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As easy to produce oil reserves are decreasing, we are increasingly relying on heavy oil and other nonconventional oil resources. These include the Canadian tar sands and shale oils in the Rockies, as well as large heavy oil reserves in Venezuela. Production techniques rely on heating to mobilize these very viscous fluids, which results in large carbon footprints. Moreover, heavy oil brought to the surface generally contains components that are undesirable. Cleaner production alternatives that are now intensely researched by the oil industry and in academics include in-situ combustion. In this recovery process, part of the oil is burned in place to create a subsurface steam flood that helps drive the oil to the producing wells. Prediction of in-situ combustion is exceedingly challenging. In this talk I will discuss the process and present the outstanding mathematical and numerical problems. (Received September 16, 2008)