Forecasting extreme meteorological events over complex topography

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Outline

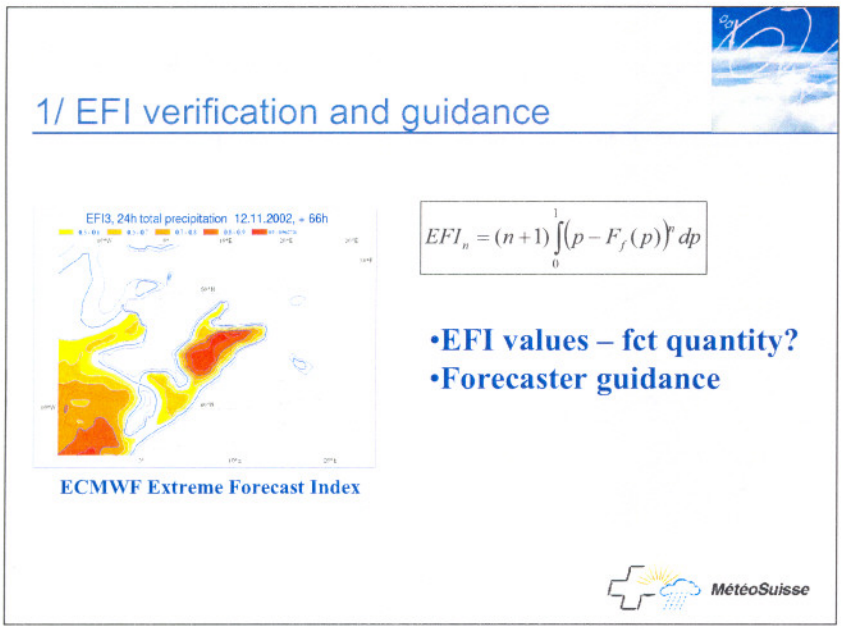
- How to target the EPS on rare events
- Extreme Forecast Index (EFI) a verification
- Processing by ANN (Artificial Neural Networks)
- COSMO LEPS

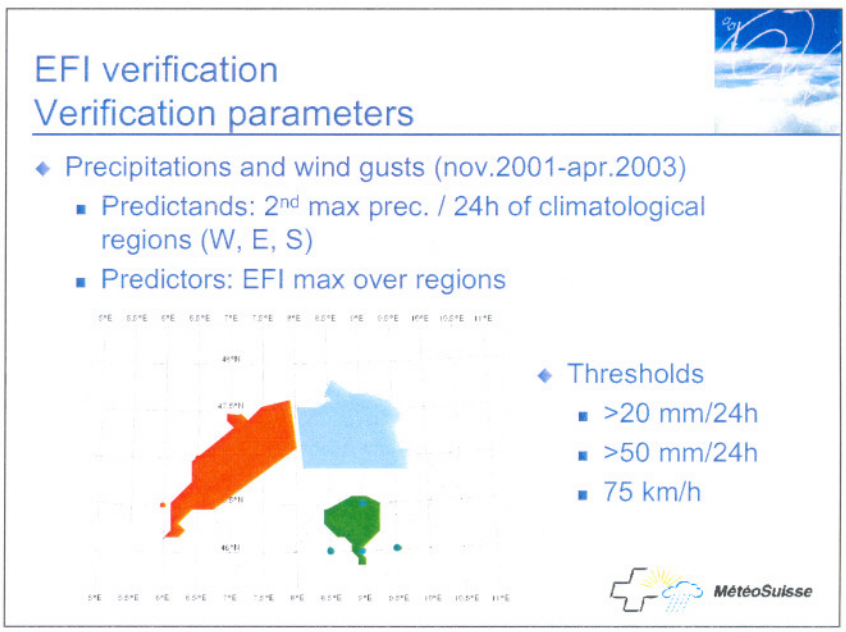
'Rescaling/ downscaling' techniques for extreme events

EFI – rescale with respect to model climate

Artificial neural Network (ANN) – pattern recognition of extreme situations with respect to a given meteorological parameter (precipitation)

LEPS – downscale ensemble with a LAM

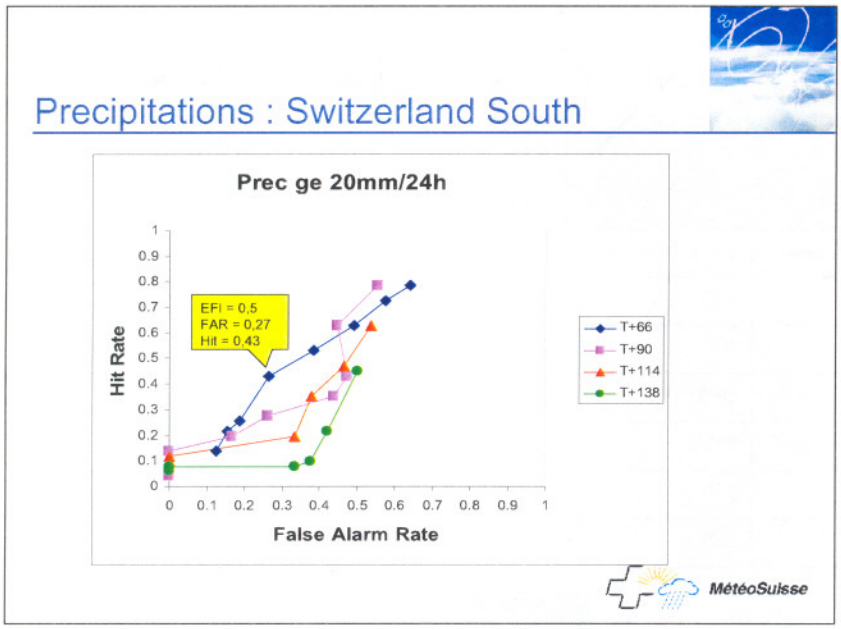


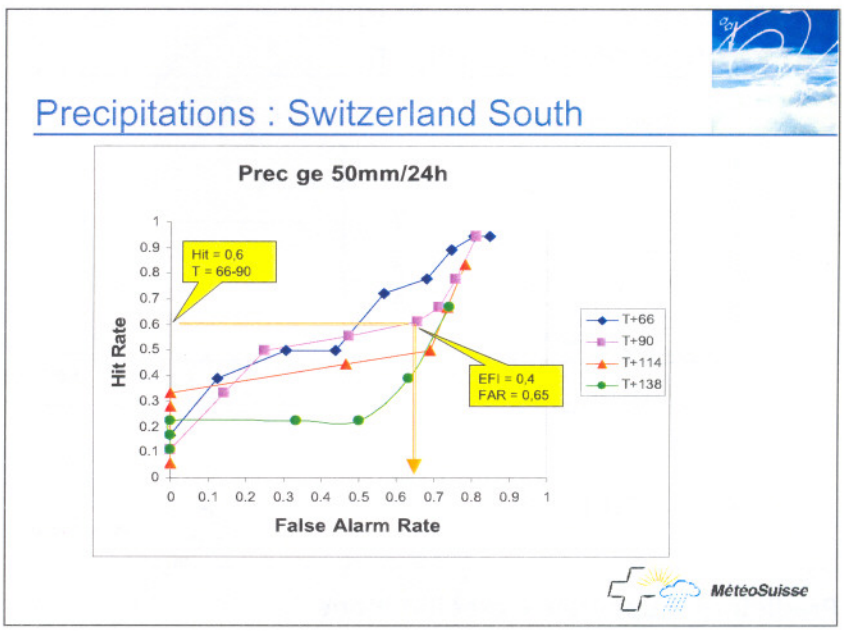


Verification: scores

Event	Observed	Not observed
Forecasted	A	B
Not forecasted	C	D

- Event forecasted: EFI gt given value
- Hit Rate = A / (A+C)
- FAR = B / (A+B)





Forecaster Guidance

T+42-66h Hit=0.6	Prec ge 10mm		Prec ge 20mm		Prec ge 50mm	
	EFI	FAR	EFI	FAR	EFI	FAR
West	0.2	0.2	0.2	0.6		
South	0.3	0.3	0.3	0.5	0.5	0.5

Gust ge 75km/hHit=0.5	T+36-60h		T+60-84h		T+84-108h		T+108-132h	
	EFI	FAR	EFI	FAR	EFI	FAR	EFI	FAR
West	0.3	0.7	0.3	0.5	0.2	0.7	0.2	0.8

2 Recognition of extreme events with Artificial Neural Network

Unsupervised training

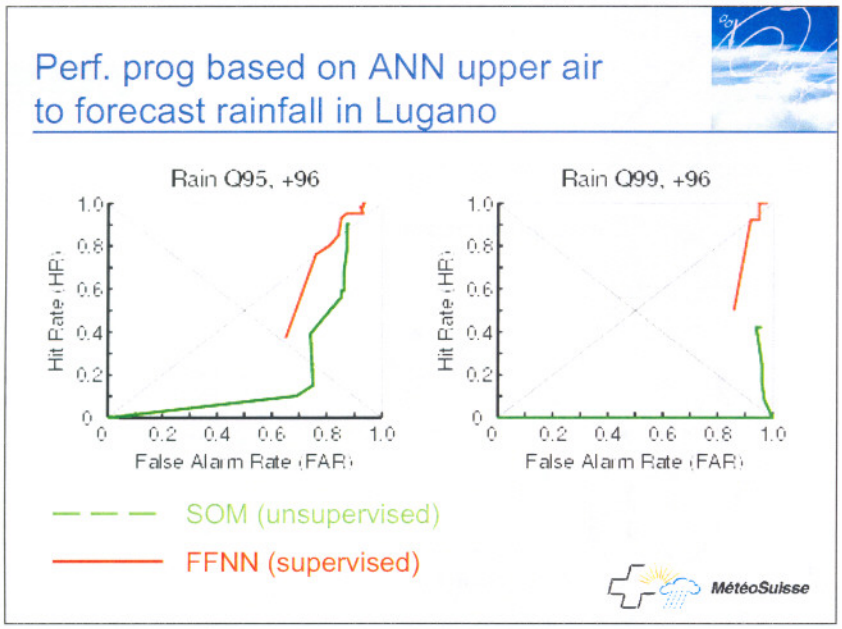
- Self Organising Map (SOM) = classification of weather patterns irrespective of the predictand (precipitation)
- Interpretation in terms of weather elements made in a second step: probability to exceed some threshold for each element of the classification

Supervised training

- The predictors and the predictand (precipitation) have to be shown simultaneously to the network
- Feed Forward Neural Network (FFNN) shown here

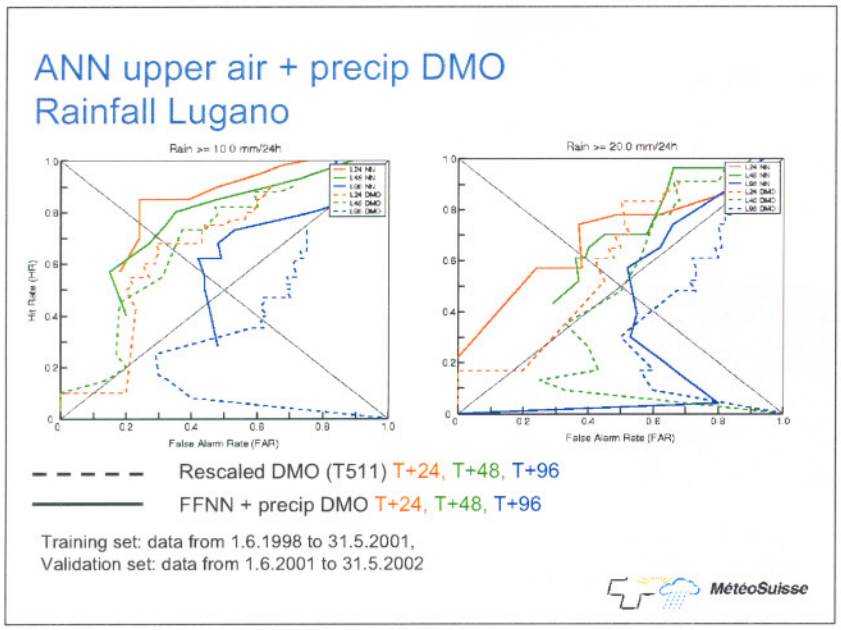
Predictors = upper air

Set	850 hPa	700 hPa	500 hPa	Input features
A_L, A_H	T	–	Z	200
B_L, B_H	T	R	W, Z	400
C_L, C_H	R, T, U, V	R, Z	R, T, W, Z	1000
D_L, D_H	R, T, U, V	R, T, U, V, W, Z	R, T, W, Z	1400
$\widetilde{C}_L$, $\widetilde{C}_H$	First 250 PCA components of C_L, C_H			250
$\widetilde{D}_L$, $\widetilde{D}_H$	First 250 PCA components of D_L, D_H			250



Predictors = upperair + precipitations

- New classification by supervised learning adding the DMO precipitations as predictors
- Work done on the ECMWF T511
- Use DMO precipitation with the simple rescaling: Event predicted when DMO rr>10mm, 20mm, 30mm,...

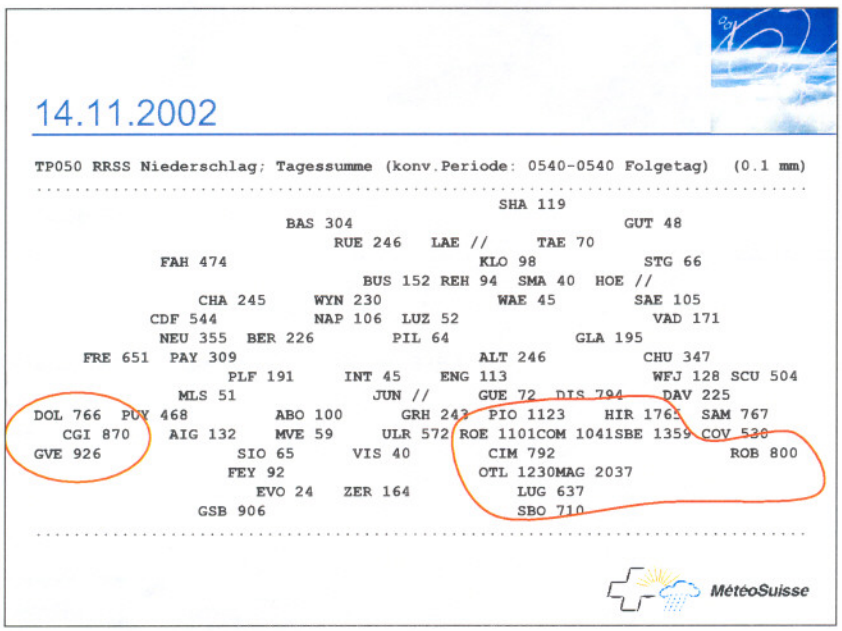


3 The COSMO LEPS

LEPS – downscale ensemble with a LAM

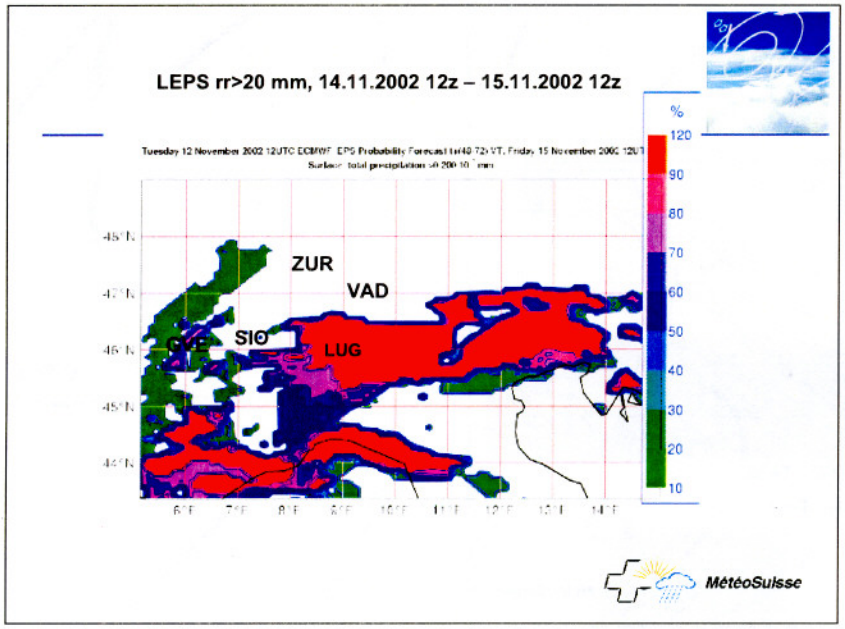
November 2002 flooding, 14–16th November

- Low over western Mediterranean
- Southerly current over the Alps
- Over 100 mm/day south of the Alps (classical)
- Geneva: 92 mm in one day (14th) *Very exceptional*



Conclusions

- Forecasting of rare events requests special treatment
- Downscaling / rescaling EPS or Deterministic fct
- Hit rate is usable•False Alarm Rate can be optimised, but remains high
- DMO, EFI, LEPS, ANN have each their own qualities
- Educating the weather service on these methods


LEPS rr>20 mm, 14.11.2002 12z – 15.11.2002 12z
%
120
90
80
70
60
50
40
30
20
10
ZUR
VAD
SIO
GVE
LUG
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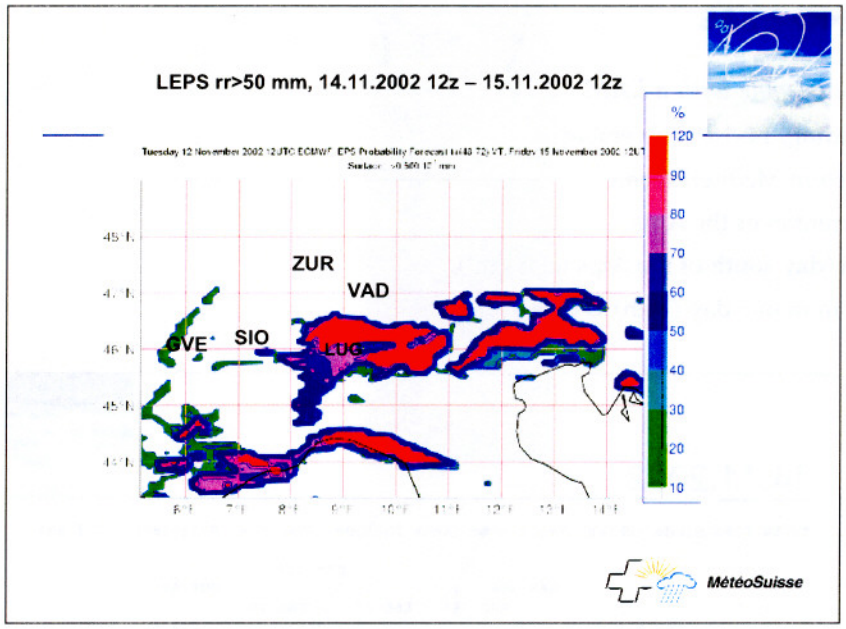
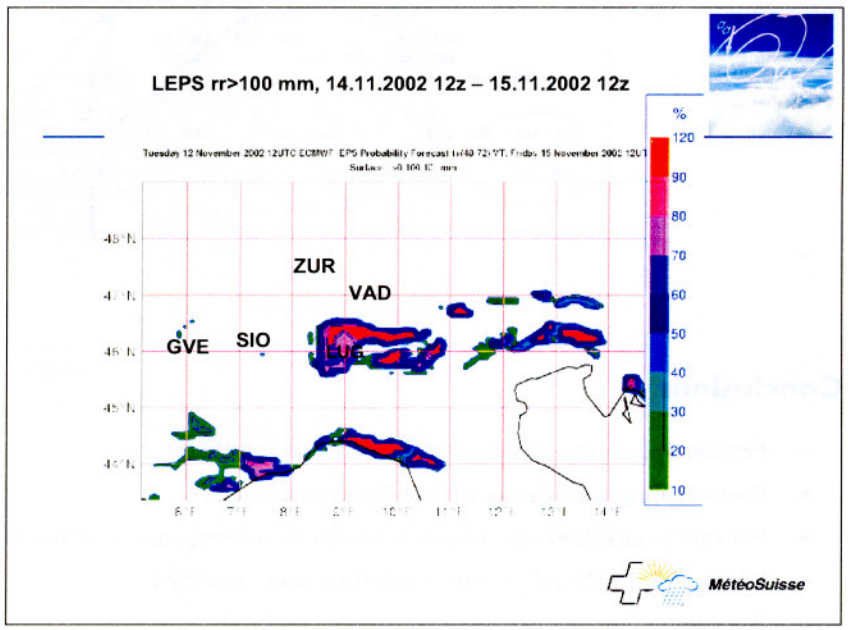
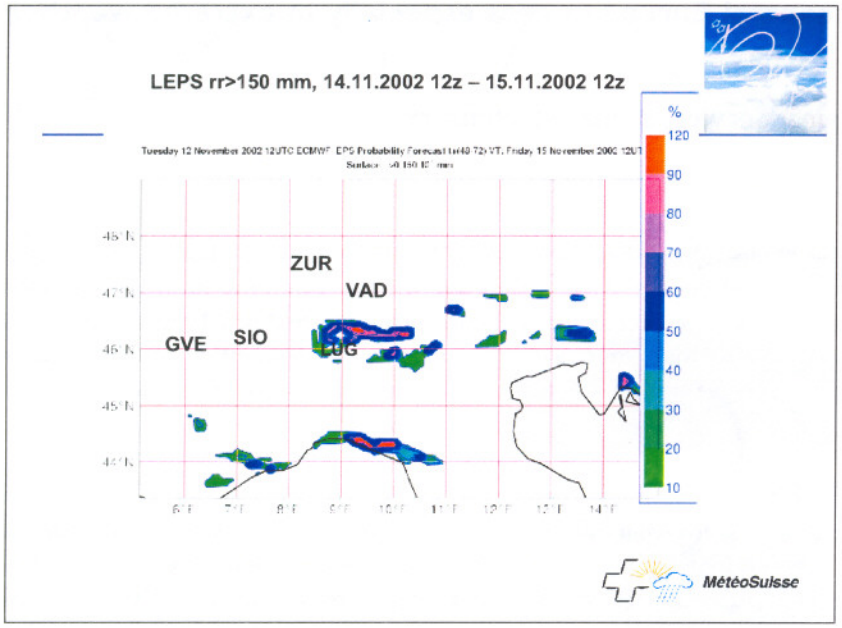

LEPS rr>50 mm, 14.11.2002 12z – 15.11.2002 12z
%
120
90
80
70
60
50
40
30
20
10
ZUR
VAD
SIO
GVE
LUG
MétéoSuisse


LEPS rr>100 mm, 14.11.2002 12z – 15.11.2002 12z
%
120
90
80
70
60
50
40
30
20
10
ZUR
VAD
SIO
GVE
LUG
MétéoSuisse


LEPS rr>150 mm, 14.11.2002 12z – 15.11.2002 12z
%
120
90
80
70
60
50
40
30
20
10
ZUR
VAD
GVE
SIO
LUG
MétéoSuisse