Equations for model

1) Primary productivity (source: adapted from Gabric et al 2004)

$\frac{dP}{dt} = P(\mu - \chi)(1 - P_{ice})$ where P_{ice} = proportional ice cover

μ = growth rate = $\mu_0 R_L R_T$

μ_0 = base growth rate = 0.79

R_L = light correction factor = $\frac{\frac{I}{I_k}}{\sqrt{1+\frac{I}{I_k}^2}}$

I_k = saturating light intensity

I = current percieved light intensity (PAR) = $I + \Delta F$ where F is forcing (see below)

Conversion factor from PAR in W/m^2 (in forcing equation) to Einsteins/m^2/day (in OceanColor database):

$1 Wm^{-2}$ = 4.6 $\mu Em^{-2}s^{-1}$

R_T = $e^{0.063(T-T_{max})}$

T = current mixed layer temperature

T_{max} = maximum annual mixed layer temperature

2) DMS concentration

In this model, DMS is directly proportional to primary productivity, given by a scaling factor which I choose so that the resulting concentration ranges match observed concentrations

$\frac{dDMS}{dt} = \gamma \frac{dP}{dt}$, $\gamma = 1.5$

3) DMS flux

I use the transfer velocity (k_w) calculations given by Liss and Merlivat (1986):

$Flux_{DMS} = k_w [DMS]$

where:

w = windspeed (m/s)

$k_w = \alpha 0.17w$ for $w \leq 3.6$

$k_w = \beta(2.85w - 10.3) + 0.61\alpha$ for $3.6 < w \leq 13$

$k_w = \beta(5.9w - 49.9) + 0.61\alpha$ for $w > 13$

$\alpha = (600/Sc)^{2/3}$

$\beta = (600/Sc)^{1/2}$

Where Sc is the Schmidt number, which depends on sea surface temperature as follows:

$Sc = 2674.0 - 147.12(SST) + 3.726(SST)^2 - 0.038(SST)^3$

4) CCN

Base numbers of CCN for Arctic (initial value): $76cm^{-3}$ (low clouds present) - $250cm^{-3}$ (no low clouds) (Yum 2001) (I plan to get an average initial CCN using percent cloud cover at the start)

Best parametrization I found for effect of DMS flux on CCN:

Woodhouse 2010 - sensitivity parameter .02. (.02% change in CCN for 1% change in DMS flux)

$$\frac{\frac{dCCN}{dt}}{CCN} = 0.02\frac{\frac{dFlux_{DMS}}{dt}}{Flux_{DMS}}$$

5) Radiative Forcing

This equation comes from Meskhidze et al (SCIENCE VOL 314 1 DECEMBER 2006)

$\Delta F = \frac{-1}{3} F_{in} A_c R_c (1 - R_c) \Delta N_{db}$

where F_{in} = monthly avg. solar flux, A_c = cloud cover fraction, R_c = cloud albedo, $\Delta N_{db} = \frac{\frac{dCCN}{dt}}{CCN}$

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