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A spatial model of calcification in scleractinian corals

J. A. Kaandorp, C. Cronemberger, L. Huisman

Section Computational Science, University of Amsterdam, The Netherlands (jaapk@science.uva.nl)

Calcification in scleractinian corals is a highly complex process depending on a wide variety of physical, chemical and biological parameters that interact on a molecular, cellular, organismal and ecosystem level. Although many of these individual parameters have been identified during recent years, coral skeletogenesis on a systems level is still not well understood, limiting the possibility to accurately predict the effect of environmental changes. Therefore we have constructed a model of calcification in which existing knowledge on the factors influencing skeleton formation is integrated within a mathematical framework. In this model we have developed a spatial representation of the coral tissue where we simulate the relevant chemical reactions in the surrounding environment, the transport processes of inorganic carbon and calcium ions, photosymthesis, respiration and calcification in the different cell layers. We model the change in space and time of the different processes as a set of coupled reaction-diffusion equations. Simulations can also be employed to clarify the relative contribution of different individual processes such as ion transport, photosynthesis or mitochondrial respiration rates. Results of these simulations can be used to guide further experimental studies. In the future we hope to combine all these models in a multi-scale model of calcification which can be used to analyse the relations between the marine environment, genetic regulation, skeletogenesis and coral growth.