6.12. Ozone, water vapor, and super high-altitude sonde observations

(1) Personnel

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(2) Objectives

The objectives of this observation are to capture the nature of material transport driven by the active convections associated with the Asian summer monsoon and the boreal summer Intraseasonal oscillation (BSISO), and to measure the vertical profiles of temperature and winds up to 40 km where the normal meteorological balloons cannot reach.

(3) Instrumentation and Method

Following special sensors were used for the material observations:

En-sci 1Z ECC ozonesonde

Meisei Skydew chilled-mirror dew/frost point hygrometer

Meisei CPS cloud particle counter

They were attached to Meisei RS-11G radiosondes and launched by TOTEX TX1200 or TX1000 balloons. The super high-altitude sonde observations were carried out by launching Meisei iMS-100 radiosondes with TOTEX TX3000 or TA4000 balloons. We launched the balloons basically with the balloon launcher made by NME and sometimes a TOTEX balloon cover. The data transmitted from radiosondes were received by three sets of Meisei RD08AC system, each of which consists of a receiver, an antenna, a pre-amplifier, a laptop computer, and cables.

We carried out 27 material observations and 27 super high-altitude observations along the route of the Mirai cruise. The observation point, date, launch time, and maximum altitude of each launch are shown in Table 6.12-1. Among the launches, we made special comparison (1) by attaching Vaisala RS41 and Meisei iMS-100 radiosondes to the ozone, water vapor, cloud particle count sensors launched by TX1200 balloons and (2) by attaching Vaisala RS41 to Meisei iMS-100 radiosonde launched by TX3000 balloons (see Sec. 6.10).

Table 6.12-1: The observation point, date, launch time, and maximum altitude of each launch of the material observations and super high-altitude observations

Date	Obs point number	Time (SMT)	Lat.	Lon.	Launch time (SMT), Sensors, Maximum height	Remarks
May 27	SPS-001	18:44	29.45N	141.76E	18:44 Ozone and water vapor (30.7 km) 19:23 Super high altitude (18 km)	
May 28	SPS-002	18:33	25.37N	144.09E	18:33 Ozone and water vapor (32 km) 19:23 Super high-altitude sonde (19.8 km)	
May 29	SPS-003	18:39	21.13N	146.40E	18:39 Ozone and water vapor (33 km) 19:39 Super high-altitude sonde (21.6 km)	
May 30	SPS-004	18:39	17.40N	148.50E	18:39 Ozone and water vapor (32 km) 19:06 Super high-altitude sonde (19.8 km)	
May 31	SPS-005	18:48	13.65N	150.54E	14:39 Super high-altitude sonde (39.8 km) 18:48 Ozone and water vapor (32 km) 19:23 Super high-altitude sonde (23.0 km)	
Jun 01	SPS-006	18:33	9.72N	152.62E	18:33 Ozone and water vapor (32 km) 18:58 Super high-altitude sonde (16.8 km)	
Jun 02	SPS-007	16:00	05.89N	154.03E	16:00 Super high-altitude sonde (16.2 km) 16:31 Ozone and water vapor (22 km)	
Jun 03	SPS-008	16:50	01.30N	155.55E	16:50 Super high-altitude sonde (39.7 km) 17:20 Ozone and water vapor (33 km)	
Jun 04						
Jun 05						
Jun 06						
Jun 07	SPS-009	16:15	04.09N	146.00E	16:15 Super high-altitude sonde (40.5 km) 16:40 Ozone (29 km)	
Jun 08	SPS-010	16:29	05.87N	141.54E	16:29 Super high-altitude sonde (40.5 km) 16:55 Ozone (33 km)	
Jun 09	SPS-011	16:50	07.67N	137.00E	16:50 Super high-altitude sonde (40.0 km) 17:15 Ozone (32 km)	
Jun 10						
Jun 11						
Jun 12	SPS-012	17:19	13.28N	136.92E	17:19 Super high-altitude sonde (39.6 km) 20:23 Ozone (32 km)	
Jun 13						
Jun 14	SPS-013	17:17	13.10N	136.57E	17:17 Super high-altitude sonde (39.9 km) 20:15 Ozone (32 km)	
Jun 15						

Jun 16	SPS-014	17:20	13.12N	136.52E	17:20 Super high-altitude sonde (39.5 km) 20:18 Ozone (31.1 km)	
Jun 17	SPS-015	17:19	13.12N	136.52E	17:19 Super high-altitude sonde (39.4 km) 20:40 Ozone, water vapor, and cloud particle count attached with RS41 and iMS-100 (29.5 km)	
Jun 18						
Jun 19	SPS-016	17:19	13.12N	136.50E	17:19 Super high-altitude sonde (40.4 km) 20:19 Ozone (31.9 km)	
Jun 20						
Jun 21	SPS-017	17:20	13.13N	136.51E	17:20 Super high-altitude sonde (37.8 km)	
Jun 22	SPS-017	20:19	13.10N	136.49E	20:19 Ozone and cloud particle count (32.0 km)	
Jun 23	SPS-018	17:20	13.12N	136.50E	17:20 Super high-altitude sonde (37.5 km) 20:45 Ozone, water vapor, and cloud particle count attached with RS41 and iMS-100 (32.0 km)	Ozone and water vapor data were obtained up to 400 m.
Jun 24	SPS-019	20:18	13.14N	136.51E	20:18 Ozone (30.6 km)	
Jun 25	SPS-020	17:20	13.12N	136.50E	17:20 Super high-altitude sonde (39.3 km) 20:39 Ozone, water vapor, and cloud particle count attached with RS41 and iMS-100 (32.5 km)	
Jun 26						
Jun 27	SPS-021	17:15	13.12N	136.50E	17:15 Super high-altitude sonde (39.0 km) 20:19 Ozone (31.5 km)	
Jun 28						
Jun 29						
Jun 30	SPS-022	17:32	13.88N	135.89E	17:32 Super high-altitude sonde (12.3 km) 20:18 Ozone (32.0 km)	
Jul 01	SPS-023	17:18	13.55N	137.31E	17:18 Super high-altitude sonde (23.3 km) 20:11 Ozone (31.0 km)	
Jul 02	SPS-024	17:19	18.00N	139.55E	17:19 Super high-altitude sonde (19.8 km) 20:20 Ozone (31.1 km)	Super high-altitude sonde was launched together with Vaisala RS41 radiosonde.

Jul 03	SPS-025	17:30	22.55N	139.49E	17:30 Super high-altitude sonde (40.8 km) 20:18 Ozone (32.3 km)	Super high-altitude sonde was launched together with Vaisala RS41 radiosonde.
Jul 04	SPS-026	17:51	26.72N	140.97E	17:51 Super high-altitude sonde (40.6 km) 20:52 Ozone (32.3 km)	Super high-altitude sonde was launched together with Vaisala RS41 radiosonde.
Jul 05	SPS-027	17:49	30.69N	141.46E	17:49 Super high-altitude sonde (37.2 km) 20:57 Ozone (32.5 km)	TA1000 balloon was used for super high-altitude sonde.

(4) Preliminary results

Figure 6.12-1 shows an example of vertical profile of ozone partial pressure obtained by the sounding on June 12, 2021. We find a remarkable ozone enhancement at about 18 km, which implies the transport of mid-latitude stratospheric air mass into the tropical region. Figure 6.12-2 shows a vertical profile of temperature obtained by the super high-altitude observation on June 13, 2021. The large amplitude wavy structure is found above 35 km which cannot be measured by normal meteorological balloon soundings, and will be useful for understanding the atmospheric dynamics in this altitude range.

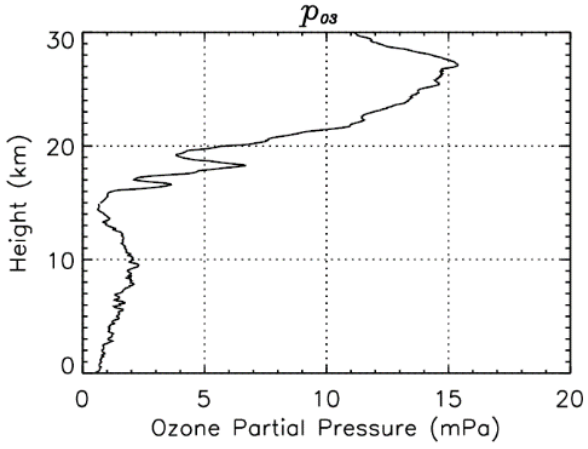


Fig. 6.12-1: Vertical profile of ozone partial pressure obtained by the ozonesonde observation on June 12, 2021.

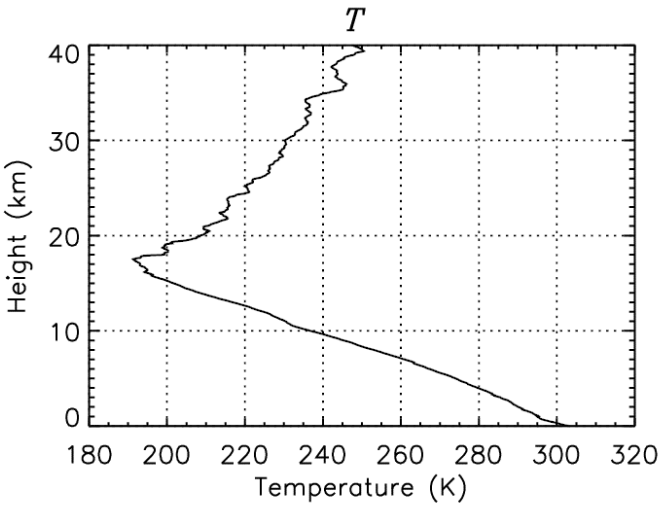


Fig. 6.12-2: Vertical profile of temperature obtained by the super high-altitude sonde observation on June 13, 2021.

(5) Data archive

The data obtained in this cruise were sent to the world meteorological community via Global Telecommunication System (GTS) through the Japan Meteorological Agency, immediately after each observation. The data will be submitted to the Data Management Group (DMG) of JAMSTEC, and will be opened to the public via “Data Research System for Whole Cruise Information in JAMSTEC (DARWIN)” in JAMSTEC web site (http://www.godac.jamstec.go.jp/darwin/e). This observation is a part of Years of the Maritime Continent (YMC). The data will be available at YMC web site (http://www.jamstec.go.jp/ymc/).