

# Inter-comparison experiments of standard gases for JMA/WCC activity



T. Kawasaki<sup>1</sup>, A. Takizawa<sup>1</sup>, M. Takahashi<sup>1</sup>, H. Koide<sup>1</sup>, T. Nakazawa<sup>2</sup>, S. Aoki<sup>2</sup>, S. Morimoto<sup>2</sup>, K. Kato<sup>3</sup>, T. Shimosaka<sup>3</sup>, N. Aoki<sup>3</sup>, T. Watanabe<sup>3</sup>, T. Machida<sup>4</sup>, Y. Tohjima<sup>4</sup>, H. Mukai<sup>4</sup>, K. Katsumata<sup>4</sup>, T. Fujitani<sup>4</sup>, S. Murayama<sup>5</sup>, S. Ishidoaya<sup>5</sup>, D. Goto<sup>6</sup>, H. Matsueda<sup>7</sup>, Y. Sawa<sup>7</sup> and K. Tsuboi<sup>7</sup>

1. Japan Meteorological Agency (JMA), Tokyo, Japan

2. Tohoku University (TU), Sendai, Japan

3. National Metrology Institute of Japan (NMIJ/AIST), Tsukuba, Japan

4. National Institute for Environmental Studies (NIES), Tsukuba, Japan

5. National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan

6. National Institute of Polar Research (NIPR), Tokyo, Japan

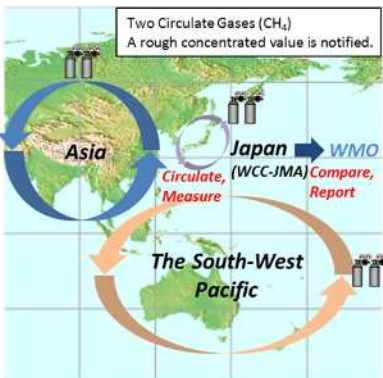
7. Meteorological Research Institute (MRI), Tsukuba, Japan

[tr\\_kawasaki@met.kishou.go.jp](mailto:tr_kawasaki@met.kishou.go.jp)

## 1. WCC Activity at JMA (CH<sub>4</sub>)

Since Apr. 2001, JMA has carried out reference gases inter-comparisons as WCC for CH<sub>4</sub> in Asia and the South-West Pacific (Figure 1). In these inter-comparisons, two reference cylinders with different CH<sub>4</sub> mole fractions were circulated to ensure inter-comparability of CH<sub>4</sub> measurements among 13 laboratories (Table 1). These results are reported to WMO/GAW, and are also published in the JMA/WCC web site to open their detailed information

(<http://ds.data.jma.go.jp/gmd/wcc/wcc.html>).



|                 |  |
|-----------------|--|
| AIST            | National Institute of Advanced Industrial Science and Technology                 |
| CMA             | China Meteorological Administration  |
| CSIRO           | Commonwealth Scientific and Industrial Research Organization                     |
| IITM            | Indian Institute of Tropical Meteorology   |
| KMA             | Korea Meteorological Administration  |
| KRISS           | Korea Research Institute of Standards and Science                                |
| MRI             | Meteorological Research Institute  |
| NIES            | National Institute for Environmental Studies                                     |
| NIPR            | National Institute of Polar Research   |
| NIWA            | National Institute of Water & Atmospheric Research Ltd.                          |
| NOAA/ESRL (CCL) | National Oceanic and Atmospheric Administration/Earth System Research Laboratory |
| TU              | Tohoku University  |
| JMA             | Japan Meteorological Agency  |

Table 1. Participants of Methane Reference Gas Inter-comparison(2001-2015).

|                                     |                       |
|-------------------------------------|-----------------------|
| 1 <sup>st</sup>                     | Apr. 2001 - Mar. 2005 |
| 2 <sup>nd</sup>                     | Jul. 2005 - Jan. 2010 |
| 3 <sup>rd</sup>                     | May 2008 - Feb. 2013  |
| 4 <sup>th</sup> and 5 <sup>th</sup> | Jun. 2011 - ongoing   |

Table 2. Period of Inter-comparison.



Figure 2. Methane Calibration System.

## 2. What's the iceGGO Project

In harmony with the WMO/BIPM in the inter-national community, JMA and other observation laboratories in Japan have established a national alliance with NMIJ to compare standard gas scales each other. According to this alliance, we started round-robin experiments named as iceGGO (Inter-Comparison Experiments for Greenhouse Gases Observation) since 2012.

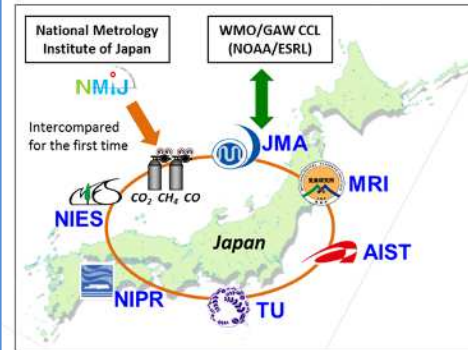


Figure 6. Inter-comparison experiments in Japan.

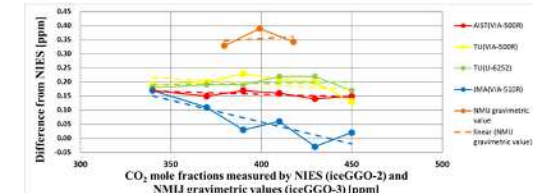


Figure 7. Graph of equivalence for iceGGO (CO<sub>2</sub>).

|                           | iceGGO-3(CO <sub>2</sub> )   | iceGGO-4(CO)  |
|---------------------------|--|---|
| Period                    | Jan. 2014 – Sep. 2014  | Aug. 2013 – Aug. 2014   |
| Participants              | AIST TU JMA MRI NIES NMIJ  |   |
| Detail of reference gases | 3 cylinders (NMIJ): CPD00070, CPD00076, CPD00069, about 380, 400, 412 [ppm] (gravimetric method), δ <sup>13</sup> C ave = -8.907, -8.964, -8.908‰, δ <sup>18</sup> O = -13.099, -13.173, -13.088‰, Purified natural air + pure CO <sub>2</sub> | 2 cylinders (NMIJ): CPB16249, CPB28680, about 346, 249 [ppb] (gravimetric method), Purified natural air + pure CO |

Table 3. Overviews of two experiments conducted as iceGGO.

## 3. The result of iceGGO-3 (CO<sub>2</sub>)

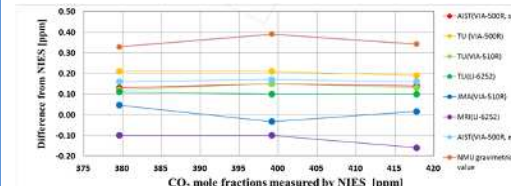


Figure 8. Difference between NIES and each participants.

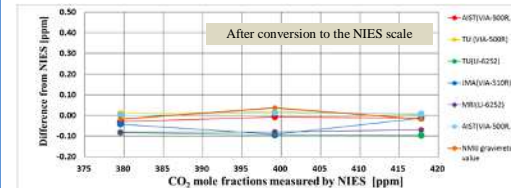


Figure 9. Difference between NIES and each participants.

|                    | AIST     | TU         | JMA       | MRI     | NIES    | NMIJ                    |
|--------------------|----------|------------|-----------|---------|---------|-------------------------|
| Standard gas scale | AIST     | TU X10     | WMO X2007 | MRI1987 | NIES    | NMIJ gravimetric method |
| Instrument (NDIR)  | VIA-500R | VIA-500R   | VIA-510R  | LI-6252 | LI-6252 | -                       |
| Instrument (MS)    | MAT-252  | Mat-deltaS | -         | -       | -       | -                       |

Table 4. The standard gas scales and instruments used for 6 laboratories in the iceGGO-3.

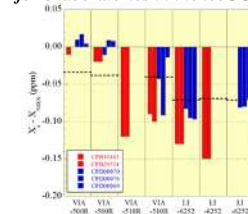


Figure 10. The effect on measurements due to differences in CO<sub>2</sub> isotope ratio.

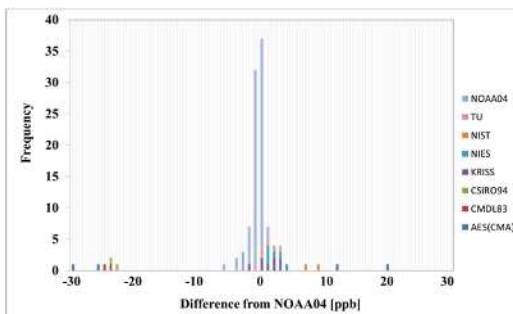


Figure 3. Histogram of difference from NOAA04(JMA) in the 1<sup>st</sup>-4<sup>th</sup> Round.

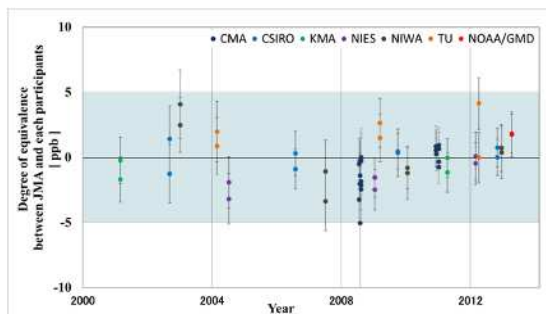


Figure 4. Degree of equivalence between JMA and each participants in the 1<sup>st</sup>-4<sup>th</sup> Round (after conversion to the NOAA04 scale). The error bar represents the expand uncertainty at a 95% level of confidence.

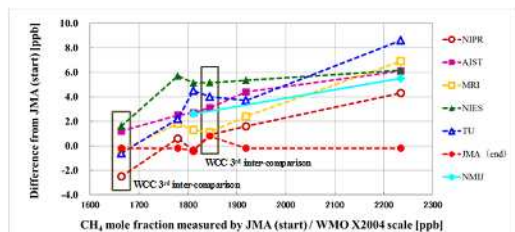
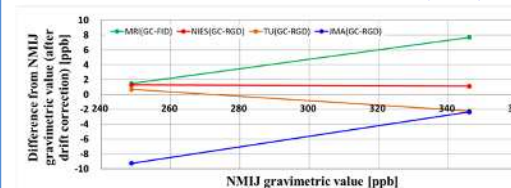


Figure 5. Difference from JMA(start). JMA has the WMO mole fraction scale propagated from the NOAA/CCL. (This experiment was made jointly with iceGGO)

## 4. The result of iceGGO-4 (CO)



|                    | MRI    | AIST | NIES   | TU     | JMA       | NMIJ               |
|--------------------|--------|------|--------|--------|-----------|--------------------|
| Standard gas scale | MRI    | -    | NIES   | TU2010 | WMO X2004 | gravimetric method |
| Instrument         | GC-FID | -    | GC-RGD | GC-RGA | GC-RGD    | -                  |

Table 5. The standard gas scales and instruments used for 6 laboratories in the iceGGO-4.

Figure 11. Difference between NMIJ gravimetric value and each participants.

Reference: Matsueda et al. (2003): Methane standard gases for atmospheric measurements at the MRI and JMA and intercomparison experiments, Papers in Meteorology and Geophysics Vol. 54 (2003) No. 3-4 March P91-109

Tohjima et al. (2009): Theoretical and experimental evaluation of the isotope effect of NDIR analyzer on atmospheric CO<sub>2</sub> measurement, *J. Geophys. Res.*, 114, D13302, doi:10.1029/2009JD011734.

Dlugokencky et al. (2005): Conversion of NOAA atmospheric dry air CH<sub>4</sub> mole fractions to a gravimetrically prepared standard scale, *J. Geophys. Res.*, 110, D18306, doi:10.1029/2005JD006035.

Takahashi et al. (2013): Intercomparison experiments for GHGs Observation (iceGGO) in Japan, GGMT-2013, Beijing, China, poster presentation. (<http://ggmt-2013.cma.gov.cn/dct/page/70030>)