Reply to the comments of Steffen Birk:

List of Comments, Replies and Intended actions:

1) Reply: We comply with the suggestion to add some more text dealing with early evolution. This is particularly needed if we want to follow suggestions of both reviewers
Proposed action for the revised version: We intend to add a case demonstrating basic mechanisms of a conduit network evolution before the breakthrough and in the pressurised flow regime. This will make the paper more self contained and the pathway selection mechanisms in pressurised and free surface flow regimes will be clearly distinct. We will also extend the discussion by proper citations and remarks concerning this comment.

2) Reply: Yes, there is only one reference of Palmer from 2007. We thank reviewer to remind us on Hubinger (2007).
Proposed action for the revised version: Reference list will be corrected and results of Hubinger will be discussed.

3) Reply: Both reviewers mentioned the work of Annable. We have access to his thesis and to the mentioned paper in Bulletin d'Hydrogeologie (1998). See also related reply to the comment of D. Ford. Annable & Sudicky (1998) is the first and only paper so far on modelling the evolution in partially filled conduit. Their model is very elaborate and correct, but geometry fairly simple: it includes a single conduit embedded in fissured matrix. Recharge is either direct to conduit or dispersed over matrix. The flow in the conduit is laminar. The aim of modelling is far from what we are targeting in out model, therefore we decided to just mention the work as the first which considers partially-filled conduits.
Proposed action for the revised version: Citation and short comment to this work will be given.

4) Reply: This comment needs a bit longer discussion. The reviewer has noted that our aim is to look for the hydraulic control of conduit network development. To this extend we have selected the situation where dissolution is transport controlled. Similar model was used to calculate the evolution of a single canyon, where use of limestone dissolution kinetics gave trivial results. To this extent we have explored situations where transport (thickness of DBL plays dominant role in spatial variations of dissolution rates).
However, few open questions remain related to the dissolution kinetics in limestone. In our case the dissolution rates in limestone are surface controlled, in fact they are slow enough to make the incision rates along most of the network almost uniform. As recently discussed by Covington (2014), pure surface control in limestone is questionable, as walls in limestone mature channels are often populated with scallops, which are a feature related to a transport control of dissolution rates.
To avoid this conundrum, we focused to the limit of transport controlled rates, which surely exists in more soluble rocks, such as salt or to a great extent, gypsum. However, the mechanisms demonstrated by our model do not depend on the selection of rate equation as can be seen from Fig. 14, where dissolution kinetics of limestone was used.
Proposed action for the revised version: We intend to add more discussion on the relevance and importance of selected dissolution kinetics in sense as stated above. We believe that more cases with (or change to) limestone dissolution (i.e. surface control) kinetics are not necessary.

5) Reply: We agree.
Proposed action for the revised version: The sentence will be deleted.

6) and 7) Reply: These are the key comments and also partially answered in the Reply to Prof. Ford. As stated, we agree that we have not clearly distinct what is new and what has been already demonstrated. We intend to improve that with additional case and extended discussion in

introduction and discussion. Scenario in Fig. 6 could be shortened, particularly its pressurised phase; we will consider this suggestion.

Proposed action for the revised version: We have already made a case where the conduits remain pressurised for cases on Fig. 9 and 13, which will be shown in the revised version. We also intend to add a figure accompanying a brief review of pathway selection mechanism during early development of protoconduit and integration/expansion of network after the breakthrough. We intend to clearly distinct the pathways selection rules of pre breakthrough phase, the phase of pressurised turbulent regime and for the phase of open surface flow regime. To this extend the introductory and discussion part will be extended and reorganised.

8) Reply: See reply to the Comment 4.

9) Reply: Regarding the equilibrium (and other) concentrations: To have dissolution rates expressed as velocity of wall retreat, concentrations are given in dimensionless form. The values are obtained by multiplying equilibrium concentration [NL^{-3}] with the molar mass [MN^{-1}] and dividing with the density of the rock [ML^{-3}].
Regarding Manning roughness coefficient. To avoid confusion with different metric systems, Manning roughness coefficient is defined as dimensionless. However, the Manning formula to this extent uses a conversion factor k[$L^{1/3}/T$], which puts dimensions in order. The value of k is 1 for the SI units. In this case, the Manning equation (Eq.1) has to be corrected to:

$$V = \frac{k}{n} R^{2/3} S_f^{1/2} .$$

Proposed action for the revised version: The equilibrium concentration will be explained in the caption of Table 1 and the Manning equation corrected.

10) Proposed action for the revised version. Will be deleted as suggested.

11) Proposed action for the revised version. Will be deleted as suggested.

13) Proposed action for the revised version. Will be deleted as suggested.

14) Reply: We agree. This is also one of the main criticism of the second reviewer. We have added a discussion on what are the new conclusions from this model compared to existing models. See also reply to Prof. Ford's comment and reply to the Comment 1.
Proposed action for the revised version: See Actions for Comments 1,6 and 7.

15) and 16) All inconsistencies related with the false citation will be resolved.

17) Reply: Yes, the discussion is on the High dip networks and the notation is a remain of the previous version where we used geographical orientation also for these nets. Latter we decided to use top-bottom-left-right notation as being more intuitional.
Proposed action for the revised version: Notations will be corrected.