Combining novel visualizations of temporal changes with maps using satellite time series of vegetation moisture

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Visualizations are important tools for conveying complex information and managing massive amounts of data [1]. With increasing computational power and data accessibility, selecting the appropiate visualization to communicate scientific information to a broader audience has become increasingly difficult. Examples of popular temporal visualizations include Warming Stripes [2] and the Climate Spiral [3] by Ed Hawkins. These visualizations provide inspiration for this thesis to adapt these models for other environmental data and for examining the multifaceted topic of wildfires. In addition, a research gap was identified and addressed within this study by empirically researching the awareness and effectiveness of Warming Stripes, which had not been explored before.

Data

Three variables were selected to demonstrate the development of fire risk factors between 1988 and 2016. All variables play an important role in the estimation of wildfires. Life Fuel Moisture Content (LFMC) refers to the moisture content of the vegetation canopy and its derivation through passive microwave remote sensing is a novel technique that is still under extensive research [4]. Fire Weather Index (FWI) is an index for estimating the potential of fire ignition and spread and is similar to temperature (TEMP) based on meteorological data.

Fig. 1: Visualization 1 - Modification of Warming Stripes using Small Multiples with multivariate data of LFMC, FWI and TEMP in summer seasons of Southern Europe

Methodology

Multiple approaches were employed to answer the defined research questions:

− Creation of a visualization process for visualizing LFMC, FWI and TEMP

− Survey to evaluate awareness and effectiveness of Warming Stripes

− Adaptation of Warming Stripes with multivariate data and global spatial representation

− Exploratory data analysis of missing data for LFMC and FWI

− Creation and evaluation of static alternative visualizations based on novel visualizations (see Fig. 1 and Fig. 2)

Results

A modification of Warming Stripes with aggregated spatial areas did not provide comparable results to those in literature. Also, the awareness and effectiveness of Warming Stripes could not be proven within the sample group of 42 participants. As a result, only the most prominent part of this visualization, the color scheme was preserved and the visualization type of Small Multiples was chosen for Visualization 1 (see Fig. 1). Within the modification of the Climate Spiral, patterns of missing data as well as seasonal patterns were made visible (see Fig. 2). Nonetheless, the goal of incorporating all variables within one static map was not successful.

Conclusion

For the tasks identified during the visualization process, it was found that the alternative visualizations were appropiate, even though Visualization 2 could not fulfill all the requirements. In comparison to other (spatio-)temporal visualizations, the alternative visualizations were effective in depicting trends, regional variability and seasonal variability.
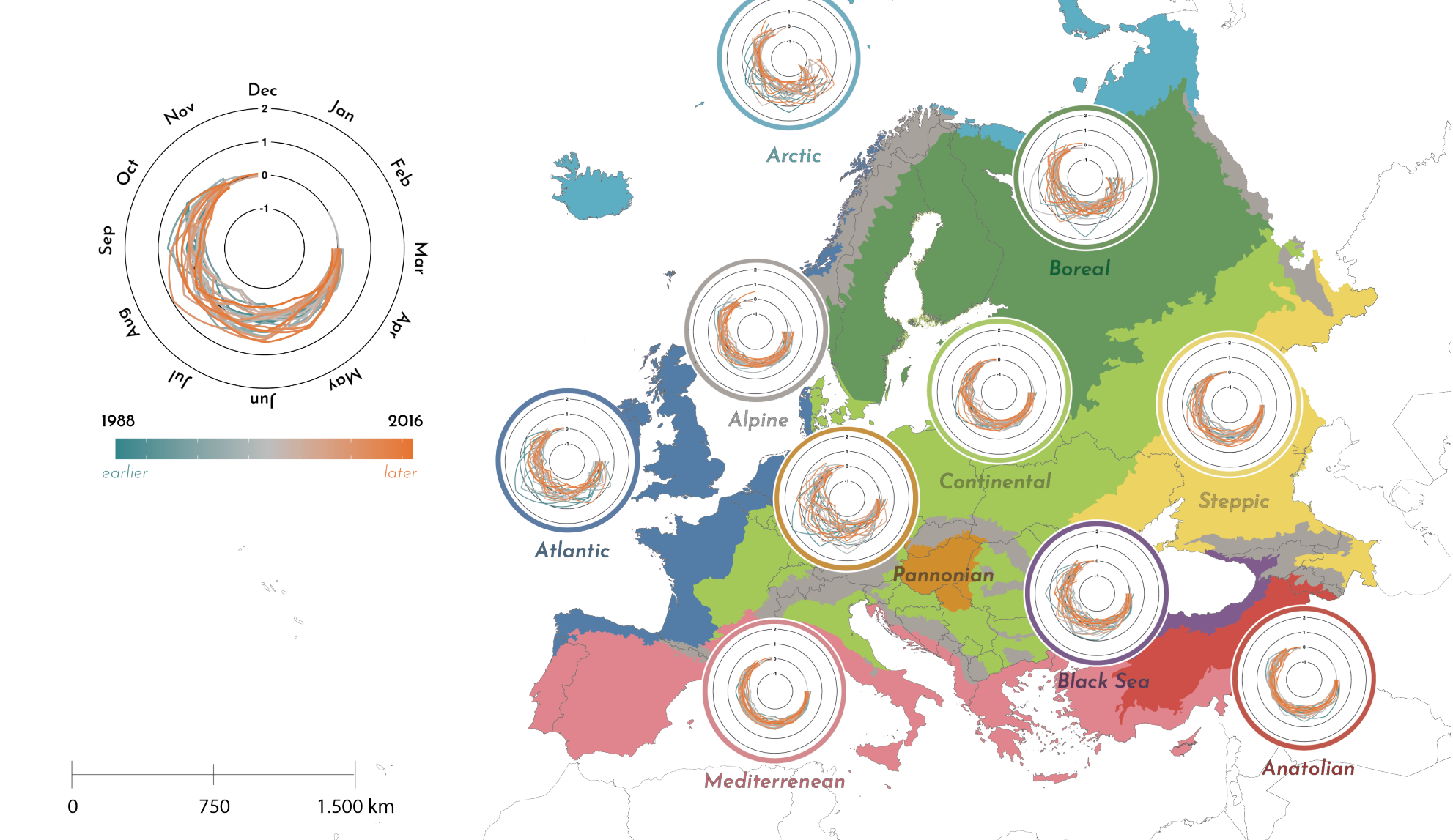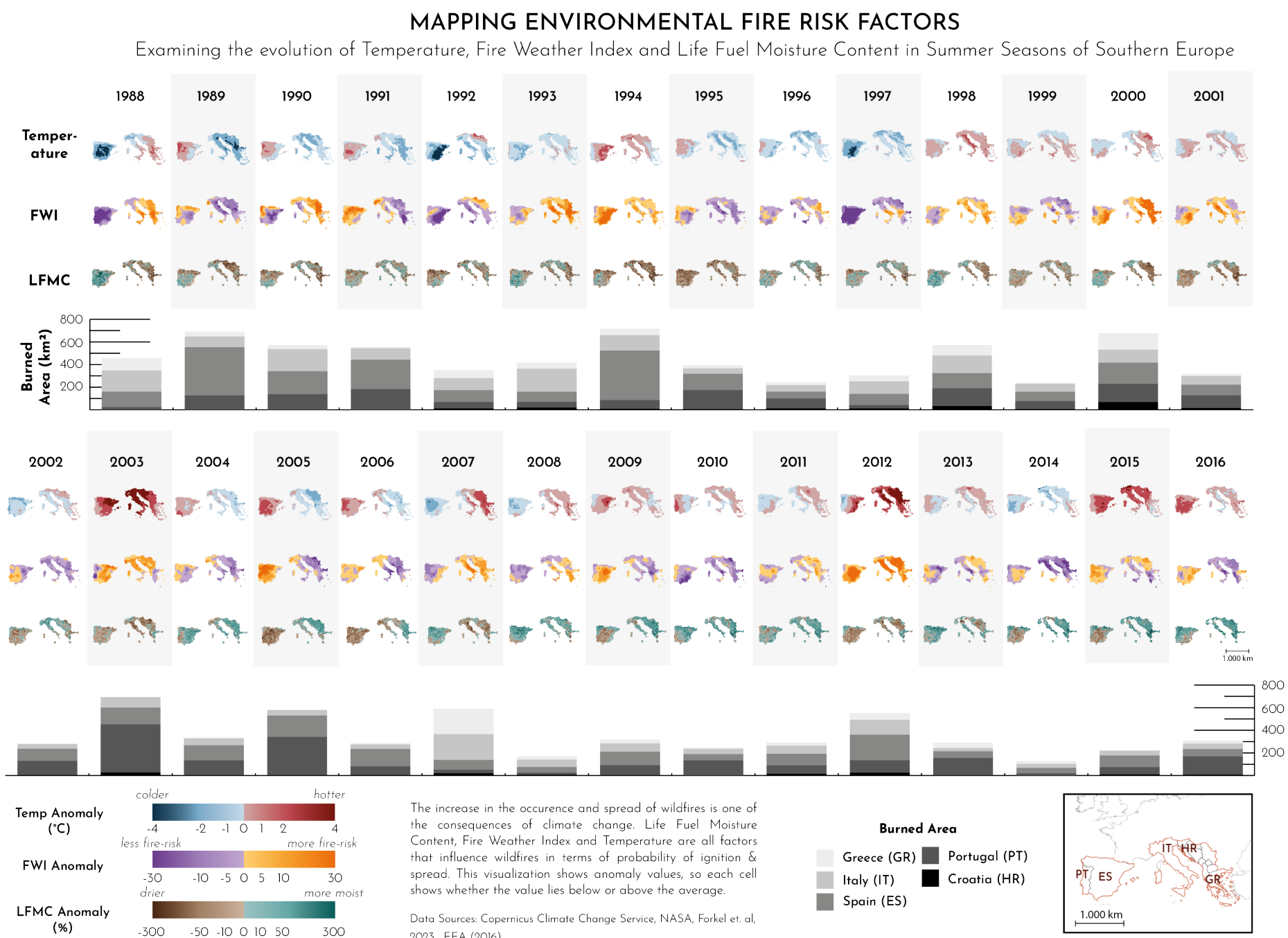

Fig. 2: Visualization 2 - One of the three modifications of Climate Spiral with FWI in biogeographical regions of Europe

References

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