

Review of

Hydrological modelling on atmospheric grids; using graphs of sub-grid elements to transport energy and water

by

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The authors propose a decomposition of atmospheric grid into so-called hydrological transfer units (HTUs) to resolve water flow on the surface more accurately. The proposed decomposition is based on a digital elevation models (HDEM) which contain flow directions. Their method introduces a truncation parameter to reduce memory requirements especially when the river flow is sufficiently resolved. The truncation parameter is dependent on the resolution of the atmospheric grid and the HDEM models in use, and is chosen to minimize a so-called topological error of the flow. Furthermore, the authors rightfully argue that the time steps a reasonable time step can be achieved in their approach, which they demonstrate in great details in a series of numerical experiments for several important grids.

This manuscript presents an interesting and a computationally useful numerical approach with a detailed study of parameters and the comparison thereof in several important studies of surface water flows. I suggest to publish this paper after a minor review.

Remarks:

L 32 “as not to introduce any discontinuity”

How does this discontinuity arise? Does this refer to the first approach mentioned in the line 38? If yes, could you please refer the discontinuity to the “first approach”?

L 36 “which is offer kilometric” -> “which is on a km-scale”

L 69 HTU is used but not introduced

L 70 What comes after “In a first step” is a list of things that you will be addressing in the paper. Could you specify where the items in this list are addressed in the paper, and also to make sure that they are really addressed.

L 73 “simplification of the digital elevation models”

It might be a bis misleading to call then models when in fact they are just data sets, or there something more to it?

L 82 “and covers the fraction” -> “and covers the area fraction”

L 87 “Because we are in a directional graph $l+1$ is unique”

This needs reformulating. Something along the lines of “HTU_ $\{l+1\}$ is unique”

L 87 “at one point should be the ocean or a water body for endorheic basins”

To what point are you referring to?

L 93 I suggest to have a consistent referring to equations in the manuscript. Sometimes it is referred to as “Eq 1”, and later in text it is referred to as “equation 1”. In addition, $W_{\{l,stream\}}$

should not have italic letter for “stream”, rather it should be $W_{\{l,\mathrm{stream}\}}$. The same goes for units - they should not be in the italic letters.

L 104 There is no need for brackets around $\lambda_{\{l,\mathrm{stream}\}}$

L 106 In Eq (6) having dz in italic is a bad example, dz is more appropriate.

L 127 There is no need for brackets around variables in the text.

L 145 “The hydrological data sets” -> “The hydrological data sets HDEM’s”

L 148 “30arcsec” -> “30 arcsec” and arcsec should not be in italic

L153 “As we will show...”

Could you please make a reference where is this shown?

L 163 “60arcmin” -> “60~ arcsec ” if you write in LaTeX

L 166 Maybe rename to “Supermesh between an atmospheric grid and HDEM”

L 169 “the list of polygons of intersecting polygons” -> “the list of intersecting polygons”

L 180 “Their upstream area is computed according to the HDEM”

It has not been revealed how this is exactly performed or meant to be. Could you elaborate here a bit more?

L 182 A variable nb_{\max} is mentioned without a meaning to it. Could you give us more information on this variable. Also, instead of writing “ nb_{\max} ” one could conveniently use a shorter $N_{\{\mathrm{max}\}}$.

L 184 “they contribute remains correct”

In what sense “correct”?

L 185 “in a single and same” -> “in a same”

L 185 Please reformulate the sentence starting with “This first step”

L 197 “HTUS” -> “HTUs”

L 237 “connex”

Do you mean convex? Why bringing up this property of HTU?

L 269 The definition of the cellular error is a bit vague. Is it possible to give a more precise definition of the cellular and the total error?

L 348 We learn that g_X is the inverse of velocity. This should have been also mentioned directly after Eq 5 in L 101.

L 362 “of the HTU : the stream” -> “of the HTU: the stream”

L 399 “in figure 6” -> “Fig. 6”

L 400 “x-axis” -> “ x -axis” in LaTeX

L 430 “But it has to kept” -> “But it has to be kept”

L 435 At the beginning of Sec. 5.2., could you please again mention the benefits of having nb_{\max} as small as possible?

L 440 “y-axis” -> “ y -axis” in LaTeX

L 547 I have not seen a study on the scaling parameter “a” but here set to 10^5 . Is it possible to specify values earlier in experiments?

L 598 “hydrological Transfer Unit (HTU)” -> “hydrological transfer unit (HTU)”

