The global contribution of diel and seasonal vertical migrants to the biological carbon pump

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Goal: How much carbon is exported and sequestered by the different functional groups performing diel vertical migrations in the pelagic, and by copepods performing seasonal vertical migrations?

Global biological carbon pump: ~10 PgC/yr exported, ~1200 PgC sequestered

Diel Vertical Migration
- Mechanistic food-web model of a pelagic water column
- DVM behavior computed with game theory

Seasonal Vertical Migration
- Focus on 5 species with enough abundance data: Calanus finmarchicus, Calanus hyperboreus, Calanoides acutus, Calanoides natalis, Neocalanus tonus

Carbon exported during diapause [gC/m3/day]

Carbon sequestered during diapause [gC/m3/day]

Species    Area [106 km2]  Abundance [#/km2]  Biomass [GgC]  Injection [GgC/yr]  Sequestration [PgC]
C. hyperboreus 16 500 - 11,500 38 - 59 12 - 28 7.5 - 15.5
C. finmarchicus 3.8 15,000 - 40,000 4.9 - 12 2.5 - 7.8 1.2 - 4.0
N. tonus 6.57 5,000 - 37,000 19 - 26 17 - 34 2.7 - 7.5
C. acutus 30.7 800 - 1,300 6 - 19 4 - 14 1.5 - 6.8
C. natalis 0.69 15,000 - 127,500 1.1 - 4.4 0.3 - 1.4 0.1 - 0.7

Conclusion
- Fish are responsible for ~12% of total carbon export, and ~30% of total carbon sequestration
- Fish are very important to the biological carbon pump!
- Diapausers export relatively little carbon, but they sequester carbon very efficiently

References: