README for gas_toolbox

Please check our GitHub page (https://github.com/dnicholson/gas_toolbox/releases) for the most recent version of these functions.

CITATION:
Manning, C.C.M. and D.P. Nicholson (2022). dnicholson/gas_toolbox: MATLAB code for calculating gas fluxes. Zenodo. https://doi.org/10.5281/zenodo.6126685

If you use these functions for scientific research, please cite or acknowledge our GitHub repository, and also cite the references listed in the headers of the individual functions (e.g., for the specific gas exchange parameterization used).

These MATLAB functions are provided as supporting information to the following publications:

Manning, C.C., R.H.R. Stanley, D.P. Nicholson, and M.J. Squibb (2016). Quantifying air-sea gas exchange using noble gases in a coastal upwelling zone. *IOP Conference Series: Earth and Environmental Science*. 35, 012017, 13 pages, https://doi.org/10.1088/1755-1315/35/1/012017

Manning, C.C.M., Z. Zheng, L. Fenwick, R.D. McCulloch, E. Damm, R.W. Izett, W.J. Williams, S. Zimmermann, S. Vagle, and P.D. Tortell (2022). Interannual variability in methane and nitrous oxide concentrations and sea-air fluxes across the North American Arctic Ocean, submitted to *Global Biogeochemical Cycles*. Preprint on *EarthArXiv*, https://doi.org/10.31223/X53G86

Purpose:
The functions in the **main directory** calculate the instantaneous air-sea and sea-air fluxes of several gases using various gas exchange parameterizations, including some that explicitly include bubble-mediated exchange. Functions beginning with **fas** represent the **air-sea flux** (positive fluxes are from air to sea) and functions beginning with **fsa** calculate the **sea-air flux** (positive fluxes are from sea to air).

The **subdirectory weighted_flux** contains functions for calculating the time-weighted sea-air flux, based on historical wind speed and sea ice data, and accounting for the mixed layer depth. It also includes scripts for downloading these historical data.

Required software:
Use of the **gas_toolbox** requires installation of the Gibbs-SeaWater Oceanographic toolbox, version 3.04 or newer (https://teos-10.org/software.htm). Use of the **weighted_flux** functions requires installation of GNU Wget (see **README_weighted_flux.txt** for details).

Gases currently supported in fas and fsa functions
He, Ne, Ar, Kr, Xe, O_2, and N_2.

Gas exchange parameterizations currently supported

With explicit bubble-mediated flux:

fas_S09: Stanley et al. 2009

fas_I11: Ito et al. 2011

fas_N11: Nicholson et al. 2011

fas_L13: Liang et al. 2013

fas_E19: Emerson et al. 2019

Without explicit bubble-mediated flux:

fas_Sw07: Sweeney et al. 2007

fas_Fd includes   W14: Wanninkhof 2014

                W92a: Wanninkhof 1992 - averaged winds

                W92b: Wanninkhof 1992 - instantaneous or steady winds

                Sw07: Sweeney et al. 2007

                Ho06: Ho et al. 2006

                Ng00: Nightingale et al. 2000

                LM86: Liss and Merlivat 1986

Please see the MATLAB function headers for the full citations for each parameterization.