JRAS Isotope reference: A generalized VPDB scale anchor for CO_2 in air?

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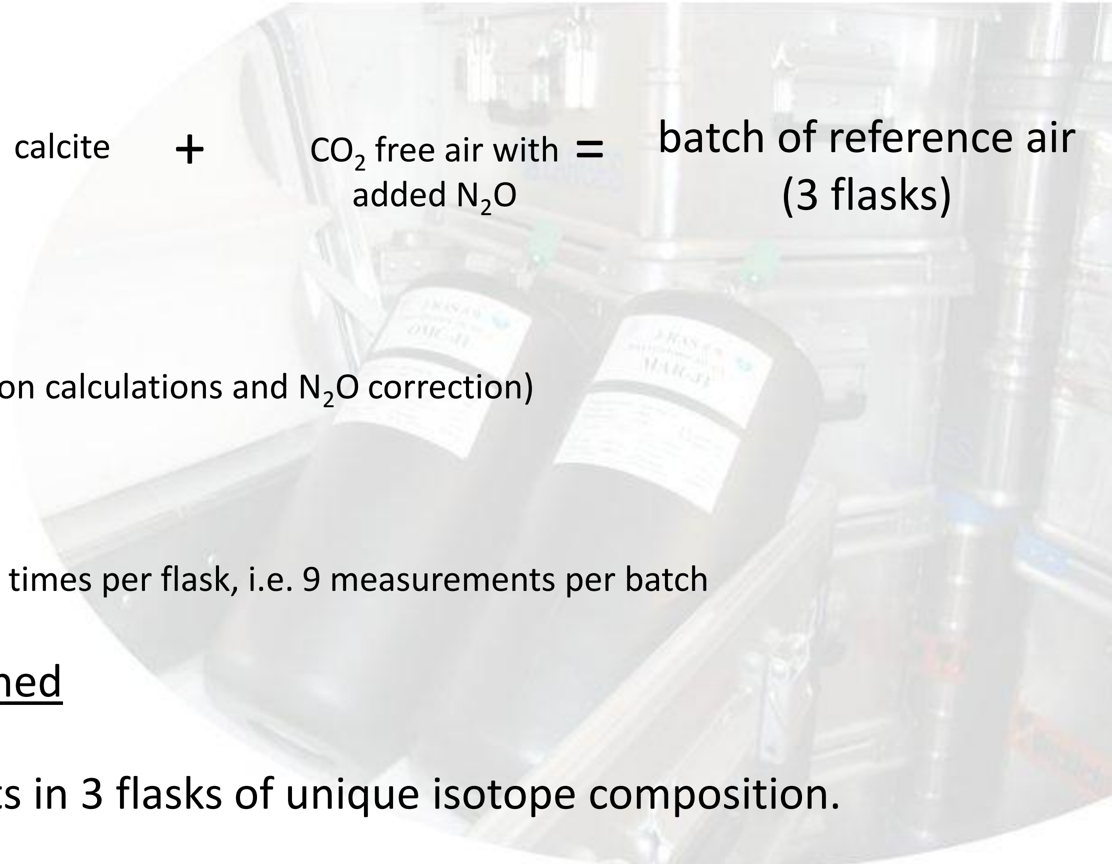
The Jena Reference Air Set - JRAS



Step 1.) Preparation

Automated acid digestion system + calcite + CO_2 free air with added N_2O = batch of reference air (3 flasks)

Step 2.) Gas analysis

$[CO_2]$ and $[N_2O]$ (for extraction calculations and N_2O correction)

Step 3.) Isotope analysis

$\delta^{13}C$ and $\delta^{18}O$ are measured 3 times per flask, i.e. 9 measurements per batch

Step 4.) Batch values are assigned

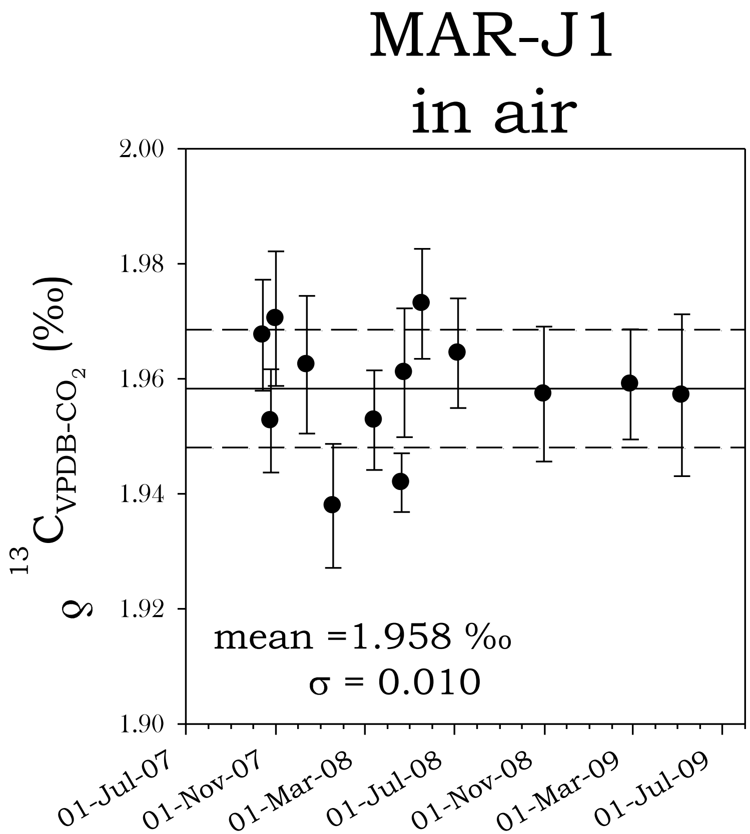
Note! One preparation results in 3 flasks of unique isotope composition.

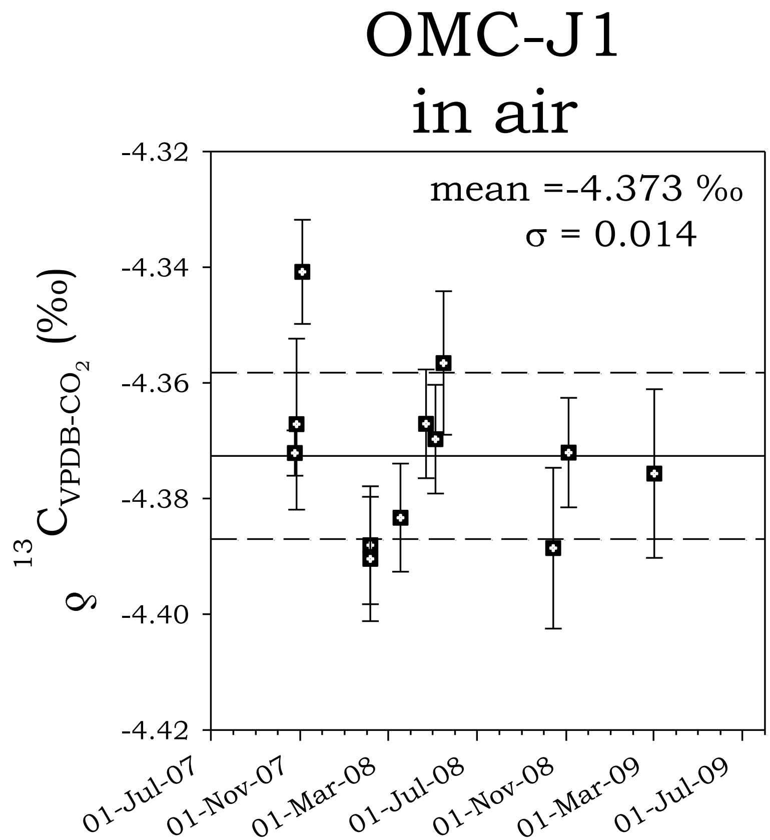
=> JRAS set consisting of 2 flasks with CO_2 from two different calcites:

MAR-J1 ($\delta^{13}C_{VPB\text{-}CO2}$ = 1.96 ‰ , $\delta^{18}O_{VPB\text{-}CO2}$ = -2.58 ‰)

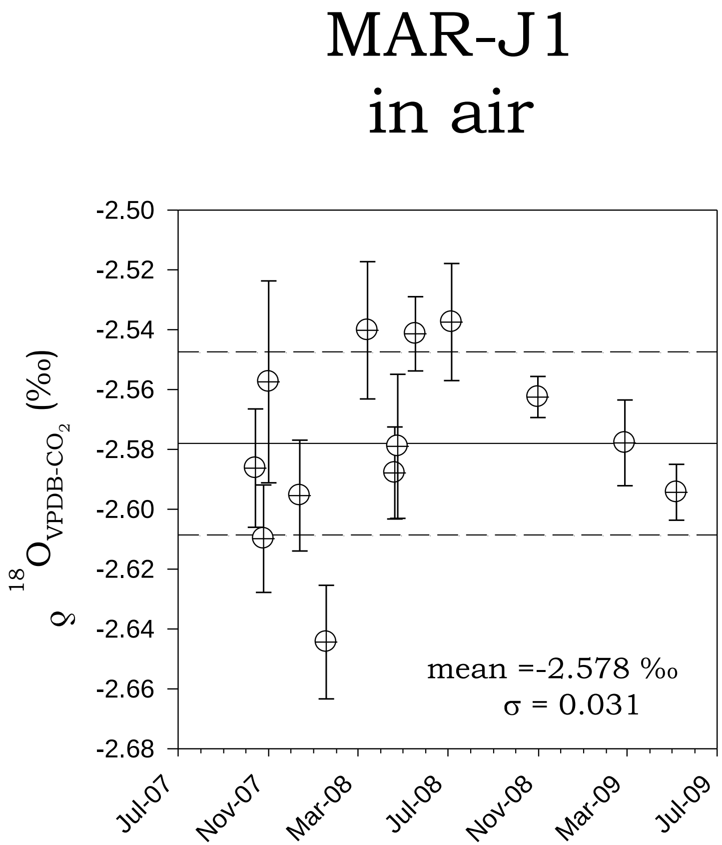
OMC-J1 ($\delta^{13}C_{VPB\text{-}CO2}$ = -4.37 ‰, $\delta^{18}O_{VPB\text{-}CO2}$ = -8.93‰)

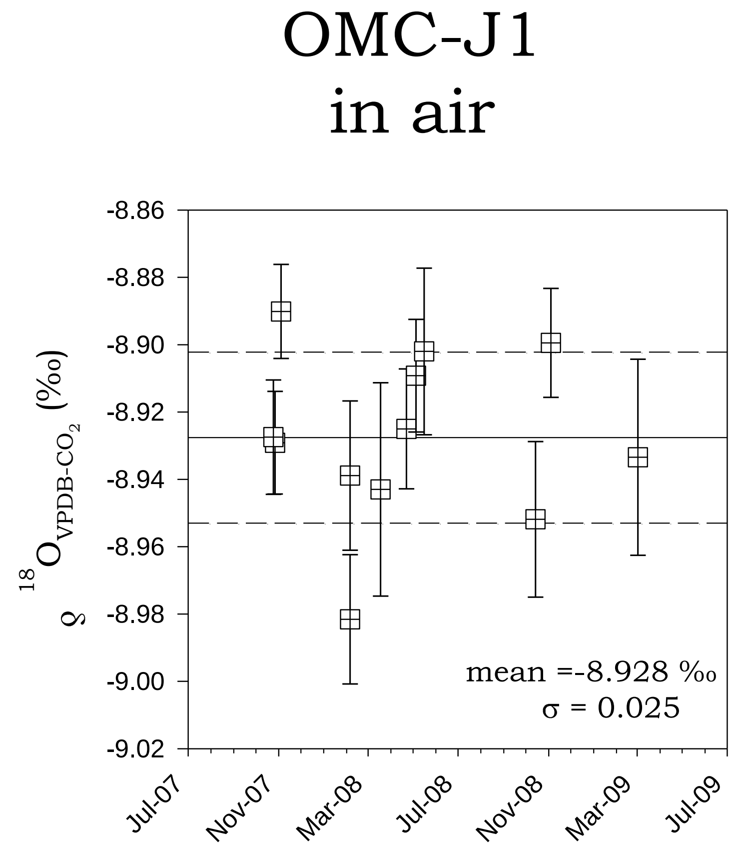
Batch record of $\delta^{13}C$





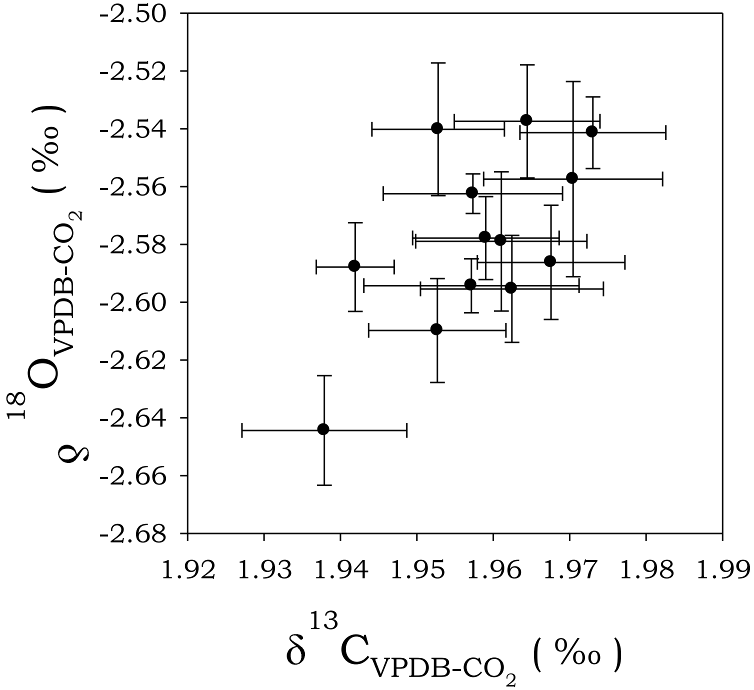
Batch record of δ^{18}O



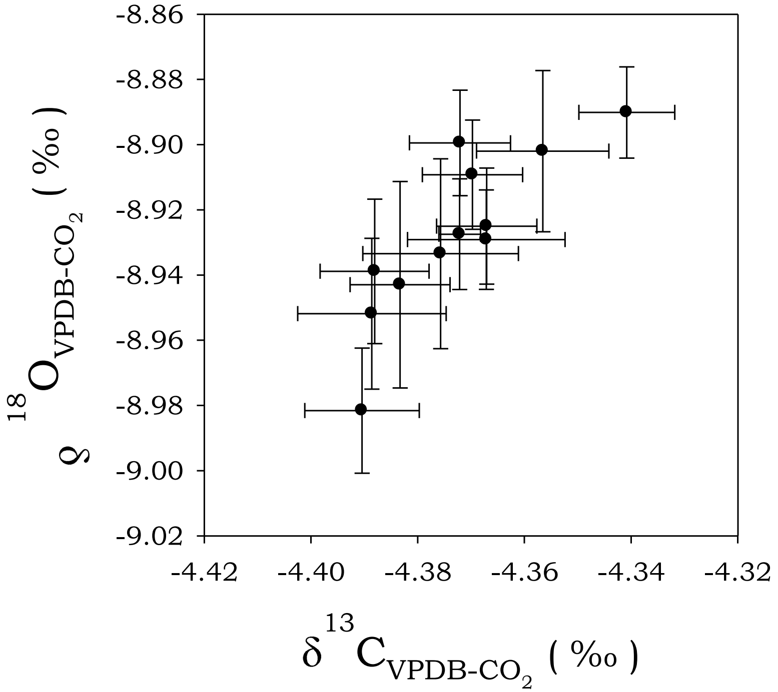


Fractionation?

MAR-J1
in air



OMC-J1
in air



IMECC project: 11 Participating Laboratories

Laboratoire des Sciences du Climat et de l'Environnement, Gif sur Yvette Cedex, France

Dep. of Enivonmental Physics , AGH-Univ. of Science and Technology, Kraków, Poland

Institute of Environmental Physics, University of Heidelberg, Germany

Scripps Institute of Oceanography, University of California-San Diego, USA

CSIRO Marine and Atmospheric Research, Aspendale, Victoria, Australia

Environment Canada, Stable Isotope Research Laboratory, Downsview Ont. Canada

National Institute for Environmental Studies, Tsukuba, Japan

Institute for Reference Materials and Measurements, Geel, Belgium

Climate and Environmental Physics, University of Bern, Switzerland

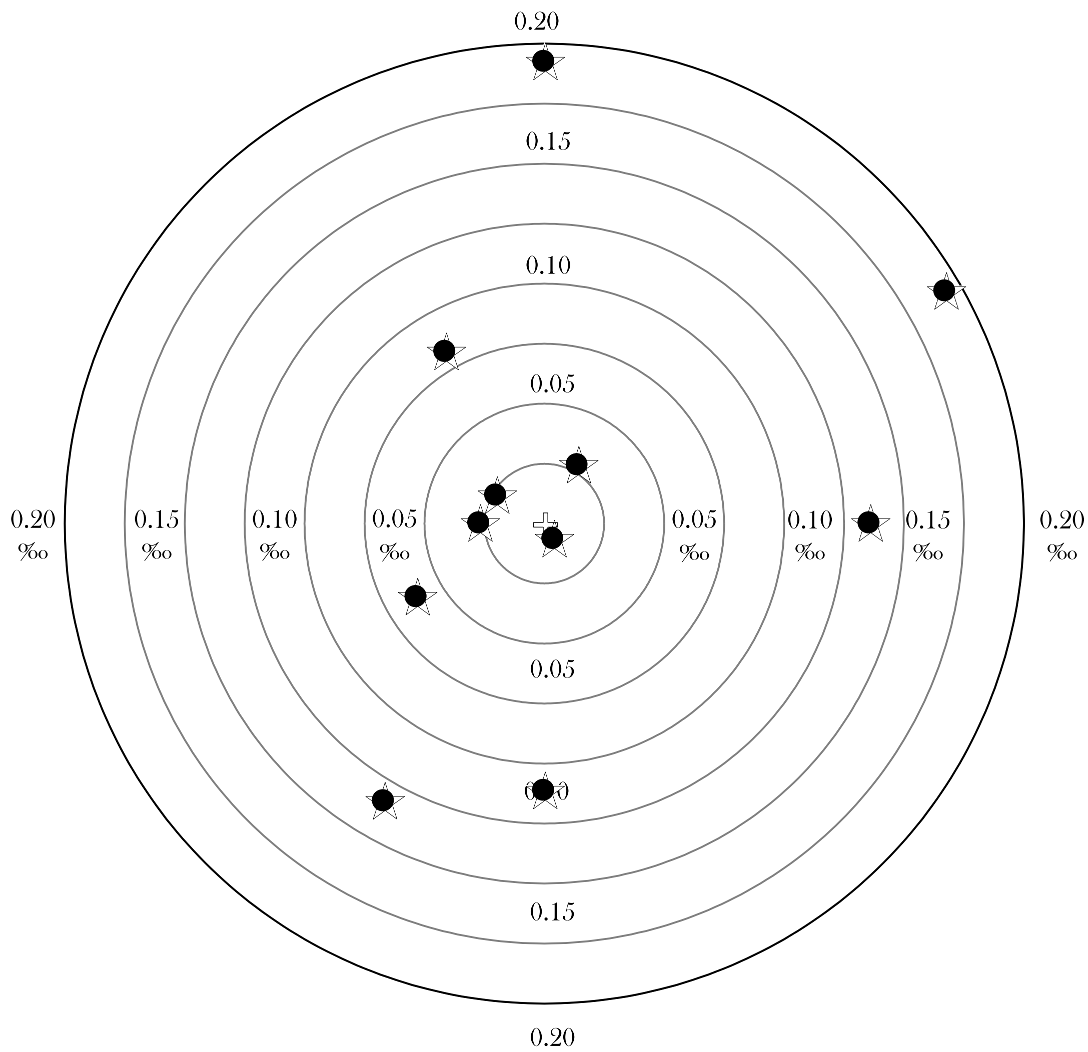
Institute of Arctic and Alpine Research, University of Colorado, Boulder CO, USA

Max Planck Institute for Biogeochemistry, Jena, Germany

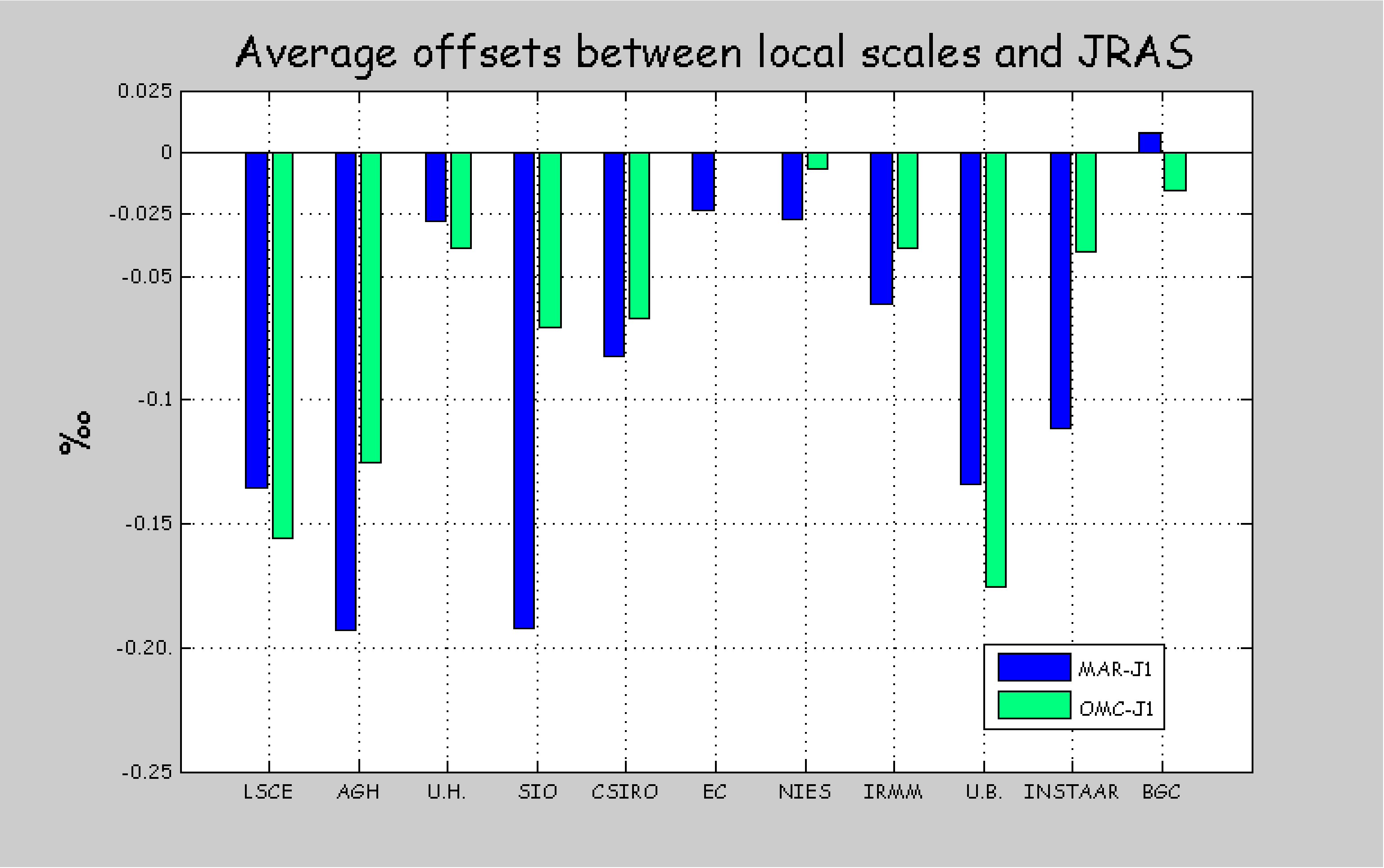
Intermediary results from the JRAS target practice:

Target at +1.96 ‰, MAR-J1 in air ≈ NBS19

(note! The radial distance represents the absolute values of the offsets)

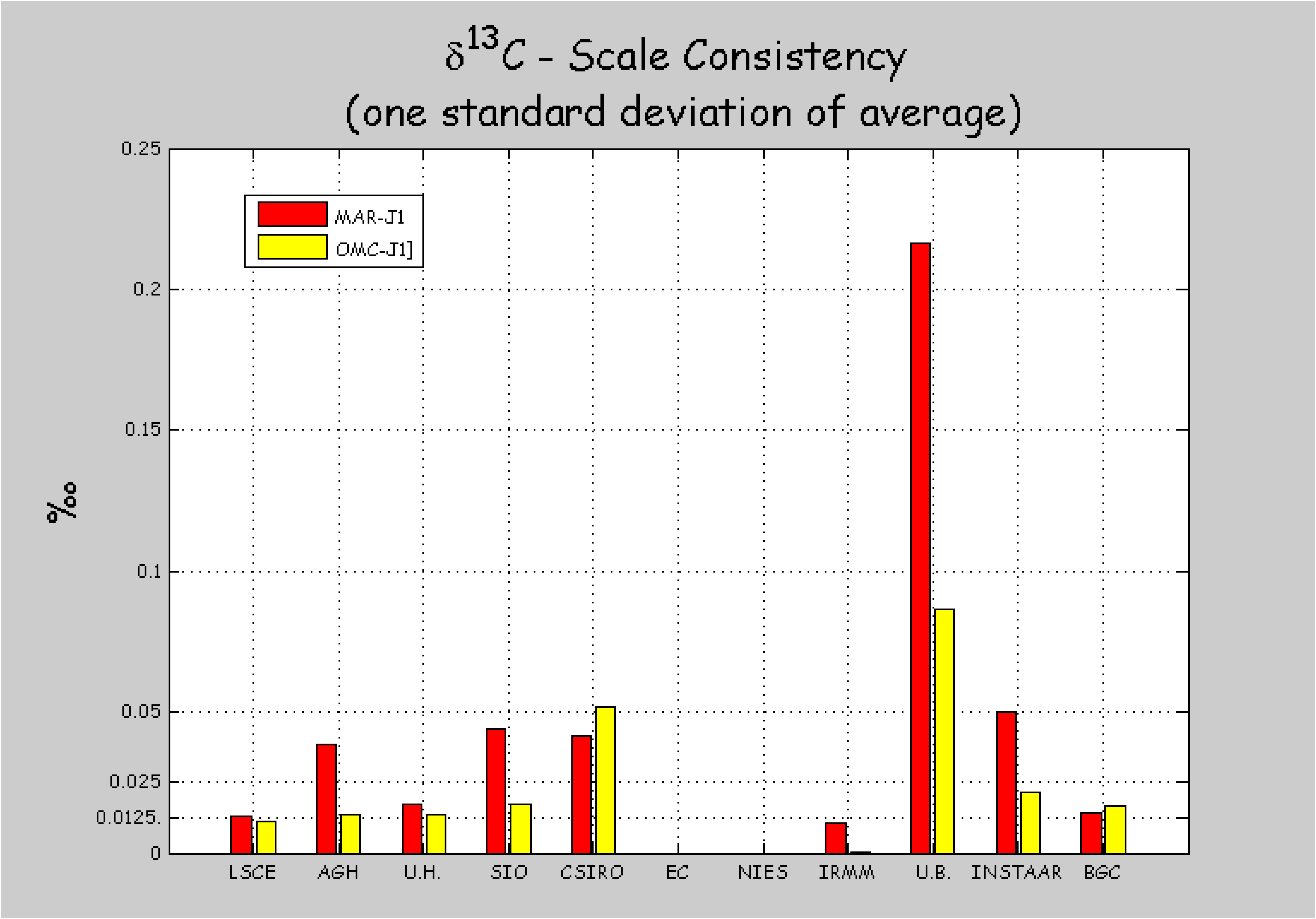


JRAS results: $\delta^{13}C$ – offsets

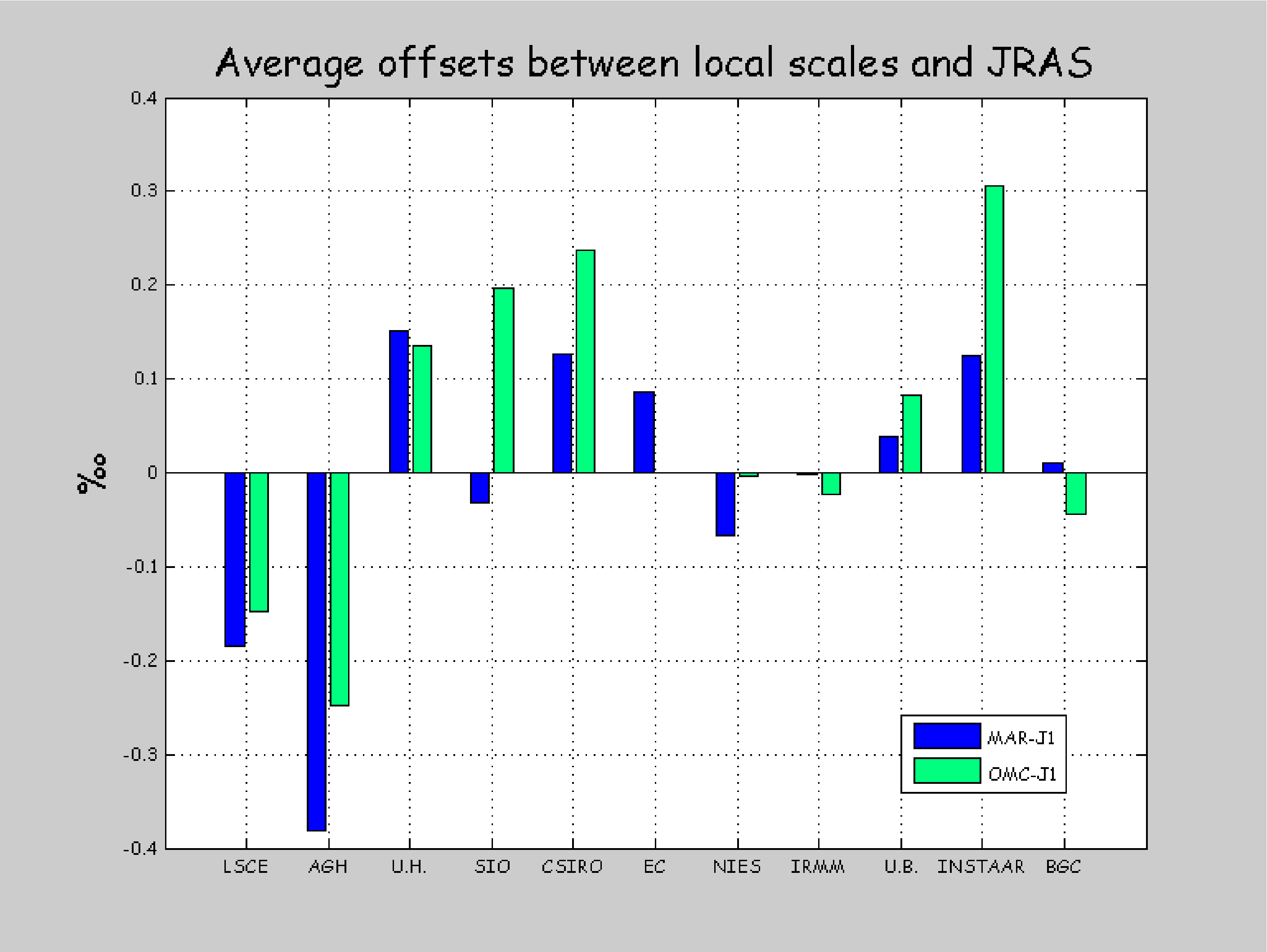


http://www.bgc.mpg.de/service/iso_gas_lab/JRAS_web/JRASWeb/JRAS_report_II.shtml

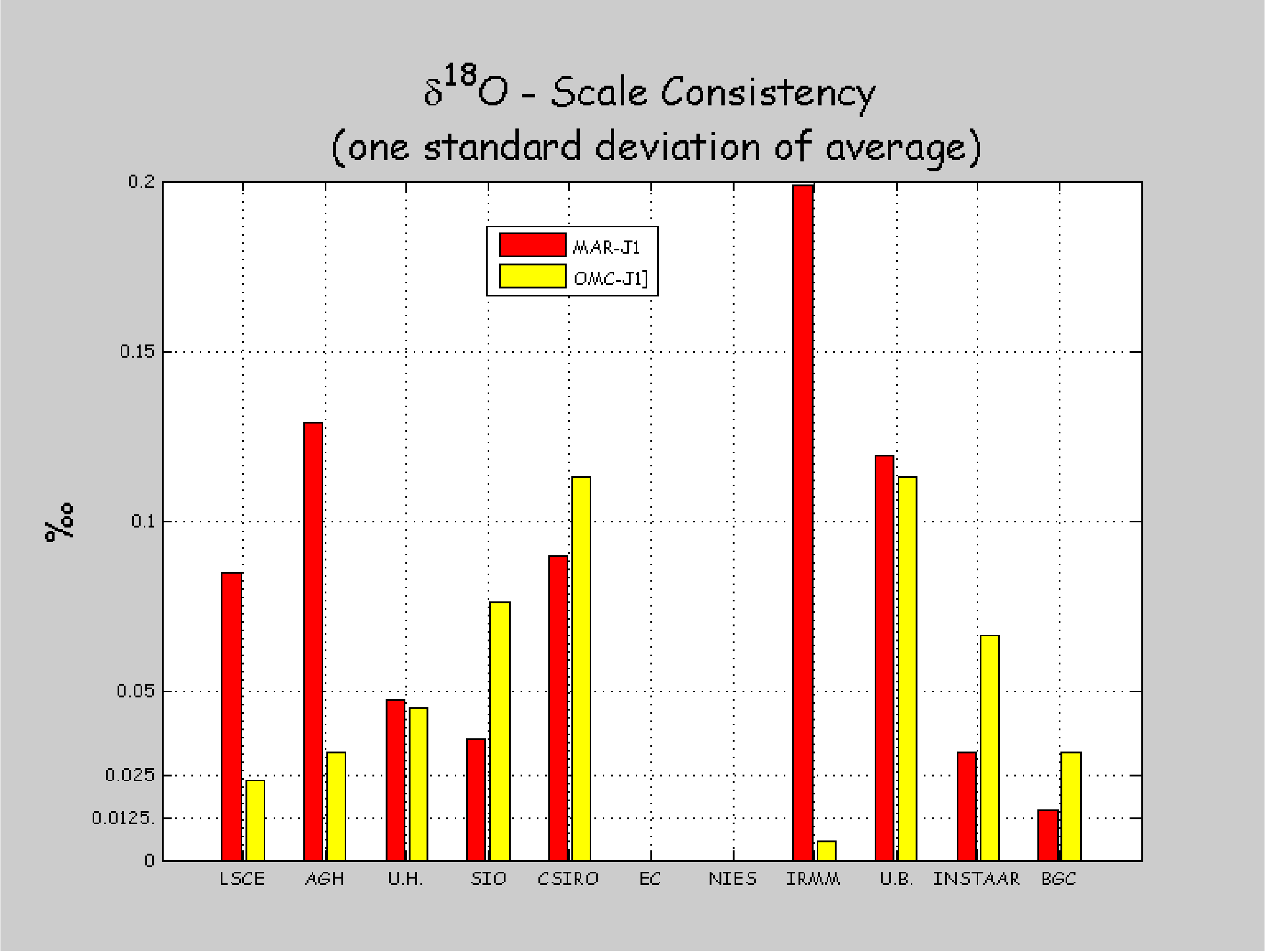
JRAS results: $\delta^{13}C$ – offsets



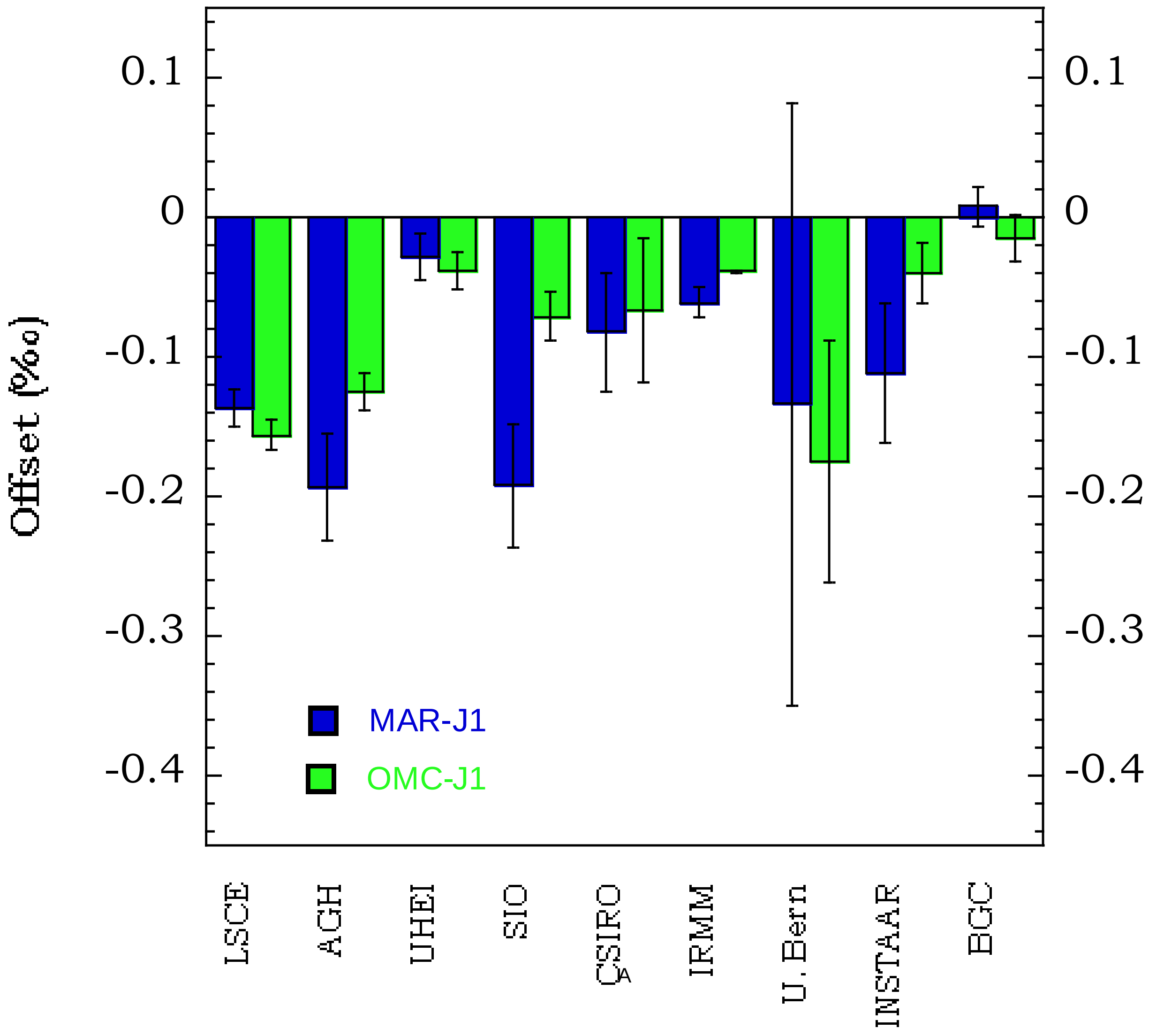
JRAS results: $\delta^{18}O$ – offsets



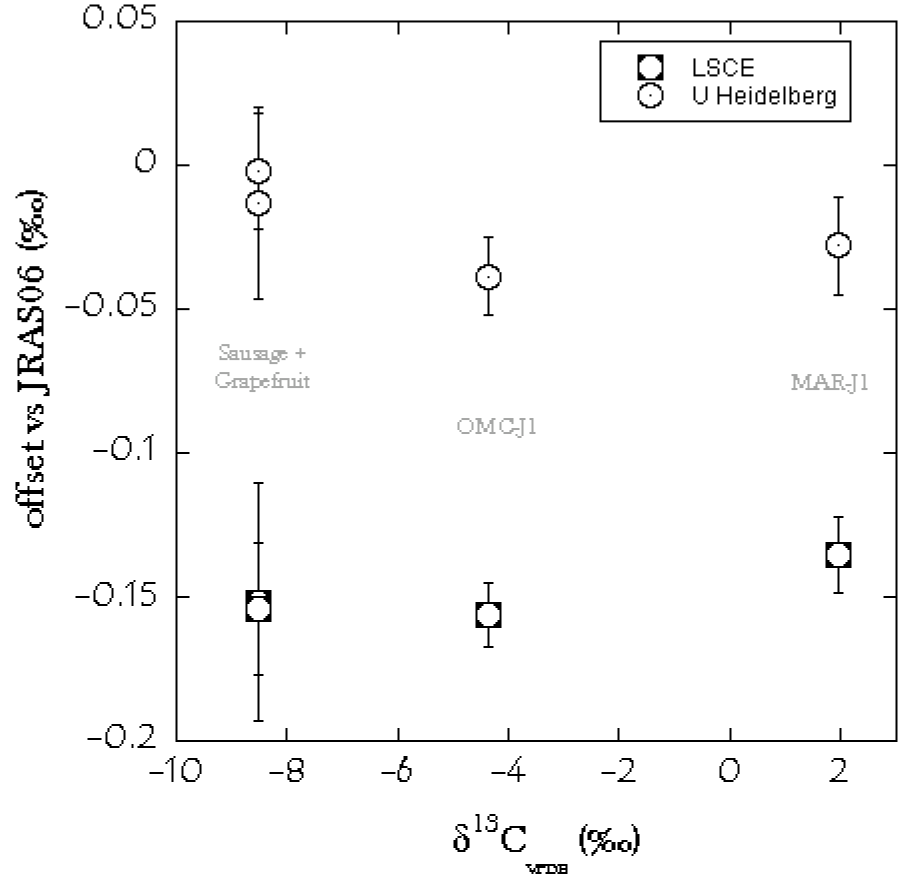
JRAS results: $\delta^{18}O$ – offsets



JRAS results: $\delta^{13}C$ – offsets



JRAS results: Sausage, Grapefruit comparison



Summary

JRAS provides a confirmed and solid anchor to VPDB for CO_2 in air measurements. (reference in air, CO_2 from calcites, MAR-J1 very similar to NBS19, highly repeatable preparation…)

The preliminary IMECC results highlights uncertainties associated with the tie to the true VPDB anchor. Also, since JRAS suffers from the same deficiency as NBS19 by not defining the $^{17}O/^{16}O$ ratio - the results are re-emphasizing the need for the use of an agreed upon ^{17}O-correction.
In this regard the second JRAS anchor, OMC-J1, provides an alternative to NBS18 as its $\delta^{18}O$ value is less negative (-9 ‰ vs. VPDB). Combined with its $\delta^{13}C$ value of -4.4 ‰, the introduced error arising from the ^{17}O correction is almost negligible

The IMECC results also provides hints, with a few exceptions, to what might be scale contractions/expansions. The detailed causes for these experimental artifacts are very difficult to assess, but it highlights the importance of a common scale anchor at air CO_2 values as well as at the VPDB anchor point.

Future developments of the JRAS scale anchor concept: addition of a clean air sample, MAR-J1, OMC-J1 in air without N_2O, and more..