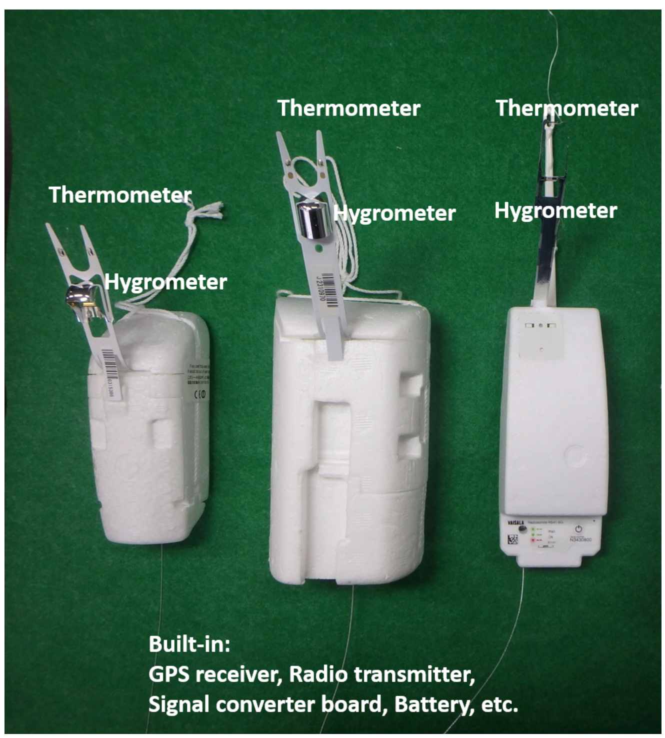
Radiosondes

Overview

Radiosondes are instruments used for meteorological observation. They are equipped with a platform of sensors that measure meteorological variables such as atmospheric pressure, temperature and humidity, and also have a radio transmitter for data communications. A thermometer and hygrometer are attached to the unit's projecting arm, and a barometer, radio transmitter, battery and other parts are embedded in the body (a storage box made of white styrene foam). Radiosondes observe atmospheric conditions (e.g., pressure, temperature, humidity, wind direction and wind speed) up to altitudes of around 30 km from the ground suspended from weather balloons. Wind direction/velocity are monitored via balloon motion tracking. Radiosondes slowly parachute down once observation is complete.

Upper-air observation using radiosondes is carried out daily at regular intervals worldwide (at 0900 and 2100 JST). Radiosonde observation is conducted by the Japan Meteorological Agency (JMA) at 16 Local Meteorological Office stations nationwide and at Showa Station in Antarctica, and on board JMA research vessels. Radiosonde data are utilized for numerical prediction models (providing basic information for weather forecasts), climate change/global environment monitoring, flight operation management and other purposes.



Radiosondes (from left: iMS-100, RS-11G, RS-41SG)

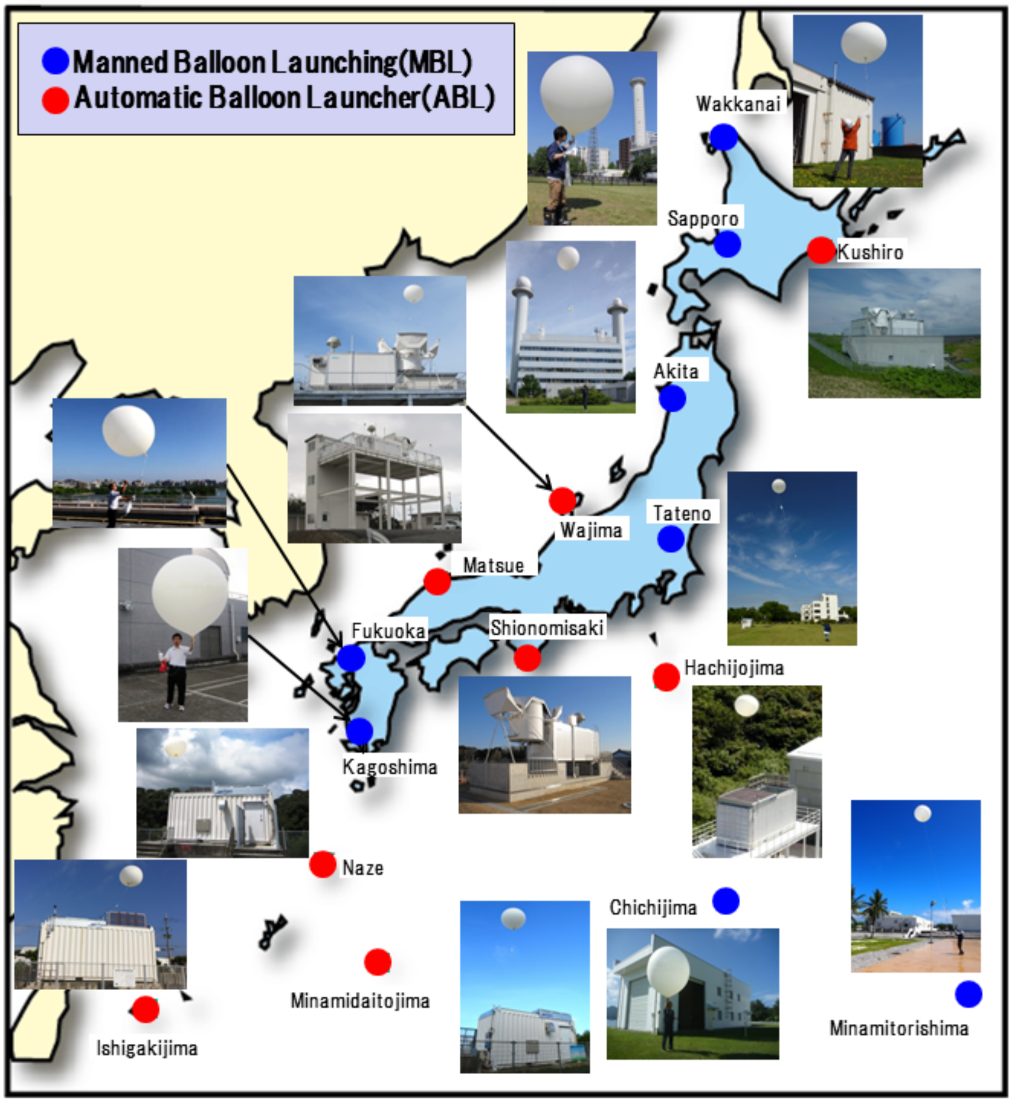
MBL: Manned Balloon Launching

ABL: Automatic Balloon Launcher

Radiosonde Observation Sites

List of observation sites

Region ID	Station	Location	Latitude (degree)	Longitude (degree)
47401	Wakkanai	Wakkanai-shi, Hokkaido	45°24.9′	141°40.7′
47412	Sapporo	Sapporo-shi, Hokkaido	43°03.6′	141°19.7′
47418	Kushiro	Kushiro-shi, Hokkaido	42°57.2′	144°26.3′
47582	Akita	Akita-shi, Akita	39°43.1′	140°06.0′
47600	Wajima	Wajima-shi, Ishikawa	37°23.5′	136°53.7′
47646	Tateno	Tsukuba-shi, Ibaraki	36°03.5′	140°07.5′
47678	Hachijojima	Hachijo-cho, Hachijojima, Tokyo	33°07.3′	139°46.7′
47741	Matsue	Matsue-shi, Shimane	35°27.5′	133°04.0′
47778	Shionomisaki	Kushimoto-cho, Higashimuro-gun, Wakayama	33°27.1′	135°45.7′
47807	Fukuoka	Fukuoka-shi, Fukuoka	33°35.0′	130°23.0′
47827	Kagoshima	Kagoshima-shi, Kagoshima	31°33.3′	130°32.9′
47909	Naze/Funcha-toge	Amami-shi, Kagoshima	28°23.6′	129°33.2′
47918	Ishigakijima	Ishigaki-shi, Okinawa	24°20.2′	124°09.8′
47945	Minami-daitojima	Minami-daito-son, Shimajiri-gun, Okinawa	25°49.8′	131°13.7′
47971	Chichijima	Ogasawara-mura, Tokyo	27°05.7′	142°11.1′
47991	Minami-torishima	Ogasawara-mura, Tokyo	24°17.4′	153°59.0′
89532	Showa	Showa-Base, Antarctica	-69°00.3′	39°34.7′



Radiosonde observation network (as of October 2017)

Observation Data

Data at specified pressure levels

【稚内 2015年5月4日9時】(Wakkanai 09:00(JST) 4 May 2015)

地上 (surface)

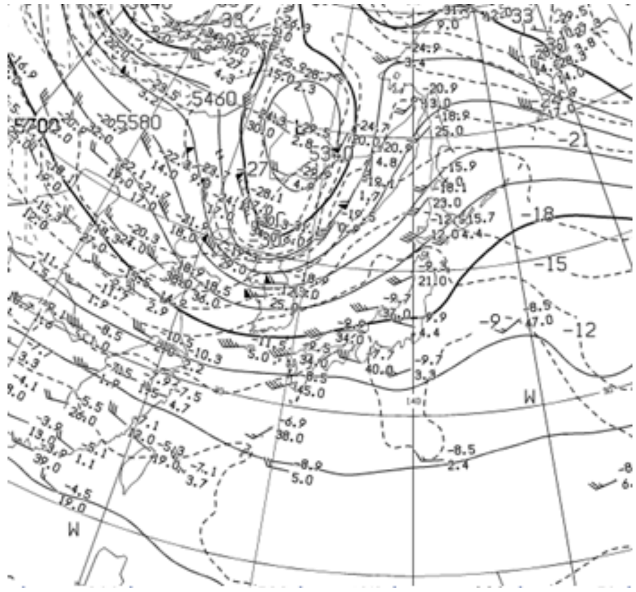
気圧(hPa)	高度(m)	気温(℃)	相対湿度(%)	風速(m/s)	風向(°)
1006.7	4	6.4	92	4.8	90

気圧：Pressure　相対湿度：Humidity
高度：Altitude　風速：Wind Speed
気温：Temperature　風向：Wind Direction

指定気圧面

気圧(hPa)	ジオポテンシャル高度(m)	気温(℃)	相対湿度(%)	風速(m/s)	風向(°)
1000	58	5.1	91	5	97
925	702	13.0	51	7	153
900	931	12.0	38	8	191
850	1409	10.6	54	10	206
800	1906	7.2	53	13	211
700	2990	-1.3	91	15	228
600	4196	-8.3	99	11	210
500	5589	-18.1	11	14	220
400	7238	-26.1	81	23	235
350	8189	-32.8	50	23	246
300	9253	-40.8	///	29	241

気圧：Pressure　相対湿度：Humidity
ジオポテンシャル高度：Geopotential Alititude　風速：Wind Speed
気温：Temperature　風速：Wind Direction



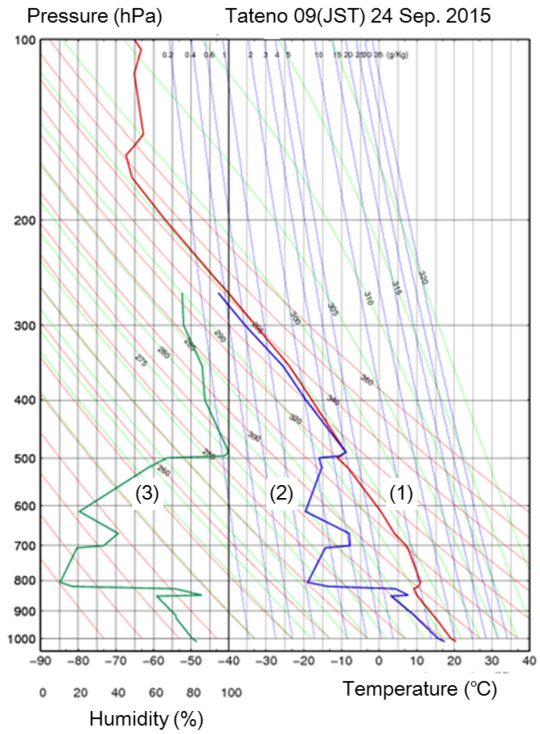
Left: partial observation data for specified pressure levels, Wakkanai, 9:00 JST, 4 May 2015
Right: weather map (500 hPa), 9:00 JST, 4 May 2015

Upper-air stability can be evaluated using observation data from radiosondes. "Atmospheric conditions are unstable" is an all-too-common term in weather forecasting; to evaluate actual stability, emagrams can be used as described below.

- Upper-air weather map (past 24 hours) (in Japanese)

Emagrams

An emagram is a kind of graphic chart illustrating atmospheric temperature and dew point temperature in relation to atmospheric pressure. As shown in Figure 1, the horizontal axis of the chart represents temperature, and the vertical axis represents pressure. Dry adiabatic lines, wet adiabatic lines and equal saturation mixing ratio lines are represented on the chart for reference in evaluating atmospheric stability. Dry adiabatic lines represent the relationship between temperature and pressure of dry air mass, while wet adiabatic lines are for saturated air mass with water vapor. Equal saturation mixing ratio lines pass through the point where the weight of water vapor contained in saturated air is equal to that of air excluding water vapor. Atmospheric stability is evaluated by comparing observation data with these reference lines.



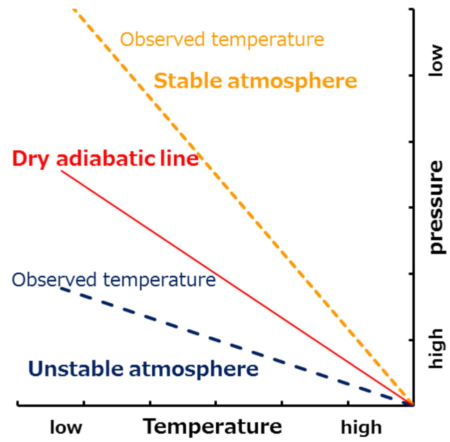


Figure 1 (left): upper-air observation (radiosonde) data from Tateno, 9:00 JST, 24 September 2015
Observation temperature data are shown by the thick red line (1). The thin red dry adiabatic lines show temperature changes in the virtually lifted air mass near the ground surface. The blue line shows the dew point temperature (2), and the green line indicates humidity (3).

Figure 2 (right): emagram-based representations of atmospheric stability evaluation

In Figure 1, the dry adiabatic (thin red) lines show the temperature change of the virtually lifted air mass near the ground surface. Atmospheric stability can be evaluated by comparing observation (thick red line) data with the reference lines.

Comparison of the thick red line (1) and the thin red line passing through the surface temperature level at the same height shows a higher temperature for (1). This means that the temperature of the lifted air mass near the ground is lower than that of the surrounding environment. As cold air is heavier (denser) than the surrounding air, upward flow will not develop. This situation is referred to as atmospheric stability.

Figure 2 shows a diagram of emagram-based evaluation of atmospheric stability. The appearance of observation data below dry adiabatic lines (meaning that the lifted air mass is warmer than its surroundings) indicates the development of updraft due to buoyancy. In response to this situation, the comment "The atmosphere is unstable" is made. Torrential rain and a range of other weather phenomena brought by cumulonimbus clouds are more likely to occur under these conditions. Meanwhile, if the air mass is wet, the stability of the atmosphere should be evaluated using the wet adiabatic line. Wet atmospheric conditions are more likely to be associated with instability than dry conditions.

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