A century of oil-field operations and earthquakes in the greater Los Angeles Basin, southern California

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Goals of Study

• Compare seismicity inside/outside oilfields
• Pumping data since 1977 & Seismicity
• Wilmington oilfield deformation 1926-1968
• Max Magnitude & injected/extracted volumes
• The 1933 Mw6.4 Long Beach earthquake
Seismicity Rates:


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First Conclusions

• Seismicity rates same inside/outside oilfields
• No clustering in oilfields
• Seismicity too deep to be related to oilfield activities
Injected & Extracted Volumes

• Is the seismicity apparently located within the perimeters of the oilfields related to activity in the oilfields regardless of depth?
  – The past Wilmington oilfield deformation
  – Compare current volumes & seismicity
  – What could the Max magnitude of likely induced quakes be?
Inglewood Oil Field

Cumulative Fluid Injection (red)

Data from CISN

Magnitude

Injection: blue; Production: green

Water/Oil [Mbbl]

Production

Injection

Data from DOGGR

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Wilmington Oilfield 1926 – 1968: 3rd largest!

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Fluid Injection and # of Quakes

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**Fluid Injection and # of Quakes**

- Wilmington (injection 1977-2014)
- Richfield
- Huntington
- Brea-Olinda
- Coyote West
- Inglewood
- Beverly Hills
- Long Beach

**Wilmington Injection**

1926-1958

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Maximum Magnitude

Injection

Extraction

$M_0 = GΔV$

McGarr (2014)

$y = -0.018 + 0.454\log(x)$  $R = 0.45$

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Huntington Beach Oil Field

M6.4 Long Beach 1933
Conclusions

• Current oilfield practices minimize the likelihood of induced seismicity

• However, if drastically different recovery techniques were applied, such as extensive horizontal drilling and associated fracking and/or deep fluid injection, the potential for induced seismicity would need to be reassessed