Modal filtering …
… without VLA!

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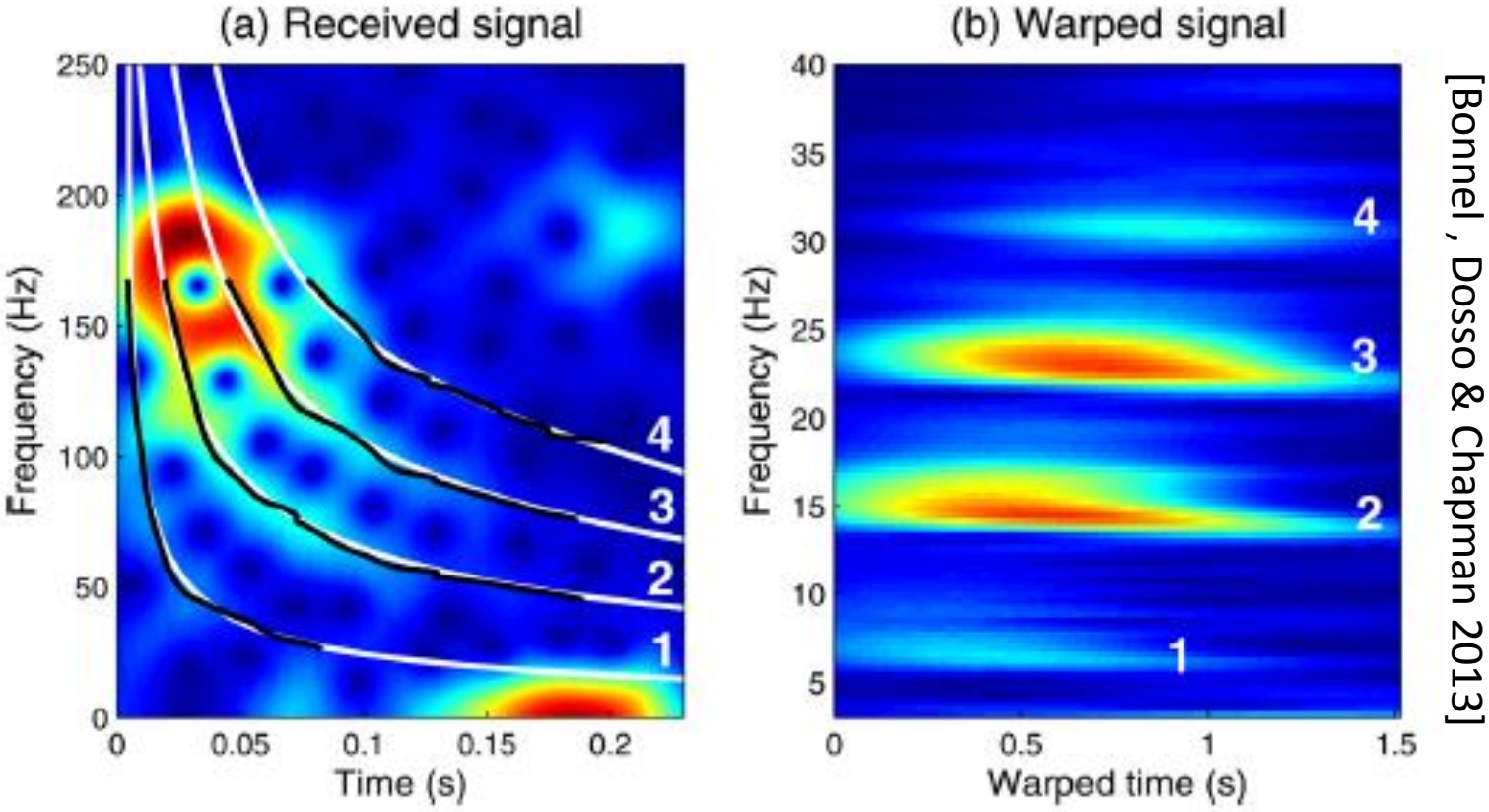
Modal filtering

- Modal based inversion methods require modal filtering
- Modal filtering is trivial with a « perfect » VLA
- What can we do without?
  - Single receiver
  - Small HLA

Single receiver

Modal filtering using warping

→ physics-based nonlinear resampling



[Bonnel , Dosso & Chapman 2013]

SW06 data : lightbulb, r=7km

Single receiver

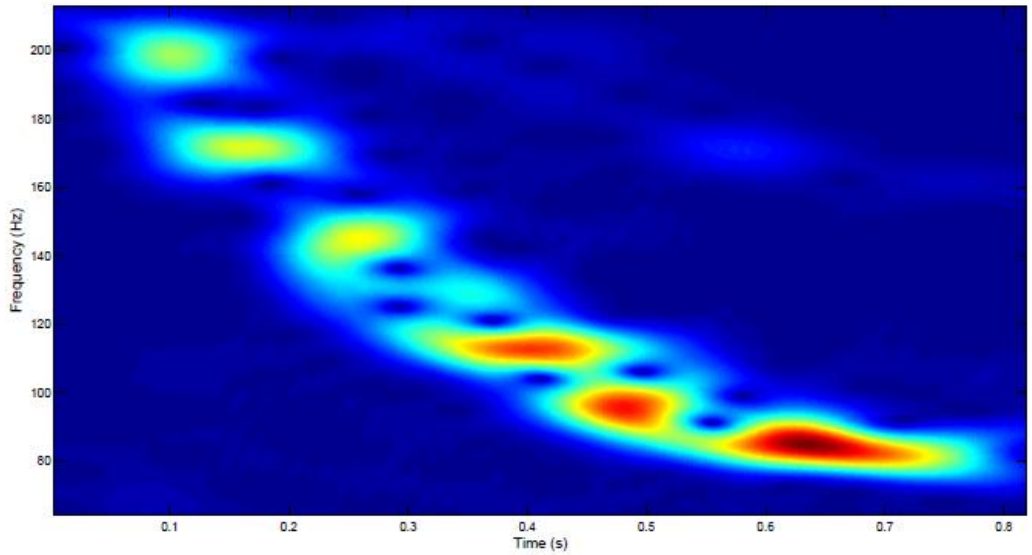
- Modal filtering using warping
  → Time-frequency dispersion curve
  → Filtered modes (i.e. time series)

- TF dispersion curves → mode group velocity

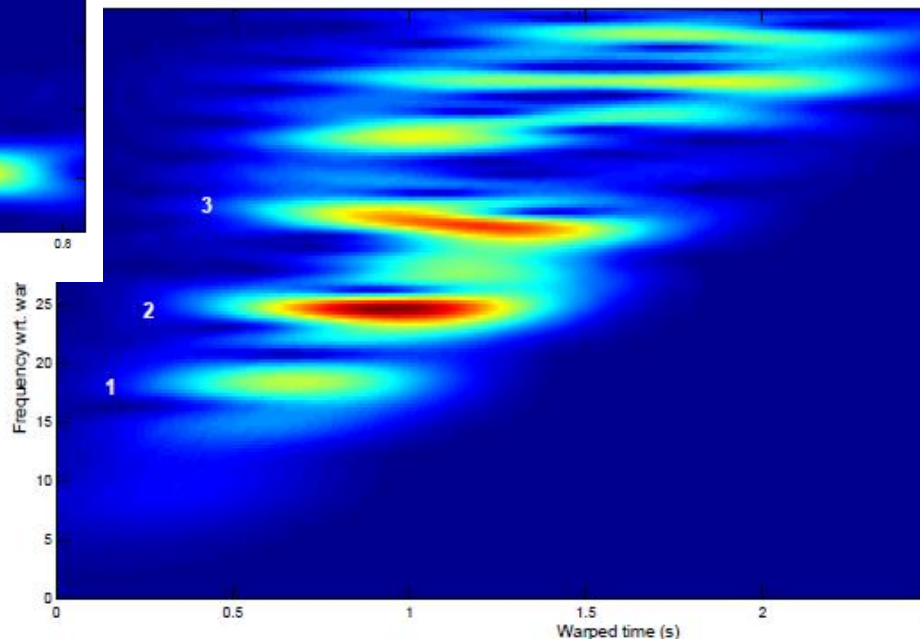
- Filtered modes → single receiver Matched Mode Processing
  → Attenuation (non-linear?), shear, …

Single receiver

- Modal filtering at (very) very range
  → better/easier geoacoustic inversion



[Bonnel & Thode, 2014]



Bowhead whale call

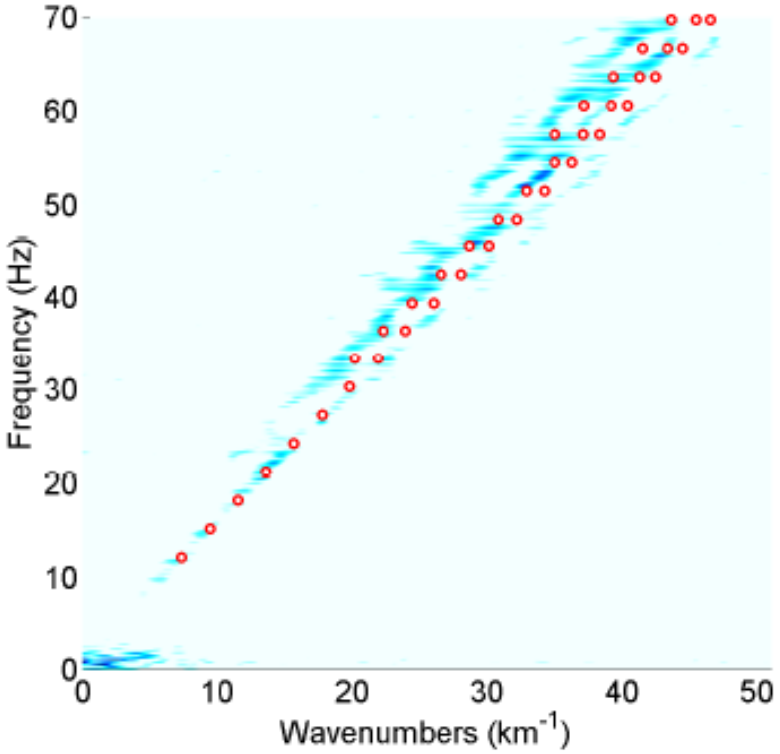
-D = 50 m

-r = 3 km

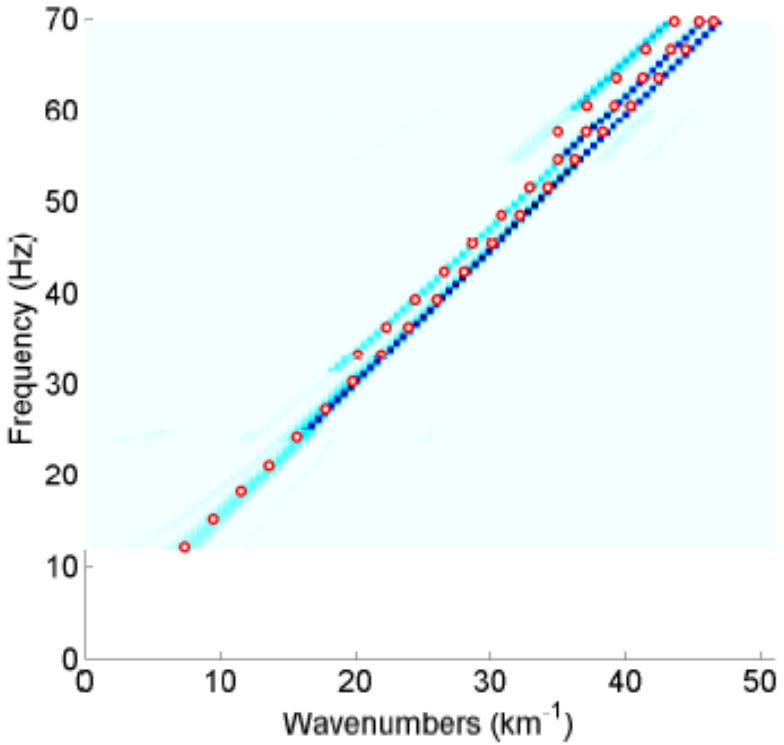
Horizontal Line Array

- Wavenumber estimation using compressed sensing followed by wavenumber tracking
- Compressed sensing (= sparse spectral estimation)
  - Allows wavenumber estimation on short HLA
  - Not restricted to endfire position
- Wavenumber tracking using particle filtering with physics-based system equation
  - Allows estimation on shorter array
- Mode amplitudes are not recovered

Horizontal Line Array



(a) 32 sensors sparse $f - k$ representation



(b) Particle histograms

[Le Courtois & Bonnel, 2014]

SW06 data : lightbulb recorded on SHARK array (32 sensors), non endfire position

Summary

- Modal filtering using warping (single receiver)
  - Allows recovering of mode time series → MMP
  - Allows inversion at « very short » range
  - Can be combined with a small VLA for array gain (high order mode estimation?)

- Wavenumber estimation using « small » HLA
  - Easier with endfire sources (but not required)
  - Mode amplitude are not recovered (?)

- Low frequency sources : Impulsive (lightbulbs, CSS, … ?) and FM sources (J15?)

- Modal estimation robust to environment variability / range dependance

- Inversion in collaboration with UVic (work in progress for single receiver MMP) will have to go range-dependant