AIMOCC at IJCAI 2022

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AI: Modeling Oceans and Climate Change 2022

An IJCAI-ECAI 2022 Workshop

It is our distinct pleasure to invite you to the **Workshop AI: Modeling Oceans and Climate Change (AIMOCC 2022)** to be held in conjunction with the **31st International Joint Conference on Artificial Intelligence and the 25th European Conference on Artificial Intelligence (IJCAI-ECAI 2022)** on July 23-29, 2022, in Messe Wien, Vienna, Austria.

The Anthropocene has brought along a drastic impact on almost all life forms on the planet. Considering the importance and amount of water in this speck of dust in the middle of nowhere that we inhabit, we should have called it Planet Ocean. Oceans are not only important because of their volume but are also about the functions and contributions they provide to biodiversity, the human species included.

The goal of this workshop is to bring together researchers that are interested and/or applying AI and ML techniques to problems related to marine biology, modeling, and climate change mitigation. We also expect to attract natural science researchers interested in learning about and applying modern AI and ML methods. Consequently, the workshop will be a first stone on building a multi-disciplinary community behind this research topic, with collaborating researchers that share problems, insights, code, data, benchmarks, training pipelines, etc. Together, we aim to ultimately address an urgent matter regarding the future of humankind, nature, and our planet.

This workshop has a related IJCAI-ECAI 2022 Challenge: AI methods for determining ocean ecosystems from space: Combining genomic information, microscopic and satellite imagery.

Topics

Topics of interest of this workshop can be grouped into two sets:

1. Addressing and advancing the state of the art in areas like AI, ML, mathematical modeling and simulation. Here the focus is set on:

- improving neural network handling of graph-structured information,
- improving the capacity of ML methods to learn in small data contexts,
- understanding causal relations, interpretability and explainability in AI,
- integrating model-driven and data-driven approaches, and
- to develop, calibrate, and validate existing mechanistic models.

2. Focus on answering the questions from the application domain, where the main questions to be addressed are:

    - Which are the major patterns in plankton taxa and functional diversity?
    - Which are the major drivers of patterns, and how do they interact?
    - How these patterns and drivers will likely change under climate change?
    - How will these changes affect the capacity of ocean ecosystems to sequester carbon from the atmosphere, that is the biological carbon pump?
    - What relations bind communities and local conditions?
    - What are the links between biodiversity functioning and structure?
    - How modern AI and computer vision can be applied as research and discovery support tools to understand planktonic communities?
    - How new biological knowledge can be derived from the application of anomaly detection, causal learning, and explainable AI.

Detailed programme (in CET timezone)

- **When:** 23 July 2022, 14:00-17:00 CET (08:00-11:00 CLT/EST, 09:00-12:00 BRT)
    - BRT timezone -5 hours; EST/CLT timezone -6 hours.
- **Attending in person:** Room Schubert 1. Messe Wien, Vienna.
- **Attending online:** Use the URI https://meet.jit.si/aimocc-2022.

14:00 - 14:15. Opening comments and welcome by the organizers.

14:15 - 14:40. A Physics-Informed Neural Network to Model Port Channels. Marlon S. Mathias1, Caio Fabricio Deberaldini Netto1, Marcel M.B. Barros1, Jefferson F. Coelho2, Lucas P. de Freitas1, Felipe M. Moreno1, Fabio Cozman1, Anna Helena Reali Costa 1, Eduardo Aoun Tannuri1, Edson S. Gomi 1, and Marcelo Dottori3. (1) University of São Paulo, (2) São Paulo University (POLI-USP), (3) Oceanographic Institute, University of São Paulo. abstract paper (pdf) online presentation

We describe a Physics-Informed Neural Network (PINN) that simulates the flow induced by the astronomical tide in a synthetic port channel, with dimensions based on the Santos-São Vicente-Bertioga Estuarine System. PINN models aim to combine the knowledge of physical systems and data-driven machine learning models. This is done by training a neural network to minimize the residuals of the governing equations in sample points. In this work, our flow is governed by the Navier-Stokes equations with some approximations. There are two main novelties in this paper. First, we design our model to assume that the flow is periodic in time,

which is not feasible in conventional simulation methods. Second, we evaluate the benefit of resampling the function evaluation points during training, which has a near zero computational cost and has been verified to improve the final model, especially for small batch sizes. Finally, we discuss some limitations of the approximations used in the Navier-Stokes equations regarding the modeling of turbulence and how it interacts with PINNs.

14:40 - 15:05. Towards Optimally Weighted Physics-Informed Neural Networks in Ocean Modelling. Hugo Carrillo Lincopi, Taco de Wolff, Luis Martí, and Nayat Sánchez Pi. Inria Chile Research Center. abstract paper (pdf)

Understanding the ocean has particular relevance with the emergence of the climate change phenomenon. Nowadays, this is an essential task, but also very expensive in the computational sense. This work explores the benefits of using physics-informed neural networks (PINNs) for solving partial differential equations (PDEs) related to ocean modeling; such as the Burgers, wave, and advection-diffusion equations. We explore the trade-offs of using data vs. physical models in PINNs for solving partial differential equations. PINNs account for the deviation from physical laws in order to improve learning and generalization. We observed how the relative weight between the data and physical model in the loss function influences training results. Additionally, we compare the variance of our results and analyze the implications of activation functions for training neural network derivatives.

15:05 - 15:30. Modeling Oceanic Variables with Dynamic Graph Neural Networks. Caio Fabricio Deberaldini Netto1, Marcel M.B. Barros1, Jefferson F. Coelho2, Felipe M. Moreno1, Marlon S. Mathias1, Lucas P. de Freitas1, Fabio Cozman1, Marcelo Dottori3, Eduardo Aoun Tannuri1, Edson S. Gomi1, and Anna Helena Reali Costa1. (1) University of São Paulo, (2) São Paulo University (POLI-USP), (3) Oceanographic Institute, University of São Paulo. abstract paper (pdf) online presentation

Researchers typically resort to numerical methods to understand and predict ocean dynamics, a key task in mastering environmental phenomena. Such methods may not be suitable in scenarios where the topographic map is complex, knowledge about the underlying processes is incomplete, or the application is time critical. On the other hand, if ocean dynamics are observed, they can be exploited by recent machine learning methods. In this paper we describe a data-driven method to predict environmental variables such as current velocity and sea surface height in the region of Santos-Sao Vicente-Bertioga Estuarine System in the southeastern coast of Brazil. Our model exploits both temporal and spatial inductive biases by joining state-of-the-art sequence models (LSTM and Transformers) and relational models (Graph Neural Networks) in an end-to-end framework that learns both the temporal features and the spatial relationship shared among observation sites. We compare our results with the Santos Operational Forecasting System (SOFS). Experiments show that better results are attained by our model, while maintaining flexibility and little domain knowledge dependency.

15:30 - 16:00. Coffee break (we stay in the online call and chat).

16:00 - 16:25. Enhancing Oceanic Variables Forecast in the Santos Channel by Estimating Model Error with Random Forests. Felipe M. Moreno1, Caio Fabricio Deberaldini Netto1, Marcel M.B. Barros1, Jefferson F. Coelho2, Lucas P de Freitas1, Marlon S. Mathias1, Luiz Schiaveto Neto3,

Marcelo Dottori4, Fabio Cozman1, Anna Helena Reali Costa1, Edson S. Gomi1, and Eduardo Aoun Tannuri 1. (1) University of São Paulo, (2) São Paulo University (POLI-USP), (3) Escola Politécnica – University of Sao Paulo, (4) Oceanographic Institute, University of São Paulo. abstract paper (pdf) online presentation

In this work we improve forecasting of Sea Surface Height (SSH) and current velocity (speed and direction) in oceanic scenarios. We do so by resorting to Random Forests so as to predict the error of a numerical forecasting system developed for the Santos Channel in Brazil. We have used the Santos Operational Forecasting System (SOFS) and data collected in situ between the years of 2019 and 2021. In previous studies we have applied similar methods for current velocity in the channel entrance, in this work we expand the application to improve the SHH forecast and include four other stations in the channel. We have obtained an average reduction of 11.9% in forecasting Root-Mean Square Error (RMSE) and 38.7% in bias with our approach. We also obtained an increase of Agreement (IOA) in 10 of the 14 combinations of forecasted variables and stations.

16:25 - 16:50. The BLue Amazon Brain (BLAB): A Modular Architecture of Services about the Brazilian Maritime Territory. Paulo Pirozelli1, Ais B.R. Castro1, Ana Luiza C. de Oliveira1, André Seidel1, Flávio N. Cação1, Igor C. Silveira1, João G M Campos1, Laura C. Motheo1, Leticia F. Figueiredo1, Lucas F.A.O. Pellicer1, Marcelo A. José1, Marcos M. José1, Pedro de M. Ligabue1, Ricardo S. Grava1, Rodrigo M. Tavares1, Vinícius B. Matos1, Yan V. Sym1, Anna Helena Reali Costa1, Anarosa Alves Franco Brandão2, Denis D. Maua1 Fabio Cozman1, Sarajane M. Peres1. (1) University of São Paulo, (2) Escola Politécnica – University of Sao Paulo. abstract paper (pdf) online presentation

We describe the first steps in the development of an artificial agent focused on the Brazilian maritime territory, a large region within the South Atlantic also known as the Blue Amazon. The “BLue Amazon Brain” (BLAB) integrates a number of services aimed at disseminating information about this region and its importance, functioning as a tool for environmental awareness. The main service provided by BLAB is a conversational facility that deals with complex questions about the Blue Amazon, called BLAB-Chat; its central component is a controller that manages several task-oriented natural language processing modules (e.g., question answering and summarizer systems). These modules have access to an internal data lake as well as to third-party databases. A news reporter (BLAB-Reporter) and a purposely-developed wiki (BLAB-Wiki) are also part of the BLAB service arquitecture. In this paper, we describe our current version of BLAB’s architecture (interface, backend, web services, NLP modules, and resources) and comment on the challenges we have faced so far, such as the lack of training data and the scattered state of domain information. Solving these issues presents a considerable challenge in the development of artificial intelligence for technical domains.

16:50 - 17:00. Final remarks.

17:00 - until available. Open topic conversations.

Submissions

We welcome submissions of **full papers** (8 pages, not counting references) and **short summary papers** (4 pages, not counting references). Papers must be written in English and in PDF format according to the IJCAI-ECAI'22 style. All submitted papers will be under a single-blinded peer review for their novelty, technical quality and impact. The submissions can contain author details.

Links

- Workshop information at IJCAI-ECAI'22: https://ijcai-22.org/workshop/#w33.
- Call for papers and further information (this page): https://oceania.inria.cl/#aimocc-2022.
- Shareable call for papers as `.pdf`: LINK.
- Shareable call for papers as `.txt`: LINK.
- AIMOCC 2022 CMT submission site: https://cmt3.research.microsoft.com/AIMOCC2022.

Important dates

- Submission deadline **extended!** : **June 4, 2022 (UTC-12)** ~~**May 20, 2022 (UTC-12).**~~
- Notification of acceptance: **June 11, 2022.**
- Reception of final version: **June 18, 2022.**

Post-proceedings publication

We will seek to publish selected, revised, extended papers later in a planned post-proceedings volume, to be published in the Lecture Notes in Artificial Intelligence (LNAI) series. The selection of papers will be managed by a subset of the workshop organizing committee.

Organizers

- **Nayat Sánchez-Pi**, Inria Chile Research Center.
- **Pablo Marquet**, Pontificia Universidad Católica de Chile.
- **Alejandro Maass**, Center of Mathematical Modeling (CMM), Universidad de Chile.
- **Luis Martí**, Inria Chile Research Center.

Scientific committee

- **José Manuel Molina**, Universidad Carlos III de Madrid,
- **Julien Salomon**, ANGE, Inria Paris,
- **Jacques Sainte-Marie**, ANGE, Inria Paris,
- **Olivier Bernard**, BIOCORE, Inria Sophia-Antipolis,
- **Michèle Sebag**, TAU, Inria Saclay,
- **Marc Schoenauer**, TAU, Inria Saclay,
- **Pablo Marquet**, Pontificia Universidad Católica de Chile (PUC),
- **André Abreu**, Fondation TARA Océan,
- **Ana Cristina Garcia Bicharra**, Unirio - Federal University of Rio de Janeiro State,
- **Hernán Lira**, Inria Chile Research Center,
- **Hugo Carrillo Lincopi**, Inria Chile Research Center,
- **Andrew Berry**, Inria Chile Research Center,
- **Luis Valenzuela**, Inria Chile Research Center,
- **Leandro Fernandes**, Universidade Federal Fluminense,
- **Roberto Santana**, University of the Basque Country (UPV/EHU),
- **Colomban De Vargas**, GO-SEE CNRS Federation, and
- **Damien Eveillard**, ComBi, Université de Nantes.

Diversity commitment

We will seek diversity in all aspects, both in school of thought, nationalities, stages in the academic career, etc.

Access

We will publish the accepted papers and talk abstracts (before the event) and the slides of the speakers (after the event) on the workshop website. We will include a bibliography of most relevant research papers to facilitate cross-pollination of ideas between these fields. Similarly, we will record the workshop and publish it online.