

## Measurement of xCO<sub>2</sub> at Meteorological Research Institute and Japan Meteorological Agency

### Variables

Variable\_Name: mixing ratio of CO<sub>2</sub> in dry air (xCO<sub>2</sub>)

Description\_of\_Variable: xCO<sub>2</sub> in marine boundary air (xCO<sub>2</sub>\_Air) and xCO<sub>2</sub> in air equilibrated with near-surface seawater (xCO<sub>2</sub>\_Sea).

### Equilibrator\_Design

Equilibrator\_Type: shower-head

Equilibrator\_Volume: 1.5 dm<sup>3</sup>

Water\_Flow\_Rate: ca. 6 – 10 dm<sup>3</sup> min<sup>-1</sup>

Headspace\_Gas\_Flow\_Rate: ca. 500 – 700 cm<sup>3</sup> min<sup>-1</sup>

Vented: Yes.

### Calibration\_Gas:

Measurements onboard Hakuho-maru, Ryofu-maru (- Jan. 1989) Taisei-maru, Hokuto-maru, Sogen-maru, Wellington-maru, Natsushima, Kaiyo, Kaiyo-maru, and Mirai have been made by MRI. For these measurements, MRI-87 CO<sub>2</sub> concentration scale of which primary standards consists of a series of primary standard gases made at Nippon Sanso Co. with a gravimetric method following the procedure reported by [Tanaka, M., T. Nakazawa and S. Aoki (1987): Time and space variations of tropospheric carbon dioxide over Japan. *Tellus*, **39B**, 3-12.] has been used. The difference in CO<sub>2</sub> concentration scale between WMO mole-fraction and MRI87 has tentatively been determined as Eq.(1):

$$\begin{aligned} & (x\text{CO}_2^{\text{WMO}} - x\text{CO}_2^{\text{MRI87}}) / \text{ppm} \\ &= -0.015 - 0.569 \cdot (x\text{CO}_2^{\text{MRI87}} - 370) \cdot 10^{-2} + 0.237 \cdot (x\text{CO}_2^{\text{MRI87}} - 370)^2 \cdot 10^{-4} \\ &+ 0.341 \cdot (x\text{CO}_2^{\text{MRI87}} - 370)^3 \cdot 10^{-6} \quad (271 < x\text{CO}_2^{\text{MRI87}} / \text{ppm} < 405) \end{aligned}$$

Measurements on onboard Ryofu-maru (Nov. 1989-), Keifu-maru, Kofu-maru, Alligator-Liberty have been made by JMA. For these measurements, WMO scale has been used, but potential offsets among different generations of WMO scales have not been corrected for.

### CO<sub>2</sub>\_Sensor : NDIR

Model: Beckman315A, 864, 865, 880, Rosemount Binos 4.1, LI-COR6251

Environmental\_Control: Temperature controlled within the instrument around the cell

of the NDIR.

CO2\_Sensor\_Calibration: Once per hour – once per 1.5 hours using four standard gases.

**Method\_References:**

Inoue, H. Y. 2000, CO<sub>2</sub> exchange between the atmosphere and the ocean: carbon cycle studies of the Meteorological Research Institute since 1968.

**Data\_set\_References:**

See publication list of the Geochemical Research Department, Meteorological Research Institute at <http://www.mri-jma.go.jp/Dep/ge/publications.html>

**Data\_Set\_Link:**

WMO's World Data Center for Greenhouse Gases

URL: [http://gaw.kishou.go.jp/wdcgg\\_j.html](http://gaw.kishou.go.jp/wdcgg_j.html)