Equation of State

The "in situ" density of the model is defined from the following polynomial from Jackett & McDougal:

$$\rho_i = \frac{Bpoly(T,S)}{Cpoly(T,S,Z)} - 1000$$

where

$$\begin{aligned} Apoly(T,S,Z) = {} & a_0 + a_1 T + a_2 T^2 + a_3 T^3 + a_4 T^4 + \\ & b_0 S - b_1 TS + b_2 T^2 S - b_3 T^3 S + \\ & d_0 S^{3/2} + d_1 S^{3/2} T - d_2 S^{3/2} T^2 + \\ & - e_0 Z + e_1 ZT + e_2 ZT^2 - e_3 ZT^3 + \\ & - f_0 ZS - f_1 ZST - f_2 ZST^2 + \\ & - g_0 ZS^{3/2} + g_1 Z^2 - g_2 Z^2 T + g_3 Z^2 T^2 + \\ & h_0 Z^2 S + h_1 Z^2 ST + h_2 Z^2 ST^2 \end{aligned}$$

$$\begin{aligned} Bpoly(T,S) = {} & q_0 + q_1 T + q_3 T^2 + q_4 T^3 + q_5 T^4 + q_6 T^5 + \\ & u_0 S + u_1 ST + u_2 ST^2 + u_3 ST^3 + u_4 ST^4 + \\ & v_0 S^{3/2} + v_1 S^{3/2} T + v_2 S^{3/2} T^2 + \\ & w_0 S^2 \end{aligned}$$

$$Cpoly(T,S,Z) = 1 + \frac{0.1\, Z}{Apoly(T,S,Z)}$$

The vertical derivative of density can be obtained by differentiating

$$\frac{\partial \rho_i}{\partial Z} = \frac{- Bpoly * [0.1\, Apoly - 0.1\, Z\, Dpoly]}{(Apoly * Cpoly)^2}$$

where

$$\begin{aligned} Dpoly(T,S,Z) \equiv \frac{\partial (Apoly)}{\partial Z} = {} & - e_0 + e_1 T + e_2 T^2 - e_3 T^3 \\ & - f_0 S - f_1 ST - f_2 ST^2 \\ & - g_0 S^{3/2} + 2 g_1 Z - 2 g_2 ZT + 2 g_3 ZT^2 \\ & + 2 h_0 ZS + 2 h_1 ZST + 2 h_2 ZST^2 \end{aligned}$$