Performance Monitoring and Analysis for Operational Improvements

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Outline

1. Background
2. Performance monitoring and data collection
3. Performance monitoring tool
4. Performance analysis
5. Examples
6. Concluding remarks

1. Background

1-1. GHG emissions regulations

- SEEMP (Ship Energy Efficiency Management Plan)
  - MEPC 62 adopted revisions of MARPOL Annex VI introducing EEDI and SEEMP
- Entry into force date: 1 January 2013

Operational measures

- slow steaming
- weather routing
- hull and propeller maintenance

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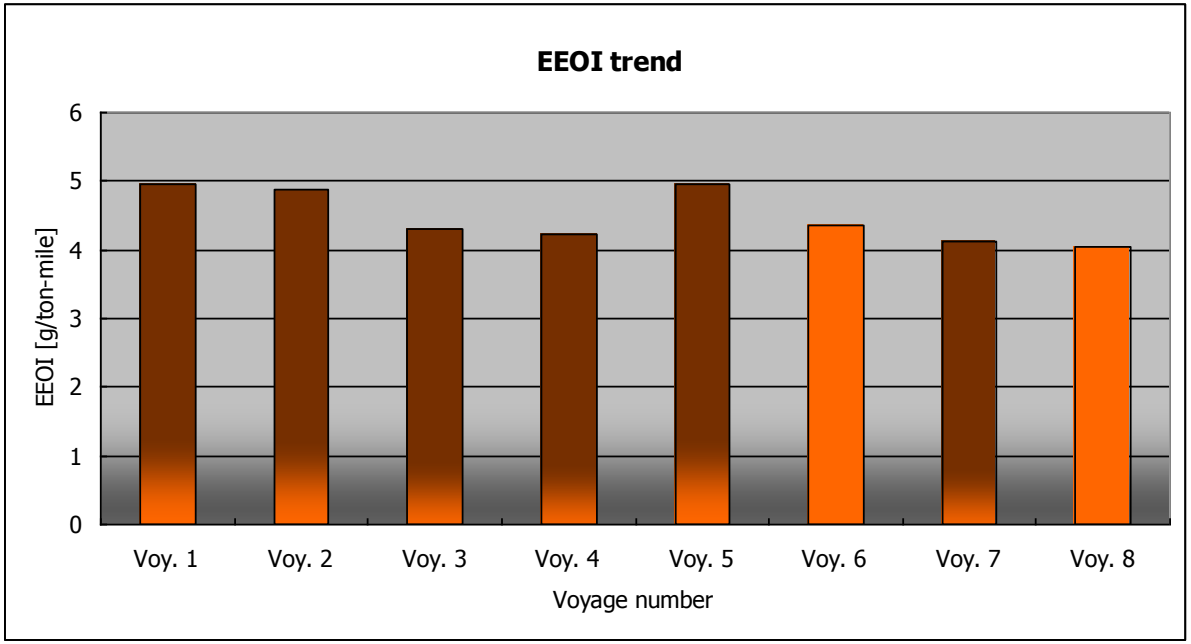
Plan Do Check Act

Continuous monitoring & improvement



1-2. Shipping companies' efforts for fuel saving

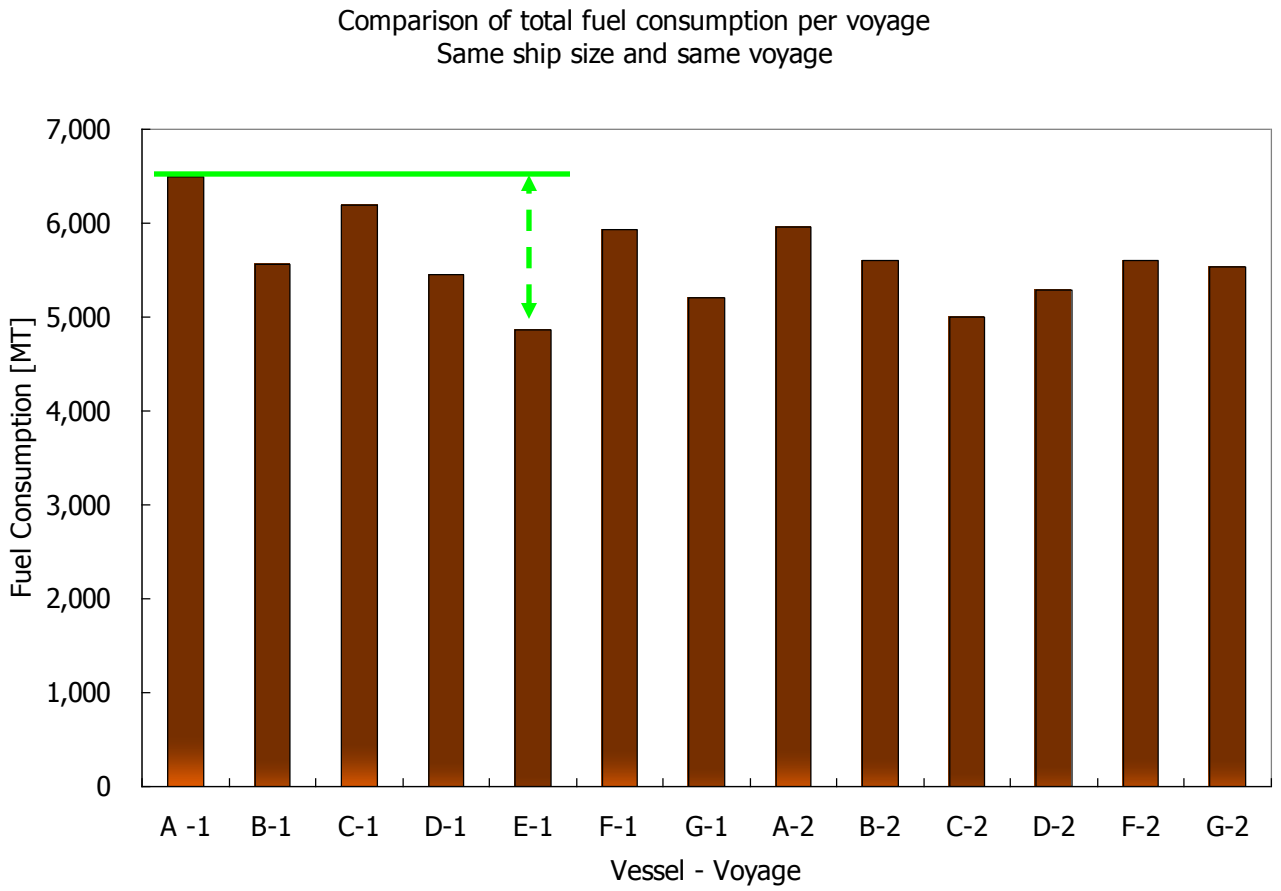
- According to increased cost of bunker, shipping companies have made efforts for fuel saving by operational and technical measures
  - Slow steaming
  - Weather routing
  - Performance monitoring
  - Applying energy saving devices

Cost benefit and emission reduction by slow steaming

e.g. 8,000 TEU container

		Slow steaming	
Ship speed	24 knot	20 knot	- 16 %
M/E fuel consumption	225 ton/day	130 ton/day	- 42 %
M/E fuel cost (@ 600 USD/MT)	134,800 USD/day	78,000 USD/day	
CO2 emission	696 ton/day	403 ton/day	

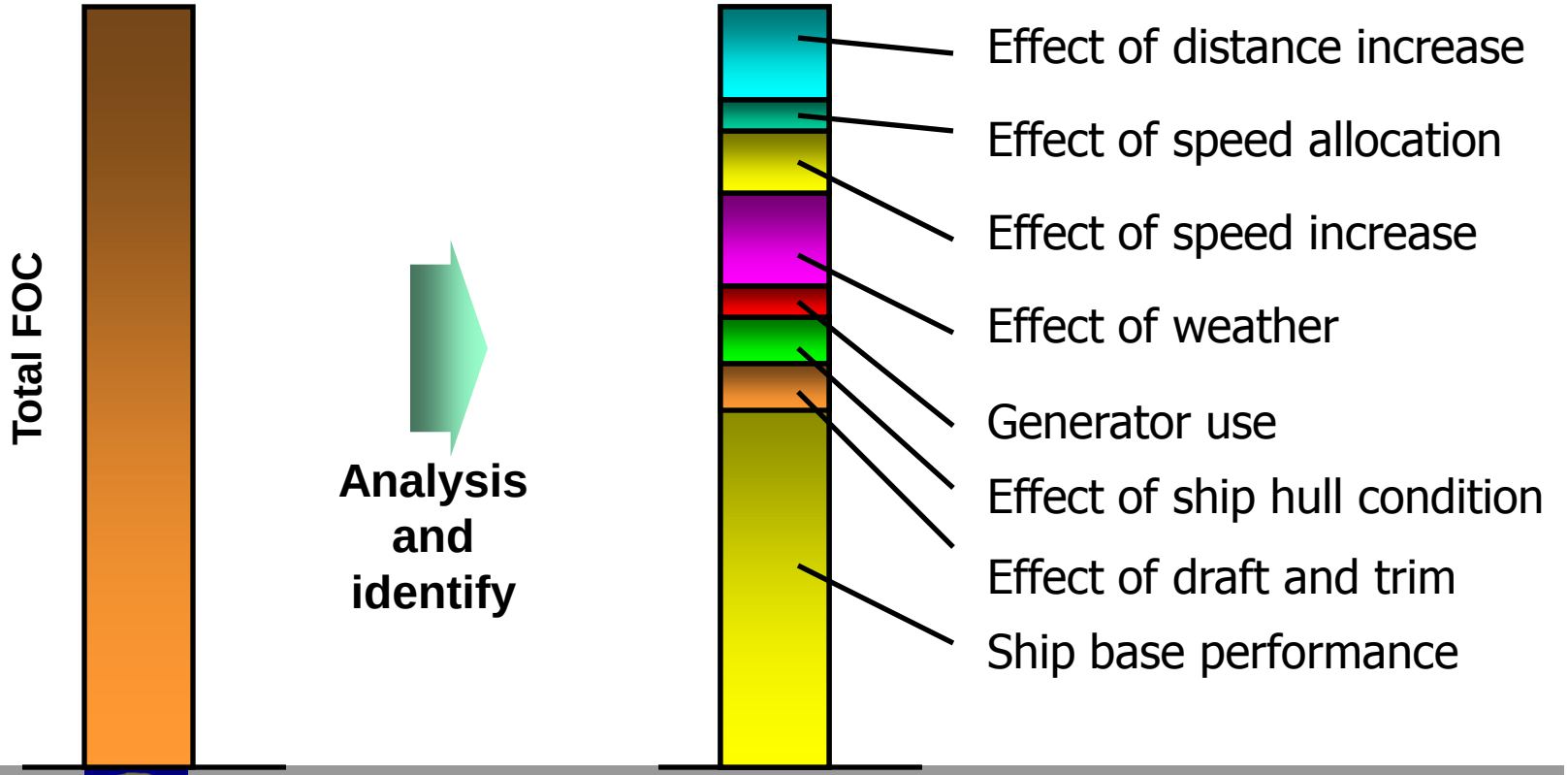
1-3. Example of actual fuel consumption - same service and same size of vessel



- Total fuel consumption per voyage largely differs -> Why ?

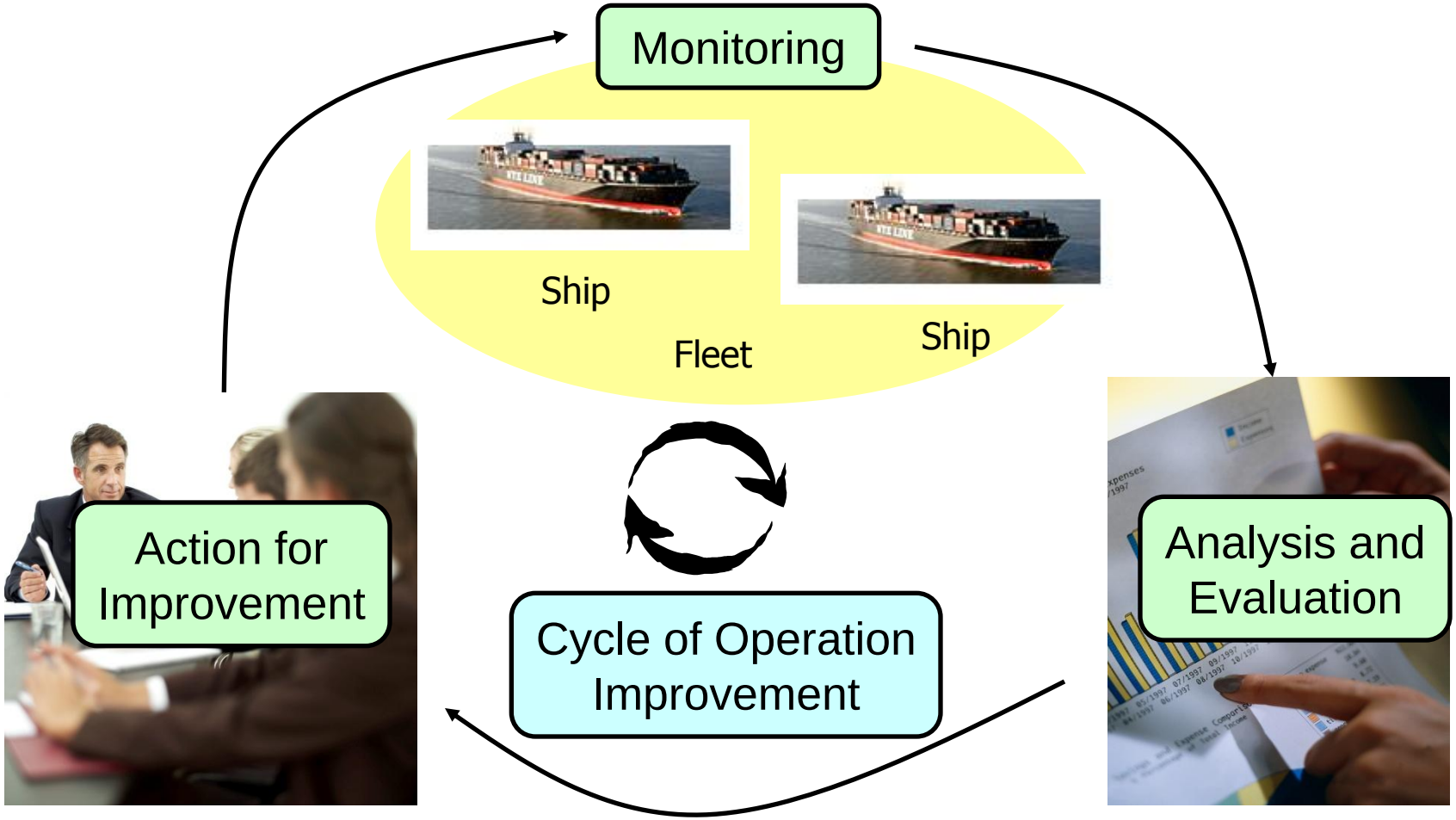
1-4. Base performance + additional factors

- Break down analysis is necessary to identify cause of fuel consumption



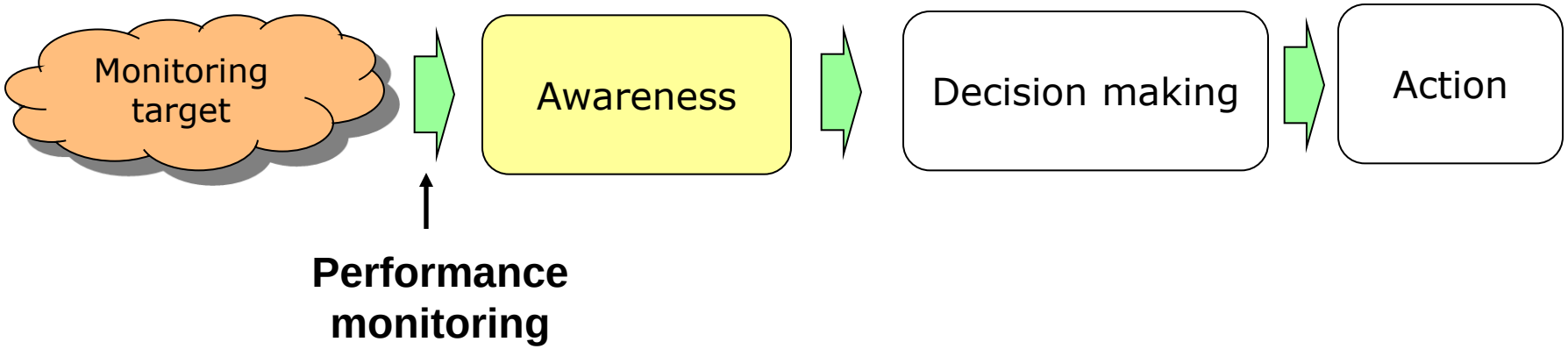
2. Performance monitoring and data collection

2-1. How can we improve operation ?



- **"Monitoring" is the key function**
  - **Basis of evaluation and action planning**

2-2. Performance monitoring for right awareness

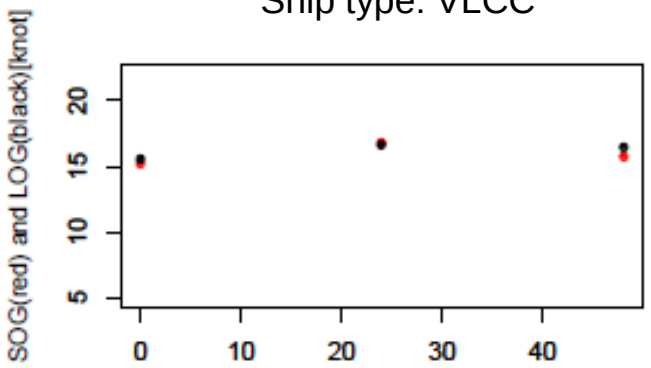


- If awareness is wrong, decision making and action will be wrong
- What is necessary for right awareness
  - **Provide correct and necessary information in right time**

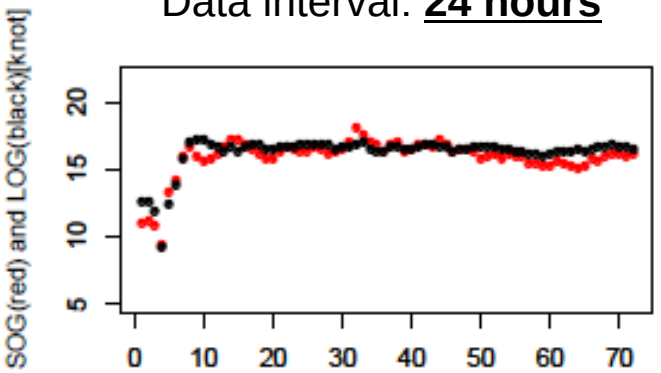
2-3 Monitor ship performance - Every 1 hour data is necessary for right awareness

- Existing data collection approaches
  - Manual reporting (every 24 hrs)
  - Automatic data collection (sampling can be every 1 sec)
- Every 1 hour data give detail information about performance
  - Speed increasing profile and effect of current can be seen in the 1 hour interval graph.
- Manual logging is inherently difficult for OG and wind.
  - Values of OG speed and wind are changing rapidly. Better to rely on computer power.

Data interval comparison
red: OG speed, **black**: log speed
Ship type: VLCC



Data interval: **24 hours**



Data interval: **1 hour**

2-4. Automatic data collection onboard

Flow meter

FUELNAVI

- Requirements
  - Interface to existing onboard equipment, such as engine D/L, ECDIS, VDR, flow meter and etc.
  - Automatic data processing and transferring to shore
  - Least additional load on crews
  - High reliability … 24 hrs, 365 days work
  - Lower cost of implementation
  - Flexibility of customization

3. Performance monitoring tool

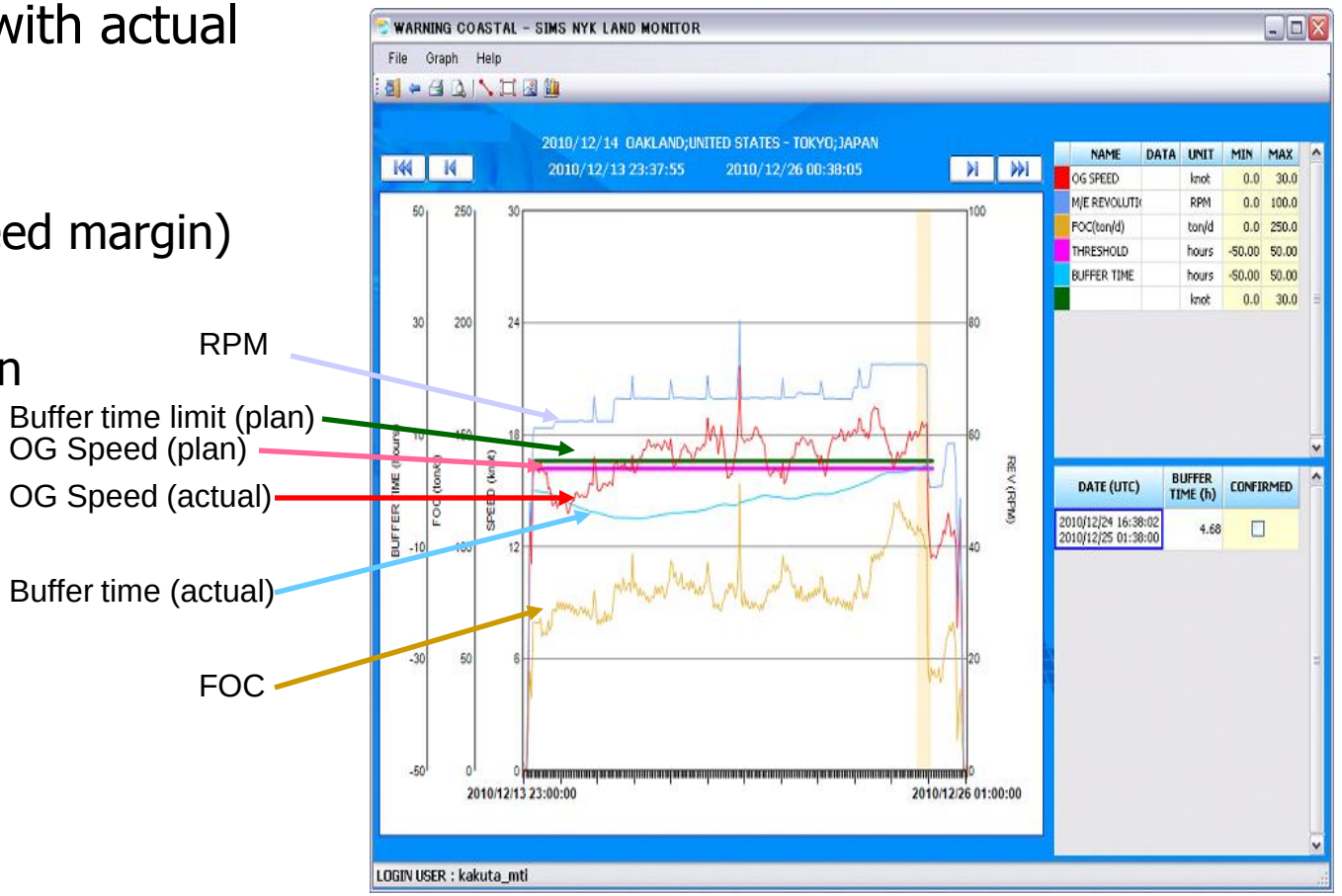
3-2. Onboard performance monitoring

- FUELNAVI
  - Real time performance indicator in bridge
  - Performance index
    - OG speed / fuel consumption [NM/MT]
    - Fuel consumption [MT/day]
  - Trip meter function for onboard performance trial
    - Energy efficiency evaluation

FUELNAVI

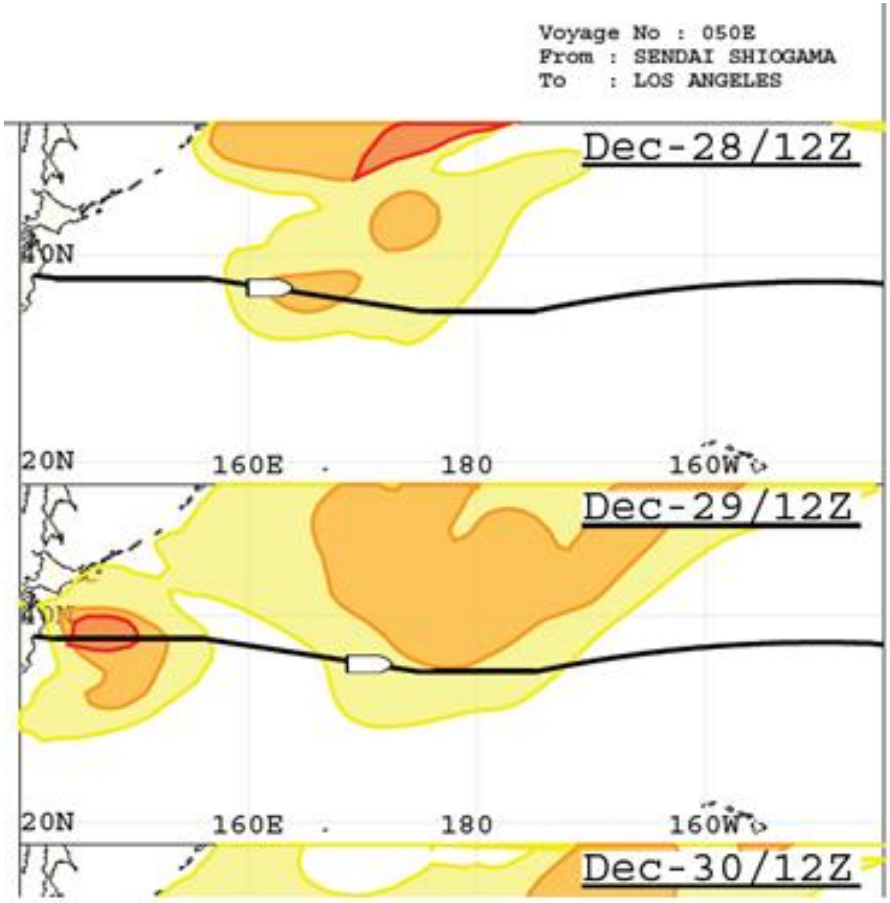
3-3. Performance monitoring at shore

- Comparison plan with actual
  - Speed
  - RPM
  - Buffer time (speed margin)
  - M/E load
  - fuel consumption



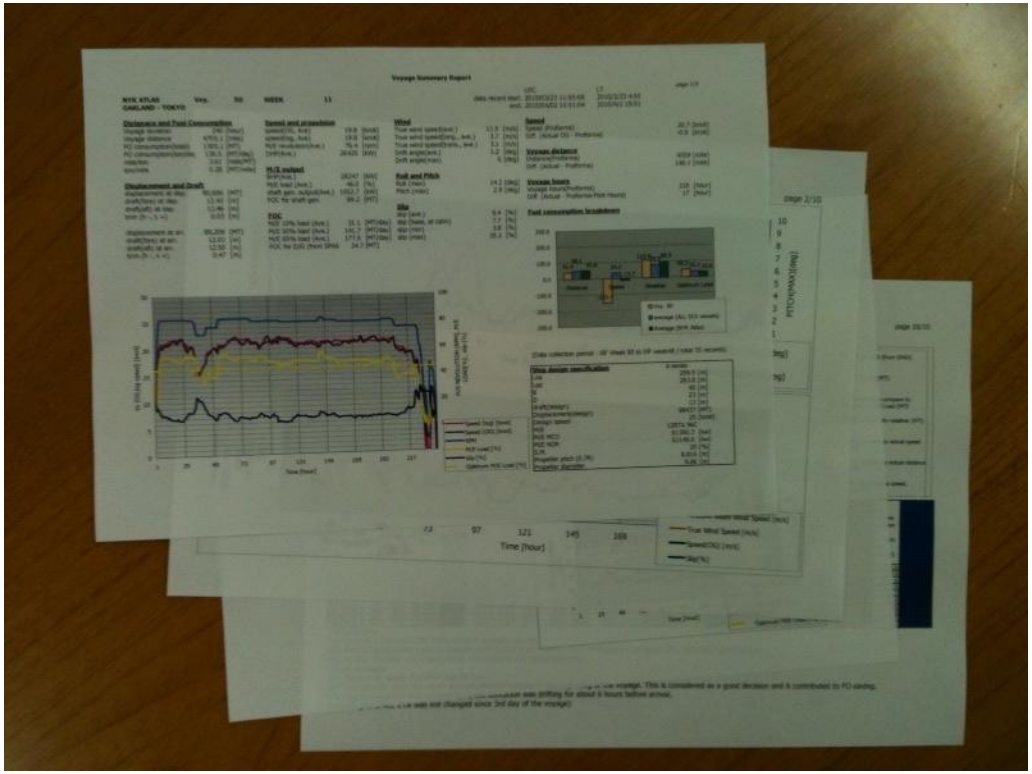
3-4. Performance monitoring by weather routing provider

- Monitoring data is also sent to weather routing provider
- Comparison between voyage plan and actual
  - Ship performance (rpm, speed, fuel consumption)
  - Weather condition (wind and ship motion)
- Corrective action
  - Update voyage recommendation



(part of voyage plan sheet)

3-5. Performance analysis report



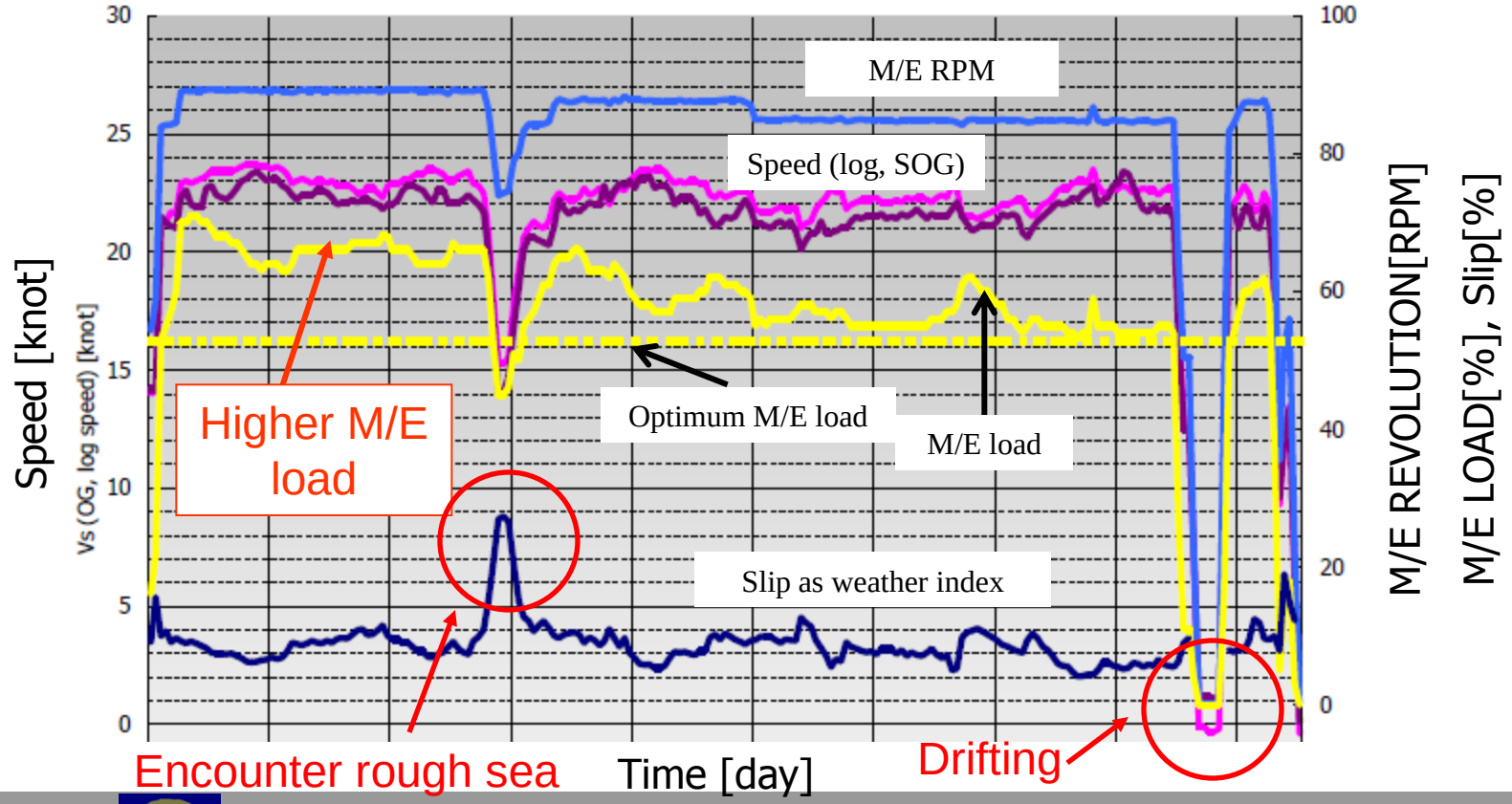
- Help action planning for operation improvement and information sharing between operators and vessels

- Consists of 10 pages
  - Summary of voyage data
  - Analysis of FOC increase causes
  - Comparison with the other vessel record
  - Evaluation of weather routeing
  - Advice for fuel saving

4. Performance analysis

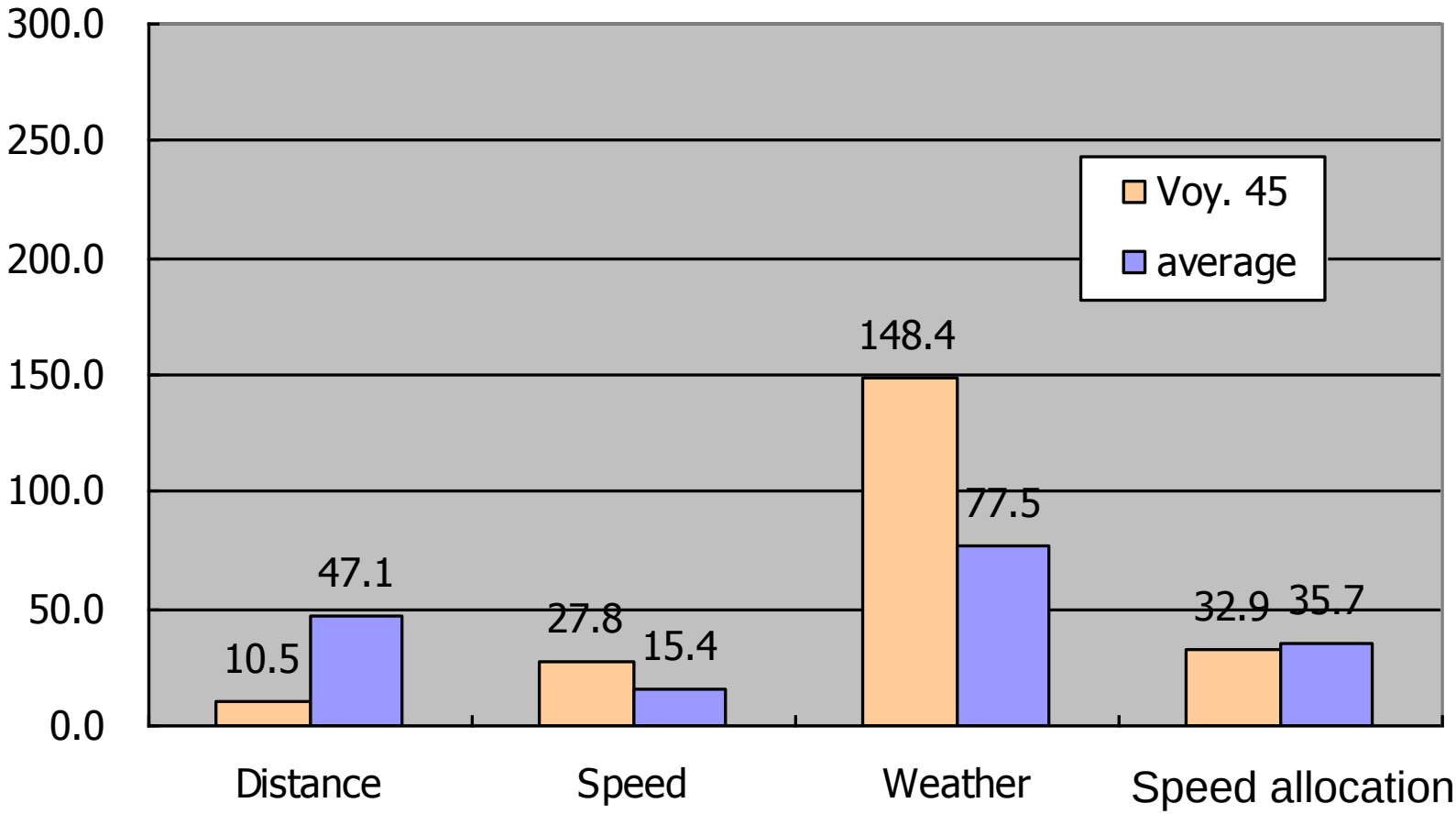
4-1. Voyage overview

- Overview how vessel operated from departure port to arrival port



4-3. Quantify and evaluate FOC increase factors

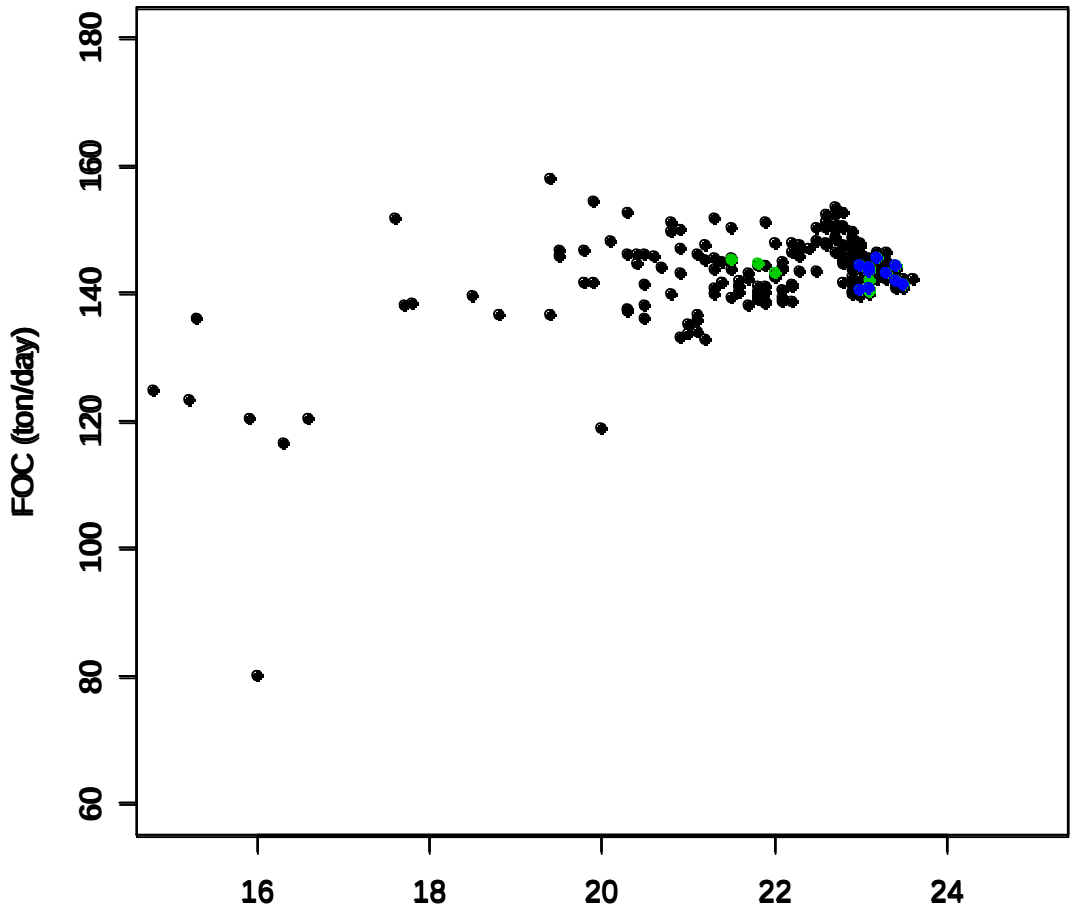
- Compare each FOC increase factors with past record



4-4. Identify base performance from collected data

Oakland to Tokyo 10 days leg

Data interval : 1 hour (about 240 data)

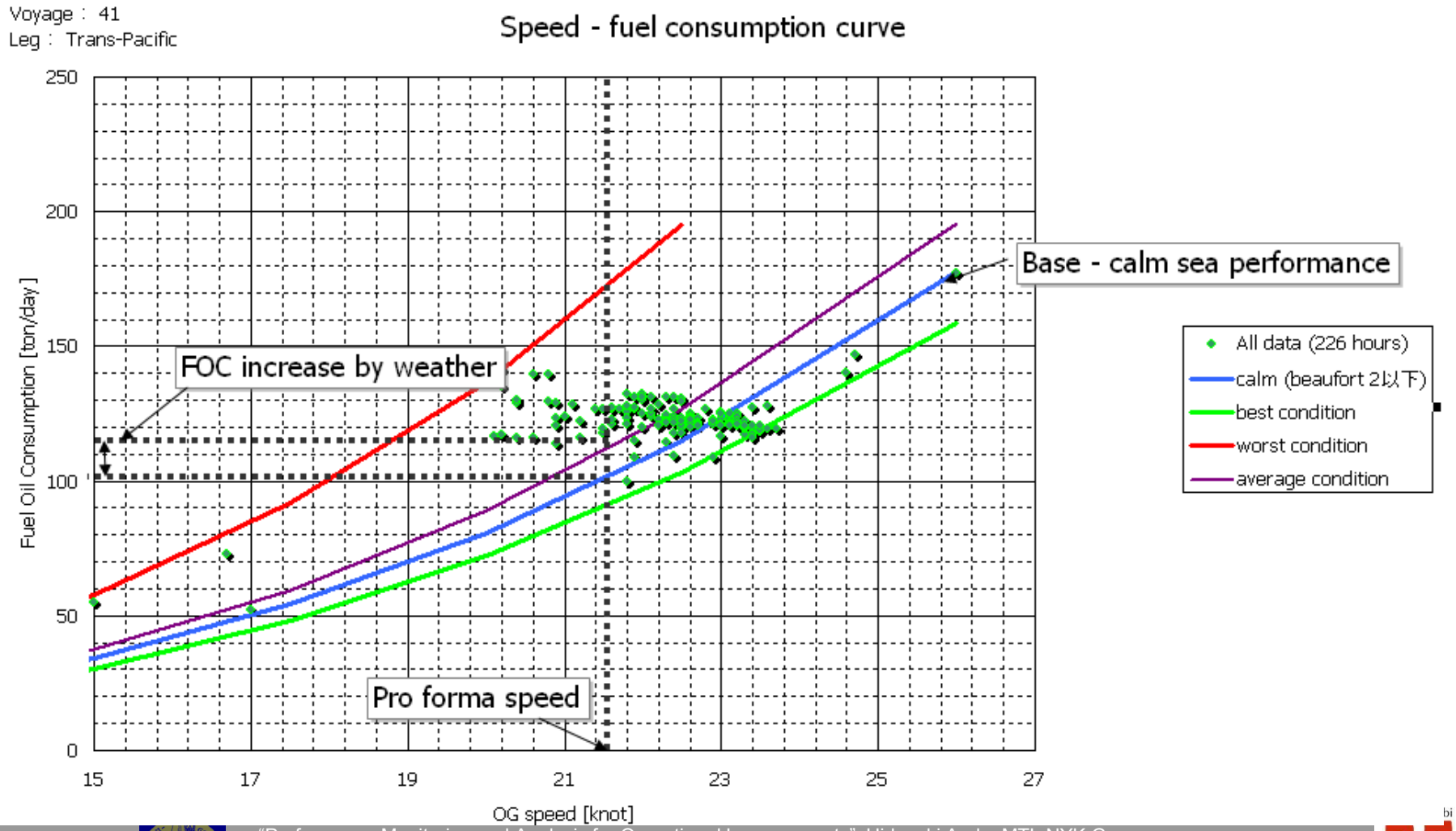


All data

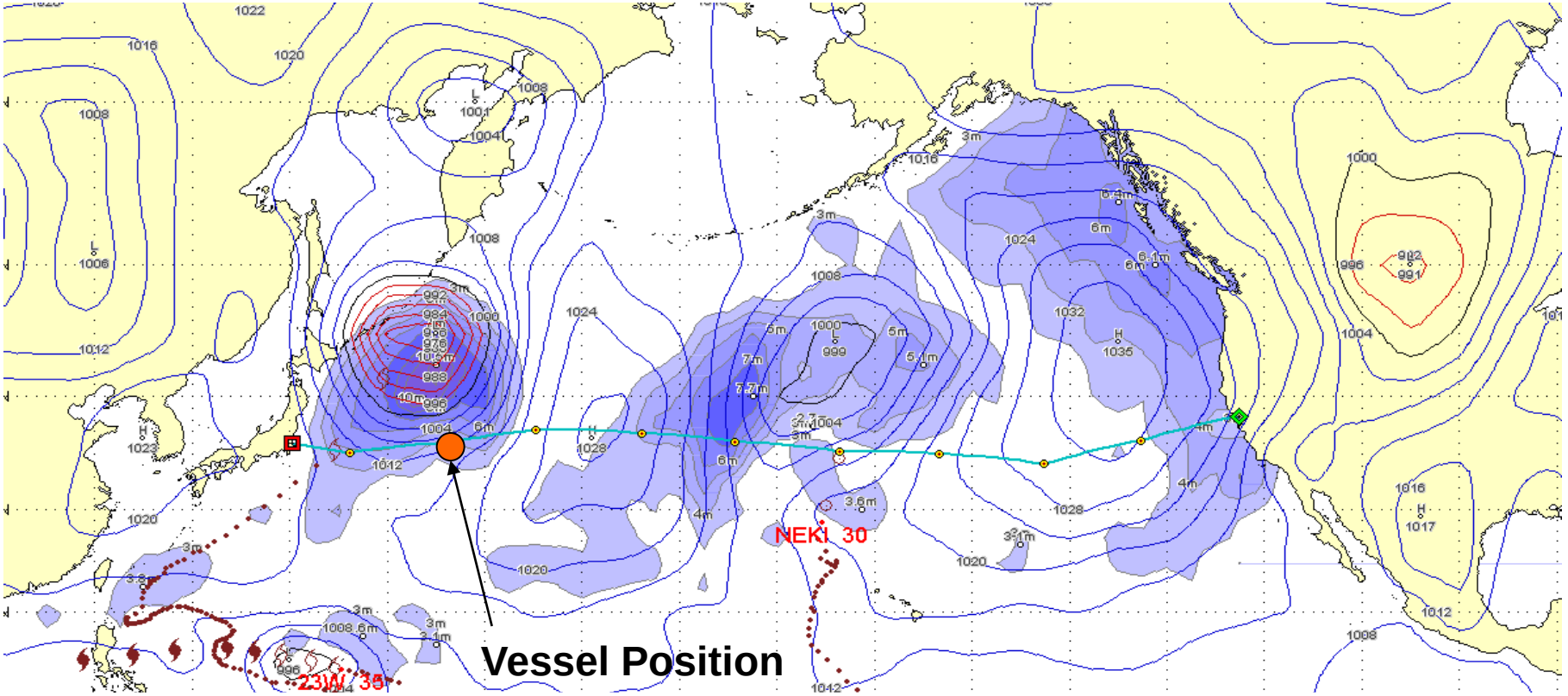
Less than Beaufort 2

Less than 2°pitch

4-5. Identify FOC increase by weather



4-7. Review of weather routing



- Longer voyage distance causes large FOC increase
  - Requires speed up to keep schedule
- Review of weather routing and discussion with its provider

4-8. Coaching comments for corrective action planning

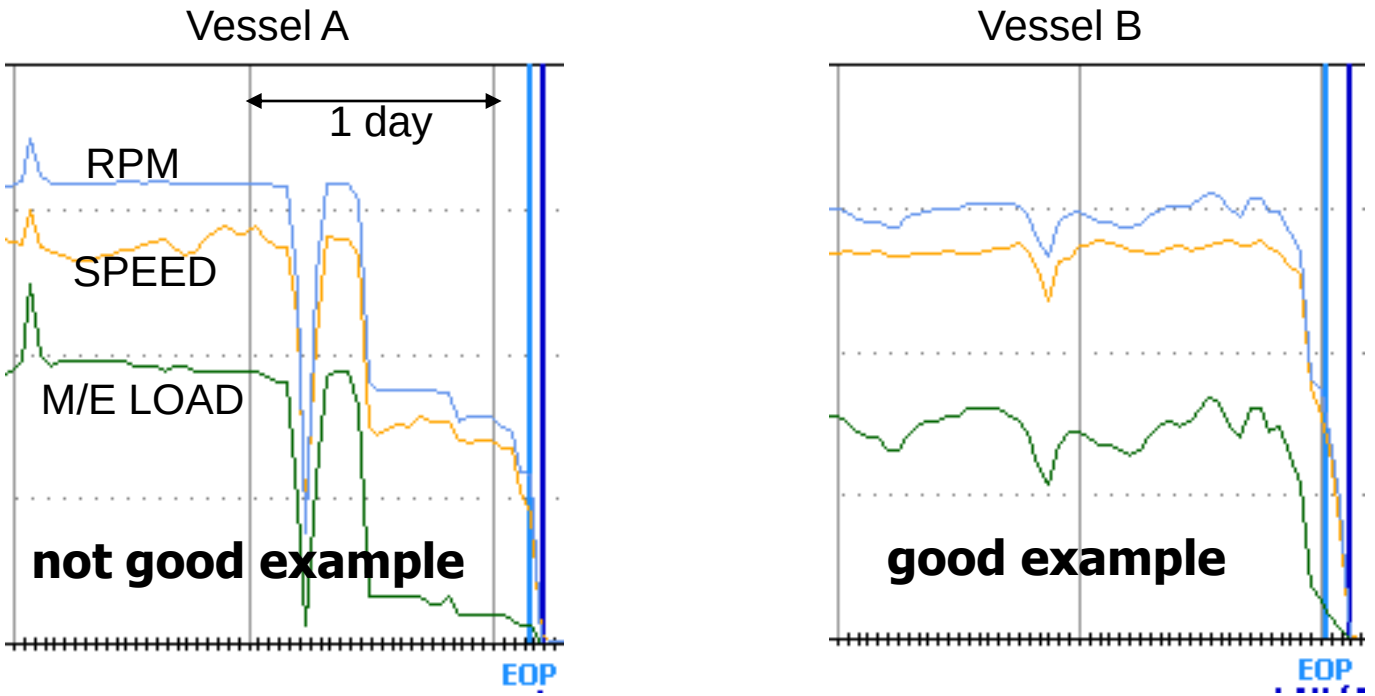
- Coaching comments for fuel saving are attached
- It helps understanding data and supports corrective actions of parties who concern

Example

- *Total FOC was 950 tons, which is the second largest value among past records.*
- *The main cause of FOC increase is 500 miles longer distance than plan, which caused 80 tons FOC increase.*
- *But FOC was saved 100 tons by reducing speed, schedule changed in advance.*

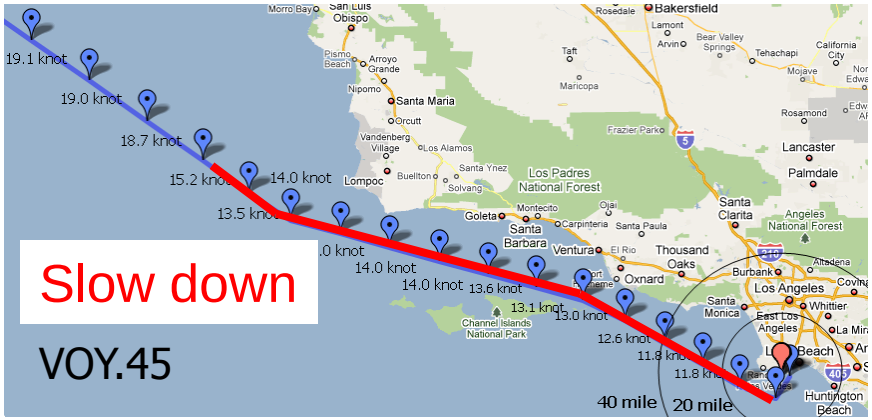
5. Examples

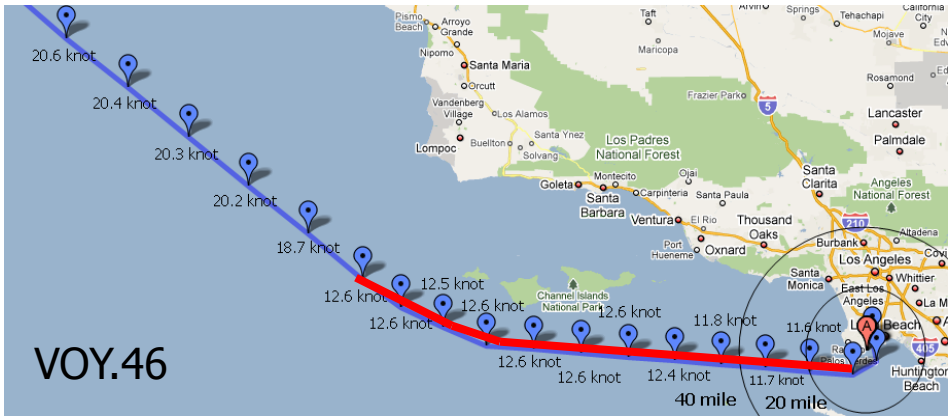
5-1. Share good practice

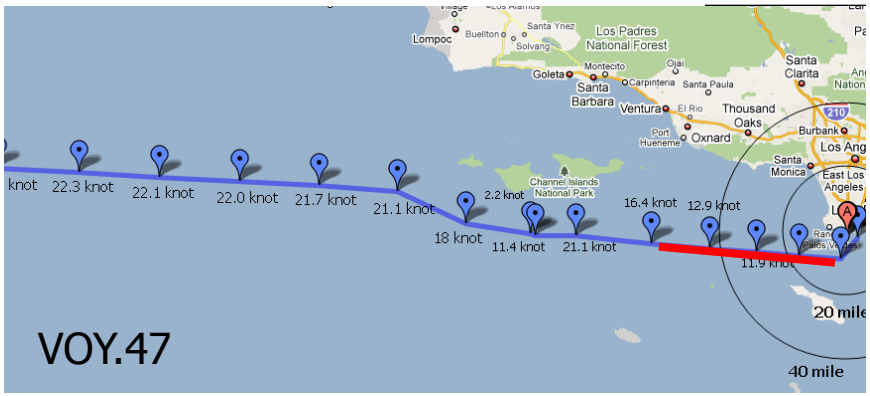


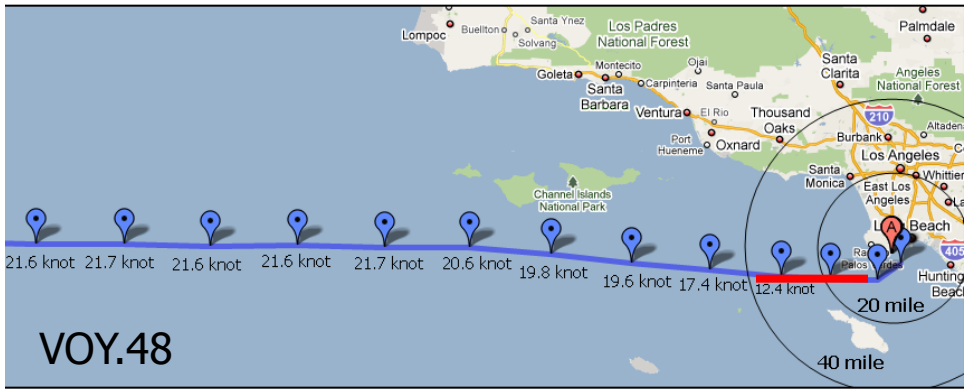
- Share good practice between operators and vessels
  - Keep averaged engine load until end of voyage

5-2. Example of operation improvement (1)



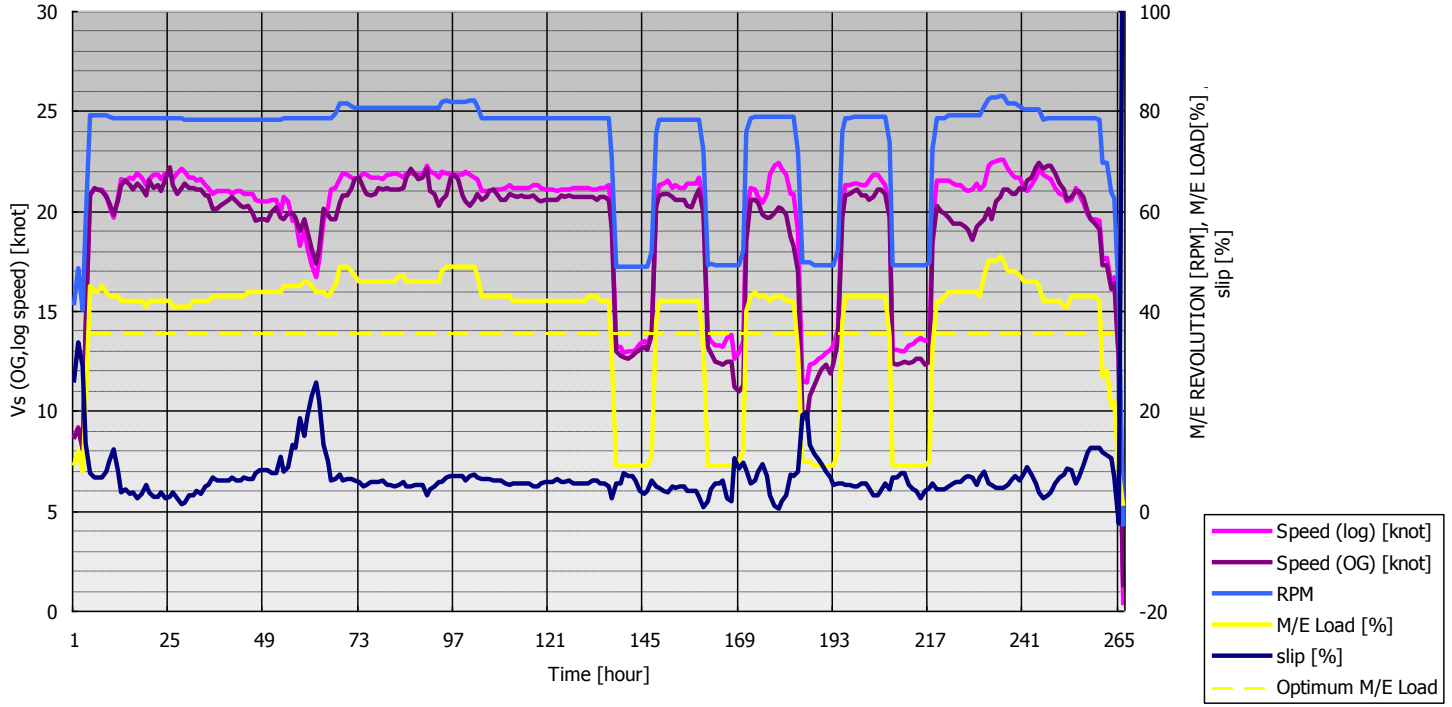






- There is 12 knot speed restriction area within 40 miles from a port
- Slow down too early timing was observed
- Approach to port was advised to captain and improved in the following voyage

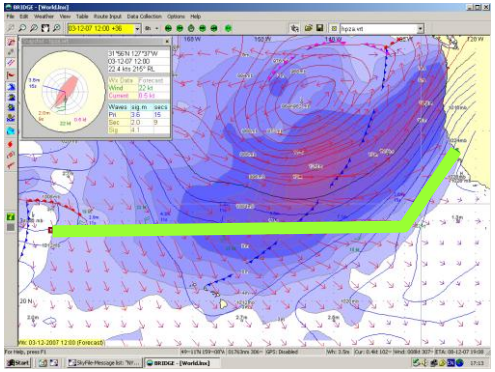
5-3. Example of operation improvement (2)



- After T/C cut, the M/E can be continuously operated under 50%
- However, there was a case that a C/E was still combining 10% low load and higher M/E load to operate shaft generator instead of diesel generator.
- This operation was less energy efficient in terms of total optimization and operation rule was changed after discussion.

6. Concluding remarks

Another reason for automatic data collection - Feedback to Weather Routing Provider



Weather Routing (PLAN)

Monitoring (CHECK)

- Voyage plan
  + course, speed, rpm, FOC, weather
  + ship performance model

Feedback

- Voyage actual
  + actual speed – rpm
  + actual weather

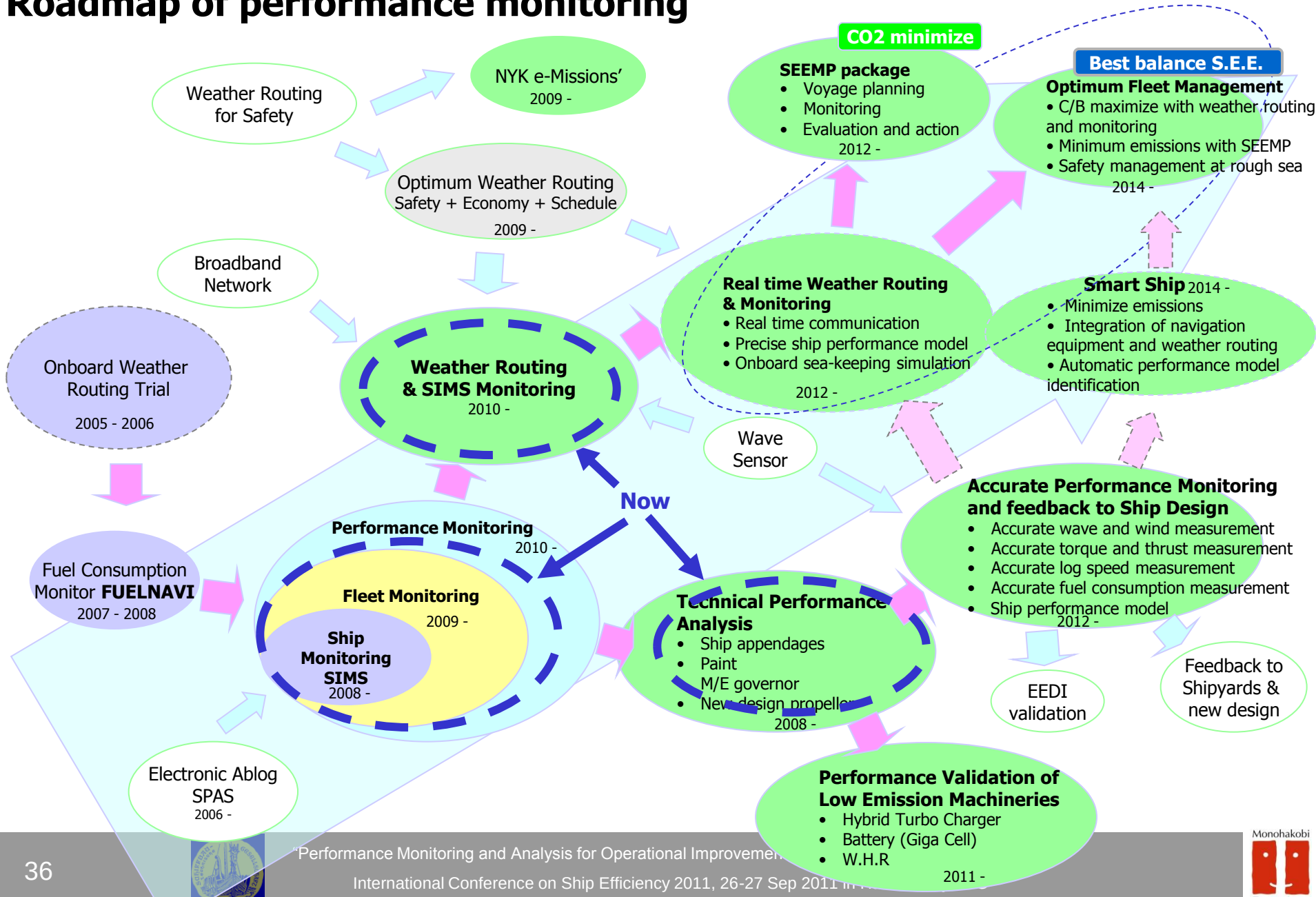
Ship model and weather forecast are inherently include errors.

But feedback loop by monitoring can make this system work.

Concluding remarks

- For further improvement of ship energy efficiency in operation, detail information by using automatic data collection and analysis are necessary
- There are several feedback loops for operation performance improvement. Providing right awareness to them is necessary.
- Especially the combination between weather routing and performance monitoring is important and it is our next things to do
- It is organizational improvement process for energy efficient fleet operation. This direction will be in line with coming SEEMP

Roadmap of performance monitoring



Thank you very much for your attention