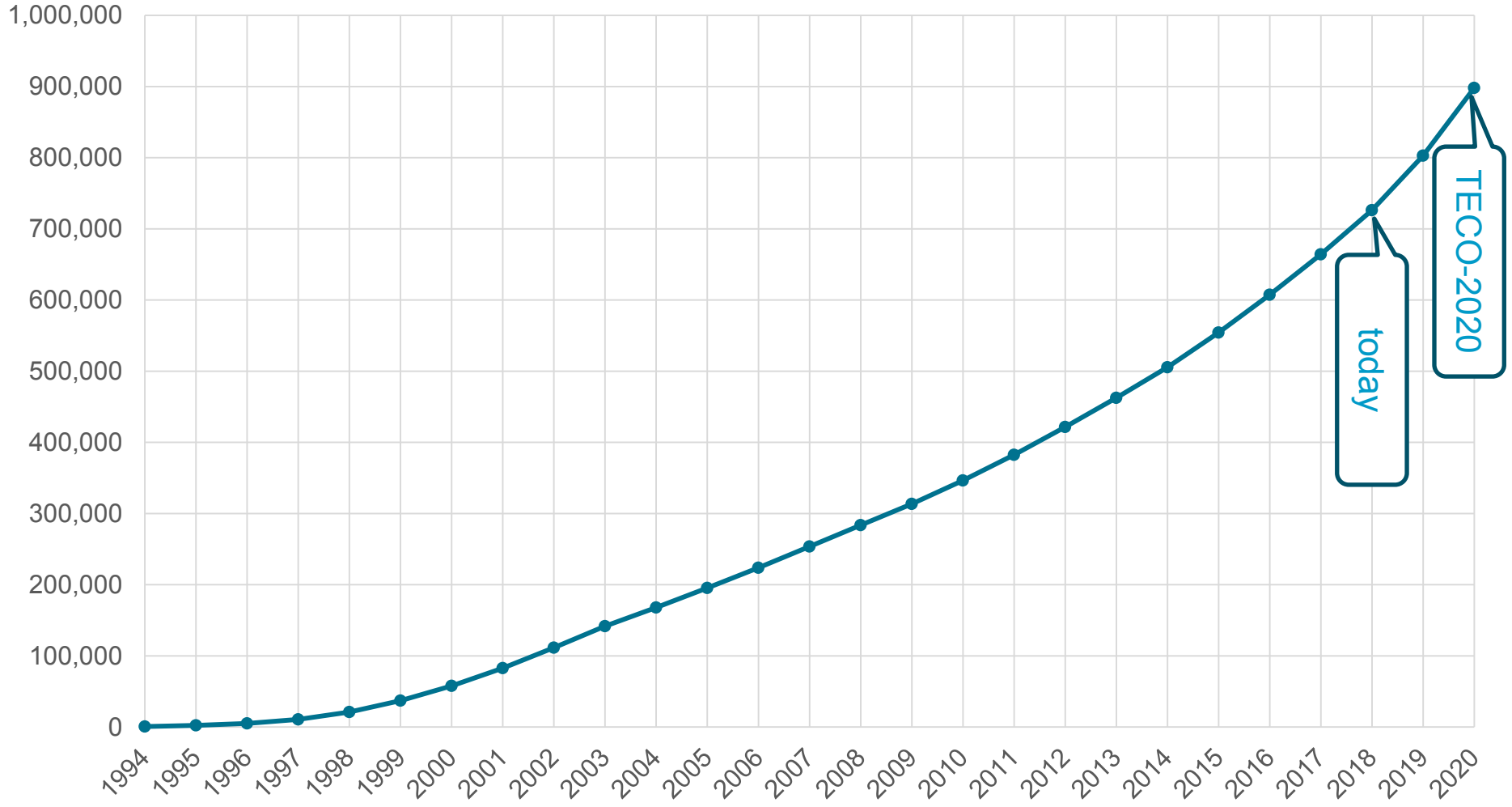
ALL
7
CONTINENTS

Accumulated experience with automatic stations



TOTAL
1055
YEARS OF OPERATION

Cumulative number of soundings (automatic systems)



730000
SOUNDINGS

1055
YEARS

94
SYSTEMS

One-month autonomous sounding system

- **60 fully automatic soundings**
  - 30 days x 2 soundings per day
- Half a day loading visit
  - **3 minutes** per radiosonde + balloon
- Automatic **ground check before flight**
- **Zero use of radiosonde battery** while loaded, **wireless** on-off mechanism
- Possibility to store 4 months worth of radiosondes and balloons in the system
  - can be used as a storage space

Vaisala AUTOSONDE® AS41

Vaisala Radiosonde RS41

designed for automated use

Testing a new automatic sounding system

- Two test sites, on purpose difficult sites
  - harsh environmental conditions
- Coast of the Gulf of Finland
- Vestkapp, Norway

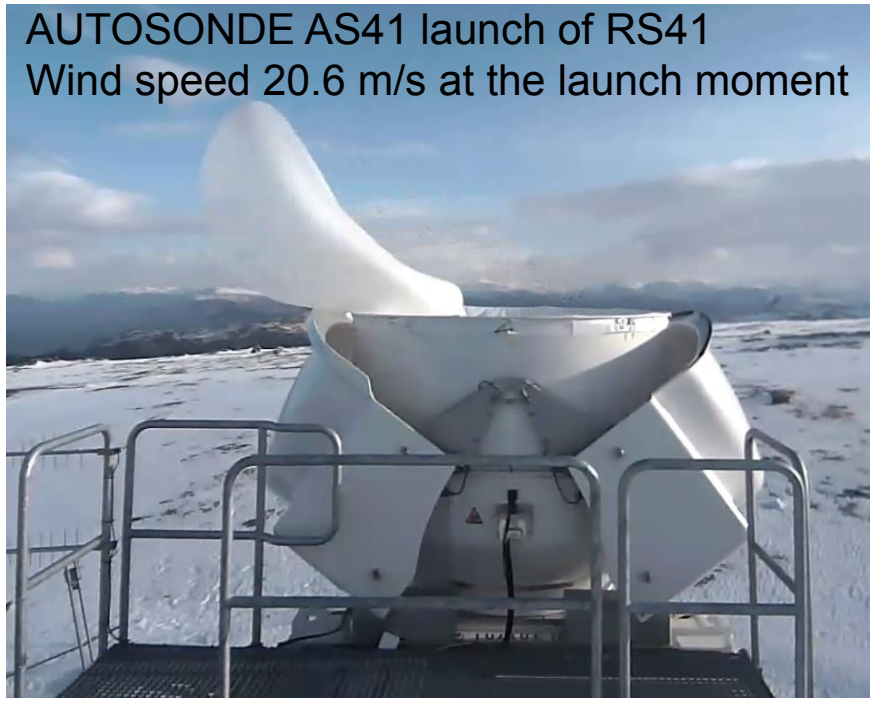
- More than 1000 test soundings

Best practices related to setting up automatic sounding stations

1. Network operational requirements
2. Occupational health and safety
3. Site selection and infrastructure
4. Operation
5. Maintenance

1. Network operational requirements

- Environmental extremes
  - Temperature range
  - Wind speed
  - Rain, snow
- Targeted sounding burst heights
  - Selection of the balloon type and size
- Targeted data availability and latency
  - Telecommunication requirements


AUTOSONDE AS41 launch of RS41
Wind speed 20.6 m/s at the launch moment

Example: EUCOS requirements (2013)

Requirement	Target
Data availability	95%
Achieving 100 hPa	97%
Achieving 50 hPa	95%
Timeliness HH+100 min	95%
Timeliness HH+50 min	75%

2. Occupational health and safety

- **Important consideration in any weather observation system**
- Electric Safety – professional electricity design and installations, according to local national regulations
- Machine Safety – measures related to safe use of automatic equipment

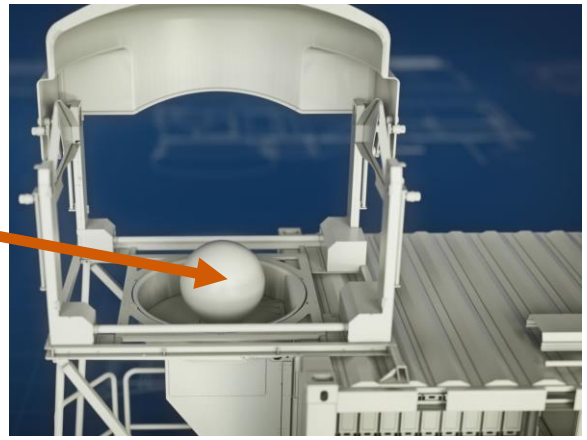
For example, in EU:
Machinery Directive 2006/42/EC

2. Occupational health and safety (cont.)

- **Important consideration in any weather observation system**
- Maintenance safety – planned and safe access to all subsystems without climbing gear
- **Gas Safety** – safe use of hydrogen (or helium) – design according to rules for potentially explosive atmospheres & suffocation risk

For example, in EU:
ATEX Directive 2014/34/EU
Equipment for potentially explosive atmospheres

Balloon filling in separate, outdoor launcher cylinder



Gas lines outdoors, no part of gas line enters the frame of the indoor work area

3. Site selection and infrastructure

- Electricity
- Telecommunications
- Road access
  - installation
  - gas logistics

4. Operations

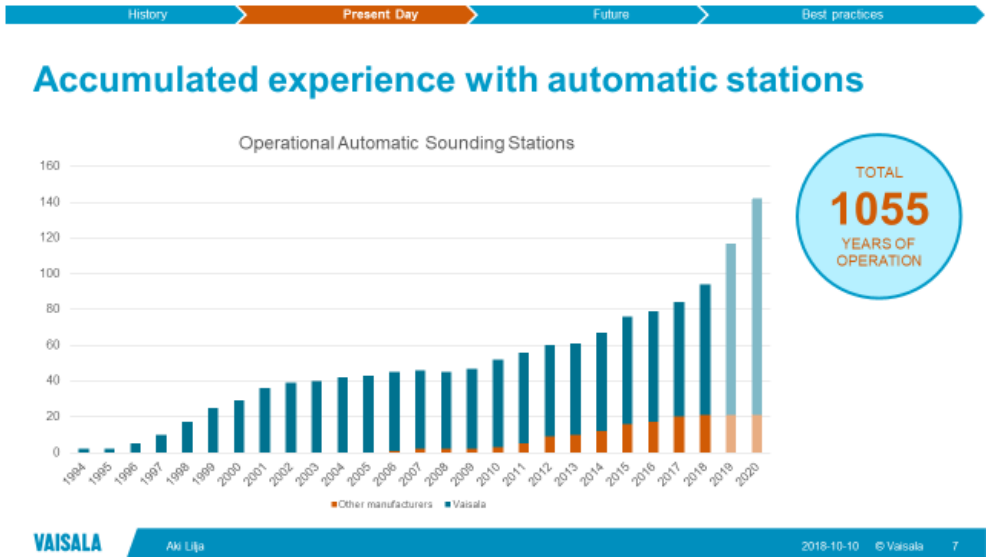
- Site visit schedules
  - radiosonde + balloon logistics
  - sounding schedules
  - personnel

5. Maintenance

- Preventive, planned maintenance
  - typically once per year
- Corrective, reactive maintenance
- Spare part inventory and logistics
  - inventory (for critical parts)
  - needs-based procurement of spares (for non-critical parts)
- Level of in-house training vs. reliance on manufacturer or other external party

Summary

- **Automatic soundings** have become mainstream of national weather observation infrastructures



- One-month automation is possible
  - Possible to operate sounding station with **half-a-day effort once per month**

- Setting up an automatic sounding station is a straightforward project when all relevant aspects are considered

Thank You!