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Fuel saving in coastal areas

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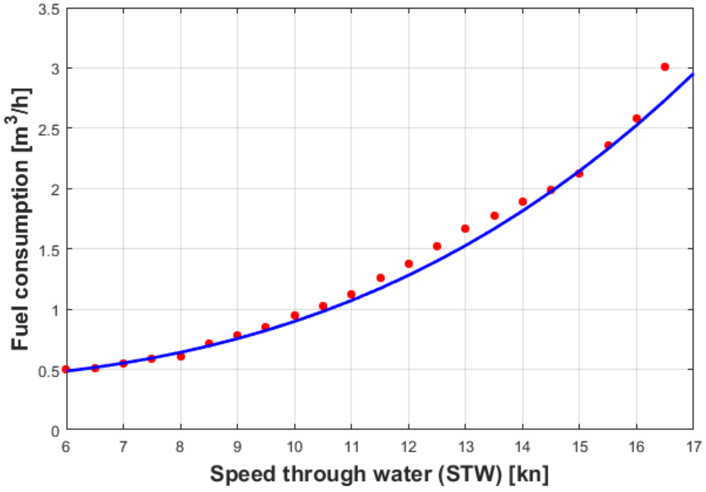
Motivation

- 90% of goods are transported by sea
  (Smith et al. 2016)
- Maritime transport emits around 1000 million tonnes of CO_2 annually
  (IMO)
- Consumption per time travelled is estimated by a cubic function of speed through water
  (Ronen 1982, Fagerholt 2010)



Area of interest: Oslofjord

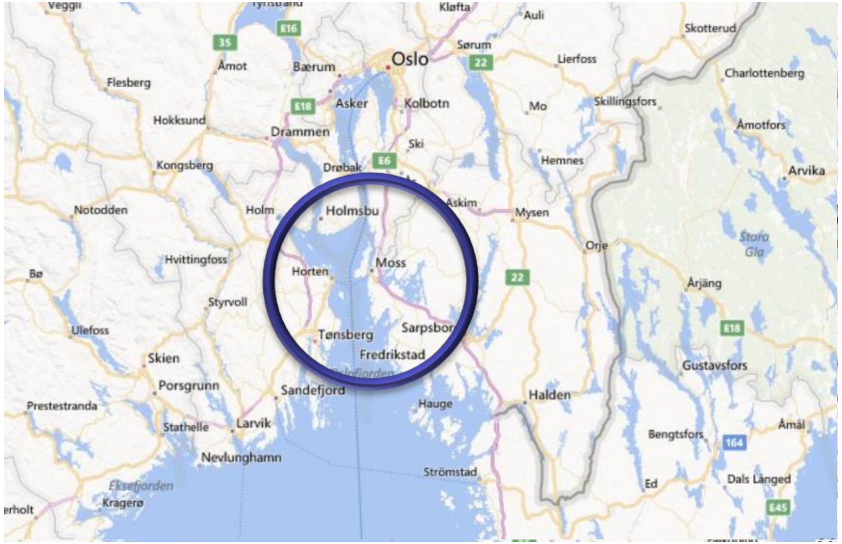
- Prior studies imply that the currents can be more exploited in this area
(Hjelmervik and Schøyen 2015)

- 150 km long

- Tidal currents of 0.5 to 2 knots

- Complex flow patterns

- Detailed currents available from numerical studies
(Røed et. al 2016)



Experiment

- K-Sim Navigation bridge and machine room simulators from Kongsberg Digital

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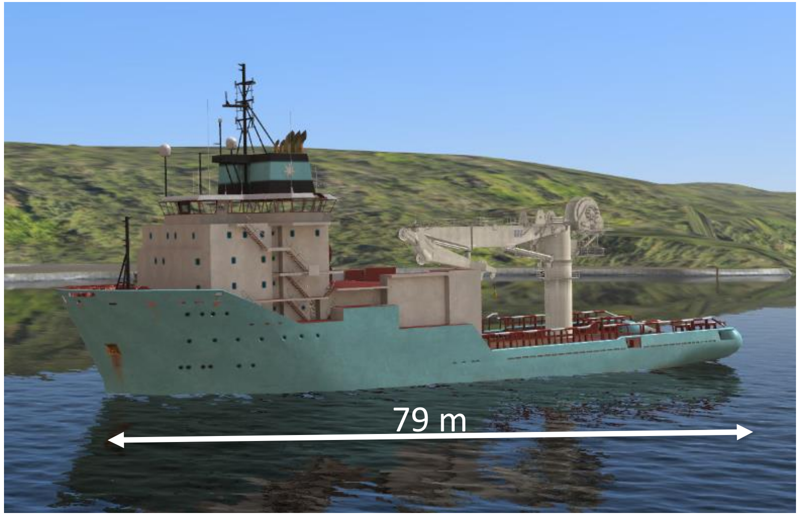
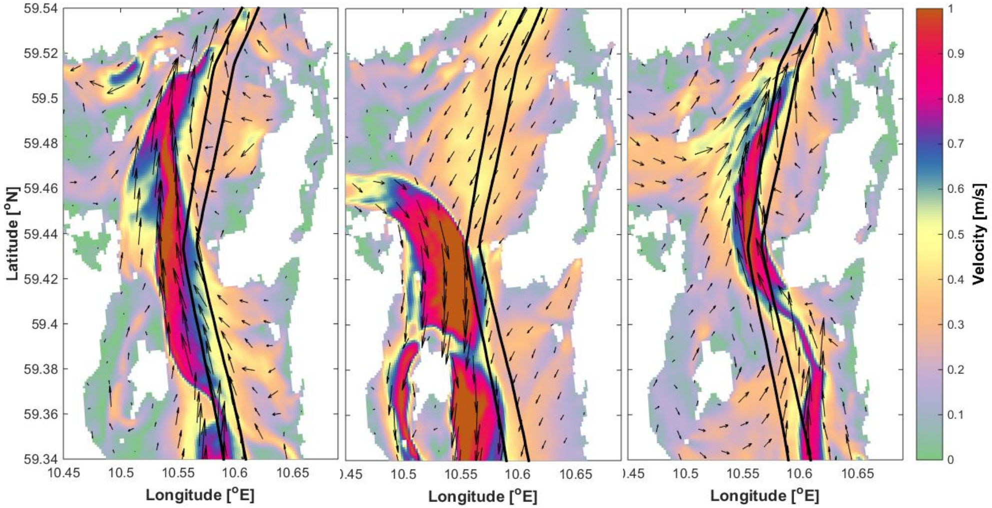


Experiment

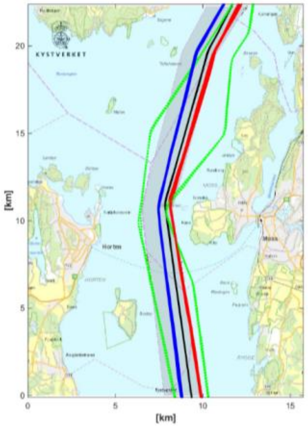
- K-Sim Navigation bridge and machine room simulators from Kongsberg Digital
- Anchor handler vessel
- Three current fields
- Northbound TSS



Experiment

- K-Sim Navigation bridge and machine room simulators from Kongsberg Digital
- Anchor handler vessel
- Three current fields
- Northbound TSS
- 10 setups, each run twice
- 4 bachelor students

ID	Current field	STW [kn]	Choice of route
1	No current	16.7	**Middle of TSS**
2	Field 1, co-current	16.7	**Western route within TSS**
3	Field 1, co-current	16.7	**Eastern route within TSS**
4	Field 1, co-current	16.7	**No TSS restrictions**
5	Field 1, co-current	**15.7**	**Eastern route within TSS**
6	Field 2, countercurrent	16.7	**Western route within TSS**
7	Field 2, countercurrent	16.7	**Eastern route within TSS**
8	Field 2, countercurrent	16.7	**No TSS restrictions**
9	Field 3, co-current	16.7	**Western route within TSS**
10	Field 3, co-current	16.7	**Eastern route within TSS**

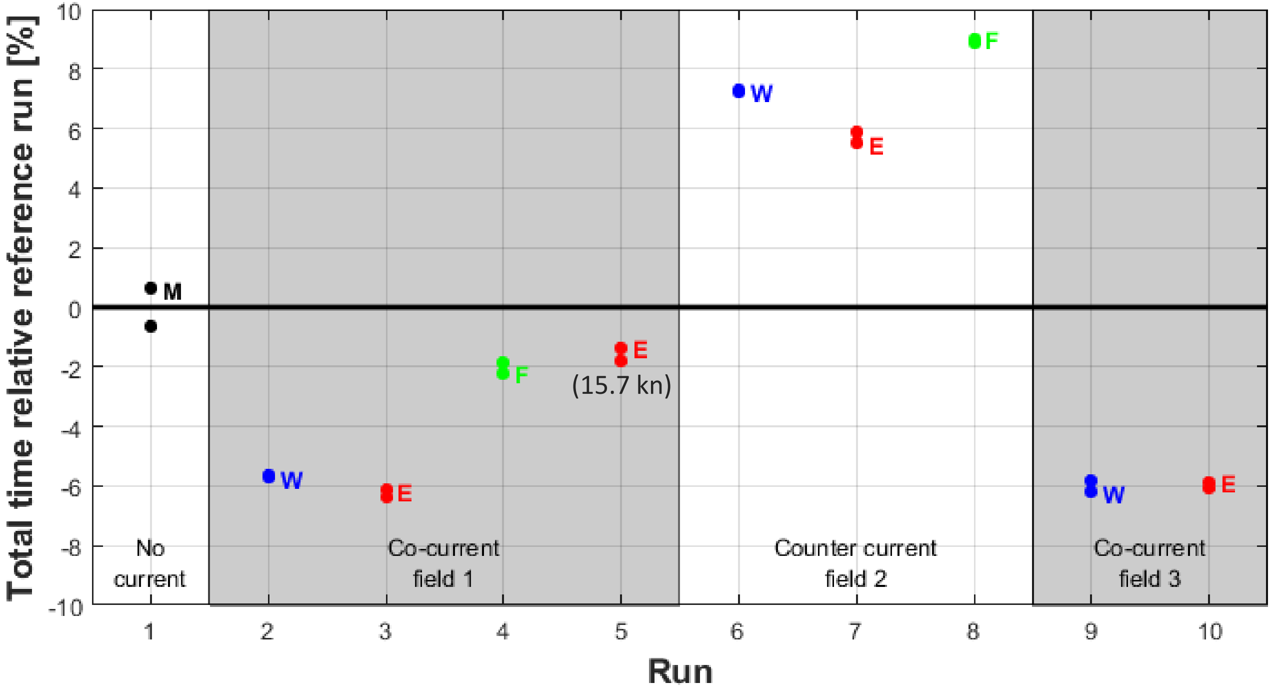


Limitations

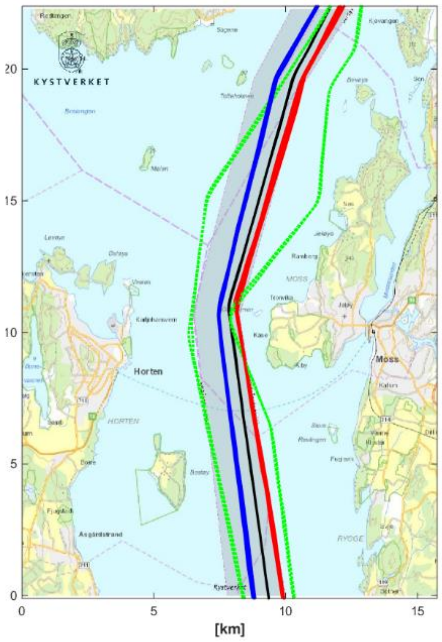
- Only effects from currents are considered
- The experiments include only a short passage
- The experiments are only performed only on one vessel

Further studies are needed to generalize the results

Results

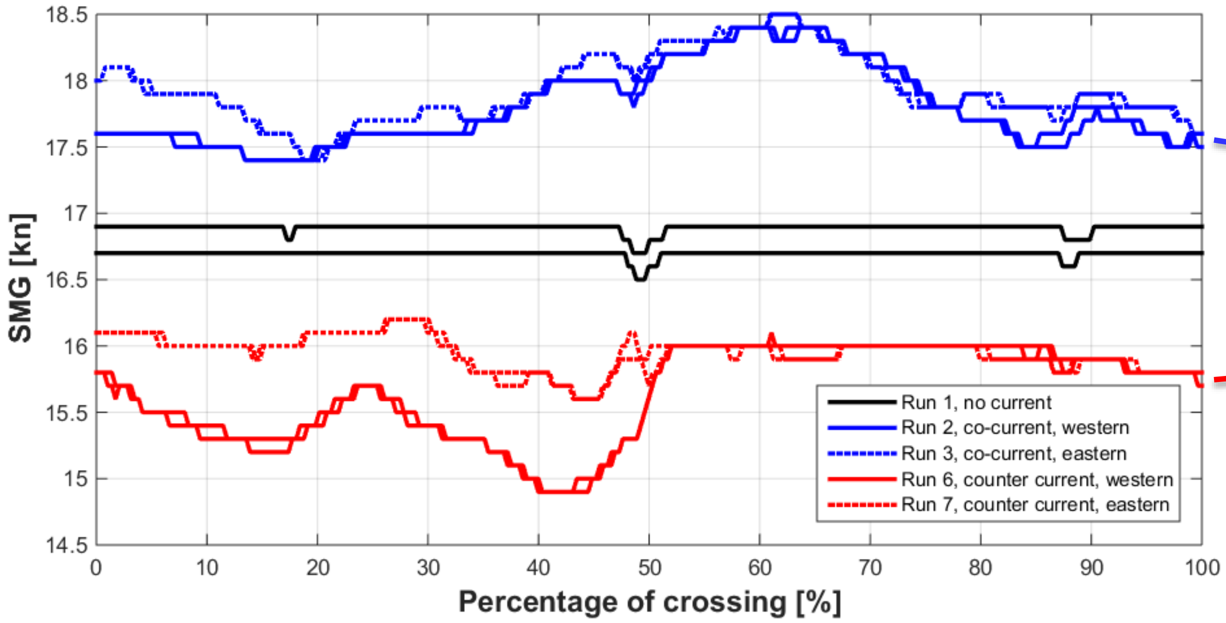


Total time relative reference run [%]
10
8
6
4
2
0
-2
-4
-6
-8
-10
M
W
E
F
E
(15.7 kn)
W
E
F
W
E
No current
Co-current field 1
Counter current field 2
Co-current field 3
1
2
3
4
5
6
7
8
9
10
Run

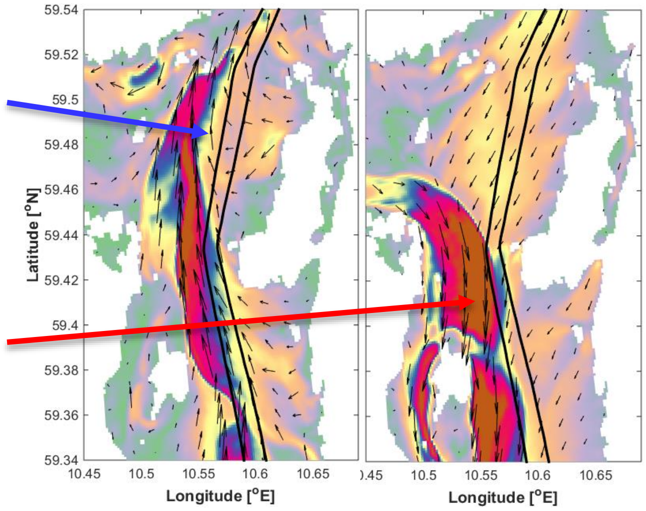


KYSTVERKET
Horten
Moss
0
5
10
15
20
[km]

Results



18.5
18
17.5
17
16.5
16
15.5
15
14.5
SMG [kn]
0
10
20
30
40
50
60
70
80
90
100
Percentage of crossing [%]
Run 1, no current
Run 2, co-current, western
Run 3, co-current, eastern
Run 6, counter current, western
Run 7, counter current, eastern



59.54
59.52
59.5
59.48
59.46
59.44
59.42
59.4
59.38
59.36
59.34
Latitude [°N]
10.45
10.5
10.55
10.6
10.65
Longitude [°E]
10.5
10.55
10.6
10.65
Longitude [°E]

Conclusion

- 6% reduced crossing time on co-currents compared with reference runs

  Alternatively: 15 % reduced fuel consumption (reduced speed, same time of arrival)

- 12-13% reduced crossing time on co-currents compared with counter currents

- Due to complex flow patterns position inside TSS has an impact

- Detailed current forecasts are needed to fully exploit the currents

Thank you