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## The Salish Sea was Saturated with respect to Aragonite in Pre-Industrial Times

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Allen, Susan, "The Salish Sea was Saturated with respect to Aragonite in Pre-Industrial Times" (2022).  
*Salish Sea Ecosystem Conference*. 31.  
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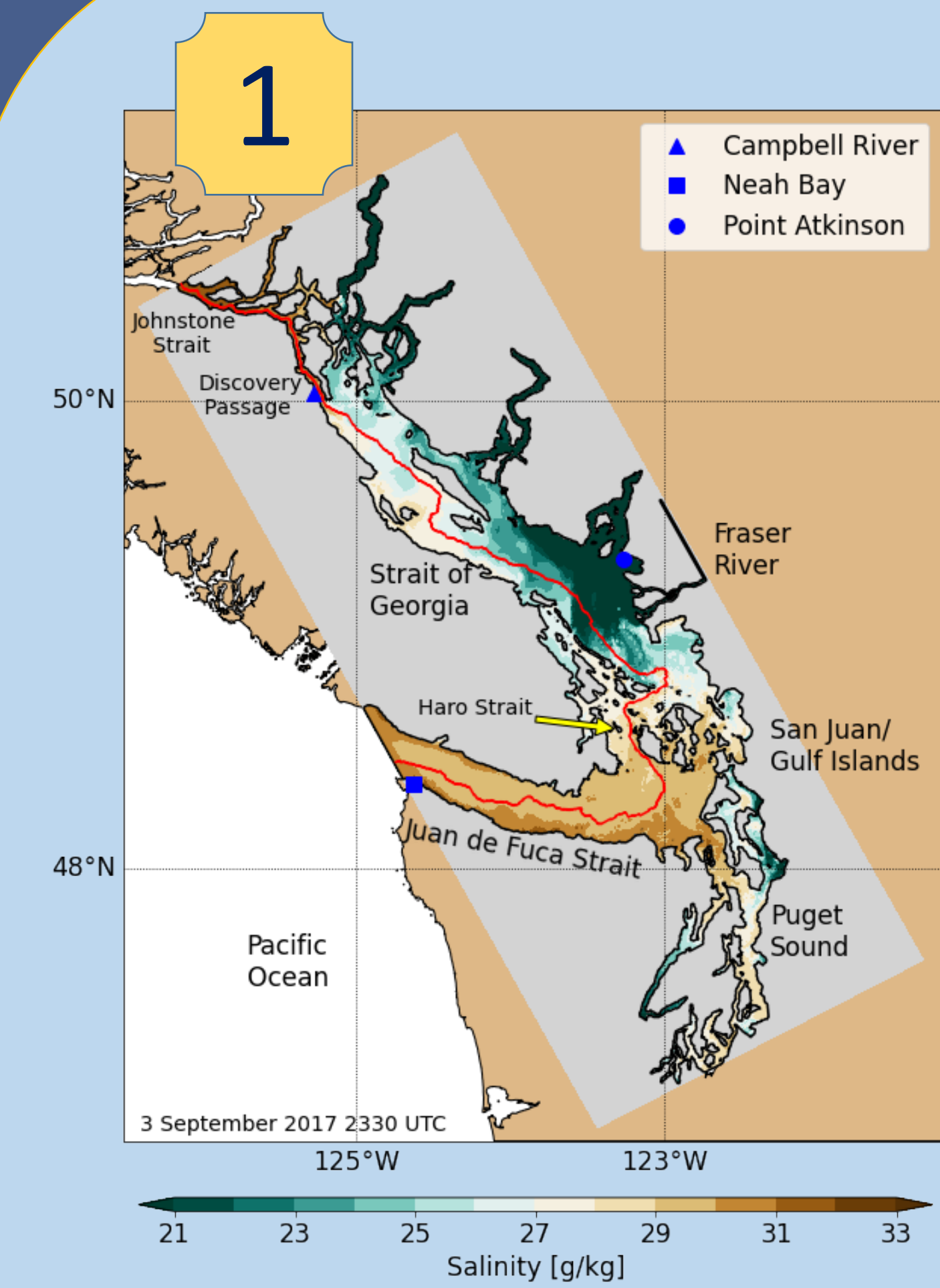
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# The Salish Sea was Saturated with respect to Aragonite in Pre-Industrial Times

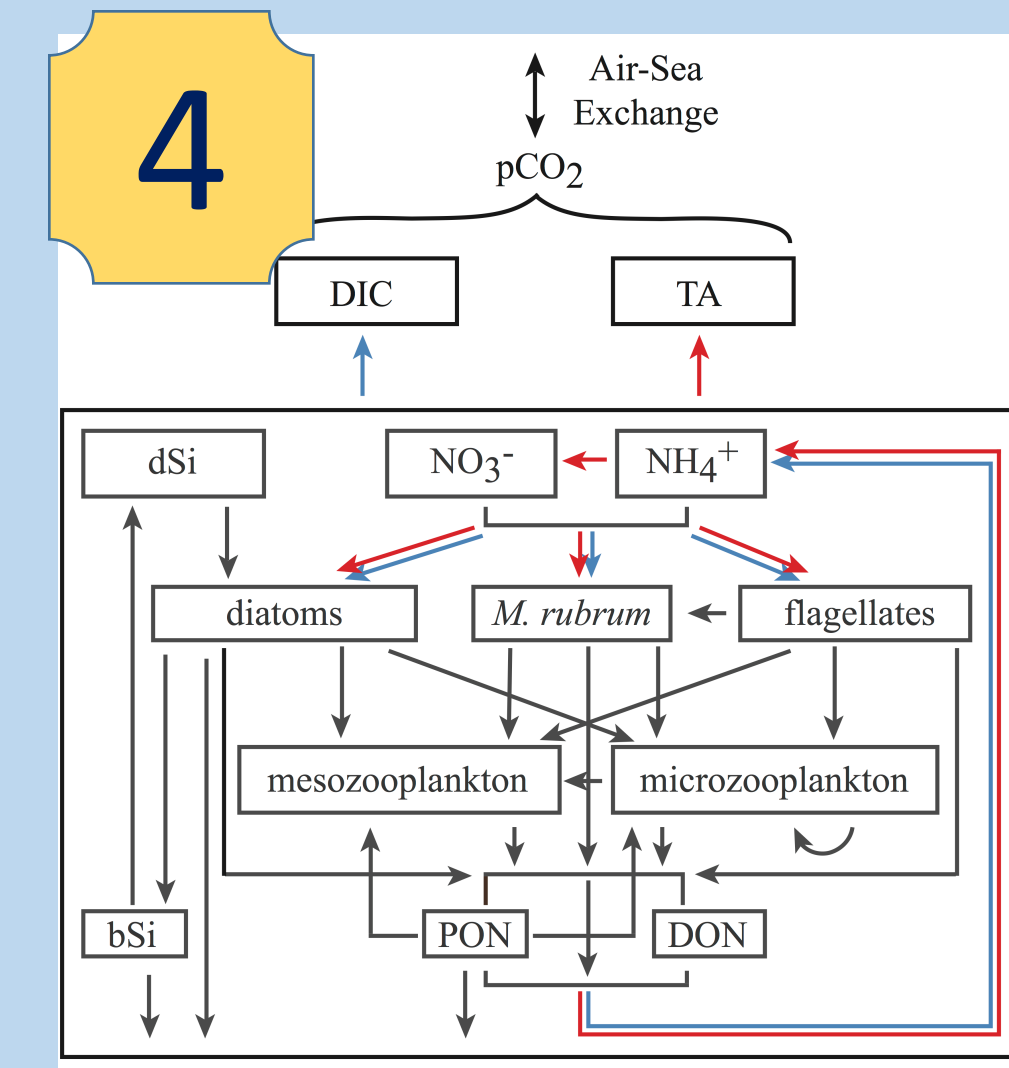
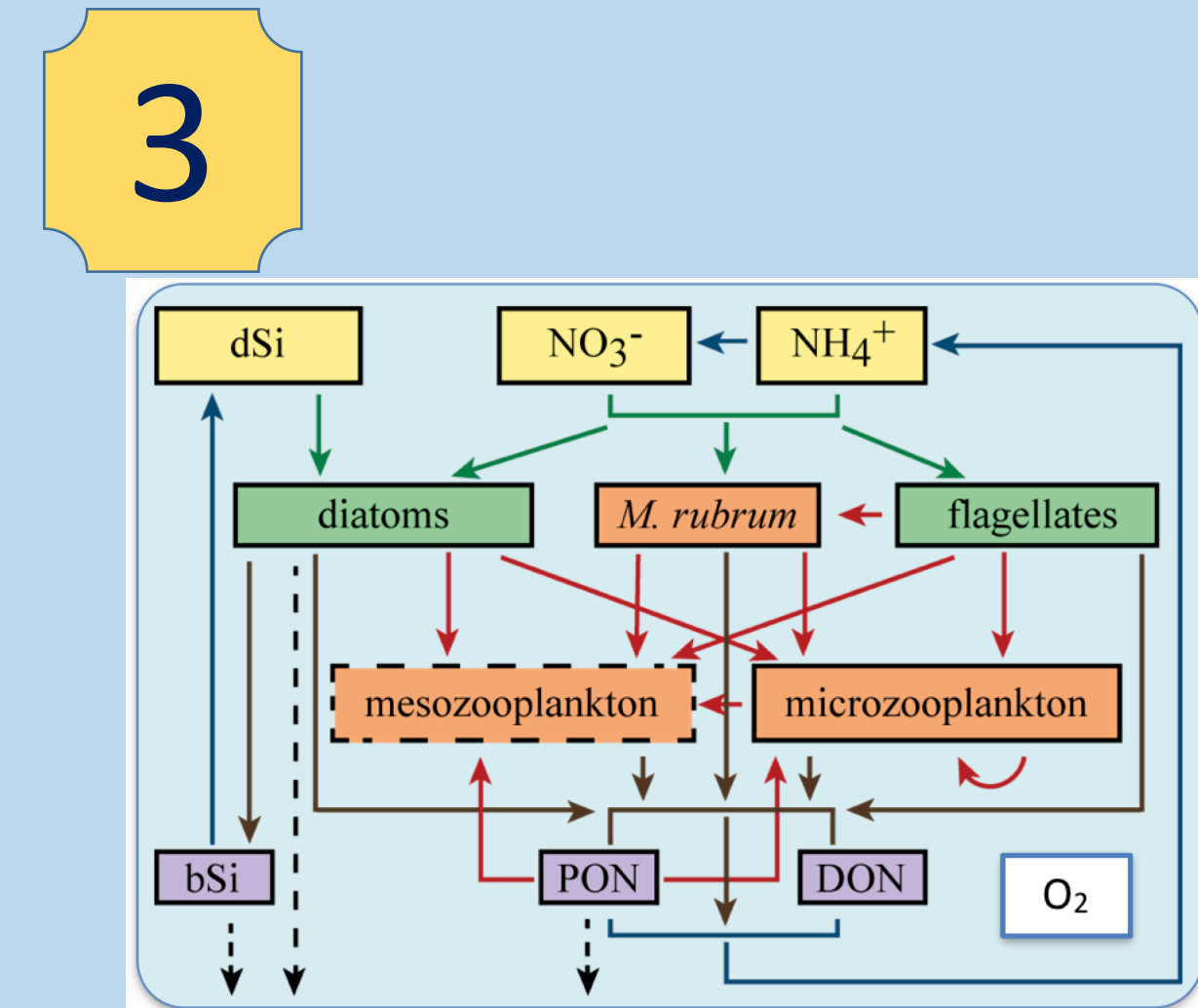
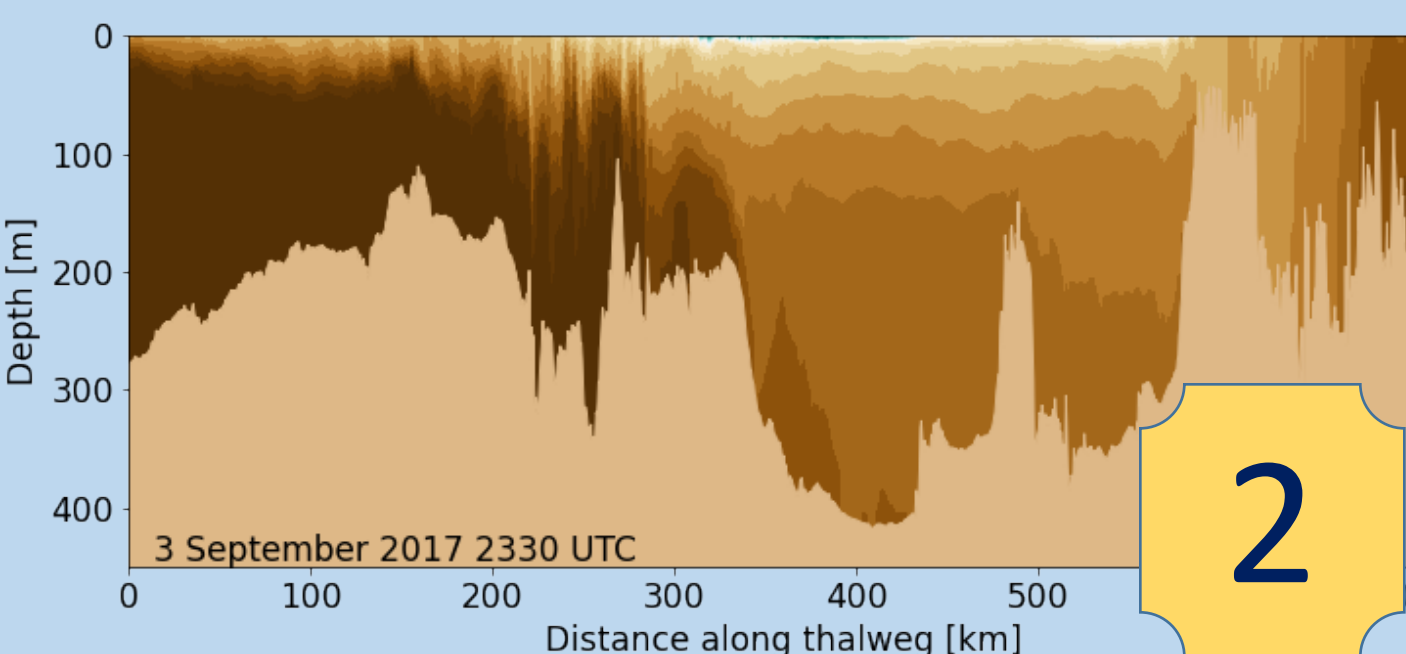
Tereza Jarníková<sup>1</sup>, Debby Ianson<sup>1,3</sup>, Susan E. Allen<sup>1</sup>, Andrew Shao<sup>2,4</sup>, Elise Olson<sup>1</sup>

<sup>1</sup>University of British Columbia, <sup>2</sup>University of Victoria, <sup>3</sup>Fisheries and Oceans, Canada <sup>4</sup>Environment and Climate Change, Canada



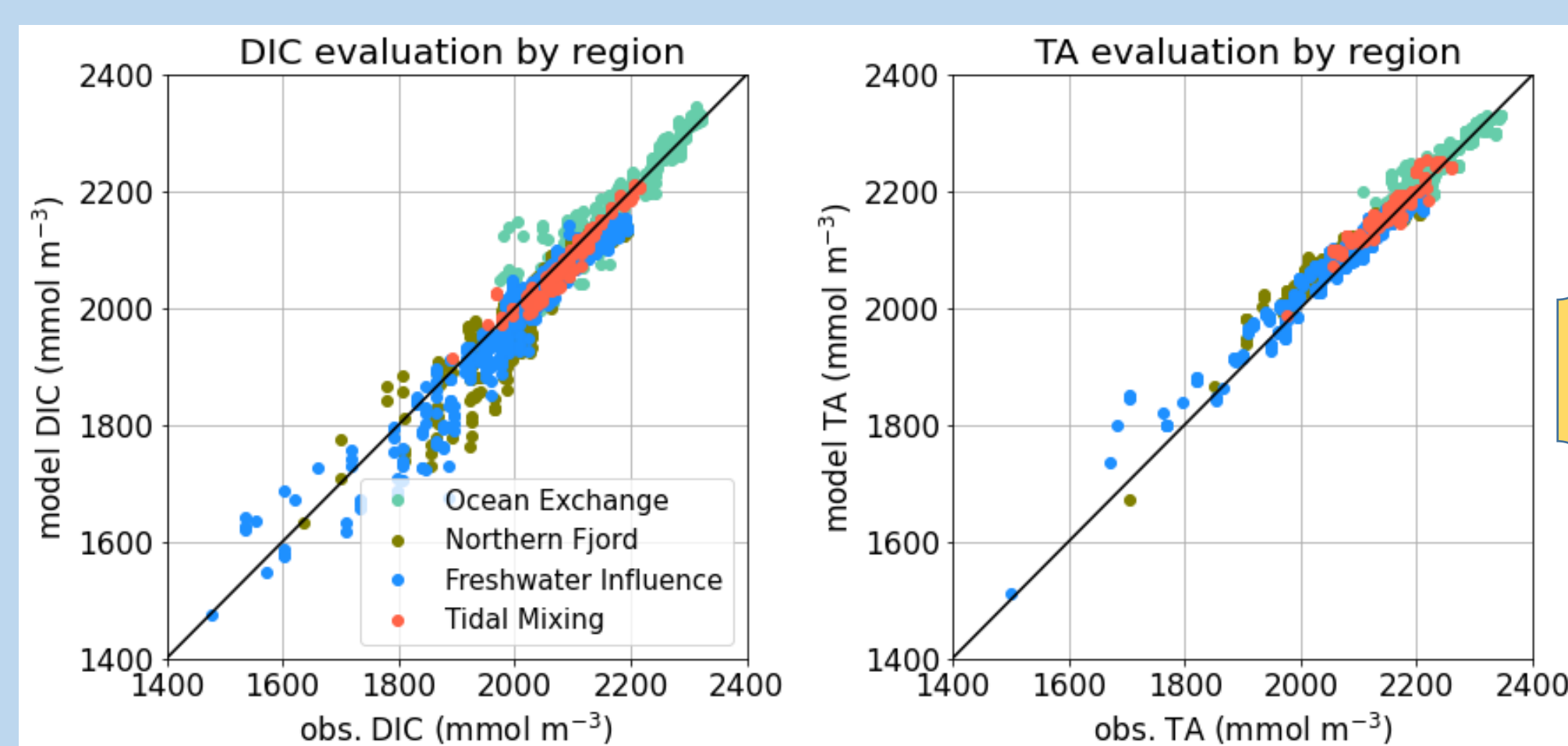
SalishSeaCast is an ocean model of the Salish Sea (domain shown in Fig 1). It is 3-D (view along thalweg [red line in Fig 1] shown in Fig 2) and based on the NEMO community model.

The physical model is coupled to a 10-tracer biological model (Fig 3) and a 2-component carbon model (Fig 4).

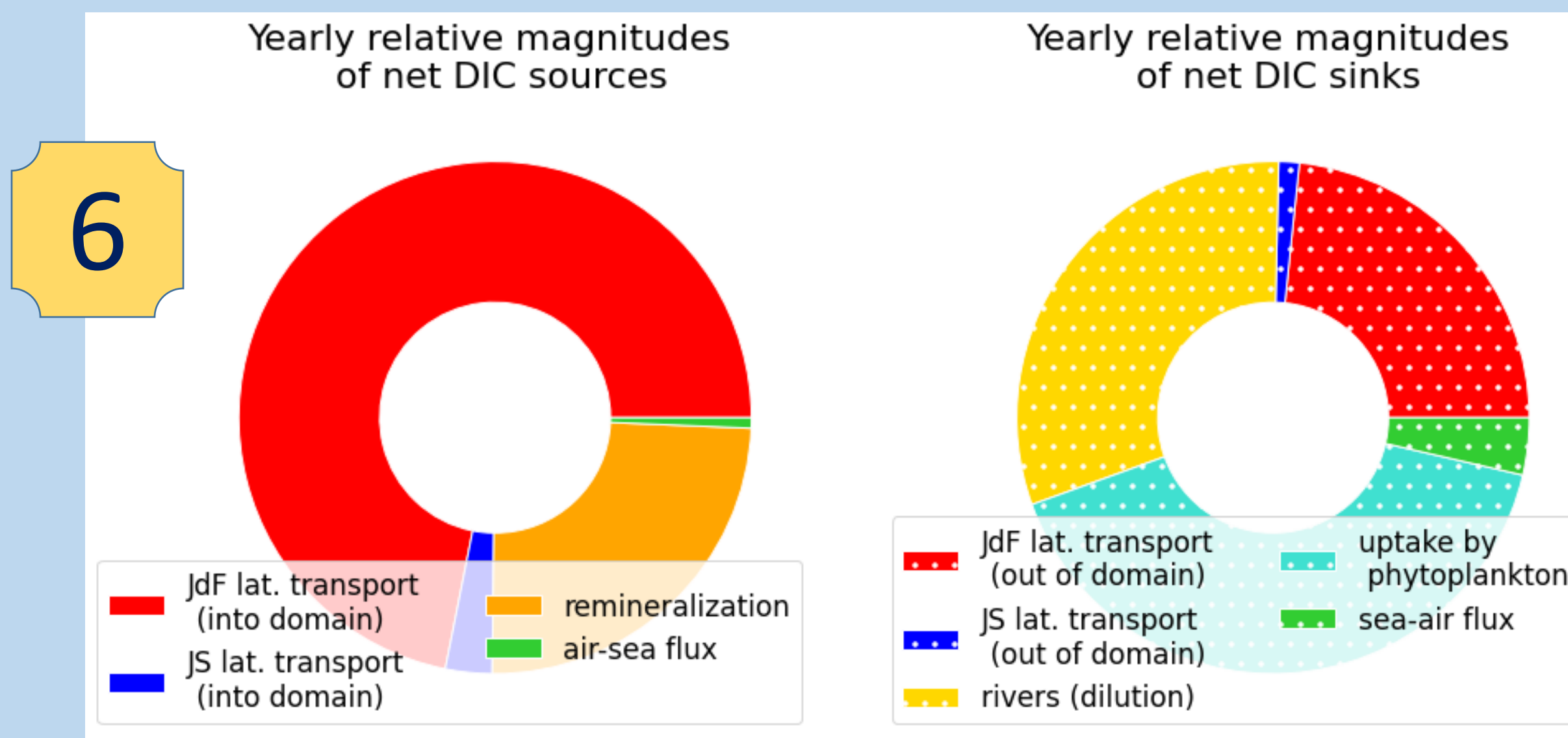


SalishSeaCast is accurate (Fig. 5) based on salinity matched, year day matched observations.

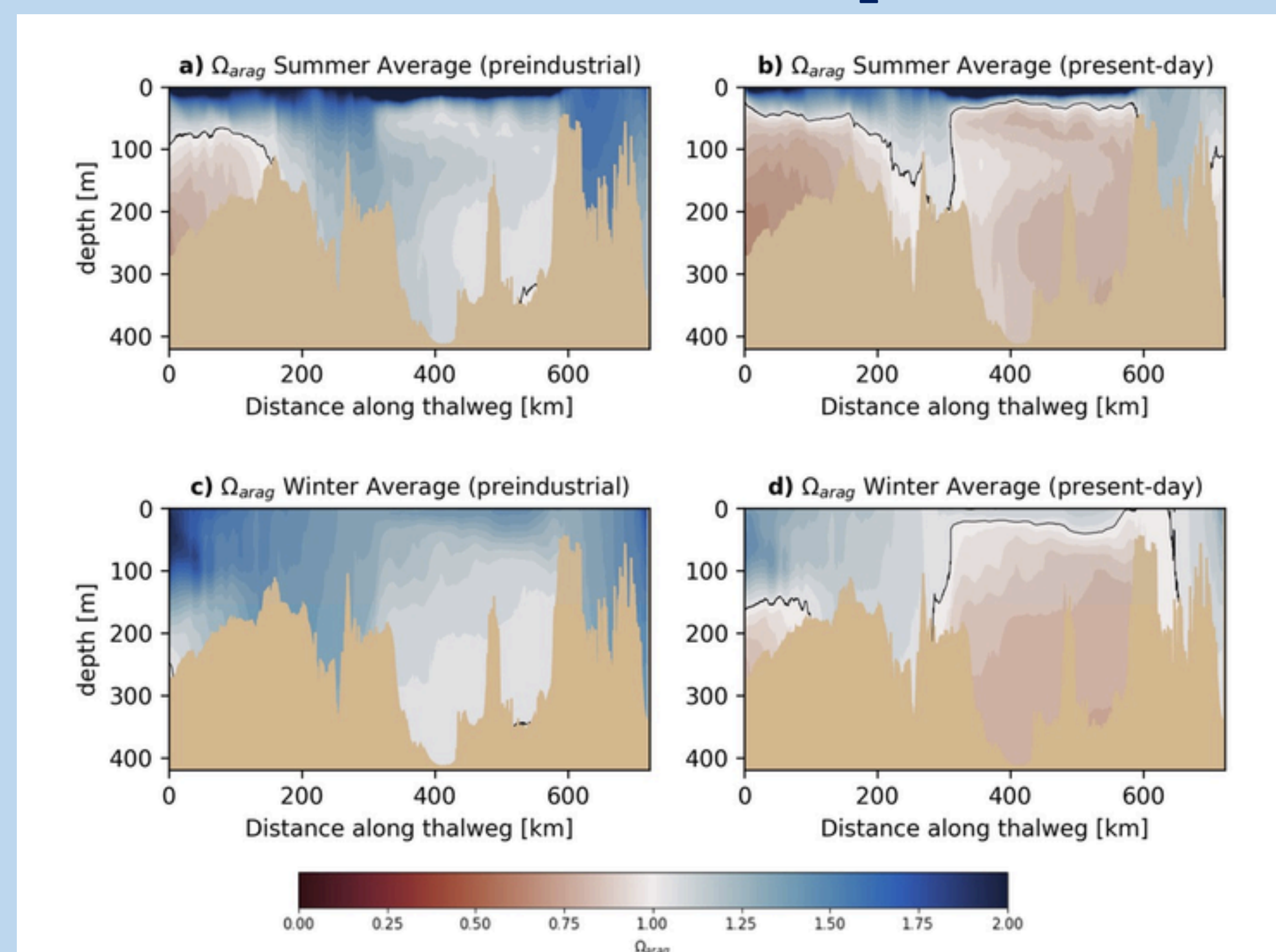
Units ( $\mu\text{M}$ )	Bias	RMSE	Willmott Score
Dissolved Inorganic Carbon (DIC)	-15	62	0.97
Total Alkalinity (TA)	12	63	0.98



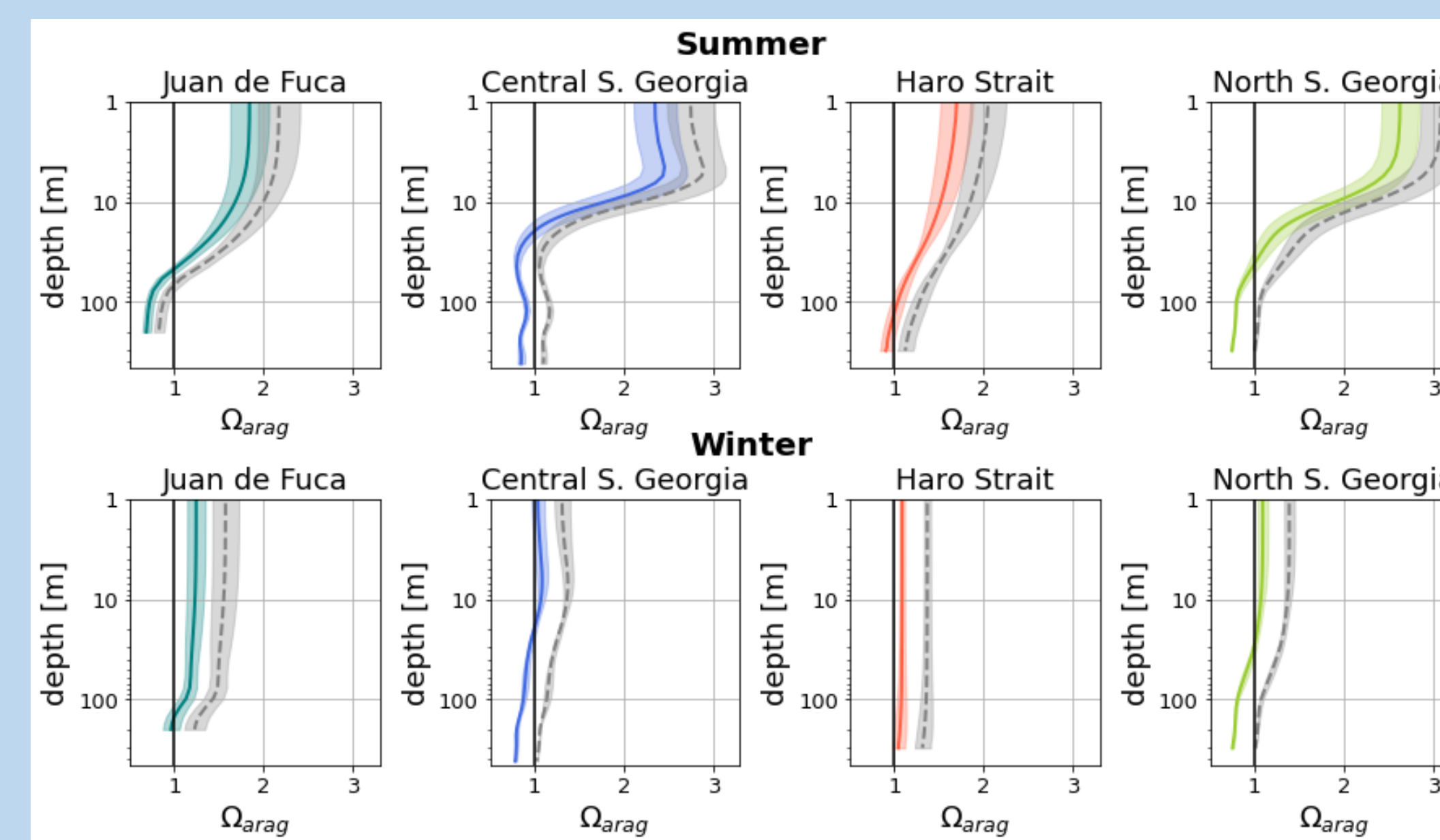
From the model we can calculate a DIC budget. The budget relative to a mean DIC concentration of 2050  $\mu\text{M}$  (Fig 6) shows the dominance of the open boundaries.



We ran for the present (year 2015) and compared to a pre-industrial run changing only the open boundary conditions and atmospheric  $\text{pCO}_2$ .



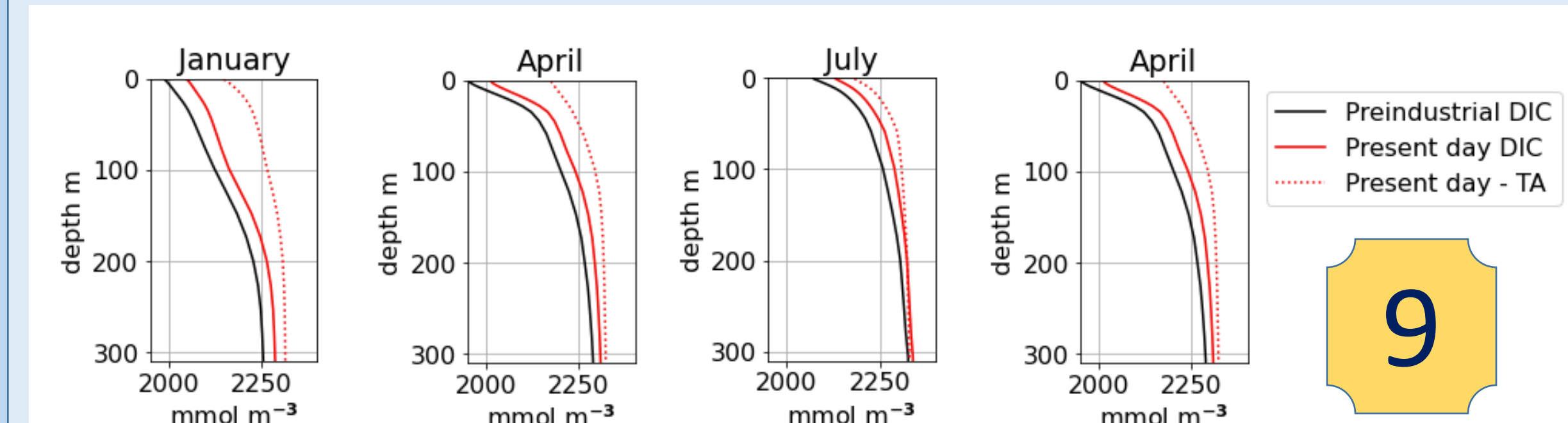
Before the industrial age, the Salish Sea had Aragonite Saturation State ( $\Omega_{\text{arag}}$ ) above 1 as a mean for each season, everywhere except at the mouth of JdF (Fig 7).



Profiles of Pre-Industrial  $\Omega_{\text{arag}}$  (grey) are distinct from 2015 profiles (colour) in most regions at most depths in both summer and winter (Fig 8). Shading shows 10-90 percentiles of daily values.

## Boundary Condition: Details

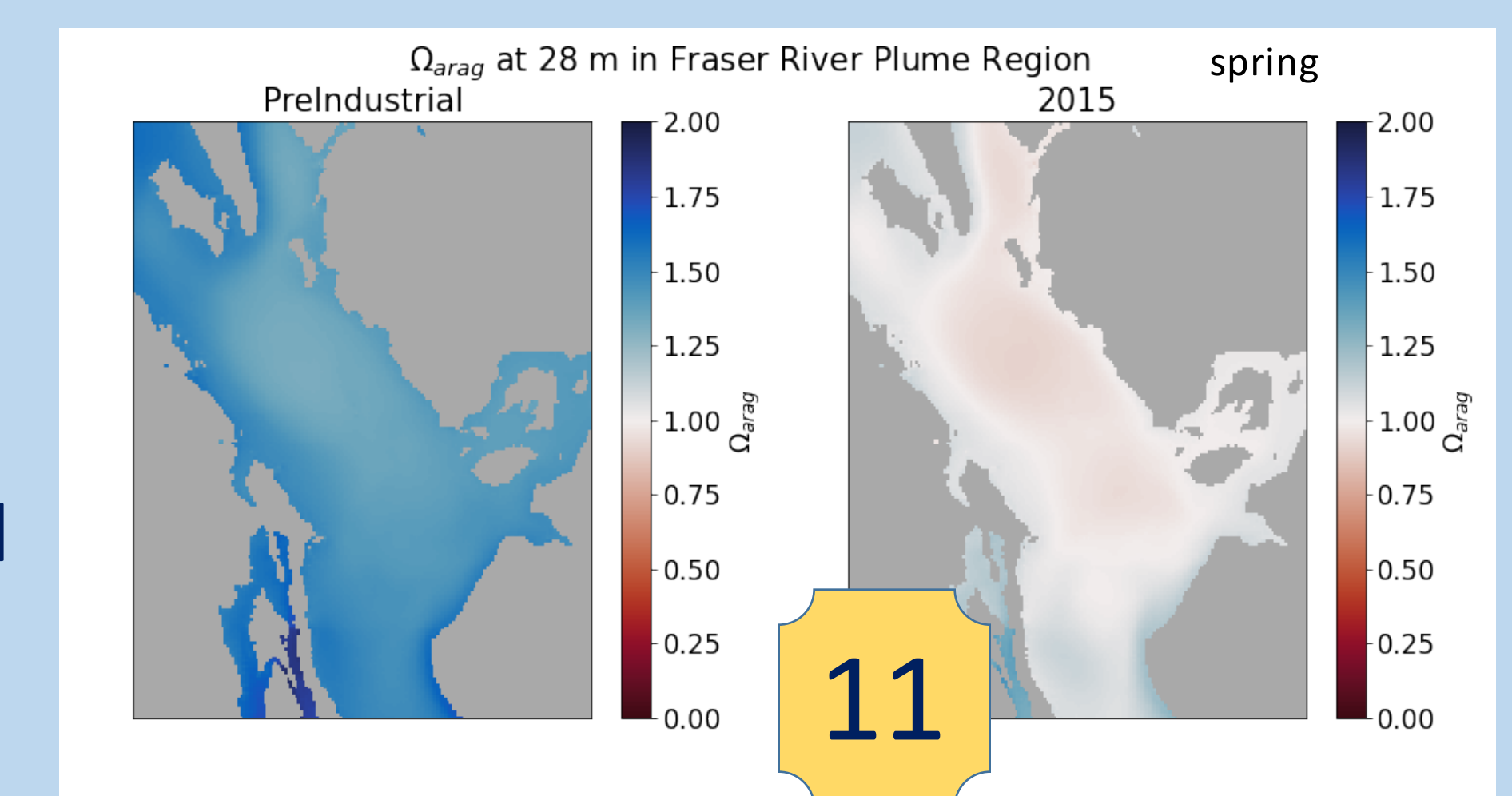
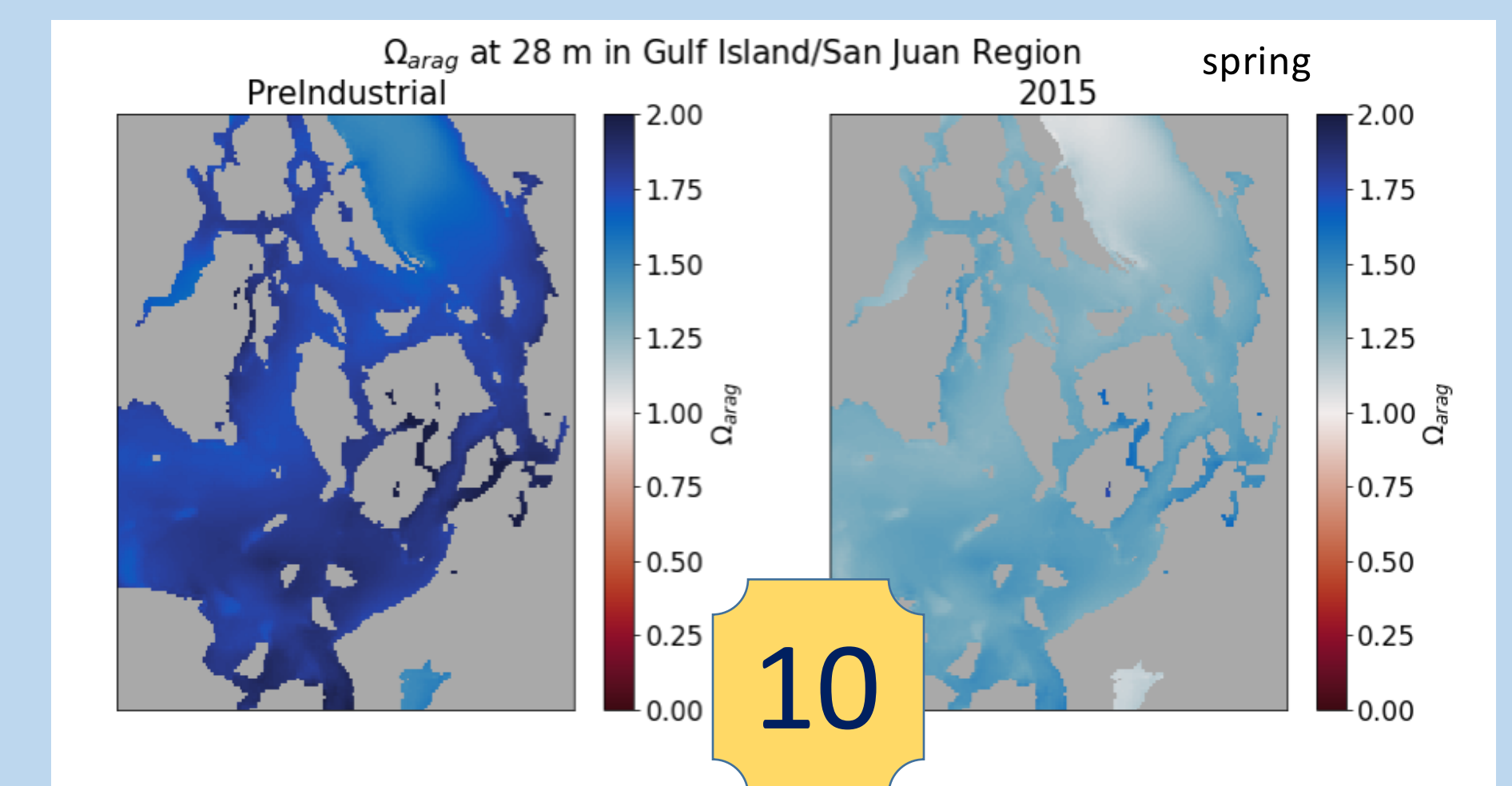
The age of the incoming water (density-matched) is inferred from nearby observations of three transient tracers [1]. We backtrack remineralized carbon to the surface using Apparent Oxygen Utilization and calculate DIC (Fig 9) using the C-star method [2].



[1] Sonnerup et al, 2013. *Deep Sea Res.* 72: 61.  
[2] Gruber et al, 1996. *Global Biogeochem. Cycles* 10: 809.

## Implications:

Significant changes are seen in the spring at 28 m depth (Fig 10, 11). Regions with significant freshwater have become undersaturated (Fig 11)



Jarnikova T, Ianson D, Allen S, Shao A, Olson E. (2022). Anthropogenic carbon increase has caused critical shifts in aragonite saturation across a sensitive coastal system. Under review at: *Global Biogeochemical Cycles*.