TAF and TREND Verification

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The TAF Verification Concept

- A TAF (Terminal Aerodrome Forecast) gives forecasts of wind, visibility, preyent weather and cloud conditions for an airport.

- Ranges of possible values or states are forecast – for most weather elements in classes.

- A TAF is essentially a forecast for time periods. The shortest applicable time period is 1 hour.

- Using change groups (BECMG, TEMPO, PROBx, FM), the ranges of forecast values can be extended to 2 or more classes.

- All observations valid for the respective hour are used fro verification. These observations display a range of conditions lying in 1 or more classes.

- For each hour, the "best" and "worst" forecast / observed classes are compared.

TAF VISIBILITY: Example (1)

TAF 0615   0700

TEMPO 0609 0200

BECMG 0911 4000

FM1200 9999

	Color
🟩 Green	Forecast and observed
🟨 Yellow	Forecast
🟦 Teal	Observed

VIS \ TIME	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15
OBS H+20	1800	0100	0500	0300	1700	3500	8000	9999	6000
OBS H+50	0300	0400	0400	1000	2300	6000	9999	9999	0300

Forecast and observed VIS classes

VIS \ TIME	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15
5000 - 9999						teal	green	green	green
3000 - <5000				yellow	yellow	green	yellow		teal
1500 - <3000	teal			yellow	green	teal			teal
0800 - <1500	teal			green	green				teal
0600 - <0800	green	yellow	yellow	green	yellow				teal
0350 - <0600	green	green	green	teal					teal
0150 - <0350	green	green	yellow	teal					teal
0000 - <0150		teal							

TAF VISIBILITY: Example (2)

VIS Class FCST \ OBS	0000-<0150	0150-<0350	0350-<0600	0600-<0800	0800-<1500	1500-<3000	3000-<5000	5000-9999
Contingency table for Maximum VIS classes								
0000 - <0150								
0150 - <0350								
0350 - <0600								
0600 - <0800			2			1		
0800 - <1500								
1500 - <3000								
3000 - <5000					1	1		1
5000 - 9999								3

TAF VISIBILITY: Example (3)

Contingency table for Minimum VIS classes

VIS Class FCST \ OBS	0000-<0150	0150-<0350	0350-<0600	0600-<0800	0800-<1500	1500-<3000	3000-<5000	5000-9999
0000 - <0150								
0150 - <0350	1	1	1					
0350 - <0600								
0600 - <0800		1			1			
0800 - <1500								
1500 - <3000								
3000 - <5000						1		1
5000 - 9999		1						1

TAF VISIBILITY: Example (4)

Examples of Scores for Class Thresholds	
Maximum VIS < or ≥ 1500m	Minimum VIS < or ≥ 350m
ORSS = 0,82	ORSS = 0,60
HSS = 0,50	HSS = 0,31
PSS = 0,50	PSS = 0,30

Scores

For n * n Contingency Tables:

- **Gerrity Score GS (Jolliffe and Stephenson, 2003)**

- **Percent above/below diagonal**

- **Heidke Skill Score HSS, Peirce Skill Score PSS**

For 2 * 2 Contingency Tables:

- **Odds Ratio Skill Score (ORSS),**

- **Bias, Hit Rate (H), False Alarm Ratio (FAR)**

- **Heidke Skill Score HSS, Peirce Skill Score PSS**
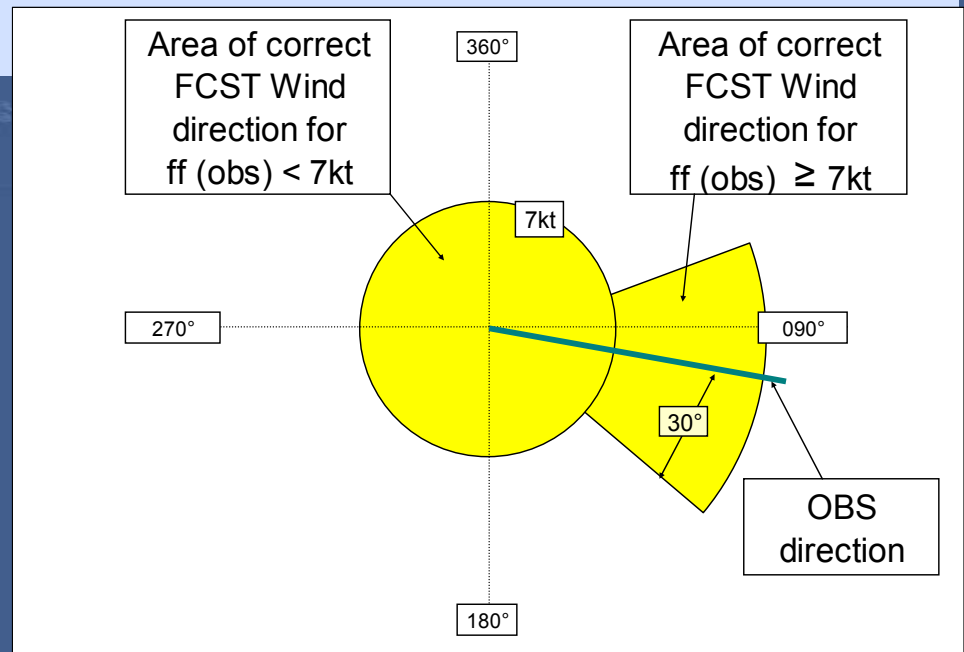
Treatment of Weather Elements (1)

- **VISIBILITY and CEILING are verified using classes (see example).**

- **PRESENT WEATHER is verified similar to classes. Mutually exclusive groups of weather phenomena are defined according to climatological frequency and effect on flight operations. Scores are computed separately for each group.**

- **For Austria, we use the following groups:**
  - **No significant weather**
  - **Freezing fog**
  - **Moderate or heavy liquid precipitation**
  - **Moderate or heavy solid precipitation**
  - **Blowing or drifting snow**
  - **Freezing precipitation**
  - **Thunderstorm (or Squall line, Funnel cloud)**

Treatment of Weather Elements (2)

Following national regulations, **WIND SPEED** and **WIND GUSTS** are verified using classes in Austria.

WIND DIRECTION is verified using deviation criteria (see figure):

- If the OBS wind direction lies within 30° of any FCST wind direction, it is counted correct (see ICAO Annex 3, Attachment B).
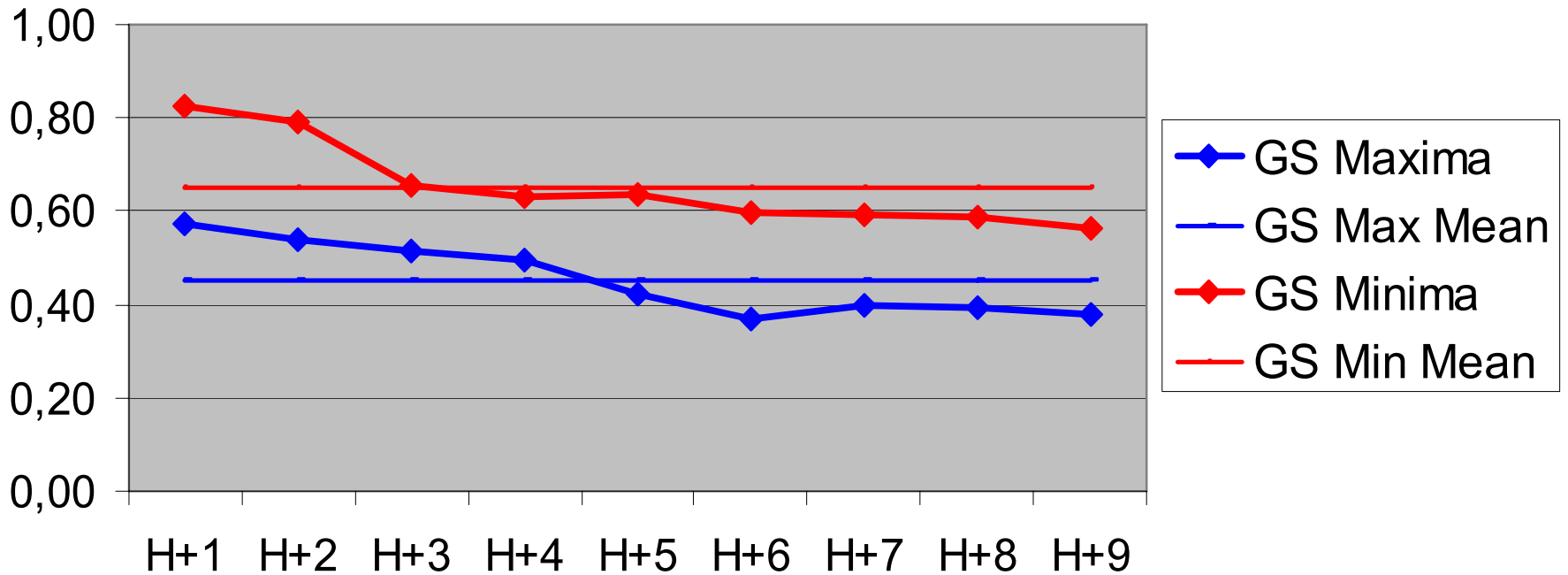- If the OBS wind speed is < 7kt, the FCST wind direction is counted correct in any case.

Area of correct FCST Wind direction for ff (obs) < 7kt

Area of correct FCST Wind direction for ff (obs) ≥ 7kt

360°

7kt

270°

090°

30°

OBS direction

180°

Treatment of Change Groups

- **All TAF change groups (BECMG, FM, TEMPO, PROB, PROB TEMPO) are used to define the range of values forecast for the period indicated.**

- **FM GGgg is verified as change within the hour GG.**

- **TEMPO, PROB, PROB TEMPO can optionally be disregarded for verification. This faciliates user oriented verification runs as PROB TEMPO is frequently disregarded in Airline flight planning procedures.**
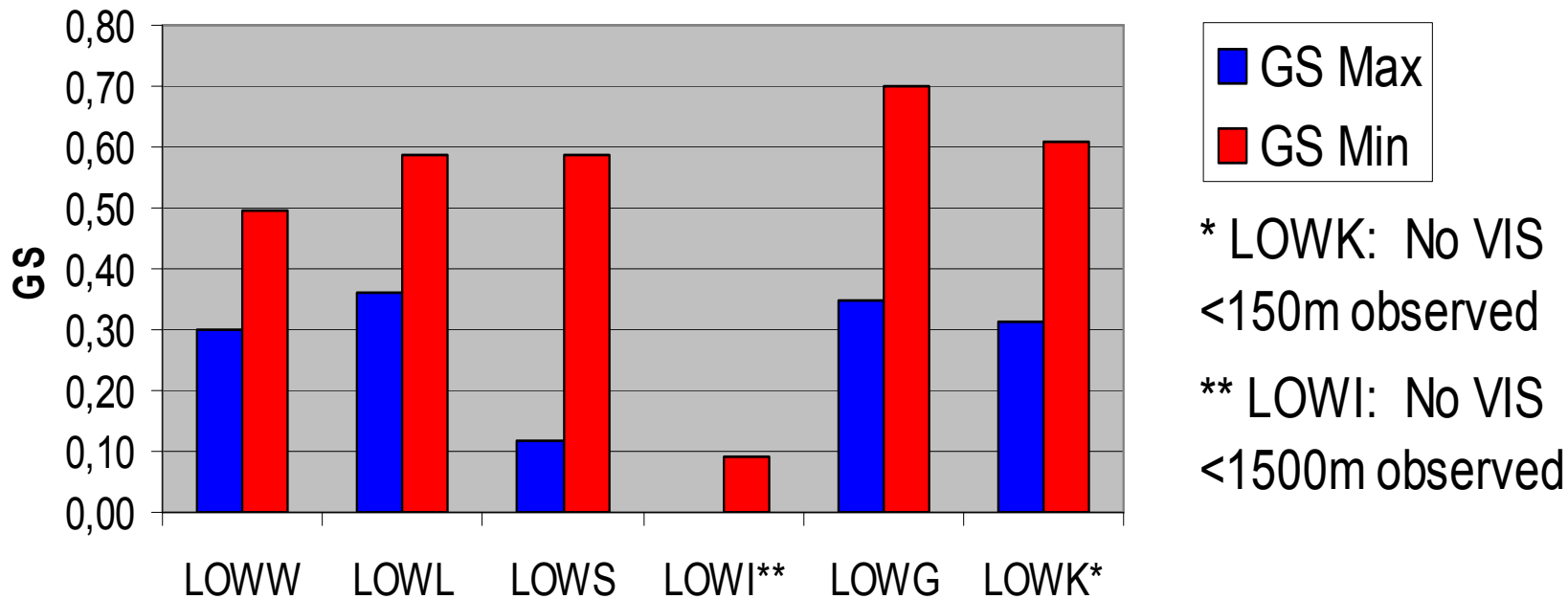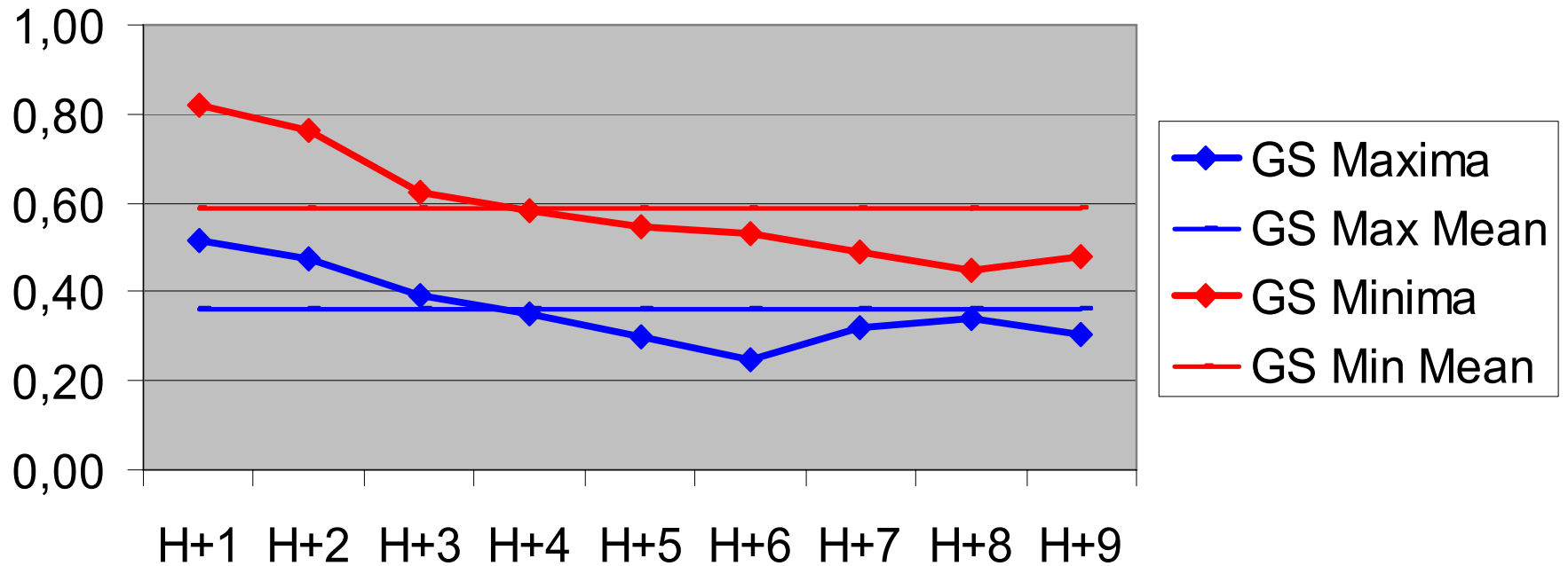
First Results (1)

TAF VIS LOWL 09-11/2006

First Results (2)

TAF VIS for Austrian Airports

Legend:
- ■ GS Max
- ■ GS Min

* LOWK: No VIS <150m observed

** LOWI: No VIS <1500m observed

First Results (3)

TAF Ceiling LOWL 09-11/2006

First Results (4)

TAF Present Weather LOWL:
Moderate or heavy liquid precipitation as "worst" condition

Contingency table

FCST\OBS	NO	YES	SUM
NO	4130	17	**4147**
YES	345	45	**390**
SUM	4475	62	4537

Scores

ORSS=	0,94	PC=	0,92
PSS=	0,65	H=	0,73
HSS=	0,18	FAR=	0,88
TSS=	0,11	Bias=	6,29

The TREND Verification Concept

The validity time of a TREND forecast is 2 hours.

In TREND forecasts, changes in

- wind,

- visibility,

- present weather,

- clouds (ceiling)

are forecast which are significant for aircraft operations.

Criteria for "significant changes"

VISIBILITY, CEILING HEIGHT: transition from above or below through significant values (ICAO Annex 3, App. 5):

Visibility: 150m, 350m, 600m, 800m, 1500m, 3000m, 5000m

Ceiling: 100ft, 200ft, 500ft, 1000ft, 1500ft

Significant Wind Changes
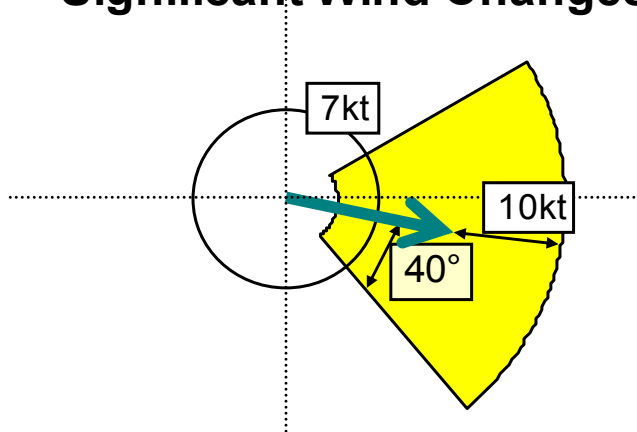
- **Wind direction change > 40° (if speed ≥ 7kt)**
- **Wind speed change ≥ 10kt**

Forecast quality criteria: ±30°, ±5kt
**(ICAO Annex 3, Attachment B)**

SIGNIFICANT WEATHER CHANGES: BEGINNING AND END OF
- **Freezing fog**
- **Moderate or heavy liquid precipitation**
- **Moderate/heavy solid precipitation**
- **Blowing or drifting snow**
- **Freezing precipitation**
- **Thunderstorm, squall line, funnel cloud)**

Verification of "significant changes"

For verification, we use 2 * 2 contingency tables and appropriate scores (see TAF).

The TRENDs are verified by investigating if certain significant changes were:

—— FCST (but not OBS)

—— OBS and FCST

—— OBS (but not FCST)

—— not OBS, not FCST
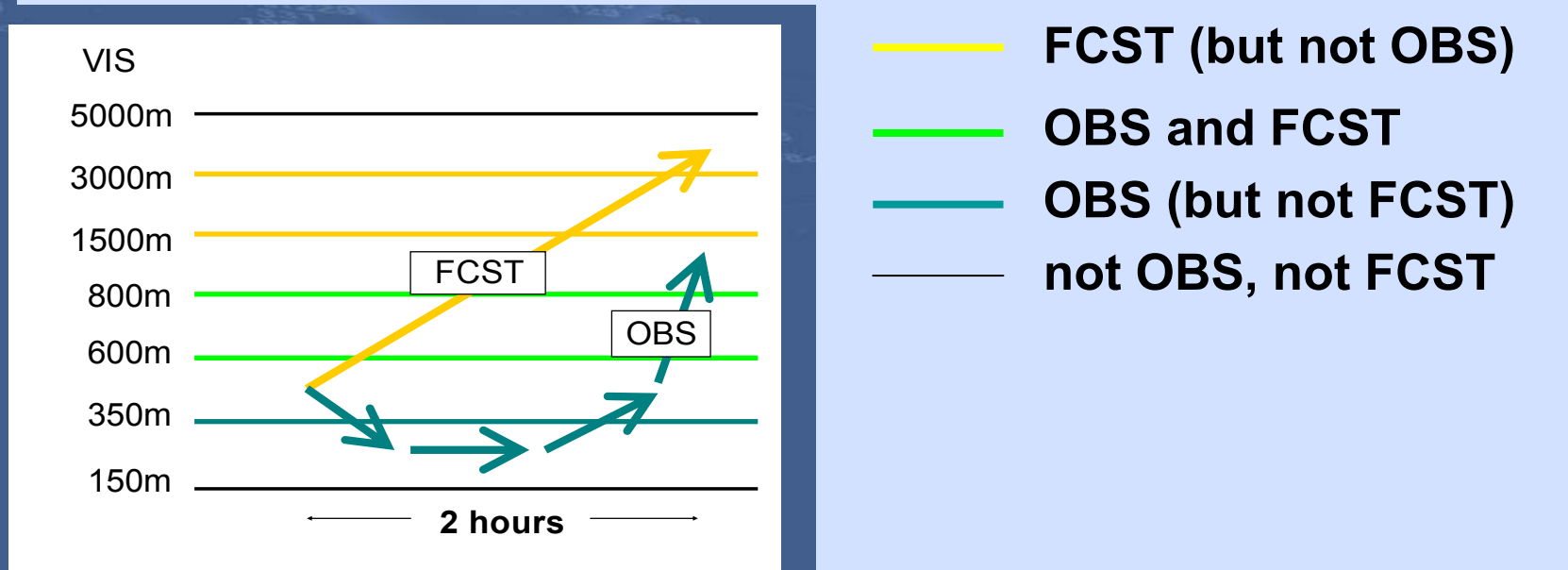
TREND Verification Results for Austrian Airports, period: 09-11/2006

Odds Ratio Skill Scores (ORSS)
Weighted: by the number of OBS significant changes