Background
Several supersonic aircraft are designing quiet supersonic business jets for service over the United States. These aircraft have the potential to increase the occurrence of mild sonic booms across the country. This leads to ongoing NASA study of the perception of sonic booms in large buildings, to gather initial data. We used the F-18s to initiate sonic booms with overpressures ranging from 30 to 120 Pa.

Sonic Booms on Big Structures (SonicBOBS)
SonicBREWS is a collaborative effort between Seismic Warning Systems, Inc. and NASA Dryden Flight Research Center. The project aims to evaluate the effects of sonic booms on EQW systems. The flight profile, described in the figure below, is designed to mimic the low-amplitude sonic booms expected from future supersonic business jets. By varying the dive point the amplitude of the sonic booms can be carefully controlled.

Early Results from SonicBOBS
The sonic booms were recorded by the accelerometers. The accelerometers recorded the coupling of the sonic boom to the ground and surrounding structures, while microphones recorded the elevated sound wave above the sensor. The sensors were deployed at a Consolidated Services Facility at Edwards AFB. One accelerometer was located on the ground floor near an office wall, and another was placed approximately 15 meters outside the building.

Sonic Booms and Seismic Sensors
Seismic sensors (microphones) with the seismometers, though care must be taken not to erroneously exclude actual seismic events due to acoustic noise. Microphones are broadband signals with more high-frequency content than earthquakes. Even a 1000 sps accelerometer was recording on day 1. We set the sampling rate to 200 sps on day 1, and noting significant aliasing in the records we increased the rate to 1000 sps (the instrument’s limit) for day 2. Due to a cabling problem, only the indoor accelerometer was recording on day 2.

The SonicBOBS experiment took place over two days, with one sortie (14 booms) on day 1 and two sorties (28 booms) on day 2. We set the sampling rate to 200 sps on day 1, and noting significant aliasing in the records we increased the rate to 1000 sps (the instrument’s limit) for day 2. Due to a cabling problem, only the indoor accelerometer was recording on day 1.

Next Steps
In 2023, we will deploy a seismometer in a building in the Supersonic Caustic Analysis and Measurement Program to test the response of high-amplitude (300 Pa) sonic booms. We will also fly these dedicated SonicBREWS flights, during which we will test specific boom cases for their impact on a building.

Strategies for Rejecting Sonic Booms
Several scenario cases were designed for describing the threat of sonic booms for EQW. The threat level is based on whether the sensors, the information between the accelerometer outside and inside is about a factor of 10 when sensor temperatures are comparable, but if sufficiently lower the sensors may still signal the events.

The Many Facets of Seismic Risk
Sonic booms are broadband signals with more high-frequency content than earthquakes, from a 30 Pa overpressure will produce pressures similar to those from an earthquake. Thus, any attempt to couple ground velocity is strongly dependent on the sampling rate, and increases as the sampling rate is reduced. This can be seen in the difference between the magnitude vs. dp relation from day 1 and day 2.


References