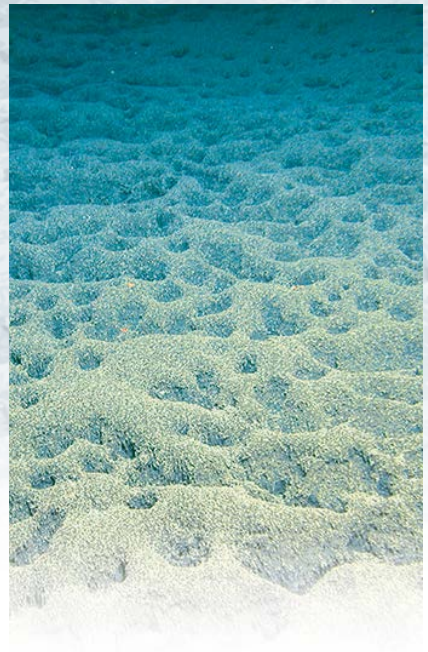
ECO2

Sub-seabed CO_2 Storage:
Impact on Marine Ecosystems

An environmental perspective on leakage scenarios



Jerry Blackford
jcb@pml.ac.uk

SEVENTH FRAMEWORK PROGRAMME

Motivation: is the need to simulate the range of plausible scenarios in order to determine if there could be sufficient input of CO_2 to natural systems to cause impact.

Three factors we need to know

- Flux rate
- Duration
- Area (and form of leakage)

ECO2 will develop site specific scenarios based on modelling work
Initially we need some generic scenarios to enable progress.

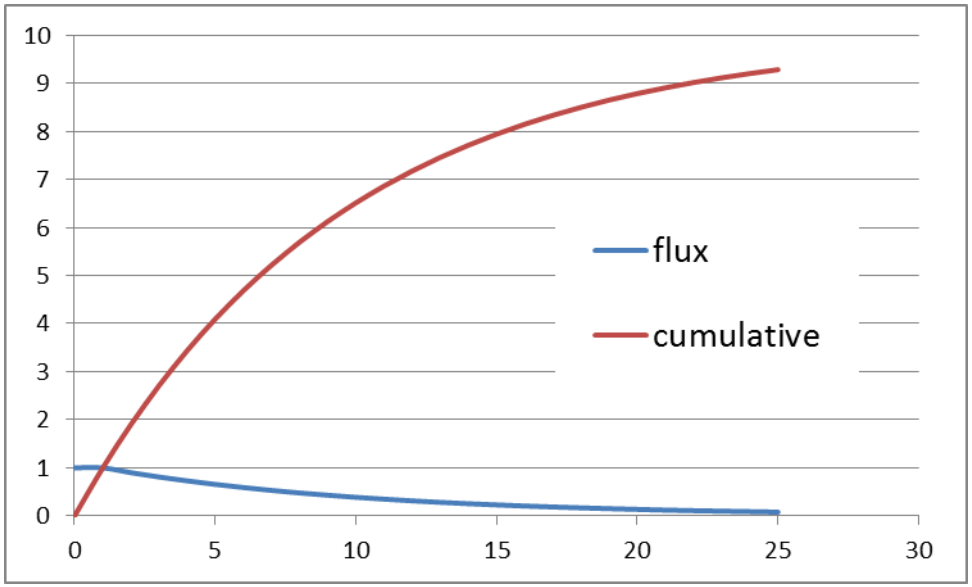
Identified 3 categories

1. worst case (Tordis-like): leakage = injectivity, on industrial scale: 5-10 Mt/a leakage over short period: ~0.5 years

2. leakage through faults/fracture with several spots at seafloor

3. leakage through open well (maybe 1T/day)

Trade off between high flux rate and longevity



As system depressurises with leakage this would decrease the flux rate.

As gas flow engineers pathways in initial phases of leakage this could lead to an increased flux rate?

Using 'end-members' to quantify a range of plausible scenarios.

- Pipeline capacity / input rate to reservoir
- Total capacity of a reservoir
- Total capacity of region
- Measured seepage rates
- Leakage estimates
- How much CO_2 would it take to cause a significant environmental problem?
- How much CO_2 will enter the marine system from the atmosphere

Pipeline capacity / input rate to reservoir

Sleipner: 1 M Tonnes CO2 / A
In Salah: 1 MT/A
Weyburn: 2.8 MT/A
Potential: ~10 MT/A
Current pipeline capacity: 0.6 – 1.4 MT/A
New generation capacity?: 2-4 MT/A

Reservoir and regional capacity

Sleipner: 15MT to date, 20MT planned
North Sea: 18000 MT Hydrocarbon reservoirs
North Sea: 200000 MT Saline Aquifers

End members

Input: 1-10 MT/A
Reservoir: 20-200MT
Region: 18000-200000 MT

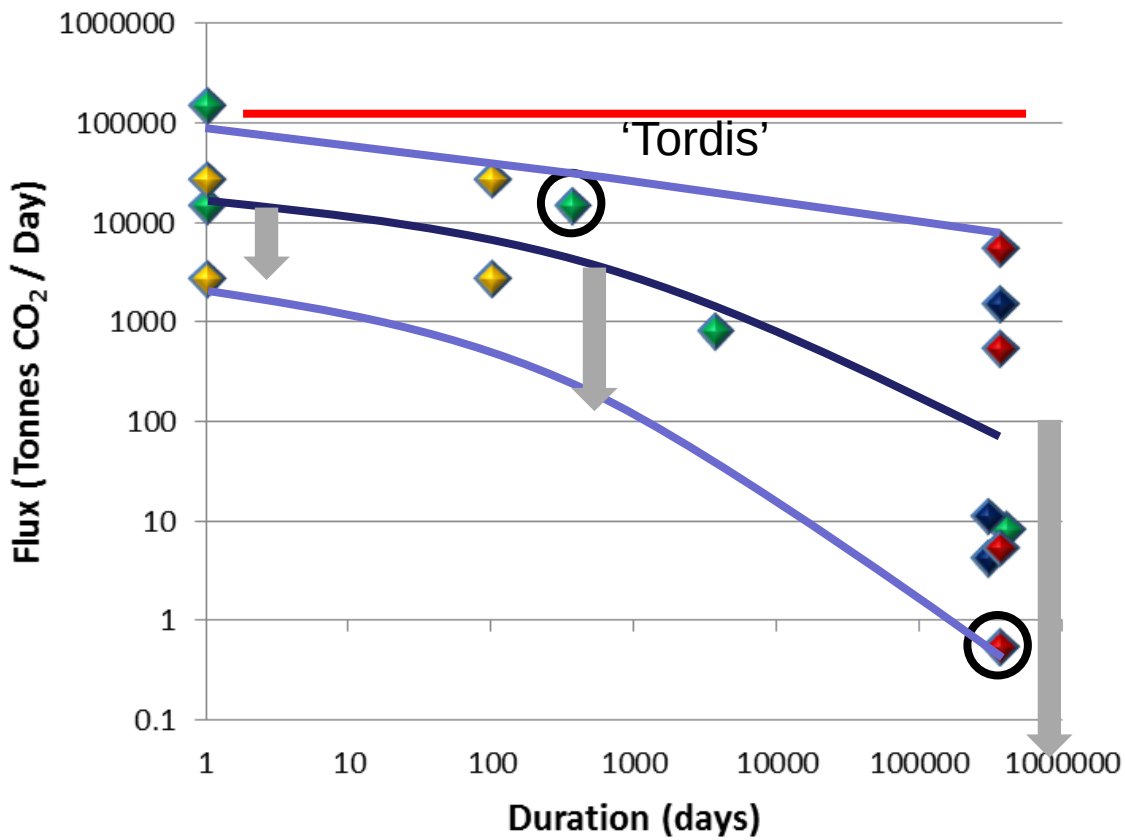
Leakage measurements and estimates

Measured seepage rates from EOR project (Rangely Field, Colorado, Klausman et al 2003)

170 – 3800 T/A (0.01% over 10 years)

IPCC leakage estimate

1% over 1000 years



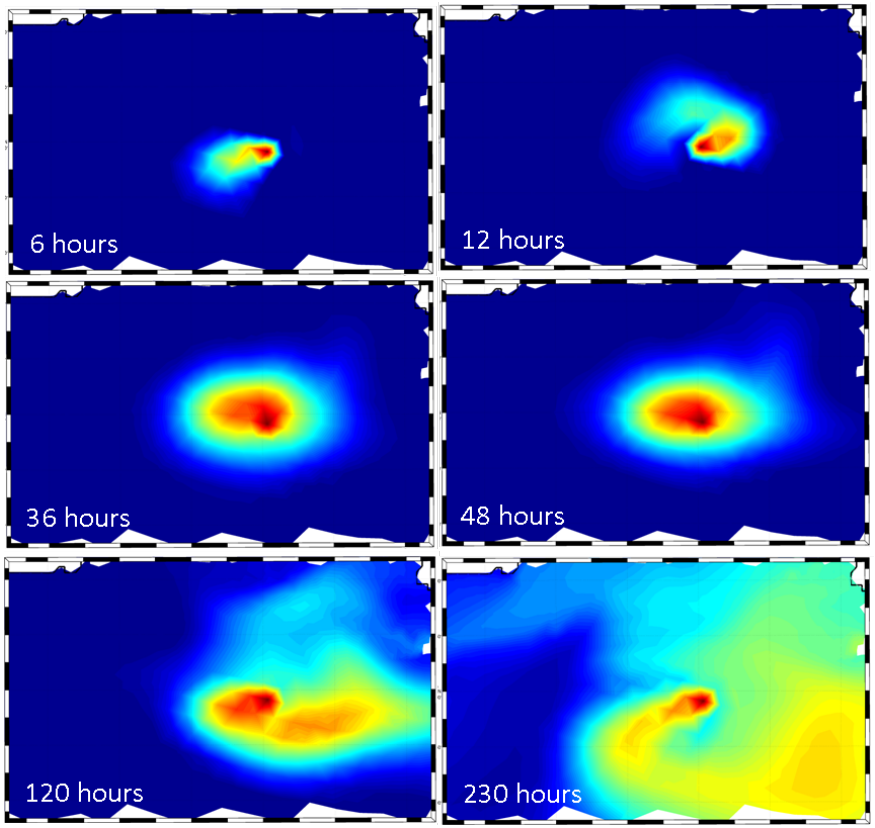
- Injection based, short term
- Capacity based, long term
- RISCS
- Blackford 2008

Decrease from initial flux rate

Approx. regional uptake of atmospheric CO_2

Moving from leakage flux to CO2 dosage is non trivial

Tidally driven plumes and CO2 density effects imply that perturbation at any given location is likely to be intermittent.



Communication of knowledge would benefit from a coherent and consistent approach to scenarios:

- Consistent naming convention
- Initial flux rates
- flux decay rate
- Duration
- Area / form