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Description _____

Lecture 1

- FM only 2D at the moment. To change in future.
- FM uses SOBEK software for 1D.

- FM needs to focus on creating continuous grids w/ triangle mesh lines.

- FM is (X, y) based & not (M, N)

- Flow & morphology are coupled. The process is run flow/mor for a time then run Wave or Wqg for a ~~test~~ short time and then feed back.

Flow/mor = 1 hour \rightarrow run Wave/Wqg \rightarrow Flow/mor (1 hour) \rightarrow repeat

- Delft effective to ~10m depth. Past that check another model.

* - Large eddy simulation is used to solve eddies at a sub-grid (i.e. more precise than current grid setup) level to improve eddy assumptions w/o tighter grid.

- Sometimes non-standard solvers are available. Need to email developers for these.

- Current < 10 . Time step small enough to not jump time steps.

1. Set time step.

2. add 50% ^{time step} and make sure outputs match.

3. Double time step & check match.

4. Try other times and see the error. (Cut in half, triple, etc.)

- FM you can't set Current. ~~Must~~ Set time step and check problem grid & cells.

It runs through time steps to check? FM automatically chooses time step based on max specified by user.

- ~~You can~~ The user can reduce resolution of grids in areas of little interest. It will not effect results like Delft3D will.

- Depth - σ is a % of total depth (best for sediment transport) - change is water depth (i.e. tide)
 Σ is a set layer thickness (best for salt wedge) - causes diffusion of WAD & salt wedges.

Flexible layer available in FM (future)

- Estimates Manning roughness recommended, ~~but other software~~ because of flexibility. Others models Chézy or Manning to be compared.


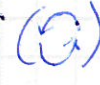
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Lecture 2

- Curvilinear grid should follow flow lines.
 - High resolution always extends along (M, N) lines.
 - Min 3 to 5 grid cells to model area of interest
 - Curvilinear grid ~~where~~ where possible.
 - A grid can be created that is does not align to the main channel, but it is not recommended.
 - Refine grids in areas of interest. Focus on ~~outline~~ creating splines in flow lines.
 - Land boundary is Mean water line (MSL). Land boundary ~~too~~ is a place holder for (M, N) boundary. Open Earth has a tool that ~~converts~~ converts shape to land boundary (LdbTool.m)
 - RFGGRID refine locally to improve resolution over small M, N area.
- Ex 1 = 65
- Ex 2 = 81
- Double right click on the list refreshes   if buttons greyed out
 - Standard current # calc is 60s time step.

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Lecture 3

- Most efficient to have rectilinear grid w/ FM transitions
- 10-20 grid cells to capture your solution
- Iterate through grids. Develop → Run → Refine problems.

Lecture 4

- TEHAL - columns X, Y, Z ~ 4 pts per grid cell ~ 1 sample point
 - Did all my tight data sets, + triangulation over sparse datasets, internal diffusion to fix other missing pts.
 - Settings + General can change Courant timestep
 - Copy Depth to Samples → saves grid samples if you need to add grid cells and other items change in the project. Also need to change any value to 1 in "General + Settings"
 - Building bathy - "shallow data" is your friend
→ "View → Depth → Contour data"
1. Did all average
 2. Bound area w/ polygon for triangulation
 - 2a. Did all averaging
 3. Depth Edit → Depth Linear
 4. ~~Internal diffusion~~ Operations → Internal diffusion
- Bathy is a fixed datum and water level corrections are applied to boundary conditions.

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Lecture 5 - Quick Plot

Tracer Simulation (tide Bandings) - plot in Muppet - Open Earth Tools

Lecture 6 - Hydraulic Model

- Sed transport will give tons of errors. This is normal.
- Latitude is important for Coriolis forces.
- Morphology want depths at grid cell centers so results are not calculated at the corners. Corner calculations are default.
- Erosion model is using correct max, mean, or min correctly when averaging grid cells.
- Dry points - include feature that is too small to pick up in the bathy E. Small island, grove, or jetty.
- Thin dam - Blocks all flow between grid cells.
- FM builds thin dam at land boundary files.
- Obstructions - thin dam with an adjustable elevation. Define as additional parameter (Check manual beyond)
- Best to build dry pts, thin dams, & obs in Quick-In.
- IT date can't change after first files are made.
- Time step is selected based on Courant #.
- Boundaries \rightarrow if nothing defined model assumes infinite depth well that absorbs everything.
- Reflection parameter $\alpha = 50$ is typical to filter out sea boundary reflection error. Make it higher is spin up to dampen to stable solution.
- Smoothing time \rightarrow forces model to run through errors. Good to check assumptions.
- Threshold depth \rightarrow adjust threshold for a constant ~~sea~~ velocity. Depths below threshold are considered dry cells. Drying & flooding check.
- Discharges represent outfalls, small streams, slivity, sediment, and can be source (+) or sink (-).
- Additional parameters: Non standard functions. Must search code or manual for key words.

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Lecture 7 - Waves

- SWAN - swell & wind waves. Gravity waves to surge is resolved in Delft3D.
- Is a Phase averaged model (i.e. non-Boussinesq) that doesn't include ~~diffraction~~ ~~refraction~~ reflection.
- Doesn't work for enclosed harbours. Need Boussinesq.
- SWAN doesn't recognize inputs for FLOW model (thin domes, etc.). These must also be included in the Wave Input.
- SWAN only simulates one spectral peak (e.g. JONSWAP). If two peaks are needed for swell and wind waves develop a custom input or run two models.
- ~~But~~ If you turn on breaking, also turn on bottom friction & whitecapping. Good to include all.
- SWAN solves iteratively until accuracy criteria are achieved.
- ~~But~~ set # of bins sets degrees wave energy is allowed to spread.
- Ensure area of interest is ~~protected~~ far away from area of interest.
- Update between wave and flow should be low (10 minutes) for large tidal exchange and high for ~~large~~ small tidal exchange.
- Must run wave & on-line wave boxes in the FLOW GUI.
- Communication output file is for wave-flow coupling.
- ~~Delft~~ Deltans has in house Boussinesq model that requires service package.
- SWAN - Best practice to nest grids. Larger grid is used to resolve equations and clean before hitting ideal model boundary.
- Depths are (+) and heights are (-). Water level -0.449 m tidal and is high tide.
- Maximum is best of boundaries that end at land. Water level boundary good for offshore.
 - ↳ Slope of water level - flexible
 - ↳ set water level
- Best to keep flow and wave models separate.
- Expand grid → add grid cells - add Depth & copy to sample → average to closest point or extend old grid inside a polygon → be patient. - time skip

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Lecture 7 (Cont.) - Wave

- Define all open water boundaries.
- Run each file separately to test. → create new file folder and run back together.

Lecture 8 - Morphology

- Can't model sand waves or small morphology.
- Best to run a model w/ large intervention and one without intervention. It's not an exact science because there is a lot we don't understand.
- Delft3D models overtopping erosion. XBeach is better for dune erosion where slump failure occurs (i.e. avalanche).
 - ^{Van Rijn} ~~Testing~~ ^{Eq.} used for sediment transport in Europe. Large difference between bed (rolling on top) and suspended load.
- Minimum bed thickness 2% of water depth to capture processes. Use this as a start and maybe increase.
- Edit transport conditions → always check no sources are being added.
- Physical Process → Morphology → Equil sand concentration. This box ensures that sed that leaves is added back (i.e. equilibrium) somewhere.