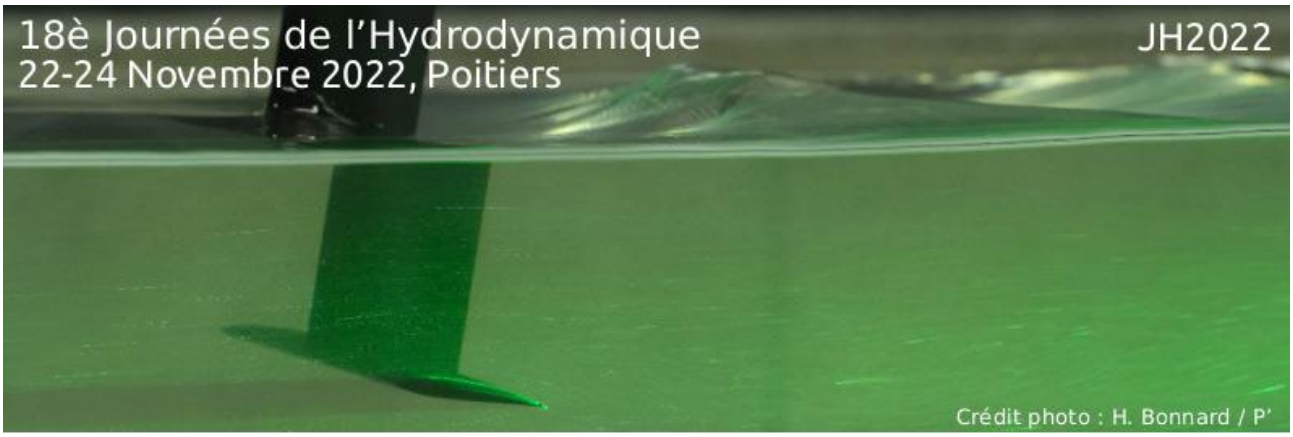

STUDY OF THE SPATIAL VARIABILITY OF THE FLOW CHARACTERISTICS FOR TIDAL ENERGY BY LES APPROACHES

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Résumé

Faced with the announced shortage of fossil fuels and the need to reduce our dependence on these energies, the use of energy from the seas becomes of interest. Among these, there is the energy of tidal currents captured by tidal turbines. The installation of tidal turbines in areas of interest requires to receive data on speeds and turbulence. Turbulence at these sites is generally high (Togneri. 2016) and can have an impact on the turbines in terms of production or fatigue (Blackmore, 2016). The most immediate approach is to make measurements with ADCPs (Thiébaut et al, 2020 a). However, this method, if it gives very good indicators (Thiébaut et al., 2020 b, c), is heavy, expensive and sometimes complicated to implement especially in area of rapid variation in seabed morphology. In that context, high fidelity numerical simulation should help to improve the flow knowledge by providing an estimation of the flow characteristics in the require area. Such an approach has been applied by developing a local LES model (mesh size of 0.25m) capable of doing simulation on a duration of 20 minutes (Mercier et al, 2020) and regional one (horizontal mesh size of 3m) capable of doing simulation for few tidal cycles (Bourgoin et al., 2020, Guillou et al., 2021). That work began during the ANR/ITE THYMOTE project is continuing in the framework of the INTERREG FCE TIGER (Tidal Stream Industry EnerGisER) project. The aim of this last project is to reduce the Levelized Cost of Energy (LCOE).

The purpose of the communication is to provide an overview of the LES simulations realised at local and regional in the project TIGER on two French sites (Raz Blanchard and Paimpol Bréhat) to characterize the flow in very complex tidal stream areas.

References

Blackmore T, Myers L, and Bahaj AS, Effects of turbulence on tidal turbines: Implications to performance, blade loads, and condition monitoring. International Journal of Marine Energy, 14:1–26, 2016.

Bourgoin A., Guillou S.S., Ata R., Thiébot J. (2021), Use of Large-Eddy Simulation for the bed shear stress estimation over a dune, International Journal of Sediment Research, 36 (6), 687-695. https://doi.org/10.1016/j.ijsrc.2019.10.002

Bourgoin A., Guillou S.S., Thiébot J., Ata R., Turbulence characterization at tidal energy sites using Large Eddy Simulations: Case of the Alderney Race, Philosophical Transactions of the Royal Society A, 378: 20190499, 2020.

Guillou S., Bourgoin A, Thiébot J., Ata R. (2021), On the spatial variability of the flow characteristics in a Tidal energy site: Case of the Raz Blanchard, 14th European Wave and Tidal Energy Conference, EWTEC2021, 5th – 9th September 2021 in Plymouth, UK, 2216.

Mercier P., Grondeau M., Guillou S.S., Thiébot J., Poizot E. (2020), Numerical study of the turbulent eddies generated by the seabed roughness. Case study at a tidal power site, Applied Ocean Research, 97, 102082. https://doi.org/10.1016/j.apor.2020.102082

Mercier P., Guillou S. (2021), The impact of the seabed morphology on turbulence generation in a strong tidal stream, Physics of Fluids, 33, 055125. https://doi.org/10.1063/5.0047791

Mercier P., Thiébaut M., Guillou S., Maisondieu C., Poizot E., Pieterse A., Thiébot J., Filipot JF, Grondeau M. (2021), Acoustic Doppler current profiler measurements of strong tidal power flows: An assessment of 8-beam configuration accuracy in rough environment with large-eddy simulation, Ocean Engineering, 226(3):108819. 10.1016/j.oceaneng.2021.108819

Thiébaut M., Filipot JF, Maisondieu C., Damblans G., C. Jochum, L.F. Kilcher, Guillou S.S., Characterization of the vertical evolution of the 3D turbulence for fatigue design of tidal turbines, Phil. Trans. R. Soc. A 378: 20190495, 2020.

Thiébaut M., Filipot JF, Maisondieu C., Damblans G., Duarte R., Droniou E., Chaplain N., Guillou S.S. (2020), A comprehensive assessment of turbulence at a tidal-stream energy site influenced by wind-generated ocean waves, Energy 192, 116550, 2020.

Thiébaut M., Filipot JF, Maisondieu C., Damblans G., Peterse A., Duarte R., Droniou E., Chaplain N., Guillou S.S., Assessing the turbulent kinetic energy budget in an energetic tidal flow from coupled ADCPs measurements, Phil. Trans. R. Soc. A 378: 20190496, 2020.

Togneri M and Masters I, Micrositing variability and mean flow scaling for marine turbulence in Ramsey sound, Journal of Ocean Engineering and Marine Energy, 2(1):35–46, 2016.