

Modeli za predviđanje utjecaja klimatskih promjena na ribarstvo

Zakon očuvanja ribarstva

DOBIT

>

TROŠAK

Socio-
ekonomski

Tehnološki

Fizikalni

Biološki

Čega ima, i koliko?

Vrste

- Izumiranje

- Prelov

- Uništavanje staništa
(fizikalno, kemijski,
biološki...)

- Invazije

- Globalizacija

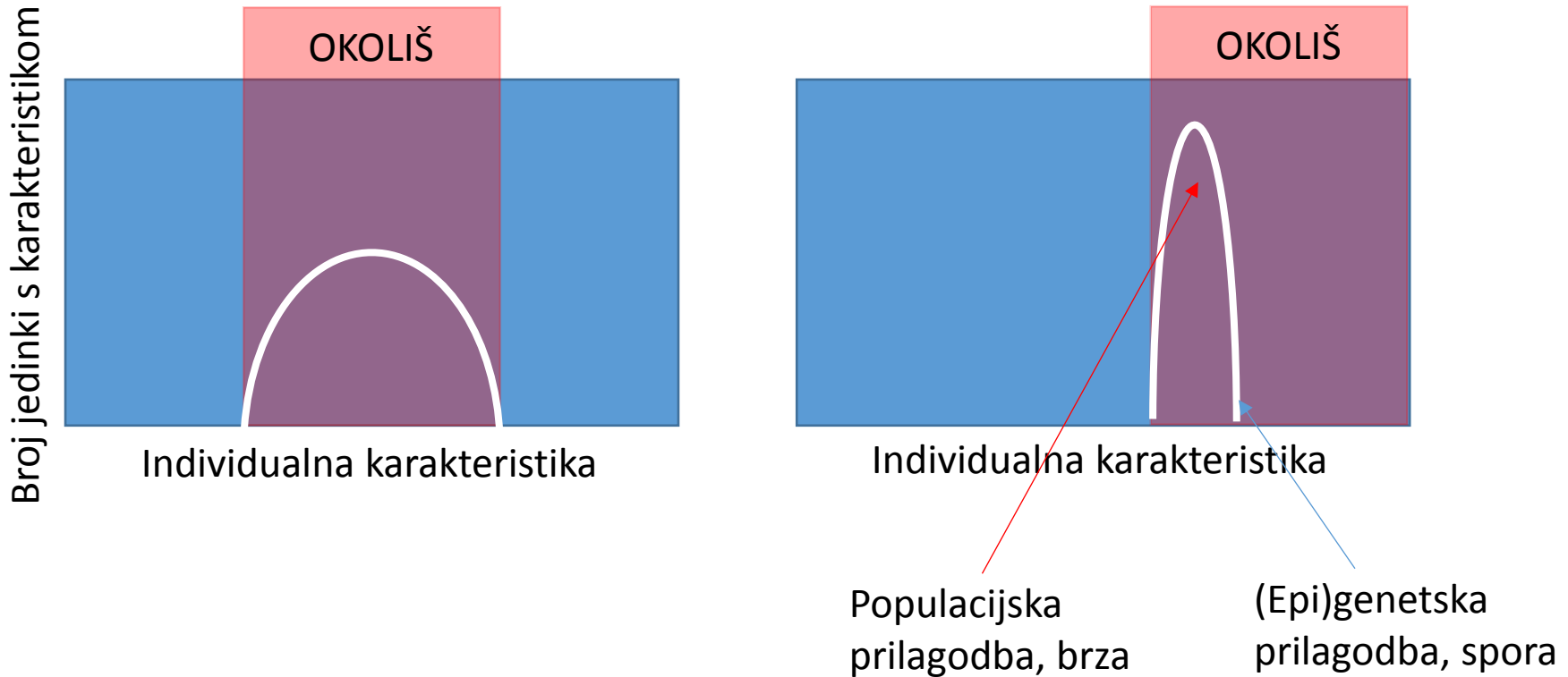
- Stvaranje novih
ekoloških niša

Evolucijska prilagodba
(evolutionary rescue)

Istiskanje natjecanjem
(competitive exclusion)

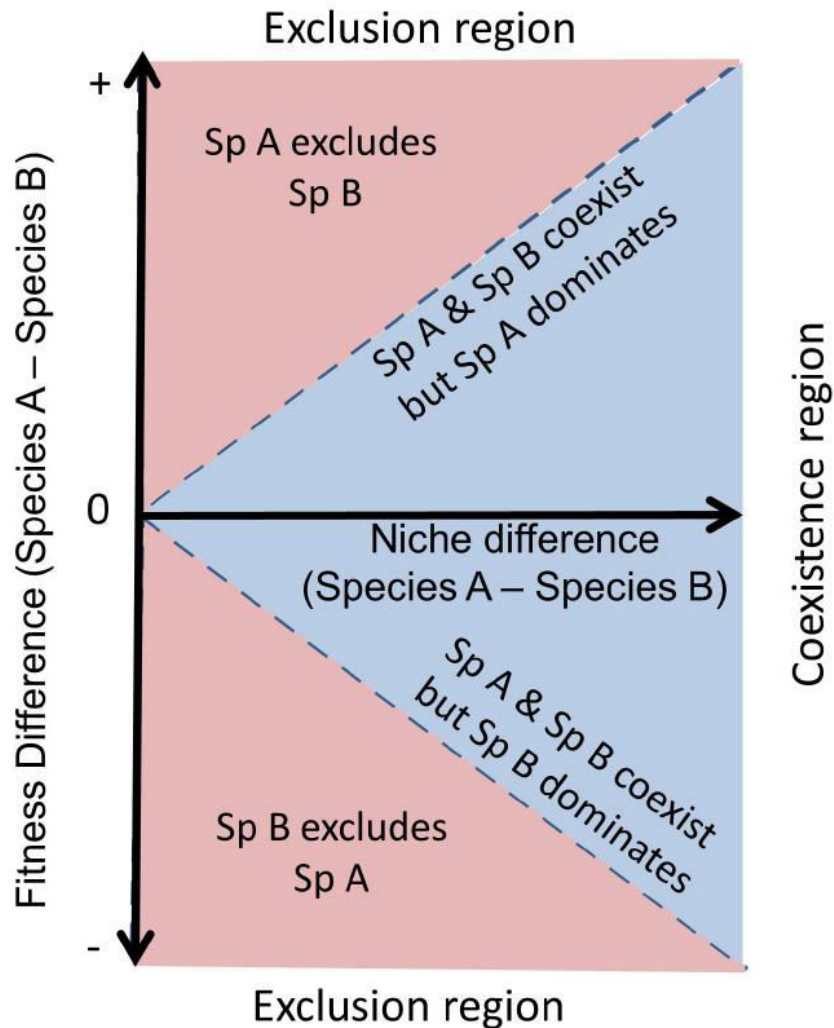
Evolucijska prilagodba

Brzina promjene u okolišu < brzine prilagodbe



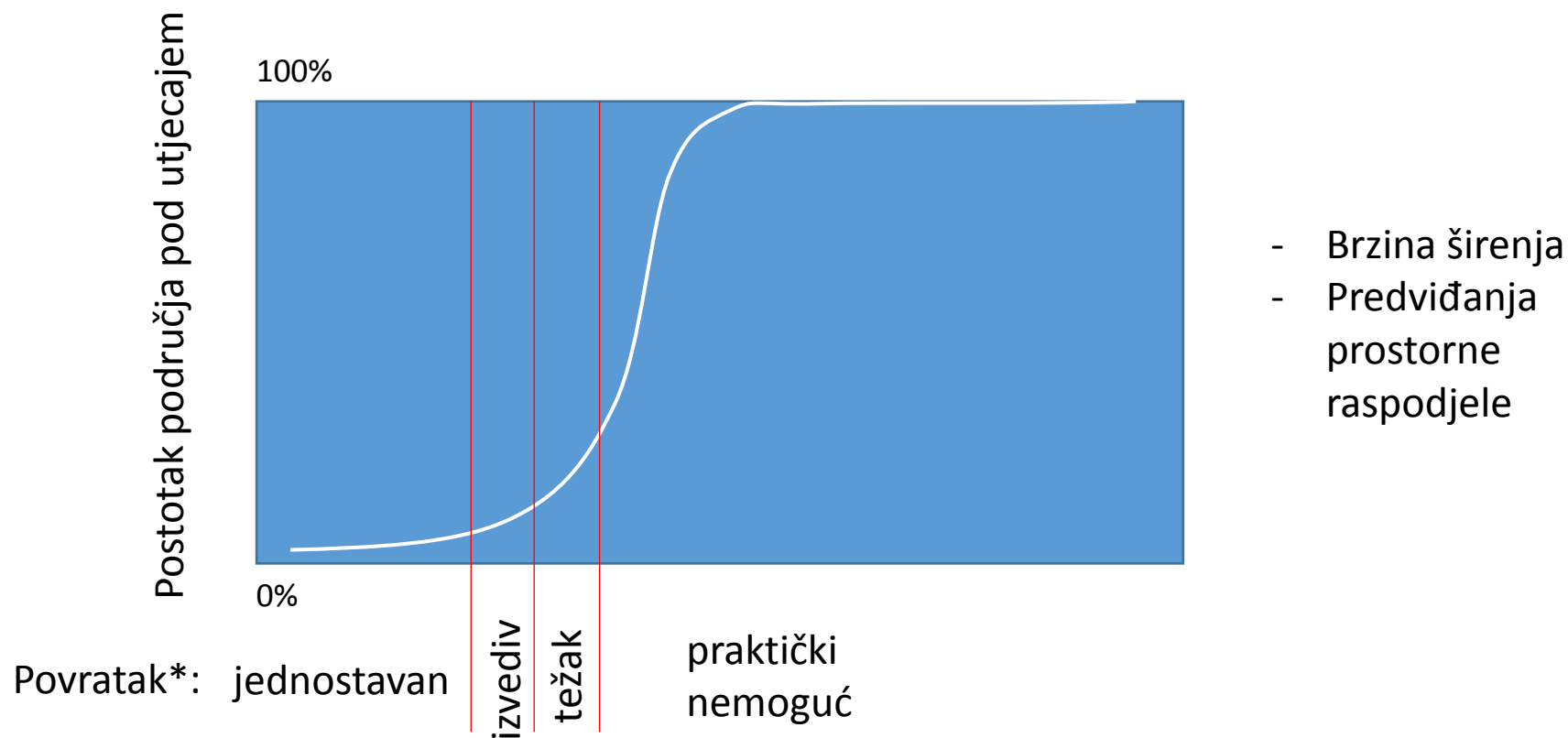
Procjena brzine promjene okoliša i prilagodbe

Istiskanje natjecanjem



Ovisi o karakteristikama
vrste i okoliša

Invazije



*u nepromijenjenom okolišu

Mogućnost „promjene faze”



Istočni Mediteran:

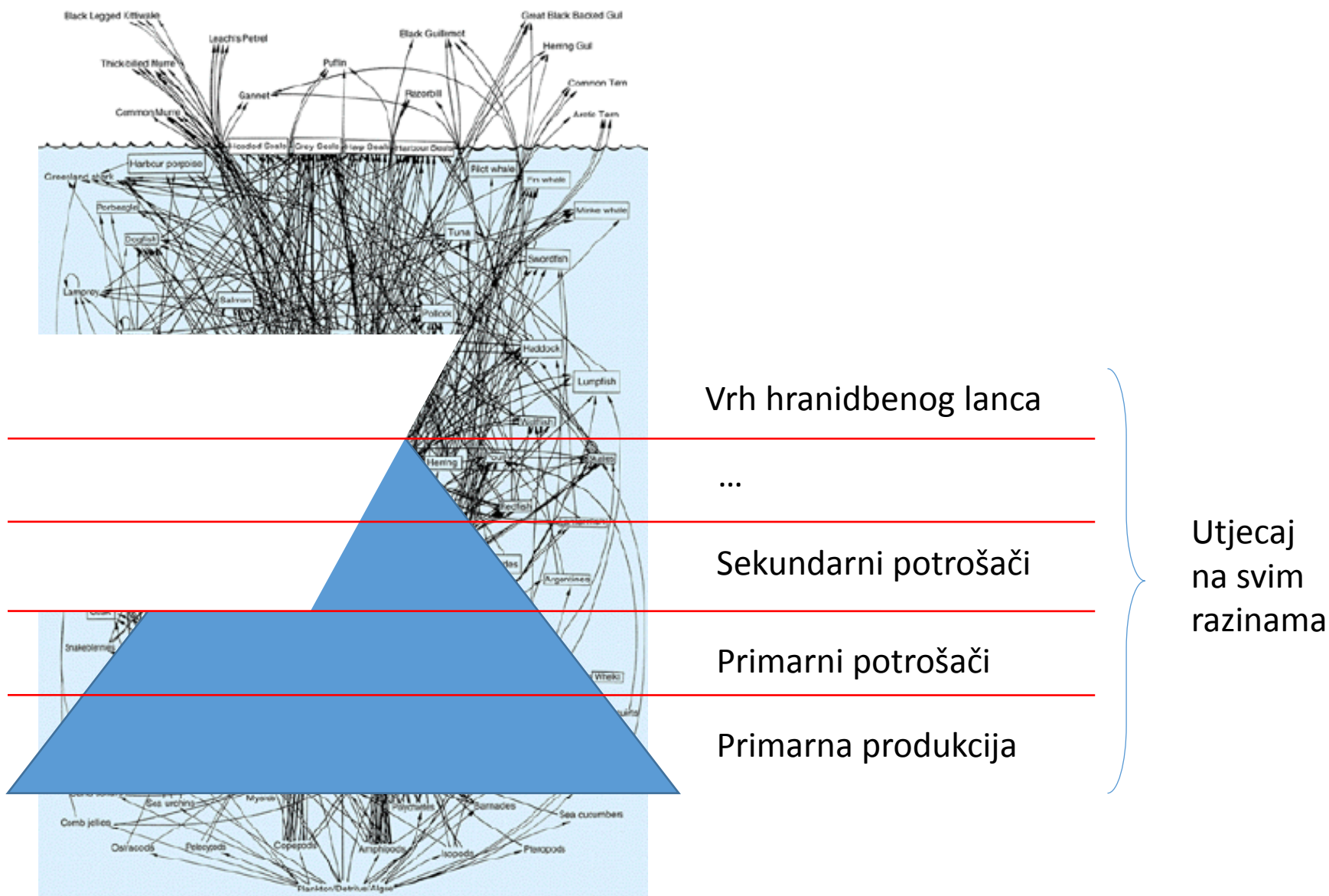
biomasa podmorja
60% manja,

diverzitet
40% manji

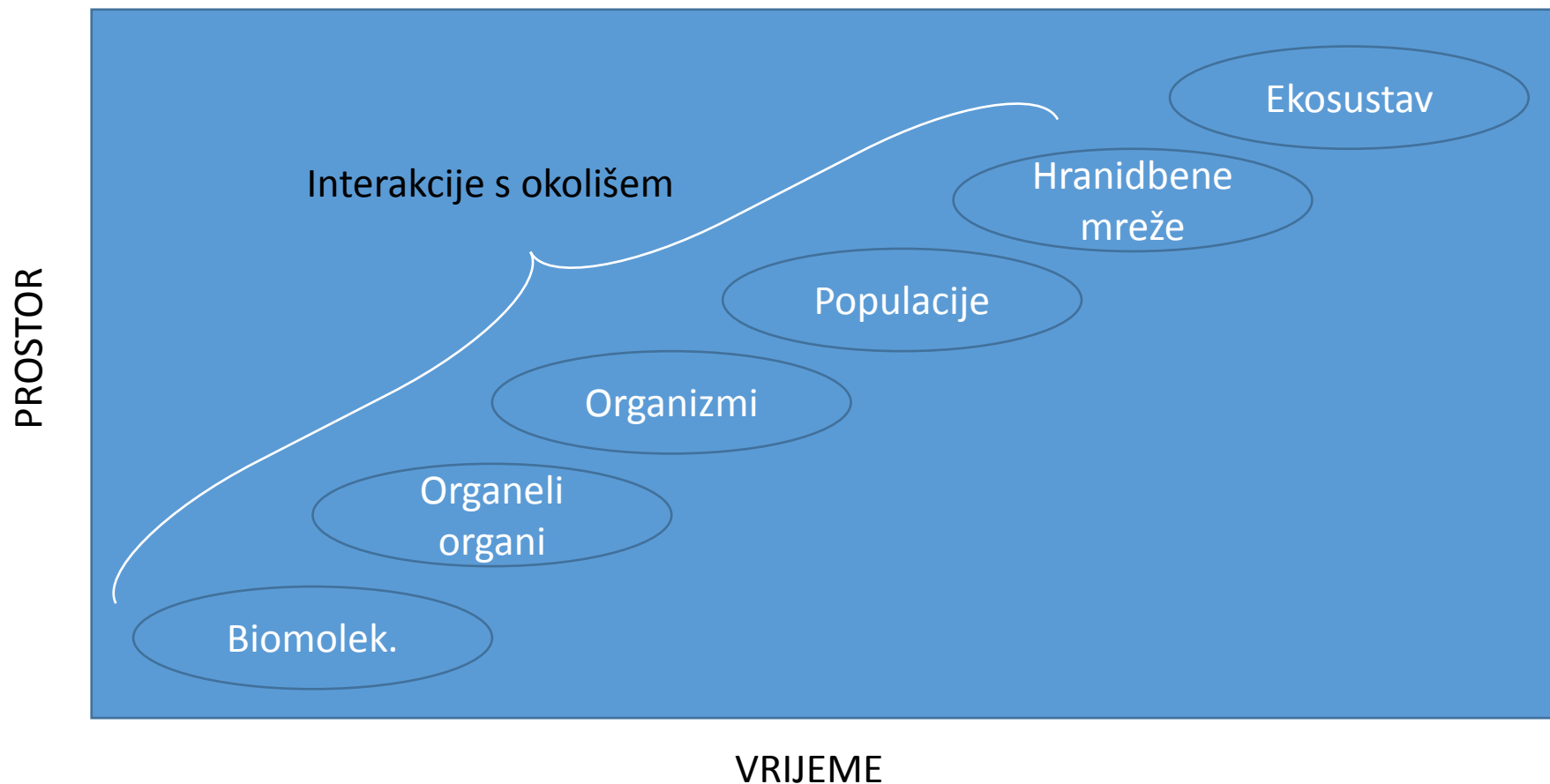
Biomasa

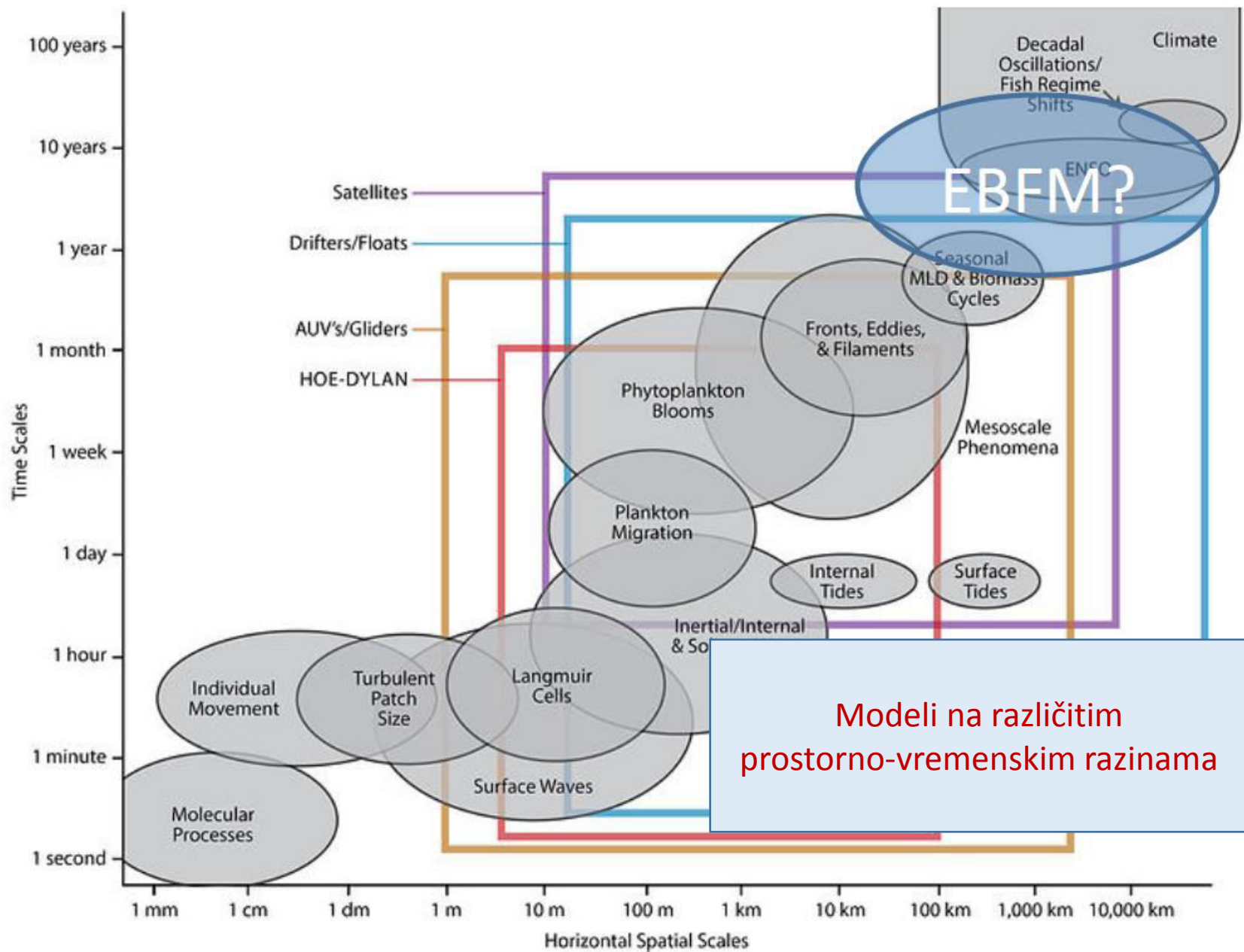
- Fizikalno-kemijske karakteristike okoliša
 - Brzina rasta
 - Mortalitet
 - Recruitment
- Biološki faktori
 - Karakteristike vrste
 - Dostupnost hrane
 - Izlov (uklj. predaciju)

Hranidbeni lanac



Povezivanje razina organizacije





Empirički vs. procesni modeli

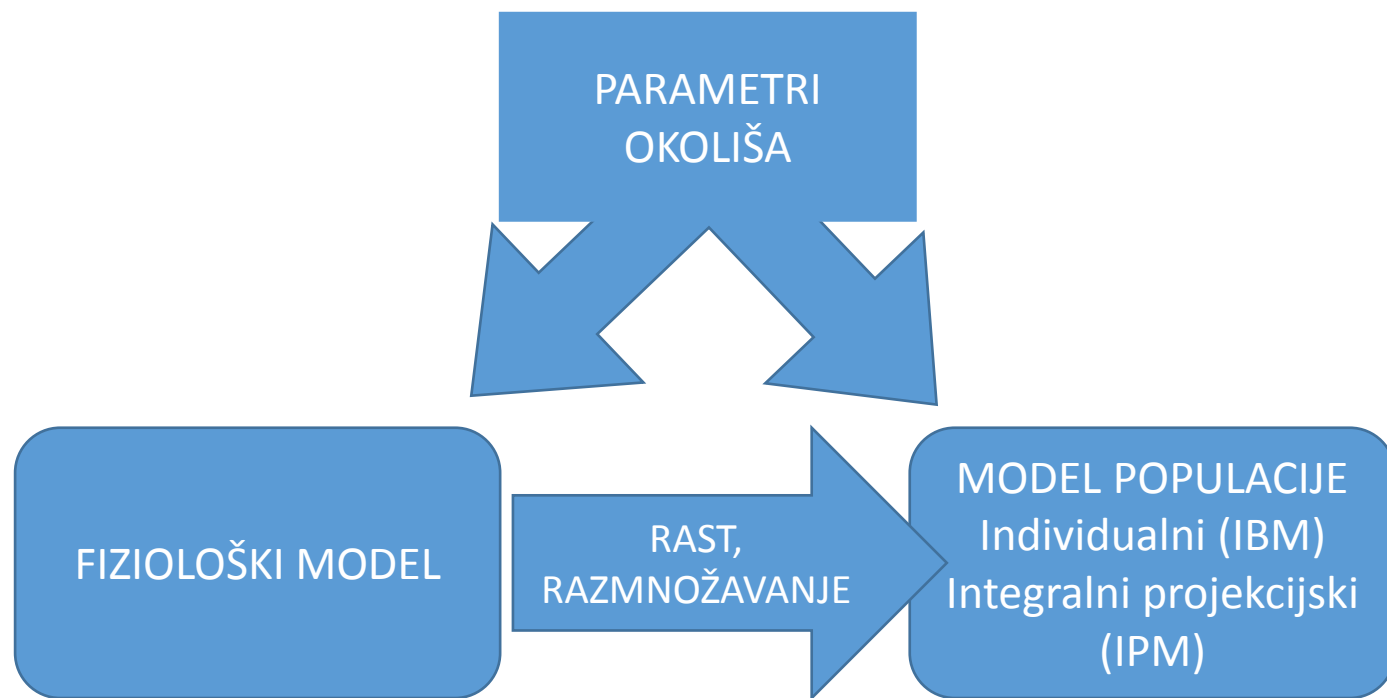
Empirički:

- Temeljeni na opaženim uzorcima
- Malo parametara
- Statistički pristupi
- Potrebna velika količina podataka
- Teško se asimiliraju različiti tipovi podataka
- Ekstrapolacija ovisi isključivo o podacima

Procesni:

- Temeljeni na poznavanju procesa
- Više parametara
- Simulacije
- Asimiliraju disparatne izvore podataka
- Ekstrapolacija ovisi o poznavanju procesa i podacima

Povezivanje do razine populacije

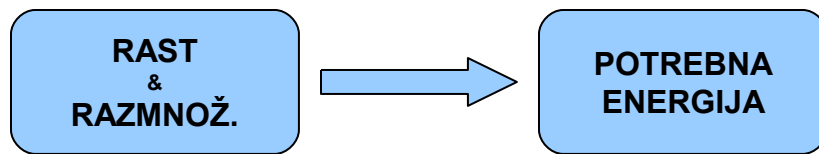


>400 vrsta
Besplatni alati
30 g razvoja

DEB-IBM od 2006.
DEB-IPM od 2016.

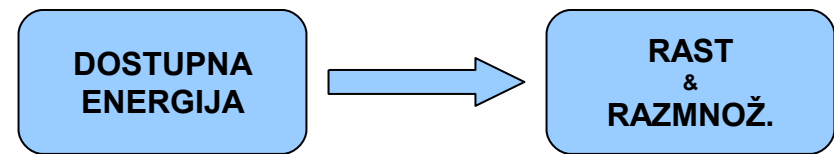
Fiziološki model

Potražni (Demand-side)



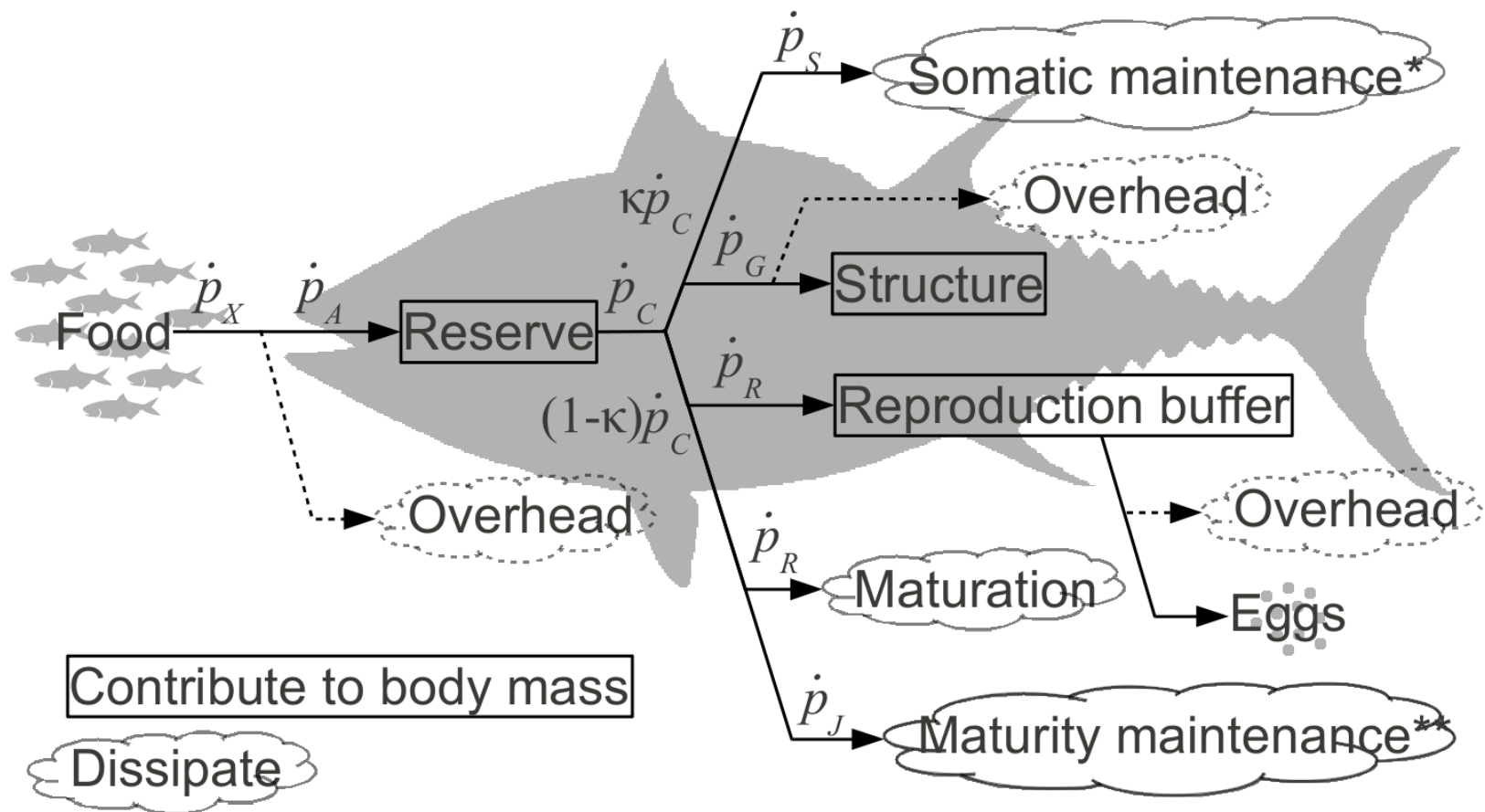
- Energijske potrebe izračunate iz opažanja
- Organizam dobija svu potrebnu energiju
- Neprikladno pri promjenjivoj akviziciji i potrošnji energije
- Najčešće samo jedna varijabla (veliki mršavi) = (mali debeli)

Ponudni (Supply-side)



- Rast i razmnožavanje funkcija su
 - Prikupljene energije
 - Potrošnje energije (kretanje, metabolički procesi, osmotska regulacija)
- Mehanistički

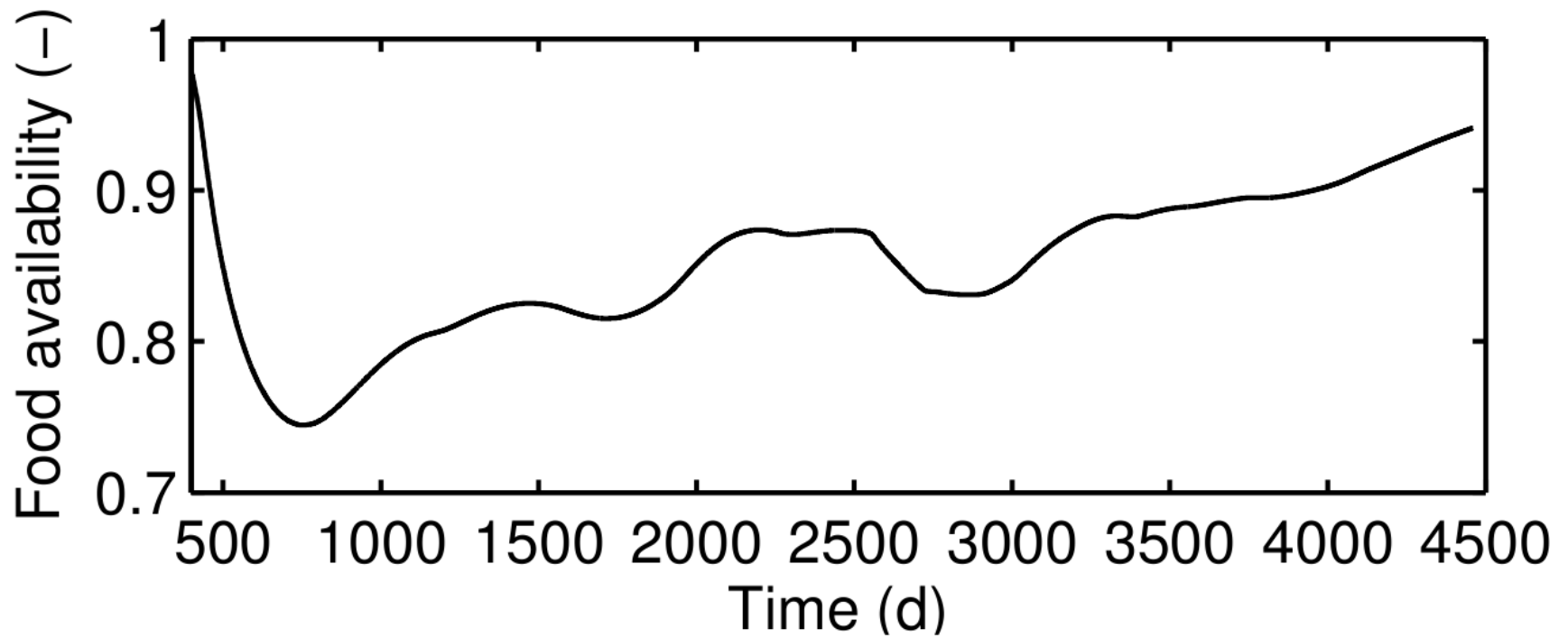
Dinamički energijski budžeti (DEB)



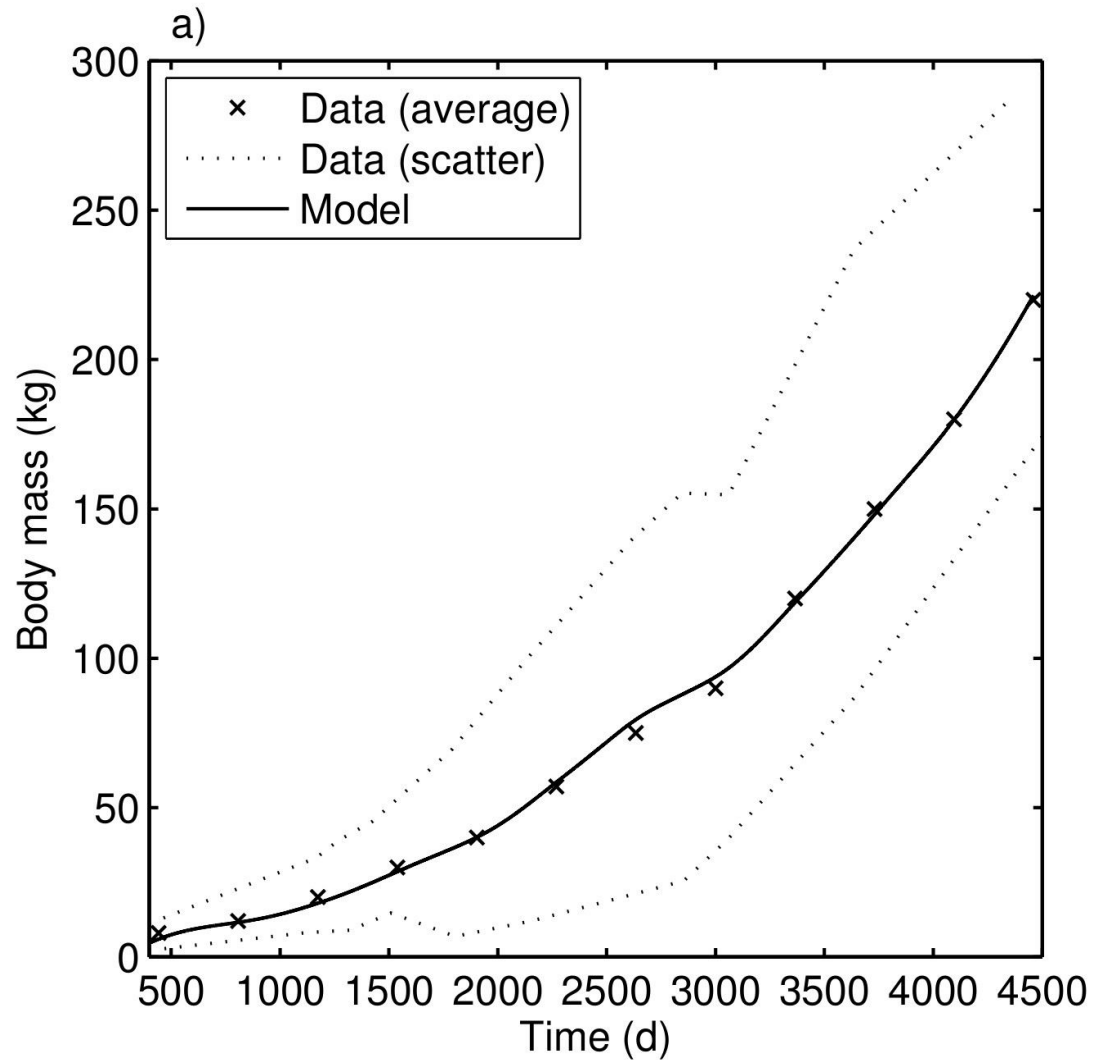
*Takes precedence over growth

**Takes precedence over maturation and reproduction

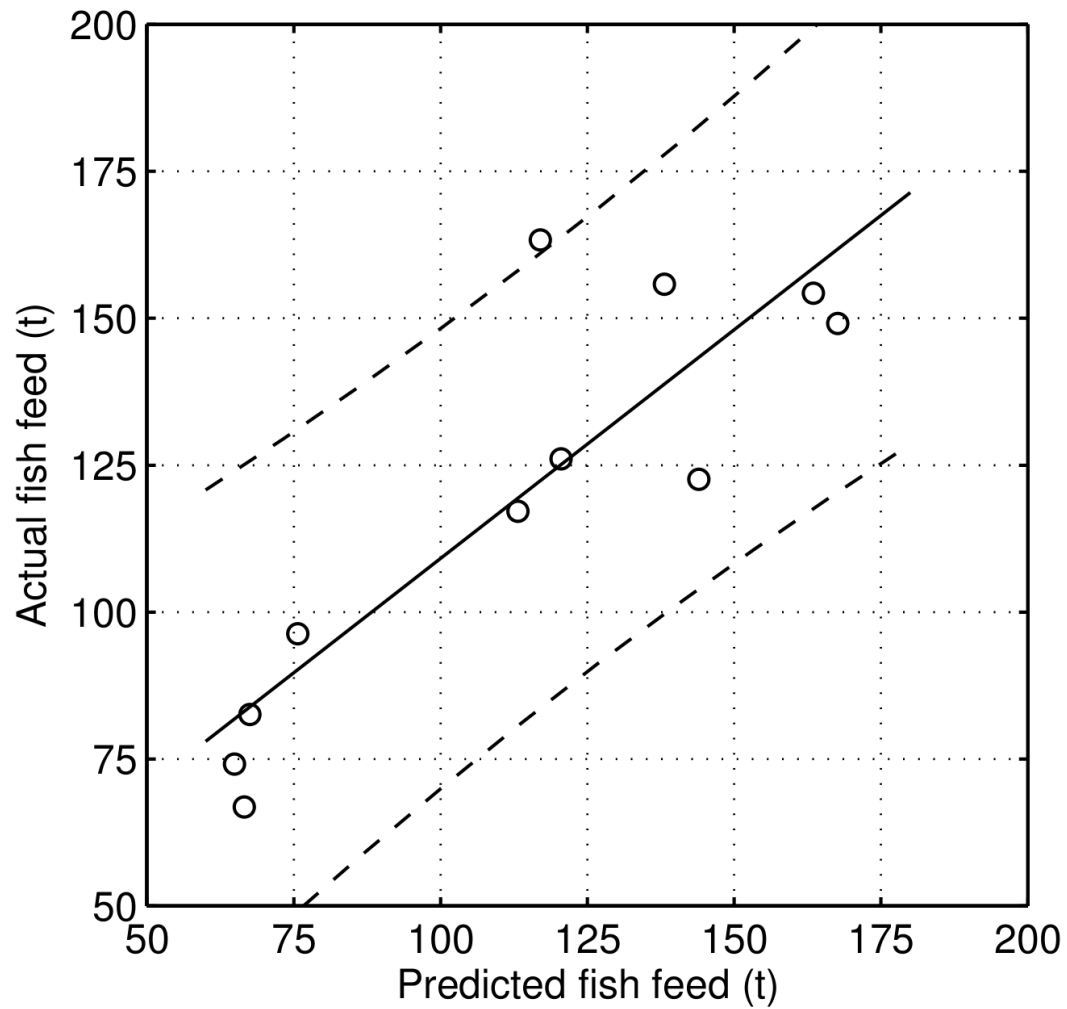
DEB model tune



DEB model tune



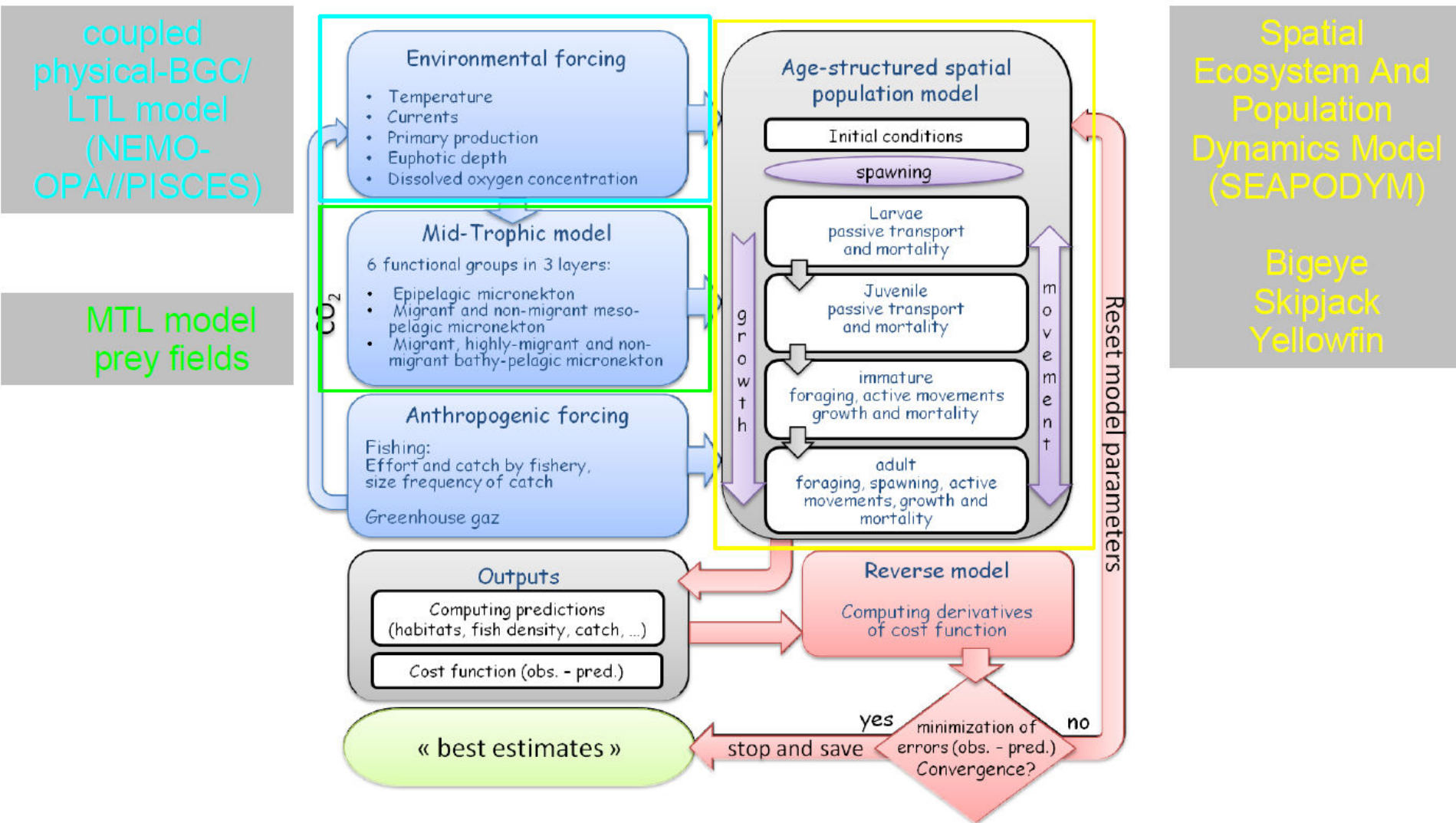
Inverzni DEB model tune



Povezivanje na razini ekosustava

- Ecopath with Ecosim
 - NOAA, 30g razvoja, 6000 korisnika, 500 publikacija
 - Koristi funkcionalne niše za simuliranje interakcija
 - Reciklaža hranjivih tvari
 - Ne daje rezultate za vrste (nego funkcionalne cjeline)
- MaxEnt (MAXimum ENTropy)
 - Modeliranje staništa iz opažanja prisutnosti neke vrste

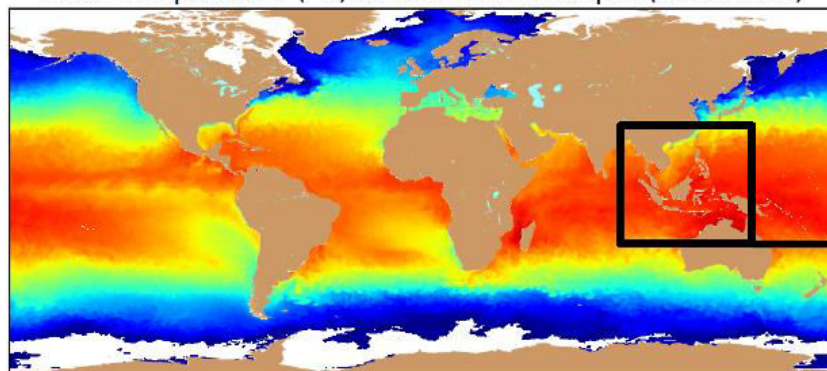
Integrated system for operational modeling of tuna



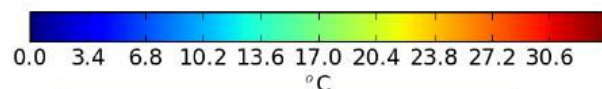
operational global model $\frac{1}{4}^\circ$ weekly forecast (MERCATOR OCEAN) (assim. of physical data)

coupled
Physical-
biogeochemical/
LTL model
(NEMO/PISCES)

Mean temperature ($^\circ\text{C}$) at 0.494025 m depth (20131231)



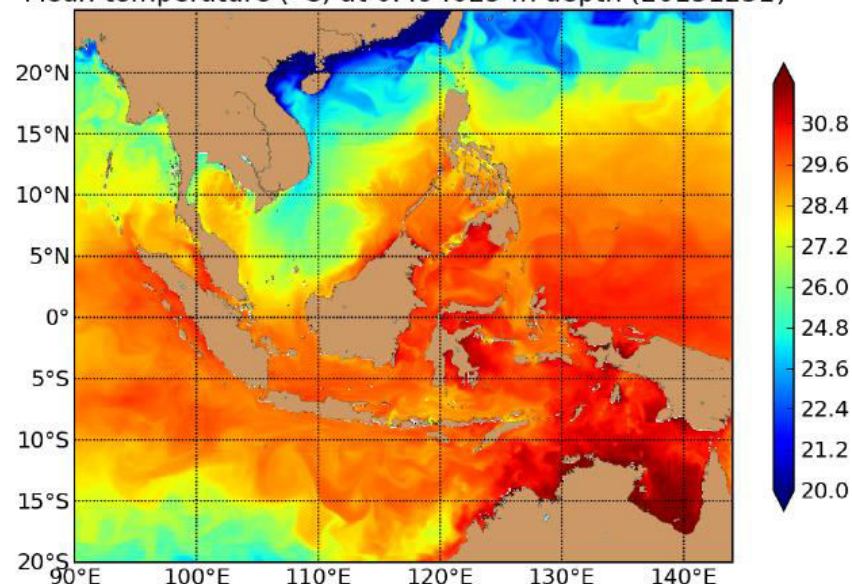
December 31, 2013



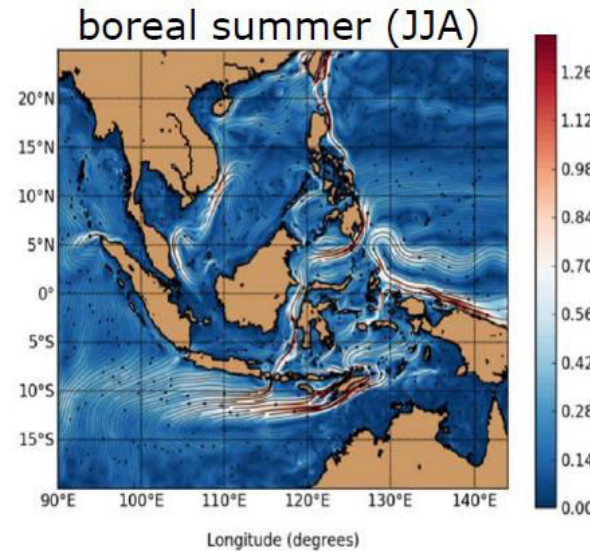
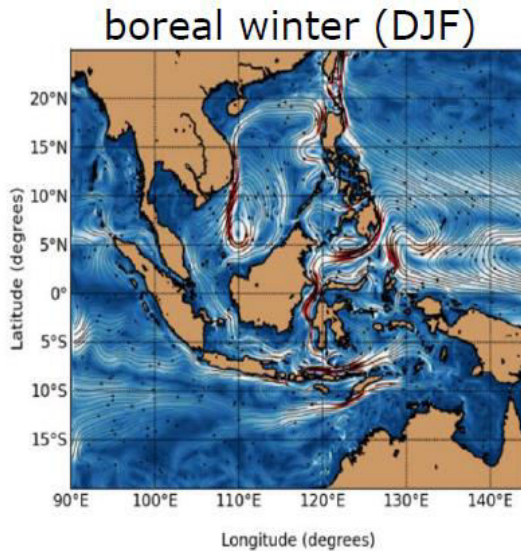
Regional model

$1/12^\circ \times 1\text{day}$
with Open
Boundaries
Conditions
provided from
global model

Mean temperature ($^\circ\text{C}$) at 0.494025 m depth (20131231)



environmental forcings

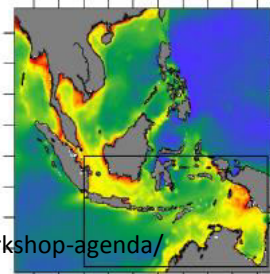
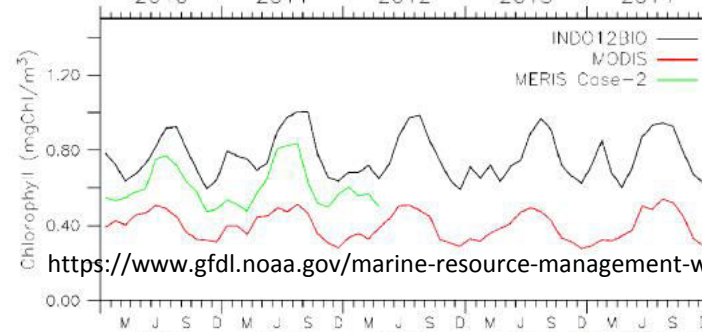
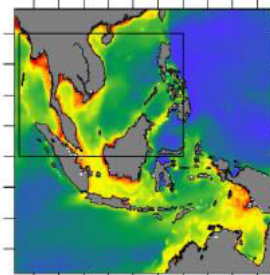
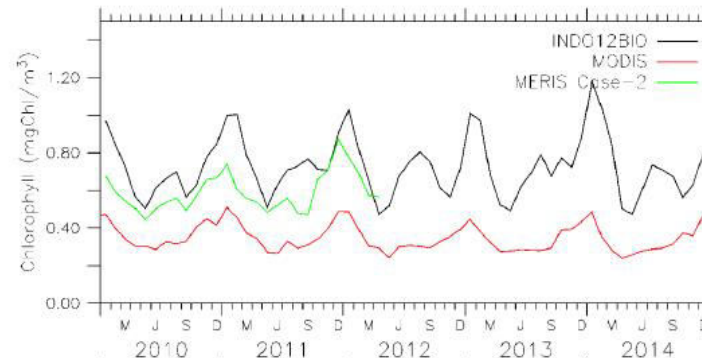


coupled
physical-
biogeochemical/
LTL model
(OPA/PISCES)

Mean Circulation at surface
(16 m depth)
during 2008-2013 period

Tranchant et al., in prep

Temporal variation of surface
chlorophyll-a concentrations
(mg Chl m⁻³)



PISCES biogeochemical model
(Aumont et al., 2015, GMDD) :

NPP, oxygen, euphotic depth

Spatial Ecosystem And POpulation DYnamics Model

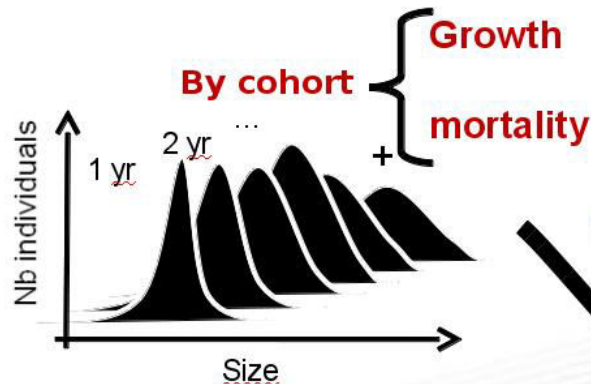
Model parameter Estimation (MLE)
(catch, size, acoustic and tagging data)



Lehodey et al. (2003,2008)
Senina et al (2008)
www.spc.int/ofp/seapodym/

Feeding habitat =
Abundance of prey (micronekton) x accessibility (T° , O_2)

Age structured population



Spawning success
Recruitment (passive drift)

Active movement to Spawning areas

Spawning habitat =
Temperature
Prey (zoopl.)
Predators (micronekton)

Fishing (catch; effort; size)

2 types of forcings of SEAPODYM

T, O_2 , PP, currents, mnk

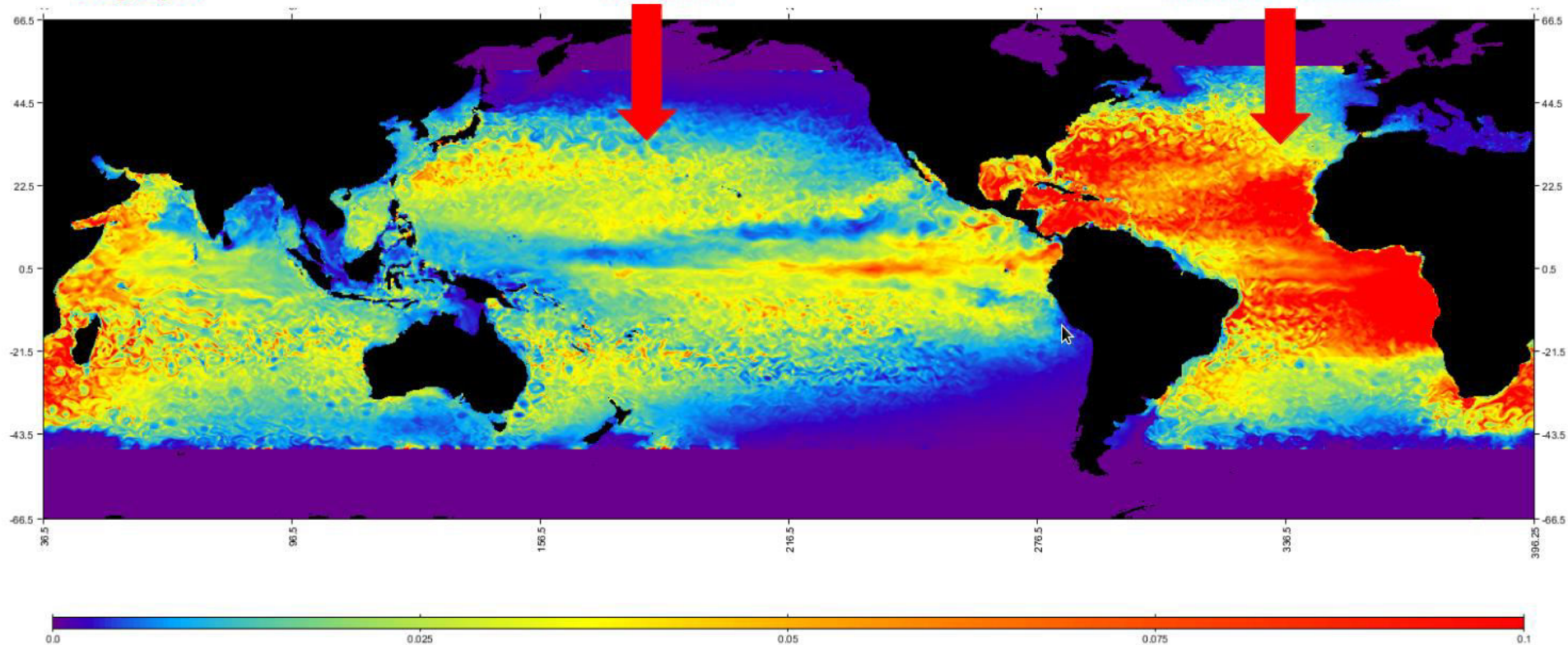
Step 2: Global operational model

Initial conditions (biomass and size structure distribution) including the historical impact of fishing are critical!

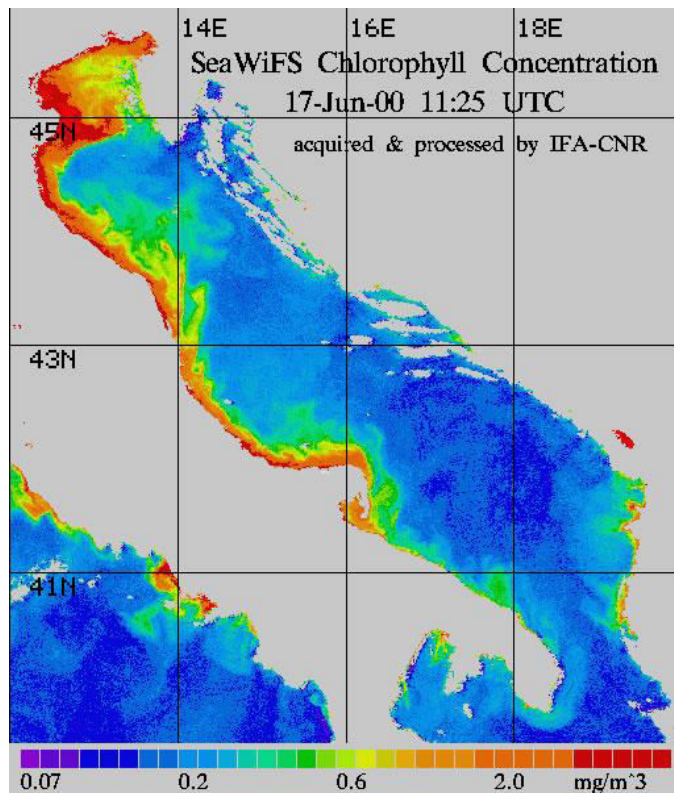
bigeye

Fishing

No fishing (virgin stock)



Jadran



<http://gos.ifa.rm.cnr.it/adricosm/tasks.html>

- Hidrodinamika
- Temperatura
- Salinitet
- Termoklina



Dinamika populacija
sardina i inćuna

(Vilibić i sur. 2016, Medit. Mar. Sci 17(1):1-12)

HVALA NA PAŽNJI!