# Tracking and forecasting single planetary waves in altimetric datasets

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## Motivation of the study

Fourier and Radon Transform analysis yields average properties over a space/time domain. **We want to look at the single planetary wave events instead.**

This should help investigate:
- El Nino-generated waves
- interannual variability of waves
- localized effects of topography
- effects of waves on SST/phytoplankton field

This approach is also useful for **forecasting** purposes

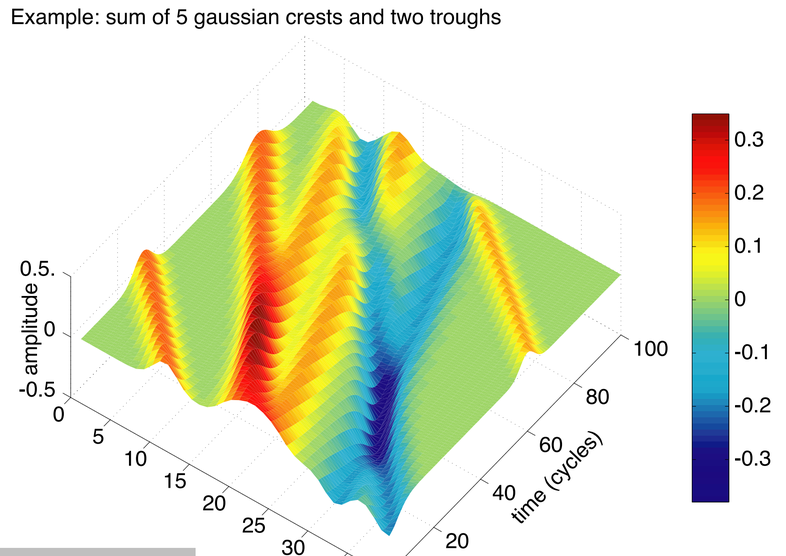
## Fitting a wave shape model

The idea is to fit a wave shape model to the 'crests' and 'troughs' observed in longitude/time diagrams of SSHA

We have chosen a **gaussian** as easy to deal with - it can be refined later.

Each gaussian wave depends on 4 parameters: **amplitude**, horizontal **width**, **slope** and **intercept** of wave trajectory (slope is inversely proportional to wave **speed**)

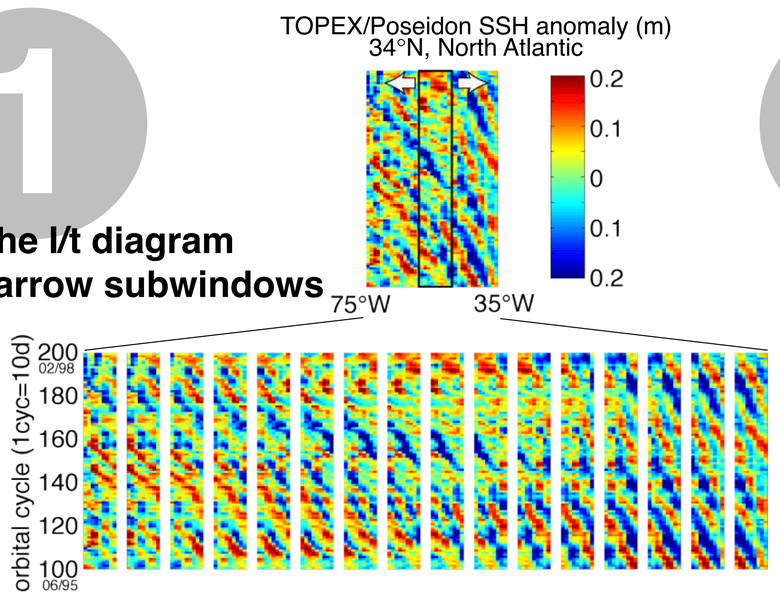
Example: sum of 5 gaussian crests and two troughs




## METHODOLOGY

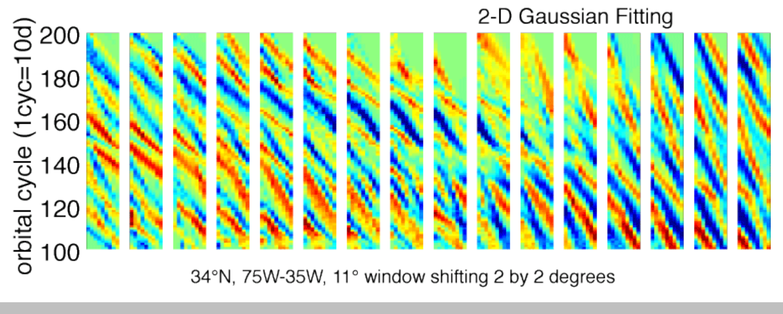
**1**

**Split the l/t diagram into narrow subwindows**



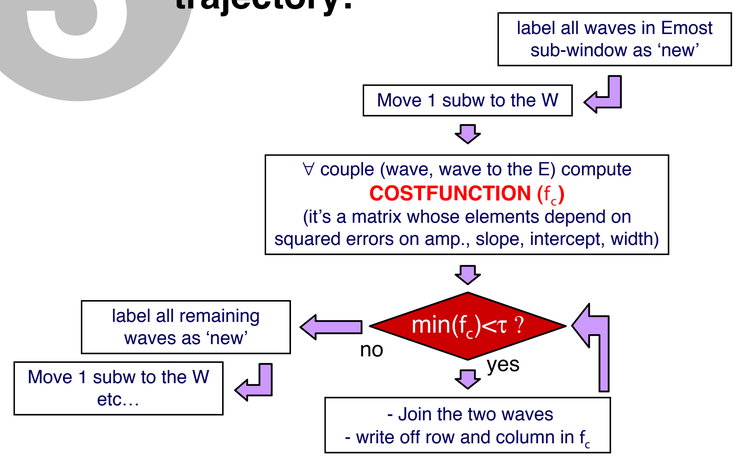

**2**

**Fit (iteratively) a number of elementary waves (gaussian) to each subwindow. Each elementary wave is just an array of four parameters. So we get a table of waves for each subwindow**



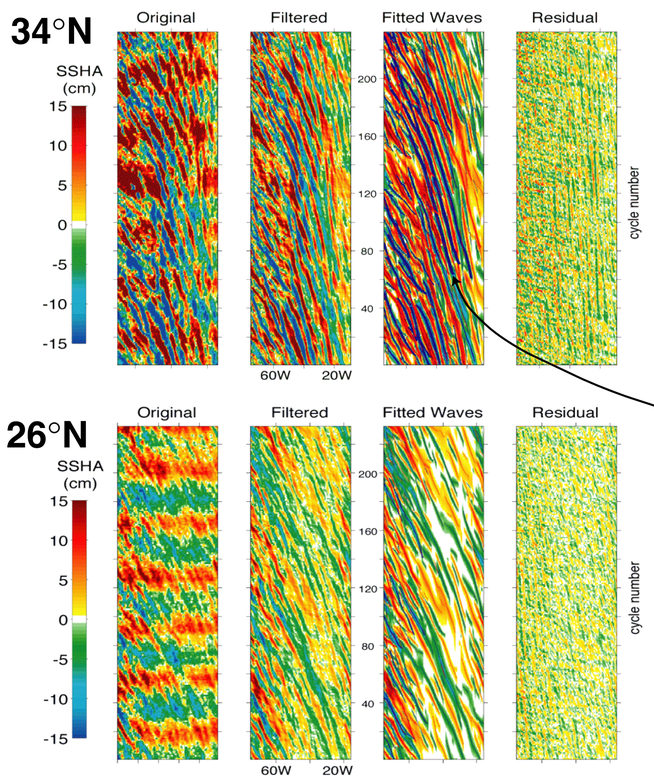

**3**

**'Join' the elementary waves, that is reconstruct their trajectory:**




## RESULTS

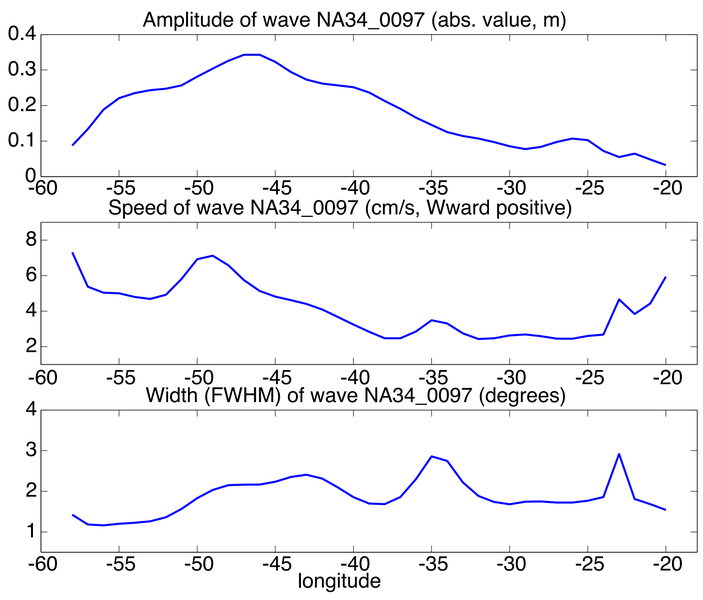
### Original vs fitted fields:



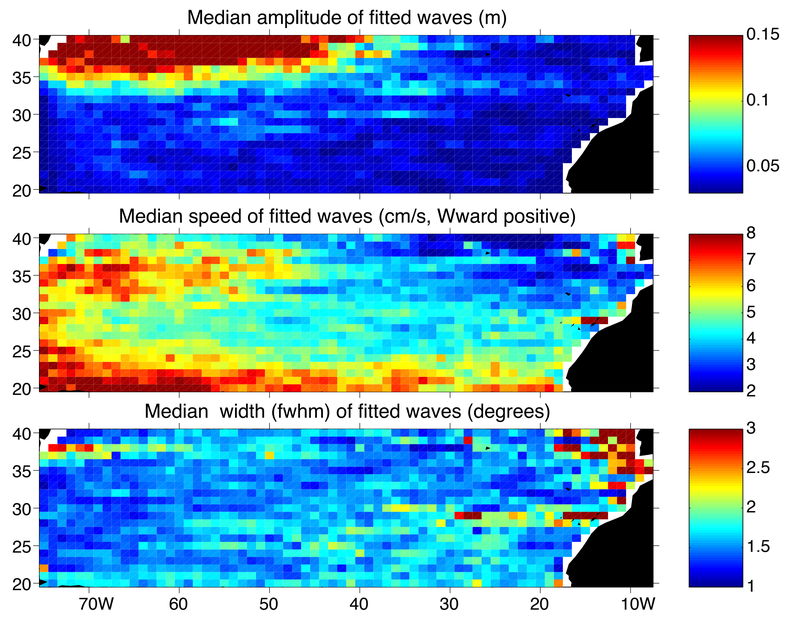

The third subplot shows the tracks of the fitted downwelling (red) and upwelling (blue) waves. For each of those we now have the values of the parameters in each point of the track

**The story of a single wave**

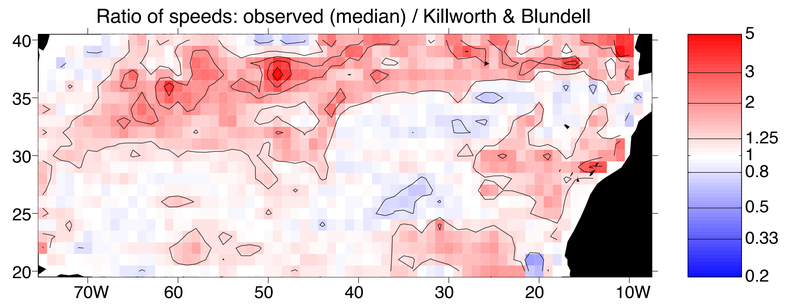
It is possible to track the evolution of each single wave, like in this example:




It is obviously possible to compute the average fields of the parameters...




...and compare them with the theoretical predictions

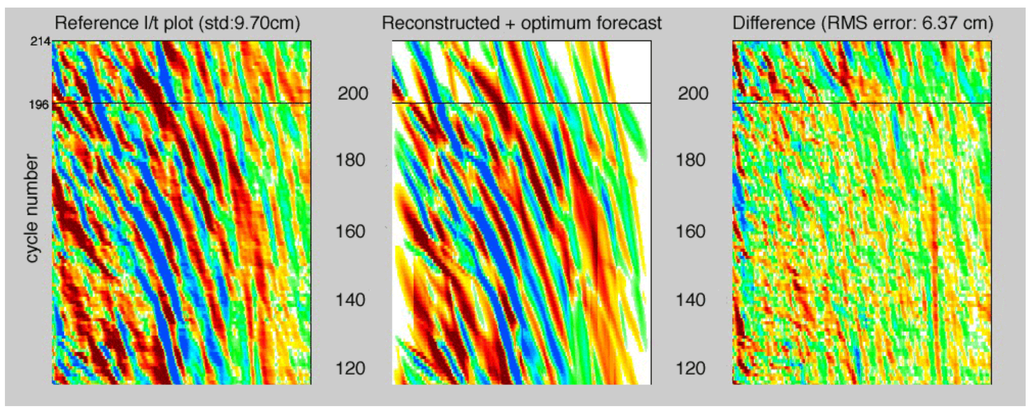



## FORECASTING PLANETARY WAVES

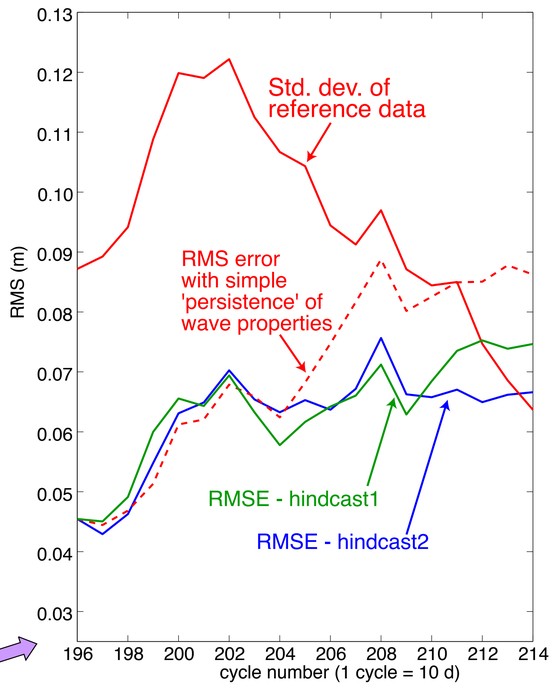
### Finding the 'most similar' wave

The set of parameters from the fitting and reconstruction exercise can be used for forecasting purposes in different ways. The approach that we have tried so far is:
- search parameter space and find 'most similar' wave to the one to be propagated ('most similar' means 'closest', once a distance is defined in parameter space)
- propagate wave in accordance to behaviour of 'most similar wave'

### Example of hindcast (from cycle 196 to 214)




Results show that for the first 8 cycles our strategy is not better than a forecast based on simple 'persistence' of the wave properties (that is, propagation of the wave without changing its speed, amplitude, etc). But in the 3-month to 5-month period our forecasting strategy performs better than simple 'persistence'. This is encouraging.

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