SHARE RIVERS: A long term monitoring of waters in central southern Himalaya (Nepal)

GLOBAL CRYOSPHERE WATCH
CryoNet Asia Workshop

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The Ev-K2-CNR Committee is a non-profit association which promotes scientific and technological research in mountain areas. Particular emphasis is placed on the HKKH region (Nepal, Pakistan). Ev-K2-CNR is best represented by its **Pyramid Laboratory** located at 5,050 meters in Nepal at the base of Mount Everest. Ev-K2-CNR research is mainly focused on **Environmental Sciences**, and development of new technologies.

Ev-K2-CNR benefits mainly from the **financial support** of Italian Government.

Ev-K2-CNR works through a network of national and international scientific collaborations, in particular with the Italian **National Research Council (CNR)**.
An integrated scientific and technological research project devoted to environmental monitoring and climatic studies in mountain regions.
Capacity building

1) Involving local partners in the meteorological monitoring (Nepal, Pakistan, Uganda).

2) Supporting the sustainable development of mountain regions.
Memorandum of understanding signed on January 2008

A) Training courses for local staff on meteorological stations management

B) Creation of a team of 7 Nepali technicians
A) The collaboration with the PMD includes a protocol of periodic maintenance (every 45 days) of the meteorological stations: Urdukas (3926 m), Baltoro glacier, Askole (3015 m).

b) Training courses on meteorological stations management.
A) The collaboration with the umd includes a protocol of periodic maintenance (every 2 months) of the highest meteorological station in Africa (Ruwenzori, 4750 m).

B) Training courses on meteorological stations management for the park rangers.
Metereological stations at high elevations

Air chemistry observatory (ABC UNEP stations)

Contribution to integrated monitoring programs such as UNEP-ABC, WMO-GAW, WCRP-GEWEX-CEOP, NASA-AERONET, ILTER, EUSAAR, ACCENT
The SHARE WATERS aims answering to the following questions:

1. How is the climate change impacting the hydrologic cycle of glacial basins and the consequent availability of water?
2. How is the climate change affecting the main biogeochemical processes (nutrients and solutes) from glaciers, through soils and streams to glacial lakes?
3. How is the climate change affecting the biodiversity and functioning of mountain lakes?
Aims

We are looking for COUPLING climatic trends with glacial and periglacial environment response to understand the impact on hydrologic process and create a reasonable future water availability scenario.

How the climate change impacts the cryosphere in central southern Himalaya (Nepal). In particular we are interested in the behavior of glaciers, permafrost, lakes and rivers.
## Temperature and precipitation time series

<table>
<thead>
<tr>
<th>Station ID</th>
<th>Location</th>
<th>Latitude (°N)</th>
<th>Longitude (°E)</th>
<th>Altitude (m asl)</th>
<th>Frequency</th>
<th>Data Availability</th>
<th>% of Missing Data</th>
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</thead>
<tbody>
<tr>
<td>AWS0</td>
<td>Pyramid</td>
<td>27.96</td>
<td>86.81</td>
<td>5035</td>
<td>2 hours</td>
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<td>86.81</td>
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<td>01/01/2000 - 31/12/2012</td>
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<tr>
<td>AWS2</td>
<td>Pheriche</td>
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<td>86.82</td>
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<td>25/10/2001 - 31/12/2012</td>
<td>14 34 14 11 20 25 34</td>
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<td>86.82</td>
<td>5039</td>
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<td>01/03/2006 - 31/12/2011</td>
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<td>AWS4</td>
<td>Kala Patthar</td>
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<td>86.83</td>
<td>5600</td>
<td>10 minutes</td>
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<td>8 6 5 8 12 13</td>
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<td>AWS5</td>
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<td>86.93</td>
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<td>10 minutes</td>
<td>01/05/2008 - 31/10/2011</td>
<td>39 100 65 26 44 47</td>
</tr>
</tbody>
</table>

A. Temperature (AWS 1994-2011): SeqMK test and SSA

Winter and pre-monsoon temperature change
B. Precipitation (AWS 1994-2011)

Significance for all months

-8.2 mm/y
Comparison with other series
### Spatio-temporal analysis of glaciers

<table>
<thead>
<tr>
<th>Satellite images</th>
<th>Sensor</th>
<th>Spatial resolution (m)</th>
<th>Acquisition date</th>
<th>Analysis purpose</th>
</tr>
</thead>
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<td>15*</td>
<td>30 Nov 2011</td>
<td>Glacier and Lake</td>
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<td><strong>Topographic maps</strong></td>
<td><strong>Scale</strong></td>
<td><strong>Year</strong></td>
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<td>Topographic map (Indian Survey)</td>
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<td>Glacier and Lake</td>
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<td><strong>Digital Elevation Model (DEM)</strong></td>
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<tr>
<td>ASTER DGEM 2</td>
<td>ASTER</td>
<td>30</td>
<td></td>
<td>Glacier, Lake and Model</td>
</tr>
</tbody>
</table>

* SLC-off corrected and pan-sharpened image
Δterm = -403±9 m (1962-2011) 
Rate: 6.1±0.2 m yr⁻¹

ΔSurf = -13.0±3.1 %; 404.6 to 351.8 km² (1962-2011) 
Rate: 0.42±0.06 % yr⁻¹

ΔSLA = +182±9 m; (1962-2011) 
Rate: 3.9±0.17 m yr⁻¹
Comparison with other regions

(a) ΔTemp (m a⁻¹)

(b) ΔSurf (% a⁻¹)
Temporal analysis of Lakes

(1960s to 2011)
River discharges
FIELD DATA (since 2011)

Meteo

- Installation of a pan evaporimeter

Rivers

- Selection of a reference site
- Stream level measurements close to glacier front (1 stations)
  - Velocity measurements
  - Isotophe measurements (altitudinal gradients of snow, rain, glaciers and rivers)
  - Water quality measurements (multiparameter probes and weekly grab samples)

Lakes

- Selection of a reference lake
- Batimetry, lake level, inflow, outflow level)
- Water quality measurements (multiparameter probes and weekly grab samples)

Permafrost

- 200 thermistors and umidity probes at three depths along and altitudinal gradient (2800-5600 m)
Comments and suggestions....

Thanks