

Q&A Report: Using Numerical Model Diagnostic Outputs

#	Question	Answer	Answer Name
1	If I were doing modelling like this, where would I get the atmospheric boundary condition data from. I imagine preprocessing that data could be a pretty significant task? Any tips how to QA the data before entering it into the model?	<p>Hello, there are some tools we've put together called the TUFLOW FV Get Tools. They help pull down met data from ECMWF ERA5, NOAA CFSv2 or the BoM's BARRA in Aus. You give it the time period you need and the spatial extent and the tools will download the data (wind speed, mslp, air temp, relative humidity, solar and terresrial radiation etc.) and prepare it with a control file for input into TUFLOW FV. There's more info on settin this up and running it here</p> <p>https://www.tuflow.com/insights/2024_03-tuflow-fv-get-tools/ and here:</p> <p>https://fwwiki.tuflow.com/TUFLOW_FV_Get_Atmos</p> <p>. If you need more info pls send me an email at support@tuflow.com</p>	Mitchell Smith
2	Is there a recommended minimum number of 3D layers when assessing density stratification in projects like this?	It depends a little on the gradient of the thermocline for lakes. Typically 1m vertical resolution near the surface is sufficient. If there was a really sharp thermocline you may need to reduce this to 0.5 m.	Mitchell Smith
3	Which software is use to develop the curtain profile animations?	<p>These are curtain plots from the TUFLOW FV Python Toolbox run in a Jupyter Notebook.</p> <p>See the following page for more information: https://fwwiki.tuflow.com/TUFLOW_FV_Python_Toolbox</p>	<p>Mitchell Smith</p> <p>Emilie Nielsen</p>
4	Is there any example model that uses the diagnostics outputs? Where can I find more information about this?	<p>There are several reports available that use diagnostics from TUFLOW FV. Here is one of Oxley Creek, Queensland:</p> <p>https://science.qld.gov.au/__data/assets/pdf_file/0/031/375763/qwmn-medli-SEQ-new-catchment-models.pdf</p> <p>The TUFLOW FV Water Quality Manual explains all the diagnostic fluxes and their outputs, as well as how to use these to do complete mass balance assessments of a system:</p> <p>https://docs.tuflow.com/fv/wqm/manual/2025.2/Outputs-3.html#FVOutputs-4</p>	Michael Barry
5	Can you provide how the temperature affects DO in the lake?	live answered	Mitchell Smith
6	At what point do you stop drilling with the 'why's'? I mean sediment transport for example would be driven by other processes as well, so what level do you aggregate your inflows to to clearly show what's going on?	<p>There are definitely plenty of unknowns in water quality and sediment transport. I would use the diagnostics as another tool in the warchest to help you as the modeller, manager etc. better understand the system, or to help you sanity check the model. Taking sediemnt transport for example, if you're looking a bed morphology... We get an increase in bed level of 0.2m. However, is the deposition occuring due to a bunch of mud, or is it sand, gravel etc. We can track bedload vs suspended load etc. If we have mud where we shouldnt' we can infer that maybe the model isn't doing the right thing. Diagnostics are also availabe in TUFLOW FV for nett sedimentatin, erosio0in, deposition, inflows, outflows, tidal exchange etc and these, wgen co-presetned tell teh story of where sediment is moving and why. This is what I think we should be presenting to our customers - the outputs are automatic and plottable in seconds, so why not have a look?</p>	Mitchell Smith and Michael Barry
7	How does the Lake lose Oxygen to the atmosphere?	live answered	Mitchell Smith
8	What duration was needed to "warm up" the initial conditions in the model before the t=0 Aug 01 assessment period?	Depending on the system between 1-3 months may be ok. For larger systems you may need six months. Usually you would start the model in winter and allow the stratification to evolve into the summer.	Mitchell Smith

9	Initially you mentioned biological fluxes and eutrophication as an issue. What are the diagnostics to look into the main processes?	live answered	Mitchell Smith
10	Is there a modelled photosynthetic flux driven by the algal content in Lake Windermere for this August case study?	live answered	Mitchell Smith
11	How long would the model run to simulate a summer?	live answered	Mitchell Smith
12	So destratify the thermocline - means the lake is more uniform in heat concentration and therefore more water mass can retain more oxygen?	Yes, the lake is more uniform, but critically the surface is cooler. This cooler surface means that water can absorb oxygen. Cooler water can hold more oxygen than warmer water.	Mitchell Smith
13	Talking about Diagnostics, Lets say your water level from the model at particular point and time validates reasonably from what was observed in the site. Then what will be the significance of fluxes here, because the source of flood will be rainfall anyway And what difference does it make knowing the flux in this particular situation? In Addition to that, flood is very uncertain, and my happen over large span, so the fluxes could change over the course of time, and what application could it possibly infer if your model validates with the field observation	While there are not as many variables to look at when compared to lake hydrodynamics, sediment transport or water quality etc. diagnostic outputs in the form of volume fluxes can still be very useful in flooding. For example, you may have different flow monitoring stations throughout the catchment, these can be used to cross check flood volume against input hydrology or direct rainfall to calculate mass balance. This mass balance can give you confidence that the model is setup correctly and that you haven't missed any boundary conditions (which can be a common mistake when applying hydrology to flood models). Also it can help understand how much flow is coming from which tributaries. Other diagnostics may help you understand timing of flood peaks, interaction of conveyance and flood storage regions of the floodplain.	Mitchell Smith
14	Thermocline = the plane of significant heat concentration differences?	The thermocline is where you have a rapid change in water temperature as you go from the surface to down lower in a lake. I often think about swimming in a dam in summer. When you swim on the surface its' warm, but then you dip your toe down a bit and it gets cold very quickly. A thermocline occurs when there is thermal stratification.	Mitchell Smith
15	Was the tracer injected at the 1L/s per port bubble plume rate?	It was injected at a rate that allowed it to act as a visual aid. It did not add to density or momentum	Michael Barry
16	And was it entered separately to the bubble plume "command line"	Yes. It was added using TUFLOW FVs 'flux' (FC) boundary condition that allows for addition of mass without water, so pure tracer inclusion without interfering with the hydrodynamics at all.	Michael Barry
17	Do the diffusers only affect the flow, or do they increase the oxygen concentration in water as well?	No - just flow	Michael Barry
18	Is this type of modelling common in water supply dams? Good quality water quality from the dam would reduce treatment costs substantially!	live answered	Mitchell Smith
19	How does the atmosphere provide O to the lake at the surface?	live answered	Mitchell Smith
20	Would mechanical mixers (which introduce turbulence) have a similar impact on temperature and DO in the lake?	live answered	Mitchell Smith
21	How can we include this in Water quality evaluations of reservoirs?	live answered	Mitchell Smith
22	Love the detailed analysis and following through to cost to demonstrate the importance of understand the why..	Thanks :)	Michael Barry
23	Have you ever tested the use of bubble plumes to improve mixing in a stratified lake or lagoon with higher salinity at the bottom and lower salinity at the surface? If not, based on your experience, do you think it will improve the mixing in the lake?	I have. The density difference generated by salinity is hydrodynamically equivalent to that generated by temperature, as far as the action of a bubble plume is concerned. It is equally robust at entraining and detrainning salty water as it is cold water. Bubble plumes are definitely used to destratify salt based systems.	Michael Barry