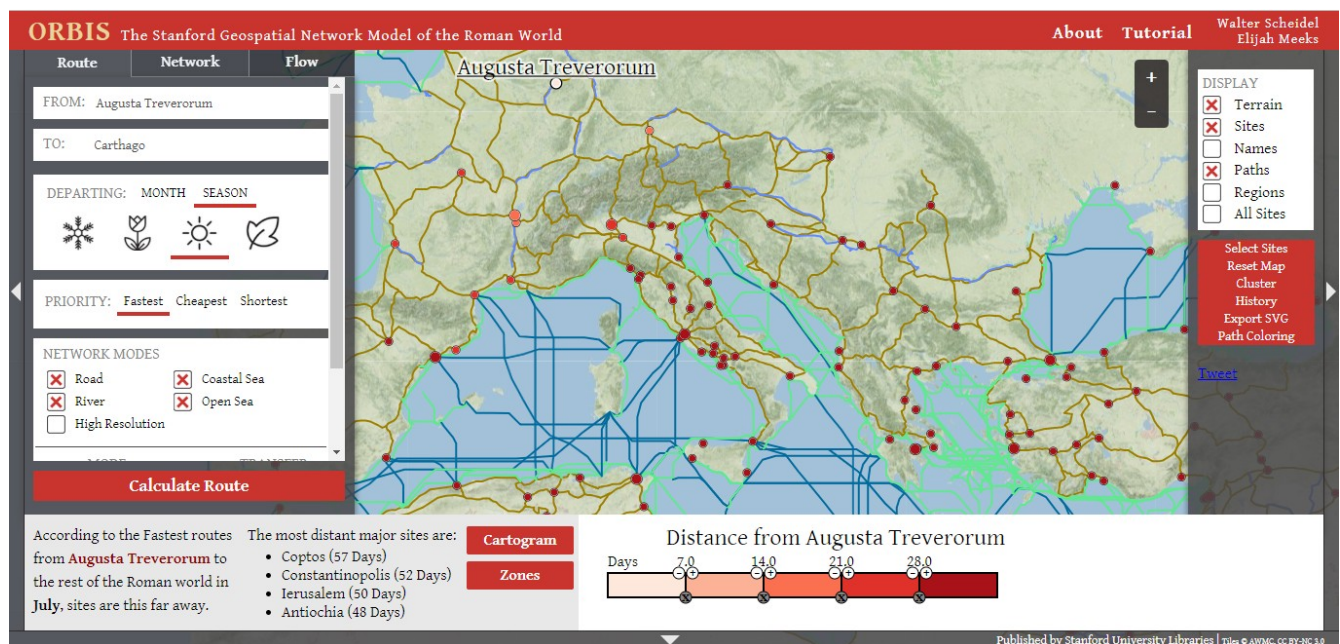


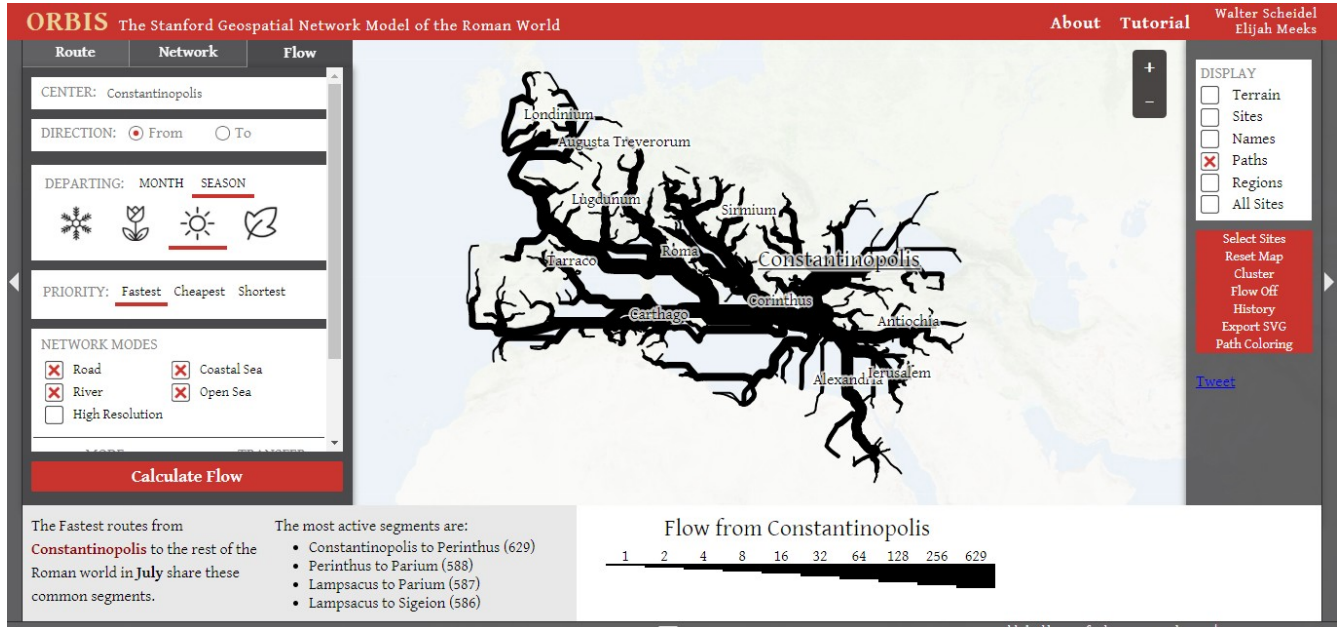
ORBIS is an interactive model used to calculate the average cost and time needed to transport either goods or people from one place to another in the Ancient Roman Empire. The model could be a powerful tool for both the public and historians to understand transportation in the ancient world. While a map shows only the distance between two points, ORBIS takes in to account numerous factors to determine the true time and cost required to travel between nodes such as road and sea networks, weather, different modes of transport, and other environmental conditions. The project is a collaboration between Walter Scheidel, a Roman historian at Stanford who designed the model and compiled data on Roman transportation from historical sources, and Elijah Meeks who developed the interactive map and assisted with other technical aspects of the project.



Main page of the ORBIS project. This is the map shown after the user clicks to "Start exploring the Roman World". The starting city is randomly selected.

The model has many three different modes on its interactive map. The route mode will find the optimal path between any two cities. The network mode will use colors to show the distance from each other city to the standard node. The screenshot shown above is the network to Augusta Treverorum. The nodes closer to that city are a lighter shade of red than the farther nodes. If the zones option is selected, the entire territory will be colored instead of just the cities. The flow mode will show a diagram that aggregates the optimal route to every other node in the entire system. The thickness of

each segment represents the number of routes that pass through that trail. While the route mode, gives a path between two nodes, the network and flow modes can be even more valuable because they show the transportation paths used throughout the entire territory.



A flow diagram out of Constantinopolis.

There are also many input options to the model:

- Time of year (either as a month or season)
- The priority the model sets in choosing a path (fastest, shortest, or cheapest)
- Network modes – which types of transport are allowed
- Vehicle type for land travel
 - Vehicles have different speeds as well as different costs of travel
 - There are nine vehicle options including on foot, ox cart, horse, and military march
- River travel is at civilian or military speeds, where the military option simulates faster rowing
- Sea travel allows for a faster or slower ship
- Transfer cost in days for changing method of travel

The model output can be highly sensitive to these options. In the image below, I have shown three different paths from Rome to Asturica to demonstrate this. The path in green is the cheapest route where land travel is on a donkey, river travel is at the civilian rate, and sea travel is slow. It also has a full day of transfer cost when changing modes of transport. The top path in red was outputted

when I changed the priority from cheapest to fastest and the vehicle from a donkey to a horse. Then to get the lower and bolded path in red, I changed the transfer cost times from one day to a half day each, the vehicle from horse to foot, and the sea speed from slow to fast. While this sensitivity is necessary for researchers with precise questions, the dependence on the options makes it impossible to get a general sense of travel times and costs without worrying about specific details.

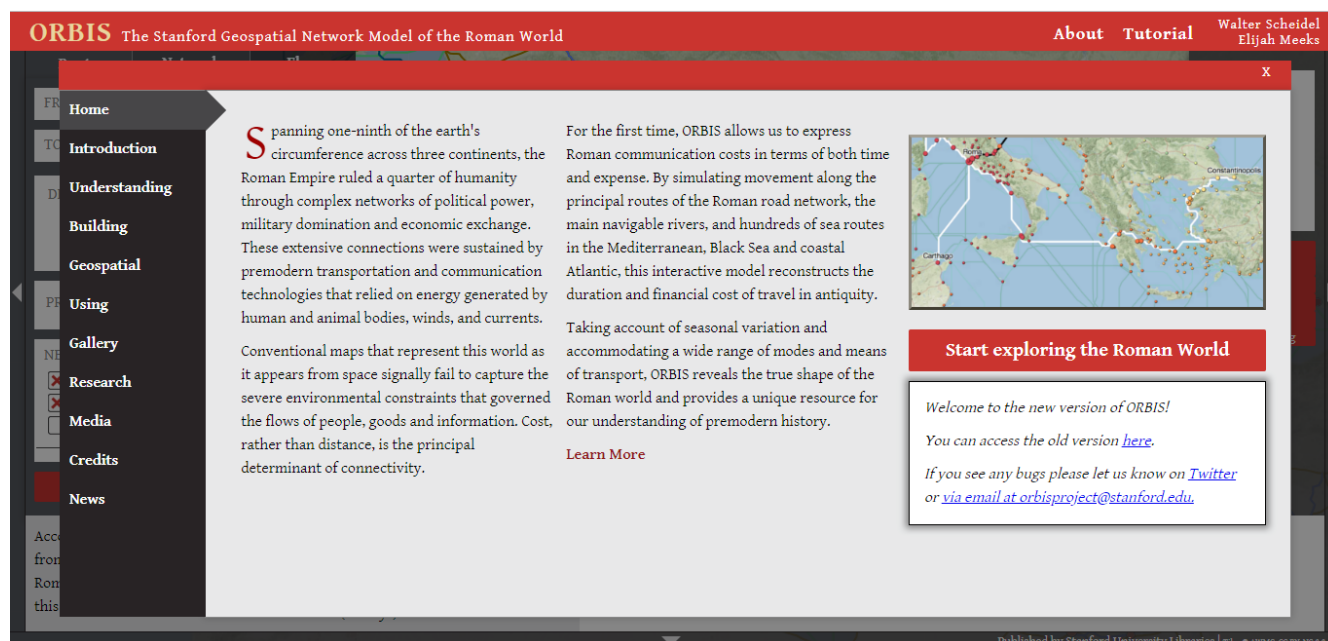


Using different options will produce very different paths in ORBIS.

The ORBIS project has the potential to be popular with the public, although unfortunately it has hamstrung itself with a poor user interface. According to their twitter account they received around 275,000 viewers when the website first launched in May 2012 (ORBIS_Stanford May 30, 2012). This is an incredible number and shows that there is a lot of interest for digital humanities projects in the future. However, they also stated that only a third of the visitors who came to the site through a Reddit link even saw the interactive map (ORBIS_Stanford May 26, 2012). Although the site has been redesigned in 2014 and a tutorial has been added its interface is still a weakness.

My first critique of the site design is that upon first loading the webpage, you reach the about page, shown below. Most of the focus on this page is on the text introducing the page. However, this text is not exciting or visually appealing enough to draw in first time viewers. The first time I viewed

the ORBIS website – I was on a mobile browser where the red button to “Start Exploring the Roman World” is even smaller – I clicked through and read several of the other tabs on the left and did not notice the interactive map feature at all. The problem is exacerbated by the fact that after opening any of the other tabs on this about screen, the larger button to go to the interactive map disappears, and the user can only view the map by clicking the smaller ‘x’ button in the top right. The fact that it is so easy for a new user to miss the interactive portion of the mode and instead get bombarded with long explanations of how the model works and was constructed is a clear design flaw.



Introduction page to the ORBIS project.

ORBIS did add a tutorial in 2013 that can be accessed via the “Tutorial” button on the top right of the page, in between the “About” link and the project authors. This location may have the same issue as the map button of not being prominent enough to a first time user. The tutorial itself is quite short, it simply walks the user through each of the buttons available on the screen and explain what each option does. It can be exited at any time, although the user will have to click through again if they decide to finish the tutorial later. Overall, I thought that the tutorial was quite helpful, but I did notice two minor inconveniences. The first is that the user can not move backwards to previous explanations without restarting the tutorial. The second is that the pop up explanations for some of the options block the features they are describing. These make the tutorial a bit harder to follow although it still

suffices to give a basic idea of how to use the site. There are also three video tutorials that give a more detailed walk-through and even cover some of the more advanced site features in the using tab of the about page. Unfortunately, these videos are not linked to or even referenced by the tutorial, so there is no way to find them without thoroughly exploring the site.

Also the functionality to download a map from the site is broken¹. While the user can work around this by taking screenshots this may not be as convenient.

In addition to interest from the public, the ORBIS model can also be a tool for ancient historians. Walter Scheidel (who also created ORBIS) published two papers that use ORBIS. The first analyzes the taxes of different shipping routes in Diocletian's edict of 301 CE and argues that the tax was proportional to the time needed to travel that route (Scheidel, 2013). In the second paper, he argues that "Roman expansion proceeded in accordance with connectivity cost constraints and that the eventual segmentation and separation of the empire was likewise shaped by the same factor" (Scheidel, 2013). ORBIS has also generated a moderate amount of interest from other scholars. A third paper introducing the ORBIS model has been cited 21 times (according to a search on Google Scholars). Taking a glance at the abstracts of some of the papers citing ORBIS, it has been used to retrace the journey of fugitive slaves (Lokkesmoe, 2015), estimate relative transportation costs (Michaels & Rauch, 2012), trace the spread of early Christianity (Fousek, 2018), and study the spread of diseases (Hanna, 2015).

In conclusion, ORBIS is a valuable tool for studying transportation networks in the ancient Roman world. Its power lies in its ability to calculate both specific routes between two destinations, as well as visualize transportation across the entire empire. While it suffers from a poor design and is no longer being updated it still stands as a decent finished product that can serve both public and scholarly interest in the ancient world.

¹ Normally the "Export SVG" button would save the current map in the svg file format.

However, the svg file format standard was updated to version 2.0 in 2016, and ORBIS exports files that now use deprecated features (Mozilla).

Metadata

Title: ORBIS: The Stanford Geospatial Network Model of the Roman World

Description: Interactive model used to compute shortest average paths for travel in the ancient Roman empire.

URL: <http://orbis.stanford.edu/>

Authors: Walter Scheidel, Elijah Meeks

Place: Stanford

Date Created: 2012 - 2014

Date Accessed: February 2019

Availability: Free

References

Fousek J, Kaše V, Mertel A, Výtvarová E, Chalupa A (2018) Spatial constraints on the diffusion of religious innovations: The case of early Christianity in the Roman Empire. *PLOS ONE* 13(12): e0208744.

<https://doi.org/10.1371/journal.pone.0208744>

Hanna, E. (2015). The Route to Crisis: Cities, Trade, and Epidemics of the Roman Empire. *Vanderbilt Undergraduate Research Journal*, 10. doi:10.15695/vurj.v10i0.4109

Lokkesmoe, Ryan (2015). Finding Onesimus: Recovering the Story of a First-Century Fugitive Slave *Electronic Theses and Dissertations*. 1039.

<https://digitalcommons.du.edu/etd/1039>

Michaels, Rauch (2012). Resetting the Urban Network: 117–2012, *The Economic Journal*, Volume 128, Issue 608, 1 February 2018, Pages 378–412, <https://doi.org/10.1111/eoj.12424>

Mozilla. (n.d.). Xlink:href. Retrieved February 11, 2019, from <https://developer.mozilla.org/en-US/docs/Web/SVG/Attribute/xlink:href>

ORBIS_Stanford. (2012, May 30). “And here is a rather subdued way of celebrating that ORBIS received 275,000 visits in its first month.” [Twitter Post]. Retrieved from

https://twitter.com/ORBIS_Stanford/status/207935266055401474

ORBIS_Stanford. (2012, May 26). “Analytics can make you sad: Reddit sent us 50k visitors but only 16k saw the map! Use direct link next time: <http://orbis.stanford.edu/#map>” [Twitter Post]. Retrieved from

https://twitter.com/ORBIS_Stanford/status/206429331763904512

Scheidel, W. (2013). Explaining the Maritime Freight Charges in Diocletians Price Edict. *SSRN Electronic Journal*. doi:10.2139/ssrn.2242577

Scheidel, W. (2013). The Shape of the Roman World. *SSRN Electronic Journal*. doi:10.2139/ssrn.2242325

Scheidel, W., & Meeks, E. (2012). ORBIS: The Stanford Geospatial Network Model of the Roman World. Retrieved February 11, 2019, from <http://orbis.stanford.edu/>