THE INTERNATIONAL REVIEW OF WEATHER, CLIMATE, AND HYDROLOGY TECHNOLOGIES AND SERVICES

# Meteorological

AUGUST 2012

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## TALKING TORNADOES

Storm chaser extraordinaire Josh Wurman debates the latest tornado research: ROTATE 2012

## SUPPORT NETWORK

High-precision road weather forecasting using models and observation goes worldwide

by Dr Marco A. F. Tadini

# WEATHER WATCH

# A METEOROLOGICAL PERSPECTIVE ON ATM OPERATIONS

## Probability can provide continually updated aeronautical meteorological information

One of the main areas of concern for the air traffic management (ATM) industry is the lack of awareness concerning its ability to comply with meteorology requirements. On top of this, air traffic controllers are often not completely satisfied with traditional ICAO Annex 3 weather watch products, as they do not consider them to be detailed enough.

In recent years, much attention has been given to the important role that weather radar data could play in supporting the ATM community's operations. The lack of detailed guidance available on the use of this data represents a major obstacle to progress, and as a consequence, advanced weather products (information from weather radar maps, for example) cannot meet the requirements because they are not usable during operational activities.

However, it must be pointed out that the use of weather radar data should be viewed in a broader perspective as a major source of information for both forecasting and nowcasting, with benefits for all aviation users.

### Procedures to support ATC

ENAV S.p.A. is the main Italian provider for air navigation services; it's meteorological division's primary goal is to satisfy the operational requirements of the client. That is to say, to provide to all levels of the ATM community a guaranteed 24 hours a day, 365 days a year, updated aeronautical meteorological information and products that are associated with adequate operational assistance and optimum system performance, in adverse weather conditions, to ensure the safety and regularity of air traffic.

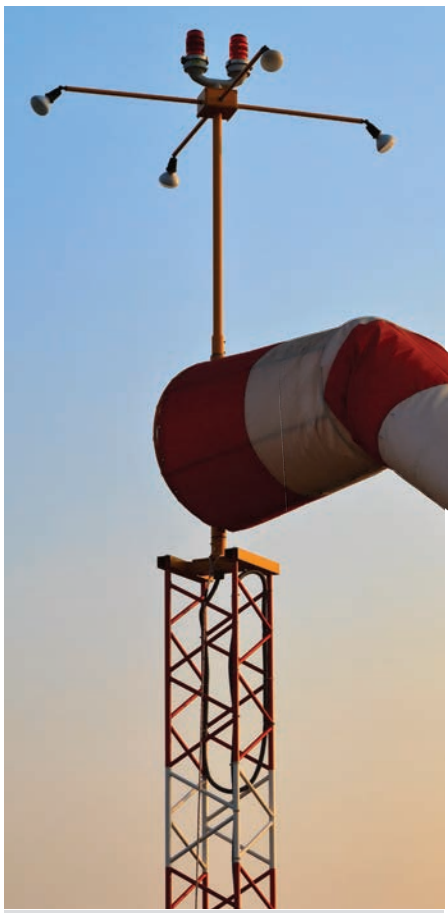
The service is divided into two forecasting centers, located in Rome and Milan Area Control Center, that provide forecasts on airports and air spaces, and observation and information for 37 meteorological offices at aerodromes.

In advance of the routine messages emitted in agreement with ICAO SaRPs, the ENAV meteorological service has developed a set of operational procedures to give warnings of critical weather phenomena affecting ATC activity at airports or terminal areas, using an extensive range of weather radar data. These procedures predict a new strategic and tactical phase. In the strategic phase, support is given to the main ATC managers by means of continuous briefing activity, in support of standard 'weather watch' information. The main goal of this side-by-side activity is the immediate translation of probabilistic meteorology information into deterministic ATM decisions, where the human forecaster still plays a key role in the decision-making activities related to planning.

In the tactical phase, specific procedures have been established for reporting the presence or forecast of adverse weather phenomena, with the aim of improving the traditional reactive actions of bad weather event recovery. For convective phenomena, extensive weather radar data is used: ENAV owns two weather radars – one north of Rome Fiumicino (LIRF) and one south of Milan Linate (LIML) – and these offer full coverage of the related terminal control area.

The forecast also includes a probabilistic assessment in terms of occurrence, introduced in accordance with the ICAO Annex 3 (and subsequently incorporated in the *Manual of Aeronautical Meteorological Practice)*, concerning the very definition of the forecast: "Owing to the variability of meteorological elements in space and time, to limitations of forecasting techniques, and to limitations caused by the definitions of some of the elements, the specific value of any of the elements given in a forecast shall be understood by the recipient to be the most probable value which the element is likely to assume during the period of the

**Aircraft lands at Milano Linate during severe weather storm**



Technology vs basic weather systems

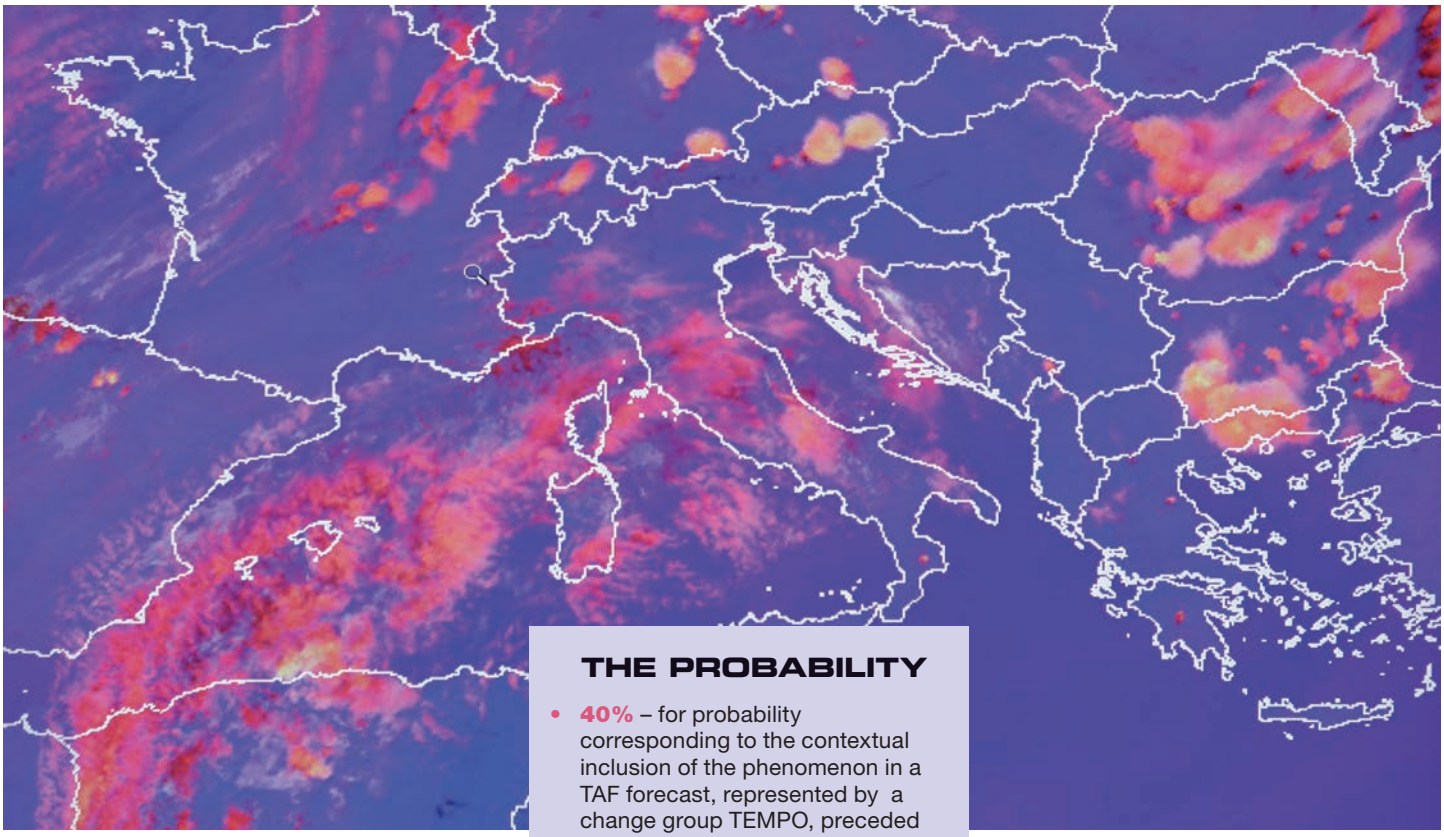
ENAV S.p.A. weather radar close to Rome Fiumicino International Airport

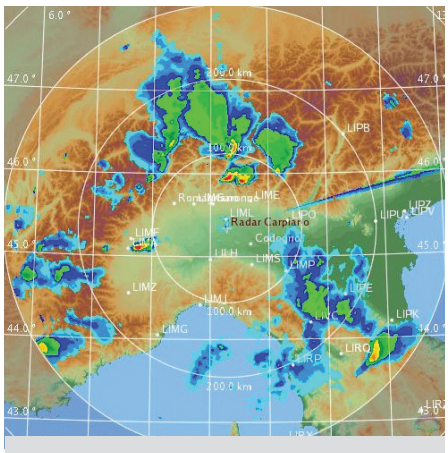
forecast. Similarly, when the time of occurrence, or change of an element, is given in a forecast, this time shall be understood to be the most probable time."

If the estimate of the value of a given parameter is to be seen as the 'most probable value' and that, in time, it will be even more probable, then it must be possible to quantify this probability and, consequently, to quantify the 'lesser probability' that the meteorologist can assign to different values for that same parameter.

Literature confirms that the estimates of the probability of a weather event can be linked not only to a numerical model, but also to the judgment of the meteorologist of the possibility that the event may occur. According to what has been reported on the user guide to ECMWF forecast products, the quality of a meteorological service can also be improved without increasing the absolute quality of its forecasts, but by trying instead to define how 'imperfect' they can be.

This idea paved the way for overcoming the traditional deterministic interpretation of weather forecasting, in favor of an innovative approach in terms of probability, seeking to add to the usual yes/no information on the future occurrence of an event and its intensity, and is also an indication of the degree of uncertainty regarding the same forecast. A probability index is thus assigned by meteorologists as a result of their general analysis, so that the ACC forecasts relate directly to the routine






**Intense thunderstorm activity over northern Italy, as detected by ENAV S.p.A. weather radar near Milan Linate Airport**

'emissions' airport forecast or warnings: in fact, as for the drafting of an hypothetical TAF or aerodrome warning, the probability index will also be set (see *Probability*, right).

It is important to stress how this particular indication of the 'probability index' has proved itself highly important from an operational perspective. It leads to an improvement of the operational ATM performances through better planning of air traffic flows in adverse meteorological conditions. This results in a considerable reduction of delays caused by weather conditions.

### THE PROBABILITY

- **40%** – for probability corresponding to the contextual inclusion of the phenomenon in a TAF forecast, represented by a change group TEMPO, preceded by a PROB40 probability indicator (a TAF is "terminal area forecast", i.e. a coded aeronautical forecast for aerodromes, with validity ranging from 9 to 30 hours, depending on the aerodrome)
- **60%** – for probability corresponding to the contextual inclusion of the phenomenon in a TAF forecast, represented by a change group TEMPO, without any probability indicator.
- **80%** – for probability corresponding to the simultaneous inclusion of the phenomenon in the main body of a TAF forecast or in a change group BECMG or FM, and/or in a TREND forecast and/or in a Aerodrome Warning (a TREND is a "landing forecast", i.e. a coded aeronautical forecast for aerodromes, with a two-hours validity).
- When the probability index is not determined, a major probability is to be considered, while the assignment of the probability index for a reported phenomenon outside an airport site will have to be made with reference to the drafting of a hypothetical TAF or aerodrome warning.

### Ground-weather-based radar report

For a better operational use of radar data related to convective phenomena, a new kind of report, named TAD (thunderstorm area detection), was introduced. TAD is also distributed to operators and flight crew members as part of the preflight information required by Annex 3.

TAD provides the following elements:

- ICAO reporting station code and sequence number;
- Validity;
- Echo intensity;
- Echo extension;
- Associated phenomena (present weather);
- Echo position;
- Top of clouds;
- Movement forecast;
- Intensity forecast;
- Remark.

The AIC A13/2008 (Dec 4, 2008) provides a detailed description of the new code. ▮

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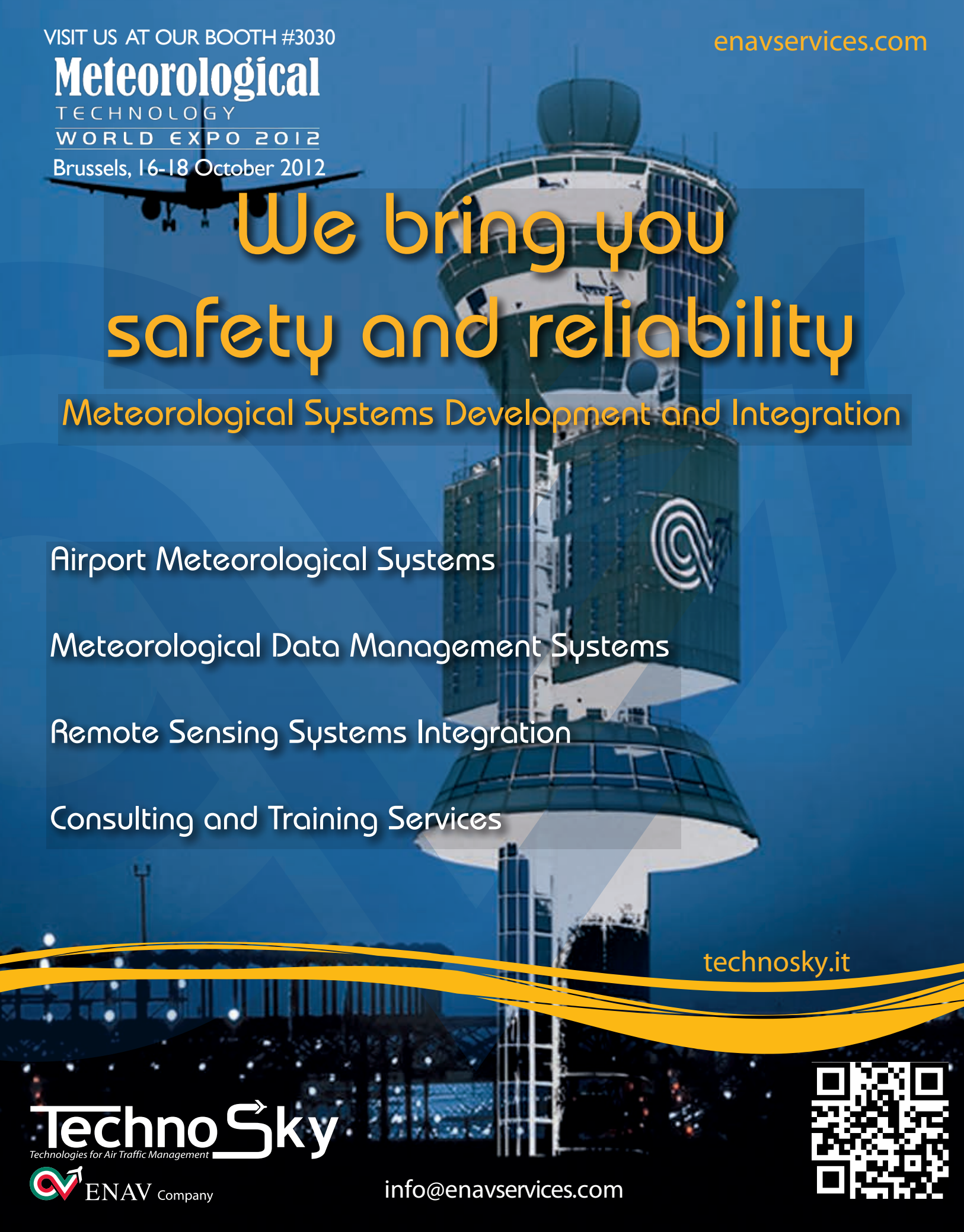
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