Estimation of the air-sea radon exchange coefficient in shallow area

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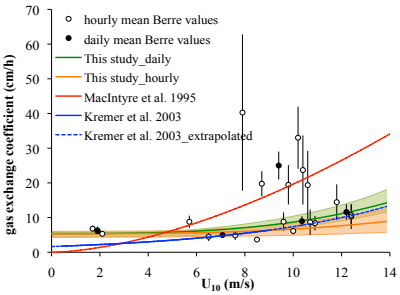
The radon-222 mass balance is commonly used for the estimation of Submarine Groundwater Discharge (SGD) fluxes in coastal areas. One of the main loss term, the radon evasion to the atmosphere (F_{atm}), is usually not measured but estimated on the basis of empirical equations linking gas exchange coefficient (k) with wind speed ($F_{atm}=k*(C_w-\alpha*C_a)$). According to the equation chosen, the result may be very different especially for high wind speed. These equations defined using gases like O_2 and CO_2 and mainly in open ocean may be less appropriate for shallow areas and ^{222}Rn.

Here we propose to estimate the gas exchange coefficient in shallow lagoon based on radon mass balance. ^{222}Rn activities in water and air, water temperature and salinity, ^{226}Ra activities and wind speed were measured on a shallow water column in the Berre lagoon (France) during several days and for different wind conditions. We estimated the different terms of the radon mass balance (F_{prod}, F_{decay} and F_{diff}) in order to evaluate F_{atm}. The gas exchange coefficients are then calculated and linked to wind speeds (Figure 1) for each days or each hours of measurements.

Figure 1: Gas transfer coefficient versus wind speed.



We obtain two equations, based on daily or hourly data, linking the gas exchange coefficient normalized to the Schmidt Number of CO_2 at 20°C in seawater (k_{660}) to wind speed at 10m height (U_{10}):

These equations will be discussed in comparison with previous one from the litterature and used in an example of SGD budget from Mar Menor lagoon (Spain).

$$k_{660daily} = (0.0033 \pm 0.0008) * U_{10}^3 + (5.4 \pm 0.6)$$

$$k_{660hourly} = (0.0013 \pm 0.0008) * U_{10}^3 + (5.3 \pm 0.7)$$