Optimization of Ship Routes With The Aid of Numerical Ocean Current Prediction Models

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Shipping and the global economy

Today almost no nation is fully self-sufficient. Every country must sell what it produces and acquire what it lacks. None can depend on domestic resources alone.

Ships have always provided the only really cost-effective method of bulk transport over any great distance.

MORE THAN 90 PER CENT OF GLOBAL TRADE IS CARRIED BY SEA

The transport cost element in the shelf price of consumer goods varies from product to product, but is ultimately marginal. For example, transport costs account for only around 2% of the shelf price of a television set and only around 1.2% of a kilo of coffee.

There are more than 45,000 merchant ships trading internationally today, transporting every kind of cargo. The world fleet is registered in over 150 nations, and manned by over one and a quarter million seafarers of virtually every nationality. Without international shipping, half the world would freeze and the other half would starve.

Ship emissions

- For 2007
  - 3.3% of global CO2 emissions
  - 2.7% international shipping
  - 870 million tones CO2
- Can increase to 18% by 2050, if we do nothing!

(IMO,2009)

Shipping and CO2

- *Although international shipping is the most carbon efficient mode of commercial transport (30x more efficient than cargo aviation),*
- *total emissions are comparable to those of a major national economy, necessitating emission reduction (ICS, 2009)*



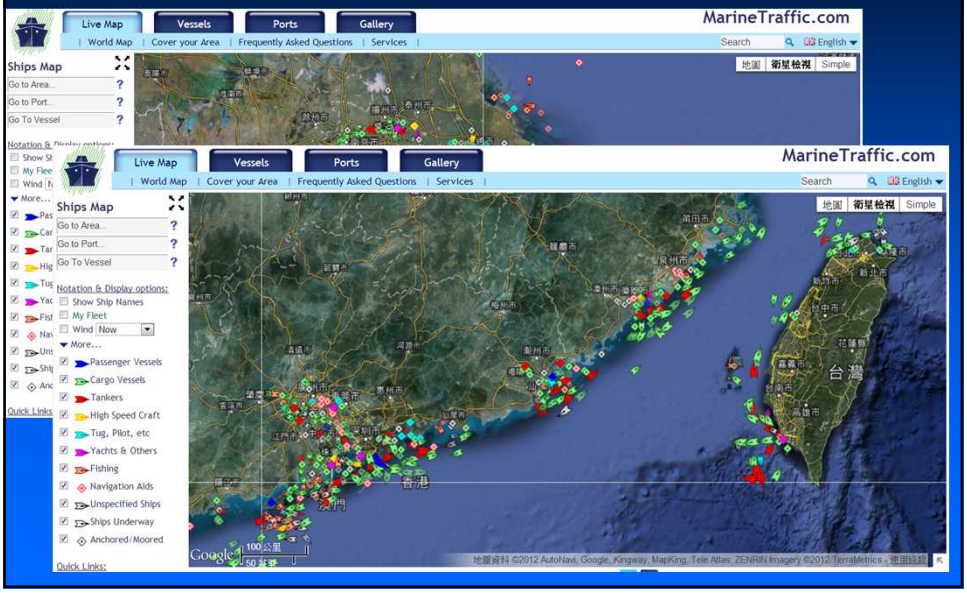
Commitment

- The consensus of opinion within the global industry is that it will be possible for shipping
- to reduce CO2 emitted per tonne of cargo transported one kilometre (tonne/km) by 20% between 2005 and 2020,
- through a combination of technological and operational developments

ICS, Brochure "Shipping, World Trade and the Reduction of CO2 Emissions"

Inter-continental and Regional Link

Busy Asian Traffics



Navigation efficiency

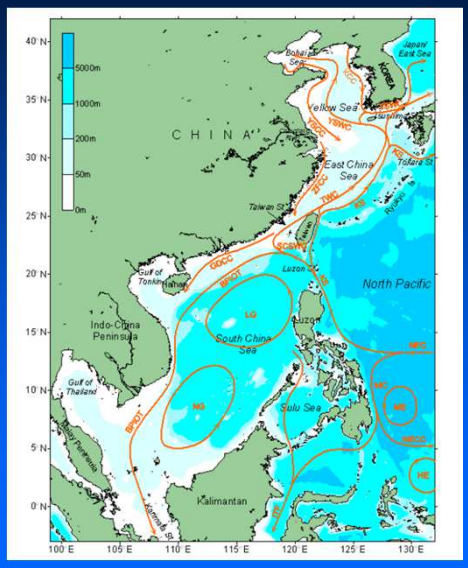
- Less unit consumptions - mega ships
  - inter-continental + regional transfer
- Better fuel efficiency – optimized cruse speed
  - From normal (20~25kn) to slow steaming(18~20kn)
  - Minimal cost (12~15kn), lower may not lead better fuel efficiency
  - Shipping time may be the major consideration!
- Influence by winds, wave and currents

Maritime Efficiency and Environment

- ship size vs cruising speed
- Fuel consumption vs ship time
- Cost of fuel vs call frequency
- Emission vs Environment
- Global economy vs Climate Change
- Improvement of shipping technology!
- Alternative fuel? LNG is ongoing …
- Improving Operation
  - **Better adaptation of the weather and sea state?**

Ocean Currents in West Pacific

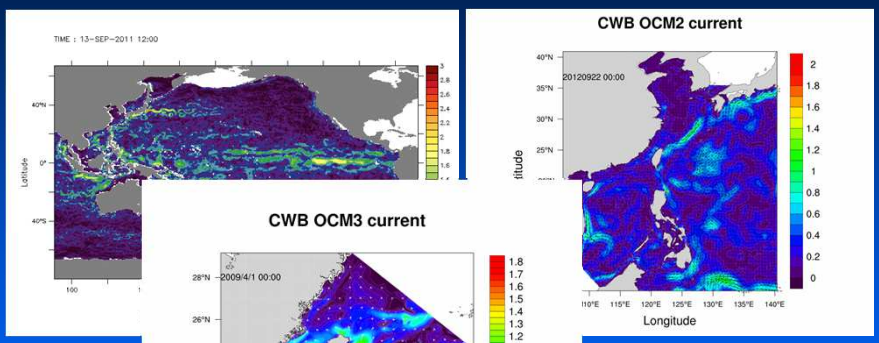
- Kuroshio
- Taiwan Warm Current
- China Coast Current
  - ZFCC, GDCC
- South China Sea
  - BPIOT (Branch of the Pacific to Indian Ocean Throughflow)
  - Luzon Gyre
  - Nansha Gyre
  - SCS Warm Current



(Zheng et al., 2006)

CWB - ROCFORS

–Regional Ocean Currents Forecasting OpeRational System



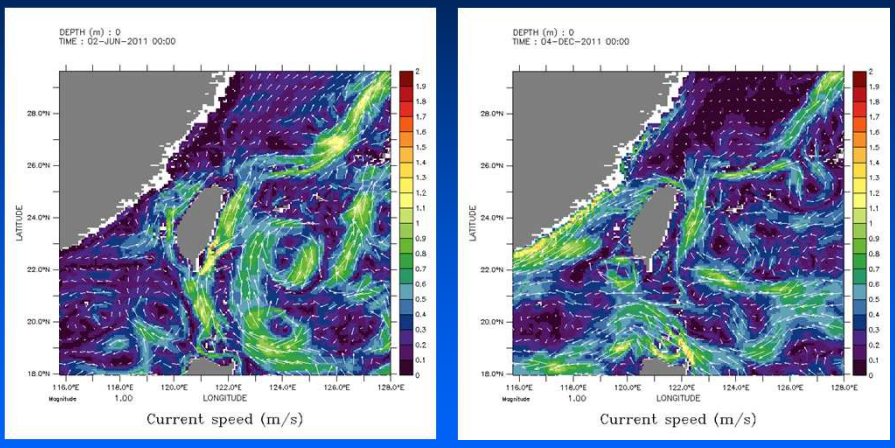
Pacific (OCM1)

NW Pacific (OCM2)

Taiwan (OCM3)

KUROSHIO

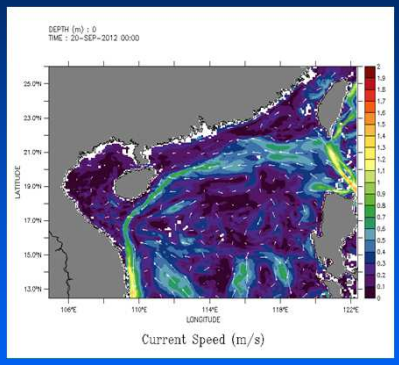
– A persistent ocean current system



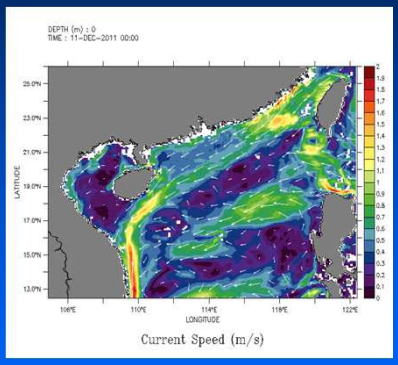
Summer

Winter

Seasonal Variation of Currents in SCS



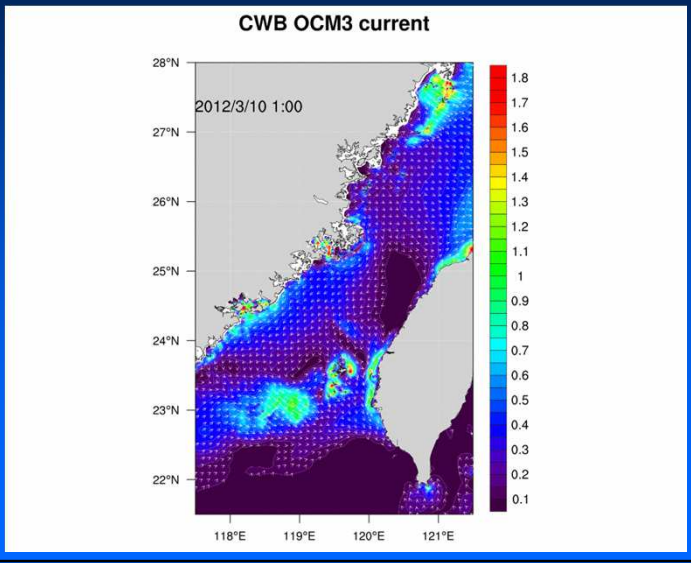
September



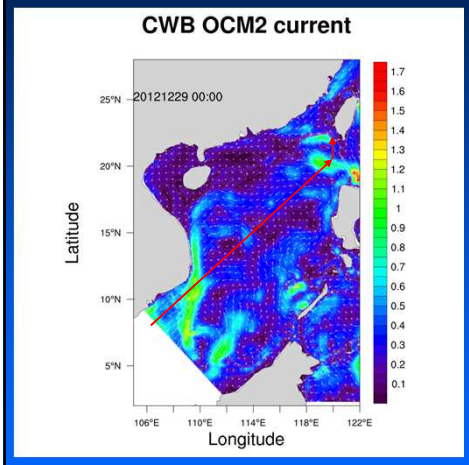
December

Tides on continental shelf

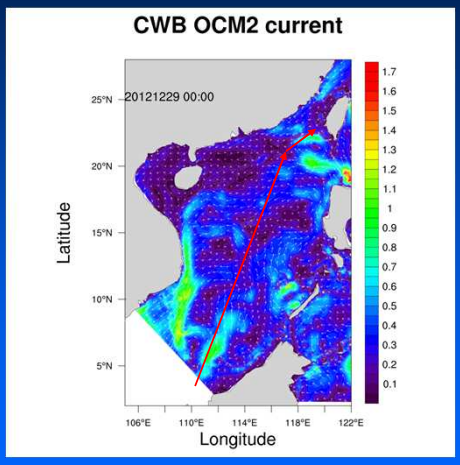
- Strong currents varying with time



Route from Singapore to North Asia through South China Sea

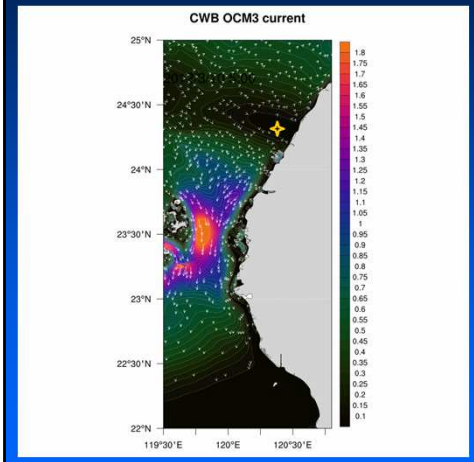


Against Currents

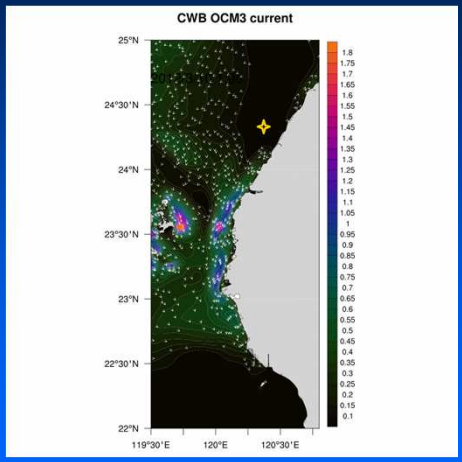


Follow Currents

Strait Navigations (Taichung → Kaohsiung)



Against Currents (flood)



Follow Currents (ebb)

Thanks for Your Attention