Medical Geography

Introduction to Medical Geography

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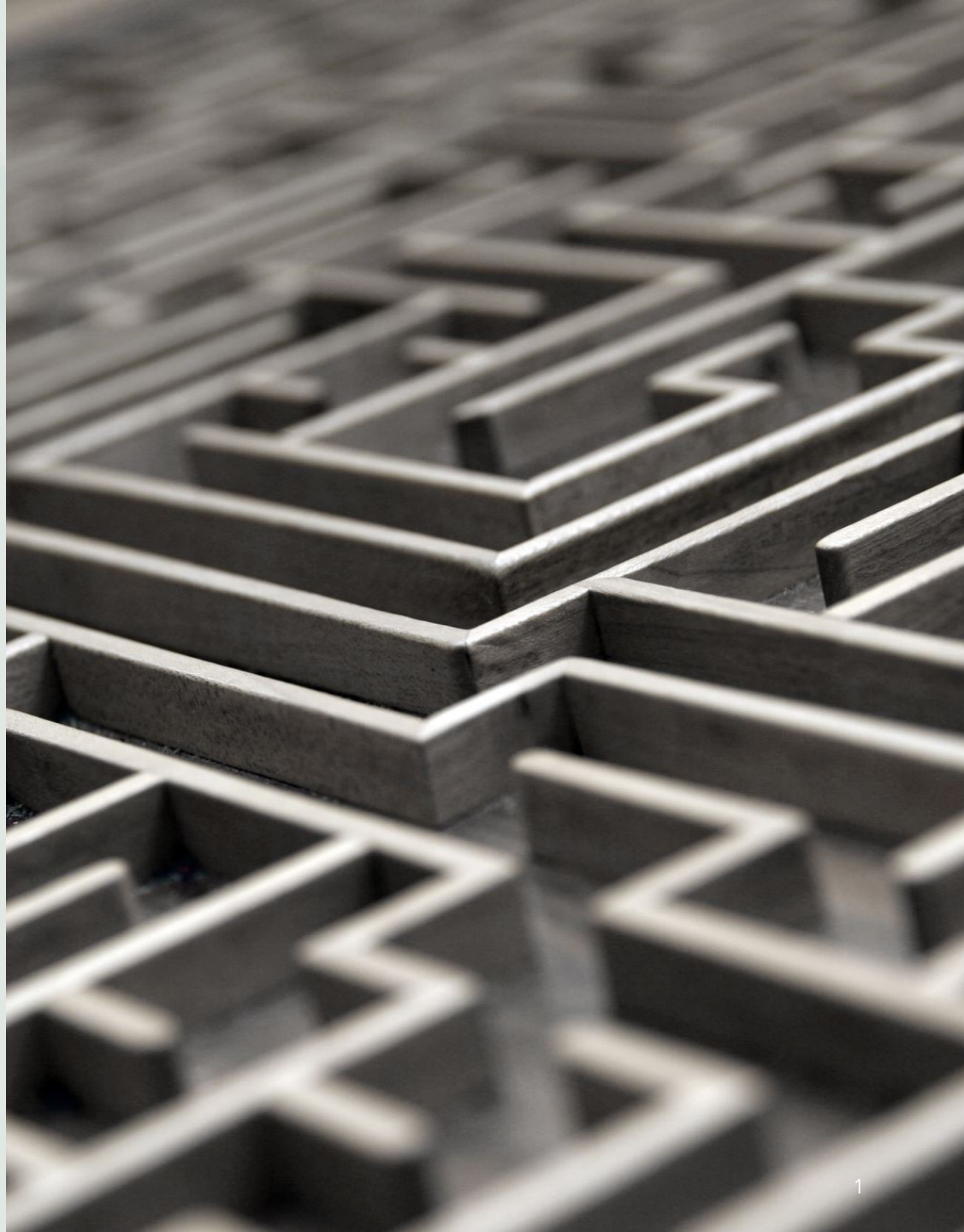
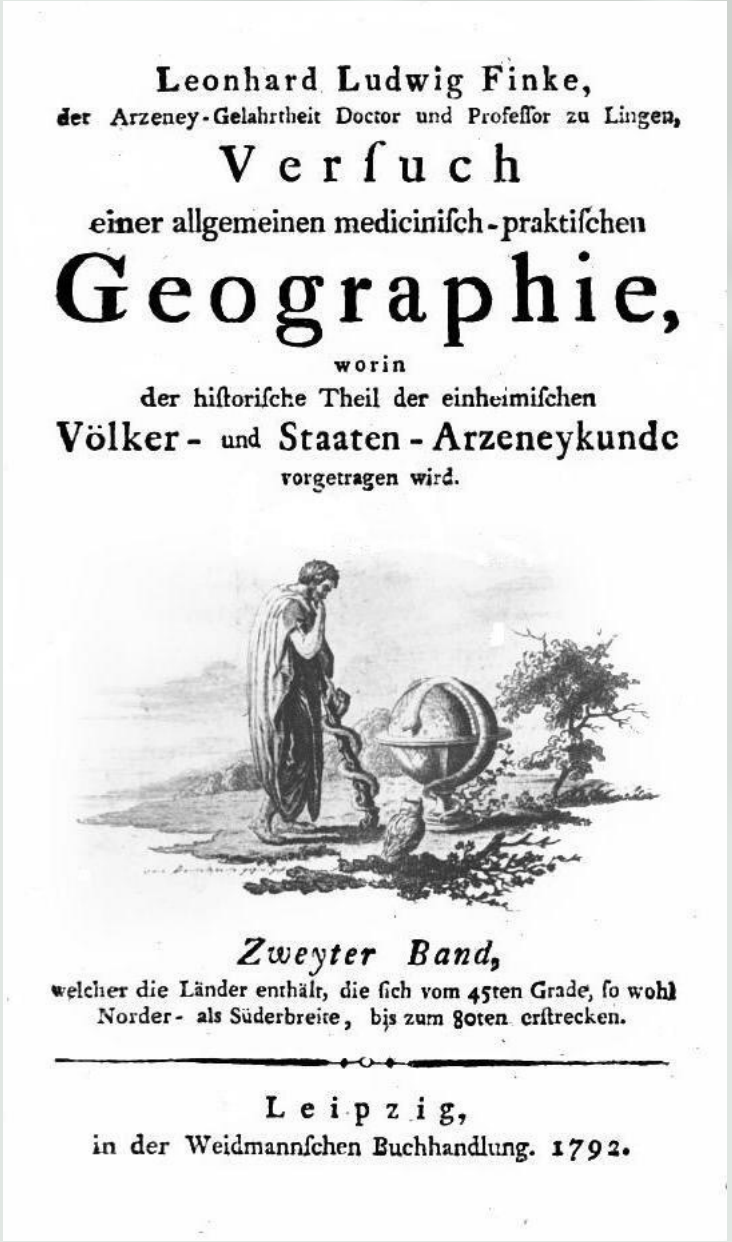
Outline

- Beginning (Malaria & Pellagra)
- The Concepts of Medical Geography
- Objective of Medical Geography
- Disease Ecology
- Basic Models
- Diffusion Models
- Spatial Techniques
- Risk Factors



To which diseases and evils is man exposed, because he lives here and not somewhere else, because he breathes this and no other air, he eats this and no other food, drinks this and no other water, has this and no other way of living and so on…

Leonhard Ludwig Finke, 1792


Leonhard Ludwig Finke,
der Arzeney-Gelahrtheit Doctor und Profeſſor zu Lingen,
Verſuch
einer allgemeinen mediciniſch-praktiſchen
Geographie,
worin
der hiſtoriſche Theil der einheimiſchen
Völker- und Staaten-Arzeneykunde
vorgetragen wird.
Zweyter Band,
welcher die Länder enthält, die ſich vom 45ten Grade, ſo wohl Norder- als Süderbreite, bis zum 80ten erſtrecken.
Leipzig,
in der Weidmannſchen Buchhandlung. 1792.

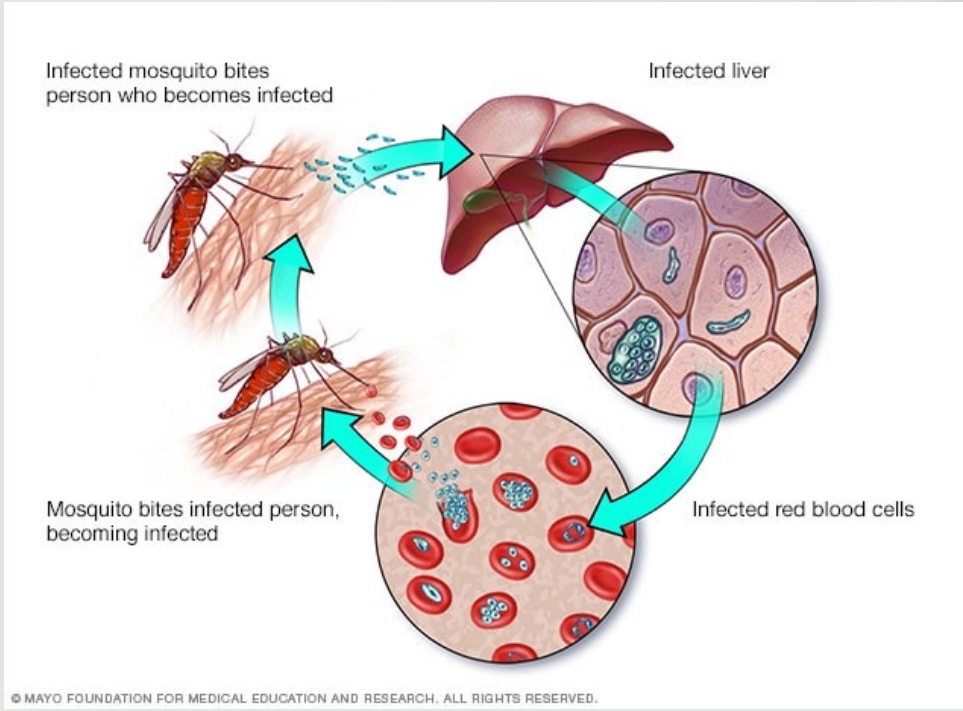
At the beginning, …

- From Richard Upjohn Light (1944) …
- Man's existence on the planet is determined basically by the physical environment offered him: the atmosphere, the animate creatures of the land and sea, the maintenance of heat, and so on.
- Were these things not as they are, life would fail altogether; alterations less than total necessarily results in impairment of life ranging from near extinction on through the gradations of sickness and ill-health to scarcely perceptible minor influences.

Light, R. U. (1944). The progress of medical geography. *Geographical review*, *34*(4), 636-641.

At the beginning, … Malaria

- From Richard Upjohn Light (1944) …
- Malaria （瘧疾）, we know, can occur wherever the anopheles mosquito lives, provided it is infected with the *Sporozoa* genus *Plasmodium*.
- But is the case of malaria as simple as this statement implies?
- The geography of malaria still holds deep mysteries.



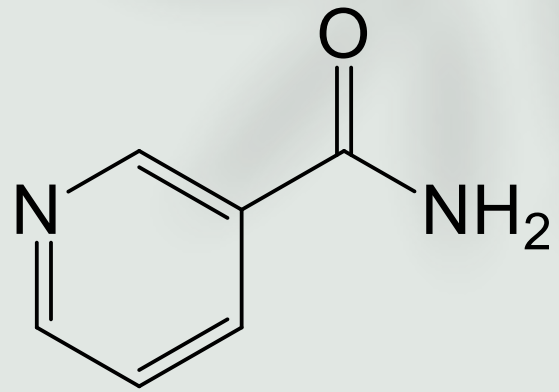
At the beginning, … Pellagra

- From Richard Upjohn Light (1944) …
- The geography of pellagra (糙皮病) is by no means dead merely because one can put one's finger on a specific chemical substance, the lack of which causes the disease to appear.
- The first cases of pellagra reported in the United States were observed in an insane asylum in Tuscaloosa, Ala., in I907 (The disease has been known in Europe at least since I780).

https://www.yxj.org.cn/detailPage?articleId=326109

At the beginning, … Pellagra

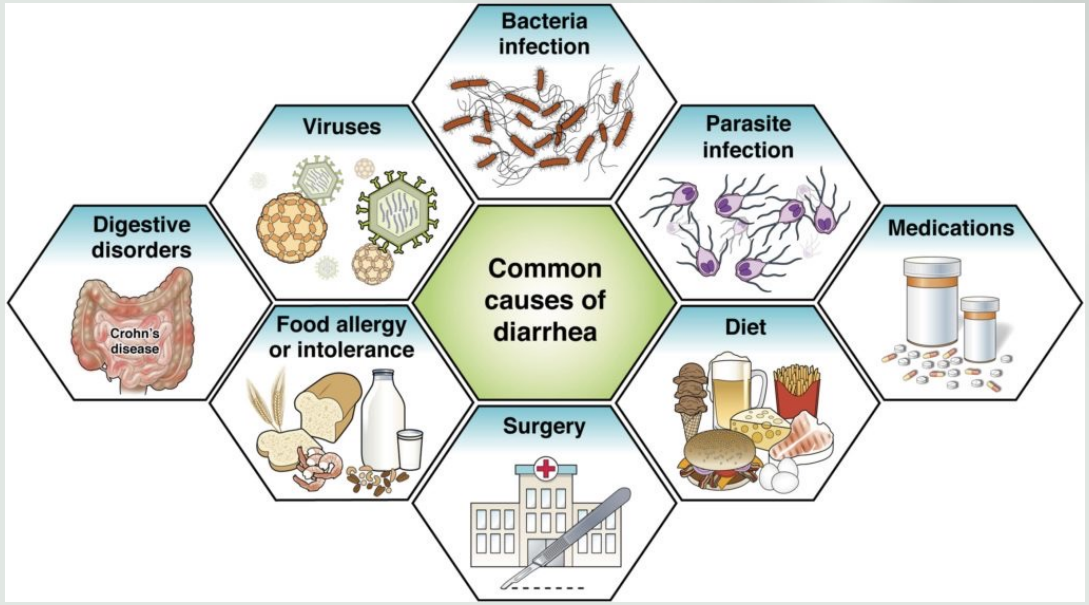
- The disease may occur anywhere on the face of the earth, yet today students of pellagra who wish to see it in its most virulent form, and in the greatest concentration of cases, still flock to northern Alabama; and Tom Spies, who first linked deficiency of nicotinic acid amide（菸鹼醯胺）to pellagra, has established there, at Birmingham, a laboratory for clinical research of ambitious proportions.



nicotinic acid amide

At the beginning, … Pellagra… Symptoms

- **Diarrhea** is loose, watery and possibly more-frequent bowel movements
- **Dermatitis** is a general term for conditions that cause inflammation of the skin
- **Dementia** is not a specific disease but is rather a general term for the impaired ability to remember, think, or make decisions that interferes with doing everyday activities.
- **Death** is just death…



https://patient.gastro.org/diarrhea/

At the beginning, … Pellagra… Prevalence

- From Richard Upjohn Light (1944) …
- Pellagra can be common in people who obtain most of their food energy from corn, notably rural South America, where maize is a staple food.

At the beginning, … Pellagra… Observe

- In 1915, Dr. Joseph Goldberger, assigned to study pellagra by the Surgeon General of the United States, showed it was linked to diet by observing the outbreaks of pellagra in orphanages and mental hospitals.
- Goldberger noted that children between the ages of 6 and 12 (but not older or younger children at the orphanages) and patients at the mental hospitals (but not doctors or nurses) were the ones who seemed most susceptible to pellagra.

Dr. Joseph Goldberger

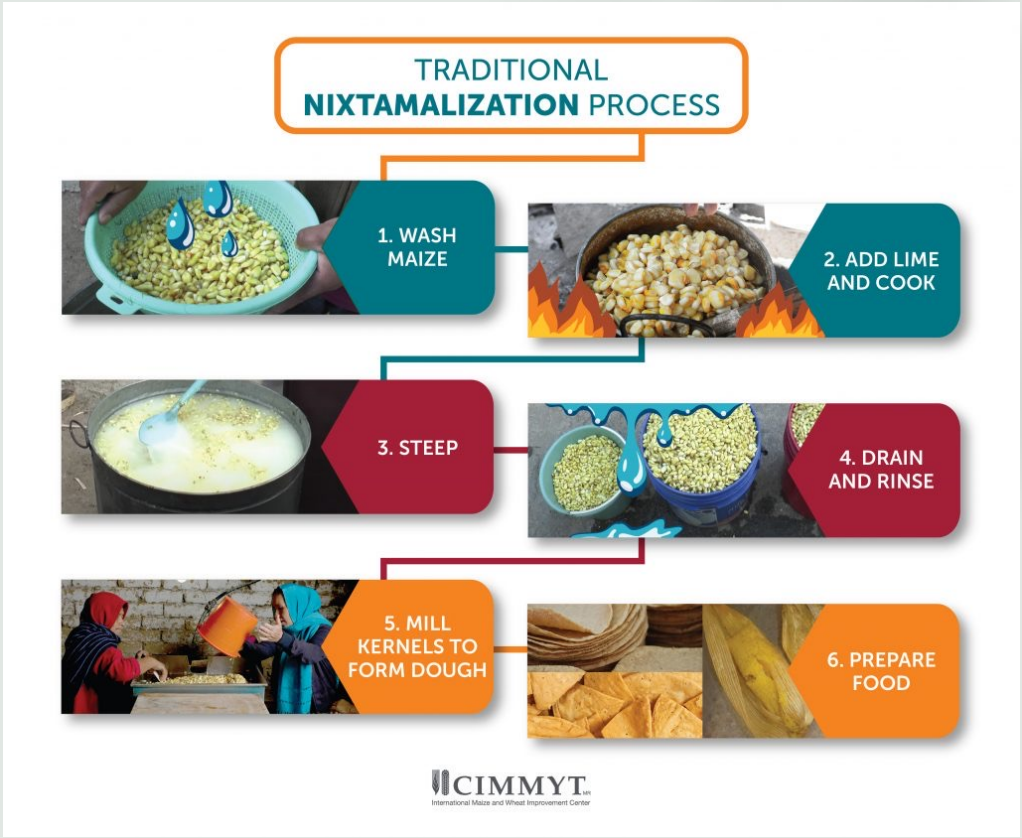
At the beginning, … Pellagra… Observe

- Goldberger **theorized that a lack of meat, milk, eggs, and legumes** (豆類) made those particular populations susceptible to pellagra.
- By modifying the diet served in these institutions with "**a marked increase in the fresh animal and the leguminous protein foods**," Goldberger was able to show that pellagra could be prevented.
- By 1926, Goldberger established that a diet that included these foods, or a small amount of brewer's yeast, prevented pellagra.

Dr. Joseph Goldberger

At the beginning, … Pellagra… Fun Fact…

- If **maize** (玉米) is not nixtamalized (鹼法烹製), it is a poor source of tryptophan (色胺酸), as well as niacin.
- Nixtamalization corrects the niacin (菸鹼酸; 維生素B3;) deficiency and is a common practice in Native American cultures that grow corn, but most especially in Mexico and the countries of Central America.



https://www.cimmyt.org/news/what-is-nixtamalization/

Discussion 1

In your understanding, how will you do for finding the possible reason of pellagra?

The Concepts of Medical Geography

- **Medical geography** as an aspect of human geography has been given different definitions by different authors and the definitions are based on perspectives of authors (Uzoma, E.I.).

The Concepts of Medical Geography

Various Definitions

- Jacques May (1952): the distribution of diseases ➔ environmental factors.
- Hall (2000): the geographic aspect of health (status) and health care systems.
- Briney (2008): the spread of diseases ➔ the impact of climate on an individual's health and the distribution of health services.
- Rosenberg (2009): the geographic distribution of diseases (including epidemics and pandemics), illness, death and healthcare.

The Concepts of Medical Geography

- **Medical Geography** is a sub-discipline of Geography which deals with **human-environment interactions** and **the influence these interactions have on public health**. It focuses on the geographic aspects of health, healthcare and disease (Lang, 2000; Meade and Emch, 2013).

Fundamentals of Medical Geography

1. **Place**: Geography is naturally about space and place. Here, we look at the specifics of particular localities in which health or ill - health is experienced, risk factors (neighbourhood, socioeconomic status and measures of health status) are negotiated, and services organized and utilized (Meade, Florin and Gesler, 1998; Mayer, 2010).

Fundamentals of Medical Geography

2. **Health**: Health refers to a state in which an individual is perfectly adapted to his environment. It is according to the WHO (1948) "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity".

Fundamentals of Medical Geography

3. **Well beings:** a state of being healthy especially with regards to landscapes and environment (Williams, 2010).

Objectives of Medical Geography

The focus of medical Geography is on

1. The geographical patterns of health and diseases from the viewpoint of the populations rather than the individuals.
2. The various factors that affect the health of the population and, hence, individuals.
3. The power of mapping their study data (diseases)
4. Health problems with geographic factors
5. Facilitating a critical understanding of health, disease, illness and society
6. Predicting the occurrence of the major infestations to enhance their prevention.

Applications of Medical Geography

- Think about it!
- Give some examples…

Disease Ecology

- Disease ecology is the interaction of the behavioural ecology of hosts with the biology of pathogens (病原體), as it relates to the impact of diseases on population.
- Disease ecology has been commonly understood to include features of the environment, population, and culture in the explanation of patterns of disease, in answer to the questions of **“why is this disease here?” or “why is this disease in places like this?**
- Disease ecology deals with the relationship between disease and the geographical environment in which it occurs.

Disease Ecology

A. To develop an understanding of the relationships between diseases and environments

B. To develop an understanding of the interactions among pathogens, hosts or receptors and the environment.

C. To make it possible to prevent change in the infectivity and virulence of organism that threatens human health at population level.

Disease Ecology

D. To explore the impact of environmental change on disease etiology, vectors and toxic organism.

E. To develop new approaches to surveillance and monitoring.

F. Improving models of host-pathogen ecology.

Basic Models

- **Environmental or Ecological Models:** These are models that try to explain the occurrence of the incidence of disease on the basis of environmental associations and causations.
- **Spatial- Temporal Models:** These models aim at understanding or explaining the implication of space, distances and time, regarding to the spread of diseases.

Basic Models

- **Behavioural Models:** These models are concerned with the actual behaviours involved in the vector-host agent relationships in the occurrence of diseases.
- **Spatial Diffusion of Diseases:** Disease diffusion refers to the spread of disease from its source into new areas (Cromley and McLafferty, 2002). The diffusion of infectious disease moves both through population and over space (Meeade and Emch, 2013).

Diffusion Models

- **By expansion diffusion :** the disease may intensify in the originating region and then diffuses outwards to new areas (Hornsby, 2000; Pyle, 1979).
- **Relocation diffusion:** here, the diseases leave the originating areas and migrate to new areas (Hornsby, 2000).
- **Mixed diffusion :** It can be through a combination of expansion and relocation diffusion or a combination of contagious, hierarchical and network diffusion as in the case of HIV/AIDS (Cromley and McLafferty, 2002; Hornsby and Kathleen, 2000).

Diffusion Models

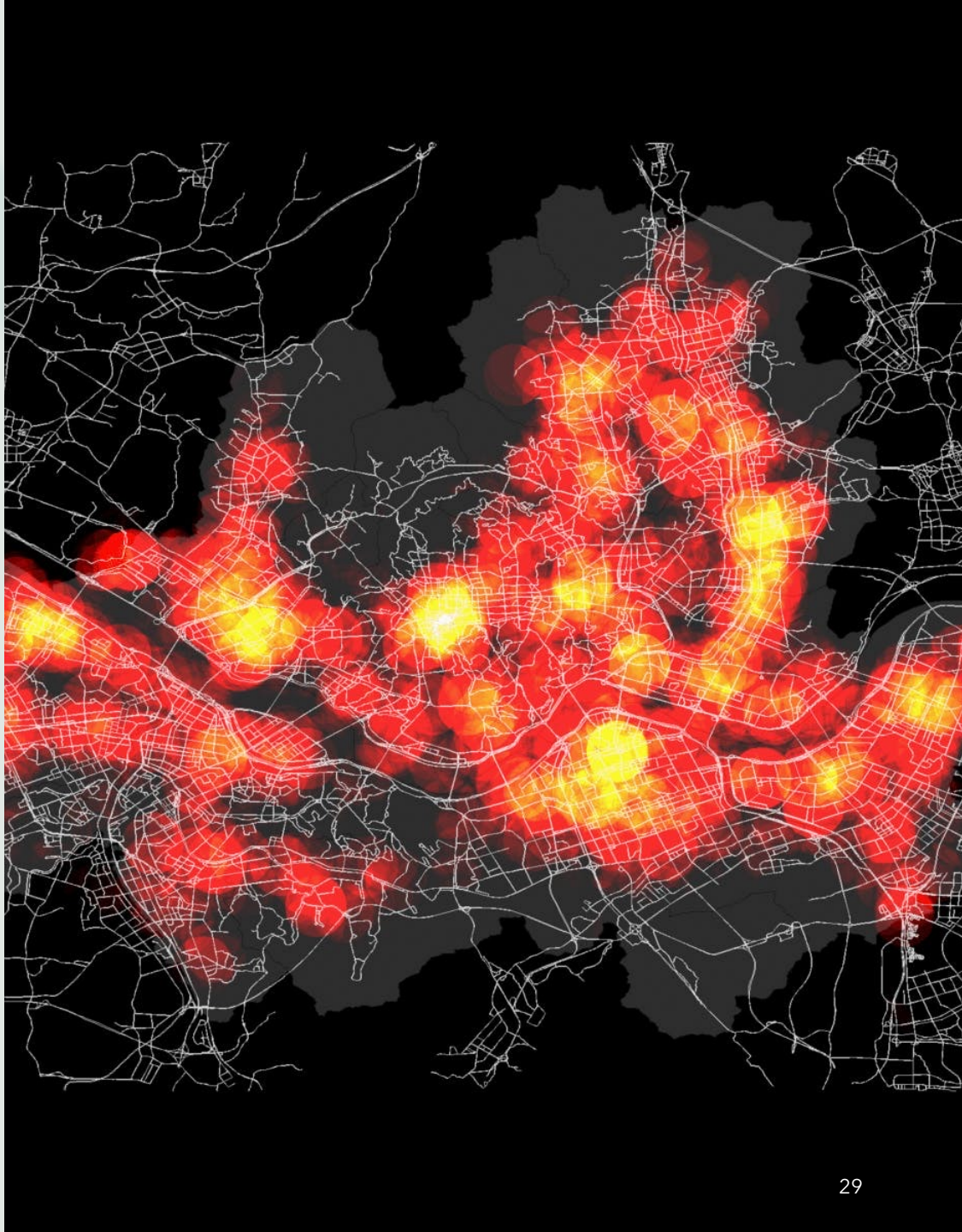
- **Network Diffusion:** Network diffusion occurs when a disease spreads via transportation and social networks (Cromley and McLafferty, 2002). It reflects the geographical and social structuring of human interaction.
- **Contagious or radial Diffusion:** Contagious diffusion is disease diffusion which depends on direct contact with individuals who have been infected (Hornsby, 2000).
- **Hierarchical Diffusion:** Hierarchical spread involves the spread of disease through an ordered sequence of classes or places (Hornsby, 2000), for example from large cities to remote villages.

Diffusion Models

- **Reversed Hierarchical diffusion pattern:** according to Altonen (2014), socio-economics and social inequality play a role in disease diffusion within densely populated areas, with certain diseases impacting the poor due to their population health features, local sanitation and environmental health related features.

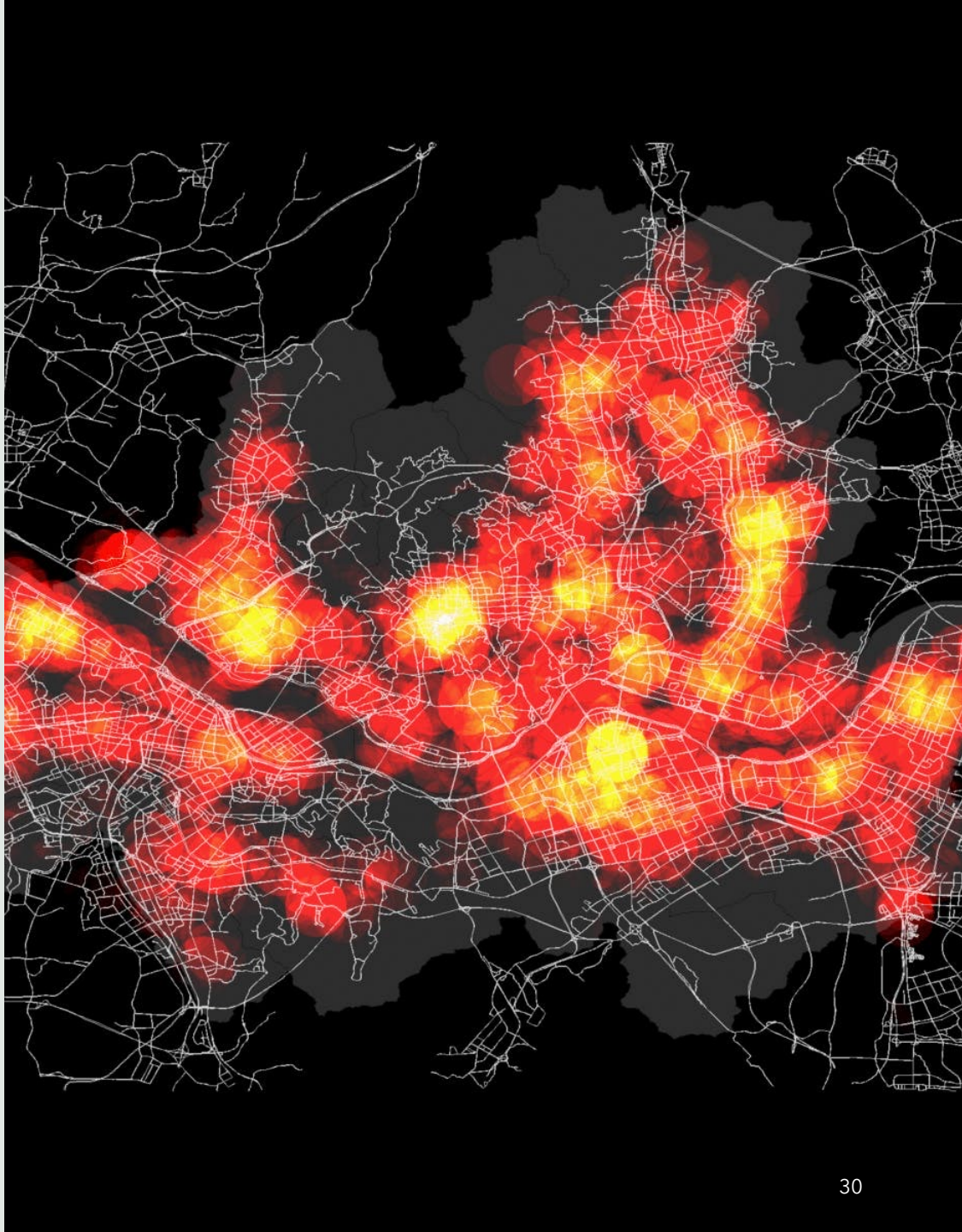
Spatial Techniques

- Spatial Analysis
- Multivariate spatial statistical modelling of disease process
- Mapping
- Spatial autocorrelation
- Local indicators of spatial association (LISA) statistics



Spatial Techniques

- Hotspot analysis (point-location; hierarchical cluster detection (kNN), partitioning, density, clumping, risk-based clustering)
- Density analysis
- Weighted overlay analysis
- Cluster analysis
- Distance analysis (k function)
- Dot-point analysis



Risk Factors

- **Pathological Factors**
  1. Causative agents
  2. Vectors
  3. Intermediate hosts
  4. Reservoirs
  5. Man

- **Geographical Factors**
  1. **Physical**
     - Climate (latitude, rainfall and humidity, temperature, barometric pressure, sunshine and cloudiness, wind direction and velocity, radiation, static electricity, ionization)
     - Relief
     - Soils
     - Hydrography
     - Terrestrial magnetism

May, J. M. (1950). Medical geography: its methods and objectives. *Geographical review*, *40*(1), 9-41.

Risk Factors

2. **Human or social**
   - Population distribution and density
   - Standard of living
   - Communications
   - Religuous customs and superstituions
   - Drug addication
3. **Biological**
   - Vegetable life
   - Animal life, on earth and in water
   - Parasitism, human and animal
   - Prevalent diseases
   - Dominant blood group

May, J. M. (1950). Medical geography: its methods and objectives. *Geographical review*, *40*(1), 9-41.

Challenges

- **Assignment:**

  In your understanding, what are the potential challenges in a medical geography example…?

  How to characterize it by leveraging spatial analysis techniques?

  What is the risk factor of this disease?

The End

Thank you for your attention!

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SCAN ME

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