www.bunkerspot.com Volume 20 Number 3 June/July 2023

BUNKERSPOT

MARITIME POWERHOUSE

BUILDING THE SHIPS OF THE FUTURE

INSIDE:

SHIP FINANCE

AMMONIA BUNKERING

MARINE LUBRICANTS

WORKFORCE SUSTAINABILITY

Scan the QR code to subscribe

Can we predict the wind?

Dr James Mason reviews his recent publication on weather routing for wind-assisted ships, developed with his colleagues at the Tyndall Centre for Climate Change Research, and considers how ship routing assessments can bring valuable certainty to the wind-assist market

The resurgence of sails has handed ship owners an exciting new tool to comply with increasingly stringent climate targets. But while wind-assist devices can offer dramatic fuel reductions, they can evoke feelings of uncertainty in a notoriously risk-averse space. Can we ever accurately predict the wind? As the renaissance of wind scrambles to the front line of the climate emergency, here we present our new publication from the Tyndall Centre for Climate Change Research that answers this question.

WIND PROPULSION AS A CLIMATE SOLUTION

The concept of decarbonisation is easy. Ships use fuels that contain carbon. When ships burn these fuels, carbon is released into the air and contributes to climate change. The solution is, therefore, simple: remove the fuel, remove the problem.

While all this is true, the next step to this linear thinking pattern can produce problematic conclusions that cause major worries to my colleagues in the climate science space:

If I change fuel to a low-carbon alternative, the problem is solved, right? Wrong.

While you'll be forgiven for jumping to this logical answer, the answer is only partially right. Don't get me wrong, low-carbon fuels are absolutely necessary. Yes, there are worries about fuel costs and uncertainties around bunkering availability and unaccounted upstream emissions. But low-carbon fuels are an essential cog driving the machine of decarbonisation. And in the long term, most ships will need to convert to one of the new low-carbon fuels that are currently

Image © Smart Green Shipping

being debated by fuel experts. But this linear thinking dismisses a critical component that sits at the heart of climate science: timescales.

The true impact of climate change stems from the total amount of CO_2 that we emit. In the climate field, this is known as a carbon budget; an amount of carbon that we need to keep to if we are to meet the Paris Climate Agreement objectives and avoid dangerous levels of climate change. And the reality is, right now our emissions are high. Each year we fail to bring our emissions down, we spend a chunk of our carbon budget. And the carbon budget is running out at an incredible speed.

What has this got to do with wind-assist? Well, climate science shows that if the shipping sector waits until the 2030s to take action, it will already be too late[1]. We will have spent so much of our carbon budget that it will be impossible to meet our climate goals. And this date – the mid-2030s – aligns with the date we expect low-carbon fuels to penetrate the market.

If we wait for the silver bullet, the ship will have already sailed.

So, what do we need to do? In fact, the science shows that the sector needs 34% cuts in CO_2 by the end of this decade to appropriately respond to the climate emergency[2]. This creates a gap in the short-term that must be filled by technologies that are available now. And here lies the promise of wind-assist devices. They not only provide substantial cuts in fuel, but they are ready to install on ships today. If low-carbon fuels are the sword of climate action, wind power might just be the shield.

WEATHER ROUTING AMPLIFIES THE PERFORMANCE OF WIND-ASSIST DEVICES

Weather routing systems, also known as voyage optimisation tools, are commonplace in the shipping world. They enable prompt arrival in port and are essential for ships to avoid dangerous storm systems. However, weather routing for wind ships plays an even more pivotal role.

To help explain this point, let's turn the analogy to airplanes. When a Boeing 747 captain turns the plane onto the runway ready to take off, do they know the route off the top of their head? For obvious reasons, they turn to their route planning software for guidance. And while safety is of paramount concern, so is fuel. The route planning software feeds in the latest weather forecasts to guide planes along fuel-efficient routes, which saves airlines thousands of dollars each year. Pilots cannot be expected to know these conditions themselves.

'While wind-assist devices can offer dramatic fuel reductions, they can evoke feelings of uncertainty in a notoriously risk-averse space'

The same scenario applies to wind ships. Weather routing software feeds in the latest information on wind forecasts to direct wind-assisted ships to areas of ocean with beneficial winds. These optimised winds amplify the performance of the sails, which results in even greater fuel benefits. And research shows that weather routing can amplify the annual fuel savings of wind-assist devices to over 30% on particularly favourable routes[3].

WEATHER FORECASTS INTRODUCE UNCERTAINTY

While this looks good on paper, in reality, we all know that weather forecasts are synonymous with uncertainty. What happens when the wind differs from the prediction? Up until now, this question had not been answered for wind-assisted ships. But a new research study from the University of Manchester, co-authored by Professor Alice Larkin and Dr Alejandro Gallego-Schmid – experts in the field of low-carbon shipping and life-cycle sustainability – provides insight[4].

The study simulates thousands of historical ship departures on three routes using wind forecast data. Results show that long shipping routes that are the most favourable for wind power – here a North Atlantic route that generates annual savings of over 28% from wind-assist – are simultaneously the most at risk from forecast uncertainty.

But why does this happen? Well, when the ship is forecasted to be in ideal conditions for sailing, large savings are predicted. However, uncertainties in the forecast can alter the wind that the ship experiences in reality. And these deviations cause detrimental changes in sail performance.

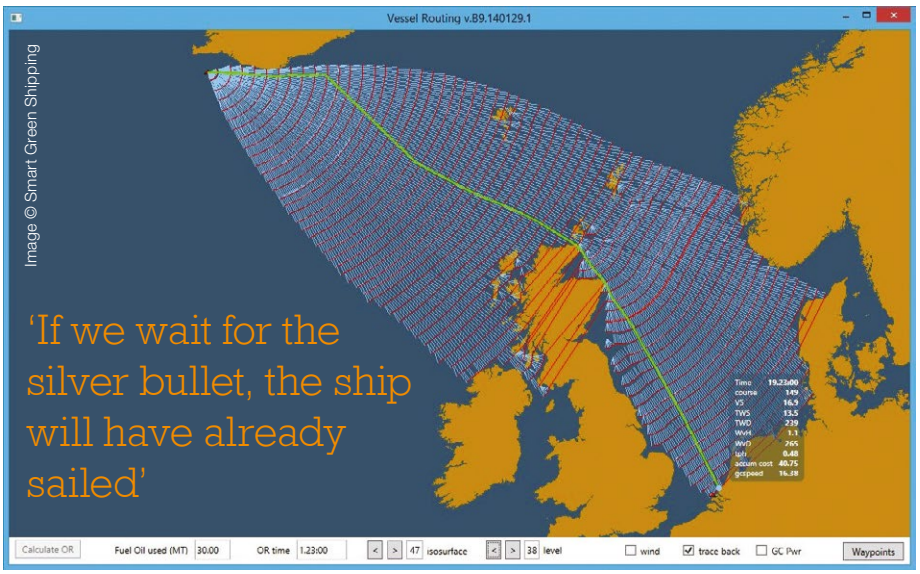
RE-ROUTING FOSTERS CERTAINTY. BUT IT ISN'T THE FINAL PIECE OF THE PUZZLE

So, weather forecast uncertainties can harm wind power. But what can we do to stop it?

Re-routing is the standard practice of uploading the latest weather forecast in real-time as ships travel along their voyage. And once updated, new ship routes are then calculated using this latest data. For wind-assisted ships, re-routing uploads new wind data so that optimal route suggestions are based on the most accurate forecast available.

The new study computationally recreates this practice to understand whether these routing strategies can reduce uncertainty for wind-assisted ships. The study finds that re-routing is an important piece of the puzzle. By uploading the latest forecast data every 12 hours, ships can accurately predict the fuel benefits from wind-assist devices.

Re-routing not only strengthens certainty but also produces large efficiency gains.



Weather routing increases carbon savings by between 1.2 to 2.5 times typical operations, enhancing fuel savings and lowering payback periods. Annual savings range from 8.9% to 25.4%, which offers handsome fuel reductions to companies willing to invest in wind-assist technologies.

However, re-routing is not the final piece of the puzzle.

NOVEL TECHNIQUES COULD MAXIMISE WIND-ASSIST BENEFITS

While re-routing provides greater assurance around the performance of wind-assist devices for ship owners, there is more to gain from weather routing. Novel routing techniques – that mainly focus on clever optimisation procedures that use advanced weather forecast data known as ensemble data – can enhance fuel savings even further.

This is one area of focus at Smart Green Shipping, a systems-design house developing technical, commercially viable, digitally enabled wind-powered solutions to accelerate shipping's green transition. Here at Smart Green Shipping, we have developed the FastRig wing sail systems; sails that bring advances in America's Cup yacht racing technology straight to the door of the shipping industry. Alongside wing sail development, we have devised FastRoute, a scientifically robust ship routing software that can accurately predict the fuel savings of wing sails on any merchant ship. And development is underway to place uncertainty at the core of the routing tool to provide customers with strong assurances around fuel savings estimates.

SO, CAN WE PREDICT THE WIND?

As shipping faces the realities of the low-carbon transition, wind-assist devices are emerging as a valuable piece of the puzzle. And while wind can be uncertain, the latest advances in science show that ship routing can tackle uncertainty to foster confidence in the investment of wind devices. Mix reliability with powerful sail performance, and you have two key ingredients in the recipe for urgent and dramatic climate action.

1. Bullock, S., Mason, J., Broderick, J., Larkin, A., 2020. Shipping and the Paris climate agreement: a focus on committed emissions. BMC Energy 2, 5. https://doi.org/10.1186/s42500-020-00015-2.

2. Bullock, S., Mason, J., Larkin, A., 2022. The urgent case for stronger climate targets for international shipping. Climate Policy. https://doi.org/10.1080/14693062.2021.1991876.

3. Mason, J., 2021. Quantifying Voyage Optimisation with Wind-Assisted Ship Propulsion: a New Climate Mitigation Strategy for Shipping. Doctoral thesis. The University of Manchester.

4. Mason, J., Larkin, A., Gallego-Schmid, A., 2023. Mitigating stochastic uncertainty from weather routing for ships with wind propulsion. Ocean Engineering. 281. https://doi.org/10.1016/j.oceaneng.2023.114674.

This article references the academic paper, Mitigating stochastic uncertainty from weather routing for ships with wind propulsion, Ocean Engineering 281 (Mason, J., Larkin, A., Gallego-Schmid, A., 2023) https://doi.org/10.1016/j.oceaneng.2023.114674.

Dr James Mason is Visiting Academic at The Tyndall Centre for Climate Change Research, The University of Manchester and is now working for Smart Green Shipping, developing their FastRoute energy harvesting tool for wing sails.

Dr James Mason,
Data Scientist,
Smart Green Shipping

Email: james.mason@smartgreenshipping.com
Web: www.smartgreenshipping.com