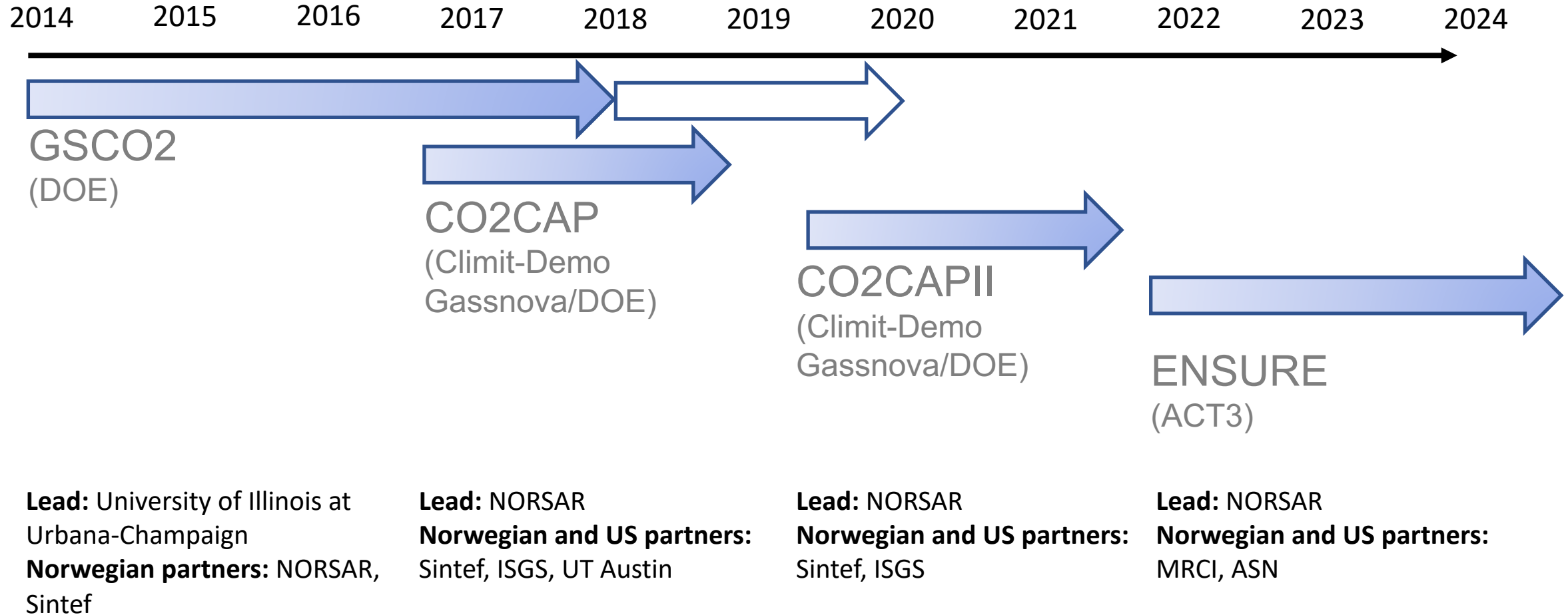


# US-Norway collaboration



**Lead:** University of Illinois at Urbana-Champaign  
**Norwegian partners:** NORSAR, Sintef

**Lead:** NORSAR  
**Norwegian and US partners:** Sintef, ISGS, UT Austin

**Lead:** NORSAR  
**Norwegian and US partners:** Sintef, ISGS

**Lead:** NORSAR  
**Norwegian and US partners:** MRCI, ASN



# CENTER FOR THE GEOLOGIC STORAGE OF CO<sub>2</sub> GSCO<sub>2</sub>

- Focuses on basic-science approaches to recognized industry and technology challenges for commercial deployment of carbon dioxide (CO<sub>2</sub>) storage
- Central research question: What is the mechanism of injection-induced microseismicity, and can we control and predict its occurrence?
- Five research themes: microseismicity, reservoir-scale geology, geomechanical measurements, pore-scale pressure transmission, and geochemical reactions.

## Key findings and achievements:

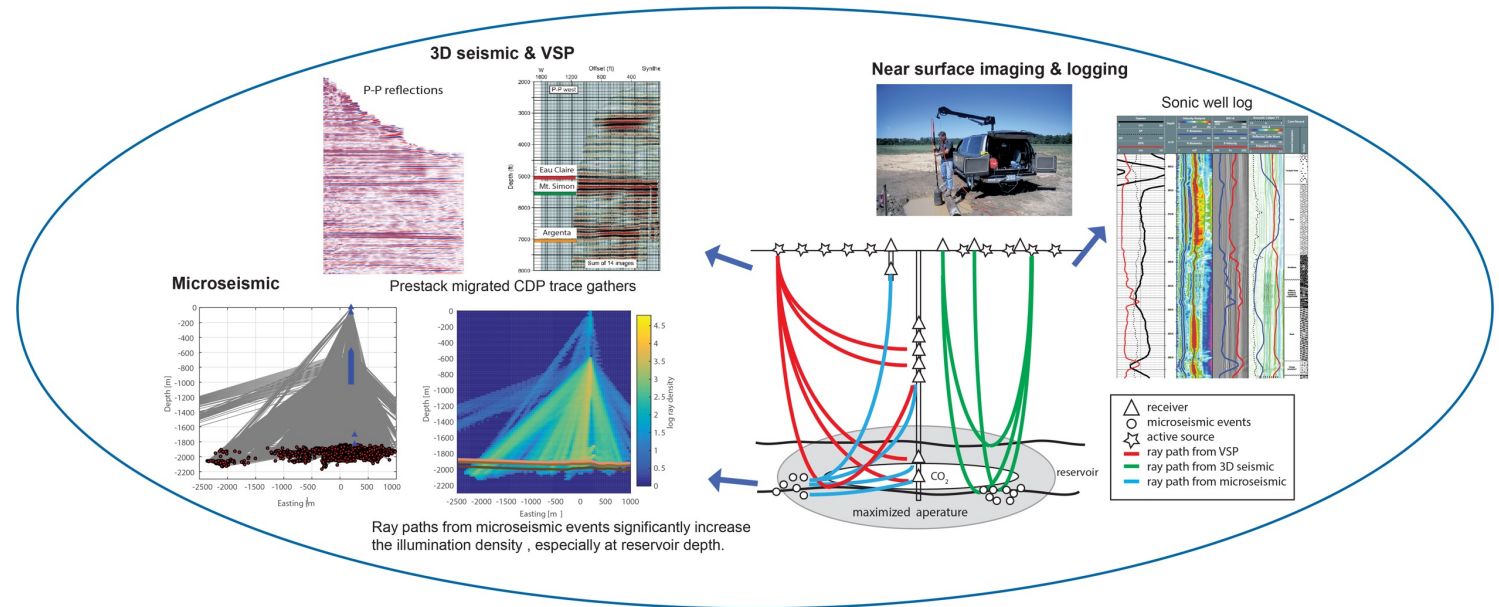
- We discovered that induced earthquakes exhibit complex spatio-temporal patterns emerging from the interplay of pore pressure propagation, fault friction evolution, and fault network interactions that lead to mechanical stress redistribution.
- We have successfully developed a novel modeling framework that can efficiently address the varying orders of magnitude of spatial and temporal scales, enabling modeling of complex fault zones with high-resolution fault zone physics.



# CO2CAP

**Main objectives:** Combine available seismic infrastructure into a holistic monitoring system to provide larger aperture and higher resolution that will allow a more precise mapping of the injected fluid.

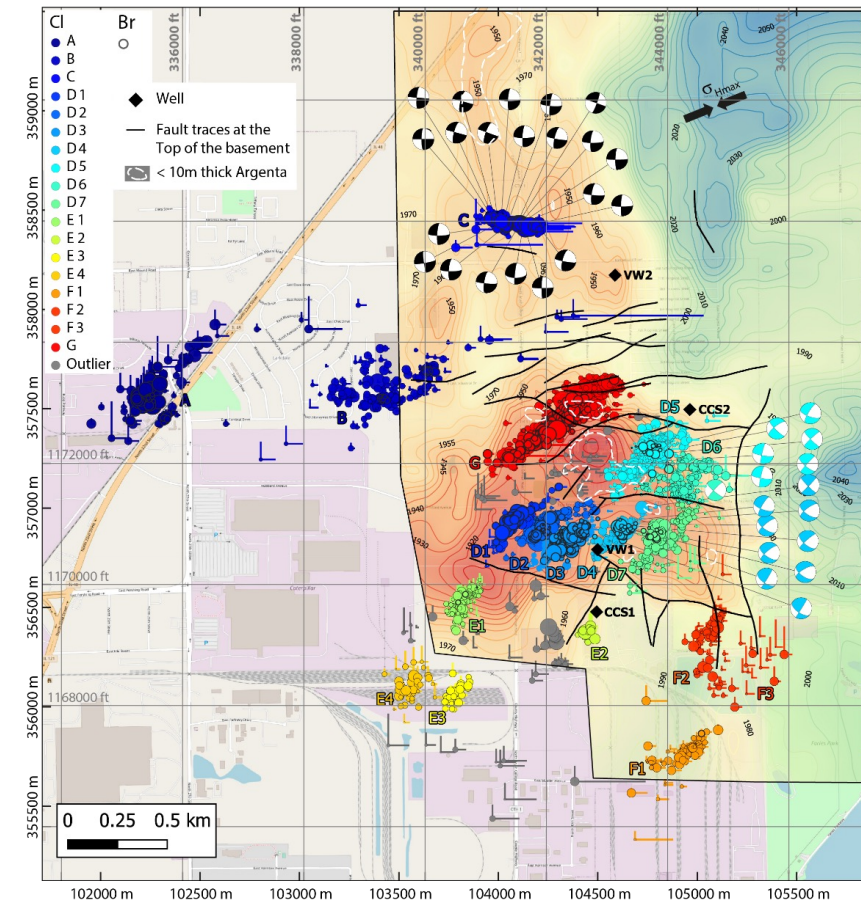
- Develop novel and effective CO2 sequestration monitoring technologies using the Decatur case study site.
- A detailed correlation-based analysis of Decatur microseismicity revealed migration patterns within seismicity clusters which are indicative of fluid migration.
- Realistic synthetic inversions provided the base to demonstrate the potential benefit of integrating active and passive data types.



# CO2CAPII

**Main objective:** demonstrate how a generalized and conceptualized microseismic model for large-scale CO<sub>2</sub> injection can be developed to be applied for calibration of fluid flow models and geomechanical models.

- Focused on detailed characterization of microseismicity from the Decatur CCS site on various scales:
  - Spatial and temporal development
  - Source parameters (focal mechanisms, b-value)
  - Triggering mechanisms
  - Comparison to pressure evolution and results from active seismic
- Compare data from the Quest site in Canada to build a more generalized model for microseismicity.



TOTAL



equinor



# Selected collaborative publications

- Oye, V., Stanchits, S., Babarinde, O., Bauer, R., Dichiarante, A. M., Langet, N., ... & Frailey, S. (2022). Cubic-meter scale laboratory fault re-activation experiments to improve the understanding of induced seismicity risks. *Scientific reports*, 12(1), 1-11.
- Dichiarante, A. M., Langet, N., Bauer, R. A., Goertz-Allmann, B. P., Williams-Stroud, S. C., Kühn, D., ... & Dando, B. D. E. (2021). Identifying geological structures through microseismic cluster and burst analyses complementing active seismic interpretation. *Tectonophysics*, 820, 229107.
- Langet, N., Goertz-Allmann, B., Oye, V., Bauer, R. A., Williams-Stroud, S., Dichiarante, A. M., & Greenberg, S. E. (2020). Joint focal mechanism inversion using downhole and surface monitoring at the Decatur, Illinois, CO 2 injection site. *Bulletin of the Seismological Society of America*, 110(5), 2168-2187.
- Williams-Stroud, S., Bauer, R., Leetaru, H., Oye, V., Stanek, F., Greenberg, S., & Langet, N. (2020). Analysis of Microseismicity and Reactivated Fault Size to Assess the Potential for Felt Events by CO 2 Injection in the Illinois Basin. *Bulletin of the Seismological Society of America*, 110(5), 2188-2204.
- Goertz-Allmann, B. P., S. J. Gibbons, V. Oye, R. Bauer, and R. Will (2017), Characterization of induced seismicity patterns derived from internal structure in event clusters, *Journal of Geophysical Research*, 122, doi:doi:10.1002/2016JB013731.

