Rockets shriveling the world

Alain L'Hostis, Maxime Hachette

Rockets Shriveling the World★

Alain L'Hostis[a,*,1], Maxime Hachette[a,2]

[a] LVMT Univ Gustave Eiffel IFSTTAR Ecole des Ponts F-77454, Marne-la-Vallée, France

ARTICLE INFO

Keywords:
Geographical time-space
Rocket transport
Shriveling

ABSTRACT

No abstract needed. No abstract needed.
No abstract needed.
No abstract needed.

1. Introduction

Representing time-space produced by transport means belongs to the major aims of cartography, addressing the questions of where and at which distance are places. In this field, the limits of the usual topographic maps have been challenged with isochrones (e.g. O'Sullivan, Morrison and Shearer, 2000), anamorphic cartography (e.g. Forer, 1978) and shriveled maps (Mathis, 1990; L'Hostis, 2009). In this paper, we will explore the latter approach. We will first explain this representation method, and will then illustrate the usefulness of this graphical model to illustrate the impact of increasing speed on the geographical space. The higher the speed, the more geographical space shrivels and transforms into a complex shape (L'Hostis and Abdou, 2021).

2. Visualisation method

On a conventional geographical map, kilometres distance measurements are often not consistent with time-distance measurements. In order to ensure more coherence, shriveled maps represent time-space by using the third dimension. This model allows proposing a cartographical model based on two different modes of transport with different speeds. The shriveling model is a representation of geographical time space where the third dimension allows drawing transport modes with different speeds. All connections remain proportional to a time-space scale. Previous applications of the model involved high speed rail (L'Hostis, 1996) and air transport modes (L'Hostis, 2009) at national or continental scales. The most recent development of the shriveling model involves using curves for the fastest mode connection (rockets) and cones for the slowest road transport surface (car) (L'Hostis and Abdou, 2021). In the shriveling model, the focus is on the cities that connect to rapid transport systems. The geometry of curves is determined to reflect the time-distance generated by the connections. The cones represent the time-distance using the slowest means of transport. In consequence, the summits of the cones are centred on the cities. The ratio between the road speed and the fastest existing connection determines the slope of the cones. The assembly of these cones generates a road transport surface. The length of an edge, or of an itinerary on the transport surface, can be converted into a duration by using a unique time-space scale.

In the shriveled model, the straight line, or the geodesic line in an unprojected representation, will indicate the fastest existing transport connection. All the other connections, by fast transport represented by curves, or using the road surface resulting from the assemblage of cones, will extend in the third dimension so that their length is proportional to the time spent to travel.

We express on figure 1 (a) the principles of the shriveled representation. The side view of the two cities shows proportional time-distances by fast – in red – and slower, road transport connections. The introduction of faster transport systems provokes a transformation of the geographic surface that bears similarities with the shriveling of a fruit, that loses internal substance while preserving the extent of its envelope.

3. Description of the visualized phenomenon

Long distance airlines are currently the fastest existing transport system, with a typical speed of 750 kilometres per hour. In 2017, the company SpaceX made public plans to introduce fast intercity connections using rockets in a ten years horizon[1]. We aim in this paper to represent how global time-space would evolve in the hypothesis of the introduction of such a transport system.

We implemented a shriveled model with current regular airline services and envisaged rocket transport services[2]. We modeled the air transport network using the OpenFlight database[3]. We created the global transport network between cities from an adaptation of the United Nations list of urban entities (United-Nations, 2015). We considered the proposed

★Research for the production of these representations and the associated reflection, in the context of project REBALANCE, has received funding from the European Union's Horizon 2020 research and innovation program under the grant agreement No. 101007019.

*Corresponding author

alain.lhostis@univ-eiffel.fr (A. L'Hostis); maxime.hachette@univ-eiffel.fr (M. Hachette)

https://www.lvmt.fr/en/equipe/alain-lhostis/ (A. L'Hostis)

ORCID(s): 0000-0002-2334-4127 (A. L'Hostis); 0000-0002-0048-7870 (M. Hachette)

[1] Web site https://www.spacex.com/vehicles/starship/ visited in 2020.

[2] Following an open science approach, the three dimensional model and the rendered images can be reproduced by using the open source applications Shriveling world (https://theworldisnotflat.github.io/shriveling_world) and Blender (https://www.blender.org/).

[3] Website https://openflights.org/ visited in 2020.

Route		Distance	Airline	Starship
Los Angeles	New York	3,983 km	5h25	25 min
Bangkok	Dubai	4,909 km	6h10	27 min
Tokyo	Singapore	5,350 km	7h10	28 min
London	New York	5,555 km	7h55	29 min
New York	Paris	5,849 km	7h20	30 min
Sidney	Singapore	6,288 km	8h20	31 min
Los Angeles	London	8,781 km	10h30	32 min
London	Hong Kong	9,648 km	11h50	34 min

Table 1
Spatio-temporal performance of existing and proposed transport services envisaged by SpaceX in 2017

Transport mode	Speed	Rocket speed is...
Road transport by car	70 kph	243 x road speed
Airline flights	750 kph	23 x airline speed
Rocket flights	17 000 kph	

Table 2
The speed of the transport modes considered

connections and their duration, presented in table 1, to generate a network and define a speed for this transport mode: 17 000 kph, i.e. 23 times the airline speed.

In order to produce a representation of geographical time-space, we consider the commercial speed of transport systems, e.g. a speed based on commercial timetables for airlines, for the reasons detailed by L'Hostis and Abdou (2021). Often substantially lower than the maximum or cruise speed of transport vehicles, the commercial speed includes most time constraints experienced by a user, and can be considered a relevant measurement of the spatio-temporal performance of the transport supply. Table 2 shows the considered transport modes and their associated speed.

On figure 1 (b) we visualise rocket services in red, along the geodesic, and airline services in blue. In this time-space, the long aircraft connections take the form of blue curves high above the earth surface. In time-space, rockets completely outperform airlines.

In order to visualize the effects of the introduction of rocket transport on terrestrial space, we need to zoom in and remove the airline connections. On figure 1 (c) we see, at a different timescale, all the proposed rocket connections, in red. This radical shift towards rocket speed for human transportation echoes the reflection on the geography of a feared global conflict with near immediacy between causes and effects in a time-space produced by the speed of rockets (Bunge, 1988). Extreme speed of movement in geographical space possesses strategical value for military affairs. Rocket transport has the ambition tu use this extreme speed for the benefit of people mobility[4]. In application of the shriveling model, the slope of cones is generated by the ratio of road speed to rocket speed, one to 243. Cones, that bear geographical space, becomes very spiky needles[5]. Rockets turn geographical time-space into a series of *time-space needles*. The very high ratio of speed between coexisting transport modes makes implementing any alternative method of representing time-space – classic map, anamorphic map (Forer, 1978) or spring maps (Plassard and Routhier, 1987; Tobler, 1997) – very challenging. The extreme difference in speed should entail a near disapearance of geographical space as in the classical geographical model of the shrinking world (McHale, 1969; Abler, Janelle, Philbrick and Sommer, 1975; Kirsch, 1995), an idea that the shriveling model converts into producing spiky needles. As all previous applications of the shriveling model considered speed ratios of two orders of magnitude less, between 3 (L'Hostis, 1996) and 7 (L'Hostis, 2009), we can here validate an enlargement of the domain of application of the model to significantly higher ratios. Referring to the shriveling metaphor, we observe that cities completely lose their geographical substance.

The proposed connections operate a selection in the upper level of the global urban hierarchy. Between these cities, all connection takes less than one hour, indicating the new size of the world in this future hypothetical time-space. The time-space scale of figure 1 (c) indicates the diameter of the world in 2030, in time units, as 45 minutes. But at the same time, most of geographical space will remain accessible only by means of current, slow speed. This argument of the coexistence of transport modes, of a coexistence of dramatically different speeds, calls for a unified representation, which is introduced here.

4. Conclusion

We introduce an implementation of the shriveling model – that has the ambition to describe the shape of geographical time-space – considering the hypothesis of the introduction of city to city earth transport with rockets. The message conveyed by these images is threefold. In a geographical time-space perspective, city to city rocket transport would reduce the overall size of the world to less than an hour. At the same time, the access conditions to the non-metropolitan space would remain largely unaffected. But the articulation of these two systems of movement will generate major transformations of the shape of geographical time-space. Any movement in geographical space for a passenger exiting a rocket will constitute an experience of a reduction of speed of two orders of magnitude. The experience of space will probably be transformed and the combination of extremely different speed would generate a dramatically transformed time-space surface and would lead to a spectacular image where geographical extent does not vanish but transforms into a series of needles, isolating major world cities.

[4] The science fiction novel "Too Like the Lightning" by Ada Palmer explores possible societal, political and economic consequences of near immediate global mobility.

[5] From a purely graphical point of view, the proposed representation echoes Kohei Sugiura's time-space anamorphic cartography characterised by sharp spikes (Sugiura, 2014), even though the method strongly differs.

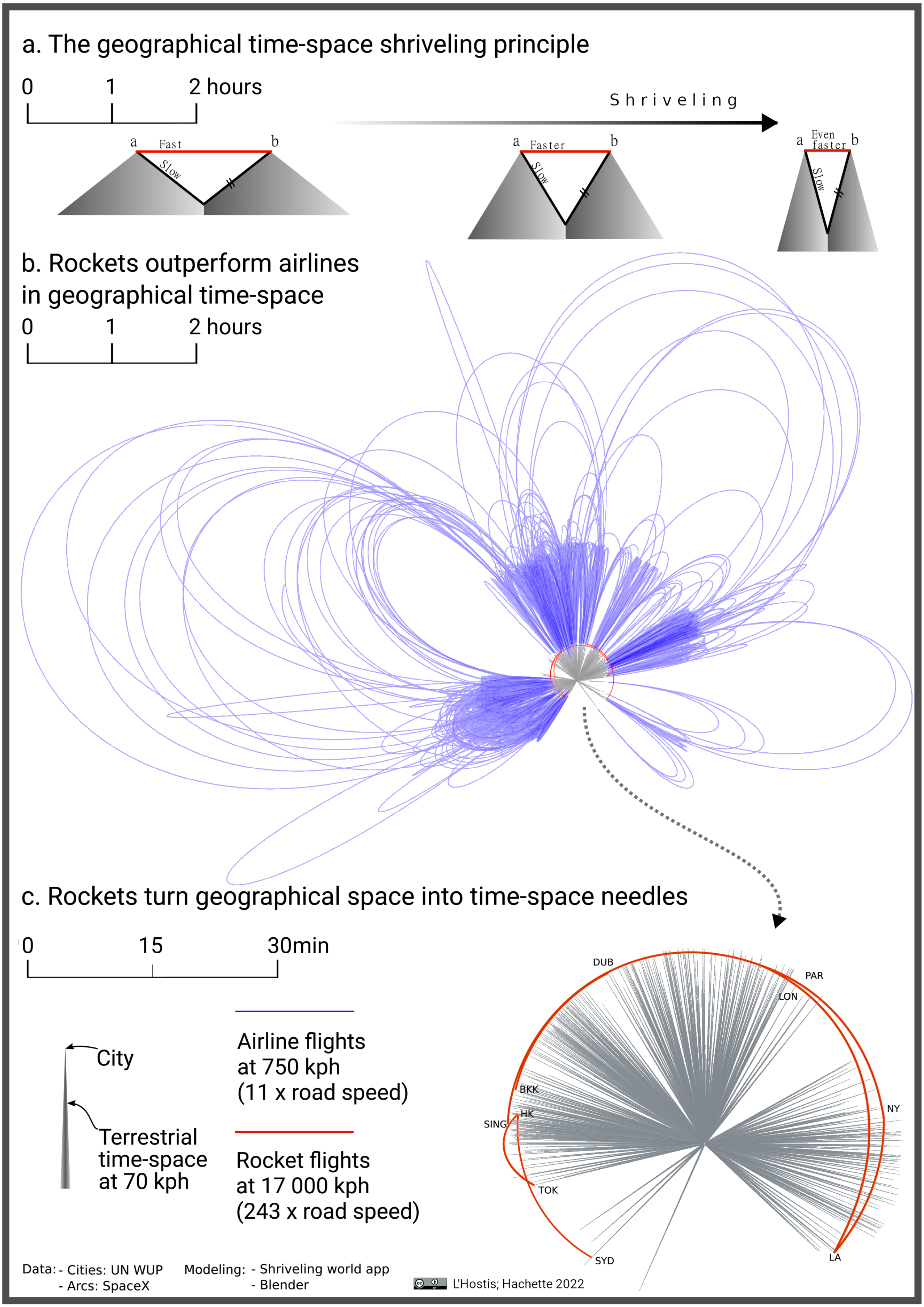


Figure 1: Rockets shriveling the world

5. Acknowledgements

The authors thank Jules L'Hostis for contributing to the illustration of the principle of the model (figure 1 (a)). The authors credit Andreu Ulied and Harvey Miller for discussing the images in the context of the European research project REBALANCE.

CRediT authorship contribution statement

Alain L'Hostis: Conceptualization of this study, Methodology. **Maxime Hachette:** Methodology.

References

Abler, R., Janelle, D.G., Philbrick, A., Sommer, J., 1975. Human Geography in a Shrinking World. Duxbury press, Scituate.

Bunge, W., 1988. Nuclear War Atlas. 1st edition ed., Blackwell, Oxford, UK ; New York, NY, USA.

Forer, P., 1978. A Place for plastic space. Progress in human geography 2, 230–267. doi:10/ggw6bs.

Kirsch, S., 1995. The Incredible shrinking world? Technology and the production of space. Environment and Planning D: Society and Space 13, 529–555. doi:10/bq4fzn.

L'Hostis, A., 1996. Transports et Aménagement du territoire: Cartographie par images de synthèse d'une métrique réseau. Mappemonde , 37–43.

L'Hostis, A., 2009. The shrivelled USA: Representing time-space in the context of metropolitanization and the development of high-speed transport. Journal of Transport Geography 17, 433–439. doi:10/dv69r3.

L'Hostis, A., Abdou, F., 2021. What Is the Shape of Geographical Time-Space? A Three-Dimensional Model Made of Curves and Cones. ISPRS International Journal of Geo-Information 10, 340. doi:10/gkcwsx.

Mathis, P., 1990. Espace et graphe, le p-graphe t-modal 1-planaire, in: Table ronde ASRDLF "Distance et analyse spatiale", ASRDLF, Chamonix. p. 10.

McHale, J., 1969. The Future of the Future. George braziller, New York.

O'Sullivan, D., Morrison, A., Shearer, J., 2000. Using desktop GIS for the investigation of accessibility by public transport: An isochrone approach. International Journal of Geographical Information Science 14, 85–104. doi:10/dx3sb7.

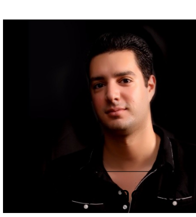
Plassard, F., Routhier, J.L., 1987. Sémiologie Graphique et Évaluation. A.R.T.U.R., Lyon.

Sugiura, K., 2014. , ... ⟨⟩: (Experiments in "Time Distance Map" : Diagram Collection by Kohei Sugiura – in Japanese). Kajima Publishing.

Tobler, W.R., 1997. Visualizing the impact of transportation on spatial relations, in: Western Regional Science Association Meeting, Western Regional Science Association, Hawaii. p. 7.

United-Nations, 2015. World Urbanization Prospects. https://esa.un.org/unpd/wup/.

Alain L'Hostis is senior researcher at the City, Mobility, Transport laboratory (LVMT) from the Université Gustave Eiffel. He holds a PhD and a habilitation thesis in spatial planning. His research topic is about geographical distances: he works on time-space cartography, on inter-urban distances through the measurement of accessibility, and on intra-urban distances in relation with the urban model of TOD.



Maxime Hachette is researcher at the City, Mobility, Transport laboratory (LVMT) from the Université Gustave Eiffel. He holds a PhD thesis in geography and spatial planning. His research topic is about sustainable mobility: he works on spatial ergonomics, on ergonomics of access to daily life resources with active mobility, on shared mobility assessment, and on investigating the culture of mobility while envisioning its evolution.