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観測網の例：JMAのAMeDAS（Automated Meteorological Data Acquisition System）

- 雨量
- 気温、風向/風速、日照時間（約840箇所）
- 雪深（約320箇所）

計測機種：
- 警備気象観測所
- 特殊自動天気観測所
- 自動気象観測所
- 自動雨量観測所

計測機種は、約1300箇所に設置されており、平均的に17kmの間隔で配置されています。
Surface Weather Observation System (JMA-10 type)

- Rain Sensor
- Precipitation Gauge
- Thermometer
- Hygrometer
- Pyranometer
- Snow Depth Gauge
- Sunlight Recorder
- Visibility Meter (Only AWS)
- Combined Wind Vane and Propeller Anemometer
- Barometer
- Data Converter & Processing Unit

Observation network of JMA "AMeDAS"
Automatic Weather Station / Automatic Precipitation Gauge Station

Observation network of JMA "AMeDAS"
In Japan, the Meteorological Service Act requires all meteorological instruments used for public to meet certain technical and performance standards.

JMA is accredited to ISO/IEC17025.

- Temperature
- Humidity
- Pressure

JMA is the National Primary Standard (National Metrology Institute of Japan)

Working instruments

Working standards (JMA sub-standard)

International Standard (SI unit)
Measurement standards traceable to national standards

Accredited Laboratory*

Temperature fixed points
- Indium point (156.5985°C)
- Mercury point (-38.8344°C)
- Water triple point (0.01°C)

Standard resistor (100 Ω)

Calibration:
- every year
- NSR-160 (Netsushin, Japan)
- every 2 years
- Water triple-point cell
- Standard resistor (100 Ω)

Check: every 6 months
Using water triple-point cell

Platinum resistance thermometer
- NSR-160 (Netsushin, Japan)
- Alternating current bridge F-600 (ASL, UK)
- Water triple-point cell (0.01°C)
- Standard resistor (100 Ω)

Meteorological Instrument Center (JMA)

Platinum resistance thermometer
- TS-81A (Chino, Japan)
- Alternating current bridge F-250 (ASL, UK)

Calibration:
- every year

Observatory (JMA)

Platinum resistance thermometer
- Calibration: at the time of installation

Check:
- every 3 months (manned observatory)
- every year (automatic weather station)

Tolerable range: ±0.4°C

Platinum resistance thermometer
- TS-81A (Chino, Japan)

Alternating current bridge F-250 (ASL, UK)

Mercury-in-glass thermometer
- (psychrometer)

Platinum resistance thermometer
- (psychrometer)

Under transition

*According to the Measurement Act in Japan, JMA standard cannot be directly calibrated to the National standard.
Traceability of Precipitation (JMA)

National Primary Standard
National Metrology Institute of Japan
Prototype of the kilogram

Working Standard
Japan Quality Assurance Organization
Standard weight

Working Standard
Meteorological Instrument Center (JMA)
Burette 1571ml Burette (Yoshino-keisoku, Japan)

Field Instruments
Observatory (JMA)
Rain gauge (tipping bucket type)

Calibration: every 10 years

Inspection: every 5 years
Traceability of Solar Radiation (JMA)

- **National Primary Standard**
  - Atmospheric Environment Division (JMA)
  - Pyranometer

- **JMA Standard**
  - Meteorological Instrument Center (JMA)
  - Pyranometer

- **Working Standard**
  - Observatory (JMA)
  - Pyranometer

- **Field Instruments**
  - Calibration: every year
    - CMP-22 (Kipp & Zonen, Netherlands)
    - MS-802F (EKO, Japan)

  - Calibration: every 5 years
    - CMP-22 (Kipp & Zonen, Netherlands)

**Comparison**
(To check the accuracy routinely out of doors)

**Calibration**:
- PMO-6 A-HF
- Absolute radiometer (WMO RAII Standard) (National Primary Standard)

**20 Mar. 2018**
**Traceability of Wind Speed (JMA)**

**National Primary Standard**
- Laser Doppler velocimeter calibrated by turning table, Calibration wind tunnel, Tow carriage

**JMA Standard**
- Meteorological Instrument Center (JMA)
  - Ultrasonic anemometer DA-700 (Sonic, Japan)
  - Pitot tube F-202 (Rika seiki, Japan), Differential pressure gauge MT210 (2sets) (YOKOGAWA, Japan)

**Working Standard**
- Ultrasonic current meter DA-470 (Sonic, Japan)
- Differential pressure gauge DPI145 (GEsensingjapan, Japan)

**Field Instruments**
- Observation equipment of propeller anemometer
  - Digital tachometer
  - Calibration: every 2 years

**National Metrology Institute of Japan**
- Laser Doppler velocimeter calibrated by turning table, Calibration wind tunnel, Tow carriage

**Meteorological Instrument Center (JMA)**
- Ultrasonic anemometer DA-700 (Sonic, Japan)
- Pitot tube F-202 (Rika seiki, Japan), Differential pressure gauge MT210 (2sets) (YOKOGAWA, Japan)

**Observatory (JMA)**
- Calibration: at the time of installation
- Relational table between wind speed and rotation frequency of the propeller anemometer

**Check**
- Calibration: every 2 years
- Check: every 5 years
- Check: every year

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**Traceable to National standard (Time)**

20 Mar. 2018
Manned Observatory, Special AWS: Every 3 months
AWS: Once or twice in a year

Instruments:
- Anemometers
- Rain gauges
- Pyranometers
- Sunshine recorders

Meteorological Instrument Center (Tsukuba):
MIC inspects about 1,600 units of instrument per year.

Maintenance of field instruments:
- Overhaul and inspection/calibration at MIC:
  - Every 5 years.
Meteorological Instrument Center Japan Meteorological Agency

Inspection/calibration: every 5 years
- Anemometers
- Rain gauges
- Pyranometers
- Sunshine recorders

• Checking:
  - whether the instrumental error concerned
  - is within a specified range or not in comparison with standard instruments.

Maintenance of field instruments
- Overhaul and inspection/calibration of field instruments at MIC
  - Overhaul
    - Replacement of deteriorated/damaged parts
    - Adjustment
  - Inspection/calibration
Maintenance of field instruments

- Overhaul and inspection for rain gauge
  - Replacement of deteriorated / damaged parts
  - Inspection
  - Adjustment

Overhaul and inspection / calibration of field instruments at MIC
Meteorological Instrument Center Japan Meteorological Agency

- Is there any rust or dirt inside the shelter?
- Is the fan working properly?
- Does the propeller respond properly to winds?
- Clean? Are there any spider webs?

JMA regularly maintains AWS in order to keep the quality of observation data.

Anemometer

Precipitation Gauge

Thermometer, hygrometer & Shelter

- Is there any damage?
- Is the gauge installed horizontally?
- Does the bucket tip properly?

Maintenance of field instruments

- Site inspection / calibration of field instruments
- Maintenance and inspection at field site

- Is there any damage to the sensors?
Meteorological Instrument Center

JMA uses

Aspirated psychrometer

Check (Every 3 months)

Platinum resistance thermometer / Electronic hygrometer

Maintenance of field instruments

- Site inspection for thermometer / hygrometer (Manned observatory & Special AWS)

Platinum resistance thermometer (psychrometer)

- Site inspection / calibration of field instruments
Maintenance of field instruments

- Calibration by comparing with traveling standard at field site every year or every 2 years.

- Site calibration for barometer (Manned observatory & Special AWS)※Same level: The sensors of these two barometers.

- Site inspection/calibration of field instruments.
JMA keeps the traceability of meteorological instruments.

- Calibration of standards at MIC.
- Calibration of field instruments at MIC (before installing).

JMA maintains the field instruments.

- Overhaul and calibration / inspection at MIC every 5 years.
- Site inspection / calibration with traveling standard.

Thank you for your attention!

Summary

- It is important that NMHSs keep the traceability of meteorological instruments and maintain the field instruments to assure the quality of observation data.