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An Object-Oriented Structure for solving Ground water and other Earth Sciences problems.

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Over the last 20 years, we have developed a large number of codes. These include TRANSIN, which is an efficient hydrogeological finite element code for parameter estimation in linear or nonlinear flow and transport problems; RETRASO, which solves multiphase reactive transport problems; and CODE-BRIGHT, which simulates coupled mechanical deformation and non-isothermal multiphase flow. All of them work in up to 3 dimensions. We have found that, after a period of intensive use and growth, our programs become stiff in the sense that it becomes increasingly difficult to keep growing, to the point that we can hardly include new developments or to transfer capabilities from one code to another. To overcome these limitations we considered shifting to an object oriented formulation. A preliminary test allowed us to verify that indeed object oriented programming leads to enhanced independence of different program parts thus facilitating the implementation of new algorithms and tasks. Thus we moved to perform the analysis of a broad code. In so doing, we have found that expected capabilities exceed the initial objectives. In this presentation we will discuss the general structure and some of the most important classes: Poblems (including couplings), mesh (including not only FD's, FE's and FV's, but also nestings); properties (which allows parametrization), optimal control (which includes data assimilation), inverse modelling (which allows a wide range of methods from genetic to Newton based algorithms); chemical systems (which allows handling multiple phases).