MCCIP ARC Science Review 2010-11
Shipping

RACHAEL WATSON[1] AND PAUL WRIGHT[2]

[1] Department for Transport, 76 Marsham Street, London SW1P 4DR

[2] University of Plymouth Marine Institute, Drake Circus, Plymouth, PL4 8AA

Please cite this document as:

Watson R., and P. Wright (2010) Shipping *in* MCCIP Annual Report Card 2010-11, MCCIP Science Review, 6pp. www.mccip.org.uk/arc

EXECUTIVE SUMMARY

What is happening now?

Shipping is aware of the potential impact that climate change will have on future opportunities for trading activities. With few exceptions shipping is a derived demand and is dependent on activities generated by other businesses.

Ports are increasingly becoming aware of the impact of climate change on their activities and of the effect of sea level rise, increasing storminess and morphological changes on port infrastructure, superstructure and equipment.

Retreating Arctic sea ice is increasing the accessibility of the 'Northern Sea Route' between Europe and Asia for a limited portion of the year. In September 2009, two cargo ships symbolically utilised the 'Northern Sea Route'.

It is difficult to identify any further direct impacts of climate change on the shipping sector due to limited research.

What could happen in the future?

Ships can be built which are capable of supporting new ventures, for example those associated with the opening of the Arctic sea passages. If new opportunities are to be undertaken there will be the need for additional marine infrastructure development.

Ports are immobile and will need to take action in the medium term to mitigate impacts caused by climate change, particularly sea level change. There will be a need to monitor navigation access to ports and make allowance for climate change impacts in all future plans.

Continued sea-level rise of the magnitude projected by UKCP09 will increase the vulnerability of port operations to flooding.

Future changes to wind speed and storminess could lead to reduced loads, route changes and restrictions for some ships.

FULL REVIEW

The UK shipping industry

The increase in world trade has, until recently, seen the volume of goods transported by sea increase significantly and now more than 80% of world trade and 92% of UK trade is transported by sea. Shipping is the most environmentally friendly way of transporting goods with 15 gms of CO_2 being emitted for every tonne / kilometre of cargo carried. (International Chamber of Shipping, 2009). Shipping is a vital industry for the United Kingdom' economy. In 2007, the UK shipping industry contributed £9.8 billion to UK Gross Domestic Product (Oxford Economics, 2007) taking into account

direct, indirect and induced impacts and employs about 25,000 seafarers (DfT, 2008).

Research Update

How will climate change impact on ships and ports?

There is limited research to indicate the impact of climate change on shipping, but the following factors are considered to be of potential importance; the reduction of Arctic sea-ice, changes in weather patterns, including any increase in storminess, sea-level rise, changes in density of water due to salinity of sea water and river discharge in ports.

A reduction in Arctic ice cover could have a positive impact on shipping through the potential reduction in time taken to transport cargo between Asia and Europe by developing the 'Northern Sea Route'. The potential was confirmed in September 2009 when two German cargo ships successfully navigated Russia's Arctic-facing northern shore from South Korea delivering project cargo in Siberia before making passage to Europe. The two ships were able to make the cost-saving voyage by the North East Passage because of the reduction in the polar ice cap. The Northern Sea Route trims 3,900 nautical miles off the usual 11,000 mile route between Japan and Europe thus saving substantial fuel costs and reducing CO2 emissions (Anderson, 2009).

In 2009 the Arctic Marine Shipping Assessment (AMSA) of the Arctic Council was approved. The AMSA 2009 Report deals with the many challenges of trans-Arctic navigation. The report considers that a majority of voyages today and over the next several decades will be destinational, that is sailing north, performing some action in the Arctic and then sailing south. It suggests that as well as the presence or absence of Arctic sea ice, the following key drivers will impact on the viability of polar routes; global commodities prices, future (mandatory) regulations, Arctic coastal state controls and the marine insurance industry.

It is anticipated that the length of the ice-free season will remain short (4-6 weeks) and the Arctic Ocean will retain substantial sea ice cover, between 9 and 10 months of each year, for decades ahead. Sea ice will require that polar class ships, which are more expensive to build will be used for the voyages.

Encountering sea ice on passage will reduce speed and may require greater power, resulting in higher emissions per mile covered. The total saving of fuel and emissions generated on the polar routes will be modified depending on the extent of the sea ice encountered. The extent of sea ice will vary annually. It will be a challenge for shipping companies to take advantage of Arctic routes for regular, particularly container services, if such routes are not available as a viable year-round option.

Arctic ice melt may encourage new developments in the Arctic, such as the exploitation of raw materials and energy sources which will need to be served by ships. AMSA state '*Arctic natural resource development (hydrocarbons, hard minerals and fisheries) and regional trade are the key driver of future Arctic marine activity'.* Arctic developments will require new marine infrastructure to be built including new ports and fairways (Jensen, 2007) which in turn will require the design and building of ships, including dredgers, capable of supporting the construction of such facilities and able to operate under Arctic conditions, far away from service support.

It is possible that changes in weather patterns could result in changes to non-polar shipping routes due to storm activity. There is no known work that analyses these changes.

Changing weather and climate patterns will present new trading opportunities for shipping, including routes for the distribution of water to areas which suffer regional water shortages and changing trade patterns associated with the growth of agricultural products.

Any changes to extreme weather conditions in the form of tropical revolving storms, including hurricanes and typhoons and storm surges will have to be faced by shipping. There remains high uncertainty in projections of future storminess particularly at a regional and UK scale, but changes in the frequency or intensity of storms are possible (see *MCCIP ARC Science Review 2010-11 Storms and Waves;* Woolf and Wolf, 2010). Ships already face storms at sea. Improvements in reliability of weather forecasting methods, developments in ship design and a review of the constructions rules for ships can reduce potential problems.

The physical impacts due to climate change on coastal shipping, including ferries, may be greater than on ocean going ships. Ship and port designers require knowledge of extreme conditions for design work, and persistence statistics for operational matters including port access and ship berthing.

The present state of climate science does not yet allow impacts to be properly considered. Whilst the UKCP09 marine projections (Lowe *et al*., 2009) provide information on mean significant wave height, it recognises that there are uncertainties associated with establishing extreme wave values. The additional height of waves due to climate change is expected to have marginal impact on the design of port infrastructure and as ships are already built to withstand wave conditions associated with the world's oceans the impact of the projected additional increase in wave height experienced around the UK will be negligible.

In 2007, Associated British Ports, a group of 21 UK ports, commissioned research into the risks of climate change on ports (ABPmer, 2007). The research identified a number of potential impacts of climate change on ports, including delays, closure of ports, prevention of port activities taking place due to flooding and severe weather, damage to port infrastructure, superstructure and cargo arising from flooding and severe weather and changes to sedimentation and tidal patterns leading to changes in the costs of maintaining navigation channels.

Maritime navigation is sensitive to storminess, wind / wave conditions and to changes of sea level in ports. To maintain operational success, ports will need to adapt their infrastructure and facilities as appropriate, for example by increasing quay levels and sea wall structures to overcome an increased frequency of overtopping and possible restrictions on existing port developments (PIANC, 2008).

Dredging activity takes place in rivers, estuaries, deltas and coastlines to provide access to port facilities. Access to ports is constantly changing in response to changes in sediment supply, water flow, wave climate and tidal range. Climate change will exacerbate the changes. It is suggested that dredging and landfill will be increasingly needed to protect ports, dykes and access channels (Jensen, 2007).

Changes in the seasonal pattern of rainfall will have an impact on water level of rivers on which river ports are located. This will affect the number of days each year that a river and its ports can be used by inland shipping without restriction. It will also have

an impact on the location of industries which need a waterfront site with waterway access.

Geographical Considerations

Climate change will have an impact on the movement and forms of shipping in different areas of the globe. For example shipping routes using the Arctic passages will also make use of the North Sea when making for north-west European and United Kingdom ports. There is concern about the lack of marine infrastructure at higher latitudes for example on the coasts of Norway and north-west Russia. The Arctic Marine Shipping Assessment (AMSA, 2009) makes comment on the limitations of hydrographic data, meteorological information, and information about the movement of ice. There is also concern about the availability of emergency response (AMSA, 2009).

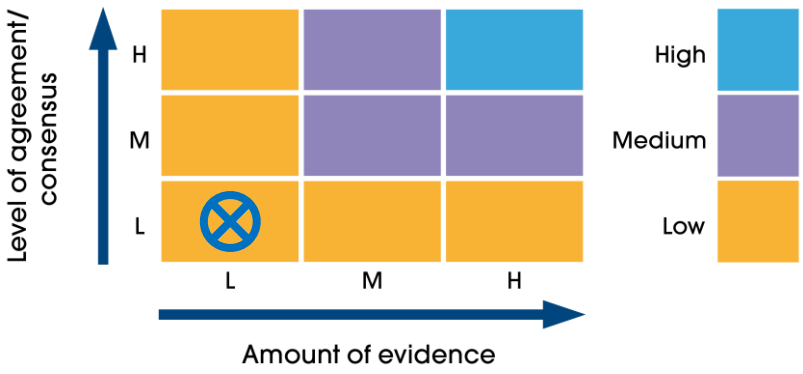
For the ports industry of the United Kingdom there are concerns about rising sea levels. Recent UK Climate Projections (UKCP09 scenarios, Lowe *et al.*, 2009 Chapter 3) give a projection for 2095 of a range of sea-level rise between 12 and 76 cm. (excluding land movement). If vertical land movement is taken into account the relative sea level rise for London is between 21cm and 68 cm and for Edinburgh 7cm and 34 cm. For vulnerability testing, a sea-level rise estimate of between 93 cm and 1.9 metres by the year 2100 is projected. The increase in sea level due to climate change will have to be considered when developing port infrastructure. It will have no impact on ship design.

The UKCP09 Report (Lowe *et al.*, 2009) states that the impact of climate change on the size of surge waves expected to occur on average about one in fifty years '*will increase by less than 0.9 mm per year (not including relative mean sea level change) over the 21st century. In most locations this trend cannot be clearly distinguished from natural variability*.' The increase in the height of surge waves due to climate change will have no significant impact on ports or ships.

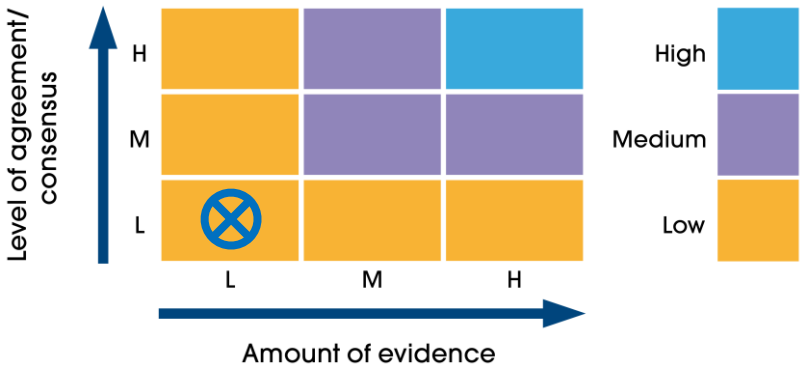
Seasonal mean and extreme waves are generally expected to increase slightly to the south-west of the UK, reduce to the north of the UK and experience little change in the North Sea. The UKCP09 states that *'there are large uncertainties especially with the projected extreme wave values'*. The additional height of waves due to climate change will have marginal impact on the design of port infrastructure. As ships are already built to withstand wave conditions associated with the world' oceans, the impact of additional increase in wave height experienced around the UK will be negligible.

1. Confidence in the science

What is already happening: ***Low***



What could happen: ***Low***



There is limited but growing research available on the direct impact of climate change on shipping.

2. Knowledge gaps

The top priority knowledge gaps that need to be addressed in the short term to provide better advice to be given to policy makers are:

There is increasing knowledge on the impact of climate change on sea-level rise, both globally and around the coast of the United Kingdom. There are gaps in the wider aspects of knowledge of climate change impact – including change in trading patterns, extreme weather, commodity (food and water) distribution and population movement - all of which impact on shipping. There is the need for further study and research in these areas.

3. Socio-economic impacts

There is limited knowledge or research on the socio-economic impact of climate change on shipping.

On the positive side the development of new Arctic shipping routes could, (providing the necessary maritime support and safety infrastructure is established) provide economies in distance and reductions in both carbon emissions and cost. There are potential new trading opportunities to places where access will be improved as a result of ice diminution. New trades may also be developed including water, resulting from change in precipitation patterns and fossil fuels such as oil and gas.

A negative impact on established ports is considered possible by the increased frequency of storms and flooding caused by sea-level rise. Additional costs to mitigate the impact of storms and flooding through rebuilding of port infrastructure will have to be considered, if not the port may be faced with the potential reduction in the availability of berths, with consequent delays to shipping and increase in overall transport costs. Changes in morphology caused indirectly by climate change may require expensive remedial port infrastructure construction, including dredging.

The area of socio-economic impact of climate change could be a fruitful area of further study and research.

4. References

ABPmer (2007). Climate Change and Ports www.abpmer.co.uk/reports-publications/climate-change-ports.asp

Anderson A. (2009) *After* the Ice: Life, Death and Politics in the New Arctic p217, Virgin Books

AMSA (2009), Arctic Marine Shipping Assessment Report 2009, Arctic Council. pame.arcticportal.org/images/stories/PDF_Files/AMSA_2009_Report_2nd_print.pdf

Department for Transport (2008) Transport Statistics Bulletin - UK Seafarers 2008 Reference B(09)17.

International Chamber of Shipping (2009) Shipping, World Trade and the Reduction of CO2 Emissions. www.shippingandco2.org/CO2%20Flyer.pdf

Lowe, J. A., Howard, T. P., Pardaens, A., Tinker, J., Holt, J., Wakelin, S., Milne, G., Leake, J., Wolf, J., Horsburgh, K., Reeder, T., Jenkins, G., Ridley, J., Dye, S., Bradley, S. (2009), UK Climate Projections science report: Marine and coastal projections. Met Office Hadley Centre, Exeter, UK. ISBN 978-1-906360-03-0

Jensen, A. (2007) Climate Change – Likely Consequences for the Dredging Industry. European Dredging Association. Annual Report 2007. p40-43

PIANC (2008) Waterborne transport, ports and waterways; A review of climate change drivers, impacts responses and mitigation. EnviCom – Task Group 3 Climate Change and Navigation p22

Oxford Economics (2009) The Economic Contribution of the UK shipping industry in 2007 Final Report.

Woolf, D., and J. Wolf (2010) Storms and Waves *in* MCCIP Annual Report Card 2010-11, MCCIP Science Review, 15pp. www.mccip.org.uk/arc