



CDM@CDG

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WWRP CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Training Workshop

8 to 10 October 2018, Hong-Kong Observatory, Hong-Kong, China

Content

- Paris-Charles de Gaulle airport
- CDM@CDG origins, concept, benefits
- The MET application cdm@cdg
- Gains

Paris-Charles de Gaulle airport



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

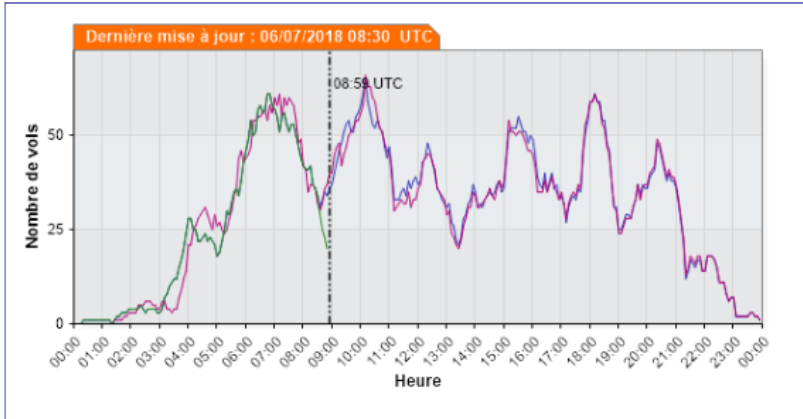
- Fog/low ceilings - Low Visibility Procedures
 - Snow
 - Winter 17/18 : 19 d – 30 cm
 - Winter 12/13 : 30 d – 59 cm
 - Winter 10/11 : 23 d – 30 cm

ATC Infrastructure

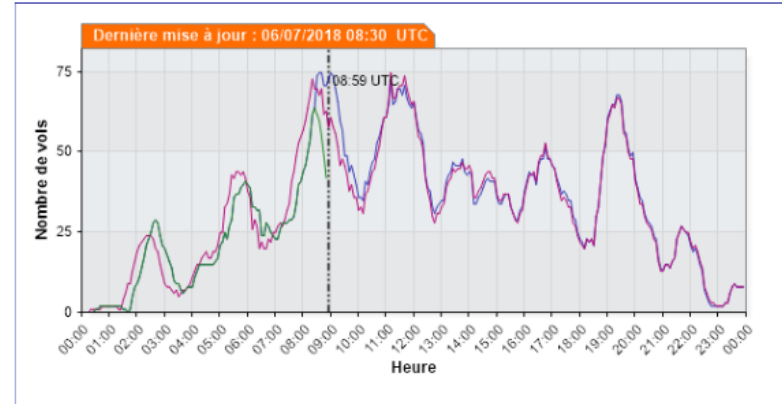
1 approach room, 3 control towers,
2 apron control centers

Paris-Charles de Gaulle airport

Arrivals



Departures



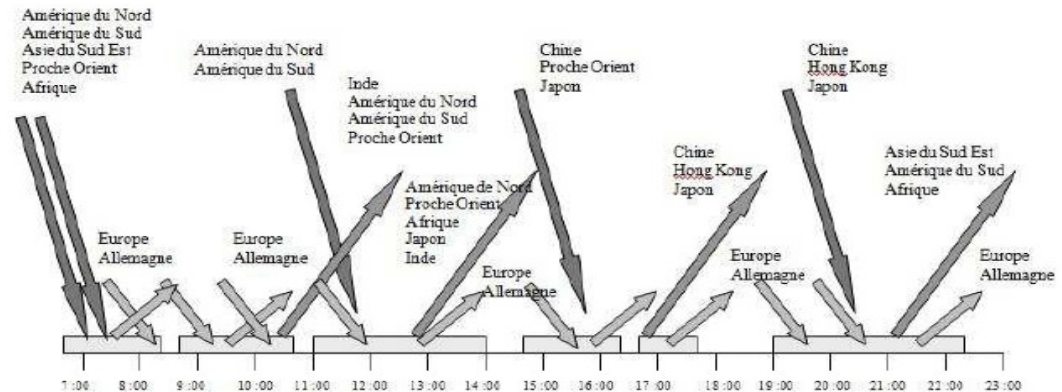
About 1,400 flights per day

2 aircrafts per min at peak hours

RWY throughput: 73 ARR/h – 76 DEP/h



Hub Structure for half of traffic



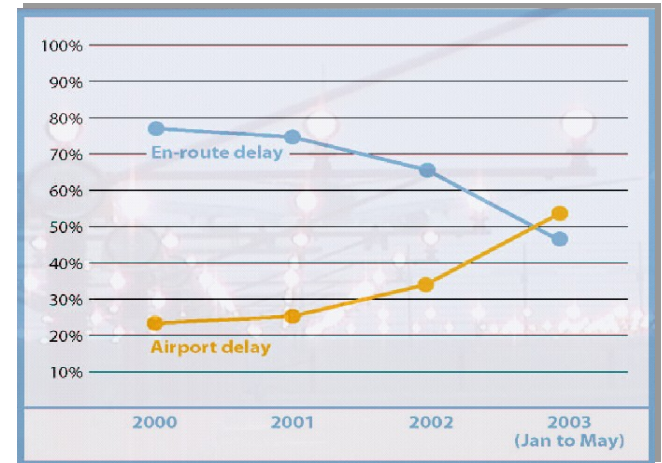
High peaks make the traffic structure decisive



CDM origins, concept, benefits

Since 2003, airports became bottlenecks

Congestion Point between
airport & en-route delays



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%

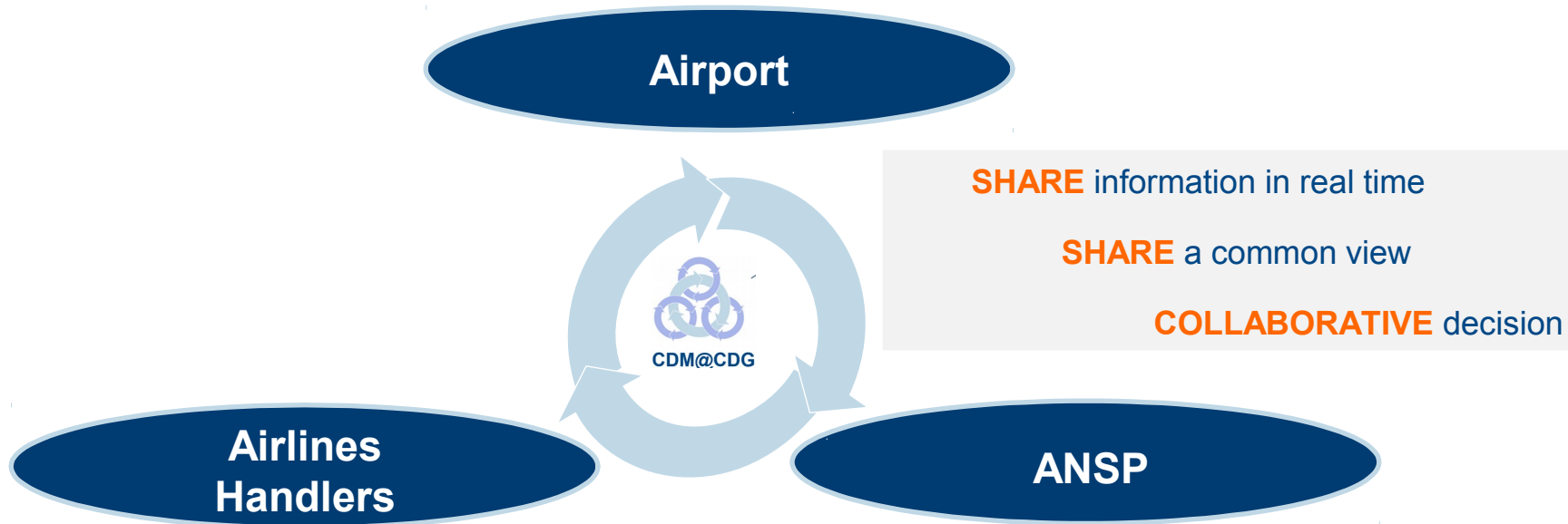


These PI targets also apply to airport operations !



CDM origins, concept, benefits

A CDM concept aiming at improving airside operations (nominal and adverse conditions), between :



This project is supported by Europe through Eurocontrol and SESAR project (Single European Sky ATM Research)



CDM@CDG origins, concept, benefits

2003 Snow Event with

- ✓ 2 days non-stop
- ✓ Cancellations : 25%
- ✓ Delays : +2h per flight
- ✓ Around 5,000 pax stucked inside terminals and 5,000 pax in the hotels

Every stakeholder used to work in silos, there was no coordination, no information sharing...

2004 DSNA, Aéroports De Paris and Air France launched CDM@CDG program in order to :

- ✓ deploy Airport Collaborative Decision Making (A-CDM) concept with Eurocontrol rules
- ✓ reduce delays, improve departures and arrivals predictability
- ✓ reduce taxi-time, kerosene consumption and polluting emissions (CO₂, NO_x, HC ...)
- ✓ optimize airport capacities and resources usage



CDM@CDG origins, concept, benefits



To be an A-CDM airport means to respect Operational and Technical concepts defined in Eurocontrol/EU Airport CDM concept and implementation manual e.g. create a PDS, optimize predictability, manage ARR/DEP with ECTL, etc.

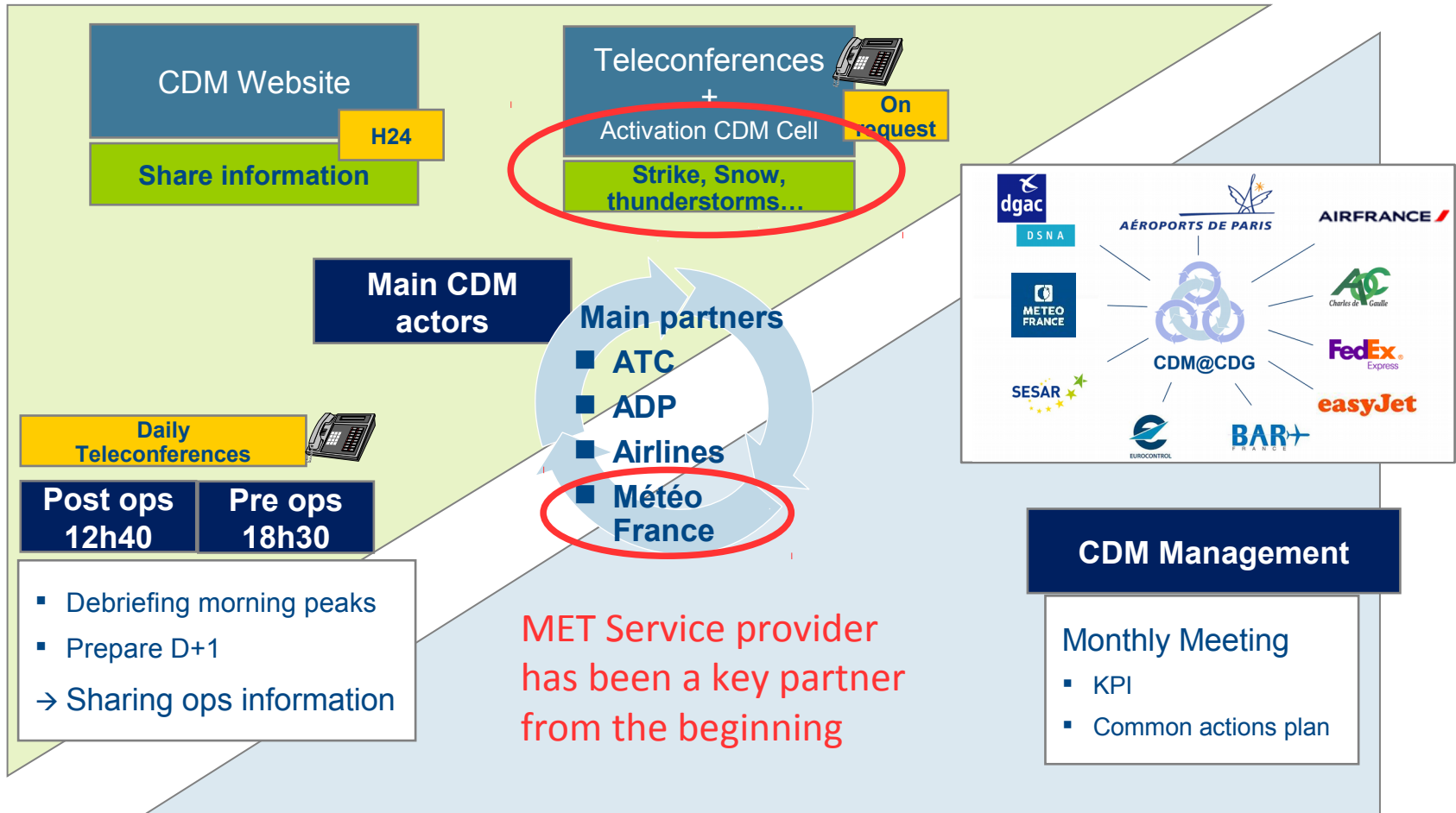


A-CDM label given to CDG on Nov 16th, 2010



CDM@CDG origins, concept, benefits

CDM@CDG Working structure



CDM@CDG origins, concept, benefits

CDM@CDG structure

Operational Pillar

To strengthen and optimise operational collaboration between stakeholders

Technical Pillar

To optimise departures flights sequencing, including

→ Enhance predictability to the Network Manager (prediction 3 hours before)

Benefits (as measured by an external audit company)

Departure taxi-time : - 2.5 min/flight

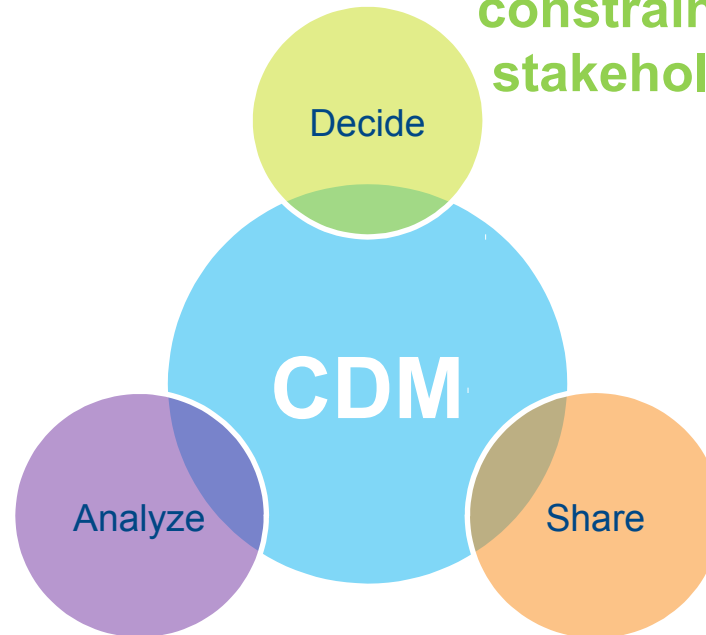
Kerosene : - 4,000 t/yr (~4 M€/yr for airlines)

CO₂ : -12,000 t/yr

CDM@CDG origins, concept, benefits

CDM Cell :

Decide together within the constraints of each stakeholder



Develop tactical solutions on resources utilization (runways, de-icing pads...) and impact on traffic

Share available Information continuously to all participants

CDM Cell :

Three activation levels :

- 1 watching in a 'nominal situation'
- 2 monitoring a non nominal situation, that would induce delays, but was anticipated
- 3 monitoring a non nominal situation ; defining strategy to optimise airside ops

All stakeholders present in the CDM cell room
incl. the Aerodrome Met Office Management

The MET application cdm@cdg

The Met partner in CDMCDG has a key role :

- Share information for pro activity
- Update on regular basis, or event-driven update
- Communicate for better understanding
- Back-up CDM community → manager on duty during winter period, physically participating to CDM cell
- Develop tools to meet customers needs and expectations → dedicated working group

=> Dedicated website providing observations & forecast
+ first steps in translation of MET information into impact



The MET application cdm@cdg

First steps in translation of MET information into impact : the CDM@CDG WG for meteorology defined impact translation matrices

BROUILLARD	RAS	brouillard peu dense ou en bancs	brouillard dense par endroits	brouillard dense
BROUILLARD GIVRANT	RAS	brouillard givrant peu dense ou en bancs	brouillard givrant dense par endroits	brouillard givrant dense
ORAGES	RAS	orages possibles	orages probables	orages forts, avec ou sans grêle
NEIGE	RAS	pluie et neige mêlées	neige faible	neige modérée ou forte
VERGLAS	RAS	inutilisé	inutilisé	pluie ou bruine verglaçante
TEMPERATURES FROIDES	> 3°C	=< 3°C	=< 1°C	<= -7°C
TEMPERATURES CHAUDES	< 32°C	>= 32°C	>= 35°C	>= 40°C
VENT MAX FREQ/EXTR	< 25kt	>= 25kt	>= 40kt	>= 55kt
VENT TRAVERS MOYEN	< 25kt	>= 25kt	>= 30kt	>= 35kt
VENT TRAV FREQ/EXTR	< 25kt	>= 25kt	>= 38kt	>= 50kt

The MET application cdm@cdg

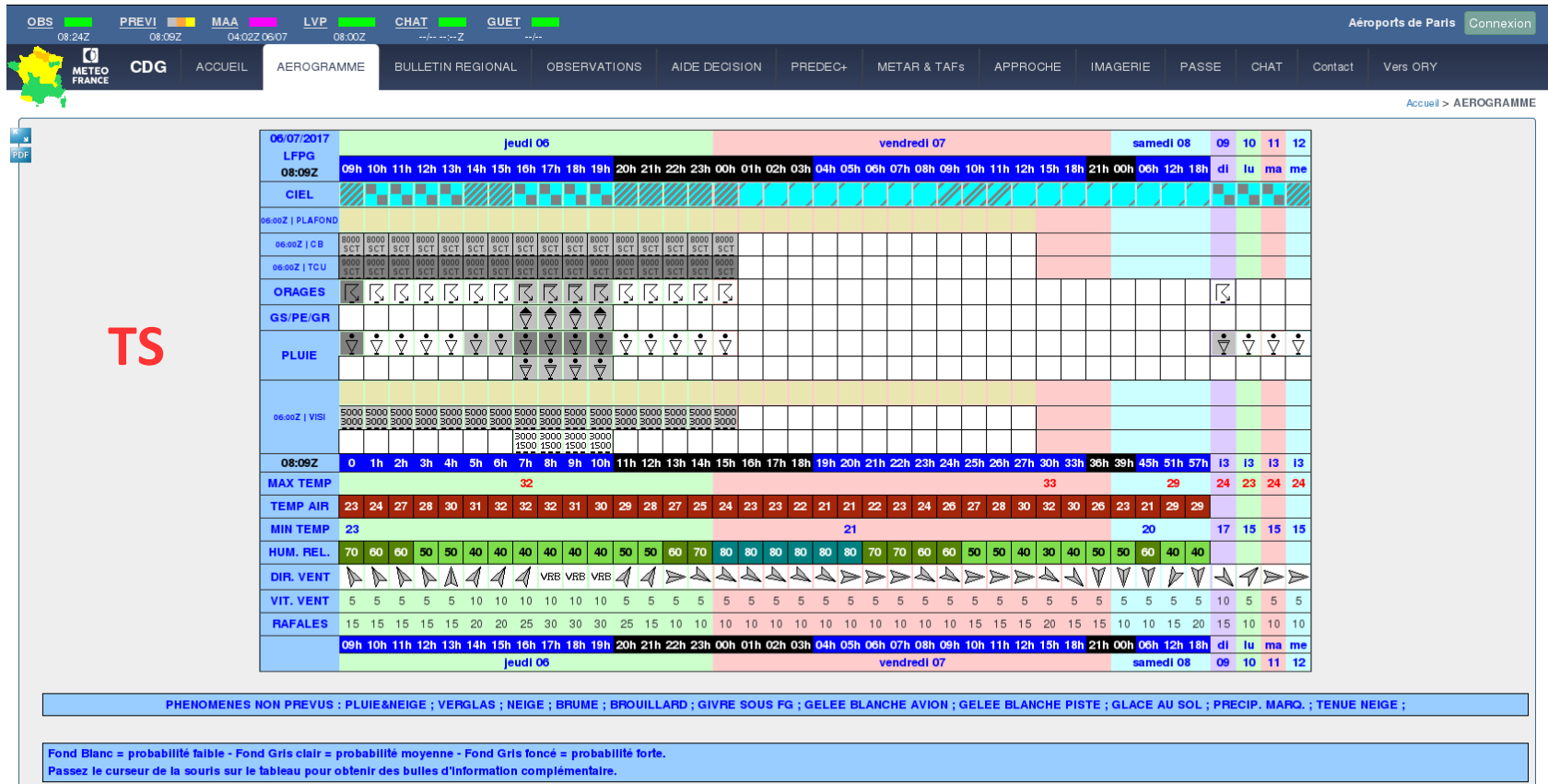
Wind is the 'every day-every time' parameter => special impact translation matrices for head/tail wind or for crosswind



Composante « de droite »	Composante « de gauche »	Signification
		Composante transversale nulle (vent dans l'axe ou calme)
		Composantes vent moyen et rafales < 25kt
		Composantes vent moyen < 25kt avec rafales >= 25kt
		Composantes vent moyen < 25kt avec rafales >= 38kt
		Composantes vent moyen < 25kt avec rafales >= 50kt
		Composantes vent moyen et rafales >= 25kt
		Composantes vent moyen >= 25kt avec rafales >= 38kt
		Composantes vent moyen >= 25kt avec rafales >= 50kt
		Composantes vent moyen >= 30kt avec rafales >= 38kt
		Composantes vent moyen >= 30kt avec rafales >= 50kt
		Composantes vent moyen >= 35kt avec rafales >= 50kt

The MET application cdm@cdg

Nowcasting, short-term and medium-term detailed forecast



The MET application cdm@cdg

Nowcasting, short-term and medium-term detailed forecast
First steps in translation of MET information into impact

OBS 08:30Z PREVI 08:09Z MAA 04:02Z 06:07 LVP 08:00Z CHAT ---Z GUET ---Z

Aéroports de Paris Connexion

METEO FRANCE CDG ACCUEIL AERGRAMME BULLETIN REGIONAL OBSERVATIONS AIDE DECISION PREDEC+ METAR & TAFs APPROCHE IMAGERIE PASSE CHAT Contact Vers ORY

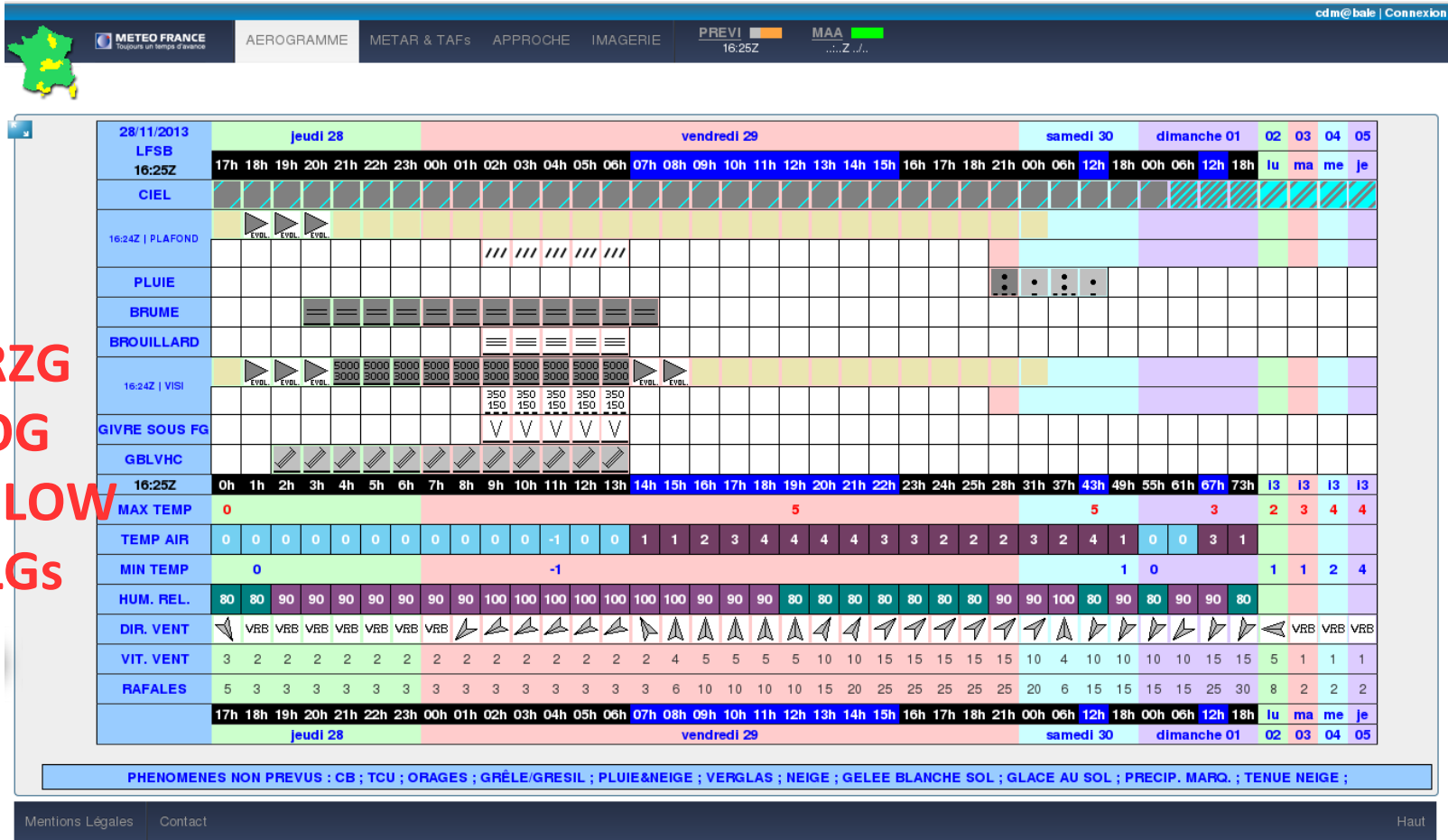
TS

06/07/2017	jeudi 06																	vendredi 07												samedi 08				09	10	11	12	06/07/2017					
08:09Z	09h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h	00h	01h	02h	03h	04h	05h	06h	07h	08h	09h	10h	11h	12h	15h	18h	21h	00h	06h	12h	18h	di	lu	ma	me	08:09Z			
LFPG	CE																																	ME				LFPG					
TEMP. MAX	[Grid of temperature values]																																	TEMP. MAX									
TEMP. MIN	[Grid of temperature values]																																	TEMP. MIN									
ORAGES	[Grid of orange/yellow cells]																	[Grid of orange/yellow cells]				[Grid of orange/yellow cells]				ORAGES																	
TEMP. CHAUDES	[Grid of temperature values]																																	TEMP. CHAUDES									
VENT MAX EXTR	[Grid of wind speed values]																																	VENT MAX EXTR									
TRAV MAX EXTR	[Grid of wind speed values]																																	TRAV MAX EXTR									
PRECIPITATIONS	[Grid of precipitation values]																																	PRECIPITATIONS									
FORTE PLUIE	[Grid of precipitation values]																																	FORTE PLUIE									
MAX	-7	-5	-5	-7	0	10	7	9	1	1	1	9	5	10	9	9	9	9	9	9	10	10	10	9	9	15	15	15	19	11	0	-2	0	-5	-3	10	9	10	10	MAX	27		
MOYEN	-2	-2	-2	-2	0	5	3	3	0	0	0	2	2	5	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	MOYEN	26
TRAVERS	[Grid of wind direction indicators]																																	TRAVERS									
09 MOYEN	2	2	2	2	0	-5	-3	-3	0	0	0	-2	-2	-5	-4	-4	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	MOYEN		
08 MAX	7	5	5	7	0	-10	-7	-9	-1	-1	-1	-9	-5	-10	-9	-9	-9	-9	-9	-9	-10	-10	-10	-9	-9	-15	-15	-15	-19	-11	0	2	0	5	3	-10	-8	-10	-10	MAX			

Légende | Seuils Visibilité et Plafond

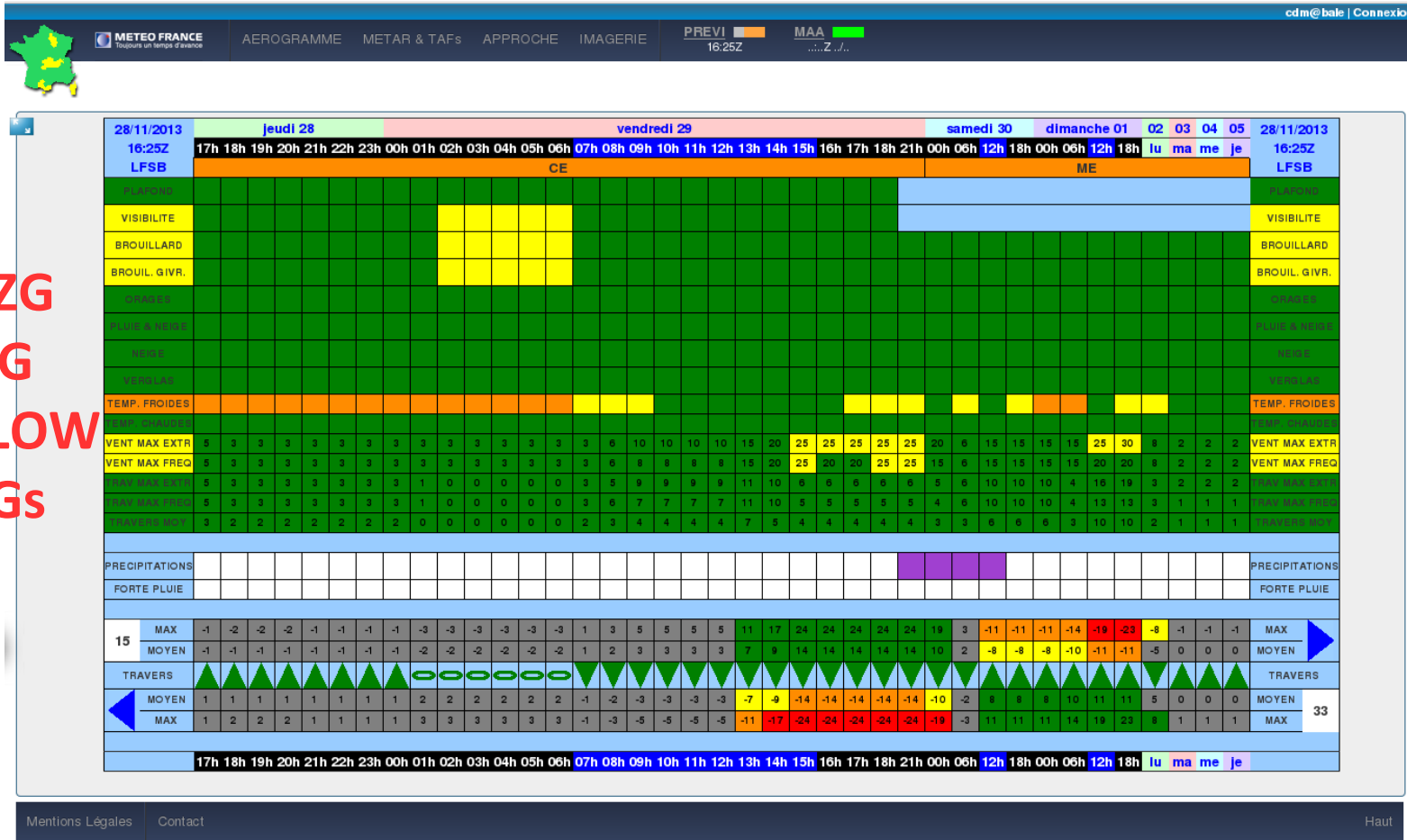
The MET application cdm@cdg

Nowcasting, short-term and medium-term detailed forecast



The MET application cdm@cdg

Nowcasting, short-term and medium-term detailed forecast
 First steps in translation of MET information into impact

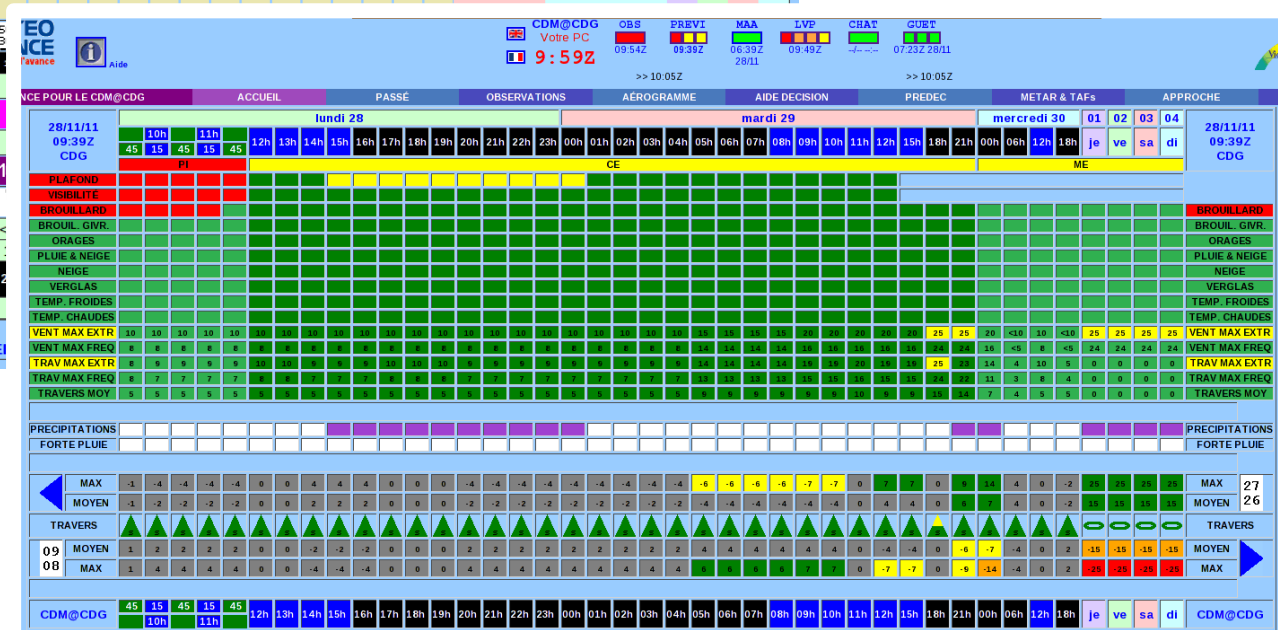
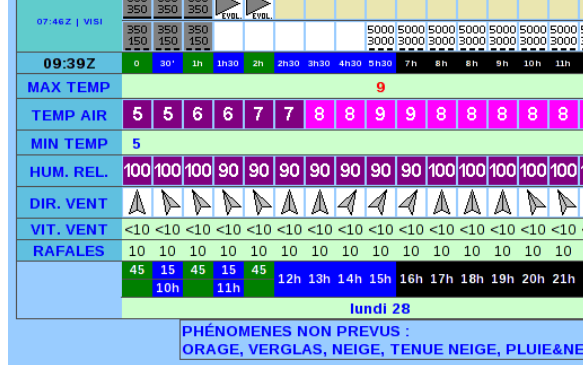
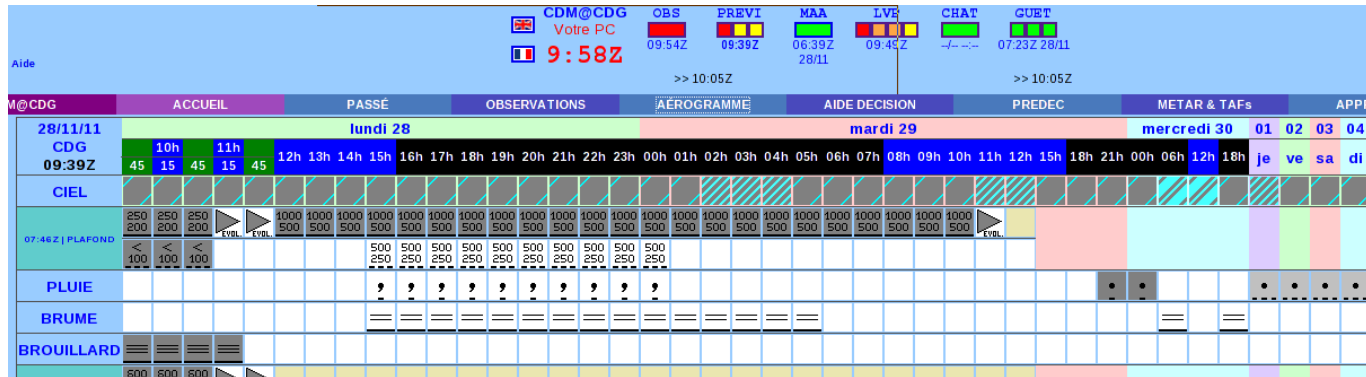


FRZG
 FOG
 & LOW
 CLGs

The MET application cdm@cdg



Nowcasting, short-term and medium-term detailed forecast
 First steps in translation of MET information into impact



**LOW
 VISI &
 CLGs**

The MET application cdm@cdg

Example of LVP forecast

CDM@CDG
Votre PC
10:00Z

OBS 09:54Z
PREVI 09:39Z
MAA 06:39Z 28/11
LVP 09:49Z
CHAT -/-/-/
GUET 07:23Z 28/11

>> 10:05Z >> 10:05Z

OBSERVATIONS AÉROGRAMME AIDE DECISION PREDEC METAR & TAFs APP

METEO-FRANCE ROISSY CDG

PREVISIONS LVP DE 10H UTC

DATE : 28/11/2011 A 09:49 UTC

RISQUE LVP	TRANCHES HORAIRES EN HEURES UTC			
	10:00 - 10:30	10:30 - 11:00	11:00 - 12:00	12:00 - 13:00
CERTAIN	XXXXXXXXXX			
PROBABLE		XXXXXXXXXX	XXXXXXXXXX	
IMPROBABLE				XXXXXXXXXX
EXCLU				

Signification du risque LVP


CERTAIN	conditions LVP prévues, avec certitude
PROBABLE	conditions LVP prévues, sans certitude
IMPROBABLE	Pas de conditions LVP non prévues, sans certitude
EXCLU	Pas de conditions LVP non prévues avec certitude

**LOW
VISI &
CLGs**


The MET application cdm@cdg

Real time observations


Aide




CDM@CDG
Votre PC
9:59Z




OBS
09:54Z




PREVI
09:39Z




MAA
06:39Z
28/11



LVP
09:49Z



CHAT
-- --



GUET
07:23Z 28/11

>> 10:05Z

>> 10:05Z

M@CDG
ACCUEIL
PASSÉ
OBSERVATIONS
AÉROGRAMME
AIDE DECISION
PREDEC
METAR & TAFs
APPR

METEO-FRANCE ROISSY LFPG

TABLEAU DE BORD OBSERVATION

lundi 28 novembre 2011 à 09:54 UTC (10:54 LT)

(indications relatives aux 6 dernières minutes écoulées)

Visibilité (RVR)	Plafond	Vitesse Vent	Composante Vent Travers	Températures Chaudes	Températures Froides
>=1500m	> 500ft	<=20kt	<=20kt	< 32 °C	> 3 °C
< 1500m	<=500ft	> 20kt	> 20kt	>=32 °C	<=3 °C
< 1000m	<=300ft	> 40kt	> 25kt	>=35 °C	<=1 °C
< 600m	<=200ft	> 55kt		>=40 °C	<=-7 °C

Phénomènes divers

Forte Pluie	Orage < 5km	Grain (ou Trombe) proche	Brouillard givrant	Pluie&Neige mêlées	Neige	Pluie verglaçante
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[Informations](#)

LOW
VISI &
CLGs

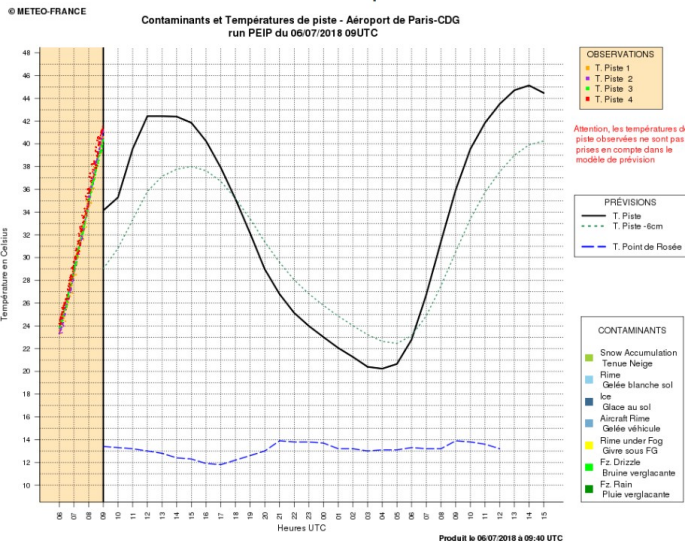
The MET application cdm@cdg

Real time observations (values ; 1-min update)

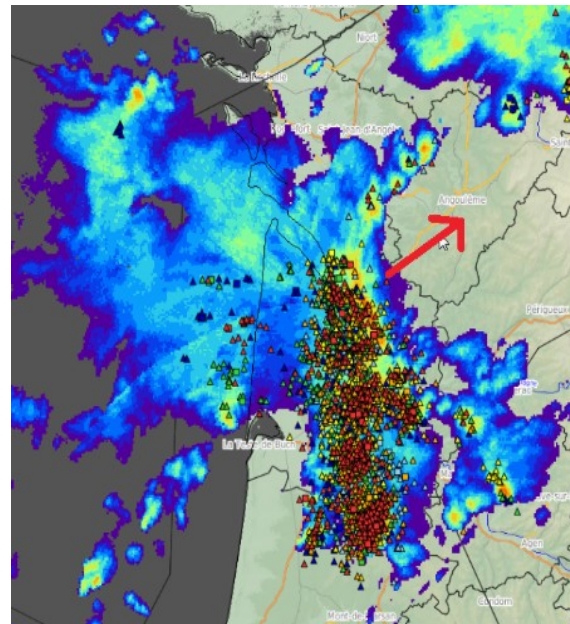
Paris-CDG (108m) - Observation du vendredi 06 juil. 2018 - 10:12 (12:11 LT)										
Temps présent		Nuages en formation ou en train de se développer								
Etat du sol naturel		Sol sec								
VISIBILITE ET CIEL										
Visibilité		Nébulosité		Couches Nuageuses						
>10km		1/8		1/8 CI 25000ft						
TEMPERATURE, HUMIDITE et PLUIE										
T. sous abri		Td (Pt. rosée)		Humidité		T +10cm		T sol		T -10cm
24.9 °C		13.4 °C		49 %		33.9 °C		45.9 °C		21.6 °C
										Pluie 6'
										0 mm
VENT										
Moyenne sur 10 minutes		Moyenne sur 2 minutes		Rafale maximale						
09		020°/3kt (5km/h)		280°/2kt (4km/h)		4kt (8km/h)				
		010°/4kt (8km/h)		020°/3kt (6km/h)		3kt (5km/h)				27
08		030°/5kt (9km/h)		040°/8kt (14km/h)		9kt (17km/h)				
		040°/4kt (7km/h)		010°/4kt (8km/h)		6kt (11km/h)				26
PRESSION										
Pression niveau mer		1021.4 hPa		QNH		1021 hPa		POM		> 2000m
HBN										
RVR		> 2000m		MSD		> 2000m		27R		> 2000m
09		> 26000ft		09R		> 2000m		27L		> 2000m
				08L		> 2000m		26R		> 2000m
08		> 26000ft		08R		> 2000m		26L		> 2000m

RWY temperature and contaminant forecast

Prévisions de Température de Piste



Radar imagery



+satellite imagery, OPMET data, historical data, etc.

The MET application cdm@cdg

Wind & Crosswind forecast for decision support

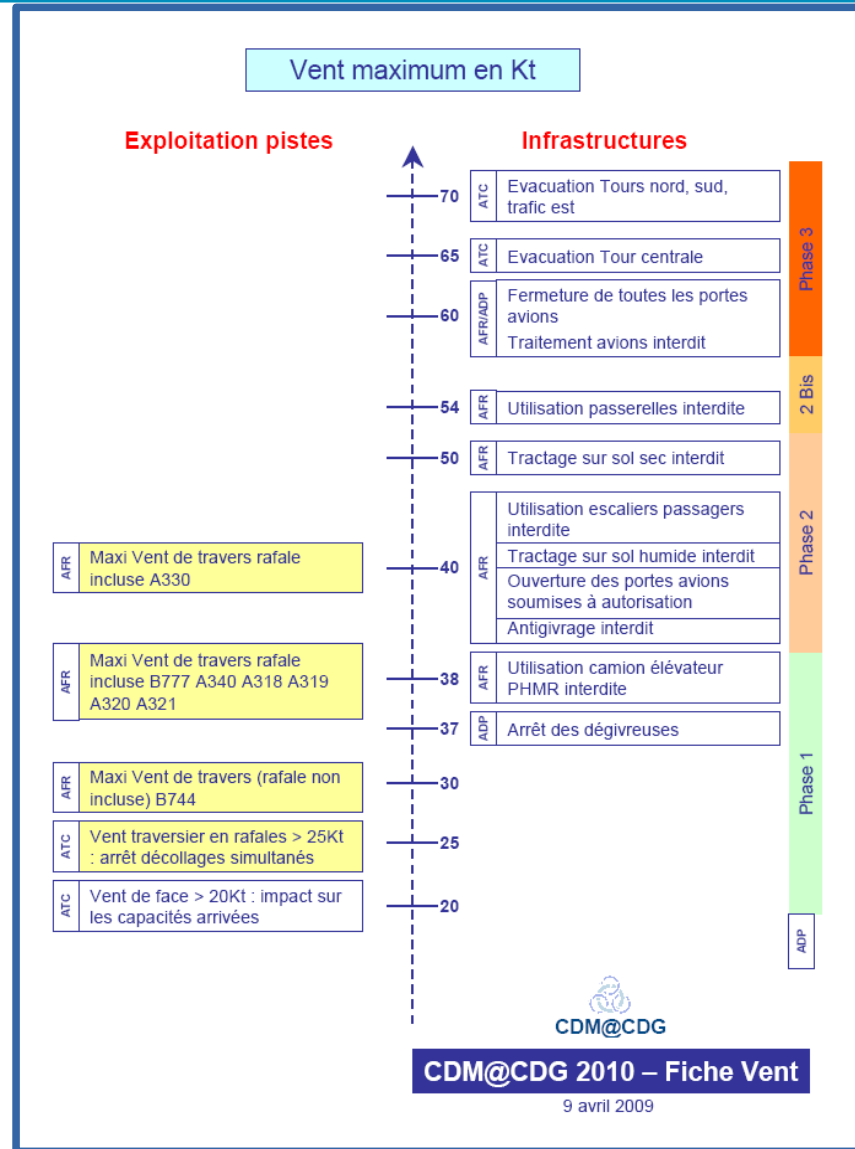


Tailored for users' needs in terms of wind/crosswind forecast over operational thresholds

The MET application cdm@cdg

Operations or procedures at CDG in case of strong winds

Wind-related operational phases (airport manager) and limiting thresholds



e.g. max wind > 54kt
=> no usage of gangways

e.g. max wind > 37kt
=> stop usage of de-icing pads or vehicles

The MET application cdm@cdg

Regional forecast

Wind forecast along approach paths

Bulletin Régional
 Edité le : 06/07/18 à 05:52 lég.

Situation météorologique jusqu'en fin de nuit du 06/07/2018 au 07/07/2018 :
 Les hautes pressions se mettent en place sur la région avec un flux très relâché en altitude comme au sol.

Incertitude du scénario :
 Accord des modèles numériques : bon.
 Modèle numérique choisi : ARPEGE.
 Commentaire : Pas d'enjeu sécurité.

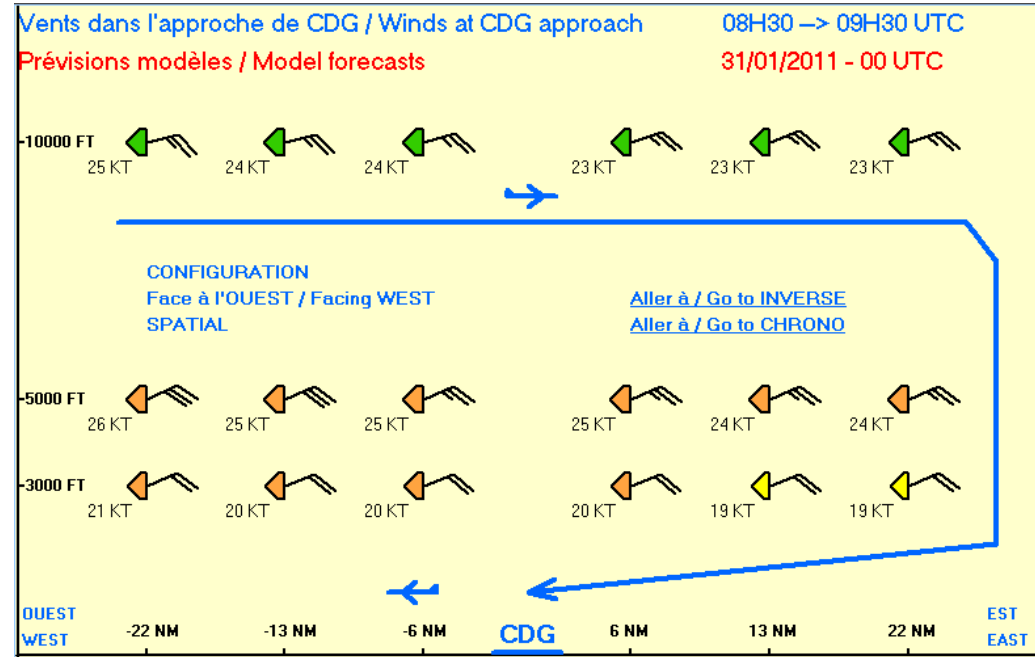
Prévision sur l'Ile-de-France :
 Temps : Calme sous le ciel dégagé, légère fraîcheur agréable de l'aube avant une journée estivale, chaude et ensoleillée (Cu).
 Soirée et nuit clémentes.
 Vent : faible parfois calme, ou dominante de secteur nord.
 Températures maximales : de 28 à 30 °C.
 Températures minimales : de 13 à 17°C localement jusqu'à 20 °C dans la capitale.

<http://www.meteofrance.com>

PRÉVISIONS DÉTAILLÉES SUR VOTRE DÉPARTEMENT | TOUTES LES PRÉVISIONS DE MÉTÉO FRANCE
 ☎ 08 99 71 02 75 | Service 2,99 €/appel + prix appel | ☎ 3 250 | Service 2,99 €/appel + prix appel

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 Version 2009

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 Tél. : -- / Fax : --
 Mél. : support.iledefrance-centre@meteo.fr <mailto:support.iledefrance-centre@meteo.fr>

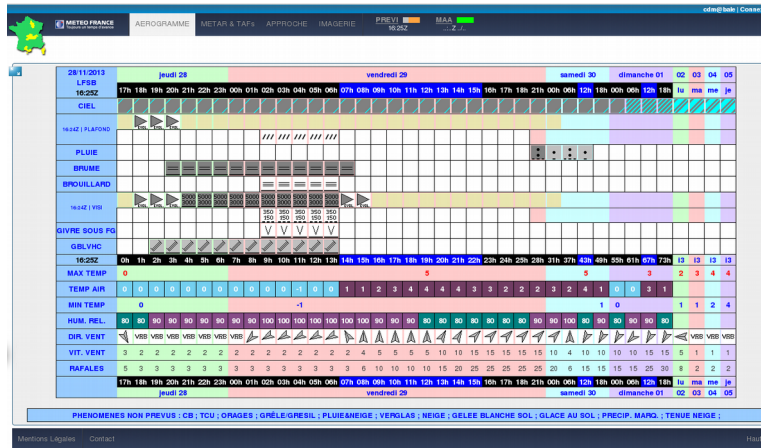


Tailwind/head wind along approach axis over pre-defined thresholds

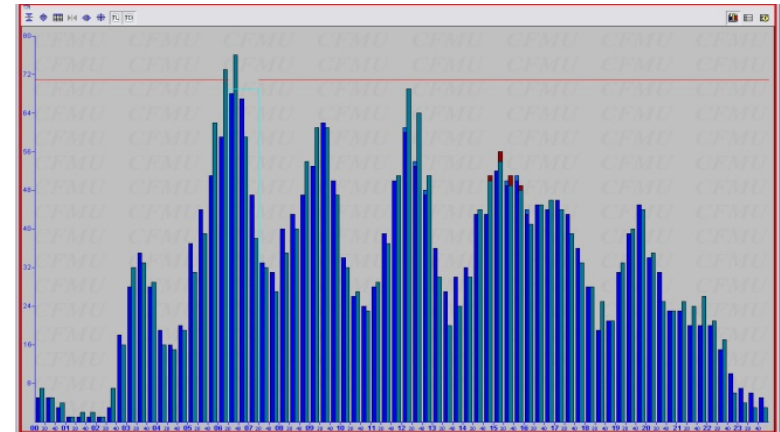
The MET application cdm@cdg

Pre-tactical work in winter conditions

Weather forecast



Global traffic forecast



And other information or partners constraints that can impact traffic flow

Share and analyze

Decision

- Characterize the CDM Cell operational collaboration's level
- Adaptate de-icing & snow clearing means
- Suggest cancellations flights

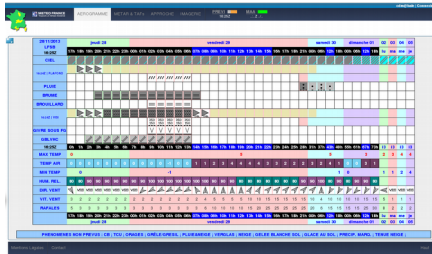


The MET application cdm@cdg

Tactical work in winter conditions

Share and analyze

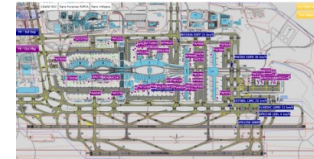
Meteorological forecast



RWY Temp & freezing point



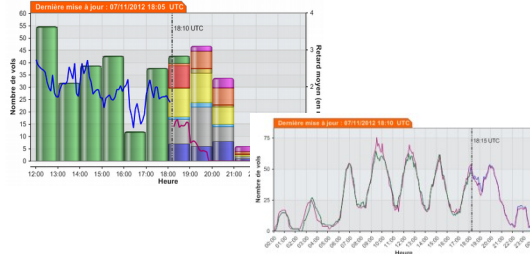
Ground movements



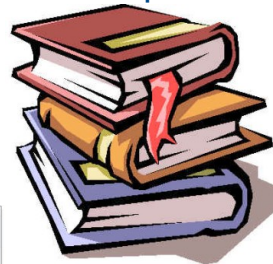
Local ATC data



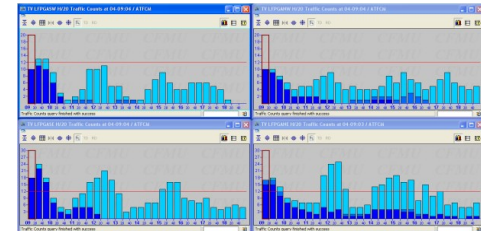
Real-time indicators : Traffic load, deicing throughput, etc.



Snow plan



Network data



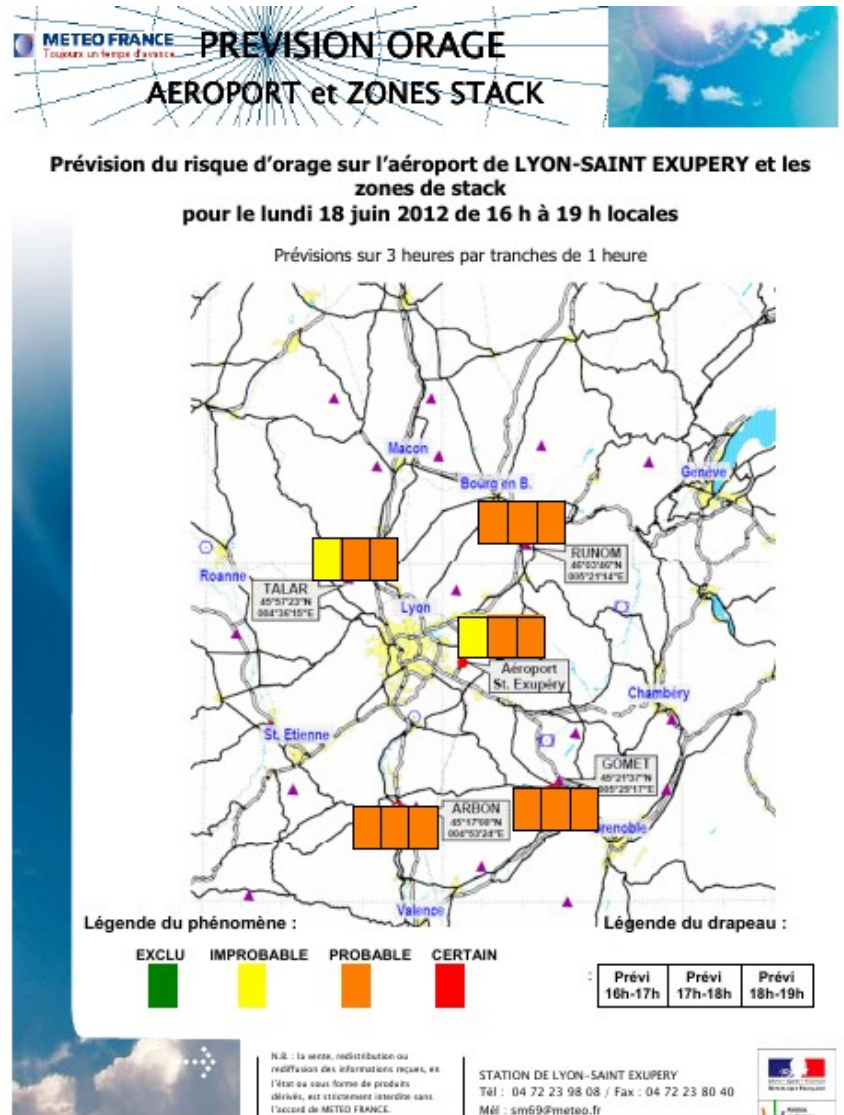
And other information!

Decision

- Decisions focused on infrastructure usage optimization
- Runways and Taxiways snow clearing strategy

The MET application cdm@cdg

The MET application concept has been applied at other major French airports incl. Lyon Saint-Exupéry airport. Similar information and products + local ones e.g. **convection probability over stack areas** around LFLL



Gains from CDM@CDG

Improvements on :

- Safety
- Punctuality
- Forecasting
- Confidence
- Performance and capacity
- Quality standards
- Risk assessment
- Crisis management
- Taxi time
- Airport image

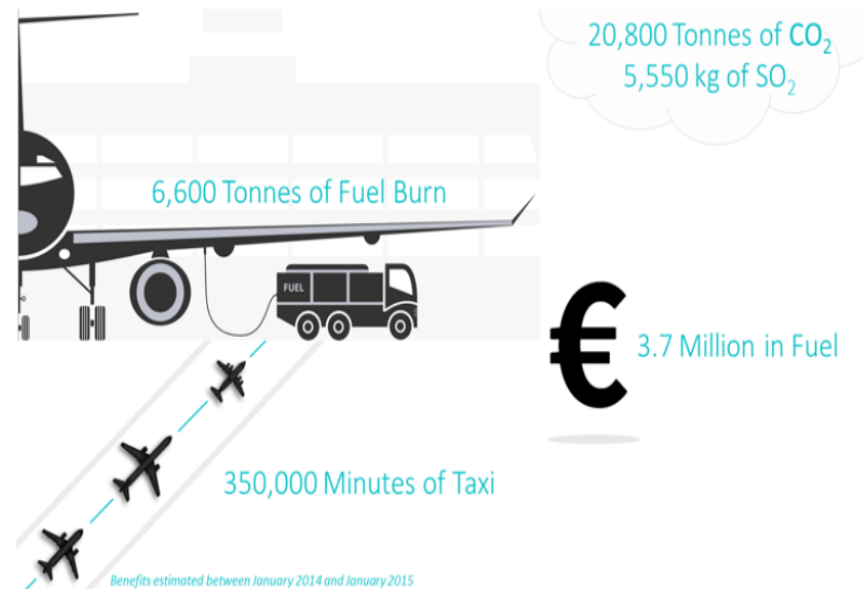


Gains from CDM@CDG

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

► Environmental impacts

- Fuel consumption
- CO₂ emissions



Also presented at WMO Aeronautical Meteorology Scientific Conference, in Toulouse, France in November 2017:

- AeM Series, 02. Proceedings of the 2017 WMO Aeronautical Meteorology Scientific Conference
- https://library.wmo.int/doc_num.php?explnum_id=4554

Thank you !

Merci !