CDG airport
Final report

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Content

- Paris-CDG airport
- Impacting weather
- Aviation community needs
- AvRDP Study Approach
- Major outcomes
- Benefits to the aviation community
- Contribution to ASBU
- Future plans and studies

Paris-Charles de Gaulle airport

Source GROUPE ADP

Airport Infrastructure Information

- Surface : 3,200 ha
- 2 pairs of runways – dedicated mode DEP/ARR (scheduled capacity: 120 mvts/h)
- 110 km Taxiways
- 8 ILS CAT.III
- 9 passenger terminals
- 2 cargo hubs

Statistics 2017

- 69.5 M passengers
- 475,000 movements
- 1,400 mvts per day
- RWY throughput: ARR 73 / DEP 76
- 146 Airlines

Weather environment

- Fog/low ceilings - Low Visibility Procedures
- Snow

Winter 17/18 : 19 d – 30 cm
Winter 12/13 : 30 d – 59 cm
Winter 10/11 : 23 d – 30 cm

ATC Infrastructure

1 approach room, 3 control towers,

2 apron control centers

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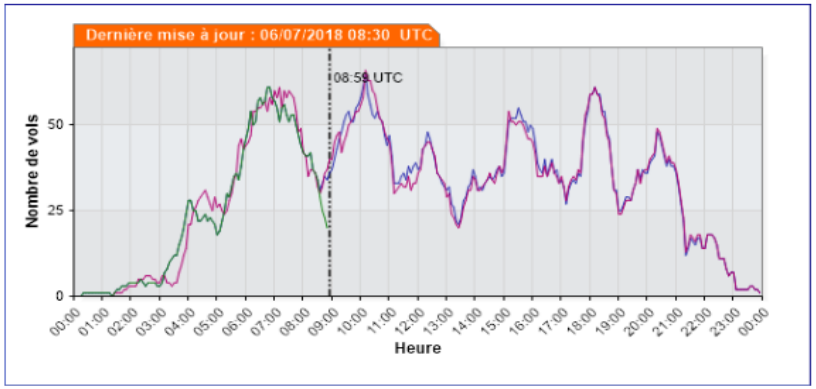
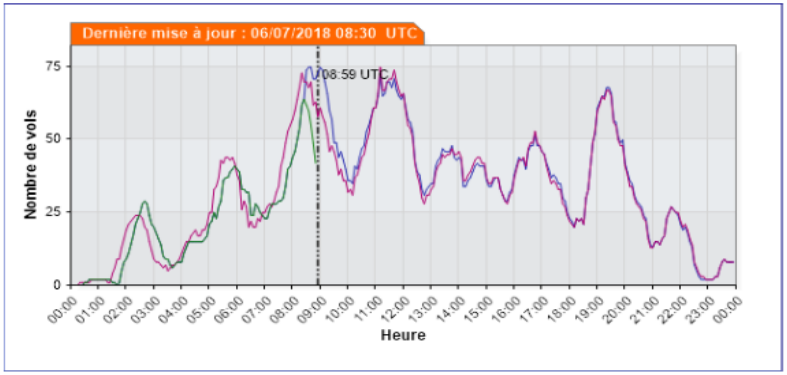
Paris-Charles de Gaulle airport

Source GROUPE ADP

Arrivals



Departures



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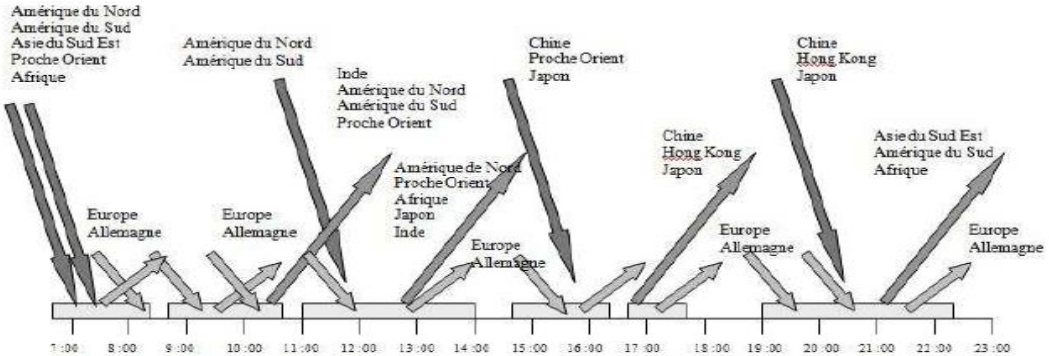
Hub Structure for half of traffic



About 1,400 flights per day

2 aircrafts per min at peak hours

RWY throughput: 73 ARR/h – 76 DEP/h

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Impacting weather

Fog

Low ceilings and visibility due to fog and stratus are primary causes of airline delays (~40%) and terminal area disruption.

During low ceiling and/or low visibility conditions, arrival capacity can drop down up to 39 aircrafts per hour (instead of 73).

After one hour of LVP conditions, 27 aircrafts (among 66 in normal conditions) are in stack areas and the delay for the 27th one is around 42 minutes!

Average number of days per year with fog at Paris-CDG: 40 days, most during Fall and Winter (Oct-Dec)

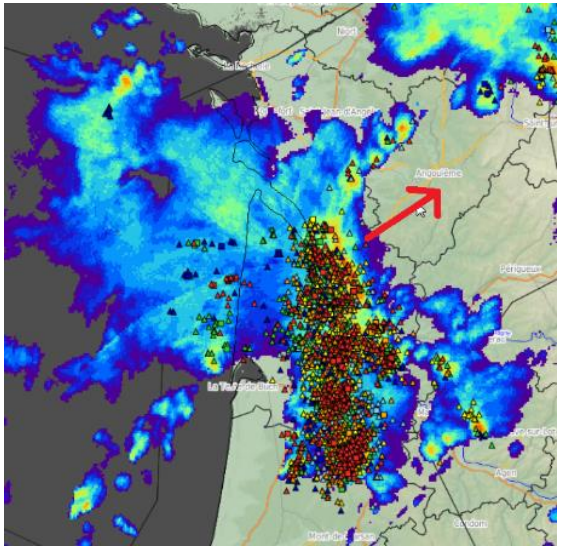
Impacting weather

Convection

It causes landing or take-off delays, modifying approaches, is dangerous for ground personnel.

Ex. 10 August 2014, between 12h and 15hUTC.

SEV TS with gusts over 40kt;
Impact on arrivals was a 12 min stand-by in landing operations;
Delays in departures with no take-off during 11 min;
And 17-min interruption of Air France ground operations



Impacting weather

Winter weather i.e. cold temperatures/ground and aircraft icing/snow/freezing precipitation etc.
These phenomena cause delays and flight cancellations at the airport. Even a light snow fall can cause terminal area disruption.

During the famous 2-day non-stop snow event in Dec 2003:

- 25% flights were cancelled;
- Delays were more than 2 hours per flight
- Around 5,000 passengers were stuck inside terminals and 5,000 were in hotels!

A very disruptive event that could occur again, knowing that during winter 2017/2018 a total of 19 days with snow were registered (19cm cumulative snow layer thickness).

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ATM/Airline/Pilot/Aviation Community Needs

Since 2003, airports became bottlenecks

Congestion Point between airport & en-route delays

ATM/Airline/Pilot/Aviation Community Needs

Single European Sky

European traffic is due to triple by 2025:

→ Triple the capacity

→ Reduce ATM costs by 50% per flight

→ Increase safety by a factor 10

→ Reduce the environmental impact per flight by 10%

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ATM/Airline/Pilot/Aviation Community Needs

During the Dec 2003 snow event at Paris-CDG stakeholders used to work in silos, without any coordination and information sharing.

⇒ a costly experience !!! ☹

In 2004 main actors on that platform decided to launch the CDM@CDG program in order to deploy the Airport Collaborative Decision Making (A-CDM) concept with Eurocontrol rules and in line with the SES requirements, in order :

- *to reduce delays,*
- *to improve departures and arrivals predictability (Network Manager)*
- *to reduce taxi-time, kerosene consumption and polluting emissions, and*
- *to optimize airport capacities and resources usage*.

"Enablers" were operational collaboration between stakeholders, in particular reinforced sharing of information including meteorological information

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ATM/Airline/Pilot/Aviation Community Needs

⇒ Enhanced meteorological information (in comparison to existing old-fashioned legacy products) with a finer temporal and spatial resolution, a higher accuracy and updated as often as the meteorological situation would require *(event-driven update; not when model outputs are available!)*

⇒ More communication towards platform stakeholders for a better understanding of the situation; this could mean involving airport met experts (managers or forecasters) physically participating to CDM operational units such as a crisis cell;

⇒ The development of tools to meet customer needs and expectations. At Paris-CDG a dedicated MET working group was set up for that purpose; and

⇒ A good level of sharing of MET information for pro activity, between all stakeholders, aiming at a common situational awareness.

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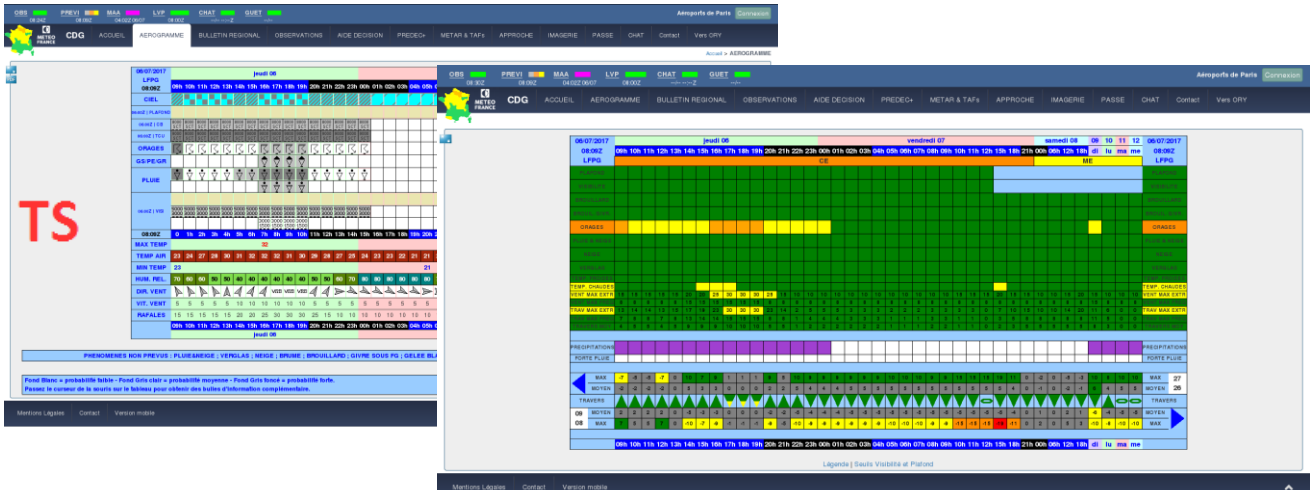
ATM/Airline/Pilot/Aviation Community Needs

As a response to CDM users' needs at Paris-CDG, an innovative solution for Paris-CDG operations, allowing a common weather hazard awareness: the CDM@CDG website

Impact of weather on terminal area and platform operations is ‘taken into account’. First steps in translation of MET information into impact…

⇒ Latest science and forecasting techniques, esp. nowcasting
⇒ First steps for inclusion of probabilistic information
⇒ Human expertise
⇒ Fine temporal resolution and a high refresh rate.



Ref. AvRDP Training workshop, Oct 2018 Presentation on CDM@CDG

AvRDP Study Approach

Focus on fog/low visibility and winter weather; studies of several events with remarkable impact

As for Phase I (MET capabilities):

1st IOP Winter Dec 2015 – Mar 2016

Fog/Low visibility; surface and aircraft icing; wintry precipitations

2nd IOP Winter Dec 2016 – Mar 2017

Icing fog; Freezing rain, ice on ground; Pollution/industrial snow

As for Phase II (MET-ATM impact translation):

3rd IOP Winter Jan 2019

Fog/Low visibility; surface and aircraft icing; wintry precipitations

For each study, ATM data was provided : arrival/departure rate, airport capacity (expected and actual nb of landings/take-off), nb of de-icing ops, rolling time,

Ref. AvRDP CDG airport reports (one per IOP)

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Outcomes

Main Météo-France NWP systems for CDM@CDG:

AROME-NWC: Meteo-France's nowcast NWP model

- Runs hourly
- High spatial resolution: **1.3km** grid point and 90 vertical levels
- High temporal resolution: forecasts range from +30min up to +6h every 15 minutes
- A European domain centered around France.
- At each run time H, a data assimilation window of [H-10min, H+10min] and 20 minutes of processing before ouputs are available.
- *At the moment*, AROME-NWC is non-cycled (initialization from the mesoscale model AROME-France).
- Non-hydrostatic physical scheme and a complex microphysical scheme called ICE3 comprising 3 frozen hydrometeor categories (pristine ice, snow, and graupel).
- Several diagnoses: fog risk, snow + stratocumulus snow (called industrial snow), freezing rain and freezing drizzle in warm front conditions, supercell index, etc.

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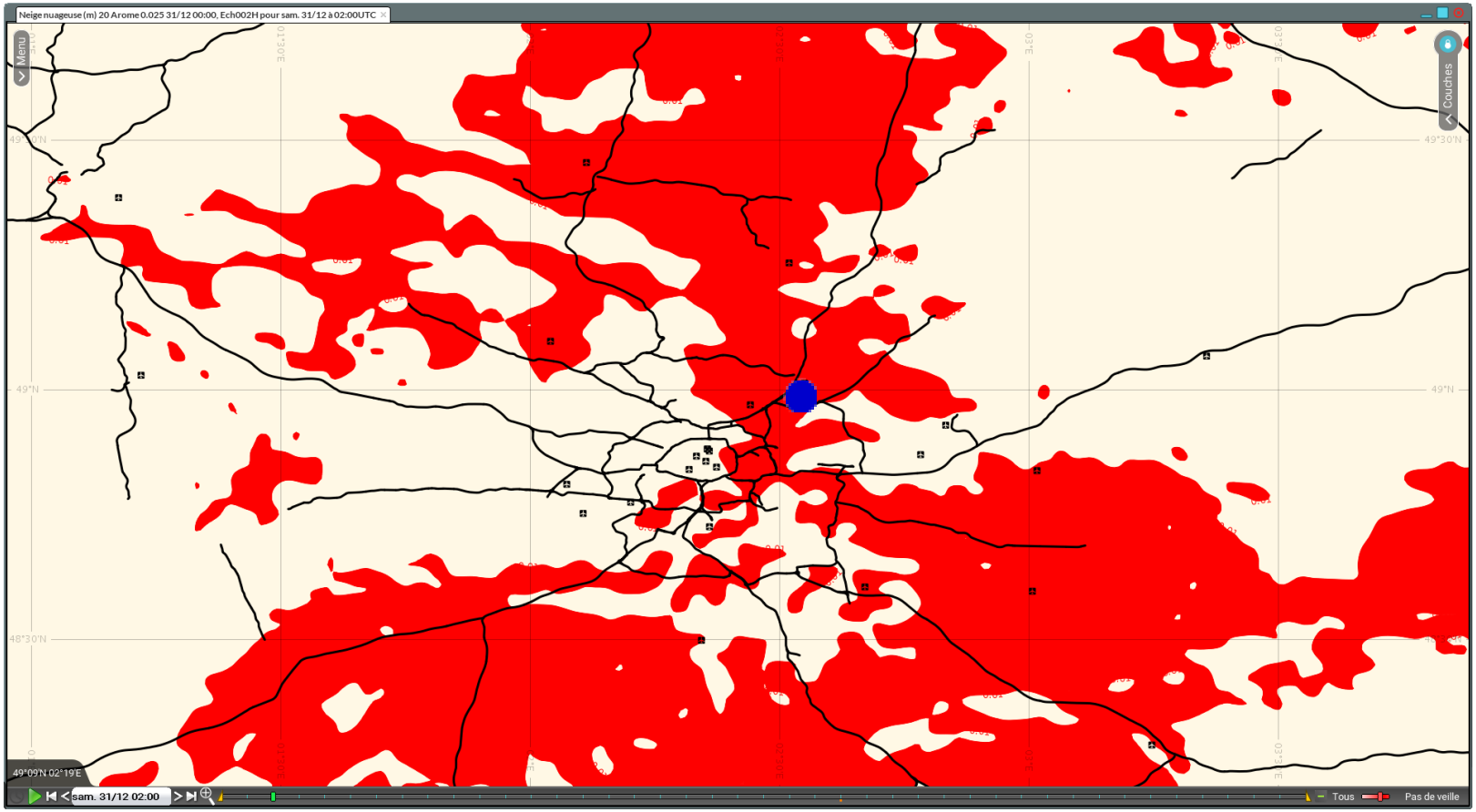
Outcomes



Snow field (20m above ground) from the AROME-France model on December 2016, 31st at 02Z (run of December, 31st at 0Z)

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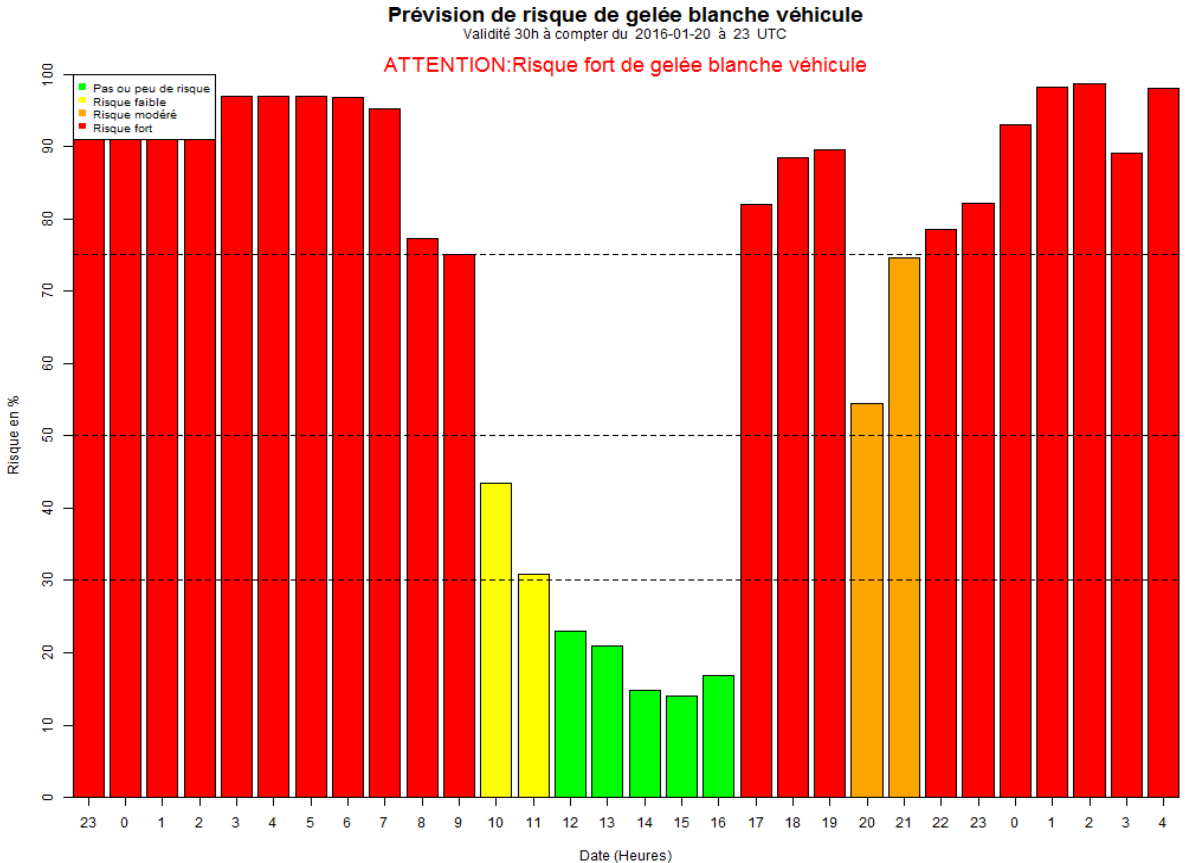
Outcomes

Main Météo-France NWP systems for CDM@CDG:

ANTIGEL: on-ground vehicle icing probabilities

- Statistical algorithm based on surface temperature, humidity, wind, and cloud amount from NWP models and forecaster's expertise
- Histogram of hourly vehicle icing probabilities up to 30 hours of forecast.



Outcomes

Main Météo-France NWP systems for CDM@CDG:

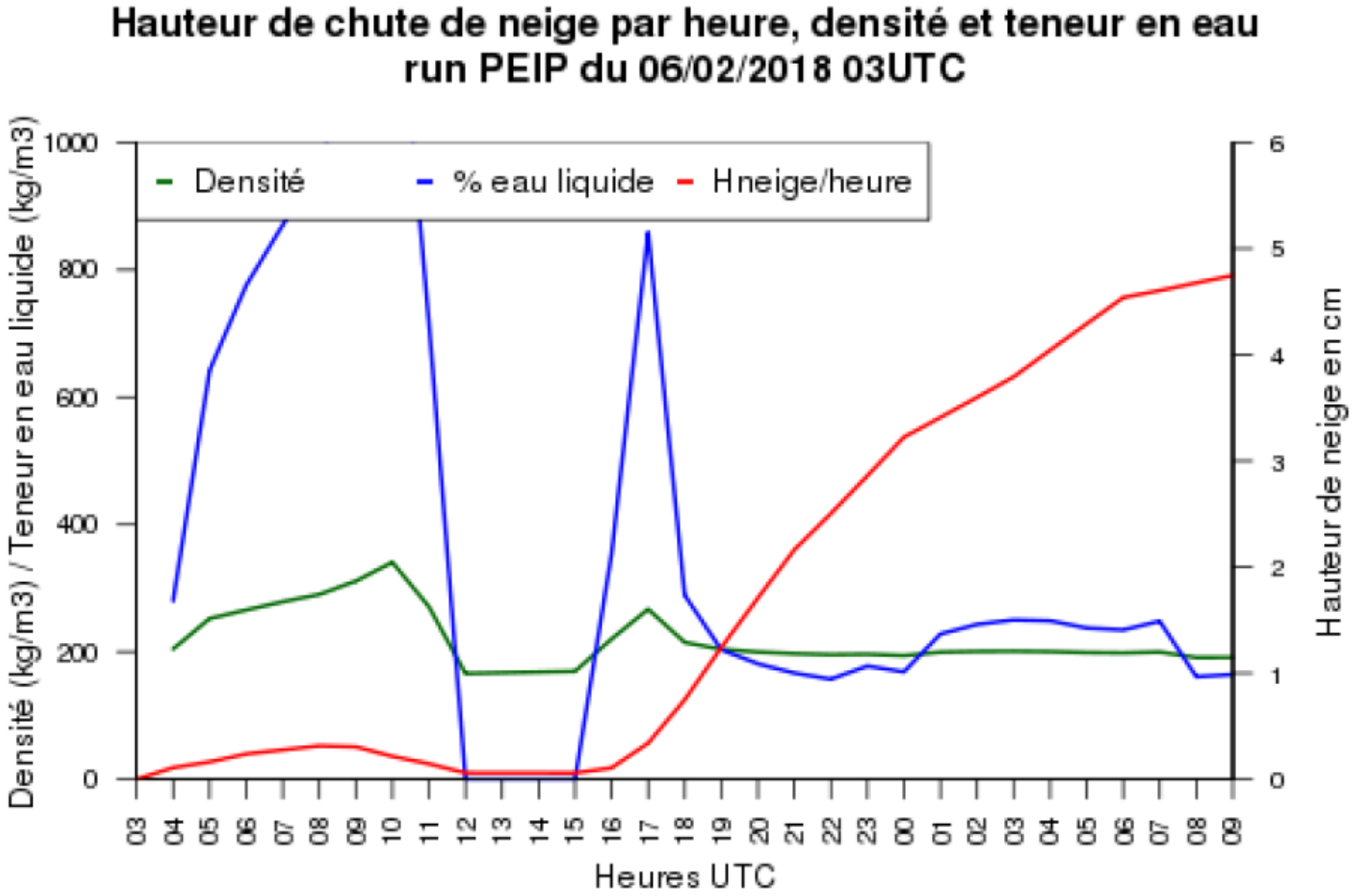
PEIP: Runway state prediction model

- Derived from a road state prediction model
- Combined with a snowpack model
- Uses atmospheric parameters from the AROME-France model and forecaster input
- Hourly forecasts, up to +30h
- Outputs : runway surface temperature, ground temperature profiles, snow height, snow density, liquid water content of snow, surface water height, ice height

Outcomes

Main Météo-France NWP systems for CDM@CDG:

PEIP: Runway state prediction model



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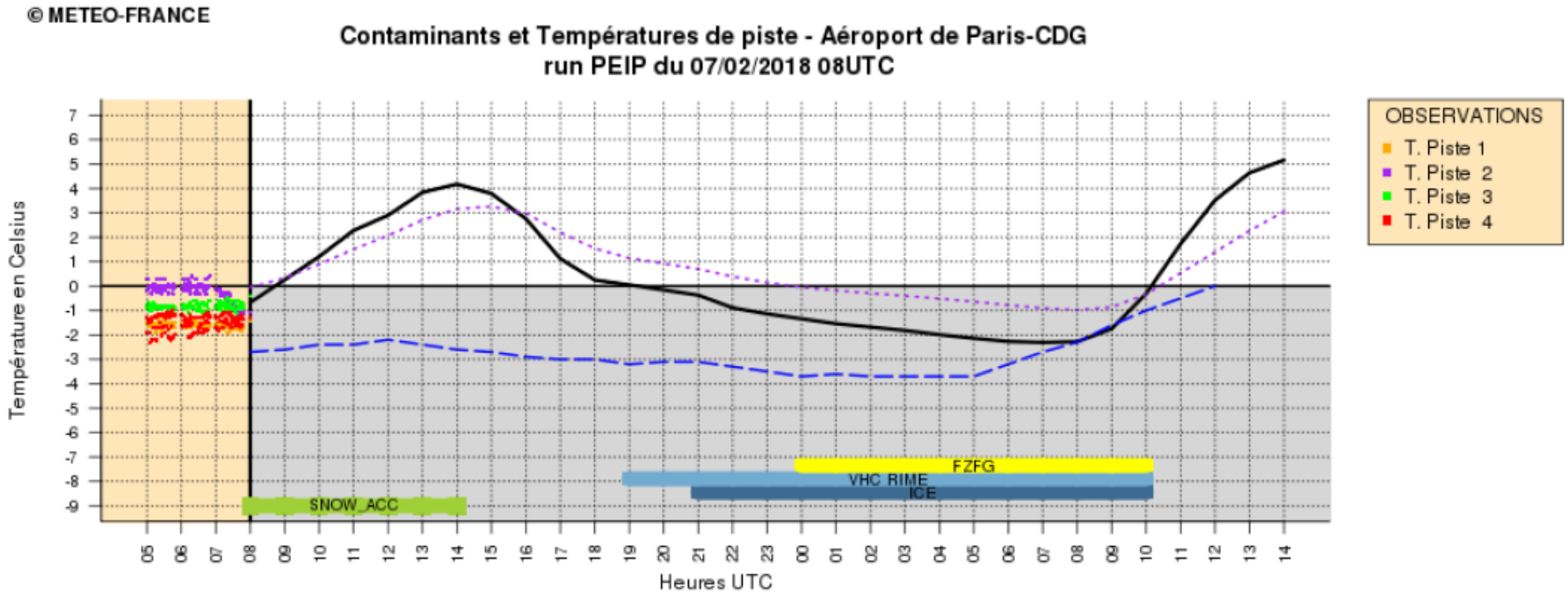
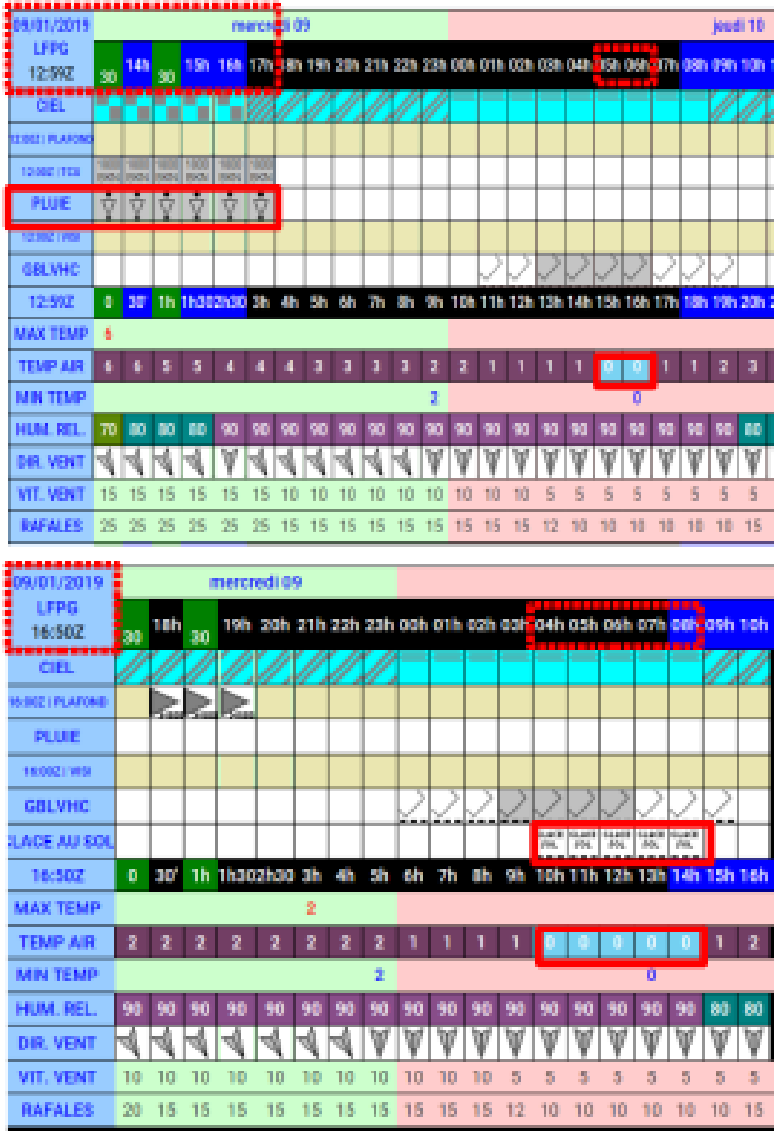


Outcomes

Forecast of those impacting events was conveyed to users via cdm@cdg .

In most cases, NWP systems data proved to be an helpful resource to anticipate those events (intensity, time of occurence, onset/offset, etc.). Positive feedback from forecasters and from users on the accuracy of the forecast timing.
In some cases, an earlier warning would have been needed: ref. IOP3 report, ice on ground event in Jan 2019

Outcomes



Weather forecast products from CDM@CDG updated on January 2019 9th at 12h59 UTC (top) and at 16h50 UTC (bottom).

BUT airport ground de-icing team is set up at 9amUTC for the next day.
Forecast of low risk of ice on ground came in too late.
Removal of residual puddles of water only.

⇒ Remaining ice patches, slippery ground
⇒ Raise in aircraft rolling time
⇒ Three AF flight approaches blocked

An earlier anticipation would have been better to match with airport de-icing staffing

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Benefits to the aviation community

Benefits to all stakeholders:

- for Eurocontrol the European **Network Manager** : more up to date and accurate information leading to better network planning
- for the **airport operator** : improved use of stands/gates
- for the **ground handler** : more accurate arrival times and planning. Better planning and use of resources
- for the **aircraft operator** : improved awareness about the status and location of the aircraft, more accurate fleet predictions. Significant decrease in fuel costs - for the environment: less noise and lower CO2 and NOx emissions
- for the **air traffic controllers** : reduced workload due to a greater predictability of traffic
- for the **passenger** : reduced delays and probability of missed connections, better reliability on flights meaning improved customer satisfaction

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Benefits to the aviation community

Benefits (as measured by an external audit company)

Departure taxi-time : - 2.5 min/flight

Kerosene : - 4,000 t/yr (~4 M€/yr for airlines)
CO_2 : -12,000 t/yr

Aircraft queueing (-40%)
Less ATC delays
Taxi time (up to -20%)

Contribution to ASBU

AMET thread and modules:

See https://www4.icao.int/ganpportal/ASBU

AMET-B0 (2013+): Global, regional and local meteorological information to support flexible airspace management, improved situational awareness, collaborative decision-making and dynamically optimized flight trajectory planning

AMET-B1 (2019+): Meteorological information supporting automated decision process or aids, involving meteorological information, meteorological information translation, ATM impact conversion and ATM decision support

AMET-B1/2 module for 'Meteorological forecast and warning information' refers the use of user defined thresholds: 'Human-readable meteorological advisory and warning products start to be derived from the meteorological information/data to better suit user needs and can be based on user defined thresholds. Meteorological information to be used to assess impact.'

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Contribution to ASBU

AMET-B2/2 (2025+): Integrated meteorological forecast and warning information in support of enhanced operational ground and air decision-making processes, particularly in the near-term.

New capabilities: Further development of space weather and radioactive material services. Further development of forecast and warning services for terminal areas. Phenomena-based meteorological information is no longer constrained by Flight Information Regions (FIRs). Implementation of a data-centric information set. Higher spatial and temporal resolution of meteorological forecasts and warnings. Automated user-defined forecast and warning products derived from meteorological information in ICAO Meteorological Information Exchange Model (IWXXM) form. Further development of probabilistic information derived from ensemble prediction systems.

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Contribution to ASBU

Dependencies on other threads and modules:

Type of dependencies: Relation-information need

Operational Thread : Airport CDM

Modules

ACDM-B0/1 Airport CDM Information Sharing

⇒ Dependency on AMET-B0/1 and AMET-B0/2

ACDM-B1/1 Airport Operations Plan (AOP)

⇒ Dependency on AMET-B1/1 and AMET-B1/2

ACDM-B2/1 Total Airport Management (TAM)

⇒ Dependency on AMET-B2/1 and AMET-B2/2

Other threads and modules with dependencies on AMET…

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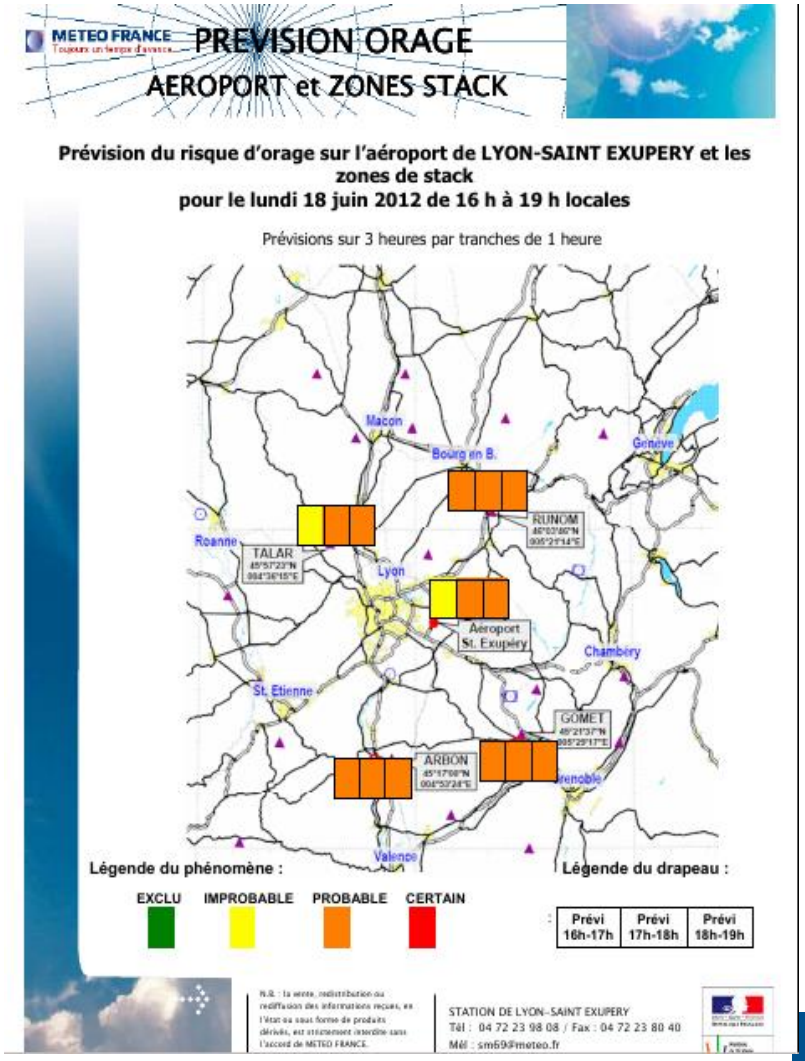
Future plans and studies

Extension to the terminal area :
- a textual product for weather forecast over Paris area already exists
- OPMET data (METAR) and radar imagery is available
- thunderstorm monitoring application is also available

Foreseen introduction of new products or services such as **convection probability over stack areas** e.g. around LFLL

On-going study in collaboration with the ATM community



Future plans and studies

- Newly introduced ICAO requirements for Global Reporting Format (runway surface condition assessment and reporting ; November 2020 as outlined in ICAO Circular 355, Assessment, Measurement and Reporting of Runway Surface)
- Enhancements to the runway temperature and state prediction model :
  - a systematic control/verification of the forecast runway surface temperature against observations from stations implemented at Paris-CDG on runway surface
  - introduction of those observations in a data assimilation or calibration process (preliminary study)
  - a probabilistic approach of the temperature modelling

New parameter/diagnosis for visibility in the atmospheric VHR NWP model AROME (AROME-NWC benefits too)

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Future plans and studies

- An increased use of outputs from the Météo-France ensemble forecast system especially to support the requested provision of probabilistic information of convection to the ATC community covering the +1h to +6h forecast ranges

Future plans and studies

From activities or projects within the SESAR framework :

- Introduction of the Time-Based Separation concept (Météo-France would provide wind data)
- Airport Operations Plan, allowing a collaborative airport operations management ; woud take into account and integrate MET information
- SWIM-compliant services to access MET information (OPMET data, local data, etc.) in SWIM-compliant formats
- First steps towards a full integration of MET information into airport management and ATM systems
- Continuing activities and developement for an increased usage of probabilistic information, supported by a scientifically sounded training and education

CDG airport – Final report

Thank you !

Merci !