Talking Rubbish: Citizen Science and The Arrochar Litter Sink

Description


The litter sink at the head of Loch Long

[Parkswatch is delighted to host this guest blog by Dr Tom Scanlon who has been researching litter in the Clyde Estuary www.mts-cfd.com]

Letâ??s talk rubbish. An estimated 62,000 items of plastic marine litter make their way on to the coastline around Arrochar each year [1]. Among the questions I asked myself included; how do they get there? Was there anything specific about the location of Arrochar that makes it such a magnet for marine litter? Why do people talk about the so-called â??Arrochar Litter Sinkâ?•? Was it possible to better understand the physical mechanisms through which this blight occurs? It was in this context that I

set about the challenge of creating a computer model of the marine litter process; my background as an engineer serving as the basis for the model creation.

My motivation? I would describe myself as a scientist and concerned citizen with an interest in nature and the environment. As a retired academic I was now in the fortunate position to apply my skills to the development of computer models of marine litter; how it is transported by winds, tides and earth spin around our coastline. There appears to be a paucity of detailed studies in the open literature related to marine litter emanating from conventional sources such as academia and government science publications. My study could therefore be regarded as â??Citizen Scienceâ?•, published on my web site [2], open to challenge, interpretation and interrogation from both the public and the traditional scientific community.

So how does one go about creating such a model? The first thing to highlight is that I have used exclusively â??open-sourceâ?• computer codes. Such codes are free to download on-line, are based on sound physical science and avoid costly commercial licence fees [3]. The model technique is called Computational Fluid Dynamics (CFD); the same method that is used to predict the weather that we see on TV forecasts each day. We are effectively solving the equations of motion for water on a computer, under the driving forces of tides, winds and Earth spin, within the confines of the Clyde estuary and Argyll and Bute coastline.

To represent the marine litter a number of â??virtualâ?• particles (like floating ping-pong balls of sizes varying from 1 mm to 10 cm) were placed on the water surface at locations on the Clyde opposite Port Glasgow and in the Estuary opposite Inverkip. The fate of the particles were then tracked over time on the back of natureâ??s motive forces. The model was run for a period of 8-days (see here for graphic showing progress of litter over this period) using typical average wind data for the location and a tidal input corresponding to water surface speeds for the tidal stream atlas for the Clyde estuary. One final motive force to be included was the Coriolis force. This is a force due to the rotation of the Earth where, for the Northern hemisphere, any water movement East-West or West-East is deflected Northwards or Southwards, respectively.

â??Hot-spotâ?• locations for marine litter were predicted at Helensburgh/Rhu, Lochgoilhead and Arrochar thus helping to validate the modelling approach. Arrochar appears to be at a particular geographical disadvantage with a â??wind funnelâ?• effect driving litter on predominantly South-Westerly winds. Earth spin also dictates that water flowing from East to West will turn Northwards adding to litter transit in the Arrochar direction. Additional complexities which have not been considered in the model include the mixing of salt and fresh water which can create density-driven flow patterns.

One question to pose perhaps is: how accurate is the model? American statistics expert George Box is credited with the saying: â??*All models are wrong, but some are useful*â?• [4]. â??*Wrong*â?• in the context that they can never be perfect and are based on certain modelling assumptions; â??*useful*â?• in the sense that they can provide reasonable engineering approximations to what happens in reality, within practical computational timescales â?? e.g. solved on a laptop without recourse to supercomputers. Good CFD practice also dictates that the modelling assumptions are based on the engineerâ??s experience and this can help reduce model uncertainties.

So what are the implications of the model in practical terms for the communities living in hot-spot locations? I would say that the CFD model study:

1. Highlights the scale of the problem existing over hundreds of kilometers of coastline and the potential impact on local communities such as Arrochar, Lochgoilhead and Helensburgh/Rhu.
2. Shows graphically the physical mechanisms of how tides, winds and Earth spin transport marine litter in a complex coastal topography.
3. Demonstrates an application of â??Citizen Scienceâ?• using free open-source codes as an alternative to Government/academic/industry research and expensive commercial software.
4. Informs in terms of education and communication â?? with the general public and potentially with schools.

Beyond the scope of this study important questions remain about what can be done to reduce the source of the litter and mitigate against its water transit, who is responsible for clearing up the litter? What official assistance will be provided to local communities for removing the rubbish? Who will pursue law enforcement for littering and pollution and what to do with the rubbish? â?? the recycling challenge.

Hopefully, this exercise in talking rubbish can raise awareness about the problem of marine plastic pollution, can spur individual and local action, and help build public support for positive change.

References

[1] https://thelochsidepress.com/2019/06/30/arrochar-plastics-sink-draws-in-62000-pieces-of-litter-a-year/

[2] www.mts-cfd.com

[3] www.openfoam.com

[4] https://www.bbc.com/news/science-environment-48596771

Category

1. Loch Lomond and Trossachs

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1. conservation
2. Litter
3. LLTNPA
4. Local communities
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