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Topological analysis of weather extremes

Gisela D. Charó

Laboratoire des Sciences du Climat et de l'Environnement, Université Paris-Saclay & IPSL, France; CONICET – Universidad de Buenos Aires. Centro de Investigaciones del Mar y la Atmósfera (CIMA), Argentina.

Davide Faranda

Laboratoire des Sciences du Climat et de l'Environnement, Université Paris-Saclay & IPSL, France; London Mathematical Laboratory, UK; Dept. of Geosciences & Laboratory of Dynamic Meteorology (CNRS & IPSL), Ecole Normale Supérieure and PSL University, France.

Michael Ghil

Dept. of Geosciences & Laboratory of Dynamic Meteorology (CNRS & IPSL), Ecole Normale Supérieure and PSL University, France; Dept. of Atmospheric Oceanic Sciences, University of California at Los Angeles, USA; and Dept. of Mathematics, Imperial College London, UK.

Denisse Sciamarella

CNRS – IRD – CONICET – UBA. Institut Franco-Argentin d'Études sur le Climat et ses Impacts (IRL 3351 IFAECI), Argentina; Centre National de la Recherche Scientifique, France.

Volumes in a dynamical system's phase space can stretch, compress, fold or tear; the combination of these processes gives rise to a structure in its space. The topology of this structure is the signature of the mechanisms that act to shape the system's flow in this phase space [1]. Our topological approach uses the novel concept of *templex* [2], which consists of finding a topological representation for the branched manifold approximated by a cell complex and a directed graph that prescribes the allowed connections between the highest dimensional cells of the complex as a function of the flow. The *templex* properties include the non-equivalent ways of circulating along the complex, which are essential to provide a complete description of the system's dynamics. The *templex* provides the key features of the topological structure underlying a dynamical system.

Weather extremes can be classified by two scalars: the instantaneous dimension and the persistence of a state of a dynamical system [3,4]. The computation of these asymptotic scalars for weather observables provides information on the rarity, and persistence of specific states. In this work, we present a first attempt to relate the instantaneous dimension and other local metrics to the topological properties of the *templex* of the system under study.

References

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E-mail: gdcharo@lsce.ipsl.fr.