On the imaging of rip currents in X-band radars

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1. Abstract
   1. Motivation
      1. Rip currents are dangerous
      2. Can image rip currents with X-band marine radar
   2. Problem Statement
      1. Do not know the limitations of imaging rip currents with X-band radar
   3. Approach
      1. Wave action equation
   4. Results
      1. Qualitative comparison with data from Duck, NC
      2. Range of rip current center line velocities needed
   5. Conclusions
      1. Worth doing more research into the subject?
2. Introduction
   1. Can use the wave action equation to model the microwave radar signatures of oceanic internal waves and current fronts, coupled with Brag or two-scale radar backscatter model (Lyzenga, 2010)
   2. Can see rip currents with X-band marine radar (Haller et al., 2014)
   3. Modeling the microwave radar signatures of rip currents using the wave action equation has never been done
   4. Literature review
      1. Lyzenga, 1998
         1. Starting point
         2. Donelan and Pierson (1987) growth rate
      2. Jansen et al., 1993
         1. Predictor-corrector Crank-Nickolson
            1. Based on Tolman WAVEWATCH method
      3. Lyzenga, 2010
         1. Runge-Kutta
         2. Snyder et al (1981) growth rate
         3. Choi and Camassa (1999) current profile
      4. Lyzenga and Bennett, 1988
         1. 2-D current
   5. Rip current model (Haller and Dalrymple, 2001)
3. Wave action equation
   1. Conservation of wave action
      1. Left hand side is the total derivative of action
      2. Right hand side is all sources and sinks of wave action (net source function)
   2. Net source function
      1. Wind growth
         1. Discuss different forms that could be used
      2. Nonlinear wave-wave interaction
      3. Dissipative terms
   3. Re-write wave action equation so it’s with respect to degree of saturation
      1. What is degree of saturation (Phillips, 1985)
   4. Method of solving the wave action equation
      1. Runge-Kutta in time
      2. Central differencing in space, wave number, and angle
4. Method validation
   1. Compare my results with Lyzenga, 2010
   2. Explain any differences
   3. Possibly compare how the results look using different source terms
      1. What assumptions need to be made to use them
5. 1-D Rip Currents
   1. Haller and Dalrymple (2001) rip current model turned 1-D
      1. Longshore slice?
   2. Controlling current centerline velocity and width scale
      1. Most important?
   3. Controlling turbulent Reynolds number and bottom friction parameter
      1. Do all of these need to be included?
      2. How do we determine them (not experimentally)?
   4. How far offshore do we want to take slices?
      1. Compare intensity slices from same rip current in different locations
   5. Qualitative comparison
6. 2-D Rip Currents
   1. Haller and Dalrymple (2001) full rip current model
      1. Not sure if we will get here
   2. Look at 2-D intensity images?
      1. Not sure how to compare data
   3. Can we look at spectra?
7. Conclusions
   1. Rip current velocities required in order to image them
   2. How well does the wave action equation model do
   3. What other source terms could be added in the future
      1. Can we make any assumptions about how that would change the results
   4. Other parameters that can be looked at in the future
      1. Rip current and wave conditions?
   5. Does the radar look direction effect results?
   6. Can we make any conclusions about the best methods?
      1. Jansen et al. vs Lyzenga…