

Test script

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This chapter explains how to examine the scavenging script in NEMO model.

1 INPUT SOURCES

The scavenging model follows the equation below:

$$\frac{X_d(t, z) - X_d(t - \Delta t, z)}{\Delta t} = Q - k \times X_d(t, z) + k_{-1} \times X_p(t, z) \quad (1.1)$$

$$\frac{X_p(t, z) - X_p(t - \Delta t, z)}{\Delta t} = k \times X_d(t, z) - k_{-1} \times X_p(t, z) + s \times \frac{X_p(t, z) - X_p(t, z - \Delta z)}{\Delta z} \quad (1.2)$$

In the Arctic, if the tracers start from zero concentrations, it takes ^{231}Pa more than 70 years and ^{230}Th approximately 5 years to reach steady state, which means to get the initial condition by spinning the model for years is unrealistic (or 'time consuming'? which word is better?). Therefore the initial conditions will generate from observation.

Due to relatively few dissolved and particulate ^{230}Th and ^{231}Pa observation for the Arctic and the fact that stations of total ^{230}Th and ^{231}Pa data locates mainly in Canda Basin and Makarov Basin - somewhere the dissolved and particulate dataset lacks, we included total ^{230}Th and ^{231}Pa concentration data for the initial condition. To extract dissolved and particulate information from total ^{231}Pa (^{230}Th) data, we assume the dissolved phase takes up 90% of the total and the particulate phase accounts for 10%.

Table 1.1: Station Locations, Calculated Sinking rates and C_1 (^{231}Pa)

Cruise	Station	Sinking rate	$e_{Sinking}$	C_1	e_{C_1}
1991 ARCTIC EXPEDITION	stn1	1322.4m/yr	730.1m/yr	0.28×10^{-2}	0.18×10^{-2}
1991 ARCTIC EXPEDITION	stn2	1302.1m/yr	274.5m/yr	0.52×10^{-2}	0.32×10^{-2}
1991 ARCTIC EXPEDITION	stn3	1269.1m/yr	544.2m/yr	0.59×10^{-2}	0.08×10^{-2}
1991 ARCTIC EXPEDITION	stn4	1731.1m/yr	516.8m/yr	0.45×10^{-2}	0.11×10^{-2}
1991 ARCTIC EXPEDITION	stn6	641.1m/yr	815.1m/yr	0.69×10^{-2}	1.00×10^{-2}

2 INTERPOLATION

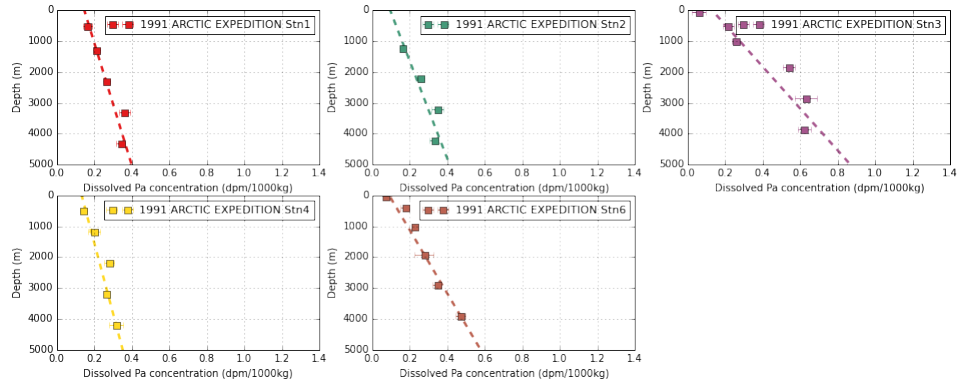
Before horizontal interpolation, linear vertical interpolations were generated in order to obtain interpolated values at the same depth as our model grid (Figure 2.1).

The horizontal interpolations⁵ were executed based on model grid that has a horizontal resolution of $\frac{1}{4} \times \frac{1}{4}$. Results were shown in figure 2.2.

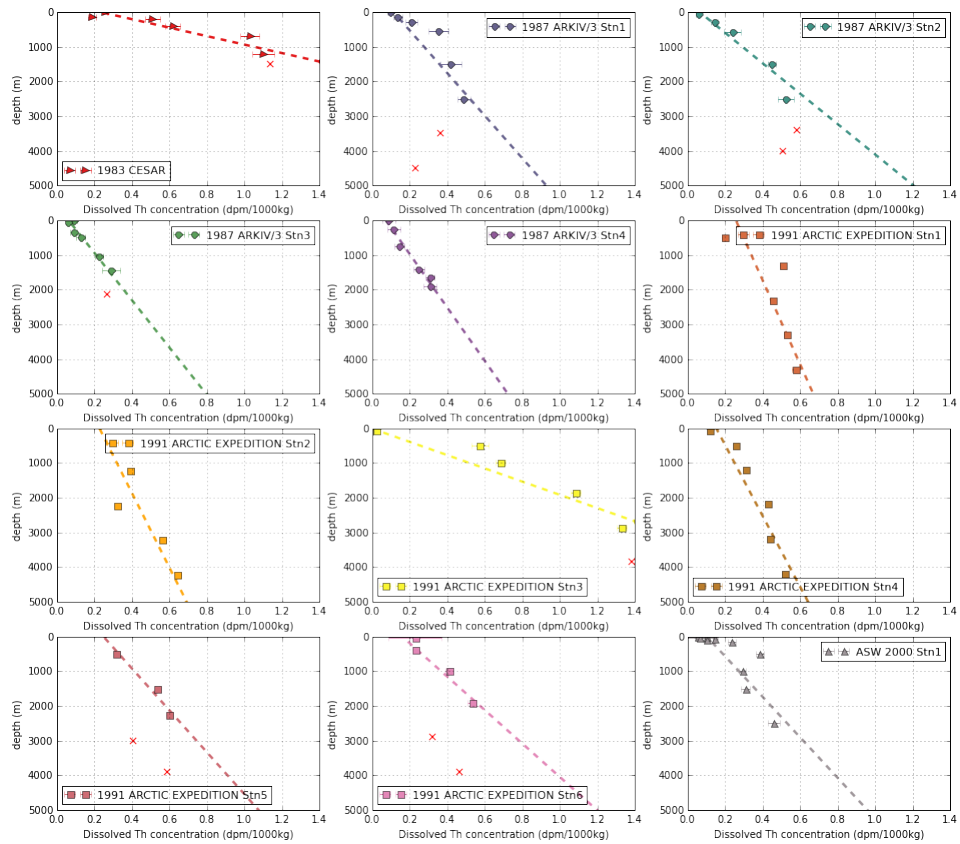
REFERENCES

[Clegg, S. L., Bacon, M. P. (1991)] Application of a generalized scavenging model to thorium isotope and particle data at equatorial and high latitude sites in the Pacific Ocean. *Journal of Geophysical Research: Oceans* (1978-2012), 96(C11), 20655-20670.

⁵The interpolation used PyKrig 0.1.2 Python package.

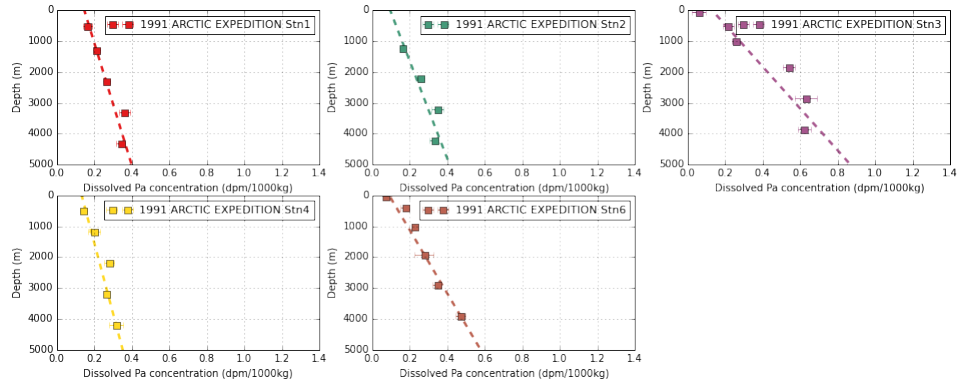


(a) ^{231}Pa dissolved data

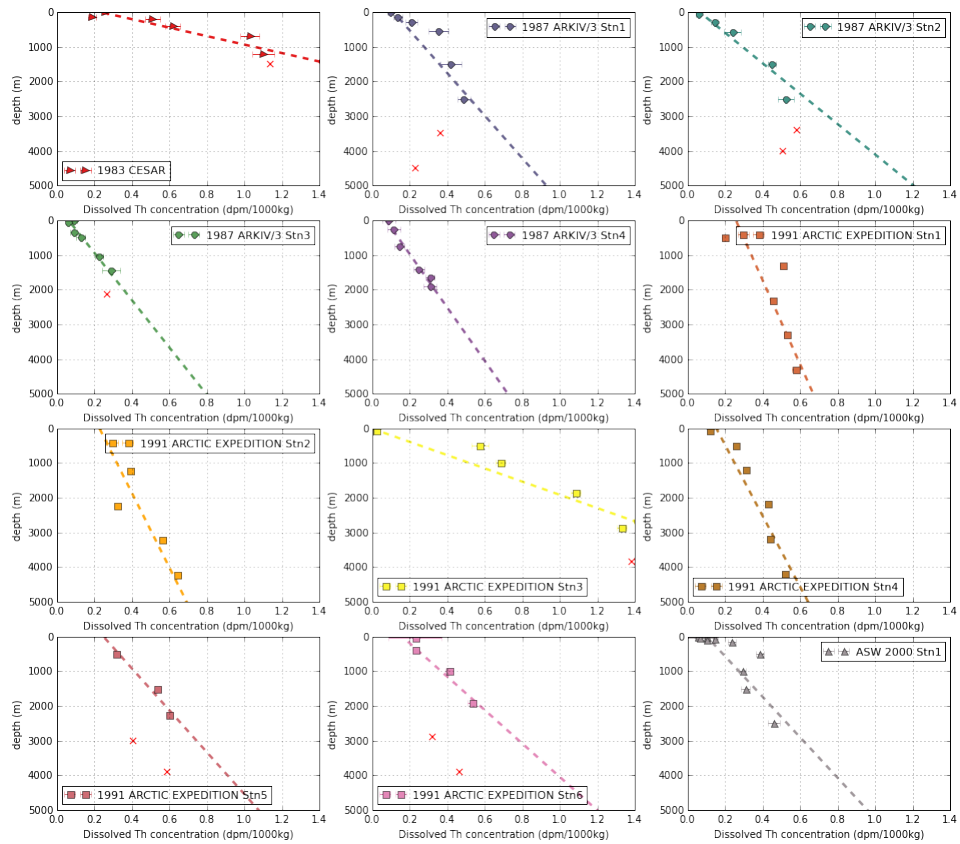


(b) ^{230}Th dissolved data

Figure 2.1: The points are the observed data and the lines are given by the linear interpolation. Interpolated results that hit the sea floor are masked.



(a) ^{231}Pa dissolved data



(b) ^{230}Th dissolved data

Figure 2.2: The points are the observed data and the lines are given by the linear interpolation. Interpolated results that hit the sea floor are masked.