Forests

Applying topographic classification, based on the ecological process, to design linkages for climate change

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Supplementary table 1. Flora and fauna used in this analysis.

Taxon	Common Name	Academic Name
Coniferous Tree	Korean red pine	*Pinus densiflora*
	Japanese larch	*Larix leptolepis*
	Pitch pine	*Pinus rigida*
	Needle fur	*Abies holophylla*
	Hinoki cypress	*Chamaecyparis obusa*
	Spruce	*Picea jezoensis*
Deciduous Tree	Oak	(*Quercus spps*.
	Japanese alder	*Alnus japonica*
	Painted maple	*Acer pictum*
	Japanese chestnut	*Castanea crenata*
	Ash tree	*Fraxinus rhynchoplylla*
	Manchurian walnut	*Juglans mandshurica*
	Cherry blossoms	*Prunus serrulata var. spontanea*
	Saw-leaf zelkova	*Zelkova serrata*
	Giant dogwood	*Cornus controversa*
Large-size mammal	Water deer	*Hydropotes inermis*
	Leopard cat	*Felis bengalensis*
	Wild boar	*Sus scrofa*
	Goral	*Naemorhedus caudatus*
Small-size mammal	White-toothed shrew	*Crocidura suaveolens*
	Asiatic chipmunk	*Tamias sibiricus*
Amphibian	Korean salamander	*Hynobius leechi*
	Asian toad	*Bufo bufo*
	Narrow-mouth frog	*Kaloula borealis*
	Dybowski's Brown Frog	*Rana dybowskii*
	Wrinkled frog	*Rana rugose*
	Black-spotted pond frog	*Rana nigromaculata*
	Tree frog	*Hyla japonica*
	Korean Brown Frog	*Rana coreana*
	Huanren brown frog	*Rana huarenensis*
	Korean redfrog	*Rana amurensis*
	Korean fire-bellied toad	*Bombina orientalis*
	Korean clawed salamander	*Onychodactylus fischeri*
	Boreal digging frog	*Kaloula borealis*

Supporting Table 2. Parameter values that classify the topography in the morphometric topographic classification. SNs in the study sites are the same and LNs are different, but they are comparable with the parameter values in Jang et al. (2009) for the Republic of Korea.

	SN (m)	LN (m)
a) Cheonan	50	550
b) Eumseong	50	500
c) Cheongju	50	350
Jang et al.(2009) (Kangwon, Rep. of Korea)	50	250 - 400

Supporting Table 3. Parameter values that classify the topography in the generic topographic classification. Although different parameter values were used according to site, these are comparable with the parameter values in the three previous studies in the Republic of Korea and the United States (Park et al. 2001; Park 2004; Jeong 2011).

	A_{si}	A_{st}	A_p	C_{si}
a) Cheonan	2.25	3	4.5	0.19
b) Eumseong	2.1	3	5.2	0.22
c) Cheongju	2.1	3.2	5	0.18
Park (2004) (Yangpyeong, Rep. of Korea)	1.5	3	4.3	0.17
Jeong (2011) (Namyangju, Rep. of Korea)	2.4	3.6	4.5	0.17
Park et al. (2001) (Wisconsin, USA)	2.5	3.5	4	0.25

Supporting Table 4. Key features of the 10 Species Distribution Models (Franklin 2009).

Model	Full name of model	Category	Data required	Descriptions
MAXENT	Maximum entropy algorithm	Machine learning based model	Occurrence only	Maximum entropy is based on statistical mechanics and information theory. MAXENT can analyze the best approximation of an unknown distribution by using the maximum entropy method that considers the most spread out and closest to uniform values.
SRE	Rectilinear envelope similar to BIOCLIM			SRE is a boxcar or parallelepiped classifier that uses BIOCLIM. SRE assesses the potential distribution of the dependent variable by using the multi-dimensional environmental space bounded by the values for all dependent variables.
CTA	Classification tree analysis		Occurrence / No occurrence	The goal of CTA is to divide data into homogeneous subgroups. The subgroups consist of variables that have similar values or are in the same class in regard to the ranges of values for the variables.
MDA	Mixture discriminant analysis			MDA is a type of linear discriminant analysis that models the multivariate density of variables by using a mixture of multivariate normal distributions.
RF	Random forest			Random forests is a type of bootstrap aggregating method that builds de-correlated trees and averages the trees. Many trees are made with subsets of input data. Furthermore, each division of the tree model is also made with a random subset of input variables.
GBM	Generalized boosted regression model			GBMs are similar with weighting variables that consider higher probabilities of selection, instead of weighting equal probabilities for subsequent variables.
ANN	Artificial neural network			ANN can be described as a two-stage classification or regression model. A hidden layer of ANN comprises features that are linear combinations of input variables. The output variable is a weighted combination of features in the hidden layer.
GLM	Generalized linear model	Statistically based model	Occurrence / No occurrence	GLMs are a representative model among SDMs. GLMs are a generalization of the multiple regression model that uses the link function to accommodate response variables that are distributed normally, namely, the response distributions.
GAM	Generalized additive model			GAMs in SDMs are suggested as a powerful methodology to detect and describe non-linear response functions. The results of GAMs can be used to build a parametric model.
MARS	Multivariate adaptive regression splines			MARS can be a type of a generalization of a stepwise linear regression. MARS are suited to analyses with large numbers of variables or a modification of the regression tree method.

Supporting Table 5. AUC values indicating the accuracy of the 10 Species Distribution Models (SDMs) identified to derive mammal's and amphibian's potential habitat distributions. Biomod2 package in R was used and performed five times. As a result, Random Forest (RF) showed the highest accuracy in all five experiments.

(a) mammals	1st	2nd	3rd	4th	5 th
MAXENT	0.683	0.704	0.665	0.688	0.68
SRE	0.556	0.566	0.549	0.568	0.55
CTA	0.679	0.701	0.653	0.669	0.683
FDA	0.687	0.703	0.664	0.69	0.68
RF	0.729	**0.758**	0.722	0.74	0.732
GBM	0.699	0.713	0.678	0.706	0.698
ANN	0.652	0.668	0.62	0.667	0.663
GLM	0.676	0.694	0.656	0.699	0.68
GAM	0.681	0.698	0.659	0.696	0.686
MARS	0.692	0.702	0.67	0.697	0.68

(b) amphibians	1st	2nd	3rd	4th	5th
MAXENT	0.705	0.744	0.739	0.732	0.733
SRE	0.567	0.595	0.581	0.567	0.571
CTA	0.753	0.735	0.713	0.748	0.776
FDA	0.689	0.716	0.716	0.714	0.704
RF	0.849	0.863	0.864	0.845	**0.873**
GBM	0.732	0.764	0.769	0.756	0.764
ANN	0.659	0.716	0.654	0.553	0.687
GLM	0.674	0.706	0.701	0.703	0.701
GAM	0.676	0.717	0.705	0.707	0.707
MARS	0.691	0.717	0.733	0.713	0.704

Figure S1. Species distribution data of trees and animals in the study site (Cheonan).