# Shelf recruitment of *Calanus finmarchicus* along the Norwegian Shelf


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NERSC

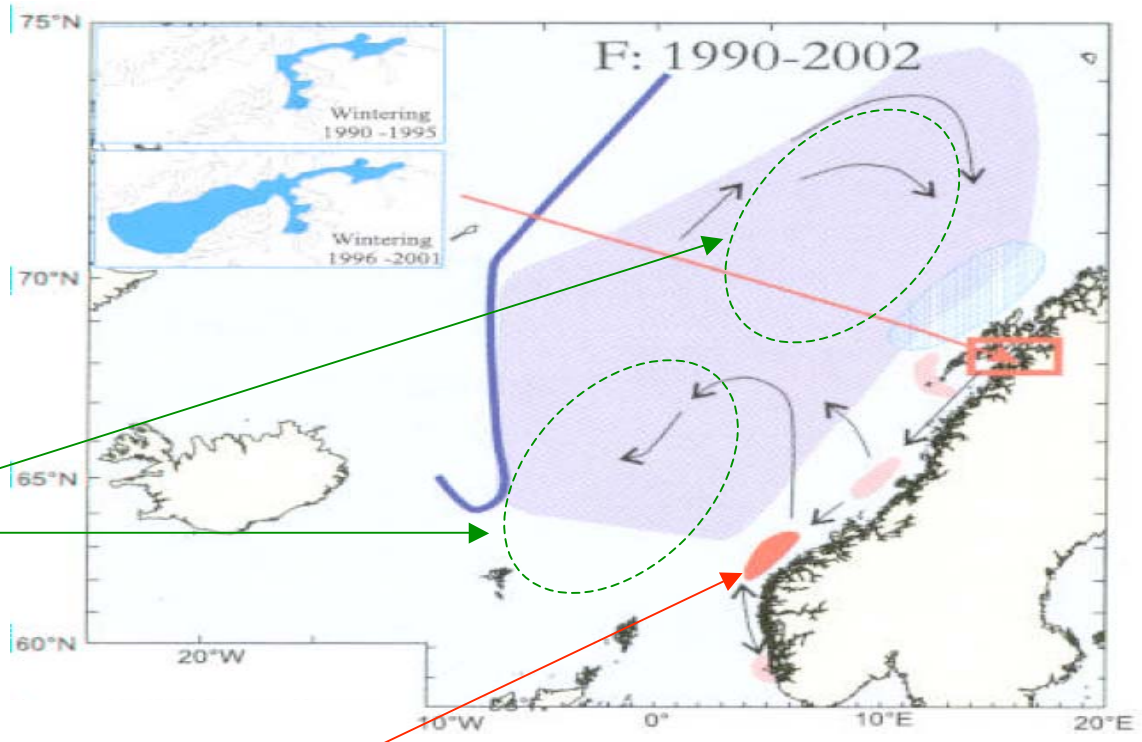
Mohn-Sverdrup Center
Global Ocean Studies - Operational Oceanography

# Calanus finmarchicus

- Key zooplankton species in the Norwegian Sea
- Main food source for many fish species.
- Life cycle of about a year - forecasting
- Survive winter by over-wintering at depth.
- Cannot over-winter on the shelf because of predators.
- Horizontal distribution decided by currents, temperature, food availability, and predators.
- 13 developmental stages

***Objective:*** To investigate the influence of currents, temperature, and food availability on the shelf recruitment of *C. finmarchicus*.

# Why study shelf recruitment?

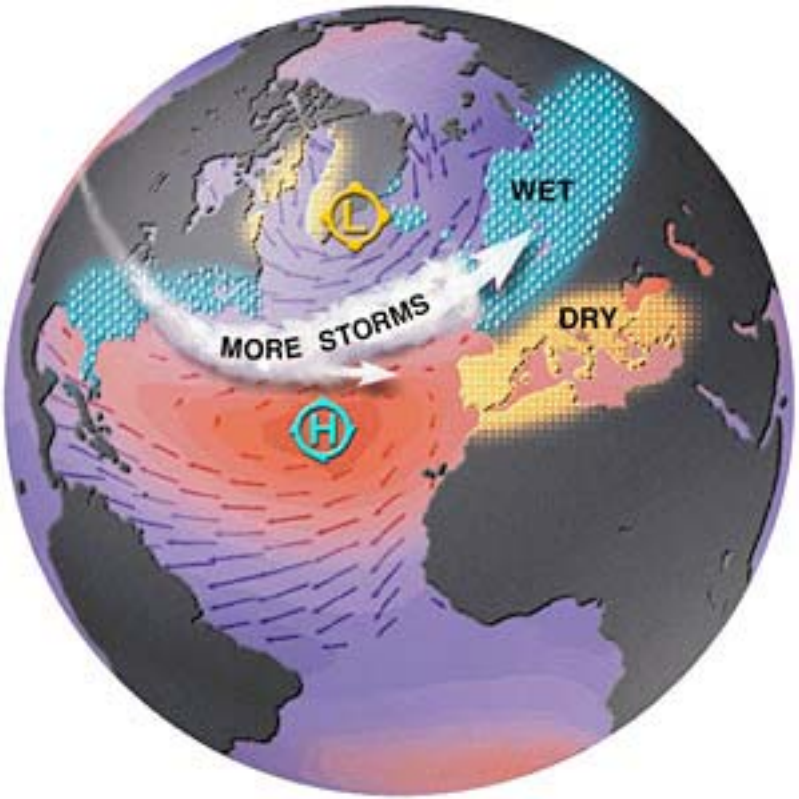



*C. finmarchicus* over-wintering area

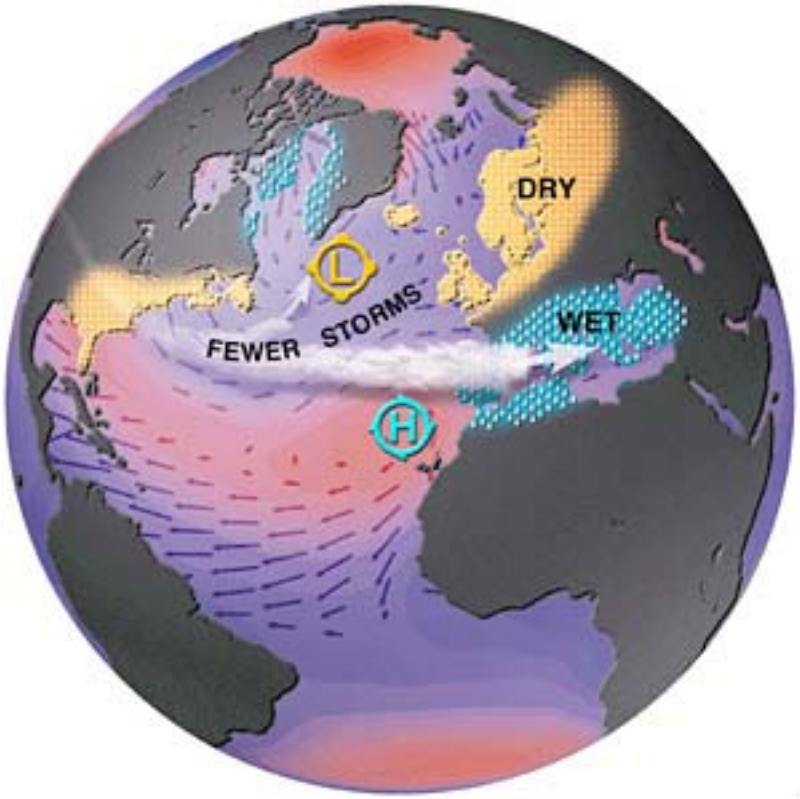
Main spawning area for herring

# North Atlantic Oscillation

Positive phase (1995)




Negative phase (1996)



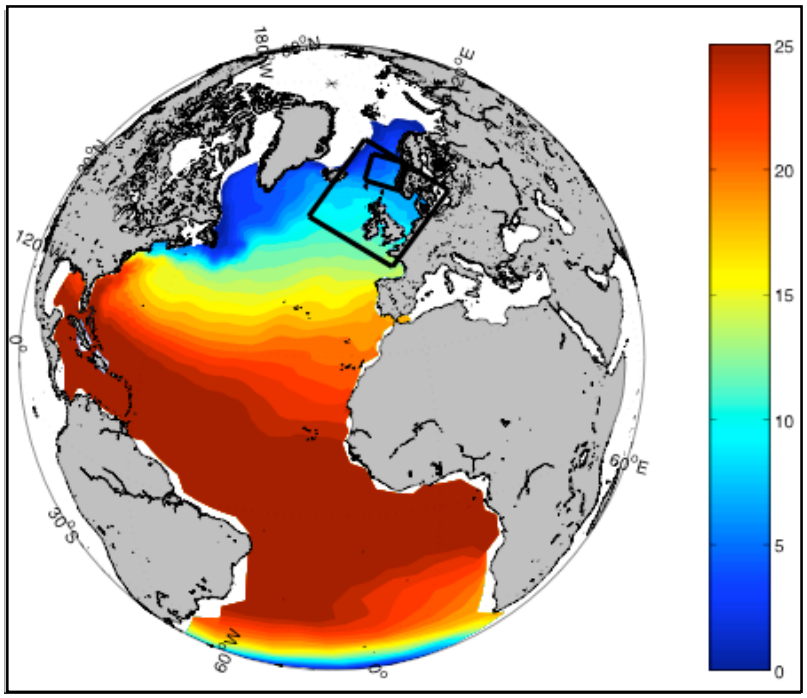

http://www.jason.oceanobs.com/html/applications/climat/nao_explication_uk.html

# Biological effects

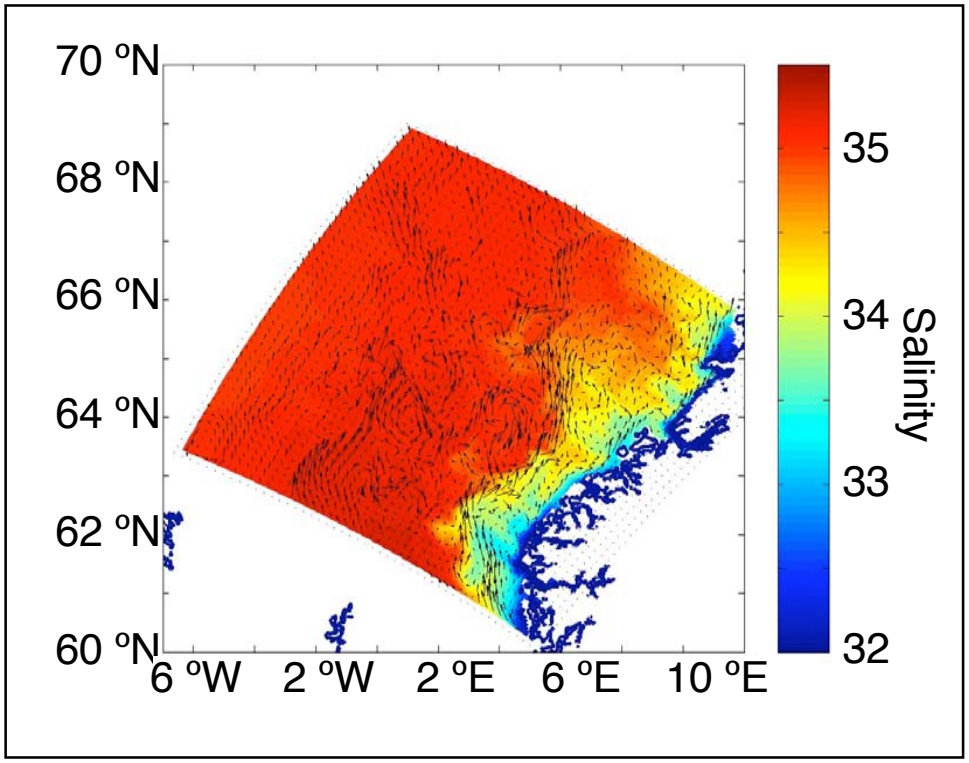
- Spring bloom started earlier in 1995 than 1996.
- There was more plankton and better growth conditions for herring in 1995.
- It has been shown that there is a positive correlation between the NAO and abundance of *c. finmarchicus*, but this relationship has broken down in the recent years.

# Model setup - physical

- Nested model
  - Atlantic (30-120 km)
  - North Sea/Norwegian Sea (16 km)
  - Norwegian Coast (5 km)
- 22 vertical layers

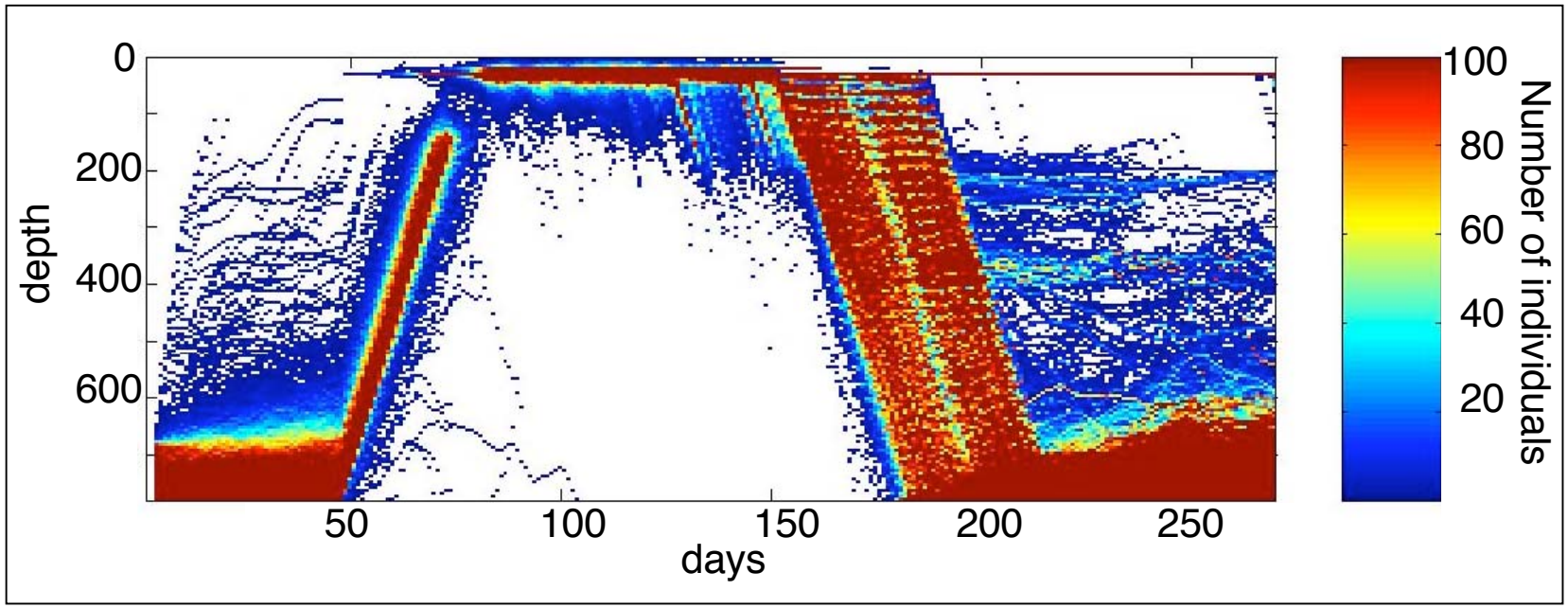


# Model setup - physical



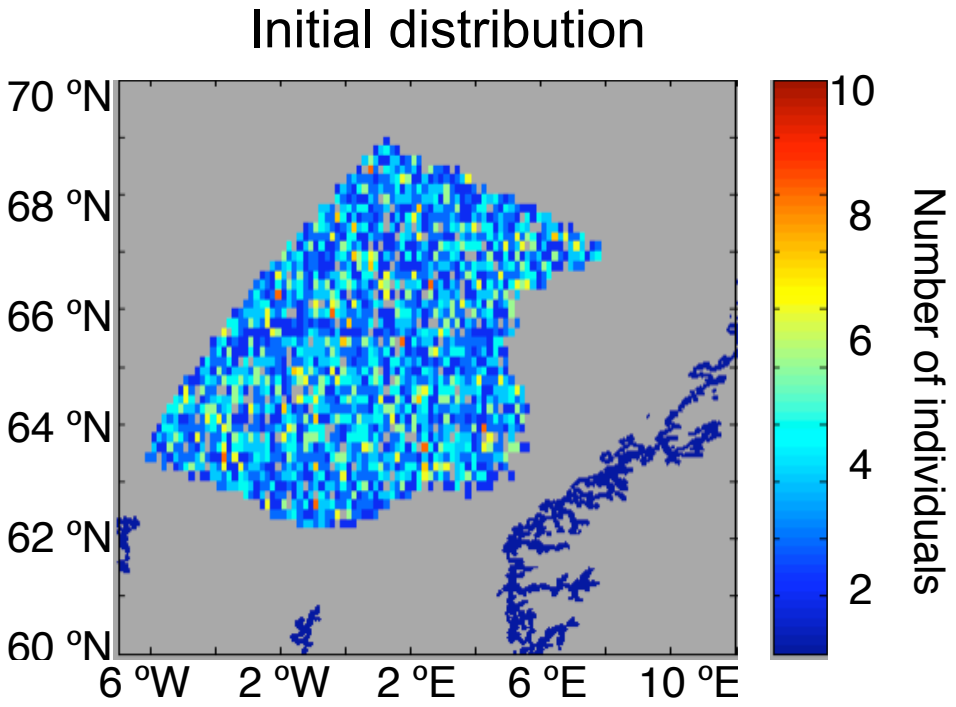
# Model setup - individual based model

- The individuals are treated as passive 3D Lagrangian floats.
  - Use the HYCOM floats code for transport.
- The individuals have vertical behavior, both annual and diurnal.

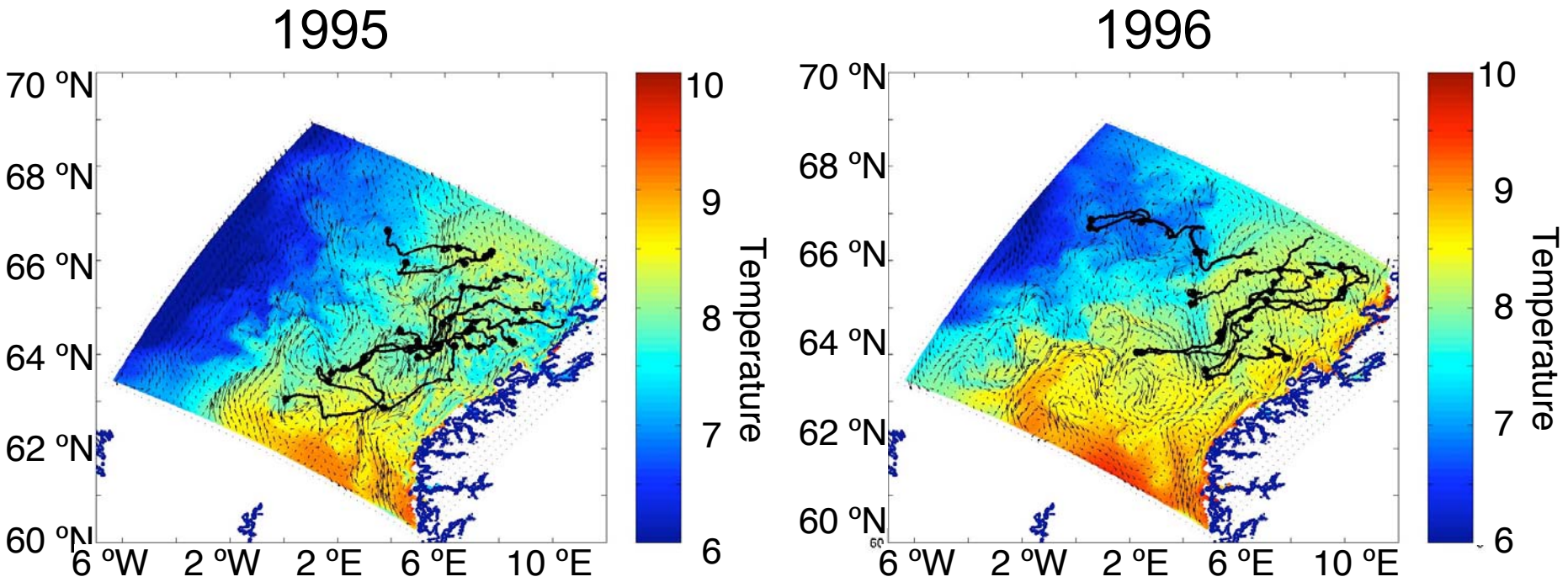


# Model setup - individual based model

- Super-individuals
  - number of individuals
  - age
  - carbon content
- The individuals are initialized at depth between 680 and 780 m.
- Mortality is stage dependent
- Food availability is spatially constant, but varies temporally according to Longhurst 1988.



# **Experiment:** comparing shelf recruitment in 1995 and 1996



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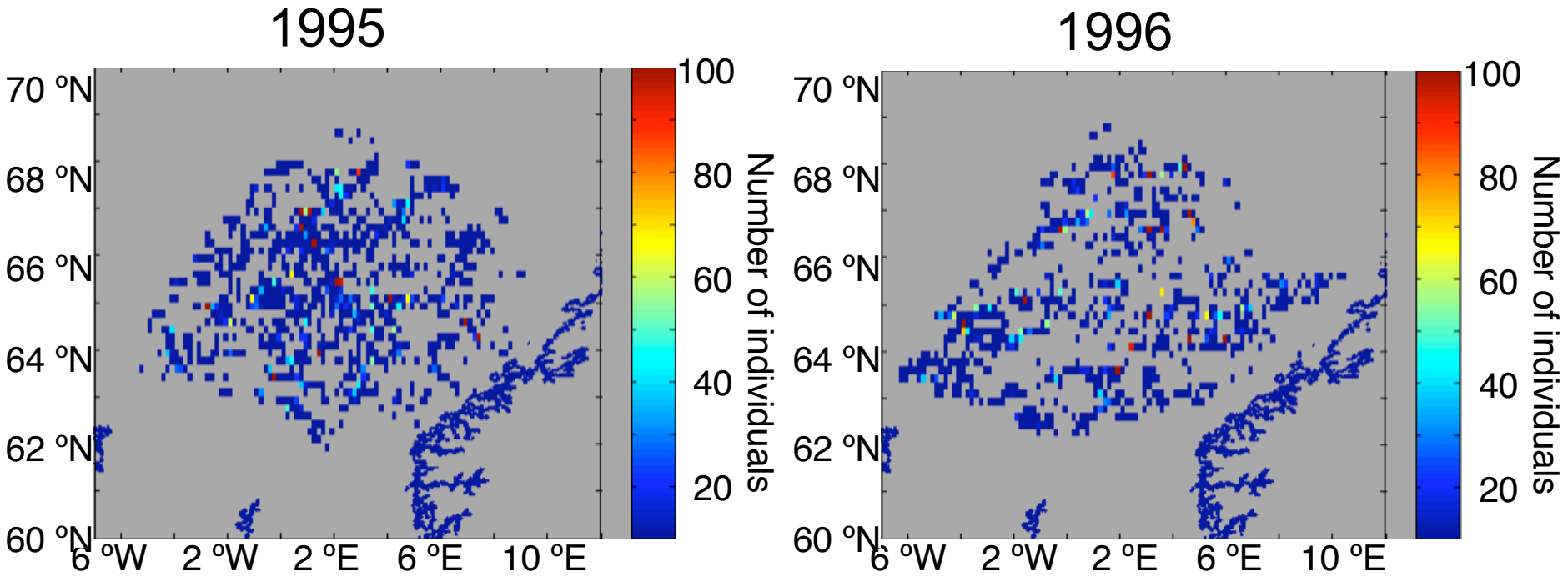
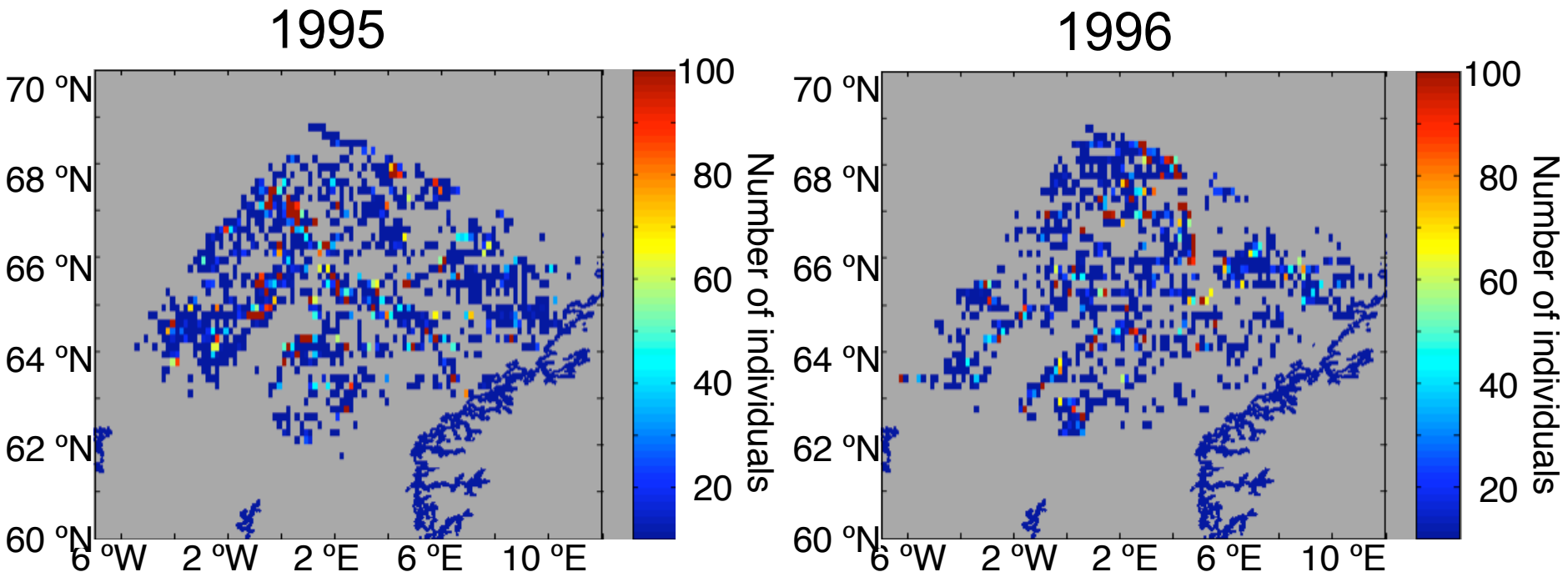


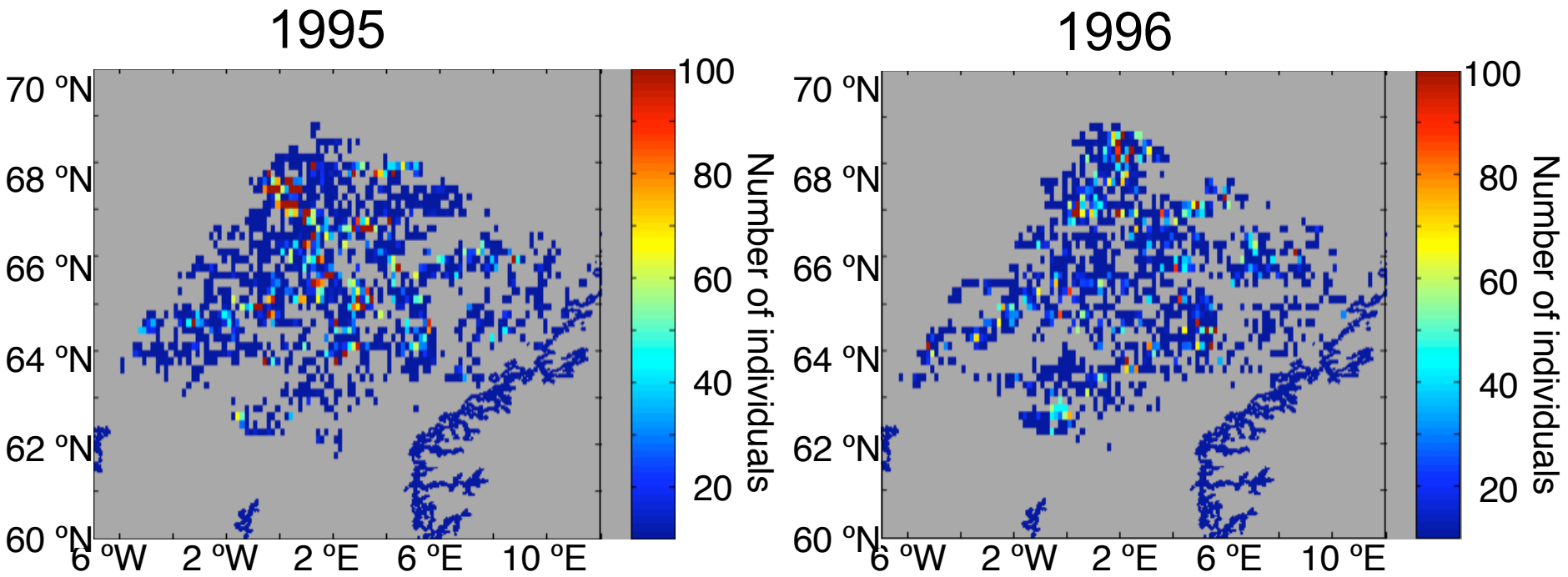

Distribution of individuals - day 100

# **Experiment:** comparing shelf recruitment in 1995 and 1996



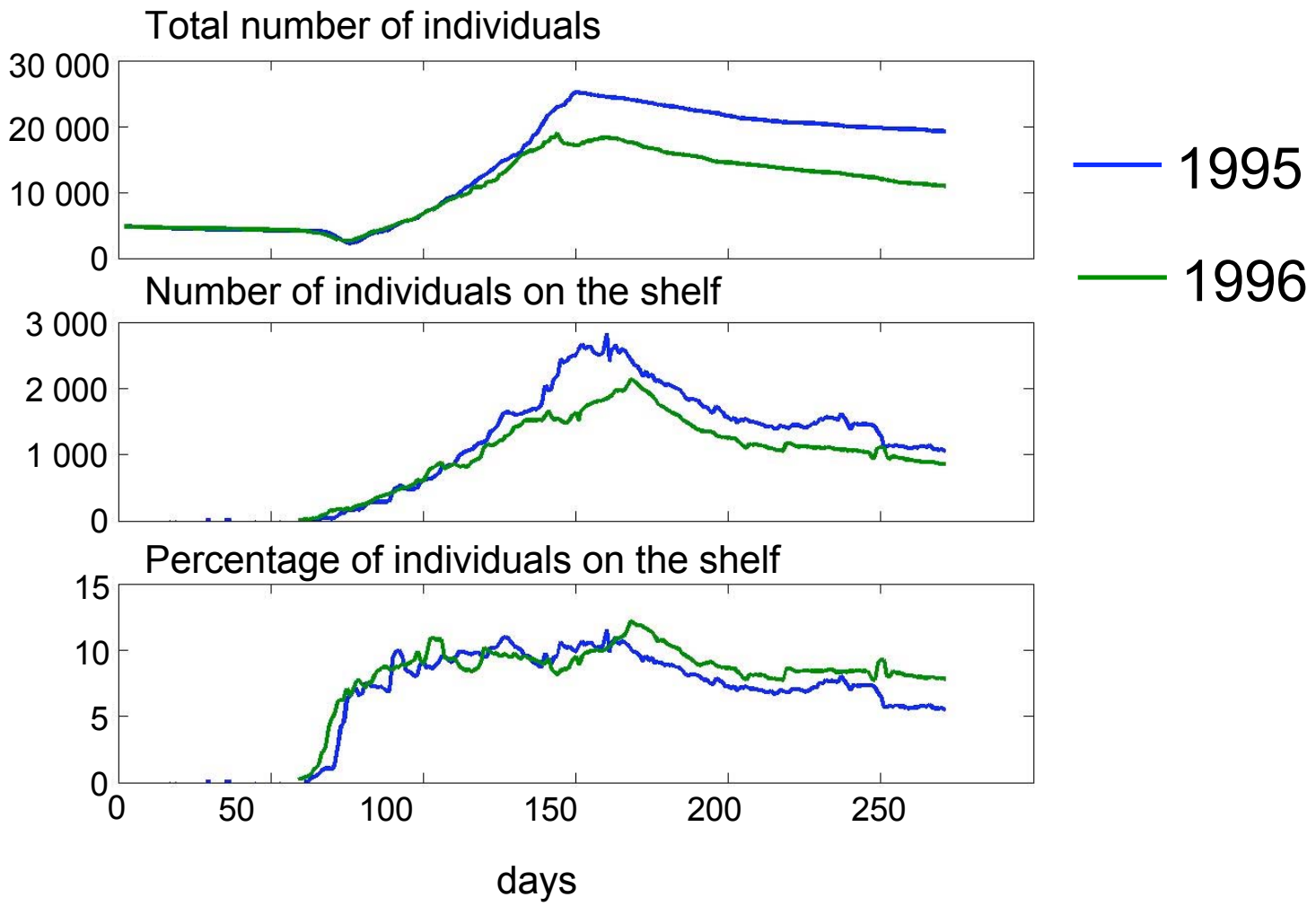

Distribution of individuals - day 150

# **Experiment:** comparing shelf recruitment in 1995 and 1996

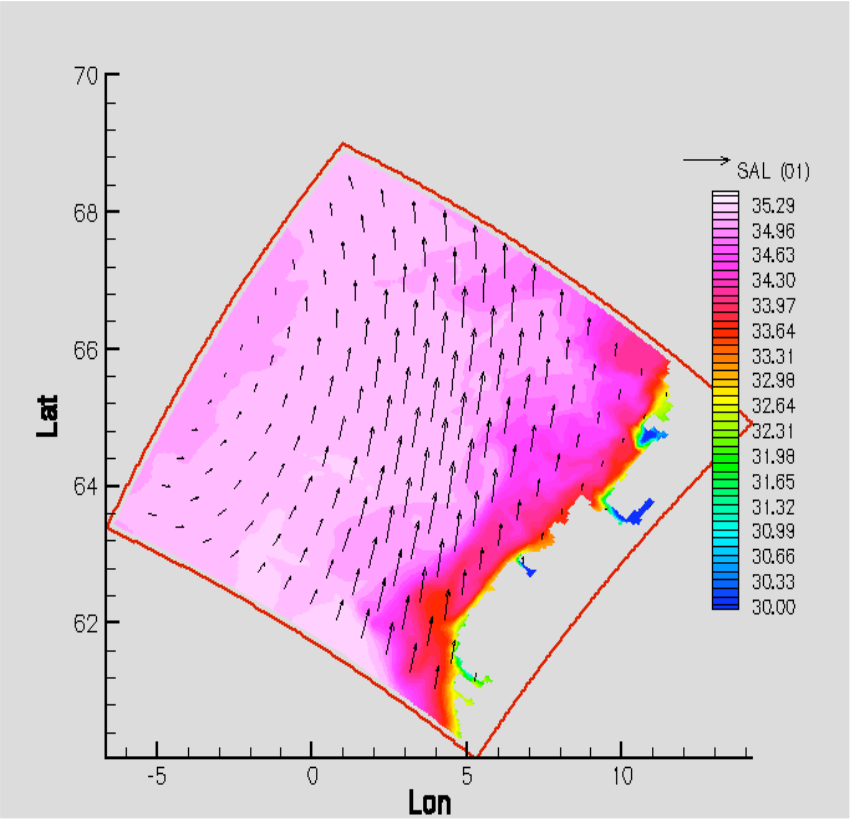


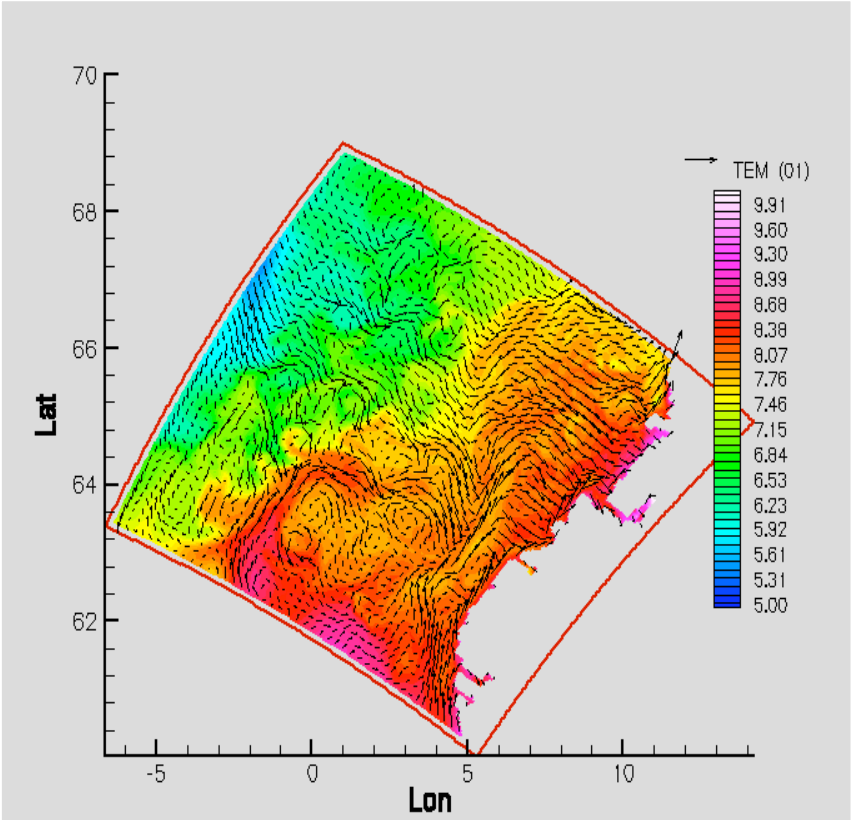

Distribution of individuals - day 200

# **Experiment:** comparing shelf recruitment in 1995 and 1996



# Wind and currents on 3. June 1996

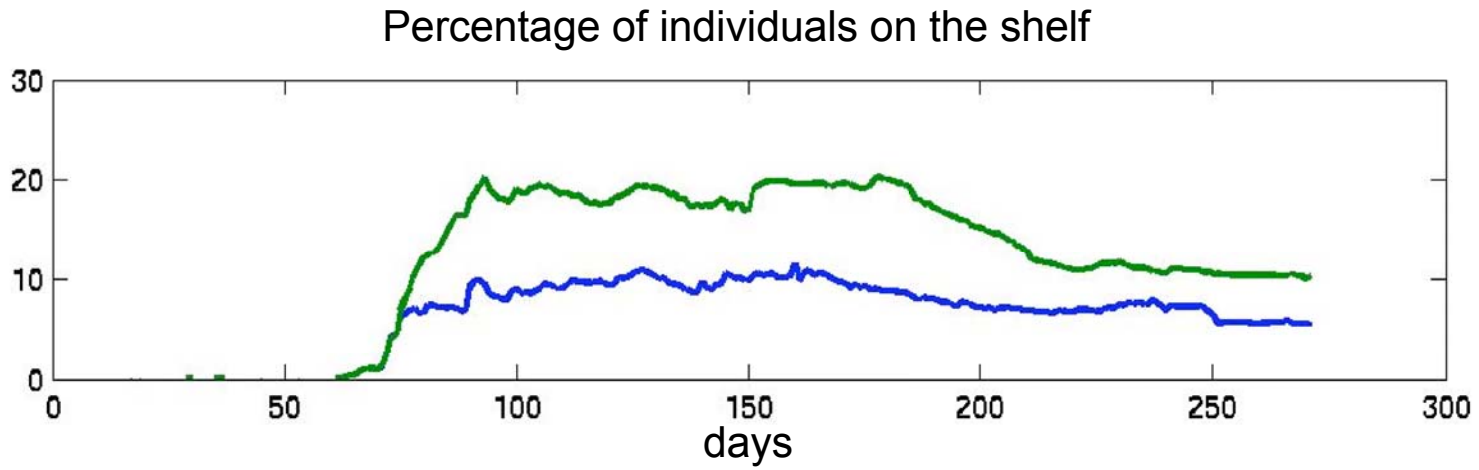


# Conclusions

- There are more individuals in the domain in 1995 because more individuals are advected out of the area in 1996.
- Shelf recruitment is larger in the first half of 1995 and the second half of 1996.
- A strong southerly wind event in 1996 lead to increased number of individuals on the shelf.

# **Experiment II:** Spring bloom occurs earlier on the shelf.




Even distribution of food

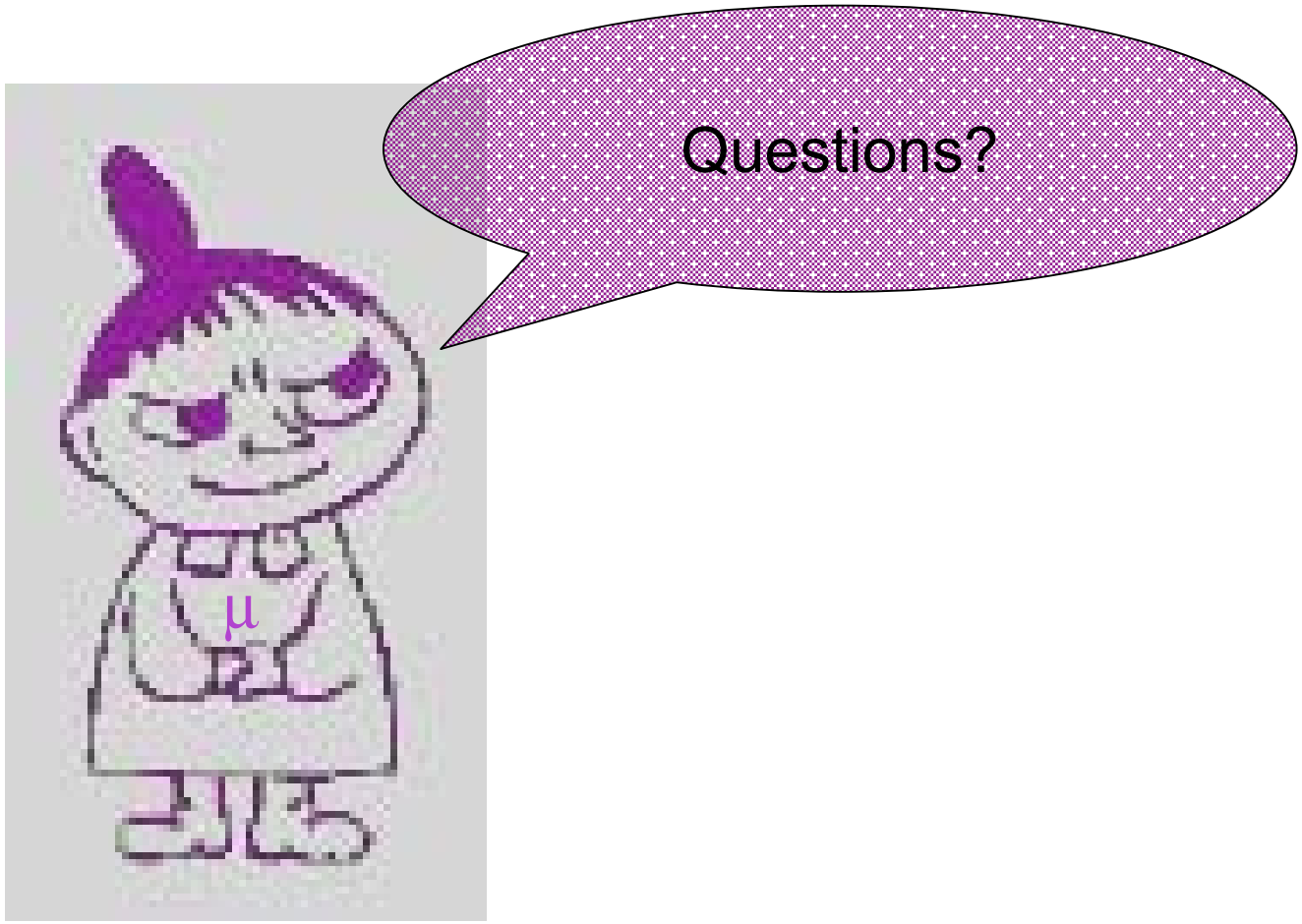
Spring bloom occurs earlier on the shelf

# Future work

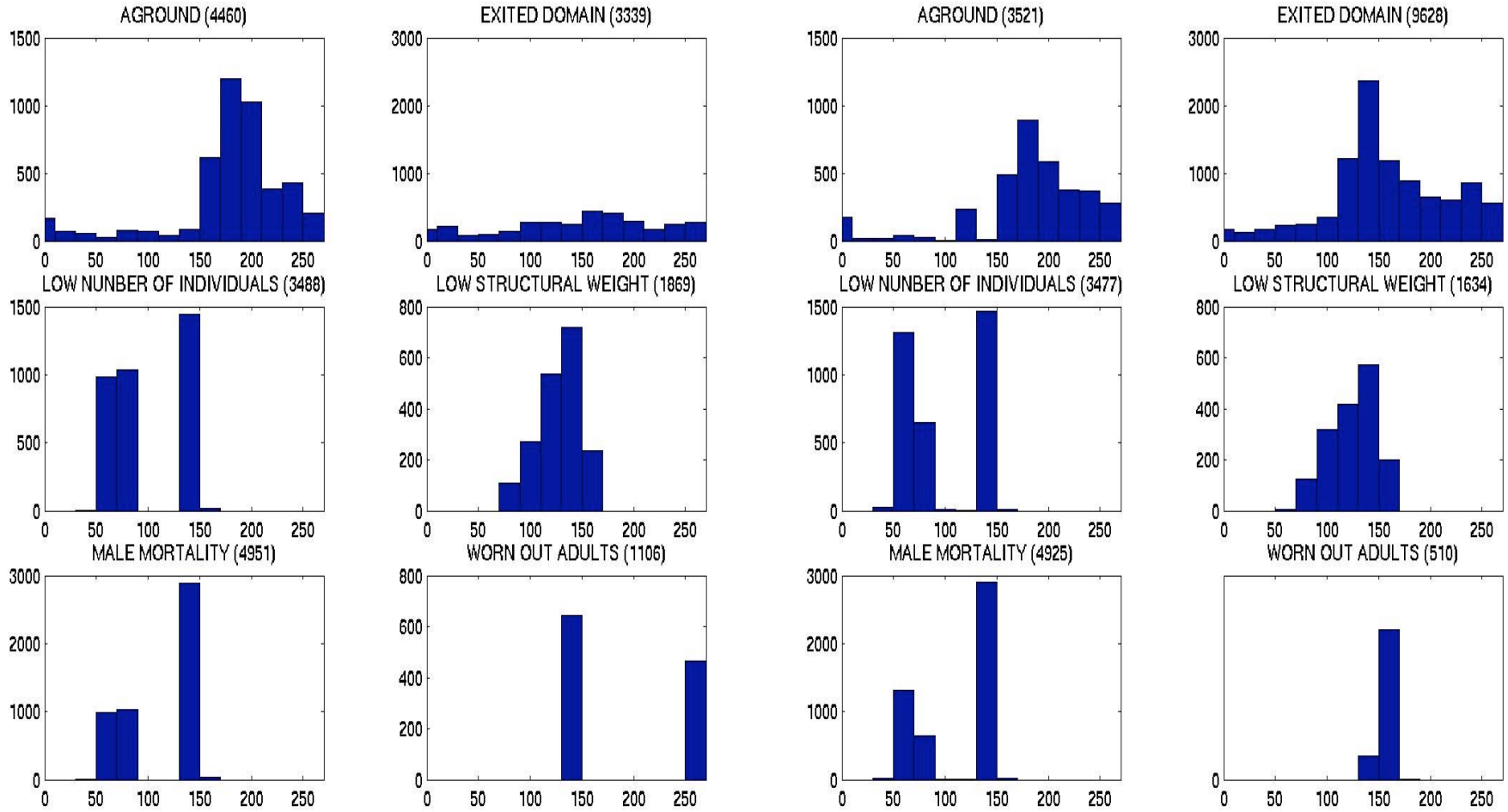
- Import food availability from primary productivity model
- Initialize in a density layer(s).
- Inflow/outflow at the boundaries.
- Investigate the influence of the timing of the spring bloom/ascent on the recruitment.
- Model validation

# Problems

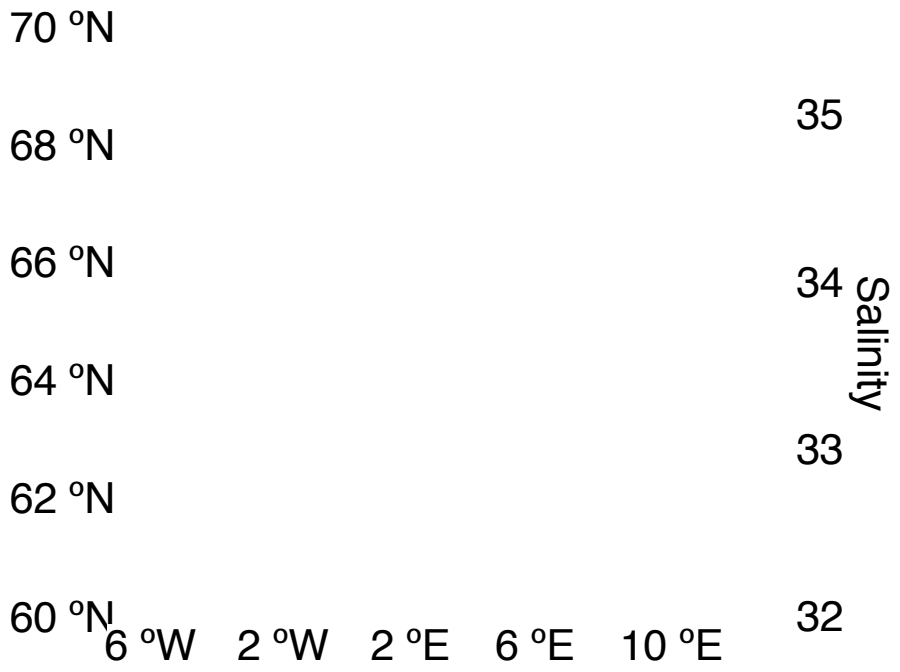
- Individuals get stuck in the bottom and “die”.
- Occasionally the individuals/floats do large vertical jumps.


Questions?
μ

# Mortality


AGROUND (4460)
EXITED DOMAIN (3339)
AGROUND (3521)
EXITED DOMAIN (9628)
LOW NUNBER OF INDIVIDUALS (3488)
LOW STRUCTURAL WEIGHT (1869)
LOW NUNBER OF INDIVIDUALS (3477)
LOW STRUCTURAL WEIGHT (1634)
MALE MORTALITY (4951)
WORN OUT ADULTS (1106)
MALE MORTALITY (4925)
WORN OUT ADULTS (510)

# Problems


70 ºN
68 ºN
66 ºN
64 ºN
62 ºN
60 ºN
6 ºW
2 ºW
2 ºE
6 ºE
10 ºE
35
34
33
32
Salinity