



## Applied Remote Sensing Training (ARSET) Program

### Remote Sensing for Climate-Sensitive Infectious Diseases

## Homework Questions

### Question 1

What aspect of an infectious disease outbreak can be observable with satellite remote sensing?

Answers: (bold correct)

- a. Individual disease vectors can be remotely identified and tracked.
- b. Environmental conditions conducive to disease propagation can be remotely monitored.**
- c. Symptoms of individuals afflicted by a disease can be remotely measured.
- d. The societal impacts of a disease outbreak can be remotely assessed.

Feedback:

Satellites can remotely monitor environmental conditions. Individual disease vectors, symptoms, and societal impacts are not directly observable with satellite data.

### Question 2

Which of the following inputs into a disease outbreak model can be informed by remote sensing?

- A. Environmental conditions, such as temperature, precipitation
- B. Land use, as a proxy for exposure
- C. Infrastructure, as a proxy for access to care
- D. Disease vector counts, broken down by species

Answers: (bold correct)

- a. A and B
- b. A, B, and C**
- c. C and D
- d. A, B, C, and D

Feedback:

Remote sensing is capable of providing formation about environmental conditions (such as temperature and precipitation), land use (such as agricultural use or urban development), and human infrastructure (such as roadways).

### Question 3

Which of the following are methods to fill gaps in remote sensing data?

- A. Regridding
- B. Compositing
- C. Interpolating
- D. Modeling

Answers: (bold correct)

- a. A and B
- b. B and C
- c. A, B, C, and D
- d. B, C, and D**

Feedback:

Compositing, interpolating, and modeling are all techniques for filling gaps in satellite data. Regridding can map satellite data into a different coordinate system, but cannot fill in for missing data.

### Question 4

Which of the following satellite remote sensors and missions have been used to study or forecast climate sensitive infectious diseases?

- A. MODIS
- B. VIIRS

- C. Landsat
- D. GPM

Answers: (bold correct)

- a. None of the above
- b. A and B
- c. A and C
- d. A, B, C, and D**

Feedback:

MODIS, VIIRS, Landsat, and GPM (especially via the IMERG dataset) have all been used to study or forecast climate-sensitive infectious diseases.

## Question 5

Which of these satellite remote sensors and missions can provide data on precipitation globally?

Answers: (bold correct)

- a. MODIS
- b. VIIRS
- c. LANDSAT
- d. GPM**

Feedback:

The Global Precipitation Measurement (GPM) mission and the associated Integrated Multi-satellitE Retrievals for GPM (IMERG) data product provides global estimates of precipitation.

## Question 6

A researcher requires daily NDVI information to study the outbreak of a disease which occurred in 2004. Which of these satellite remote sensors and missions could provide the necessary information?

Answers: (bold correct)

- a. MODIS
- b. VIIRS
- c. Landsat
- d. GPM

Feedback:

VIIRS instruments were not operational in 2005. Landsat does not provide daily revisits for the same location. GPM does not collect the spectral data necessary for calculating NDVI. Of the instruments listed, only MODIS provides daily measurements relevant for computing NDVI for 2004.

## Question 7

A researcher requires information on land cover classification categories at 30m spatial resolution in order to forecast a potential disease outbreak. Which of these satellite remote sensors and missions could provide the necessary information?

Answers: (bold correct)

- a. MODIS
- b. VIIRS
- c. Landsat**
- d. GPM

Feedback:

MODIS, VIIRS, and Landsat all provide land cover information, but only Landsat provides this information at 30m spatial resolution.

## Question 8

Satellite remote sensing data provided which of the following inputs for the EPIDEMIA Malaria forecasting tool in Ethiopia?

Answers: (bold correct)

- a. Air temperature, which impacts the behaviour of mosquitoes
- b. Rainfall, which affects the available larval habitats for mosquitoes**
- c. Atmospheric humidity, which moderates the impacts of temperature
- d. Human migration patterns, which can transport parasites across long distances

Feedback:

Of the listed data, the EPIDEMIA Malaria forecasting tool uses rainfall data.

## Question 9

In the case study of the EPIDEMIA Malaria forecasting system in Ethiopia, which of these was a key benefit of remote sensing data in supporting the application?

Answers: (bold correct)

- a. **Satellite remote sensing was the only feasible source of the required environmental data in Ethiopia.**
- b. Satellite remote sensing provided full data coverage, including during the monsoon season.
- c. Satellite remote sensing data files were small enough for local analysis on low-cost portable computers.
- d. Local public health experts were already familiar with how to use satellite remote sensing data.

Feedback:

Satellite remote sensing was identified as a key benefit for the EPIDEMIA Malaria forecasting system in Ethiopia because of the lack of other feasible sources of required environmental data in the region.

## Question 10

Which of the following methods were used to overcome the challenge of processing high volumes of remote sensing data in the EPIDEMIA system?

Answers: (bold correct)

- a. Machine learning models were used to reconstruct the full dataset from smaller segments.
- b. **Remote sensing data access and pre-processing was implemented in a cloud computing system.**
- c. Computer clusters were purchased and installed at the Ethiopian Ministry of Health.
- d. Analysis-ready commercial datasets were purchased from satellite data vendors.

Feedback:

Remote data access and pre-processing using cloud computing resources was the strategy used by the EPIDEMIA system to overcome the challenge of processing high volumes of remote sensing data.

## Question 11

Which of the following techniques is a specific example of data harmonization to facilitate integration of epidemiological data with satellite remote sensing?

Answers: (bold correct)

- a. **Aggregating data from administrative units that were split to create a geographically consistent dataset of malaria cases**
- b. Developing computer software to facilitate efficient download and process satellite remote sensing data
- c. Carefully evaluating the epidemiological data and have discussions with stakeholders to identify potential issues with data quality
- d. Providing an interface that allows users to efficiently summarize and visualize the epidemiological data

Feedback:

Data harmonization refers to the standardization of data from multiple sources to ensure consistency. Aggregating data from multiple administrative units into a geographically consistent dataset is an example of data harmonization. Developing computer software to download and process data, evaluating epidemiological data quality, discussing potential data quality issues with stakeholders, and providing a user interface for efficiently summarizing and visualizing data are all important to the tracking of climate-sensitive infectious diseases, but are not examples of data harmonization.

## Question 12

Which of the following statements about distributed lag models of malaria are true?

- A. Distributed lag models can model delayed environmental effects across a range of lag times without having to incorporate a large number of separate lagged variables.
- B. Rather than requiring the user to select specific lagged variables, distributed lag models can estimate the timing of lagged effects from the data.
- C. Outputs of distributed lag models can be displayed as graphs that highlight the strength and timing of the lagged effects.
- D. The environmental determinants of malaria estimated with distributed lag models are expected to remain consistent over different locations with diverse environmental characteristics.

Answers: (bold correct)

- a. None are True
- b. A and C

**c. A, B, and C**

d. A, B, C, and D

Feedback:

Distributed lag models can model delayed environmental effects across a range of lag times, can estimate the timing of lagged effects from data, and can output graphs of the strength and timing of lagged effects. However, the determinants identified by a distributed lag model are not likely to be consistent across different locations with diverse environmental characteristics.