# A Lagrangian view of spring phytoplankton blooms

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The basic mechanism behind spring phytoplankton blooms is investigated using a 1-dimensional Lagrangian NPZD model, where the movement and transfers of nutrient parcels are solved by tracking a nitrogen parcel. The Lagrangian framework is useful for understanding how the nitrogen cycle works in the ocean since it naturally follows the movement of materials through the turbulent ocean environment. The model reveals that the onset of spring blooms depends on the cumulative euphotic age, which is the total time that inorganic nutrient is exposed to light before the photosynthetic conversion to phytoplankton biomass. This is regardless of the underlying mechanism, such as critical depth hypothesis or critical turbulence hypothesis. The difference between the two modes lies in how cumulative euphotic age is accumulated and this can be distinguished by examining the cumulative euphotic age spectrum. We further examined the impact of mortality by comparing the model experiments with and without mortality. The cumulative euphotic age necessary for a spring bloom is found to increase, as expected, but the spectral shapes remained similar.

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