Muztag Glacier Velocity Extraction Based on the Offsets Derived from SAR images

Liu Guang, Yan shiyong, Ruan zhixin and Li Xinwu

Centre for Earth Observation and Digital Earth (CEODE)
Chinese Academy of Sciences (CAS)

ABCC workshop, August 24, 2010, Perth, Australia
Outline

- Introduction
- Study Area and Datasets
- Methodology
- Result Analysis
- Conclusion
Glacier or ice sheet is important in function of climate change reflection and sea level change.

The most glaciers overall the world have shown a generalized tendency for retreat.

Accurate displacement measurements are needed to understand the dynamics of glaciers.

Remote Sensing is an effective way to study glaciers.
Tibet Plateau

Source: Microsoft Encarta 2008
Glacier area change of Tibet Plateau

Glacier Distribution In 2005
From China Glacier Catalog

Glacier Distribution In 2000
The glacier retreated quite a lot, especially the south part of Tibet plateau.
Glacier area change of Tibet Plateau

- Decrease
- No change
- Increase
Study Area and Datasets
An Observation on Surface Ablation on the Yangbark Glacier in the Muztag Ata, China, Pujian Chen, etc.
KekeSai Glacier is about 8 km long, and the change of elevation is about 800 meters of the main body, this cause a rapid movement of the glacier.
Datasets:

- ALOS/PALSAR
- Landsat ETM+

<table>
<thead>
<tr>
<th>Date</th>
<th>Bpara(m)</th>
<th>Bperp(m)</th>
<th>Path</th>
<th>Frame</th>
<th>Temporal baseline(day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/14/2009</td>
<td>-135.54</td>
<td>-148.25</td>
<td>525</td>
<td>750</td>
<td>44</td>
</tr>
<tr>
<td>03/01/2009</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/01/2009</td>
<td>140.92</td>
<td>-213.16</td>
<td>525</td>
<td>750</td>
<td>44</td>
</tr>
<tr>
<td>10/17/2009</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The magnitude map (left), the coherence map (middle) and the interferogram (right) of Muztagh glacier area (2009.1.14-2009.3.1)
Pixel Track Method

1. Select images
2. Pre-filtering of images
3. Post-processing
4. Grid and Marker
5. Model fit
6. Base image subtract
7. Normalized Cross Correlation
Model Fit – *DIA* Method

Overall Model Test (OMT)
$q = m - n$

Model Adjustment

Data Snooping
$q = 1$

Prof. dr. Peter J.G. Teunissen
Result Analysis

Azimuth movement

Range movement
The velocity field map
during the period from January 14, 2009 to March 1, 2009
Azimuth movement

Range movement
The velocity field map
during the period from September 1, 2009 to October 17, 2009
The velocity profile along the glacier surface
Velocity Map based on Landsat ETM+

2001-9-30 Landsat ETM+

2002-8-16 Landsat ETM+
Conclusion

The surface motion velocity map of Muztagh glacier can be effectively estimated using SAR and optical remote sensing data, velocity pattern of Kekesai Glacier between SAR and optical data is consistent. In summary, the preliminary result is promising.

Future work

Validation: Muztagh area GPS experimental
Thanks

Center for Earth Observation and Digital Earth
Chinese Academy of Sciences
Add: No.9 Beiyitiao Road, Zhongguancun, Beijing China 100190
Tel: 86-10-58887301  Fax: 86-10-58887302
E-mail: office@ceode.ac.cn
Web: www.ceode.ac.cn