



The Global Database: EPIC input data and LC/LU statistics

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EPIC input requirements for global runs:

Global coverage of geographically referenced data on:

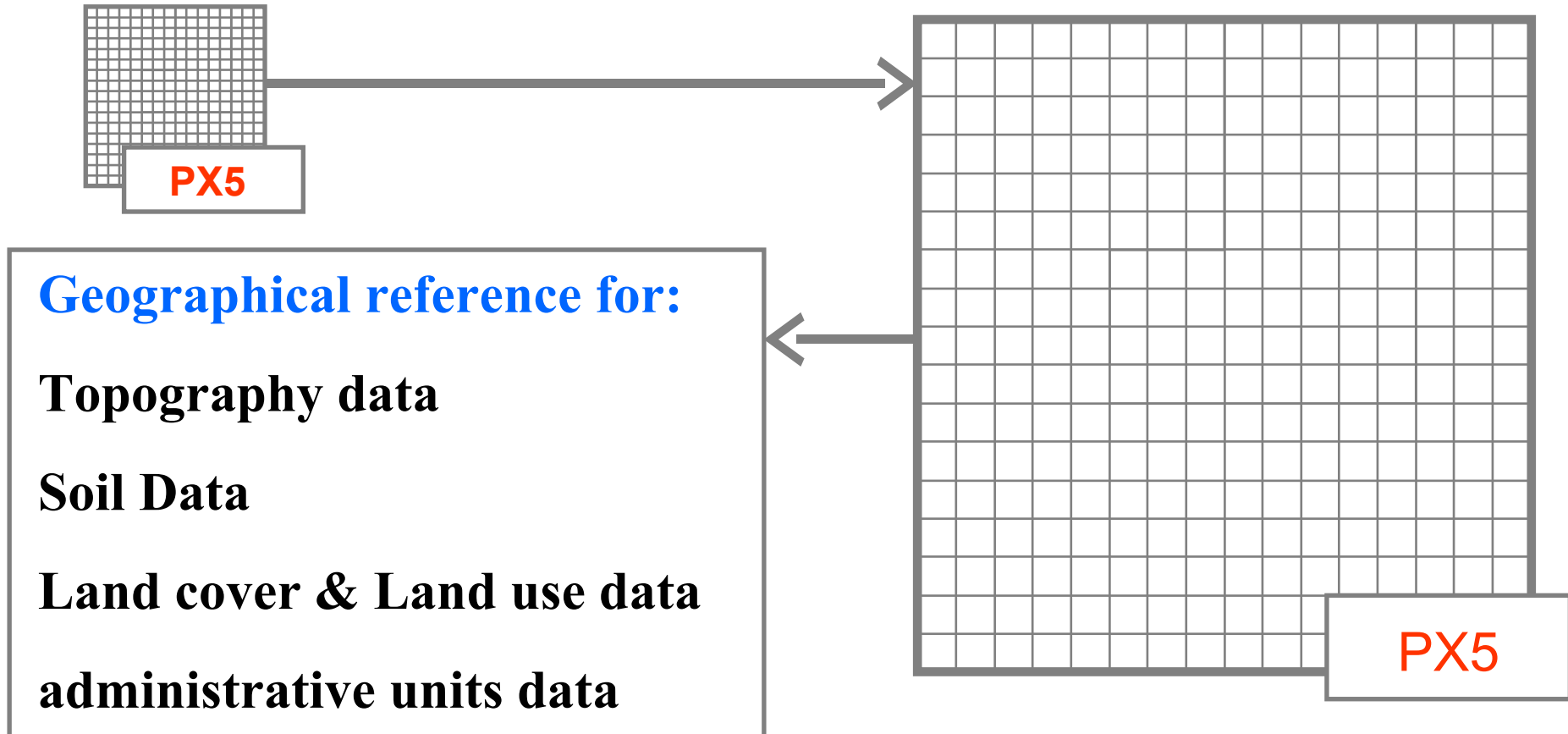
- **Homogenous response units (HRU)** as geographically generalized spatial units for implementation and interpretation of simulated LC/LU change alternatives (scenarios implementation);
- **Simulation units (SimU)** geographically detailed spatial units nested in HRU delineations attributed with data necessary for EPIC model runs:
 - Topography data;
 - Soil data;
 - Weather data;
 - Land Cover/Land Use data & management data;

Global database for EPIC:

database comprise two logical subsets:

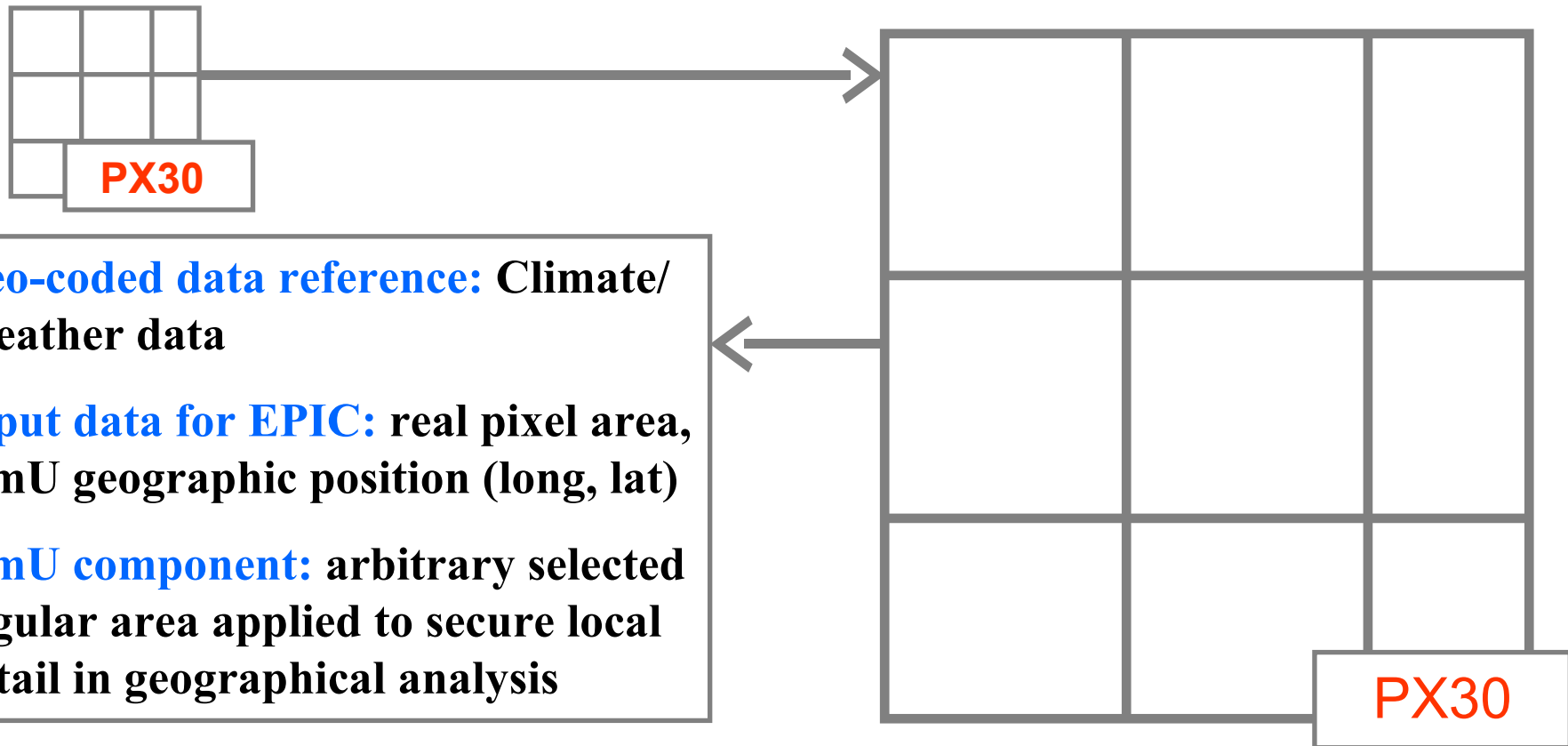
- **geo-spatial database** – storage and management of geo-referenced and geo-coded data (HRU & SimU delineations + topography, soil, climate/weather and LC/LU data) – **finished!!!**;
- **non-geo-spatial database** – storage and management of non-geo-spatial data (agricultural management: crop rotations, crop calendar, fertilization, irrigation and tillage practices) – **in process**;

geo-spatial reference for global data: **PX5**



5 arcmin resolution grid with extent of 90°N – 90°S and 180°E – 180°W, column/row number identified basic geographical reference for display input geographical and geo-coded data, **only land surface** pixels considered;

geo-spatial reference for global data: PX30



30 arcmin resolution grid with extent of 90°N – 90°S and 180°E – 180°W, column/row number identified geographical reference for selected geographical and geo-coded data and interpretation frame for selected geographical analyses;

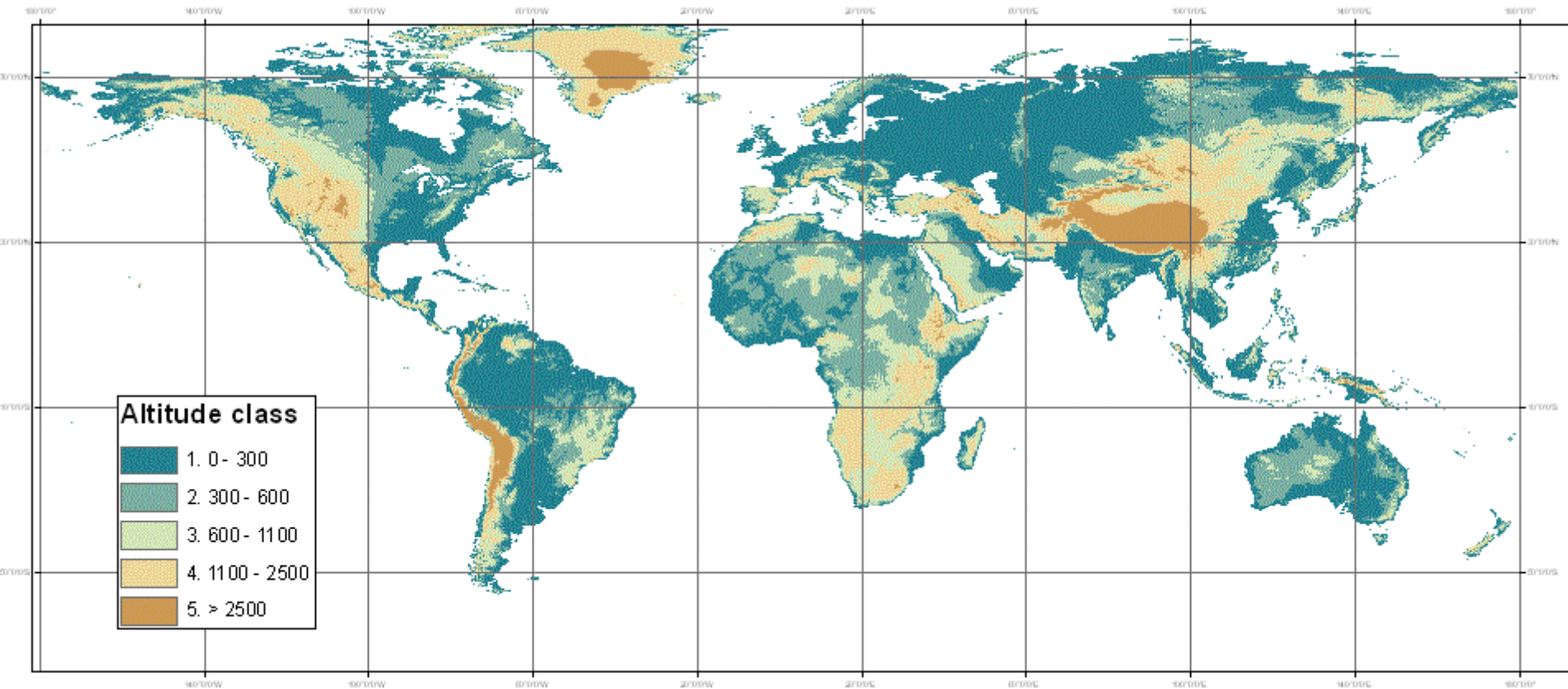
input data pre-processing: topography data

- **GTOPO 30** – 30 arcsec resolution global grid of altitude (m above sea level), data authority: USDA EROS data center;
- **SRTM** – 3 arcsec resolution grid for latitudes less than 60 (north or south) of altitude (m above sea level), data authority: NASA;

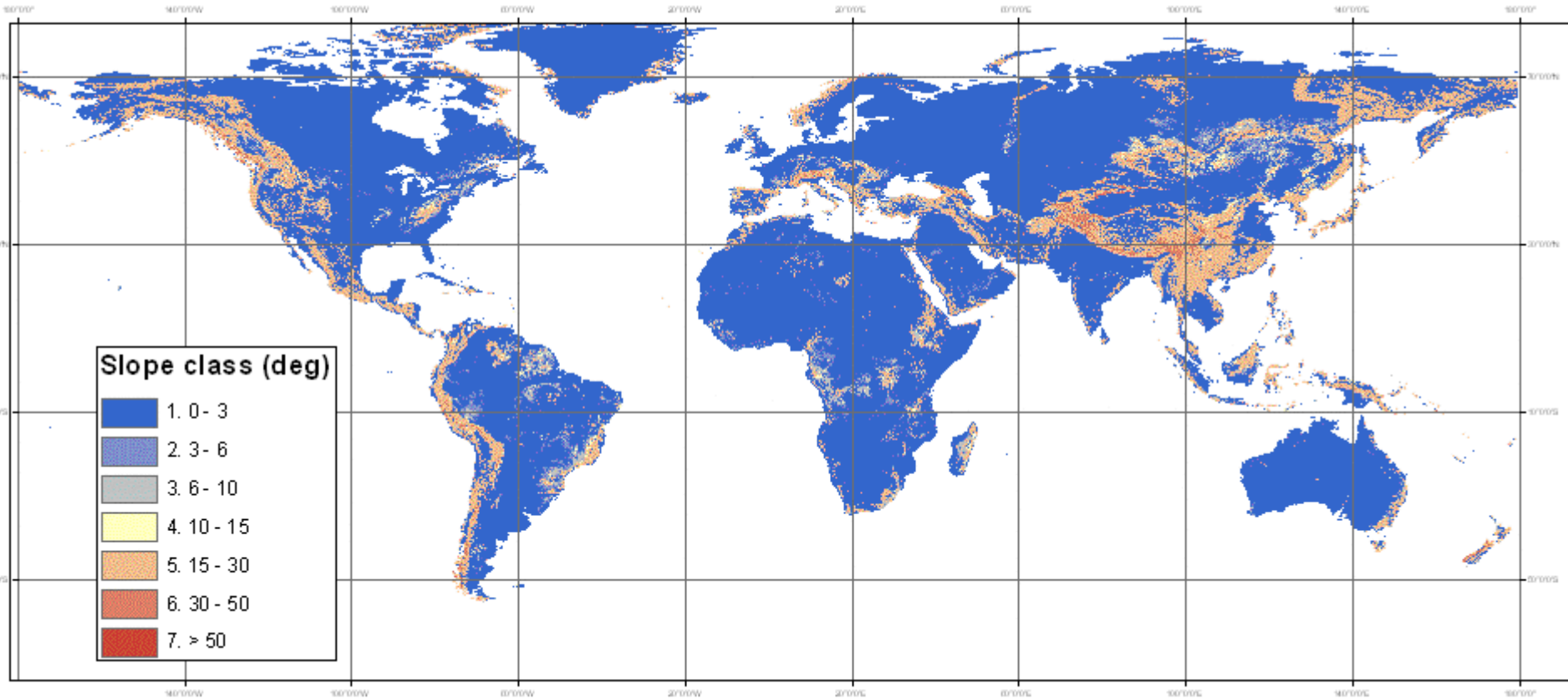
pre-processing results:

- **Altitude class** – 5 arcmin resolution grid derived as zonal majority of pre-classified GTOPO30 data;
- **Altitude** - 5 arcmin resolution grid derived as zonal mean of GTOPO30 data;
- **Slope class** – 5 arcmin resolution grid derived as zonal majority of combined SRTM & GTOPO30 (30 arcsec resolution) pre-classified data for PX5 grid pixels;

Altitude class (input for HRU delineation)



Slope class (input for HRU delineation)



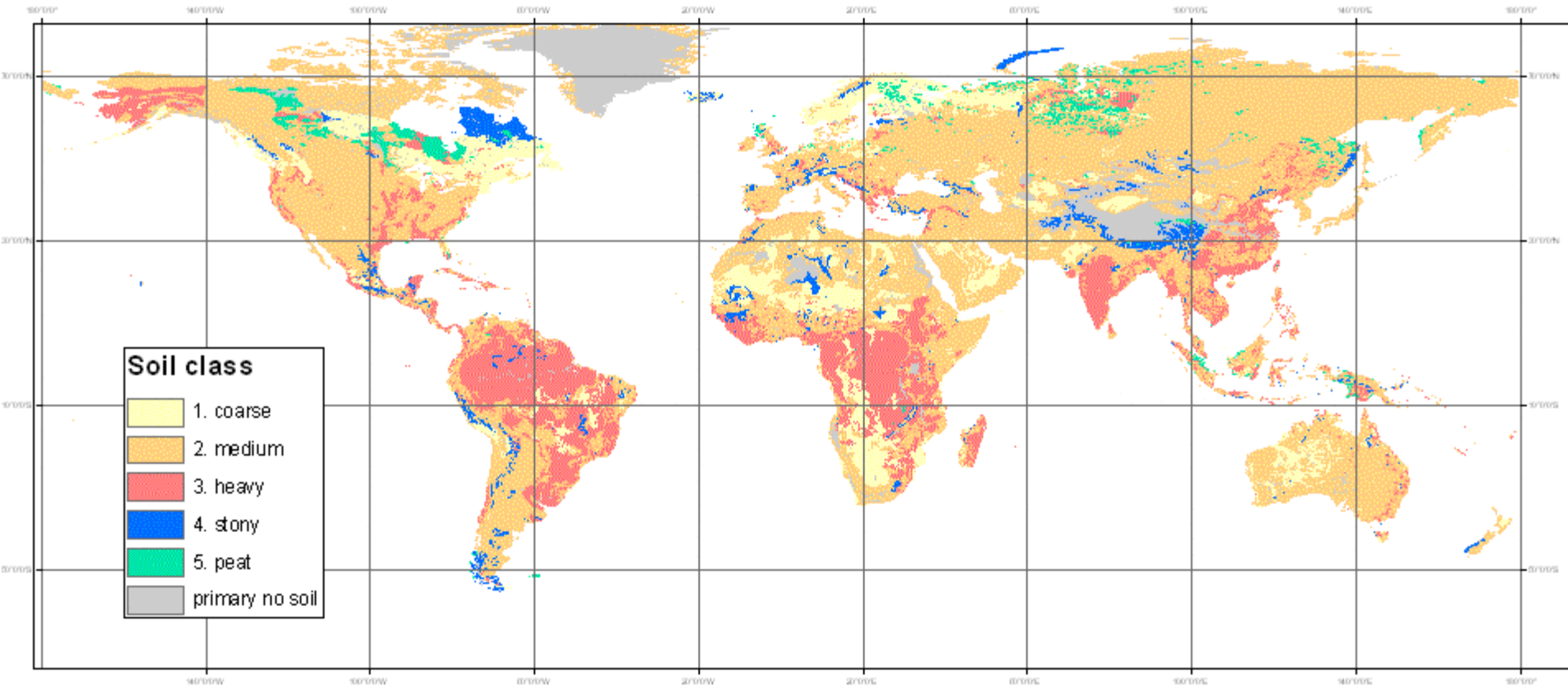
input data preprocessing: soil data

- **DSMW** – digital version of 1:5 000 000 scale soil map of the world, data authority: FAO;
- **WISE 5 min** – 5 arcmin resolution World inventory of soil emission potential project derived data on soil analytical properties, data authority: ISRIC;

pre-processing results:

- **SMU** – 5 arcmin resolution grid of DSMW soil mapping units (rasterized version of DSMW), data on SMU components (soil typological units – **STU**);
- **Soil class** – 5 arcmin resolution grid of interpreted DSMW SMU based on SMU dominant texture;
- **Soil Data** – STU related soil analytical data for **5 soil layers** (totally for 106 STU) taken from WISE data set and completed by pedo-transfer rules application;

Soil class (input for HRU delineation)



input data pre-processing: weather data

- East Anglia climate data years 1901-2002 (**Tyndall**)
- Scenario data 2001-2100 for 18 various scenarios (**Tyndall**)
- Variation data (**ECMWF**)

pre-processing results:

- **Climate/Weather** – data on monthly averages of climate characteristics (Tmin, Tmax, precipitation, radiation) and related statistics (standard deviation of Tmin, Tmax, precipitation, skewness of precipitation, probabilities of wet day after wet day and wet day after dry day, wet days per month), geo-coded data referenced to **30 arcmin** resolution grid (**>67,000 files**);

=> EPIC weather generator

input data preprocessing: land cover & land use data

- **GLC2000** – global land cover data in 30 arsec resolution, 22 land cover classes globally (including natural, cultivated and artificial land covers, no detailed data on cropland), data authority: EC-JRC;
- **GLU** – global crop distribution data, statistics on physical and harvested area (ha) and crop yields (t/ha) for 20 most important crops produced in 4 production systems related to 5 arcmin grid pixels, data authority: IFPRI;

pre-processing results:

- **LC&LUstat** – statistics on physical areas (ha) of LC (cropland, other agricultural land, grassland, forest, wetlands, other natural land, not relevant) and **cropland production systems** (high input, low input, irrigated and subsistence systems), geo-coded data referenced to **5 arcmin** resolution grid pixels;

=> typical crop rotation systems

input data processing: administrative units

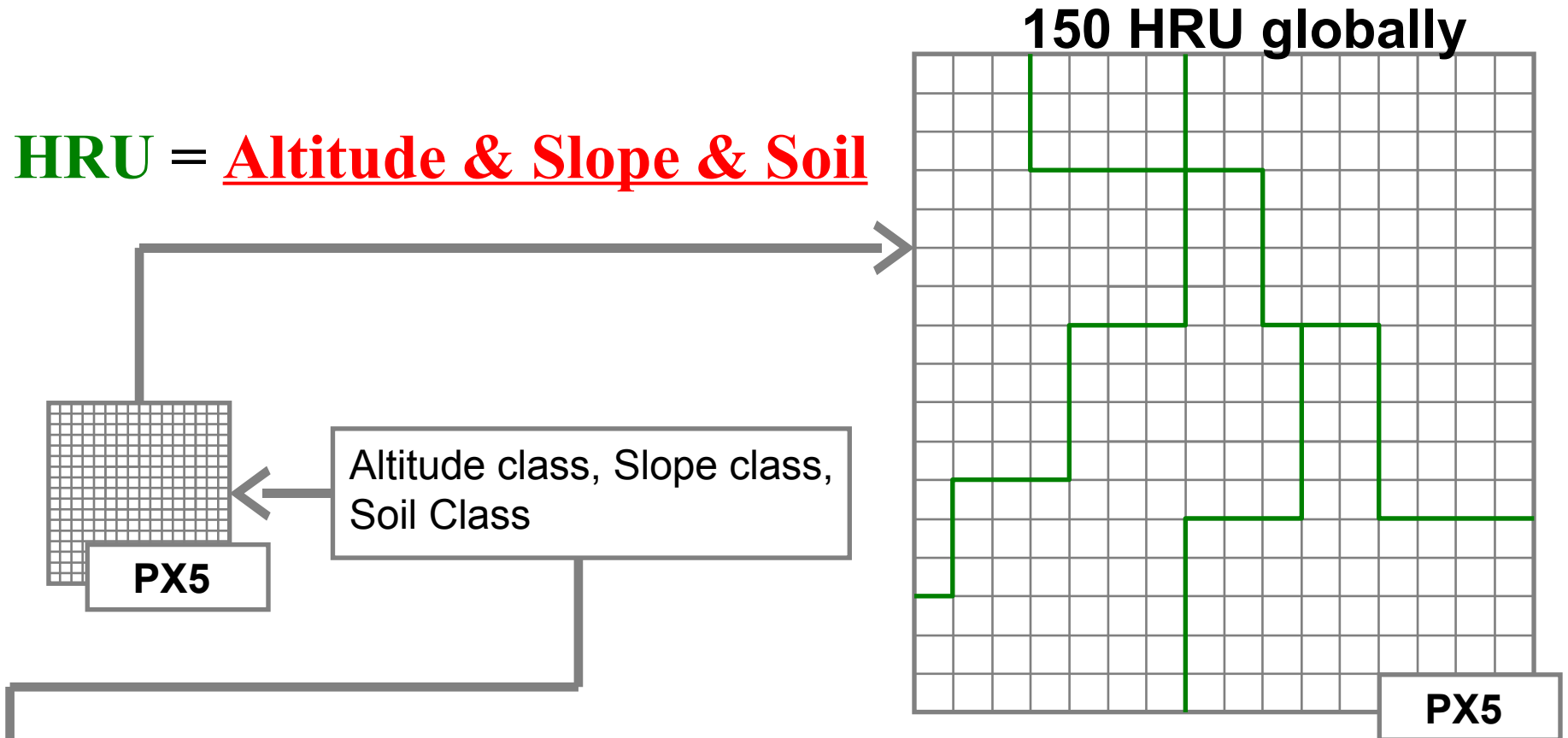
- **GAUL** – global administrative units data, geo-referenced digital coverage, data authority: EC, FAO;

pre-processing results:

- **COUNTRY** – 5 arcmin resolution grid of GAUL administrative units on country level (rasterized version of GAUL), official UN coding system for countries, geographical reference for selected geo-coded data (**agricultural management data**) and interpretation frame for selected geographical analyses;

Data Integration for HRU delineation

HRU = Altitude & Slope & Soil

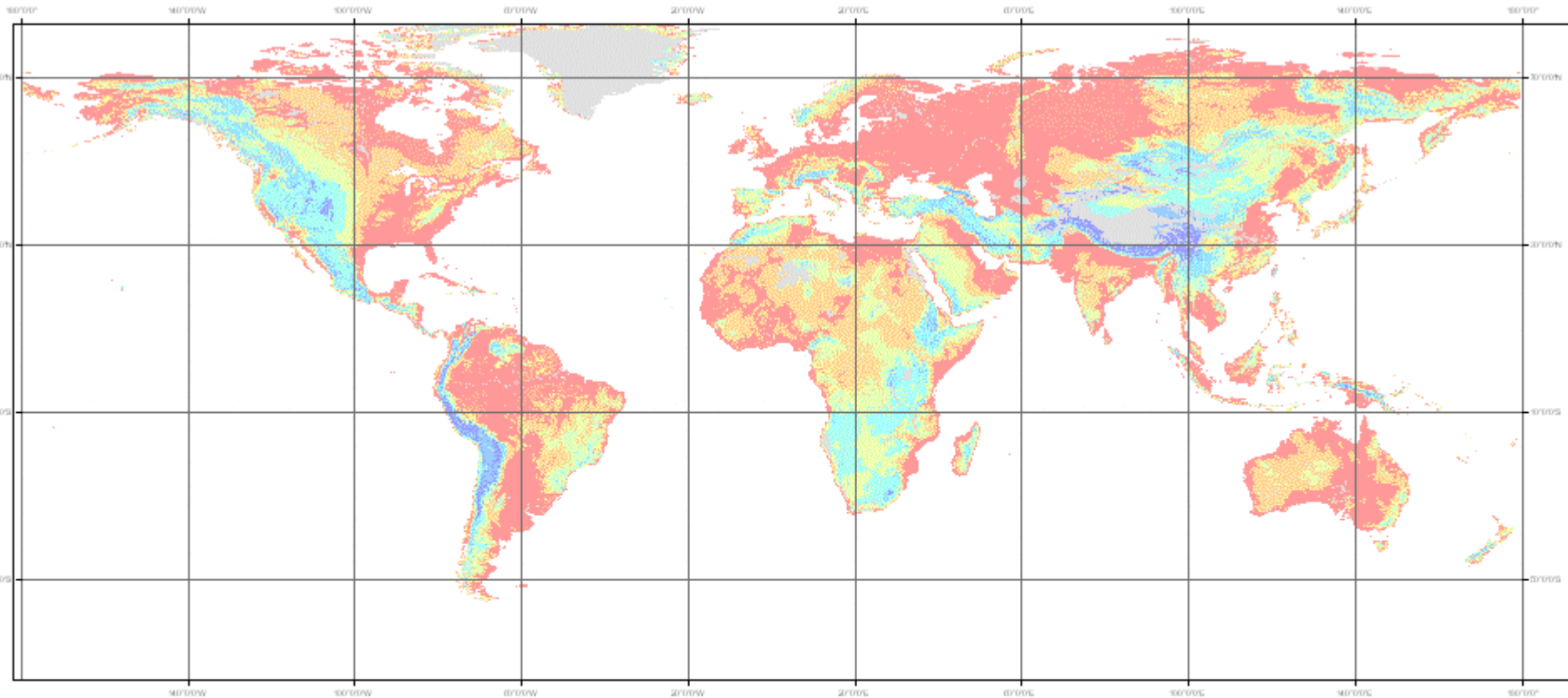


Altitude class (m): 0 – 300, 300 – 600, 600 – 1200, 1200 – 2500 and > 2500;

Slope class (deg): 0 – 3, 3 – 6, 6 – 10, 10 – 15, 15 – 30, 30 – 50 and > 50;

Soil texture class: coarse, medium, fine, stony and peat;

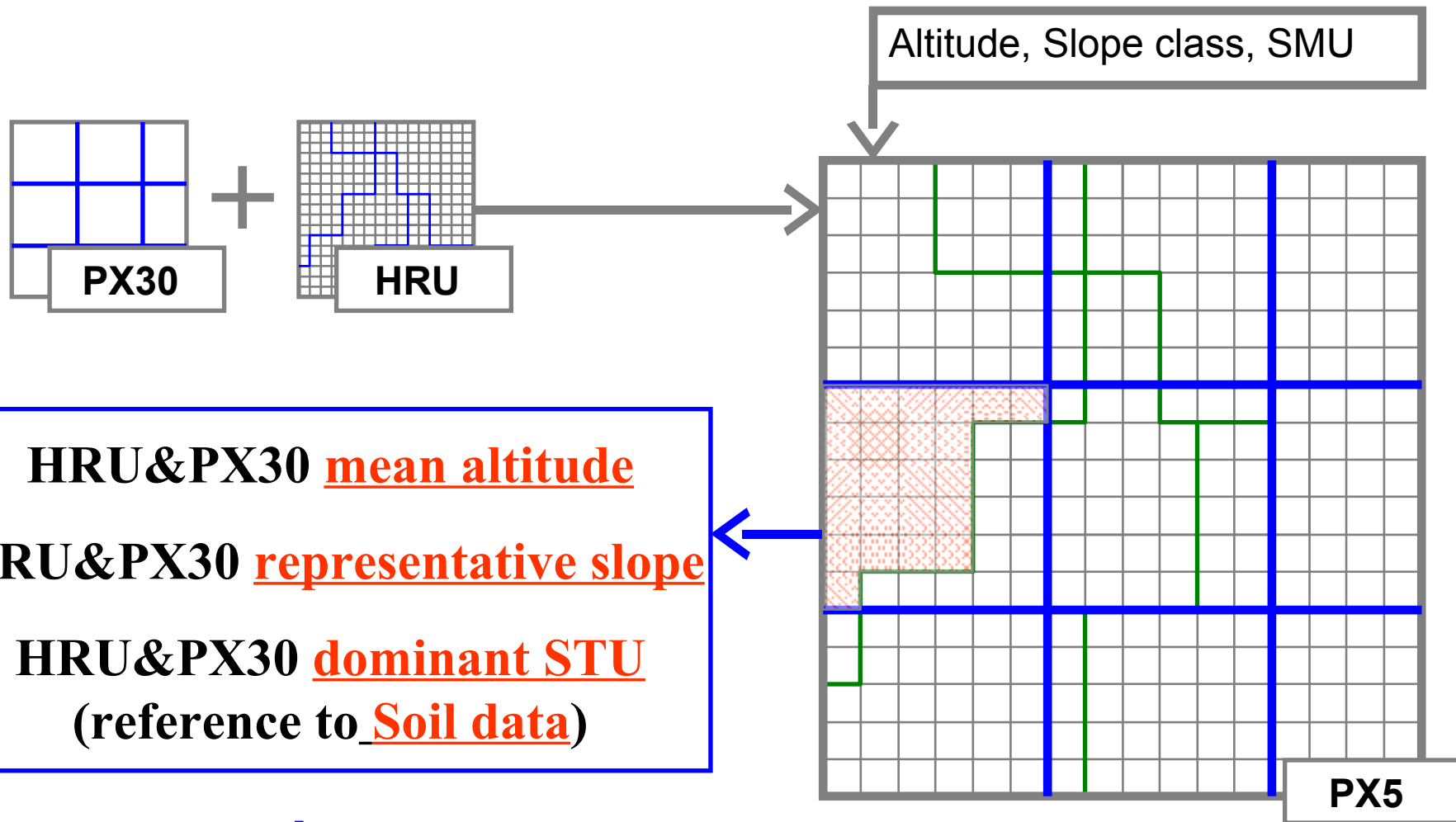
Global HRU delineation



HRU delineations (Altitude class*Slope class*Soil class)

no soil	122	135	153	211	224	242	255	313	331	344	362	414	432	446	463	522	535	553
no soil	123	141	154	212	225	243	261	314	332	345	363	415	433	451	464	523	541	554
111	124	142	155	213	231	244	262	315	333	351	364	421	434	452	511	524	542	555
112	125	143	161	214	232	245	263	321	334	352	365	422	435	453	512	525	543	561
113	131	144	162	215	233	251	264	322	335	353	374	423	441	454	513	531	544	562
114	132	145	163	221	234	252	265	323	341	354	411	424	442	455	514	532	545	563
115	133	151	164	222	235	253	311	324	342	355	412	425	443	461	515	533	551	564
121	134	152	165	223	241	254	312	325	343	361	413	431	444	462	521	534	552	565

HRU & PX30 zone: Topo & Soil data for EPIC

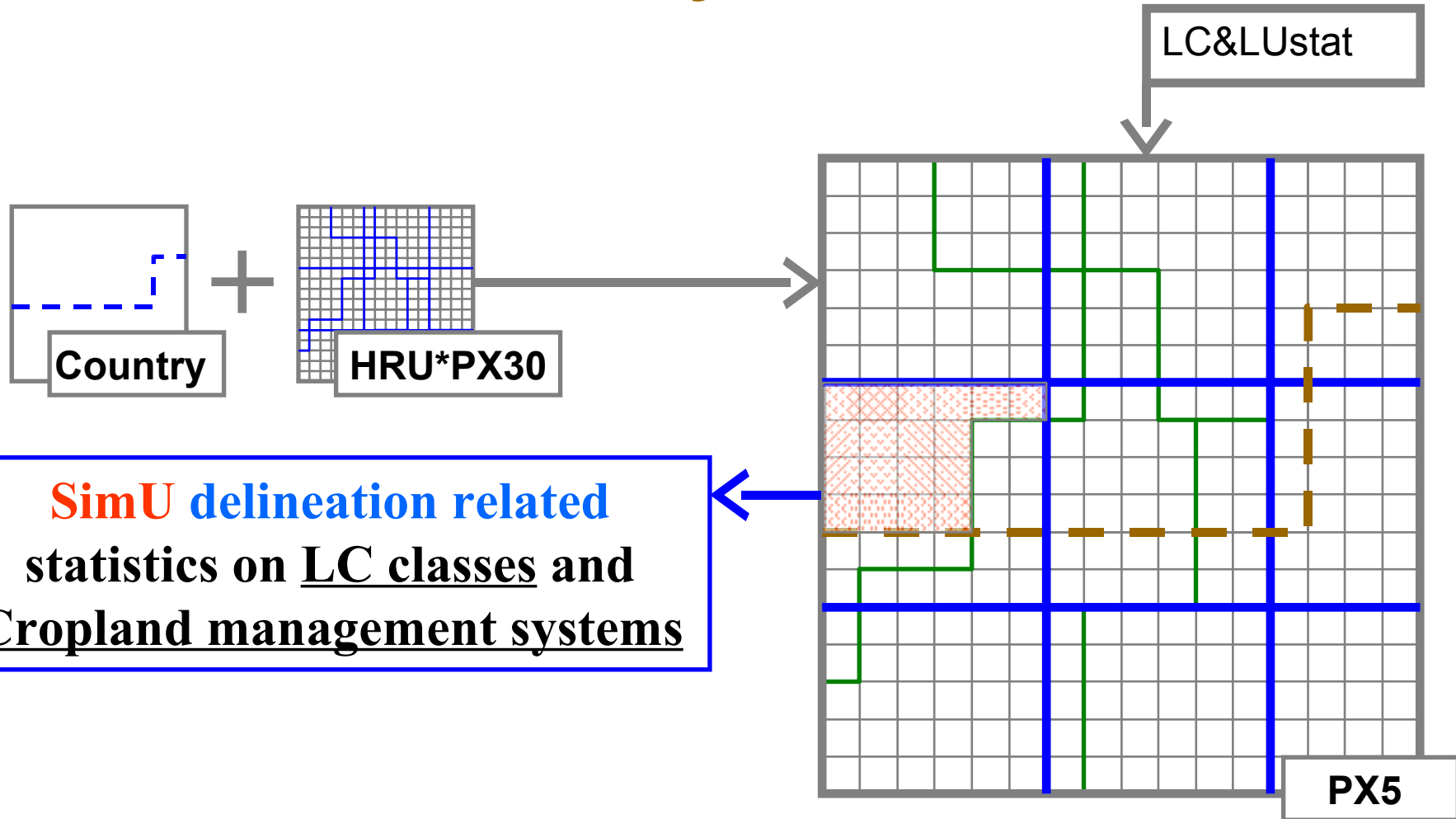


>200000 PX30 globally

geo-referenced input data for EPIC!!!

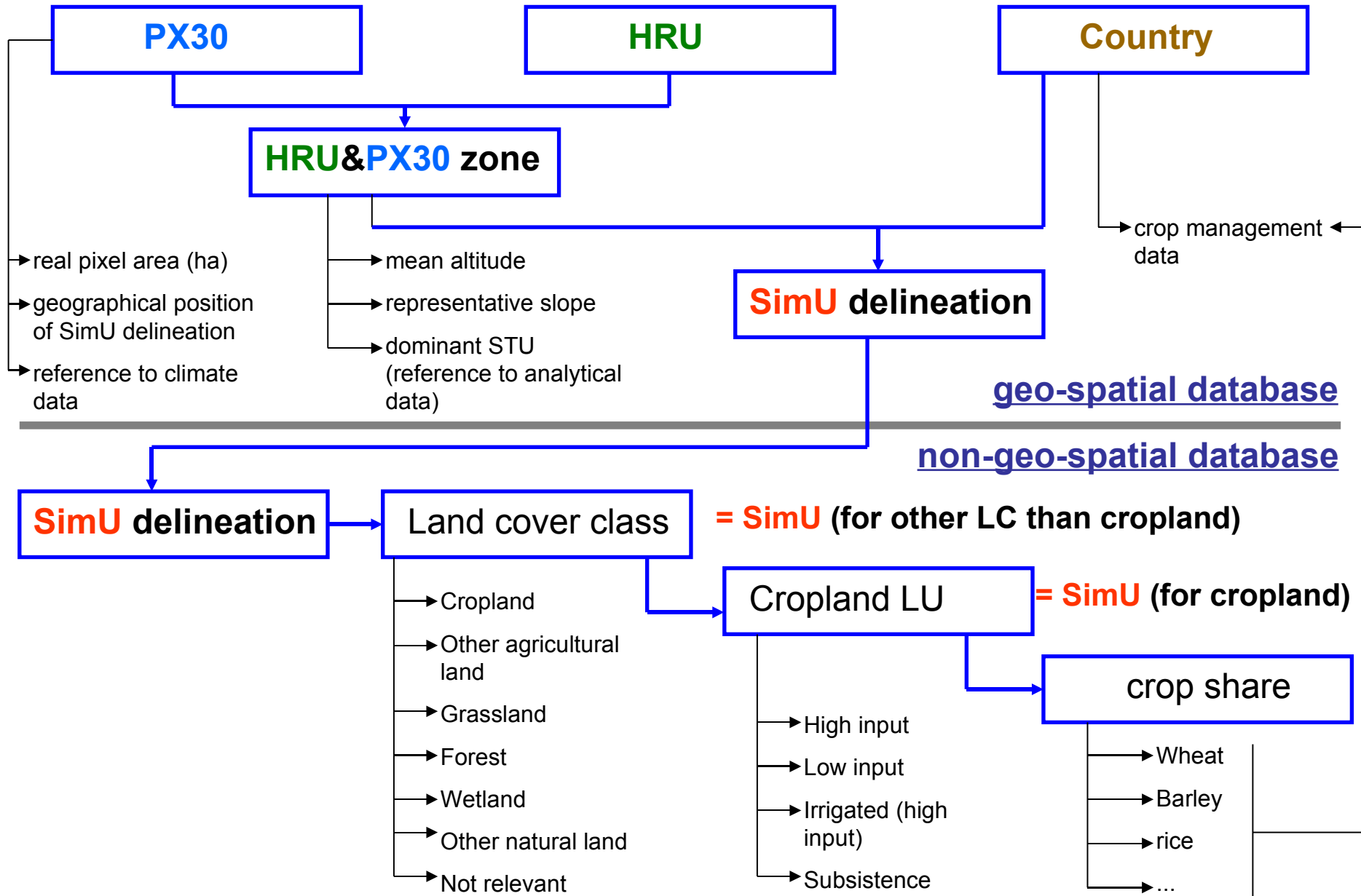
Information on:

HRU & PX30 & Country zone = SimU

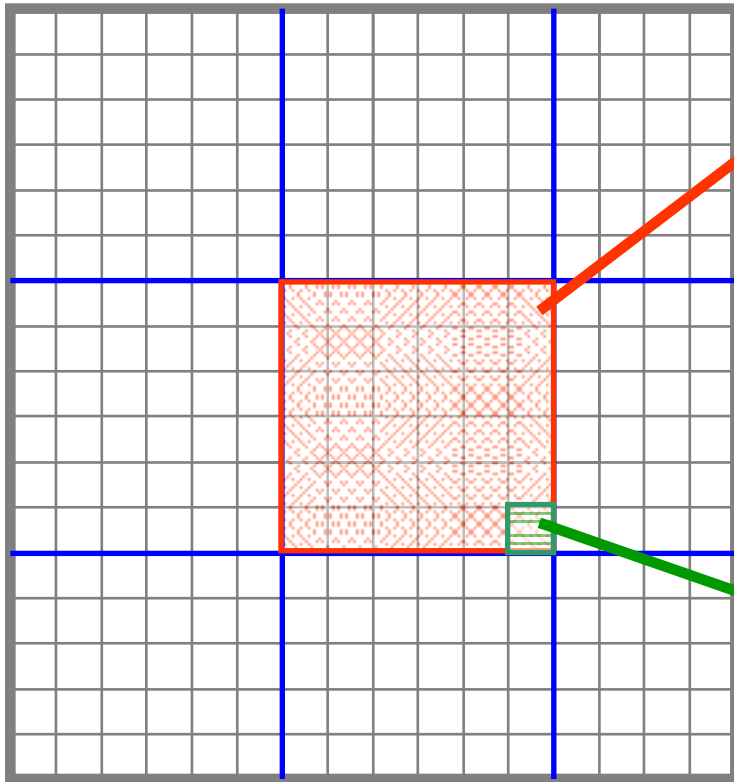


reference for geo-coded data on crop management;
input statistical data for LC/LU economic optimization;

Global EPIC database logic: an overview



SimU delineation Min & Max area



Max area of SimU delineation

~ 180 000 – 300 000 ha
(depending on latitude)

Min area of SimU delineation

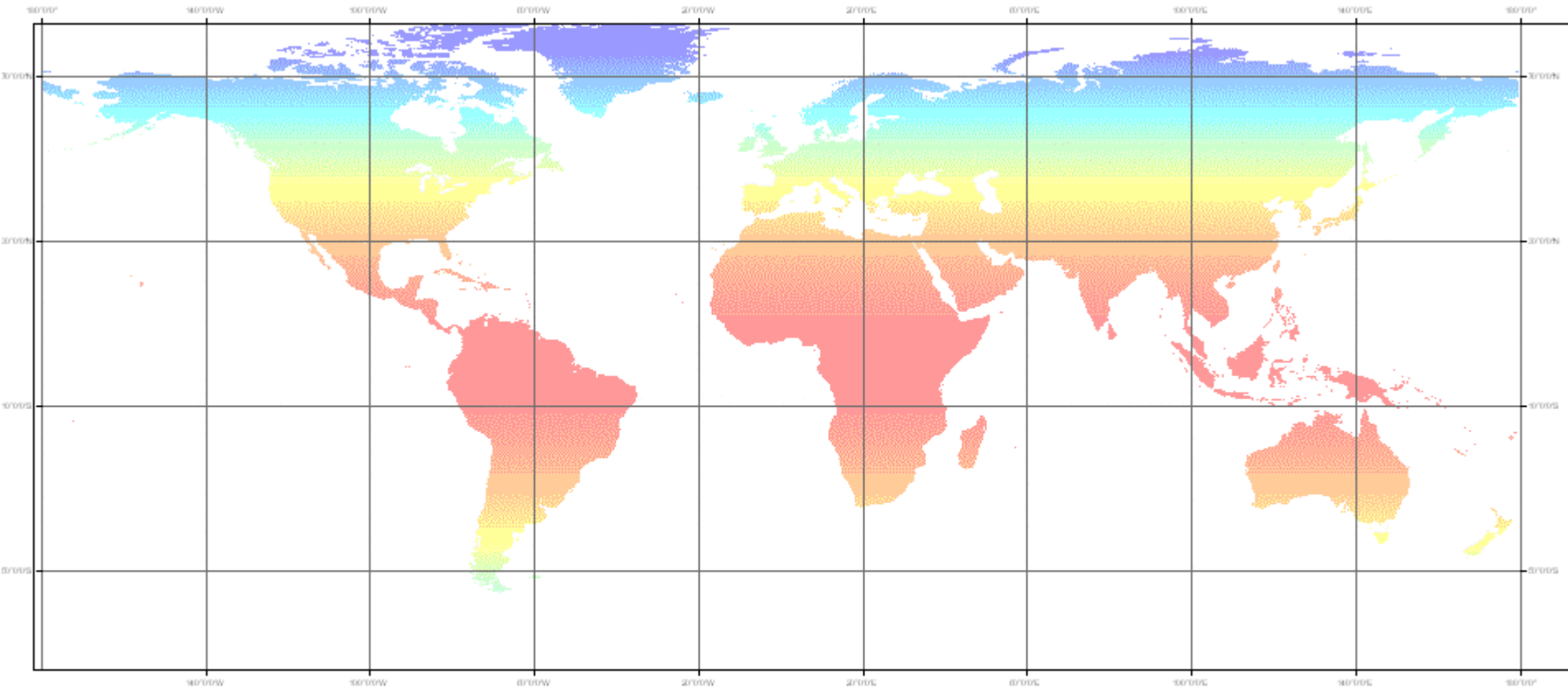
~ 5 000 – 8 500 ha
(depending on latitude)

□ PX30 (PX30 = 36*PX5)

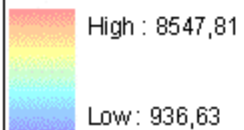
□ PX5

SimU delineation = HRU&PX30&Country

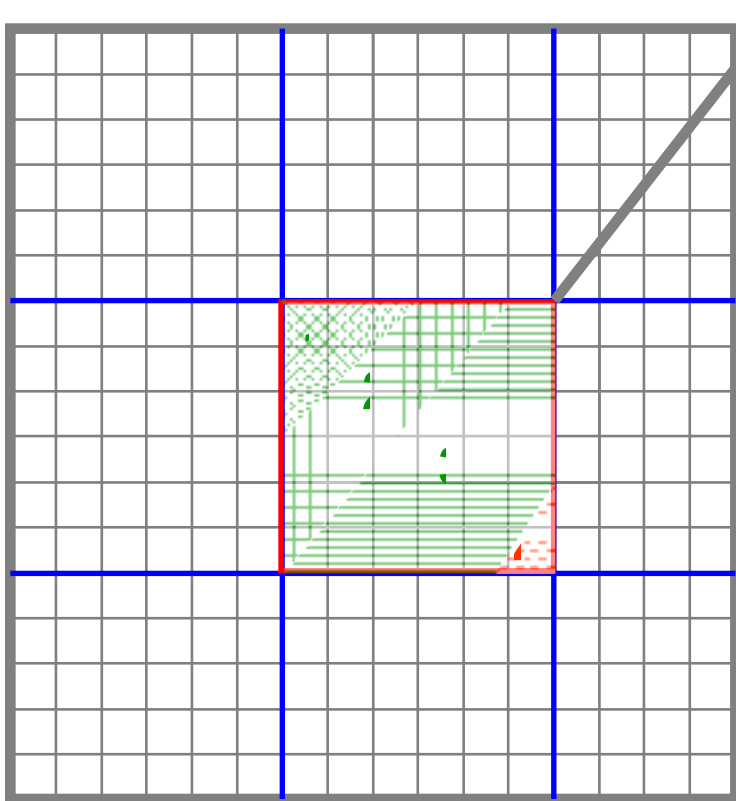
Real pixel area (ha), PX5



Real pixel (5 arcmin resolution) area (ha)



SimU delineation relevance for LC/LU simulation



LC class area relative to total SimU del. area (%) or LU class area relative to Cropland area (%)

relevant LC/LU simulation alternative

1 15%

2 32%

3 50%

not relevant LC/LU simulation alternative

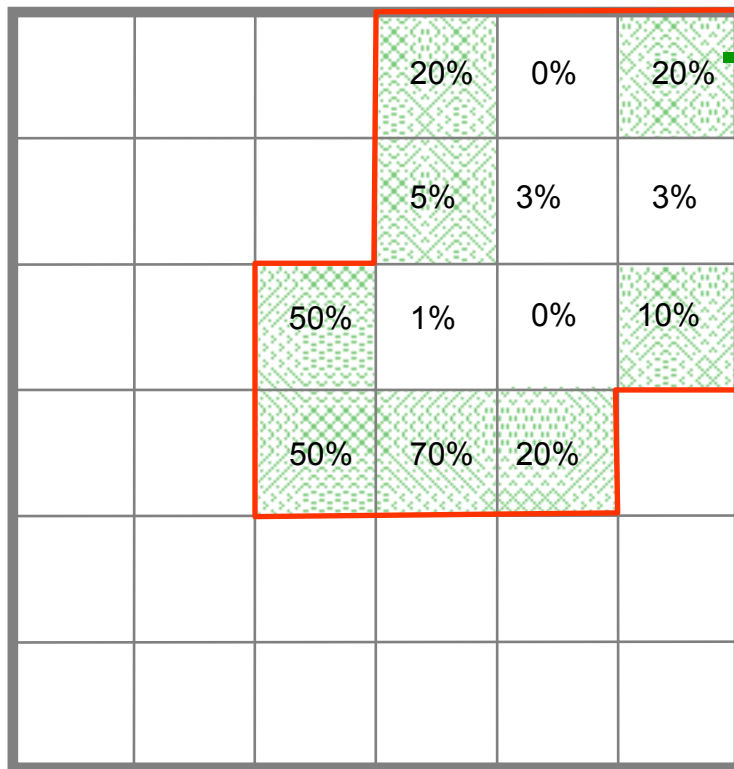
4 3%

□ PX30 (PX30 = 36*PX5)

□ PX5

RULES: LC/LU relevance threshold = 5%

LC/LU visualization mask



→ visualized PX5 pixels

VISUALIZATION RULES:

LC/LU alternative is relevant for
SimU del. or Cropland

&

LC/LU relevance threshold = 5%

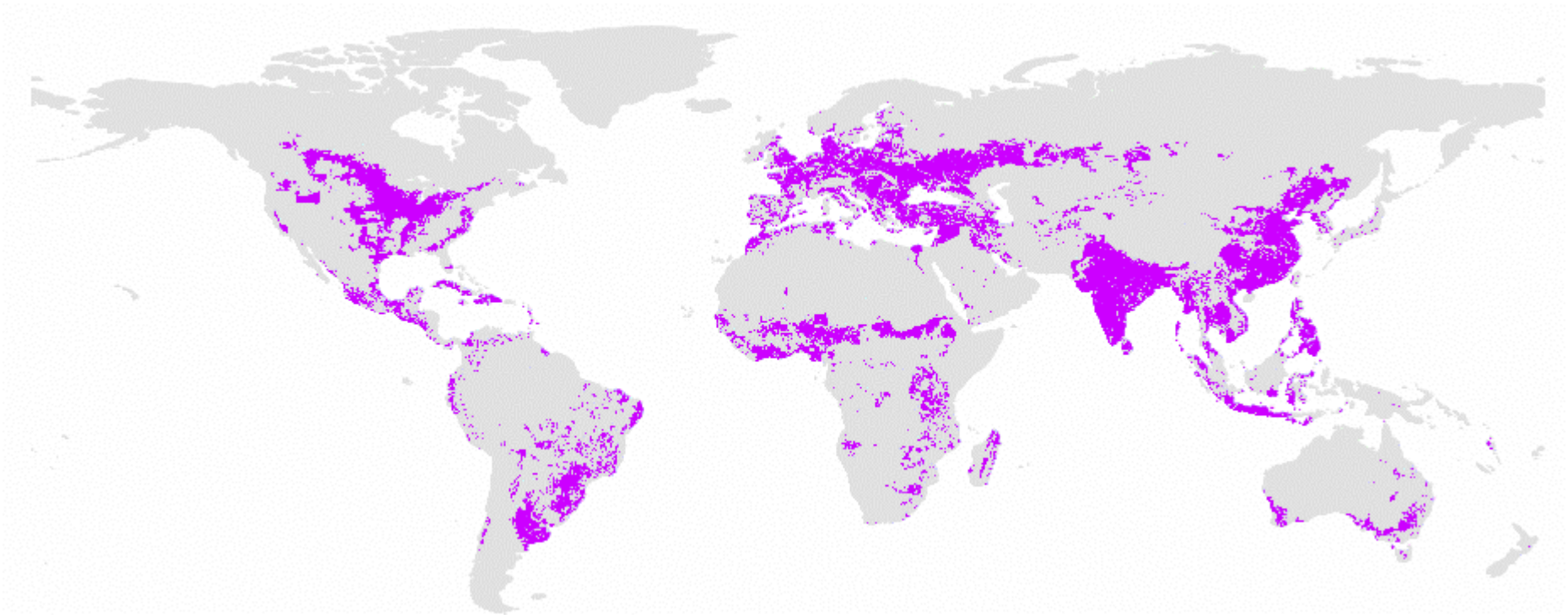
SimU relevant for LC/LU alternative simulation

PX30

PX5

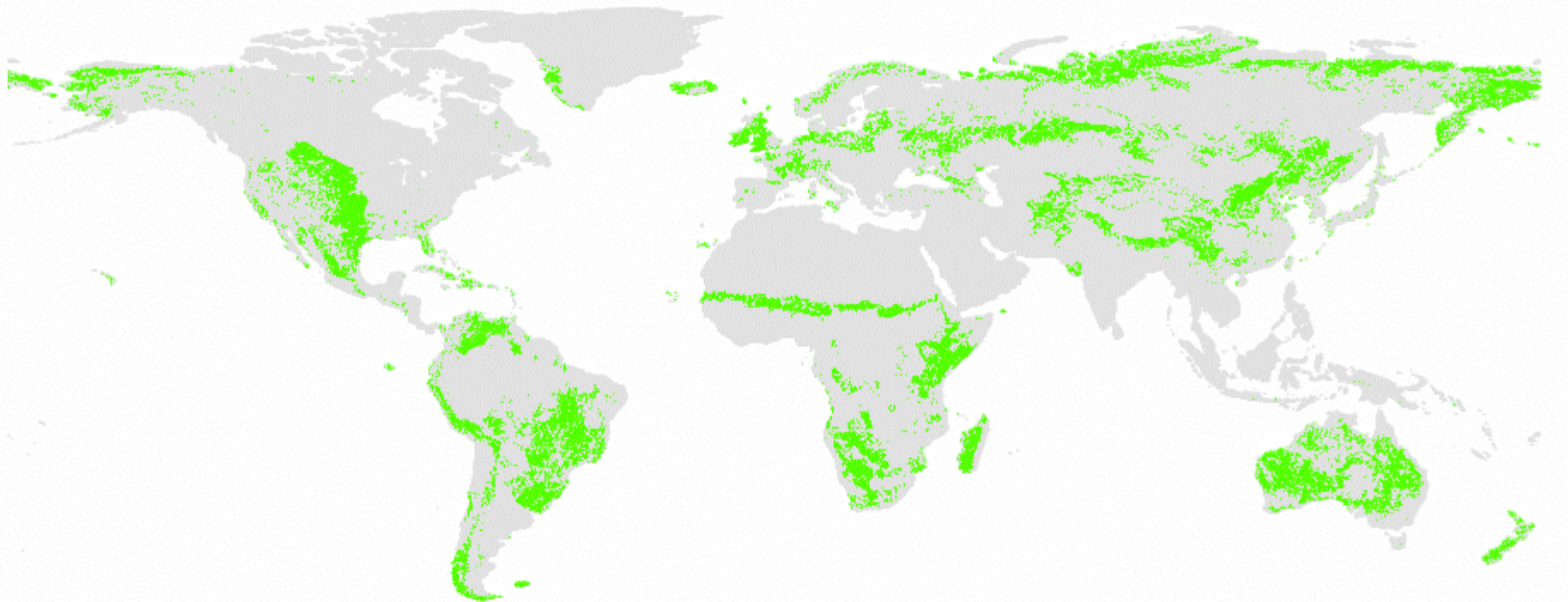
50% LC area relative to PX5 area or LU area relative to PX5 Cropland area

Cropland (visualisation only for SimU)



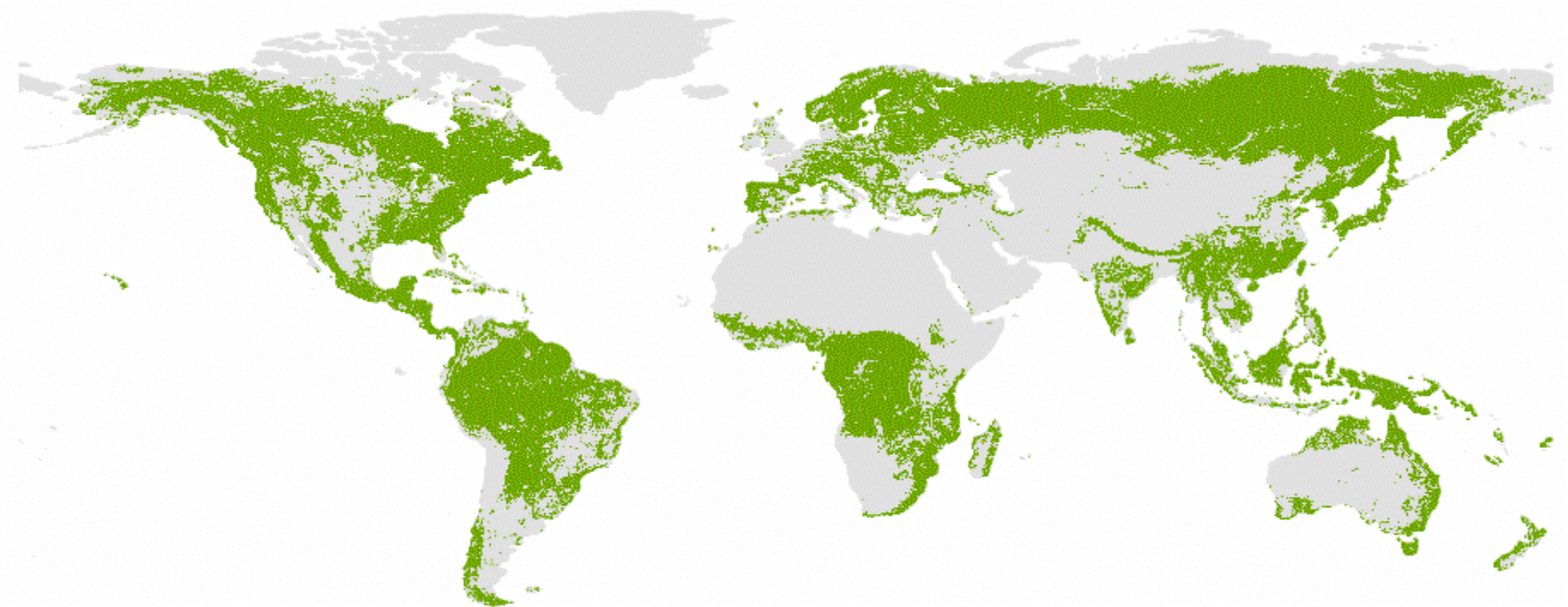
threshold of 5% LCI area of total pixel area

Grassland (visualisation only for SimU)



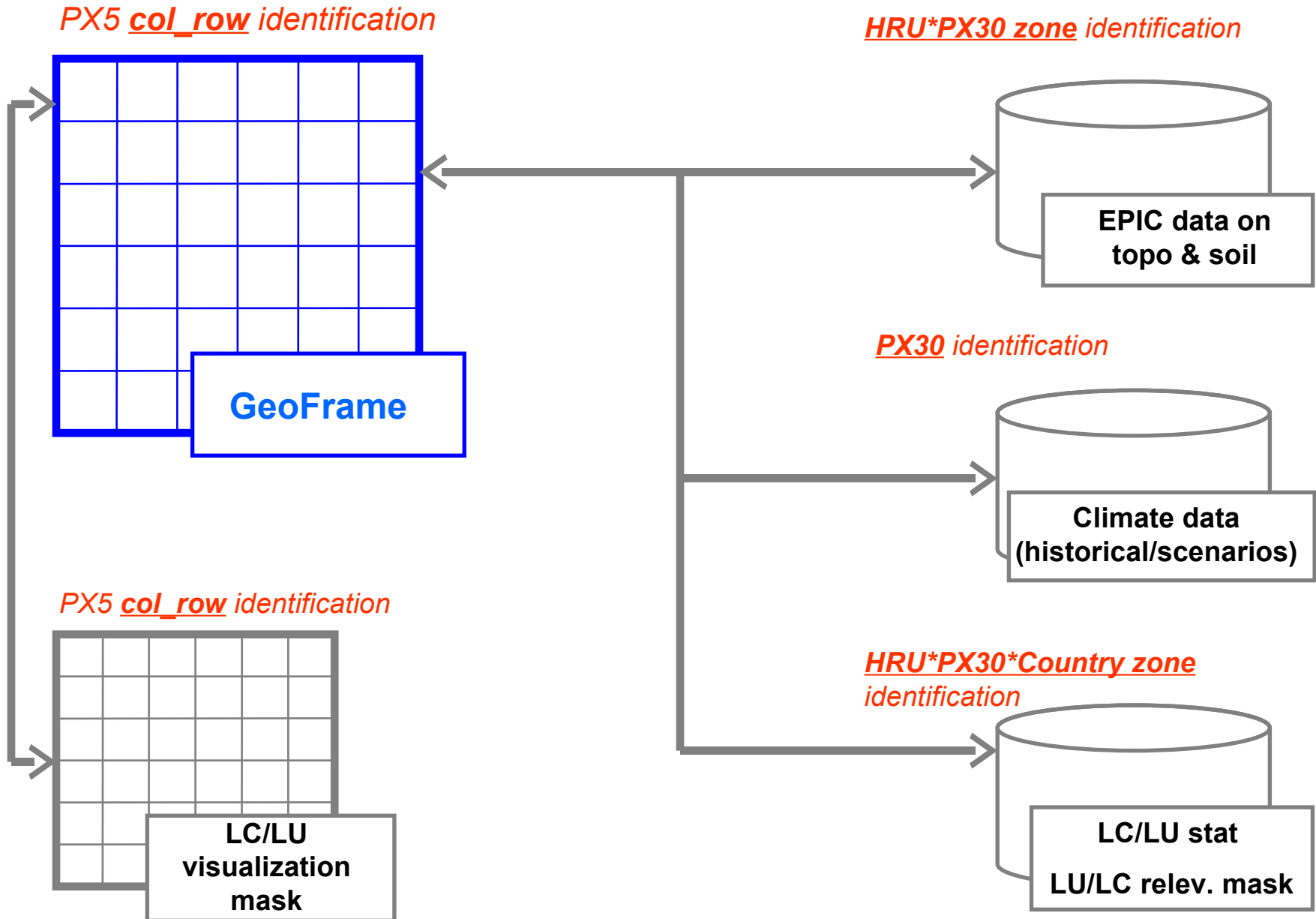
threshold of 5% LCI area of total pixel area

Forest (visualisation only for SimU)



threshold of 5% LCI area of total pixel area

Global EPIC inputs database organization:



Global EPIC inputs database: attribute list

GeoFrame:

ATTRIBUTE	DATA TYPE	SHORT DESCRIPTION
COL_ROW	Text(12)	primary database key , column and row based indexing of 5min resolution grid;
XCOORD	Number(Double)	geographic projection field; x coordinate [decimal degree] of 5 arcmin resolution pixel centroid;
YCOORD	Number(Double)	geographic projection field; y coordinate [decimal degree] of 5 arcmin resolution pixel centroid;
Pxarea	Number(Double)	real physical area of 5 arcmin resolution pixel [ha];
HRU	Number(Integer)	foreign database key , code of homogenous response unit (3-digit combination of 1. altitude class (values 1 – 5), 2. slope class (values 1 – 7) and 3. soil texture class (values 1 – 5));
COL_ROW30	Text(12)	foreign database key , identification of 30min reference grid pixel (data interpretation frame);
COUNTRY	Number(LongInteger)	foreign database key , identification of country according to official UN list of country codes;

Global EPIC inputs database: attribute list

LC/LUstat (part1):

ATTRIBUTE	DATA TYPE	SHORT DESCRIPTION
COL_ROW	Text(12)	primary database key , column and row based indexing of 5min resolution grid;
CrpLnd	Number(Double)	physical area (ha) of cropland within the SimU delineation;
CrpLnd_H	Number(Double)	physical area (ha) of cropland, high input management system within the SimU delineation;
CrpLnd_L	Number(Double)	physical area (ha) of cropland, low input management system within the SimU delineation;
CrpLnd_I	Number(Double)	physical area (ha) of cropland, irrigated management system within the SimU delineation;
CrpLnd_S	Number(Double)	physical area (ha) of cropland, subsistence management system within the SimU delineation;
OthAgri	Number(Double)	physical area (ha) of other agricultural land within the SimU delineation;
Grass	Number(Double)	physical area (ha) of grassland within the SimU delineation;
Forest	Number(Double)	physical area (ha) of forestland within the SimU delineation;
WetLnd	Number(Double)	physical area (ha) of wetland within the SimU delineation;
OthNatLnd	Number(Double)	physical area (ha) of other natural vegetation within the SimU delineation;
NotRel	Number(Double)	physical area (ha) of not relevant land covers within the SimU delineation;

Global EPIC inputs database: attribute list

LC/LUstat (part2):

ATTRIBUTE	DATA TYPE	SHORT DESCRIPTION
mCrpLnd	Number(Byte)	cropland mask for spatial representation and visualization of the data;
mCrpLnd_H	Number(Byte)	cropland, high input management system, mask for spatial representation and visualization of the data;
mCrpLnd_L	Number(Byte)	cropland, low input management system, mask for spatial representation and visualization of the data;
mCrpLnd_I	Number(Byte)	cropland, irrigated management system, mask for spatial representation and visualization of the data;
mCrpLnd_S	Number(Byte)	cropland, subsistence management system, mask for spatial representation and visualization of the data;
mOthAg	Number(Byte)	other agricultural land mask for spatial representation and visualization of the data;
mGrass	Number(Byte)	grassland mask for spatial representation and visualization of the data;
mForest	Number(Byte)	forestland mask for spatial representation and visualization of the data;
mWetLnd	Number(Byte)	wetland mask for spatial representation and visualization of the data;
mOthNat	Number(Byte)	other natural vegetation land mask for spatial representation and visualization of the data;
mNotRel	Number(Byte)	not relevant areas mask for spatial representation and visualization of the data;

Global EPIC inputs database: attribute list

EPICinput (topo data):

ATTRIBUTE	DATA TYPE	SHORT DESCRIPTION
HRU	Number(Integer)	primary database key , code of homogenous response unit (3-digit combination of 1. altitude class (values 1 – 5), 2. slope class (values 1 – 7) and 3. soil texture class (values 1 – 5));
COL_ROW30	Text(12)	primary database key , identification of 30min reference grid pixel (data interpretation frame);
COUNTRY	Number(LongInteger)	primary database key , identification of country according to official UN list of country codes;
SimU_lon	Number(Double)	longitude (decimal degrees) assigned to SimU delineation;
SimU_lat	Number(Double)	latitude (decimal degrees) assigned to SimU delineation;
CrLn_area	Number(Single)	SimU information field, physical area (ha) of a cropland within the SimU delineation;
SimU_alti	Number(Double)	mean altitude (m) for SimU delineation;
SimU_slp	Number(Double)	dominant slope (%) within SimU delineation;
SimU_STU	Text(2)	SimU information field, area dominant DSMW soil typological unit within the SimU;

Global EPIC inputs database: attribute list

EPICinput (soil data):

ATTRIBUTE	DATA TYPE	SHORT DESCRIPTION
HG	Number(Byte)	USDA NRCS soil hydrological group;
ALB	Number(Single)	albedo of moist soil surface, a constant value set to 0,15;
* ₁)DEPTH_	Number(single)	depth of soil layer bottom (m), soil layers 1 - 5;
* ₁)VS_	Number(Integer)	volume of stones (%); content of soil fragments > 2mm in diameter, soil layers 1 - 5;
* ₁)SAND_	Number(Integer)	sand content (%), content of particles of 0.063 - 2 mm, soil layers 1 - 5;
* ₁)SILT_	Number(Integer)	silt content (%), content of particles of 0.002 - 0.063 mm, soil layers 1 - 5;
* ₁)CLAY_	Number(Integer)	silt content (%), content of particles of 0.002 - 0.063 mm, soil layers 1 - 5;
* ₁)BD_	Number(Single)	bulk density (t/m ³) of soil, soil layers 1 - 5;
* ₁)CEC_	Number(Single)	soil cation exchange capacity (cmol/kg) , soil layers 1 - 5;
* ₁)SB_	Number(Single)	sum of bases (cmol/kg) , soil layers 1 - 5;
* ₁)PH_	Number(Single)	soil pH in H ₂ O, soil layers 1 - 5;
* ₁)CARB_	Number(Single)	(calcium) carbonate content (%) in a soil, soil layers 1 - 5;
* ₁)CORG_	Number(Single)	soil organic carbon content (%), soil layers 1 - 5;
* ₁)FWC_	Number(Double)	water content in soil (mm/mm) at field water capacity, soil layer 1 - 5;
* ₁)WP_	Number(Double)	water content in soil (mm/mm) at wilting point, soil layer 1 - 5;
* ₁)KS_	Number(Double)	saturated soil hydraulic conductivity (mm/hour), soil layer 1 - 5;

Source:

Skalský R., E. Schmid, Z. Tarasovičová, and J. Balkovič (2007): *Detailed description of the data strategy for global EPIC modelling*. The GEO-BENE Database Report. 30.09.2007.