

COST Action CA19109 “MedCyclones”

Deliverables D1.6, D2.6 and D3.5

Yearly internal report on dissemination strategies, stakeholders' involvement and products tailored to their needs
(in WG1, WG2 and WG3)
4rd Year: October 2024

1. Common Communication Activities

Website

The **dedicated website** has been also renewed and constantly updated:

<https://medcyclones.eu>

In particular, two updates specifically addressed to the general public, were added:

- A report on cyclone Daniel occurred in September 2023, including a description of the event and its dramatic impacts <https://medcyclones.eu/storm-daniel/>
- A section devoted to medicanes in form of Questions&Answers <https://medcyclones.eu/medicanes-qa/>

Social media channels

The MedCyclones [Twitter](#), [Facebook](#) and [LinkedIn](#) accounts have been used to publish news from WG activities and discuss with scientists and the general public events related to Mediterranean cyclones. So far, more than 300,000 users have interacted with the MedCyclones social media accounts.

On a dedicated [YouTube channel](#) we store all the videos related to Mediterranean cyclones:

<https://www.youtube.com/@medcyclones>

Three mailing lists, one for each WG, and a mailing list for the Management Committee, have been constantly updated with newcomers, to ensure information flows among the Action members:

WG1: medcyc_wg1@cyi.ac.cy

WG2: medcyc_wg3@cyi.ac.cy

WG3: medcyc_wg3@cyi.ac.cy

MC: medcyc_mc@cyi.ac.cy

Clear information on how to join the Action is provided on the website.

On the e-COST platform all the Action members are subscribed to the WGs.

Videos

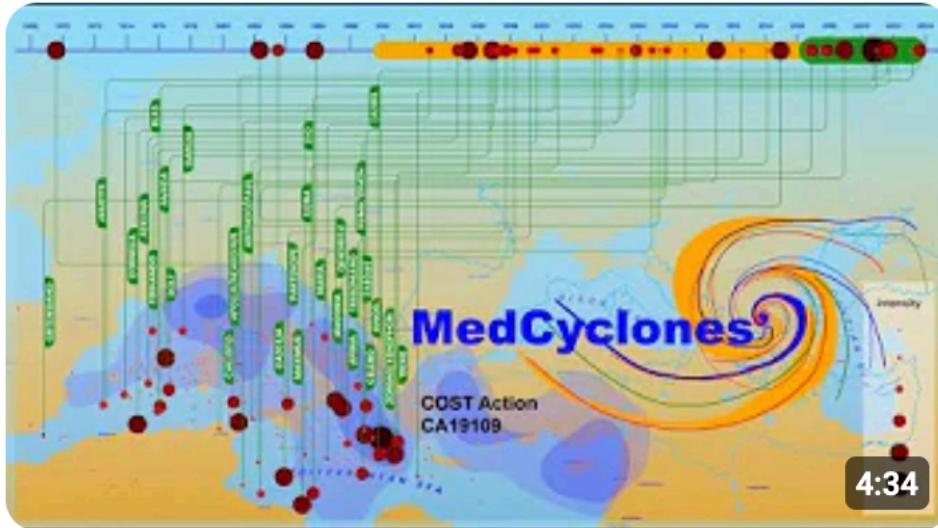
A new 4-min video devoted to Medicanes has been created and it is available on the youtube channel:

“Medicanes: The Mediterranean tropical-like cyclones”

<https://www.youtube.com/watch?v=JtbvDtRj6CU>

MedCyclones

CA19109 | European network for
Mediterranean cyclones in weather and climate



Medicanes: The Mediterranean tropical-like cyclones



The video has already more than 540 views.

Graphics

Three graphical products, each for promoting a WG, have been produced and are also available on the website:

MEDITERRANEAN CYCLONES AND WEATHER FORECASTING

Forecasting the track and intensity of Mediterranean cyclones is a challenging task due to the numerous atmospheric phenomena involved.

The complex topography of Mediterranean basin affects the development and activity of cyclones in a highly non-linear way, increasing the uncertainties involved in forecasting.

Understanding and improving the performance of weather forecasting models is of paramount importance for minimizing cyclones' impacts in the Mediterranean basin.

The exchange of timely data and expertise among the European operational weather services can increase the preparedness for high-impact Mediterranean cyclones.

Funded by the Horizon 2020 Framework Programme of the European Union

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This illustration is based upon work from COST Action MEDCYCLONES CA19109, supported by COST (European Cooperation in Science and Technology). COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation. www.cost.eu

MEDITERRANEAN CYCLONES AS IMPORTANT PLAYERS FOR REGIONAL CLIMATE AND EXTREME EVENTS

Mediterranean cyclogenesis is favoured close to and to the south of mountains. The leeward side of the Alps is a cyclogenetic hotspot in the Mediterranean.

Intense cyclones usually originate over maritime areas of the Mediterranean and when they reach the coasts, they often result in severe damage. Regardless of their intensity, Mediterranean cyclones play a dominant role in modulating the regional water cycle.

Several studies have investigated the change in cyclone frequency and intensity due to the global warming, which particularly affects the Mediterranean basin. Most of them agree on a decrease in cyclone frequency occurrence, with strong cyclones intensifying further.

Some of the Mediterranean cyclones acquire tropical-like characteristics. They can have a comparable intensity with tropical cyclones, and are known as "Medicanes", a portmanteau of "Mediterranean Hurricanes".

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MEDITERRANEAN CYCLONES HAVING STRONG ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS

Mediterranean cyclones are related to windstorms, either by enhancing local winds or due to their cyclonic circulation. They are responsible for most of the wind extremes in the Mediterranean basin, that result in socio-economic and environmental disasters.

Intense Mediterranean cyclones can transport huge amounts of Saharan dust, thousands of kilometers far from its origin. Dust aggravates air quality, affects numerous atmospheric phenomena, reduces the solar radiation that reaches the ground, and constitutes an excellent nutrition for the sea ecosystem.

Cyclones produce most of the precipitation in the Mediterranean basin, and are responsible for up to 50% of all precipitation extremes.

Low atmospheric pressure during Mediterranean cyclones and fierce cyclonic winds produce high waves and induce storm surges that inundate densely populated coastal areas of the Mediterranean basin.

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Experimental forecast web-site

DynForMed initiative has represented and still represents a significant community effort that aimed to develop a prototype website providing operational forecast information on Mediterranean cyclones. The primary goal was to offer a central platform that predicts cyclone tracks, intensities and impacts tailored to the needs of researchers, forecasters, and stakeholders. It is worth stressing that this web site is not considered to replace National Weather Service (NWS) duties. On the contrary, it aims at being an additional useful tool to be used to a variety of users, including NWS, based on the most advanced scientific achievements provided by the networking research activities

carried on by the Cost Action. Currently, the absence of centralized and reliable cyclone information in the Mediterranean region often leads to confusion and challenges in decision-making processes. The website is also aimed at increasing public awareness of high-impact weather events connected with Mediterranean cyclones.

DynForMed engages eight operational modeling systems (more are expected in the near future) that provide deterministic forecasts on a daily basis and extend up to three-to-seven days ahead.

Recently, the web site was migrated to the National and Kapodistrian University of Athens (NKUA) where it is operational and future developments are planned in order to keep it active beyond the end of the Action:

<https://medcyclones.eu/dynformed/>



Interactive graphics have been already implemented and allow to show and compare the forecast characteristics of the Mediterranean cyclones. These enhancements are designed to create a dynamic and engaging user experience, making it easier than ever to explore and understand cyclone forecasts.

One key upgrade that took place during the migration phase is the Composite Tracks Approach. This enhancement involves the exploitation and implementation of the "composite tracks" methodology, a concept developed during another scientific initiative developed in the first two years of the Action and named "3T: Tracks Task Team". This approach refines the selection of cyclone tracks by adopting only those with a high level of agreement among different cyclone tracking algorithms. This ensures that users are presented with the most accurate and reliable cyclone track information. It should be mentioned that for the operational needs of this initiative, seven tracking algorithms are adopted.

The DynForMed team is also actively exploring the addition of new features to enrich the website's capabilities. These potential additions include phase space diagrams tailored for specific cyclone cases and impact-oriented graphics. These features will provide users with deeper insights into cyclone dynamics and their potential effects, further enhancing the utility of the platform.

2. Meetings

Since most of the research initiatives were already well organized and most of them close to a conclusion, it was not necessary to organize WG meetings. The 3rd and final Workshop was an opportunity for participants to meet and share the scientific results and possible plan for the future. On the other hand, during the fourth year, a number of informal online meetings have been organized by the coordinators of the research initiatives especially to finalize the activities into papers, to share new scientific findings and to promote collaborations and further involvements.

The Core Group met regularly to ensure the progression of the Action and to organize the 3rd Training School and Workshop.

A Core Group meeting was held in Zurich at the ETHZ on 14 March 2024 with the following agenda:

- (1) Training school and workshop organization
- (2) Deliverables status
- (3) STSM and grant status
- (4) Budget revision

Many informal meetings were held among the Chair, Vice Chair and WG leaders or Coordinators for ensuring a smooth progression of research and communication activities.

3rd MedCyclones Workshop

The third MedCyclones Workshop was held in Frascati (Rome), hosted by the European Space Agency which also contributed to the organization of the event.

The general objectives of the workshop were to present and discuss recent scientific progress in understanding and modeling dynamical processes and socio-economic impacts of Mediterranean cyclones, as well as advancement in their monitoring and forecasting, from weather to climate time-scales. The aim was to reinforce efficient networking and collaborations between stakeholders, professionals from weather/climate services, and academic researchers.

The workshop programme consisted of 29 oral and 29 poster presentations, all in plenary. Being the final workshop of the project, keynote talks from the coordinators provided an overview of the advancement in the fields attained through the networking activity fostered by the COST Action.

Several invited speakers provided insightful talk about specific aspects of Mediterranean cyclones. Taking the advantage of the hosting agency, some specific talks covered topics in satellite observations and foreseen missions of interest for the community. This is the list of invited speakers and titles of contributions:

E. Flaounas (ETHZ): MedCyclones overview

M. Pourshamsi (ESA): WIVERN, an ESA Earth Explorer Candidate that Fill the Gap of Wind Observations Inside Cyclones

D. Herndon (University of Wisconsin-Madison): Estimation of Medicane Intensity and Structure from Multispectral Satellite Imagery

E. Fluck (ESA): Monitoring Cyclones using EO: Current Initiatives and Future ESA Missions

On the website, oral presentations are available:

<https://nikal.eventsair.com/medcyclone-workshop-2024/>

Also Diego Fernández Prieto, Head of ESA Science Section, attended the workshop and provided a Welcome address.

About 100 participants attended the workshop during the three days, 15-17 July 2024.

3rd MedCyclones Training School

The third Training School was organized in Frascati (Rome), hosted by the European Space Agency which also contributed to the organization of the event. It was held on the same week of the Workshop, between 15-19 July 2024. Primarily addressed to PhD students, PostDoc and early career investigators as well as professionals and scientists from regional and national meteorological agencies, the school covered several aspects of Mediterranean cyclones: dynamics, processes, forecasting, predictability, climate change and impacts. It consisted of frontal lectures and practical activities where the students performed specific analysis in small groups. Students were required to attend the workshop. The hands-on activities were coordinated and tutored by the Core Group members and exploited the teaching material provided by specialists of Meteo-France. The final results of the hands-on activity were presented in the form of short talks on the last day of the Training School to trigger discussions and provide the opportunity to enhance the collaborative spirit and develop new skills.

Topics and lecturers of the Training school:

Introduction - P. Patlakas (University of Athens) and F. Pantillon (University of Toulouse)

Mesoscale Dynamics - S. Gray (University of Reading)

Medicanes - M. Miglietta (CNR-ISAC)

Climate change - D. Faranda (CNRS)

Lectures are available on the website of the event:

<https://nikal.eventsair.com/medcyclone-workshop-2024/>

3. Peer-reviewed papers

- A review paper devoted to the analysis of the socio-economic impacts of Mediterranean cyclones is currently under review for Review of Geophysics, and available online: Khodayar,S.; Kushta,J.; Catto,J.L.; Dafis,S.; Davolio,S.; Ferrarin, C.; Flaounas, E.; Groenemeijer,P.; Hatzaki, M.; Hochman, A.; Kotroni,V.; Landa,J.; Láng-Ritter,I.; Lazoglou, G.; Liberato, M.L.R.; Miglietta, M.M.; Papagiannaki,K.; Patlakas, P.; Stojanov,R.; Zittis, G. Mediterranean cyclones in a changing climate: a review on their socio-economic impacts, ESS Open Archive . <https://doi.org/10.22541/essoar.172202069.91367609/v1>, 2024.
- A paper has been submitted recently to Weather and Climate Dynamics (Copernicus Ed), at present in open discussion. It covers many aspects of the destructive cyclone Daniel, from its dynamics to the impacts and the attribution to climate change. This paper demonstrates an integrated approach that could be followed to any high-impact weather event. Emmanouil Flaounas, Stavros Dafis, Silvio Davolio, Davide Faranda, Christian Ferrarin, Katharina Hartmuth, Assaf Hochman, Aristeidis Koutroulis, Samira Khodayar, Mario Marcello Miglietta, Florian Pantillon, Platon Patlakas, Michael Sprenger, and Iris Thurnherr: Dynamics, predictability, impacts, and climate change considerations of the catastrophic Mediterranean Storm Daniel (2023), submitted to Wea. Clim. Dyn., 2024.
- Another manuscript is currently under review in Frontiers for Young Minds journal:

Rare types and features of Mediterranean cyclones. Stavros Dafis, Margarida L. R. Liberato and Mihaela Brâncus, Core Concept, *Front. Young Minds - Earth Sciences*. Received on: 10 Jul 2024

Other papers, resulting from a collaboration among many Action participants were published:

- Sandler, D., Saaroni, H., Ziv, B., Tamarin-Brodsky, T., and Harnik, N.: The connection between North Atlantic storm track regimes and eastern Mediterranean cyclonic activity, *Weather Clim. Dynam.*, 5, 1103–1116, <https://doi.org/10.5194/wcd-5-1103-2024>, 2024.
- Pantillon, F., Davolio, S., Avolio, E., Calvo-Sancho, C., Carrió, D. S., Dafis, S., Flaouas, E., Gentile, E. S., Gonzalez-Aleman, J. J., Gray, S., Miglietta, M. M., Patlakas, P., Pytharoulis, I., Ricard, D., Ricchi, A., and Sanchez, C.: The crucial representation of deep convection for the cyclogenesis of medicane Ianos, *EGUsphere* [preprint], <https://doi.org/10.5194/egusphere-2024-1105>, 2024.
- Portal, A.; Raveh-Rubin, S.; Catto, J. L.; Givon, Y.; Martius, O. Linking compound weather extremes to Mediterranean cyclones, fronts, and airstreams. *Weather and Climate Dynamics*, 5, 1043–1060, <https://doi.org/10.5194/wcd-5-1043-2024>, 2024.
- Rousseau-Rizzi, R.; Raveh-Rubin, S.; Catto, J.L.; Portal, A.; Givon, Y.; Martius, O. A storm-relative climatology of compound hazards in Mediterranean cyclones. *Weather and Climate Dynamics*, 5, 1079–1101, <https://doi.org/10.5194/wcd-5-1079-2024>, 2024.
- Pérez-Alarcón, A.; Coll-Hidalgo, P.; Trigo, M.R.; Nieto, R.; Gimeno, L. CyTRACK: An open-source and user-friendly python toolbox for detecting and tracking cyclones. *Environmental Modelling & Software*, 176, 106027. <https://doi.org/10.1016/j.envsoft.2024.106027>, 2024
- Gutiérrez-Fernández, J.; Miglietta, M. M.; González-Alemán, J. J.; Gaertner, M. A. A new refinement of Mediterranean tropical-like cyclones characteristics. *Geophysical Research Letters*, 51, e2023GL106429. <https://doi.org/10.1029/2023GL106429>, 2024
- Givon, Y.; Hess, O.; Flaouas, E.; Catto, J. L.; Sprenger, M.; Raveh-Rubin, S. Process-based classification of Mediterranean cyclones using potential vorticity, *Weather and Climate Dynamics*, 5, 133–162, <https://doi.org/10.5194/wcd-5-133-2024>, 2024.
- Sanchez, C., Gray, S., Volonte, A., Pantillon, F., Berthou, S., and Davolio, S.: How a warmer Mediterranean preconditions the upper-level environment for the development of Medicane Ianos, *EGUsphere* [preprint], <https://doi.org/10.5194/egusphere-2023-2431>, 2023.
- Stathopoulos, C.; Chaniotis, I.; Patlakas, P. Assimilating Aeolus Satellite Wind Data on a Regional Level: Application in a Mediterranean Cyclone Using the WRF Model. *Atmosphere*, 14, 1811. <https://doi.org/10.3390/atmos14121811>, 2023
- D’Adderio L.P., Panegrossi G., Dafis S., Rysman J.F., Casella D., Sanò P., Fucello A., Miglietta M.M.: Two falsely acclaimed medicanes? *Atmospheric Research*, 107179, ISSN 0169-8095, <https://doi.org/10.1016/j.atmosres.2023.107179>, 2023
- Lfarh, W., Pantillon, F. & Chaboureau, J.P. The Downward Transport of Strong Wind by Convective Rolls in a Mediterranean Windstorm. *Monthly Weather Review*, 151, 2801–2817. <https://doi.org/10.1175/MWR-D-23-0099.1>, 2023
- Ferrarin, C., Orlić, M., Bajo, M., Davolio, S., Umgieser, G. & Lionello, P. The contribution of a mesoscale cyclone and associated meteotsunami to the exceptional flood in Venice on

November 12, 2019. Quarterly Journal of the Royal Meteorological Society, 1–14.
<https://doi.org/10.1002/qj.4539>, 2023.

A list of recent peer-reviewed papers published by MedCyclones members and related to scientific topics provides an up-to-date overview of the results of this Action. Recent publications are summarized, continuously updated and available on the website (<https://medcyclones.eu/publications/>).

4. Short Term Scientific Missions (STSM)

Dissemination of MedCyclones STSM calls and their results are communicated through the network. During the fourth Grant Period, nine STSMs were successfully accomplished and they are described in the following:

1) Grantee name: Helena FLOCAS, who visited the group of Margarida Lopes Rodrigues Liberato (University of Trás-os-Montes e Alto Douro)

Title: Impact of low frequency climatic variability on cyclonic tracks in Western Mediterranean

Start and end date: 11/05/2024 to 19/05/2024

This STSM work consists of a contribution to WG2 of the MedCyclones COST action in exploring the Mediterranean cyclones at climate time scales and more specifically to classify them according to their genesis and characteristics. The goal of this STSM was to investigate the impact of the above-mentioned teleconnection patterns on the frequency and intensity of surface cyclonic tracks in the Western Mediterranean along with any intra-annual and interannual variations, as derived by the new reference composite set of cyclonic tracks by Flaounas et al (2023).

2) Grantee name: Sophia BRUMER, who visited the group of Sue Gray (University of Reading)

Title: How do the ocean and surface waves impact sting jets?

Start and end date: 14/04/2024 to 20/04/2024

The main objective is to assess the impact of ocean and wave coupling on the characteristics of sting jets. Wave coupling includes roughness impact of stress and sea-spray impacts on turbulent heat and momentum fluxes. Ocean coupling includes thermal feedback resulting from heat fluxes and mixing as well as current-wind feedbacks. A series of coupled simulations of a Mediterranean cyclone presenting a sting jet are analyzed based on the coupled framework deployed at the LAERO with Meso-NH for the atmosphere, CROCO for the ocean and WAWWATCH-III for the waves. Storm Julia was chosen as Mediterranean Sting Jet case study based on the findings of the SYSTRA-SJ led by A. Volonté (Virtual Mobility Grant, University of Reading, March 2024). High resolution coupled ocean-wave-atmosphere simulations of Julia will be designed depending on results from the initial analysis of the SYSTRA-SJ simulations. They will build on the ongoing work on Atlantic storm Alex and Medicane Ianos carried out at LAERO using the Meso-NH (atmosphere), CROCO (ocean) and WAVEWATCHIII (wave) models.

3) Grantee name: Christian FERRARIN, who visited the group of Emmanouil Flaounas (ETHZ)

Title: The marine and coastal hazards of Mediterranean cyclones

Start and end date: 14/04/2024 to 19/04/2024

The goal of the STSM was to setup a set of high-resolution ocean simulations for assessing the sea conditions in the Mediterranean Sea during the most extreme cyclones. A modelling system is implemented and comprises the finite element SHYFEM hydrodynamic model, two-way coupled with the unstructured WW3 wave model, thus accounting for the wave-current interaction in deep and shallow waters. The hydrodynamic and wave numerical computations are performed on the same spatial domain representing the Mediterranean Sea using an unstructured grid with a resolution varying from 10 km in the open sea to less than 1 km at the coasts.

We successfully implemented a modelling framework composed by the high-resolution meteorological model WRF and the ocean and wave coupled model SHYFEM-WW3.

4) Grantee name: Lisa BERNINI, who visited the group of Stephan Pfahl (Free University of Berlin - Institute of Meteorology)

Title: Thermodynamic and Dynamic Contribution in Precipitation Extremes Linked to Mediterranean Cyclones

Start and end date: 01/05/2024 to 11/10/2024

The grant supported a long staying in the hosting institute, aimed to create a collaboration between the CIMA Research Foundation (Italy), the University of Milano-Bicocca (Italy), and the Free University of Berlin (Germany) to investigate the thermodynamic and dynamic contributions to extreme precipitation over Europe and the Mediterranean Sea. The diagnostic developed by Pfahl et al. (2017) is applied to a convection-permitting regional model to analyze if precipitation associated with different types of Mediterranean cyclones presents a different signature in their thermodynamic and dynamic contribution. The dataset of Mediterranean cyclones tracks produced in the 3T initiative (Flaounas et al., 2023) is exploited to build a classification between typical extratropical cyclones and cyclones developing tropical characteristics.

5) Grantee name: Emmanouil FLAOUNAS, who visited the group of Suzana Camargo (Lamont-Doherty Earth Observatory)

Title: Towards the development of statistical methods for the probabilistic modelling of Mediterranean cyclone intensity

Start and end date: 30/09/2024 to 04/10/2024

The aim of this STSM is to transfer and eventually adapt existing knowledge from the field of tropical cyclones to the one of extratropical cyclones. The overarching goal of this project is to initiate a long-term collaboration for the risk assessment of European and Mediterranean storms. Dedicated methodologies that provide a thorough statistical range of scenarios for all possible storm tracks and intensities have been developed for tropical cyclones. However, the complexity of cyclonic systems that physically define the mid-latitude storms makes it a rather difficult task to apply the same methodologies to extra-tropical cyclones. The activity thus focuses on the probabilistic estimation of the intensity of extratropical cyclones, ideally in conjunction with the statistical simulation of the cyclone tracks. Exploiting available datasets, the eventual development of a statistical model will allow the production of a very high number of synthetic storm systems. As a result, a robust climatological dataset will provide insights into the atmospheric processes that control the formation and propagation of catastrophic storms in Europe.

6) Grantee name: Diego SAUL CARRIO CARRIO, who visited the group of Rossella Ferretti (University of L'Aquila-CETEMPS)

Title: Implementation of Data Assimilation into Regional Coupled Models: Improving the trajectory and intensity of medicane forecasts

Start and end date: 10/06/2024 to 21/06/2024

This STSM aimed to integrate advanced Data Assimilation techniques with high-resolution coupled Ocean-Wave-Atmosphere models to enhance the accuracy of tropical-like cyclones forecasting. The activity first tackled technical aspects to compile and run the modelling system. Then focusing on three tropical-like cyclones, Ianos, Rolf and Qendresa, several high-resolution simulations using 50 ensemble-members across two nested domains were performed. These simulations involved testing various parameterizations and grid-model resolutions to establish a control simulation, which represents the best possible simulation we can obtain without using coupled models and Data Assimilation techniques. A simulation was designed to assimilate high-resolution scatterometer surface wind observations (ASCAT) over the sea at the beginning of the Qendresa's life cycle, to improve the initial conditions. Finally, further simulations were conducted by assimilating ASCAT observations together with conventional in-situ observations (e.g., radiosondes, maritime buoys). The refined analysis from these assimilations was then used to further enhance the coupled model's performance.

7) Grantee name: Mario Marcello MILGIETTA, who visited the group of Miguel Angel Gaertner (Universidad de Castilla-La Mancha)

Title: Climate projection of different types of warm-core cyclones in the Mediterranean

Start and end date: 07/09/2024 to 12/09/2024

This STSM is in the framework of the WG1/WG2 initiative for the definition of "Mediterranean tropical cyclones" (TLC), aka medicane. Recent results were discussed concerning the definition of medicanes, the possibility to discriminate the different kinds of Mediterranean cyclones using the precipitable water as a prognostic tool, and identification of criteria to predict the possible occurrence of medicanes some days in advance. A plan for future activity has been setup, aimed to extend the results of the recent studies, more focused on Atlantic cyclones, to the Mediterranean region, and to define the climatology for each category of "medicanes" (i.e., warm seclusions, tropical transitions, STC, and Mediterranean "polar lows") in the current climate and in future scenarios.

8) Grantee name: Juan Jesús GONZÁLEZ ALEMÁN, who visited the group of Heini Wernli (ETHZ)

Title: Developing a physically descriptive cyclone phase space to better categorize Mediterranean cyclones

Start and end date: 29/04/2024 to 09/05/2024

The main activity of this STSM focused on the use of the LAGRANTO tool in cyclone case studies and the analysis of the trajectories and dynamics within cyclone surroundings. The tool was first installed and then used for specific case studies in ERA5 (Tropical transition (TT) of Hurricane Leslie, TT of Hurricane Alex, and Medicanes Zorbas and Ianos). Various specific metrics were developed, which try to summarize the changing behaviour in trajectories while the cyclone goes through different phases. The analysis of these metrics has been undertaken and reveals promising results for differentiating different stages. More specifically, it has been possible to differentiate the intense warm seclusion phase of precursors for Hurricane Leslie and Alex, with their tropical transition stages by analysing the different behaviour of the trajectories. Having found different

behaviour of the Lagrangian trajectories associated with cyclone dynamics in different stages of TT cyclones in the North Atlantic, suggest promising results also for the Mediterranean.

9) Grantee name: Antonio RICCHI, who visited the group of Florian Pantillon (University of Toulouse - Laboratoire d'Aérodologie)

Title: Digital twins of the atmosphere and ocean: application to the coupled modeling of tropical-like cyclone Ianos

Start and end date: 21/05/2024 to 31/05/2024

The research activity of this STSM was based on undertaking coupled modeling simulations of Tropical-Like Cyclone (TLC) Ianos and comparing results from two numerical frameworks: COAWST (Coupled Ocean Atmosphere Wave Sediment Transport system) based on the WRF-ROMS-SWAN chain (performed by the grantee) and MESONH-CROCO-WWIII coupled with OASIS (performed by the host). Coupled simulations were also compared with uncoupled experiments taken as benchmark. The final goal was to structure an analysis tool for coupled ocean-atmosphere-wave simulations in the context of studying a TLC case, the 2020 IANOS event. In addition to the implementation of the tool and the analysis needed to study such a peculiar case, we integrated a structured numerical workflow for intercomparison between two coupled frameworks, COAWST and MESONH-CROCO-WWIII, obtaining interesting results and suggestions not only physical but also numerical (useful for repeatability of experiments by third parties).

5. Dissemination Conference Grants and ITC Conference Grants

- Florian Pantillon was supported by a Dissemination Conference Grant to give a solicited oral presentation of the results concerning MIP initiative (WG1) at the EMS Annual Meeting in Barcelona (Spain) between 2-6 September 2024

Title of the presentation: The crucial representation of deep convection for the cyclogenesis of medicane Ianos. Authors: Florian Pantillon, Silvio Davolio, Elenio Avolio, Carlos Calvo-Sancho, Diego Saul Carriò Carriò, Stavros Dafis, Emmanouil Flaounas, Emanuele Silvio Gentile, Juan Jesus Gonzalez-Aleman, Suzanne Gray, Mario Marcello Miglietta, Platon Patlakas, Ioannis Pytharoulis, Didier Ricard, Antonio Ricchi, and Claudio Sanchez

The context and aims of COST Action MedCyclones were presented. As the COST Action is nearing its end, the focus was on the promotion of results, mentioning first a few key published papers, as well as the benefits of the networking aspect through the yearly workshops and training schools organized in the past years. More details about the model intercomparison project of WG1 were given together with its outcome for better understanding the dynamics and predictability of medicanes, which resulted in two papers very recently accepted for publication.

- Emmanouil Flaounas was supported by a Dissemination Conference Grant to give a solicited talk at the Joint Earth System Science Initiative organized by the European Space Agency (ESA) in Frascati (Rome, Italy)

Title of the presentation: Paving the way from understanding to predicting intense Mediterranean cyclones and the specific case of medicanes

The talk was within the section "Earth Observation for High-Impact Hydroclimatic Hazards". An overview of the state-of-the-art in Mediterranean cyclones was provided, that covers dynamics, climatology and prediction aspects with an emphasis on the use of earth observations. COST Action

support was properly acknowledged and most of the presentation was devoted to outcomes of collaborative work that took place within MedCyclones. The talk triggered interesting discussions about earth observations and their role in the advancing the field especially under the prism of new space missions. After discussions with the ESA officers who were present in the conference room, there was a positive overall impression.

- Shira Raveh-Rubin was supported by a Dissemination Conference Grant to give an invited oral presentation at the HIWeather Final Conference at the LMU in Munich (Germany).

Title of the presentation: Community efforts for understanding and predicting hazards across the Atlantic-Euro-Mediterranean regions

For the past 10 years the High-Impact Weather (HIWeather) project in the World Weather Research Programme of WMO has focused the attention of researchers across the world and across many disciplines on the challenges of making forecasts and warnings more effective in saving lives and reducing damage and disruption from weather-related hazards. In it, the “processes and predictability” task team focused on the beginning of the warning value chain, namely on understanding atmospheric dynamical and physical processes conducive for HIWeather, and how these are linked to their predictability. The final conference of the project aims to bring together scientists from the whole warning value chain and summarize key findings and future directions. In this invited keynote talk I summarized key achievements from the MedCyclones COST Action – its objectives, the building up of the community, key coordinated efforts, community products and finally new process understanding. I ended with outlining future coordinated research directions, including other community efforts such as FutureMed and the NAWDIC field campaign, all beneficial for further advancing and sustaining our community towards to the initial objectives of the COST Action.

- Valentina Di Francesca was supported by a Dissemination Conference Grant to give a talk at the 5° Congresso Nazionale dell’Associazione Italiana di Scienze dell’Atmosfera e Meteorologia (AISAM) in Lecce (Italy)

Title of the presentation: Use of Spaceborne Passive Microwave Radiometry for the identification and characterization of Mediterranean Tropical-Like Cyclones (Medicanes)

This dissertation aimed to provide a deeper understanding of Tropical-Like Mediterranean cyclones and to improve significantly the European capacity of tracking and predict their environmental and climate impact. The targeted audience was the Italian scientific community committed in the field of atmospheric sciences, meteorology and climatology. The expected impact was the dissemination of the results of this study, which contribute to the Medicanes’ definition – Working Group 1 activity in the context of the MedCyclones COST Action 19109.

- Ioannis Karagiorgos was supported by an ITC Conference Grant to give a poster presentation at the 55th International Liège Colloquium on Ocean Dynamics - "Ocean Extremes" in Liege (Belgium).

Title of the presentation: Oceanic influence on Mediterranean cyclones: Insights from coupled ocean-wave-atmosphere simulations

The 55th edition of the International Liège Colloquium focused on Ocean Extremes, encompassing a wide range of phenomena such as extreme waves, storm surges, marine heatwaves, harmful algal blooms, extreme storms and unique occurrences like Medicanes (Mediterranean hurricanes), which are of particular interest to the MedCyclones Action. The thematic sessions of the conference were

directly related to my research interests, particularly in the understanding of oceanic feedback during the prediction of extreme phenomena such as Mediterranean cyclones. My poster presented the findings of the research, which uses ocean-wave-atmosphere simulations to accurately represent the air-sea processes that are essential for reliable forecasting of the track, intensity, and impacts of Mediterranean cyclones. This work is relevant to the objectives of MedCyclones Action and especially with the initiatives of Working Groups 1 and 2.

6. Virtual Mobility Grant

Maria Hatzaki was granted the Virtual Networking Support (VNS). MedCyclones Action has already enabled a range of networking tools (three workshops, three training schools, multiple short-term scientific missions (STSMs)) and dissemination activities in order to meet its objectives and deliverables. In particular, during the last year of the Action, MedCyclones experienced a strong demand for STSMs, which proposed important contributions to the common objectives of the MedCyclones WGs, which is a positive development for the Action as it approaches its end. The VNS contributes to further promoting the Action by supporting all current networking tools and mainly by involving new ones, such as Virtual Mobilities among the Working Groups leaders. Most importantly, the VNS contributes to the establishment of a long-term strategy to sustain the legacy of MedCyclones, leading to follow-up collaborations and projects.

Alexandros Karlis was granted a Virtual Mobility (VM) aimed at developing and implementing a novel numerical method for potential vorticity (PV) inversion within the Weather Research and Forecasting (WRF) model. This method builds upon the theoretical framework established by Decker (2010), which employs a nonlinear balance approach in terrain-following coordinates to accurately invert PV fields and derive balanced atmospheric variables. The new PV inversion tool tailored for the WRF model was successfully developed and validated. It provides a solid foundation for further development that will involve extensive testing to evaluate the tool's accuracy and effectiveness across a range of meteorological conditions.

Florian Pantillon was granted a Virtual Mobility (VM) aimed to ensure that the requirements of WG1 are met (Process-based understanding of Mediterranean cyclones at weather time scales) and to assist ongoing activities of WG1 towards the related deliverables stated in the Memorandum of Understanding and finally preparing for a smooth transition into the post-MedCyclones era. More specifically: i) Two papers are almost ready and needs to be properly advertised. ii) The new version of the website collecting operational forecasts of cyclones is ready and needs further refinements before being launched and promoted within the MedCyclones community and beyond and for operating even after the end of the Action. iii) Some ongoing activities, mainly related to STSM or VM grants, won't reach an end within the timeframe of MedCyclones. Thus, it is necessary to discuss opportunities and setup conditions for their continuation with the involved researchers.

Ambrogio Volonté was granted a Virtual Mobility (VM) to perform a systematic trajectory identification of sting jets in WRF simulations of Mediterranean Cyclone. A dataset of 200 intense Mediterranean cyclones was analysed with the aim of investigating the potential presence of sting

jets in Mediterranean cyclones. The Lagrangian trajectories computed for each of those 200 cyclones and available in the dataset (ECMWF Special Project “Understanding dynamics and impacts of cyclone systems through a comprehensive dataset of convection-permitting simulations”) were interrogated using a set of thresholds to identify airstream consistent with the common evolution of sting jets in mid-latitude cyclones. Two cyclones were identified as containing near-surface strong winds associated with airstreams meeting the constraints defining the behaviour of sting jets in extratropical cyclones. They stand out as the only two cyclones with a sizeable number of trajectories meeting the “sting-jet constraints”. Now, further analysis is needed to fully elucidate the properties of these “potential sting jet” airstreams and to characterise them in the context of the dynamics of the cyclones they are part of.

Samira Khodayar was granted a Virtual Mobility (VM) to improve our knowledge in regard the socio-economic impacts of Medicanes on local and regional scales in the Mediterranean region. Given that cyclones affect a large variety of socio-economic activities, this topic raises significant interest to the general public and stakeholders and it is relevant for decision-makers on the difficult decisions to be taken to mitigate and adapt to climate change. The main goal of this initiative will be achieved through the search and collection of existing information in relation to the socio-economic impacts of Mediterranean cyclones. It envisages a close collaboration with other communities such as the recently funded ESA project MEDICANES Earth Observations as a cornerstone to the understanding and prediction of tropical-like cyclone risk in the Mediterranean and the COST Action FutureMed CA22162.

Silvio Davolio was granted a Virtual Mobility (VM) aimed at collecting information from the WG leaders and co-leaders for a synthesis and harmonization of networking and research results, as well as the preparation and dissemination of the final deliverables. After the completion of the third training school and of the workshop, organized at the European Space Agency, MedCyclones has grown further, involving almost 300 members. The timely sharing of information and of the main results is of remarkable importance to coordinate and promote the follow-up of the Action even after its end. Therefore, the VM has the goal of collecting and promoting information on ongoing activities and results produced so far, especially within the main research initiatives, but also including the outcomes of the STSMs and VMs, in order to provide a clear synthesis of the state of the art. Based upon this, it will be possible to plan the continuation of collaborations among scientists well beyond the end of the Action. Also, the VM assists the writing, collection and harmonization of the deliverables, in view of the final assessment.

Shira Raveh Rubin was granted a Virtual Mobility (VM) to investigate the link between Mediterranean cyclone classification and the role of air-sea interaction in cyclone deepening. Applying the composite cyclone track dataset (Flaounas et al. 2023), classified into the Mediterranean basin-wide and year-round 9 categories (Givon et al. 2024), the ocean evaporation data from ERA5 have been quantified, aiming to categorize air-sea interaction under Mediterranean cyclone conditions. The results of this work provide new insight on the association of ocean evaporation to cyclones from cyclone-centred (Lagrangian) perspective, as well as from a geographically-fixed view. A strong variability of surface fluxes by cyclone class was found. This work establishes also ways forward for the implementation of a similar approach for other climate datasets.

