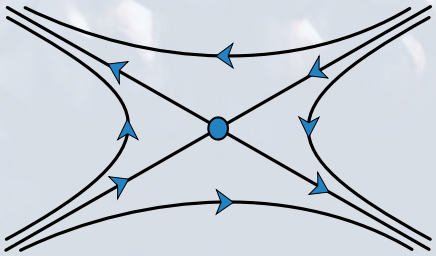

imaea

1st International Meeting on Differential Equations and Applications

Book of abstracts

Universidad Politécnica de Madrid
Dpto. Matemática Aplicada a las TIC
April 25, 2025 - Madrid (Spain)

This meeting has been partially supported by the **Departamento de Matemática Aplicada a las Tecnologías de la Información y las Comunicaciones**, located at the **Escuela Técnica Superior de Ingenieros Informáticos** of the **Universidad Politécnica de Madrid**, and by **Madrid Government (Comunidad de Madrid-Spain)** under the Multiannual Agreement 2023-2026 with Universidad Politécnica de Madrid in the Line A, Emerging PhD researchers. Grant agreement DOCTORES-EMERGENTES-24-UMDLRU-108-XVLWPC.

We would like to express our sincere gratitude to all the collaborating entities for making the **1st International Meeting on Differential Equations and Applications** possible.

Contents

Preamble

Welcome to the **1st International Meeting on Differential Equations and Applications**, to be held on **April 25, 2025**, at the Departamento de Matemática Aplicada a las Tecnologías de la Información y las Comunicaciones, located at the Escuela Técnica Superior de Ingenieros Informáticos of the Universidad Politécnica de Madrid, in Boadilla del Monte (Madrid, Spain).

This international meeting is dedicated to bringing together researchers and students from around the World to share the **latest scientific advancements** concerning both ordinary and partial **differential equations** as well as their **applications** in real life.

The event will feature a series of **plenary lectures** and **interactive discussions**, providing a platform to explore new methodologies, innovative solutions, and emerging trends in the the theory of differential equations and their applications.

With contributions from leading researchers, the conference will cover a **wide range of topics**, including mathematical modeling, numerical analysis, and applications to engineering, physics, biology, and other sciences.

The goal of this meeting is to create an inspiring and collaborative environment for the **exchange of knowledge**, fostering interdisciplinary dialogue and promoting the integration of theoretical developments with practical applications.

We look forward to welcoming you to this exciting event and to a fruitful day, where new ideas, collaborations, and opportunities for future research will emerge.

Committees

You can find below the committees of the **1st International Meeting on Differential Equations and Applications**, to be held on **April 25, 2025**.

Scientific committee

Tomás Caraballo	Universidad de Sevilla (Spain)
Ma To Fu	Universidade de Brasília (Brazil)
Héctor Barge	Universidad Politécnica de Madrid (Spain)
Alexandre N. Oliveira-Sousa	Universidade Federal de Santa Catarina (Brazil)

Organizing committee

Javier López-de-la-Cruz	Universidad Politécnica de Madrid (Spain)
Paulo N. Seminario-Huertas	Universidad Politécnica de Madrid (Spain)
Felipe Rivero	Universidad Politécnica de Madrid (Spain)
Ramón Barral	Universidad Politécnica de Madrid (Spain)

Venue

The **1st International Meeting on Differential Equations and Applications**, to be held on **April 25, 2025**, will take place in the **conference room H-1003** located on the ground floor of **Building 1** at the Escuela Técnica Superior de Ingenieros Informáticos (Campus de Montegancedo) of the Universidad Politécnica de Madrid (you can find it on Google maps by clicking here).

There are different ways to arrive at the Escuela Técnica Superior de Ingenieros Informáticos, either by **private vehicle** or by **public transport** (both by **metro**, **light rail**, **RENFE local trains** and **bus**).

By private vehicle

To reach the campus by private vehicle, the most convenient option is to access it via the **A-6 highway** or the **M-40 ring road**. Since the campus is located in the middle of nature, it is possible to park in a large parking located here. From there, Building 1 (where the conference room H-1003 is located) is around three minutes on foot here.

By public transport

It is possible to reach the campus by public transport, both by **metro**, **light rail**, **RENFE local trains** and **bus**. You can find below a list with the options we consider most convenient for you. Additionally, you can also download the map of **metro and light rail network** here as well as the map of **Renfe local trains** here for your convenience.

▶ Bus - Line 591

This bus operates between **Madrid (Aluche)** and **ETSI Informáticos stops**. To reach the campus, you can get the bus next to **Metro - Line 5 (Aluche station)** here, next to **Metro - Line 5 (Empalme station)** here or next to **Metro – Line 10 (Colonia Jardín station)** here. Then, you have to get off the bus at the last stop inside the campus

here. From there, Building 1 (where conference room H-1003 is located) is around one minute on foot here. You can find the outbound timetable here and the return timetable here.

▶ Bus - Line 865

This bus operates between **Madrid (Intercambiador de Moncloa)** and **Centro de Empresas** stops. To reach the campus, you can get the bus next to **Metro - Lines 3 or 6 (Moncloa station)** here. Then, you have to get off the bus at the ETSI Informáticos stop inside the campus here. From there, Building 1 (where conference room H-1003 is located) is around five minutes on foot here. You can find the outbound timetable here and the return timetable here.

▶ Bus - Line 571

This bus operates between **Madrid (Av. de Las Águilas)** and **Boadilla del Monte (Avenida Monte Segovia)** stops. To reach the campus, you can get the bus next to **Metro - Line 5 (Aluche station)** here, next to **Metro - Line 5 (Empalme station)** here or next to **Metro - Line 10 (Colonia Jardín station)** here. Then, you have to get off the bus at the Av. Montepríncipe – Facultad Informática stop next to the campus here. From there, Building 1 (where conference room H-1003 is located) is around three minutes on foot here. You can find the outbound timetable here and the return timetable here.

▶ Bus - Line 573

This bus operates between **Madrid (Ruperto Chapí/P.° Moret)** and **Boadilla (Miguel Ángel Cantero Oliva)** stops. To reach the campus, you can get the bus next to **Metro - Lines 3 or 6 (Moncloa station)** here. Then, you have to get off the bus at the Av. Montepríncipe – Facultad Informática stop next to the campus here. From there, Building 1 (where conference room H-1003 is located) is around three minutes on foot here. You can find the outbound timetable here and the return timetable here.

▶ Light Rail - Line 3

This light rail line operates between **Colonia Jardín** station (connected with Metro - Line 10) and **Puerta de Boadilla** station. To reach the campus, you can get on the train at Colonia Jardín station (connected with Metro - Line 10) and then you have to get off the train at Montepríncipe station here. From there, the campus is around fiveteen minutes on foot here. You can find the timetable here.

Program

You can find below the program of the **1st International Meeting on Differential Equations and Applications**, to be held on **April 25, 2025**.

Friday - April 25, 2025

8:00 - 8:45	**Registration**
8:45 - 9:00	**Opening**
9:00 - 9:45	**Jaqueline G. Mesquita** State-dependent delay equations and applications
9:45 - 10:30	**Lourdes Tello** On a climate energy balance model with nonlinear diffusion
10:30 - 11:00	**Coffee break**
11:00 - 11:45	**Cristian Morales-Rodrigo** Analysis of some taxis models arising in biology
11:45 - 12:30	**Pedro Marín-Rubio** On non-autonomous exponential attractors for a RD model
12:30 - 12:45	**Closing**
12:45 - 12:50	**Official photo**

Abstracts

The following pages compile the abstracts of the plenary talks presented at the **1st International Meeting on Differential Equations and Applications**.

The meeting featured contributions from **four distinguished speakers**, whose lectures covered a broad spectrum of topics related to differential equations and their relevance in the modeling of real-world phenomena.

The abstracts included herein offer a concise overview of the central ideas and results discussed by each speaker, providing valuable insights into current advances and methodologies in the field.

imaea

1st International Meeting on
Differential Equations and Applications
April 25, 2025 - Madrid (Spain)

State-dependent delay equations and applications

Jaqueline G. Mesquita
Departamento de Matemática
Universidade de Brasília

In this talk, I will introduce the state-dependent delay equations, explain the interest behind of their study. Also, I will show some results for these equations and present some applications.

imaea

1st International Meeting on
Differential Equations and Applications
April 25, 2025 - Madrid (Spain)

On a climate energy balance model with nonlinear diffusion

Lourdes Tello
Dpto. Matemática Aplicada, ETS Arquitectura
Universidad Politécnica de Madrid

We are concerned with global climate models formulated in terms of partial differential equations.

Energy balance models (EBM) in global climate were introduced independently by M.I. Budyko [1] and W.D. Sellers [6]. Both models include the planetary coalbedo effect, which is the dominant feedback mechanism in the energy balance. We distinguish energy balance models by the choice of the Coalbedo function: Budyko-type models and Sellers-type models. It is well known that this type of model is very sensitive to the fluctuations in some parameters such as the Solar parameter Q. Most of the analyses of this type of energy balance model assume that the planetary coalbedo is monotone (see [2, 5]). In this work we consider a non-monotone Coalbedo and consequently the model distinguishes different climatic zones (see [4]).

We also consider a coupled model surface-deep ocean effect, where an Energy Balance Model (EBM) is used to model the surface temperature and a parabolic equation in a global ocean with a dynamic and diffusive boundary condition represents the evolution of the deep ocean temperature. Although this model is based on that proposed by Watts & Morantine [7], it also incorporates other processes such as the nonlinear diffusion and the effect of coalbedo as a function of temperature (see [2] and [3]). We analyse the number of steady states of the model under study, using the solar constant as parameter. We find an interval of values of the solar constant Q where there exist at least three stationary solutions. Moreover, for such an interval of Q more than three stationary solutions are obtained numerically.

References

[1] M. I. Budyko, The effects of solar radiation variations on the climate of the earth, Tellus, 21 (1969), 611–619.

[2] J. I. Díaz, A. Hidalgo and L. Tello, Multiple solutions and numerical analysis to the dynamic and stationary models coupling a delayed energy balance model involving latent heat and discontinuous albedo with a deep ocean, *Proc. R. Soc. Lond. Ser. A Math. Phys. Eng. Sci.*, **470** (2014), no. 2170, 20140376, 20 pp.

[3] G. Hetzer and L. Tello On a reaction diffusion system arising in Climatology, *Dynamic Syst. Appl.*, **11** (2002), 381–402.

[4] A. Hidalgo, L.Tello, *On a global climate model with non-monotone multivalued coalbedo*. Discrete Contin. Dyn. Syst. Ser. S 15 (2022), no. 10, 2929–2943.

[5] G. North and K. Kim, Energy Balance Climate Models, Wiley-VCH Verlag, Weinheim, Germany 2017.

[6] W. D. Sellers, A global climatic model based on the energy balance of the earth- atmosphere system, J. Appl. Meteorol., 8 (1969), 392–400.

[7] R.G. Watts, M. Morantine, Rapid climatic change and the deep ocean. Climatic Change (1990), 16, 83–97.

imaea

1st International Meeting on
Differential Equations and Applications
April 25, 2025 - Madrid (Spain)

Analysis of some taxis models arising in biology

Cristian Morales-Rodrigo
Dpto. de Ecuaciones Diferenciales y Análisis Numérico
Universidad de Sevilla

The purpose of this talk is to introduce some macroscopic models in which species respond to an external stimulus either moving towards or away from it and to study its mathematical properties, like existence of global solutions and its convergence to equilibrium.

imaea

1st International Meeting on
Differential Equations and Applications
April 25, 2025 - Madrid (Spain)

On non-autonomous exponential attractors for a RD model

Pedro Marín Rubio
Dpto. Ecuaciones Diferenciales y Análisis Numérico
Universidad de Sevilla

The following classical non-autonomous reaction-diffusion model is considered:

$$\begin{cases} \dfrac{\partial u}{\partial t} - \Delta u = f(u) + h(t) \quad \text{in } \Omega \times (\tau, \infty), \\ u|_{\partial\Omega} = 0 \quad \text{on } \partial\Omega \times (\tau, \infty), \\ u(\tau) = u_\tau \quad \text{in } \Omega, \end{cases}$$

where $\Omega \subset \mathbb{R}^N$ $(N \geq 1)$ is an open bounded set (no regularity on the boundary is required), $\tau \in \mathbb{R}$, $u_\tau \in L^2(\Omega)$, and the time-dependent force satisfies $h \in L^2_{loc}(\mathbb{R}; H^{-1}(\Omega))$. Additional assumptions concerning the nonlinearity term f and h are given in two differentiated settings.

Firstly we establish the well-posedness of the process associated with the above problem under a nonlinearity f with certain growth condition depending on the dimension of the space and a translation bounded force h with values in $H^{-1}(\Omega)$, i.e. $h \in L^2_b(\mathbb{R}; H^{-1}(\Omega))$.

Our main goal is to ensure the existence of a pullback exponential attractor in $L^2(\Omega)$, and, consequently, the existence of a pullback attractor in $L^2(\Omega)$ with uniform finite fractal dimension of its sections. This is done using two different approaches, one by following the construction by Carvalho and Sonner [2, 3]; for the second one, the force h is relaxed to have exponential growth in the past, and there we follow the ideas developed in a previous work by Czaja [4].

This work has been done jointly with Álvaro Aguilar-Reyes (Universidad de Sevilla) (see [1]).

References

[1] Á. Aguilar-Reyes and P. Marín-Rubio, Remarks on exponential attractors for a non-autonomous PDE with H^{-1} valued forces, *Commun. Pure Appl. Anal.*, **24** (2025), 1261–1279.

[2] A. Carvalho and S. Sonner, Pullback exponential attractors for evolution processes in Banach spaces: theoretical results, *Commun. Pure Appl. Anal.*, **12** (2013), 3047-3071.

[3] A. Carvalho and S. Sonner, Pullback exponential attractors for evolution processes in Banach spaces: properties and applications, *Commun. Pure Appl. Anal.*, **13** (2014), 1141-1165.

[4] R. Czaja, Pullback exponential attractors with admissible exponential growth in the past, *Nonlinear Anal.*, **104** (2014), 90-108.

Contact

Please, do not hesitate to contact us if you have any **question** or need **assistance**. You can send us an email by scanning the **QR code** below or by clicking here!.

Postal address

Prof. Dr. Javier López-de-la-Cruz
Dpto. Matemática Aplicada a las Tecnologías de la Información y las Comunicaciones
Bloque 1, Planta 3, Despacho 1312
Escuela Técnica Superior de Ingenieros Informáticos
Universidad Politécnica de Madrid
Campus de Montegancedo
28660 Boadilla del Monte (Madrid)

Created and edited by
Javier López-de-la-Cruz