STATISTICAL STUDY OF WIND FIELD DISTRIBUTION WITHIN EXTRA-TROPICAL CYCLONES FROM 7-YEARS OF QUIKSCAT WIND DATA

Zorana Jelenak[1], Joseph Sienkiewicz[2], Khalil Ahmed[2] and Paul S Chang[1]

[1]NOAA/NESDIS/StAR
[2]NOAA/NWS/NCEP/OPC

ABSTRACT

The SeaWinds scatterometer on QuikSCAT satellite is scanning microwave radar that uses electromagnetic backscatter from the wind roughened ocean surface at multiple antenna look angles to infer surface wind stress magnitude and direction.. The geophysical product of the scatterometer is calibrated to the equivalent neutral-stability wind vector, 10-m above the sea surface. The QuikSCAT mission was launched in June 1999 as a quick recovery mission to fill the gap created by the unexpected loss of the NASA Scatterometer (NSCAT) in June 1997. The polar orbiting QuikSCAT satellite is in a sun-synchronous orbit, 803km above the earth's surface, with an orbit period of 101 minutes, and 1800km wide measurement swath QuikSCAT samples 90% of the global oceans daily. QuikSCAT mission provides the longest remotely sensed global ocean surface wind vector time-series with highest quality today.

The Ocean Prediction Center (OPC) is an integral component of the National Centers for Environmental Prediction (NCEP) within the National Weather Service (NWF). The primary responsibility of OPC is the issuance of marine warnings, forecasts, and guidance in text and graphical format for maritime users. OPC warning bulletins are required to be received and monitored by all commercial vessels of 300 gross tons and greater operating over the North Atlantic and North Pacific high seas and offshore waters.

Extratropical cyclones that reach hurricane force intensity are a significant threat to the safety of life at sea and a risk to cargo and vessels. Extratropical cyclones vary on scale from less than 100 km in diameter up to 4,000 km in diameter and have an average life cycle of five days from genesis to death. Associated wind conditions can range from light (10 to 20 knots), gale force (33 to 47 knots), storm force (48 knots to 63 knots), or hurricane force (greater than 63 knots). Knowledge the wind structure and in particular the frequency of occurrence and distribution of hurricane-force winds in extratropical cyclones has been greatly enhanced by data from QuikSCAT scatterometer. Gale force winds and stronger can extend over several million square kilometers of open ocean. At any given time, five to as many as eight individual cyclones can be impacting the Atlantic basin and seven to eleven impacting the Pacific basin. Movement of these cyclones during development can exceed 30 knots, and the movement slows as the cyclone matures and the vortex deepens through the troposphere. These facts pertain to the main extratropical storm tracks of the North Pacific and Atlantic. Dangerous winds and waves associated with these extreme cyclones can result in the loss of lives and property. The economic impact is far reaching and can consist of the loss of or damage to cargo or a vessel, increased transit times, increased fuel usage, lost time due to vessel damage, and late delivery of perishable goods. These large storms also can generate significant swell that causes dangerous and destructive conditions along coastlines thousands of miles away.

Prior to QuikSCAT, OPC forecasters infrequently received ship observations of wind of hurricane-force strength but had no way to consistently detect or warn for these extreme conditions. The warning category of Hurricane Force (HF) was added in December 2000 once it became clear that QuikSCAT was able to consistently detect HF conditions. During the period from the fall 2006 through spring 2007, the OPC identified and issued warnings for 115 separate nontropical ocean storms that reached hurricane-force strength (64 in the Atlantic and 51 in the Pacific as seen in Fig .19). While many of these storm systems live their entire lives at sea, over the last two seasons hurricane-force conditions produced by extratropical ocean storms have impacted the coasts of Alaska, the Pacific Northwest, and New England. As an example a mid-December 2006 extratropical cyclone caused widespread tree damage across the states of Washington and Oregon and resulted in power outages to 1.5 million people.

In this study we used QuikSCAT measurements over extratropical storms that reached hurricane force (HF) wind status in North Pacific over a period of 7 years from 2001-2008. During this period a total of 225 HF winds storms were identified and followed in North Pacific and 233 in North Atlantic. To study the wind field distribution in these extreme winter storms, QuikSCAT composites were created using 30°x 30° wide box that was divided into 240 lat/lon grid cells over the storms.. This resulted in an approximate grid resolution of 12.5km. The grid box was centered on the storm center location, which were interpolated from OPC's best track storm files. December proved to be most active month in the Pacific with 56 storms reaching HF winds over a 7 year period. The Atlantic consistently had a maximum number of events in January totaling 53 events within the same 7 year period. The peak activity is located within the western portion of each ocean basin. Both ocean basins appear to have preferred tracks for these extreme cyclones, with the average heading of ~70° from north. The lifetime of HF conditions is different for the Pacific and the Atlantic, with 27% of storms having HF condition lasting between 12 and 24h in the Atlantic and 38% in the Pacific. The average storm motion was found to be ~24knots for both ocean basins.

Complete statistical study of wind field distribution within extratropical storms as observed by QuikSCAT scatterometer will be presented and discussed.