MASTER OF SCIENCE IN METEOROLOGY AND PHYSICAL OCEANOGRAPHY

EVALUATION OF DYNAMICAL TRACK PREDICTIONS FOR TROPICAL CYCLONES IN THE ATLANTIC DURING 1997-98

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Carr and Elsberry (1999; NPS Technical Report) have described eight conceptual models that explain most cases of large (> 300 n mi at 72 h) western North Pacific tropical cyclone (TC) track errors by the Navy Operational Global Atmospheric Prediction System (NOGAPS) and the Geophysical Fluid Dynamics Lab (Navy version – GFDN) models. This study is for TCs in the Atlantic basin and includes the European Centre for Medium-range Weather Forecasting (ECMWF) and the United Kingdom Meteorological Office global models, whereas the GFDL model is eliminated. A detailed examination is made of large (> 250 n mi at 72 h) errors made by the three dynamical models for two seasons of Atlantic TC tracks (1997-98). The percentages of > 250 n mi 72-h errors for the NOGAPS, UKMO, and ECMWF models were 23%, 26%, and 19%, respectively. The same error mechanisms found to apply in other basins also affect the dynamical models in the Atlantic. The NOGAPS and UKMO models have a tendency to over-represent TCs and other circulations, which leads to a cyclonic rotation, or even merger, via the Excessive Direct Cyclone Interaction (E-DCI) process, just as was found in the western North Pacific. The primary ECMWF error source was Excessive Midlatitude CycloGenesis (MCG).

DoD KEY TECHNOLOGY AREA: Battlespace Environments

KEYWORDS: Tropical Cyclone Track Forecasting, Tropical Cyclone Motion

IMPROVING MARITIME SITUATIONAL AWARENESS THROUGH THE CORRELATION OF ELINT-DERIVED SHIP TRACKS AND SONAR TIME-BEARING PLOTS (U)

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The purpose of this study was to facilitate the development of a dynamic acoustic noise model based upon correlation of shipping locations and tracks obtained from electronic intelligence (ELINT) and sonar time-bearing tracks from acoustic arrays. This marriage of tracking sources was achieved through the development of the Multiple-Intercept Data Fusion (MIDF) process during the analysis of ELINT and acoustic data collected during FBE-E (Fleet Battle Experiment-Echo). All 28 of the ELINT multiple-intercept tracks of U.S. assets available for comparison with ground truth were correctly identified as

military platforms. Twenty-one vessels were correctly typed by category (e.g., DDG, CG) and 19 were accurately identified by hull name.

Correlation between ELINT tracks and acoustic tracks also yielded great success. Of the 28 multiple-intercept ELINT tracks, 23 (82%) were matched to acoustic tracks. Numerous examples were developed to show that when ELINT intercepts are absent, detectable acoustic signatures permit the continued tracking of a vessel. Likewise, the possibility exists to continue tracking a vessel with ELINT data should the acoustic plot become congested as in a near-shore environment. The marriage of ELINT and acoustic tracking methods provides great promise for improving the ship tracking capabilities of the warfighter.

DoD KEY TECHNOLOGY AREA: Sensors

KEYWORDS: ELINT, Acoustic, Ship Tracking

EFFECTS OF THERMOHALINE GRADIENTS AND THE COLUMBIA RIVER PLUME ON THE CALIFORNIA CURRENT SYSTEM

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To study the combined effects of thermohaline gradients and the Columbia River plume on the ocean circulation of the California Current System (CCS), results from three numerical experiments of increasing complexity are examined. In all three experiments, seasonal climatological winds are used to force the model. In the first experiment, the effects of seasonal thermohaline gradients along the western boundary are evaluated. In the second experiment, the additional effects of thermohaline gradients along the northern and southern boundaries are investigated, while in the third experiment, the effect of the Columbia River plume on the CCS is explored. The results from the first two experiments show that thermohaline gradients associated with the North Pacific Central, Pacific Sub-Arctic, and Southern waters help to maintain more realistic temperatures and salinities in the CCS, particularly in the coastal regions. The third experiment shows that the Columbia River plume exhibits a strong seasonal signal with poleward flow close to the coast in winter and equatorward flow farther offshore in summer. The plume also has a significant impact on the near-surface stratification and baroclinic structure of the velocity field of the CCS from Washington to San Francisco.

DoD KEY TECHNOLOGY AREAS: Battlespace Environments, Modeling and Simulation

KEYWORDS: Primitive Equation Model, California Current System, Currents, Meanders, Eddies, Filaments, Columbia River Plume

AMBIENT NOISE CHARACTERISTICS DURING THE SHEBA EXPERIMENT

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The ambient noise data recorded by two free-drifting buoys during the 1997-98 SHEBA experiment presented a unique opportunity to gauge the noise field of the Arctic Ocean in a unique and changing environment. The two buoys drifted in unison for 12 months, providing an hourly ambient noise data set between 50 and 1000 Hz. The drift pattern was divided into five legs in response to the season or major changes in the direction of ice flow. The two buoys exhibited similar median spectra for all frequencies. When examined on a seasonal basis, summer low frequency (< 200 Hz) noise levels were much closer to

winter noise levels than past studies. This was mainly due to the low number of storms during the winter of 1997-98, which resulted in lower winter median noise levels. When compared with previous ambient noise studies in the Beaufort Sea, the SHEBA noise data were consistent with the concept that noise levels decrease (especially in summer) during the years when cyclonic atmospheric circulation dominates the west Arctic. Cross correlation analysis indicated a strong association of wind speed and wind stress to ambient noise. Locally measured wind stress (as opposed to that computed using the geostrophic wind) did not substantially improve the correlation with ambient noise. Two tools to conceptualize the Arctic noise field were employed during the SHEBA experiment: the use of RADARSAT with RGPS and the PIPS computation of energy dissipation rate. By comparing the output from these two systems with the ambient noise record, their effectiveness and usefulness as input to an Arctic ambient noise model could be determined. Several notable events in the winter and summer noise record were examined utilizing RGPS and PIPS. The event analysis confirmed the fact that distant noise sources can have an effect on a local noise field. RGPS and PIPS were not useful in the summer due to the open nature of the icepack.

DoD KEY TECHNOLOGY AREA: Battlespace Environments

KEYWORDS: Ambient Noise, SHEBA Experiment

A COMPOSITE STUDY OF THE MADDEN-JULIAN OSCILLATION (MJO) AND NORTHEASTERLY COLD-SURGES DURING THE NORTHERN WINTER MONSOON

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During the northern winter monsoon, the Madden-Julian Oscillation (MJO) and northeasterly cold-surges are active over the eastern Indian Ocean and western Pacific. The MJO consists of an active (wet) phase and inactive (dry) phase and varies over global spatial and intraseasonal time scales. Interactions between the MJO and northeasterly cold-surges, which vary over regional space and synoptic time scales, are examined. The interactions are examined between 1979-1998 using winds at 1000 hPa and a representation of convection during the northern winter monsoon. To identify interactions, the active and inactive phases of the MJO are divided into early or late phases (based on MJO duration). Examination of composite maps based on cold-surges defined to occur during each phase of the MJO revealed that the phase of the MJO acts to either enhance or weaken a cold-surge that may have been forced by the mid-latitudes. When MJO convection is located over the South China Sea, the surge intensifies. The favorable convection pattern dominates the unfavorable pressure-wind pattern of the MJO. When the MJO dry-phase is over the South China Sea, mid-latitude forcing appears to interact favorably with the pressure-wind pattern of the MJO to dominate the unfavorable MJO convection pattern.

DoD KEY TECHNOLOGY AREA: Other (Monsoon Meteorology)

KEYWORDS: Northern Winter Monsoon, Madden-Julian Oscillation, Northeasterly Cold-Surges