# A theoretical relation between infrasonic celerities and signal phases

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An analytical expression for the infrasonic group velocity in a stratified atmosphere has been derived using the normal mode method. At high frequency limit, the group velocity expression, which describes the horizontal velocity of a wave packet, reduces to one obtained using ray tracing. In a stratified atmosphere, the group velocity is constant and is, therefore, identical to the infrasonic celerity. As a consequence, the celerity of an arrival can be predicted if the sound speed and wind velocity profiles are known. An infrasonic phase diagram, showing the relationship between the group velocity and trace velocity, has been developed. Such a diagram is very useful in identifying different infrasonic phases as well as in predicting the celerity that corresponds to a given trace velocity. Using such a diagram, the range of the celerity and trace velocity values for each type of arrivals can be predicted. Typical atmospheric profiles that were tested yield group velocities that are in good agreement with known celerities for tropospheric, stratospheric, and thermospheric arrivals. Future investigation will focus on the application of this result to related acoustic inversion problems.