ON COMPUTATION OF WEEKLY DORIS SOLUTIONS FOR 1999-2001 TIME PERIOD

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ABSTRACT *- This paper presents results of the global DORIS network data processing, carried out at the INASAN Analysis Center by the use of measurements from all satellites having onboard DORIS receivers (SPOT2+SPOT4+TOPEX/POSEIDON) for the time period April, 1999-December, 2001. Data analysis was performed with the use of GIPSY/OASIS software (LINUX version). Time series of weekly station coordinates in the ITRF2000 system are discussed. The so-called free-network approach for a simultaneous estimation of station coordinates and Earth's orientation parameters has been applied.*

A general description of the methods used at the INASAN Analysis Center for DORIS data processing has been reported two years ago [Kuzin S.P. and S.K.Tatevian, 2000]. This solution was performed with the use of GIPSY/OASIS-2 software in LINUX OS, developed at JPL together with ENSG/LAREG. The method of analysis is a dynamical one and consists of computing of satellites orbital parameters, site positions and Earth's orientation parameters in a single inversion. Orbital parameters are estimated on a daily basis, using 24 hours measurements from all satellites having onboard Doris receivers (SPOT2+SPOT4+ TOPEX/POSEIDON). The so-called free-network approach was applied. Every daily solution was obtained with the use of loose constraints in station coordinates (an apriori value of standard deviation is 100 m). For estimation of all daily station coordinates solutions in a uniqe reference frame, a specific procedure [Willis 96; Willis 97; Willis et al. 98; Dorie 97], based on the technology similar to the methodics of GPS data analysis developed at the JPL, has been used.

The period: 11.04.1999-23.12.2001 (141 weeks) was chosen for the analysis of DORIS data from all operating stations of the DORIS network. It should be mentioned that during this period the measurements of three DORIS satellites

(SPOT2 + POT4 + TOPEX/POSEIDON) were available. The days, when maneuvers of satellites took place, were excluded in most cases. The total amount of maneuvers is 30 (for SPOT 2), 31 (for SPOT 4) and 10 (for TOPEX). All derived weekly solutions were obtained in the same reference frame (ITRF2000) with the accuracy depending on a quality of the DORIS solution itself and on the accuracy of the adopted reference system at the epoch of measurements.

Time series of weekly DORIS solutions for the coordinates (3 components) of several stations, located at the Eurasian plate, are plotted (Fig. 1). Along the ***y*** axis the differences between weekly values of coordinates (longitude, latitude and radial) and the values at the mean date of the first processed week (April 14,1999) are shown. Repeatability of station coordinates are estimated at the level 30-80 mm and standard deviations –1.5-5.0 cm. A small slope of the fitting curves of all three components is evident, but it varies for different sites and is smaller for the radial components. The rates (or velocities) of the sites were determined on the whole time period (3 years) in multi- satellite and multi- year solution. The meanings of the horizontal velocity vectors and their directions are presented in Table1. A comparison with GPS results for three collocated sites are also presented. There is a rather good agreement in directions of the velocity vectors. Discrepancies of absolute values of horizontal velocities may be explained by differences of time periods of measurement data used for estimation.

Trying to find periodicity of deviations of station coordinates, we used the Fourier Transformations for the analysis of time series of weekly coordinates. It was found (Table.2) that a period, close to one year, is inherent in all components of the stations positions, but it shows itself more obvious for radial (height) components. These studies will be continued with the use of more long time series of DORIS and GPS data for collocated sites.

ACKNOWLEDGEMENTS

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Site	DORIS (1999-2001)		GPS	
	V_h (mm/y)	*A* (degree)	V_h (mm/y)	*A* (degree)
BADA	21.3	81.4	–	–
DIOA	32.1	128.0	–	–
EVEB	62.0	57.7	–	–
KITB	11.7	77.4	28.0	82.7 (1999.0 – 2002)
KRAB	14.5	93.0	24.5	99.2 (1999.5 – 2002)
META	11.8	96.8	23.3	59.0 (1992.5 – 2002)
PURA	48.0	80.6	–	–
TLHA	41.2	43.4	–	–

Table 1. ***Vectors of horizontal velocities of the stations, derived from the 3-years DORIS data analysis. Comparison with the GPS data.***

Station		.LAT	.LON	.RAD
BADA (*BADARY*)	*P(d)*	406.7	379.9	346.7
	A(cm)	**1.13**	**1.33**	**3.50**
DIOA (*DIONYSOS*)	*P(d)*	368.8	266.7	339.3
	A(cm)	**2.21**	**1.09**	**3.28**
EVEB (*EVEREST*)	*P(d)*	286.4	365.5	347.8
	A(cm)	**2.54**	**3.40**	**2.47**
KITB (*KITAB*)	*P(d)*	308.0	258.9	336.8
	A(cm)	**1.48**	**1.28**	**2.41**
KRAB (*KRASNOYARSK*)	*P(d)*	392.5	395.0	390.7
	A(cm)	**1.68**	**2.09**	**3.53**
META (*METSAHOVI*)	*P(d)*	340.8	271.4	306.5
	A(cm)	**0.98**	**0.75**	**2.89**
PURA (*PURPLE MOUNTAIN*)	*P(d)*	309.9	368.1	349.5
	A(cm)	**2.80**	**1.77**	**4.80**
TLHA (*TOULOUSE*)	*P(d)*	330.3	270.5	330.3
	A(cm)	**2.05**	**1.33**	**2.81**

Table 2. ***Periodicity of the stations coordinates derived from the 3-years DORIS data analysis (P – oscillation period in days, A – amplitude of oscillation in cm)***

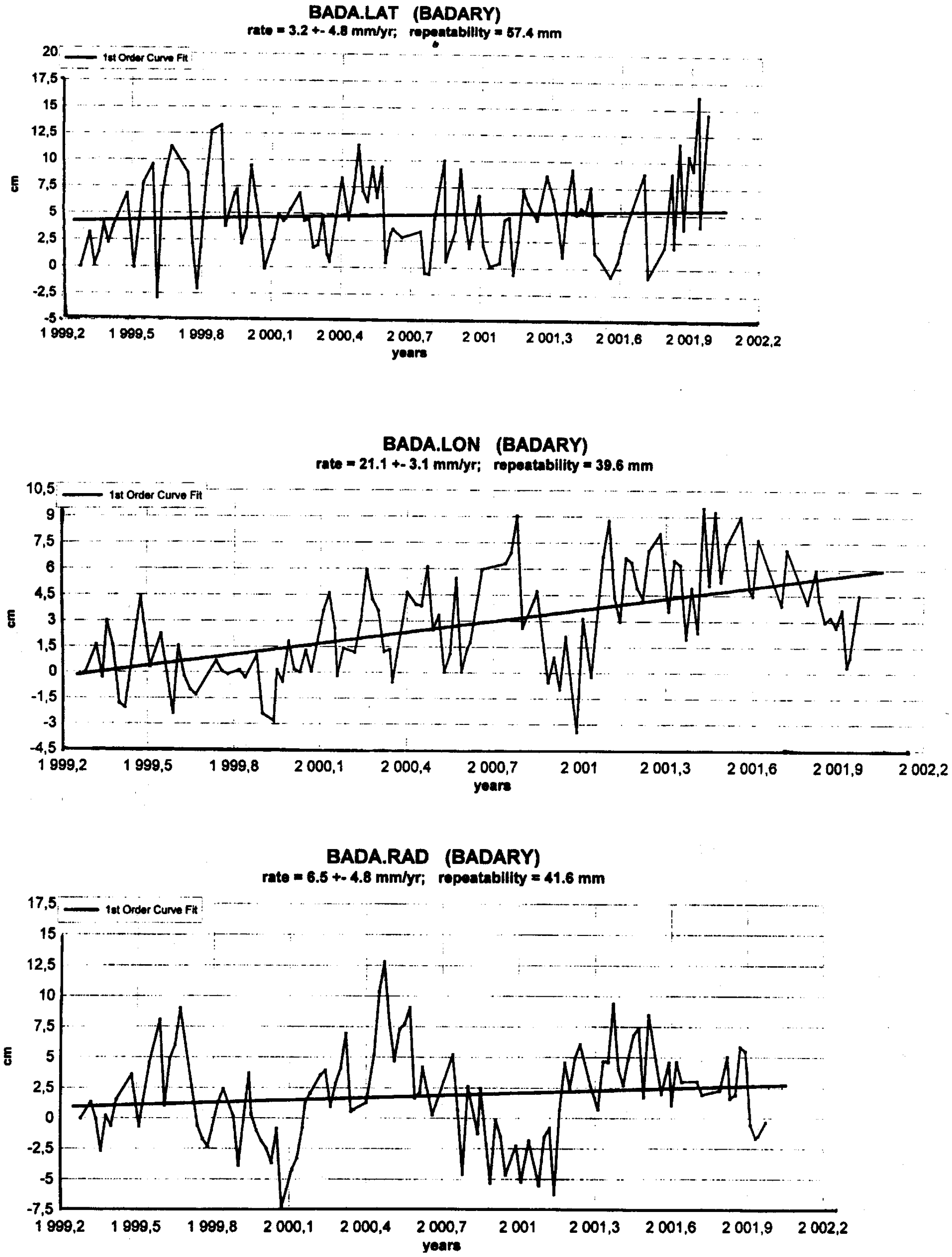
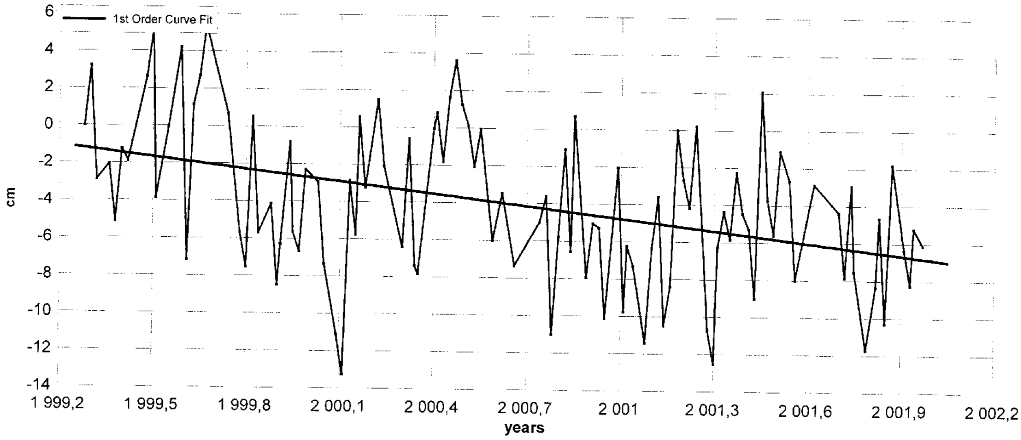


Fig.1. Variations of 3-d coordinates of several (Eurasian) DORIS stations for the time-period April, 1999 - December, 2001.

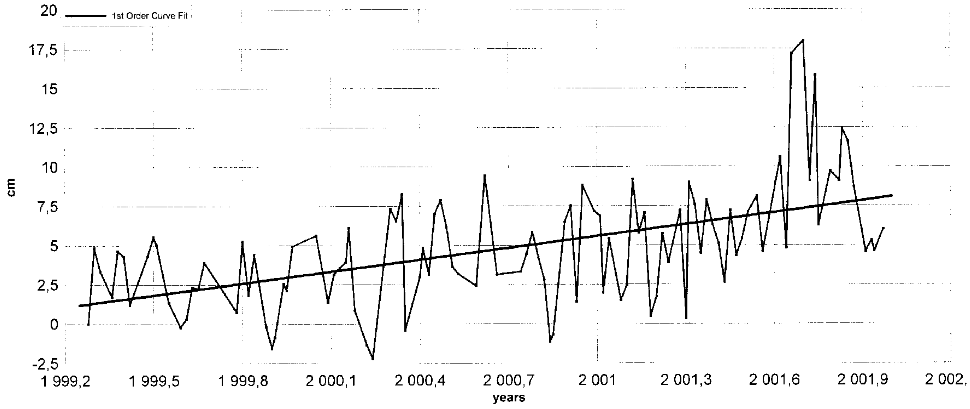
DIOA.LAT (DIONYSOS)

rate = - 19.9+- 4.7 mm/yr; repeatability = 59.3 mm



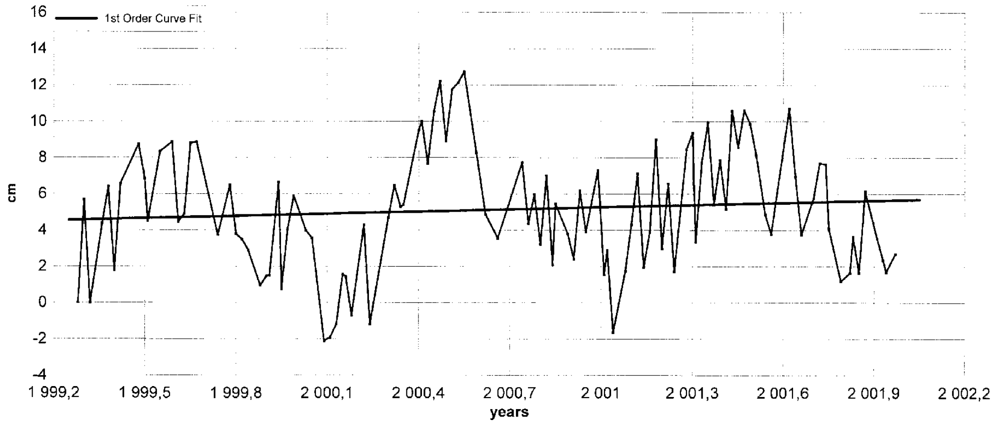
DIOA.LON (DIONYSOS)

rate = 25.3 +- 4.0 mm/yr; repeatability = 59.0 mm



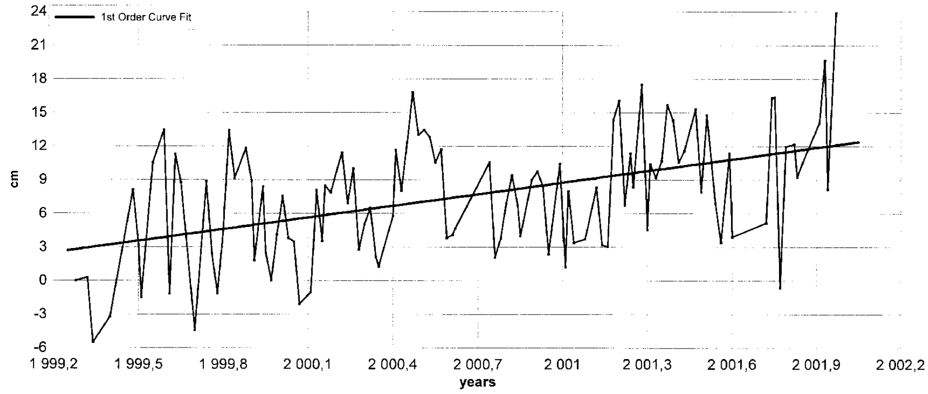
DIOA.RAD (DIONYSOS)

rate = 4.3 +- 4.2 mm/yr; repeatability = 63.1 mm



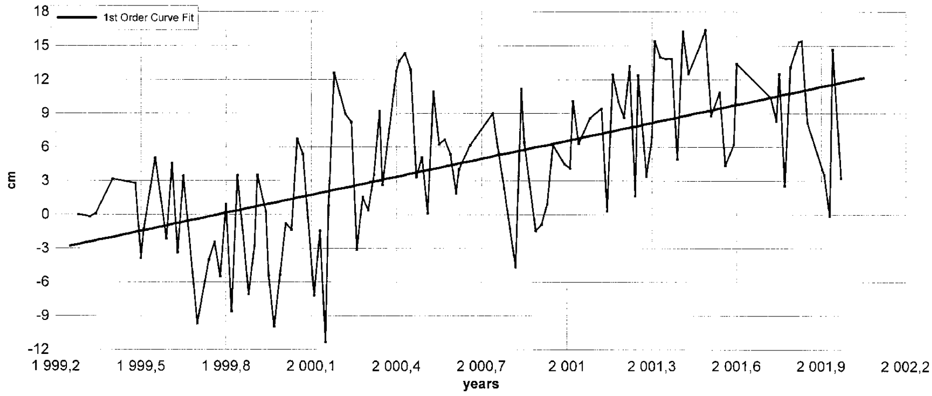
EVEB.LAT (EVEREST)

rate = 33.2 +- 6.3 mm/yr; repeatability = 89.9 mm



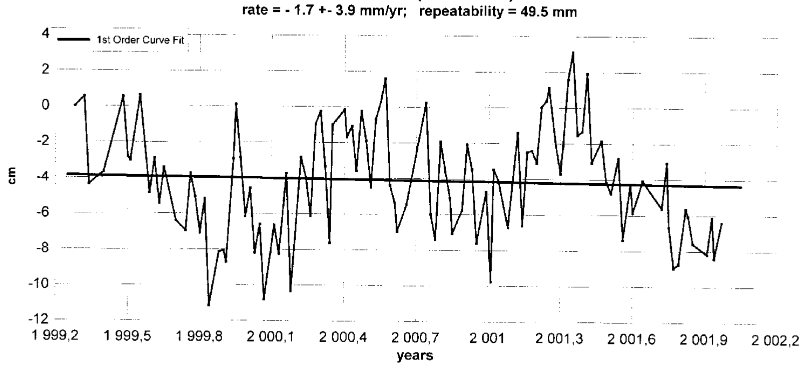
EVEB.LON (EVEREST)

rate = 52.4 +- 6.9 mm/yr; repeatability = 81.6 mm



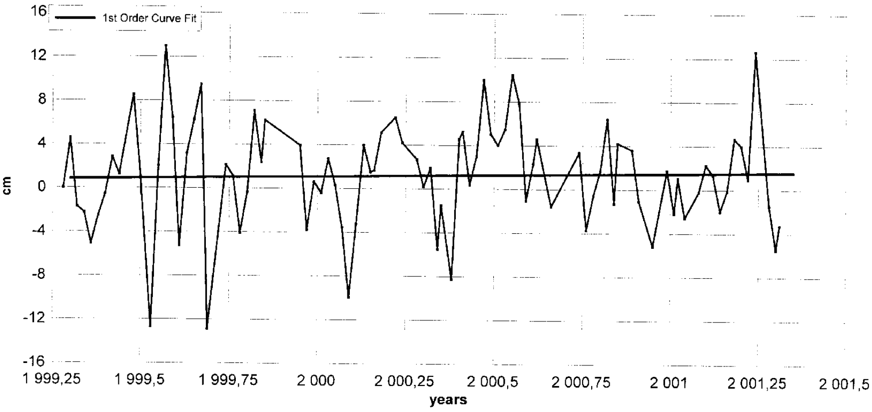
EVEB.RAD (EVEREST)

rate = - 1.7 +- 3.9 mm/yr; repeatability = 49.5 mm



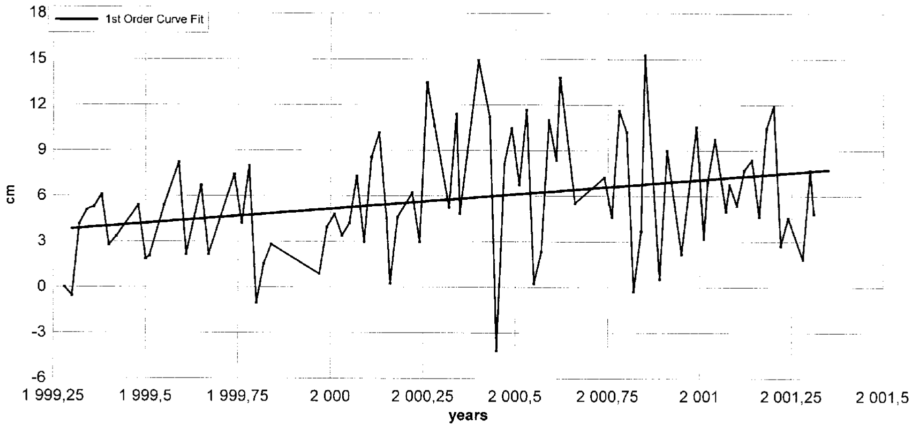
KITB.LAT (KITAB)

rate 2.5 +- 8.5 mm/yr; repeatability = 50.7 mm



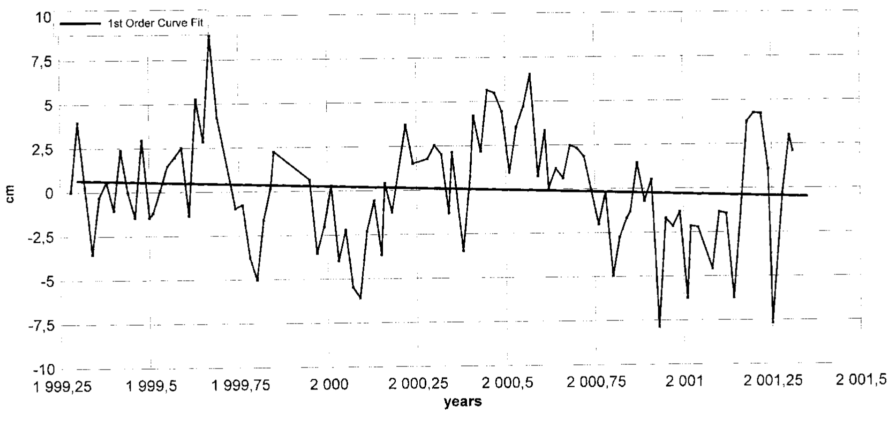
KITB.LON (KITAB)

rate = 11.4 +- 8.0 mm/yr; repeatability = 37.9 mm

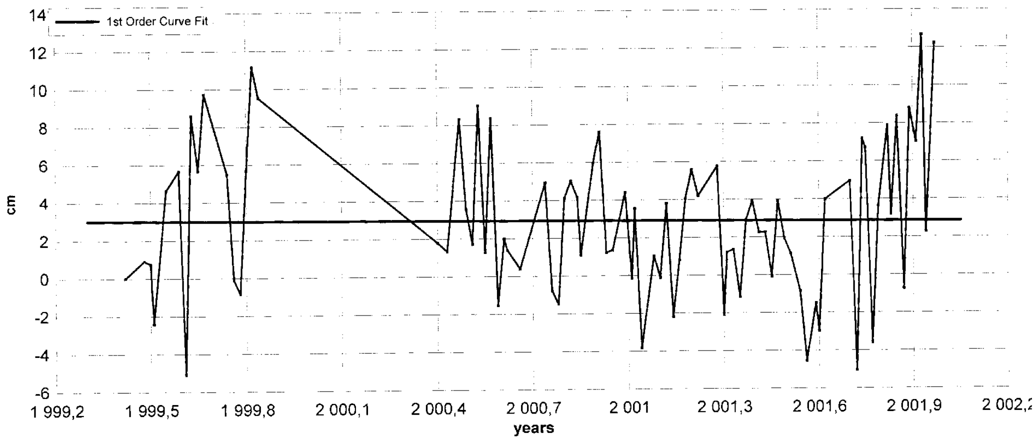


KITB.RAD (KITAB)

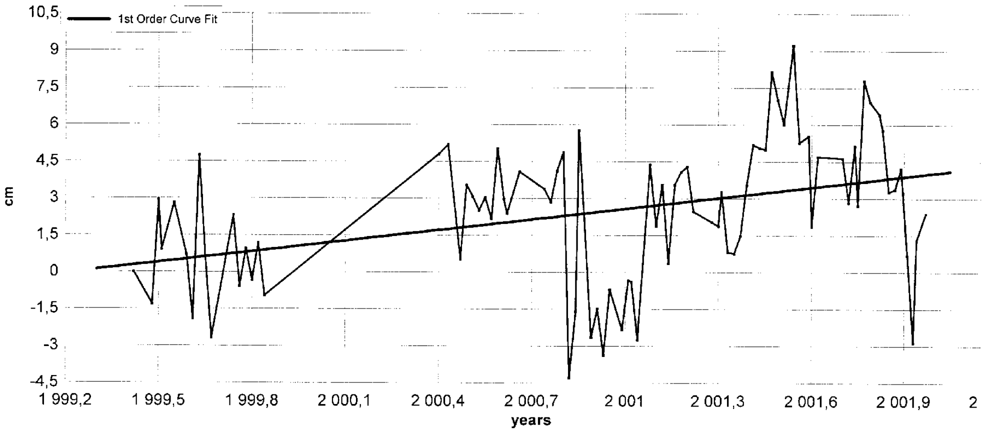
rate = -4.3 +- 5.2 mm/yr; repeatability = 37.6 mm



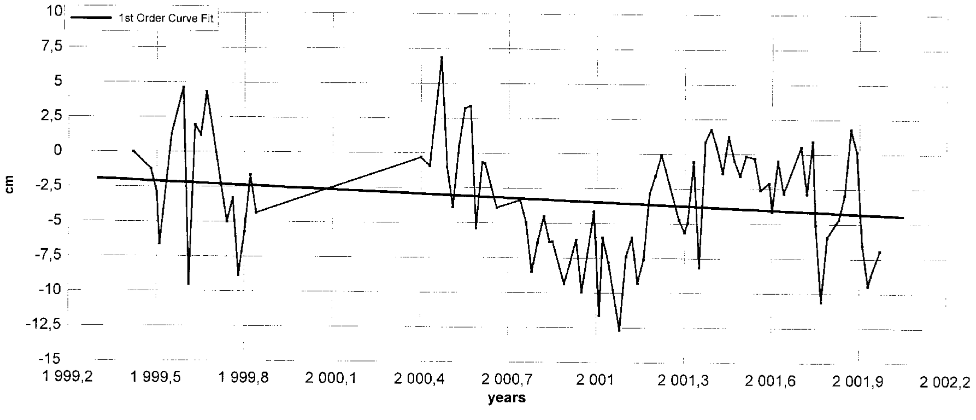
KRAB.LAT (KRASNOYARSK)
rate = - 0.6+- 5.9 mm/yr; repeatability = 44.8 mm



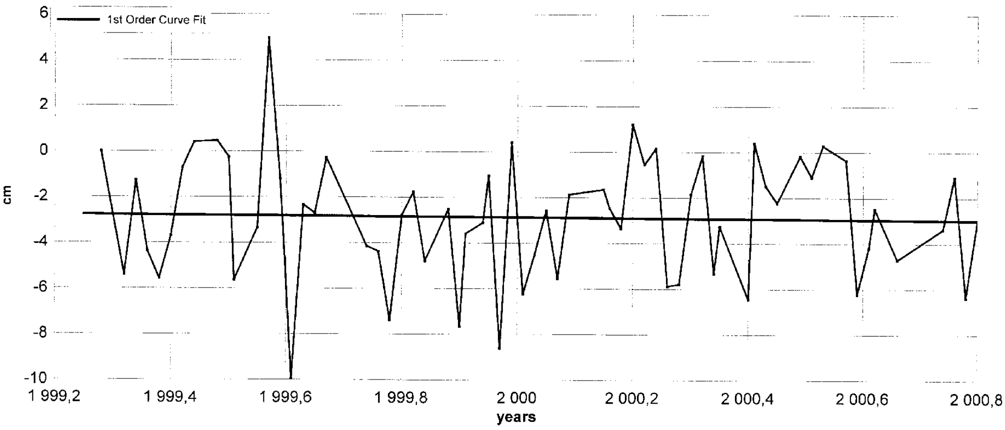
KRAB.LON (KRASNOYARSK)
rate = 14.5 +- 3.9 mm/yr; repeatability - 37.7 mm



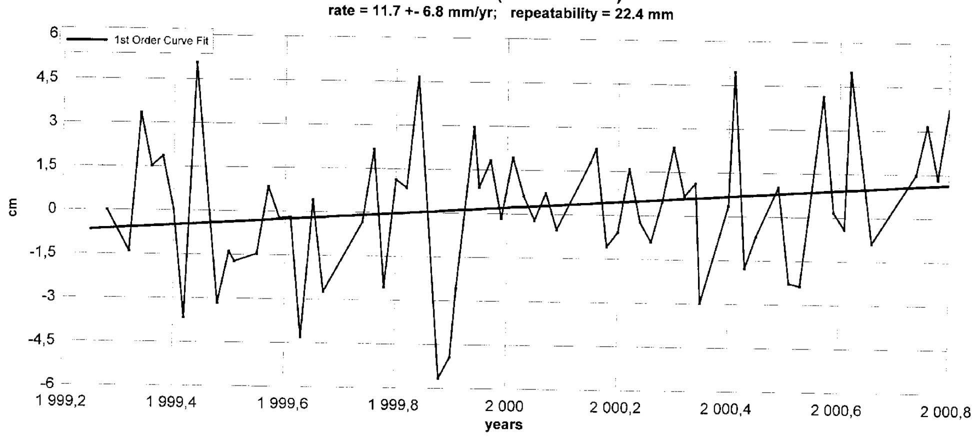
KRAB.RAD (KRASNOYARSK)
rate = - 9.2 +- 5.9 mm/yr; repeatability = 54.3 mm



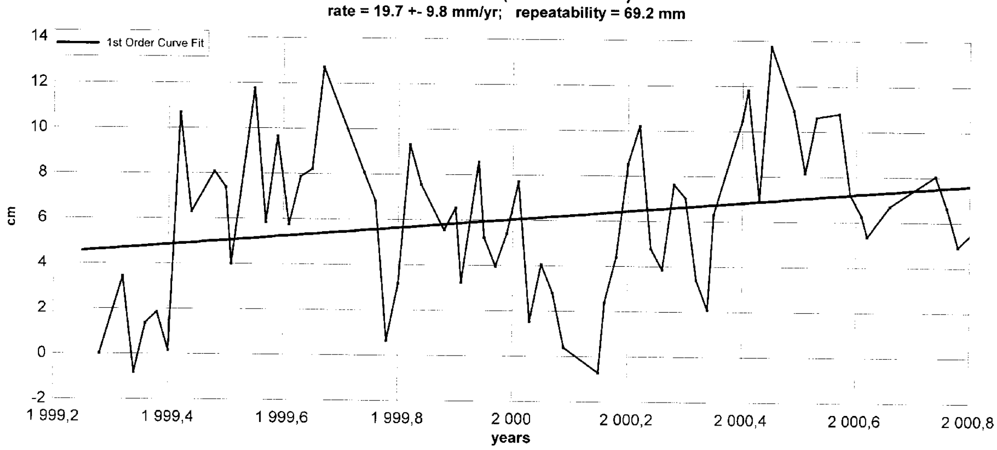
META.LAT (METSAHOVI)
rate = - 1.4 +- 7.9 mm/yr; repeatability = 40.2 mm



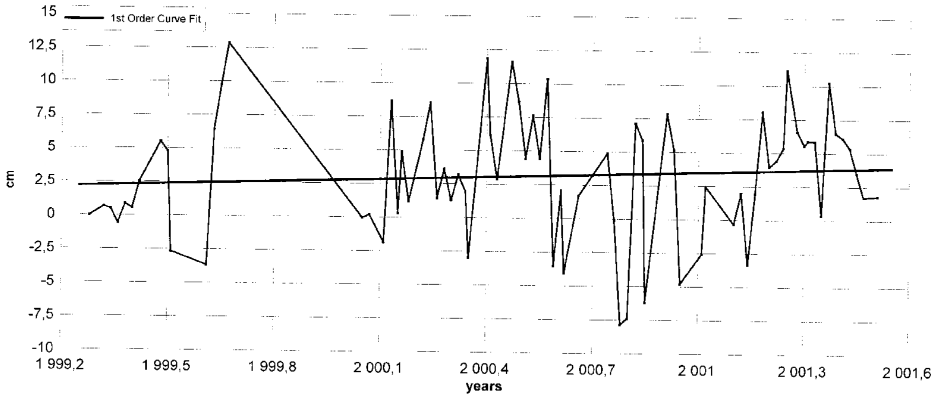
META.LON (METSAHOVI)
rate = 11.7 +- 6.8 mm/yr; repeatability = 22.4 mm



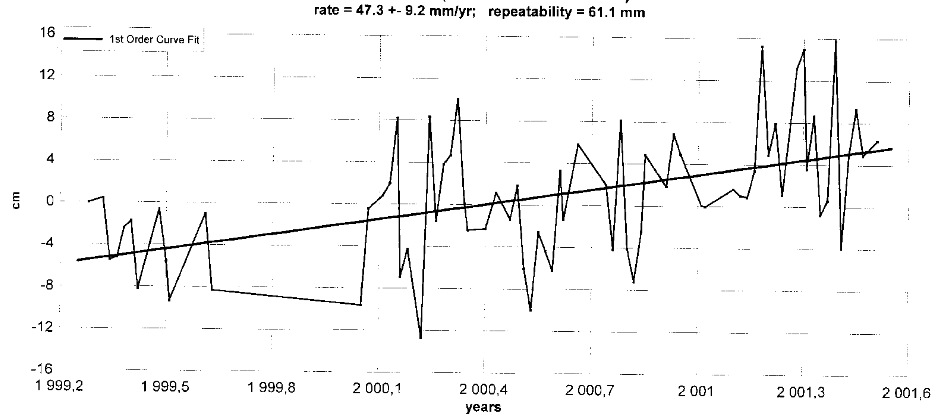
META.RAD (METSAHOVI)
rate = 19.7 +- 9.8 mm/yr; repeatability = 69.2 mm



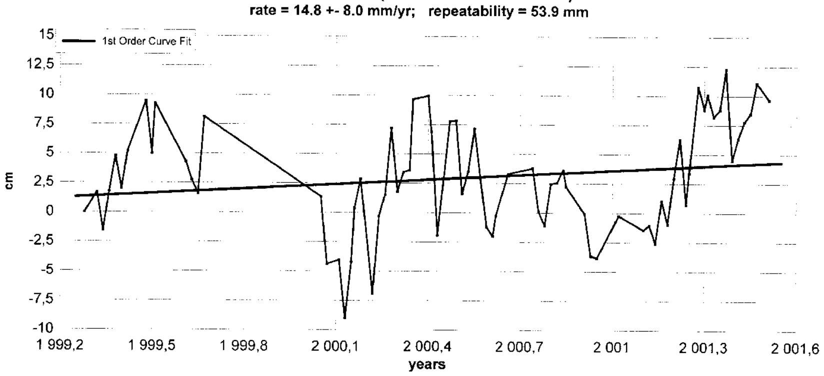
PURA.LAT (PURPLE MOUNTAIN)
rate = 7.8 +- 8.1 mm/yr; repeatability = 50.2 mm

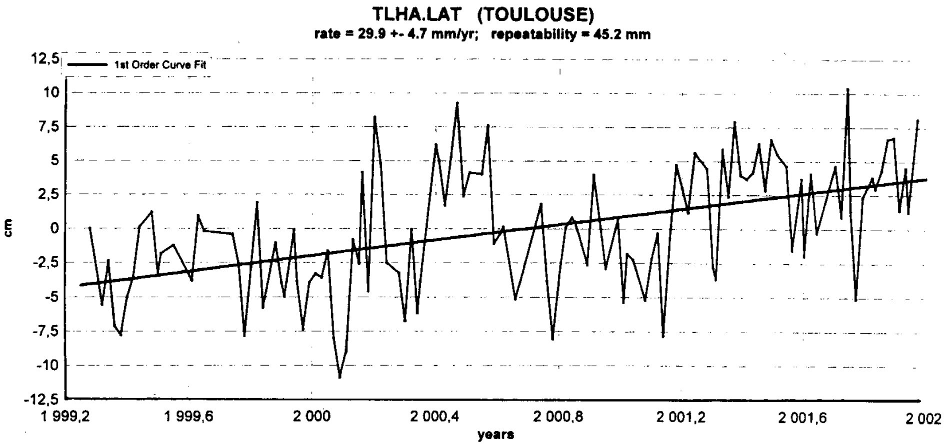


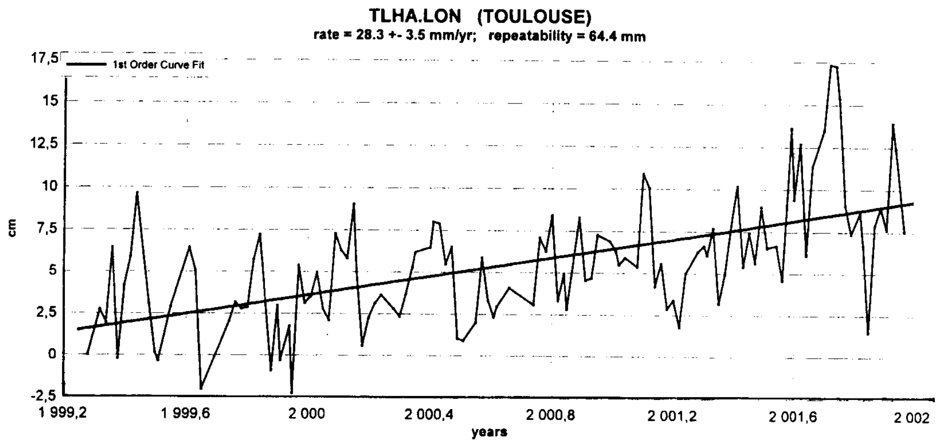
PURA.LON (PURPLE MOUNTAIN)
rate = 47.3 +- 9.2 mm/yr; repeatability = 61.1 mm

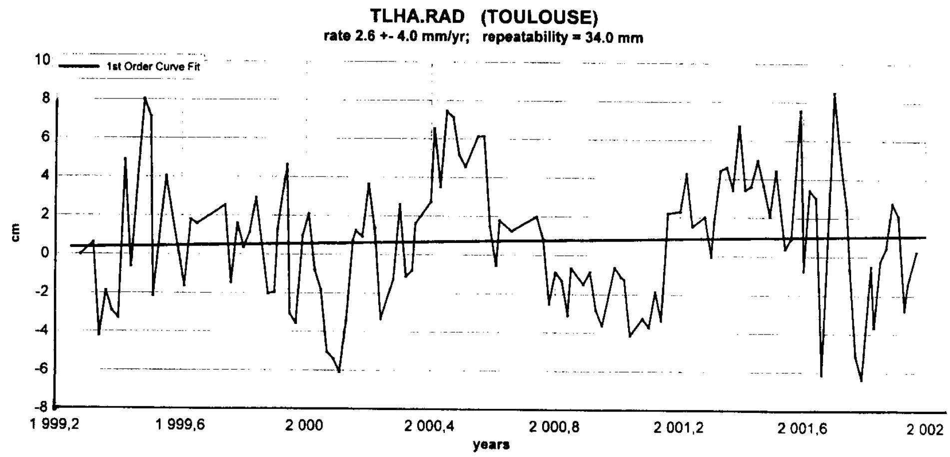


PURA.RAD (PURPLE MOUNTAIN)
rate = 14.8 +- 8.0 mm/yr; repeatability = 53.9 mm




TLHA.LAT (TOULOUSE)
rate = 29.9 +- 4.7 mm/yr; repeatability = 45.2 mm
1st Order Curve Fit
cm
years
12,5
10
7,5
5
2,5
0
-2,5
-5
-7,5
-10
-12,5
1 999,2
1 999,6
2 000
2 000,4
2 000,8
2 001,2
2 001,6
2 002


TLHA.LON (TOULOUSE)
rate = 28.3 +- 3.5 mm/yr; repeatability = 64.4 mm
1st Order Curve Fit
cm
years
17,5
15
12,5
10
7,5
5
2,5
0
-2,5
1 999,2
1 999,6
2 000
2 000,4
2 000,8
2 001,2
2 001,6
2 002


TLHA.RAD (TOULOUSE)
rate 2.6 +- 4.0 mm/yr; repeatability = 34.0 mm
1st Order Curve Fit
cm
years
10
8
6
4
2
0
-2
-4
-6
-8
1 999,2
1 999,6
2 000
2 000,4
2 000,8
2 001,2
2 001,6
2 002