MONITORING GEOIDAL POTENTIAL ON THE BASIS OF TOPEX/POSEIDON ALTIMETER DATA

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With the availability of high precision TOPEX/POSEIDON (T/P) and ERS-1 altimeter data [Nerem et al., 1993, Ménard et al., 1994, Le Traon et al., 1995], the determination of geoidal geopotential W_o and/or the geopotential scale factor $R_o=GM/W_o$ has entered a new era.

Introduction

Since they do not limit the actual accuracy of the solution, the geocentric gravitational constant [Ries et al., 1992] $GM = (398600441.8 \pm 0.8) \times 10^6 \ \text{m}^3\text{s}^{-2}$ and the mean angular velocity of the Earth's rotation [IAG SC3 Rep., 1995] $omega= 7292115 \pm 10^{-11} \ \text{rad s}^{-1}$ can be adopted. The T/P and ERS-1 altimeter data made available to us by the AVISO Altimetry Project [AVISO, 1995] and the sea surface topography (SST) model POCM4B (360x360), based on a global circulation model [Rapp et al., 1996], made it possible to significantly refine the previous GEOSAT altimeter data solutions and commence monitoring of W_o and R_o.

Monitoring of W_o and R_o.

Continuous monitoring of the geoidal geopotential W_o and geopotential scale factor R_o has been initiated on the basis of T/P, cycles 7-171 (Nov 20, 1992 - May 15, 1997), see Figure 1. The formal rms of W_o and R_o are about $\pm0.016 \ \text{m}^2\text{s}^{-2}$ (±1.6 mm) for monthly and about $\pm0.005 \ \text{m}^2\text{s}^{-2}$ (±0.5mm) for yearly solutions, respectively. The mean yearly values are quite stable; see Table 1. However, the TOPEX altimeter calibration error limits the actual accuracy of the W_o and R_o values to about $\pm0.3 \ \text{m}^2\text{s}^{-2}$ and ±3 cm, respectively [Ries, personal comm., 1996]. The W_o and R_o changes due to the differences in recent geopotential models, as well as due to the degree (>90) of retained harmonic expansions, are not significant [Burša et al., 1997a].

Year	W_0 (m^2 s^{-2})	R_0 (m)
1993	62 636 855.712 ±0.005	6 363 672.5898 ±0.0005
1994	62 636 855.719 ±0.005	6 363 672.5891 ±0.0005
1995	62 636 855.708 ±0.005	6 363 672.5901 ±0.0005
1996	62 636 855.724 ±0.004	6 363 672.5886 ±0.0004

Table 1
Yearly mean values of geoidal potential W_o and of the geopotential scale factor R_o
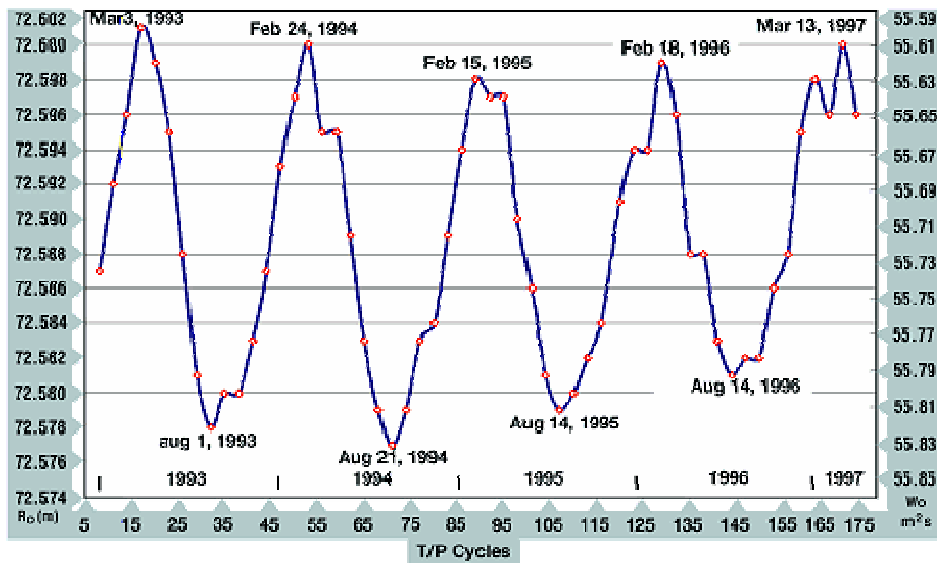

Figure 1
Monthly variation in W_0 (62 636 800 m^{2}s^{-2} subtracted) and R_0
(6 363 600 m subtracted).

There are annual variations with an amplitude of about 0.10 m^{2}s^{-2} in W_o and 10 mm for R_o (Figure 1). The annual and other systematic variations are due to the seasonal variations of the sea surface. Their origin should be sought in the ocean dynamics and geodynamics.

The permanent W_o / R_o monitoring should enable an investigation of the long-term variations in the volume defined by the surface $W= W_o$ as well as unmodeled long-term variations in T/P orbits [Burša et al., 1997b].

Acknowledgments

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