MASTER OF SCIENCE
IN
PHYSICAL OCEANOGRAPHY

SEASONAL VARIABILITY OF EXTRATROPICAL NORTH PACIFIC WIND STRESS, EKMAN PUMPING AND SVERDRUP TRANSPORT

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The annual cycle of the North Pacific wind stress, Ekman pumping and Sverdrup transport is investigated by means of empirical orthogonal function (EOF) analysis techniques. Fifty-two years of National Centers for Environmental Prediction (NCEP, formerly "NMC") and the National Center for Atmospheric Research (NCAR) Reanalysis daily averaged surface wind components covering the extratropical North Pacific are used to calculate daily averaged wind stress components. These wind stress components are averaged to 624 monthly mean fields from which monthly mean Ekman pumping and Sverdrup transport fields are derived. Each data field has the long-term annual mean and linear trend removed at each grid point before EOF analysis. The first three modes are considered to be physically significant based on the plot of the log eigenvalue against its root. The first principal components of each field are highly coherent, have most of their spectral energy at the annual cycle, and are nearly in phase. The second mode of these fields show significant spectral energy at the semiannual cycle. The third mode has more complex spatial variability than the first and second mode. The annual cycle is best described by the first EOF mode which is composed of two seasons (winter and summer) that last for five months each separated by two rapid (approximately one month) transition periods (spring and fall). The annual cycle is complex and certain geographical regions are seasonal "hot spots" that add to the complexity. Relationships are derived between the various modes to help explain seasonal movement of the Ekman pumping zero isotach and seasonal variations in Sverdrup transport. The annual variability can reasonably be described using only the first three EOF modes.

KEYWORDS: North Pacific Wind Stress, Ekman Pumping, Sverdrup Transport, Empirical Orthogonal Function (EOF), Isotach, Seasonal Variations

SEAWIFS ANALYSIS OF THE JAPAN AND EAST CHINA SEA AIR/SEA ENVIRONMENT

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Using visible wavelength radiance data obtained from the spaceborne Sea-viewing Wide Field-of-View Sensor (SeaWiFS), during the Aerosol Characterization Experiment-Asia (ACE-Asia), an analysis of the Japan and East China Sea regions was completed to determine the background ocean reflectance characteristics and distribution, the effects of both ocean turbidity and various aerosols on the radiance received from the top of the atmosphere, and develop algorithms designed to identify areas of airborne dust

and high ocean turbidity. The primary objective of the analysis was to better characterize and parameterize the regional background reflectance in order to improve the accuracy of the aerosol optical depth algorithms currently in use. A secondary objective was to develop a method of determining the geographic extent and basic intensity of the ocean turbidity. The intent of the study was to explore how visible wavelength solar radiation is affected by its interaction with the regional environment. The work has operational significance because many types of military systems operate using visible wavelength energy and are greatly affected by scattering particles either airborne or suspended in the water column. The types of systems affected range from imaging and targeting to mine hunting and identification equipment.

KEYWORDS: Sea-viewing Wide Field-of-View Sensor, SeaWiFS, Japan Sea, East China Sea, Aerosol Optical Depth, Turbidity, Dust

SHIP DETECTION PERFORMANCE PREDICTION FOR NEXT GENERATION SPACEBORNE SYNTHETIC APERTURE RADARS

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Following success in other areas as a remote sensor, the spaceborne microwave image radars are assuming a notable position in the problem of ship detection for civilian and military purposes. This work will discuss the strong and weak points of Synthetic Aperture Radar (SAR) when used for ship detection. First, the thesis gives a brief description of SAR fundamentals, image processing and the parameters for ship detection. Second, the actual techniques, limitations, errors and some models used for ship detection are described. Finally, using a well-known and reliable ship detection model (Vachon et al. 1997), tested in the Canadian Ocean Monitoring Workstation and in some validation field programs, the new generation of spaceborne SARs, mainly RADARSAT 2, are analyzed for ship detection capabilities. During the analysis parameters like wind velocity, wind direction related to the antenna, satellite incident angle and Number of Looks are changed to study their influence on ship detection.

KEYWORDS: Ship Detection, Synthetic Aperture Radar, SAR, RADARSAT