**Introduction**

**Why you should care**

* Don’t understand how we use oceans
* Other parts of environment coming into regulation (fishing and emissions)
* Lots of plans for fishing
* Shipping is huge use of ocean – big revenue source
* Wild west in terms of control of shipping – especially in comparison to other environmental issues
* Part of the problem is that shipping is extremely international – more than fishing
* Very international, but not regulated
* The other comparison is airlines, but that is very regulated
* There are other transportation networks – road, rail – that are very well understood
* Shipping is out of sight, out of mind
* We don’t have data partially because it is very valuable and those who have any data (Lloyds) want lots of money for it – part of reason for low amounts of research
* We also don’t have data because this sort of thing was traditionally collected by govts but they don’t the capacity to do it now
* Only real regulation is at ports, otherwise just GPS units and a hope that no one crashes
* Don’t understand cumulative impact on human health and the environment
  + Greenhouse gas emission
  + 60 K deaths
  + lots of ecological impacts
* shipping growing very dramatically, but don’t have handle on it (especially in comparison to other environmental issues in ocean)
* shipping has big economic benefit, but costs are externalized
* there are good actors in shipping who want to do the right thing, but don’t have the tools to do it
* only scientific community can do this
* can only do msp by bringing stakeholders together

**What we know – existing work**

* important work with ben – science paper – bigger than just shipping
* first work that looked at global impact of shipping using all available data and synthesizing it all together
* first work to really look at how humans are affecting marine environment
* problem with data is that it was based upon volunteer data – and most of volunteers were not representative (lots of scientific ships, for example)
* second problem, bad spatial mapping – tons of gaps. Highly variable from ship to ship on quality of data gathering
* missing whole categories of ships
* missing big areas of oceans that we know lots of ships are using
* paper two – based on Lloyds data
* written for network theory audience
* only data is port order for specific ships
* used this data to come up with proposed routes of ships based on great circle distances
* problem – they don’t actually know where ship went
* doesn’t actually help answer questions about where ships are, because you still don’t know where they are travelling
* this paper is still the best that looks at shipping at a global level
* neither paper is geared towards geographers – paper 2 ignores geography and paper 1 doesn’t address data models (very important for geographers)
* Lots of papers that focus on specific parts of the shipping problem – few that take large perspective
* Goodchild – how well does your data representation get at addressing your scientific question in geography; also addressing the new issue of volunteer driven data
* The reason goodchild matters is that the data models in this work are there to address the questions at hand across disciplines
* There isn’t one answer – different data models give you different answers, but the different models are needed for different questions – average model, tanker model etc.
* Important that you can go from raster layer back and forth to actual data
* Need to tie work into transportation geography
* Ocean is more interlinked than land, making questions of space even more important (can’t just put buffer around forest)
* AIS data is still biased because receivers aren’t everywhere

Outline

* **Introduction**
* Shipping critical issue for theoretical and applied geography
  + How shipping ties in to theory
    - New theory of VGI
    - Goodchild?
  + How shipping ties into applied problems
    - Shipping is huge and growing use of ocean
      * Throw in stats of bigness of shipping for economy
    - Shipping has huge unseen impact on human health and the environment (out of sight, out of mind)
      * Giant greenhouse gas emission
      * 60 K annual human deaths from air pollution
      * invasive species (ballast water)
      * ship strikes
      * noise pollution
      * groundings (direct effects like oil spills, grey water, chemical spills, smashing into coral)
        + acute damage
        + chronic damage
      * certain to be many other ecological and human impacts – we just have no idea
    - Other parts of ocean environment coming into regulation, particularly fishing
    - Regulation of shipping very rudimentary
      * Wild west in terms of control of shipping
      * Part of the problem is that shipping is extremely international, more than fishing
      * Only real regulation is at ports, otherwise just GPS units and a hope that no one crashes
* Very poor data on shipping
  + There are other transportation networks – road, rail – that are very well understood
  + A comparison with airlines – both cases, captains have choice of route (follow desire lines) - but that is very regulated and lots of data
  + We don’t have data because this sort of thing was traditionally collected by govts but they don’t the capacity to do it now
  + We also don’t have data partially because it is very valuable and those who have any data (Lloyds) want lots of money for it – part of reason for low amounts of research
* Work on global shipping
  + Lots of papers that focus on specific parts of the shipping problem – few that take large perspective
  + Ben’s Science paper
    - first work that looked at global impact of shipping, but paper bigger than shipping
    - first work to really look at how humans are affecting marine environment, by synthesizing together all available global data
    - problem with data is that it was based upon unrepresentative ships - missing whole categories of ships
    - second problem, bad spatial mapping – tons of gaps. Data quality highly variable from ship to ship - overview
      * missing big areas of oceans that we know lots of ships are using
    - problem three - doesn’t address data models (very important for geographers)
  + Kalusa paper, based on Lloyds data
    - written for network theory audience
    - data is port order for specific ships, which is used to come up with proposed routes of ships based on great circle distances
    - problem – they don’t actually know where ships travelled, which means results aren’t helpful for problems where ship locations actually matter
    - can’t share data, as it is proprietary
    - this paper is still the best that looks at shipping at a global level
    - this paper ignores geography
* Where my work comes in
  + Building new global datasets of shipping that provide new insights by connecting new datasets together
  + High res AIS data only used for subcontinental data before – VOSCLIM used for Ben’s paper
  + AIS provides high resolution view at near shore, where we tend to care the most
  + Combining AIS with VOSCLIM provides best to date view of how ships travel through ocean

**Methods**

* Using two kinds of VGI data – needs to be handled in special ways
  + Describe AIS data
  + Describe VOSCLIM data
  + Filtering process
* Goodchild stuff on vgi
* Merger of data – which can give single representation of data
* In order to address multiple issues of shipping (strikes, pollution, etc.) you need to know different kinds of things for each
* It is necessary to have multiple representations of the data – the data model must flow from the question asked – goodchild
* Overview table of summary statistics of data – intermediate workflow product
* Can link data representations all the way back to attributes of raw data
* Data representations
  + Raw point data
  + Density estimates of ships by ship type
  + Speed density estimates of ships by ship type
  + Network model of ship travel

discussion

* + - shipping has big economic benefit, but costs are externalized
    - there are good actors in shipping who want to do the right thing, but don’t have the tools to do it
    - only scientific community can do this
    - can only do msp by bringing stakeholders together