

NUMERICAL EXPERIMENT OF LAND COVER CONVERSION EFFECT ON DISSOLVED IRON PRODUCTIVITY OF THE AMUR RIVER BASIN



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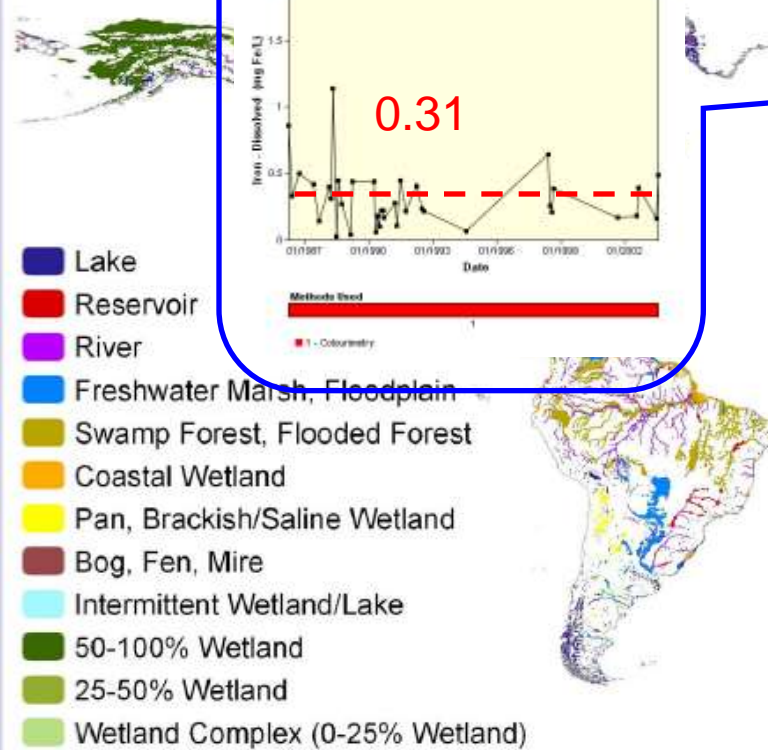
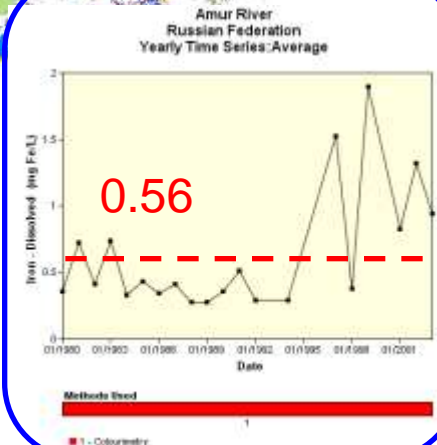
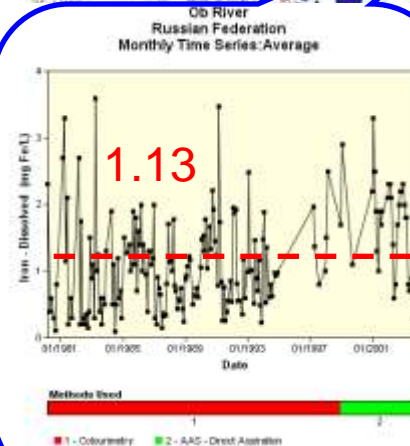
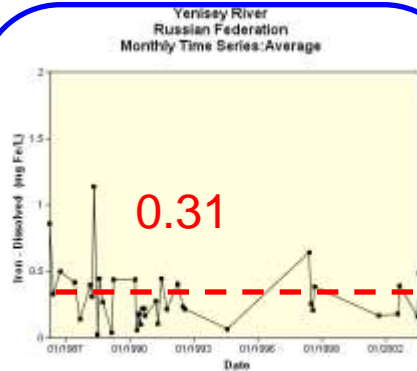
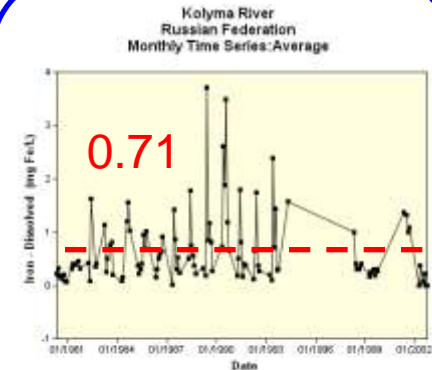
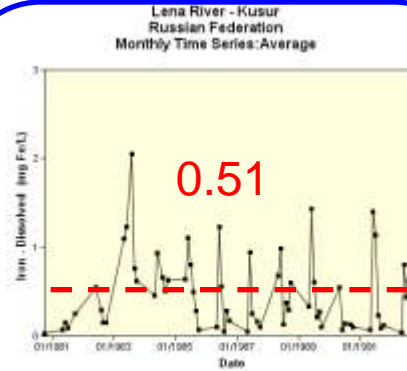
Dissolved iron concentration of rivers

River: 0.04 mg/L (=ppm)

Groundwater: 0.0-11 mg/L

Seawater: 0.0034 mg/L

Handbook of Hydrology (1992,
pp.11.13-11.18)



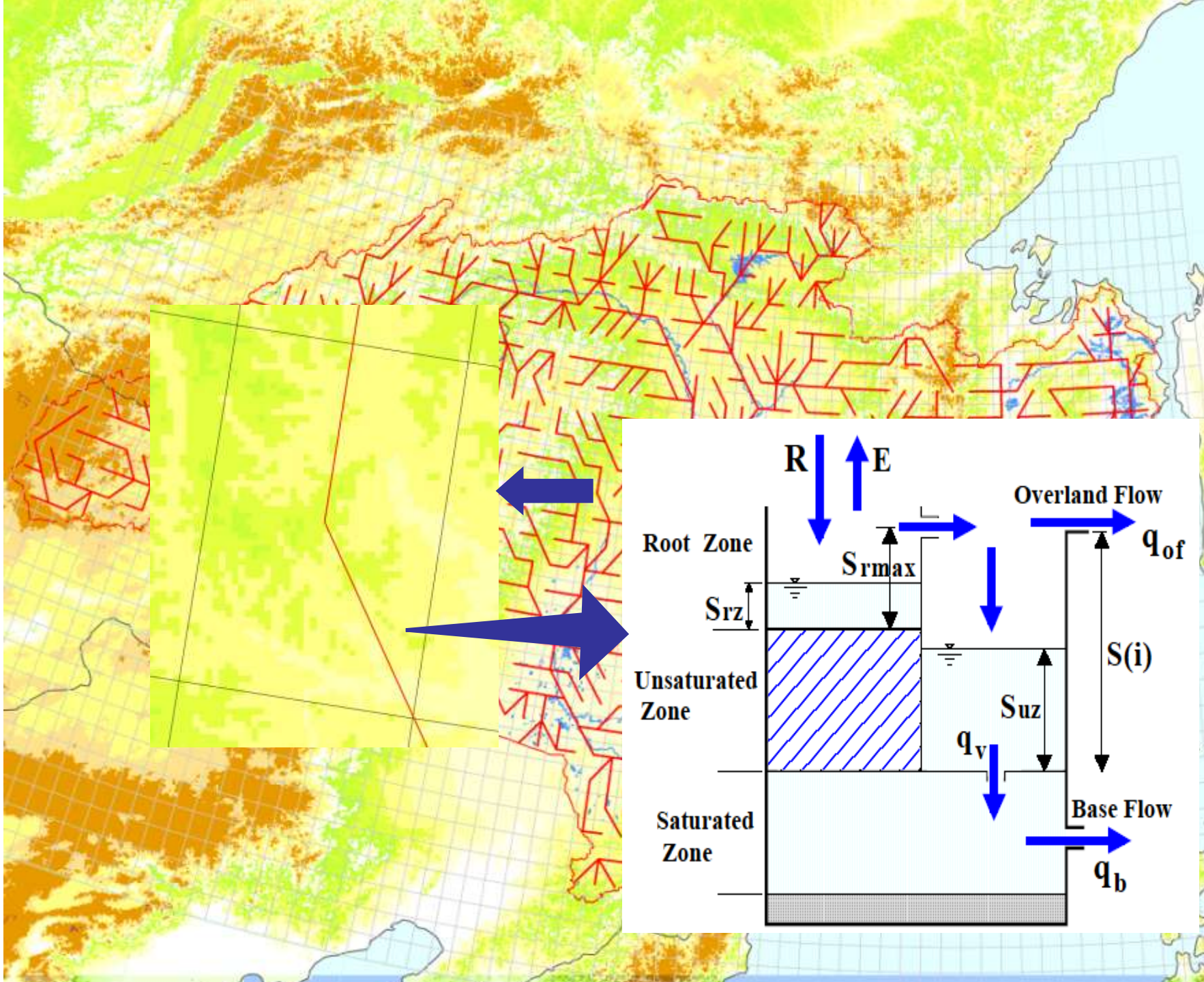
Global Lakes and Wetlands Database GLWD (Lehner & Döll 2004)

Dissolved iron conc. : GEMSTAT(UNEP, <http://www.gemstat.org/>)

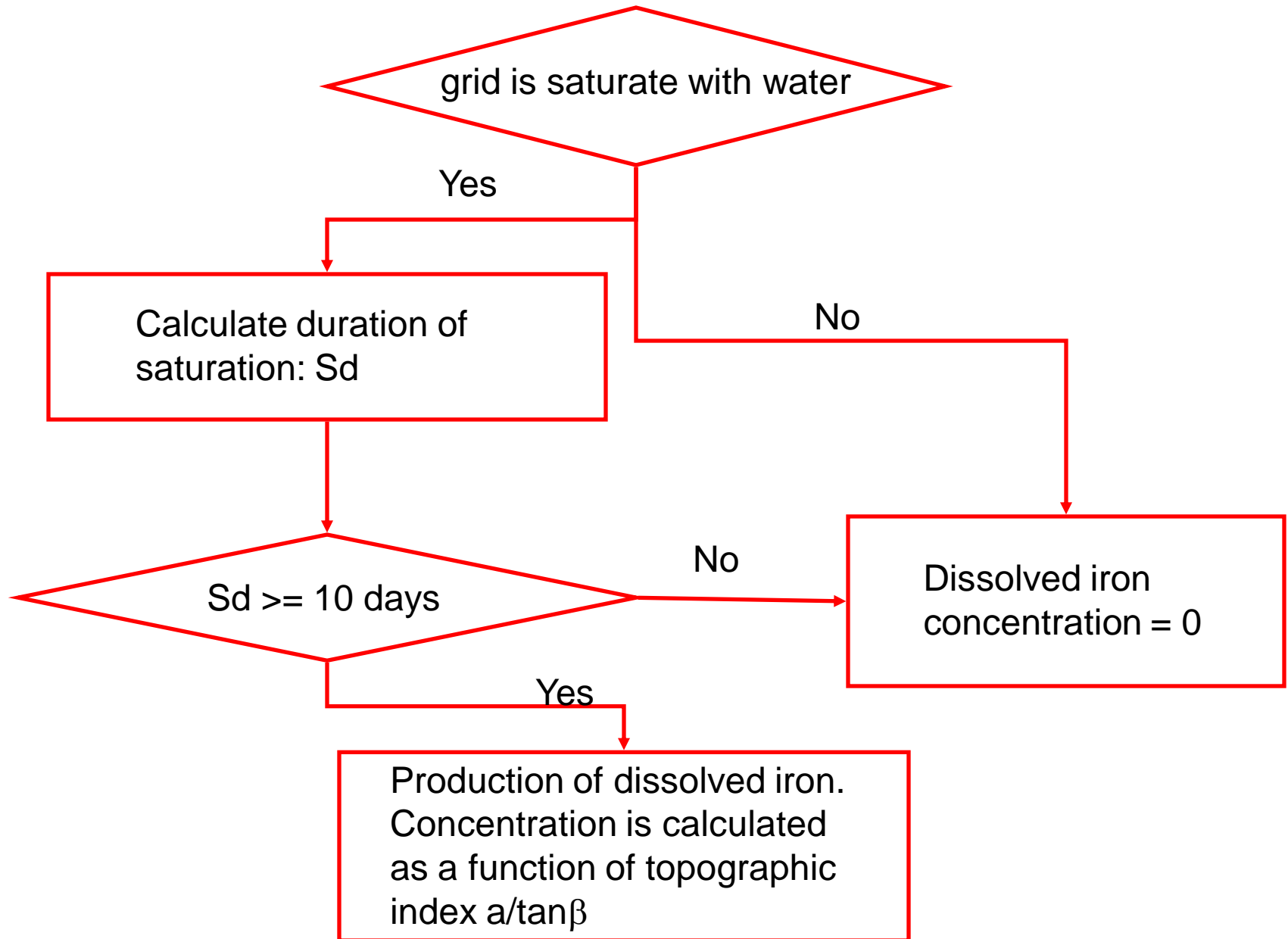
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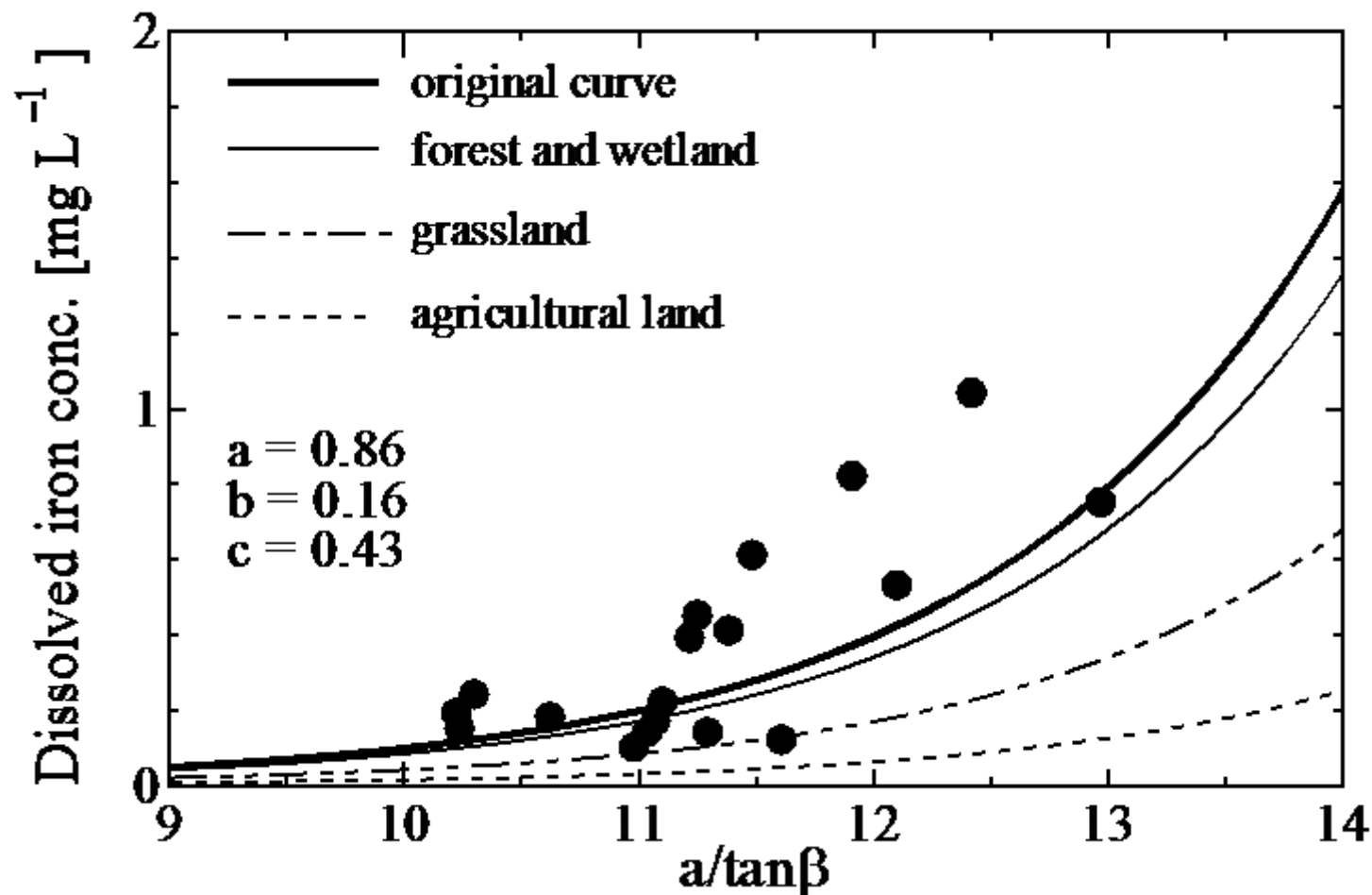
1. Structure of Hydrological Model



Modeling of dissolved iron production mechanism



Dissolved iron production curve of each land cover type

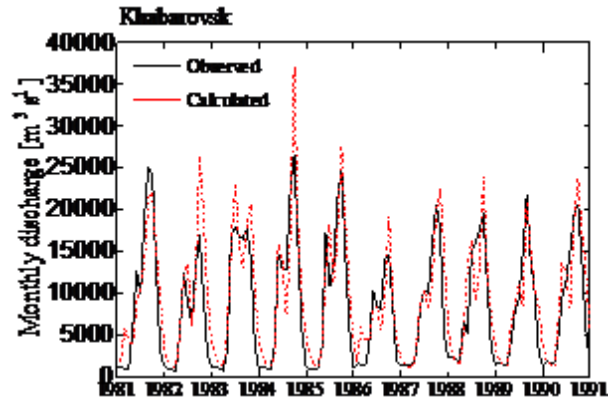


2. Model Validation

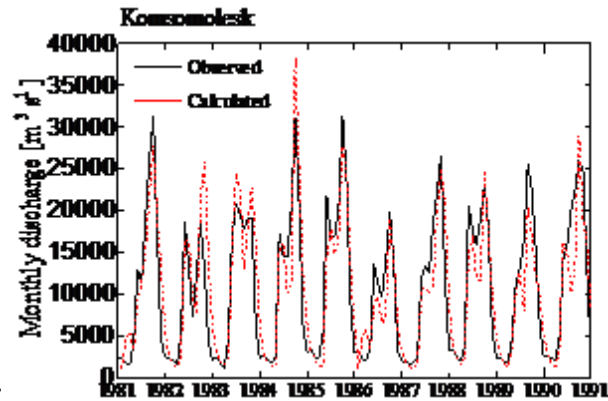
Validation of calculated discharge



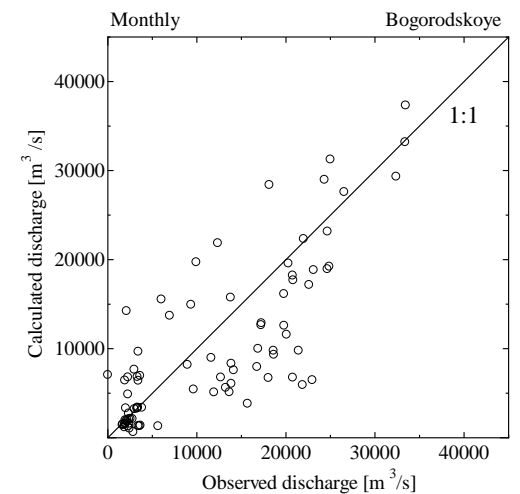
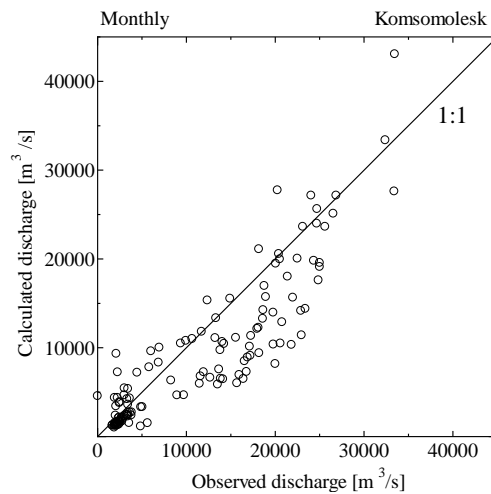
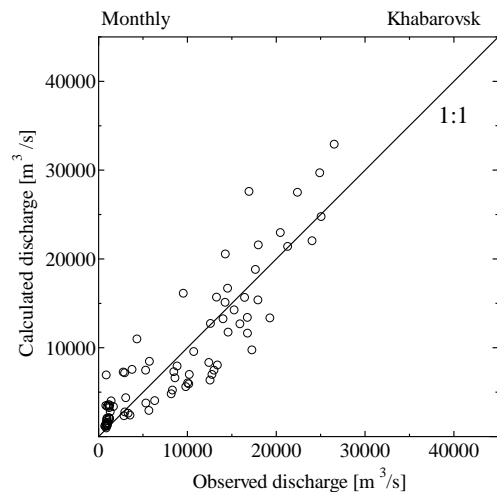
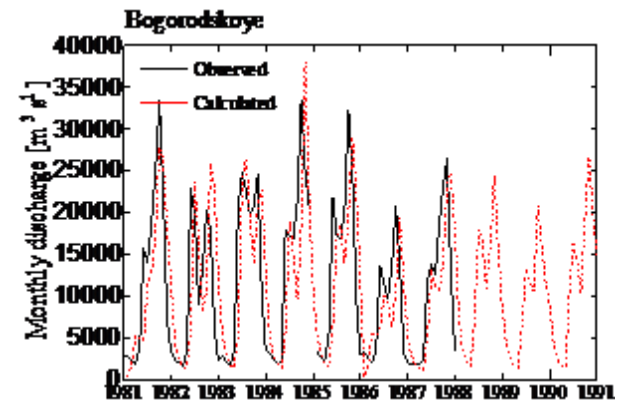
Khabarovsk



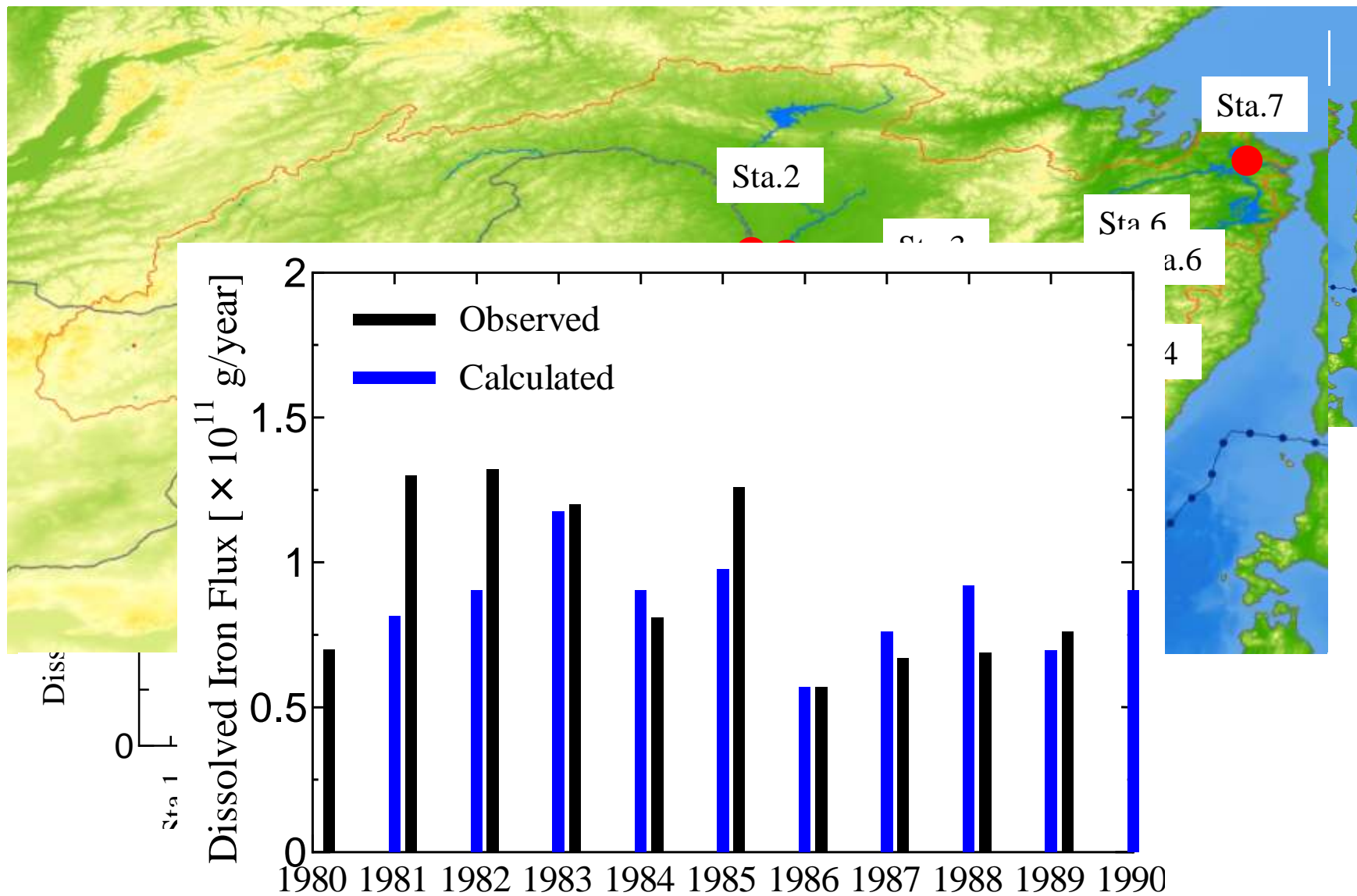
Komsomolesk



Bogorodskoye



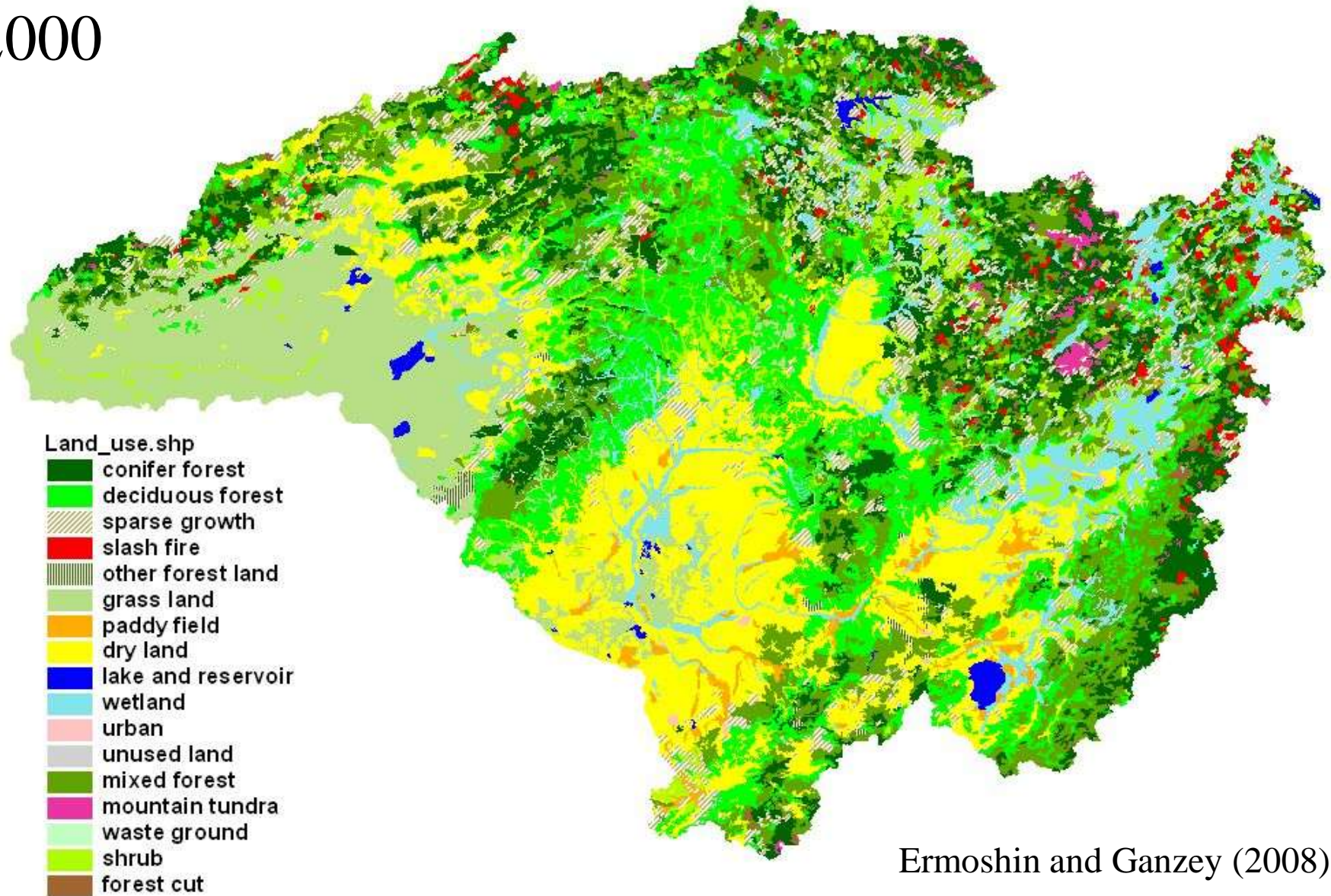
Validation of calculated dissolved iron



3. Land cover change experiments

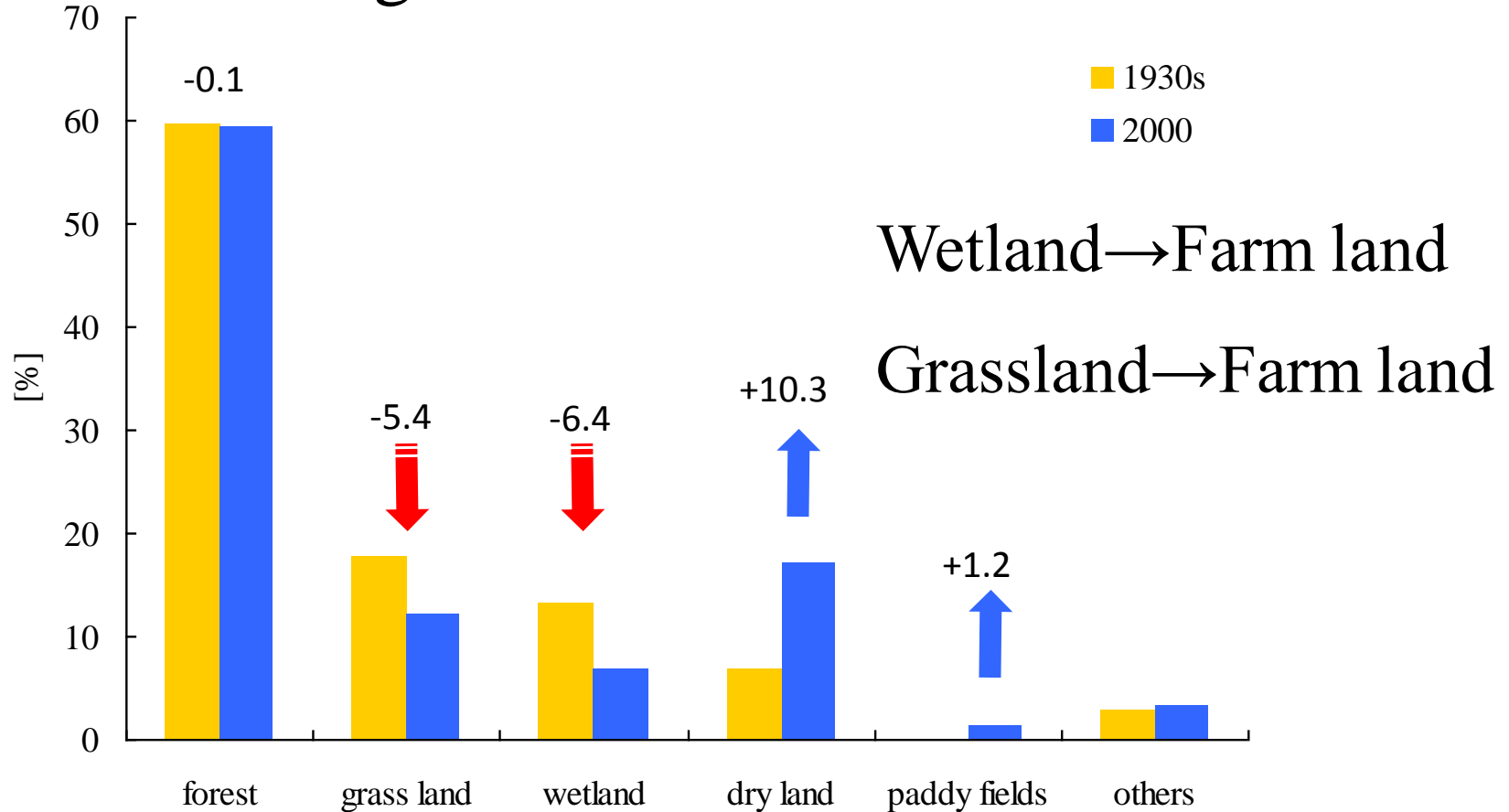
Land cover change in 20th century

2000



Ermoshin and Ganzey (2008)

Difference of major land-cover change between 1930s and 2000



Forest: Coniferous + Deciduous + Mixed Forest + Shrub + Sparse growth

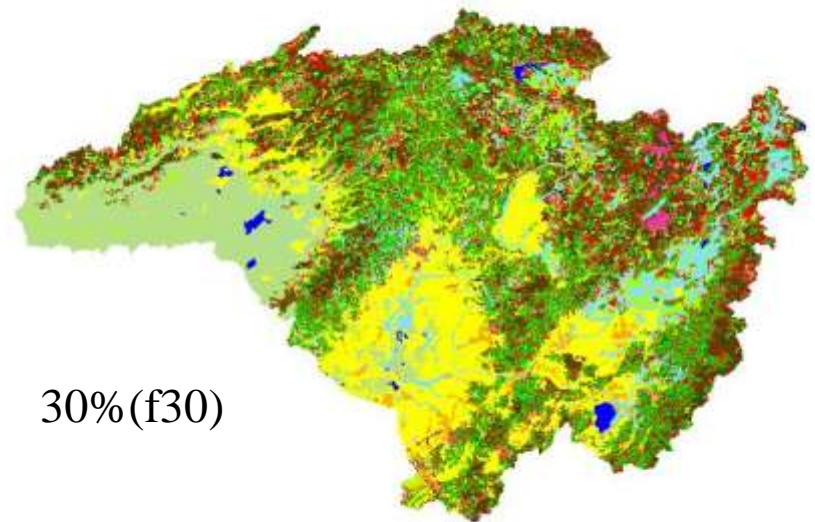
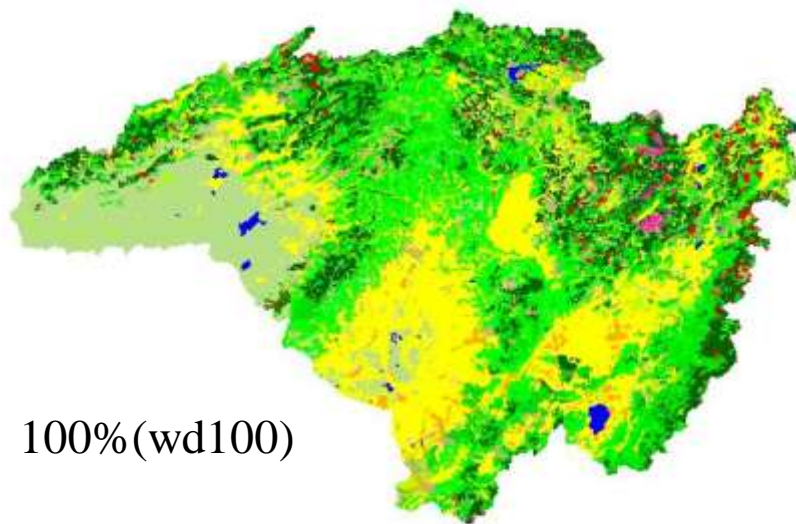
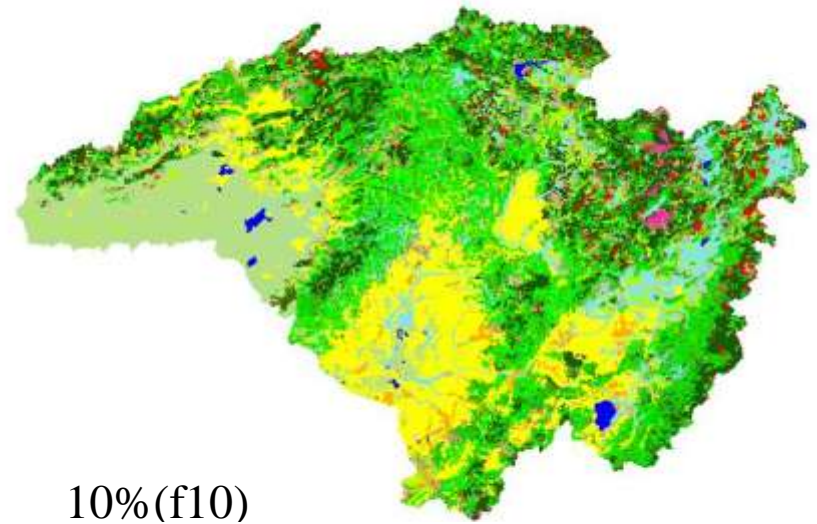
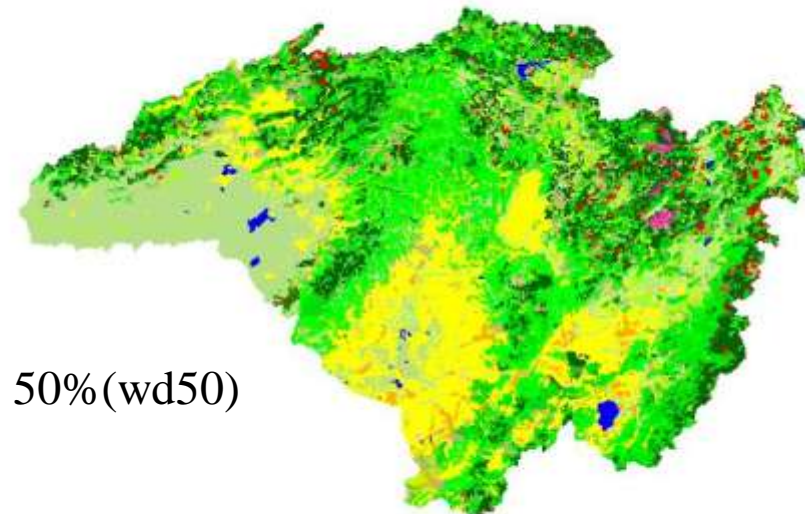
Others: Lake and reservoir + urban + unused land + waste ground + slash fire + mountain tundra + forest cut

Ermoshin and Ganzey (2008)

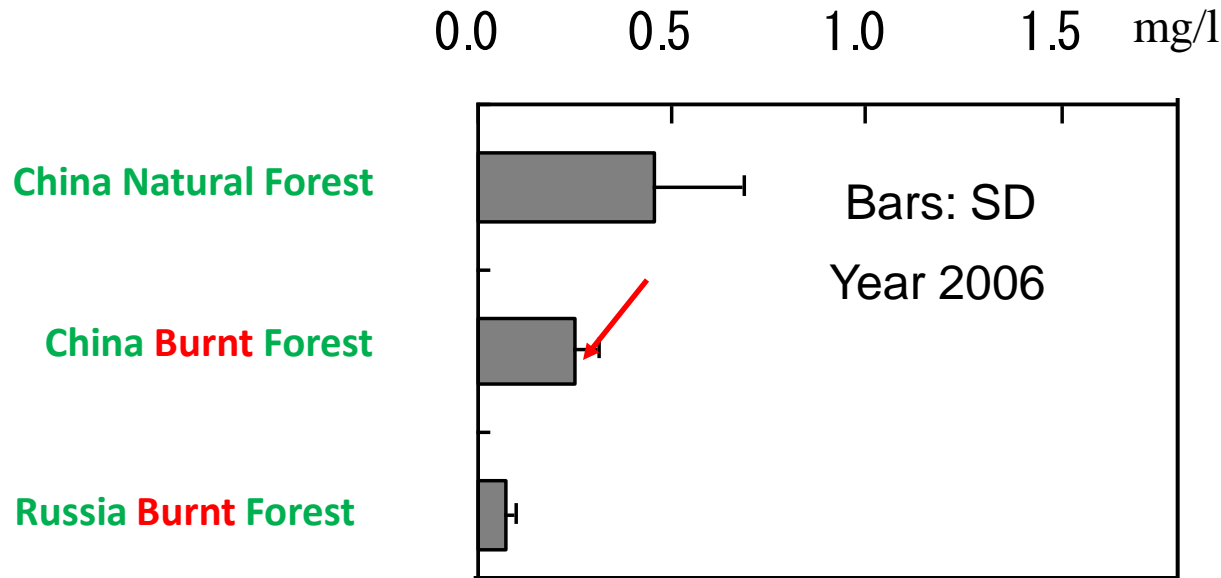
Land cover conversion scenario

Wetland → Dryland

Forest fire



How to calculate the effect of forest fire



Shibata et al. (unpublished)

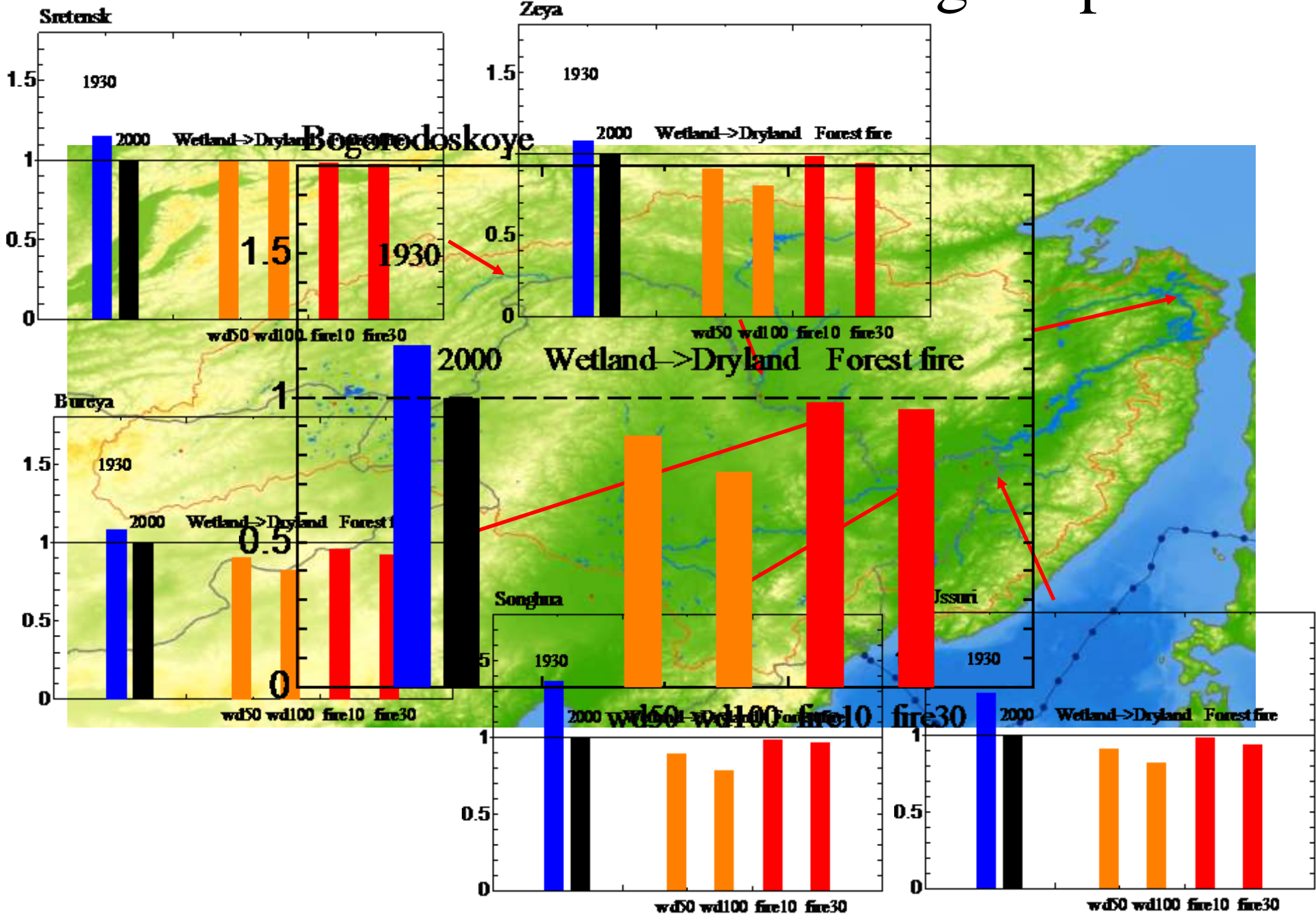


In each forest fire grid ...

Dissolved iron concentration of forest fire

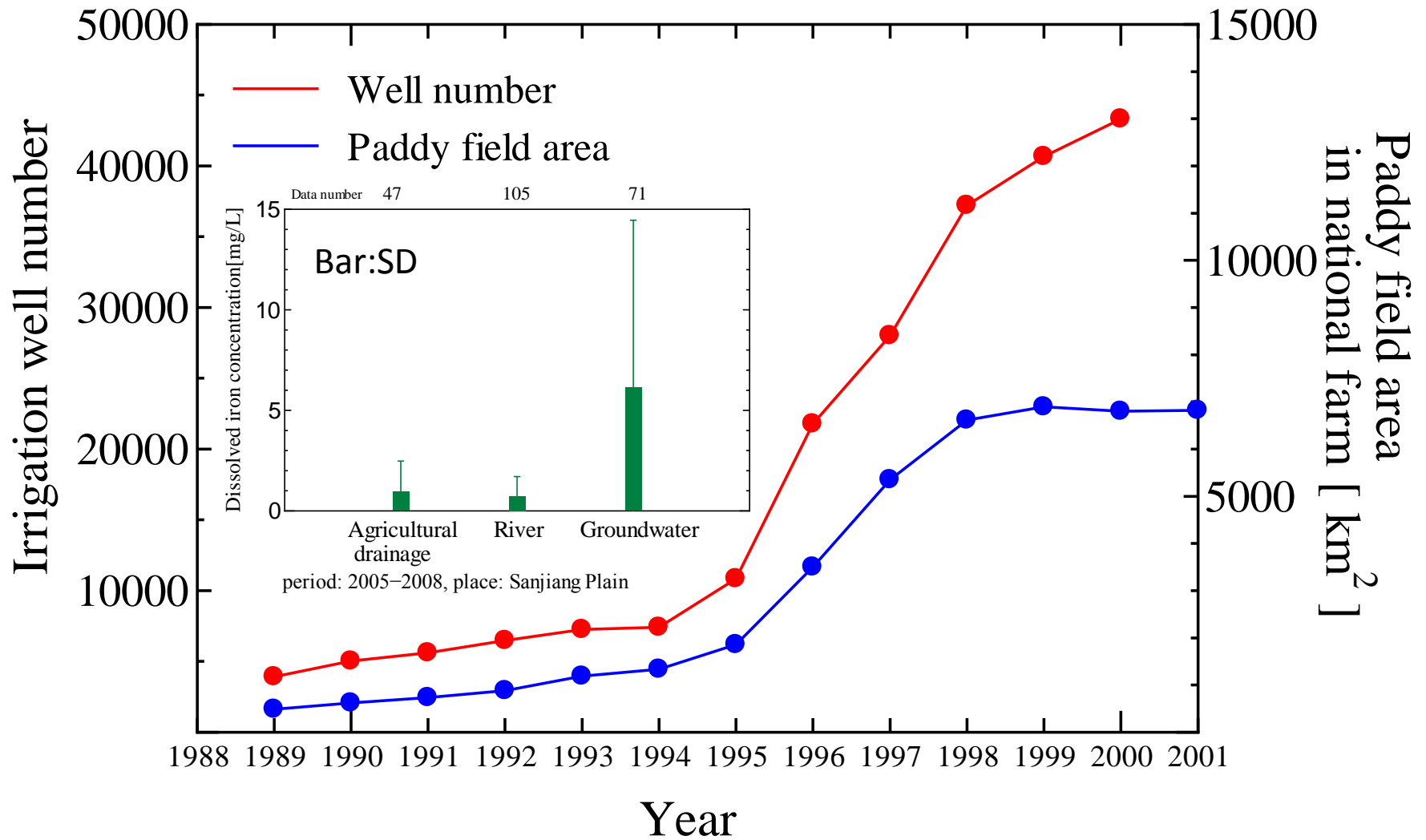
$= 0.5 \times \text{Dissolved iron concentration of original forest}$

Result of land cover change exp.



4. Groundwater irrigation experiments

Drastic increase in irrigation wells in China part



*Well number: Statistical data of Heilongjiang Province, China

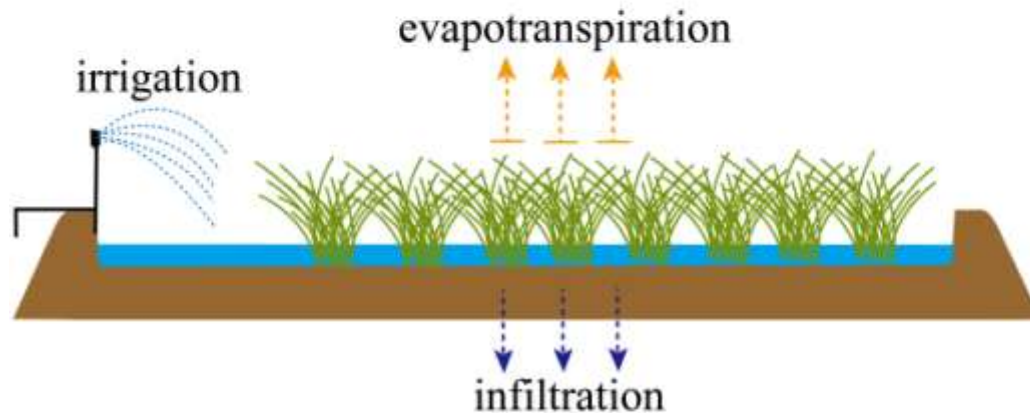
**Agricultural land area: Statistical data of Heilongjiang
Agricultural Land Area, China

Water management scheme of paddy fields

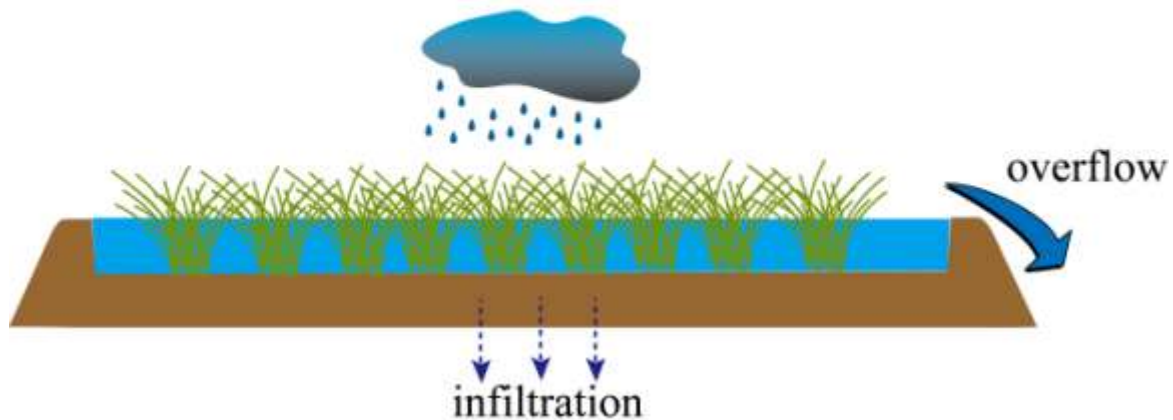
Paddling



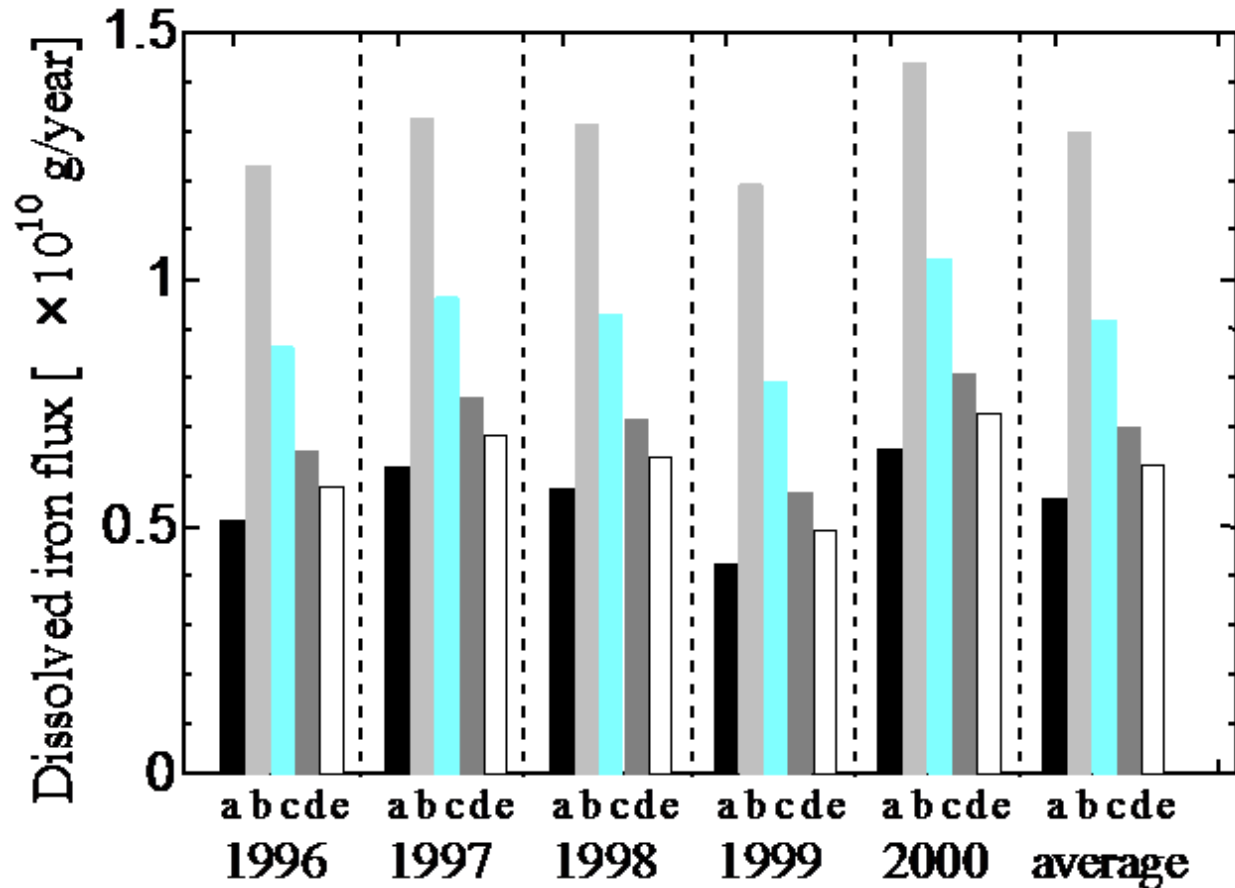
irrigation



Overflow



Result of groundwater irrigation exp.



a: no groundwater irrigation, b-e: groundwater irrigation, the ratio of remained dissolved iron is different b:100%, c: 90%, d: 70%, e: 50%

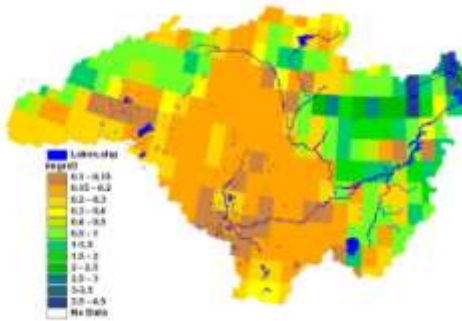
Conclusion

- Hydrological model incorporating dissolved iron producing mechanism is constructed.
- Constructed model is successful in simulating monthly discharge, and annual dissolved iron flux.
- Dissolved iron flux in 1930s' might be 20% higher than present according to the wetland decrease.
- If the all wetland is converted to agricultural land, dissolved iron flux will decrease about 40% compared to present.
- Groundwater irrigation may have great effect on increasing dissolved iron flux.

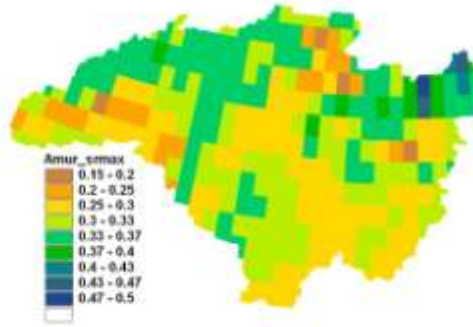
Supplement

List of input parameters

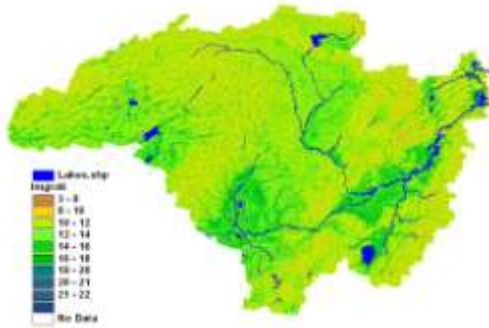
Hydraulic conductivity[m/day]



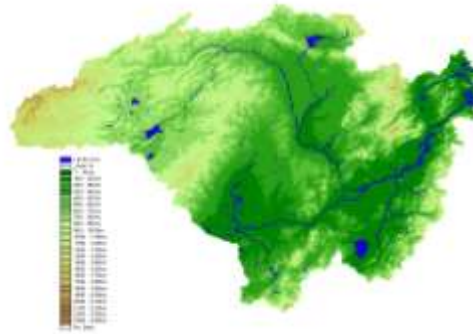
Field capacity[m]



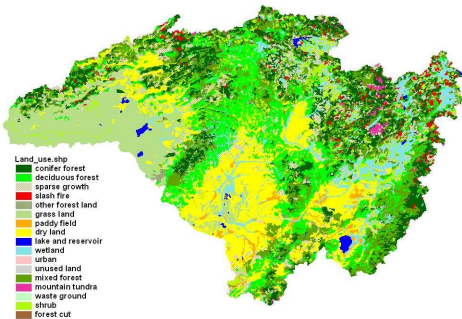
Topographic index $a/\tan\beta$ [m]



Elevation[m]



Land cover type



Symbol	Description	Unit	Resolution	Value	Source
<i>Prescribed with horizontal distribution</i>					
$a/\tan\beta$	land cover type	-	1000m		AO ^a
	soil type	-	1°		ISLSCP2
	elevation	m	1000m		SRTM
	topographic index	m	1000m		SRTM
<i>prescribed with land cover type</i>					
LAI	leaf area index	m ² /m ²	1000m		ORNL DAAC
	height of canopy top and bottom	m	1000m		ORNL DAAC
	surface conductance	m/s	1000m		Kondo (1994)
	aerodynamic conductance	m/s	1000m		Kondo (1994)
<i>prescribed with soil type</i>					
T_0	saturated hydraulic conductivity	m/s	1°		ISLSCP2
<i>prescribed as constant</i>					
szm	scaling parameter for runoff	m	-	0.001	-
SR_{max}	maximum root zone deficit	m	-	0.01	-
t_d	time constant for recharge to the saturated zone	m/h	-	0.1	-
chv	channel routing velocity	m/s	-	0.5	-
rv	river routing velocity	m/s	-	0.5	-
Cw	snow water retention capacity	-	-	0.1	-
T_s	threshold temperature for 100% snow	K	-	2.0	Beven (2000)
T_r	threshold temperature for 100% rain	K	-	4.5	Beven (2000)
T_m	threshold temperature for snow melt	K	-	0.0	Beven (2000)
PD_c	upper limit of ponding depth of paddy fields	m	-	0.1	-
SD_c	threshold for starting of dissolved iron production	day	-	1	-

a: Product of Amur-Okhotsk project

Symbol	Description	Unit	Resolution	Array	Source
U_a	zonal wind velocity	m/s	2.0°	-	NCEP2
V_a	meridional wind velocity	m/s	2.0°	-	NCEP2
T_a	atmospheric temperature	K	2.0°	-	NCEP2
q_a	atmospheric humidity	kg/kg	2.0°	-	NCEP2
R_d	downward radiation	W/m ²	2.0°	S/L ^a	NCEP2
R_u	upward radiation	W/m ²	2.0°	S/L	NCEP2
P	precipitation	mm/day	0.5°	-	Aphrodite

^a S: shortwave radiation, L: longwave radiation

