Mark Delaplaine

From:	Charles Greene [cgreene@greeneridge.com]
Sent:	Friday, May 07, 1999 5:41 PM
To:	mdelaplaine@coastal.ca.gov
Subject:	Fax received, USGS airgun survey

Hello Mark,

First, regarding the first paragraph and the Greeneridge data from Harmony in 1998, I think it was a mistake to use "least-squares, straight line fit to all data, which yelds a transmission loss of 27log(R)." The reported loss rates of 48 to 60 dB/decade of distance were for the shortest ranges, <500 m, which are those of interest in the proposed USGS survey. The lower loss rate of 27 dB/decade comes from including the much slower loss rates over the longer ranges (5-6 km).

The second paragraph on ATOC sounds reports a high transmission loss rate of 43 log(R) for water 10-80 m deep but neglects to say over what distances they see that rate. If again they used long ranges, those are not relevant to the ranges of interest (short, near the source). We have seen 10log(R) spreading losses in shallow water out to distances of 1 km or so from airgun arrays in the Beaufort Sea, but the losses increase to about 40log(R) for long distances--the opposite effect of our S.B. Channel/Platform Harmony experience. This is an example of the site variability mentioned by others.

It is often true that up-slope sound propagation, from deeper into shallower water, will be more severely attenuated than downslope sound propagation. However, at Platform Harmony we saw the opposite effect over short distances (about 75 to 400 m) of 60log(R) downslope and 48log(R) upslope. There is no reason to expect reciprocity, that is, that a source in shallow water and a receiver in deep water would see the same transmission loss in acoustic pressure when their positions are exchanged.

The question at the bottom of the page may be answered by the air pressures used in the two guns. It can probably be shown that 3000 psi in a 35 cu.in. airgun will result in a stronger sound than would 2000 psi (the "usual" air pressure in Bolt PAR airguns) in a 40 cu.in. airgun. Also, the peak pressure, as I recall, varies with the cube root of the airgun volume, all else being equal; the cube root of 40/35 is 1.0455, which is just about 1.0.

The key to a higher spreading loss than 10 or 20log(R) is in the shallow depth of the airgun. At 1 or 2 m depth and a long-wavelength (low frequency) source, the surface pressure release effect (Lloyd mirror) will result in poor coupling to the water and severe sound attenuation. For example, if the airgun frequency is concentrated around 100 Hz, its wavelength will be 15 m, and a depth of 2 m does not leave much room for the principal components of the sound. There are excellent models of this effect and I can dig them up for you if you like.

In short, I think 25log(R) probably is a conservative estimate of the short-range sound attenuation when considering the broadband nature of the airgun pulse. There are frequency effects that come into this that I won't go into here.

I hope this helps.

Regards,
Charles Greene
Greeneridge Sciences, Inc.
Tel & Fax: 805-967-7720
email: cgreene@greeneridge.com

Mark Delaplaine

From: Charles Greene [cgreene@greeneridge.com]
Sent: Monday, May 10, 1999 3:22 PM
To: mdelaplaine@coastal.ca.gov
Subject: More on spreading loss rates

Hello Mark,

Following up on your fax and my hasty response, I've looked to see what we use in our own modeling of airgun pulse spreading over short ranges in the Beaufort Sea, and it is 10log(R) for both 2 m and 5 m source depth. The constant is different for the two depths, corresponding to the effective source level being different. Also, we are modeling for arrays of airguns, not just a single airgun, although we don't explicity take into account the array geometry. Sorry I didn't look this up before I wrote last Friday.

Regards,
Charles Greene