A. Questions related to the contain of the paper

Yuhan Yang and Jie Yin, 2019, Multi-coverage Optimal Location Model for Emergency Medical Services (EMS) facilities under various disaster scenarios: A case study of urban fluvial floods in the Minhang District of Shanghai, China", NHESS.

The paper focuses on a "*multi-coverage optimal location model for Emergency Medical Services (EMS) facilities based on the results of disaster impact simulation and prediction*" (p. 1) ». "*The main purpose of our location model is to reduce the probability of delays in the emergency response caused by insufficient emergency facilities and resources*" (Lines 94-95). "… ***the objective of this model was to determine the locations of emergency stations to rescue the largest number of people in 8 minutes***." (Lines 359-360).

This article focuses on optimizing the location of 12 EMS (China, Shanghai, Minhang District) by considering 514 demand points and 106 potential EMS points. For this, the authors combine 3 complementary aspects/steeps:

- Approach of the optimization of the EMS location (with Lingo 10.0 software)
- A flood simulation approach (1D and 2D models). The software used is not indicated? However, two references are mentioned (Yu and Lane 2006a and 2006b).
- And geomatic processing (GIS) with ArcGIS 10.2 (especially Network Analyst module).

Line 86: "... *here we describe a novel approach for the optimization of EMS*"

And line 189: "*we propose a new method to estimate the level of demand*"

What is/are the innovative aspect-s of the paper?

- The implementation of a treatment chain including the development of flood scenarios (100 and 1000 years return periods).
- An interesting aspect is the "*Coverage level analysis*" (2.4 section).

The aspect of "*Disaster risk level*" analysis (2.5 section) simply depends on the proximity of the flood hazard and EMS (Euclidean distance? See line 215).

Assumption number ② (line 131): in general, the EMS capacity and the number of ambulances are variables by EMS (for each EMS). These aspects would constitute future developments (perspective) for improving the model proposed (see below).

Line 163 : "*To ensure the efficiency of rescue, the emergency response time must be minimized*": for each ambulance (each rescue) or for all ambulances (all calls/rescues)?

The aim is to minimize the time (OD) between i (demand point) and j (facility or EMS point) OR to minimize the total time of all trips/journeys between all demand points (i) and EMS (j)?

If only the travel time of each ambulance must be optimized (independently of the trips of the others ambulances), the corresponding OD distance must indeed be minimized.

[As you know, during a crisis period, the emergency vehicles can travel relatively faster compared to regulatory speed limits according to the traffic jam (the ambulance use there sirens). On the other hand, the urban density tends to homogenize and to reduce the statutory road speeds of 30, 50, 70 to 90 km/h between the city center and the countryside areas.]

However, calls usually come to a call center, which distributes them according to different aspects, such as the availability of ambulances, the remaining capacities of the nearest EMS of the site, and so on. But it seems that the paper is not in this configuration (sorry, I am not familiar with the Chinese rescue system). Please, see the comment above related to the assumption ②.

The minimization of the total time (sum) of all the journeys between the demand points (i) and EMS (j) induce the problem of competition between calls and therefore peoples to be rescued: first come, first served (beds in a hospital / EMS).

Hence, the combinatorial aspect (complex problem, NP ...) of such assignment depends on: the number of peoples to be rescued per calls / demand points (i); the capacity of each EMS (j) and available ambulances / vehicles and their own / specific capacities (equipment).

[Other aspect: not all EMS will be able to welcome some people suffering from a particular pathology / disease / trouble (asthma or heart attack due to anxiety and fear of flooding). For such cases, the ambulance must be equipped with specific equipment/material plus qualified stretcher (nurses). This neglected aspect can be indicate as future perspective.]

Line 167 :

$\sum$ (i=1 to n) of yj = F

Or

$\sum$ (j=1 to n) of yj = F ?

Line 255: "…*in the Huangpu River Basin in the 2010s, 2030s, and 2050s* (Fig. 2)"

Does this mean that the flood simulation model takes into account aspects such as precipitation trends, urban sprawl and / or population change in 2010, 2030 and 2050 (in a context of climate change?). I imagine that all these aspects are considered in the cited references of Yu and Lane 2006a and 2006b (Line 249).

Line 263 : "*We used five levels for the road speed limit*"

Remember that ambulances and rescue services (fire brigade) in general are allowed to exceed speed limits during an intervention. For low speed road sections (30 km/h for example), we could increase this speed in the model... (under ArcGIS, it is quite possible / easy to change the speed of a category / class of road sections with VB or Python script).

Section 3.3:

I understand that the potential stations (106) are the centroids of squared meshes (fishnet) of the applied grid (2 km * 2 km) on the site.

On the other hand, the method/process of designing the 514 demand points is less clear (red dots, Fig. 4 - 5, page 11). Shanghai → Minhang district → Community unit (demand unit = smallest block unit)?

Does each red dot correspond to a block of buildings (group of contiguous buildings)? If yes, how to know the population by block/group of buildings (in China)? Do you know the population per building? (see section 3 Grouping of Buildings, *Alaeddine et al*., 2015, pages 689-690).

About the applied grid of **2 km * 2 km**: can be discussed in the section of results / discussion / conclusion of the article. Indeed, what is the impact of such division/regular zoning on the method and results obtained? Can we develop / imagine a **multi-scale** division with variable squared meshes taking into account the distribution density of the population (spatial distribution of red dots)?

Please see the example of map 1, page 17 of the paper:

https://www.researchgate.net/publication/26431851_Integration_quantitative_du_paysage_lors_de_la_determination_de_traces_d%27un_amenagement_lineaire

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Line 327: Tab 1. No need to display/show the coordinates of points 1, 2, 3, etc. (latitude and longitude values). However, it misses the values of: min (A1), min (A2), max (A1) and max (A2) (equation 8) to allow the reader (who wishes to do it) to calculate/verify Q_i?

Point ID 1 (Tab.1) generated 74 EMS calls and the coverage level calculated Q_i is equal 4.

Where Q_i is : "*the number of times that each demand point i should be covered by the emergency stations in the service area within a specified time*" (lines 322-323).

So, do you know the number of real trips (statistical data of 2017)[1] done by ambulances between EMS and Point ID 1 (or at least the ratio between calls and trips)? If possible to

[1] Line 240, page 6: Statistical data of the 2017 Shanghai Emergency Center indicates that the number of EMS calls in 2017 exceeded 40,000 and the average emergency response time was about 15 minutes.

compare the distribution of Q_i (calculated values) with the values observed on the site in the recent past (a way to appreciate/validate the values obtained/calculated of Q_i).

Line 340, Section 3.3.2: which flood scenario is considered in Fig. 5?

The 3 buffers of **1 km each** used to characterize the indicator "*Disaster Risk Level*" are more relevant (pertinent) especially if it is the flood scenario of 100-y (rather than 1000-y). In this case, the spatial discretization (by the 3 buffers) will be interesting to take into account the variability (uncertainty) of the flood extension between the simulated scenario and the observed one (flooding closer to 150 or 200-y ... than 100-y).

A flood of 1000-y, may already be considered as an extreme event (I am not familiar with the site studied). To have water beyond the flooded area of 30 cm (Fig.5), it would take a more extreme flood event (1500-y ...). Is this possible in the context of the study site (climate change)? In the past, has there been a higher (historical) flood than the 1000-y scenario?

Here is a proposal for the flood of 1000-y:

- p_j = 0 if water height is > 30 cm (EMS is completely inundated)
- p_j = 1 if water height is <= 30 cm
- p_j = 2 if water height is = 0 cm (EMS is not inundated)?

The method shown in Fig.5 seems more suitable (pertinent) for the 100-y flooding scenario.

Line 355: The calculation of the OD matrix with the ArcGIS NetworkAnalyst extension does not take into account the traffic jam during the crisis? (see Line 192)

The implementation of a transport model (traffic model) can be considered as a significant improvement (perspective) of the proposed model especially during crisis (flash flooding).

Line 374 : "*…i.e., the larger the service area, the larger the number of people who can be served by this station*": this statement (affirmation) is not always true.

In the center of the cities (metropolitan area), the service area of an EMS (or "shelters" in general) can be relatively small but with a large / high number of people to take care of. It therefore depends on the urban location and the capacity of each EMS.

Please see Figure 1, page 3 of the paper: « Optimisation combinatoire de l'affectation interne de la population de Nice aux centres d'accueil en cas de séisme », 2017.
https://www.researchgate.net/publication/322040849_Optimisation_combinatoire_de_l'affectation_interne_de_la_population_de_Nice_aux_centres_d'accueil_en_cas_de_seisme/

Or see: https://hal.archives-ouvertes.fr/SAGEO2017/hal-01650670

In the present case of this article, the service area is calculate only according to the ambulance travel time (t_{ij}). It is an area of the same accessibility (isochronic or isodistance area). The higher the t_{ij} (8, 12, 15 min), the larger the area ("and the larger the population") to be cared for may be important.

Hence, the importance to consider (in the future) the capacity of EMS (perspective).

Finally, what about the indirect impact of flooding (indirect vulnerability)?

Some doctors, drivers of ambulances, nurses, fire brigade agents, etc. living outside the flash flooded area will probably not be able to join their job location/office/building (due to the 'barrier area' effect, Line 281)…

B. Questions related to the form of the article ("technical corrections")

Questions ①, ②, ③ and ④ are not repeated / recalled ... in the section dedicated to the results. Example: Line 318: "The coverage level Q_i of the demand points (question 1, line 119, page 3) ..."

There is a risk of confusion between Questions ①, ②, ③ and ④ (page 3) and Assumptions ①, ②, ③ and ④ (page 4). Use: Q1, Q2, Q3 and Q4 // A1, A2, A3 and A4 or other solution.

Line 188 : "*... the disaster risk level mi/pj of the demand points/potential facilities*"

mean:

... the disaster risk levels of the demand points (m_i) and potential facilities (p_j) separately? (see Line 116 : "*We consider the risk of a disaster at the potential emergency points and the demand points separately*")

Could you please precise / reformulate this line.

Line 242: for the reader unfamiliar with the study site and in terms of urban vulnerability, the selected flash flood scenario impact how many km of roads and how many peoples (buildings), the duration (number of hours, days…) of flooding…? If possible to provide more relevant /precise ideas about the flood impacts on the site.

Fig 1: I suggest considering another color than RED one to represent district boundaries.

In general, the legend of maps (Fig 1, 2 ...) are too small (not visible).

Concerning the two selected flood scenarios (100 and 1000-years), what is the major historical flood that has been observed on the site? It would be interesting to consider the major historical hazard? (section 3.2, line 255)

Line 274: In terms of emergency management, when ~~When~~ fluvial flood disasters occur, roads near rivers become inundated, leading to traffic…

Line 287: "*Figure 2 shows that during a 100-y flooding occurs, one emergency station* (Name = ?, see Fig. 3) *will lose capacity due to inundation*"

Line 288 : "*whereas a 1000-y flooding will affect two stations* (Names = ?)"

Line 290: "*Figure 3 shows the impact on the area serviced by each station for the different flood scenarios.*"

For the Fig 3, is it possible de precise ("again") the duration considered finally to compute (with ArcGIS, Network Analyst, Service Area Analysis) the best (shorted) trip of the ambulance 8, 12 or 15 min?

Line 298: it is difficult to make visually and easily the link between the coloured curves and the legend (the name of each EMS).

At least, the order of the name of the stations (12 EMS) in the legend must be the same than the order of the curves to improve the reading of this Fig.

Line 322: why the alpha and beta weights are the same (equal)?

Line 411: Fig. 9 Comparisons of the average coverage level

Figure 9 shows "*coverage level*" in REAL values (3**.**54, 3**.**74 etc.) and not in **INTEGER** values? (See equation 9, page 5)

Finally, I propose to the authors (if possible) to design a logi-gram related to the developed methodology and results. Please, see example of the Figure 2, page 689, *Alaeddine et al.*, 2015.

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