Building a ShakeMap in the minutes, hours, and days following the Anchorage earthquake

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intro to ShakeMap

- USGS-developed software, run for Alaskan earthquakes by Earthquake Center
- step beyond magnitude and location
- rapidly maps out distribution and severity of shaking
- ground-truthed where data exists
- provides estimates in areas with sparse or no data coverage
- returns intensity (MMI), acceleration (PGA), velocity (PGV), & spectral (PSA 0.3s, 1.0s, 3.0s) estimates in graphic form and gridded data
- input to USGS PAGER & Ground Failure, FEMA Hazus
creating a ShakeMap

- earthquake occurs
- automated system detects and locates earthquake
- automated system confirms that origin meets ShakeMap criteria (location + magnitude)

ShakeMap start:
- origin information
- compute PGA, PGV, PSA values at stations within 300km
- create spacial grid of MMI, PGA, PGV, PSA values based on GMPE, Vs30, measured values at sites
- create graphics
- posts results to Earthquake Center website
- submits results to NEIC
- manual: add finite fault, DYFI?
Phase 1: Automated

- Automated location
- Automated magnitude (local)
- PGA, PGV, PSA at stations with near-real time data

M6.9, 38.5 km depth
phase 2: reviewed

- Earthquake origin: 08:29:29 AKST
- Automated location: 08:30:20 AKST
- Automated ShakeMap: 08:49:27 AKST
- Reviewed location: 08:58:36 AKST
- Reviewed ShakeMap: 09:14:28 AKST
phase 2: reviewed

- reviewed location
- reviewed magnitude (local)
- pga, pgv, psa at stations with near-real time data

M6.6, 44.1 km depth
phase 3: manual updates

- earthquake origin: 08:29:29 AKST
- automated location: 08:30:20 AKST
- reviewed location: 08:58:36 AKST
- automated ShakeMap: 08:49:27 AKST
- reviewed ShakeMap: 09:14:28 AKST
- manual ShakeMap, M7.0: 09:33:30 AKST
phase 3: manual updates

- reviewed location
- reviewed magnitude (moment)
- pga, pgv, psa at stations with near-real time data

M7.0, 44.1 km depth
phase 4: additions

Earthquake origin
08:29:29 AKST

Automated location
08:30:20 AKST

Review location
08:58:36 AKST

Automated ShakeMap
08:49:27 AKST

Review ShakeMap
09:14:28 AKST

Manual ShakeMap, M7.0
09:33:30 AKST

Manual ShakeMap w/ FF, outliers, DYFI?
14:06:11 AKST
phase 4: additions

- finite fault
- removed data from clipped broadbands
- basic Did You Feel It? data

M7.0, 44.1 km depth
phase 5: refinement

- Earthquake origin: 08:29:29 AKST
- Automated location: 08:30:20 AKST
- Automated ShakeMap: 08:49:27 AKST
- Reviewed location: 08:58:36 AKST
- Reviewed ShakeMap: 09:14:28 AKST
- Manual ShakeMap, M7.0: 09:33:30 AKST
- Manual ShakeMap w/ FF, outliers, DYFI?: 14:06:11 AKST
- Manual ShakeMap: Metadata corrections (Dec 4, Dec 22)
  M7.1 (Mar 8)
phase 5: refinement

- corrected metadata
- additional strong-motion sites
- enhanced Did You Feel It? data

M7.1, 44.1 km depth
• Technical:
  – limit 1 run with automated result
  – prioritize mainshock runs during aftershock sequence
  – programmatically remove clipped sensor data

• Field:
  – harden telemetry at A/C powered sites
  – ensure accuracy of station metadata

• Scientific:
  – incorporate basin effects
  – revisit GMPE selection