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Hydrology and Earth System Sciences
Discussions
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Interactive comment on "Evaluating scale and roughness effects in urban flood modelling using terrestrial LIDAR data" *by* H. Ozdemir et al.

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Comment 1: My main concern about the manuscript is related to the way the Authors justify their conclusions. They say that higher resolutions generates 'small connecting "channels" that rapidly convey water across the domain'. However, these features and the differences between models in this regards are not shown in the figures. Figure 6 is not really readable at this level of detail and the other figures refer to some points but do not give information about the effect of various geometrical details. Further, the effect of the roughness coefficient seems to be marginal, as shown in Figure 12. Another general, minor concern relates to the description of the model, which in my opinion relies too much on the previous publications of the Authors. Since I was not

familiar with their work, I found it difficult to understand how the model works without reading some of the Authors' previous papers, especially De Almeida et al. (2012).

Response 1: Thanks for the comment. First of all, "small connection" "and channel" properties was explained under the 2.4 Model application subtitle in the first paragraph with Fig. 3. How they represented in 10 cm, 50cm and 1m can be seen in clearly in Fig. 3. Secondly, Fig. 6 has been edited and now easily can be seen that how water propagates in different resolutions and different friction conditions in a particular time step. Detail explanation are given in first paragraph under 3.1 Overview of simulation. Also to able to show channel properties and road chamber and kerb representation capacity of the DEMs, figure 7 has been added. Thirdly, roughness coefficient in Figure 12 is only to test whether decreasing surface friction in 1m DEM model could potentially achieve same effect like 10cm model in water propagation speed. Therefore being a marginal of the coefficient is normal. Finally, this manuscript is a result of a group study and eliminates some deficiencies in previous publications of the authors. Hence, giving all the information presented in the previous publications is not possible in this manuscript. However, what they did in the previous paper were explained shortly under the Introduction title.

Comment 2: Introduction: I found this section very long and I think some parts could be shortened (for example, the part of page 5907, lines 5-24).

Response 2: Thank you. All sub-sections of introduction were written to give information about related to subjects and progress of the manuscript. Therefore, the introduction contains these following sub-sections: the importance of urban flood, an example from England to access the importance of surface water flood, the progress of topographic and blockage effects representation in surface urban flooding, the progress of urban flood modelling with related to our model, surface friction conditions and how it is used in the flood modelling and the aim of the paper. Hence, all sub-sections are important for the authors and the shortening in the introduction has not been.

Comment 3: P5906, L28-P5907, L4: this phrase is too long.

Response 3: Thanks. The sentences has been shortened and clarified.

Comment 4: P5908, L11-L15: this phrase is too long.

Response 4: Thanks. The sentences has been shortened and clarified.

Comment 5: P5911, L19: '(ranging...'.The parenthesis is opened here but not closed.

Response 5: Thanks. The parenthesis has been closed.

Comment 6: P5911, L24: '...the Saint-Venant equations...' are called '...the de Saint-Venant equations...' in the abstract. Please, be consistent.

Response 6: Thanks, we have now changed the abstract for consistency.

Comment 7: Eqs 1 and 2: since the model is 2D, I would present the equations in 2D. Otherwise, it is quite difficult for readers not familiar with the previous work of the Authors to understand what is going on.

Response 7: Thanks, we have now written the equations in 2D.

Comment 8: Eq. 3: the symbol n had been also used to indicate the Manning coefficient. Although the difference is clear, it might be worth it to change the symbol of one of those.

Response 8: Thanks, we have changed the time step superindex to η.

Comment 9: Eq. 3: how is the spatial weighting factor (\theta) chosen? Does that play a role similar to the Manning factor? The Authors might comment on that, since it looks like some comparison with different \theta has been done in de Almeida et al. (2012).

Response 9: Theta does not play the same role as Manning's factor. In particular, it controls the magnitude of a diffusive term, which has the effect of smearing high gradients (or discontinuities) zones of the solution. On the other hand, Manning's coefficient affects the friction term that is functionally rather different to diffusion. The particular

value of θ used in the simulations is selected as the maximum (i.e. closest to unity) that provides solutions free from spurious numerical oscillations. This information has been added to the new version of the manuscript.

Comment 10: Eq. 6: the parameter \alpha in this equation looks more like the symbol to indicate proportionality.

Response 10: Thanks, we have now modified this symbol

Comment 11: '...\alpha is a coefficient...'

Response 11: Thanks, we have included the article "a".

Comment 12: P5914, L1-3: this was already said at P5911, L8-11.

Response 12: Thank you very much. However, P5911, L8-11 gives information about how 1m and 50cm DEMs created with procedures and also decreasing cells, while P5914, L1-3 gives only information which DEMs were used in the model with a small reminding how they produced and which one is benchmark.

Comment 13: P5915, L23: the value of \alpha was already specified at P5913.

Response 13: Thanks, in P5913 it is described the model's default value of alpha, while in P5915 we explicitly state the value used in the particular simulations performed in this paper.

Comment 14: P5915, L24: Eq. 5 should be Eq. 6.

Response 14: Thanks. It has been corrected.

Comment 15: P5916: from Figure 6, it is not really possible to see many details that are discussed.

Response 15: Thanks. Figure 6 has been edited.

Comment 16: P5917, L8-L19: the results that are shown do not make readers understand the role of these "channels". Maybe, it might be worth it to show some cross-sections to identify differences due to the LIDAR resolution.

Response 16: Thanks. The cross-sections are given in Fig.3.

Comment 17: P5917, L28: I did not really understand how the Authors concluded that the simulations are grid-independent. The example they used is a very simplified geometry; would the grid become more important if the test simulation didn't use a straight channel?

Response 17: The idea of these simulations is to separate potential structural model errors (e.g. truncation errors introduced by the finite difference discretization) from the effect of different representations of the terrain at different resolutions. Unfortunately this must be done using idealized test cases with a rather simple geometry. We have now changed the text and also provided further references that support our results.

Comment 18: P5918, L11-L12: in the previous page it is said that the results are grid independent, but here it is said that the grid resolution is important. I would try to check the words not to confuse between model grid resolution and LIDAR resolution (if I have well understood, this should be issue here).

Response 18: Thanks, we have now changed the text for the sake of clarity.

Comment 19: P5920, L11: it is not really clear how the FËĘ2 fit statistic is defined in this case. Also, FËĘ2 is called F2 at P5916.

Response 19: Thanks. The correction has been made in writing F2. However, explanation of F2 formulae is not purpose of the paper. Therefore the reference is given.

Comment 20: P5922, L14: It was said before that \theta was fixed at 0.8.

Response 20: Theta was fixed to 0.8 is only done for 50 cm DEM model. For 10cm model it is used 0.7 and form 1 m model, 0.9 was used. It is directly related to decrease oscillation in the model.

Comment 21: P5924, L9-L11: I don't think this conclusion is supported by the results

presented (see general comments).

Response 21: Thanks. The response already has been given in the Response 1.

Comment 22: '...they generate frictional...'

Response 22: Thanks, we have edited it.

Comment 23: L4-L8: this phrase is too long.

Response 23: Thanks. The sentence has been edited and clarified.

Comment 24: Fig 10: the name of the axes is a bit confusing (at a first sight, it looks like 1m, 50 cm, and 10 cm are the name of the axes).

Response 24: Thanks. The text of Fig. 10 (now 11) has been edited.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/10/C3669/2013/hessd-10-C3669-2013-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 5903, 2013.

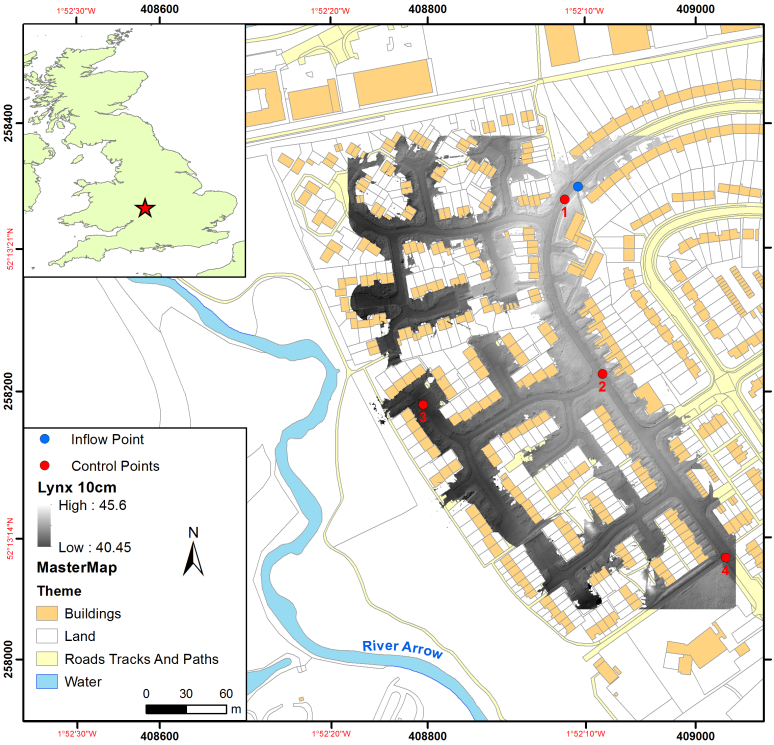

Fig. 1. MasterMap® data of study area in Alcester with over plotted 10 cm LYNX data of the model domain. The locations of the assumed sewer surcharge inflow point and the control points are highlighted.

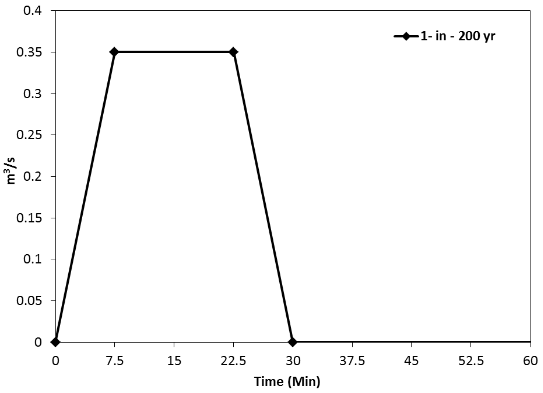

Fig. 2. Inflow boundary conditions.

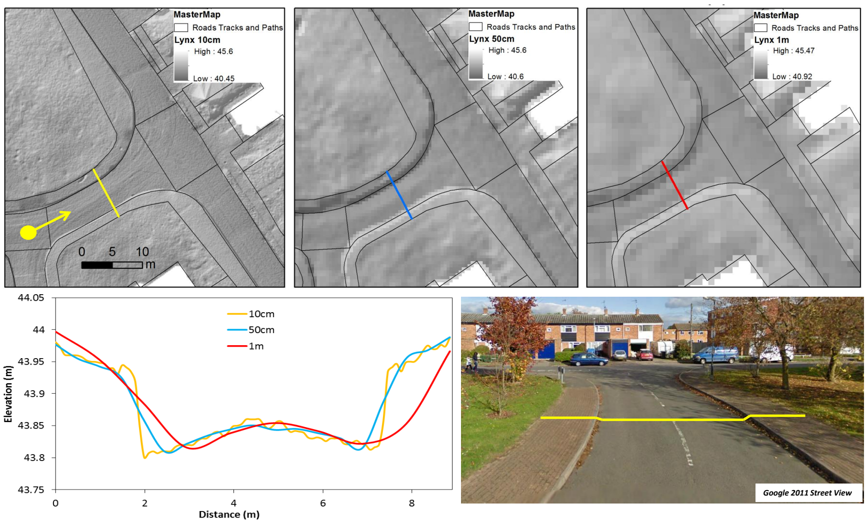

Fig. 3. Google street view and street cross-sections showing the variation in kerb and road surface camber representation on the 10cm and derived 50cm and 1m terrestrial DEMs.

Fig. 4. Land use classification and Manning's n value distribution (a) Google© satellite image (b) distributed Manning n value (c) single composite friction value.

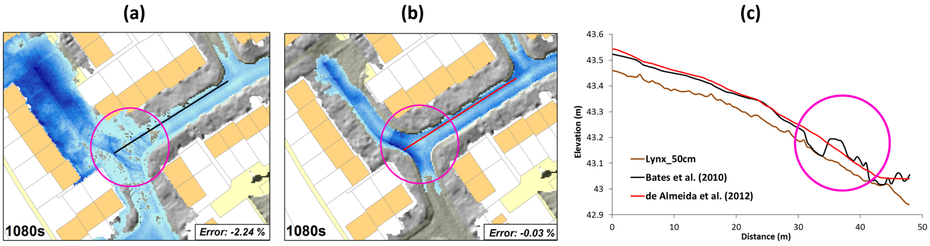

Fig. 5. (a) Simulation result at t=1080s using inertial formulation Bates et al. (2010) (b) Simulation result at t=1080s using inertial formulation de Almeida et al. (2012) (c) water surface profiles with ori

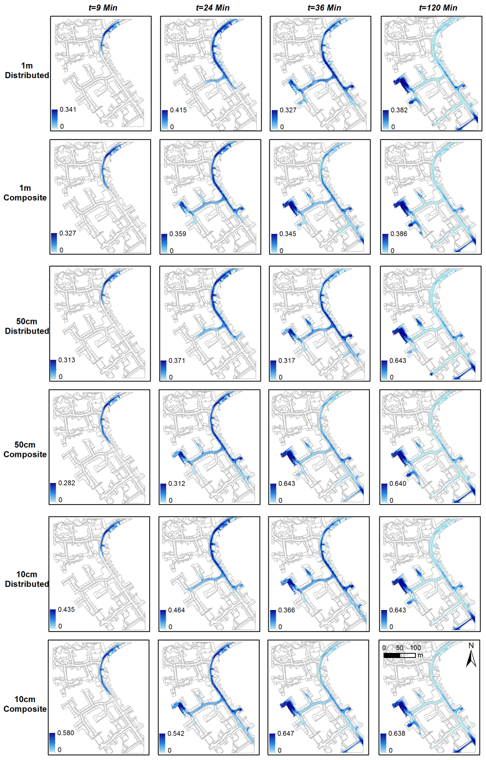

Fig. 6. Progression of surface flooding predicted by different resolution and roughness conditions using the new inertial formulation.

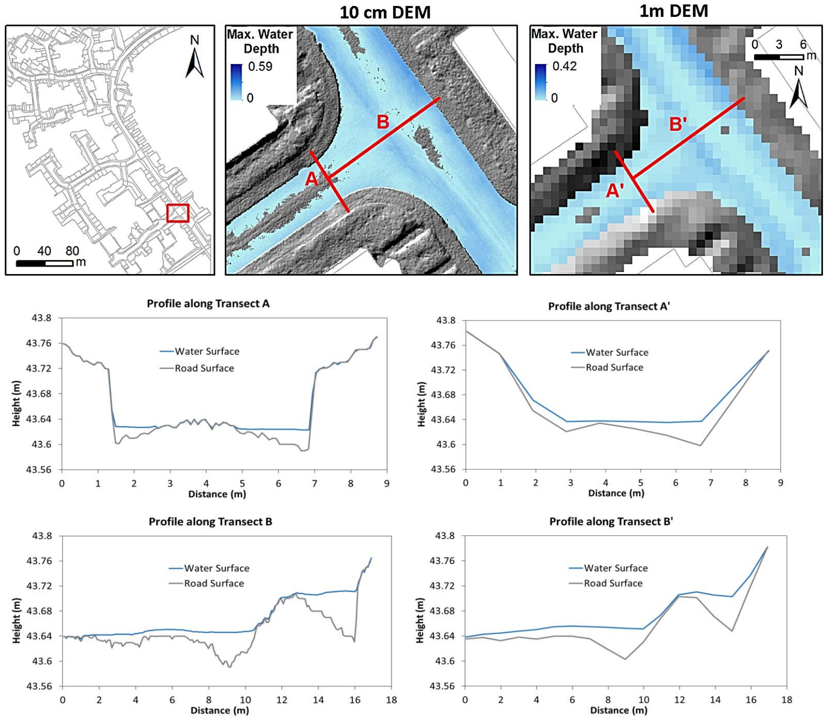

Fig. 7. South junction road surface and maximum water depth transects for simulation of 1-in-200 year event on 10 cm and 1 m terrestrial LIDAR DEM.

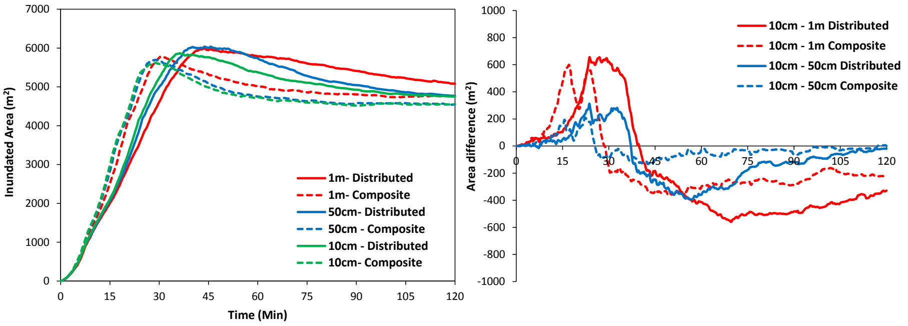

Fig. 8. Predictions of inundated area and differences based on 10 cm models through time with different resolutions and roughness conditions.

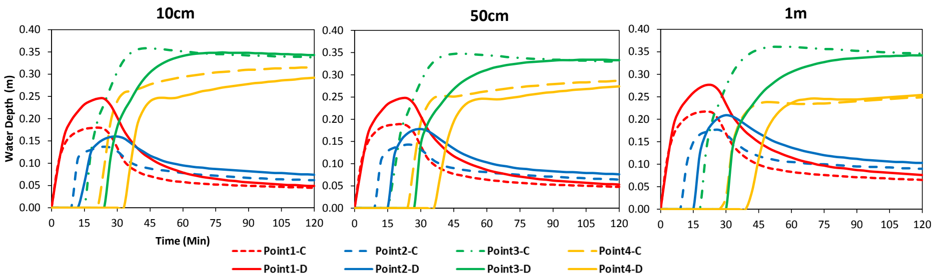

Fig. 9. Profiles of simulated water depth through time at the four control points at ∆x= 10cm, 50cm and 1m using Composite (C) and Distributed (D) roughness conditions.

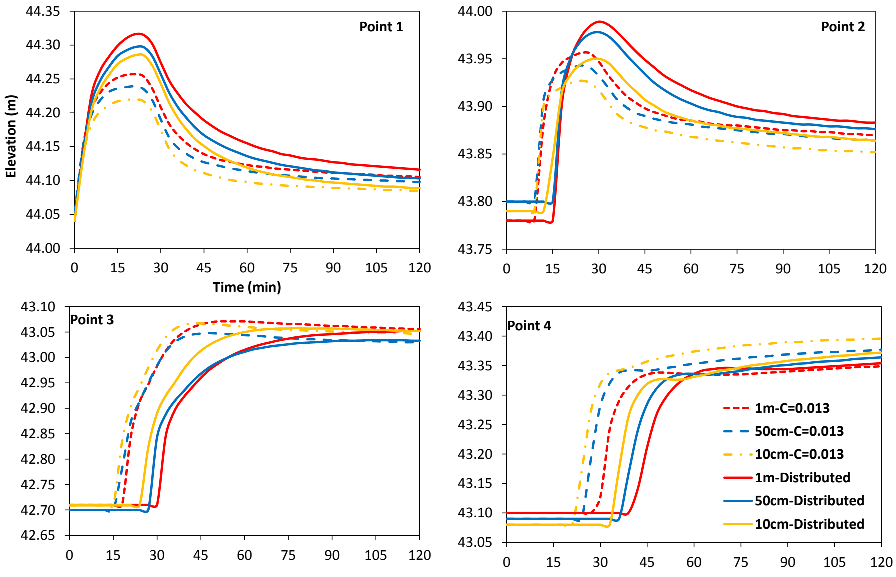

Fig. 10. Profiles of simulated water elevation through time at the four control points at ∆x= 10cm, 50cm and 1m using Composite (C) and Distributed roughness conditions.

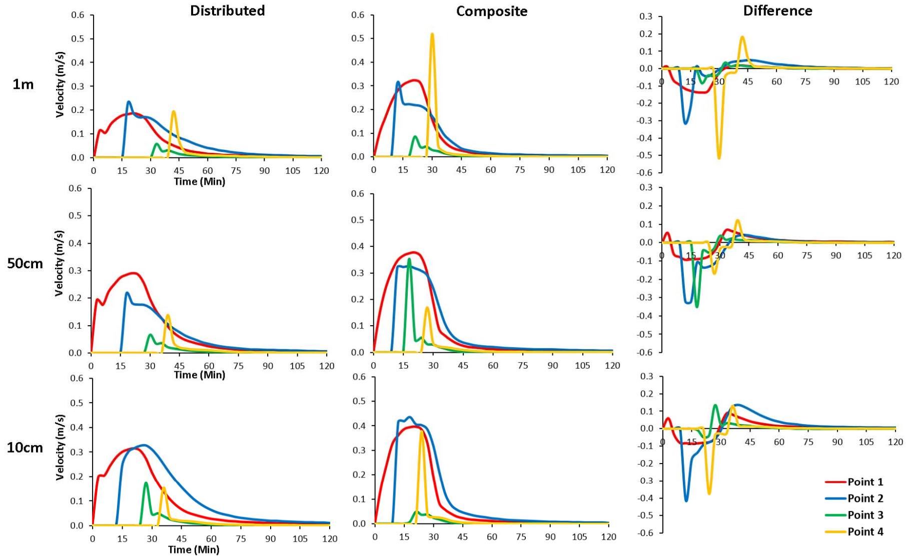

Fig. 11. Simulated velocity over time at the four control points across the different resolutions using distributed and composite frictions and difference plots (distributed minus composite).

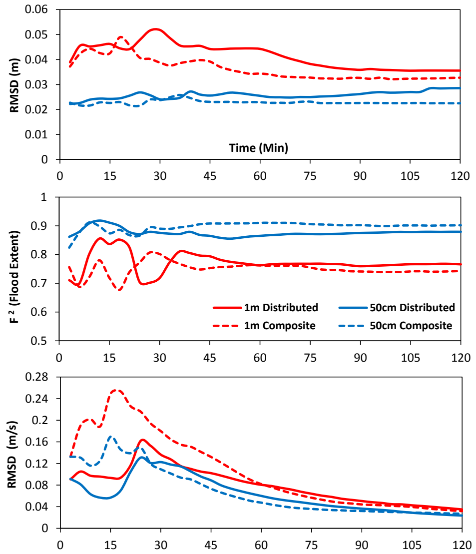

Fig. 12. Evolution of the root mean squared difference (RMSD) and F2 between the benchmark Δx=10 cm models with distributed and composite roughness and the coarser 50cm and 1m models throughout the simulation

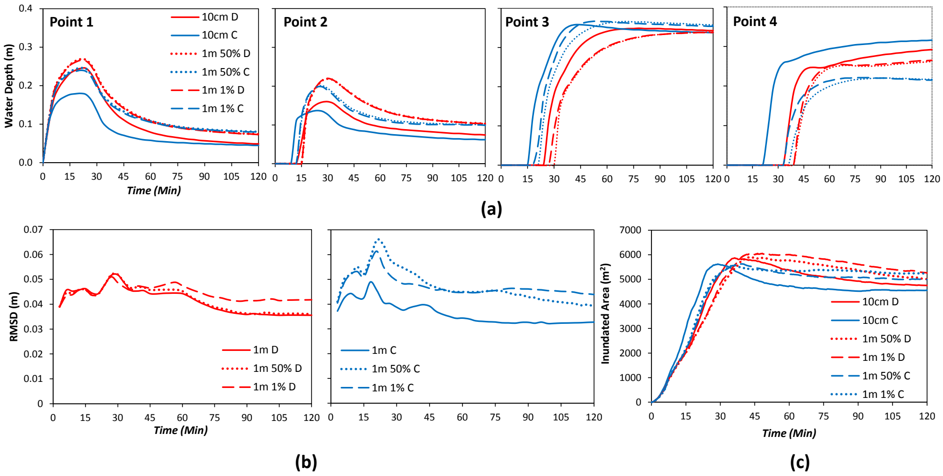

Fig. 13. (a) Comparison of simulated water depth through time at the four control points between 10cm models using distributed (D) and composite (C) friction and 1m models using 50% and 1% of distributed and