



COMBINING NOVEL VISUALIZATIONS OF TEMPORAL CHANGES WITH MAPS USING SATELLITE TIME SERIES OF VEGETATION MOISTURE

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INTRODUCTION AND MOTIVATION

Increasing data availability due to improving computational power

Environmental data: advancement of satellite data acquisition

Visualizations as valuable tools for conveying complex but useful information



INTRODUCTION AND MOTIVATION

Novel visualizations of temporal change for transmitting information on climate change

Global increasing temperatures as temporal visualizations



Warming Stripes (Hawkins E., 2023)



Climate Spiral (Hawkins E., 2021)



INTRODUCTION AND MOTIVATION

Intensification of wildfires as consequences of anthropogenic climate change

Wildfires are multifaceted phenomena

- Fuel availability
- Fuel moisture

- Climatic conditions
- Sources of ignition



DATA

Life Fuel Moisture Content (LFMC)

- Moisture content of vegetation canopy
- Passive microwave remote sensing

Fire Weather Index (FWI)

- Metric to estimate fire ignition and spread
- Meteorological data
- 2 Meter Above Ground Temperature (TEMP)
- Reanalysis data through data assimilation

RESEARCH OBJECTIVES



RO 1: Creation of evaluation framework on novel and historic temporal and spatio-temporal visualizations for time series data visualizations of LFMC, FWI and TEMP

RO 2: Evaluation of novel visualization Warming Stripes to test their awareness and effectiveness

RO 3: Combining two novel visualizations with maps for a static representation of time series of LFMC, FWI and TEMP







VISUALIZATION PROCESS FOR LFMC, FWI AND TEMP

Target audience

Who will see the visualization?

Data classification What kind of information is dealt with?

Task specification Why is the visualization useful?

Types of visualizations How can the information be visualized? Non-experts but interested in unfamiliar topics

Quantitative, spatial, multivariate data depicting states

Differed between the two visualizations

Differed between the two visualizations



TASK SPECIFICATIONS FOR VISUALIZATION I: MODIFICATION OF WARMING STRIPES



Key elements for Visualization 1 (Warming Stripes)

FULFILMENTS OF TASKS FOR VISUALIZATION

	Warming Stripes	Modification
Spatial representation	No	Incorporation of a map
Regional variability	No	Division of map by biomes
Comparison of three variables	No	Creation of three distinctive stripes
Overall trend	Yes	-



ADAPTATION OF WARMING STRIPES (PRELIMINARY VISUALIZATION)



Trend of FWI not as expected from literature

No regional variability due to size of biomes

- → Further modifications needed
- → Color scheme of Warming Stripes maintained



FULFILMENT OF TASKS FOR AMENDED VISUALIZATION

New visualization type: Small Multiples with colors as visual variable to identify change

New extend: Southern Europe



Small Multiples (Aigner et. al, 2011)

	Small Multiples with Pixel-based Colors	Modification
Spatial representation	Yes	-
Regional variability on Pixel level	Yes	-
Comparison of three variables	No	Creation of three distinctive map series
Overall trend	Yes	-

VISUALIZATION I



MAPPING ENVIRONMENTAL FIRE RISK FACTORS

Examining the evolution of Temperature, Fire Weather Index and Life Fuel Moisture Content in Summer Seasons of Southern Europe





EVALUATION OF VISUALIZATION I

Tasks	Spatial Representati on	Regional variability on pixel level	Comparison of three variables	Overall trend
Visualization 1	Yes	Yes	Yes	Yes
Line Plot	Yes	No	Yes	Yes
Horizon Graph	Yes	No	Yes	Yes
Warming Stripes	Yes	No	Yes	Yes
Climate Spiral	Yes	No	No	Yes
Helix Icons	Yes	No	Yes	Yes

 \rightarrow Visualization 1 is the only visualization type that fulfils all defined tasks.



TASK SPECIFICATIONS FOR VISUALIZATION 2: MODIFICATION OF CLIMATE SPIRAL



Key elements for Visualization 2 (Climate Spiral)



FULFILMENTS OF TASKS FOR VISUALIZATION 2 & NEEDED MODIFICATIONS

	Climate Spiral	Modification
Spatial representation	No	Incorporation of a map
Periodic patterns of monthly data	Yes	-
Comparison of three variables	No	Creation of three distinctive spirals
Overall trend	Yes	-

VISUALIZATION 2







EVALUATION OF VISUALIZATION 2

Tasks	Combination with map	Periodic pattern of monthly data	Comparison of three variables	Nine biogeographic al regions
Visualization 2	Yes	Yes	No	Yes
Line Plot	No	No	No	Yes
Horizon Graph	No	No	No	Yes
Warming Stripes	No	No	Yes	Yes
Small Multiples	No	No	No	No
Helix Icons	Yes	Yes	Yes	Yes

 \rightarrow Visualization 2 does not fulfill all the criteria due to missing comparability of the variables. Helix Icons are suitable, but visualization needs to be interactive.



SURVEY TO EVALUATE WARMING STRIPES

42 participants (39 on site, 3 online)

Long Night of Sciences in Dresden

Defined target audience



OUTLINE OF SURVEY





AGE DISTRIBUTION & DISTRIBUTION OF EDUCATIONAL LEVEL





FAMILIARITY & KNOWLEDGE ON WARMING STRIPES





INTERPRETATION OF WARMING STRIPES



Addressing Research objectives



RO 1: Creation of evaluation framework on novel and historic temporal and spatio-temporal visualizations for time series data visualizations of LFMC, FWI and TEMP

- Achieved with specified tasks for visualizations of LFMC, FWI and TEMP
- Comparison of historic and novel visualizations
- Excerpt of suitable visualizations



Addressing Research objectives $\mathbb{III} \square \square \square \square \square \square \square$

RO 2: Evaluation of novel visualization Warming Stripes to test their awareness and effectiveness

- Results did not add up to reputation
- No familiarity within sample group could be proven
- Majority (83%) did not know the graph or confused it with other visualization
- Color scheme is intuitive for third of the people within sample group

RO 3: Combining two novel visualizations with maps for a static representation of time series of LFMC, FWI and TEMP

- Combination of novel visualizations with maps partially achieved because not all tasks defined could be fulfilled
- Visualization 1: Only color scheme kept of Warming Stripes
- Visualization 2: Comparison of all 3 variables not achieved
- Advantages
 - Visualization 1: Comparison and regional variability
 - Visualization 2: Seasonal patterns and missing data

LIMITATIONS & FUTURE WORK



Excerpt of suitable visualizations

Larger sample group, other setting or more information on Warming Stripes for survey

Evaluation of visualizations on accuracy

Evaluation of visualizations for effectiveness



