Incorporating CoSiNE into ROMS (The Official Version?)

Upwelling test cases and comparison with Fasham model and NEMURO

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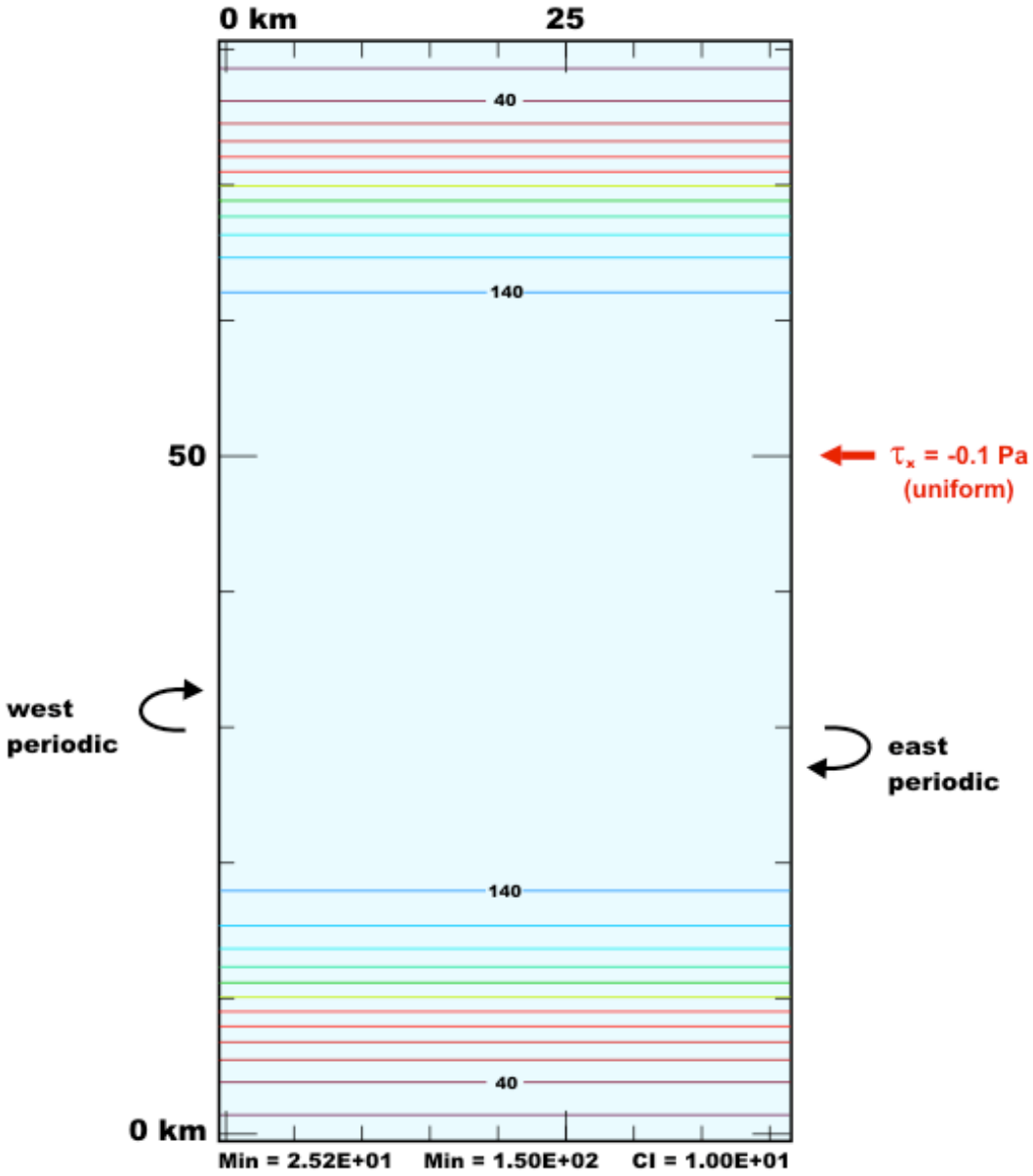
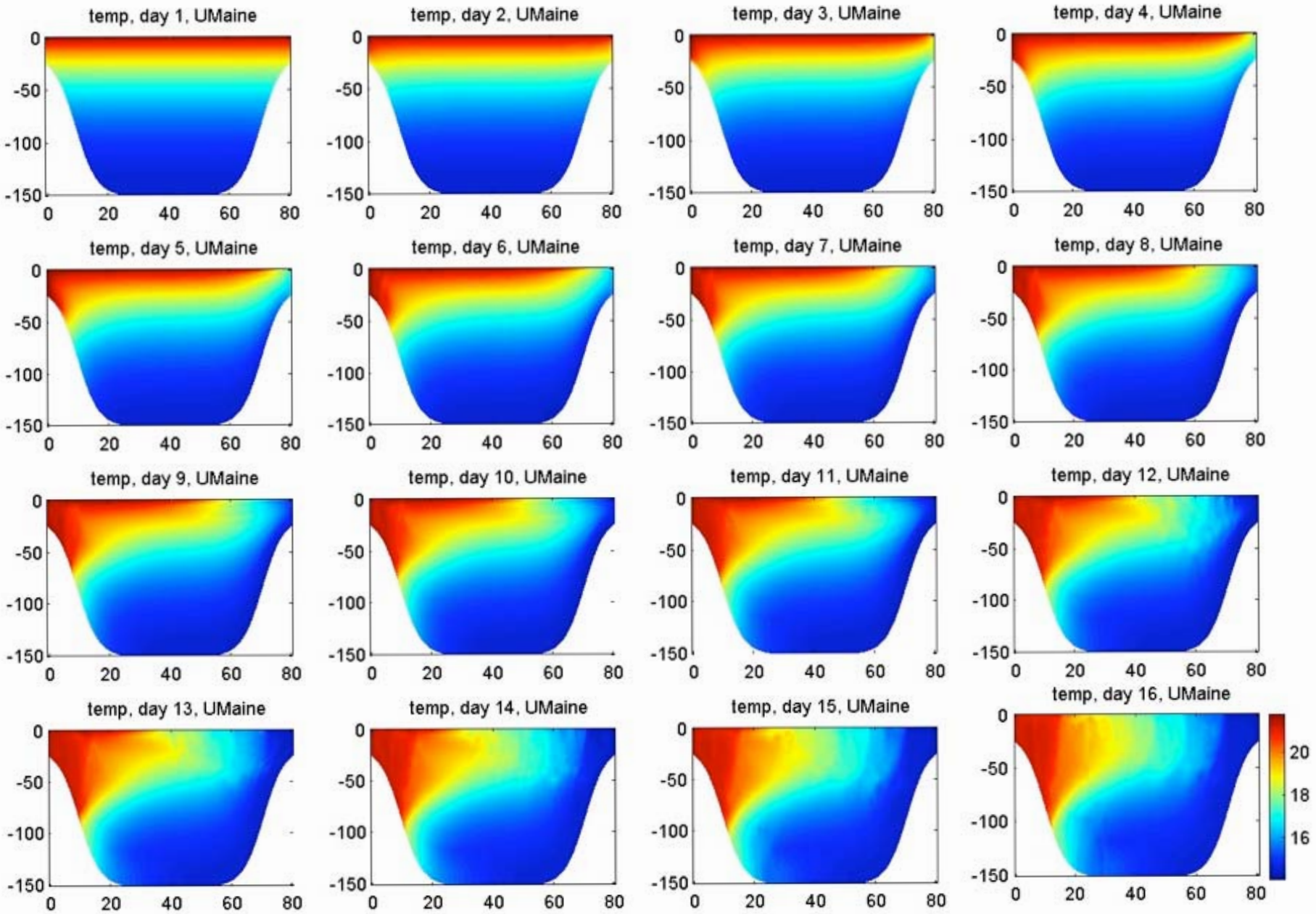
Test case: wind-driven upwelling/ downwelling over a periodic channel

- Domain is a 80 km wide, and 40 km long channel, since case uses a periodic boundary condition, the length of the channel is essentially infinite. https://www.myroms.org/wiki/index.php/UPWELLING_CASE
- The channel is 150 meter deep in the middle, and 25 meter (shallowest) near shore.
- The location of the channel is at 34.5S.
- A spatially uniform winds blowing from east to west at 0.1 N/m^2.
- Short-wave radiation is 150 $Watts/m^2$, (PAR=0.46*150 = 69 W/m^2).

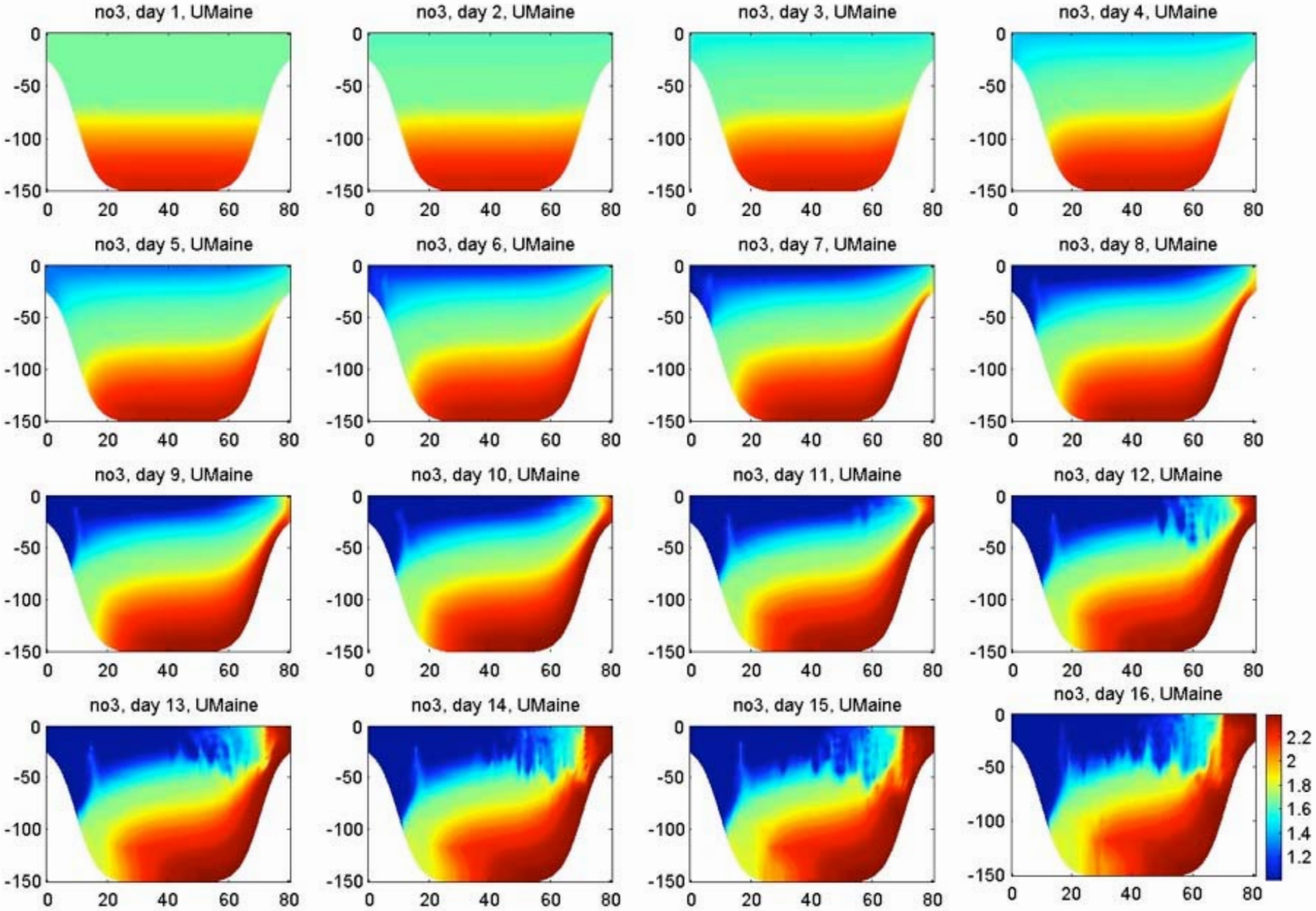
Upwelling test case, model domain and bathymetry



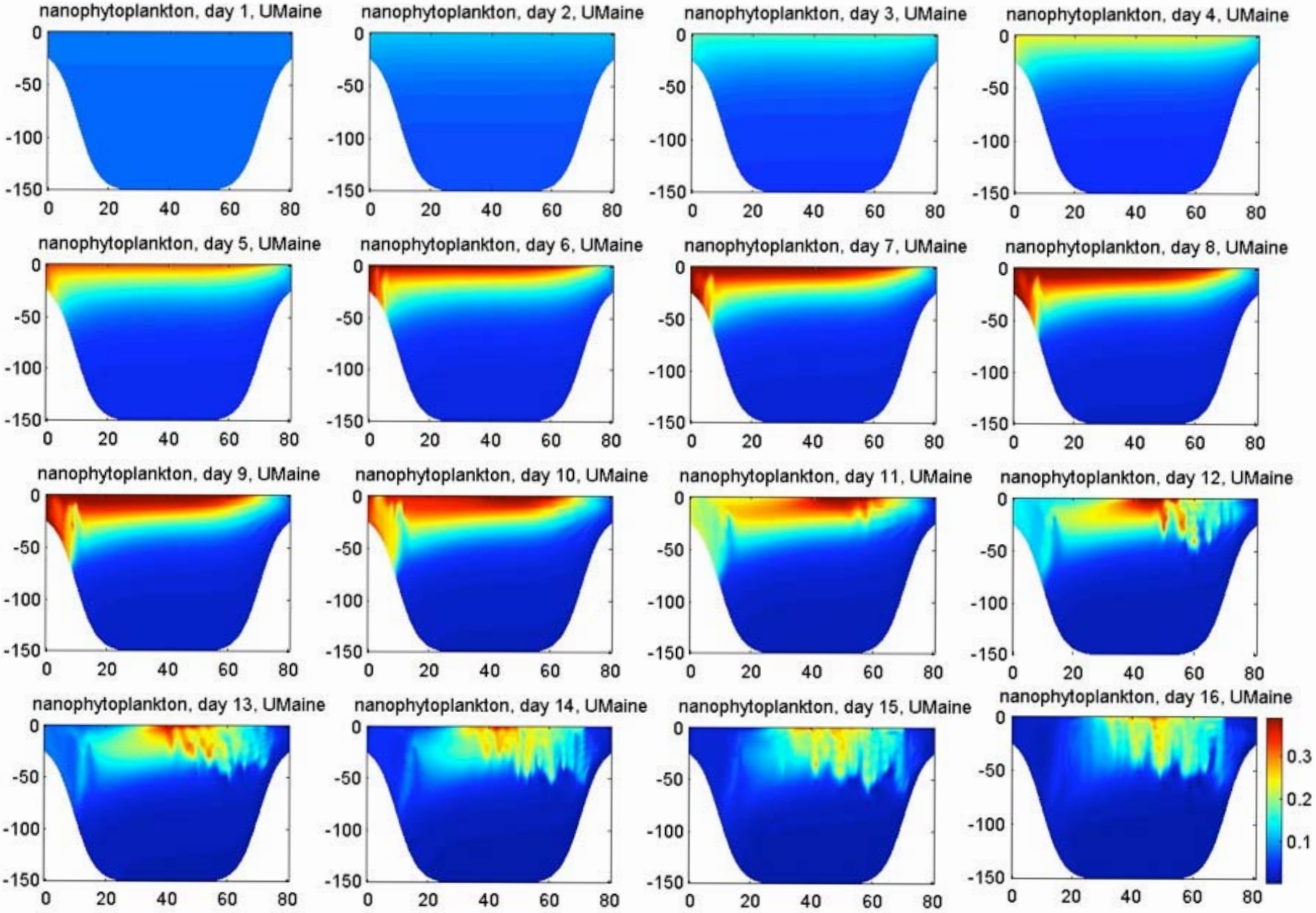
Temperature profiles from day 1 to 16



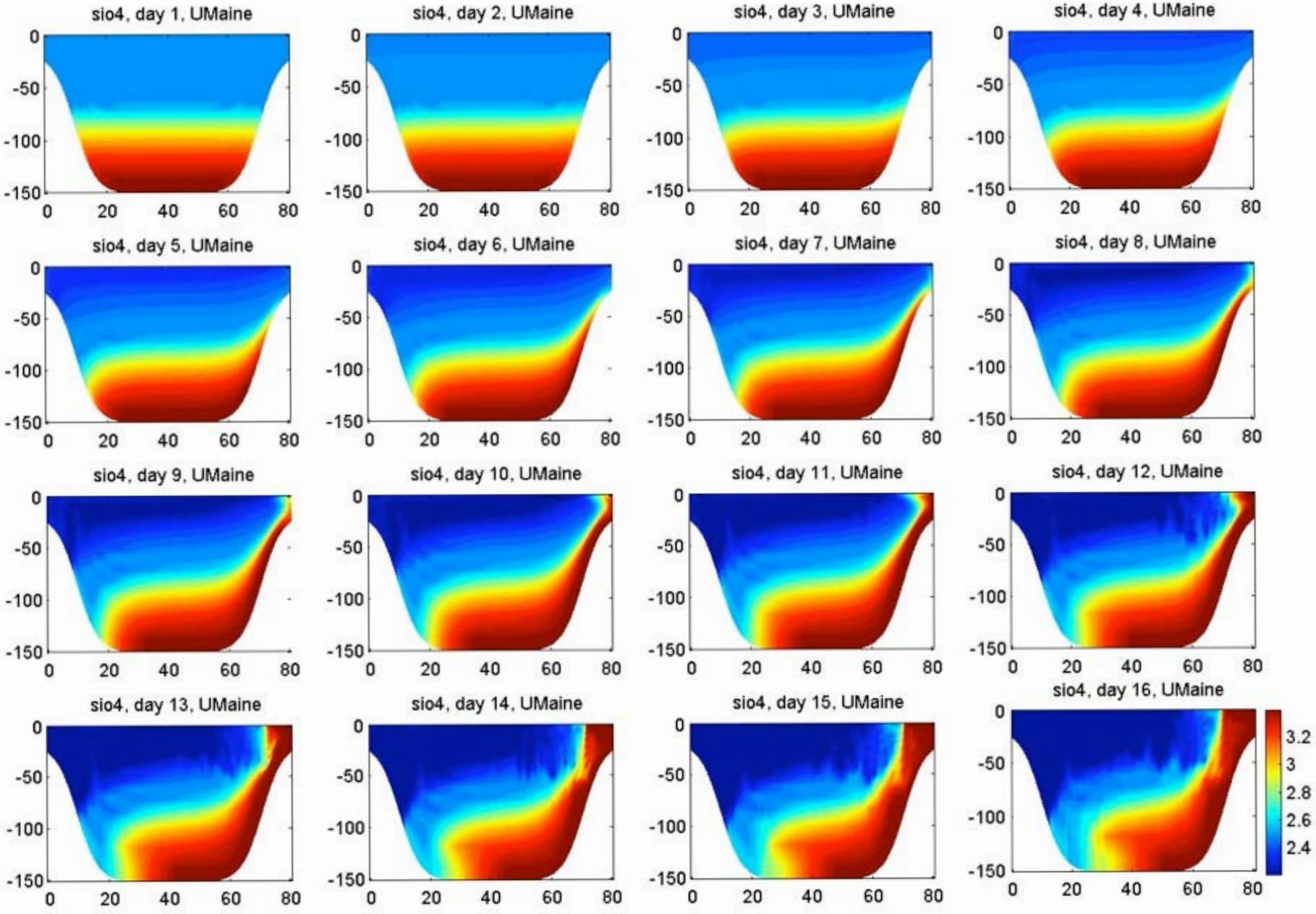
NO3 profiles from day 1 to 16



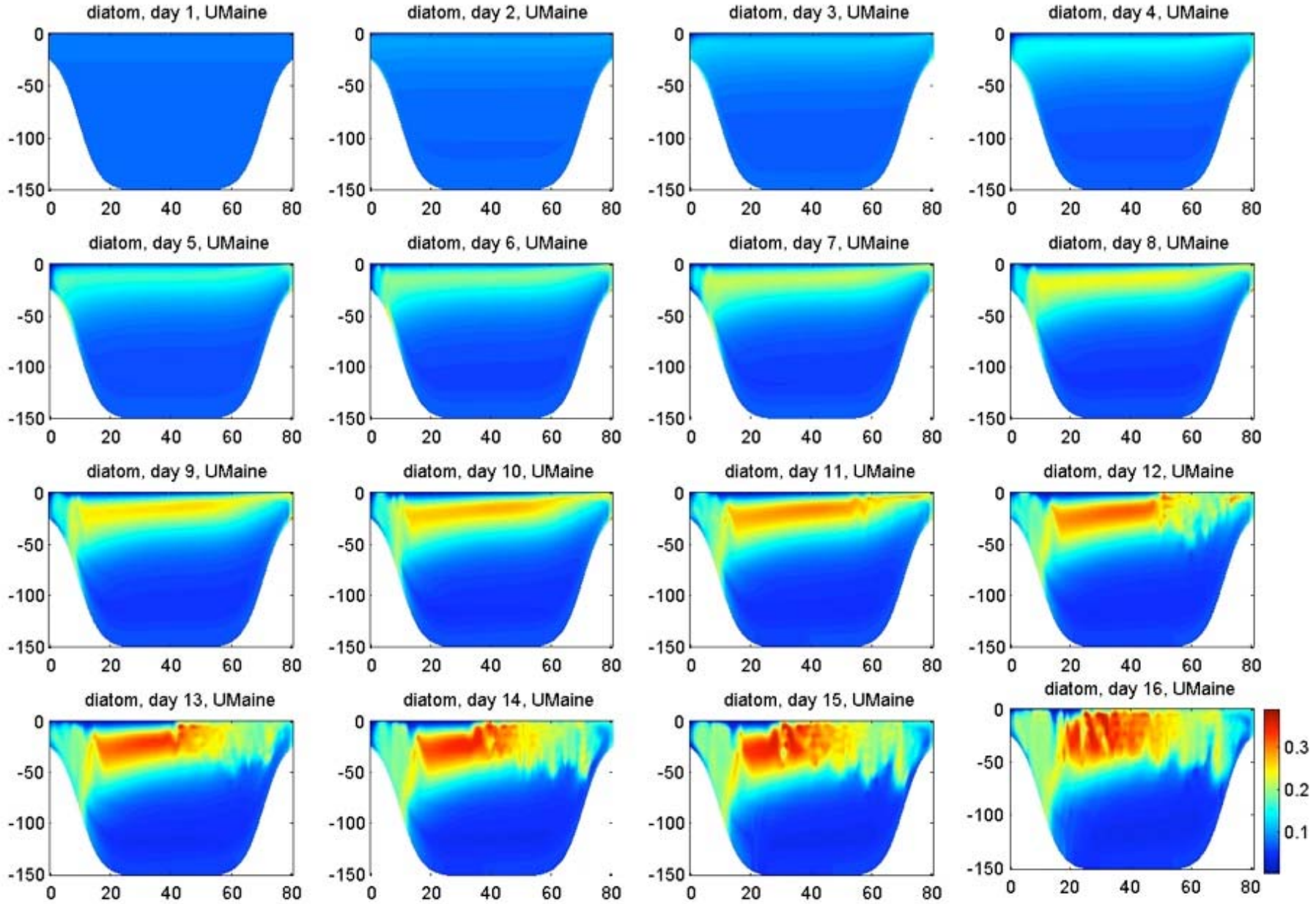
Small phytoplankton from day 1 to 16



Si(OH)4 profiles from day 1 to 16

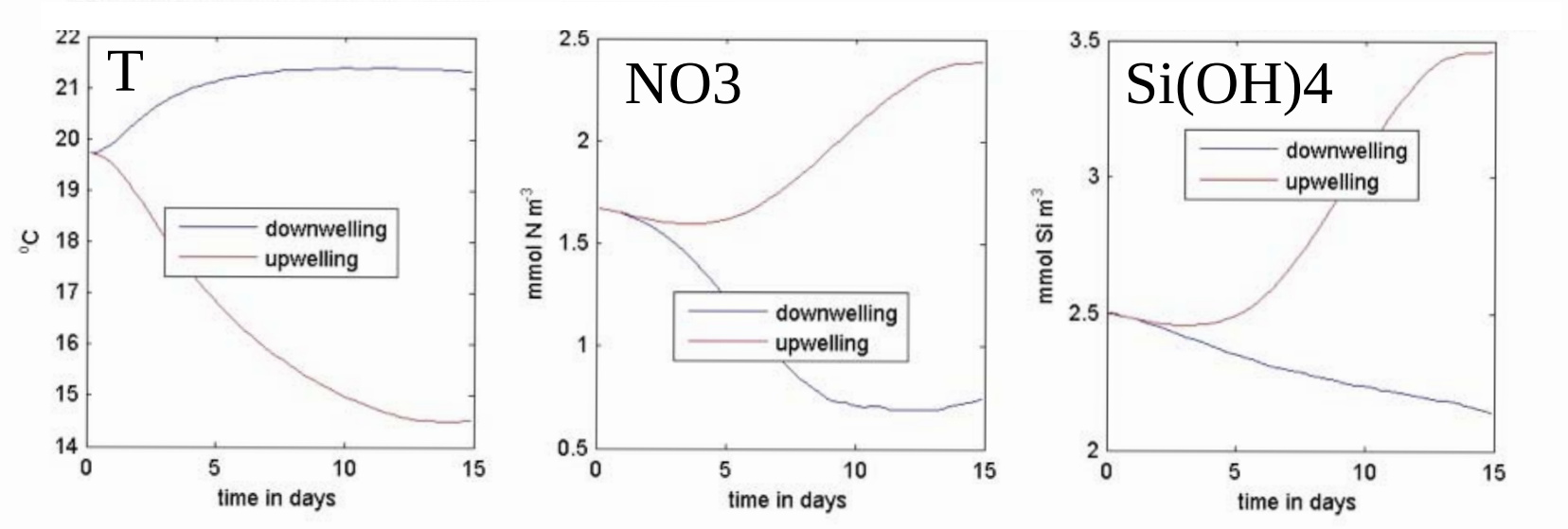


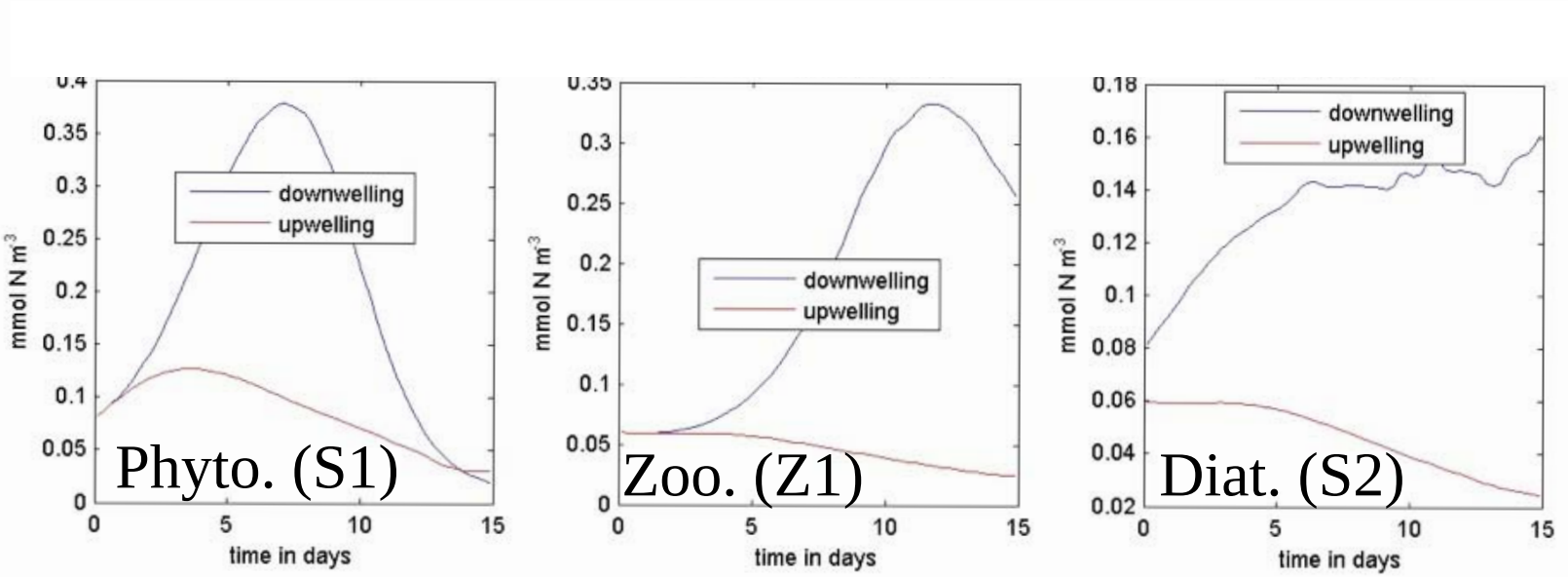
Diatom profiles from day 1 to 16



Time Series of Variables:

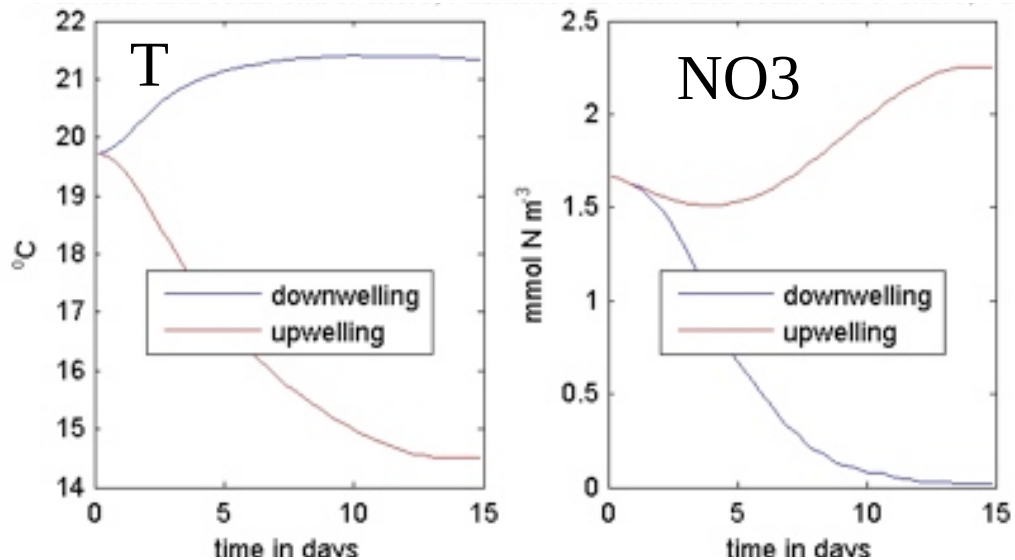
Upwelling and downwelling sides (0-10km, depth averaged)

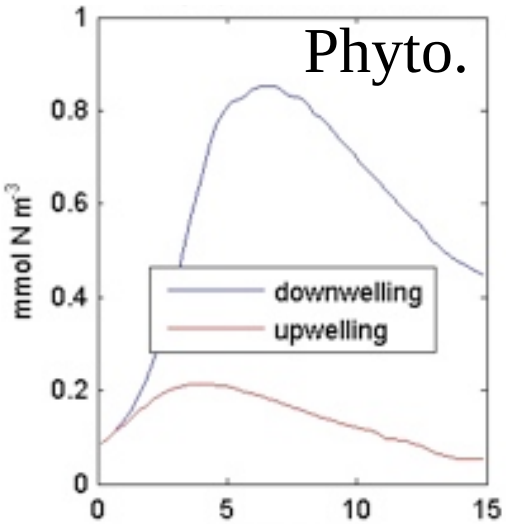


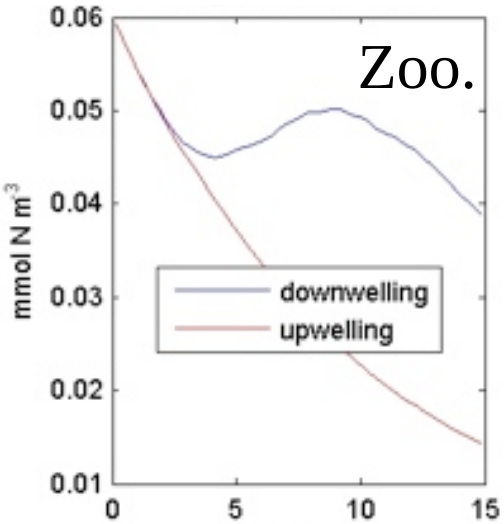


Time Series of Variables (Fasham):

Upwelling and downwelling sides (0-10km, depth averaged)

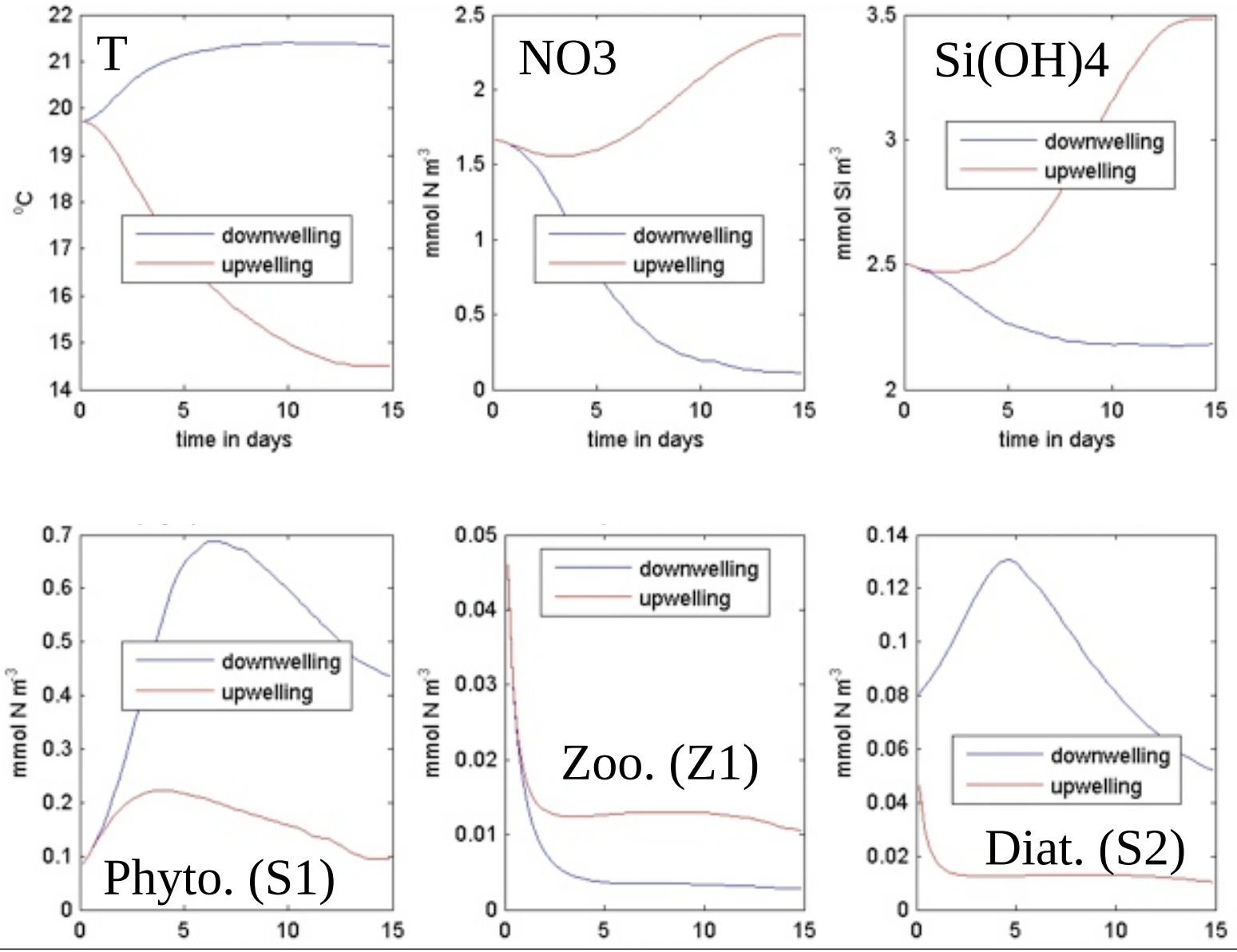






Time Series of Variables (NEMURO):

Upwelling and downwelling sides (0-10km, depth averaged)



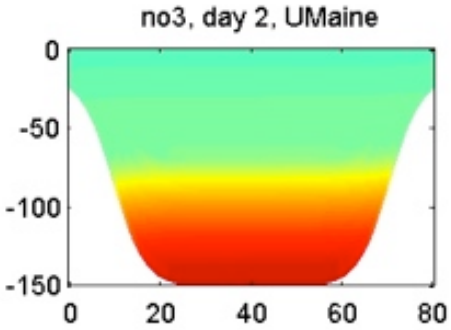
NO3

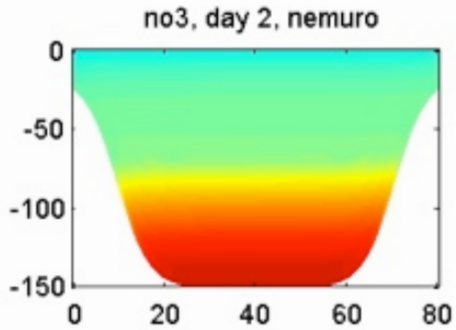
CoSiNE

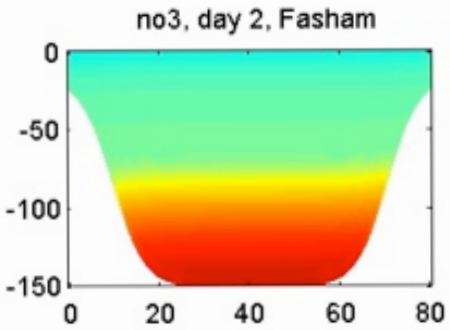
NEMURO

Fasham

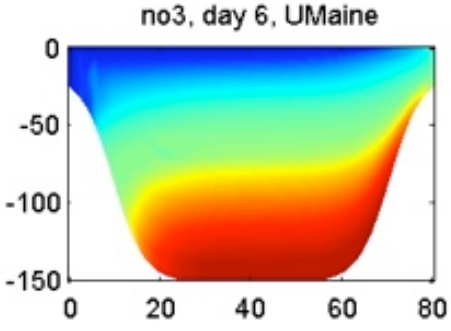
Day 2

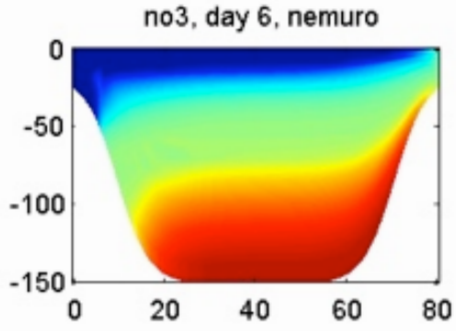


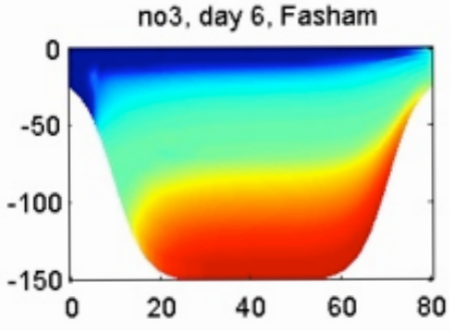




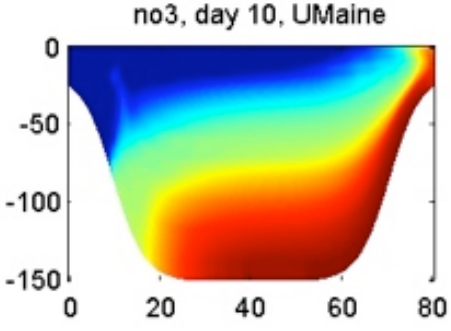
Day 6

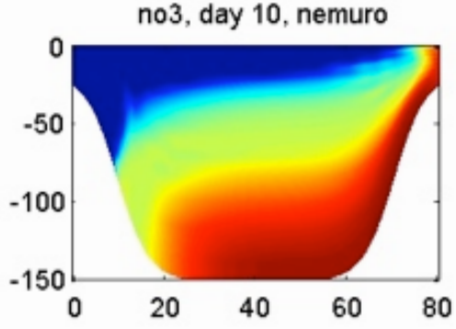


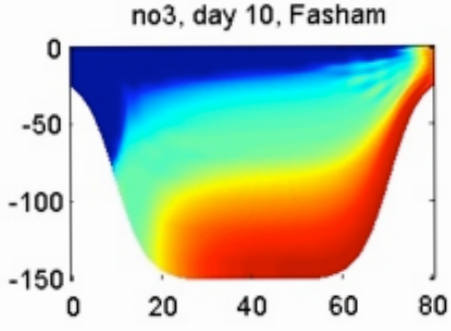




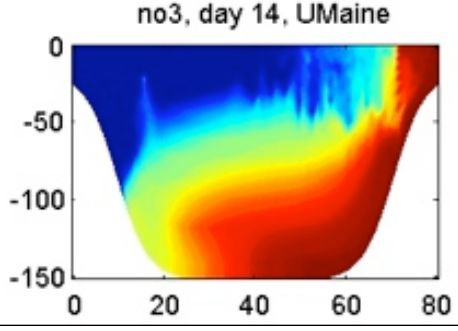
Day 10

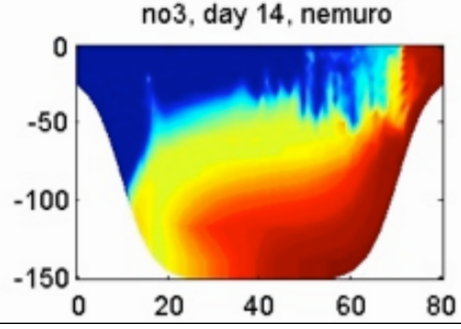


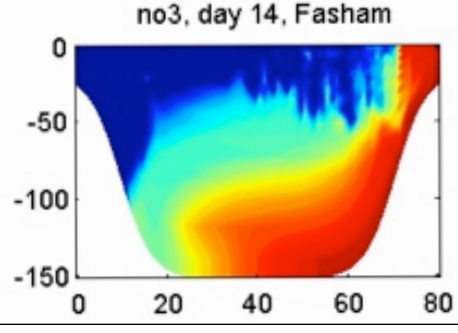




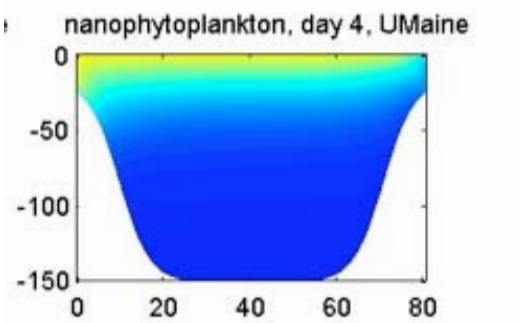
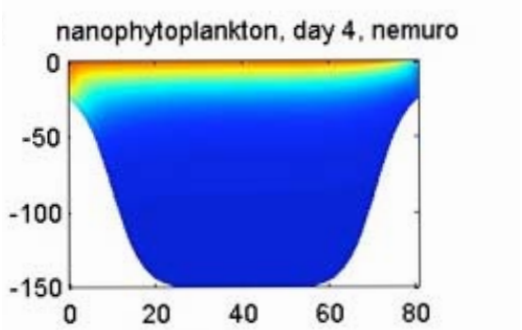
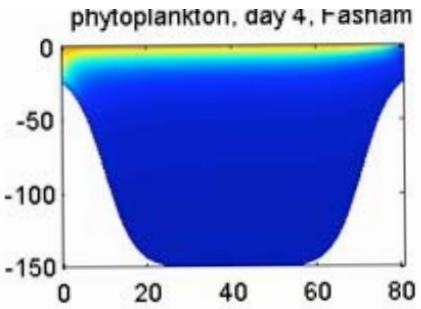
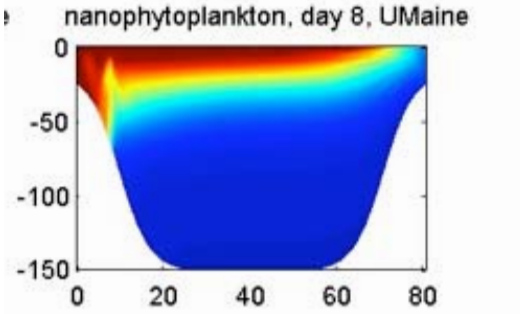
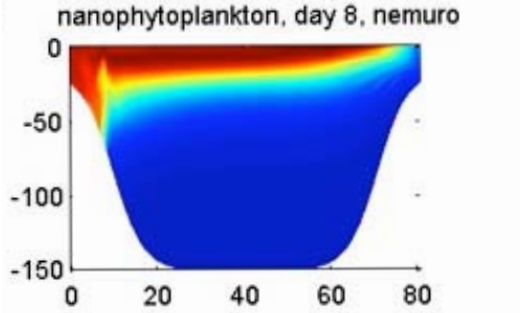
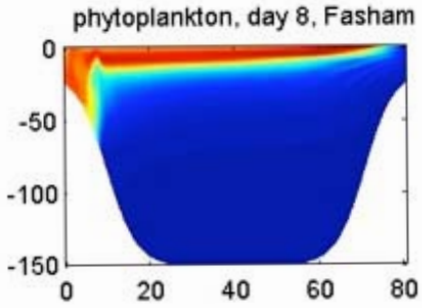
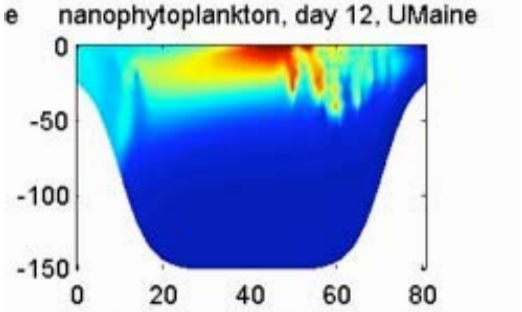
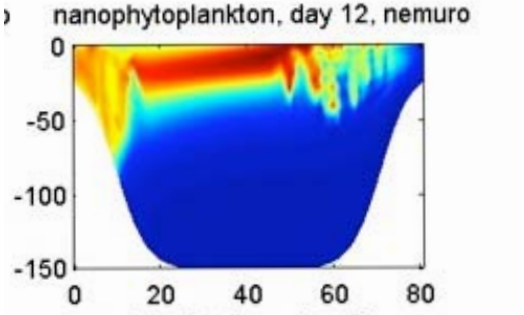
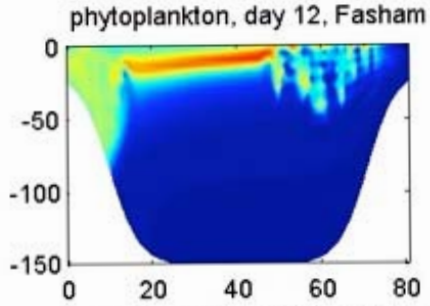
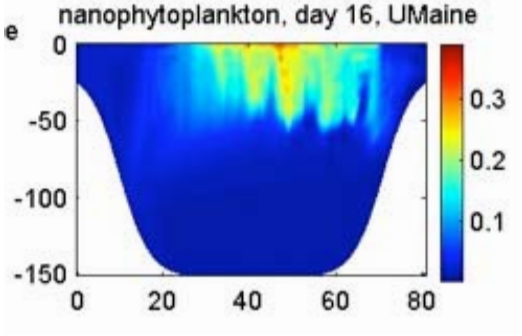
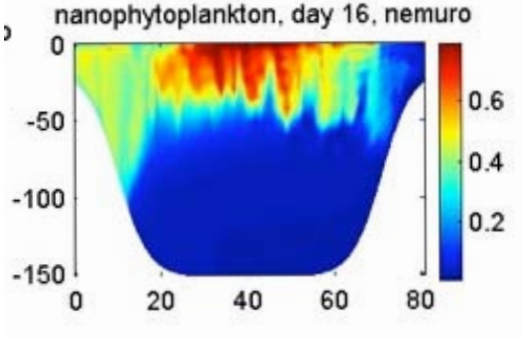
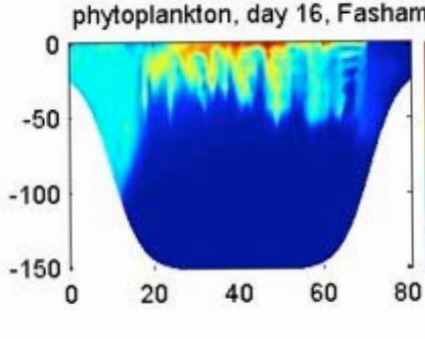
Day 14

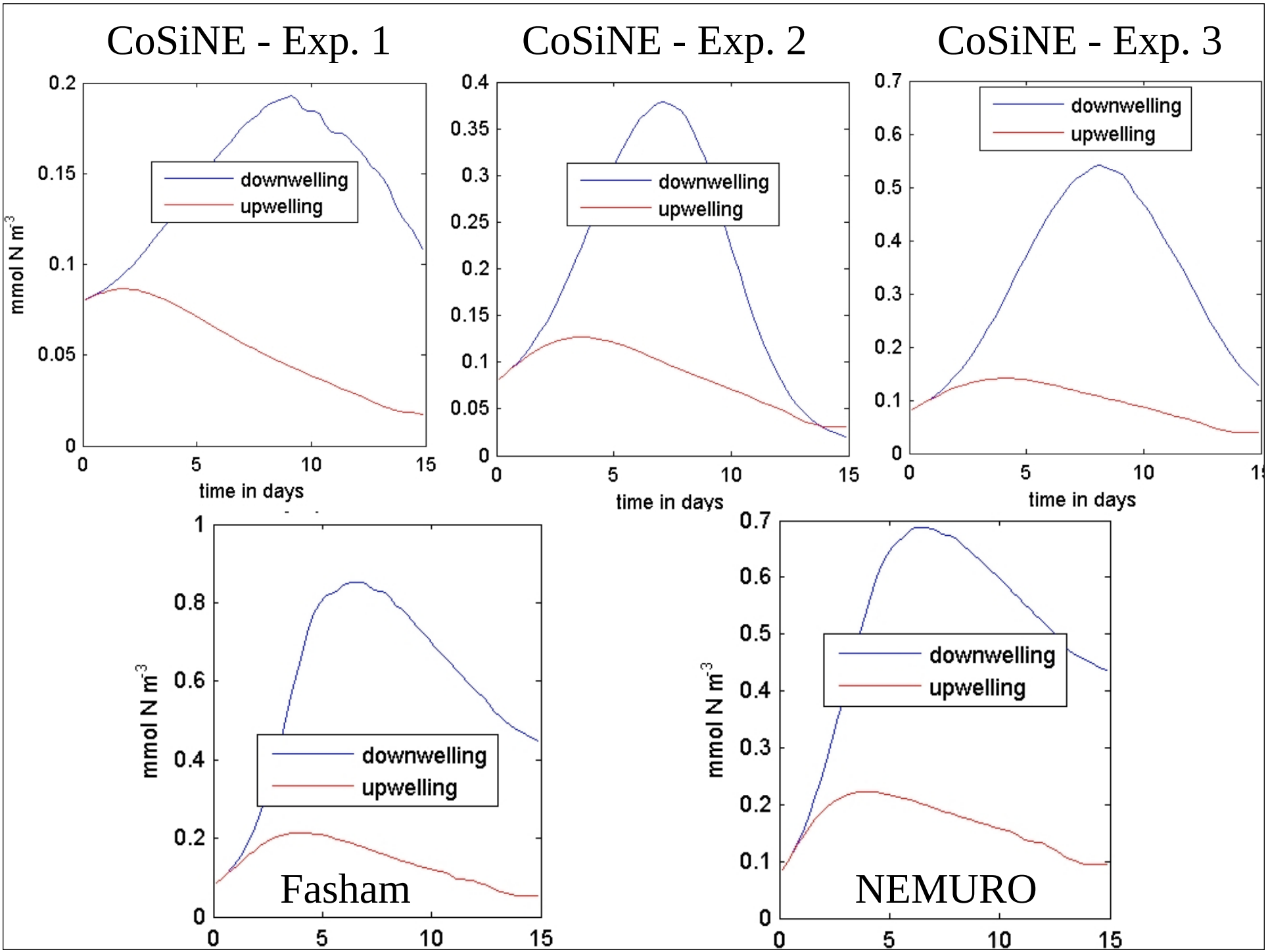






Small Phyto.

	CoSiNE	NEMURO	Fasham
Day 4			
Day 8			
Day 12			
Day 16			


CoSiNE - Exp. 1
CoSiNE - Exp. 2
CoSiNE - Exp. 3
downwelling
upwelling
mmol N m-3
time in days
Fasham
NEMURO

The UMiane CoSiNE code: bio_UMaine.h

```
 SUBROUTINE biology (ng,tile)
!
!svn $Id: bio_UMAINE.h 702 2008-08-12 16:44:47Z kate $
!********************************************** Hernan G. Arango ***
!  Copyright (c) 2002-2008 The ROMS/TOMS Group
!    Licensed under a MIT/X style license
!    See License_ROMS.txt
!***********************************************************************
!
!  This routine computes the biological sources and sinks and adds
!  then the global biological fields. The model is based on the
!  Carbon, Silicon, Nitrogen Ecosystem (CoSiNE) model (Chai et al.,
!  2002). The model state variables are:
!
!    iNO3_      Nitrate
!    iSiOH      Silicate
!    iNH4_      Ammonium
!    iSphy      Small Phytoplankton
!    iLphy      Diatoms
!    iSzoo      Micro Zooplankton
!    iLphy      Meso Zooplankton
!    iSDet      Detritus-nitrogen
!    iopal      Detritus-silicate
!    iPH4_      Phosphate
!    iOxyg      Dissolved Oxygen
!    ITIC_      Total CO2
!    iTAlk      Total Alkalinity
!
!  Reference:
!
!    Chai, F., R.C. Dugdale, T-H Peng, F.P.Wilkerson, and R.T. Barber
!      (2002): One dimensional Ecosystem Model of the Equatorial
!      Pacific Upwelling System, Part I: Model Development and Silicon
!      and Nitorgen Cycle. Deep-Sea Res. II, Vol. 49, No. 13-14,
!      2713-2745.
!
!  Adapted from 1D code develped by Fei Chai of UMaine. The 3D
!  ROMS-COSINE model code has been implemented and further developed
!  by Lei Shi of UMaine by adding 4 more biological state variables
!  (phospate, dissolved oxygen, total co2 and total akalinity)
!***********************************************************************
!
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Low Resolution ROMS-CoSiNE
Model evaluation, mainly with SeaWiFS and nutrients
Spring and Fall Bloom Dynamics