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The Proton Exchange Membrane Fuel Cell (PEMFC) is a promising candidate for many applications, either stationary or transportation. Of the many barriers, cost and durability represent two of the most significant challenges to achieving clean, reliable and cost-effective fuel cell systems. Effective management of the liquid water and heat produced in PEM fuel cells remains crucial to increase both its performance and durability. Indeed, significant liquid water and temperature variations over the cell surface area and among the cells may accelerate long-term structural problems such as micro-cracks in the membrane.

A two-phase multi-component model of a PEM fuel cell is developed. The model considers the cell as a multilayered system and each layer is accurately in-plane discretized to allow the simulation of local temperature and species heterogeneities, including liquid water. The objective of the model is the prediction of the distributions of current density, species concentrations, water content and temperature in all the components of the cell, while taking into account the real flow-field designs. The model can be compared to experimental temperature and current density data and liquid water measurement obtained from neutron imaging tests in several operating conditions.

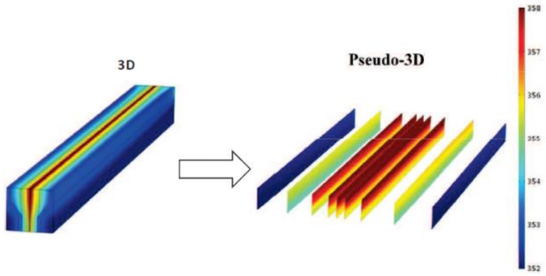

Figure 1 : 3D Model vs Pseudo-3D Model

Currently, the model is starting to deliver some results, which will be analyzed shortly but the calculation time is relatively long. Indeed, the 2-fluid model is complex since the transfer of mass, momentum and energy from one phase to another are implemented in the model. Therefore, it is necessary to find the appropriate closure laws, which are still widely discussed in the literature. In addition, the closure laws have a significant impact on the convergence of the model and the accuracy of the results.

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[2] F. Nandjou, J-P. Poirot-Crouvezier, M. Chandesris, Y. Bultel, *International Journal of Hydrogen Energy*, **41** (**2016**) 15545-15561