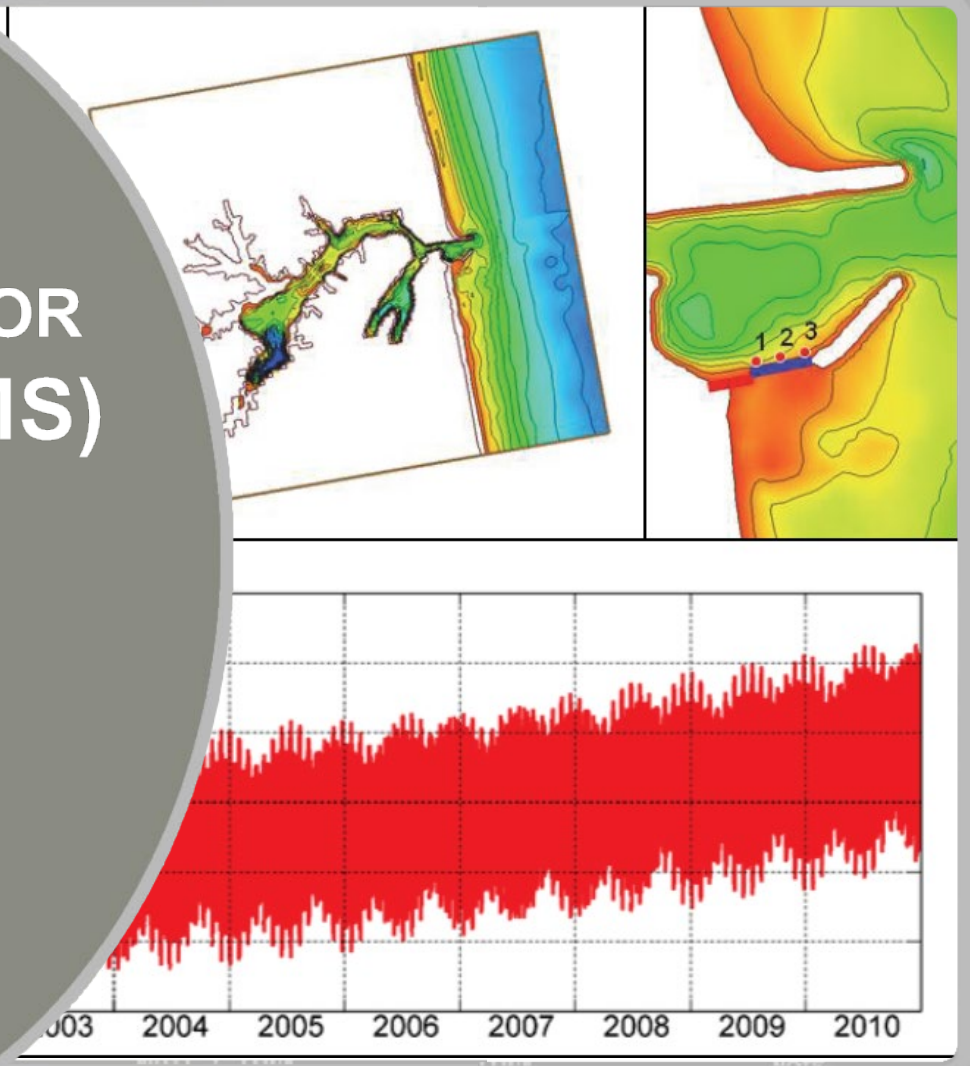
Recent updates within SMS 13.0 for the Coastal Modeling System (CMS)



Mitchell Brown
Coastal & Hydraulics Laboratory

03 December 2019

US Army Corps of Engineers

CHL COASTAL & HYDRAULICS LABORATORY

ERDC ENGINEER RESEARCH & DEVELOPMENT CENTER

BLUF

Changes to SMS beginning with SMS 12.x allow PIs to design/implement new features into the SMS GUI relatively quickly with a Dynamic Model Interface (DMI).

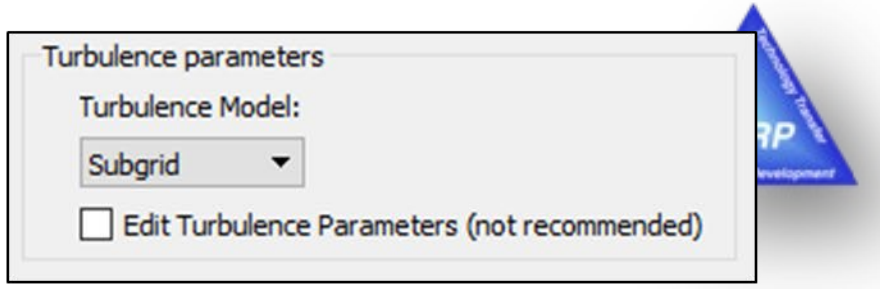
Previously, when new features were to be implemented, a task order to the Aquaveo contract would have to be created and funded. Aquaveo would implement the new feature within a defined time frame (~3-6 mo.)

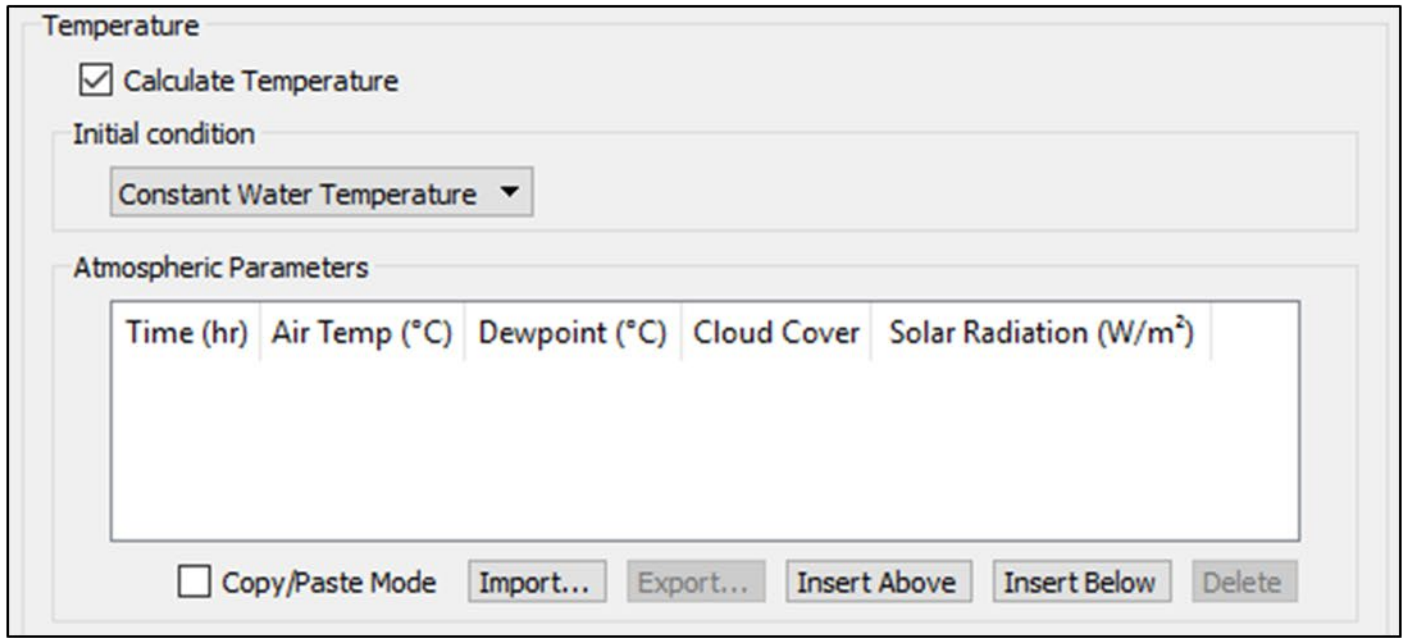
Now, ERDC staff can write XML statements to define the new interface changes in-house with the finished product ready within a much shorter window of time.

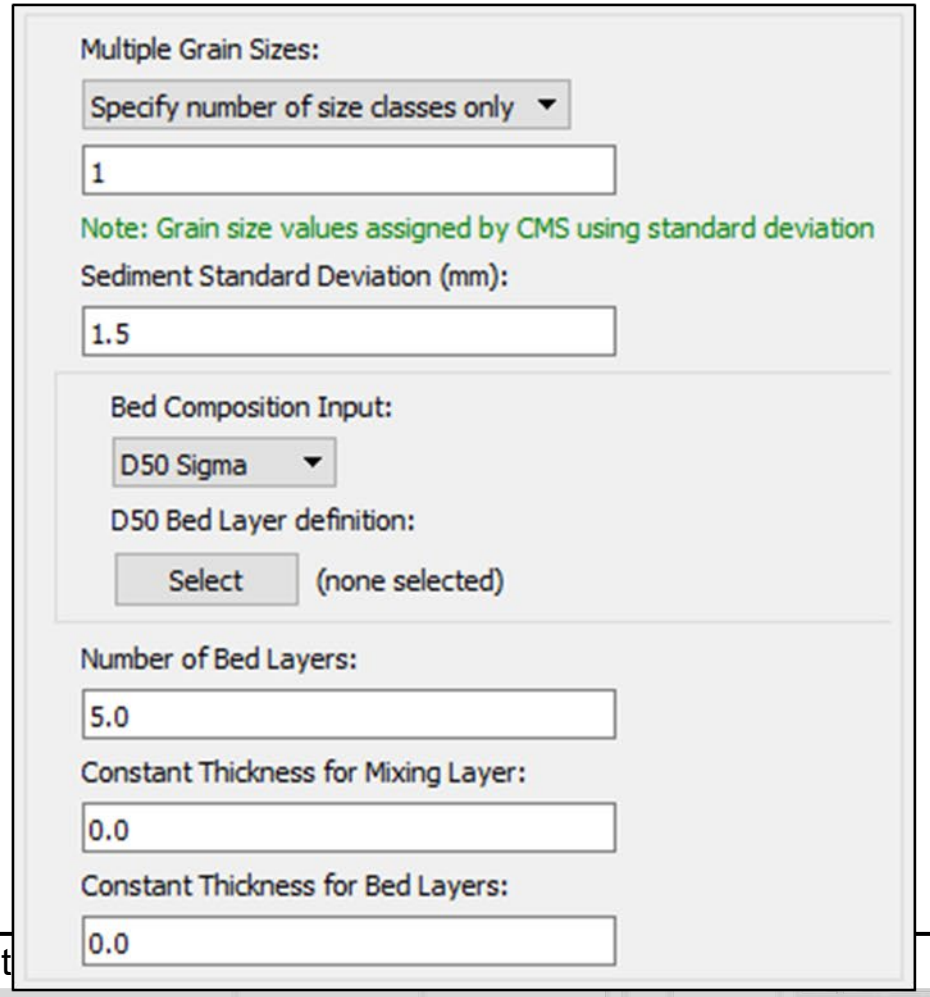
```
<declare_page  text="Advanced" display ="NO_NAV">
 <contains>
  <item text ="Table of Advanced Cards">
   <table unique_name ="tblAdvanced" min_height="150">
    <column text ="Cardname">
     <edit_box unique_name="edtAdvancedCardname" type="text"></edit_box>
    </column>
    <column text ="Value">
     <edit_box unique_name="edtAdvancedValue" type="text"></edit_box>
    </column>
   </table>
  </item>
 </contains>
</declare_page>
```

Changes recently implemented

- Hiding parameters only advanced users should modify.
- Adding forgotten options/capabilities (multiple sediment grain options)
- Adding new feature for Temperature calculations

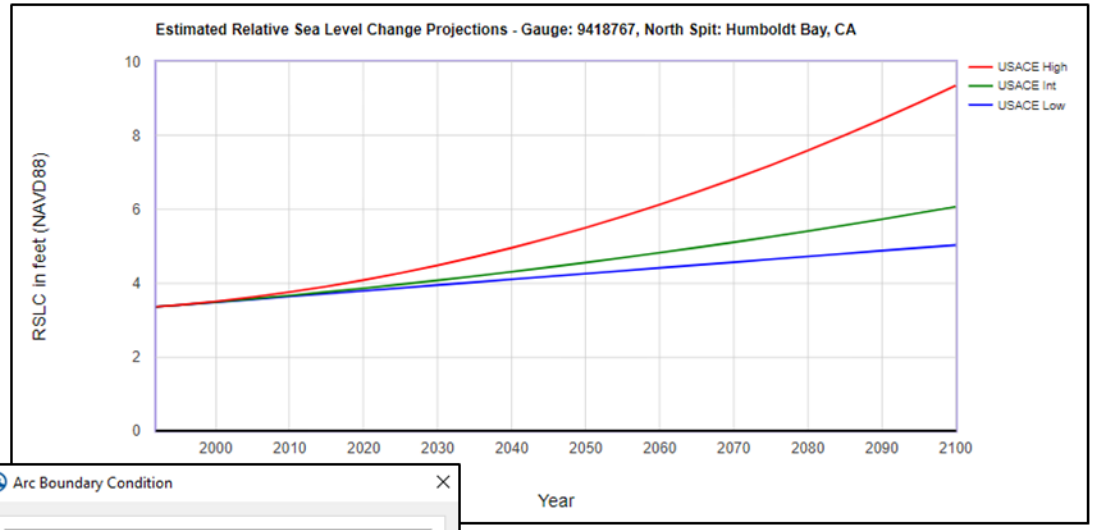






Creation of DMI for Sea-level change into SMS 13.0

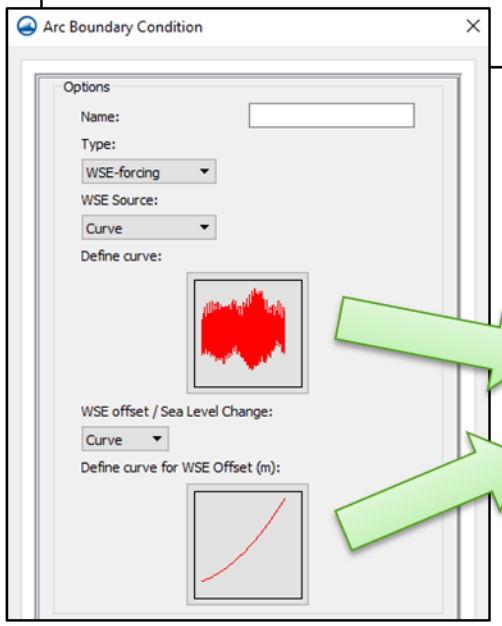
http://corpsmapu.usace.army.mil/rccinfo/slc/slcc_calc.html

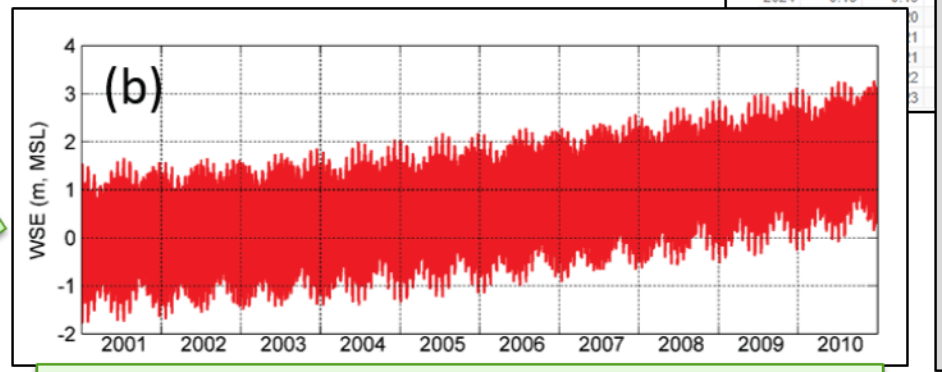


Print Curves

Long-term Morphology Simulation
9418767, North Spit: Humboldt Bay, CA
NOAA's Regional Rate: 0.00513 meters/yr
All values are expressed in meters relative to LMSL

Year	USACE Low	USACE Int	USACE High
2000	0.04	0.04	0.05
2001	0.05	0.05	0.06
2002	0.05	0.05	0.06
2003	0.06	0.06	0.07
2004	0.06	0.07	0.08
2005	0.07	0.07	0.09
2006	0.07	0.08	0.09
2007	0.08	0.08	0.10
2008	0.08	0.09	0.11
2009	0.09	0.10	0.12
2010	0.09	0.10	0.13
2011	0.10	0.11	0.14
2012	0.10	0.11	0.15
2013	0.11	0.12	0.16
2014	0.11	0.13	0.17
2015	0.12	0.13	0.18
2016	0.12	0.14	0.19
2017	0.13	0.14	
2018	0.13	0.15	
2019	0.14	0.16	
2020	0.14	0.17	
2021	0.15	0.17	
2022	0.15	0.18	
2023	0.16	0.19	
2024	0.16	0.19	
2030	0.20	0.23	0.36
2031	0.20	0.24	0.37
2032	0.21	0.25	0.39
2033	0.21	0.26	0.40
2034	0.22	0.26	0.42
2035	0.22	0.27	0.43
2036	0.23	0.28	0.44
2037	0.23	0.29	0.46
2038	0.24	0.29	0.48
2039	0.24	0.30	0.49
2040	0.25	0.31	0.51
2041	0.25	0.32	0.52
2042	0.26	0.32	0.54
2043	0.26	0.33	0.56
2044	0.27	0.34	0.57
2045	0.27	0.35	0.59
2046	0.28	0.36	0.61
2047	0.28	0.36	0.62
2048	0.29	0.37	0.64
2049	0.29	0.38	0.66
2050	0.30	0.39	0.68
2051	0.30	0.40	0.70
2052	0.31	0.41	0.72
2066	0.38	0.53	1.00
2067	0.39	0.54	1.02
2068	0.39	0.55	1.04
2069	0.40	0.56	1.07
2070	0.40	0.56	1.09
2071	0.41	0.57	1.11
2072	0.41	0.58	1.13
2073	0.42	0.59	1.16
2074	0.42	0.60	1.18
2075	0.43	0.61	1.20
2076	0.43	0.62	1.23
2077	0.44	0.63	1.25
2078	0.44	0.64	1.28
2079	0.45	0.65	1.30
2080	0.45	0.66	1.33
2081	0.46	0.67	1.35
2082	0.46	0.68	1.38
2083	0.47	0.69	1.40
2084	0.47	0.70	1.43
2085	0.48	0.71	1.45
2086	0.48	0.72	1.48
2087	0.49	0.73	1.51
2088	0.49	0.74	1.53





Effective WSE forcing with SLC curve

SLC is incorporated in the CMS through application of a constant value or a time-series curve within the SMS framework.

SLC/WL Offset is applicable to the *WSE-forcing* open boundary type specified as a WSE *Curve* or by *Tidal Constituents* in the CMS.

Scheduling dredging/placement during simulation

Issue: How to simulate a long time-period during which a navigation channel or other area was dredged and material placed in a new location?

Previous Solution:

1. Start the simulation and stop just before the material was moved.
2. Modify grid bathymetry as indicated by dredge/placement event.
3. Start a new simulation with the new bathymetry until desired end time.
4. Combine solution datasets and evaluate.

New Solution:

1. Use CMS with the Dredge Module interface in SMS 13.0.9+
   - Dredge/Placement areas are pre-defined and triggered by one of multiple methods.

Implementation of Dredge Module into SMS 13.0

Enable Dredge Module

Name:
CapitolDredge

Dredging Update Interval (Explicit scheme only)
0.0 seconds

Dredge Dataset
Select DredgeArea

Dredge Method
Specified Cell
Note: A dredging starting point is defined by a specified cell ID and progresses to cells farther
5292 Enter Cell ID for starting cell

Dredge Rate
10000.0
m^3/day

Trigger
Method:
Depth
Note: Dredging is triggered when the depth of a cell in the source area exceeds a depth thresh
Trigger Depth and Units
6.0 Enter depth beyond which dredging begins.
m

Distribution
Percent
Note: A percentage of the dredge material is assigned for each placement area.
The percentages of all placements must sum up to 100.

Define Placement Area 1

Placement Area 1

Placement Dataset
Select PlacementArea

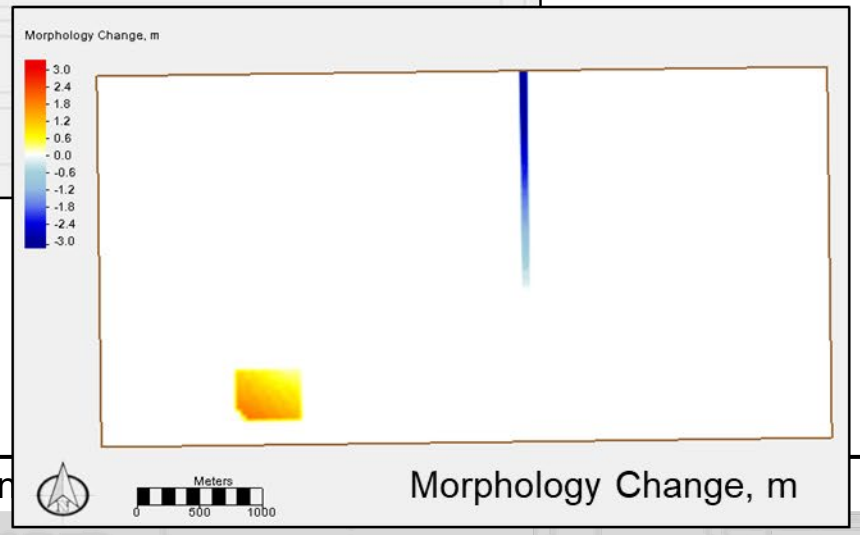
Placement Method
Specified Cell
Note: The dredge material is placed starting at the user-specified point.
2679 Enter Cell ID for starting cell

Distribution Percentage
100.0 Enter percentage of material from Dredge Area placed in Placement Area 1

Choose Method for Limits on Placement in this Placement Area
Depth
3.0 m
Enter the depth below water surface that material placement cannot exceed.

Define Placement Area 2

Define Placement Area 3



Morphology Change, m

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Creation of multiple Sediment Management Alternatives

Issue: How to define multiple alternatives which incorporate various sediment removal/placement sites with defined volumes?

Current Solution:

1. Create multiple grids based on initial bathymetry.
2. For each grid, select cells in areas of removal/placement and hand-enter values for depth to get as close to the desired volumes as possible.
3. Repeat steps as needed for each area.
4. Save and move on to next grid.
   - This is very tedious to get the exact desired volumes.

New Solution (SMS 13.1):

1. Use SMS Sediment Volume Operations tool to define the areas and to assign the exact volumes/depth desired.
2. Confirm the quantities from a table.
3. Click a button to create a new grid based on the initial grid.

Sediment Volume Operations tool coming in SMS 13.1

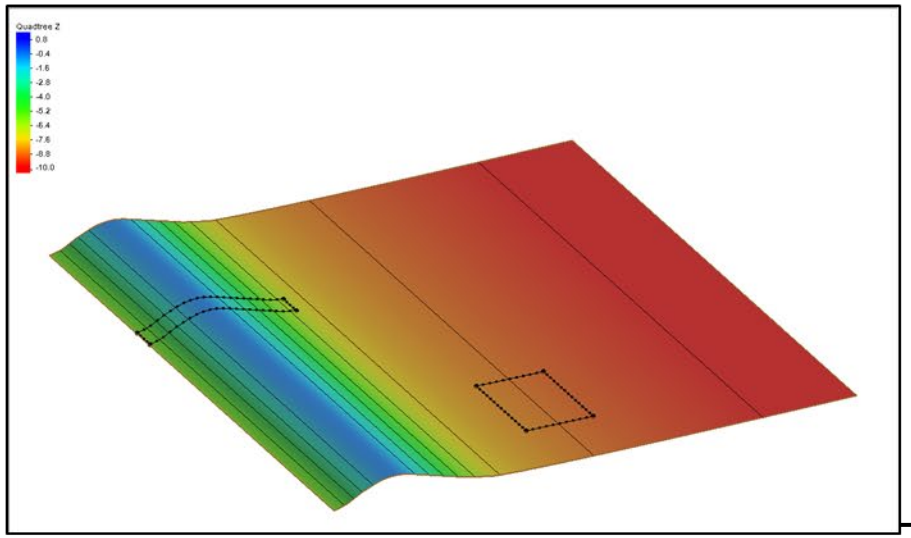
Mass Balance Table

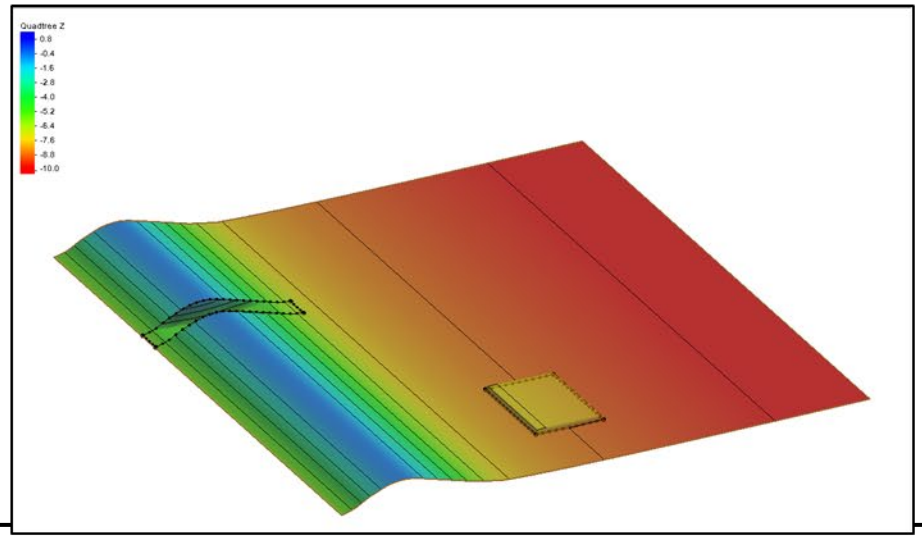
Mass Balance Table

	Name	ID	Polygon type	Cut / fill type	Value	Priority	Priority %	Total (m^3) based on slope	Required (m^3)	Available (m^3)	Cut (m^3)	Fill (m^3)
1	Channel	2	Specified cut region	Constant elevation (m)	-5			1.03508e+6	(350078)		(350078)	
2	Placement	1	Available fill region	Relative thickness (m)	5	1	100	3.78217e+6		1.60559e+6		350078
3										**Sum**	(350078)	350078
4										**Net**	0	0

Sort/Normalize | Compute | Save to File...

Help...





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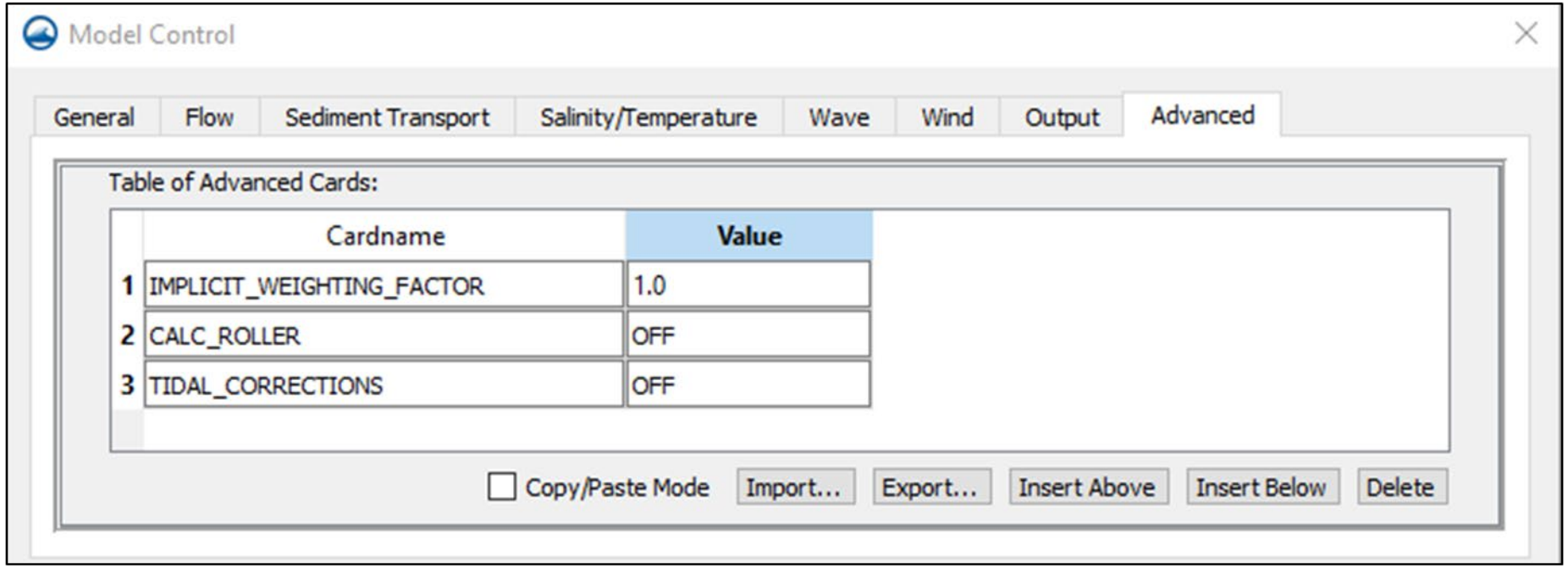
Reintroduction of CMS Advanced Cards to SMS 13.1

One feature widely used in CMS applications was the Advanced Card tab. This allowed the user to quickly add cards that SMS does not presently understand. It was useful when loading older CMS grids into newer SMS version.

With the DMI and Python scripts, we are adding this feature back to SMS starting in Version 13.1.



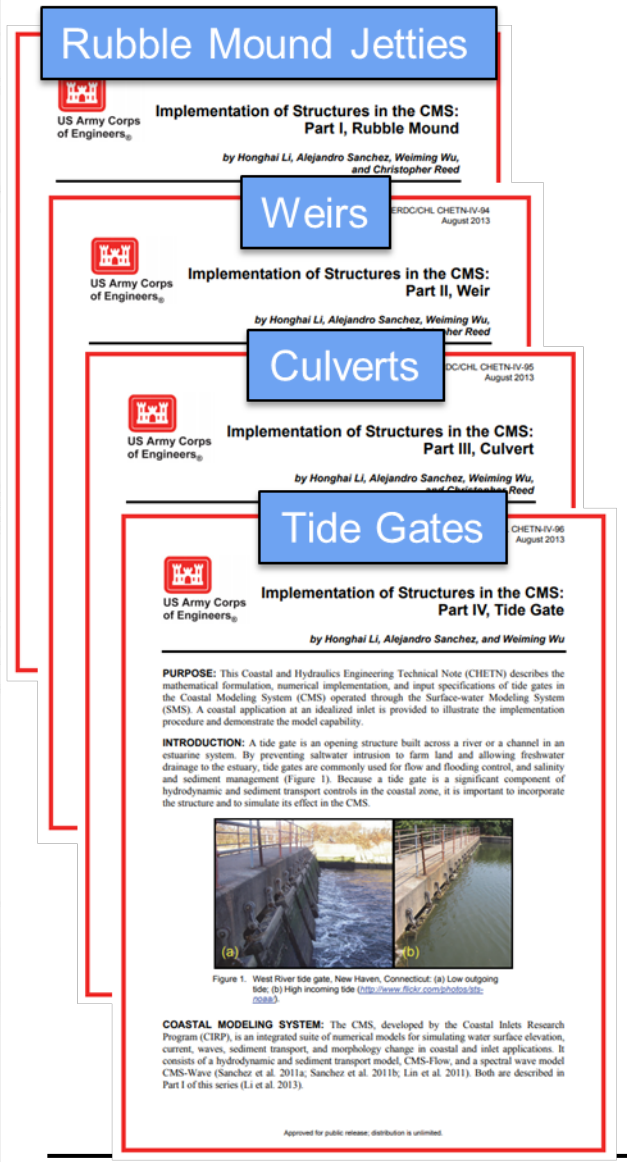
Creation of DMI for CMS Structure types in SMS 13.1

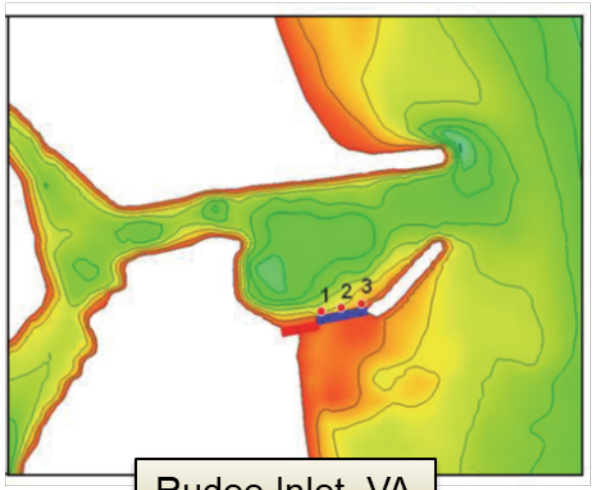
Rubble Mound Jetties

Weirs

Culverts

Tide Gates

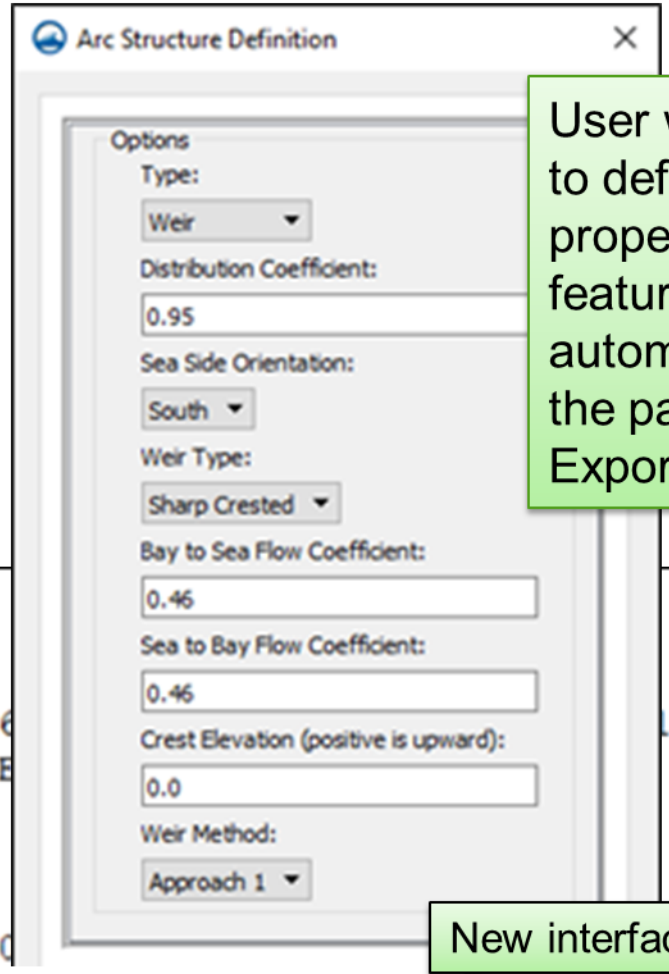




Rudee Inlet, VA

```
1  WEIR_BEGIN
2    NUMBER_WEIRS 2
3    NUM_CELL_WEIRS 8 8
4    CELLS 16864 16865 1686
5    DISTRIBUTION_COEFFICIE
6    ORIENTATION 3 3
7    TYPE 2 2
8    FLOW_COEFFICIENT 0.46
9    CREST_ELEVATION 0.0 -0
10   METH 1 1
11 WEIR_END
12
```

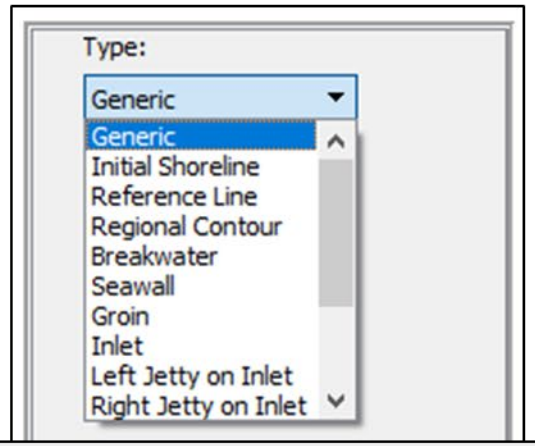
Old method

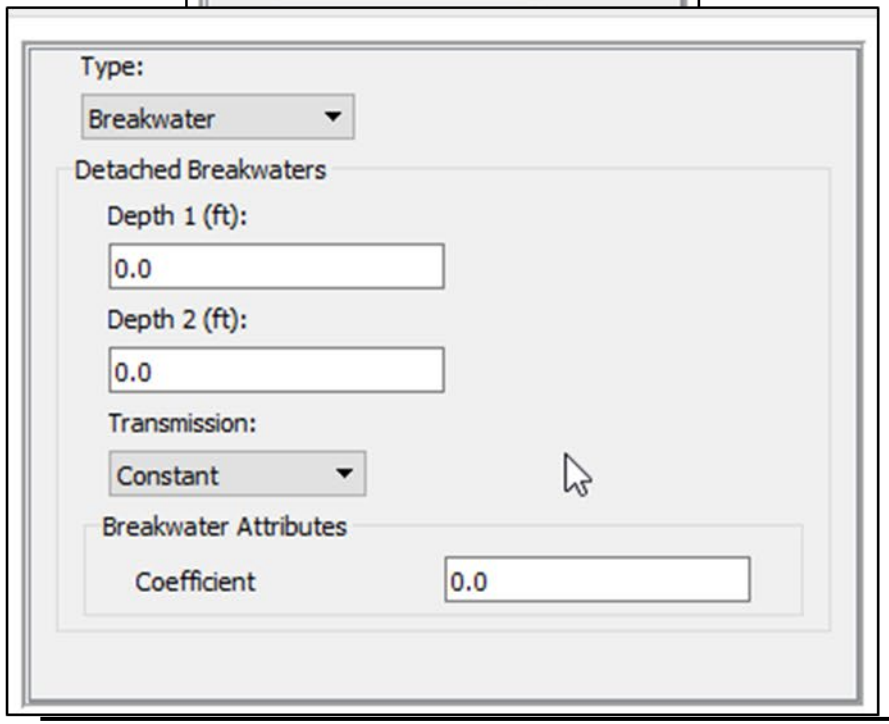


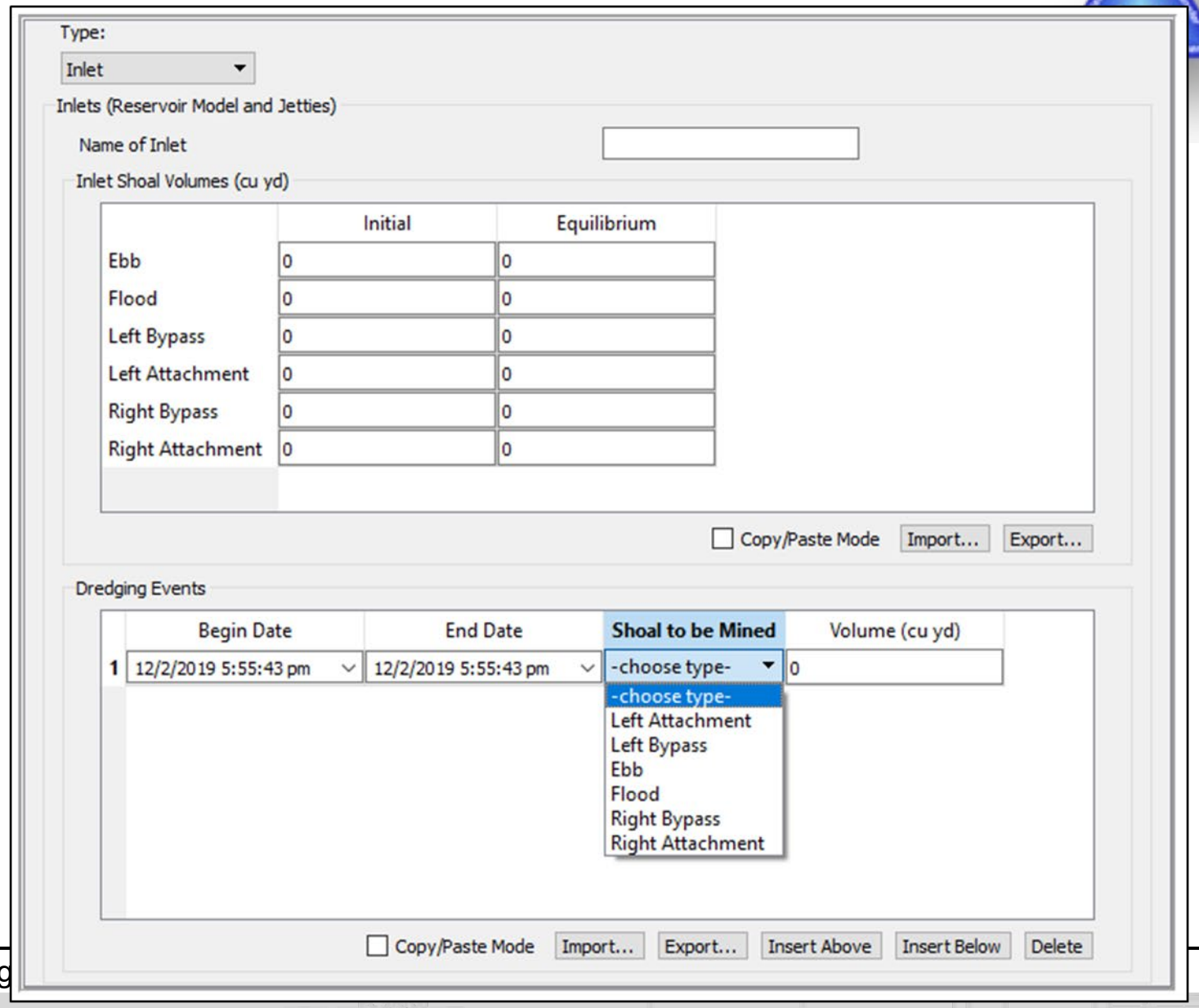
User will have an interface to define the weir and all properties assigned to feature arcs. Information will automatically get written to the parameter file upon Export.

New interface

Next steps – Finish DMI for GenCade

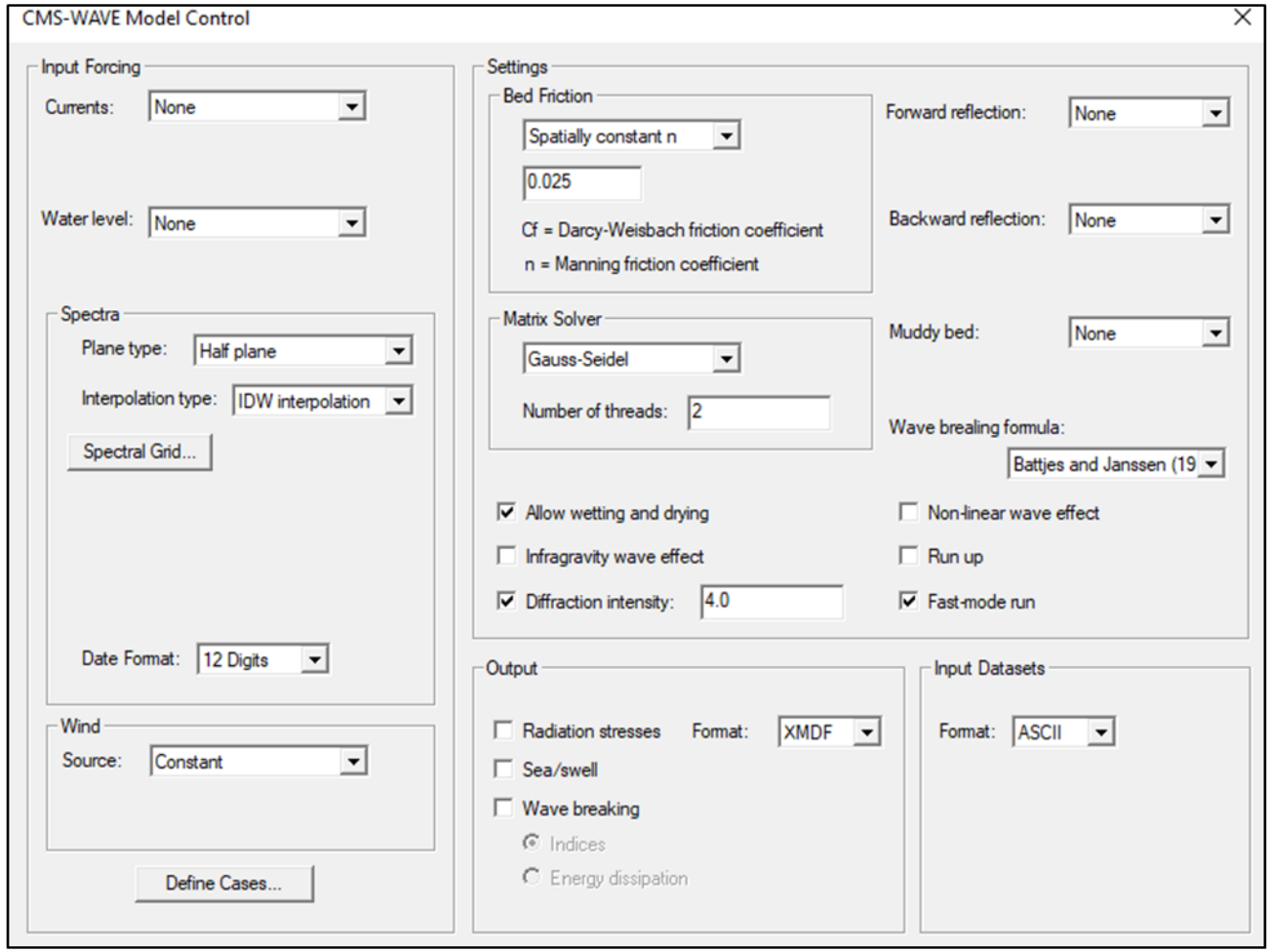


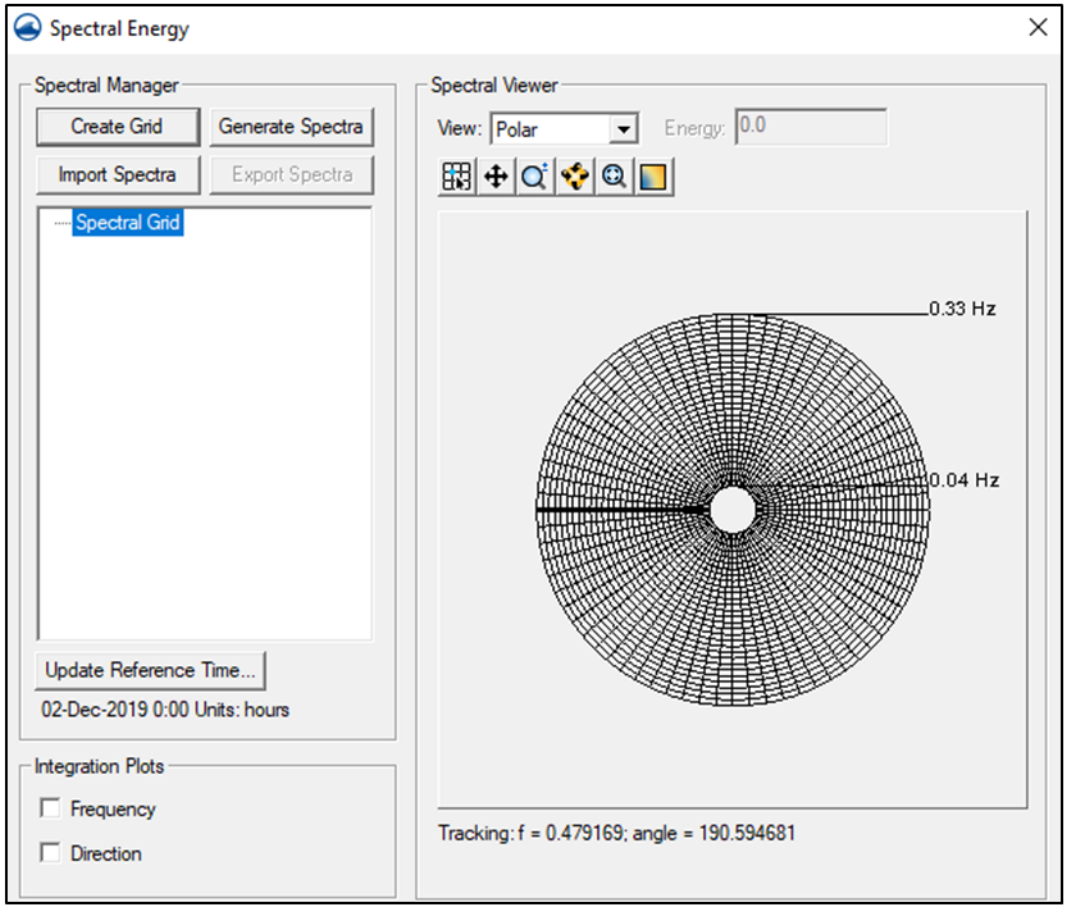




Next steps – Start DMI for CMS-Wave

CMS-Wave is still using the same static interface as much older versions of SMS (11.2 and previous) and is in need of updating.





What's Next?

FY20 –

- Finish remaining Structure types (Tide Gate, Culverts) with DMI interfaces
- Learn more about Python scripting combined into DMI
- Additional interfaces to be defined:
  - Sediment Mapping
  - Cross-shore sediment option/parameters
- CMS source code modified to support NetCDF input/output
- Creation of larger suite of test cases for VV/UQ of CMS-Flow and CMS-Wave

Thank You!

Questions?