Webinar Delft3D Phytoplankton modelling: concepts of BLOOM Questions and answers

1. **Is the DELWAQ-BLOOM model a good choice to simulate phytoplankton dynamics in rivers at a 1D scale?**

   Yes, it is. It doesn't matter for BLOOM how the system is physically organized. BLOOM has been applied in 1D rivers, as well as in many other systems modeled in 1D, 2D and 3D, including lakes, estuaries, bays, coasts, and oceans.

2. **There is a kind of series of floating islands called Phumdis exclusively present in Loktak Lake, Manipur, Northeast India; This Phumdis are made up of heterogeneous mass of algae, soil and silts. They get nutrients from the ground while temperature, light, salinity do not play much role. I just want to know if there is any other module to model this Phumdis.**

   These floating islands are a special situation for which we do not have dedicated modules available. Yet, it may be possible to adjust the parameters of one of the benthic species groups in BLOOM (e.g. Ulva) to approximate the dynamics of the floating islands. Since BLOOM algae cannot interact with nutrients from the sediment, this would however require the assumption that these floating islands are not nutrient limited. Nice option for the Ulva in BLOOM is that both a fixed and a floating variant are available; depending on a certain critical shear stress, the Ulva may switch between these two variants.

3. **How is grazing considered in BLOOM?**

   The simplest, semi-dynamic, option is to impose grazer biomass (zoobenthos, zooplankton or both) by using the CONSBL module. This module will compute all grazer-related processes as based on the imposed biomass. If the algal biomass is insufficient to support the imposed grazer biomass, the grazer biomass will be reduced. An alternative option is to fully dynamically model the grazer biomass (filterfeeding zoobenthos including shellfish and zooplankton) by using the GRZDEB module, which is based on the Dynamic Energy Budget (DEB) theory. This module has been recently added to the code, and will soon be added to the manual as well.

4. **Are there configuration files for different model applications available, e.g. for sediment water interaction?**

   Several substance files are available on the DELWAQ open source forum (http://oss.deltares.nl/web/delft3d/delwaq). At the moment, we are working on a new and extended set of demonstration models and standard substance files that include BLOOM dynamics. These models and files will also become available via the forum. One of the provided substance files will also include a simple sediment-water interaction. A more

comprehensive sediment module is also available in Delft3D-ECO, but for this option we do not provide a standard substance file yet.

5. **Apart from nutrient limiting conditions, how do pollution discharges (from point sources, especially from metropolitan cities) affect the BLOOM and can this be captured in the model?**

   Pollution discharges may affect BLOOM in several ways. First, discharges may provide nutrients for phytoplankton to growth. Second, pollution may contribute to light extinction in the water column (DOM, suspended solids) and can thus have a negative impact on phytoplankton growth. Toxic impacts of compounds to algae are not considered in Delft3D-ECO.

6. **Some phytoplankton have a cyst mode in their live cycle. How can this be applied in the model?**

   At the moment cysts are not part of Delft3D-ECO. For most existing BLOOM applications, the presence of cysts is of low importance and has been neglected. However, in predicting harmful algal blooms, cysts could play an important role.

7. **Is light extinction computed with phytoplankton biomass simulated by BLOOM and does it impact the hydrodynamic model?**

   BLOOM takes into account the contribution of algal biomass to extinction and also considers self-shading. Currently, there is no feedback from phytoplankton extinction to hydrodynamics. However, we do acknowledge that in some cases this is a relevant feedback, since extinction can affect the heat balance and vertical mixing. Hence it is on our development list.

8. **May I know the parameter we should input to the model? Such as for example nutrients.**

   Several substance files are available on the DELWAQ open source forum (http://oss.deltares.nl/web/delft3d/delwaq). At the moment, we are working on a new and extended set of demonstration models and standard substance files that include BLOOM dynamics. These models and files will also become available via the forum. The demonstration models also contain input parameters, including nutrients, temperature and radiation.

9. **Does the requirement of species/group vary per region?**

   One of the main assumptions in BLOOM is that the algal requirements are dependent on the environmental conditions. In other words, the algae adapt themselves to local conditions, and their requirements may thus change per region or throughout time (as will their stoichiometry). This however does not require any adjustments in algal coefficients.

10. **My question regards the affirmation by Dr. Los that "usually default coefficients work OK in most applications of the model", I wanted to know if he or the team have enough evidence of this in tropical areas, because we had a recent experience with another model**

where default coefficients from many references failed in a Coastal lagoon in North Colombia composed mainly by Oscillatoria and Diatoms.

Yes, we can indeed confirm that our default coefficients do work in most applications. We have applied default BLOOM coefficients in models for several tropical systems (including a South American lake, as well as tropical reservoirs and a coastal system in Singapore.

11. **In reference to the 24h time-step, do you have suggestions for how to compare against observations, when there are significant variances at shorter time scales. Should I take 24h average of observations?**

    We suggest comparing model results to the full set of observations. The average of measurements is not equal to the daily output of BLOOM.

12. **Can we capture the succession of phytoplankton species during blooms**

    Yes, this is actually one of the strong points of BLOOM. Typically, opportunistic (r-strategy) species dominate at the start of the bloom and towards the end of the bloom, equilibrium (k-strategy) species dominate.

13. **May I ask why the BLOOM run at 24 hours' time-step? And if we want to model the diurnal variations of water quality parameter, what model should we go for?**

    BLOOM is run on a 24hr time step to take into account the fact that algae do not react instantaneously to their surroundings. If you would want to model the algal dynamics using shorter time steps, you would need to include a lot more physiological detail and processes in your model (e.g. algal reserves of carbon, nitrogen, and phosphorous and detailed photosynthesis processes).

    However, regardless of the BLOOM time step, biogeochemical dynamics of several other water quality parameters can still be run on smaller time-steps. Diurnal variations of oxygen can be included by a separate process (VarOXY).

14. **Some cyanobacteria species can migrate at a sub-daily time-step. Does it impact BLOOM simulation of cyanobacteria biomass?**

    All algae in BLOOM can be given a sedimentation or buoyancy rate. This rate can be specified to be constant or changing in time and/or space. In the standard BLOOM code, there is however no means to relate this rate to environmental or physiological conditions.

15. **What's the upper limit for the species number that can be incorporated in the model?**

    The total number of types included in a model application is limited to 30. Since we typically use three types per species, the number of algae that can be selected in one model is limited to about 10-12.

16. **Can I use some data with a monthly period?**

    Technically speaking, it is possible to use forcing data of any temporal resolution.

17. Does the BLOOM applies to zooplankton and other grazer?

No, BLOOM itself only deals with algae, and cannot be used to model grazers. To model grazers, other modules are available (see question 3).

18. How is the interaction with macrophytes modeled?

The interaction between algae and macrophytes depends on the module with which the macrophytes are modeled. When modeled in BLOOM, macroalgae are included in the optimization procedure together with the other algae, and are thus modeled in full consistency with the other algae. In contrast, when macrophytes are modeled using our submerged vegetation module, the macrophytes will not be included in the optimization routine, but will still compete with algae for pelagic nutrients and light. In this case uptake of nutrients by macrophytes and algae will take place in the model in two consecutive steps, and the modeled time step should thus be chosen small enough not to affect the results.