

Charleston Seismic Source Characterization

Developed by
WLA SSHAC Level 2 Technical Integrator Committee
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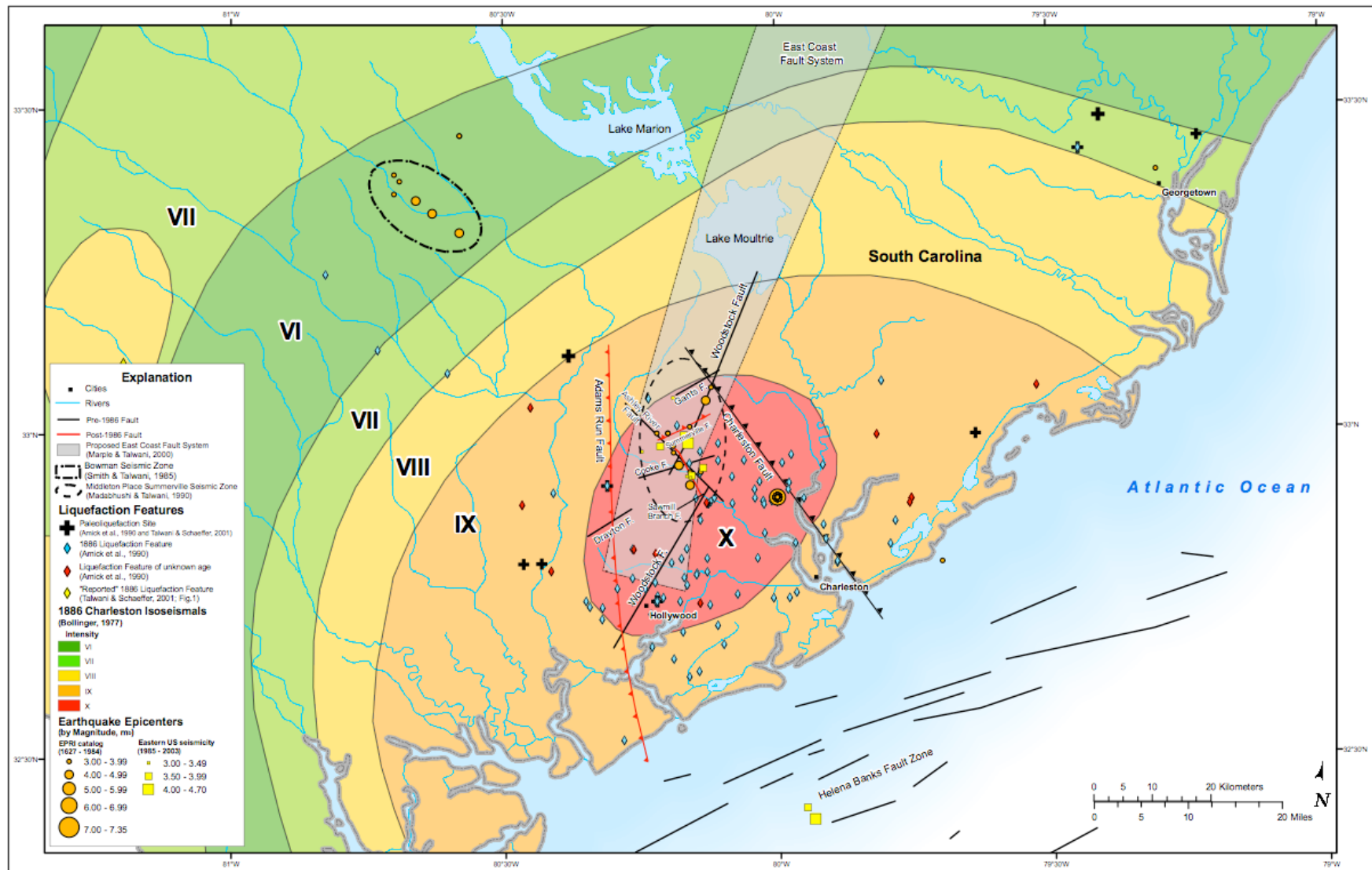
For
Bechtel and Southern Nuclear Company

Presented by Scott Lindvall
USGS CEUS Workshop
Boston, MA
May 9-10, 2006

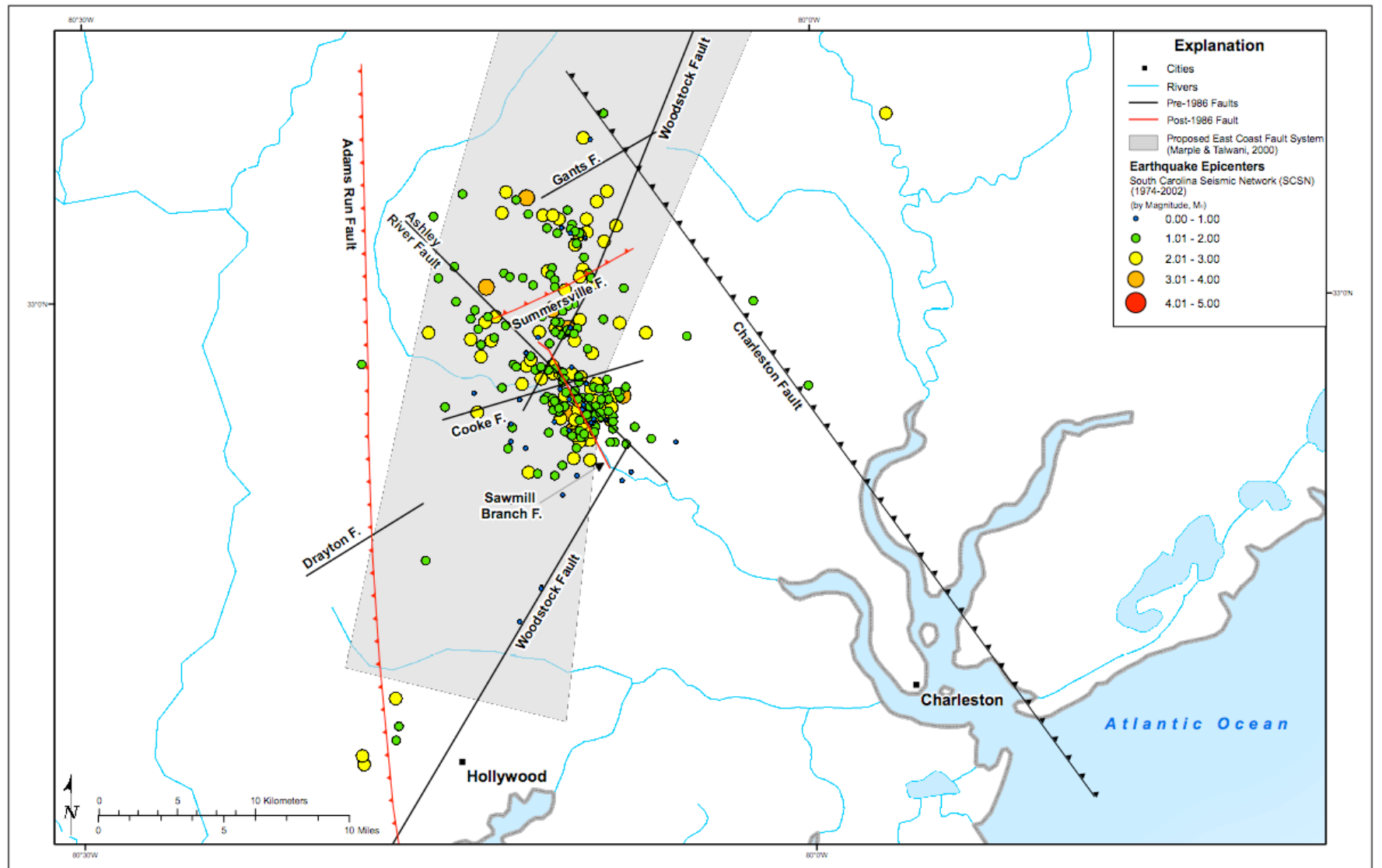


William Lettis & Associates, Inc.

Local Charleston Tectonic Features

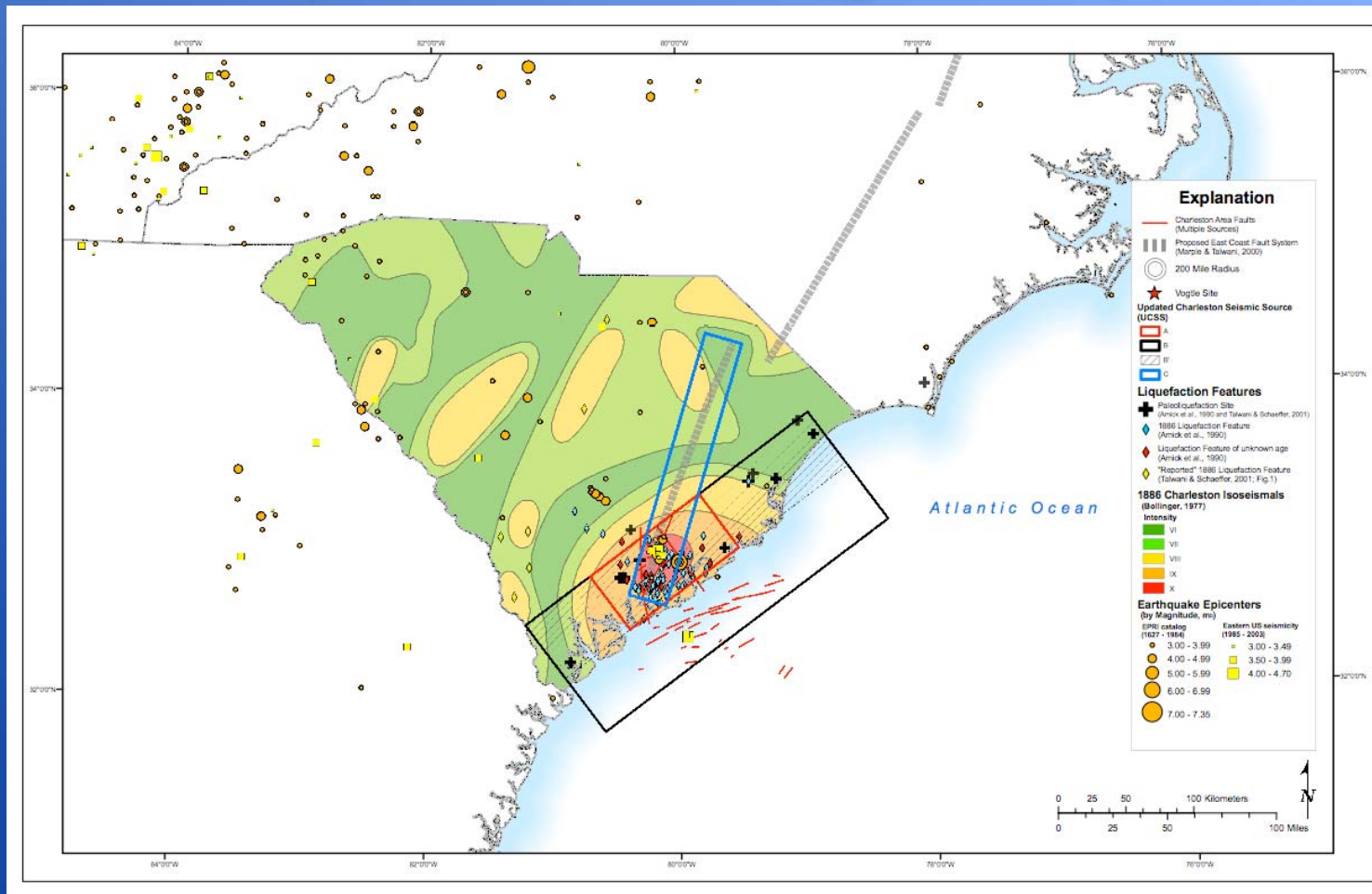


Local Seismicity



Updated Charleston Seismic Source - Geometry -

- Four, mutually exclusive source zone geometries (A, B, B', & C)

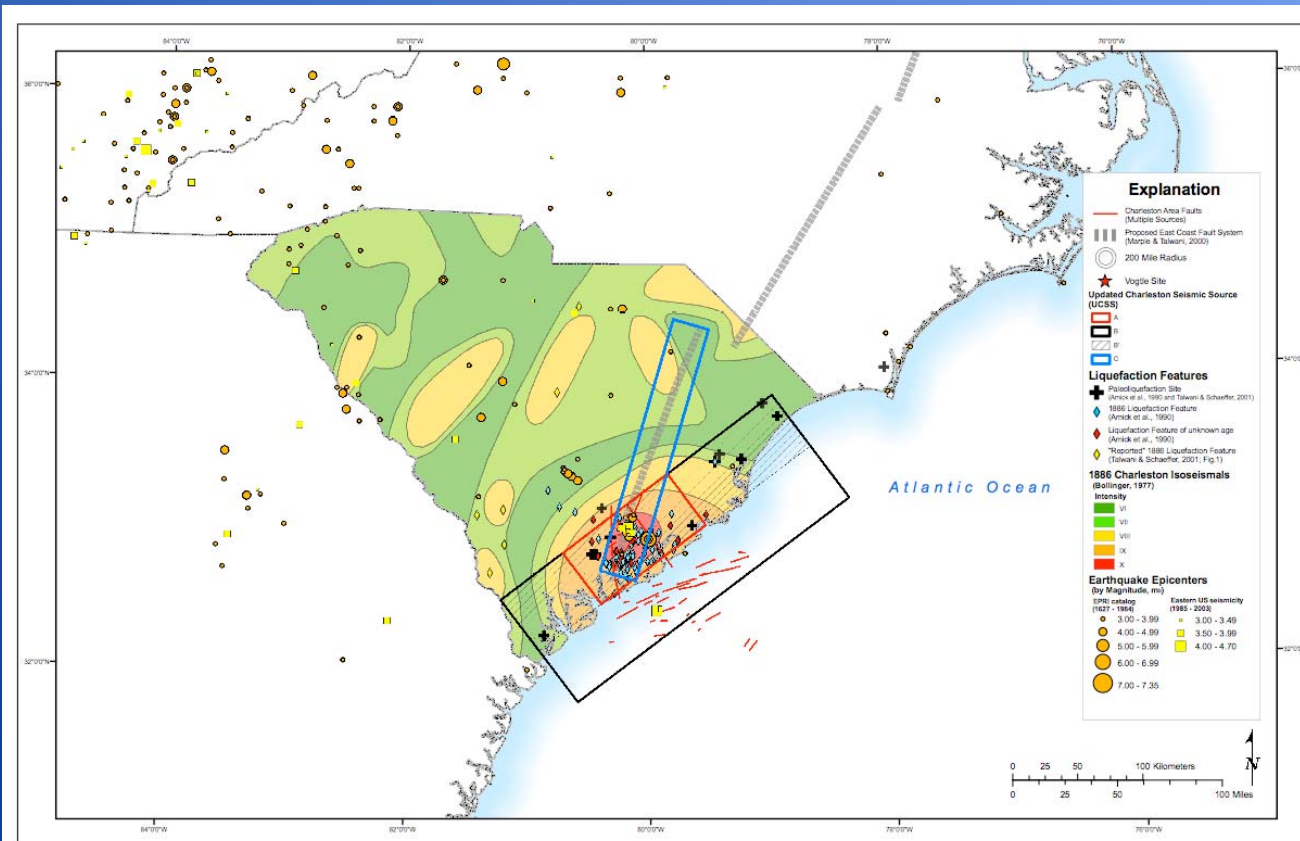


Updated Charleston Seismic Source - Geometry -

GEOMETRY A - Charleston - 0.70 weight
100 x 50-km, northeast-oriented, localized source centered
on the 1886 meizoseismal area

GEOMETRY A ENVELOPES:

- 1886 meizoseismal area
- the area containing the majority of local tectonic features
- the area of ongoing concentrated seismicity (MPSSZ)
- the area of greatest density of 1886 liquefaction and pre-historic liquefaction

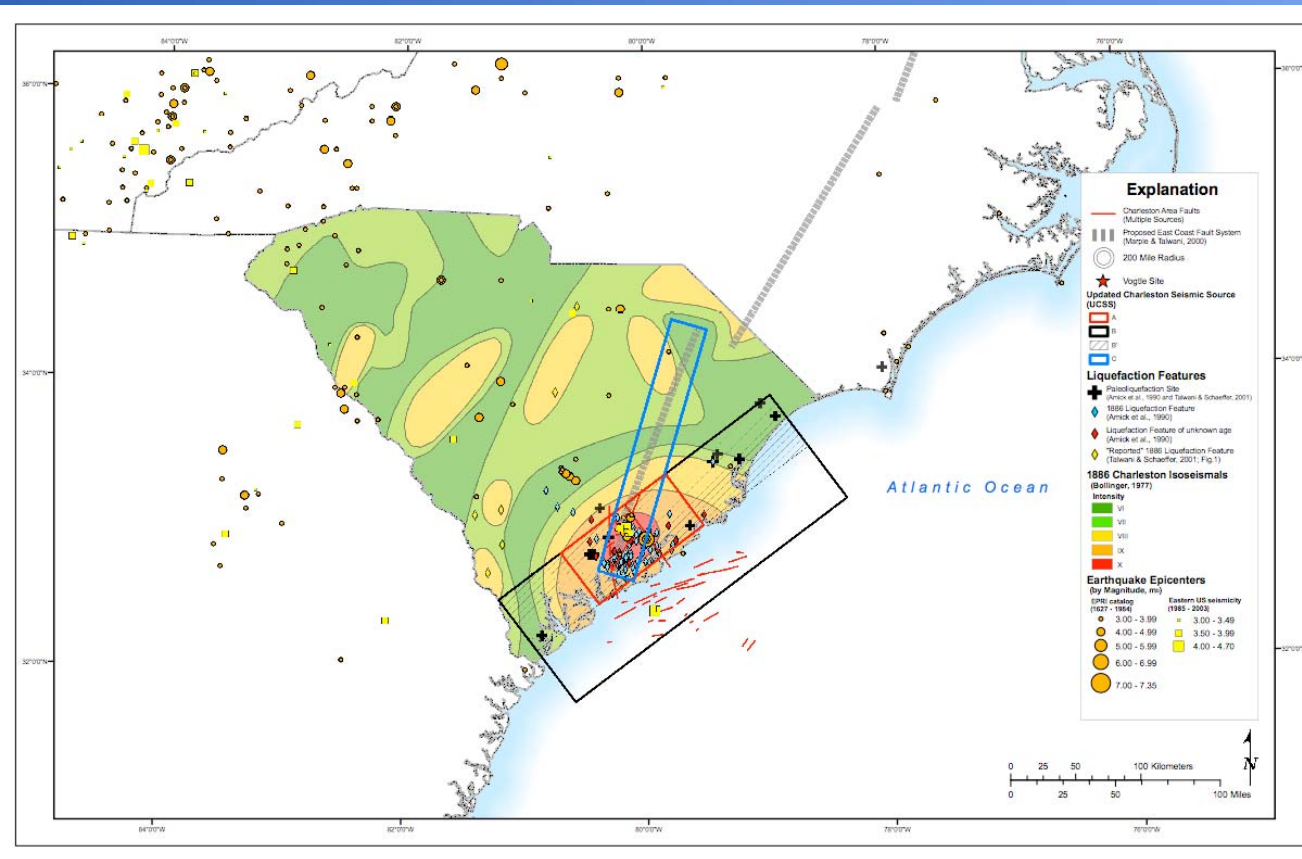


Updated Charleston Seismic Source - Geometry -

GEOMETRY B - Coastal and Offshore - 0.10 weight
~260 x 80-km, coast-parallel source area

GEOMETRY B ENVELOPES:

- all of Geometry A
- other, more distant liquefaction features in coastal SC
- offshore Helena Banks fault zone
- parallel to regional structural grain & elongation of 1886 isoseismals
- NE & SW extents of controlled by mapped extent of paleoliquefaction features

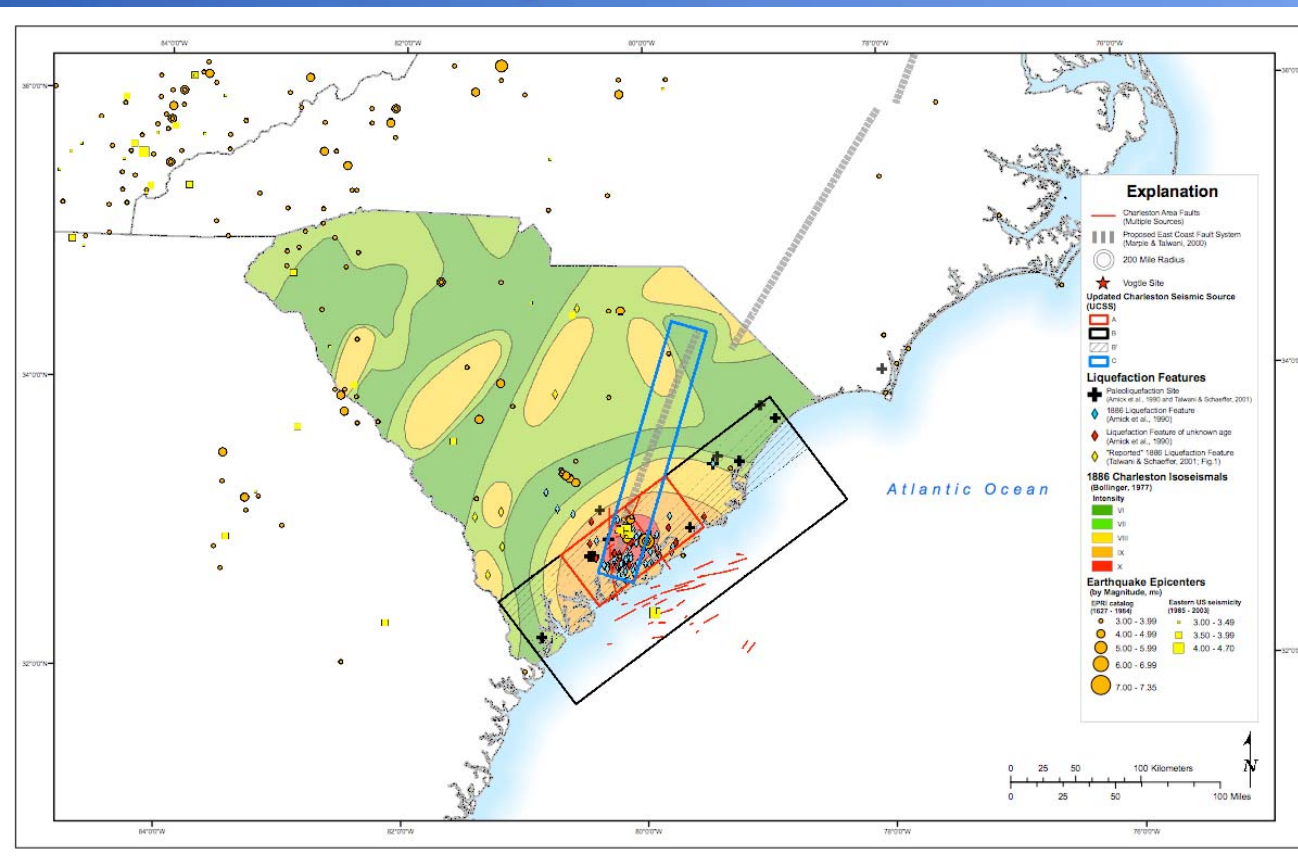


Updated Charleston Seismic Source - Geometry -

GEOMETRY B' - Coastal Zone - 0.10 weight
~260 x 50-km, coast-parallel source area

GEOMETRY B' ENVELOPES:

- all of Geometry A
- other, more distant liquefaction features in coastal SC
- DOES NOT include offshore Helena Banks fault zone
- Why is HBF excluded? Preponderance of data and evaluations suggest it's not active & that the 1886 Charleston event occurred onshore

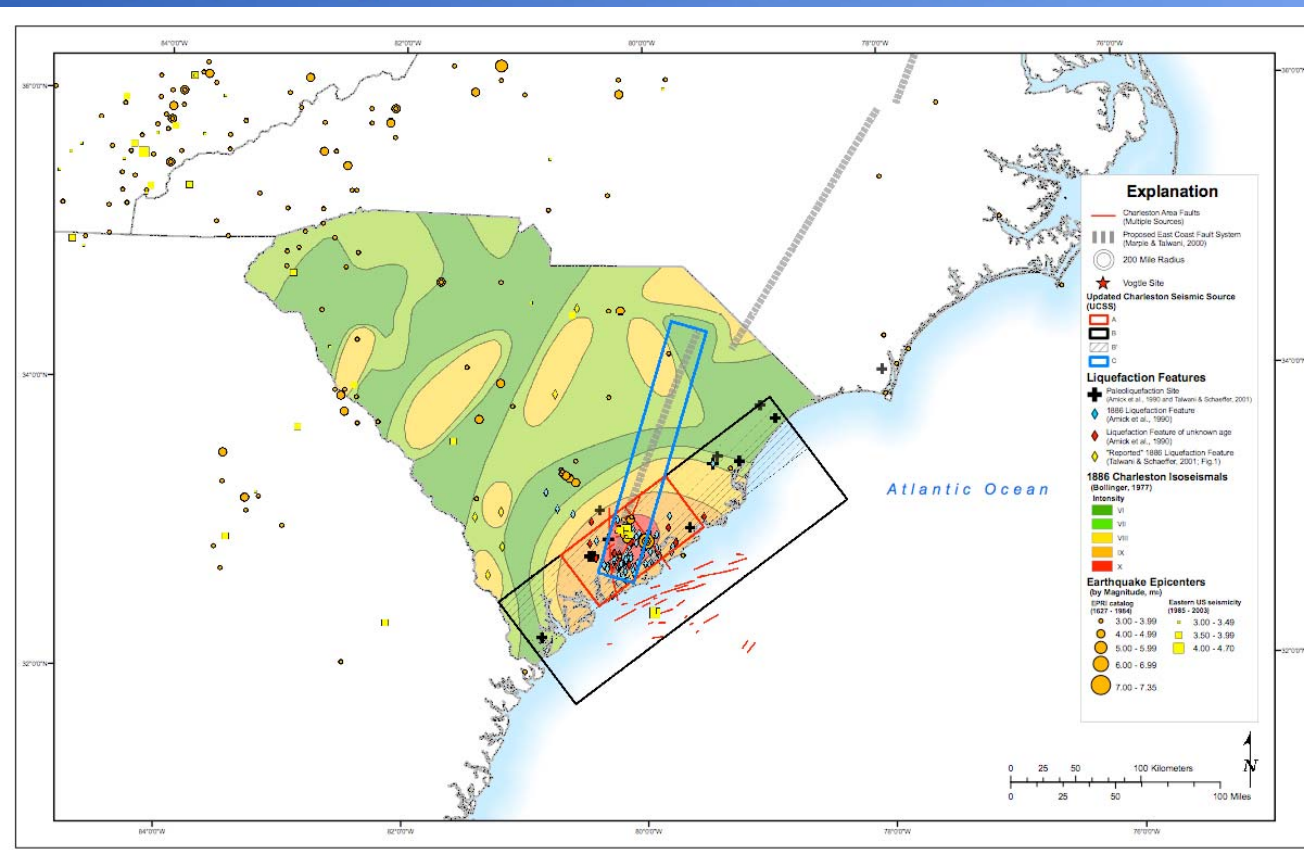


Updated Charleston Seismic Source - Geometry -

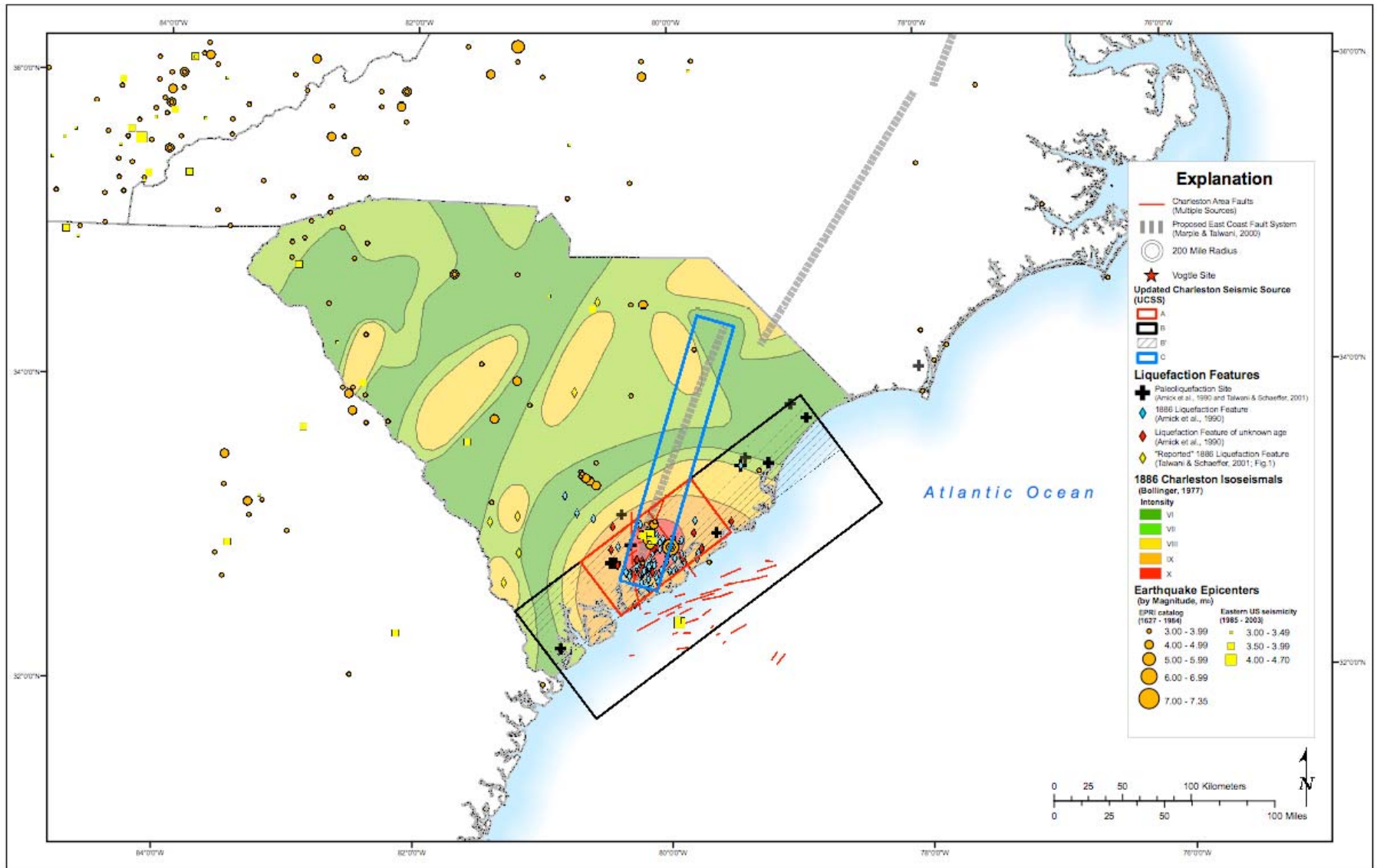
GEOMETRY C - ECFS-s - 0.10 weight
~200 x 30-km, north-northeast-oriented source

GEOMETRY C ENVELOPES:

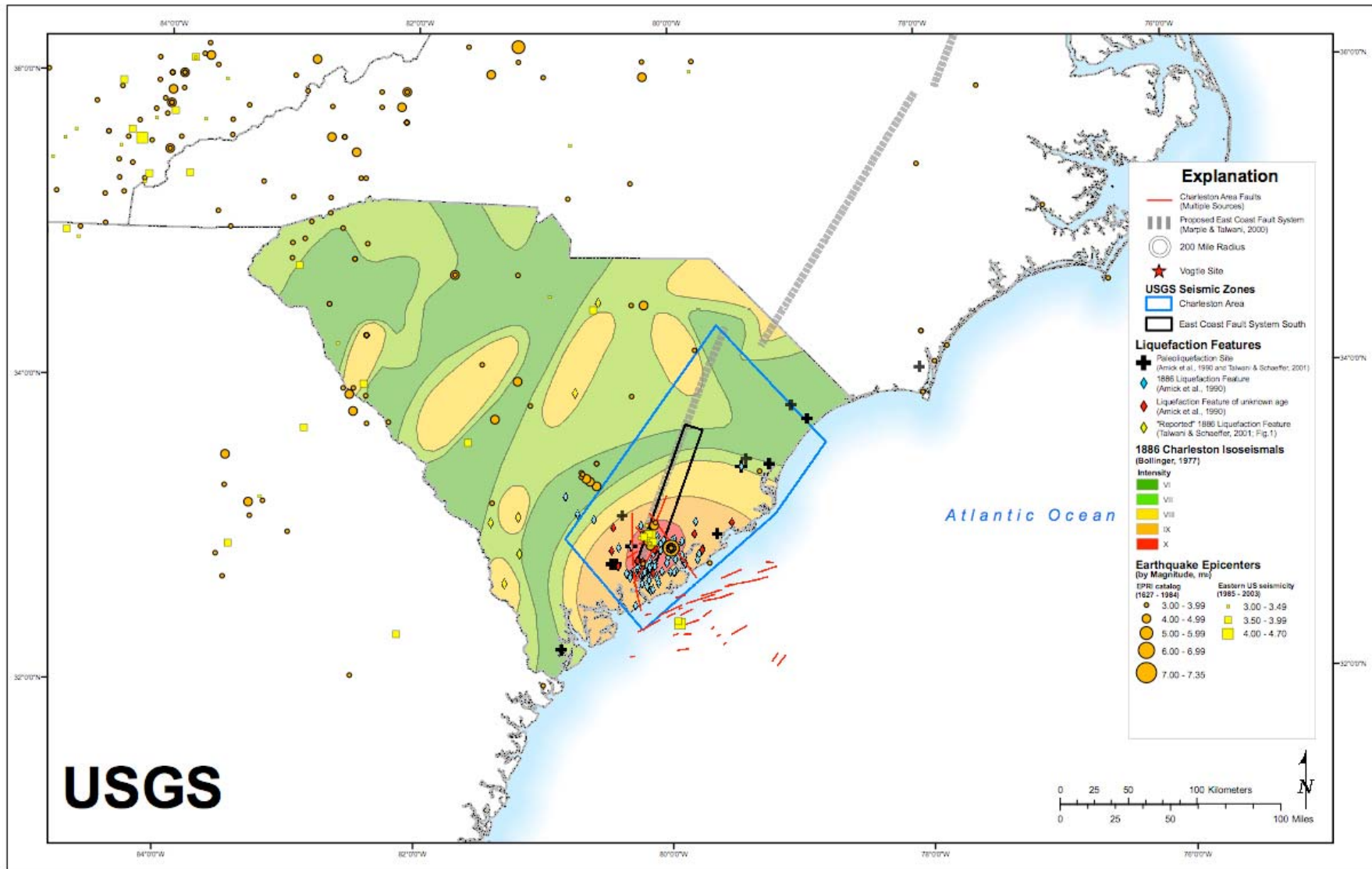
- southern segment of the proposed East Coast fault system (ECFS-s)
- Area of geometry C is restricted to envelope the original depiction of the ECFS-s (Marple and Talwani, 2000).



Updated Charleston Seismic Source (UCSS)



USGS (2002) Charleston Source



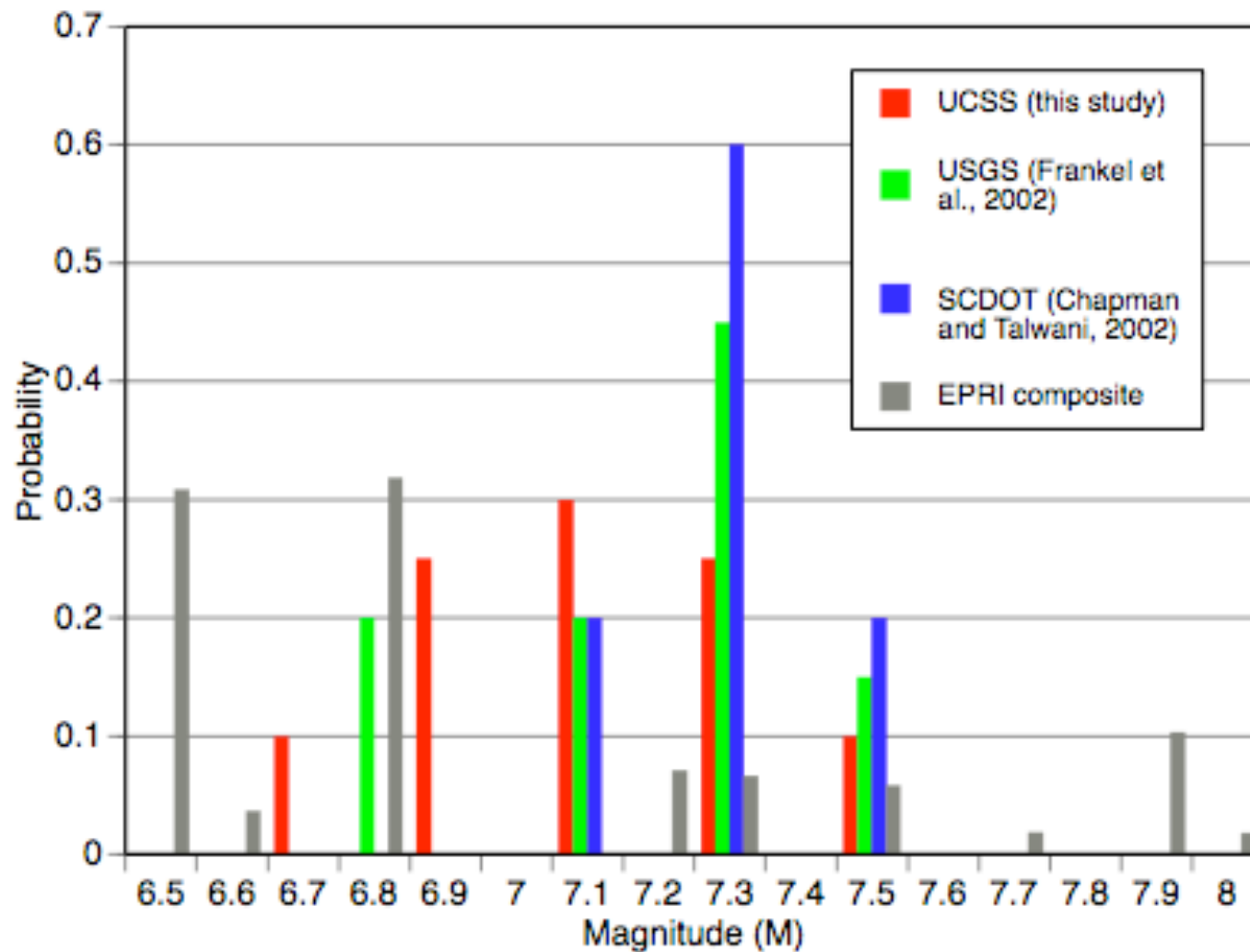
Updated Charleston Seismic Source - Mmax -

- The UCSS magnitudes and weights are as follows:

| <u>M</u> | <u>weight</u> | |
|----------|---------------|-----------------------------------|
| 6.7 | 0.10 | |
| 6.9 | 0.25 | Bakun and Hopper (2004) preferred |
| 7.1 | 0.30 | |
| 7.3 | 0.25 | Johnston (1996) mean |
| 7.5 | 0.10 | |

- UCSS weighted Mmax mean magnitude: **M 7.1**
- USGS weighted Mmax mean magnitude: **M 7.2**
(Frankel *et al.* 2002)
- SCDOT weighted Mmax mean magnitude: **M 7.3**
(Chapman & Talwani 2002)

Mmax Distributions



Updated Charleston Seismic Source - Recurrence -

- Our analysis suggests:
 - 4 large earthquakes (3 inter-event times) in the most-recent, ~2,000-year portion of the paleoliquefaction record (1886, A, B, & C')
 - 6 large earthquakes (5 inter-event times) in the entire ~5,000-year paleoliquefaction record (1886, A, B, C', E, & F')
- Calculation of Recurrence:
 - Two average recurrence intervals covering two different time intervals (used as two recurrence branches on the logic tree)
 - ~2,000-year record - 0.80 weight
 - ~5,000-year record - 0.20 weight
 - Mean recurrence intervals and their parametric uncertainties calculated according to the methods outlined by Savage (1991) and Cramer (2001)

Updated Charleston Seismic Source

- Recurrence (cont'd) -

- Average inter-event time is expressed as two continuous lognormal distributions:
 - (1) ~2,000-year record - best estimate mean value of 548 years, and an uncertainty distribution described by a median value of 531 years and a lognormal shape factor of 0.25.
 - (2) ~5,000-year record - best estimate mean value of 958 years, and an uncertainty distribution described by a median value of 841 years and a lognormal shape factor of 0.51.
- At one standard deviation, the average recurrence interval for the ~2,000-year record is between 409 and 690 years; for the ~5,000-year record, it is between 452 and 1564 years
- Mean values (548 and 958 years) - combined with logic tree weights (0.8 and 0.2, respectively) results in a weighted mean of 630 years for Charleston Mmax recurrence

Updated Charleston Seismic Source - Logic Tree -

