

48th IAH Congress

Inspiring Groundwater

Lena Kämpfner, Thomas R. Rüde, Doni P. E. Putra

Vulnerability Assessment of a Tropical Cone Karst Area in Gunung Kidul (Java) as a Resource for a Water Supply Improvement in a Changing Climate

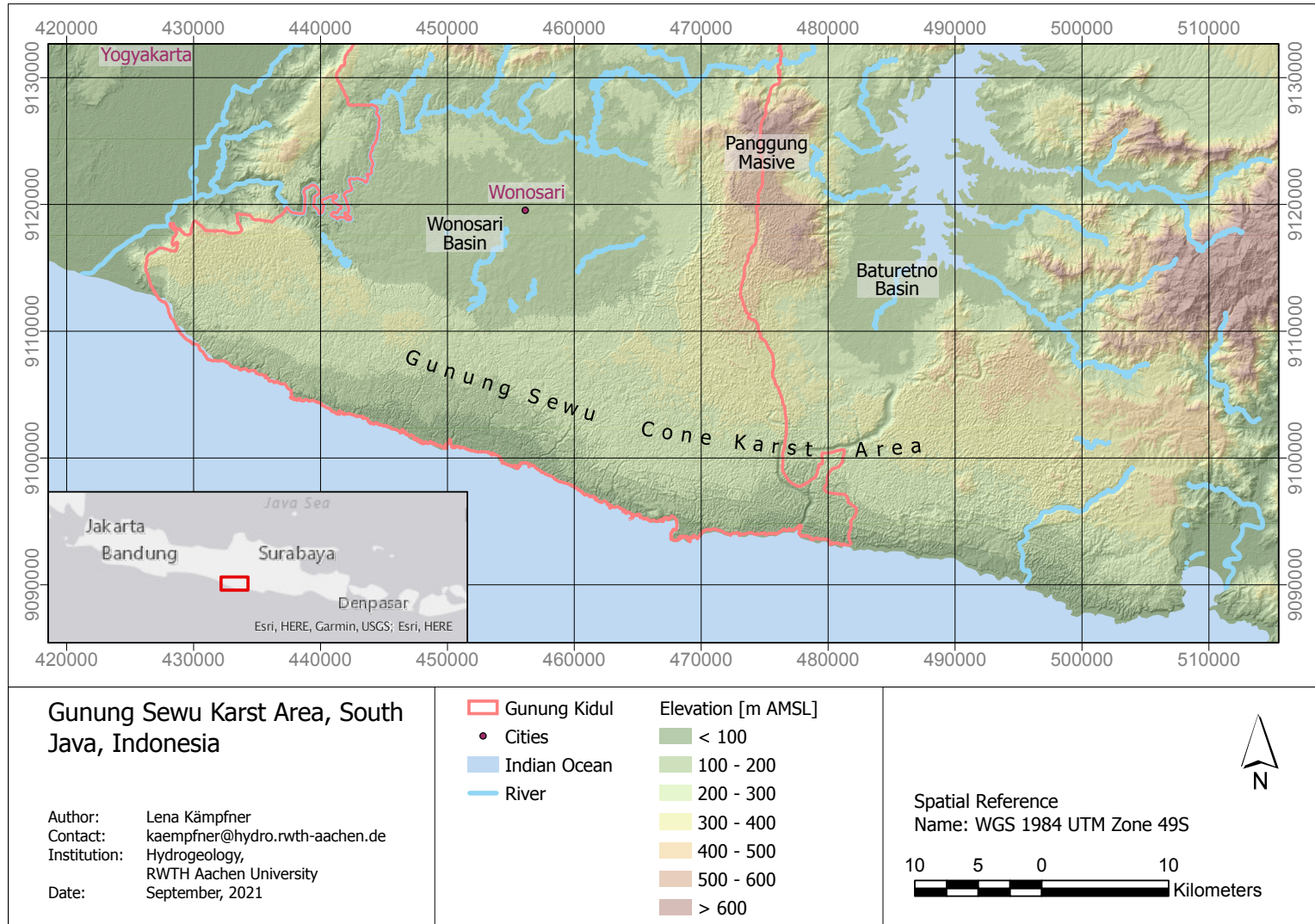


Agenda

- Introduction to the Research Area
- Water Supply Issues 2020
- Vulnerability Assessment of a Cone Karst Area
- Impact of Climate Change in Gunung Sewu
- Conclusion and Outlook



Gunung Sewu Cone Karst Area



Water Supply Issues in 2020

- Severe drought as reoccurring issue
- Dug wells often dry out during dry season
- 11 of 18 subdistricts applied for clean water distribution
- Approx. 130,000 inhabitants affected
- Intervention by the National Board of Disaster Management (BPDP)
- 550 clean water tanks distributed

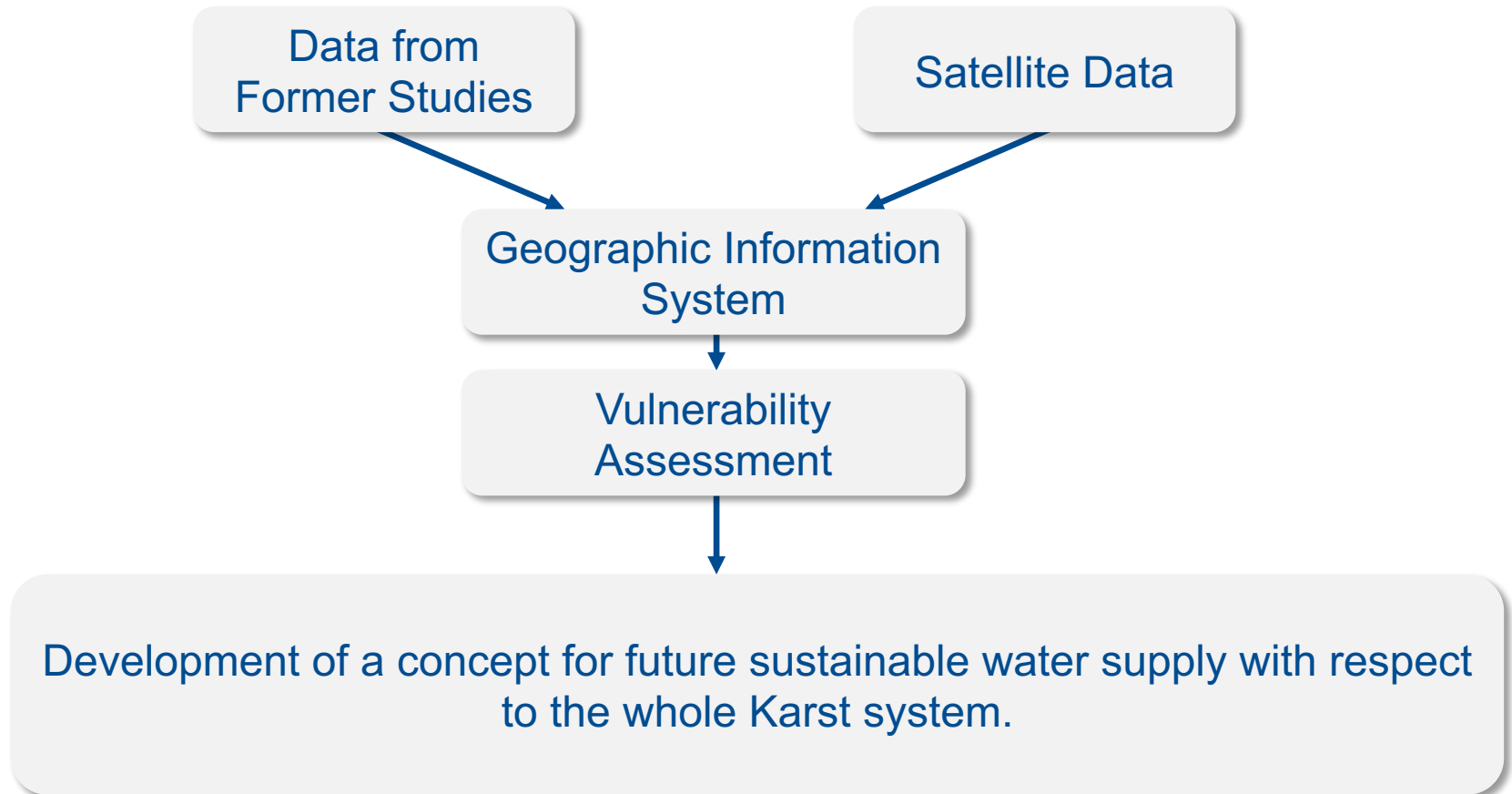


[<https://www.facebook.com/BPBD.GK/>, 22.06.21]

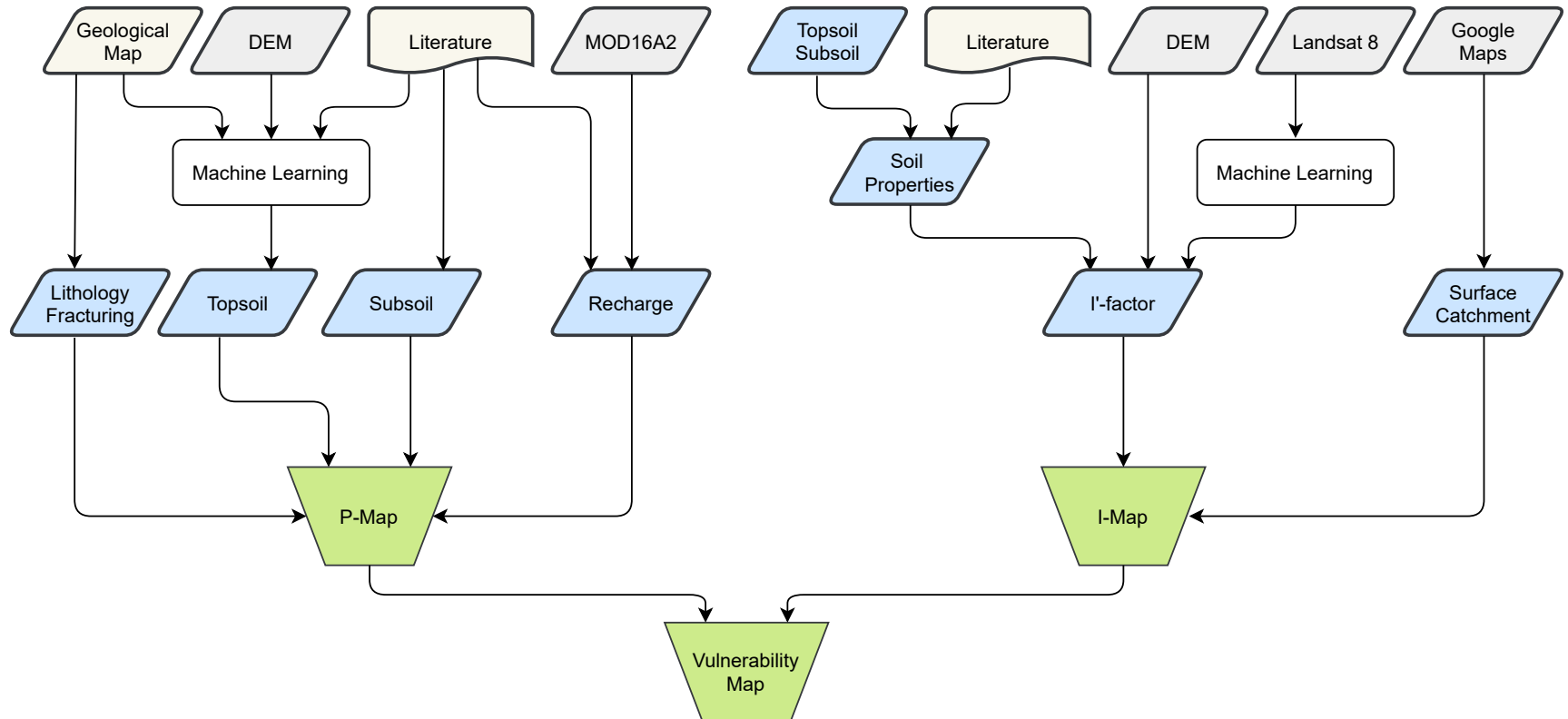
[nasional.tempco.co, 02.09.2020]



Objective: Tackle Clean Water Scarcity



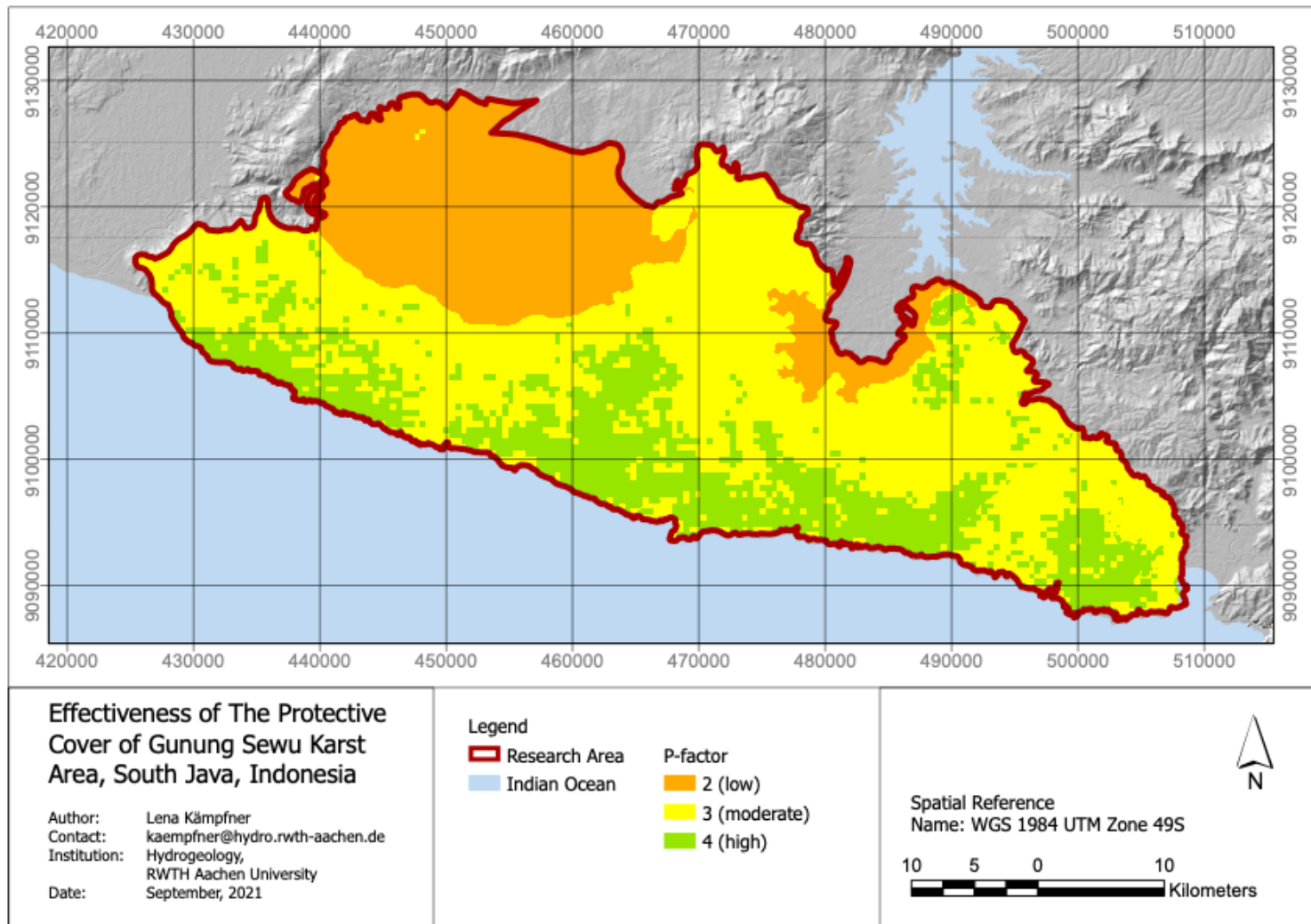
Vulnerability Assessment – Methodology



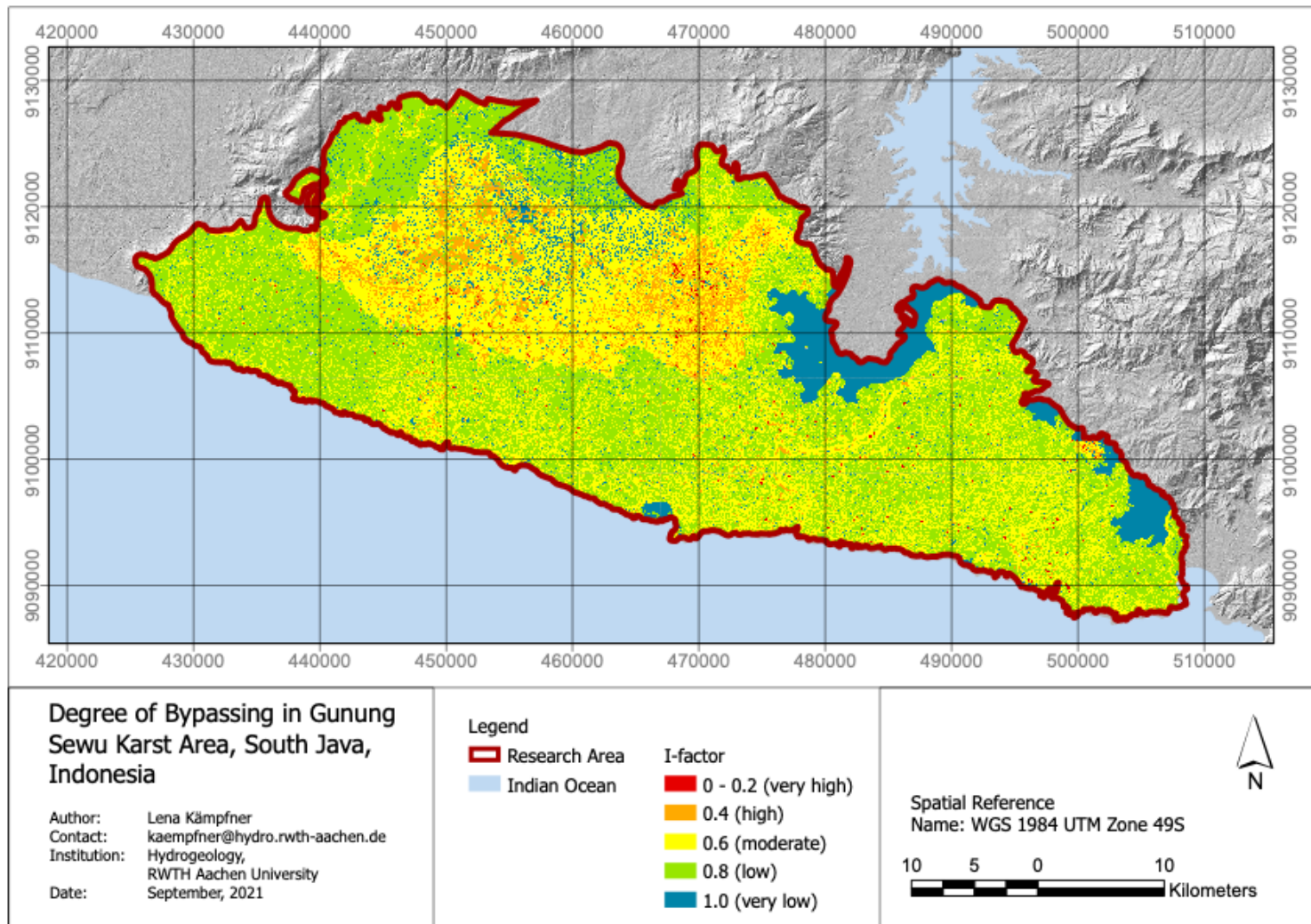
[PI-Method according to Goldscheider et al., 2000]



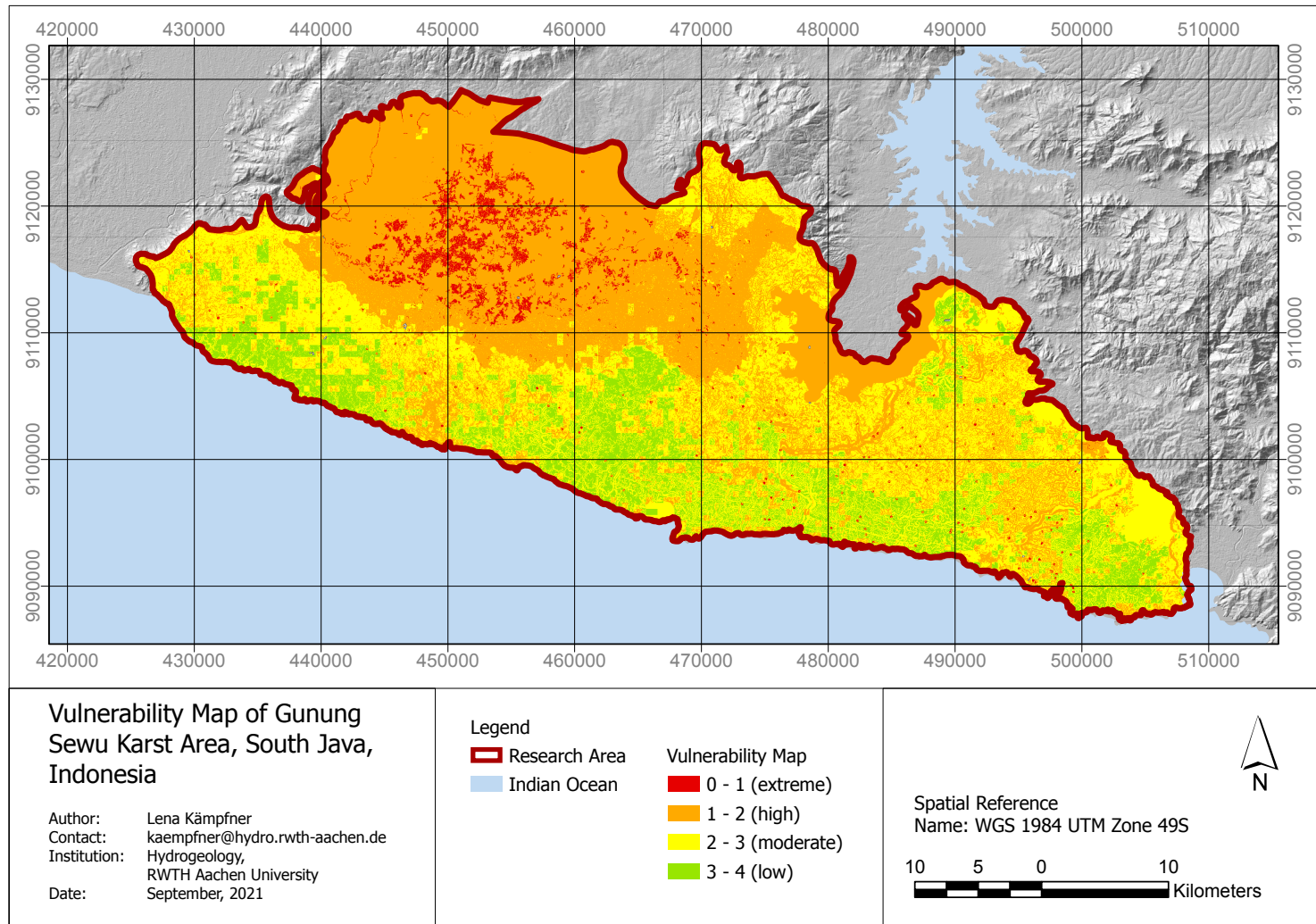
Effectiveness of the Protective Cover



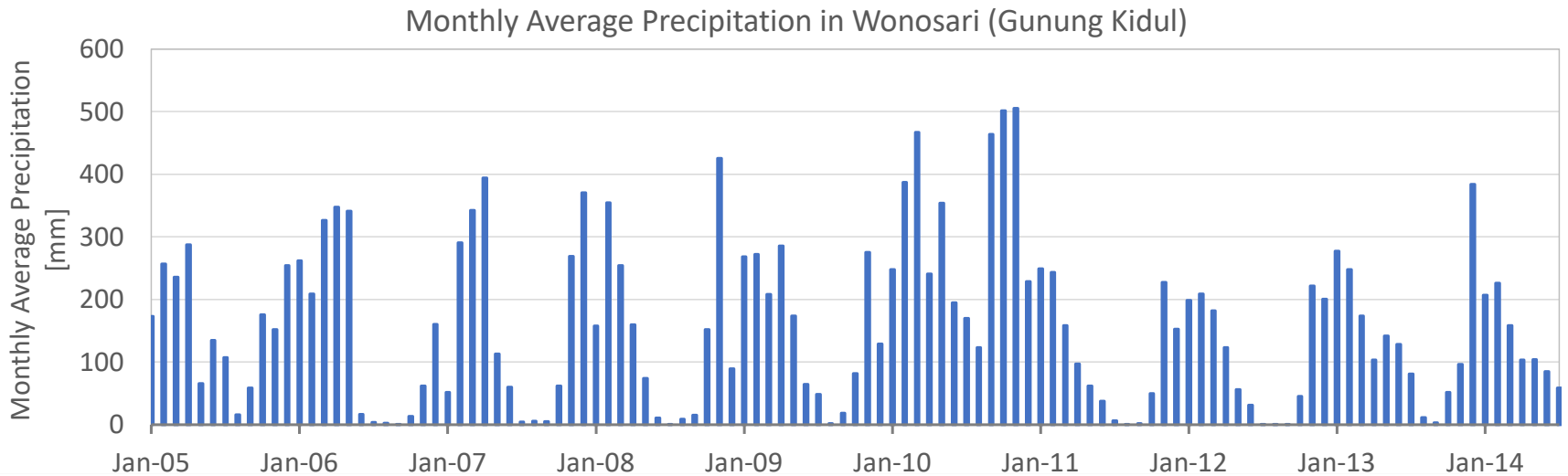
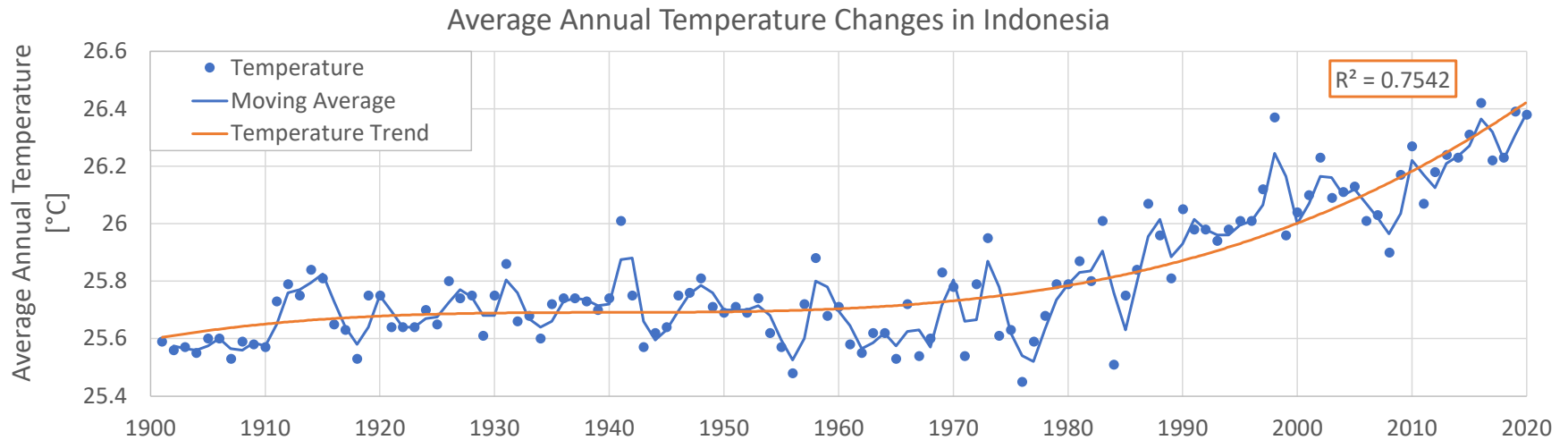
Degree of Bypassing



Vulnerability Assessment



Impacts of Climate Change

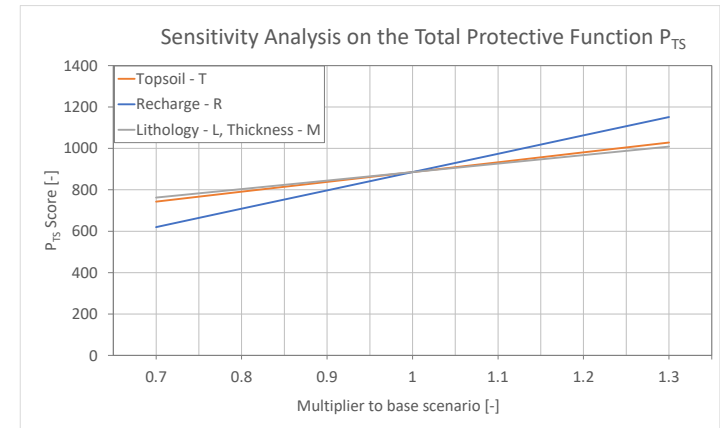


[Data Source: Climate Risk Profile Indonesia, Worldbank, 2021; globalweather.tamu.edu, 2021]



Impacts of Climate Change in Gunung Sewu Karst

- Recharge has highest impact on the effectiveness of protective cover
- Trend of rainfall intensity higher in wet season and lower in dry season
- Flood events reported in wet season
- Periods of drought in dry season



$$P_{TS} = \left[T + \underbrace{\left(\sum_{i=1}^m S_i M_i + \sum_{j=1}^n B_j M_j \right)}_{=0} \right] R$$

[Goldscheider et al., 2000]

Base Scenario		
Topsoil T	T	559
Recharge R	R	0.85
Lithology * Fracturing	B	7.4
Thickness	M	65.3

[Brunsch et al., 2011; Cahyadi et al., 2019]



Conclusion and Outlook

- Gunung Sewu Karst area shows mainly moderate to high groundwater vulnerability
- Eastern and Southern Karst areas show lowest vulnerability
- Further studies in eastern area needed for more detailed groundwater resource estimations
- More intense rainfall events can lead to higher vulnerability
- Risk assessment needed for drought and extreme rainfall

The development of a sustainable water supply concept needs to take into account the effects of climate change on groundwater vulnerability and risk management.



Thank you for your attention!

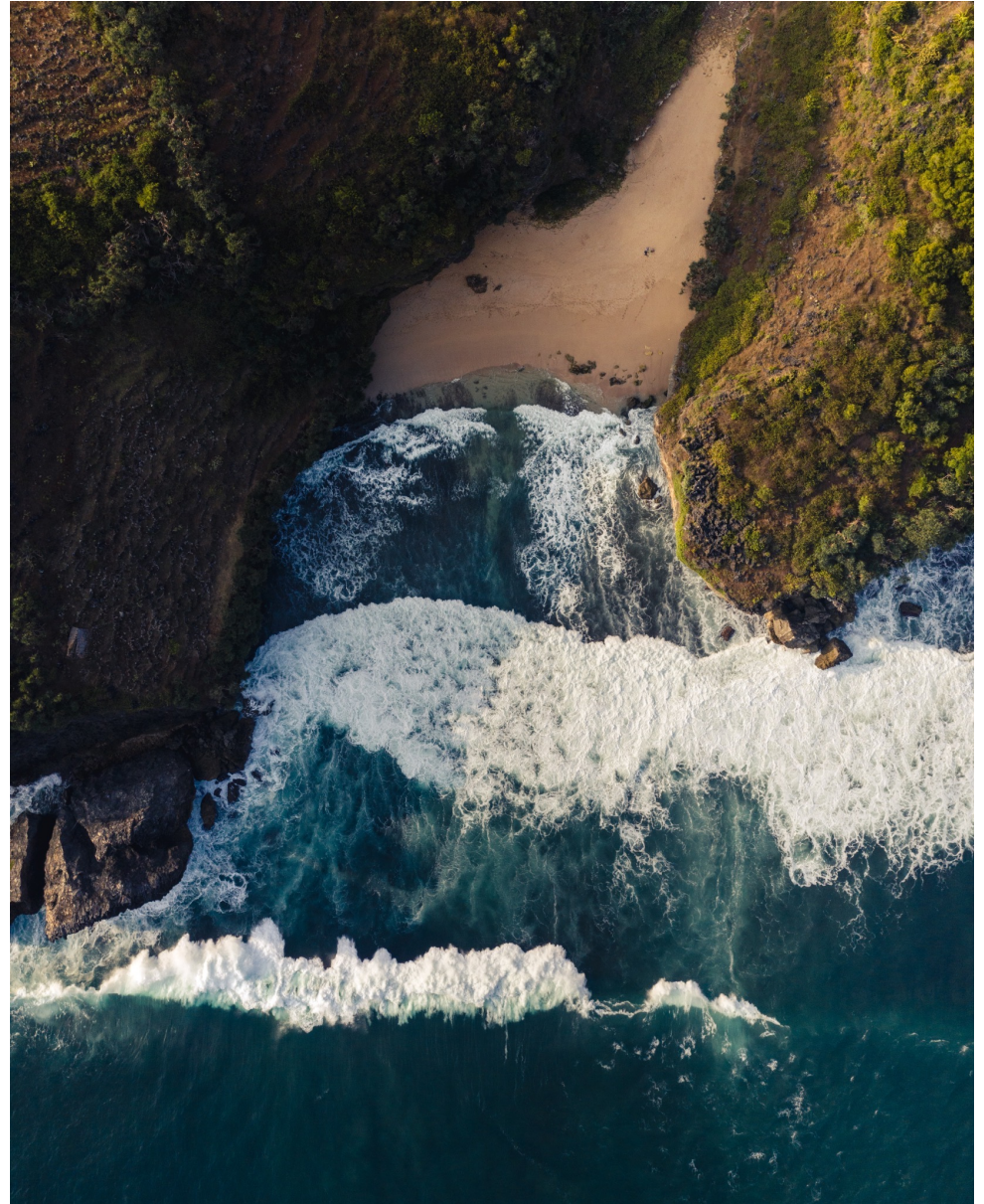
Lena Kämpfner, M. Sc.

Hydrogeology

RWTH Aachen University

Germany

kaempfner@hydro.rwth-aachen.de



List of References

Literature:

- Haryono, E. and Suratman, *Significatant Features of Gunung Sewu Karst as Geopark Site*, 4th International UNESCO Conference on Geopark, 2010
<https://nasional.tempo.co/read/1381761/kekeringan-melanda-15-dari-18-kecamatan-di-gunungkidul> [accessed: 22.06.2021]
- Iván, V. and Mádl-Szőnyi, J., *State of the art karst vulnerability assessment: overview, evaluation and outlook*, Environmental Earth Science (76:112), 2017
- Goldscheider, N., Klute, M., Sturm, S. and Hötzl, H., *The PI-Method – a GIS-based approach to mapping groundwater vulnerability with special consideration of karst aquifers*, Zeitschrift für Angewandte Geologie (46, 3:157-166), 2000
- Climate Risk Profile: Indonesia (2021): The World Bank Group and Asian Development Bank
<https://climateknowledgeportal.worldbank.org/country/indonesia/climate-data-historical> [accessed: 30.08.2021]
- <https://globalweather.tamu.edu>. (accessed: 30.08.2021)
- Cahyadi, A., Haryono, E., Adji, T. H., Widyastuti, M., Riyanto, I. A., Nurteisa, Y. T., Fatchurohman, H., Reinhard, H., Agniy, R. F., Nurkholis, A., Naufal, M. and Nurjani, M., Groundwater Flooding due to Tropical Cyclone Cempaka ind Ngreneng Karst Window, Gunungsewu Karst Area, Indonesia, E3S Web of Conferences (125, 01020), 2019
- Brunsch, A., Adji, T. N., Stoffel, D., Ikhwan, M., Oberle, P. and Nestmann, F., Hydrogeological Assessment of a Karst Area in Southern Java With Respect to Climate Phenomena, Asia Trans-Disciplinary Karst Conference, Yogyakarta-Indonesia (55), 2011

Satellite Data:

- Digital Elevation Model: <http://tides.big.go.id/DEMNAS/index.html> [accessed: 04.09.20]
- Landsat 8 OLI/TIRS L2: https://www.usgs.gov/centers/eros/science/usgs-eros-archive-landsat-archives-landsat-8-9-olitirs-collection-2-level-2?qt-science_center_objects=0#qt-science_center_objects [accessed: 03.08.21]
- MOD16A2 v006: <https://earthexplorer.usgs.gov/scene/metadata/full/5e83d0b656b77cf3/LC81190662020076LGN00/> [accessed: 18.06.21]

