

Climate Prediction Services in Hong Kong

APCC Climate Symposium 2010

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Hong Kong Observatory




June 2010

An Overview of Climate Prediction Services provided by HKO

1. Annual outlook (since 2001)
 - rainfall in tercile category
 - no. of TC within 500 km of HK
2. Seasonal forecast (since 2006)
 - 4 times a year
 - rainfall and temperature in tercile category
3. Experimental Monthly forecast (since mid 2008)
 - still for HKO's internal reference only.
 - rainfall and temperature in numerical values
 - No. of TC in the South China Sea
 - No. and timing of cold surges in winter

Tool and data support

- A suite of global and regional climate model adapted from Experimental Climate Prediction Centre (ECPC)
- Digital model data from WMO Global Producing Centres (JMA and NCEP)
 - Complete set of hindcast and model forecast data

  **Tokyo Climate Center** 


Welcome to Tokyo Climate Center Website.


This website provides global weather and climate information produced by Japan Meteorological Agency (JMA). JMA established in April 2002 to facilitate the development of climate services in the Asia-Pacific region.

RCC RA-II
Homepage
under construction

GPC for LRF
Products
only for NMHS users

TCC
Top page
News and products

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 **National Centers for Environmental Prediction**
Climate Forecast System

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The NCEP Climate Forecast System (CFS)

The CFS was developed at the Environmental Modeling Center at NCEP. It is a fully coupled model representing the interaction between the Earth's oceans, land and atmosphere. It became operational at NCEP in August 2004.

A description of the CFS is given in the following manuscript. **Please reference this article when using the data.**


S. Saha, S. Nadiga, C. Thiaw, J. Wang, W. Wang, Q. Zhang, H. M. van den Dool, H.-L. Pan, S. Moorthi, D. Behringer, D. Stokes, M. Pena, S. Lord, G. White, W. Ebisuzaki, P. Peng, P. Xie, 2006: The NCEP Climate Forecast System. *Journal of Climate*, Vol. 19, No. 15, pages 3483-3517.

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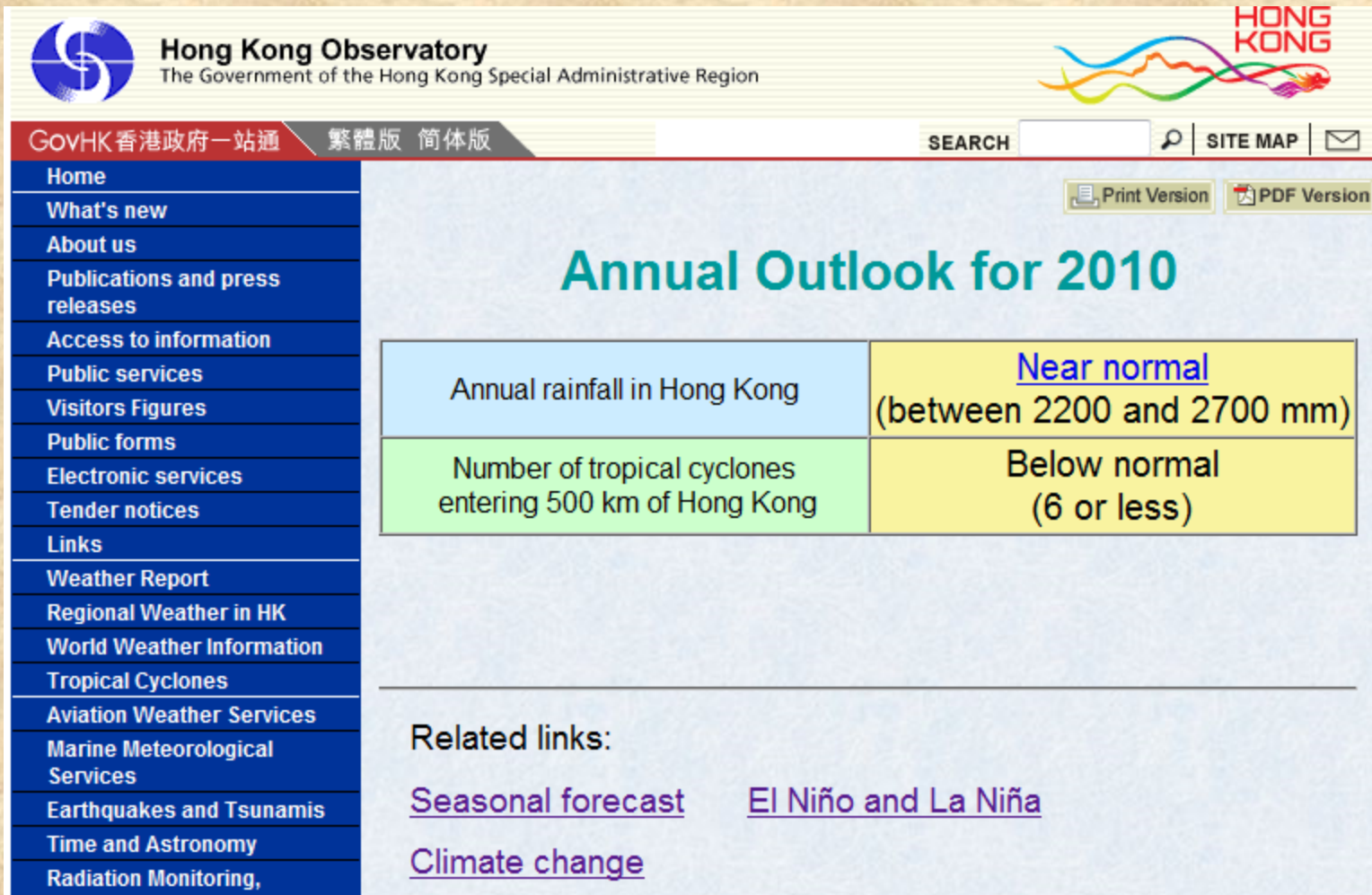
CFSRR
Overview

Operational CFS
ENSO at CPC

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Annual Outlook – since 2001



The screenshot shows the Hong Kong Observatory website interface. At the top left is the logo and name of the Hong Kong Observatory, with the text 'The Government of the Hong Kong Special Administrative Region'. To the right is a colorful wave logo with 'HONG KONG' written vertically. Below the header is a navigation bar with 'GovHK 香港政府一站通', language options '繁體版' and '简体版', a search box, and links for 'SITE MAP' and an email icon. A secondary navigation bar contains 'Print Version' and 'PDF Version' buttons. The main content area features the title 'Annual Outlook for 2010' in large green text. Below this is a table with two rows of data. The first row shows 'Annual rainfall in Hong Kong' with a value of 'Near normal (between 2200 and 2700 mm)'. The second row shows 'Number of tropical cyclones entering 500 km of Hong Kong' with a value of 'Below normal (6 or less)'. Below the table is a section for 'Related links' with three links: 'Seasonal forecast', 'El Niño and La Niña', and 'Climate change'. On the left side of the page is a vertical menu with various service links.

Hong Kong Observatory
The Government of the Hong Kong Special Administrative Region

GovHK 香港政府一站通 繁體版 简体版

SEARCH [SITE MAP](#)

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Annual Outlook for 2010

Annual rainfall in Hong Kong	Near normal (between 2200 and 2700 mm)
Number of tropical cyclones entering 500 km of Hong Kong	Below normal (6 or less)

Related links:

[Seasonal forecast](#) [El Niño and La Niña](#)
[Climate change](#)

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Annual Outlook - Tropical cyclones Affecting Hong Kong

- Previously : Poisson regression model using observed Nino 3.4 SST
 - Drawbacks: (a) perfect prognosis approach
 - (b) consider Nino 3.4 SST only
- 2010 : Poisson regression model using EOF coefficients of GPC model hindcasts as predictors (*on going project in collaboration with Prof. Johnny Chan of CityU, HK*)
 - Hindcast verification : Outperformed climatology
 - Only NCEP data are used for 2010, will incorporate JMA data next year.
 - Programming tool: R (powerful and free of charge)
 - an on-going study and still refining the method

Poisson Distribution – for modelling count data

$$p(x,\lambda) = \exp(-\lambda) \lambda^x / x! \quad \text{for } x = 0,1,2,\dots$$

where λ = average count

Poisson regression model (PRM):

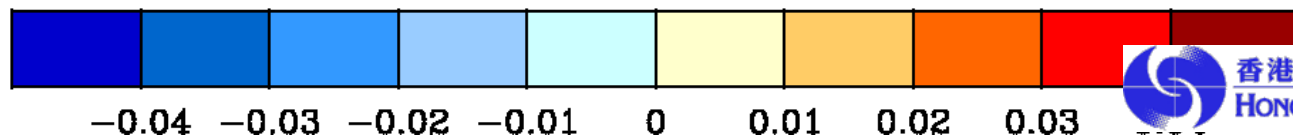
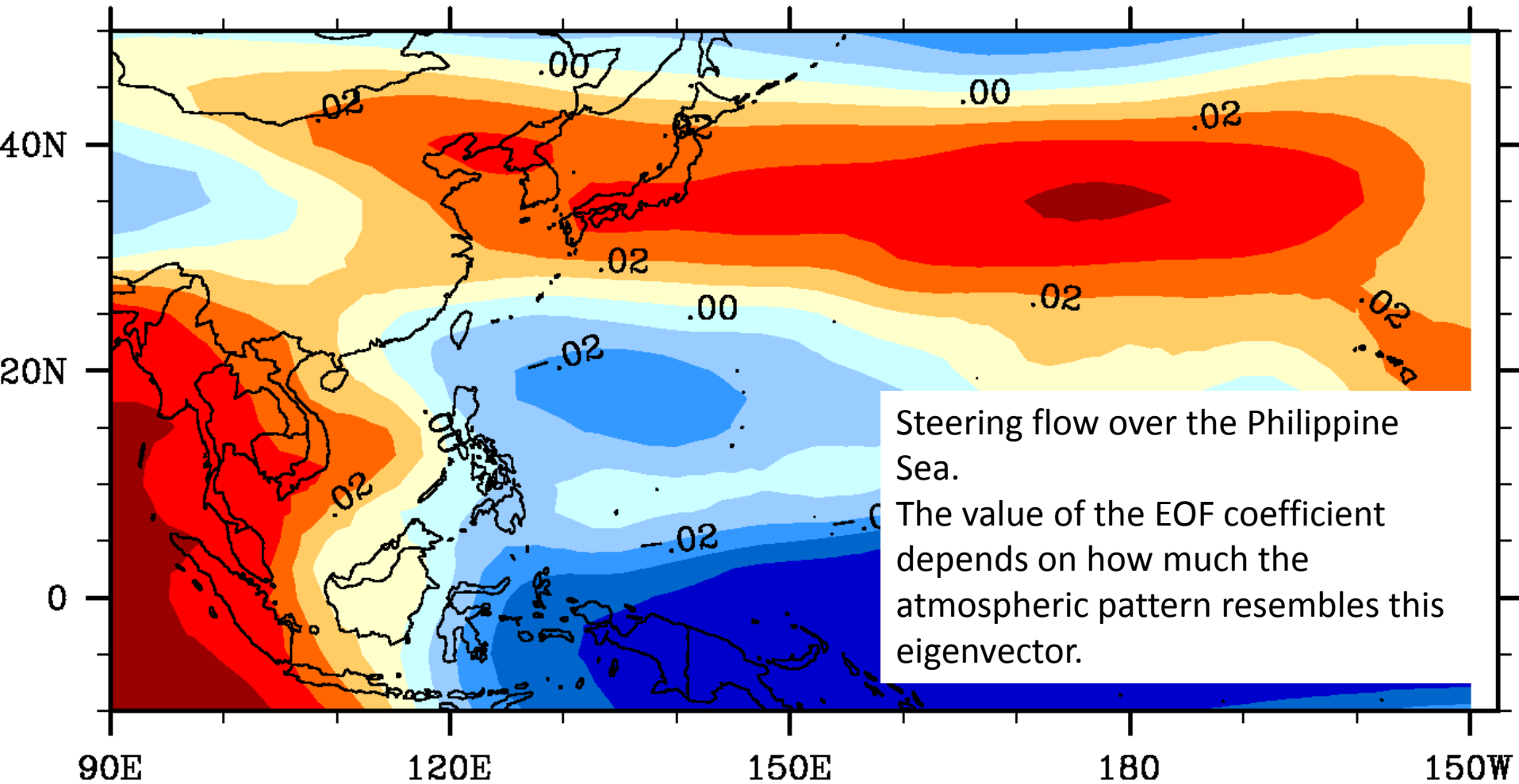
$$\log \lambda = A_0 + A_1 X_1 + A_2 X_2 + \dots + A_n X_n$$

EOF coefficients

X_i : principal components (EOF coefs)

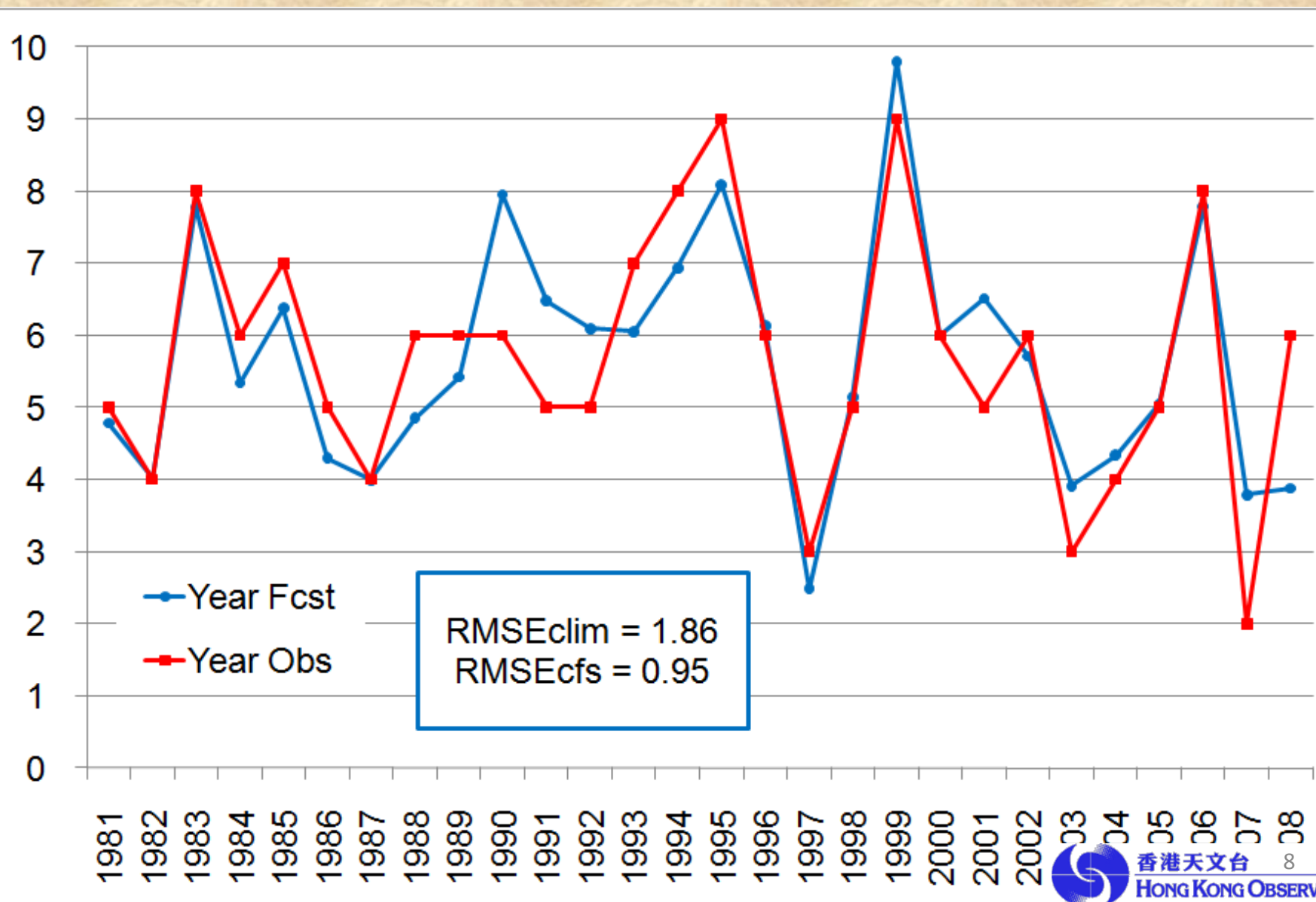
Eigenvectors – atmospheric patterns favouring more TC coming within 500km

ason_u200ev_1



Forecasting yearly N500 using statistical downscaling

Hindcast Verification

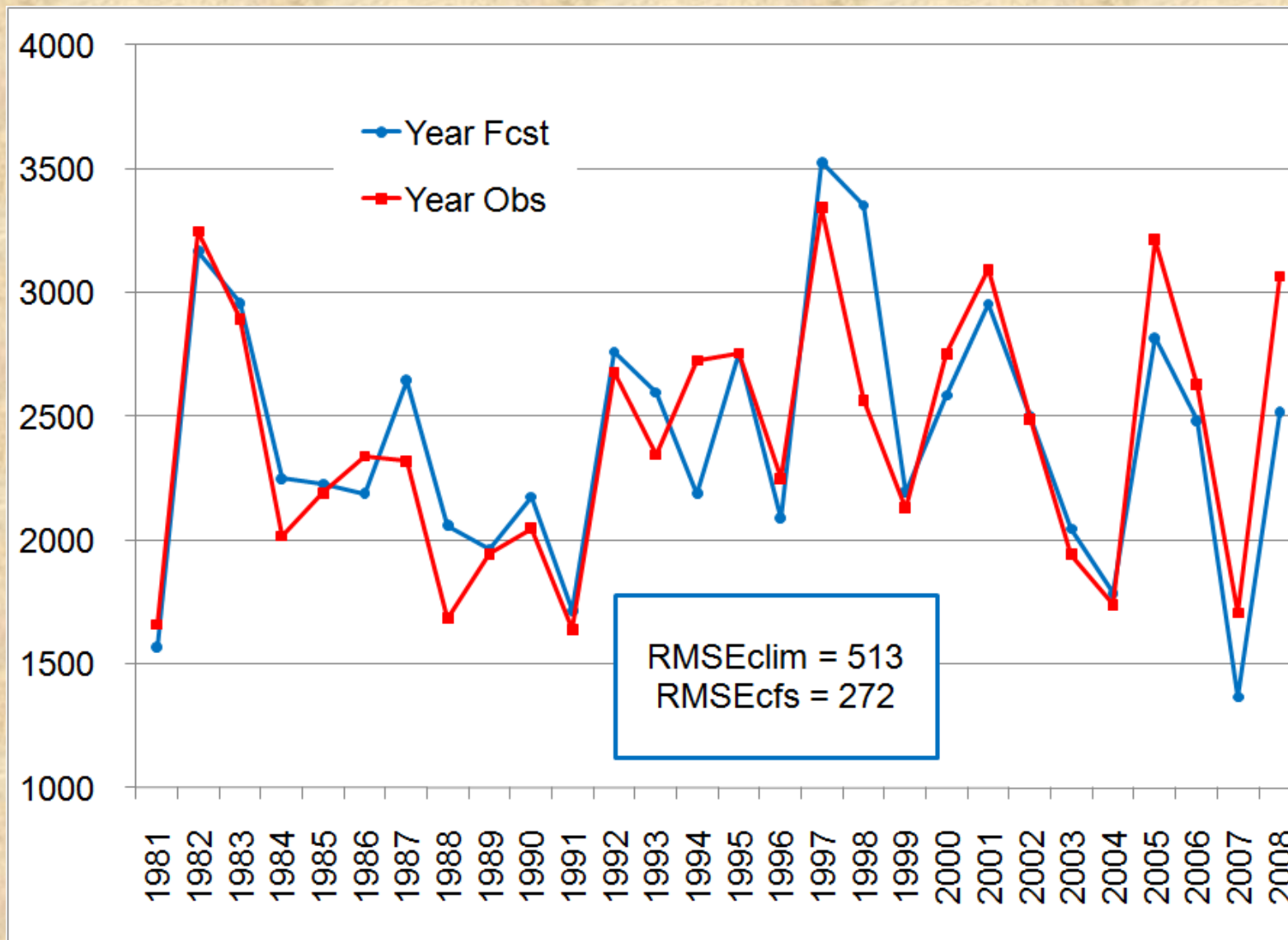


Annual Outlook - Rainfall

- Previously : Statistical downscaling of model outputs using simple linear regression approach
 - Performance marginally on par with climatology
- 2010 : Gamma regression model (GRM) using EOF coefficients of GPC model hindcasts as predictors
 - Hindcast verification : Outperformed climatology
 - Only NCEP data are used for 2010, will incorporate JMA data next year.
 - Programming tool: R
 - an on-going study and still refining the method

Forecasting yearly RF using statistical downscaling

Hindcast Verifications



Seasonal Forecast – since 2006



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GovHK 香港政府一站通

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SITE MAP



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Seasonal Forecast for Summer 2010 (June to August 2010)

Hong Kong is expecting:

1. [above-normal](#) temperatures
2. [near-normal](#) rainfall

Note:

1. The assessment is based on the [Global-Regional Climate Model \(G-RCM\)](#) operated by the Hong Kong Observatory and dynamical prediction model outputs from major climate centres.
2. The Observatory gratefully acknowledges the Tokyo Climate Center of the Japan Meteorological Agency and the National Centers for Environmental Prediction of National Oceanic and Atmospheric Administration, USA for providing dynamical prediction model forecast and hindcast data to support the formulation of seasonal forecast for Hong Kong.
3. Forecast for autumn 2010 (September to November 2010) will be available from 10th September 2010.



香港天文台 11

HONG KONG OBSERVATORY

Experimental Monthly Forecast – since Jun 2008

Experimental Monthly Forecast for June 2010

		Possible range ^[2]	Tercile category ^[1]
Mean temperature	27.9 °C	27.6 - 28.2 °C	Near normal
Total rainfall	360 mm	200 - 520 mm	Near normal

Tropical cyclones in the South China Sea ^[4]:

Period	Number
1 - 10 June	1
11 - 20 June	0
21 - 30 June	0

Seasonal / Monthly Forecast – methodology

- Bias corrections of forecast outputs from HKO global and regional climate model (adapted from ECPC)
- Statistical downscaling (simple linear regression) of the digital model data from WMO Global Producing Centres (JMA and NCEP)
- Winter surge, tropical cyclones:
 - Diagnosis / Analysis of prognostic charts and time series
- A New Direction in 2010 : Statistical downscaling using EOF coefficients of GPC model hindcasts as predictors
 - Both JMA and NCEP data are used

Future Work

- Forecast seasonal no. of TC within 500 km of HK (collaboration with CityU)
- Statistically downscale other climate models
 - possibility of MME
- Pilot projects
 - provision of experimental monthly forecasts for relevant government departments for planning purposes
 - e.g. Monthly RF forecasts (numerical) for Water Supplies Department to estimate the yields at major reservoirs (for water management).

Thank you

HKO Global-Regional Climate Model

- Adapted from ECPC in 2006
- Global model – T62(~200 km), 28 vertical levels
- Regional model – 60 km
- Provides input to seasonal and monthly forecasts

Initial conditions:

(i) NCEP GFS data; or

(ii) NCEP/NCAR re-analysis data

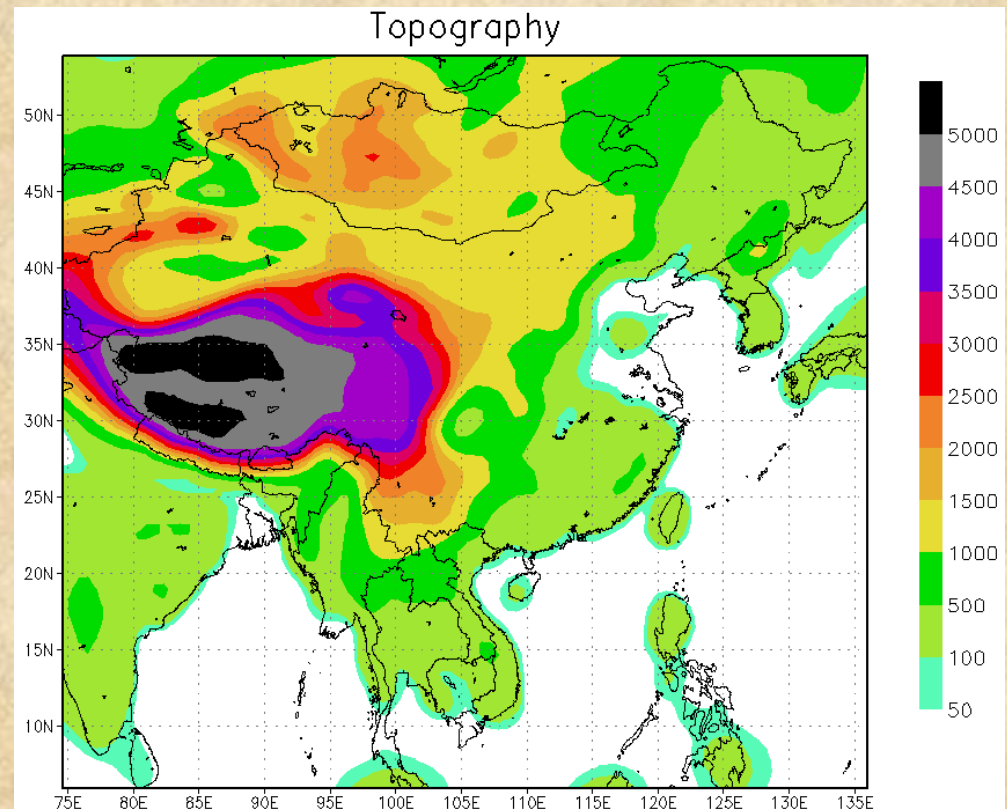
Boundary condition:

NCEP CFS SST f/c

GFS – Global Forecast System

CFS – Climate Forecast System

ECPC – Experimental Climate Prediction Center of the University California at San Diego



Experimental Monthly Rainfall Forecast for Water Service Department

- A pilot project to provide monthly rainfall forecast for the purpose of water management
- Quantitative forecasts at station level are required for 10 stations
- The forecast rainfall is then used to forecast yields collected at 4 reservoirs.