The CEOP-HE Scientific Rationale and Regional Water and Energy Cycle (WEC) Research

- Prospects by Himalayas/Tibet studies -

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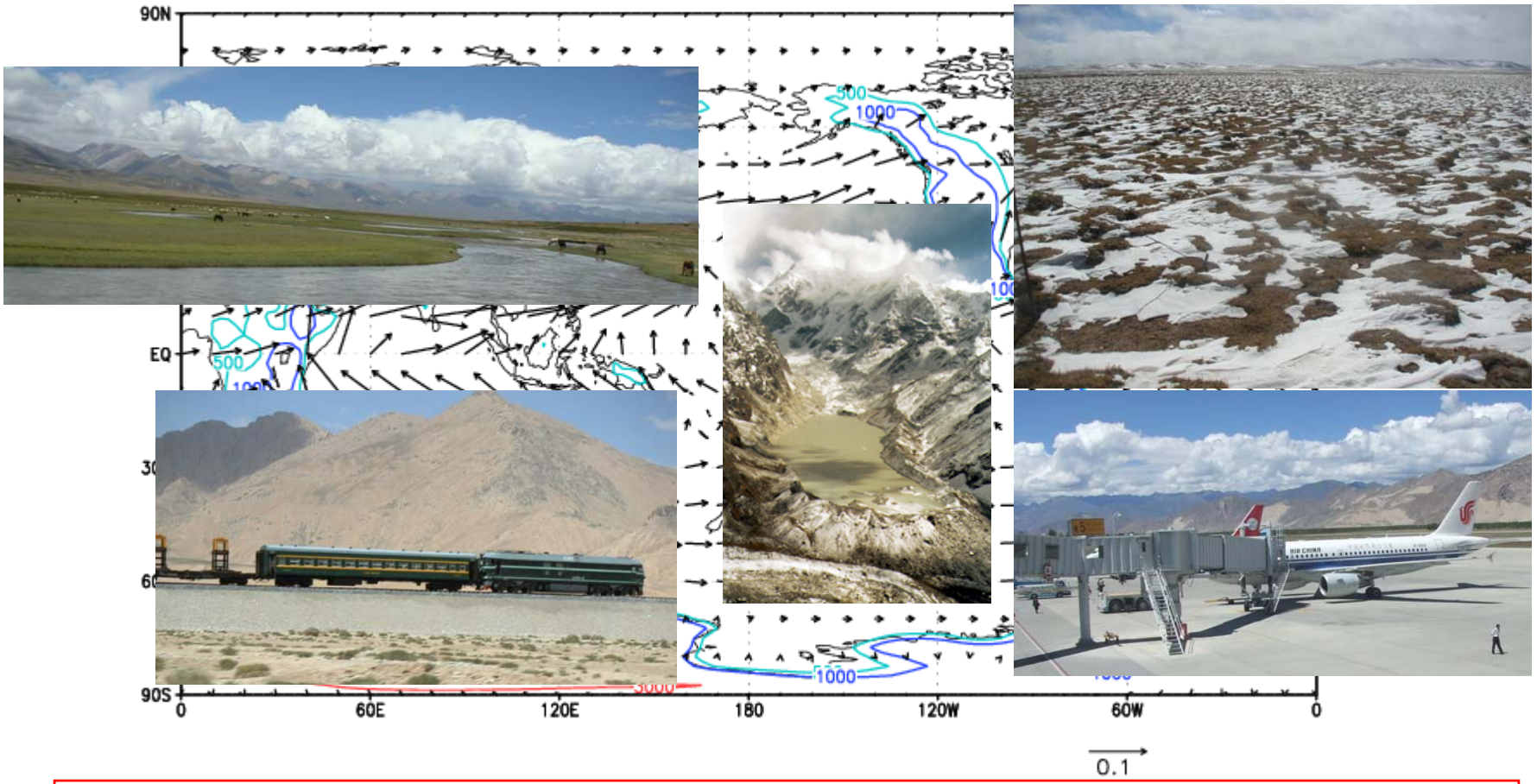
Sub-continental scale mountain ranges distribute in different climate zones, and strongly affecting the regional WEC system trough thermo-dynamical functions.



High-elevations are composed with various surface conditions, and their recent environments are changing rapidly.

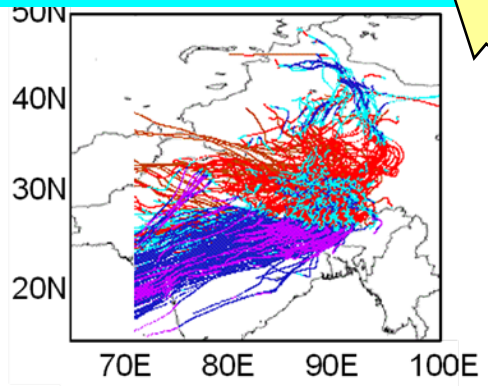
Mountain ranges as driving function of WEC

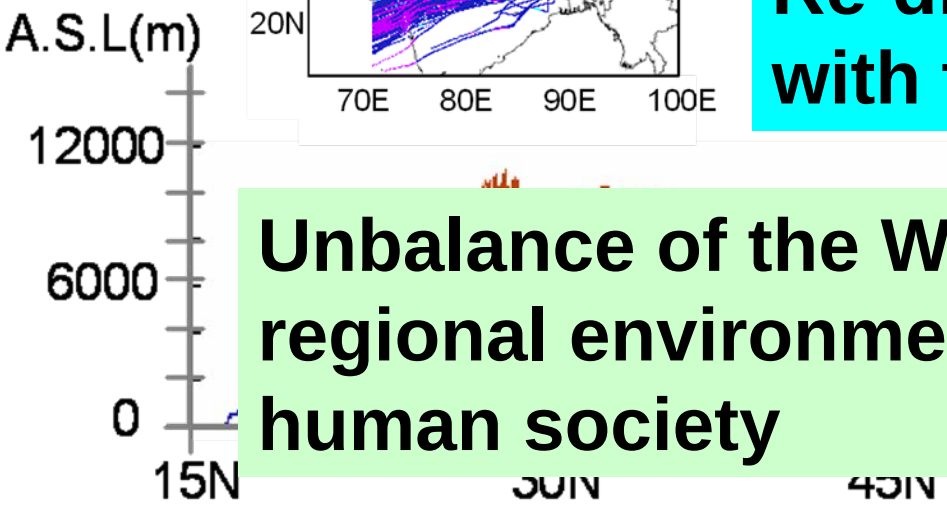
Pump up the WV
Releasing heat in the atm.

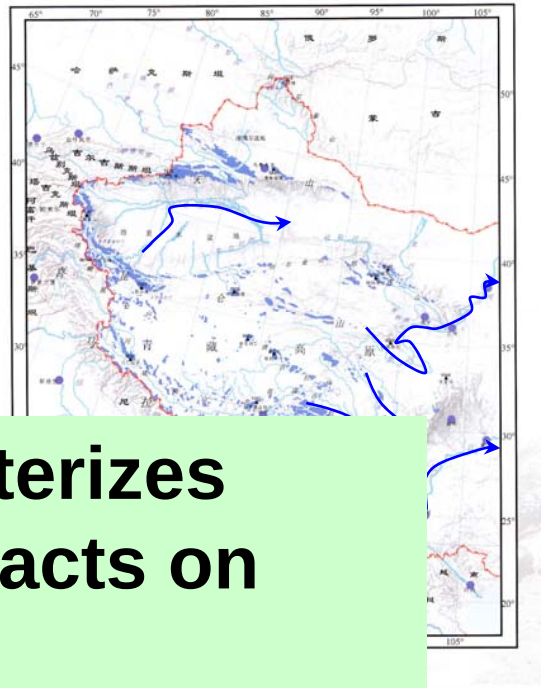
Keep water as glacier/s.c.
Drain as surface water

Re-distribution with time-lag

Back trajectory analysis by Sugimoto et al. (2007)







Glacier and river map by ITP

Unbalance of the WEC characterizes regional environment and impacts on human society

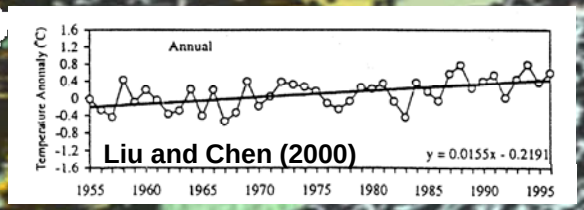
<Water vapor transportation>
Relatively quick motion (hourly-daily)
Low to high elevations
Temperature dependency

<Surface water runoff>
Relatively slow motion (daily-monthly)
High to low elevations
Topography dependency

Recent concerning of environment changes and problems, examples in Tibet/Himalayas

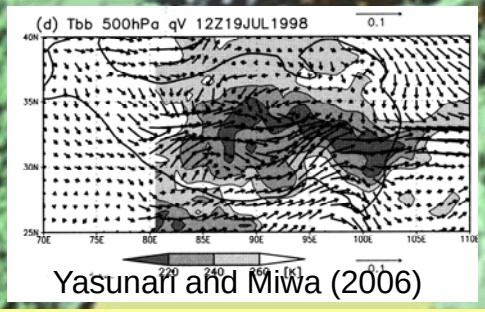
Water deficient in the semi-arid areas

Advanced warming in the Tibet



Liu and Chen (2000)

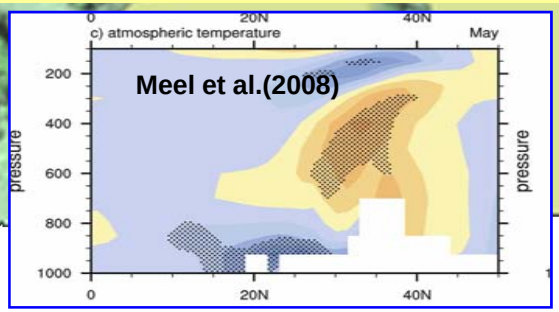
GLOF problem in Himalayas



Yasunari and Miwa (2006)

Extreme rains and flooding

Aerosol/pollutants transportation

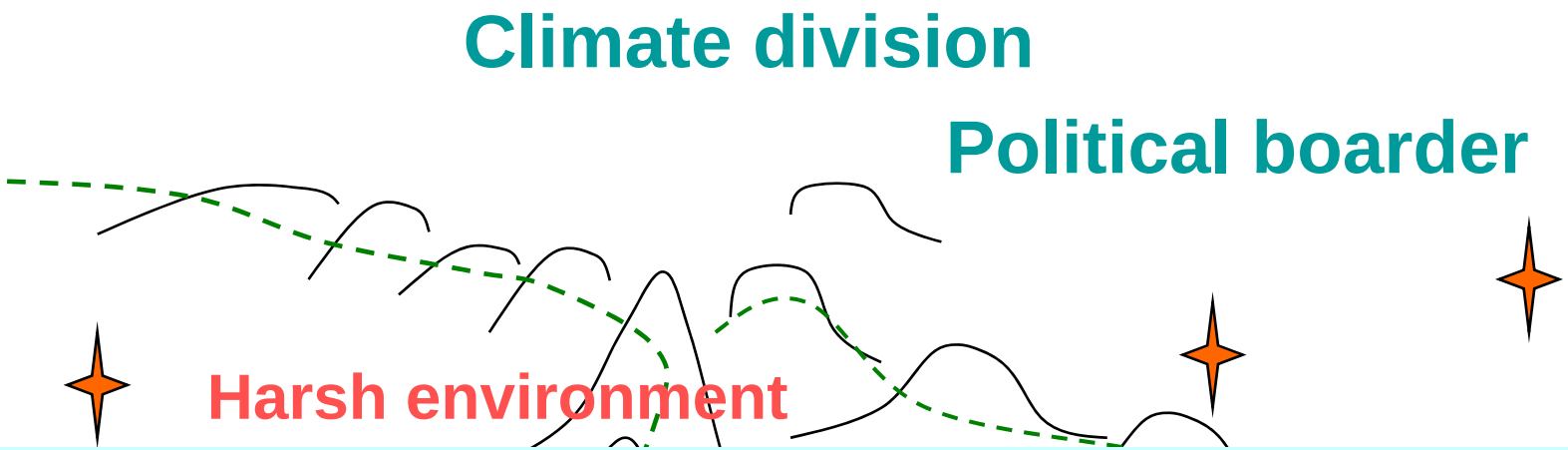


Meel et al.(2008)

10 20 30 40 50

70 80 90 100 130

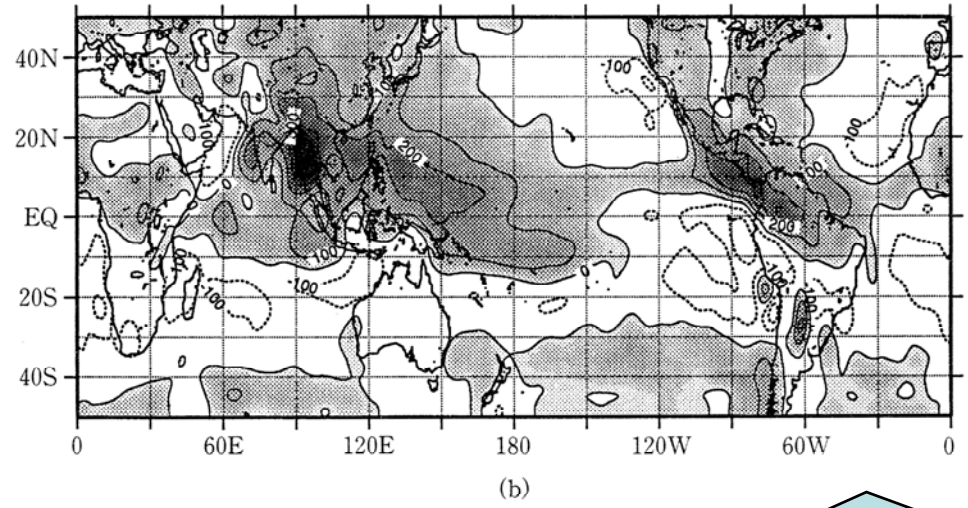
Let's think about the location of HE/ Mountain ranges

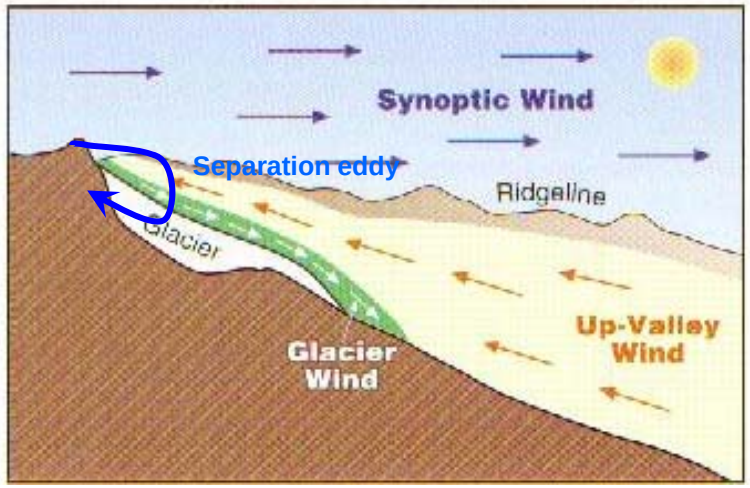


Beside, the **WEC** study is not limited by the elevation or certain region, that **is borderless**, and their complex and heterogeneous behaviors meets to be studies under the **international framework**, such as GEWEX/CEOP component. And that is CEOP-HE, with supports of **remote-sensing technique and model evaluation**.

CEOP-HE should play as a key node observing mountains in GEOSS.

How to overcome the gap of understanding between continental scale WEC and basin scale WEC over the complex terrain ?





↔ 3000 km

↔ 10 km

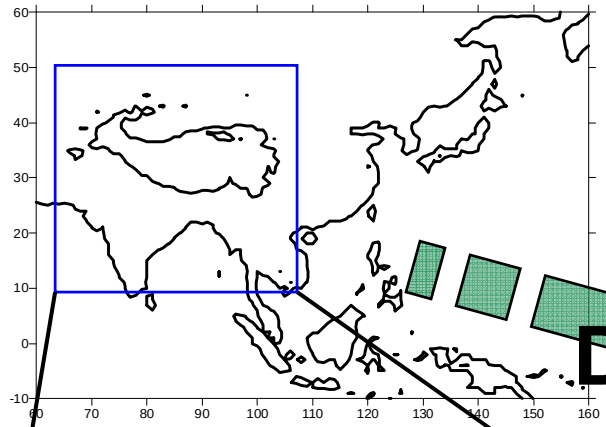
Eg. Sub-continental scale monsoon system

Eg. Meso-scale local circulations

Monsoon and adiabatic heating (Yanai and Tomita, 1998)

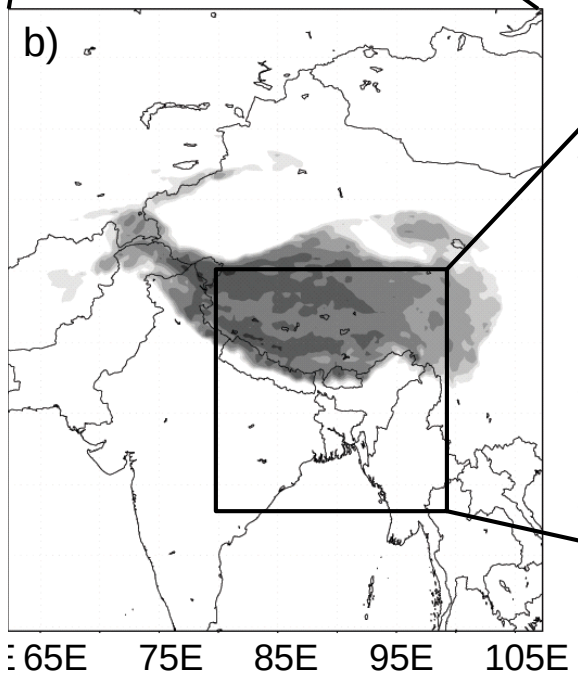
Mountain circulation and Glacier (Adapted from Geiger et al., 1995, From Whiteman, 2000)

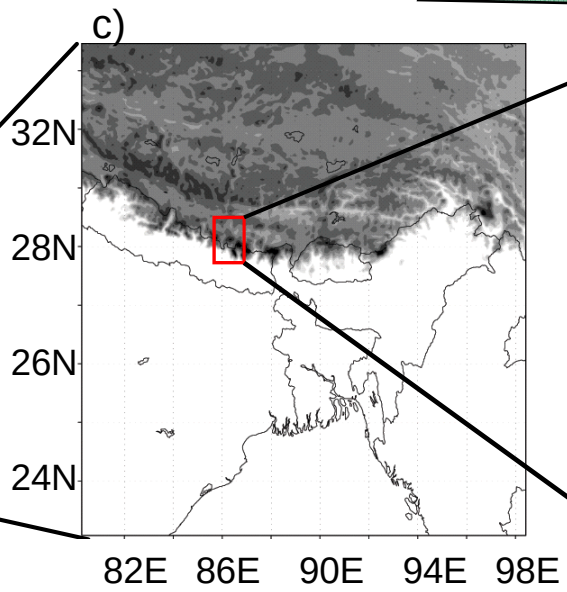
Recognition of two directions in the WEC studies

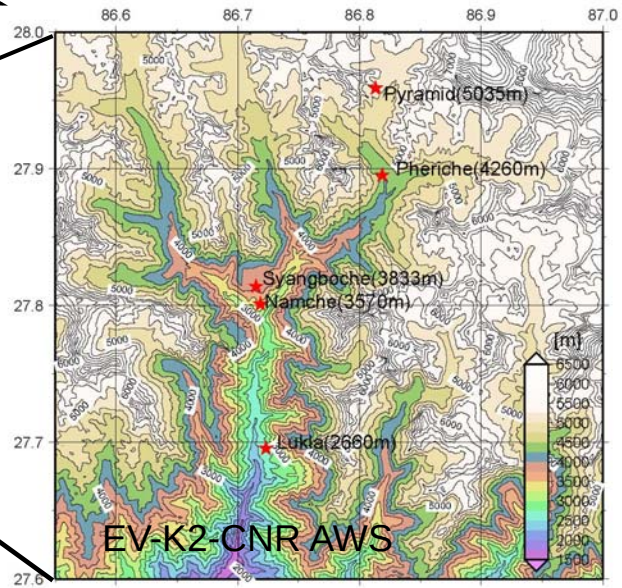


Up-scaling

Down-scaling

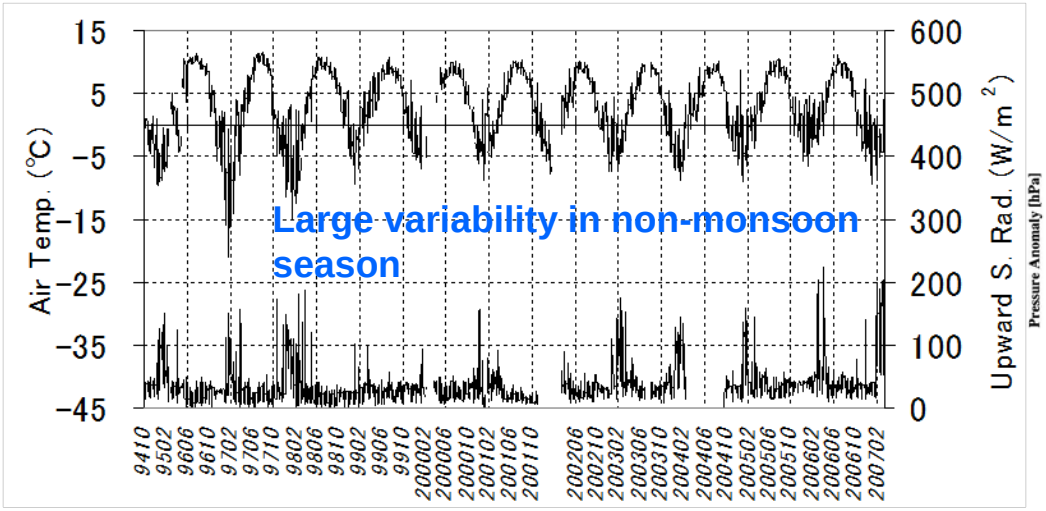


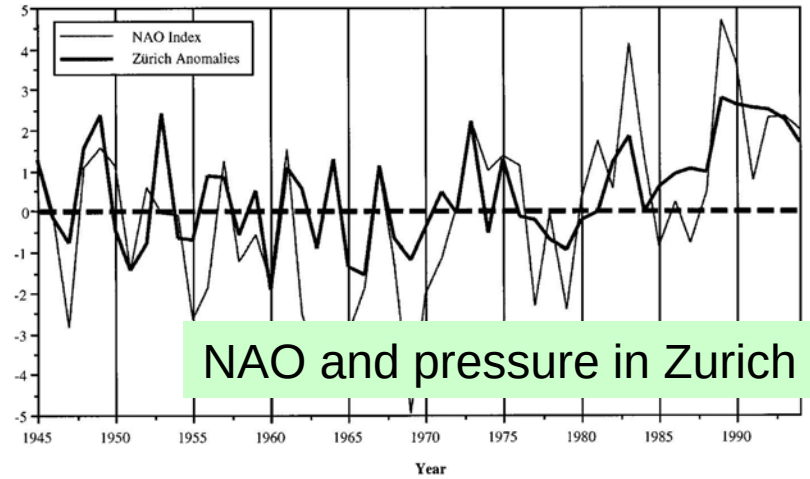




10 km

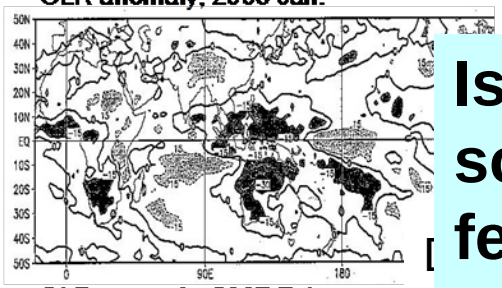
Example 1
Impact under large scale teleconnection

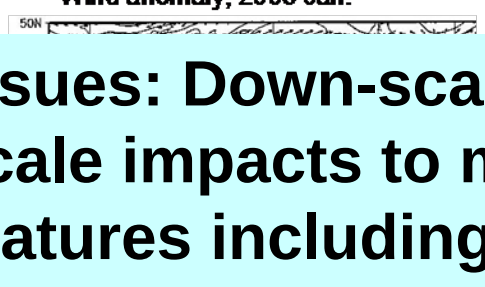


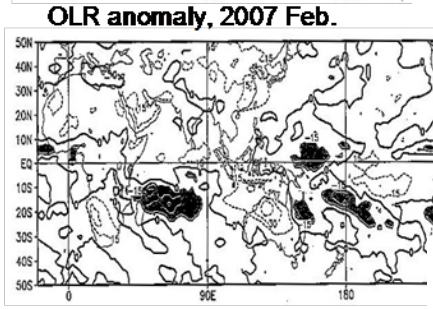


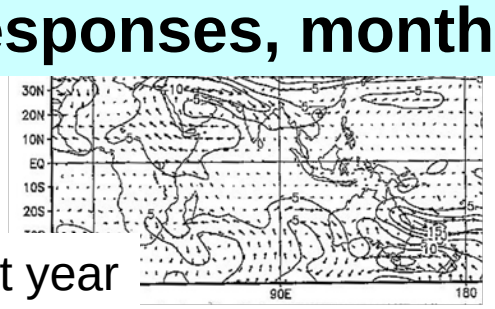
NAO and pressure in Zurich

(Beniston, 1996)



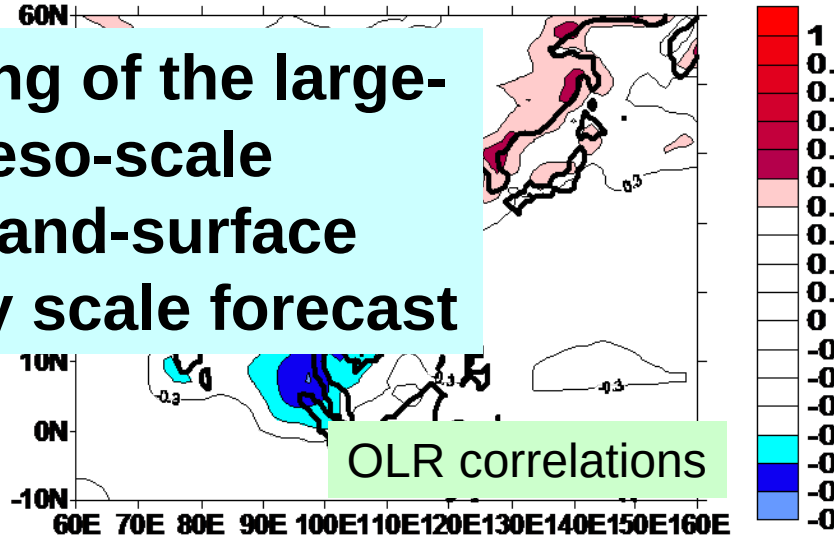






Wet year

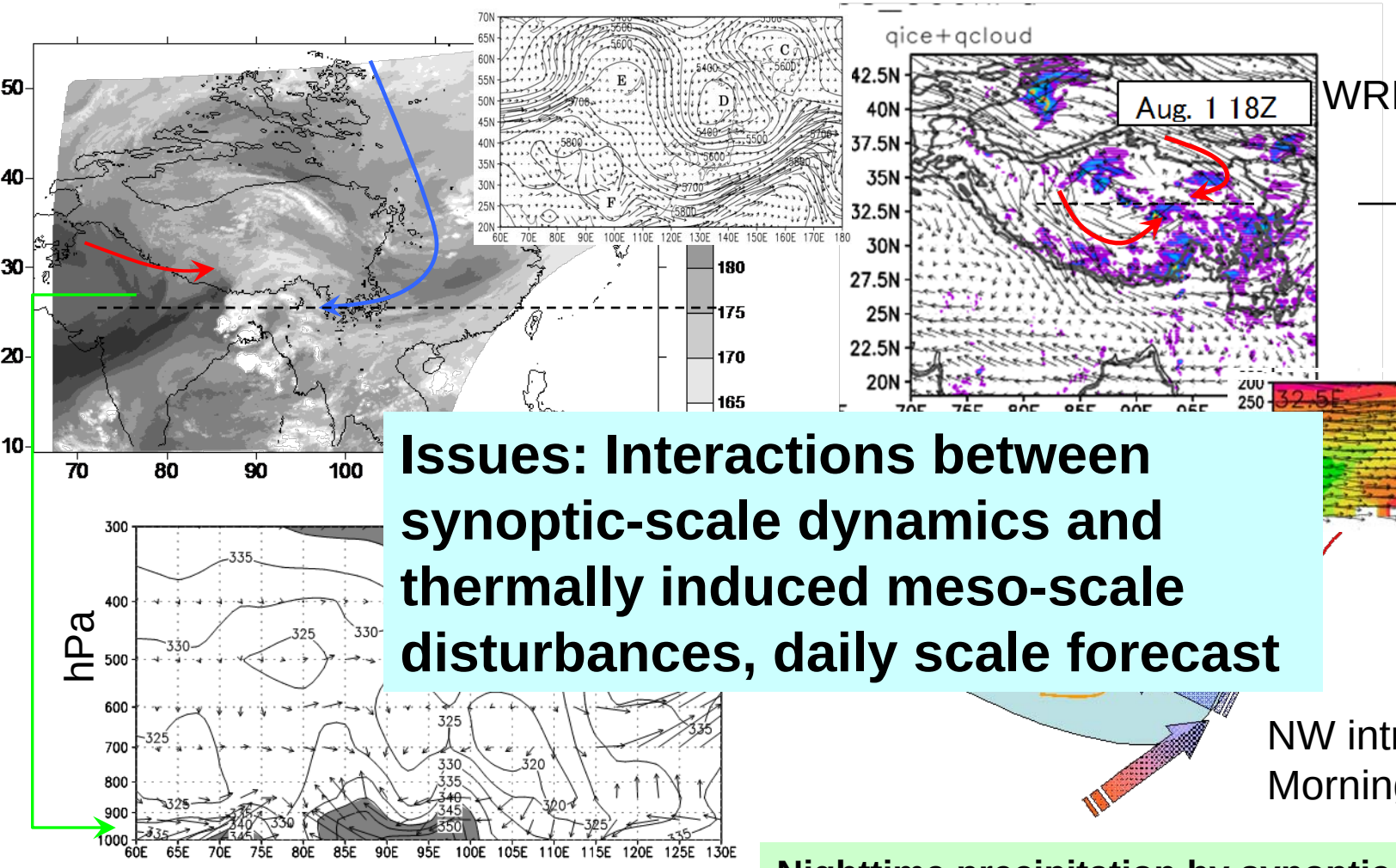
Issues: Down-scaling of the large-scale impacts to meso-scale features including land-surface responses, monthly scale forecast



OLR correlations

(Ueno and Aryal, JGR, 2008)

Example 2
Dynamic effects of massif topography to change the synoptic flow pattern



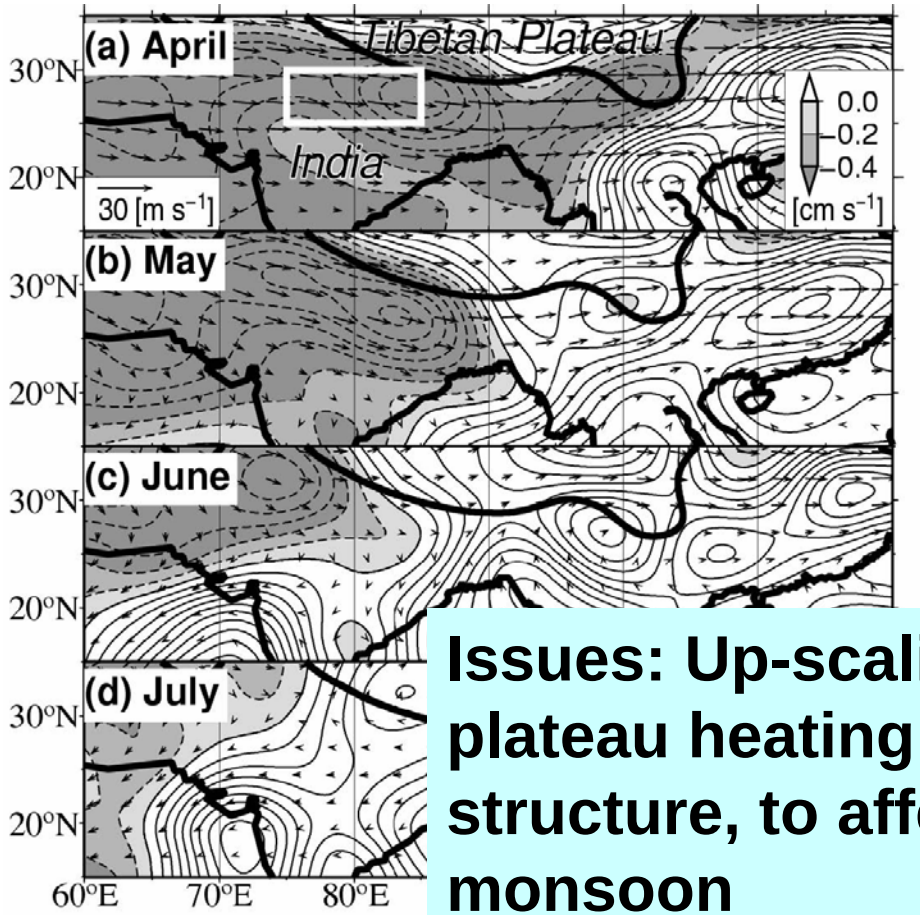
Issues: Interactions between synoptic-scale dynamics and thermally induced meso-scale disturbances, daily scale forecast

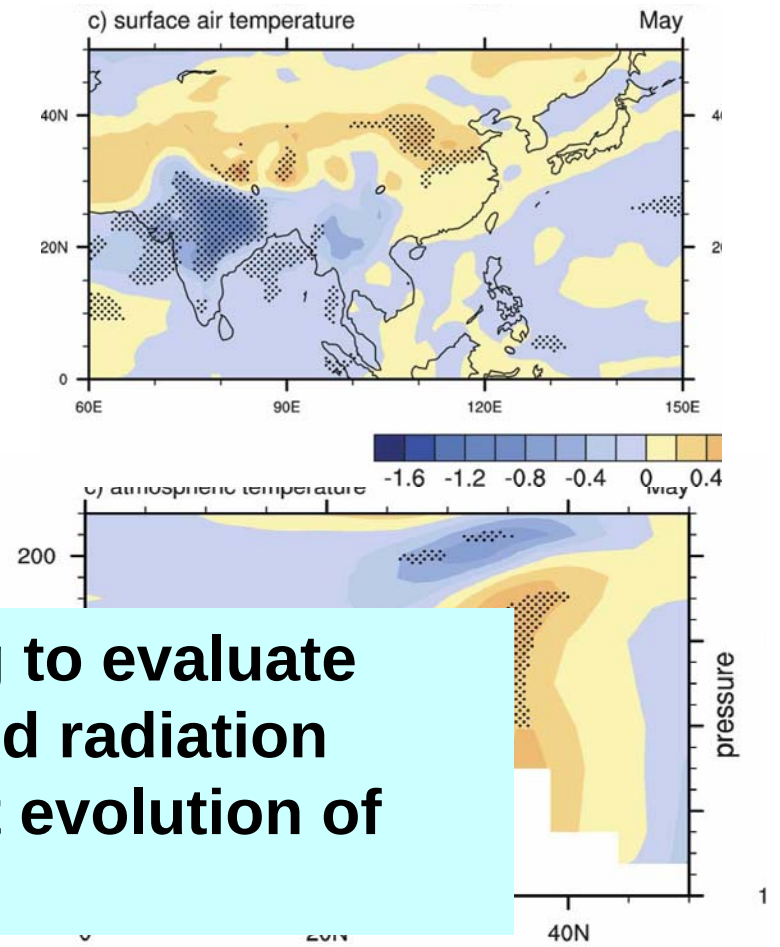
Cold surge and winter convections (Ueno, GRL, 2005)

Nighttime precipitation by synoptic scale convergence in monsoon season (Ueno et al., 2008 submitted to JMSJ)

Example 3

Thermal effects to surrounding circulations



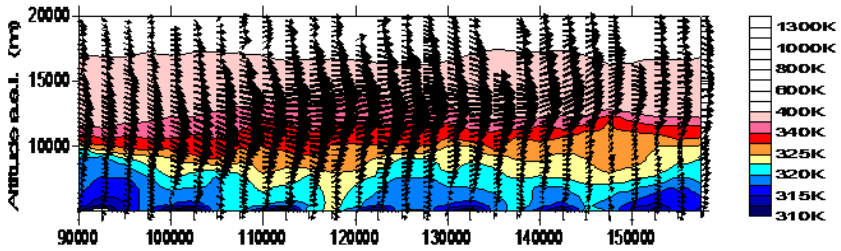


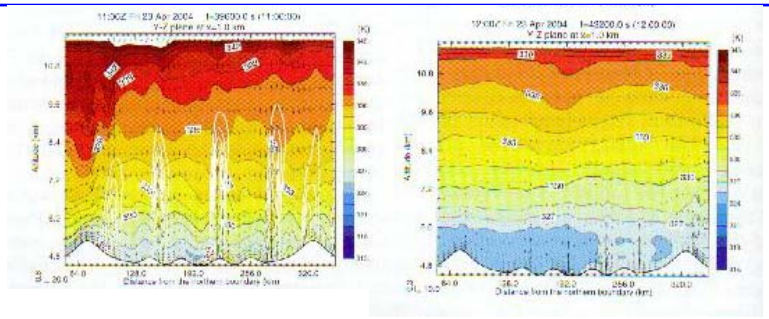
Issues: Up-scaling to evaluate plateau heating and radiation structure, to affect evolution of monsoon

Possible influence of subsidence to the progress of Indian monsoon (Sato and Kimura, MWR, 2006)

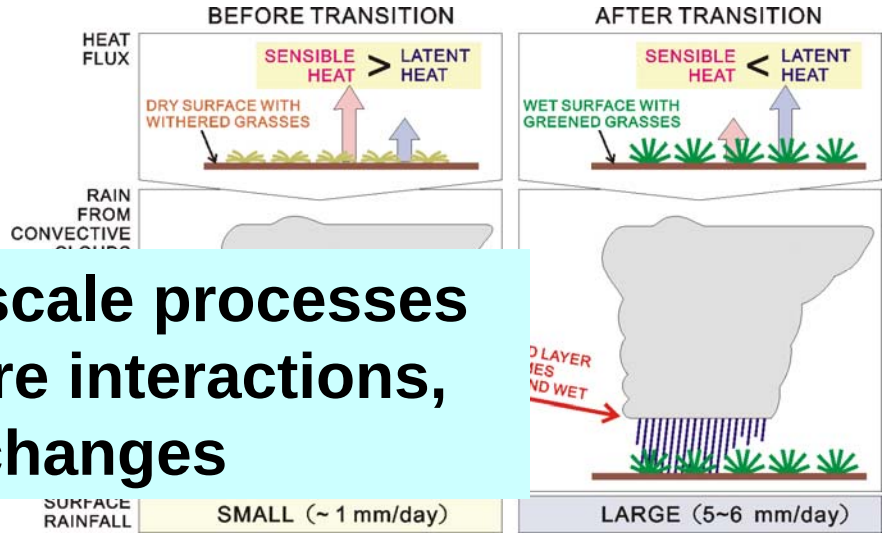
Temperature response by BC aerosols on May (Meel et al., JC, 2008)

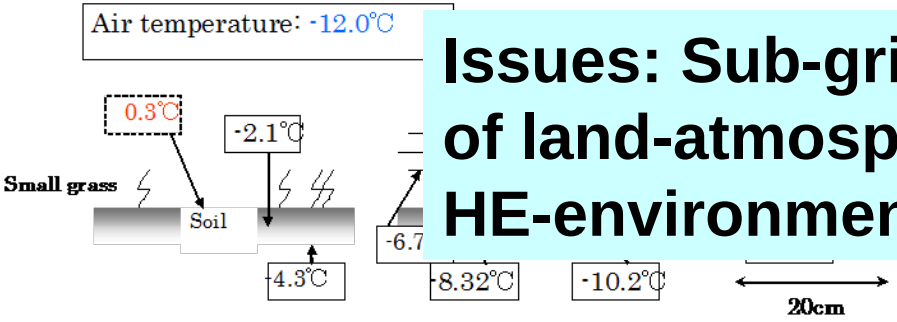
Example 4
Interactions between meso-scale convection and heterogeneous land surfaces





Sensitivity study of convection in pre-monsoon Tibet (Taniguchi and Koike, 2007)





Issues: Sub-grid scale processes of land-atmosphere interactions, HE-environment changes

Patchy snow covers and re-distribution in non-monsoon season (Ueno, AAAR, 2007)

Changing of precipitation cells in the synoptic condition of TH by wetting the surface (Yamada and Uyeda, 2007)

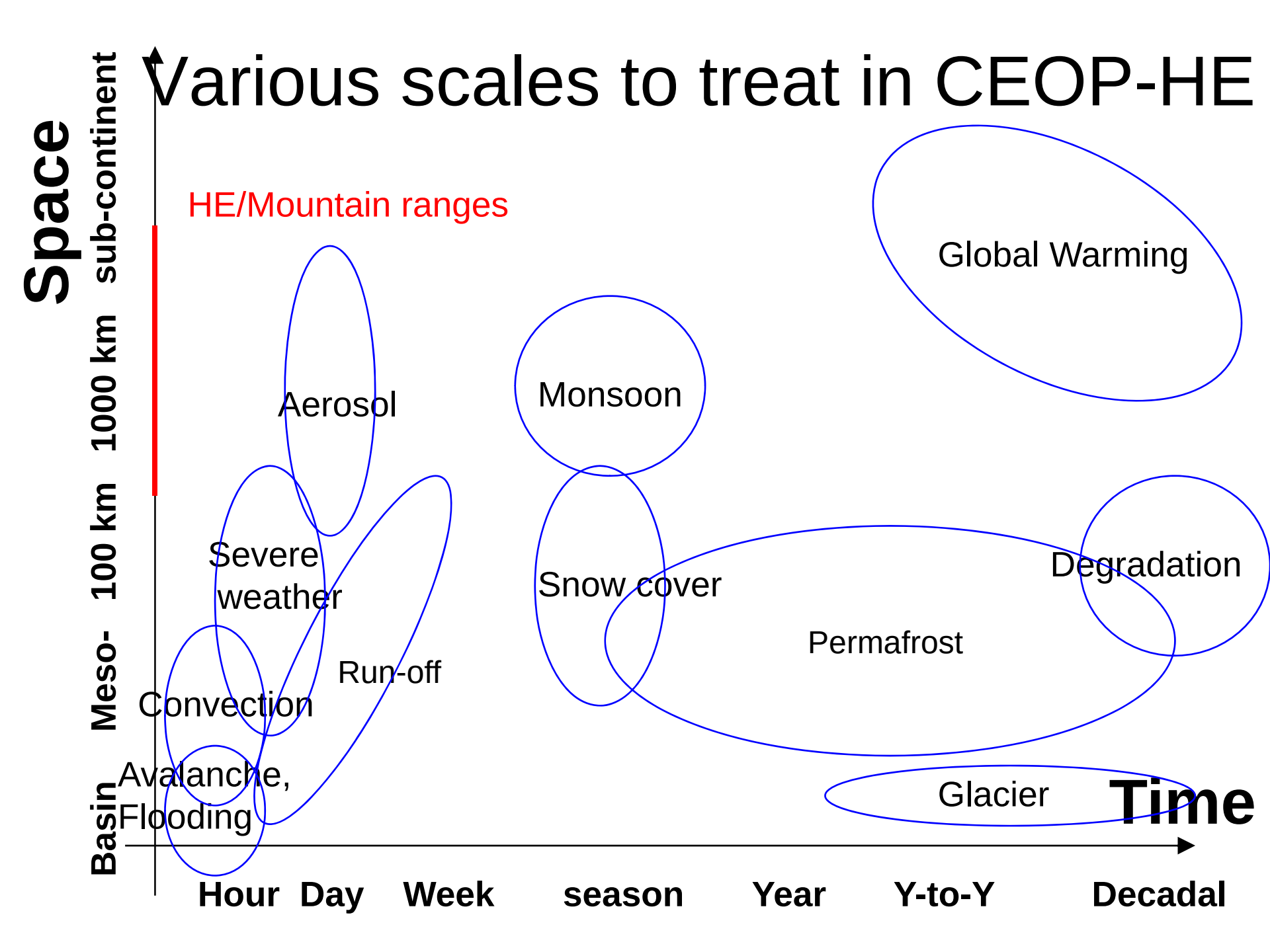
Way of understanding the CEOP-HE in SIP

Essence of 6 regional issues

- *Tibet/Himalayas: Local ci… the Himalayas and Land-atmosphere interaction on t… mpact from (to) the tropics (Asian monsoon), Glacier a… urces*
- *Central Asia (Altai, Tien S… ir): Glaciers in the cold and semi-arid desert, river-runo… e-coring*
- *North America Mountains… NSO and its prediction, land-atmosphere interaction, mo… phic processes with stream flow*
- *South America Ande… bservatories, ENSO effects, temperature/precipitation…*
- *European Alps: long-term … od access, climate change, impact by NAO and impact to tourism/hydropower/degradation,,*
- *African Mountains: few observatories,* human habitation/livestock, glaciers in low latitudes

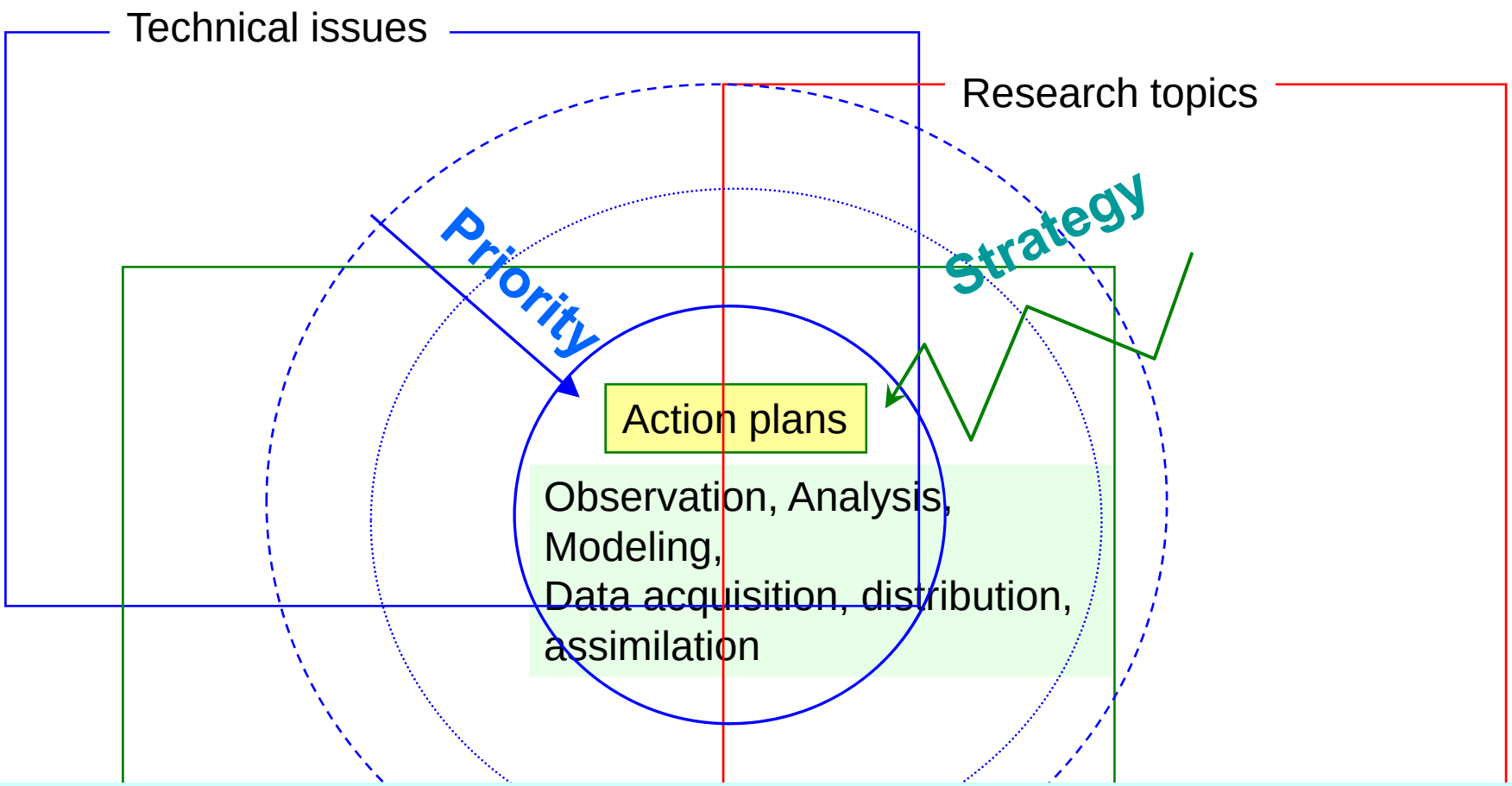
What is the common issues ?

Aggregate the multiple issuers through brain storming of steering member


Various scales to treat in CEOP-HE
Space
sub-continent
1000 km
100 km
Meso-
Basin
HE/Mountain ranges
Aerosol
Severe
weather
Convection
Run-off
Avalanche,
Flooding
Monsoon
Snow cover
Global Warming
Degradation
Permafrost
Glacier
Time
Hour
Day
Week
season
Year
Y-to-Y
Decadal

Last slide

Way of implementing actions



We can not do everything at once,,, We need strategic brain storming, that could borne new sciences and determine priority.