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ARCTIC OCEAN BOUNDARY ARRAY: METHODS, AND MODELLED SEASONALITY OF FLUXES AND STORAGE

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We treat the Arctic Ocean as a closed volume, defined by the seabed, the surface (whether ice or ocean), coastlines, plus ocean locations (gateways) occupied by long-term fixed (moored) installations, in Fram, Davis and Bering Straits, and the Barents Sea Opening. Then any surface flux is represented mathematically by divergence terms calculated around the ocean boundary, plus interior storage terms. Formally, we start from Gauss' Theorem, and incorporate time-varying conservation equations for mass and other properties. This formal approach demonstrates the arbitrariness of "reference values". The quantity that emerges from the algebra in place of a reference value is a well-defined quantity: the ice and ocean boundary mean of the relevant property. Consider freshwater fluxes, by way of illustration. A freshwater flux through a single section is meaningless: 96.5% of the ocean is freshwater. There are only two well-defined freshwater fluxes: one is the actual addition (or removal) of H_2O at the surface, the other is its seawater analogue, manifested as (and measurable as) dilution (or concentration) of salinity. Consider this: a surface flux presumes a surface area; a surface area describes an ocean volume; combine ocean mass transport with ocean salinity divergence and you get a true ocean freshwater flux (allowing for storage terms). This means the mass (freshwater) that must be added at the surface to obtain the observed change in salinity flux. The mean salinity of the ocean boundary defines the quantity that looks like a reference value - nothing else. Freshwater content is similarly meaningless: the ocean is still 96.5% water. The quantity that does have meaning is the change in freshwater content - which can happen either by changing mass within a defined volume, or by changing salinity within a defined volume. This is described fully in Bacon et al., Phil Trans. (2014, sub.), and is set out, with illustrations of applications to mass, freshwater and heat fluxes and storage, in this poster.