The University of Miami Wave Model (UMWM)

Version 2.1

Addendum to Version 2.0 Description and User's Manual

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Changes from Version 2.0

The most significant change is with the calculation of the grid spacing in **src/umwm_init.F90**. Specifically, the following code was changed:

Showing 1 changed file with 4 additions and 4 deletions | Hide whitespace changes | Inline | Side-by-side

src/umwm_init.F90 | View file @ 79d56b27

```diff
@@ -511,9 +511,9 @@ IF(gridFromFile)THEN

   DO n=1,nm
     DO m=2,mm-1
-      dx_2d(m,n) = R_earth*2*asin(sqrt((sin(0.5*(rlat(m+1,n)-rlat(m-1,n))))**2&
+      dx_2d(m,n) = R_earth*2*asin(sqrt((sin(0.25*(rlat(m+1,n)-rlat(m-1,n))))**2&
                                  +cos(rlat(m-1,n))*cos(rlat(m+1,n))&
-                                *(sin(0.5*(rlon(m+1,n)-rlon(m-1,n))))**2))
+                                *(sin(0.25*(rlon(m+1,n)-rlon(m-1,n))))**2))
     ENDDO
   ENDDO

@@ -522,9 +522,9 @@ IF(gridFromFile)THEN

   DO n=2,nm-1
     DO m=1,mm
-      dy_2d(m,n) = R_earth*2*asin(sqrt((sin(0.5*(rlat(m,n+1)-rlat(m,n-1))))**2&
+      dy_2d(m,n) = R_earth*2*asin(sqrt((sin(0.25*(rlat(m,n+1)-rlat(m,n-1))))**2&
                                  +cos(rlat(m,n-1))*cos(rlat(m,n+1))&
-                                *(sin(0.5*(rlon(m,n+1)-rlon(m,n-1))))**2))
+                                *(sin(0.25*(rlon(m,n+1)-rlon(m,n-1))))**2))
     ENDDO
   ENDDO

```

With the change, the distance between grid points is correctly calculated. This mainly affects the propagation of waves away from their source fetch regions, e.g., long period swell.

The second difference is the **explim** parameter in **namelists/main.nml**. It is now set to 0.8 in the namelist (formerly 1.1) provided with the repository, which has proven to be numerically stable in multiple high resolution hurricane test runs. Explim limits the growth of the wave spectrum to a finite value and it is one factor that is used to determine the dynamic time step used by UMWM. Setting it too large results in a too long time step and numerical instabilities. These instabilities usually first occur at the steep transitions between deep and shallow water (Bermuda, Bahamas) or at one of the domain edges.

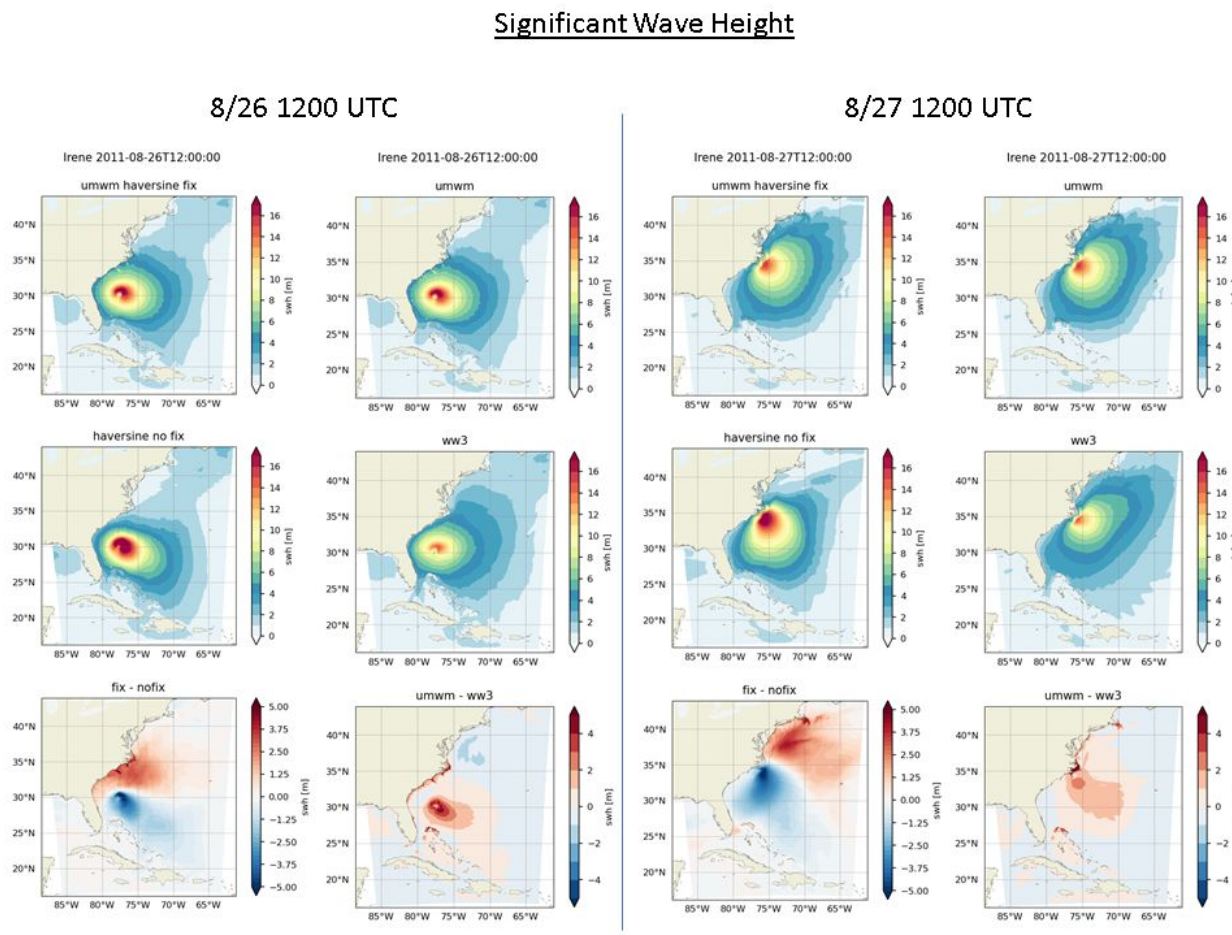
Thirdly, the **&STOKES depths** provided in the v2.0 **namelists/main.nml** is incompatible with the code. The code is hard wired for 12 levels, and will crash if too many levels are specified. The updated namelist has 12 levels which have been tested for high resolution hurricane and global runs.

As a temporary fix to help with the numerical instability issue, a new Python script is included to mask out areas of steep transition between deep and shallow water near Bermuda, Bahamas, ect: **tools/topo/modify_land_mask.py**. (Note that even when instabilities do not occur, sometimes the model may choose a very small time step, < 10 sec). By default, this script will set all points in a box containing Bermuda with bathymetry shallower than 3000 m to land. Additional boxes can be added and the cutoff bathymetry value can be modified near the top of the script. To run it, first copy **umwm.gridtopo** to **umwm.gridtopo.orig**. It will read from **umwm.gridtopo.orig** and overwrite **umwm.gridtopo**.

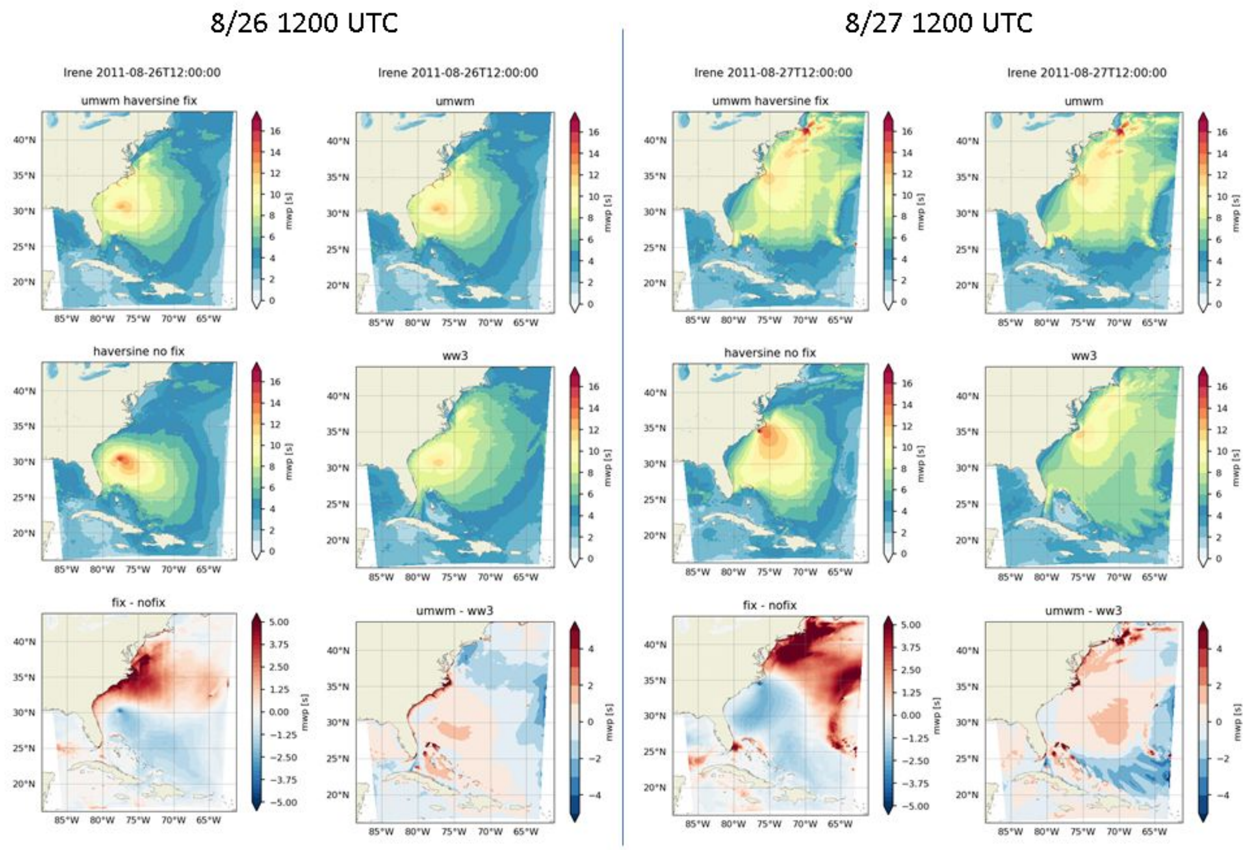
Finally, this addendum has been added to the docs/ directory in the repository. The file **docs/umwm_manual_v2.pdf** has NOT been changed.

Example output comparisons from test runs

For this test run, UMWM v2.0, UMWM v2.1, and Wavewatch 3 were driven using the same winds from a high resolution simulation of Hurricane Irene (2011). The propagation of the swell ahead of the storm is much more pronounced in UMWM v2.1, and it is more similar to the swell propagation from Wavewatch 3.



Mean Wave Period



Remaining Issues

- It is not clear whether the current dynamical time step in UMWM is the best. Addressing this is being looked at for a Version 3.0, and may reduce or eliminate the need for the Python script.
- In shallow water (< 100 m) near the coast, there is a dramatic and sudden increase in the mean wave period and dominant wave period as the storm's swell approaches. This is not the case in Wavewatch 3. It is not entirely clear how realistic the UMWM wave period/wavelength is in the shallow coastal waters.