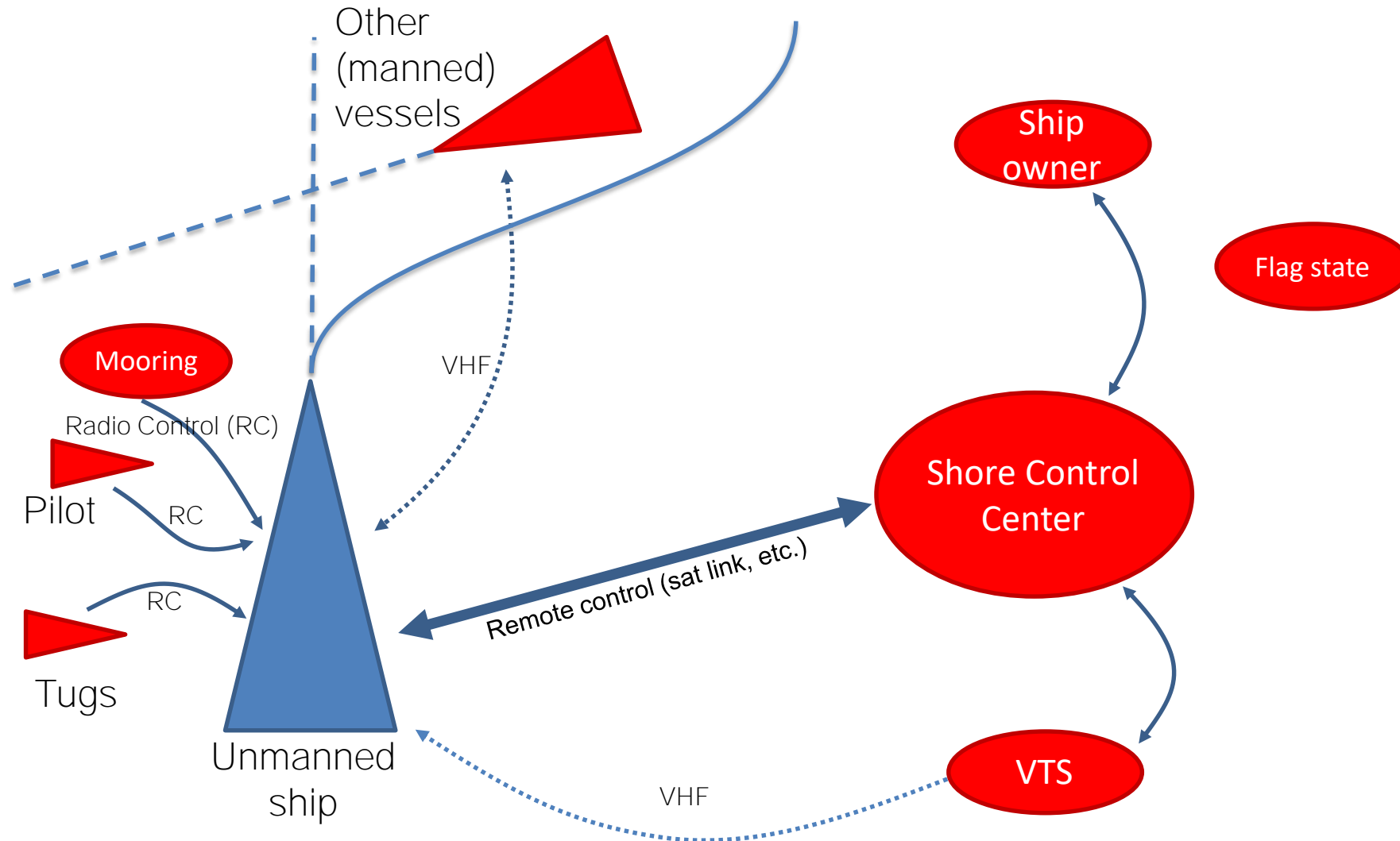


Navigational safety for small manned non-SOLAS vessels in an autonomous context



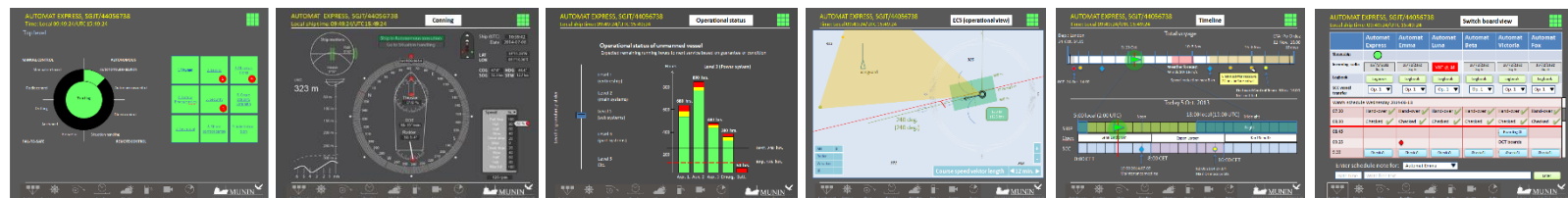
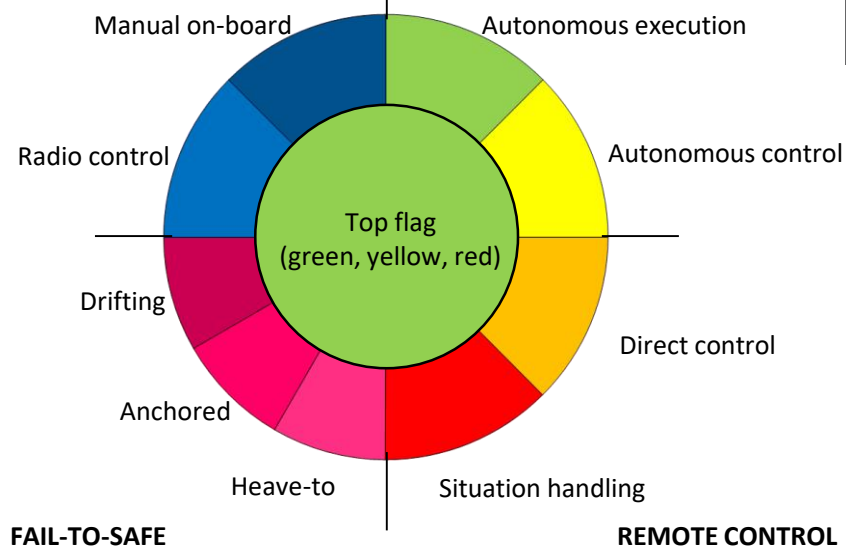
Thomas Porathe
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Norwegian University of Science and
Technology
Trondheim, Norway

Humans in the unmanned ship system



MANUAL CONTROL

AUTONOMOUS



Complete HMI for a
Shore Control Centre
for autonomous ships

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NTNU's autonomous passenger ferry project in Trondheim harbour



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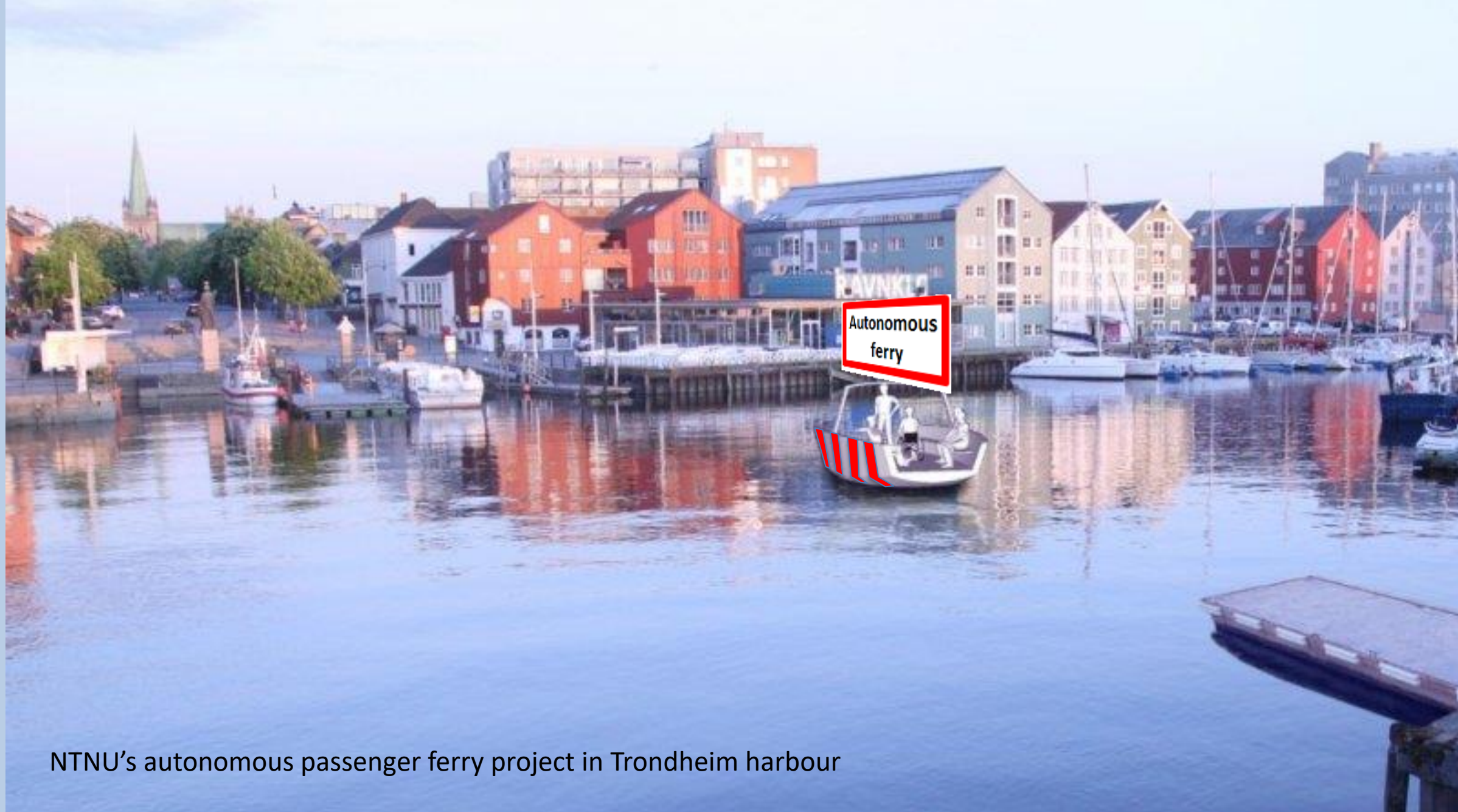
NTNU's autonomous passenger ferry project in Trondheim harbour



NTNU's autonomous passenger ferry project in Trondheim harbour



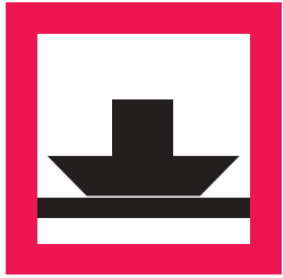
NTNU's autonomous passenger ferry project in Trondheim harbour



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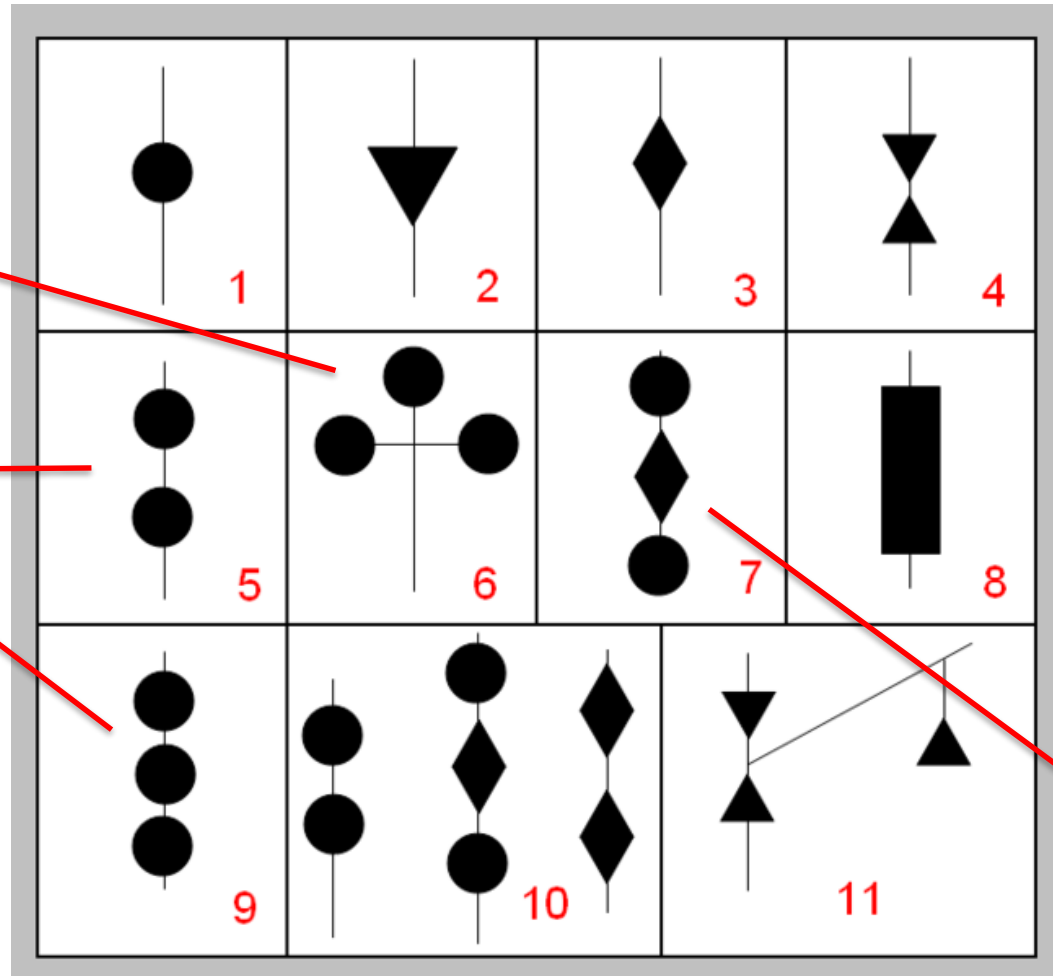
NTNU's autonomous passenger ferry project in Trondheim harbour



Linfärja

Not under command

Vessel constrained by draught



Vessel working in chains (for example, Raymond Island Ferry)

Vessel shows an all-round red light at each end and an all-round green light above the red light at the forward end to indicate the direction in which the vessel is proceeding.



Vessels operating in the vicinity of the Paynesville/Raymond Island vehicular ferry must proceed with caution and keep clear of the ferry.

COLREG (Rule 23)

A hovercraft must display an all-round flashing yellow light

A wing-in-ground craft must also display a bright all-round flashing red light when taking off, landing, or flying near the surface

Restricted in ability to maneuver

Human-autonomous ship interaction: Research agenda

- Marking: Colour, signage (day and night time)

Human-autonomous ship interaction: Research agenda

- Marking: Colour, signage (day and night time)

Is it even important?

Anthropomorphism

is the attribution of human traits, emotions, and intentions to non-human entities and is considered to be an innate tendency of human psychology.

Hutson, Matthew (2012). *The 7 Laws of Magical Thinking: How Irrational Beliefs Keep Us Happy, Healthy, and Sane*. New York, NY: Hudson Street Press. pp. 165–18

Anthropomorphism

is the attribution of [human](#) traits, [emotions](#), and [intentions](#) to non-human entities and is considered to be an innate tendency of [human psychology](#).

Sense making

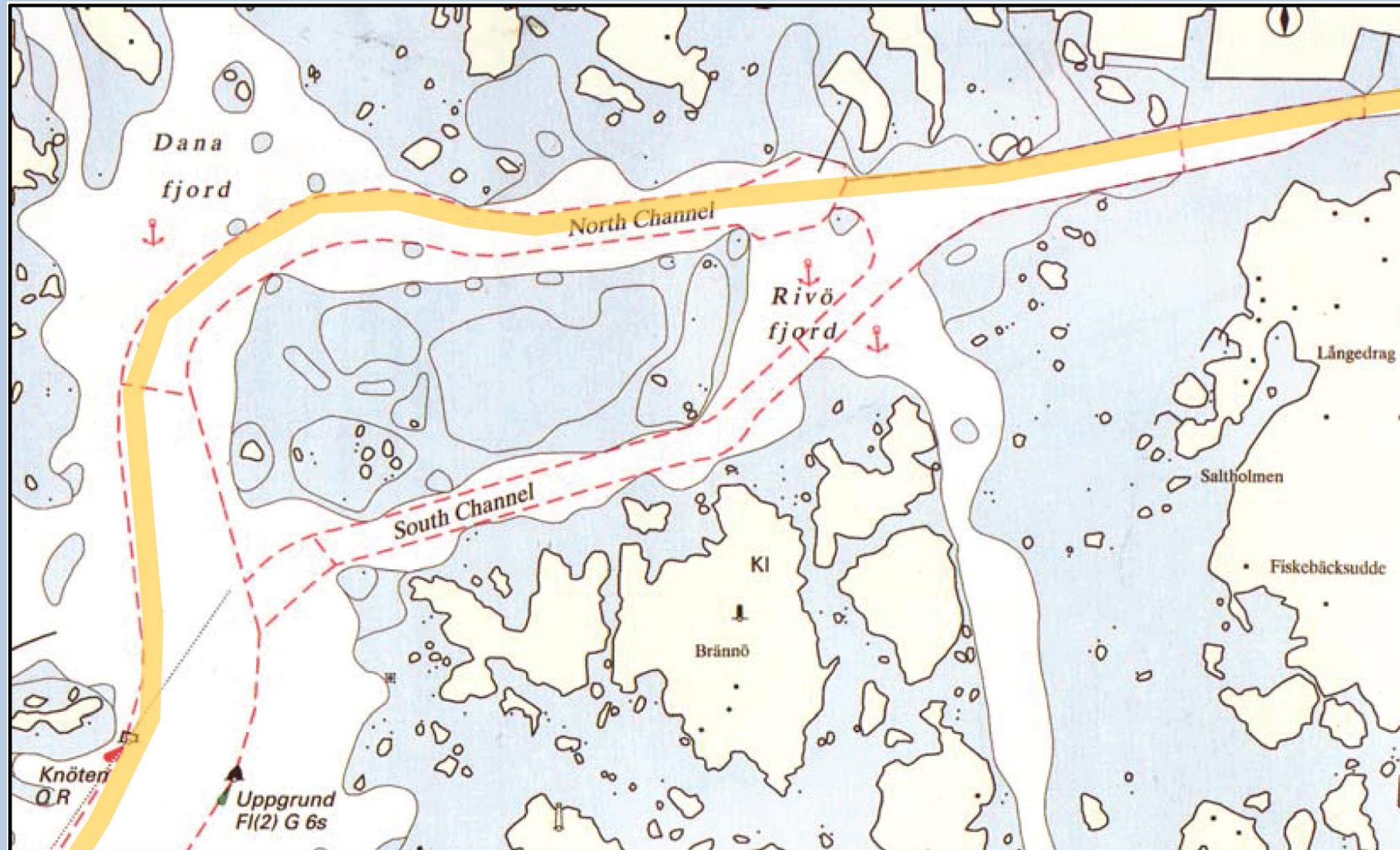
Hutson, Matthew (2012). *The 7 Laws of Magical Thinking: How Irrational Beliefs Keep Us Happy, Healthy, and Sane*. New York, NY: Hudson Street Press. pp. 165–18

Human-autonomous ship interaction:

Research agenda

- Marking: Colour, signage (day and night time)
- Where do autonomous ships appear? (Can I avoid them?)

Designated autonomous ship lanes?





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Understanding intentions



A small eastbound craft (in the red circle) would need to know the intentions of the autonomous unmanned westbound vessel A: will it continued straight, or turn port for the South Channel?

Human-autonomous ship interaction:

Research agenda

- Colour, signage (day and night time)
- Where do autonomous ships appear? (Can I avoid them?)
- How do I know the intentions of the autonomous ship?



Intentions and SOLAS ships

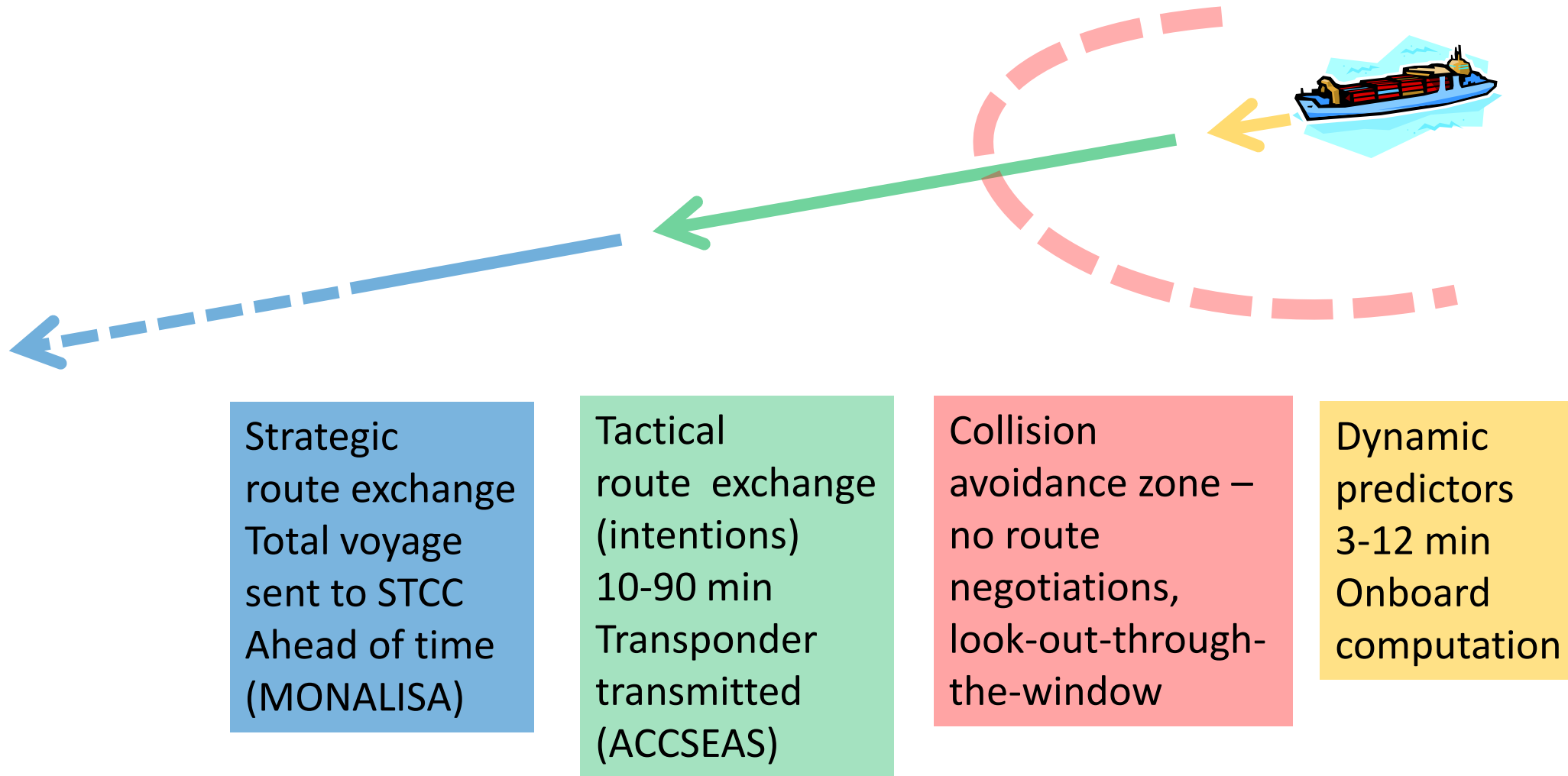
Route coordination/exchange

EU projects EfficienSea 1+2, MONALISA 1+2 , ACCSEAS, STM, SESAME Strait. New standard (RTZ: **IEC 61174**)

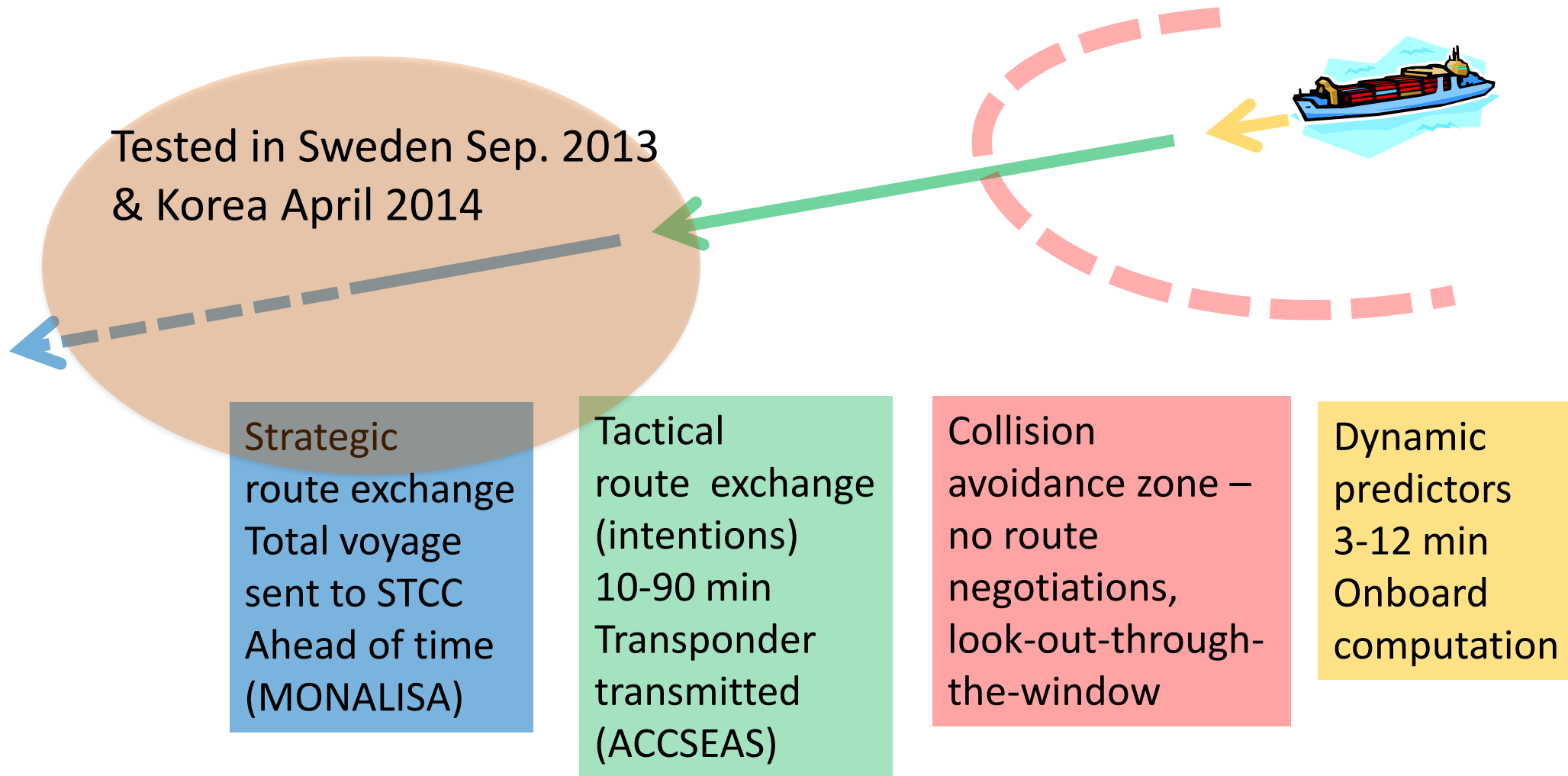
Route intentions

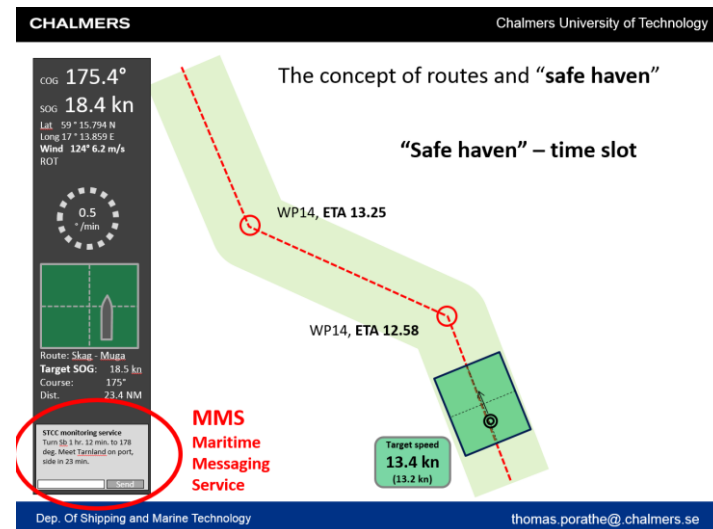
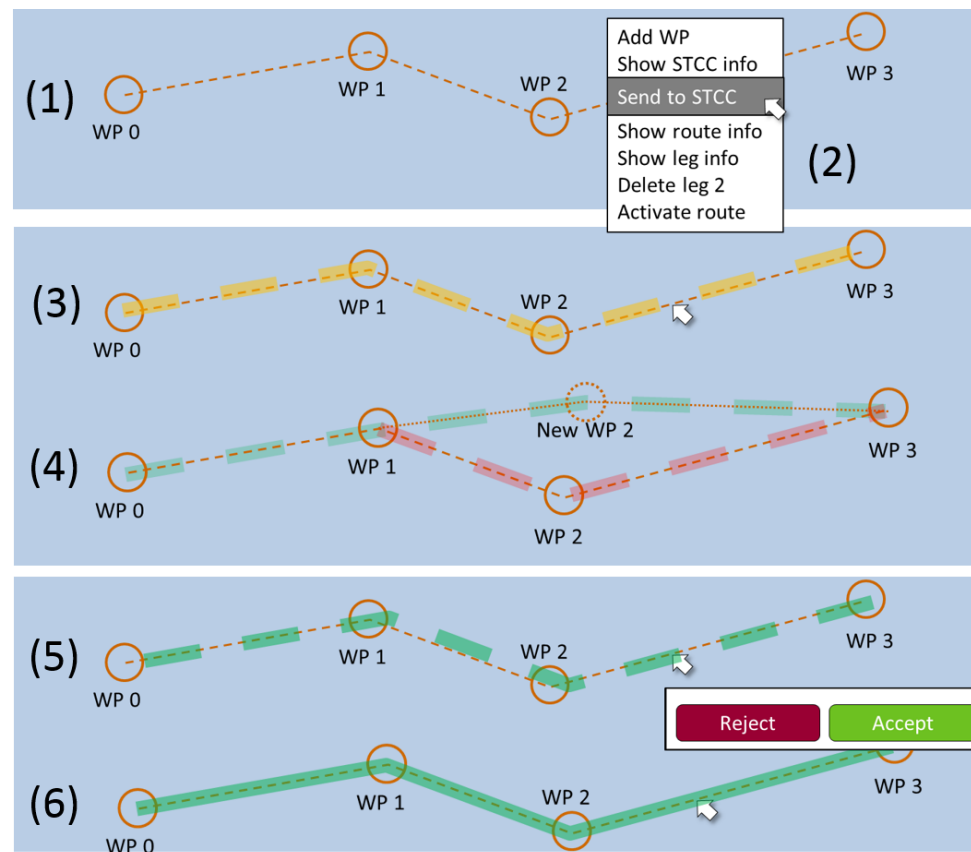
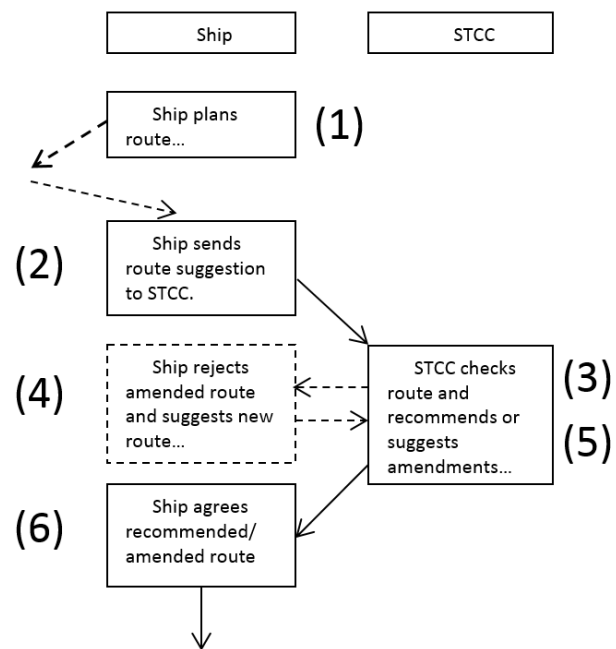
EU projects: ACCSEAS

Route exchange taxonomy

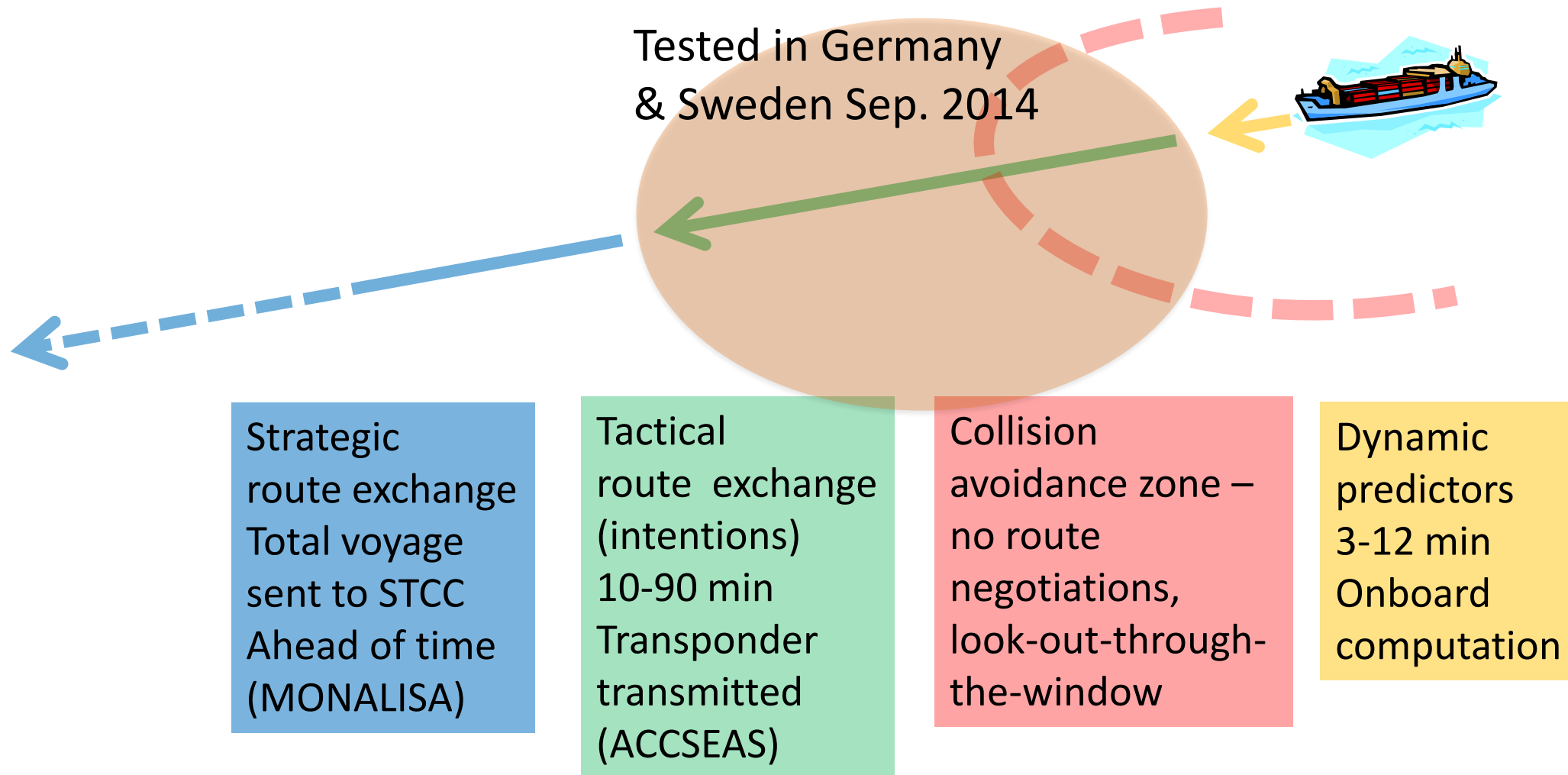


Route exchange taxonomy





Route exchange taxonomy



ACCSEAS project 2014

Simulations using the EPD (e-Navigation Prototype Display) Humber Estuary





Margriet



Orakai

**Collision between MV *Orakai* and FV *Margriet*
North Hinder Junction, North Sea, 21 December 2014**

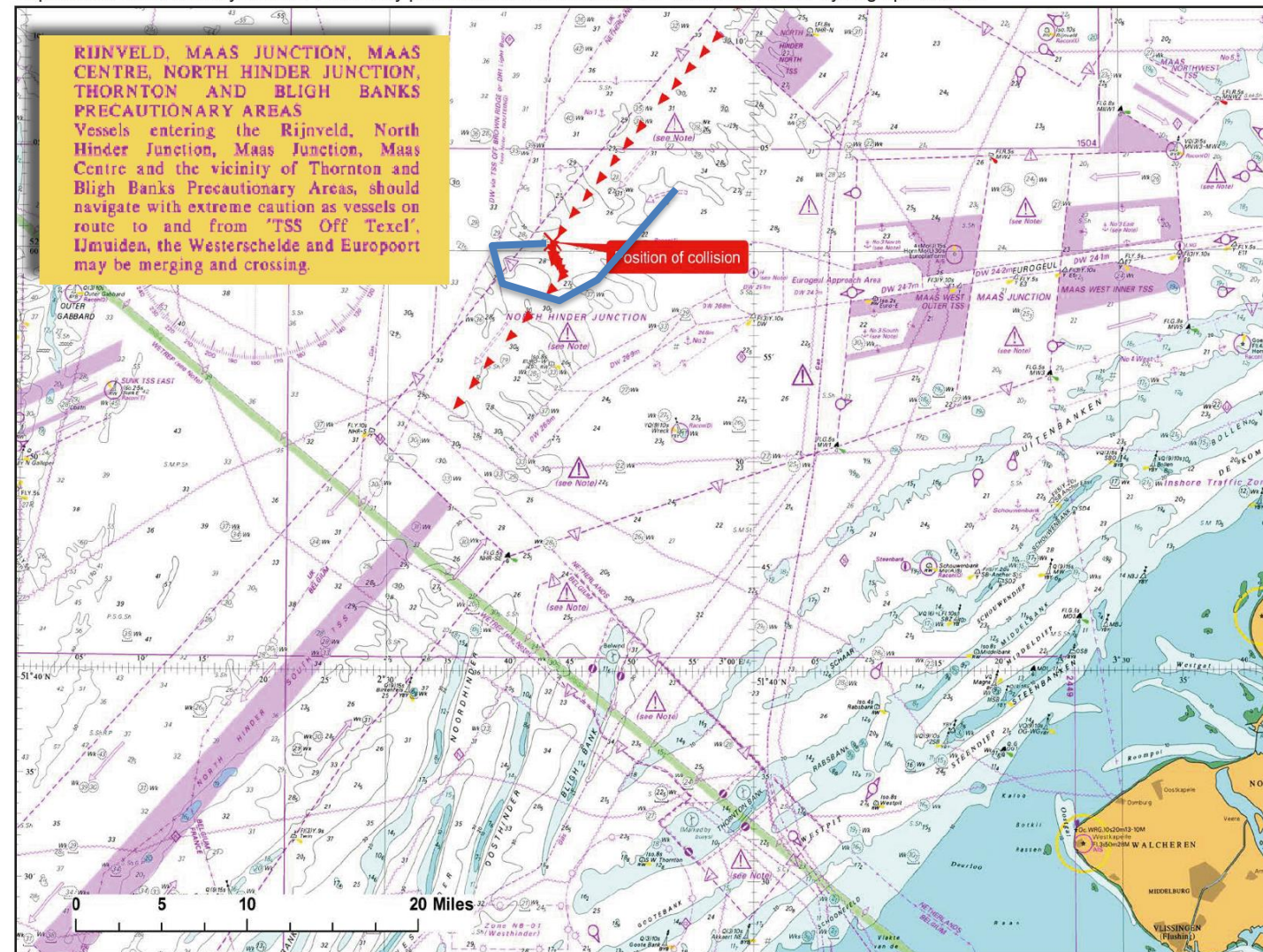
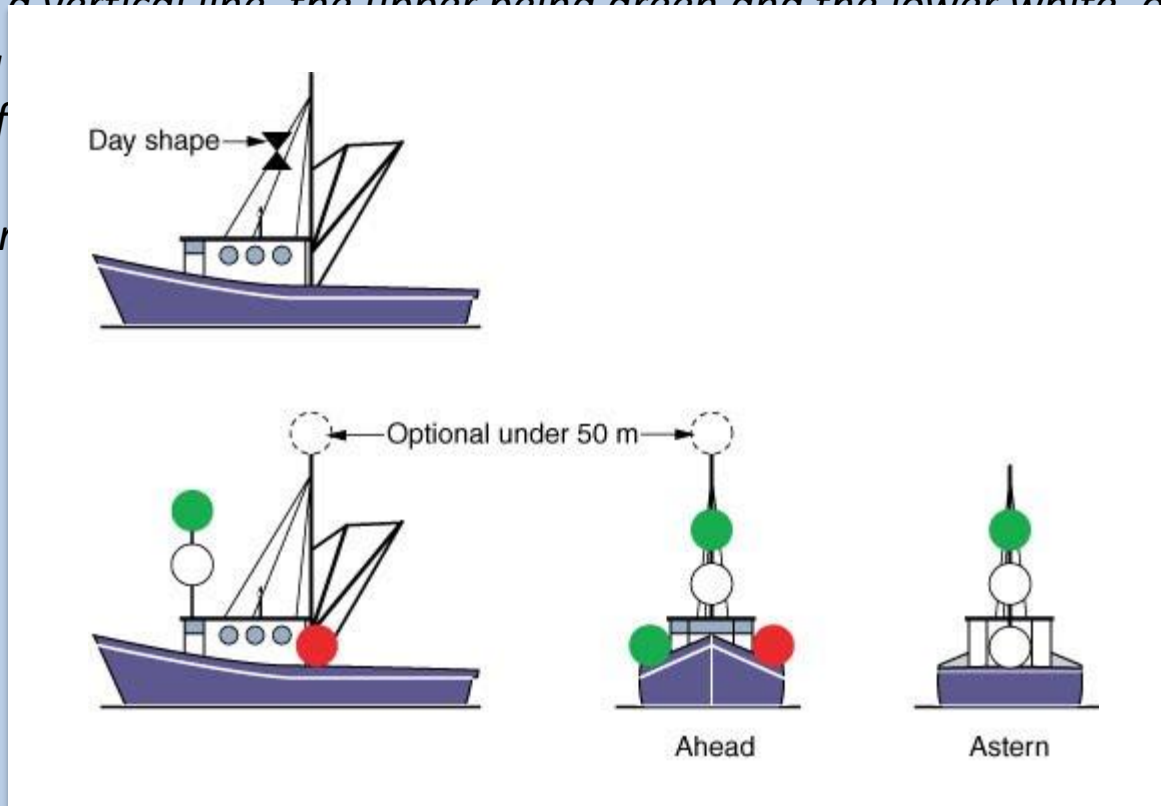


Figure 1: Extract of Chart BA 1406-0 showing *Orakai*'s track and position of accident

COLREG: Rule 26(b) of the International Regulations for Preventing Collisions at Sea 1972, as amended (COLREGS) requires: A vessel when engaged in trawling, by which is meant the dragging through the water of a dredge net or other apparatus used as a fishing appliance, shall exhibit:

- (i). two all-round lights in a vertical line, the upper being green and the lower white, or a shape consisting of two cones with their apexes together in a vertical line;
- (ii). a masthead light abaft of and higher than the all-round light, and a vessel of less than 50 metres in length shall not be obliged to exhibit such light;
- (iii). when making way through the water, sidelights and a sternlight.



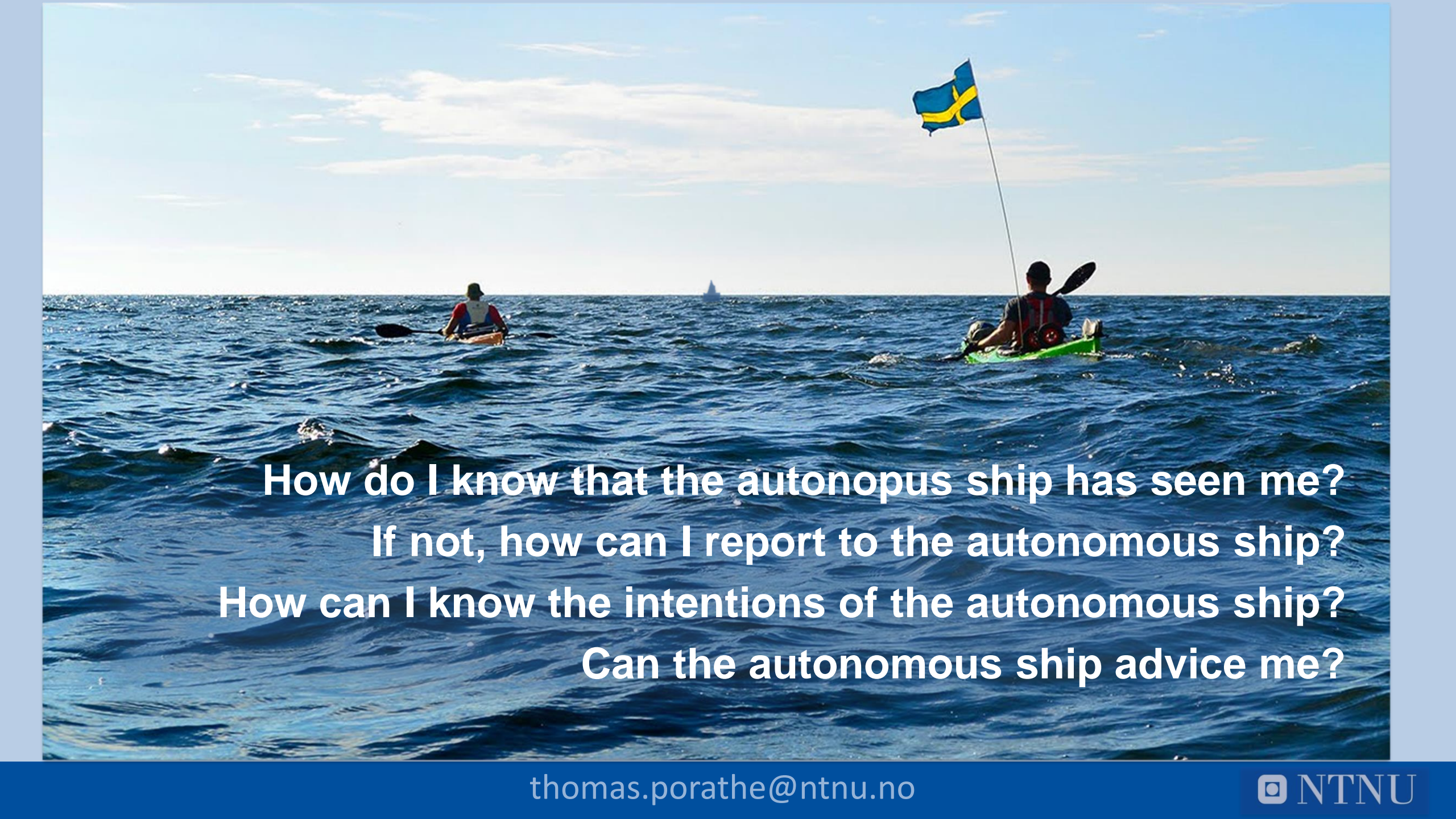
COLREG: Rule 18 Responsibilities between vessels

- (a) A power-driven vessel underway shall keep out of the way of:
 - (iii) a vessel engaged in fishing;

MAIB records indicate there have been 173 collisions between fishing vessels and merchant vessels between 1991 and 2014. These collisions resulted in the deaths of 23 fishermen from UK registered fishing vessels.



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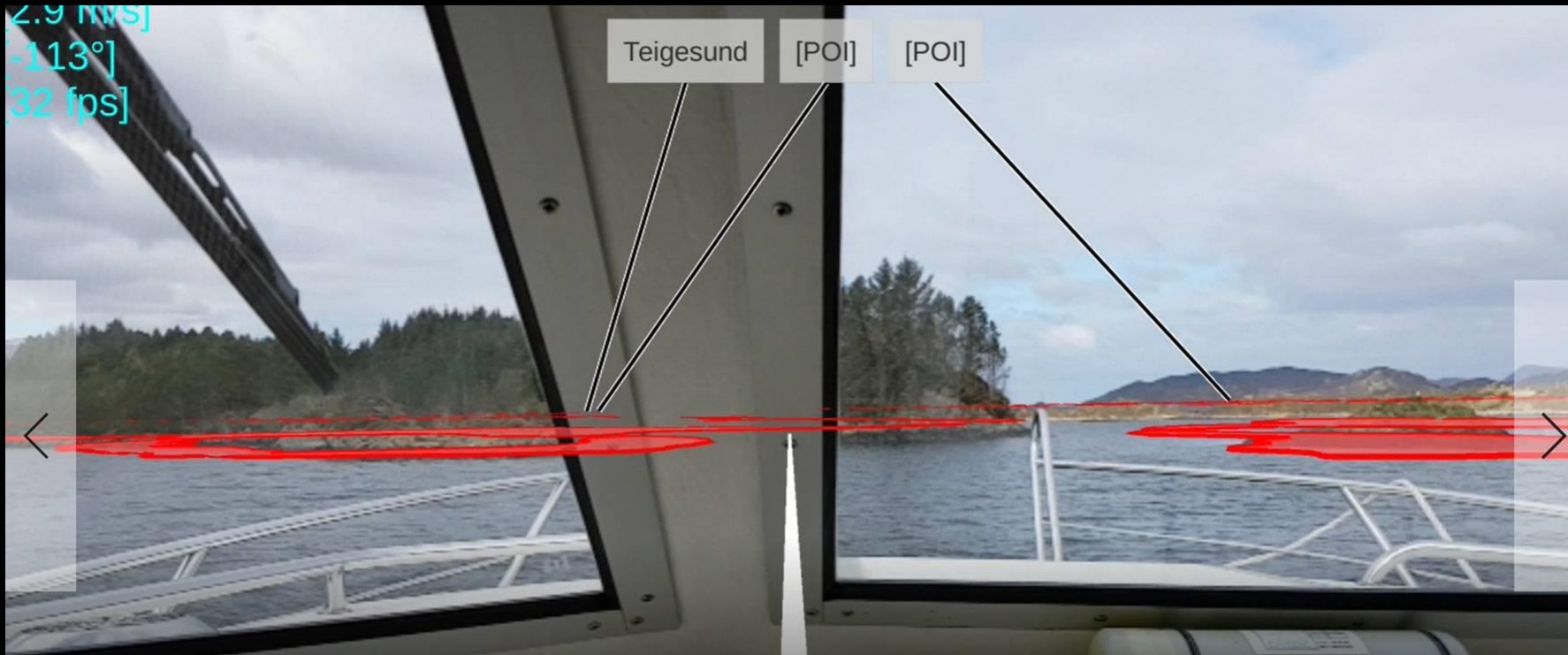
A photograph of two kayakers on a blue ocean under a clear sky. The kayaker in the foreground is on a green kayak and is holding a long pole with a Swedish flag (blue with a yellow cross) attached to it. The kayaker in the background is on an orange kayak. A small sailboat is visible on the horizon.

How do I know that the autopilot ship has seen me?
If not, how can I report to the autonomous ship?
How can I know the intentions of the autonomous ship?
Can the autonomous ship advise me?

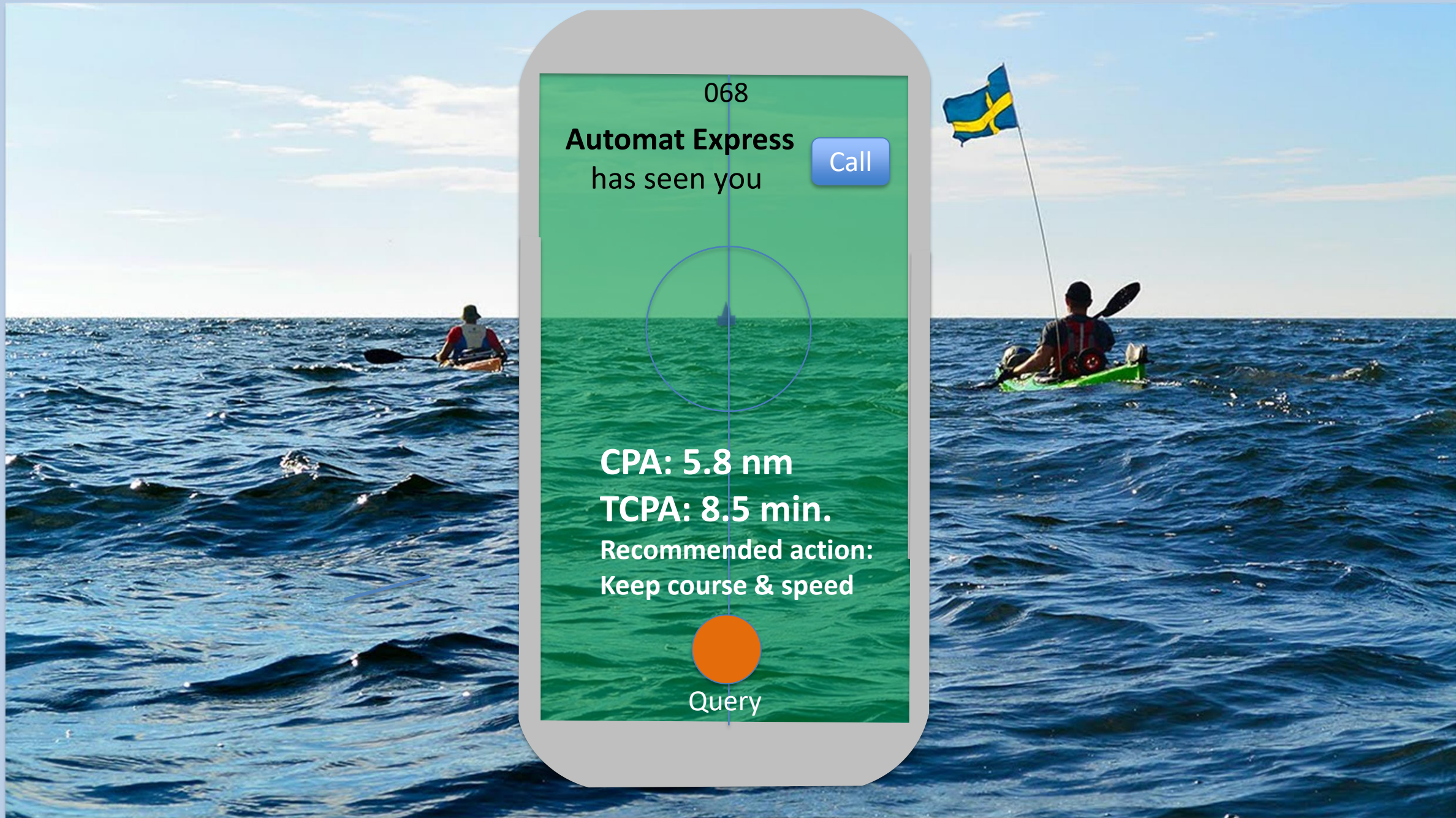




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068

COLLISION WARNING

Automat Express
is approaching your position

Call

CPA: 0.2 nm

TCPA: 8.5 min.

Recommended action:

Turn to course 115