

# SCHISM Boundary Condition Generation within UFS-Coastal (V1.0)

# Type 3 Boundary Condition file format

```

08/24/2018 00:00:00 UTC
8 50.000 !number of earth tidal potential, cut-off depth for applying tidal potential
S2
2 0.112841 0.145444E-03 1.00000 0.00000
M2
2 0.242334 0.140519E-03 1.02082 56.66478
N2
2 0.046398 0.137880E-03 1.02082 235.62621
K2
2 0.030704 0.145842E-03 0.86103 289.02826
K1
1 0.141565 0.729212E-04 0.94663 234.20135
P1
1 0.046843 0.725229E-04 1.00000 117.76917
O1
1 0.100514 0.675977E-04 0.91319 186.46606
Q1
1 0.019256 0.649585E-04 0.91319 5.42749
8 !number of boundary forcing freqs
S2
0.145444E-03 1.00000 0.00000
M2
0.140519E-03 1.02082 56.66478
N2
0.137880E-03 1.02082 235.62621
K2
0.145842E-03 0.86103 289.02826
K1
0.729212E-04 0.94663 234.20135
P1
0.725229E-04 1.00000 117.76917
O1
0.675977E-04 0.91319 186.46606
Q1
0.649585E-04 0.91319 5.42749
1 !nope
748 3 3 0 0 !Ocean
S2
0.176964 242.554062
0.177690 242.384430
0.177510 242.174347
0.176355 241.902740
0.174373 241.548157
0.171825 241.117950
0.169072 240.680725
0.166394 240.491669
--5975 lines: 0.164891 248.413308
0.007916 264.885040
0.008107 265.548402
0.008303 266.226685
0.008532 267.003479
0.008761 267.780273
0.009003 268.606262
0.009250 269.447815
0.009417 269.872803
S2
0.013654 7.256115 0.004914 93.759575
0.020770 408.793701 0.008645 366.466309
0.018554 407.063904 0.015181 377.297852
0.014287 389.791382 0.022409 352.792572
0.014968 362.867188 0.028418 345.676514
0.021243 338.996063 0.031904 343.857056
0.021490 317.573822 0.029729 336.248840
0.019136 315.128906 0.025946 330.115540
--5983 lines: 0.016465 314.147400 0.022100 327.066016
  
```

- Tidal species # (0: declinational; 1: diurnal; 2: semi-diurnal),
- Amplitude constants
- Angular frequency

- Nodal factor
- Earth equilibrium argument (in degrees)

- Number of ocean boundary nodes
- Elev b.c. (3): tides
- Velocity b.c. (3): tides
- Temperature b.c. (0): none
- Salinity b.c. (0): none

amplitude and phase

**Color scheme:**

- Only related to a constituent, not changing with time or space (rarely changed among events)
- Change with time (needs to be changed if the run period is changed)
- Change with space (needs to be changed if the boundary nodes are relocated)

tidal boundary forcing frequencies

tidal potential (contribute to a term in the momentum equation)

**Elevation**  
 Number of rows: (1 name + 748 nodes) × 8 constituents  
 Number of cols: 2 (amplitude, phase) (the order of the nodes/constituents matters)

tidal boundary forcing frequencies and amp/phase at each boundary node (contribute to ocean b.c.)

**Velocity (u, v)**  
 Number of rows: same as elevation  
 Number of cols: 4 (the order of the nodes/constituents matters)

<https://schism-dev.github.io/schism/master/input-output/bctides.html>

# Type 4 Boundary Condition file format

```
10/27/2012 00:00:00 UTC
0 0.000 ! number of earth tidal potential, cut-off depth for applying tidal potential
0 ! number of boundary forcing freqs
1 ! number of open boundaries
23 4 0 0 0 0 ! type of b.c.
```

# gen\_bctides.py

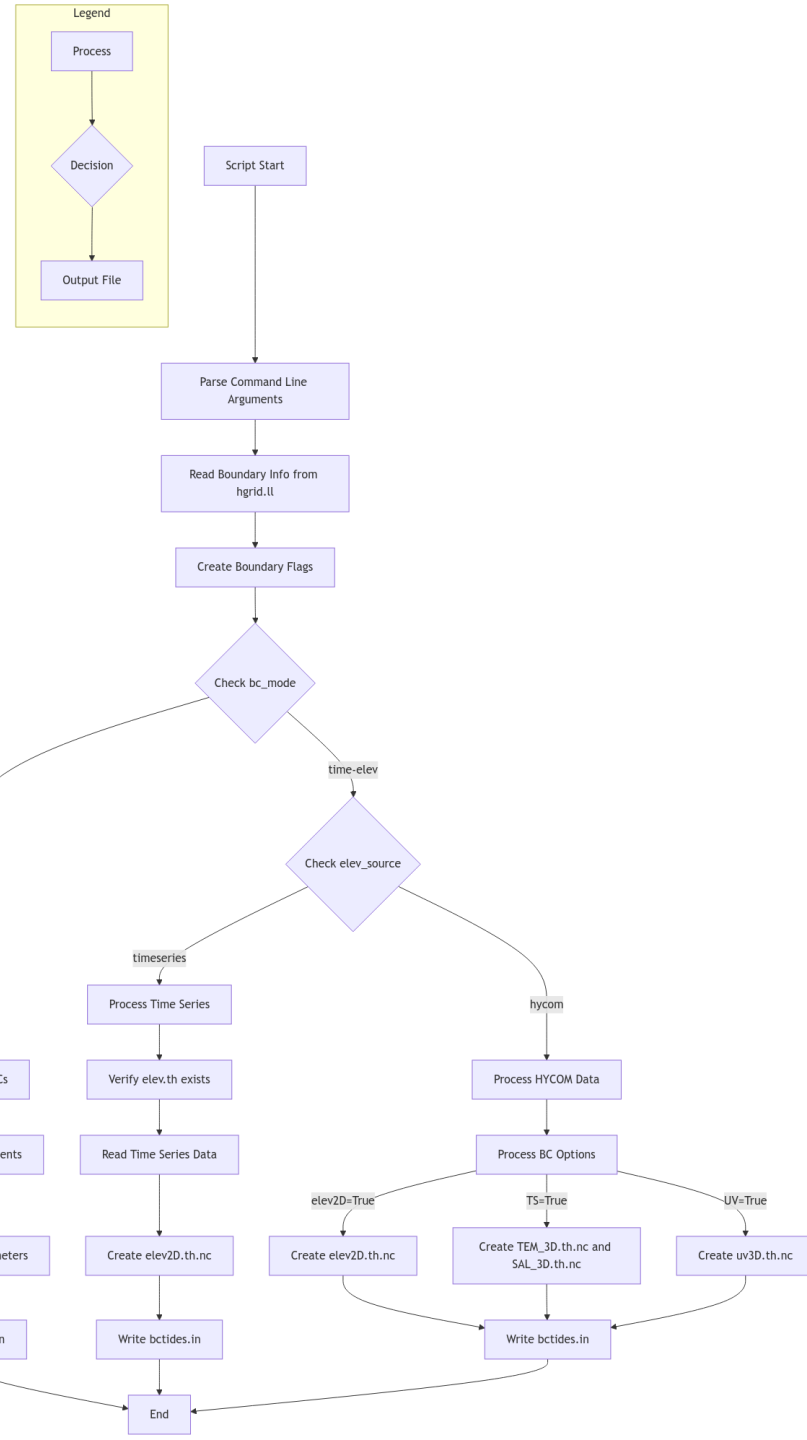
[GitHub Link: https://github.com/mansurjisan/UFS-Coastal-Inputs/tree/main/scripts/coastal\\_ike\\_shinnecock\\_atm2sch](https://github.com/mansurjisan/UFS-Coastal-Inputs/tree/main/scripts/coastal_ike_shinnecock_atm2sch)

- automates the creation of type-3 and type-4 SCHISM boundary condition files
  - bctides.in
  - elev2D.th.nc from user provided timeseries of surface water elevation file (elev.th). Note, type 1 boundary condition can't be used in UFS-Coastal due to a known bug.
  - elev2D.th.nc, SAL\_3D.th.nc, TEM\_3D.th.nc files from HYCOM data.

## Features:

- Supports type 3 (bctides.in) and type 4 (bctides.in and elev2D.th.nc) boundary generation.
- Reads open boundary information directly from hgrid.ll.
- Generates bctides.in for both boundary types.
- Multiple data sources for Type 4:
  - Time series from file (elev.th)
  - HYCOM data for elevation, temperature, and salinity.

# Workflow



# How to Use gen\_bctides.py

- **Tidal Boundary (Type 3)** Example:

```
python gen_bctides.py hgrid.II 2024-01-01 10 \  
  --bc_mode tidal \  
  --bc_type 3 \  
  --constituents K1,O1,M2,S2,N2,P1,Q1 \  
  --database tpxo \  
  --earth_tidal_potential Y
```

- **hgrid.II**: Path to horizontal grid file.
- **2024-01-01**: Model start date.
- **10**: Model run duration (days).
- **--bc\_mode tidal**: Specifies tidal boundary mode
- **--bc\_type 3**: Sets boundary condition type to 3 (tidal).
- **--constituents**: List of tidal constituents.
- **--database tpxo**: Use the TPXO tidal database
- **--earth\_tidal\_potential Y**: Include Earth tidal potential.

# How to Use gen\_bctides.py (timeseries of water elevation)

- **Tidal Boundary (Type 4)** Example:

```
python gen_bctides.py hgrid.ll 2024-01-01 10 \  
  --bc_mode time-elev \  
  --bc_type 4 \  
  --elev_source timeseries \  
  --elev_th elev.th \  
  --vgrid vgrid.in
```

- **hgrid.ll**: Path to horizontal grid file.
- **2024-01-01**: Model start date.
- **10**: Model run duration (days).
- **--bc\_mode** time-elev: Set boundary mode to time-elevation.
- **--bc\_type** 4: Sets boundary condition type to 4 (time series of water elevation; 2D.th.nc).
- **--elev\_source** *timeseries of water elevation or hycom*
- **--elev\_th** elev.th: Path to elevation time series file.
- **--vgrid** vgrid.in: Path to vertical grid file

# How to Use gen\_bctides.py (HYCOM)

- **Tidal Boundary (Type 4; HYCOM)** Example:

```
python gen_bctides.py hgrid.ll 2024-01-01 10 \  
  --bc_mode time-elev \  
  --bc_type 4 \  
  --elev_source hycom \  
  --gen_bc elev,temp,salt \  
  --vgrid vgrid.in
```

- **hgrid.ll**: Path to horizontal grid file.
- **2024-01-01**: Model start date.
- **10**: Model run duration (days).
- **--bc\_mode** time-elev: Set boundary mode to time-elevation.
- **--bc\_type** 4: Sets boundary condition type to 4 (time series of water elevation; 2D.th.nc).
- **--elev\_source** *timeseries of water elevation or hycom*
- **--gen\_bc** elevation, temperature, salinity, velocity
- **--vgrid** vgrid.in: Path to vertical grid file