



Ground Based Microphones

Uninstalled Engine Standard Meeting

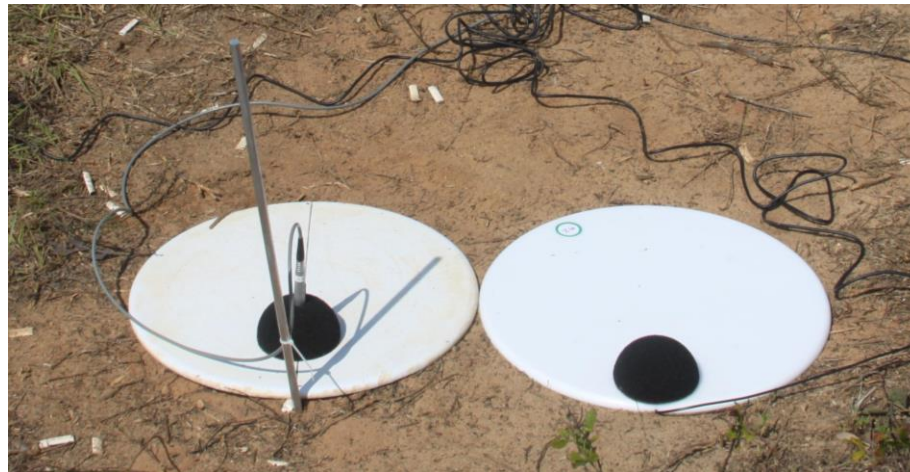
February 25-27, 2014

Charlotte Whitfield

NASA's Microphone Configurations



- NASA has chosen to use ground based microphones such as



15" Diameter ground board*
Offset from center
Inverted ½" B&K 4189
Diaphragm 1/4" over board

15" Diameter ground board*
Offset from center
GRAS ½" 47AX
Mounted from underneath with
diaphragm flush with surface

* Based on ICAO Environmental Technical Manual SGAR 1

Background



- NASA used towers until 2009 for gathering community noise data. It was thought that the integration of the data into the metrics masked the reflection issues.
- We now use narrow band data for research and when evaluating community noise.
- Reflections are visible in narrow band and 1/3 octave tower data.

Reflection Test

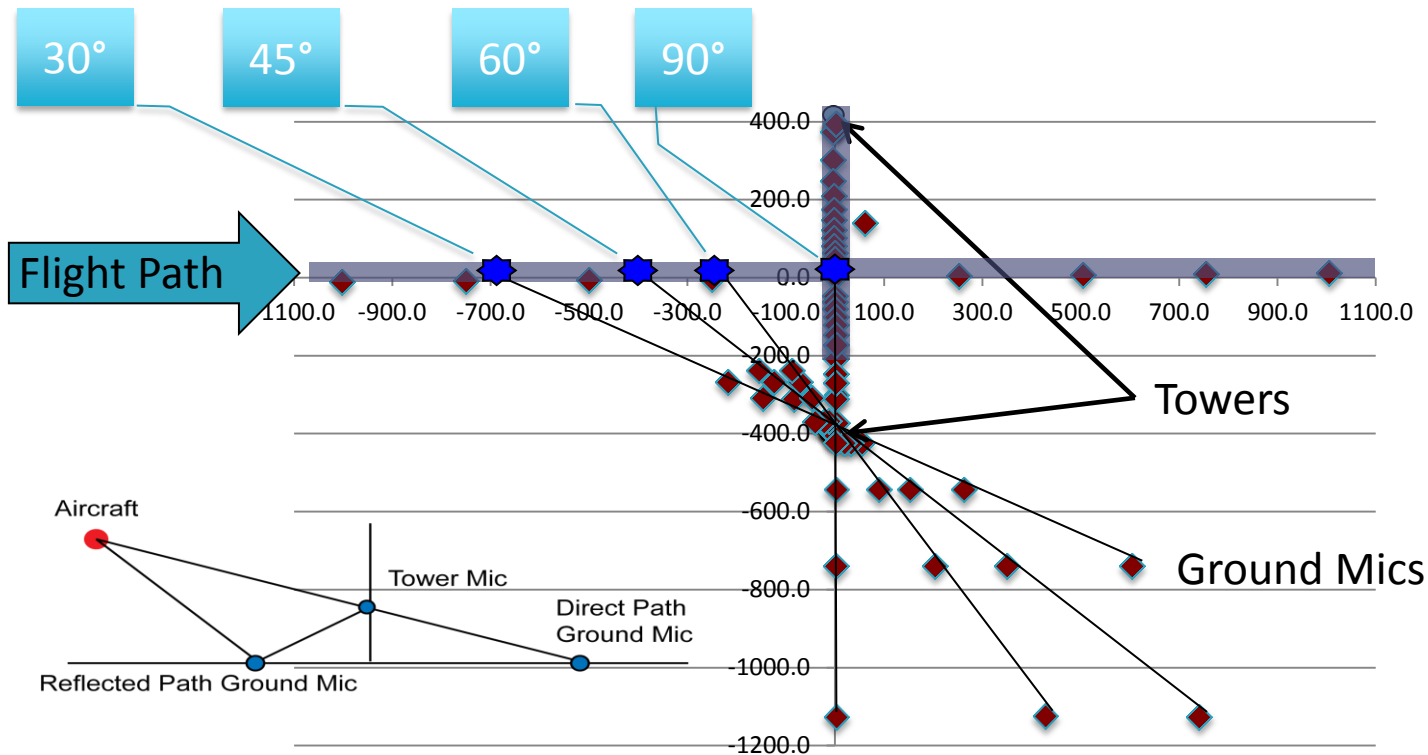


- Data was taken at the ARC facility in Sept. 2008 as part of the ARC checkout testing
- Aircraft is a OH-6 helicopter
- Sample Rate is 24000 samples per second
- Data analyzed 2000 feet before center to 1000 ft after center
- Data normalized for spherical spreading to common reference distance
- Microphone installation pressure doubling removed
- Data is de-Dopplerized using time based method
- Un-averaged 8192 FFT block size (~ 2 revs)
- Hann window
- The signal is greater than 6 dB above noise floor for data presented

Reflection Test Microphone Layout



1. Tower and Ground Microphone reflection configuration

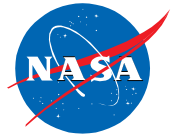


2. Center Line Microphones (0° configuration)

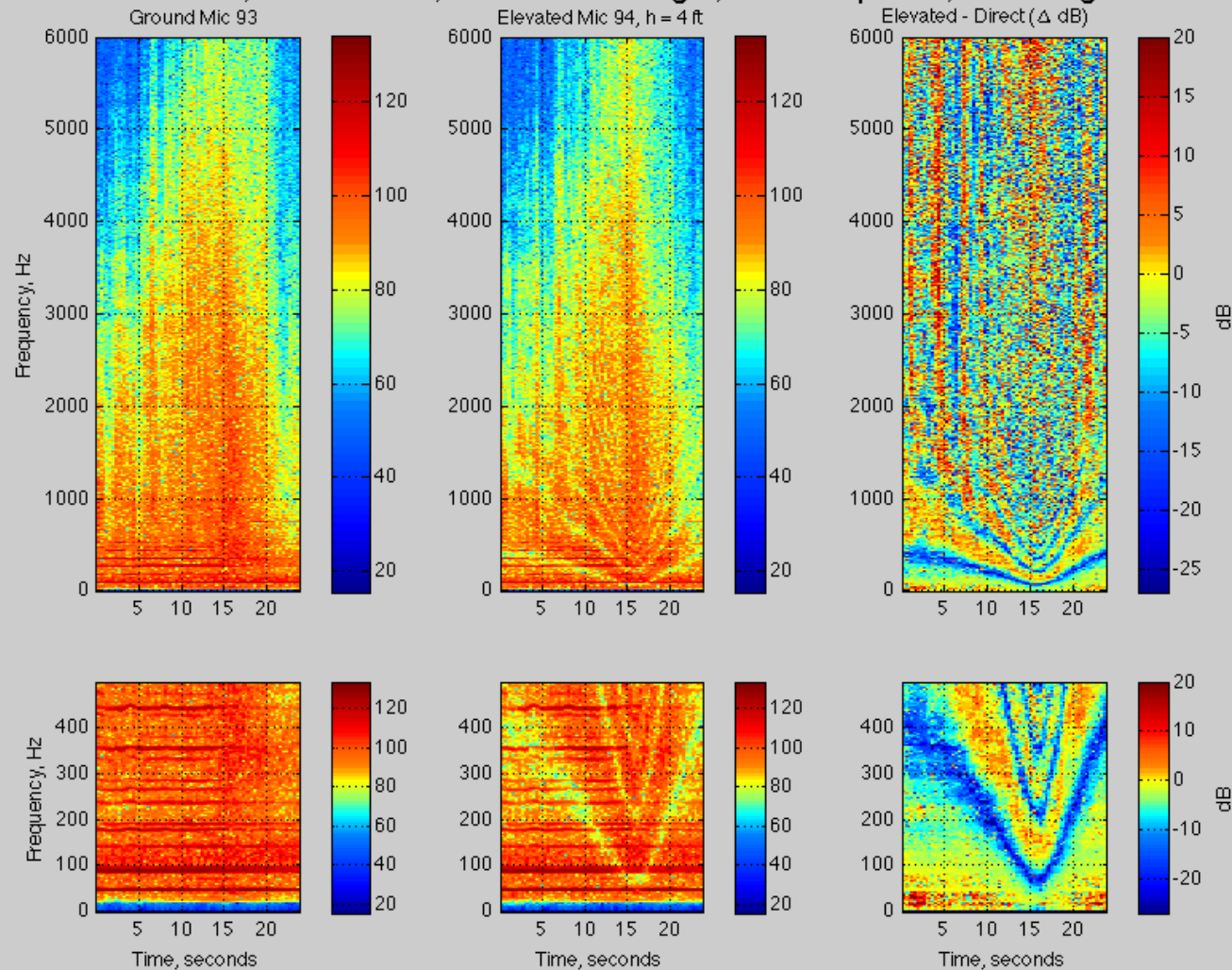
Ground microphone on ground board at center point

Elevated microphone on 1.2m tripod 9.5 feet Right of center point.

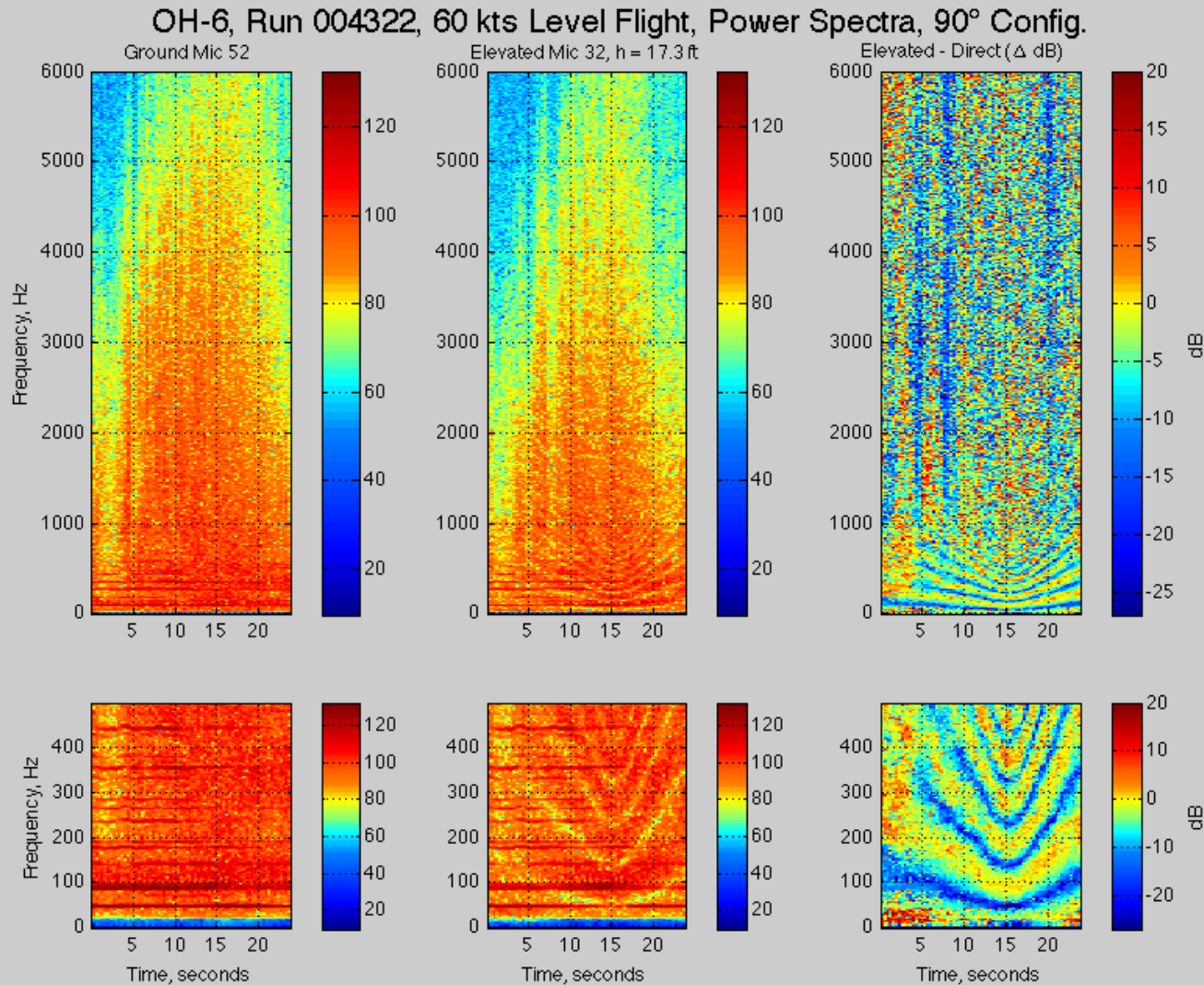
60 kts, 4 ft Mic Spectrogram



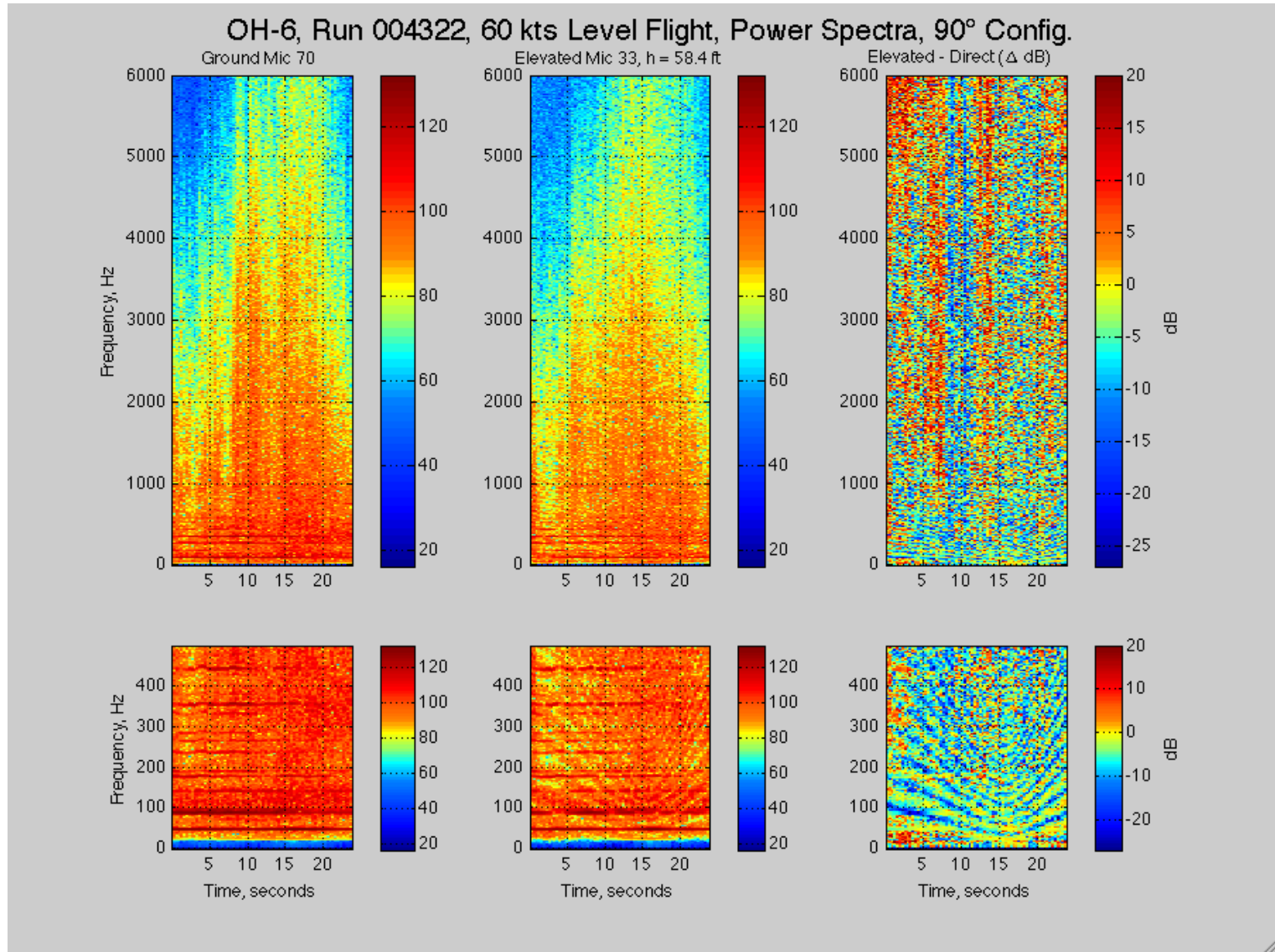
OH-6, Run 004322, 60 kts Level Flight, Power Spectra, 0° Config.



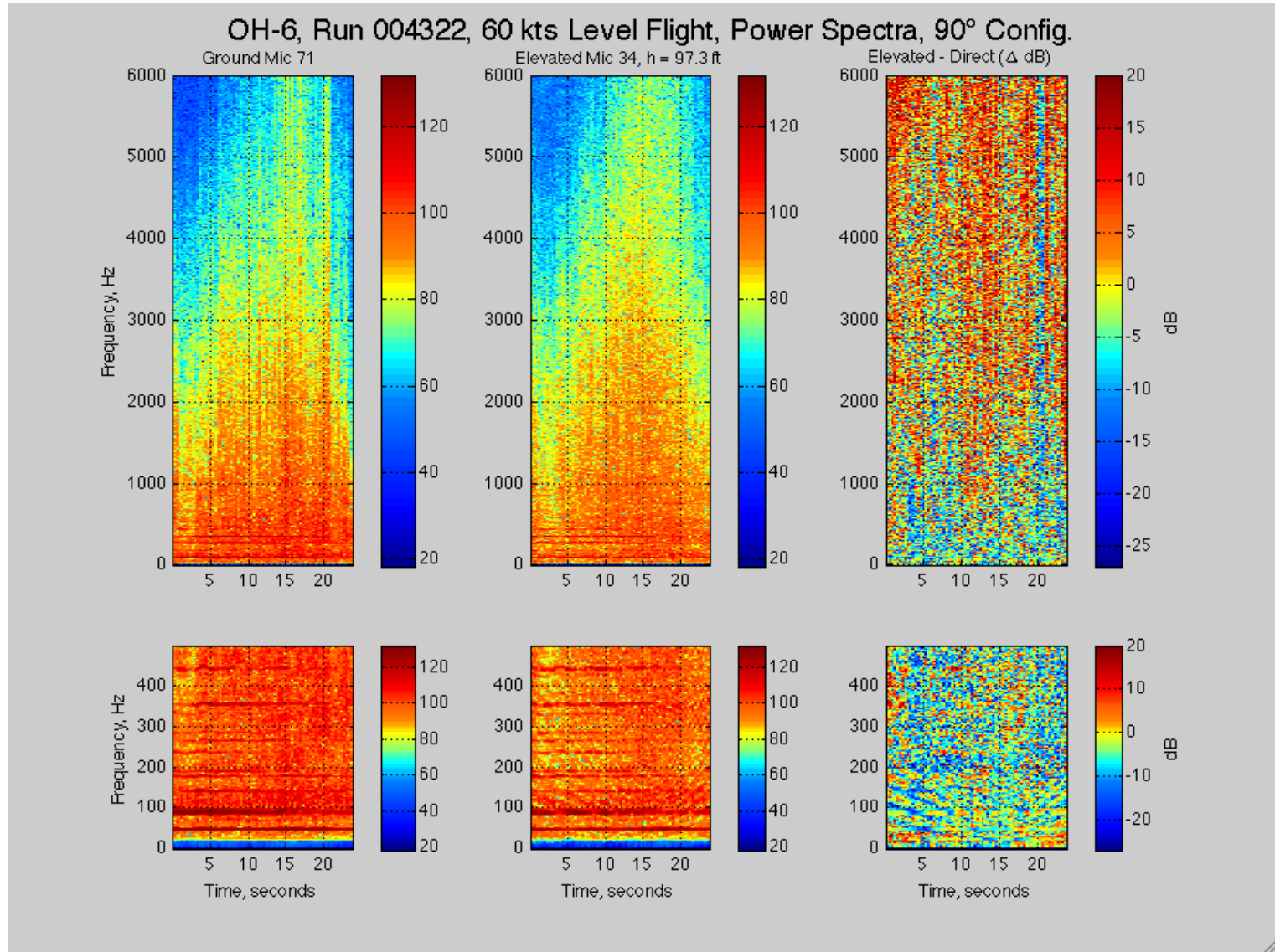
60 kts, 17.3 ft Mic Spectrogram



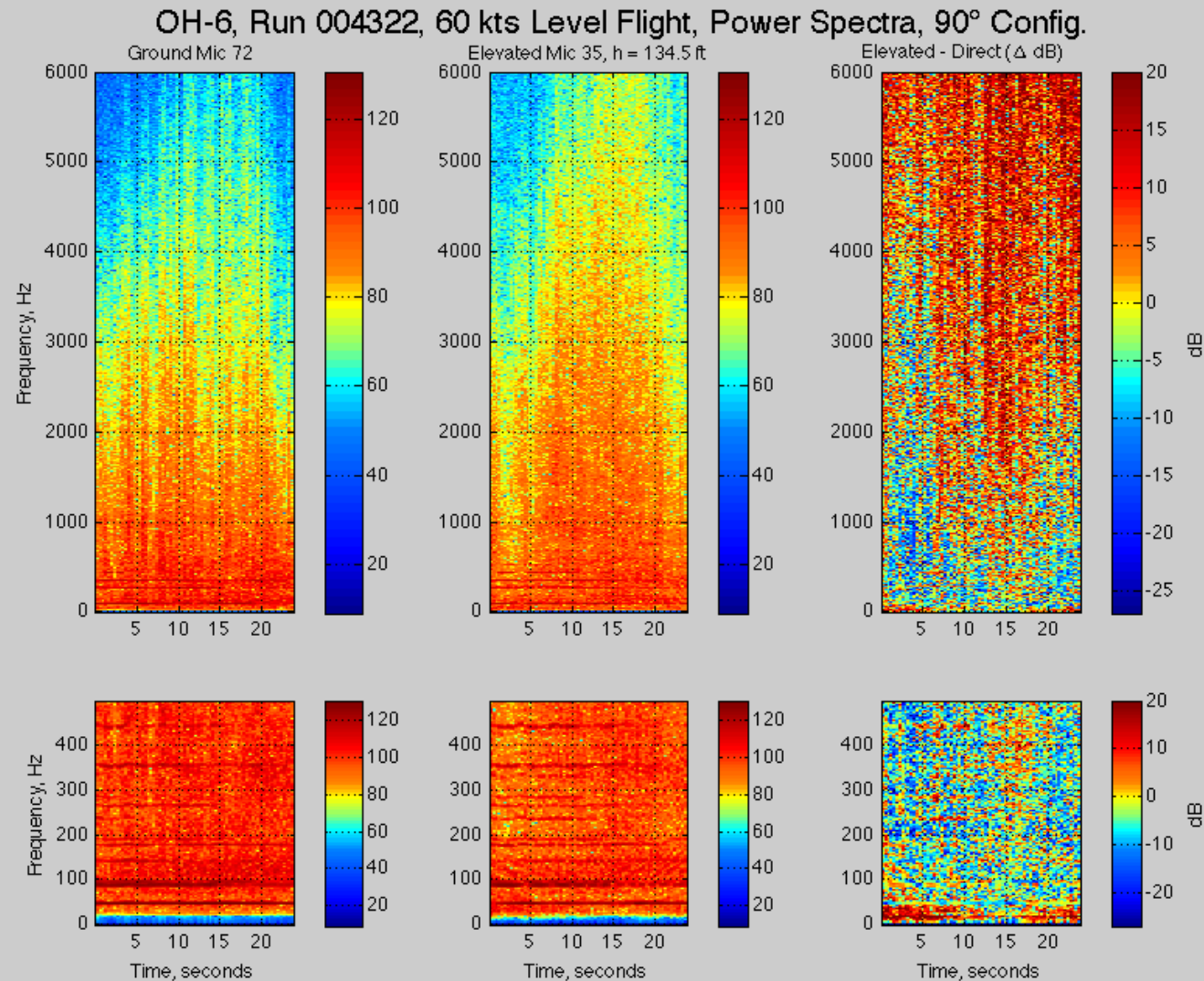
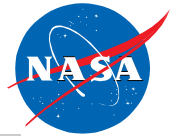
60 kts, 58.4 ft Mic Spectrogram



60 kts, 97.3 ft Mic Spectrogram



60 kts, 134.5 ft Mic Spectrogram



Conclusions

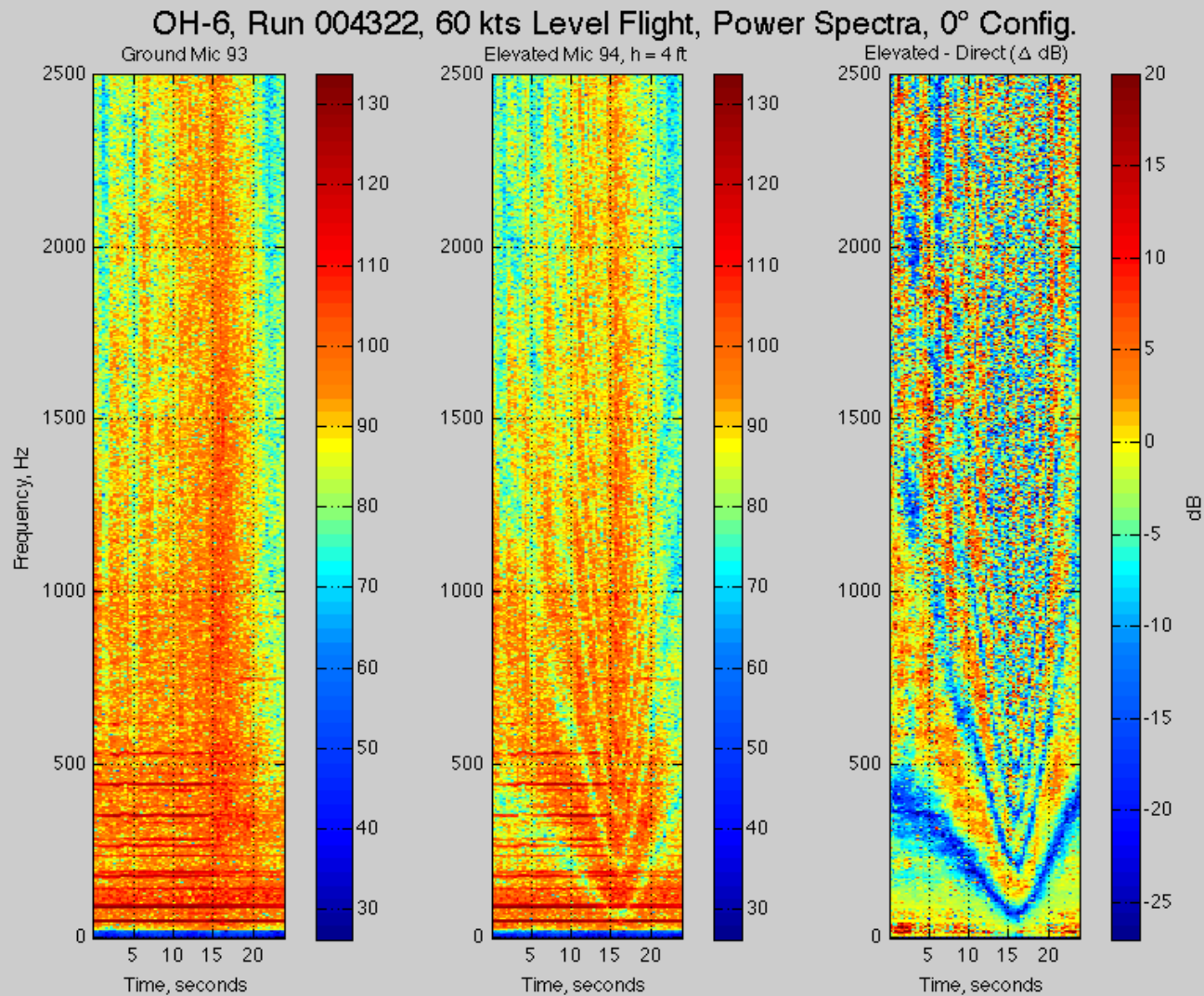
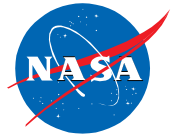


- Reflection effects are seen in the narrow band data
- The reflection effects diminish with microphone elevation over the ground and for higher frequencies. However, it is still slightly evident for the 134 foot microphone at the lower frequencies.
- Theory and experiment indicate surface wave should be negligible for most terrain types and frequencies. (Albert, D.G, "Observations of acoustic surface waves in outdoor sound propagation", J. Acoust. Soc. Am. 113 (5), May 2003)

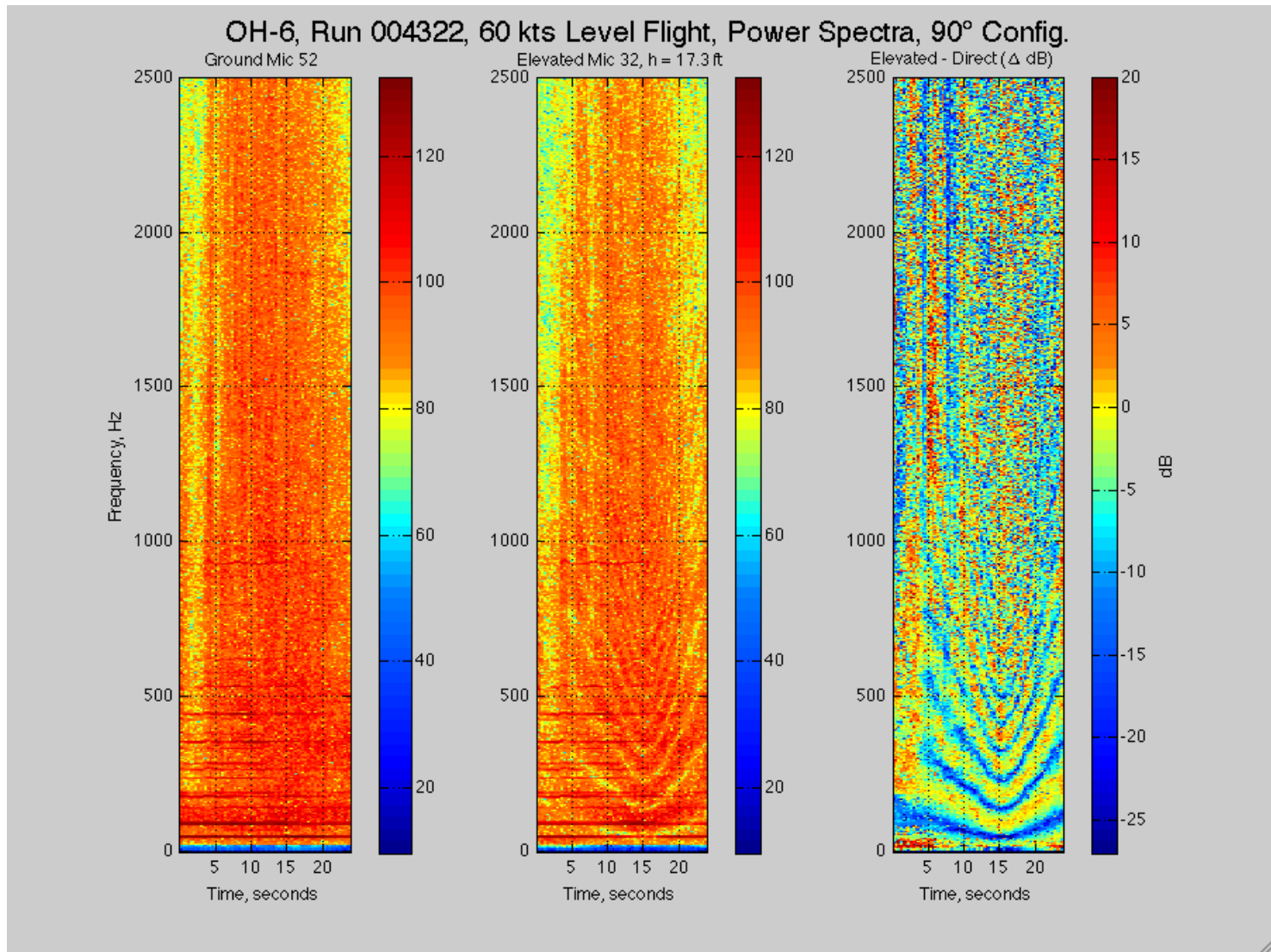
Backup Slides



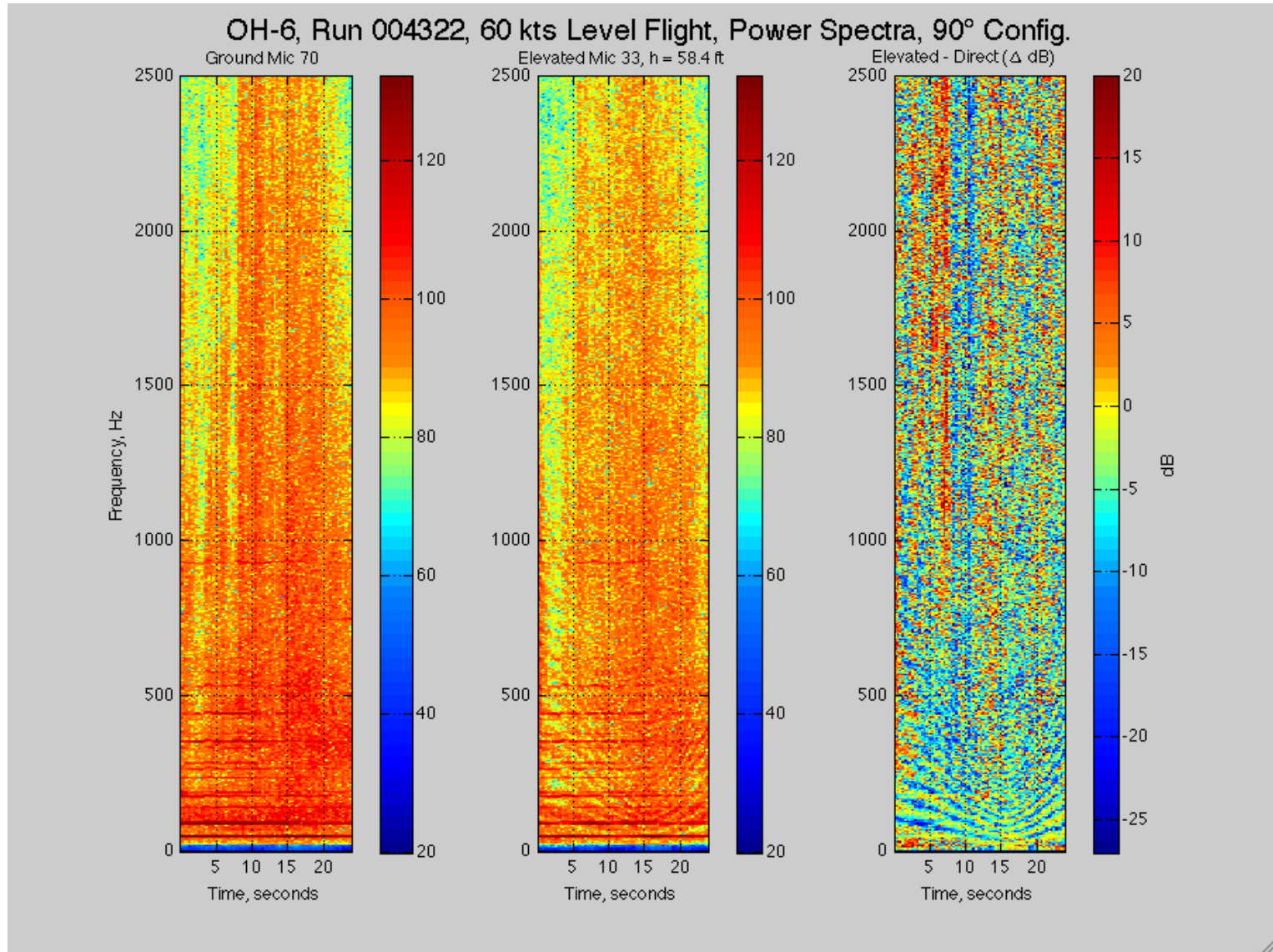
60 kts, 4 ft Mic Spectrogram



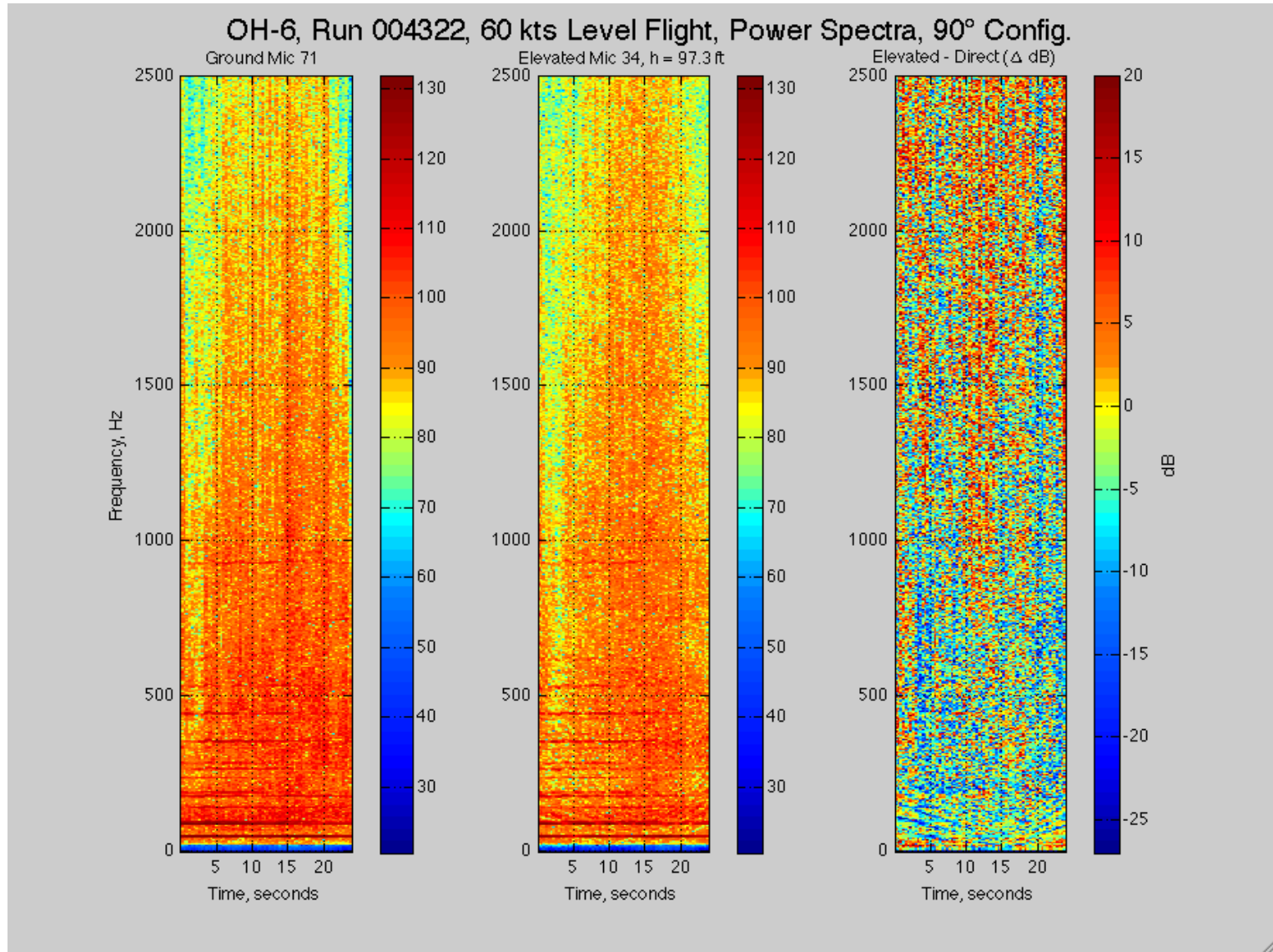
60 kts, 17.3 ft Mic Spectrogram



60 kts, 58.4 ft Mic Spectrogram



60 kts, 97.3 ft Mic Spectrogram



60 kts, 134.5 ft Mic Spectrogram

