day; activities of 8×10^{-7} μC per ml have been observed.

It is the intention to place the results of the observations at the disposal of the Royal Netherlands' Academy of Sciences. I would, however, appreciate if you could consider the possibility of publishing these data also in Tellus and in case your reaction to this suggestion is favorable, to invite other countries to follow our example.

I hope you will agree with me that it is of importance to make information on this subject available to scientists, the more so as the study of artificial radio-activity may in the long run lead to interesting meteorological results.

Sincerely yours,

Ir. C. J. WARNERS
Director in Chief of the Royal Netherl. Meteor. Institute

Note on Fjørtoft's Graphical Method of Integrating the Barotropic Vorticity Equation

Dear Sir:

In the graphical method of integration of the barotropic vorticity equation due to FJØRTOFT (1952) the grid length of the finite difference net is chosen to be one quarter of the wavelength of the most rapidly changing Fourier components of the contour field. This ensures the complete damping of those components when the finite difference equivalent is substituted for the Laplacian operator and a fictitious velocity field changing more slowly than the real velocity field can be derived.

If a more accurate determination of vorticity is required than is possible with a 600 km grid, then as Fjørtoft pointed out, a new slowly changing advection field would have to be found to make the graphical method practicable. It can be shown however that where the most rapidly changing component is taken to have a wavelength of about 2,500 km, such a velocity is possible only for a grid length of about 600 km.

For with Fjørtoft's notation, in the conservation formula

$$\frac{d\xi}{dt} = 0 \text{ put } z = +z^{\star\star} + z^{\star} \text{ where } z^{\star\star} = c\xi.$$

The constant c has then to be found for some grid length d.

$$\text{Now } \frac{\partial \xi}{\partial t} = \frac{g}{f}\nabla z^{\star} \times \mathbf{k} \cdot \nabla \xi = \frac{g}{f}\nabla\,(z - c\xi) \times \mathbf{k} \cdot \nabla \xi$$

$$= \frac{g}{f}\nabla z \times \mathbf{k} \cdot \nabla \xi$$

$$= \frac{g}{f}\nabla[\bar{z} + J(\phi)] \times \mathbf{k} \cdot \nabla z \qquad (1)$$

The same result can be derived directly from the conservation formula without any substitution for,

$$\frac{\partial \xi}{\partial t} = \frac{g}{f}\nabla z \times \mathbf{k} \cdot \nabla \xi$$

$$= -\frac{g}{f}\nabla z \times \mathbf{k} \cdot \nabla[\bar{z} + J(\phi)]$$

$$= \frac{g}{f}\nabla[\bar{z} + J(\phi)] \times \mathbf{k} \cdot \nabla z \qquad (2)$$

From (1) and (2)

(a) It does not matter what value is given to c for $\frac{g}{f}\nabla c\,\xi \times \mathbf{k}$ has no advective effect on the field of ξ

The substitution $z = z^{\star} + z^{\star\star}$ is not necessary for the same result is found more directly as in (2).

(b) Advection of the ξ field is equivalent to advection of the z field by the geostrophic wind due to the $\bar{z} + J(\phi)$ field.

(c) $\bar{z} + J(\phi)$ is slowly changing only when the most rapidly changing components are suppressed, *i.e.* when d = about 600 km. For any other grid length more slowly changing components are damped out and therefore the time steps would have to be shorter. The graphical method is practicable then for one grid length only.

REFERENCE

FJØRTOFT, R. (1952): On a numerical method of integrating the barotropic vorticity equation. *Tellus* 4, 179—194.

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Professor R. Fjørtoft wants to refer to a forthcoming article in Tellus Vol. 7, No. 4 where his results are generalized and where the questions raised by Drs J. F. de Lisle and I. S. Kerr will be discussed in some detail.

The Editor