$$\frac{\Delta F_\nu}{F_\nu}(\nu > \nu_m) = \frac{-2(2\alpha+1)}{T}, \quad \frac{\Delta\nu_m}{\nu_m} = \frac{-(4\alpha+5)}{(\alpha+2\cdot5)T} \qquad (4)$$

where T = age of the source measured in years. In the case of source 1934–63 (ref. 1):

$$\alpha_{\nu > \nu_m} = 0\cdot1$$

Assuming $T \sim 100$ years:

$$\frac{\Delta F_\nu}{F_\nu}(\nu > \nu_m) \sim 2\cdot4\%, \ \Delta\nu_m \sim 12 \text{ megacycles/sec/year}$$

Note that for $\nu < \nu_m$, F_ν will increase approximately proportionally to r.

Naturally, one has to bear in mind the simplifying assumptions that were made in deriving expression (2), primarily the assumption that $H \propto r^{-2}$. In reality, the relationship between H and r may be more complex. Furthermore, our estimate of the age of source 1934–63 may be too rough. All this, however, does not alter our main conclusions : source 1934–63 is very young and, therefore, the secular diminution of its F and ν_m proceeds very rapidly and may be detected by specially arranged precision observations.

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METEOROLOGY

Wind and Temperature Representations in the 26-month Oscillation

Reed and Rogers[1] have presented amplitudes of the 26-month zonal wind oscillation at various heights and latitudes. Elsewhere, Reed[2,3] has presented temperature amplitudes and phases and shown that meridional forces are in geostrophic equilibrium. The purpose of this communication is to present an analytical expression for the zonal wind oscillation which accurately describes the observations and which, through the thermal wind equation, also leads to an accurate analytical expression for the temperature oscillation. These expressions should prove useful in theoretical investigations of the oscillation.

The zonal wind disturbance is accurately described by a downward propagating and downward attenuating disturbance the latitudinal profile of which has the form of the normal probability curve:

$$u = u_{EM} e^{-ky^2} e^{\alpha_a z + i(\alpha_p z + \nu t)} \qquad (1)$$

where u_{EM} is the magnitude of u over the equator at a level where the height z is arbitrarily zero, e is the base of natural logarithms, k is a positive constant equal approximately to 5×10^{-3} (lat. deg.)$^{-2}$, y is distance northward from the equator, α_a is a positive 'attenuation' constant, i is the imaginary unit, α_p is a positive vertical wave number, ν is the frequency, and t is time. The wave speed, approximately 1 km mo^{-1} downward, is given by $c = \alpha_p^{-1}\nu$, where $\nu = 2\pi(26 \text{ mo})^{-1}$.

The thermal wind equation which follows from geostrophic equilibrium of meridional forces and hydrostatic equilibrium is:

$$\frac{\partial u}{\partial z} + \frac{g}{fT}\frac{\partial \tau}{\partial y} = 0 \qquad (2)$$

where g is the acceleration of gravity, f is the Coriolis parameter, T is the undisturbed temperature, and τ is the temperature disturbance. Substitution of (1) in (2) and partial integration with respect to latitude yield:

$$\int_0^\tau d\tau = -\frac{T}{g}\int_{y_0}^{y} f\frac{\partial u}{\partial z}\partial y = -\frac{T(\alpha_a + i\alpha_p)u_E}{g}\int_{y_0}^{y} fe^{-ky^2}\partial y \qquad (3)$$

where the disturbance has been assumed to vanish at latitude y_0. Within about 20 deg. of the equator, $f \approx 2\Omega a^{-1}y$, where Ω is the Earth's angular velocity and a is Earth radius. Completion of the integration now yields:

$$\tau = \frac{\Omega T}{gak}(\alpha_a^2 + \alpha_p^2)^{1/2} e^{i\omega}(e^{-ky^2} - e^{-ky_0^2})u_E \qquad (4)$$

where:

$$\omega = \arctan\frac{\alpha_p}{\alpha_a} \qquad (5)$$

and u_E is the time and height dependent value of u over the equator. Hence the temperature disturbance precedes the zonal wind disturbance by $(13\omega/\pi)$ months, has in meridional profile the shape of a normal probability curve, and is positive for $y < y_0$ and negative for $y > y_0$. All these features are consistent with revised temperature amplitudes presented by Reed[3]. The temperature profile is not so accurately known as the zonal wind profile, but it can readily be shown that an exponential, rather than probability, meridional profile of zonal wind leads, through the thermal wind equation, to a temperature profile which is difficult to adjust qualitatively or quantitatively to observations.

In (4) if we set $\alpha_a = \alpha_p = 2\pi/26$ km, $T = 210°$ K, $k = 5 \times 10^{-3}$ (lat. deg.)$^{-2}$, $u_{EM} = 20$ msec^{-1} and $y_0 = 15$ lat. deg. (Reed[3]), the temperature amplitude over the equator becomes $2\cdot7°$ C, a value in good agreement with Reed's[2,3] results. The temperature phase precedes the corresponding wind phase by 3·25 mo. For $\alpha_a = 0$ temperature phase precedes zonal wind phase by 6·5 mo. Both these values agree reasonably well with Reed's[2] results.

Equations (1) and (4) should prove useful either as the objects of a fundamental theory of the 26-month oscillation or as reliable descriptions of the zonal wind and temperature disturbances which may be substituted in the complete set of fundamental equations in order to obtain accurate descriptions of the weak meridional and vertical motion fields.

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GEOPHYSICS

Evidence for Wave Motions in the *E*-Region in the Ionosphere

THE measurement of 'drift' in the ionosphere using the changes of signal strength of a radio wave reflected nearly vertically from the ionosphere and received by three antennae a fixed distance apart[1] has often been difficult to interpret, and different methods of analysis appear to give different results. In an attempt to resolve some of these discrepancies it was decided to test the hypothesis that the scattering irregularities of electron density[2] were due to hydrodynamic waves travelling horizontally in the ionosphere, rather than the movement being a drift of the medium as a whole.

A possible type of wave in the E region of the ionosphere is the so-called 'surface gravity wave' originally examined by Helmholtz[3]. These waves correspond to water waves, except that in the case of water waves there is a sharp discontinuity of density between the water and