GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE
AEMet Agencia Estatal de Meteorología

Datos Meteorológicos a través de los radares MODE-S

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AEMET

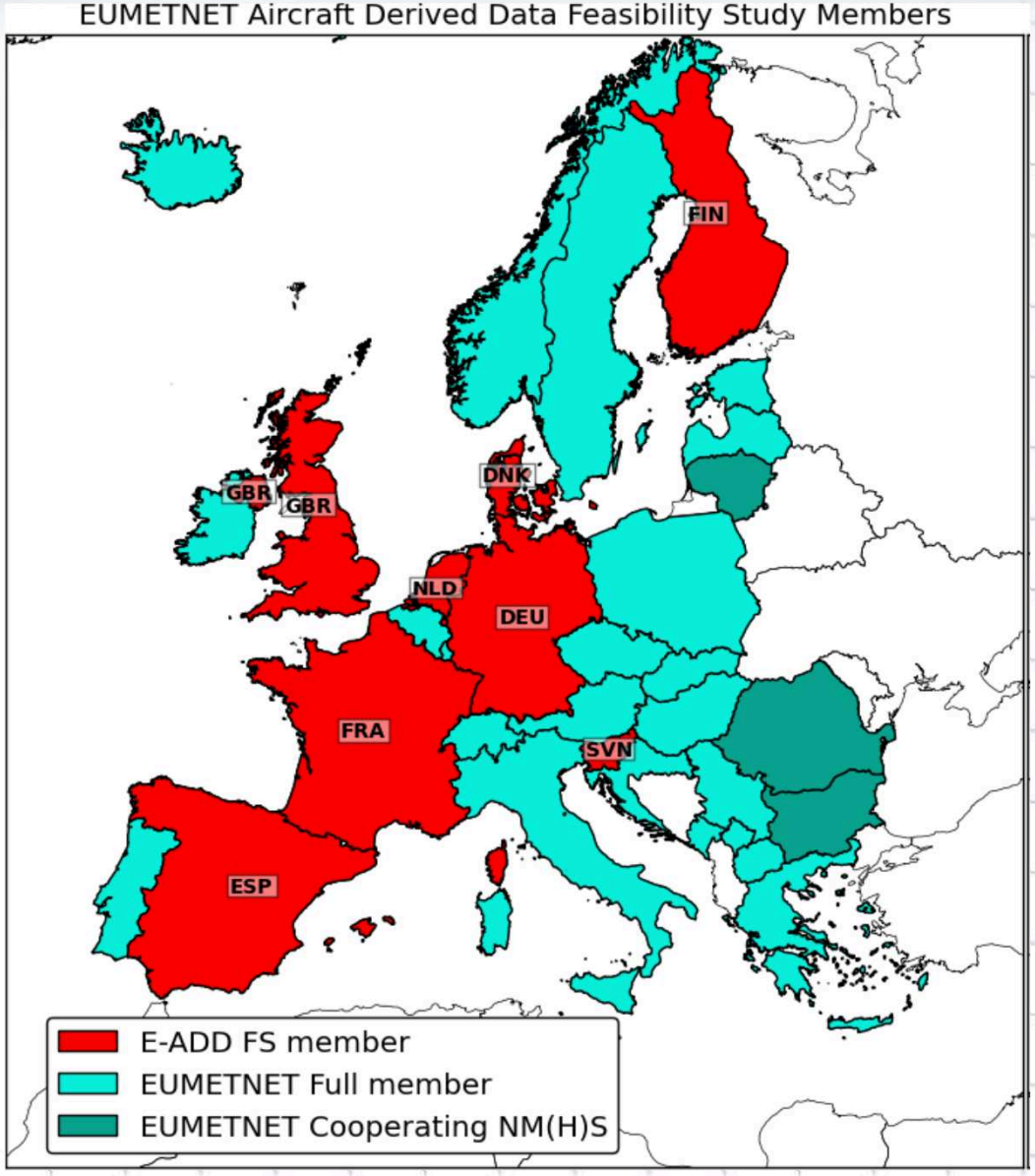
Foro de Usuarios Aeronáuticos
18 Noviembre 2015, Madrid

EUMETNET

- Es la asociación que incluye a todos los servicios meteorológicos europeos.
- Su principal finalidad es coordinar las actividades relacionadas con la Meteorología a escala europea.
- Con las contribuciones de los miembros se financian proyectos de investigación comunes.
- Puede acudir como cuerpo único a convocatorias de proyectos de investigación financiados externamente (SESAR).

AERONAÚTICA

- Una de las principales prioridades de EUMETNET es la atención a los usuarios aeronáuticos.
- En SESAR ha obtenido la gestión del paquete de trabajo sobre Meteorología operativa aplicada a la Aeronáutica.
- En el programa de observación financia el proyecto AMDAR para la instalación y uso de las observaciones meteorológicas a bordo de aeronaves (1.732.000 € para el 2016).
- Durante el 2015 se ha financiado un grupo de expertos en el uso de datos provenientes de los radares MODE-S en el ámbito de la meteorología operativa (EUMETNET Aircraft Derived Data Feasibility Study Expert Team).
- AEMET ha participado en el citado grupo.

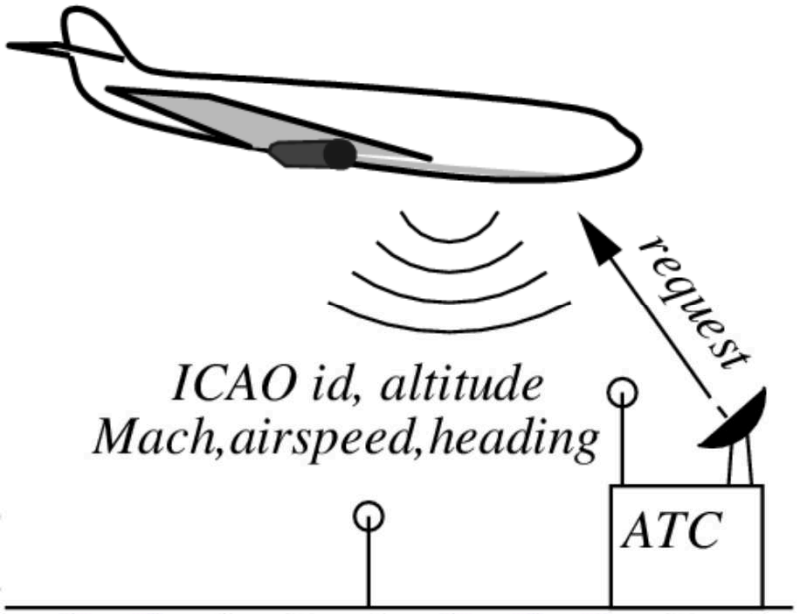


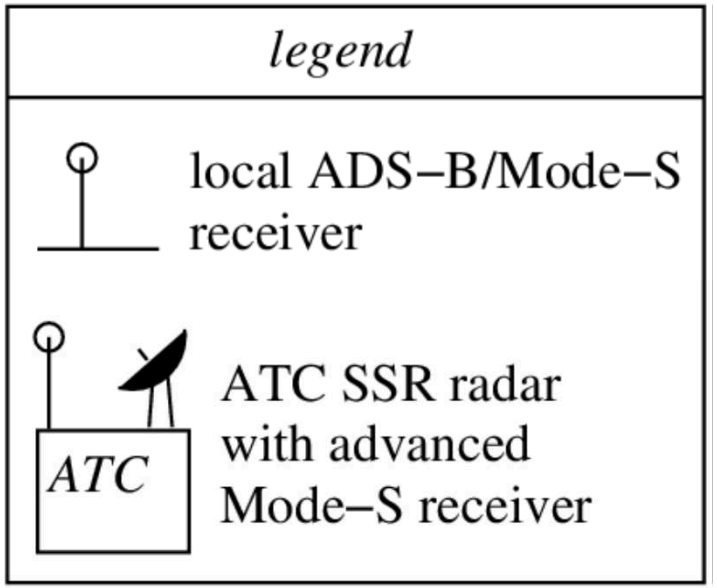
Aircraft Derived Data (ADD)

- The main objective of the EUMETNET Aircraft Derived Data (ADD) Feasibility Study is to study the feasibility of operational collection of ADD data for meteorological purposes.
- New air traffic control surveillance technology like ADS-B and Mode-S are designed to help modernize the air transportation system. They provide foundational technology for improvements related to the Single European Sky Air Traffic Management Research program (SESAR), aiming to support a larger volume of airplanes more efficiently. The European Community (EU) and EUROCONTROL are the founding members of SESAR.
- One of the objectives of the meteorological community is to obtain as many high quality meteorological observations for as little costs as possible. New air traffic control surveillance technologies present opportunities to obtain or derive wind direction, wind speed and temperature from aircraft derived data (ADD).

MODE-S

- With the exception of ADS-C and E-AMDAR data all sub-data types can be collected via local ADS-B/Mode-S receivers.
- For Mode-S data types an interrogation of an authorized body (Air Traffic Control - ATC) is a precondition.
- As already existing Air Traffic Management infrastructure is utilized there are no data communication costs involved. ADD data can be provided by ATC for free or for distribution costs.
- In situations where ATC is reluctant to provide the ADD data or asks excessive fees the meteorological community can deploy local receivers.





MODE-S EHS variables

- BDS (Comm B Data Selector) registers 4.0, 5.0 y 6.0
- Quality of derived meteorological parameters from Mode-S EHS after quality control and corrections

Meteorological parameter model	Presence	Observed	Quality	Accuracy wrt. NWP
Wind speed	Derived	All aircraft	Good	2-2.5 m/s
Wind direction	Derived	All aircraft	Good	10-15 degrees
Temperature	Derived	All aircraft	Moderate	2K

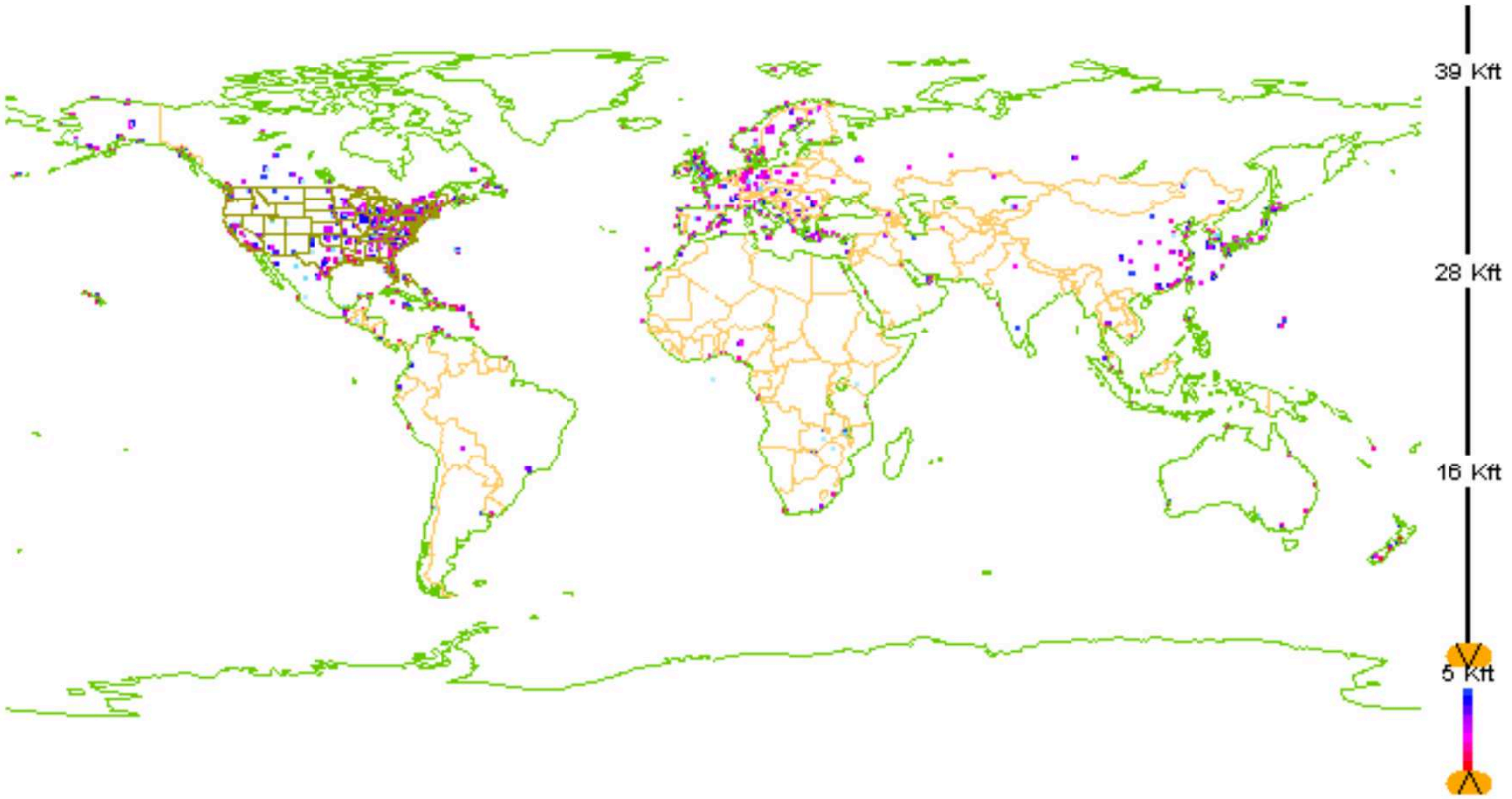
MODE-S MRAR

- BDS register 4.4
- Quality of meteorological parameters from Mode-S MRAR

Meteorological parameter	Presence	Observed	Quality	Accuracy wrt. NWP model
Wind speed	Yes	10% aircraft	Good	2-2.5 m/s
Wind direction	Yes	10% aircraft	Good	10-15 degrees
Temperature	Yes	10% aircraft	Good	1K

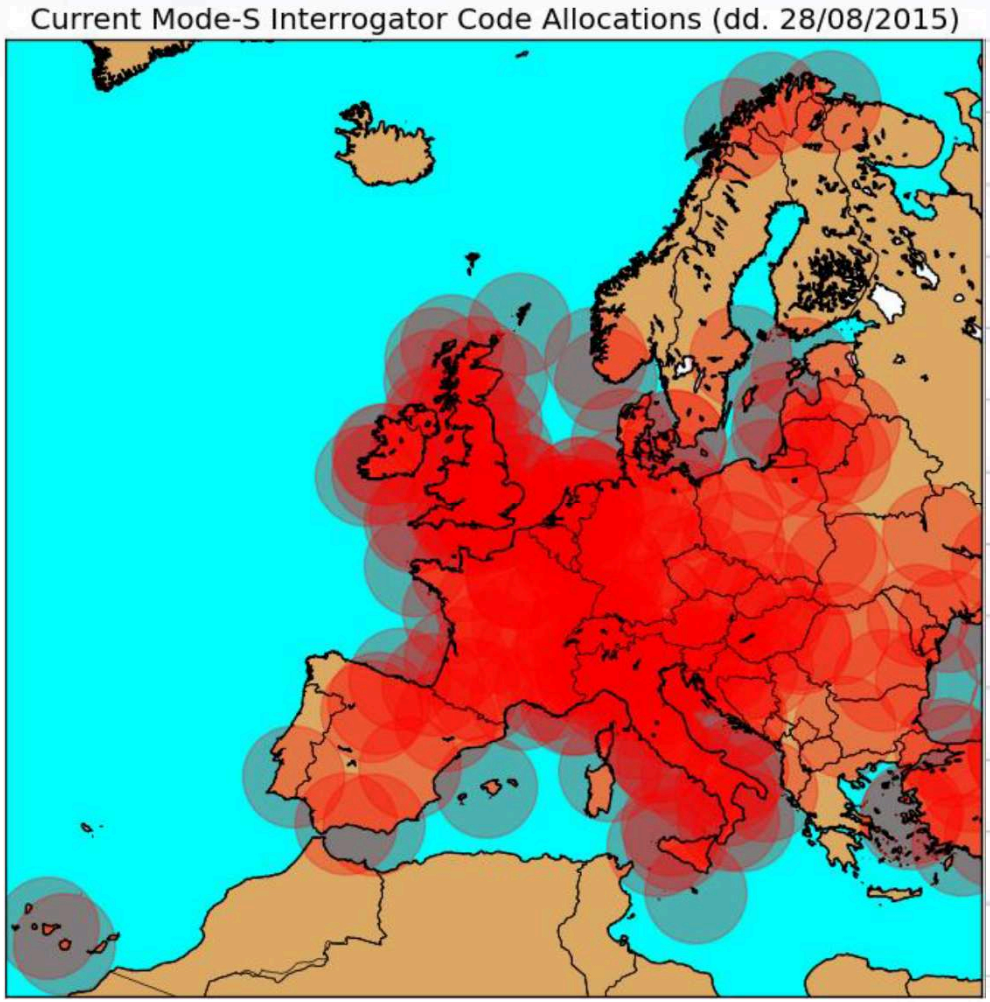
AMDAR

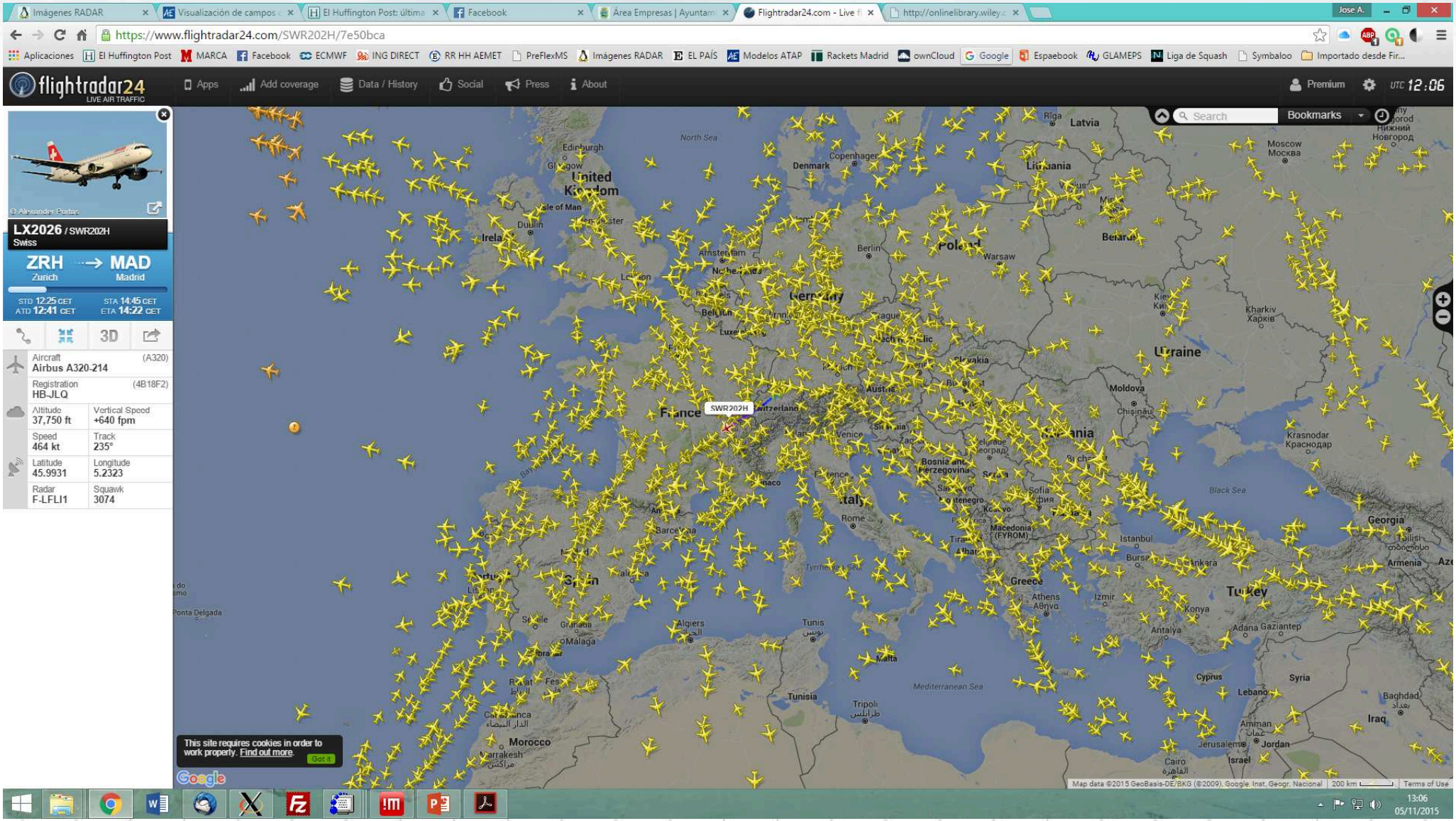
- Worldwide distribution of AMDAR measurements over 24 hours.
- The altitude range goes from ground to 5,000 ft.
- Only the locations of vertical profiles can be seen.



MODE-S Europe

The ADS-B data is routinely collected by aviation enthusiasts and provided to services such as FlightRadar24 (http://www.flightradar24.com)




https://www.flightradar24.com/SWR202H/7e50bca
flightradar24
LIVE AIR TRAFFIC
LX2026 / SWR202H
Swiss
ZRH → MAD
Zurich
Madrid
Aircraft
Airbus A320-214
(A320)
Registration
HB-JLQ
(4B18F2)
Altitude
37,750 ft
Vertical Speed
+640 fpm
Speed
464 kt
Track
235°
Latitude
45.9931
Longitude
5.2323
Radar
F-LFLI1
Squawk
3074
SWR202H
France
Switzerland
Germany
Italy
Spain
Morocco
Tunisia
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Turkey
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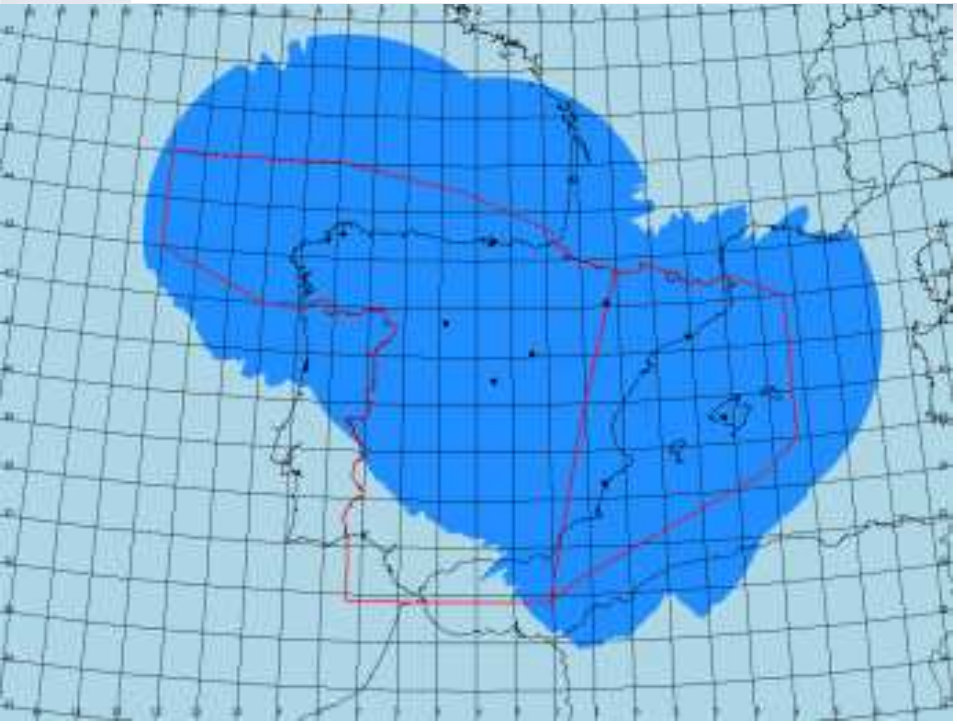
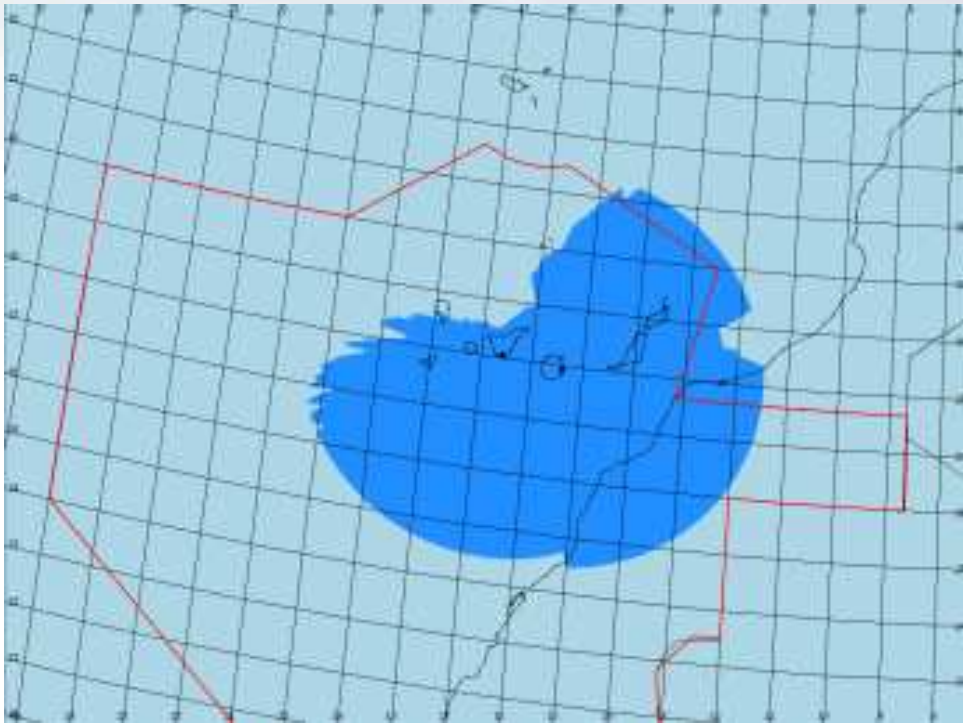
MODE-S España





The ADS-B data is routinely collected by aviation enthusiasts and provided to services such as FlightRadar24 (http://www.flightradar24.com)


flightradar24
LIVE AIR TRAFFIC
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HV6730 / TRA63N
Transavia
SVQ → AMS
Seville
Amsterdam
STD 12:45 CET
ATD 12:49 CET
STA 15:45 CET
ETA 15:36 CET
3D
Aircraft
Boeing 737-8K2
(B738)
Registration
PH-HZO
(484506)
Altitude
36,000 ft
Vertical Speed
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Speed
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Track
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Latitude
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Longitude
-4.9002
Radar
F-LESA3
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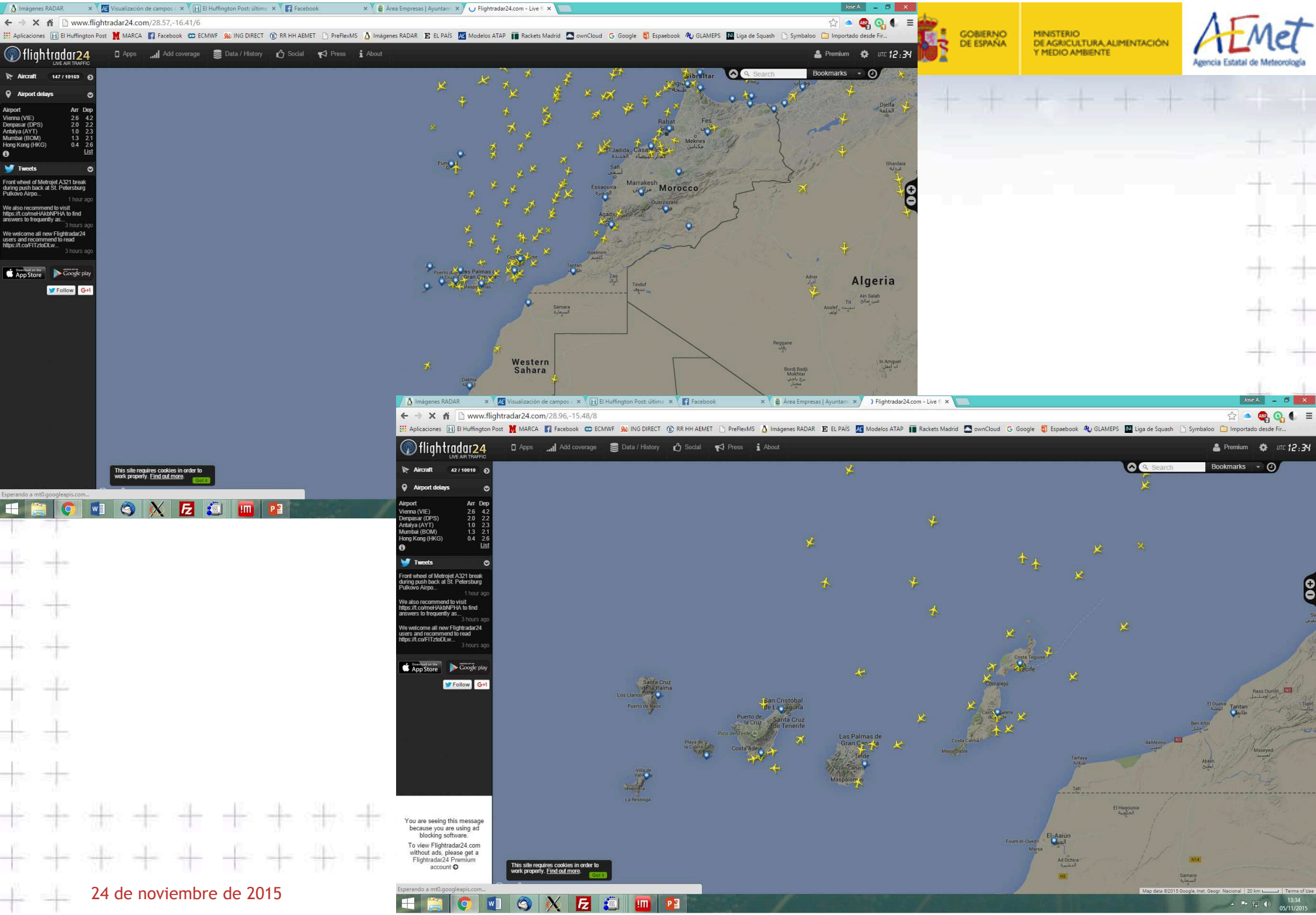
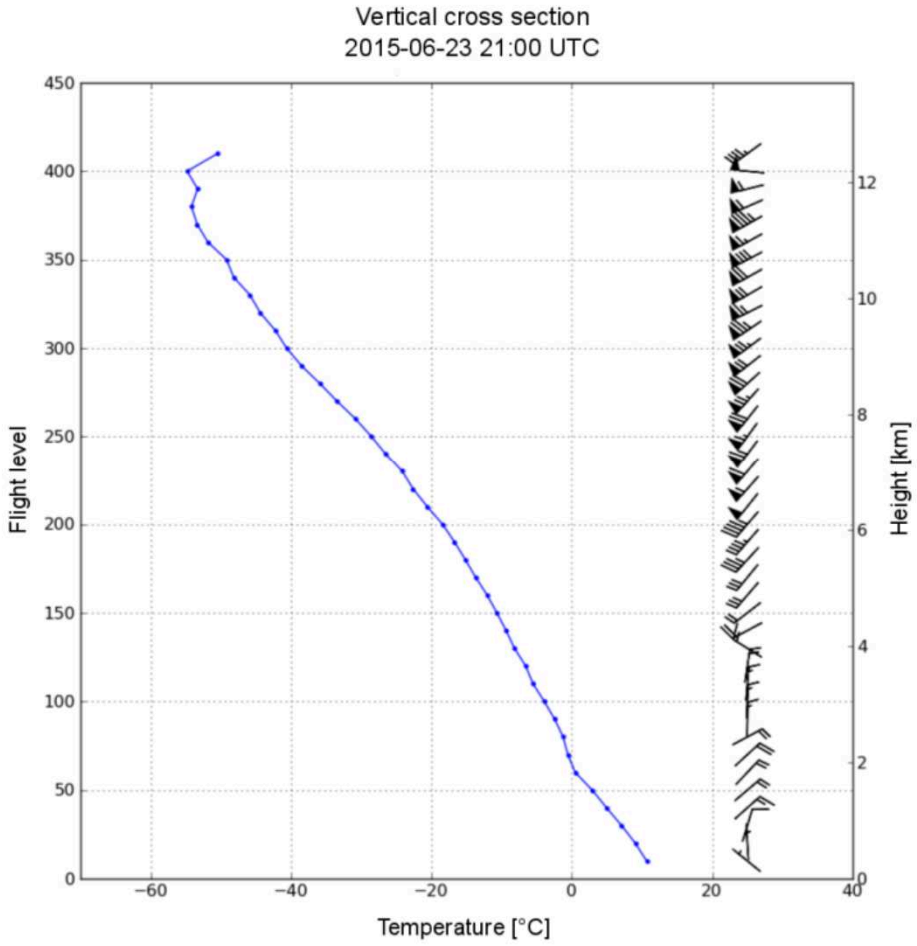


24 de noviembre de 2015

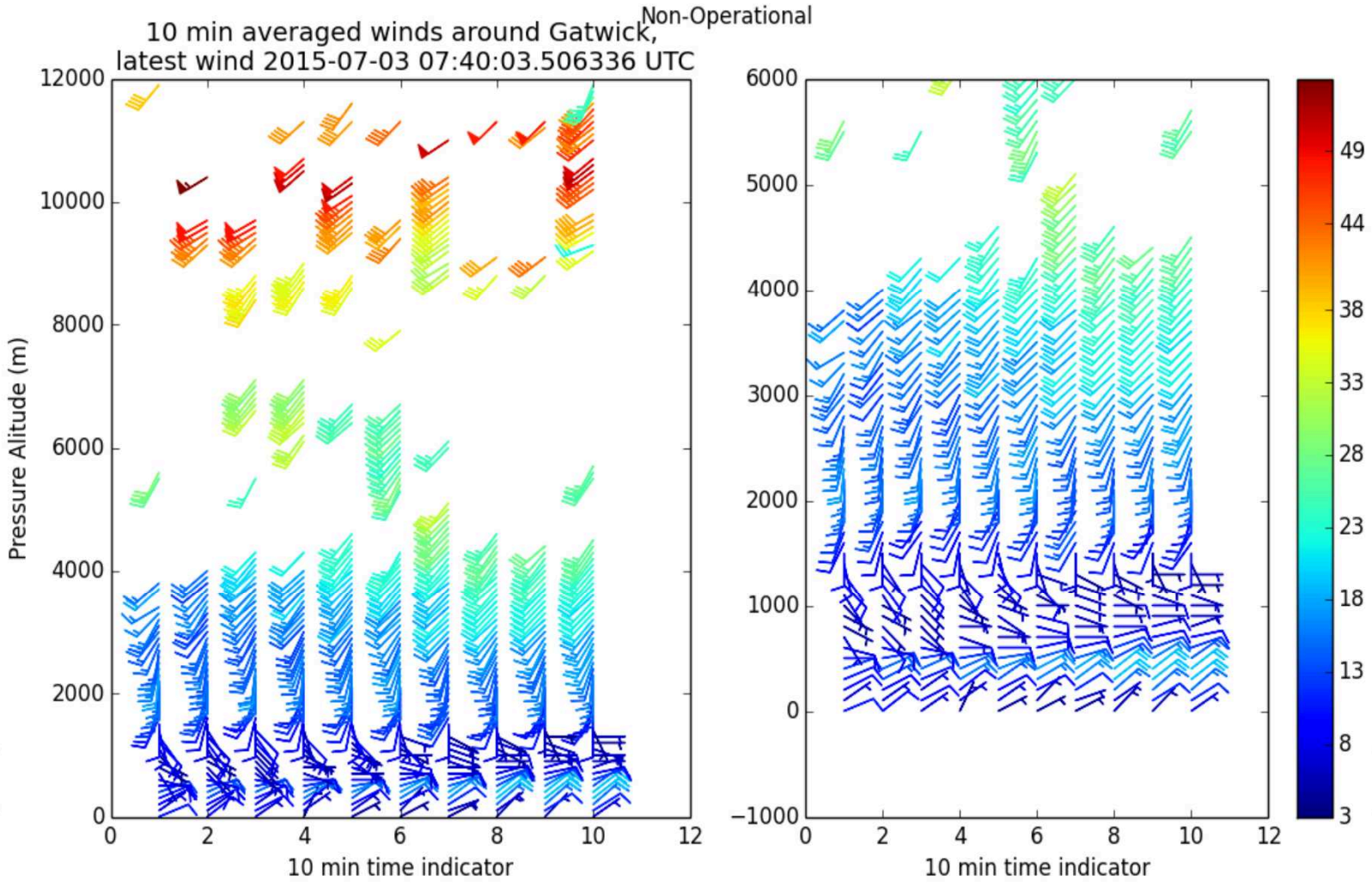
Predicción Aeronáutica Operativa

- Vertical profile of smoothed 3-hourly average of Mode-S MRAR temperature and winds as visualized at ATC of Slovenia.



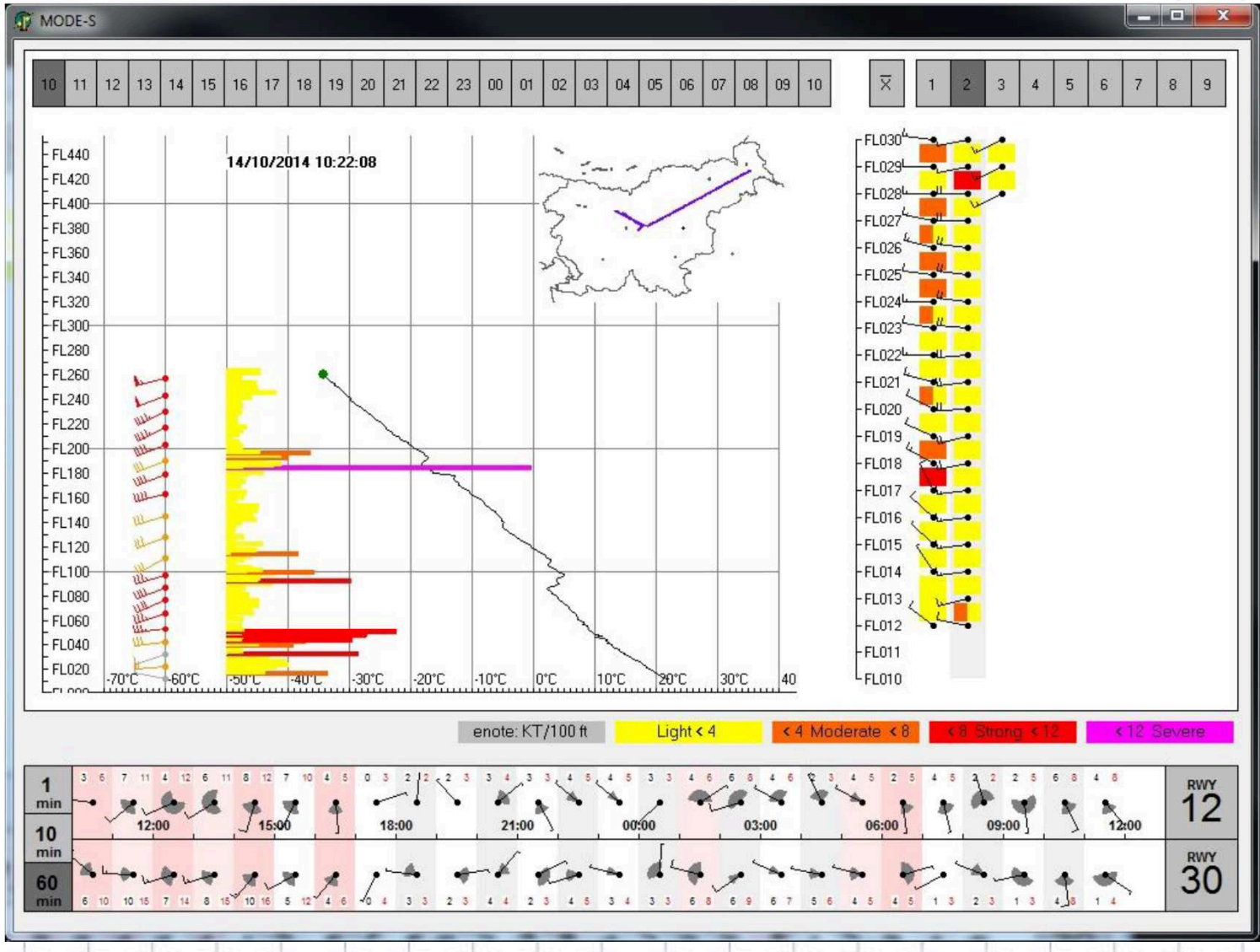
Predicción Aeronáutica Operativa

- Mode-S EHS (Mode-S/ADS-B) wind data plotted over London Gatwick airport.
- Each profile is a 10 min average of data in altitude bins of 100 ft.
- The latest data is shown on the left of each graph.
- The right hand graph shows a zoomed in view of the lower atmosphere.



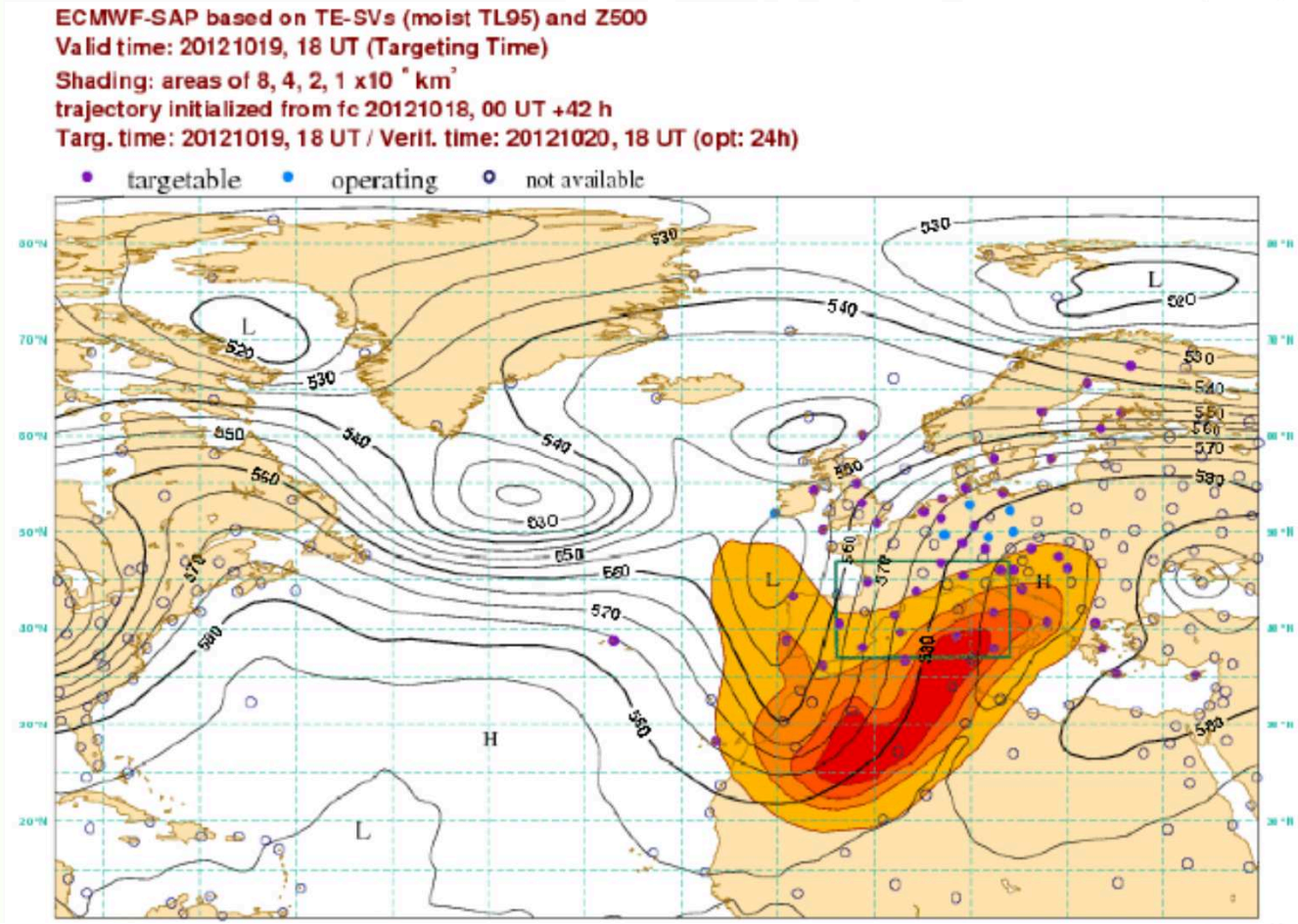
Predicción Aeronáutica Operativa

- Vertical profile of Mode-S MRAR temperature and winds with indication of wind shear in colors.
- The wind shear can be computed as hourly average or separately for each flight.
- The application is used operationally at aviation forecasting department of SEA



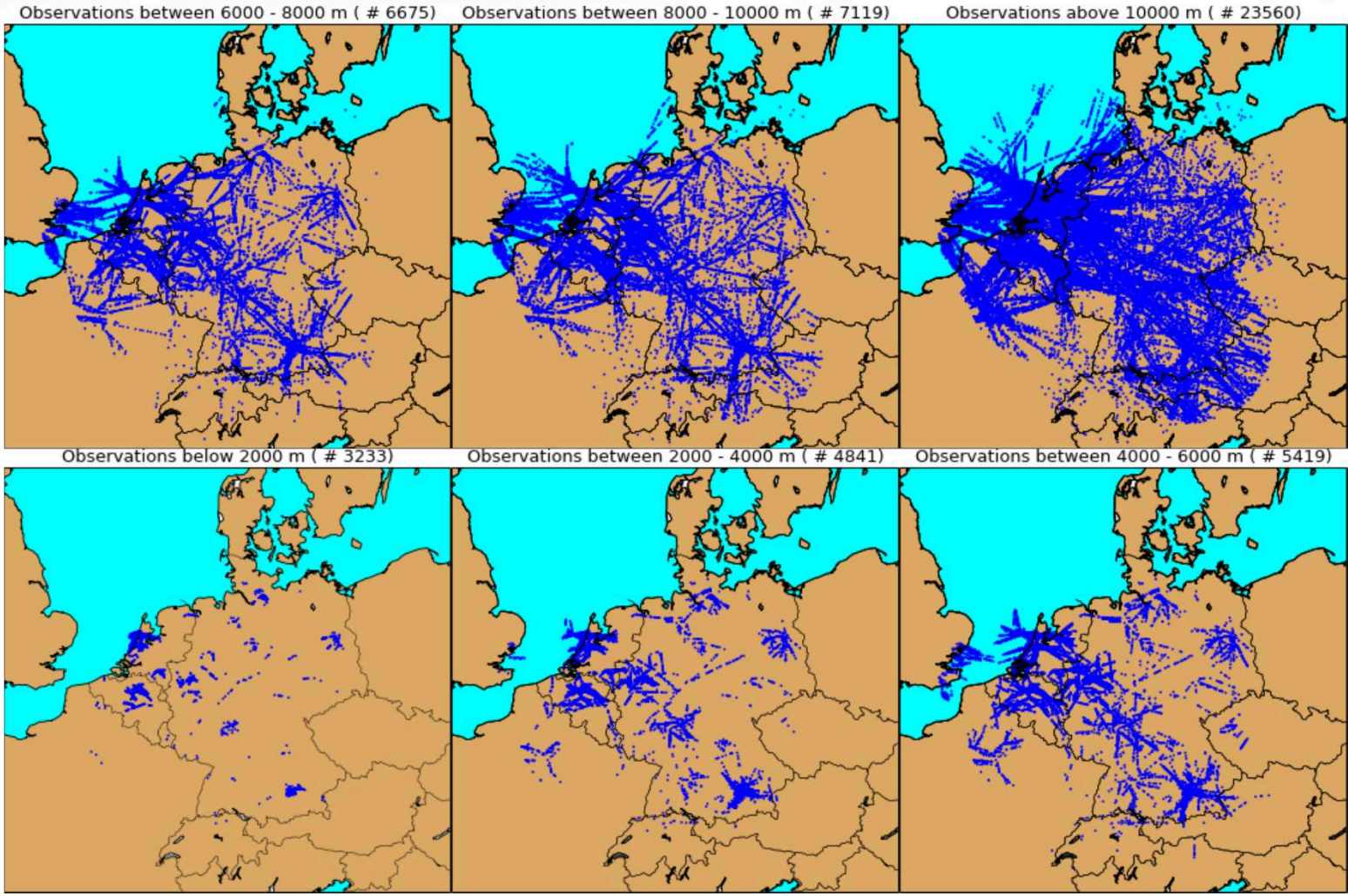
Modelos Numéricos de Predicción del tiempo

- Sensitive Area Prediction (SAP) for a blocking case.



Modelos Numéricos de Predicción del tiempo

- ADD data coverage over Europe.
- Data assimilated by the KNMI operational model.



Assimilation of High-Resolution Mode-S Wind and Temperature Observations in a Regional NWP Model for Nowcasting Applications

SIEBREN DE HAAN AND AD STOFFELEN

KNMI, De Bilt, Netherlands

(Manuscript received 22 August 2011, in final form 6 January 2012)

ABSTRACT

In this paper the beneficial impacts of high-resolution (in space and time) wind and temperature observations from aircraft on very short-range numerical weather forecasting are presented. The observations are retrieved using the tracking and ranging radar from the air traffic control facility at Schiphol Airport, Amsterdam, the Netherlands. This enhanced surveillance radar tracks all aircraft in sight every 4 s, generating one million wind and temperature observations per day in a radius of 270 km around the radar. Nowcasting applications will benefit from improved three-dimensional wind fields. When these observations are assimilated into a numerical model with an hourly update cycle, the short-range three-dimensional wind field forecasts match the observations better than those from an operational forecast cycle, which is updated every 3 h. The positive impact on wind in the first hours of the forecast gradually turns into a neutral impact, when compared to other wind and temperature observations. The timeliness of the forecasts combined with the high resolution of the observations are the main reasons for the observed nowcasting benefits. All in all, the assimilation of high-resolution wind (and temperature) observations is found to be beneficial for nowcasting and short-range forecasts up to 2–3 h.

REF – Sin MODE-S

Con MODE-S

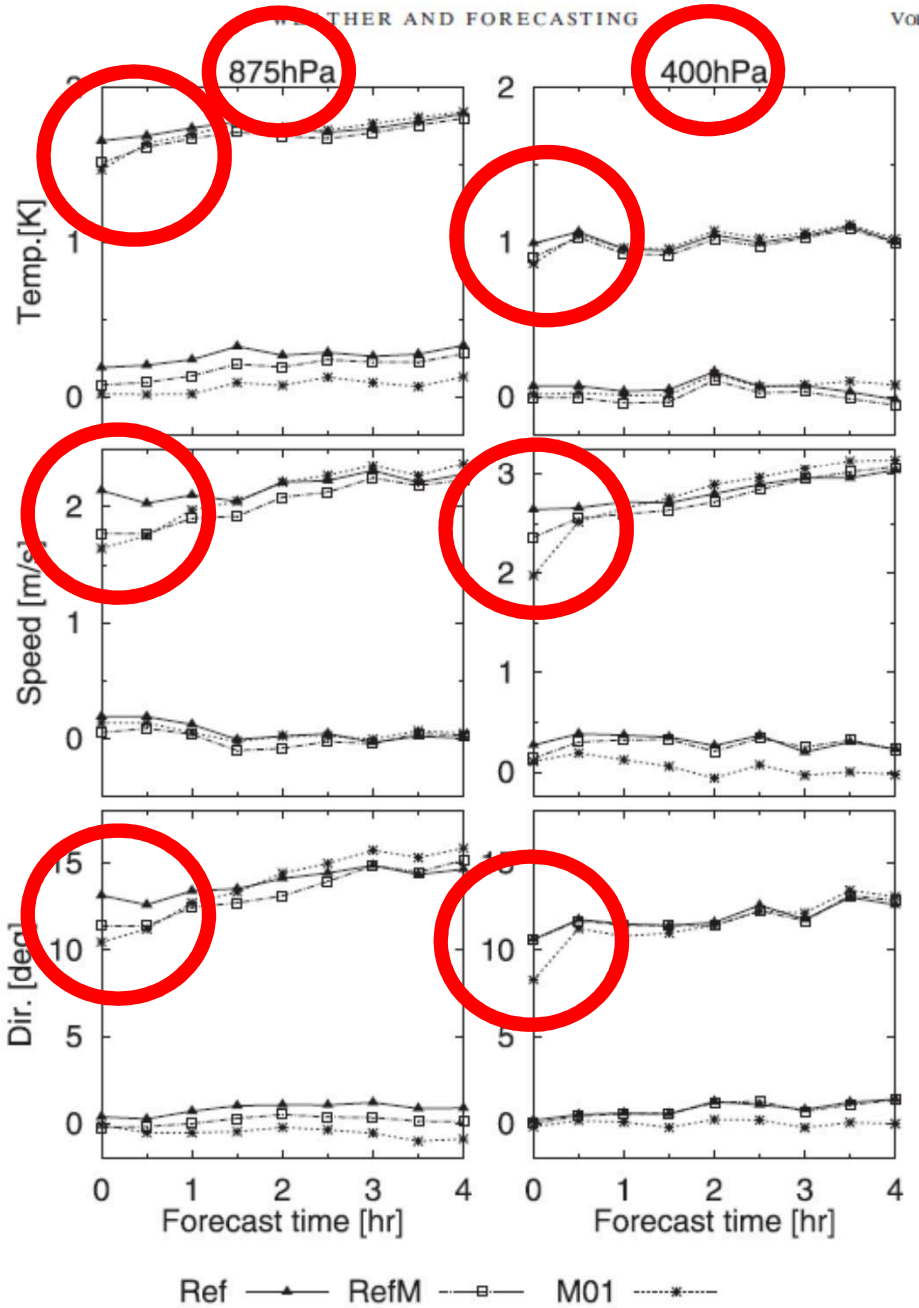


FIG. 9. Statistics for the comparison of the model forecasts against Mode-S observations at the full and half hour for experiments Ref, RefM, and M01 at the (left) 875- and (right) 400-hPa levels. The bias and RMS are plotted for (top to bottom) temperature, wind speed, and wind direction. Thick lines represent the RMS; thin lines (lowest values) denote the bias between the model and observations.