WACOMA SYMPOSIUM

on Water and Coastal Management

Held on July, 14th and 15th, 2022
at the Congress Center, Largo Firenze 1, Ravenna, Italy

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

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BOOK OF ABSTRACTS

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WACOMA SYMPOSIUM
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https://eventi.unibo.it/wacoma-symposium   https://wacoma.unibo.it/

Organized by the **University of Bologna** in collaboration with the **University of Algarve** (Portugal) and the **University of Cadiz** (Spain), the WACOMA Symposium is held on **July, 14th and 15th**, 2022 at the Congress Center, Largo Firenze 1, **Ravenna, Italy**.

The main aim of the Symposium is to provide insights on aquatic, environmental and coastal marine sciences, water and coastal hazard and risk mitigation, climate change impacts on coastal areas and green economy. International scientists, representative of the Associate Partners, as well as the WACOMA Alumni will exchange experiences and knowledge. Keynote speakers will give inspiring talks on related topics.

The WACOMA SYMPOSIUM is the concluding event of the Erasmus Mundus Joint Master Degree Programme in **Water and Coastal Management** (WACOMA), lasting from 2017 to July 2022, which was promoted by the Department of Biological, Geological and Environmental Sciences at the Campus of Ravenna of the University of Bologna.

About the Erasmus Mundus WACOMA

Three cohorts of students from overall the world had the possibility to study in three different Countries (Italy, Spain and Portugal), in association with several European and non-European Country academic institutions, research centres and companies representing a wide spectrum of complementary scientific knowledge and of diverse fresh water and marine sites. The **course objective** is to train managers and scientists for Water and Coastal Zone Risk Management, with a solid knowledge of environmental and legal instruments.

Graduates became specifically experts in **water and coastal hazards and risks** and their interrelations with **global changes** and use of **resources**. Consistent with the percepts of **management sciences**, it also concerns mitigation and adaptation to changes and it deals with the relevant aspects of a **sustainable green** and **blue economy**. The EMJMD WACOMA links natural sciences and societal challenges focusing on biology, geology, management, law and economics, thus being both multidisciplinary and interdisciplinary. It aims at integrating aquatic, environmental and marine sciences into an advanced teaching program, while promoting an exchange of information with a direct involvement of the coastal end users and stakeholders. The diversity and complexity of these topics relating to freshwater and coastal systems require a broad academic platform for an effective integration between the institutions representing different ecosystems scenarios, management and risk cultures.

WACOMA has been funded by the EU programme **Erasmus+ 2014/2020**, budget line "Erasmus Mundus". EMs are offered by multiple higher education institutions and run across various countries. They are distinguished by their academic excellence and by their high-level of integration. Students at master's level from all over the world can apply. In addition, scholarships are available for the best students. The aim of this action is to promote academic excellence in a teaching Master Degree Programme that aims at developing common understanding and deepening scientific knowledge in the vital, challenging and continuously evolving field of water and coastal ecosystems.

Programme OUTLINE

THURSDAY, JULY 14

9.30 *Welcome greetings,* Wacoma Coordinators, Academic and Local Authorities

10.00 *Key note lecture*, Mike Elliott (University of Hull, United Kingdom)

10.40 Sebastián Díaz Ribes (University of Cadiz, Spain)

11.05 Andrea Valentini (ARPAE, Italy)

       Break

11.50 Tegan Blount (*WACOMA Alumna*, University of Padua, Italy)

12.10 Eduardo Ramírez-Romero (ICMAN-CSIC, Spain)

12.25 Enrico Sassi (Lighthouse spa, Bologna, Italy)

       Break and Posters tour with WACOMA Students

14.15 *Key note lecture*, Alice Newton (University of Algarve, Portugal)

14.55 Antonio Navarra (University of Bologna; President of CMCC, Lecce, Italy)

15.20 Irene Delgado-Fernandez (University of Cadiz, Spain)

15.45 Marcus Polette (University do Vale do Itajaí, Brasil)

       Break

16.30 Luis Biolchi (*WACOMA Alumnus*, ARPAE, Italy)

16.50 Pietro Solaroli (Agnes Power srl, Ravenna, Italy)

17.10 Antonio Persichetti & Tommaso Beschi (Archetipo srl, Padova, Italy)

FRIDAY, JULY 15

9.30 *Key note lecture*, William Pan (Duke University,USA)

10.10 Marco Marani (University of Padua, Italy)

10.35 Alessia Cariani & Alice Ferrari (University of Bologna, Italy)

11.00 Ifigeneia Giannoukakou- Leontsini (*WACOMA Alumna*, TecnoAmbiente, Spain)

11.20 Caterina Righini (F.lli Righini spa, Ravenna, Italy)

11.35 Closing remarks

       12.00 WACOMA *Final greetings*

10:00 Key note lecture, Mike Elliott (University of Hull, United Kingdom)

Estuarine and coastal management in a changing word – risks, challenges and opportunities

Michael Elliott[1,2*], Angel Borja[3,4], Roland Cormier[5]

[1] Department of Biological & Marine Sciences, University of Hull (UK)
[2] International Estuarine & Coastal Specialists (IECS) Ltd, Leven (UK)
[3] AZTI, Marine Research, Basque Research and Technology Alliance (BRTA). Herrera Kaia, Pasaia (Spain)
[4] King Abdulaziz University, Faculty of Marine Sciences, Jeddah (Saudi Arabia)
[5] National Centre for Effectiveness Science, Fisheries and Oceans (Canada)

(unbounded boundaries, moving baselines, exogenic pressures, endogenic pressures, footprints)

Coastal, estuarine and marine systems are subject to endogenous and exogenous pressures which emanate respectively from hazards inside and outside the system. Those hazards may be both natural and anthropogenic although even the natural ones may be exacerbated by human actions. The hazards become risks when they affect features valued by society for human safety and well-being and so they need to be addressed by a risk assessment and management approach. However, changes due to stressors such as climate change, and the potential for mitigation and adaptation, can also lead to opportunity assessment and management. These aspects are discussed in the light of where and when: (a) human activities take place (the activity-footprints); (b) the pressures generated by the activities on the prevailing habitats and species, in which pressures are defined as the mechanisms of change (the pressures-footprints), and (c) any adverse or beneficial effects occur on the natural system and on ecosystem services from which society extracts goods and benefits (the effects-footprints). These footprints then need to be addressed by a spatial and temporal programme of management measures, i.e. the management response-footprints. The latter extend from small area management, through regional initiatives, to global initiatives. This presentation explains and defines these footprints in relation to the implementation of marine governance (policies, politics, administration and legislation). This will include current European marine management and the relevant EU Directives and indicate the challenges for scientists and policy-makers involved in marine management. It emphasises the transboundary nature of these aspects and their inclusion in marine resource sustainable and successful management. This internationally-based approach encompasses Maritime Spatial Planning, Cumulative Impacts Assessment and Strategic and Regional Environmental Assessments.

10.40 Sebastián Díaz Ribes (University of Cadiz, Spain)

Drones and the new pollution surveyance of EMSA and UE members: Gibraltar Straight and Gulf of Biscay. Decarbonization in Shipping Industry

Sebastián Díaz Ribes[1, 2]

[1] Associated Teacher of International Public Law and International Relations Department (External Professional teacher) at University of Cadiz, Spain
[2] Diaz y Asociados Law Firm

(EU maritime polution policy, EMSA jurisdiction and member states, International maritime polution framework Paris MOU, aicrafts and drones use against pollution, artificial sniffers and righTs protection)

The conference will try to explain the European Policy related to Maritime Polution and the green deal in Maritime Transport. EMSA is an specialized agency that belongs to EU whose jurisdiction is to coordinate and set up the European policies related among others in the enforcement of EU and international regulation related to maritime polution in all kind of aspects.

The Maritime businness is one of the international activities more regulated from IMO – International Maritime Organization-, United Nations, European Unión and each state.

However the weaker position is the enforcement of the regulation.

IMO established allmost all European Union member states as Dry area and the bunkers sulphur contain had been reduced a lot, in line to IMO 2020 regulation.

The European Union developed Directives which entered in force, and the member states had been enforced after being introduced in their own national law.

Afterwards EMSA has developed an uniform policy to give a technical background to all port state control officers and the member states are being audited by EMSA to confirm the enforcement of the rules.

The role of the European Union, EMSA and the member states related to the use of air surveillance by aircrafts under Bonn Agreement and Drones including the artificial sniffers.

In our professional experience we have found several bullets points such as:
-   The prospective evidence of the sniffer is accepted in breach of ship owners rights.
-   The acceptance of the evidence taken in other country jurisdictional waters.
-   Validity of the equipment certificates and Laboraty samples results.
-   The way of taken samples.

The European Union is now developing a new policy to avoid carbon print and green house gases that charge to the owners of ship trade the costs of environmental levies.

Therefore the new regulation can bring certain european ports such as Maltese, Italians, Greek or Spanish where their trade is not import export and only transhipment of cargo to other parts -hubs ports- to reduce their activity in favour of other non european ports that will not charge these levies to their clients.

Furthermore there are other ways of transports that do not charge to the owners the costs of this environmental matters, such as, air, trucks or trains transport.

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11.05 Andrea Valentini (ARPAE, Italy)

New developments for supporting the Emilia-Romagna Region coastal management through European Italy-Croatia Interreg Projects (AdriaClim, CASCADE, STREAM)

Andrea Valentini (Presenter)[1], Luis Germano Biolchi[1], Silvia Unguendoli[1]

[1] Hydro, Meteo and Climate Service of the Regional Agency for Prevention, Environment and Energy of Emilia-Romagna (Arpae-SIMC)

(coastal management; climate change adaptation and mitigation; observing systems; coastal-marine modelling)

Among the many obstacles encountered towards adequate coastal management, the integration of modelling and observational activities has the utmost importance as the major provider of information on current and future conditions. Additionally, when dealing with mitigation, adaptation, and disaster risk reduction, forming personnel and instructing stakeholders and citizens assume a very important role. In this context, European Projects provide the opportunity to improve currently existing systems as well as to acquire new equipment for both modelling and observing activities. Moreover, such projects also allow for the preparation of citizens and stakeholders involved directly or indirectly on decision making processes at different stages. Hence, the current developments of three European projects called AdriaClim, CASCADE, and STREAM are the source of recent progress performed at Arpae-SIMC.

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Biosketch: Head of the Marine and Coastal Numerical Forecasting Unit at the Hydro Meteo and Climate service of Emilia-Romagna region with a strong background in the ocean-coastal dynamics and modelling, the observing systems and the marine data analysis. Project manager of several EU research and cooperation projects, mainly related to the coastal risk assessment, reduction and mitigation, to the study of the Climate Change's effects on the coastal areas and to the management and the prevention of marine pollution due to oil-spills. Manager of the marine-coastal observation network of Emilia-Romagna. Adjunct Professor of Advanced technologies and Decision Support Systems in water and coastal management at the University of Bologna - Department of Biological, Geological and Environmental Sciences. Member of few national and international working group in the field of the ocean observing systems, bathing water quality management and short-term water pollution.

11.50 Tegan Blount (*WACOMA Alumna*, University of Padua, Italy)

Remote sensing application in coastal wetlands: two case studies

Tegan Blount[1]

[1] Department of Geosciences, University of Padua, Padua, Italy

(salt marshes; remote sensing; multispectral data; Ria Formosa Lagoon; Venice lagoon)

Salt marshes are ecologically and socio-economically highly valuable ecosystems that are suffering rapid losses worldwide due to pressure from environmental and anthropogenic drivers. As a blue carbon ecosystem (BCE), salt marshes are efficient sinks and long-term reservoirs of carbon with a key role in the global carbon cycle. Thus, the sustainable management of salt marshes is vital for climate change mitigation, as well as for preserving the multitude of additional ecosystem services that they provide. Long-term spatially explicit monitoring of salt marshes is essential as a foundation for informed management approaches. One of the most adept salt marsh monitoring methods is remote sensing, which has the potential to provide affordable long-term coverage of key parameters at a global scale. There are, however, challenges in using remote sensing to accurately capture the spatial extent and internal variability of salt marshes over large spatio-temporal scales.

The potential and accuracy of selected non-cost-prohibitive remote sensing applications in salt marshes is the focus of the two European case studies discussed herein: (1) the capability of open-source multispectral data to capture multi-decadal salt marsh lateral evolution (Ria Formosa Lagoon, Portugal); (2) the ability of unmanned aerial vehicle (UAV) based Hyperspectral and LiDAR data to infer the distribution of carbon sequestration stocks (Venice Lagoon, Italy). As a result of the first case study, the open-source Sentinel-2 and Landsat Programmes archive was found suitable as a tool for salt marsh shoreline mapping and monitoring in an operational coastal management context. Initial data from the Venice Lagoon study suggests that the approach applied will also prove to be a useful tool for coastal managers.

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12.10 Eduardo Ramírez-Romero (ICMAN-CSIC, Spain)

Modelling planktonic food webs with jellyfish under climate change and eutrophication scenarios

Eduardo Ramírez-Romero[1], Valentina Leoni[2], Alejandro Ariza[3], Juan Carlos Molinero[3]

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[3] MARBEC, IRD, CNRS, Ifremer, Université de Montpellier, Sète, France

(climate change, eutrophication, jellyfish, food webs, lagoon)

The role of jellyfish emerged as crucial in marine food webs, showing a prominent top-down control funneling the biomass, promoting trophic cascades and both competing and feeding on high trophic levels such as fish larvae. Furthermore, there is a rising concern regarding jellyfish blooms due to the dramatic impacts on human activities such as fisheries, aquaculture or tourism.

In the other hand, despite these pervasive effects in marine socio-ecosystems, a mechanistic understanding and forecasting of population dynamics and trophic interactions of this group has been barely addressed. Furthermore, marine food webs are expected to shift in the next future due to anthropogenic impacts, such as eutrophication and climate change and jellyfish response should be explained.

In this study, we have developed a dynamic, mechanistic plankton food web model coupled to a stage-resolved population model of different jellyfish. Jellyfish selected represent two main species inhabiting European waters and present different ecological features. We aim at simulating the plankton seasonal dynamics in shallow lagoons to depict biotic and abiotic drivers of the jellyfish populations features. Moreover, we have tested the potential effect of climate change and eutrophication on food webs and jellyfish features, providing insights for management strategies and anticipating the next future response.

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12.25 Enrico Sassi (Lighthouse spa, Bologna, Italy)

Present and future developments of autonomous surface vehicle to support coastal survey

Enrico Sassi[1]

[1] Chief Commercial Officer, LIGHTHOUSE SpA, Bologna, Italy

(coastal environment; data acquisition; autonomous vehicles; eco-friendly surveys; low-emission technologies)

Marine coastal data acquisition and data processing are the base of many research and commercial studies. The transition to net-zero emissions, target set for the mid-century, impose great challenges that also affect the traditional way to investigate the marine environment especially in coastal areas. New and innovative technologies are pushing the limits on how we may explore the marine environment. Can autonomous, unmanned, low-emission vehicles, allow reliable data acquisition with the ambitious target to work 24-hours a day, 7-days a week, 365-days a year in all sea condition? What are the challenges that have found an answer, which are the current progress? Eco friendly marine surveys are possible in the commercial market? The presentation will cover some examples on the progress made by technology during recent years, the key benefit and the biggest challenges of this work in progress journey to net-zero.

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14.15 *Key note lecture*, Alice Newton (University of Algarve, Portugal)

Water and Coastal Management: past, present and future

Alice Newton[1]

[1] University of Algarve, Portugual

(management of water resources; coastal environments; lessons learned; adaptation to climate change; sustainability)

Humans have been managing their water resources and coastal environments for Millenia
These past endeavours have sometimes been very successful, but also sometimes disastrous.
Some notable examples from around the world are presented. What can we learn from these?
Recent shifts in attitudes are shaping how we decide to manage our water and coasts in the present.
However, the current rapid changes in climate are challenging us to come up with innovative and sustainable ideas and concepts.
These are the challenges that future Water and Coastal Managers will face in the coming decades.

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Biosketch: She is a chemical oceanographer with a research focuson eutrophication and lagoons. She is:
-a Council member of the Estuarine and Coastal Sciences Association (ECSA);
-the European Engagement Partner of Future Earth Coasts, (FEC, formally LOICZ);
-a member of RAMSAR Mediterranean Wetlands Scientific and Technical Network Climate Change Specialist Group;
-a member of the Future Earth Ocean Knowledge Action Network development team;
-a member of the Integrated Marine Biosphere Research (IMBeR) Science Executive Committee;
-a member of the pool of experts for the second United Nations World Ocean Assessment;
-a member of the Future Earth Coast Academy;
-a member of the Dialogue Forum of the Oceans-Pact.

14.55 Antonio Navarra (University of Bologna; President of CMCC, Lecce, Italy)

The challenge of climate science

Antonio Navarra[1]

[1] Department of Biological, Geological, and Environmental Sciences, University of Bologna, Italy

(Climate change; science-based approach; advanced numerical models)

The problem of climate change is becoming one of the great historical problems of our era. Climate change has a global reach and a pervasive influence on all sectors of our society. It is a threat to economical well-being, to an equilibrated and sustainable path to development for emerging economies and to the equilibrium of the mature economies. The recently acquired capability of mankind to change our environment is posing unprecedented issues for complexity and outreach.

Climate change is also strongly science-based. The base for this debate is rooted in sophisticated scientific arguments derived by using advanced numerical methods and techniques. This fact poses a special responsibility on the climate scientific community: we have to respond to society demands for information that has to be accurate, honest and timely.

We can easily convince ourselves of the extreme complexity of the climate system, a system that contains unknown or poorly known processes, strong nonlinear interactions that enhance sensitivity to small perturbation. How is it possible a quantitative scientific consideration of such a system? This is the great challenge that climate science is facing today, to obtain a scientific method that will produce assessments that will be reliable, consistent and quantitative. The main tool to respond to this challenge is the numerical circulation models of climate. The numerical approach to climate will be presented with a review of recent results and a critical assessment of its potential and limitations.

References: The following web sites have a rich and complete collections of documents:
- **www.ipcc.ch:**The site of the Intergovernmental Panel on Climate, change The UN based body that prepares regularly the assessment reports on climate change. The IPCC reports are available here. Especially the reports:
- IPCC WG 1 Summary Report: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf
- IPCC WG 2 Reports: https://www.ipcc.ch/report/ar6/wg2/
- **www.unfccc.de:** United Nations Framework Convention on ClimateChange.
- **www.unep.ch:** The environmental program of the UN, Particularly engaged in the mitigation and adaptation programs.
- **www.wmo.ch:** The site of the World Meteorological Organization, the UN Agency that is responsible for the international cooperation in meteorology and climate
- This book is a good introduction: J. Houghton, Global Warming, The Complete Briefing, 5ed,Cambridge University Press, 2015

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Biosketch: Antonio Navarra is a Full Professor at the University of Bologna. He graduated in Physics at the University of Bologna in 1980. He then moved to Princeton University to get a PhD at the Geophysical Fluid Dynamics Laboratory. He is also President of the Foundation "Centro Euromediterraneo sui Cambiamenti Climatici" (CMCC), a multidisciplinary research center whose mission is to investigate and model the human climate system. He has an extensive experience in climate numerical experiments and on numerical methods as a tool of scientific investigation and discovery. He has also held appointments as Affiliate Scientist at the National Center for Atmospheric Research (NCAR, Boulder) and in the advisory board of the Asia-Pacific Climate Center in South Korea. He is or has been on the board of the ECMWF Council, Joint Programming Initiative "Climate" and he is on the Board of the UN Adaptation Fund.

15.20 Irene Delgado-Fernandez (University of Cadiz, Spain)

Foredunes, beaches, and coastal management: an interconnected system

Irene Delgado-Fernandez[1]

[1] Earth Sciences Department, University of Cadiz, Spain

(coastal processes, morphodynamics, littoral cells, sea-level rise, sandy coastlines)

Sandy coastlines comprising beaches and coastal dunes are one of the most heavily used environments on Earth. Recent reports suggest that ¾ of the world's population could be living within 60 km of the coastline by 2020, with human activities such as tourism, residential uses, and resource extraction strongly affecting coastal environments. Beach-dune systems are, however, one of the most dynamic landscapes on our planet. Waves, winds, tides, and currents drive sediment transport and interact with complex, changing topographies in three dimensions. This makes coasts some of the most difficult environments to model.

This talk will explore our current understanding of **beach-dune system changes at a range of spatial and temporal scales**. We will discuss how our research contributes to understanding of coastal behaviour and thus to improving predictions of coastal change. The talk will **critically analyse current coastal management paradigms** and their links to coastal sciences. Despite their relevance to society and to coastal protection schemes, it is common to find gaps between research-led projects and coastal planning decisions, with short-term and long-term socio-economic impacts. The talk will end with references to recent **science communication efforts** and transdisciplinary coastal projects (e.g., Coasts for Kids | @Coasts4Kids)

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15.45 Marcus Polette (University do Vale do Itajaí, Brasil)

Marine Vessel traffic as a guiding element in the construction of the Marine Spatial Planning process

Marcus Polette[1]

[1] Universidade do Vale do Itajaí – UNIVALI, Santa Catarina, Brazil

(marine vessel traffic, maritime uses; sectoral conflicts; socioeconomic development; estuaries)

The marine vessel traffic is an issue still little explored in the world literature and proves to be relevant in the scope of coastal and marine management and governance. It is a fundamental theme in the scope of Marine Spatial Planning - MSP and its insertion today reveals to be a fundamental strategy to understand the structure and functioning of maritime uses, as well as the possible sectoral conflicts existing in the scope of coastal and marine waters.

The marine vessel traffic analysis also makes it possible to survey and assess the degree of institutional responsabilities as legal interactions within the coastal and marine territory. Each different type of vessels (Container, RoRo, cruise ships, military ships, superyachts, fishing ships, etc) identified by size, shape, autonomy and/or scope of action (local, regional, national, international), form of pollution control and technologies employed reveal complex interactions and interests between diferente stakeholders whose mediation requires proactive actions having as a principle the maintenance of coastal and marine ecosystem services. This is an important issue in the social dimension, as it is responsible for the dynamics of generating employment and income for millions of families, from artisanal fishing to long-scale navigation. There are thousands of vessels all over the planet, of different sizes and types, which are responsible for the incessant transport of cargo and passengers, which also establish trade relations, services, connections between places and exchanges between different cultures.

The present research aims to evaluate the marine vessel traffic in the geographic area of the estuary of the Itajaí-Açu River (Santa Catarina - Brazil) and adjacent marine area, taking into account the Sustainable Development Goals - SDG, as well as the vision of the Decade of Ocean Sciences. It also aims to evaluate the structure and functioning of the main economic sectors with direct and indirect influence in the region, having as a reference an extensive survey of existing secondary data, thus demonstrating the need to make this topic essential in the scope of plans, programs and projects that seek to coastal and marine zone management and governance. From a geographical point of view, the study focuses on the estuarine system of the Itajaí-Açu river, located on the north-central coast of Santa Catarina and adjacent marine area. The method for developing this analysis was structured through the UNESCO Manual, which follows a step-by-step process within the integrated coastal management cycle. It is based on the collection of secondary data, which structured the diagnosis through the following research steps: 1. Characterization of the estuary of the Itajaí-Açu River and the history of the Port Complex in terms of its spatial evolution and current infrastructure. 2. Local evolution of vessel traffic through historical cycles and associated infrastructure. 3. Analysis of the direct and indirect impacts of maritime activities (in the region and under different groups/sectors) especially oil and gas production, as well as fishing activities. Finally, the view of the estuary of the Itajaí-Açu river is presented within the scope of the implementation of the research on vessel traffic as a strategic element in environmental licensing actions, as well as in the scope of Marine Spatial Planning - MSP. It is evident that the traffic of vessels in the estuary of the Itajaí-Açu river is a vital element for the socioeconomic development of this coastal sector on a national scale, as well as presenting itself as an integrating element not only of the port-city relationship through its logistics, but also as well as the infrastructure installed there. This proves to be a link between the hinterland of the territory of the state of Santa Catarina in the national and international scope. It is evident the importance of vessel traffic as an entity responsible for the flow of energy, matter and information resulting from a process of institutional interactions, technological advancement, as well as territorial integration between the river, the estuary and the sea, which is a new link for coastal and marine governance and management at local, regional and international scales.

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16.30 Luis Biolchi (*WACOMA Alumnus*, ARPAE, Italy)

An expansion towards probabilistic oceanographic forecasts: recent developments at Arpae-SIMC

Luis Germano Biolchi[1], Silvia Unguendoli[1], Andrea Valentini[1]

[1] Hydro, Meteo and Climate Service of the Regional Agency for Prevention, Environment and Energy of Emilia-Romagna (Arpae-SIMC)

(coastal-marine forecast; hydrodynamic modelling; morphodynamic modelling; ensemble systems)

Oceanographic modelling has always been a challenging subject with increased difficulties if attempted in operational settings. Furthermore, while meteorology focused progressively on probabilistic approaches in the last 30 years, storm surge and hydrodynamic models lagged behind. Lately, work has been done at Arpae-SIMC to move from deterministic frameworks towards probabilistic implementations of oceanographic, wave, and morphodynamic forecasting models. Results have been proven helpful as the new approaches allow for tackling uncertainty in ways that single forecasts are not able to.

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Biosketch: Luis graduated in Oceanography from the Federal University of Rio Grande (FURG) and completed a masters in Marine Geology from the Federal University of Rio Grande do Sul (UFRGS). Moreover, he is an ex-WACOMA (UNIBO, UCA, UAlg) fellow having graduated in 2020. He has experience with wave, ocean, and morphodynamic modelling and he is currently working on European Interreg Italy-Croatia projects involving climate change in the Adriatic Sea, marine and coastal forecasting, and the testing and implementation of a variety of ocean related models at different spatio-temporal scales.

16.50 Pietro Solaroli (Agnes Power srl, Ravenna, Italy)

The AGNES_ROMAGNA project: an innovative offshore renewable energy hub

Pietro Solaroli[1]

[1] Agnes Power srl, Ravenna, Italy

(wind farm; innovative energy hub; Adriatic sea; environmental impact evaluation; authorization procedures)

Agnes, which stands for Adriatic Green Network of Energy Sources, is a development company based in Ravenna with a diversified portfolio of renewable energy projects located through the Adriatic Sea; one of them, the Romagna project, consists in an innovative energy hub located both onshore and offshore in the Ravenna area.

The multiple scopes of the project are described as follows:
- Production of electricity from renewable energy through n. 2 offshore wind farms and n. 1 offshore floating photovoltaic power plant;
- Storage of electricity through n. 1 battery energy storage system;
- Production of green hydrogen via electrolysis using the green energy output of the off-shore systems;
- Optional opportunities of re-utilization of oxygen (by-product of the hydrogen production) to support local aquacolture and commercial fishing;

Agnes Romagna is regarded as one of the most innovative projects in the Italian and European green energy sectors, and is greatly endorsed by national institutions as well as local communities;

nevertheless, considering the project size (750 MW) and the fact that it is mostly located offshore, it has to undergo a thorough authorization procedure, which includes the national Environmental Impact Assessment (EIA).

The aim of the presentation is to describe the Romagna project, with specific insight on the complex processes and activities involved in the realization of the Environmental Impact Study, the key document for the above mentioned EIA procedure.

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17.10 Antonio Persichetti & Tommaso Beschi (Archetipo srl, Padova, Italy)

Drones and sensors for innovative techniques of environment monitoring: experiences and case studies

Antonio Persichetti[1], Tommaso Beschi[1]

[1] Archetipo srl, Padova, Italy

(drones, environment monitoring; coastal systems; data analysis; water resources)

The constant technological progresses in recent years in the field of instruments used for the remote sensing industry led to the improvement and to a new definition of the survey techniques. The Unmanned Aerial Vehicles (UAV) are confirmed to be an efficient and innovative instrument for the remote sensing due to its high flexibility and the use scalability to a lot of different contexts. Furthermore, the spread of their applications is also due to the increase of the number of sensors that can be mounted on the UAV Systems. The high accuracy of the data and scenes acquired through these particular aerial platforms favors their use for operational monitoring by supporting, in general, the planning and sustainable management of agri-environmental systems at various territorial scales. Through the narration of activities carried out in the context of experimental works and projects relating to the survey of specific environmental contexts, the intervention in question will illustrate some case studies with a particular focus on monitoring operations of coastal systems and acquisition and analysis of data related to use of water resources.

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Biosketch: He is co-founder and business partner of Archetipo srl of Padua. This company provides Hi-tech services for territorial survey with drones and satellite images.
Since 2015, he rules as supervisor in the fields of Environmental Remote Sensing, Precision Farming and Research and Development. He has a Master Degree in Archaeology and he is a licensed UAV pilot for Critical Operations. He research for new environmental survey techniques with a wide range of sensors as Thermal, Multispectral, Hyper-Spectral and lidar. He published on scientific magazines and played seminaries at the University of Padua even on archaeological and Agro-Environmetal remote sensing.

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Biosketch: He ended his academic studies in prehistoric archaeology in 2016. During the last years of study, he started its approach to the GIS technology and he decided to specialize in it with a II Level Master in GIS Science at the University of Padua. Since 2020 he rules as GIS Analyst in Archetipo and he is an expert in the photogrammetric processing of images picked with UAV systems, in the management and analysis of all kind of geographic data and in the Satellite Remote Sensing for the Agro-Environmental Monitoring. He works with data derived from a wide range of sensors: Thermal, Multispectral and Hyperspectral. His main job consists in Research and Development for the automation of workflows for the creation of maps in the field of Agro-Environmental Remote Sensing.

9.30 *Key note lecture*, William Pan (Duke University, USA)

One Health Approach to Mitigating Human Health Risks in Coastal Regions

William Pan[1]

[1] Global Environmental Health, Duke University (USA)

(human vulnerability; climate change; health risks; malaria; managing health risks)

In this seminar, I will explore the questions of how many people are vulnerable to environmental change in coastal environments, what health risks these populations are threatened by, and how existing health, coastal, and water management infrastructure are insufficient to address current and future risk both regionally and globally. I will present the concept of One Health and efforts by WHO, OIE and FAO (Tripartite) to create a one health training program for disease management. Time permitting, I will describe a case study of mining and malaria as an example of a systems-based approach to managing multiple health risks.

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Biosketch: William Pan, PhD, joined the faculty at Duke in 2011. He holds a joint appointment at DGHI and the Nicholas School of Environment, and is Adjunct Assistant Professor in the Department of International Health at Johns Hopkins Bloomberg School of Public Health. Pan's research interests focuses on population, health, and environmental interactions in developing countries, with particular interest in translational research directed toward sustainable development activities and global environmental health. He has worked in countries throughout Latin America and Africa on topics ranging from land use change, reproductive health, migration, tuberculosis, HIV, enteric infections, and childhood nutrition. Pan received his doctoral training in Biostatistics from UNC-Chapel Hill with a focus on demography and spatial analysis. He also received a Master of Public Health from Rollins School of Public Health at Emory University.

10.10 Marco Marani (University of Padua, Italy)

Statistical modelling of geophysical extremes

Marco Marani[1]

[1] Department of Civil, Environmental an Architectural Engineering, University of Padova and Department of Civil and Environmental Engineering, Duke University

(costs of extreme events; MEDV; innovative versus traditional evaluations; probability of occurrence)

Extreme events in human-natural processes generate large financial, social, and health impacts and costs. The proper estimation of the likelihood of extreme event magnitudes is hindered by limited observational records, traditional methods that do not make optimal use of all observations, and by the frequent presence of non-stationarities. Here I describe the Metastatistical Extreme Value Distribution (MEVD), which relaxes some key limitations of the traditional Extreme Value Theory and makes use of all the available information, rather than just of yearly maxima or of a few events over a high threshold as in traditional approaches. I illustrate the effectiveness of this general approach by applying coastal storm surges, Atlantic tropical cyclones, rainfall, floods, and large epidemics. Overall, the MEVD significantly reduces the uncertainty in the estimation of high-quantile events. Use of the MEVD also permits the identification of trends in the probability of occurrence, e.g. in the case of extreme hurricanes. I conclude that the MEVD constitutes a significant advance over the traditional extreme value theory, which is particularly suited for non-stationary geophysical processes.

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10.35 Alessia Cariani & Alice Ferrari (University of Bologna, Italy)

Piloting the sustainable fishery in the Adriatic Sea: goals and outputs of Italy-Croatia projects PRIZEFISH and TECHERA

Alice Ferrari[1], Alessia Cariani[1], Luca de Marchi[2], Fausto Tinti[1]

[1] Department BIGEA, University of Bologna, Campus of Ravenna, Italy
[2] Department DEI, University of Bologna, Italy

(Blue transition, big data, Sustainable Development, Scientific Knowledge, innovation)

In the last decades, the non-selective and multitarget fishery activities impoverished the Adriatic marine ecosystem. Despite long-term time series of data are available and several platforms and ecological models have been elaborated to assess fishery exploitation thresholds and forecast marine resource availability, overall catches' decline, size reduction of commercial species and biodiversity loss cannot provide long-term opportunities for future generations. Such evidence calls for innovative solutions for responsible fisheries and ecosystem management, starting from the valorisation and the management of fishing activities stemming in the ecosystem approach. Proof of concept are the standing outcomes of the Interreg Italy-Croatia Project PRIZEFISH, which delivered sustainable and environmental-friendly technological solutions and added-value seafood in the Adriatic supply-chains. With the implementation of a cross-border, territorial and socio-economic developmental change in the cooperative renewable exploitation of Adriatic fishery resources the Interreg managed to empower small-scale fishermen and fishery operators adopting low-impact, eco-certified fishing methods and products. As a step in the future, PRIZEFISH legacy converged in TECHERA, where the collaboration and data exchange among policy makers, companies, suppliers, and customers via the integration of digital technologies into the supply chain are the main objectives. In TECHERA, it will be analysed how big data integration can benefit from the outcomes of previous Projects (ADRIREEF, FAIRSEA, ITACA, SUSHIDROP, PRIZEFISH and BLUE KEP) and from the innovation driven by Universities, Research Centers, and NGOs, involving and addressing its results to policy makers and younger generations.

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Biosketch: Alessia Cariani, graduate and doctorate in Marine Environmental Sciences (University of Bologna), carries out her activity at the Ravenna Campus in the laboratory of Genetics and Genomics of Resources and Marine Environment - GenoDREAM - in the field of genetics and genomics, from molecular taxonomy to the evaluation of the evolutionary and environmental drivers of population structure and biodiversity in marine species (with focus on marine fish). The scientific results are applied in a context of traceability and sustainable management of fish resources, with specific application to the conservation of marine animals. Project Manager of the PRIZEFISH project in which action plans for responsible fishing are implemented and the enhancement of fish products is evaluated and quantified through innovative transformation processes and eco-certification. FAO Regional Project Consultant to support the management of shared marine resources.

E-mail: alice.ferrari6@unibo.it
Biosketch: She joined the Alma Mater Studiorum University of Bologna in 2009 as a Masters' Student in Marine Biology. With her PhD and a Post-doc assignments, she has been deepening her research interests focussing on the application of molecular tools in favour of the conservation of marine species and the investigation of their evolutionary history. She has been collaborating with other National and International Research Bodies, UN Organisations (FAO) and other Universities for the management of fishery resources. Alice is now developing her new research line on the transition towards a blue economy and responsible fishery.

11.00 Ifigeneia Giannoukakou- Leontsini (*WACOMA Alumna*, TecnoAmbiente, Spain)

A road map to energy transition: the Spanish strategy

Ifigeneia Giannoukakou- Leontsini[1]

[1] Tecnoambiente SLU, Barcelona, Spain

(Offshore windfarms, renewable energy, MSP)

Marine environment is an ecosystem that supports a range of human uses and activities, providing goods and services that contribute to the economic and social development of coastal countries. Such activities require the use of maritime space, either temporarily or permanently and thus an adequate Maritime spatial planning (MSP). In Spain, the EU Directive has been transposed into the Spanish law, establishing its framework: Government may approve guidelines common to all marine strategies in order to ensure the consistency of their objectives, in aspects such as the management of activities that are carried out or may affect the marine environment. In the case of the offshore windfarms, such regulation divides the marine environment into five spanish maritime boundaries. In order to asure the ease of the commercial operation and to guarantee the compatibility with human activities, several zones within the aforementioned boundaries have been proposed as "Priority-use areas for offshore wind energy" and/or "High-potential areas for developing offshore wind energy", after an extensive socio-economic impact analysis. In order to install an offshore wind farm, it is necessary to have a positive Environmental Impact Assessment (EIA) as well as a favourable study of the compatibility of the farm with other uses of the maritime space. As a reference, Parc Tramuntana is the first promoted offshore wind project in the Catalonian waters and would stand 24km offshore of the Gulf of Roses with 35 wind turbines and floating technology.

Overall, energy transition is the pathway toward transformation of the global energy sector from fossil-based to zero-carbon and such regulations, studies and inclusiveness are fundamental in order to secure minimal socio-environmental impact.

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11.20 Caterina Righini (F.lli Righini spa, Ravenna, Italy)

Study and work experiences abroad as key enablers in a fast-paced work environment

Caterina Righini[1]

[1] F.lli Righini Srl, Ravenna, Italy

(international study experiences; fast adaptation to challenges; Oil &Gas Industry; Energy transition; innovative solutions)

The Ancient Greek Philosopher Heraclitus used to say that "Change is the only constant" but he probably couldn't foresee the pace at which the world is moving and will keep on moving. As a student and then worker I always tried to investigate and understand which tools could better equip me and endow me with the needed skillset to navigate future changes. From my experience and the one of people I had the honour to interact with, I believe that being open-minded is the single most powerful skill that makes people find new solutions to old and new problems and the most impactful ways to achieve it, among other things, are through education and travelling. Education is the most straightforward method to discover and learn new concepts and ideas while travelling is the way to put them in practice by encountering different cultures. Throughout the years, in our family company, F.lli Righini Srl, we faced many changes in the ways of working and in the Oil&Gas industry but the ongoing Energy Transition has proved to be much faster and impactful then we could anticipate. In this case, keeping an open-mind meant readjusting our extensive engineering and manufacturing know-how to the Offshore Wind market which is driven by different commercial and technical dynamics.

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WACOMA students cohort 2020/2022

Poster session

Victor ALMEIDA

Climate change and human migration: Managing the cascade effects initiated by natural disasters

Supervisor: Paolo F. Ricci (Berkeley University, U.S.A.)

(Climate Change, Human Migration, Cascade Effect, Natural Disasters, Game Theory)

The potential links between climate change, human migration and conflict have been receiving an increasing amount of attention since the turn of the century. Up-to-date reports that address the most recent understanding of climate change and environmental hazards indicate that humans have undeniably contributed to the rising global temperature and will continue to do so if lower pollution thresholds are not maintained. While this enacts a multitude of physical, biological, chemical, and societal changes, it is imperative to analyze and address the impact of climate change on human migration trends. Human migrants face several types of problems ranging from environmental issues related to climate change (sea-level rise, more frequent and intense storms and floods, drought, wildfires, etc.), to conflicts from physical migration into neighboring towns, cities, regions, or countries. These types of physical migration that are climate change driven, which can be referred to as "adaptation migration" can be capable of snowballing from a human-to-environment issue into a human-to-human conflict; usually involving some type of violence or political discrimination/persecution. The aim of this study is to analyze how climate change is impacting human migration trends, the possible percolating effects that can result from human migration, and how these factors have influenced and will continue to influence governments and governance in the coastal area. The information in this report will be able to provide a greater understanding of adaptation migration through the use of differential equations, how these trends can be modeled, and how Game Theory can be used as a strategic tool for policymakers moving forward.

Elaine BARONI DE OLIVEIRA

Developing a management-based ranking of beaches from a worldwide perspective

Supervisors: Alice Newton (University of Algarve, Portugal), Camilo Botero (University of Algarve, Portugal)

(beach ranking; beach quality; indicators; beach management)

Beaches are one of the most popular touristic destinations worldwide. Many users utilize beach rankings found on websites to choose the best beach to visit. However, the criteria used to rank the beaches are often not specified or clearly stated. The research aimed to develop a robust and objective framework to rank beaches, based on management effectiveness. The methodology involved a critical analysis of web-based rankings to collect the information on how they are made and the indicators used. In addition, a survey was conducted in the Science Direct database to identify the indicators used in beach quality assessments by the scientific literature. The indicators identified were evaluated according to their usefulness for beach management and grouped into domains and categories. Moreover, a measurement technique and a 5-point rating score for each indicator was suggested based on the literature. Weights were calculated for different beach types using analytical hierarchical process and focus group. The results show that web-based rankings are mostly subjective and that beaches on these lists are not directly compared to one another. Moreover, they are exploring the visual appealing aspect. The scientific literature, despite incorporating a wider set of indicators, are also focusing on user satisfaction. The indicators chosen to compose the framework are distributed into four domains (recreation, protection, conservation and sanitary) that cover main functions of a beach and aim to see it from a holistic view. The weights allowed respecting the differences provoked by distinct urbanization levels, granting the safeguard of the characteristics of every beach type, while the rating score helped to reduce the subjectivity by ensuring that the scale of comparison is always the same. The application of the framework validated the methodology and showed the framework fulfills its purpose of ranking and pointing out the strengths and weakness of every beach.

Sarah Anne BROUDER

The Spatial distribution of the common dolphin, Delphinus delphis, along the Portuguese mainland coast and their interaction with the purse seine fishery

Supervisors: Jorge Dos Santos Gonçalves (University of Algarve, Portugal), Ana Marçalo (University of Algarve, CCMAR, Portugal)

(Common dolphin, Bycatch Risk assessment, Sardine, Purse Seine Fishery, Distribution Map)

The common dolphin, *Delphinus delphis,* is the most abundant cetacean species along the Portuguese mainland coast and are faced with many threats. Over the past decade, intense fishing practices have contributed to a decline in the availability of their main prey, the sardine. Furthermore, the high Purse Seine Fishing (PSF) activity has led to an concern in the level of by-catch along the coast.

The purpose of the study is to (i) investigate the distribution of the common dolphin along the Portuguese mainland coast, and (ii) to estimate the overlap between the PSF effort and the common dolphin's distribution. The study uses sighting data from 2005-2020 to identify dolphin hotspots. In addition, the study analyses changes in their offshore distribution across different time periods. Finally, the study overlaps Automatic Information System (AIS) data of the purse seine fishery with common dolphin distribution data, in order to identify high by-catch risk areas.

The outputs of the study identify major hotspots for the common dolphin in the central and southern Portuguese mainland coast, which coincide with important fishing ports and geographic features. Furthermore, the common dolphin was found to occur significantly further from the coast during from 2013-2016 (p-value < 0.05), which corresponds to a period of particularly low sardine biomass. Finally, the by-catch risk assessment reported high risk areas off the western Algarve, particularly near the important fishing grounds.

The study highlights the major common dolphin hotspots and the potential conflict areas with the PSF. These results can be used by managers to inform conservation measures and for the sustainable management of PSF fleet along the Portuguese mainland coast.

Josè Eduardo CARNEIRO BARROS

Coastal Flooding risk assessment at Garachico - Canary Islands

Supervisors: Juan Garzon Hervas (University of Algarve, Portugal), Theocharis Plomaritis (University of Cadiz, Spain), Javier Lopez Lara (IH Cantabria)

(Coastal Flooding; Coastal Hazards; Risk Assessment; Wave Runup; Rocky Shorelines)

Coastal Hazards are a topic of great interest for managers, given the possible socio-economic consequences associated with them. Specifically, investigating coastal flooding is particularly critical to assess the risk related to extreme ocean events. Also, climate change impacts will potentially increase the risks associated with it. In this sense, a critical parameter to predict the occurrence of flooding in vulnerable areas is the wave runup. In this study, the estimation of wave runup and overtopping were based on several published empirical formulas, derived from field and laboratory experiments, mainly depending on the oceanographic parameters, and the geomorphology of the beach or geometry of the structure. This study aims to 1) investigate the ability of expressions found in the literature to compute wave runup into a rocky and steep bottom at Garachico Island (Spain), by comparing it with past historical events; and 2) assess the risks of coastal flooding based on return periods (response approach) for extreme events using the tilted bathtub approach for evaluating the flooding extension, considering current and future conditions. Moreover, the effect of sea-level rise on different IPCC (Assessment Report 6) scenarios were evaluated. This study will contribute to the development of a methodology to assess coastal flooding, especially for areas characterized by rocky and steep bottoms, which represents a gap in the literature.

Ruth Pamela CUENCA PORTILLO

Characterizing saltmarsh vegetation using in situ observations and uav data: a case study in the Venice Lagoon

Supervisors: Sonia Silvestri (University of Bologna, Italy), Marco Assiri (University of Padova, Italy)

(Salt marsh, Remote Sensing, Halophytes, Biomass)

The geomorphological system, dynamics and spatial distribution of plant species of coastal salt marshes are poorly understood. They are unique systems, which must always grow in height in order to be at peace with the sea level rise. For this reason, the vegetation present as well as the accumulation of organic matter in the marsh accretion process is of utmost importance. There is a lack of information on the spatial distribution with which it is possible to gather information on the existing dynamics in this ecosystem, especially because it has a great variety of species and species associations.
By using the spatial distribution of species, vegetation biomass and in situ observations in a study area, much of these dynamics and functioning can be understood. The
present work presents results of data obtained by in situ sampling and data collected by
UAVs in the San Felice marsh (Venice lagoon, Italy). The study area hosts at least twelve species of halophytes grouped in six main associations. Samples were collected
in September 2021, providing spatially georeferenced data and samples on the distribution of vegetation associations, above- and below-ground biomass, vegetation height, bulk density and soil organic carbon content.
The results suggest (i) the importance of the spatial distribution of the different plant associations as a function of elevation above mean sea level, (ii) the importance of studying the carbon stock capacities in relation to the soil elevation, (iii) a positive correlation between soil elevation and bulk density values. In addition, the results show the importance of studying salt marshes using different sources of information obtained by remote sensing.

Ankur DEB

Coastal sustainability assessment of the sundarbans using the Circles of Coastal Sustainability (CCS) framework: a comparative analysis between India and Bangladesh

Supervisors: Alice Newton (University of Algarve, Portugal), Purvaja Ramachandran (National Centre for Sustainable Coastal Management, Ministry of Environment, Forest and Climate Change, Government of India)

(Sundarbans, transboundary governance, Coastal Circles of Sustainability framework (CCS))

The Sundarbans, part of the Ganges-Brahmaputra-Meghna (GBM) delta, is one of the largest continuous tract of mangrove wetland areas in the world and faces an increasing threat from environmental and socio-economic problems like climate change and loss of livelihoods. These issues weigh on the millions of people who depend directly or indirectly on its ecosystem services. The complications are further magnified by the transboundary nature of governance in the region shared between India and Bangladesh. The Circles of Coastal Sustainability (CCS) framework was utilized to analyze the coastal system using the four interdependent boundary domains of Environment and Ecology, Social and Cultural, Economics, and Governance and Policy. The Indian as well as Bangladesh side scored an overall Satisfactory score. But on a country scale comparison, India looked more vulnerable than Bangladesh due to its poor sustainability scores on environmental grounds. The identified pressures on the whole biogeographic system included lack of efficiency and accountability of the government, intensification of cyclones, sea level rise, coastal erosion, high poverty, lack of dignified and sufficient work, and the lack of basic amenities. But further ground based due diligence is necessary. On an indicator level, a comparative analysis between the two countries showed that India scored poorly for the Environment and Ecology and Social and Cultural domains as compared to Bangladesh. Whereas the opposite is true for the Economics and Governance and Policy domains. The nature of the ecosystem due to its presence as a single biogeographic entity presents a burning need for joint co-operation through transboundary governance. Building on the elemental sustainability scores and the data repository compilation for Sundarbans, this study can act as an excellent starting point to inform bilateral collaboration and more effective transboundary governance between the two countries in the future.

Edwin Josuè ESPINA SANDOVAL

The role of agriculture in marine plastic production

Supervisors: Maria del Carmen Morales-Caselles (University of Cadiz, Spain),Enrique Montero Montero (University of Cadiz, Spain)

(Intensive farming, Greenhouses, Drones, Multispectral sensors, Geographic Information Systems)

The world consumption of plastics in agriculture amounts yearly to approximately 7.4 million tons and forecasts expect it to increase to 9.5 million tons in 2030, but this data is still limited. Conventional and selective polymers such as PE, PVC, EVA and nets are used to optimize crop production efficiency in the Mediterranean coast. The major drawback starts when the material has reached its useful time and is abandoned and dumped near dry river bed channels where it accumulates as it waits for runoff to wash them towards the sea. Since there is a lot of data missing on the amounts, composition and environmental fate, this research aims to fill the above mentioned substantial gap by performing a research on the Agriculture Plastic Waste life cycle and current management. Once the main issues were identified, a proposal for monitoring sources and fluxes was studied using Unmanned Aerial Vehicles (UAVs) imagery combined with GIS systems as a tool for plastic litter detection, and fluxes on hotspots as they represent a key source of plastic litter accumulation before it reaches the marine systems if actions are to be taken. For the latter, imagery data acquired by UAVs and combined with *in situ* surveillance to detect mismanaged macroplastics location due to illegal dumping on dry riverbeds in Castell de Ferro, a town located in the tropical coast of Granada in Spain which is as famous for its tourism as for the plastic greenhouses. The study area, was considered suitable for these purposes because it involves a dry riverbed constantly impacted by APW dumped or abandoned by farmers nearby.

The image data acquired was then processed and validated with in situ identification of the macroplastics. As a result, the GIS tool was considered to deliver the necessary data for accurate plastic litter assessment and detection. The aim of this study was to develop a methodology as a rapid, easy, practical and cost-effective assessment tool useful for monitoring Agriculture Plastic Waste –APW- for academic researchers, land planners, and policy makers useful to understand plastic waste dynamics in order to propose and implement measures that leads to a better plastic waste management serving as a model in future projects.

Regine Anne FAELGA

Geomorphological and statistical analysis of the dune changes in Lido di Classe (Ravenna, Italy) based on remote sensing techniques

Supervisors: Beatrice M.S. Giambastiani (University of Bologna, Italy), Luigi Cantelli (University of Bologna, Italy), Sonia Silvestri (University of Bologna, Italy)

(coastal dunes, geomorphology, SfM photogrammetry, sediment volume calculation, change detection)

The study aimed to contribute to the assessment of the 2016 dune restoration project in the protected natural area of the Bevano River mouth in Lido di Classe (Ravenna, Italy) by utilizing UAV monitoring surveys from 2016 to 2021. The first objective is to assess the impact of the installed fences to the dune development in terms of sand volume changes through Structure from Motion (SfM) photogrammetry and Geomorphic Change Detection (GCD) toolset. Next is to establish a systematic data processing workflow that is suitable for sediment volume calculations. Last is to utilize orthomosaic images for vegetation change detection. For the methodology, UAV topographic survey, coupled with GPS ground survey using Real-time Kinematic positioning, were carried out. SfM was utilized to generate and classify point clouds and orthomosaic images using Agisoft Metashape Professional. The classified ground points were interpolated in ArcMap to create digital elevation models, while the orthomosaic images were utilized to confirm possible sources of data noise and assess vegetation changes. GPS profiles were used to validate the DEMs and the volumetric changes were calculated using GCD. The results show that sand accumulation was observed along the dune foot where the fences were established. Progradation of the front dune, development of insipient dunes, decrease in slope stoss, decrease of blowout features due to increase in vegetation colonization have also been evident. Overall, the fence has proven to be effective in preventing dune erosion since significant geomorphological changes and vegetation colonization have occurred. The GCD toolset can be an effective tool provided that sources of uncertainties are well accounted for. The results of the study showcase the importance of dune fencing and limiting debris cleaning against dune degradation along the Ravenna coast. The proposed workflow can also aid in creating transferable guidelines to stakeholders in ICZM implementation.

Joyce Rukia FONDO

Phytoplankton community structure in the Goro lagoon analysed by microscopy and molecular approaches

Supervisors: Laura Pezzolesi (University of Bologna, Italy), Federica Costantini (University of Bologna, Italy), Nicolè Caputo (University of Bologna, Italy), Francesco Mugnai (University of Bologna, Italy)

(Transitional coastal lagoon, phytoplankton, Harmful Algal Blooms (HABs), eDNA metabarcoding, Chlorophyll-a)

This study aimed at investigating the phytoplankton dynamics in a coastal lagoon with complex hydrological dynamics (Sacca di Goro, Northern Adriatic Sea, Italy) utilized for shellfish farming, by combining a morphological approach (microscopy) with the innovative eDNA metabarcoding, towards a more informed management of transitional areas. A monthly sampling was carried out between September 2020-2021 in 4 sites. Both the molecular and morphological method resulted valid tools for phytoplankton monitoring. Seasonal variation in phytoplankton abundances and high densities during spring dominated by diatoms (*Chaetoceros, Skeletonema*, *Pseudo-nitzschia,* and *Cyclotella* spp.) were found. Differences in taxa identification between the two methods were observed, as 147 and 158 taxa were reported using the morphological and molecular approach respectively. Although eDNA resulted efficient in detecting cryptic taxa and picophytoplankton that were not morphologically identified, limitations were reported in resolution at species level, in quantification and in identification of some groups (Cyanobacteria and Euglenophyceae), due to the lack of representative sequences in current databases. Potential HAB species were found at low densities (dinoflagellates: *Prorocentrum cordatum, Gonyaulax* sp*., Alexandrium* sp., *Heterocapsa* sp., and diatoms: *Pseudo-nitzschia delicatissima* and *seriata* complex) which could be threats to shellfish farm and human health. The study highlights the value of implementing monitoring programs using innovative tools (e.g., eDNA) to analyse the phytoplankton diversity and identify toxic species. Due to the sensitivity of transitional ecosystems, combining different approaches, such as microscopy able to quantify phytoplankton at low taxonomic level and a fast and powerful molecular tool, could be fundamental to assess the composition and ecological function of microalgal communities and facilitate a better conservation strategy in view of climate changes.

David GALLO VELEZ

Integrated assessment of the Magdalena River Delta and estuary socio-ecological system

Supervisors: Alice Newton (University of Algarve, Portugal), Juan Camilo Restrepo López (Universidad del Norte, Colombia), Juan Dario Restrepo Ángel (Universidad EAFIT, Colombia)

(Magdalena River; Colombia; coasts; Sustainability; Integrated Coastal Zone Management)

River-mouth systems and deltas are hotspots where many of the coastal symptoms can be found. These systems provide essential ecosystem services that can be affected by population growth, economic activities, technological advances, governance, and global change. This research assesses the multidimensional sustainability in the river-mouth of Colombia's most important river: the Magdalena. The socio-ecological system (SES) formed at the Magdalena main river-mouth (MRm) (i.e., Bocas de Ceniza) is in the Central Caribbean Region. The sustainability of the MRm-SES was assessed with a framework known as 'Circles of Coastal Sustainability' (CCS). It uses a transdisciplinary approach that analyses the system in 4 domains: Environment, Society and culture, Economy, and Governance, which are divided in five (5) categories that are evaluated with different indicators. A total of 52 locally relevant indicators were chosen (i.e., 16 Environment, 16 Economy, 12 Society, 8 Governance). Overall sustainability of the MRm-SES is 'Satisfactory'. The social domain presented 'Good' conditions; the rest exhibited 'Satisfactory' conditions. The main strengths of the system are in the Economic and Social domains. The main weaknesses are also within those domains, specifically, Social Benefits, Demographics, Economic Security, and Resources Management categories (i.e., 'Poor' sustainability). This assessment serves as a first step to prioritize management strategies. It was recommended to put categories in the worst conditions at the centre of the discussion and, having a holistic view of the system, some management strategies were discussed (e.g., Preserving and restoring habitats; tackling sources of pollution and excessive sediment; local mitigation and adaptation to climate change; among others). Finally, it is argued that despite all the improvement opportunities, the CCS is a valuable tool to evaluate and communicate the sustainability of coastal systems in Colombia and the world.

Renan GONÇALVES MENEZES

Remediation strategies and management of oil spill hazard along the Emilia-Romagna coast (Italy)

Supervisors: Beatrice Giambastiani (University of Bologna, Italy), Andrea Valentini (ARPAE, Italy), Lorenzo Mentaschi (University of Bologna, Italy)

(Oil Spill; Coastal Management; Risk Assesment, Oil Pollution; Hazard Mitigation)

In the Adriatic Sea, large vessel traffic is dense, and accordingly there is a great deal of operational pollution along with the constant threat of accidents and incidents.
The Emilia-Romagna region does not have any planning documents for managing the oil spill risk. The aim of the thesis is to propose strategies for a management plan (not currently available) and intervention strategies of coastal protection from oil spill events utilizing models (simulations) of potential scenarios which could happen near the Emilia-Romagna coast, and how it should be the proper reaction due to these possible accidents, in a way to build preparedness and improve the efficiency regarding to the response, raising the level of safety and marine security towards those events that can impact not only environmental units, but also other society development pillars as economy and health.

Thilanka Chamara Madhushankha HERATH MUDIYANSELAGE

The population dynamics and morphological traits of the new species Alpheus qatari in the Gulf of Cadiz (Spain)

Supervisors: Enrique González-Ortegón (ICMAN-CSIC, Spain), Irene Laiz (University of Cadiz, Spain)

(Alpheus qatari, Population Dynamics, Morphological traits, Fulton´s condition factor, Hureau Index*)*

Alpheus qatari n. sp. is a new, exotic species, probably a lessepsian species, with an established population in the Bay of Cádiz. The main objective of this study is to analyse the A. qatari population in the San Pedro River focusing on the population dynamic, assessing whether a temperate region could shape the population dynamics of a tropical species, and examining the morphological traits of this species. Individuals of Alpheus qatari were collected in Cadiz, Spain from June 2021 to April 2022. The average sex ratio of this population showed a similar proportion between both sexes (Male:Female) 1:0.92. Two cohorts could be identified in the males and females from the new juvenile recruits to the population starting in July and in November.

The fullness index of the stomach may indicate a greater activity of the females during the morning, which does not mean a better performance when analysing the condition index. In the case of Fulton's condition factor, the highest values occurred in summer, and mainly in males. The high availability of food in the summer in the coastal area, and a higher predatory activity may explain the greater feeding intensity during that season of the A. qatari.

Adult males were bigger than females, and males showed a significantly larger chela than females. This trait is similar to other alpheid species and a similar proportion of male-female, could be explained by the role of the male possibly protecting the female.

Lilit KHACHATRYAN

Earth Observation data validation: Implementation and Performance evaluation of methods for Chlorophyll a retrieval

Supervisors: Priscila Goela (University of Algarve, Portugal), Sonia Cristina (University of Algarve, Portugal)

(Phytoplankton pigments; High-Performance Liquid Chromatography; Chlorophylla, Performance Metrics, Earth Observation)

High-Performance Liquid Chromatography (HPLC) allows determining the concentrations of phytoplankton pigments and is the most used technique to validate Earth Observation (EO) data of Chlorophyll*a* (Chl*a*).
The challenges of current HPLC methods for pigment analysis are the use of toxic solvents and the coelution of important pigment peaks (e.g. mono and divinyl forms of chlorophylls). Despite that, these methods are established in reference laboratories, and its performance metrics were already assessed in previous work conducted by National Aeronautics and Space Administration (NASA) intercalibration exercises.
A more recent method Sanz et al. (2015) is referred as having several chromatographic and instrumental advantages as: a) the use of a simpler binary elution gradient; b) the complete resolution of mono and divinyl forms of chlorophylls; and c) a mobile phase with low toxicity solvents (methanol and ethanol).
In the first part of the thesis, the laboratorial performance of Sanz et al. (2015) methodology for the analysis of phytoplankton pigments was assessed, according to performance metrics defined in NASA HPLC Round-Robin Experiments, such as resolution, injection precision and retention time precision. Considerations about main coelutions and the response to different injection volumes are also discussed.
In the second part of the thesis, phytoplankton pigments were quantified in 12 coastal water samples. The followed methodology implemented in CIMA-UAlg laboratorial conditions showed to be easy to implement for a routine level of work and the resolution between mono and divinyl forms of Chlorophyll*a* was achieved. Implications of the results for the pigment quantification were also discussed and are presented.
This study contributes to the overall effort of providing accurate in-situ data to validate satellite EO Chl*a* data, and to accomplish the goal of improving the estimations of phytoplankton distribution.

Viergine LEOPOLD

Effects of environmental pharmaceuticals on physiological parameters of marine mussels, Mytilus galloprovincialis

Supervisor: Elena Fabbri (University of Bologna, Italy), Marco Capolupo(University of Bologna, Italy), Ayesha Rafique (University of Bologna, Italy)

(Antidepressants, marine environment, Mytilus galloprovincialis, fertilization, embryo development)

The increasing consumption of pharmaceutical products is of environmental concern, as excreted parent compounds and their possibly active metabolites are not completely removed by wastewater treatment plants. Several studies have confirmed the occurrence of antidepressants in coastal waters in the ng/L concentration range. This research focuses on four antidepressants e.g. fluoxetine, FLX; sertraline, SERT; and citalopram, CITA (selective serotonin reuptake inhibitors, SSRIs) and venlafaxine, VEX (serotonin-norepinephrine re-uptake inhibitor, SNRI) and two metabolites norfluoxetine, NF and O-desmethylvenlafaxine, ODV, chosen because: serotonin and norepinephrine are the main invertebrate neuromodulators, thus changing their levels influences animal functions; antidepressants are among the top prescribed pharmaceuticals worldwide, biologically active at low concentrations with the potential to cause neuroendocrine disruption. This work aimed to observe difference in the toxicity among parent compounds, and the relative toxicity of metabolites. The effects have been measured on early life stages of Mediterranean mussel *Mytilus galloprovincialis* analysing different end points after exposure to environmental concentration range (0.5 - 500 ng/L). SSRIs had greater effect on fertilization rate than SNRIs, with a similar effect by parent compound and metabolites. SERT caused the highest percentage of unfertilized eggs in a wide range of concentrations, from 10 ng/L to 500ng/L. The range of effect on embryo – larval development is as follows NF (5 -500 ng/L) > SERT (25-500 ng/L) > FLX (100-500 ng/L) > CITA (500 ng/L), while VEN and ODV were ineffective. Poor effects of antidepressants was observed on larvae motility and survival. In conclusion antidepressants and their metabolites affected mussel gamete fertilization and embryo development, thus representing a threat for the formation and maintenance of populations, disrupting the ecological system and biodiversity.

Maria Esther LEYVA OLLIVIER

Coast Assessment of the Chesapeake Bay Watershed in the United States of America, using the Circles of the Coastal Sustainability framework

Supervisors: Alice Newton (University of Algarve, Portugal), Heath Kelsey (University of Maryland Center of Environmental Science, U.S.A.)

(Chesapeake Bay, Management, Holistic Framework, Sustainability, Indicators)

The Chesapeake Bay is the largest estuary in the United States of America, with watershed drainage covering parts of six states and a Federal District. The system was the first estuary in the nation targeted by Congress after the rapid loss of wildlife and aquatic life. The Chesapeake Bay Watershed's (CBW) main socio-ecologic issues are eutrophication, overexploitation of resources, and industrial and urban development. This thesis aims to improve CBW management knowledge using holistic frameworks. The objectives are to contribute and assess the management, evaluate the sustainability of the socio-ecologic system, develop a normalized score for sustainability, and present these results using science communication techniques. The holistic frameworks used were DAPSI(W)R(M) and Circles of Coastal Sustainability (CCS). The DASPI(W)R(M) identified the CBW's structure, function, dynamics, and management. Meanwhile, CCS assessed its socio-ecologic sustainability in four domains: Environmental, Social, Economic, and Governance. To evaluate each domain, recognizable and comprehensive indicators were needed. Therefore, an independent literature review of each domain was developed to represent each score classification. The results of the DAPSI(W)R(M) framework indicate that the CBW is a complex system with conflicts between ecosystem health and social well-being. Overall, the score system gave a "Satisfactory" result in the CCS framework assessment. The grade was given because the socio-ecologic system is not healthy but is working towards sustainability. The results for each domain were "Satisfactory" in environmental, economic, and governmental and "Poor" in Social. The graphic design for the results was developed by a collaboration of experts, which aims to communicate sustainability to a broad audience with different specialties. The main discussion of the thesis was about the management recommendation for the CBW using the holistic framework results.

Endalkachew Yeshewas MUCHE

Exploring Chlorophyll-a Satellite Derived Data to Characterise the Coastal Waters of the South of Portugal

Supervisors: Sónia Cristina (University of Algarve, Portugal), Clara Cordeiro (University of Algarve, Portugal)

(Remote Sensing; Chlorophyll-a; Physical-chemical variables; Inter-annual variability; Coastal waters)

The chlorophyll-a (Chl-*a*) concentration can be used as the main indicator of the productivity, trophic condition, and proxy of phytoplankton biomass in coastal, and oceanic waters. This ecological indicator will provide useful information for reliable monitoring systems and government policy (e.g., European directives); however, assessment of Chl-*a* using *in situ* measurements in coastal and oceanic waters has some economic challenges and gives a restricted view of the dynamics of the phytoplankton. To overcome this limitation this study used Chl-*a* datasets from the Copernicus Marine Environment Monitoring Service (CMEMS), that provide merged multi-sensor ocean colour products. This study aimed to characterise the inter-annual variability of the Chl-*a* concentration retrieved by multi-ocean colour sensors data and relate these variabilities to the coastal environmental changes in five stations in the south coast of Portugal. Statistical analyses were performed to help the understanding and the characterisation of Chl-*a* at the coastal water stations along the southern Portugal coast based on 17 years of data (2002-2019). In addition, a comparison between Chl-*a* and physical (sea surface temperature (SST)) and chemical (nutrients) parameters were made to understand the inter-annual variability in these coastal waters. The extracted Chl-*a* values in the study area showed a seasonal cycle where the Chl-*a* is triggered in early spring. A clear negative relationship between Chl-*a* and SST was found in all stations. In the study area, a positive correlation was found between Chl-*a* and nutrients (NH_4^+, NO_3^-, PO_4^{-3}, and SiO_4^{-4}). Results show that SST and nutrients influence the Chl-*a* concentration availability in the study area. The Chl-*a* retrieved by satellite data reveals to be an efficient alternative tool and valuable approach to study environmental conditions of the coastal water, especially in response to eutrophication, which is the common management issue in coastal waters.

Kady RAMJATTAN

A meta-analysis of the carbon ecosystem service in human-managed coastal environments

Supervisors: Gonzalo Munoz Arroyo (University of Algarve, Portugal), Sara Haro Paez (University of Algarve, Portugal)

(Land use change, salt marshes, mangroves, carbon storage, carbon sequestration)

Coastal wetlands sequester and bury substantial amounts of atmospheric carbon dioxide (CO_2) via photosynthesis. These blue carbon (BC) ecosystems play an essential role in climate change mitigation. Despite the key role that BC ecosystems play, they are increasingly threatened by land use changes (LUC). This may impact their carbon storage and sequestration ecosystem services. We used meta-analysis in ecology to study carbon storage and sequestration within natural and transformed salt marshes and mangroves, across a global scale. Articles published since 2000 on the Web of Science Core Collection, that contained experimental data on carbon storage and sequestration for natural and modified ecosystems, were selected. Case studies were integrated into a database, and standardised. Research on mangroves concentrated on Asia and Oceania, whilst salt marshes concentrated on North America, eastern Asia and Oceania. We found that LUC in BC coastal ecosystems decreased carbon storage and carbon sequestration rates at a global scale. Carbon storage in mangrove sediments significantly decreased from 520.49 ± 388.99 Mg C ha^{-1} (mean $\pm$ SD) in natural systems to 186.81 ± 234.02 Mg C ha^{-1} in modified settings. Carbon storage in salt marsh sediments also decreased from 97.80 ± 107.69 Mg C ha^{-1} in natural ecosystems, to 31.42 ± 33.47 Mg C ha^{-1} in human-managed environments. Biomass carbon storage (aboveground and belowground biomass) averaged 103.07 ± 198.86 Mg C ha^{-1} in natural mangroves, whereas carbon storage in modified mangroves yielded an average of 29.01 ± 47.40 Mg C ha^{-1}. Within natural salt marshes, biomass carbon stocks had an average value of 3.66 ± 5.24 Mg C ha^{-1}. Carbon sequestration rates, significantly decreased in modified in mangroves, but not in salt marshes, due to inter-site variability. We found that sampling depth may affect the measurement of organic carbon stocks. Conversion of natural coastal ecosystems may decrease their carbon storage capacity.

Olinda Jack Mariano RUFO

Characterization of vegetation patterns in a Venice lagoon saltmarsh from drone-based hyperspectral remote sensing

Supervisor: Sonia Silvestri (University of Bologna, Italy), Tegan Blount (University of Padova, Italy)

(*above-ground biomass, below-ground biomass, organic carbon, hyperspectral imaging, vegetation index*)

Coastal wetlands are unique and complex geomorphological systems that respond to a wide range of changing influences, and their responses remain poorly understood, emphasizing the need for and importance of this study. These ecosystems provide useful feedbacks to coastal systems, such as soil stabilization and coastal protection. They are very important carbon sinks. For carbon to be stored in the soils there must be biomass that is produced. This study focuses on the above ground biomass and the below ground biomass in the saltmarsh in order to evaluate the amount of organic matter that is stored in the soils. To obtain this, field campaigns were conducted to sample the above ground vegetation and core samples to analyse the amount of vegetation biomass and carbon stock in the soil. The marsh selected for this study is characterized by three different levels of elevation, high mid and low. We found that the middle marsh is the area that stores the highest amount of organic matter in the soil as compared to the lower and the higher marsh. In addition, we found that there is a linear positive correlation between the AGB and the BGB. Furthermore, the study concludes that it is possible to use vegetation indices retrieved from remote sensing to characterize the biomass. The NDVI (Normalized Difference Vegetation index) demonstrated to be a good proxy for the AGB only for low and mid-marsh vegetation species, while it saturates for high-marsh high-biomass vegetation. Studying the distribution of the NDVI ranges across the studied marsh, we found that it is mainly covered by dense vegetation, with AGB biomass larger than 400 g/m2.

Wint Mon SWE

Assessment of the sustainability and resilience of Cork Harbour against climate change using the concept of Circles of Coastal Sustainability (CCS)

Supervisors: Alice Newton (University of Algarve, Portugal), Martin Le Tissier (University College Cork, Ireland)

(Sustainability, resilience, coastal management, socioeconomic, socioecology)

Coastal areas are where many socioeconomic and ecological processes come together to provide important services that drive the economy, social and culture of the community. With climate change impacts becoming more apparent, the sustainability and the resilience of the community is crucial when these climate extremes occur. This paper discusses on the sustainability and resilience of Cork Harbour using recently established sustainability framework – Circles of Coastal Sustainability – stemming from Circles of Sustainability but tailored for coastal zones. Cork Harbour was evaluated to be in 'good' status in terms of sustainability, also putting it in a resilient position against climate impacts. The shortcomings encountered using the framework include difficulty in choosing locally relevant indicators and complication in scoring the chosen indicators.

WACOMA Students - Cohorts 2018/20, 2019/21, 2020/22

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South Africa	Brazil	Myanmar	India	Lithuania	Nigeria
Ghana	Bangladesh	Sri Lanka	Brazil	Ecuador	Ethiopia
Nigeria	Spain	Costa Rica	Egypt	Peru	Brazil
Bangladesh	Argentina	Germany	Brunei Darussalam	Kenya	Sri Lanka
Vietnam	Pakistan	Ecuador	Sri Lanka	United States of America	United States of America
Brazil	Ireland	Brazil	Paraguay	India	Guatemala
Philippines	Kenya	Colombia	Brazil	Sri Lanka	Armenia
Armenia	Mauritius	México	Ethiopia	Nigeria	South Africa
Mozambique	Myanmar				
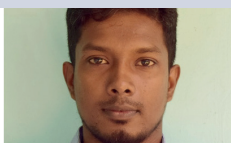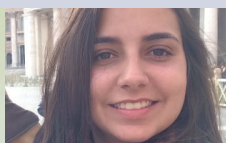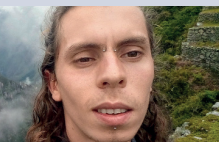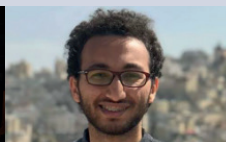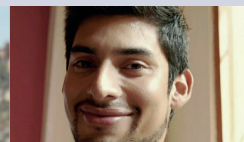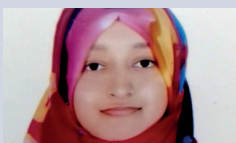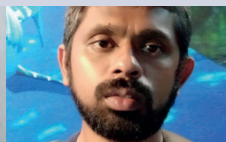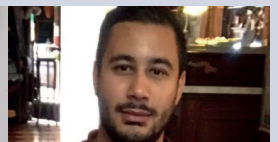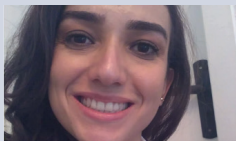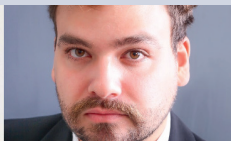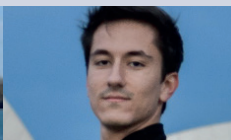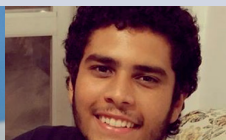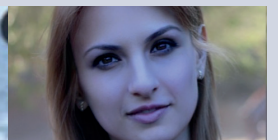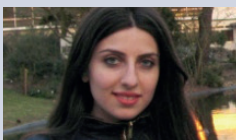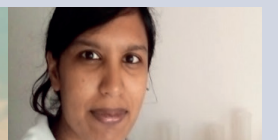
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