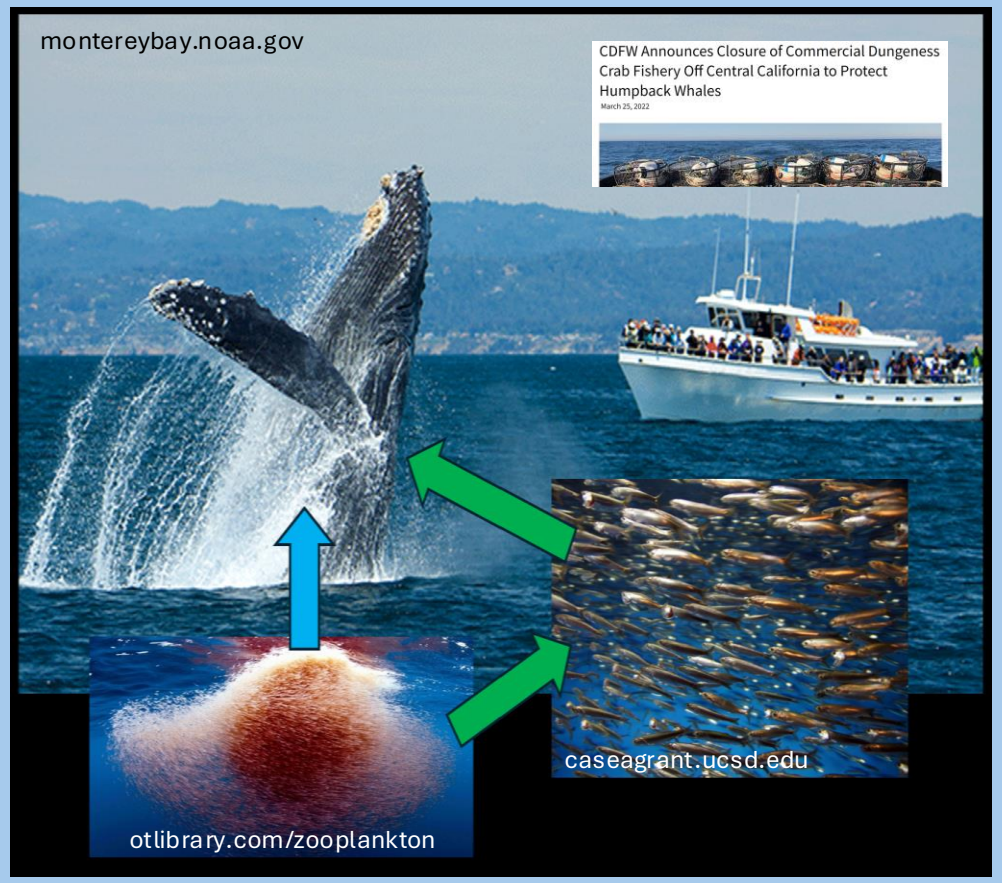
A Super Ensemble View of Krill and Climate Change in the California Current

Jerome Fiechter, UC Santa Cruz

Co-authors:
M. Cimino, M. Messié, M. Jacox, M. Pozo Buil, J. Santora

Funding:
U.S. National Science Foundation (NSF)
U.S. National Oceanography and Atmospheric Admin. (NOAA)

Objectives



- **Projecting climate change and variability of krill in California Current ecosystem**
- **Identifying uncertainty sources in projections (humans, krill)**
- **Quantifying future departure from present-day conditions**

Multi-Model Krill Super Ensemble

3 downscaled projections

A Dynamically Downscaled Ensemble of Future Projections for the California Current System

Mercedes Pozo Buil[1,2], Michael G. Jacox[1,2,3], Jerome Fiechter[4], Michael A. Alexander[3], Steven J. Bograd[1,2], Enrique N. Curchitser[5], Christopher A. Edwards[4], Ryan R. Rykaczewski[6] and Charles A. Stock[7]*

RCP8.5 High Emissions Scenario

- Low rate of warming (GFDL)
- Moderate rate of warming (IPSL)
- High rate of warming (Hadley)

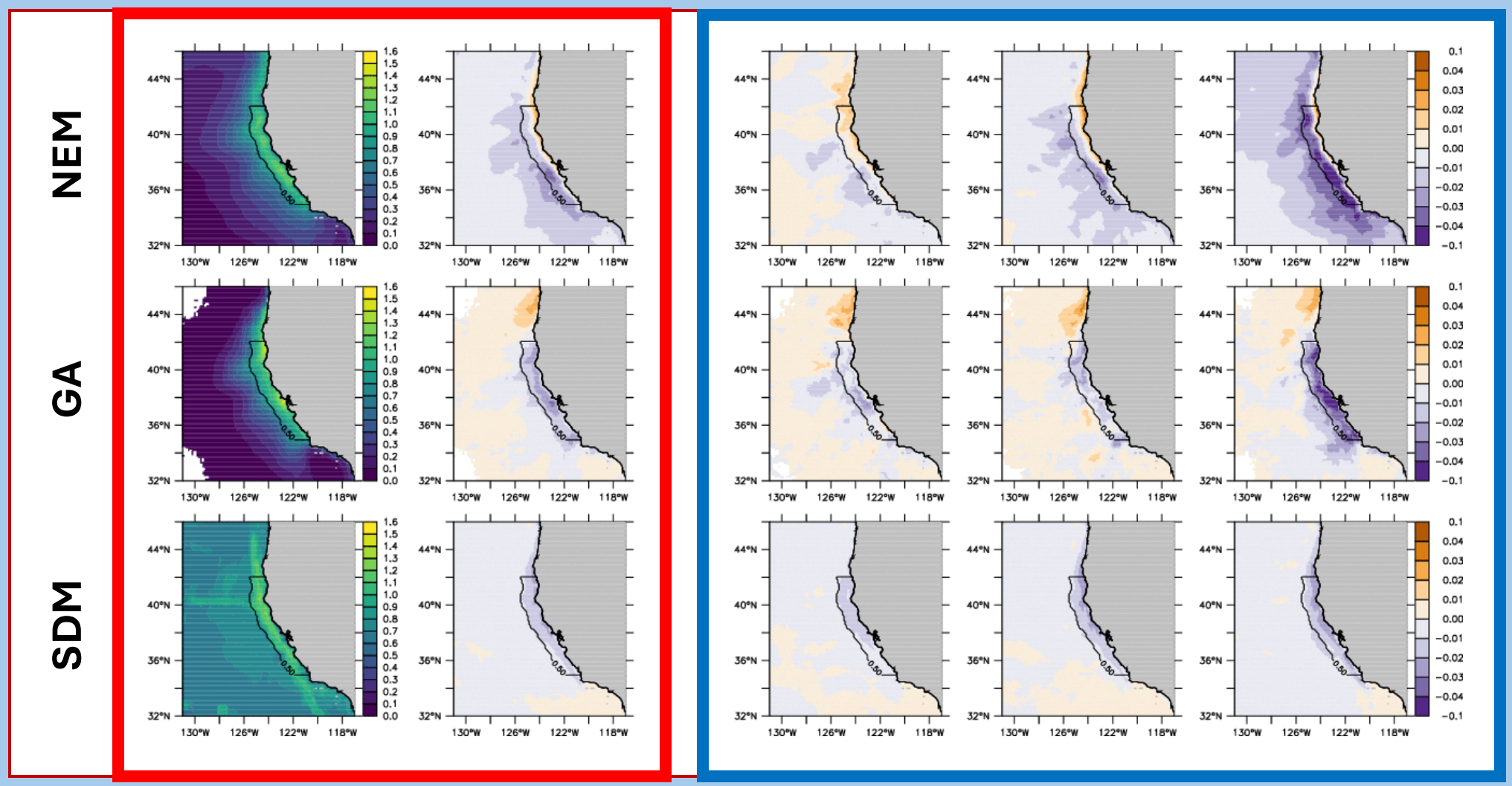
3 Krill Model Formulations

NEMUCSC (NEM)
Deterministic, Eulerian

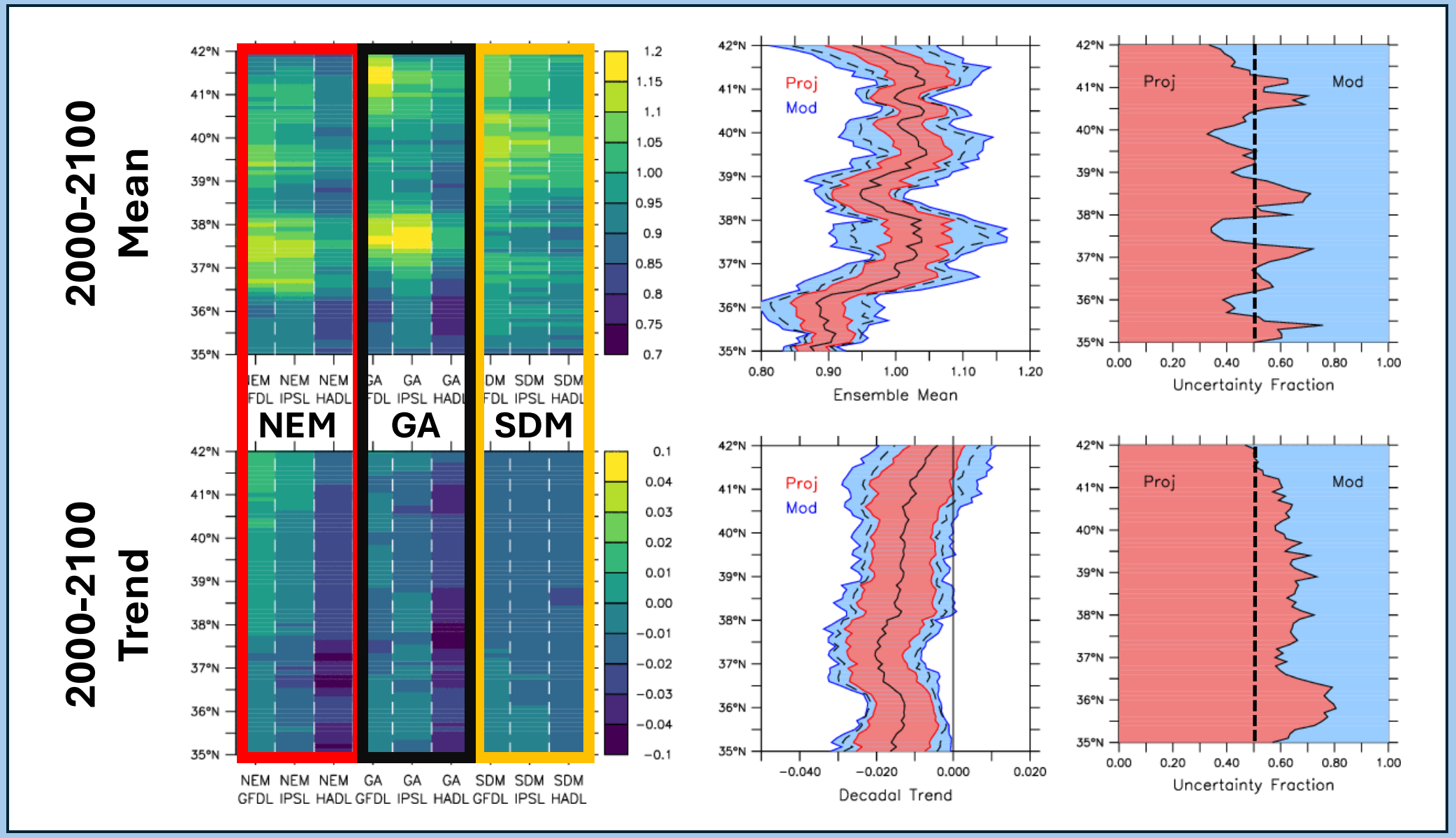
Growth-Advection (GA)
Determinisitic, Lagrangian

Species Distribution Model (SDM)
Statistical, Eulerian

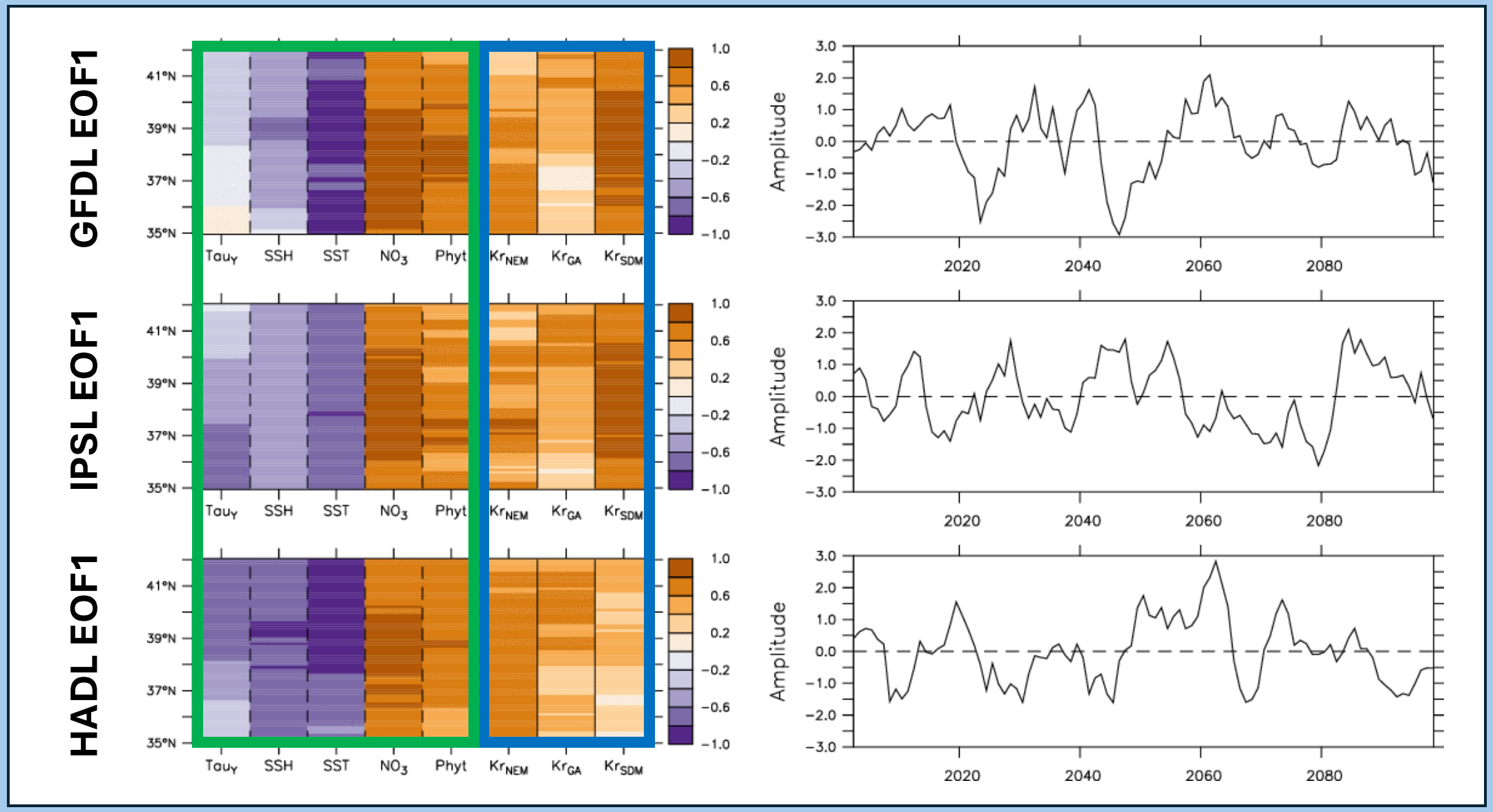
Multi-Model Krill Super Ensemble (9 Members)



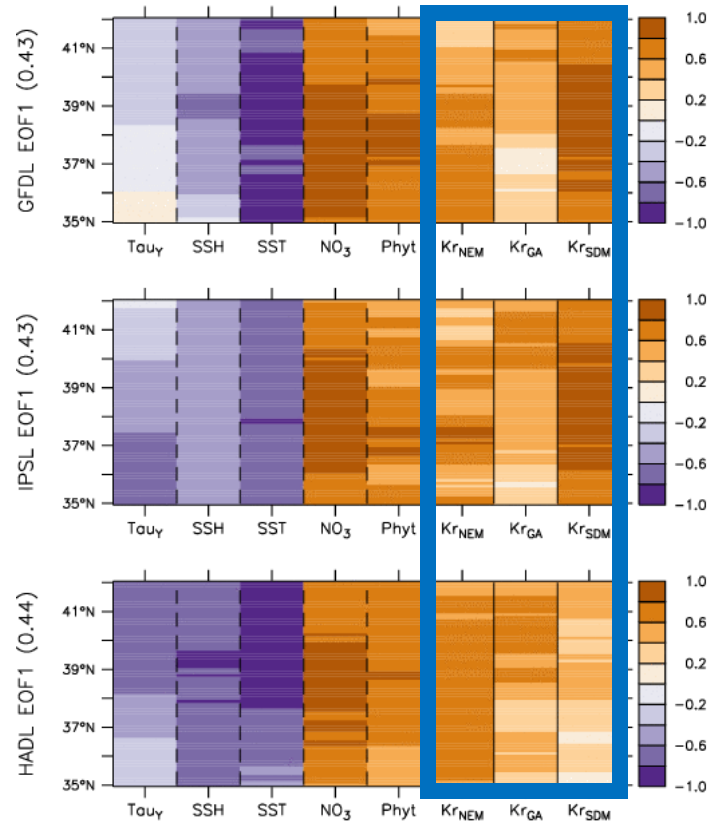
Long-term Means, Trends, and Uncertainty

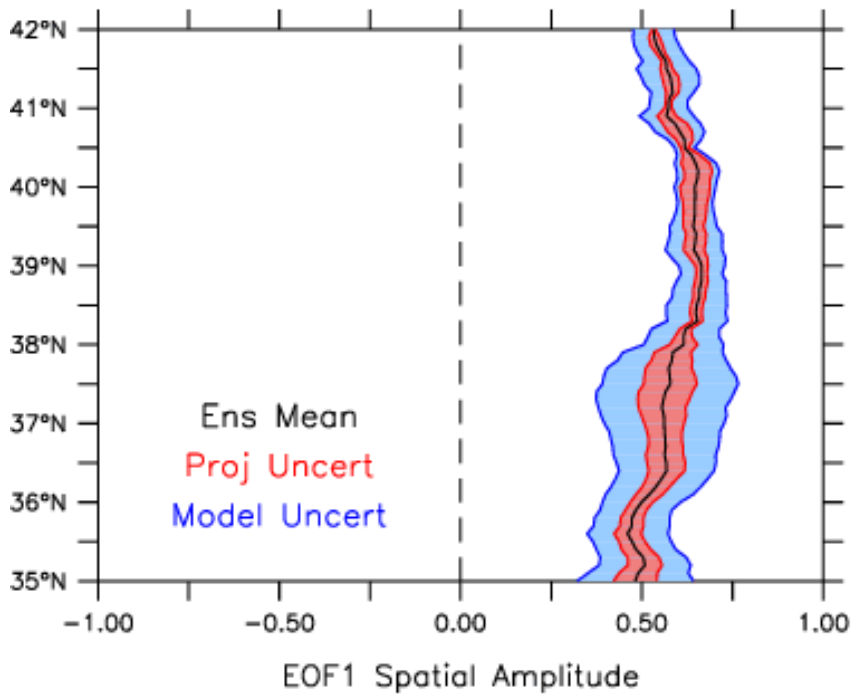


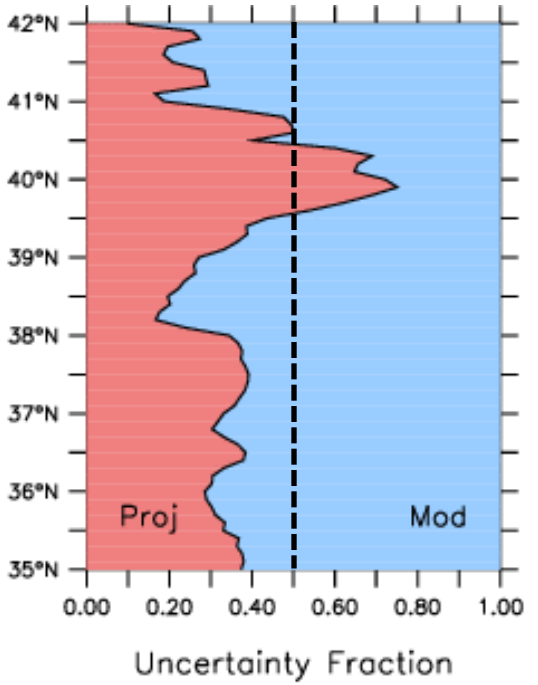
Leading Mode of Combined Variability (Krill + Environment)



Leading Mode: Krill Alongshore Patterns and Uncertainty

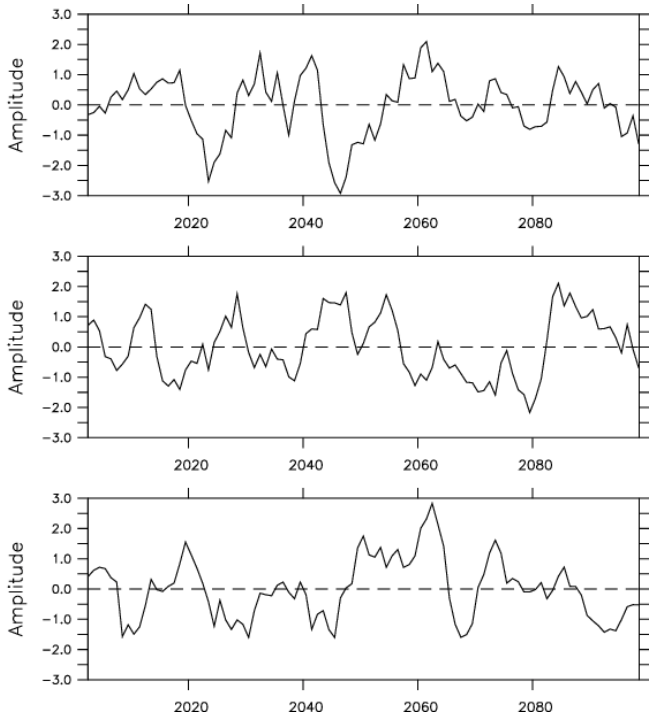




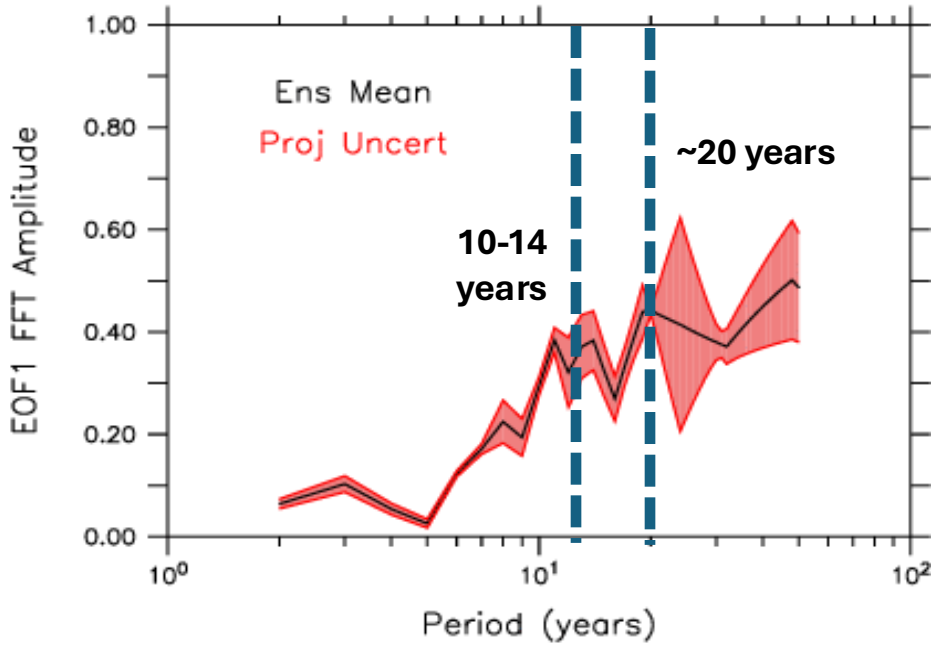


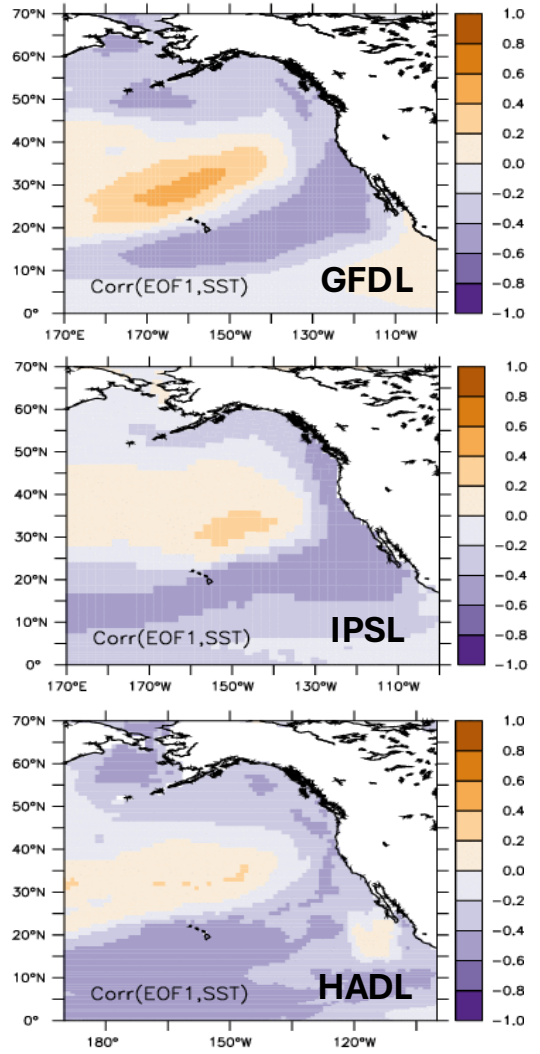
Synchronous variation in krill abundance with coastwide increases during colder, more productive periods (~45% of explained variance)

Leading Mode: Krill Temporal Variability and Uncertainty



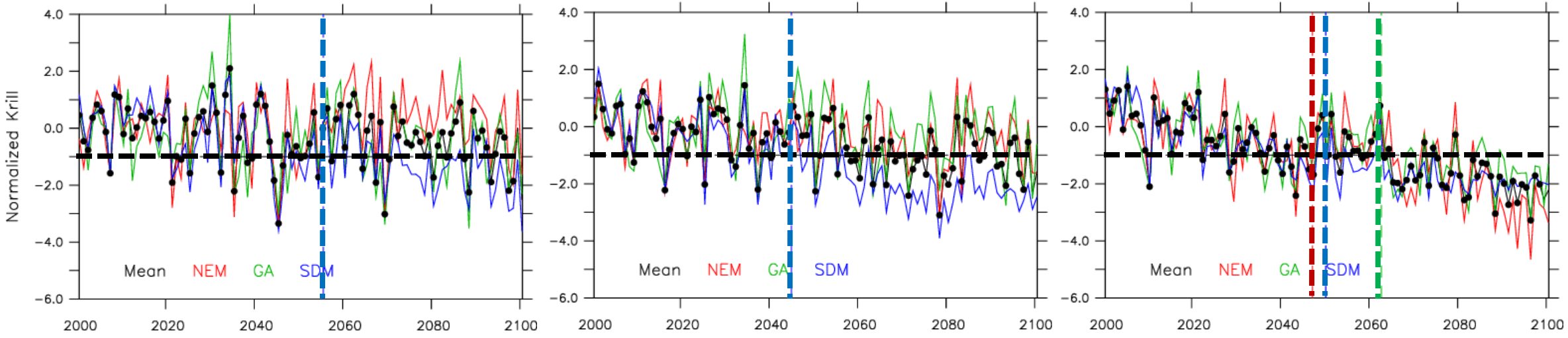
Temporal Ensemble in Frequency Domain (EOF1 Fourier transforms)





Correlations indicate PDO connection

Departure from Present Day Conditions: Emergence

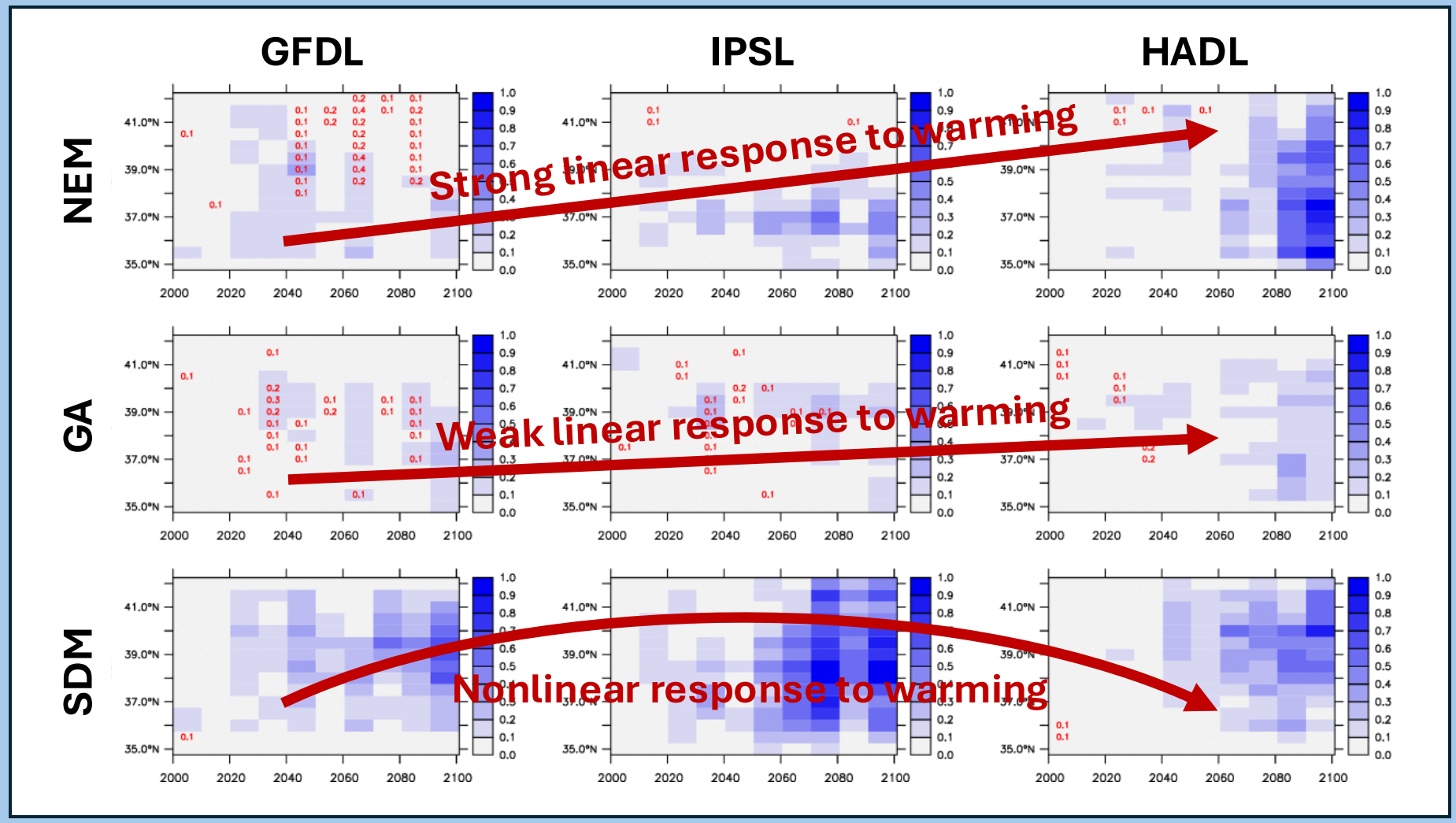


GFDL: 33% (1/3) **IPSL: 33% (1/3)** **HADL: 100% (3/3)**

Super Ensemble: 56% (5/9)

Departure from present-day (2000-2030) conditions identified when trend exceeds 1 standard deviation from present-day mean

Departure from Present Day Conditions: Extremes



Fraction of years exceeding 2 standard deviations from present-day mean

Conclusions

- **Different properties of krill dynamics are affected by different sources of uncertainty**
- **Stronger warming does not necessarily mean worse future for all krill models**
- **Even under high emissions scenario, climate change signal for krill will be obscured by strong interannual and decadal variability**