Projected changes of hydrological cycle in Northern Eurasia and maritime continent

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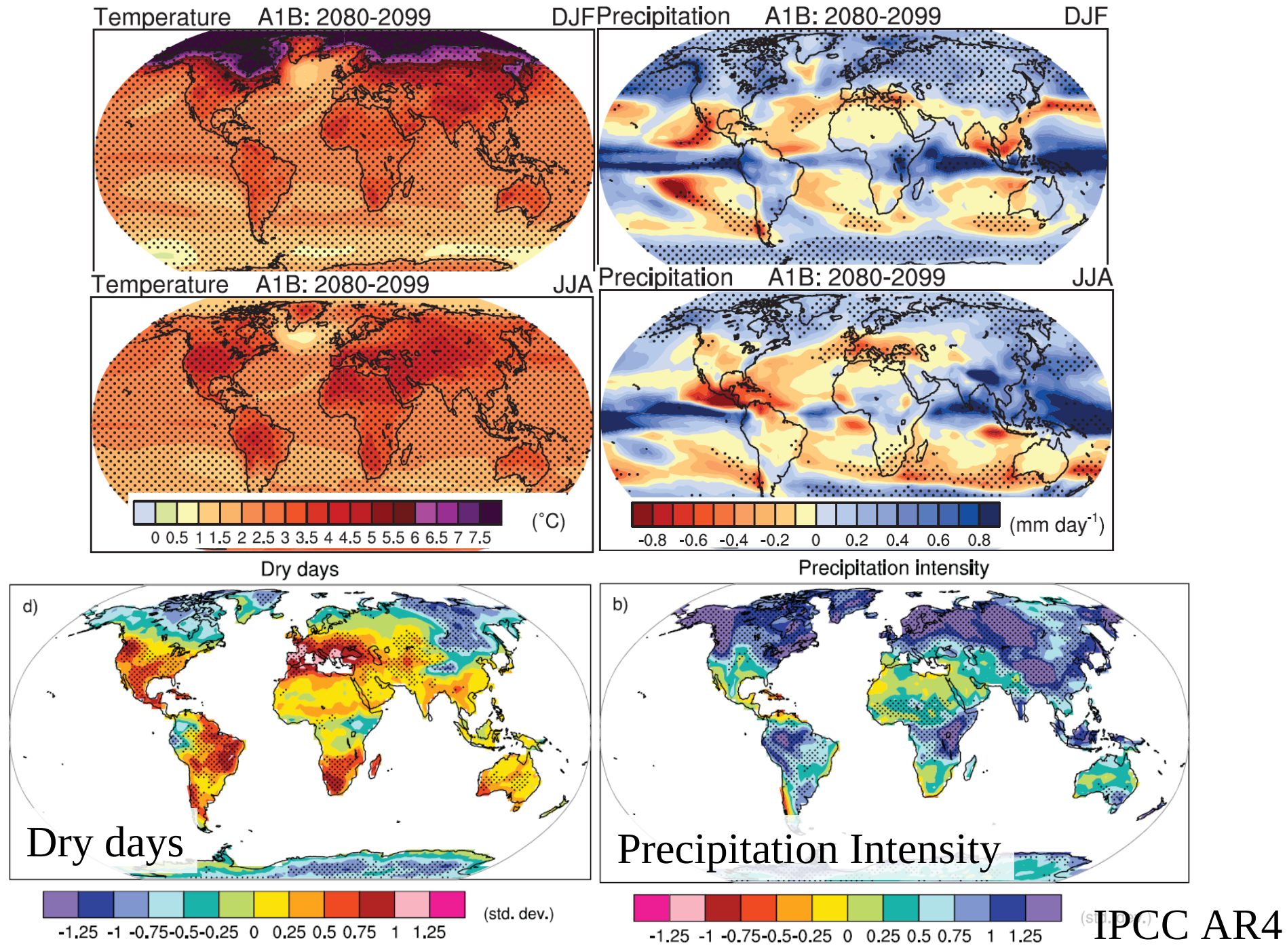
Background

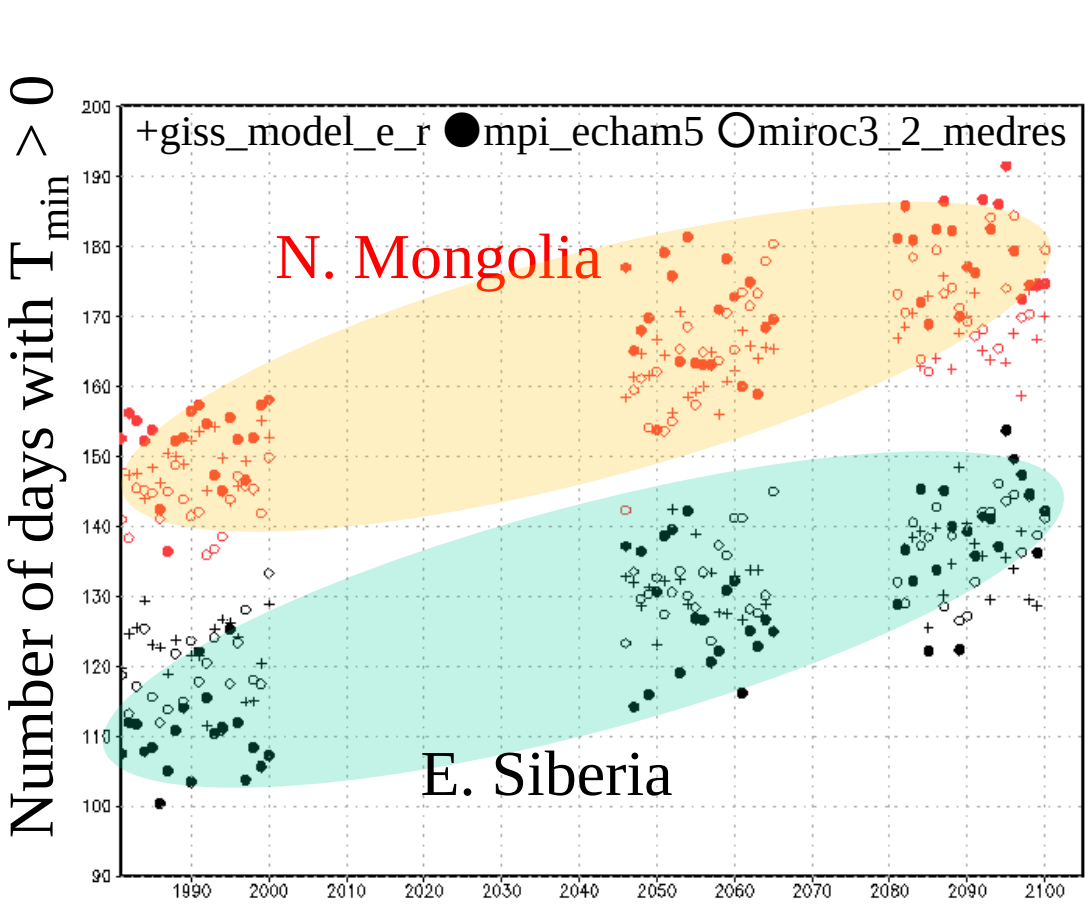
- Global climate simulation is inevitably important.
- We need to know more about the regional issues for adaptation because (1) decision making is required for each nation and (2) impacts are different among regions.

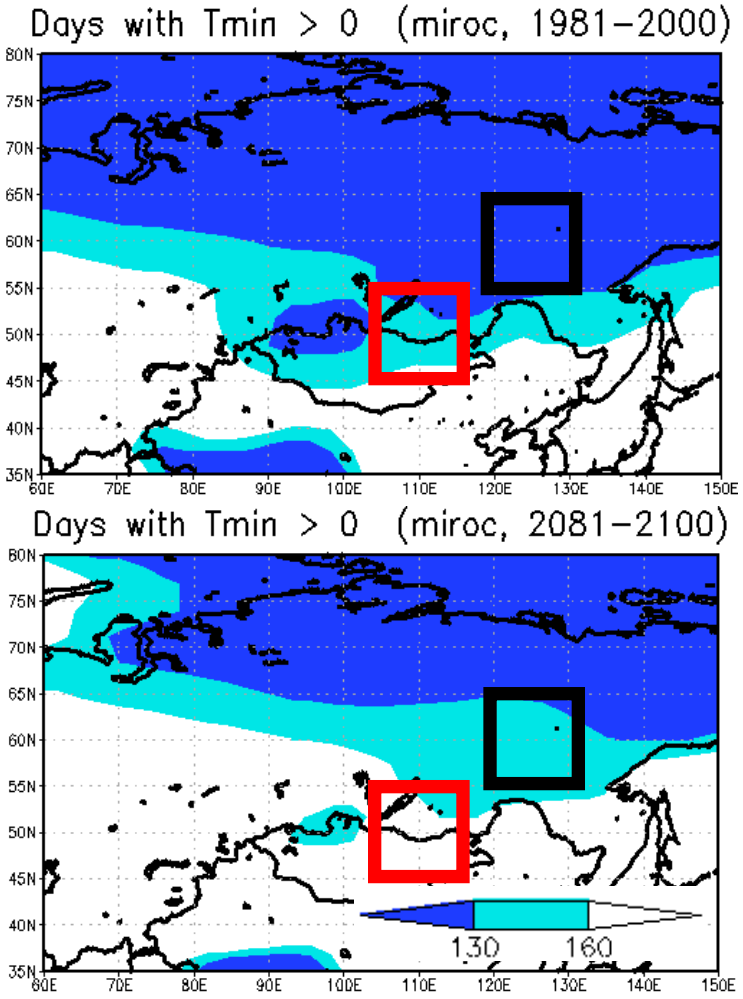
Purpose of this talk

- To address how our key regions are influenced by the global warming in terms of hydrological regime.
- To show how local human activity has potential to influence the regional climate.


Temperature A1B: 2080-2099 DJF
Precipitation A1B: 2080-2099 DJF
Temperature A1B: 2080-2099 JJA
Precipitation A1B: 2080-2099 JJA
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5
(°C)
-0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8
(mm day-1)
Dry days
Precipitation intensity
d)
b)
Dry days
Precipitation Intensity
-1.25 -1 -0.75 -0.5 -0.25 0 0.25 0.5 0.75 1 1.25
(std. dev.)
IPCC AR4

Northern Eurasia: Siberia & Mongolia

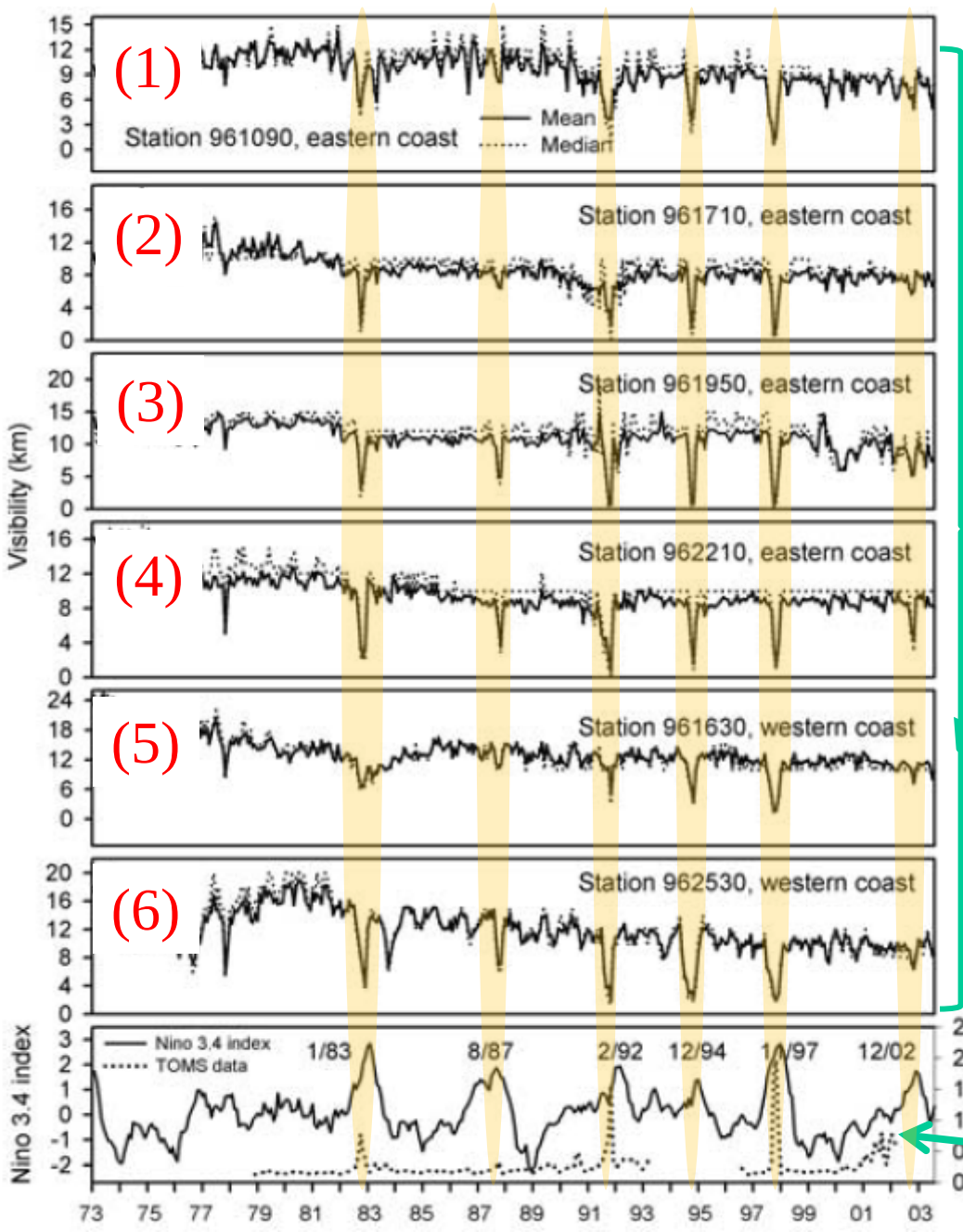




- Present Mongolia is an image of future Siberia?

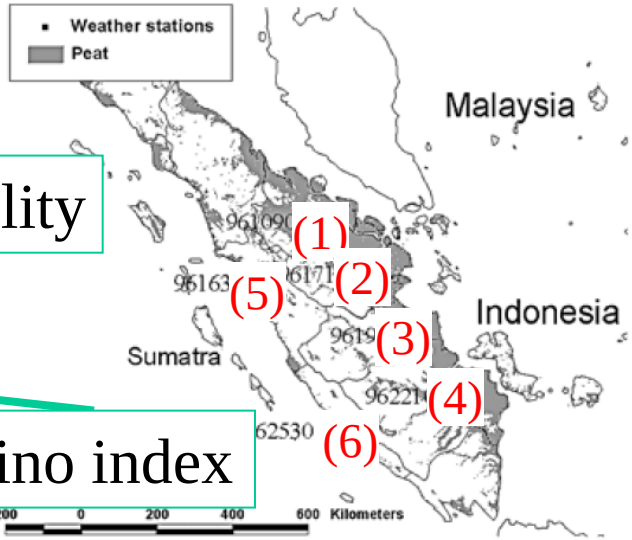
Indonesia

- Interannual variation of Precip&fire is strongly affected by ENSO.
- Shift of ElNino-like SST pattern (more warming in central and east Pacific than in the west). However, significant changes in dry spell does not detected.
- Human activity also enhances the peat land fire (Field, et al., 2009)



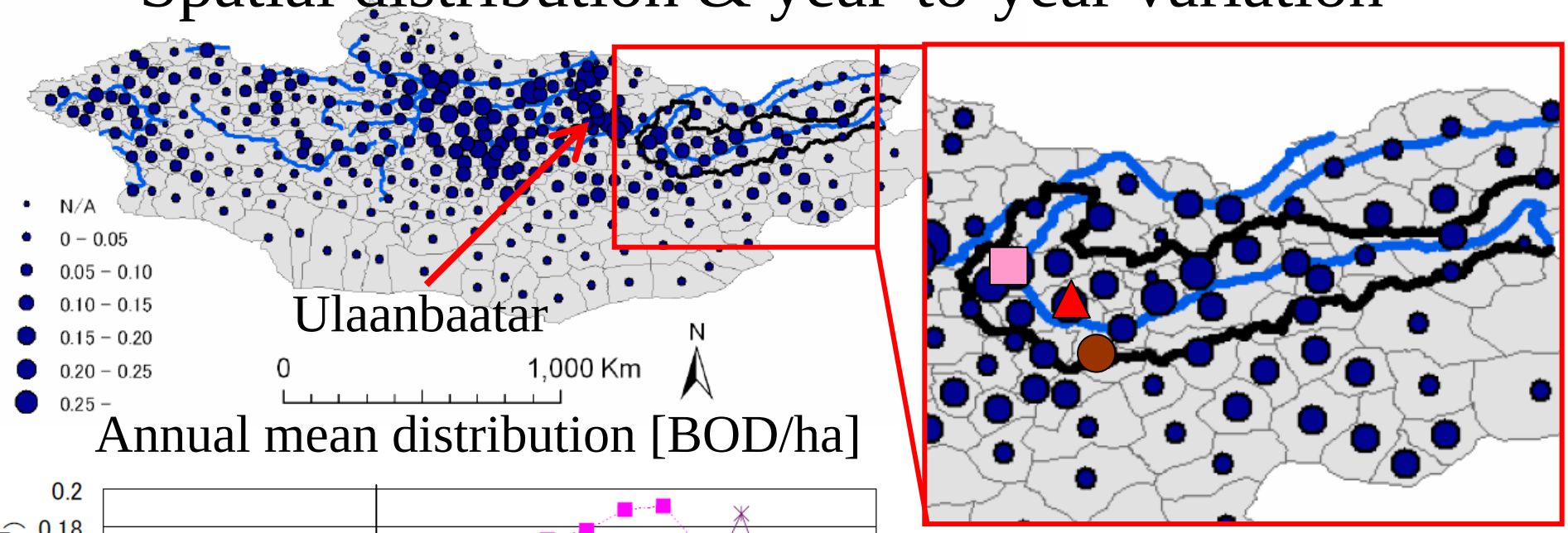
Visibility

El Nino index

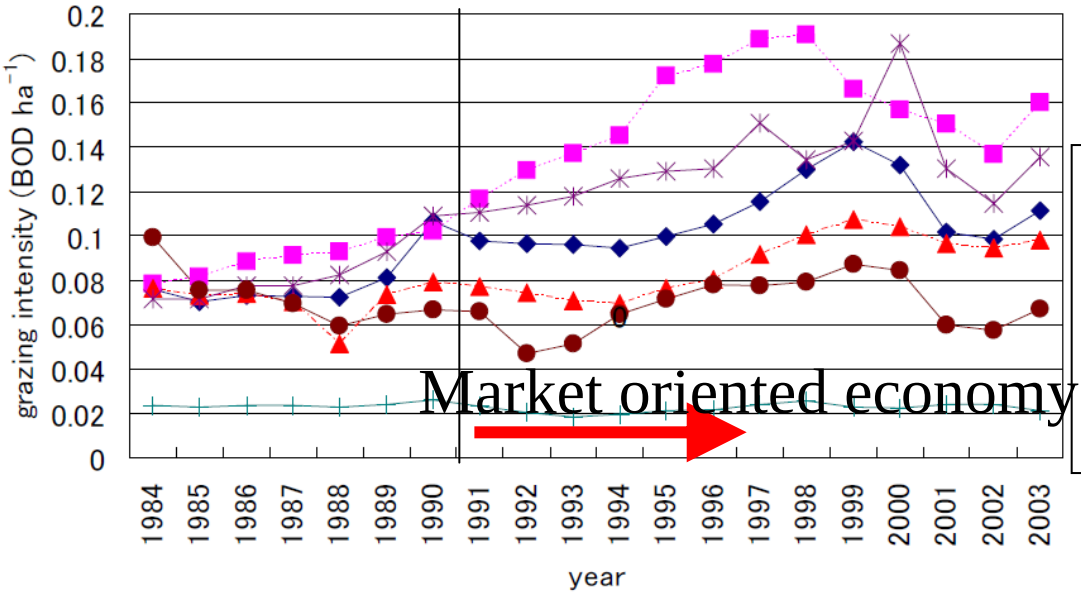


Sumatra: Wang et al. (2004)

Grazing pressure
Spatial distribution & year-to-year variation



Annual mean distribution [BOD/ha]



- Concentrates around big city & surroundings.
- Increase after the change of political system in Mongolia.

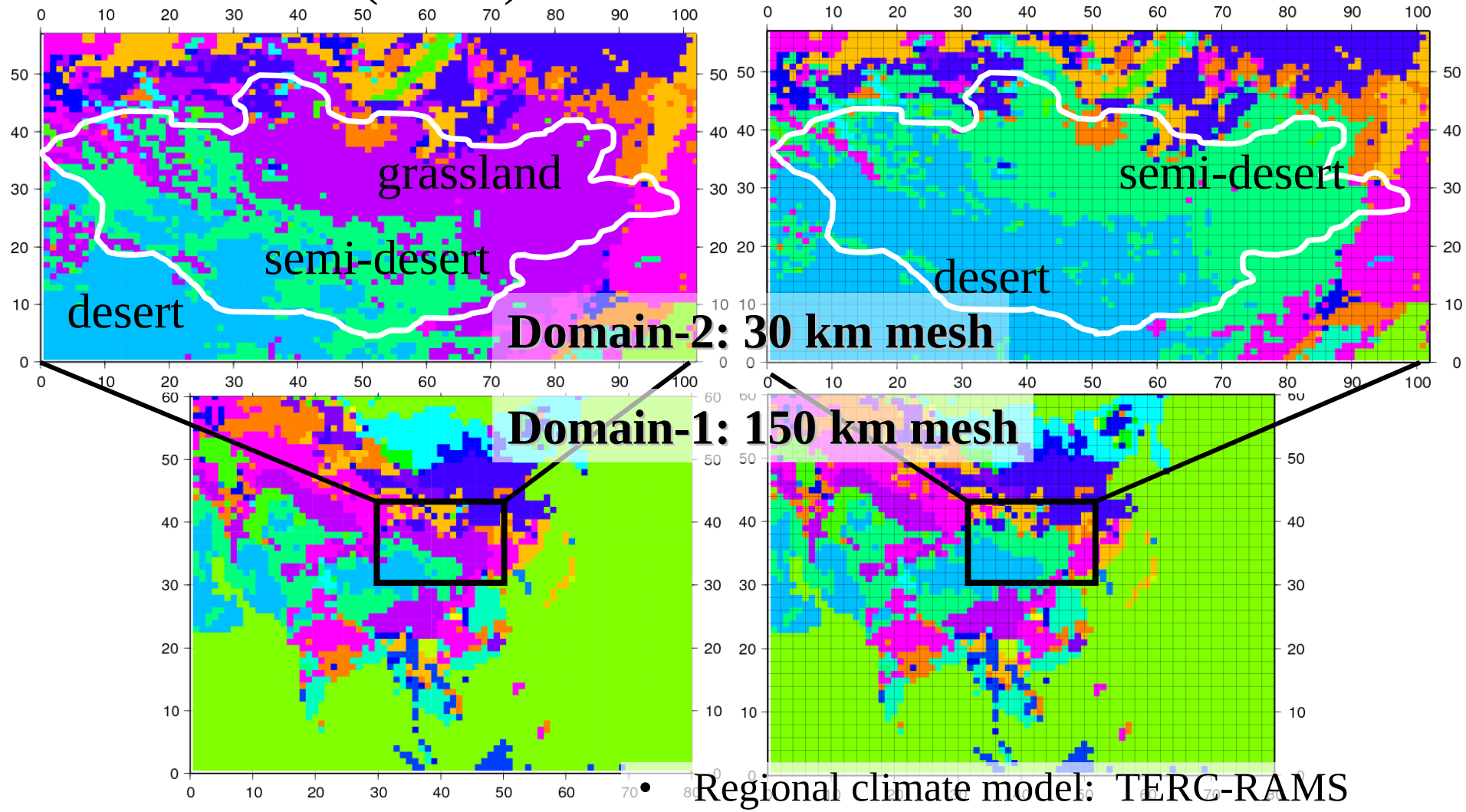
Interannual variation at selected city/village.

(Sugita et al. 2007)

LC change scenario

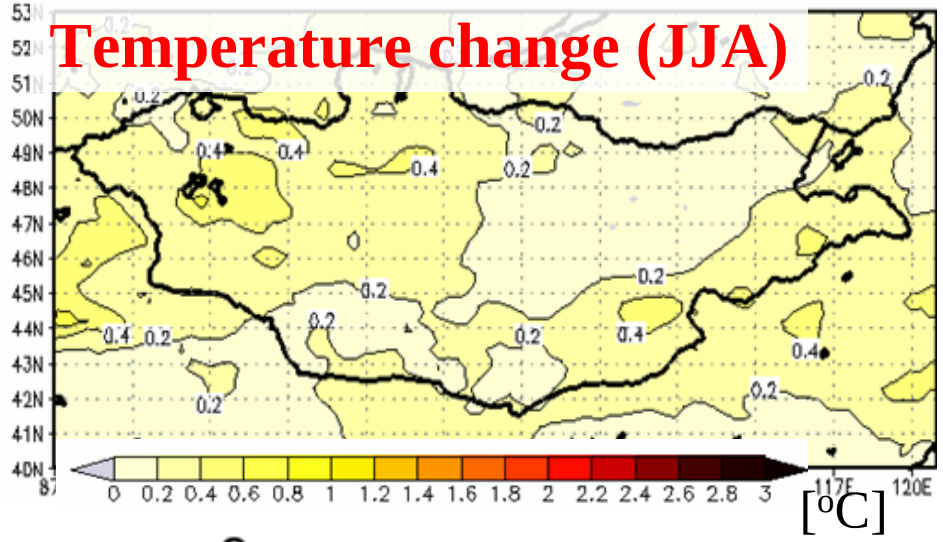
Present LC run (USGS)

Desertification run

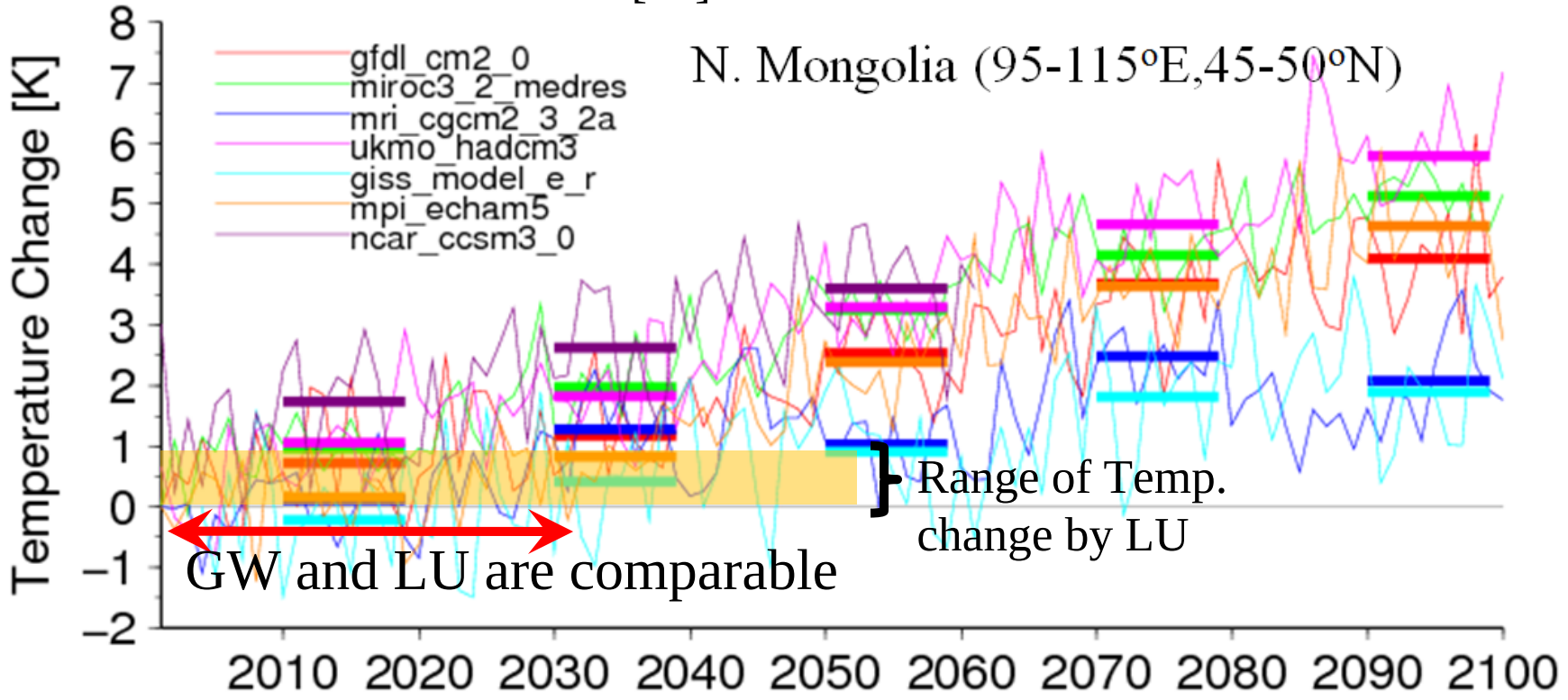


- Regional climate model: TERC-RAMS
  Domain(1) 150 km mesh, 80 x 60, 30 layers
  Domain(2) 30 km mesh, 102 x 57
- Nudged to NCEP-NCAR reanalysis

Impact of LULC change on warm season temperature

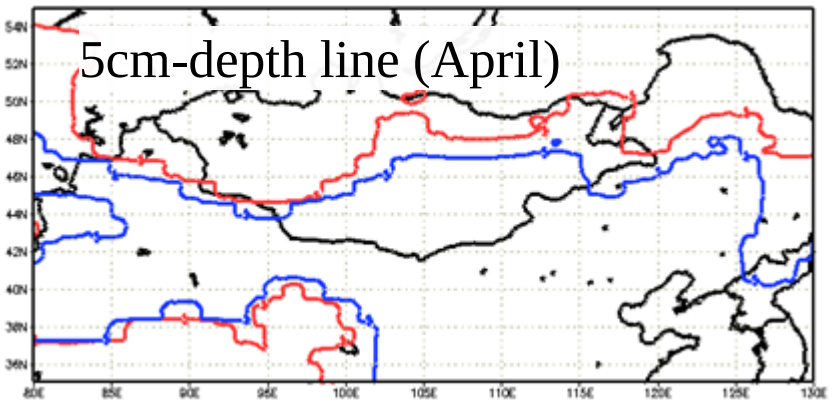


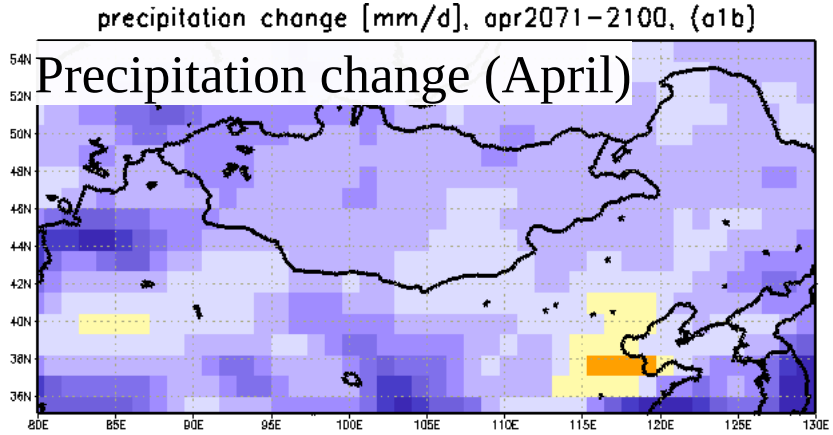
- Both GW and LC forcing increase mean temperature.
- Temperature increment exceeds 2 ºC due to global warming while less than 1 ºC by LC change.
- LC change is not primary cause of rapid warming.

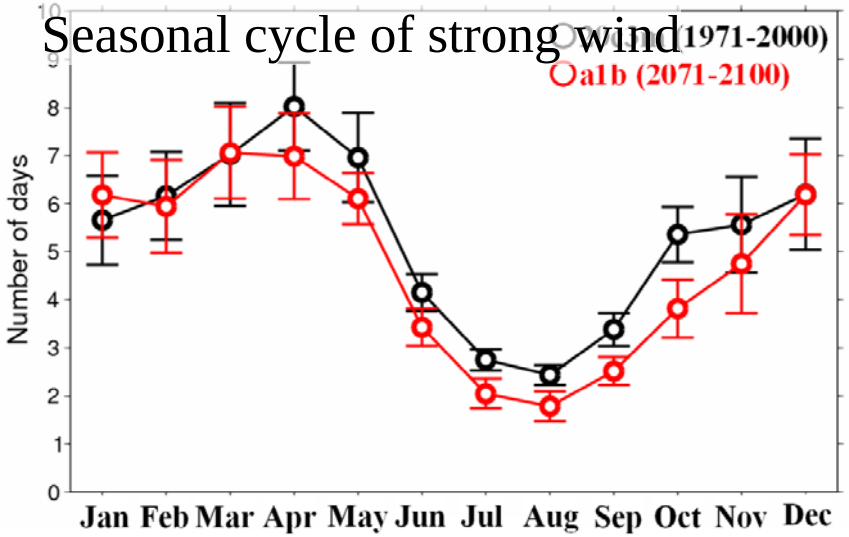


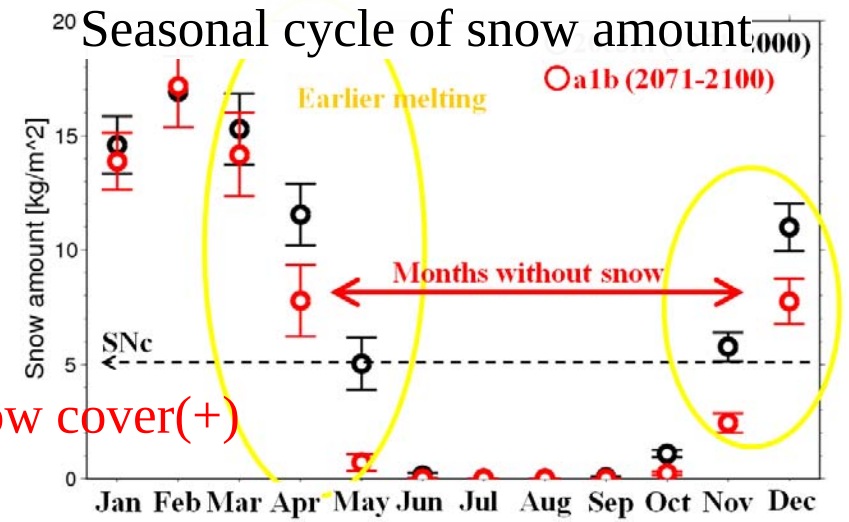
Global warming and mineral dust emission

- Characteristic arid region with snow cover during spring -







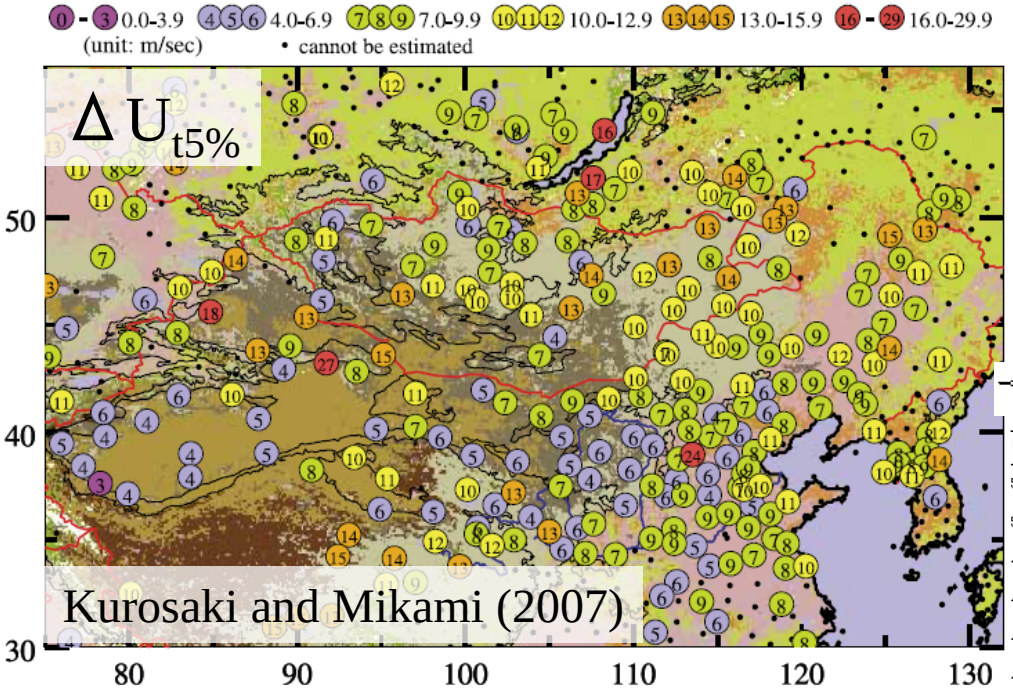


Warming in NE Asia causes

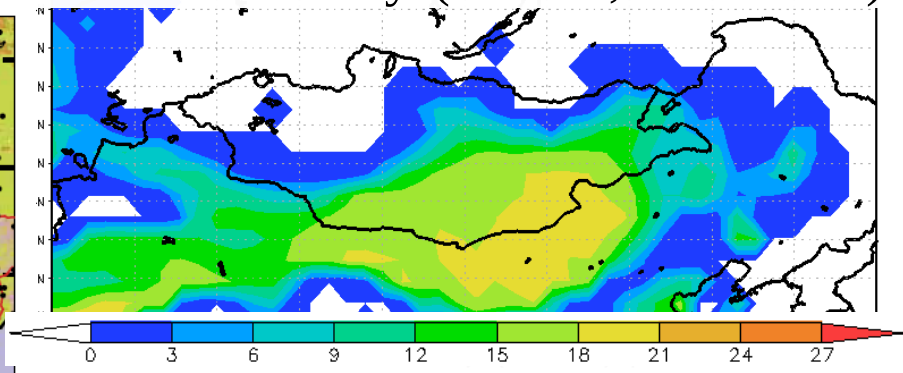
- Earlier melting of snow(+), decreasing snow cover(+)
- Reducing strong wind events(-)
- Precipitation increases (-)
- Changes in potential source area by LULC change (+/-)

Then, how does dust emission event change?

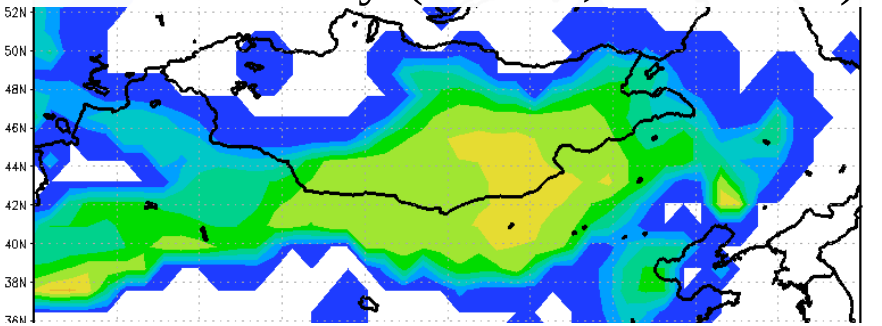
Sensitivity of dust storm on GW and LC change



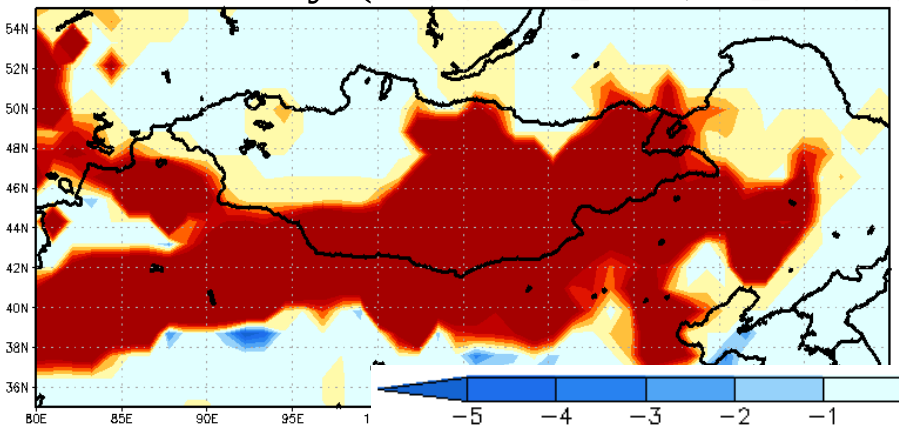
Potential dust days(Uc=6.5, 1971-2000)



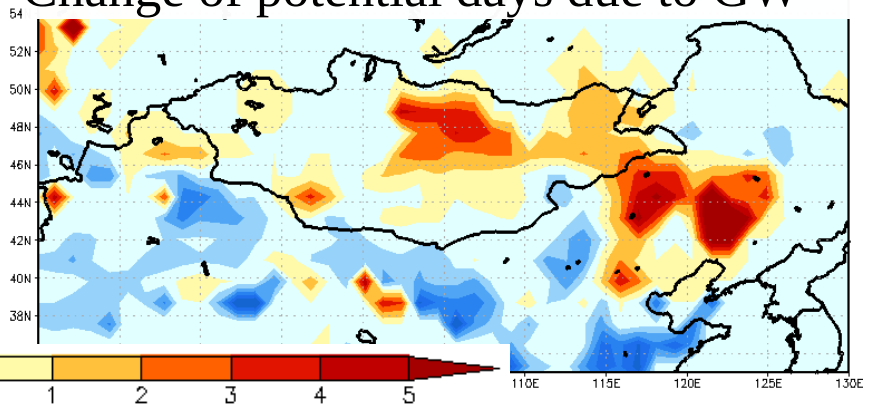
Potential dust days(Uc=6.5, 2071-2100)



Potential dust days(Uc=6.5 => 4.3, with GW)



Change of potential days due to GW



Land cover change is about to have significant influence on dust storm

Summary

- Mean precipitation is projected to increase in Siberia and Mongolia while uncertainty remains for Indonesia.
- Land use/Land cover change do have capacity to alter local temperature and mineral dust events.
- Quantitative comparison of local human activity and global warming is possible.