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# Vegetation Suitability Mapping in Coarse Sandy Hilly Catchments, China

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# CONTENT



- ◆ **Objectives**
- ◆ **Theory of Spatial Modelling of Vegetation Suitability**
- ◆ **Practice of Spatial Modelling of Vegetation Suitability**
- ◆ **Results for the modelling: single, collective and vegebin**





# OBJECTIVES



- ◆ To select the models to assess the suitability of main species in Coarse Sandy Hilly Catchments (CSHC), and
- ◆ To provide the results to stakeholders for CSHC re-plantation scheme





## Model selection: theory

Species distribution is mainly controlled by climatic, landscape, soil conditions and other resources.

- (1) Resources: consumed by the plant *e.g.*, N,P;
- (2) Direct variables: not consumed by the plant yet have a direct physiological influence on growth *e.g.*, pH; and
- (3) Indirect variables: no direct physiological influence on growth, they are correlated with species distribution due to their correlation with variables, *e.g.* topography  
(Austin, 1987)

In any vegetation site suitability assessment (or predictive vegetation mapping) exercise these variables can either be continuous or categorical

There are many models dealing with this problem

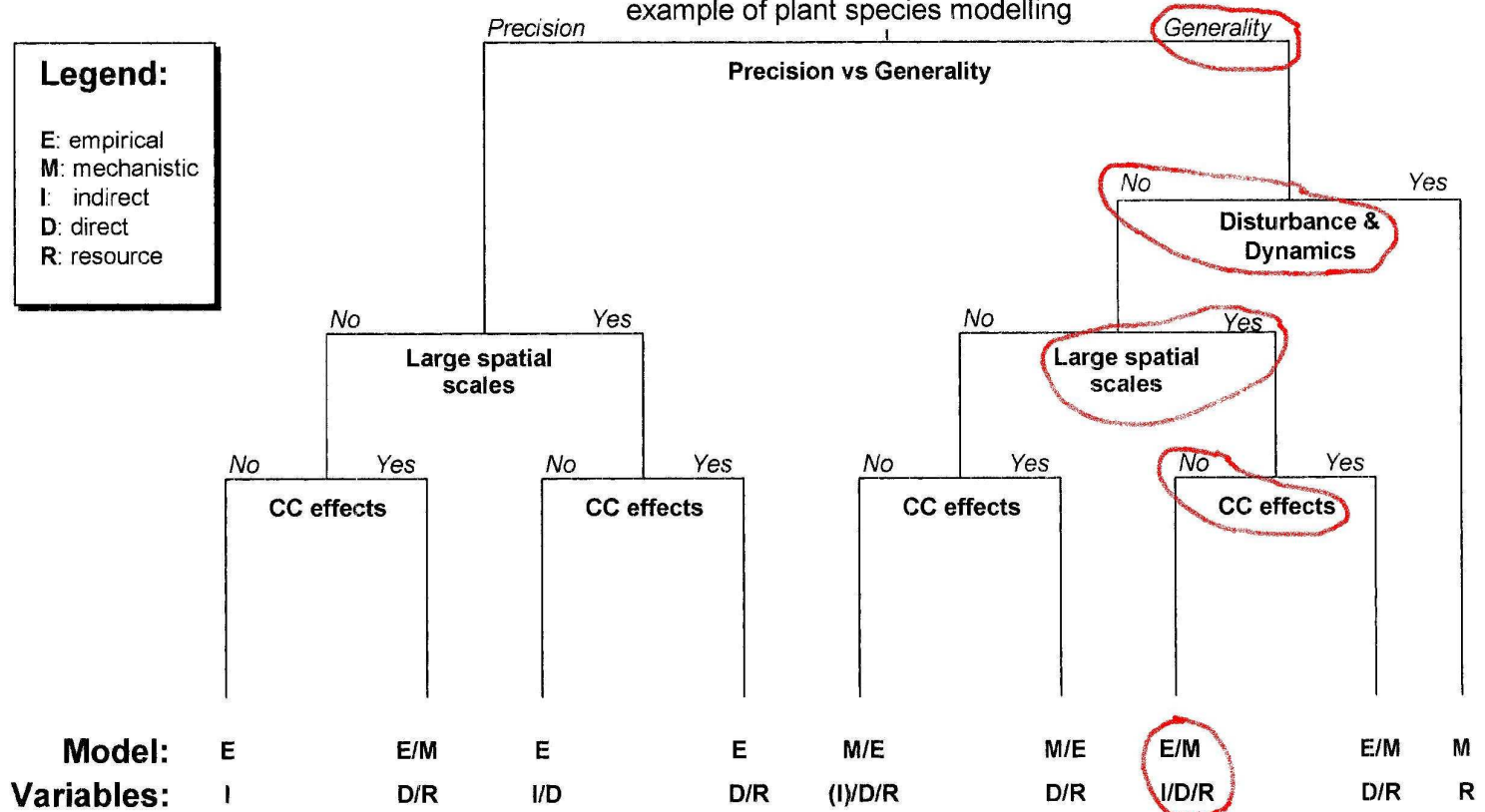


# Model selection: theory



## Model selection and criteria

example of plant species modelling



Criteria for model selection. Examples of considerations for modeling vascular plant species in space and/or time, given a set of possible criteria to reach the project goals, CC: climatic change. **From Guisan and Zimmerman (2004) Ecological Modelling**



## Model selection: theory



Criteria for model approach selection :

- ◆ the goals of the project ; and
- ◆ the data availability (meaning both spatial environmental variables and either a database of species presence data, or rules defining the species' requirements or tolerances).



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## Model selection: model for CSHC

The CSHC vegetation suitability mapping has the characteristics of:

- (1) being general;
- (2) not incorporating disturbance and dynamics;
- (3) is over a large spatial scale; and
- (4) will not incorporate climate change effects

the range of models could be either empirical or mechanistic, and

- (1) the variables used can be any combination of resources, direct variables, and indirect variables.

In our case, the conceptualisation of criteria for model / variable selection for predictive vegetation mapping has not assisted refining the options. Hence we are limited by readily available datasets (both spatial layers and knowledge of species resource needs).

**This is what drives our selection of implemented a Boolean model – or a discrete gradient approach – we allow for multiple species in each grid cell**



## Model selection: model for CSHC



### Environmental Variables:

1. Annual precipitation (R)—from Lingtao and Tim's work
2. Air temperature (D) )—from Lingtao and Tim's work
3. Land position (I) )—from DEM improved by Qinke
4. Soil pH (D)— from soil map by Xiaoping
5. Soil TN (R) — from soil map by Xiaoping



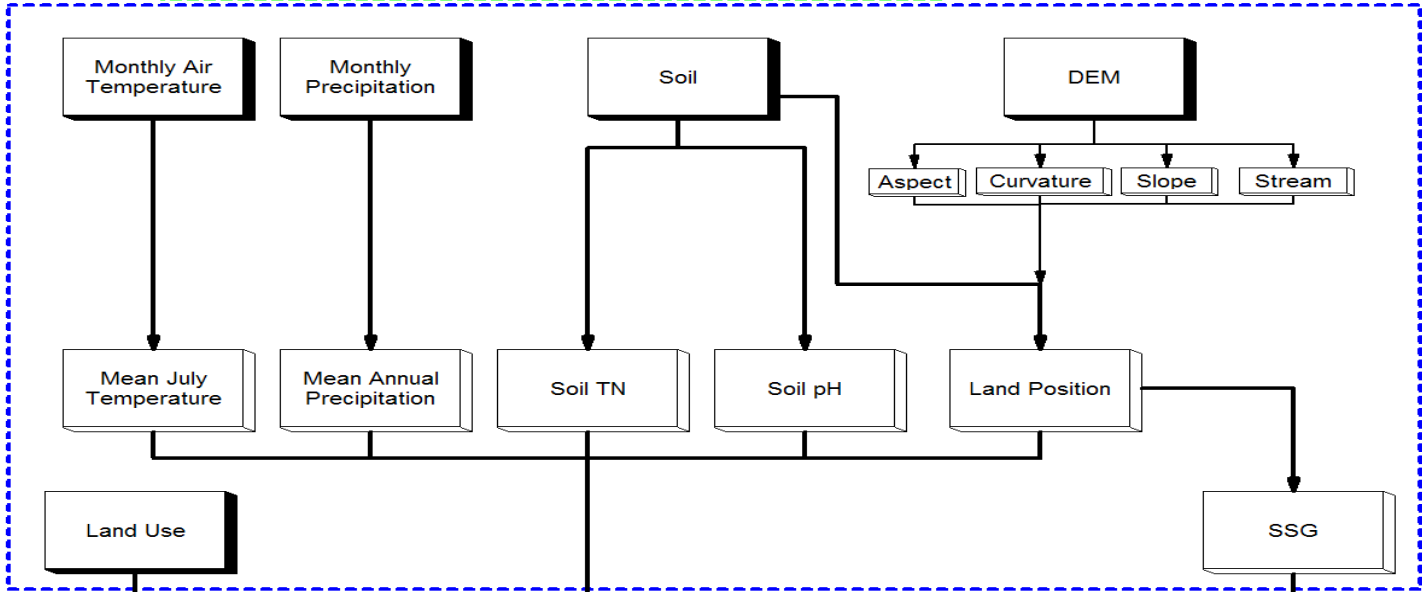


# Suitability mapping: flowchart

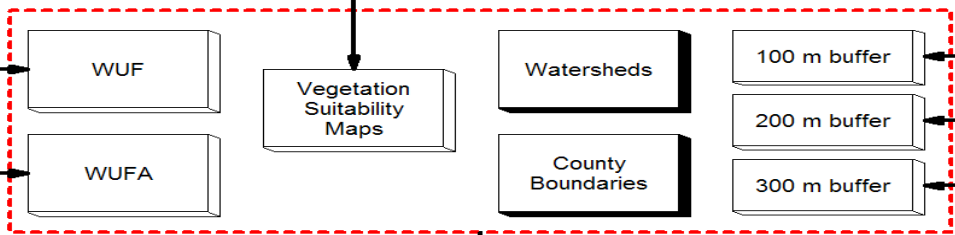
Model Selection



Data Preparation



Map Generation



Legend  
Existing Data  
Generated Data  
SSG = steep slope & gully  
WUF = water, urban, forest  
WUFA = water, urban, forest, Agriculture

Vegetation Suitability Maps for each of 42 watersheds for each of 70 counties taking into account priority and land limitation



# Suitability mapping: species selection, land position definition and suitability assessment



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Code Number	Native	Growth form	Chinese Name	Latin Name
1 *	Yes	T	油松	<i>Pinus tabulaeformis</i> Carr.
2 *	Yes	T	白桦	<i>Betula Platyphylla</i> Suk.
3 *	Yes	S	山毛桃	<i>Amygdalus davidiana</i> (Carr.) C. de Voe ex Henry
4	Yes	S	黄刺梅	<i>Rosa xanthina</i> Lindl.
5 *	Yes	T	辽东栎	<i>Quercus liaotungensis</i> Koidz.
6 *	Yes	T	白榆	<i>Ulmus pumila</i>
7 *	Yes	T	小叶杨	<i>Populus simonii</i> Carr.
8 *	Yes	T	侧柏	<i>Platycladus orientalis</i> (L.)
9	Yes	S	荆条	<i>Vitex negundo</i> Linn. var. <i>heterophylla</i> (Franch.) Rehd
10	Yes	S	狼牙刺	<i>Sophora davidii</i>
11 *	No	T	刺槐	<i>Robinia pseudoacacia</i>
12 *	Yes	T	旱柳	<i>Salix matsudana</i>
13	Yes	S	酸枣	<i>Ziziphus jujuba</i> var. <i>spinosa</i>
14	Yes	T	山杨	<i>Populus davidiana</i>
15 *	Yes	S	虎榛子	<i>Ostryopsis davidiana</i> Decne
16 *	No	S	紫穗槐	<i>Amorpha fruticosa</i>
17	Yes	S	沙枣	<i>Elaeagnus angustifolia</i>
18 *	Yes	S	柠条	<i>Caragana microphylla</i>
19 *	Yes	S	沙柳	<i>Salix psammophila</i>
20	Yes	S	怪柳	<i>Tamarix spp</i>
21	Yes	S	乌柳	<i>Salix cheilophila</i> Schneider
22 *	Yes	T	臭椿	<i>Ailanthus altissima</i>
23 *	Yes	S	沙棘	<i>Hippophae rhamnoides</i>
24	Yes	T	青杨	<i>P. cathayana</i> Rehd
25	No	T	新疆杨	<i>Populars albav</i>
26 *	Yes	T	桃	<i>Prunus davidiana</i>
27 *	Yes	T	杏	<i>Prunus armeniana</i> var. <i>ansu</i>
28	Yes	T	毛白杨	<i>Populus tomentosa</i> carr.
29 *	Yes	T	河北杨	<i>Populars hopeiensis</i>
30 *	Yes	T	苹果	<i>Malus domestica</i> Borkh.
31 *	Yes	T	梨	<i>Pvres bretschneideri</i>
32	Yes	T	桑	<i>Mofusalba</i> L.
33	Yes	T	核桃	<i>Juglans regia</i>
34	Yes	S	文冠果	<i>Xanthoceras sorbifolia</i> Bge.
35 *	Yes	T	杜梨	<i>Pyrus betulaeifoli</i>
36	Yes	T	楸树	<i>Catalpa bungei</i> C.A. Mey
37 *	Yes	T	枣	<i>Zizyphus jujuba</i> Mill
38	No	T	箭杆杨	<i>Populus nigra</i> var. <i>thevestina</i> (Dode) beain

A



# Suitability mapping: species selection, land position definition and suitability assessment



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Code number	TN (%)	pH	precipitation (mm)	Temperature July (°C)	Land positions
*1	No limit	5.6<pH(<6.5)	200≤R(≤400)	T≥14	LM, NFS, RM
*2	No limit	5.6<pH<6.5	R>400	No limit	SFS,RM
*3	No limit	No limit	R>200	No limit	SFS,RM
4	No limit	No limit	R>400	No limit	(SFS +),RM
*5	No limit	No limit	R>200	No limit	RM
*6	No limit	No limit	R>200	No limit	SFS,NFS,FB,RM
*7	≥0.05	No limit	R>200	No limit	SFS,NFS,FB
*8	No limit	No limit	R>200	T≥14	(LM +),SFS,FB,RM
9	No limit	No limit	R>200	T≥14	SFS
10	No limit	No limit	R>200	T≥14	SFS
*11	No limit	No limit	R>200	T≥14	(LM -), SFS,NFS,FB,RM
*12	No limit	No limit	R>200	T≥14	(SFS +),FB
13	No limit	No limit	R>300(400)	T≥14	SFS,RM
14	No limit	No limit	R>400	T≥14	(NFS +),RM
*15	No limit	No limit	R>400	T≥14	(NFS +),RM
*16	No limit	No limit	R>200	No limit	(LM +),SFS,FB,RM
17	No limit	No limit	R>200	No limit	SFS,FB,RM,
*18	No limit	No limit	R>200	No limit	LM,SFS,FB
*19	No limit	No limit	R>200	No limit	FB,
20	No limit	No limit	R>400(200)	No limit	(LM -),SFS,NFS,FB
21	No limit	No limit	R>200	No limit	FB,
*22	No limit	No limit	R>200	No limit	LM,SFS,FB
*23	No limit	No limit	R>200(400)	T≥14	LM,SFS,NFS,FB,RM
24	≥0.05	No limit	R>200(400)	No limit(T≥14)	(LM -),NFS,FB
25	≥0.05	No limit	R>200(400)	No limit(T≥14)	(LM -),FB
*26	≥0.05	No limit	R>400	T≥14	LM,FB,RM
*27	≥0.05	No limit	R>200(400)	T≥14	LM,SFS,FB,RM
28	≥0.05	No limit	R>500(400)	T≥14	LM,FB
*29	≥0.05	No limit	R>200(400)	T≥14	NFS,(FB+ ),RM,(SFS-)
*30	≥0.05	No limit	R>400	T≥14	LM,FB,RM
*31	≥0.05	No limit	R>400	T≥14	LM,FB,RM
32	≥0.05	No limit	R>400	T≥14	LM,FB,(RM -)
33	≥0.05	No limit	R>400	T≥14	LM,SFS,FB,RM
34	≥0.05	No limit	R>400	T≥14	LM,SFS
*35	≥0.05	No limit	R>300(400)	T≥14	LM,SFS,FB,
36	≥0.05	No limit	R>400	T≥18	NFS,FB,(LM -)
*37	≥0.05	No limit	R>400	T≥18	NFS,FB,(LM -)



# Suitability mapping: species selection, land position definition and suitability assessment



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Name	Description	Identities			
		Slope (°)	Aspect (°)	Curvature	River buffer area
LM	Liang_Mao and high flat area;	<0.8	N/A	>=0	N/A
SFS	South facing slopes	0.8=< & <15	>=270°, <90°	N/A	N/A
NFS	North facing slopes	0.8=< & <15	90°=<; <270°	N/A	N/A
FB	Flat bottom	<0.8	N/A	<=0	In
SSG	Steep slope and gullies	>=15	N/A	N/A	N/A
RM	Rock mountains	Derived from the soil map			



# Suitability mapping: species selection, land position definition and suitability assessment



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**Yuan:** Plain highland covered by deep loess. Generally big and flat



**Mao:** Small quaquaversal hill, looks like a steamed bun.



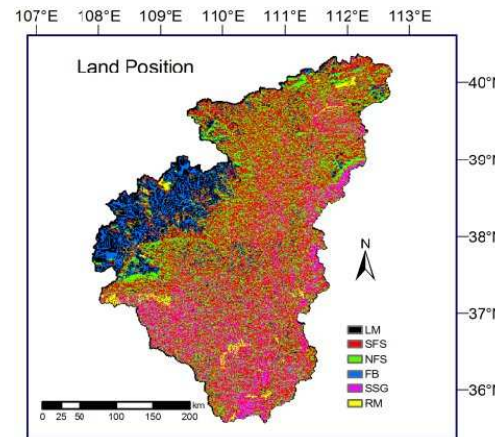
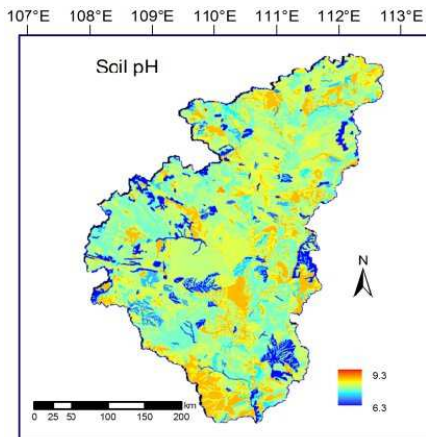
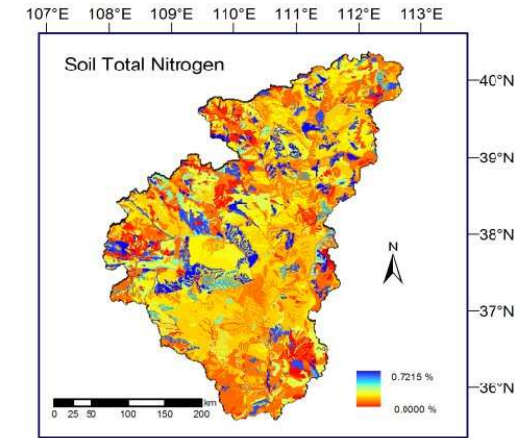
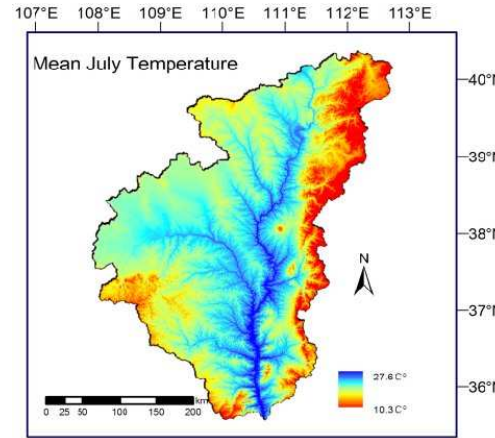
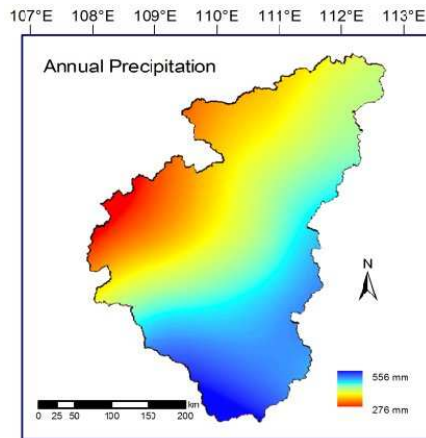
**Liang:** Striped highland between gullies with quaquaversal top



# Suitability mapping: input data

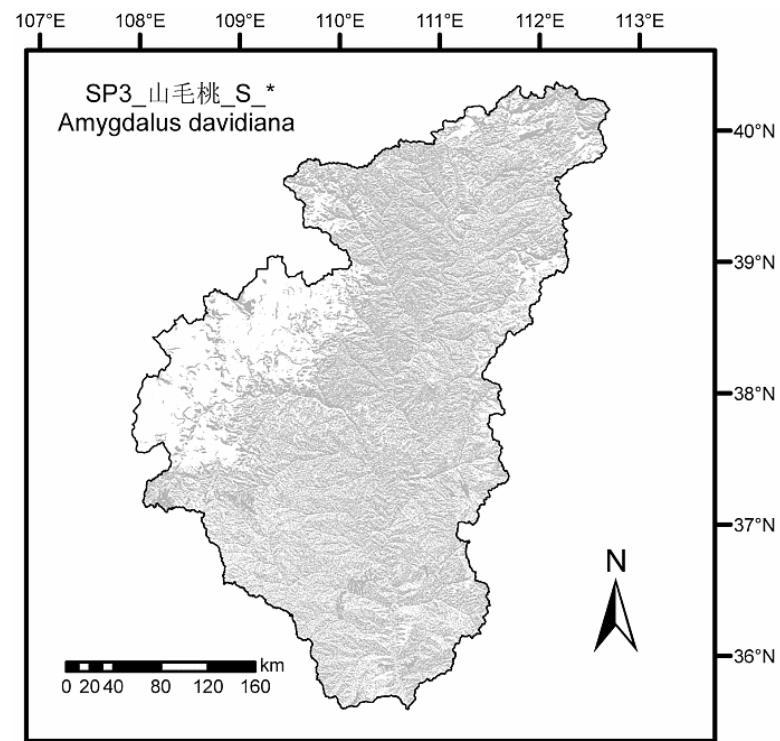
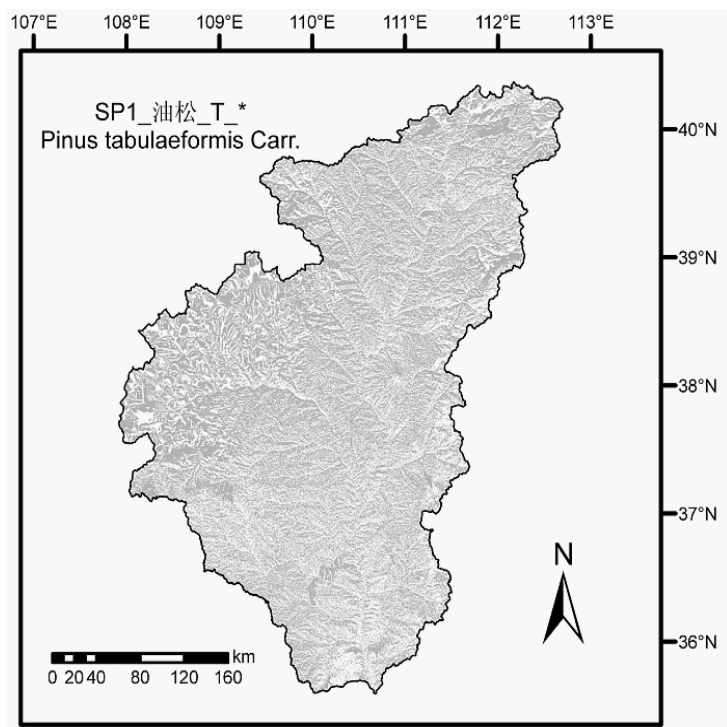


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# Suitability mapping: single maps

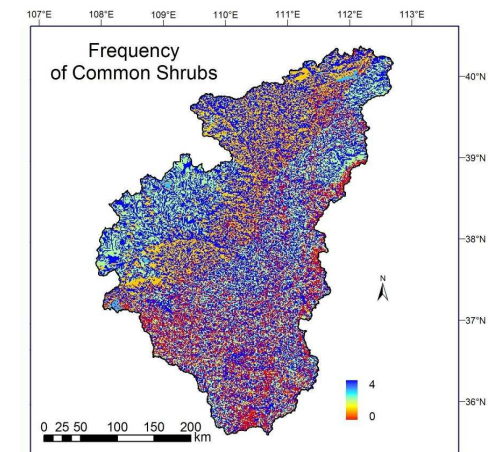
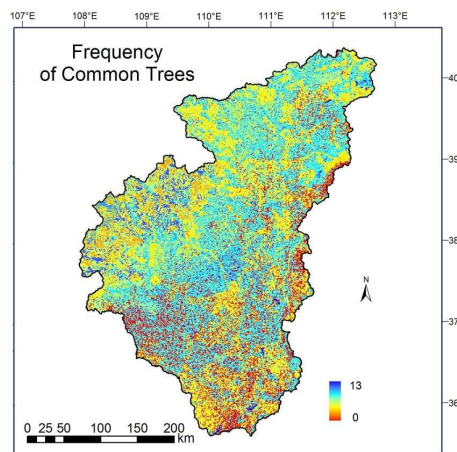
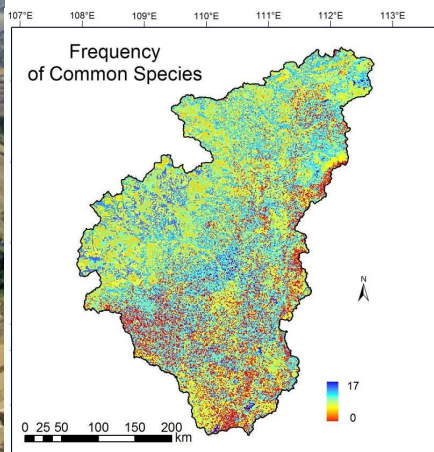
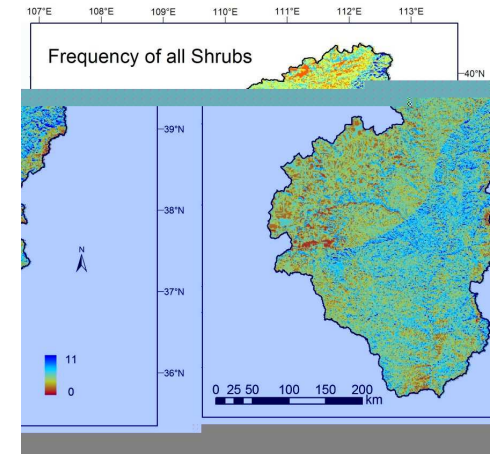
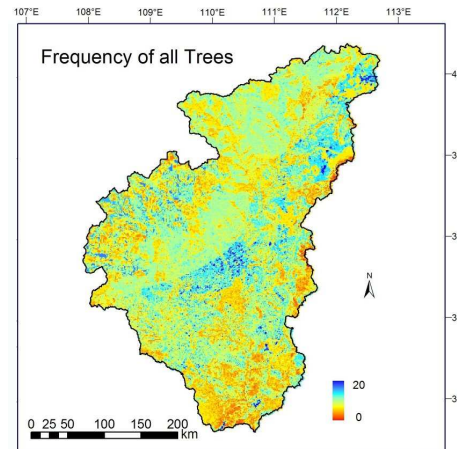
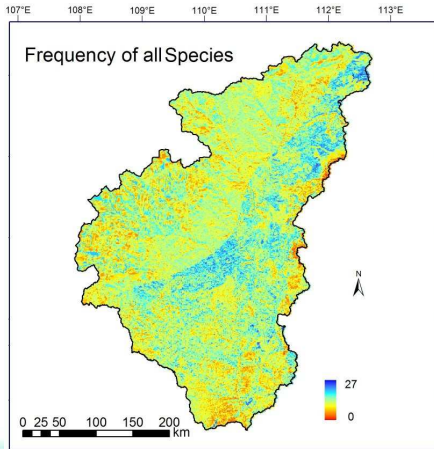




# Suitability mapping: collective maps



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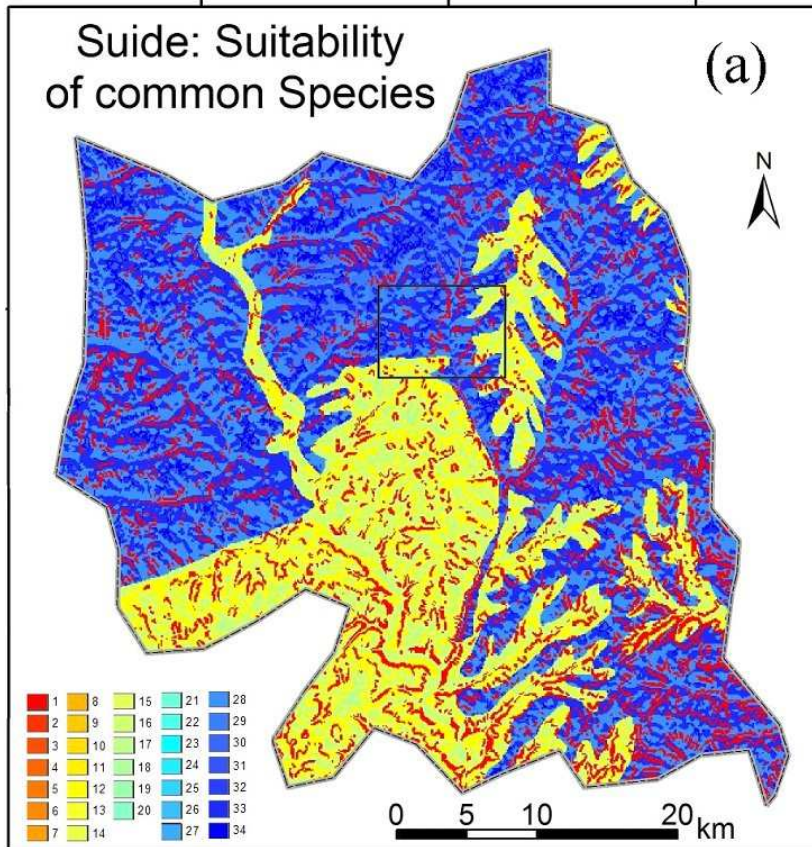
# Suitability mapping: binary maps:

Double LUT:

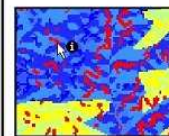
$$1. \text{vbcode} = 2^0 + 2^1 + 2^2 + 2^3 + \dots + 2^n$$

2. vbcode  $\longleftrightarrow$  value

110°12'E      110°24'E      110°36'E



37°36'N



37°24'N

(c)

vb_cspecies		Location: [102969.182003]	
Property	Value	Property	Value
Order_ID	32	Order_ID	32
Value	33	Value	33
Count	1331533	Count	1331533
Vbcode	2245297	Vbcode	2245297
Freq	8	Freq	8
Sp1	1	Sp1	1
Sp2	0	Sp2	0
Sp3	0	Sp3	0
Sp5	0	Sp5	0
Sp6	1	Sp6	1
Sp7	1	Sp7	1
Sp8	0	Sp8	0
Sp11	1	Sp11	1
Sp12	0	Sp12	0
Sp15	1	Sp15	1
Sp16	0	Sp16	0
Sp18	0	Sp18	0
Sp19	0	Sp19	0
Sp22	0	Sp22	0
Sp23	1	Sp23	1
Sp26	0	Sp26	0
Sp27	0	Sp27	0
Sp29	1	Sp29	1
Sp30	0	Sp30	0
Sp31	0	Sp31	0
Sp35	0	Sp35	0
Sp37	1	Sp37	1



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谢谢

Thank You

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