NOTES AND CORRESPONDENCE

ing factor decreases with increasing $K_n$. However for the second scheme, as $K_n$ increases from zero, $|\Gamma|$ decreases until $K_n \Delta t = 1$ and thereafter increases rapidly again back to unity.

This result is in accord with the results obtained by Simmonds if we note that he used a 15-minute timestep. It suggests that the continued growth of the r.m.s. error with the increase of the relaxation coefficient $K_n$ in his experiments may in part be a numerical effect.

5. FURTHER CONSIDERATIONS

We conclude with a comment upon a nonlinear aspect of updating that is particularly relevant to the comparison of schemes [E] and [F]. Current observational data distributed in space and time, although almost adequate to specify the large planetary scale motion, are insufficient to capture details of the synoptic–subsynoptic development. Thus, if development on the latter scale is primed by the larger, observationally well-defined scales, it is conceivable that the synoptic–subsynoptic fields derived from a numerical model integration could contain useful information that is not available in the external data. The direct insertion scheme with the diffusive terms will severely damp the meteorological motion on this scale. In contrast pure ‘Newtonian’ dynamical relaxation has the attractive and desirable feature of a scale-dependent damping of the meteorological motion and will allow essentially unmodified development on this length scale.

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COMMENT ON THE PAPER BY A. S. THOM AND H. R. OLIVER ‘ON PENMAN’S EQUATION FOR ESTIMATING REGIONAL EVAPORATION’ (*Q.J.*, 1977, 103, 345-357)

By J. H. C. GASH

In a recent paper Thom and Oliver (1977) have proposed that regional evaporation would be better estimated using a version of the Penman equation, modified to take account of variations in aerodynamic and surface resistances of vegetation. In Eq. (19) of their paper the evaporation is calculated as $E = \left( \Delta Q_n + m \gamma E_{an} \right) / \left( \Delta + \gamma (1 + m) \right)$, where $m$ is related to surface roughness and $n = r_s / r_e$. To account for the different rates of evaporation of intercepted rainfall and transpired water, $r_s$ is adjusted so that $r_s = (1 - \Sigma i / \Sigma E) r_{st}$, where $r_{st}$ is the resistance in totally dry conditions and $\Sigma i / \Sigma E$ is the ratio of intercepted water evaporation to total evaporation (over a month). It was suggested that this be obtained empirically from previous studies of selected catchment analyses. However in some circumstances, particularly the study of forested catchments, a separate measurement or estimate of $i$ may be available; in which case $E$ would appear on both the left and right
hand sides of Eq. (19) and the alternative formulation below might be considered more appropriate. Substituting for \( n \) with \( r_s = (1 - i/E)r_{sd} \), Eq. (19) becomes

\[
E = \frac{(\Delta Q_n + \gamma E_{ap})}{(\Delta + \gamma(1 + (1 - i/E)r_{sd}/r_s))}.
\]

Multiplying by the denominator and rearranging gives

\[
E \{\Delta + \gamma(1 + r_{sd}/r_s)\} = \frac{\Delta Q_n + \gamma E_{ap} + i\gamma r_{sd}/r_s}{\Delta + \gamma(1 + r_{sd}/r_s)}, \text{ or}
\]

\[
E = \frac{\Delta Q_n + \gamma E_{ap}}{\Delta + \gamma(1 + r_{sd}/r_s)} + \frac{i\gamma r_{sd}/r_s}{\Delta + \gamma(1 + r_{sd}/r_s)} = \frac{\Delta Q_n + \gamma E_{ap}}{\Delta + \gamma(1 + r_{sd}/r_s)} + i(1 - c_t)
\]

where \( c_t = (\Delta + \gamma)/\{\Delta + \gamma(1 + r_{sd}/r_s)\} \), the ratio of evaporation under totally dry conditions, to the evaporation under totally wet conditions.

By rearranging Eq. (19) in this way it can now be seen that the total evaporation is calculated as the sum of the transpiration, assuming the canopy is always dry, and the interception loss. The correction term \( c_t \) compensates for calculating the transpiration even under wet conditions. Gash and Stewart (1977) have used a similar approach, with the Monteith version of the Penman equation, to estimate the evaporation from Thetford Forest. For Thetford \( c_t \) was calculated to be 0.07.

Reference


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