Deterministic Model of Earthquake Clustering Shows Reduced Stress Drops for Nearby Aftershocks

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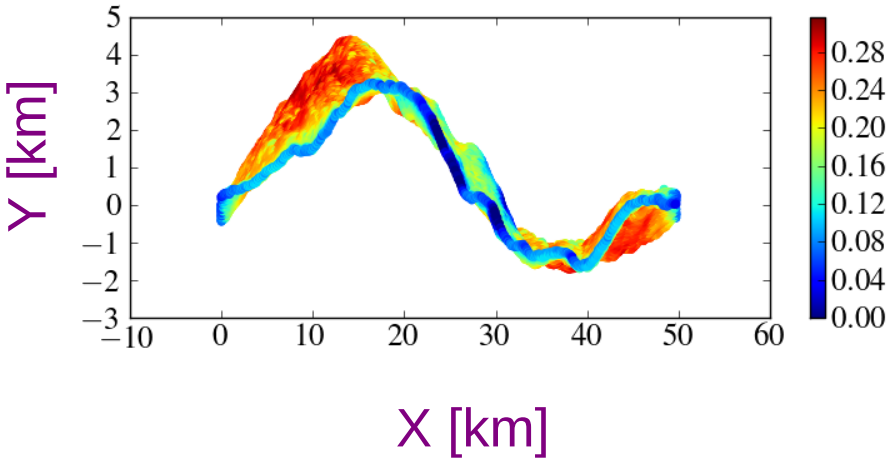
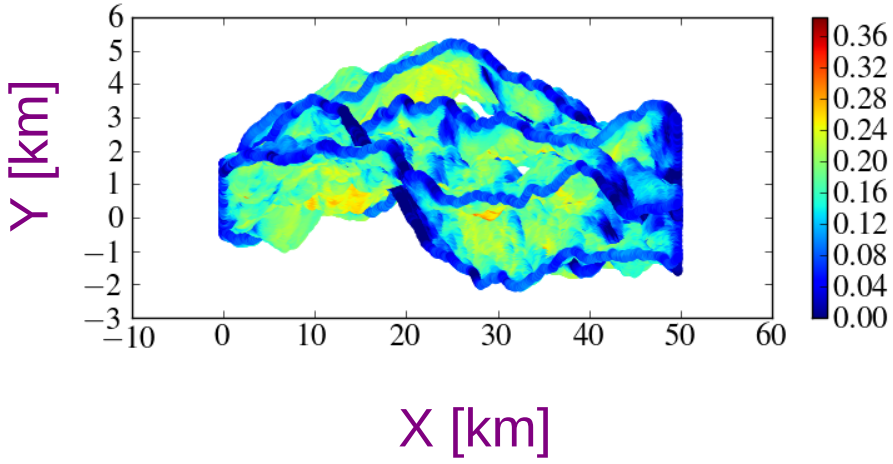
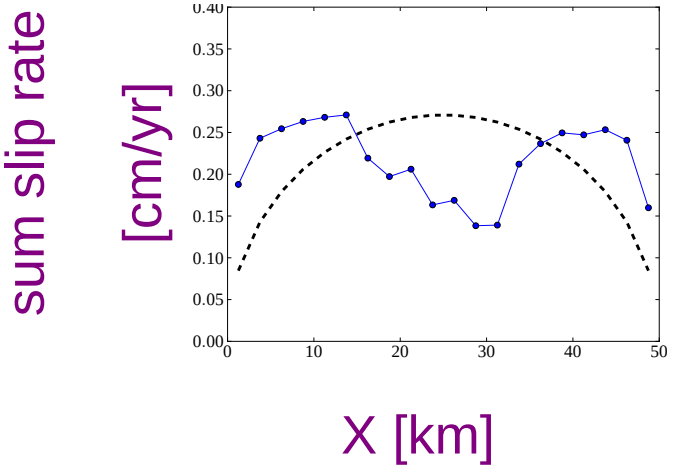
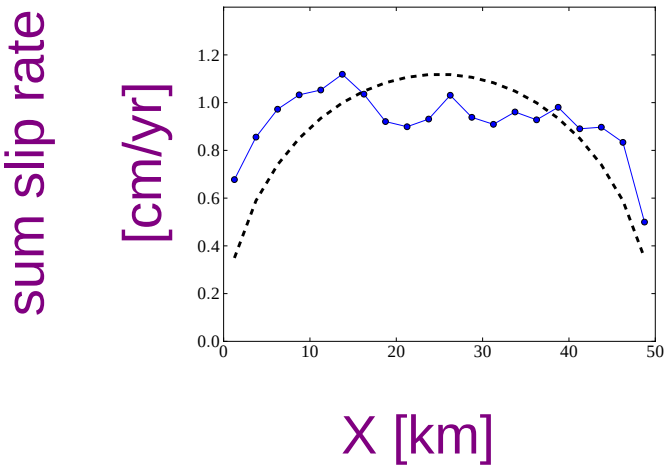
Singlestrand vs Multistrand



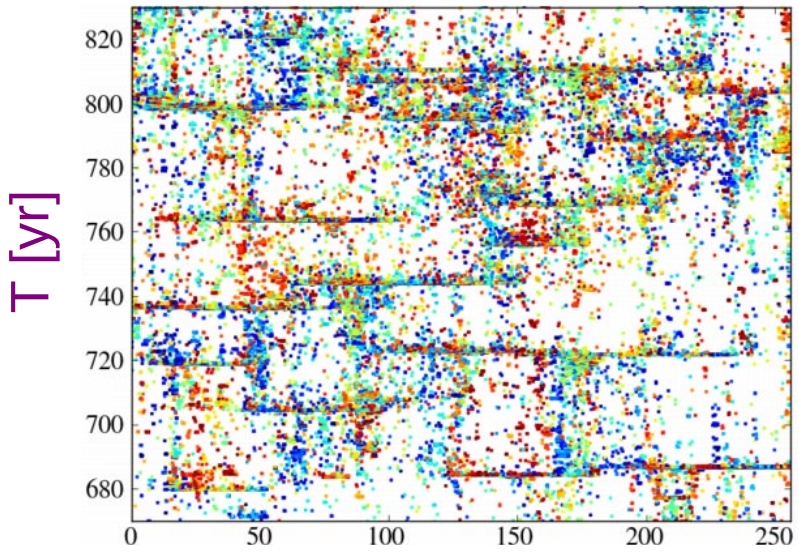


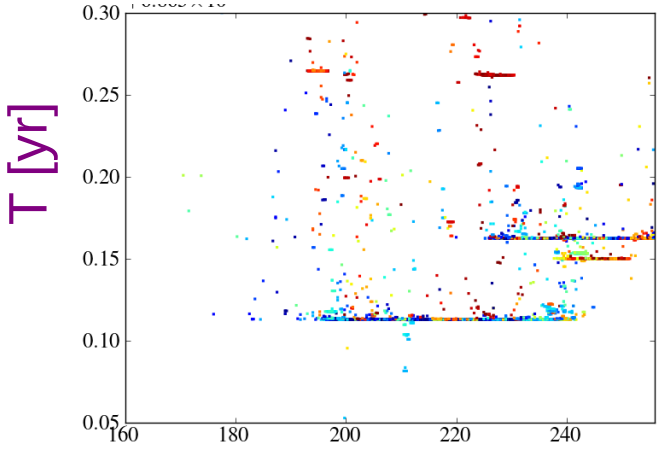


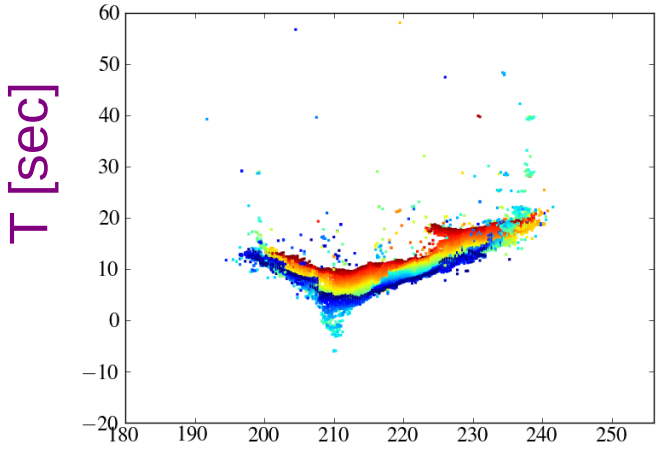


- Multistrand more crack-like with higher slip

Seismicity in Different Timescales

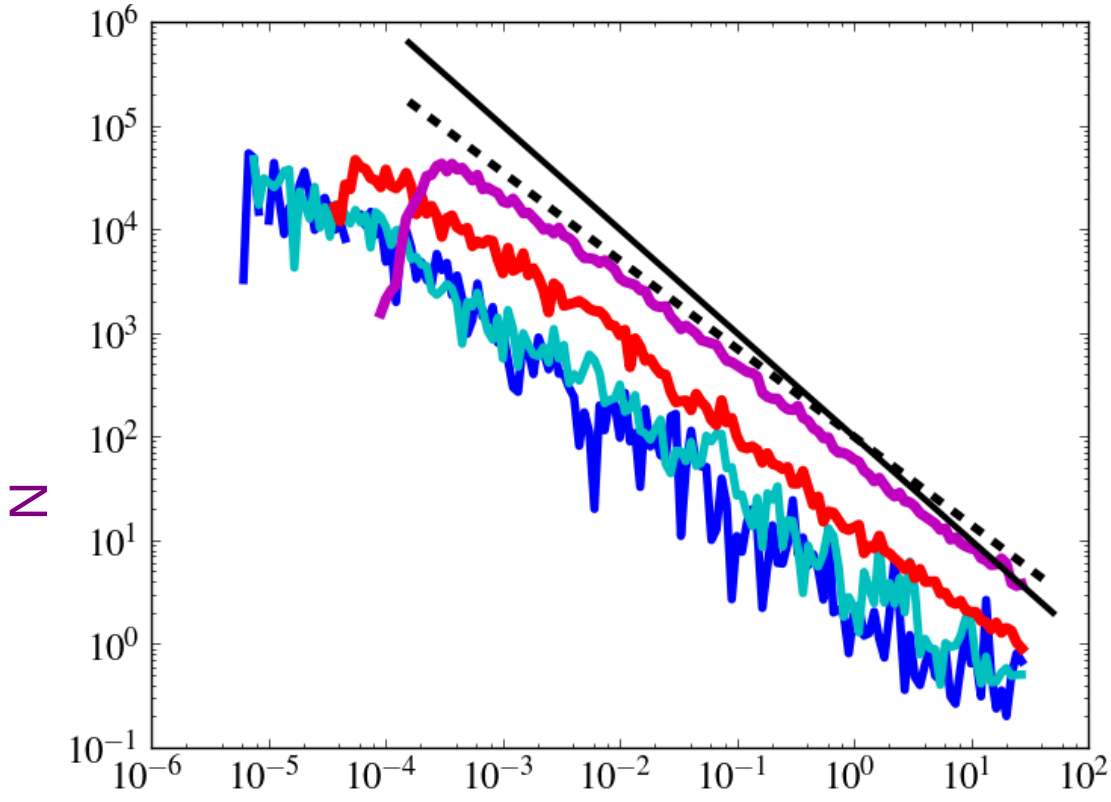






- Aftershocks along mainshock rupture area

Omori Law

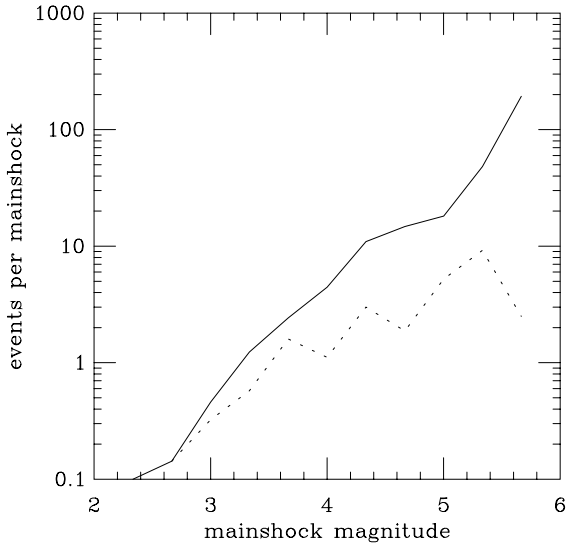


M5 foreshocks, M6 foreshocks, M5 aftershocks, M6 aftershocks.

- Modified Omori law: $p \sim .8$

Foreshock vs Aftershock Productivity

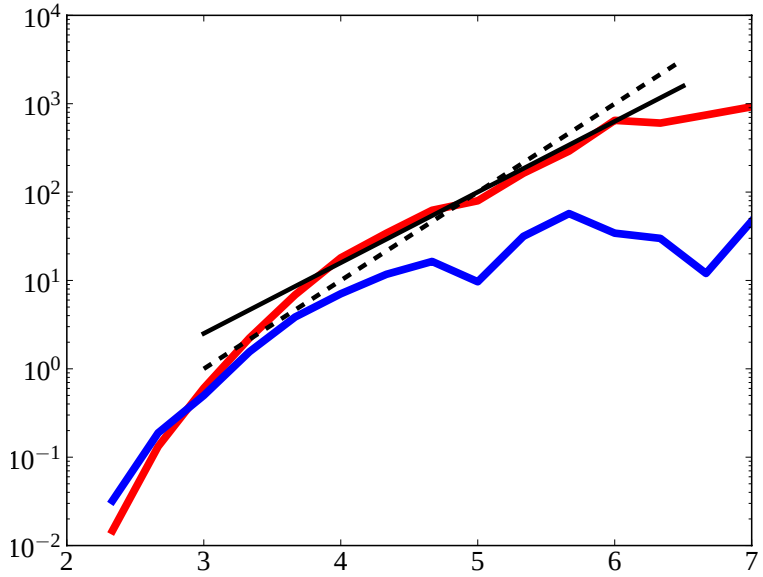
Events per mainshock



Mainshock Magnitude

California Data

Events per mainshock

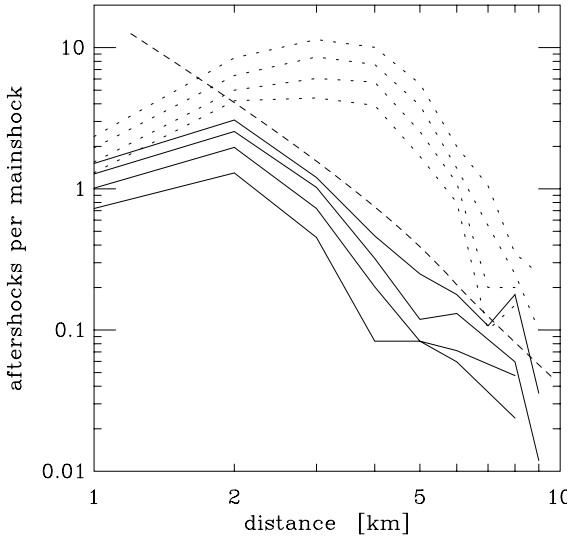


Mainshock Magnitude

Model

Spatial Distribution

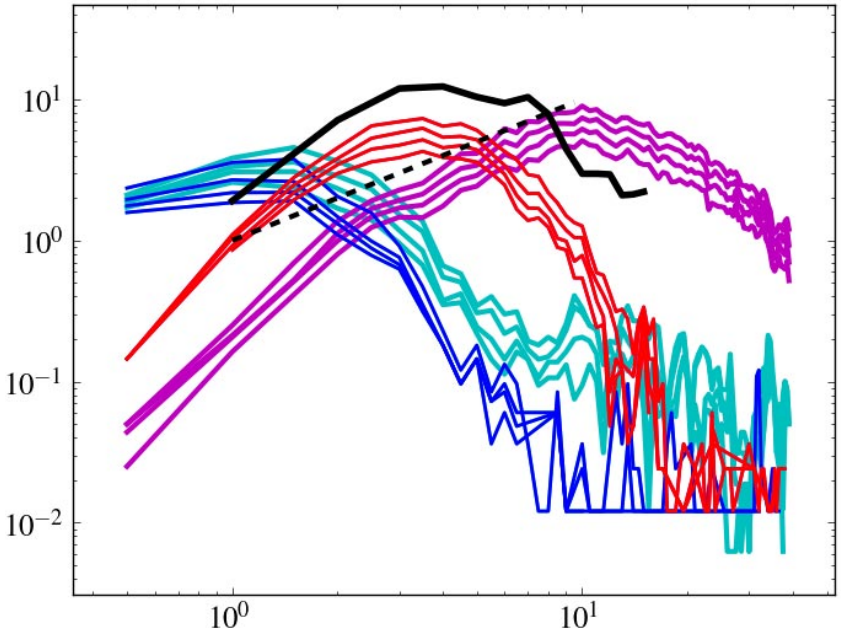
Events per mainshock



distance [km]

California Data

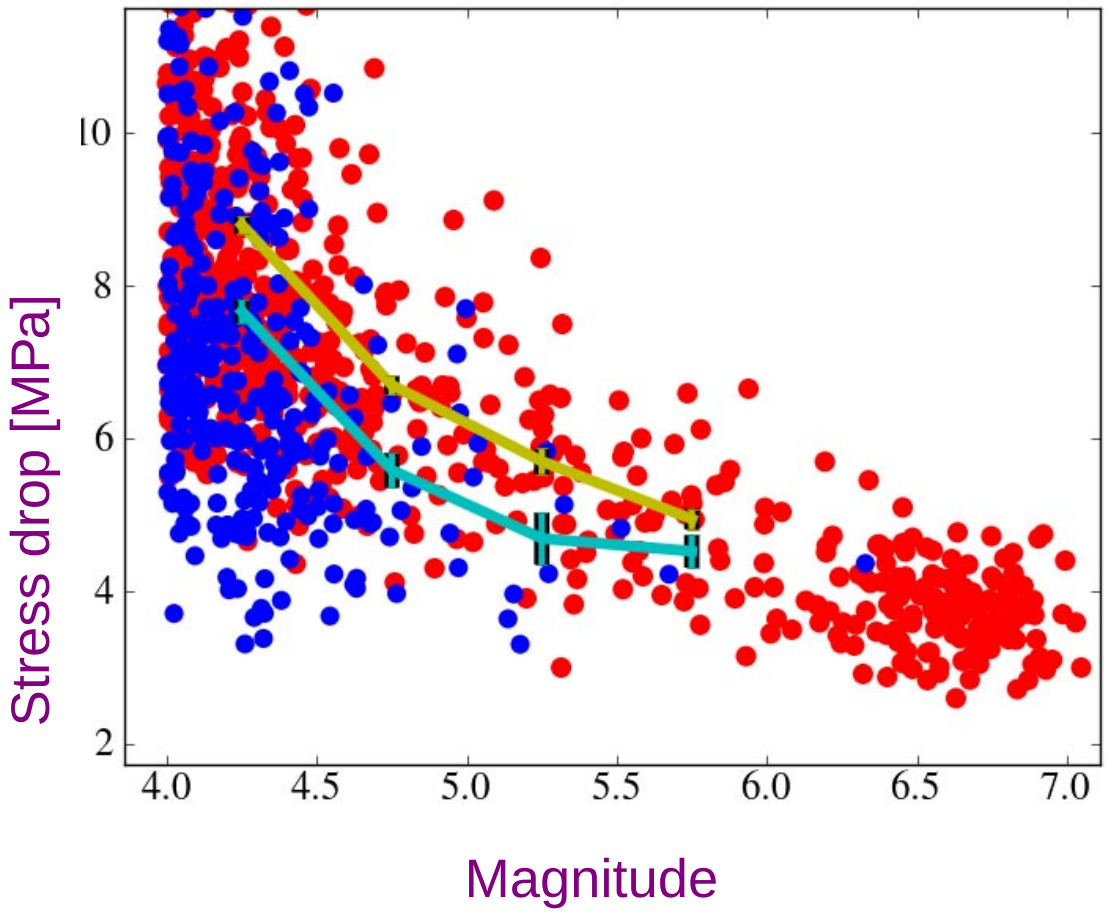
Events per mainshock



distance [km]

Model

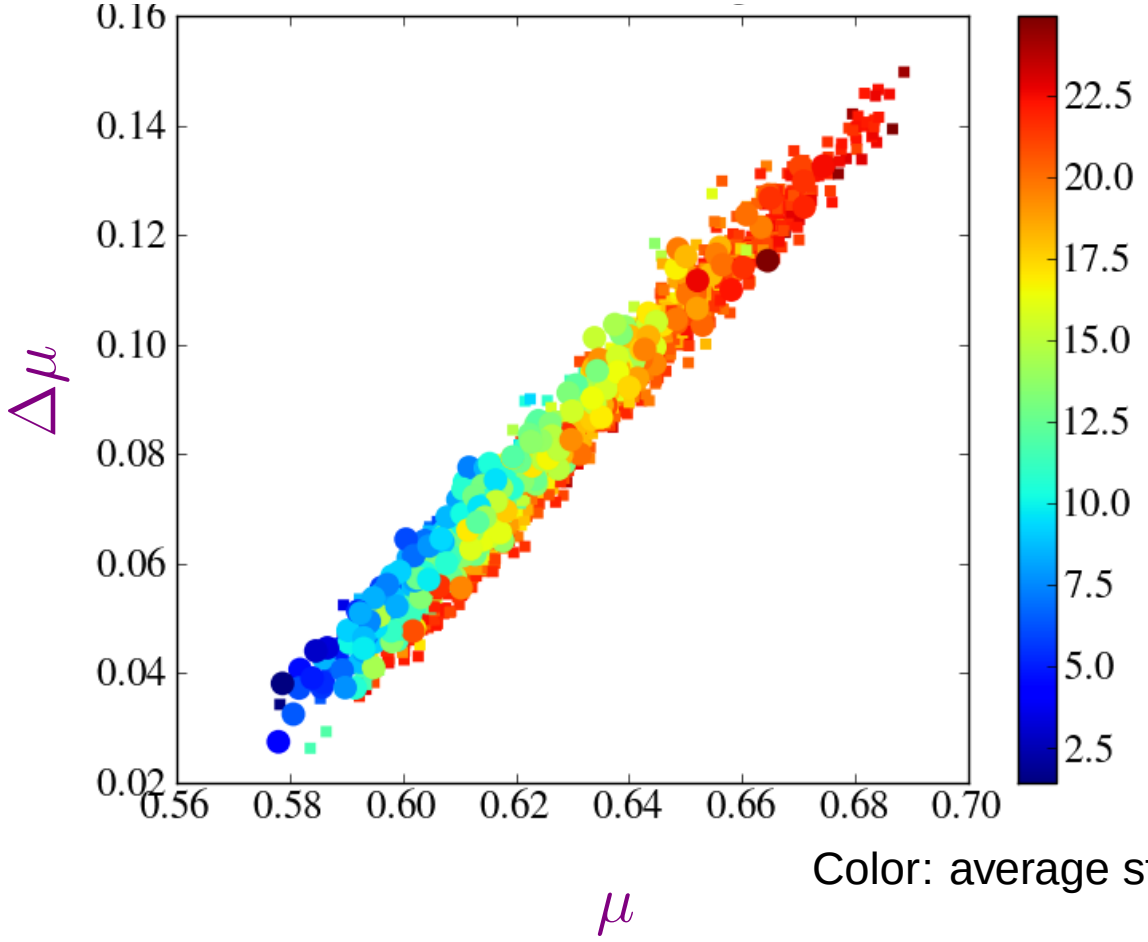
Lower Stress Drops for Nearby Aftershocks



Nearby aftershocks , Mainshocks, Mean of nearby aftershocks , Mean of mainshocks .

- Consistent with ground motion phenomenology
- Statistical models can put in, but not explain
- Aftershocks not the same population as mainshocks

Why Low?: Rebreaking incompletely rehealed



Color: average state variable

- Low friction drop due to incomplete healing
- Nearby aftershocks can rebreak parts of mainshock
- Log healing halfway through EQ cycle after few days

Conclusions

- New deterministic model of Aftershocks
- Obtain aftershocks along mainshock rupture area
- Aftershock population differs from mainshocks
- Lower stress drops for some nearby aftershocks
- Reason is rebreaking incompletely healed areas
- Explains puzzling ground motion observations