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Influence of Th-230 measurements on the estimation of the abyssal circulation

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Although the abysses dominate the world oceans by volume, the abyssal circulation remains difficult to study for obvious logistic but also physical reasons. Far from intense deep western boundary currents, the dynamical method is relatively delicate to apply in the subthermocline region owing to the smallness of the horizontal density gradients, whereas current meters and neutrally buoyant floats experience in general an important influence by eddying motions. Thus, studies of the abyssal circulation rely also traditionally on the distribution of dynamically inactive tracers. Here we will examine to which extent a new member in the palette of marine tracers – a radioisotope of thorium (^{230}Th) – provides quantitative information about the abyssal circulation in the North Atlantic basin. Unlike density ^{230}Th exhibits very large horizontal variations in the abyssal interior, which current understanding suggests to be due to the circulation. Our approach is based on the quantitative combination of the ^{230}Th data (as well as supplementary data such as density data) with a simple (geostrophic) model of the abyssal circulation in the North Atlantic on the basis of an inverse method. Neither the data nor the physical balances of the model are strictly imposed in the analysis; rather they constrain the flow field according their respective estimated uncertainties. It is hoped that this approach will provide a rigorous assessment of the dynamical information contained in the radiochemical data.