



**ОРГАНИЗАТОР**  
ЦЕНТР СТРАТЕГИЧЕСКИХ  
РАЗРАБОТОК В ГРАЖДАНСКОЙ  
АВИАЦИИ (ЦСР ГА)



**ПРИ УЧАСТИИ**  
ФЕДЕРАЛЬНЫХ  
ОРГАНОВ ВЛАСТИ

# АВИАЦИОННЫЙ IT ФОРУМ РОССИИ И СНГ - 2018

IV международный форум

**ГЕНЕРАЛЬНЫЙ СПОНСОР ФОРУМА**



**ПАРТНЕР ФОРУМА**



**28-30 ноября 2018, Москва**

Renaissance Moscow  
Monarh Centre



# AIRSIDE WATCH

Radar data at work

## Putting RADAR Data to work towards airside efficiency

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Aviation IT Forum for Russia & CIS / Moscow 2018

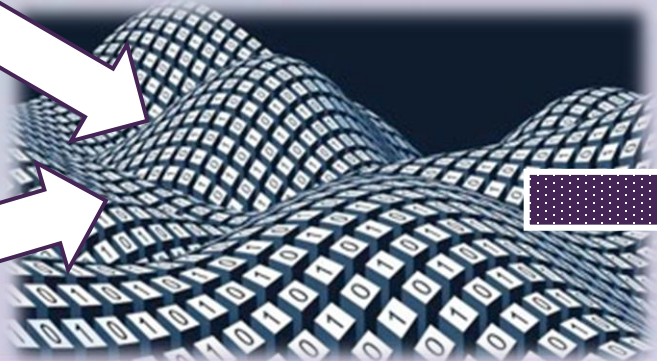
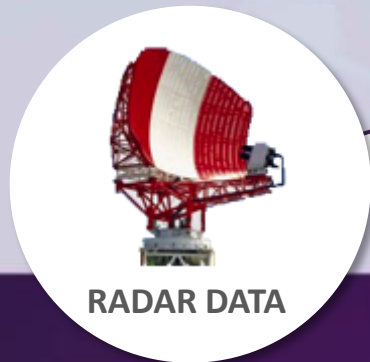
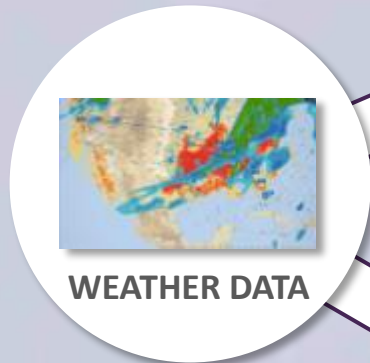
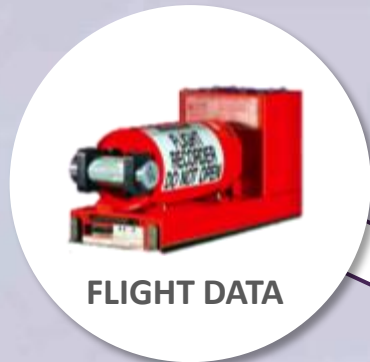
François Chazelle – Partner & CCO



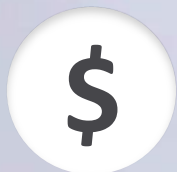
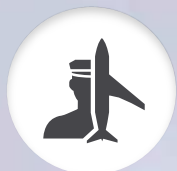
**SAFETY LINE**

Big Data applied to Aviation

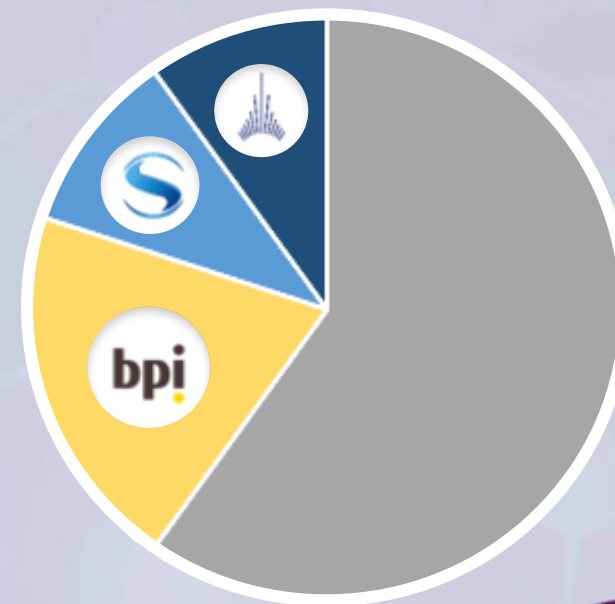
# BIG DATA SOLUTIONS FOR SAFETY AND EFFICIENCY OF AVIATION OPERATIONS



# SAFETY LINE SERIES A FUNDING ROUND



3 MEUR Series A



May 2017 ✓

# GROUND RADAR DATA



Primary Radar

## A-SMGCS or ASDE-X Feed

Succession of timestamped  
instantaneous snapshots of the platform



Secondary Radar

# A-SMGCS / ASDE-X – A RICH SOURCE OF DATA

- **Range:**  $\approx$  60 km
- **Sampling Frequency:** 2 to 10 Hz
- **Available Data:**
  - Position (X,Y)
  - Speed (VX, VY)
  - Timestamp (ms)
  - Altitude
  - Callsign
  - Aircraft Type
  - Departure and Arrival
  - Stand



ASMGCS feed at Paris-CDG over one day

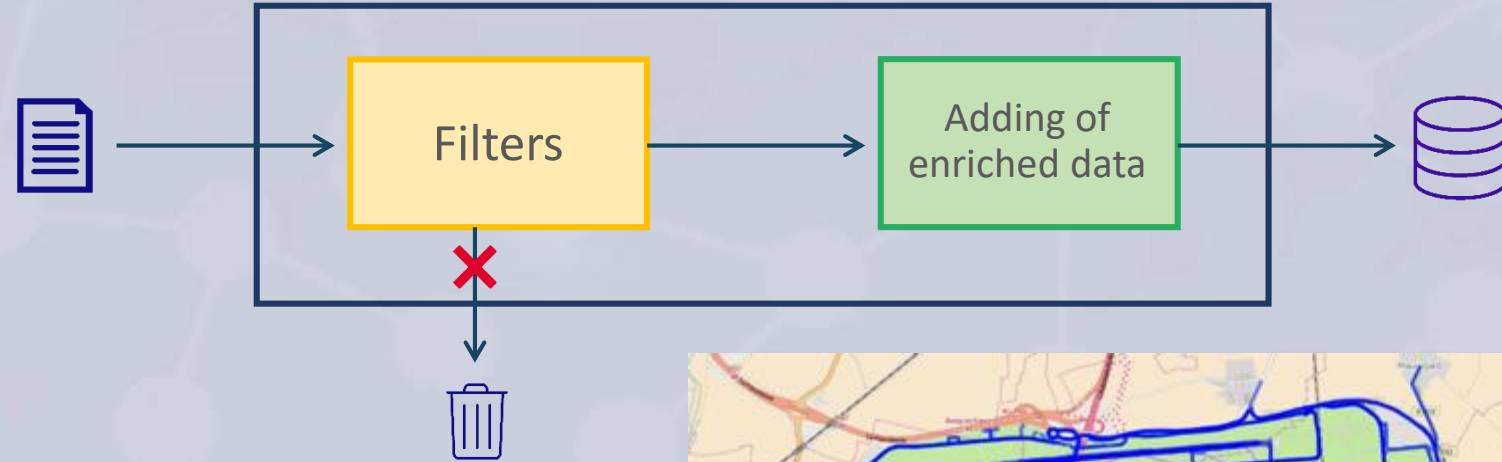
# A-SMGCS / ASDE-X – DATA PROCESSING

STEP 1: Decoding and Breakdown into Trajectories



# A-SMGCS / ASDE-X – DATA PROCESSING

## STEP 2: Data pre-treatment and enrichment



### ➤ Additional data:

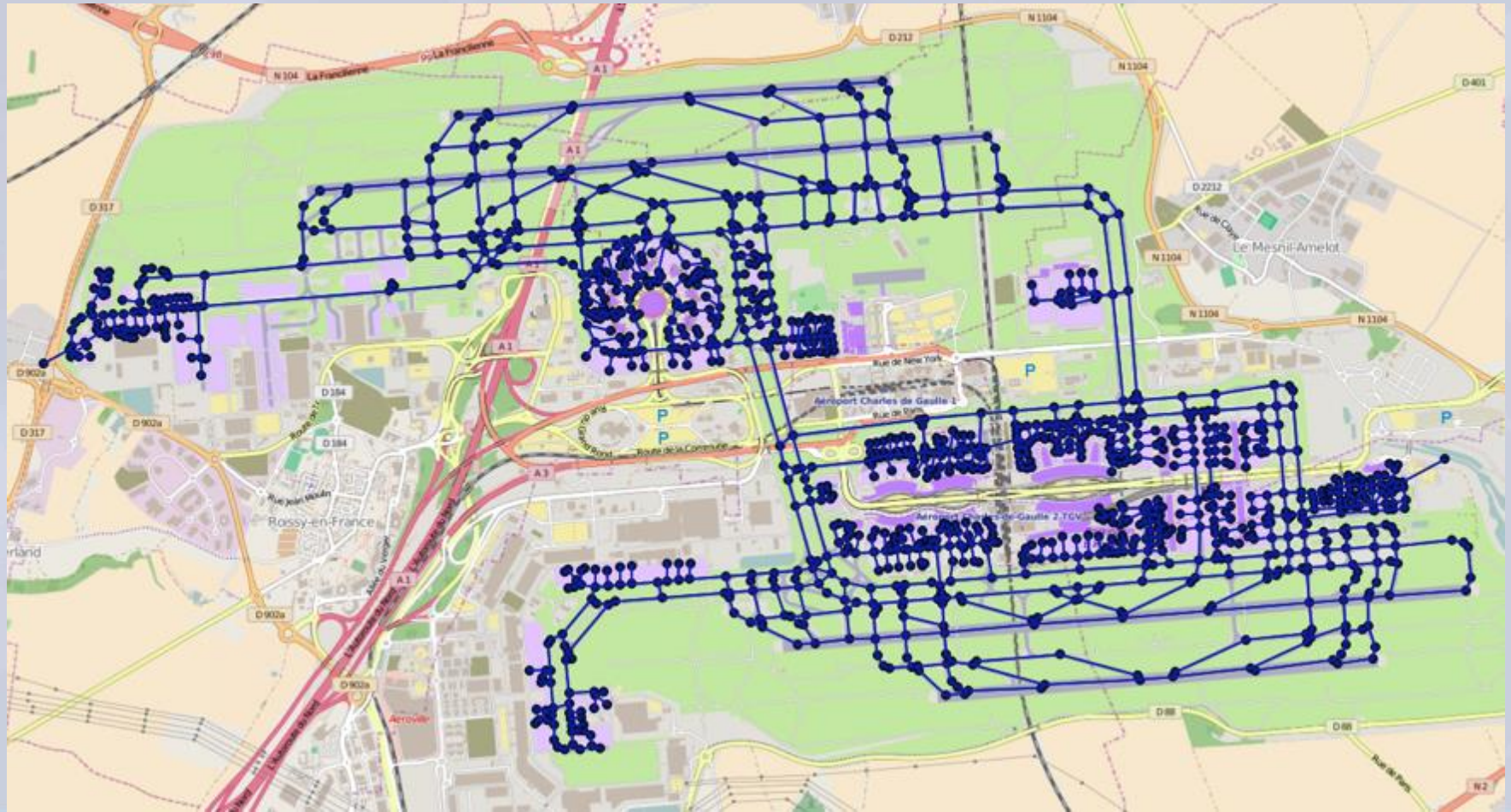
- Acceleration
- Type of Trajectory (Take-off / Landing)
- Trajectory Phases (pushback, taxi, de-icing...)
- ...





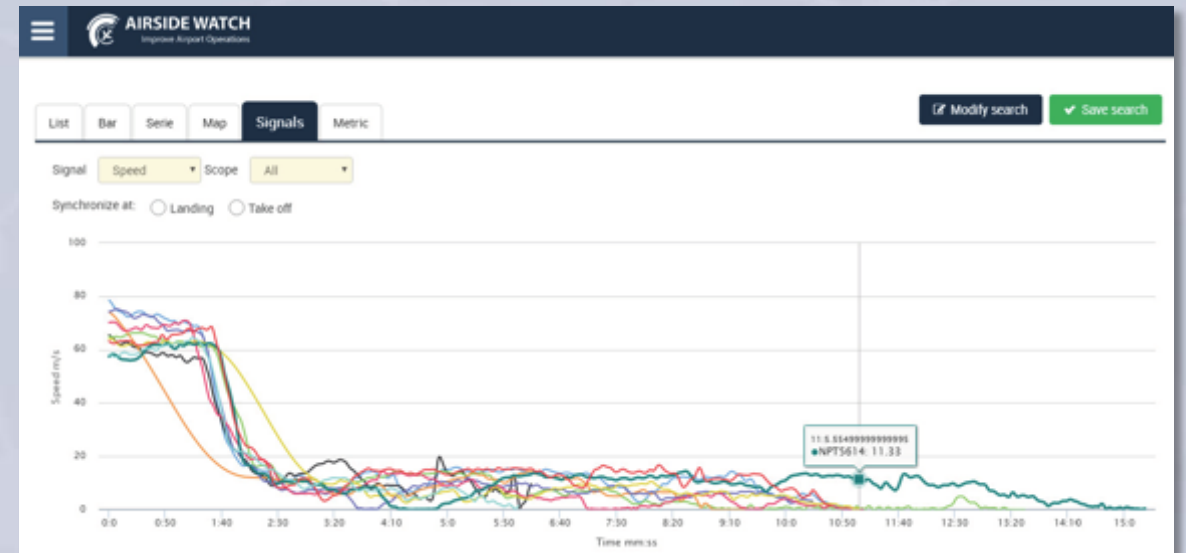
# AUTOMATED MAPPING

Automated mapping of taxiways, runways and aprons



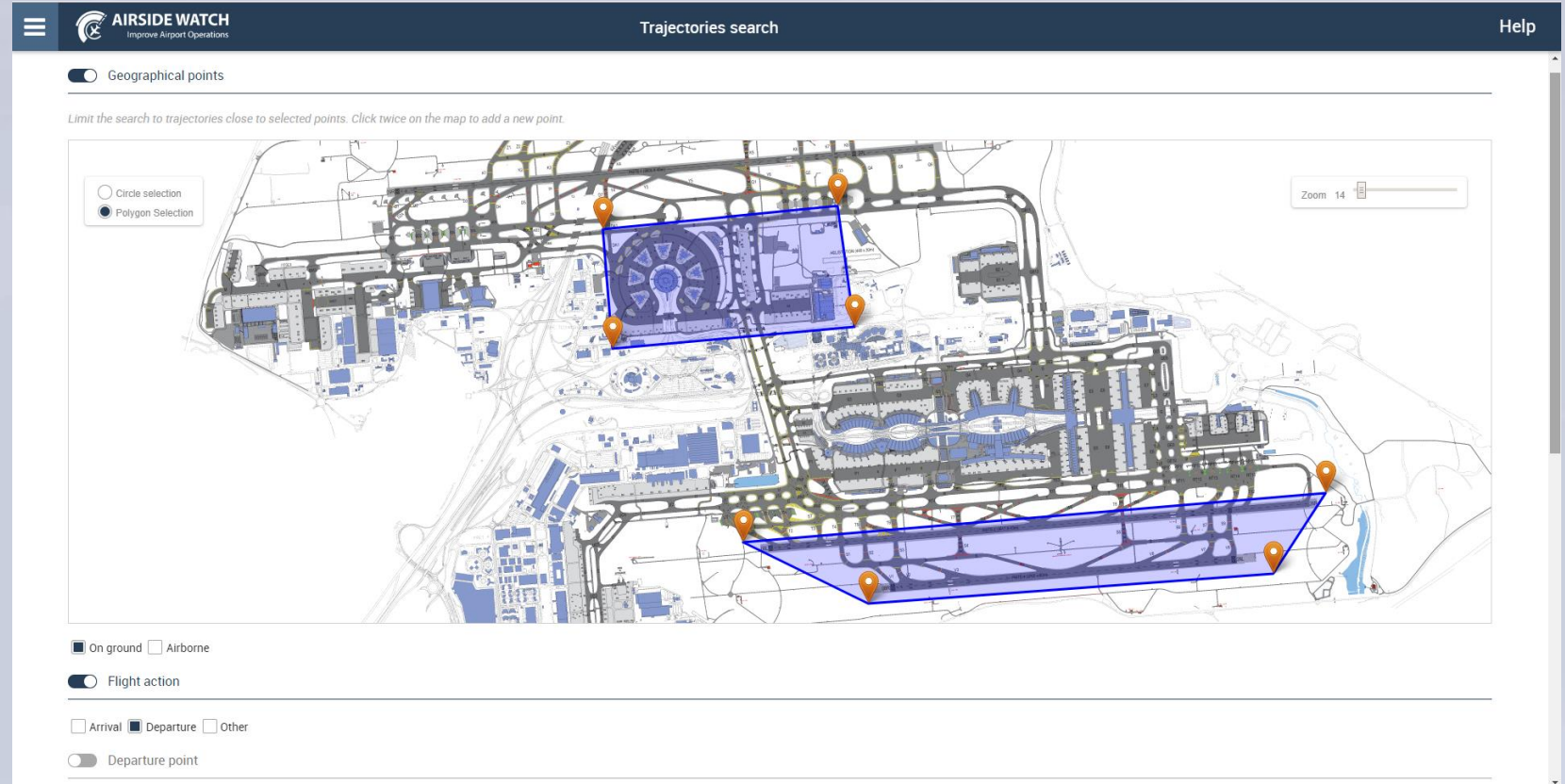
## ➤ Visualization of trajectories:

Aircraft **surface movement radar data** is broken down into trajectories for each aircraft movement, from landing to gate or gate to takeoff.



## ➤ Search Parameters

- Multiple zones of passage
- On ground / Airborne
- Arrival / Departure
- Gate or stand, Runway
- Airline
- Aircraft type
- Origin / Destination
- Visibility & lighting conditions
- Date and/or Time window
- ””



The screenshot displays the 'Trajectories search' interface of the AIRSIDE WATCH application. The main map shows an airport layout with two blue-shaded search zones: one around a central terminal building and another along a runway. Orange location pins are placed at various points on the map. The interface includes a top navigation bar with the AIRSIDE WATCH logo and 'Trajectories search' title. Below the map, there are several filter sections: 'Geographical points' (checked), a zoom slider set to 14, and a legend for selection methods (Circle and Polygon). Below the map, there are checkboxes for 'On ground' (checked), 'Airborne', 'Flight action' (checked), 'Arrival' (unchecked), 'Departure' (checked), 'Other' (unchecked), and 'Departure point' (checked).

## ➤ Efficiency Analytics

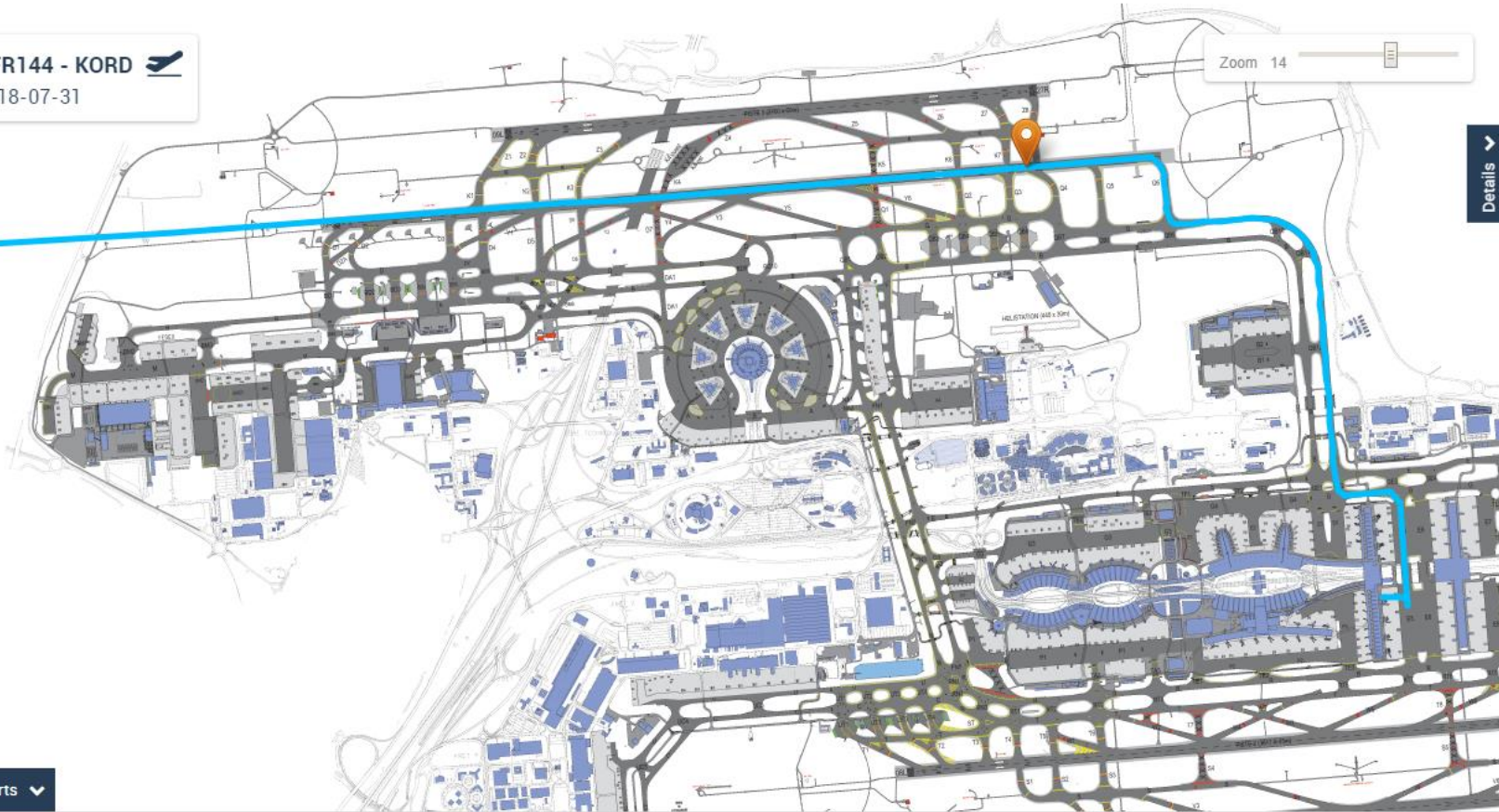
- Runway occupancy time
- Runway throughput
- De-icing bay throughput
- Delays at holding points
- Congestion detection
- Taxiing time
- Most used taxiing routes



# AIRSIDE WATCH ANALYTICS



AFR144 - KORD ✈️  
2018-07-31



Charts ▾

- Acceleration
- Speed
- Altitude

Center by marker:



## Vehicle properties

Manufacturer: Airbus | Type: A332 | Airline: Air France

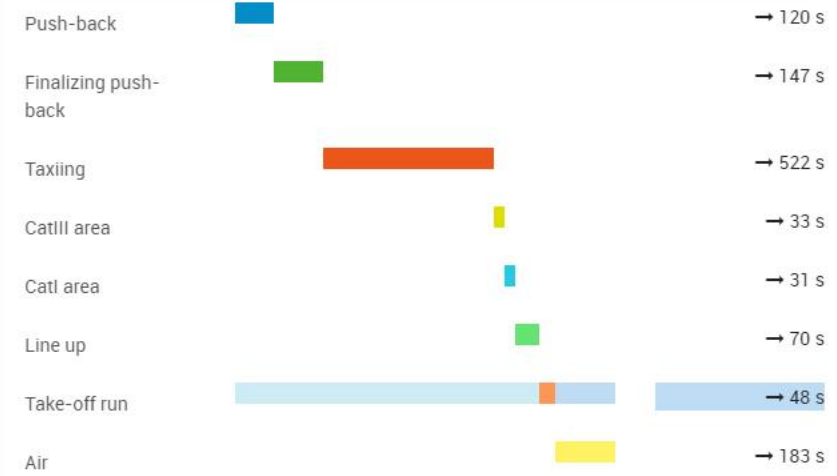
Mobile type: aircraft | RECAT-EU code: B

## Trajectory properties

Timing

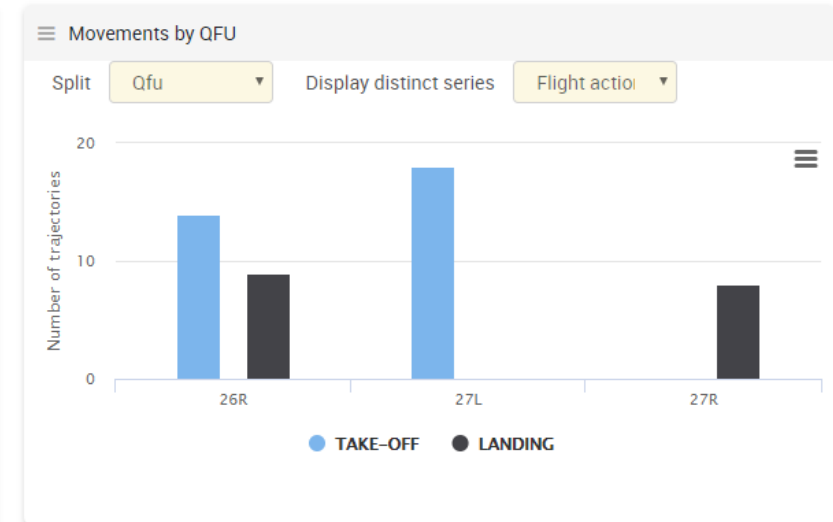
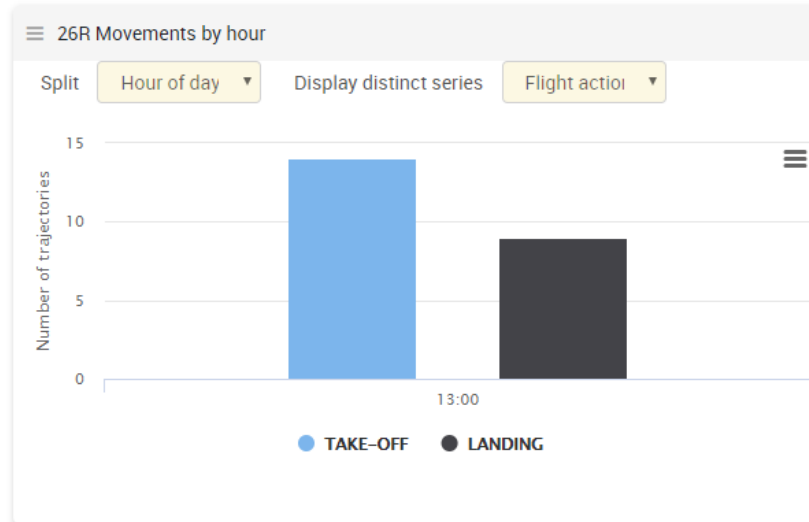
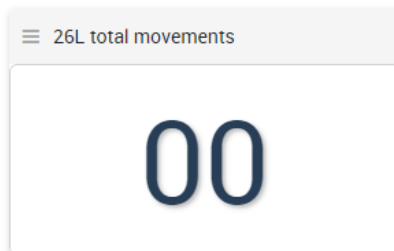
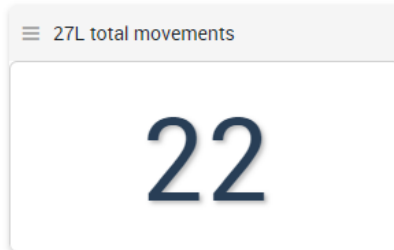
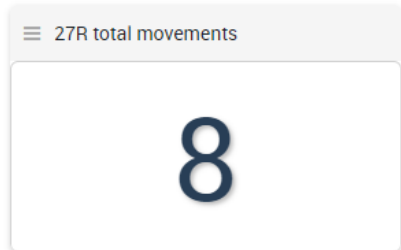
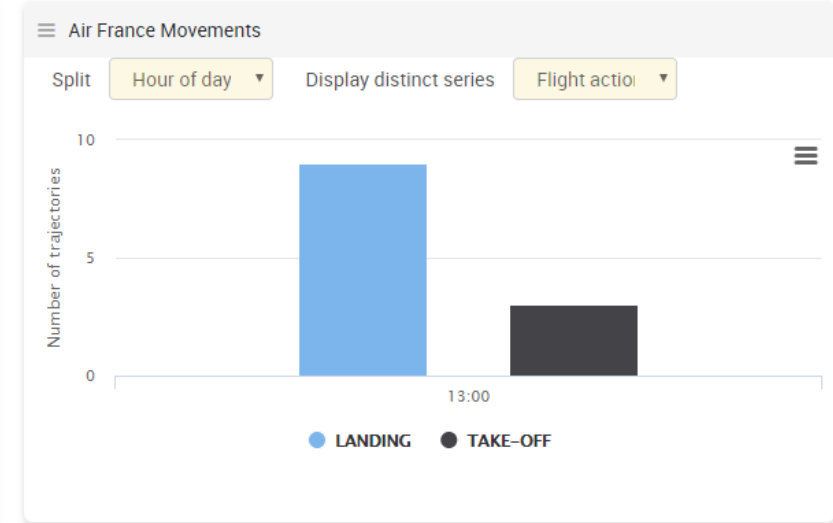
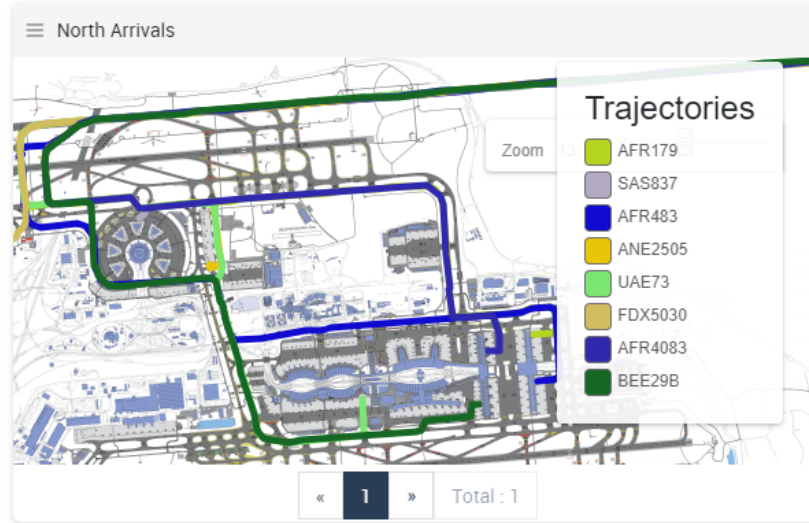
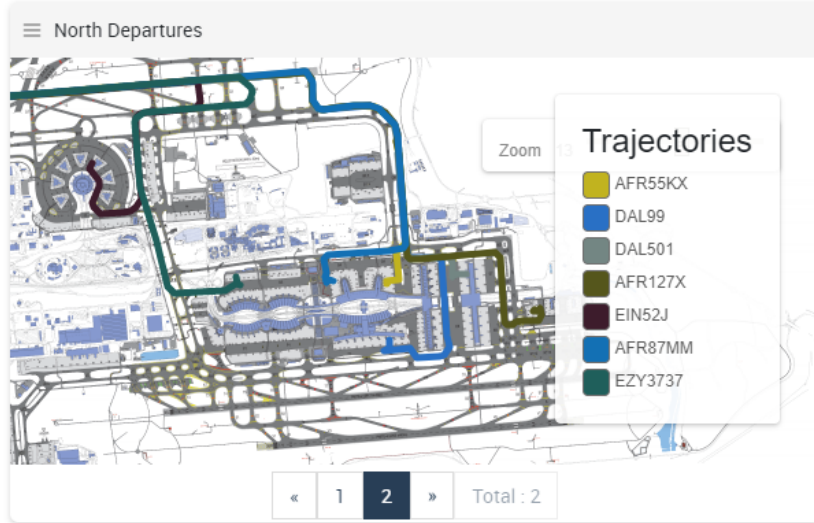
Speed

Others



# CUSTOMIZABLE DASHBOARDS

🕒 Time last 3 hours [Refresh](#) [Edit](#)



# ENVIRONMENTAL IMPACT

## ➤ Environmental Module

Real-time & historical noise & emissions reporting based on actual trajectories, speeds and accelerations

### Emissions & Air Quality:

- Daily reporting per aircraft & airline based on actual aircraft trajectories
- Modelling of Air Quality

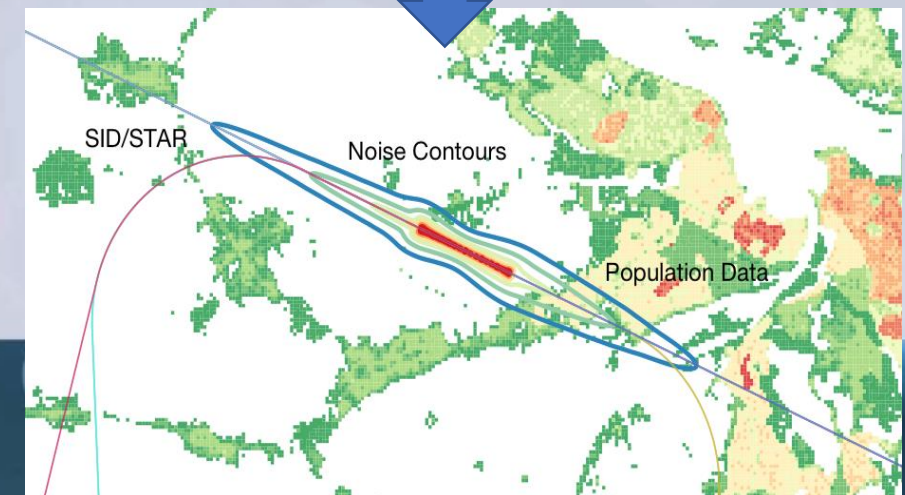
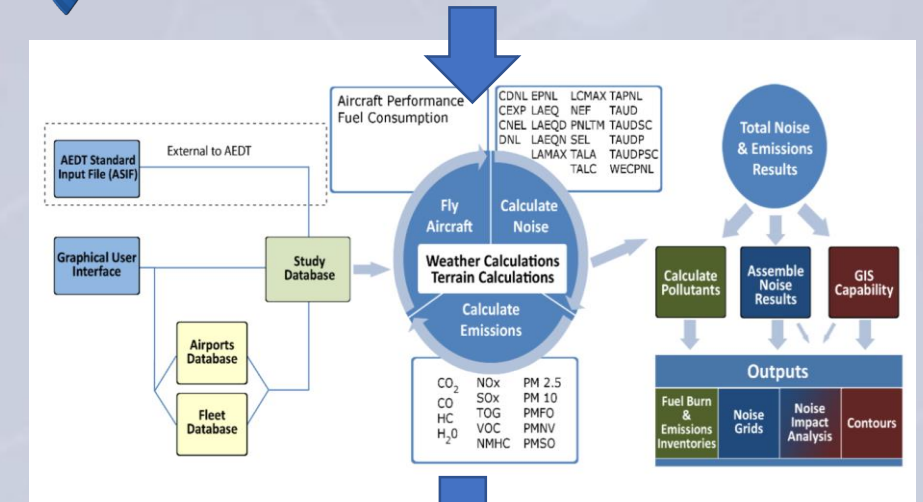
### Noise:

- Noise modelling
- Benchmarking vs. Actual measurements



## AIRSIDE WATCH

Radar data at work

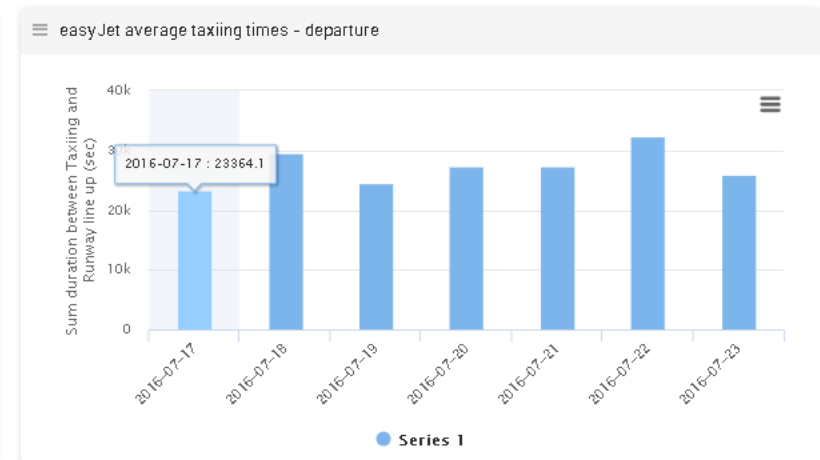
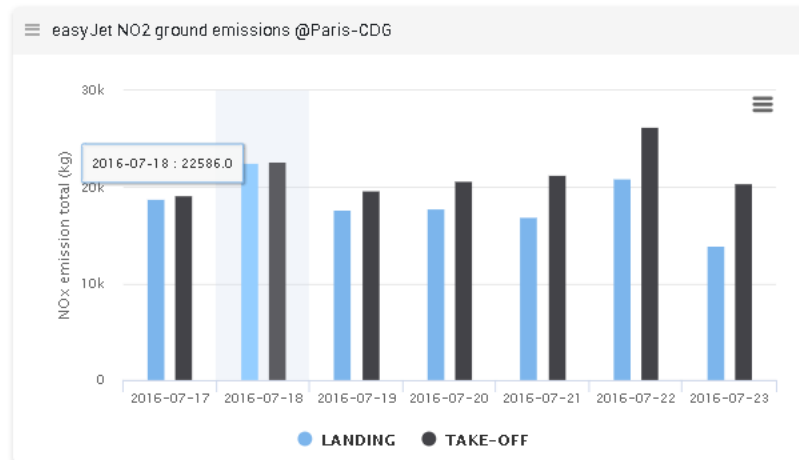
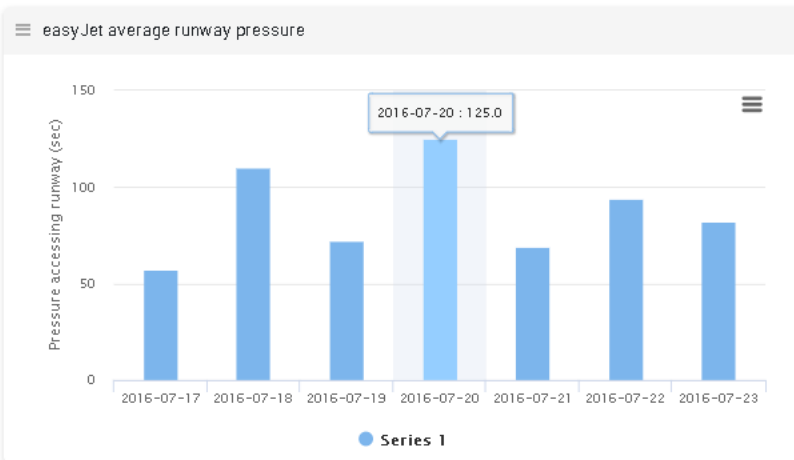
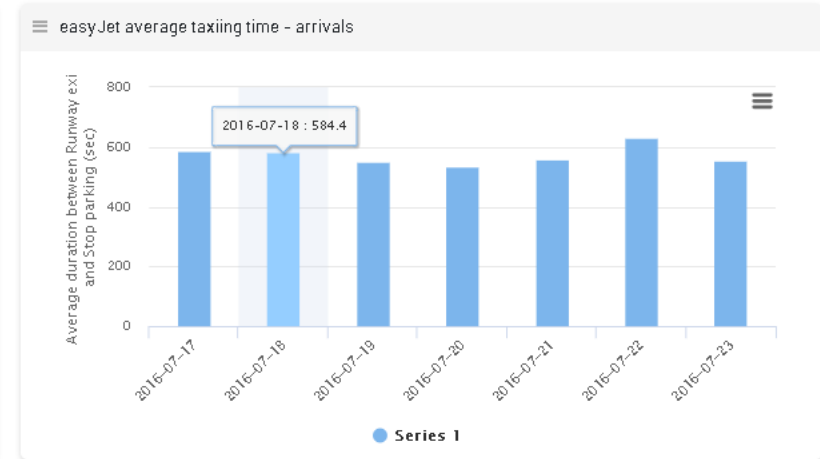
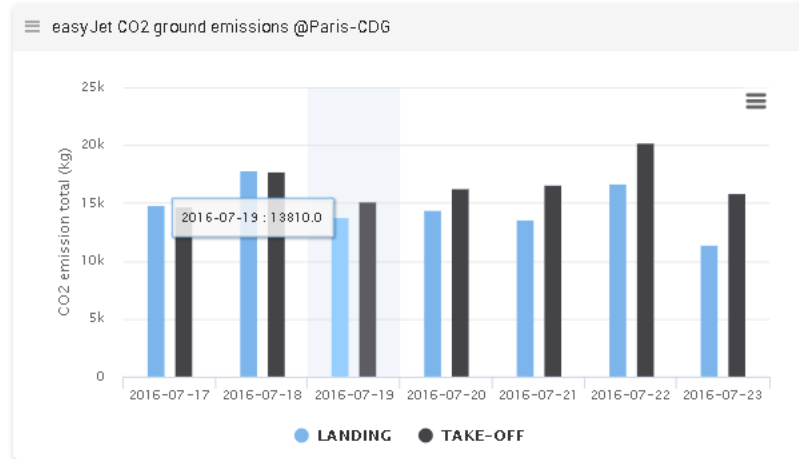
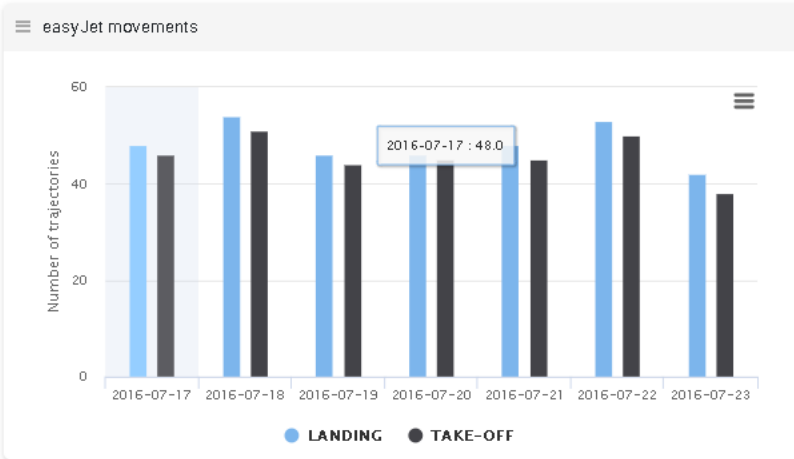


# SAMPLE DASHBOARD – easyJet emissions @Paris-CDG



easyJet emissions @Paris-CDG - Week of July 17-23

Time Refresh Edit





# RUNWAY CONDITION – TALPA RCC

Automated real-time updates of RCCs for each runway



**MACHINE LEARNING  
OF WEATHER DATA**



**AIRSIDE WATCH**  
Improve Airport Operations

PAVED RUNWAY CONDITION ASSESSMENT TABLE				
Airport Estimated Runway Condition Assessment				Pilot Reports (PIREPs) Provided To ATC And Flight Dispatch
Runway Condition Assessment – Reported		Downgrade Assessment Criteria		
Code	Runway Description	Mu (μ)	Deceleration And Directional Control Observation	PIREP
6	• Dry	-	-	Dry
5	• Wet (Smooth, Grooved or PFC) • Frost 1/8" or less of: • Water • Slush • Dry Snow • Wet Snow	40μ or higher	Braking deceleration is normal for the wheel braking effort applied. Directional control is normal.	Good
4	At or below -13°C: • Compacted Snow	39-36μ	Brake deceleration and controllability is between Good and Medium.	Good to Medium
3	• Wet (Slippery) At or below -3°C: • Dry or Wet Snow greater than 1/8" Above -13°C and at or below -3°C: • Compacted Snow Greater than 1/8" of:	35-30μ	Braking deceleration is noticeably reduced for the wheel braking effort applied. Directional control may be slightly reduced.	Medium
2	• Water • Slush Above -3°C: • Dry or Wet Snow greater than 1/8" • Compacted Snow	29-26μ	Brake deceleration and controllability is between Medium and Poor. Potential for hydroplaning exists.	Medium to Poor
1	At or below -3°C: • Ice	25-21μ	Braking deceleration is significantly reduced for the wheel braking effort applied. Directional control may be significantly reduced.	Poor
0	• Wet Ice • Water on top of Compacted Snow • Dry or Wet Snow over Ice Above -3°C: • Ice	20μ or lower	Braking deceleration is minimal to non-existent for the wheel braking effort applied. Directional control may be uncertain.	Nil



**AIRPORT SURFACE  
MOVEMENT RADAR DATA**



**AIRSIDE WATCH**  
Improve Airport Operations

**Current:**

Manual processing of Weather forecast + sensor data

CFME

Vehicle

Pilot

\*CFME: Continuous Measurement Equipment

# RUNWAY CONTAMINATION DATA

## SENSORS



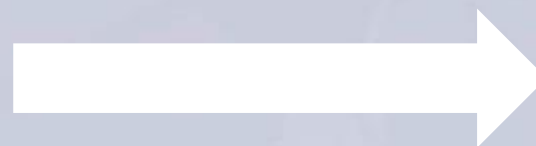
Runway Contamination Depth (RCD) /  
Runway Contamination Type (RCT)



Ice Early Warning Systems

## TALPA

- Contaminant Type
- Contaminant Depth
- Air Temperature



PAVED RUNWAY CONDITION ASSESSMENT TABLE			
Airport Estimated Runway Condition Assessment			Final Reports (PDRPs) Provided To ATIS And Flight Dispatch
Runway Condition Assessment - Observed	Discrepancy Assessment Criteria		
Code	Runway Description	Min. 30	Discrepancy And Discrepancy Control Observation
4	<ul style="list-style-type: none"> <li>• Dry</li> <li>• Total (Observed) Observed on PFC</li> <li>• PFC</li> <li>• 18" or less of</li> <li>• 1/8"</li> <li>• 1/4"</li> <li>• 1/2"</li> <li>• 3/4"</li> <li>• 1"</li> <li>• 1 1/2"</li> </ul>	--	--
5	<ul style="list-style-type: none"> <li>• Dry</li> <li>• Total (Observed) Observed on PFC</li> <li>• PFC</li> <li>• 18" or less of</li> <li>• 1/8"</li> <li>• 1/4"</li> <li>• 1/2"</li> <li>• 3/4"</li> <li>• 1"</li> <li>• 1 1/2"</li> </ul>	25-30	Braking performance is normal for the (lower runway effort) aircraft. Discrepancy criteria is normal.
6	<ul style="list-style-type: none"> <li>• At or below -1°F</li> <li>• 18" or less of</li> <li>• 1/8"</li> <li>• 1/4"</li> <li>• 1/2"</li> <li>• 3/4"</li> <li>• 1"</li> <li>• 1 1/2"</li> </ul>	30-35	Braking performance and penetrability is below normal (and not hazardous).
7	<ul style="list-style-type: none"> <li>• At or below -1°F</li> <li>• 18" or less of</li> <li>• 1/8"</li> <li>• 1/4"</li> <li>• 1/2"</li> <li>• 3/4"</li> <li>• 1"</li> <li>• 1 1/2"</li> </ul>	35-40	Braking performance is significantly reduced for the (lower runway effort) aircraft. Discrepancy criteria may be significantly reduced.
8	<ul style="list-style-type: none"> <li>• At or below -1°F</li> <li>• 18" or less of</li> <li>• 1/8"</li> <li>• 1/4"</li> <li>• 1/2"</li> <li>• 3/4"</li> <li>• 1"</li> <li>• 1 1/2"</li> </ul>	40-45	Braking performance and penetrability is below normal (and not hazardous). Potential for hydroplaning exists.
9	<ul style="list-style-type: none"> <li>• At or below -1°F</li> <li>• 18" or less of</li> <li>• 1/8"</li> <li>• 1/4"</li> <li>• 1/2"</li> <li>• 3/4"</li> <li>• 1"</li> <li>• 1 1/2"</li> </ul>	45-50	Braking performance is significantly reduced for the (lower runway effort) aircraft. Discrepancy criteria may be significantly reduced.
10	<ul style="list-style-type: none"> <li>• At or below -1°F</li> <li>• 18" or less of</li> <li>• 1/8"</li> <li>• 1/4"</li> <li>• 1/2"</li> <li>• 3/4"</li> <li>• 1"</li> <li>• 1 1/2"</li> </ul>	50-55	Braking performance is extremely reduced for the (lower runway effort) aircraft. Discrepancy criteria may be significantly reduced.



- Contaminant Type
- Contaminant Depth
- Air Temperature
- Dew Point
- Freezing Point
- Ground Temperature

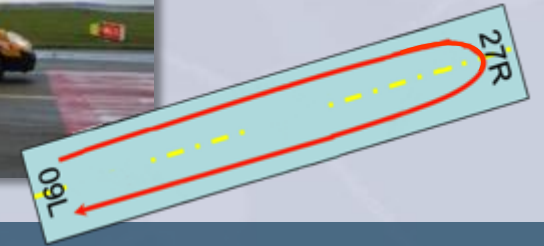


**MACHINE LEARNING OF WEATHER DATA**

# RUNWAY FRICTION ( $\mu$ ) / PILOT REPORTS

PAVED RUNWAY CONDITION ASSESSMENT TABLE				
Airport Estimated Runway Condition Assessment			Pilot Reports (PIREP) Provided To ATIS And Tower Dispatch	
Code	Runway Description	Downgrade Assessment Criteria	PIREP	
		$\mu$ (u)	Directional And Directional Control Observation	
8	• Dry • Wet (Smooth, Grooved or PFC) • Frost • 1/8" or less of: • Water • Snow • Dry Snow • Wet Snow	-	-	Dry
5	• Wet (Smooth, Grooved or PFC) • 1/8" or less of: • Water • Snow • Dry Snow • Wet Snow	40% or higher	Braking deceleration is normal for the wheel braking effort applied. Directional control is normal.	Good
4	All or below -1 PFC • Compacted Snow	35-39%	Braking deceleration and controllability is between Good and Medium.	Good to Medium
3	• Wet (Smooth, Grooved or PFC) • All or below -1 PFC • Dry or Wet Snow greater than 1/8" • Above -1 PFC and all or below -1 PFC • Compacted Snow • Smaller than 1/8" of: • Water • Snow • Dry Snow • Wet Snow	30-34%	Braking deceleration is noticeably reduced for the wheel braking effort applied. Directional control may be slightly reduced.	Medium
2	• Wet (Smooth, Grooved or PFC) • All or below -1 PFC • Dry or Wet Snow greater than 1/8" • Above -1 PFC • Compacted Snow	25-29%	Braking deceleration and controllability is between Medium and Poor. Potential for hydroplaning exists.	Medium to Poor
1	All or below -1 PFC • Ice	20-24%	Braking deceleration is significantly reduced for the wheel braking effort applied. Directional control may be significantly reduced.	Poor
0	• Wet ice • Water on top of Compacted Snow • Dry or Wet Snow over ice • Above -1 PFC • Ice	20% or lower	Braking deceleration is minimal to non-existent for the wheel braking effort applied. Directional control may be uncertain.	Nil

Use of CFME vehicles disruptive



PIREP (Pilot Report)  
Highly Subjective

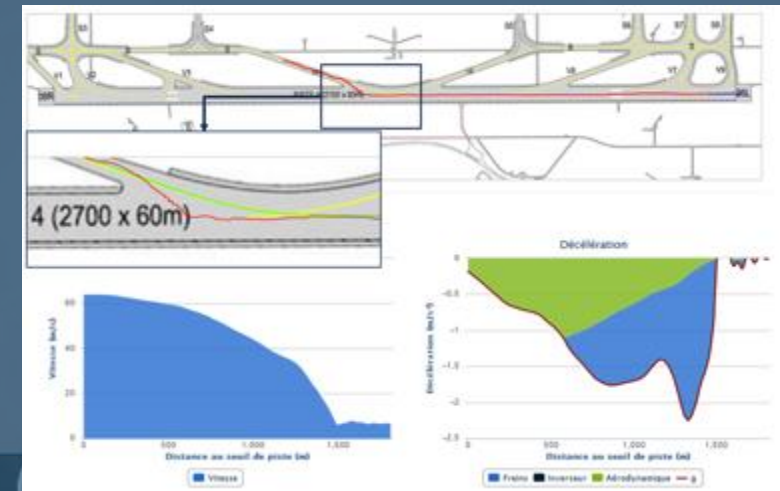


**AIRPORT SURFACE  
MOVEMENT RADAR DATA**



→ Use of ground radar data  
each aircraft becomes a sensor

→ No disruption of runway operations





Automated RCC for each third of each runway in real time

The dashboard displays a map of Runway 1 (09R-27L) with three sections marked with blue circles containing the numbers 5, 6, and 6. The interface includes a top navigation bar with 'HOME', 'LANDINGS', and 'REPLAY' options, and a date/time display showing 'DATE 2017-01-13' and 'HOUR 22:11 (UTC)'. Below the map, there are three main data panels:

- Inputs:** A table of environmental and operational parameters.
- TALPA level:** A control panel for Runway 1 (09R-27L) with three sections, each having a 'Selected RCC' and 'Recommended RCC' indicator.
- TALPA classes:** A section containing a 'Probabilities' bar chart and an 'Inputs contribution' table.

Inputs	Last update
Contaminant type	dry 9 minutes ago
Contaminant depth	0 mm 9 minutes ago
Air temperature	2.7 °C 9 minutes ago
Ground temperature	1.9 °C 9 minutes ago
Freezing point	-0.3 °C 9 minutes ago
Dew point	7.3 °C 9 minutes ago
ABAR (view flight)	0.89 a day ago
IMAG	- a few seconds ago

TALPA level	Runway 1 ( 09R-27L )
Selected RCC	Recommended RCC
0 1 2 3 4 5 6	0 1 2 3 4 5 6
0 1 2 3 4 5 6	0 1 2 3 4 5 6
0 1 2 3 4 5 6	0 1 2 3 4 5 6

Inputs contribution
Contaminant depth 0.371
Contaminant depth 0.371
Air temperature 0.058
Ground temperature 0.07
Freezing point 0.07
Dew point 0.058
ABAR --
IMAG --

Recommended RCC: 5  
Theoretical RCC: 6

## Automated RCC for each third of each runway in real time

- More reliable output for improved runway safety
- Optimized scheduling of CFME measurements
- Optimized scheduling of de-contaminations



# AIRSIDE WATCH DEPLOYMENT

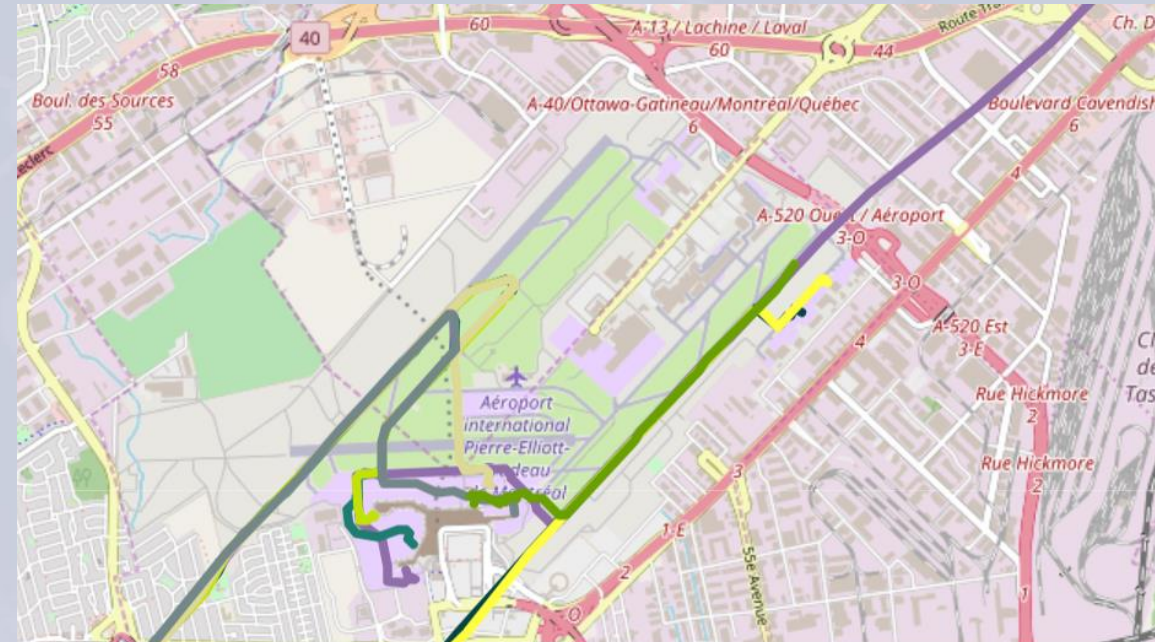


- Paris-CDG Airport – AirsideWatch + TALPA RCC
- Paris-Orly Airport – AirsideWatch



- Inputs for Taxiing time simulations at Beijing Capital Airport

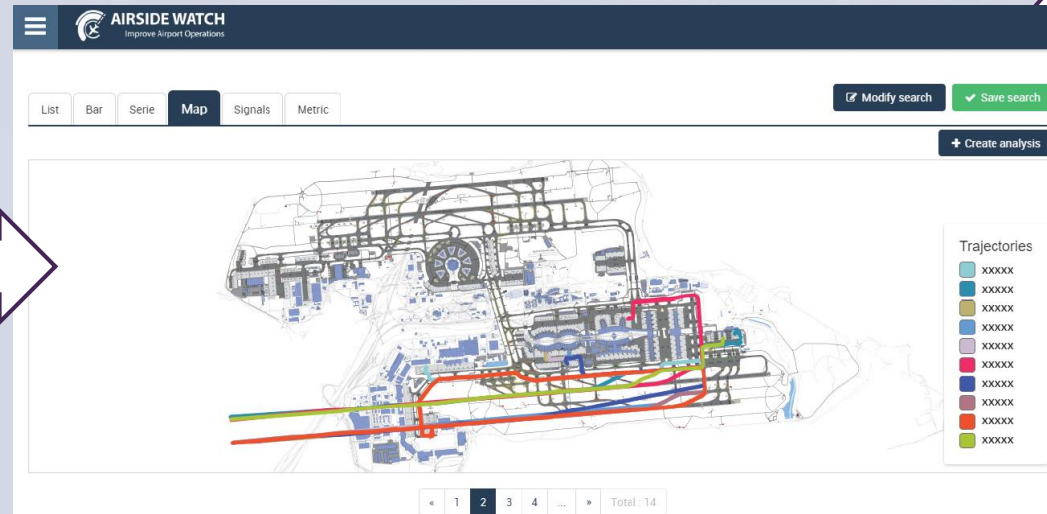
- Demo at Montréal-Trudeau Airport



# AIRSIDE WATCH USE CASES



RADAR Data



Breakdown into searchable trajectories

**AIRSIDE ANALYTICS**

**SAFETY EVENTS  
TALPA RCC**

**NOISE & EMISSIONS  
IMPACT**