GAMBLE

WP4 –Scientific/Technical theme 3 – Orbit Determination and Tracking

Summary Report

December 2002

1. Introduction

This is a summary of discussions and contributions made to GAMBLE work package 4. It provides an overview of information that will be presented in the final report for this work package. The final report will discuss the requirements for tracking and orbit determination that are necessary to satisfy the user needs contained in the sea state (WP3) and sea surface height (WP2) reports.

Contributions have been gained from a wide variety of sources. A GAMBLE workshop was held in Delft in November 2002 where key issues were further debated.

Until the final report is completed (due in April 2003) readers who desire further detail are directed to the WP4 interim report and WP4 submissions available on the GAMBLE website (http:/www.altimetrie.net/theme3_workshop.shtml).

2. Orbit choice

The final recommendations concerning orbit choice shall be made under GAMBLE Work Package 8: Constellation optimization. Still at this point, the following suggestions can be made:

In order to obtain multi-decadal time-series of altimetry data over the same ground tracks, the orbit choices of both TOPEX/Poseidon/Jason and ERS-1/ ERS-2/Envisat must be adopted for their follow-on missions.

Solar activity will be at a minimum in its 11-year period around 2006. Still, if GRACE models have eliminated the gravity-induced radial orbit error, drag perturbations will likely remain a large error source at lower altitudes. The choice of a high altitude orbit is recommended.

3. Tracking systems

Future high-accuracy altimeter satellites should carry either a GPS/Galileo or DORIS receiver for high-accuracy, near continuous tracking.

In addition, a laser retro reflector is required for several purposes: for additional high-accuracy tracking, for validation of the radiometric tracking, for calibration of the altimetric range, and as a fail-safe backup tracking device,

The TOPEX/Poseidon and Jason missions have proven that each of the three available tracking devices (SLR, DORIS and GPS) adds unique valuable information to the computed orbits and to the improvement of force and measurement models. It is

therefore recommended to take this combination into consideration for the follow-on missions of Jason and Envisat as well.

4. Other general issues

When real-time orbits are required, the DORIS/DIODE navigator system is a flight-proven technology. Onboard orbit determination at the same precision using GPS is more difficult, because of the need for auxiliary information. However, this might also become possible in the near future.

In the design of new satellites, often a large solar array will be required in order to generate sufficient power. Also, mass must often be minimized in order to reduce launch costs. Despite this, it is still advisable to take the area to mass ratio into account during the design of altimetry satellites. A low area to mass ratio can greatly improve dynamic orbit determination, because of the lower sensitivity to surface forces.

5. GANDER specific issues

A high-precision tracking system for GANDER only needs to be considered if its altimeter instrument is upgraded for making sea-height measurements. Otherwise, the use of NORAD elements might be sufficient.

If sea-height measurements will be part of the GANDER products, it might be possible to use crossovers with a reference-class mission such as Jason, in order to generate GANDER orbits. These orbits will likely be accurate enough to study meso-scale ocean signals. However, because crossovers only contain information in the radial direction, another means of tracking will be required to fix the orbit in the along-track and cross-track directions.

6. Conclusions

Several recommendations for the planning of future altimeter missions can be made using the details on tracking systems and precise orbit determination presented in the interim report. Some of these recommendations might conflict with each other, or with restrictions on costs, mass, etc. In these cases, further discussion could be required, both inside or outside the framework of GAMBLE.

Appendix – Contributors to the GAMBLE Orbits and Tracking Work Package

Contributor	Topic
Eelco Doornbos (DEOS, TU Delft, The Netherlands)	Orbit solutions and precise orbit determination (GAMBLE WP4 Leader)
Ron Noomen (DEOS, TU Delft, The Netherlands)	Satellite Laser Ranging
Patrick Vincent (CNES, France)	DORIS systems
D. Svehla and M Rothacher (FESG/ IAPG, TU Munich, Germany	GPS Orbit determination
M Meerman (SSTL, Guildford, UK)	GNSS/GPS micro-satellite applications
P. Moore (U Newcastle, UK)	Precise Orbit Determination, Cross Over Orbit Reduction
C.K. Shum (Ohio State University, USA)	Orbit choices and orbit issues
P Visser (DEOS, TU Delft, The Netherlands)	Gravity Field Modelling
P-Y le Traon (CLS, Toulouse, France)	Sea Surface Height Issues
David Cotton (Satellite Observing Systems, UK)	Sea State Issues