Sunglint: an Investigation under Controlled Laboratory Conditions

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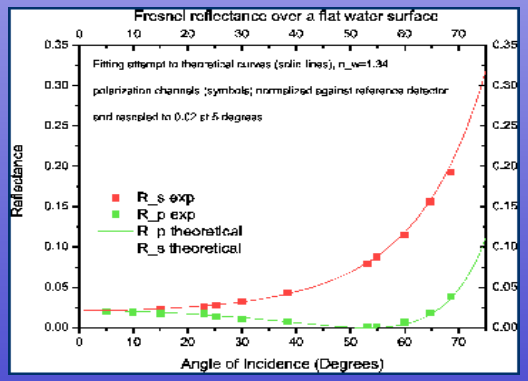
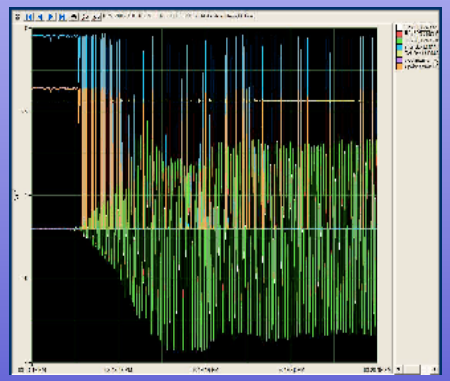
Goal: Advance our knowledge of the relationship between wave slope statistics and sunglint statistics with the purpose of developing a model to accurately describe ocean surface processes from sunglint data.

Natural Sunglint

Laboratory Study Of Laser Glint



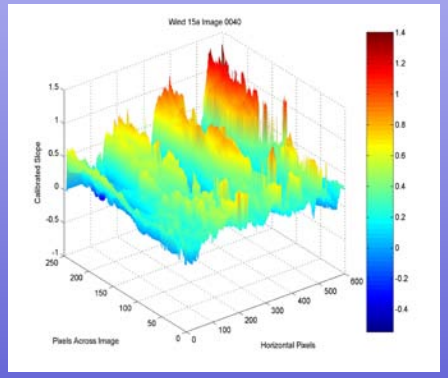
Optical Setup Verified: Theory and Measurements



Wave Slope vs. Time (green)

Glint Intensity (blue)

Glint S-Polarization (orange)



Wave Slope from Digital Images

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Top Left: Natural sunlight provides specular reflections (sunglint) whenever the clear sunlight angles at the water surface are correct for the viewer and the solar source. In nature, what is seen comes from many (even thousands) of wave facets that reflect the sunlight into the cone of possibilities for the viewing angle at the viewers eye. We postulate that wave information is contained in these patterns.
Middle Left: A laboratory study is being conducted at the NASA Air-Sea Interaction Research Facility at NASA GSFC / Wallops Flight Facility by a research group from Stevens Institute of Technology, Light and Life Laboratory (Prof. Knut Stamnes, Matteo Ottaviani, and Jeff Koskulics), University of Oslo, Scientific Computing Group (Hans Eide), NASA GSFC (Warren Wiscombe and Steven Long), and NASA LaRC (Wenying Su). The wave tank has a test section of 60 feet in length, a water depth of 2.5 feet, with 1.5 feet for airflow through an across channel width of 3 feet. Shown is the optical arc holding the Stevens Institute glint instruments: left side is the laser source, and right side is the receiving optics. The center of curvature of the arc is at the still water surface. The angles can be accurately set and adjusted. Within the tank, waves can be produced using a hydraulic wave maker, wind flow, or a combination of the two in the presence of current in either direction, or no current. At the same test section, wave elevation with wire gauges was recorded, and optical digital slope images were acquired at a rate of 60 images/sec for the purpose of studying the relationship between the slope distribution statistics and the observed glint statistics.
Bottom Left: Verification of laboratory optical setup. Measurements shown as squares in agreement with theoretical predictions for S-polarization (red) and P-polarization (green)
Bottom Middle: Measurements of wave slope by capacitance wires (green) vs. time as waves begin the the laboratory, shown with occurrence of measured glint intensity (blue) and S-polarization (orange). Glints are shown where they occur on the wave slope, with their intensities.
Bottom Right: A 3D perspective view of wave slopes from a single digital image of surface slope in light winds. Note that in a slope representation, the extremes correspond to slope extrema, not wave elevation extrema, not crests and troughs. The digital imager acquires 60 images/sec, from which slope statistics can be developed.
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