**An alternative approach to determine critical angle of contrast reversal and surface roughness of natural oil slicks under sun glint**

Yingcheng Lu1, 2, 3\*, Mengqiu Wang3, Chuanmin Hu3,Shaojie Sun3, and Minwei Zhang3

1Jiangsu Provincial Key Laboratory of Geographic Information Science and Technology, International Institute for Earth System Science, Nanjing University, 210093, China

2 Key Laboratory for Satellite Mapping Technology and Applications of State Administration of Surveying, Mapping and Geoinformation of China, Nanjing University, 210093, China

3College of Marine Science, University of South Florida, St. Petersburg, FL 33701, USA

\* Corresponding author: Y. Lu, Nanjing University, No.163 Xianlin Avenue, Qixia District, Nanjing, Jiangsu 210046, P. R. China; Fax: +86-25-89681030. E-mail addresses: luyc@nju.edu.cn.

**Abstract:** The critical angle is the angle at which the contrast of natural oil slicks reverse their contrasts against the background seawater, which is related to the surface roughness of oil slicks and seawater. Accurate determination of the critical angle could help estimate surface roughness of both oil slicks and seawater. In this study, the angle between the viewing direction and the direction of mirror reflection is found to be a good indicator for quantifying the critical angle, and the former can be calculated from the solar/viewing geometry from observations of the Moderate Resolution Imaging Spectroradiometer (MODIS). The oil slicks in the Gulf of Mexico were first delineated using a customized segmentation approach to remove noise and applya morphological filter. Then, from the histograms of the brightness values of the delineated oil slicks, the range of the critical angle was determined. An optimal critical angle between oil slicks and seawater was then determined from statistical and regressional analyses in this range. Such a determined critical angle corresponds to the best fitting between the modeled and observed surface roughness of oil slicks and seawater.

**Keywords:** Sunglint, critical angle, oil slicks, surface roughness, MODIS.