Implementation of Global-regional Climate Model for Seasonal Forecasting

APCC Member Working Group Report
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Brief introduction

- Both global & regional climate models were originated from NCEP
- Global model were used in NCEP/NCAR re-analysis
- Regional model was derived from a version originally used in weather forecasting
- Perturbation method applied to reduce computational error
- Very good reference obtained from

  http://g-rsm.wikispaces.com/References

Operation of Global Model in Hong Kong

Data used for the computation of model climate and verification

- 1948-2006 (00UTC, Day 1 of each month)
- NCEP/NCAR re-analysis - Initial conditions for global model
- 1948-2006 Daily sea surface temperature analysis – boundary condition for global model
- 1948-2006 Daily sea ice analysis – boundary condition for global model
- Download from tsuzumi.ucsd.edu (Hideki - http://g-rsm.wikispaces.com/ECPC+data+server)

Data required for routine operations

- "Real-time" Daily NCEP/NCAR re-analysis
- Download from NOMADS
  (http://www.nomad3.ncep.noaa.gov)

- Alternative is from NCEP GFS output
- Download from NCEP
  (ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/gfs/prod)
- (Different set of model code is required)

NOMADS – NOAA Operational Model Archive Distribution System

GFS – Global Forecast System

Data Required for Routine Operations

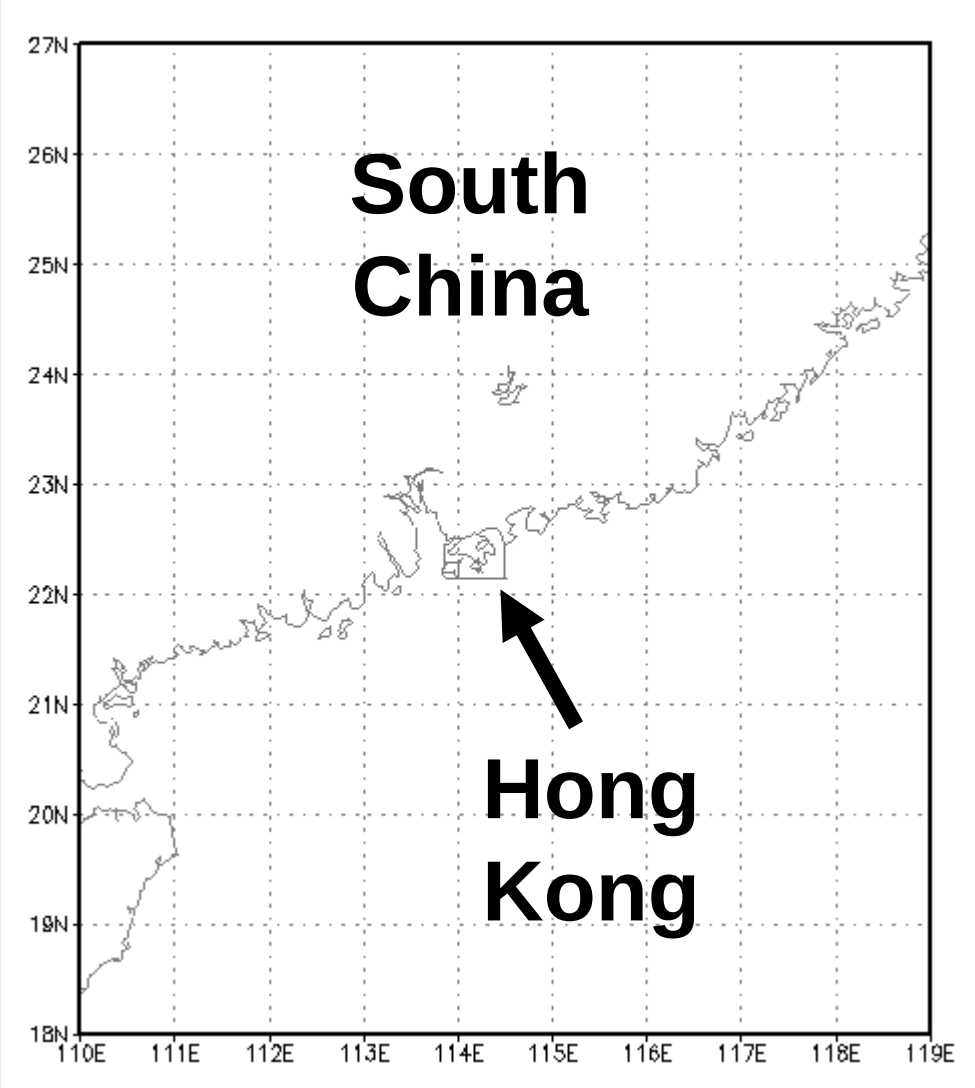
- "Real-time" 9 month sea temperature forecast

- Download from NCEP (http://cfs.ncep.noaa.gov)

Global—Regional model Configuration used in Hong Kong Observatory

Computer	IBM p630 (4 CPUs)
Resolution of Global model	T62 Horizontal ~ 200km Verticle = 28 layer
Resolution of Regional Model	Horizontal ~ 15km Verticle = 28 layer
Terrain resolution	0.5 degree lat/long
Version	MPI

Domain of Regional Model



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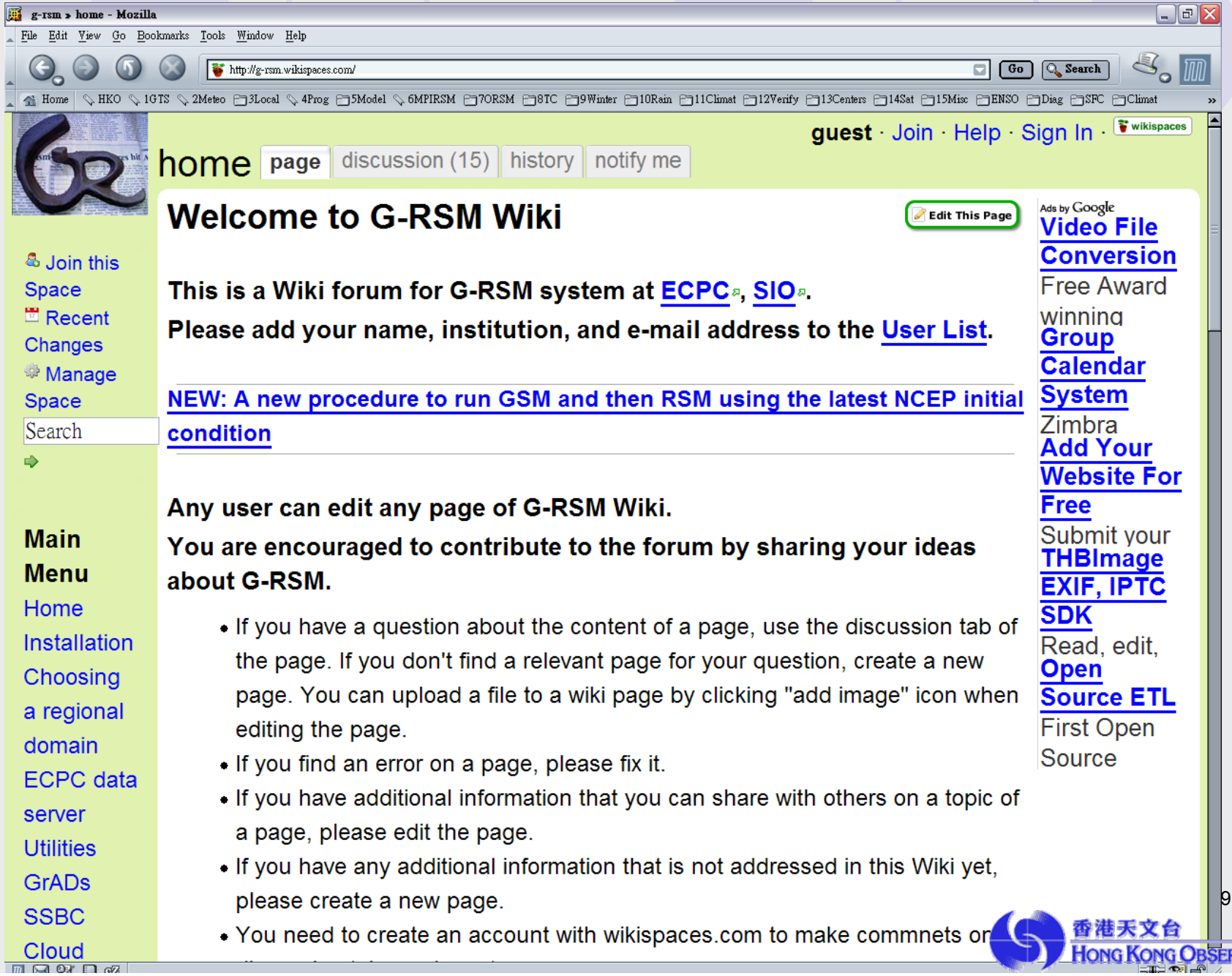
Global—Regional model Forum



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Traditional Verification Method

- **Assumption :**
  Real climate and Model Climates ~ Normally Distributed

Category	Definition
Above normal	anomaly > 0.5 std dev
Below normal	anomaly < -0.5 std dev
Normal	-0.5 std dev < anomaly < 0.5 std dev

If forecast category = observed category, then forecast is correct

- **Evaluate scaled Hanssen and Kuipers score**
- **Ks=(POD - FAR + 1)/2**
- **Ks=1 : best skill Ks=0 : worst skill**

Data used for verification

- 9 weather stations from South China
- 1991-2006 model predictions

	Weather station data	Model output
1961-1990	Evaluate actual climate	Evaluate model climate
1991-2006	Verification period	

Model skill in forecasting above-normal rainfall

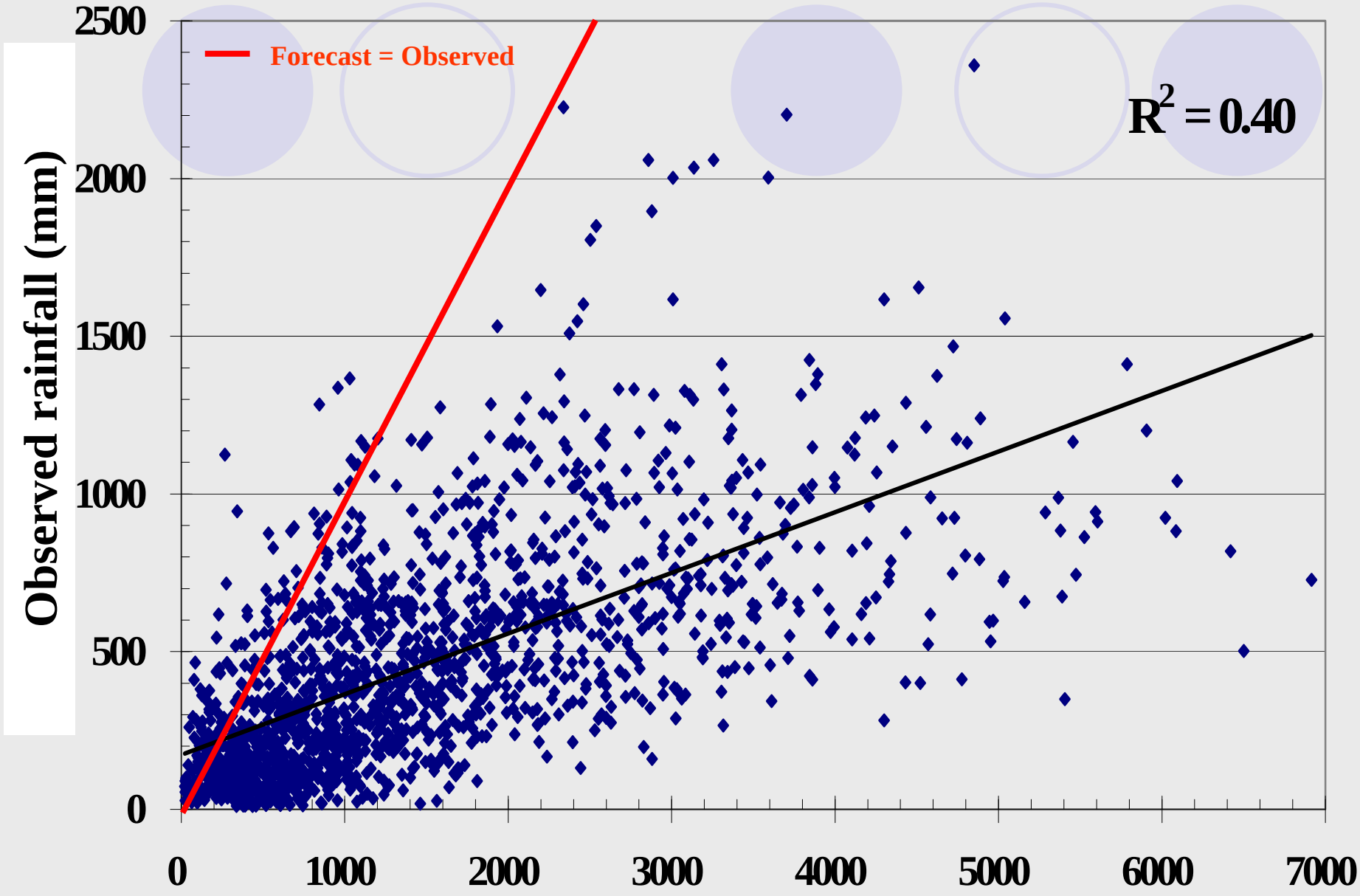
	Ks
Spring (MAM)	0.51
Summer (JJA)	0.51
Autumn (SON)	0.48
Winter (DJF)	0.66

Model skill in forecasting below-normal rainfall

	Ks
Spring (MAM)	0.54
Summer (JJA)	0.48
Autumn (SON)	0.49
Winter (DJF)	0.59

Model skill in forecasting above-normal temperatures

	Ks
Spring (MAM)	0.69
Summer (JJA)	0.58
Autumn (SON)	0.52
Winter (DJF)	0.55



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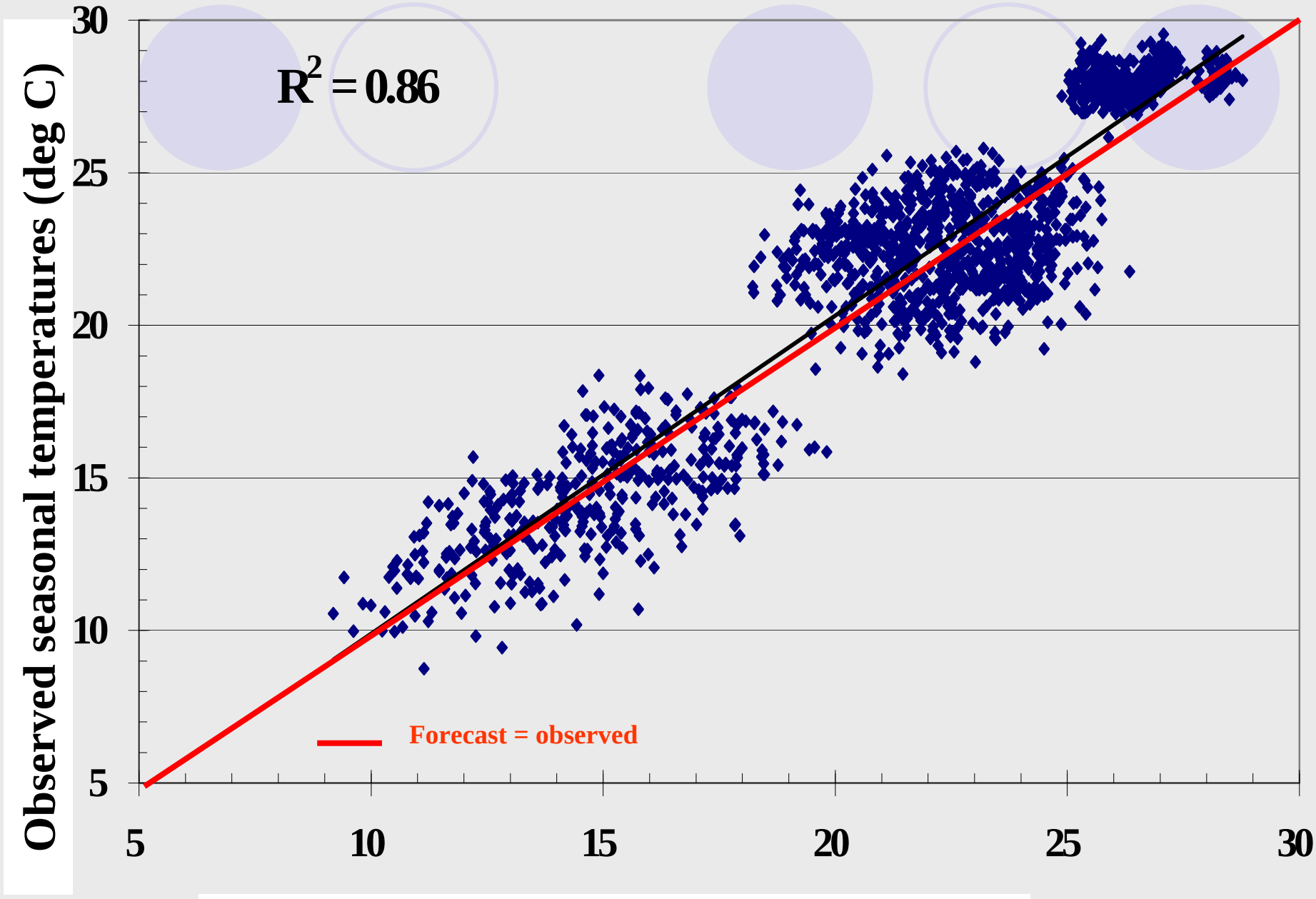

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Assessment of accuracy of numerical seasonal temperature forecasts

- Verification period 1981-2006
- Weather station — only Hong Kong Observatory
- ｜model forecast - observed｜ <= 0.5 C → acceptable forecast

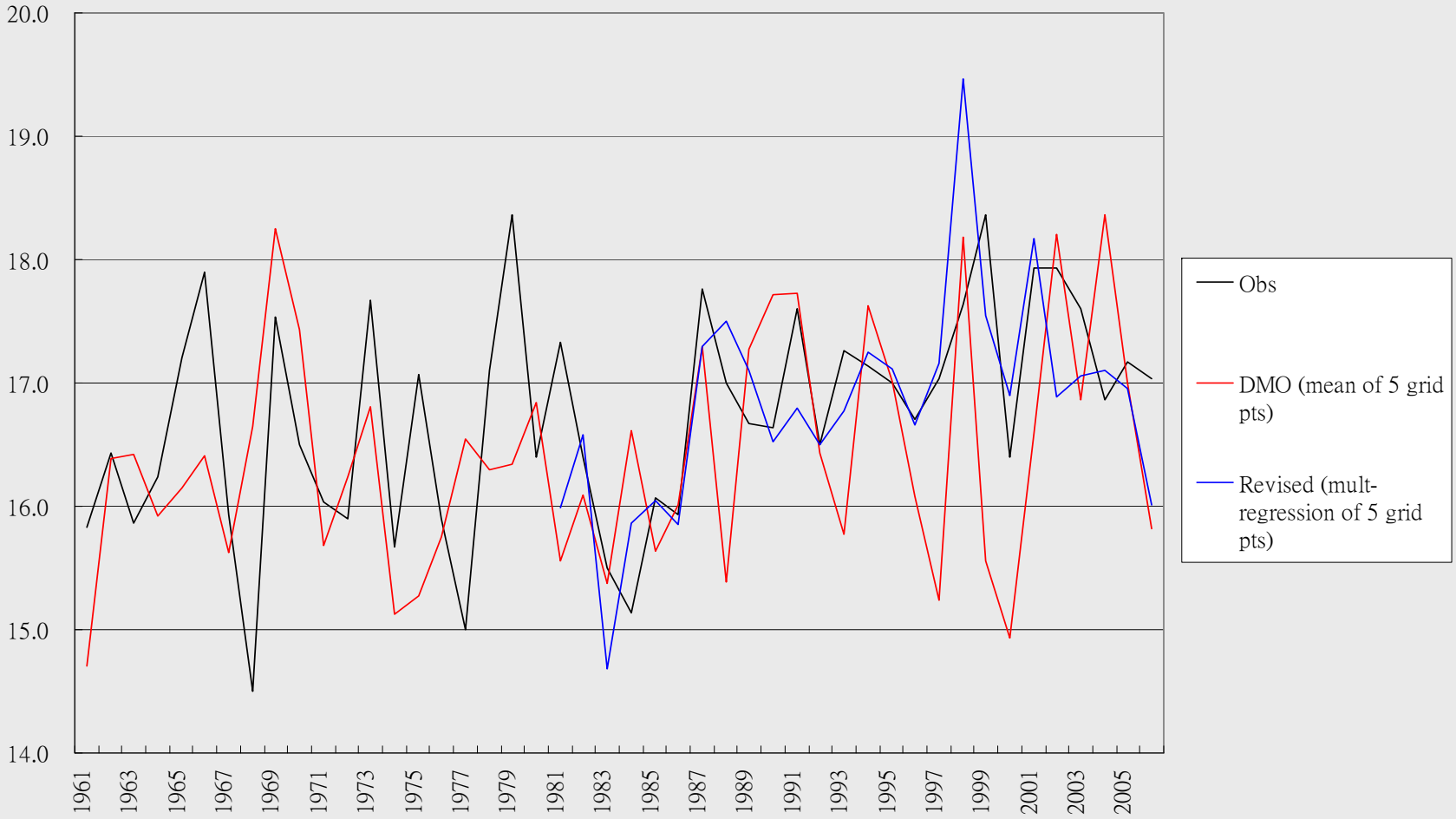
Direct model forecast:

- ❖ Nearest grid point value；or
- ❖ Mean value of nearest 5 or 9 grids

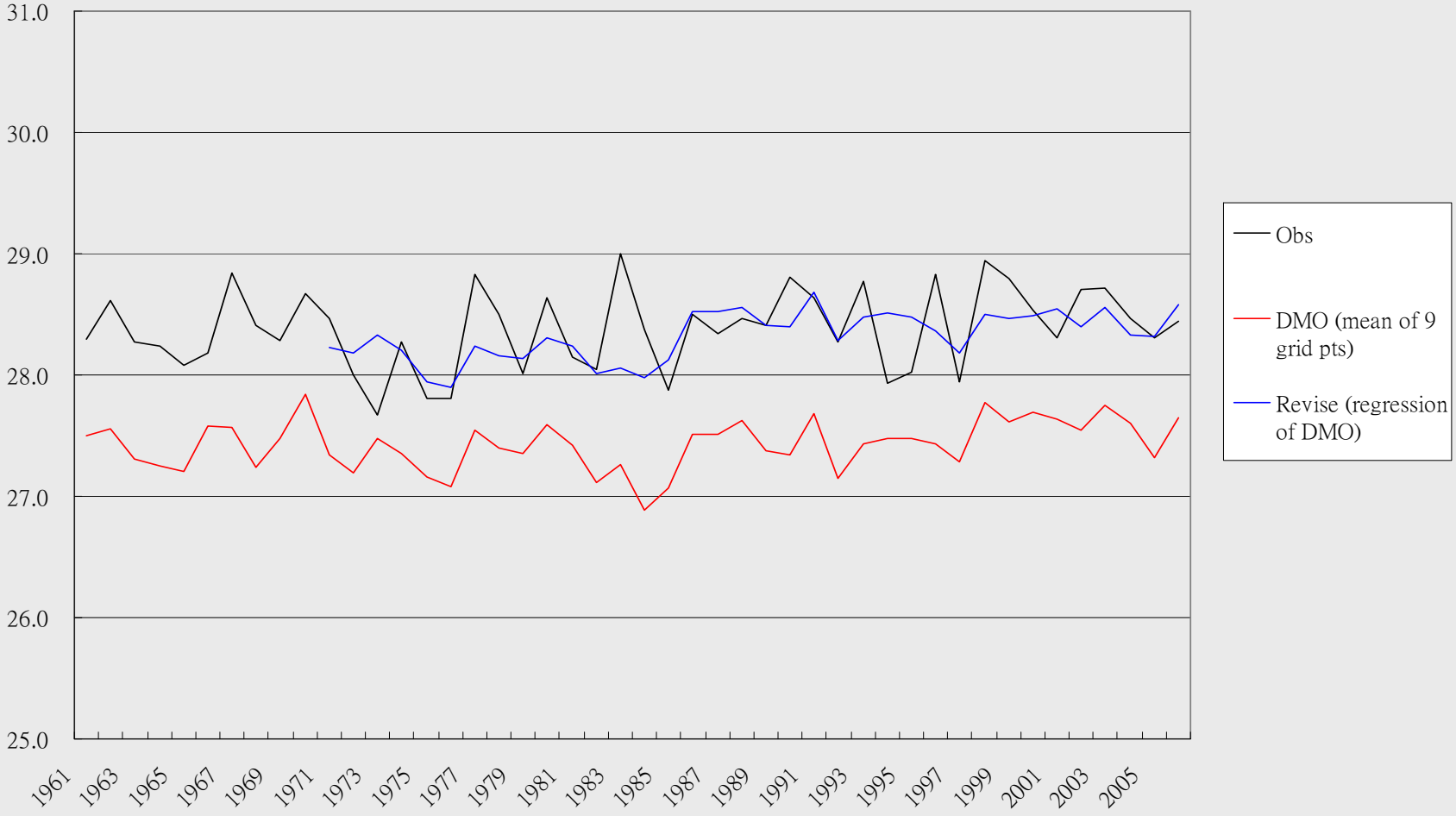
Model Output Statistics Corrected forecast

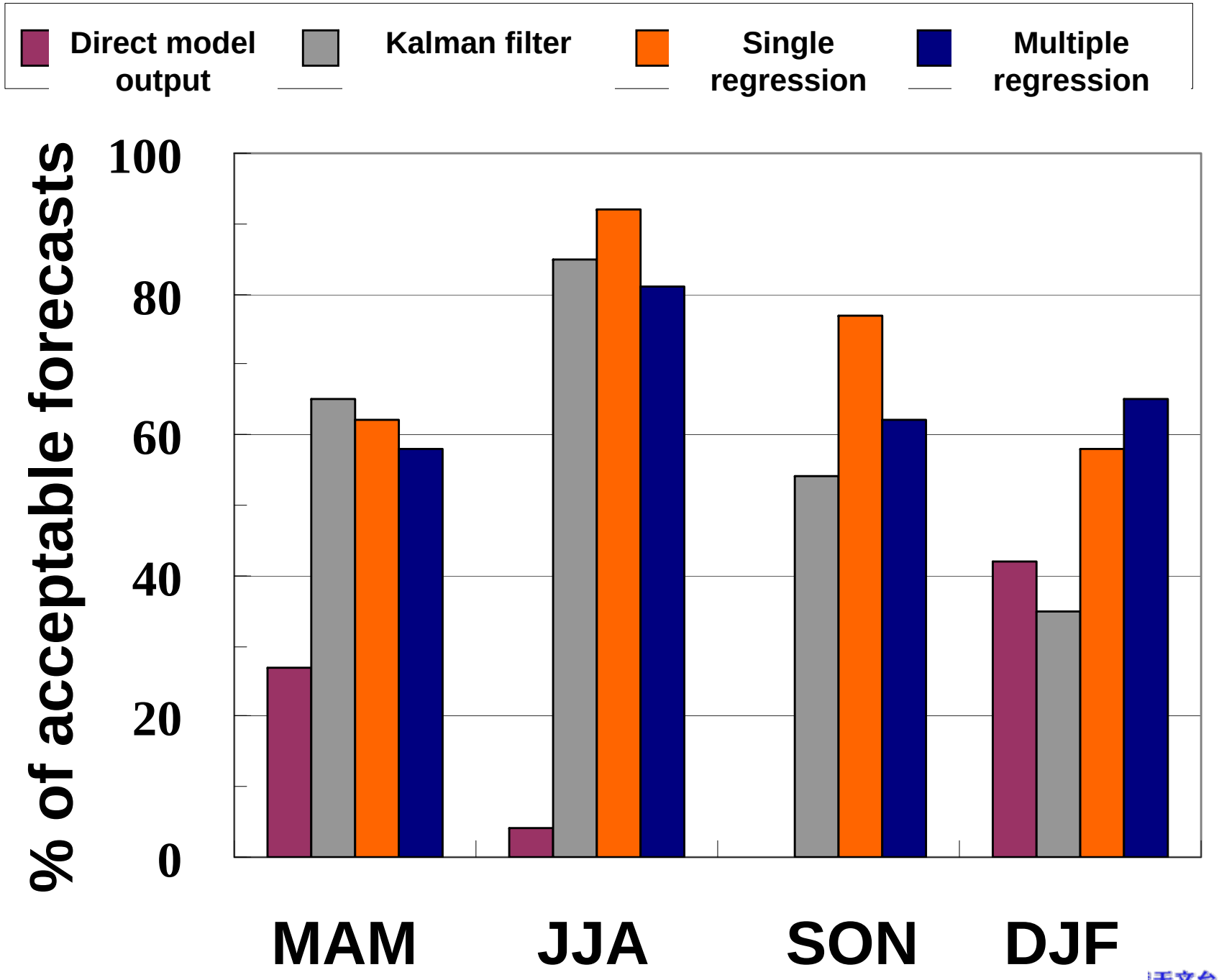
- ❖ Kalman filter
- ❖ Single and multiple regression

Comparison of direct and MOS-corrected model outputs against observed seasonal temperatures (Winter)



Comparison of direct and MOS-corrected model outputs against observed seasonal temperatures (Summer)





scaled Hanssen and Kuipers score

Average of 4 seasons

Temperature		**BN**	**NN**	**AN**
KS	DMO	0.57	0.51	0.59
KS	MOS	0.66	0.66	0.71
Rainfall		**BN**	**NN**	**AN**
KS	DMO	0.5	0.47	0.54
KS	MOS	0.59	0.63	0.62

Future Plans

- Provide monthly temperature and if possible rainfall predictions for Hong Kong
- Explore the possibility of predicting frequency of occurrence of tropical cyclones

Thank you