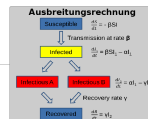
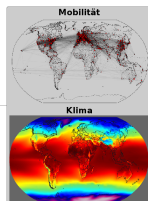


Klima und Mobilität

HyFly-TV4

Bewertung von Flughäfen nach klimatischen Standortfaktoren unter Berücksichtigung des weltweiten Flugverkehrs

P. Hoffmann

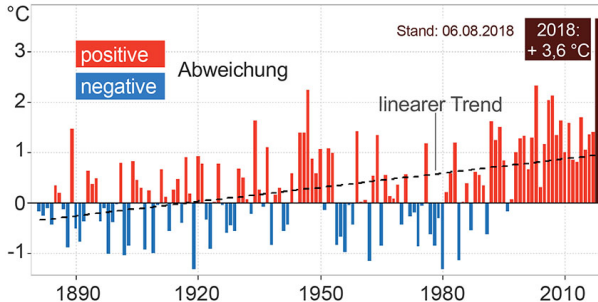


2018

Lufttemperatur April - Juli von 1881-2018



▼ Deutschland | Abweichungen vom vieljähr. Mittelwert 1961-1990



Ein Extremjahr in Mitteleuropa:

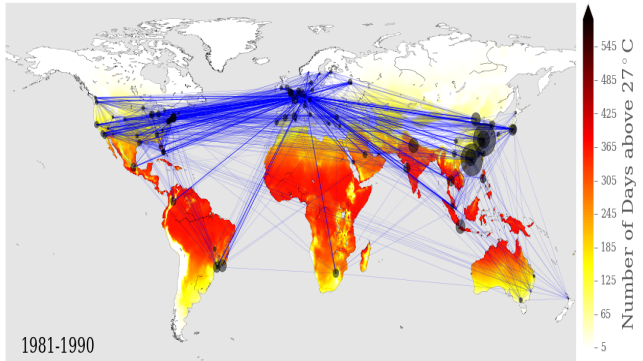
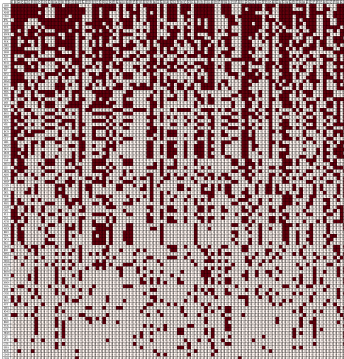
- Andauer: Hitze/Trockenheit
- Niedrigwasser
- Ertragsverluste
- Waldbrände
- Medienanfragen (>100)
- Referentenanfragen
- Folge: Projektrückstand (2-3 PM)

1. Arbeitsstand

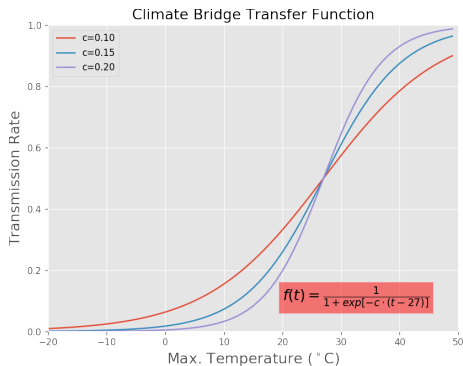
Arbeitspakete	Beschreibung	Stand
AS1-AP1	Klimatische Bewertung von Flughafenstandorten	100%
AS2-AP1	Klimabrücken durch Flugrouten	100%
AS2-AP2	Klimabedingte Infektionsbrücken	80%
AS2-AP3	Klimatische Bewertung von Flughäfen unter Berücksichtigung von Flugrouten	100%
AS2-AP4	Einfluss klimatischer Veränderungen auf die Bildung von Klima- & Infektionsbrücken	80%
AS2-AP5	Simulation von Infektionsübertragungen durch den Flugverkehr	80%
AS2-AP6	Ableitung eines Bewertungskatalogs zum Infektionsübertragungsrisiko	50%
AS2-MS1	07/2017: Identifikation von Klimabrücken	✓
AS2-MS2	06/2018: Bewertung von Flughäfen nach Klimabrücken	✓
AS2-MS3	02/2019: Risikoabschätzung von klima-bedingten Infektionsbrücken	(✓)

2. Daten und Methoden

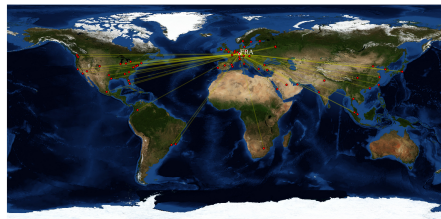
2.1. Netzwerk



2.2. Diagnostik - Klimabrücken

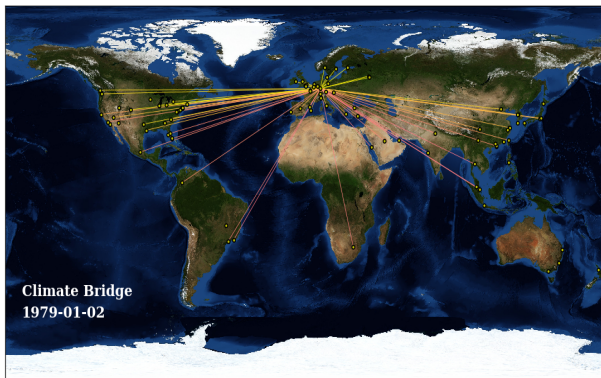


Klimabrücke



$$W_{CB} = \frac{f(T_a) + f(T_b)}{2}$$

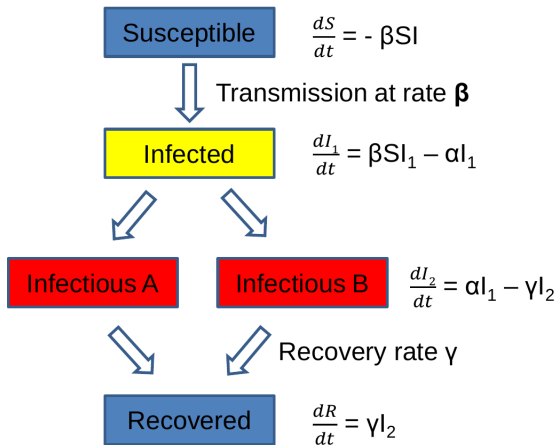
Klimabrücken - gewichtete Flugrouten



```
<node id="ATL">
<data key="city">Atlanta</data>
<data key="date">2016-12-29</data>
<data key="lat">33.636700</data>
<data key="lon">-84.428101</data>
<data key="population">1.839227</data>
<data key="tasmax">15.036804</data>
<data key="pr">5.207859</data>
</node>
```

```
<edge source="ATL" target="MCO">
<data key="weight">0.331124</data>
</edge>
```

2.3. Simulation - Verbreitung



Epidemiologie

empfänglich: S

Übertragungsrate: β

infiziert: I_1

erkrankt: I_2

Erholungsrate: γ

genesen: R

3. Ergebnisse

3.1. Netzwerkeigenschaften

Graph: un-/gerichtet, un-/gewichtet, graphml

NetworkX: python library

Socnetv: Visualisierungs-Tool

Knoten: 99/3284 Flughäfen

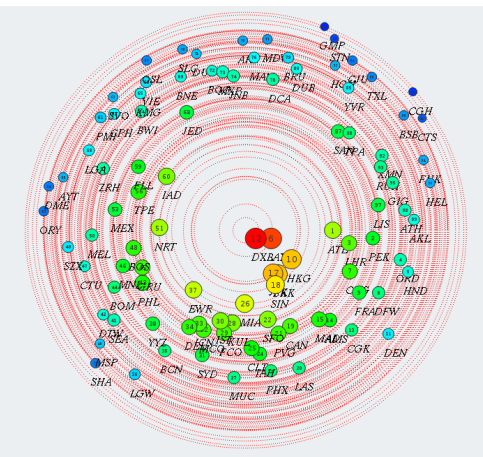
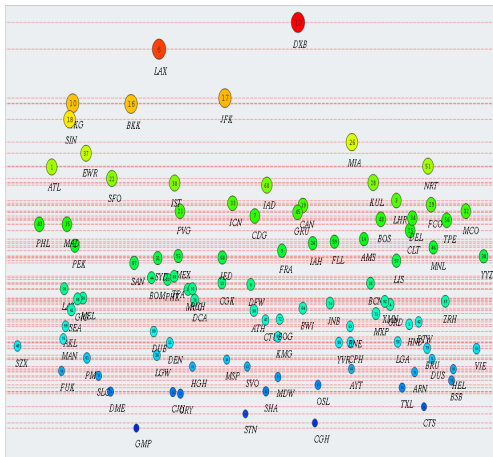
Kanten: 3255/37323 Flugrouten (Dichte=vorhanden/möglich=0.335)

Degree: Anzahl der Verbindungen je Knoten (hoher Degree viel Einfluss)

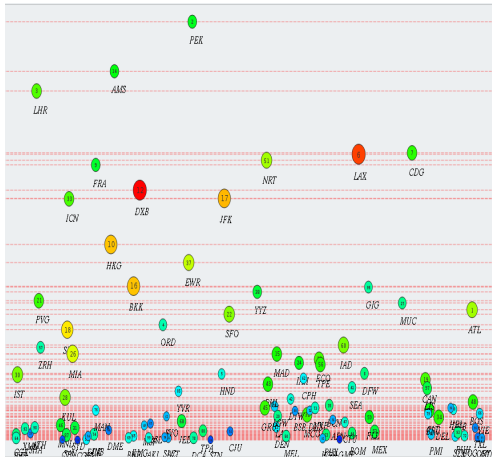
Betweenness-Centrality: Wahrscheinlichkeitsmaß, ob Informationsaustausch über einen dritten Akteur geführt wird

Closeness-Centrality: Isolierung von Akteuren eines Netzwerks

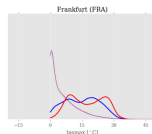
Degree: FRA (9)



Betweenness Centrality: FRA (9)



Node ↓	Label ↓	BC ↓	BC' ↓	%BC' ↓
2	PEK	460.971867	0.048493	4.849273
14	AMS	406.320450	0.042744	4.274358
3	LHR	384.550413	0.040453	4.045344
7	CDG	316.385551	0.033283	3.328272
6	LAX	314.926350	0.033129	3.312922
51	NRT	308.293371	0.032431	3.243145
9	FRA	303.118995	0.031887	3.188712
12	DXB	275.352335	0.028966	2.896616
17	JFK	266.222996	0.028006	2.800579
33	ICN	265.734938	0.027954	2.795444
10	HKG	215.449521	0.022665	2.266458
37	EWR	195.526192	0.020569	2.056871
16	BKK	169.500310	0.017831	1.783088
95	GIG	168.456691	0.017721	1.772109
38	YYZ	163.228761	0.017171	1.717113

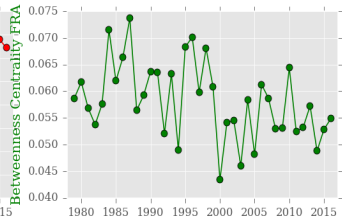
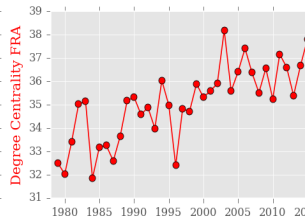
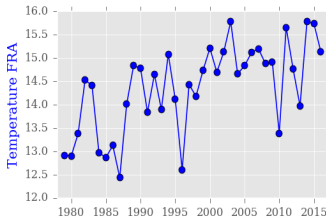
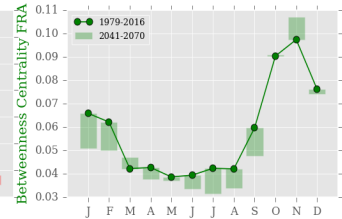
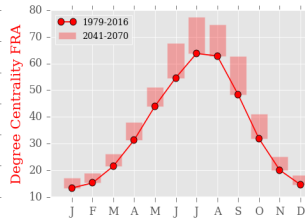
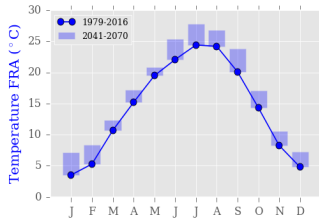
[illegible]

Frankfurt

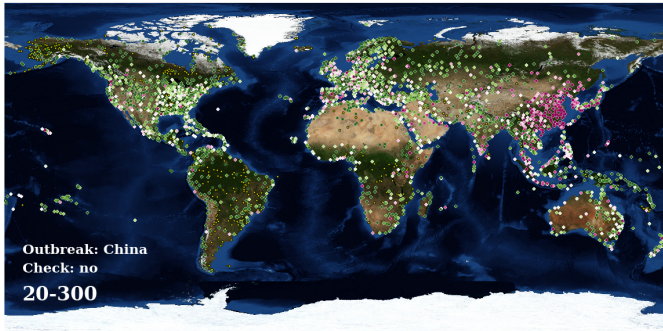
ranking

	DEG	BC
1979-2016	9.	6.
2041-2070	7.	6.

Frankfurt: Temperatur, Degree, Betweenness Centrality



3.3. Ausbreitungsrechnung



Pandemie

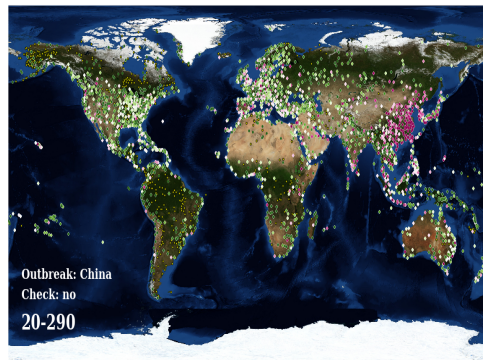
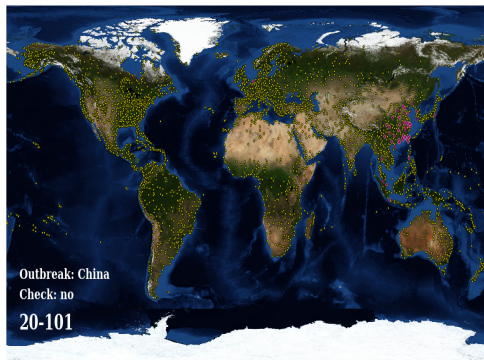
Region: Mexiko, China

Check: mit und ohne

Ensembles: 20

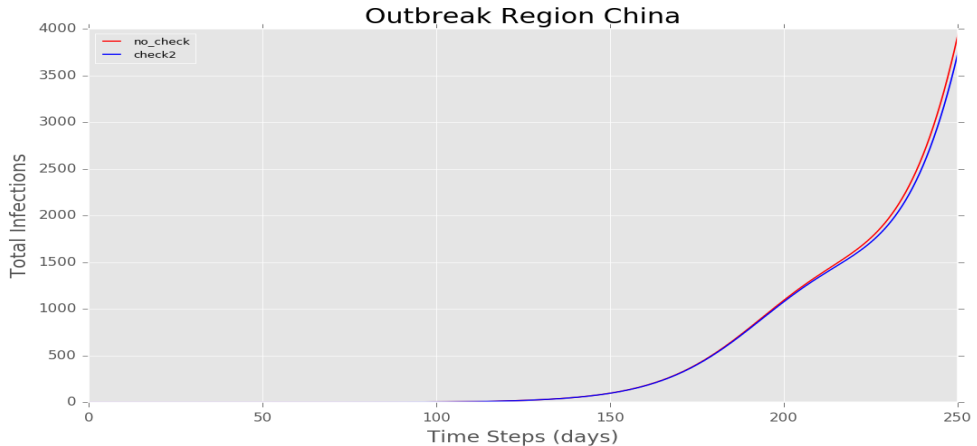
Ergebnis: Zeitschritte
<150 / >250

Ausbruch China



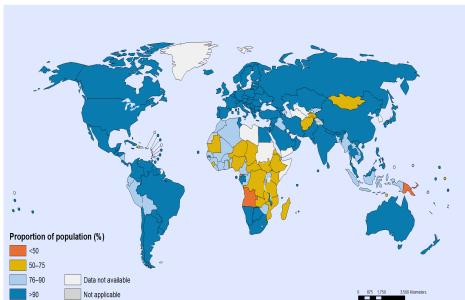
[LINK](#)

Ausbruch China: check-0.2 (Hong Kong, Peking, Shanghai)



3.4. weitere Faktoren: Water, Sanitation, Hygiene

Proportion of population using improved drinking water sources (%), 2015



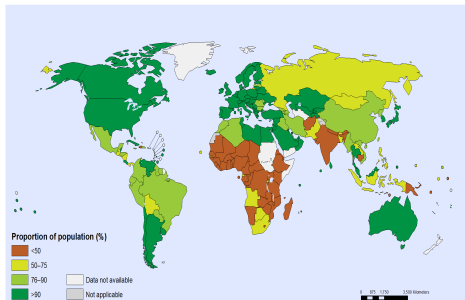
The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the distribution of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization



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Proportion of population using improved sanitation facilities (%), 2015



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the distribution of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization



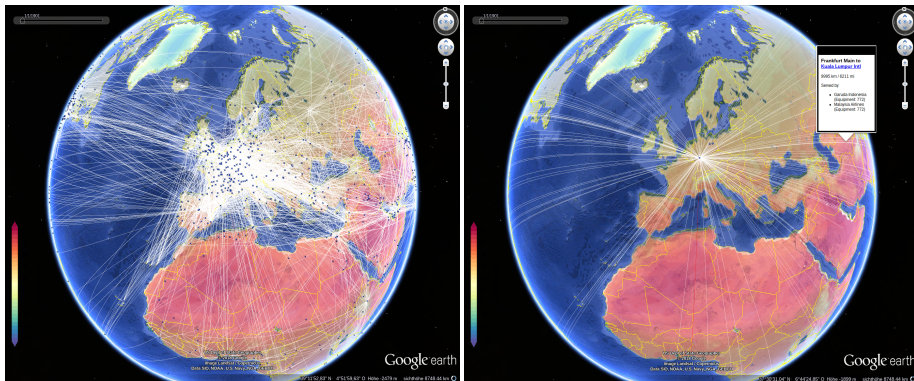
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4. Ausblick

4.1. Restarbeiten

- Ausbreitungsrechnungen unter Berücksichtigung klimatischer Einflussfaktoren
- Interpretation der Resultate
- Bewertung anderer Einflussfaktoren (z.B. Hygiene)
- Konferenzbeitrag & Veröffentlichungen
- Integration der Ergebnisse in Google-Earth

4.2. Google-Earth



4.3. Konferenzbeitrag: EMS2019 in Kopenhagen



OSA2 – Applications of meteorology

OSA2.1

Reducing weather risks to transport: air, sea and land ▶

Convener: Fraser Ralston 🔍 | Co-Convener: Christine Le Bot 🔍

[Abstract submission](#)

EMS Annual Meeting Abstracts
Vol. 16, EMS2019-236, 2019
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Assessment of climate bridges in the world air traffic network using centrality measures

Peter Hoffmann

Potsdam Institute for Climate Impact Research, Climate Impacts & Vulnerability, Potsdam, Germany
(peterh@pik-potsdam.de)

4.4. Publications (Manuscript)

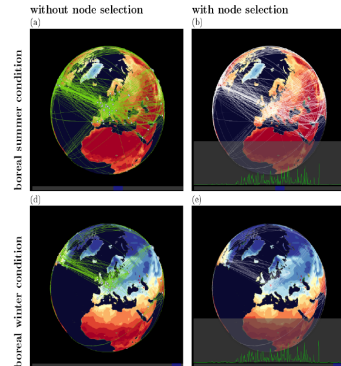
IEEE COMPUTER GRAPHICS AND APPLICATIONS, VOL. X, NO. Y, AUGUST 2019

GPU-based, interactive Exploration of large spatio-temporal Climate Networks

Stefan Buschmann, Peter Hoffmann, Ankit Agarwal, Norbert Marwan, and Thomas Nocke

Abstract—This paper introduces the GPU-based tool GTX integrating a set of highly interactive techniques for visual analytics of large geo-referenced networks from the climate research domain. The visual exploration of these networks faces a multitude of challenges related to the geo-reference and the size of these networks with up to several million edges and the manifold types of such networks. In this paper, solutions for the interactive visual analysis for several distinct types of large networks will be discussed, in particular time-dependent, multi-scale, and multi-layered ensemble networks. Custom-tailored for climate researchers, the GTX tool supports heterogeneous tasks based on interactive, GPU-based solutions for on-the-fly large network data analysis, as well as for 2D and 3D information visualization (GPGPU methods, fragment and geometry shaders, billboards). These solutions are illustrated for two use cases: climate infection risk and multi-scale climatic process networks.

Index Terms—Information Visualization, Visual Analytics, Networks, Graphs, Climate, Infectious Diseases, GPGPU



Danke für die Aufmerksamkeit!

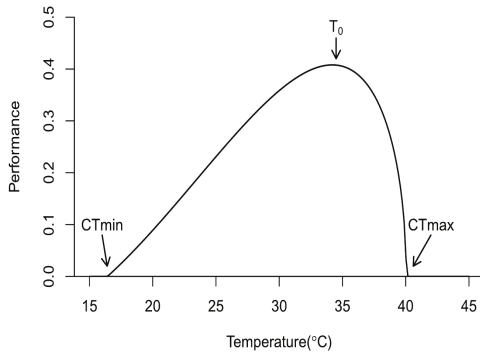
Anhang

Probenentnahme

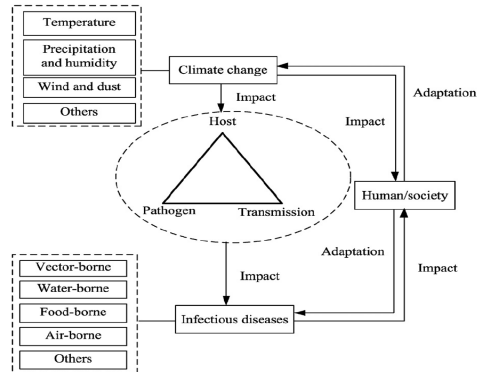
°F	30.11.2017	01.12.2017	24.01.2018
Frankfurt, Deutschland	36	32	48
Pune, Indien	–	–	–
Johannisburg, Südafrika	(66)	60	57
Hanoi, Vietnam	75	71	72
Peking, China	–	–	–

Literatur

Lafferty et al (2016)



Wu et al (2016)



Gesamtnetzwerk

