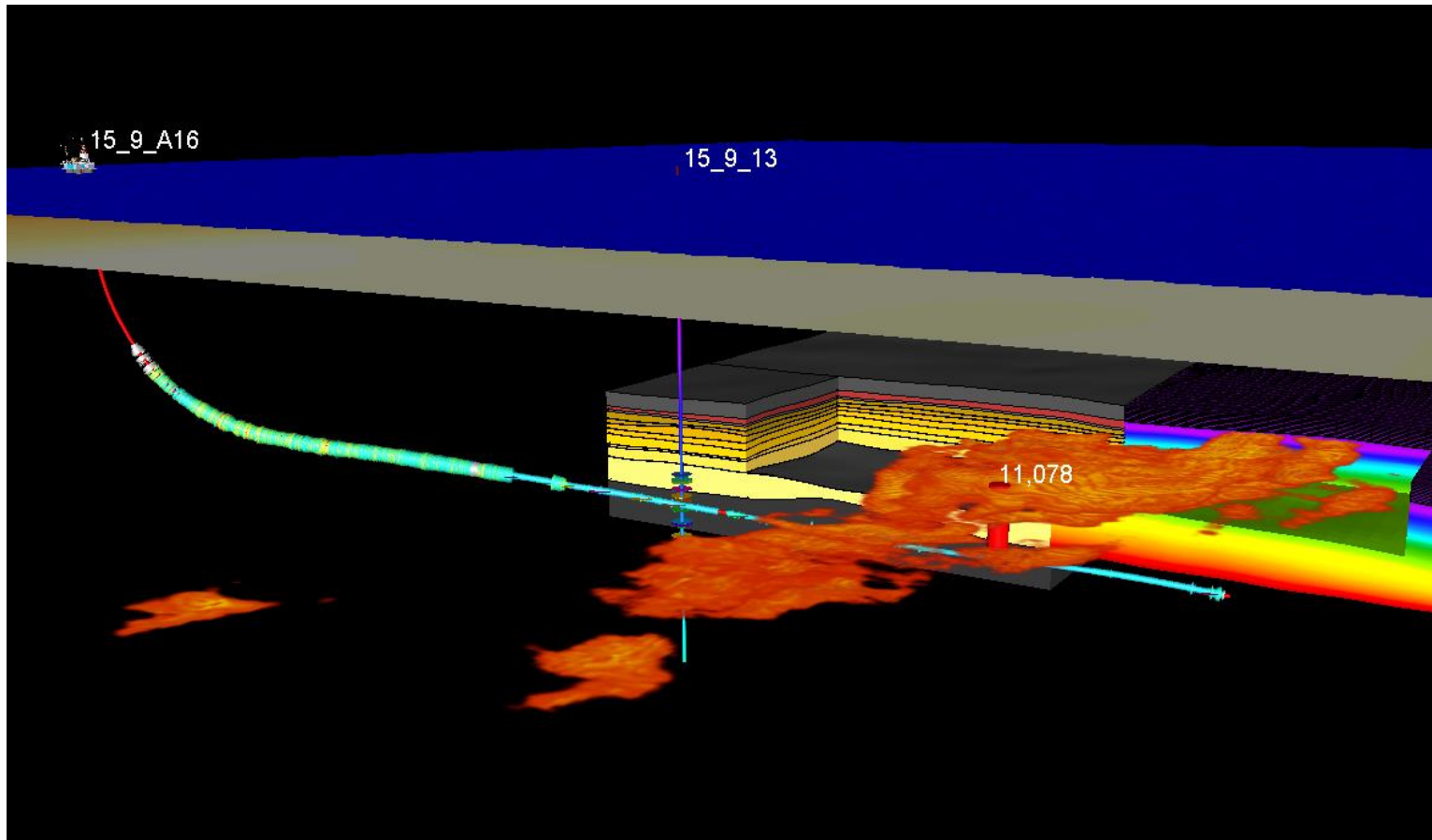


Monitoring CO₂ Injection Volumes in the Sleipner Field



Monitoring CO₂ Injection Volumes in the Sleipner Field

Introduction

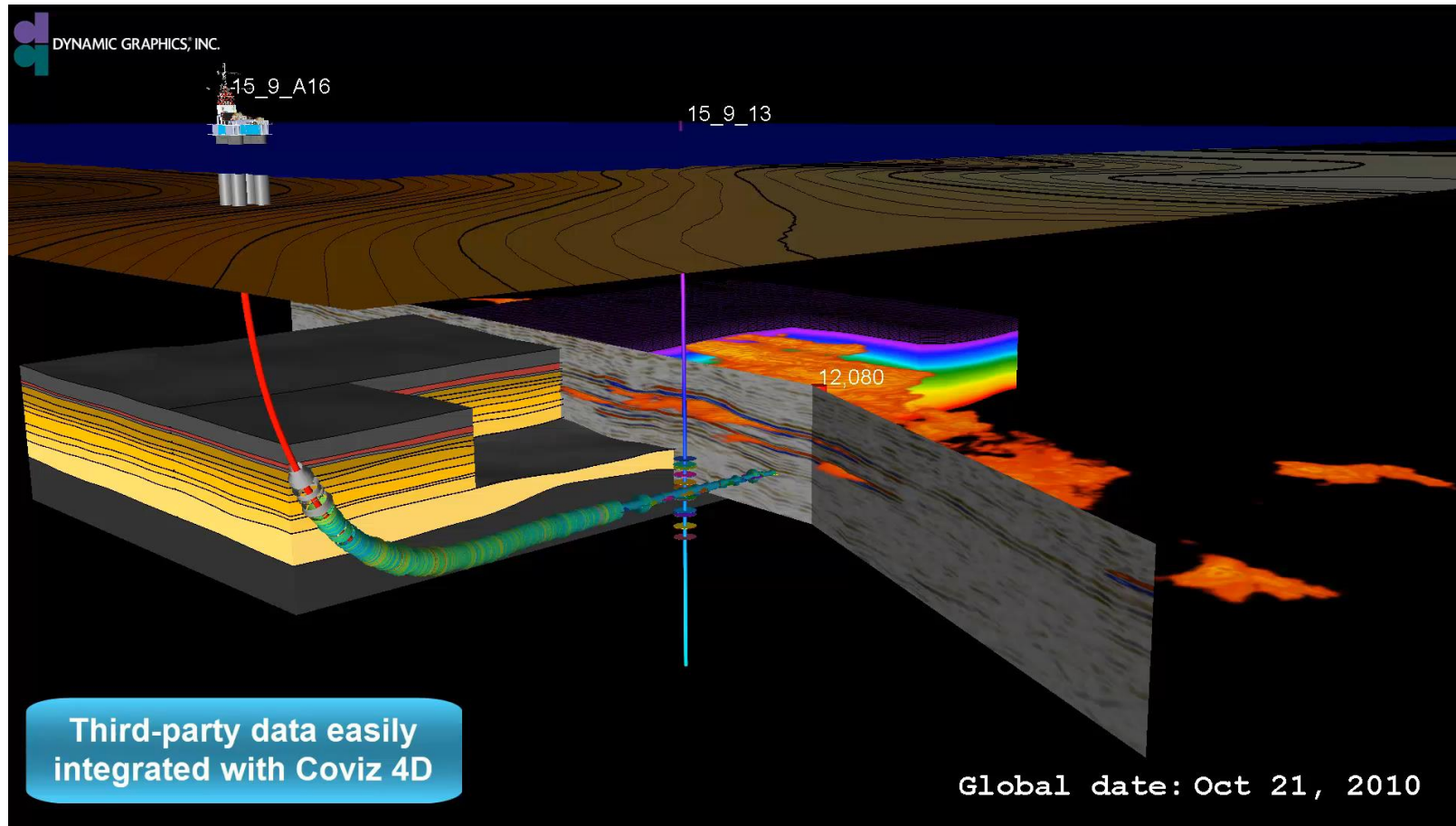
- CCS proven and key technology in achieving net zero goals
- Challenges:
 - No direct financial benefit - no end product
 - Reliance on Government goodwill and carbon tax/carbon credits/regulatory bodies
 - Long time frame – 100s rather than 10s of years
 - Seepage/leaks inevitable – need to define tolerances and strategies
 - Critically important to minimize costs and adopt new technology
- Robust MMV Monitoring, Measurement and Verification critical
- Need to accommodate all available diverse data streams and subsurface models
- Example using the publically available Sleipner data set from Equinor

Monitoring CO₂ Injection Volumes in the Sleipner Field

Sleipner CCS Dataset

- Norwegian North Sea dataset Includes:
 - Well logs
 - Reservoir models
 - Seismic volumes
 - Structural interpretations
 - CO₂ injection history since 1996 when sequestration began
- Data is stored in third-party formats and was ingested into CoViz 4D
- DGI's EarthVision used to build stratigraphic model for geologic context
- Huge value to integrated 4D visualization of all 2D/3D/4D data

Monitoring CO₂ Injection Volumes in the Sleipner Field



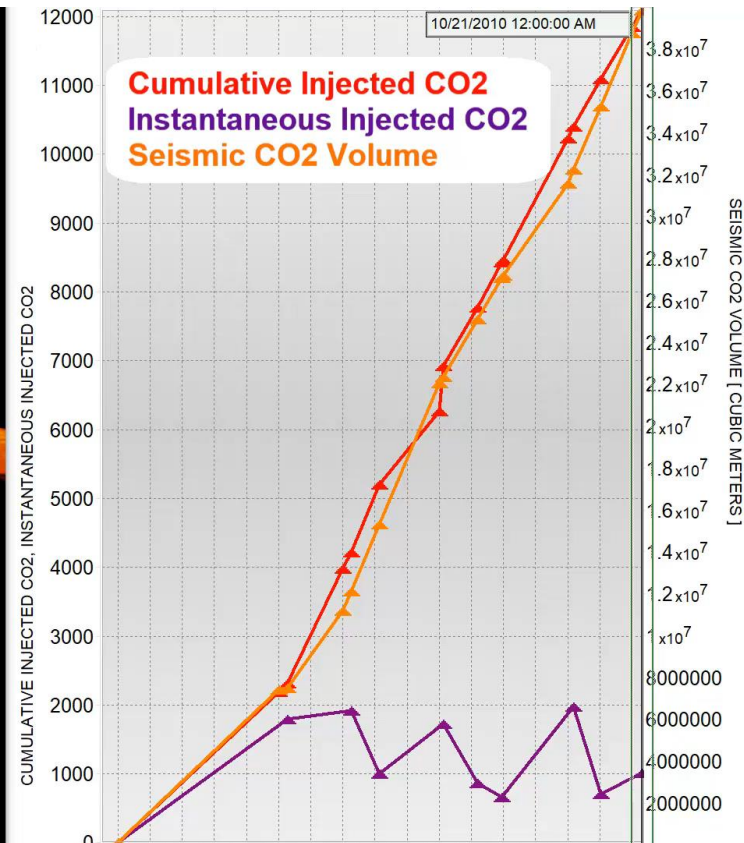
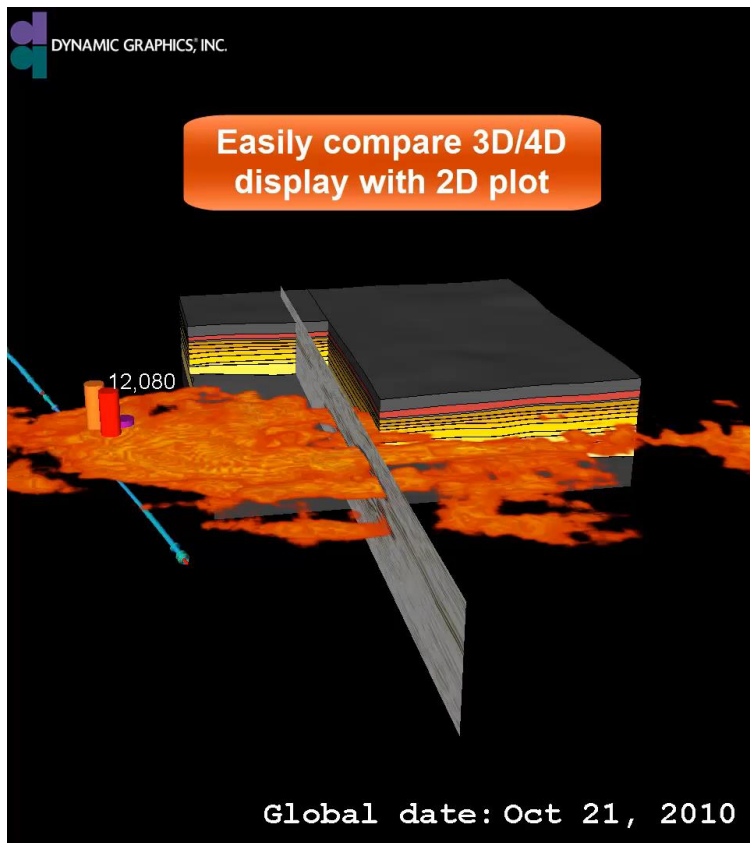
Monitoring CO₂ Injection Volumes in the Sleipner Field

Analytical Workflows

- Combining Quantitative analysis with powerful visualization tools
- Cap Rock integrity
- Fault zone transmissibility
- Sim2Seis to verify and calibrate predictive models with 4D Seismic surveys
- Geomechanics – potential induced seismicity, fault reactivation
- Inclusion of Gravity/EM for MMV
 - 4D Seismic expensive and limitations in sensitivity with gas volumes
 - Forward modelling using different CO₂ density distributions

Monitoring CO₂ Injection Volumes in the Sleipner Field

Animation showing 2D time series plot alongside the 4D display showing how the gas injection history tracks the volume of the plume detected by the seismic



Monitoring CO₂ Injection Volumes in the Sleipner Field

Conclusion

- Increasing number of large scale CCS projects
- Best practice is still evolving – what are the right tools?:
 - Onshore/Offshore/Greenfield/Brownfield/Gas depleted reservoir/Aquifer
- MMV key component and vitally important to use all available data in the most efficient and cost effective way
- This example shows the value of utilizing all data, reducing time and achieving optimum results.