THE DEVELOPMENT OF SEASONAL AND INTER-ANNUAL CLIMATE FORECASTING

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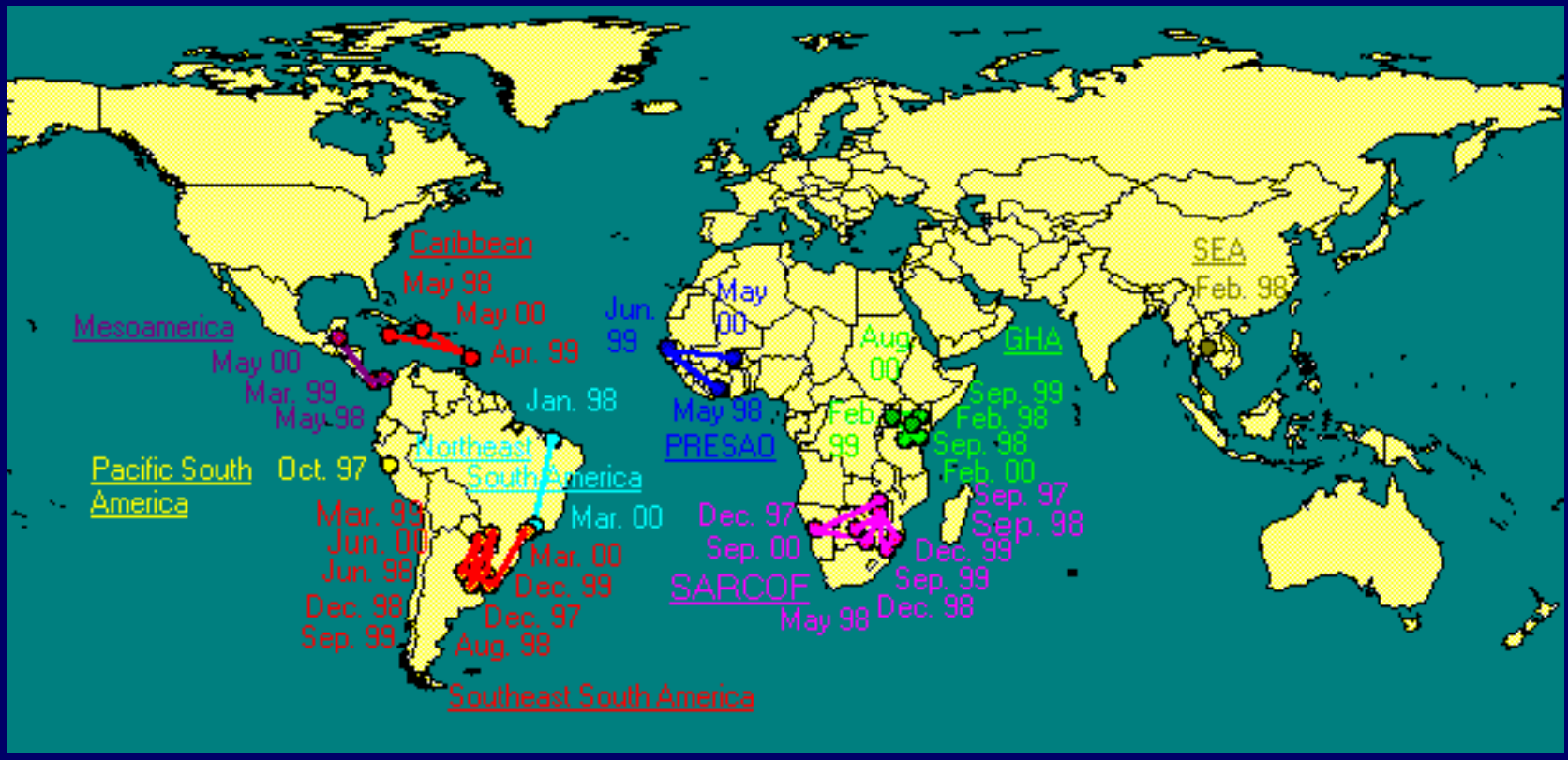
Survey on use of SIP by NMHSs, by CLIPS Rapporteur to CCl - Yoshihiro Kimura

Table 1 Issuance of official climate forecasts

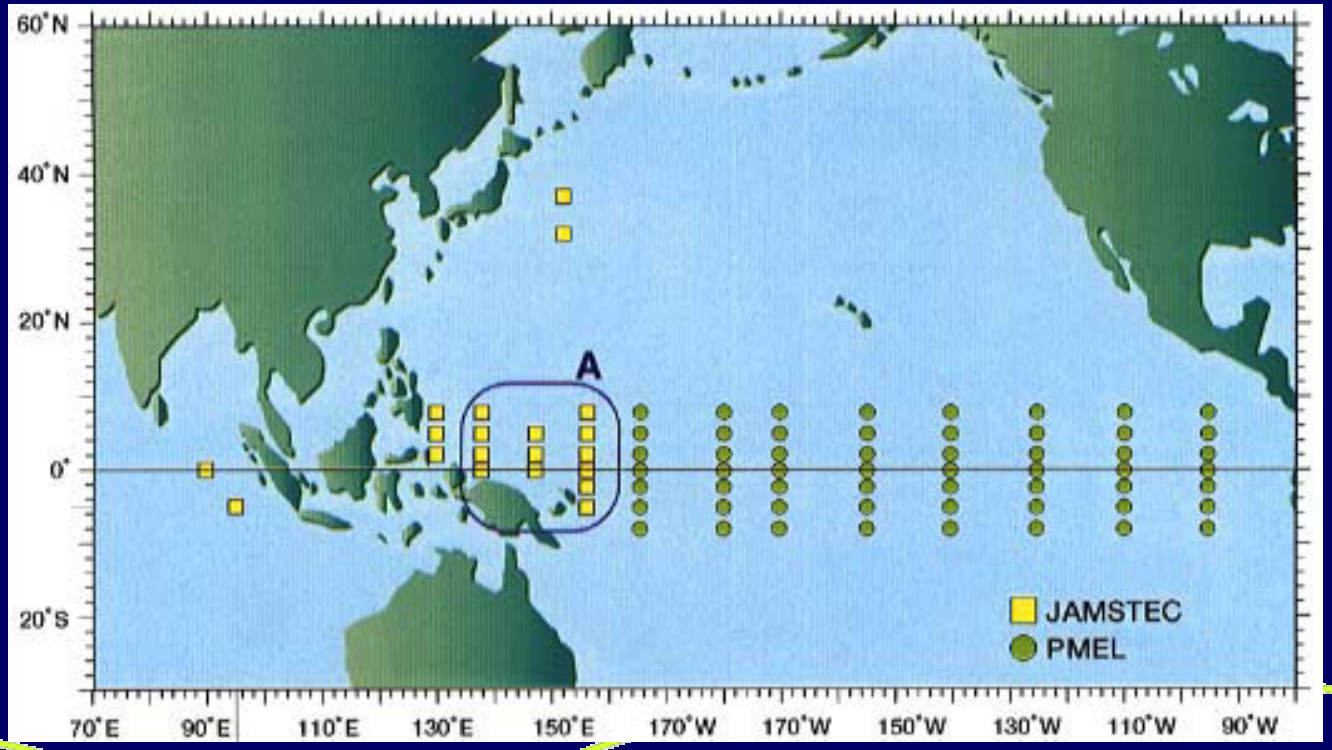
	RA I	RA II	RA III	RA IV	RA V	RA VI	Global
yes (Class A)	15	9	4	4	7	10	49
planned (Class B)	7	2	0	0	0	5	14
no (Class C)	0	6	0	0	1	12	19
Total	22	17	4	4	8	27	82

RCOFs worldwide 1997-2000



Part of the key basis for seasonal to interannual prediction

- TAO-TRITON



The Sources of Predictability

- At short ranges it lies in the current state of the atmosphere/ocean/land surface system …
- … but this has a limit of prediction of perhaps 15 days
- For longer ranges the source of predictability lies in the slowly-varying lower boundary conditions of the oceans (mainly through sea-surface temperatures) and land (mainly through soil moisture)

Issues ...

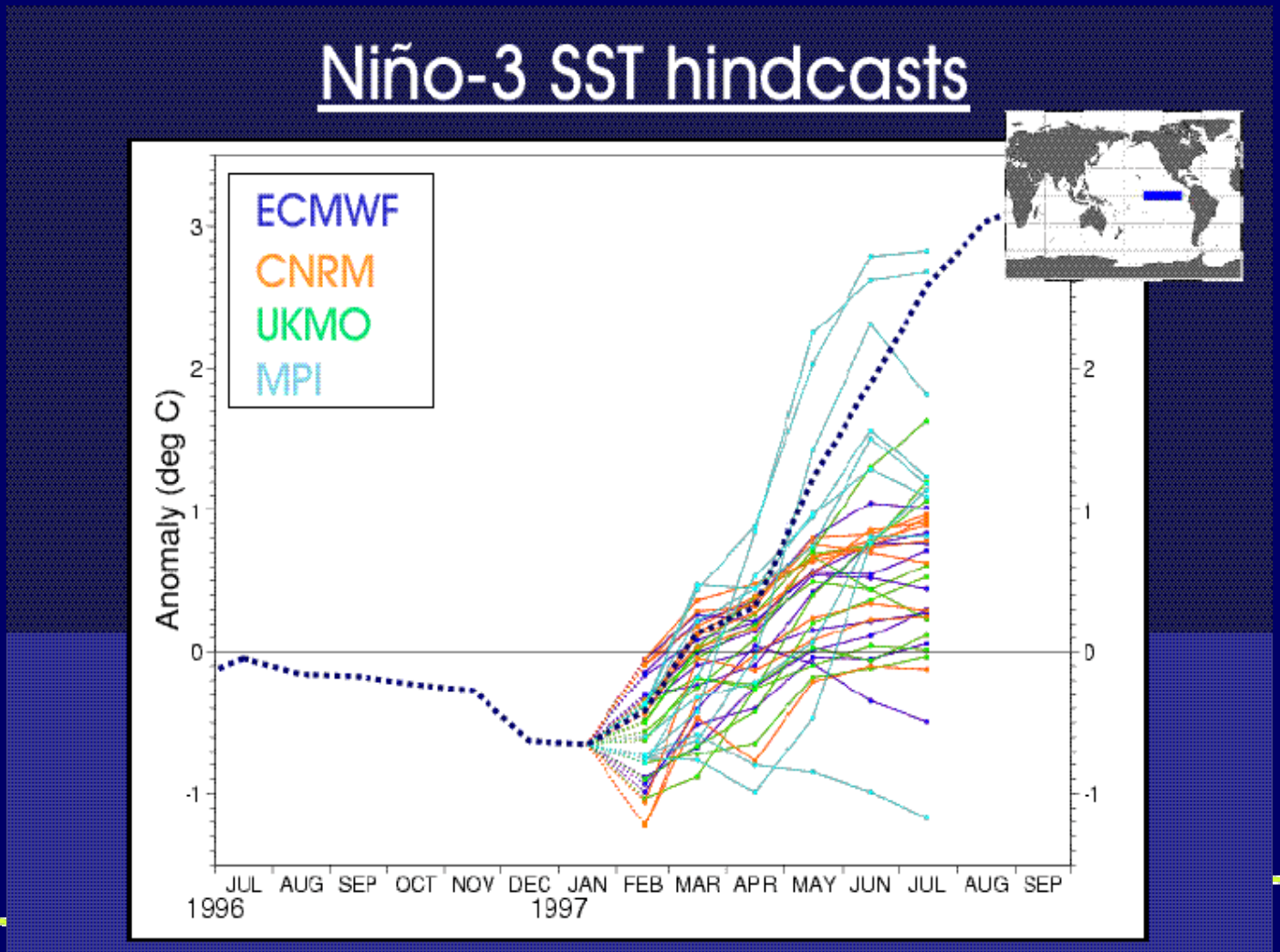
- The atmosphere/ocean system is chaotic ...
- … meaning that it is sensitive to small perturbations.
- The main consequence of this chaotic nature is that deterministic prediction is, in principle, not possible ...
- … and that predictions should be issued as probabilities.
- Further, consensus predictions are “better” than individual predictions
- Predictions are made on spatial and temporal scales substantially larger than requested by users

… Practical Issues

- Validating the models
- Forecast verification
- Understanding probabilities
- Application of forecasts
- Estimation of value

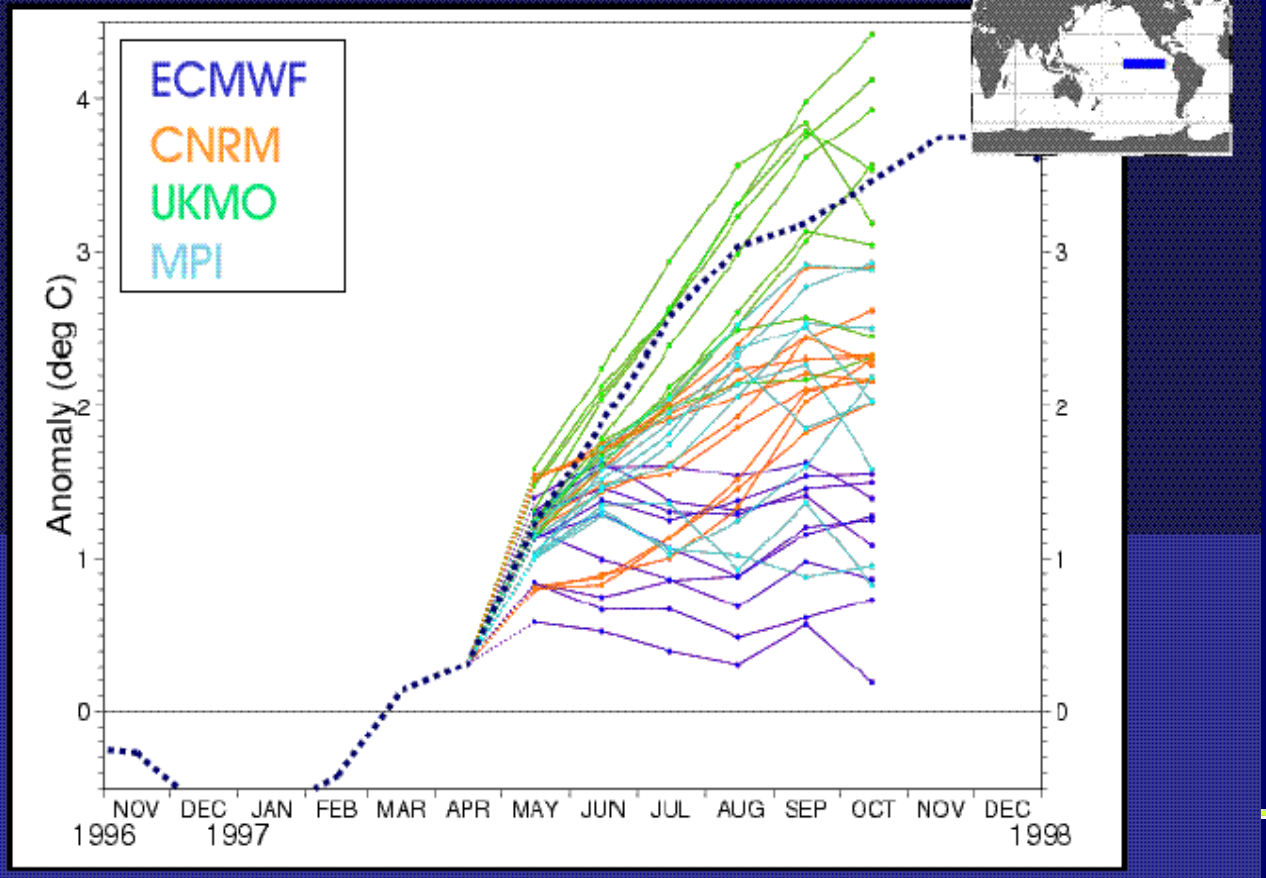
Practical Issue 1 - Validating the Models

DEMETER Jan 97



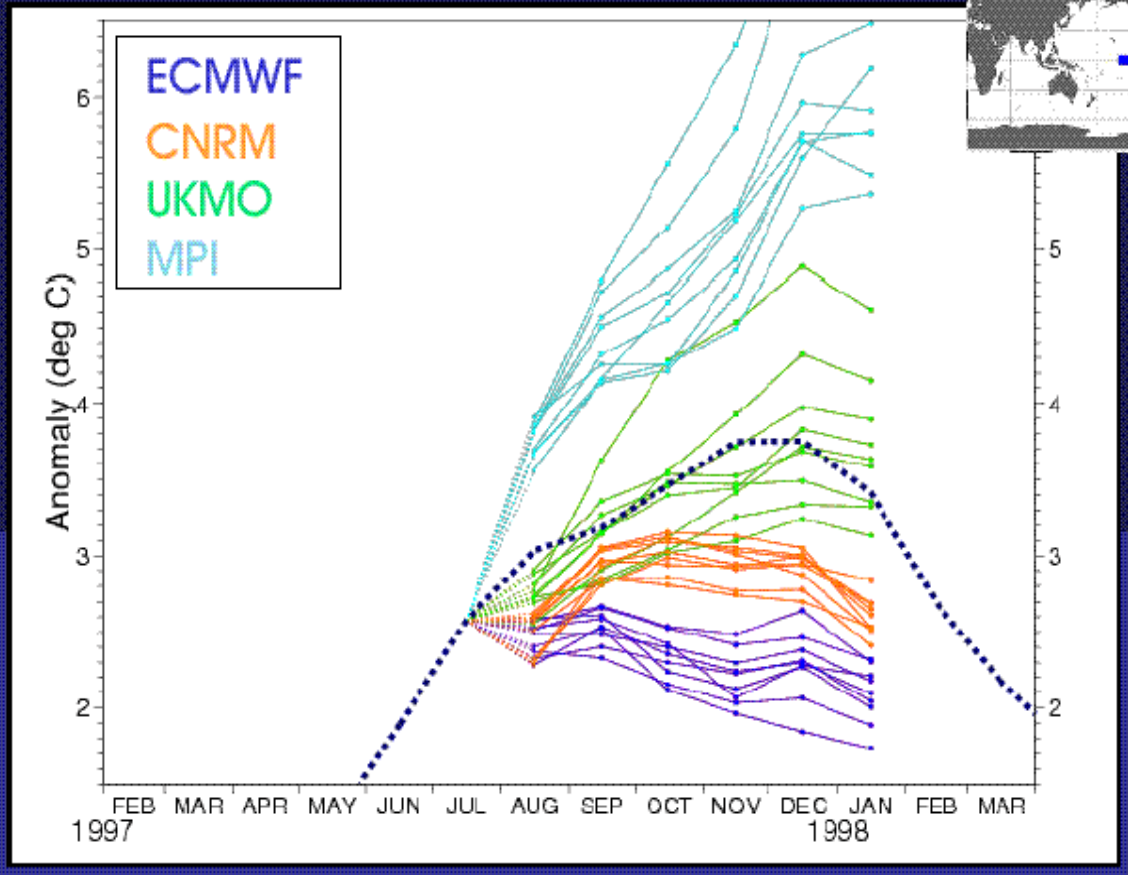
DEMETER Apr 97

Niño-3 SST hindcasts

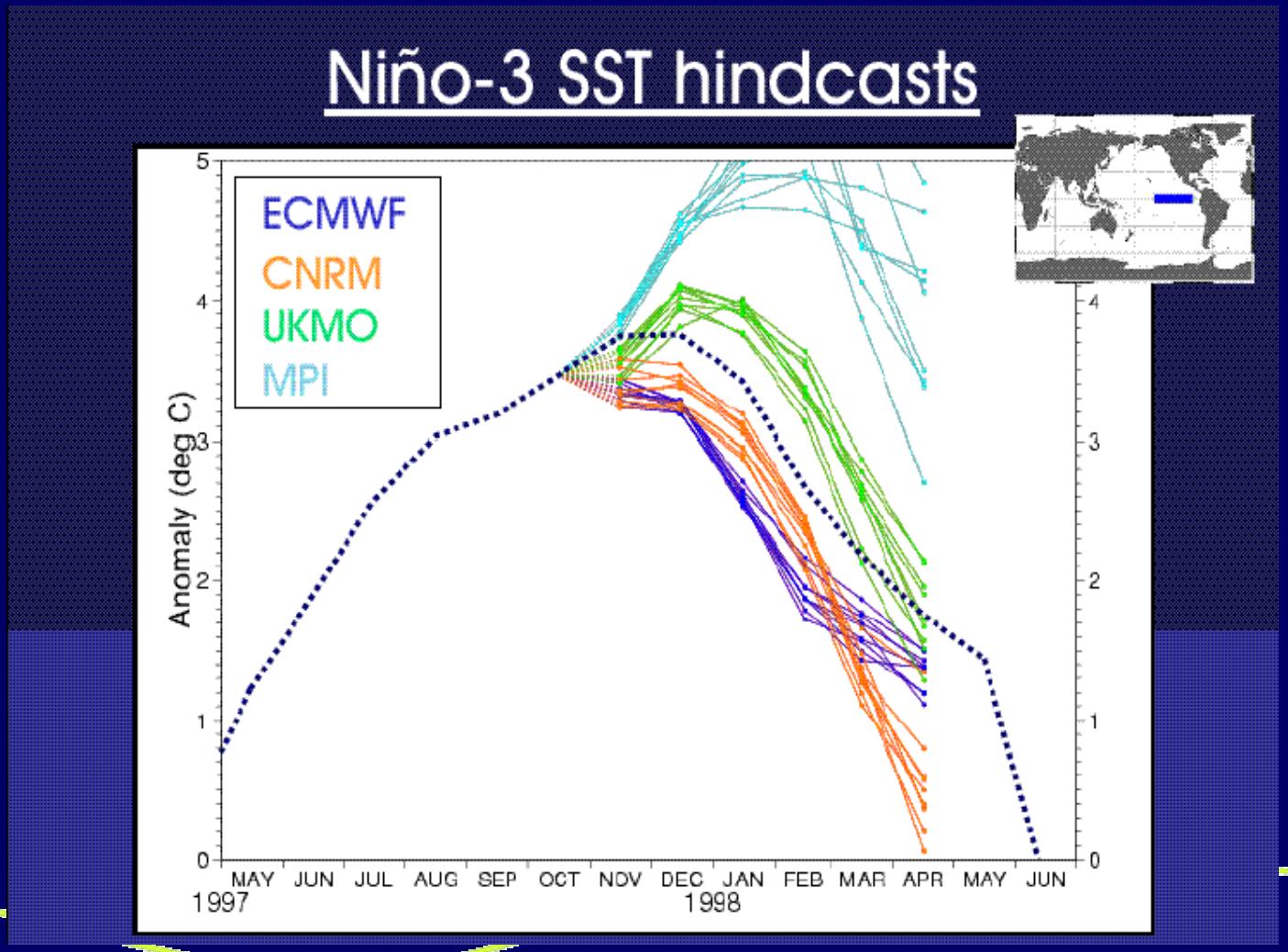


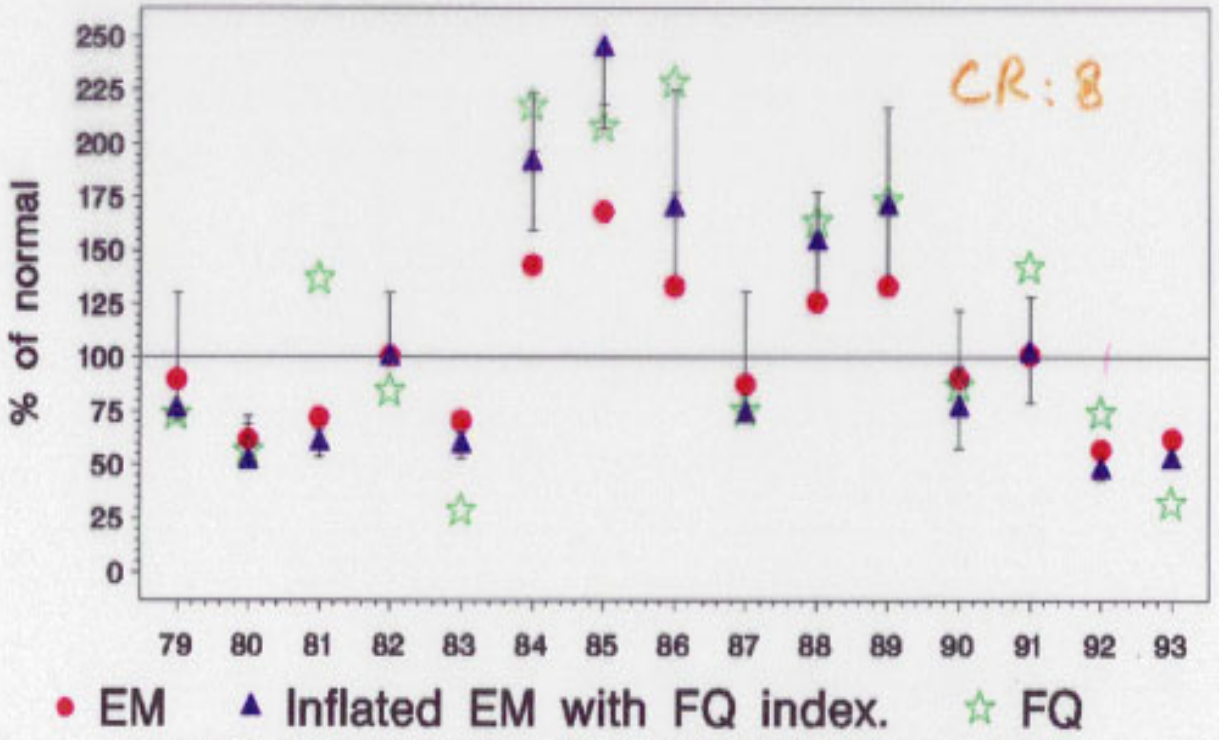
DEMETER Jul 97

Niño-3 SST hindcasts



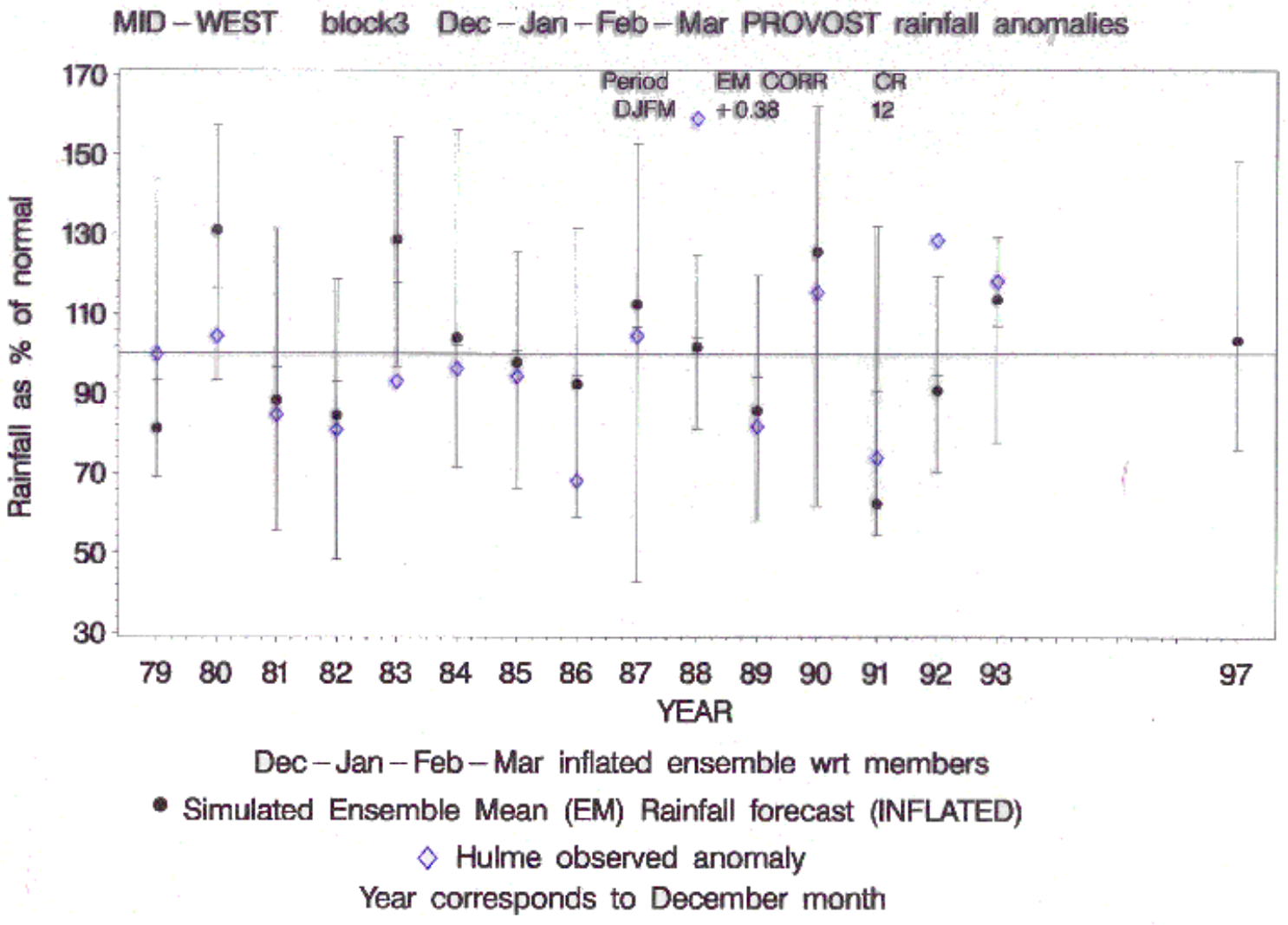
DEMETER Oct 97





Time series of inflated and uninflated PROVOST Ensemble Mean (EM) rainfall (Mar to May) (as % of normal) pre- and post-inflation of ensembles created using observed SSTs and for the Fortaleza-Quixeramobim Nordeste rainfall index. Bars indicate inflated range of the ensembles and median. Capture rate (CR) indicates the number of years out of 15 when the observations lies within the range of the inflated ensemble.

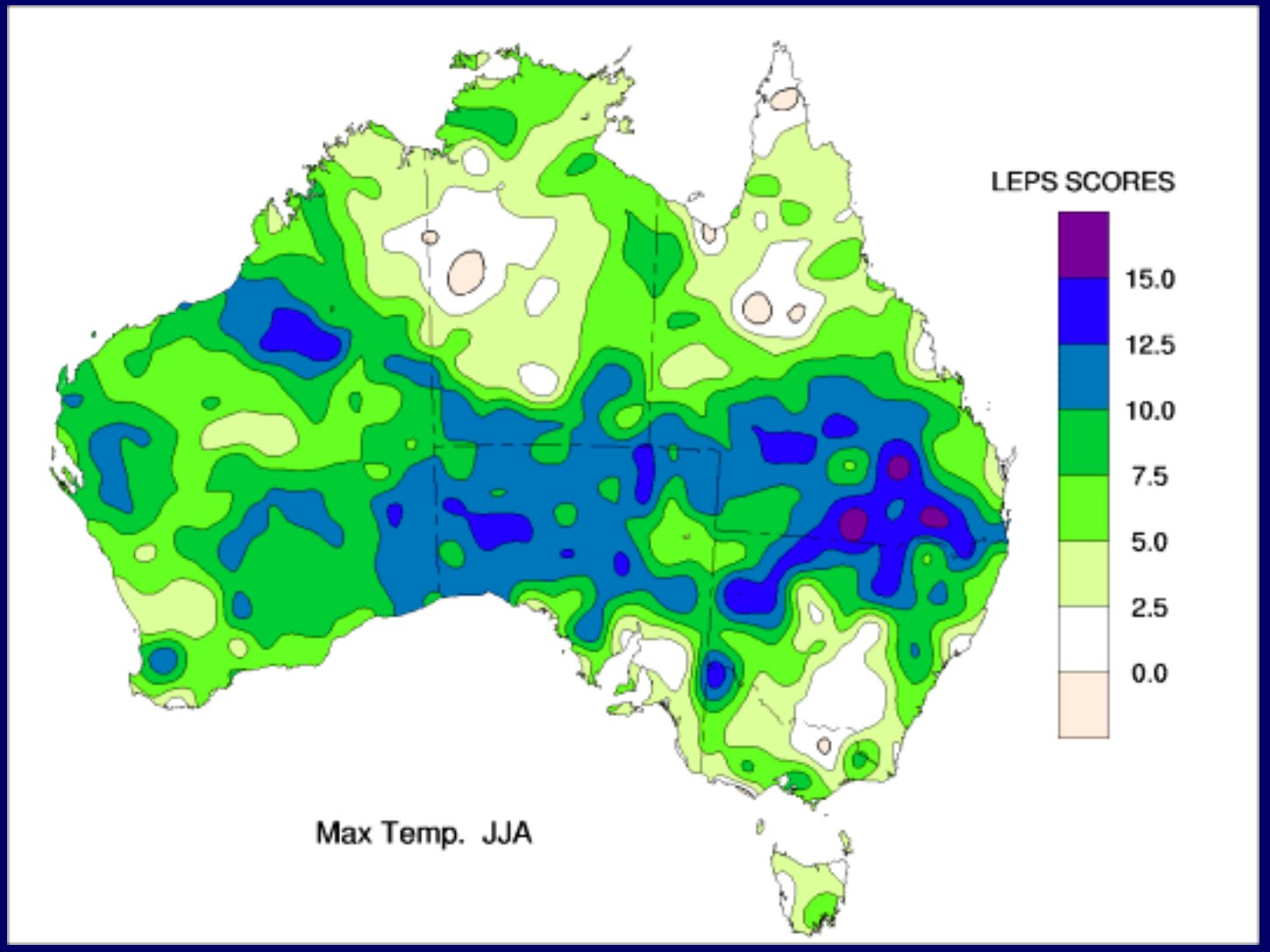
Met Office


MID – WEST block3 Dec – Jan – Feb – Mar PROVOST rainfall anomalies
Period EM CORR CR
DJFM +0.38 12
Rainfall as % of normal
170
150
130
110
90
70
50
30
79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 97
YEAR
Dec – Jan – Feb – Mar inflated ensemble wrt members
Simulated Ensemble Mean (EM) Rainfall forecast (INFLATED)
Hulme observed anomaly
Year corresponds to December month

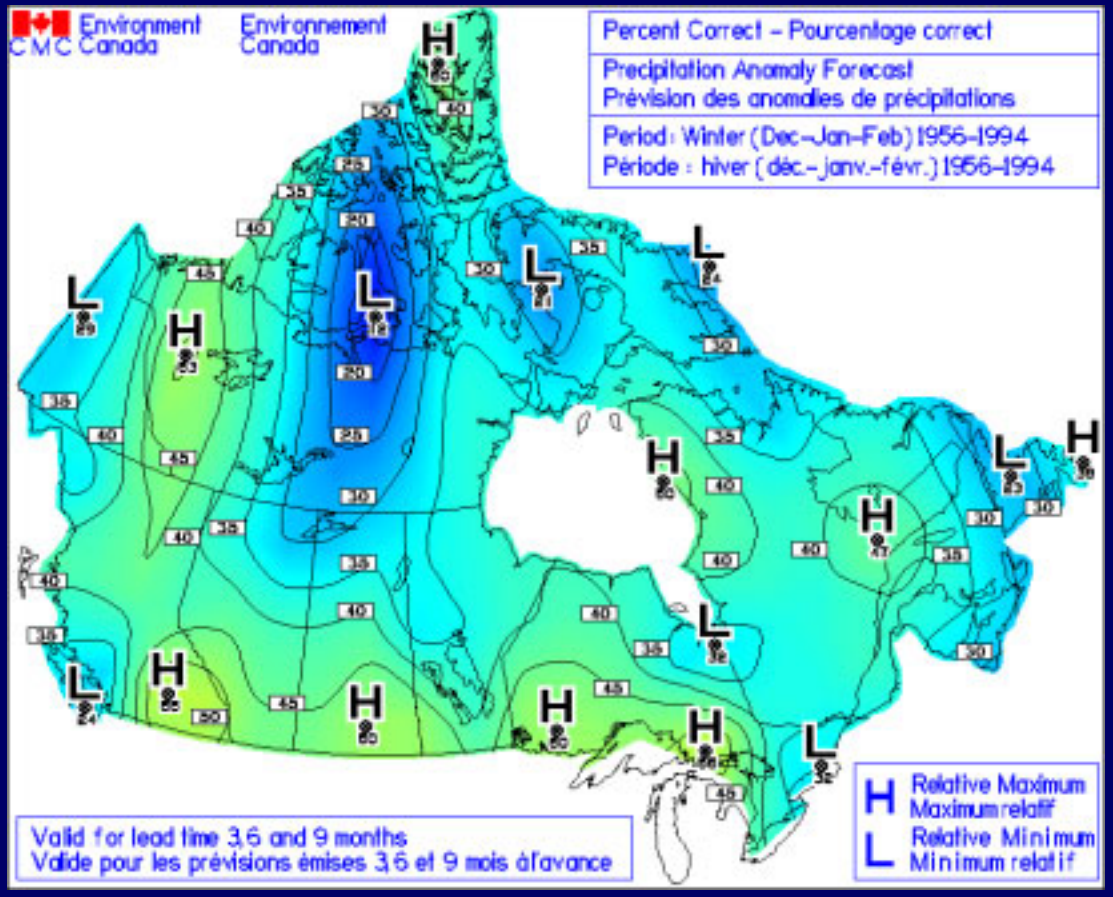
Practical Issue 2 - Forecast Verification

Verification is ...

- … one of the key issues from the perspective of applications …
- … as it should provide sufficient information on which to base strategies on how to use the predictions.


LEPS SCORES
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Max Temp. JJA

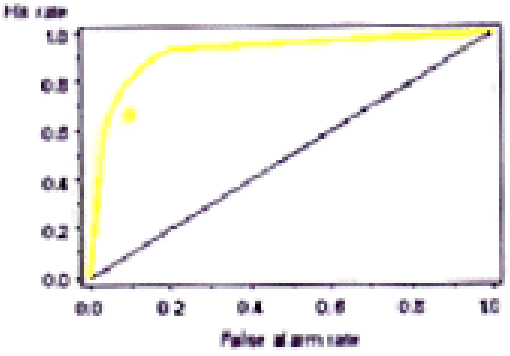
Canadian Meteorological Centre CCA Model



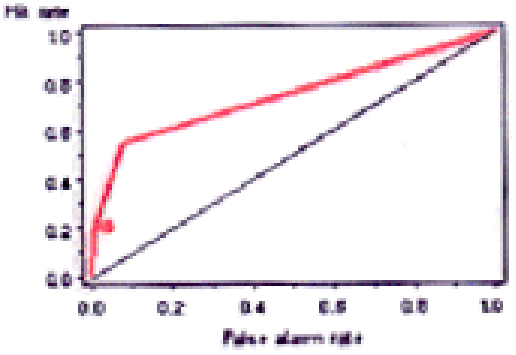
Precipitation Anomaly PERCENT CORRECT, Winter (Austral Summer) Terciles

http://www.cmc.ec.gc.ca/~cmcdev/saisons/subdir/pc/pc_a.html

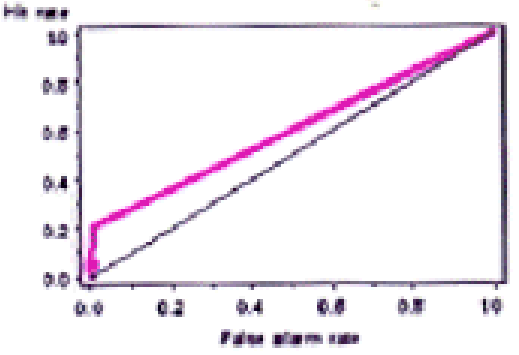
T > 15



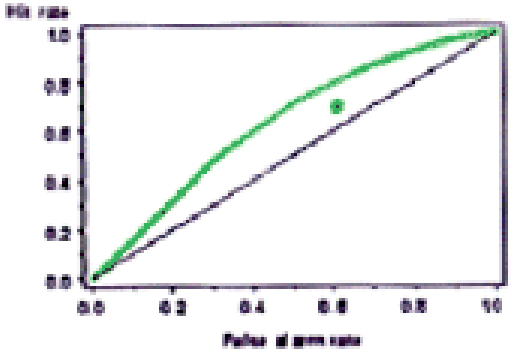
T > 20



T > 25



R > 0.1



RELATIVE OPERATING CHARACTERISTICS

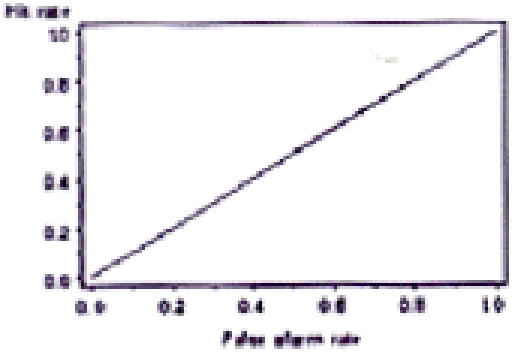
51—member ECMWF ensembles

D.T.'s since 11/6/97

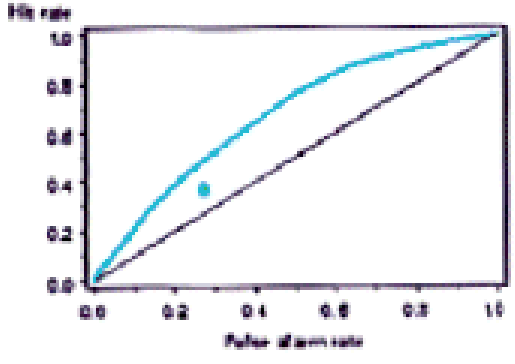
Time: T+ 168

Solid line: ROC for ensembles
Dots: ROC from T213/319 forecasts

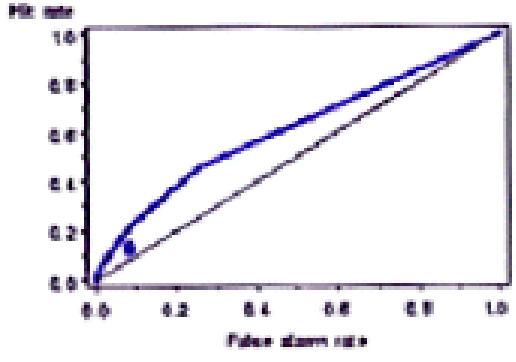
T > 30



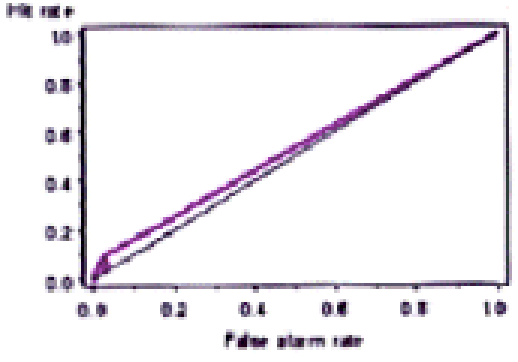
R > 1.0



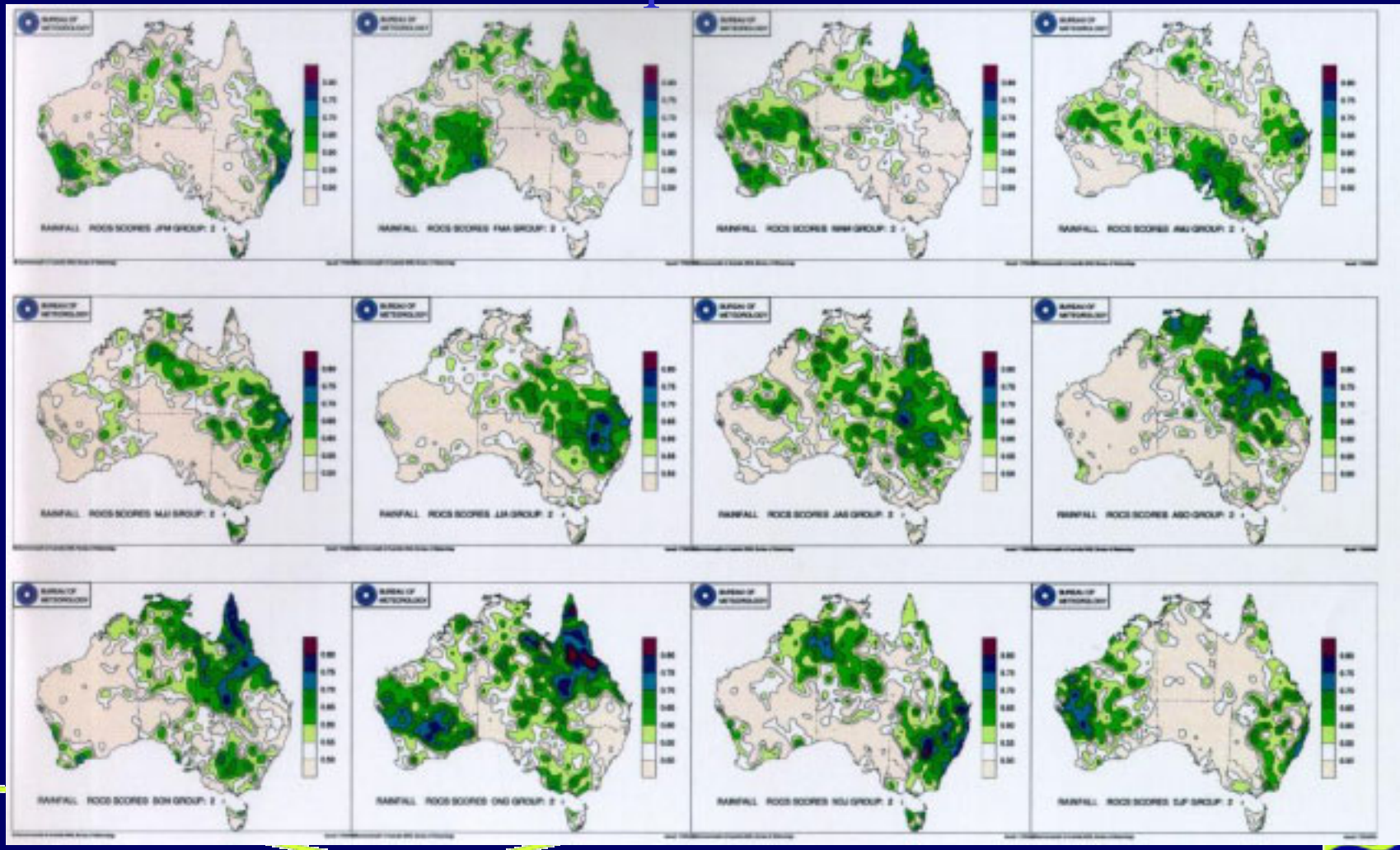
R > 5.0



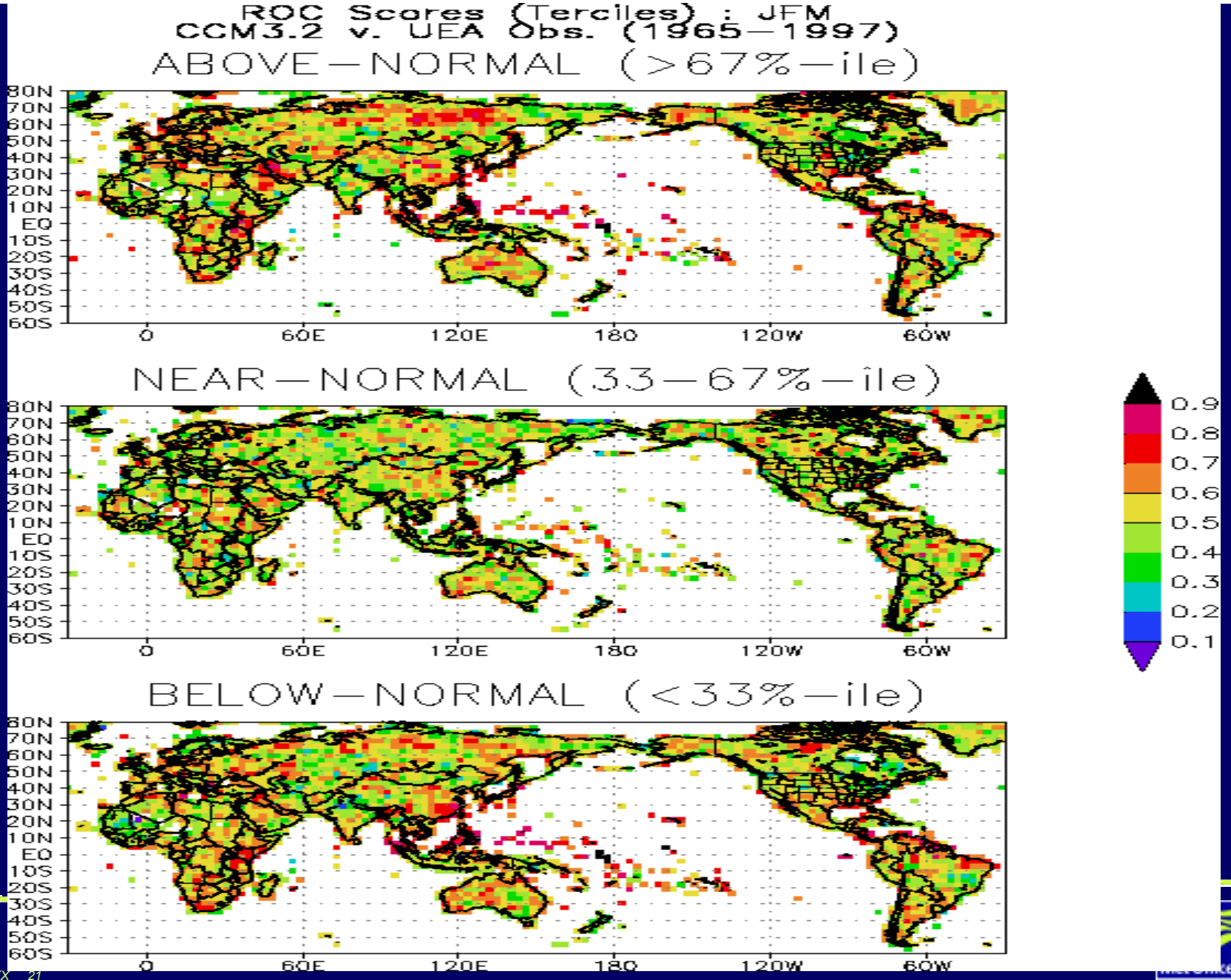
R > 10.0



Seasonal Variation in ROC Scores Precipitation



Met Office


ROC Scores (Terciles) : JFM
CCM3.2 v. UEA Obs. (1965–1997)
ABOVE–NORMAL (>67%–ile)
NEAR–NORMAL (33–67%–ile)
BELOW–NORMAL (<33%–ile)
80N
70N
60N
50N
40N
30N
20N
10N
EQ
10S
20S
30S
40S
50S
60S
0
60E
120E
180
120W
60W
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

Some Current Verification Standardisation Exercises

- WWW Standardised Verification System for Exchange of Long-Range Forecasts - uses MSSS and ROC
- CLIVAR WGSIP standardised verification in model development (process approach)
- CAIPS Expert Team - developing verification from the user perspective

Practical Issue 3 - Understanding Probabilities

Practical Issue 4 - Application of Forecasts

WGSIP 2001 Conclusion on Downscaling

"… there is no evidence to suggest that regional models add value on seasonal to interannual time scales for any part of the globe or that they added value in the tropics on any time scale other than those for climate change. It was … agreed that further work … needs to be undertaken as a matter of priority …"

Alternatives to Downscaling

- Intermediate downscaling and upscaling of, say, agricultural information
- Re-examination of decision making in applications in order to develop a better fit between applications and forecast capabilities

Decision Making Approaches

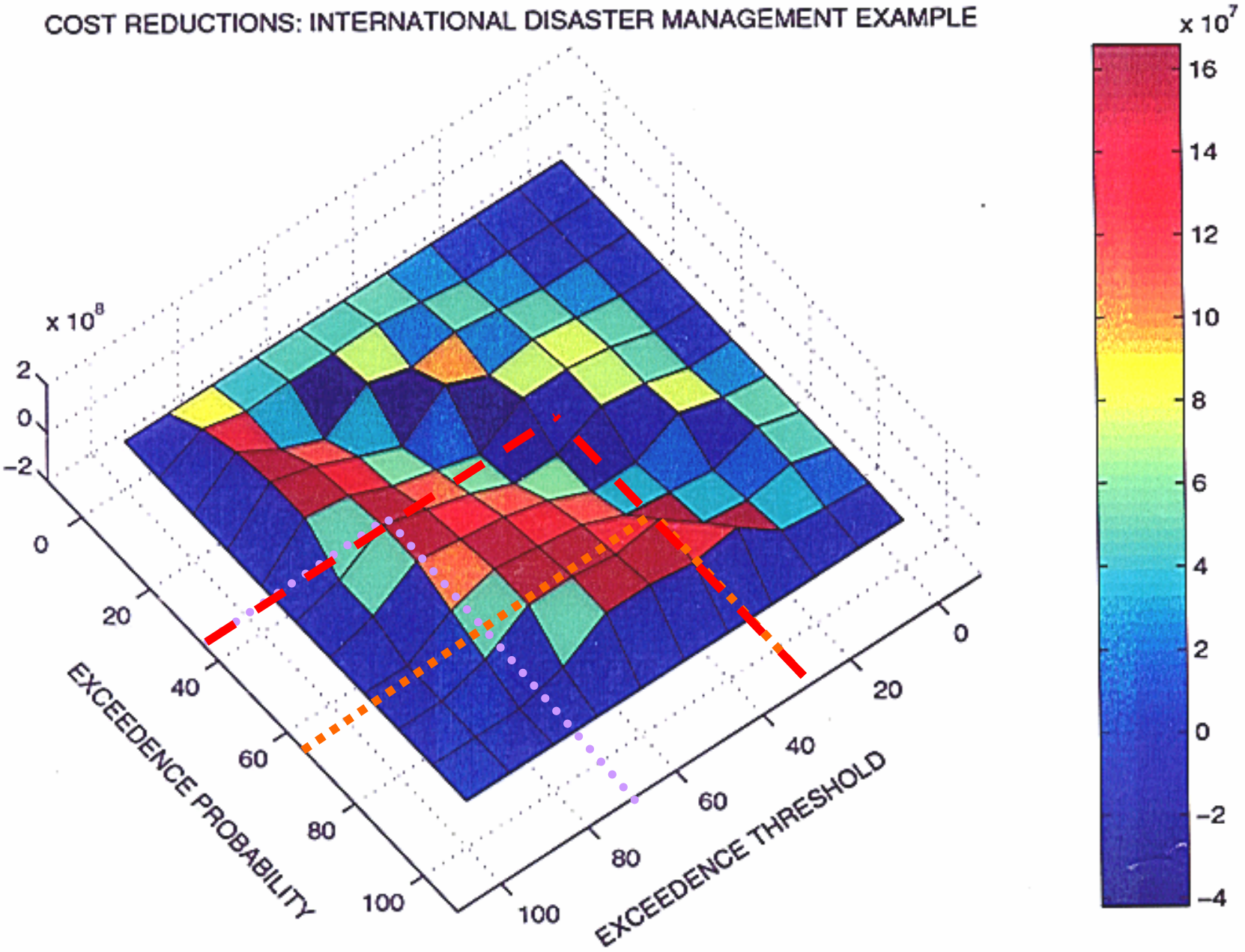
- Deterministic
- Analogues
- ‘Least Regret’
- ROC

Conclusion and future possibilities for seasonal weather forecasting - from the CLIPS Food Chain Showcase Project

- Accurate seasonal weather forecasting has the potential to improve customer and consumer service levels through improved planning of supply and demand
- A 5% improvement in matching production to demand equates to 250,000 kilos of product for Intercrop!
- Successful exploitation of seasonal weather forecasts requires the collaboration of the complete food chain

Met Office

Practical Issue 5 - Estimation of Value


COST REDUCTIONS: INTERNATIONAL DISASTER MANAGEMENT EXAMPLE
x 10^8
2
0
−2
0
20
40
60
80
100
EXCEEDENCE PROBABILITY
0
20
40
60
80
100
EXCEEDENCE THRESHOLD
x 10^7
16
14
12
10
8
6
4
2
0
−2
−4

Summary … CAIPS OPAG

- Main Expert Teams:
- - Implementation - Co-ordination Team
- - Research Needs
- - Operations
- - Verification
- - Capacity Building
- - End-User Liaison
- - Operational Heat/Health Warnings
- - Health-Related Climate Indices
- - Urban Climatology
- - Energy
- Plus:
- - agrometeorology, hydrology and other areas

Met Office

Challenges

- Improved model validation from the perspective of applications
- Improved forecast verification designed to assist decision making
- New methods for interpreting forecasts in the context of applications
- Methods for identifying optimal strategies for forecast applications and for defining value
- Adequately defined pilot projects