Marsh Model- Output analysis

Karinna Nunez

Outline

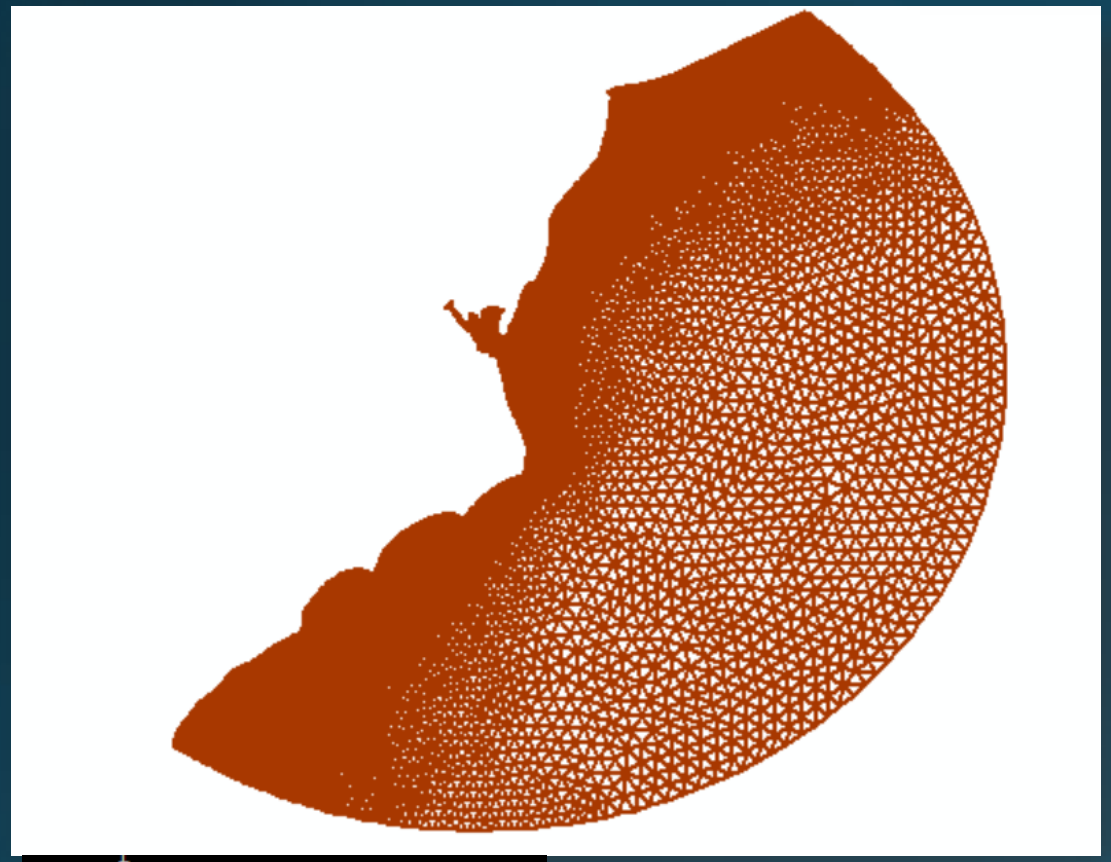
- Evaluation of the Grid
- Revision of the parameters (configuration, physical & numerical parameters)
- Review output format options

Comparison of the final spatial marsh distribution with the different physical outputs

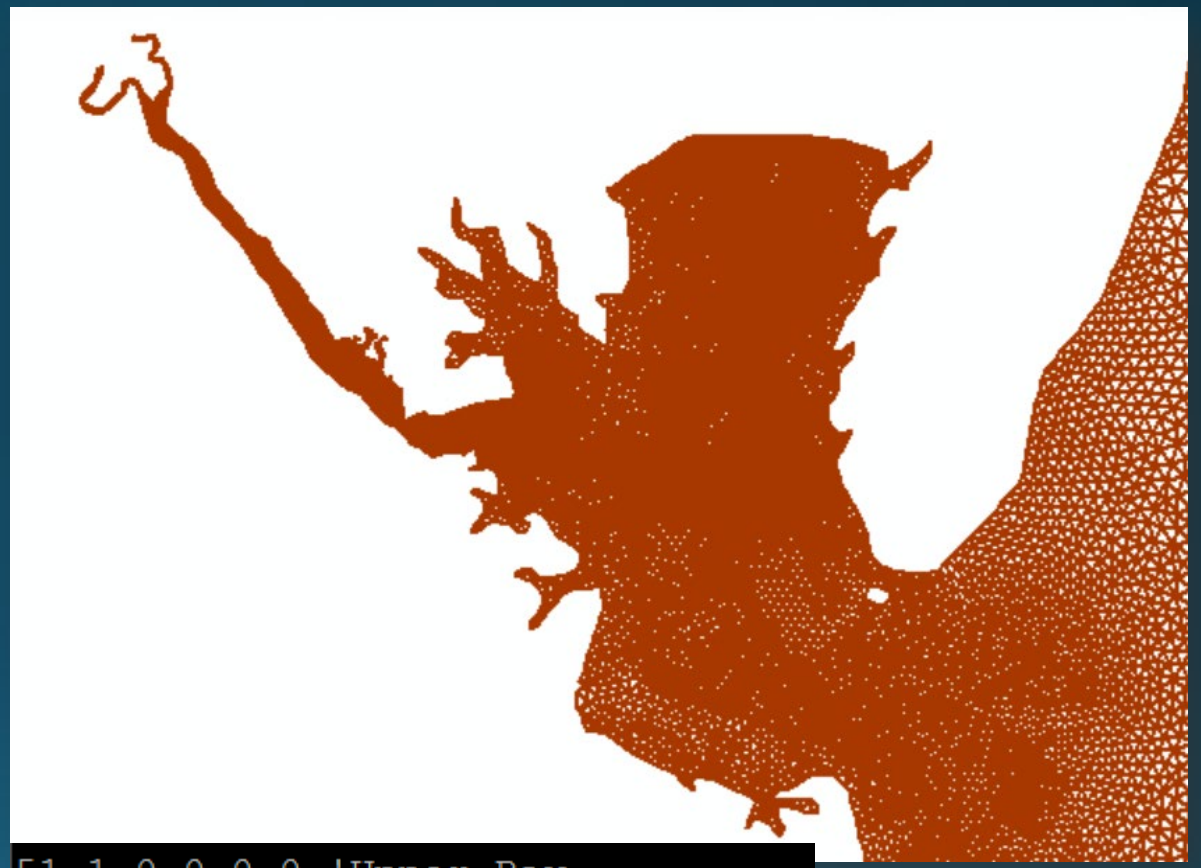
- Questions/Discussion

Grid

4 open boundaries: Ocean, Bay, Mattaponi River, & Pamunkey River

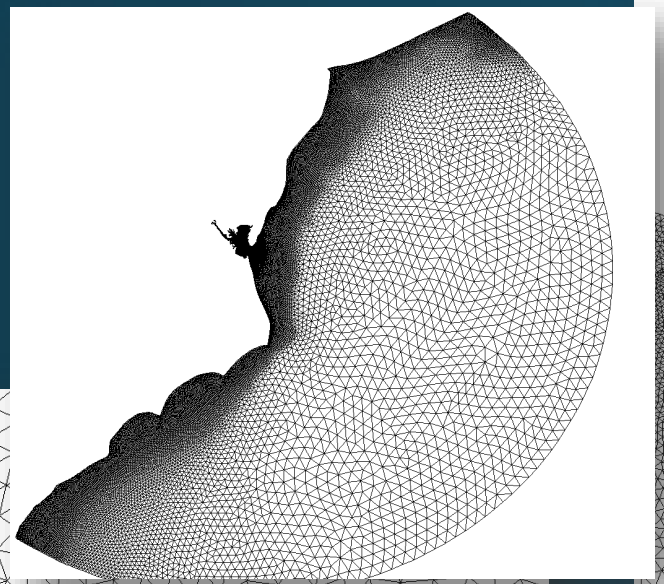


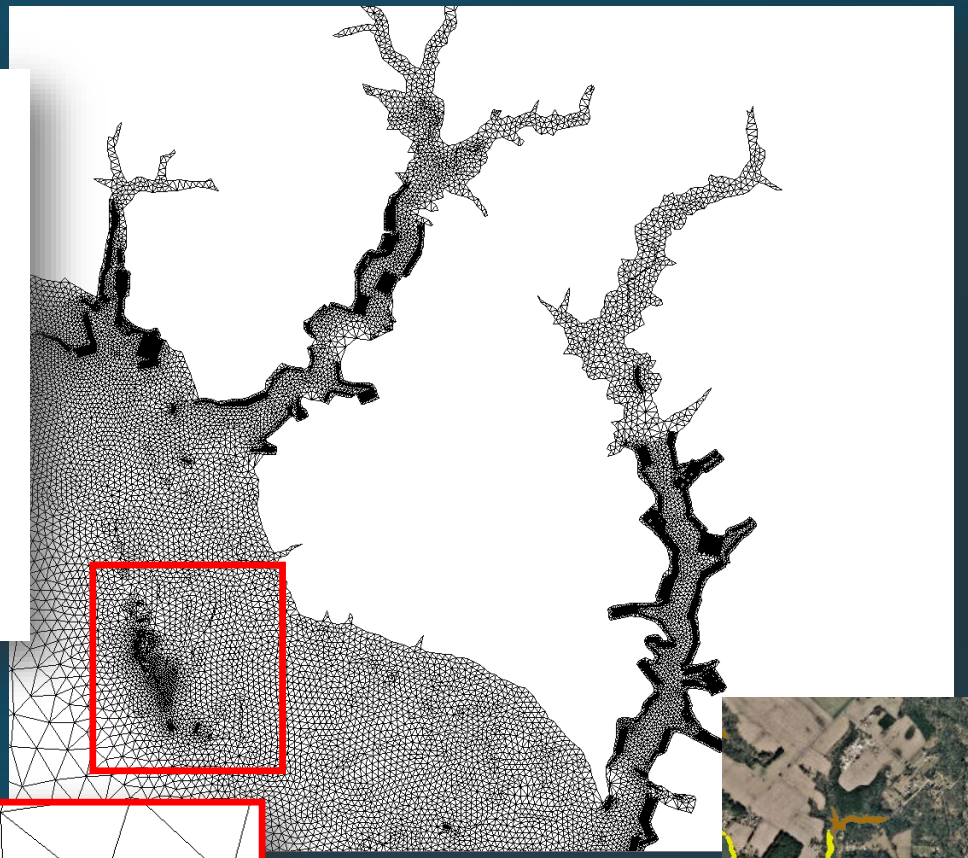
```
222  5  0  0  0  0  ! ocean
```

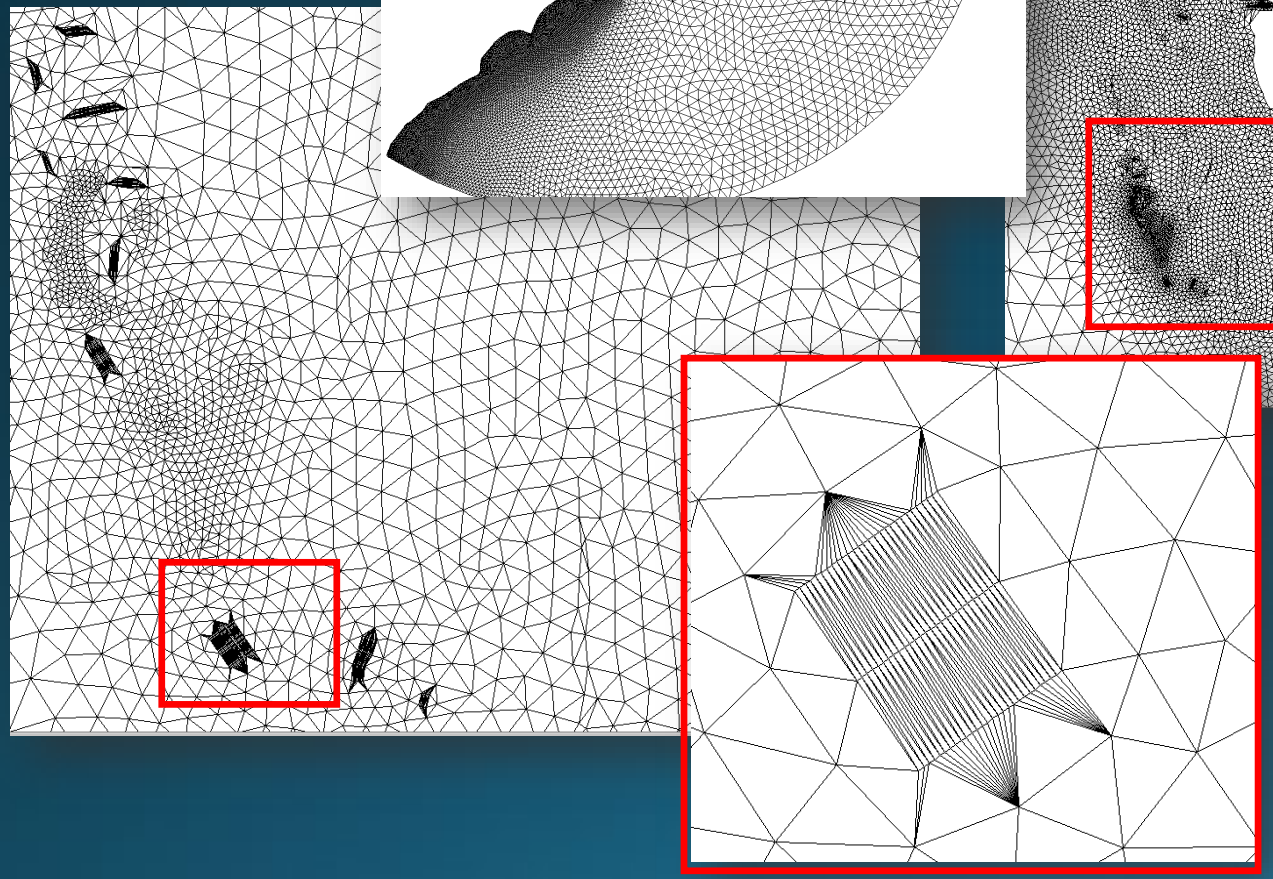


```
51  1  0  0  0  0  !Upper Bay
2  0  1  0  0  2  !Mat. River (York 1)
0.  0.  0.
1.
2  0  1  0  0  2  !Pam. River (York 2)
0.  0.  0.
1.
```

Grid







param.in - Model Configuration Parameters

```
!------------------------------------------------------------------
! If WWM is used, set coupling/decoupling flag. Not used if USE_WWM is distabled in Makefile
!       0: decoupled so 2 models will run independently;
!       1: full coupled (elevation, vel, and wind are all passed to WWM);
!       2: elevation and currents in wwm, no wave force in selfe;
!       3: no elevation and no currents in wwm, wave force in selfe;
!       4: elevation but no currents in wwm, wave force in selfe;
!       5: elevation but no currents in wwm, no wave force in selfe;
!       6: no elevation but currents in wwm, wave force in selfe;
!       7: no elevation but currents in wwm, no wave force in selfe;
! Note that all these parameters must be present in this file (even though not used).
!------------------------------------------------------------------
  icou_elfe_wwm = 1
  nstep_wwm = 4 !call WWM every this many time steps. If /=1, consider using quasi-steady mode in WWM
  iwbl = 0 !1: modified Grant-Madsen formulation for wave boundary layer; used only if icou_elfe_wwm/=0; if icou_elfe_wwm=0, set iwbl=0
  msc2 = 24 !same as MSC in .nml ... for consitency check between SELFE and WWM-II
  mdc2 = 30 !same as MDC in .nml
  hmin_radstress = 1. !min. total water depth used only in radiation stress calculation [m]
```

param.in - Model Configuration Parameters

```
!-------------------------------------------------------------------
! Define # of tracers in each module (if enabled)
!-------------------------------------------------------------------
  sed_class = 3

!-------------------------------------------------------------------
! Bed deformation option (0: off; 1: vertical deformation only; 2: 3D bed deformation).
! If imm=1, bdef.gr3 is needed; if imm=2, user needs to update depth info etc
! in the code (not working for ics=2 yet).
!-------------------------------------------------------------------
  imm = 0
! ibdef = 10 !needed if imm=1; # of steps used in deformation
```

```
-------------------------------------------------------------------
Point sources/sinks option (0: no; 1: on). If =1, needs source_sink.in,
vsource,th, vsink.th, and msource.th
-------------------------------------------------------------------
if_source = 1
```

param.in - Model Configuration Parameters

```
!------------------------------------------------------------------
! Baroclinic/barotropic option. If ibcc=0 (baroclinic model), itransport is not used.
!------------------------------------------------------------------
 ibcc = 1 !Baroclinic option
 itransport = 1
 nrampbc = 0 !ramp-up flag for baroclinic force
 drampbc = 1. !not used if nrampbc=0
```

```
------------------------------------------------------------------
 Hydraulic model option. If ihydraulics/=0, hydraulics.in
 is required. This option cannot be used with non-hydrostatic model.
------------------------------------------------------------------
 ihydraulics = 0
```

param.in – Physical Parameters

```
!------------------------------------------------------------------
! Bottom friction.
!          bfric=0: drag coefficients specified in drag.gr3; bfric=-1: Manning's
!          formulation (even for 3D prisms).
!          bfric=1: bottom roughness (in meters) specified in rough.gr3 (and in this case, negative
!          or 0 depths in rough.gr3 indicate time-independent Cd, not roughness!).
!          Cd is calculated using the log law, when dzb>=dzb_min; when dzb<dzb_min,
!          Cd=Cdmax*exp[dzb_decay*(1-dzb/dzb_min)], where Cdmax=Cd(dzb=dzb_min),
!          and dzb_decay (<=0) is a decay const specified below.
!          If iwbl=1, bfric must =1.
!------------------------------------------------------------------
  bfric = 1 !nchi in code
  dzb_min = 0.5 !needed if bfric==1; min. bottom boundary layer thickness [m].
  dzb_decay = 0. !needed if bfric=1; a decay const. [-]
!  hmin_man = 1. !needed if bfric=-1: min. depth in Manning's formulation [m]
```

param.in – Numerical Parameters

```
!-------------------------------------------------------------------
 Initial condition for T,S. This value only matters for ihot=0 (cold start).
 If ic_*=1, the initial T,S field is read in from temp.ic and salt.ic (horizontally varying).
 If ic_*=2, the initial T,S field is read in from ts.ic (vertical varying).
 If ihot=0 && ic_*=2 || ibcc_mean=1, ts.ic is used for removing mean density profile.
!-------------------------------------------------------------------
  ic_TEM = 1
  ic_SAL = 1 !must be same as ic_TEM
```

```
!-------------------------------------------------------------------
! Methods for computing velocity at nodes.
! If indvel=0, conformal linear shape function is used; if indvel=1, averaging method is used.
! For indvel=0, Shapiro filter is used for side velocity.
!-------------------------------------------------------------------
  indvel = 1
  ishapiro = 0
  shapiro = 0.5 !default is 0.5
```

param.in

Outputs

```
!--------------------------------------------------------------------
! Global output options.
!--------------------------------------------------------------------
  nspool = 720 !output step spool
  ihfskip = 3600 !stack spool; every ihfskip steps will be put into 1_*, 2_*, etc...

  elev.61 = 1 !0: off; 1: on - elev. [m]
  pres.61 = 1 !air pressure [Pa]
  airt.61 = 0 !air temperature [C]
  shum.61 = 0 !Specific humidity [-]
  srad.61 = 0 !solar (shortwave) radiation [W/m/m]
  flsu.61 = 0 !sensible flux (positive upward) [W/m/m]
  fllu.61 = 0 !latent heat flux (positive upward) [W/m/m]
  radu.61 = 0 !upward longwave radiation (positive upward) [W/m/m]
  radd.61 = 0 !downward longwave radiation (positive downward) [W/m/m]
  flux.61 = 0 !total flux=-flsu-fllu-(radu-radd) [W/m/m]
  evap.61 = 0 !evaporation rate [kg/m/m/s]
  prcp.61 = 0 !precipitation rate [kg/m/m/s]
  bdrc.61 = 0 !Bottom drag coefficient [-]
  wind.62 = 1 !wind speed [m/s]
  wist.62 = 0 !wind stress [m^2/s/s]
  dahv.62 = 1 !depth-averaged vel. [m/s]
  vert.63 = 0 !vertical velocity [m/s]
  temp.63 = 0 !water temperature [C]
  salt.63 = 0 !water salinity [PSU]
  conc.63 = 0 !water density [kg/m^3]
  tdff.63 = 0 !eddy diffusivity [m^2/s]
  vdff.63 = 0 !eddy viscosity [m^2/s]
  kine.63 = 0 !turbulent kinetic energy
  mixl.63 = 0 !turbulent mixing length [m]
  zcor.63 = 1 !z-coordinates [m]
  qnon.63 = 0 !non-hydrostatic pressure
  hvel.64 = 0 !horizontal vel. [m/s]
```

param.in

Outputs

```
!-----------------------------------------------------------------------
! Outputs from WWM (USE_WWM must be on in Makefile)
!-----------------------------------------------------------------------
 wwm_1.61  = 1 !sig. height (m)
 wwm_2.61  = 0 !Mean average period (sec) - TM01
 wwm_3.61  = 1 !Zero down crossing period for comparison with buoy (s) - TM02
 wwm_4.61  = 0 !Average period of wave runup/overtopping - TM10
 wwm_5.61  = 0 !Mean wave number (1/m)
 wwm_6.61  = 0 !Mean wave length (m)
 wwm_7.61  = 1 !Mean average energy transport direction (deg)
 wwm_8.61  = 0 !Mean directional spreading (deg)
 wwm_9.61  = 0 !Discrete peak period (sec)
 wwm_10.61 = 1 !Continuous peak period (Tp) based on higher order moments (sec)
 wwm_11.61 = 0 !Peak phase vel. (m/s)
 wwm_12.61 = 0 !Peak n-factor [-]
 wwm_13.61 = 0 !Peak group vel. (m/s)
 wwm_14.61 = 0 !Peak wave number (1/m)
 wwm_15.61 = 0 !Peak wave length (m)
 wwm_16.61 = 1 !Peak (dominant) wave direction (degr) ... some buoys record this
 wwm_17.61 = 0 !Peak directional spreading (deg) ... some buoys record this
 wwm_18.61 = 0 !Discrete peak direction (deg) ... some buoys record this
 wwm_19.61 = 0 !Orbital vel. (m/s)
 wwm_20.61 = 0 !RMS orbital vel. (m/s)
 wwm_21.61 = 0 !Bottom excursion period (sec)
 wwm_22.61 = 0 !bottom wave period (sec)
 wwm_23.61 = 0 !Ursell number based on peak period
 wwm_24.61 = 0 !none
 wwm_25.62 = 0 !Etot energy vector (m^2)
 wwm_26.62 = 0 !none
```

param.in - Outputs

```
-------------------------------------------------------------------
 Specific outputs in SED3D (USE_SED must be on in Makefile;
 otherwise these are not needed)
-------------------------------------------------------------------
 SED_1.63 = 1 !conc. of 1st class (one output need by tracer)
 SED_2.63 = 1
 SED_3.63 = 1
 SED_bfrac_1.61 = 0 ! Bed fraction 1st tracer (one output need by tracer)
 SED_bfrac_2.61 = 0
 SED_bfrac_3.61 = 0
 SED_qbdl_1.62 = 0 ! Bedload transport rate (kg.m-1.s-1) for 1st tracer (one output need by tracer)
 SED_qbdl_2.62 = 0
 SED_qbdl_3.62 = 0

 SED_depth.61 = 1 !bottom depth _change_ from init. condition (m)
 SED_bedd50.61  = 1 ! Bed median grain size in the active layer (mm)
 SED_bstress.61 = 1 ! Bottom shear stress (Pa)
 SED_brough.61  = 1 ! Bottom roughness lenght (mm)
```

sediment.in

```
!=============================================================================
!-                SEDIMENT CHARACTERISTICS FOR EACH CLASS                    -
!-             IN THIS SECTION [1:Ntracers] values expected                  -
!=============================================================================

!- SEDIMENT TYPE - [1:Ntracers] ---------------------------------------------
!- Use to distinguish different sediment behavior:
!- 0 = MUD-like : transport only in suspension, no bedload transport
!- 1 = SAND-like: suspension + bedload with Van Rijn formulations (with limits
!-                on grain size: 0.05 <= D50 < 2.0 mm)
!- 2 = GRAVEL-like: NOT AVAILABLE NOW (only bedload transport expected)
!-
!- IMPORTANT NOTE: if the computation of settling velocity or of critical bed
!- shear stress are activated (comp_ws=1 or comp_tauce=1), computed values
!-  will only be applied to SAND-like classes (SED_TYPE=1). For other types
!- (MUD-like or GRAVEL-like) user-defined values (defined below) will be
!- applied.
!-----------------------------------------------------------------------------
SED_TYPE == 1 1 1


!- D50 MEDIAN SEDIMENT GRAIN DIAMETER (mm) - [1:Ntracers] --------------------
!-----------------------------------------------------------------------------
SAND_SD50 == 0.05d0 0.10d0 0.20d0
```

```
!- D50 MEDIAN SEDIMENT GRAIN DIAMETER (mm) - [1:Ntracers]
!-----------------------------------------------------------
SAND_SD50 == 0.05d0 0.10d0 0.20d0
```

Phi Units*	Size	Wentworth Size Class	Sediment/Rock Name
-8	256 mm	Boulders	Sediment: GRAVEL Rock RUDITES: (conglomerates, breccias)
-6	64 mm	Cobbles	
-2	4 mm	Pebbles	
-1	2 mm	Granules	
0	1 mm	Very Coarse Sand	Sediment: SAND Rocks: SANDSTONES (arenites, wackes)
1	1/2 mm	Coarse Sand	
2	1/4 mm	Medium Sand	
3	1/8 mm	Fine Sand	
4	1/16 mm	Very Fine Sand	
8	1/256 mm	Silt	Sediment: MUD Rocks: LUTITES (mudrocks)
		Clay	

* Udden-Wentworth Scale

Marsh Model Outputs

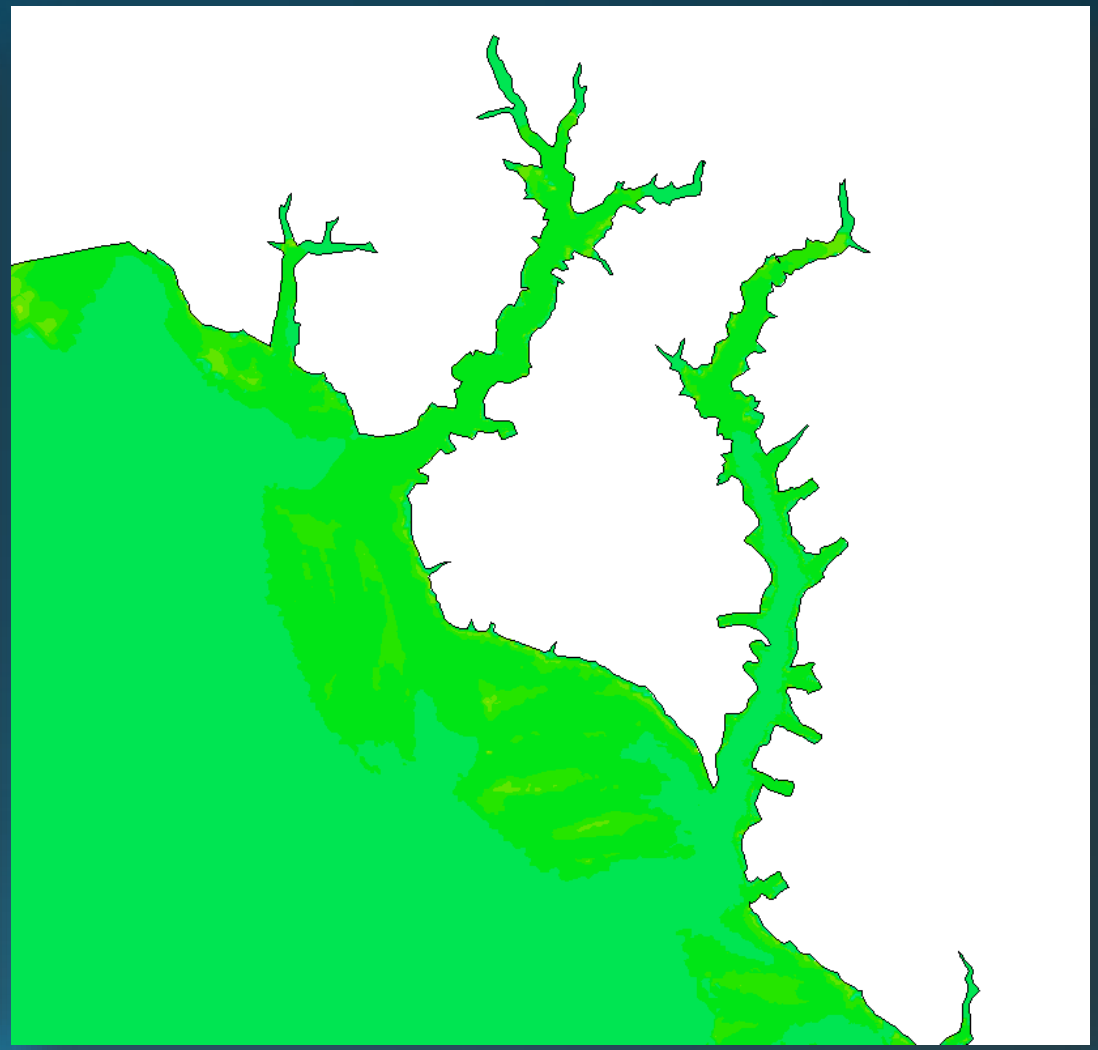
```
1_dahv.62
1_elev.61
1_mrsh.66
1_pres.61
1_SED_1.63
1_SED_2.63
1_SED_3.63
1_SED_bedd50.61
1_SED_brough.61
1_SED_bstress.61
1_SED_depth.61
1_wind.62
1_wwm_10.61
1_wwm_1.61
1_wwm_16.61
1_wwm_3.61
1_wwm_7.61
1_zcor.63
```

```
69_dahv.62
69_elev.61
69_mrsh.66
69_pres.61
69_SED_1.63
69_SED_2.63
69_SED_3.63
69_SED_bedd50.6
69_SED_brough.6
69_SED_bstress.
69_SED_depth.61
69_wind.62
69_wwm_10.61
69_wwm_1.61
69_wwm_16.61
69_wwm_3.61
69_wwm_7.61
69_zcor.63
```

69_mrsh.66

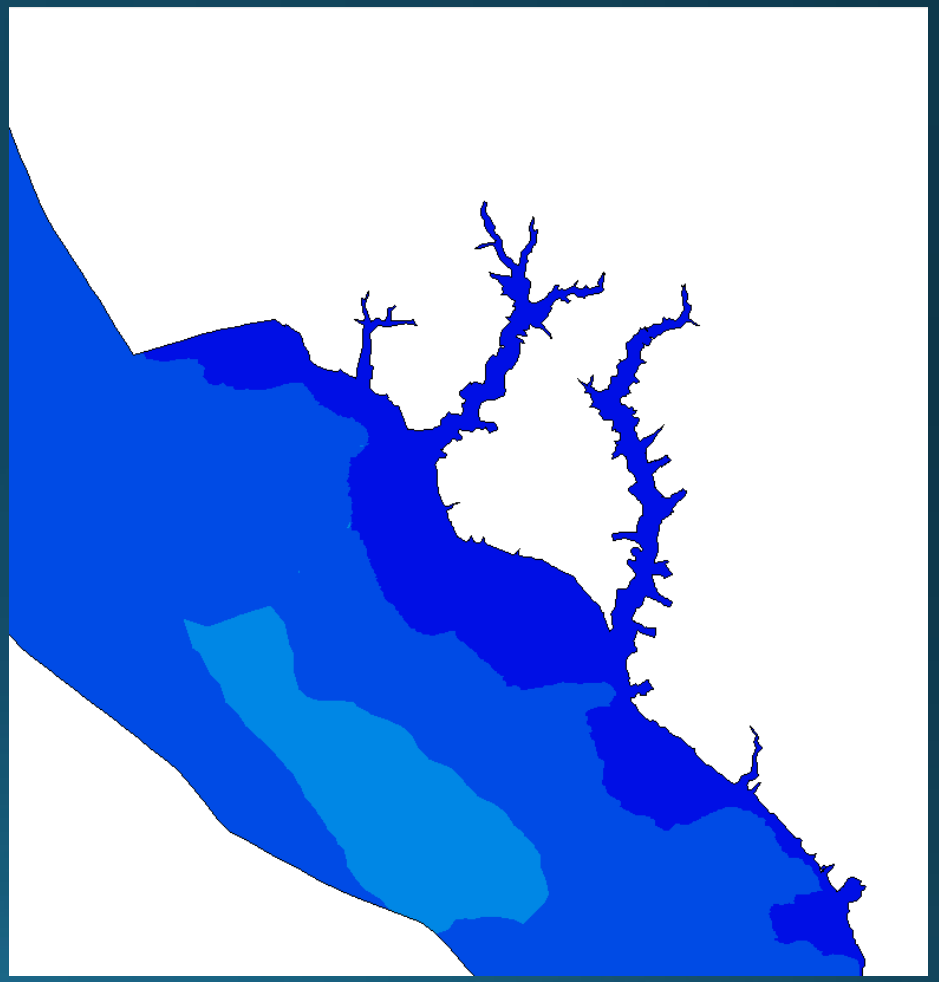
1_mrsh.66 & 69_mrsh.66

Elevation: 69_elev.61



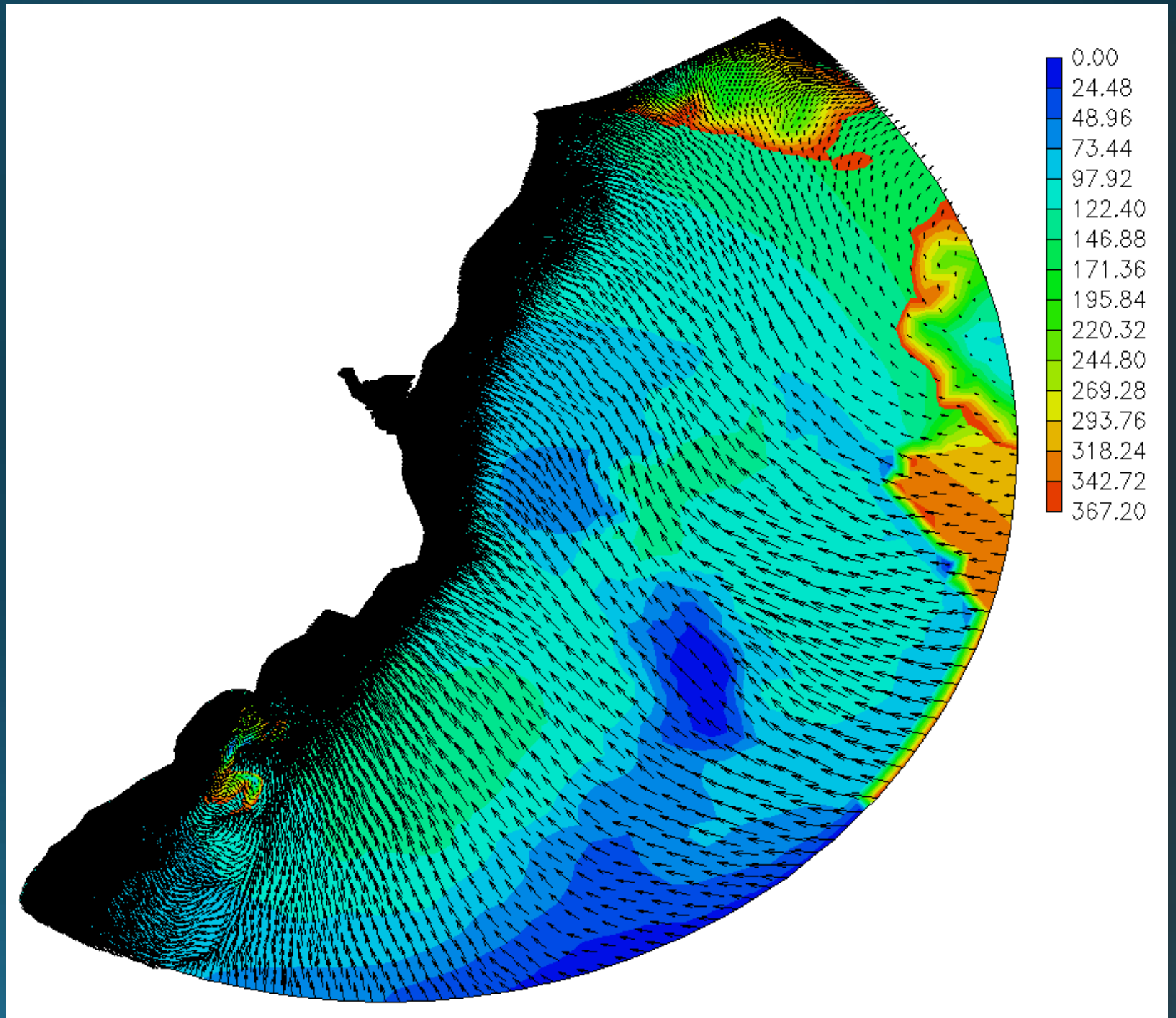
Wave Model

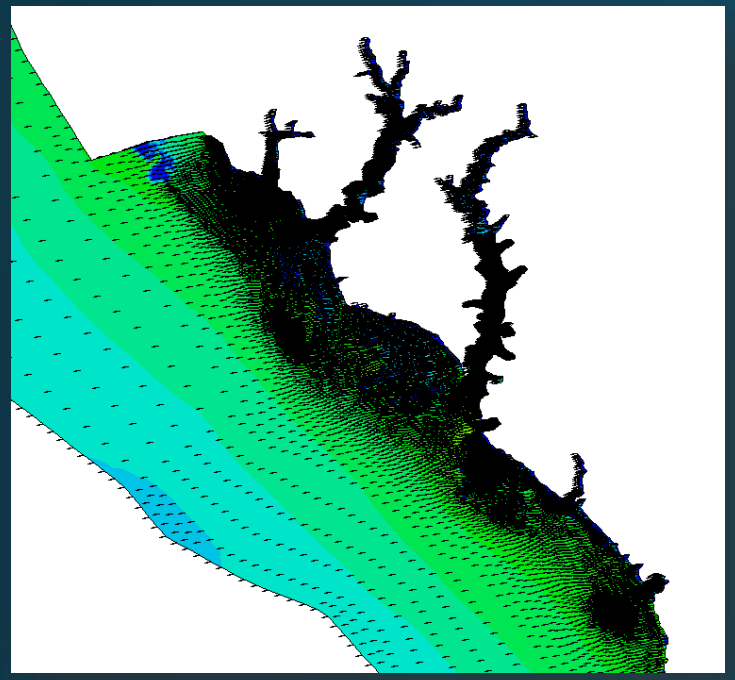
Significant wave height — 69_wwm_1.61

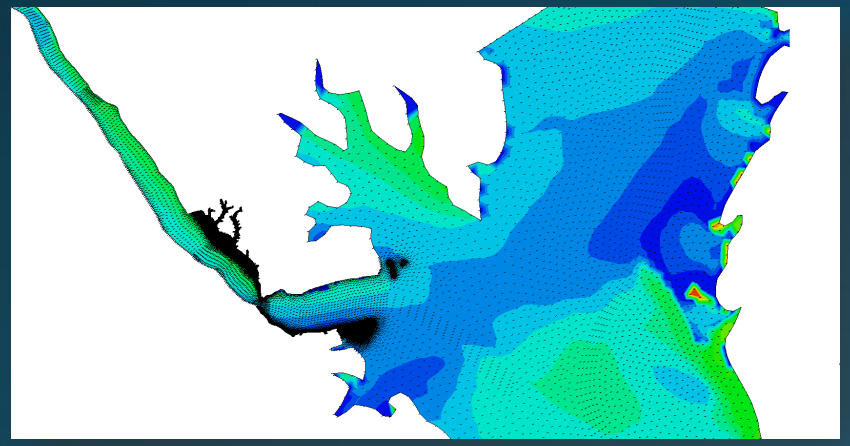


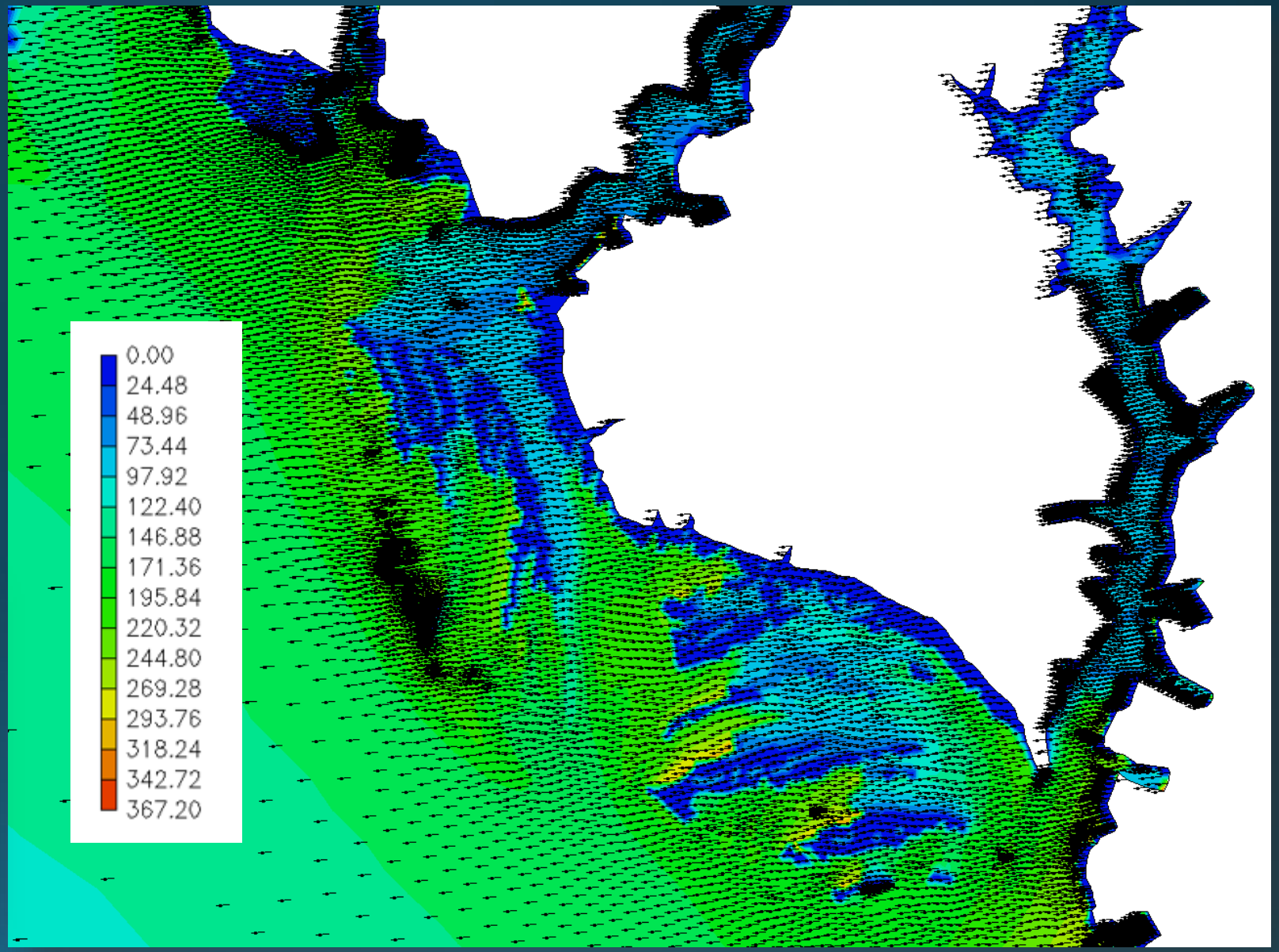
$$H_s = \frac{1}{N/3}\sum_{i=1}^{N/3} H_i$$

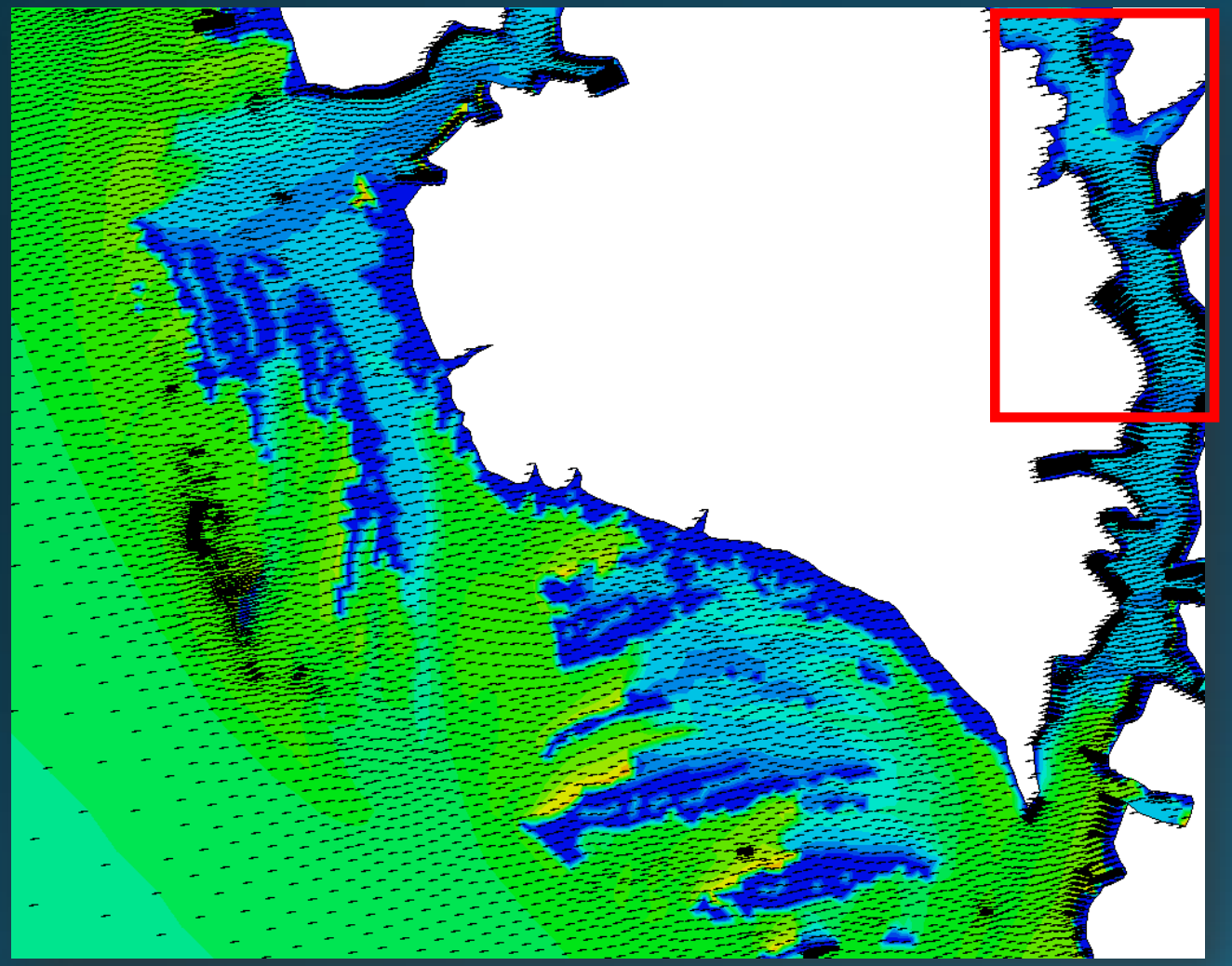
Wind direction
&
Wave direction
(Stack 69)

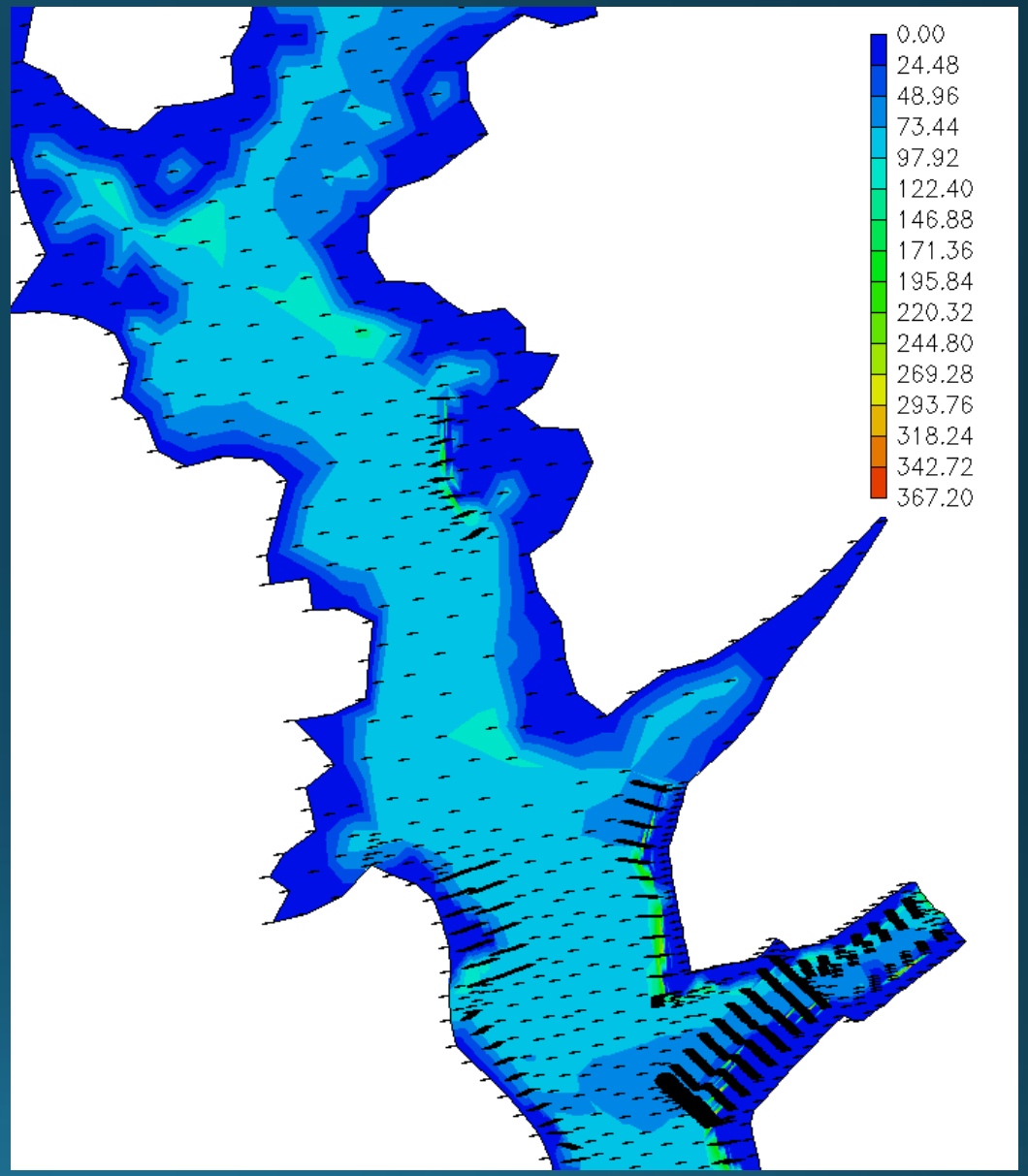


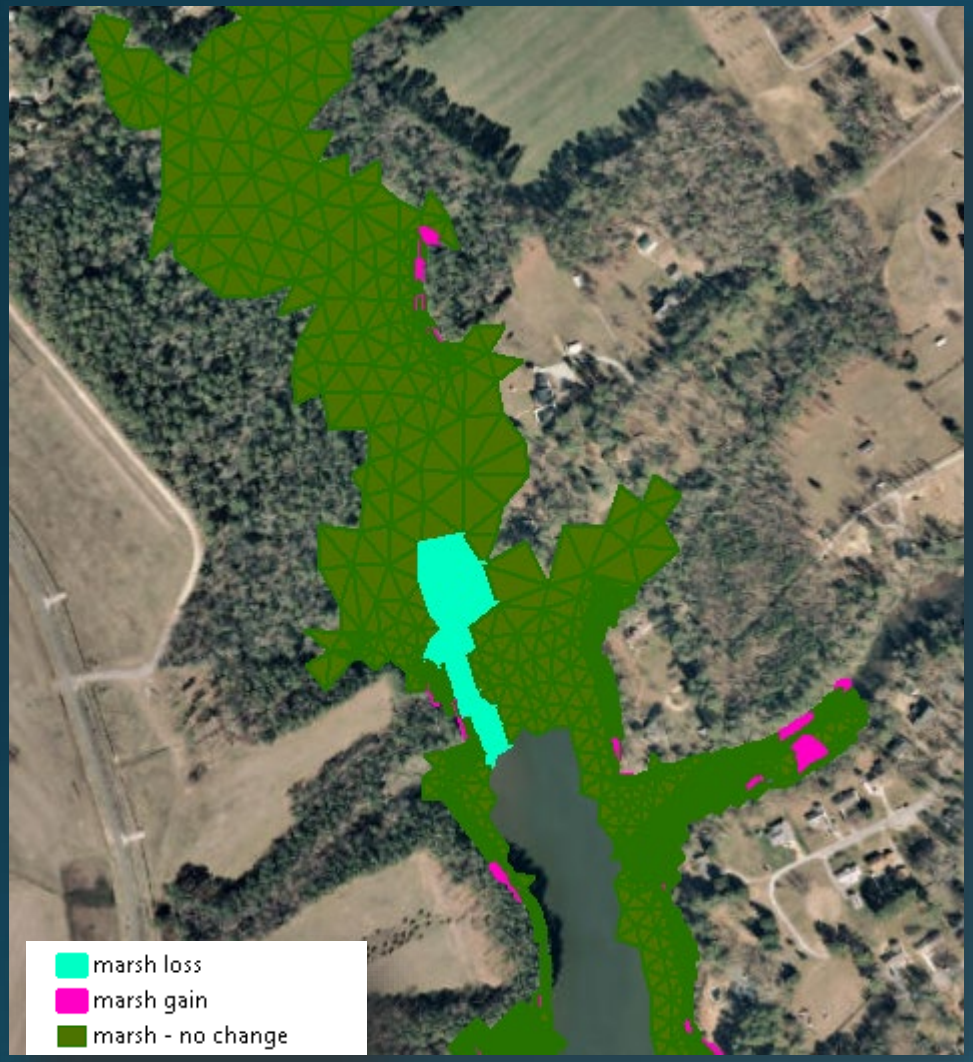


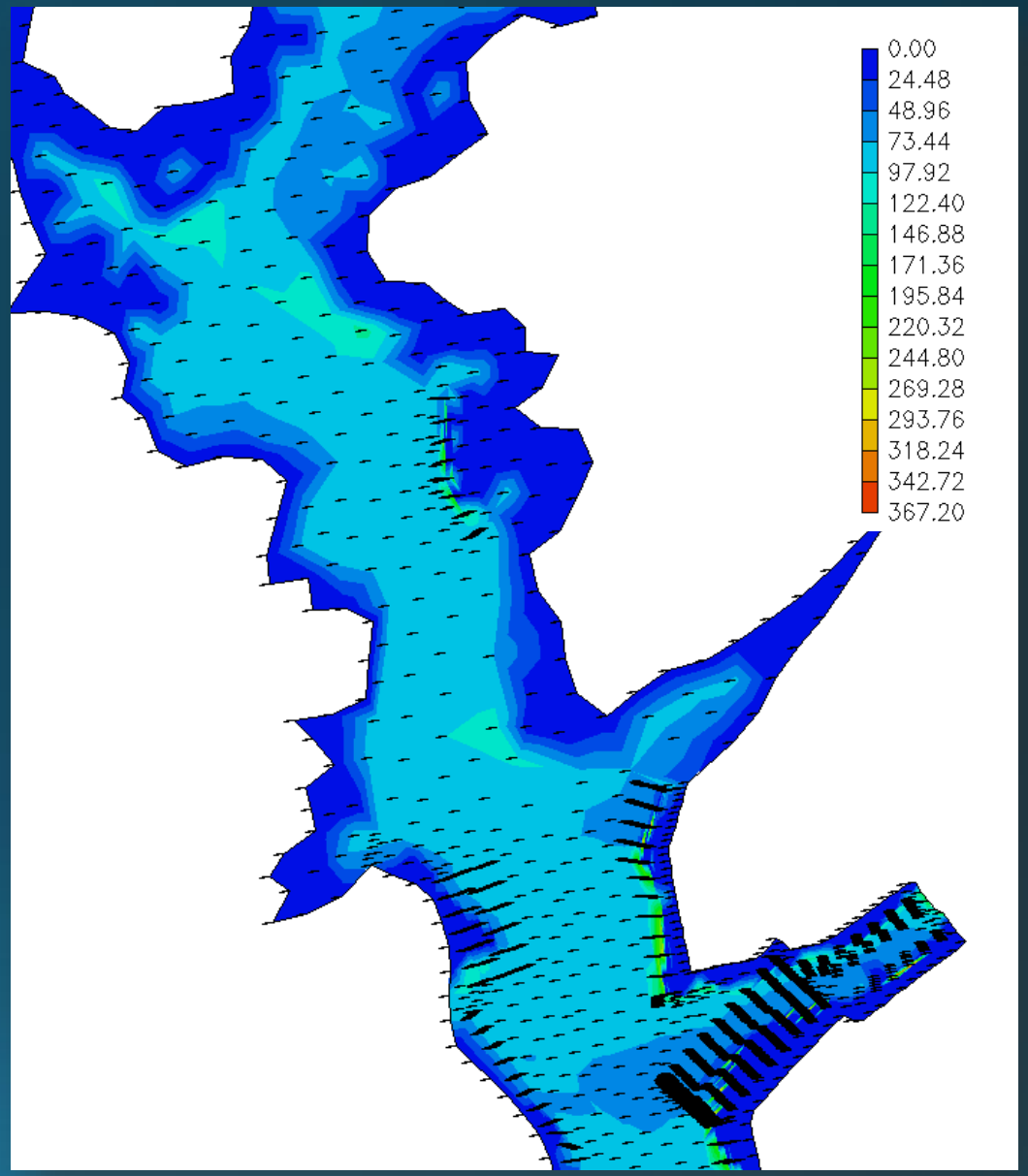



0.00
24.48
48.96
73.44
97.92
122.40
146.88
171.36
195.84
220.32
244.80
269.28
293.76
318.24
342.72
367.20

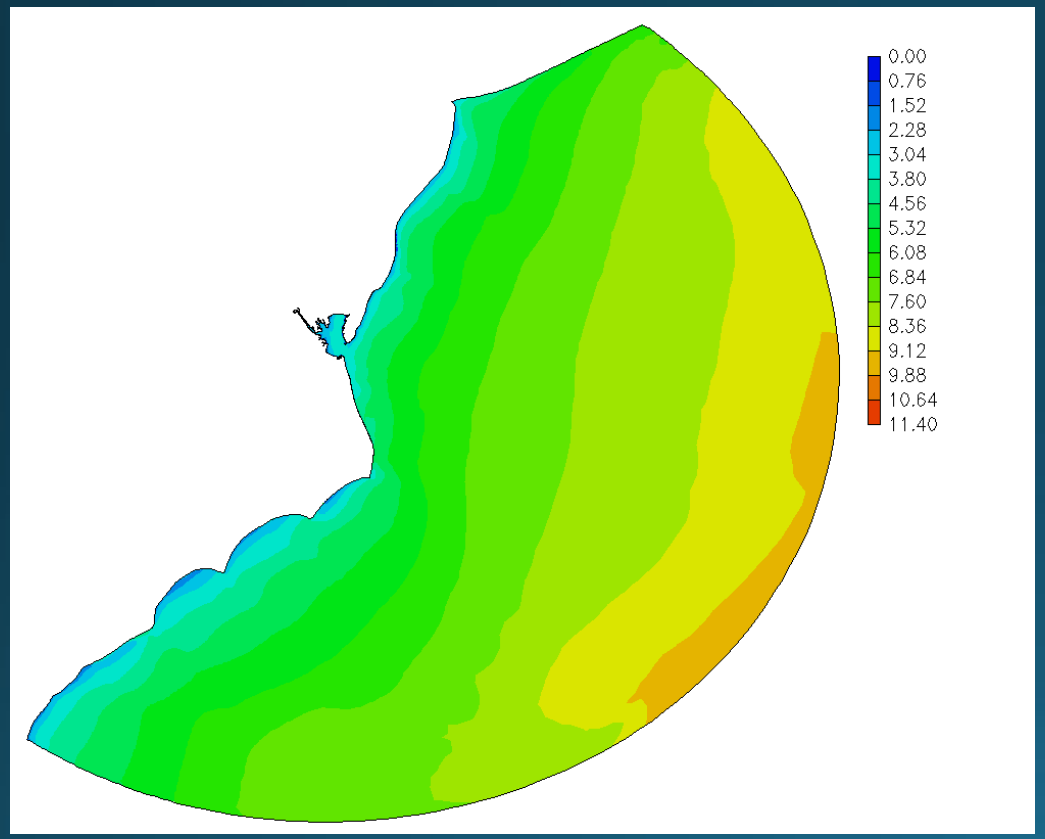



0.00
24.48
48.96
73.44
97.92
122.40
146.88
171.36
195.84
220.32
244.80
269.28
293.76
318.24
342.72
367.20

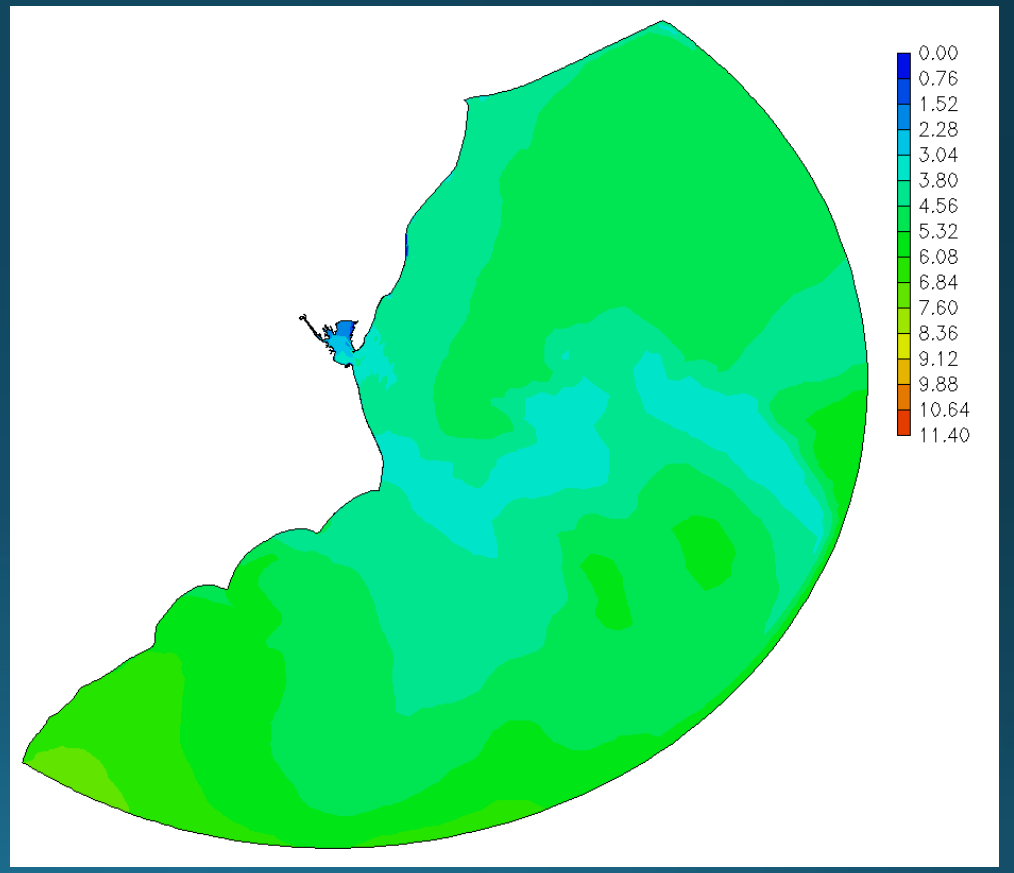

marsh loss
marsh gain
marsh - no change


0.00
24.48
48.96
73.44
97.92
122.40
146.88
171.36
195.84
220.32
244.80
269.28
293.76
318.24
342.72
367.20

Wave period (69_wwm_10.61)

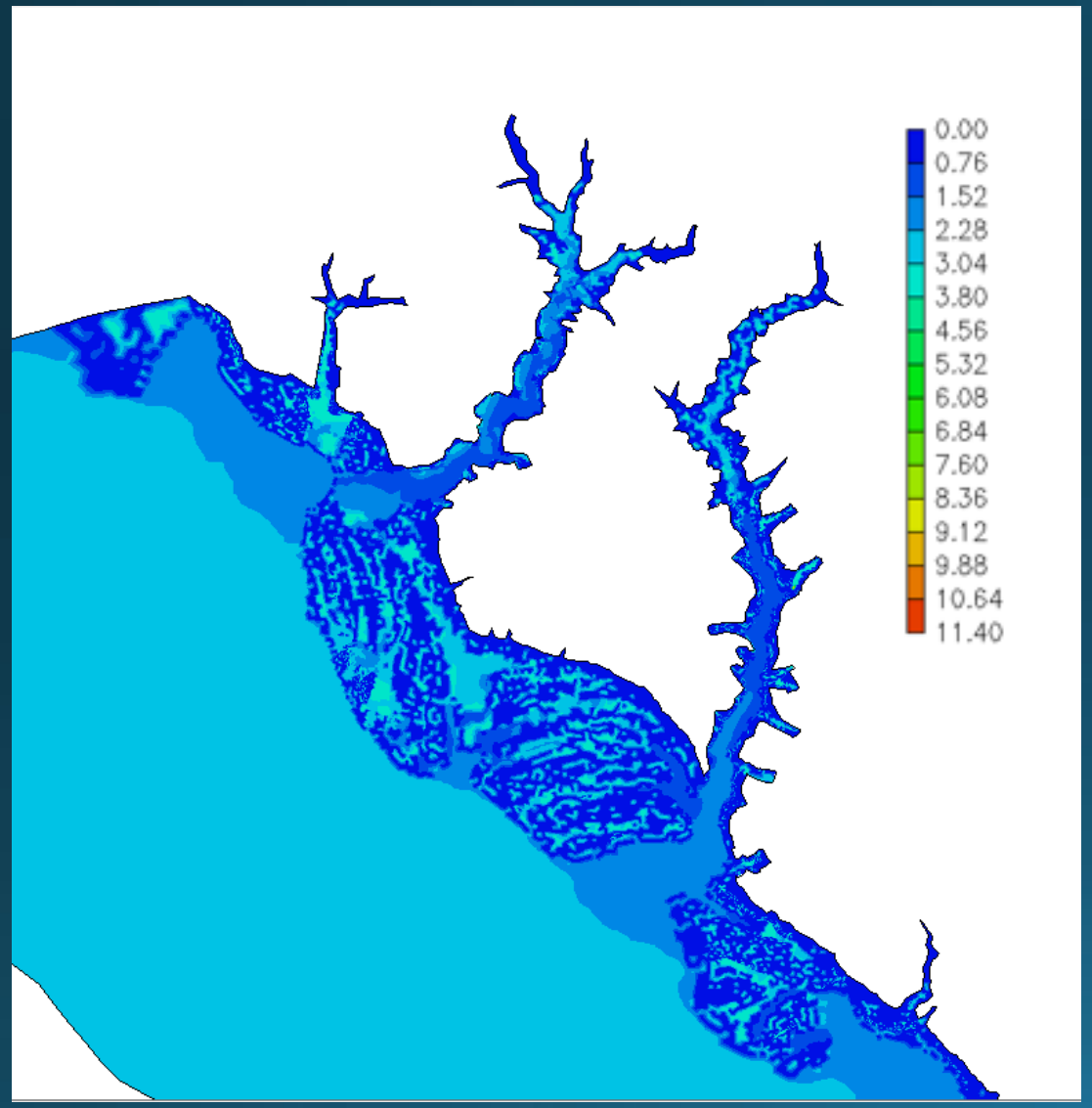


Time step 1

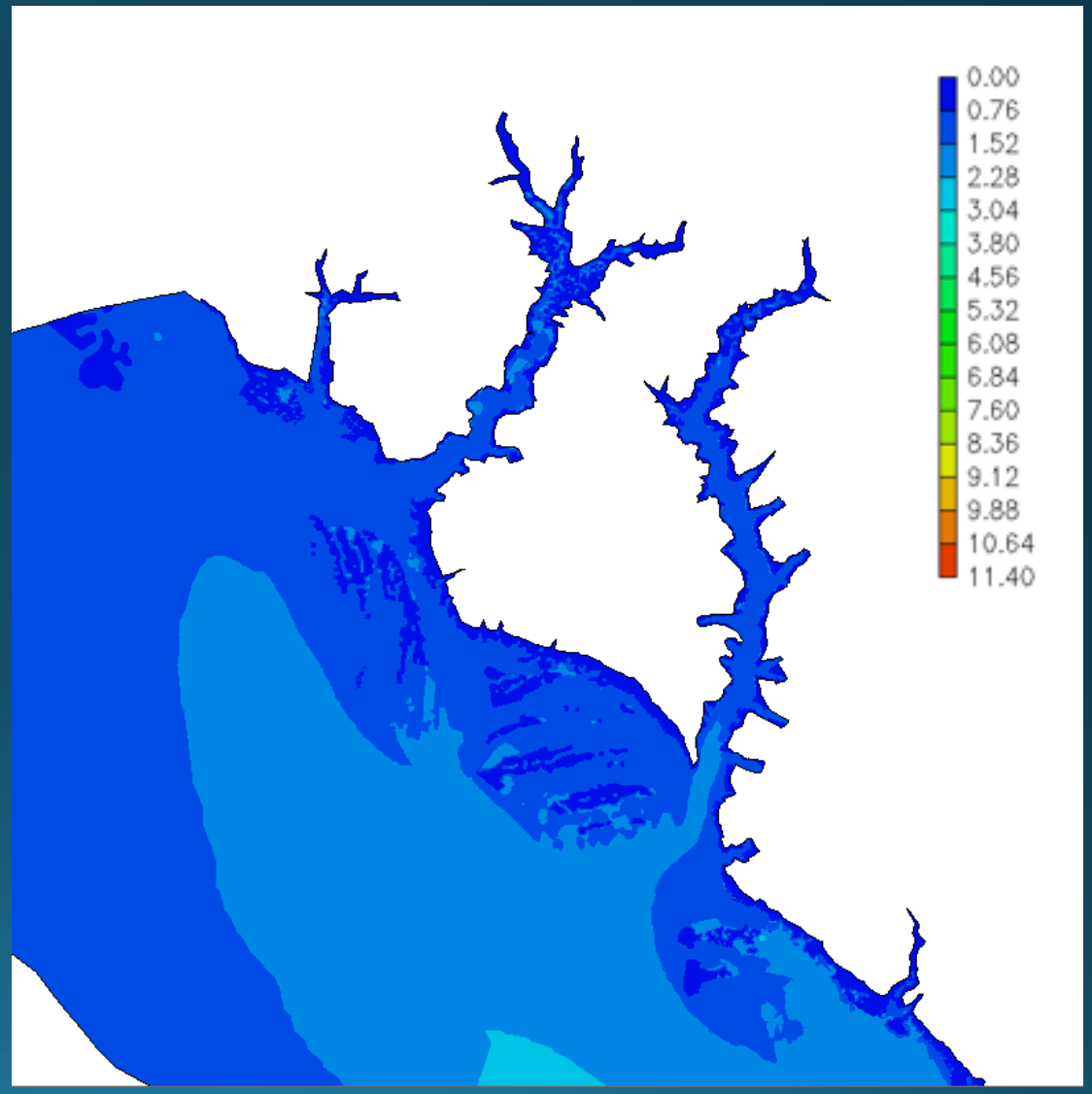


Time step 2

Wave period (69_wwm_10.61)

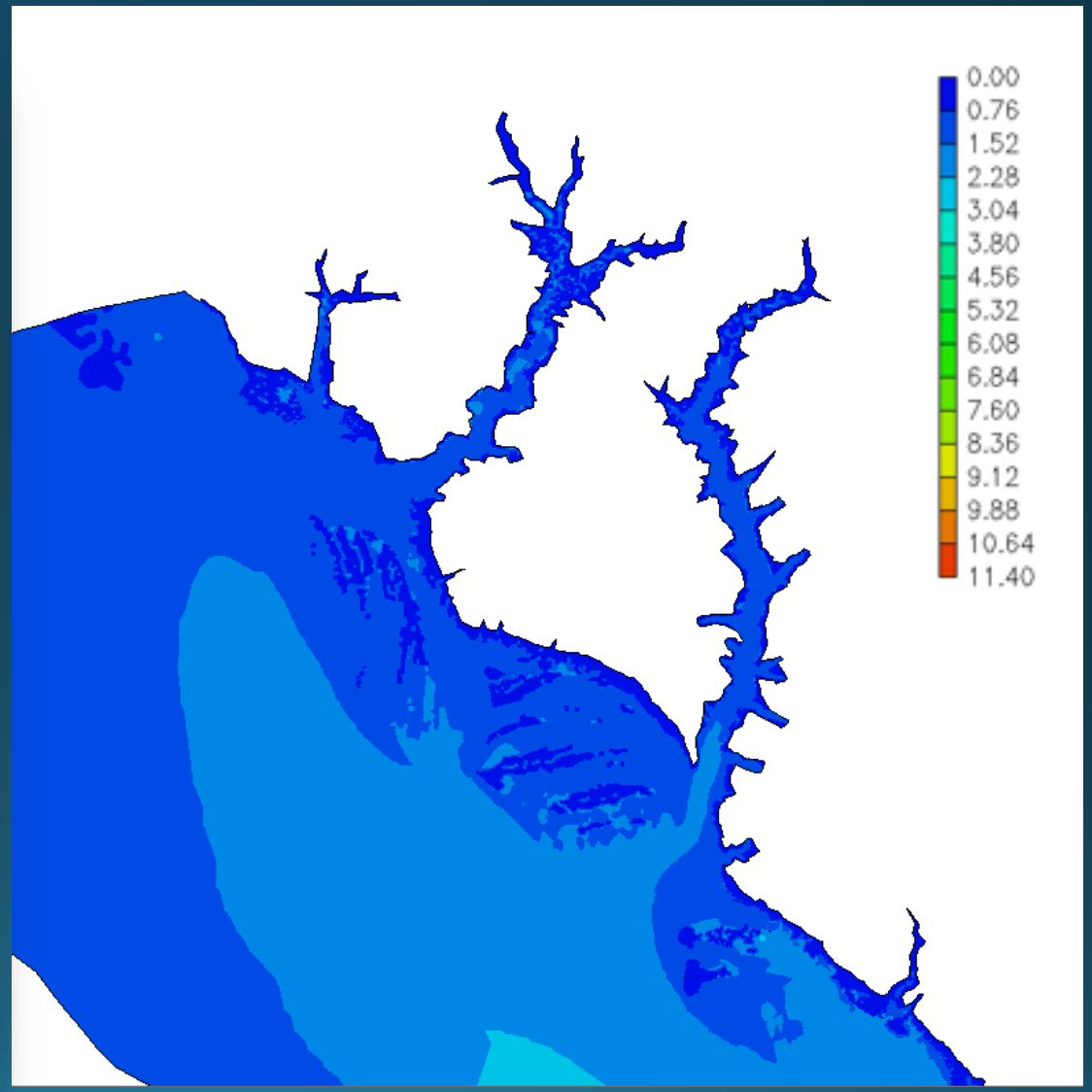


Time step 1



Time step 2

Wave period (69_wwm_10.61)

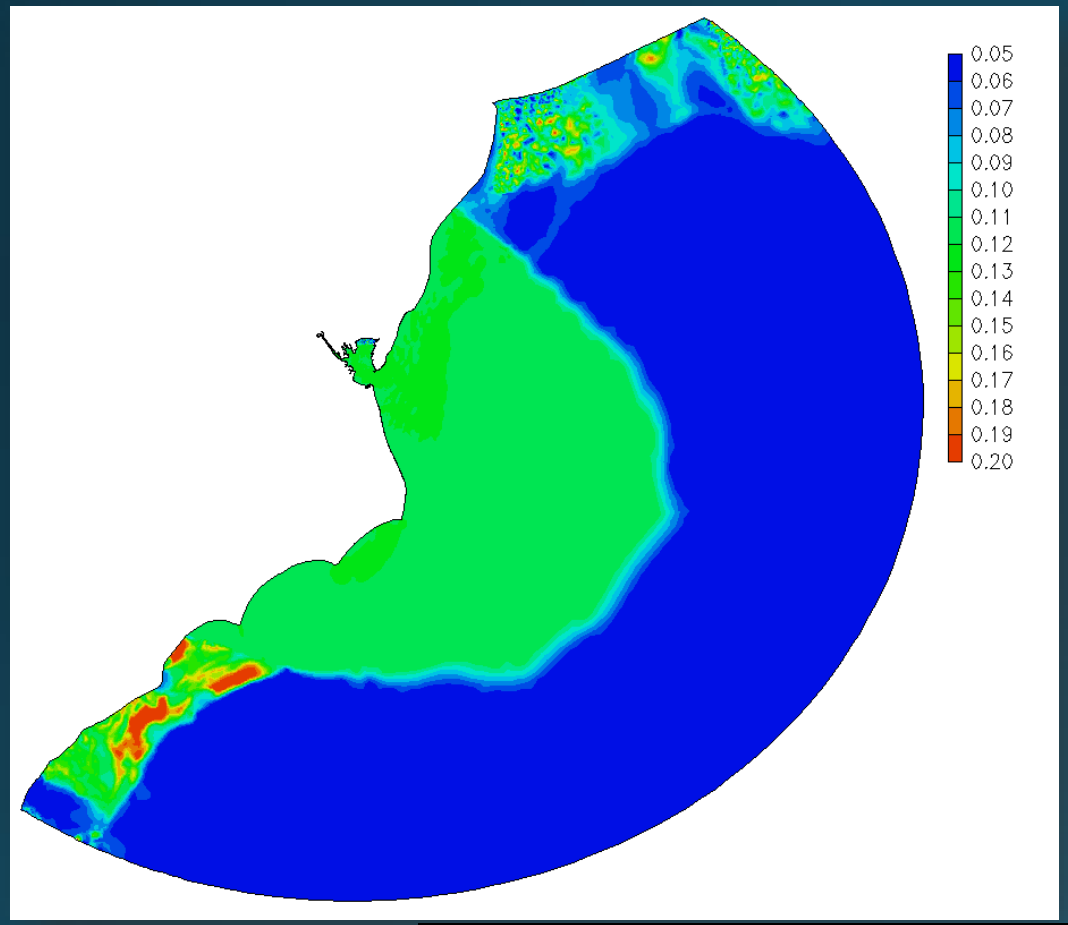


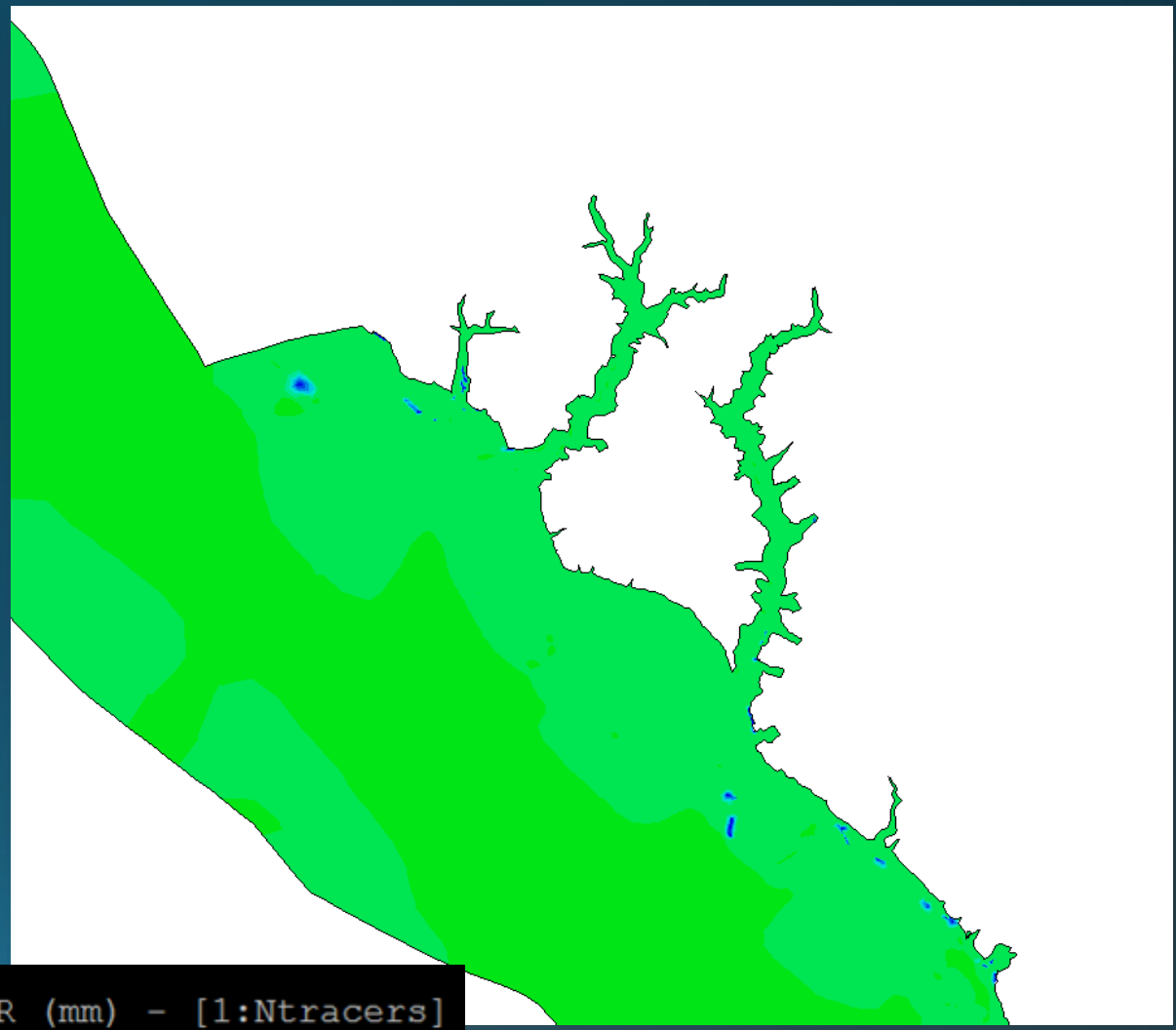
Time step 2

Sediments

Bed median grain size in the active layer

69_SED_bedd50.61

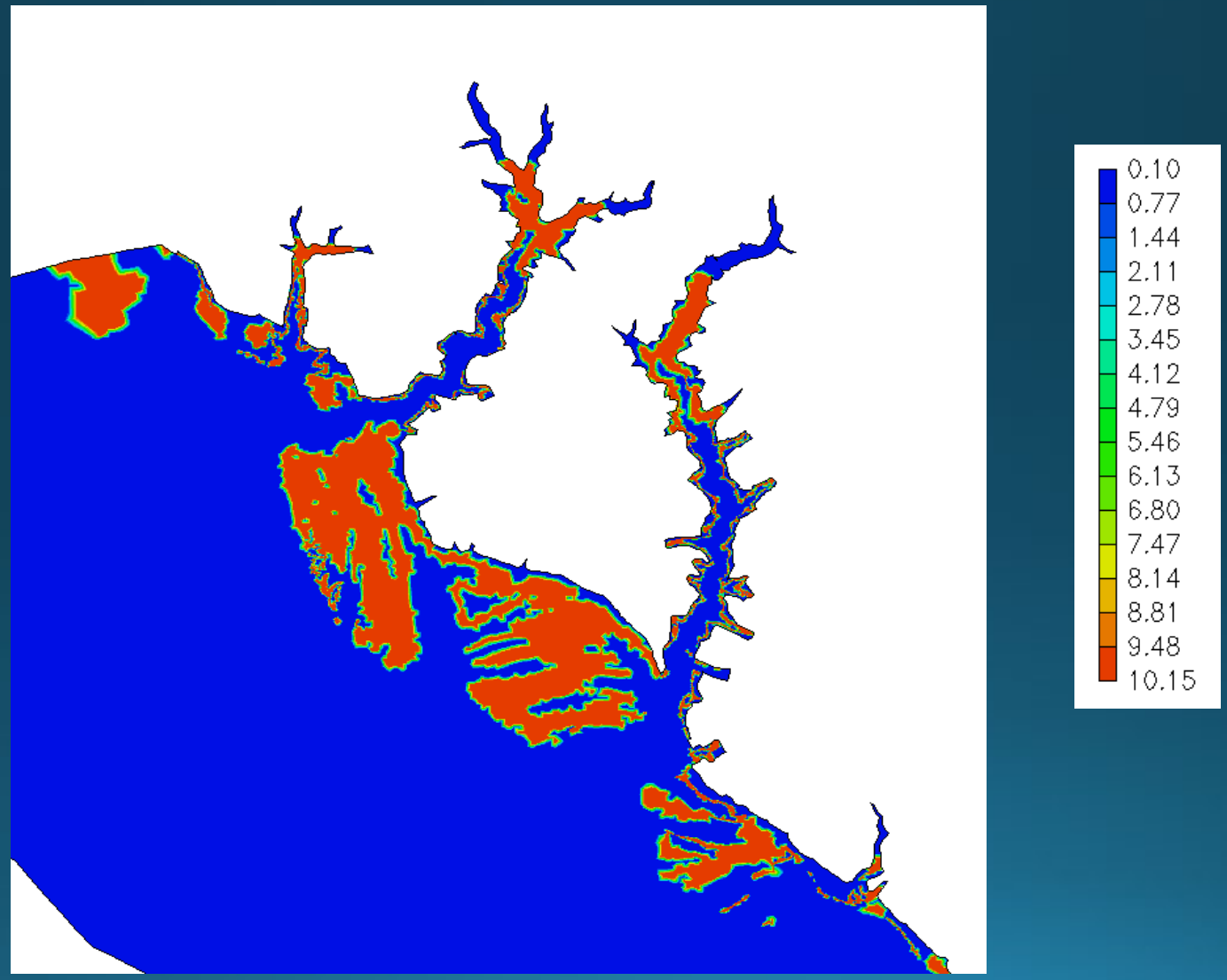




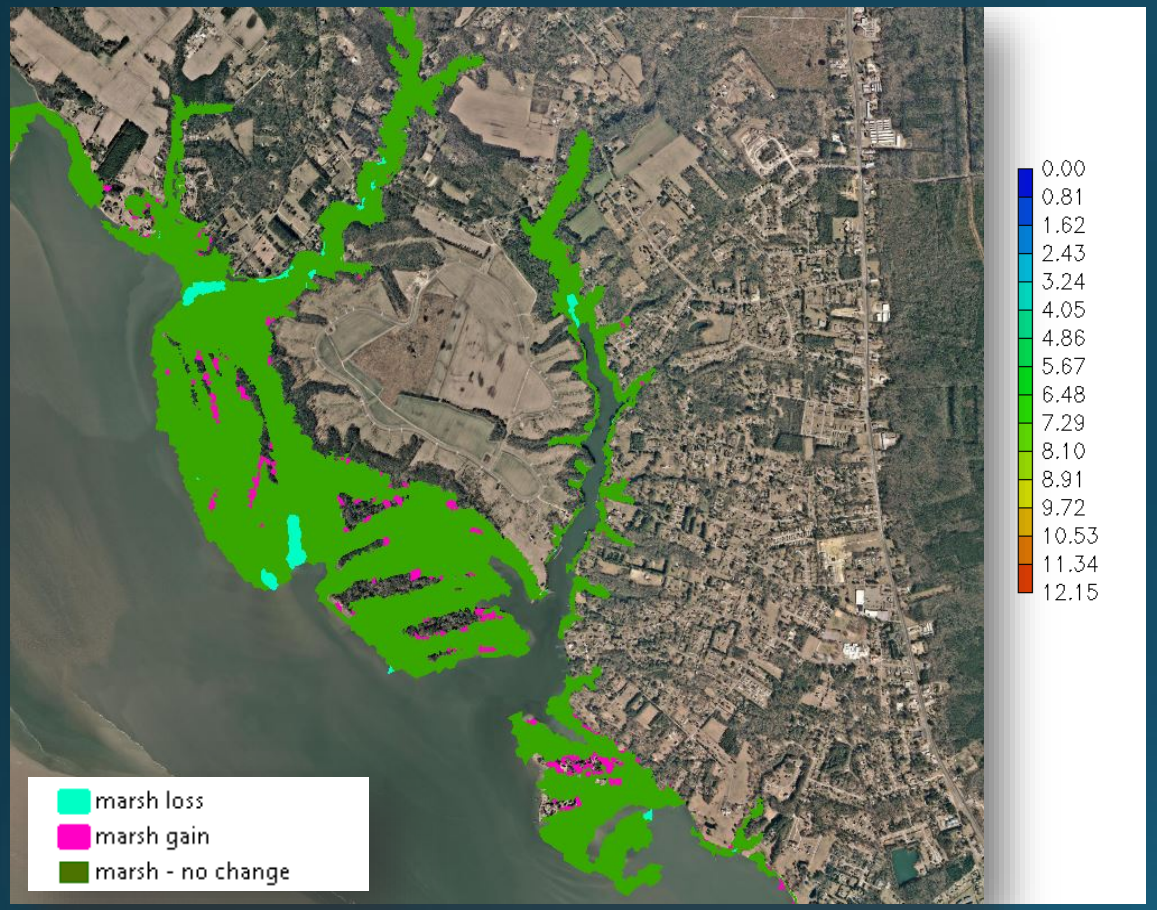
```
!- D50 MEDIAN SEDIMENT GRAIN DIAMETER (mm) - [1:Ntracers]
!-------------------------------------------------------
SAND_SD50 == 0.05d0 0.10d0 0.20d0
```

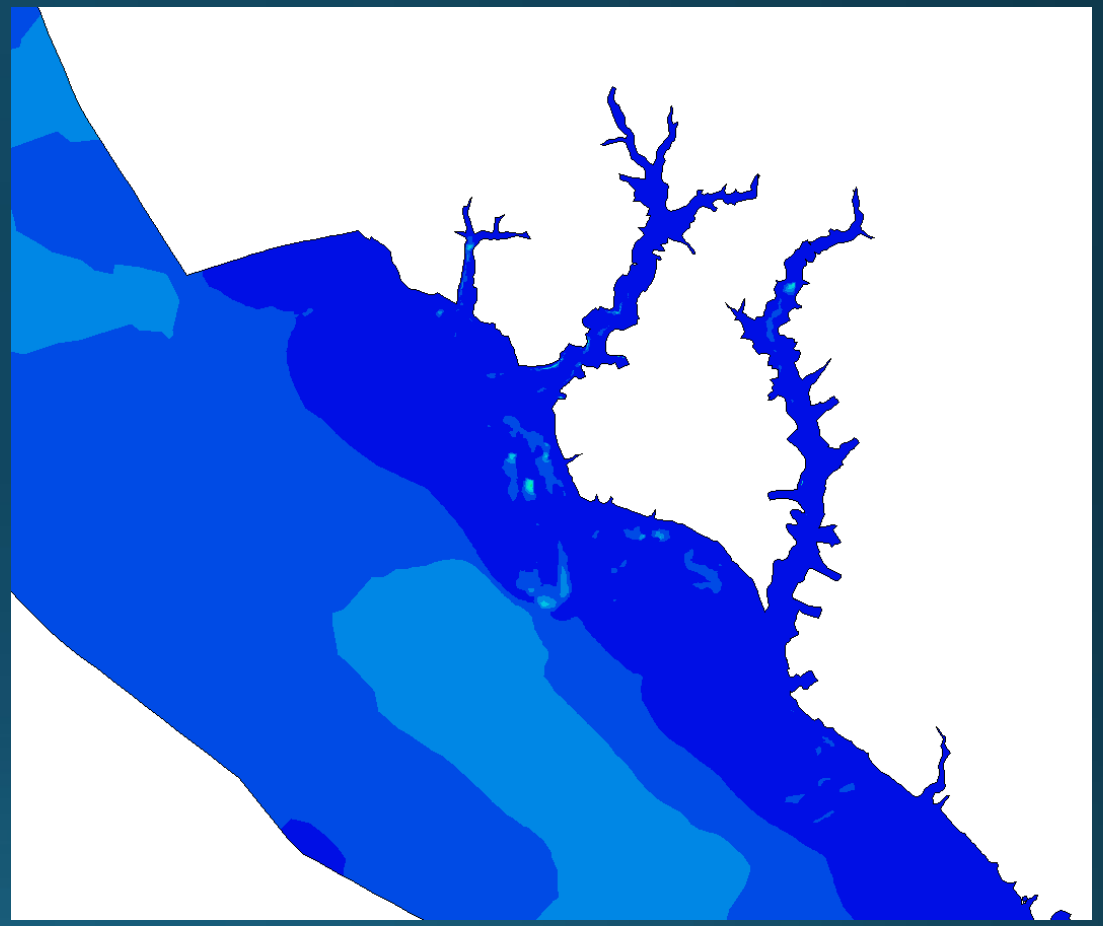
Bottom roughness length

69_SED_brough.61



Bottom shear stress (69_SED_bstress.61)



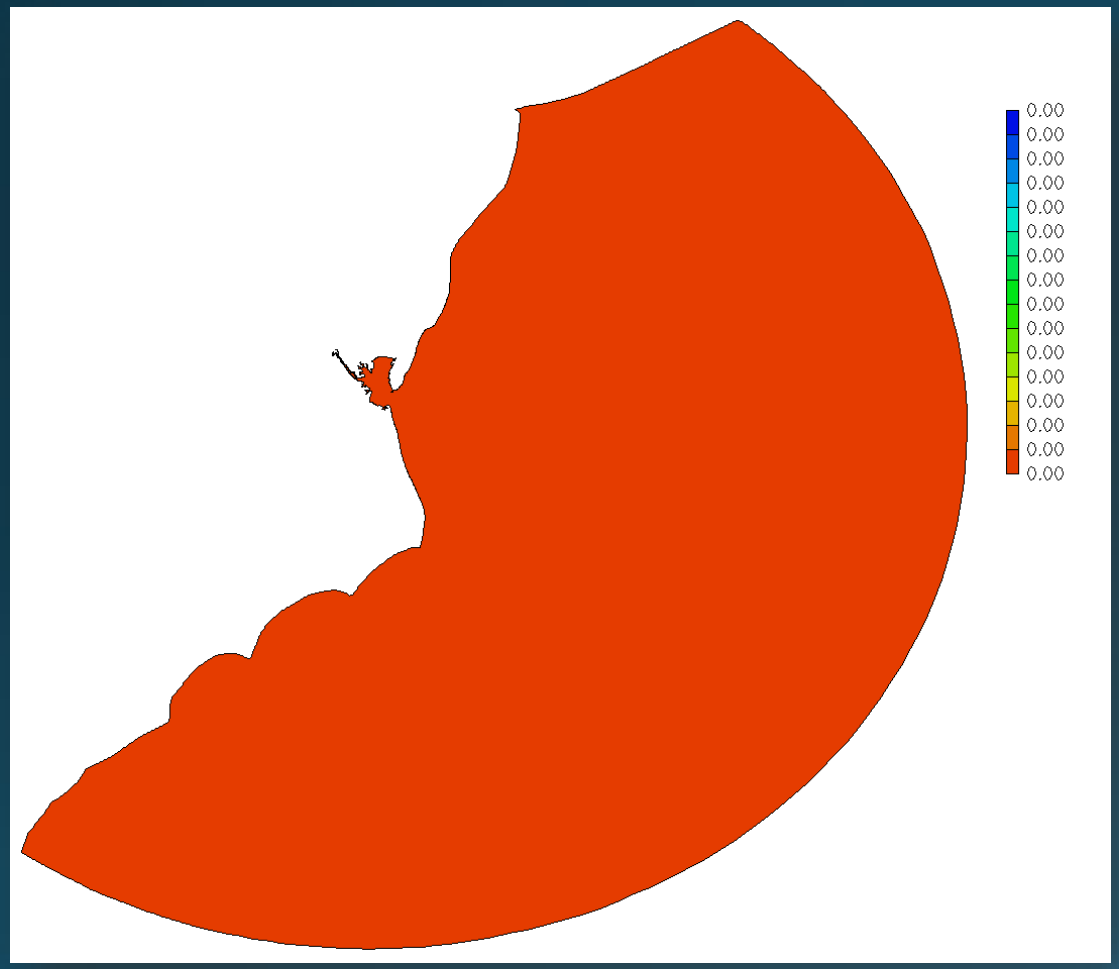


The specific form of the bottom stress depends on the type of boundary layer used

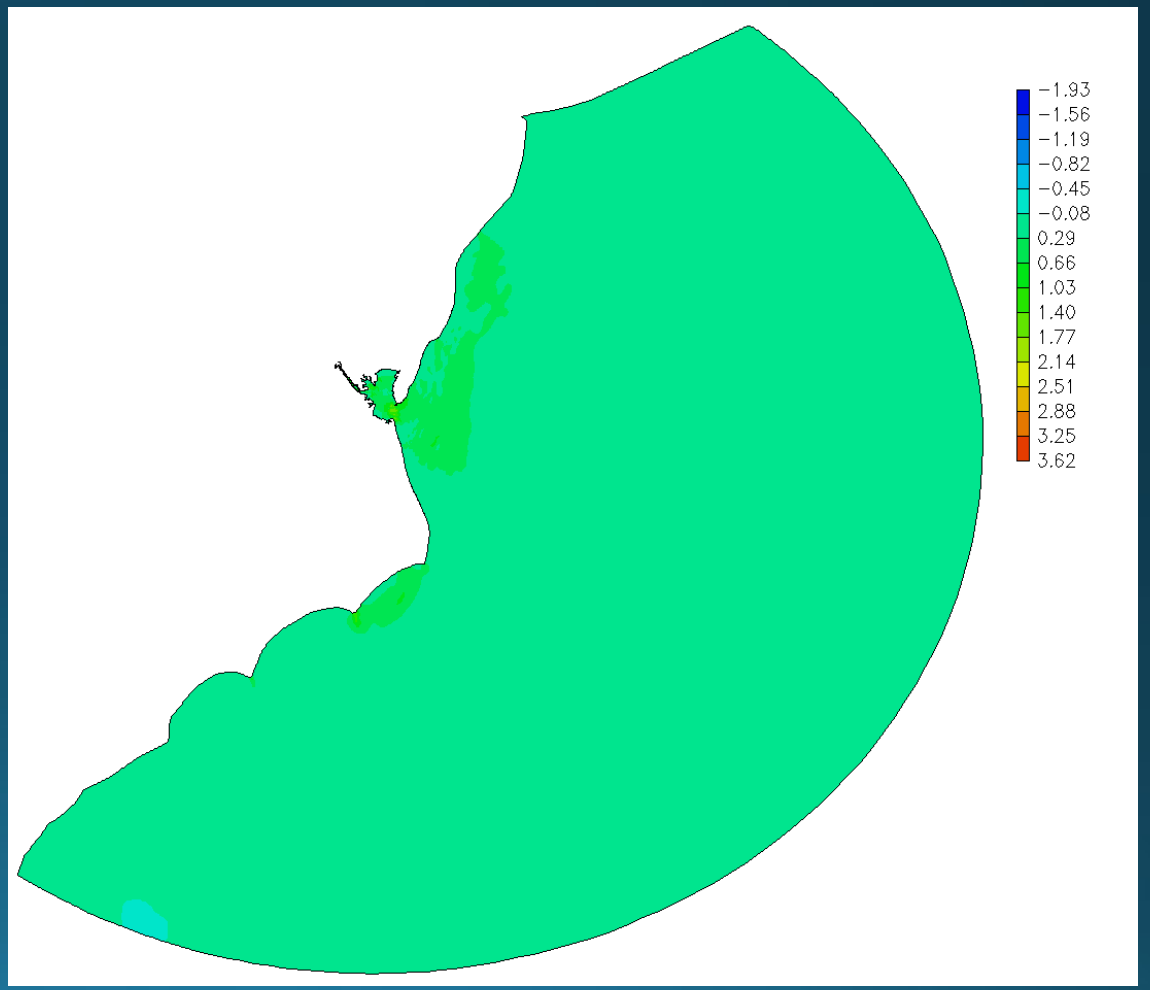
$$\boldsymbol{\tau}_b = C_D|\boldsymbol{u}_b|\boldsymbol{u}_b.$$

Bottom depth change from initial condition (m)

(1_SED_depth.61)

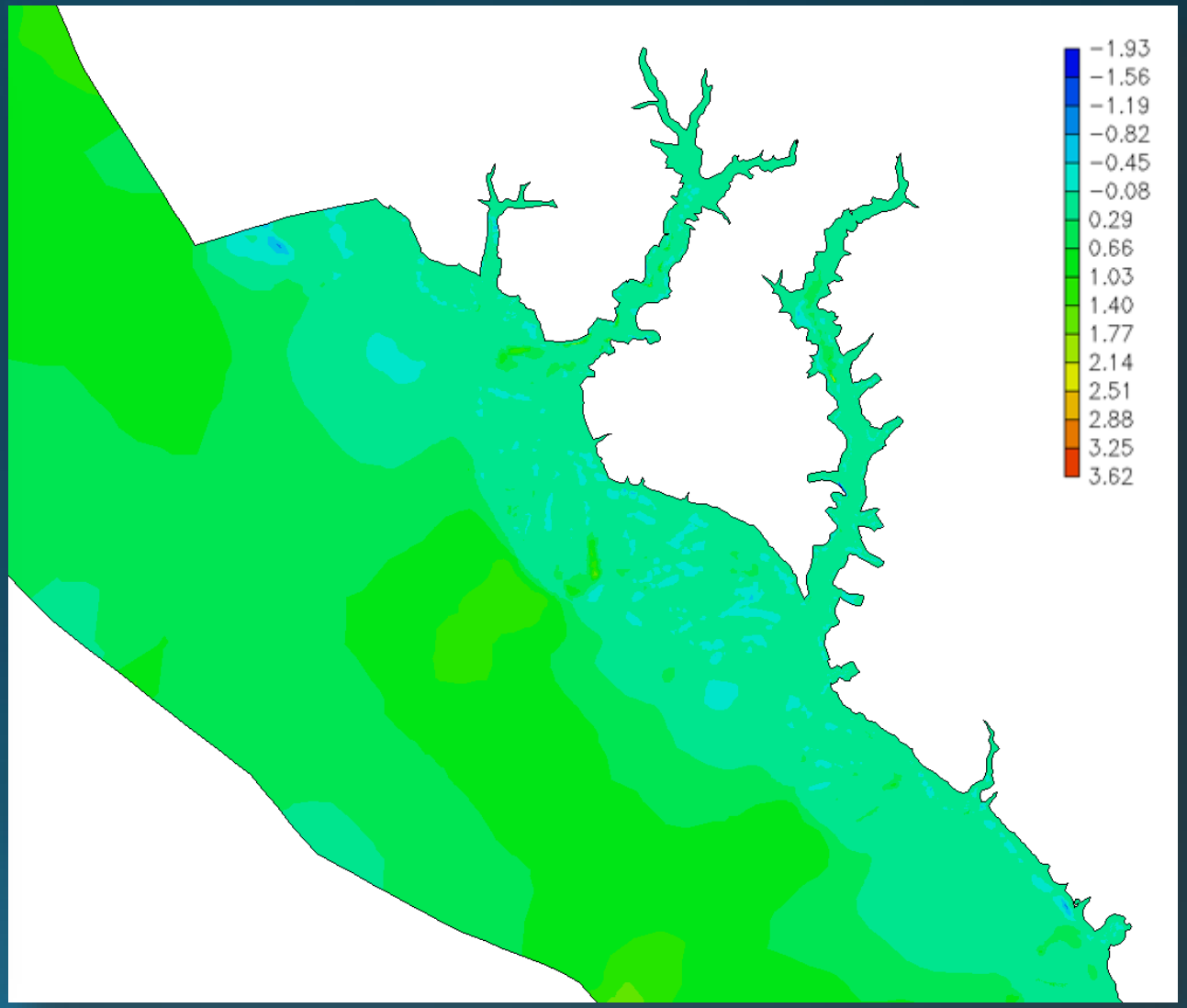


(69_SED_depth.61)



Bottom depth change from initial condition (m)

69_SED_depth.61

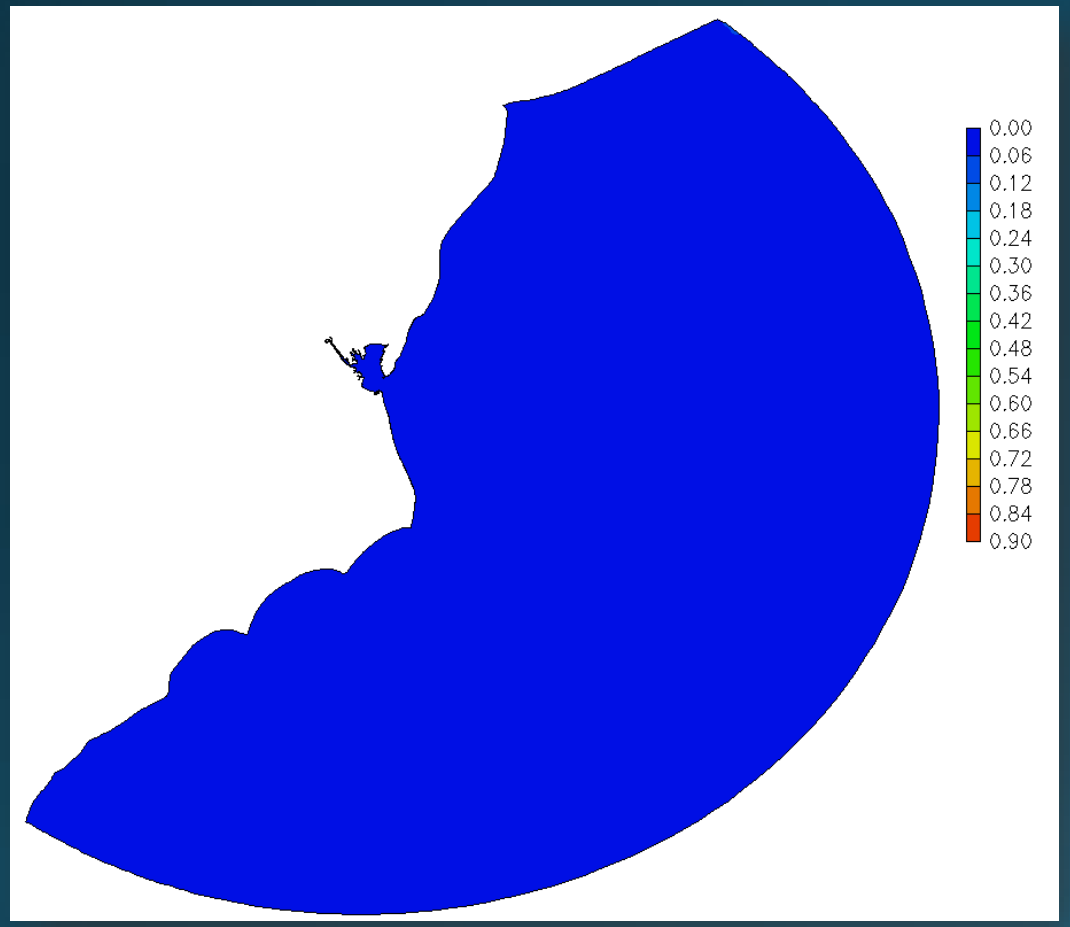


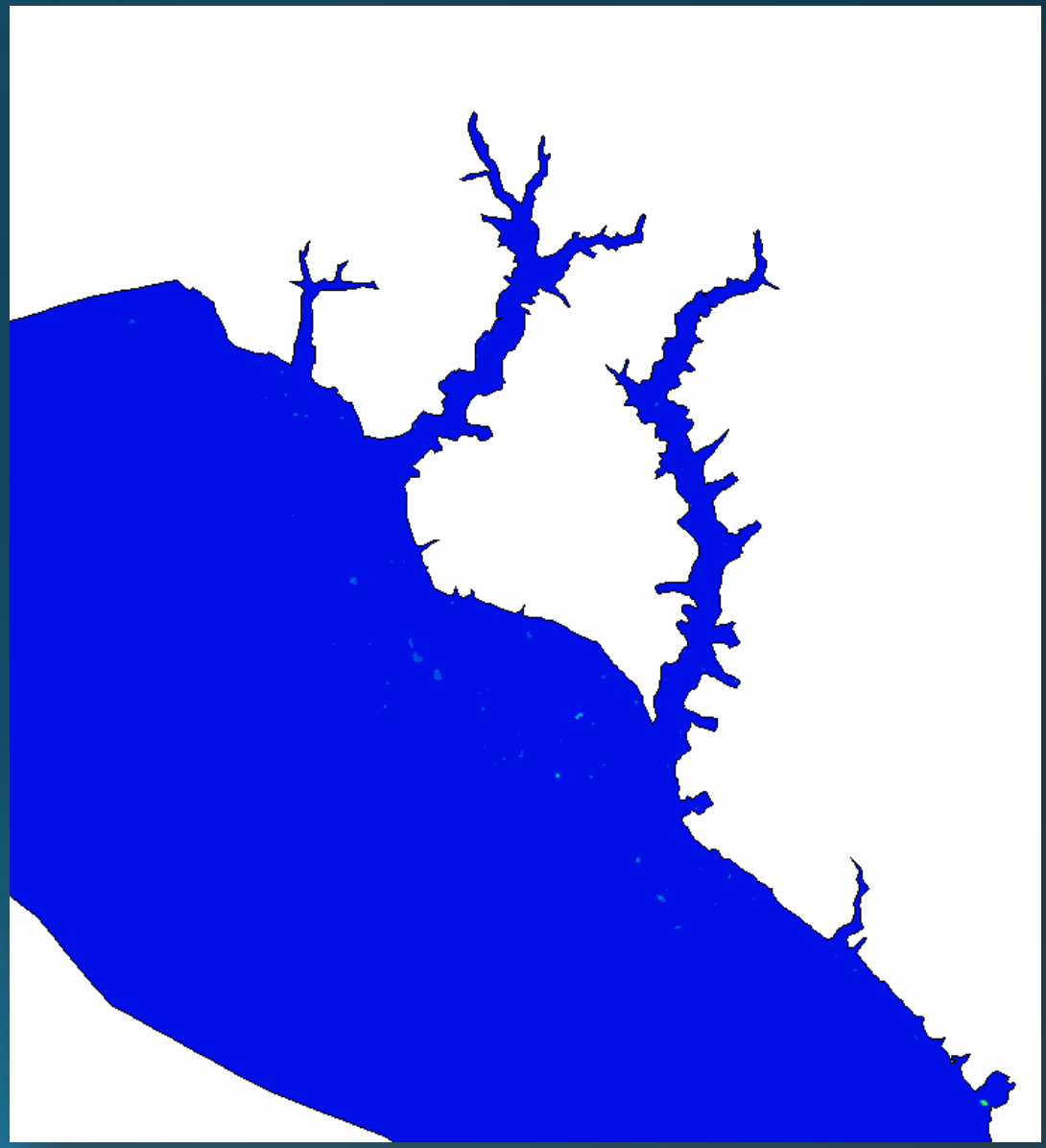
```
!- D50 MEDIAN SEDIMENT GRAIN DIAMETER (mm) - [1:Ntracers]
!-----------------------------------------------------------
SAND_SD50 == 0.05d0 0.10d0 0.20d0
```

Phi Units*	Size	Wentworth Size Class	Sediment/Rock Name
-8	256 mm	Boulders	Sediment: GRAVEL Rock RUDITES: (conglomerates, breccias)
-6	64 mm	Cobbles	
-2	4 mm	Pebbles	
-1	2 mm	Granules	
0	1 mm	Very Coarse Sand	Sediment: SAND Rocks: SANDSTONES (arenites, wackes)
1	1/2 mm	Coarse Sand	
2	1/4 mm	Medium Sand	
3	1/8 mm	Fine Sand	
4	1/16 mm	Very Fine Sand	
8	1/256 mm	Silt	Sediment: MUD Rocks: LUTITES (mudrocks)
		Clay	

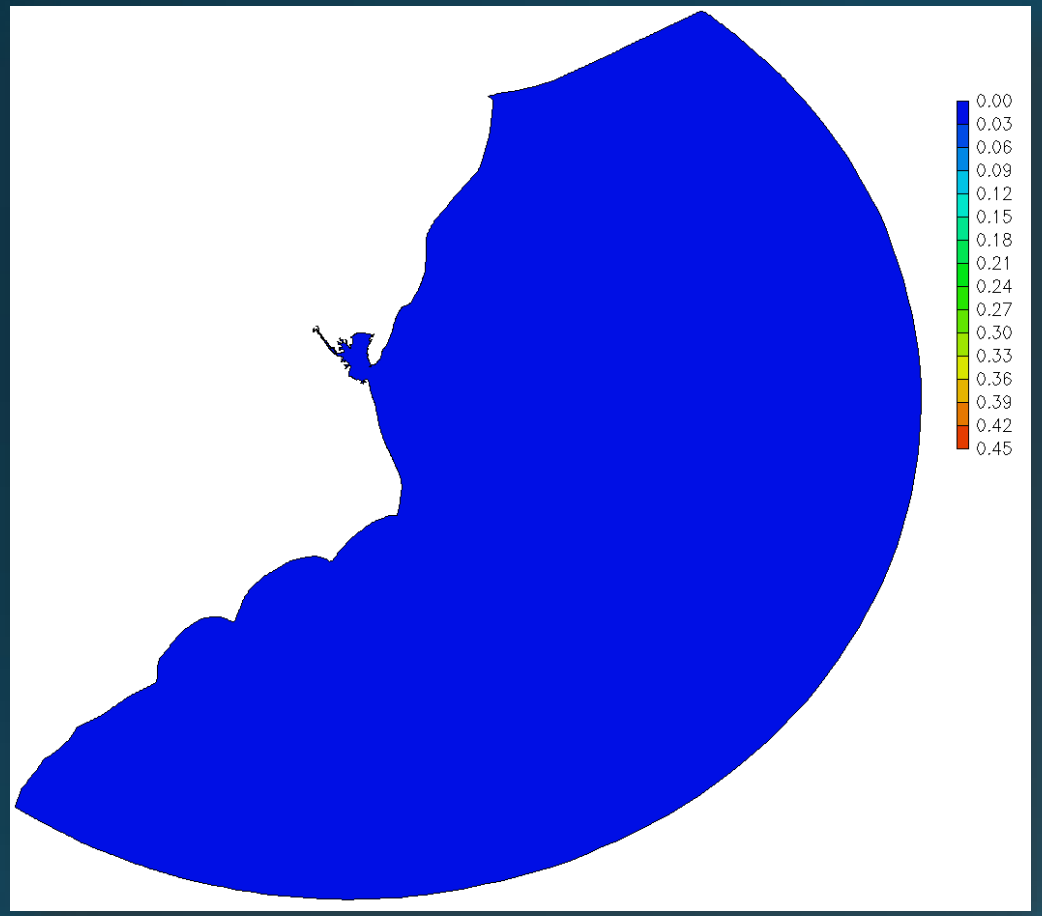
* Udden-Wentworth Scale

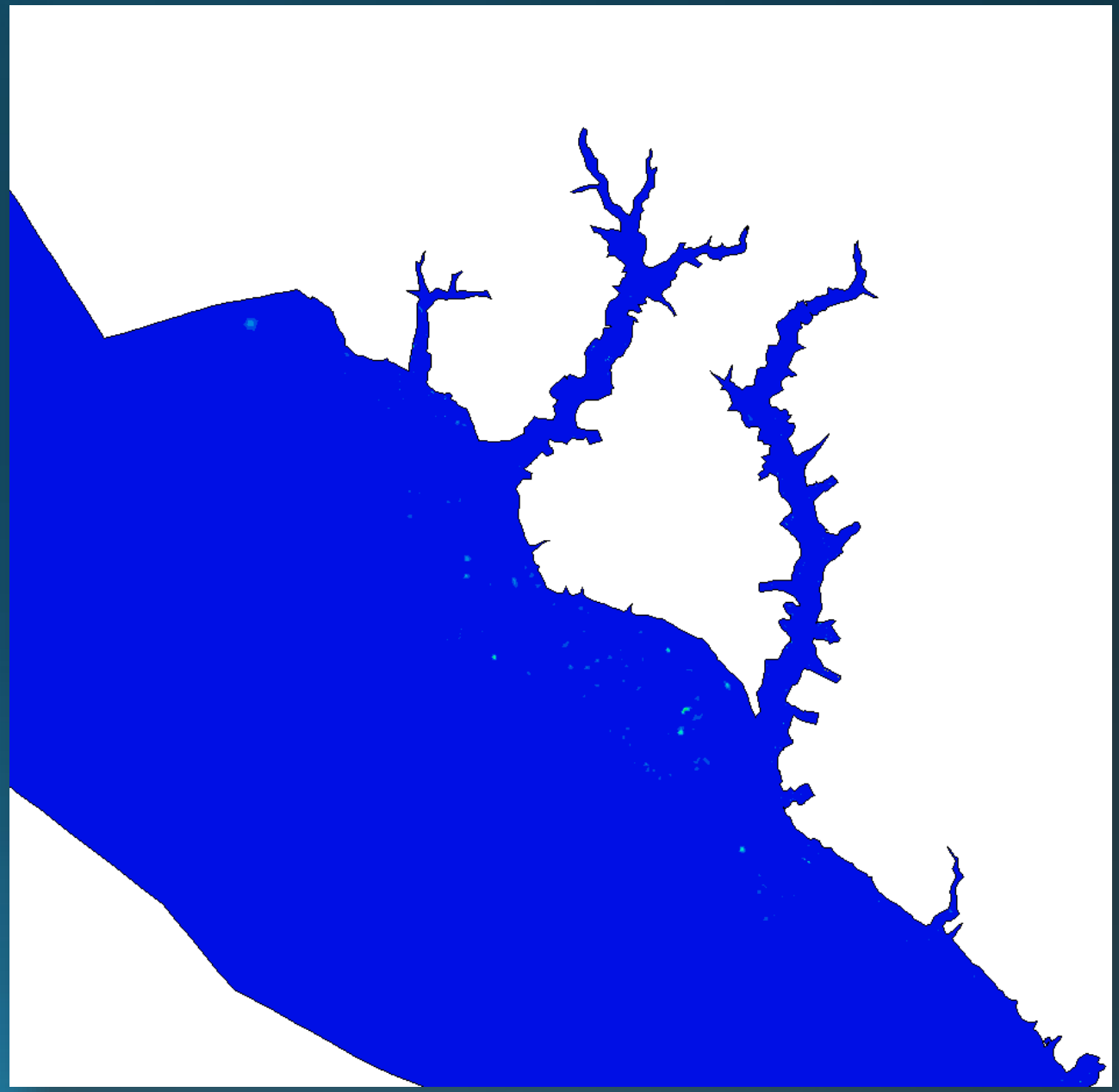
Concentration of Silt (69_SED_1.63)



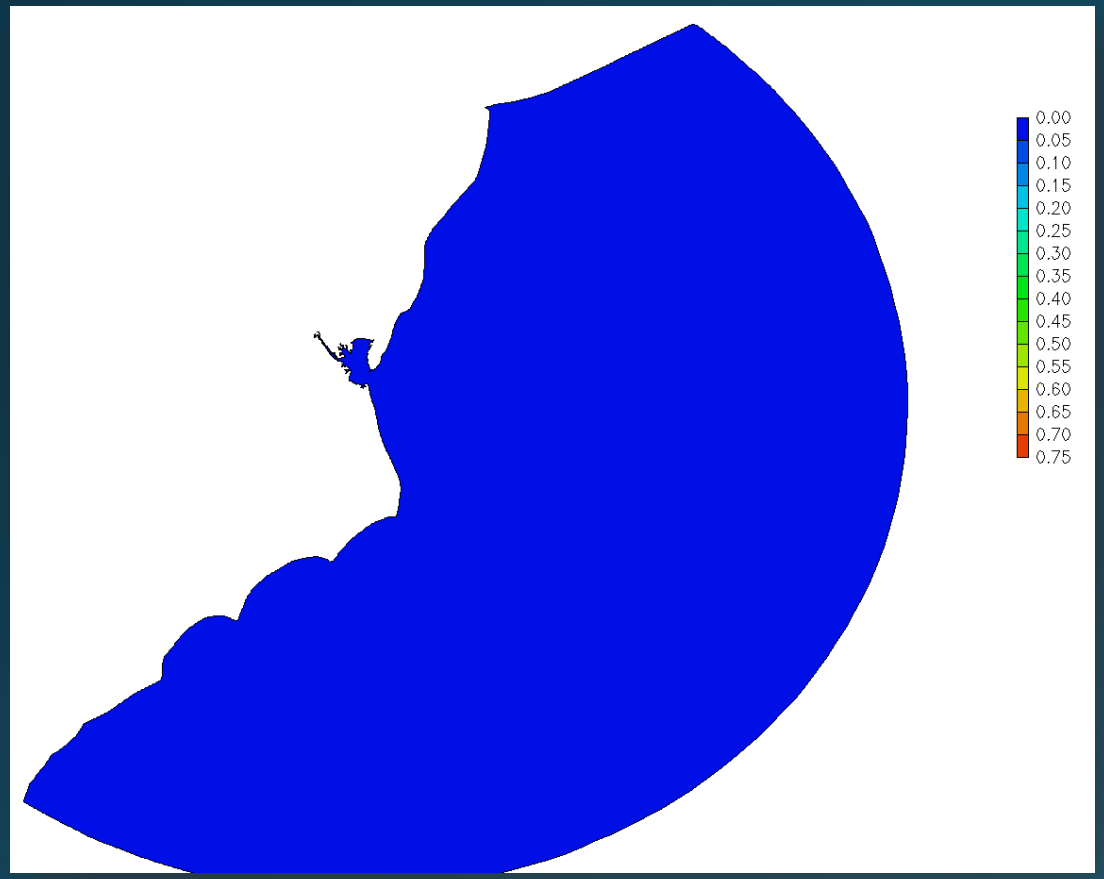


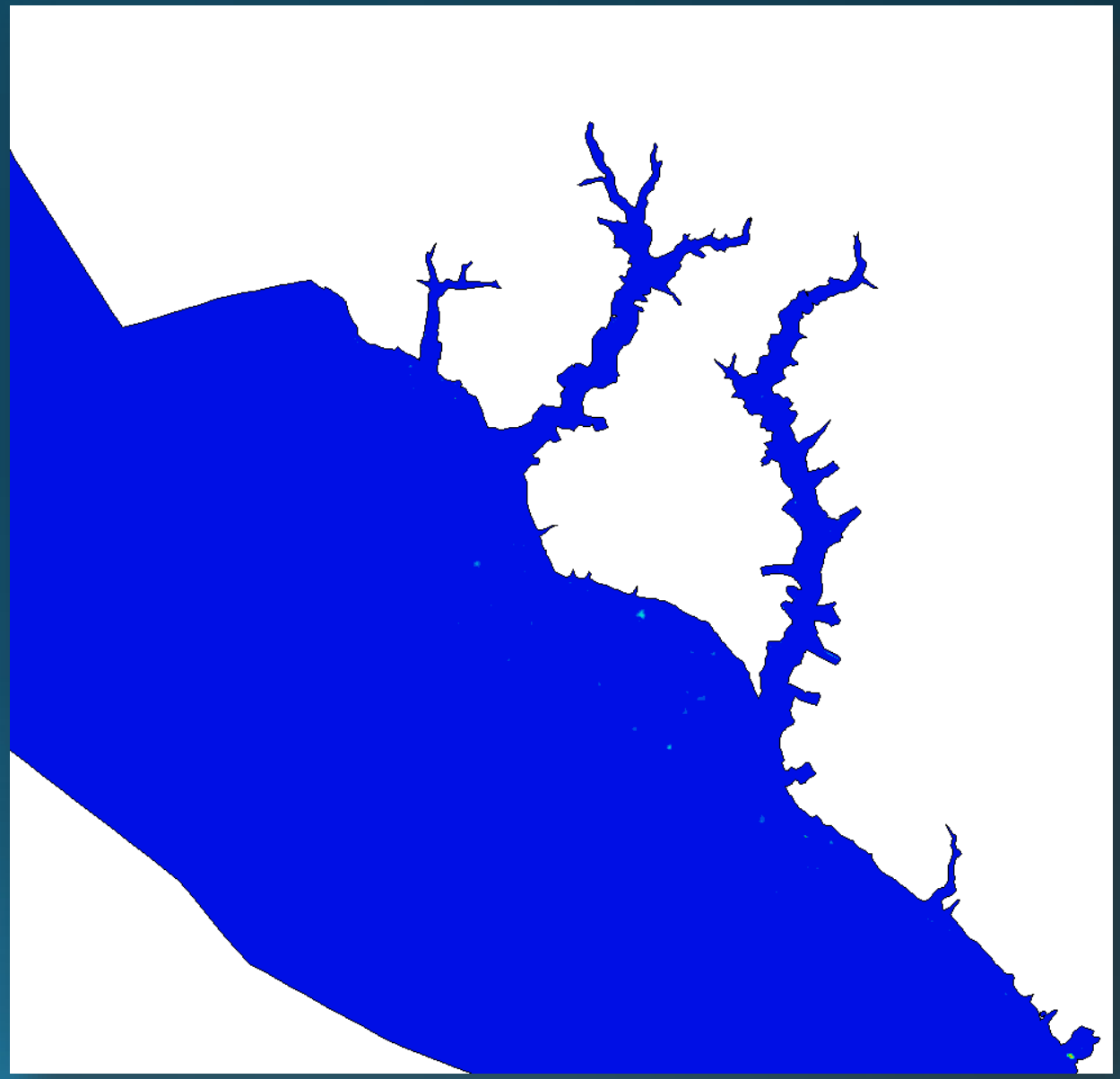
Concentration of very fine sand (69_SED_2.63)





Concentration of fine sand (69_SED_3.63)

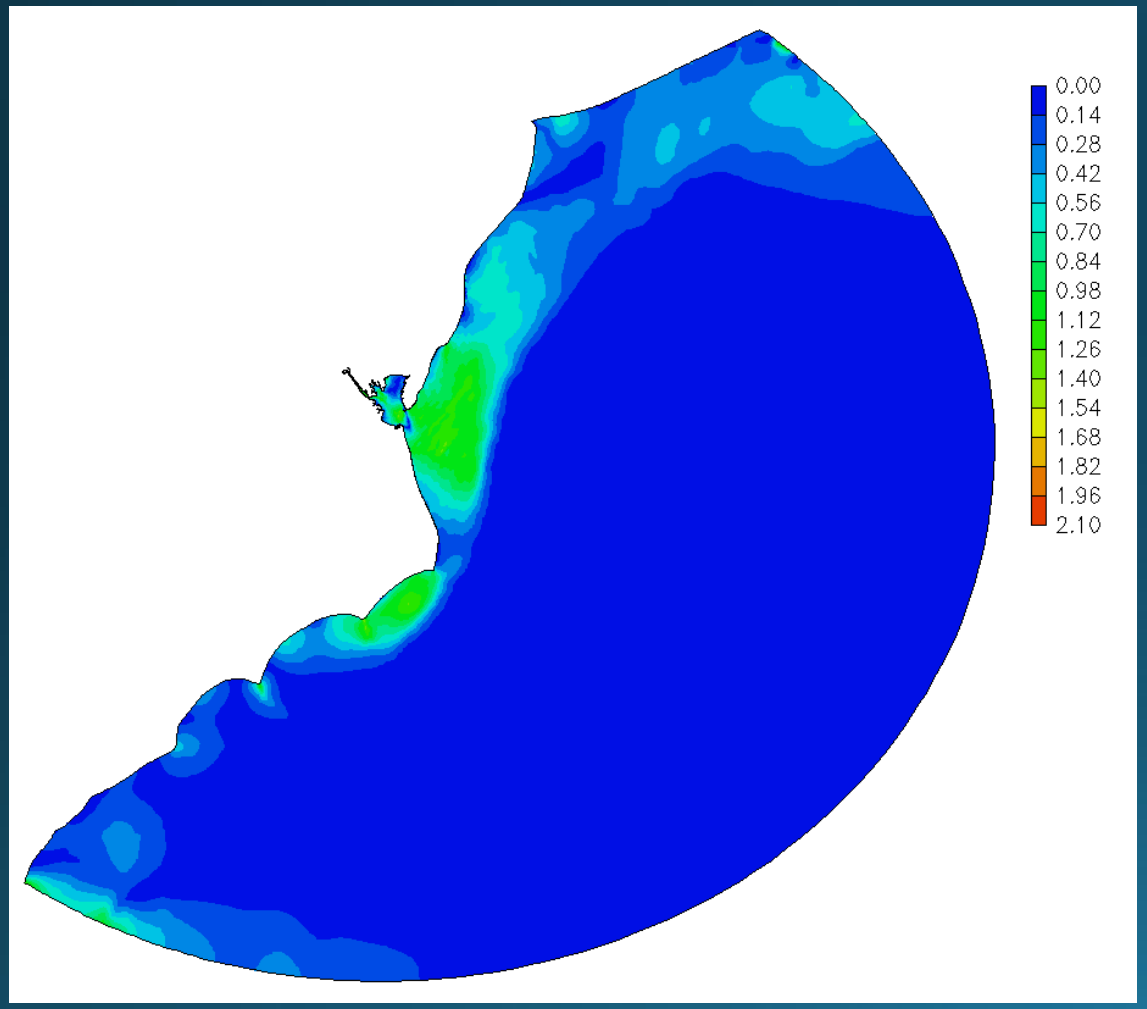


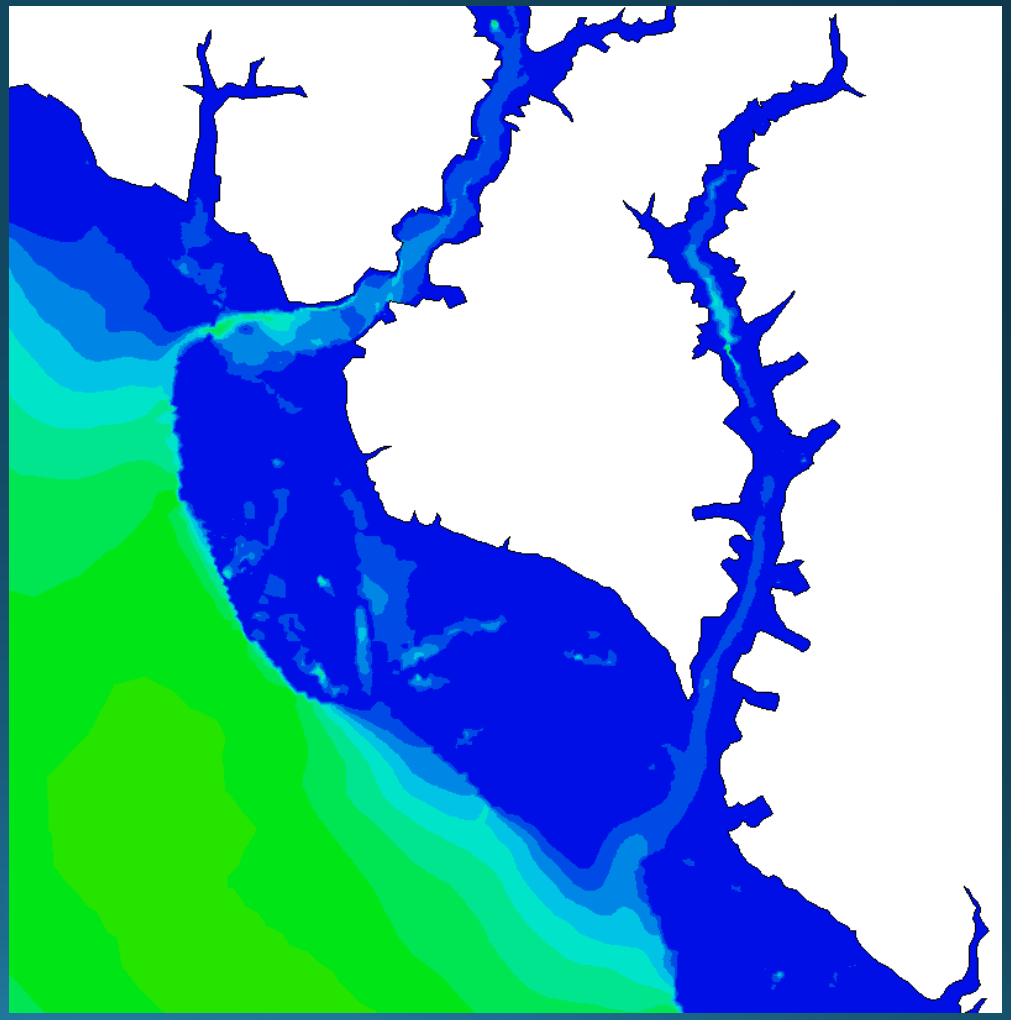


Questions/Discussion

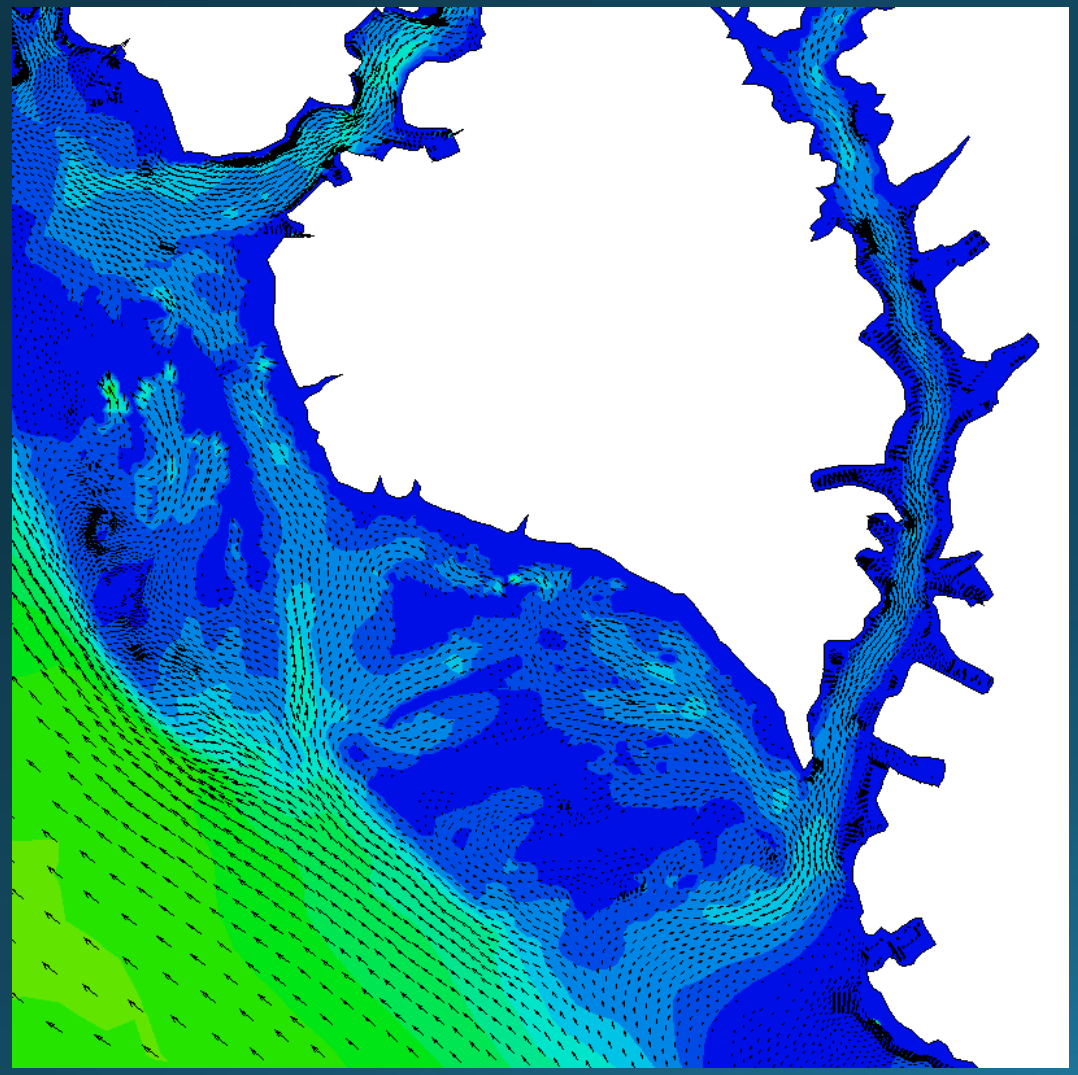
- Are more sediment classes needed?
- Bed deformation is off, but active morphology is on=?
- Bedthick.ic (initial thickness of the bed)?

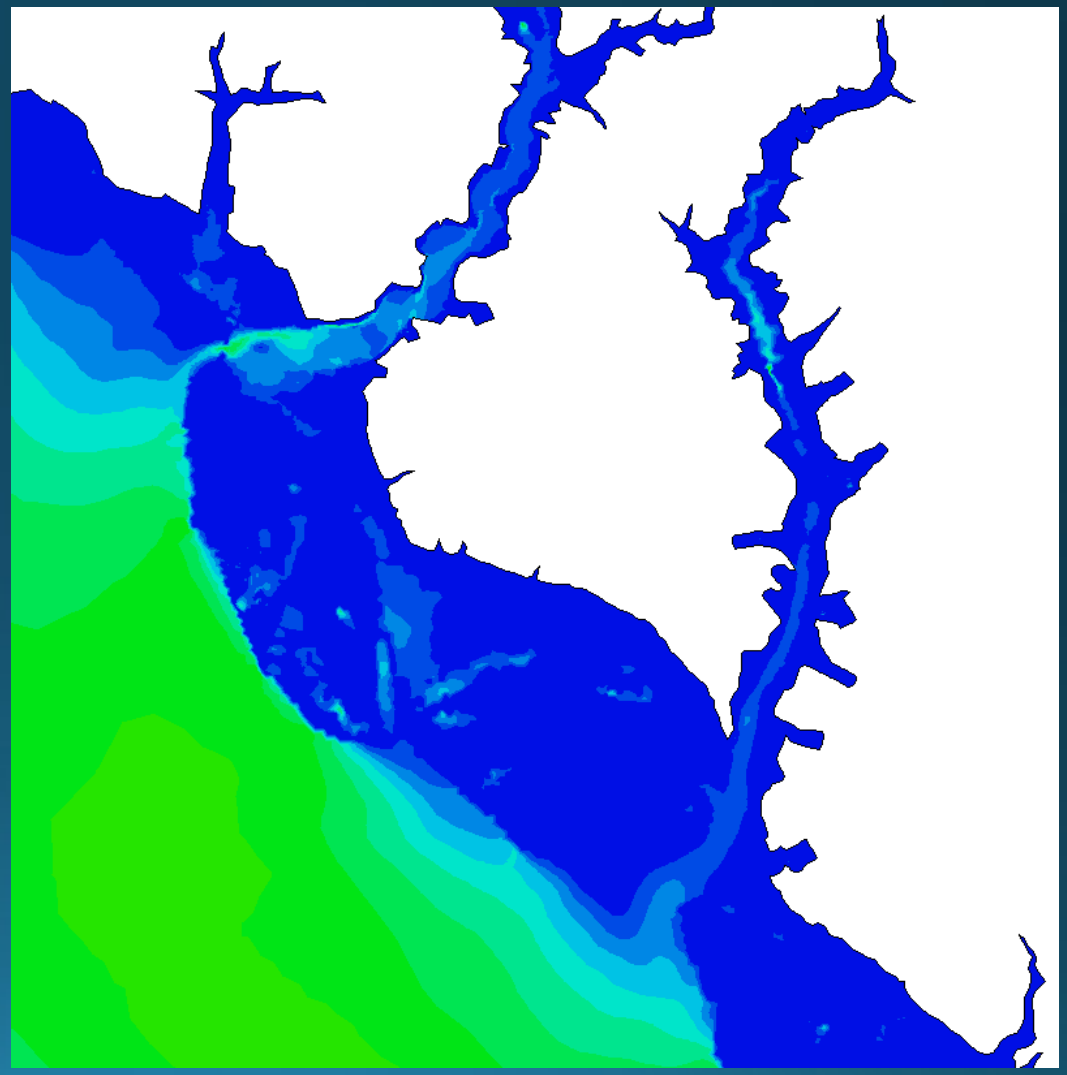
Concentration of fine sand (69_dahv.62)

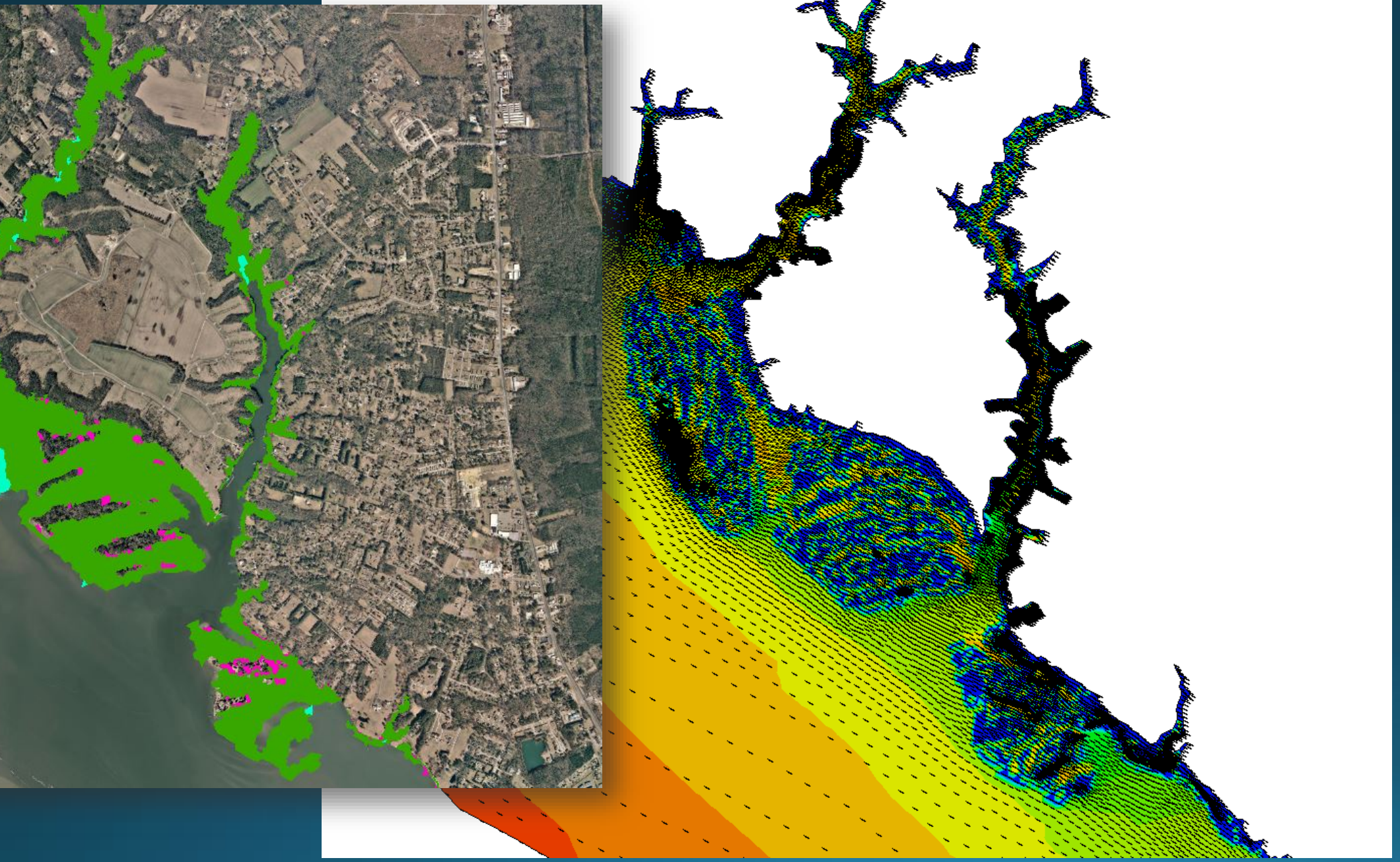




Concentration of fine sand (69_dahv.62)



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73.44
97.92
122.40
146.88
171.36
195.84
220.32
244.80
269.28
293.76
318.24
342.72
367.20