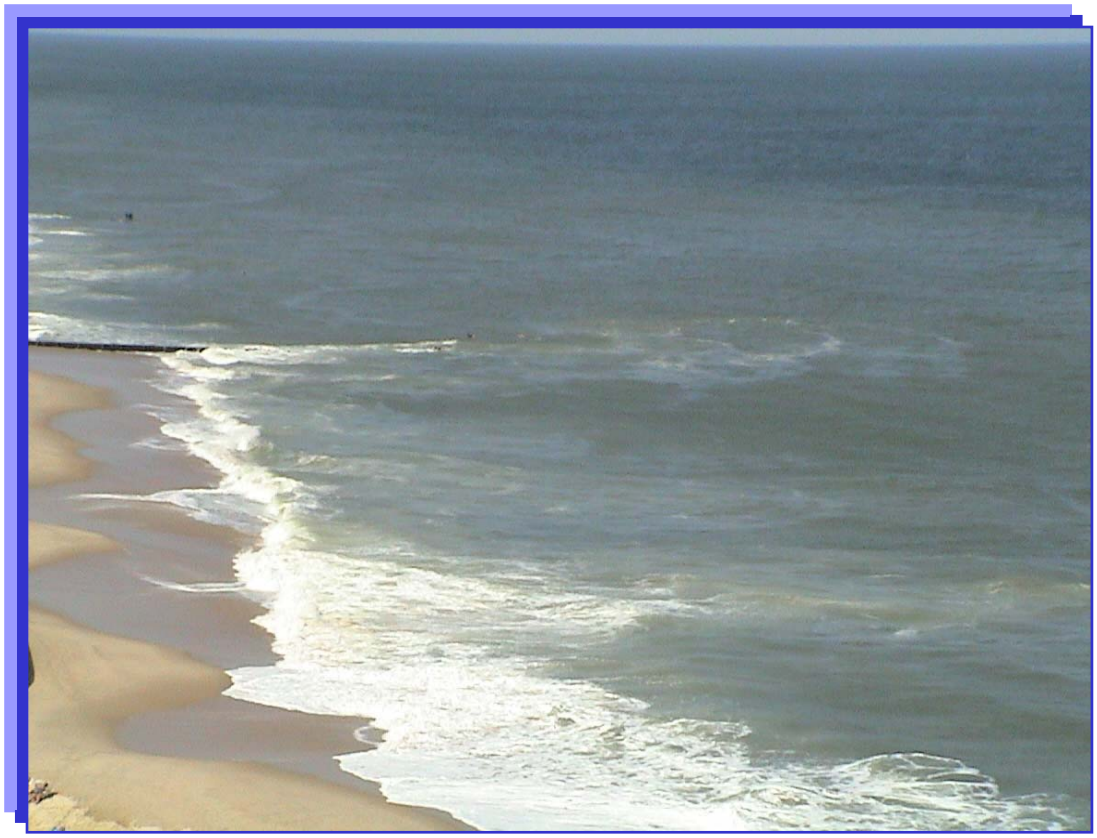
Technical Workshop

Rip Current Science:
Coordinating Coastal Engineering Research and Forecast Methodologies to Improve Public Safety

Jacksonville, Florida
April 6 - 7, 2004



Sponsors:

Sea Grant Coastal Hazards Theme Team
NOAA - National Weather Service
Delaware Sea Grant — Florida Sea Grant — New Jersey Sea Grant
North Carolina Sea Grant — Oregon Sea Grant — South Carolina Sea Grant

NOAA - Sea Grant - National Weather Service Technical Workshop Agenda
Rip Current Science: Coordinating Coastal Engineering Research and Forecast Methodologies to Improve Public Safety
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AGENDA

Tuesday, April 6

1:00 - 1:15 **Welcome —** Mike Spranger, Florida Sea Grant

Introductions and Workshop Overview

Wendy Carey, Delaware Sea Grant

Tim Schott, National Weather Service

1:15-3:25 **Session 1: Rip Current Overview: Research and Forecasts**

Overview of coastal engineering knowledge of rip current development and behavior

Tony Dalrymple, Johns Hopkins University, Baltimore, MD

Bob Dean, University of Florida, Gainesville, FL

Overview of criteria and methodologies used in NWS forecasts

Jim Lushine, WFO Miami, FL

East Central Florida Rip Current Program

Randy Lascody, WFO Melbourne, FL

Round-table discussion, comments

3:25 - 3:40 Refreshment Break

3:40 - 5:30 **Rip Current Overview: Research and Forecasts**

Rip currents: A coastal geology perspective

Skip Davis, University of South Florida, Tampa, FL

Session 2: Potential Applications of Existing Knowledge in Prediction and Research in the Mid-Atlantic

Issues related to transfer of rip current research into rip current prediction (difficulties in taking science from pure research to prediction)

Jim Eberwine, WFO Mount Holly, NJ

Tom Herrington, Stevens Institute of Technology, Hoboken, NJ

Round-table discussion, comments

5:30 - 6:30 No Host Reception (cash bar) Dinner (on your own)

Wednesday, April 7

7:30 - 8:30 Continental Breakfast: coffee and pastries

8:30 - 9:45 **Session 3: Rip Currents — Regional and Local Issues**

Great Lakes

Rip currents in the Great Lakes

Guy Meadows, University of Michigan, Ann Arbor, MI

Case study of the deadly Lake Michigan rip current event of July 4, 2003

Dave Guenther, WFO Marquette, MI

Round-table discussion, comments

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Wednesday, April 7 (continued)

9:45 - 10:00 Refreshment Break

10:00 - 12:00 **Session 4: Rip Currents — Regional and Local Issues**

West Coast

Rip Current Pulsations

Jamie MacMahan, Naval Postgraduate School, Monterey, CA

Rip Currents in Southern California

Brandt Maxwell, WFO San Diego and Joe Sirard, WFO Los Angeles, CA

Rip currents: an Oregon State perspective

Merrick Haller, Oregon State University, Corvallis, OR

East and Gulf Coast

Improving rip current prediction in Florida: the difficulties of site specificity and the need for data collection

Bob Thieke, University of Florida, Gainesville, FL

Round-table discussion, comments

12:00 - 1:15 Lunch (on your own)

1:15 - 3:00 **Session 5: Rip Current Models, Instrumentation, and Wave Models**

Numerical and physical modeling of rip current systems

Kevin Haas, Georgia Tech, Savannah, GA

Wave data and nearshore observing systems applicable to rip current prediction

Bill Birkemeier, USACE Field Research Facility, Duck, NC

Effective use and interpretation of wave models used by NWS for forecasts and prediction

Steve Pfaff, WFO, Wilmington, NC

Round-table discussion, comments

3:00 - 3:15 Refreshment Break

3:15 - 5:00 **Session 6**: **Continuing Partnerships — Where Do We Go From Here?**

Identification of data gaps and research needs: what is needed for improved understanding of rip current development and behavior?

Andrew Kennedy, University of Florida, Gainesville, FL

National efforts to improve forecasts and enhance public awareness

Tim Schott, NWS HQ, Silver Spring, MD

Development of a forecaster rip current training module with UCAR

Kevin Fuell and Katherine Olson, UCAR, Boulder, CO

Rip current outreach, education, and awareness; *May 24, 2004 National Media Event*

Spencer Rogers and Katie Mosher, North Carolina Sea Grant, Wilmington, NC

Round-table discussion, comments

5:00 Wrap-up, Workshop Conclusion

NOAA-Sea Grant and NOAA-National Weather Service
Rip Current Technical Workshop
April 6-7, 2004
Overview and Summary

Introduction

NOAA-Sea Grant and NOAA-National Weather Service convened a technical workshop on rip current research and forecasting on April 6-7 in Jacksonville, Florida. The workshop was held to enhance communication and information sharing among National Weather Service forecasters, coastal research scientists, and Sea Grant outreach personnel. Each organization presented its latest rip current research, forecasting methodologies, and hands-on data applications. The workshop also helped each agency identify data gaps, partnership opportunities and future research needs to enhance and improve rip current prediction and forecasting. A strong commitment from all agencies was made by attendance – forty-eight participants, representing sixteen states, were actively involved in workshop presentations and discussions.

Sponsorship and Coordination

- The rip current technical workshop was organized and coordinated through the cooperation of several organizations: Delaware Sea Grant, Florida Sea Grant, North Carolina Sea Grant, and the National Weather Service (Headquarters) Marine and Coastal Weather Services Branch.
- Direct official sponsorship funds to support the rip current workshop were provided by: NOAA Sea Grant-Coastal Hazards Theme Team and the following individual Sea Grant Programs: Delaware, Florida, New Jersey, North Carolina, Oregon, and South Carolina.
- Additionally, the following Sea Grant programs provided travel funds for research scientists or outreach/extension personnel: Delaware, Florida, Michigan, New Jersey, North Carolina, Oregon, Texas, and Wisconsin.
- The National Weather Service supported travel and participation for 25 National Weather Service forecasters and Region Marine Program Managers from around the country.

Workshop Format, Topics, and Handouts

- The program was organized to address both general and regional rip current issues. An effort was made to coordinate paired presentations, linking National Weather Service scientists with a research scientist from the same geographic area.
- General session topics included: Rip current overview of research and forecasts; Potential applications of existing knowledge in prediction and research in the mid-Atlantic; Rip currents - regional and local issues in the Great Lakes, West Coast, and East/Gulf Coasts; Rip current models, instrumentation, and wave models; and Continuing partnerships - where do we go from here?
- A representative of the IOOS program also made a presentation regarding connections between ocean observing systems and rip current research/forecasting.
- A rip current resource/reference notebook was distributed to all participants. The notebook included workshop overview, participants contact list, cumulative bibliography of rip current references, and copies of selected papers on rip currents from 1936 through 2004.

Discussion Focus

- Bridging the gap between meteorology and nearshore coastal processes
- Models (rip current models, nearshore circulation models, and wave models) and their applicability as forecast/predictive tools
- Nearshore wave modeling shows promise as a tool to improve rip current forecasts.
- Wave data and gauges. What instruments are available? Major data gaps related to few nearshore wave gauges.
- Field studies - more are needed
- Describing mechanisms of rip current development for the general public: There are several wave mechanisms that appear capable of initiating and maintaining rip currents, some of which are more likely than others to occur in nature. There appeared to be a consensus that the simple descriptions of the cause now in use (i.e. waves piling water behind a bar and longshore current deflection at structures) are best for public presentation without confusing the issue with high level physics and hydrodynamics.
- Rip currents are most likely to become dangerous when existing bar systems are already in place and affected by swell roughly parallel to the shoreline. For each pair of conditions, one water level is likely to be tuned to create the fastest currents. Several local studies have shown that rip currents are more likely to be dangerous around low tide. Longer frequency waves and pulses in wave groups are also likely to affect rip velocities.
- Rip currents can be dangerous periodic channels through long shore-parallel bars. They can also be dangerous around shore attached bars and somewhat rhythmic shoreline features.
- On shorelines with many natural or manmade structures it becomes more likely that angled wave approach and fast longshore currents can result in dangerous rip currents.

General Recommendations

- The continued use of forecast indices, customized for local shorelines, appear to be the only viable forecast method at this time and should use whatever data is available. The quality of available data will vary with location but is likely to include: offshore wave gauges and offshore wave forecasts. Where possible, the indices should be calibrated using local rescue or drowning data.
- Research is showing that the indices can be improved if the water depth over the bar is added. Adding rip channel depth is also likely to improve the indices. However, there is no convenient way to collect or reliably forecast the bathymetry in advance for use in a rip current forecast index.
- It would be useful to organize such data collection by lifeguards or other observers that could be later used to modify the indexes or for research.
- Wave height, period and direction at the shoreline are the most likely sea conditions that will correlate with dangerous rip currents on most beaches. We should encourage installation of real-time nearshore, directional, spectral wave gauges.
- Timely, deep water wave modeling is available for most shorelines for forecasting. However, nearshore bathymetry significantly alters the waves as they approach the shoreline. Further development of nearshore wave modeling should be encouraged as a nationally available tool to improve rip current forecasts.

General Recommendations (continued)

- Most research on rip currents has been conducted to better understand coastal processes and sediment transport. We should encourage additional research related to the prediction of hazardous rip currents as a threat to beach users.
- Comparisons of the bar elevations relative to tide levels and wave heights should aid and improve prediction.
- Large data gaps exist at the local level for rip current predictions, especially related to waves and bottom topography.
- Improved partnerships are needed to collect data, disseminate, and produce local rip current estimates and predictions.
- We should encourage local beach patrol groups to keep accurate records of rescues and drownings and determine the causes whenever possible. Beach patrols should also be encouraged to share these rip-related rescue data with rip current research scientists and associated NWS Forecast Office.

Specific Recommendations

1) A pre-arranged "rapid response" field effort is encouraged to gather perishable data after a documented case of significant rip currents, certainly after rip-related drownings and rescues. Data should be collected on wave, wind, tide, current conditions, as well as local bathymetry of rip channels and/or nearshore sand bars. Local diving clubs could possibly be organized to provide this service. (Dr. Robert G. Dean; Dr. Andrew Kennedy)
2) A program is recommended to quantify the nearshore morphology and the capability to predict rips based on this morphology and the waves. Certainly if the bar crest is at an elevation of say, -8 feet and the waves are 3 feet high, one would expect less potential for rip current development than if the bar crest was at -4 feet for the same wave height. Of course, tide plays a role. Obviously, this effort would be more successful if carried out in a location known for rip current occurrence and by interested lifeguards. (Dr. R. G. Dean; Dr. Andrew Kennedy)
3) A "pilot program" of predicting rip currents should be implemented at a site where the lifeguards were especially interested in participating. Ideally, the basis for the prediction could be a simple model that would be based on the information contained in (2) above and at the same site. This could be a low cost way of initiating and improving an effective predictive capability. Perhaps, by spending time in the water, the participating lifeguards could remove the factor of whether rips were present, but few people were in the water to be entrained. (Dr. Robert G. Dean; Dr. Andrew Kennedy)
4) Perhaps Sea Grant (USLA or another agency) could establish a permanent program to document cases of rip current drownings and possibly rescues. The program could be national or international. For example, the University of Florida serves as the repository of documentation (including photographs) of international shark bites. This could provide a model for the rip current program. Special forms for rip current events could be developed for uniform reporting. (Dr. Robert G. Dean; Dr. Andrew Kennedy)
5) NWS Forecast Offices providing Rip Current Outlooks are responsible for providing rip current data (drownings, rescues) to the NWS Publication Storm Data, where all weather-related fatalities are imported into a national database. NWS forecasters can only receive this data through a cooperative relationship with local lifeguards and beach patrols, and we would benefit from Sea Grant's involvement in data collection. (T. Schott)

Specific Recommendations (continued)

6) Develop a detailed regional-level matrix of nearshore wave, water level and bathymetry data to enhance and improve existing rip current prediction indices used to generate forecasts. (Dr. Jamie MacMahan)
7) Additional research is required to assist forecasters in improving prediction of rip currents. This will require field surveys, post-storm surveys, and "real-time" numerical modeling of rips (Dr. Robert A. Dalrymple).
8) Develop programs that will provide training, testing, and verification opportunities to incorporate existing models (FUNWAVE, SHORECIRC) into National Weather Service forecasting and prediction methodologies. Numerical models can predict rip currents - given waves and bathymetry. Additional funding should be provided for technology transfer - putting existing numerical models into operational use in rip current forecasts and prediction. (Dr. Robert A. Dalrymple, Dr. Kevin Haas, Dr. Andrew Kennedy).
9) Establish local instrumentation programs (e.g. nearshore wave gauges) to address the major data gaps and the required critical data that is needed to improve forecasting. To enhance and improve rip current prediction, it is essential to incorporate data on local waves, water level, and nearshore bathymetry, i.e. channel development, bar depth. (Dr. Andrew Kennedy)
10) Provide funding to support technology needed to fill data gaps: real time directional wave measurements with buoys, radar, acoustic or pressure sensors; video monitoring of channel development. (Dr. Andrew Kennedy)
11) Based on the inputs provided through our NWS forecasters, the NWS Marine and Coastal Services Branch will update planning and requirements documents for the following initiatives to be incorporated into NWS operations: higher resolution, nearshore wave models for use by each NWS coastal office; deployment of additional nearshore wave buoys; wave height sensors to be added to NOS tide gauges; wave direction sensors to be added to NDBC buoys, where not currently available; graphical wave spectrum output for NDBC buoys (to provide multiple wave components from different directions). (Tim Schott)

Future Inter-Agency Coordination and Cooperation

- Expand research program on rip currents, including a focus on site specificity of nearshore wave/current conditions, nearshore bathymetry, and rip current occurrence
- Develop regional programs for rip current monitoring surveys
- Identify funding sources for research projects
- Encourage continued coordination between research scientists and forecast meteorologists (i.e. future workshops and conferences)
- Training opportunities
- Continued efforts towards coordinated programs resulting in a greatly expanded rip current outreach, education and awareness campaign

Recommendations for Future Action and Expanding Funding

An improved rip current research, prediction, and education program would include a national research effort which could be developed through cooperative efforts of multiple NOAA agencies.

A national initiative should be established for rip current research, prediction/forecasting, and education/awareness/outreach. The program should provide:

- expanded funding for coordination of a rip current initiative at the national, regional, and local levels;

- expanded funding for an advanced national rip current research program and development of research projects that are directly tied to technology transfer and direct application of the research results into operational use, i.e. rip current prediction and forecasting. As part of this research program, we must improve our ability to better understand the local and regional processes that generate rip currents, rip current behavior, and nearshore circulation; and how they become hazardous to people;

- expanding funding to implement a permanent rip current survey program based upon standardized measurements that will be made at specific sites around the country. To make these surveys and data collection possible, we will need to spend significantly more on training at the local level and provide funding support for observation and reporting;

- funding to support a national comparative database against which the success of forecasts and predictions can be measured;

- expanding funding to support continued work on the national level rip current education and public awareness campaign. Under the leadership of NOAA-National Weather Service and NOAA-Sea Grant, a unified national rip current awareness program has been established. However, the coordinating agencies must continue to focus on outreach programs;

- increased teaming among NOAA line offices, to include NWS, Sea Grant, and NOS, to continue assessments and implementation of higher resolution, nearshore wave models for use by every NWS coastal and Great Lakes Forecast Office; preservation of existing buoys and the deployment of additional nearshore wave buoys; wave height sensors to be added to NOS tide gauges; wave direction sensors to be added to NDBC buoys, where not currently available; and the addition of graphical wave spectrum output for NDBC buoys (to provide multiple wave components from different directions). These efforts will also enhance the NWS forecast verification program and the greater NWS coastal flood program.

This workshop summary/overview document was prepared by Wendy Carey, Spencer Rogers, and Tim Schott resulting from discussions associated with the NOAA (Sea Grant and National Weather Service)Rip Current Technical Workshop held on April 6-7, 2004, in Jacksonville, Florida.