General FAQs

Last Modified on 17/04/2024 3:15 pm BST

What is model-based geostatistics (MBG)?

Geostatistics is a short-hand for the collection of statistical methods relevant to the analysis of geolocated data. The aim is to study geographical variation throughout a region of interest by using data that are limited to observations from a finite number of sampled locations. The term model-based geostatistics (MBG) was coined to mean the embedding of geostatistics within the general frameworks of statistical modelling and likelihood-based inference, as applied to geostatistical problems.

How is MBG different from the current method for estimating trachoma prevalence?

MBG uses a model-based approach, whereas the current Tropical Data method uses a design-based approach, to estimate trachoma prevalence. The current design-based approach uses prevalence data and the population census from a single evaluation unit (EU), and provides a point prevalence estimate and confidence intervals. A model-based approach also uses prevalence data, but can use data from multiple EUs. It allows the inclusion of relevant factors such as population density and environmental and sociodemographic covariates, whilst accounting for spatial variation exhibited in the data. In addition to the prevalence estimates, MBG provides a prediction of how likely an area is to have reached elimination (probability of being below the elimination threshold, PBT).

What is the Probability of being Below Threshold (PBT)?

The PBT is the probability of being below the elimination threshold: a prevalence of less than 5% for trachomatous inflammation—follicular (TF), or less than 0.2% for trachomatous trichiasis (TT). As PBT values get closer to 100% or 0%, we can be very confident that the elimination has or has not been achieved. A PBT of 50% would indicate a lot of uncertainty in the achievement of elimination.

How will the PBT threshold be decided?

Setting the PBT threshold is a decision that is both political and technical, as it is a question about how much uncertainty the global trachoma community is willing to tolerate. A special advisory group (SAG) is in the process of being created, led by Lancaster University as a WHO Collaborating Centre. The SAG will include members from research, health ministry, programmatic, policy and NGO backgrounds, in order to get insight from as wide a range of perspectives as possible.

Does MBG replace the need for surveys?

No, surveys will still be required in most cases as some data are always needed to run the models. The more data that are available, the better the predictive ability of the model.

How has MBG been used so far within the context of trachoma elimination?

To date, MBG has been used to create a geostatistical survey design to quantify the likelihood that TT prevalence at EU-level is below the TT elimination threshold (See publications folder for relevant papers supporting this). It has also been used to analyse data from field surveys, including for Malawi in its dossier submission to WHO, with the country now validated as having eliminated trachoma as a public health problem. Click here to view the publication.

What is required in order to run MBG?

Permission to use country-specific prevalence data is needed, with access provided to the individual-level data contained in all relevant datasets. The surveys must have been supported by the Global Trachoma Mapping Project (GTMP) and/or Tropical Data. Other criteria will also need to be fulfilled in order to determine whether MBG can be used, such as: having data to feed into the model; the data showing spatial correlation; having EU-level polygon shapefiles to demarcate the EU boundaries; having cluster-level GPS coordinates; and having the necessary covariate data.

Do more or fewer clusters need to be visited when using the MBG approach for survey design?

Past research in both trachoma and other neglected tropical diseases (NTDs), such as soil-transmitted helminthiases and lymphatic filariasis, has shown that MBG requires fewer clusters compared to the standard survey design. This is because MBG targets certain areas for sampling based on expected prevalence of TF/TT, and provides more information than random sampling.

Can MBG be used to estimate prevalence in inaccessible EUs?

MBG has not yet been used to estimate prevalence in inaccessible EUs, however, it is theoretically possible to do this when there are enough existing data in nearby EUs to estimate trachoma prevalence in the area of interest. There would need to be strong spatial correlation present in the available data in order for this application to work, and several assumptions made for example that correlations that exist within the available data also apply to the population in the inaccessible area.

Can MBG be used when there is large population movement?

When there is large population movement within an EU, one of the challenges for the models is trying to incorporate more assumptions and to account for more variation than normal, and this leads to a lot of uncertainty. It may be possible to account for population movement if there was information on how people move, however this would require more specialised models, which in turn would require a lot more data. To date, this has not been done as there are very few reliable data on population movement. For reference, the current standard data analysis method makes an assumption that there is no population movement.

Can MBG be used for islands in an archipelago community?

This would depend entirely on the spatial relationship of trachoma amongst the different islands. If there was

strong spatial correlation between islands it may be possible to use MBG, however this would need to be reviewed on a case-by-case basis.

Is it possible to use MBG for an entire country?

Theoretically yes, it is possible, however it would be context dependent. To date, MBG has been implemented to estimate trachoma prevalence for a specific area (usually an individual EU) by using data from a wider area within the same country. We have not used data from neighbouring countries, because previous research has shown that the relationship between trachoma prevalence and the covariates (environmental, demographic, etc.) tends to be highly specific to each country and so using data from another country would not necessarily be reliable.

Where is the funding coming from to support the research and the Tropical Data development?

Funding is currently provided by the United States Agency for International Development (USAID) via the Task Force for Global Health, until May 2024.

Is there any support available for health ministries interested in implementing MBG?

Currently, the MBG models require intensive computations and the larger the datasets that have to be processed, the longer it takes - some take up to a week to generate results! It is therefore not yet possible for Tropical Data or Lancaster University to support health ministries to implement MBG themselves. There is an app being developed that may in the future allow health ministries to run MBG themselves after appropriate training, however this is not yet ready.

In terms of support for health ministries to engage with MBG methods, we will be creating training materials and guides on when MBG can be used, how the models work, and how to interpret the outputs. We hope there will be funding available in the future to hold workshops on utilising MBG as part of the Tropical Data platform.

When will we have official confirmation from WHO/Tropical Data to use MBG?

MBG was officially confirmed as an acceptable method to demonstrate that TT prevalence was below the elimination threshold at the 4th Global Scientific Meeting on Trachoma in 2018 (https://www.who.int/publications/i/item/who-htm-ntd-pct-2019.03) and in the WHO template for the dossier documenting elimination of trachoma as a public health problem. In relation to incorporating MBG as a routine option for data analysis and/or survey design within the Tropical Data platform, we are still in the research stage of the process, and there are a number of steps that need to be taken before we can start implementing it on a regular basis. If there is interest in using MBG before it is a routine offering, contact the Lancaster University (e.giorgi@lancaster.ac.uk) and/or Tropical Data (admin@tropicaldata.org) teams directly.

Who owns the MBG output?

All outputs from the model will be owned by the countries whose data were used to generate them.

How will the data be shared with Lancaster University and how will they be managed?

Data will be shared with Lancaster University via the health ministry. Tropical Data is available to support this process by preparing the required dataset(s) and a secure link for the health ministry to share these data with Lancaster University. Lancaster University has a memorandum of understanding that they will not share the data they receive with any third parties, and will only use it for the purpose agreed upon by health ministries.

How do we decide between two different outputs, one from the standard analysis and one from MBG?

This is a technical decision and a political one. We will seek advice from the SAG to help make recommendations to health ministries for such scenarios.

Can MBG data be used in the elimination dossier submitted to WHO?

Yes, MBG data can be included in the elimination dossier. It is not a mandatory element, but can be useful for demonstrating that the criteria for validation of elimination of trachoma as a public health problem have been satisfied.