Seismogenic structure source models

Issues, challenges, and outlooks
Three major issues of seismogenic structure source models:

- Completeness of structures
- Correctness of structural parameters
- Structural geometries
Completeness of structures:

- Offshore structures that are not related with the subduction zone
- Structures that did not have co-seismic surface ruptures
- Structures with short length
- Structures that have low slip rates
Offshore structures that are not related with the subduction zone:

- In New Zealand: Many previous offshore survey results to constrain their parameters
- In Japan: does not have complete offshore mapping yet, will begin offshore survey for selected structures
- Will require more offshore data, especially the age of sea bottom surface sediments
- May attempt to use geodetically determined total strain budget to distribute to the structures
Structures that did not have co-seismic surface ruptures:

- A global magnitude threshold for surface rupture? ~7 for New Zealand, upper 6’s for many places
- Faults that produce smaller events, how to consider?
- Operation in Taiwan: put most of the events in the 6’s as areal source → to avoid double counting
Structures with short length:

- In Japan: ~20 km
- Related with the previous issue: what length would be “seismogenic”?
Structures that have low slip rates:

- More, better data......
- Methods other than geomorphology......
Correctness of structural parameters (especially slip rate and recurrence intervals):

- Shallow slip deficit: implications for recurrence interval calculations
- Reconciliation between geologic slip rates and geodetic slip rates
Shallow slip deficit:

- Do they sustain? Or will they be filled up by small events or post-seismic deformation?
- Kumamoto case: very small co-seismic surface offset compared with paleoseismic data
- Need more and longer geodetic observations
Reconciliation between geologic and geodetic slip rates:

- Creeping faults: how to assign the “accumulated” strain? May be hard to do, need longer observations
- Identification of creeping deformation in trenches. Should be doable in Japan and Taiwan
Structural geometry issues:

- Issues related with fault width
- Segmentations and joint ruptures
- Shallow crustal “secondary” ruptures
- Asperities
Issues related with fault width:

- Rupture depth: geothermal gradient, seismogenic depth (background seismicity)
- But, events that are deep in western Taiwan…
- Uppermost part of the crust: Is energy released there?
- Different cases in Japan and Taiwan
- Maybe need to consider cases of individual structures, i.e., structures in soft basins vs. hard bedrocks
Segmentations and joint ruptures:

- Assign the probability for each case, use logic tree to calculate
- For joint ruptures: kinematic information to determine if the faults are more likely to belong to the same system, in Japan, determine the “master fault” and the “secondary fault”
- For segmentations: determine the characteristics of segment boundaries: do they sustain???
- Geodetic results may help!
Shallow crustal “secondary” ruptures:

- Observations in Meinong and Kumamoto
- Those short surface ruptures in Kaikoura: also similar?
- Faults that are important in fault displacement hazard, but may not be major seismogenic structures
- Back to the previous issue: how to determine whether they are seismogenic?
- After earthquake events: using seismic wave data to see if that rupture is related with moment release
Asperities:

- Where to put them when doing earthquake scenarios? → simulations
- Why are there asperities? Do they sustain?
- Paleoseismic observations and geodetic models. → similar to subduction zones, LVF case
- More earthquakes……