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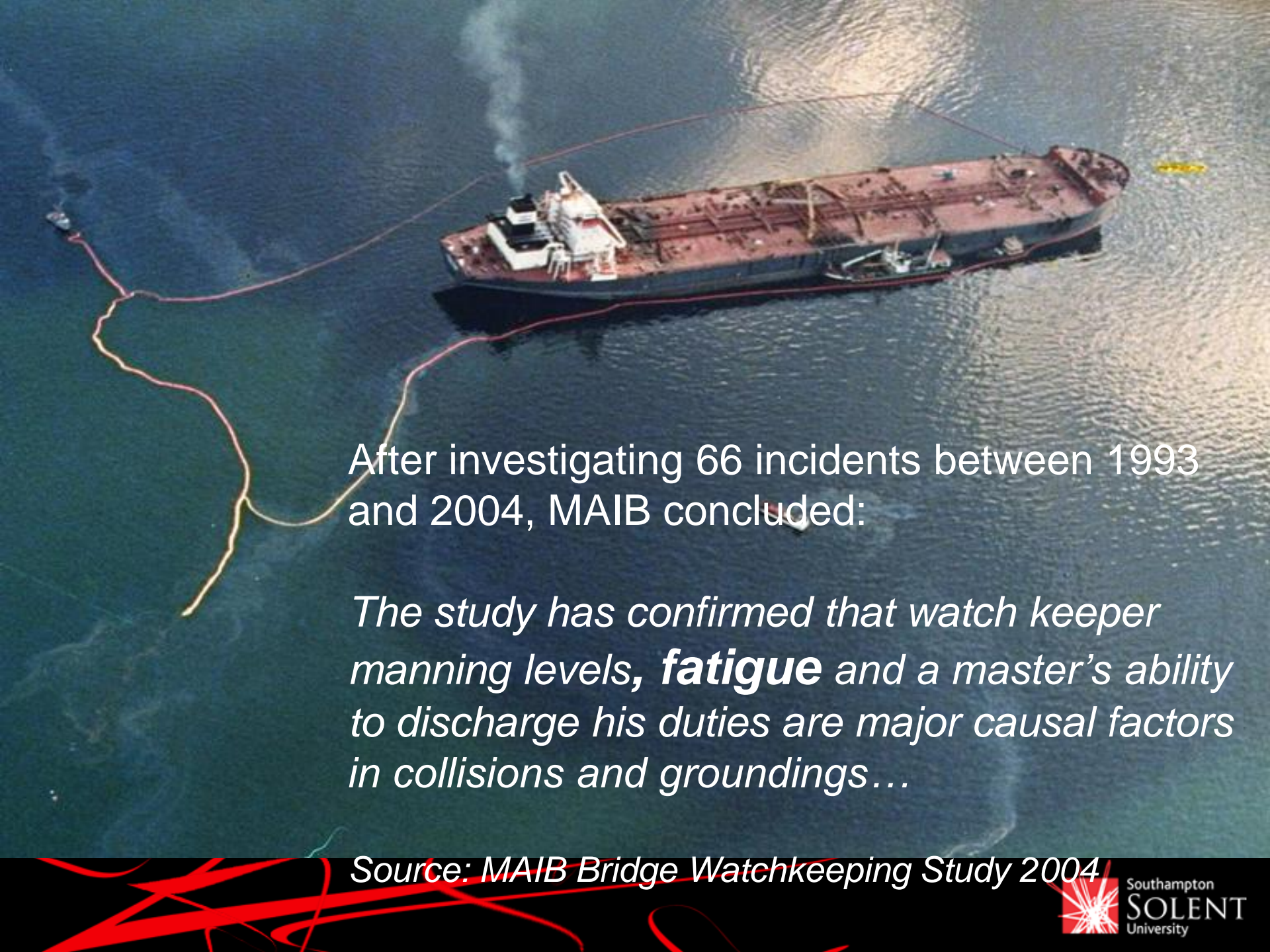
WARSASH  
MARITIME ACADEMY

# The Effects of Fatigue on Seafarers

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# Summary of key points

- **Fatigue as a causal factor in marine casualties**
- **The effects of fatigue**
- **How do we measure fatigue?**
- **Project HORIZON**



After investigating 66 incidents between 1993 and 2004, MAIB concluded:

*The study has confirmed that watch keeper manning levels, **fatigue** and a master's ability to discharge his duties are major causal factors in collisions and groundings...*

Source: MAIB Bridge Watchkeeping Study 2004

# The Grounding of CITA off the Isles of Scilly on 26 March 1997



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Shortly after midnight, the Mate took over the bridge watch from the Master as CITA was approaching a course alteration position south of Lizard Point. On reaching it, course was altered to head for the southern end of the Land's End Traffic Separation Scheme.

Some time later the Mate fixed the vessel's position and found he was about a mile to the north of the intended track, so he adjusted the course to port by a few degrees and returned to his seat to resume his watch.

Soon afterwards he fell asleep. Two and a half hours later, and without anyone on board being aware of what was happening, CITA ran aground on rocks at 13 knots.

# The Grounding of *Antari*

Near Larne, Northern Ireland - 2008



# The Grounding of *Antari* Near Larne, Northern Ireland - 2008

At 0321 on 29 June 2008 the general cargo vessel *Antari* grounded on the coast of Northern Ireland.

The OOW had fallen asleep shortly after taking over the watch at midnight.

**With no-one awake on the bridge, the vessel continued on for over 3 hours, crossing the North Channel of the Irish Sea before grounding on a beach about 7 miles north of Larne.**

# Symptoms of Fatigue

- Impaired performance
- Impaired cognition: (Situational Awareness)
- Loss of concentration
- Ill health
- Psycho-social issues

Reference: Reference: Smith, A., P. Allen & E. Wadsworth, 2006. *Seafarer Fatigue: The Cardiff Research Programme*. [online]. Available: [http://www.mcga.gov.uk/c4mca/research\\_report\\_464.pdf](http://www.mcga.gov.uk/c4mca/research_report_464.pdf)

# The Research Evidence

- There is extensive evidence from both laboratory and field studies showing that acute fatigue is associated with impaired performance and compromised safety.
- Three key trends which have emerged from research into shift schedules and safety:
  - 1) risk of an accident is higher when working at night (and to a lesser extent when working in the afternoon) compared to the morning.
  - 2) risk of an accident increases over a series of shifts, again especially at night.
  - 3) risk of an accident increases as total shift length increases over 8 hours (in any 24 hour period).

Source: Folkard, S., Lombardi, D. A., & Tucker, P. T. (2005). Shiftwork: Safety, Sleepiness and Sleep. *Industrial health*, 43, 20-23.

# Negative combination of factors

- If an individual is sleep deprived then this fatigue will be amplified by other factors which also induce fatigue (e.g. doing a boring task or having to work at night).
- Depending on the task measured, 20 to 25 hours of wakefulness produces performance decrements equivalent to a BAC of 0.05 - 0.10% (Dawson)
- Fatigue can also lead to poorer social interaction with other workers which can extend to life outside work.
- **Reduced safety due to fatigue will increase the risk of accidents that may lead to loss of life, environmental damage and huge economic cost.**

# Measuring Sleepiness

- Diaries with subjective sleepiness scales
- Actigraph watches
- Psychomotor vigilance tests
- Electroencephalograms with electrodes (EEG)

# Measurement Diaries

Three typical types of diary:

1. **A Sleep diary**

Contains questions about the quality of the last period of sleep.

2. **A Work diary**

One page that is to be filled in fully after each watch and contains questions about sleepiness, stress and workload on the last watch.

3. **A Wake diary**

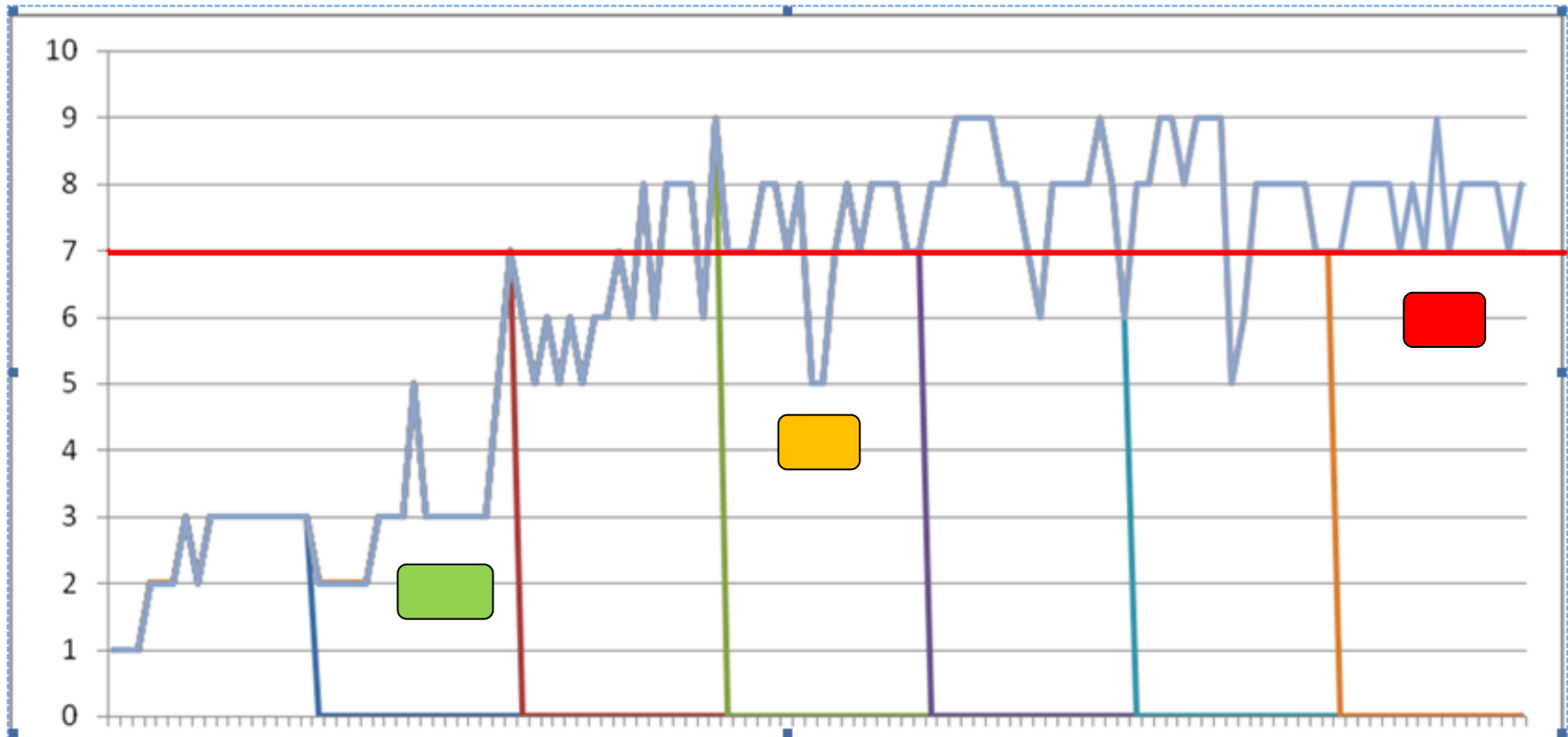
One page that is to be filled in fully off watch and contains questions about fatigue and health (wake diary).



# The KSS Scale - Karolinska Sleepiness Scale

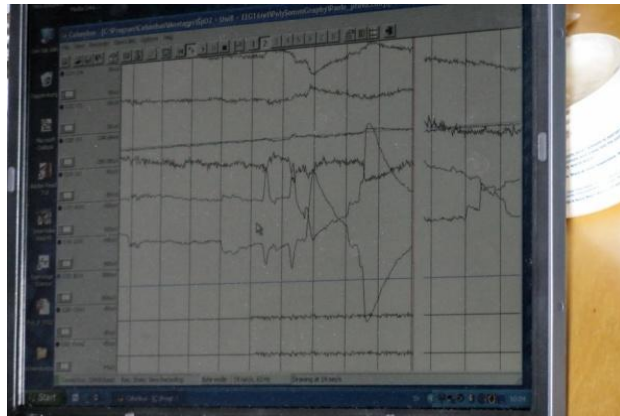
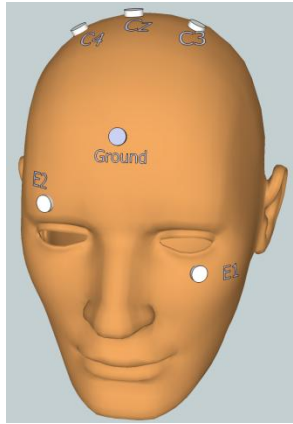
1. extremely alert
2. very alert
3. alert
4. quite alert
5. neither alert nor sleepy
6. some signs of sleepiness
7. sleepy, no effort to stay awake
8. sleepy, some effort to stay awake
9. very sleepy, great effort to keep awake, fighting sleep.

# Possible Levels of Sleepiness during a week of working 6on/6off

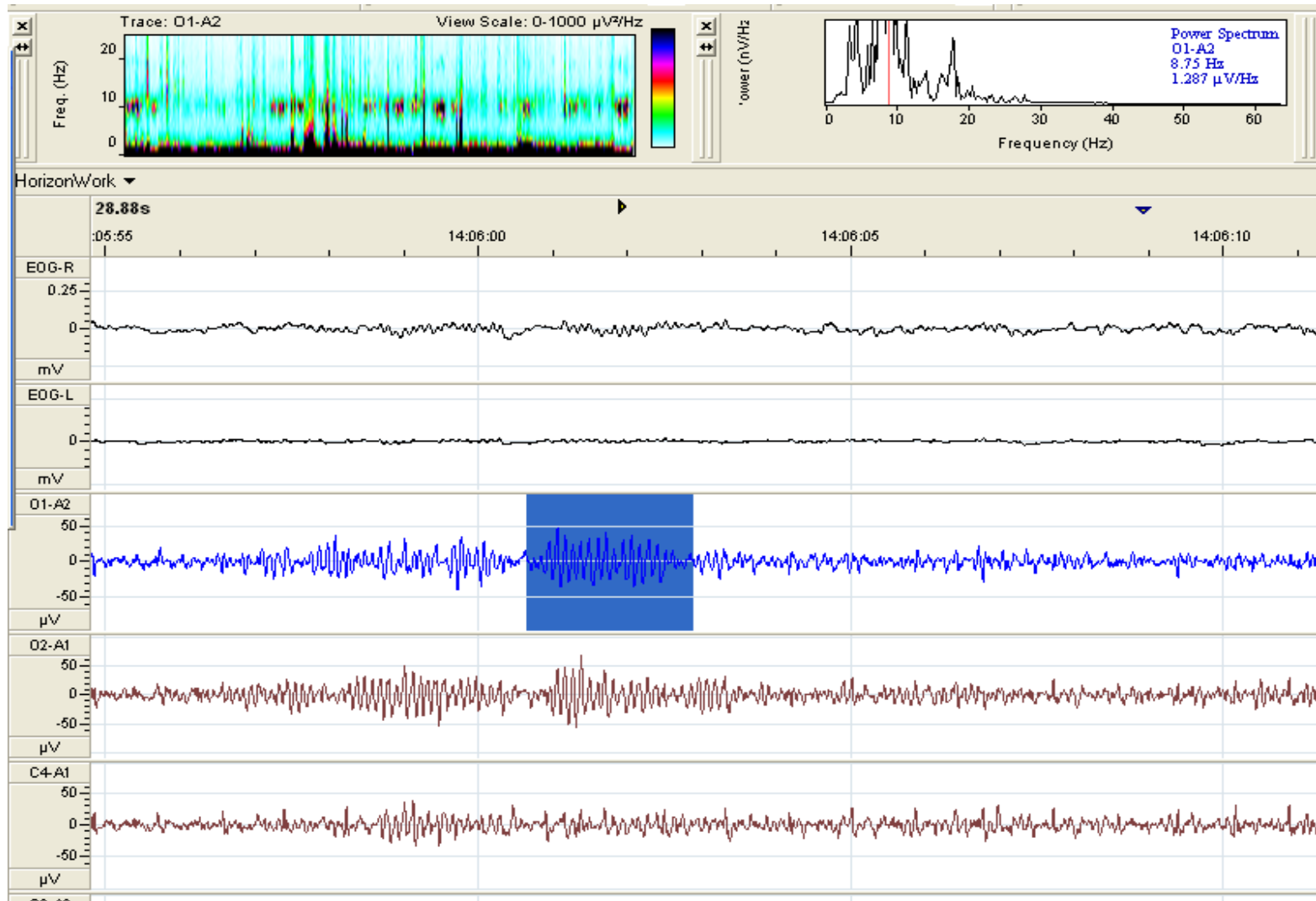


KSS Sunday Monday Tuesday Wednesday Thursday Friday Saturday

# The measurement of sleepiness through changes in brain activity(EEG)



# EEG File showing Microsleep





# Project Objectives

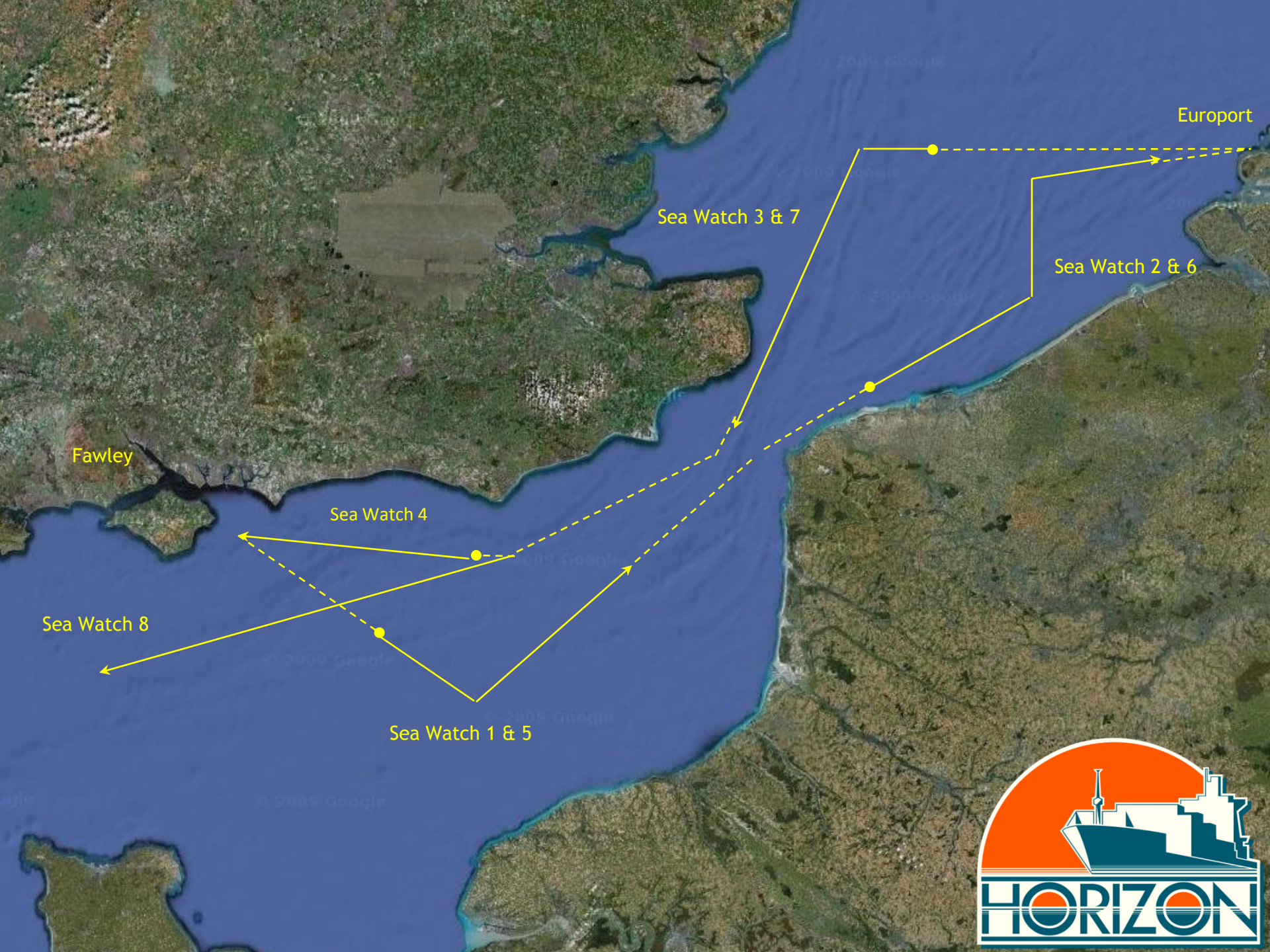
- To create sustained “voyages” using a range of simulators
- To test selected watch keeping patterns under the same “voyage” conditions
- To capture empirical data on fatigue levels of watch keepers
- To capture data on the cognitive performance of watch keepers to determine effects of fatigue
- To develop a fatigue management toolkit for industry
- To derive recommendations for industry



# Methodology

- Development of voyage scenarios:
  - Bridge, engine and cargo simulators are linked
  - 7 day voyage, with incidents replicated twice
  - Variable levels of workload
- Fatigue measurement by EEG, Actigraph, PVT tests, KSS scales and diaries
- Analysis provides data on alertness levels
- Performance observation provides dataset on cognitive performance





Fawley

Europort

Sea Watch 3 & 7

Sea Watch 2 & 6

Sea Watch 4

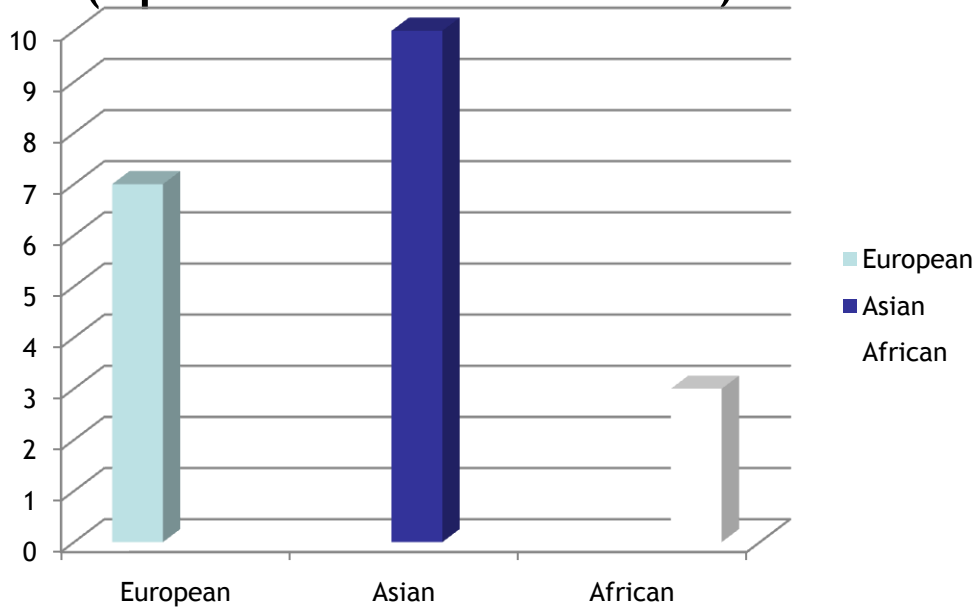
Sea Watch 8

Sea Watch 1 & 5



# The Participants

■ Deck officers and engineers  
(up to December 2010)



# Outcomes - Fatigue Management Tools

- **Predictive models of fatigue**
- **Improved watch scheduling**
- **Recommendations to industry**
- **Experimental methodology**



# Current Status of project

- Phase 1: Design of Experiment Protocol completed in December 2009
- 4on/8off experiment runs with 30 participants and 6on/6off with 20 deck officers completed at Chalmers in August 2010
- 6on/6off experiment runs at Warsash commenced: 40 deck and engineer officers by April 2011
- Final results and analysis by December 2011



# Thank You

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