Synopsis:
To resolve or not to resolve?
To nest or not to nest?
Seems best not to.
(in some cases at least)

Don't Upscale the Coastline: Scales of Cumulative Change Emerge

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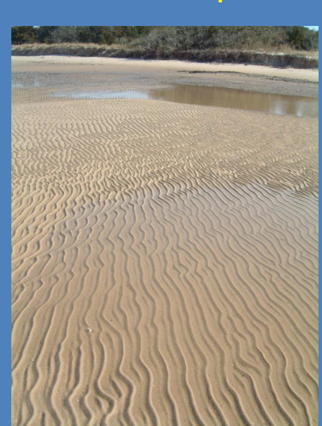
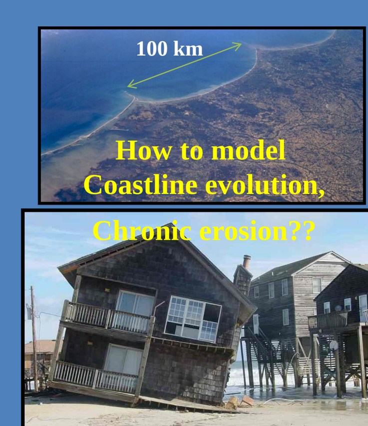
Conclusion:
Treat emergent dynamics when available
(like fluid dynamics vs. molecules)
More insight, and large-scale results may
not depend on small-scale processes
(e.g. could be worms or ice lenses…)

Intro: Coastline Change: many scales
Where to start??



small

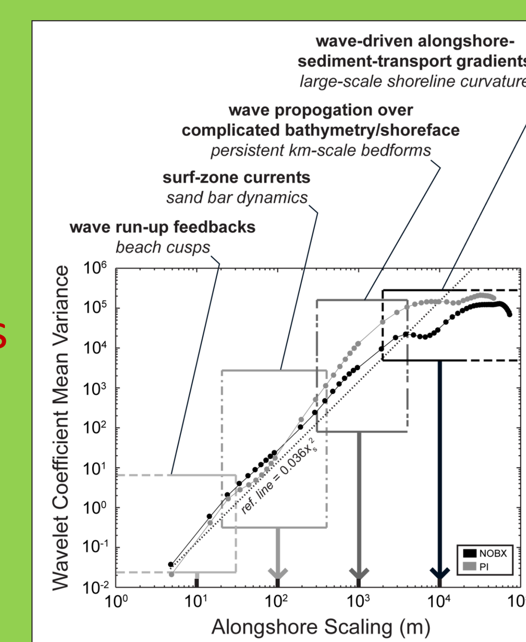
medium

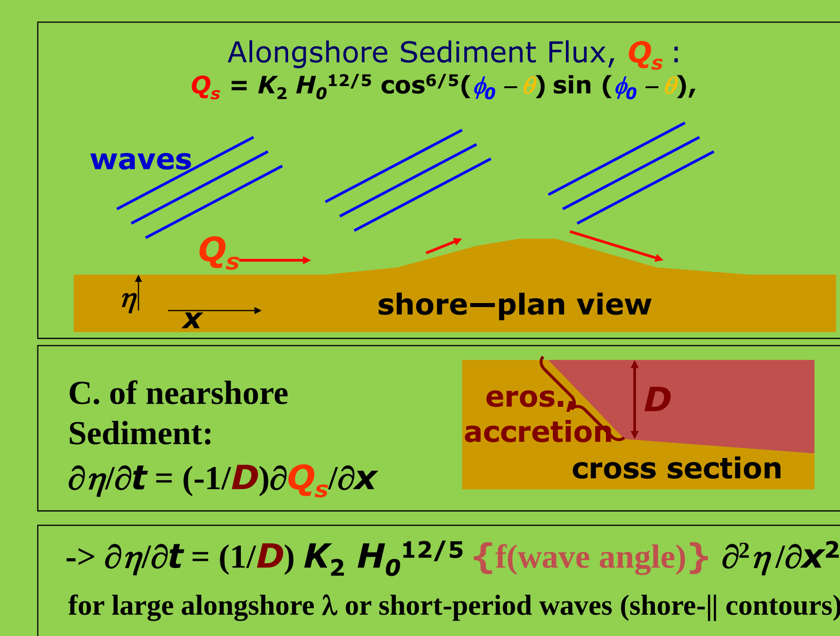


large

Interpretation: Coastline diffusion at large scales

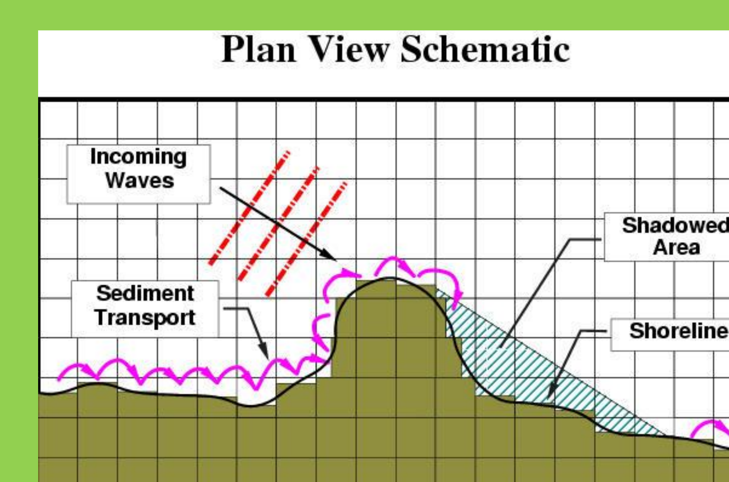
- Behaviors differ w/ scale
- At smaller scales, timescales < yrs, independent undulations
- At larger scales, diffusion dominates (change ∝ curvature)



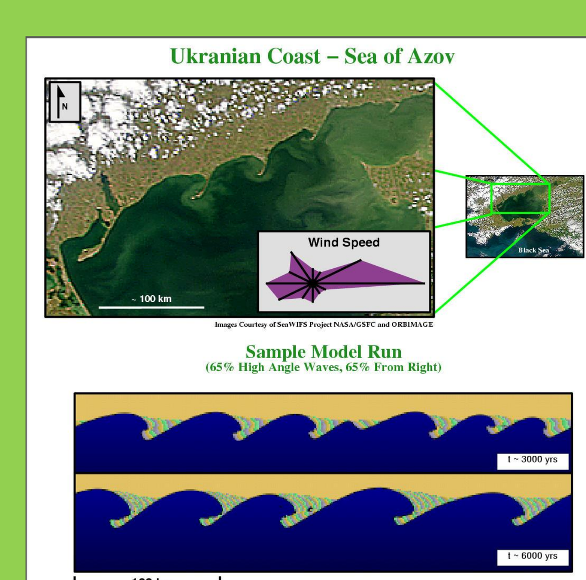


Modeling large scale dynamics directly:
diffusion, antidiffusion, and finite amplitude behaviors

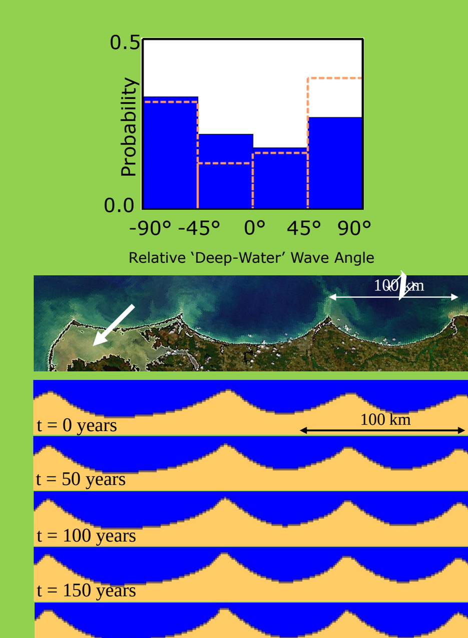
- Discretize alongshore sediment flux, C. of mass
- Variables limited to:
  - Shoreline orientation (on scales ~ km)
  - 'Deep-water' wave height, direction
  - (No ripples, bars, channels…)
- Partly rule-based (wave shadowing; coupling wave models soon)

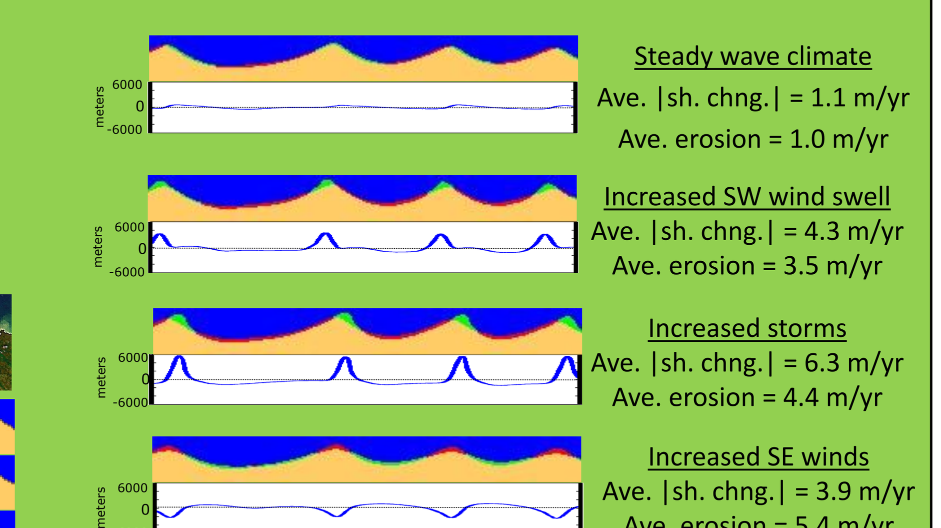


e.g.:



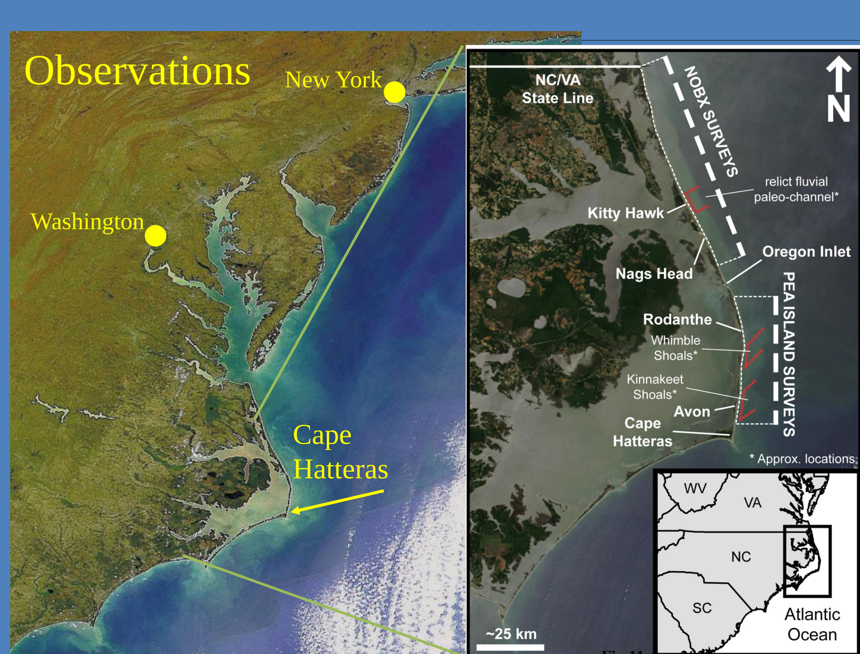
Changing storm climates

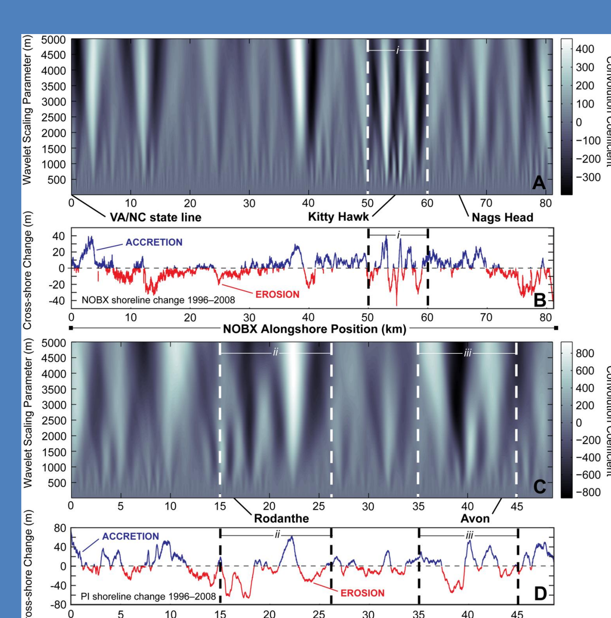


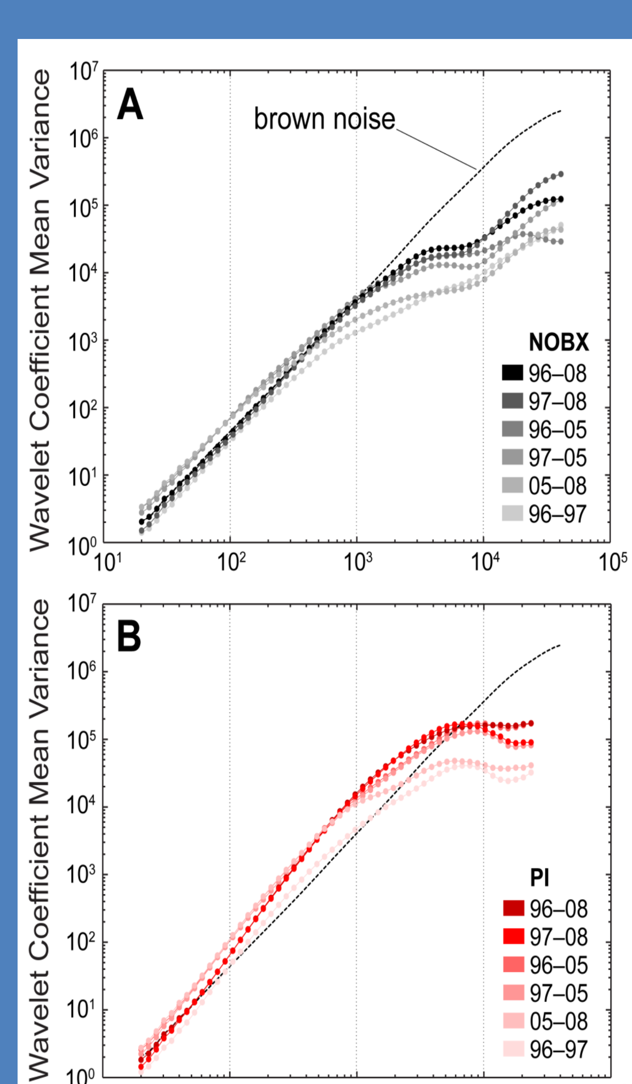


Wave Climate Change Scenarios

Observations: Large is different than small





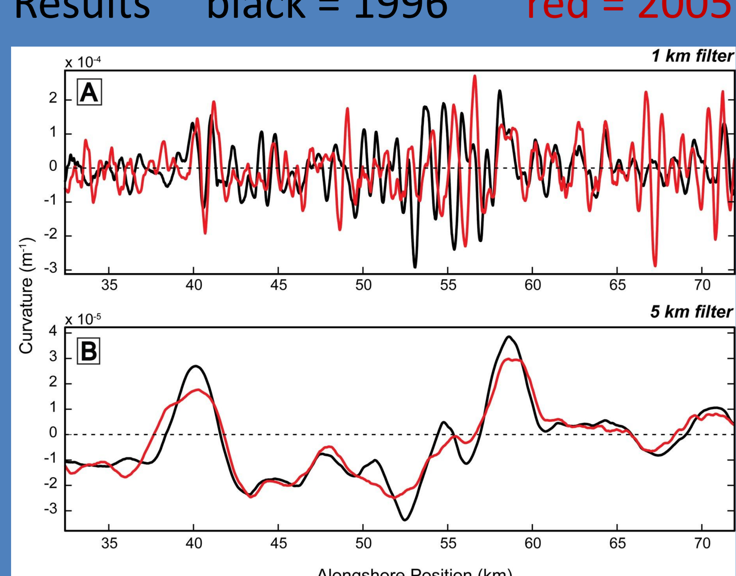


Results

small scales (< ~ km):
var. independent of duration

Larger scales (kms):
change increases w/time;
var. maxima, 4 – 8 km;
scale of max. increase w/time;
scaling consistent w/diffusion
(4 km → T ≅ 3 yrs;
10 km → T ≅ 16 yrs)

Results black = 1996 red = 2005



Shoreline smoothing—
at large scales

Terrestrial example: modeling hillslope evolution

With Explicit Numerical Reductionism:
What if sub model for worm behaviors isn't just right…
And what about other hillslopes (e.g. dominated by small girls)?
Or:
empirically based, mathematically rigourous, modeling of hillslopes directly?