elev.th file conflict in SCHISM and UFS-Coastal

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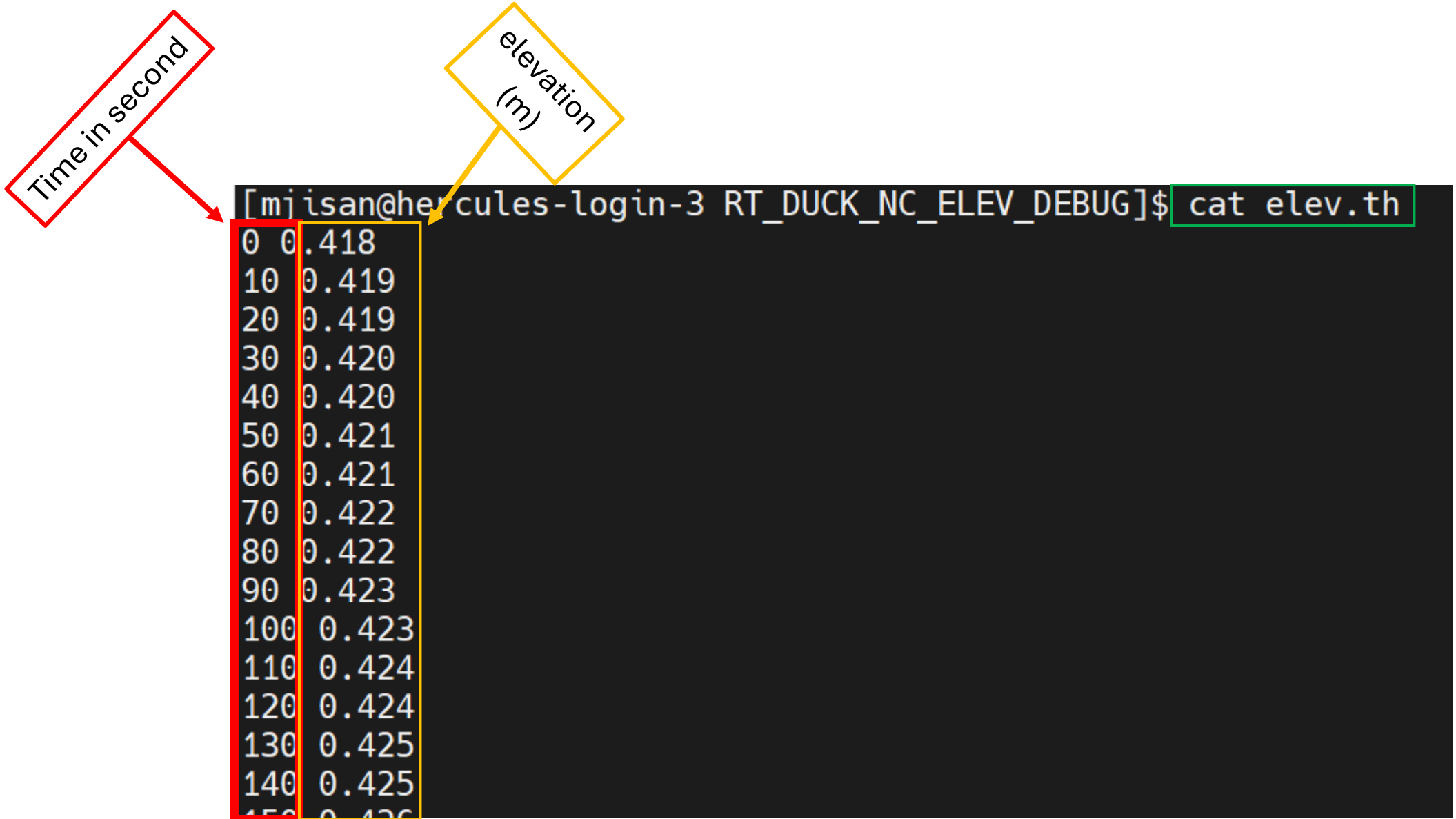
The Problem

- During the simulation of SCHISM with ESMF as coupler within UFS-Coastal, a conflict arose where ESMF unintentionally overwrote the boundary condition file (elev.th; type 1), leading to model failures.

- SCHISM needed consistent, read-only access to **elev.th** file to maintain model accuracy and boundary conditions.

elev.th file

Time varying surface water elevation



elev.th file

During simulation, it gets modified by ESMF_LogWrite

Except the first two lines, the entire elev.th file gets modified by ESMF with logs related to PET00.ESMF_LogFile

```
[mjisan@hercules-login-3 RT_DUCK_NC_ELEV]$ cat elev.th
0 0.418
10 0.419
20240927 171955.322 INFO            PET0  stop_option = nhours
20240927 171955.322 INFO            PET0  stop_ymd = -999
20240927 171955.322 INFO            PET0 ReadAttributes ALLCOMP_attributes:: end:
20240927 171955.323 INFO            PET0 OCN initialize (p=1) component  ...
20240927 171955.325 INFO            PET0 OCN initializing parallel environment  ...
20240927 171955.325 INFO            PET0 OCN writes results to directory "./outputs".
20240927 171955.325 INFO            PET0 OCN initializing science model  ...
20240927 171955.325 INFO            PET0 OCN meshloc is set to element
20240927 171955.325 INFO            PET0 OCN debug_level is set to 0
20240927 171956.230 INFO            PET0 OCN initialized science model
20240927 171956.236 INFO            PET0 Driver is in ModifyCplLists()
```

Error Messages

err file

Errors related to schism_stepand schism_nuopc_cap subroutines

```
+ srun --label -n 10 ./fv3_coastalS.exe
0: forrtl: severe (24): end-of-file during read, unit 50, file /work/noaa/nosofs/mjisan/ufs-weather-model/tests/stmp/mjisan/FV3_RT/RT_DUCK_NC_ELEV/.//elev.th
0: Image              PC                Routine            Line        Source
0: fv3_coastalS.exe   0000000001FDECA9  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   0000000001DEB5F0  schism_step_             1323  schism_step.F90
0: fv3_coastalS.exe   0000000001D244B7  schism_nuopc_cap_         790  schism_nuopc_cap.F90
0: fv3_coastalS.exe   0000000001104778  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   00000000011046E7  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   00000000011032C3  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   0000000000ABACF2  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   0000000001F09D5D  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   0000000000ACF214  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   0000000000AD318F  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   000000000114368A  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   00000000012D8288  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   0000000000AD066A  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   00000000009E27B0  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   0000000000DBA571  Unknown               Unknown  Unknown
0: fv3_coastalS.exe   0000000000966EE7  Unknown               Unknown  Unknown
```

Error Messages

schism_step.F90 code snippet

```
!      Get new time series values from *.th
       if(nettype>0) then
         if(time>th_time(1,2,1)) then !not '≥' to avoid last step
           ath(:,1,1,1)=ath(:,1,2,1)
Line 1323  read(50,*) tmp,ath(1:nettype,1,2,1)
           th_time(1,1,1)=th_time(1,2,1)
           th_time(1,2,1)=th_time(1,2,1)+th_dt(1,1)
         endif !time
!         if(it==iths_main+1.and.abs(tmp-time)>1.e-4) then
!           write(errmsg,*)'Starting time wrong for eta',it,tmp
!           call parallel_abort(errmsg)
!         endif
```

Unit number

Time-stamp

Data-point

Error Messages

schism_nuopc_cap.F90 code snippet

Error occurring in the line associated with schism_step call within the schism_nuopc_cap

Line 790

```
num_schism_steps=int(seconds/dt)
do i = it, it+num_schism_steps-1
   call schism_step(i)
   it = it + 1
end do
```

Solution Attempt: 1

Make the elev.th file read-only (chmod 444 elev.th)

Model failed because **ESMF** is unable to modify the **elev.th file**

0: forrtl: **severe (47): write to READONLY file, unit 50**, file /work/noaa/nosofs/mjisan/ufs-weather-model/tests/stmp/mjisan/FV3_RT/RT_DUCK_NC_ELEV/.//elev.th

0: Image PC Routine Line Source 0: fv3_coastalS.exe 0000000001FF7398 Unknown Unknown Unknown
0: fv3_coastalS.exe 0000000000D9ADAD Unknown Unknown Unknown
0: fv3_coastalS.exe 0000000000D9797C Unknown Unknown Unknown
0: fv3_coastalS.exe 0000000001D2DB8E schism_nuopc*cap* 347 schism_nuopc_cap.F90
0: fv3_coastalS.exe 0000000000ACF214 Unknown Unknown Unknown
0: fv3_coastalS.exe 0000000000AD318F Unknown Unknown Unknown

Solution Attempt: 2

Change unit number of elev.th in schism_step.F90 and misc_subs.F90

I suspect there's a conflict with unit number 50 which might also be used in ESMF side

- Modified unit number associate with elev.th which is part of misc_modules and schism_step subroutine.
- Replace unit number 50 with 52

Misc_subs.F90

```
! ...   Init reading t.h. files
      if(nettype>0) then
        open(52,file=in_dir(1:len_in_dir)//'elev.th',status='old')
        rewind(52)
        !Get dt 1st
        read(52,*)tmp !,ath(1:nettype,1,1,1)
        read(52,*)th_dt(1,1) !,ath(1:nettype,1,2,1)
        if(abs(tmp)>real(1.e-6,rkind).or.th_dt(1,1)<dt) call parallel_abort('MISC: check elev.th')
        rewind(52)
        ninv=time/th_dt(1,1)
        do it=0,ninv
          read(52,*)ttt,ath(1:nettype,1,1,1)
        enddo
        th_time(1,1,1)=ttt
        read(52,*)ttt,ath(1:nettype,1,2,1)
        th_time(1,2,1)=ttt
      endif !nettype
```

Solution Attempt: 2

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- Replace unit number 50 with 52

Schism_step.F90

```
if(nettype>0) then
  if(time>th_time(1,2,1)) then !not '≥' to avoid last step
    ath(:,1,1,1)=ath(:,1,2,1)
    read(52,*) tmp,ath(1:nettype,1,2,1)
    th_time(1,1,1)=th_time(1,2,1)
    th_time(1,2,1)=th_time(1,2,1)+th_dt(1,1)
  endif !time
```

Solution Attempt: 2

- Solution attempt 2 worked and model run completed successfully
- The elev.th file didn't get modified by the ESMF and the model was able to read it correctly.
- Next steps would be to check if the model results are affected by these changes.
- Solution attempt 2 indicates that there might be conflict regarding unit number between SCHISM and ESMF subroutines.

Some Workarounds

- I tried running the model using type 3 boundary condition (tidal amp/phase).
- Using BC type 3 doesn't require elev.th file since the model reads data directly from the bctides.in file.
- The simulation worked fine when **type 3 boundary condition** (tidal amp/phases) was used