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MAPS CAN SUPPORT QUANTITATIVE EVALUATION OF EARTH'S SURFACE FEATURES AND THEIR EVOLUTION IN TIME BETTER THAN GLOBAL NUMERICAL PARAMETERS

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In recent years, the almost exclusive use of global numerical parameters is preferred to characterize trend changes in time in scientific fields like meteorology and climate science (IPCC is a reference of basic importance). The preference arises from the new possibilities allowed by the systematic use of informatics means to extract the relevant information from wider and wider databases having induced the new term 'Big Data'.

On the contrary, the present trend of informing about global changes and related parameters is the one preferred by all the International Organizations involves in climate change, namely IPCC. It consists in summarizing the changes via global numerical parameters, typically assumed to represent the evolution of the mean numerical value of big datasets correctly. However, in their synthesis, global numerical parameters may miss scientist's understanding of the existing complexity of the full set of values obtained from the measured data that they intend to qualify.

On the other hand, the traditional field of using maps for extended sets of data, namely the spatial one, was not surpassed in its unique capability to clearly convey, with its (visual) representation, details on the significance of the studied phenomena and of their variations in time, especially when the aim is to forecast future trends. In some fields, like that of analyses of the Earth's surface, maps have long since been used and recently the Food and Agriculture Organization of the United Nations has also confirmed its preference for their use. Accordingly, a revamp of the generalized advantages of visualization in science occurred, as found in the literature, especially in philosophy of science. On the other hand, within the recent developments of informatics one might also observe a possible increase of visualized-data misunderstanding.

Especially when the maps illustrate a great variety of situations, a comprehensive geometrical examination is recognized to report superior information –also quantitative since maps are graduated. This allows an overall and more reliable evaluation and its evolution, typically in time, a possibility that does not introduce any kind of conflict between mathematical and geometrical human examination but simply useful complementarities, already appreciated in the literature.

The paper first provides a comprehensive introduction to the state-of-the art of data collation in databases and manipulation. Then, illustrates data visualization by means of maps, but not from a cartographic-science viewpoint, instead from the viewpoint of measurement-science, according to the Journal readers main interest: this is a multidisciplinary frame allowing deep analyses of data of various origins according to the discipline of metrology, author's main competence. How the original numerical data

can be used to plot a map is a cartography-science task. Providing evidence of the main new features introduced by Earth's mapping of climate parameters, and of the ways to take advantage of the different types of representation in the maps, will be the only author's aim.

However, the term 'visualization' indicates a great variety of types of data graphical representation, from simple graphs, to 3D complex mapping, to its use in simulation. Therefore, the paper will restrict the subject matter exclusively to the examination of the mapping of Earth's surface—full or partial but never local, and never enter into the task of map realization from the original dataset.

It only intends to bring evidence of map superior content of information: in addition to simple visualization, this paper shows how maps allow to also retrieve underlying numerical data by means of a computer-based method recently introduced by the author. It allows the interested scientist to extend her analysis beyond the global parameters without the need to retrieve the original dataset, so paralleling the qualitative analysis obtained by visualization with the addition of quantitative analyses.

Some problems, related to the presently dominant way to get the desired local and overall information in climate science, are also shortly discussed according to the relevant literature but without the intention of making a review paper of those subject matters. The Global Mean Surface Temperature (GMST) will be used as the single example because of its special importance and normally consideration by the Intergovernmental Panel on Climate Change and others Committees, as one of the most popular parameters.

The basic features of a quantitative analysis of GMST with the method reported in this paper are fully reported and a flowchart summarizes the procedure.

Finally, qualitative examples of visualization are reported, while detailed quantitative examples and the related procedure are shortly introduced, then, due to their extension, fully discussed in an Appendix.

References

1. Pavese F. (2020) Graphic method for retrieval of quantitative data from computer-mapped qualitative information. With a NASA video as an example. ESIN **13** pp.65-662.