1. Background

Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values. (From "Contribution of Working Group I to AR4 of IPCC")

The trend over last 100-year: 0.13 m per decade and over last 50 years is twice that for the last 100 years : 0.74 m (0.56-0.92)

Sea level rose at an average rate of 1.8 [1.3 to 2.3] mm per year over 1961 to 2003

New data since the TAR now show that losses from the ice sheets of Greenland and Antarctica have very likely contributed to sea level rise over 1993 to 2003

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**

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**Data sources**

<table>
<thead>
<tr>
<th>Code name</th>
<th>Start Date</th>
<th>End Date</th>
<th>Release</th>
<th>Points of Revolution</th>
<th>Code of laser</th>
<th>Num. of files</th>
</tr>
</thead>
</table>

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**Data processing**

- GLA12
- Topography information Extraction
- Ellipsoid Conversion
- Crossover Candidates Seeking
- Interpolate candidates for high coincidence in geolocation
- Crossovers Extraction
- Elevation change

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**5. Result analysis**

- 92% of 238 total points are limited the range of -1m to +1.2m
- Minimum maximum, mean and standard deviation are -1.010m, 0.059m and 0.380m respectively
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.