**Digital Earth: Modelling of Ecosystem, Human Infectious Disease and Medicine under the Climate Changes of Cura****çao**

Duration of the project: 10 months

**Public Summary**

This research will try to include several environmental and social concepts that may able to influence the infectious diseases and medicinal situation in past and today’s Curaçao, and to entail an analysis to understand links among ecosystems, climates, human infectious diseases and their corresponding medicines as well as how they interact with each other. Through understanding this, it will in turn lead to the acquisition of specific related parameters that may enable to create dynamic models, do simulation experiments and create a detailed database about concepts of this study area. By illustrating these relationships it could be possible to figure out necessary environmental conditions which are lead to occurrences and transmitting of infectious diseases, as well as survival conditions of medicinal plants. This method could be introduced in Curaçao to prevent environmental and human property damage, public health threats and develop pharmaceutical researches, and the model created also has a potential to be applied to a wider range based on different local geographical and social features.

**Budget**

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| **Type of costs** | **Clarification** | **Costs in euros** |
| Personnel | Four scientific personnel, ten months, (fieldwork, model analysis and writing paper).  Two scientific personnel, three months, (model formalization and writing paper). | € 20000.00  € 7000.00 |
| Materials | One computer of adequate and specified type with required software, one camera. | € 1300.00 |
| Travel | Fieldwork to collect information. Including vaccines and medicine needed. | € 9000.00 |
| Lab Experiments | Required software, updating information and data, consulting. | €275.00 |
| **Total** |  | € 37575.00 |

**Project Plan**

**Introduction**

Located in the south Caribbean Sea, Curaçao is the largest island in the Netherlands Antilles. The climate type of Curaçao is semi-arid climate, with a distinguishable dry season (January-April) and rainy season (August-December), storms and hurricanes represent the main rainfall source there [1]. About 7,500 plant species and 880 vertebrates are endemic to this region, as well as a large number of microorganisms is also an important part of local ecosystems [2]. Traditional medicinal plants, as a part of its terrestrial ecosystems, such as COCOLODE (*Heliotropium angiospermum* Murr.), ANGLO (*Tribulus cistoides* L.) and MAMPURITU (*Porophyllum macrocephalum* DC.) plays a huge role in local indigenous herbal treatments [3]. Although Curaçao is modernizing nowadays with a high sanitation level, these herbal treatments are still practiced on this Island [4]. At the same time, human infectious diseases like Measles, Rabies, Typhoid, Yellow Fever, Dengue and Zika still exist in this area, and it is dangerous to exposure to animals, germs and body fluids here [5]. So creating and keep updating a model and detailed database that can help to predicate the potential human infectious outbreaks and medicinal plants situations might be useful to improve local public health conditions, develop pharmaceutical industry and pharmacoeconomic benefits of Curaçao.

**Previous Research**

Linkages among climate, ecosystem, human infectious diseases and medicinal plants have been proved by previous research. Climate forms through the statue of atmosphere over a relatively long period of time, and atmosphere can impact day-to-day different states of temperature, humidity, precipitation, winds and form certain weather types, so that provide particular environmental situations that are optimal for the growth, survival, transport and dissemination of diseases agents and their vectors [6]. Climate factors such as annual mean temperature, mean monthly temperature range, isothermality, annual mean precipitation, sunshine duration, etc. have different effects on phenotypes of medicinal plants [7]. Recent research found that plants pathogens and animal pathogens are able to cross the kingdom border and infect each other, and different evolutionary stages and transient time of human infectious diseases have also been discovered [8][9]. Social factors, for example, deforestation, increasing population, migration and other human behaviors, are also crucial extra relevant concepts although they are hard to be quantified [10].

**Methods**

Pre-fieldwork: This first stage will include preparations of the fieldwork. Based on previous research, model contents like relevant concepts that we already know, information about dynamic relationships between concepts, action generation and formalization of concepts can be assumed, so that one simple draft of model can be created as assumption. In order to take this fieldwork successfully, fieldwork equipment, a detailed research plan and time schedule should be prepared, as well as what kind of data that still need to be collect during the field work. It should be noticed that related people should check the vaccines and medicines list on Curaçao government website and visit doctor at least a month before the field work to get vaccines or medicines that are mandatory.

Fieldwork: In this stage, a fieldwork will be taken to collect necessary materials for this research. During the fieldwork, detailed descriptions and/or photos of local environmental feathers, medicinal plants, sanitation situations, typical habits that may related to public health, distribution of hospitals, clinics and apothecaries, political status, deforestations, etc. should be collected. Interviews with local residents especially indigenous residents which could be useful to learn local history of diseases and medicines as well as their knowledge about local vegetation including its possible medicinal properties and traditional herbal treatments might be needed during the field work.

Post-fieldwork: Based on data and information collected during the fieldwork and pre-designed draft models, dynamic relationships among relevant concepts by numerical variables may able to be formalized, the effects of certain actions and dependencies over time for import actions could also be estimated preliminarily and roughly. Experimental Software MATLAB and ArcGIS are needed in this stage to perform a large scale of computations and simulations, and make several maps with different layers about distribution of certain concepts. Combining with the results that get from models and related literatures, preliminary judgments about errors and noises are possible to be recognized, and the model can be further adjusted to get more accurate results. Contacts with local research institutions and government are needed to get more detailed recent information to update the model and database. To verify models of this research, data and information of other random areas could be input to test the reliability. Further applications can be planed after this stage.

**Risk and impact**

The interactions within earth system, including climate, ecosystem, human infectious diseases and medicinal plants are very complex and still not be totally discovered yet, so the risk of this research method might be relevant factors have not be fully included in the model, and some specific linkages which might be matter have the possibility to be ignored. Some social factors are still qualitative, instead of quantitative could also be a problem, but this risk is possible to be fix during the research process.

In order to test the validity of this models, other study area can be picked randomly in a worldwide range. Specific local data and conditions should also be taken into considerations and regarded as input for the model. After these steps, the model with certain universal rules could also be capable to make global applications, and can make contributions to the formation of digital earth system. Moreover, if the information about medicinal plants that we generated are sufficient, it is possible to imitate similar environment in order to achieve mass production, and more commercial medical products could be invented to cure human diseases.

**References**

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