Several aerospace companies are designing quiet supersonic business jets for service over the United States. NASA Dryden Flight Research Center. This project aims to evaluate the effects of sonic booms on EQW sensors.

characterizing the effect of sonic booms on seismic sensors in the field, their potential impact on EQW systems, and means of discriminating their signatures from those of earthquakes. The SonicBREWS project (Sonic Boom Research and Evaluation System) is a collaborative effort between Boeing Warning Systems, Inc. and NASA Dryden Flight Research Center. The project aims to evaluate the effects of sonic booms on EQW sensors.

The sonic booms from April 19 to 30 are readily detectable on student acelerometers (Lanou et al., 1998; Nava et al., 2002). The figure shows a record of a sonic boom from April 24 at Edwards AFB. The blue trace is a microphone in the free field, and the green trace is the vertical displacement from nearby CISN station EDW2. The displacement is integrated from velocity and inverted to overlay with the microphone record. The initial sonic boom phase, the N-wave, has a characteristic shape which is easily discernible in displacement, but is far less obvious in velocity or acceleration as in the figures below.

The accelerometers recorded the coupling of the sonic boom to the ground and surrounding structures, while microphones recorded the reflected sonic boom wave down near the sensor. The sensors were deployed at a Consolidated Services Facility at Edwards AFB. One accelerometer was located on the ground floor near an exterior wall, and another was placed approximately 15 meters outside the building. The accelerometers recorded the coupling of the sonic boom to the ground and surrounding structures, while microphones recorded the acoustic wave above ground near the sensor. The sensors were deployed at the

The Effect of Sonic Booms on Earthquake Warning Systems

Gleed Wurman, Edward A. Haering, Jr., and Michael J. Price

Strategies for Rejecting Sonic Booms

Several possible mechanisms exist for distinguishing sonic booms from EQW. The time delay to arrival of the sensors. The attenuation between the accelerometer outside and inside is almost a factor of 10 when sensor temperatures are comparable, but a sufficiently intense boom can still spoof the sensors.

By the enhanced high-frequency component, sonic booms may be discernible from earthquakes by use of spectral methods such as Fourier transforms. Allen and Kanamori (2003) and Allen (2004) used spectral methods such as Fourier transforms to pick up the enhanced high-frequency component of the sonic booms. The enhanced high-frequency component of the boom can help in this determination.

Next Steps

In May 2011 we will deploy 4 accelerometers in arrays at Cuddeback dry lake during the Superboom Caustic Analysis and Measurement Program to test the response of high-altitude (8000 ft) sonic booms. We will also fly three dedicated sonic boom flights, during which we will test specific boom data-based verification of a building.

References


\[ M = 1.63 \log(\text{PGA}) + 4.40 \log(\sigma) + 1.65 \]

where \( M \) is the magnitude at 10 km, \( \text{PGA} \) is the peak ground acceleration, \( \sigma \) is the ratio of peak ground velocity to peak ground acceleration, and 1.63, 4.40, and 1.65 are constants. In this determination, booms at 30 000 ft altitude will produce a peak ground acceleration of 0.05 g. Above this value, the enhanced high-frequency component of the boom can help in this determination.

The time delay between the boom onset at the two sensors is consistent with a sound wave travelling at 1000 km/s rather than an acoustic one. This discrimination requires two sensors because the boom is normally incident to the array.