

INTEGRATED COASTAL MORPHOLOGY MODELING

AEOLIS-CMS COUPLED MODEL DEVELOPMENT

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COASTAL INLETS RESEARCH PROGRAM
FY23 IN PROGRESS REVIEW



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ERDC

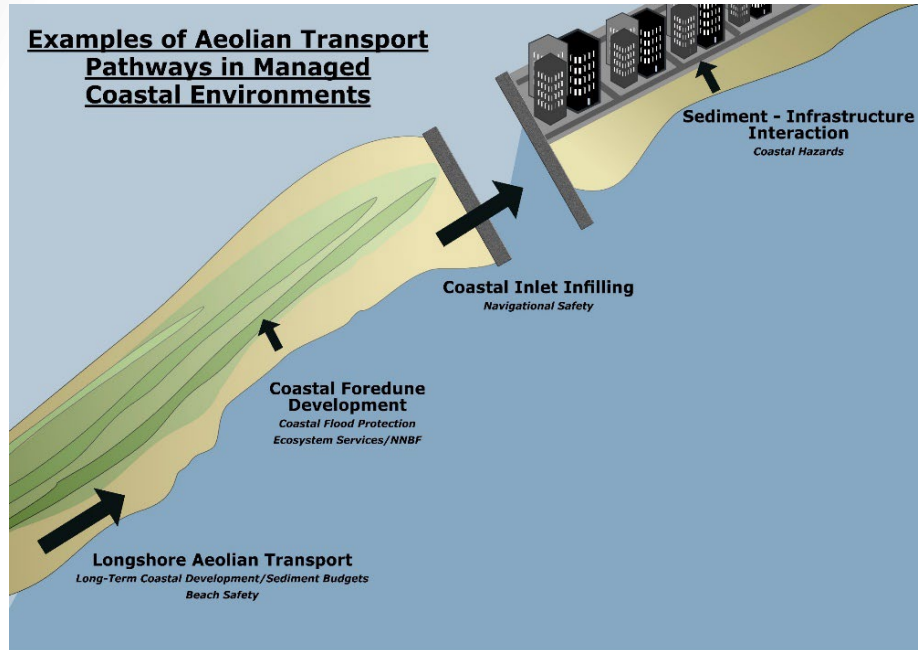


CIRP





PROBLEM STATEMENT



Wind can transport sand and modify landscapes in managed coastal systems, resulting in sediment deposition that may adversely (inlet infilling) or positively (dune growth) impact project performance

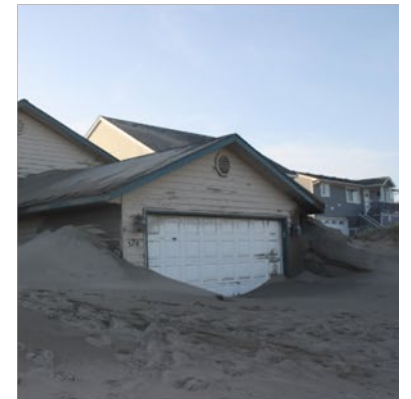
Suitable tools do not currently exist for USACE to simulate wind-blown sediment transport and related hazards

Relevant Statements of Need:

2017-N-72 Improved Simulation of Dune Morphological Response at Short & Long Time-scales

2020-F-1539 Improved Capabilities for Quantifying Coastal Dune Evolution and Resilience

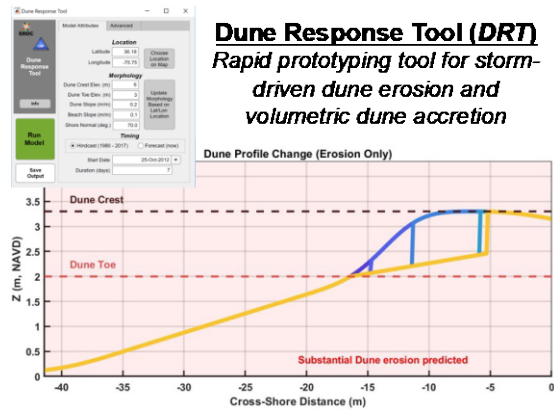
2023-F-1859 Adaptive Modeling for Coastal NNBF Applications





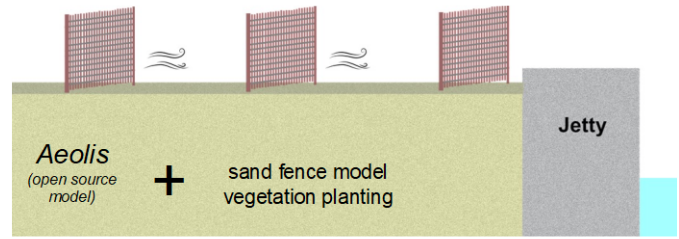
CAPABILITY AND STRATEGIC IMPACT

This work unit aims to develop and extend state-of-the-art tools for simulating wind-driven sediment transport processes in proximity to navigational channels and in other USACE-managed coastal settings.

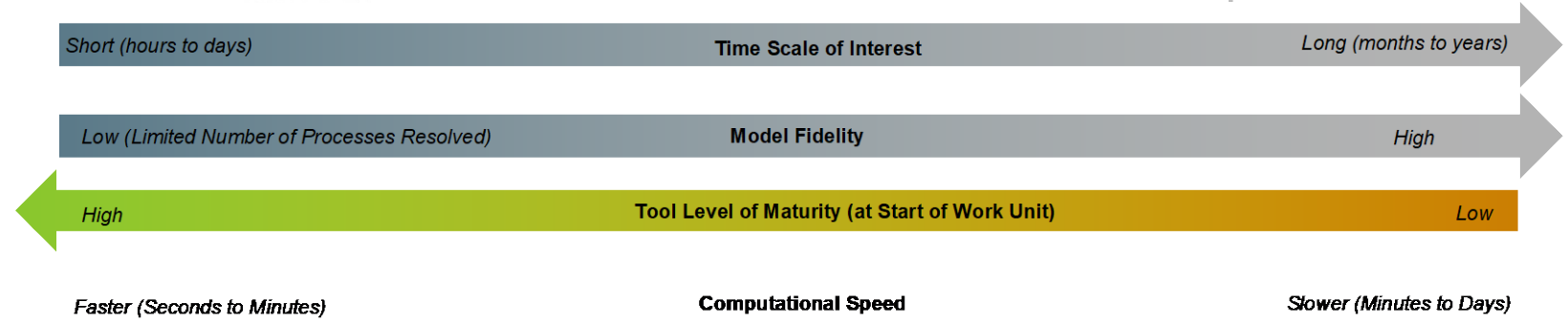


Dune Response Tool (DRT)
Rapid prototyping tool for storm-driven dune erosion and volumetric dune accretion

Aeolis Process-based aeolian transport model with USACE management alternatives being added



Aeolis-CMS Fully coupled subaqueous-subaerial model for simulating the co-evolution of coastal morphology from wind and waves



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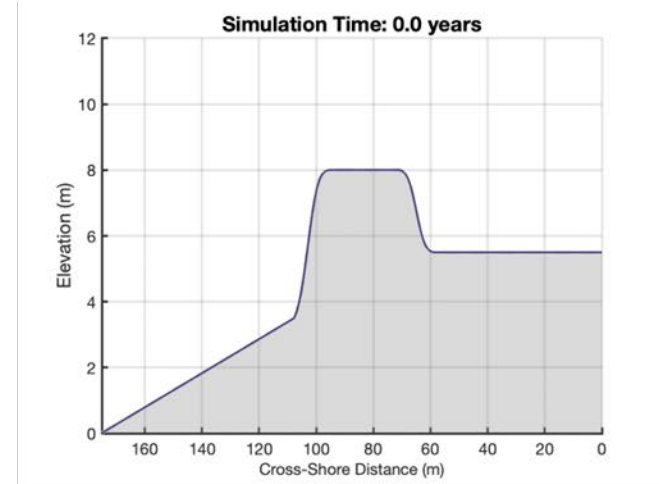
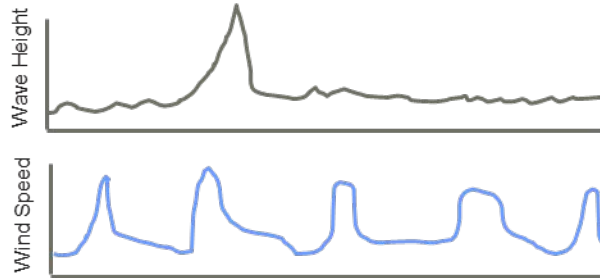


DRT: MODEL TRANSITION

Empirical/Fast Approaches for Estimating Sediment Transport



Environmental Time Series



ERDC R&D Partners:



University Partners:



Reimbursable Partners:



Dune Response Tool (DRT) <https://github.com/erdc/dune-response-tool>





AEOLIS: MODEL DEMONSTRATION AND VALIDATION



Ongoing Collaborations on Validation/Site Specific Applications:

VIMS: northern North Carolina

Oregon State: Oregon/Washington

NOAA: southern North Carolina

USGS: Grand Canyon

KU Leuven: Belgium

TU Delft: Netherlands

Montclair State: New Jersey

Internal ERDC: CONUS Sandsnap

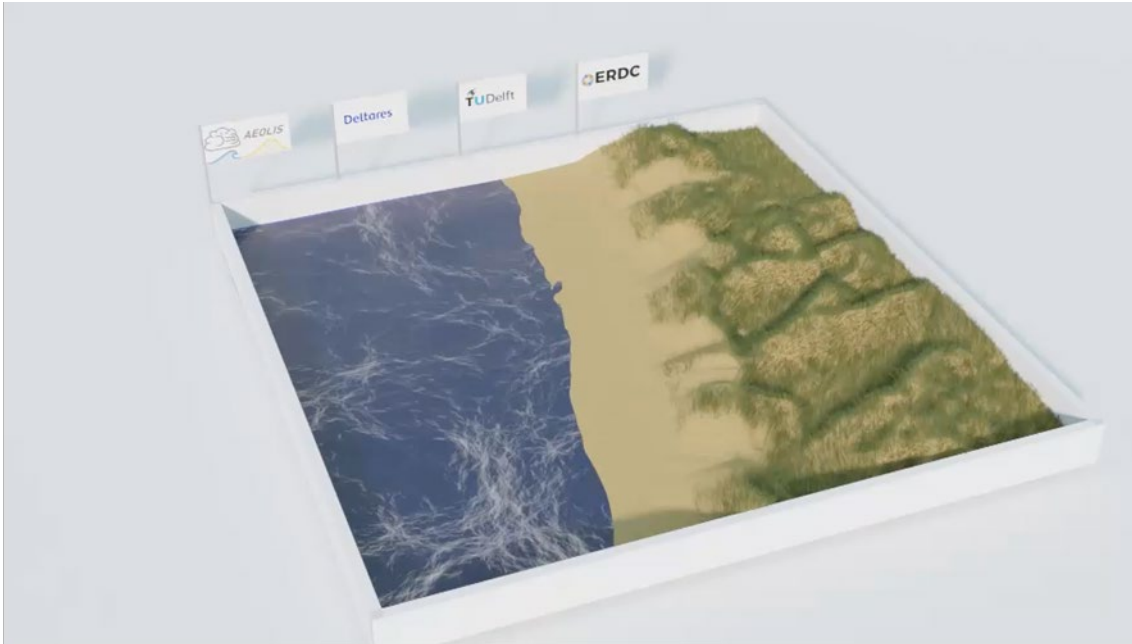
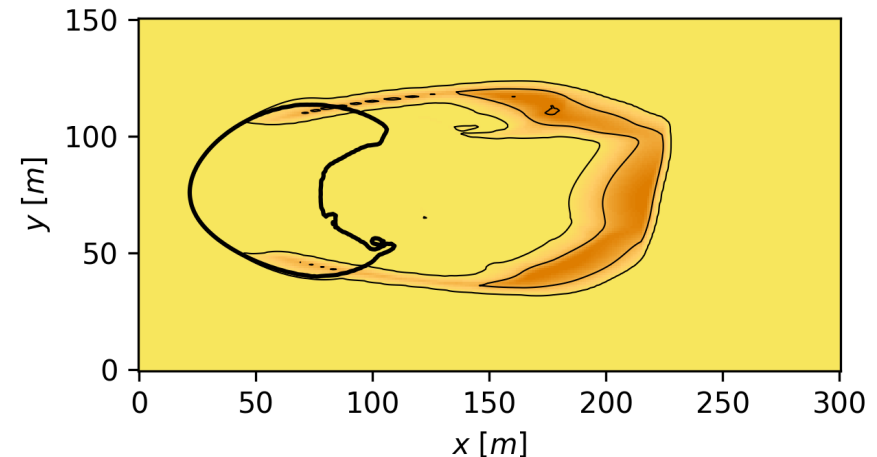
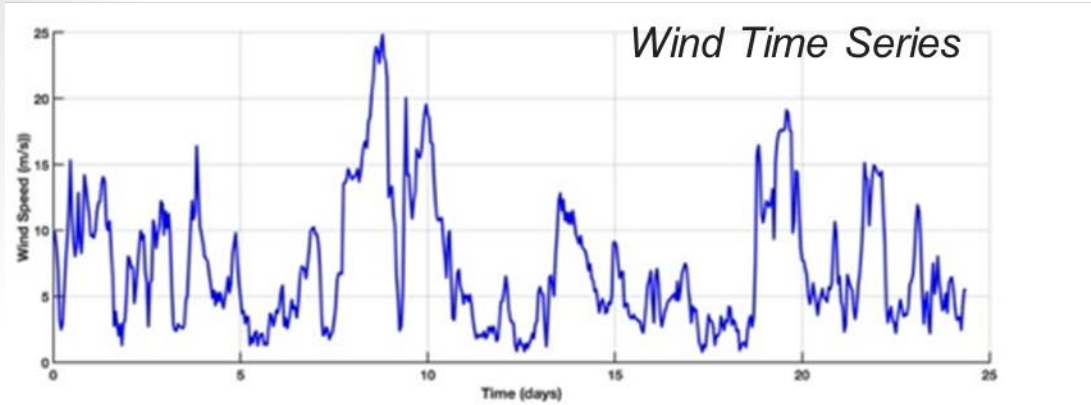


Image Credit: Bart van Westen (TU Delft/Deltares)

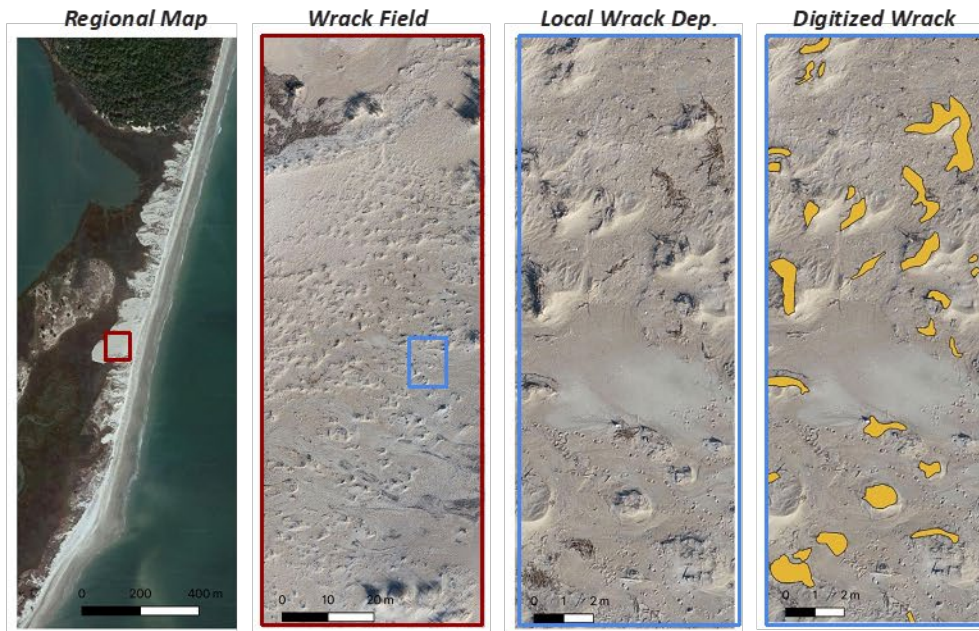




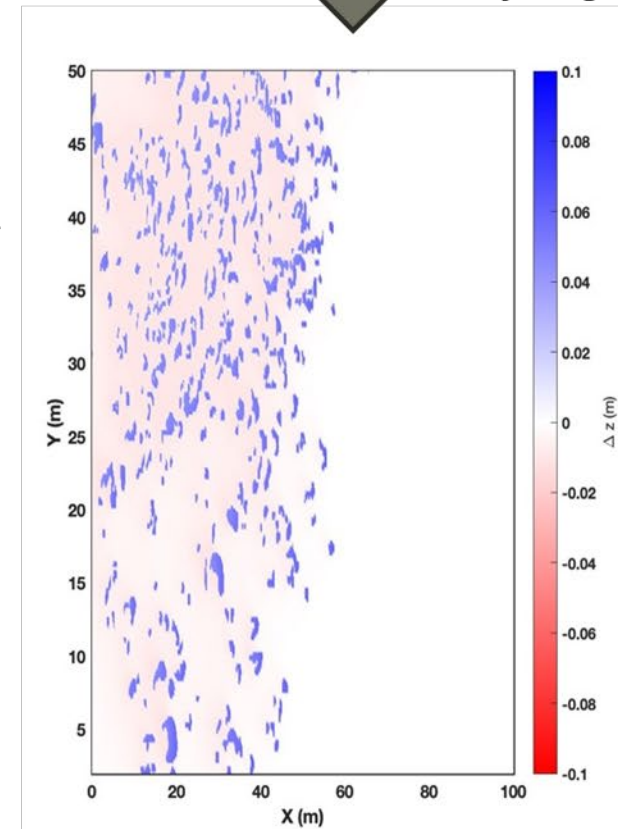
AEOLIS: MODEL DEV (WRACK)



*Field-Derived Wrack.
Infilling Parameterization*



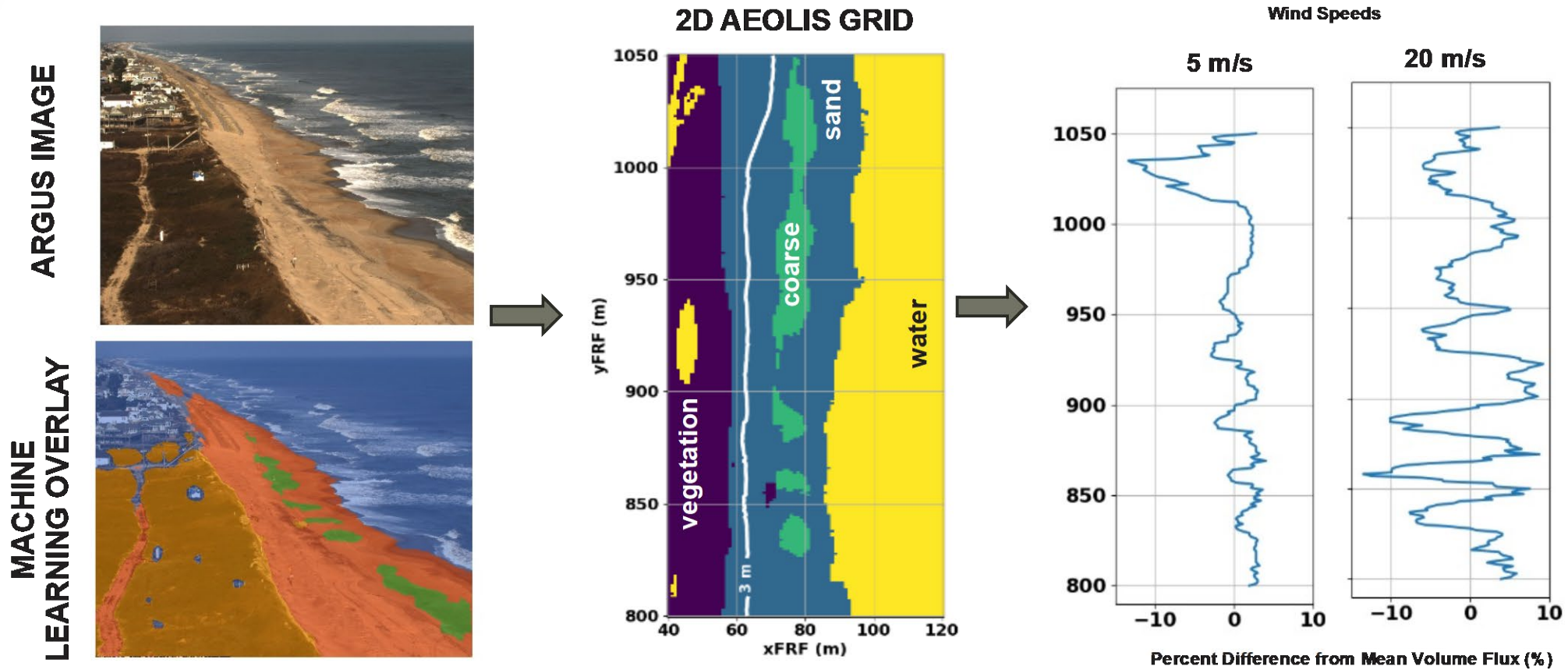
*Field Data for
Spatial Wrack
Discretization
and Validation*



2D Predictions of Bed Elevation Change Incorporating Wrack Effects



AEOLIS: MODEL DEV (MULTIFRACTION EFFECTS)



Assessing and improving 2D multifraction simulation capabilities and developing guidance for sediment input needs

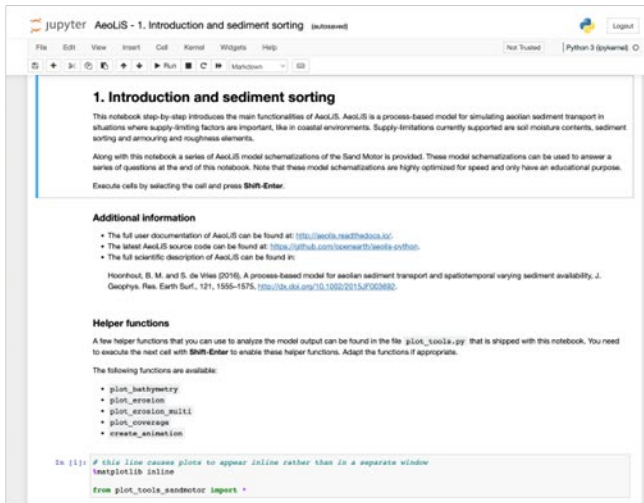


AEOLIS: MODEL TRANSITION

Open Source Code

<https://github.com/openearth/aeolis-python>

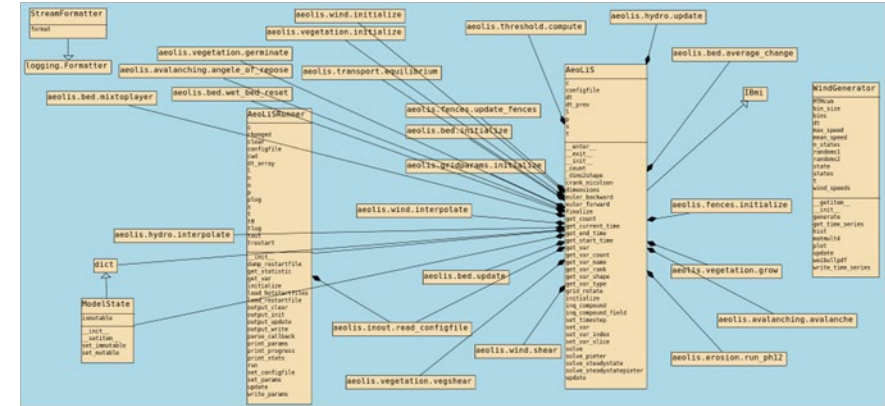
AeoLiS Model Full Day Short Course:
Coastal Sediments, New Orleans, LA



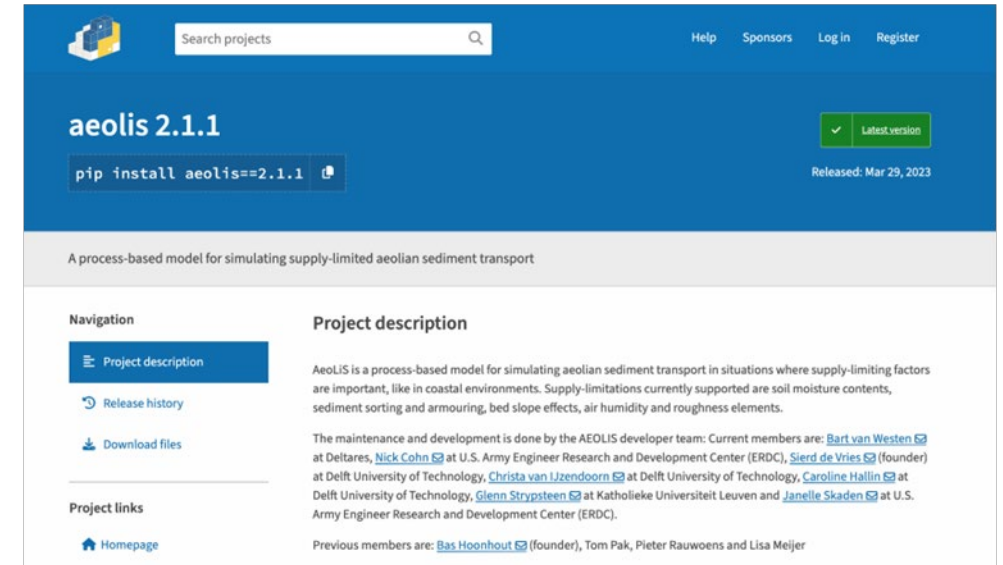
Course Materials: <https://zenodo.org/records/7957593>

Online Documentation:

<https://aeolis.readthedocs.io/en/latest/>



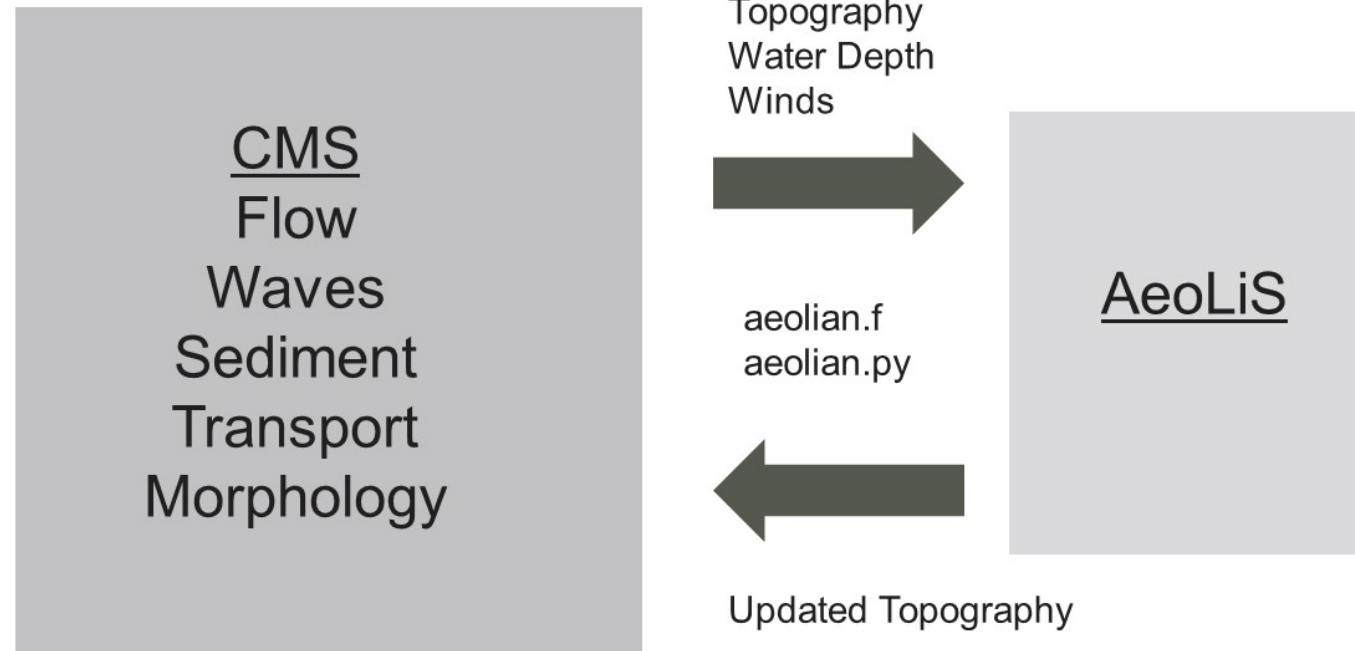
Model Accessibility:



CMS-AEOLIS: COUPLED MODEL DEVELOPMENT



- All open-source models
- Extended capability for standard USACE models
- Fast computations



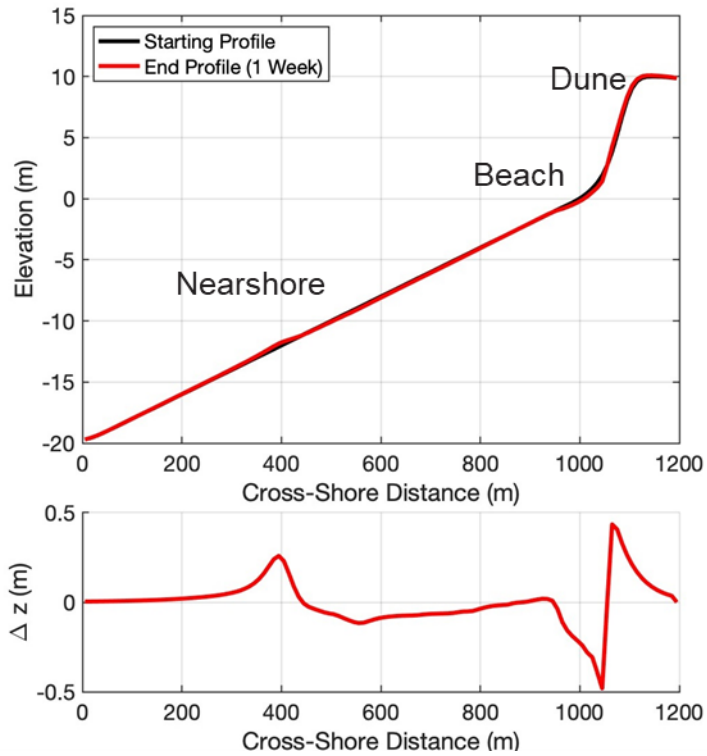
New CMS dependencies: python, AeoLiS



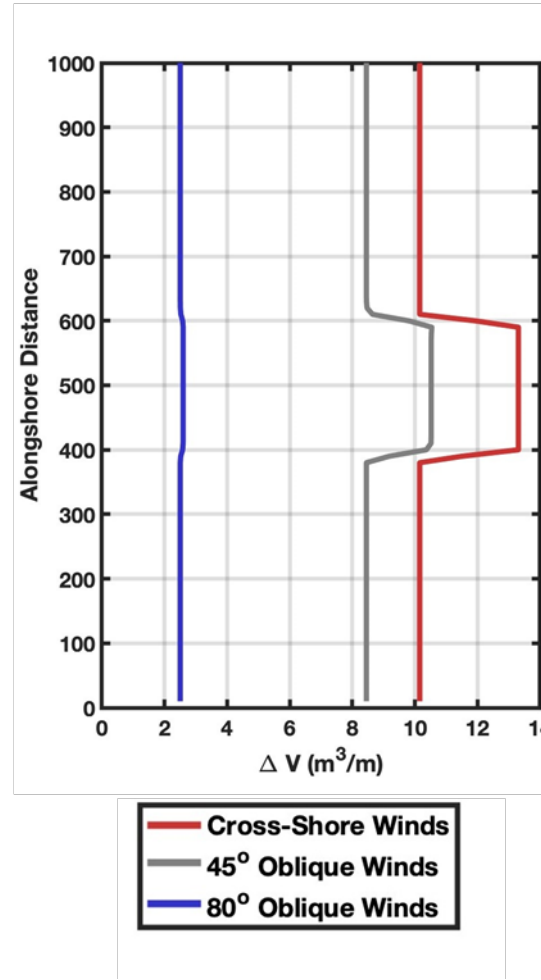
CMS-AEOLIS: COUPLED MODEL DEVELOPMENT (CONT)



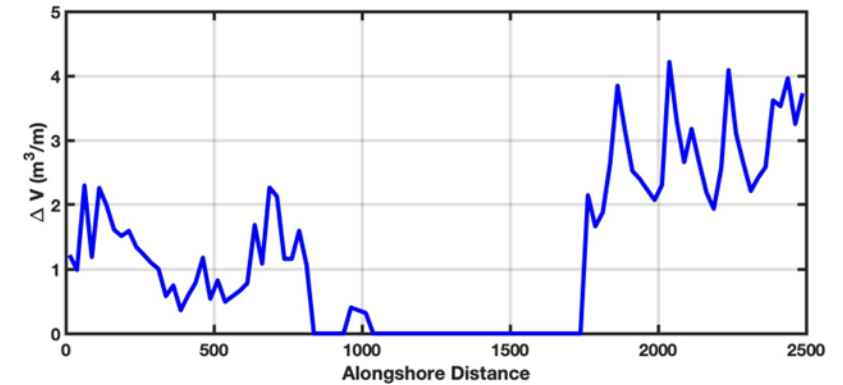
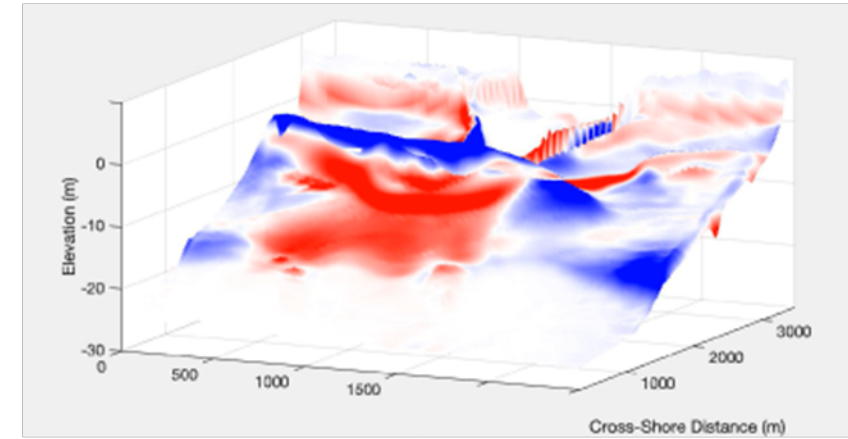
Cross-Shore Sediment Redistribution



Beach Nourishment Effects On Dune Growth Rates



Nearshore-Beach-Dune Evolution at Merrimack Inlet





SUMMARY



FY23 Major Advancements in Capability

- Improved AeoliS Model Useability
 - Automated installation via pip
 - Improved online documentation
 - Publicly available self guided coursework
 - First in-person training session
 - New wrack capabilities added
- New Coupled Model Capabilities
 - Coupled model upgraded to new CMS code with enhanced stability
 - Initial model demonstration for complex inlet site with both wave- and wind-driven management challenge

Planned FY24/FY25 Products & Advancements

- Dune Response Tool – Updated code release of rapid planning model with full morphological capabilities
- AeoliS – Continued joint development and demonstration for applied engineering use cases; emphasis on validation of new groundwater and moisture capabilities
- AeoliS-CMS – Real world application demonstration, initial documentation and improved useability

FY23 Major Products & Collaborations

- **CIRP Technical Discussions**
 - Multifraction aeolian transport processes
 - Wrack-integration into Aeolis
 - CMS-Aeolis coupling
- **Publications**
 - van Westen, B., de Vries, S., Cohn, N, et al. (in review). AeoliS: Numerical Modelling of Coastal Dunes and Aeolian Landform Development for Real-World Applications. Environmental Modeling and Software
 - Heminway, S., **Cohn, N.**, et al. (in press). Exploring ecological, morphological, and environmental controls on coastal foredune evolution at annual scales using a process-based model. Sustainability
- **Global & Growing Network of AeoliS Collaborators & Users**
 - Core Development Team: ERDC, TU Delft, Deltares, Lund University
 - Over 20 Participants at Coastal Sediments Training
 - Growing code base, online documentation, and validation