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## ORV SAGAR KANYA CRUISE 133: INDOEX FFP-1998

**Area of operation :** Western Tropical Indian Ocean

**Cruise Duration :** 18 Feb.-30 March 1998

**& Track** Mormugao-Male-Port Louis-Mormugao

**Objective:** To collect the data on atmospheric and oceanic parameters during the north-east monsoon period of 1998 from the western tropical Indian ocean under the First Field Phase of Indian Ocean

Experiment,  
an International field experiment .

Participants:

1. Mr. L.V.G. Rao	NIO, Goa	Chief Scientist
2. Dr. N. Bahulayan	-do-	
3. Mr. V. Ramesh Babu	-do-	
4. Mr. M.T. Babu	-do-	
5. Dr. M.D. George	-do-	
6. Mr. D.M. Shenoy	-do-	
7. Mr. M.S.S. Sarma	-do-	(Goa-Male-Port Louis)
8. Dr. K.S. Zalpuri	NPL, Delhi	
9. Mr. Prabhat K. Gupta	-do-	
10. Mr. Tuhin Mandal	-do-	
11. Dr. Umesh C. Kulshrestha	-do-	
12. Dr. A. Jayaraman	PRL, Ahmedabad	
13. Dr. Manish Naja	-do-	
14. Mr. P. Murugavel	IITM, Pune	
15. Mr. M. Venkata Ramana	SPL, Trivandrum	
16. Mr. A. Saha	-do-	
17. Mr. J.V.S. Raju	IISc, Bangalore	
18. Mr. D.G. Russel	IMD, Delhi	
19. Mr. K. Shaik Koya	-do-	
20. Lt. Cdr. T.T.A. Raja	DNOM, Delhi	
21. Mr. Biju V. Nair	NORINCO, Vasco	
22. Mr. P. Boopathy	-do-	
23. Mr. Vijayakumar, M	NCSU (USA)	
24. Mr. Vinayak, K.P.	-do-	
25. Dr. Dan Lubin	C4/SIO (USA)	(Goa-Male)
26. Dr. J.C. Meywerk	-do-	
27. Mr. W.H. Cantrell	Univ. Of Alaska (USA)	
28. Mr. W.C. Conant	C4/SIO (USA)	(Port Louis-Goa)
29. Mr. T.D. Rucker	NCAR (USA)	(Male-Port Louis)
30. Mr. M.G. Strong	NCAR (USA)	(Port Louis-Goa)
31. Mr. A.M. Ramiz	Met. Dept. (Maldives)	(Male-Port Louis)
32. Mr. D.S. Ramen	Met. Ser. (Mauritius)	(Goa-Port Louis)
33. Mr. J.M. Rosette	Univ. Of Mauritius	(Port Louis-Goa)

## CRUISE ITINERARY

### First Leg (Goa -Male):

ORV Sagar Kanya sailed from Mormugao (with 28 scientists on board) on 18 Feb. 8 at 1820 hrs. The ship proceeded south-westwards and carried out observations long a section parallel to the west coast of India beyond 200 nautical miles away from the coast in SSEly direction upto 20 Feb. mid-night. Then the ship moved SEwards and occupied a station off Trivandrum from 0750 hrs to 1720 hrs on 22 Feb. for inter-comparison studies. Then the ship moved westwards and occupied a station off Minicoy from 0650 hrs to 1450 hrs on 23 Feb. for inter-comparison studies. Then the ship proceeded southwards along 74 deg. E towards Male.

On 24 Feb. 98, at 1600 hrs LT, the clearance from Maldivian Govt. for the visit of the ship was received (through fax from the Indian High Commission, Male) and the ship entered Male Port and anchored at 1730 hrs LT.

### Halt in Maldives:

On 24 Feb. 98, Dr. Dan Lubin (US Scientist) disembarked from the ship.

On 25 Feb. 98, the following dignitaries visited the ship, and met the scientists, the Captain and the ship's officers. They appreciated the work being done.

1. Mr. Abdul Rasheed Hussain - Hon. Minister, Ministry of Planning, Human Resources & Environment (MPHRE), Republic of Maldives.
2. Mr. A. Majeed - Dy. Minister, MPHRE
3. H.E. Mr. K.S. Jasrotia - High Commissioner for India at Male
4. Shri Yogeshwar Varma - Dy. High Commissioner for India at Male
5. Dr. V. Ramanathan - Director, C4/SIO (USA) and CS, INDOEX.

At 1200 hrs, Metocean Multiparameter Drifting Buoy with ID No. 11351 (which landed at Maldives earlier and kept under the custody of Indian High Commission, Male) was transferred to the ship. Around 1600 hrs LT the Trailer (with LIDAR, Micro-Wave Radiometer and Class-sonde equipment) from NCAR was loaded on the ship.

On 26 Feb. 98, Dr. Bruce Gandrud, INDOEX Project Director came to the ship and requested for at least two days of measurements near Kaashidhoo island for inter-comparison and calibration purpose. In view of this, it became necessary to seek extension of the ship's halt at Male by one day and a request for the same was made by the Indian High Commissioner at Male to the Govt. of Maldives. Installation of LIDAR was completed and Mr. T.D. Rucker (NCAR) joined the ship.

On 27 Feb. 98, the ship sailed from Male at 0700 hrs LT and reached the region near Kaashidhoo Island at 1400 hrs LT and started the measurements.

On 28 Feb. 98, Mr. Jurgen M. Lobert, Project Scientist, INDOEX/KCO visited the ship and invited the scientists to visit the Kaashidhoo Climate Observatory.

On 28 Feb. 98, the scientists visited the Climate Observatory at Kaashidhoo.

After completing the measurements near the Kaashidhoo island, the ship sailed from that area on 1<sup>st</sup> March 98 at 0830 hrs LT and reached Male outer harbour at 1430 hrs LT. Approval for one day additional halt (i.e. upto 1<sup>st</sup> March 98) in Maldives was received from the Maldivian Govt. through the High Commission of India (by fax). After embarkation of Mr. A.M. Ramiz from Met. Dept., Maldives, the ship sailed from Male at 1400 hrs LT on the second leg of the cruise, with 29 scientists on board.

### **Second Leg (Male-Port Louis):**

The ship proceeded southwards along 74 deg. E upto the equator and then changed the course to southwestwards on 2 March at 2015 hrs LT.

On 3 March 98 at 1840 hrs IST (Position: 02 deg. S, 72 deg. 24 min. E), Metocean Multiparameter Drifter with ID No.11355 was deployed from the ship.

On 4 March 98, permission for the visit of the ship to Port Louis from the Govt. of Mauritius was received through Indian High Commission by fax. After completing the observations along the second leg of the cruise, the ship reached Port Louis on 12 March 98 at 1000 hrs LT.

### **Halt at Port Louis:**

On 12 March 98, Mr. T.D. Rucker and Mr. D.S. Ramen disembarked from the ship. Members from the Univ. of Mauritius and Meteorological Services visited the ship and the programme for the next two days was finalised.

On 13 March 98, Multi-Wave length Radiometer measurements, Radiosonde ascent and Ozonesonde ascent were carried out from the ship for inter-comparison studies. The Chief Scientist and senior scientists visited the Indian High Commission, met the High Commissioner (H.E. Shri M.L. Tripathy), the Dy. High Commissioner (Shri K.V. Bhagirath) and the First Secretary, E & C (Ms. Ruchira Kamboj) and invited them to visit the ship.

On 14 March 98, the cruise team visited the Univ. of Mauritius Faculty of Science, made brief presentation on INDOEX programme and the significance of relevant measurements carried out during the cruise. The Pro-Vice Chancellor (Prof. A. Peerally) also attended the presentation. Then the cruise team visited the Meteorological Services HQ.

On 15 March 98 (FN), The High Commissioner, the Dy. High Commissioner and officials from the Indian High Commission, and the Pro-Vice Chancellor of the Univ. of Mauritius visited the ship. They appreciated the work being carried out during the cruise.

Mr. A.M. Ramiz (Maldives) and Mr. M.S.S. Sarma (India) disembarked from the ship. Mr. M.G. Strong (USA), Mr. W.C. Conant (USA) and Mr. J.M. Rosette from the Univ. of Mauritius embarked on the ship. Then the ship sailed from Port Louis at 1700 hrs LT, with 28 scientists onboard.

### **Third Leg (Port Louis-Goa):**

From Port Louis the ship proceeded north-eastwards and encountered rough seas on 16 March due to the effect of a tropical storm. On 17 March morning the weather improved and the observations were resumed while proceeding north-north-eastwards towards the equator. The ship reached the equator at 69 deg E on 23 March 98. After crossing the equator, the ship proceeded northwards continuing the measurements along 69 deg E upto 09deg 30 min N. On 26 March at 1725 hrs, the course was changed to NNE and then to North at the position 11 deg N, 68 deg 15 min E on 27 March at 0935 hrs LT. Then the ship proceeded northwards along 68 deg 15 min E upto 14 deg N.

On 28 March at 0900 hrs LT, the course was changed to NE and all measurements were stopped on 29 March at 0100 hrs (15 deg 10 min N, 69 deg 44 min E). Then the course was changed to east and the ship proceeded towards Mormugao. The ship reached Mormugao and berthed at the harbour on 30 March at 0840 hrs, after completing the cruise.

## **SUMMARY OF OBSERVATIONS**

In general, during the first leg of the cruise (Goa-Male), the ship halted 4 times a day, at 0530 hrs, 1130 hrs, 1730 hrs and 2330 hrs, for about an hour to facilitate measurements from an instrumented boom with fast response sensors for boundary layer studies, operation of CTD upto 1000 m depth and release of balloons for radiosonde ascents. During the second and third legs of the cruise (Male-Port Louis-Goa), the mid-day stop at 1130 hrs was skipped on alternate days in order to facilitate uncontaminated sampling for aerosol studies.

### **Atmospheric measurements:**

#### **NPL:**

Parameters measured include NO, NO<sub>2</sub>, NO<sub>x</sub>, CO continuously and aerosol concentration using high volume aerosol sampler daily. Overall 26 samples were collected.

Aerosol samples and rain water samples were collected for chemical analysis of inorganic and organic aerosols (In collaboration with MISU, Stockholm, Sweden and CFR, France).

Aerosol samples were also collected with a periodicity of 48 hours using high volume aerosol samplers (in collaboration with Univ. California, San Diego and RSMAS, Univ. Miami)

Vertical profiles of ozone concentration, temperature, humidity and pressure were measured using ECC type balloon-borne sensors. Balloon ascents were made one per day in general. A total of 15 ascents were made.

#### **PRL:**

Aerosol optical depth at five spectral bands were measured using sun-photometer hourly during cloud free days. Also surface reaching direct solar flux were measured using Pyrheliometer. Aerosol mass concentration and size distribution were also measured hourly using QCM cascade impactor.

Continuous measurements of surface level ozone, CO and NO were made. Air samples were also collected at every half degree latitude intervals. About 106 samples were collected for subsequent analysis for different trace gases such as SF<sub>6</sub> in the laboratory using GC-MS.

**IITM:**

Aerosol mass concentration and size distribution were measured using electrical aerosol mobility analyser and air conductivity was measured using conductivity apparatus. Aerosol measurements were made at a rate of one measurement per two hours and the conductivity measurement was made continuously with one minute average.

**IMD:**

Radiosonde ascents were made twice a day at 0530 hrs and 1730 hrs. Altogether 56 ascents were made. Ozone sonde ascent was also made on most of the days in general. Altogether 14 ozone sonde ascents were made.

Surface meteorological data were also collected at three hourly intervals.

**SPL, IISc. & NCSU**

Using an instrumented boom, fast and slow response measurements for wind speed and wind direction, temperature and humidity were carried out for boundary layer studies (in collaboration with IISc & NCSU). Multi-wavelength radiometer and Scan Photometer were also operated. During 0930 hrs to 1800 hrs, high volume sampler was operated and filter papers were collected for studying pollutant concentration.

**NCAR**

SABL LIDAR, Class Sonde ascents and Microwave Radiometer were operated.

**C4/SIO**

Measurements were carried out using ASD Spectroradiometer, BSI Radiometer, Pyranometers, particulate soot absorption radiometer, nephelometer. Cloud camera was also operated.

**Univ. of Alaska**

CCN Spectrometer was operated to measure cloud concentration nuclei.

## Oceanographic measurements by NIO

CTD was operated upto 1000 m depth at 75 stations. At these stations, wave recorder was also operated.

Expendable CTD was operated at 12 stations.

XBT was operated at 29 stations.

ADCP and Thermosalinograph were operated along most of the cruise track.

Automatic Weather Station was operated continuously.

Two multi-parameter drifting buoys were deployed in the equatorial region.

At 26 stations water samples from different depths were collected for analysis of DMS, CO<sub>2</sub>, N<sub>2</sub>O, Dissolved Oxygen, pH and nutrients.

Total distance covered during  
the cruise : 5815 N. Miles

*L.V. Sridharan*

CHIEF SCIENTIST  
ORV "SAGAR KANYA"

**133 CRUISE OF ORV SAGAR KANYA : INDOEX FFP-1998  
18 Feb - 30 March 1998, Goa-Male-Port Louis-Goa**

