

# ~~10 hard rules for writing a better paper~~

**Stop thinking about rules  
Think about readers**

**Wouter Berghuijs**

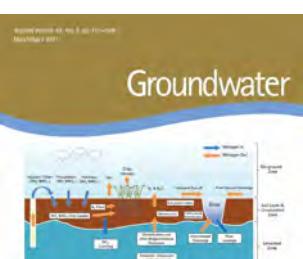
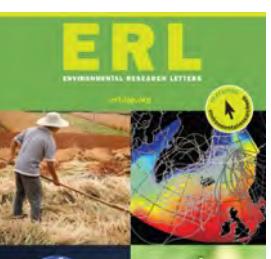
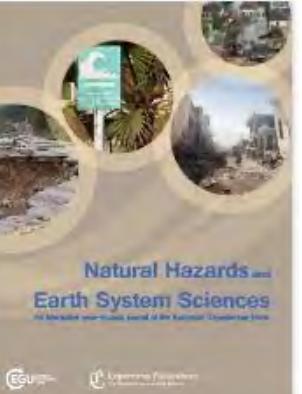
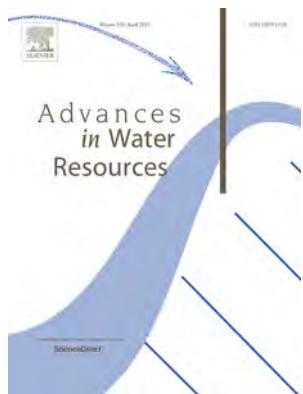
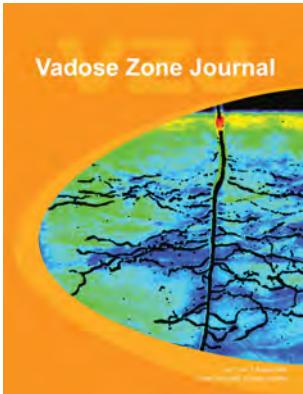
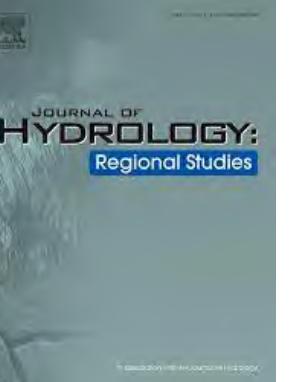
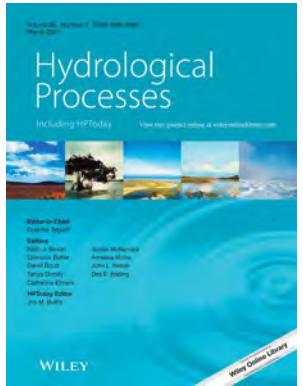
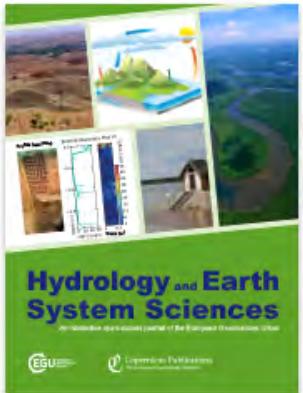
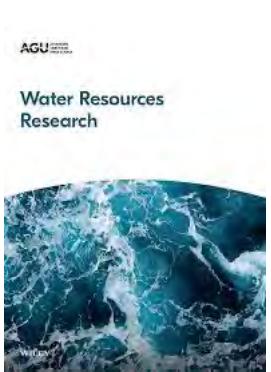
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# Writing is not about communicating your ideas It is about changing readers' ideas



# Readers have to be picky



Readers read }  
Journals publish } things that are valuable to them

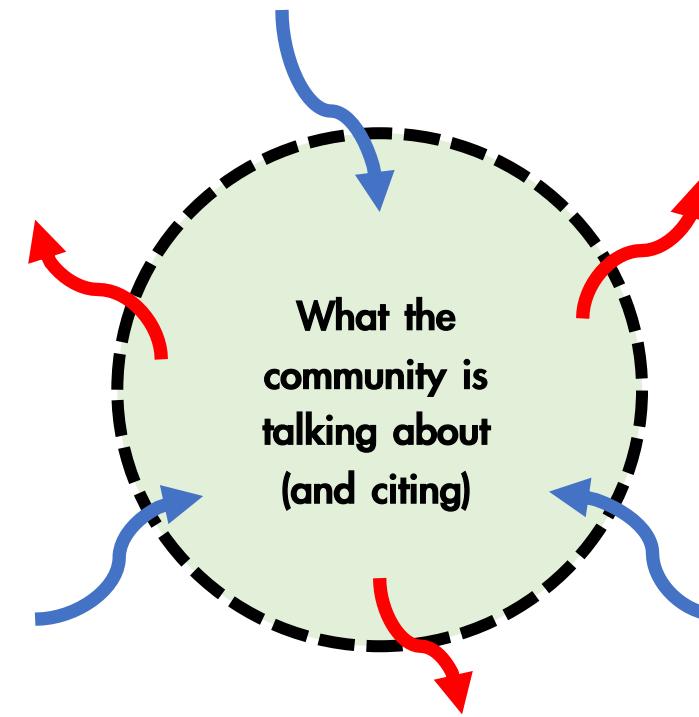
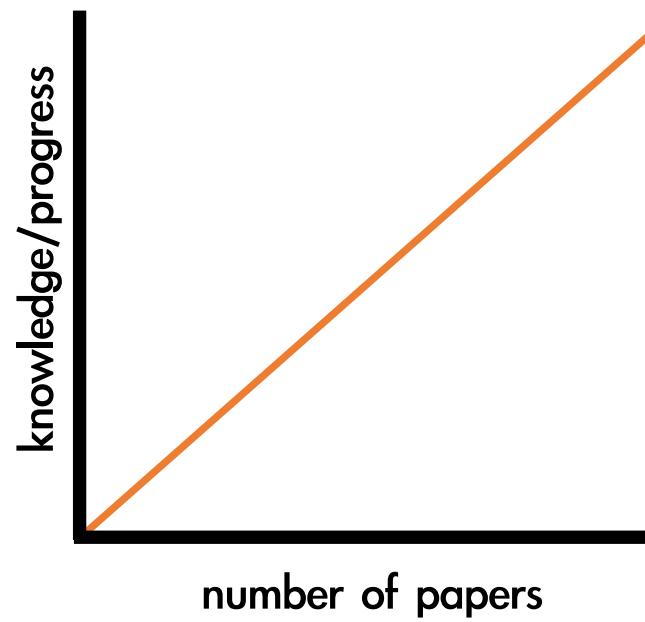
## Paper 1

I have always had interest in  
\*\**insert topic*\*\* and here is what  
new knowledge I have to  
contribute to this topic

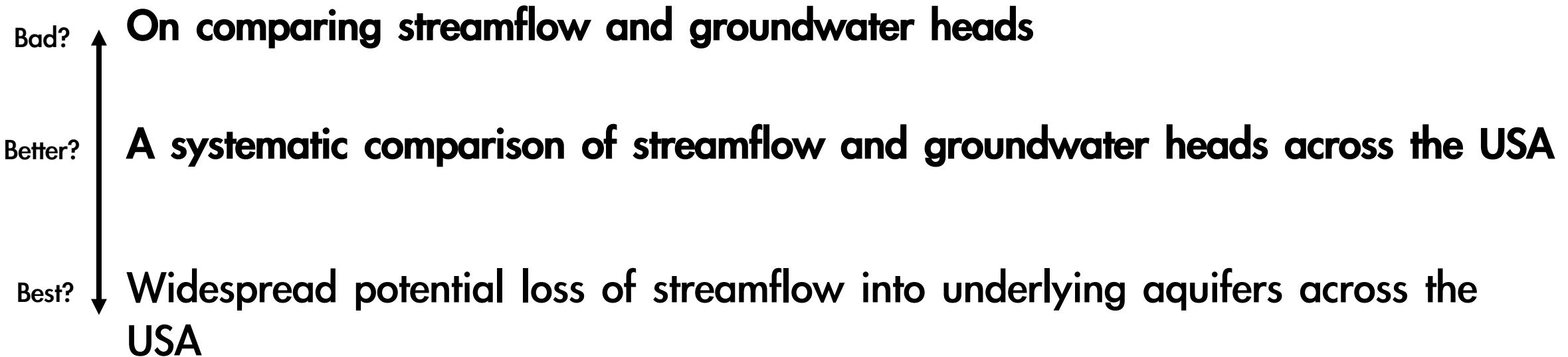
## Paper 2

Given what studies have reported  
before, my findings indicate you  
should think differently about the  
world (because you were wrong)

# What is scientific knowledge?



# Make a good first impression... (the title)



....by stating what you discovered

# Make a good first impression... (the abstract)

Annotated example taken from *Nature* 435, 114–118 (5 May 2005).

One or two sentences providing a basic introduction to the field, comprehensible to a scientist in any discipline.

Two to three sentences of more detailed background, comprehensible to scientists in related disciplines.

One sentence clearly stating the general problem being addressed by this particular study.

One sentence summarizing the main result (with the words “here we show” or their equivalent).

Two or three sentences explaining what the main result reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.

One or two sentences to put the results into a more general context.

Two or three sentences to provide a broader perspective, readily comprehensible to a scientist in any discipline, may be included in the first paragraph if the editor considers that the accessibility of the paper is significantly enhanced by their inclusion. Under these circumstances, the length of the paragraph can be up to 300 words. (This example is 190 words without the final section, and 250 words with it).

During cell division, mitotic spindles are assembled by microtubule-based motor proteins<sup>1,2</sup>. The bipolar organization of spindles is essential for proper segregation of chromosomes, and requires plus-end-directed homotetrameric motor proteins of the widely conserved kinesin-5 (BimC) family<sup>3</sup>. Hypotheses for bipolar spindle formation include the ‘push–pull mitotic muscle’ model, in which kinesin-5 and opposing motor proteins act between overlapping microtubules<sup>2,4,5</sup>. However, the precise roles of kinesin-5 during this process are unknown. Here we show that the vertebrate kinesin-5 Eg5 drives the sliding of microtubules depending on their relative orientation. We found in controlled *in vitro* assays that Eg5 has the remarkable capability of simultaneously moving at ~20 nm s<sup>-1</sup> towards the plus-ends of each of the two microtubules it crosslinks. For anti-parallel microtubules, this results in relative sliding at ~40 nm s<sup>-1</sup>, comparable to spindle pole separation rates *in vivo*<sup>6</sup>. Furthermore, we found that Eg5 can tether microtubule plus-ends, suggesting an additional microtubule-binding mode for Eg5. Our results demonstrate how members of the kinesin-5 family are likely to function in mitosis, pushing apart interpolar microtubules as well as recruiting microtubules into bundles that are subsequently polarized by relative sliding. We anticipate our assay to be a starting point for more sophisticated *in vitro* models of mitotic spindles. For example, the individual and combined action of multiple mitotic motors could be tested, including minus-end-directed motors opposing Eg5 motility. Furthermore, Eg5 inhibition is a major target of anti-cancer drug development, and a well-defined and quantitative assay for motor function will be relevant for such developments.

source: <https://www.nature.com/documents/nature-summary-paragraph.pdf>

....by again emphasizing what you discovered (and why it matters)

# Make a good first impression... (figure)

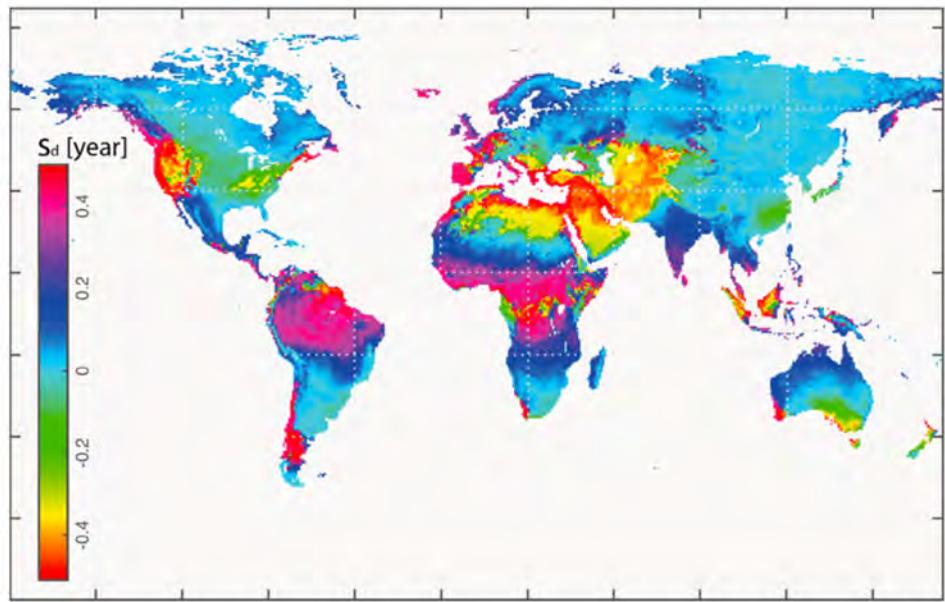
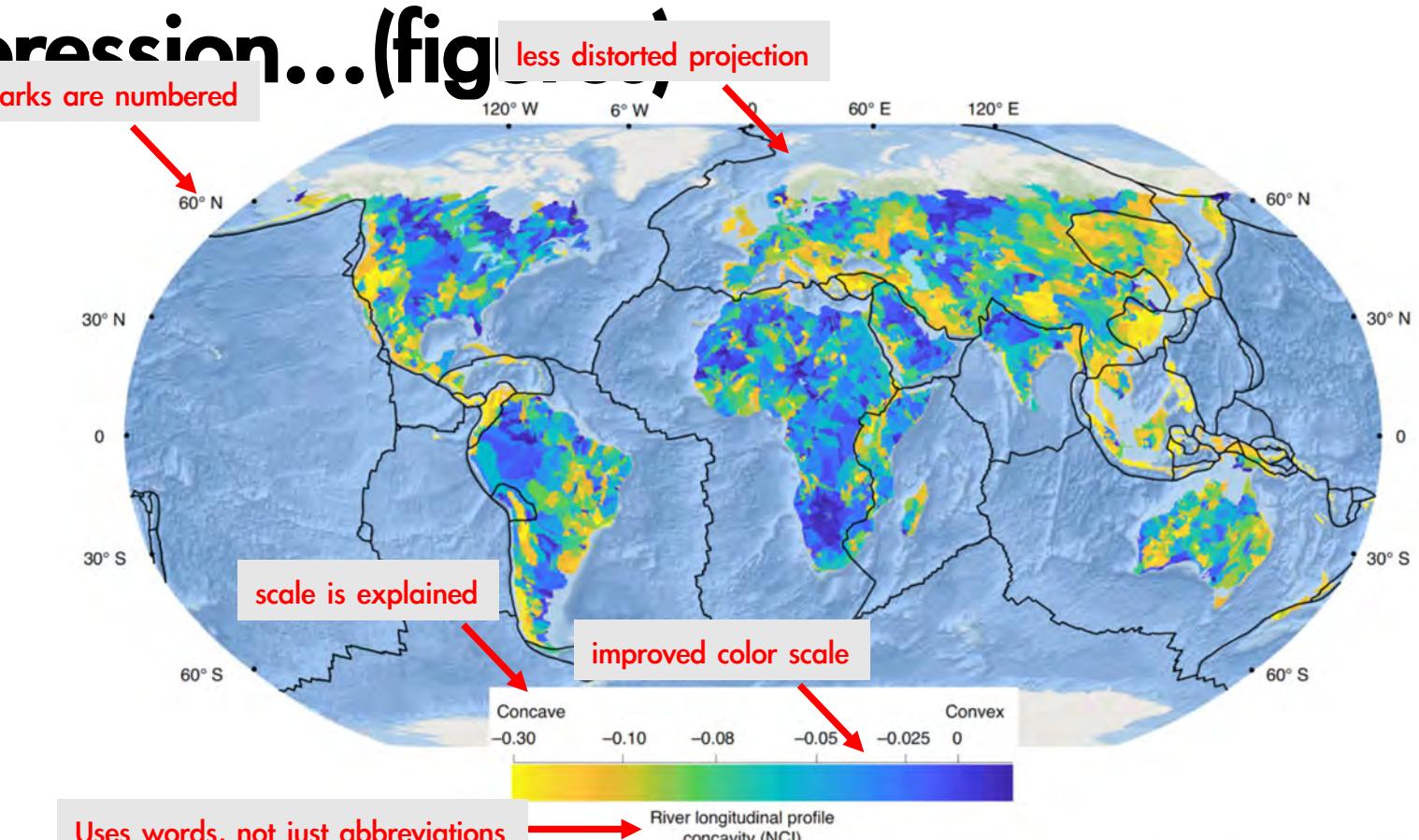


Figure 4. The phase difference between the precipitation and temperature regime ( $s_d$ ).

States the conclusions of the figure



Berghuijs & Woods (2016) IJOC

Seybold, Berghuijs, et al. (2021) Nature Geoscience

...by stating what to look for in the figures

**Is the reader still interested?**

# Write simple and clear...

*“research methods were deployed to analyze the quantity of the uncertainty of streamflow modeled by hydrological models”*

vs.

*“We quantified uncertainty of modeled streamflow”*

**...so the reader can focus on the content.**

# Create a logical structure...

## within paragraphs

main message preferably stated upfront

Our meta-analysis of 77 local-scale studies (Supplementary Table 1) suggests that losing rivers may be more common where climate conditions are drier, topographic slopes are flatter, and groundwater withdrawals are greater (Fig. 1b). These hypotheses are confirmed, at the continental scale, by our analysis of 4.2 million wells and their nearest stream segments (Fig. 4). The fraction of well water levels that lie below the nearest stream—consistent with losing rivers—is significantly correlated with county-scale averages of groundwater withdrawals<sup>32</sup> (Spearman rank correlation  $\rho = 0.32$ ), topographic slope<sup>29</sup> ( $\rho = -0.33$ ) and precipitation divided by potential evapotranspiration<sup>33</sup> ( $\rho = -0.38$ ; all correlations are statistically significant at  $P < 0.0001$ ). Although these correlations exhibit considerable scatter (Supplementary Fig. 24), they suggest that all of these variables substantially influence the prevalence of losing streams at the continental scale.

Jasechko et al. (2021) Nature

## across paragraphs

the paragraphs' THMs create a logical story

WORKING LIFE  
by Jeffrey A. McDonnell

### Paper writing gone Hollywood

**S**o you want to be a writer?" one of my professors asked me when he learned I was interested in a career as an academic scientist—a question warning that a life of science is about a life of writing. But I learned this in advance. I found that writing was a challenge when I had a good tale, I struggled to tell it. I tried starting with the opening sentence and hoping I'd make it to the paper's end. But more often than not, I wrote my way down many blind alleys. My permanently unfinished papers outnumbered my published ones. Worst of all, I was not helping my Ph.D. students and postdocs learn proper writing craft.

My big break came shortly after giving a presentation to a passing colleague, a movie director who mentioned that his process for writing screenplays was similar to mine and described the parts of writing that as helped me derive a highly publishable paper. I had the small money to be told. I had thought that the standard academic writing approach—methods, results, discussions, conclusions—was enough to keep me on track, but my colleague helped me realize that my writing was not good enough to elicit enough breadth to get much writing done—ever.

I took a cue from the standard paper structure as its own movie writing drill. Writing papers is really the same as writing screenplays. I had to do the initial thought and time stalking, all these pieces first. I call it the *hypotheses writing approach*. Each new paper proposal must start with a story producer and ask the Ph.D. student or postdoc to play the role of screen or movie director plotting a new movie. The story producer asks the screen or movie director plotting a new movie what's the title? What's the story? What's the status quo? What's wrong with the status quo? How does this new paper go beyond the status quo?

For each new paper, the screen or movie director places key arguments and methods. Dialogue or scenes. Refining each of the main paper elements is a great way to set up the manuscript. The director can then write the screen or movie script or set the stage. He feeds the reader to the research questions or hypotheses. Not too little about what we already know and one risks losing a large audience who may be interested in the paper. The reader can then interact with the current state of knowledge and the reader can

wonder why we need yet another paper on that topic. What's the new story beyond what others have done and the novelty of the paper. The result is a roadmap of the research story. A map, which brings the document—the entire tough science for the writing process—into focus.

Once the pitch makes sense, we go back and forth reading the first few shots or scenes. The screen or movie director becomes paragraph topics, with every paragraph topic represented in the story. The screen or movie director can be any writing allows us to determine whether the research story requires a 100-page paper or a 10-page paper or 10 days or weeks or the entire art is right, but it's time well spent. The screen or movie director can also determine whether the paper makes a clear and wise contribution: whether the title, objectives, and methods are proper, and whether the figures are truly related to the research questions. I ask the screen or movie director to play the role of screen or movie director plotting a new movie. The screen or movie director plots the new movie and I can immediately learn. But the *top-down approach* has been a game-changer in my group. Now, when a new grad student comes in, I ask him or her to do the first paper. I ask, "So you want to be a Hollywood producer?"

Jeffrey A. McDonnell is a professor in the School of Earth and Atmospheric Sciences and the University of Tennessee's Department of Earth and Planetary Sciences and the 20th Century Chair at the University of Alberta, in the United Kingdom. We thank the members of our lab and the members of the McDonnell family for feedback.

McDonnell (2017) Science

...so the reader can focus on the content.

# Conclude using references to your figures...

## 4. Summary and Conclusions

When rivers flood, surrounding rivers often flood at the same time. Using annual flood data from several thousand European rivers, our analysis shows that the flood synchrony scale (Figure 1)—the distance over which multiple rivers flood near synchronously—far exceeds the size of individual drainage basins and varies regionally by more than an order of magnitude (Figure 2). Over the period 1960–2010 flood synchrony scales have grown by about 50% (Figure 3a), and years with spatially extensive floods tend to follow one another (Figure 3b). The synchrony of interbasin flooding is a largely overlooked dimension of flood behavior, because flood risks are typically assessed and managed at the scale of individual basins. Risk finance, flood forecasting, and interpretations of flood trends can be improved by accounting for how flood risks extend beyond the borders of individual drainage basins.

Berghuijs et al. (2019) GRL

... so it is easier to understand what backs up your claims

# Convey 1 main message... (not 10)

410 citations



## A precipitation shift from snow towards rain leads to a decrease in streamflow

W. Berghuijs<sup>1,2\*</sup>, R. A. Woods<sup>2</sup> and M. Hrachowitz<sup>3</sup>

In a warming climate, precipitation is less likely to occur as snow<sup>1,2,3</sup>. A shift from a snow to a rain-dominated regime is expected to result in a mean annual streamflow significantly<sup>1,2,3</sup>. Contradicting the current paradigm, we argue that mean annual streamflow is likely to reduce for catchments that receive a significant part of their precipitation falling as snow. With more than one-sixth of the Earth's population depending on meltwater for their water supply<sup>4</sup> and ecosystems that can be sensitive to streamflow alterations<sup>5</sup>, this finding has important implications for the potential impacts of climate change on the hydrological potential (P<sub>h</sub>) to the mean precipitation (P). The Budzik hypothesis is a widely used method to determine observations showing a wide range of seasonal water balance patterns. We find that a catchment's water balance can be identified<sup>6</sup>. We examine the influence of the snow fraction of precipitation that falls as snow (Q<sub>s</sub>) on the mean streamflow (Q<sub>st</sub>). Because mean precipitation falling as snow has a significant impact on the annual streamflow within individual catchments, this study is limited to investigating these observations process-based understanding of the mean annual streamflow in the context of a warming climate. Given the importance of streamflow for society, further studies are required to respond to the consequences of a temperature-induced precipitation shift from snow to rain.

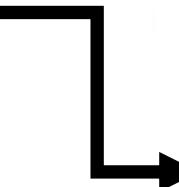
Notes and references are available in the online version of the paper. The authors declare that they have no conflicts of interest in the hydrologic cycle that undermine the assumption that it can be considered stationary<sup>7</sup>. One of the most profound and widely accepted hydrologic hypotheses is the Budzik hypothesis, which states that the mean annual streamflow is inversely related to the mean annual induced shift of precipitation from snow towards rain and earlier melt of the snowpack<sup>8,9,10</sup>. Future temperatures increase will affect precipitation and streamflow patterns. In the later part of the new century, a shift from a snow regime towards a rain regime leads to changes in the within-year distribution of streamflow<sup>11</sup>, which are consistent with a significant impact on human freshwater resources and ecosystem functioning<sup>12</sup>. The projected global temperature increase is expected to affect future snowfall<sup>13</sup> and consequently the temporal distribution of river water availability<sup>14</sup>. In this study, we argue that, despite the warning on temporal streamflow predictability, the influence of the change in form of precipitation on the long-term mean streamflow is greater than can be negligible<sup>15</sup>, on based to the work of Berghuijs *et al.* (2013) and FLECKNUT data<sup>16</sup> as simulations<sup>17</sup>. However, mechanistic modeling of a catchment as two-basin suggests a wetter climate with more rain and less snow will result in a decrease in mean annual streamflow. Despite this assumption that the long-term water balance is not yet significantly affected by a precipitation shift from snow towards rain, is not yet substantiated by empirical findings at the catchment scale.

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†See [www.nature.com/nature/journal/vaop/ncurrent/abs/nature13059.html](http://www.nature.com/nature/journal/vaop/ncurrent/abs/nature13059.html)

‡See [www.nature.com/nature/journal/vaop/ncurrent/abs/nature13059.html](http://www.nature.com/nature/journal/vaop/ncurrent/abs/nature13059.html)

which was  
Figure 9c of



134 citations



## Water Resources Research

### RESEARCH ARTICLE

#### Patterns of similarity of seasonal water balances: A window into streamflow variability over a range of time scales

Wouter R. Berghuijs<sup>1</sup>\*, Murugesu Sivapalan<sup>2</sup>, Ross A. Woods<sup>2</sup>, and Hubert H. G. Savenije<sup>1</sup>

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**Abstract** Recent hydrologic synthesis efforts have presented evidence that the seasonal water balance is at the core of catchment responses, and understanding it will assist in predicting signatures of streamflow variability at other time scales, including interannual variability, the flow duration curve, low flows, and floods. In this study, we group 321 catchments located across the continental U.S. into several clusters with similar seasonal water balance behavior. We then delineate the boundaries between these clusters on the basis of a similarity framework based on three hydroclimate indices that represent aridity, precipitation, and snowmelt. The results show that the seasonal water balance has a strong spatial pattern, with a strong relationship not only with regional patterns of the three variables included but also with environmental variables such as soil, vegetation, and the hydrologic regime. Building on these catchment clusters, we demonstrate that seasonal water balance does have an imprint on signatures of streamflow variability over a wide range of time scales (daily to decadal) and a wide range of streamflow (flows to floods). The seasonal water balance is a key variable that controls streamflow variability at longer time scales, and it is only partially reflected in the observations at shorter time scales, including flooding and low flows. Overall, the seasonal water balance has proven to be a similarity measure that serves as a link between both short-term hydrologic responses and long-term adaptation of the landscape with climate.

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### 1. Introduction

The well-known heterogeneity and complexity associated with catchments make it difficult to produce generalizations of their streamflow response beyond individual catchments (Dooge, 1968; Beven, 2000; McDonnell *et al.*, 2007). Yet, the hydrologic response and complexity present in catchments is a general property that they hold some level of robustness and simplicity of responses, which should permit a degree of predictability of their functional behavior (Dooge, 1968; Savenije, 2001; Sivapalan, 2003; McDonnell *et al.*, 2007). One example of generalized predictive behavior is that the mean-annual partitioning of precipitation into evaporation and streamflow is primarily a function of the relative atmospheric supply and demand of water, expressed by the aridity index, the ratio of the mean available energy potential to the mean precipitation (Beven, 2000). This understanding of the process control of the annual water balance would allow a prior prediction, albeit first order, of long-term average streamflows for catchments where no streamflow measurements are available (McMahon *et al.*, 2013). It has been shown that the energy versus water competition, as per the Budzik hypothesis, can even extend to the interannual variability of the annual water balance (Milly and Dunne, 2002; A. D. Cammarano *et al.*, Regional patterns of inter-annual variability of catchment water balances across the continental United States, *Geophysical Research Letters*, **39**, L18403, doi:10.1029/2012GL052985, 2012; Fekkenkamp and Chapman, 1989), for uncovering additional secondary controls, and for studying changes to the long-term water balance of catchments in response to climate and land cover change (e.g., Dooge, 1992; Zhang *et al.*, 2001; Gerits *et al.*, 2009; Li *et al.*, 2013).

The dominant climatic and landscape controls on hydrologic responses are time scale dependent (Atkinson *et al.*, 2002; Farmer *et al.*, 2003). Therefore, a natural extension of the Budzik-type framework would be one that might help to understand the physical controls on the similarity and differences of streamflow variability at shorter time scales. In this paper, we focus on developing a similarity framework for seasonal water

0 citations

## Comparative hydrology across climatic and physiographic diversity

A search for simple patterns and predictability

Master thesis



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Dr. R.A. Woods

December 2013

Berghuijs *et al.*, (2014) Nature CC

Berghuijs *et al.*, (2014) WRR

Berghuijs (2013) MSc Thesis

... so readers know what to focus on

# Stop thinking about rules.

## Think about readers

- Your work should change how readers see the world
- Communicate your findings in the title, abstract, and figures
- Once these conditions are met we can worry about the detailed writing
- No hard rules exist, but make the readers' lives as easy as possible

# References

- The craft of writing efficiently. University of Chicago
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