Università degli Studi di Trieste

PhD Course in

Earth Science, Fluid-Dynamics, and Mathematics. Interactions and Methods

Presentation Days: February 23-25, 2021

The event will be held by remote on the team "Presentation Days Dottorato ESFM" of MsTeams. Speakers, ESFM PhD students, ESFM PhD Board members and DMG members have access as members to this team. Other people interested in this event should write to ftarlao@units.it to attend the event. For other information write to maset@units.it.

Tuesday February 23

Time schedule	*Speaker*	*Title*	*Session chair*
9:00-9:05	**Opening**		
9:05-9:30	Costanza Del Gobbo	Use of the Regional Climate Model RegCM4 to assess circulation, precipitation and temperature patterns sustaining the Tagliamento glacier (southeastern Alps) at 21 ka	
9:35-9:50	Giulia Areggi	Surface deformation analysis in Northeast Italy by using PS-InSAR and GNSS data	
9:55-10:05	Eleonora Denich	Electromagnetic inversion under the Low Induction Number approximation	
Break			
10:30-11:15	**Plenary lecture: Filippo Giorgi**	Climate change: Scientific evidence, mitigation options and frontier research issues	
11:25-11:40	Heba M.M.I. Elkosiri	Geoelectric and Electromagnetic investigations of some urban areas West of Ismailia, Egypt	
11:45-12:00	Asma Farooq	How perturbations propagate along the solution of linear ordinary differential equations: a normwise and a componentwise relative error analysis	
12:05-12:30	Tommaso F. M. Pivetta	Monitoring water storage variations in Karst through gravimetry.	
Break			
14:00-14:45	**Plenary lecture: Mauro Reini**	Is the evolution of energy-based systems driven by a physical principle? Constructal Law and Thermoeconomic Optimization	
14:55-15:20	Francesca Maddaloni	Lithospheric structure and tectonic evolution of intracratonic basins: the Congo basin a natural laboratory	
15:25:15:35	Nicolò Bertone	Tectonic evolution of the Eastern Mediterranean Basin	
15:40-15:50	Giovanni Biagioli	Convective aggregation in idealized stochastic models	
Break			
16:15-16:40	Sara Markovic	Internal waves and turbulent mixing in periodically forced closed stratified basin	
16:45-17:00	Simon Blondel	Imaging of the Algerian basin's salt system	
17:05-17:20	Donna M. Bourabee	Records of Paleo Seismic Events in Cave Sediments	
17:25-17:35	Arianna Cuius	Rapid Estimation of Fault Directivity and Source Parameters from Strong Motion Data	
17:40-17:50	Waed H.A. Abed	Detection and attribution of high precipitation convective events in climate change using advanced machine learning methods	

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Wednesday February 24

Time schedule	*Speaker*	*Title*	*Session chair*
9:05-9:30	Laura Cataldi	Improving the quality of seismic monitoring by development of novel ground motion prediction techniques	
9:35-9:50	Francesca Cairoli	Abstraction of Markov Population Dynamics via Generative Adversarial Nets	
9:55-10:05	Nicolò Barago	Toxic trace metals in the Pb-Zn Raibl mine area: geochemical behavior and attenuation processes	
Break			
10:30-11:15	**Plenary lecture: Adrian Tompkins**	Spontaneous clustering of convection in marginal resolution models: What is it and why do we care?	
11:25-11:50	Hari Ram Thapa	Ambient Noise Rayleigh wave Two-Dimensional Tomography and Three-Dimensional Shear-wave Velocity Structure of Crust beneath Central Himalaya	
11:55-12:10	Andrea Facca	Further Developments on monitoring continuous casting processes with ultrasounds	
12:15-12:30	Alessandra Lanzoni	The Messianian Salinity Crisis in the Adriatic Sea	
Break			
14:00-14:45	**Plenary lecture: Dimitri Breda**	Mathematical modeling of a complex reality - An interdisciplinary journey from monotone systems to honey bee colony losses	
14:55-15:05	Andrea Savio	Comparison of different cavitation models	
15:10:15:20	Giovanni Petris	A three-dimensional numerical model for the noise propagation in an inhomogeneous medium	
15:25-15:35	Marco Bartola	DinSAR analysis for crustal deformation induced by tectonics and hydrogeology in Karst area	
15:40-15:50	Ginevra Carbone	Robustness of Bayesian Neural Networks to Gradient-Based Attacks	
Break			
16:15-16:40	Johnatan Ford	Diffraction imaging to characterise mass-transport complexes	
16:45-17:00	Renè Gabriel Navarro	The vertical structure of global ocean heat budget under momentum and heat flux perturbations	
17:05-17:20	Enrico Pochini	Dynamics of Ross Sea water masses and basal melt rate: present and past	
17:25-17:35	Mahsa Yousefi	Training deep neural networks by Quasi-Newton methods	
17:40-17:50	Ilaria Santin	Integrated geophysical imaging and characterization of Antarctic and Alpine glacial and periglacial environments	

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Thursday February 25

Time schedule	*Speaker*	*Title*	*Session chair*
9:05-9:20	Luigi Zampa	A comparison between sea-bottom gravity and satellite altimeter-derived gravity in coastal environments: A case study of the Gulf of Manfredonia (SW Adriatic Sea)	
9:25-9:40	Nessim Douss	Sedimentological investigation on the depostional sequences along the western margin of Svalbard (Arctic)	
9:45-10:00	Fabio Pezzolo	Recent results on Beckner systems of inequalities	
Break			
10:30-11:15	**Plenary lecture: Romina Gaburro**	Some inverse problems arising in Earth exploration.	
11:20-11:35	Gabriele Sbaiz	Multi-scale Analysis in Geophysical Fluid-Dynamics	
11:40-11:55	Marco Venier	Textural and chemical characterization of mantle xenoliths	
12:00-12:10	Melese T. Salilih	Separation of intrinsic and scattering attenuation in heterogeneous media	
12:15-12:25	Anna Maria Sklodowska	Innovative methodologies for soil-structure interaction assessment	
12:25-12:30	**Closing**		

Plenary Lectures

Filippo Giorgi. ICTP . Tuesday February 23, 10:30-11:45

Title. Climate change: Scientific evidence, mitigation options and frontier research issues.

Abstract. In this seminar I will review the different scientific evidences that lead the scientific community to state that global warming is unequivocal and is due for the most part to anthropogenic emissions of greenhouse gases, in primis, carbon dioxide and methane. I will then discuss the changes in the climate system induced by global warming and some of their main impacts on society. Finally I will review future climate scenarios and mitigation options that may contain global warming below the danger threshold. Some outstanding issues in need of future research will be highlighted throughout the presentation.

Mauro Reini. Università di Trieste, DIA. Tuesday February 23, 14:00-14:45

Title. Is the evolution of energy-based systems driven by a physical principle? Constructal Law and Thermoeconomic Optimization.

Abstract. The Constructal Principle has been recently formulated as an extension of the Maximum Entropy Production Principle and it has been used in literature to explain the shape and structure of all kind of flowing system. Applying the Constructal Principle to energy system productive structures allows to infer that their evolution is strictly related to the exploitation of resources from the Environment. When limitations on the exploited resources does not affect the system (typically, because it is too small) the latter evolves toward a continuous increment of the product, consistently with the Malthusian growth. When the exergy extraction is declining, or constant, the evolution is driven by the effort of reducing the unit resource (exergy) cost of the product, either by increasing the efficiency of the internal components, or by modifying its supply chain. Therefore the widely accepted assumption that energy systems have to be optimized by minimizing the specific resource (exergy) cost of products, has no more to be regarded as an axiom, but as a consequence of a physical principle that tells us which energy systems can persist in time (to survive) and which others would be selected for extinction. Moreover, the creation of recycling flows is shown to allow a further reduction of the unit exergy cost of the product, with respect to the reduction allowed by the components' efficiency improvement alone. More generally, the results obtained may be regarded as the physical justifications of the evolutionary tendency toward the more and more complex and highly circular pathways that can be observed in both natural and artificial (energy) production systems. Finally, it is shown how the continuous accumulation of wastes and sub-products in the environment directly implies an increment of the unit resources (exergy) cost of the product, exactly because the exergy stock of the Environment is affected. Therefore, residues and sub-products have to be generally converted into some kind of product by different (new) production processes, supporting the paradigm of the Circular Economy and highlighting the importance of recycling not only for system efficiency, but also for system surviving.

Adrian Tompkins. ICTP. Wednesday February 24: 10:30-11:15

Title. Spontaneous clustering of convection in marginal resolution models: What is it and why do we care?

Abstract. In the 80s and 90s, as computing power reached the level that allowed the integration of "cloud resolving models" (using horizontal resolutions of order 1 km, actually only permitting the coarsest scales of motion in deep convection) for periods of several weeks in idealized experiments of radiative-convective equilibrium over fixed sea surfaces, it was noted that deep convection would sometimes organise spontaneous into clusters. In this presentation I will explain why understanding this phenomenon could be important for our assessment of climate sensitivity, introduce some of the physical processes that lead to its occurrence, and then cast a word of warning regarding the sensitivity of model results to their set up. Finally I will point to some developments underway with observations and even more idealized models which may help to understand the CRM results more completely.

Dimitri Breda. Università di Udine. Wednesday February 24: 14:00-14:45

Title. Mathematical modeling of a complex reality - An interdisciplinary journey from monotone systems to honey bee colony losses.

Abstract. Honey bees form highly complex biological societies. Honey bee colony losses recently reported and the consequent threat of a possible pollinator crisis are provoking justified concern. Attempts to assess the role of several stressors like viruses, parasites, pesticides or nutritional impairment, under field condition, have produced contrasting results. To explore the possible causes of this incongruity a mathematical model of honey bee health has been developed, starting from experimental observations and conceptual considerations. The resulting dynamical system is monotone and can lead to multi-stability, suggesting that individual bees exposed to the same stressors can end into different health conditions depending on minor differences in their initial states. For instance, the immune-suppressive capacity of a common virus can generate a bimodal distribution of the mortality which, embedded into a model of the hive, can favor in turn the collapse of the colony. The model analysis can thus explain the variability of results depending on field conditions and, at the same time, the difficulty of predicting the net effect of each single stress factor affecting bee health outside of the controlled lab environment. Overall, the study is a concrete example of a fruitful interdisciplinary collaboration among experimental and theoretical biology, dynamical systems, control theory and scientific computing, leading to a potential advance in the comprehension of nature, grounded on mathematical modeling.

Romina Gaburro. **Università di Limerick (Irlanda). Thursday February 25: 10:30-11:45.**

Title: Some inverse problems arising in Earth exploration.

Abstract: We discuss the problem of imaging the subsurface of the Earth via the inverse problems known in geophysics as Electrical Resistivity Tomography (ERT) and Full Waveform Inversion (FWI) with partial data. For the ERT problem we model the data in terms of the so-called Neumann-to-Dirichlet (NtoD) map; for the FWI we employ time-harmonic Cauchy data obtained with dual sensors measuring the pressure and the normal velocity. Cauchy data do not suffer from eigenfrequencies unlike the Dirichlet-to-Neumann map, which, in fact, cannot be observed directly in seismic marine acquisition.