MicroStep-MIS

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Article name

Fog Prediction for Road Traffic Safety in a Coastal Desert Region: Improvement of Nowcasting Skills by the Machine-Learning Approach

Impact factor (2019)

3.011

Authors

Ivana Bartoková, Andreas Bott, Juraj Bartok, and Martin Gera

Journal

Boundary-Layer Meteorology

Publisher

Springer

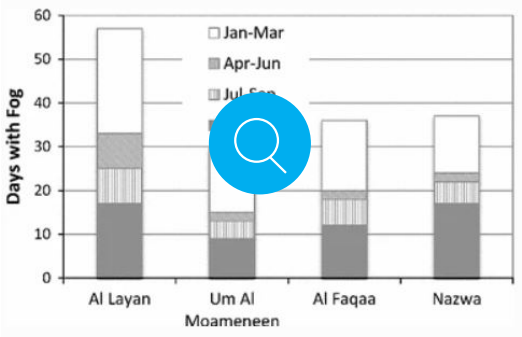
Year

2015

Accessible here

Abstract

A new model for nowcasting fog events in the coastal desert area of Dubai is presented, based on a machine-learning algorithm—decision-tree induction. In the investigated region high frequency observations from automatic weather stations were utilized as a database for the analysis of useful patterns. The induced decision trees yield for the first six forecasting hours increased prediction skill when compared to the coupled Weather Research and Forecasting (WRF) model and the PAFOG fog model (Bartok et al., Boundary-Layer Meteorol 145:485–506, 2012). The decision tree results were further improved by integrating the output of the coupled numerical fog forecasting models in the training database of the decision tree. With this treatment, the statistical quality measures, i.e. the probability of detection, the false alarm ratio, and the Gilbert's skill score, achieved values of 0.88, 0.19, and 0.69, respectively. From these results we conclude that the best fog forecast in the Dubai region is obtained by applying for the first six forecast hours the newly-developed machine-learning algorithm, while for forecast times exceeding 6 h the coupled numerical models are the best choice.



Article name

Fog Prediction for Road Traffic Safety in a Coastal Desert Region

Impact factor (2019)

3.011

Authors

Andreas Bott, Juraj Bartok, and Martin Gera

Journal

Boundary-Layer Meteorology

Publisher

Springer

Year

2012

Accessible here

Abstract

Modern weather prediction models use relatively high grid resolutions as well as sophisticated parametrization schemes for microphysical and other subgrid-scale atmospheric processes. Nonetheless, with these models it remains a difficult task to perform successful numerical fog forecasts since many factors controlling a particular fog event are not yet sufficiently simulated. Here we describe our efforts to create a mechanism that produces successful predictions of fog in the territory located on the north coast of the Arabian Peninsula. Our approach consists in the coupling of the one-dimensional PAFOG fog model with the three-dimensional WRF 3.0 (Weather Research and Forecast) modelling system. The proposed method allows us to construct an efficient operative road traffic warning system for the occurrence of fog in the investigated region. In total 84 historical situations were studied during the period 2008–2009. Moreover, results of operative day-by-day fog forecasting during January and February 2010 are presented. For the investigated arid and hot climate region the land-sea breeze circulation seems to be the major factor affecting the diurnal variations of the meteorological conditions, frequently resulting in the formation of fog.

Article name

Assessing the Contribution of Data Mining Methods to Avoid Aircraft Run-Off from the Runway to Increase the Safety and Reduce the Negative Environmental Impacts

Authors

Olga Vorobyeva, Juraj Bartok, Peter Šišan, Pavol Nechaj, Martin Gera, Miroslav Kelemen, Volodymyr Polishchuk, and Ladislav Gaál

Impact factor (2019)

2.849

Journal

International Journal of Environmental Research and Public Health

Publisher

MDPI

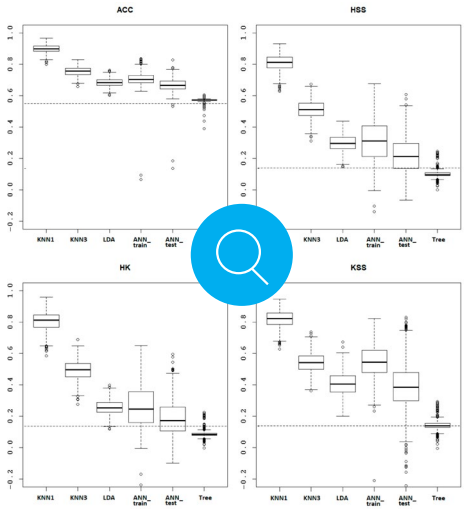
Year

2020

Accessible here

Abstract

The Single Europe Sky Air Traffic Management Research (SESAR) program develops and implements innovative technological and operational solutions to modernize European air traffic management and to eliminate the negative environmental impacts of aviation activity. This article presents our developments within the SESAR Solution “Safety Support Tools for Avoiding Runway Excursions”. This SESAR Solution aims to mitigate the risk of runway excursion, to optimize airport operation management by decreasing the number of runway inspections, to make chemical treatment effective with respect to the environment, and to increase resilience, efficiency and safety in adverse weather situations. The proposed approach is based on the enhancement of runway surface condition awareness by integrating data from various sources. Dangerous windy conditions based on Lidar measurements are also discussed as another relevant factor in relation to runway excursions. The paper aims to explore four different data mining methods to obtain runway conditions from the available input data sources, examines their performance and discusses their pros and cons in comparison with a rule-based algorithm approach. The output of the SESAR Solution is developed in compliance with the new Global Reporting Format of the International Civil Aviation Organization for runway condition description to be valid from 2020. This standard is expected to provide concerned stakeholders with more precise information to enhance flight safety and environmental protection.



Article name

Monitoring of Low-Level Wind Shear by Ground-based 3D Lidar for Increased Flight Safety, Protection of Human Lives and Health

Impact factor (2019)

2.849

Authors

Pavol Nechaj, Ladislav Gaál, Juraj Bartok, Olga Vorobyeva, Martin Gera, Miroslav Kelemen, and Volodymyr Polishchuk

Journal

International Journal of Environmental Research and Public Health

Publisher

MDPI

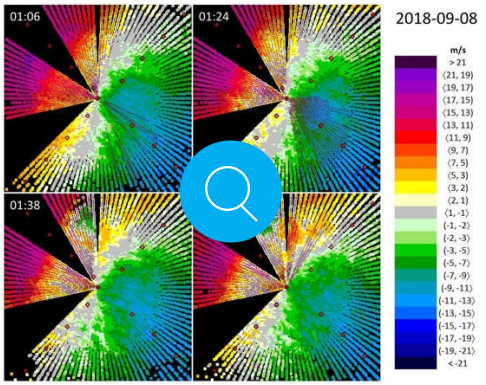
Year

2019

Accessible here

Abstract

Low-level wind shear, i.e., sudden changes in wind speed and/or wind direction up to altitudes of 1600 ft (500 m) above-ground is a hazardous meteorological phenomenon in aviation. It may radically change the aerodynamic circumstances of the flight, particularly during landing and take-off and consequently, it may threaten human lives and the health of passengers, people at the airport and its surrounding areas. The Bratislava Airport, the site of this case study, is one of the few airports worldwide and the first in Central Europe that is equipped with a Doppler lidar system, a perspective remote sensing tool for detecting low-level wind shear. The main objective of this paper was to assess the weather events collected over a period of one year with the occurrences of low-level wind shear situations, such as vertical discontinuities in the wind field, frontal passages and gust fronts to increase the level of flight safety and protect human lives and health. The lidar data were processed by a computer algorithm with the main focus on potential wind shear alerts and microburst alerts, guided by the recommendations of the International Civil Aviation Organisation. In parallel, the selected weather events were analyzed by the nearby located meteorological radar to utilize the strengths of both approaches. Additionally, an evaluation of the lidar capability to scan dynamics of aerosol content above the airport is presented.



Article name

Improved Radar Composites and Enhanced Value of Meteorological Radar Data Using Different Quality Indices

Impact factor (2019)

2.576

Authors

Ladislav Méri, Ladislav Gaál, Juraj Bartok, Martin Gažák, Martin Gera, Marián Jurašek, and Miroslav Kelemen

Journal

Sustainability

Publisher

MDPI

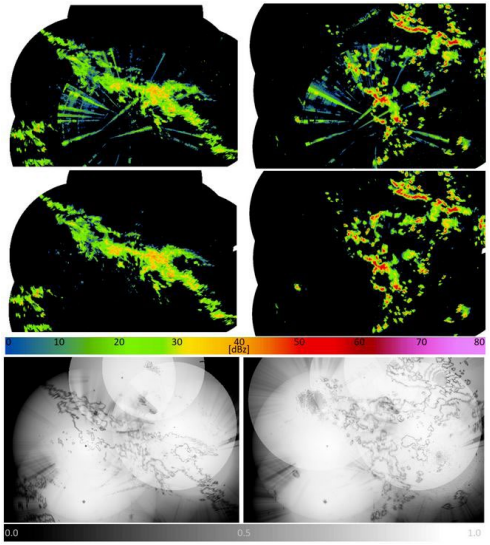
Year

2021

Accessible here

Abstract

Radar measurements are inherently affected by various meteorological and non-meteorological factors that may lead to a degradation of their quality, and the unwanted effects are also transferred into composites, i.e., overlapping images from different radars. The paper was aimed at answering the research question whether we could create 'cleaner' radar composites without disturbing features, and if yes, how the operational practice could take advantage of the improved results. To achieve these goals, the *qRad* and *qPrec* software packages, based on the concept of quality indices, were used. The *qRad* package estimates the true quality of the C-band radar volume data using various quality indices and attempts to correct some of the adverse effects on the measurements. The *qPrec* package uses a probabilistic approach to estimate precipitation intensity, based on heterogeneous input data and quality-based outputs of the *qRad* software. The advantages of the *qRad* software are improved radar composites, which offer benefits, among others, for aviation meteorology. At the same time, the advantages of the *qPrec* software are manifested through improved quantitative precipitation estimation, which can be translated into hydrological modeling or climatological precipitation mapping. Beyond this, the developed software indirectly contributes to sustainability and environmental protection—for instance, by enabling fuel savings due to the more effective planning of flight routes or avoiding runway excursions due to information on the increased risk of aquaplaning.



Article name

Model of Evaluation and Selection of Expert Group Members for Smart Cities, Green Transportation and Mobility: From Safe Times to Pandemic Times

Authors

Miroslav Kelemen, Volodymyr Polishchuk, Beata Gavurová, Róbert Rozenberg, Juraj Bartok, Ladislav Gaál, Martin Gera, and Martin Kelemen, Jr.

Impact factor (2019)

1.747

Journal

Mathematics

Publisher

MDPI

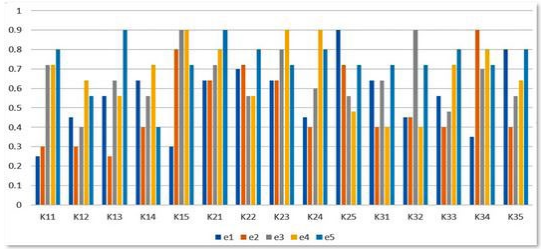
Year

2021

Accessible here

Abstract

This paper presents the development of technologies to support the decision making of local government executives and smart city concept managers in selecting and evaluating the competencies of new members for advisory groups for solving problems that are implemented in safe times in individual areas or in crises, such as pandemics. The reason for developing effective urban transformation strategies and for the transparent selection of independent experts (non-politicians) for policymaking, decision making and implementation teams is not only the heterogeneity of smart city dimensions together with the necessary complexity and systems approach, but also the nature of the capacities and tools needed for smart city concepts. The innovative hybrid competency assessment model is based on fuzzy logic and a network for neuro-fuzzy assessment. It is a technological model for evaluating the competencies of specialists, taking into account the influence of human factors on the processes of personnel selection and system management. An innovative web platform named “Smart City Concept Personnel Selection” has been designed, which can be adapted to various users of municipalities or regional institutions for the transparent selection of qualified personnel for effective decision making and the use of public funds during safe times or emergencies, such as the COVID-19 pandemic.



Article name

Dispersion of Fukushima radionuclides in the global atmosphere and the ocean

Impact factor (2019)

1.270

Authors

P. P. Povinec, M. Gera, K. Holý, K. Hirose, G. Lujanienė, M. Nakano, W. Plastino, I. Sýkora, J. Bartok, M. Gažák

Journal

Applied Radiation and Isotopes

Publisher

Elsevier

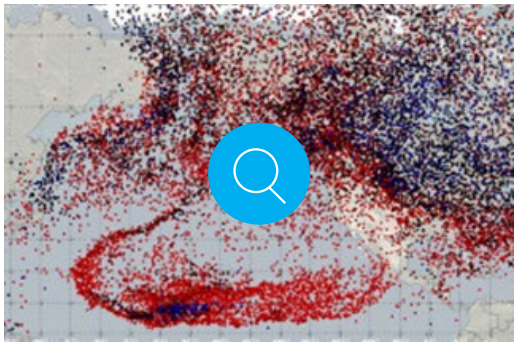
Year

2013

Accessible here

Abstract

Large quantities of radionuclides were released in March–April 2011 during the accident of the Fukushima Dai-ichi Nuclear Power Plant to the atmosphere and the ocean. Atmospheric and marine modeling has been carried out to predict the dispersion of radionuclides worldwide, to compare the predicted and measured radionuclide concentrations, and to assess the impact of the accident on the environment. Atmospheric Lagrangian dispersion modeling was used to simulate the dispersion of ^{137}Cs over America and Europe. Global ocean circulation model was applied to predict the dispersion of ^{137}Cs in the Pacific Ocean. The measured and simulated ^{137}Cs concentrations in atmospheric aerosols and in seawater are compared with global fallout and the Chernobyl accident, which represent the main sources of the pre-Fukushima radionuclide background in the environment. The radionuclide concentrations in the atmosphere have been negligible when compared with the Chernobyl levels. The maximum ^{137}Cs concentration in surface waters of the open Pacific Ocean will be around 20 Bq/m^3. The plume will reach the US coast 4–5 y after the accident, however, the levels will be below 3 Bq/m^3. All the North Pacific Ocean will be labeled with Fukushima ^{137}Cs 10 y after the accident with concentration bellow 1 Bq/m^3.



Article name

Data mining for fog prediction and low clouds detection

Impact factor (2019)

0.496

Authors

Juraj Bartok, František Babič, Peter Bednár, Jan Paralič, Jozef Kováč, Ivana Bartoková, Ladislav Hluchý, Martin Gera

Journal

Computing and Informatics

Publisher

Institute of Informatics of the Slovak Academy of Sciences

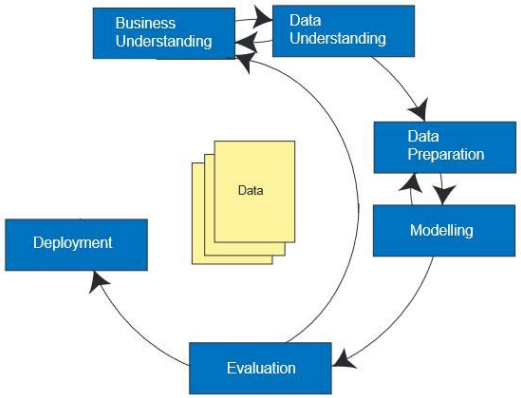
Year

2012

Accessible here

Abstract

This paper describes our contribution to the research of parametrized models and methods for detection and prediction of significant meteorological phenomena, especially fog and low cloud cover. The project covered methods for integration of distributed meteorological data necessary for running the prediction models, training models and then mining the data in order to be able to efficiently and quickly predict even sparsely occurring phenomena. The detection and prediction methods are based on knowledge discovery -- data mining of meteorological data using neural networks and decision trees. The mined data were mainly METAR aerodrome messages, meteorological data from specialized stations and cloud data from special airport sensors -- laser ceilometers.



Article name

New possibilities to detect low level wind shear by means of lidar [in Slovak]

Impact factor (2019)

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Authors

Ladislav Gaál, Pavol Nechaj

Journal

AeroJournal

Publisher

Air Transport Department at the University of Žilina

Year

2017

Accessible here

Abstract

Wind shear is one of the most dangerous meteorological phenomena in the aviation since abrupt changes in the wind speed and/or wind direction may dramatically influence aerodynamical circumstances of the flight, and may threaten the safety of the aircraft landing or take-off. Wind shear may be detected by a traditional technology that consists of several anemometers installed in the vicinity of the airport area. This method is, however, expensive and measurements often do not have sufficient temporal or spatial resolution. Systems based on distant measurements (small meteorological radars and lidars) represent a viable alternative to the anemometer-based methodology. Although lidars or radars are still relatively expensive, they meet the current technological standards, and their installation do not require complicated administrative procedures or logistics. The anemometer-based technology of low level wind shear detection is included in the market portfolio of the company MicroStep-MIS. Nevertheless, they decided –as the first in the Central Europe – to upgrade their low level wind shearalert system (LLWAS) by having a lidar-based system integrated. They purchased a lidar from the world-leading manufacturer Leosphere (France) within the framework of the research project 'A Novel Method for Low-level Wind Shear Alert Calculation from Data Measured by LIDAR'. The current paper is aimed at summarizing the reasons that lead to this decision and the goals of the scientific project.

Article name

Inhomogeneity introduced to the climate data series by instrumentation changes of the thermometer shields and rain gauges

Impact factor (2019)

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Authors

Ivana Bartoková, Monika Kľocová, Juraj Bartok

Journal

Contributions to Geophysics and Geodesy

Publisher

Earth Science Institute of the Slovak Academy of Sciences

Year

2014

Accessible here

Abstract

Recently we can see the trend of introducing a new instrumentation and automatization in the field of information and monitoring systems for the meteorology, hydrology and crisis centers. Nowadays a great number of sensors are used in projects in many countries of various climates. Therefore it is crucial to deeply understand how the change of sensor types will affect the accuracy of measurements and how is accuracy of individual sensor type affected by different weather conditions. We analyzed several screen/shields and rain gauges at the premises of faculty of Meteorology and Climatology of FMFI UK. On the basis of our results we can recommend as a most accurate and not depending on weather condition artificially ventilated screen although it is the most expensive. Our second choice would be a large naturally ventilated shield. In case of Stevenson screens we would recommend painting it with a high gloss coating. Our last choice would be a small naturally ventilated screen because of its high sensitivity to the global radiation. Our first choice of the participating rain gauges would be the weighing rain gauge because of its best results in both cases, of rainfalls up to 2 mm and also over 2 mm. The tipping bucket rain gauge gave also agreeable result in both cases. The optical sensor gave very good results in rainfalls over 2 mm but it is unsuitable for rainfalls up to 2 mm. The radar sensor is also completely unsuitable for low intensity rainfalls and his performance for rainfalls over 2 mm was just average.

Article name

Lidar-Based Detection of Dangerous Meteorological Phenomena at the Bratislava Airport

Impact factor (2019)

–

Authors

Olga Vorobyeva, Pavol Nechaj, Ladislav Gaál

Journal

Transportation Research Procedia

Publisher

Elsevier

Year

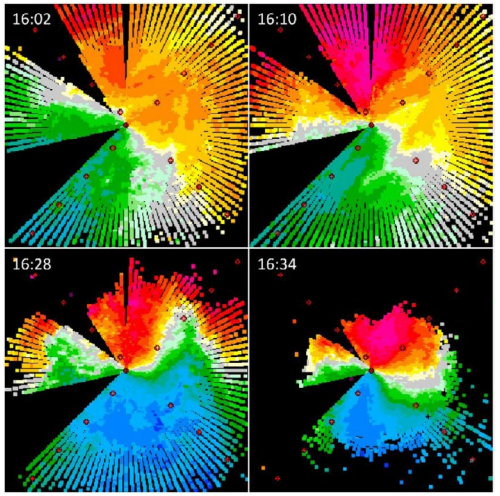
2019

Accessible here

Abstract

Low level wind shear is a hazardous meteorological phenomena that may seriously threaten the safety of the aircraft during the phase of landing and take-off. Automated, lidar-based systems for wind shear detection and alerting offer indispensable help to pilots to avoid landing in risky weather circumstances. Due to the efforts of the company MicroStep-MIS, the Bratislava Airport is one of the few (~15) airports worldwide and the first in Central Europe that has been equipped with a Doppler lidar. This remote sensing tool monitors the surrounding air space in a circle with a radius of 6 - 7 km with high temporal and spatial resolutions (~100 m horizontally, scan frequency: 2 minutes). The elevation angle of the lidar's laser beam is set to a constant of 3°, which corresponds to the angle of the glide path of the landing aircraft.

In the current paper, we focus on a selected weather event that occurred on July 5th, 2018. It was a cold front that passed over the airport area, and showed several significant and abrupt changes in the wind field during its short existence (~2.5 hours). We further analyze the situation from the perspective of the meteorological radar, installed in the neighborhood of the airport, and estimate the low level wind shear according to the requirements of the ICAO.



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