Royal Netherlands
Meteorological Institute
*Ministry of Infrastructure
and Water Management*

EMADDC update on COVID-19
April 30th 2020

COVID-19
The COVID-19 pandemic has a significant impact on the quantity and quality of weather observations and forecasts, as well as atmospheric and climate monitoring (see WMO press release). Most notably the significant decrease in air traffic has had a clear impact. In-flight measurements of air temperature and wind speed and direction are a very important source of information for both weather prediction and climate monitoring. In Europe the decrease in the number of commercial flights has resulted in a reduction of around eighty percent of observations of meteorological measurements from aircraft platforms over the last couple of weeks.

About EMADDC
The acronym EMADDC stands for the European Meteorological Aircraft Derived Data Center that is operated by KNMI. The objective is to obtain as many high quality meteorological upper air observations across the whole of Europe for as little cost as possible. This is accomplished by running an operational service for collecting, processing, and disseminating Aircraft Derived Data such as Mode-S EHS and MRAR into quality controlled upper air observations of wind direction, wind speed and air temperature.

Currently EMADDC version 1.0 is operational and processes data provided by EUROCONTROL MUAC for the Benelux and Germany area. The system is developed and operated using the DTAP (development, test, acceptance and production server) philosophy. The EMADDC program is a SESAR Deployment Project run by KNMI and supported by the UK Met Office. As of 2021 it is anticipated that EMADDC will become a module of the EUMETNET Aircraft Based Observation (E-ABO) Programme.

EMADDC and COVID-19
The sharp drop of AMDAR observations in Europe due to COVID-19 resulted in a request from EUMETNET PFAC and STAC to KNMI to provide additional upper air observations via EMADDC to EUMETNET Members. In order to facilitate this request at short notice the EMADDC team came up with the solution to process all available operational and test data streams on the EMADDC TEST server. As of April 24th the EMADDC TEST system now produces regularly (every 15 minutes) a WMO 7 BUFR and ASCII file containing all derived observations with a latency of on average 15 minutes and is available via KNMI FTP server. The service will be provided on a best effort basis for the duration of the COVID-19 situation.

The amount of EMADDC observations in COVID-19 situation compared to AMDAR is significant as is shown below in figure 1. The new software version of EMADDC TEST compared to the operational EMADDC system results in significantly more input quality controlled derived observations. The majority of the observations are above FL100 as shown in figure 2.
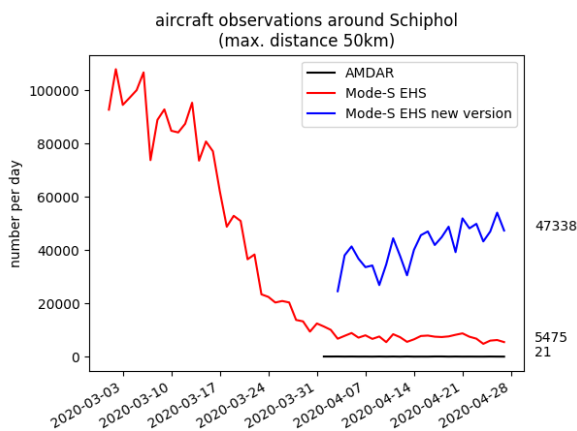
Figure 1: Daily amount of AMDAR and EMADDC Mode-S EHS derived observations around Schiphol. Clearly shown is the significant difference in the number of observations between AMDAR and EMADDC.
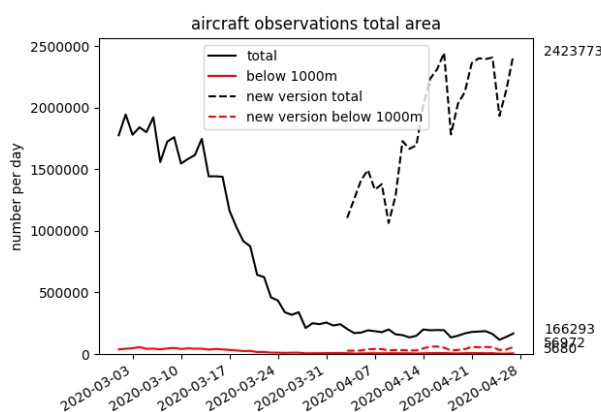

Figure 2: Daily amount of all EMADDC Mode-S EHS derived observations in Europe. Clearly shown is the significant difference in the number of derived observations between the operational and EMADDC TEST system. This can be explained by the larger area (Benelux and Germany compared to Europe) and the updated correction algorithms that utilize more of the available data.

EMADDC technical details

The TEST system uses the most recent developed correction algorithms for heading and temperature correction as presented by Dr. Siebren de Haan at the EUMETNET/ECWMF ABO workshop in February 2020 in Reading. The heading correction algorithm assesses the magnetic declination table used on board at each individual aircraft and is geographical independent, thus enabling processing data from every geographical location. The temperature correction algorithm calculates the Mach number based on IAS and pressure, after which Temperature is derived from Mach and TAS. The derived Temperature is averaged by using five calculated derived Temperatures of this specific aircraft in a small time window. Averaging between aircraft is not performed at this stage, this is only applicable when vertical profiles are being generated.

Black listing of aircraft, as is done at the operational EMADDC system, is not performed at this stage and is foreseen to be implemented in one of the next versions. The aircraft-ID are anonymized on request of data stream suppliers, although discussions are on-going to make aircraft-ID available in the future.

A status report of the TEST server is produced daily, and an example of this status report is enclosed as an appendix. The report provides an overview of the number and statistics of the last 7 days. The statistics are the observation minus model forecast bias and standard deviation for wind direction, wind speed and temperature of all data streams and per data stream provider. As well as coverage plots of all data streams for all levels and coverage plots per provider.

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and Water Management

EMADDC surveillance data providers

Surveillance data used by EMADDC can be provided by air traffic control organizations, or by parties that have their own local ADSB/Mode-S receivers in place. Currently EMADDC receives surveillance data from the following partners: EUROCONTROL MUAC, AIR SUPPORT A/S Denmark, Austro Control, DMI, ENAIRE / AEMET, Meteo France, Met Eireann, METNO, Romatsa, and Met Office. For the specific duration of the COVID-19 situation all partners authorized EMADDC to use their data and make the operational output available. This is highly appreciated by EMADDC and the MET community.
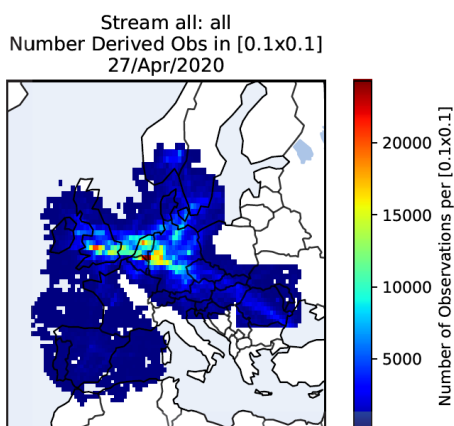

Figure 3: Coverage plot providing a geographical overview of all available data provided by all data providers.

EMADDC next steps

The COVID-19 situation has impacted the planning of the EMADDC project. On the agenda are the following topics that will be addressed in the coming year(s).

- Integration into the EUMETNET Aircraft Based Observation Programme;
- Geographical expansion through new data providers, roll out of local ADS-B/Mode-S receivers and expanding with current data providers as e.g. Air Support Denmark;
- Realization of NewPENS connection to collect ATS data and move to near real time processing instead of batch processing every 15 minutes;
- Execution of business case to see if EMADDC can be hosted in the cloud (AWS);
- Implementation of output quality control next to the current input quality control;
- The launch of the EMADDC website;
- The realization of a data portal (web services) at the end of 2020; and
- Further research on ADS-C data and turbulence.

Getting access to EMADDC data

The EMADDC output is made available to ECMWF and EUMETNET Members via KNMI FTP server. A prerequisite is the signing of a standard NDA to respect the conditions under which the data are to be used. Non-EUMETNET Members that are interested to use the data can submit a request to KNMI EMADDC via email at mode-s@knmi.nl

On behalf of the KNMI EMADDC team, Siebren de Haan, Paul de Jong, Michal Koutek, Sander Noorman, Ruud Vink, KNMI colleagues in the support departments and SSC CAMPUS.

Jan Sondij MBA
Programme Manager EMADDC