Cascadia 120 Slim Posthole: A Combined Strong and Weak Motion Sensor for Early Warning and Regional Networks

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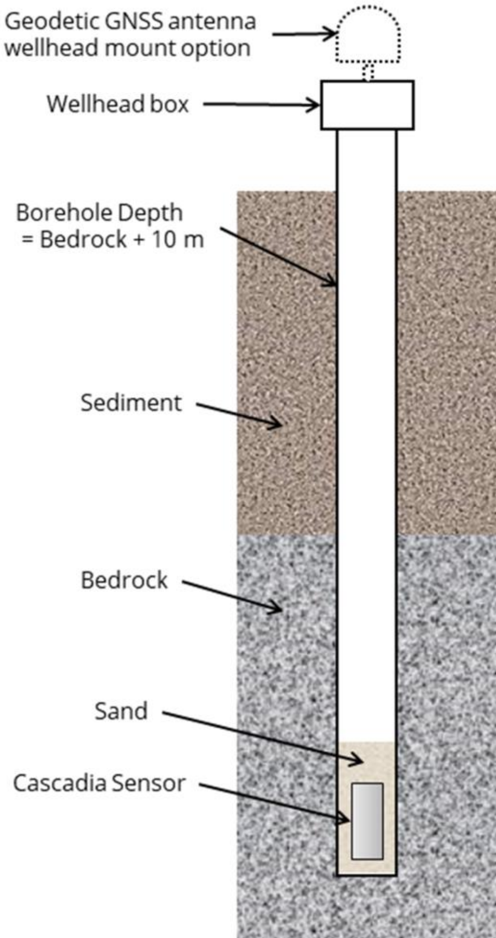
Cascadia Instruments

- Strong and weak motion sensor in single downhole package
- Provides high-gain weak motion data in precise alignment with strong motion data at a single point in bedrock
- Allows combined processing to create a seamless data set with maximum dynamic range
- Options to combine Titan class A accelerometer with either:
  - Trillium Compact Posthole
  - Trillium 120 Slim Posthole
  - Trillium 120/360 Posthole or Borehole (with holelock)

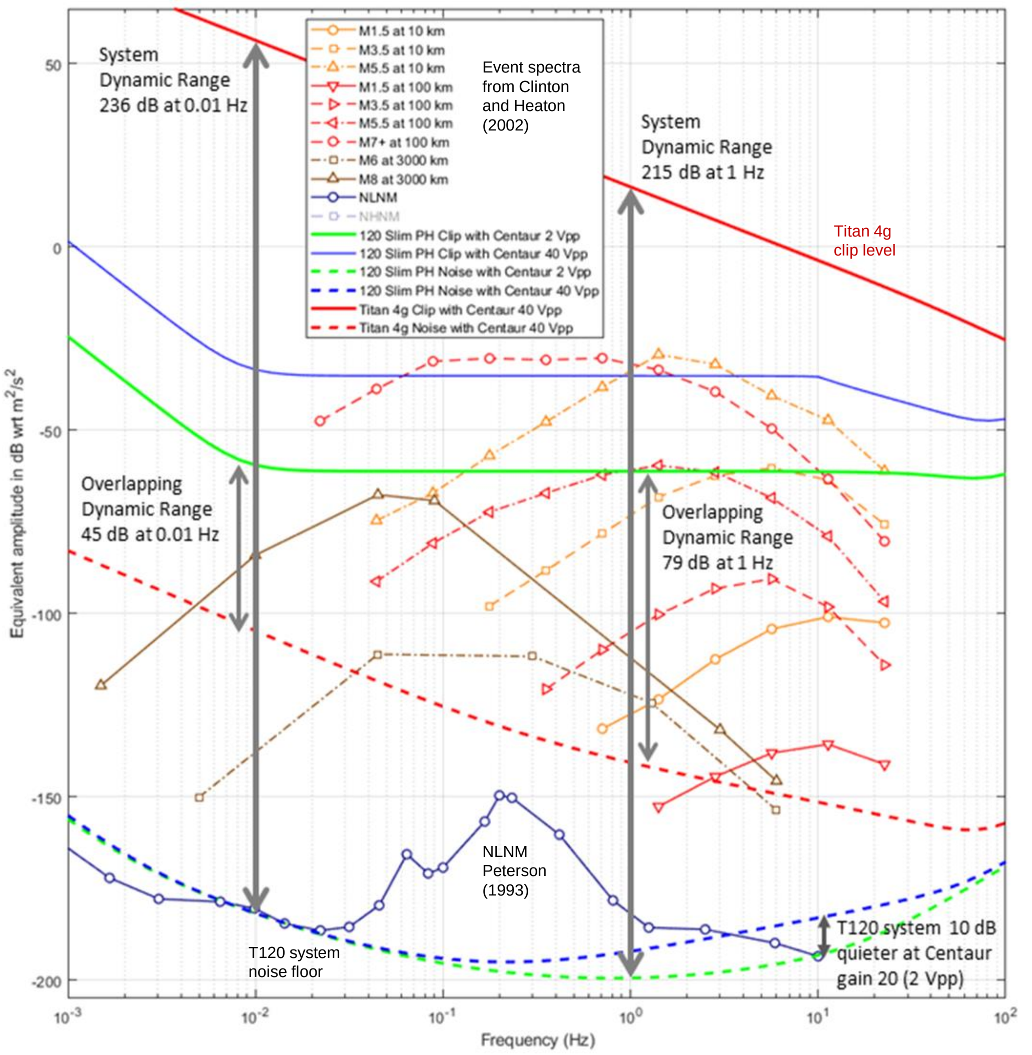
Cascadia product line (approximately to scale)

Example borehole design for Cascadia multi-sensor early warning + scientific networks



Maximizing Dynamic Range

- Full range of ground motion from 4g to NLNM cannot be captured by a single sensor or digitizer
- Data from two instruments can be used together if they are:
  - Co-located
  - Mutually aligned
  - Precisely calibrated
- Digitizer is limiting factor for dynamic range. A single digitizer cannot cover the full range of a single sensor.
- However, two digitizers can cover the full range of ground motion. Set gain high on weak motion system when its clip level is covered by the strong motion system.

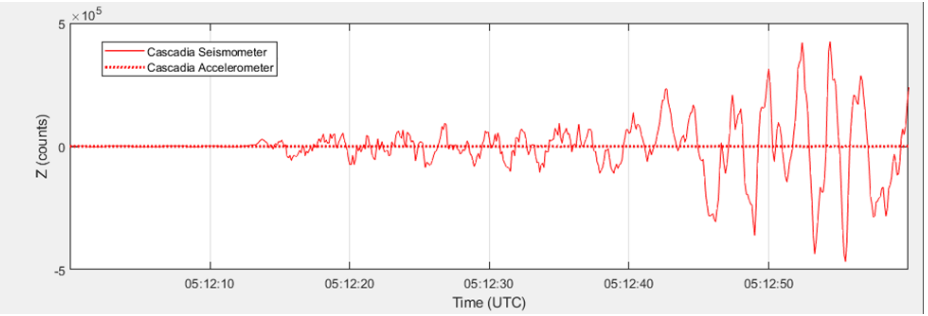


Example of combined data set

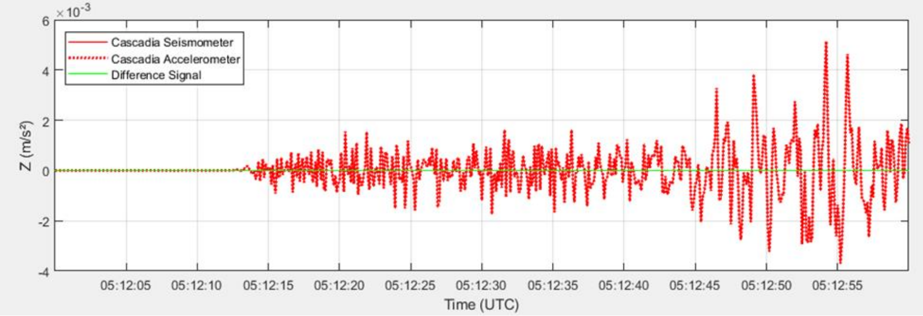
Cascadia 120 Slim PH in Taiwan Downhole Seismic Observation Network, M6.5 earthquake near Yilan, 2021-10-24 5:11

- At 260 km distance, non-clipping event (at left) matches within 0.46% on the two sensors after response correction
- At 34 km distance, larger arrival (at right) clips weak motion seismometer but not the Titan accelerometer

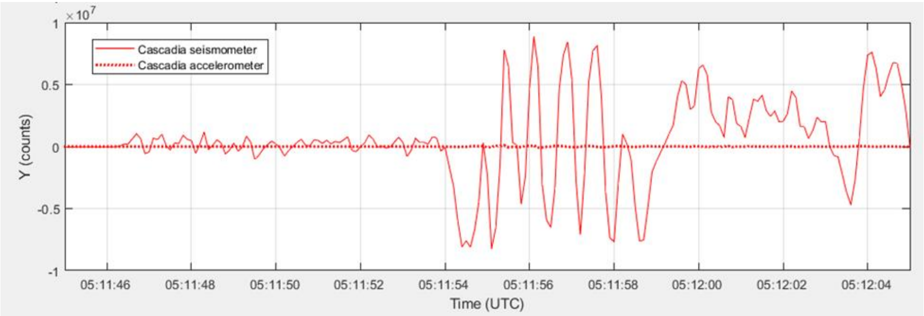
Raw data from non-clipping earthquake event



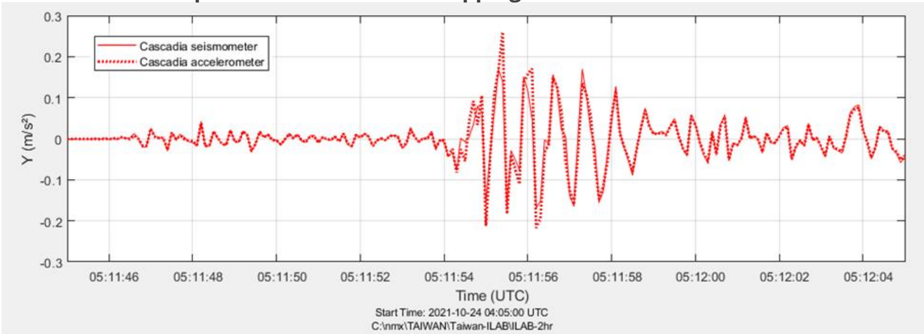
Data after response correction from non-clipping earthquake event



Raw data from earthquake event clipping weak-motion seismometer



Data after response correction from clipping event



Conclusion

The Cascadia 120 Slim Posthole instrument captures the full dynamic range of ground motion using two sensors that are

- Co-located at a single point in bedrock
- Precisely aligned
- Precisely calibrated in sensitivity and frequency response

so that the two data streams can be considered as equivalent after response correction.

Questions? email geoffreybainbridge@nanometrics.ca

References:

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Clinton, J.F. and Heaton, T.H., (2002) Potential Advantages of a Strong-motion Velocity Meter over a Strong-motion Accelerometer, Seismological Research Letters 73, 3, p. 332–342.