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Session 1 Notes

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Session I Notes

These notes are intended as a supplement to the Session I presentation. The following discussion points were captured by workshop rapporteurs:

- Waves need to be measured properly since they influence so many processes and operations near the coast and at sea. For many applications it is essential to determine the directional properties of the waves in addition to their heights and periods; yet, worldwide, there have been relatively few quantitative measurements of directional characteristics

- Buoy size and shape is an important consideration since the buoy should follow the motion of the water particles at the surface in all directions. The buoy will not be able to follow waves that are smaller than the buoys approximate diameter. Thus, the shortest wavelength that a buoy can follow is determined by the size of the buoy, while the shape of the buoy determines its responsiveness to vertical wave motion.

- Calibrating a wave buoy to specific sea states is not practical. Wave buoys are calibrated by most manufacturers using a calibration fixture that validates the buoys' wave measurements, e.g., accelerations, heave, pitch, roll, and direction. System data such as buoy orientation and GPS position are also recorded and checked. If there are significant anomalies in any of the output, buoys should be returned to the manufacturer for more exhaustive inspection and calibration. Complementary sensors such as thermistors, anemometers, and current meters also need to be checked in the laboratory or at a calibration facility. The uses of intercomparison tests (e.g., measurements against wave staffs and pressure arrays) in wave tanks, towing basins, and at an actual deployment location should be encouraged, as they increase the confidence in the data.

- Buoys and sensors need to be carefully chosen and configured for the specific environment. Environmental factors to consider include water depths and norms, means, and extremes for parameters such as wind speeds, wave heights, current profile (surface to bottom) and water temperatures.

- Prior to deployments, individual sensors should be calibrated and operationally checked. Wave buoys should then be calibrated with individual sensors attached. If at all possible, system resonances and frequency responses should be established.

- An important parameter that should be computed and provided to wave buoy users is wave steepness. The National Data Buoy Center does provide estimates of wave steepness based on the relationship between significant wave height and dominant wave period. Since wave measurements cannot be customized for each vessel’s safety, the prudent mariner should know the physical limits of their vessel with respect to wind speed, wave height, and wave steepness. Pitch poling and capsizing becomes a real threat when wave steepness becomes severe. Steeper waves also contribute to beach erosion while less steep waves contribute to accretion. Wave steepness is especially important to mariners traversing fetch-limited bodies of water such as Lake Pontchartrain and especially the Great Lakes.

- Satellite radar altimeters are used to map significant wave heights while other remote sensors to include Synthetic Aperture Radar and weather radar have been used to map the sea surface. Issues with temporal and spatial resolution (e.g., some waves may be missed by radars) indicate the continued need for wave buoys. In addition, a fixed reference station such as a moored wave buoy station is needed to validate the satellite altimeter derived significant wave heights. Satellite altimetry observations are assimilated by global ocean circulation, sea state and coupled numerical models, and are used to support a variety of forecasting applications.

- Satellite or airborne photographs can be used to measure wavelengths, but wave heights are much more difficult to determine from cameras, except by rather complex procedures such as stereo photography, or Fourier transformation of the image density. Some investigators have estimated wave heights based on the deformation of the edges of cloud shadows. Satellites complement the study of waves and are not anticipated to replace wave buoys. Wave buoys provide both "sea truth" and time series at specific locations.

- Buoys are generally outfitted with rechargeable lead acid batteries and solar panels which are sufficient for most simple wave monitoring stations for long term operation (6-12 months between services). Major servicing is anticipated on 4-5 year cycles for systems using rechargeable lead acid batteries and 12-18 month cycles for systems using non-rechargble primary batteries.

- Polar latitudes with reduced temperatures and lack of sunlight limits the power output of buoy power system, which are based on conventional silicon-based photovoltaic cells and sealed lead-acid batteries. However, wave buoys are not generally deployed during periods when the ocean is frozen.

- Alternative energy technologies that increase buoy power capabilities need to be considered. However, the uses of alternative technologies cannot adversely impact the buoys' measurement of waves.

- NDBC is testing Wave Gliders as a weather and tsunami detection platform. Wave Gliders could potentially replace weather buoys at selected stations if they can collect data that meets NOAA/NWS requirements owing to potential operational cost benefits and logistics simplification.

- Fixed weather buoys are an incredibly valuable part of NWS basic sea state forecasting and the hurricane warning system. Both require input data from a static location to support and improve existing models. Additionally, long term records from these fixed stations form the basis for climate change analysis.

- During a maritime mishap an EPIRB (emergency position indicating radio beacon) could be deployed that is capable of transmitting wave and current information in addition to location. This information would be useful in Search and Rescue Planning or in mitigating marine spills. Wave height information would be useful in deploying the correct oil spill containment booms. It would help in the deployment of booms to divert and channel oil slicks along desired paths. In addition, wave energy conversion could be used to help power the EPIRB, especially those used for merchant vessels transporting hazardous cargo.

These rapporteur notes do not necessarily reflect the view of all participants and speakers participating in the discussion session.