LUCC and Its Influences on Regional NPP

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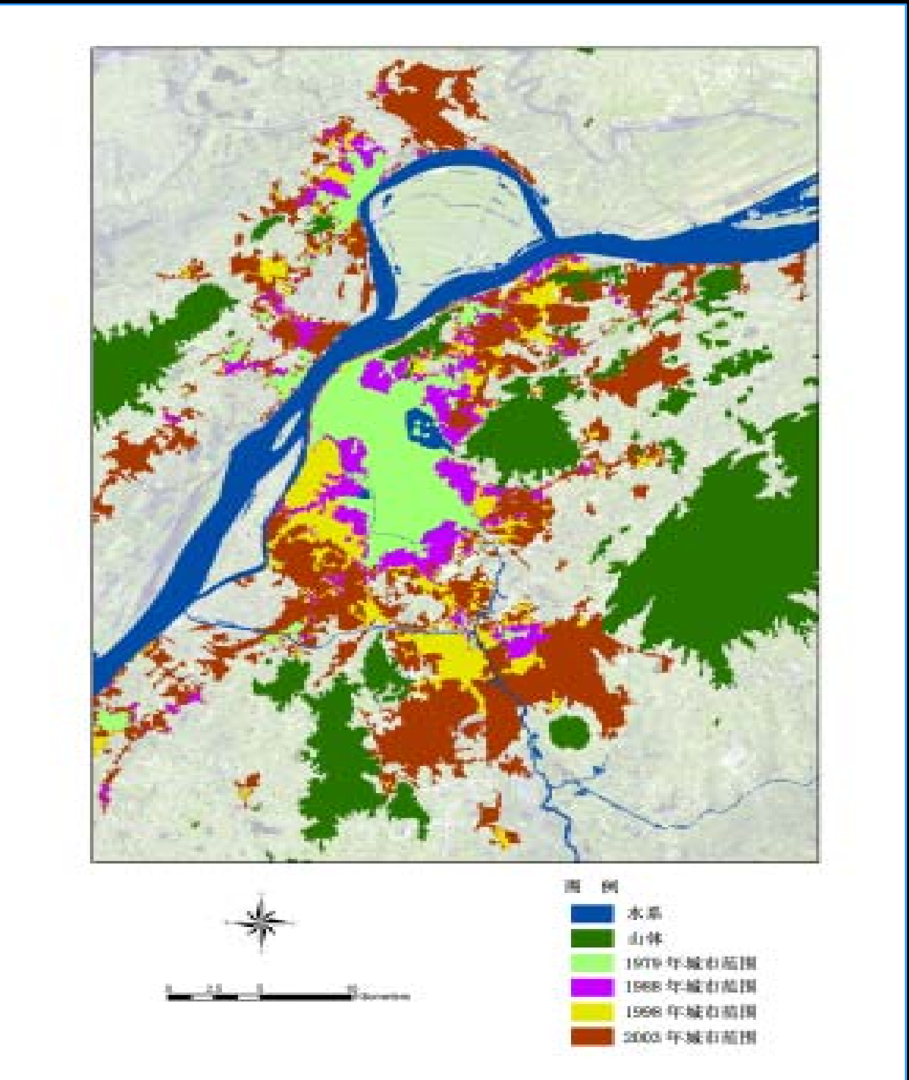
Topic

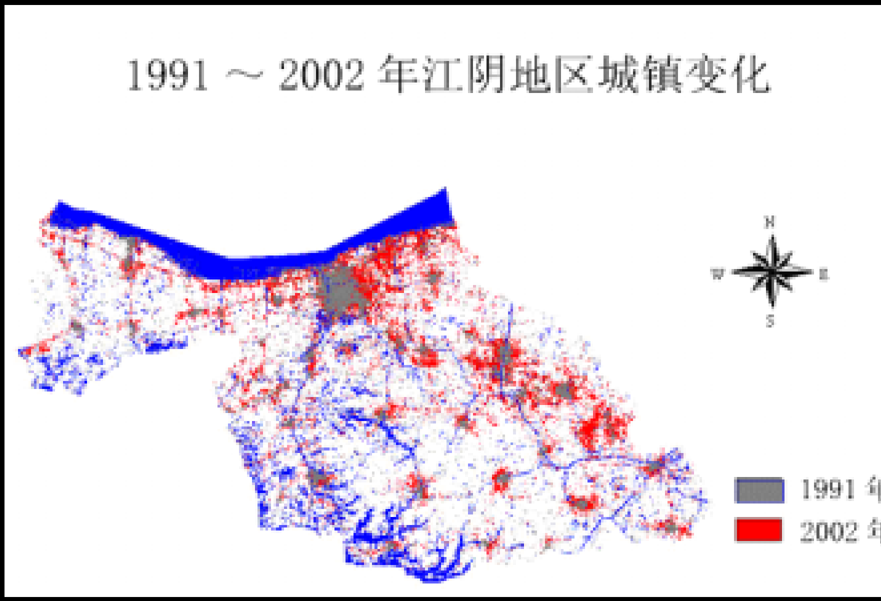
1. Urbanization and Vegetation
2. NPP in urbanizing area
3. Topography and NPP

1. Urbanization and Vegetation

- Urbanization is one of the most important force driven LUCC, and affect many features of vegetation, such as NPP, biodiversity, landscape quality.
- Urbanization is represented as urban-suburb gradient belts, and can be studied by the gradient analysis.
- The vegetation types and the FC affected by many fractors, especially economic.
- NPP correlated with urbanization, and has very important influences on air quality, many because the gas exchange.

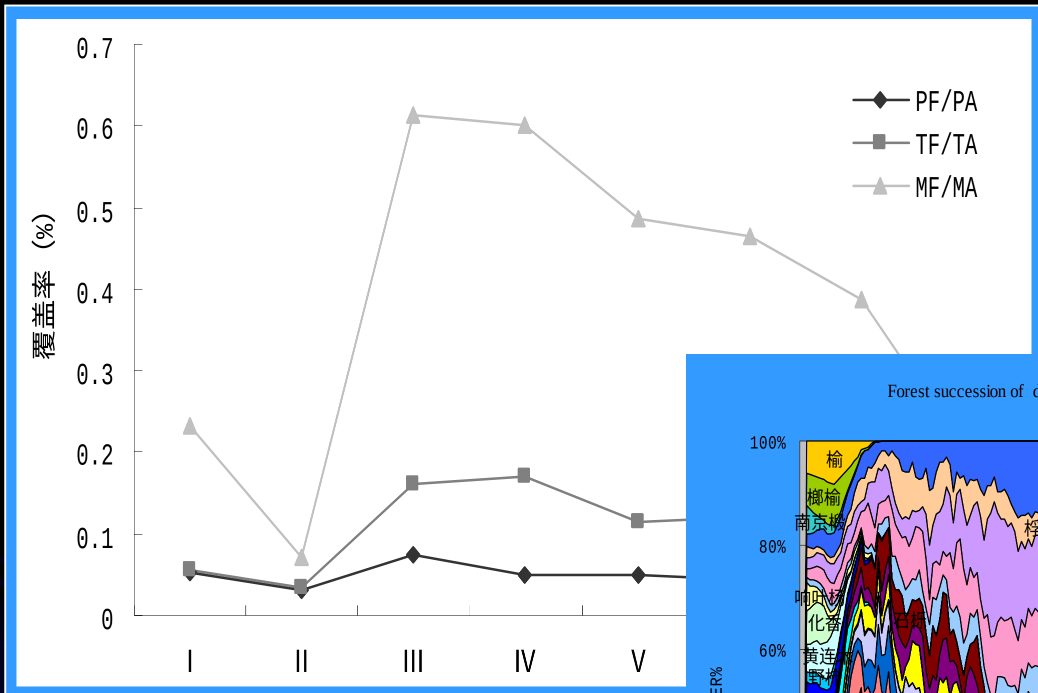
1. Urbanization and Vegetation



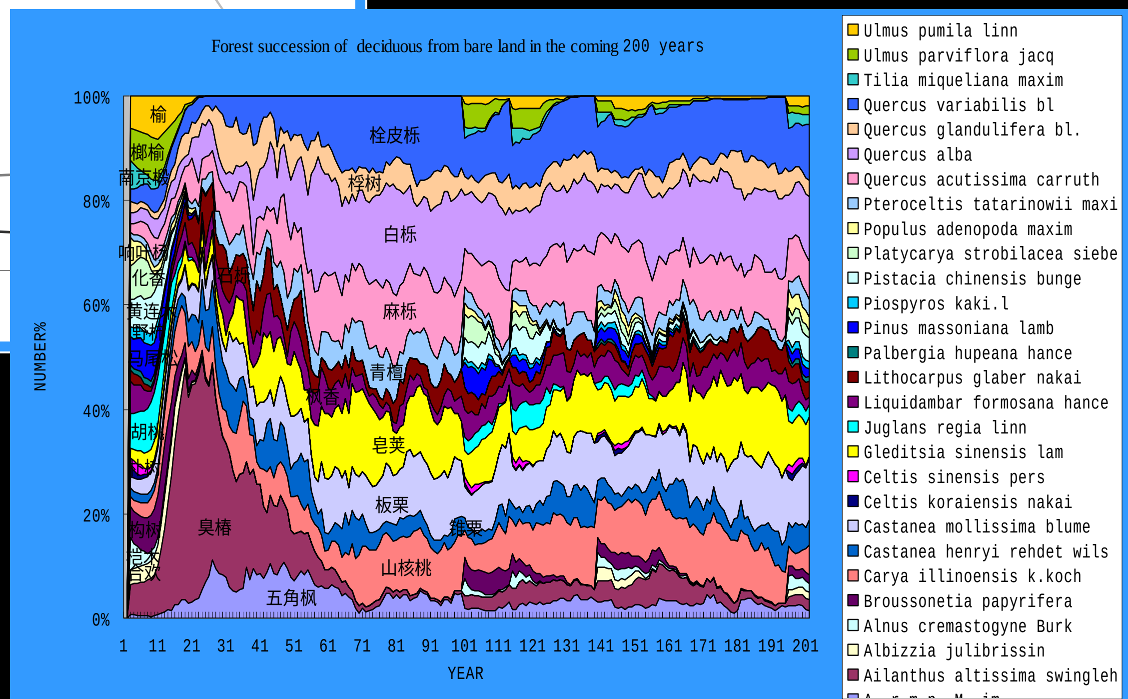


Urban sprawl in Nanjing and Jiangyin

1. Urbanization and Vegetation



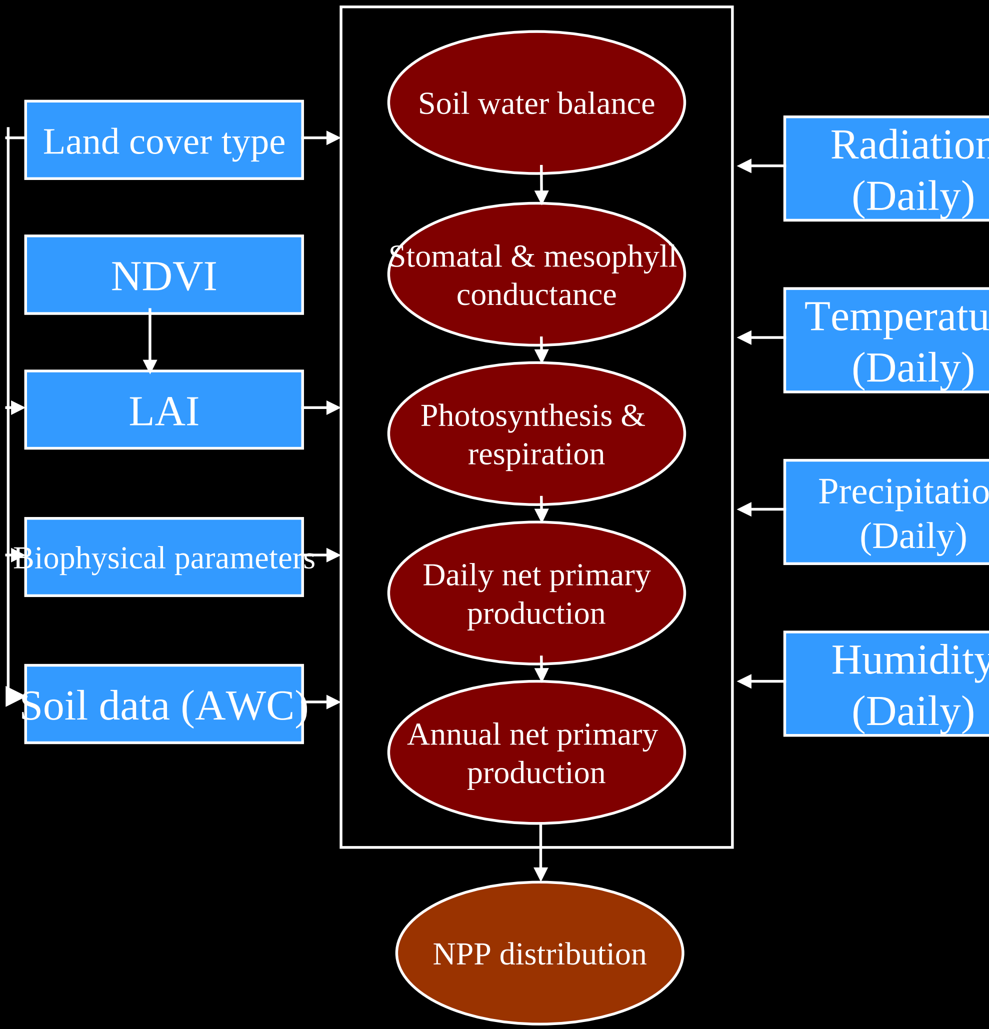
Succession of forests



Forest Coverage changed along urban-suburb gradient

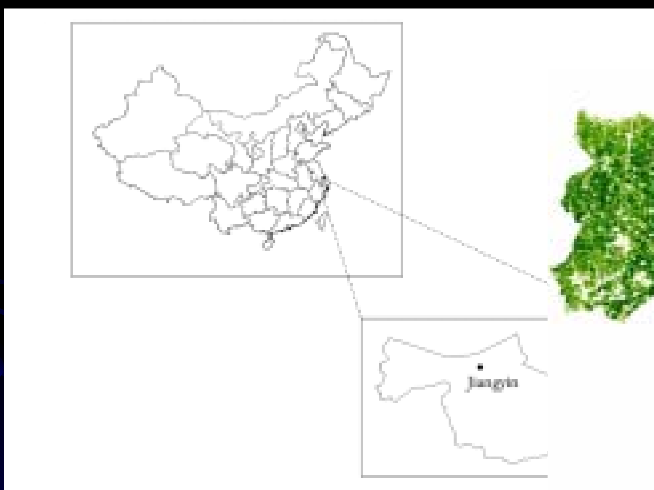
2. NPP in urbanizing area

- BEPS is a process based biogeochemistry model developed on the base of Forest-BGC model and it is refined by incorporating a more advanced photosynthesis model (Farquar, 1988)with a new temporal and spatial scaling scheme and an advanced canopy radiation transfer model concerning of canopy architecture of different vegetation type. BEPS model can calculate gross primary productivity (GPP), NPP and evapotranspiration (ET) with the input data including land cove, leaf area index (LAI), soil available water capacity (AWC) and daily meteorology data.



2. NPP in urbanizing area

- Case study: NPP in Jiangyin



1991年L

2002年LAI分布

2. NPP in urbanizing area

		Residential (A_1)	Water (A_2)	Cropland (A_3)	Forest (A_4)
Area in 1991		17898.45	11251.8	67757.36	1890.38
Area in 2002		29302.27	8421.13	60135.11	939.48
Changed area		11403.82	-2830.67	-7622.25	-950.9
Amplitude (1991→2002) (%)		63.71	-25.16	-11.25	-50.30
Transitional area (A_{ij}) (1991→2002)	Residential A_1	12263.79	83.63	5526.36	24.67
	Water A_2	992.67	6912.71	3340.61	5.81
	Cropland A_3	15568.18	1411.2	50728.23	49.75
	Forest A_4	477.63	13.59	539.91	859.25
Transitional probability (P_{ij}) (1991→2002)	Residential A_1	68.52	0.47	30.86	0.14
	Water A_2	8.82	61.44	29.69	0.05
	Cropland A_3	22.98	2.08	74.87	0.07
	Forest A_4	25.27	0.72	28.56	45.45

2. NPP in urbanizing area

- **Biological parameters and initial carbon content for various land covers in BEPS model**

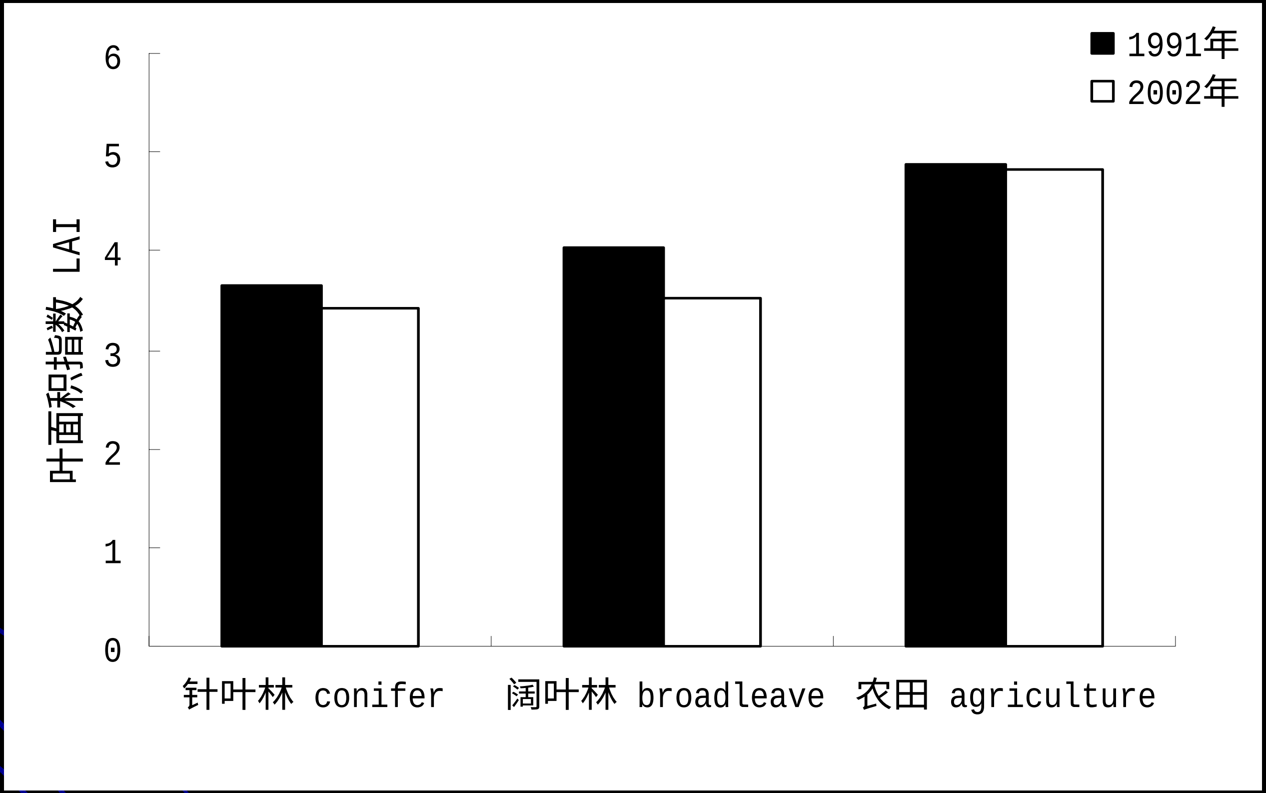
	unit	Broadleaved forest	Conifer forest	crop	references
Clump index	—	0.7	0.5	0.9	Chen (1996)and Chen and Cihlar (1995)
Maximum stamotal conductance(H_2O)	m/s	0.0045	0.00225	0.002	Hunt et al. (1996) and Matsushita, et al. (2002)
Leaf respiration coefficient	kgC/day/kg	0.00398	0.00267	0.002	Foley (1994) and Matsushita, et al. (2002)
Stem respiration coefficient	kgC/day/kg	0.00005	0.00005	0.00005	Foley (1994) and Matsushita, et al. (2002)
Root respiration coefficient	kgC/day/kg	0.0002	0.0002	0.0002	Foley (1994) and Matsushita, et al. (2002)
Leaf carbon content	kgC/m2	0.3	0.5	0.1	Foley (1994) and Matsushita, et al. (2002)
Stem carbon content	kgC/m2	8	9.2	0.1	Foley (1994) and Matsushita, et al. (2002)
Root carbon content	kgC/m2	1.7	2.3	0.1	Foley (1994) and Matsushita, et al. (2002)

2. NPP in urbanizing area

- **Mean and total NPP in 1991a and 2002a**

	Cropland	Conifer forest	Broadleaved forest	total
Mean NPP（g Cm^{-2} y^{-1}）				
1991	1168	782	995	-
2002	1137	718	908	-
Loss	31	64	87	-
fraction（%）	2.65	8.18	8.74	-
Total NPP（Gg C y^{-1}）				
1991	791.41	8.62	7.84	807.87
2002	683.74	4.19	3.23	691.16
Loss	107.67	4.43	4.61	116.71
fraction（%）	13.60	51.39	58.80	14.45

2. NPP in urbanizing area



Variation of mean LAI of all vegetation type

3. Topography and NPP

- Topography affect the spatial pattern of PP, mainly through light, water, nutrients, temperature, winds. Especially soil water flow direction.
- Topography affect the RS imageries, such as distortion, caused the shift of pixels, and so on. So, in NPP calculation based on RS data, we must consider the topography charactors.

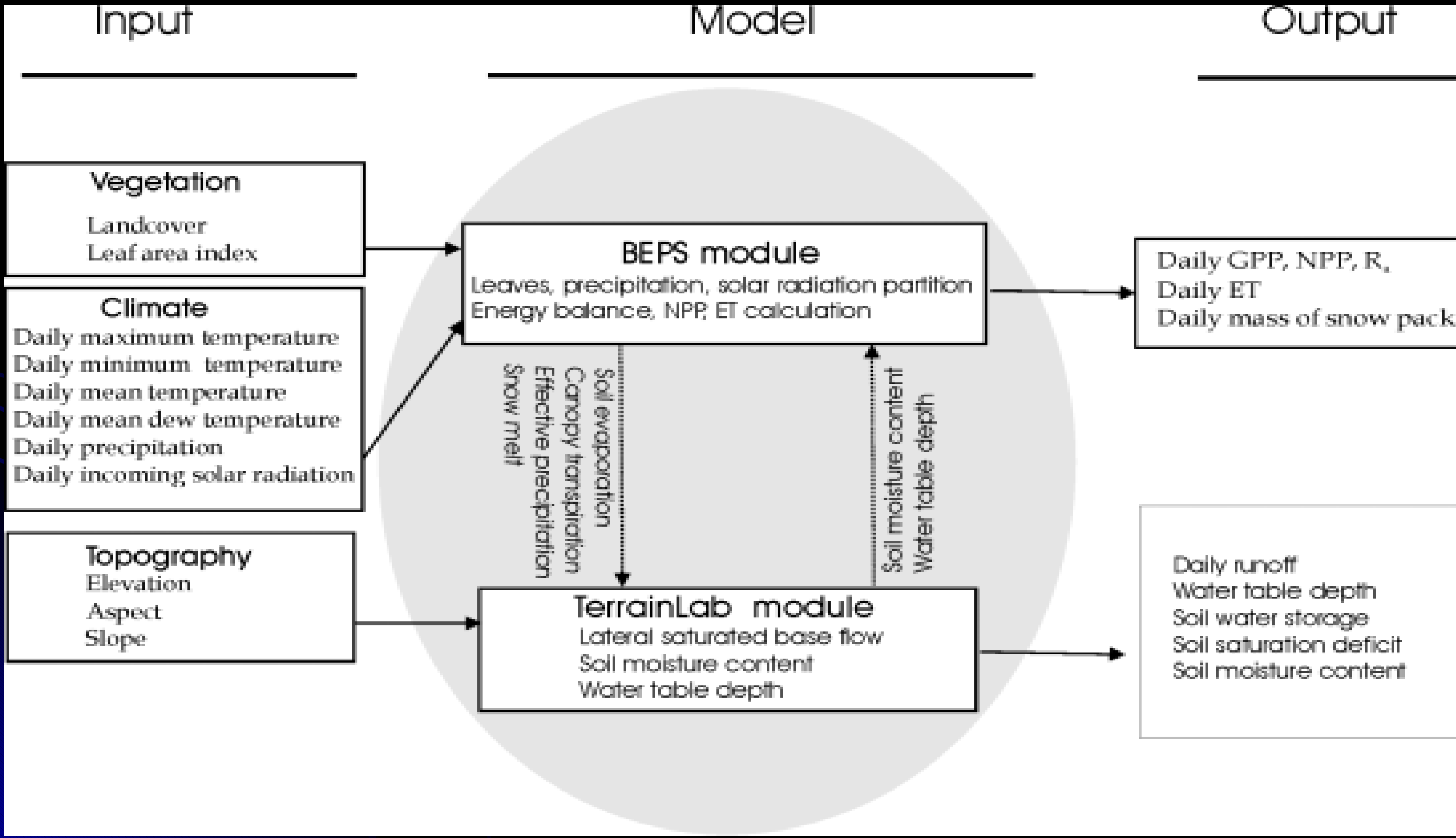
3. Topography and NPP

- BEPS-TerrainLab model

BEPS and TerrainLab are developed by J.Chen. BEPS not dealing with soil water horizontal flow but TerrainLab did. So we use these two models together, and test the effects of topography on NPP.

3. Topography and NPP

- BEPS-TerrainLab model



3. Topography and NPP

- Case study

1. Study area: Boahe watershed near Xi’an, area 3908 km^2, annual precipitation 782mm, av. Temp. is 7.6 ℃.
2. Data measured：LAI，NPP
3. Landsat TM，LAI，Landcover, DEM
4. soil map, AWC
5. Prec., Temp. Humidity

3. Topography and NPP

- 4 types of model considerations

Scenario	Topography on meteorology	Topography on soil water lateral flow
1	yes	yes
2	yes	no
3	no	yes
4	no	no

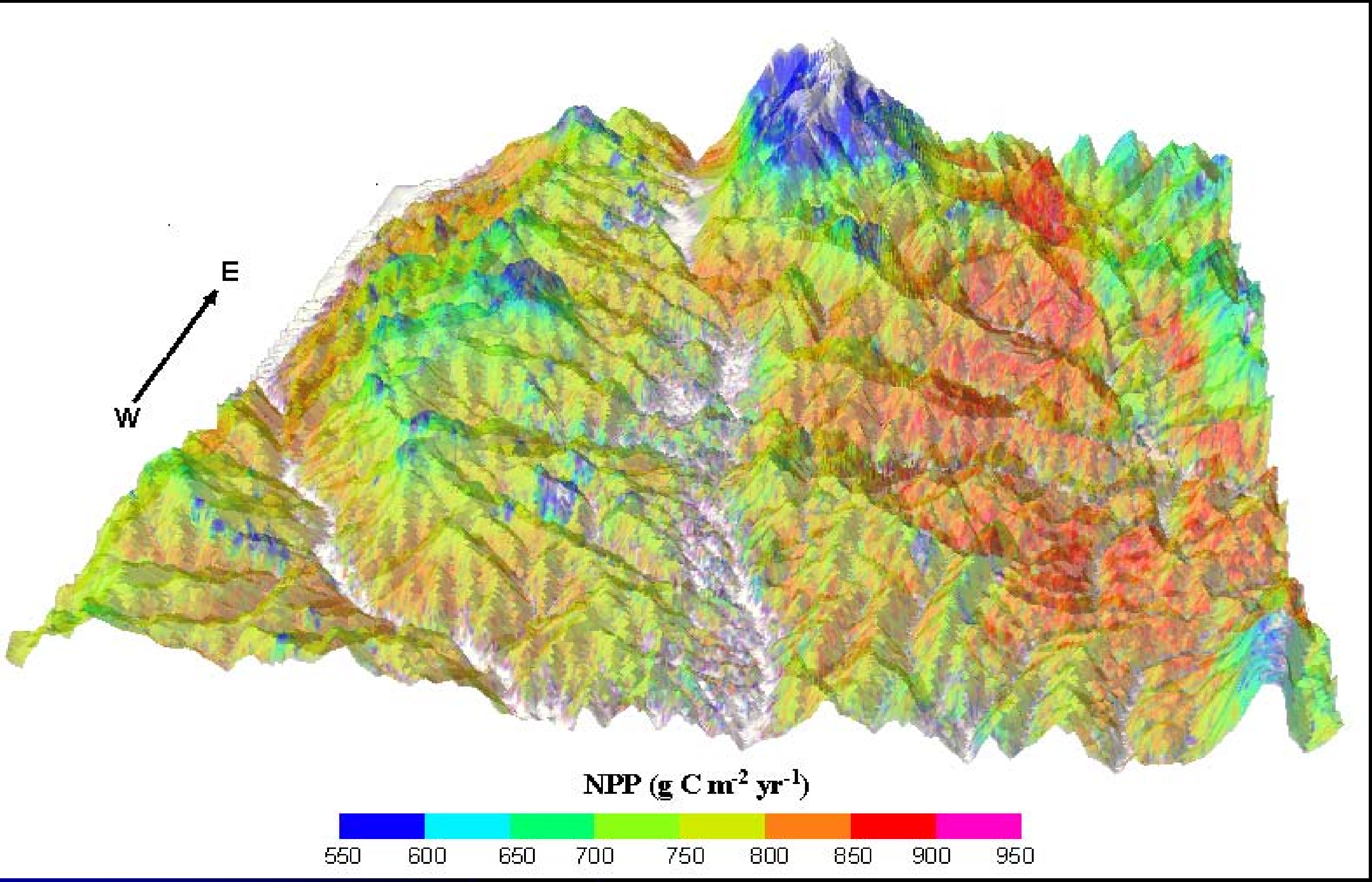
3. Topography and NPP

- Calculated and observed annul NPP

scenario	Regression equation	R^2
1	Y=0.6403x+307.43	R^2 =0.8151
2	Y=0.6639x+277.66	R^2 =0.7611
3	Y=0.4675x+490.96	R^2 =0.6513
4	Y=0.4626x+495.35	R^2 =0.6418

3. Topography and NPP

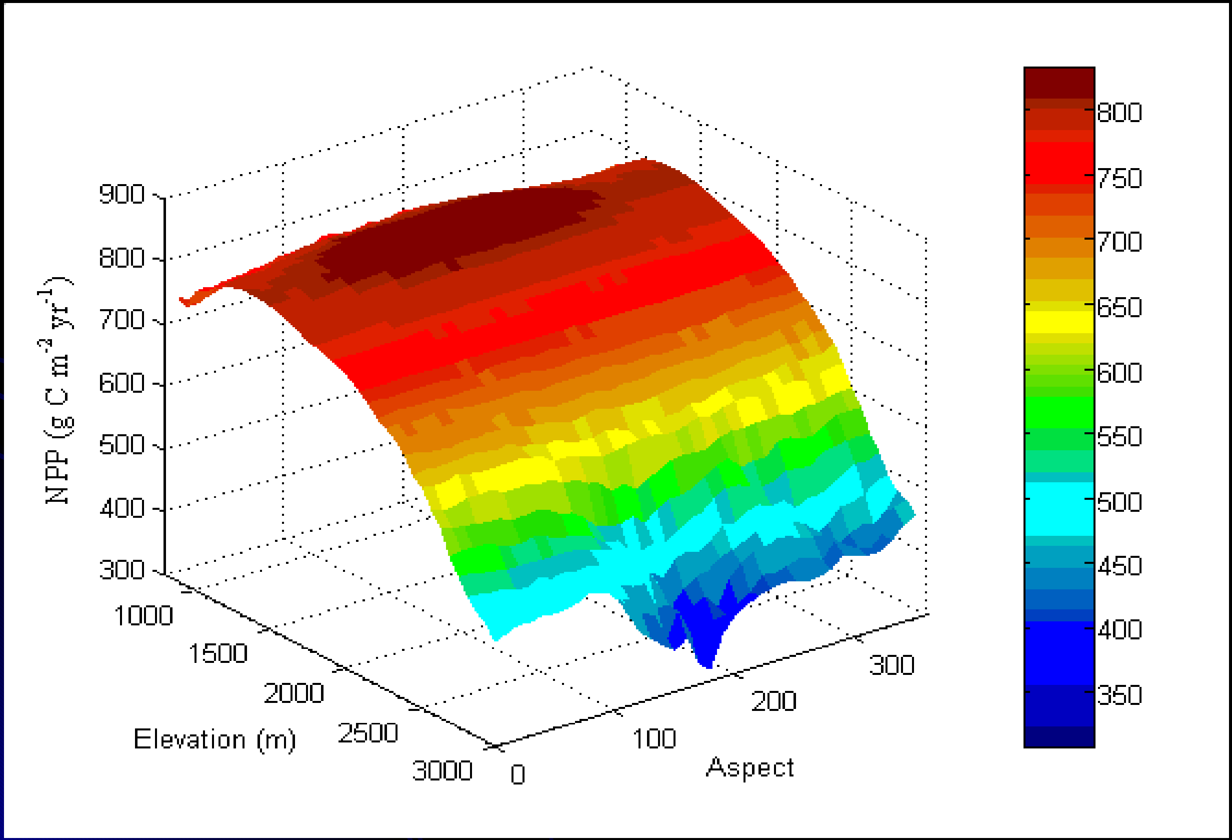
- Distribution of ANPP (Model output)



ANPP varied between 400-920 gCm^{-2} yr^{-1}, Aver. ANPP is 741 gCm^{-2} yr^{-1}， and in forest, ANPP varied in 700-880 gCm^{-2} yr^{-1}。

3. Topography and NPP

- ANPP changed with elevation and slope direction



ANPP increased with elevation while < 1350m but decreased when > 1350m and has a maximum at 1350m, while below 1900m, ANPP changed not more than 6% with slope direction, and nearly not changed regular while higher than 1900m.

THANKS!!!