Hong Kong Observatory 1-year Placement Programme 2025

Project Code	Project Title	Project description	Preference of department	Knowledge / skills required
A2(a)	Automatic weather reporting for the Hong Kong International Airport (HKIA)	This project aims to adopt machine-learning techniques to develop automatic algorithms for generating standard weather reports for aviation purpose. Weather elements to be incorporate in the report include rain, thunderstorms, fog/haze and clouds. Data used in the project will come from both in-situ and remote-sensing equipment at HKIA.	Physics, Computer Science, Engineering	Interest in meteorology and knowledge in the Python programming language. Experience with machine-learning tools preferred.
A2(b)	Estimation of turbulence Eddy Dissipation Rate (EDR) using data recorded on aircraft and comparison with computer simulations	Eddy Dissipation Rate (EDR) is closely related to the intensity of turbulence in the atmosphere. It can be calculated from high frequency data recorded by equipment onboard of aircraft during flight. The project will, based on previous results, explore and test various scientific methods for the estimation of EDR for different types of aircraft. The use of Computational Fluid Dynamic (CFD) model to simulate flow pattern at the Hong Kong International Airport will also be conducted and the result will be compared with aircraft data.	Physics, Computer Science, Engineering	Interest in meteorology and aviation. Knowledge in aviation systems and experience with Python programming language preferred. Experience in running CFD models would be an advantage.

A4(a)	Study of characteristics of precipitation over Hong Kong using Two-Dimensional Video Disdrometer (2DVD) data	This project aims to: (1) study the characteristics of precipitation over Hong Kong in various seasons; (2) compare 2DVD data with radar dual-pol products; and (3) develop an interactive webpage to display 2DVD data.	Physics, Earth System Science, Mathematics, Computer Science or related disciplines. Completion of 2nd or 3rd year of study.	Strong background in Physics or Mathematics. Experience in Web programming and software development, e.g. Python programming and Linux shell scripting, would be an advantage.
A4(b)	Enhancement of volcano monitoring using satellite data	This project aims to: (1) verify and improve the algorithm of estimating height of volcanic ash (VA); (2) explore the way to provide quantitative volcanic ash (QVA) concentration information using various satellite data; and (3) enhance the volcano monitoring webpage to facilitate operational use.	Physics, Earth System Science, Mathematics, Computer Science or related disciplines. Completion of 2nd or 3rd year of study.	Strong background in Physics or Mathematics. Experience in Web programming and software development, e.g. Python programming and Linux shell scripting, would be an advantage.

A6	Investigate risk associated with aviation hazardous weather based on deterministic and probabilistic forecasts	Turbulence and significant convection are major aviation hazardous weather phenomena. Risk might depend on the severity of hazard and their probability of occurrence. This project aims to study the risk on operation based on analysing observed impacts and their relationship with forecast severity and probability.	Computer Science, Mathematics, Physics, Earth System Science. Completion of 2nd or 3rd year of study.	Genuine interest in aviation, meteorology and/or data science. Experience in computer programming. Familiar with Linux/Unix environment. Knowledge in Python or parallel programming would be an advantage.
A6 & A1	Study on providing high fidelity weather data near Hong Kong International Airport (HKIA).	Weather near HKIA is largely affected by the terrain of Lantau Island. For example, wind vortices and turbulence are commonly seen in HKIA with air flowing around and/or over surrounding mountains. This project aims to explore the automatic generation of high fidelity weather data near HKIA to better support flight operations, like the provision of hourly forecast of weather elements at the touch down zone, as well as forewarning on the occurrence of weather conditions conducive to unsuccessive landing approaches leading to go-arounds.	Computer Science, Mathematics, Physics, Earth System Science. Completion of 2nd or 3rd year of study.	Genuine interest in aviation, meteorology and/or data science. Experience in computer programming. Familiar with Linux/Unix environment. Knowledge in Python or parallel programming would be an advantage.

D2(a)	Enhancement of a regional air–sea coupled modelling system for marine forecasting	This project aims to: (1) Implement three-way Coupled-Ocean-Atmosphere-Wave-Sediment Transport (COAWST) model to generate marine forecasts for operational trial; (2) Enhance the COAWST model to improve forecast of ocean parameters, particularly under the combined effect of tropical cyclone and northeast monsoon; (3) Develop and integrate a data assimilation module to incorporate observation data into the model analysis field; and (4) Model verification against various types of marine observations and perform model tuning to improve forecast performance.	Earth System Science, Computing Science, Oceanography, Coastal Engineering, Marine Environmental Science, Physics, Mathematics.	Strong academic background and IT knowledge. Experiences in computer programming (e.g. Python, NCL, MATLAB) under UNIX/Linux environment. Interest in marine environmental science, oceanography.

D2(b)	Quantitative study of the effect of sea temperature and salinity profiles on rapid intensity change of tropical cyclones near the South China coastal areas	Carry out systematic evaluation of the contribution of sea temperature and salinity to rapid intensity change of tropical cyclones over the South China coastal region based on upper ocean model analysis field, HKO's best-track data of past tropical cyclones, and dynamical parameters derived from NWP model.	Earth System Science, Computing Science, Oceanography, Coastal Engineering, Marine Environmental Science, Physics, Mathematics.	Strong academic background and IT knowledge. Experiences in computer programming (e.g. Python, NCL, MATLAB) under UNIX/Linux environment. Interest in marine environmental science, oceanography.
D2(c)	Development of a multi-model ensemble storm surge prediction system	This project aims to: (1) Implement an enhanced algorithm for post-processing of ECMWF EPS tropical cyclone tracks and intensity prediction to generate ensemble storm surge forecast at various flood prone locations; (2) Carry out simulation of past tropical cyclone and monsoon cases using Delft3D Flexible Mesh model and perform model calibration and tuningto improve performance of the model; and (3) Develop an interactive tool for ensemble storm surge prediction system to facilitate generation of conditional probabilistic forecasts.	Earth System Science, Computing Science, Engineering, Land surveying and Geo-Informatics, Physics, Mathematics.	Strong academic background with IT knowledge. Knowledge in marine environmental science / oceanography. Experiences in computer programming (e.g. Python, QGIS, ArcGIS, JavaScript) under UNIX/Linux environment.

D2(d)	Enhancement of GIS-based flood/inundation indication tool for storm surges, heavy rain and tsunamis in Hong Kong	This project aims to: (1) Enhance inundation indication maps for storm surges and/or tsunamis; (2) Explore the extent of flooding due to hydrodynamic processes such as overtopping waves. Develop data-driven models to predict flooding due to these processes; and (3) Identify high vulnerability regions of Hong Kong under threats of coastal flooding and explore automatic identification of routes to safe shelter.	Earth System Science, Computing Science, Engineering, Land surveying and Geo-Informatics, Physics, Mathematics.	Strong academic background with IT knowledge. Knowledge in marine environmental science / oceanography. Experiences in computer programming (e.g. Python, QGIS, ArcGIS) under UNIX/Linux environment.
D3	Evaluate the skills and explore new prediction tools for supporting sub-seasonal to seasonal forecast	For sub-seasonal to seasonal forecast (S2S), bridging the gap between short-term weather forecasts and long-term climate projections, has long been considered a major challenge in climate forecast. However, some recent research studies have identified significant potential sources of predictability within this time range. The student is expected to: (1) Study the skill and predictability of existing dynamical, statistical or AI models; and (2) Explore the potential climate drivers and prediction tools for enhancing sub-seasonal to seasonal forecast.	Physics, Atmospheric Science, Computer Science and Engineering, Earth System Science, Mathematics, Statistics, or related disciplines.	Strong background in computer programming (e.g. Python, R, Fortran); Experience in data analysis and data visualization are required. Experience in working in Linux environment would be a plus.

F1(a)	Study of extremely hot weather (XHOT) conditions in Hong Kong and development of XHOT nowcasting guidance using AI and weather observations.	This project aims to: (1) Identify the weather conditions crucial for the occurrence of XHOT; (2) Develop an AI-based nowcasting method to predict the temperature change leading up to XHOT using real-time observations such as satellite, solar radiation, stability, surface temperature, winds, etc.; and (3) Review and enhance the existing guidance materials on the issuance of XHOT Special Weather Tips.	Meteorology, Physics, Earth System Science, Computer Science and Engineering, Data Science, Mathematics, Statistics or related disciplines. Completion of 2nd year of study	Experience in Python programming Knowledge in AI/ML (practical experience in using relevant Python libraries, e.g. Scikit-learn, TensorFlow, PyTorch, would be preferred) Interest in meteorology

F1(b)	Study of rainstorm characteristics in Hong Kong using rain gauge data	In Hong Kong, the dense network of automatic rain gauge is crucial to the monitoring of rainfall distribution. With more and more rain gauges became available in recent years, this project aims to study the spatial and temporal characteristics of rainstorms in Hong Kong using different densities of rain gauges, including frequency analysis and characterization of extreme rainfall events. Potential use of the study results will also be explored, e.g. flooding, landslide, traffic, etc.	Meteorology, Physics, Earth System Science, Computer Science and Engineering, Data Science, Mathematics, Statistics or related disciplines. Completion of 2nd year of study	Experience and/or knowledge in Python programming. Knowledge and experience in statistical analysis, machine learning, and Linux OS would be preferred. Genuine interest in meteorology and social science.

F12	Application of Artificial Intelligence (AI) and Machine Learning (ML) in high-impact weather analysis and forecasting.	HKO has been producing real-time analyses of the 3-dimensional atmospheric state containing detailed spatial distributions of dozens of weather parameters, which are ingredients to the development of high-impact weather such as rainstorms. This project will use AI and ML techniques to extract key information from the vast analysis dataset and to generate objective short-term forecast guidance on high-impact weather events.	Computer Science and Engineering, Artificial Intelligence, Data Science, Statistics, Physics, Mathematics, Earth System Science or related disciplines.	Knowledge and experience in Python and ML frameworks required. Familiar with Linux programming environment. Interest in meteorology, AI and ML.

F13(a)	Study of severe weather impact on people in terms of population and societal activities	Risk of severe weather may be considered as a product of vulnerability and exposure. Vulnerability is more related to infrastructure, while exposure relates more to the people subject to the risk. As a continuation of an ongoing effort to estimate the population affected by high-impact weather, this project aims to refine the estimation of exposure to severe weather by, for example, data related to common societal activities such as transport, utility or public events, in the general direction of further studying the actual impact of severe weather to people at daily-living context. This would improve our preparedness for coping with severe weather.	Computer Science, Physics, Mathematics or Engineering of related areas.	Experience and knowledge in programming e.g. Python or R are required. Knowledge of GIS or html would be an advantage.

F13(b)	Study the use of urban-scale weather observations and land use data in forecasting regional temperature and wind	Urbanization has a wide range of effects on the weather, from the urban heat island effect to the wind channeling effect. Modelling requires detailed land use types and geometry of buildings, via, say, urban canopy models. This project aims to explore the use of available land use data and incorporate the data from smart lampposts/microclimate stations installed in the urban area to look at regional temperature and wind forecasts in response to the latest NWP roadmap work on “SmartCity” model development.	Atmospheric Science, Computer Science, Physics, Mathematics or related disciplines.	Experience and knowledge in programming e.g. Python or R are required. Knowledge of GIS or html would be an advantage.

F2	Application and exploration of Artificial Intelligence (AI) and Machine Learning (ML) in assisting weather forecasting.	Harness the power of AI and ML to aid forecasters in weather forecasting. For example, leveraging image recognition techniques to identify analogous weather cases from historical weather imageries and forecasts, and large language models to analyse and draw inspirations from the selected past weather cases, thereby providing timely recommendations to forecasters.	Computer Science and Engineering, Artificial Intelligence, Data Science, Statistics, Physics, Mathematics, Earth System Science or related disciplines.	Knowledge and experience in Python or other computer programming language and environment (e.g. Linux or Unix). Keen interest in AI and ML.

F3(a)	Enhancement of Automatic Forecast of Regional Weather and Probabilistic Prediction	To conduct review of methodologies and enhance: (1) automatic forecast of weather parameters and probabilistic prediction for the next few days to 2 weeks ahead, such as the products provided in the Automatic Regional Weather Forecast (ARWF) portal and the Extended Outlook; and (2) prediction of the state-of-sky (or weather icon) in ARWF The student intern will apply: (1) data products from numerical weather prediction (NWP) models and ensemble prediction system (EPS) to enhance the current systems and to develop new technique for improving forecasts of extreme weather; and (2) machine learning model for analyzing the weather photos and visibility conditions, enhancing the techniques and verifying model prediction of weather conditions.	Earth System Science, Physics, Computer Science and Engineering, Artificial Intelligence, Data Science, Mathematics, Statistics or related disciplines. Completion of 2nd year of study.	Experience and/or knowledge in Python programming required. Genuine interest in meteorology and weather prediction using numerical model data products. Knowledge and experience in machine learning and using Linux OS preferred.

F3(b)	Enhancement of Severe Weather Nowcast Algorithm for High-impact Significant Convective Weather Phenomena	SWIRLS currently provides nowcasts of severe weather for the next couple of hours regarding high-impact significant convective weather phenomena, including lightning, hail and convective induced gusts. This project aims to: (1) enhance the current methods to identify and track the significant convective weather object; and (2) develop artificial intelligence / machine learning (AI/ML) algorithm(s) for enhancing severe weather nowcast using multiple sources of data, including but not limited to surface and upper-air observations, radar (including dual-polarization Doppler weather radar) and satellite images. The student intern is expected to: (1) review and enhance the severe weather object detection algorithm, study and refine the method(s) in severe weather cases; (2) develop AI/ML algorithm to predict location and intensity of severe weather objects; and (3) conduct studies and verification of the developed algorithms and models using severe weather cases and real-time data. Reference: https://journals.ametsoc.org/view/journals/wefo/35/6/waf-d-20-0028.1.xml https://journals.ametsoc.org/view/journals/wefo/35/4/wafD190242.xml	Earth System Science, Physics, Computer Science and Engineering, Artificial Intelligence, Data Science, Mathematics, Statistics or related disciplines.	Experience and/or knowledge in Python programming required. Genuine interest in meteorology, and AI/ML preferred.

F4(a)	Development of tools for analysing weather-related Big Data and assessment of potential weather impacts	Smart use of the weather-related Big Data, including weather observations and data of weather impacts, is beneficial for weather forecasting operations by enhancing situational awareness of weather forecasters and aiding analysis of potential impacts of severe weather such as tropical cyclones and heavy rain. In this project, the student will (1) assist in extracting useful information from the weather-related Big Data, and (2) develop and enhance real-time analysis tools for generating predictive results. Application of artificial intelligence technology might be involved to improve the analysis processes.	Computer science, Physics, Earth System Science, Mathematics, Statistics or related disciplines.	Experience and knowledge in programming e.g. Python and data analysis are required. Knowledge in development of artificial intelligence applications would be an advantage.

F4(b)	Development of derived numerical weather prediction model products in support of severe weather forecasting	Every day the Observatory receives numerical weather prediction (NWP) model outputs from major meteorological centres in support of its weather forecast operations. While model outputs of basic weather parameters, such as wind, temperature and rainfall amount, have been routinely used in formulating weather forecasts and issuing warnings, derived parameters may offer additional guidance for forecasters. For example, “wind shear” calculated from wind speed and direction at different vertical levels may be useful for forecasters to assess the likelihood of thunderstorms and associated intense wind gusts. In this project, the student will (1) evaluate the usefulness of various derived parameters from raw NWP outputs in forecasting local weather through verification and case studies. (2) help develop charts and maps of such parameters to enhance the range of NWP products available to forecasters.	Physics, Earth System Science, Mathematics or related disciplines.	Knowledge and experience in computer programming language and environment (e.g. Linux/Unix and Python) as well as statistical analysis tool (e.g. R). Keen interest in meteorology.

R2	Development and enhancement of the radiation and meteorological measurement device and assembly kit for school community	Arduino-based radiation and meteorological detection device and assembly kit are being used in a STEM education package for secondary schools. A new version of the device is being developed by using ESP32 microcontroller unit. It is aimed to further develop and optimize the device and its dedicated web-based platform. The student is expected to: (1) enhance and optimize the ESP32 and Arduino program; (2) assemble the detection device and perform corresponding quality check; (3) improve the design of device, including hardware resilience, data transfer, power supply etc.; (4) optimize the dedicated web-based platform; (5) study the relationship between the collected data and weather situations, geology etc.; and (6) assist in the outreach educational activities related to the assembly kit (https://youtu.be/i32ETRVvmjQ).	Engineering, Electronics, Physics, Computer Science, Earth System Science or related disciplines.	Knowledge in basic electronics, Arduino, ESP32 and 3D-printing required. Basic knowledge of programming languages such as HTML5, javascript, php etc. preferred.

R3(a)	Enhancement and optimization of microclimate station network for urban weather monitoring	The Observatory has established a network of microclimate stations for urban meteorological measurement. The stations comprise self-developed modules and compact meteorological sensors, as well as bollard enclosure using 3D-printing technique. It is aimed to enhance and optimize the network of microclimate stations. The student is expected to: (1) improve the design of microclimate stations, including hardware resilience, data transfer, power supply & consumption and so on using off-the-shelf and open-sourced electronics; (2) tailor-make parts for bollard-type microclimate stations by 3D-printing; (3) conduct research on microclimate observation data of special weather events; and (4) carry out educational outreach programmes. *Remarks:* *(1) Outdoor duty is required; and* *(2) Training on microcontroller programming can be provided.*	Physics, Applied Physics, Computer Engineering, Electronic Engineering, Earth System Science, Computer Science or related disciplines.	Knowledge in physical science and programming (e.g. Python) are essential. Knowledge in 3D-printing, Arduino, electronics and statistical analysis are desirable.

R3(b)	Studies of urban meteorological data from urban microclimate stations and street level sensors at smart lampposts	Urban meteorological data has been collected for a couple of years from microclimate stations and smart lampposts. It is aimed to conduct studies on the data to fully utilize the valuable urban measurements, as well as to enhance data quality assurance algorithms for urban observation. The student is expected to: (1) study urban meteorological data of normal and special weather events; (2) conduct data comparison between various types of urban meteorological devices and operational instruments; (3) enhance the data quality assurance algorithms for urban observation; and (4) carry out educational outreach programmes. *Remark:* *Outdoor duty is required.*	Physics, Applied Physics, Mathematics, Earth System Science, Statistics, Computer Science or related disciplines.	Knowledge in physical science and programming (e.g. Python) are essential. Knowledge in statistical analysis, machine learning and AI are desirable.

R4	Enhancement of particle dispersion models and their applications for radiation monitoring and assessment	HKO has been utilising atmospheric dispersion models to simulate dispersion events of radioactive materials to facilitate nuclear emergency assessments. This project aims to further enhance the applications and set up a model for hydrological dispersion simulations. The student is expected to: (1) configure atmospheric and hydrological dispersion modules; (2) use dispersion models to simulate the dispersion of radioactive materials in pre-set scenarios; (3) conduct research on simulated outputs; and (4) execute required applications on a high performance computing (HPC) system.	Physics, Earth System Science, Nuclear Science, Computer Science, or related disciplines. Completion of 2nd year of study.	Knowledge in computing skills and data analysis including Linux and Python programming are preferred. Knowledge of GIS and hydrodynamics would be an advantage. Interest in dispersion modelling is a plus.