AVIATION IN THE XXI-ST CENTURY

INTERNATIONAL CIVIL AVIATION ORGANIZATION
NATIONAL ACADEMY OF SCIENCES OF UKRAINE
MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY

PROCEEDINGS

THE FOURTH WORLD CONGRESS "AVIATION IN THE XXI-st CENTURY"

"Safety in Aviation and Space Technologies"

Volume 1

September 21-23, 2010
Kyiv, Ukraine

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SYMPOSIA

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N.S. Kuz'menko , I.V. Ostroumov (National Aviation University, Ukraine)

WEATHER WEB SERVICE

New Weather Web Service which can be used for education and flight operation support has been represented. It collects information from different weather servers and current information from weather station in suitable form for pilots.

Introduction

Aviation meteorology is an essential element of the complex system that constitutes Air Traffic Management (ATM) in its broadest sense. Weather conditions impact the operations of ATM by variations in head and tail-wind components, through changes in pressure and temperature values at airports, and in imposing low visibility operating conditions. Adverse meteorological conditions have the greatest impact on the ATM system creating disruption and the consequent problems of disturbed flow rates, lost capacity and induced additional costs. It is important for air crews to understand the implications of weather on their flight plan as well as their aircraft.

Meteorological information

On-board meteorological information can be given by flight management system (FMS) for pilot operation.

This system helps pilots to guide and control aircraft during the flight. One of it's subsystem provides optimum operation and control of air-to-ground, two-way datalink communications with your selected ground-based service provider. Communications may be routed through the aircraft's VHF, satcom or airborne telephone systems (fig.1). It is also included for ACARS messaging over VDL Mode 2 along with growth capability to support the Aeronautical Telecommunications Network.

It makes opportunities for messaging, flight plan up-loading, pre-departure and other clearances, automatic position reporting, digital ATIS and text weather information such as TAF, METAR, SIGMETS, winds aloft and TWIP and others. All of this information with weather graphics is indicated for pilot on FMS and through Electronic Flight Instrument System. Represented information can include displays of composite radar, tops and movements, IR satellite images, significant weather, winds aloft as well as icing and turbulence potentials.

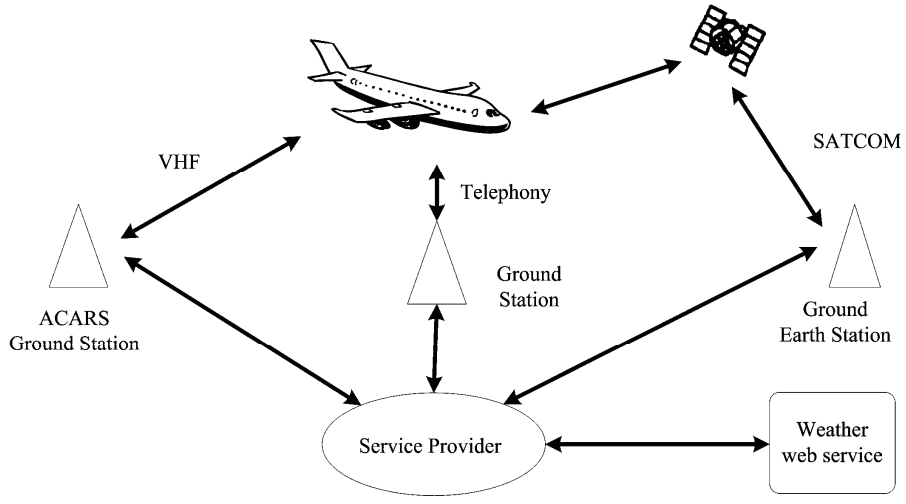

Fig.1. Communication conception aircraft-service provider

During the flight FMS connects with Ground Service Provider and download from it's computer servers all of this information.

Weather Web Service

For education process' supporting a special Weather Web Service was created at the department web site www.ANS.nau.edu.ua. This Weather Web Service collects all the data that a pilot also can get from the FMS on-board.

Weather Web Service includes:

- METAR, TAF, SIGMET information;
- Image of different weather conditions;
- Astronomical information about Sun and Moon;
- Current weather

Current and recent METAR and TAF reports from around the world are taken from public noaa service [1]. So, the information presented on these pages is considered public information and may be distributed or copied. The servers automatically collect information for site management and for statistical purposes, which are used for such purposes as assessing what information is of most and least interest, determining technical design specifications, and identifying system performance or problem areas.

To display the most recent METAR and TAF reports for one ore more observing locations, it is necessary to enter the four-character ICAO code (almost all of the world airports are set in the database).

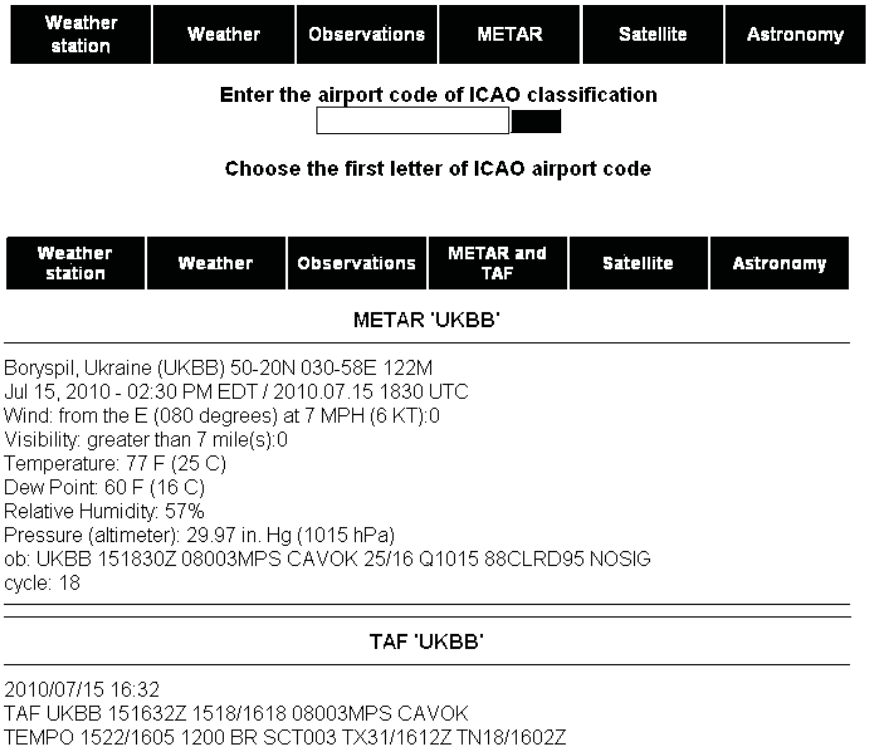

Fig.2. METAR and TAF information

Due to the big amount of satellites NASA can provide a lot of visual weather information of different electronic types.

Example of image provided by NASA service you can found in Fig.3.

It's mosaic picture that is continuously updated with images from MODIS TERRA satellite, which has almost global daily coverage. This layer is the most current, near-global image of the earth available. New images are added on top of the old data, in the order in which they become available. In general, the latest images are between 6 and 24 hour old.

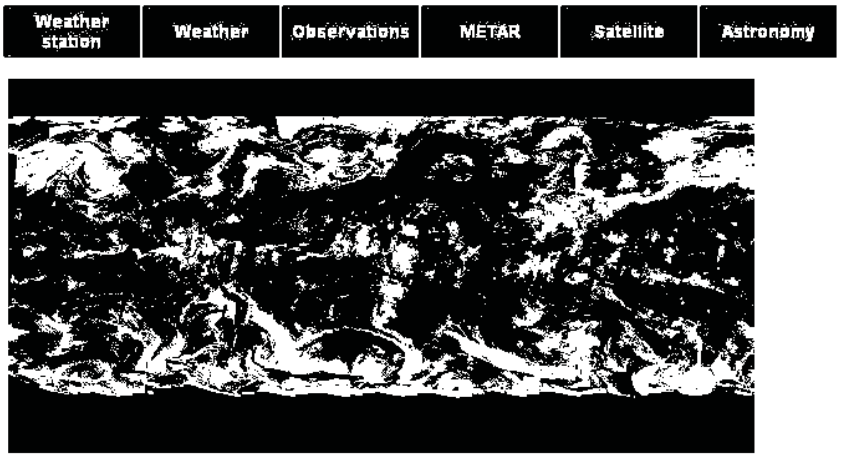

Fig.3. Image of the Earth surface and weather from the meteorological satellite for current day

For pilot it is necessary to know astronomical information about Sun and Moon position, sunrise/sunset time and day duration that helps him to plan flight in the given area.

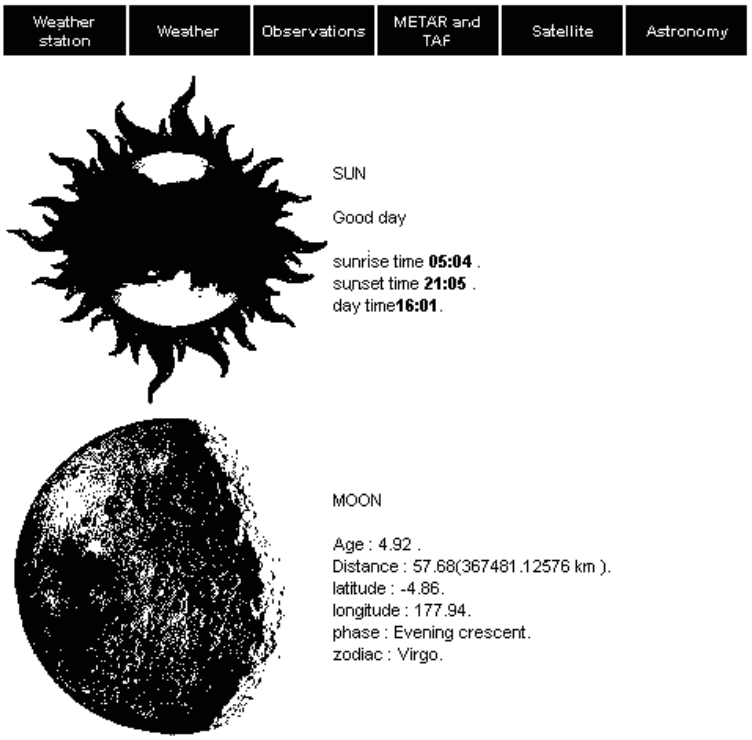

Fig.4. Astronomical information about Sun and Moon position

Current weather information has been provided by the Weather Transmitter which has been mounted at the department's building. This system measures and saves this information in a special weather department server. It works 7 days per week, 24 hours per day. The Weather Transmitter measures wind speed and direction, precipitation, barometric pressure, temperature, and relative humidity.

Wind speed and direction are determined by measuring the time it takes for the ultrasonic signal of one transducer to travel to the other transducers. Wind direction is not calculated when the wind speed drops below 0.05 m/s. In this case, the last calculated direction output remains until wind speed increases. The computed wind speeds are independent of altitude, temperature, and humidity.

This system uses the sensitive Sensor to measure accumulated rainfall, rain intensity, and rain duration. Precipitation is measured one raindrop at a time. Whenever a raindrop hits the precipitation sensor, an electrical signal is produced that is proportional to the volume of the drop.

The sensor is also capable of distinguishing hail stones from raindrops. The measured rain and hail parameters are cumulative amounts of rain or hail, rain or hail intensity, and the duration of a shower.

For indication of this data special software which works on-line has been developed. Web interfaces of this system have been represented in Fig.4.

To avoid the system overloading the current weather data renewal appears each 2 seconds.

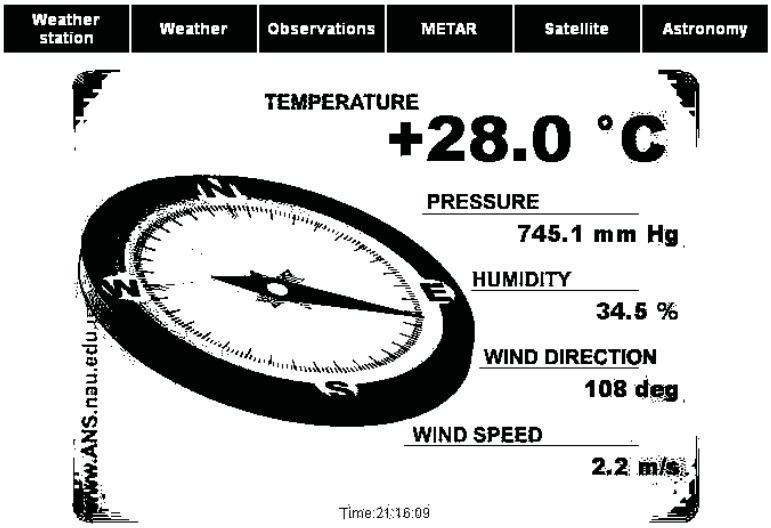

Fig.4. Weather station information interface

For flight guidance pilot needs information about cloudiness. For cloudiness determination the dew point deficit and pressure dependence is used.

Dew point deficit Δ – difference between air temperature T and dew point Td: $\Delta = T - Td$

Dew point is determined by formula [3]:

$$Td = (235 \cdot \beta)/(7.45 - \beta);$$

$$\beta = \lg(RH) + (7.45 \cdot T/235 + T) - 2,$$

where RH – relative air humidity [%], T – air temperature [°C]

Determined dew point deficit will be compared with it's limits and cloudiness will be determined.

Conclusion

Developed Weather Web Service supports the educational process and can serve as on-board FMS system. Data given at the Weather Web Service can be used by everyone who needs to know weather and astronomy information.

References

1. National weather service // http://weather.noaa.gov

2. Jet propulsion laboratory. NASA // http://onearth.jpl.nasa.gov

3. *Ahrens D.C.* Meteorology today: an introduction to weather, climate, and the environment/ Ahrens D. C. – Belmont, USA, Tomson learning academic resource center, 2007. – 537 p.

CONGRESS SECRETARIAT
National Aviation University 1, Kosmonavta Komarova ave., Kyiv, 03680, Ukraine
Tel: +38044 406-71-56
Fax: +38044 406-72-12
e-mail: aviacon@nau.edu.ua
Congress homepage:
http://congress.nau.edu.ua/