



«ETTORE MAJORANA» FOUNDATION AND CENTRE FOR SCIENTIFIC CULTURE  
TO PAY A PERMANENT TRIBUTE TO ARCHIMEDES AND GALILEO GALILEI, FOUNDERS OF MODERN SCIENCE  
AND TO ENRICO FERMI, THE "ITALIAN NAVIGATOR", FATHER OF THE WEAK FORCES



# INTERNATIONAL SCHOOL OF NONEQUILIBRIUM PHENOMENA

## 2nd Course: *UNDERSTANDING THE RECURRENCE OF RARE ATMOSPHERIC EVENTS: A DYNAMICAL SYSTEMS APPROACH*

**ERICE-SICILY: 28 JULY – 1 AUGUST 2022**

Sponsored by the: • Italian Ministry of Education, University and Scientific Research • Sicilian Regional Government

### PROGRAMME AND LECTURERS

*Extreme dissipation events and singularities in turbulent and geophysical flows*

- B. DUBRULLE, SPEC, CEA Paris Saclay, CNRS, FR

*Compound extreme events in the climate system*

- G. MESSORI, University of Uppsala, SE

*Dynamical systems tools for the study of climate extremes*

- S. VAIENTI, CPT Université de Marseille, Université de Toulon, FR

*Scale-dependent properties of complex attractors*

- T. ALBERTI, INAF, Roma, IT

*Recurrence and analogs in atmospheric flows*

- P. YIOU, CEA Saclay, Université de Paris, Saclay, FR

*Convective extremes in state-of-the-art climatic simulations: challenges and possibilities*

- E. COPPOLA, ICTP, Trieste, IT

*Methods to track the thermodynamic energy balance*

- V. LEMBO, ISAC CNR, Bologna, IT

### PURPOSE OF THE COURSE

The Course UNDERPIN aims at bridging experts in statistical physics, statistics, dynamical systems and climate sciences to study persistent, high-impact climate extremes such as heatwaves, cold-spells and slow-moving cyclones. These events may be conceptualized as arising from situations where the large-scale atmospheric flow in the midlatitudes is extremely zonal or blocked and meandering. Traditional statistical extreme value techniques are only partly successful in characterizing extreme events as the result of extremely zonal or blocked flows: while they successfully define a framework to determine the probability of occurrence of events that are large or small with respect to some specific observables (e.g. temperature maxima or minima, precipitations, floods), they are not adapted to relate persistent or rare phenomena with the extreme regimes of the mid-latitude atmospheric flow. To overcome this knowledge gap, UNDERPIN proposes to build a community of scientists working together towards a new formalism based on a decomposition of the atmospheric circulation patterns in multiple scales where the definition of extreme events as rare recurrences of high dimensional systems is easier. The main result that we expect to obtain in UNDERPIN is the identification of typical scales where these events are triggered and whether climate change or atmospheric variability change the typical magnitude/persistence and probability of these phenomena. We will also address the problem of the mathematical formalization of the obtained results: that is, we will leverage the numerical results to derive a general framework for the statistics of recurrences of non-stationary systems. The members of UNDERPIN come from different horizons (physics, statistics and mathematics). They have already written several papers leading to a better understanding of physical processes via a rigorous mathematical formalism. We would like to continue and reinforce this interdisciplinary and international collaboration through this international workshop and train a new generation of students with interdisciplinary expertise in extreme climate events.

### APPLICATIONS

Persons wishing to attend the Course are requested to write to:

Dr. Davide Faranda  
CNRS - LSCE-CEA Saclay  
Université Paris Saclay  
E-mail: [davide.faranda@lsce.ipsl.fr](mailto:davide.faranda@lsce.ipsl.fr)

### • PLEASE NOTE

Participants must arrive in Erice no later than 12 a.m. on 28th July 2022.

### POETIC TOUCH

According to legend, Erice, son of Venus and Neptune, founded a small town on top of a mountain (750 metres above sea level) more than three thousand years ago. The founder of modern history — i.e. the recording of events in a methodic and chronological sequence as they really happened without reference to mythical causes — the great Thucydides (~500 B.C.), writing about events connected with the conquest of Troy (1183 B.C.) said: «*After the fall of Troy some Trojans on their escape from the Achaei arrived in Sicily by boat and as they settled near the border with the Sicilians all together they were named Elymi: their towns were Segesta and Erice.*»

This inspired Virgil to describe the arrival of the Trojan royal family in Erice and the burial of Anchises, by his son Aeneas, on the coast below Erice. Homer (~1000 B.C.), Theocritus (~300 B.C.), Polybius (~200 B.C.), Virgil (~50 B.C.), Horace (~20 B.C.), and others have celebrated this magnificent spot in Sicily in their poems. During seven centuries (XIII-XIX) the town of Erice was under the leadership of a local oligarchy, whose wisdom assured a long period of cultural development and economic prosperity which in turn gave rise to the many churches, monasteries and private palaces which you see today.

In Erice you can admire the Castle of Venus, the Cyclopean Walls (~800 B.C.) and the Gothic Cathedral (~1300 A.D.). Erice is at present a mixture of ancient and medieval architecture. Other masterpieces of ancient civilization are to be found in the neighbourhood: at Motya (Phoenician), Segesta (Elymian), and Selinunte (Greek). On the Aegadian Islands — theatre of the decisive naval battle of the first Punic War (264-241 B.C.) — suggestive neolithic and paleolithic vestiges are still visible: the grottoes of Favignana, the carvings and murals of Levanzo.

Splendid beaches are to be found at San Vito Lo Capo, Scopello, and Cornino, and a wild and rocky coast around Monte Cofano: all at less than one hour's drive from Erice.

More information about the «Ettore Majorana» Foundation and Centre for Scientific Culture can be found on the WWW at the following address:  
<http://www.ccsem.infn.it>