Title

Flooded by jargon: how the interpretation of water-related terms differs between hydrology experts and the general audience

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Abstract

Communication about water-induced hazards (floods, droughts et cetera) is important, in order to keep their impact as low as possible. However, sometimes the boundary between specialized and non-specialized language can be vague. Therefore, a close scrutiny of the use of hydrological vocabulary by both experts and laypeople is necessary. In this study, we compare the expert and lay definitions of 12 common water-related terms and 10 water-related pictures to see where misunderstandings might arise both in text and pictures. Our primary objective is to analyze the degree of agreement between experts and laypeople in their definition of the used terms. In this way, we hope to contribute to improving the communication between these groups in the future. Our study was based on a survey completed by 34 experts and 119 laypeople.
Especially concerning the definition of water-related words there are some profound differences between experts and laypeople: words like 'river' and 'river basin' turn out to have a thoroughly different interpretation between the two groups. Concerning the pictures, there is much more agreement between the groups.

1. Introduction

Water related natural hazards have impacted society throughout the ages. Floods, droughts and changing river patterns all had their influence on where and how people lived. One thing that has changed throughout the last centuries, however, is the way these hazards are communicated to the general public. The availability of newspapers, magazines, television, radio and the internet has enabled more hydrogeocommunication, thus possibly contributing to a better informed society.

In specific, communication about water-induced hazards is becoming more and more important. A key aspect of increasing climate change is the expectation that water-related natural hazards, like floods and levee breaches, will occur more frequently in the future (IPCC, 2014).
Geoscientific studies (e.g. hydrological studies) are sometimes being ignored in policy and public action, partly because of the fact that scientists often use complicated language that is difficult to understand (Liverman, 2008). Other studies show that policy makers are more willing to take action if they understand why a situation could be hazardous (Forster and Freeborough, 2006). To be effective, early warning systems for natural hazards like floods need to focus on the people exposed to risk (Basher, 2006).
One way to improve communication with non-experts is to avoid professional jargon (Rakedzon et al., 2017). However, sometimes the boundary between specialized and non-specialized language can be vague. Some terms are used both by experts and by laypeople, but in a slightly different way. A term like 'flood' might not be considered jargon since it's quite commonly used, but could still have a different meaning in the scientific language than in day-to-day language.

In the health sciences, clear communication by doctors has been linked to better comprehension and recall by patients (Boyle, 1970; Hadlow and Pitts, 1991; Castro et al., 2007; Blackman and Sahebjalal, 2014). Similar benefits from effective communication can be expected in other scientific areas as well. An important factor is the degree to which people have the capacity to understand basic information – in the health sciences, this is referred to as health literacy (Castro et al., 2007) and in the geo-sciences as geo literacy (Stewart and Nield, 2013). We prefer to avoid the term 'literacy' in this article, since it is a limited way of addressing shared comprehension of science concepts (Kahan et al., 2012). We prefer to focus more on the divergent definitions of jargon.

In our research, we choose to study both the understanding of textual terms and the understanding of pictures. Some interesting work has been done about alternate conceptions in oceanography, focusing on students and using both textual and pictorial multiple choice questions (Arthurs, 2016). Arthurs' study also focuses on the topic of intermodality, i.e. switching between modes of communication (textual vs. pictorial).

However, no studies have been done about the extent to which geoscientists use jargon in interaction with the general audience (Hut et al., 2016). Therefore, a close scrutiny of hydrological vocabulary and the interpretation of common water related terms by both experts and laypeople is necessary. Health scientific studies show that a significant difference in the interpretation of specific definitions (both in text and illustration) can be found between doctors and patients (Boyle, 1970). A similar difference between experts and laymen can be expected in the communication in other scientific areas, e.g. hydrology. Experts can be unaware of using jargon, or they may overestimate the understanding of such terminology by people outside their area of expertise (Castro et al., 2007). Knowledge about which terms can cause misunderstanding could help hydrogeoscientists in understanding how to get their message across to a broad audience, which will benefit the public.

The word 'jargon' derives from Old French (back then, it was also spelled as 'jargoun', 'gargon', 'ghargun' and 'gergon') and referred to 'the inarticulate utterance of birds, or a vocal sound resembling it; twittering, chattering', as noted by Hirst (2003). In the same article, the author comes up with several general definitions of jargon, the two main ones being 1) 'the specialized language of any trade, organization, profession, or science'; and 2) 'the pretentious, excluding, evasive, or otherwise unethical and offensive use of specialized vocabulary'. The first one can be considered neutral definition, the second one has a negative connotation (Hirst, 2003).

Within the geosciences, no specific definition of jargon is available. As noted by Somerville and Hassol (2011), scientists often tend to speak in 'code' when communicating about geosciences to the general public. The authors refer in their article to climate change communication, and encourage scientists to use simpler substitutes and plain language, without too much detail - as an example they suggest 'human caused' instead of 'anthropogenic'. However, they do not suggest a specific definition of jargon.

Nerlich et al. (2010) write that climate change communication (as part of geocommunication) shares features with various other communication enterprises, amongst which health communication. Since there is no specific definition of jargon in geosciences and since the definitions by Hirst are very broad and not science-specific, we chose adopt the definition from medical sciences (Castro et al., 2007) in which jargon is defined as both (1) technical terms with only one meaning listed in a technical dictionary, and (2) terms with a different meaning in lay contexts. In other words, jargon has a broader definition than some scientists think. It can be expected that hydrogeological terms sometimes have a less strict meaning for laypeople than for experts, meaning that hydrologists should be aware of this second type of jargon (Hut et al., 2016).

In this article, we compare the expert and lay definitions of some common water-related terms, in order to assess whether or not these terms can be considered jargon and to see where misunderstandings might arise. With this goal in mind, we developed a questionnaire to assess the understanding of common water-related words by both hydrology experts and laypeople. Our primary objective is to analyze the degree of agreement between these two groups in their definition of the used terms. In this way, we hope to contribute to improving the communication between these groups in the future.

To our knowledge, no study has measured the agreement in understanding of common water-related terms between hydrology experts and laypeople. A matched vocabulary could increase successful (hydro)geoscientific communication.

2. Methodology

We started by analysing the hydrologic terms frequently mentioned in the twelve 'Water Notes' (European Commission, 2008). These Notes contain the most important information from the European Water Framework Directive (European Parliament, 2000), a European Union directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies. This was done by counting how often each water related term appeared in the text. We chose these Notes because they are a good representation of hydrogeocommunication from experts to laypeople: they are meant to inform laypeople about the Framework Directive. From this list, twenty of the most frequently used terms were chosen (ten of these were also present in the definition list of the Framework Directive itself), such as river, river basin, lake and flood. The questionnaire (including the chosen terms) can be found in Appendix A. Although the word 'water' was the hydrological term most frequently used in the Notes, we decided to exclude this from the survey, because it is too generic a term.
A focus group was carried out at the American Geophysical Union fall meeting in San Francisco in December 2016., to check the list of terms and to come up with appropriate definitions. Eight participating hydrology experts were asked to describe the above mentioned hydrologic terms on paper, and to discuss the outcomes afterwards. The focus group consisted of experts, which mimics the process of science communication: the experts choose and use the definitions, which are then communicated to laypeople. This discussion was audio recorded, with consent of the participants. This focus group was important because we wanted to generate reasonable answers for our survey. Ten of the terms that turned out to be too Framework Directive specific (for example 'transit waters', which was not recognized as common hydrological language by the focus group participants) were left out of the survey. The ten other terms, which generated some discussion (like whether the word 'dam' only relates to man-made constructions) were deemed to be fit for the survey, because they were

recognized as common water-related words by the experts. Two additional, less frequented terms (discharge and water table) were also chosen, based on the focus group. The focus was only on textual terms; the ten pictorial questions (see below) were chosen by ourselves, based on water related pictures we came across in various media outlets. The pictures were chosen by two of the authors: one of them a hydrologist, one of them a ‘lay-person’ in terms of hydrology.

Survey

Our survey contained 22 multiple choice questions about commonly used terms by water experts. Twelve of these were ‘textual’ questions: participants were asked to choose (out of four options) which answer described a specific hydrologic term best, in their opinion. Ten of these were pictorial questions: participants were asked to choose (out of four options) which full colour photo depicted a specific hydrologic term best, in their opinion. In addition, we asked some demographic data (gender, age, level of education, postcode area + country). The complete survey can be found in Appendix A.
Pictures were found using the Wikimedia Commons feature. An example of both types of questions can be found in Figure 1.

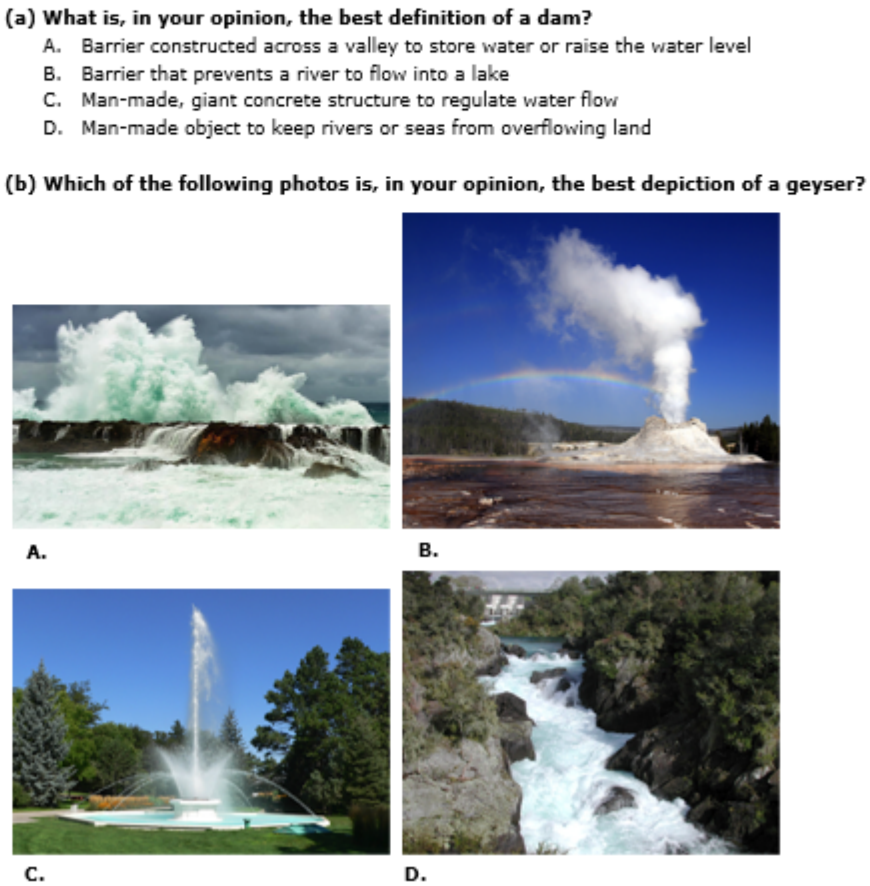


Figure 1: Example of a textual multiple choice question (a) and a pictorial question (b) from

the survey

Participants

We developed a flyer with a link to the survey, which we handed out to experts at the international hydrology conference IAHS in South Africa in July 2017. Furthermore, the link to the survey was sent via email to hydrology experts around the globe: members of the hydrology division of the European Geosciences Union, and professional hydrologists (studying for PhD or higher) at various universities. The total number of respondents from the experts was n = 34.

The laypeople were approached in a different way. In the first week of September, 2017, one researcher went to Manchester to carry out the survey on various locations on the streets, to make sure that native English speaking laypeople would participate. Manchester was chosen because it is a large city in the UK, meaning that it would be convenient to find participants from a general population who were also native English speakers. In total, the number of laypeople that were incorporated in the study was n = 119. In the initial Google form results, the number of laypeople was n=131, but 22 participants were excluded because they didn't fill out the electronic consent or because they accidentally sent the same electronic form twice or thrice (in that case, only one of their forms was incorporated in the study).

The participants could fill out the survey on an iPad. If there were more participants at the same time, one would fill the survey out on the iPad and the other ones filled out an A4-sized printed full-colour hand-out. In this way, multiple participants could fill out the survey at the same time.

All participants, both experts and laypeople, were asked to fill out an electronic consent form stating that they were above 18 years of age and were not forced into participating.The questionnaire was of the forced-choice type: participants were instructed to guess if they did not know the answer.

Analysis

In order to detect definition differences between experts and laypeople, we wanted to analyse to what extent their answers differed from each other for each question. As pointed out before, it was not about giving the 'right' or 'wrong' answer, but about analysing the match between the resemblance between the answering patterns of the laypeople and the experts.

For each term, the hypotheses were as follows:

H_0: Laypeople answer the question the same as experts;

H_1 : Laypeople answer the question differently than experts.

A statistical analysis was carried out in *R* (R Core Team, 2017), by using Bayesian contingency tables. A contingency table displays the frequency distribution of different variables, in this case a 2 by 4 table showing how often which definition of a specific term was chosen by experts and laypeople.
For each term, the hypothesis is tested using a so-called Bayes Factor (BF; computed using Morey & Rouder, 2015). A value BF < 1 is evidence towards H_0: it is more likely that laypeople answer questions the same as experts than differently. A value BF > 1 is evidence towards H_1: differences are more likely than similarities. The BF can be interpreted as the so-called likelihood-ratio: a BF-score of 2 means that H_1 is twice as probable as H_0, given the data. BF = 0.5 means that H_0 is twice as probable as H_1. An example: aquifer has BF = 7801. This means it's almost 8000 times as probable with these data that there is indeed a difference between laypeople and experts in defining this term. As the values can become very large, one often interprets their logarithm instead.

The Bayes Factors can be interpreted as follows:

* BF > 10 : strong evidence for H_1 against H_0
* 3 < BF < 10 : substantial evidence for H_1 against H_0
* 1/3 < BF < 3 : no strong evidence for either H_0 or H_1
* 1/10 < BF < 1/3 : substantial evidence for H_0 against H_1
* BF < 1/10 : strong evidence for H_0 against H_1

An additional benefit of the use of Bayes Factors is that, unlike their frequentist counterpart, no corrections for multiple testing are necessary (Bender & Lange, 1999).

In addition to a Bayes Factor for the 'significance' of the difference, we also calculated the misfit: the strength of the difference. The misfit was calculated by a 'DIF' score (Differential Item Functioning), in which DIF = 0 means 'perfect match', and DIF = 1 means maximum difference. This DIF-score was operationalised as

$$DIF = \sqrt{\frac{1}{2}\sum_{i=1}^{4}\left(p_{E,i} - p_{L,i}\right)^2} ,$$

where $p_{E,i}$ is the proportion of experts choosing option i, and $p_{L,i}$ is the proportion of laypeople making that choice. Thus, DIF is based on a sum-of-squares comparison between the answer patterns of laypeople and experts.

Subsequently, we plotted the posterior distribution of DIF, for each term. This posterior distribution indicates the likelihood for a range of DIF-scores, based on the observed data.

For example, if the answering pattern would be A: 50%, B: 50%, C: 0% and D: 0% for both the experts and the laypeople, there would be a perfect match (DIF = 0). The misfit was plotted in graphs, ranging from the largest to the smallest misfit. The higher the misfit, and the higher the BF, the more meaningful a difference between laypeople and experts. Low values of misfit indicate agreement between laypeople and experts. The R-code and data used for the analyses is available from https://osf.io/wk9s6/.

3. Results

For the overall view of all the 22 terms (both texts and illustrations), there is extreme evidence for differences between laypeople and experts. This can be quantified by multiplying the BF's with each other, leading to a 10 log-value of 33.50 (H_1 is approximately $3*10^{33}$ more probable than H_0).

However, this difference is only visible when looking at the textual questions, with a combined 10 log-value of 46.14 . For the pictorial questions, there is a very strong evidence for the *absence of differences*, with a negative 10 log-value -12.63.

Interestingly enough, there was a lot of internal disagreement for both experts and laypeople on the term stream (47% agreement of experts on the most chosen answer, C: 'Small river with water moving fast enough to be visible with the naked eye', 37% agreement of laypeople on the most chosen answer, D: 'General term for any body of flowing water') and on the picture of a sewer (56% agreement of experts on answer D*, 55% agreement of laypeople on answer D). -
* see Appendix A for the picture

Concerning the text questions, there was full agreement between the experts on 'discharge' (100% agreement, N = 33 answered B, N = 1 answered blank) and almost full agreement on ‘downstream’ (97% agreement, N = 33 answered D). This can be seen in Figure 2 and Appendix C.

Concerning the pictures, there was full agreement between the experts on ‘geyser’ (100% agreement, N = 34 answered B) and on ‘river’ (100% agreement, N = 34 answered B). High levels of agreement were found on the pictures ‘flood’ (97% agreement, N = 33 answered C), ‘hydro power’ (97% agreement, N = 33 answered D). and ‘reservoir’ (97% agreement, N = 33 answered D). This can be seen in Figure 2. The complete table with an overview of the multiple choice answers (and the number of laypeople and experts that chose that specific answer) can be found in Appendix C.

*Figure 2a: Bar charts showing the answer distribution of both textual and pictorial questions (pictorial questions are marked with an asterisk *)*

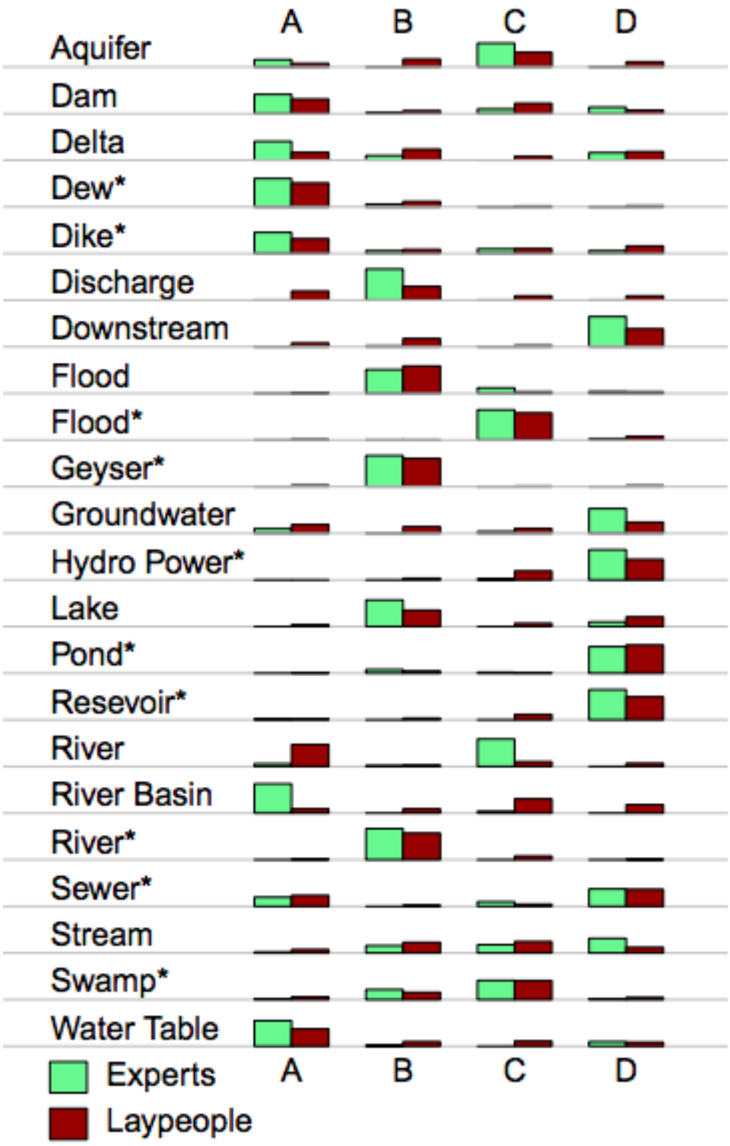


Figure 2b: Answer distribution of pictorial questions[a]

Lay people (%)	4	91	2	3
Experts (%)	0	100	0	0

2. Sewer

Lay people (%)	35	3	7	55
Experts (%)	29	0	15	56

3. Flood

Lay people (%)	0	0	87	12
Experts (%)	1	0	97	3

4. Pond

Lay people (%)	1	7	2	90
Experts (%)	0	12	3	85

5. Swamp

Lay people (%)	9	23	61	7
Experts (%)	3	32	62	3

Lay people (%)	0	5	29	66
Experts (%)	0	0	3	97

7. Reservoir

Lay people (%)	4	5	17	74
Experts (%)	3	0	0	97

8. Dike

Lay people (%)	47	13	16	24
Experts (%)	68	9	14	9

9. River

Lay people (%)	2	85	12	1
Experts (%)	0	100	0	0

10. Dew

Lay people (%)	77	17	2	3
Experts (%)	91	9	0	0

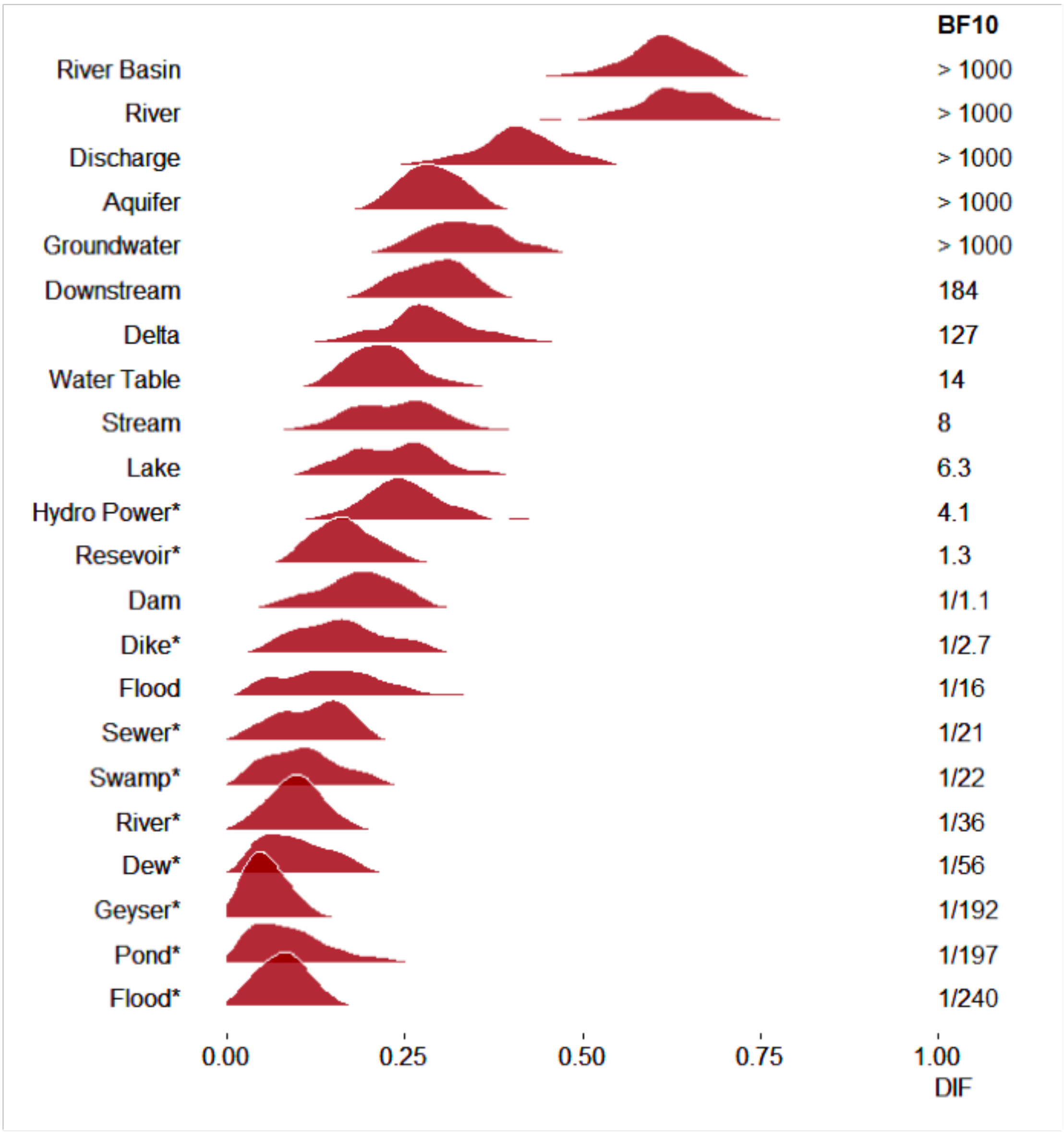
[a] The number of lay respondents was 115 to 117: N=115 for hydro power, reservoir; N=116 for geyser, pond, swamp, dike, dew; N=117 for sewer, flood, river. [b]The number of expert respondents was N=34 for all terms.

3.1 Misfits between laypeople and experts

The most prominent misfit between laypeople and experts was found in the textual questions, for the definitions of river basin (log-10 BF 14.9), river (log-10 BF 11.9), discharge (log-10 BF 6.2), aquifer (log-10 BF 3.9) and groundwater (log-10 3.4) (for more BF-values, see table in appendix B).

For these words, we have clear evidence that there is disagreement between experts and laypeople on the interpretation. This can be seen in Figure 3. None of the pictorial questions made it to the 'top 10' of biggest misfits. The pictorial questions that lead to the most prominent misfits were hydro power, reservoir, dike, sewer and swamp.

Figure 3: Graph showing the posterior distribution of the misfit between laypeople and experts by using Bayes Factor (BF) for every term used in the survey. Pictorial questions are marked with an asterisk.
A value BF < 1/10 is strong evidence towards H_0: it is more likely that laypeople answer questions the same as experts than differently. A value BF > 10 is strong evidence towards H_1: differences are more likely than similarities.



The broader and flatter the distribution, the stronger the Bayes Factor. If both experts and laypeople have a high internal agreement (above 90%) the misfit is smaller than if there's a lot of internal disagreement.

This can be seen in the graph: the posterior distribution of the 'misfit' parameter is visible. It is important to note that under H_0, the misfit is not exactly equal to 0, because there is a certain degree of 'randomness'. In other words: the misfit describes to what extent the answering patterns of the laypeople and the experts are similar to each other.

4. Discussion and conclusion

In total, we collected 119 questionnaires from native English-speaking laypeople and 34 questionnaires from (not necessarily native English-speaking) experts. Fifteen of the experts were native English/American speakers (two others came from South Africa, where English is also a major language, two others didn't fill this question out and the rest of the experts came from the Netherlands, Belgium, Germany, Turkey, Switzerland, Luxembourg, Brazil, France and Italy. All experts warer of PhD level or above and were thus considered to have sufficient knowledge of the English scientific language. Nevertheless, two participants wrote in the comments that they found some of the terms difficult to understand due to the fact that they were non-native English-speakers.

This could be a limitation to our study, because possibly the non-native English-speaking experts would have answered differently if they had been native English-speaking experts. However, since the majority of the experts (n=32) didn't have trouble understanding the questions (or at least did not write a comment about this), we don't consider this a major limitation and we did not exclude these experts because they did meet our criteria (PhD level or above).

Our definition from jargon is adopted from a study by Castro et al. (2007), in which it is described as both (1) technical terms with only one meaning listed in a technical dictionary, and (2) terms with a different meaning in lay contexts. Therefore, this definition is not influenced by a distinction between native and non-native English-speakers. However, it can be expected that hydrogeological terms sometimes have a less strict meaning for non-native English speakers in general, and especially for non-native English speaking laypeople, due to the difference in understanding between laypeople and experts (Hut et al., 2016). This is why we excluded non-native English-speaking laypeople.

A disadvantage of the survey was that some of the text questions were still quite ambiguous. The interpretation of some terms changes depending on the context, the specific background and the exact definitions. Due to the limitations of a multiple choice format, in some cases none of the definitions might seem to have a perfect fit, whereas with the pictures it is the other way around and sometimes more than one picture could fit a generic term. Giving only four predefined options could seem a bit leading and restricted Moreover, non-native speaking experts could be confused by some of the English definitions.

In this study, we have chosen to use terms as defined by experts, because it mimics the 'real life' situation in which scientists use specific terms by communication to a broader audience. As suggested by one of the reviewers, in future research it would be interesting to adopt a broader perspective by also incorporating terms as defined by laypeople. This could be done by organizing a focus group consisting of laypeople and discuss with them the meaning of specific terms.

Concerning the surveys of the laypeople, a disadvantage of the hand-outs was the fact that the pictures could not be enlarged. In addition, the prints were two-sided, and in some cases participants overlooked some of the questions. Even though the survey was of the forced type, not all people did answer all the questions. As one of the reviewers suggested, in a next survey we could ask people to describe their experiences with flooding - people who are familiar with water-related hazards may answer differently from people who don't have this experience.

The answering pattern within a group (laypeople or experts) could be inherent to the specific answers. In some cases, the answers were quite similar to each other, in other cases, the difference was quite big. However, this could not explain the misfit between laypeople and experts, since they both filled out the same survey.

We expected there would be no difference between people who filled out the survey on paper and people who filled out the survey on iPad. However, we did not test for this, so we cannot take into account any possible influences of the material used. This might be a topic for future research.

Of course, this research is only a first step in investigating the possibilities of a common vocabulary. By introducing our method to the scientific community (and making it accessible via open access) we hope to encourage other scientists to carry out this survey with other terminology as well.

Since relatively little is known about the interpretation of jargon by laypeople and experts (especially in the natural sciences), additional research in this field is recommended.

Concluding, this study shows that there exists a strong difference in the definition of common hydrological terms between laypeople and experts. This difference is more strongly present when the terms are presented in a textual way. When they are presented in a visual way, we have shown that the answer patterns by laypeople and experts are the same.

Therefore, the most important finding of this study is that pictures may be clearer than words when it comes to science communication around hydrogeology. We strongly recommend using relevant pictures whenever possible when communicating about an academic (hydrogeological) topic to laypeople.

Our findings differ from medical jargon studies which take into account both textual terms and illustrations. For example, Boyle (1970) finds that there is a significant difference between doctors and patients when it comes to the interpretation of both terms and illustrations. However, these illustrations differed in various ways from the pictures in our study: they were hand drawn, and only meant to indicate the exact position of a specific bodily organ.

What makes a 'good' picture for science communication purposes would be an interesting topic for further research. Also, more research could be done on the textual terms: how could the existing interpretation gap between experts and laypeople be diminished? What impact would the combination of pictures and textual terms have - would the text enhance the pictures and vice versa? All in all, a broader research which incorporates more terminology and pictures (from various scientific disciplines) would be a very valuable starting point. Also, in line with Hut et al. (2016), it would be interesting to analyse the understanding of motion pictures (e.g. documentaries) in geoscience communication, while TV is a powerful medium.

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Appendix A: questionnaire

Questionnaire hydrological terms

Thank you for participating in this survey! We will ask you some questions about water and terminology. We are not looking for a 'right' answer, but for the answer that is, in your opinion, the best definition.
It will take approx. 5 minutes to participate. Have fun!

1. What is, in your opinion, the best definition of a river?

- A: Path of fresh water flowing into the ocean
- B: Water flowing only on the surface of the land and never underground
- C: Large stream which serves as the natural drainage for a basin
- D: Flow of surface water within a straight channel

2. What is, in your opinion, the best definition of a river basin?

- A: Area having a common outlet for its surface runoff
- B: Dry river channel which may be flooded during high water events
- C: Catchment which a river flows into
- D: Body of water (lake, sea, ocean) a river flows into

3. What is, in your opinion, the best definition of groundwater?

- A: All water stored in the ground
- B: All water which is in direct contact with the ground
- C: Water flowing under ground
- D: Subsurface water occupying the saturated zone

4. What is, in your opinion, the best definition of an aquifer?

- A: Subsurface water body
- B: Groundwater that reaches the surface through a permeable rock layer
- C: Geological formation capable of storing, transmitting and yielding water
- D: Man-made structure first built by the Romans to transport water

5. What is, in your opinion, the best definition of a lake?

- A: Man-made body of standing surface water of significant extent
- B: Inland body of standing surface water of significant extent
- C: Small body of water encompassed by high mountains
- D: Area of variable size filled with water

6. What is, in your opinion, the best definition of a dam?

- A: Barrier constructed across a valley to store water or raise the water level
- B: Barrier that prevents a river to flow into a lake
- C: Man-made, giant concrete structure to regulate water flow
- D: Man-made object to keep rivers or seas from overflowing land

7. What is, in your opinion, the best definition of a delta?

- A: Feature resulting from an alluvial deposit at a rivermouth
- B: River mouth that spreads out a little bit, like the shape of a Greek letter Delta
- C: Triangular shaped island in a river
- D: Landform that forms from deposition of sediment carried by a river

8. What is, in your opinion, the best definition of downstream?

- A: Heavy intensity rain water falling down
- B: Direction from which a fluid is moving
- C: Stream that branches off from the main stream
- D: Direction in which a fluid is moving

9. What is, in your opinion, the best definition of a flood?

- A: Large wave of moving water
- B: Overflow of water onto lands that are not normally covered by water
- C: Rise in the water level to a peak from which it recedes at a slower rate
- D: Unusually large run-off event that leads to economic damage

11. What is, in your opinion, the best definition of discharge?

- A: Volume of water that passes through the whole river in one day
- B: Volume of water flowing through a river cross-section per unit time
- C: Water with enough sediment in it to limit visibillity to less than 1 feet
- D: Flowing water in a reservoir used to generate electricity

12. What is, in your opinion, the best definition of a water table?

- A: Top surface of the zone of saturation
- B: Saturated part of an aquifer
- C: Tide table kept at water authority
- D: Height to which water raises in a well

10. What is, in your opinion, the best definition of a stream?

- A: River that drains into another river and not into a lake, sea or ocean
- B: Watercourse that flows into a larger watercourse or into a lake
- C: Small river with water moving fast enough to be visible with the naked

13. Which of the following photos is, in your opinion, the best depiction of a geyser?

A:

B:

C:

D:

14. Which of the following photos is, in your opinion, the best depiction of a sewer?

A:

B:

C:

D:

15. Which of the following photos is, in your opinion, the best depiction of a flood?

A:

B:

C:

D:

16. Which of the following photos is, in your opinion, the best depiction of a pond?

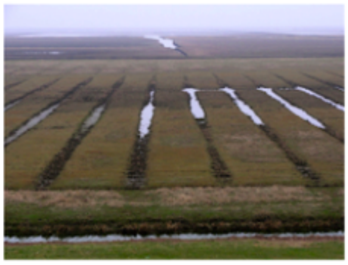
A:

B:

C:

D:

17. Which of the following photos is, in your opinion, the best depiction of a swamp?



A:

B:

C:

D:

18. Which of the following photos is, in your opinion, the best depiction of hydro power?

A:

B:

C:

D:

19. Which of the following photos is, in your opinion, the best depiction of a reservoir?

A:

B:

C:

D:

20. Which of the following photos is, in your opinion, the best depiction of a dike?

A:

B:

C:

D:

21. Which of the following photos is, in your opinion, the best depiction of a river?

A:

B:

C:

D:

22. Which of the following photos is, in your opinion, the best depiction of dew?

◯ A:

◯ B:

◯ C:

◯ D:

23. Do you have any comments concerning the questions?

Your answer

24. What is your gender?

◯ Female

◯ Male

◯ Other or prefer not to say

25. What is your age?

Your answer

26. What is your country and postcode area?

Your answer

27. What is your highest completed education level?

Your answer

Appendix B

Table 1: Bayes Factors (BF) and their base-10 logarithms.

Term	BF	Log 10 BF
Aquifer	7.801e+03	3.892
River basin	7.428e+14	14.871
Dam	8.783e-01	-0.056
Delta	1.273e+02	2.105
Dew	1.798e-02	-1.745
Dike	3.685e-01	-0.434
Discharge	1.531e+06	6.185
Downstream	1.841e+02	2.265
Flood (text)	4.165e-03	-2.380
Flood (picture)	6.403e-02	-1.194
Geyser	5.209e-03	-2.283
Groundwater	2.418e+03	3.383
Hydro power	4.070e+00	0.610
Lake	6.324e+00	0.801
Pond	5.069e-03	-2.295
Reservoir	1.274e+00	0.105
River (text)	2.784e-02	-1.555
River (picture)	7.094e+11	11.851
Sewer	4.790e-02	-1.3197

Stream	8.046e+00	0.906
Swamp	4.601e-02	-1.337
Water table	1.360e+01	1.134

Appendix C

Table 2: Answer distribution for textual questions

Term with possible definitions	Answer distribution (%)	
	Laypeople[a]	Experts[b]
1. River		
A. Path of fresh water flowing into the ocean	**71**	9
B. Water flowing only on the surface of the land and never underground	4	3
C. Large stream which serves as the natural drainage for a basin	15	**88**
D. Flow of surface water within a straight channel	10	0
2. River basin		
A. Area having a common outlet for its surface runoff	13	**94**
B. Dry river channel which may be flooded during high water events	13	0
C. Catchment which a river flows into	**47**	6
D. Body of water (lake, sea, ocean) a river flows into	27	0
3. Groundwater		
A. All water stored in the ground	28	15
B. All water which is in direct contact with the ground	21	0
C. Water flowing under ground	15	6
D. Subsurface water occupying the saturated zone	**36**	**79**

4. Aquifer		
A. Subsurface water body	11	24
B. Groundwater that reaches the surface through a permeable rock layer	25	0
C. Geological formation capable of storing, transmitting and yielding water	**47**	**76**
D. Man-made structure first built by the Romans to transport water	17	0
5. Lake		
A. Man-made body of standing surface water of significant extent	6	0
B. Inland body of standing surface water of significant extent	**53**	**85**
C. Small body of water encompassed by high mountains	10	0
D. Area of variable size filled with water	31	15
6. Dam		
A. Barrier constructed across a valley to store water or raise the water level	**47**	**62**
B. Barrier that prevents a river to flow into a lake	9	3
C. Man-made, giant concrete structure to regulate water flow	33	15
D. Man-made object to keep rivers or seas from overflowing land	11	20
7. Delta		
A. Feature resulting from an alluvial deposit at a rivermouth	25	**61**

B. River mouth that spreads out a little bit, like the shape of a Greek letter Delta	**35**	15
C. Triangular shaped island in a river	12	0
D. Landform that forms from deposition of sediment carried by a river	28	24
8. Downstream		
A. Heavy intensity rain water falling down	12	0
B. Direction from which a fluid is moving	26	3
C. Stream that branches off from the main stream	4	0
D. Direction in which a fluid is moving	**58**	**97**
9. Flood		
A. Large wave of moving water	2	0
B. Overflow of water onto lands that are not normally covered by water	**88**	**76**
C. Rise in the water level to a peak from which it recedes at a slower rate	5	18
D. Unusually large run-off event that leads to economic damage	5	6
10. Stream		
A. River that drains into another river and not into a lake, sea or ocean	11	3
B. Watercourse that flows into a larger watercourse or into a lake	34	24
C. Small river with water moving fast enough to be visible with the naked eye	**37**	26

D. General term for any body of flowing water	18	**47**
11. Discharge		
A. Volume of water that passes through the whole river in one day	29	0
B. Volume of water flowing through a river cross-section per unit time	**45**	**100**
C. Water with enough sediment in it to limit visibility to less than 1 feet	13	0
D. Flowing water in a reservoir used to generate electricity	13	0
12. Water table		
A. Top surface of the zone of saturation	**56**	**82**
B. Saturated part of an aquifer	15	3
C. Tide table kept at water authority	16	0
D. Height to which water raises in a well	13	15

[a] The number of lay respondents varied from 115 to 119: N=115 for aquifer, water table;N=116 for lake, delta; N=117 for stream; N=118 for river basin, groundwater, dam, downstream, flood, discharge; N=119 for river. [b] The number of experts respondents was N=33 for delta and discharge and N=34 for all other terms.