SUBSIDENCE I (35)

I Main Topics
A Recognition of subsidence hazards (Case histories)
B Characterization of subsidence hazards
C Evaluation of subsidence hazards (Subsidence mechanics)
D Assessment and mitigation of subsidence hazards

II Recognition of subsidence hazards

http://water.wr.usgs.gov/sub/
http://water.usgs.gov/pubs/circ/circ1182/

A Distribution of hazard
1 World-wide: see highly incomplete distribution below
2 U.S.
   a >44,000 km$^2$ (See Figure 1 from Panel on Land Subsidence)
   b $125$ million annually (as of 1991)

B Fluid withdrawl from porous media
http://geo0.eng.morgan.edu/center/gallery-hazarWD.html
1 Extraction of oil and gas (e.g., Long Beach, CA; Niigata, Japan)
2 Extraction of geothermal fluids
   a Wairakei, NZ. 4.5m subsidence 1964-1975
   b The Geysers, CA. 13 cm subsidence 1973-1977
3 Extraction of ground water (e.g., Tokyo; Mexico City; Venice; Santa Clara and San Joaquin Valleys, CA; Houston, TX)

C Subsidence of organic soils
(e.g., Mississippi river Delta; Everglades, FL; Sacramento Delta, CA)
1 Magnitude: near 10 meters in the 20th century near Sacramento
2 Causes
   a Void loss due to water withdrawal
   b Compaction due to plowing
   c Wind (and water) erosion
   d Burning
   e Biochemical oxidation