Does the low frequency variability of mesoscale dynamics explain a part of the phytoplankton and zooplankton spectral variability ?

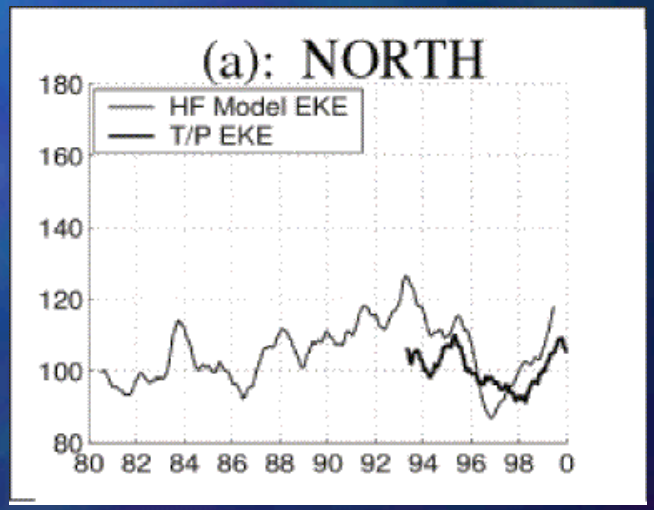
Marina Levy and Patrice Klein

Plankton patchiness and LFV ?

- The wavenumber spectrum of any dynamical properties in the upper ocean displays a power law as k^{-n} between a peak at 100 km (mesoscale) and a scale of 10 km (submesoscale)
- small n : energetic small scales
- Observed phyto and zoo variance spectra show significant variability : k^{-1} to k^{-3}
- This variability is often attributed to biological processes (Abraham ,1998; Mahadevan and Campbell, 2002; Martin and Srokosz, 2002)
- Does the low frequency variability associated with mesoscale turbulence explain a part of this variability?

Low Frequency Variability

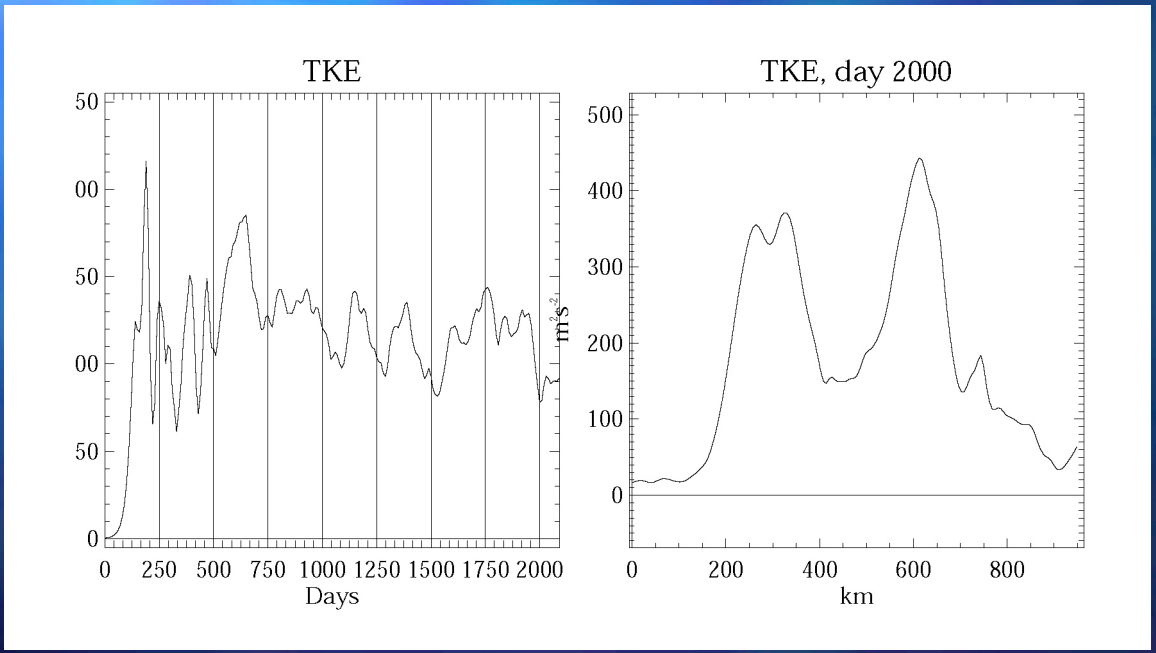
- Non-linear interactions between the eddy field and the mean flow (Pedlowski and Frenzen , 1980)
- weather regimes in the atmosphere (Vautard and Legras, 1988)
- LFV exists in a large region of parameter space (Panetta, 1993)
- Measure of LFV in the ocean : EKE temporal changes (Stammer and Wunsch, 1998; Penduff et al., 2003)



Penduff et al., 2003

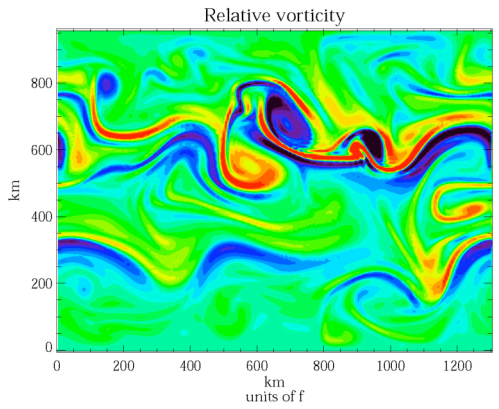
Experimental protocol

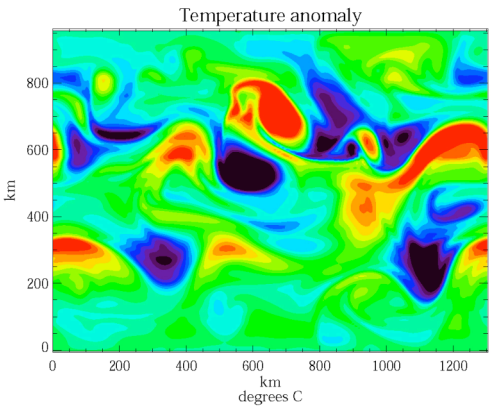
- Numerical turbulent eddy field + simple biological model
- periodic 1300km x 960 km, Δ=6 km
- spin-up (1600 days) + 500 days
- oligotrophic regime, mid-latitudes (35N)

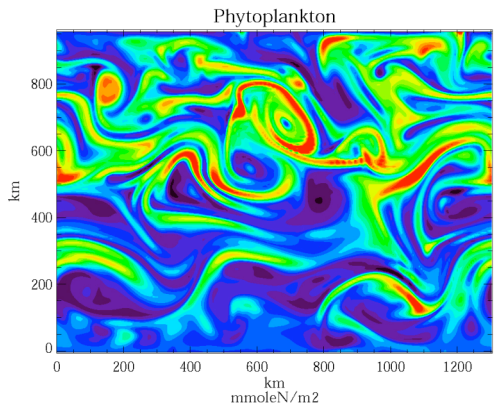


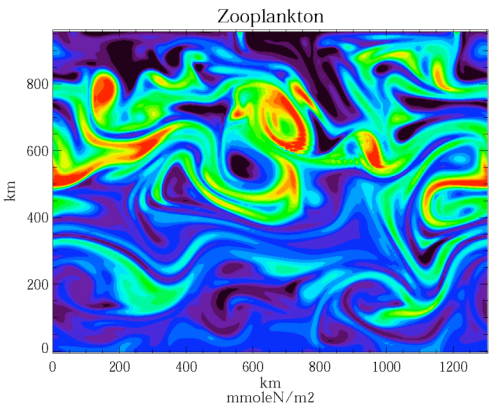
Plankton patchiness

Snapshots at day 1970

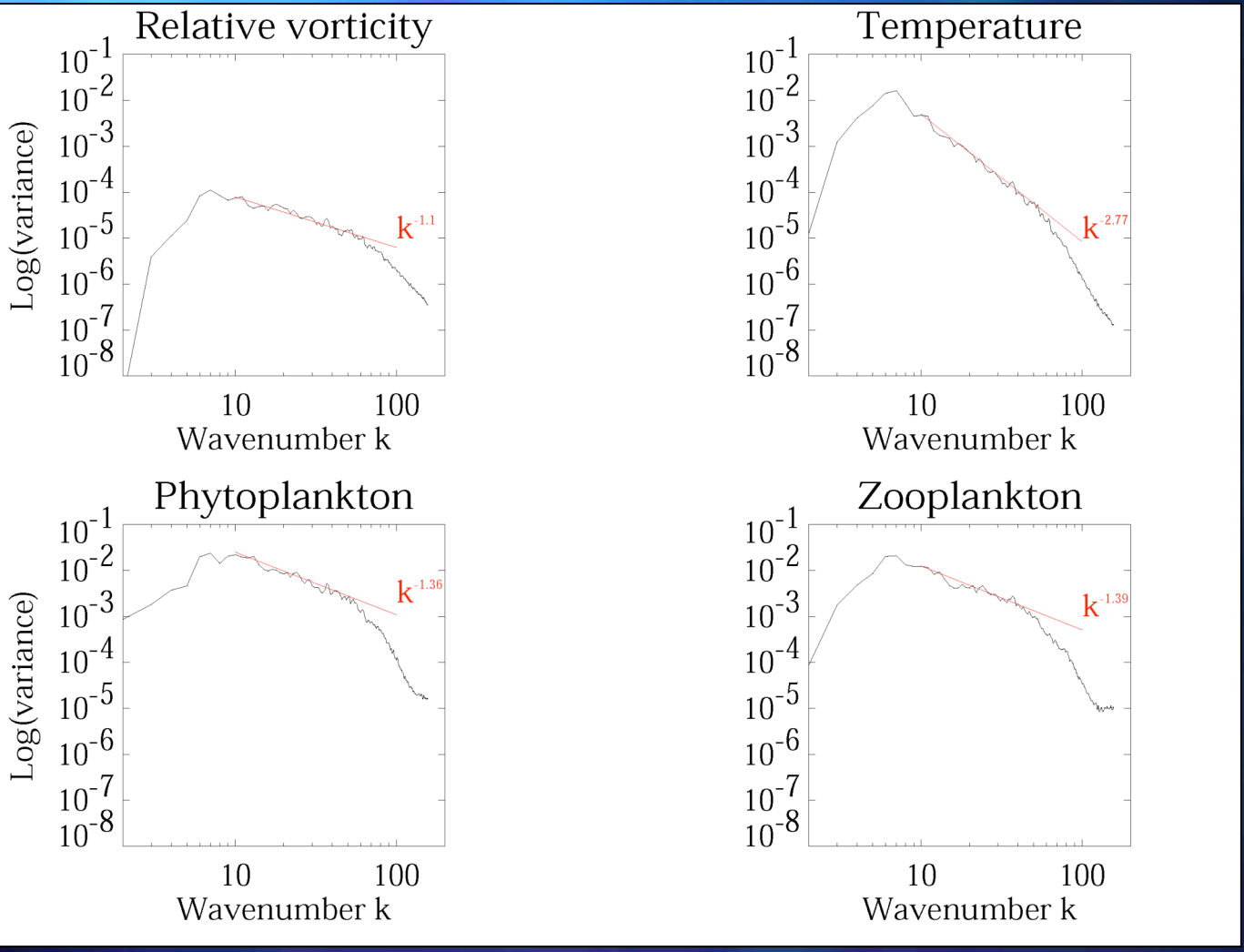


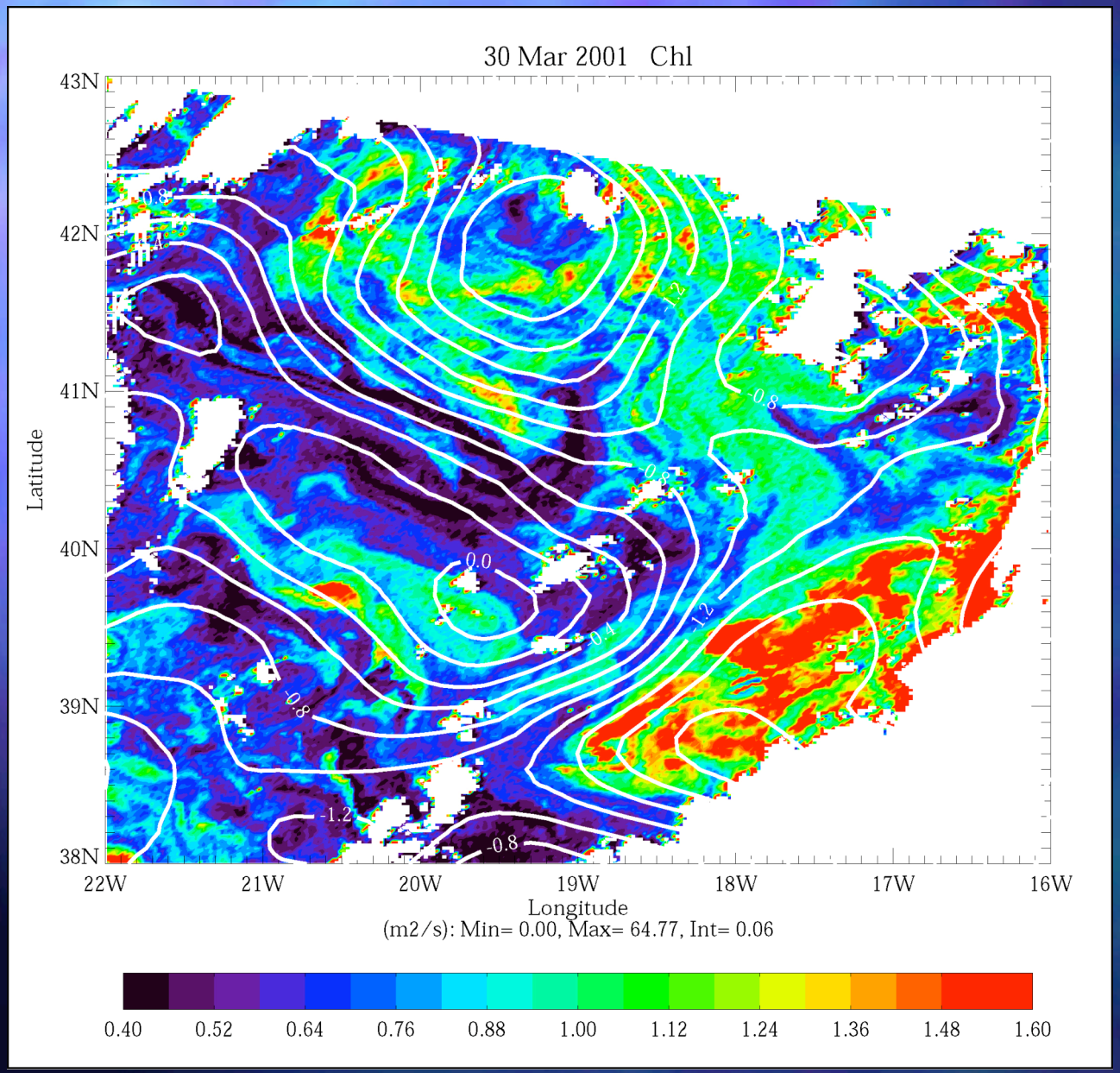






Plankton patchiness
Variance spectra

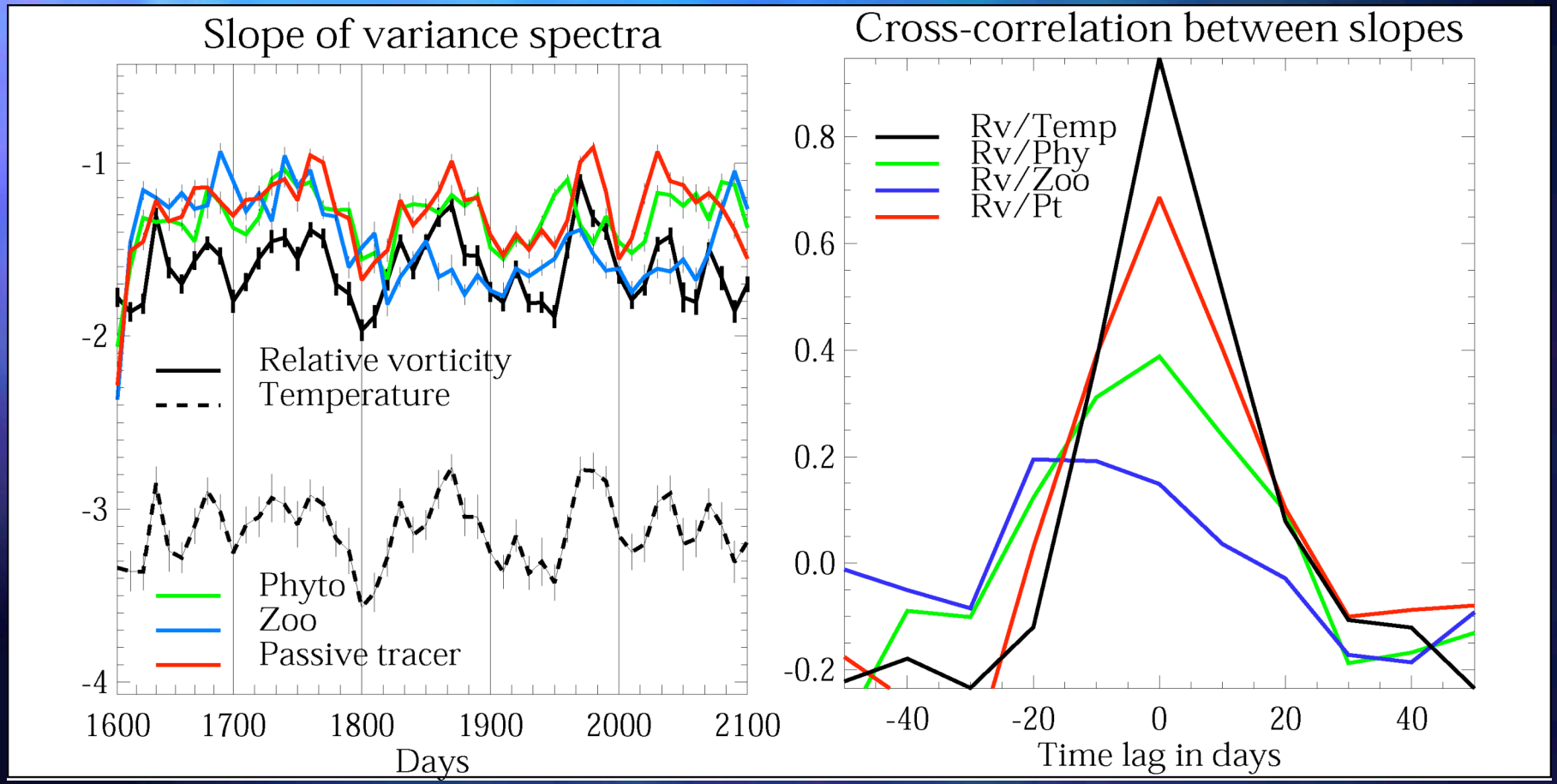




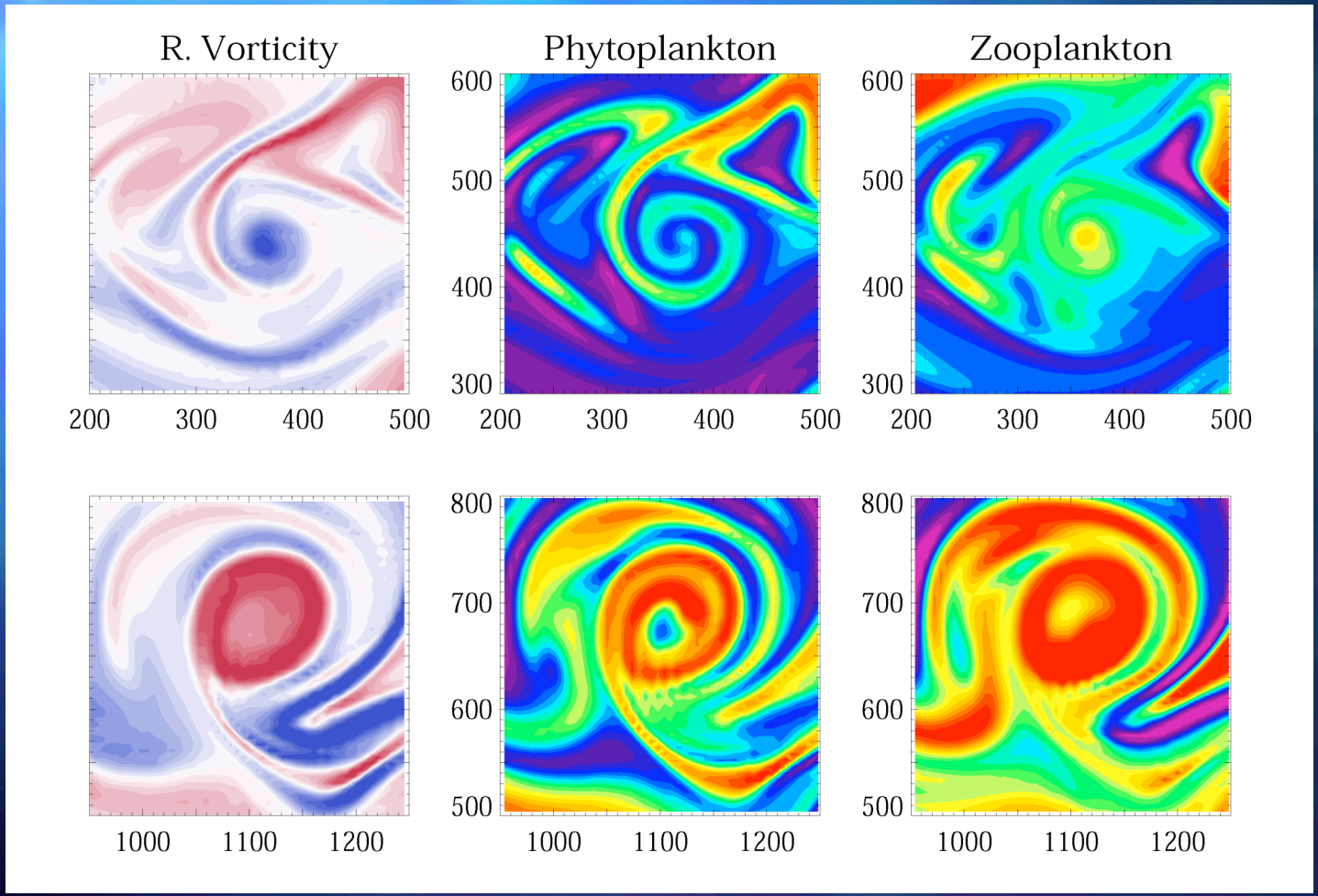
Plankton patchiness Observations in the NE Atl

Y. Lehahn, work in progress
SSH : M. Assenbaum

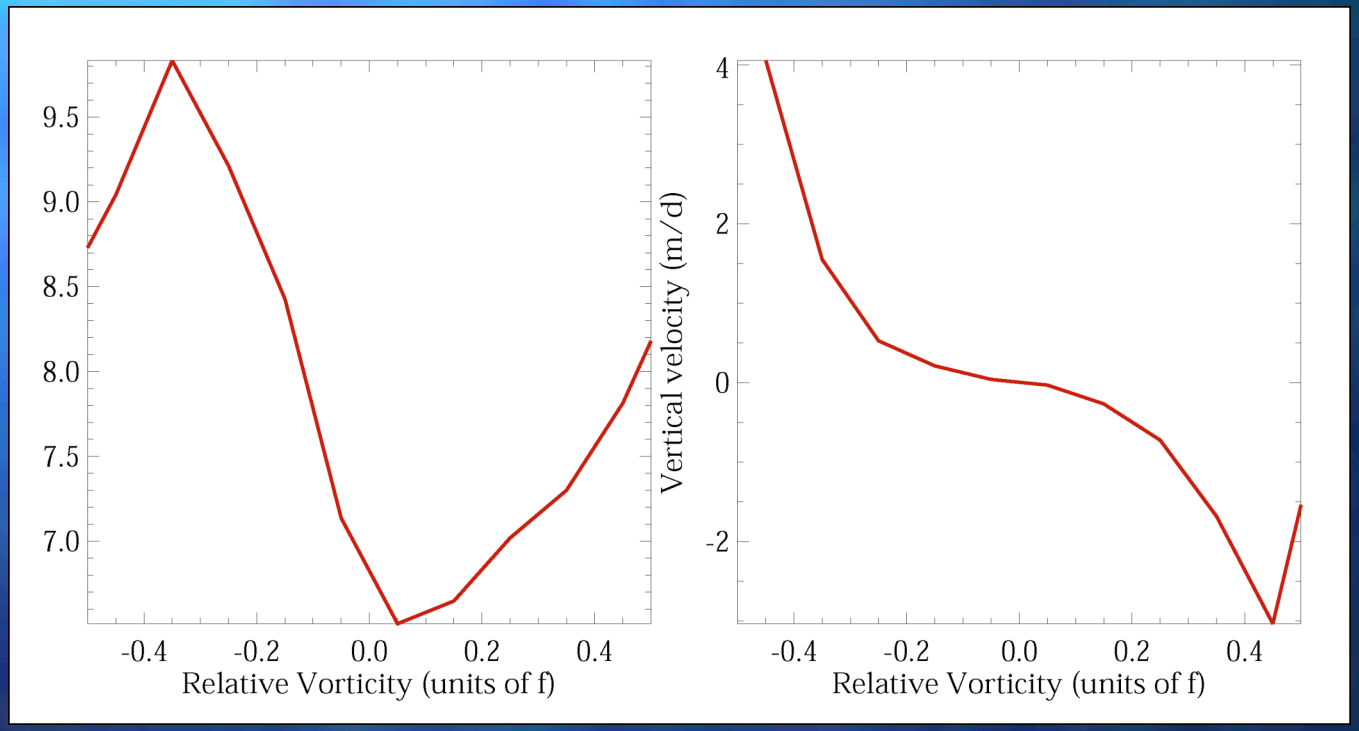
Plankton patchiness
LFV Spectral variability



Parity between plankton and vorticity



Parity between plankton and vorticity



Conclusions

- The LFV inherent to mesoscale turbulence explain a part of the spectral variability of plankton patchiness
- The role of the biological factors can be assessed only when the part of LFV of the mesoscale field is well estimated and removed.