The Earth's fastest and most scalable reservoir simulator..... in the cloud!

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"What is the shape of water?" asks one Senior Reservoir Engineer with a wry smile. Then looks down at his coffee mug, pointing at what is in all essence hot water (perhaps some steam) plus coffee beans (now in a new form from their original state only 5 minutes earlier). To accentuate the point the Senior Reservoir Engineer proceeds to lift the coffee mug, takes a gulp, and once consumed asks, (again with a wry smile) "what shape is it now?!?!".

The point that is being made is that describing the shape of water itself is actually really quite complex. What form is it in? What temperature is it? Where is it situated and what supporting structures does it own? Are there other factors affecting its shape that we need to consider?

Of course, the reality is that the shape of water is really quite complex. In actual fact, it's really rather difficult to describe and define too. Particularly when there are always other factors that can affect the shape of water that are completely out of the control of an individual, for example the temperature in the room or if you are in a coffee shop that has heavy traffic of people of vehicles outside causing constant vibrations. So one may say…..there is always room for a degree of uncertainty when we answer the original question of "what is the shape of water?".

"But wait just a second……..does the water know what shape it has?", provokes the Senior Reservoir Engineer.

Well of course the water knows what shape it is. It is indeed the subject matter and does not need to define itself to anyone. If it alters form……it does so without having to tell anyone or worry about the consequences.

We are now 293 words later writing about a mug of coffee which let's be fair, is far from defined. If we amplify this concept to an oil field in the North Sea, let us consider some possible dimensions. The field lies on top of 100 metres of water at total depth of 1,500 metres; the reservoir is 22 square kilometres and has an average pay thickness of say give or take 50 meters.
What shape is the oil???
And how many cups of coffee would that look like???

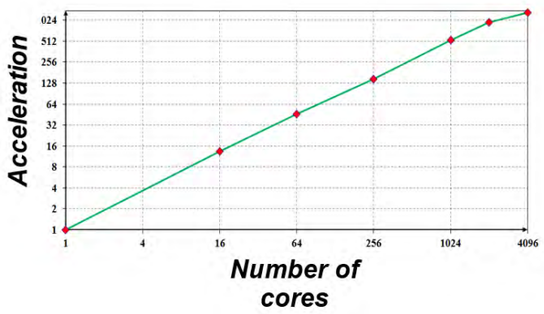
The uncertainty we face as an industry is enormous. And when we consider the costs involved in an attempt to successfully and commercially recover hydrocarbons it is essential that we reduce limitations on how we study our reservoirs in search of optimal 'bang for buck'. Many may therefore agree that the role of a Reservoir Engineer is to communicate the probabilities for success to those who make the decisions to drill.

Reservoir simulation is a widely accepted technical practice when planning to drill. It is an exercise that offers technology to use intelligent mathematical algorithms given a range of parameters and assumptions to describe the physical aspects within a reservoir and predict fluid flow behaviour.

The point of simulation is that in comparison to the reality of drilling a well, it is very cheap. One may run many simulations of drilling scenarios on a field at a tiny fraction of the actual cost. It helps us to understand the potential behaviour of the well in order to make the best decisions.

The ethos behind the development of the tNavigator reservoir simulator was to create a reservoir simulation technology that was built for speed. If a model can be run fast, it offers two undeniable benefits. Number 1 is that you have additional time to run more simulations, therefore having more data to analyse as your results provide a greater range of probabilities to be considered. And number 2 is that if the simulation is faster the reservoir engineer has more time to actually do the analysis (and challenge it) which in itself should allow the probability range to be better understood and better defined.
tNavigator has seen an exceptional rise in growth with the industry recognising the benefit of speed. This is coupled with a synchronised user interface to visualise data on the fly during simulation allowing the engineer to really interrogate data that was previously difficult or impossible to get at.

The vision was to change the way the industry thought about simulation. Addressing complex, full fielded, high resolution models to run them in a reasonable time frame at a cost friendly price. The unique 'Hybrid Algorithm' that embodies tNavigator allows near unlimited scalability on the acceleration of reservoir simulation models.

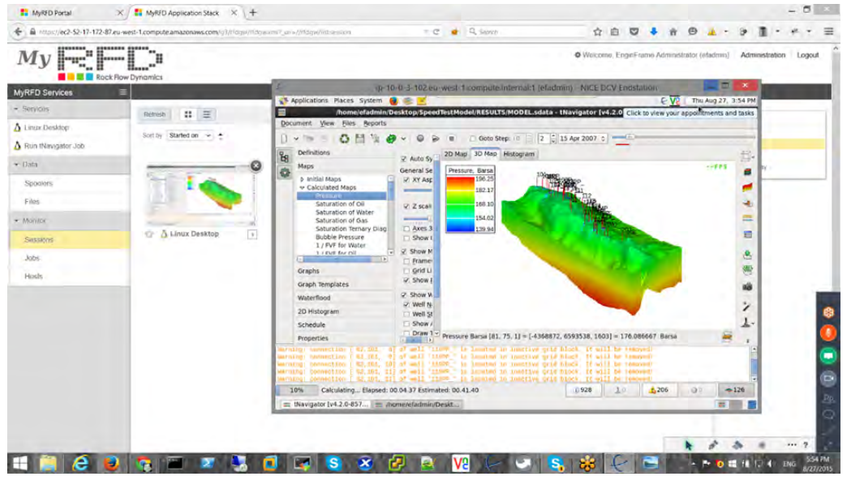


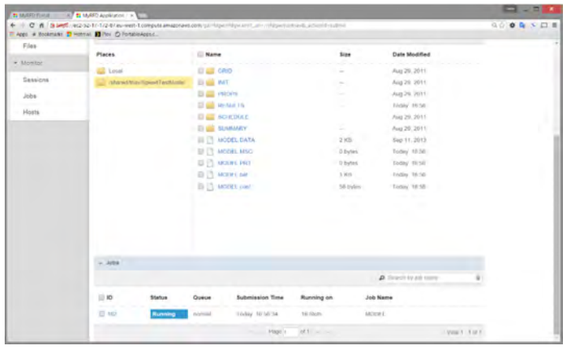
Such examples of scalability include a 22 million active cell model being run on 4096 cores showing the simulation time reduced from 2.5 weeks to just 19 minutes; a model running at 6 weeks being run on only 320 cores at 5 hours; and a 43.5 million active cell model being reduced from 3 days to just 40 minutes on 240 cores.

All different sizes of oil companies are seeing the value of introducing a cluster to their business for reservoir simulation practice. Their engineers now become far more productive and the implementation of such hardware is a very low burden on the IT department, space and resources.

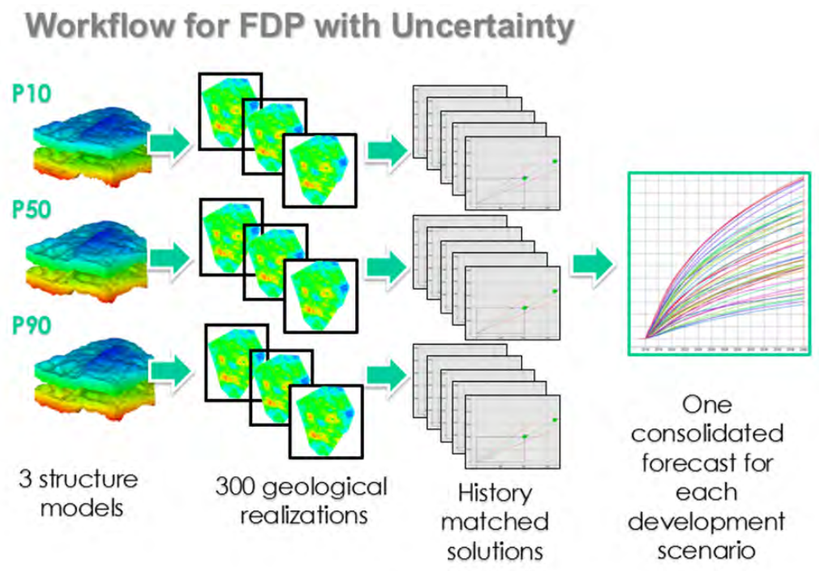
The imminent next direction for all of this 'game changing' technology is to be available on the cloud. Rock Flow Dynamics have created a fully-fledged cloud solution. The user / business can create an account, upload data and work with all the functionality that would be available on a tNavigator user desktop screen. It offers access to giant High Performance Computing clusters with no additional investment of computing power is required inside of the office.

The industry will have some reservations about cloud based offerings. Number 1 is undoubtedly security? tNavigator initially will be available on Amazon Web Services (AWS). The same guys we give our credit card details to every year in order to buy presents and search for new clothes, music, kitchenware etc. The highest protection available is being used to secure data with no stone left unturned.





AWS are seen as a prime fit for reservoir simulations in the cloud. They have more available hardware than all other commercial cloud services and state of the art node configuration to allow a seriously scalable simulation offering. Clients eagerly anticipate the launch of the fully fledged cloud solution and see it as an ideal pairing for a lightweight in-house cluster where the reservoir engineers can do the day to day jobs, and then for larger scale uncertainty studies with thousands of reservoir model iterations there are cloud based applications with unlimited computational hardware available.



One of many case studies using cloud based hardware comes from a project that incorporates uncertainty quantification and probabilistic forecasts into the same simulation workflow.

The workflow involved 3 structural models with P10, P50 and P90 ranges. 300 geological realisations of each model were then history matched and consolidated for each development scenario. 83 history matched forecasts were used to provide conclusions. In order to get to this point, some 8100 history matched cycles were run over 2 days using a giant cluster.

The cloud is the perfect match for allowing the reservoir engineer to make probabilities less uncertain. We will never fully define the shape of our reservoir……..but we can undoubtedly get a lot closer to the 'truth'.