

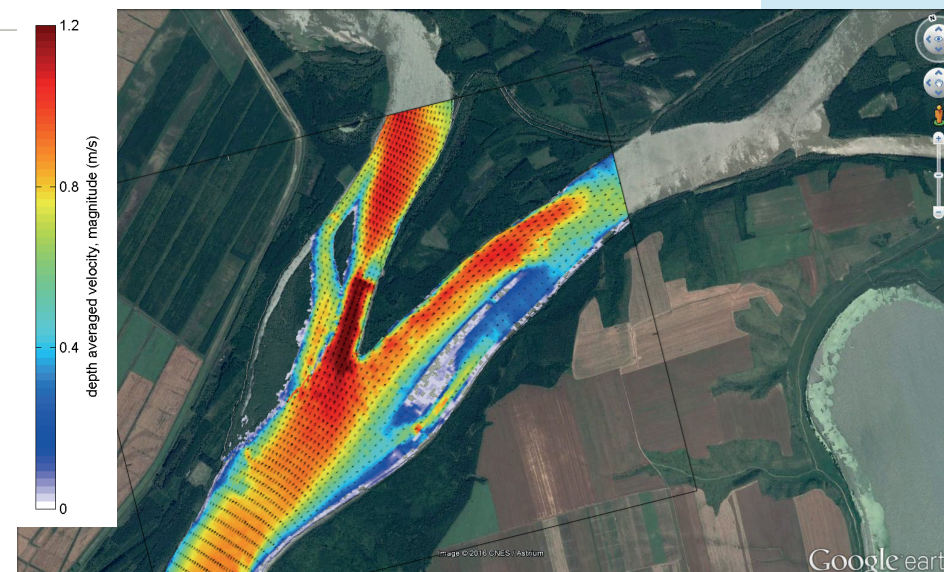
Improving the navigability of the Lower Old Danube in Romania

At 2783 kilometres, of which 2414 kilometres are navigable, the Danube is the second longest river in Europe. It is one of Europe's most important inland waterways and it has been designated a Priority Axis, a pan-European inland transport link from the port of Rotterdam on the North Sea to the port of Constanța on the Black Sea. In Romania, the Danube covers 1075 kilometres from its point of entry at Baziaș to the mouth at Sulina.

The section between Călărași and Brăila (km 375 – km 175) connects the Danube to the Danube - Black Sea navigation channel and the maritime Danube. The Danube Commission recommends a minimum depth of 2.5 m for the navigable channel and a width of between 150 and 180 m for this section.

Currently, the main arm of the Danube (km 347 – km 300) does not meet the minimum depth and width criteria on approximately 150-160 days each year. On these days, traffic is diverted through the Bala – Borcea branch, where the conditions are sometimes difficult due to the limited width of the fairway and sharp bends at some locations. Furthermore, this detour increases the distance travelled between Călărași and Cernavodă by some 110 km. Dredging is routinely carried out to comply with the recommendations of the Danube Commission. The morphodynamics of the river mean that this dredging is inadequate and only effective in the short term.

Several studies have been conducted in recent years and recommendations have been made to improve the navigation conditions on the Danube between Călărași and Brăila. The aim of the present project is to evaluate alternatives for improving navigability. In order to provide sound recommendations, we developed two different models: a detailed 3D hydrodynamic model for the Bala bifurcation, and a large-scale quasi-3D morphodynamic model for the Danube branches. The models were used to simulate



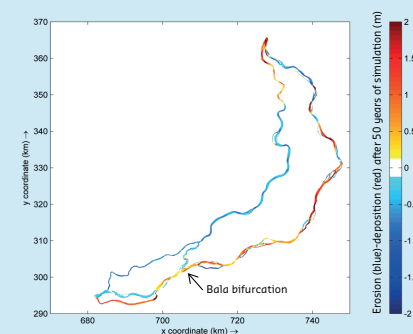
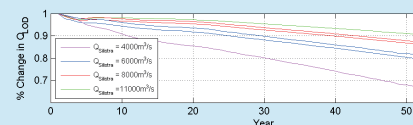
Velocity pattern
at the Bala
bifurcation

and analyse two scenarios for improving navigability by comparison with the benchmark condition.

A challenging task in this analysis was the simulation of the large-scale autonomous morphological behaviour of the Danube. We were able to successfully reproduce the long-term trend of discharge reduction into the Lower Old Danube. After both models were validated, they were used jointly to analyse the proposed alternatives. Finally, we presented our client Egis Eau with a complete overview of the effect of the alternatives on water levels, discharge distribution and velocities, as well as the large-scale morphological impact. These results can now be used to select the best alternative from a hydraulic point of view. In conjunction with other factors such as costs, maintenance and environmental considerations, they will be used to produce recommendations about a solution to improve navigability.

Further reading:

Yossef et al. (2016) Modelling large scale and long term morphological response to engineering interventions at river bifurcation,. In: River Flow 2016 – Constantinescu, Garcia & Hanes (Eds), © 2016 Taylor & Francis Group, London, ISBN 978-1-138-02913-2.



Long-term (50 years) and large-scale morphological behaviour