Induced Seismicity and Carbon Storage

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Seismicity observed at CO_2 injection operations

Operation	Category	Max Observed Magnitude	Seismicity Type
Aneth USA	CO2-EOR	**M** 0.8	Type II
Cogdell USA	CO2-EOR	**M** 4.4	Type I
Weyburn Canada	CO2-EOR	**M** -1	Type II
Decatur USA	Dedicated Storage	**M** 1	Type I
In Salah Algeria	Dedicated Storage	**M** 1	Type I & II

Type I = Seismicity concentrated within overpressured zone.
Type II = Seismicity outside overpressured zone.

Aneth: Rutledge 2010, Zhou et al. 2010, Soma & Rutledge 2013. **Cogdell**: Gan and Frohlich 2013, Davis and Pennington 1989. **Weyburn**: Whittaker et al. 2011, White et al. 2011, Verdon et al. 2010 & 2011. **Decatur**: Will et al. 2014, Couëslan et al. 2014, Kaven et al. 2014 & 2015. **In Salah:** Oye et al. 2013, Goertz-Allman et al. 2014, Verdon et al. 2015.

Three key hurdles to effective seismicity management:

① Faults are pervasive, and current tools to identify and characterize them have intrinsic limitations.

② The relationship between fluid injection, seismic activity, and damage is complex, and projects have little time to figure it out.

③ The knobs we can turn to reduce seismicity often have a lag before taking effect, can increase cost, and can reduce storage rates.

Novel solutions to these problems will significantly improve our ability to manage seismic risk.

NRAP Focus: Next-generation stoplight systems based on real-time hazard forecasting.

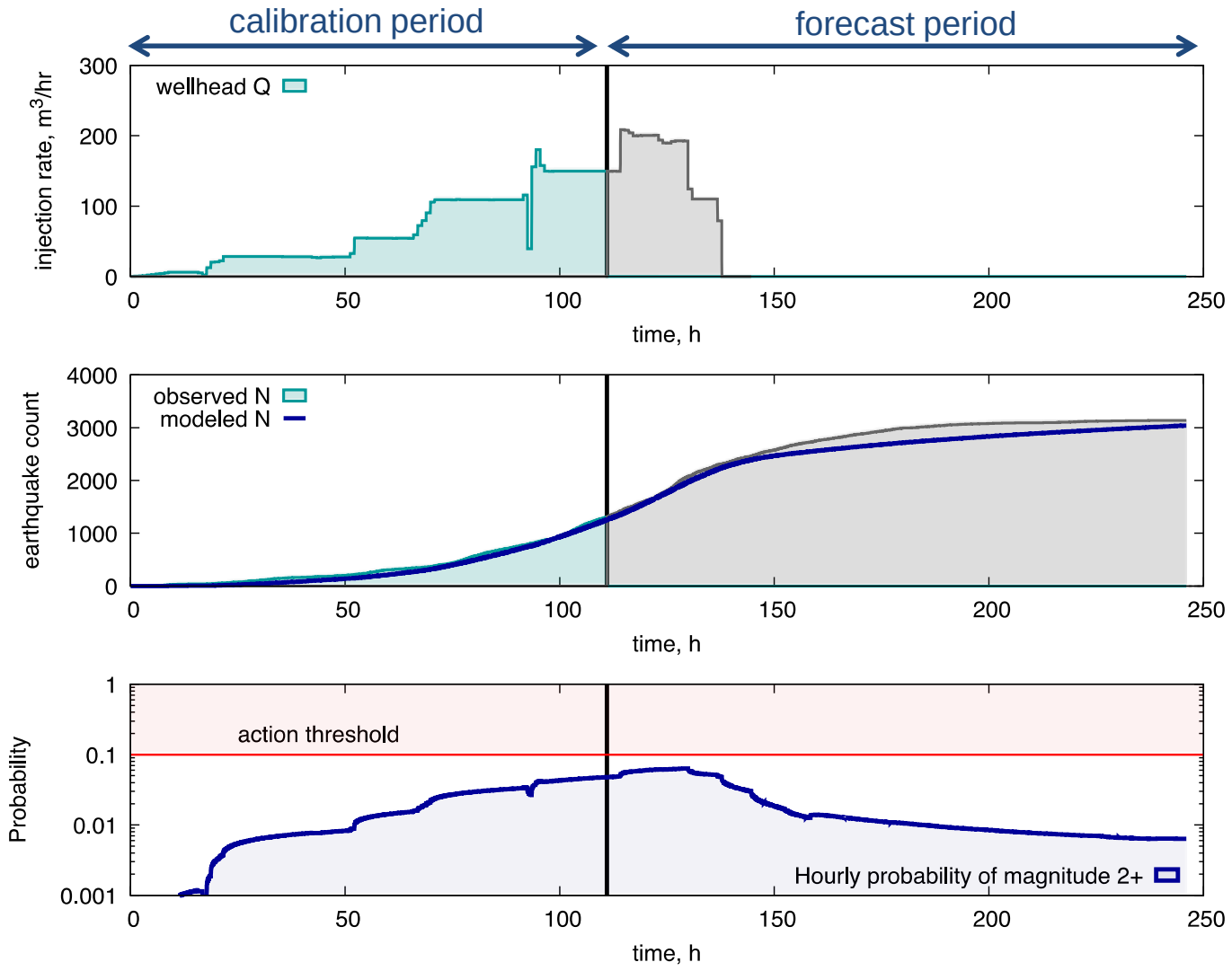

Figure: Conceptual workflow for generating a continuously-updated hazard estimate using flow rate and microseismic data.

References

- J.A. White and W. Foxall (2016). **Assessing induced seismicity risk at CO_2 storage projects: Recent progress and remaining challenges**. Int. J. Greenhouse Gas Control 49:413-424.

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- Bachmann et al. (2011) **Statistical analysis of the induced Basel 2006 earthquake sequence: Introducing a probability-based monitoring approach for Enhanced Geothermal Systems.** Geophys. J. International 186.2: 793-807.

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