# LISEM input variables

LISEM uses a series of maps as input that feed directly into the main processes that are simulated. There are very few algorithms in the model that translate input data into something else. For instance LISEM does not know that we are simulating a Maize crop on a slope, you have to breakdown the Maize crop into appropriate variables yourself with help of this document. Therefor background knowledge of runoff and erosion is assumed to some extent, LISEM is NOT a decision support model, at least not directly. The model aims to simulate the spatial processes of runoff and erosion in detail, allowing you to investigate if certain scenarios of for instance conservation methods reduce erosion.

To understand how LISEM operates and builds information of a gridcell before simulation, it is important to realize that the model can handle to a certain extent sub-gridcell size information. It needs basic information about soils and vegetation of a gridcell, and requires extra layers of man-made structures on top of that. Therefore the landuse map should not include for instance roads or channels if these are smaller than the gridcell size, because LISEM needs to know what is beside the road in order to simulate the entire gridcell.

A second important feature is that there are two surface flow networks in LISEM, one that connects all cells using the steepest slope, and one that is used for channels and artificial drainage systems and ditches. Flow is calculated first for the slopes and overland flow moves into the channels (if these exist) and is further transported to the outlet point. Both networks must be continuous and connected without interruption to the outlet. LISEM cannot simulate spreading of water as small floods, it only converges water to a single outlet point.

# Basic input maps

LISEM needs only a few basic input maps from which all maps are derived. The user has to provide these input maps and generally we use the freeware GIS PCRaster (pcraster.geo.u.nl). The PCRaster website provides extensive help and the model comes with a PCRaster script and example database derived from the Ganspoel catchment in Belgium XXX. The original database can be found here: XXX.

The basic maps are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Base map | Lisem maps | Units | Origin | remarks |
| DEM | Grad (slope) | - | GIS | DEM itself is not used |
|  | LDD (flow network) | - | GIS (PCRaster) |  |
|  | Outlet (end of network) | - | GIS (PCRaster) |  |
| landuse | Per (fraction cover) | - | GIS/image | Classified map |
|  | CH (crop/plant height) | M | Field |  |
|  | RR (micro roughness) | Cm | Field/literature |  |
|  | LAI (leaf area index) | m2/m2 | Field/literature | or use Smax |
|  | Smax (canopy storage) | Mm | Field/literature | or use LAI |
|  | n (Manning’s n) | - | Field/literature | Flow resistance |
| Soils/landuse\* | Ksat (saturated hydraulic conductivity) | mm/h | Field/literature | From infiltration tests or pedotransfer functions |
|  | Pore (porosity) | cm3/cm3 | Field/literature | Id. |
|  | Psi (suction at wetting front) | cm | Field/literature | Id. |
|  | Thetai (initial moisture content) | cm3/cm3 | Field/literature | Id. |
|  | Depth (soil depth) | mm | Field/literature | Id. |
| Man made | Road width (tarred roads) | m | Field | Road cannot be wider than gridcell size |
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\* = infiltration parameters depend on the type of infiltration equation chosen. SWATRE needs a different set of maps and tables.

#! --matrixtable --lddin

##########################################################################

# PCRASTER script for the generation of a LISEM input database #

# Victor Jetten 17/05/10 #

# Data for the GANSPOEL catchment #

# DESIRE LISEM course #

##########################################################################

## CHANGES KAMPALA

**binding**

####################

### input maps ###

####################

dem = gpdem.map;

# digital elevation model, area must be <= mask

unitmap = landuse.map;

Consists of basically two units: bare soil and vegetation, vegetation can be further split up in grass, crops and trees if possible this relates to interception of rainwater, which is different for different land uses.

NOTE: soil parameters can also be related to this, e.g. grass infiltrates more than bare soil

# texture = soils.map;

# NOT USED

# assumed all one soil type or else specify a soil map

roads = roads.map;

Basis for different road widths, only tarred roads and cannot be wider than gridcell. Roads.map could contain a classified road map with for instance 0 background, 1 = wide roads, 2 = narrower roads etc. Depends on digitized data and field work

chanmask= chanmask.map;

Same as the roads, a classified channel map, where different classes are different dimensions. Cannot be wider than the gridcell. Depends on digitization and ground truth.

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### input tables ###

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unittbl = unitbase.tbl;

Table with the main parameters tied to the land use classes. Ach column is a variable, each row is a land unit in landuse.map

# unitbase table layout #

#-------------------------#

# 01 ksat (mm/h)

# 02 porosity (cm3/cm3)

# 03 psi initial (cm)

# 04 initial moisture content (cm3/cm3)

# 05 RR (cm)

# 06 Manning's n (-)

# 07 Vegetation cover (-)

# 08 Crop/plant height (m)

# 09 cohesion sol (kPa)

# 10 cohesion roots (kPa)

# 11 aggregate stability (number)

#######################

### input constants ###

#######################

Some constants that are not veryimporant and will be adapted in LISEM runs.

Soildepth = 1000; # *in mm!*

d50 = 30; # median texture, e.g. loess = 30 mu

#channel properties:

Chancoh = 100; # high cohesion, kPa

Chanman = 0.02; # smooth channel

Chanside = 0; # tangent top angle 0 = rectangular, 1 = 45 degrees

Chanwidth = 2; # 2 meter, DEPNDS ON FIELD WORK

**###################**

**### output maps ###**

**###################**

The following mapa are derived from the DEM:

Ldd = ldd.map;

# Local Drain Direction following steepest desent

grad = grad.map;

# natural slope in drain direction

id = id.map;

# pluviograph influence zones

outlet = outlet.map;

# location outlet (1) and additional checkpoints (2,3, etc), pit in LDD

# impermeable roads width in m

roadwidth = roadwidt.map;

# crop maps

coverc= per.map;

lai= lai.map;

cropheight= ch.map;

grass= grasswid.map;

# soil maps

ksat= ksat1.map;

psi= psi1.map;

pore= thetas1.map;

thetai= thetai1.map;

soildep= soildep1.map;

# maps for G&A 2nd layer

# ksat2= ksat2.map;

# psi2= psi2.map;

# pore2= thetas2.map;

# thetai2= thetai2.map;

# soildep2= soildep2.map;

# surface maps

rr= rr.map;

mann= n.map;

stone= stonefrc.map;

crust= crustfrc.map; # crusted fraction, only used when option chosen in LISEM

comp= compfrc.map;

hard = hardsurf.map;

# erosion maps

cohsoil = coh.map;

cohplant = cohadd.map;

D50 = d50.map;

aggrstab = aggrstab.map;

# channel maps

lddchan = lddchan.map;

chanwidth = chanwidt.map;

changrad = changrad.map;

chanman = chanman.map;

chanside = chanside.map;

chancoh = chancoh.map;

mask=mask.map;

**initial**

#################

### BASE MAPS ###

#################

# correct topo for local depressions

report Ldd = lddcreate (dem\*mask, 1e20,1e20,1e20,1e20);

report outlet = pit(Ldd);

# LDD is reference in later LISEM eversions

# sine gradient (-), make sure slope > 0.001

report grad = max(sin(atan(slope(dem\*mask))),0.001);

#########################################

### MAPS WITH RAINFALL INFLUENCE ZONE ###

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report id = nominal(mask);

# use spreadzone for thiessen polygons when more than 1 rainfall station

# value 1 if only one rainfall station

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### LAND USE MAPS ###

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# fraction soil cover (including residue)

report coverc = lookupscalar(unittbl, 7, unitmap) \* mask;

# crop height (m), FIELD DATA

report cropheight = lookupscalar(unittbl, 8, unitmap) \* mask;

# LAI of plants inside gridcell (m2/m2)

# needed for interception

# calculate from cover map

coverc = min(coverc, 0.95);

lai = ln(1-coverc)/-0.4;

report lai = if(coverc gt 0, lai/coverc, 0);

###########################################################

### INFILTRATION MAPS for option one layer GREEN & AMPT ###

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report ksat = lookupscalar(unittbl, 1, unitmap) \* mask;

report pore = lookupscalar(unittbl, 2, unitmap) \* mask;

report psi = abs(lookupscalar(unittbl, 3, unitmap)) \* mask;

report thetai = lookupscalar(unittbl, 4, unitmap) \* mask;

report soildep = scalar(Soildepth);

#########################

### SOIL SURFACE MAPS ###

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# micro relief, random roughness (=std dev in cm)

report rr = max(lookupscalar(unittbl, 5, unitmap) \* mask, 0.01);

# Manning's n (-)

# take from table

report mann = lookupscalar(unittbl, 6, unitmap) \* mask;

# or use simple regression from Limburg data: CAREFULL this is not published

# report mann = 0.051\*rr+0.104\*coverc;

report crust=mask\*0;

# crust fraction map

report stone = 0 \* mask;

# stone fraction

report comp = 0\*mask;

#fraction compacted

report hard = 0\*mask;

#hard surface cells

report roadwidth = scalar(if(roads eq 20, 4, if(roads eq 21, 8, 0)))\*mask;

# road width, 21 is tarred road = 8 m, dirt rods are 4 m wide

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### EROSION MAPS ###

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report D50 = 30\*mask;

report cohsoil = lookupscalar(unittbl, 9, unitmap) \* mask;

report cohplant = lookupscalar(unittbl, 10, unitmap) \* mask;

report aggrstab = lookupscalar(unittbl, 11, unitmap) \* mask;

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### CHANNEL MAPS ###

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Chanmask = chanmask/chanmask; # make 1 and missing value

report lddchan=lddcreate(dem\*chanmask,1e20,1e20,1e20,1e20);

report changrad=max(0.001,sin(atan(slope(chanmask\*dem))));

report chancoh=chanmask\*scalar(Chancoh);

report chanman=chanmask\*scalar(Chanman);

report chanside=chanmask\*scalar(Chanside);

report chanwidth=chanmask\*scalar(Chanwidth);

##############

### HOUSES ###

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housecover = if( chanmask eq 1, 0, housecover);