

***Snowfall variation in Mongolia and its
relationship with atmospheric
circulation***

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Climate, M2 (st.ID 201225024)

1

- *General background*

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- *Objective of the study*

3

- *Previous study*

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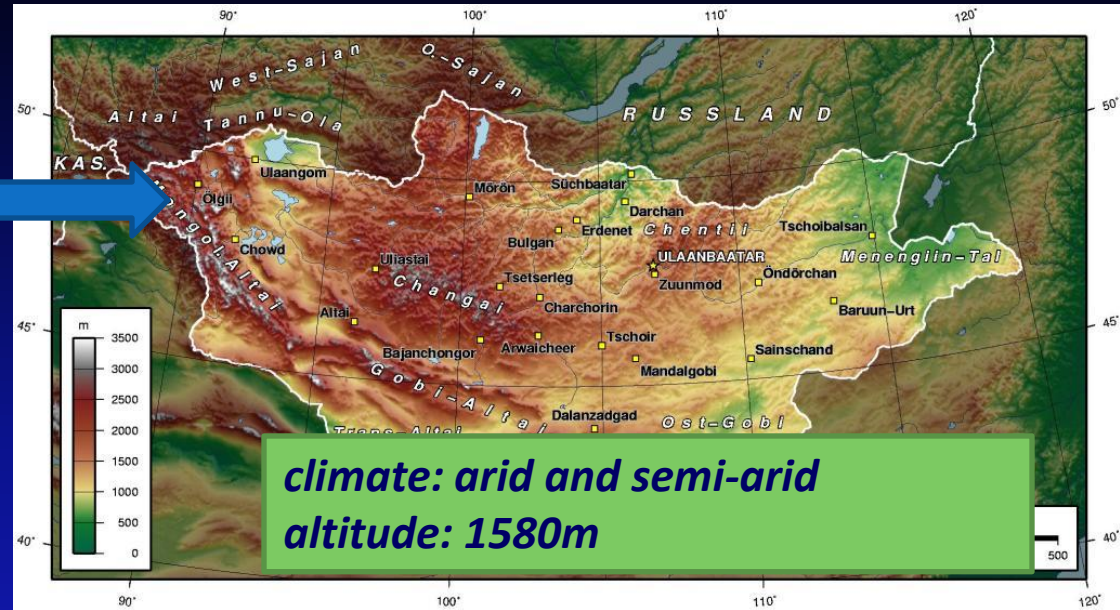
- *Result: (Climatology in Mongolia)*

5

- *Conclusion*

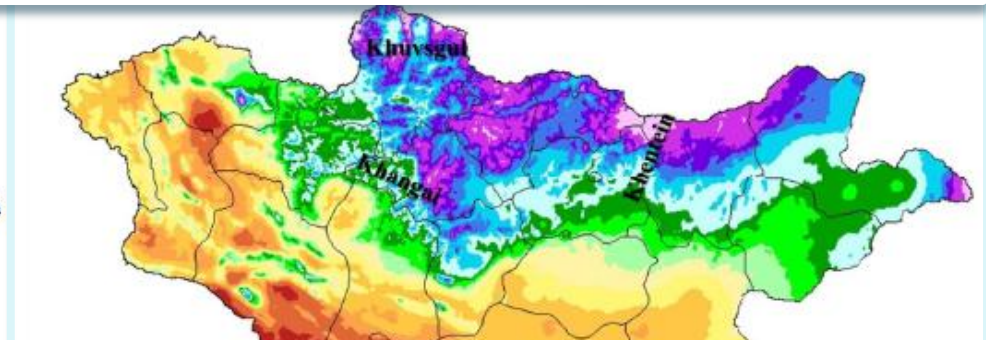
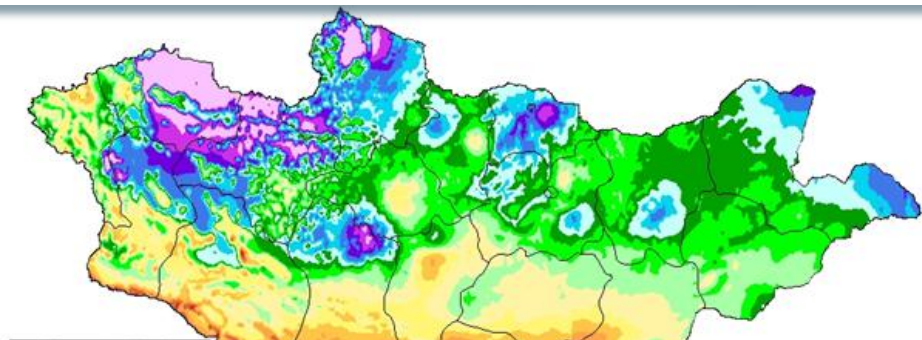
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- *Future study*



climate: arid and semi-arid
altitude: 1580m

Distribution of air temperature, (Jan) & Annual precipitation



Annual temperature is increased by 2.1°C since 1940 and annual precipitation is decreased by 0.7% compare to climate normal since 1940

Temperature (deg C)	
< -32	-26 to -25
-32 to -31	-25 to -24
-31 to -30	-24 to -23
-30 to -29	-23 to -22
-29 to -28	-22 to -21
-28 to -27	-21 to -20
-27 to -26	-20 to -19
> -19	

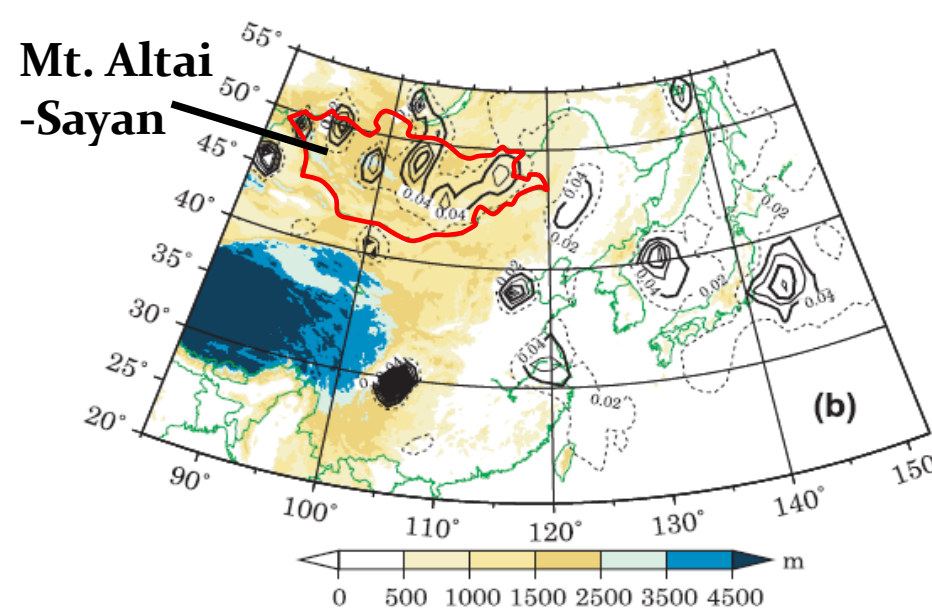
One major reason is to study that nomadic livestock husbandry is one of the important parts of the society of Mongolia. It highly depends **weather condition**. **Even a few centimeters of snow accumulation in Mongolia can cause big effect the livestock.**

Thus, the ability to **provide long-term forecasts** of snowfall is important



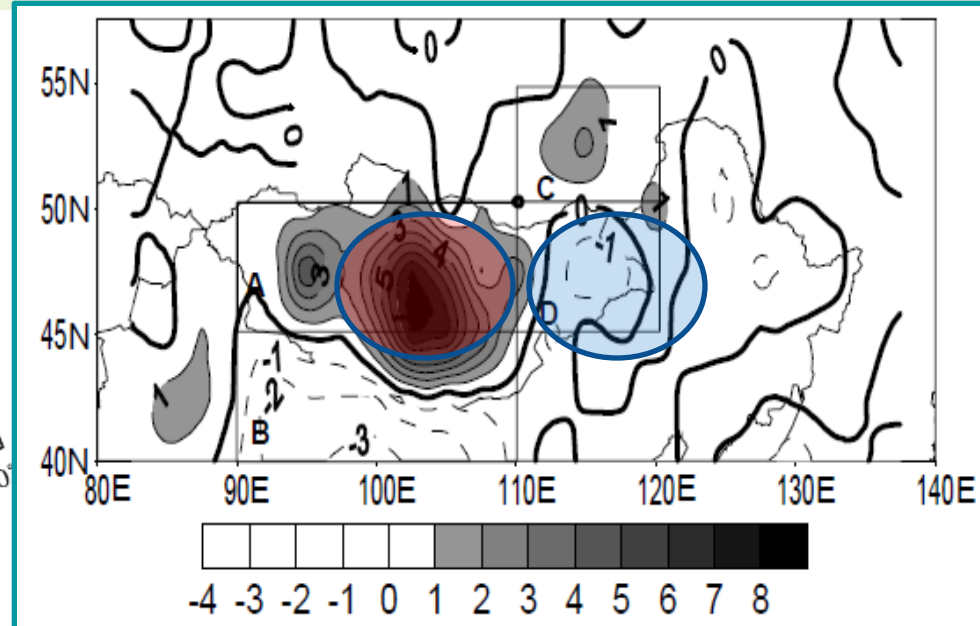
Snow fall variation is related atmospheric circulation

Frequency of cyclogenesis



Adachi and Kimura., 2007.

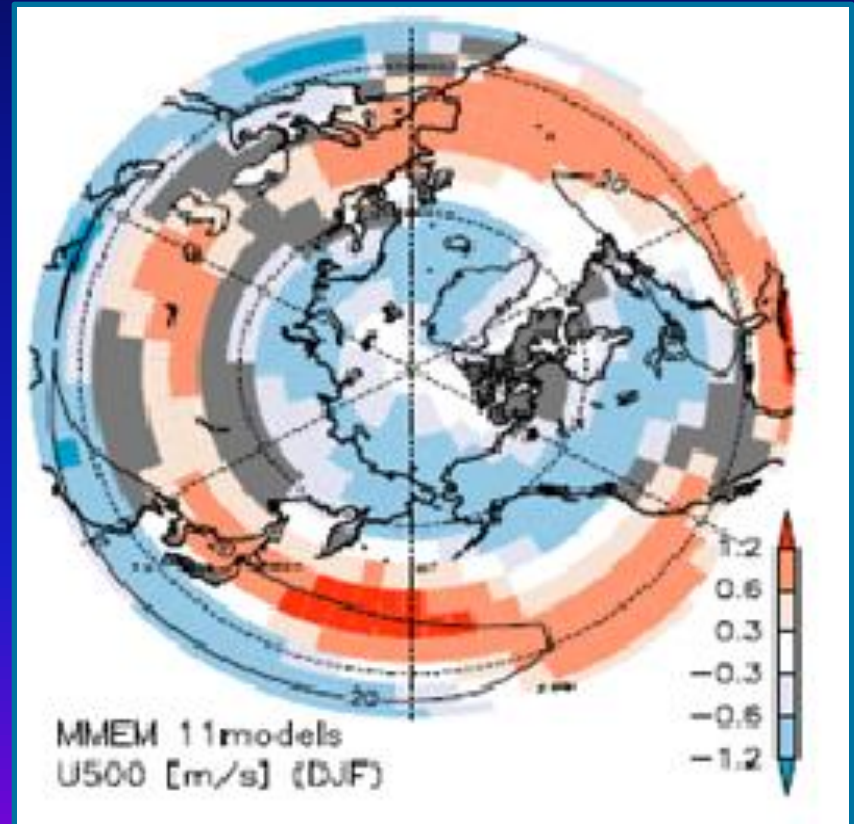
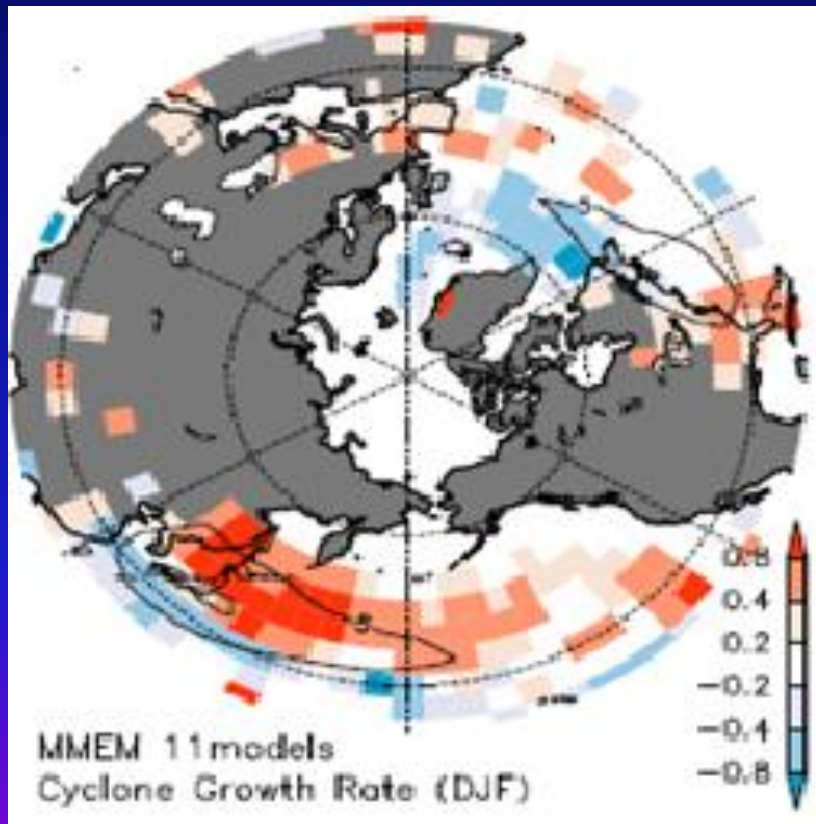
The highest frequency of cyclogenesis was located over the Mongolian Plateau, on the lee side of Altai-Sayan Mountain



Xinmin Wang et al. 1999

Differences in annual counts of extratropical cyclones between 1980-2001 and 1958-1979 on the northern Asia

In the future climate experiments shows number of intense cyclones a significant increase whereas the number of total cyclones a significant decrease



Ryo Mizuta, (2012)

Multi model ensemble means of change from the historical run.

In the future climate experiments shows number of intense cyclones a significant increase whereas the number of total cyclones a significant decrease

< Meridional gradient >

The lower troposphere warming in the tropics is weaker than high latitudes, resulting in a weakened MTG.

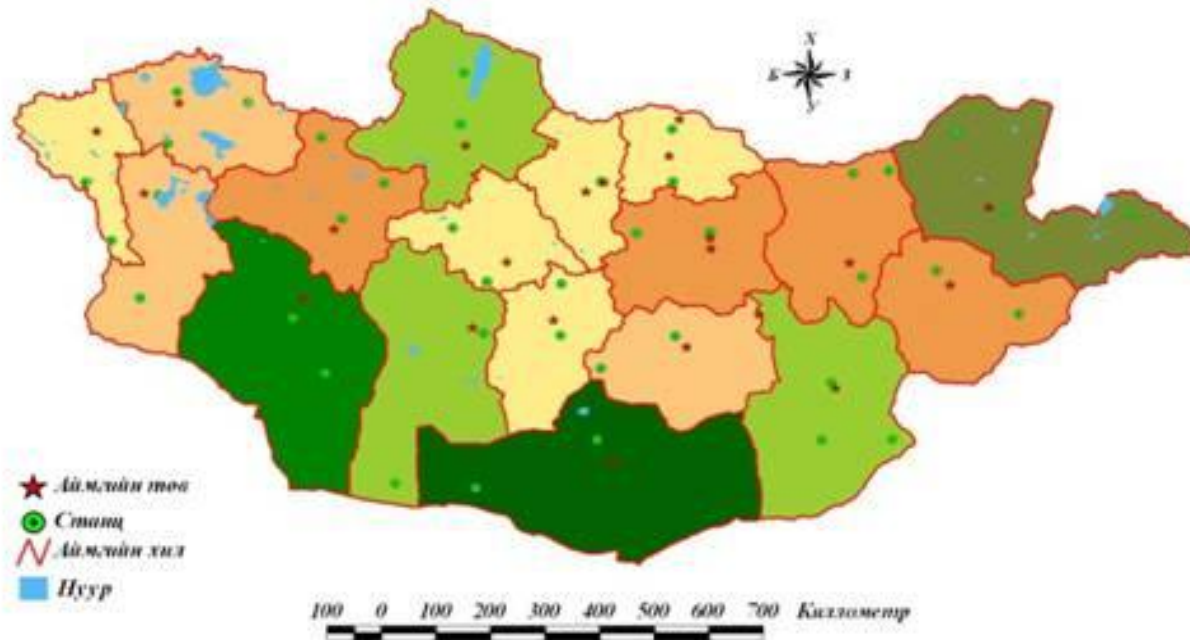
Which may suppress number of cyclone

In upper troposphere, the MTG is enhanced due to much stronger warming in the tropics than in high latitudes.

Which may enhance storm track activity

Multi model ensemble means of change from the historical run.

Location of meteorological stations



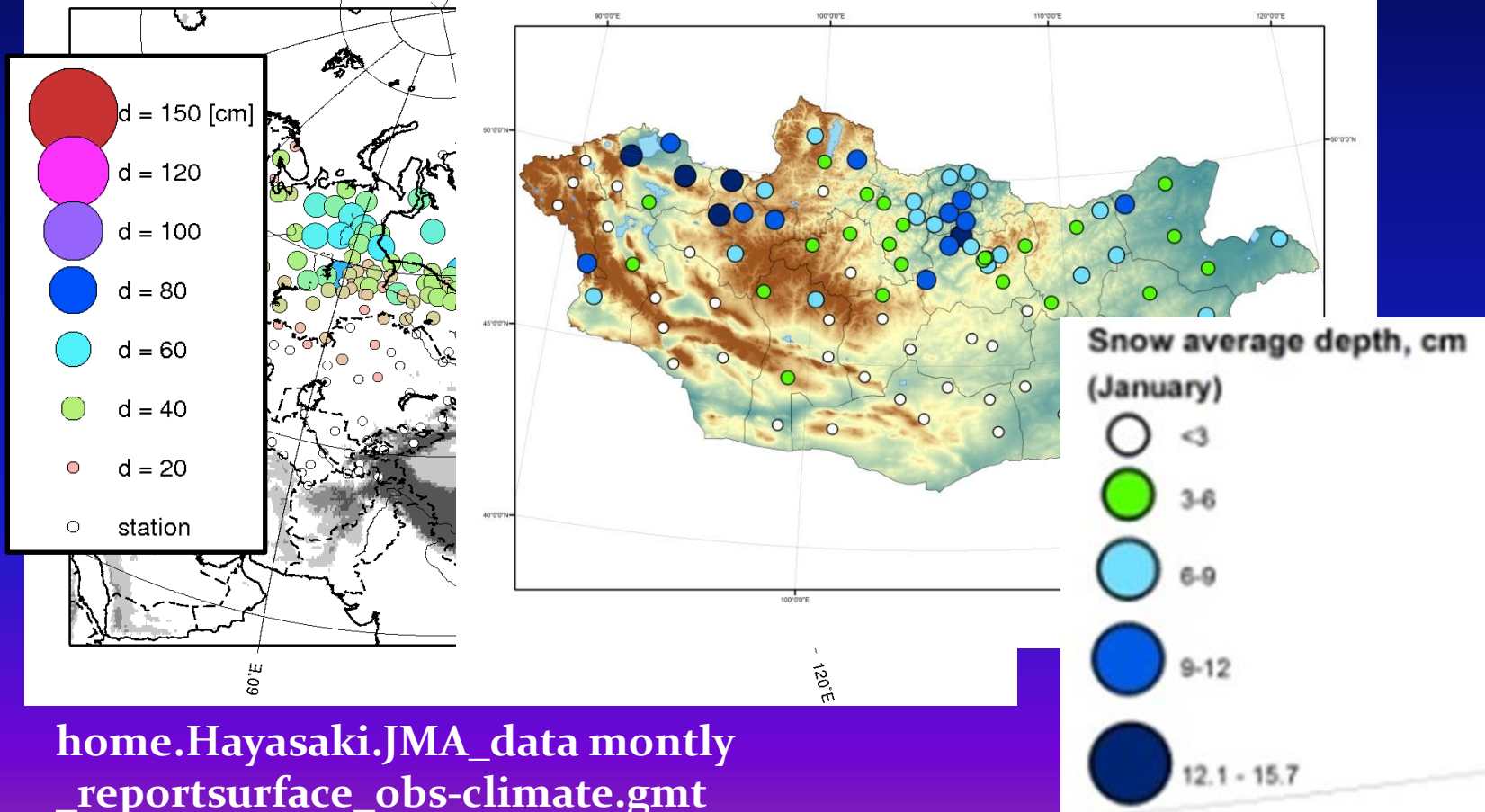
Used 80 meteorological stations: **1969-2012**

Snow depth, Number of snow day and
Surface temperature

Institute of Meteorology and Hydrology (IMH)

Monthly mean snow depth in northern Eurasia, Japan & Mongolia

Monthly climatology of snow depth in Jan (ave)



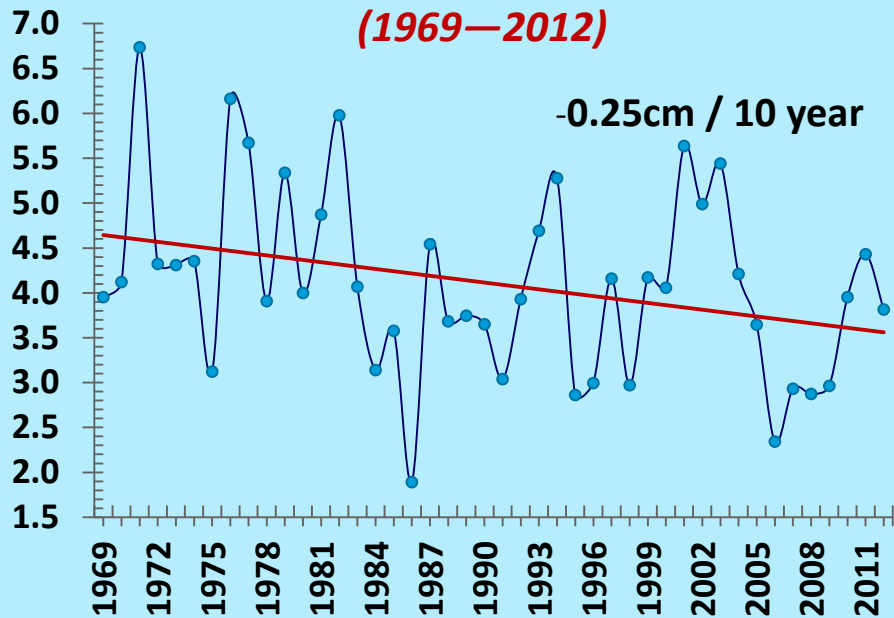
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Anomalies in Northern Hemisphere Snow Cover

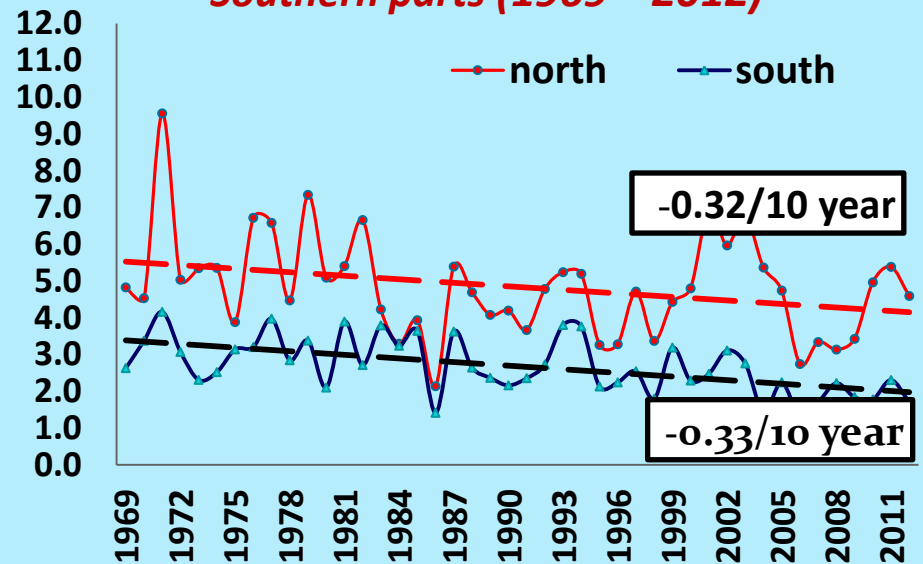
Million square kilometres



Annual snow depth in Mongolia (1969–2012)

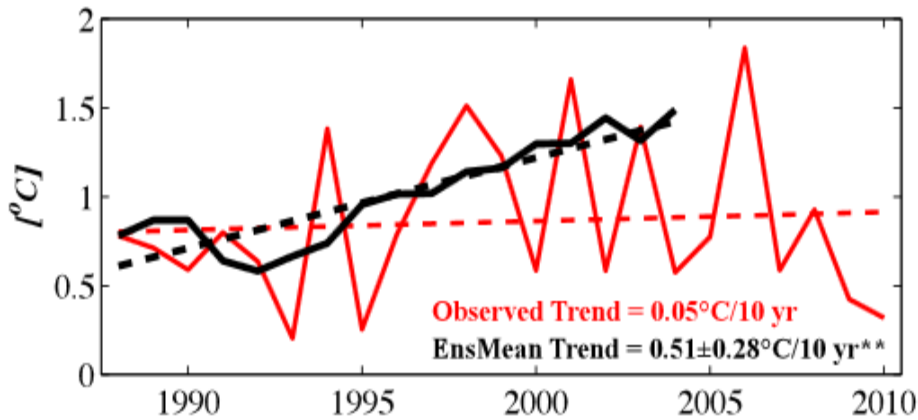


Annual snow depth in Northern and Southern parts (1969–2012)



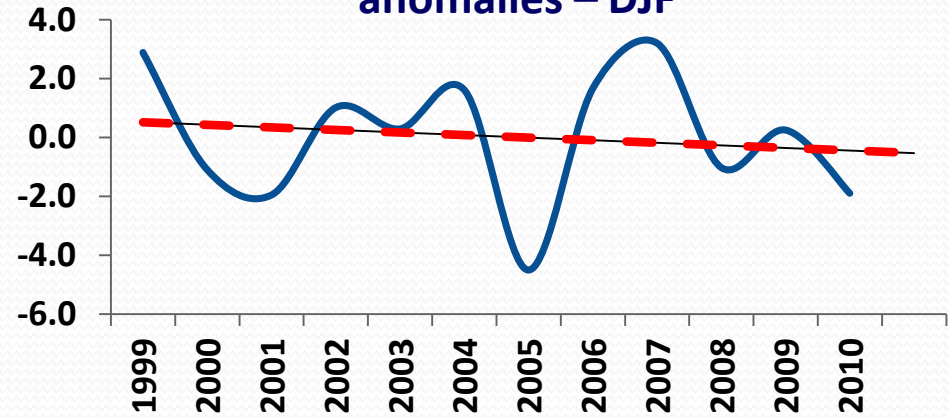
The surface temperature has increased lineally from mid 1960s, while the air temperature in the Stratosphere temperature salient decreasing trend, which is consistent with radiative -convective equilibrium theory.

NH Land temperatures anomalies - DJF



Cohen et al. (2013, Environ. Res. Lett.)

Mongolia Surface temperature anomalies – DJF

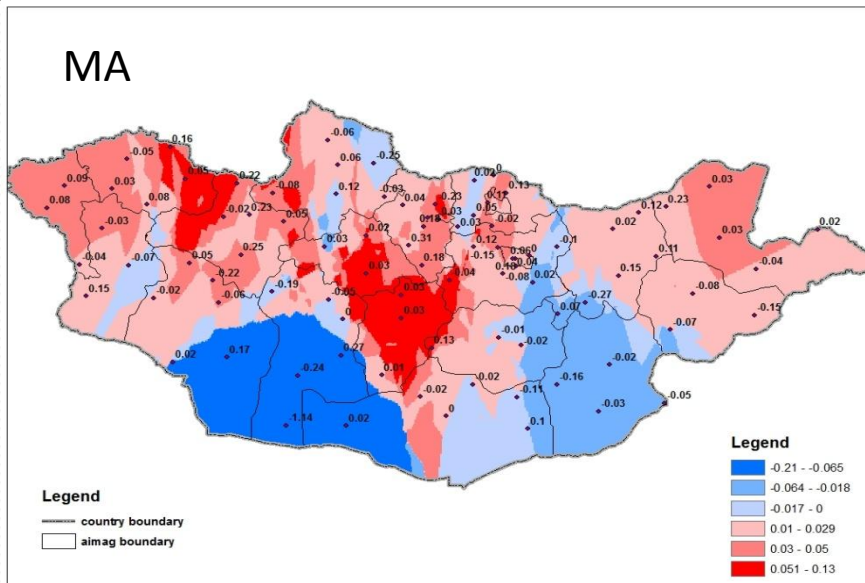
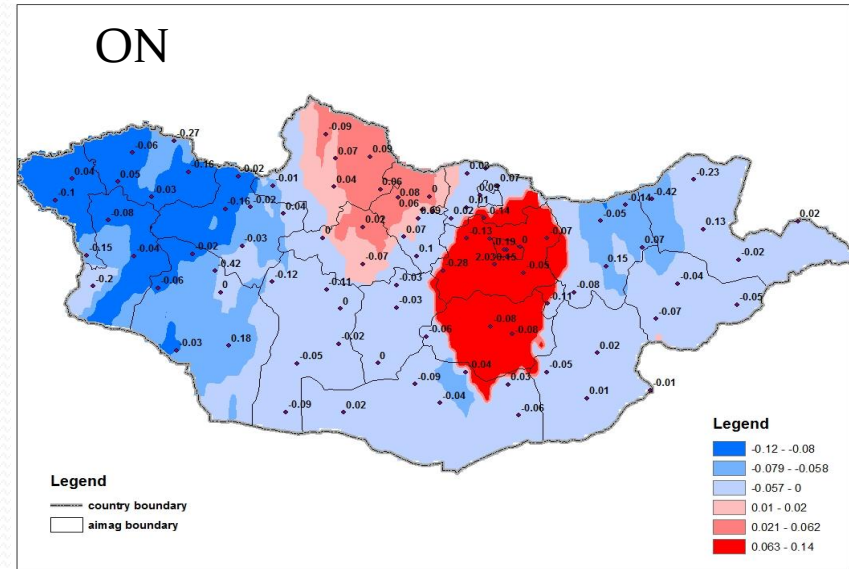
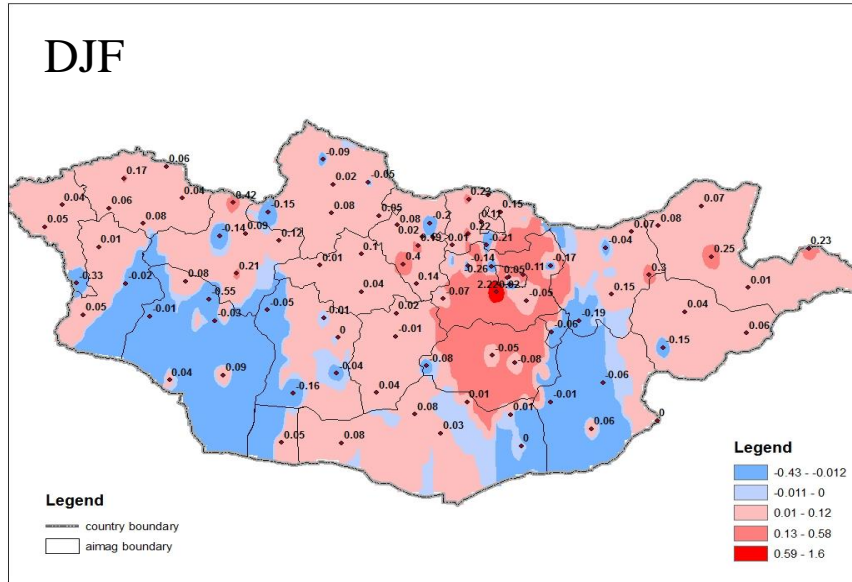


Observed trend:

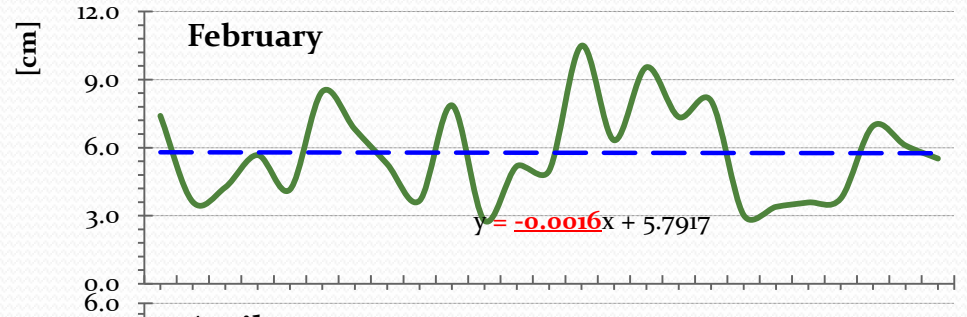
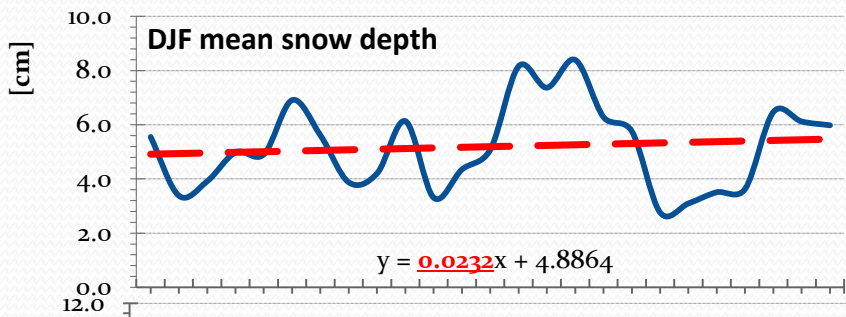
NH = 0.05 °C /10 year

Mongolia = -0.8 °C /10 year

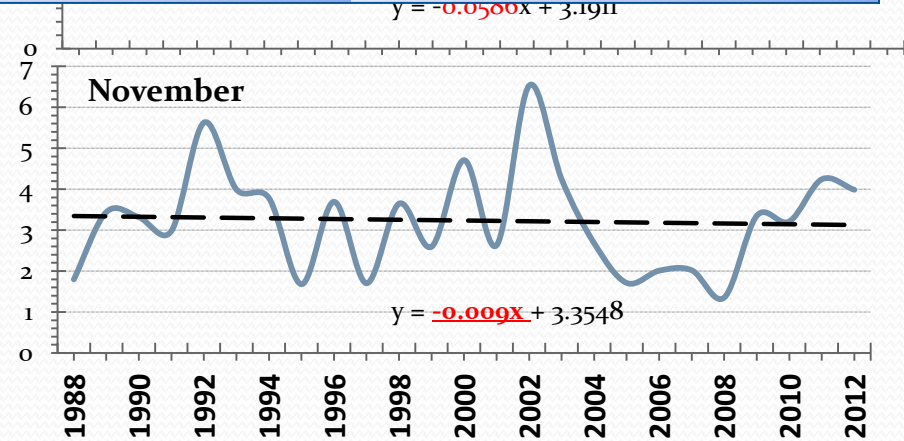
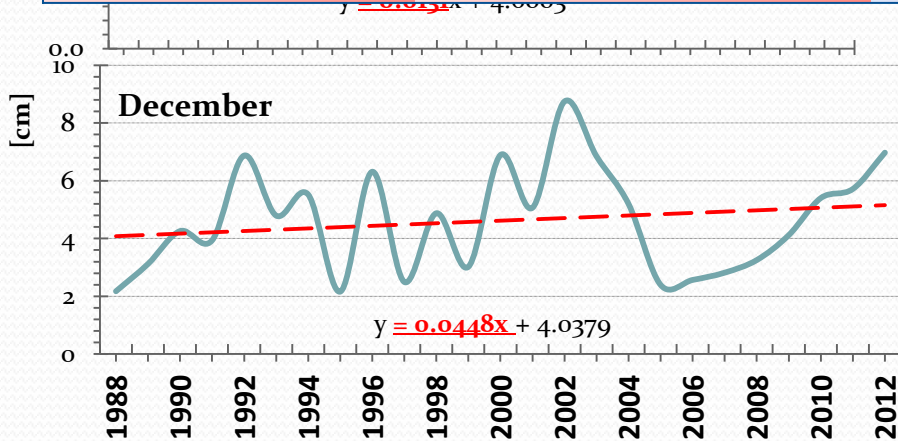
The spatial pattern of linear trends in DJF, ON, MA snow depth (cm/year), 1988-2012



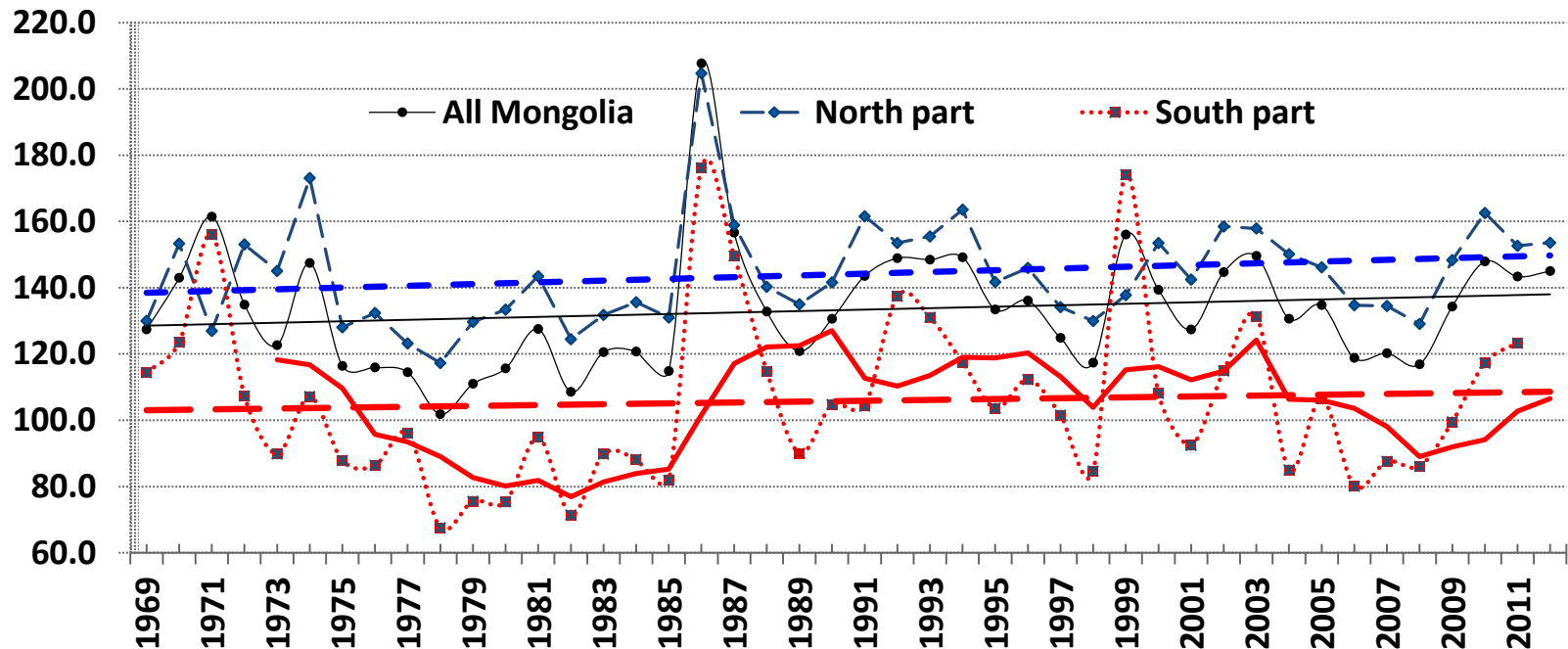
The red (blue) shaded areas indicate positive (negative) coefficient.



Increasing		Decreasing	
DJF	0.2cm/10 year	Annual	-0.05cm/10 year
January	0.1cm/10 year	February	-0.012cm/10 year
March	0.1cm/10 year	April	-0.3cm/10 year
December	0.5cm/10 year	May	-0.4cm/10 year
		October	-0.6cm/10 year
		November	-0.1cm/10 year



Number of day with snow cover in Mongolia



All Mongolia	Northern part	Southern part
+ 2.0 day/10 year	+ 2.6 day/10 year	+ 1.3 day / 10 year

Continental-scale snow cover extent is a potentially sensitive indicator of climate change. **In Mongolia, snow fall process is very closely related with synoptic disturbance embedded in the westerly Jet.** Ueda et al (2003) demonstrated that springtime diminishment of snow is regulated through not only surface temperature but also cyclonic activity relevant to the meridional warm air advection.

1. Evaluate of cyclic activity such as frequency of surface cyclogenesis over the Mongolia
2. Cyclone track
3. Relationship between snowfall variation and cyclones.

Data:

- in situ observation data SLP, AT, ST, WS (1975-2012) at 40 Met Stations
- Reanalyze data JRA55, ERA-40 (1981-2000)
- CMIP5 data (6 hourly)

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Thank you very much for
attention.