Discussion

On: "Migration by Fourier transform," by R.H. Stolt (January 1978 GEOPHYSICS, 43, p. 23-48).

In this paper (page 34) the migrated section is given by

$$\phi(X, D, D) = (1/2\pi)\int dp \int dk\, B(p, k) e^{-i(pX-kD)} \quad \ldots \quad (51)$$

where,

$$B(p, k) = \{1/\sqrt{(1 + p^2/k^2)}\} . A\{p, (kc/2)\sqrt{1 + p^2/k^2}\} \ldots \quad (52)$$

However, I find a factor $(c/2)$ is missing in either equation (51) or (52). The necessary derivation follows.

The migrated section is given by equation (50) of this paper,

$$\phi(X, D, D) = (1/2\pi)\int dp \int d\omega A(p, \omega) e^{-i\{pX-\sqrt{(4\omega^2/c^2-p^2)}\,.\,D\}}$$

We have, $k = \sqrt{4\omega^2/c^2 - p^2}$ (i)

then, $k^2 = 4\omega^2/c^2 - p^2$ (ii)

or, $2kdk = (4/c^2) \,.\, 2\omega d\omega$ (iii)

Now, from (ii), $4\omega^2 = (p^2 + k^2)c^2$

or, $\omega = (kc/2)\sqrt{1 + p^2/k^2}$ (iv)

Therefore, $d\omega = (kc/2)(1/\sqrt{p^2 + k^2})\, dk$

or, $d\omega = (c/2) \,.\, dk/\sqrt{1 + p^2/k^2}$ (v)

Now by change of variable from ω to k

$$\phi(X, D, D) = (1/2\pi)\int dp \int (c/2)/\sqrt{(1 + p^2/k^2)}\, dk.$$

$$A\{p, (kc/2)\sqrt{1 + p^2/k^2}\} e^{-i(pX-kD)} \quad (vi)$$

If we consider,

$$B(p, k) = \{1/\sqrt{(1 + p^2/k^2)}\} . A\{p, (kc/2)\sqrt{1 + p^2/k^2}\}, \quad (52)$$

equation (vi) becomes

$$\phi(X, D, D) = \{(c/2)/2\pi\}\int dp \int dk \,.\, B(p, k) e^{-i(pX-kD)} \quad (vii)$$

Thus, the migrated section $\phi(X, D, D)$ in equation (vii) has an additional factor of $c/2$.

Introducing $B1(p, k) = (c/2)B(p, k)$, (viii)

$$\phi(X, D, D) = (1/2\pi)\int dp \int dk \,.\, B1(p, k) \,.\, e^{-i(pX-kD)}. \quad (ix)$$

Consequently, although the shifted frequency ω' remains unchanged, the factor for change of scale is given by,

$$B1(p, k)/A(p, \omega) = (c/2) \,.\, 1/\sqrt{1 + p^2/k^2}$$
$$= (c/2) \,.\, k/\sqrt{(p^2 + k^2)}$$
$$= (c/2)\omega'/\omega.$$

The equation (ix) for the migrated section is equivalent to equation (51) given in this paper, but the change of scale will be $(c/2).\ \omega'/\omega$ instead of ω'/ω as given in this paper.

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Reply by the author to Somaditya Dutta

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Mr. Dutta is correct. To be consistent with equation (50), equation (51) should have a factor of $c/2$ out front.