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INJECTINGWASTEWATER SINCE

The Raton Basin, a coal-bed methane field, has had large volumes of fluid pumped from and injected into the subsurface as well as increased earthquake occurrences. Prior to 2001 there was one M≥4 earthquake and after major injection began in 1999 there have been over two dozen.



Understand how wastewater injection changes subsurface processes over time as well as its effects on regional seismicity.



FIGURE 1 - Area of interest map: Raton Coal Basin boundary (green), DEM region (orange), and outline of satellite path 151 and frame 115 (blue)

Geodetic Techniques Applied Towards Understanding Induced Earthquakes in Raton Basin, Colorado & New Mexico

Problem?

INDUCED earthquakes pose a HAZARD to local and infrastructure as as create CHALLENGES for energy production.

Time series analysis uses images from the European Space Agency Sentinel-1 C-band instrument. Differential InSAR time series analysis quantifies line-of-sight (LOS) ground deformation at a centimeter spatial resolution. The results provide high resolution images of ground motions in the basin and measure LOS deformation over ~ 55 months from May 2017 to July 2020.





DISCUSSION & CONCLUSION

- •ANALYSIS 01: Time series reveals positive vertical displacement (**uplift**) in regions where there is induced seismicity this can be seen in figure 2.
- •ANALYSIS 02: Time series reveals negative vertical displacement (subsidence) in regions where there are injectioni wells this can be seen in figure 2.
- **CONCLUSION:** The uplift signals were found to correlate spatially to wastewater injection wells where injection volumes were the highest.



FUTURE WORK & REFERENCES

- ALOS-1 L-band instrument (2006-2011
- •Incorporate mining data into analysis
- •**Test** different time series parameters
- Extend processing to northern region



• Increase time span for time series using Sentinel-1 and Japanese Space Agency

