The AES40 North Atlantic Wind and Wave Climatology: A 50-Year Retrospective

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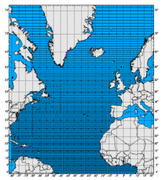
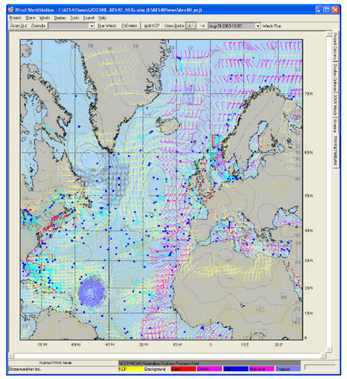


History

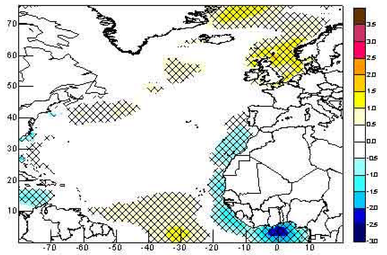
In the mid-1990s, two separate efforts that would revolutionize long-term wave hindcasting were underway. The first was the NCEP/NCAR Reanalysis (NRA) project, which for the first time made available a skillful, homogeneous long-term wind database that was free of major discontinuities found in previous efforts that pasted together operational products. The second advance was the development of the Wind Workstation (WWS) that made it possible to perform kinematic analysis of ocean winds in a time-productive manner. These advances, coupled with a proven 3rd generation wave model, led to the AES40 Wind and Wave Climatology which has now reached the 50-year mark having hindcast the North Atlantic over the period of June 1954 to July 2003. Presented here is a general overview of the project methodology, hindcast products, and selected results shown in the hindcast. Finally, a review of the research and publications produced and underway based on AES40 data is shown.

Project Methodology

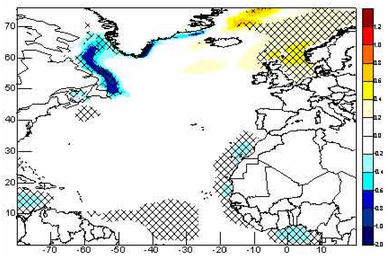


The hindcast methodology, first presented at the 5th Wave Workshop, has been consistently applied since the project start in 1997. The 10-metre surface winds from the NRA were first adjusted for neutral stability and then brought into the WWS every 6-hours in monthly segments. All available marine surface data, including buoy observations, ship reports from COADS, C-MAN stations, ERS 1 & 2, NSCAT and QUIKSCAT scatterometer winds are displayed and selectively assimilated (as determined by the analyst) in the the final wind field. Winds from tropical systems were generated using a proven tropical cyclone model and included. An interactive kinematic analysis was then performed with particular attention to the strong storm systems contained in the hindcast. Final winds were then run through a 3rd generation wave model on a 0.625° by 0.833° grid.

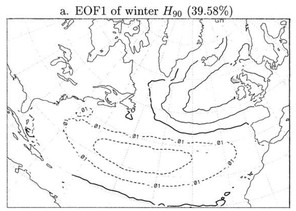
Select Results



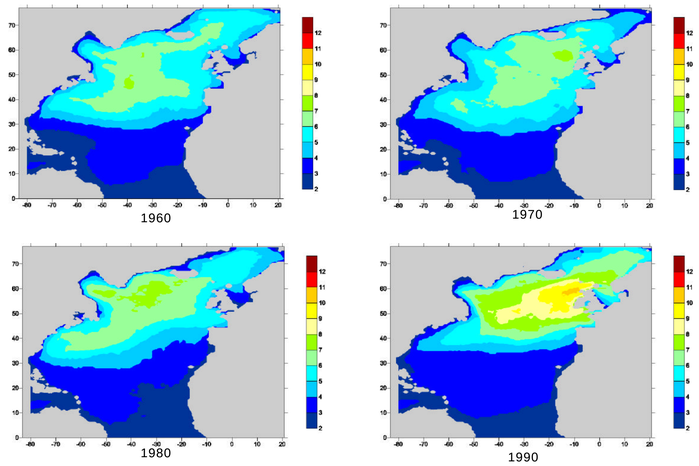
Inferred change over the period 1958 - 1997 with 99% statistical significance in annual mean wind speed (m/s)



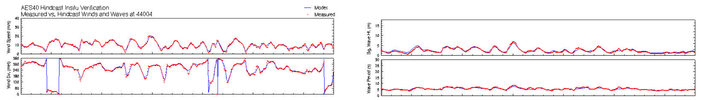
Inferred change over the period 1958 - 1997 with 99% statistical significance in annual mean significant wave height (m)



The EOF1 and PC1 of winter (JFM) seasonal 90th percentiles of SWH (H_{90}, in m). (a) The contour interval is 0.01; solid, bold, and dashed lines are positive, zero, and negative contours, respectively. The number in parentheses is the percentage of variance explained by the EOF. (b) The solid curve represents the PC1 of the numerical hindcast, and the dashed curve, the PC1 of the statistical hindcast. The solid and dashed straight lines represent trends estimated from the solid and dashed curves, respectively.



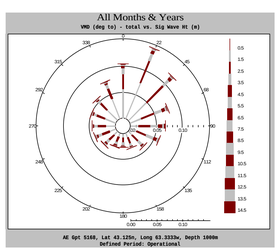
90th Percentile annual significant wave height (m)



Validation at Buoy 44004 during January 2002

Hindcast Products

- 17 wind and wave parameters archived at all 9,023 model locations (includes sea/swell partitions), 6-hourly time step
- Full 23 frequency by 24 direction band wave spectra at 233 select locations (including 5-degree sub grid)
- Pre-computed extremes of wind speed and wave height
- Graphical representations of annual mean and maximum wind speed and wave height
- Canadian-waters archive with analysis tool for offshore operators
- Summary of validation, graphical representation of computed extremes, monthly climate statistics at www.oceanweather.com/aes40/



Follow-on Research and Related Publications

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Caires, S., Sterl, A., Bidlot, J.-R., Graham, N. and Swail, V., 2004: ***Intercomparison of different wind wave reanalyses***. J. Climate, **17** (10), 1893-1913

Cardone, V.J., A.T. Cox and V.R. Swail, 2003. ***Evaluation of NCEP reanalysis surface marine wind fields for ocean wave hindcasts***. JCOMM Technical Report No. 13, WMO/TD-No. 108, pp. 68-85.

Cardone, V.J., R.E. Jensen, D.T. Resio, V.R. Swail, A.T. Cox, 1996: ***Evaluation of Contemporary Ocean Wave Models in Rare Extreme Events: The "Halloween Storm" of October 1991 and the "Storm of the Century" of March 1993***. J. Atmospheric and Oceanic Technology: Vol. 13, No. 1, pp. 198–230.

Cox, A.T., J.A. Greenwood, V.J. Cardone and V.R. Swail, 1995. ***An Interactive Objective Kinematic Analysis System.*** 4th International Workshop on Wave Hindcasting and Forecasting. October 16-20, 1995. Banff, Alberta, Canada.

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Cox, A.T. and V.J. Cardone, 2000. ***Operational System for the Prediction of Tropical Cyclone Generated Winds and Waves***. 6th International Workshop on Wave Hindcasting and Forecasting November 6-10, 2000, Monterey, California.

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Swail, V.R., E.A. Ceccacci and A.T. Cox, 2000. ***The AES40 North Atlantic Wave Reanalysis: Validation and Climate Assessment***. 6th International Workshop on Wave Hindcasting and Forecasting November 6-10, 2000, Monterey, California.

Swail, Val R., Andrew T. Cox, 2000: ***On the Use of NCEP–NCAR Reanalysis Surface Marine Wind Fields for a Long-Term North Atlantic Wave Hindcast.*** J. Atmospheric and Oceanic Technology: Vol. 17, No. 4, pp. 532–545.

Swail, V.R., A.T. Cox and V.J. Cardone, 1999. ***Trends and potential biases in NCEP-driven ocean wave hindcasts***. Proc. 2nd International Conference on Reanalyses. 23-27 August 1999, Reading, UK, WMO/TD-NO. 985, WCRP-109, p.129-132.

Swail, V.R., V.J. Cardone and A.T. Cox, 1998. ***A Long Term North Atlantic Wave Hindcast.*** 5th International Workshop on Wave Hindcasting and Forecasting. January 26-30, 1998. Melbourne, Florida.

Swail, V. R., A. T. Cox and V. J. Cardone, 2003. ***Analysis of wave climate trends and variability***. JCOMM Technical Report No. 13, WMO/TD-No. 108, pp. 217-226.

Swail, V.R., Xiaolan L. Wang and Andrew Cox, 2002. ***The Wave Climate of the North Atlantic - Past, Present and Future .*** Proceedings 7th International Workshop on Wave Hindcasting and Forecasting, 21-25 October 2002, Banff, Alberta

Wang, Xiaolan L., Val R. Swail, 2002: ***Trends of Atlantic Wave Extremes as Simulated in a 40-Yr Wave Hindcast Using Kinematically Reanalyzed Wind Fields.*** Journal of Climate: Vol. 15, No. 9, pp. 1020-1035.

Wang, Xiaolan L., Val R. Swail, 2001: ***Changes of Extreme Wave Heights in Northern Hemisphere Oceans and Related Atmospheric Circulation Regimes.*** Journal of Climate: Vol. 14, No. 10, pp. 2204–2221.

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