Australia Risk Assessment

- Geodisc, Otway, Zerogen, Gorgon, Flagships (Carbonnet, SW Hub)
  - Heavy use of both RISQUE and Risk Registers
  - Qualitative probabilistic risk assessments
  - Strong interaction between operators and regulators
  - Operator advice on what is required for safe storage
  - Carbonnet: actively looking for existing methods
Risk Assessment

• P from Probability X Consequences
• Focus on P
• P ultimately boils down to
  – What do we know?
  – How well we know it?
  – Accurately understanding and reflecting the uncertainty in the risk is critical
  – How do we estimate uncertainties & how good are the estimates?
  – i.e., How could is the information we provide and how do we assess that.
Uncertainties

• Geological storage risk assessment is heavily dependent on reservoir simulation, however concepts apply across all disciplines

• Many different uncertainties and ways to describe them, two broad categories:
  – Aleatory – random and irreducible
  – Epistemic – ultimately reducible

• Maybe easier in CCS risk context to describe with:
  – Static geological model
  – Other parameter uncertainty (effective porosity, relative perm, etc)
  – Model uncertainty – basic set up of dynamic model (grid spacing, physical eqs, geochemical eqs)
Addressing the Uncertainty

Two main ways uncertainty is estimated and incorporated into CCS risk assessment

1. Simulations (Primary emphasis in CCS):
   1. Probability distributions on parameters, Monte Carlo simulations, use of multiple static models, etc

2. Expert Elicitation:
   1. Key to a full exploration of the uncertainty
   2. We know the model predictions are not correct
      1. Structured expert elicitation can help to better estimate and incorporate that uncertainty
   3. Final result is only as good as the EE process used
   4. EU Guidelines on structured EE, etc.
      1. Structured elicitation, workshops, etc
      2. Expert selection
      3. Expert Bias (last two challenging to get around in industry application)
Interdependence of risks & the effect of mitigation on risk

• Risks are not independent of one another (e.g., induced seismicity and leakage/migration through a fault)

• Mitigation measures may have effect on risk in other parts of the system (e.g., additional injection wells: reservoir behaviour, financial risk, etc)

• Economics: capacity/volume stored is not independent of economics (i.e., carbon price) & hence risk
Key Uncertainties

• Long term behaviour
  – is it truly a steady decrease? Estimating change with time is key

• Volume scaling behaviour?

• Reservoir modelling: understanding if/how the uncertainties change with time (testing models beyond history matching)

• Induced seismicity