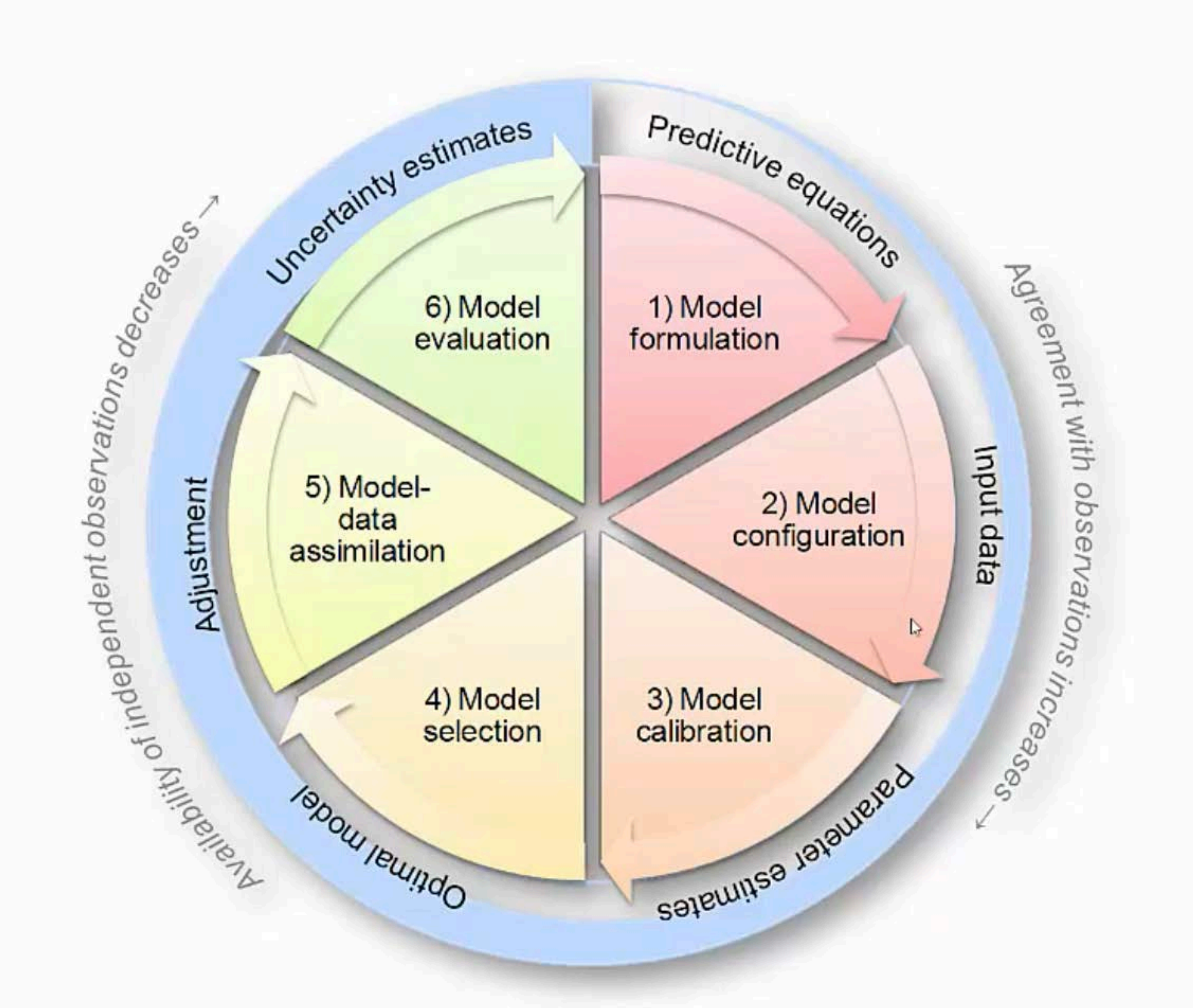
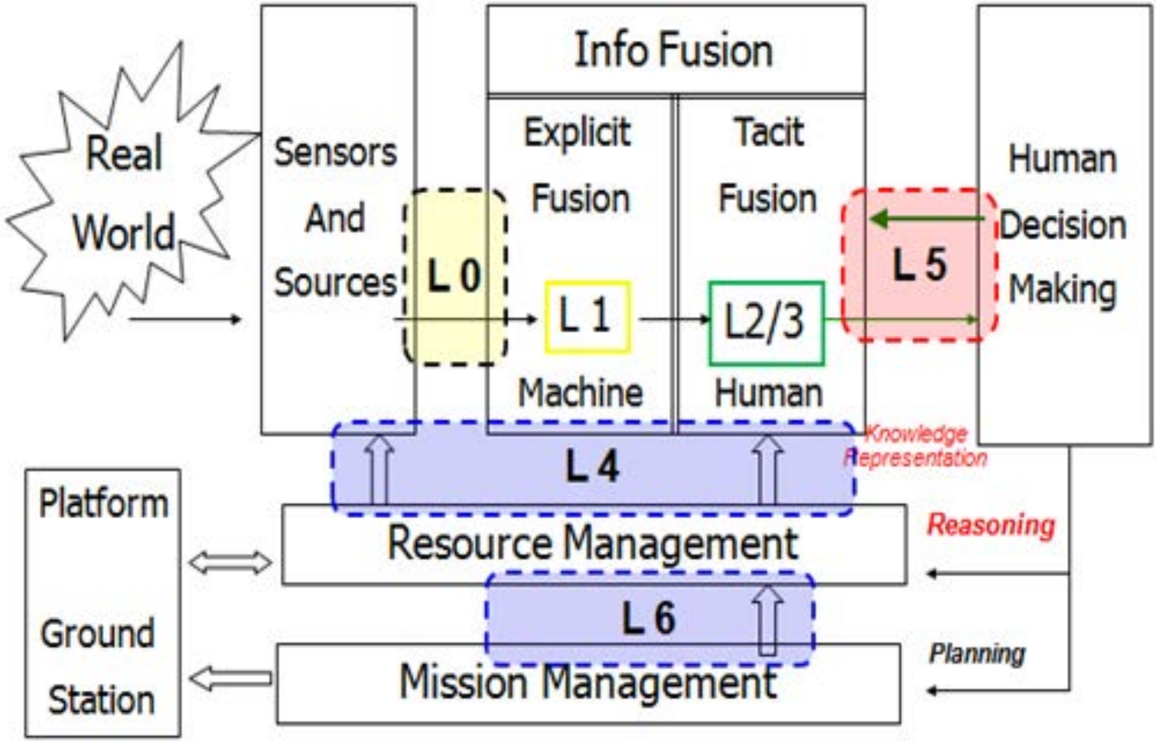
Model-Data Fusion and Geodesy

Min Ding

Model-Data Fusion



Data Fusion – JDL/DFIG Model

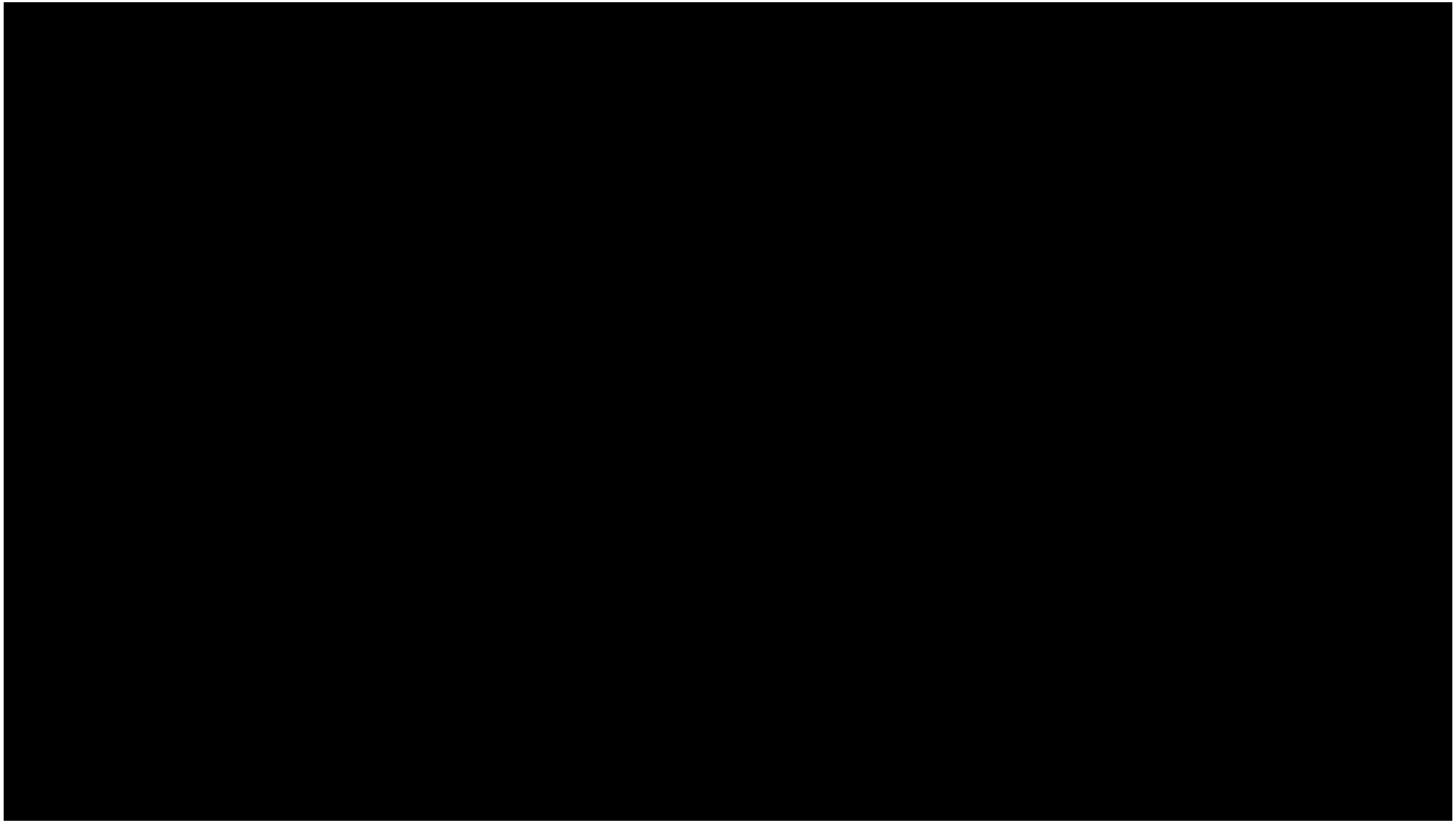


- Level 0: Source Preprocessing (or Data Assessment)
- Level 1: Object Assessment
- Level 2: Situation Assessment
- Level 3: Impact Assessment (or Threat Refinement)
- Level 4: Process Refinement (or Resource Management)
- Level 5: User Refinement (or Cognitive Refinement)
- Level 6: Mission Refinement (or Mission Management)

NASA Data Levels

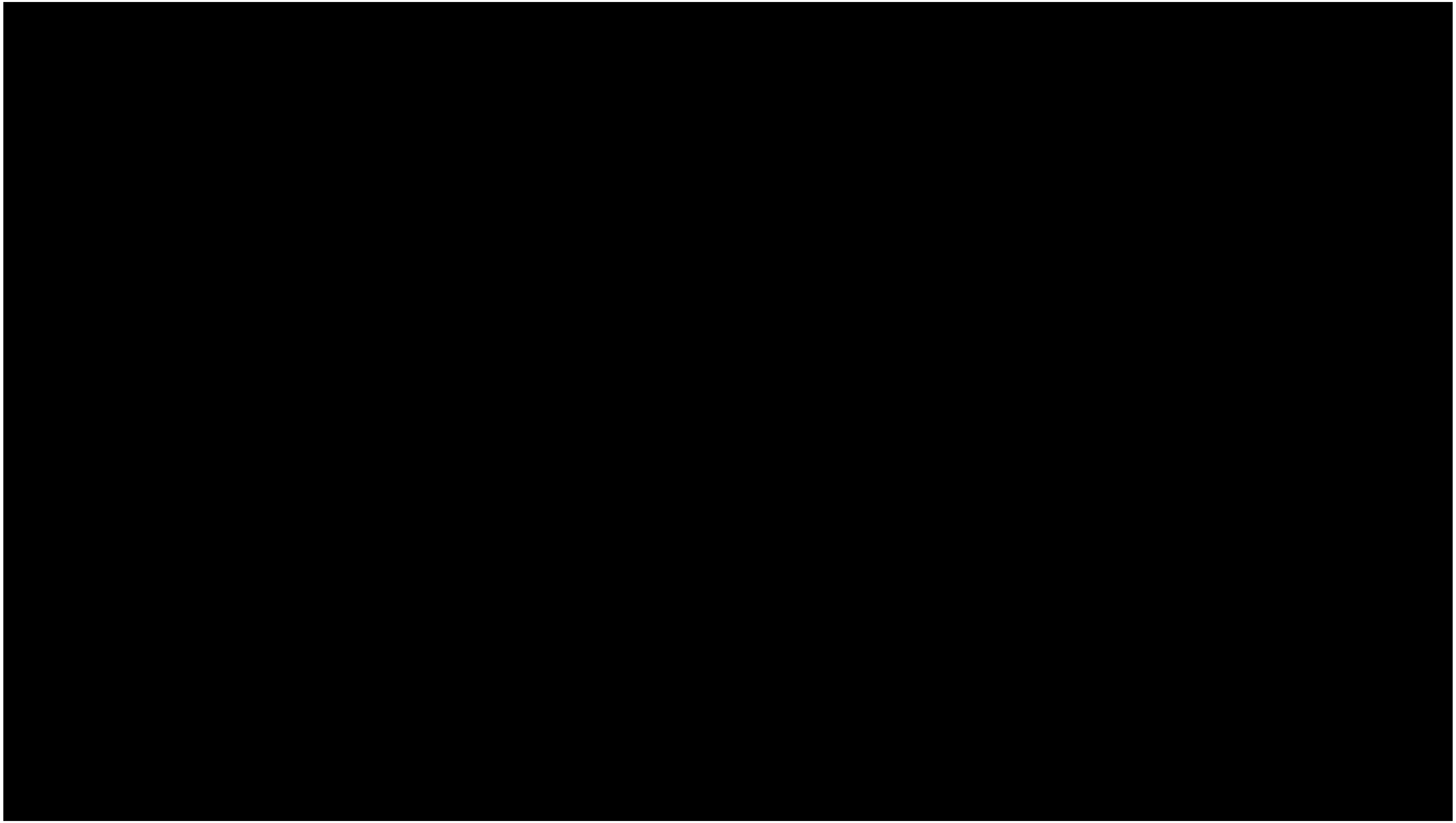
Data Level	Description
Level 0	Reconstructed, unprocessed instrument and payload data at full resolution, with any and all communications artifacts (e.g., synchronization frames, communications headers, duplicate data) removed.
Level 1A	Level 1A (L1A) data are reconstructed, unprocessed instrument data at full resolution, time-referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and georeferencing parameters (e.g., platform ephemeris) computed and appended but not applied to L0 data.
Level 1B	L1B data are L1A data that have been processed to sensor units (not all instruments have L1B source data).
Level 1C	L1C data are L1B data that include new variables to describe the spectra. These variables allow the user to identify which L1C channels have been copied directly from the L1B and which have been synthesized from L1B and why.
Level 2	**Derived geophysical variables at the same resolution and location as L1 source data.**
Level 2A	L2A data contains information derived from the geolocated sensor data, such as ground elevation, highest and lowest surface return elevations, energy quantile heights ("relative height" metrics), and other waveform-derived metrics describing the intercepted surface.
Level 2B	L2B data are L2A data that have been processed to sensor units (not all instruments will have a L2B equivalent).
Level 3	**Variables mapped on uniform space-time grid scales, usually with some completeness and consistency.**
Level 3A	L3A data are generally periodic summaries (weekly, ten-day, monthly) of L2 products.
Level 4	Model output or results from analyses of lower-level data (e.g., variables derived from multiple measurements).

Geodesy



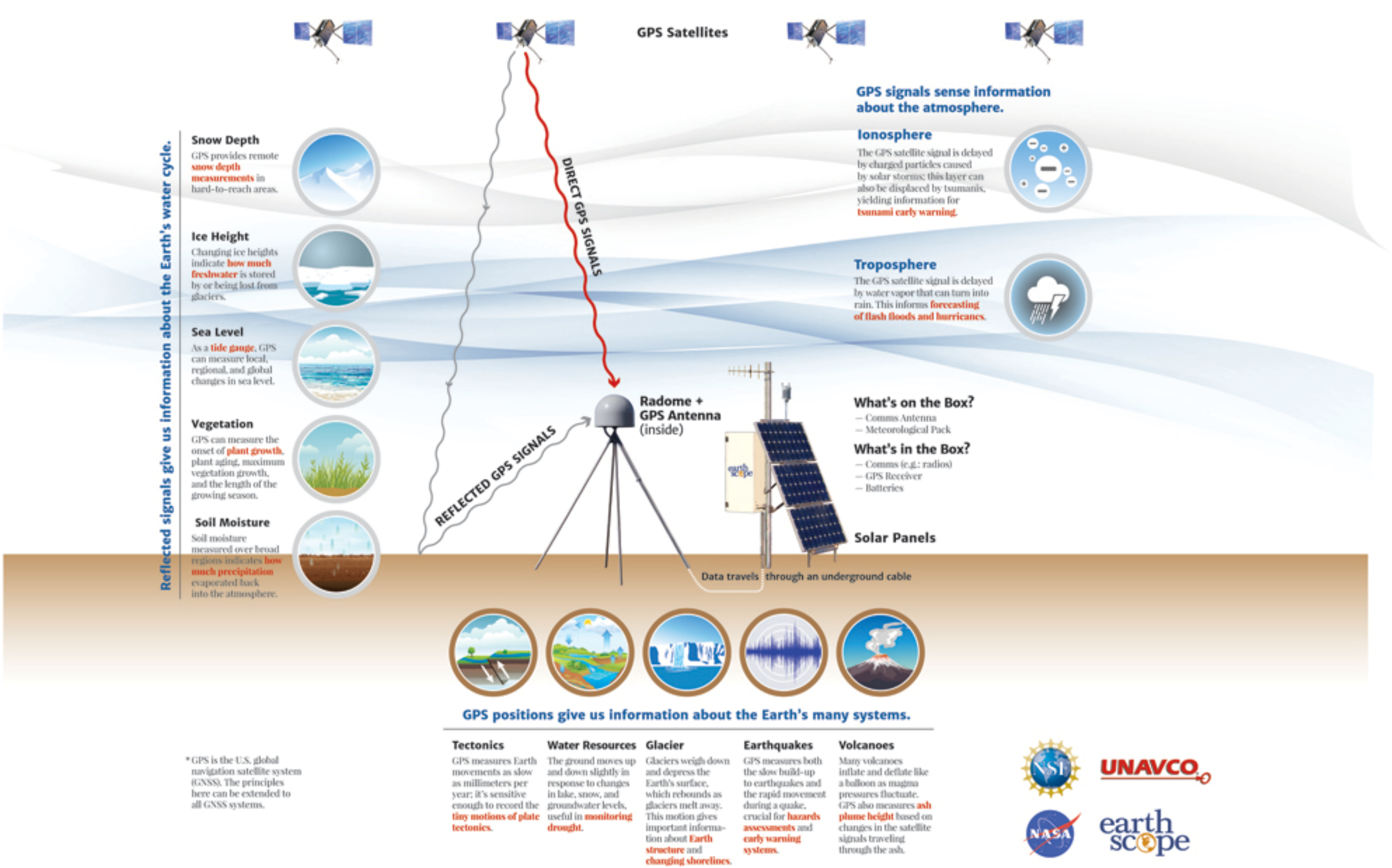
Ref: https://serc.carleton.edu/getsi/geodesy/index.html

手机定机和导航

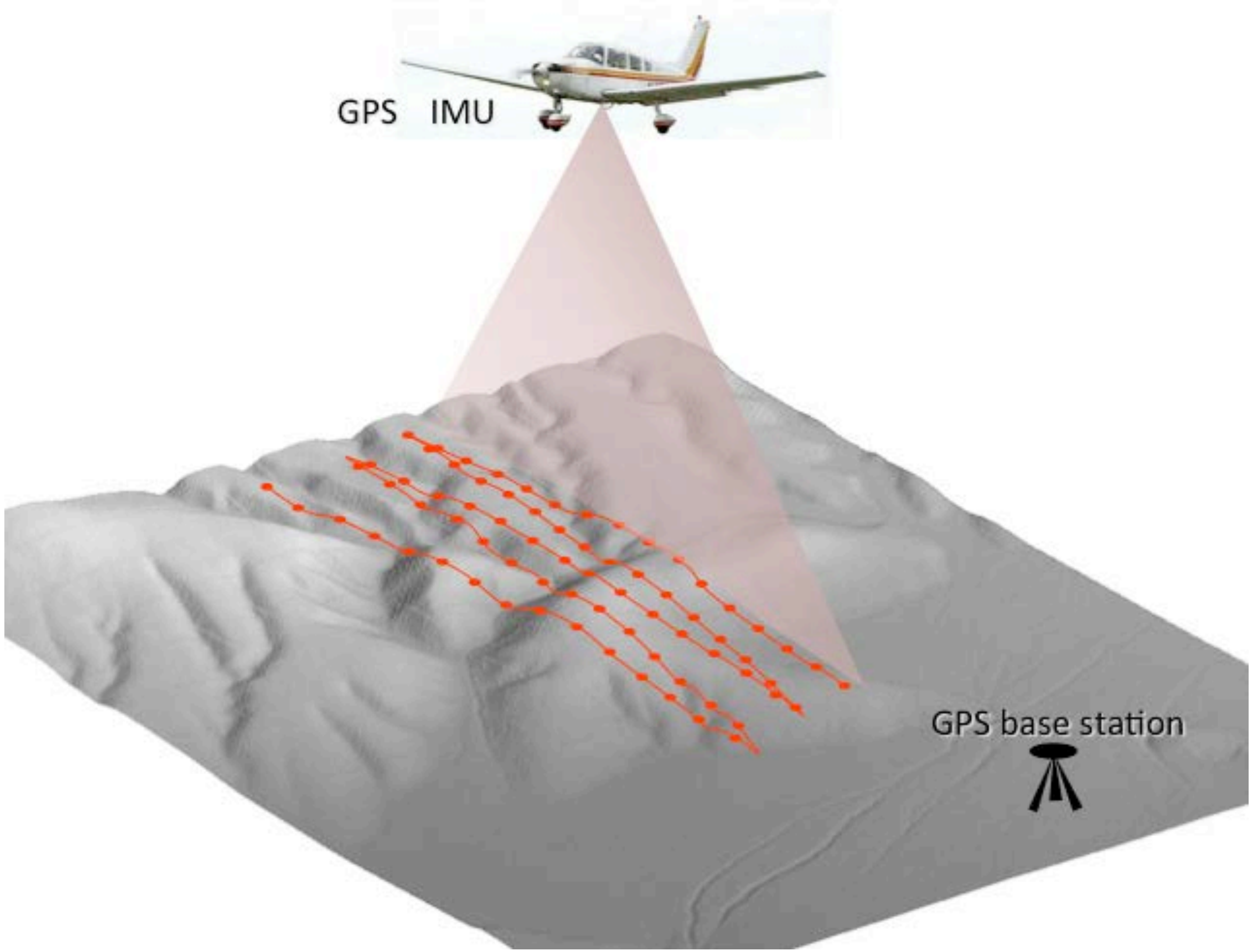


What GPS can tell us about the Earth

High-precision GPS* Stations measure natural phenomena and hazards.

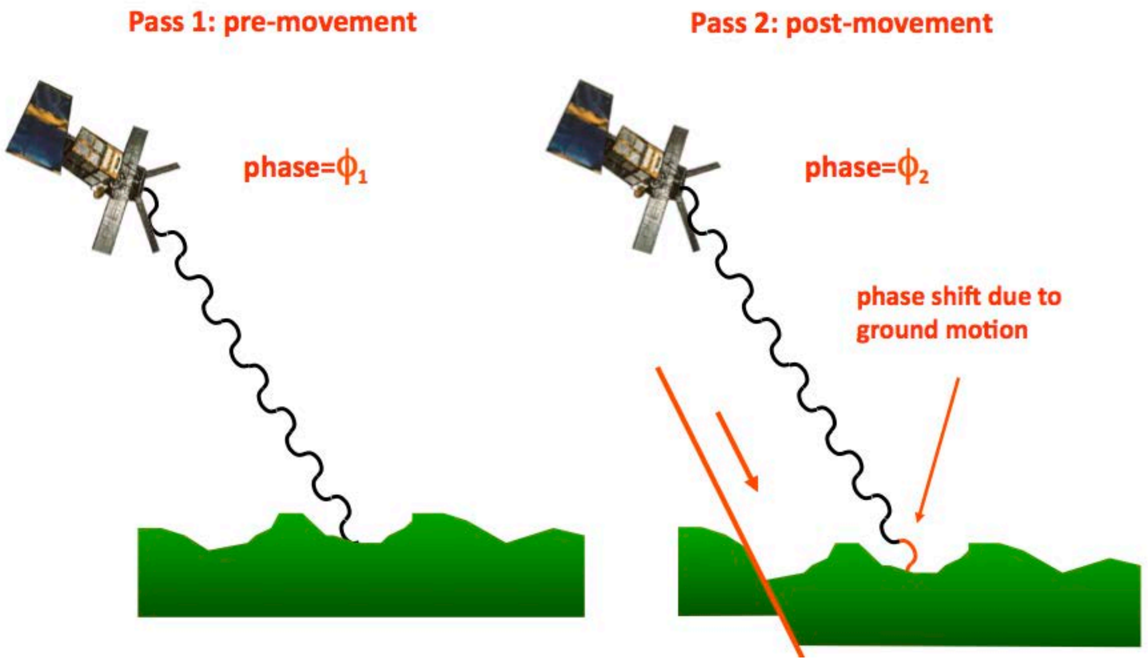


SAR (Light detection and ranging)



- A remote sensing technology that measures distance by sending out laser pulses and calculating the reflection return time.

InSAR (Interferometric synthetic aperture radar)



- InSAR measures ground deformation using two of more synthetic aperture radar (SAR) images. Most commonly, the images are from Earth-orbiting radar satellites but the method can be used from aircraft or ground-based sensors too. The radar signal phase changes between repeat images allows for centimeter-scale measurement of deformation over spans of days to years and over large regions.

InSAR+GPS - coseismic

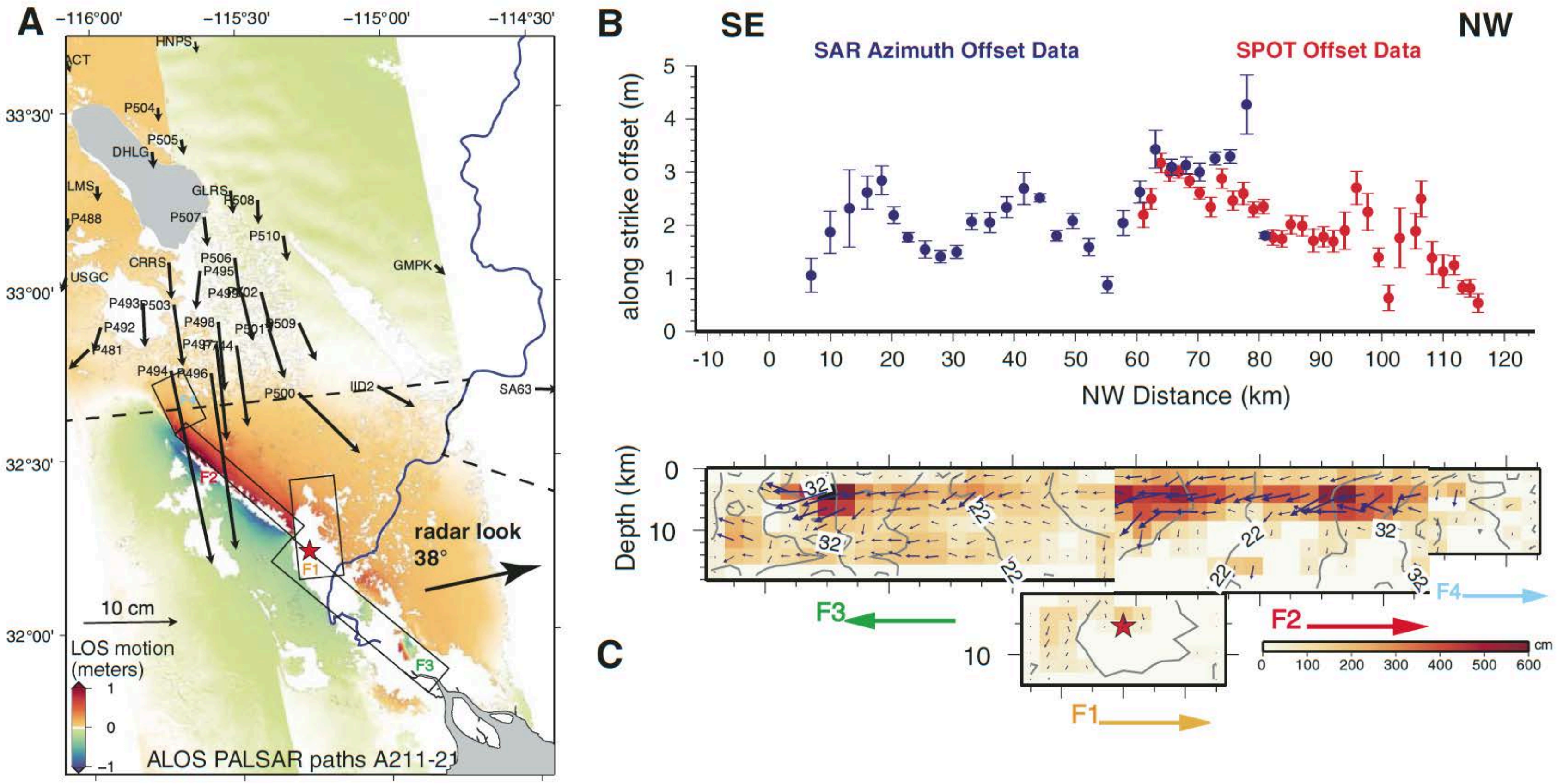
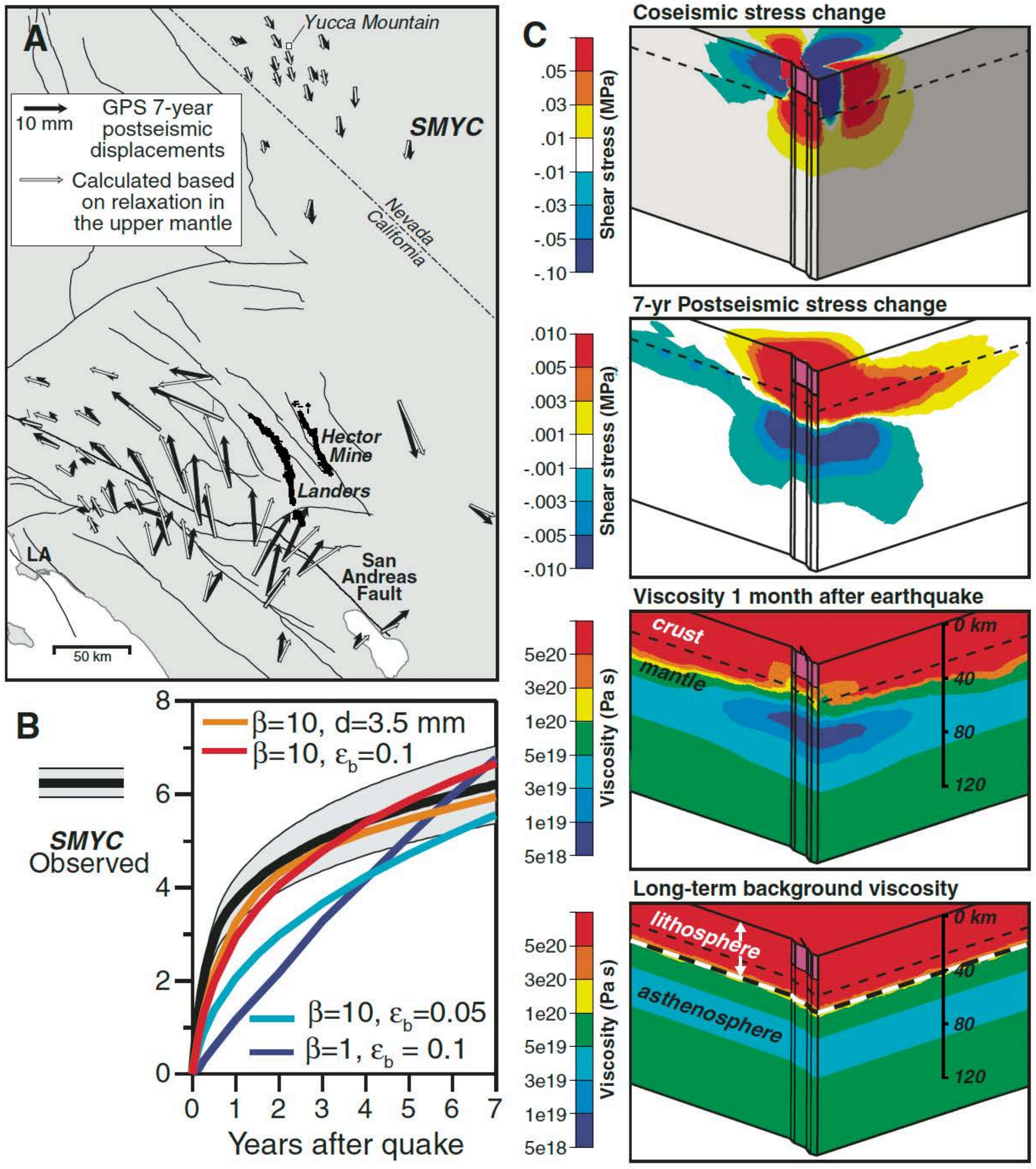


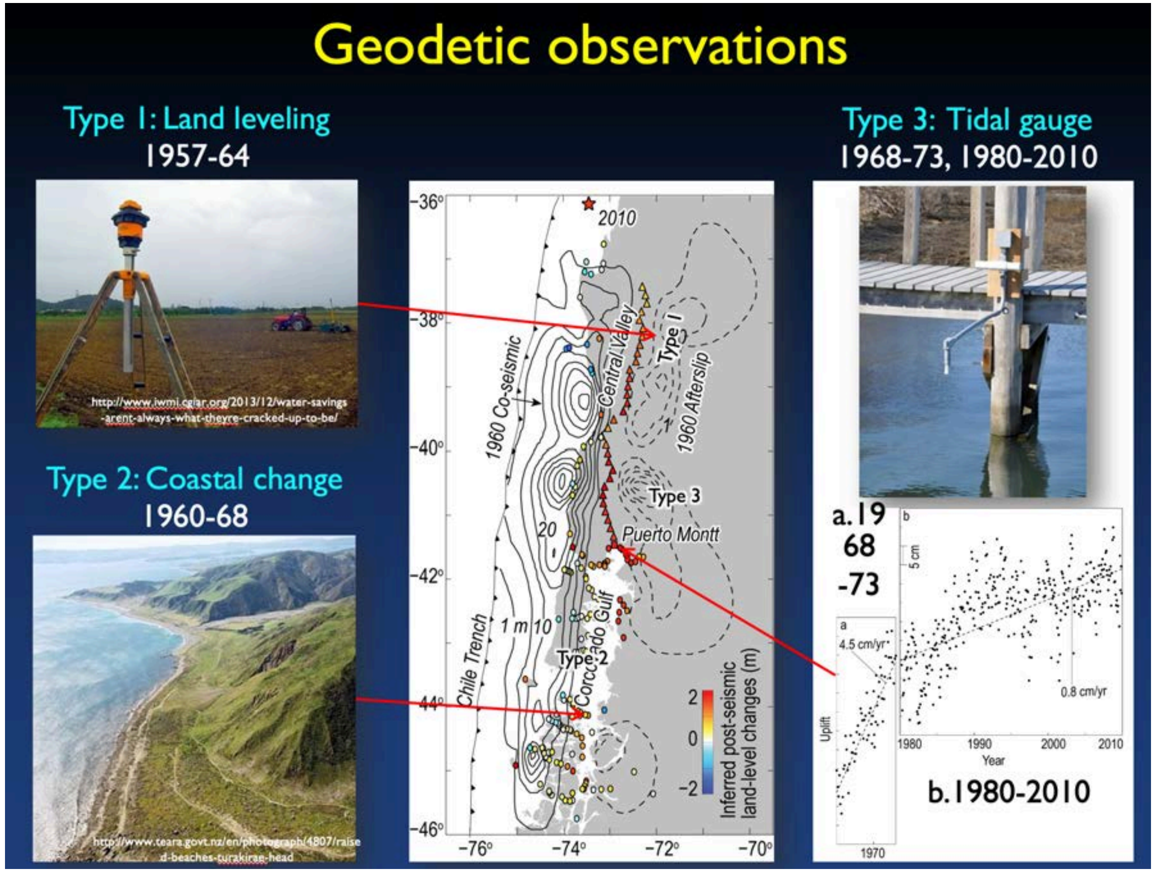
Figure 6. Coseismic deformation and slip of the 2010 **M** 7.2 El Mayor–Cucapah earthquake (modified from Wei et al., 2011b). (A) Example of unwrapped ascending orbit ALOS interferograms spanning the earthquake, showing displacements in the LOS direction with an average incidence angle of 38° (Eric Fielding, 2012, personal commun.). Black arrows show horizontal coseismic displacements of continuously operating stations of the PBO network. Rectangles show the surface projection of the model rupture segments, and the star is the epicenter. (B) Coseismic surface offsets along the rupture trace, estimated from pixel offsets of ALOS SAR amplitude (blue) and SPOT optical (red) images. (C) Preferred coseismic slip model of Wei et al. (2011b), inverted from GPS, ALOS, and Envisat interferograms, SAR azimuth offsets, SPOT optical satellite imagery pixel offsets, and seismic waveform data. Color contours and arrows show cumulative slip amplitude and slip direction, respectively, and contour lines (seconds) are isochrons illustrating the propagation of the seismic rupture front relative to the onset of slip at the hypocenter obtained from seismic data.

Burgmann+Thatcher, 2013

GPS - postseismic

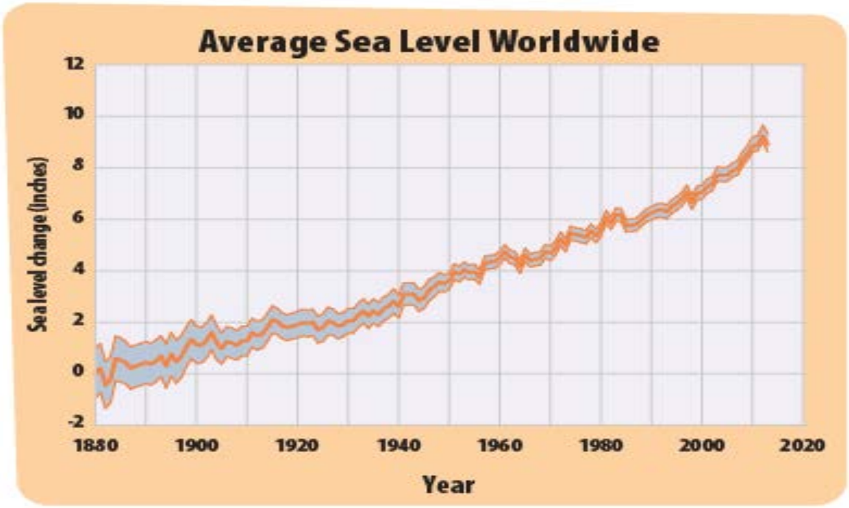


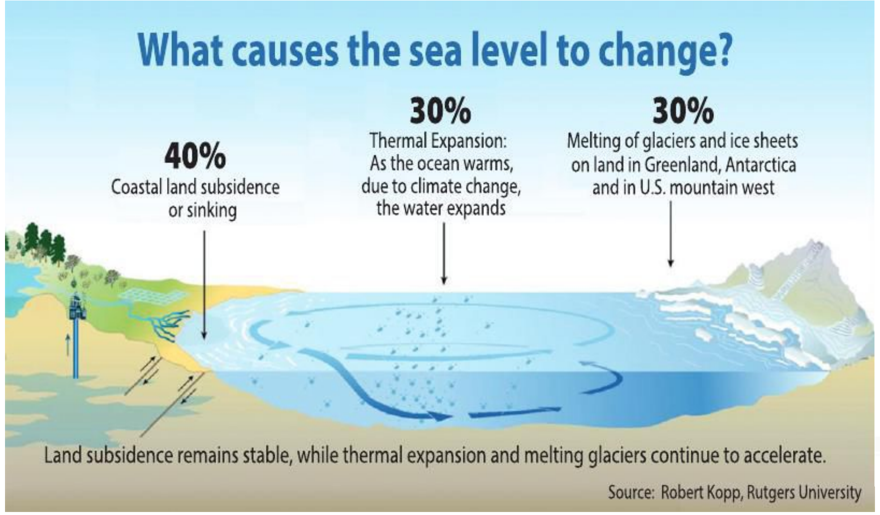
Freed+2012

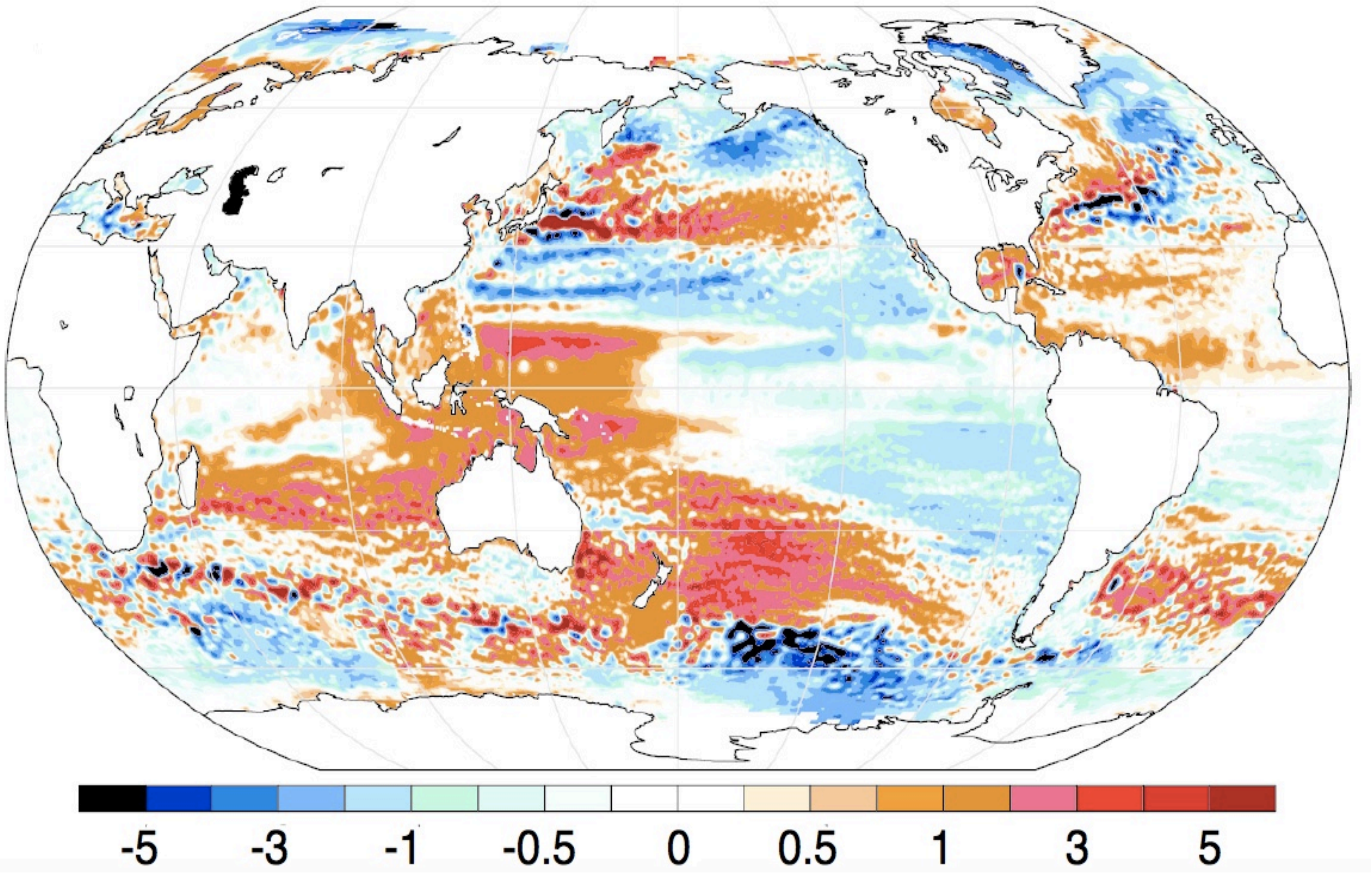


Ding+Lin 2014

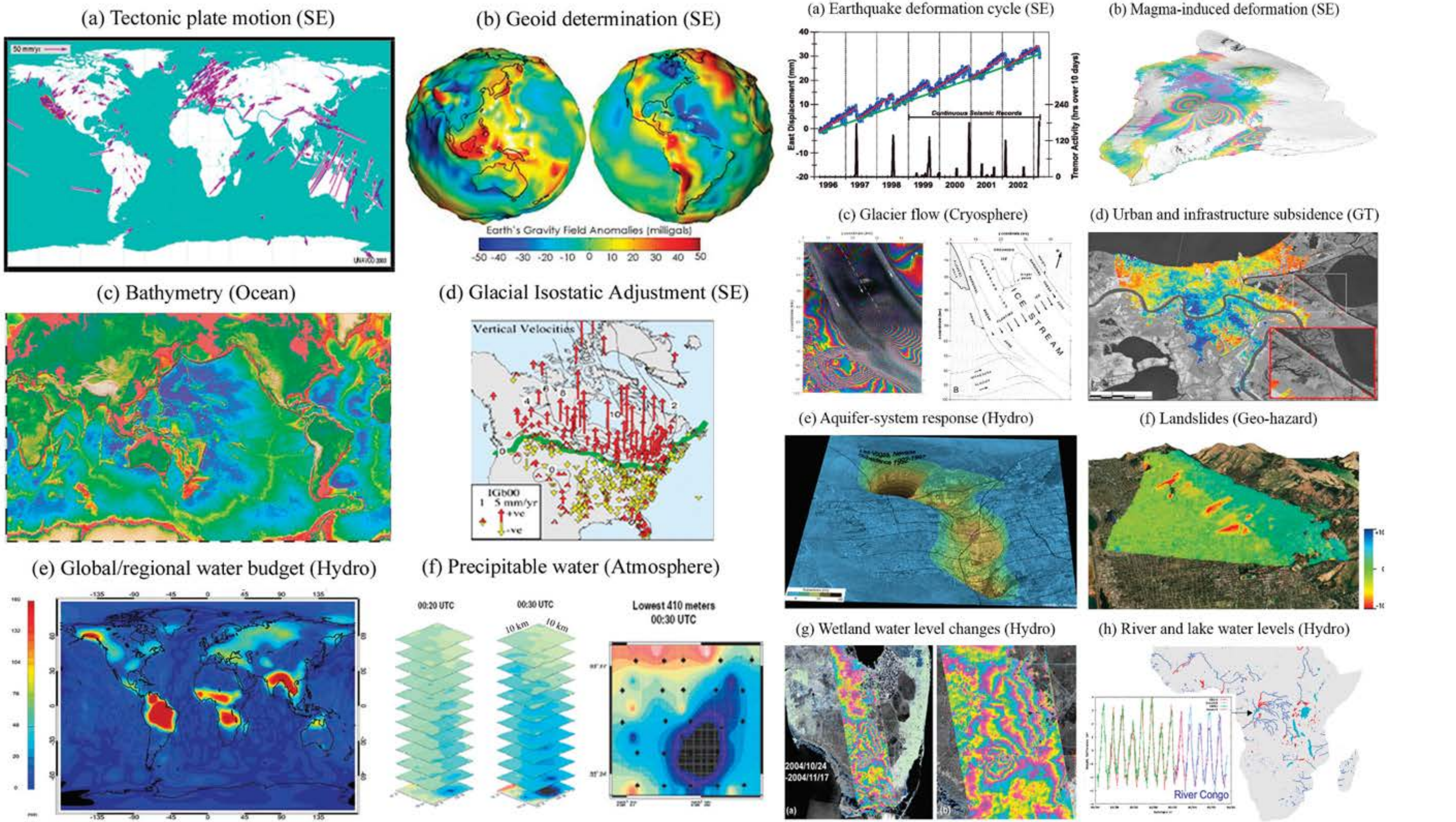
Other contributors to sea level changes





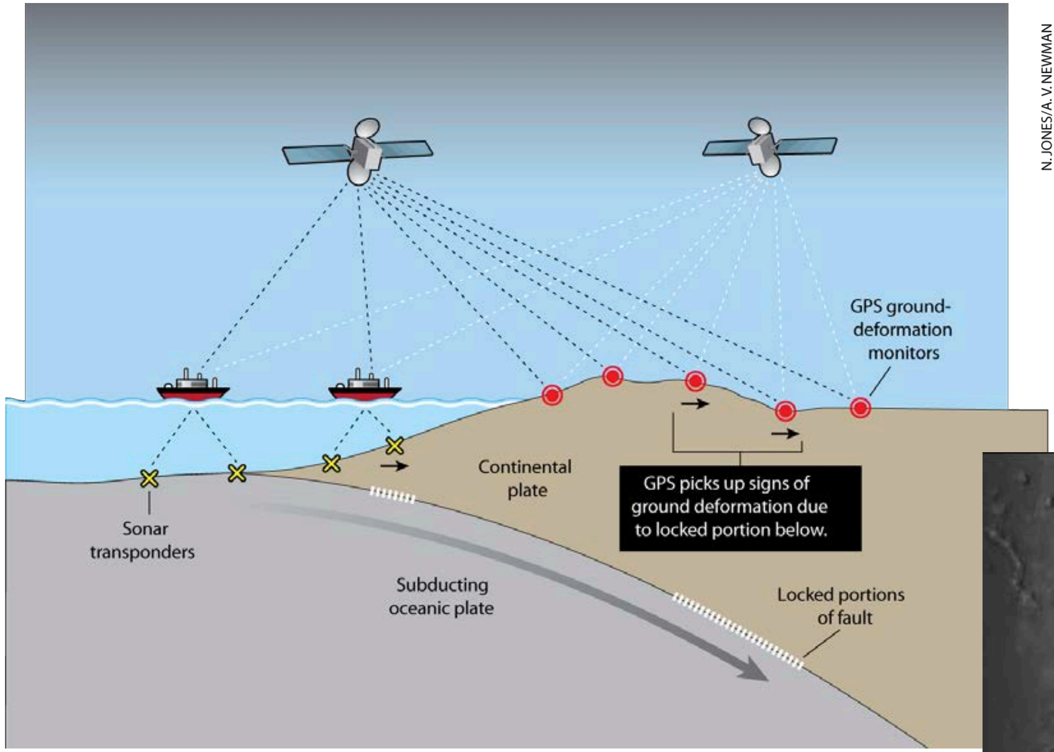


Space Geodesy

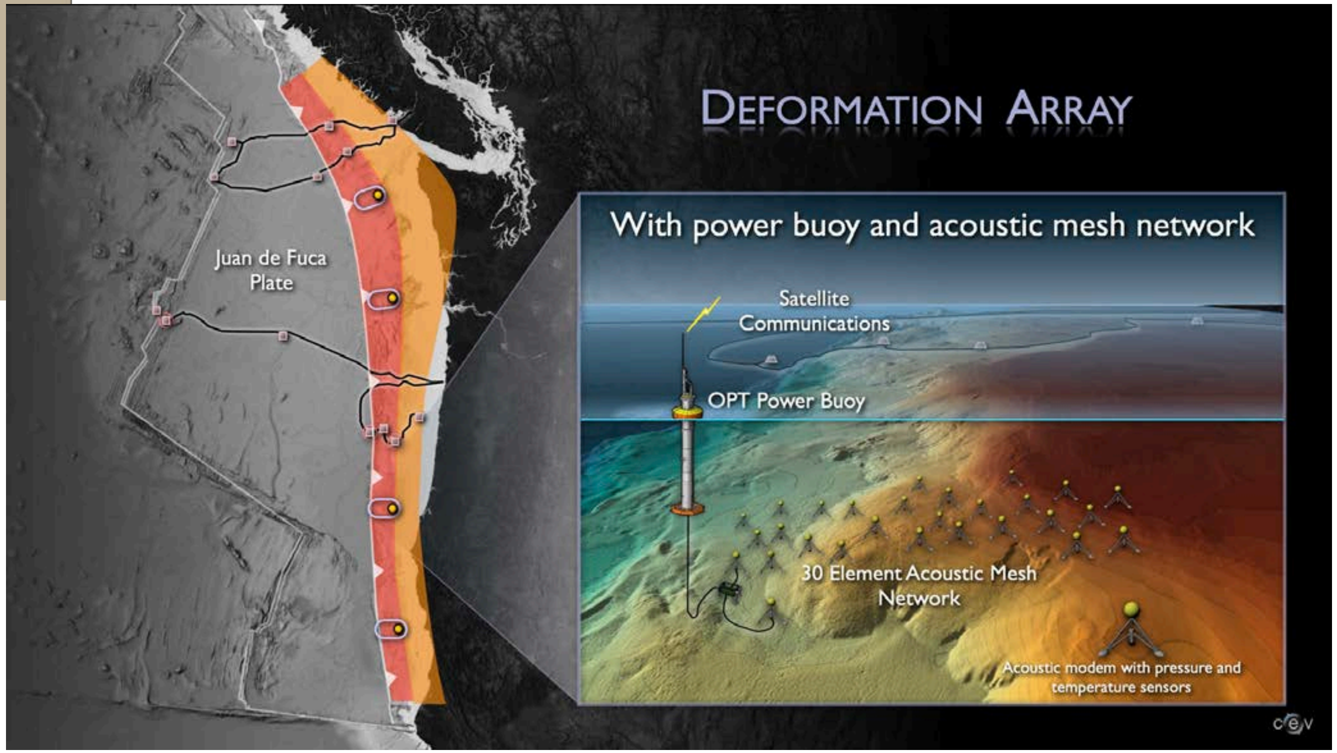


(Wdowinski & Eriksson, EOS, 2009)

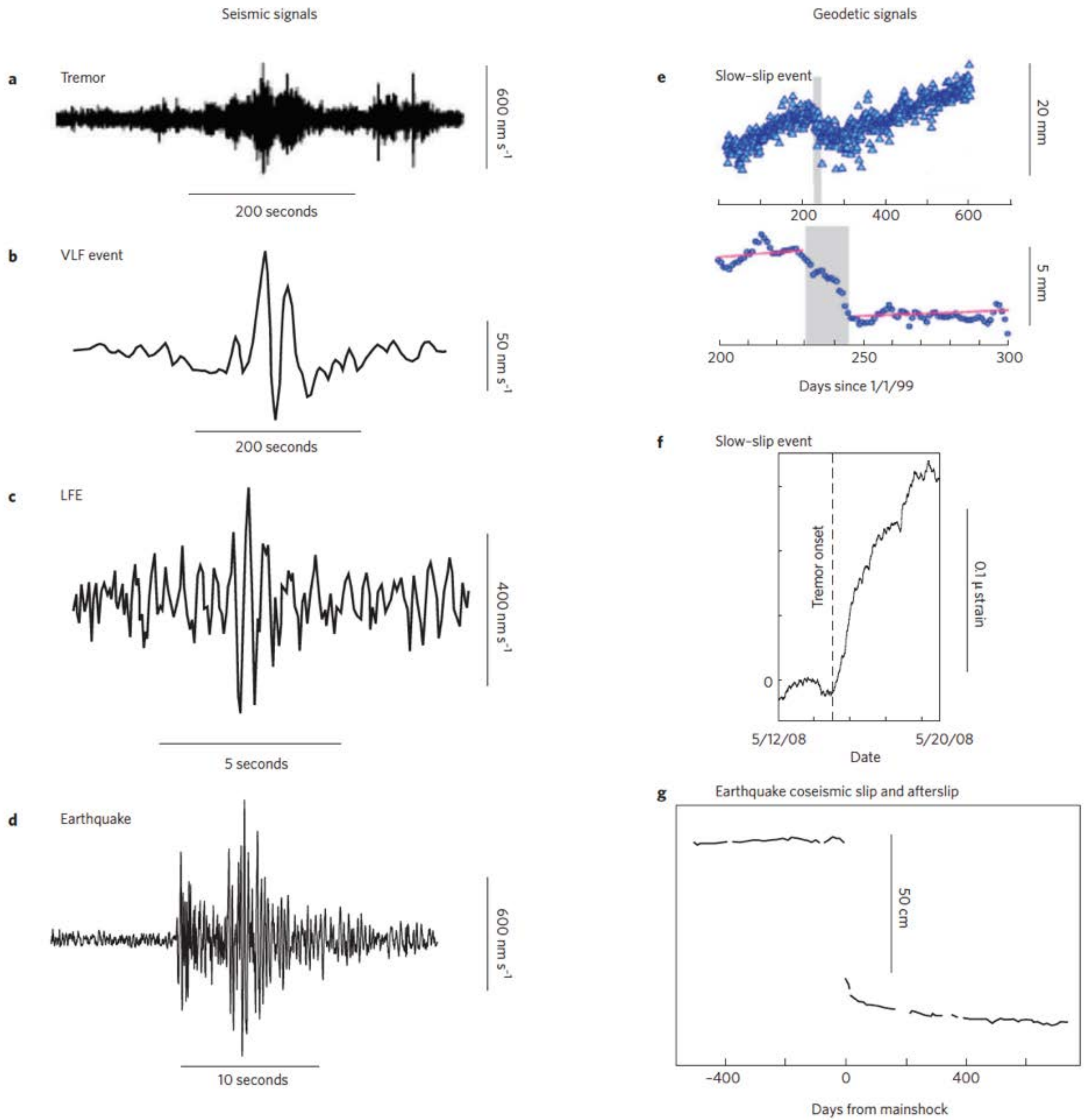
Seafloor Geodesy



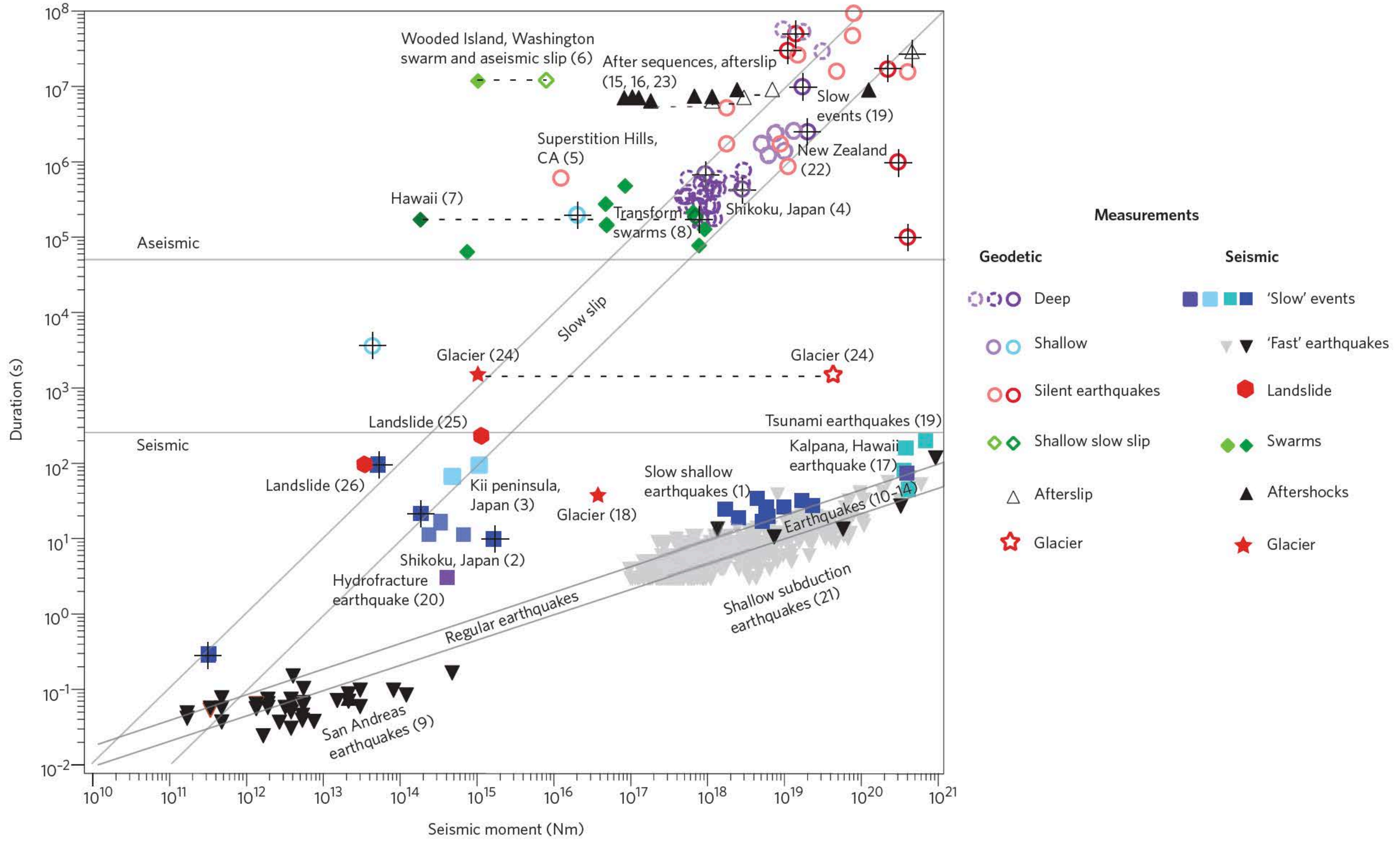
N.JONES/A. V. NEWMAN



- GPS-acoustic methods can extend GPS observation offshore (from Newman, 2011).



Peng & Gomberg, 2010



Wooded Island, Washington swarm and aseismic slip (6)
After sequences, afterslip (15, 16, 23)
Slow events (19)
Superstition Hills, CA (5)
New Zealand (22)
Hawaii (7)
Transform swarms (8)
Shikoku, Japan (4)
Aseismic
Slow slip
Glacier (24)
Glacier (24)
Landslide (25)
Tsunami earthquakes (19)
Seismic
Kalpana, Hawaii earthquake (17)
Landslide (26)
Kii peninsula, Japan (3)
Glacier (18)
Slow shallow earthquakes (1)
Earthquakes (10-14)
Shikoku, Japan (2)
Hydrofracture earthquake (20)
Regular earthquakes
Shallow subduction earthquakes (21)
San Andreas earthquakes (9)
Duration (s)
Seismic moment (Nm)
Measurements
Geodetic
Deep
Shallow
Silent earthquakes
Shallow slow slip
Afterslip
Glacier
Seismic
'Slow' events
'Fast' earthquakes
Landslide
Swarms
Aftershocks
Glacier