| **Förderinformationen** | |
|---|---|
| Förderinitiative | „Complex systems“ |
| Aktenzeichen | I/85 241 |
| Titel des Vorhabens | 1st Mid-European Summerschool on Geomorphology: Complex response of Earth Surface Processes to Environmental Change |
| Projektleiter/innen und Kooperations-partner/innen | Dr. Michael Krautblatter (Bonn)<br>Dr. Wolfgang Schwanghart (Basel)<br>Dr. Tobias Heckmann (Eichstätt)<br>Dipl.-Geogr. Annegret Kranz (Kiel) |

**Inhaltliche Einschätzung des Vorhabens (bitte nicht mehr als 12 Seiten)**

*Zusammenfassung in englischer Sprache* (etwa 1 Seite)

The 1st Mid-European Summerschool on Geomorphology (SSOG) took place from September 26th to October 2nd in Heimbuchenthal in the Spessart mountains near Frankfurt am Main/Germany. 32 Participants from 10 countries explored, together with international lecturers, the potential of complexity theory as a novel overarching paradigm for geomorphology. A focus was put on discussing the interpretation of sediment archives as records of “complex response of earth surface processes to environmental change”.
At the beginning, keynote lectures introduced the participants to important aspects of complexity theory and its implications for problems, methods and theories in geomorphology. During a day in the field, important topographic and sedimentary features of the research site “Kirschgraben” were visited, and a short introduction to modern field methods was given: Geoelectrics, Terrestrial Laserscanning, Description and interpretation of colluvial strata in artificial outcrops, sampling for OSL dating and anthracology.
After some hands-on data processing, the participants were introduced to geostatistical methods which were later used to create a spatial model of the thickness of the youngest colluvial strata in the Kirschgraben catchment.
Another important module of the SSOG dealt with the concept of self-organised criticality in geomorphology and with modelling complex geomorphic systems, using the example of the landscape evolution model CAESAR. Participants were able to use their own data for CAESAR simulations.
The final discussion revealed that nearly every participant identifies complexity issues in his or her own research. Many of them will continue working with the methods taught during the SSOG; all stressed the importance of networking with colleagues and lecturers. A key result of the discussions held during the SSOG is the demand for multiple competing hypotheses in interpreting sedimentary archives. These interpretations have to deal with the postulate that stratigraphy is formed by a complex geomorphic system; hence, it neither necessarily nor exclusively reflects external (e.g. climate change or landuse change) forcings.

*Zusammenfassung in deutscher Sprache* (etwa 1 Seite)

Vom 26. September bis zum 2. Oktober 2010 fand in Heimbuchental/Spessart die erste mitteleuropäische Sommerschule für GeomorphologInnen statt. Unter dem Titel "Complex Response of Earth Surface Processes to Environmental Change" lernten 32 TeilnehmerInnen aus 10 Ländern gemeinsam mit international renommierten Dozenten Komplexität als ein teilgebietsübergreifendes Paradigma der Geomorphologie kennen. DoktorandInnen in unterschiedlichen Stadien ihrer Arbeiten sowie promovierte

NachwuchswissenschaftlerInnen setzten sich intensiv mit Komplexität auseinander, sowohl in Kleingruppen als auch im Plenum mit den Dozenten.
Am Beginn standen Keynote-Vorträge zu wichtigen Grundlagen der Komplexitätstheorie und v.a. zu den Implikationen von Komplexität für Forschungsgegenstände und Theorien in der Geomorphologie.
Ein Geländetag umfasste eine gemeinsame Exkursion in das Kirschgraben-Einzugsgebiet und die Einführung in moderne Geländemethoden (Kleingruppen; Geoelektrik, Terrestrisches Laserscanning, Interpretation der Stratigraphie in Baggerschürfen, Probenahme für OSL-Datierung und Anthrakologie).
Die Datenauswertung mündete in einen Block über geostatistische Verfahren, mit denen ein räumliches Modell für die Mächtigkeit des jüngsten Kolluviums erstellt wurde.
Ein weiterer thematischer Block setzte sich mit Konzepten wie Selbstorganisierter Kritizität sowie der Modellierung komplexer geomorphologischer Systeme auseinander; hier wurde mit dem Landschaftsentwicklungsmodell CAESAR gearbeitet. Die TeilnehmerInnen hatten hier auch die Gelegenheit, mit eigenen Daten zu arbeiten.
Die Schlussdiskussion zeigte, dass im wesentlichen alle TeilnehmerInnen die Inhalte der Sommerschule in ihren eigenen Forschungsarbeiten wiederfinden. Viele werden mit den Methoden weiterarbeiten und damit die eigenen Arbeiten voranbringen; als besonders wichtig wurde auch der rege Austausch mit den KollegInnen und den Dozenten angesprochen. Ein zentrales Resultat der intensiven Diskussionen während der Sommerschule ist die Forderung nach konkurrierenden Interpretationen der Feldbefunde; bei der Interpretation von Sedimentarchiven ist stets im Kopf zu behalten, dass die Stratigraphie keinesfalls immer und ausschließlich auf externe Einflussfaktoren (z.B. Klimawandel und Landnutzungswandel) zurückzuführen sein muss.

*Wissenschaftliche Ergebnisse des Vorhabens* (etwa 4 – 6 Seiten)

The **keynote lectures (day 1)** provided an embracing introduction to complexity issues in geomorphology and stimulated intense discussion:


**Figure 1: Prof. Tom Coulthard presented an embracing overview of the present research front of geomorphological modelling and quality criteria for model enhancement.**

- "Climate, chaos and catastrophes" (Prof. Dr. Klaus Fraedrich, Hamburg) introduced complexity issues from a meteorological and hydrolological perspective.
- This lecture was followed by a talk by Prof. Dr. Richard Dikau (Bonn) on "the role of complexity in process geomorphology and geoarchive geomorphology". During the discussions, the participants stressed the (potentially) integrative role that the frameworks of "complexity" and "sediment budgets" have or will have on the science of

geomorphology, scientific approaches and research projects.

- From the ‘geoarchive’ perspective of geomorphology, Prof. Dr. Hans-Rudolf Bork (Kiel) continued with a talk on “event-based interpretation of complex fluvial and hillslope archives in the Kirschgraben Catchment” which was complemented by the talks of
- Prof.Dr. Gert Verstraeten (Leuven, “Temporarily changing Holocene sediment budgets”) and
- PD Dr. Markus Fuchs (Bayreuth, “event-based sediment stratigraphy exploiting the luminescence record”).
- The keynotes were completed with a talk introducing a comparatively novel method, the analysis of charcoal particles in sediment archives (“event-based sediment stratigraphy exploiting the anthracological record”), which was given by Vincent Robin (Kiel).
- The focus on geoarchives represented by these four talks was very important for the field day (day 2) in the Kirschgraben catchment which has been the site of extensive geomorphological studies in Holocene landscape development during the past years.

**Figure 2: Participants being introduced to colluvial strata in a large excavator trench by Prof. Dr. Hans-Rudolf Bork (Kiel). Photo: SSOG**

During the first half of **day 2 (hands on)**, important features of the Kirschgraben catchment (major gullies attributed to Holocene erosion, artificial outcrops showing different colluvia, alluvial fan intercalated with floodplain sediments) were visited in a field trip. A lively group discussion was held concerning the recognition and interpretation of sedimentary archives, the most important point being the necessity of multi-proxy approaches and multiple hypotheses. After the field trip, the participants were introduced in small groups to the principles of the following field techniques

- Interpretation and sampling of colluvia in large artificial outcrops (trenches dug with an excavator; Prof. Dr. Hans-Rudolf Bork, Dipl.-Geogr. Annegret Kranz), including sampling techniques for OSL dating (PD Dr. Markus Fuchs) and anthracology (Vincent Robin)
- Geophysical investigations: Electrical resistivity tomography (Dr. Michael Krautblatter)
- Terrestrial laserscanning for the generation of high-resolution and high-accuracy surface models (Dr. Tobias Heckmann)

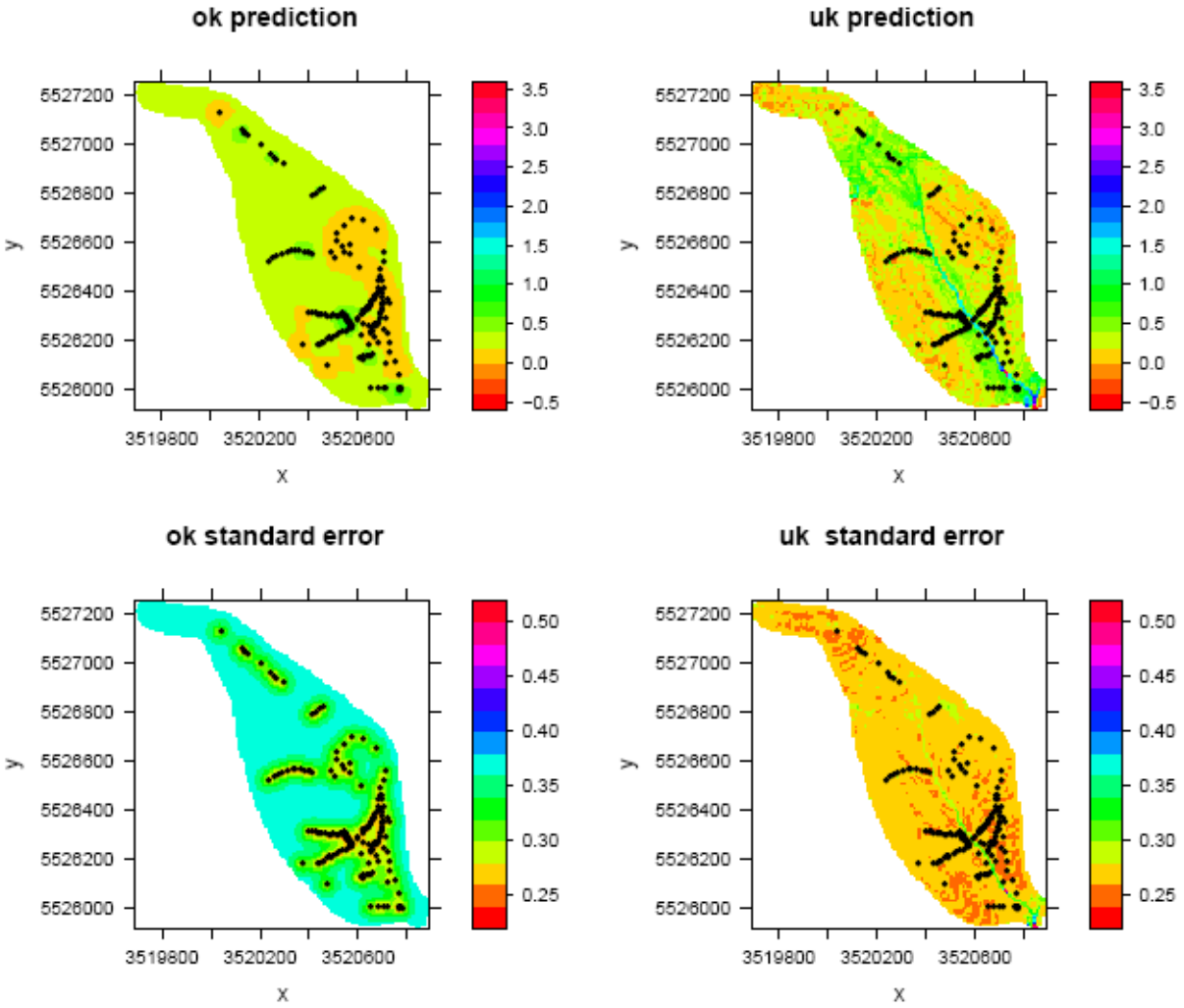


**Figure 3: Different spatial models showing modern soil erosion and the corresponding deposition in the youngest colluvial layer. Comparison of isopach maps of the youngest colluvial layer in the Kirschgraben catchment (top row) generated with ordinary (left) and universal (right) kriging. The latter geostatistical model included predictor variables generated with digital relief analysis. The bottom row shows the respective standard errors of the kriging models.**

**Day 3** was dedicated to different **analysis tools** (hands-on, small groups) such as

- analysis of geophysical data to quantify sediment bodies and to reveal internal structures
- digital relief analysis using SAGA GIS
- preparation and microscopical analysis of soil samples for anthracology
- The day was completed with an introductory lecture on geostatistics by Dr. Andreas Papritz (ETH Zürich).

Hands-on work with geostatistical methods continued on day 4. Depending on their state of knowledge, groups of participants completed simple and more advanced geostatistical exercises on their own computers using R and example datasets. Supported by Dr. Papritz, one group created an isopach map of the youngest colluvial layer found throughout the Kirschgraben catchment using a kriging approach (data from ongoing research in the Kirschgraben area, Dipl.-Geogr. Annegret Kranz). At the end of the geostatistics exercise, the results of the latter analysis were explained in detail to all participants and discussed.

**Figure 4: Tom Coulthard (Hull) discussing results of CAESAR simulations with participants.**

The afternoon of **day 4 and day 5** was dedicated to **modelling approaches** of complex systems. Prof. Dr. Tom Coulthard (Hull) introduced the participants to his cellular automata landscape evolution model CAESAR. One of the most important conclusions of his talk and the ensuing discussion was that sedimentary discharge of a catchment might not at all be a function of changing climatic conditions, which is due e.g. to nonlinear transport relations, filling and depletion of storages and system-internal changes through the built-up and decay of stream bed armour layers. The CAESAR model was prepared to run on everyone's computers, small groups were formed to experiment with CAESAR, some with their own data, some with Kirschgraben data. The results were presented by the groups in short presentations. Later on, the concept of self-organised criticality was introduced and discussed by the participants using the example of a cellular automata forest fire model (hands-on, using the NETLOGO software).

**Figure 5: During the plenary session different working groups worked on key questions with respect to complex environmental systems and presented findings to the audience.**

On **day 6**, the **concluding plenary session**, moderated by Prof. Coulthard and members of the organising committee, summarized the most important points made during the summer school and reflected on the consequences for everyone's personal research. Small groups of participants were asked to answer specific questions in the context of complexity and to present their thoughts.

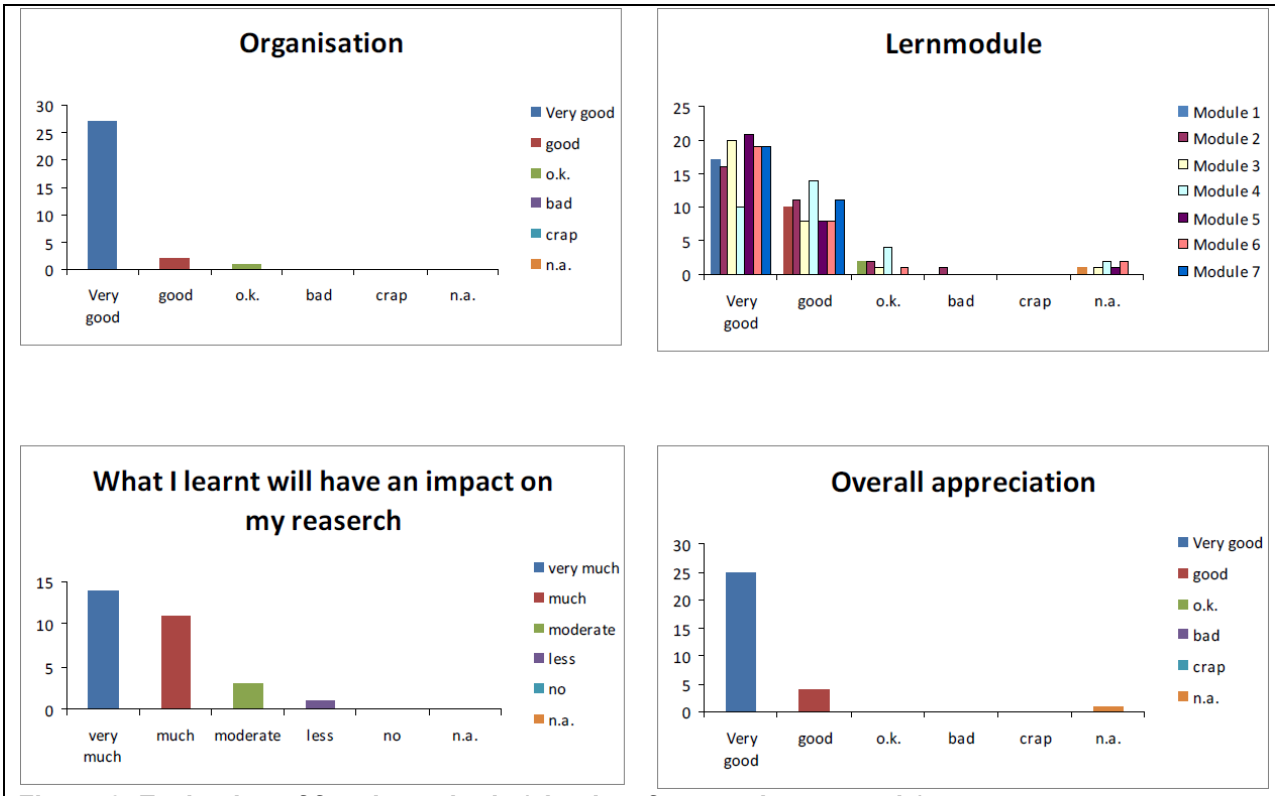


**Figure 6: Evaluation of four key criteria (absolute frequencies on y axis).**

The evaluation on personal questionnaires was filled out by all participants on the last day and resulted in a very good overall rating by the participants. Here, we give the 4 most important questions and report some single comments made in the “open questions” section.

**Personal comments made by participants (selection):**

- You found really a perfect balance between "boring" theoretical stuff and hands on practice. Never been to a summer school as "balanced" as this one
- The organisers managed to find a balance between disciplines during the day working on scientific topics, and relaxed and flexible dealing with coffee breaks, parties a.s.o. Not too rigid. I really enjoyed this week. Good job, nice people, thanks !
- group size was good, not too big not too small; also nice: have one (small) catchment as an example that everyone has seen; but don't focus on that all the time, which was done really well here (so going from case study to more general and back)
- I found the whole SSOG fantastic and all personal comments are minor additives. Not only the lectures gave good new input on how to proceed in my work & made curious for more of these things but also the networking gave a power and motivation boost and is just very helpful to see with what others have to struggle & find oneselves in these problems
- I think the "broad concept" of the SSOG was very good and covered a large part of topics geomorphologists have to deal with

*Selbsteinschätzung im Vergleich mit den ursprünglichen Zielen und Planungen*
(z.B. unerwartete Ergebnisse, andere inhaltliche/methodische Abweichungen)

In fact most things were running well in accordance with what we had planned (see personal comments). The chosen lecturers were indeed very supportive of the participants. The remote place of the SSOG together with a number of social events that took part in the historical mill with its cosy fireside chats created a common bond for the participants and the lecturers; some lecturers even called it a “karma” of the SSOG. In some instances, however,

above all during the geostatistics lecture, we had to spontaneously change the schedule in order to react to very different levels of prior knowledge (and preparation with respect to the material circulated before the SSOG) of the participants. In case of the geostatistics module, this prevented the whole group from working with the Kirschgraben data, and some participants were rather trained with more simple datasets, that we had prepared in advance.

Some personal comments of the evaluation (participants) and our own impressions from the SSOG let us draw the following conclusions on what should have been done differently:

- although the breadth of different approaches and methods was frequently appreciated, we feel that we could have reduced the number of different topics and give the remaining more depth (and time on the schedule).
- picking up people where they are proved to be quite difficult, especially when it turned out that the circulated materials had not been thoroughly worked through by everyone. Hence, more efforts should have been put on the preparation of participants in order to ensure a common basis
- more time should have been spent in the field; consequently, more of "own data" could have been collected and processed during the remaining part of the SSOG.
- Some mentioned the lack of a short presentation of everyone's own work at the beginning of the SSOG. We had left that open to the "icebreaker", "parties" in the evening and working together in small groups.

*Erkenntnisgewinn durch interdisziplinäre und internationale Zusammenarbeit*

Summing up the two most important points made in the "scientific results" section, bringing together active PhD students, postdocs and scientists has resulted in a better understanding of complexity theory with respect to geomorphological research:

- When interpreting the sediment record of a catchment, ignoring system-internal factors such as storage effects, connectivity and feedbacks might lead to improper conclusions on the reaction of the catchment to change. It has to be kept in mind that stratigraphy might be the result of complexity inherent in the system, or of changes in system structure rather than of external (e.g. climate) or internal (e.g. landuse) changes.
- The interpretation of field findings has to be based on multiple proxies, and should include multiple (and competing) hypotheses

The vast majority of participants expect that these thoughts will have an impact on their own research work.

*Weiterführende Perspektiven und nachhaltige Wirkungen des Vorhabens*
(z.B. Anschlussprojekte, Berufungen)

- a facebook group has been created to facilitate keeping in touch with fellow participants
- informations on the SSOG are distributed on the webpage http://www.ak-geomorphologie.de/organisation/ssog
- it is planned to publish a paper in Geomorphology discussing the role of complexity as an integrative framework (re-)unifying process and archive geomorphology
- it is planned to prepare follow-up events and future SSOGs. We plan on crosslinking and advertising these future events to the EGU summer school programme. EGU geomorphology section president Prof. Dr. Andreas Lang (Liverpool) and his predecessor (Prof. Dr. Nils Hovius, Cambridge) have pledged strong support for these ideas.

*Beitrag zu den besonderen Zielen der Förderinitiative*

- 25 of the participants stated that the focus on complexity research in earth sciences will “very much (14)” or “much (11)” impact on their research. We think, that the SSOG vitally contributed to the reflection and implementation of the broader physical paradigm of complexity research in earth science research of a younger generation.
- The SSOG provided an important platform for the future career of young scientist – For a number of them the SSOG created an international informal network with professionals in several EU countries.
- The SSOG network is also evident at international conferences such as the EGU where participants and lecturers cluster in several new research topics.

*Öffentlichkeitsarbeit und Medienresonanz* (z.B. Hörfunk- oder TV-Reportagen)

- A report on the SSOG was published in the German „Rundbrief Geographie“ (December 2010), which is the key report of important events related to Geography in Germany.
- Local print media reported on the SSOG taking place in Heimbuchenthal.
- The outcome of the summerschool was presented at the “Deutscher Arbeitskreis für Geomorphologie” in Frankfurt.
- The outcome of the summerschool has been communicated with the leaders of the Geomorphology Division of the European Geosciences Union and a report will soon appear on the EGU webpage.

*Weitere Aspekte* (z.B. besonders förderliche oder hemmende Umstände, Kooperationserfahrungen)

n.a.

Teilnehmer und Dozenten

**Teilnehmer – Universität, Land**

Dr. Nils Hempelmann - Mainz, D
Dr. Konstantin Kostov - Sofia, BULG
Dr. David Morche - Halle, D
Ph.D.-candidates (27):
Josh Larsen - Wollongong, AUS
Jan Henrik Blöthe - Potsdam, D
Jens Bußmann - Osna, D
Dorothea Deus Malongo - Freiburg, D
Thomas Euler - BN, D
Hao Long - Bayreuth, D
Janneke Ijmker - RWTH Aa, D
Stephan Imbery - Giessen,D
André Kirchner - Leibzig, D
Sabine Kraushaar - UFZ Halle, D
Ariane Kujau - Bochum, D
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Riccardo Klinger - Berlin,D
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Martin Geilhausen - Salzburg, A
Joachim Götz - Salzburg, A

Sarah-Jane Phelan - Exeter, UK
Ronald E. Pöppl - ENGAGE Wien, A
Wouter van Gorp - Wageningen, NL
Bert Dusar - Leuven, BEL
Mathias Will - Exeter, UK
Emanuele Giachetta - Bari, IT
Anna Bucała - Kraków; POL

**Dozenten (außer Organisatoren) – Universität, Land**
Dr. Vincent Robin - Marseille, F
Prof. Richard Dikau – Bonn, D
Prof. Hans-Rudolf Bork – Kiel, D
Prof. Klaus Frädrich – Hamburg, D.
Prof. Tom Coulthard – Hull, UK
Prof. M. Fuchs – Gießen, D.
Prof. Gert Verstraeten - Leuven, BEL
Dr. Andreas Papritz, ETH Zürich, CH

* Für **Symposien und Sommerschulen** entfällt der Tabellenteil des Schlussberichts. Eine Teilnehmerliste, das endgültige Programm und Abstracts sollten beigefügt werden. Bitte geben Sie ggf. an, ob und wo die Beiträge der Veranstaltung veröffentlicht werden.