

Crossover analysis of Lambert-Amery Ice Shelf drainage basin for elevation changes using ICESat GLAS data

Shen Qiang, E Dongchen, Jin Yinlong

Chinese Antarctic Center of Surveying and Mapp, SGG, Wuhan University, P. R. CHINA, 430079

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Content

- ◆ 1 Background
- ◆ 2 ICESat introduction
- ◆ 3 LAS characteristics
- ◆ 4 Detection Methods
- ◆ 5 Results Analysis
- ◆ 6 Conclusions

1. Background

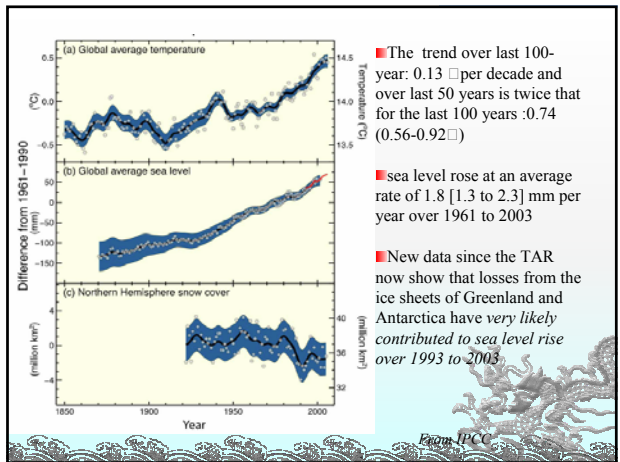
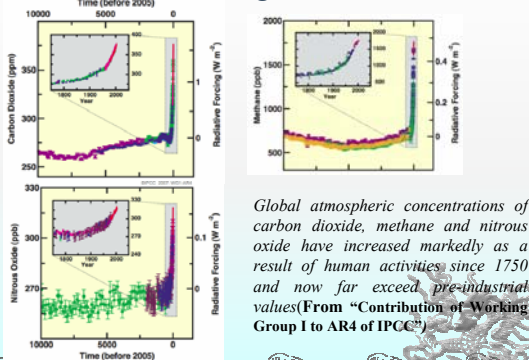


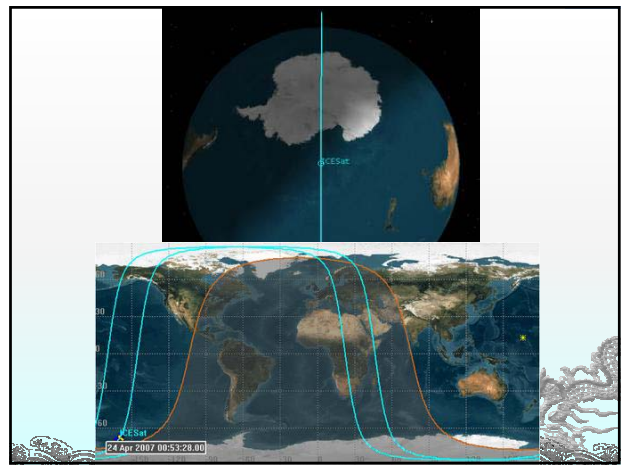
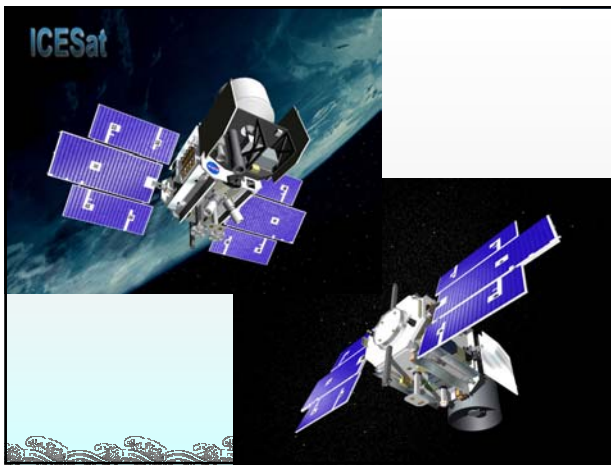
Table SPM-1. Observed rate of sea level rise and estimated contributions from different sources. [5.5, Table 5.3]

| Source of sea level rise | Rate of sea level rise (mm per year) | |
|---|--------------------------------------|-------------|
| | 1961 – 2003 | 1993 – 2003 |
| Thermal expansion | 0.42 ± 0.12 | 1.6 ± 0.5 |
| Glaciers and ice caps | 0.50 ± 0.18 | 0.77 ± 0.22 |
| Greenland ice sheet | 0.05 ± 0.12 | 0.21 ± 0.07 |
| Antarctic ice sheet | 0.14 ± 0.41 | 0.21 ± 0.35 |
| Sum of individual climate contributions to sea level rise | 1.1 ± 0.5 | 2.8 ± 0.7 |
| Observed total sea level rise | 1.8 ± 0.5* | 3.1 ± 0.7* |
| Difference: (Observed minus sum of estimated climate contributions) | 0.7 ± 0.7 | 0.3 ± 1.0 |

Table note:
* Data prior to 1993 are from tide gauges and after 1993 are from satellite altimetry.

2. ICESat Introduction

- ◆ Geoscience Laser Altimeter System (GLAS) is carried on the Ice, Cloud and land Elevation Satellite (ICESat)
- ◆ ICESat was launched 13 January 2003 00:45 UTC from Vandenberg Air Force Base in California
- ◆ Bands: 1) near infrared (1064 nanometers)
2) green (532 nanometers)



GLAS Science Objectives

- ◆ ice-sheet topography and associated temporal changes
- ◆ cloud and atmospheric properties
- ◆ along-track topography

Advantages

- ◆ intrinsic precision of better than 10 cm
- ◆ associated temporal change at the centimeter per year level

3. LAS Characteristics

- ◆ LAS situates 67-82°S and 40-95°E, the largest glacier/ice shelf system in east Antarctica.
- ◆ LAS's area is about 1/10 of all of Antarctica and the length of ice tongue is about 1/60 of entire Antarctic coastline, so the velocity of ice streams in the front of Amery ice shelf is faster than the other areas along the Antarctic coastline (Wang Qianghua, 2002)

4. Detection Method

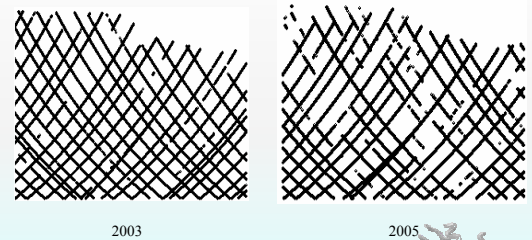
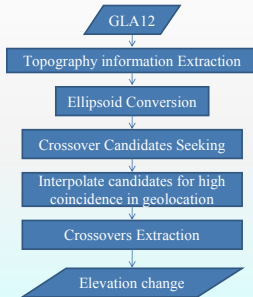
- ◆ Direct comparison of surface profiles
- ◆ Crossovers analysis

- ◆ 183-day ground track repeat cycle **yields 15 km track spacing at the equator and 2.5 km at 80 degrees latitude**

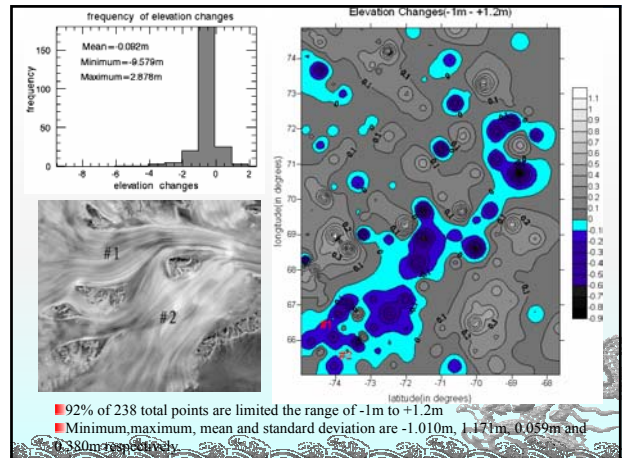
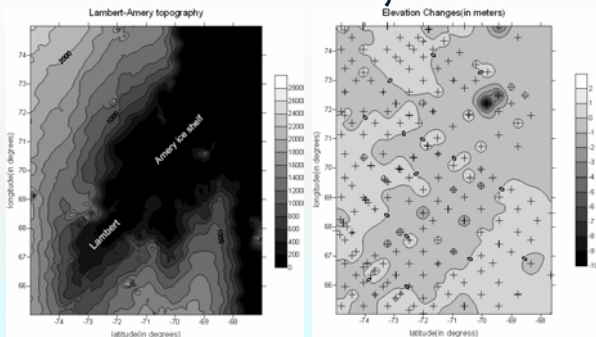
Data sources

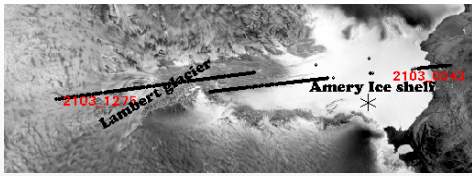
| Code name | Start Date | End Date | Release Version | Num. of Revolutions | Code of laser | Num. of files |
|-----------|------------|------------|-----------------|---------------------|---------------|---------------|
| Data1 | 10/13/2003 | 11/09/2003 | Release-26 | 541 | Laser | 38 |
| Data2 | 10/21/2005 | 11/24/2005 | Release-28 | 493 | Laser 3D | 34 |

Data processing

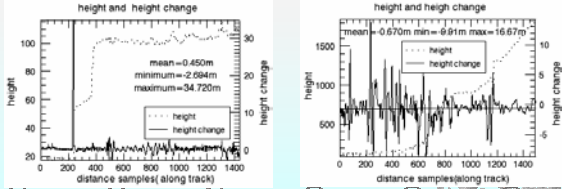


5. Result analysis





Noted: The minimum of elevation change in crossover analysis is denoted black asterisk



6. Conclusions

- ◆ The LAS are the negative elevation change (-0.6-0m) in comparison of two datasets acquired in 2003 and 2005 year respectively
- ◆ The other ice sheets are positive elevation change in the range of 0~0.4m
- ◆ The value of mass balance can't be made certain in direct comparison because the uncertainty of detection may be exceed largely the rates of elevation change in the two periods

Thank for your attention

