

The Barents Sea ecosystem dynamics as coupled oscillators to long tides

Harald Yndestad



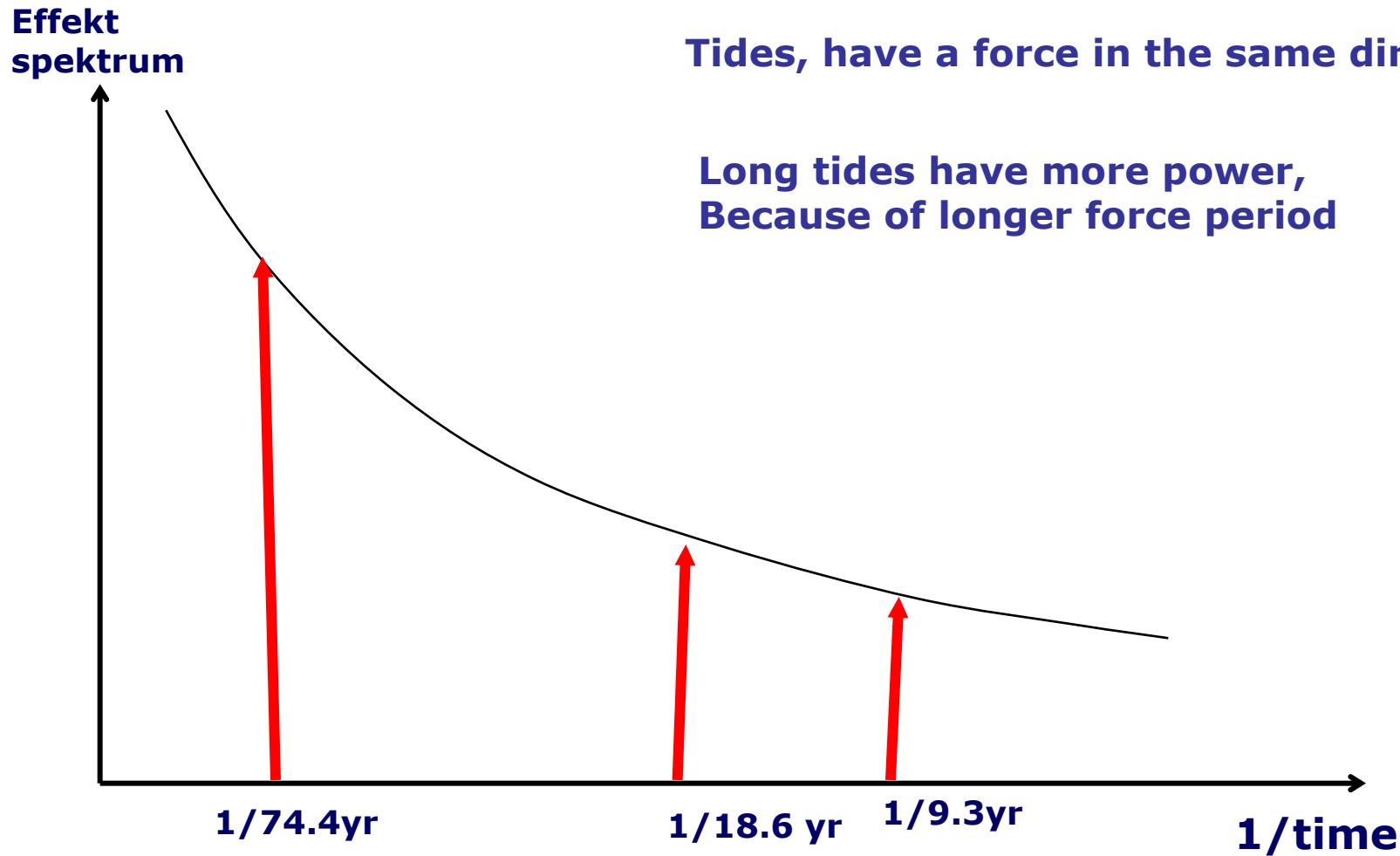
Why flower-power?



$$\text{Power} = \text{Force} \times \text{Time}$$

There is much power
in small forces,
when integrated,
over a long time,
in the same direction

Power spectrum of long tides

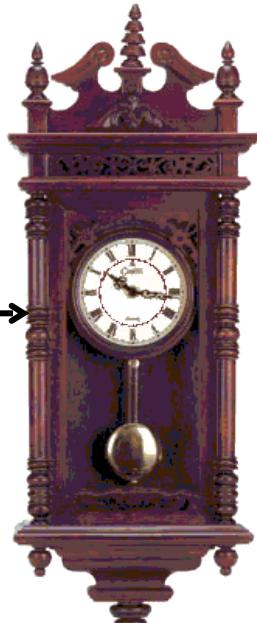
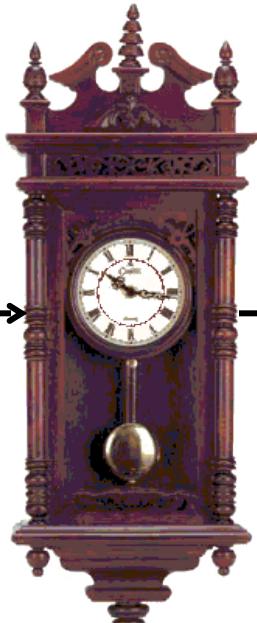


Nature as coupled oscillators

Gravity
forced tides

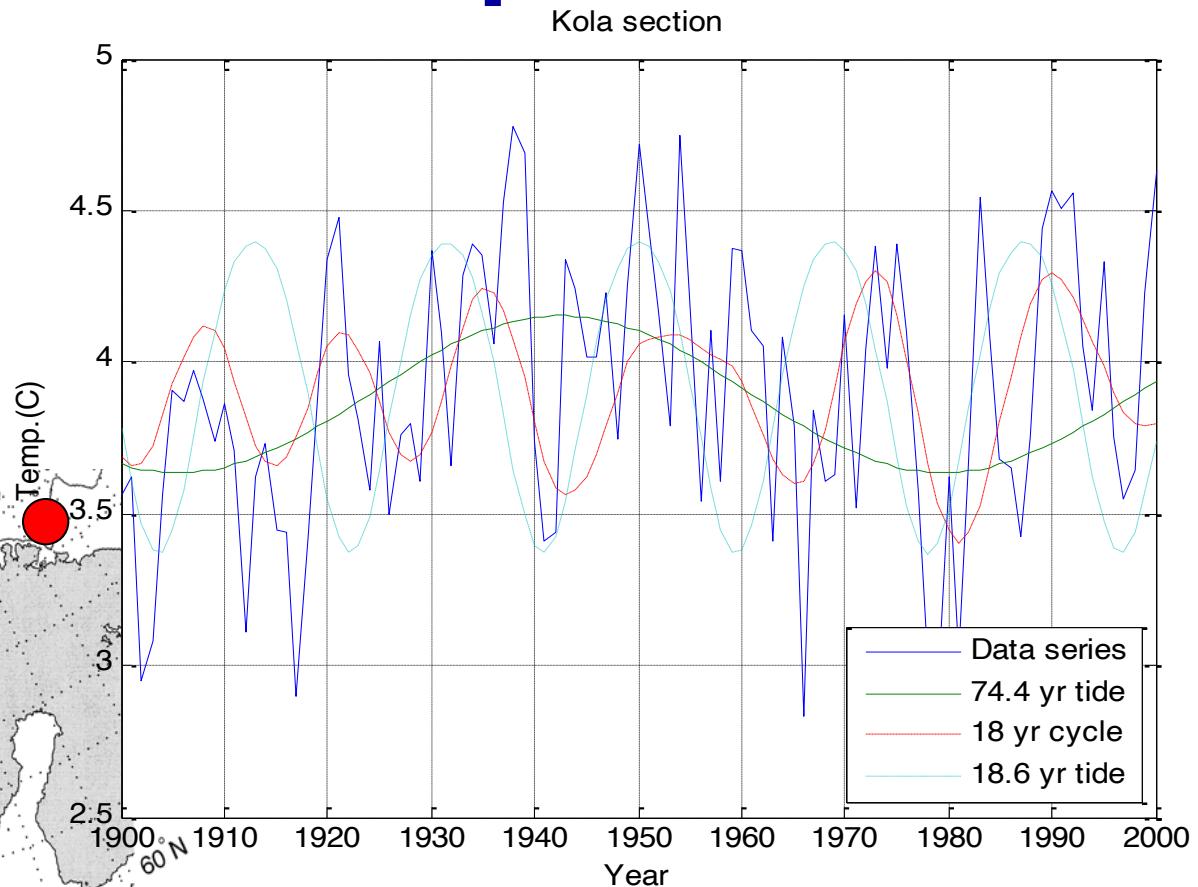
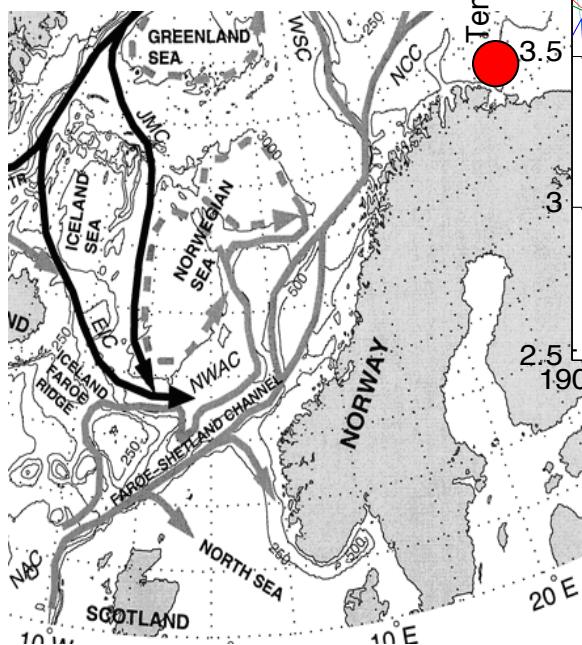
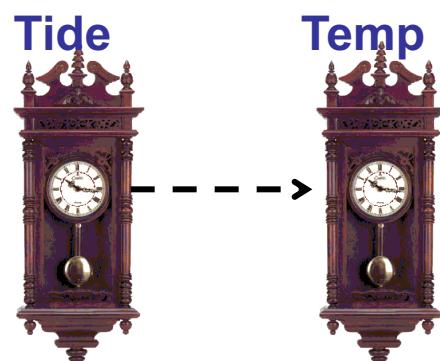
Barents Sea
Temperature

Barents Sea
Eco system



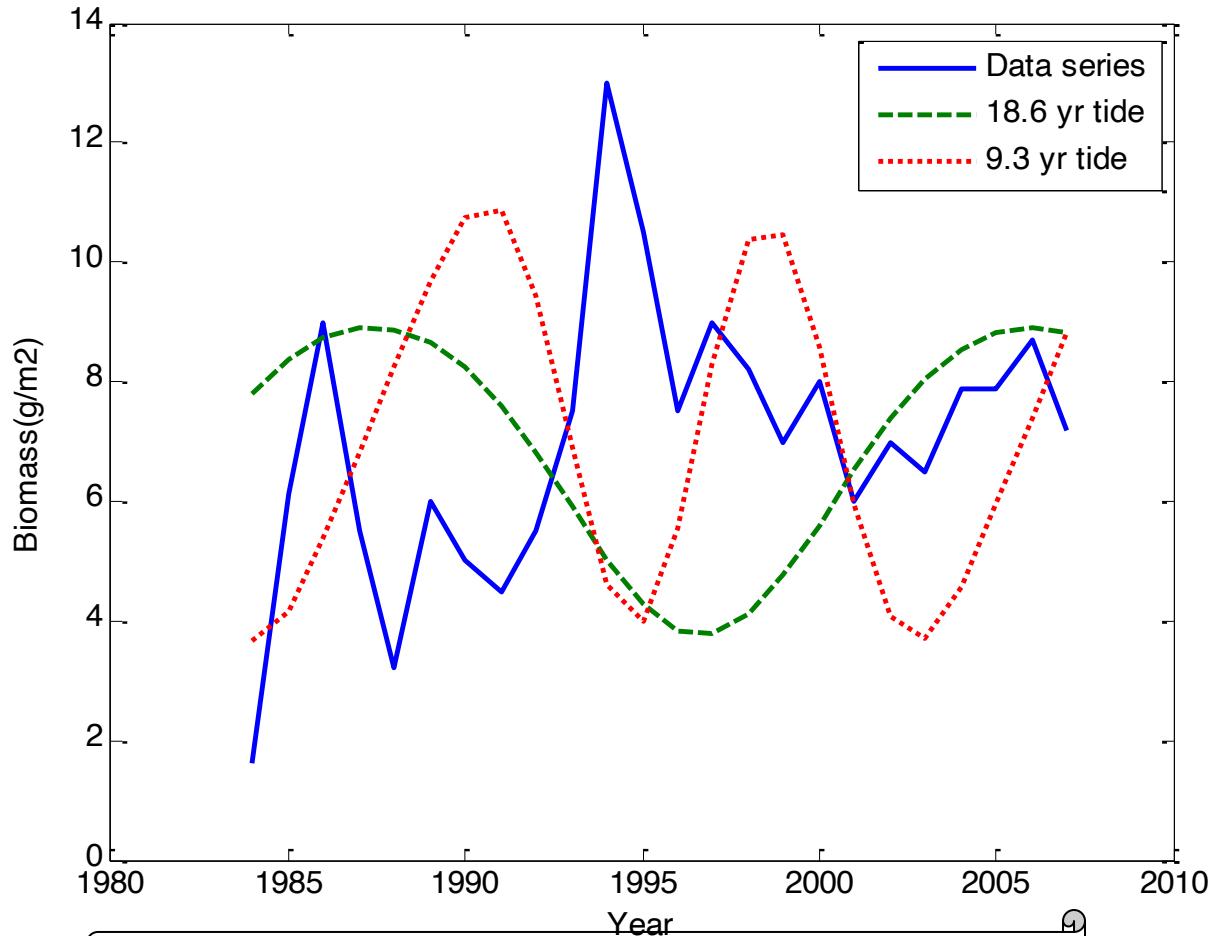
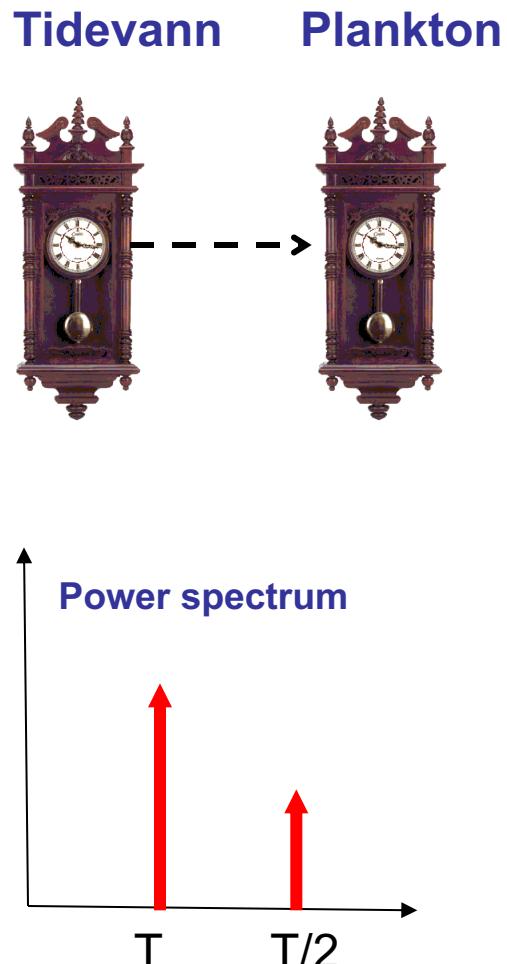
**Christian Huygens
(1629 - 1695)**

Long tides- Temp. osc.



1. Kola section temperature dataseries
2. Dominant cycles, correlated to lunar nodal tide periods of 9.3, 18.6 and 74.4 years

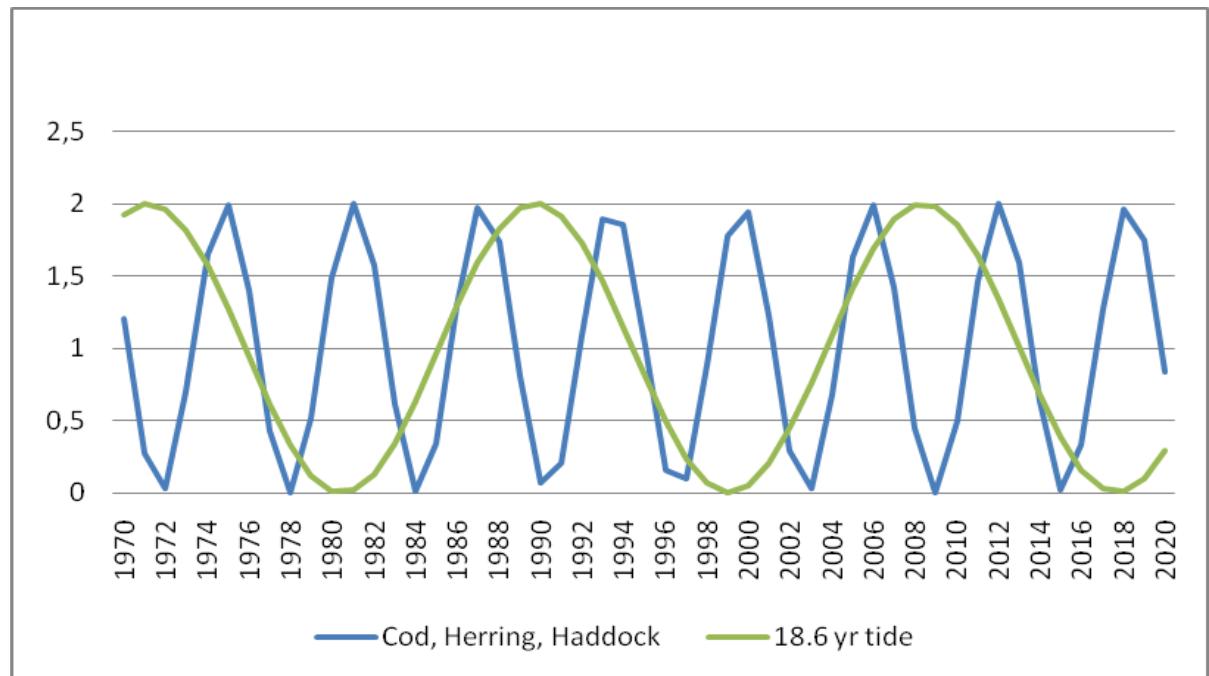
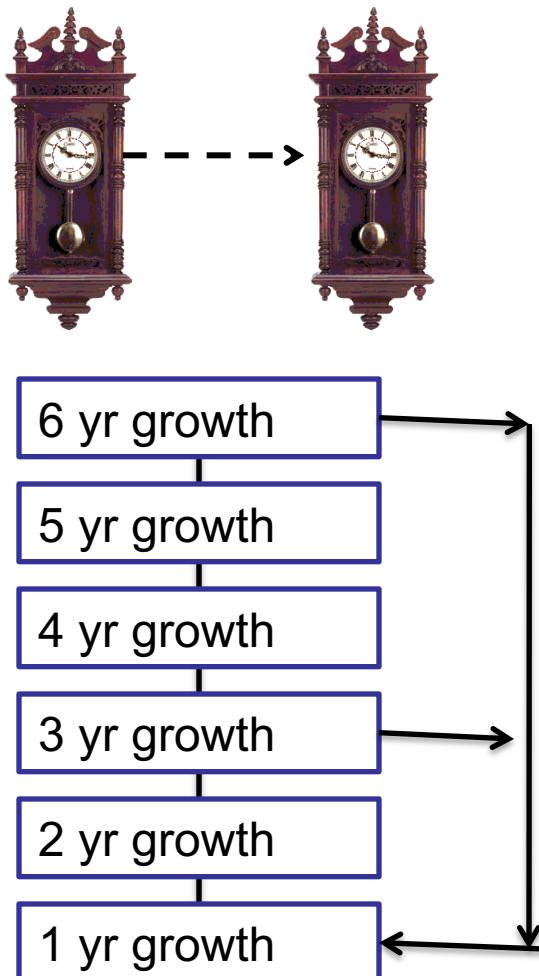
Plankton biomass oscillation



**Tide and Plankton oscillates
in opposite phase**

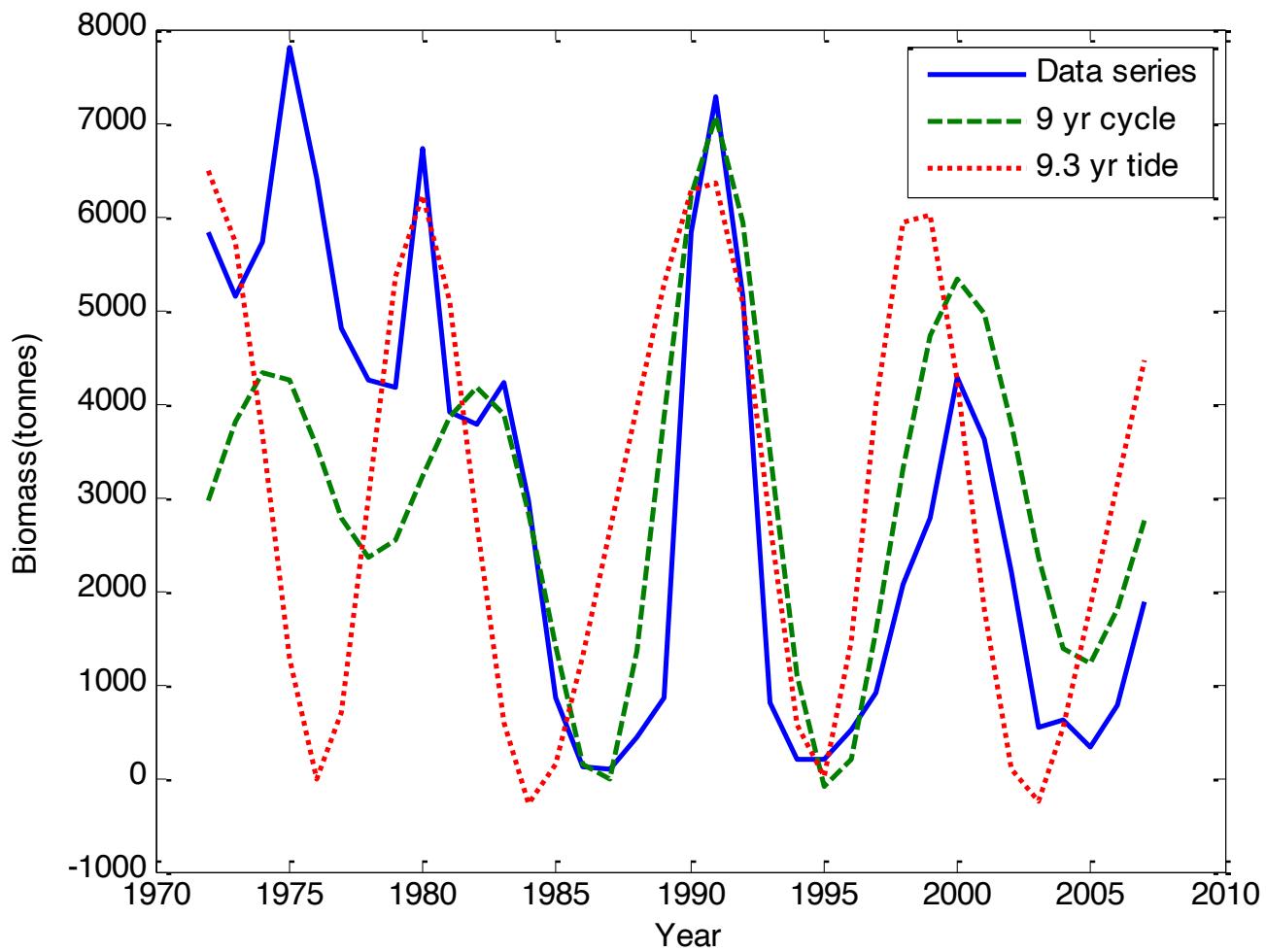
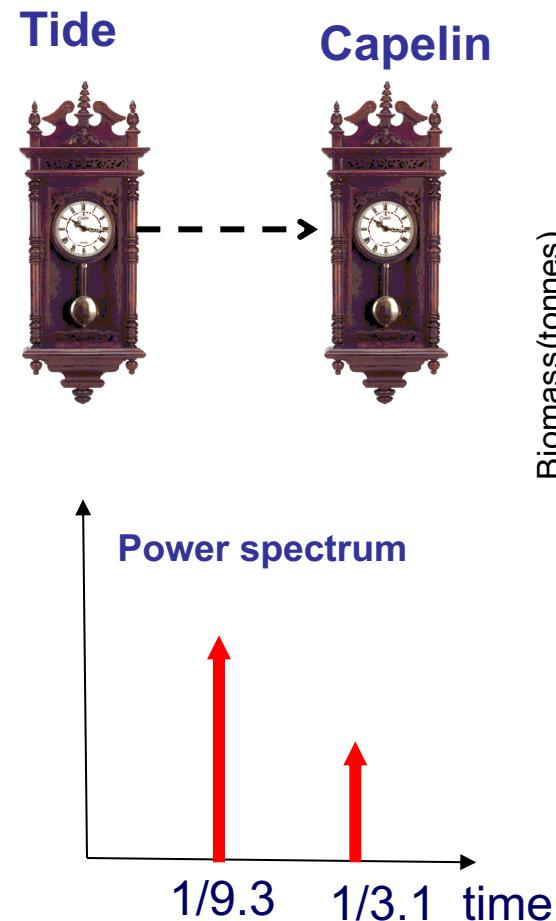
Biomass feedback dynamics

Tide Recruitment

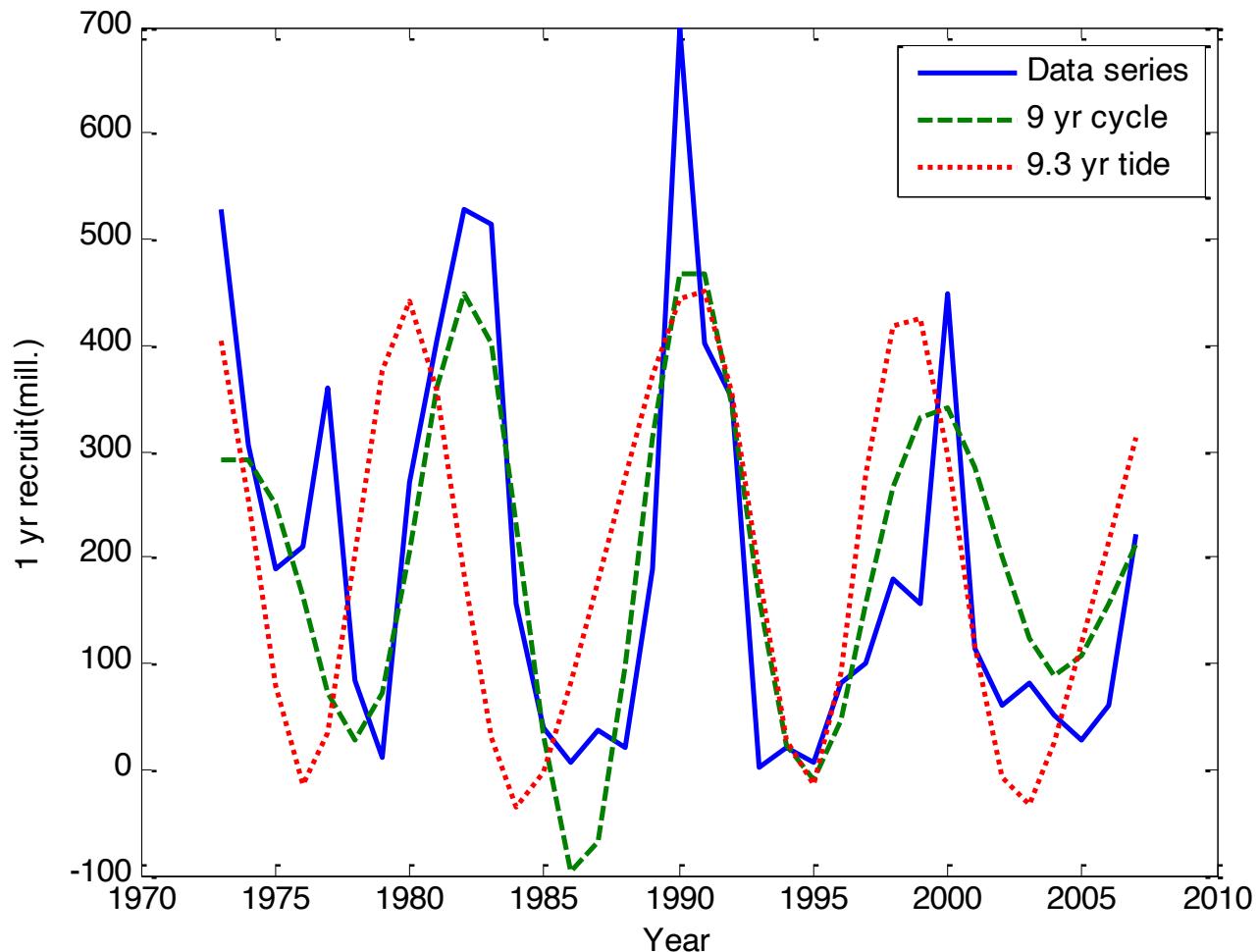
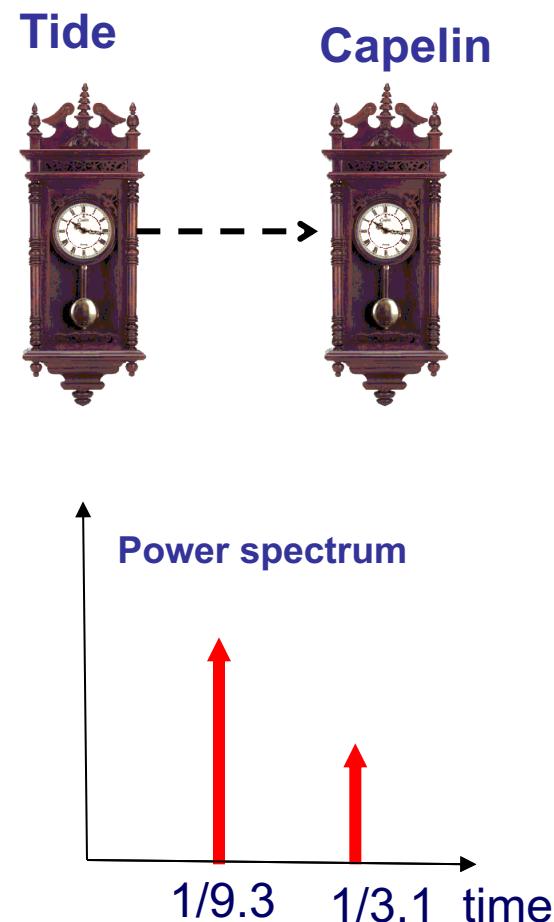


Capelin: about 3 years
North Arctic cod, herring, haddock: 6-7 years

Barents Sea capelin biomass



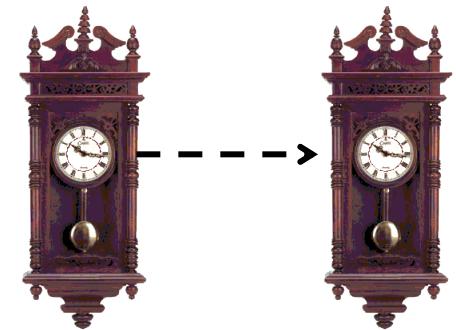
Barents Sea capelin recruitment



North Arctic cod (3 yr)

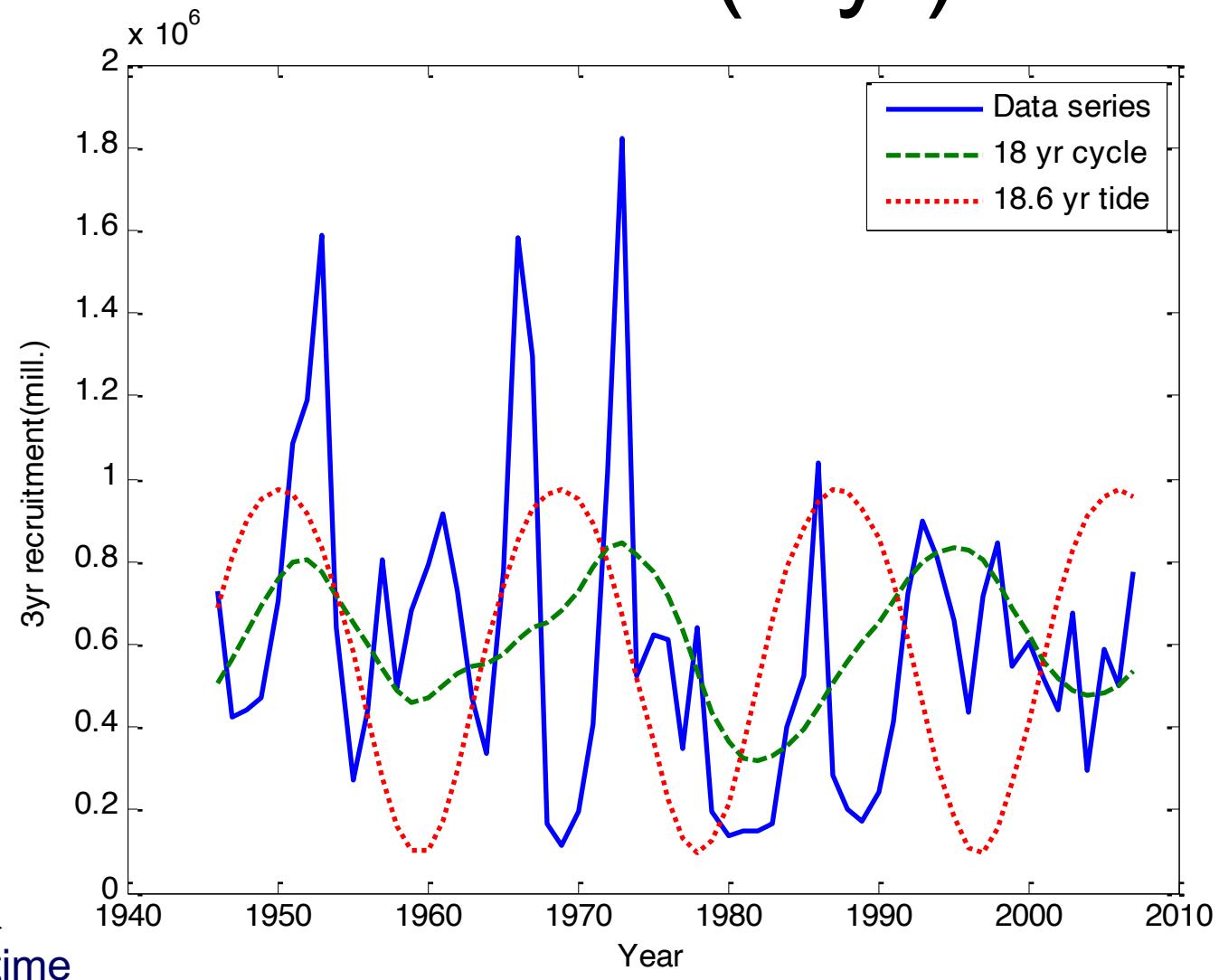
Tide

Cod



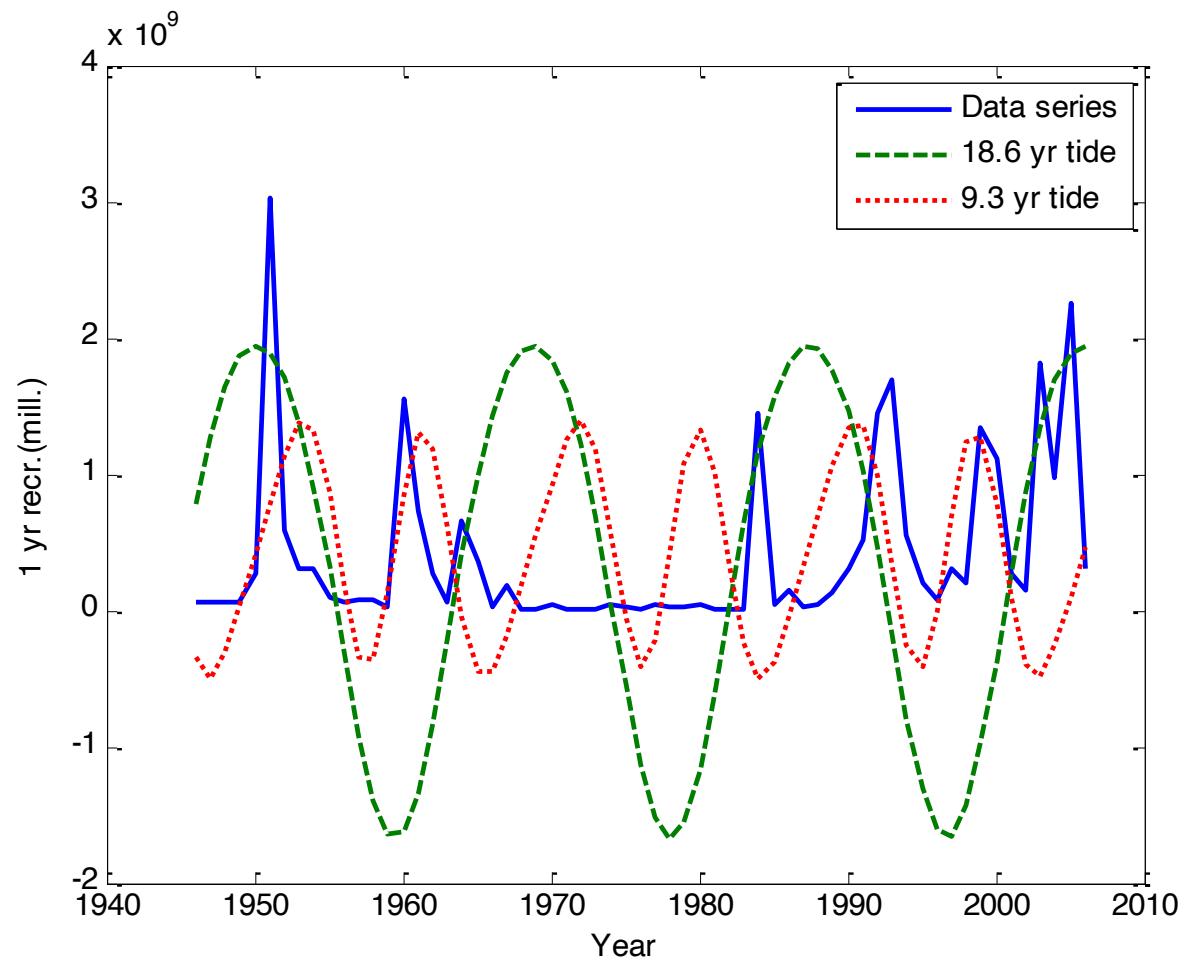
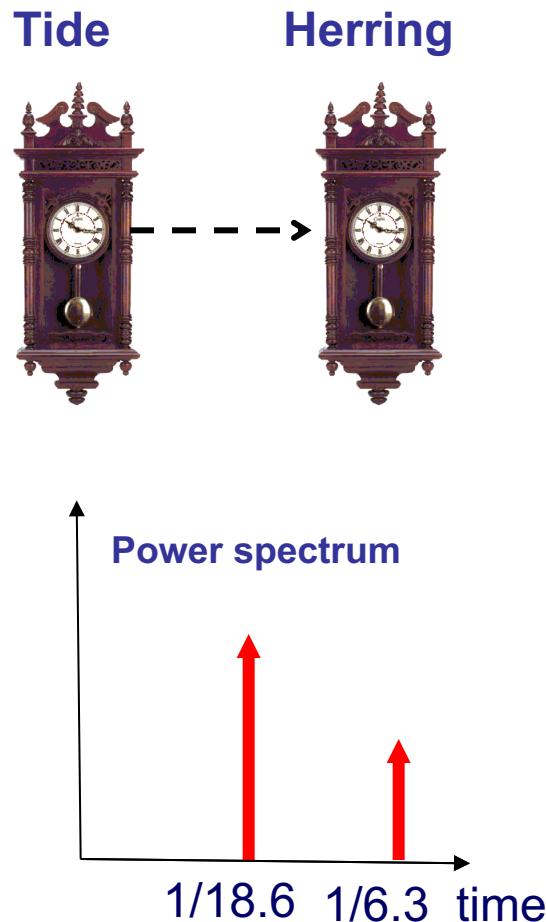
Power spectrum

$1/18.6$ $1/6.3$ time

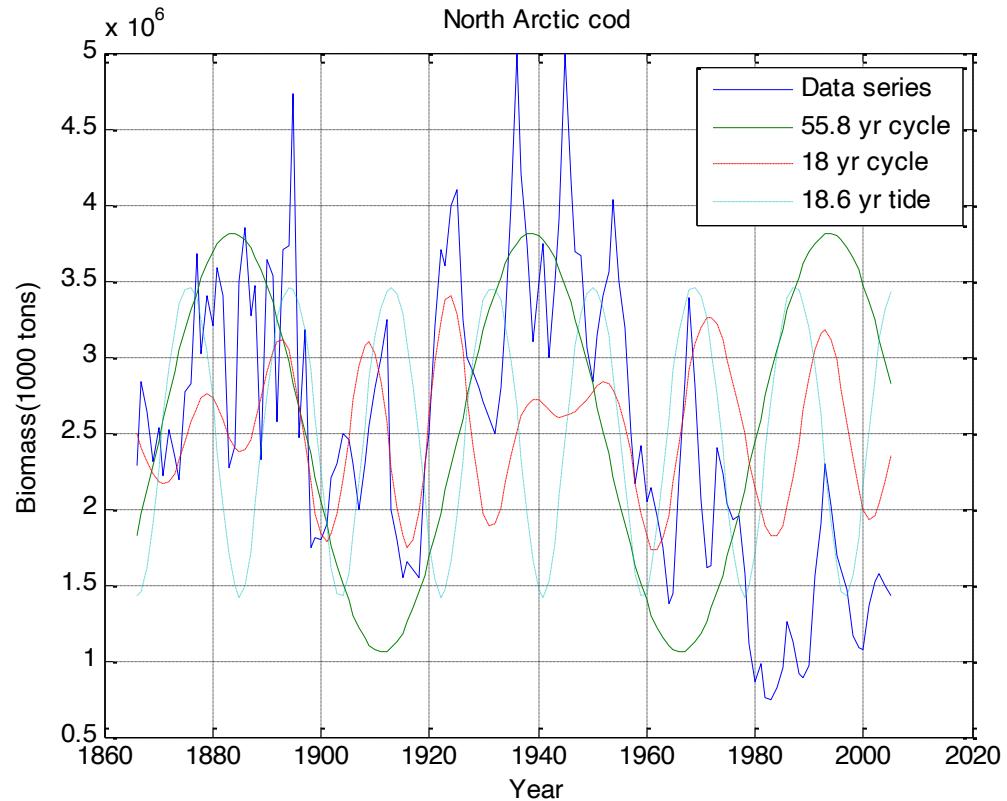
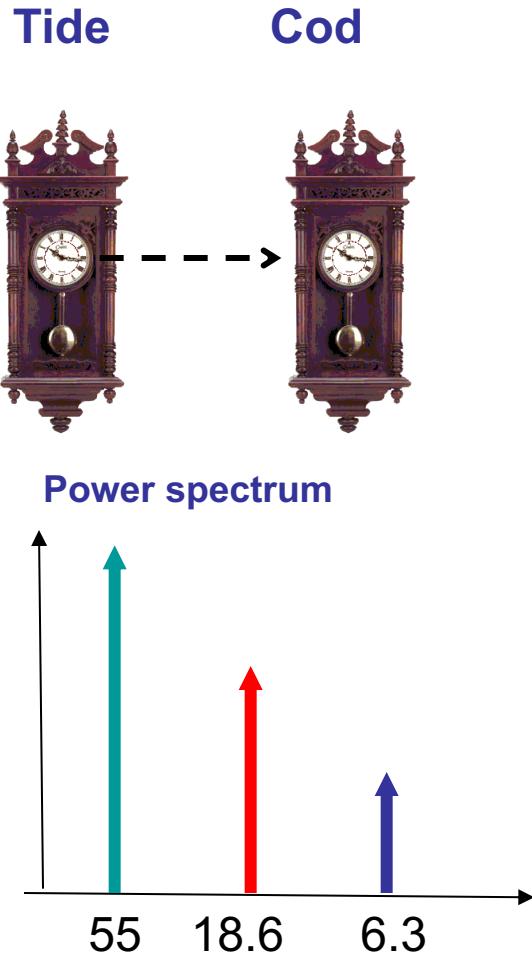


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Herring recruitment (1yr)



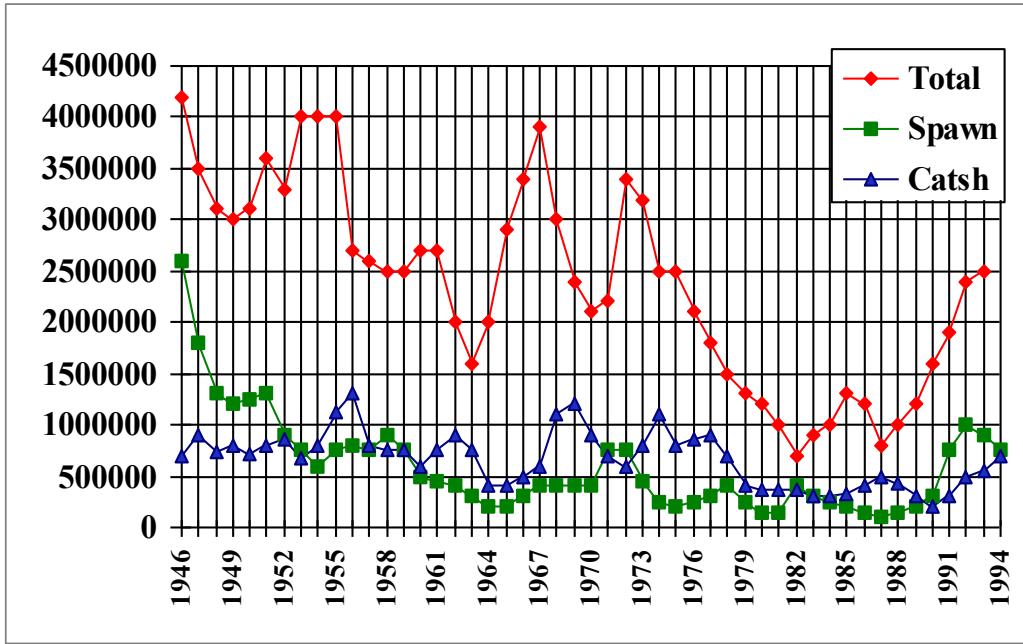
North Arctic cod oscillation



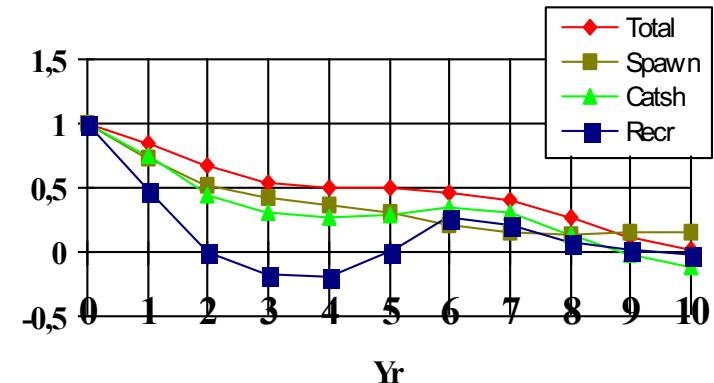
Recruitment cycle $18.6/3=6.3$ yr
Tide coupling cycle 18.6 yr
Long time integration: $3 \times 18.6 = 55.5$ yr

Er der en syklus i torskebestanden?

Norsk Artisk torsk



Autokorrelasjon

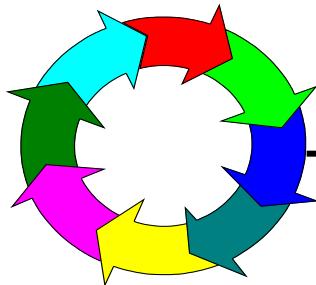


En vil da alltid tjene penger om en satser i oppgangstider
En vil alltid tape penger om en satser i nedgangstider

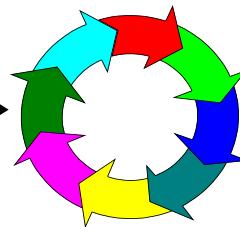
Er det en stasjonær periode, kan vi si noe om framtiden
Er det en tilfeldig periode, kan vi bare forklare fortiden

Hvorfor sykliske perioder i økosystemet?

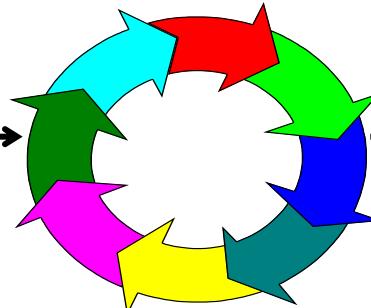
Tidevann
syklus
18.6 år



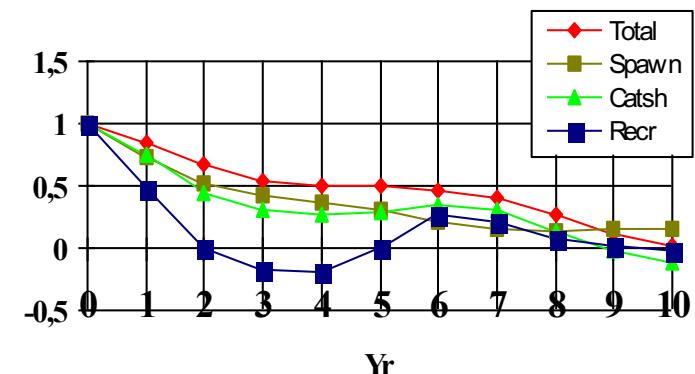
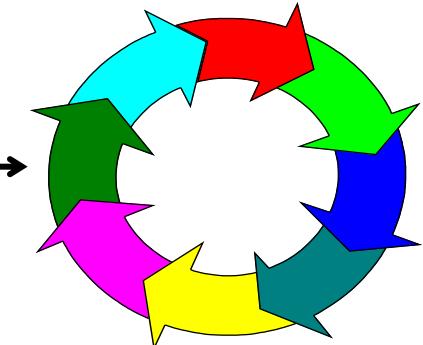
Rekruttering
syklus
18.6/3=6-7 år



Akkumulert
biomasse syklus
3*6=18 år



Akkumulert
biomasse syklus
3*18=55 år



A wide-angle photograph of a modern, light-colored multi-story building complex situated in a green, hilly landscape. In the background, a range of mountains with patches of snow is visible under a dramatic sky filled with dark, heavy clouds. A vibrant rainbow arches across the sky from the upper left towards the center-right, its colors bright against the dark clouds.

Vil du vite mer?
Du finner meg, ved enden av regnbuen

<http://ansatte.hials.no/hy/>