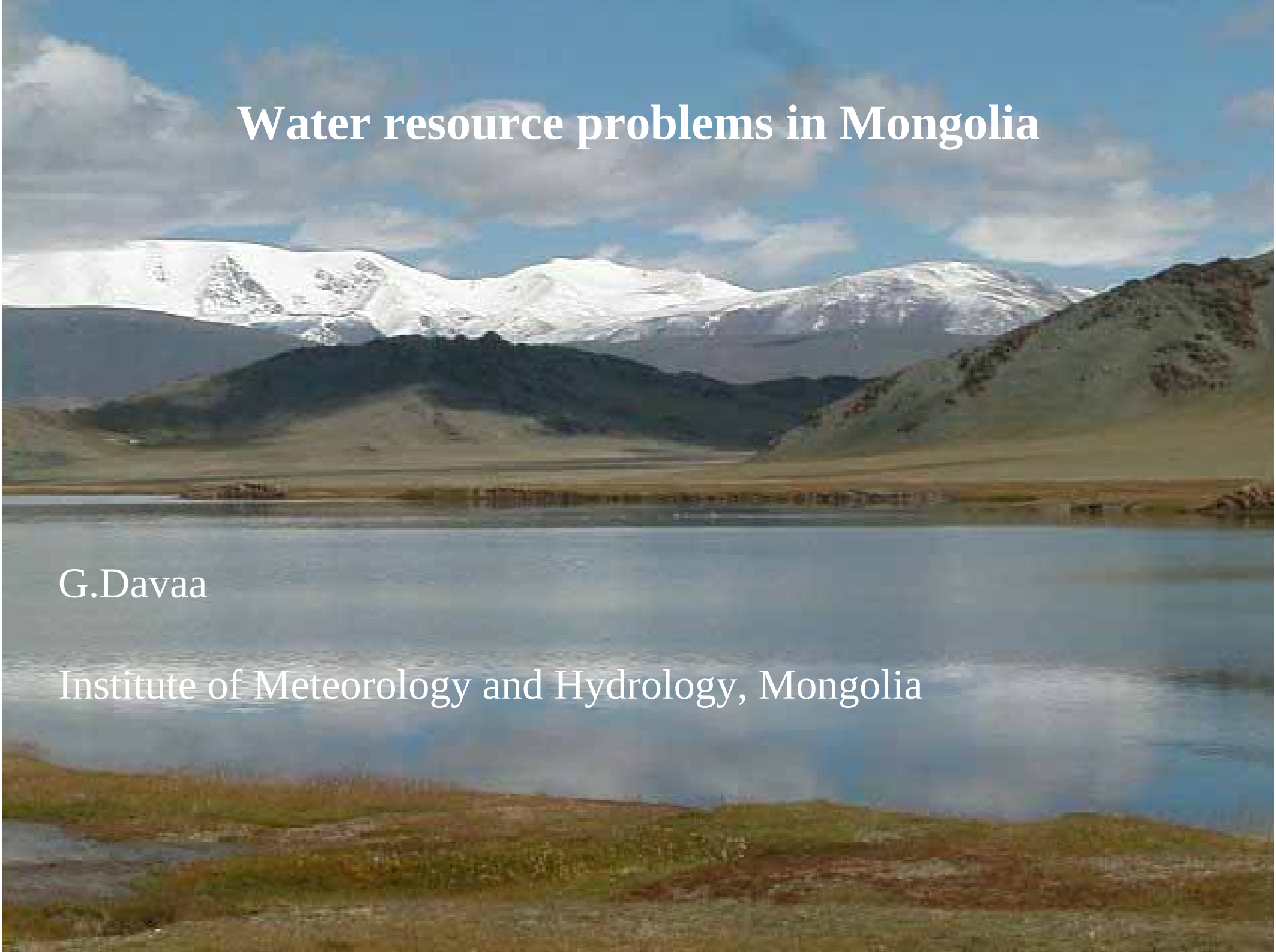
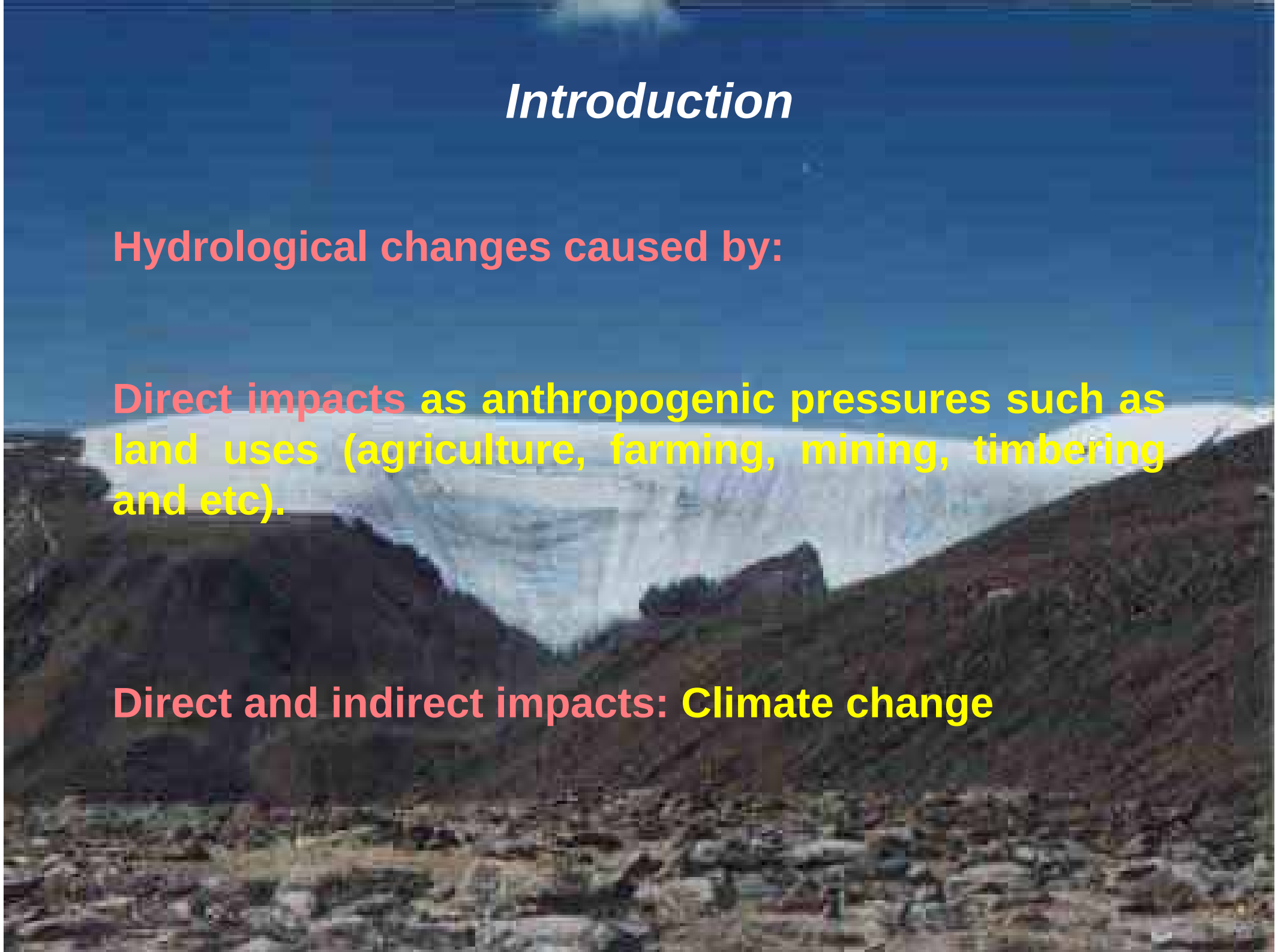


Water resource problems in Mongolia

G.Davaa

Institute of Meteorology and Hydrology, Mongolia

Water cycle variations possibly impacted by the climate change



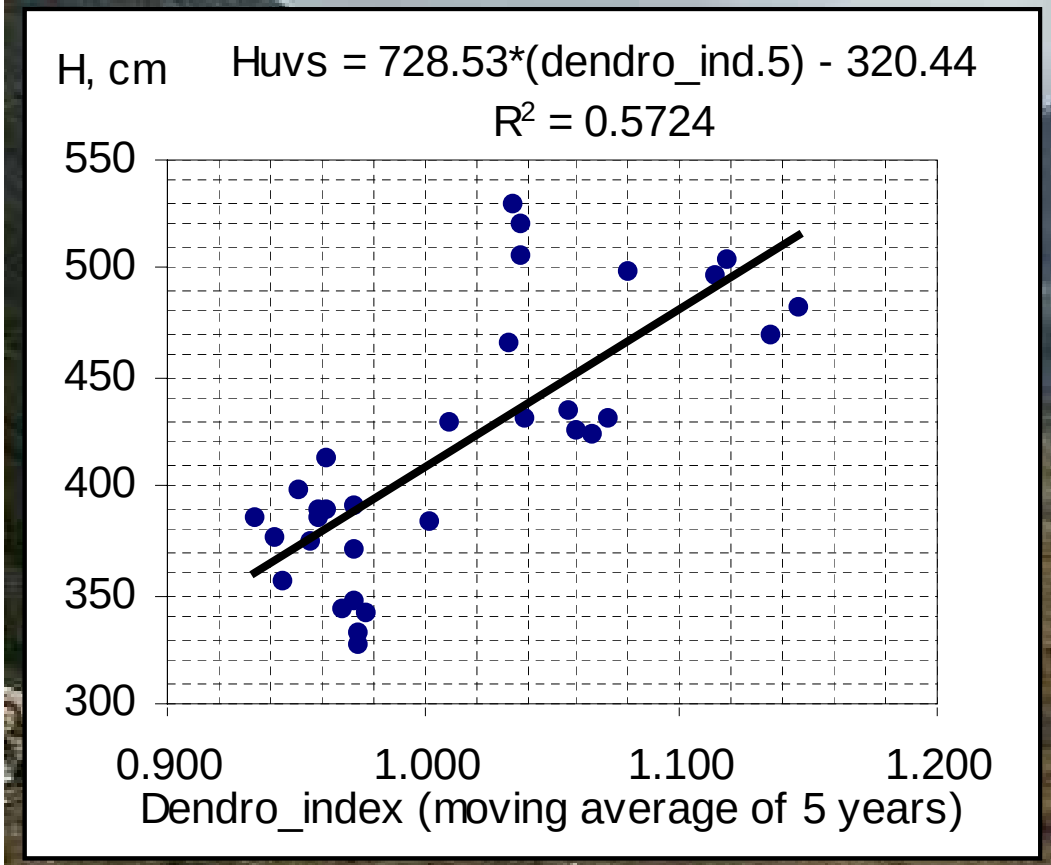
Introduction

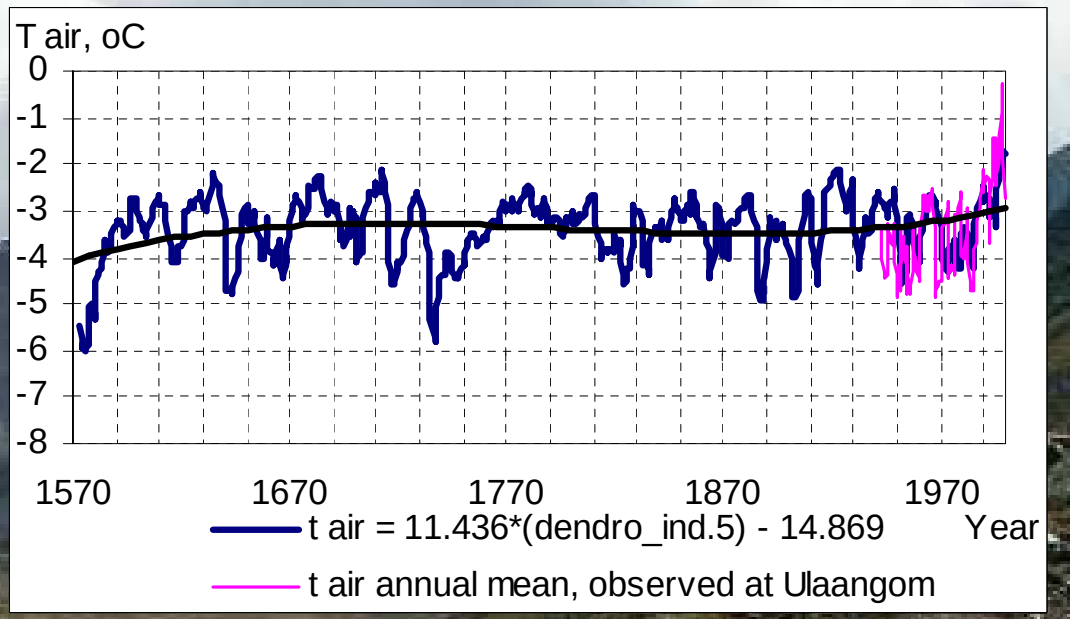
Hydrological changes caused by:

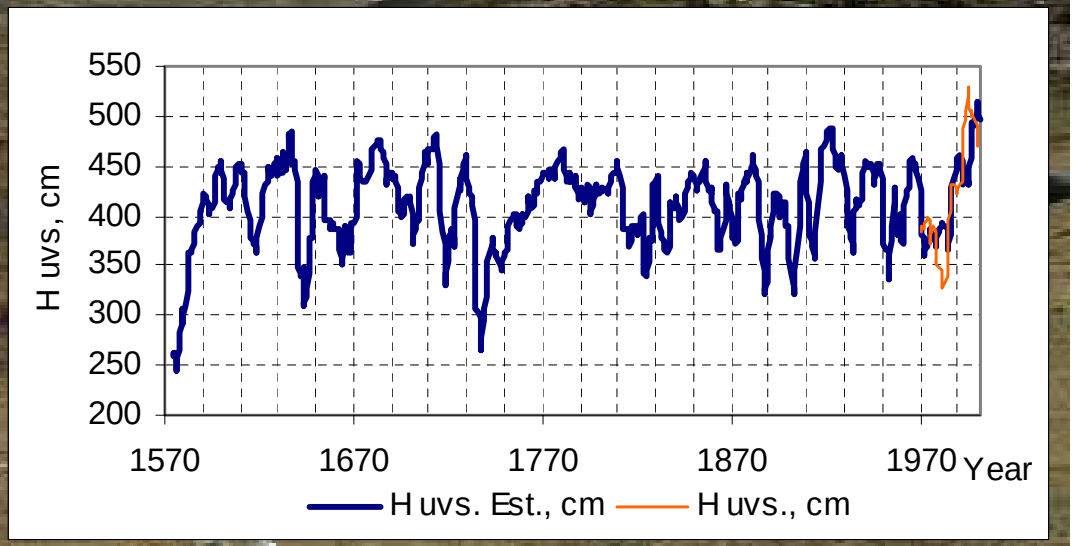
Direct impacts as anthropogenic pressures such as land uses (agriculture, farming, mining, timbering and etc).

Direct and indirect impacts: Climate change

Reconstructed and observed air temperature and water level of the Uvs lake



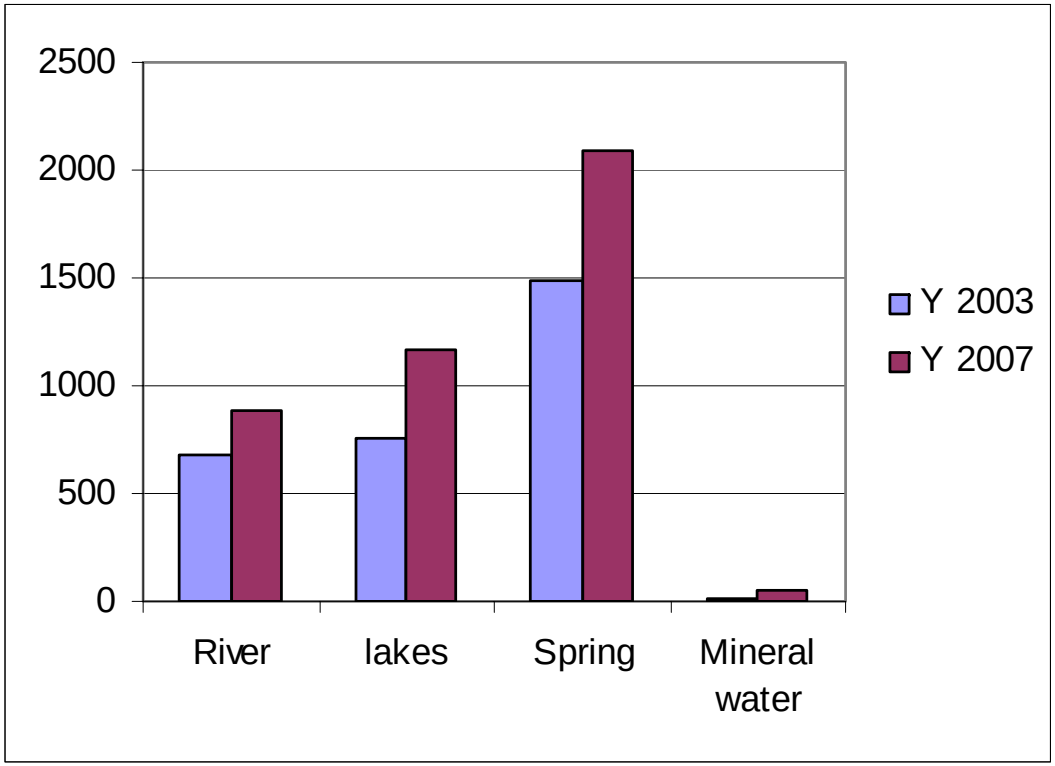




Total numbers of rivers, springs, lakes and mineral waters in Mongolia, in 2003

Name of provinces /Aimag/	Rivers and streams		Springs		Mineral waters		Lakes and ponds	
	total	dried	total	dreid	total	dried	total	Dried
Arkhangai	546	124	474	123	31	3	249	32
Bayan-Ulgii	293	17	736	42	13		1180	217
Bayankhongor	299	61	837	55	22		104	38
Bulgan	449	62	668	238	36		254	27
Gobi-Altai	219	2	779	35			75	0
Gobisumber	3	0	19	1	2		1	0
Darkhan-Uul	21	4	27	13			4	2
Dornogobi	0	0	345	50	4		1	0
Dornod	156	39	354	121	24		515	233
Dundgobi	1	0	187	15	5		12	0
Zavkhan	217	19	444	18	15		118	2
Orkhon	5	0	28	7			4	1
Uvurkhangai	294	51	530	97	37	3	110	20
Umnugobi	2	1	559	20	5		18	0
Sukhbaatar	35	22	368	41	6		55	4
Selenge	596	90	208	70	28	2	46	6
Tuv	537	94	413	103	17	1	235	72
Ulaanbaatar	72	22	106	22	20	1	4	1
Uvs	183	0	493	31	16		121	6
Khovd	214	7	468	10	9		201	4
Khuvsugul	1233	70	969	193	78		642	30
Khentii	246	17	588	179	6		247	65
Total in provinces	5621	702	9600	1484	374	10	4196	760
Total in the country	5565	683	9600	1484	374	10	4193	760

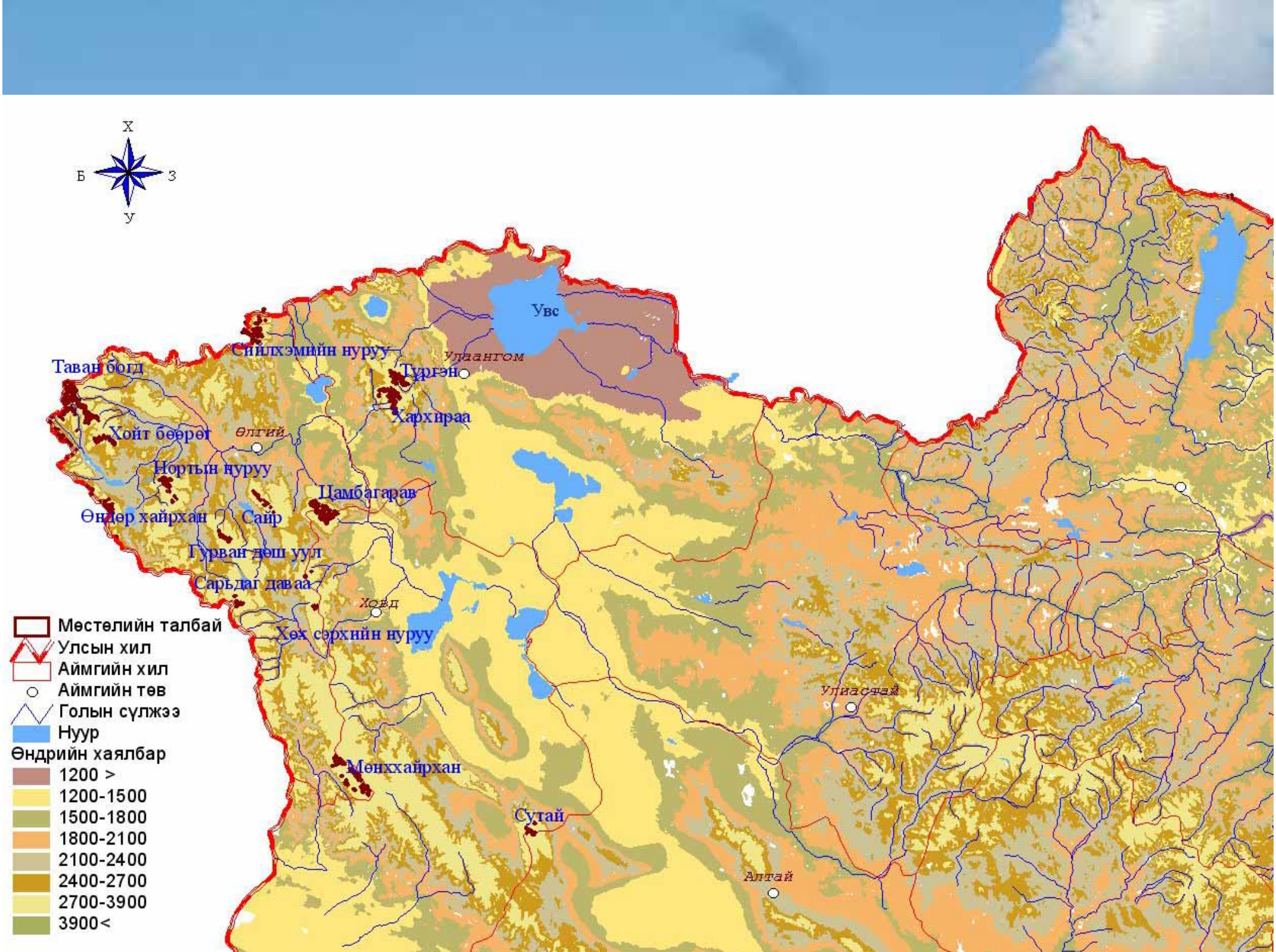
Hydrological inventories were organized in 2003 and 2007.

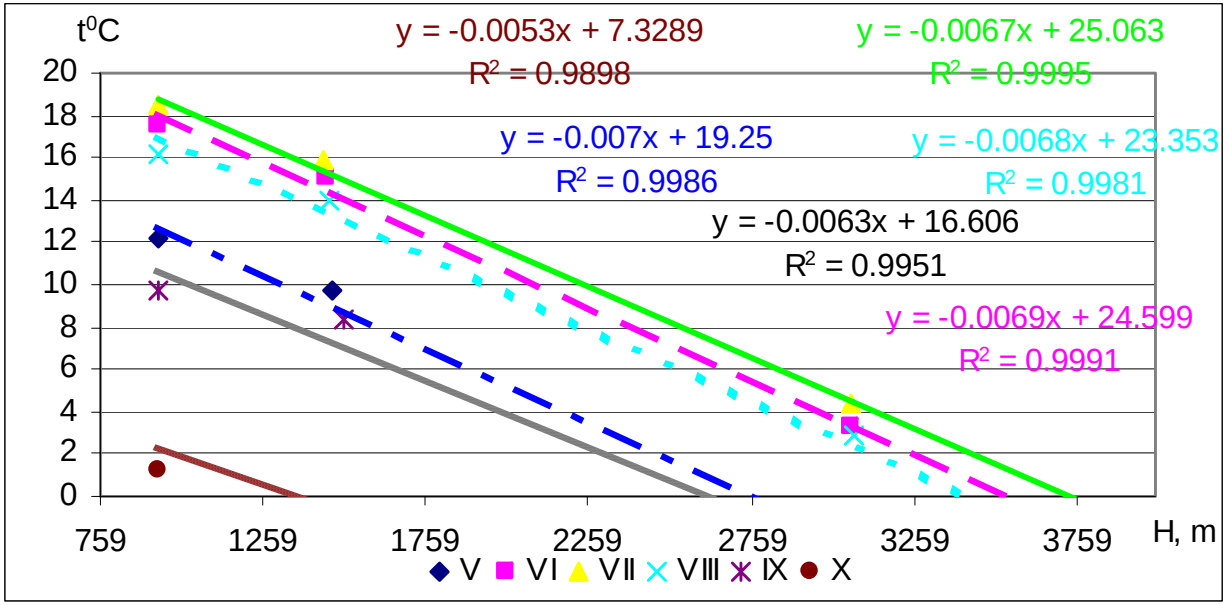


Number of water sources dried out in 2003 and 2007

Many changes occurring in water regime:

Increase in flood peak discharge, shortening its duration, increase in low flow duration, late ice phenomena in autumn, yearly spring ice clearance, ice break occurs in winter and etc.


Х
Б
З
У
Увс
Сийлхэмийн нуруу
Улаангом
Таван богд
Тургэн
Хархираа
Хойт бөөрөт
Өлгий
Нортын нуруу
Цамбагарав
Өндөр хайрхан
Сайр
Гурван дөш уул
Сарьдаг даваа
Ховд
Хөх сэрхийн нуруу
Улиастай
Мөнххайрхан
Сутай
Алтай
Мөстөлийн талбай
Улсын хил
Аймгийн хил
Аймгийн төв
Голын сүлжээ
Нуур
Өндрийн хаялбар
1200 >
1200-1500
1500-1800
1800-2100
2100-2400
2400-2700
2700-3900
3900<



Monthly average height of 0°C, determined from radio sonde data

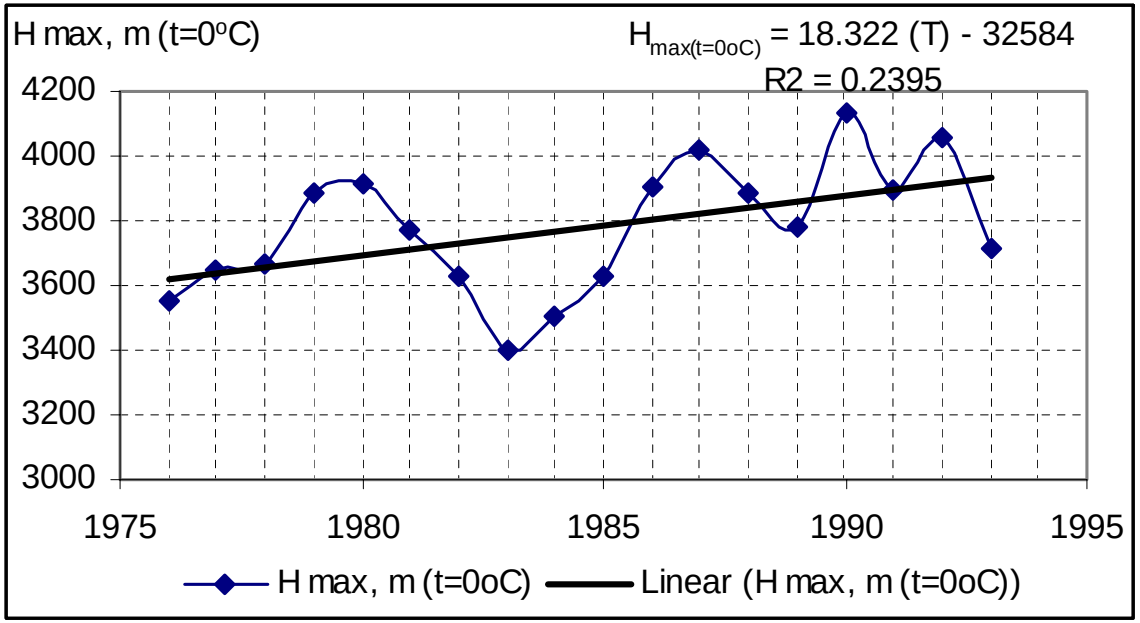
May 1386 m

June 3545.9

July 3735.7 m

August 3420.4

Sep. 2629.7 m.



Annual maximum height of 0°C in 1976-1993.

It is increasing by 17.3 m/year. Total increase is estimated as 531.3 m in 1976-2005 period.

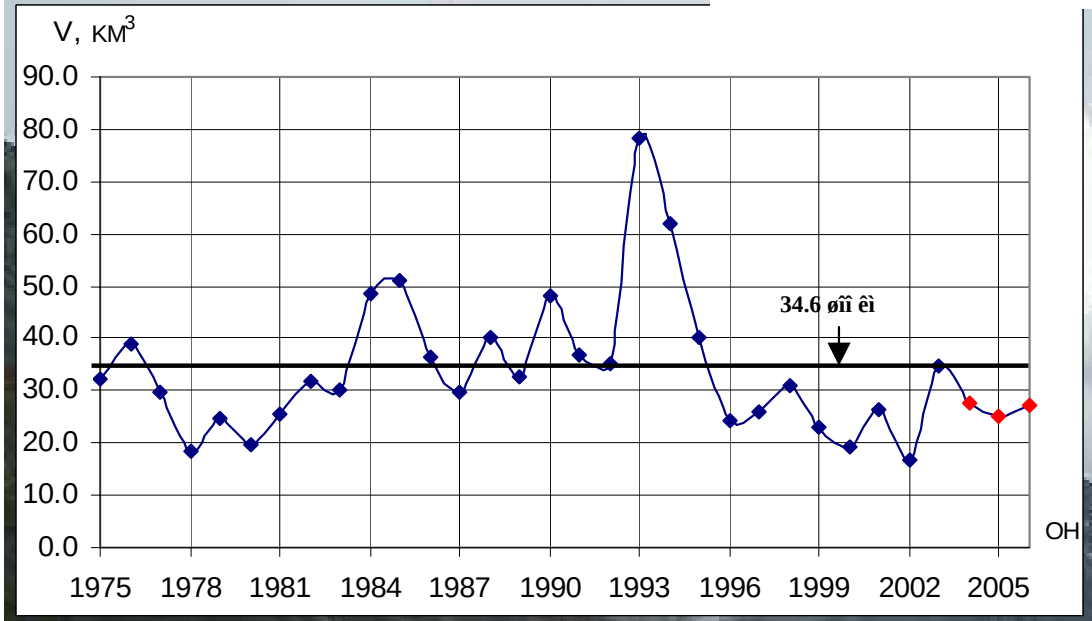
Changes in glacier areas, sq.km

Glacier	1940-th map	25 June, 1992	10 Sep. 2000	8 Aug. 2002
Kharkhiraa	43.02	-	36.08	31.29
Turgen	50.13	-	34.74	33.83
Munkhkharhan	-	36.96*	-	27.42
Tsambagarav	105.09	90.98	74.8	71.52
Sair	-	11.51	-	6.62

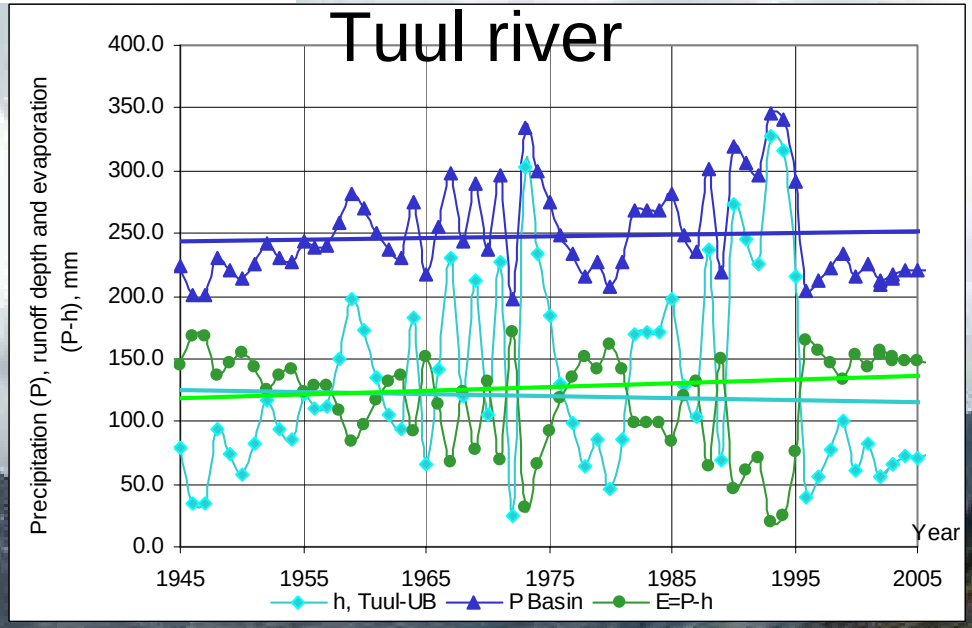
Changes in glacier areas, % in comparison with area of 1940-th

Glacier	1940-th	25 June, 1992	10 Sep. 2000	8 Aug. 2002
Kharkhiraa	0.0	-	16.1	27.3
Turgen	0.0	-	30.7	32.5
Tsambagarav	0.0	13.4	28.8	31.9

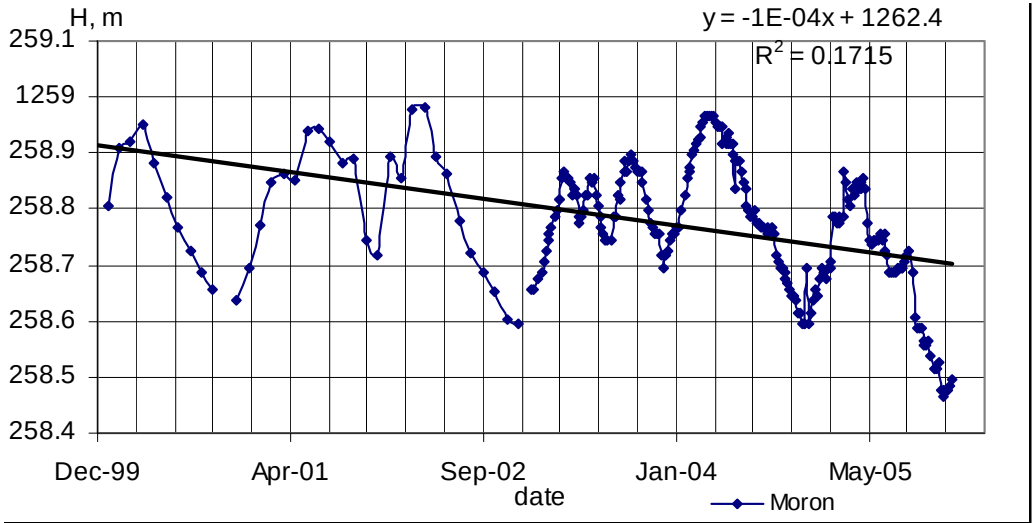
River water

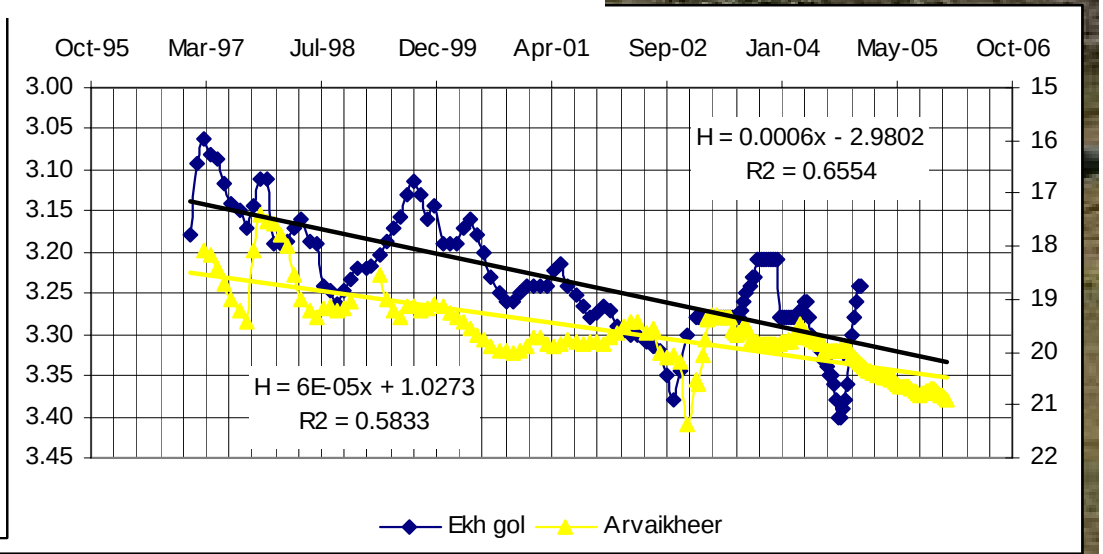


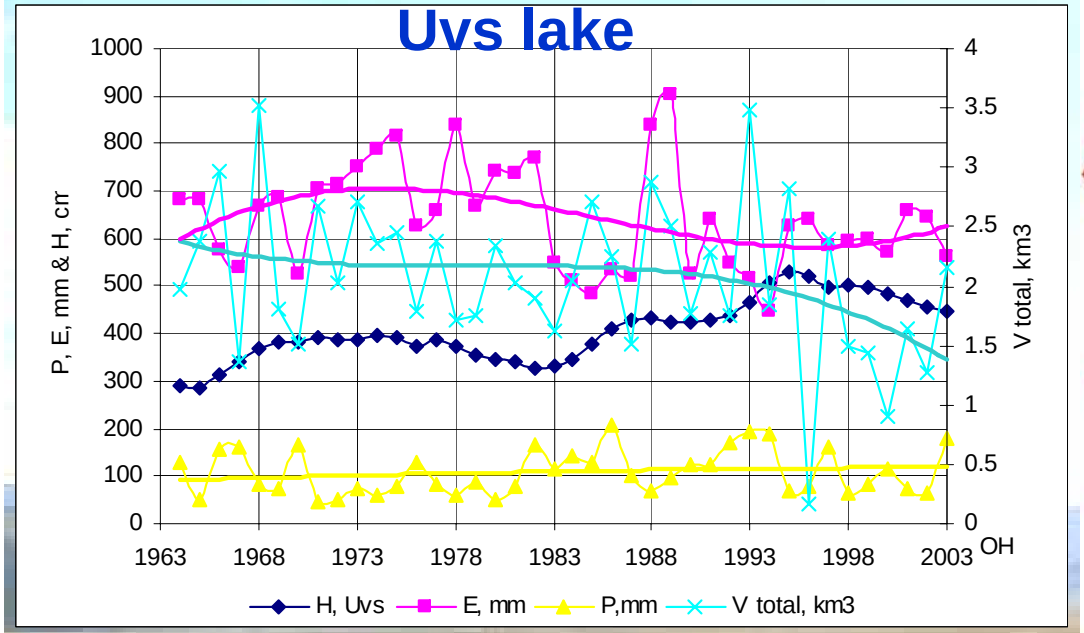
Tuul river

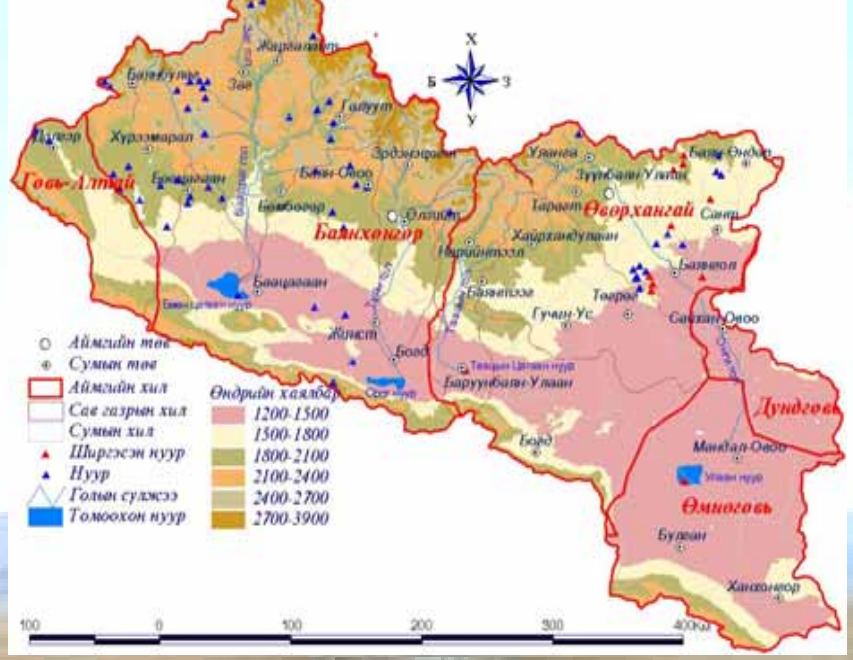


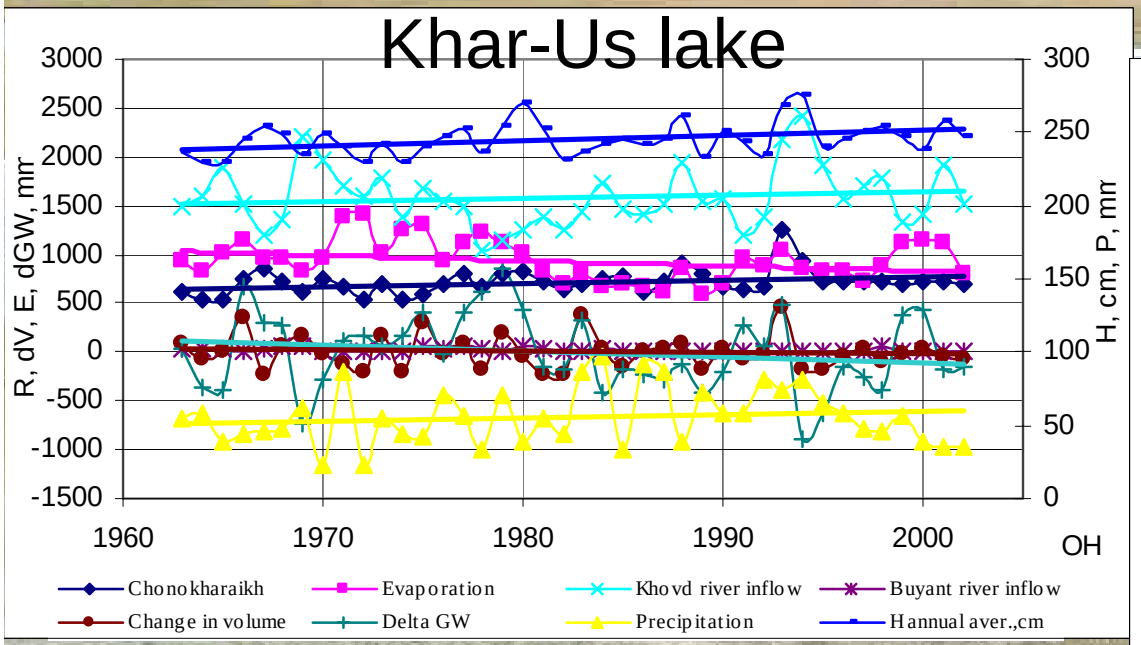
Ground water level

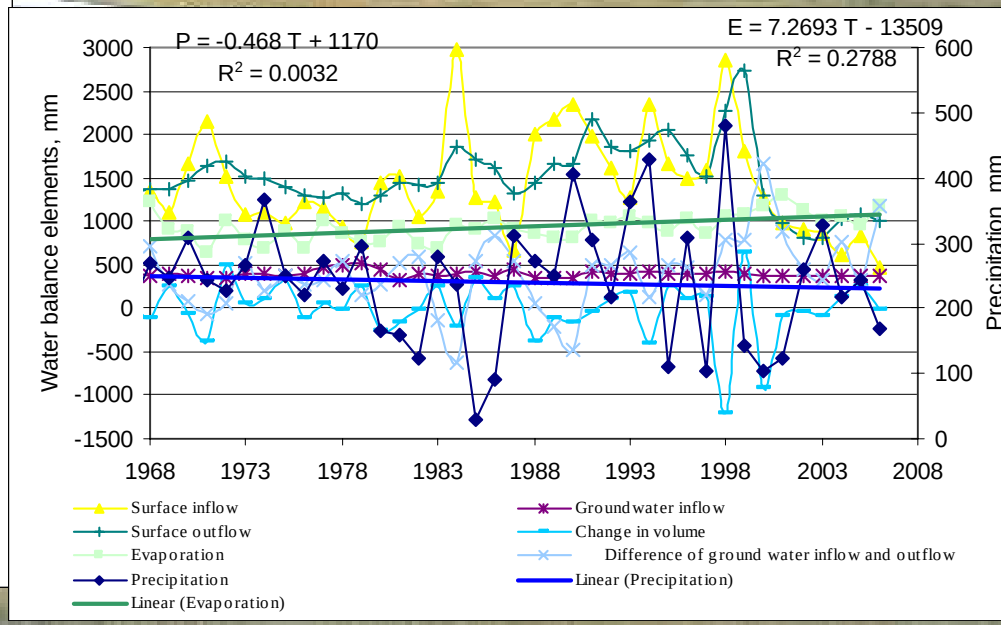





Uvs lake
P, E, mm & H, cm
V total, km3
OH
H, Uvs
E, mm
P,mm
V total, km3


Говь-Алтай
Баянхонгор
Өвөрхангай
Дундговь
Өмнөговь
Аймгийн төв
Сумын төв
Аймгийн хил
Сав газрын хил
Сумын хил
Ширэгэсэн нуур
Нуур
Голын сувгээ
Томоохон нуур
Өндрийн хялбар
1200-1500
1500-1800
1800-2100
2100-2400
2400-2700
2700-3900


Khar-Us lake
R, dV, E, dGW, mm
H, cm, P, mm
OH
Chonokharaikh
Evaporation
Khovd river inflow
Buyant river inflow
Change in volume
Delta GW
Precipitation
Hannual aver.,cm


Buir lake
P = -0.468 T + 1170
R² = 0.0032
E = 7.2693 T - 13509
R² = 0.2788
Water balance elements, mm
Precinitation mm
Surface inflow
Surface outflow
Evaporation
Precipitation
Linear (Evaporation)
Groundwater inflow
Change in volume
Difference of ground water inflow and outflow
Linear (Precipitation)

Mongolia's strategy and countermeasures (ongoing and/or planning)

Government Policies: National Water Program, National Program on Reduction of Natural Disasters, National Action Plan on Climate change, National Action Plan for Combating Desertification etc.

Government Policy on Ecology – In the article under 3.1 states that Water resources, its proper use and protection are key policy of the Government and needed to upgrade and improve water resources monitoring;

National Program on Reduction of Natural Disasters (2000-2010), Paragraph 3 states Policy on reduction of natural disasters, in its 14.1 states to improve monitoring activities for natural disaster prevention;

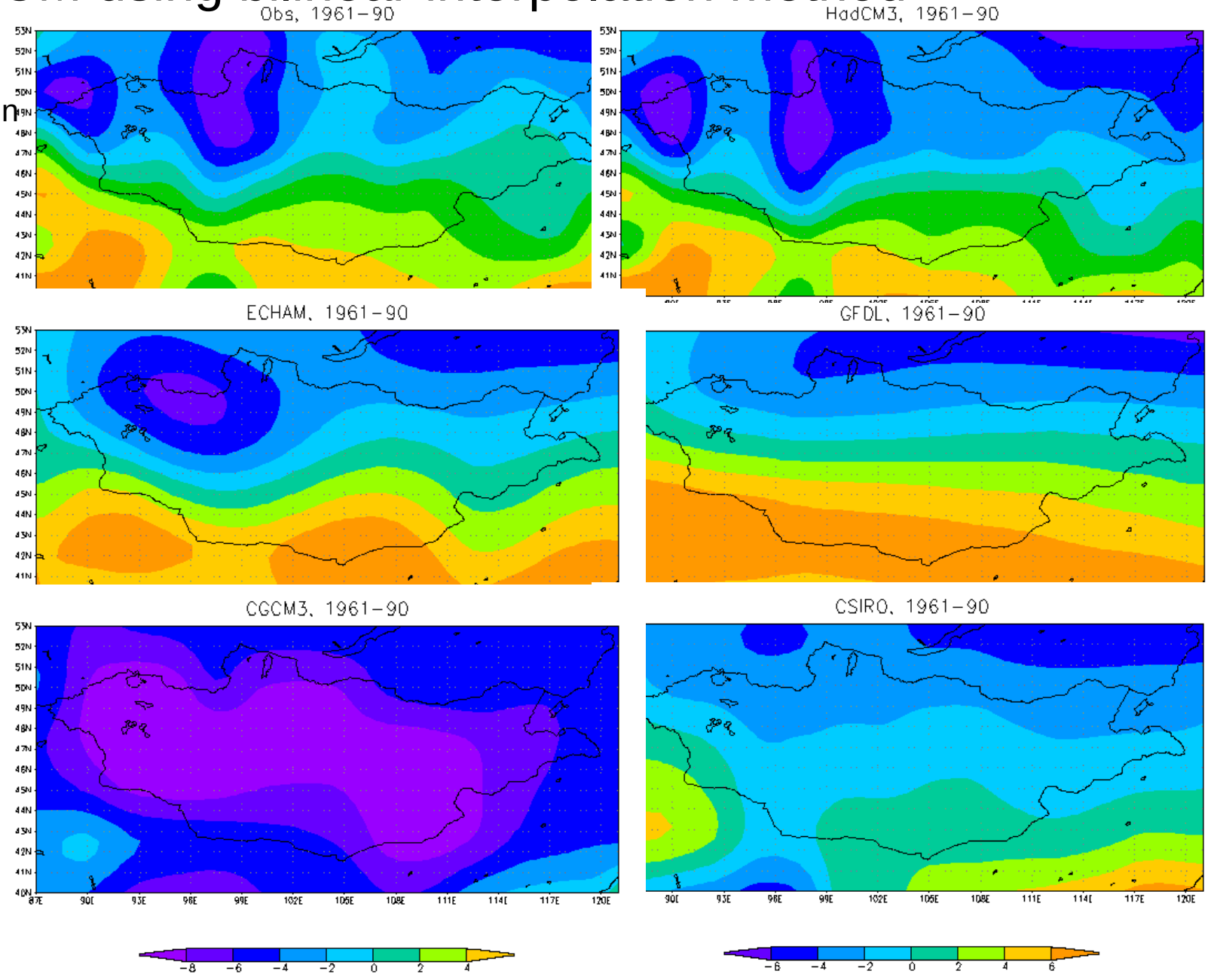
National Action Plan on Climate change: Adaptation measures, Natural disaster and infection diseases, and herewith focused to strengthening capacity building

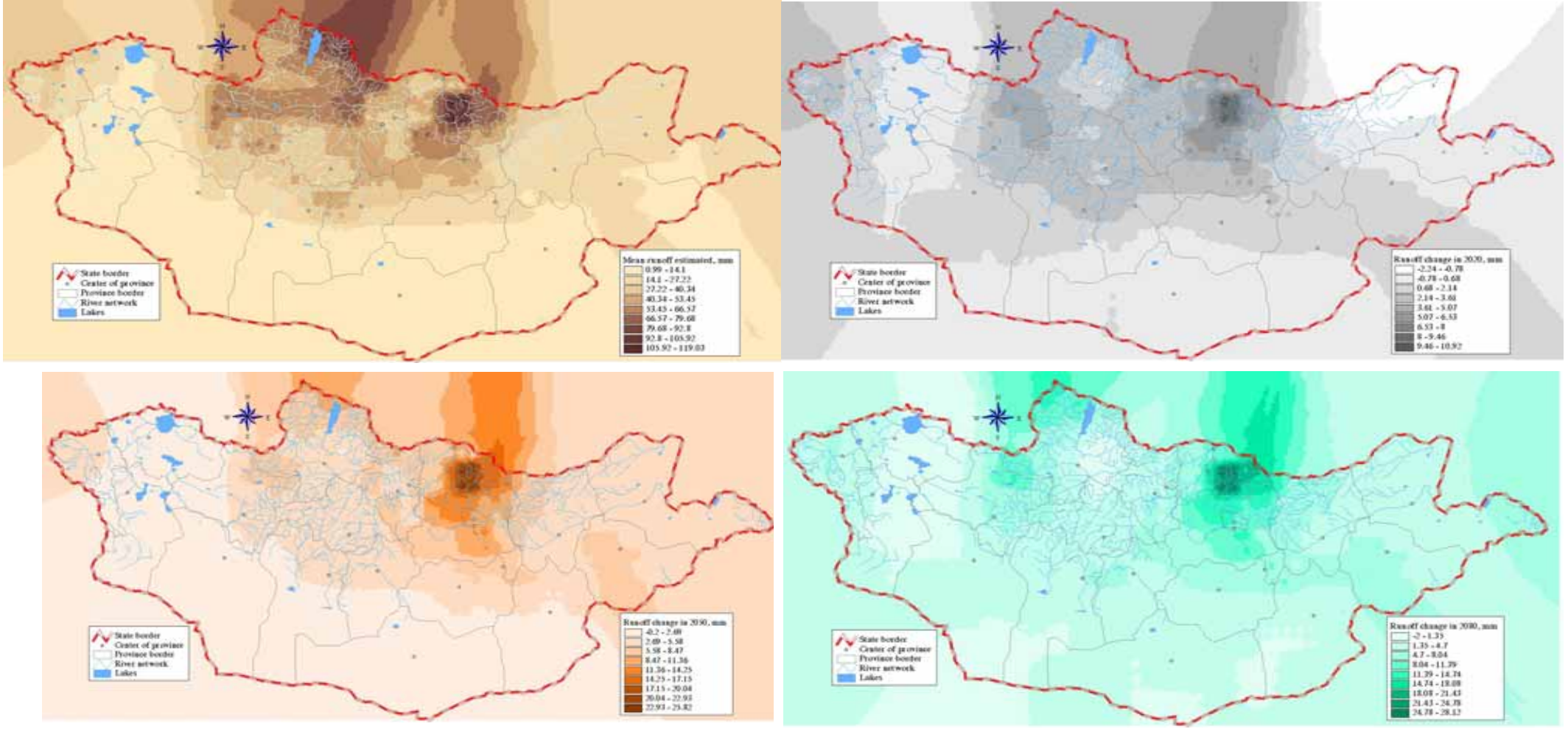
“Law on Environmental protection”, “Law on fees for water resources and mineral water uses”, “Law on hydrological, meteorological and environmental monitoring”, “Law on Water”, and “Law on Protection against natural disasters” and others.

Comparison of current climate and simulation results of GCM using bilinear interpolation method

- Annual mean air temp. in 1961-1990
- HadCM3- U.K.
- ECHAM4- Germany
- GFDL- USA
- CCGM3 - Canada
- CSIRO-Australia

$$bias = \frac{1}{N}\sum_{n=1}^{N}\left(X_n^o - X_n^m\right)$$



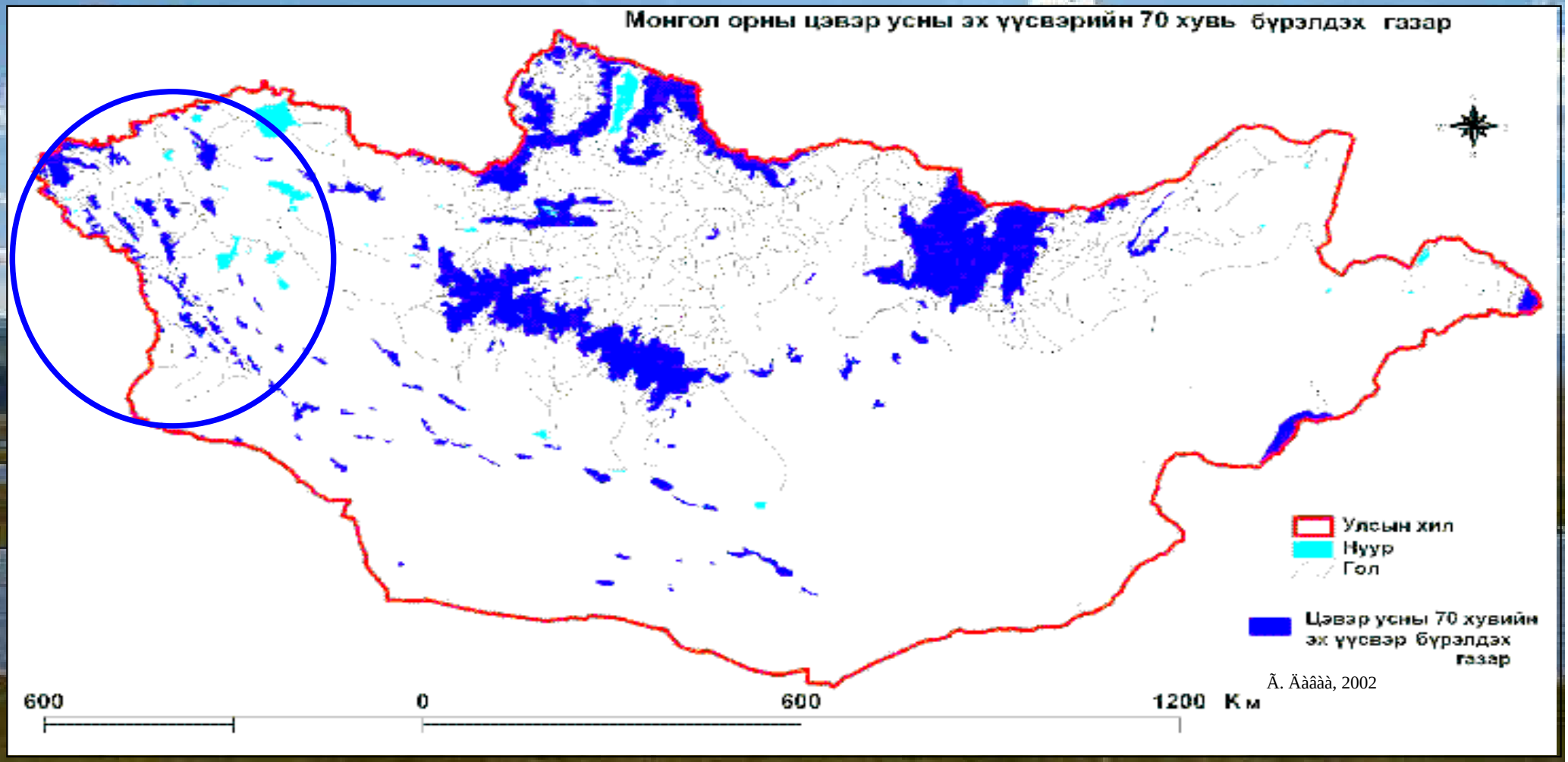


Runoff depth and its future changes, mm/year

Rainfall intensity parameter (I) equals to 0.40 in AOB, 0.27 in POB, 0.5 in IDB.

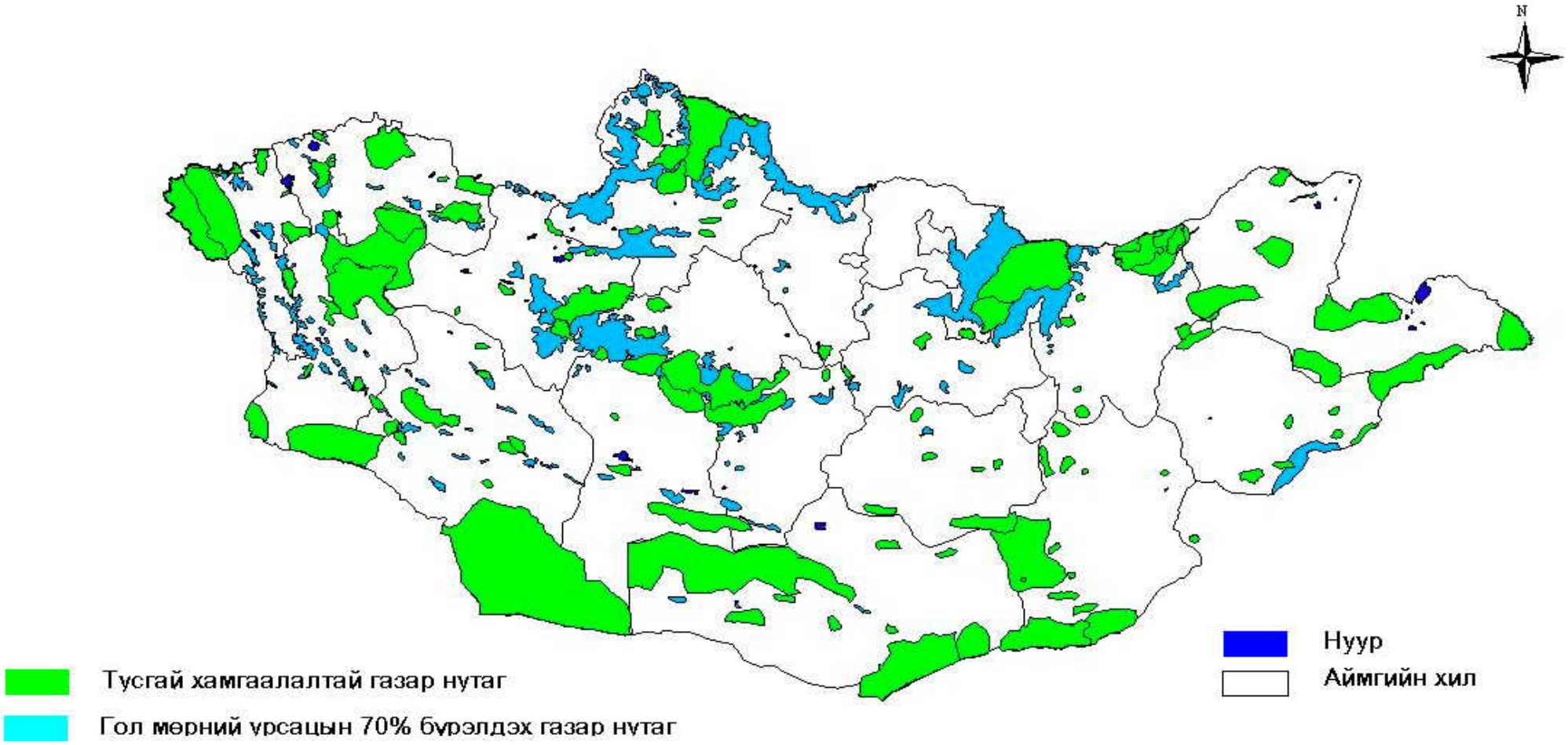
Runoff change: A2: 2020, dY= 10 mm in Khentei Mts., 2-5 mm in other mountain areas, -2 mm in intermountainous valleys, steppe and Gobi regions. Increase in runoff is 10 times less than increase value in potential evaporation.

River water formation zone



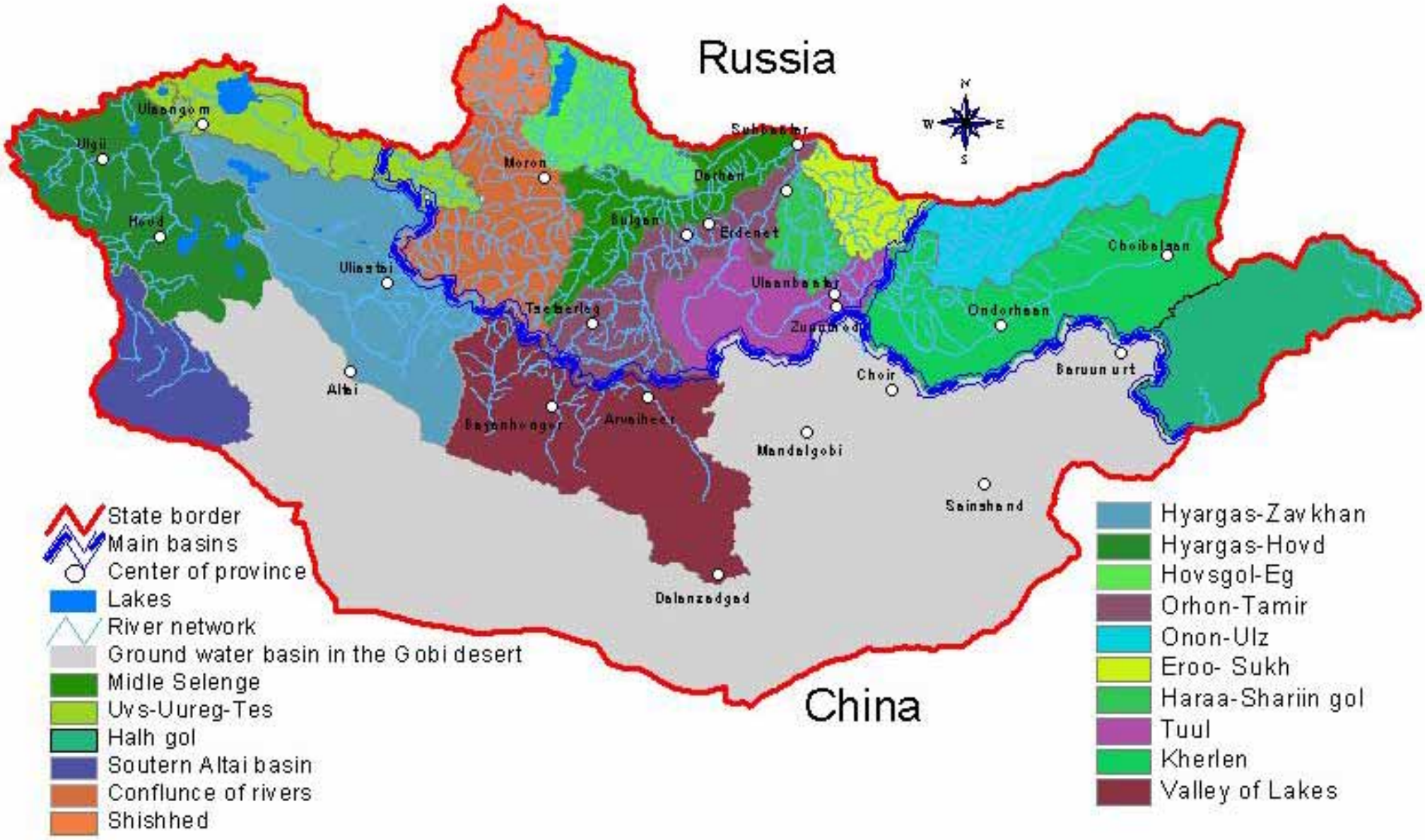
“National program on protection of head water and water sources”

Current protected area and the area where forms 70 % of river water resources



Strengthening Integrated water resource management:

Major river basins where proposed to establish river basin Consuls



Needs for the above strategy and countermeasures

Socio-economic scenarios (detail)

Climate change scenarios at regional scale

Land use scenarios (options)

Impact assessment results on ecosystems and vulnerability analysis

Adaptation policy – (real financed)

Impact of climate change and anthropogenic pressures on water resources and its integrated management

What we expect from GEOSS

Use of GEOSS products (MOLTS, Satellite (GPM, soil moisture (MAVEX), glacier (ALOS), lake, natural disaster monitoring), water and energy budget monitoring, modeling and prediction)

Capacity Building Programs

Use of training and workshops organized within AWCI and others

Public awareness: Dissemination of knowledge for water resources management and application to practices

Shearing with best practices in IWRM, experiences, technologies

Application of IWRM to National and regional levels (Demonstration project : Selbe River basin, Mongolia)

Updated CEOP Ref. site configuration