Poleward propagating features as observed in the California network of HF radar

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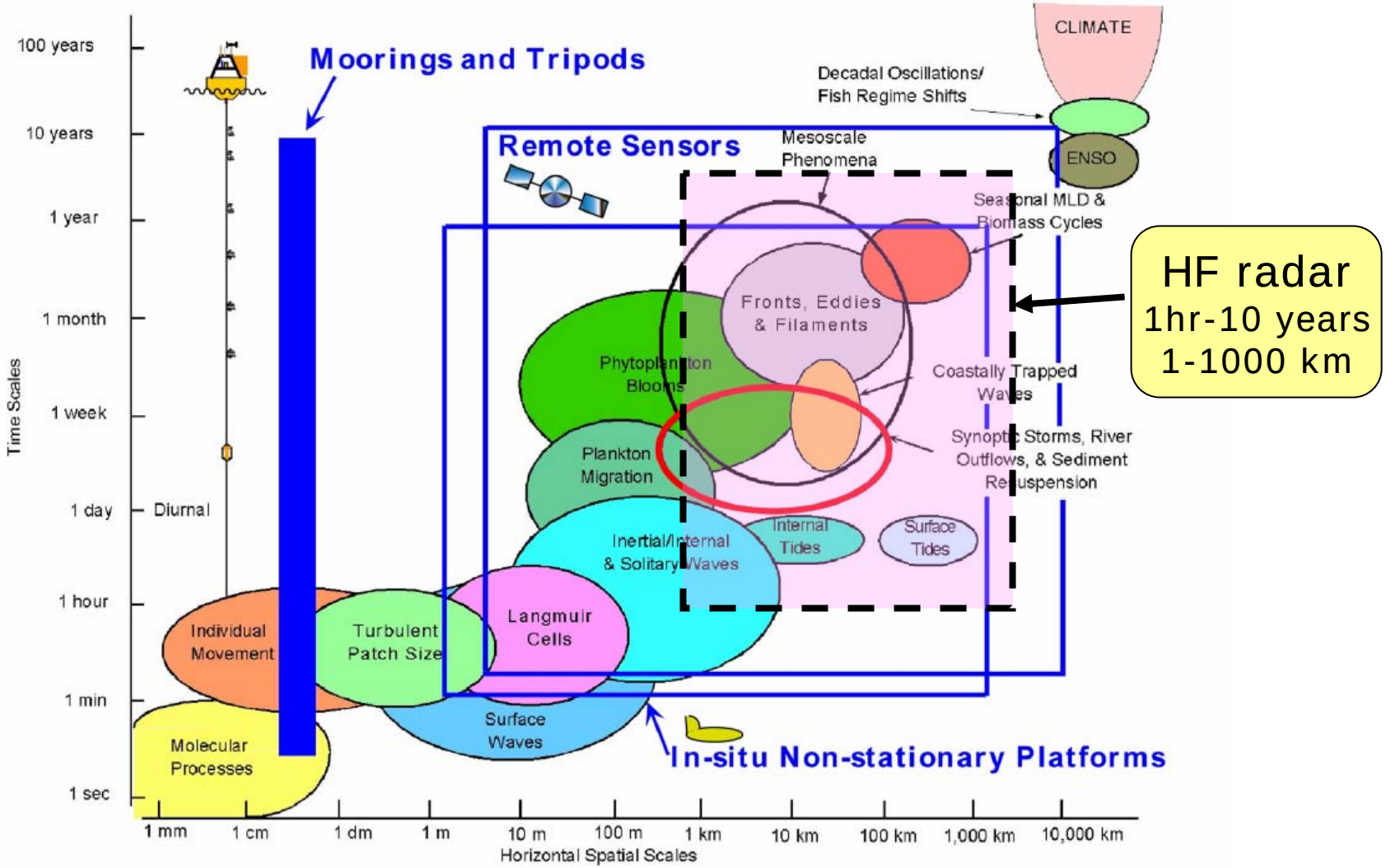
Outline

- Observation domain and bathymetry
- Preliminary results
  - Poleward propagating features in surface currents
  - NDBC wind data (mean and variance)
  - Wind impulse response function estimate
- Summary

Scales of variability

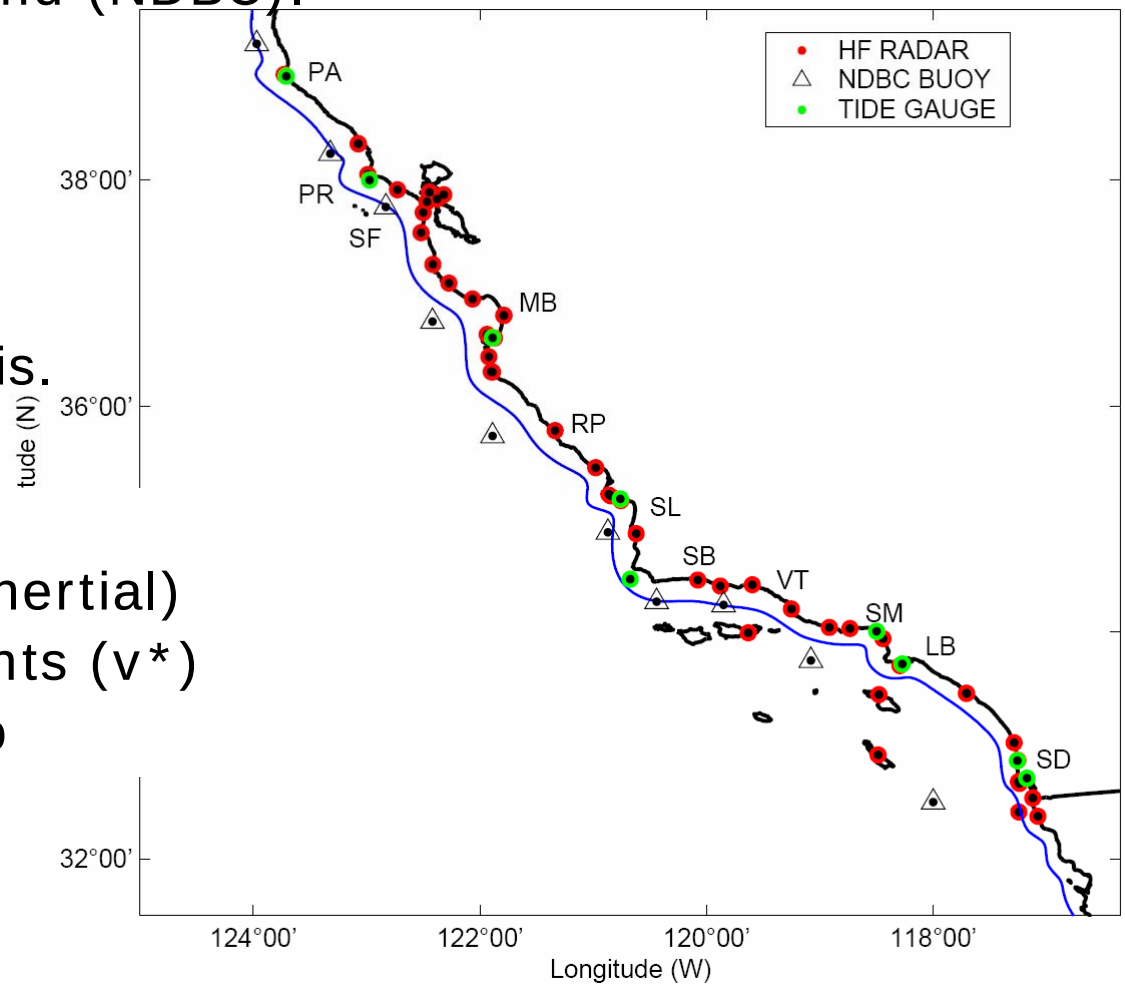


HF radar
1hr-10 years
1-1000 km

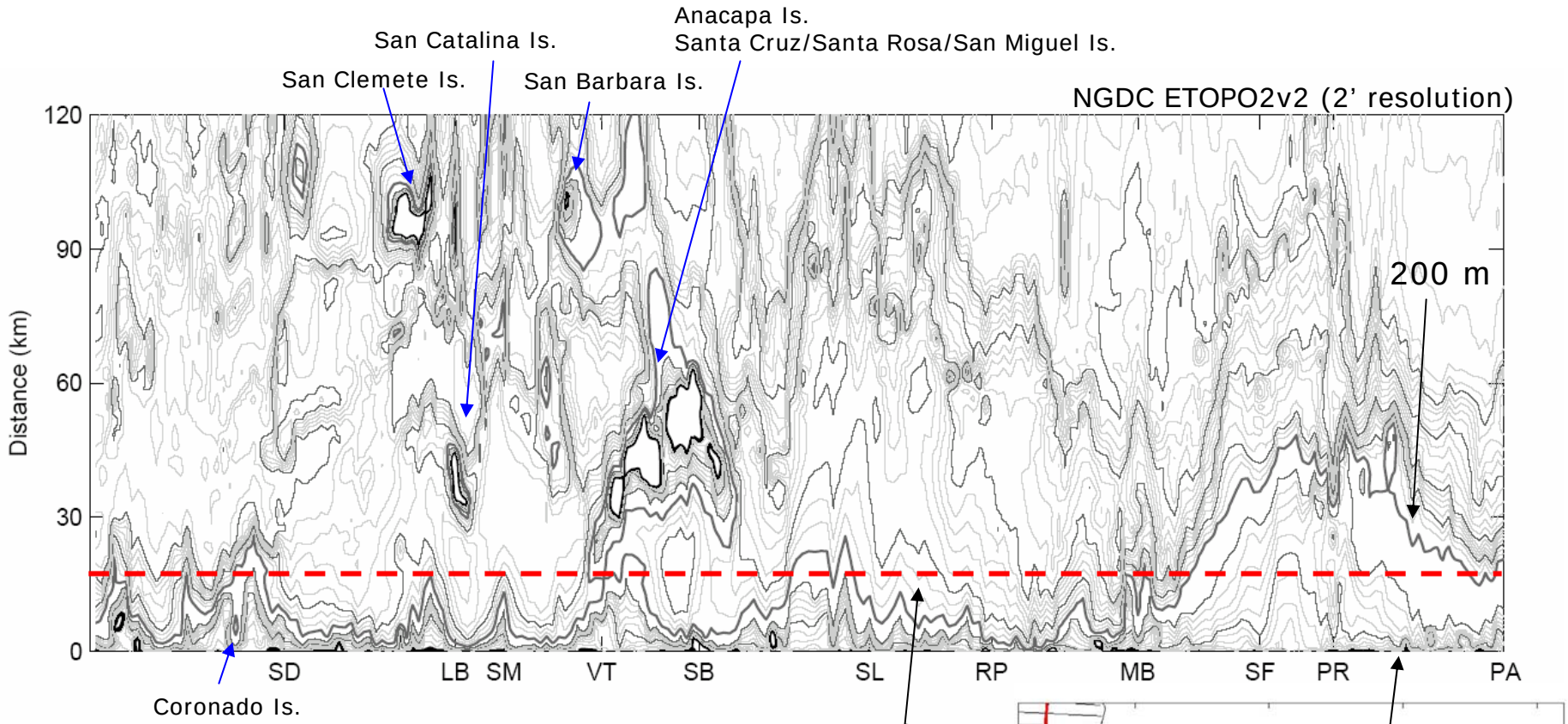
Dickey, Rev. Geophys. 2006

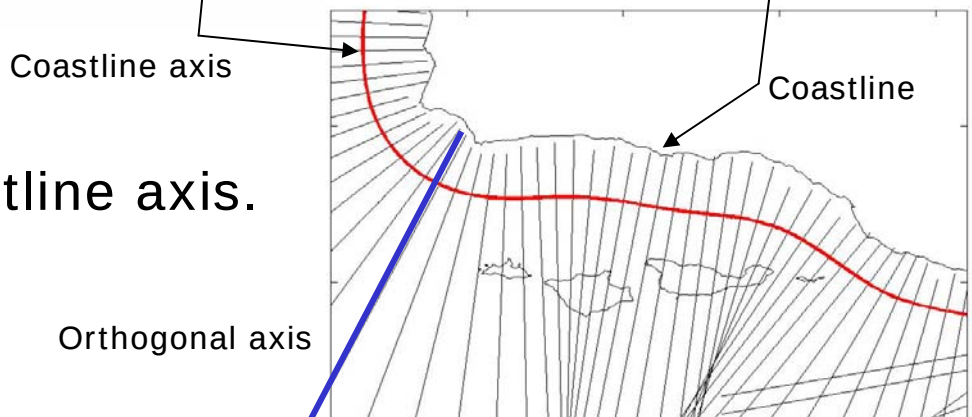
HF network in California

- Observations
  - Surface currents (47 HF radars in SCCOOS & CeNCOOS).
  - Tides (NOAA), Wind (NDBC).
- Coastline axis
  - Within 15-25km.
  - Passing SBC.
  - Evenly spaced axis.
- OI-UV map
  - 25 hrs avg. (subinertial)
  - Alongshore currents (v*) projected parallel to coastline axis.



Bathymetry along the CA coast

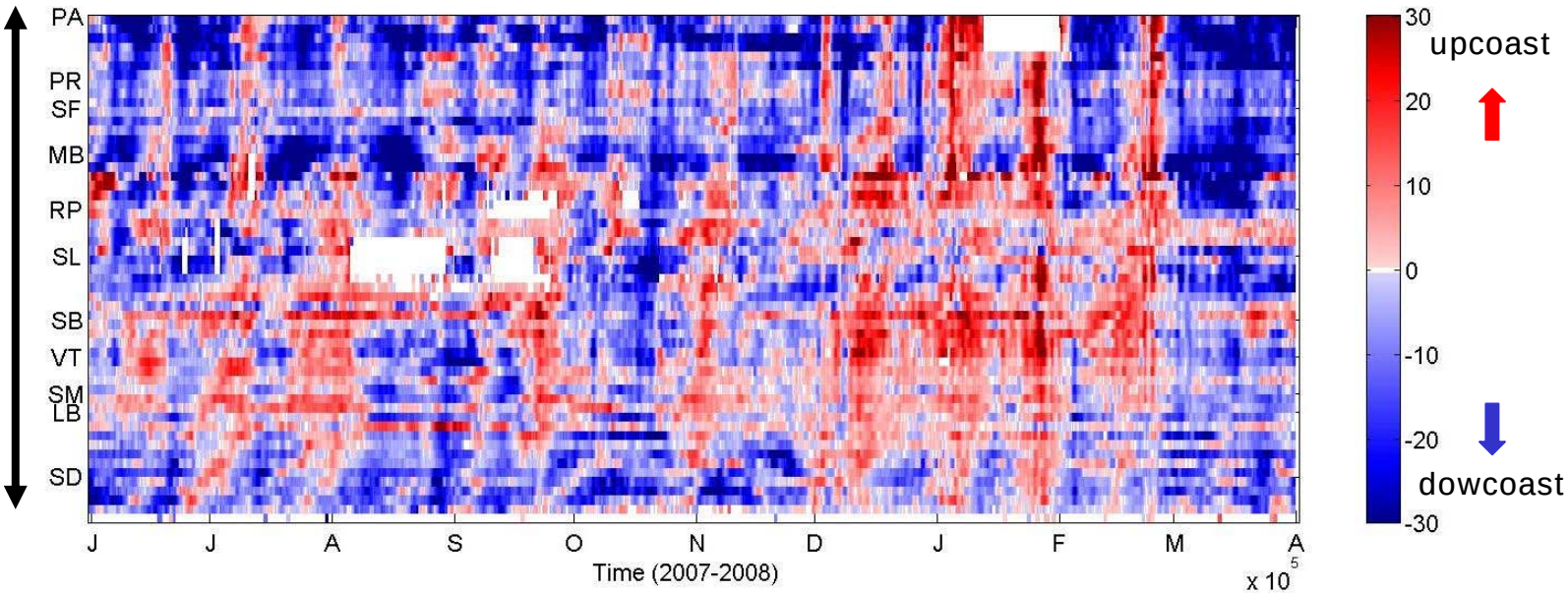




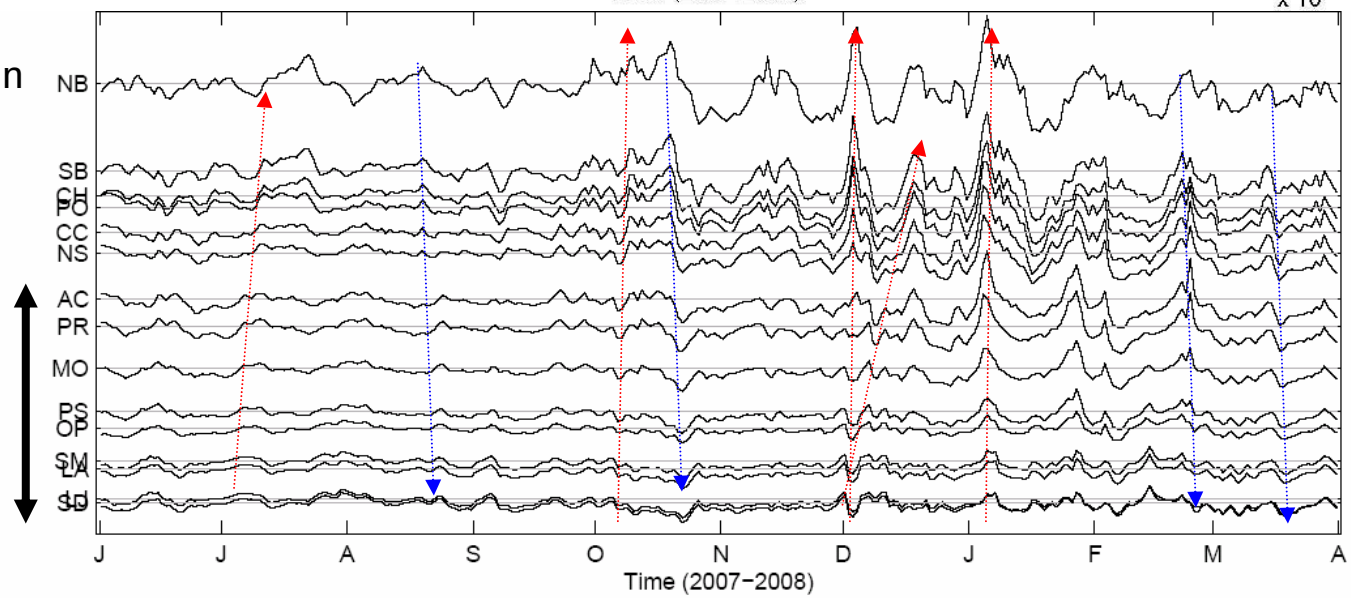
Bottom topography
at the line normal to the coastline axis.

Alongshore currents (v*) and sea elevation anomaly (δη)

25 hrs avg. alongshore currents



Sea elevation Anomaly (daily avg.)



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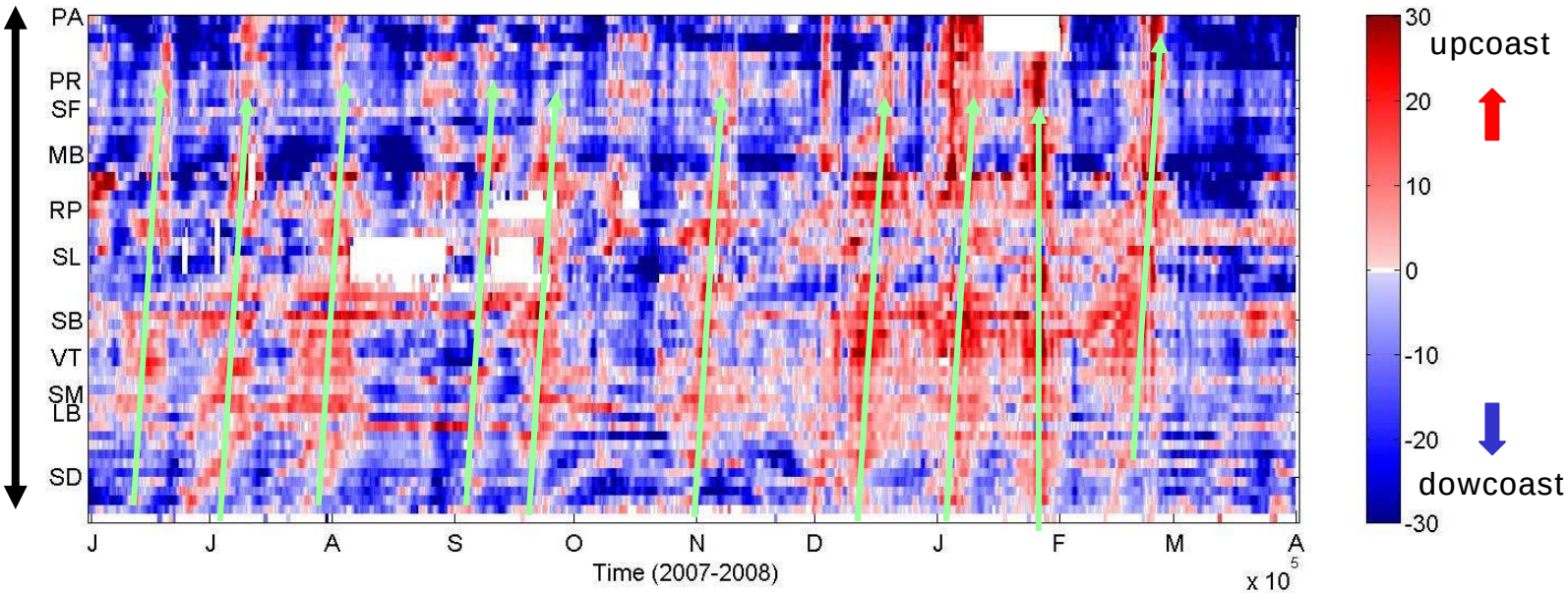

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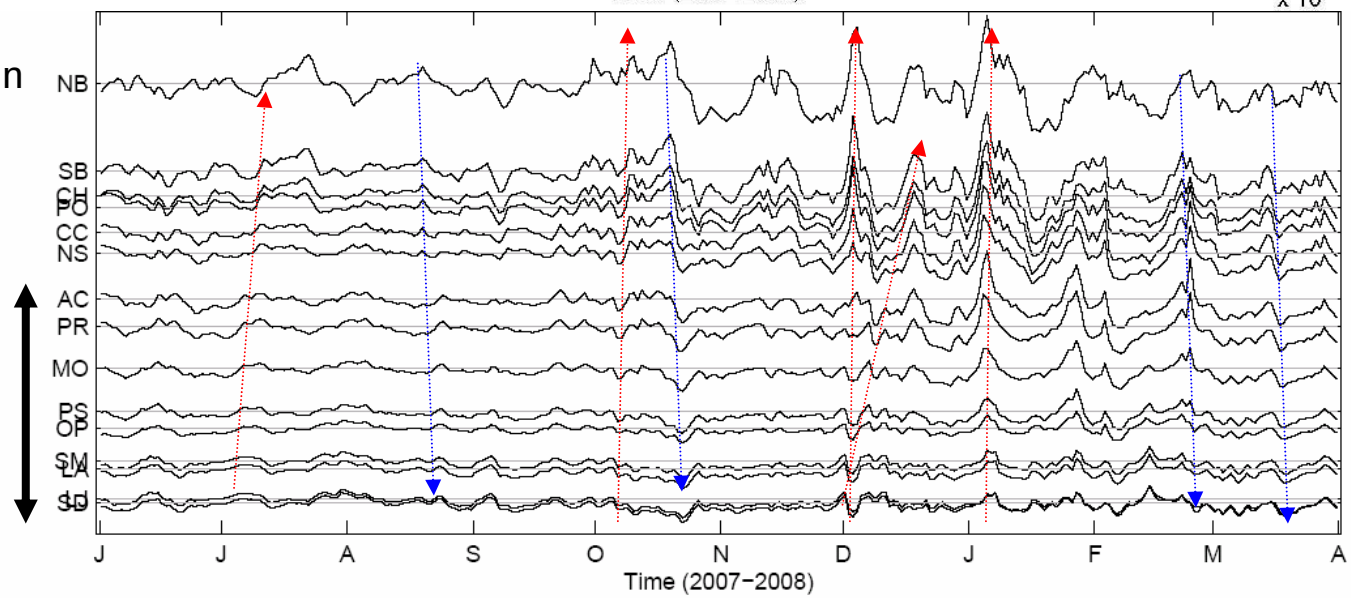

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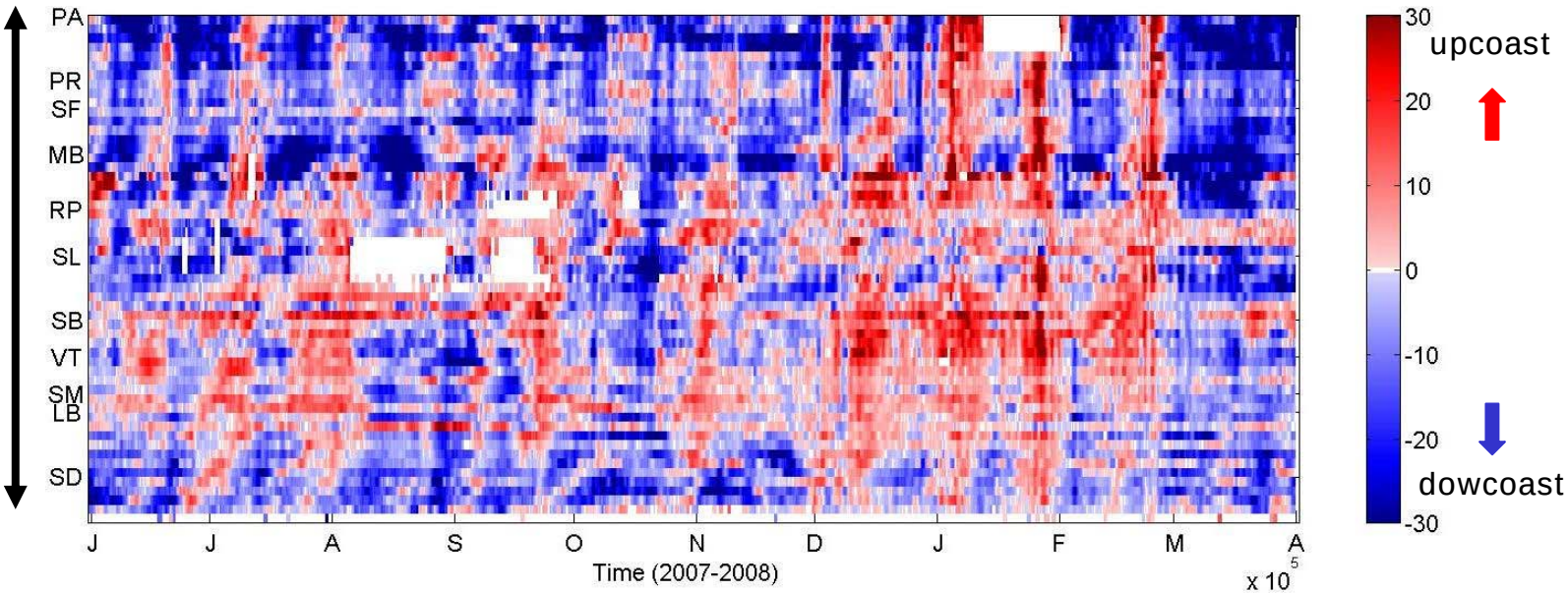

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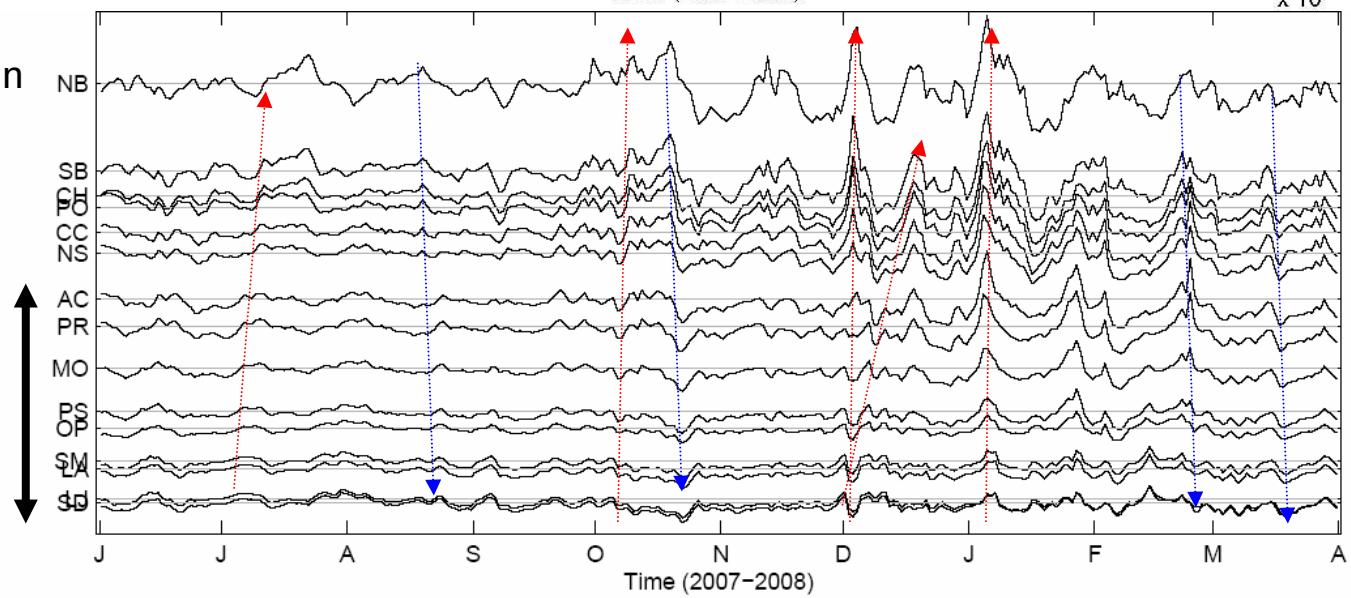

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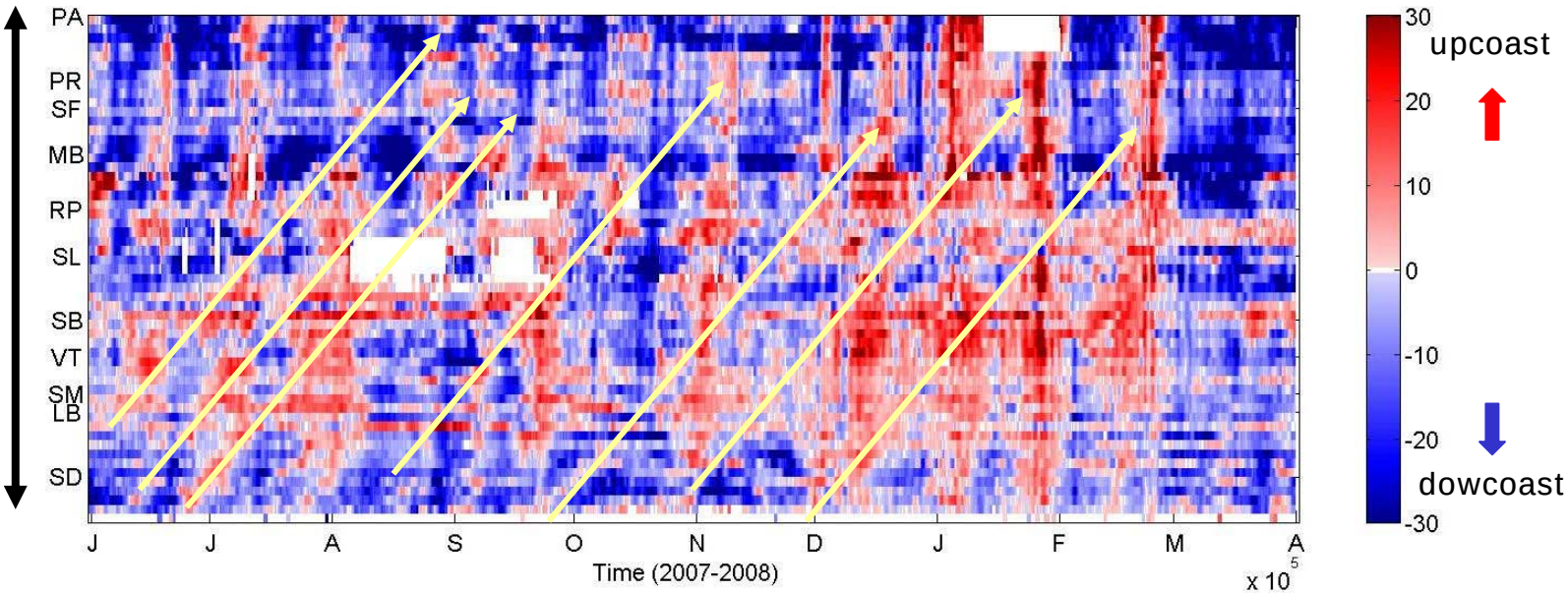

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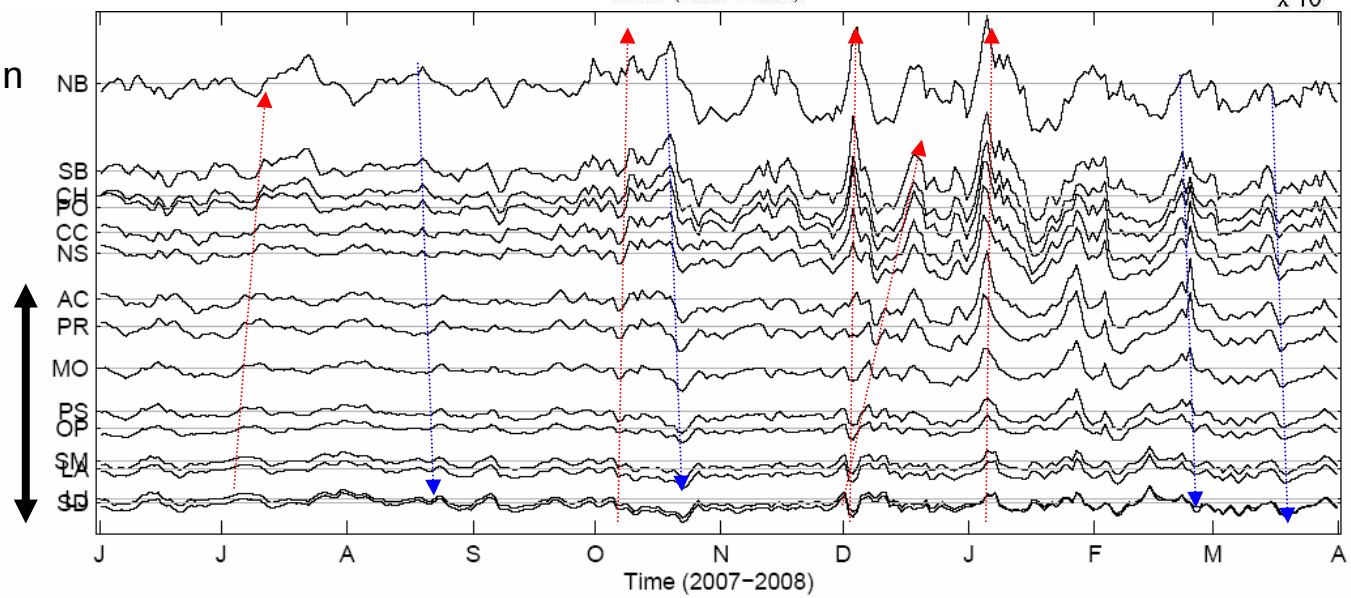


Coastal trapped waves (CTWs)

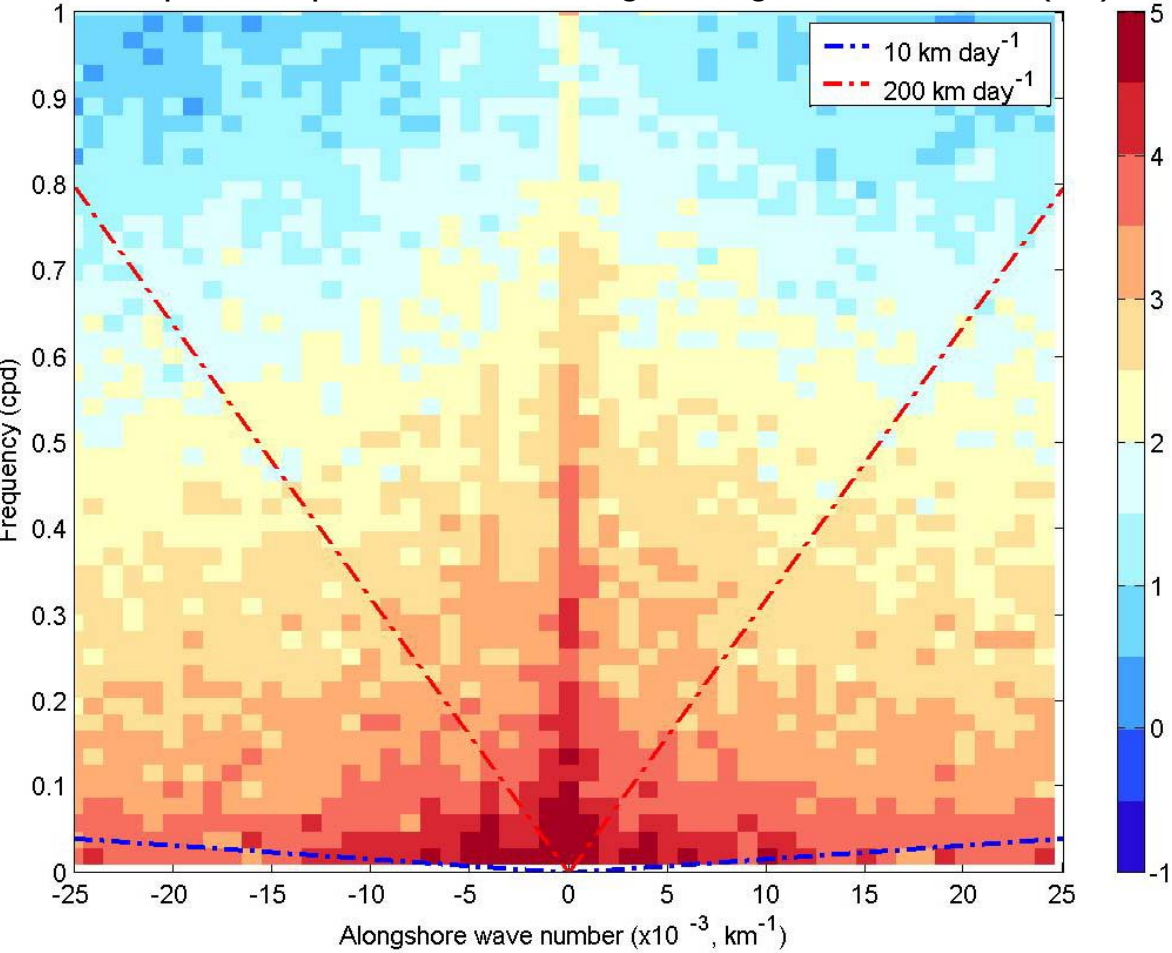
- A hybrid of barotropic Rossby (shelf) waves (no stratification, sloping bottom, $S \rightarrow 0$) and baroclinic Kelvin waves (stratification, flat bottom, $S \rightarrow \infty$).
- Propagation along the coastline (continental shelves and slopes) on the right in the N.H. (left in the S.H.)
- Sub-inertial time scale (days~weeks)

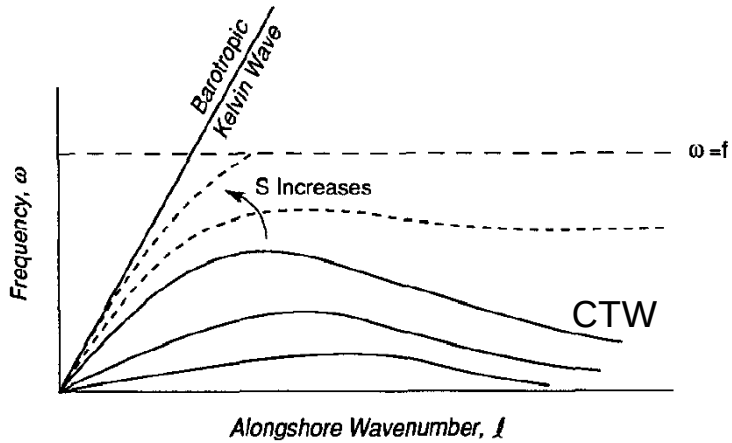
Burger number

$$S = \left(\frac{N_0 H}{fL} \right)^2$$

Power spectra

2D power spectra of 25h avg. alongshore current (v*)





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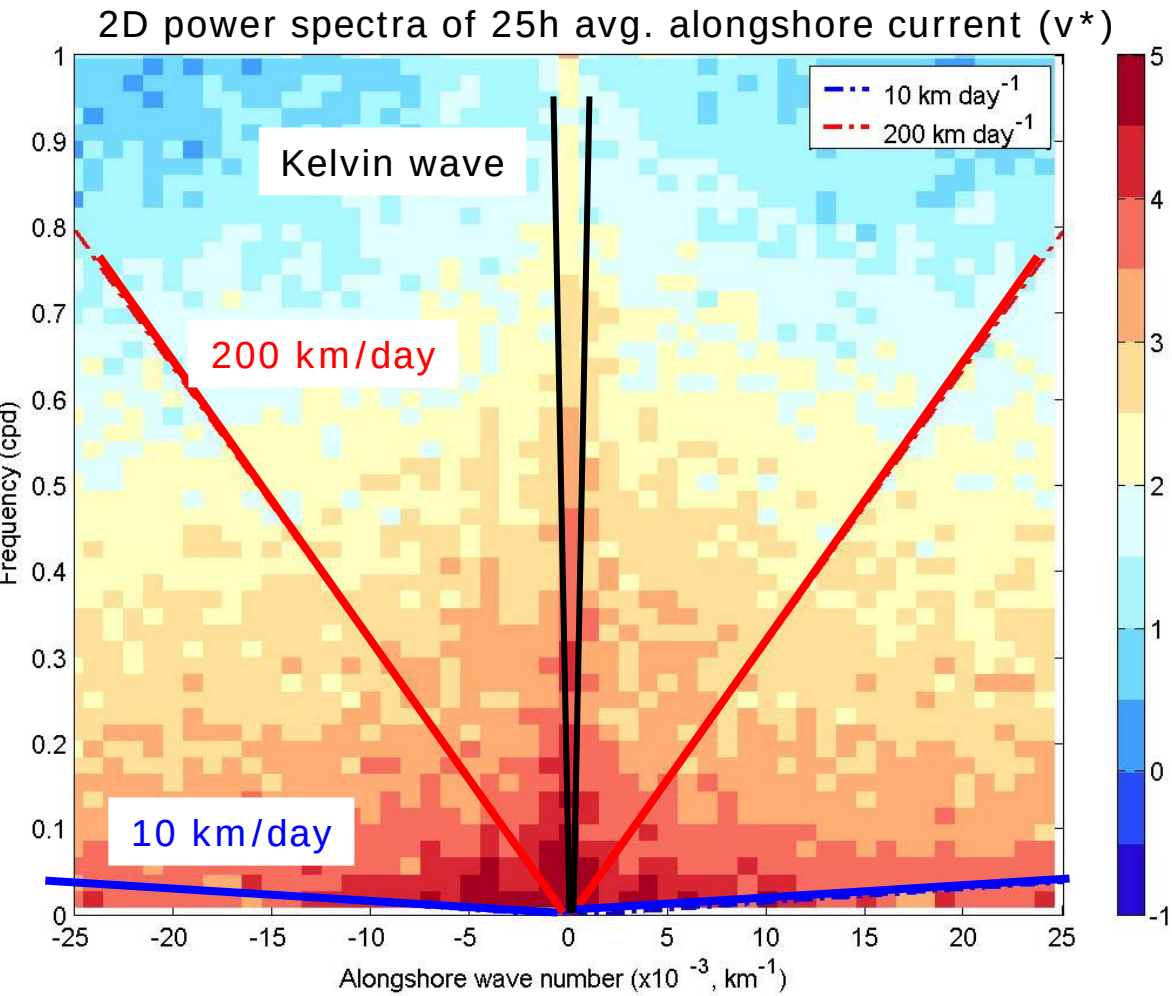
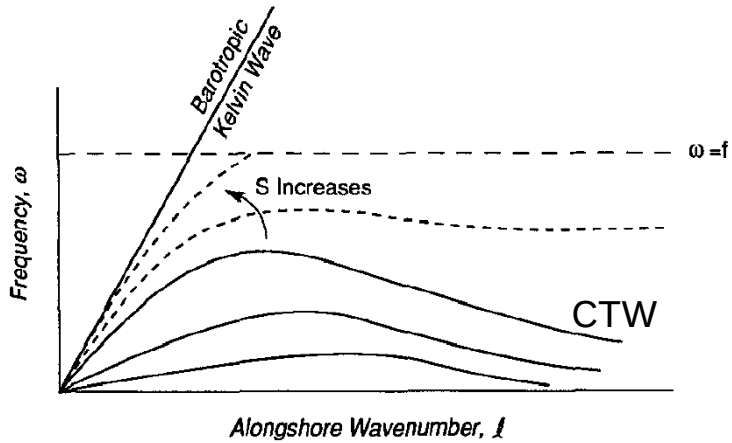
(Brink, ARFM 1991)

Power spectra





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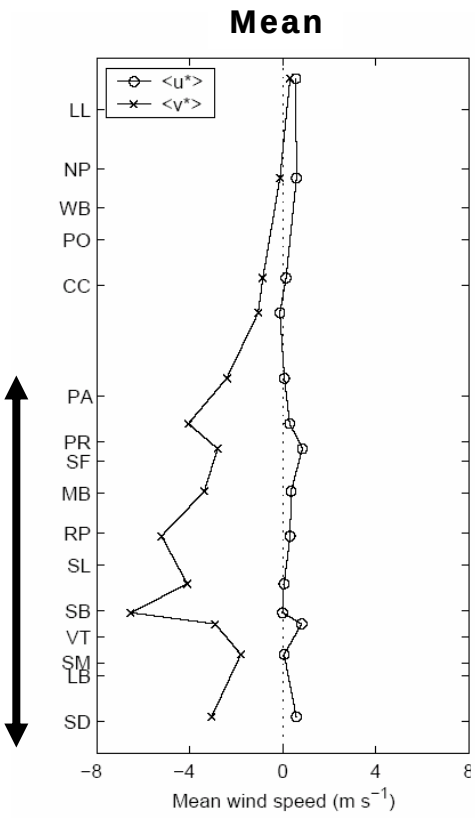
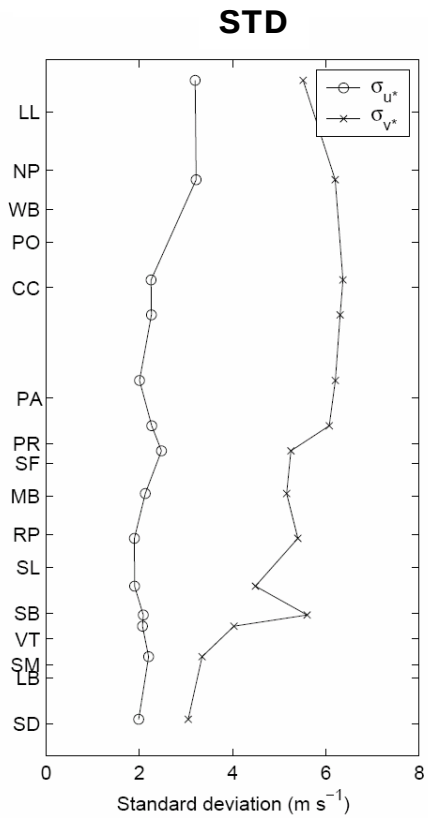
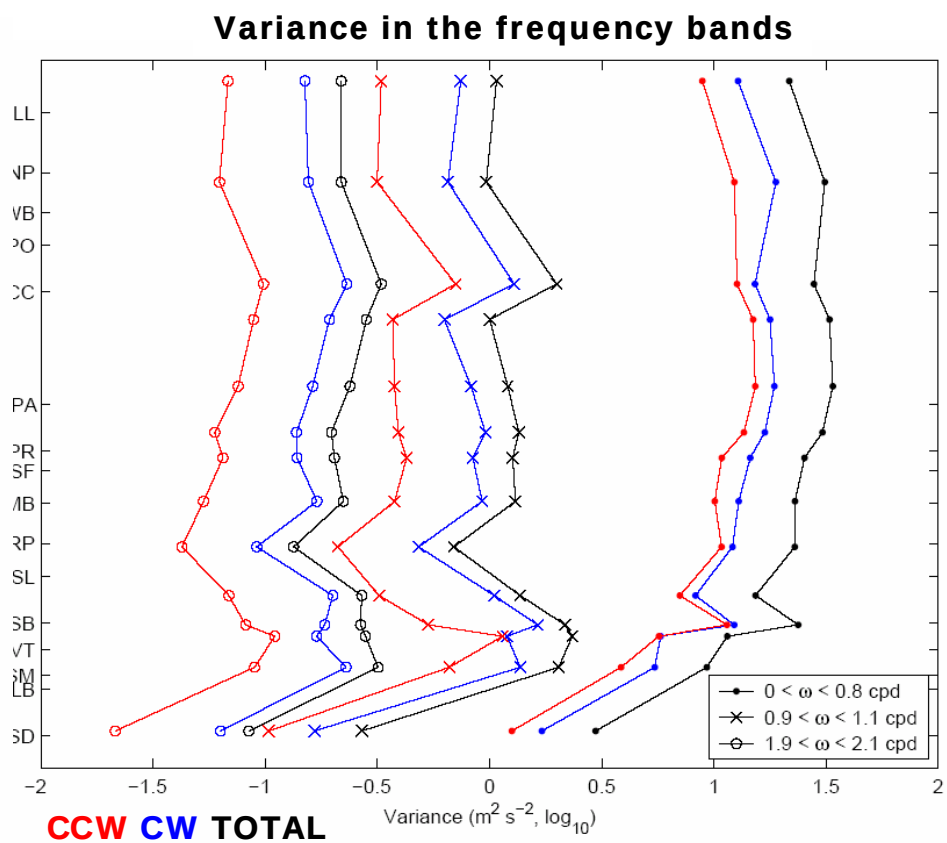
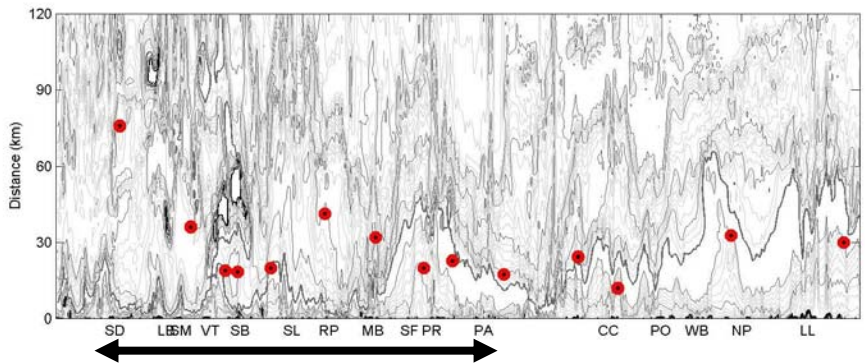
NDBC wind (1995-2007)







- Rotated with the principal axis
- Southern Cal. < Northern Cal. & Oregon.
- Strong variance at Pt. Conception.
- CCW < CW
- Variance in the diurnal band depends on whether the location of buoy is within sea/breeze cell.



Wind-driven current estimate

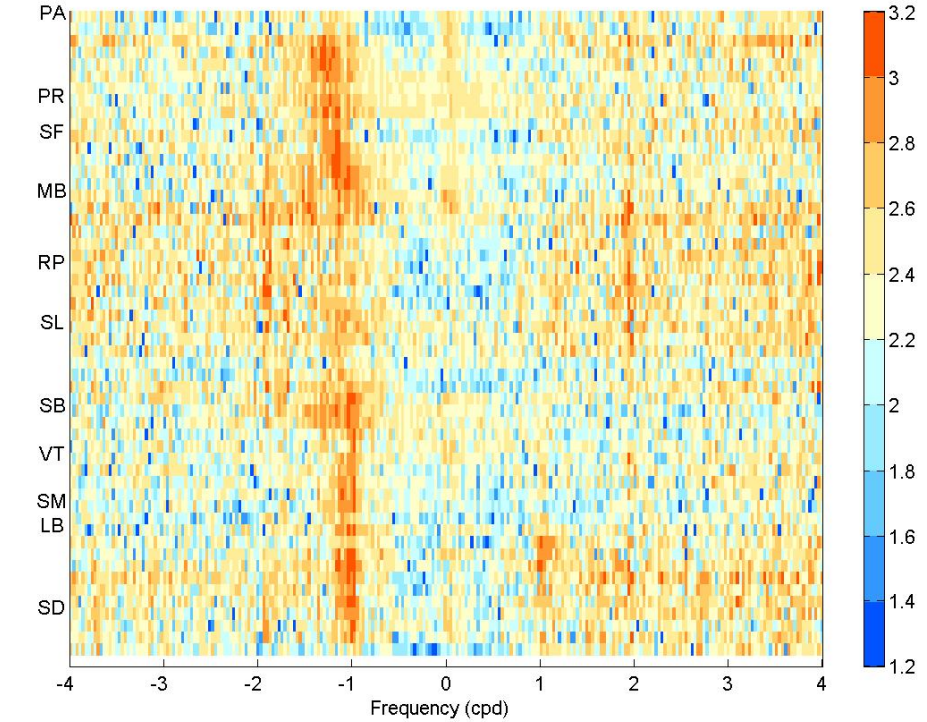
- Wind impulse response function (WIRF) estimate using hourly NDBC buoy winds and hourly de-tided surface currents for 10 months.
- Time/frequency domain isotropic WIRF.
- 6 days time lag wind stress as the impulse.

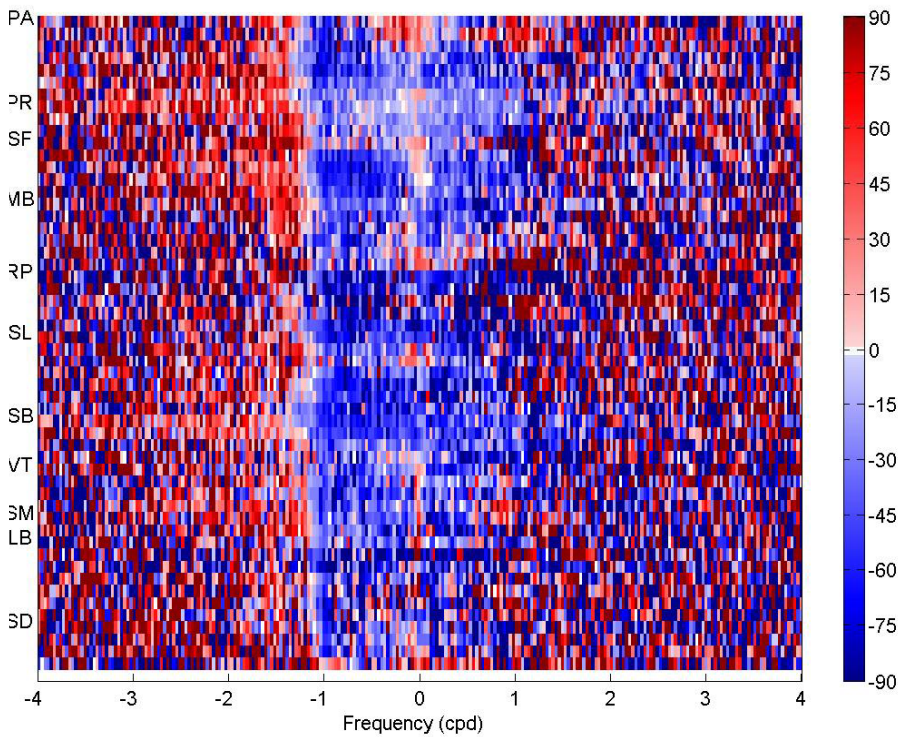
$$\mathbf{u}(z,t) = \int_{t'} \mathbf{G}(z, t-t')\boldsymbol{\tau}(t')\,\mathrm{d}t',$$

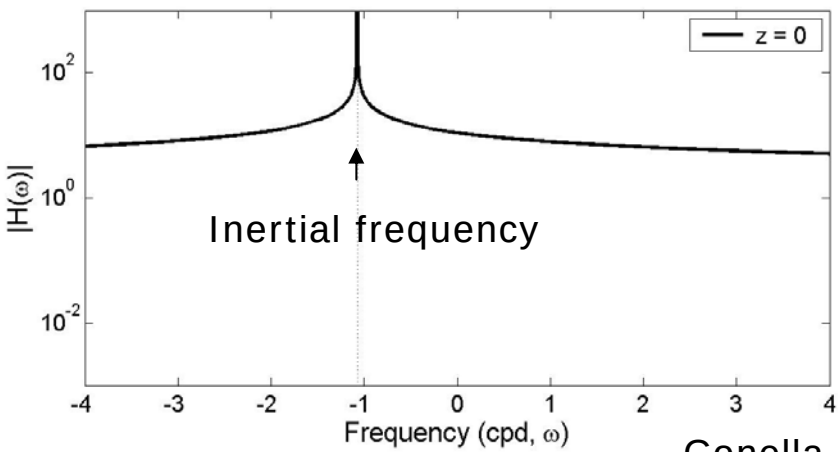
$$\mathbf{G}(z,t) = \left(\langle \mathbf{u}(z,t)\,\boldsymbol{\tau}_N^{\dagger}(t)\rangle\right)\left(\langle \boldsymbol{\tau}_N(t)\,\boldsymbol{\tau}_N^{\dagger}(t)\rangle + \mathbf{R_b}\right)^{-1}$$

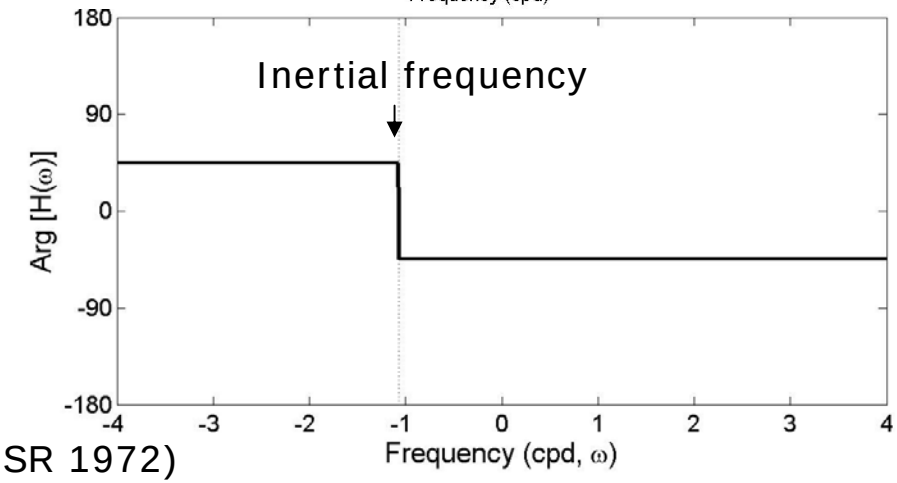
$\boldsymbol{\tau}_N(t)$: *N* hour advanced time lag wind stress

Wind-impulse response function



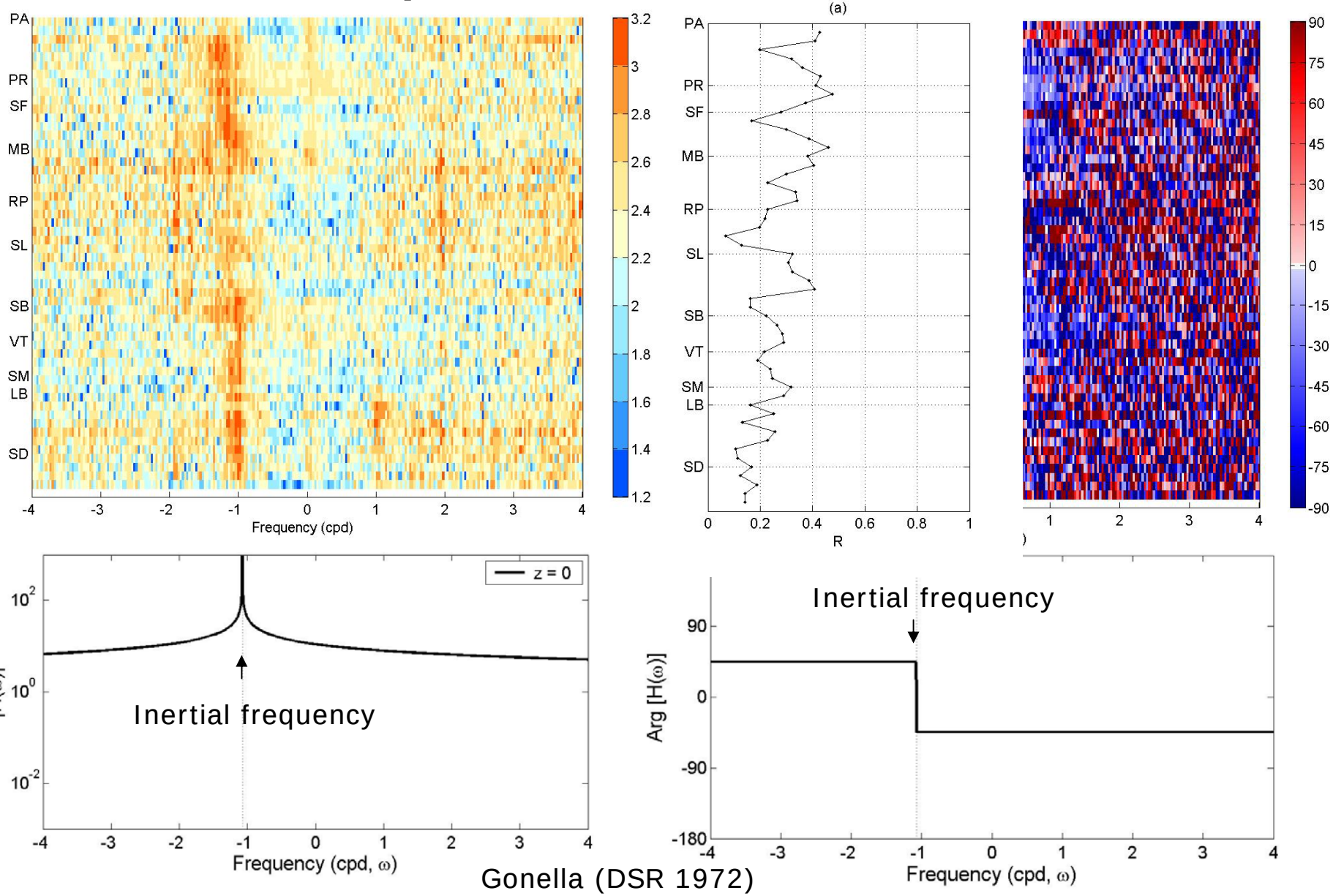






Gonella (DSR 1972)

Wind-impulse response function

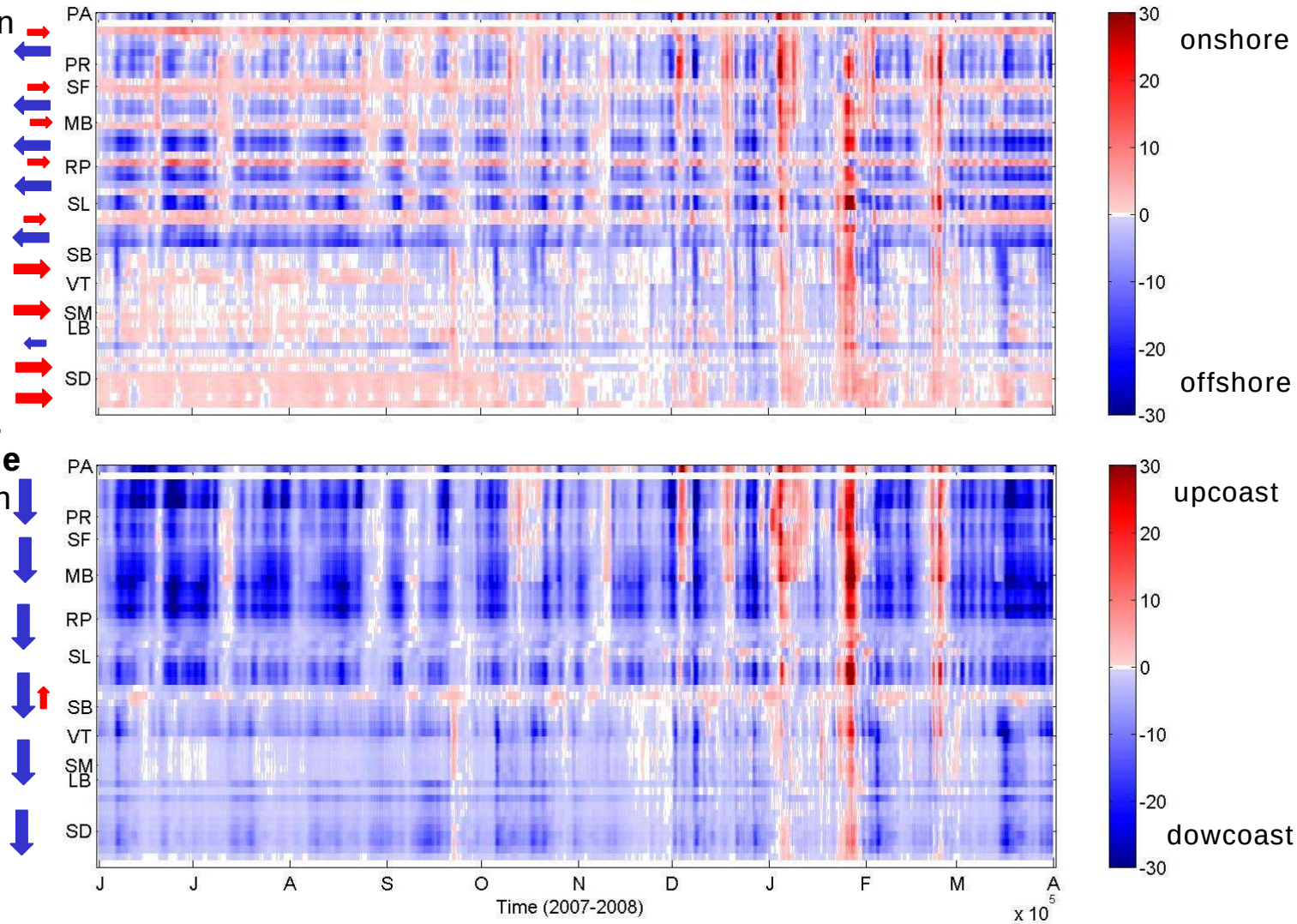


Gonella (DSR 1972)

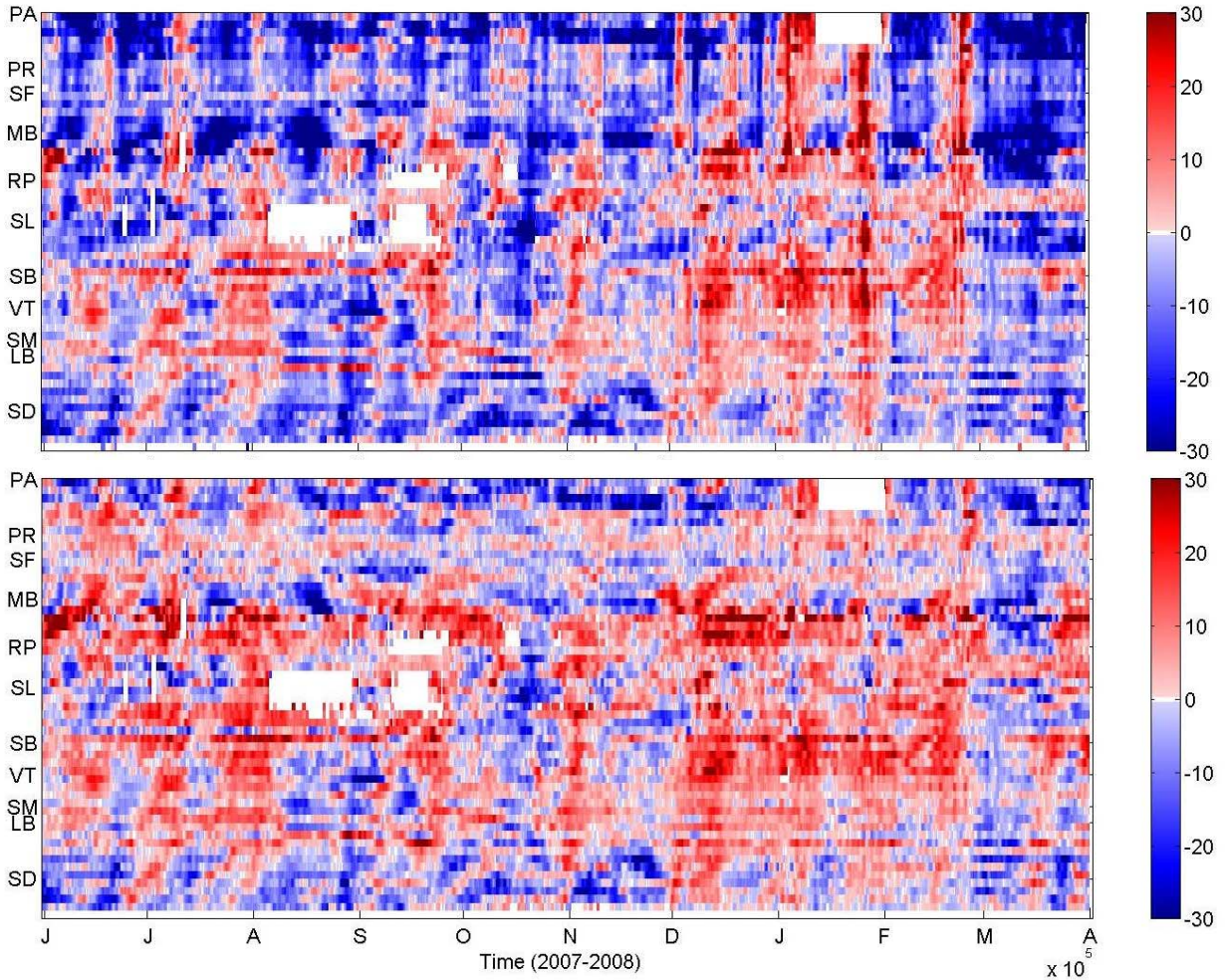
Wind-driven surface currents

25 hrs avg. **cross shore** wind-driven currents

25 hrs avg. **alongshore** wind-driven currents



Unconditioned vs. wind-free surface currents



- Most of wind-driven currents are downcoast, so upcoast currents are discovered and the noises are added

Summary

- Poleward propagating features in surface currents along the CA coast show O(10-100) km/day speed with the period of 10-30 days.
- Wind-driven currents were filtered out to magnify the poleward propagating features.
- Need to revisit the vector current estimate with multiple frequency radars (long and short range radar) and refine the estimate.