



IMPROVE SURFACE WIND INPUT FOR COASTAL ZONE APPLICATIONS Coastal Modeling system

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DISCOVER | DEVELOP | DELIVER

Improve Wind Input for Coastal Applications



SoN 2017-N-1:Test & Evaluate USACE Coastal Numerical Models

- Objective: improve wind input for engineering applications in coastal zone, including inlets, bays and estuaries
- Advancement: provide USACE user community more reliable and accurate wind input for various applications
- Products: document research findings and provide a user guide on procedure for







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Correction of Land-Based Wind Data for Offshore Applications

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(1)
$$U_{sea}(m/sec) = 1.85 + 1.2 U_{land}(m/sec)$$
 (Liu et al., 1984)

(2)
$$U_{sea}(m/sec) = 1.62 + 1.17 U_{land}(m/sec)$$
 (Hsu, 1985)



- Eq.(1) is based on graphs by Resio and Vincent (1977) for the Great Lakes region
- Eq.(2) is based on NDBC, NOAA, Oil Rig, Airport data
- Wind is blowing from land to sea
- U_{sea} at 20-m level, above MSL

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Simple 1-D Model of Over-Water Wind Speed







An Example of Wind Estimate @ 17090500 Superior Bay, Lake Superior



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Station No.	Station ID	Usage Index
1	45028	5
2	45006	4
3	DULM5	1
4	KDYT	3
5	PNGW3	0

Usage Index is the weight for wind data applied to the boundary of a box area (Index 5 corresponds to the maximum weight)

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Terrain Effect on Land Surface Wind



Steady-state Bernoulli Equation:

$$\frac{U_1^2}{2} + gh_1 + \frac{p_1}{\rho_1} = \frac{U_2^2}{2} + gh_2 + \frac{p_2}{\rho_2}$$

where h is the land surface elevation.

Assume
$$\frac{p_1}{\rho_1} = \frac{p_2}{\rho_2}$$

$$U_2 = \sqrt{U_1^2 + 2g(h_1 - h_2)}$$

and

$$U_2 \geq U_1/\sqrt{2}$$



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Wind Tunnel Effect on Over-Water Wind



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Station No.	Station ID	Usage Index
1	44014	1
2	KPTV2	3
3	CBBV2	5
4	44058	5
5	LWTV2	4
6	COVM2	3
7	44062	3
8	BISM2	4
9	RPLV2	0



Comparison of Time Series and Wind roses Model Wind Estimates vs Data



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Summary

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FY19 major advances

- Investigated and developed a method to construct 2-D wind fields over water from coastal wind stations
- Tested the method in Superior Bay and Chesapeake Bay
- Wind estimates compared well to data

FY20 key products/advances

- Conduct additional testing of wind fields at FRF and Matagorda Bay, TX
- Evaluate impact of estimated wind field on wave and flow model predictions (Test sites: Superior Bay, Chesapeake Bay, FRF, Matagorda Bay, Grays Harbor, Hilo Harbor, Chicago Harbor)



