5.3. Ecoregional application of the LINTUL-POTATO model

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The potential crop production depends on the daily intercepted radiation and the ambient temperatures at a specific site. The LINTUL model is derived for prediction of crop yield at experimental plot scale and field scale. This implies that the variability at smaller scales (subplot scales) can not be reproduced by this model because some processes are lumped into more robust process-descriptions. Therefore the LINTUL model assumes a homogenous distribution of environmental variables at a specific site with plot or field size. This however has consequences for the application of this model at larger scales. The environmental variables have in first to be generated for each site with an average size of a field. When the environmental heterogeneity between sites can be ignored, these sites can be aggregated into larger ones until the variability within a site increase. The model simulates after this the expected crop yield for each site. Further aggregation of sites into larger spatial areas has to be performed with the simulated crop yield rather then with the environmental input variables. Non-linearity's in the crop growth model cause a large variability in simulated crop yields while little variability in the environmental input variables is perceptible.

An example of environmental heterogeneity in input variables is shown in Figure 5.10. The FAO long year mean climate stations are shown with the spatial extension for each station. The spatial extension for each station is calculated by using a Thiessen tessellation which is a procedure that produce the weighted average distance between separate stations. Potato crop yields for each spatial unit can be simulated by using the climate variables of each station. This approach however leads to erroneous predicted crop yields. The spatial extension of the weather stations is however large compared to the known spatial heterogeneity in soil type, elevation, etc. of the region. So in order to increase the reality of the simulated crop production more environmental variables have to be included either in the model or in the environmental data-analysis. A proper procedure is to include more climate stations in the simulations up to the level that the heterogeneity within the spatial unit becomes sufficient small.

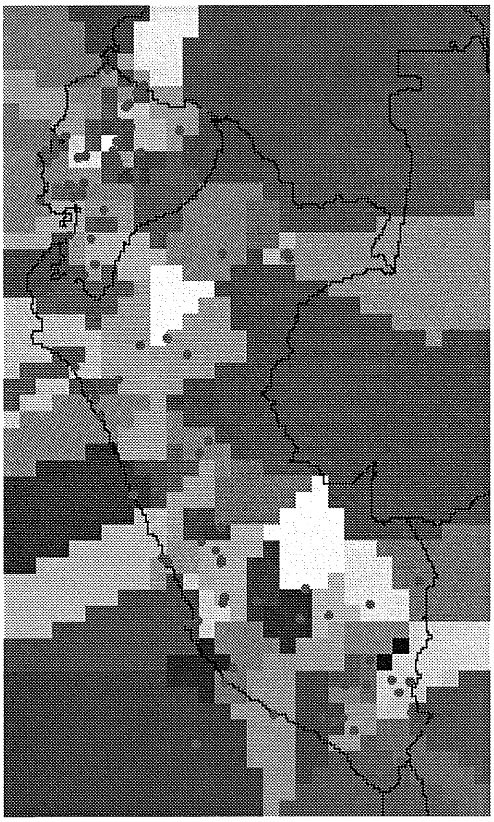

Figure 5.10 The FAO weather stations in Ecuador and Peru. The spatial coverage of each station is determined by a Thiessen tessellation procedure.

Another source of environmental heterogeneity is the soil type. The water holding capacity and the amount of available nutrients are determined by soil characteristics. The soil types for the Andean region which are derived from the FAO-soil map are shown in figure 5.11. The environmental heterogeneity increases by combining the weather station map and the soil map. The spatial influence area of each weather station might cover several soil types. So the in first spatial homogenous distributed potential crop yield for each weather station is now decomposed into several simulated crop productions in the combination station-soil type, see figure 5.11. The spatial decomposition increases further by overlaying figure 5.11 with a digital elevation map. The in first apparent spatial homogeneity of the spatial extension of each climate station in figure 5.10 becomes a mosaic of smaller spatial units. It is this mosaic which should be applied as smallest spatial unit for crop simulation studies.

The objectives of this application are to understand the basic principles of crop growth simulation and its application in an ecoregional context. The main objective is to understand the limitations of straightforward application of crop simulation models. These limitations are based on:

1) A model is only a partial description of reality
2) The result of a crop simulation model is a point prediction of crop yield. Additional methodology has to be developed before simulation results can be applied in an ecoregional context.

Especially the issue of scale where point based crop simulation results are aggregated to represent the mean simulated crop yield of a region has to be handled carefully. The DME-NOR project is aimed to develop a generic methodology with which multi-scale issues can be handled.

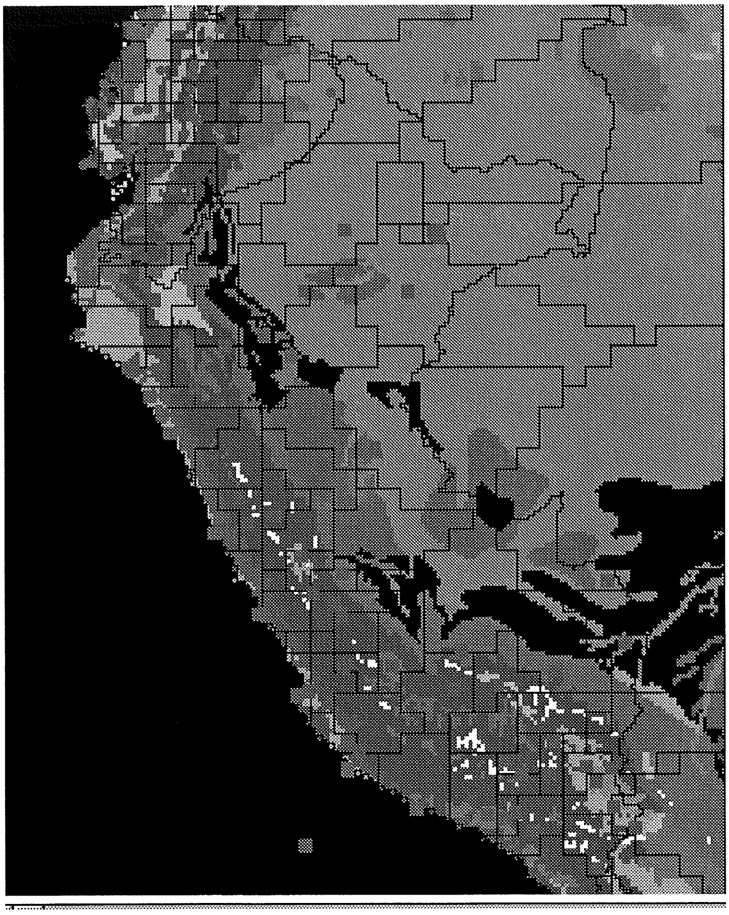

Figure 5.11 FAO soil map of Ecuador and Peru in combination with the polygons of the Thiessen tessellation of the FAO weather stations.

5.4. Summary of the tool

Tools Fact Sheet	
Name	**LINTUL1-potato and LINTUL2-potato**
Version	**FST**
Development	**Model: Spitters & Schapendonk, 1990, Plant and Soil 123:193-203** **Windows user interface: R. van Haren**
Status (freeware /shareware/ commercial)	**model: available upon request and registration (nominal cost)** **windows user interface: available upon request and registration (nominal cost)**
System requirements	**MS Windows (3.1 or 95)**
Links with commercial software	**Fortran compiler is recommendable, not necessary**
Objectives	**LINTUL has been developed for educational and application purposes**
Data Requirements	**weather (potential production) and soil data (water limited production)**

References

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