

# **UNIVERSITY OF PATRAS**

**SCHOOL OF SCIENCE**

**DEPARTMENT OF PHYSICS**

## **LABORATORY OF ATMOSPHERIC PHYSICS**

### **Activity Report 2020**

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**Ioannis Kioutsioukis**

**February 2021**

**Patras, Greece**



## **Laboratory of Atmospheric Physics of the University of Patras<sup>1</sup>**

### **Activity Report 2020**

#### **Note of the Head of the LAPUP**

Dear friends and colleagues,

This report provides an overview of our activities for the year 2020. It is more than obvious that the unprecedented health crisis due to COVID-19 pandemic has put tremendous strain on our activities, disrupted project plans and halted huge parts of our planned social activities like our annual celebration of World Meteorology Day, our core event every March 23<sup>rd</sup>.

In this race against the fast-changing conditions and facts, we scaled-up our productivity in terms of new projects and journal publications. Since the beginning of the COVID-19 crisis in early February, we are committing substantial resources to developing new projects, maintaining essential experimental activities, increasing our staff, and publishing peer-reviewed papers. Moreover, we have established more robust internal processes, flowcharts, and descriptions of work.

So, at the end of 2020, we are proud to see that we have reached the highest ever number in terms of employed colleagues and on-going projects as well as a rich bouquet of journal publications across our research areas.

Patras, February 6<sup>th</sup>, 2020

Professor Andreas Kazantzidis

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<sup>1</sup> Your comments are more than welcome and can be addressed to [akaza@upatras.gr](mailto:akaza@upatras.gr)

You can follow our activities via the following links:

- LAPUP's Web Page: [www.atmoshpere-upatras.gr](http://www.atmoshpere-upatras.gr)
- The LAPUP on Facebook: <https://www.facebook.com/455557894536561>
- The LAPUP on YouTube: <https://www.youtube.com/channel/UCqMUy30C-U8IEPEebxkzJHQ>

## Staff

### Faculty Members

- Athanassios A. Argiriou, Physicist (University of Patras), D.E.A. (I.N.P. Grenoble) - Ph.D. (Univ. Aix-Marseille 1), Professor (2006 - ).
- Andreas Kazantzidis, Physicist, M.Sc., Ph.D. (Aristotle University of Thessaloniki), Professor (2009 - ).
- Ioannis Kioutsoukis, Physicist, M.Sc. (Aristotle University of Thessaloniki), Ph.D. (Aristotle University of Thessaloniki, Joint Research Centre Ispra), Associate Professor (2016 - ).

### Postgraduate Researchers

- Efterpi Nikitidou, Physicist, M.Sc., Ph.D. University of Patras (Aerosol/Cloud optical properties and radiative transfer in the atmosphere).
- Vasileios Salamalikis, Physicist, M.Sc., Ph.D. University of Patras (Stable isotopes in atmospheric processes).
- Panayiotis Tzoumanikas, Computer and Informatics Engineer, M.Sc., Ph.D. University of Patras (Study of atmospheric parameters using digital image processing techniques).
- Ioannis Vamvakas, Physicist, M.Sc., Ph.D. University of Patras (Cloud and aerosol effects on solar irradiance).

### Graduate Students

#### Ph.D. Candidates

- Vasileios Armaos, Physicist, University of Patras, M.Sc. Applied Mathematics & Theoretical Physics, University of Cambridge. Topic: Quantum computing applications in atmospheric sciences.
- Anastasia Aggelou, Physicist, University of Patras, M.Sc. Applied Meteorology & Environmental Physics, University of Patras. Topic: Early warning for disease epidemics.
- Constantinos Villiotis, Physicist, University of Patras, M.Sc. Applied Meteorology & Environmental Physics, University of Patras. Topic: Impact of ABL assimilation in NWP skill.
- Kalliopi Droutsas, Physicist, National & Kapodistrian University of Athens, M.Sc. in Environmental Physics, National & Kapodistrian University of Athens. Topic: Energy and environmental imprint of the Hellenic tertiary sector buildings and study of their energy retrofit taking into account the implications of climate change.
- Athanasios Karavoulias, Physicist, University of Patras, M.Sc. Applied Meteorology & Environmental Physics, University of Patras. Topic: "Optical properties of clouds and aerosols from modeled and measured data from solar irradiance spectra".
- Constantinos Kolokythas, Hellenic Air Force - Meteorologist, M.Sc. in Environmental Sciences, University of Patras. Topic: Wind energy forecast – Topography and extreme weather events impact.
- George Kosmopoulos, Physicist, M.Sc. Energy & Environment, University of Patras. Topic: Effect of atmospheric constituents on solar irradiance.

- Stavros – Andreas Logothetis, Physicist, M.Sc. Applied Meteorology & Environmental Physics, University of Patras. Topic: The effect of the aerosols and clouds on the energy budget of the Earth-Atmosphere system.
- Iasonas Markantonis, M.Sc. Applied Meteorology & Environmental Physics, University of Patras. Topic: Extreme and Compound Events in EMED.
- Dimitrios Michos, Mathematician, M.Sc. Applied Meteorology & Environmental Physics, University of Patras. Topic: Short-term wind turbine Energy-yield forecasting.
- Orestis Panagopoulos – Kontostavakis, Physicist, M.Sc. in Green Energy, University of Patras. Topic: Experimental study and modelling of the Urban Heat Island in Patras.
- Areti Pappa, M.Sc. Applied Meteorology & Environmental Physics, University of Patras. Topic: Applications of complex networks in atmospheric sciences.

### Research Associates

- Ioannis Kanakaris, Informatics for Business Planning Engineer (Technical Educational Institute of Patras), M.Sc. in Accounting (Price Waterhouse Coopers S.A.)

### Teaching Activities

During the reporting period, the LAPUP faculty taught the following undergraduate and graduate courses:

#### Undergraduate Programs

- Atmospheric Physics I - Meteorology (7<sup>th</sup> semester, Dept. of Physics, University of Patras)
- Atmospheric Physics II (8<sup>th</sup> semester, Dept. of Physics, University of Patras)
- Atmospheric Pollution (7<sup>th</sup> semester, Dept. of Physics, University of Patras)
- Calculus (1st semester, Dept. of Physics, University of Patras)
- Differential Equations (2<sup>nd</sup> semester, Dept. of Physics, University of Patras)
- Introduction to Environmental Physics (5<sup>th</sup> semester, Dept. of Physics, University of Patras)
- Dynamical Systems and Complexity (7<sup>th</sup> semester, Dept. of Physics, University of Patras)
- Meteorology – Climatology (7<sup>th</sup> semester, Dept. of Geology, University of Patras)
- Atmospheric Physics I-Meteorology I (7<sup>th</sup> semester, Dept. of Mathematics, University of Patras)
- Atmospheric Physics II-Meteorology II (8<sup>th</sup> semester, Dept. of Mathematics, University of Patras)
- Physics Laboratory II (Mechanics – Fluid Mechanics) (2<sup>nd</sup> semester, Dept. of Physics, University of Patras)
- Physics Laboratory III (Thermodynamics – Waves - Optics) (3<sup>rd</sup> semester, Dept. of Physics, University of Patras)
- Physics Laboratory IV (Electromagnetism) (4<sup>th</sup> semester, Dept. of Physics, University of Patras)

- Renewable Energies Laboratory (8<sup>th</sup> semester, Dept. of Physics, University of Patras)

## **Graduate Programs**

### ***Graduate Program on Applied Meteorology and Environmental Physics***

- Dynamic and Synoptic Meteorology (1<sup>st</sup> semester)
- Radiation and Atmosphere (1<sup>st</sup> semester)
- Measurements and Data Processing in Atmospheric Sciences (1<sup>st</sup> semester)
- Energy Meteorology (2<sup>nd</sup> semester)
- Statistical Methods in Atmospheric Sciences (2<sup>nd</sup> semester)
- Atmospheric Modelling (2<sup>nd</sup> semester)

### ***Interdisciplinary Graduate Program on Environmental Sciences, University of Patras***

- Environmental Physics (1<sup>st</sup> Semester)

### ***Interdisciplinary Graduate Program on Distributed green electricity and advanced network infrastructure management and economy, University of Patras***

- Integrated Modelling (1<sup>st</sup> semester)
- Energy Meteorology (2<sup>nd</sup> semester)

## **Awarded Theses**

### **Ph.D. Theses**

- Vamvakas Ioannis, Assessment of aerosol and cloud optical properties on solar irradiance, December 2020, Supervisor: A. Kazantzidis. (Handle not available at this time; queries can be submitted later at <https://nemertes.lis.upatras.gr/jspui/handle/10889/1>)

### **M.Sc. Theses**

- Athina Pavlidi, Study of the stratospheric temperature structure, April 2020. Supervisor: A. Argiriou. (<http://hdl.handle.net/10889/13429>)

- Elias Tzouras, Homogenization of climate time series of the weather station of the Laboratory of Atmospheric Physics. Supervisor: A. Argiriou, (<http://hdl.handle.net/10889/13659>)

- Anastasia Aggelou, Development of a spatial forecasting model for the risk of human infections by the West Nile virus, April 2020. Supervisor: I. Kioutsioukis. (<http://hdl.handle.net/10889/13220>).

- Konstantinos Vylliotis, Synchronization phenomena of extreme weather events in Greece, April 2020. Supervisor: I. Kioutsioukis. (<http://hdl.handle.net/10889/13430>)

- Ioanna Panagiotopoulou, Assessment of human exposure to ultraviolet sunlight in relation to environmental conditions, September 2020. Supervisor: A. Kazantzidis (<http://hdl.handle.net/10889/13836>).

## **Research Activities**

The main research axes of the LAPUP include:

- Measurements, quality control, processing, and homogenization of meteorological and environmental time series.
- Stable isotopes ( $\delta^{18}\text{O}$  &  $\delta^2\text{H}$ , nitrogen isotopes) in rain and in atmospheric water vapor.
- Ultraviolet radiation: Measurements, modeling and biological dose rates.
- Solar Radiation: Measurements, modeling and solar energy.
- Energy meteorology.
- Artificial intelligence methods applied to atmospheric and environmental physics problems.
- Atmospheric Modeling, Ensemble Forecasting, and Predictability.
- Uncertainty propagation and Sensitivity analysis of model output.
- Chemical Weather forecasting.
- Modeling Environment and Vector-borne Disease Interaction.

In the frame of the above research axes, the LAPUP carried out a number of research projects that led to a series of publications in international scientific journals and conferences.

## **On-going research projects**

- Solar Resource for High Penetration and Large Scale Applications, International Energy Agency - Photovoltaic Power Systems Program Task 16, 7/2017 – 6/2023.
- Solar Collectors with Static Concentrators, for solar thermal applications at intermediate to medium temperatures - SCoSCo (Bilateral cooperation between Greece and Germany), 5/2018 – 4/2020.
- Global Monitoring of Nitrogen Isotopes in Atmospheric Waters (International Atomic Energy Agency Coordinated Research Project F32008 – Contract #22879/R0), 6/2018 – 5/2021.
- Comparative study of changing climate extremes between China and Europe / Greece, based on homogenized daily observations -CLIMEX (Bilateral cooperation between Greece and China), 11/2019 – 11/2021.
- PatrasAir: Set-up and monitoring of the air quality in the metropolitan area of Patras, Self-funded project (<http://www.patrasair.gr/>).
- UHI: Set-up and monitoring of the urban heat island effect in the metropolitan area of Patras , Self-funded project.

- AQMEII (phase IV): Air Quality Model Evaluation International Initiative
- Modeling Environment and Vector-borne Disease Interaction. Self-funded project.
- Early Warning for Disease epidemics. Self-funded project, 10/2019-10/2023.
- Middle East – North Africa Hybrid Solar System (HYMENSO), ERANETMED Renewable Energies, 1/11/2016 – 30/4/2019 ([www.hymenso.eu](http://www.hymenso.eu)).
- Towards an innovative strategy for skills development and capacity building in the space geo-information sector supporting Copernicus user uptake, H2020 Erasmus+, 1/1/2018 – 31/12/2021 ([www.eo4geo.eu](http://www.eo4geo.eu))
- Panhellenic infrastructure for atmospheric composition and climate change, GSRT 1/9/2018 – 31/8/2021 (<https://panacea-ri.gr/>).
- Spatiotemporal variability of air particulate matter in the city of Themi and investigation of possible effects on human health, 10/10/2018 – 9/10/2020 (<http://www.thermi-air.gr/>).
- Introducing Recent Electrical Engineering Developments into Undergraduate Curriculum (IREEDER), Erasmus+, 15/11/2019-14/11/2022 (<http://ireeder.ahu.edu.jo/>).
- Smart Air Quality Monitoring, Region of Western Greece 1/1/2019-31/12/2020 (<https://smartaqm.yodiwo.com/>).
- Accurate short-term wind turbine Energy-yield forecasting, IMEC, 10/2019-9/2023.
- Advanced Earth Observation and Information Technology Techniques for Early Investigation/ Analysis and Warning of Mosquito-Borne Diseases, GSRT 7/2020-7/2023
- Development of an innovative and flexible system of ground-based meteorological, atmospheric and solar measurements with the synergy of physical models and methods of computational vision and deep learning, GRST 6/2020-11/2022 (<https://deepsky-project.com>)
- Spatiotemporal variability in cloud/solar resource and forecasting with the use of satellite estimations and high resolution ground-based measurements, GSRT 2/2020-4/2021.

## Publications in peer-reviewed journals

- WANG Liwei, ZHANG Mingjun, WANG Shengjie, Athanassios A. ARGIRIOU, WANG Gaofei, Vasileios SALAMALIKIS, SHI Mengyu, JIAO Rong, (2020). Stable Isotope Signatures and Moisture Transport of a Typical Heavy Precipitation Case in the Southern Tianshan Mountains. Chinese Geographical Science, 30(1): 180–188. <https://doi.org/10.1007/s11769-019-1091-6>.
- K. Zioutas, A. Argiriou, H. Fischer, S. Hofmann, M. Maroudas, A. Pappa, Y.K. Semertzidis (2020) Stratospheric temperature anomalies as imprints from the dark Universe. PHYS DARK UNIVERSE, 28, 100497. <https://doi.org/10.1016/j.dark.2020.100497>
- Qinqin Du, Mingjun Zhang\*, Shengjie Wang, Athanassios A. Argiriou, Cunwei Che, Peipei Zhao, Zhuanzhuan Ma, Pengyan Su (2020) Plant water resource partitioning and xylem-to-leaf deuterium enrichment in Lanzhou City, Northwest China. Water Supply, 20(3): 1127-1140 <https://doi.org/10.2166/ws.2020.045>
- Fenli Chen, Mingjun Zhang, Athanassios A. Argiriou, Shengjie Wang, Xin Zhou and Xueyuan Liu (2020) Deuterium Excess in Precipitation Reveals Water Vapor Source in the Monsoon Margin Sites in Northwest China. Water 12(12): 3315, <https://doi.org/10.3390/w12123315>
- Yudong Shi, Shengjie Wang, Mingjun Zhang, Athanassios A. Argiriou, Rong Guo, Yang Song and Xiaofan Zhu (2020) Isoscape of  $\delta^{18}\text{O}$  in precipitation of the Qinghai-Tibet Plateau: Assessment and improvement. Water 12: 3392, <https://doi.org/10.3390/w12123315>
- Optimization of parabolic trough power plant operations in variable irradiance conditions using all-sky imagers, B. Nouri, K. Noureldin, T. Schlichting, S. Wilbert, T. Hirsch, M. Schroedter-Homscheidt, P. Kuhn, A. Kazantzidis, L. Zarzalejo, P. Blanc, Z. Yasser, J. Fernandez, and R. Pitz-Paal, Solar Energy, 198, 434-453, 2020, <https://doi.org/10.1016/j.solener.2020.01.045>.
- Aerosol classification in Europe, Middle East, North Africa and Arabian peninsula, based on AERONET Version 3, S. Logothetis, V. Salamalakis, A. Kazantzidis, Atmospheric Research, 239, 104893, 2020, <https://doi.org/10.1016/j.atmosres.2020.105343>
- Evaluation of enhancement events of global horizontal irradiance due to clouds at Patras, South-West Greece, I. Vamvakas, V. Salamalakis, A. Kazantzidis, Renewable Energy, 151, 764-771, 2020, <https://doi.org/10.1016/j.renene.2019.11.069>.
- Benchmarking on improvement and site adaptation techniques for modeled solar irradiance datasets, J. Polo, C. Fernandez-Peruchena, V. Salamalakis, L. Mazorra-Aguiar. M. Turpin, L. Martin-Pomares, A. Kazantzidis, P. Blanc, J. Remund, Solar Energy, 201, 469-479, 2020, <https://doi.org/10.1016/j.solener.2020.03.040>.
- Benchmarking of six cloud segmentation algorithms for ground-based all-sky imagers, M. Hasenblag, P. Kuhn, S. Wilbert, B. Nouri. A. Kazantzidis, Solar Energy, 201, 596-614, 2020, <https://doi.org/10.1016/j.solener.2020.02.042>.
- Ultraviolet B radiation affects growth, physiology and fiber quality of cotton, D. Zouzoulas, E. Vardavakis, S.D. Koutroubas, A. Kazantzidis, V. Salamalakis, African Journal of Agricultural, Research, 15(3), 473-482, 2020, <https://doi.org/10.5897/AJAR2020.14774>.



- Estimation of global horizontal irradiance using satellite-derived data across Middle East-North Africa: The role of aerosol optical properties and site-adaptation methodologies, I. Vamvakas, V. Salamalakis, D. Benitez, A. Al-Salaymeh, S. Bouaichaoui, N. Yassaa, A. Guizani, A. Kazantzidis, *Renewable Energy*, 157, 312-331, 2020, <https://doi.org/10.1016/j.renene.2020.05.004>.
- Low-cost sensors for measuring airborne particulate matter: Field evaluation and calibration at a South-Eastern European site, G. Kosmopoulos, V. Salamalakis, S.N. Pandis, P. Yannopoulos, A.A. Bloutsos, A. Kazantzidis, *Science of the Total Environment*, 748,141396, 2020, <https://doi.org/10.1016/j.scitotenv.2020.141396>

### **Presentations in peer-reviewed international conferences**

- Goettsche J, Alexopoulos S, Dümmler A, Argiriou AA, Panagopoulos O, Kosmopoulos G, Dokouzis A, Hilger P, Xarchis S (2020). Solar Process Micro mirror concentration system. EUROSUN 2020 – 13th International Conference on Solar Energy for Buildings & Industry, Athens, September 1-3, 2020.
- A. Argiriou, A. Mamara, P. Ioannidis (2020) Analysis of parallel measurements of daily maximum and minimum temperatures in Greece. 10th Seminar for Homogenization and Quality Control and 5th Conference on Spatial Interpolation Techniques in Climatology and Meteorology. 12–14 October 2020, OMSZ (Hungarian Meteorological Service), Budapest.
- Kazantzidis A, Salamalakis V, Tzoumanikas P, Argiriou A (2020). Assessment of the spatiotemporal variability of surface global horizontal irradiance using high-resolution satellite data and ground based measurements. EUROSUN 2020 – 13th International Conference on Solar Energy for Buildings & Industry, Athens, September 1-3, 2020.
- Pappa A, Solomou ES, Kioutsioukis I, Melas D, “CAN POST-PROCESSING TECHNIQUES OF HIGH-RESOLUTION URBAN PARTICULATE MATTER FORECASTS ACCOUNT FOR INACCURATE EMISSIONS AND/OR PROCESSES?”, 12<sup>th</sup> International Conference on Air Quality, 9-13 March 2020, Thessaloniki, Greece
- Parselia E, Kontoes C, Kioutsioukis I, Mourelatos S, Hadjichristodoulou C, Stilianakis N, “EARLY WARNING SYSTEM FOR WEST NILE VIRUS OUTBREAKS BASED ON SATELLITE EARTH OBSERVATION DATA”, EGU General Assembly, 4-8 May, 2020

### **Organization of Conferences and Workshops**

- [“Early warning for Epidemics using dynamical models, AI and space technology”](#), Webinar, 9/7/2020 and 14/7/2020.



## Dissemination activities

- Sailing Meteorology – A free course offered for the students of the sailing schools of the Sailing Club of Patras (IOP).
- Guided visits in the Lab for high school students.
- Weather forecasts, extreme weather event analyses and air quality for the local and national news media

Those interested can find details regarding our dissemination activities by visiting our:

- Web page: [www.atmposhpere-upatras.gr](http://www.atmposhpere-upatras.gr)
- Facebook page: [www.facebook.com/455557894536561](https://www.facebook.com/455557894536561)
- YouTube channel: <https://www.youtube.com/channel/UCqMUy30C-U8IEPEebxkzJHQ>

## Other Activities

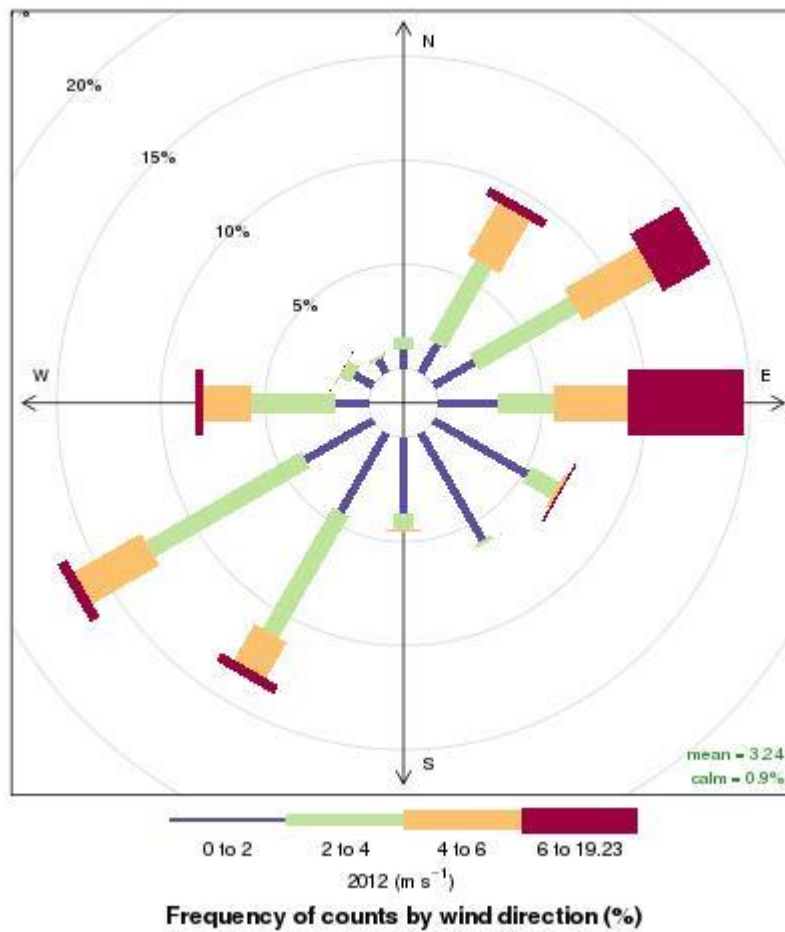
Athanasios Argiriou visited the Climate Change Center, Department Geography, Universitat Rovira I Virgili, Tarragona, Spain, from 10/02/2020 till 13/02/2020, in the frame of the Erasmus + Staff Mobility for Teaching Program agreement, where he gave the following undergraduate lectures: Physics of Climate change and Mitigation of and Adaptation to Climate Change.

## Weather Bulletin

### Summary

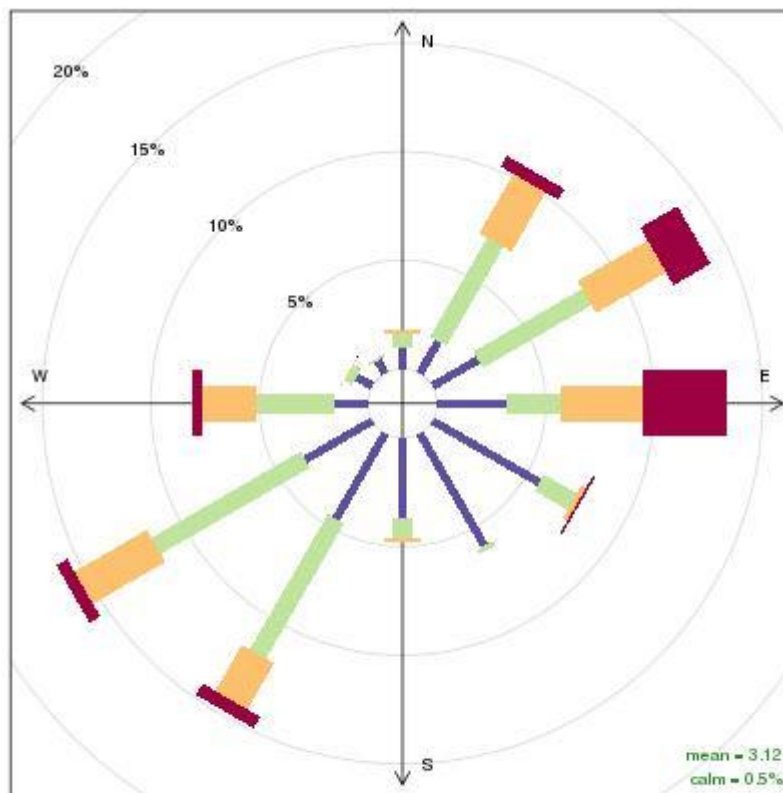
2012	Min	Max	Annual Average (Total for precipitation)
T (°C)	-0.1	38.4	17.9
RH (%)	8.5	91.3	61.5
WV [gust] (m.s <sup>-1</sup> )		19.2 [30]	
RF (mm)			1 182.8
p (hPa)	978	1027	1009

T: air temperature, RH: relative humidity, RF: precipitation, p (pressure at 24.78 m)



2013	Min	Max	Annual Average (Total for precipitation)
T (°C)	0.4	35.7	17.7
RH (%)	5	91.3	62.4
WV [gust] (m.s <sup>-1</sup> )		19.2 [30]	
RF (mm)			958.6
p (hPa)	985	1029	1008

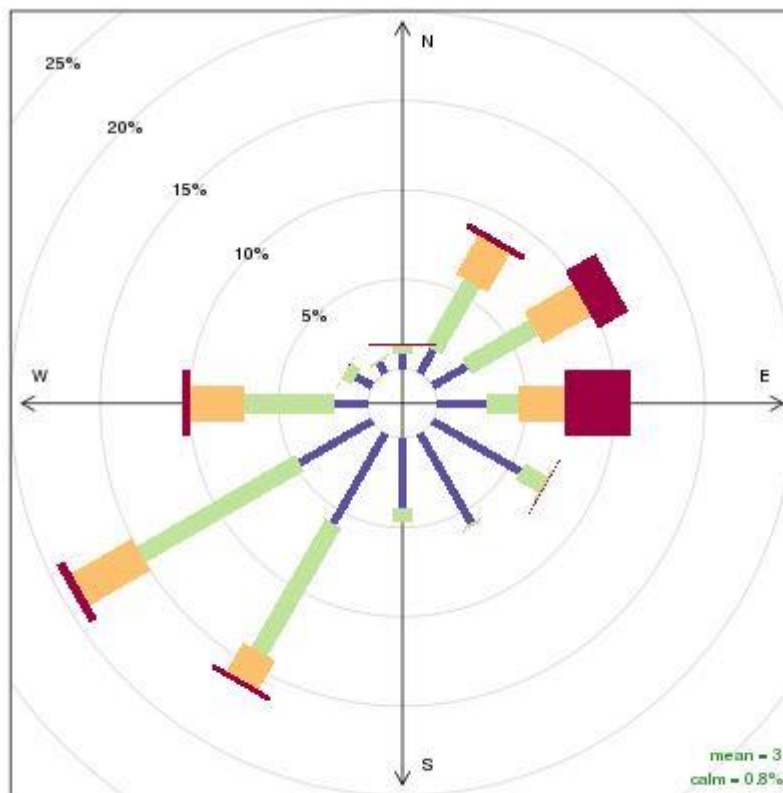
T: air temperature, RH: relative humidity, RF: precipitation, p (pressure at 24.78 m)



0 to 2    2 to 4    4 to 6    6 to 19.21  
2013 (m s<sup>-1</sup>)  
Frequency of counts by wind direction (%)

2014	Min	Max	Annual Average (Total for precipitation)
T (°C)	3.2	35.8	17.3
RH (%)	9.4	91.2	68.1
WV [gust] (m.s <sup>-1</sup> )		19.2 [30]	
RF (mm)			976.6
p (hPa)	989	1023	1009

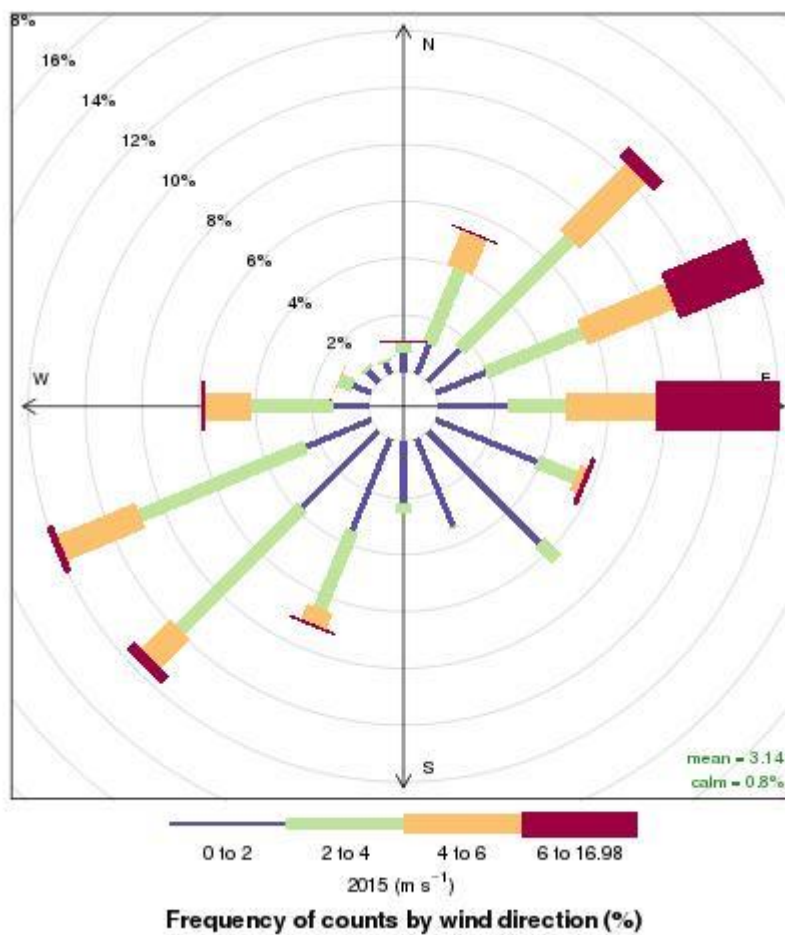
T: air temperature, RH: relative humidity, RF: precipitation, p (pressure at m.s.l.h.)



0 to 2    2 to 4    4 to 6    6 to 19.21  
2014 (m s<sup>-1</sup>)  
Frequency of counts by wind direction (%)

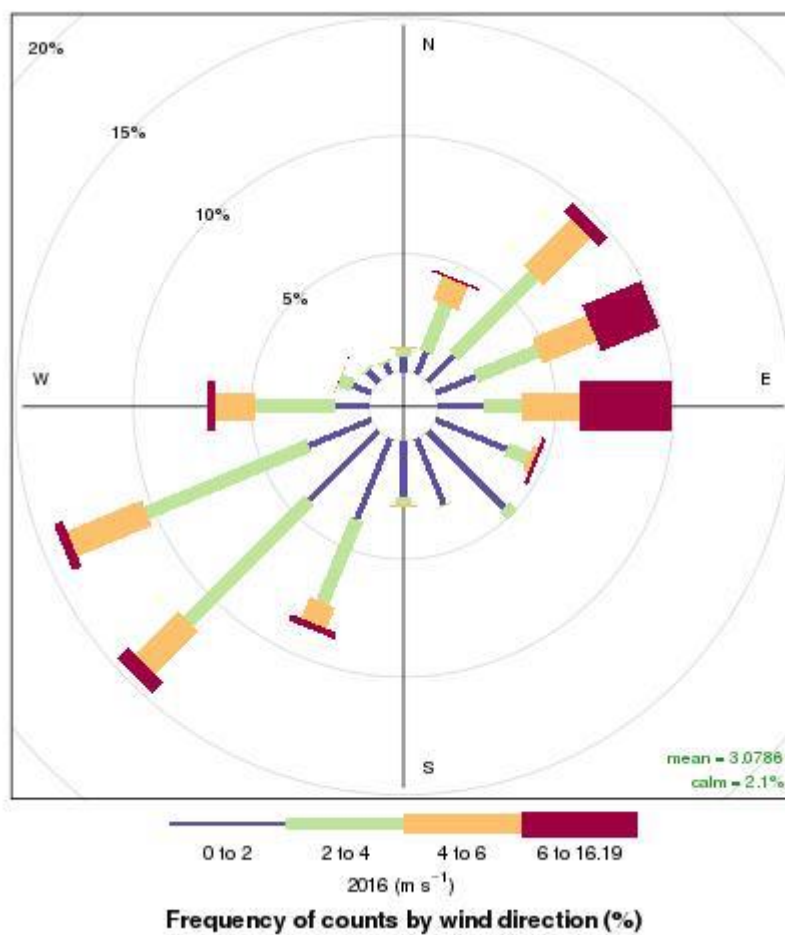
2015	Min	Max	Annual Average (Total for precipitation)
T (°C)	-0.5	37.9	18.2
RH (%)	5.8	97.7	63
WV [gust] (m.s <sup>-1</sup> )		17 [53]	
RF (mm)			803.6
p (hPa)	987	1030	1010

T: air temperature, RH: relative humidity, RF: precipitation, p (pressure at 24.78 m)



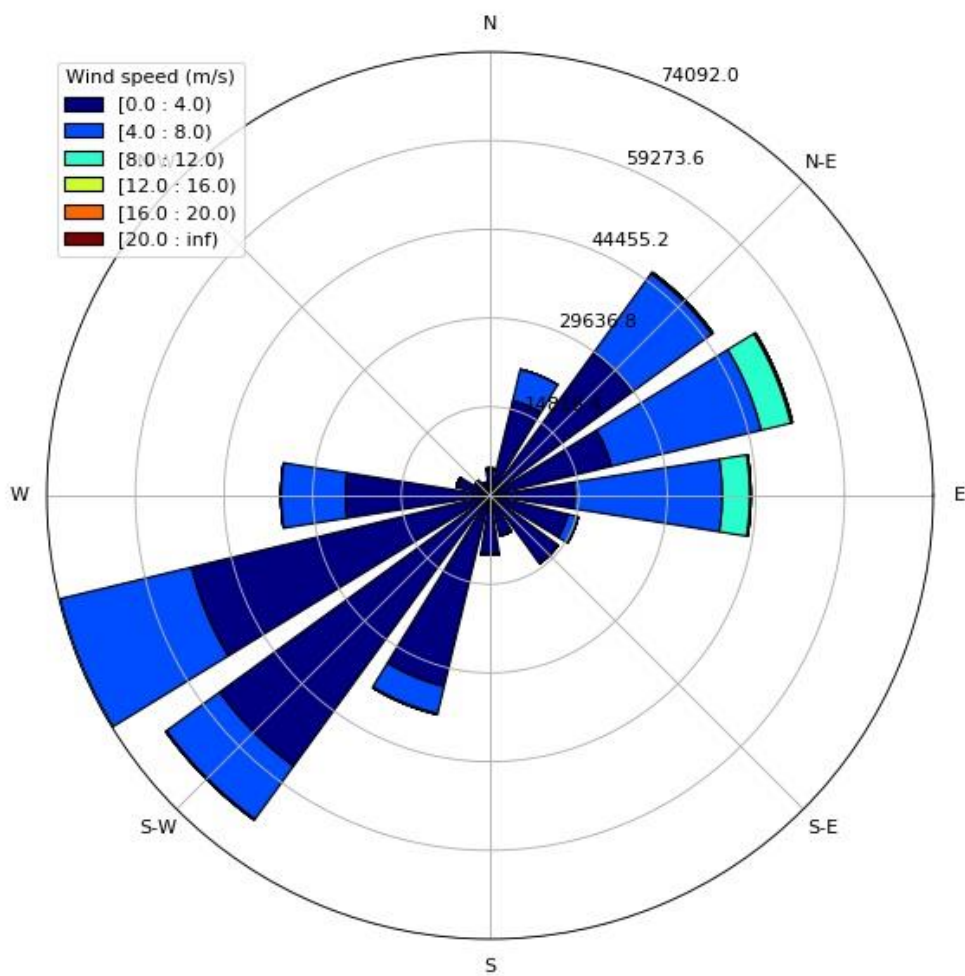
2016	Min	Max	Annual Average (Total for precipitation)
T (°C)	1.0(4)	38.8	19.2
RH (%)	11.73	97.7	64
WV [gust] (m.s <sup>-1</sup> )		17 [53]	
RF (mm)			772.4
p (hPa)	990	1029	1010

T: air temperature, RH: relative humidity, RF: precipitation, p (pressure at 24.78 m)



2017	Min	Max	Annual Average (Total for precipitation)
T (°C)	-1.2	40.4	18.1
RH (%)	9.15	97.7	62.7
RF (mm)			813.0
p (hPa)	978	1026	1010.3

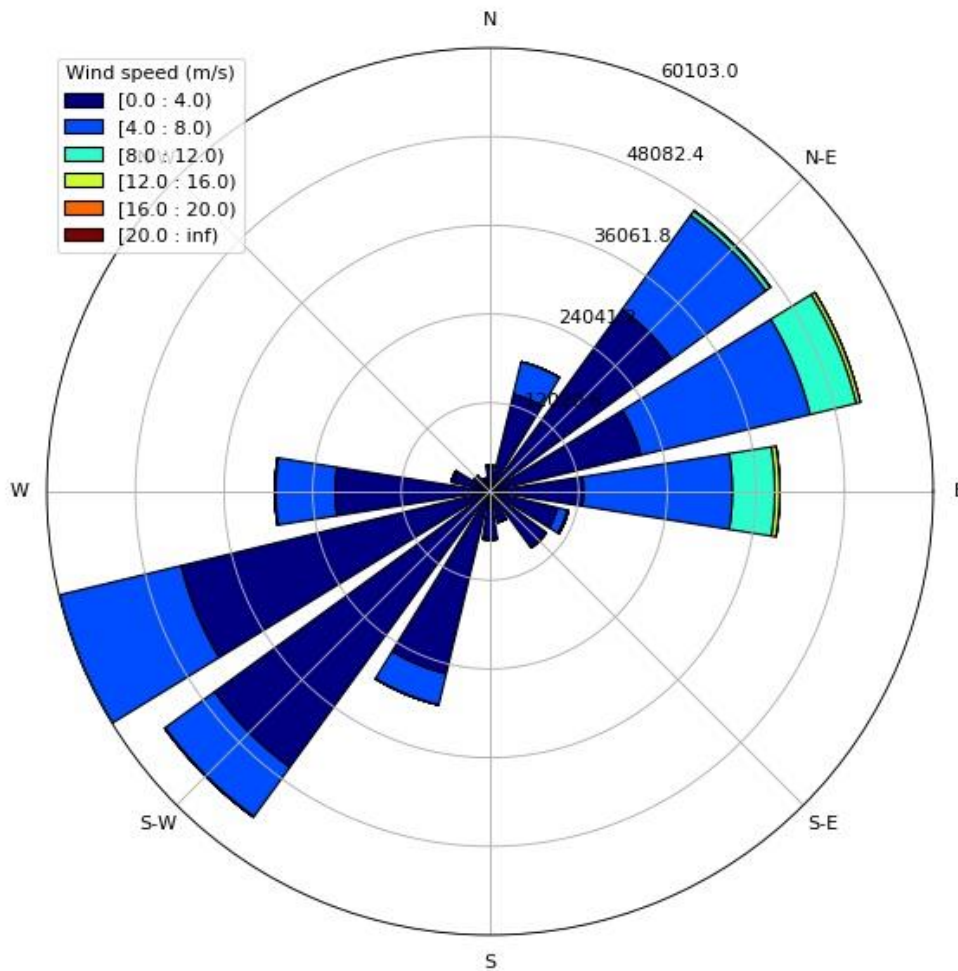
T: air temperature, RH: relative humidity, RF: precipitation, p (pressure at 24.78 m)





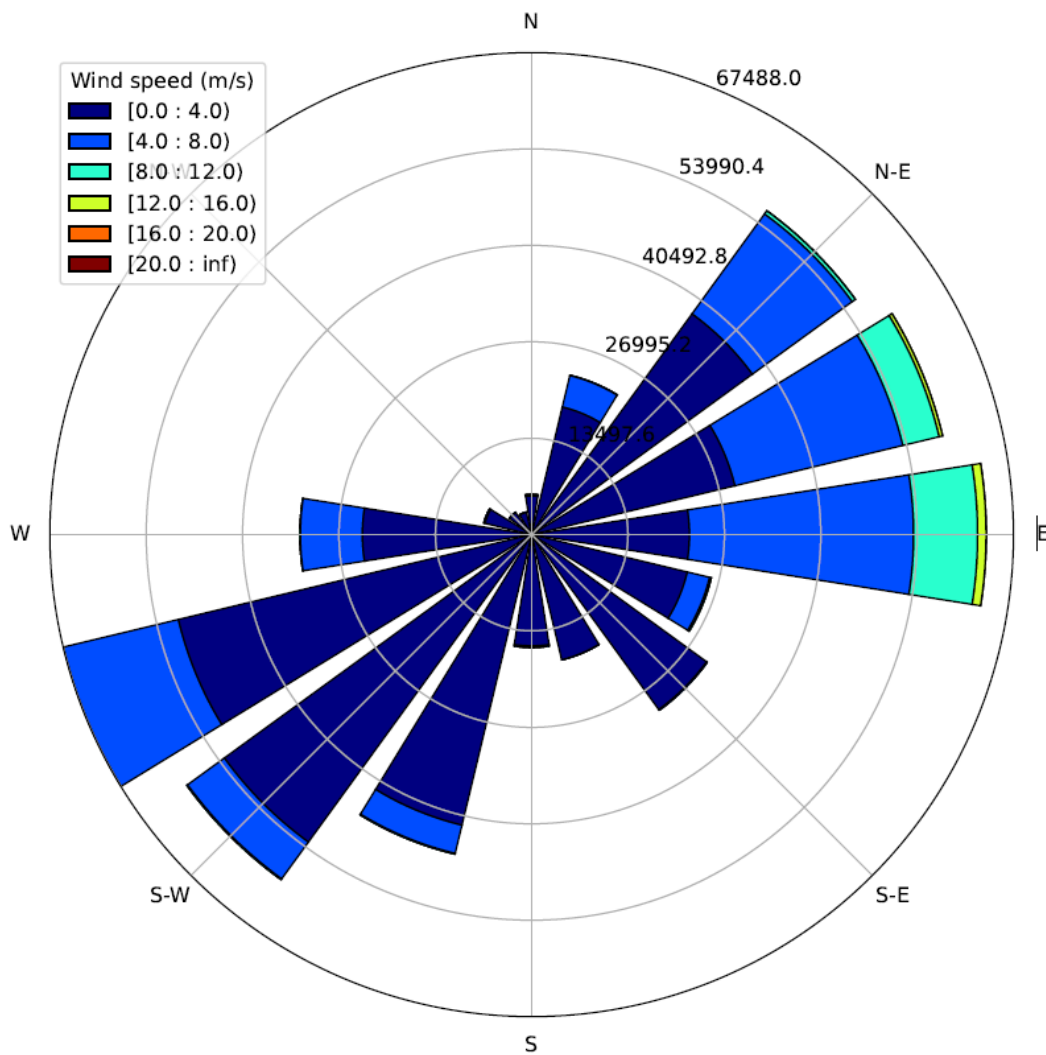
2018	Min	Max	Annual Average (Total for precipitation)
T (°C)	2.5	35.4	18.7
RH (%)	7.5	97.7	64.9
RF (mm)			809.8
p (hPa)	987	1026	1008.6

T: air temperature, RH: relative humidity, RF: precipitation, p (pressure at 24.78 m)



2019	Min	Max	Annual Average (Total for precipitation)
T (°C)	-0.8	37.4	18.6
RH (%)	8.8	97.7	64.0
RF (mm)			1033.6
p (hPa)	972.2	1023.8	1008.6

T: air temperature, RH: relative humidity, RF: precipitation, p (pressure at mean sea level)



2020	Min	Max	Annual Average (Total for precipitation)
T (°C)	2.5	37.9	18.4
RH (%)	6.3	98.3	61.6
RF (mm)			533.60
p (hPa)	985.6	1030.0	1010.0

