GGOS/IGCP565-IAG-GEO Workshop Sept.30-Oct.02, TUG, Austria

A Plan for GRACE-type Satellite Gravity Mission

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Background

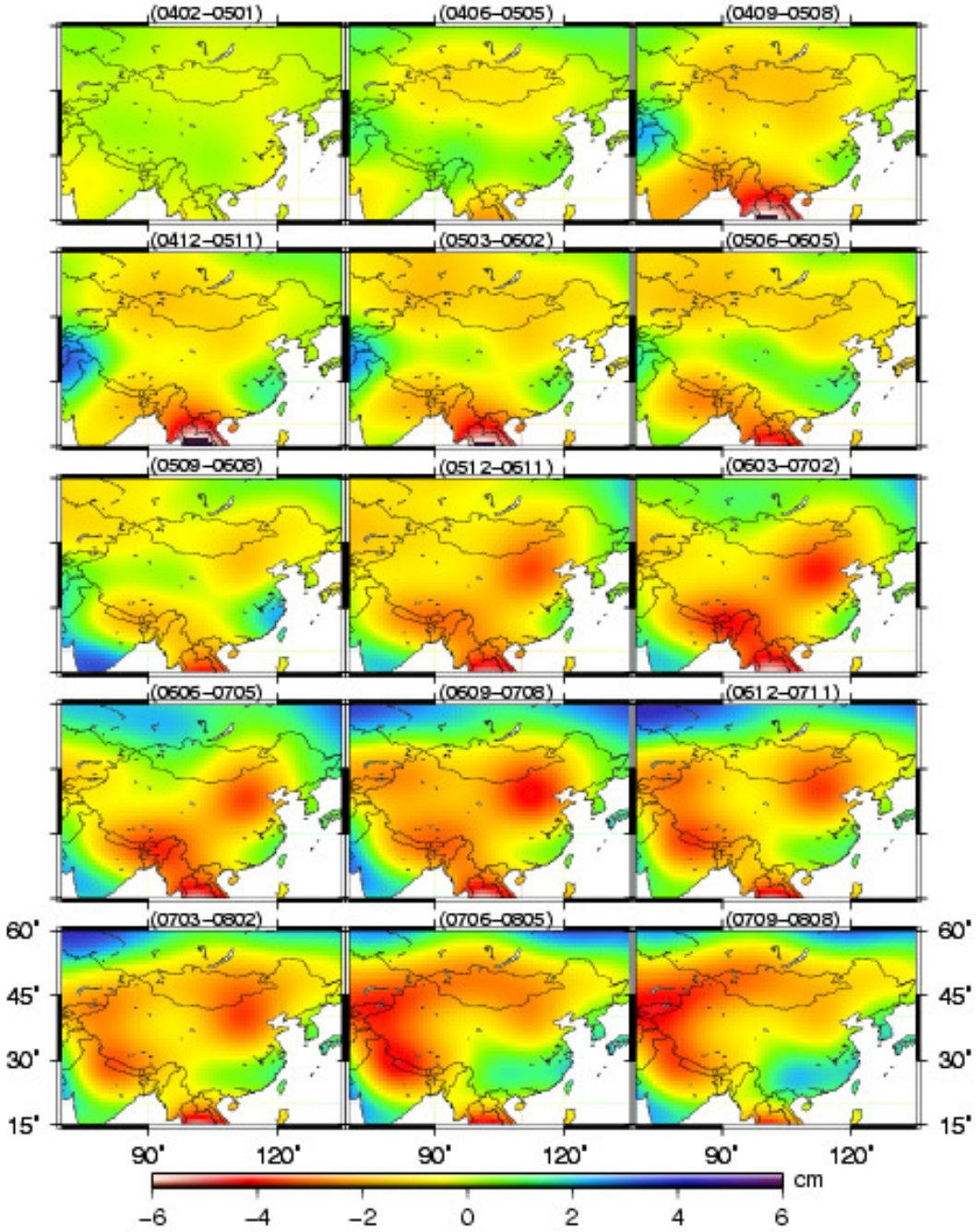
- Requirement from application fields and agencies

Satellite gravity products (static and/or temporally changing) can be used in many displines: geodetic topography, marine science, hydrology, earthquake, climate variation…

China (administrations and researchers) has recognized these for years, and is studying the application of GRACE data for monitoring the regional land water storage change.

A joint group from Chinese administrations and research institutes has been promoting the GRACE like mission for years.

Long-term change of land water storage in China



Background

- Progress of Developing Geo-Science Satellites in China

Satellite geodetic and remote sensing techniques have been routinely used and are playing important roles in weather forecast, surveying resources and monitoring/mitigating natural hazards in China.

These satellites include meteorological satellites(FY-1,2,3,4)) and the oceanographic (HY-1,HY-2…) , as well as several geodetic satellites scheduled to launch in following years.

The Chinese Academy of Sciences (CAS), in potential future collaborations with other agencies, has identified a wide range of scientific rationales and applications within China and globally which requires a long range planning of satellite geodetic and remote-sensing missions,

including satellite gravity missions (Ref: Lau's talk in this meeting).

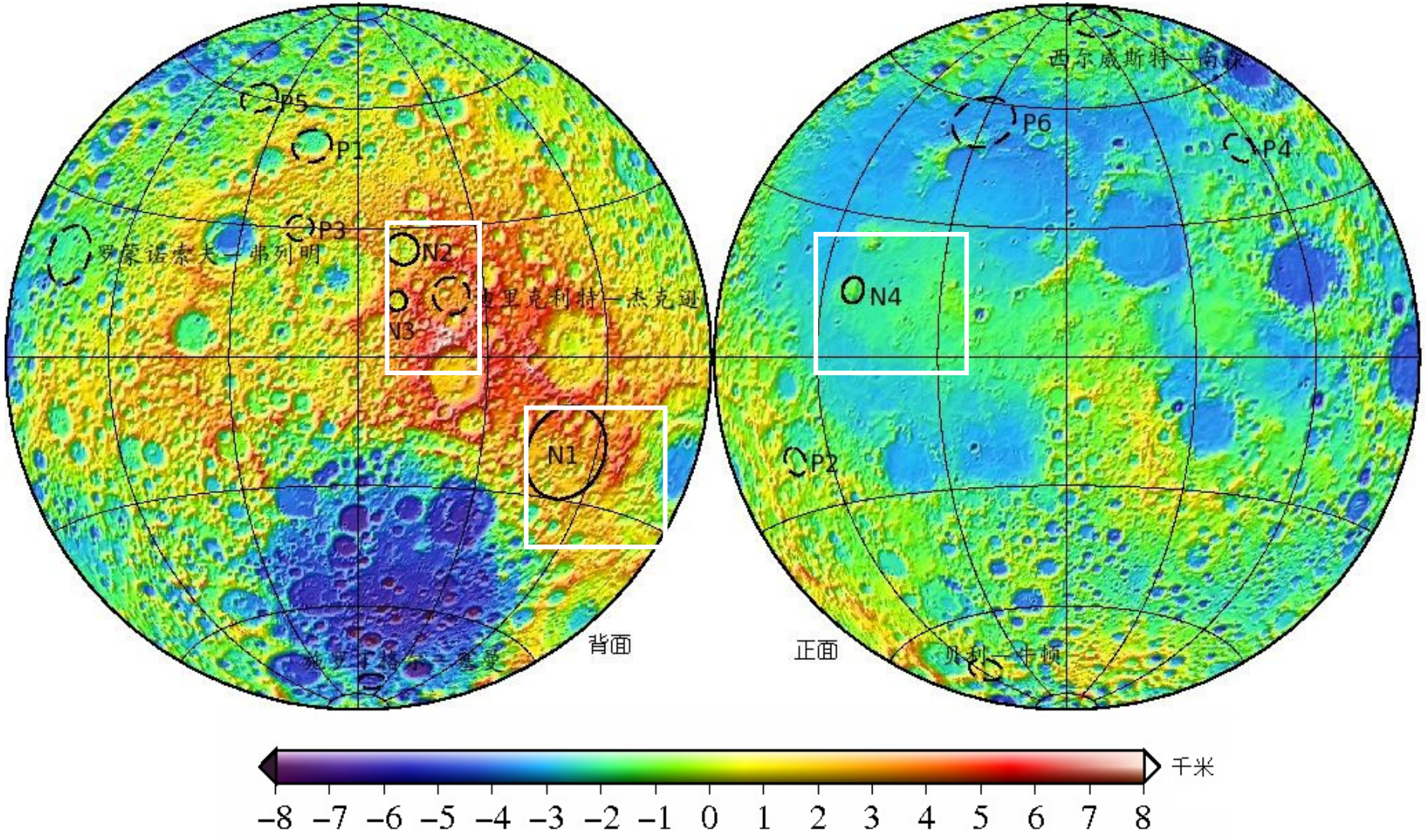
Background

- Progress of Lunar/Planetary Exploration in China

Lunar Missions: China's lunar exploration program features three mile- stones, "orbiting", "landing" and "returning".

Planetary Missions: Mars Probe, Yinghuo-1, is planned to launch together with the Russia Phobos-Grunt landing mission. YH-1 will explore the space weather of the Mars, and test the the deep space communication and navigation techniques.

New features revealed by CLTM-s01

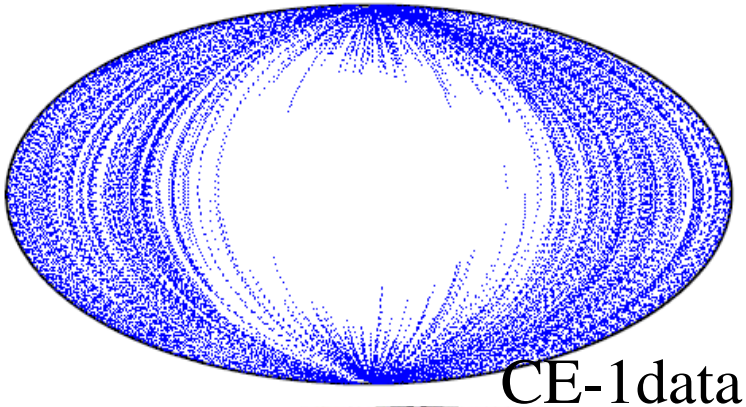


Lunar Topographic Model Ref. Ping et al. 2008

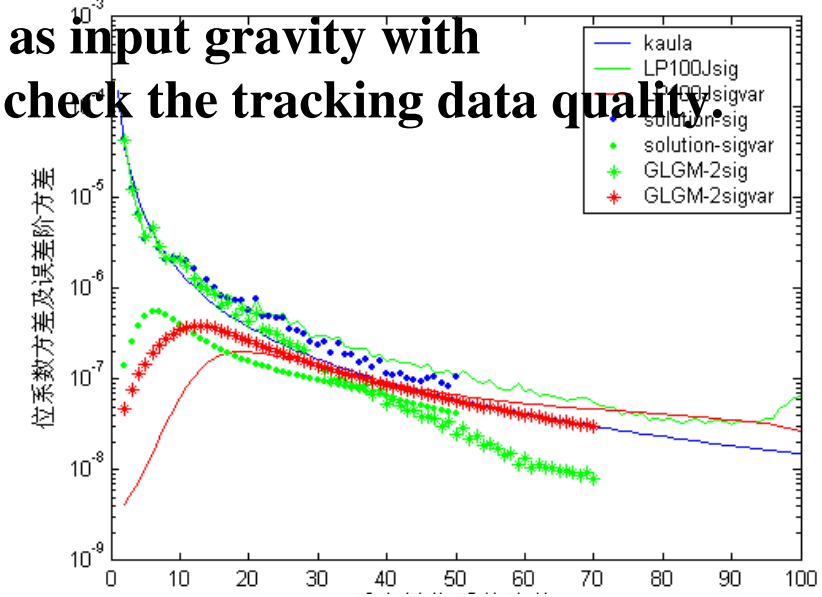
Lunar Gravity Field based on CE-1 tracking data only

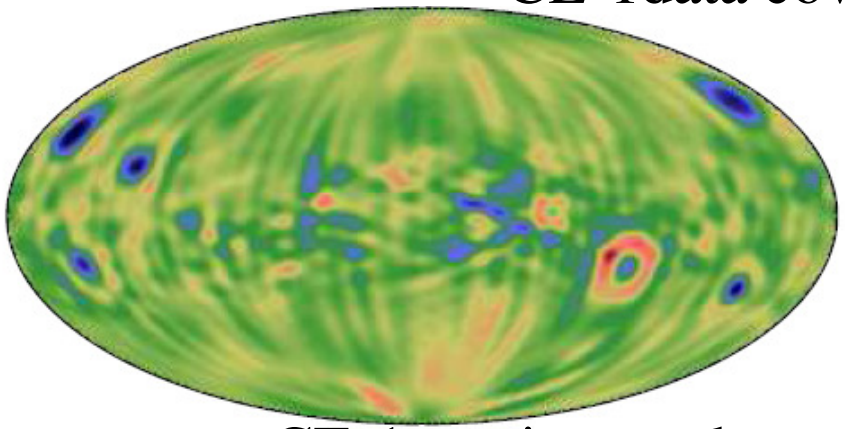
Ref: Yan & Ping, APSG2009, Urumuqi, China

Using CE-1 R&RR/VLBI data (2007.11-2008.10), after calibrating the effects due to the atmosphere and ionosphere, POD is carried out for further application. Also, using GLGM2 as input gravity with Kaula constrain, gravity field is estimated to check the tracking data quality.

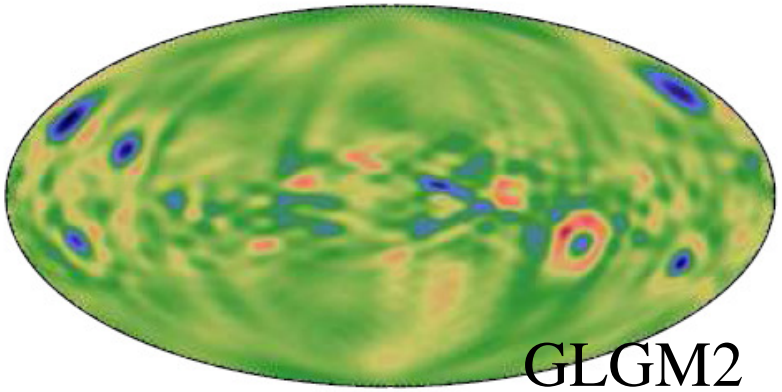


CE-1data coverag

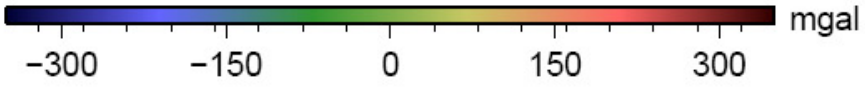




CE-1gravity result



GLGM2



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Long range planning frame

of satellite geodetic and remote-sensing missions

One such program is China's Geo-Hazards Monitoring Program.

- The planned satellite missions include the electro-magnetic satellite mission to monitor space weather, to study co-/post-seismic earthquake signals, and to explore the feasibility of the potential detectability of earthquake pre-cursor signals;
- A near-infrared remote sensing satellite for geo-hazard imaging.
- A GRACE-type satellite gravity mission with enhanced accuracy and spatial resolution directly addresses some of the objectives of this program, such as long term variations of land mass.

Long-term plan for gravity mapping

The overall identified scientific rationale include, but not limited to, the efficiency, accuracy and potential timeliness from such global gravity field mapping satellites, the monitoring and potential mitigations of geo- and environmental hazards, the accurate observables enabling monitoring and quantification of anthropogenic climate change, water balance budget and water resource availability, especially within China.

Long-term plan for gravity mapping

The mission promoting group from China like to show the articulation of scientific interest within the Chinese scientific and other community to take part or to undertake GRACE-type satellite gravity field mission, and a first-cut plan for a possible roadmap and mechanism to support the realization of a GRACE Stop-Gap mission in the appropriate time frame to minimize data loss between GRACE and GRACE follow-on missions.

Interest in GRACE Stop-Gap Mission(s)

The work plan of the promoting group from China includes the following up of the Workshop Roadmap to discuss with international partners including the US, Germany, France and others to potentially realize a GRACE Stop-Gap mission or a GRACE Stop-Gap constellation mission, on: (1) a possible offer of a couple of 10–12 m radio tracking ground support system for the GRACE Stop-Gap mission(s), (2) the possibility of launch support of the GRACE Stop-Gap satellites, and (3) the feasibility of more than one pair of enhanced GRACE-type satellites with distinct inclinations and at lower altitudes.

Interest in GRACE Stop-Gap Mission(s)

Since 2002, promoting group members from other agencies developed some payload for GRACE-like mission:

- KBR
- GPS receiver for POD and Occultation
- Star tracker

USO (with long term stability) and other key payloads are under development.

Roadmap

Before 2009 Promoting independent mission by China;

From 2009 Starting the multi-lateral collaboration work;

2009~2011 Constructing the ground segment and data analysis center

2010~2012 Developing and testing key payloads;

2011~2013 Approving the mission together with CNSA

2013~2015 Launching one or two pairs of the GRACE like mission together with oversea agencies, where one pair of S/Cs flying at low inclination angle orbit.

2015~2020 Analyzing/Validating/Calibrating the variations of Chinese regional and global water distribution, using multi-missions data.

Interest in GRACE Stop-Gap Mission(s)

The ongoing discussion of formal collaborative agreement between Chinese Academy of Sciences and NASA on specific cooperation on space geodetic infrastructures and satellite missions should help the possibility of a potential collaboration of GRACE Stop-Gap satellite mission. The planned GRACE laser interferometric tracking instrument development (talk by Professor Lau in this Session, Project Leader: Professor Hu, Institute of Mechanics, CAS) will be part of the long-range plan to develop satellite gravity missions.

Several Words about Ground Segments

Geo-science satellite ground segments, include the TT&C, a couple of 10-12m antenna, geo-science data analysis center is planned to be accomplished in a couple of years at SHAO/CAS.

As polar stations are playing important roles for geo-satellite gravity missions, SHAO/CAS and Polar Research Center of National Ocean Administration start to discuss about constructing Geo-science satellite TLM and downlink scientific data receiving system at polar stations, Yellow River Station and Great Wall Station.

Thank You ！

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