Incorporating Geoprofessional Input into Improved Infrastructure Decision Making

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Questions

When considering risk management, long-term, and lifecycle performance of infrastructure:

- Describe your job responsibilities and how and to whom you provide geological and geotechnical input?
- How and when is that information used to inform decisions, and what kind of decisions (e.g., related to risk for underwriting and evaluating exposure)?
- Have you seen changes in the way this input has been requested and used over time?
- How is geo-input used to inform monitoring, inspections, maintenance, or contractual changes of conditions?
- What are the most effective ways geoprofessionals can provide input to non-geoprofessional decision makers?

FM Global

- FM Global is a leading commercial and industrial property insurer (property loss and business interruption)
- One third of Fortune 1000 companies
- Business model is to identify potential losses and avoid them through engineering and scientific solutions – no actuaries
- Develop solutions in our Research Division
- Visit insured locations to spot problems and give advice
- Mutual organization enables long term view

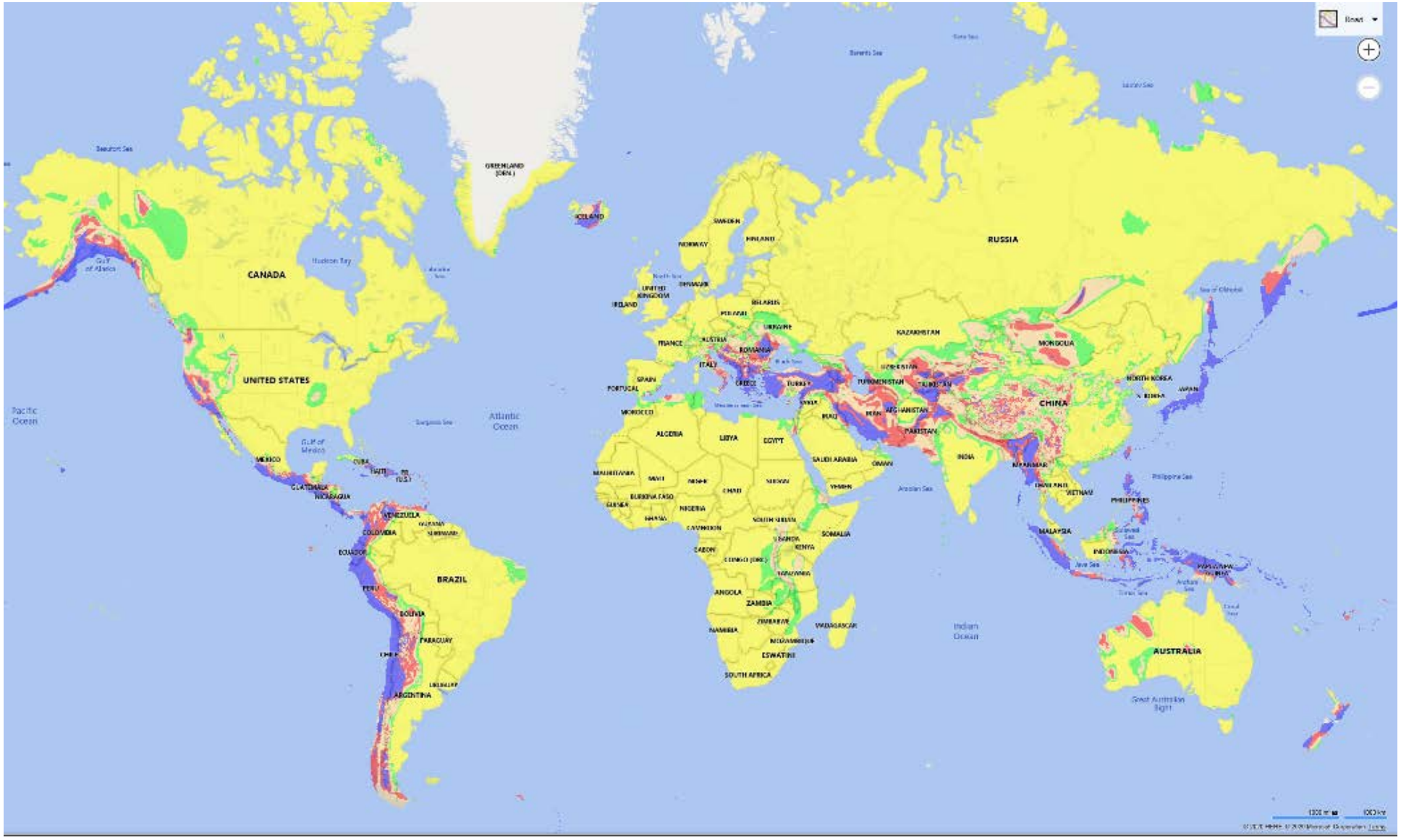
Job responsibilities and how provide input

- Natural hazards teams use geological and geotechnical data to develop hazard and risk maps of perils
  - Underwriting. Underwriting decisions, aggregate
  - Engineering Standards. Develop operating standards
  - Field Engineers. Set levels of recommendations to clients and information gathered by field engineers

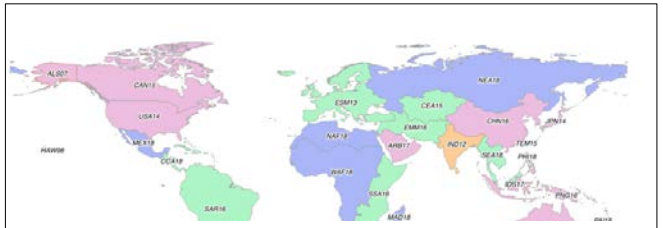
Typical Data

- Geological maps
- Topographic
- Geodetic

FM Global earthquake risk zones



Hazard * Vulnerability = Risk



GEM EQ Hazard Model

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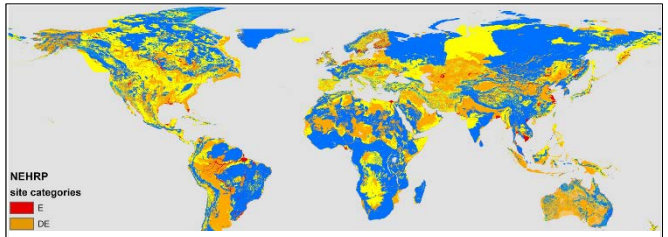

Soil Conditions

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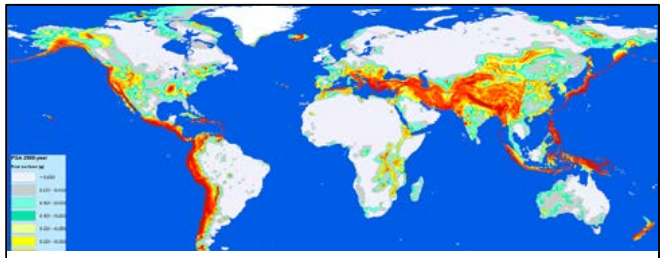


Soil Adjusted Ground Shaking

Model Degree of Damage

Picture of risk map

FM Global EQ Risk Map

FM Global earthquake risk maps:

- PSHA
- Amplify ground motions – use geology as a proxy for Vs30
- Compare to ground motion threshold for certain damage levels
- Plot return times of damaging ground motion

NEHRP site categories

- Define in terms of Vs30
- Can have significant amplification
- Use proxies (topographic slope, geology)

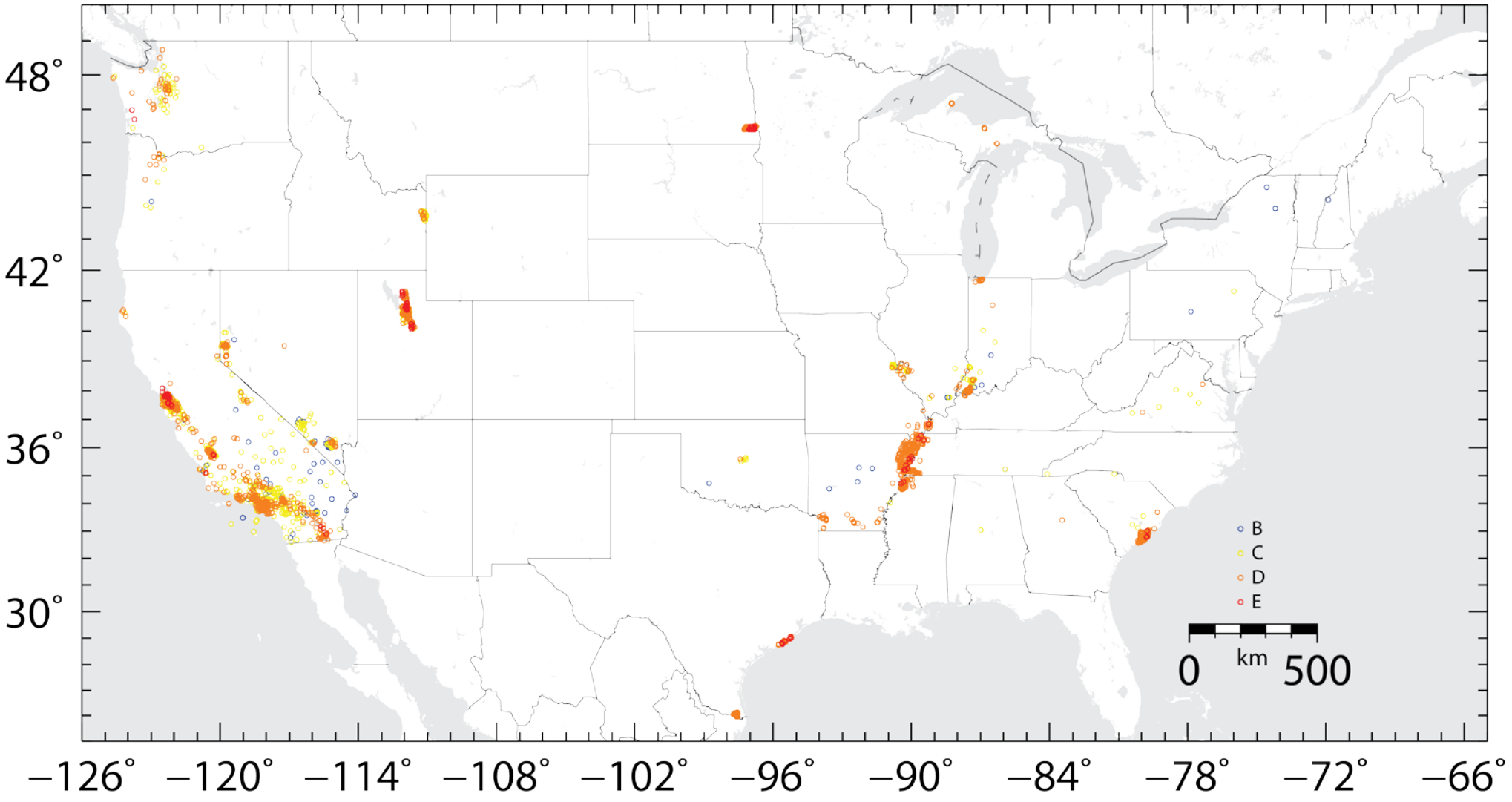
NEHRP Site Category	Description	Vs30 Range, m/s
A	Hard rock	Vs30 > 1500
B	Soft rock	760 < Vs30 ≤ 1500
C	Very dense soil	360 < Vs30 ≤ 760
D	Stiff soil	180 ≤ Vs30 ≤ 360
E	Soft soil	Vs30 < 180
F	Soils requiring site-specific evaluations	

Spectral response acceleration at 1.0 s period

	≤ 0.1	0.2	0.3	0.4	0.5	≥ 0.6
A	0.8	0.8	0.8	0.8	0.8	0.8
B	0.8	0.8	0.8	0.8	0.8	0.8
C	1.5	1.5	1.5	1.5	1.5	1.4
D	2.4	2.2	2.0	1.9	1.8	1.7
E	4.2	3.3	2.8	2.4	2.2	2.0

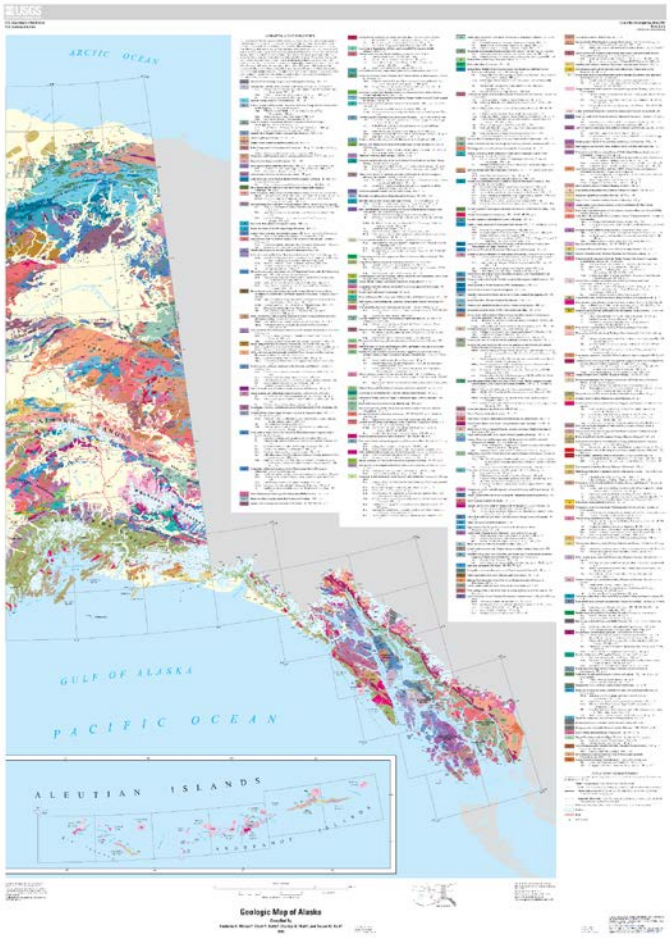
Stewart and Seyhan 2013

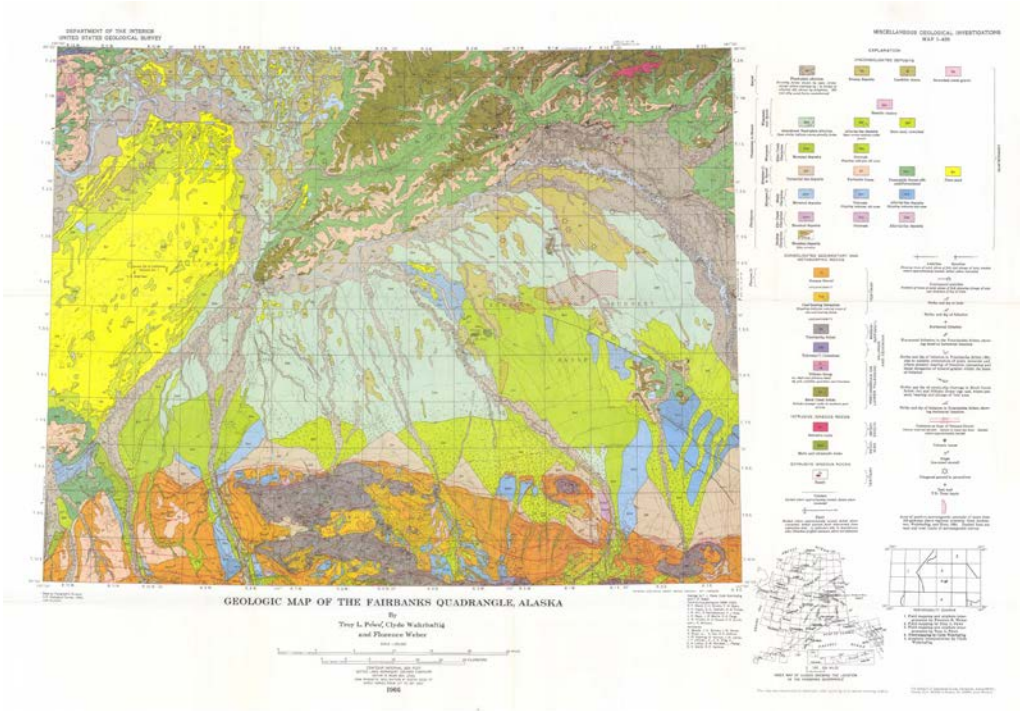
U.S. Vs30 locations



USGS

Geological map scales



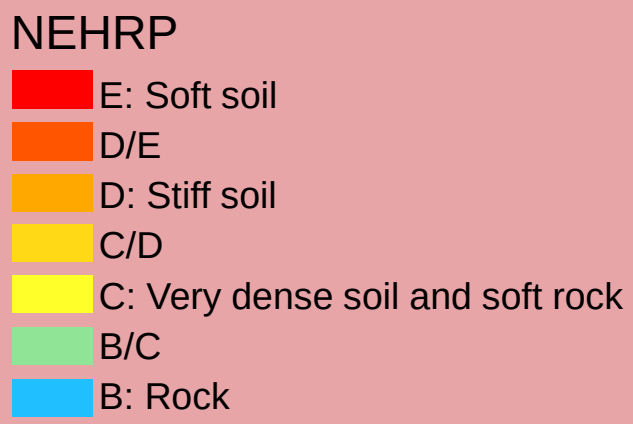


USGS

Mixing scales

Site category map of Alaska

Using geological maps



Global site response

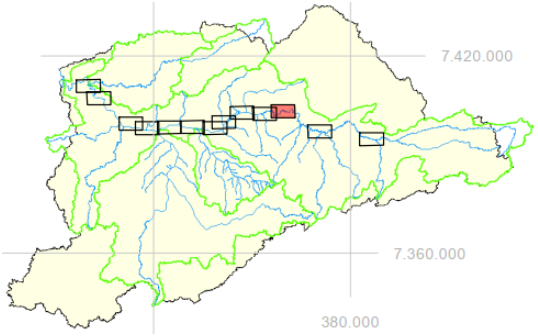
Using topographic data

- Soil properties for infiltration
- Land use for friction

Global flood map

Using topographic data

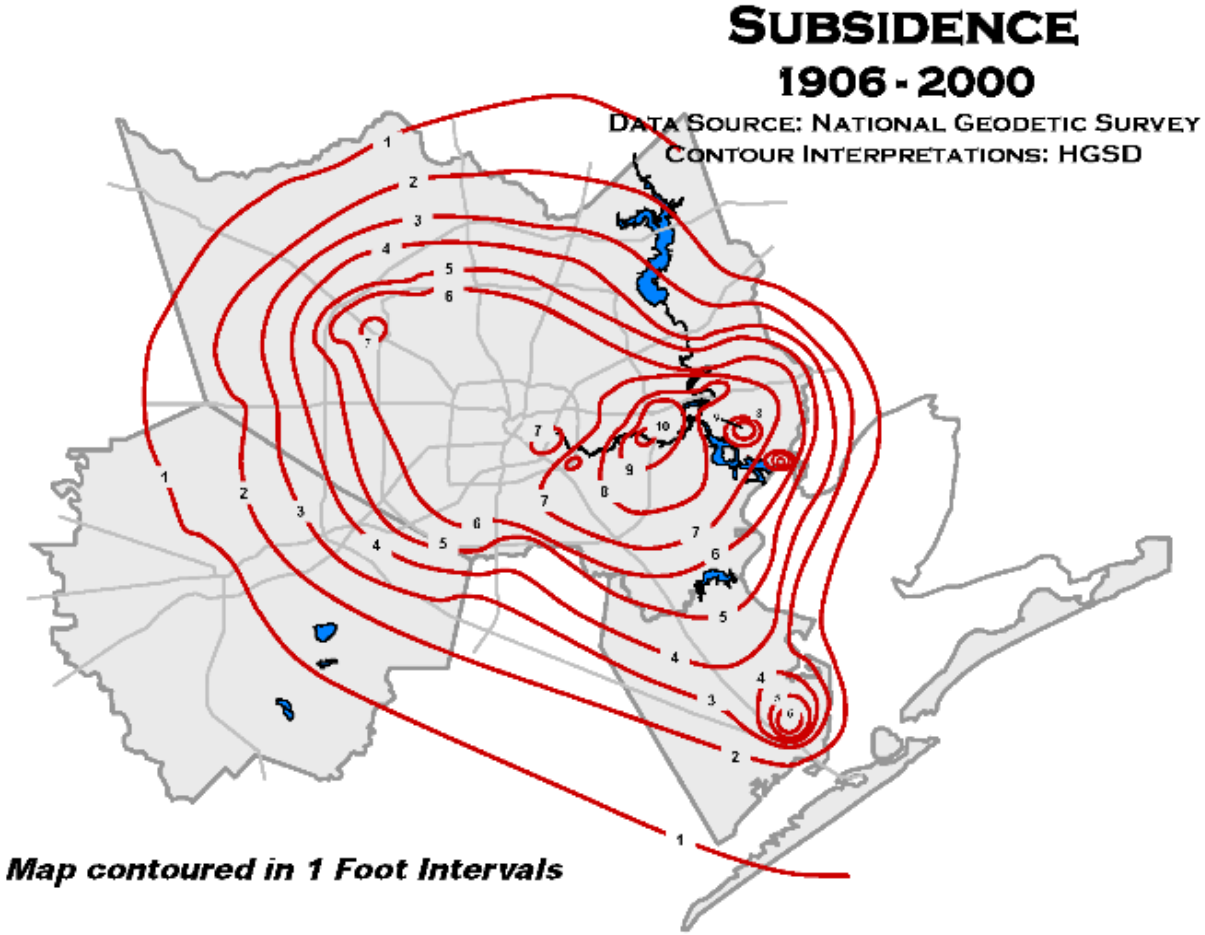
- Merged datasets
- Change in topography data results in straight flood boundary
  - Higher quality elevations used for urban area



Small flood extent maps

Using geodetic data

- Topography changes
- Subsidence is widespread issue



Data issues

- Uneven distribution
- Merging different resolutions
- Merging different data types
- Fragmentation

Questions

- How and when is that information used to inform decisions, and what kind of decisions (e.g., related to risk for underwriting and evaluating exposure)?
  - Geo-input used to create hazard and risk maps
  - Maps affect pricing and coverage offered to prospects and to clients at sign-up and annual renewals
  - Maps affect aggregate and capacity considerations internally and during reviews by regulatory agencies
- Have you seen changes in the way this input has been requested and used over time?
  - If loss history, Underwriting or Engineering request input (flood)
  - Often geopros drive changes (earthquake)
  - Rate of change

Questions

- How is geo-input used to inform monitoring, inspections, maintenance, or contractual changes of conditions?
  - Risk zone determines recommendations and contract terms and conditions
  - Risk zone determines information gathered during inspections of client locations
  - Risk zone determines advice given to clients – client response determines retention
- What are the most effective ways geoprofessionals can provide input to non-geoprofessional decision makers?
  - Keep it simple – maps are a good example
  - Keep it digital
  - Have bright-line divisions
  - Non-geopros have other things to worry about

Summary

- We use basic geologic and geotechnical data, e.g., geology, topography
- Incorporate that data into maps for ease of communication and use

Thank you