

Comparative analysis of impacts of groundwater droughts in a European context

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Introduction

- Because groundwater is the main source of water supply, droughts propagating into groundwater systems pose a threat to water security.
- There is a need to study groundwater droughts in general.
- In particular, within the **Groundwater Drought Initiative (GDI) project**, we aim to understand the impacts that groundwater droughts have on environmental systems and society.
- In this study, we screened the European Drought Impact Inventory (EDII, Stahl et al. 2016) for groundwater-related impacts and present some first results.

Aims

- To compile a European dataset of groundwater-related impact reports.
- To systematize groundwater-related impacts into meaningful categories.
- To analyze said impacts over time and between different climatic and legislative settings (i.e. different countries).
- To accommodate for these aims, first answering the questions: is there a) enough reports for analysis, and b) enough difference between countries?

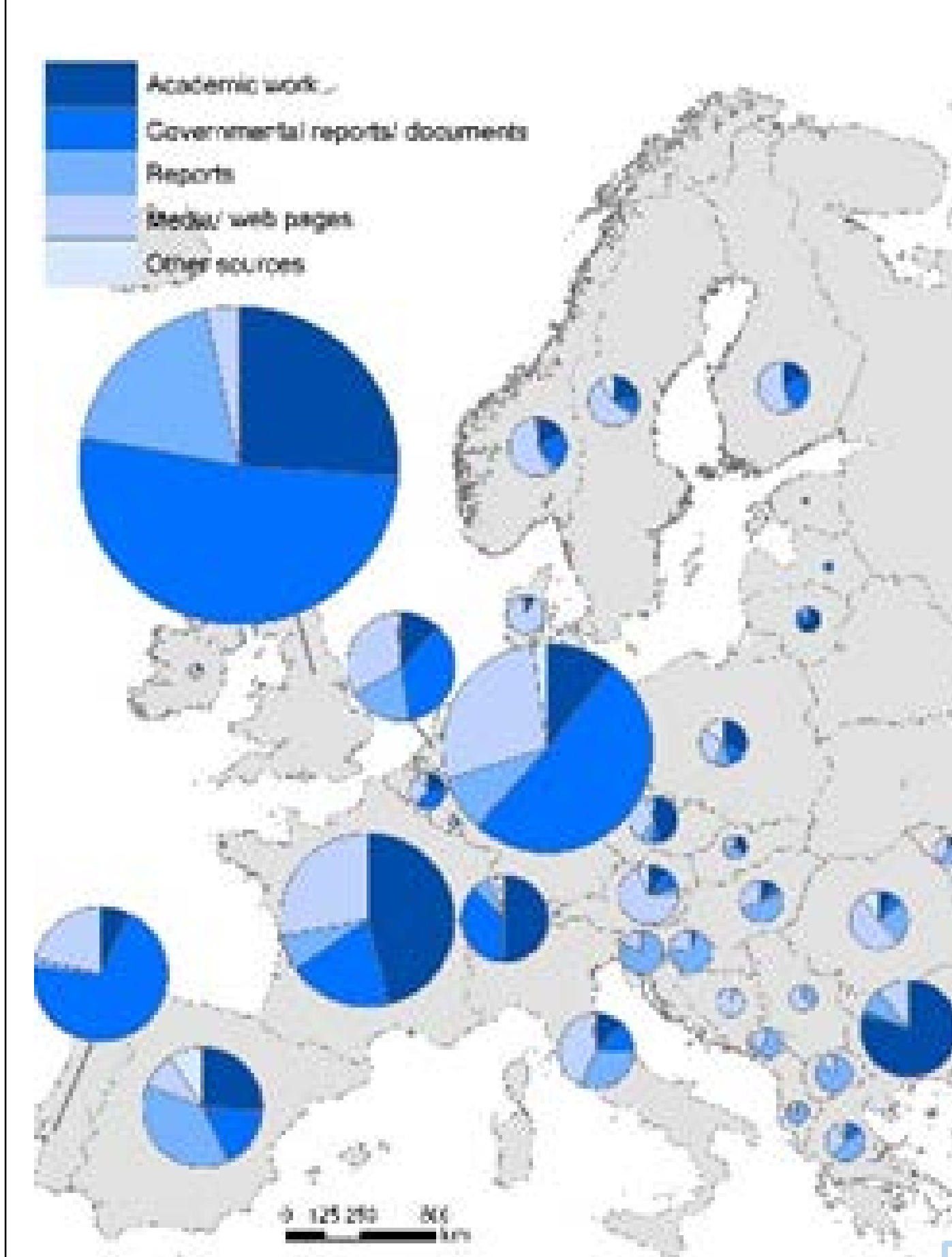


Figure 2: Word cloud of keywords related to groundwater drought in the EDII. Word size relates to number of impacts associated with it.



Data selection

- As a database, we use the EDII, which contains reports of drought impacts in 15 different categories.
- To synthesize groundwater-related impact reports from the EDII, we used a semiautomatic screening approach:
 - First, we manually screened ~1/3 of the EDII impacts to derive keywords.
 - Second, we automatically searched the rest (~2/3) of the EDII based on derived keywords.

← **Figure 1:** Distribution of impact reports in Europe (Stahl et al., 2016).

Exploration of groundwater drought impacts

Out of 8506 reported impacts in the EDII, there are 245 groundwater-related impacts (without duplicates), unequally distributed over space & time

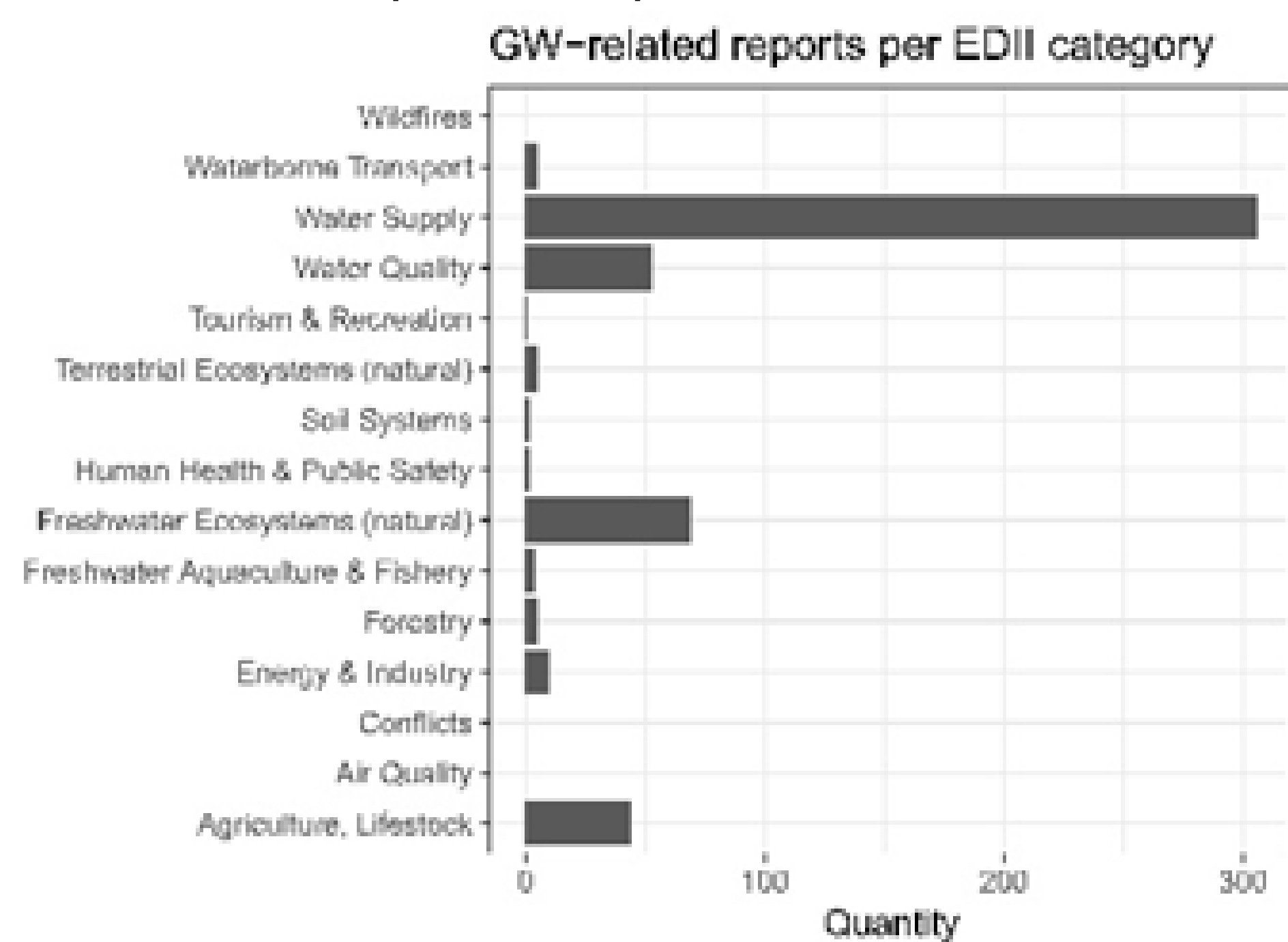


Figure 3: The number of groundwater-related impact reports in each of the impact categories of the EDII.

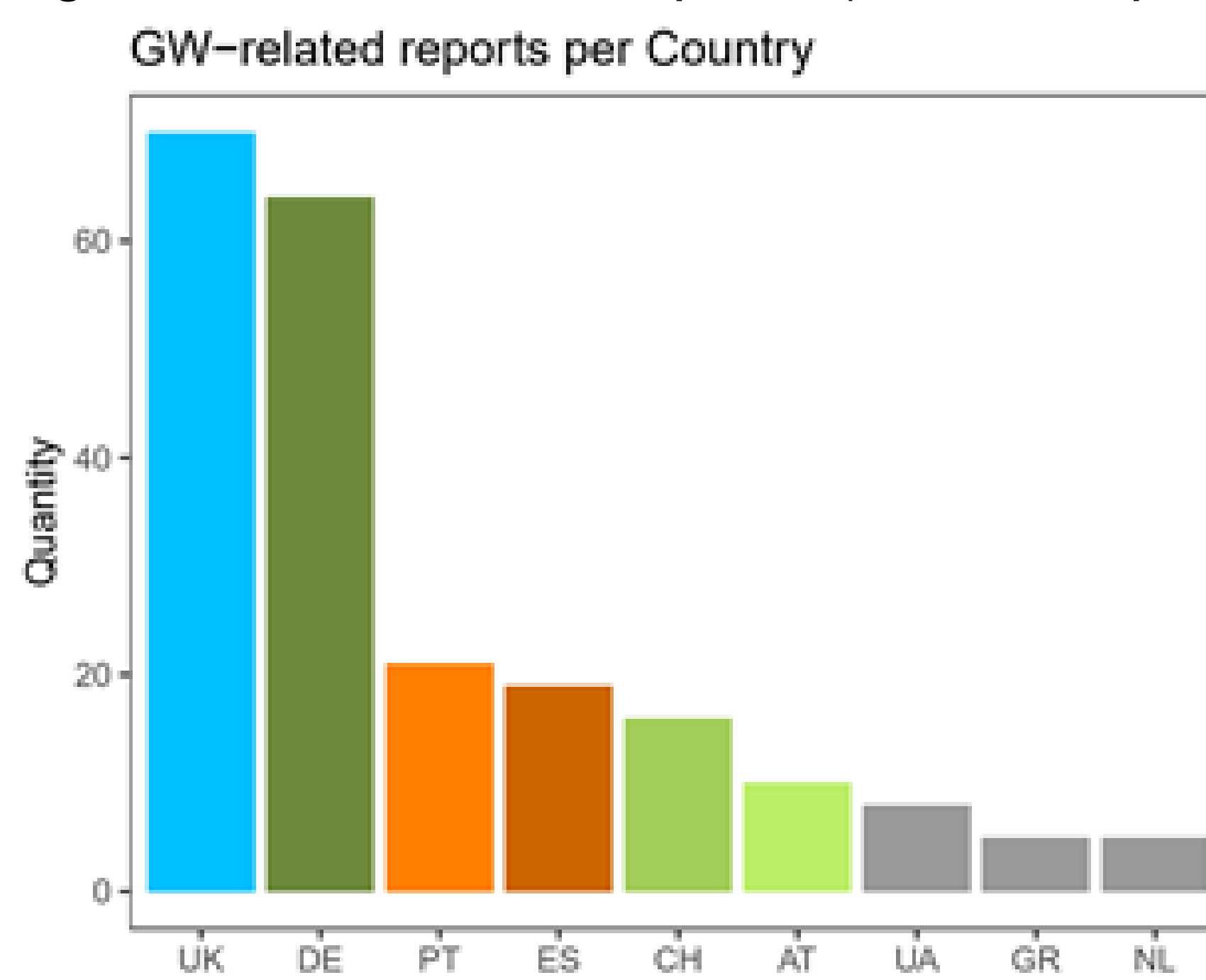


Figure 4a): Number of groundwater-related impact reports for every country in Europe.

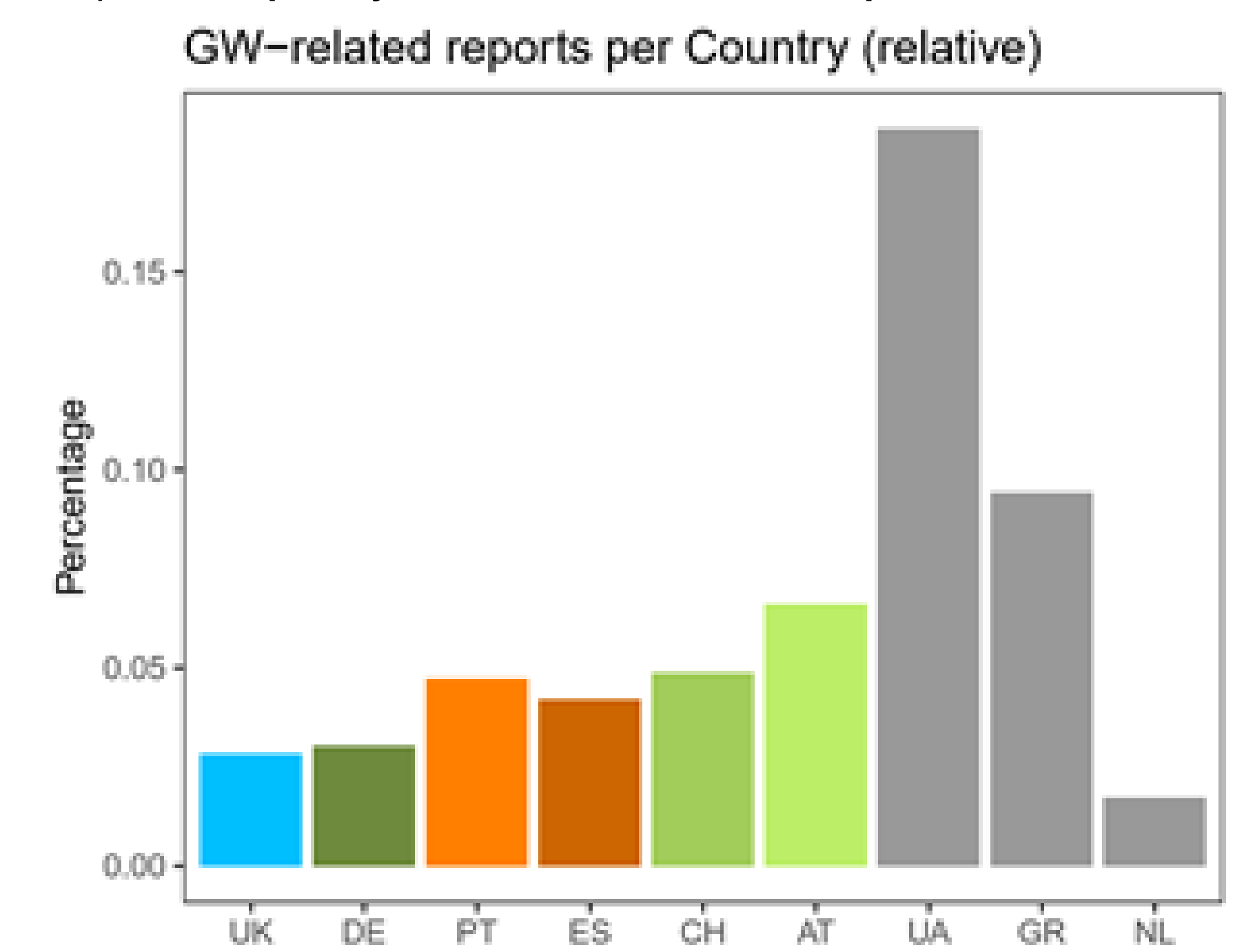


Figure 4b): Percentage of groundwater-related impact reports (relative to absolute number of impacts reports) for every country in Europe.

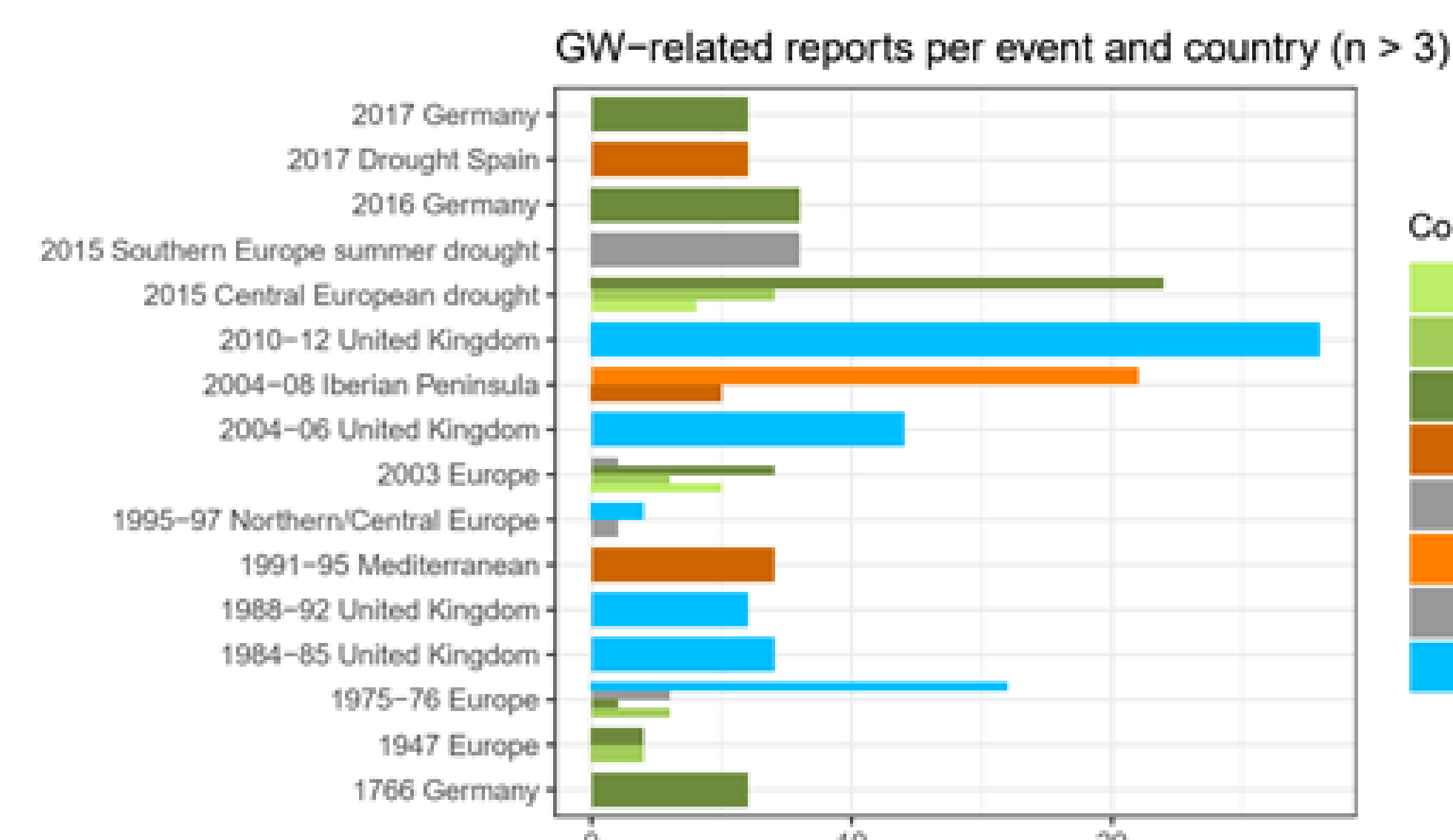


Figure 5: Number of impacts per event and country. Only events with n>3 impacts are shown.

Figure 6: Newly defined groundwater-related impact categories, ranked according to overall number of reports, and compared between three macro-regions: The UK, The DACH region (Germany/Switzerland/Austria), and the Iberian region (Portugal/Spain). Yellow columns indicate where groundwater is acting as an impacted resource. Red columns indicate where groundwater is acting as a drought mitigation agent.

	Total	DACH	UK	ES/PT
Total	244	90	70	41
Dried-up GW resources	71	44	11	6
Low GW levels	68	18	25	9
Decreased spring discharge	21	14	2	2
Deteriorated GW quality	17	4	3	5
Low GW discharge	3	1	2	
Drilling of new wells/boreholes	17		5	9
Use of alternative GW sources	14		10	3
Increased GW abstraction	12	3	2	5
GW augmentation of low flows	7		6	1
Other	14	6	4	1

Conclusions

- Groundwater acts in fundamentally different roles:
 - Groundwater as an impacted resource
 - Groundwater as a drought hazard, causing impacts in other systems
 - Groundwater as a drought mitigation agent, alleviating impacts in other systems
- Case study comparison yields regional differences:
 - Less frequent reporting of critical GW conditions as an impact in Iberia
 - GW almost never reported as drought mitigation agent in the DACH region.

Future steps

- Increase dataset: Looking for more impact reports!
- Timewise analysis: Do impacts cascade in time?
- Find more information about groundwater management in specific events to understand processes
- Combine with GDI European groundwater level dataset to analyse effects of abstraction on groundwater drought

Acknowledgements

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References

Stahl et al. (2016): Impacts of European drought events: insights from an international database of text-based reports. In *Nat. Haz. Earth Syst. Sci.* 16 (3), pp. 801-819.
Heudorfer et al. (2019, in preparation): Impacts of major groundwater droughts based on the European Drought Impact Inventory (EDII).



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