Using field observations and satellite data for the energy and water cycle study over heterogeneous landscape: from Tibetan Plateau to Third Pole region and Pan-Third Pole region

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Why do we have this kind of study?

Western wind

Cold air

Atmospheric heating source

Warm water vapor
Heating to the atmosphere

Tibetan Plateau

Energy fluxes and water vapor flux exchange between the land surface and near surface atmosphere
How to get the regional surface heat and water vapor fluxes over the Tibetan Plateau
1. Set up observation stations at different land surfaces (ecosystems).

2. Satellite data

3. Models

4. LDAS

Observation → Data analysis

Parameterization → Modeling

Energy and water vapor fluxes at each land surface

Understanding of regional surface energy and water vapor fluxes over the Tibetan Plateau.
Comprehensive observation of the multi-sphere land-atmosphere interaction in the TP

Local characteristic parameters \( C_D, C_H, C_q, z_{om}, z_{oh}, d_0 \) and \( kB^{-1} \) etc.

Taking multi-scale topographic impacts into account

Effective parameters for the typical area (mountain, forest, alpine meadow, desert grassland, etc.) in the TP

Satellite remote sensing

The land-atmosphere interaction parameters, surface albedo, vegetation coverage and land surface temperature in the TP

RS Parameterization, Validation

Long-term temporal variation and spatial distribution of energy and water flux in the TP

Understanding the long-term variation of surface energy fluxes and water fluxes in the TP region
Tibetan Observation and Research Platform

--- TORP
7 ITP/CAS comprehensive observation stations in TP

- Mustagata Station
- Ali Station
- Shuanghu Station
- Nam Co Station
- Mt. Qomolangma Station
- Naqu Station
- Lizhi Station
Qomolangma Station for Atmospheric and Environmental Observation and Research (QOMS/CAS)

Nam Co Station for Multisphere Observation and Research (NAMORS/CAS)
Southeast Tibet Station for Alpine Environment Observation and Research (SETS/CAS)

Ngari Station for Desert Environment Observation and Research, Chinese Academy of Sciences (NASDE/CAS)

AWS and radiation system
Turbulent system & CO₂/H₂O flux measurement
Flux stations over the different land surfaces

Radiation Stations (19)
Land surface heat fluxes
ET-by eddy covariance system

Pre-monsoon
Monsoon
Post-monsoon
### Table 1. Aerodynamic Roughness Length $z_{0m}$ Derived From Different Land Surfaces

<table>
<thead>
<tr>
<th>Land Surface</th>
<th>Observation Height, m</th>
<th>$z_{0m}$, m</th>
<th>$z_{0m}$, m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grassland</td>
<td>~5 cm</td>
<td>0.00436</td>
<td>0.0139</td>
</tr>
<tr>
<td>Grassland</td>
<td>~15 cm</td>
<td>0.00267</td>
<td>0.0028</td>
</tr>
<tr>
<td>Sand</td>
<td>2.90</td>
<td>0.00267</td>
<td>0.0028</td>
</tr>
<tr>
<td>Desert</td>
<td>5.60</td>
<td>0.00267</td>
<td>0.0028</td>
</tr>
<tr>
<td>Gobi</td>
<td>2.90</td>
<td>0.00267</td>
<td>0.0028</td>
</tr>
<tr>
<td>Bean</td>
<td>2.90</td>
<td>0.061</td>
<td>0.138</td>
</tr>
<tr>
<td>Wheat</td>
<td>4.90</td>
<td>0.302</td>
<td>0.302</td>
</tr>
<tr>
<td>Corn</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Thermodynamic Roughness Length $z_{0h}$ Derived From Different Land Surfaces

<table>
<thead>
<tr>
<th>Land Surface</th>
<th>Height of Observation, m</th>
<th>$z_{0h}$, m</th>
<th>$z_{0h}$, m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grassland</td>
<td>~5 cm</td>
<td>0.00041</td>
<td>0.00114</td>
</tr>
<tr>
<td>Grassland</td>
<td>~15 cm</td>
<td>0.000049</td>
<td>0.000011</td>
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<tr>
<td>Sand</td>
<td>2.90</td>
<td>0.000049</td>
<td>0.000011</td>
</tr>
<tr>
<td>Desert</td>
<td>5.60</td>
<td>0.000049</td>
<td>0.000011</td>
</tr>
<tr>
<td>Gobi</td>
<td>2.90</td>
<td>0.000049</td>
<td>0.000011</td>
</tr>
<tr>
<td>Bean</td>
<td>2.90</td>
<td>0.000685</td>
<td>0.00132</td>
</tr>
<tr>
<td>Wheat</td>
<td>4.90</td>
<td>0.00227</td>
<td>0.00227</td>
</tr>
<tr>
<td>Corn</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fig. 2. Diurnal variations of the excess resistance to heat transfer $kB^{-1}$ of Aado Station and NPAM Station.