



Royal Netherlands
Meteorological Institute
*Ministry of Transport, Public Works
and Water Management*

Improved low visibility forecasts at Amsterdam airport - Schiphol -

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Schiphol





Visibility-> operation Schiphol



Photo: Remco Piet



Low Visibility Procedure

Visibility class	Visibility / RVR ¹⁾ (m)		Cloud base (ft)	Capacity [movements per hour]
Good	$VIS \geq 5000$	and	$CLB \geq 1000$	68 arriv. or 74 depart. max 104/108 movements
Marginal	$1500 \leq VIS < 5000$	or	$300 < CLB < 1000$	As above but with independent parallel runways
LVP²⁾ phase A	$550 \leq RVR < 1500$	or	$200 \leq CLB \leq 300$	56 arriv. or 52 depart. max 80 movements
LVP phase B	$350 \leq RVR < 550$	or	$CLB < 200$	44 arriv. or 52 depart. max 74 movements
LVP phase C	$200 \leq RVR < 350$			30 arriv. and 17 depart. max 47 movements
LVP phase D	$RVR < 200$			16 arriv. and 20 depart. max 36 movements



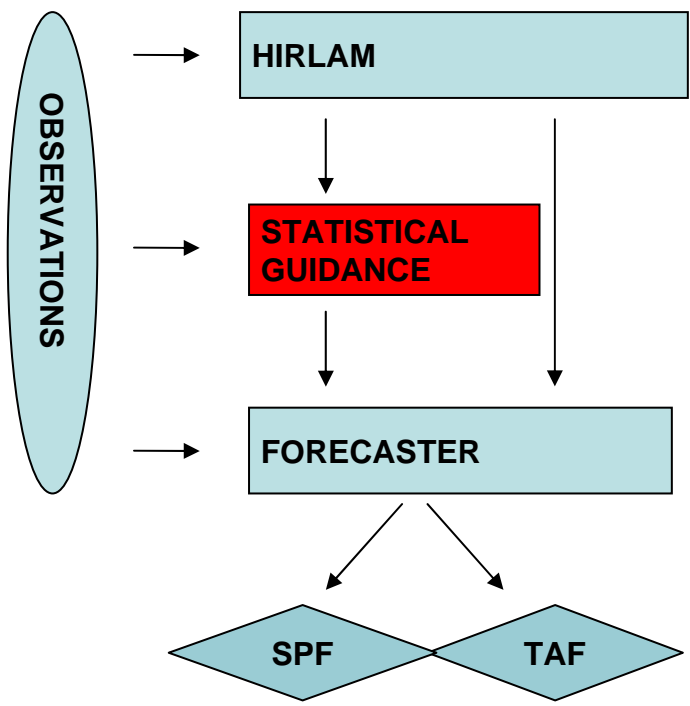
**Reduced
visibility:
Reduced
capacity**

LVP: Low Visibility procedure

Reliable forecasts important!



Forecast cascade



2008: MOR and ceiling forecasts



Tailored statistical forecast

1) Joint probabilities: horizontal visibility and ceiling

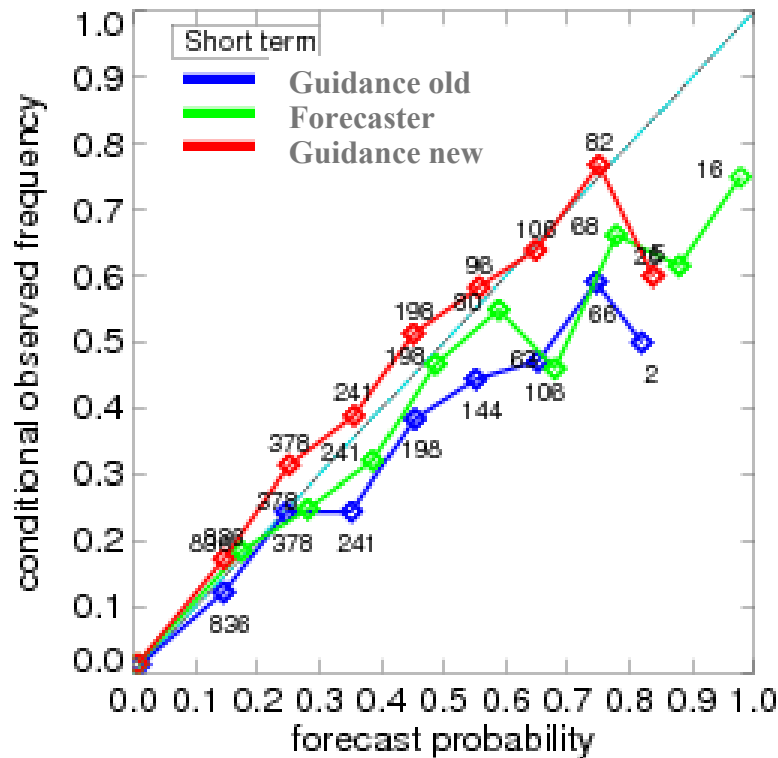
2) Runway Visual Range

- MOR
 - Background luminance
 - Lamp settings
- } RVR

RVR as a function of MOR and background luminance (cd/m2)						
MOR	RVR					
	NA	SD	SL	DD	DG	DH
	<50	50-300	300-1000	1000-4000	4000-12000	>=12000
50	175	150	125	125	100	100
100	325	275	250	200	175	150
150	500	375	325	275	250	200
200	650	500	400	350	300	250
250	800	600	550	450	350	275
300	900	700	650	550	400	325
350	1000	800	700	600	500	375
400	1100	900	800	650	550	400



Old versus new 2004-2007 (RVR < 1500 m | CLB <= 300 ft)



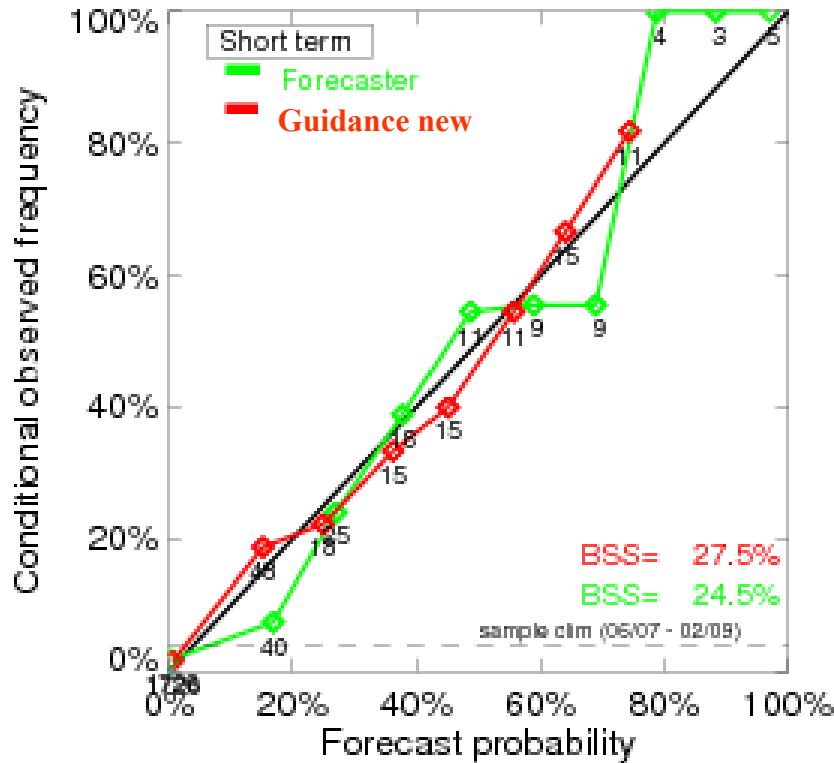
BSS= 15,7 %

BSS= 18,3%

BSS= 22,7%



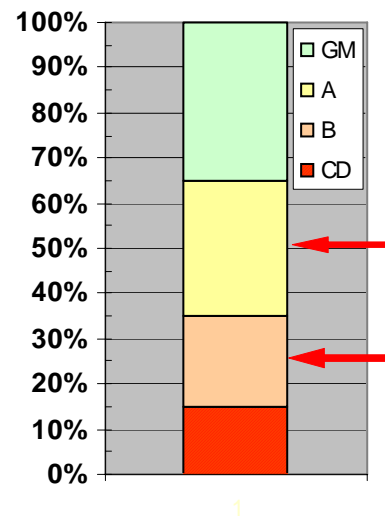
Verification 2007-2009





Decision making process

- Probabilistic meteorological information (rather than deterministic)
.....But a categorical decision
- How to use probabilistic information to make a well-founded categorical decision?
different scores -> different outcomes
- Dilemma: What is the best percentile?
decision point
- *Cost effective decision*
reliable forecast good basis





Integral approach: Using an expense matrix

Extra "costs" due to a wrong forecast

Forecast
→ Increasing vis.

	CD	B	A	MG
CD	0	1	10	100
B	.1	0	1	10
A	1	.1	0	1
MG	10	1	.1	0

$$F_a / M_i = 0.1$$

Reliable forecast basis



Overall "costs"

System performance

		Forecast			
		CD	B	A	MG
Observati	CD	0	2	1	1
	B	8	9	10	4
	A	2	7	2	23
	MG	1	9	21	1332

X

User's 'cost' estimation

		Forecast			
		CD	B	A	MG
Observation	CD	0	1	10	100
	B	.1	0	1	10
	A	1	.1	0	1
	MG	10	1	.1	0

=

Total expense

		Forecast			
		CD	B	A	MG
Observatio	CD	0	2	10	100
	B	.8	0	10	40
	A	2	.7	0	23
	MG	10	9	2.1	0

Threshold percentile is 25 %; $Fa/Mi=0.1$

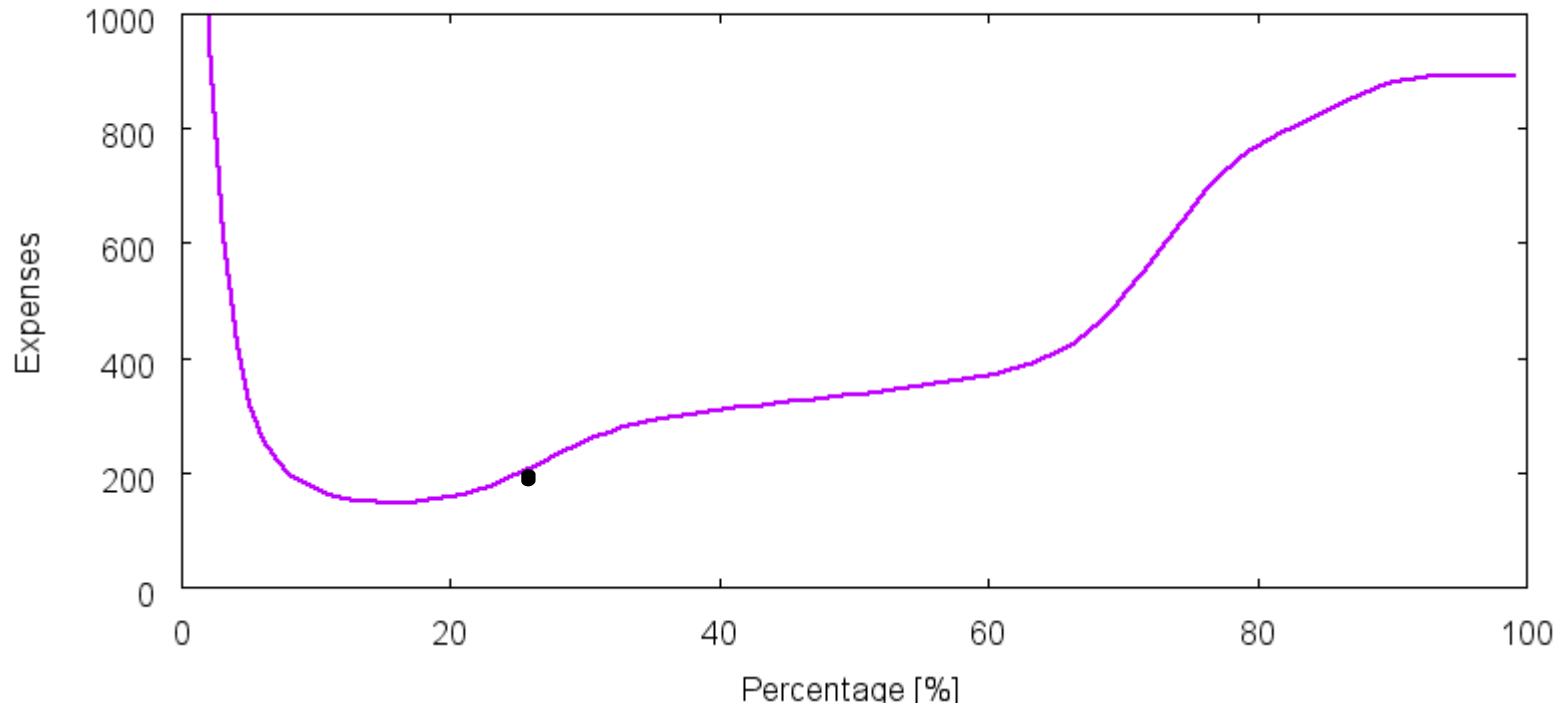
$\Sigma 210$

Repeat for P=1.....100



Expense function

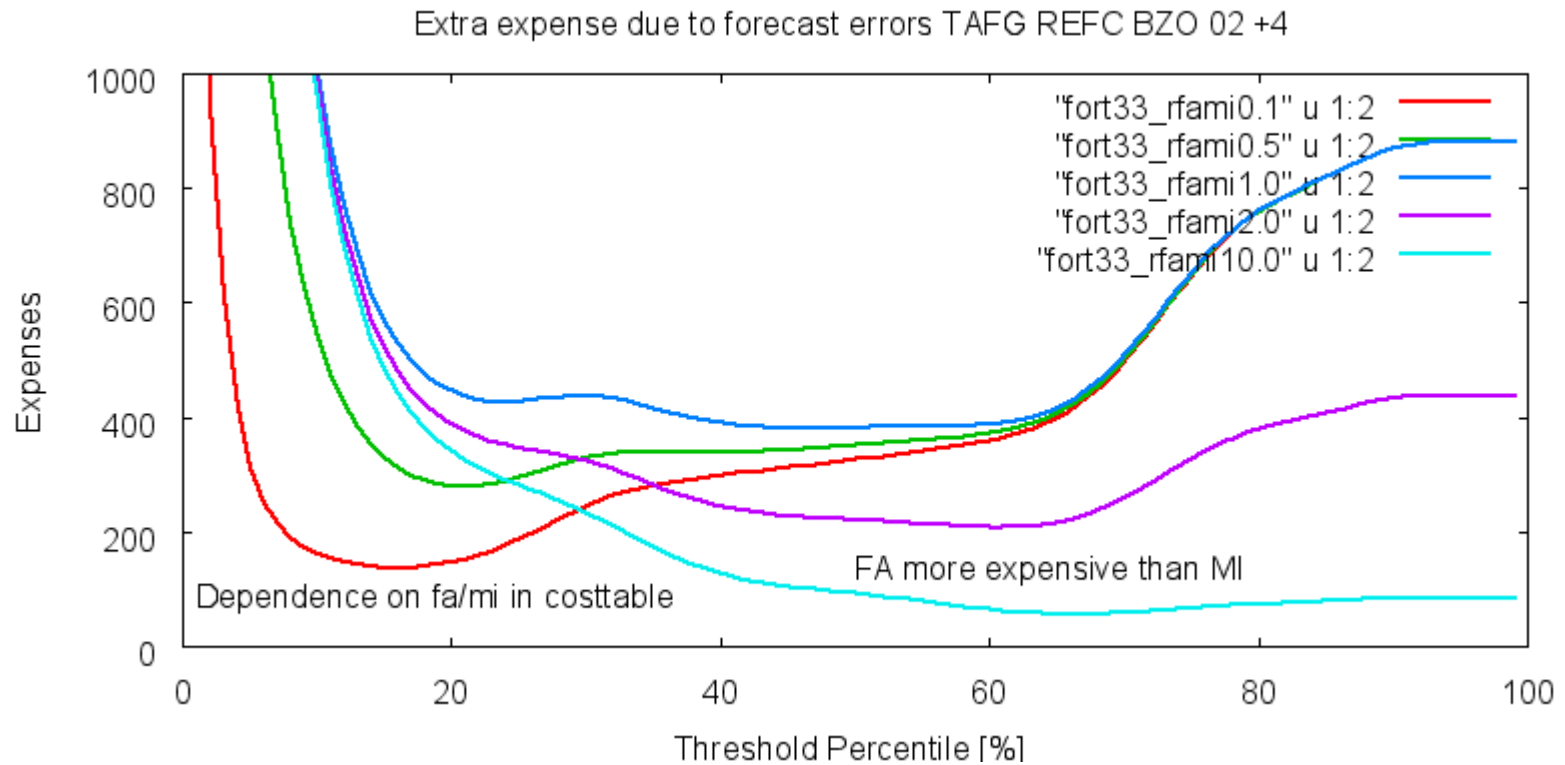
Extra expense due to forecast errors TAFG REFC BZO 02 +4



Minimum > optimal percentile



Expense function



Different users: different expenses-> other optimal percentile (minimum)



Concluding

Visibility forecast improved:

- Statistical model improved
- Tailored to the operation
- Maybe most important:
user's ability to handle probability forecast
one probability forecast, user-specific application