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CONTROL ID: 750730

TITLE: Underwater light polarization distribution and short-term fluctuation induced by nonlinear ocean surface waves

PRESENTATION TYPE: Assigned by Committee

SECTION: Interdisciplinary (IT)

SESSION: The Time-Dependent Near-Surface Light Field: Optics and Surface Wave Effects (IT03)

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Title of Team:

ABSTRACT BODY: Theoretical studies on the underwater light polarization have mainly been performed with respect to its dependence on Sun's position, and sky and water turbidity only. On the other hand, experiments have shown that ripples on the air-sea boundary distort polarization patterns outside and inside Snell's window. Current modeling of ocean surface effects on underwater polarization is generally based on empirical statistic descriptions of the static surface in terms of the slope distribution. In this study, we use a high-order spectral method to obtain broadband surface wavefields with fine spatial and temporal resolutions. The surface waves obtained account for nonlinear wave-wave interactions up to a desired order so that they represent a more realistic and dynamic air-sea boundary. We then perform three-dimensional Monte Carlo polarized radiative transfer simulations of the dynamic atmosphere-ocean system that includes the effects of Mie scattering and multiple refraction.

Our study of the underwater polarization focuses on four quantities: (i) orientation of the light's electric field, the e-vector orientation; (ii) degree of linear polarization; (iii) degree of circular polarization; and (iv) radiance intensity. Our results show strong dependence of the distribution of polarization properties on wave steepness, and measurement depth relative to the wavefield dominant frequency. With the help of statistic tools, the spatial and short-term temporal fluctuation characteristics of the maximum degree of linear polarization, circular degree of polarization adjacent to the critical angle, and radiance are obtained and analyzed.

INDEX TERMS: [4264] OCEANOGRAPHY: GENERAL / Ocean optics, [0360] ATMOSPHERIC COMPOSITION AND STRUCTURE / Radiation: transmission and scattering, [4455] NONLINEAR GEOPHYSICS / Nonlinear waves, shock waves, solitons.

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