



Coordinated Energy and water cycle Observation Project (CEOP)

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CEOP Components: Crosscutting Studies

Mountain/High Altitude Initiative (MHAI)

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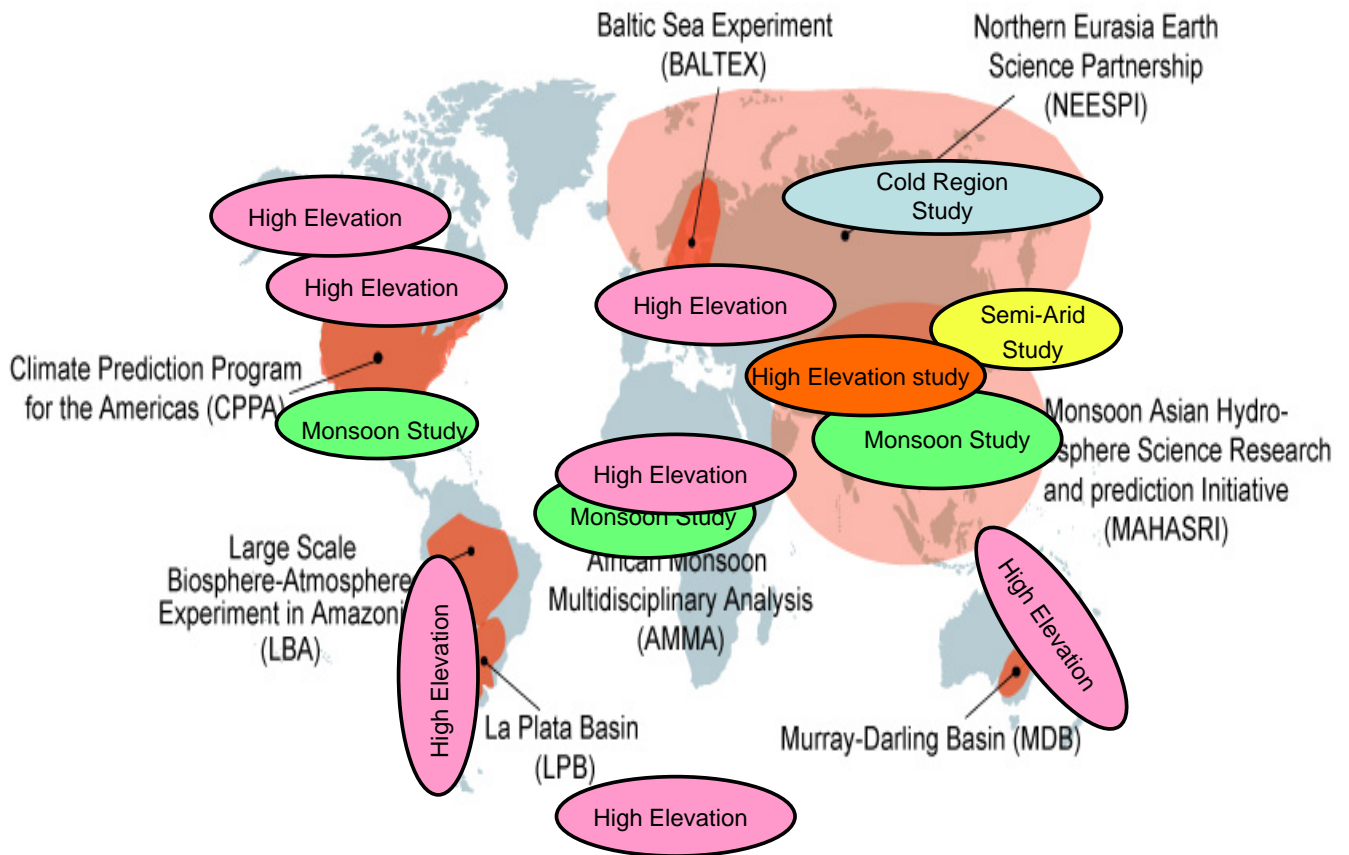
Some key questions

The representativeness of monitoring stations is more critical with the increasing of altitude, moreover the high altitude areas are more sensitive at the changing in climate. In this direction seems to be an interest to investigate:

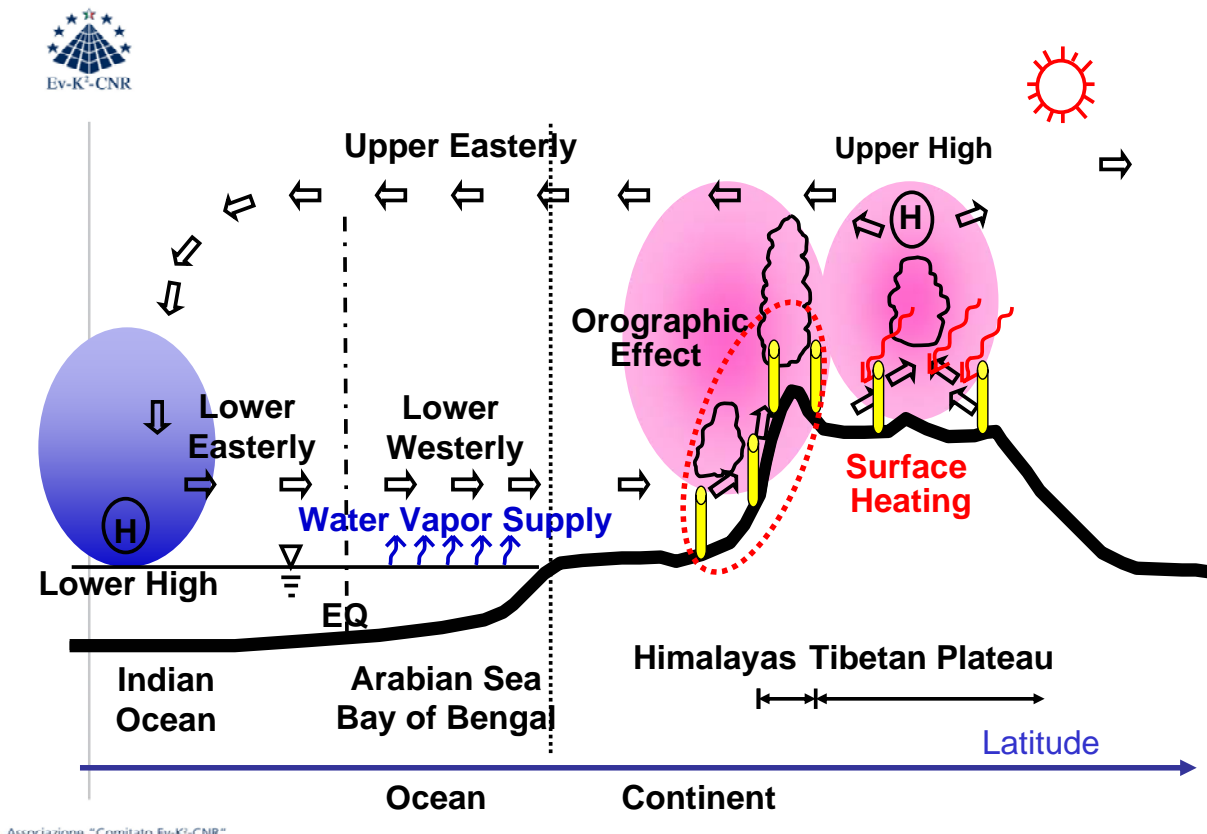
- 1) **how many high altitude stations have long time series?**
- 2) what is the evidence of climate change in these stations?
- 3) **how are representative of continental mountain chains?**
- 4) what contribute can have these station in the verification of numerical NWP models performance?
- 5) **which interest have the modeler to high altitude data and with complex orography?**
- 6) which role can have the high altitude reference stations to calibrate the satellite data?

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CEOP Regional Foci (*J. Roads, modified*)



(*T. Koike, modified*)





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Interdisciplinary approach by SHARE (Stations at High Altitude for Research on the Environment) Project

- Meteo-climatology: 5 AWSs in Nepal; 2 in Pakistan; 1 Africa
- Limnology: Sagarmatha National Park lake studies (more 130)
- Glaciology: Kumbu and Baltoro valleys
- Atmospheric chemistry: 1 ABC complementary station
- Monsoon modelling

Activities are performed with the collaboration of local Government, Institutions, etc.

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Planned milestones during 2007 to 2012 by SHARE Project

- | | |
|------|--|
| 2007 | Improve Nepal and Pakistan AWSs in the direction of reference stations. New studies on atmospheric depositions, nitrogen cycle, and micropollutants in lake sediments records. Glaciers studies in Mt Everest region |
| 2008 | Glaciers studies and possibly hydrological studies in Mt Everest region. Improve Africa site on Ruwenzori with news and possibly in Buthan or Caucasus. |
| 2009 | Install a new ABC Complementary Station in Pakistan to study the aerosols and air composition. Paleolimnology in Africa site on Ruwenzori |
| 2010 | Enlarge the High Altitude Network |
| 2011 | Maintain High Altitude Networks |
| 2012 | ... |

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GEWEX Objective #1:

Produce consistent research quality data sets complete with error descriptions of the Earth's energy budget and water cycle and their variability and trends on interannual to decadal time scales, for use in climate system analysis and model development and evaluation.

- the number of monitoring sites at high altitude is very low with an inhomogeneous distribution on Earth surface, not depending by mountain chains;
- on high altitude observatories the disposable instrumentation is mainly commercial and in general not dedicated to work at low pressure (air density) and low humidity and temperature. These environment conditions affects the data quality assurance giving important consequences on data recorded;
- the inhomogeneous landscape in the surrounding areas of high altitude sites, according to morphometry of mountain chains can influences in deep the data records representativeness. This should be considered in the use of high altitude reference station of CEOP network. This is a part of more general problem of significance of data collection in reference stations;
- It is important to link the high altitude reference stations with regional monsoons (Africa, South America, North America, Asian/Australian)

2012: Complete a "state-of-the-art" suite of global energy and water cycle products complete with error bars for closing the global water and energy budgets for the period 1980 to 2010.



GEWEX Objective 4:

Undertake joint activities with operational hydrometeorological services, related ESSP projects like the GWSP, and hydrological research programs to demonstrate the value of GEWEX research, data sets and tools for assessing the consequences of climate predictions and global change for water resources.

- high altitude are in general remote areas (Himalayas, Karakorum, Andes, etc.) where the monitoring strategies requires an high technological approach to guarantee the long term measurements with low percentage of data lost. This is a combination of several components, that require a strategic approach based on: good instruments, good organization and high level of experience;
- high altitudes are often in developing areas of the Earth where it is fundamental to promote a capacity building at local level;
- the extreme conditions at high altitude encourage the develop of interdisciplinary scientific programs and give the opportunity to reduce costs, personnel and structures. One example is to joint the physical observations with the monitoring of chemical composition of the atmosphere (gases, aerosols, AOT, etc.);
- the high altitude observatories can give a fundamental contribution to know the upper troposphere behaviours in relation to the global change.
- the high altitude reference stations can play an important role if the data are end-users oriented: early warning information; contribution to long time forecast, etc.

2012: Demonstrate benefits of improved hydrometeorological predictions for water resources (CEOP).



Strategy for a project of projects (1)

- 1) Data needs from whom and purpose
Monitoring studies for long-term series, data collection as reference site, data supply to other research studies (glaciology, limnology, etc.); study the mechanisms of transport and depositions of micropollutants (POPs); climatic support to study the aerosol interactions (ABC) with the Himalaya chain; collaborative studies on diurnal/seasonal climatic features; support the RCM; etc.
- 2) Data infrastructure need purpose
Future improving will be addressed on different strategies: a) to improve the Pyramid Observatory (new hydrometeorological instrumentations near the reference site); b) to strengthen the other reference sites according to the CEOP Phase II; c) expand the network in other high altitude areas;
- 3) Climate region commonality which can be shared with whom
To share/collaborate the data/experience with the other high altitude remote areas (Tibetan Plateau, Alps, Andes, ...)



Strategy for a project of projects (2)

- 4) Needs for up-scaling and down-scaling
In future.
- 5) Needs for pilot demonstrations
Pyramid is a pilot study area to compare the results with TP, to make a comparison with other Himalayan/Karakoram sites
- 6) Clarification of limitations
The principal limitations are: instrumentations energy supply, the remoteness that influence the instrument maintenances, the technology of the instrumentation in some case not adequate, etc.
The main limitation is the frequency of funds supply.



Final remarks

The high altitude initiative that will developed in CEOP/GEWEX Phase II should be considered in the framework of the scientific plan as integrated part of entire project, with a mutual interaction oriented to give e complete support to the target aims.