THE USE OF METEOSAT SYSTEM IN AERIAL NAVIGATION

Keywords: Meteosat system, meteorologic risk, aerial navigation.

Introduction
The Meteosat system, a complex system of collecting, stocking, processing and distributing the meteorological and environmental data successfully satisfies the need of many utilizers. Aerial navigation is one of these.

In this paper I wish to bring into focus the way in which the Meteosat system provides important information for the aerial transports, especially in the European area. In some way, it helps to ensure an optimal air traffic in the unique European airspace.

Information regarding meteorologic phenomena risky for aerial navigation is obtained by visually interpreting the Meteosat images (in analogical system) and by processing digital images, the latter registered is Visible (V), Infrared (IR) and Water Vapours (WV) Thus, the following data can be extracted: - the localization of the cloud systems and cloud characteristics (the temperature of the cloud top, deducible from infrared images;the dynamics of the atmosphere through noticing the cloud movement on sequences of images; cloud texture which shows the type of clouds, as an expression of a meteorological situation) quantity data (dot-like and area-like ) regarding the state of the atmosphere. On the basis of the above mentioned, the following documents are made: Cloud Top Heights (CTH), Cloud Movement Winds (CMW) and Numerical Weather Prediction (NWP), the last one being the main product of the weather forecast from Eumetsat.

The stocked and filtered information forms the basis for elaborating studies destined to improve the European and continental aerial routes of different companies.

1. The Meteosat system contributes to making flights safer in the area of the European airports

1.1. Monitoring with the aid of Meteosat system the meteorological processes highly risky for the airport aerial communication

A. The fog
The fog is a meteorological phenomenon highly risky the taking off or landing of the airships because , sometimes, it reduces ground visibility at a distance of some meters on the Meteosat images advection-fog areas and radiation-fog areas can be identified and sketched. Advection-fog is linked to the atmospheric fronts and more frequently in the regions with oceanic and transitional climate from Western Europe, Central Europe and Northern Europe (fig. 1.,3.). It may affect the aerial communication on the airports from London, Paris, Amsterdam, Frankfurt/Main, and Copenhagen.

Radiation-fog, associated with thermic inversions frequently occurs in the cold semester within the area of negative forms of relief (plains, depressions, valleys) ( fig.2.) . In the cold season this phenomenon is often met with by airports in Central and Eastern Europe like those in Geneva, Zurich, Munich, Vienna, Prague, Budapest, Warsaw, Moscow, Bucharest, Sofia.
B. Storms

Because of the very high speeds that the air currents can reach – of about 100-200 Km/h in the case of lightning storms and 800 Km/h in the case of tornadoes and strong showers, storm may endanger the aerial communication.

Meteosat recordings allow for the identification of the various types of storms having as basis the *cumulonimbus* clouds and the barium gradient:

1. *Thermic storms* are local atmospheric linked to the phenomenon of thermic convection frequently produced in the warm semester of the year (April-September). They are manifested by gusty winds (the speed of the descendent current can reach 100-110 Km/h at maturation and 200 Km/h at climax), lightning storms, heavy showers.

   They can be spotted taking into account the *cumulonimbus* clouds vertically grown, from 300-600 m up to 9000-12000 m altitude, due to the ascending currents of a thermic convection cell.

2. *Cyclonic storms* are generated by high atmospherics that is by the low pressure centers (cyclons). Extratropical cyclons, like the ones in the European space and those adjacent to it, are characterized by medium and high speed winds (under Knots/h, 12th level on Beaufort).

   Cyclogenesis areas that are essential for the weather evolution on the European continent are the North Atlantic (the Iceland depression, with a permanent character) and the Mediterranean Sea (in the cold semester).

   The cyclones are serially produced and move in chain toward Europe (fig. 2).

   These atmospheric are easy to identify and sketched on Meteosat images having as basis the spiral clouds indicating the cyclonic gyration – counterclock - of the air from a low pressure center.

   The cyclonic storms may affect the aerial communication in the airports from Western Europe (especially in the warm season of the year) and southern Europe (especially in winter).
3. Frontal storms are produced in the cold front areas and are highly frequent in spring and summer. They can manifest themselves throughout Europe.

On Meteosat images cumulonimbus clouds developed along cold fronts are sketched (fig.3).

1.2. Using Meteosat information in drapting weather forecasts destined to aerial communication.

The reception, processing and interpretation - using the highest technology - of Meteosat information allow for the drapting weather forecasts (diagnosis, prognosis, warning) by the specialized services in airports with the view to taking correct decisions at the controlling tower and aboard the aircraft. Highly important is Numerical Weather Prevision. (NWP).
In highly risky meteorologic situations, the controlling system operators can make one of this decisions: stopping the aircraft to the ground or directing it to other airports.

2. The Meteosat system contributes to the betterment of the european and intercontinental aerial routes

2.1. Monitoring with the aid of Meteosat system the atmospheric processes with highly risky potential for the aerial routes.

A. Turbulences
Turbulences represent very powerful ascending turbine currents (small cyclons) felt up to 9000-12000 m altitude.

Push the aircraft up all of a sudden, from where the so-called air-pocket fall occurs (a mistaken impression because the air like any other fluids, does not have void spaces, therefore, a fake sensation).

On Meteosat images, the most frequent turbulences are localized starting from the cumulonimbus clouds, because their special great vertical development is related to ascending turbine currents (fig.4.). They are the so-called „Charlie Bravo” clouds, which rise high above the stratiform cloud roof (fig.5.). On the basis of the temperature taken by the IR sensors installed aboard the satellite, cloud top height (CTH) can be specified hence the possibility to avoid turbulence area by rectifying flight route.

Fig. 4. Turbulences around the Alps. They can be spotted after the cumulonimbus clouds visible on the satellite image, fact which allows for rectifying the aerial routes (METEOSAT; VIS; 28.08.2000; 05.30 UT)
Clear Air Turbulence – CAT-are also known. These are related to the orographic clouds, which, in tropopause climax can generate violent turbulent movement. On satellite images they appear as bands, with a vermicular structure and turn function of the obstacle height into stratocumulus or altocumulus (fig.6).

Clear air turbulence have a high-level risk for aerial communication because marking them is more difficult.
B. Jet-streams

There are very violent winds (more than 400 Km/h), of high altitude (8000-12000 m), circulating around the Earth, from West to East, at subtropical and subpolar latitude, having meanders with great meridional-extension.

Subtropical jet-stream (30-40 latitude) and a polar front jet-stream (arctic jet-stream) are known.

Their position can be determined with precision because of the cirrus clouds associated to them, visible clusters on Meteosat images. They can be spotted even in the absence of cirrus clouds blankets.

The precise jet-stream location is very important for aerial communication, in establishing continental and intercontinental aerial routes.

2.2. Using METEOSAT documents for the betterment of the European and intercontinental aerial routes

Meteosat information and GPS opportunities are used to correct, during flights, the flight parameters (height, speed) and the aerial routes from the European space and those linking Europe to the other continents thanks to the satellite communication. That is how the risk level is diminuated.

Meteosat information and GPS facilities make possible the betterment of aerial routes by the boards of aerial companies, in cooperation with EUROCONTROL, agency responsible with the aerial communitar and extracommunitar space management.

Conclusions

Meteosat information, thanks to the technology specific to satellite imagery and its transmision through the system of satellite telecommunication, can be successfully used in
the domain of air transport, both for improving security at landing and taking off and for rectifying flight routes.

Moreover, through processing a larger quantity of data stocked in time, informatics models can be elaborated destined to the betterment of the routes used by different aerial companies.

These opportunities have, partially, been demonstrated by this paper.

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