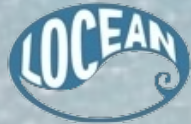




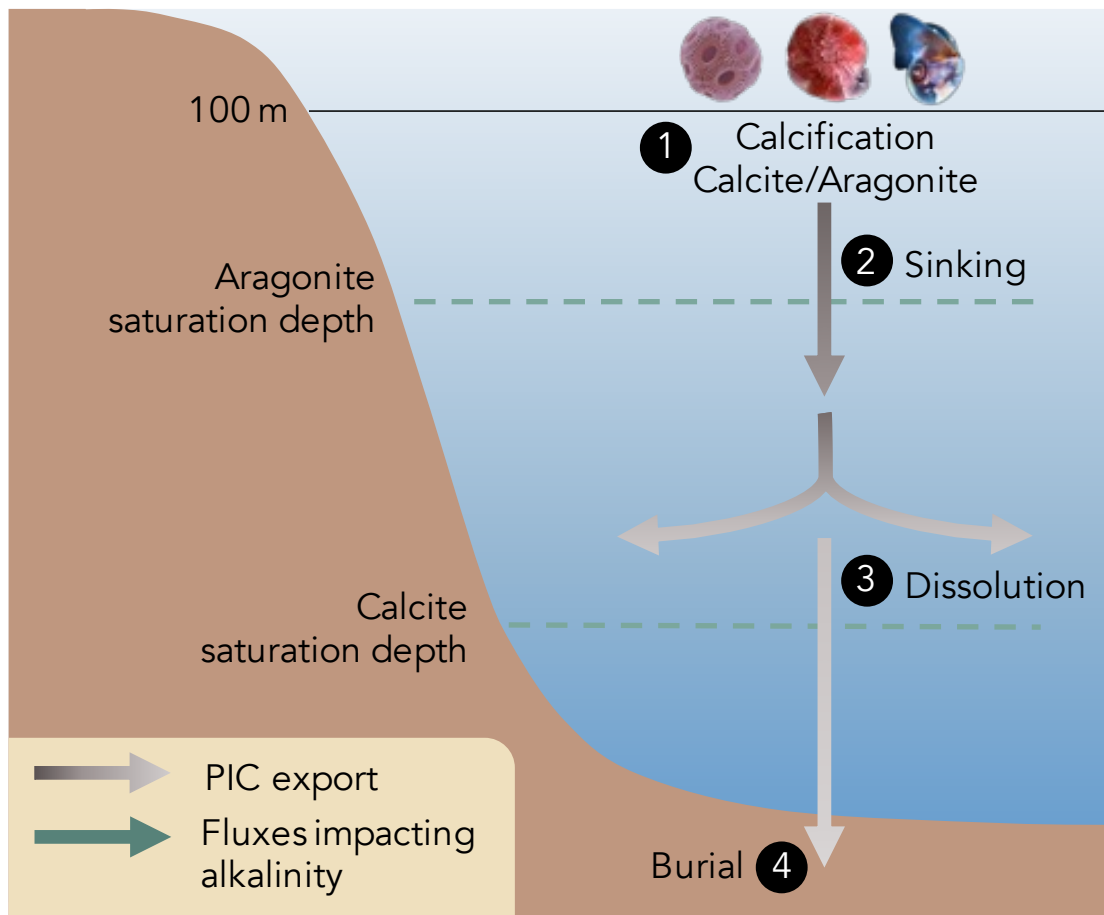
The representation of alkalinity and the calcium carbonate pump from CMIP5 to CMIP6 ESMs



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2022

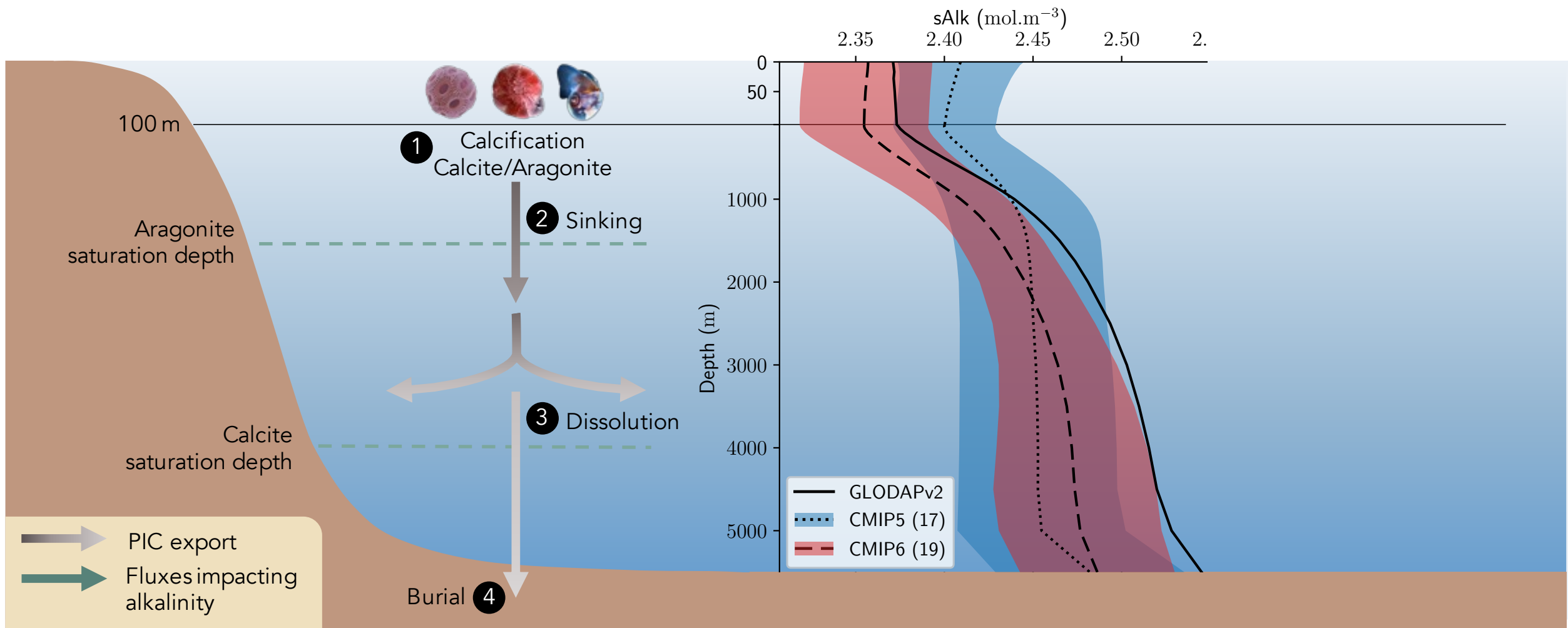


The carbonate pump mostly shapes the vertical profile of Alk (and DIC to a lesser extent)

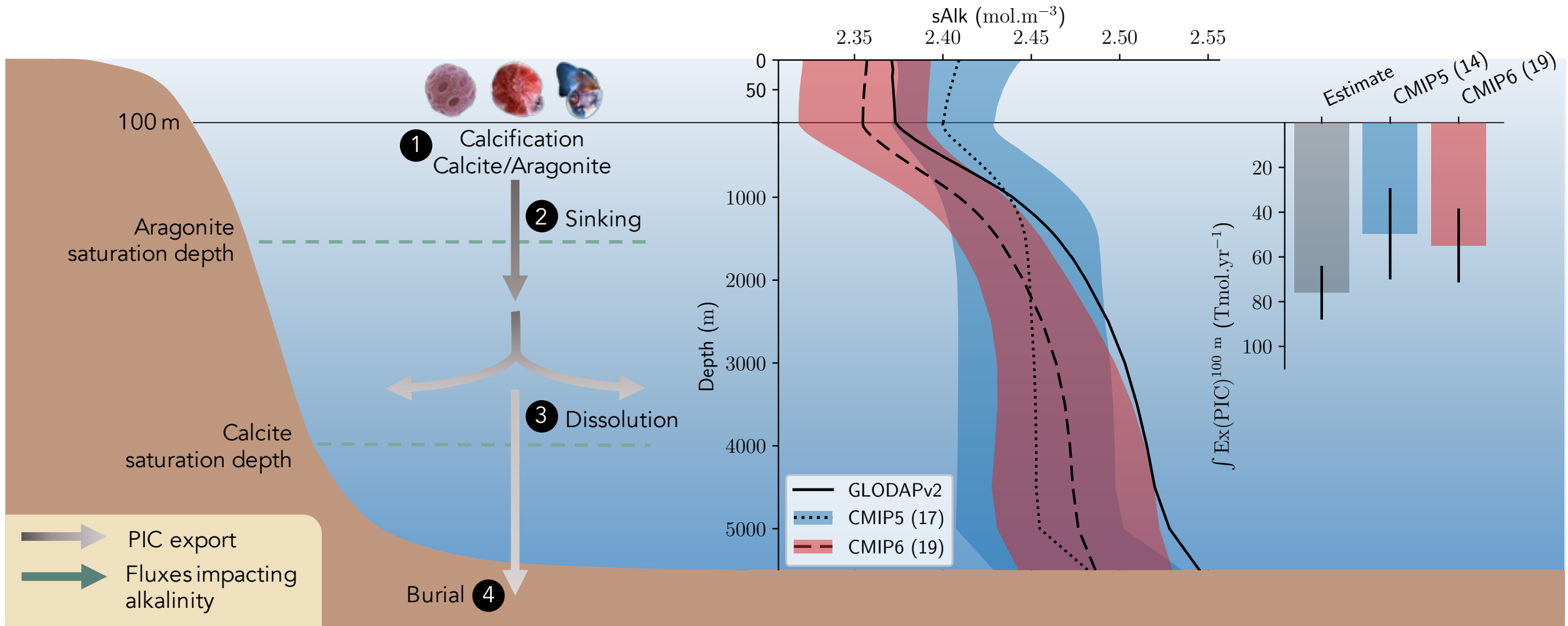
Alk (excess of proton acceptors over proton donors)
→ The relative balance between Alk and DIC at the ocean surface chemically drives the uptake of atmospheric carbon

Methodological point

- 17 ESMs for CMIP5 and 19 for CMIP6
- ESM historical data averaged around 2002



$$sAlk = 35 \cdot \frac{Alk}{S}$$

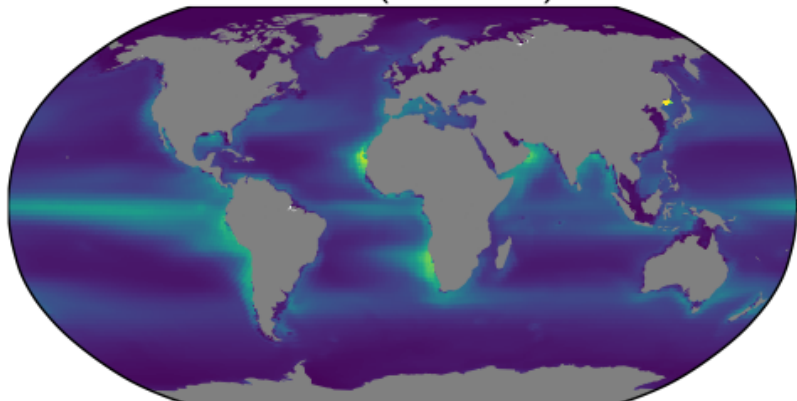


$$sAlk = 35 \cdot \frac{Alk}{S}$$

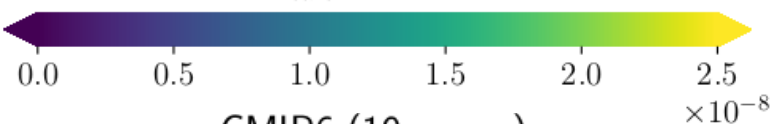
A strong link with the POC export and a noteworthy inter-ESM variability

PIC export
at 100 m

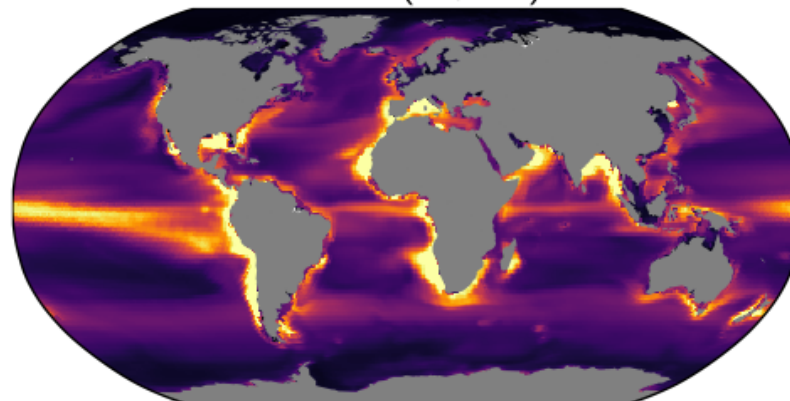
CMIP6 (18, mean)



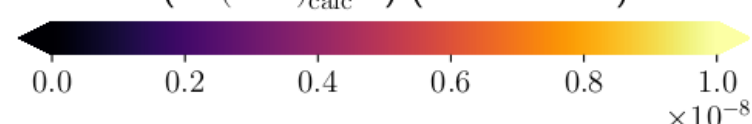
$\text{Ex}(\text{PIC})_{\text{calc}}^{100 \text{ m}} (\text{mol m}^{-2} \text{s}^{-1})$



CMIP6 (18, std)

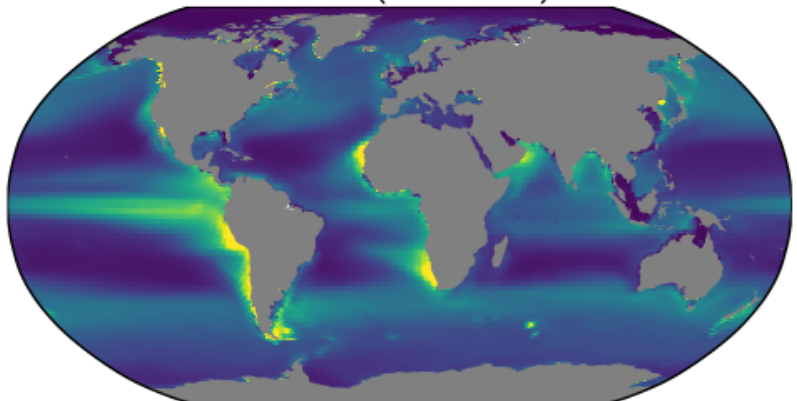


$\sigma(\text{Ex}(\text{PIC})_{\text{calc}}^{100 \text{ m}}) (\text{mol m}^{-2} \text{s}^{-1})$



POC export
at 100 m

CMIP6 (19, mean)

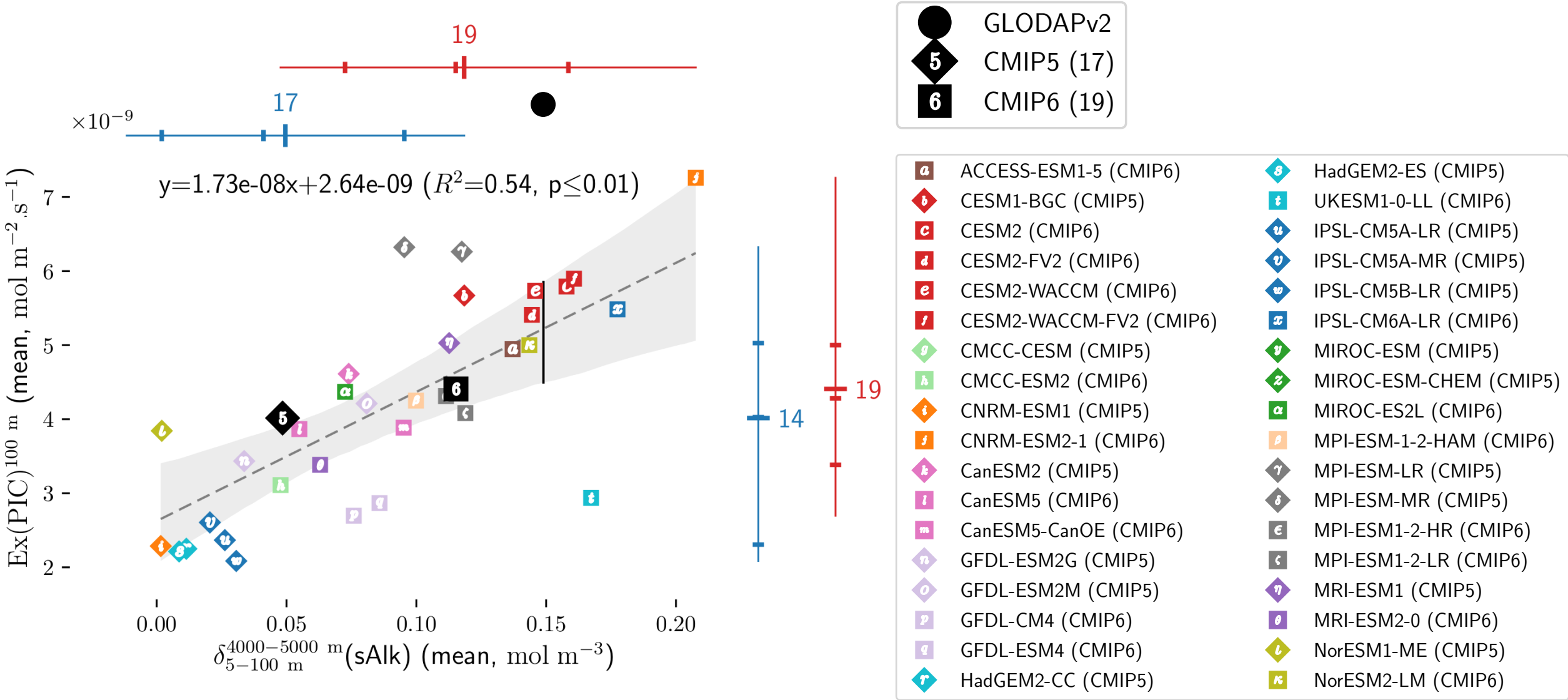


$\text{Ex}(\text{POC})_{\text{calc}}^{100 \text{ m}} (\text{mol m}^{-2} \text{s}^{-1})$



- None of the biogeochemical models represent explicit planktonic calcifiers
- Calcite rather than aragonite

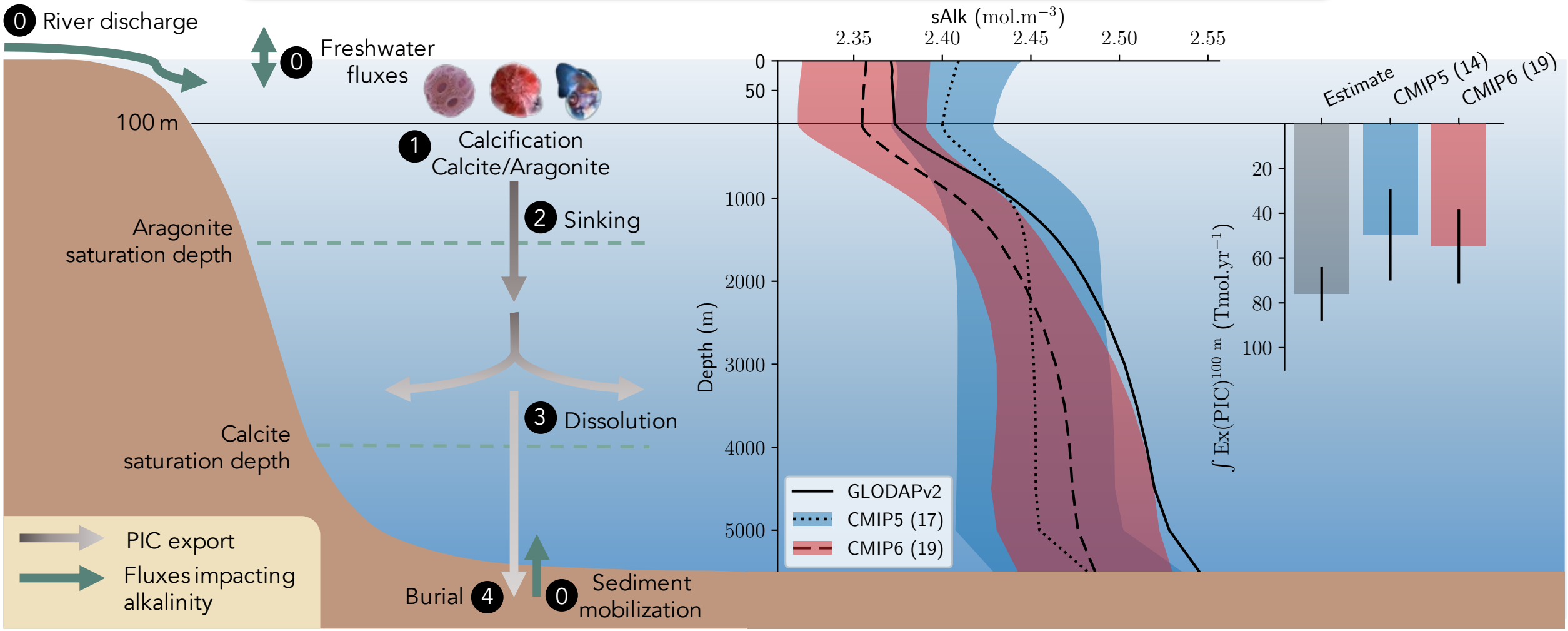
A connection between the PIC export and the vertical sAlk gradient

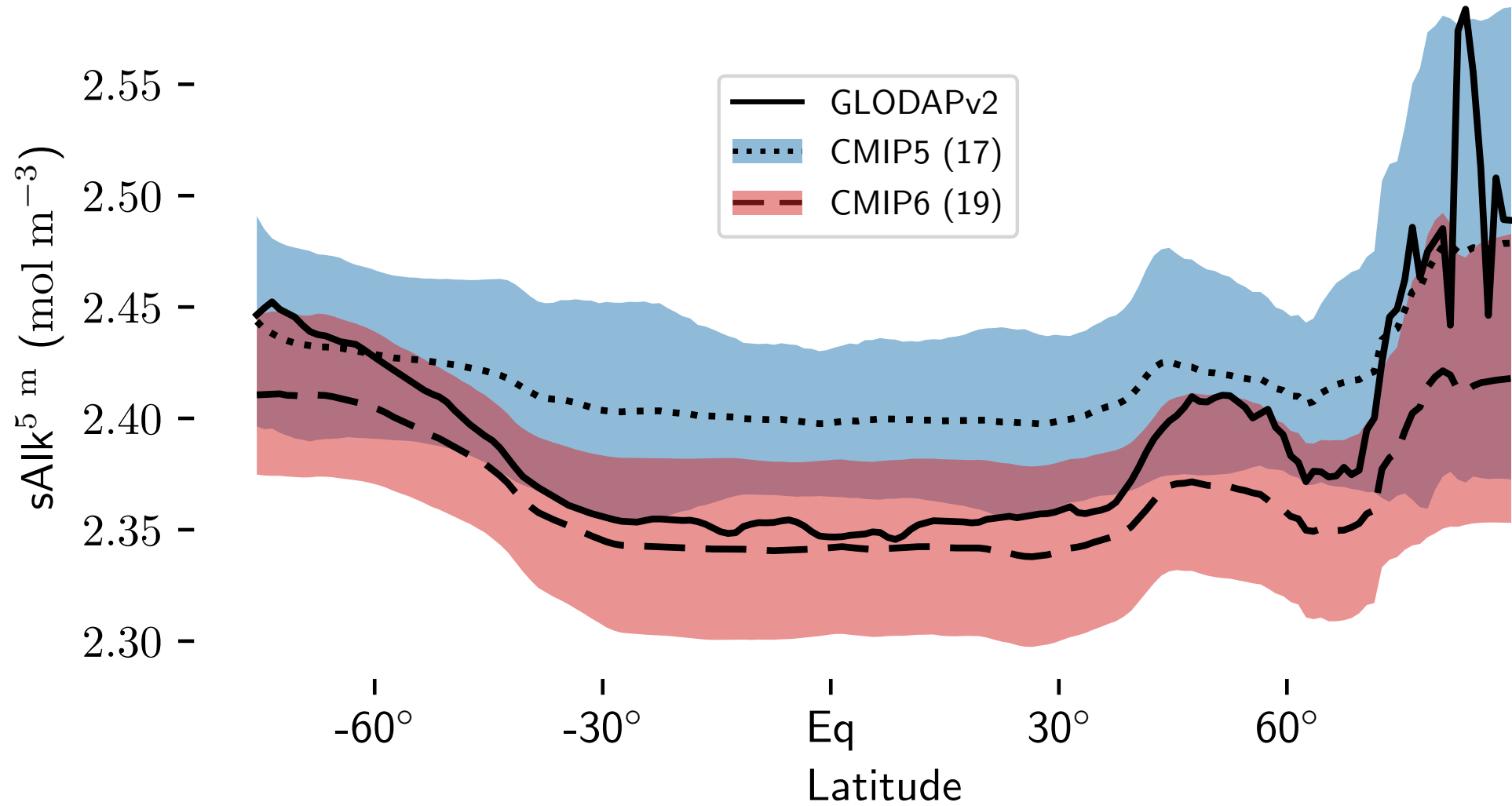


The relationship overpasses the influence of the modelling schemes for CaCO_3 and boundary processes on Alk

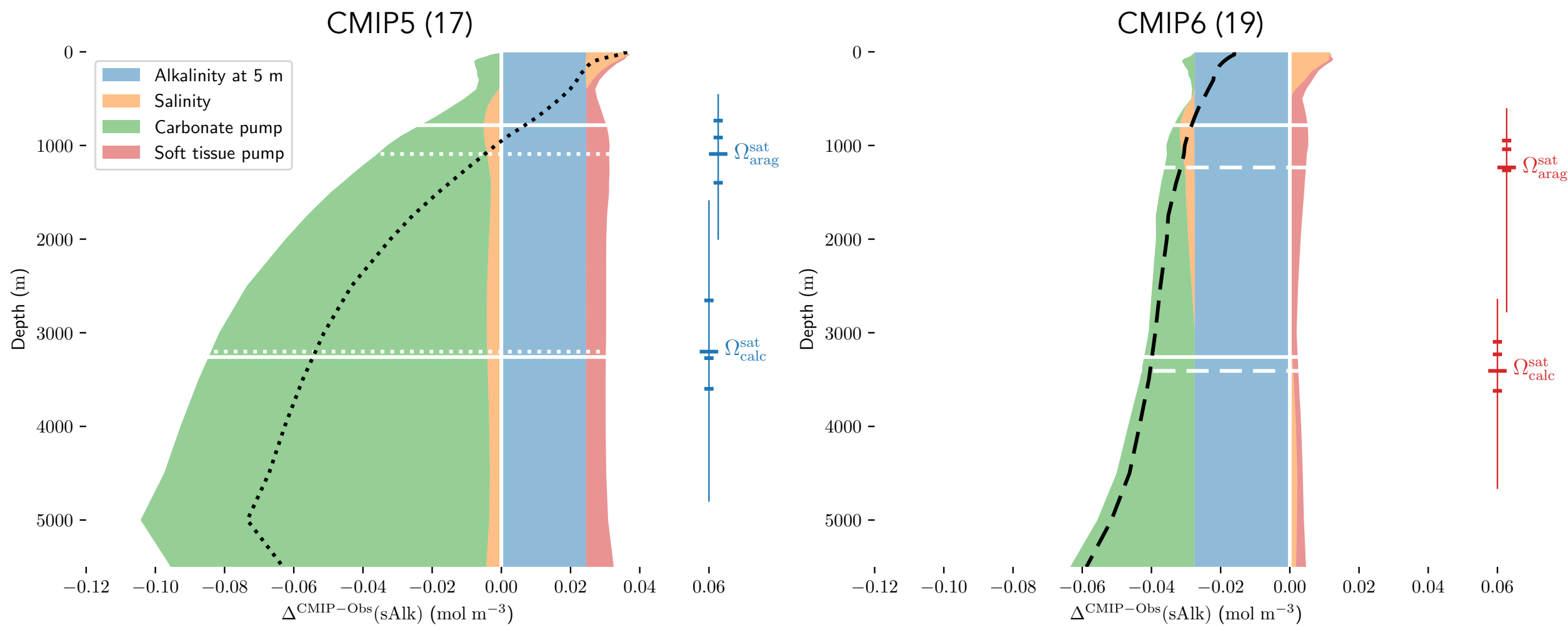


- Sinking and dissolution of PIC can be either explicit or implicit
- Possible coupling with organic matter (sinking and/or dissolution)
- Sparse dependence on the saturation state (production, dissolution, burial)





The carbonate pump enhancement has driven the reduction in the vertical sAlk bias





Take-home message

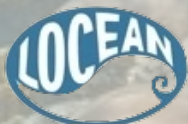
The improvement in the representation of the carbonate pump from CMIP5 to CMIP6 has entailed a reduction of surface and vertical biases of alkalinity (as well as DIC)

STAY TUNED



About to be a master of the representation of the carbonate pump and alkalinity in the biogeochemical models

→ Feel free to come and ask me questions!



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