Polonium-210 and Lead-210 as tracers of particle export and attenuation on the first EXPORTS cruise at Station PAPA

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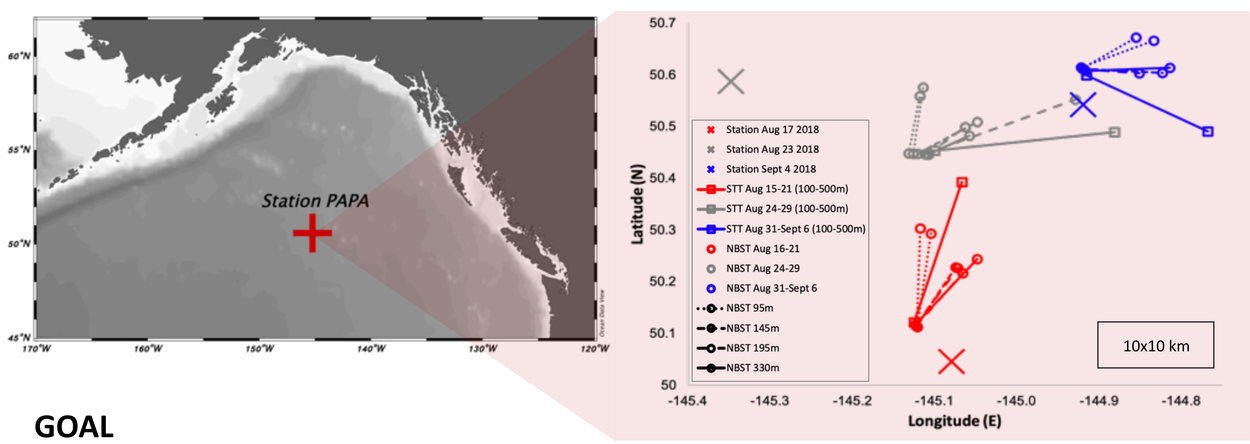
The EXPORTS (EXport Processes in the Ocean from RemoTe Sensing) Program focuses on linking remotely sensed properties to the processes that control the export of ocean primary production from surface waters to depth. Here we present preliminary results from the naturally-occurring radionuclide pair ^{210}Po/^{210}Pb as part of the first NASA supported EXPORTS cruise in the NE Pacific at Station PAPA (August-September 2018). ^{210}Po and ^{210}Pb have been used to quantify sinking particle fluxes and their attenuation below the euphotic zone at a seasonal scale. These estimates will be compared to other methods with shorter time scales, ^{234}Th (weeks) and sediment traps (days), with the aim to provide a wider perspective into particle export and remineralization in the upper 500 m of the water column. Remarkable consistency between seawater profiles of ^{210}Po and ^{234}Th sampled over a period of three weeks suggests that the variability in the processes that lead to particle flux was relatively small over the summer. Particulate Carbon (PC) fluxes have been estimated using the PC/^{210}Po ratio on size-fractionated particles collected using in-situ pumps. Overall, we show low PC export fluxes (< 5 mmol C m^{-2} d^{-1}) at 100 m decreasing rapidly below the well-lit surface ocean.

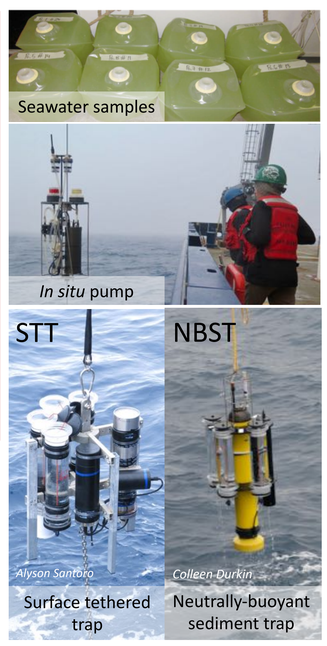


GOAL

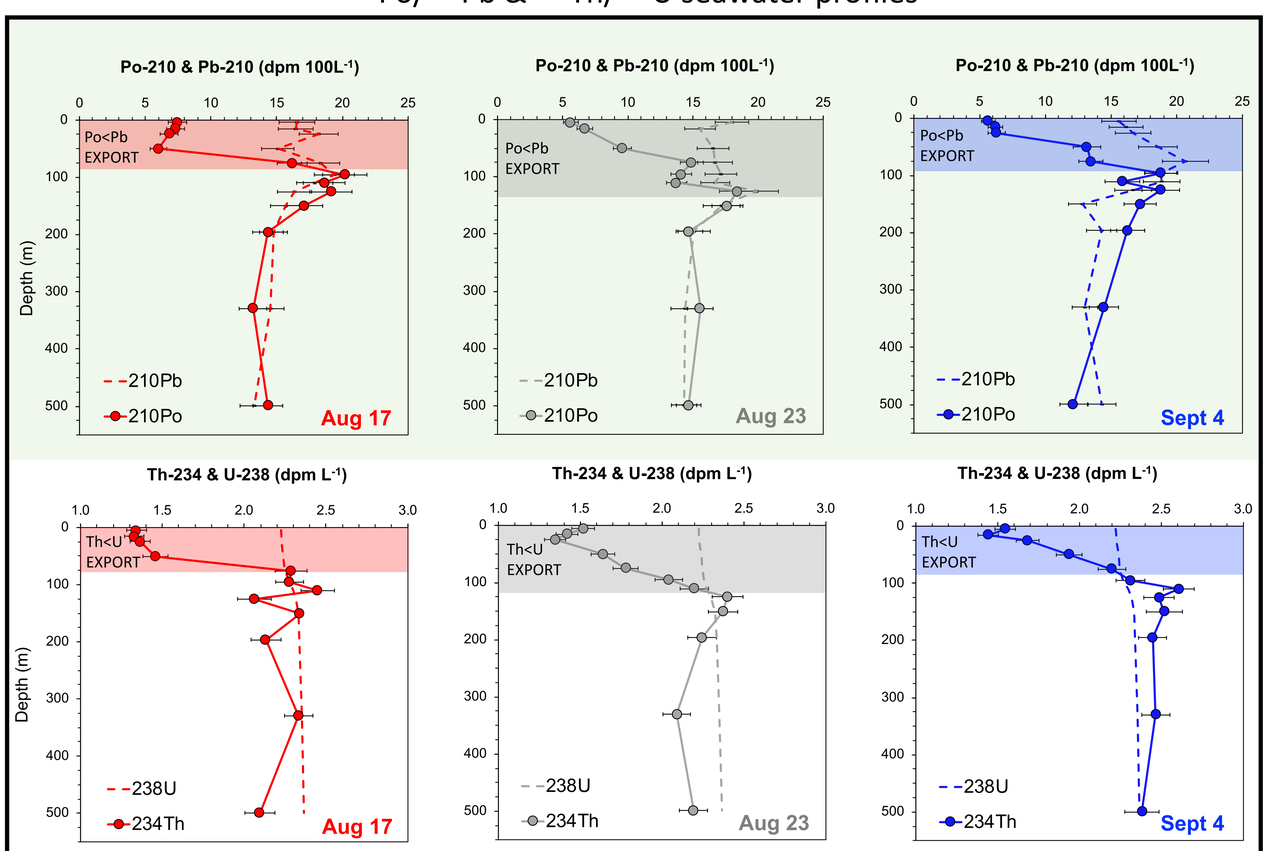
Provide quantitative **estimates of sinking particle fluxes and attenuation** with depth integrating a seasonal time scale (^{210}Po half-life = 138 days)

TYPE OF SAMPLES

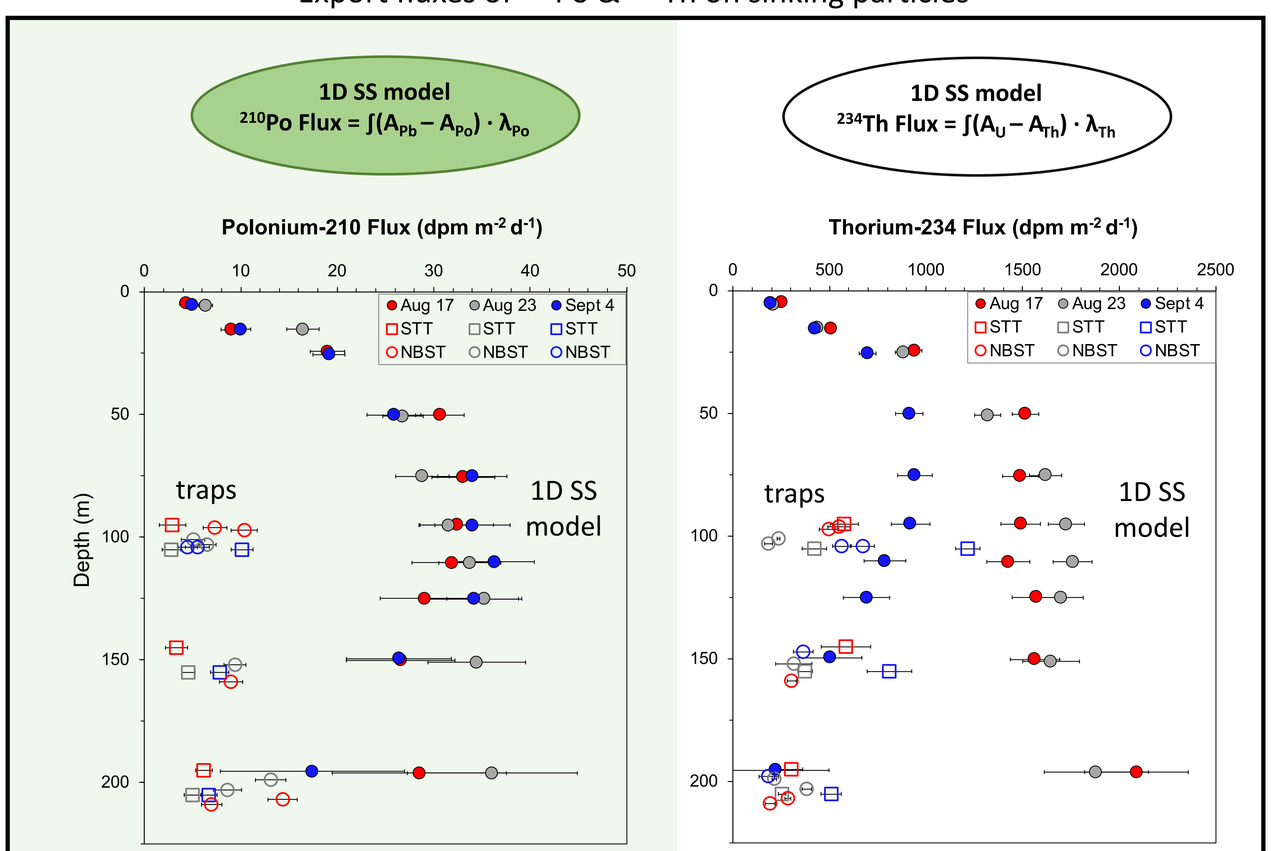
- 3 seawater profiles
- Sized-fractionated (1-5, 5-51, >51 µm) particles (in *situ* pumps)
- Sinking particles (sediment traps)



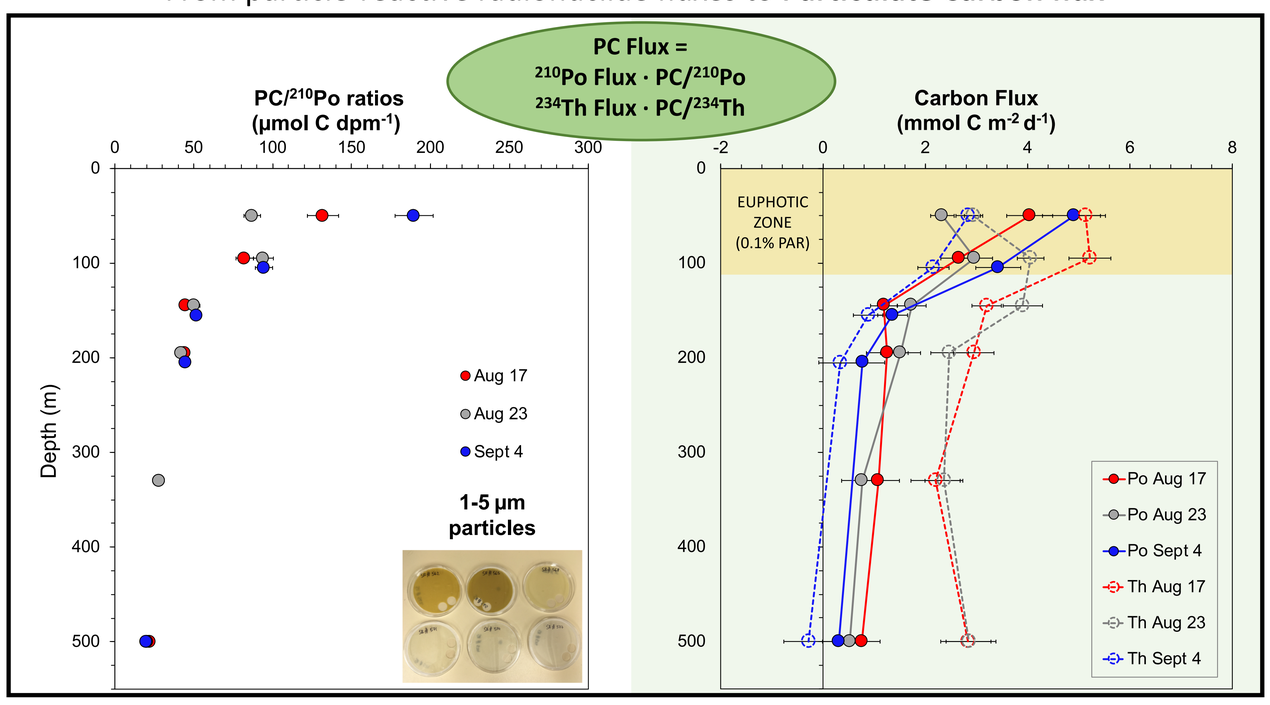
^{210}Po/^{210}Pb & ^{234}Th/^{238}U seawater profiles



Export fluxes of ^{210}Po & ^{234}Th on sinking particles



From particle-reactive radionuclide fluxes to **Particulate Carbon flux**



CONCLUSIONS

- ✓ Similar export depth for ^{210}Po and ^{234}Th (surface to 75-125 m) where Po<Pb and Th<U
- ✓ Low ^{210}Po fluxes were constant during 3 weeks
- ✓ The drop in ^{234}Th flux on September 4th may indicate a recent decrease in particle export and increase in flux attenuation at this station
- ✓ ^{210}Po fluxes derived from the water column were at least 3 times higher than those measured with both trap designs
  - ✓ Non-steady state & physical mixing not included in ^{210}Po model
  - ✓ Does a single profile match particle source funnel for traps?
  - ✓ Loss of particles attached to zooplankton when picking swimmers?
  - ✓ Due to zooplankton diel vertical migration (particle removal in surface and release at depth)?
- ✓ Particulate Carbon (PC) flux at the base of the euphotic zone (110 m = 0.1% PAR) was ≈ 3 mmol C m^{-2} d^{-1} in good agreement with ^{234}Th estimates (2-5 mmol C m^{-2} d^{-1})
- ✓ Rapid decrease in PC fluxes below the euphotic zone leading to fluxes < 1 mmol C m^{-2} d^{-1} at 500 m
- ✓ The attenuation of PC fluxes between 100 and 500 m was 82 ± 8%
- ✓ Future work: quantify PIC, PN and bSi fluxes and explore what we can learn from different methods

Acknowledgements

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