Seamless transition from ocean to coastal retracking algorithms

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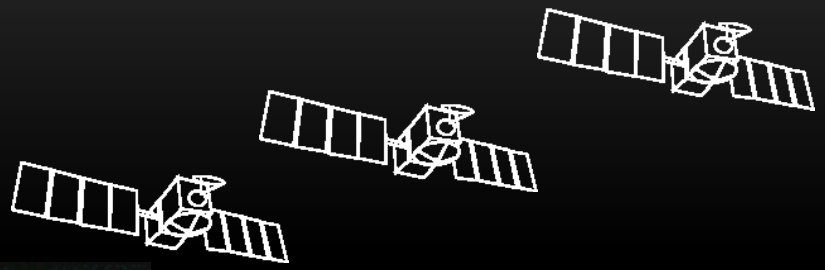
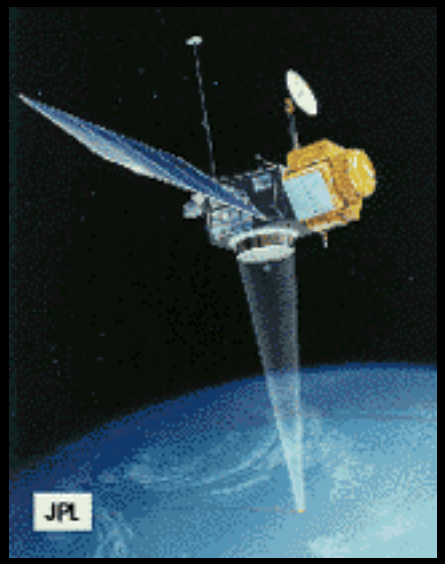
Homogeneity





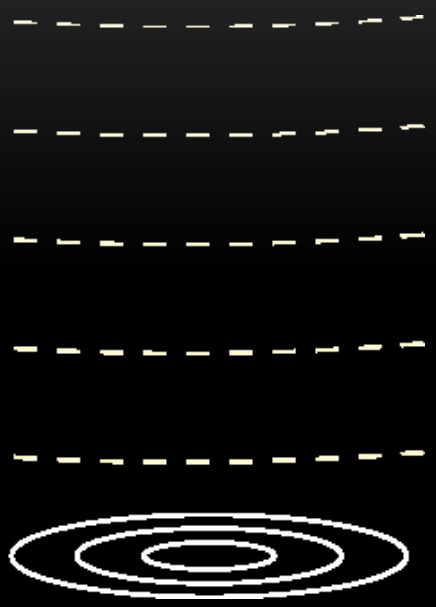
Matching TOPEX and Poseidon data

Continuity of T/P, Jason-1, Jason-2 etc

New instrumental techniques
(delay-Doppler, AltiKa, WSOA,)

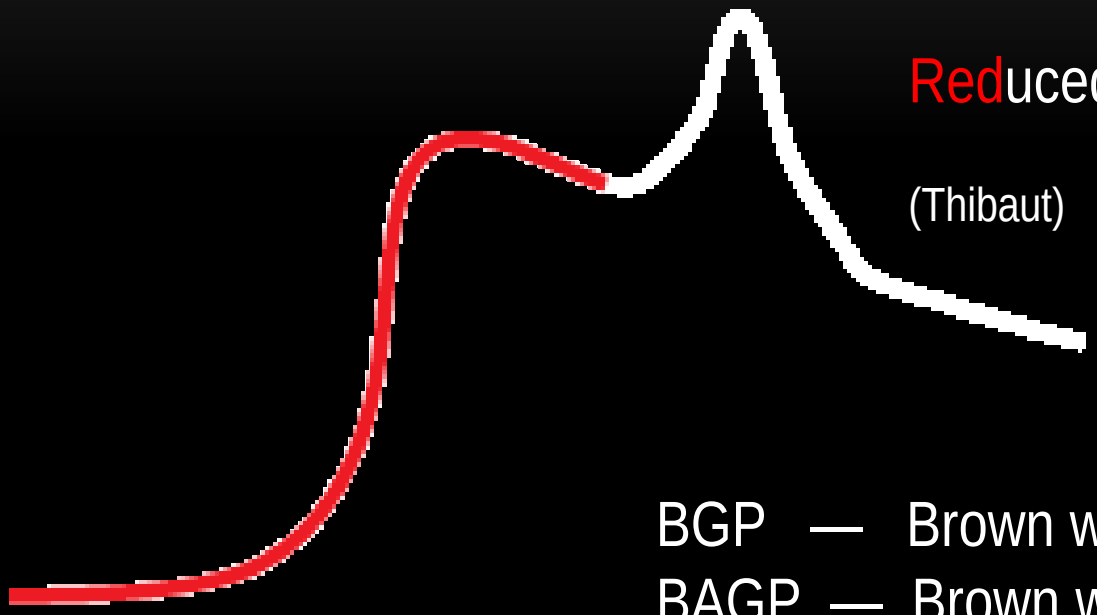
So what's so difficult about linking COASTAL and OPEN OCEAN?

“Brown Model” PLUS



Extra reflectance, due to land or localised very calm waters

Tackling individual waveforms



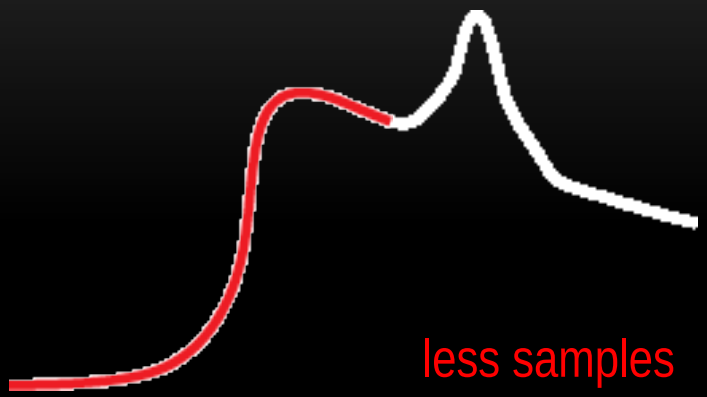
Reduced

(Thibaut)

BGP — Brown with Guassian Peak
BAGP — Brown with Asymmetric GP

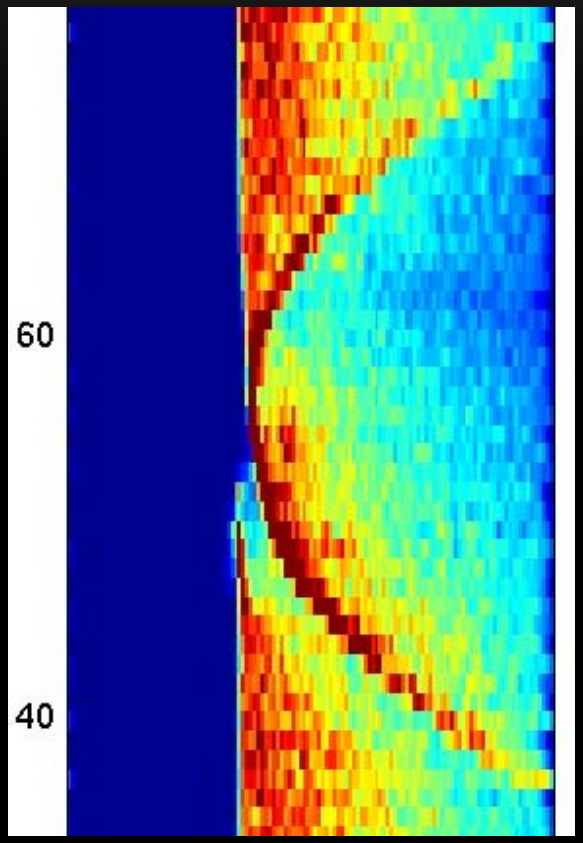
(Halimi, Thibaut et al,)

Why not use coastal tracker everywhere?

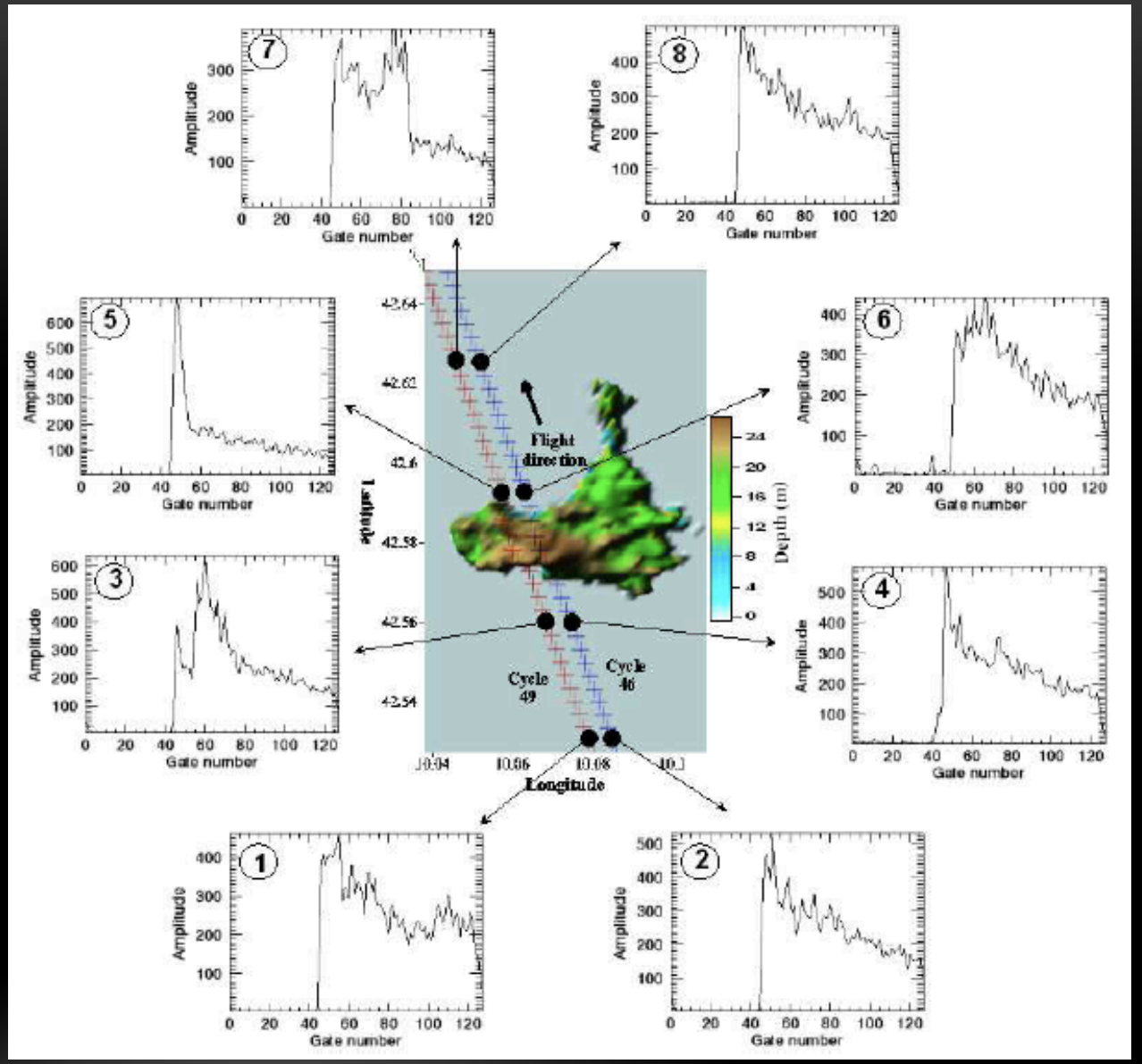


Brown : 3 + params

Reduced : 3

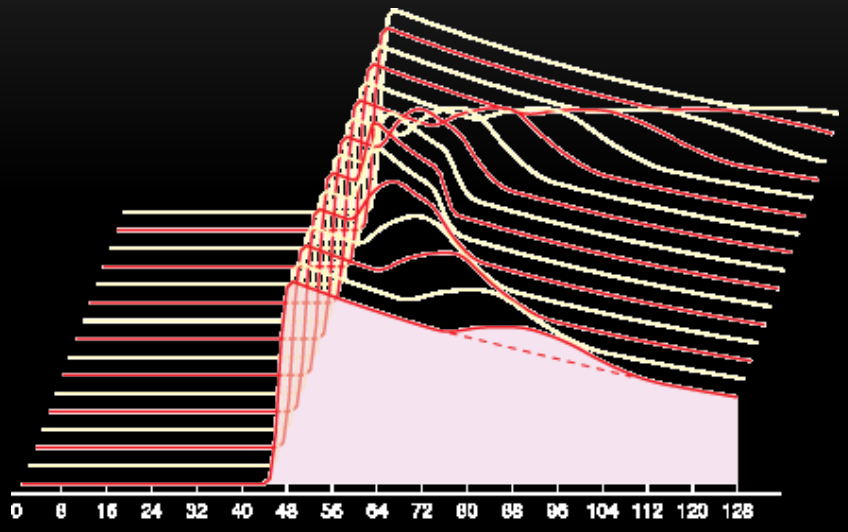


Bright target migrates through waveform as nadir point approaches



Successive waveforms affected — example from overflight of Pianosa (Gómez-Enri et al., 2010)

Processing multiple waveforms

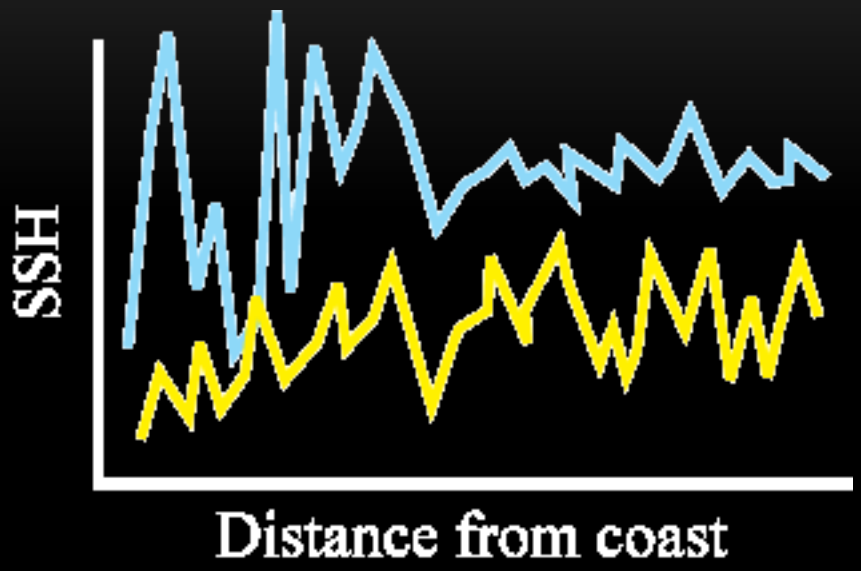


Hyperbolic pre-tracker
(Quartly)

Singular Value Decomposition
(Thibaut)

Bayesian Retracker
(Challenor)

Minimize effect of switching retrackers



Open Ocean retracker

- At what distance does its variability increase?

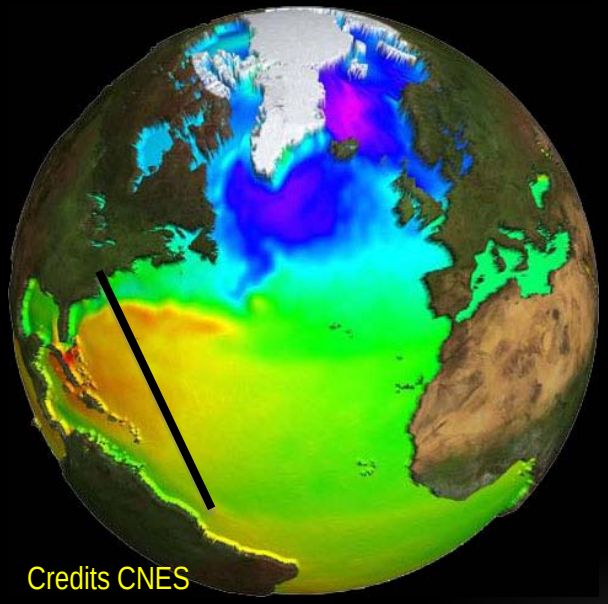
Coastal retracker

- How variable in open ocean?
- Is it biased relative to open ocean tracker?
- How variable is the offset?

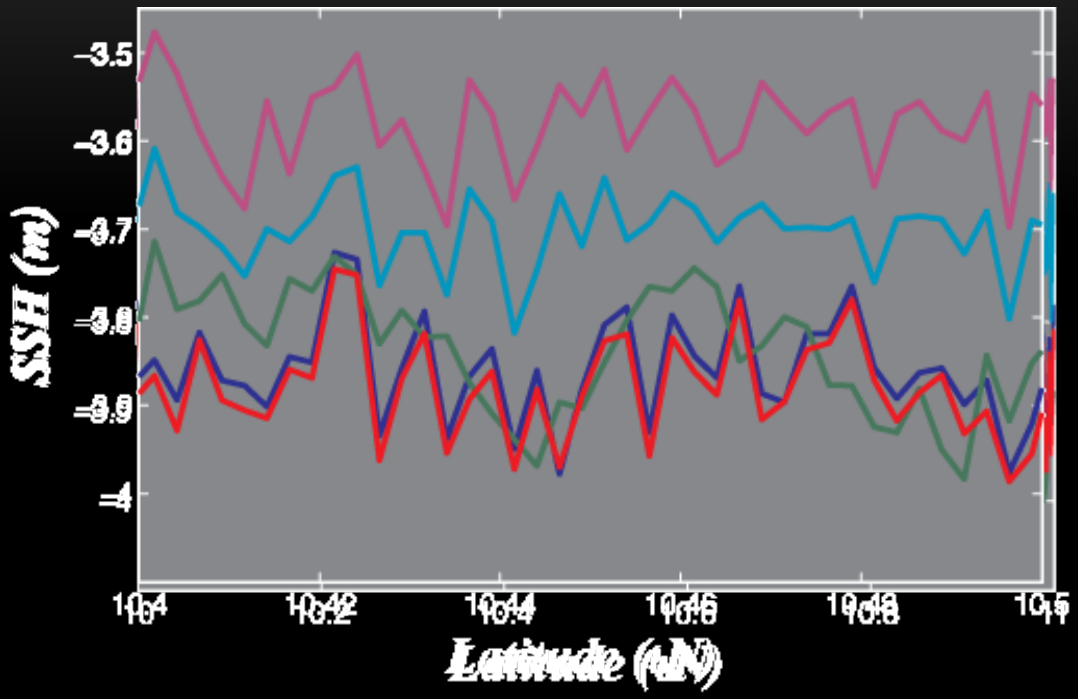
- Should change point be set by distance, coastal proximity or some property of waveform?

Example from Pistach

Standard (MLE-4)
Oce3
Red3
Ice3
Ice



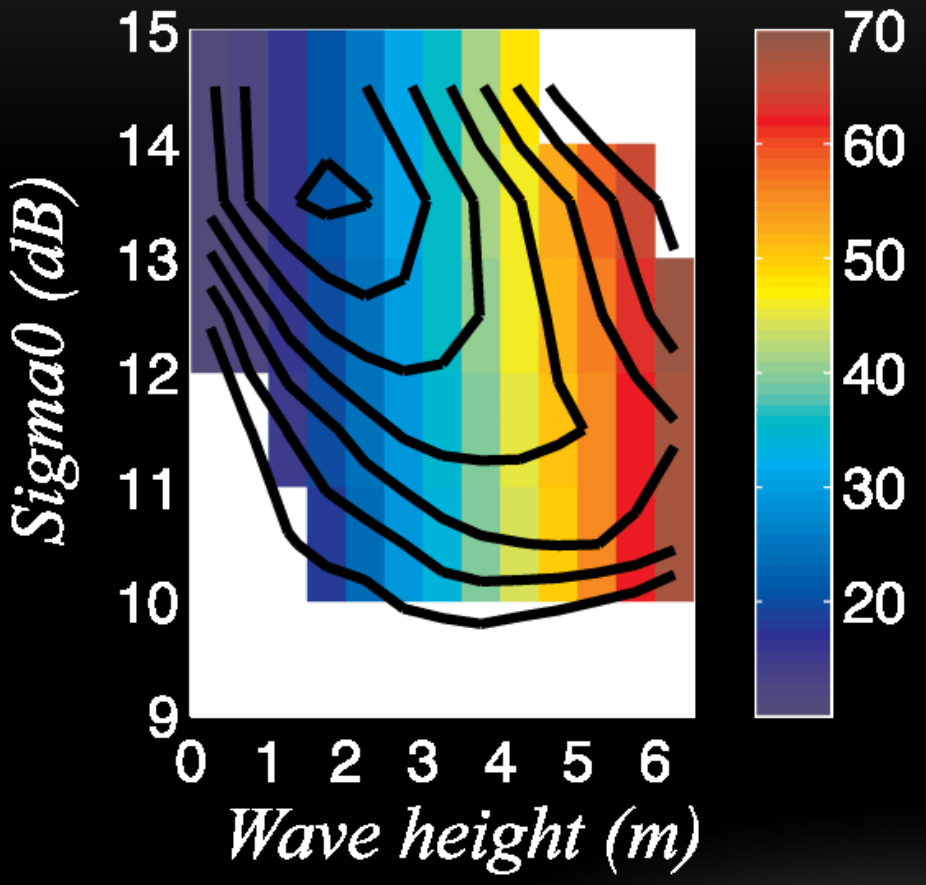
Credits CNES

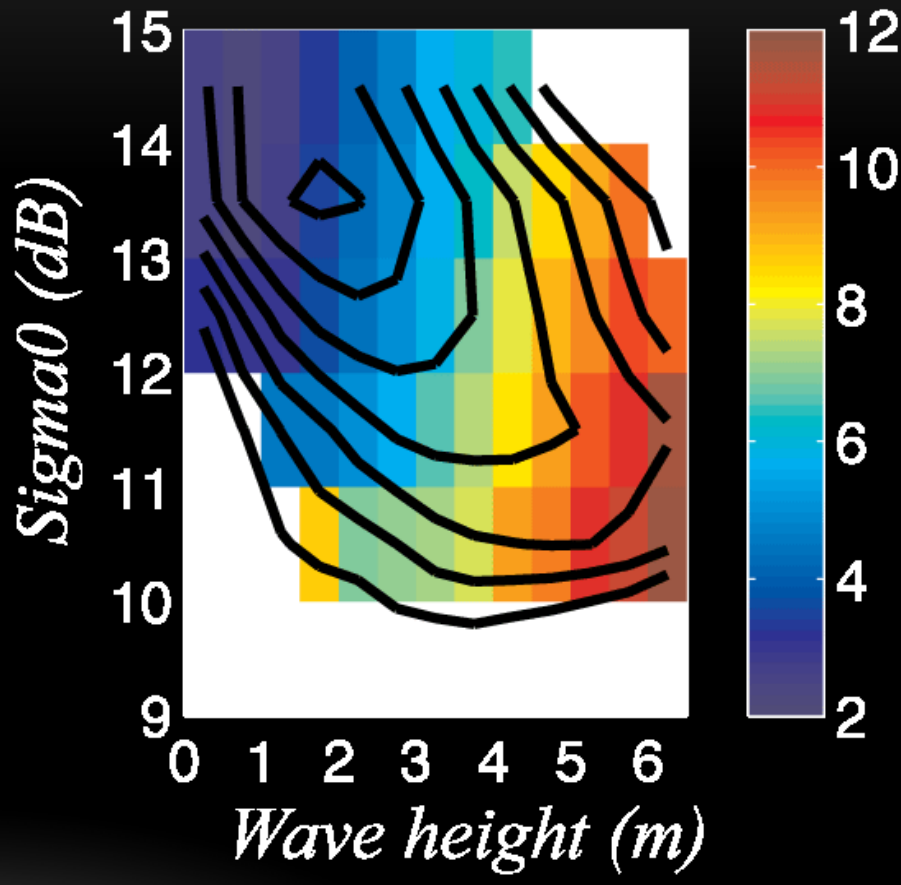


Note ice retrackers are intended for hydrology applications, not open ocean or coastal; simply included here to show diversity of behaviour

http://www.aviso.oceanobs.com/en/data/products/sea-surface-height-products

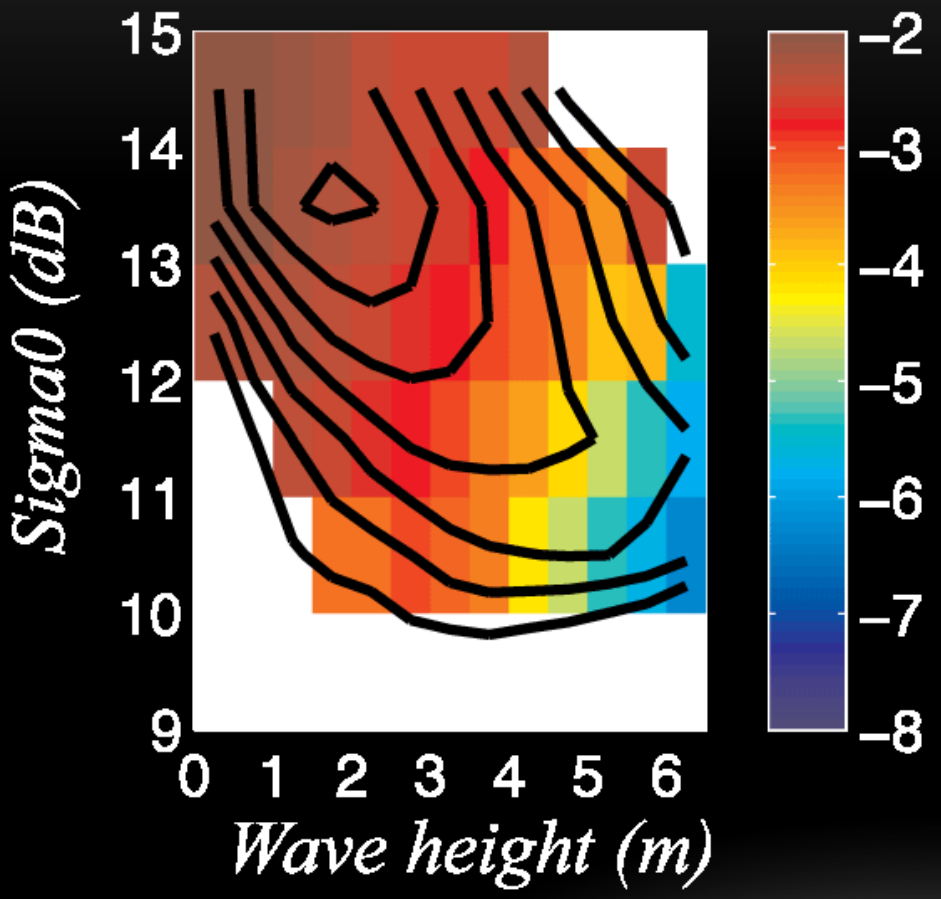
Bias and variability of ice3 rel. to MLE-4

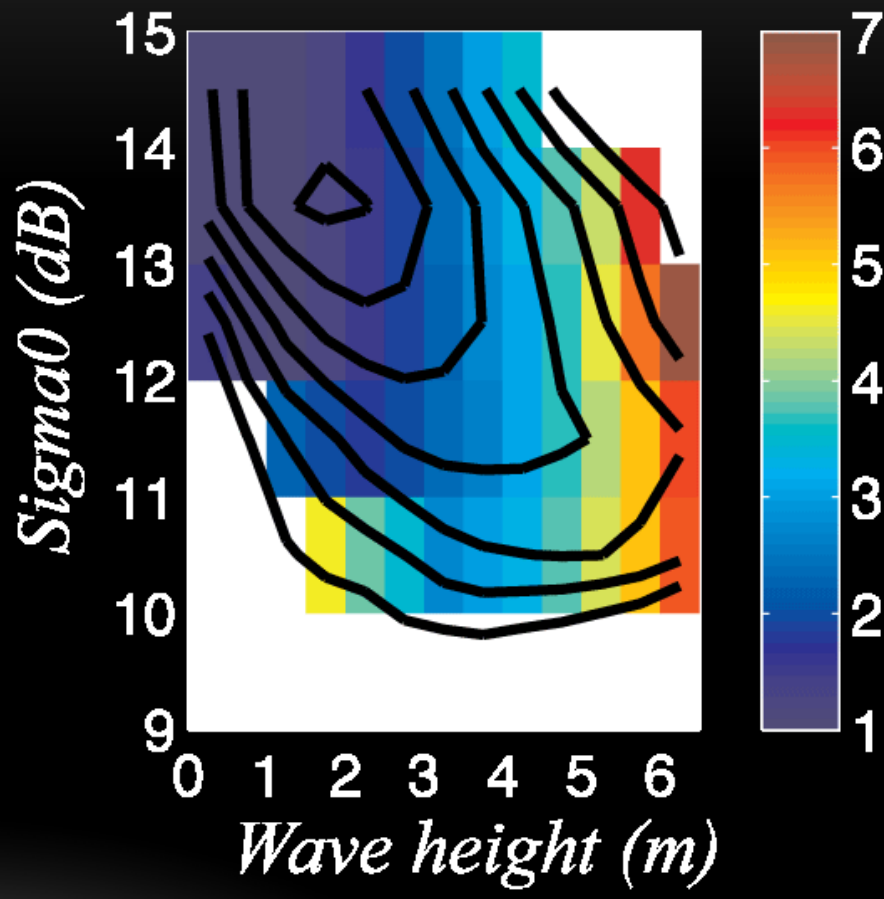




Offset between trackers is f (Hs,σ^0) — effectively an adjustment to SSB

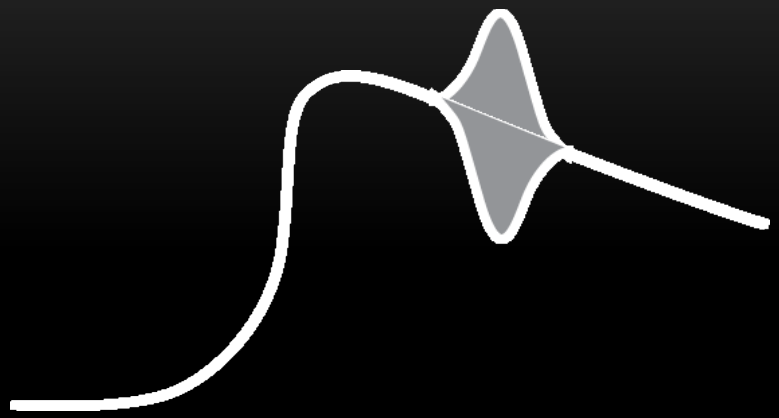
Bias and variability of red3 rel. to MLE-4





Note Pistach product does provide an alternative SSB for oce3 retracker

Inverse example



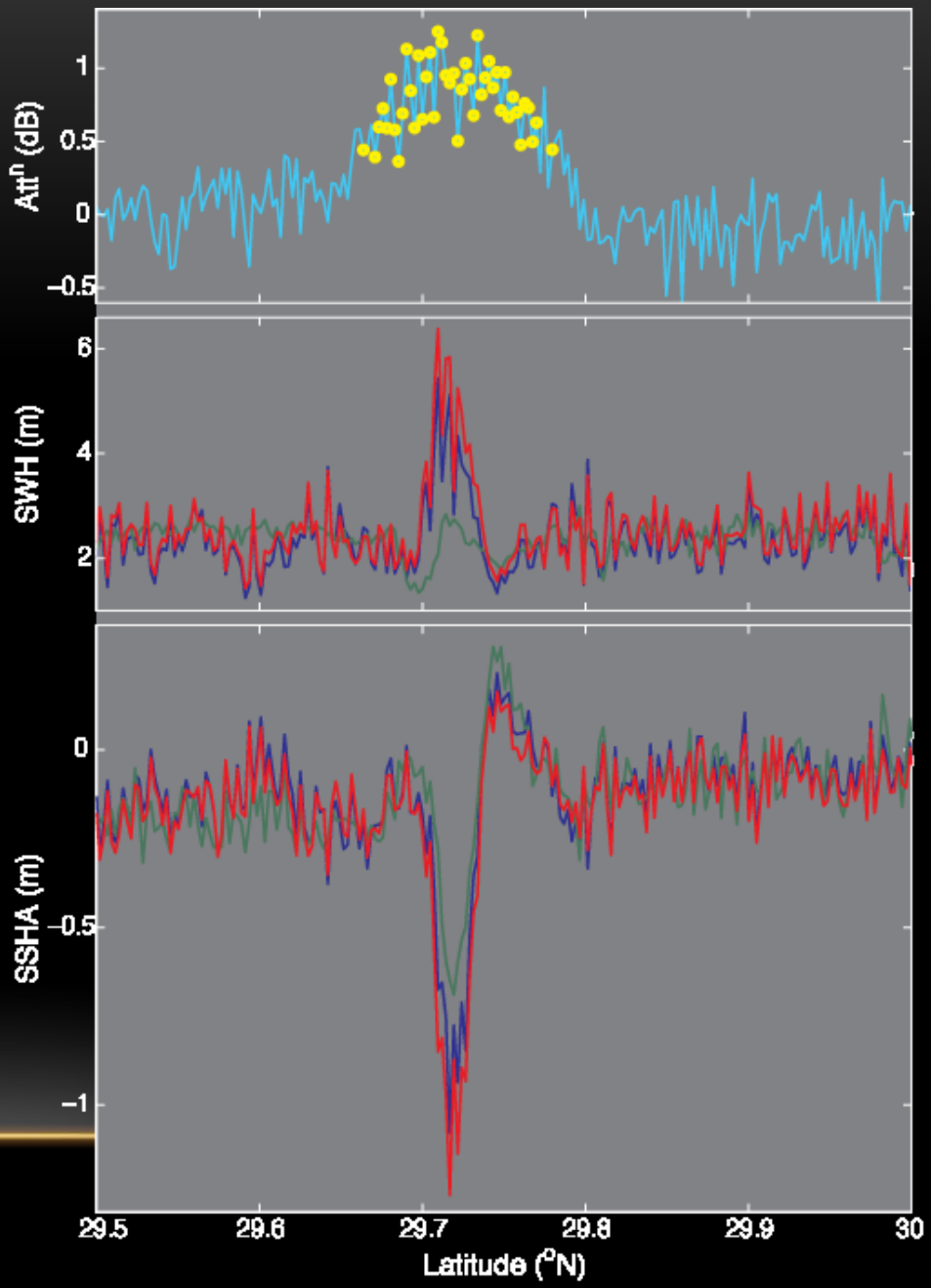
Minor rain event (~1 dB of attenuation)

Both SWH and SSHA affected (needed for studies of wave extremes and storm surges)

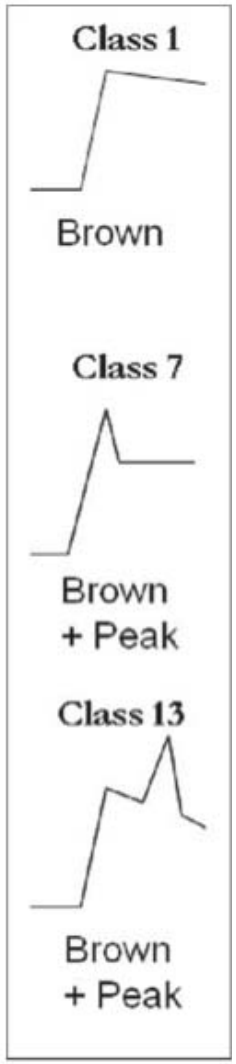
Not all trackers respond the same — need to know which is better

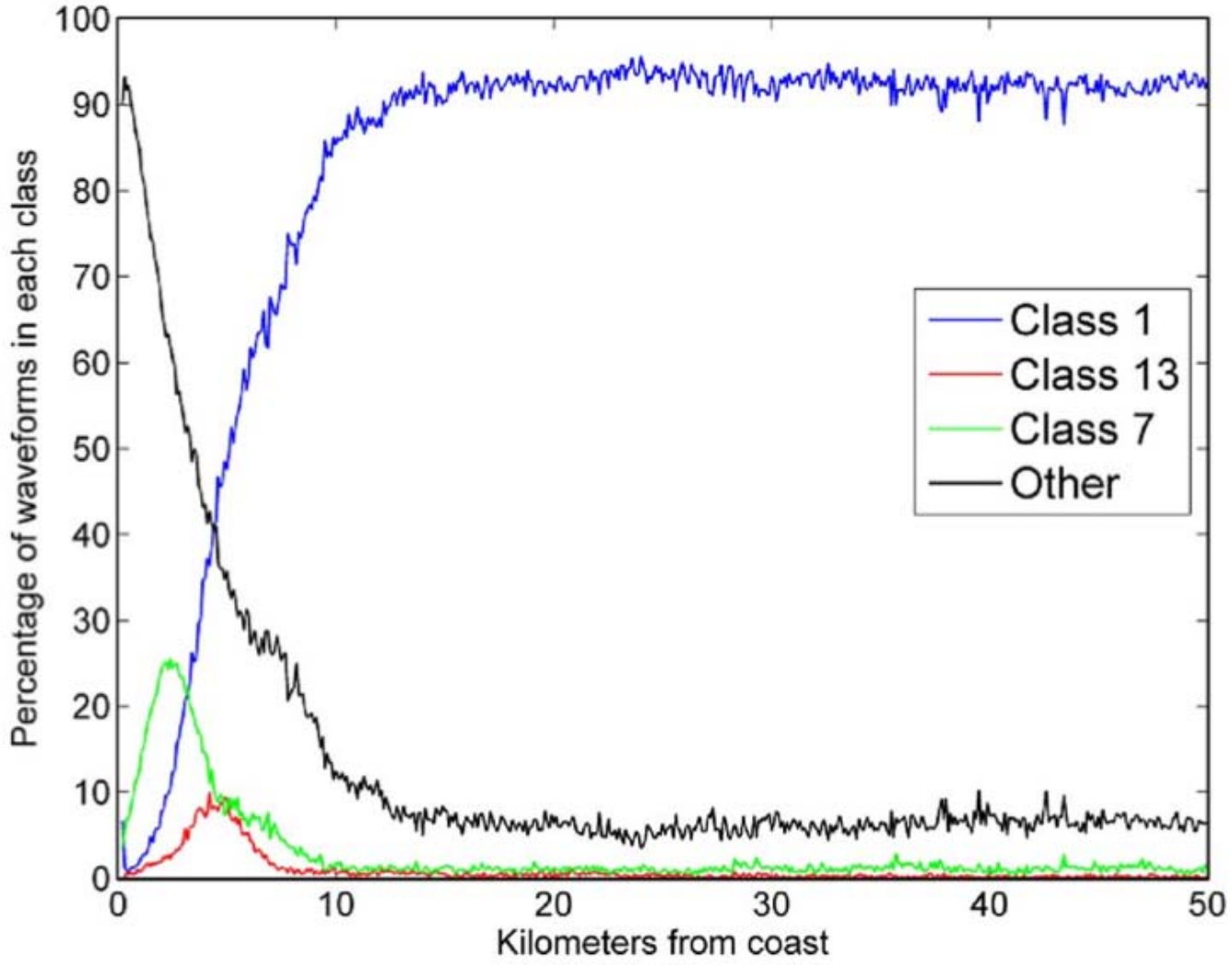
Requirement on relative range bias is less strict

Region to switch trackers is not fixed



Further random thoughts





Summary / Points for discussion

Need for specialist retrackers

Mean offset can be removed; need to minimize variability of offset
Model offset as f (Hs,σ^0)

Characterise r.m.s. of tracker change
20 Hz??, 5 Hz??, Spectral description

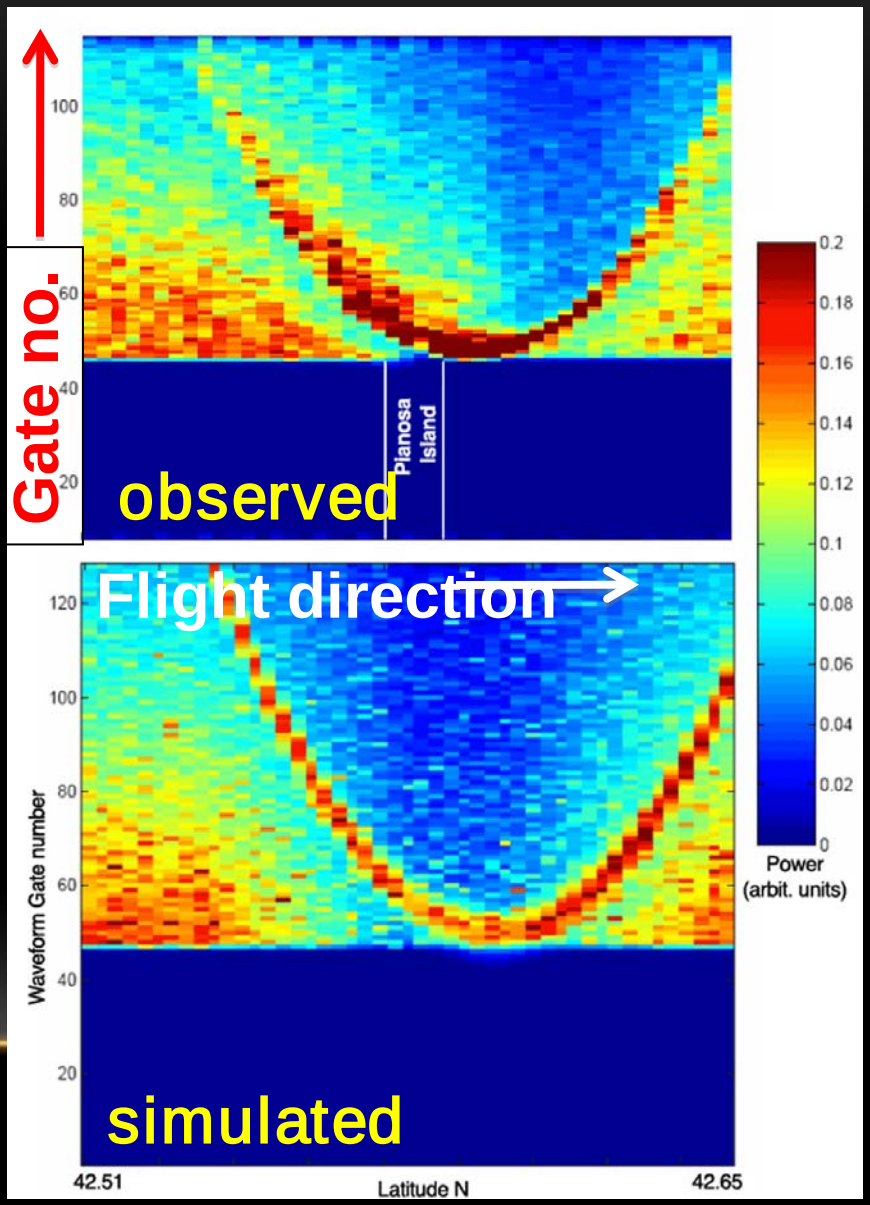
Transition — how near to coast? Sharp or fade?

Non-oceanic returns in open ocean
— storms, slicks & sea-ice

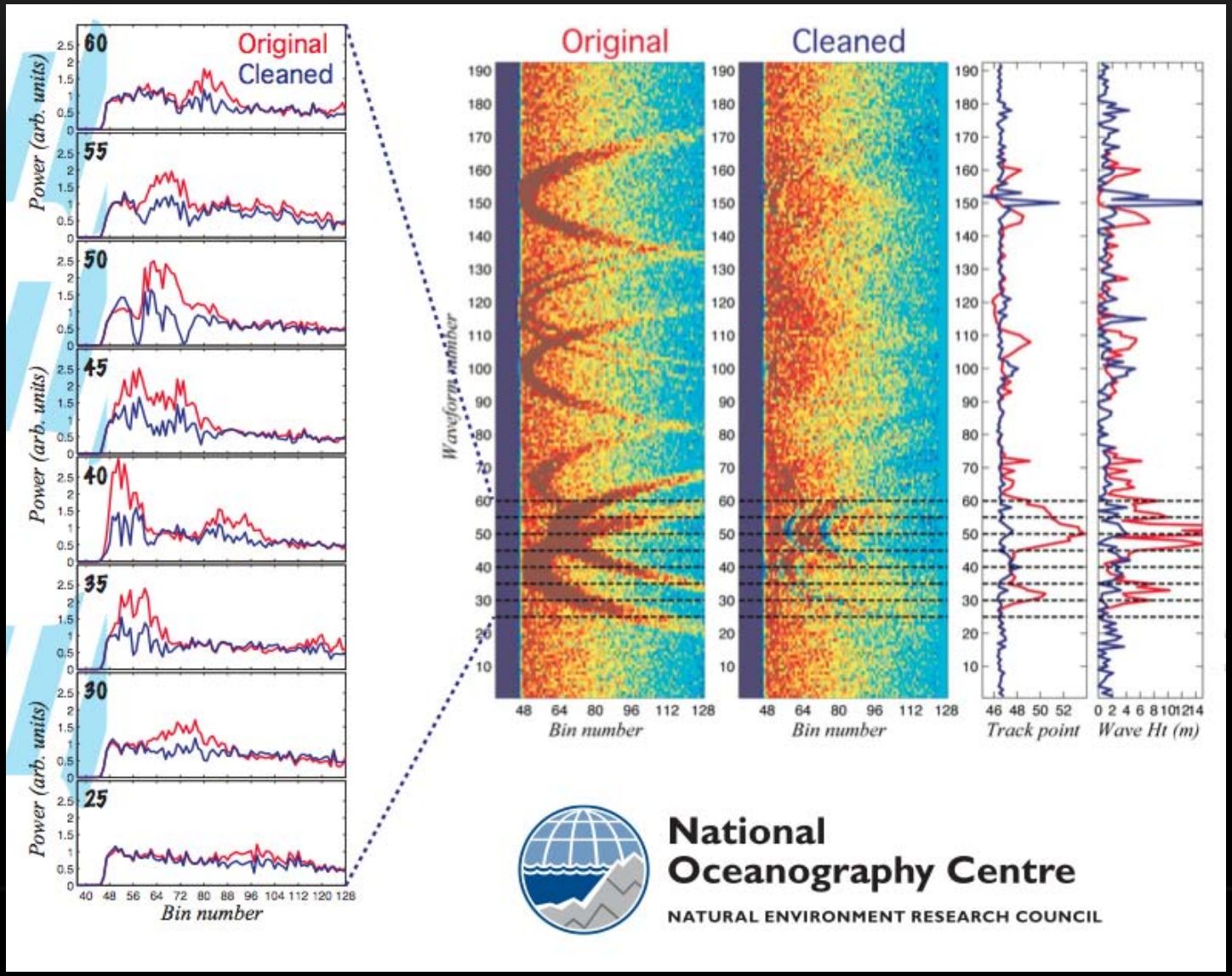
Hyperbolic features are relatively common

In cycle 49, bright target due to wave sheltering in NW bay (Golfo della Botte)

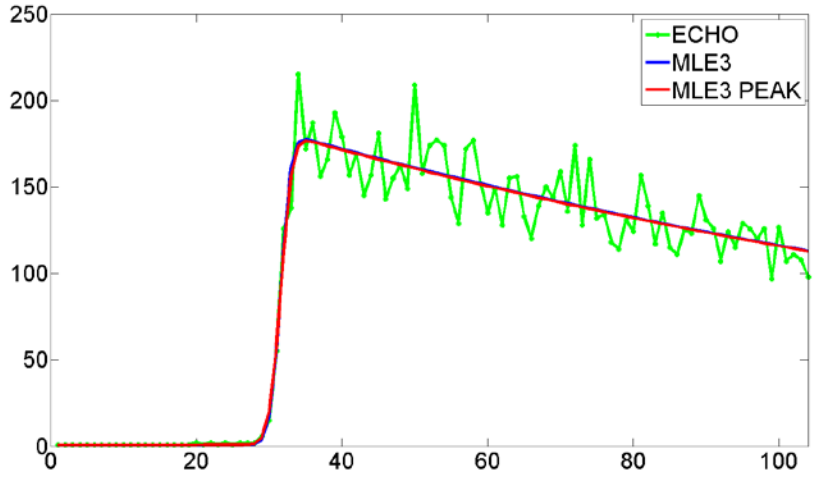
J. Gómez-Enri et al., IEEE GRSL 2010



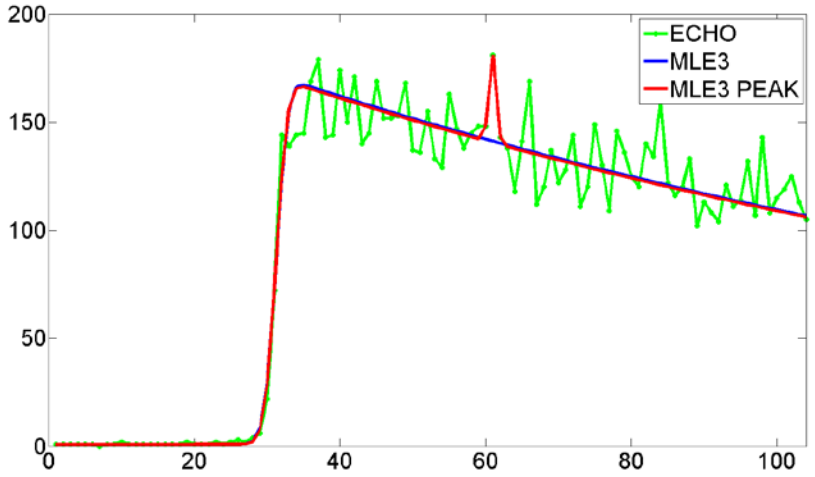
Hyperbolic *pre-tracker*, then Brown fitting



Regression with MLE3 on normal WFs



Sometimes, no peaks are fitted



Sometimes, small peaks are fitted

➔ No regression with respect to MLE3

➔ Very important to assure the continuity between retrackings when approaching the coasts (assures also the continuity of the SSB correction)

Brown with Asymmetric Gauss. Peak (BAGP)

$$\tilde{s}_k = s_k + p_k$$

with

$$p_k = A \exp\left[\frac{-1}{2\sigma^2}\left(kT_s - T\right)^2\right]\left\{1 + \operatorname{erf}\left[\gamma\frac{\left(kT_s - T\right)}{\sqrt{2}}\right]\right\}$$

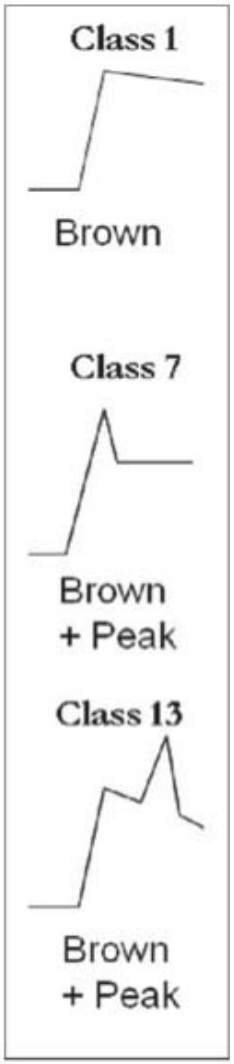
where γ is the asymmetry coefficient of the peak

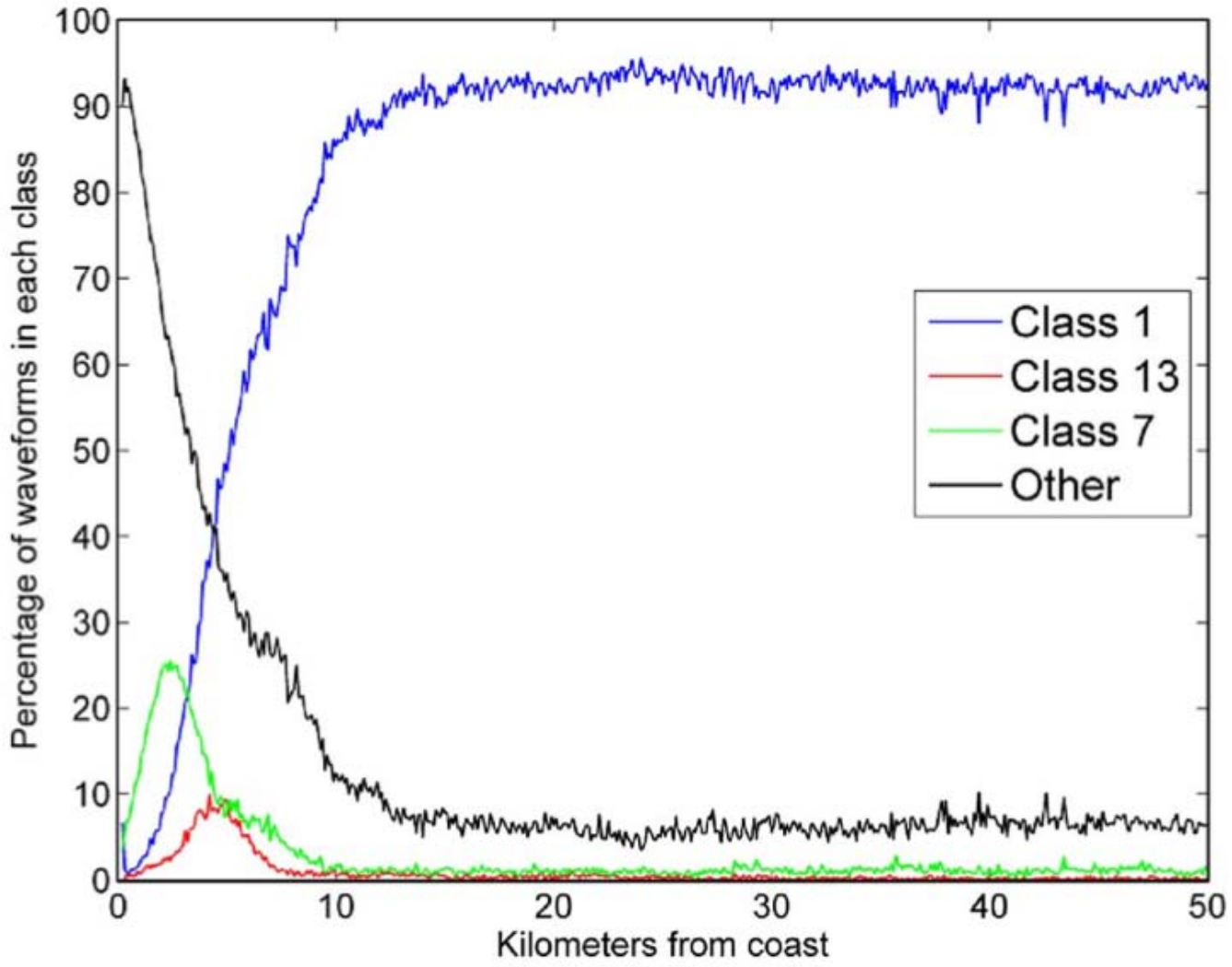
Generalization of the Brown and BGP models

- BAGP reduces to the Brown model for $A = 0$
- BAGP reduces to the BGP model for $\gamma = 0$

- It should work in many coastal cases, and yield continuous values of parameters
- Should we use it as a reference for other coastal retrackers?!

Hyperbolic features are relatively common





Halimi et al, TGARS, 2012