

*Public seminar on Review and Development of
Marine Water Quality Objectives, October 31, 2009*

Challenges of Marine Water Quality Management in Hong Kong

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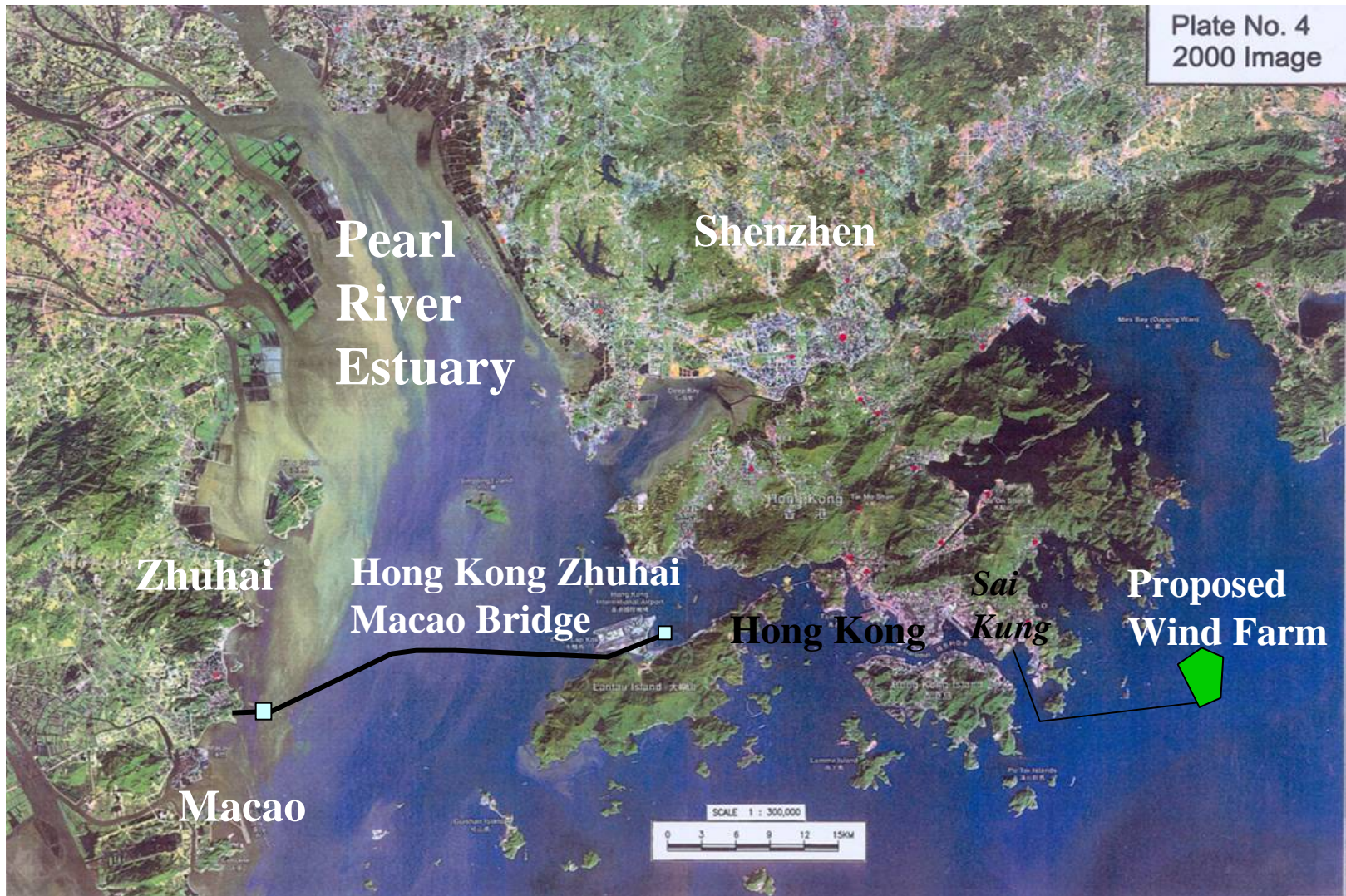


裘槎水力實驗室

- Challenges of setting WQO
 - Pollution threats
 - Intensive coastal development
 - Trans-boundary pollution
 - Complex hydrodynamic environment
- Examples of WQO
 - Eutrophication and total inorganic nitrogen
 - Beach water quality and *E.coli*



Hong Kong and the Pearl River Delta

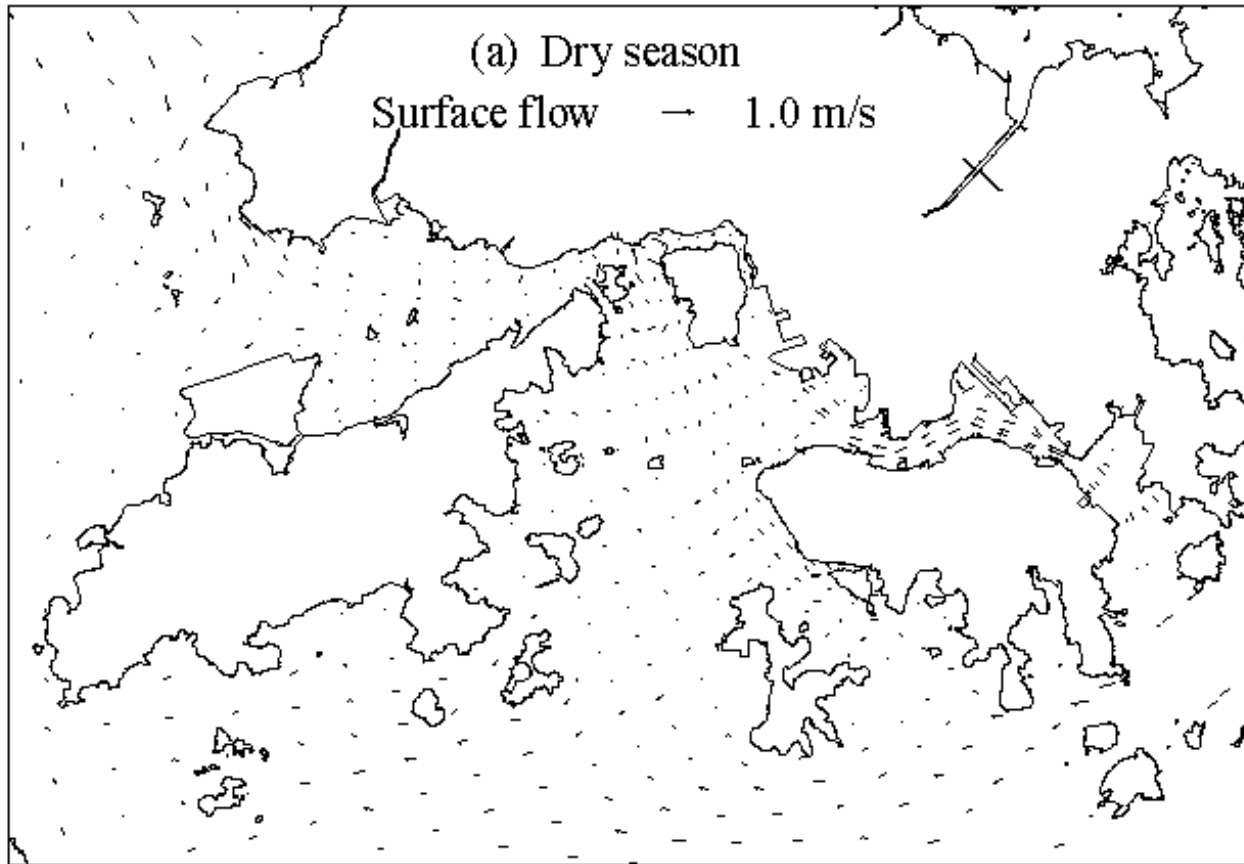


香港水質管理有以下的考慮

- 所有排污及基建工程，受到嚴格的環境影響評估 (EIA) 法例管制
- 污染源往往很接近受影響區 (sensitive receivers)
- 複雜的水文條件
- 香港位於珠江下游，承受珠江三角洲的污染負荷
- 污水管理設施，供地嚴重短缺
- 富營養化問題的主要成因複雜，投資龐大的污水處理工程，沒有絕對保證有預期效益。

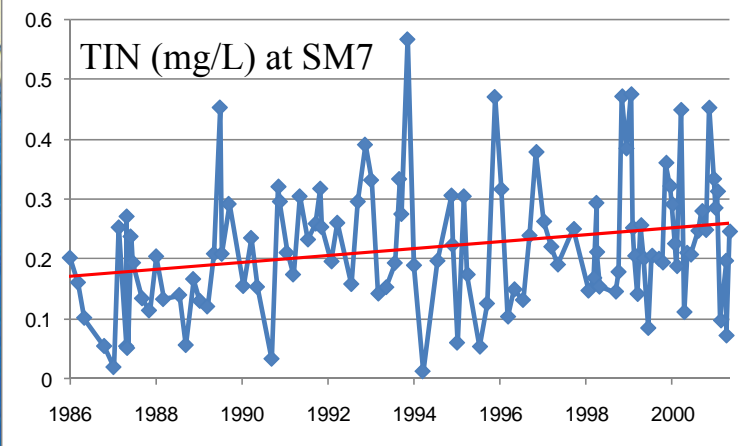
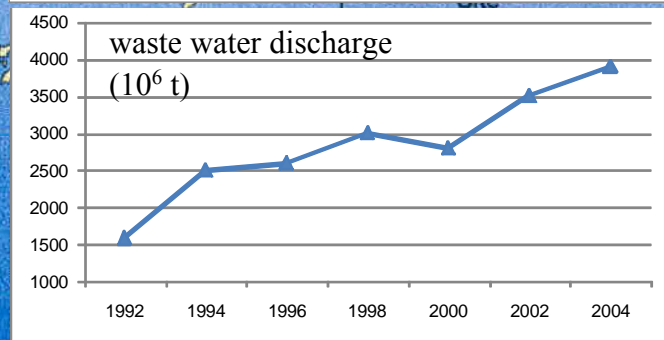
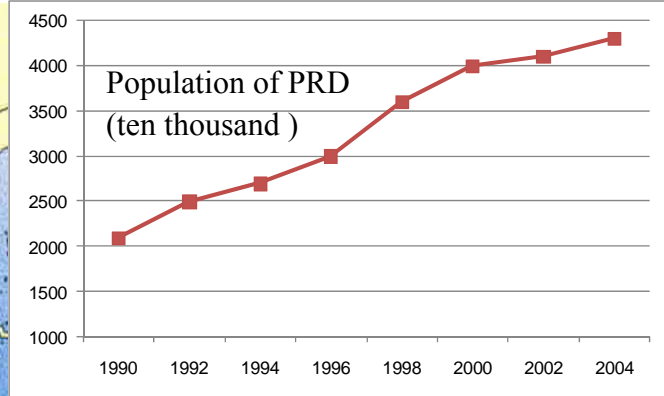
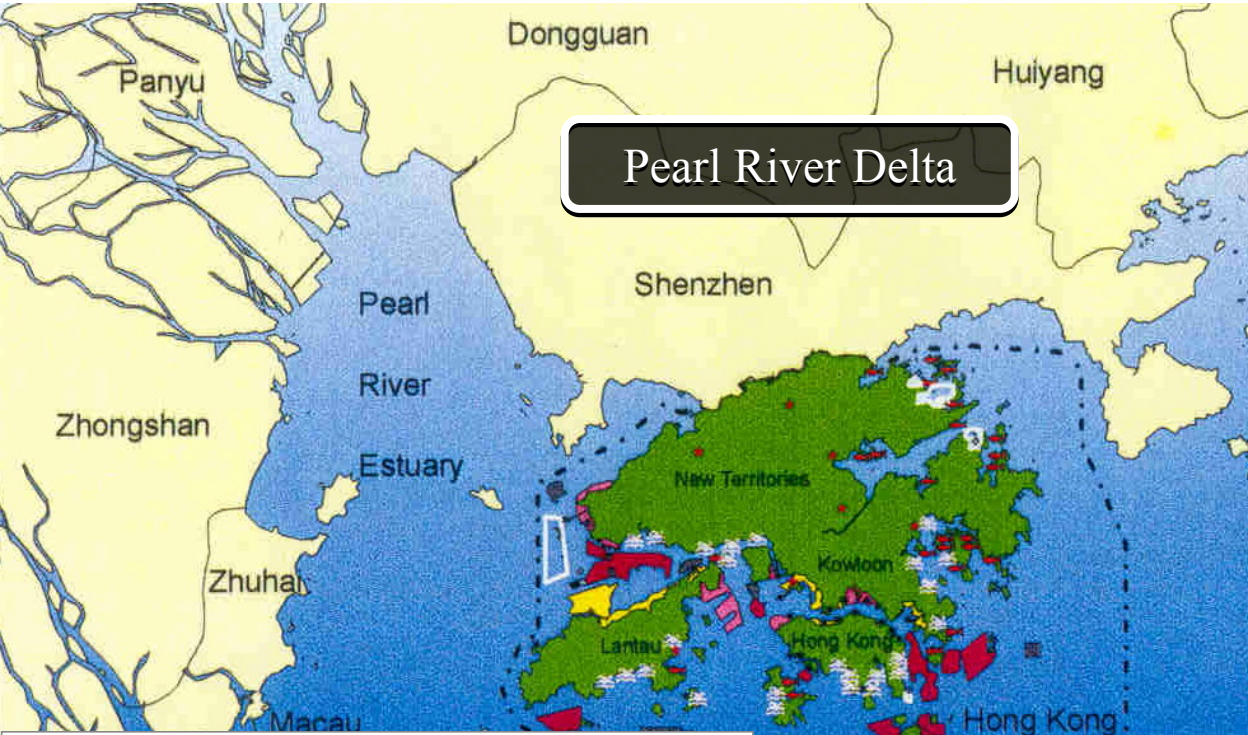


香港處於珠江河口，近海的水流決定於潮差、地理條件、鹹淡水的湍流混合交換、風速及海洋環流。一般而言，香港海域的水流偏強，對排污物有良好的沖泄作用。



枯水期季節的典型潮流 (11月 - 3月)

Physical processes drive biological processes



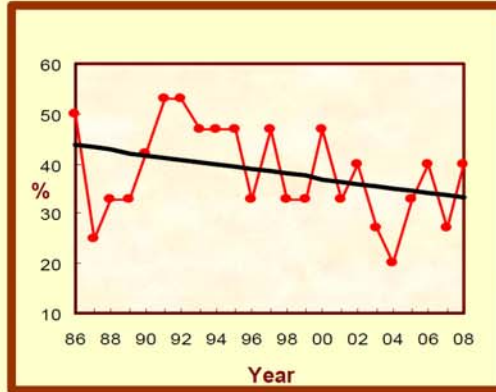
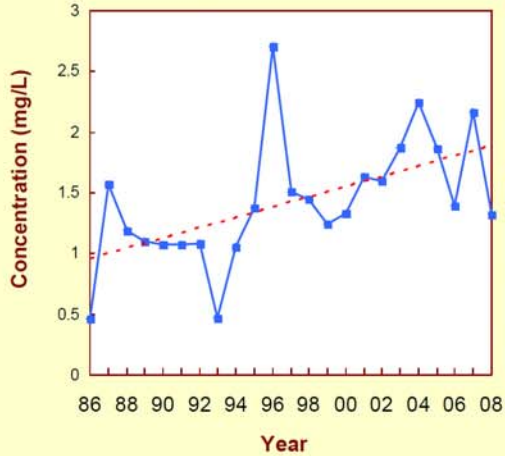
Hong Kong SAR
 1,072 km² of land area
 1,800 km² of coastal waters
 Population 6.7 M

Increase in Total Inorganic Nitrogen (TIN) in Pearl River flow

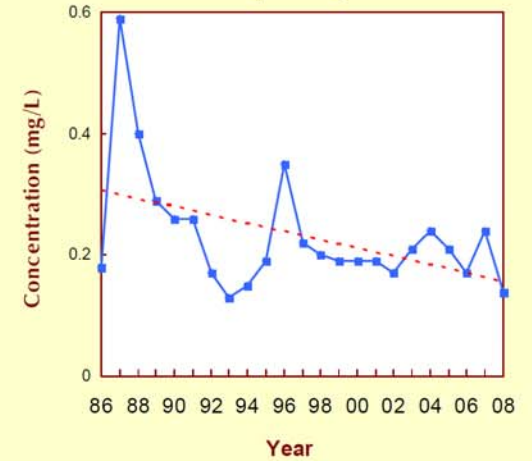
Pearl River - 2200 km; Annual precipitation 1470 mm; wet season flow 20,000 m³/s

Overall WQO compliance in Deep Bay

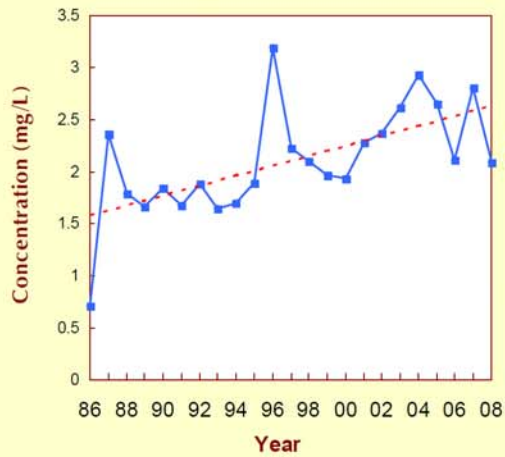
Ammonia Nitrogen



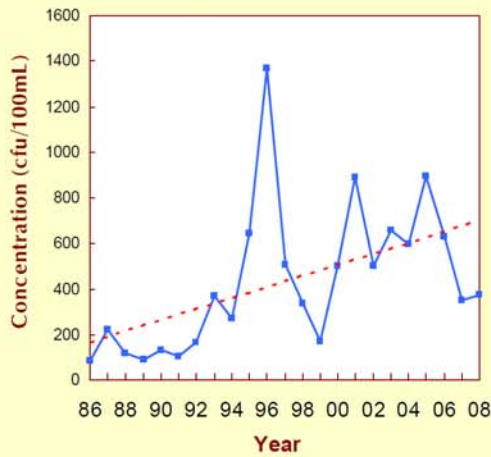
Orthophosphate



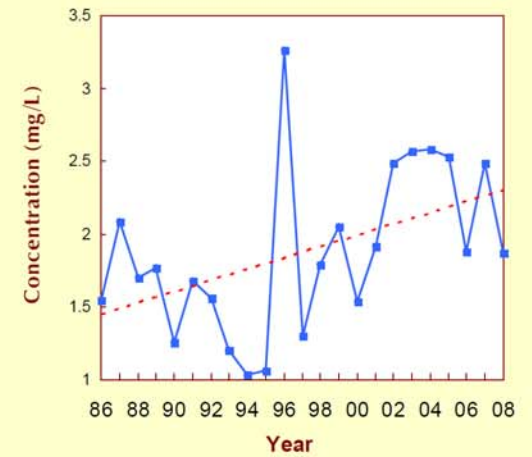
Total Inorganic Nitrogen



E. coli



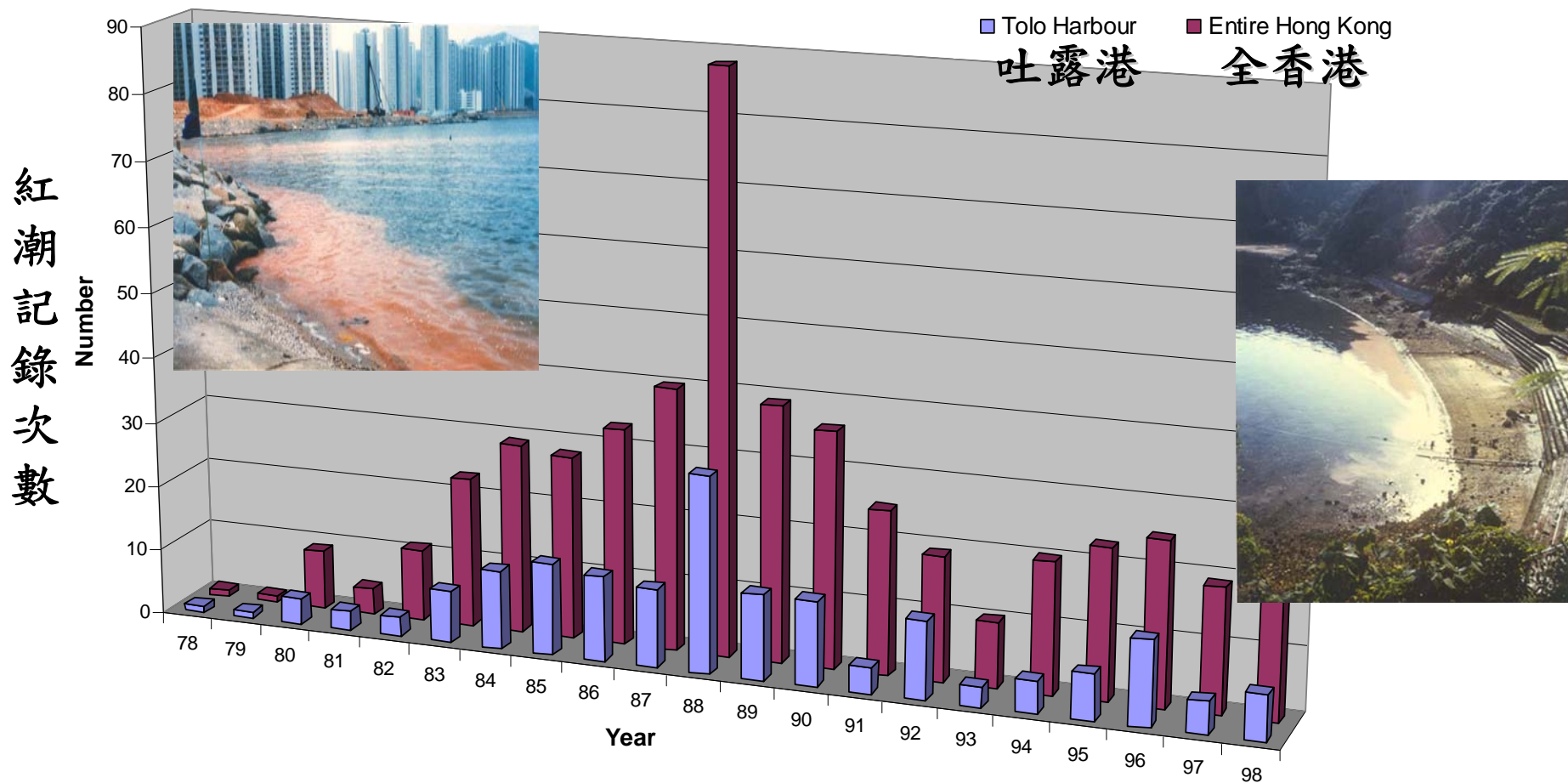
BOD₅



Water Quality Changes in the Deep Bay Water Control Zone, 1986-2008

富營養化及赤潮問題 — 珠江沿岸及香港本身產生的有機污染，為沿海帶來大量的養料 (nutrients, N, P)。在適當的水文氣象條件下，海藻在短時期內可以大量繁殖，引起「藻華」及「赤潮」。香港赤潮發生的頻率及強度，都可能是世界上罕見的。

Red tide occurrences in Hong Kong



Hydrodynamic Tracking of The Massive Spring 1998 Red Tide in Hong Kong

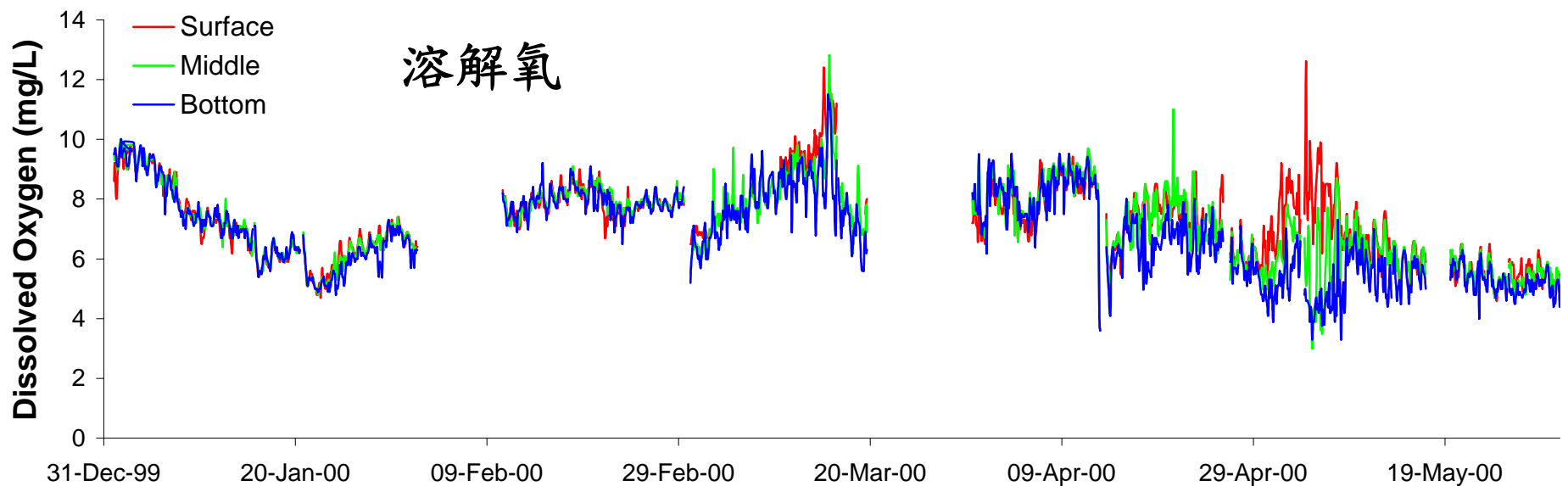
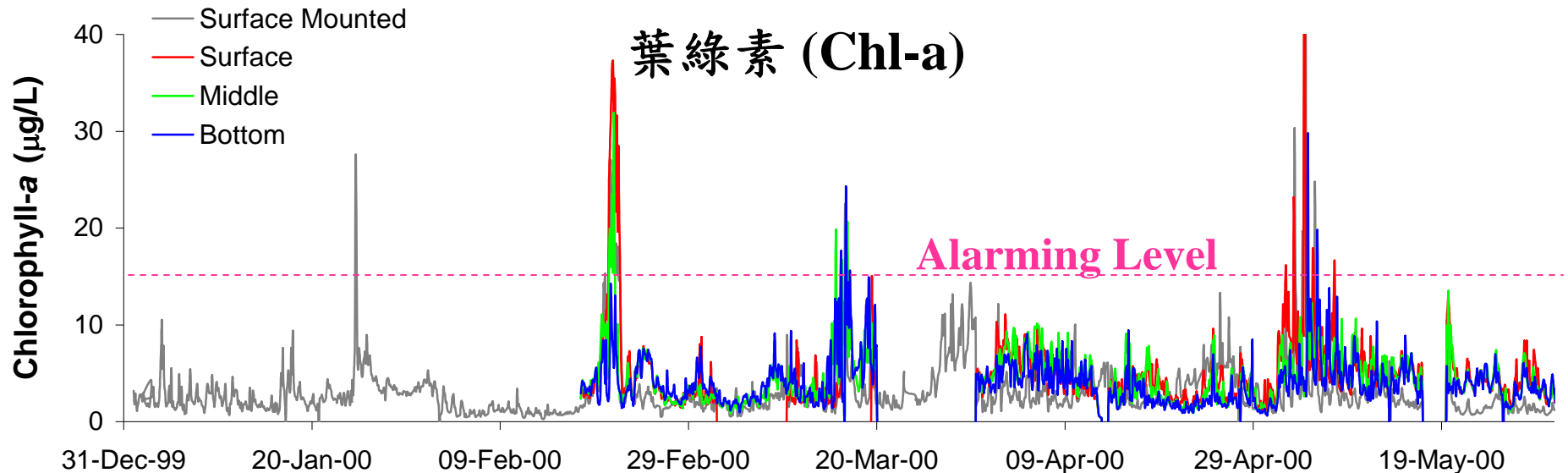
(Lee and Qu, J. of Environmental Engineering, ASCE, May 2004)



Loss estimation:
3400 tonnes (80%) fish
stock
HK\$312 million



2000 年在香港吉澳現場觀察到的赤潮動態



Hong Kong Harbour Area Treatment Scheme (HATS)

第一期於2001年12月全面啟用



每日處理140萬立方米以上的污水
每天仍有45萬立方米污水排入維港

23.6 km 深層隧道

WATERMAN Services

Environmental Impact Assessment and Public Engagement

Example of 3D Virtual
Reality EIA system

Impact of Harbour Area
Treatment Scheme
(HATS) on beach water
quality

3D EIA enables risk
assessment, effective
appreciation and
communication of
impact, improves
sustainability



Hong Kong's beach grading system

Grade	Beach Water Quality	<i>E. coli</i> count* / 100 mL	Minor illness rate** / 1000 swimmers
1	Good	≤ 24	Undetectable
2	Fair	25-180	≤ 10
3	Poor	181-610	11-15
4	Very Poor	> 610	> 15

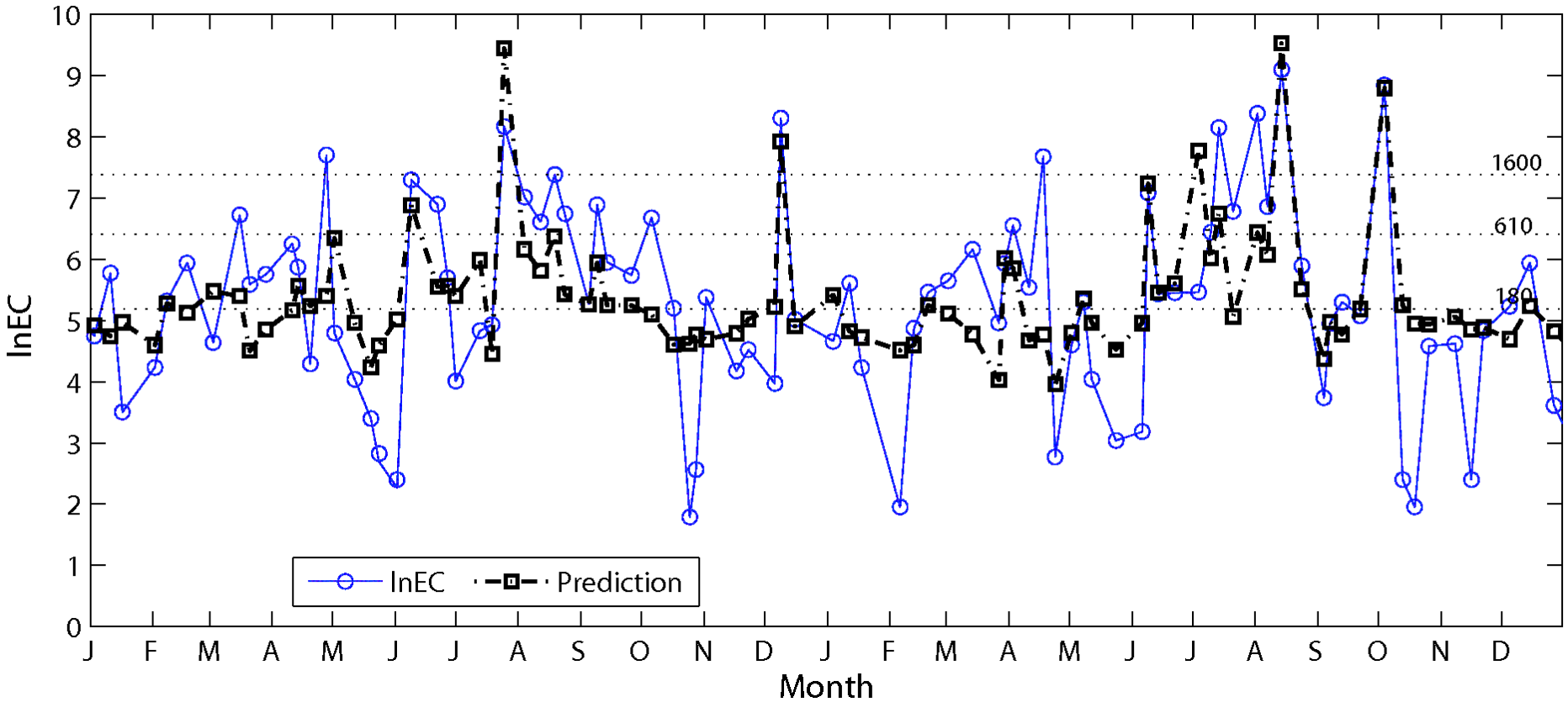
* Except where indicated, the *E. coli* level is the geometric mean *E. coli* level of the 5 most recent sampling occasions

** Skin and Gastrointestinal illnesses

Comparison of model prediction with data

In *E.coli* (counts/100mL)

New Cafeteria, 1994–1995



Applications of Enterococci as indicator

- USEPA (1986) recommends Enterococci as the **sole** bacterial indicator for **marine** recreational waters
- WHO (2003) suggests intestinal Enterococci is **best** bacterial indicator of the relationship between bathing water pollution and swimming associated illnesses
- *Hong Kong's beach grading system is based on E.coli as an indicator organism*

Correlation of enterococci and *E.coli* with swimming associated illnesses

Indicator	Correlation coefficient		Reference
	Fresh water	Marine water	
Enterococci	0.74		Cabelli, 1982
		0.75	Cabelli, 1976
		0.60	Cheung <i>et al.</i> , 1990
<i>E.coli</i>	0.80		Cabelli, 1982
		0.52	Cabelli, 1976
		0.73	Cheung <i>et al.</i> , 1990



Thank You!