

CIRP TECHNICAL DISCUSSION 24 AUGUST 2021

UPDATE ON THE DUNE RESPONSE TOOL AND CMS-AEOLIS COUPLING

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Tools for Simulating Aeolian Sediment Transport Near Inlets

Inlet Engineering Toolbox

Primary Work Unit Goal: Development of processbased numerical modeling tools for simulating aeolian transport and dune evolution in managed coastal environments



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Dune Response Tool

Graphical User Interface



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TOOL DEVELOPMENT

承 Dune Response Tool			—		×		
**	Model Attributes	Advanced					
Dune	Latitude	Location 36.18	Cho	oose ation			
Response Tool	Morphology						
Info	Dune Crest Elev. (m) 6					
	Dune Toe Elev. (m) 3	Upo	Update Morphology			
	Dune Slope (m/m) 0.2	Based on				
	Beach Slope (m/m) 0.1	Lat/	Lat/Lon Location			
	Shore Normal (deg) 70.0					
Run	Timing						
Model	Hindcast (1980 - 2017) Forecast (now)						
	Start Date	•	25-Oct-2012 💌				
Save Output	Duration (days		7				

Step 1. Type in location coordinates manually or choose on map



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** Redundancy built in to pull different data servers in case of server outages

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Dune Response Tool



JSON SOAP JALBTC View In: View Fool Service D All Layers : Has Versi	X/JALBTCX_Geomorphic_Features (FeatureServer) ArcGIS Online Map Viewer sprint In: ArcGIS Online Map Viewer escription: and Tables and Tables
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Service D All Layers Has Versi	escription: and Tables
All Layers : Has Versi	and Tables
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	bned Data: true
MaxRecor	d Count: 10000
Supporte	I Query Formats: JSON
Supports	Query Data Elements:
Layers:	
 Bluff Bluff Dune Dune Dune Dune Zero MHW 	Points (1) Lines (2) Points 2016 (4) Points 2009 (5) Lines 2009 (7) _Transects (8) Contour (10) Contour (11)
Tables:	
• <u>GIS.</u>	<u>COE GEO NCMP.SurveyJob ProductInfo</u> (12)
Descriptio	in:

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Dune Response Tool

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<> Code ⊙ Issues ి1	Pull requests () Actions	凹 Projects 🕮 Wiki 🕕 S	lecur
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ncohn updated Windows in	nstall	80effca on Jul 17 🕚 36 commits	
.idea	update	7 months ago	0
dependencies	update	7 months ago	0
installation	updated Windows install	last month	h
paper	updated metadata	2 months ago	0
DS_Store	updated Windows install	last month	h
	Create LICENSE	8 months ago	0
README.md	update	9 months ago	0
drt_accretion.m	code reorganization	9 months ago	0
🗋 drt_env.m	update storm surge database	2 months ago	0
drt_erosion.m	code reorganization	9 months ago	0
drt_grid.m	reduce default smoothing	last month	h
🗋 drt_gui.mlapp	addpath update	last month	h
drt_plotting.m	code reorganization	9 months ago	o
drt_plotting_ensemble.m	code reorganization	9 months ago	o

• GUI and backend codes are all publicly available on GitHub:

https://github.com/erdc/dune-response-tool

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- Installation Options:
 - Windows Executable
 - MacOS Executable
 - Matlab Mlapp

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Operational Simulations of Dune Impacts Using DRT: Hurricane Henri

Observed Morph + Forecasted Conditions: 12 hours before landfall



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Operational Simulations of Dune Impacts Using DRT: Hurricane Henri





 Lots of pictures of waves breaking and heavy surf, minimal reports of beach and dune erosion

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Operational Simulations of Dune Impacts Using DRT: Hurricane Henri

Observed Morph + Forecasted Conditions: 12 hours before landfall



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Model Exploration: Benefits of a Very Fast Model

(1) What if don't have good morphology data?





Exploratory Case: Average regional morphology, still using local environmental forcings

*Note once environmental data is downloaded, simulations take ~1 second each

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Model Exploration: Benefits of a Very Fast Model

(1) What if don't have good morphology data?(2) What if don't have good environmental data?



Original Case: USGS-derived beach + dune morphometrics and WW3/ESTOFS forcing

Exploratory Case: Same as above with 0.5 m SWL added

*Note once environmental data is downloaded, simulations take ~1 second each

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Model Exploration: Benefits of a Very Fast Model

(1) What if don't have good morphology data?(2) What if don't have good environmental data?



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Dune Response Tool

FY21 Goal: Explore porting of DRT to cloud

Step 1: Deploy Matlab Webapp Server on local server to test configuration

Step 2:

Install/Test server code on Azure, AWS, and ERDC CCE Environment

Step 3:

AWS/Azure: Build capabilities for secure, public facing website

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CCE: Build CAC enabled capabilities for access

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CMS-Aeolis Coupling

Traditional CMS Workflow – Aeolian Transport Not Considered



FY21 New Model Development

<u>Goal:</u>

Add in capability to directly couple Aeolis with CMS for 2D applications

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CMS-Aeolis Coupling

Traditional CMS Workflow – Aeolian Transport Not Considered



Approach:

- cms_flow.f90 (modification) modify main code to call aeolian steering file and handle topographic updates
- aeolian.f90 (new) interface between CMS and Aeolis which includes system call to aeolian.py which generates all Aeolis input files, runs Aeolis, and returns data for incorporation to CMS
- scenario.cmcards (modification)

 new options for coupling interval and subaerial grain size

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Average Daily Growth of Dunes for Different Wind Conditions

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Colors represent different cross-shore transects

Lots of variability in trends based on local beach and dune morphology and vegetation properties



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For most time periods, wave driven processes are larger contributor to morphology change than wind-driven processes



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Next Steps for Coupling:

- Linkages from CMS → Aeolis
 - Hard Structures
 - Variable Grain Size
- Other Fixes Needed:
 - Remove any hardcoding from testing
 - Expose vegetation/wind/aeolian variables in aeolian cards

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- Testing:
 - More complex geometries/sites

Questions/Comments?

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