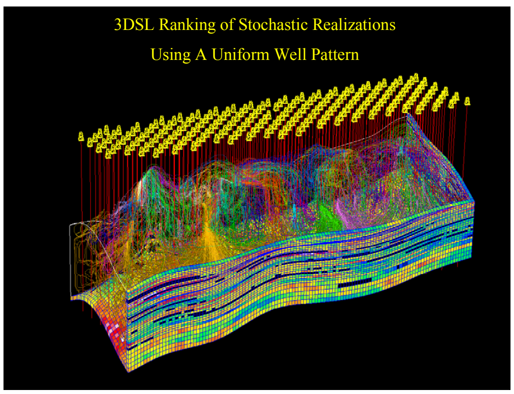
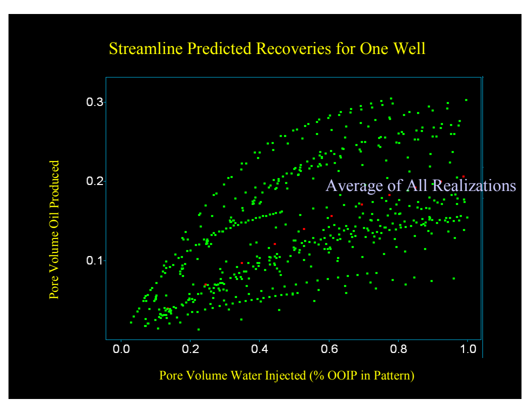
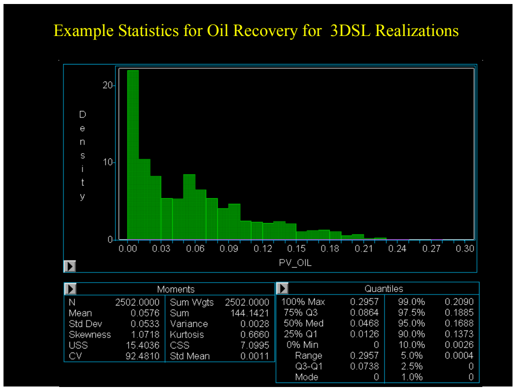
Statistical Ranking of Stochastic Geomodels Using 3DSL



The 3DSL streamline simulator (from StreamSim Technologies, Inc. http://www.streamsim.com/) is being used as part of iReservoir's integrated 3D reservoir characterization and modeling process to dynamically rank complex geologic realizations. One unique approach is the use of uniform well patterns to compare the dynamic performance. These patterns are not necessarily representative of actual well patterns or injected fluids rates. The waterflood efficiency; however, can still be used as a basis of comparison for ranking different realizations. The use of regular well patterns is different from the common approach of trying to use existing wells with pseudo boundary conditions. The uniform spacing ensures complete coverage of the area-of-interest and not just the areas where the model is already conditioned to existing data. The purpose is to test "connectivity" of geologic models and to provide a graphical basis for calculating the uncertainty in recoveries as determined from the ranking process. The models are already conditioned to existing well data. This method tests the variability of the models away from existing wells as these areas will have longer-term effect on performance and affect the decision regarding future infill wells and recovery methods. Alternative well patterns can be used to show how performance varies with well spacing. These simulations are not intended to match or directly predict field recovery, as they must necessarily neglect some important physics in order to run quickly on large geomodels. The streamline simulations can be considered simply as a method to run "experiments" on the geologic model to understand the geologic complexity and variability of the models.

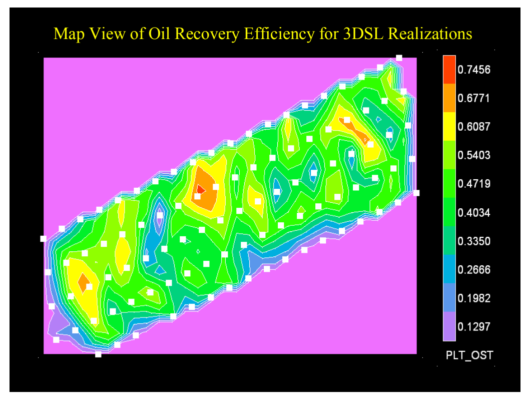
This slide shows an example of the recovery efficiencies of an individual well for a number of sensitivity runs. This shows the wide variation that is possible for an individual well for different realizations. Graphical and automated methods are needed to quickly understand this uncertainty and to turn these numbers into useable information for calculating economic risk.

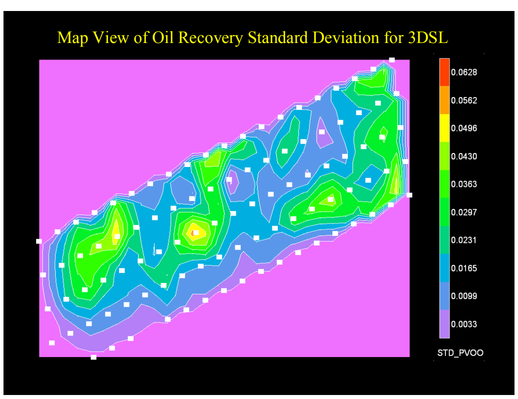




To provide useable information, all the realizations are loaded into a statistical program and analyzed. Such techniques allow quick calculation of averages, standard deviations, and cumulative distributions of recovery by well and by run. For example this figure shows the distribution of pore volumes oil recovered for all wells for all realizations. These data are useful for assessing the variability; however, it is still difficult to quickly interpret and use the results.

This figure shows one type of plot that can be used to more easily understand the variability in the realizations. This slide is a map view of the average oil recovered by all wells from all the realizations. The numbers shown here are relative to the highest calculated well recovery for all realizations. Such figures can indicate locations in which there is the most likely chance for waterflood success. Similar plots are made for recovery efficiency (water injected divided by oil produced) and for well productivity.





This slide is a map view of the normalized standard deviation in oil recovery from all the realizations. This slide shows the areas where there is the largest uncertainty in calculated oil recovery. Such maps can be used for economic evaluations and for assessing development programs.

Modern tools and analysis techniques are greatly improving the ability to understand complex reservoirs which allows improved decisions regarding optimum development. However, with the large volume of data that is becoming available and included in the analyses, it is important to fully use the capabilities of modern software and hardware to analyze and visualize the data. This will ensure a better understanding of the interpretations and the resulting uncertainties.

For more information. contact iReservoir.com, Inc. (http://www.ireservoir.com/).