

# **EqPOS Shipboard CO-O3-Ship-Met Data**

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## **1.0 Data Set Overview:**

### 1.1 Overview of EqPOS Research Cruise

Equatorial Pacific Ocean and Stratospheric/Tropospheric Atmospheric Study (EqPOS) research cruise was organized as a part of SOLAS Japan activity to understand biogeochemical ocean-atmospheric interaction in the eastern equatorial Pacific Ocean using R/V Hakuho Maru owned by Atmosphere and Ocean Research Institute (AORI), University of Tokyo, starting from 29 January to March 7, 2012 for 39 days from Callao (Peru) to Tokyo (Japan). Coordinated atmospheric, oceanic, and marine biological observations including sampling/characterization of thin air-sea interfacial layer (sea surface microlayer: SML) and launching large stratospheric air sampling balloons were carried out on-board mainly in 10 ocean observation stations. Biogeochemically important trace/long-lived gases such as CO<sub>2</sub>, dimethyl sulfide (DMS), and some volatile organic carbons (VOCs) both in the atmosphere and seawater were continuously monitored and their air-sea fluxes were also observed using gradient and eddy-covariance techniques. Continuous sampling and physiochemical measurements of atmospheric aerosols samplings (e.g., size distribution, number concentrations such as CN and CCN, single particle chemical characterization) in addition to atmospheric trace gas measurement of CO and O<sub>3</sub>.

The EqPOS cruise (official cruise ID: KH-12-1) was actually the last half of two consecutive research cruises. The former research cruise (official cruise ID: KH-11-10) started from 1 December 2011 and ended on 26 January 2012, which traveled from Tokyo to Peru.

In this dataset, not only dataset obtained during EqPOS cruise (KH-12-1, Peru => Honolulu=> Tokyo), but also one during KH-11-10 (Tokyo => Honolulu => Peru) is included.

No oceanic/atmospheric data was measured in the coastal regions which Peru claims its EEZ/territorial water (Peru claims 200 nm from its coastline as its territorial water).

### 1.2 Dataset Overview

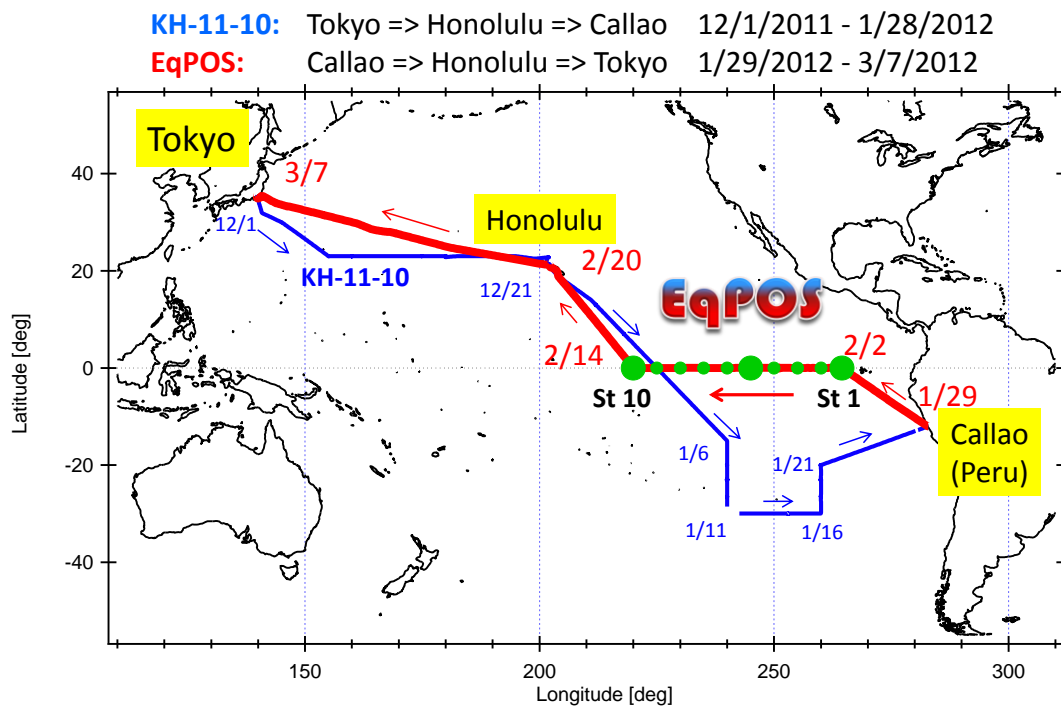
This dataset covers two research cruises

- |                                                              |                        |
|--------------------------------------------------------------|------------------------|
| (1) Tokyo => Honolulu => Peru (official cruise ID: KH-11-10) | 12/1/2011 to 1/28/2012 |
| (2) Peru => Honolulu => Tokyo (EqPOS cruise (KH-12-1))       | 1/28/2012 to 3/7/2012  |

Hourly physical location of R/V Hakuho Maru is included in the dataset



**Figure 1.** Photo of R/V Hakuho Maru used in the EqPOS and KH-11-10 research cruises.



**Figure 2.** Ship tracks of EqPOS and KH-11-10 research cruises. Atmospheric CO and O<sub>3</sub>, ship and meteorological data observed on-board are provided in this dataset (no data available in Peruvian EEZ/territorial waters and US territorial waters. No data within US EEZ is not available during EqPOS cruise).

## 2.0 Instrument Description:

For both CO and O<sub>3</sub> measurements, atmospheric air was drawn from ~ 3 m above roof of wheel house through a ¼" OD and delivered to O<sub>3</sub> and CO instruments located inside the wheel house.

### CO Measurement

Atmospheric CO gas concentration was measured with a non-dispersive CO analyzer (Thermo, Model 48C) with a CO-HC reactor-type zero gas generators (Thermo, Model 96) for zero measurement.

### O<sub>3</sub> Measurement

Using a UV absorption O<sub>3</sub> monitor (model 1150, Dyleck, Japan), O<sub>3</sub> concentration was continuously monitored during KH-11-10 and EqPOS cruise. To avoid water vapor condensation within the monitor, sampled atmospheric air was dried with an electric air dryer (model EC-95, Dyleck, Japan) before introducing it to the monitor.

### Ship and Meteorological Data

These data were all measured and logged with on-board instruments on R/V Hakuho Maru. Shortwave solar irradiance was measured with a horizontal pyranometer with thermopile sensor (S-185, Ishiwaka-trading, Japan,  $\lambda = 0.3 \sim 2.8 \mu\text{m}$ ), while total (shortwave + longwave) solar irradiance was measured with horizontal pyranometer with thermopile sensor (RL-5, Ishikawa-trading, Japan,  $\lambda = 0.35 \sim 60 \mu\text{m}$ ).

More detail about R/V Hakuho Maru is available here:

<http://www.aori.u-tokyo.ac.jp/english/coop/hakuhomaru.html>

## 3.0 Data Collection and Processing:

### O<sub>3</sub> Measurement

O<sub>3</sub> concentration was measured about 5 times each minute (about every 12 seconds). The raw data was averaged into hourly data as provided here.

### CO Measurement

CO instrument reports CO concentration every minute. But the reported value contained significant level of background which needs to be subtracted to obtain true atmospheric CO concentration. Due to slow-variable nature of the background, background (zero CO) measurement was carried out every hour for 10 minutes (from XX:02 to XX:12) and used to simulate variable background concentration in every minutes. The zero values during XX:05 to XX:10 in each background measurement were averaged out and the averaged backgrounds were then interpolated using a polynomial fitting curve to simulate every minute background. The calculated every-minute background was then subtracted from raw CO concentration to

calculate actual every-minute CO concentration. The every-minute actual CO concentration values were then averaged into hourly values and provide here.

### **NG Data Removal**

When wind blows from behind of the R/V Hakuho Maru, exhaust from the ship often interferes CO and O<sub>3</sub> measurements (which results in increase in CO and sudden drop of O<sub>3</sub> concentrations). Such exhaust events are removed based on sudden changes in CO and O<sub>3</sub> and relative wind direction and speed (blowing from behind).

### **Data within Territorial Waters**

No data available within territorial waters of USA and Peru. Peru claims 200 nm as its EEZ and territorial water, while USA claims 12 nm.

### **Data within US EEZ (200 nm from its coast)**

Available during KH-11-10 (12/1/2011 – 1/28/2012), but not available during EqPOS (1/29/2012 – 3/7/2012). EqPOS did not ask US-government a permission to perform ocean observation within US EEZ, while KH-11-10 did it.

## 4.0 Data Format:

General tab-delimited column-based ASCII (Text) format.

The first row of each column contains name of the data in the column.

All data was averaged into hourly values. For example, 10:00 O3 = 34.2 means all raw data between 10:00:00 and 10:59:59 were averaged and its values was 34.2.

Description of each data field (column) is provided below.

Data Field Description is also presented in a separate Excel file.

DataField No	Data Field Name	Description	Format	Note
1	DateAndTime.UTC_EqPOS	Observation time in UTC	m/dd/yyyy h:mm:ss	JST = UTC + 9 hours
2	DateAndTime.JST_EqPOS	Observation time in JST	m/dd/yyyy h:mm:ss	JST = UTC + 9 hours
3	Latitude_EqPOS	Ship position: Latitude	Decimal (N: Pos, S: Neg)	
4	Longitude_EqPOS	Ship position: Longitude	Decimal (W: Pos, E: Neg)	
5	ShipCourseGPS_EqPOS	Actual ship moving direction derived from GPS measurement	Degree	
6	ShipHeading_EqPOS	Direction of ship's heading	Degree	
7	ShipSpeedGPS_EqPOS	Ship speed relative to the earth	Knot	
8	ShipSpeedGPS_ms_EqPOS	Ship speed relative to the earth	m/s	
9	ShipSpeed_2sea_kt_EqPOS	Ship speed relative to ocean	Knot	
10	SST1_EqPOS	Sea surface temperature observed on-board sensor #1	Degree C	
11	SST2_EqPOS	Sea surface temperature observed on-board sensor #2	Degree C	
12	WindDir_EqPOS	True wind direction	Degree	
13	WindSpd_EqPOS	True wind speed	m/s	
14	RelWind_Dir_EqPOS	Relative wind direction	Degree	
15	RelWind_Spd_EqPOS	Relative wind speed	m/s	
16	AtmPress_EqPOS	Atmospheric pressure	hPa	
17	AmbTemp_EqPOS	Ambient temperature	Degree C	
18	AmbRH_EqPOS	Ambient relative humidity	%	
19	Rain_EqPOS	Precipitation intensity (Last 10 min integration)	mm/h	Zero values were replaced with NaN
20	SolarRadiation_EqPOS	Shortwave solar irradiance	kW/m2	Wavelength range 0.3 ~ 2.8 um
21	Radiation_EqPOS	Total (shortwave + longwave) solar irradiance	kW/m2	Wavelength range 0.35 ~ 60 um
22	RadTemperature_EqPOS	Radiation temperature	Degree C	
23	Salinity_ppm_EqPOS	Salinity of seawater	Per mil	
24	Conductivity_EqPOS	Conductivity of seawater	mS/cm	
25	CO_EqPOS	Atmospheric CO mixing ratio	ppbv	
26	O3_EqPOS	Atmospheric O3 mixing ratio	ppbv	