Global Seismology 2 (GEO4-1509)

Tentamen - 29 January 2009

Jeannot Trampert

The numbers in () indicate the percentage for evaluation. No documents are allowed during the examination. Please write clearly and don't forget to indicate your name.

1. (10) Why are surface waves dispersive in the real Earth?

2. (20) It is well know that the Earth is anisotropic. Most evidence comes from surface waves. Explain the difference between transverse and azimuthal anisotropy and how surface waves can be used to put constraints on both types of anisotropy.

3. (20) We have seen that for Love waves $\omega^2 I_1 - k^2 I_2 - I_3 = 0$ and $U = \frac{I_2}{cI_1}$. Use these expressions to show that for Love waves, the group velocity is always smaller than the phase velocity for a given frequency.

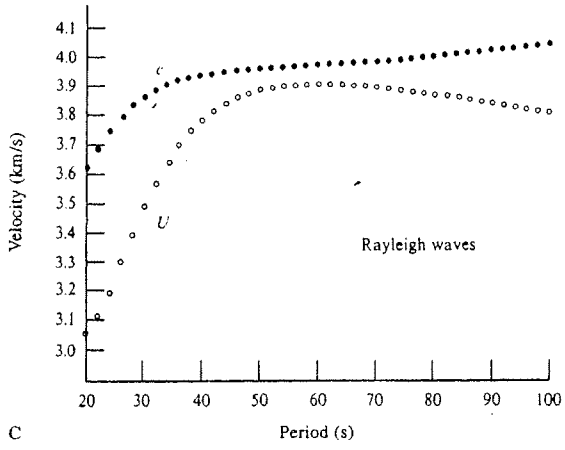
4. (30) The displacement of a Love wave can be written as

$$u^L = G^L[M_{xx}\sin\phi\cos\phi - M_{yx}\cos^2\phi + M_{xy}\sin^2\phi - M_{yy}\sin\phi\cos\phi - \frac{1}{ik_n l_1(h)}\frac{dl_1(h)}{dz}(M_{xz}\sin\phi - M_{yz}\cos\phi)] \quad (1)$$

   where G^L is the Green's vector for Love waves, ϕ is the azimuth of the station with respect to the epicentre and h is the depth of the earthquake. u^L is independent of M_{xz} and M_{yz} if the earthquake occurs at the surface. Why? Write in this case the simplified expression for u^L in terms of $\cos 2\phi$ and $\sin 2\phi$. The term in brackets in equation (1) is called the radiation pattern. Draw the radiation pattern for a strike slip fault oriented East-West, for which $M_{xx} = M_{yy} = 0$ and $M_{xy} = M_{yx} = M_0$. What is the radiation for an explosion? Explain your results.

5. (20) Define and explain the difference between group and phase velocity in general. Looking at the attached group and phase velocity for a fundamental mode Rayleigh wave, sketch what a seismogram would look like at a distance of ten thousand km.

Good luck.



Phase and group velocity of the fundamental-mode Rayleigh waves for the Gutenberg Earth model.