# Citizen observers in hydrology -Experiences from the CrowdWater project

Jan Seibert, Barbara Strobl, Simon Etter, Marc Vis and Ilja van Meerveld







On the following slides we compiled information about CrowdWater activities, but you can also skip the slides and jump directly to the action points below:

• Go and get the app ③ (Search for CrowdWater, Spotteron in your app store)

(\*\*\*)

- Play the CrowdWater game: <u>https://crowdwater.ch/en/crowdwater-game/</u>
- Watch the PhD seminars by Barbara Strobl and Simon Etter on our Youtube channel, <u>https://www.youtube.com/channel/UC088v9paXZyJ9TcRFh7oNYg</u>)
- Sign up for our Open Online Course about CrowdWater (in German, <u>https://edu-exchange.uzh.ch/courses/course-v1:UZH+Crowdwater+2019\_T1/about</u>
- Spread the word about our two new PhD positions, applications still welcome (<u>https://crowdwater.ch/wp-</u> content/uploads/2020/04/PhD\_announcement\_CrowdWater2020\_DE.pdf)

### http://www.crowdwater.ch

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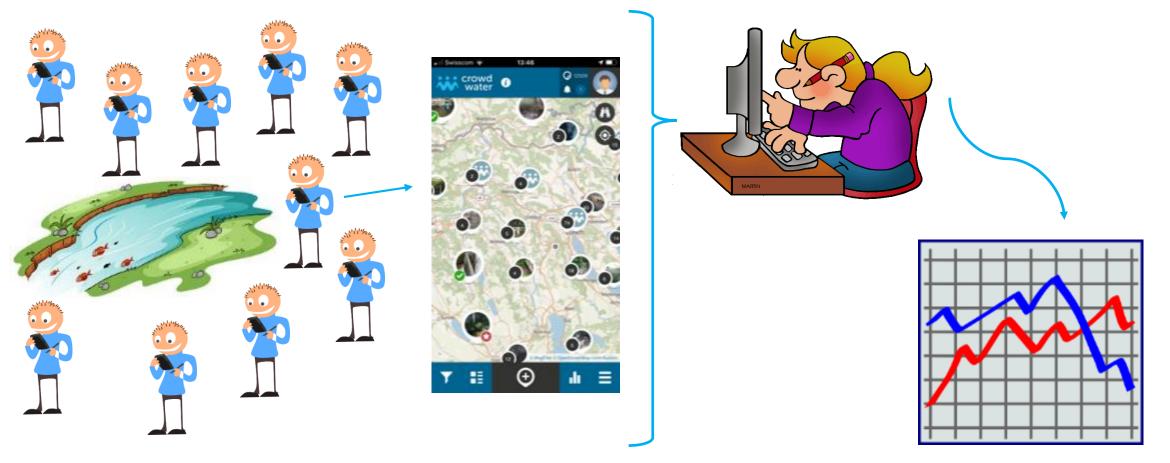


Take home



# Vision:

Scalable approach based on smartphone app



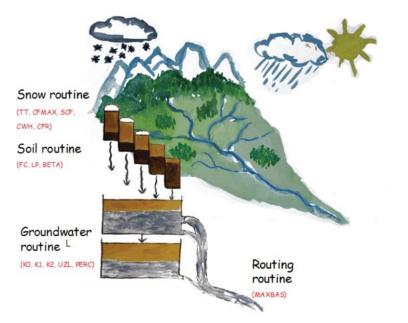


# CrowdWater :

Evaluate the potential of crowd-based data for hydrological modelling



What can be observed by the ,crowd' (citizen scientists)? At which accuracy?



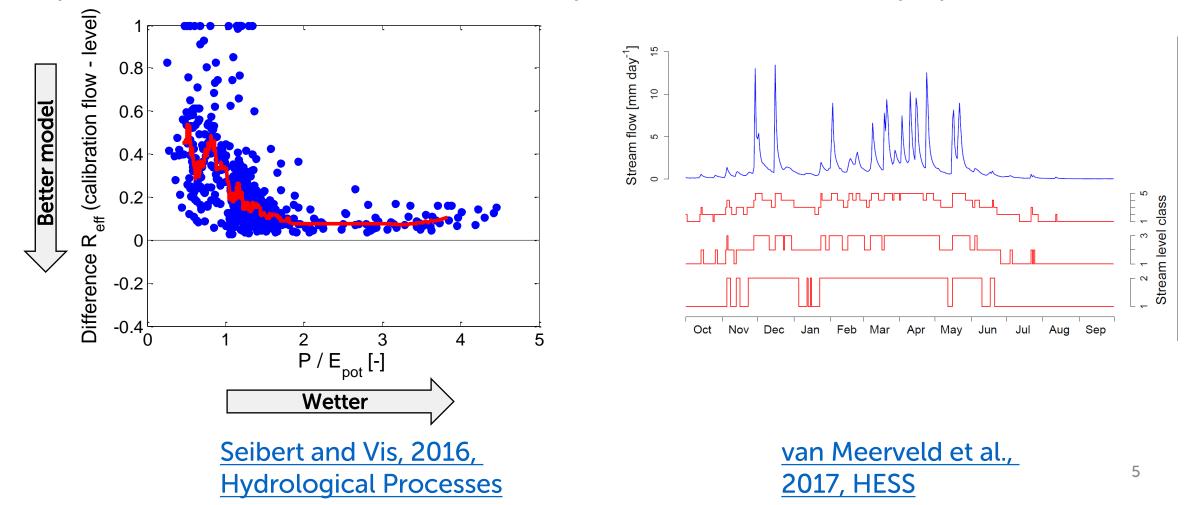
Which data would be most informative?

Value of data for modelling?

As shown at previous EGU meetings, water level (classes) are surprisingly informative, especially for humid catchments. Two plots as a reminder, for details please see the two papers.

Water levels

(**\*\*\***)

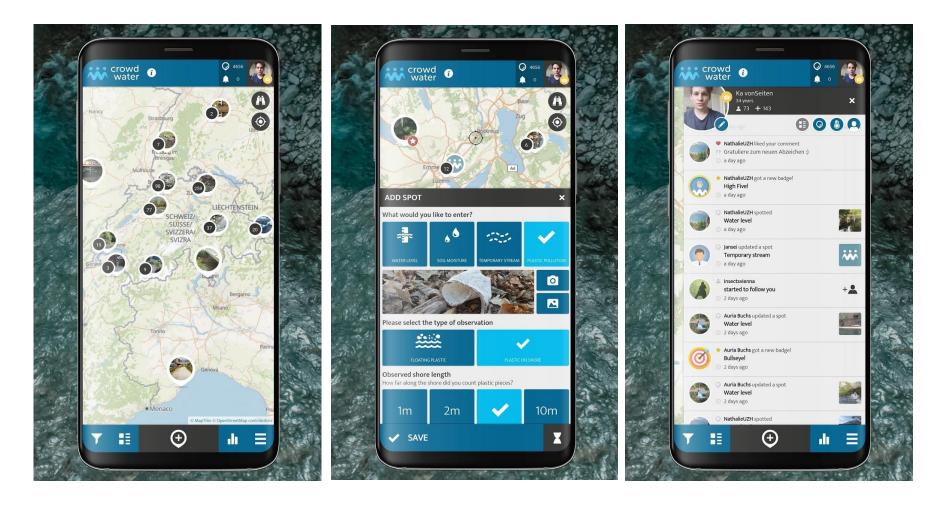


# The CrowdWater | SPOTTERON App

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## CrowdWater app: Water levels classes

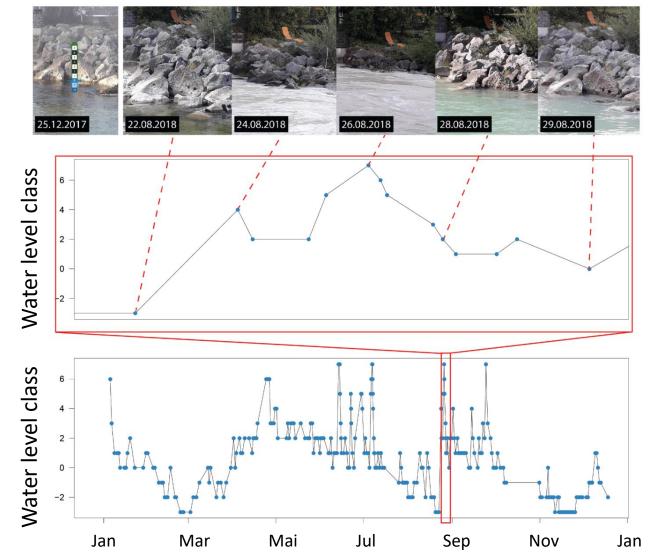
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### Example time series





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<u>Rinderer et al., 2012,</u> <u>Hydrological Processes</u>

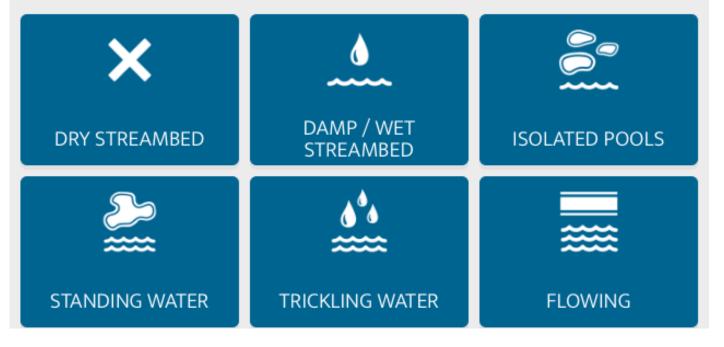
# App: Temporary streams

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### What do you observe?

Estimate the current flow condition of the temporary stream:

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# **App: Plastic pollution**

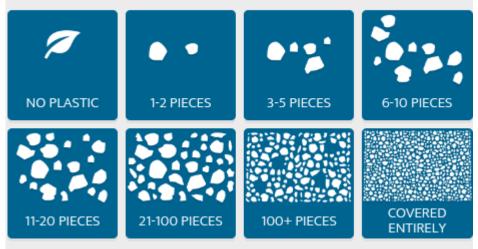
(iii)

### Please select the type of observation



### Did you see any plastic?

How many plastic pieces did you count during your stated time and over the stated width of the river?



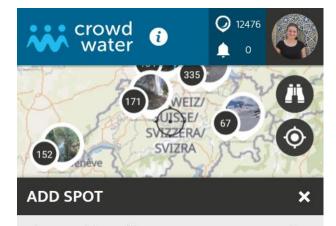


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# New: two more categories





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What would you like to enter as a new spot? Please check if there already is a spot close to you that you can update with the (+) button.



### Leave a comment..

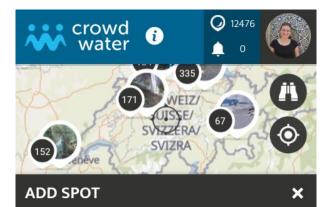




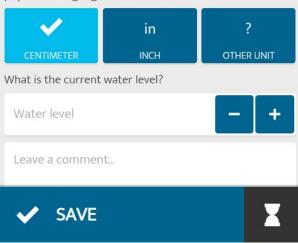
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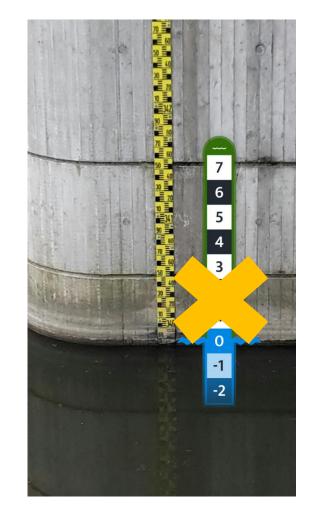


## New: Physical staff gauge

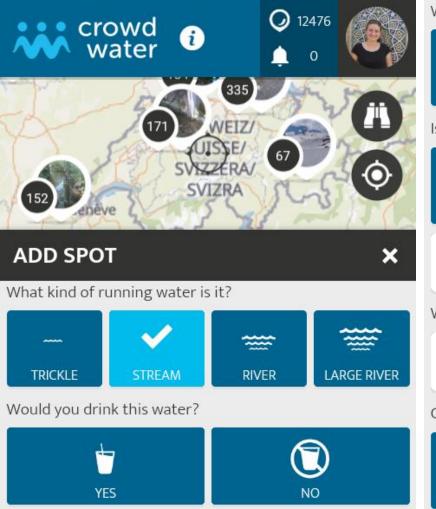


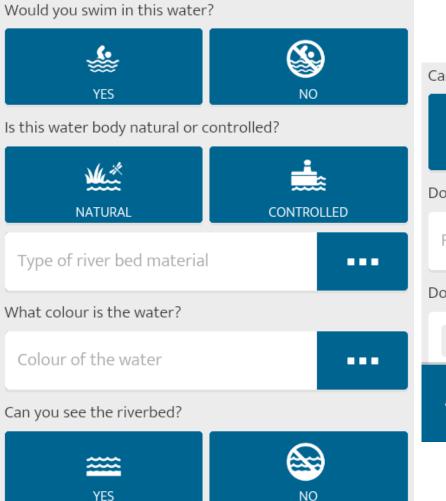
Please report the current water level indicated on the physical staff gauge. Choose a unit:





## New: Stream type





Can you see fish or other living beings in the water?

(\*\*\*)



Do you see signs of water pollution?

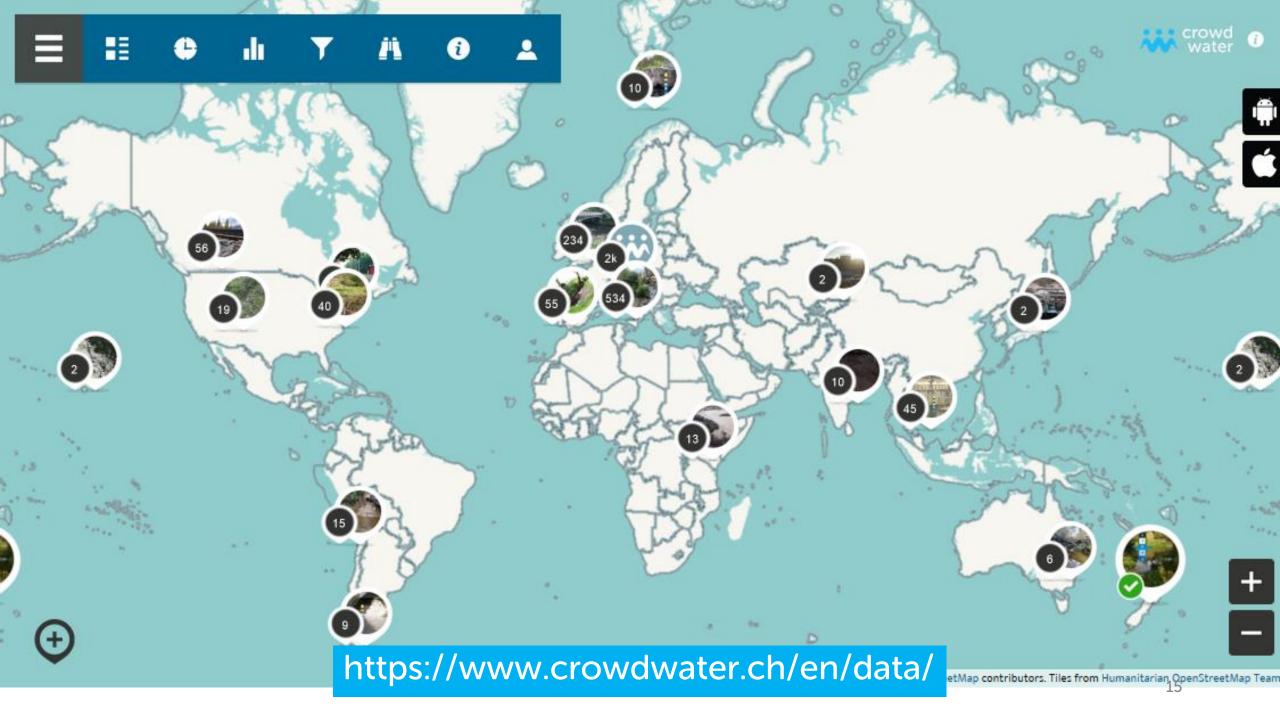
Pollution

App

Does this stream sometimes dry up?

Yes, it sometimes dries up

🖌 SAVE



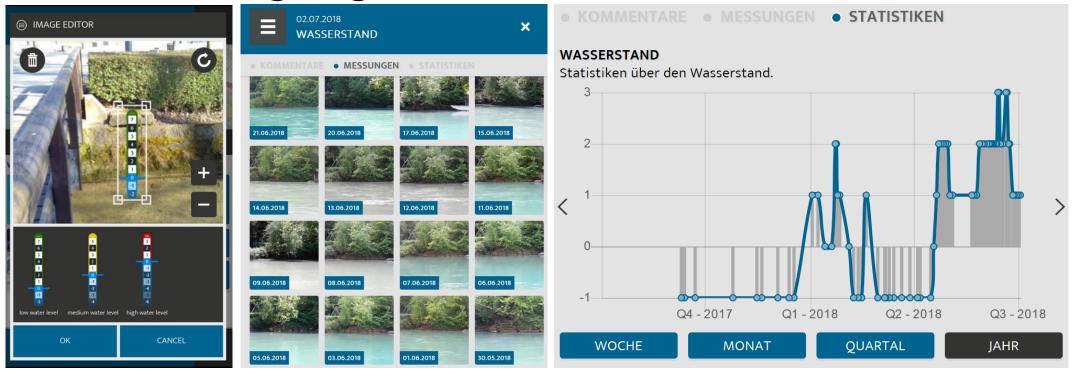


# Some of our publications ....

### Virtual staff gauge for crowd-based observations

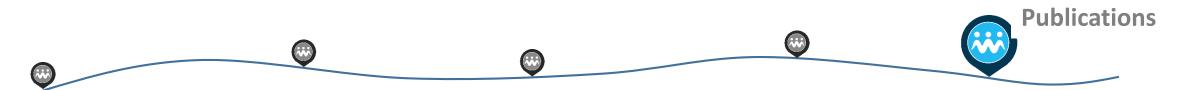
(iii)

(\*\*\*\*)



Seibert, J., Strobl, B., Etter, S., Hummer, P., van Meerveld, H.J.: Virtual staff gauges for crowd-based stream level observations, Front. Earth Sci. – Hydrosphere, <u>https://doi.org/10.3389/feart.2019.00070</u>, 2019.

**Publications** 



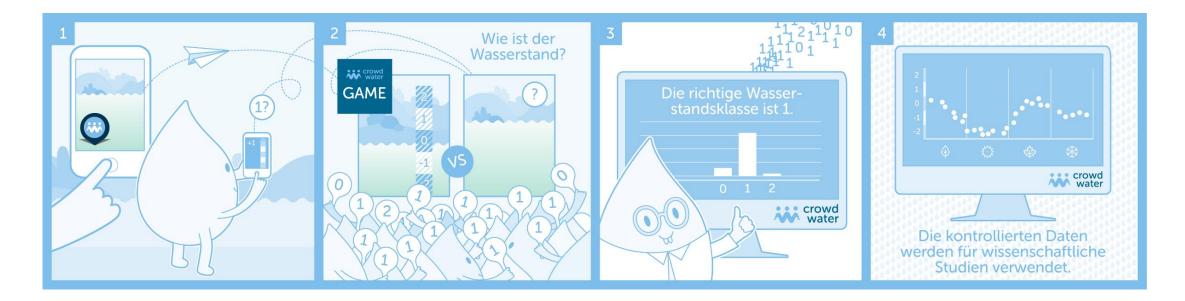
### Crowd-based water level classes are informative



Etter, S., Strobl, B., Seibert, J., & van Meerveld, H. J.: Value of crowd-based water level class observations for hydrological model calibration. Water Resources Research, 56, e2019WR026108. <u>https://doi.org/10.1029/2019WR026108</u>, 2020

### 

### Data quality control based on an online game



Strobl, B., Etter, S., van Meerveld, I., Seibert, J.: The CrowdWater game: A playful way to improve the accuracy of crowdsourced water level class data – PLoS One, <u>https://doi.org/10.1371/journal.pone.0222579</u>, 2019

https://crowdwater.ch/en/crowdwater-game/

Take home

### — CrowdWater publications

O PLOS ONE

Check for updates

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Citation: Strobi B, Etter S, van 1 (2019) The CrowdWater game.

Editor: Seyedali Mirjalili, Torrer Azstralia, ALISTRALIA

Accepted: September 2, 2019

Published: September 26, 2019

Received: April 5, 2019

class data. PLoS ONE 14(9): e0222579. https://di

Copyright: © 2019 Shobl et al. This is an open screen seticle distributed service the lower of the

permits unrestricted use, distribution, and

Data Availability Statement: All data files are available from the Zanodo data repository (http:

Funding: This study was lunded by the Swis

to publish, or preparation of the manuscript.

National Science Foundation (www.snl.ch; project 163008, CrowdWater). The funders had no role in study design, data collection and analysis, decision

Competing interests: The authors have declared

1. Introduction

Data quality and quality control are frequently disc

doi.om/10.5281/mando.26305820

### Testing the Waters: Mobile Apps for Crowdsourced Streamflow Data

Citizen scientists keep a watchful eye on the world's streams, catching intermittent streams in action and filling data gaps to construct a more complete hydrologic picture





and in successive many largest of B: Sanharia Korof, Bathers 1 Selbert, and Ilja van Meenvel

### Virtual Staff Gauges for Crowd-Based Stream Level Observations



The CrowdWater game: A playful way to improve the accuracy of crowdsourced water level class data rbara Stroblo<sup>1-</sup>, Simon Ettero<sup>1</sup>, Ilja van Meerveldo<sup>1</sup>, Jan Selberto Department of Geography, University of Zurich, Zurich, Switzenland, 2 Department of Aquatic Sciences nd Assessment, Swedish University of Agricultural Sciences, Uppsala, Sweden

Abstract Data quality control is important for any data collection program, especially in citizen science ciects, where it is more likely that errors occur due to the human factor. Ideally, data qually control in citizen science projects is also crowdsourced so that it can handle large amounts of data. Here we present the CrowdWater game as a gamilied method to check crowdsourced water level class data that are submitted by citizen scientists through the CrowdWater app. The app uses a virtual staff gauge approach, which means that a digita scale is added to the first picture taken at a site and this scale is used for water level class observations at different times. In the name, participants classify water levels based on the comparison of the new picture with the picture containing the virtual staff gauge. By Marc 2019, 153 people had played the CrowdWater game and 841 pictures were classified. The average water level for the game votes for the classified pictures was compared to the wate level class submitted through the app to determine whether the game can improve the gua rough the app. For about 70% of the level class was the same for the CrowdWater app and game. For a guarter of the classified nichang there was disag average game vote. Expert judgement suggests that for three quarters of these cases, th game based average value was correct. The initial re

### game helps to identify erroneous water level class obs onstrates the potential of gamified approaches for d ANDROLOGICAL SCIENCES KOURNAL projects.

SPECIAL ISSUE: HYDROLOGICAL DATA: OPPORTUNITIES AND BARRIERS Accuracy of crowdsourced streamflow and stream level class estimates

### Barbara Strobl @\*, Simon Etter @\*, Ilja van Meerveld @\* and Jan Seibert @\*\*

Department of Geography, University of Zurich, Zurich, Switzerland; \*Department of Aquatic Sciences and Assessment, Swedish Universit of Anticultural Sciences, Danuala, Sweden

(\*\*\*)

### AGUIOO ADVIANCE Check for

Hydrol, Farth Syst. Sci., 22, 5243-5257, 2018

Value of uncertain streamflow observations for

https://doi.org/10.5194/hess-22-5243-2 @ Author(s) 2018. This work is distribution

### Water Resources Research

Value of Crowd-Based Water Level Class Observations RESEARCH ARTICLE for Hydrological Model Calibration

### S. Etter<sup>1</sup>, B. Strobl<sup>1</sup>, J. Seibert<sup>1,2</sup>, and H. J. Ilia van Meerveld

nt of Geography, University of Zurich, Zurich, Switzerland, <sup>3</sup>Depar wedish University of Agricultural Sciences, Uppsala, Sweden with precise water level measurements Errors to water level class data Abstract While hydrological models generally rely on continuous streamflow data for calibration previous studies have shown that a few measurements can be sufficient to constrain model parameter Other studies have shown that continuous water level or water level class (WL-class) data can be informative for model calibration. In this study, we combined these approaches and ecolored the potential value of a the index satisfies and statisfies in the study, we considered approximate and performed a set potential index on a limited number of WL-class observations for calibration of a backet cryppe runoff mode [OHN] for four antichments in Switzerland. We generated synthetic data to represent citizen science data and examined the effects of the temporal resolution of the observations, the numbers of WL-classes, and the magnitude of the errors in the WL-class observations on the model validation performance. Our results indicate that on artus in ure wo-caso uservations on the mode visuaness perturbance. Our results instance material weekge one observation per week for a J-pare predict cas anglicitativity improve model performance compared to the situation without any streamflow data. Furthermore, the validation performance for model parameters: calibrated with W-caso assocrations was similar to the performance of the calibration with precise water level measurements. The number of WL-classes did not influence the validation performance tter, S., Strobi, R., Seibert, J., & van noticeably when at least four WL-classes were used. The impact of typical errors for citizen science-based estimates of WL-classes on the model performance was small. These results are encouraging for citizen cience projects where citizens observe water levels for otherwise ungauged streams using

> Plain Language Summary Normally, multiple years of streamflow measures calibrate a hydrological model for a specific catchment so that it can be used to, for instance, predict floods or droughts. Taking these measurements is expensive and requires a lot of effort. Therefore, such data ner often missing, especially in remote areas and developing countries. We investigated the potential value of water level class (WL-class) data for model calibration. WL-classes can be observed by citizens with the help of a virtual rolew with different classes that is pasted onto a picture of a stream band.

### Figure 2). We show that one WL-class observation per week for 1 year improves model cal to situations without streamflow data. The model results for the WL-class observations were water level observations that require a physical staff gauge or continuous water level data where two observations has require a physical scaling angle or committees were rever clust that can be obtained from a water level sensor that is installed in the stream. However, the good as when streamflow data were used for model calibration, but these are more expensiv in the WL-class observations did in most cases not affect the model performance noticeab

### 1 Introduction

Taylor & Franc

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Hydrological models are usually calibrated with continuous streamflow data acquis ich data sets are scarce, especially for remote regions and developing countries, eve these areas are often affected by various kinds of water issues (Mulligan, 2013). Globally, I ation networks are on the decline, mainly due to reduced financial resources. vation networks are on the decane, mainty due to reduced institution resolutions. Purthermore, access to available data is often restricted (Fekter et al., 2012). To colle basins, citizen science approaches that use modern communication technology (i.e., 3 helpful. Citizen science approaches can also incorporate local knowledge, for instance

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Hydrology and

Sciences

### Jan Seibert, H. J. (Ilia) van Meerveld, Simon Etter, Barbara Strohl, Rick Assendelft & Philipp Hummer

Wasserdaten sammeln mit dem Smartphone -Wie können Menschen messen, was hydrologische Modelle brauchen?

**Publications** 

### Collecting water data using smartphones – how can people measure what models need

Die Bürgerwissenschaft (Citizen Science) ist ein potenziell interessanter Ansatz, um bestehende hydrologische Mes De helper port anno 1995 en portente en portente de manifestaria de la portenti de la porteni de la portenti de la porteni de la portentida d beitragen. Für die Wassentrandsbechachtung wird eine virtuelle Masslatte verwendet. Das Bild einer Messlatte wird dabei digital in ein Foto eines Fließgewässers eingefügt. Damit kann der Wassentand zu späreern Zeitpunken abgeschützt werden. Für Boderleuchte und trockenfahlende Siche werden bechreibende Risson verwendes, die im Feld boderhet werden Nanne. Die ersten Ergebnisse wei weiten beschreitbende Klassen verwendet, die im Feld beobachtet werden künnen. Die ers welWater-Projekts zeigen, dass Daten aus Mitmachprojekten potenziell informativ sein können und dass die Sam Jank der Smartphone-App gut möglich ist.

Schlagwörten Rüngerwissenschaft Smartphone App virtuelle Messlatte Datensammlung Wert von Daten

Citizen science is a potentially useful approach to complement existing hydrological observation networks, and to obtain importan Cases science a potentially until approach to comparement example and in physical potential of the comparement in the comparement is the comparement. The comparement is the comparement is the comparement is the comparement is the comparement. The comparement is the comparement. The comparement is ment sites can be created by anyone and at any location and these sites can be found by the creator or othe

pproach makes use of a virtual staff gauge for water level measurements; this r into a photo of a stream bank or a bridge pillar, and the water level during a subse on the first picture. For soil moisture and the status of tempora er project showed that citizen science data could potentially be informative and that

HW 63, 2019, H.;

Earth System staff gauge, data collection, value of data

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# Conclusions

- Simple approaches can provide useful data
- Value of data can be evaluated
- Crowd-based water-level class observations can be informative
- A game can help for data quality control

http://www.crowdwater.ch



# If you liked what you saw here, please consider following up with the action point below:

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- Go and get the app ③ (Search for CrowdWater, Spotteron in your app store)
- Play the CrowdWater game: <u>https://crowdwater.ch/en/crowdwater-game/</u>
- Watch the PhD seminars by Barbara Strobl and Simon Etter on our Youtube channel, <u>https://www.youtube.com/channel/UC088v9paXZyJ9TcRFh7oNYg</u>
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### http://www.crowdwater.ch

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### Hydrological Citizen Science

# crowd water



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