Posters relating to Session 1

Aeronautical Meteorological Observations, Forecasts, Advisories and Warnings

Dashti Abdulkarim, Sulaimaniyah International Airport, Iraq
dashti.krg@gmail.com

Speaker: Dashti Abdulkarim

Aeronautical Meteorological services support air traffic safety in the first place.
The other major activity is to support efficiency and capacity resulting in economic and environmental benefits. These services will have objectives to support take off and landing (local Air Traffic Management, typically in terminal area, i.e. the upper air area around the aerodromes and at surface level on the airfield and with short time frames) and to support the en route (level flight) flight planning (typically global Air Traffic Management).
Forecast , containing information on phenomena, with impact on safety, such as:

- convective activity (Cb cloud areas)
- icing in clouds
- clear air turbulence, both in the vicinity of jet streams and near convection
- mountain wave activity
- tropical cyclone (name and position only)
- volcanic eruption
- accidental release of radioactive materials, and

In addition to the phenomena indicated above (convective systems, heavy precipitation, icing - both in-flight and on the ground -, and high winds), particular emphasis is placed on the following issues, relevant for landing and take off, inclusive ascent and descent:

- low-level wind shear and turbulence (including wake vortices)
- lightning and microbursts, gust fronts
- heavy, solid (hail) and freezing precipitation
- super cooled large cloud droplets ("freezing drizzle droplets")
- low visibility and ceiling situations (low stratus); and,
- snow fall and black ice formation on the runway.

Analysis of Clear Air Turbulence Events in Indonesia (Period of 2007-2016)

Bagas Ega Amirul Haq, STMKG, Indonesia
bagasega909@yahoo.co.id

Speaker: Bagas Ega Amirul Haq

Clear Air Turbulence (CAT) is a natural phenomenon caused by the difference of vertical wind velocity that triggers the formation of Kelvin-Helmholtz waves. This phenomenon can be hazardous to the flight, because it can not be observed using existing equipments in the aircraft. If the aircraft experiences CAT incident, pilot shall report it via Aircraft Meteorological Data Relay (AMDAR). For operational purpose, CAT event is simulated using data models, one of which is WRF-ARW. In Indonesia, there have been 7 CAT events reported during 2007 until 2016. this study aims to determine the main factors that cause turbulence in Indonesia and the best index to detect it. The method used is qualitative descriptive analysis, where the author explains the details of the events studied. This research uses IR and Visible channel satellite image data, and WRF-ARW model outputs. The parameters used are Kain-Firtsch for cumulus scheme, WSM 6 for microphysic scheme, and MYJ for the Planetary Boundary Layer scheme. The indices used in detecting turbulence phenomena are Richardson Number, Vertical Wind Shear, TI1 and TI2. The results of this study show that there is a Billow cloud pattern that indicates turbulence. In addition, there are also events of Near Cloud Turbulence which play a role in the formation of turbulence. The best index in detecting CAT phenomena is TI1 index with treshold NMG and 28% accuracy.

Ice Rain Forecasting Based on Measurement Data from MTP-5 Temperature Profiler

Nikolay Baranov, Dorodnicyn Computing Centre, Federal Research Center “Computer Science and Control” of Russian Academy of Sciences, Russian Federation
baranov@ccas.ru
----
co-authors: Evgeny Miller (RPO ATTEX)

Speaker: Evgeny Miller

Winter weather phenomena remain one of the essential factors for both flight safety and economic efficiency of the air transport system. Among these phenomena ice rain stands out as this weather condition results in abnormal icing of the airliner hull due to the presence of large supercooled drops in the atmosphere. In addition, freezing precipitation increases the work load for airport services preparing aircraft and airfield for flight operations which can lead to delayed flights.

According to studies (in particular, the general report by Vaisala on the application of aerological sensing data for identification of the precipitation type), the phase state of precipitation is determined by the temperature profile. However, numerical modelling does not allow obtaining sufficiently accurate data on temperature profile dynamics in the surface layer in view of spatial resolution limitations in the models. The increase in the forecast reliability through radio sensing data assimilation does not produce a significant effect as well, due to longer time intervals between observation data.

At the same time, effective instruments for remote temperature profile sensing currently exist that provide high-frequency data with spatial resolution by altitude.

The present report describes the technology of using temperature sensing data for a short-term forecast of the precipitation type based on the actual observations using MTP-5 temperature profiler in the Moscow region and Pulkovo airport (Saint-Petersburg). The advantage of using the actual MTP-5 observations of the temperature stratification in the surface layer of the atmosphere is that this device provides almost continuous measurement of the temperature profile with high spatial resolution. Neither aerological sensing, nor numerical modeling provides such a significant amount of data.

The report presents analysis results for temperature stratification dynamics in the surface layer during ice rains. Ice rain is formed under condition of an inversion layer with positive temperature present above the surface layer of cold air. The analysis of data available on temperature stratification dynamics in the surface layer during ice rains has shown that elevated warm inversions typical for this precipitation type are quite stable which makes it possible to predict the precipitation type several hours in advance from observations of the surface temperature field.

The analysis made it possible to set a technology for forecasting ice rains based on data from remote temperature monitoring in the surface layer of the atmosphere.

The core of this technology is assessing characteristics of inversions and their time derivatives on the basis of a continuous flow of temperature profile measurement data using the methods of sliding smoothing to reduce the effect of random temperature fluctuations in the nodes of the measurement grid.

These assessments provide baseline data for short-term forecasting of the precipitation type. The disadvantage of current assessments of the temperature stratification dynamics is the low reliability of its extrapolation for longer time intervals. The report shows that the forecast horizon of the phase state of precipitation can be increased through blending data from actual remote temperature profile measurements and results of numerical modelling.

The work was partially supported by the Russian Foundation for Basic Research under Project 16-07-01072.

Mountain waves as hazard for high-flying aircraft? - A Case Study

Martina Bramberger, DLR, Institute of Atmospheric Physics, Germany
martina.bramberger@dlr.de
----
co-authors: A. Dörnbrack, S. Gemsa, K. Raynor, R. D. Sharman, H. Wilms, M. Rapp
----
Speaker: Martina Bramberger

On 12 January 2016, the High Altitude and Long Range Research Aircraft HALO was flying above Italy when it encountered sudden and strong horizontal temperature variations. These variations lead to several stall warnings, a situation that could only be mitigated by the intervention of the pilots. We present a detailed analysis of aircraft measurements, forecasts of the graphical turbulence guidance system (GTG) and European Centre for Medium-Range Weather Forecasts (ECMWF) forecasts and operational analysis to explain the chain of events for this incident.
Strong northwesterly surface winds together with an aligned polar front jet favored the excitation and propagation of strong mountain waves at and above the Apennines (Italy) on this day. These mountain waves contained energy fluxes of 8W/m^2 and propagated from the troposphere to the stratosphere.
While turbulence is a well acknowledged hazard to aviation, this case study reveals that not only breaking mountain waves and the consequent turbulence can proof to be hazardous for air traffic in the lower stratosphere and upper troposphere. Instead, also non-breaking, vertically propagating mountain waves can pose a hazard especially to high-flying aircraft.
Such waves can modulate the ambient temperature field in a way that decreases the aircraft speed towards the minimum needed stall speed.

Forecast of snowstorms

Viktoria Bychkova, Hydrometcentre of Russia, Russian Federation
er-riad@mail.ru
----
co-authors: Dr.K.G. Rubinstein

Speaker: Viktoria Bychkova

Low visibility often hinders, and sometimes blocks, the aircraft flight. Limited visibility, together with low clouds, determines the minimum of weather. Meteorologists and synoptic always take seriously the forecast of these elements. In the cold season, one of the phenomena that can significantly reduce the meteorological visibility is a blizzard. Therefore, the study and accurate forecast of snowstorms is extremely important for safety and regularity of flights. Blizzards not only worsen visibility, but can also increase wind speed. Analysis of the observational data clearly illustrates the fact of the wind speed increase during the snowstorm [V. Bychkova, M. Smirnova, 2017]. Theoretical studies confirm this fact [G. I. Barenblatt 1973, R.A. Bangold 1937, A.K. Dynin, 1963]. This work contains parameterization of beginning and evolution blowing snow. Parameterization takes into account all the basic physical mechanisms of transfer air and snow particles dynamics and evaporation suspended particles [V. Bychkova, 2016]. The parameterization uses the input data of the mesoscale model (WRF-ARW). The output parameters of the parameterization are the fields of wind, visibility, concentration of snow particles at 10 vertical levels. The main output parameter is the number of suspended snow particles. The change in the meteorological regime in snowstorms is calculated using data on the number of suspended particles. Using the blizzard parameterization and the WRF-ARW model, you can calculate the forecast of a snowstorm (and other specified parameters) for a certain point and for a region. Thus, the output can be used to make forecasts for the airport (TAF format) and to compile area forecasts for low aviation (GAMET format). Comparison of the wind speed during snow storms calculated using this parameterization, with stations data, showed an improvement in the wind forecast compared with the model WRF-ARW. The Pirsi criterion for the prediction of the snowstorms was 0.6 [V. Bychkova, V. Perov, K. Rubinstein, 2015].

This work is supported by RFBR according to the research projects No. 16-05-00822, 16-35-00489, 15-05-02395

Improving the forecast of aircraft icing conditions

Marie Cassas,Météo-France, France
marie.cassas@meteo.fr
----
co-authors : S. Riette, B. Vie, C. Lac

Speaker : Marie Cassas

Aircraft icing may cause critical damage to the plane's wings, probes or engines and even result in a crash. Reliable forecasts of icing conditions are therefore crucial to ensure the safety of the flights. In this project, we aimed to improve the forecast of in-flight icing environments by working on two different approaches.

First, we developed a new icing index using the AROME model (Meteo-France's operational high resolution model, Seity et al., 2011) and a database of observed icing occurrences. This index is based on a multidimensional icing probability histogram explicitly computed using an optimal set of AROME variables and these observations.

We developed an iterative algorithm that chooses the most relevant variables based on an icing forecast score. We studied different scores and found the Peirce Skill Score to be the most appropriate to perform the selection.

We ran sensitivity tests for various parameters of our algorithm (such as the number of bins of the probability histogram) and finally selected the best configuration, which uses three model variables: temperature, specific humidity and relative humidity over ice.

Finally, we compared this new index with the one already operational at Meteo-France on a subset of the database observations that was not used to build the icing index. We noticed an improvement in icing detection with equal false alarm rate and vice versa. The new index is currently available in real time and under examination by forecasters.

In a second part, we compared the ability of two microphysics schemes, the single-moment scheme ICE3 (Pinty and Jabouille, 1998) and the double-moment scheme LIMA (Vié et al., 2016), to forecast supercooled water content. Simulations run with the Meso-NH research model were compared to measurements of temperature, liquid water content and mean volume diameter in icing conditions for twenty-three flights of an icing observations campaign.

We carried out a statistical study to assess and compare the behaviour of the four versions of schemes. All of them seemed to underestimate the liquid water content, missing at least 50% of the observed icing points. The droplets mean volume diameter was also underestimated by LIMA, but a more realistic aerosol initialisation could improve the forecasts for this variable. We also compared these results with other studies from the literature.

Two main reasons explain the discrepancies. Firstly, it is difficult for the model to exactly place the convective clouds. Secondly, the two schemes may operate a too large conversion of supercooled water into ice. Ice water content measurements were not available to confirm this hypothesis, but it is still a possible way of improvement.

Improvements in the microphysics schemes' ability to forecast icing conditions could be combined with the method we set up in the first part of the project in order to enhance the in-flight icing forecasting skill of the new index.

An Overview of High Altitude Ice Crystals (HAIC) Satellite and Nowcasting Activities

Eric Defer, Laboratoire d'Aérologie, France
eric.defer@aero.obs-mip.fr
----
co-authors : A. Calmels (Airbus Operations SAS), J. De Laat (KNMI), J. Delanoë (LATMOS), F. Dezitter (Airbus Operations SAS), A. Gounou (Météo-France), F. Huet (Airbus Operations SAS), C. Le Bot (Météo-France), J. F. Meirink (KNMI), J-M. Moisselin (Météo-France), R. Nohra (LOA), F. Parol (LOA), A. Protat (BoM), P. Rieu (Météo-France), S. Turner (ATMOSPHERE), and C. Vanbauce (LOA)

Speaker : Eric Defer

Commercial aircraft have been experiencing in-service events while flying in the vicinity of deep convective clouds since at least the early 1990s. Heated probes and engines are the areas of aircraft most prone to mixed phase and glaciated icing thread. The European FP7 High Altitude Ice Crystals (HAIC) project aimed at characterizing specific environmental conditions in the vicinity of convective clouds conducive to in-service events. Academics and aeronautic industries collaborated within 6 main research activities: dedicated field campaigns, development of new in situ probes, space-based detection and monitoring, upgrade of on-board weather radars, improvement of ground test facilities, and modeling of melting and impingement processes. All activities were designed to enhance aircraft safety when flying in mixed phase and glaciated icing condition.

The HAIC Sub-Project 3 (SP3), entitled Space-borne Observation and Nowcasting of High Ice Water Content Regions, focused on the development of space-borne remote detection of high Ice Water Content (IWC) and nowcasting techniques to support the three HAIC flight campaigns and ultimately provide relevant near real-time weather information. The SP3 investigations were dedicated to the:

- Detection of high IWC cloud regions from geostationary satellites mainly from the SEVIRI (Spinning Enhanced Visible and Infrared Imager) imager on MSG (Meteosat Second Generation) during daytime.
- Detection of high IWC cloud regions from low-orbit missions based on measurements from visible, infrared and microwave passive and active instruments, mainly from the A-Train mission.
- Nowcasting of convection over the Tropics for operational applications using the Rapid Development Thunderstorm (RDT) nowcasting tool.

First we will briefly describe the HAIC project. The SP3 activities will then be discussed with an emphasis on the observational-based methodologies applied within the three main SP3 research activities. The main SP3 results will then be summarized with some discussions on how the airborne measurements collected during the HAIC campaigns were used to validate SP3 products and methodologies. Finally we will discuss on the applicability to SP3 products and methodologies to the observations of new and up-coming space missions.

Acknowledgement:
This project has received funding from the European Union’s Seventh Framework Program in research, technological development and demonstration under grant agreement n°ACP2-GA-2012-314314.

Low orbiting space-borne high IWC retrievals in the framework of the European HAIC project: from case studies to regional and seasonal distribution

Eric Defer, Laboratoire d'Aérologie, France

eric.defer@aero.obs-mip.fr

----

co-authors: J. Delanoë (LATMOS), R. Nohra (LOA), F. Parol (LOA), A. Protat (BoM), and C. Vanbauce (LOA)

Speaker : Eric Defer

It is currently assumed that deep tropical convection can be a threat for aviation, but not always, and for some specific clouds, with high concentration of small ice particles, it can lead to some ice accretion in engines. If this potential threat is confirmed by in situ observations of cloud microphysics and a signature of this hazardous cloud environment is identified in space-based observations, therefore a real-time monitoring should be possible. Indeed space-based remote sensing of High IWC is an appropriate detection/awareness technique that covers the globe and could enhance flight safety when flying in such weather conditions. It can be supplementary to in-situ and close-range sensitive weather radar detection on-board the aircraft..

The High Altitude Ice Crystals (HAIC) project is a European FP7 large-scale integrated project, which aims at enhancing aircraft safety when flying in mixed phase and glaciated, icing conditions. Within HAIC project, the WP33 work package is dedicated to the detection and characterization of high Ice Water Content (IWC) cloud regions from low-orbit missions based on measurements from visible, infrared and microwave passive and active instruments of the A-Train mission. Space-borne observations dedicated to the detection and characterization of the convective clouds come mainly from Cloudsat cloud radar, CALIPSO lidar, Parasol and MODIS imagers, and AMSRE microwave imager on-board the different satellites of the A-Train mission.

A first study, based on co-located space-borne measurements, identified four categories of cloud systems that led to in-service events distinguished by different time exposures to ice conditions. Nevertheless, as not enough low-orbit observations were coincident with reported in-service events, we focalized on the three HAIC flight test campaigns (Darwin 2014, Cayenne 2015, Darwin-La Réunion 2016) by relying on in-situ reports of high IWC conditions (ROBUST and IKP2 microphysics probes, RASTA radar) during concurrent overpasses of low orbit missions. We have also investigated signatures of high IWC by analyzing concurrent space-borne active (Dardar, radar-lidar product) and passive cloud observations from the A-Train mission.

The used A-Train dataset, the observational-based strategy and the methodologies will be first introduced. Examples of cases and the main results will then be presented. Regional and seasonal distribution of High IWC will then be introduced. Finally the relevance of the future low-orbit missions for high IWC detection will be discussed.

Acknowledgement:

This project has received funding from the European Union's Seventh Framework Program in research, technological development and demonstration under grant agreement n°ACP2-GA-2012-314314.

Diagnosis of turbulence associated with convection as part of the Graphical Turbulence Guidance product

Wiebke Deierling, NCAR/RAL, United States of America
deierlin@ucar.edu
----
co- authors: *R. Sharman, **E. Defer, *J. Pearson, and *G. Meymaris,
*NCAR, Boulder, CO. U.S.A.
**CNRS, Laboratoire d'Aerologie, University of Toulouse, France
----
Speaker: Wiebke Deierling

Convective-induced turbulence (CIT) is of significant concern to aviation, as it impacts flight safety and airspace capacity. CIT has been observed in-cloud and also out-of-cloud. NCAR's graphical turbulence guidance product (GTG) provides forecasts of clear-air turbulence (CAT) and mountain wave turbulence (MWT) and is currently expanded upon to include convectively-induced turbulence forecasts. Inclusion of CIT into GTG will be utilized in the GTG-Nowcast (GTG-N) algorithm and merged with other observational based predictors of CIT.

Case studies of in and out-of-cloud CIT diagnosis for the use in a new version of GTG will be presented. Comparisons to observed in-cloud energy dissipation rate (EDR) estimates – a measure of turbulence - from observations such as the NEXRAD turbulence detection algorithm (NTDA) and in situ EDR measurements will also be shown.

"This research is in response to requirements and funding by the Federal Aviation Administration (FAA). The views expressed are those of the authors and do not necessarily represent the official policy or position of the FAA."

Aviation, weather, and climate: scientific research and development for aeronautical metrological service is changing the atmospheric environment

Parandhaman Durairaj, Entomology Research Institute, Loyola College,Chennai-34, India
parandhaman_eri@live.com

Speaker: Parandhaman Durairaj

It is time be focus the development of Aeronautical techniques (Aviation) for metrological services is to be upgrade “environmental-friendly” without affect the atmospheric environment, weather and climate. In term of aircraft releases contain the excess amount ‘smog’ in the atmosphere also aviation Aircraft denaturing the structures of rainclouds, seriously affecting the global rainfall and weather and climate results can be clarify this. Time to be important to discuss about Aircraft releases contain smog, this smog accumulate with atmospheric layer even this layer prevent the evaporation of water from the earth. Also, affects the global rainfall towards the earth from the atmosphere. Experiments “standard measuring cylinder method” on the glasshouse was constructed estimate the calculations of amount of water evaporation from the earth during the year April-02016 to March-02017 was resulted 116% cm (9.6%) and April 02017 to November-02017 (27.2%) (6.8%).

Result significantly correlated with the total amount of the annual global rainfall during the year April-02016- March-0201 (37.5cm the result reflects WMO; IMD;-33%) and April-02017 to November -02017 (8.4 %*). Ref: (IMD; WMO:-5.7%). this time be focus use aircraft useful purpose without affect the natural resources like rainclouds to improve the rainfall in the planet.

Aircraft measurements of Saharan mineral dust events over Germany – preparation for airborne volcanic ash measurements

Dörthe Ebert, DWD, Germany
doerthe.ebert@dwd.de
----
co-authors: V. Bachmann1, A. Diehl1, C. Fischer4, H. Flentje2, J. Förstner1, I. Mattis2, G. Müller2, S. Müller5, T. Pohl4, D. Schell5, A. Steiner1, W. Thomas2, F. Wagner1,3, K. Weber4 and T.Steinkopff1
1-Deutscher Wetterdienst (DWD),
2-Deutscher Wetterdienst (DWD),
3-Karlsruhe Institute of Technology (KIT),
4-Hochschule Düsseldorf (HSD

Speaker: Dörthe Ebert

The Deutscher Wetterdienst (DWD) is responsible for the detection of volcanic ash contaminations within the German airspace by national rules and the regulations of the International Civil Aviation Organization (ICAO). For this task DWD has implemented several procedures including airborne measurements, in order to determine atmospheric ash concentrations and their spatial extension (Weber et al., 2012; Weinzierl & Diehl, 2014). The aircraft measurements are used for verification of the volcanic ash model forecasts as well as for comparison with data from the DWD ceilometer network. Final goal of these collaborative efforts is an improved and distinguished designation of the flight restriction zones in case of an intense volcanic ash plume over Germany (Schumann et al., 2011). To guarantee the operational readiness of airborne measuring systems, which has permanently to be adopted by following latest scientific and technical improvements, DWD performs flights on a regular basis. During these measurement flights technical and organizational steps/iterations are practiced and optimized under realistic scenarios. Airborne volcanic ash concentrations are determined by optical particle counters which measure the particle size distribution. For data evaluation it is crucial to consider that the scattering properties of volcanic ash particles strongly differ from a typical European background aerosol. Because of the lack of intense volcanic ash plumes over Central Europe Saharan dust events were chosen as a realistic test scenario. Saharan dust and volcanic ash are both dominated by larger and irregular shaped particles having comparable optical properties. Furthermore, the operational procedures in case of a mineral dust event over Germany are basically similar to those of the volcanic ash case. DWD uses the ICON-ART model (Rieger et al., 2015) to predict the occurrence of Saharan Dusts over Germany with a lead time of 4 days. During a Saharan dust event on December 17th 2015 a flight over Northwestern Germany was conducted with two measuring aircrafts. This campaign was successfully performed even under challenging winterly conditions. The focus of this test flight was the intercomparison of two different airborne volcanic ash measuring systems. The Hochschule Düsseldorf operated a Diamond Twin Star DA42 D-GOMH and the company enviscope performed measurements onboard a Partenavia P68B D-GERY. In the area between the German-Dutch border and Mönchengladbach/Germany both aircrafts successfully measured Saharan dust during coordinated horizontal flights at heights between 500m and 3000m. The experiment showed that DWD may rely on high-quality aircraft based aerosol particle measurements, even under challenging conditions. The results of this campaign will be presented and will demonstrate that Saharan Dust events are well suited to act as test scenario for the evaluation of airborne volcanic ash measurements.

Keywords: volcanic ash, mineral dust, aircraft measurements

References:

- Schumann U., Weinzierl B. et al., Airborne observations of the Eyjafjalla volcano ash cloud over Europe during air space closure in April and May 2010, Atmos. Chem. Phys., 11, 2245-2279, 2011.
- Weber, K., et al., Airborne in-situ investigations of the Eyjafjallajökull volcanic ash plume on Iceland and over north-western Germany with light aircrafts and optical particle counters. Atmospheric Environment 48, 9–21, 2012.

- Weinzierl B. and Diehl A., Warnung vor Vulkanasche: Was haben wir aus den isländischen Vulkanausbrüchen 2010 und 2011 gelernt, promet, 39, 91- 103, 2014.
- Rieger, D. et al., ICON–ART 1.0 – a new online-coupled model system from the global to regional scale, Geosci. Model Dev., 8, 1659-1676, 2015.

Routine operation of the DLR volcanic ash algorithm VADUGS within the German Weather Service facilities: Outcome of the project LuFo TeFiS

Kaspar Graf, Institut für Physik der Atmosphäre, DLR, Oberpfaffenhofen, Germany
kaspar.graf@dlr.de
co-authors: R. Müller, M. Vazquez-Navarro, M. Schmidl, B.-R. Beckmann
----
Speaker: Kaspar Graf

Volcanic eruptions can have a severe impact on the air transport system with significant economic effects. Satellite data are the most reliable source of information on volcanic ash for wide parts of the globe. Temporally resolved ash retrievals from geostationary satellite data are an essential source of information for making large-scale assessments of how an ash cloud is spreading.

In the VolcATS project, funded by the German Aerospace Center DLR, a satellite algorithm for detection of volcanic ash and quantitative retrieval of the ash load in the atmosphere and the ash layer top altitude was developed. The algorithm is called VADUGS (Volcanic Ash Detection using Geostationary Satellites). It is based on the seven thermal channels from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) aboard the geostationary Meteosat Second Generation satellite series. The algorithm is designed as a neural network. For the training of the network, extensive radiative transport simulations were performed, taking into account different optical properties from several typical chemical compositions of volcanic ash clouds. The results of the algorithm were compared with airborne in-situ measurements, as the ones taken by DLR during the Eyjafjallajökull period in 2010, and the algorithm participated in the Volcanic Ash Algorithm Intercomparison organized by the WMO.

Here we are presenting a further development of the VADUGS algorithm. We have expanded the algorithm by including nowcasting capabilities and we have tailored it to meet the requirements of users and limitations for routine operation of the code within the German Weather Service (Deutscher Wetterdienst; DWD). Currently VADUGS detects volcanic ash and retrieves the column mass load and the top altitude of the ash layers. Furthermore it allows the extrapolation of the movement of the volcanic ash objects into the future. The involvement of the German airline Lufthansa ensured that the requirements of the air travel industry were taken into consideration. Technically, the algorithm is implemented as an ecflow/SMS job in the DWD satellite processing system. This expansion of VADUGS has been carried out under the LuFo TeFiS project (Technology for Flight Management in large Structures), coordinated by the German Air Traffic Control service (DFS) and funded by the German Federal Mi
nistry for Economic Affairs and Energy.

Currently, the algorithm is implemented in the language IDL. Future plans are to migrate the algorithm to python and to perform processing and visualization of the data within the “pytroll” environment, and to extend the algorithm to data from the Advanced Himawari Imager (AHI) aboard the Japanese Himawari satellites, the Advanced Baseline Imager aboard the GOES-R satellite, and, in some years, data from the Flexible Combined Imager (FCI) aboard the Meteosat Third Generation (MTG) satellites data. In addition, we intend to participate in the upcoming second WMO intercomparison of satellite algorithms on volcanic ash, currently planned for 2018.

European surface based remote sensing capability for aviation hazards

Alexander Haefele, MeteoSwiss, Switzerland

Alexander.haefele@meteoswiss.ch

----

co-authors: L. Mona, N. Papagiannopoulos, R. Rüfenacht, M. Coltelli, N. Theys, A. Apituley, H. Lihavainen, H. Marcus, A. Delcloo, G. Papalardo, and G. Wotawa

----

Speaker: Rolf Rüfenacht

Volcanic eruptions present a serious hazard for aviation, though quantitative, three dimensional detection of air born ashes in real-time is experimentally challenging. It has been recognized that only an integrated observing system comprising various measurement techniques deployed from surface, air and space can provide the required information. Work package 3 of the H2020 project called EUNADICS-AV, analyzes the capabilities of surface-based remote sensing networks for volcanic ash monitoring and other natural hazards in the scope of the project. A survey has been conducted to generate a comprehensive catalogue of relevant products considering both active and passive measurement techniques including lidars, radars, sun photometers, sun spectrometers and infrasound instruments. Key products are ash location, optical and microphysical properties and ash mass density. The catalogue contains information on data availability, timeliness and coverage, measurement uncertainty, suitability for validation, assimilation and early warning applications and shall serve as a guideline for the development of future developments of services related to volcanic ash hazard management systems for aviation.

NowCastSAT-Aviation: Thunderstorm nowcasting for the en-route flight phase

Stephane Haussler,DWD, Germany

stephane.haussler@dwd.de

----

co-authors: Dr. Richard Müller, Dr. Matthias Jerg

Speaker: Stephane Haussler

NowCastSAT-Aviation (NCS-A) is a novel product presently under development at Deutscher Wetterdienst (DWD). The intended scope of use is aeronautical meteorology for the en-route phase of intercontinental flights. During this segment of long-distance flights, only a limited amount of ground-based meteorological data is available to pilots, due to remote areas with scarce or nonexistent radar coverage. NCS-A provides near global detection of convective cells, rendering both detailed contours as well as simplified polygons marking large regions of dense thunderstorm activity.

The detection algorithm combines near real-time geostationary satellite data with numerical weather predictions calculated with the ICON model. The coverage currently implemented results from imagery measured with Meteosat-10 (Europe Middle East and Africa), Meteosat-8 Indian Ocean Data Coverage (IODC) and Himawari-8 (Asia-Pacific). Increased time resolution is further available over the European continent with Meteosat-9 Rapid Scan Service (RSS).

Forecasting in NCS-A is based on the nowcasting of satellite imagery with optical flow.

The lightning data from the LINET network which cover Europe are used as reference for testing. Scores are calculated using an object-based methodology.

We first outline the technical infrastructure of NCS-A, from data collection to end-user delivery. In particular, we present our web based virtual globe, as well as prototype visualization within the NinJo meteorological workstation. We then sketch out the underlying algorithms for detection and nowcasting. Finally, preliminary results regarding both detection and nowcasting scores over central Europe are discussed, together with a brief outlook of future developments.

The E-PROFILE network of automatic lidars and ceilometers for cloud and aerosol/ash profiling

Maxime Hervo, MeteoSwiss, Switzerland
maxime.hervo@meteoswiss.ch

----

co-authors: A Haefele (1),M. Turp (2), M. Haeffelin (3), M-A. Druoin (3), E. Hopkin (4), S. Kotthaus (3,4), I. Mattis (5), F. Wagner (6), M. Wiegner (7), W. Thomas (5), J-L. Lampin (8), C. Münkel (9), and H. Wille (10),
(1) MeteoSwiss, (2) Met Office, (3) IPSL, CNRS, (4) University of Reading, (5) DWD, (6) KIT, (7) Ludwig-Maximilians-Universität, (8) Météo-France, (9) Vaisala GmbH, (10) Lufft GmbH

Speaker: Maxime Hervo

It has been shown in various publications that state of the art ceilometers have the capability to do vertical profiling of aerosols including volcanic ash. Hundreds of ALCs with profiling capabilities are operated across Europe and are currently being integrated in the E-PROFILE ALC network. 87 instruments from 12 countries are already operationnal and several hundreds are expected for the end of the year. This network will primarily provide vertical profiles of attenuated backscatter coefficient and complement existing networks of high performance research lidars bringing a higher density network of instruments and high data availability. It will significantly enhance the capabilities of the current observing system to detect volcanic ash and provide the basis for new applications in the area of data assimilation, air quality and fog now-casting.
In a tight collaboration between EUMETNET/E-PROFILE, COST/TOPROF and the industry, some of the best known state-of-the-art ALCs have been characterized establishing a good understanding of the instrument output. Correction algorithms and recommendations for instrument operation have been developed to improve data quality and consistency. Finally, the liquid cloud and Rayleigh calibration methods have been implemented to calibrate ALCs in an automatic and unattended manner. Based on comparisons with research lidars and on Monte Carlo simulations the calibration uncertainty is currently estimated to be 25%.
We will give a detailed description of the network architecture, the calibration algorithms and the envisaged network density and discuss the benefits of the ALC network with focus on volcanic eruption events and fog now-casting.

Acknowledgements: E-PROFILE team, TOPROF team

Toward a machine learning based ceiling forecast diagnosis for TAF initialization (IniTAF project)

Pauline Jaunet, Météo-France, France
pauline.jaunet@meteo.fr
----
co-authors : A. Drouin, P. Crispel, A. Audevart, T. Kranitz, C.e Delin
----
Speaker : Pauline Jaunet

Optimizing the forecasters' workload while maintaining high safety levels in take-off, taxi, and landing operations at all times is one of the greatest challenges for meteorological authorities providing services to the air navigation users. The major weather information provided to the airport managers and airlines lies in TAFs (Terminal Aerodrome Forecast), whose production is time-consuming for forecasters. Indeed, a wide range of weather factors is required to meet the standards in ICAO's Annex 3. Forecasting the evolution of such parameters is complex since some of them are not part of the available outputs of Meteo-France's models.

That is why the IniTAF (TAF Initialization) innovative project was launched. It is intended to provide first guess of draft TAFs by using machine learning and deep learning techniques, and thus improve the forecasters' efficiency. Hence, it allows freeing up time for working on other tasks such as accompanying the weather forecast users on the phone. Indeed, upon weather conditions and related safety threats, this product will allow them to focus on forecasting the evolution of the most critical parameters (i.e horizontal visibility in case of fog forming, etc.). Several inputs are required to draft TAFs from model data: wind, cloud cover, ceiling, etc. Some of them, such as wind strength and direction, are direct calculation from NWP models. For their part and since they are not yet included in Meteo-France's mesoscale model AROME-France, visibility and ceiling require further developments.

To overcome the lack in ceiling forecast data, we propose to develop a ceiling forecast from a combination of available model parameters as an input of the IniTAF project. A data set of one year and a half of carefully selected model variables (including humidity, cloud fraction, wind, etc.) matched with corresponding ceiling observations over the metropolitan French airports is first shaped. Statistical techniques are then applied to build an accurate ceiling diagnosis. Several methods are deployed, including machine learning algorithms such as logistic regressions or random forest processes. A second part of the development aims at implementing deep learning techniques. These algorithms are applied to independent validating datasets to assess their respective performance and accuracy.

Impact Analysis of Thunderstorms/Dust storms/Intense rain spells and associated winds on India's Aviation sectors 2008-2017, their Meso-Features and its real time Early Warning System and Gap areas

Rajendra Kumar Jenamani, India Meteorological Department, India
rjenamani@hotmail.com

Speaker: Rajendra Kumar Jenamani

Characteristics, severity and impact of various summer convective weathers e.g. Thunderstorms, Hailstorms and dust storms(TS, HS, DS) those routinely affect aviation sector across vast part of northern and eastern parts of India have been center of attention by meteorologist, aviators and publics. Jenamani, current Science, 2013 has 1st time analyzed impact of various severe weather events including TS/DS and its wind turbulance on aviation across India using authentic data compared with findings of NTSB(www.currentscience.ac.in/Volumes/104/03/0316.pdf). Science of understanding, capacity to monitor and issue of early warnings for these events, have been quantum jumped only in recent years of 2010-2016 with IMD modernization phase 1 completed in 2010-2015, with installation of DWR at airports, FDP –Storm Nowcasting project undertaken by various IMD field Forecasting offices in coordination with NWFC in 2010-2016 and rapid improvement in the NWP meso-scale models (IMD Vision document, 2011, Osuri et al, 2017- www.nature.com/articles/srep41377, Das et al, 2014, BAMS,(http://journals.ametsoc. org/doi/full/10.1175/BAMS-D-12-00237.1).

With passage of each of these severe storms and damages they are accounting for each summer for past almost 150-years, one may historically looks back to conclude that improving early warning of these severe events especially at airports still lies with how respective local airport met office has been well equipped with time to time latest technological equipments and knowledge of various enabling ways of monitoring of these systems and identifying of their critical meso-scale features with the evolving of time.

Besides utmost need of better techniques and technology to detect these localized severe storms, the other major limitation of capturing and issuing timely early warnings for these systems is their unique fast development and explosive growth and quick dissipation in few minute over the airports which are closely linked with large-scale-synoptic and localized heating, topography and meso-scale metrological set up at that location for which one certainly needs a very committed team works and efforts e.g. through NWP model, synoptic and upper air diagnostic or through local checklist developed using their longer period data and time to time DWR and satellite image diagnostic. With major airports like Delhi, Amritsar, Lucknow and Jaipur of north India are always vulnerable in peak summer of May-June affected at least one or more occasion by temp of 42-48degC continued for 2-5 days, it poses new challenges especially in northwestern India on how to issue early warnings for sudden dry convective storms accompanied with sudden dust storms occurrences which have been resulting sometimes diversion. The higher diversion of flights from summer storms also makes us worry as they are reaching upto 90-110 number of flights as was in May 2008 and May-June 2016 at Delhi and May 2011 across Delhi, Lucknow, Patna, Kolkata and Bhubaneswar when a series of MCS were affecting in chain across whole Indo-Gangetic plains.

In the present study, author who has worked for at MET Watch Office at IGIA Delhi for last 12-years, has attempted 1st to find impact of TS/DS/Heavy rains on aviation sector e.g. on air traffic, on flights covering their take off stage, enroot and landing stage, on parking aircrafts using meteorological features of some major severe thunderstorms/dust storms dates of Delhi for 2007-2017 and respective impact data from AOCC and ATC for IGA Delhi. IGIA being equipped with most sophisticated meso-netwroks of 6 AWS/DCWIS and 18 number of RVR at three RWY ends with data of 1-10 second and 10-minute gap of DWR products, we have analyzed critically all these meso-scale data for all dates when TS/DS have caused total flight diversion of 5 and more to understand their unique meso-features in terms of wind peak, pressure fall, temp fall, humidification, warm-cold advection, lowest RVR recorded and related them with specific meteorological causes attributed to cross winds impact from Gust fronts, frequent RWY TDZ wind direction changes from wind squalls closing the RWY for an hour to three, non availability of desired RVR minima due to severe DS co-occurred with it or it was the large CB clouds who stand tall on the glide path causes turbulence and thus forced all those flight to divert. Using same high resolution RVR/AWS data and data from METAR for 1995-2016 of IGI, we have developed micro-climatological TS/DS information system and severe storm hazards

information system. We have used timings of DWR max Z and max Z of highest reflectivity and peak of surface winds and lowest RVR at respective location of the airport for major TS/DS/squall dates to determine the timing of gust front/dust storm those had affected respective RWY ends. We also have determined the time taken by each guest front/dust storm to travel from one end of airport from data of AWS/RVR located nearest to it, at RWY ends using their data. Finally, we have discussed the MWO storm real time early warning system which use Satellite(Kalpana, R! APID)-DWR-AWS and WDSS-II based nowcast system and analyzed all these severe storms occurred in 2010-2017 in hind cast mode to validate what extreme features of these storms based upon such systems could be nowcasted at 1-2 hours lead time. Then we have made demo how the best way to nowcast winds from likely squall is use of meso-climate information system of squalls as was prepared based upon 19995-2005 which helps improve of wind nowcast skills while use of climatological DWR storm tracks based upon past case studies of 2010-2012 improves in nowcasting of whether a particular TS/DS CB type cells noted in DWR at 150-200km far, likely to hit or missed the airport. The new TS/DS/Squall checklist/Thresholds for short range forecast/nowcast at 0-12 hours lead time for IGIA determined from Antecedent thermodynamic stability indices and parameters of UA ascent of 1200 UTC or 0000UTC based upon past occurrences of 2001-2012 have also been briefly discussed. We have also discussed various challenges we face regularly and major gap areas through case studies especially our limitations of RWY-TDZ wind direction and wind gusts Nowcast/ forecast at airport for safe operation at airport as this remain to be most non-linear component of any severe storm occurrences to be nowcasted or forecasted by any techniques/technology/NWP nowcast models precisely as per expectation of users .

Forecasting the severe weather: A deep learning approach

Zhou Kanghui, National Meteorological Center of China, China
zhoukh@cma.gov.cn

Speaker: Zhou Kanghui

A severe weather, including thunderstorm, short-time heavy precipitation, hail, thunderstorm gale, etc., forecast solution with deep learning, which extracted the vapor, dynamic condition and instability energy features for convective system automatically, was proposed.

Deep Learning is a new area of Machine Learning research, which use a cascade of many layers of nonlinear processing units for feature extraction and transformation. It was confirmed that the performance of deep learning would be much better than the traditional machine learning methods, such as Support Vector Machine, Multilayer Perceptron and Radom Forest, etc. In this work, a deep convolutional network, with 6 convolutional layers, was built to predict convective systems. There were 3 steps of the work.

First, it is the data set construction. 5 years of severe weather observations were utilized to label the NCEP reanalysis data. Actually, it is a binary classification task for severe weather forecast. 1 for happened, and 0 for not happened. More than 10,000 labeled samples for each weather phenomena were selected for model training. The temperature, pressure, humidity and wind from 1000hPa to 100hPa, as well as the surface elevation, were taken as the features of the samples.

Second, it was the deep learning model architecture design and training. We built a 6 layers Convolutional Neural Network(CNN) model to extract features for different severe weather. Various hyper parameters were tuned in the training. Finally, we got a model weight with test accuracy of 91%,92%,93% ,93% for thunderstorm, Short-time heavy precipitation, hail, thunderstorm gale.

Third, the trained model was applied to predict the severe weather with the NWP forecast data as its inputs. The predictions were probability forecast.

The model was evaluated with the forecast from April to August 2015. The threat score (TS) of thunderstorm, Short-time heavy precipitation, hail, thunderstorm gale prediction was 0.42, 0.32, 0.07 and 0.08 respectively, while it was 0.36, 0.25, 0.02 and 0.07 for the weather forecasters in the National Mete Center (NMC). Nowadays, the products of deep learning forecast mode has been applied in the NMC, drawing forecasters' attention to the potential convective weather.

Characterization of the Different Wind-Shear Mechanisms Impacting the Nice Airport Approaches

Jean-Luc Lampin, Météo-france, France

jean-luc.lampin@meteo.fr

----

co-authors : E. Schwartz (Météo-France), F. Besson (Météo-France)

Speaker: Florence Besson

Nice airport is affected by weather phenomena that have a significant impact on air traffic. Any reduction in the capacity of use of the Nice runways, or worse, their closure, quickly causes chain repercussions on the fluidity of European traffic, in flight and on the ground (delays, reroutings, cancellations) with significant financial and media effects.

Aerological characteristics of Nice airport induce wind shears in clear sky. There are many mechanisms generating wind shears at the local scale (marine breezes, valley breezes, thunderstorms, orographic phenomena, density current) or synoptic (frontal passages, MCS, ...) Nice has the particularity of proposing almost all of these causes.

In the absence of cloudy markers, the observation of wind shears is difficult. Wind shears forecast is also difficult due to a lack of knowledge and a confusion between the different mechanisms involved.

That's why several studies and successive experiments were carried out at Nice airport.

A climatological study has listed the go-around occurrences flagged for meteorological reasons. Cases of troublesome breezes and wind reversals (opposite winds at the two ends of the runway) were recorded. Four synoptic configurations leading either to wind reversals or to important cross breezes concerning the mouth of the Var Valley were identified.

Numerical simulations were carried out showing that the previous generation models could not correctly describe the phenomena observed because the wind shears occur on a scale smaller than their mesh.

Additional anemometers were installed at various locations to improve the Bay of Nice coverage and further experiments were carried out.

A L-band radar wind profiler was installed but the results were not satisfactory:

- ❖ the profiler didn't identify with certainty the breeze phenomenon of the Var Valley;
- ❖ it didn't detect the frequent recorded horizontal shear between the two runway thresholds probably because the shear front is located outside the zone probed by the profiler which is near the threshold SW;
- ❖ and especially low-level measurements (less than 500 m) are not very usable because they are often invalidated because of the echoes of the ground which hide the useful signal.

A first experiment with a scanning Lidar in 2009 allows to completely understand the phenomena of wind reversal: this is frontal structure, which is virtually vertical over 500 m in height and generally perpendicular to the coast, moving horizontally along the coast.

ICAO requirements were also tested during this first experiment. They aren't completely adapted to the need of Nice.

Technical definition of an all-weather system and understanding of the operating procedures to be implemented for an operational use were upgraded during a complementary experiment carried out in 2011 with the rental of an X-band radar and a scanning lidar.

All these studies documented and characterized the various phenomena in order to gain access to their understanding and thus to define what instrumentation to put in place to satisfy the operational need for safety and optimization of air traffic.

What's Happening with the Feasibility Study toward a WMO Intercomparison of Volcanic Ash Observation Tools

Jean-Luc Lampin, Météo-france, France
jean-luc.lampin@meteo.fr
----
co-authors : P. Keckhut (LATMOS), F. Besson (Météo-France)

Speaker: Jean-Luc Lampin

In response to the 2010 volcanic eruption in Iceland, the World Meteorological Congress strongly encouraged the creation and the coordination of a composite observing system (ground-based, in-situ and space-based) that would allow quantifying ash concentrations in near-real time and could be used to calibrate ash dispersion and transport models.
A gradual transition from determining the location of "any ash" towards a more quantifiable prediction of ash loading would require an upgrade of the relevant observing capabilities.
Lidars and ceilometers have shown their interest to supplement satellites. They are able to give information with a LOW uncertainty in terms of aerosol presence in clear sky, but with an IMPORTANT uncertainty in terms of concentration.
An international ad-hoc Lidar expert team has been constituted to:

- Identify the potential outputs pertinent for volcanic ash detection (1), attribution (2) and quantification (3) provided by lidar and ceilometer systems.
- Review potential strategies and experimental setup to be deployed to evaluate capabilities of active systems and to characterize their performances depending on weather conditions and to evaluate the uncertainty of the measurements, propose uncontroversial observation methods and quality control.

The final report assesses the potential role of lidars and ceilometers in a global volcanic ash detection and alerting system. It provides requirements and recommendations to the Task Team that is in charge of carrying out the feasibility study for an instrument intercomparison for volcanic ash detection:

- Review of requirements for detection of volcanic ash
- Detection, typing and quantification
- Identification of key lidar parameters for volcanic ash detection
- Lessons learnt from previous ceilometer inter-comparison activities

Recommendations for a Lidar intercomparison for volcanic ash detection
The scientific work is going to be achieved for the end of the year. After that, the feasibility study by itself will kick off.
An intercomparaison is expensive, takes up a lot of time and is logistically
challenging. The feasibility study has to determine if such an intercomparaison is
not only workable but also worthwhile.
Based on the work of the ad-hoc lidar expert team and related to in-situ and space-based observations, the Task Team will have to estimate the delay/cost/benefits report of performing a WMO Intercomparison of Volcanic Ash Observation Tools. The members of this task team have to be defined. Probably some people from the ad-hoc lidar expert team, a specialist in
space-based measurements and maybe a specialist in in-situ aerosols measurements.

The final report will assess :

- the interest of performing an intercomparaison
- the kind of instruments that should be intercompared
- the characteristics required for the observing site
- the methodology to be followed to reach this goal
- the cost

Airport Low-Level Wind Shear Detection Technology Based on LIDAR Wind Profilers

Ekaterina Lemischenko, JSC "International Aeronavigation Systems Concern", Russian Federation
lev@ians.aero
----
co-authors: N. Baranov

Speaker Ekaterina Lemischenko

Detection of low-level wind shear and respective notification of various aviation users is one of the issues determining the safety of take-off and landing operations at the airport.

Currently, three basic technologies exist to monitor the wind shear:

- based on a network of anemometers;
- based on a network of wind profilers;
- based on scanning pulse Doppler LIDARs.

IANS has been actively developing low-level wind shear monitoring technologies based on WINDEX-300 wind profilers. WINDEX-300 is a LIDAR with continuous emission ensuring measurement of the wind speed vector in the surface layer of the atmosphere (up to 300 m).

The advantage of using these devices is that they provide timely measurement of the three wind speed components with high spatial resolution in elevation.

The technology of utilizing LIDAR profilers for wind field monitoring and detection of the low-level wind shear includes establishing a network of LIDARs in the terminal area. Measurement data are then integrated through a mathematical processing server that generates information messages about the observed dangerous wind phenomena, including:

- assessment of intensification/weakening of the headwind/tailwind by altitudes;
- assessment of the turbulence level by altitudes;
- information on wind gusts by altitudes;
- identification of vertical wind shears and wind gusts by altitudes;
- display of airport wind conditions: altitude profile of the wind speed and wind direction; turbulence profile with color-coded hazardous areas with the wind shear; horizontal wind field at the airport.

The altitude turbulence indices are subsequently calculated based on the computed values of the turbulence characteristics, in accordance with ICAO recommendations.

To increase reliability of dangerous wind phenomena identification, algorithms has been specifically developed for temporary median smoothing of wind profiles to eliminate random emissions in wind speed measurements.

In addition, to reduce the probability of false positives when identifying wind shear, a specialized algorithm for majorant filtering of unverified wind shear messages is used. At this, vertical wind shear can be identified according to different indicators, such as:

- gradient of the tailwind/headwind component;
- gradient of the velocity vector value;
- gradient of the wind speed vector.

The choice of wind shear indicators, as well as adjustment of the criterial values of the shear intensity and filtering algorithms are customized by the user in accordance with the characteristic features of the wind conditions in a given area.

The presented technology is an effective tool for monitoring wind conditions in the terminal area with timely detection of hazardous phenomena.

The work was partially supported by the Russian Foundation for Basic Research under Project 16-07-01072.

Study of pre-monsoon and post-monsoon thunderstorms over a south western tropical indian station for aeronautical advisories

V K Mini, India Meteorological Department, India

minijayalal@yahoo.co.in

----

co-authors: A.U.Ramesan, N.T Niyas, S.Sudevan and Arun Kumar

Speaker: V K Mini

Thunderstorm is an important mesoscale system and is one of the hazards to aviation activities. An attempt is made to study the thermodynamic structure of convective atmosphere during pre-monsoon and post monsoon season over southern peninsular India, which falls in the humid region of the tropics utilizing radiosonde data. The use of radiosonde data is very much useful for understanding of atmospheric thermodynamics. The stability indices were computed for the south western tropical Indian station, Thiruvananthapuram (8.50N, 76.9380E), which is having a busy international airport, using the radiosonde data for pre-monsoon and post-monsoon seasons of fifteen consecutive years. The stability indices viz, Showalter Index (SI), Lifted Index (LI), K index (KI), Cross total Index (CTOT), Vertical total index (VTOT), Total Totals Index (TTI) and thermodynamic parameters such as Convective Available Potential Energy (CAPE) and Convective Inhibition Energy (CINE) have been studied and threshold values of these indices for occurrence of thunderstorm are determined for the station. When there is a convective system over south peninsular India, the value of LI over the region is less than −6. On the other hand, the region where LI is more than 1 is comparatively stable without any convection. Similarly, when KI values are in the range 28 to 40, there is a fair chance for convective activity. The threshold value for TTI is found to be between 50 and 52. Prior to convection, dry bulb temperature at 1000, 850, 700 and 500 hPa is minimum and the dew point temperature is a maximum, which leads to increase in relative humidity. Further, we found that the total column water vapor is maximum in the convective region and minimum in the stable region. The threshold values for the different stability indices are determined for the station, Tiruvananthapuram, which can be utilised as a forecast criteria for the local thunderstorms while issuing Terminal Aerodrome Forecast (TAF), local forecast and aerodrome warning for aviation purpose.

Key words: thunderstorm, sability indices, Showalter Index (SI), Lifted Index (LI), K index (KI), Cross total Index (CTOT), Vertical total index (VTOT), Total Totals Index (TTI), CAPE, CINE

WMO Aeronautical Meteorology Scientific Conference 2017

6 - 10 November 2017

Centre International de Conférences - Météo-France - Toulouse - France

Monitoring of Weather Extremes from INSAT-3D/3DR satellites over the Indian region and future aspects for aeronautical meteorology.

Ashim Mitra, India Meteorological Department, India.
ashimmitra@gmail.com
----
co-authors:S.K Peshin

Speaker: Ashim Mitra

Any meteorological phenomena such as fog, thunderstorm, heavy rain which creates significant societal and economic problems especially as a major havoc to day to day routine life as well as entire communication as well as transportation system especially over the Indian subcontinent. Successful commissioning of indigenous satellite INSAT-3D on 26th July 2013 and INSAT-3DR on 8 September 2016 has provided a new opportunity to the Indian meteorologists. The INSAT-3D imager is to provide imaging capability of the earth disc from geostationary altitude in one visible (0.52 – 0.77 m) and five infrared channels; 1.55 – 1.70 m (SWIR), 3.80 - 4.00 m (MIR), 6.50 – 7.10 m (water vapour), 10.3 – 11.3 m (TIR-1) and 11.5 – 12.5 m (TIR-2) bands. The ground resolution at the sub-satellite point is nominally 1km x 1km for visible and SWIR bands, 4km x 4km for one MIR and both TIR bands and 8km x 8km for WV band.
A new RGB scheme (Red, Green, Blue) have been introduces in the processing of INSAT-3D/3DR satellite for monitoring of different day-today weather forecast . It consolidates the information from different spectral channels (such as Visible, Infrared, Near Infrared)) into single products that provide more information than any one image can provide.
In the current paper, some of the extreme events including fog, thunderstorm and the interpretation of cloud types such as turbulence near CB cloud tops, significant tropical convection, cloud heights using RGB will be presented in the conference.
An online INSAT-3D/3DR data visualization software on GIS platform 'RAPID' will also be demonstrated.

Study Of Clear Air Turbulence In Indonesia

Muhammad Arif Munandar, BMKG, Indonesia
arif_btngmi@yahoo.com
----
co-author: Hari Tri Wibowo

Speaker: Muhammad Arif Munandar

Clear Air Turbulence (CAT) became concerns in aviation because can reduce comfort, loss of fuel and injured passengers. CAT research has been widely applied in various regions through observation and numerical models. For the tropics research on CAT still limited so necessary to study. The study using numerical simulation model WRF-ARW because limitations of observational data and the problems are quite complex. Turbulence data derived from PIREPs from ATC staff. Boundary and initial conditions for the simulation model using FNL (Final Global Assimilation System) data. Output models have been validate using radiosonde data at the point nearest observation of Surabaya and Makassar in which the results are considered representative of actual conditions. From the results of simulation models WRF-ARW values obtained Richardson Number (Ri) <1 in the region reported the occurrence of CAT. This is due to the presence of wind shear due to changes in wind speed on the site.

A new method to forecast aircraft icing from high-resolution NWP

Esbjörn Olsson, SMHI, Sweden
esbjorn.olsson@smhi.se

Speaker: Esbjörn Olsson

Output from advanced microphysical parameterizations of different cloud processes in today's Numerical Weather Prediction models can be used to give detailed forecasts of the icing conditions in the atmosphere. Here we use output from the non-hydrostatic HARMONIE-AROME model that is run at 2.5 km horizontal resolution. The method is based on developments done for the wind energy sector where icing on the wind turbine blades is a significant problem in cold climates. The rate of ice build-up on a cylinder is calculated using an ice accretion model. Then this icing rate is translated to aircraft icing severity. The accretion model uses as input temperature and all hydro-meteors (liquid cloud water, cloud ice, rain, snow and graupel) available from HARMONIE-AROME model runs. The main sources for icing are supercooled cloud water and rain, but cloud ice and snow contribute to the ice build-up when mixed-phase clouds are present. So far no systematic verification of this icing index has been done but it has been used in the operational forecasting office last winter during a helicopter certification campaign. According to the forecasters the new icing index in many cases provided good guidance for their briefings. This method can be applied to coarser resolution model output and it is now being used with data from the global ECMWF-model. In order to address forecast uncertainties of the icing, an ensemble prediction system (EPS) can be employed. The Nordic countries Sweden, Norway and Finland are now running a high-resolution (2.5 km) operational EPS based on HARMONIE-AROME. The described icing index will be used to forecast probabilities of different severities of aircraft icing based on output from this EPS. Furthermore, aircraft icing climatology studies are possible e.g. using the regional reanalysis UERRA as input. The UERRA reanalysis covers all Europe for 55 years with 11 km horizontal resolution.

WRF-EMS Aviation Products

Ammar Ouali, National Institute of Meteorology, Tunisia
ouali@meteo.tn

Speaker: Ammar Ouali

A case-study of an extreme rainfall event flooding Tunis-Carthage airport
"Ladies and gentlemen, this is your captain speaking. We have a small problem. Due to bad weather out of our control, we were rerouted to another airport ... "
Why did it happen?
Air traffic was disturbed due to the weather conditions after the torrential rains of to day. All flights scheduled for the Tunis Carthage Enfidha airport where rerouted to the Monastir airport.
Where did it happen?
Heavy rains took place in almost all of northern Tunisia, civil safeguards have been on permanent standby and worked on water drainage, sewage pumping, and rescuing people who were stuck in the inundation. Rain totaled 180 millimeters in some regions.
When did it happen?
On Sunday 30 October 2011 at midday
What is the event?
A severe convective storm hit cities on the north coast of Tunisia resulting in many fatalities and damage to infrastructure. This event is representative of convective storms in the Mediterranean region. It resulted from a cut-off low which crossed Europe and reached the Straits of Sicily and Gulf of Hammamet.
What is your plan to avoid this kind of situation?
I'm working for risk management to reduce Crisis. I will start with a brief introduction of this case and taking look at synoptic scale processes to assess preconditions for this event from 00 UTC on the 29 of Oct through 00 UTC 31 Oct.
Using Global Data Analysis System and Global Forecast System data of the National Centers for Environmental Prediction. I will investigate on the local processes and dynamical and physical aspects of this weather phenomena from the beginning to cessation of this convective storm.
Analysis of situation using conceptual models (such as Bergen model, T-bone Model, Baroclinic interaction, Conveyor belt, …) and satellites images of Moderate Resolution Imaging Spectro-radiometer and Meteosat-9 images, considered to be a precursor to weather science product, will be used to construct three-dimensional mental figures of pre-storm weather structures, storm development and post-storm environment.
After that I will present the capability to accurately numerical predict clouds and rain over the airport and closer to Terminal Area. The Weather Research and Forecasting (WRF) model is designed to simulate atmosphere and made predict weather fields over regional and local domains.
For my case study, I perform model simulation using the famous WRF-EMS model. I apply two downscaling methods focused on the airport. First the nesting method of three domains with the finer horizontal space resolution 9km, 3km and 1km and the finer temporal resolution, and time output filed for the domains are respectively 1h, 30mn and 15mn. In the second method I use sequential domains run, I run model with the big domain then de middle then the small one.
Maps and automatic reports will be presented and discussed in my presentation.
Finally I will present my conception to apply downscaling technique to build mesoscale modeling and perform the state-of-art nowcasting, deterministic and probabilistic on weather and downscaling appalling to climate forecast system needed for planning holiday, 9 month in-advance.

A multi-model system to estimate volcanic, aerosols and nuclear hazards to aviation (EUNADICS-AV)

Matthieu Plu, Météo-France, France
matthieu.plu@meteo.fr
----
co-authors: D. Arnold2, R. Baro2, A. Carvalho3, L. El Amraoui1 , M. Hirtl2, L. Robertson3, B. Sic1 , M. Sofiev4, A. Uppstu4, G. Wotawa2
1: MF, 2: ZAMG, 3: SMHI, 4: FMI

Speaker: Matthieu Plu

Aviation shows vulnerability with regard to “airborne” hazards, including volcanic ash and sulfur clouds, nuclear accidents and other high-density aerosol plumes such as sand storms and forest fires. While several observation networks and satellites provide large amount of data that are relevant for the monitoring of such events, their integration to provide a timely best possible analysis of these hazards is one of the objective that the EU/H2020-funded EUNADICS-AV project is tackling.

A multi-model system, based on MATCH (from SMHI), MOCAGE (from Meteo-France) SILAM (from FMI) and WRF-Chem/Flexpart (from ZAMG) is being developed in EUNADICS-AV. Each model assimilates measurements relevant to the hazards: aerosols and SO2, from ground-based networks (lidars), satellites (AOD, ash retrievals, SO2 columns) and in-situ measurements (radionuclides). The point-source emission terms are also of specific attention, either computed from source-inversion algorithm or modeled by the most up-to-date methods. The integration of the distributed observational information provide a harmonized 4-D (space- and time-resolving) quantitative analysis of the crisis situation.

Considering the above model outputs, products and charts relevant to aviation are developed. The multi-model approach proposes probabilistic outputs and/or a characterization of the uncertainty of the products under the guidance of stakeholders feedback. We propose a poster for describing the EUNADICS-AV multi-model system, as well as first examples of products on test cases.

AIRBUS THALES Selex ES METEO FRANCE

WMO Aeronautical Meteorology Scientific Conference 2017

6 - 10 November 2017

Centre International de Conférences - Météo-France - Toulouse - France

The use of on-board in situ energy dissipation rate (EDR) estimates in improving situational aware and in verifying turbulence forecasts

Robert Sharman, NCAR, United States of America
sharman@ucar.edu
----
co- authors: J. Pearson, NCAR; G. Meymaris, NCAR; L. Cornman, NCAR; T. Farrar, FAA

Speaker: Robert Sharman

In the U.S., a program has been underway for many years to outfit commercial aircraft with a software package that automatically estimates and reports atmospheric turbulence intensity levels (as EDR=ε^1/3 where ε is the energy dissipation rate) during each minute of flight. EDR is aircraft independent and is the International Civil Aviation Organization (ICAO) specified turbulence reporting metric. The automatic nature of the reports obviates the need for subjective pilot reports (PIREPs) and, since it is a true atmospheric measure, is preferable to the use of derived vertical gust measurements (DEVG) available in AMDAR reports on some aircraft. The reporting frequency is variable depending on the airline, but some reports are routinely made at intervals of 15-20 minutes, while others report when the turbulence EDR level exceeds some threshold or "trigger", typically corresponding to “moderate” turbulence. The amount of turbulence data gathered is unprecedented - as of Sep 2017 there are ~ 260 aircraft outfitted with this system (including UAL B777s, DAL B737s, B767s, B777s, and SWA B737s), contributing to well over 150 million archived records of EDR mostly at cruise levels of commercial aircraft, i.e., in the upper troposphere and lower stratosphere (UTLS). Many of these now provide international coverage, allowing turbulence observations and their use for verification of turbulence forecasts over previously data sparse regions. Other international carriers are expected to expand this pool.
In this talk, the algorithm technique is described and coverage maps will be provided. Examples of its use in enhancing real-time situational awareness and in verification of turbulence forecasts, will be provided. Some results of statistical analyses of the data will also be provided.

“This research is in response to requirements and funding by the Federal Aviation Administration (FAA). The views expressed are those of the authors and do not necessarily represent the official policy or position of the FAA.”

Develop of numerical forecast methods of visibility for detection of fog

Grigory Zarochentsev, Hydrometcentre of Russia, Russian Federation
grinj@easycoding.org
----
co-authors: Byichkova V.I., Ignatov R.Y., K.G. Rubinstein

Speaker: Grigory Zarochentsev

Fog is common and dangerous phenomenon in the temperate latitudes of the northern hemisphere. Annually airports delay dozens of flights because the planes can not land and take off in conditions of low visibility due to the formation of fog. Existing methods of fog forecasting based on the high value of relative humidity of air shows low accuracy due to that a high value of humidity does not always lead to the formation of fog. It is important to identify additional criteria for the formation of fog for its prediction.

In this work data from meteorological and aerology stations over Europe for 12 years were analyzed and a number of fog formation factors were identified: high relative humidity at 2 meters, low wind speed at the altitude of 10 meters, temperature gradient in the 2m-925 h layer.

Based on the obtained results, was developed the method for predicting the value of horizontal visibility for fog forecast in the form of a discriminant function: if the value is less than 1000 meters, fog is predicted, otherwise – it is not fog.

Mesoscale model WRF-ARW was used for modeling the meteorological characteristics of air and thermophysical parameters of the underlying surface for the territory of Europe and the European part of Russia. The estimation of the developed algorithm was made and it showed better results in comparison of existing methods of fog forecasting [1-4]:

On the average the accuracy of availability is 7% higher and the number of false alarms is 5% lower.

This work with title “Comparison of forecast methods of visibility for detection of fog.” is accepted for publication in the “Optic of Atmosphere, 2017”.

[1] Smirnova T. G., 2000.
[2] Doran, J.A., P.J. Roohr, D.J. Beberwyk, 1999.
[3] Stoeling, M.T., T.T. Warner, 1999.
[4] Wantuch F., 1999.

Wind over airport with complex Terrain

Zhongfeng ZHANG, Aviation Meteorological Center, ATMB,CAAC, China
mazzf@vip.sina.com
----
co-authors: J. Wu, C. Lin

Speaker: Zhongfeng Zhang

The regional wind patterns in the airport with complex terrain is investigated using data from wind profiler and anemometer at the Jiuhuang airport. Wind direction probability density functions and wind rose histograms show the tendency for north-northwestly flow above the valley which represents winds from the synoptic direction above the influence of the valley, southwesterly flow (along the valley's axis) within the valley which is a classic channelized flow due to the steep and narrow valley, and shallow valley wind (perpendicular to the valley's axis) near the valley floor below 115 m observed by radar wind profiler and surface anemometer. In January, the strongest wind shear occur in the nearby ridge (about 900m from the airport level) after sunrise result from the strong upper westerly and the stable layer. In the afternoon, the westerly reach the valley ground by the downward transport of momentum and the vertical velocity reach the peak near the ridge. There is a strong positive correlation between westerly component and the descend movement near the ridge in the winter. The relationship between overlying synoptic-scale flows and winds within valley is weaken in the summer with the westerly decrease.

AIRBUS THALES Selex ES METEO FRANCE