Water level analysis in Tibet using CryoSat-2

Lun Yan, Hassan Hashemi Farahani, Dennis Mattes, Omid Elmi, Nico Sneeuw
Geodätisches Institut der Universität Stuttgart - GIS

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Introduction

- **Research Area**
  - Tibetan plateau
  - Approx. 400 lakes

- **Data gap**
  - Lack of in situ stations
  - Solution: Satellite Altimetry

- **CryoSat-2**
  - SARin: discrimination of coastal echoes between land and water
  - L2 data: 2010 - 2018
Methodology

- Calculation of water level $H$

\[ h = A - R \]
\[ H = h - N \]

$H$: Orthometric height (→ Water level)
$h$: Ellipsoidal height
$N$: Geoid undulation
$A$: Altitude
$R$: Range (with retracking correction)
Methodology

➤ Choice of Geoid

➤ EGM2008:
  Geoid matrix provided by earlier work
  Accuracy low -> **not good anymore**

➤ Eigen6C4
  Geoid matrix calculated with ICGEM
  [http://icgem.gfz-potsdam.de/home](http://icgem.gfz-potsdam.de/home)
  Accuracy high -> **good**

Methodology

Geoid difference (Eigen6C4 - EGM2008)
Methodology

Geoid difference in Tibet
Methodology

Taro Co all measurements before outlier detection

Water level [m]

5000 6000 7000 8000 9000

31.1°N 31.2°N 31.1°N 31.2°N

83.9°E 84°E 84.1°E 84.2°E 84.3°E
Methodology

- **Data snooping step 1**
  - For measurements in the whole area (4 sigma)

- **Data snooping step 2**
  - For measurements along 1 track (3 sigma)

- **Example: Taro Co**
Methodology

Taro Co 1. step data snooping (scale as before)

Total: 2453    Eliminated: 78
Methodology

Taro Co 1. step data snooping (true scale)

Total: 2453   Eliminated: 78
Methodology

Total: 2453     Eliminated: 29
Quote: \(\frac{78+29}{2453} \approx 4.36\%\)
Methodology

- Trend analysis
  - Rising or sinking?
  - How Fast?

Trend: \(-0.121 \text{ m/yr}\)
Results

- Water level and trend of selected lakes

[Map showing the water levels of Mapam Yumco, Burog Co, Taro Co, Xiangyang Hu, Dorsoidong Co, and Puma Yumco]
Results

Water level and trend of selected lakes

Eliminated Quote: 1.88 %   Trend: +0.318 m /yr
Results

Water level and trend of selected lakes

Eliminated Quote: 22.33 %  Trend: +0.043 m /yr
Results

Comparison

- Burog Co
- Taro Co
- Xiangyang Hu
- Mapam Yumco
- Dorsoidong Co
- Puma Yumco
Conclusion

- Tendency
  - South
  - North

- Cause
  - Global warming
  - Usage & Pollution

- Future work
  - Small lakes in Tibet
  - Comparison with Jason-2
Thank you very much!

Lun Yan, Hassan Hashemi Farahani, Dennis Mattes, Omid Elmi, Nico Sneeuw
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