Second review of Beljaars et al, 'On the numerical stability of surface-atmosphere coupling in weather and climate model'

Alex West, Met Office Hadley Centre

This revised study describes a method of approximating implicit coupling between surface exchange and the underlying medium. It differs principally from the first version in that in addition to evidence from 1-dimensional experiments, it contains mathematical proof that the method described is, like truly implicit coupling, unconditionally stable, irrespective of the forcing atmospheric temperatures used. In addition, some aspects of the presentation have been clarified.

The authors have addressed my previous concerns about clarity well. My 'point 2' about the atmospheric air temperatures needing to be known for the solution of equations (14) and (15) was based on a misunderstanding (forced versus coupled simulation), and the authors have ensured this will not be repeated with their revised introduction to section 3. The revised section 5 also reads much better. I take the authors' point about the temperature at depth $\Delta z/2$ being a slightly different concept to the modelled temperature of the grid cell centred at $\Delta z/2$.

The new matrix stability analysis, illustrated with Figures 8 and 9, is a very useful addition to the paper, and appears to be well reasoned. Florian Lemarié's point that instability could occur even with constant air temperature was very illuminating. The authors are correct in stating that temperature-dependent diffusion is a much more complex problem and beyond the scope of the paper.

I have only one revision to suggest: with the altered reasoning of section 5, the variable h_0 is used on page 7, line 18 without having been defined. It might be a good idea if this sentence was either deleted, or reworded: 'Surprisingly, the function asymptotes to 1'. Alternatively, h_0 could be redefined further up.

With this addressed, the manuscript can be published.