A Comparison of Two Lower Trophic Models for the California Current System

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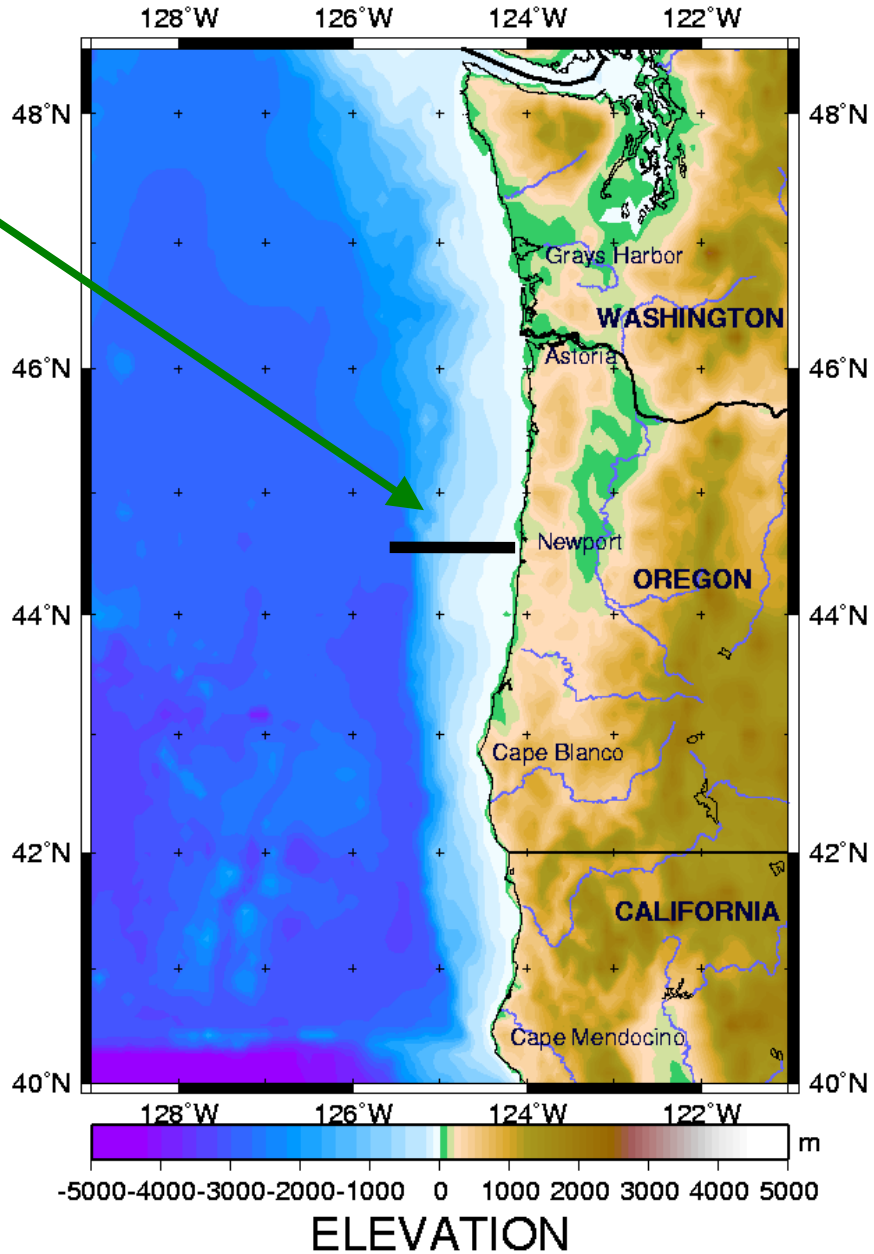
Introduction

- Interest in zooplankton production as fish food (CCCC goals)
- Focus on California Current System
  - Salmon primary species of concern
  - Focus on links between physics and ecological processes
- Previous work presented at PICES
  - C.A. Brown et al.(2001): NPZ model embedded in 2D physics model
  - T.C. Wainwright (2001): 8-component model, time scales of top-down and bottom-up processes.

CCS Study Region

Newport Line



Issues

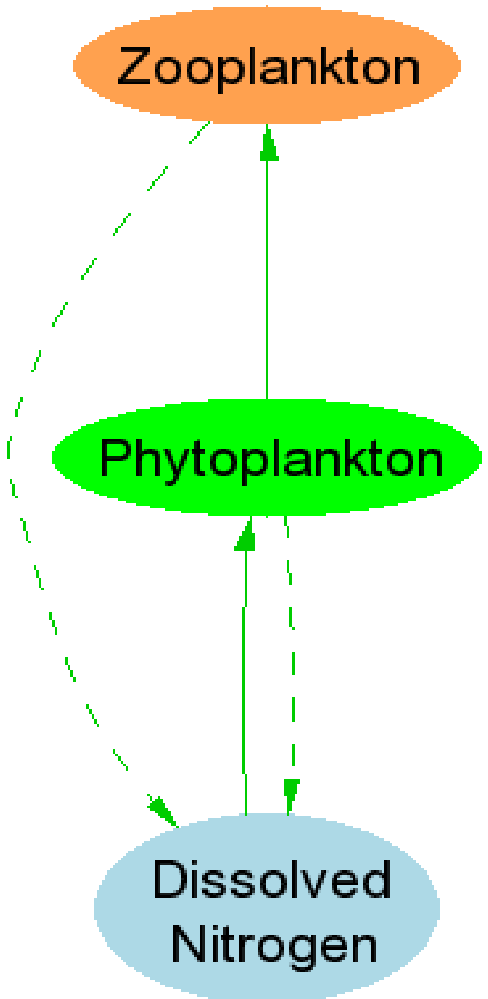
- Is an NPZ model adequate?
- Do we need a more complex model? Balance conflicting goals:
  - Predictive ability: model that adequately captures production dynamics
  - Analytic ease: model that can be used for estimation, sensitivity analysis, scenario analysis
  - Confidence: measurable parameters, reasonable behavior within range of parameter uncertainty

Issues

- Compare two models
  - NPZ: simple (3-component) N-based model
  - NEMURO: complex (11-component) N + Si model
- Look at ecological summary variables:

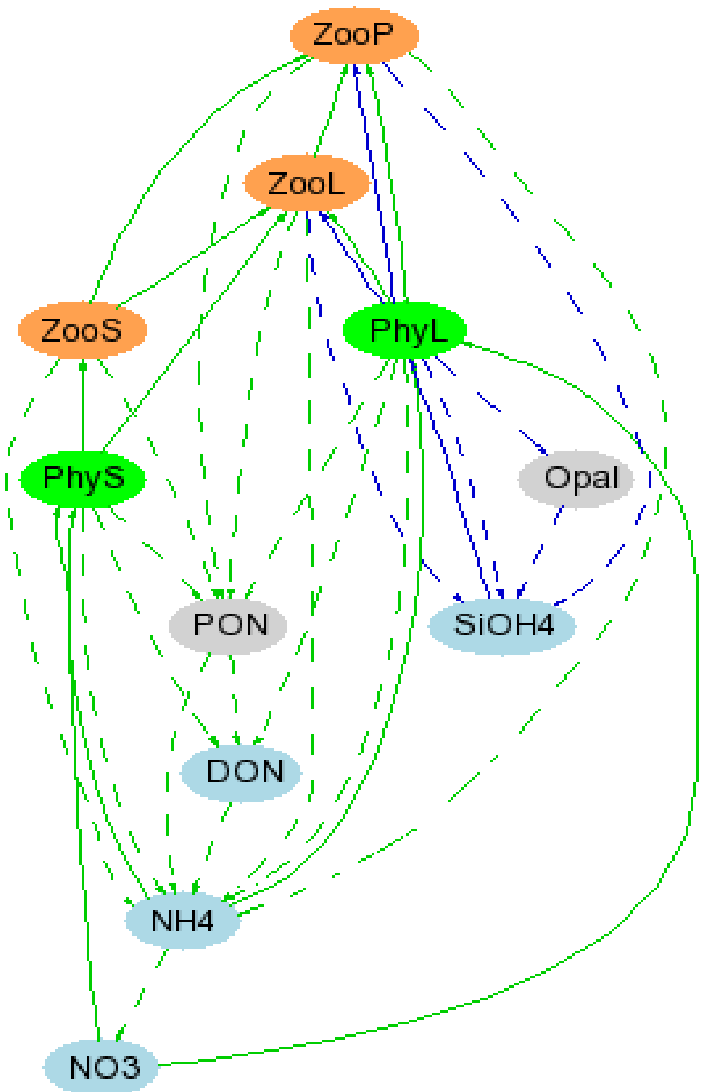
- Biomass variables:
  - Total Dissolved N (Nitr)
  - Total Phytoplankton N (Phyt)
  - Total Zooplankton N (Zoop)
  - Total Detrital N (Detr)
- Productivity variables:
  - Phytoplankton P/B (PBPhy)
  - Zooplankton P/B (PBZoo)
  - Ecotrophic Efficiency (EE)

NPZ Model



- Originated by Wroblewski (1977 J. Mar. Sci.)
- Several applications to California Current
- Well-known behavior
  - Busenberg et al. 1990 (Bull. Math. Biol. 52:677-696)
  - Edwards et. al. 2000 (J. Mar. Res. 58:37-60)
  - Newberger et al. 2003 (J. Geophys. Res. 108(C3))

NemPort Model

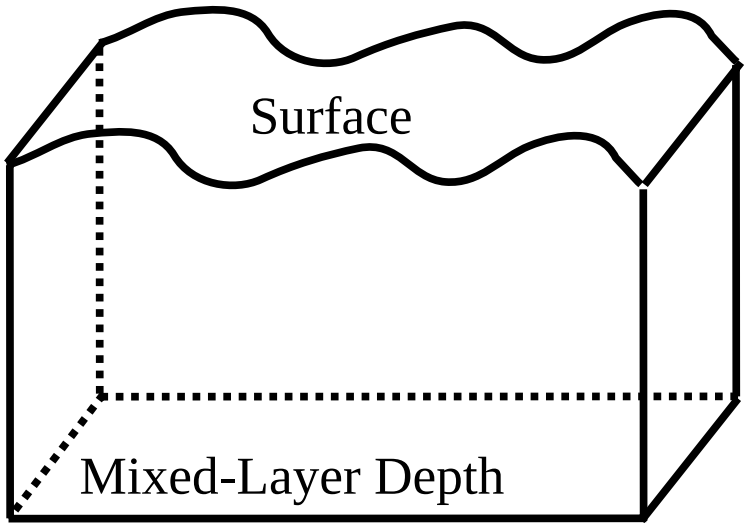


- "NEMURO Ported to Newport Line"
- Based on Kishi et al. 2001 (J. Ocean. 57:499-507) + PICES reports
- Simplifications
  - No temperature dependence
  - Simplified light response
  - Grouped parameters

Parameter Values

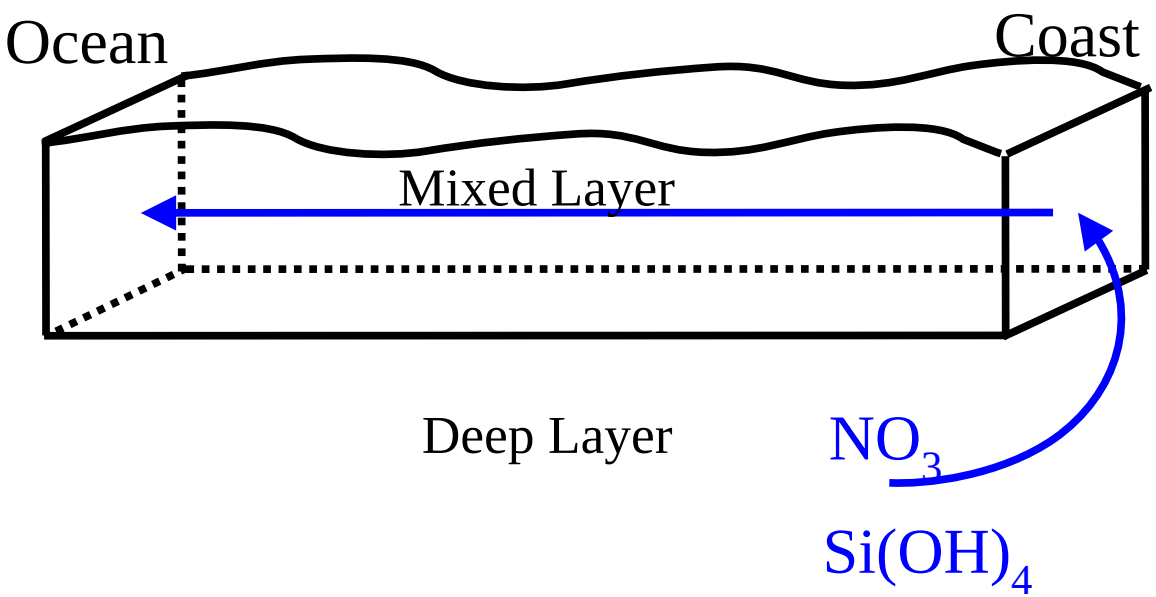
- Common parameters based on Wroblewski, Spitz et al. 2003 (J. Geophys. Res. 108(C3))
- Other NEMURO parameters taken from 2002 workshop report
- NemPort grouped parameters:
  - Density dependent mortality rate (M_0)
  - Maximum grazing rate (G_{max})
  - Ivlev constant (λ)
  - Other phytoplankton & zooplankton parameters

Two Physics Models



- Closed Box
  - Unrealistic
  - Used for equilibrium, sensitivity analysis

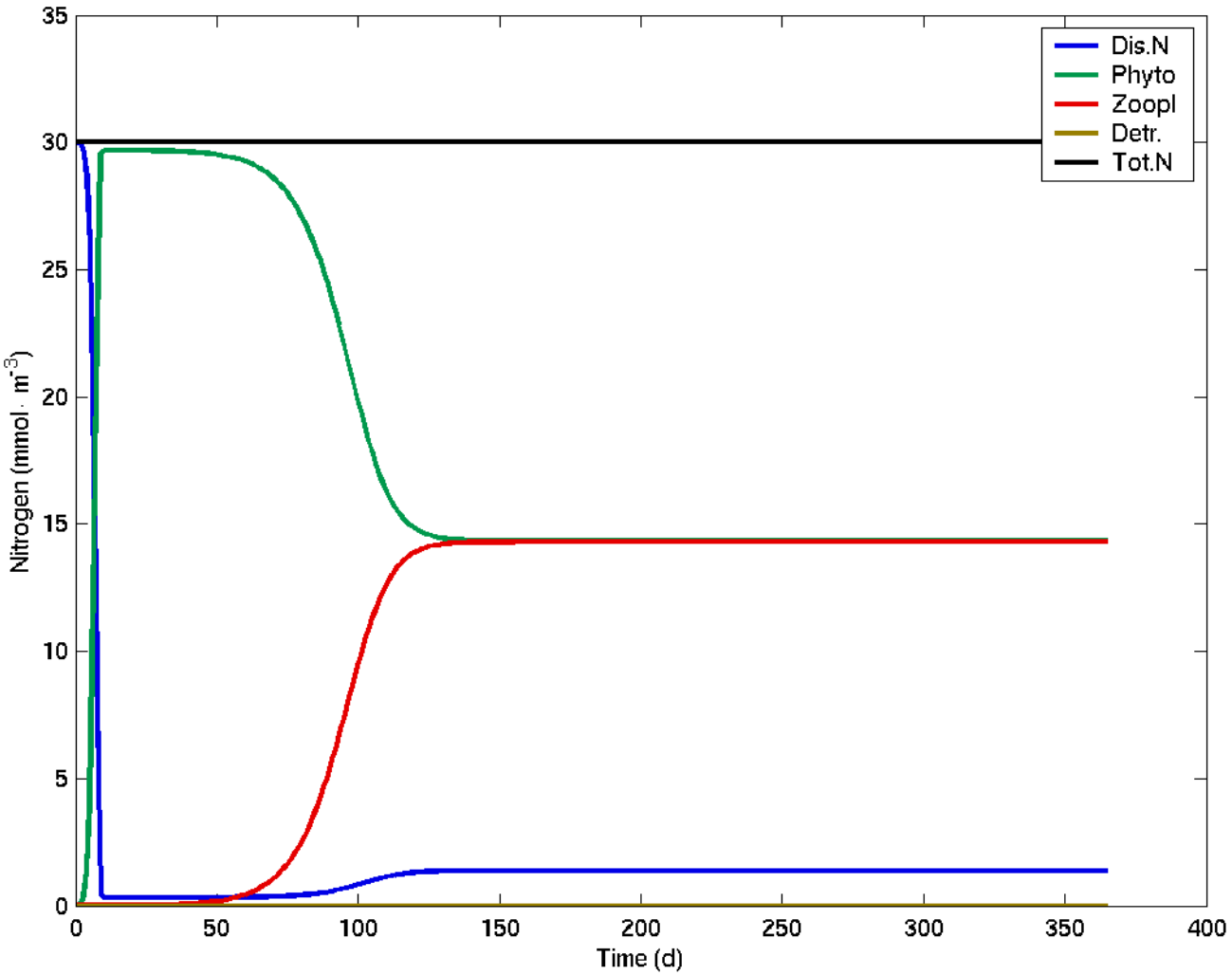
- Conveyor Belt
  - Not quite entirely unrealistic
  - Allows comparison with field data



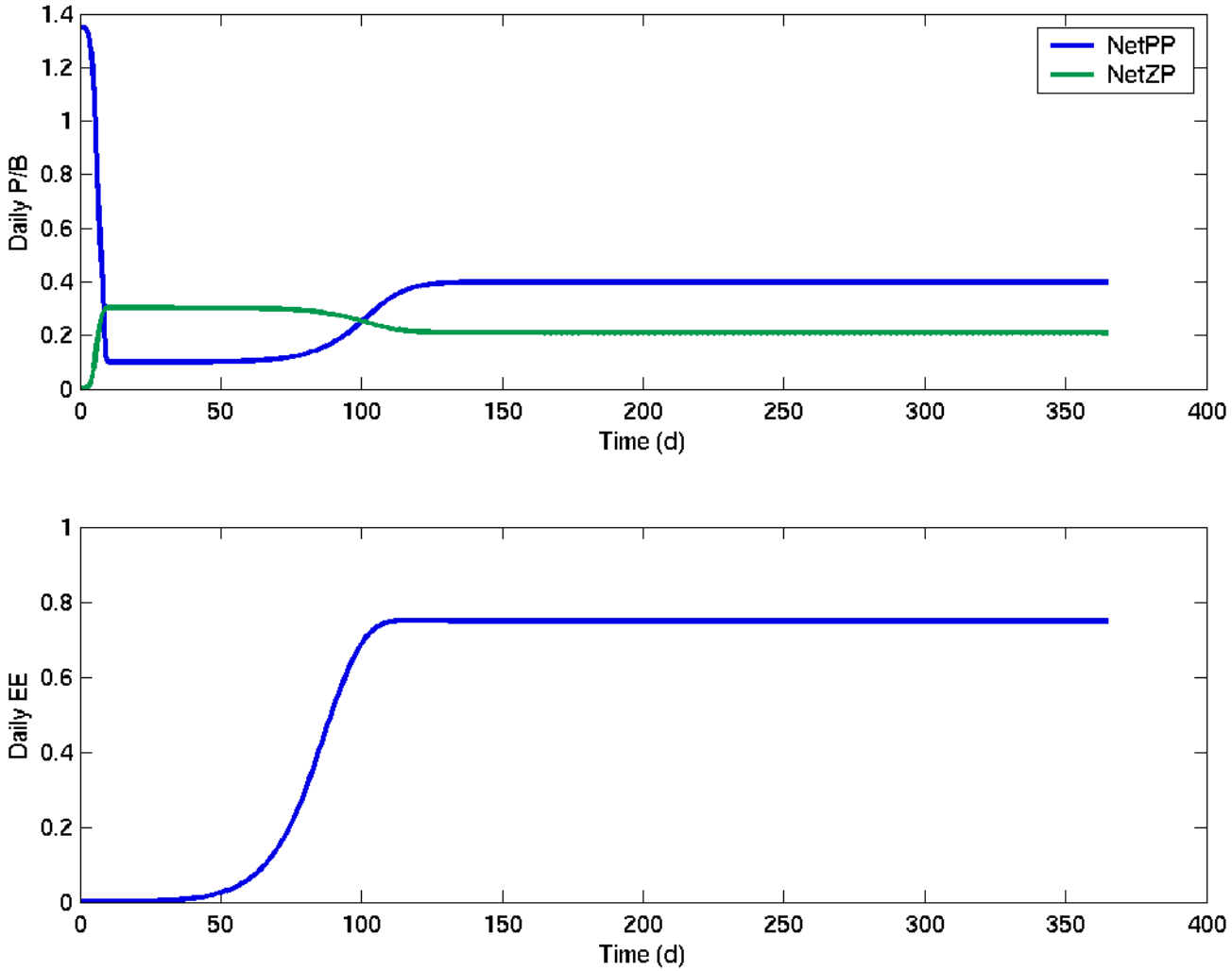
Results

- Closed Box
  - Equilibria
  - Sensitivities
- Conveyor-Belt
  - Cross-shelf patterns
  - Data comparisons

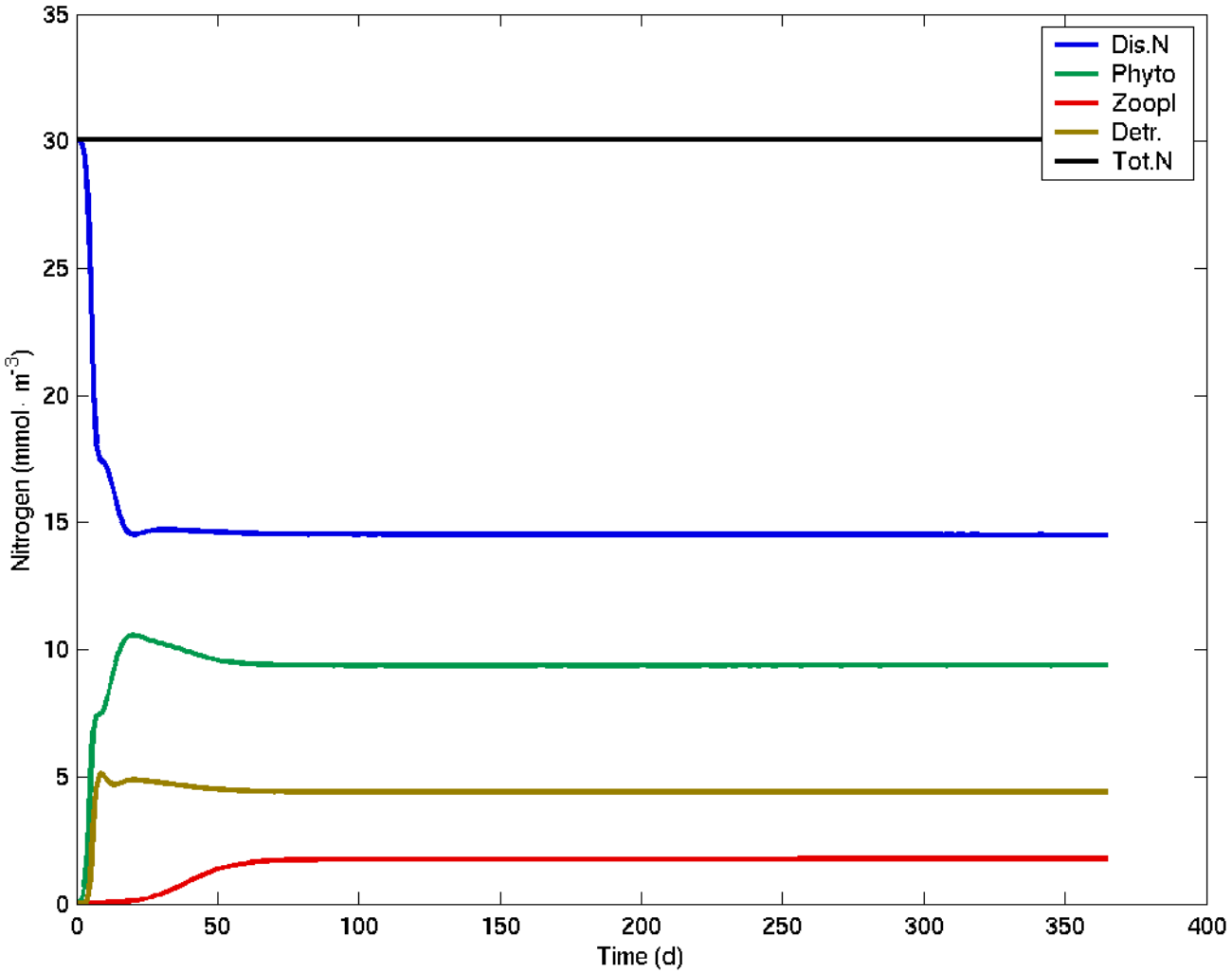
Equilibria: NPZ



Equilibria: NPZ



Equilibria: NemPort



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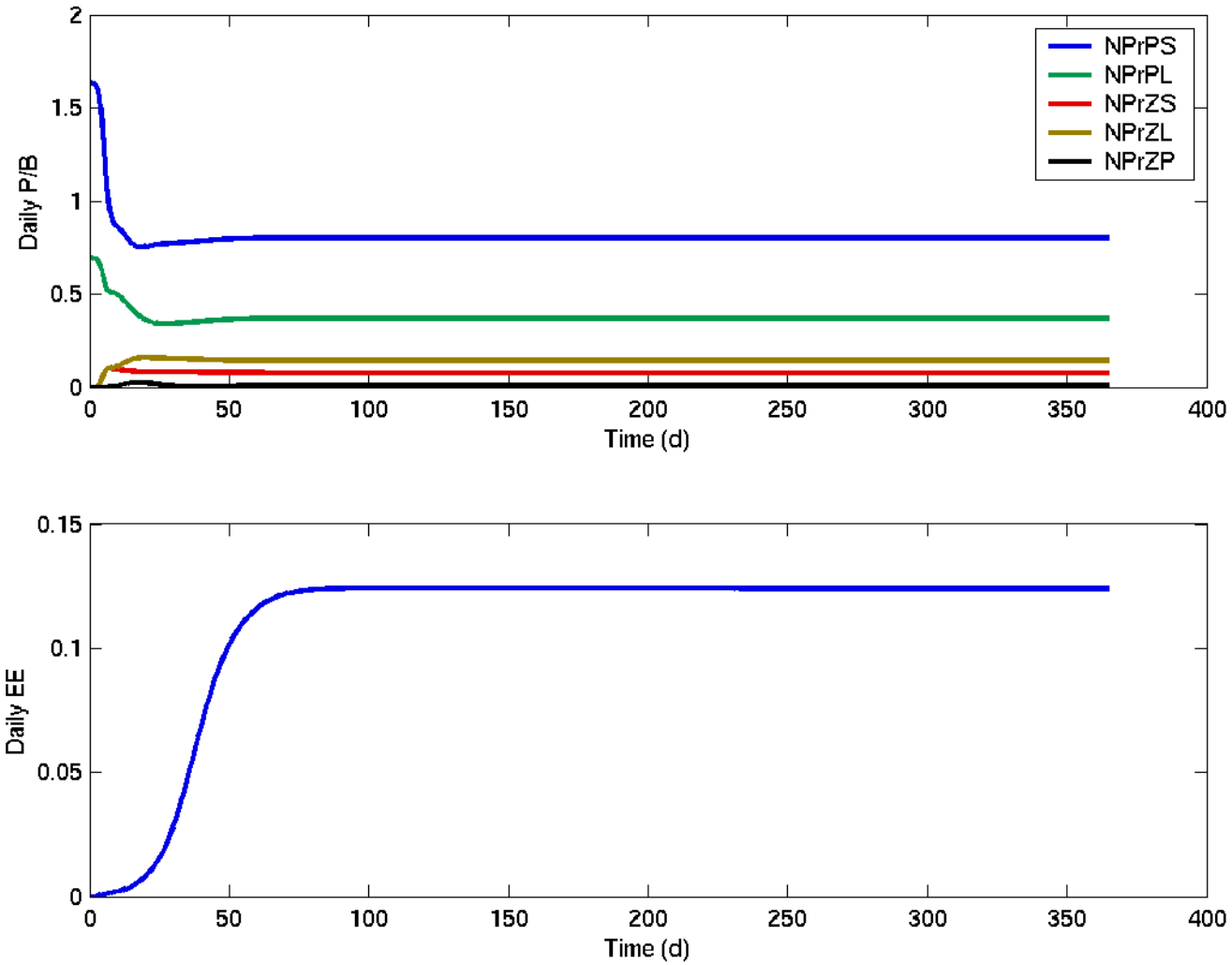
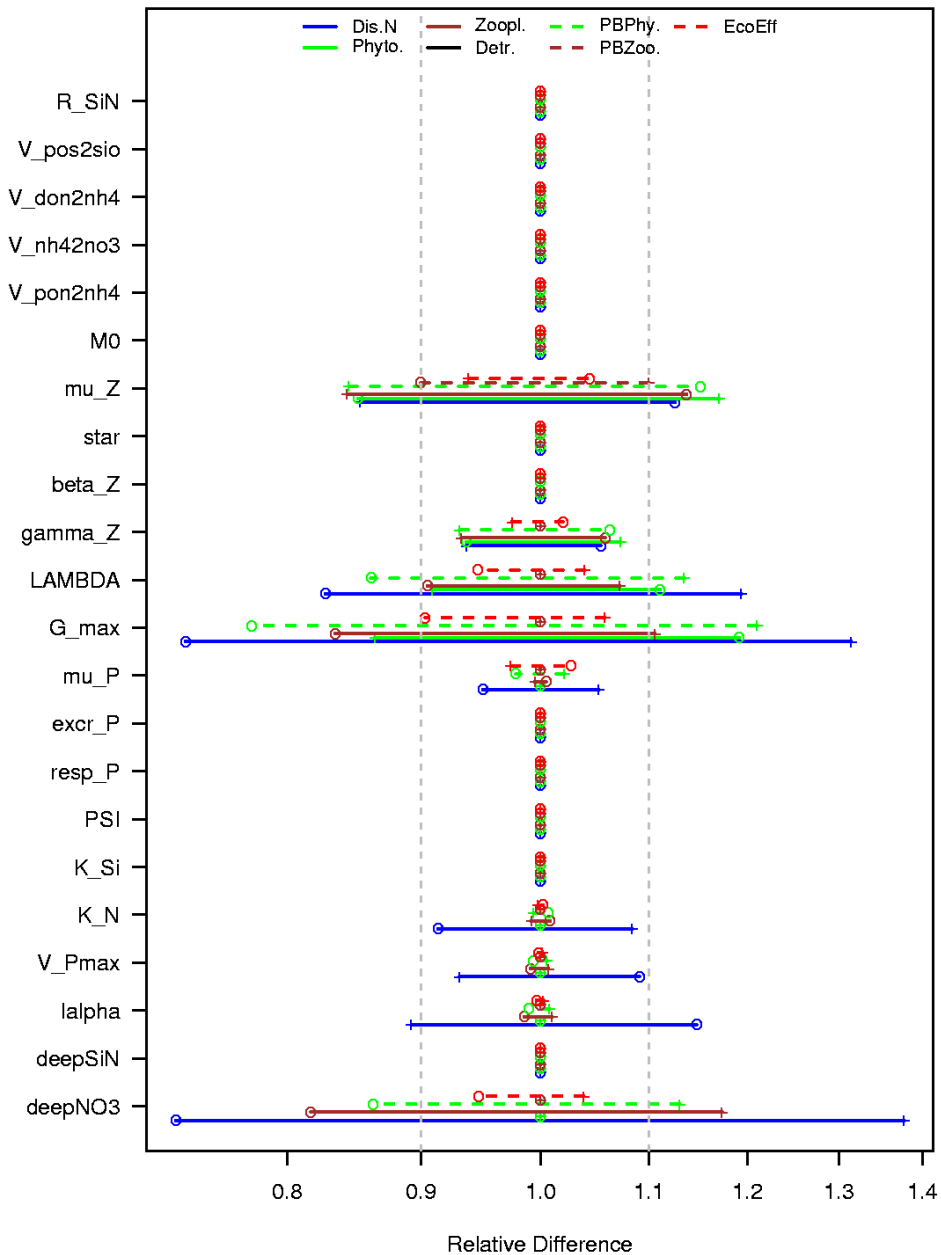
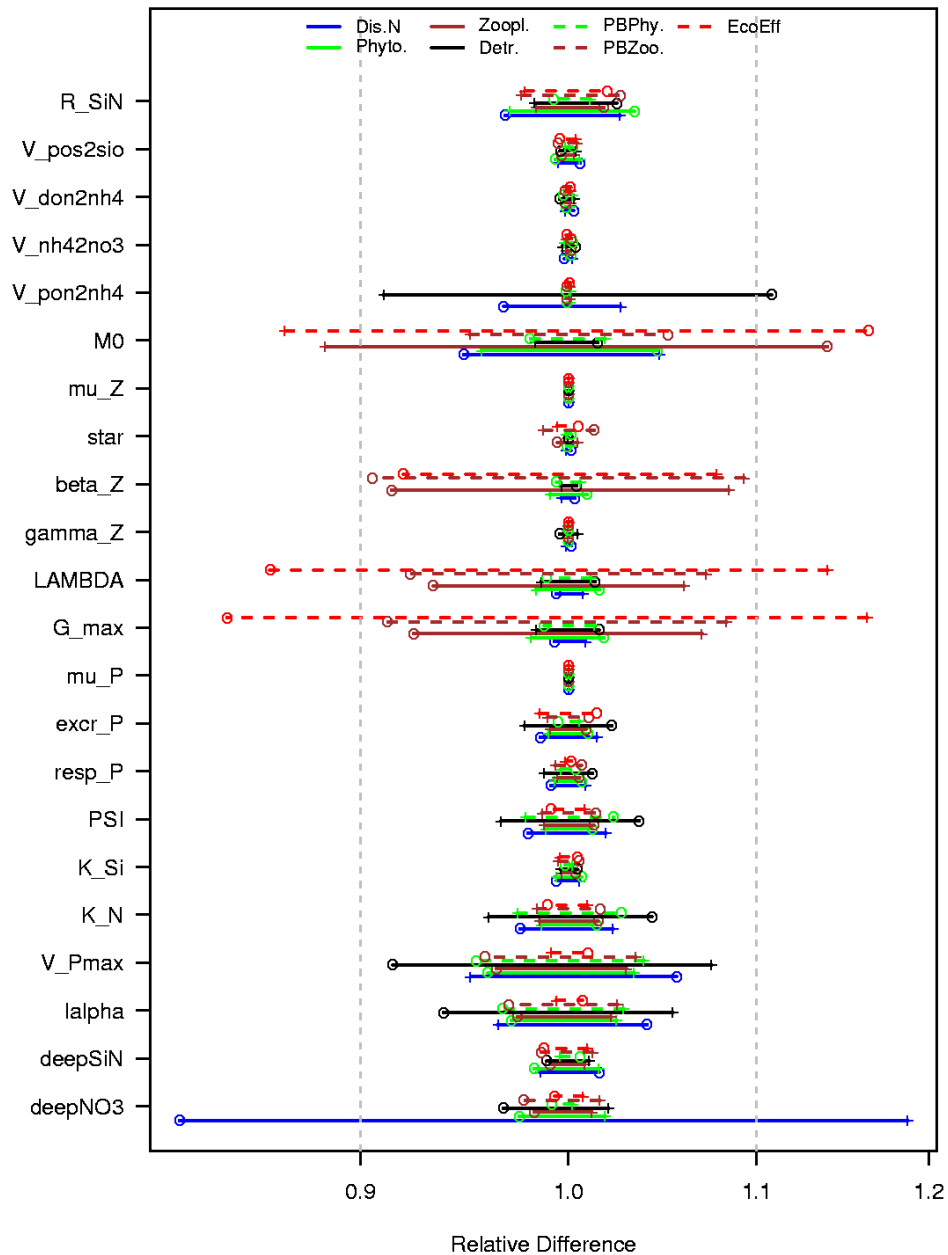


Sensitivities

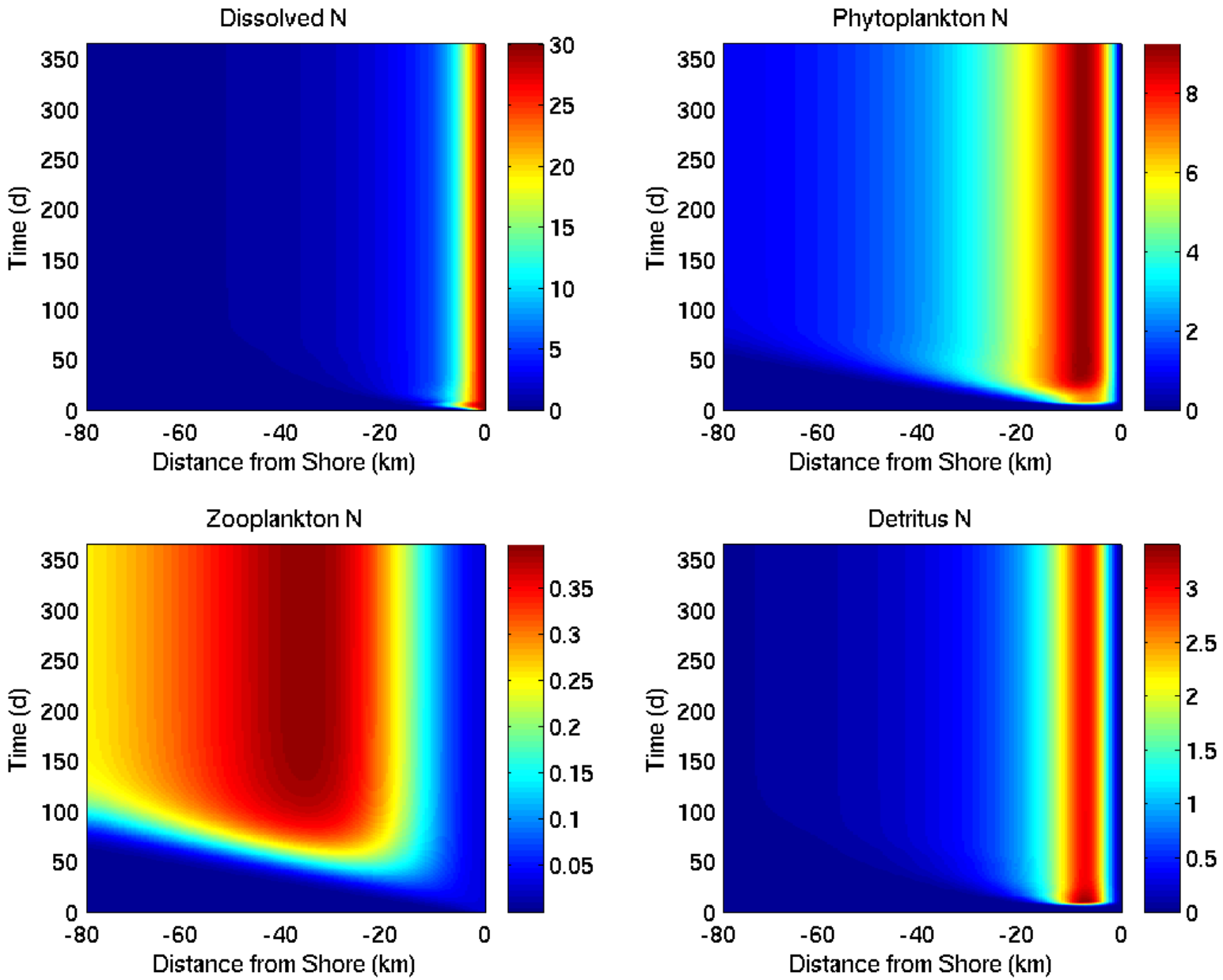
NPZ



NemPort



Cross-shelf patterns



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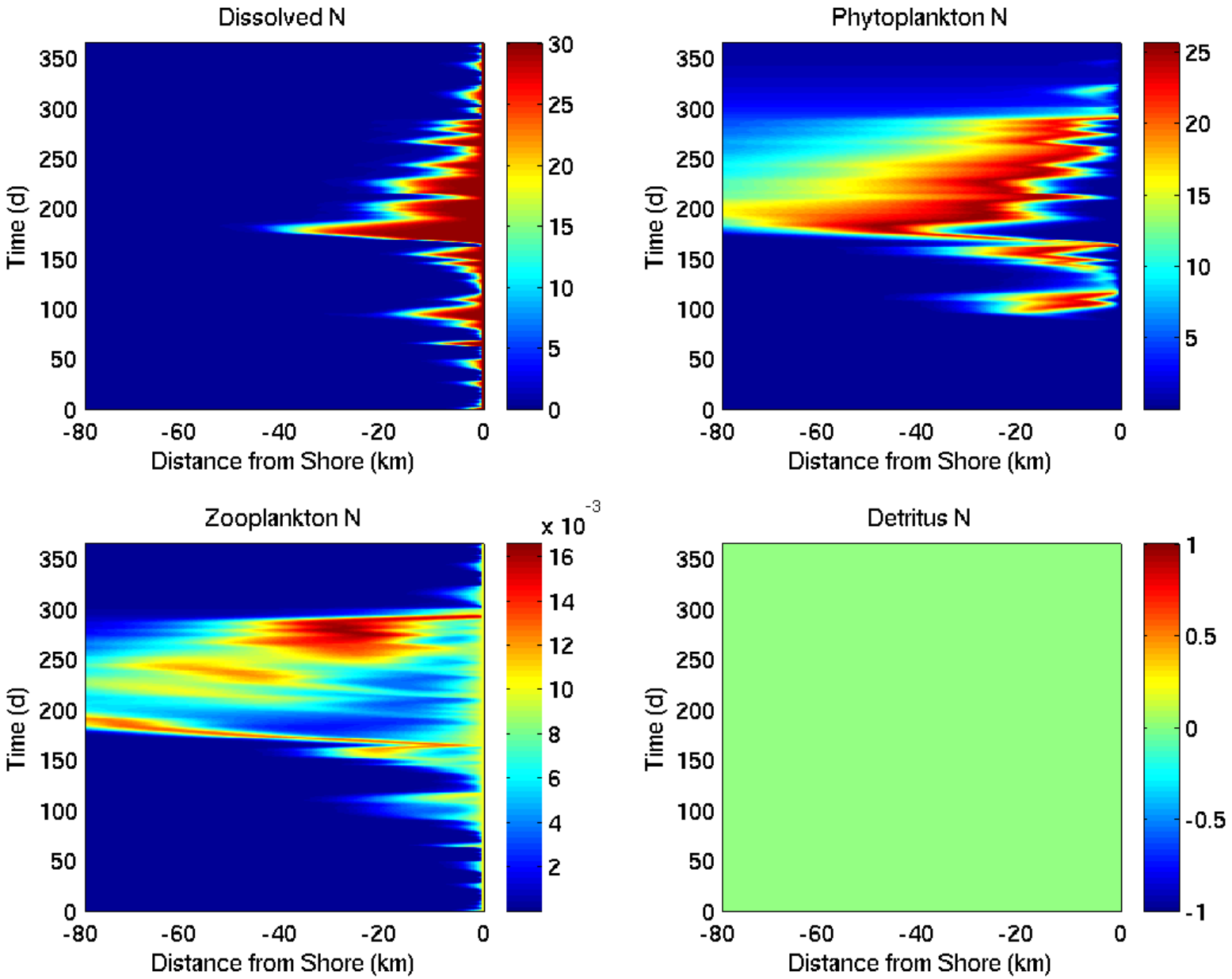

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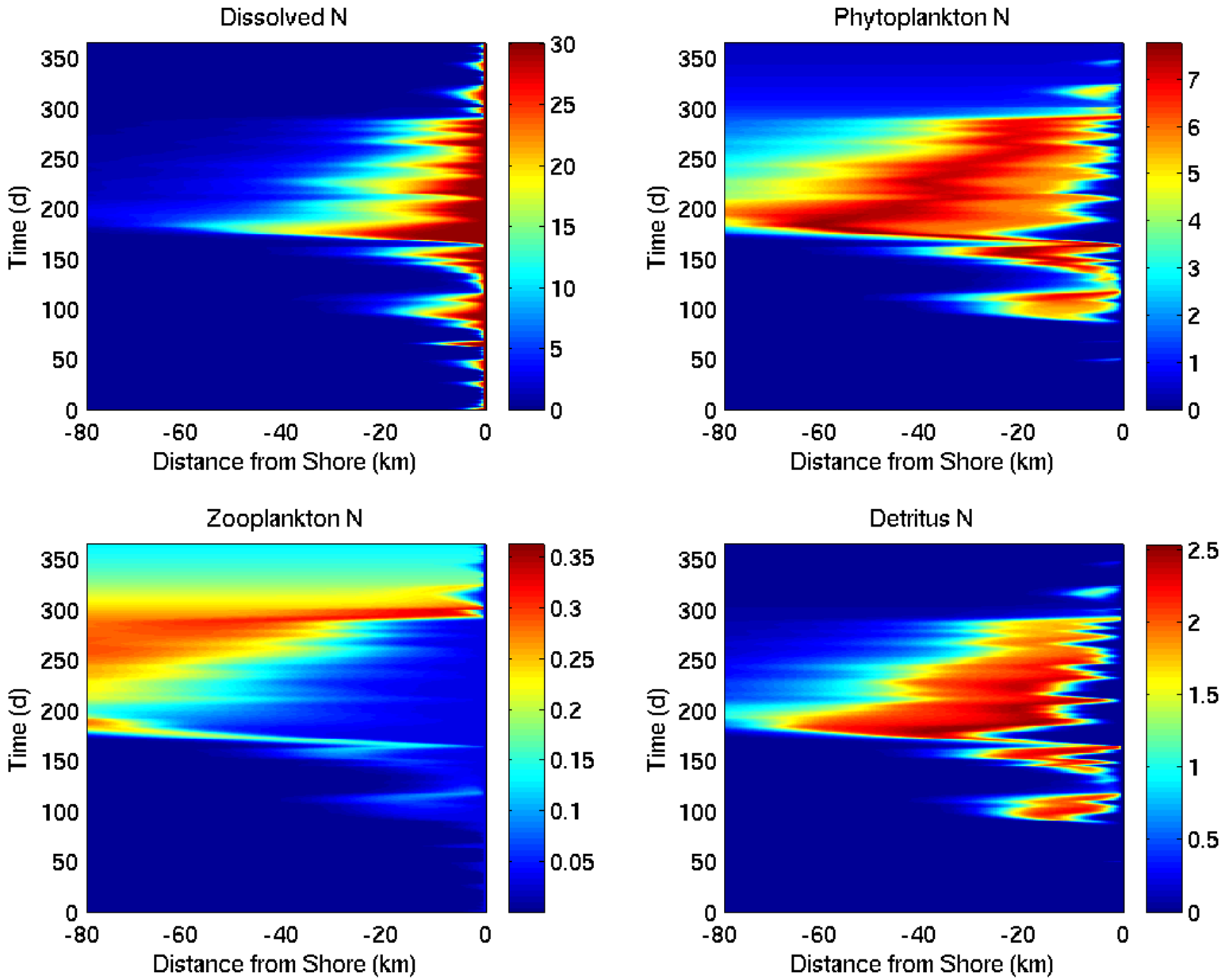
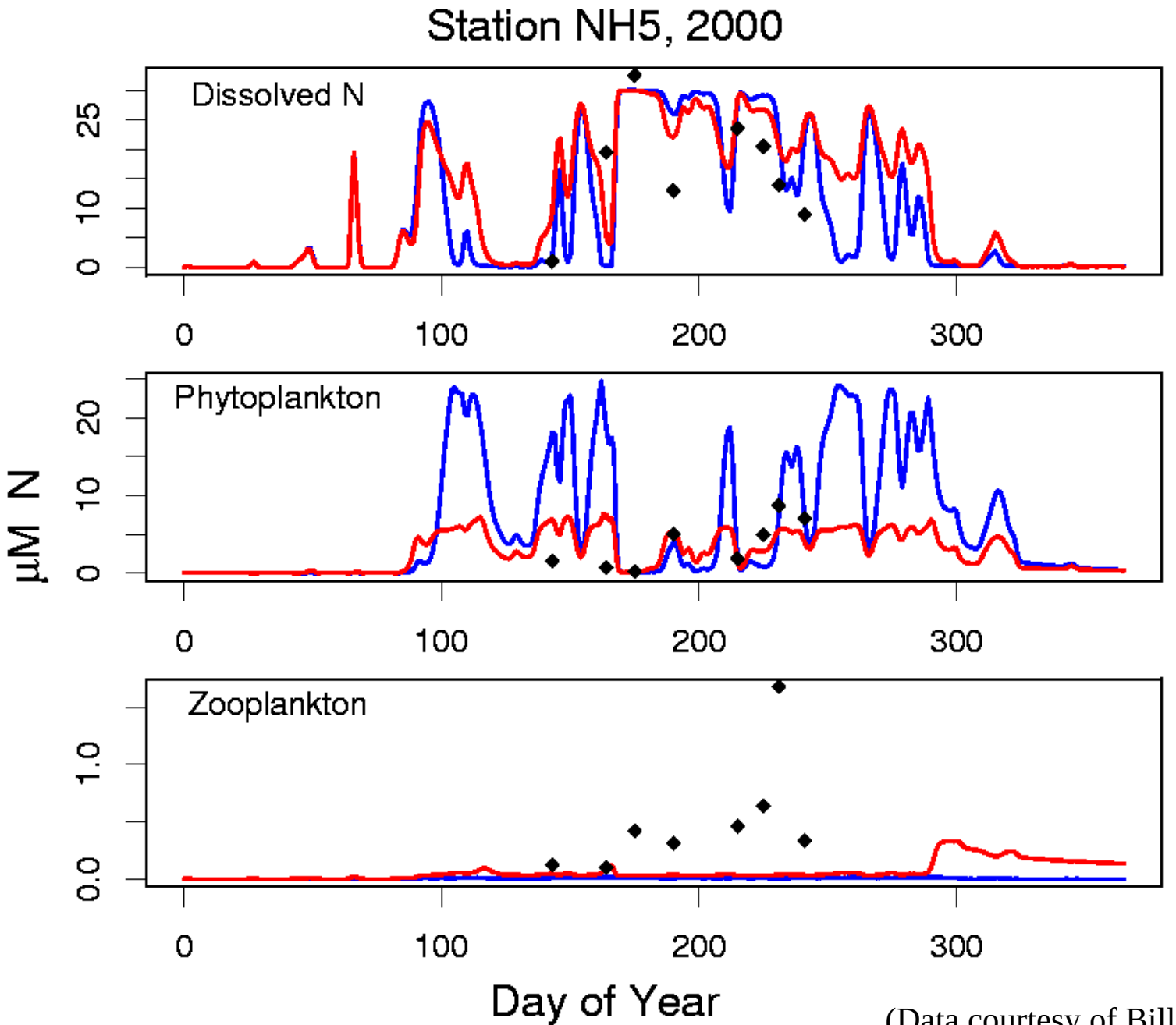
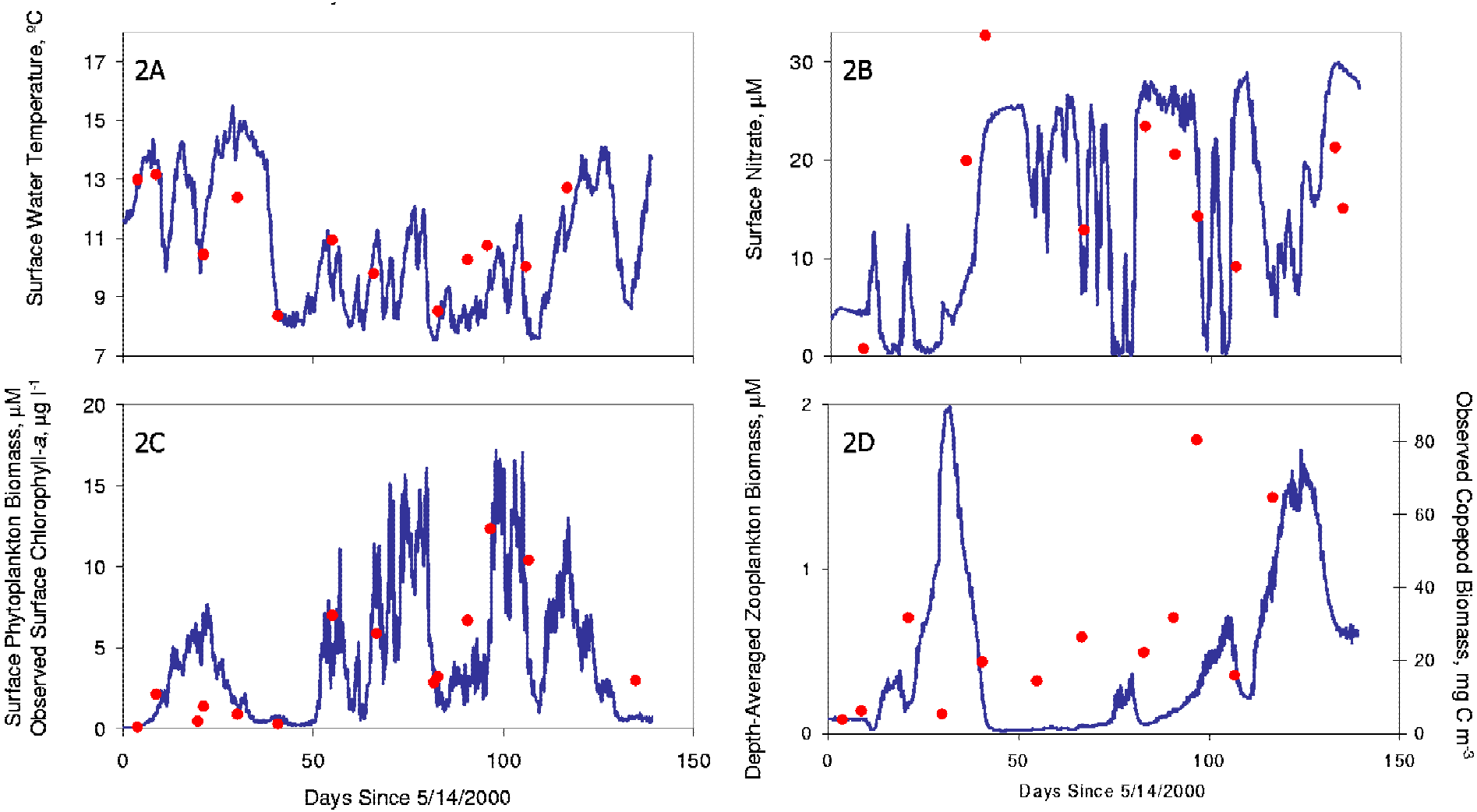


Data Comparison



(Data courtesy of Bill Peterson)

Previous results



C.A. Brown et al. (in prep.)

Future Work

- Parameter fitting
  - Focus on the 4 most sensitive parameters
  - Compare with full Newport Line data
  - Repeat for other years
- Applications
  - Tie into juvenile salmon growth/survival model
  - Consider herring or anchovy modelling
  - Develop zooplankton production index

Acknowledgments

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