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TECHNICAL NOTE

THE EDITING AND AVERAGING OF ALTIMETER WAVE AND WIND DATA

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No. 1. Burroughs, L. D., 1986: Development of Forecast Guidance for Santa Ana Conditions. National Weather Digest. (in press).

No. 2. Richardson, W. S., D. J. Schwab, Y. Y. Chao, and D. M. Wright, 1986: Lake Erie Wave Height Forecasts Generated by Empirical and Dynamical Methods -- Comparison and Verification. Ocean Products Center Technical Note, 23pp.

No. 3. Auer, S. J., 1986. Determination of Errors in LFM Forecasts of Surface Lows Over the Northwest Atlantic Ocean. Ocean Products Center Technical Note/NMC Office Note No. 313, 17pp.

No. 4. Rao, D. B., S. D. Steinrod, and B. V. Sanchez, 1986: A Method of Calculating the Total Flow from a Given Sea Surface Topography. NASA Technical Memorandum. (in press).

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No. 9. Auer, S. J., 1986: A 5-Year Climatological Survey of the Gulf Stream and Its Associated Ring Movements. Journal of Geophysical Research. (Submitted).

No. 10. Chao, Y. Y., 1987: Forecasting Wave Conditions Affected by Currents and Bottom Topography. Ocean Products Center Technical Note, 11pp.

No. 11. Esteva, D. C., 1987: The Editing and Averaging of Altimeter Wave and Wind Data. Ocean Products Center Technical Note, 4pp.

The Editing and Averaging of Altimeter Wave and Wind Data.

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1. Introduction

Satellite borne altimeters provide estimates of significant wave height (SWH) and wind speed over the global oceans. These estimates are typically available for one second intervals at the nadir point of the satellite track, and constitute a valuable data set for studies of both ocean wave and marine boundary layer dynamics.

SWH estimates from altimeters flown on board GEOS-3 and SEASAT proved to be within 0.5 m of NOAA Data Buoy Center (NDBC) buoy estimates for SWH under 6 m (Fedor and Brown ,1982). Wind speed estimates were within 2 m/s and 1 m/s of the buoy winds for GEOS-3 and SEASAT respectively for wind speeds under 12 m/s (Tapley et al., 1979,1982). Presently a space borne altimeter is available on board the U.S. Navy satellite GEOSAT. Pickett, Burns and Boome (1986) suggest the GEOSAT wind and SWH are within 1.8 m/s and 0.5 m, respectively, of the buoy estimates. Thus these SWH are perhaps the most reliable existing source of data available to validate the performance of global ocean wave forecast models. Potentially, these estimates may be used in initializing ocean forecast models along the lines followed by the numerical weather prediction community.

For these reasons, it is desirable to develop systematic procedures to edit the SWH and wind speed retrievals from satellite altimeters and archive the resulting data set. For most practical purposes a one every second estimate is too high a frequency, and these individual values tend to be too noisy; hence a time averaging procedure is advisable.

This note describes the error checking and averaging procedures used in processing the GEOSAT data. With suitable modifications, these procedures should be applicable to data from all satellite borne altimeters.

2. THE GEOSAT SATELLITE

GEOSAT is a Navy satellite launched on March 12, 1985. Although the first phase of its mission is classified the Navy agreed to unclassify the SWH and wind speed estimates and make them available to the scientific community. GEOSAT carries only an altimeter and was placed in a non repeating polar orbit until October 1, 1986. Adjustments to the orbit started on this date and were completed by November 8, leaving GEOSAT on a seventeen day repeat orbit approximately duplicating that of SEASAT.

Fleet Numerical Oceanographic Center, Monterey, California transmits the unclassified portion of the data in near real time over a dedicated 1200 baud line, to the computer facility of the National Meteorological Center in Suitland, Md. The transmitted data have been subjected to limited gross error checks.

3. DATA QUALITY CHECKS AND AVERAGING

The editing and averaging procedures developed had to:

-be suitable for handling the large volume of data expected,
-ensure statistically meaningful results, and
-provide a set of averages of adequate resolution for a variety of applications.

To accomplish this aim, the data were subjected first to a gross error check followed by a more detailed editing as described in the following subparagraphs A and B. For the averaging, a 0.5 by 0.5 degree grid from 71.0S to 73.5N was adopted. This provides adequate resolution for applications requiring fine resolution such as in coastal areas. For other applications where a coarser resolution might be sufficient or desirable, the 0.5 by 0.5 degree averages can be easily grouped to the desired resolution.

A. GROSS ERROR CHECKS

Upon receipt at Suitland the data are subjected to the following error checks:

-wind speed (m/s) and SWH (m) are bounded by 0.0 and 99.0.
-longitudes are corrected to lie within 0 and 360 degrees.
-consecutive reports must be separated in time by 0.9 seconds or more.
-the satellite ground speed is bounded by 5 and 7 km/s.

Approximately two thirds of the raw GEOSAT data pass these tests; erroneous values are coded as missing.

B. FURTHER EDITING AND DATA AVERAGING

Sections of alongtrack data values were edited separately. Sections within 2.5 by 2.5 degree squares are expected in general to have enough values to yield statistically meaningful results and yet cover a geographical area small enough to preclude large variability in the estimated SWH and wind speed. Data values within 1.25 degrees in latitude and longitude from grid points from 70.0S to 72.5N are grouped and edited as follows:

-isolated values departing three standard deviations or more from

-Groups of two or more successive bad values are discarded and no data values assigned at these points.
-Missing values are noted, but are not replaced with interpolated
-values.

Edited values within 0.25 degrees in latitude and longitude of each 0.5 by 0.5 degree grid point were averaged and assigned to the grid point. An example of the editing and averaging of a section is given in the following paragraph.

The alongtrack values within the 2.5 by 2.5 degree square centerd at 60.0S and 177.5E are given below and shown schematically in the Figure.

Time(s)	Lat/Long(°)	SWH(m)	Wind Speed(m/s)
42447	-60.25/178.64	4.80	9.5
42448	-60.21/178.56	4.69	9.0
42449	-60.16/178.49	4.33	9.0
42451	-60.07/178.33	4.18	9.0
42452	-60.03/178.25	4.23	9.0
42453	-59.98/178.18	4.14	8.7
42455	-59.89/178.02	4.47	8.7
42456	-59.84/177.95	4.41	9.0
42457	-59.80/177.88	4.09	9.0
42458	-59.75/177.81	3.95	9.0
42460	-59.66/177.66	4.04	9.0
42461	-59.61/177.59	3.95	9.0
42462	-59.59/177.51	4.12	8.9
42463	-59.52/177.44	4.04	9.3
42466	-59.38/177.22	4.44	9.7
42467	-59.23/177.15	4.56	10.6
42469	-59.20/176.93	4.59	11.6
42471	-59.10/176.78	4.51	11.3
42472	-59.06/176.71	4.84	11.6
42473	-59.01/176.64	4.78	11.3
42475	-58.92/176.49	4.87	11.1
42476	-58.87/176.42	5.00	11.1

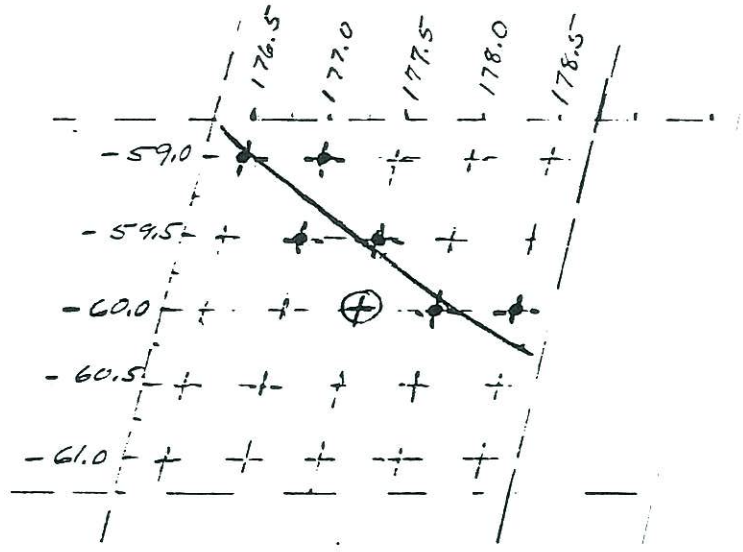

Figure. Schematic of subsatellite track within ±1.25 degrees of grid point at -60.0/177.5 of the 2.5 by 2.5 degree grid: (⊕). Satellite ground track: solid line. 0.5 by 0.5 degree grid points: + ; locations assigned to the resulting averages: + .

All the data values passed the editing tests. (Missing values have not been noted in the example). The resulting averages are as follows:

Time(s)	Lat/Long(°)	Mean SWH(m)	Mean Wind Speed(m/s)
42450	-59.00/176.50	4.45	9.1
42456	-59.00/177.00	4.21	8.9
42461	-59.50/177.50	4.04	9.0
42466	-59.50/177.00	4.44	9.7
42469	-60.00/178.00	4.55	11.2
42474	-60.00/178.50	4.87	11.3

4. SUMMARY

Procedures for processing satellite borne altimeter data have been described. These procedures include, gross error checks, editing and averaging of the data. The result is a reduced data set on a half degree grid. This data set may be applied to grids of different resolutions with mesh lengths in multiples of half degrees, and is of adequate resolution for applications in coastal waters.

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