Regional monitoring of Cascadia tectonics

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Outline

• The Cascadia subduction zone
• Lessons from Japan & the 2011 M9 Tohoku earthquake
• Saving lives with real-time GPS
Cascadia Subduction Zone

Earthquake magnitude is proportional to fault size
Cascadia today: 20y of GPS
Cascadia:
36 mm/yr loading rate
Coast moves ~2 cm/yr today
Margin-wide recurrence: 550 years (var ~200 yrs)
311 years into the eq cycle
10 meters of post-1700 accumulated slip deficit
Last eq appears to have been margin-wide (M9)
Moment, damage ~ width of seismogenic zone
470 Cascadia rtGPS

1000 Japanese rtGPS
東北地方太平洋沖地震に伴う海底の動き（水平）
Slow Slip

Dragert, Wang and James, 2001
August 2010 GPS Displacements

Horizontal

Vertical
May 2008
M=6.5

Fault slip

0 10 20 30 40

5 mm
Many magnitude 6s

Chapman and Melbourne., 2009

Szeliga et al., 2008
• ~Half of convergence is accommodated by large ETS events
• All imaged slip occurs below 25 km depth, above 40 km
• But max slip ~ 1/smoothing
ETS delineates a 25 km lower limit to interseismic strain accumulation

After Hyndman, Dragert, Wang, etc, 1992-2003
Testing this model:

- It should replicate current GPS data (which has many new stations)
- Run in reverse, it needs to satisfy paleoseismic constraints
Test 1: comparison with current interseismic deformation:

36 mm/yr
GPS stations with ~10 years of measurements

Data from Leonard et al, 2004

ETS-delineated coupling model:
Replicates gross distribution of paleoseismic subsidence

Chapman and Melbourne 2009
A rough forecast of future slip after full recurrence interval
Why rtGPS? Tohoku in Cascadia

No stable reference station in a 2-state radius!

USGS, M9, 30m max slip
Concluding thoughts

• The Cascadia subduction zone will have great earthquakes
• Real-time GPS network is in place
• Data analyses are evol
• Saving lives with real-time GPS