

## ***Interactive comment on “Parameterization of atmosphere–surface exchange of CO<sub>2</sub> over sea ice” by L. L. Sørensen et al.***

### **Anonymous Referee #3**

Received and published: 1 October 2013

#### General

The topic of this paper is timely and very important. Measurement and parameterization of CO<sub>2</sub> exchanges over ice are extremely scarce and the knowledge concerning controls of fluxes is limited. This paper attempts to improve on this but unfortunately there are a number of shortcomings.

#### Specific

Page 3905, Lines 5-10: Not necessary with all this detail on a method that is not used in the paper

Page 3906, Eq. 4 and Fig. 1: The conceptual description of the system is wholly and inconsistent. According to Fig. 1 ‘c0’ is the CO<sub>2</sub> concentration at the height above the

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surface where the (theoretical) wind speed is zero, at the  $z_0$  level. If 'cs' is supposed to be the concentration at the surface, then 'Rc' should not be included in Eq. 4. If 'cs' is located at some level into the ice, then it is correct to include also 'Rc' in the equation but then this level must be defined and as far as I can see, it is not.

Page 3908, Eq. 10: What exactly is the definition of the parameter 'z0c'? If it is associated with the CO<sub>2</sub> concentration at the surface, then it must be zero by definition. Please explain.

Page 3908, Eq. 11: In Kramm and Dlugi, 1994, 'Bi' is denoted Stanton number and not 'Bi-1'. Please explain how the parameters (or variables) of this equation was obtained. How was, e.g., the characteristic velocity 'uz0' obtained?

Page 3908, Eq. 12: Should be '-Rb' here.

Page 3909, Eq. 13: How was the vertical advection (first term on right-hand side) determined? Please also describe the instrumentation and the corrections/calculation of fluxes and also how the instrument were calibrated.

Page 3910, L 13-15: As already expressed by another reviewer, the fluxes are extremely small and there is no justification made that such small fluxes can be detected by the measurement system. I also lack an error analyses of the EC measurements including assessment of both systematic and random errors. It is also mentioned that the inertial dissipation method was used but there are no results shown from this method.

Page 3910, L 24: The ice was cut in 12 cm sections so the estimated 'cs' was an average over this depth. The question is if there were vertical gradients of pCO<sub>2</sub> in the ice and if there was made any attempt to calculate a true surface pCO<sub>2</sub> concentration based on such estimates.

Page 3914, L7-8: Was there any consistency check made based on the sign of the gradient (c-cs) as compared to the measured fluxes? This could be important in order to understand the variability of the fluxes and subsequent calculation of 'Rb'.

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Page 3915, L4: Why correlating pCO<sub>2</sub> with temperature when temperature is used to estimate pCO<sub>2</sub>?

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Interactive comment on The Cryosphere Discuss., 7, 3899, 2013.

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7, C1938–C1940, 2013

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