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ARCTIC OCEAN BOUNDARY ARRAY: CORNERSTONE OF ARCTIC MONITORING

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The Arctic Ocean is a mediterranean basin with well-recognised ocean “gateways”. Four of these gateways have been occupied by fixed (moored) installations, delivering continuous, year-round measurements for over a decade: Fram, Davis and Bering Straits, and the Barents Sea Opening (see figure). These four gateways completely enclose the Arctic Ocean, measuring most of the ocean inflows and outflows. The immediate benefit of this assembly is that mass conservation is possible, including sea ice as well as ocean transports, which in turn enables calculation of true fluxes as ice and ocean divergences. Where a surface pathway exists, the ocean divergence is the surface flux (with due allowance for storage terms). The utility of this approach has been shown in a series of recent “baseline” flux calculations, in: Tsubouchi et al., JGR 2012, for heat and freshwater; Torres Valdes et al., JGR 2013, for inorganic nutrients; MacGilchrist et al., DSR-I 2014, for carbon. The importance of this approach derives from the sparseness of surface and interior Arctic Ocean measurements: these quantities can hardly be calculated directly from measurements in any other way, even though recent technological developments – such as Ice-Tethered Profilers – are beginning to address the problem of sparseness, and even though occasional concentrated measurement campaigns – such as the International Polar Year – provide a relatively high density of measurements for a short, if seasonally-biased, period. A second point of utility lies in the unambiguous definition of a metric: a specific geographically-defined Arctic boundary, which is transferrable to the world of models, whether reanalyses, ice-ocean general circulation models, or climate models. Thus independent validation of models becomes possible. Also, quantities which are hard to measure, such as storage terms, are calculable: Bacon et al., Phil. Trans. (sub.) 2014. For these reasons, we argue that the Arctic Ocean Boundary Array should form the cornerstone of any sustained Arctic climate monitoring system.

