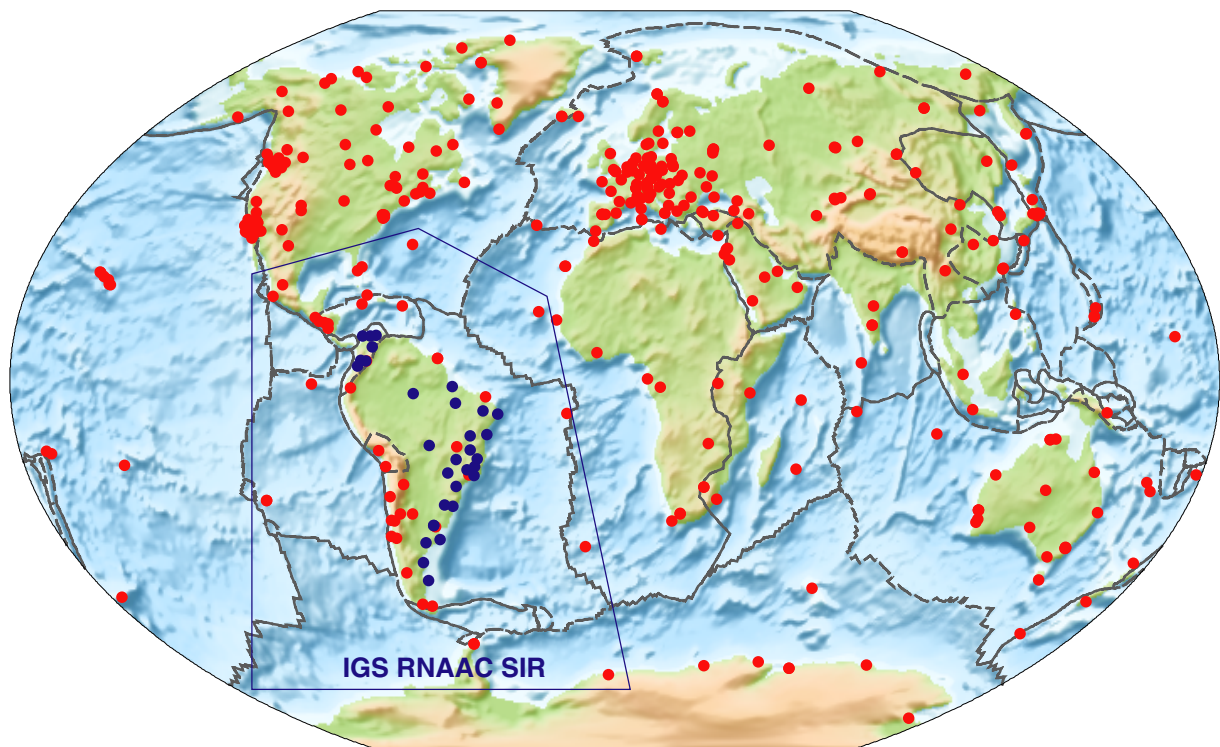


**DGFI Report  
No. 76**

**Station Positions and Velocities of  
the IGS Regional Network for SIRGAS**

WOLFGANG SEEMÜLLER, KLAUS KANIUTH, HERMANN DREWES



Deutsches Geodätisches Forschungsinstitut  
Marstallplatz 8, D-80539 München / Germany  
2004



# Station Positions and Velocities of the IGS Regional Network for SIRGAS

W. Seemüller, K. Kaniuth, H. Drewes  
Deutsches Geodätisches Forschungsinstitut, München/Germany

## Content

1	Introduction	1
2	IGS Regional Network Associate Analysis Center for SIRGAS (RNAAC SIR)	1
3	Station Positions and Velocities Solution 2004	2
4	Earthquakes in the Region	3
5	References	3

## Tables

Table 1: Main characteristics of IGS RNAAC SIR processing	1
Table 2: Receivers and antennae of the GPS stations	4
Table 3: Geocentric station positions and velocities of solution DGFI04P01	6
Table 4: Ellipsoidal station positions and velocities of solution DGFI04P01	7

## Figures

Fig. 1: IGS RNAAC SIR network	9
Fig. 2: Horizontal velocities of solution DGFI04P01	11
Fig. 3: Vertical velocities of solution DGFI04P01	13
Fig. 4: Earthquake signals (excluded from processing)	15
Fig. 5: Station displacements due to earthquakes	17
Figs. 6.1 ... 6.10: Time series of IGS stations used as fiducials (CRO1, KOUR, FORT, ASC1, SANT, EISL, RIOG, LPGS, OHIG, OHI2)	19
Figs. 7.1 ... 7.68: Time series of RNAAC SIR stations	26
Antarctica (PALM, VESL)	26
Argentina (UNSA, TUCU, CFAG, CORD, IGM0, IGM1, MPLA, VBCA, RWSN)	27
Barbados (BARB)	31
Brazil (IMPZ, MANU, CRAT, RECF, BOMJ, SALV, CUIB, VICO, MCLA, UBER, GVAL, VARG, BRAZ, CHPI, BELE, RIOD, PARA, UEPP, POAL, SMAR)	32
Chile (IQQE, COPO, VALP, CONZ, ANTC, PARC)	42
Colombia (CART, VALL, CUCU, PERA, BOGT, BOGA, CALI)	45
Costa Rica (MOIN)	48
Cuba (SCUB)	49
Ecuador (RIOP, GALA, GLPS)	49
El Salvador (SSIA)	51
Guatemala (GUAT)	51
Honduras (TEGU/TEG1, SLOR)	52
Jamaica (JAMA)	53
Mexico (CIC1, INEG, MANZ)	53
Nicaragua (ESTI, MANA)	55
Peru (AREQ, ARE2)	56
United Kingdom (BRMU, GOUG)	57
USA (RCM5/RCM6, AOML, PUR3)	58
Venezuela (MARA)	59



## 1 Introduction

The International GPS Service (IGS) started a densification of its global network and of the IERS Terrestrial Reference Frame (ITRF) by regional networks in June 1996. The global IGS network is processed by (at present) ten Analysis Centres (AC), and the regional networks by each one Regional Network Associate Analysis Centre (RNAAC). All the global and regional network solutions are combined to a global polyhedron by two Global Network Associate Analysis Centres (GNAAC). The Deutsches Geodätisches Forschungsinstitut (DGFI) is acting as the RNAAC SIR for the Geocentric Reference System for the Americas (Sistema de Referencia Geocéntrico para las Américas, SIRGAS).

## 2 IGS Regional Network Associate Analysis Centre for SIRGAS (RNAAC SIR)

The IGS RNAAC SIR generates a coordinate solution including all the available GPS data of the regional network and delivers it to the IGS Global Data Centres each week. The number of processed stations is increasing continuously. By the end of November 2004 the RNAAC network consists of 84 stations (53 global and 31 regional stations, figure 1). As some stations do not always provide their data in time to be included in the processing (AUTF, BHMA, COYQ, TGCV, VALP) or have ceased operation (BARB, ESTI, INEG, MOIN, RCM5/6, RIOP, SLOR, SSIA, TEGU/TEG1) the coordinate set is often not complete.

The processing software used at RNAAC SIR is the Bernese Processing Engine (BPE). We started with version 4.1, currently the version 4.2 (Hugentobler et al. 2001) is installed, and in the near future we'll switch over to the latest version 5.0. The current main characteristics of the procedure are shown in table 1. Also different computer platforms were in operation (GPS weeks 0860-0885: HP 9000 Series 700; GPS weeks 0886-1143: IBM AIX; since GPS week 1144: Pentium 4 2.8 GHz). The processing strategy was always changed according to the latest developments of computers, models and research.

The results of the processing depend, besides of the observations, on the station data. Table 2 shows the used receivers/antennae and antennae heights of the processed GPS stations (shown is the latest status; several changes occurred over the years). The final (precise) IGS orbits (IGSwwwd.SP3, www = IGS week, d = day of the week), which refer to ITRF2000, and the IGS Earth Orientation Parameters (IGSwwwd.ERP) are used (see table 1).

**Table 1: Main characteristics of IGS RNAAC SIR processing**

---

Start of processing:	June 30, 1996, GPS week 0860	(test phase during weeks 0847 - 0859)
Software used:	Bernese GPS software version 4.2	(version 4.1 before week 1144)
Analysis approach:		
Sampling rate:	30 sec. for 1-day solution	(before GPS week 1053: 300 sec.)
Elevation cutoff:	10°	(before GPS week 1053: 15°)
Orbits/EOP:	IGS final referred to ITRF 2000	(before GPS week 1143: ITRF94/96)
Troposphere:	zenith delay estimated each 2 hours	(before GPS week 1053: 4 h)
	a priori sigmas applied with respect to prediction model:	
	- first parameter +/- 5m absolute	
	- following parameters +/- 10 cm relative	
Ambiguities:	partly resolved, remaining ambiguities estimated as real values with no a priori constraints (QIF of BPE)	
Ocean loading:	implemented since GPS week 1156	
Station coordinates	(daily) estimated in a "free" network adjustment, a priori sigmas 1 m,	
	→ daily normal equations	
Station coordinates	(weekly) accumulated daily normal equations and solutions	
	→ weekly SINEX file	

---

### 3 Station Positions and Velocities Solution 2004

Combined solutions for estimating the kinematics of the network were performed almost regularly during the past years (e.g. Seemüller et al. 2002). The latest realisation dates back to November 2002. Since then many new permanent stations joined the network. Therefore, a new solution DGFIO4P01 was computed which covers the time period from June 30, 1996 to July 31, 2004. This allows the estimation of reliable velocities more precisely and for much more stations than in the previous solutions. The combined adjustment is done with the programme ADDNEQ of the Bernese software 4.2 (Hugentobler et al. 2001) without any major modifications, and is based on the weekly SINEX files regularly submitted by the RNAAC SIR to the IGS. The main features of the adjustment are:

- Inversion of the weekly SINEX files to free normal equations and removing the loose constraints included in the weekly solutions;
- Accumulation of all normal equations and parameter transformation from weekly epoch coordinates to coordinates at the reference epoch 2003.0 and linear velocities;
- Accounting for antenna height or antenna phase centre offset errors, which could not be corrected at the stage of the operational weekly processing, by according transformation of the right hand side of the normal equations;
- Analysis of time series of inter-station vectors, which are not sensitive to the datum, in order to identify remaining outliers; reduction of outliers from the normal equations;
- Identification of position discontinuities due to episodic effects such as co-seismic displacements or antenna configuration changes, and set-up of appropriate parameters in the combined adjustment;
- Introduction of the positions at epoch 2003.0 and the velocities of fiducial stations selected for realising the reference frame, and application of appropriate weights or condition equations.

The last issue is of particular importance for the SIRGAS network because the ITRF2000 (Altamimi et al. 2002; <http://lareg.ensg.ign.fr/ITRF>) does not provide sufficiently accurate fiducial station coordinates. Therefore, we have adopted positions and velocities of the global IGS solution IGB00 (ftp server macs.geod.emr.ca, directory pub/requests/sinex/rfwg) which is also used by the IGS Analysis Centres since 2004. This includes at least three more years of observations and is referred to the ITRF2000 reference frame. The following stations were selected as fiducials for the datum realisation: ASC1, CRO1, EISL, FORT, KOUR, LPGS, RIOG and SANT. In addition the two stations OHIG and OHI2 at the Antarctic site O'Higgins are included because there is a precise local tie between both antennae. The positions and velocities of the reference stations were not fixed but constrained such that the network is in the least squares sense optimally referred to the ITRF2000. The average standard deviations for the velocities of these fiducial stations are 1.1 mm/yr, 1.4 mm/yr and 1.0 mm/yr in X, Y and Z, respectively.

Figures 2 and 3 display the horizontal and vertical velocities of all stations with at least one year of observations. Stations with less observations got only a coordinate solution. There appear some large discrepancies between this solution and the ITRF2000, mainly in the vertical velocities. These are simply due to the very short observation period available for ITRF2000. The solution DGFIO4P01 can be accessed as SINEX file at <ftp://ftp.dgfi.badw-muenchen.de/pub/gps/DGF>.

Based on the results of the combined adjustment we generated weekly coordinate solutions back to 1996 by fixing the fiducial stations. The time series of the north, east and vertical components for each station are displayed in figures 6.1 to 6.10 and 7.1 to 7.68. In addition, from 2004 onward the weekly solutions are made available as support for national surveys. They may be accessed also at <ftp://ftp.dgfi.badw-muenchen.de/pub/gps/DGF>.

## 4 Earthquakes in the Region

The western part of the IGS RNAAC SIR region, i.e. the plate boundary zone between Pacific, Cocos and Nazca plates in the west and North American, Caribbean and South American plates in the East, is a seismically extremely active area, and therefore earthquakes cause many episodic station movements (DGFI Annual Reports 2001/2002 and 2002/2003). These episodic events with impact on the station position have to be taken into account in the coordinate and velocity estimates by introducing new position and/or velocity parameters for these stations after an earthquake (Kaniuth et al. 2002, Seemüller and Drewes, 2001 and 2002, see also figures 1, 4 and 5).

Three mayor earthquakes causing observable displacements of station positions were detected by analysing the time series of station coordinates (figure 4). The first one occurred in January and February 2001 near station El Salvador (SSIA) with a total displacement of 5.0 cm in SE direction (figure 4a), the second one was in June and July 2001 near station Arequipa (AREQ) with a large displacement of 66.5 cm in SW direction (figure 4b), and the last one in November 2002 and January 2003 near Manzanillo (MANZ) with a strange post-seismic behaviour (figure 4c). The post-seismic displacements look strange because the station moved 9.7 cm to the NW, then a creeping movement of 4.8 cm backward, and finally a 5.3 cm movement to SW, nearly 90° to the first movement direction is seen. The displacements are shown in figure 5. Figure 5b shows that the analysis of Satellite Laser Ranging (SLR) data of Arequipa confirms the main features after July 07, 2001 (Kaniuth et al. 2002).

## 5 References

- Altamimi, Z., P. Sillard, C. Boucher (2002): A new release of the International Terrestrial Reference Frame for earth science applications. *Journal of Geophysical Research*. 107 (B10), ETG2/1-17.
- DGFI Annual Reports 2001/2002 and 2002/2003.
- Hugentobler, U., S. Schaer, P. Fridez (eds.)(2001): *Bernese GPS Software, Version 4.2*. Astronomical Institute, University of Berne.
- Kaniuth, K., H. Müller, W. Seemüller (2002): Displacement of the space geodetic observatory Arequipa due to recent earthquakes. *Zeitschrift f. Vermessungswesen*, 127, 238-243.
- Seemüller, W., H. Drewes (1997, 1998, 1999, 2000, 2001): *Annual Reports of RNAAC SIRGAS*, IGS Technical Reports, IGS Central Bureau, Pasadena, CA: Jet Propulsion Laboratory.
- Seemüller, W., K. Kaniuth, H. Drewes (2002): Velocity estimates of IGS RNAAC SIRGAS stations. In: H. Drewes, A. Dodson, L.P.S. Fortes, L. Sanchez, P. Sandoval (eds.): *Vertical Reference Systems*, IAG Symposia, Volume 124, 7-10, Springer.
- USGS: United States Geological Service, National Earthquake Information Centre. (<http://neic.usgs.gov/neis>)

**Table 2: Receivers and Antennae of the GPS Stations**

<b>Station</b>	<b>Domes No.</b>	<b>Receiver</b>	<b>Antenna</b>	<b>Ant. Height</b>
ANTC	41713S001	ASHTECH Z-XII3	ASH700936D_M	0,0000
AOML	49914S001	ROGUE SNR-8000	AOAD/M_T	0,0000
ARE2	42202M005	ROGUE SNR-8000	AOAD/M_T	0,0610
AREQ	42202M005B	ASHTECH UZ-12	AOAD/M_T	0,0610
ASC1	30602M001	AOA SNR-8000 ACT	AOAD/M_T	0,0677
AUTF	41515S001	ASHTECH Z-XII3	ASH700936D_M	0,0000
BARB	43401S001	ASHTECH UZ-12	ASH700936E_C	0,0000
BELE	41622M001	TRIMBLE 4000SSI	AOAD/M_T	0,0075
BHMA	43605S002	LEICA CRS1000	LEIAT504	0,0000
BOGA	41901M002	LEICA CRS1000	LEIAT504	1,3720
BOGT	41901M001	ASHTECH Z-XII3	AOAD/M_T	0,0610
BOMJ	41612M001	TRIMBLE 4000SSI	TRM29659.00	0,0080
BRAZ	41606M001	TRIMBLE 4000SSI	AOAD/M_T	0,0080
BRMU	42501S004	TRIMBLE 5700	TRM29659.00	0,0000
CALI	41903S001	TPS LEGACY	TPSCR4	0,0000
CART	41902M001	LEICA CRS1000	LEIAT504	0,0006
CFAG	41517S001	ASHTECH Z-XII3	ASH700936D_M	0,0000
CHPI	41609M003	ASHTECH UZ-12	ASH701945C_M	0,0792
CIC1	40508M002	ROGUE SNR-8000	AOAD/M_T	0,0793
CONZ	41719M002	JPS LEGACY	JPSREGANT_DD_E	-0,0125
COPO	41714S001	ASHTECH Z-XII3	ASH700936D_M	0,0000
CORD	41511M001	ROGUE SNR-8000	AOAD/M_T	0,0792
COYQ	41715S001	ASHTECH Z-XII3	ASH700936D_M	0,0000
CRAT	41619M001	TRIMBLE 4000SSI	TRM29659.00	0,0070
CRO1	43201M001	ASHTECH Z-XII3	AOAD/M_T	0,0814
CUCU	41904S001	TPS LEGACY	TPSCR4	0,0000
CUIB	41603M001	TRIMBLE 4000SSI	TRM29659.00	0,0080
EISL	41703M003	AOA SNR-8000 ACT	AOAD/M_T	0,0610
ESTI	41202S001	TRIMBLE 4000SSI	TRM29659.00	0,0000
FORT	41602M001	ROGUE SNR-8000	AOAD/M-TA_NGS	0,6430
GALA	42005M001	ASHTECH Z-XII3	AOAD/M_T	0,0814
GLPS	42005M002	ASHTECH Z-XII3	ASH701945B_M	0,0083
GOUG	30608M001	TRIMBLE 4000SSI	TRM29659.00	0,0030
GUAT	40901S001	TRIMBLE 4000SSI	TRM29659.00	0,0000
GVAL	41623M001	ASHTECH UZ-12	ASH700700.B	0,0500
IGM0	41505M002	ASHTECH Z-XII3	ASH700936D_M	1,3930
IGM1	00000M001	ASHTECH UZ-12	ASH700936C_M	0,0000
IMPZ	41615M001	TRIMBLE 4000SSI	TRM29659.00	0,0080
INEG	40507M001	TRIMBLE 4700	TRM29659.00	0,0705
IQQE	41708S002	ASHTECH Z-XII3	ASH700936D_M	0,0000
JAMA	42601S001	ASHTECH UZ-12	AOA/M-TA_NGS	0,0000
KOUR	97301M210	ASHTECH UZ-12	ASH701945C_M	0,0450



<b>Station</b>	<b>Domes No.</b>	<b>Receiver</b>	<b>Antenna</b>	<b>Ant. Height</b>
LPGS	41510M001	AOA BENCHMARK ACT	AOAD/M_T	0,0460
MANA	41201S001	TRIMBLE 4000SSI	TRM29659.00	0,0000
MANU	41614M001	TRIMBLE 4000SSI	TRM29659.00	0,0080
MANZ	40513S001	ASHTECH Z-XII3	ASH701933B_M	0,0000
MARA	42402M001	LEICA SR9500	LEIAT303	0,0445
MCLA	41624M001	ASHTECH UZ-12	ASH700700.B	0,0600
MOIN	40601M001	ROGUE SNR-8000	AOAD/M_T	0,0857
MPLA	41521M001	LEICA MC1000	LEIAT504	0,0000
OHI2	66008M005	AOA SNR-8000 ACT	AOAD/M_T	-0,0080
OHIG	66008M001	AOA SNR-8000 ACT	AOAD/M_T	0,0010
PALM	66005M002	ASHTECH Z-XII3	ASH700936D_M	0,0794
PARA	41610M001	TRIMBLE 4000SSI	TRM29659.00	0,1550
PARC	41716S001	ASHTECH Z-XII3	ASH700936D_M	0,0000
PERA	41905S001	TPS LEGACY	TPSCR4	0,0000
POAL	41616M001	TRIMBLE 4000SSI	TRM29659.00	0,0075
PUR3	82001S003	ASHTECH Z-XII3	ASH700829.3	0,0000
RCM5	40499S018B	ROGUE SNR-8000	DORNE MARGOLIN T	0,0000
RCM6	40499S020	ROGUE SNR-8000	DORNE MARGOLIN T	0,0000
RECF	41617M001	TRIMBLE 4000SSI	TRM29659.00	0,0700
RIOD	41608M001	TRIMBLE 4000SSI	TRM29659.00	0,0080
RIOG	41507M004	ASHTECH Z-XII3	ASH700936C_M	0,0350
RIOP	42006M001	ROGUE SNR-8000	AOAD/M_T	0,0729
RWSN	41513M001	ASHTECH UZ-12	ASH700936D_M	0,0000
SALV	41618M001	TRIMBLE 4000SSI	TRM29659.00	0,1570
SANT	41705M003	ASHTECH Z-XII3	AOAD/M_T	0,0614
SCUB	40701M001	ASHTECH Z-XII3	ASH700936C_M	0,0460
SLOR	41102S001	TRIMBLE 4000SSI	TRM29659.00	0,0000
SMAR	41621M001	TRIMBLE 4000SSI	TRM29659.00	0,0080
SSIA	41401S001	TRIMBLE 4000SSI	TRM29659.00	0,0000
TEG1	41101S001	TRIMBLE 5700	TRM29659.00	0,0000
TEGU	41101S001	TRIMBLE 4000SSI	TRM29659.00	0,0000
TGCV	39601S001	LEICA CRS1000	LEIAT504	0,0000
TUCU	41520S001	ASHTECH Z-XII3	ASH700936D_M	0,0000
UBER	41625M001	ASHTECH UZ-12	ASH700700.B	0,0400
UEPP	41611M001	TRIMBLE 4000SSI	TRM29659.00	0,0000
UNSA	41514M001	ASHTECH Z-XII3	AOAD/M_T	0,0460
VALL	41906S001	TPS LEGACY	TPSCR4	0,0000
VALP	41712S001	ASHTECH Z-XII3	ASH700936D_M	0,0000
VARG	41626M001	ASHTECH UZ-12	ASH700700.B	0,0500
VBCA	41512M001	LEICA SR9500	LEIAT303	1,0707
VESL	66009M001	TRIMBLE 4000SSI	TRM29659.00	-0,0112
VICO	41613M001	TRIMBLE 4000SSI	TRM29659.00	0,0160

**Table 3: Geocentric Station Positions (2003,0) and Velocities of Solution DGF04P01**

Stat. / Country	ID	Domes no	X [m]	Y [m]	Z [m]	$v_x$ [m/a]	$v_y$ [m/a]	$v_z$ [m/a]	
Antuco	CL	ANTC	41713S001	1608539,5334	-4816369,7138	-3847798,5661	0,0133	0,0009	0,0093
Key Biscayne	US	AOML	49914S001	982296,7371	-5664607,2192	2752614,4811	-,0104	0,0084	-,0058
Arequipa	PE	AREQ	42202M005	1942826,7992	-5804070,2315	-1796893,8905	0,0118	0,0043	0,0124
Arequipa 2	PE	ARE2	42202M005	1942826,2266	-5804070,2970	-1796894,2726	-,0176	-,0117	-,0110
Ascencion	UK	ASC1	30602M001	6118526,0647	-1572344,7360	-876451,1070	-,0011	-,0054	0,0096
Barbados	BB	BARB	43401S001	3143384,5423	-5359714,5596	1434871,5799	0,0041	0,0133	0,0129
Bogotá	CO	BOGA	41901M002	1744517,4213	-6116051,6912	512580,8432	-,0166	0,0412	0,0164
Bogotá (IGS)	CO	BOGT	41901M001	1744399,0474	-6116037,6006	512731,6777	-,0089	0,0353	0,0086
Bom Jesus	BR	BOMJ	41612M001	4510195,8343	-4268322,3373	-1453035,2727	-,0003	-,0061	0,0119
Brasilia	BR	BRAZ	41606M001	4115014,0830	-4550641,5603	-1741443,9979	-,0005	-,0048	0,0098
Bermuda	UK	BRMU	42501S004	2304703,4973	-4874817,1574	3395186,9168	-,0133	0,0011	0,0045
Cartagena	CO	CART	41902M001	1567348,5771	-6075293,5600	1142850,7844	0,0106	0,0018	0,0105
Caucete	AR	CFAG	41517S001	2016584,8561	-5050165,6370	-3323308,7996	0,0064	-,0031	0,0084
Cachoeira	BR	CHPI	41609M003	4164613,8864	-4162456,8762	-2445028,8472	-,0045	-,0025	0,0140
Enseñada	MX	CIC1	40508M002	2433177,0274	-4845044,9226	3348295,8104	-,0418	0,0254	0,0208
Concepción	CL	CONZ	41719M002	1492007,5083	-4887910,7114	-3803639,9782	0,0314	-,0023	0,0151
Copiapó	CL	COPO	41714S001	1907040,7140	-5337379,0056	-2916334,8754	0,0202	-,0066	0,0046
Córdoba	AR	CORD	41511M001	2345503,8730	-4910842,8275	-3316365,3882	0,0046	-,0072	0,0063
Crato	BR	CRAT	41619M001	4888826,0352	-4017957,4602	-798308,9890	-,0049	-,0002	0,0113
Saint Croix	US	CROI	43201M001	2607771,1991	-5488076,7223	1932767,7503	0,0053	0,0126	0,0096
Cuiaba	BR	CUIB	41603M001	3430711,4019	-5099641,5801	-1699432,9129	-,0009	-,0055	0,0094
Easter Island	CL	EISL	41703M003	1884951,3653	-5357595,9844	-2892890,5473	0,0658	-,0172	-,0070
Esteli	NI	ESTI	41202S001	394283,5169	-6201541,4245	1436325,8107	0,0118	-,0062	0,0124
Fortaleza	BR	FORT	41602M001	4985386,6115	-3954998,6071	-428426,4158	-,0018	-,0034	0,0109
Galapagos	EC	GALA	42005M001	-33795,8162	-6377522,6434	-82120,8432	0,0483	-,0036	0,0083
Gough	UK	GOUG	30608M001	4795578,6019	-835299,4200	-4107633,9557	0,0103	0,0167	0,0172
Guatemala	GT	GUAT	40901S001	-56063,5901	-6174978,6705	1596665,2460	0,0039	0,0010	0,0016
Buenos Aires	AR	IGM0	41505M002	2751801,0619	-4479882,6958	-3598917,2530	0,0035	-,0080	0,0059
Buenos Aires	AR	IGM1	00000M001	2751804,0232	-4479879,2749	-3598922,5465	0,0035	-,0080	0,0059
Imperatriz	BR	IMPZ	41615M001	4289656,4483	-4680884,9594	-606347,3084	-,0021	-,0042	0,0108
Aguascalientes	MX	INEG	40507M001	1260435,6846	-5788547,3382	2360340,1230	-,0013	0,0957	-,0405
Iquique	CL	IQQE	41708S002	2034208,4457	-5629172,2749	-2196141,8912	0,0236	-,0031	0,0057
Kingston	JM	JAMA	42601S001	1388059,8224	-5909149,0645	1951963,8507	0,0025	-,0015	0,0101
Kourou	FR	KOUR	97301M210	3839591,4073	-5059567,5753	579957,0031	-,0018	-,0046	0,0116
La Plata	AR	LPGS	41510M001	2780102,9861	-4437418,9031	-3629404,5367	0,0029	-,0071	0,0073
Managua	NI	MANA	41201S001	407981,8352	-6222925,7199	1333528,9521	0,0043	0,0008	0,0081
Manaus	BR	MANU	41614M001	3179009,3514	-5518662,1198	-344401,8027	-,0049	0,0003	0,0094
Manzanillo	MX	MANZ	40513S001	1489330,7211	-5843667,5627	2070027,8155	-,0127	-,0060	0,0010
Manzanillo *	MX	MANZ	40513S001	1489331,1396	-5843667,4297	2070027,9234	-,0127	-,0060	0,0010
Maracaibo	VE	MARA	42402M001	1976117,1259	-5948895,1660	1173592,1865	0,0063	0,0065	0,0103
Limon	CR	MOIN	40601M001	755369,2162	-6236567,7003	1098850,9758	0,0208	0,0126	0,0004
Mar del Plata	AR	MPLA	41521M001	2700316,8280	-4243736,7076	-3908569,7669	0,0019	-,0061	0,0068
O'Higgins	AN	OHIG	66008M001	1525812,5939	-2432481,3165	-5676146,0940	0,0191	-,0020	-,0014
O'Higgins 2	AN	OHI2	66008M005	1525871,8344	-2432478,2205	-5676165,6007	0,0191	-,0020	-,0014
Palmer	AN	PALM	66005M002	1192671,8772	-2450887,6040	-5747096,0286	0,0172	-,0046	-,0001
Curitiba	BR	PARA	41610M001	3763751,6485	-4365113,8132	-2724404,6747	0,0018	-,0070	0,0084
Punta Arenas	CL	PARC	41716S001	1255992,4256	-3622975,1060	-5079719,2836	0,0067	-,0098	0,0027
Porto Alegre	BR	POAL	41616M001	3467519,4025	-4300378,5426	-3177517,7103	0,0022	-,0066	0,0082
Puerto Rico	US	PUR3	82001S003	2358177,9051	-5573619,6950	2007083,9132	0,0055	0,0081	0,0103
Richmond 5	US	RCM5	40499S018	961334,7262	-5674074,2028	2740535,1870	-,0051	-,0039	0,0045
Richmond 6	US	RCM6	40499S020	961334,7138	-5674074,1314	2740535,1549	-,0051	-,0039	0,0045
Recife	BR	RECF	41617M001	5176588,6429	-3618162,1640	-887363,8942	-,0019	-,0015	0,0112
Rio de Janeiro	BR	RIOD	41608M001	4280294,8829	-4034431,2405	-2458141,3628	0,0007	-,0063	0,0114
Rio Grande	AR	RIOG	41507M004	1429907,7751	-3495354,7966	-5122698,6576	0,0073	-,0091	0,0026
Riobamba	EC	RIOP	42006M001	1255144,9533	-6253609,4447	-182569,8738	-,0044	-,0061	-,0008
Rawson	AR	RWSN	41513M001	1956973,4254	-4217335,2869	-4351745,5150	0,0011	-,0091	0,0050
Salvador	BR	SALV	41618M001	4863495,7257	-3870312,3618	-1426347,7917	0,0022	-,0052	0,0099
Santiago/Chile	CL	SANT	41705M003	1769693,4722	-5044574,1639	-3468320,9802	0,0230	-,0029	0,0108
Santiago/Cuba	CU	SCUB	40701M001	1474538,0969	-5811243,2736	2168958,7979	-,0085	0,0049	0,0013
San Lorenzo	HN	SLOR	41102S001	277528,9583	-6198801,8101	1471065,5891	0,0086	-,0007	0,0044
Santa María	BR	SMAR	41621M001	3280748,4052	-4468909,7542	-3143408,6725	0,0015	-,0047	0,0104
San Salvador	SV	SSIA	41401S001	95566,9917	-6197785,5867	1500590,5013	0,0054	-,0019	0,0086
Tegucigalpa 1	HN	TEG1	41101S001	301692,6897	-6181037,6571	1542881,1472	0,0121	-,0030	0,0096
Tegucigalpa	HN	TEGU	41101S001	301697,3989	-6181025,0916	1542919,8771	0,0121	-,0030	0,0096
Tucumán	AR	TUCU	41520S001	2386117,1761	-5171223,3016	-2862949,1573	0,0038	-,0051	0,0069
Pres. Prudente	BR	UEPP	41611M001	3687624,3146	-4620818,6176	-2386880,3232	0,0012	-,0064	0,0095
Salta	AR	UNSA	41514M001	2412830,4178	-5271936,7335	-2652209,0764	0,0045	-,0006	0,0091
Salta **	AR	UNSA	41514M001	2412830,3991	-5271936,7088	-2652209,0625	0,0045	-,0006	0,0091
Bahía Blanca	AR	VBCA	41512M001	2319240,8061	-4411743,9195	-3966484,1441	0,0033	-,0075	0,0054
Snae/Veslesk	AN	VESL	66009M001	2009329,7620	-99741,4765	-6033158,4273	0,0101	-,0045	-,0006
Vicosa	BR	VICO	41613M001	4373283,3139	-4059639,0613	-2246959,7080	0,0013	-,0065	0,0094

\* after earthquake

\*\* after antenna and radome replacement

**Table 4: Ellipsoidal (GRS80) Station Positions and Velocities of Solution DGF04P01**

Stat. / Country	ID	Domes no	Latit. [°]	Longit. [°]	h [m]	v <sub>φ</sub> [m/a]	v <sub>λ</sub> [m/a]	v <sub>h</sub> [m/a]	
Antuco	CL	ANTC	41713S001	-37,33870301	288,46795005	745,403	0,0094	0,0129	-0,0030
Key Biscayne	US	AOML	49914S001	25,73469150	279,83780096	0,088	-0,0009	-0,0088	-0,0116
Arequipa	PE	AREQ	42202M005	-16,46551349	288,50720902	2488,910	0,0118	0,0126	-0,0038
Arequipa 2	PE	ARE2	42202M005	-16,46551711	288,50720374	2488,904	-0,0090	-0,0204	0,0084
Ascencion	UK	ASC1	30602M001	-7,95121388	345,58792762	105,131	0,0095	-0,0055	-0,0011
Barbados	BB	BARB	43401S001	13,08791472	300,39092267	-38,637	0,0147	0,0103	-0,0062
Bogotá	CO	BOGA	41901M002	4,63867975	285,92005110	2610,483	0,0199	-0,0047	-0,0427
Bogotá (IGS)	CO	BOGT	41901M001	4,64007238	285,91906041	2576,815	0,0115	0,0011	-0,0356
Bom Jesus	BR	BOMJ	41612M001	-13,25555816	316,57826469	419,402	0,0125	-0,0046	0,0011
Brasilia	BR	BRAZ	41606M001	-15,94747514	312,12213093	1106,021	0,0103	-0,0036	0,0004
Bermuda	UK	BRMU	42501S004	32,37039852	295,30372718	-11,646	0,0074	-0,0116	-0,0032
Cartagena	CO	CART	41902M001	10,39133403	284,46614606	4,095	0,0102	0,0107	0,0028
Caucete	AR	CFAG	41517S001	-31,60216758	291,76735173	702,561	0,0099	0,0048	0,0001
Cachoeira	BR	CHPI	41609M003	-22,68714610	315,01484166	617,427	0,0124	-0,0049	-0,0067
Ensenada	MX	CIC1	40508M002	31,87067760	243,33423982	64,305	0,0197	-0,0488	0,0076
Concepción	CL	CONZ	41719M002	-36,84376168	286,97451779	180,701	0,0189	0,0294	0,0000
Copiapo	CL	COPO	41714S001	-27,38452728	289,66176304	479,087	0,0101	0,0168	0,0094
Córdoba	AR	CORD	41511M001	-31,52843508	295,52995166	746,854	0,0098	0,0010	0,0039
Crato	BR	CRAT	41619M001	-7,23801845	320,58439445	436,051	0,0107	-0,0033	-0,0051
Saint Croix	US	CRO1	43201M001	17,75689784	295,41567997	-31,949	0,0119	0,0102	-0,0057
Cuiaba	BR	CUIB	41603M001	-15,55526281	303,93013334	237,450	0,0101	-0,0038	0,0014
Easter Island	CL	EISL	41703M003	-27,14820934	250,61670910	114,538	-0,0088	0,0678	-0,0018
Esteli	NI	ESTI	41202S001	13,09953579	273,63787238	852,676	0,0105	0,0114	0,0096
Fortaleza	BR	FORT	41602M001	-3,87744550	321,57438742	19,463	0,0109	-0,0038	-0,0000
Galapagos	EC	GALA	42005M001	-0,74269535	269,69638061	7,441	0,0083	0,0483	0,0032
Gough	UK	Goug	30608M001	-40,34883329	350,11928306	81,225	0,0178	0,0182	-0,0056
Guatemala	GT	GUAT	40901S001	14,59040393	269,47981701	1519,869	0,0018	0,0039	-0,0006
Buenos Aires	AR	IGM0	41505M002	-34,57219790	301,56063366	48,802	0,0098	-0,0012	0,0038
Buenos Aires	AR	IGM1	00000M001	-34,57224417	301,56068068	50,682	0,0098	-0,0012	0,0038
Imperatriz	BR	IMPZ	41615M001	-5,49176602	312,50276537	105,022	0,0109	-0,0044	0,0006
Aguascalientes	MX	INEG	40507M001	21,85615373	257,71579712	1888,065	-0,0029	-0,0216	-0,1016
Iquique	CL	IQQE	41708S002	-20,27354174	289,86828552	38,943	0,0091	0,0211	0,0083
Kingston	JM	JAMA	42601S001	17,93902308	283,21912785	-2,931	0,0090	0,0021	0,0050
Kourou	FR	KOUR	97301M210	5,25218090	307,19404041	-25,744	0,0113	-0,0042	0,0036
La Plata	AR	LPGS	41510M001	-34,90674556	302,06770048	29,864	0,0103	-0,0013	0,0020
Managua	NI	MANA	41201S001	12,14893826	273,75100603	71,045	0,0080	0,0043	0,0012
Manaus	BR	MANU	41614M001	-3,11615024	299,94396915	40,172	0,0092	-0,0041	-0,0032
Manzanillo	MX	MANZ	40513S001	19,06386643	255,70185064	-14,174	-0,0020	-0,0108	0,0088
Manzanillo *	MX	MANZ	40513S001	19,06386544	255,70185480	-14,185	-0,0020	-0,0108	0,0088
Maracaibo	VE	MARA	42402M001	10,67397835	288,37556913	28,379	0,0109	0,0080	-0,0022
Limon	CR	MOIN	40601M001	9,98712764	276,90599035	26,570	0,0021	0,0222	-0,0098
Mar del Plata	AR	MPLA	41521M001	-38,03560393	302,46885808	20,120	0,0092	-0,0017	0,0007
O'Higgins	AN	OHIG	66008M001	-63,32072297	302,09966093	30,710	0,0100	0,0151	0,0066
O'Higgins 2	AN	OHIG	66008M005	-63,32108138	302,09866672	32,466	0,0100	0,0151	0,0066
Palmer	AN	PALM	66005M002	-64,77509035	295,94887696	31,038	0,0105	0,0135	0,0051
Curitiba	BR	PARA	41610M001	-25,44836839	310,76904510	925,761	0,0104	-0,0032	0,0022
Punta Arenas	CL	PARC	41716S001	-53,13695513	289,12011771	22,288	0,0108	0,0031	0,0047
Porto Alegre	BR	POAL	41616M001	-30,07404225	308,88023516	76,741	0,0104	-0,0024	0,0015
Puerto Rico	US	PUR3	82001S003	18,46297622	292,93304240	89,578	0,0115	0,0082	-0,0018
Richmond 5	US	RCM5	40499S018	25,61377958	279,61606875	-15,571	0,0028	-0,0057	0,0046
Richmond 6	US	RCM6	40499S020	25,61377960	279,61606875	-15,650	0,0028	-0,0057	0,0046
Recife	BR	RECF	41617M001	-8,05096359	325,04848352	20,168	0,0110	-0,0023	-0,0023
Rio de Janeiro	BR	RIOD	41608M001	-22,81784423	316,69372331	8,636	0,0124	-0,0041	0,0000
Rio Grande	AR	RIOG	41507M004	-53,78547232	292,24888189	32,032	0,0106	0,0033	0,0045
Riobamba	EC	RIOP	42006M001	-1,65059606	281,34889281	2817,179	-0,0007	-0,0055	0,0051
Rawson	AR	RWSN	41513M001	-43,29888109	294,89275172	27,382	0,0096	-0,0028	0,0029
Salvador	BR	SALV	41618M001	-13,00866970	321,48764077	35,755	0,0108	-0,0027	0,0026
Santiago/Chile	CL	SANT	41705M003	-33,15028864	289,33144543	723,067	0,0147	0,0207	0,0028
Santiago/Cuba	CU	SCUB	40701M001	20,01206312	284,23768373	20,909	0,0036	-0,0070	-0,0060
San Lorenzo	HN	SLOR	41102S001	13,42391831	272,56349964	11,998	0,0040	0,0086	0,0021
Santa María	BR	SMAR	41621M001	-29,71892376	306,28340674	113,111	0,0114	-0,0016	-0,0011
San Salvador	SV	SSIA	41401S001	13,69708458	270,88340445	626,625	0,0079	0,0054	0,0040
Tegucigalpa 1	HN	TEG1	41101S001	14,09007289	272,79435452	951,342	0,0084	0,0119	0,0058
Tegucigalpa	HN	TEGU	41101S001	14,09043946	272,79440374	948,821	0,0084	0,0119	0,0058
Tucumán	AR	TUCU	41520S001	-26,84325556	294,76964830	485,061	0,0090	0,0013	0,0024
Pres. Prudente	BR	UEPP	41611M001	-22,11990455	308,59146597	430,950	0,0110	-0,0031	0,0018
Salta	AR	UNSA	41514M001	-24,72745681	294,59235642	1257,780	0,0093	0,0038	-0,0016
Salta **	AR	UNSA	41514M001	-24,72745681	294,59235649	1257,813	0,0093	0,0038	-0,0016
Bahía Blanca	AR	VBCA	41512M001	-38,70076861	297,73077285	59,475	0,0093	-0,0006	0,0030
Sanae/Veslesk.	AN	VESL	66009M001	-71,67379651	357,15821720	862,347	0,0096	-0,0040	0,0038
Vicosa	BR	VICO	41613M001	-20,76150035	317,13001043	665,957	0,0107	-0,0039	0,0017

\* after earthquake

\*\* after antenna and radome replacement



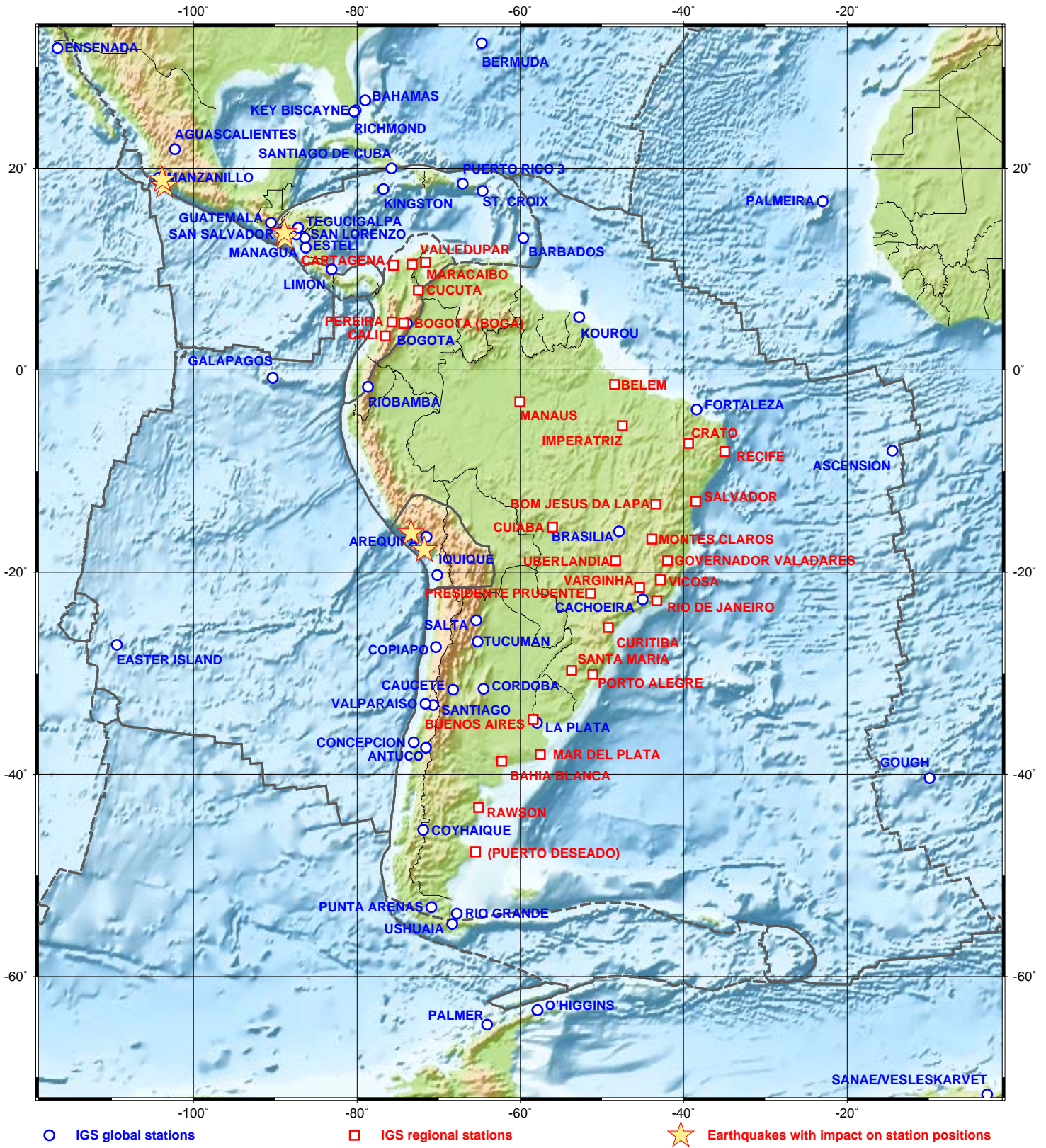


Figure 1: IGS RNAAC SIR Network (Status: Nov. 30, 2004)



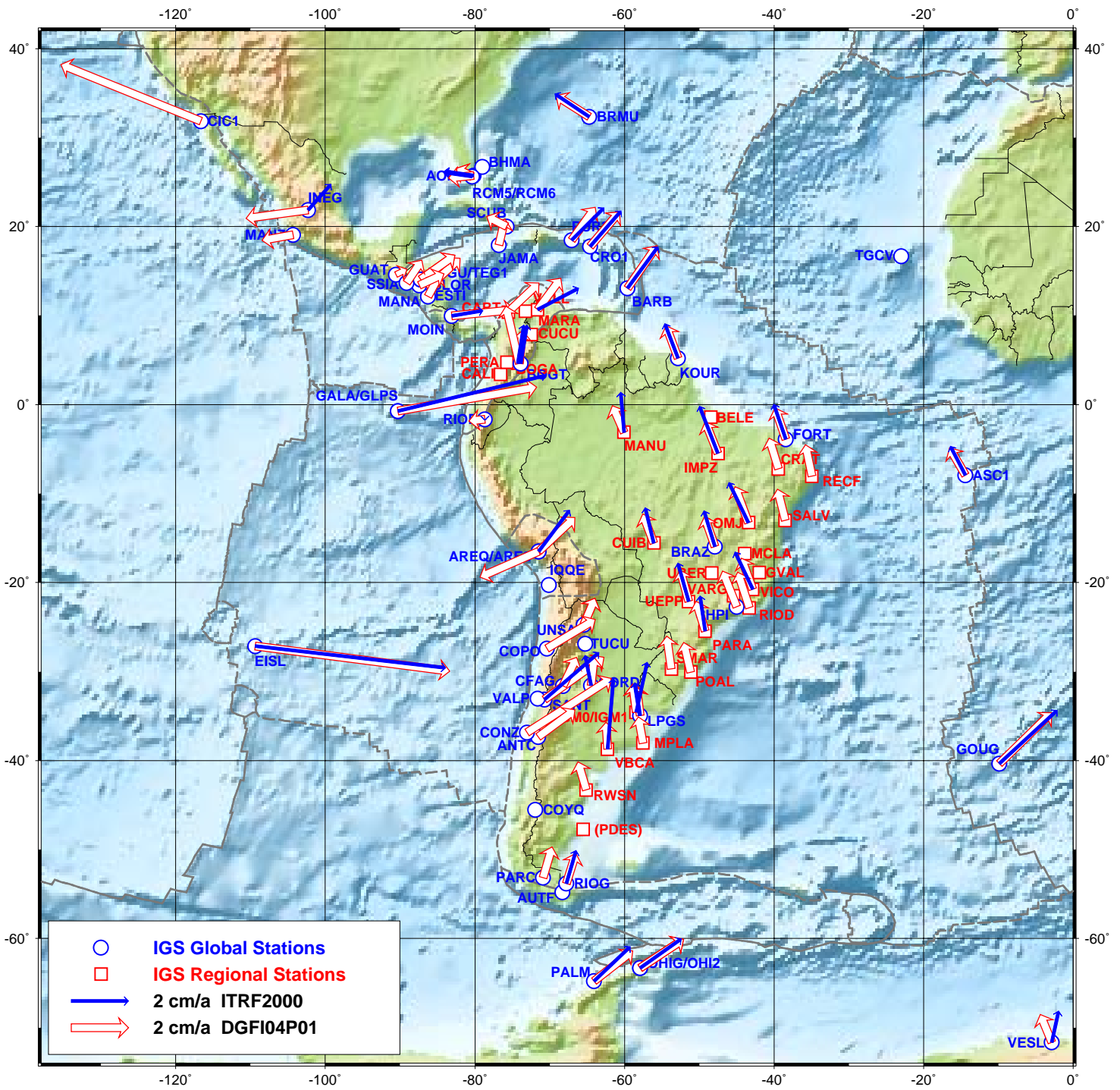


Figure 2: Horizontal Velocities of DGFI04P01 Solution





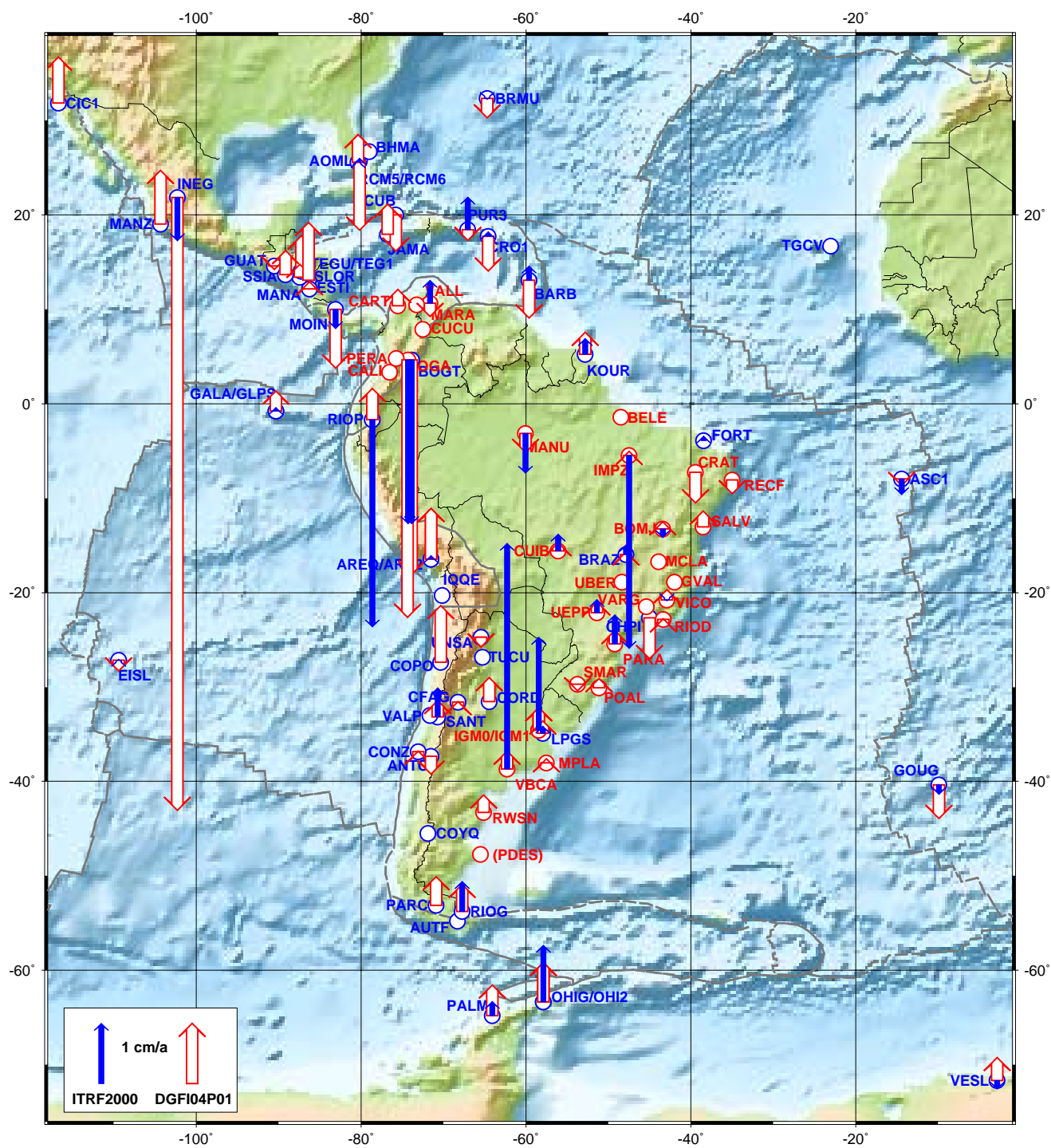
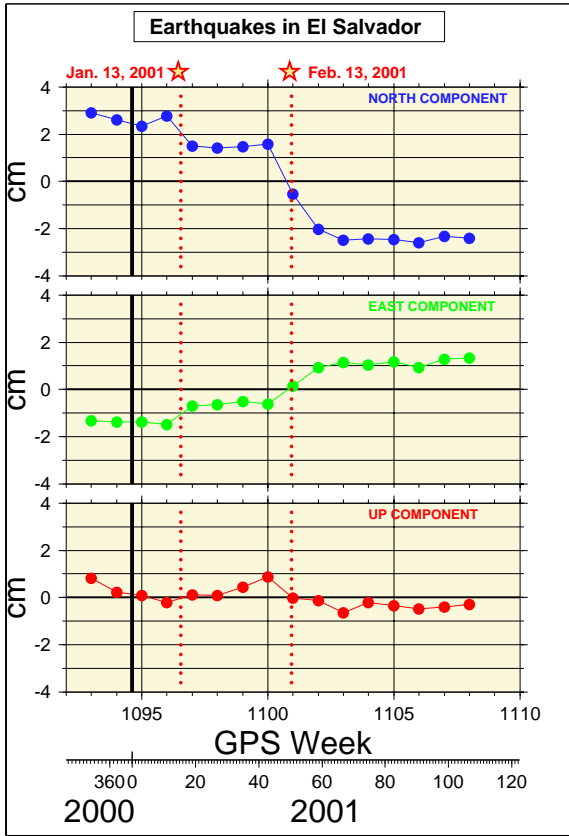
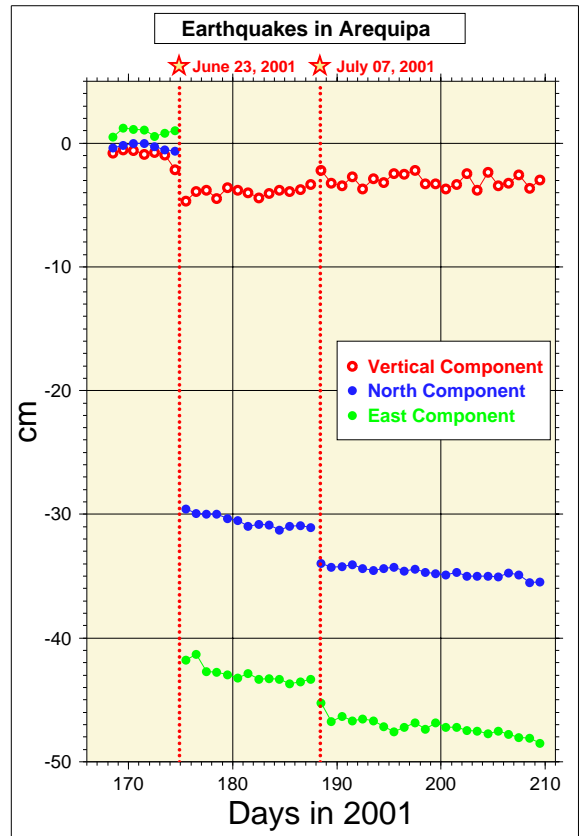


Figure 3: Vertical Velocities of DGF104P01 Solution

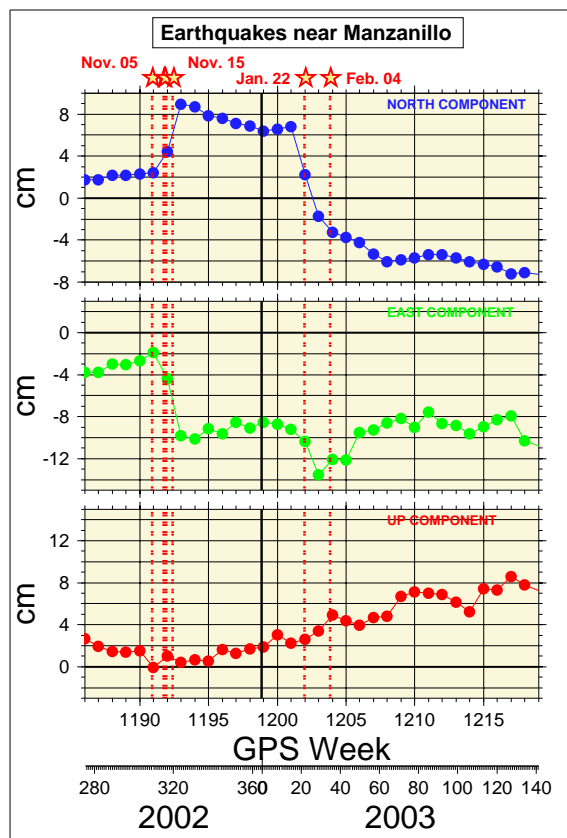




a) Earthquakes in San Salvador



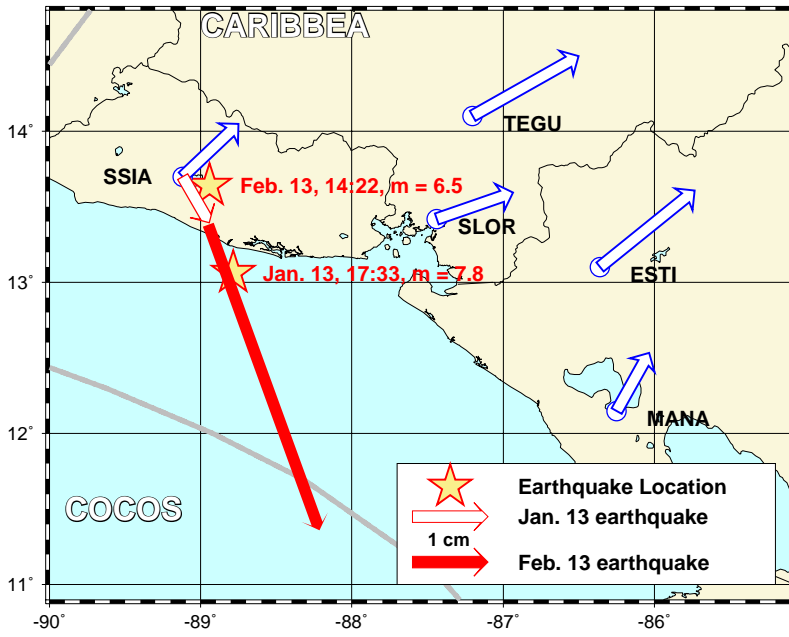
b) Earthquakes in Peru



c) Earthquakes in Mexico

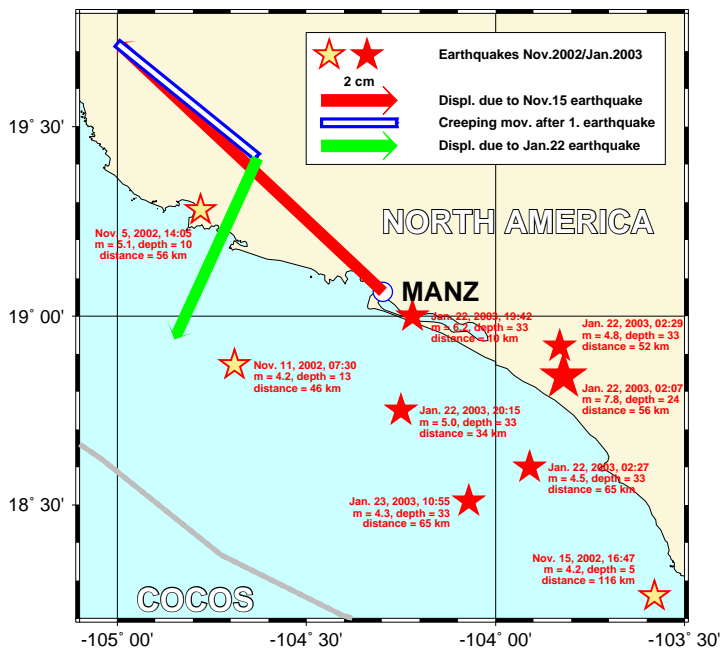
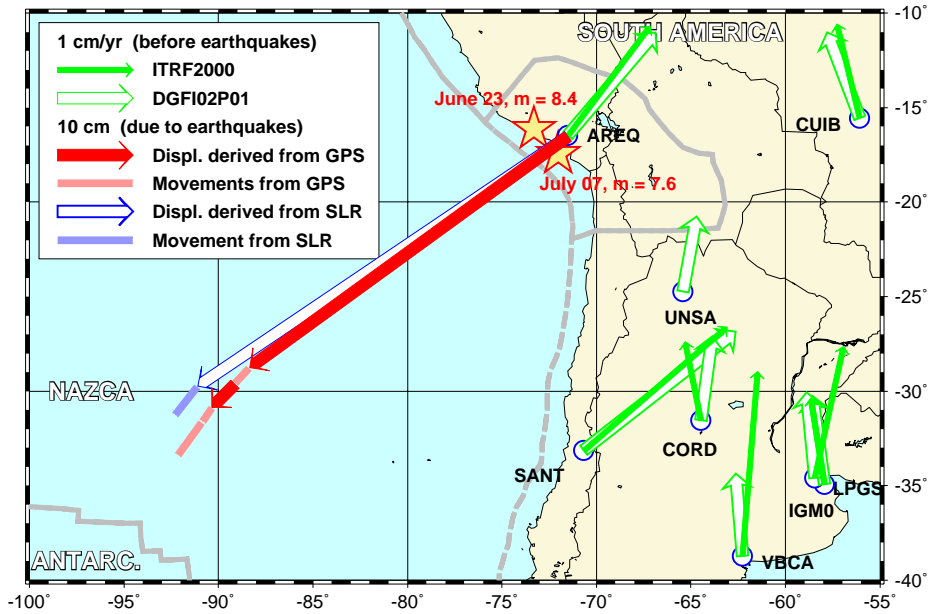
Figure 4: Earthquake Signals (excluded from the Station Position and Velocity Solution)





a) Displacements of station SSIA

b) Displacements of station AREQ



c) Displacements of station MANZ

Figure 5: Station Displacements due to Earthquakes



## Figures 6.1 ... 6.10: Time Series of IGS Stations Used as Fiducials

The figures show the time series of weekly coordinate solutions for the IGS stations used as fiducials in DGFI04P01. They are compiled from the files igsyyPwww.ssc.Z available at the ftp server [cddisa.gsfc.nasa.gov/pub/gps/products](http://cddisa.gsfc.nasa.gov/pub/gps/products). (Marked bold in the list below)

## Figures 7.1 ... 7.68: Time Series of RNAAC SIR Stations

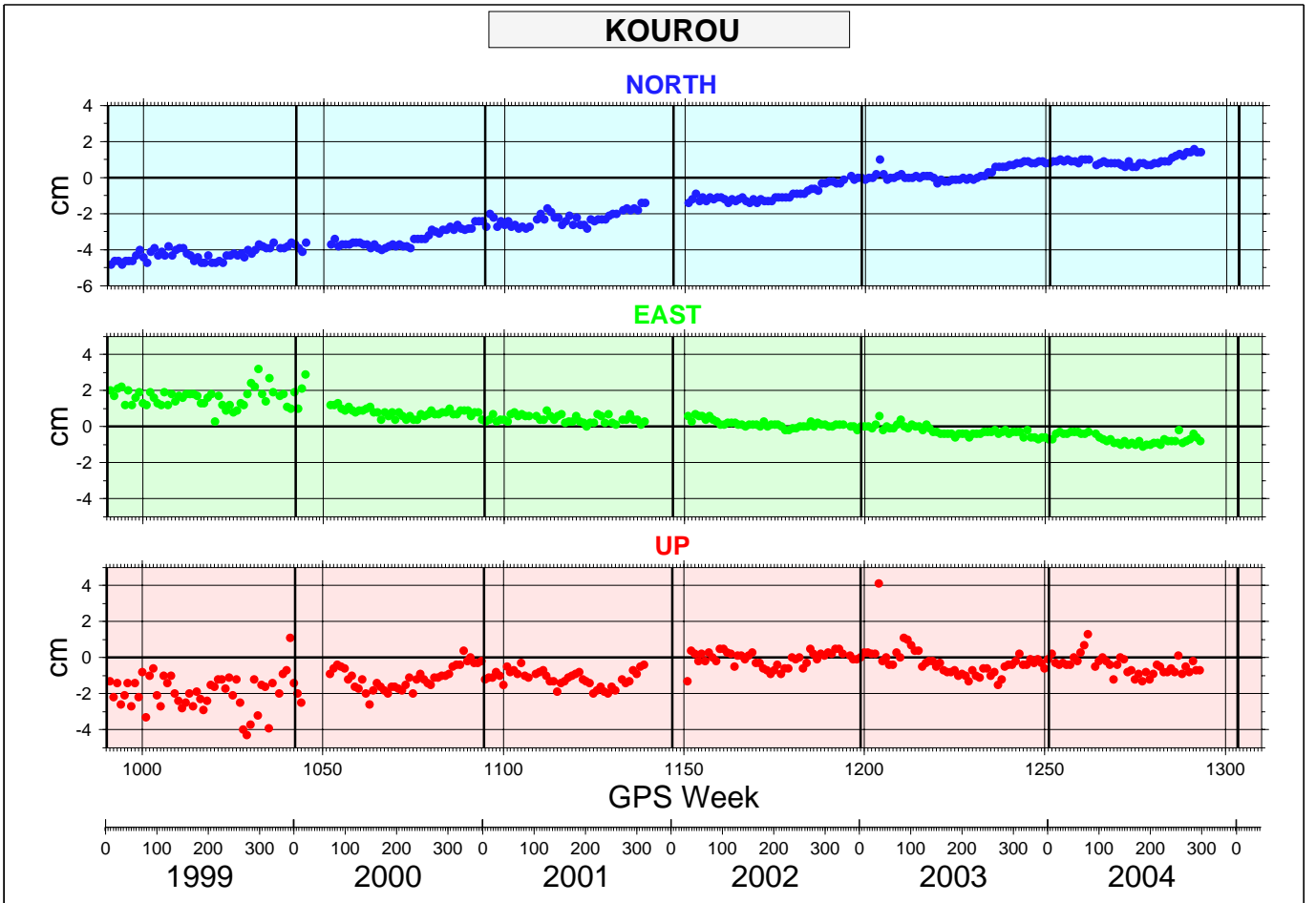
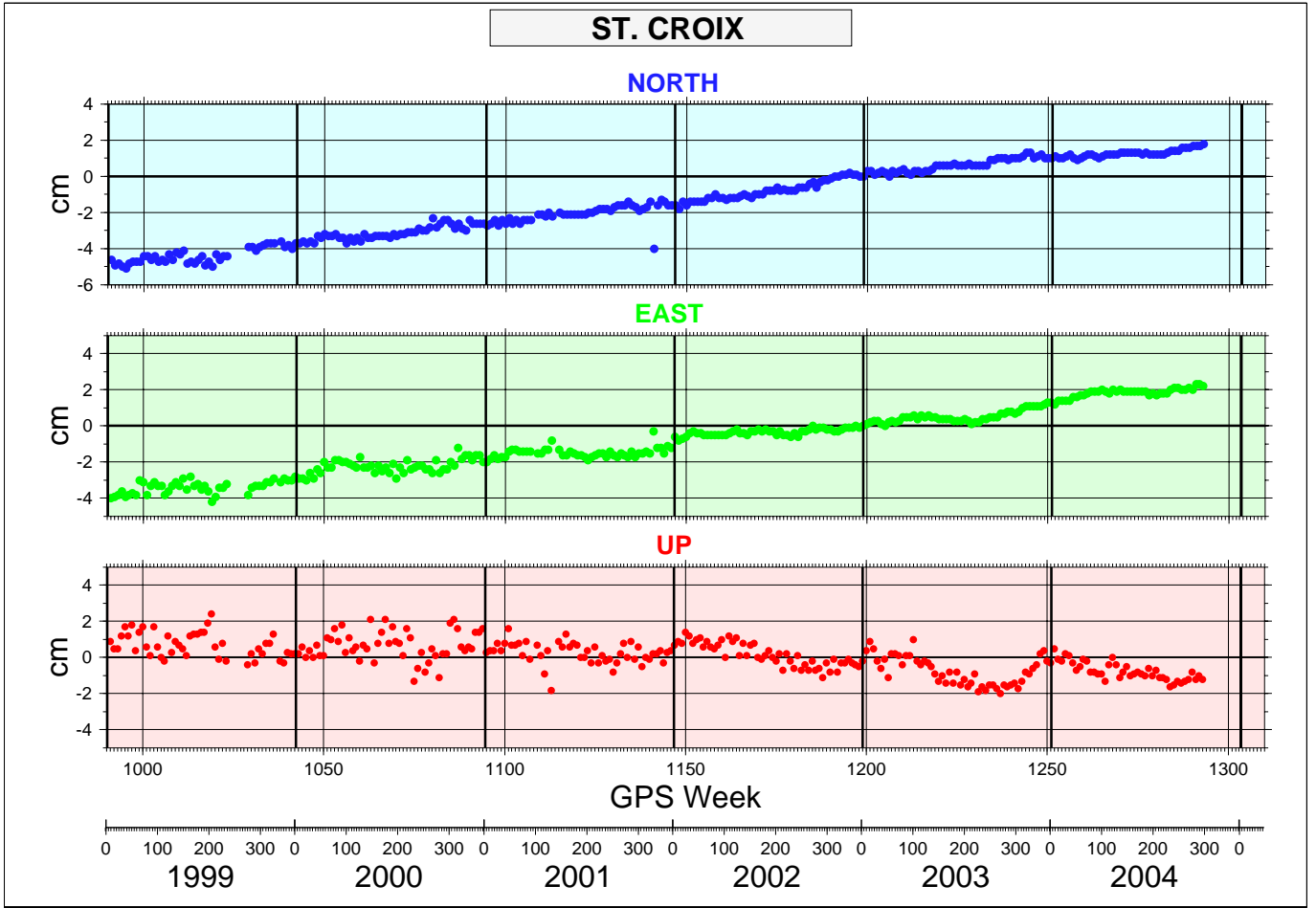
The figures show the time series of weekly coordinate solutions computed by the Regional network Associate Analysis Centre for SIRGAS at DGFI, Munich. The data files are available at the ftp server [ftp.dgfi.badw-muenchen.de/pub/gps/DGF](http://ftp.dgfi.badw-muenchen.de/pub/gps/DGF).

## Index of Plots of Station Coordinates' Time Series (bold = Stations used as Fiducials)

Country	Station	ID	Page	Country	Station	ID	Page
Antarctica	<b>O'Higgins</b>	<b>OHIG</b>	<b>25</b>	Chile (cont'd)	Iquique	IQQE	42
	<b>O'Higgins 2</b>	<b>OH12</b>	<b>25</b>		Copiapo	COPO	42
	Palmer	PALM	26		Valparaiso	VALP	43
Argentina	Sanae/Vesl.	VESL	26	Concepción	CONZ	43	
	<b>Rio Grande</b>	<b>RIOG</b>	<b>24</b>	Antuco	ANTC	44	
	<b>La Plata</b>	<b>LPGS</b>	<b>24</b>	Punta Arenas	PARC	44	
	Salta	UNSA	27	Colombia	Cartagena	CART	45
	Tucuman	TUCU	27		Valledupar	VALL	45
	Caucete	CFAG	28		Cúcuta	CUCU	46
	Cordoba	CORD	28		Pereira	PERA	46
	Buenos Aires	IGM0	29	Bogotá	BOGT	47	
	Buenos Aires	IGM1	29	Bogotá	BOGA	47	
	Mar del Plata	MPLA	30	Cali	CALI	48	
Bahia Blanca	VBCA	30	Costa Rica	Limon	MOIN	48	
Rawson	RWSN	31	Cuba	Santiago	SCUB	49	
Barbados	Barbados	BARB	31	Ecuador	Riobamba	RIOP	49
Brazil	<b>Fortaleza</b>	<b>FORT</b>	<b>22</b>	Galapagos	GALA	50	
	Imperatriz	IMPZ	32	Galapagos	GLPS	50	
	Manaus	MANU	32	El Salvador	San Salvador	SSIA	51
	Crato	CRAT	33	Fr. Guiana	<b>Kourou</b>	<b>KOUR</b>	<b>21</b>
	Recife	RECF	33	Guatemala	Guatemala	GUAT	51
	Bom Jesus	BOMJ	34	Honduras	Tegucigalpa	TEGU	52
	Salvador	SALV	34	San Lorenzo	SLOR	52	
	Cuiaba	CUIB	35	Jamaica	Kingston	JAMA	53
	Vicosa	VICO	35	Mexico	Enseñada	CIC1	53
	Montes Claros	MCLA	36	Aguascalientes	INEG	54	
	Uberlandia	UBER	36	Manzanillo	MANZ	54	
	Valadares	GVAL	37	Nicaragua	Esteli	ESTI	55
	Virginha	VARG	37	Managua	MANA	55	
	Brasilia	BRAZ	38	Peru	Arequipa	AREQ	56
	Cachoeira	CHPI	38	Arequipa 2	ARE2	56	
	Belem	BELE	39	UK	<b>Ascencion</b>	<b>ASC1</b>	<b>22</b>
	Rio de Janeiro	RIOD	39	Bermuda	BRMU	57	
Curitiba	PARA	40	Gough	GOUG	57		
Pres. Prudente	UEPP	40	USA	<b>Saint Croix</b>	<b>CRO1</b>	<b>21</b>	
Porto Alegre	POAL	41	Richmond	RCM5/6	58		
Santa Maria	SMAR	41	Key Biscayne	AOML	58		
Chile	<b>Santiago</b>	<b>SANT</b>	<b>23</b>	Puerto Rico	PUR3	59	
	<b>Easter Island</b>	<b>EISL</b>	<b>23</b>	Venezuela	Maracaibo	MARA	59

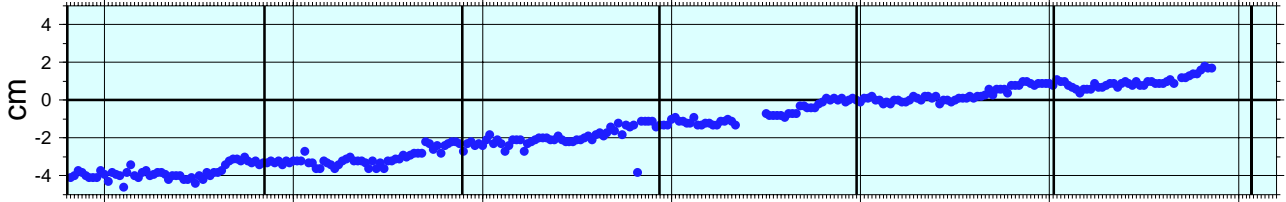




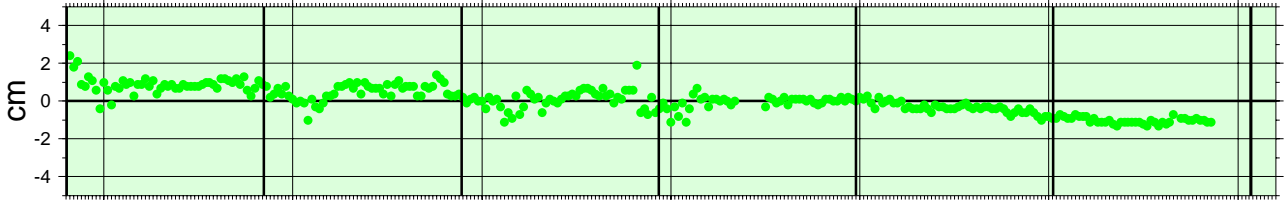


# FORTALEZA

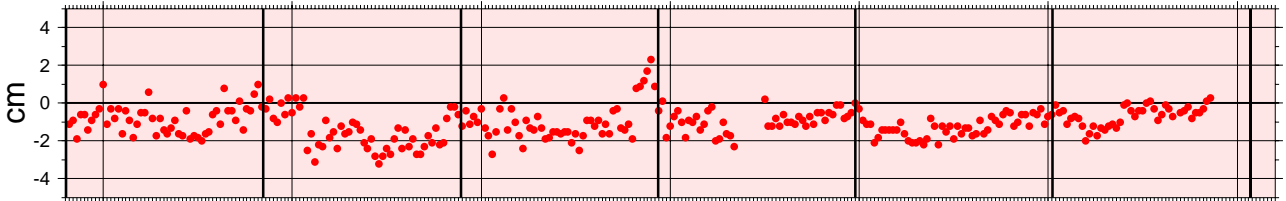
NORTH



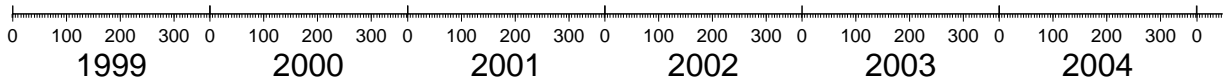
EAST



UP

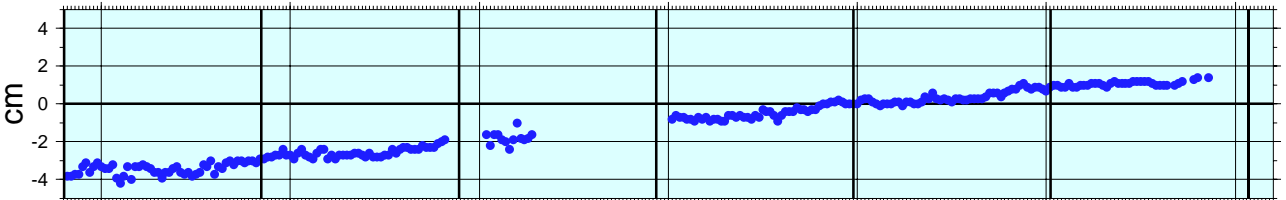


GPS Week

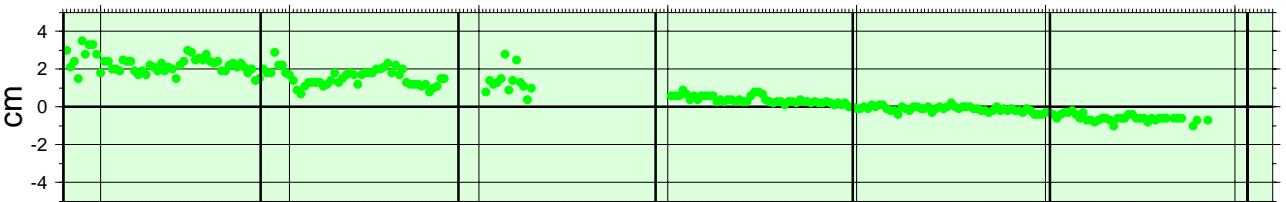


# ASCENSION

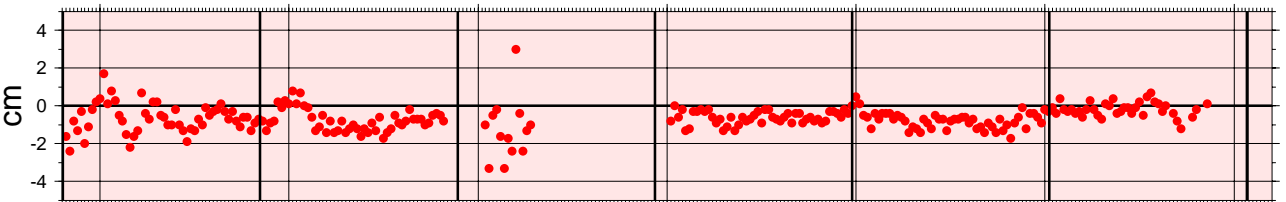
NORTH



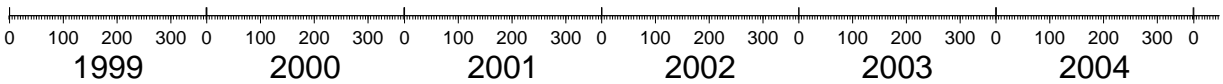
EAST



UP

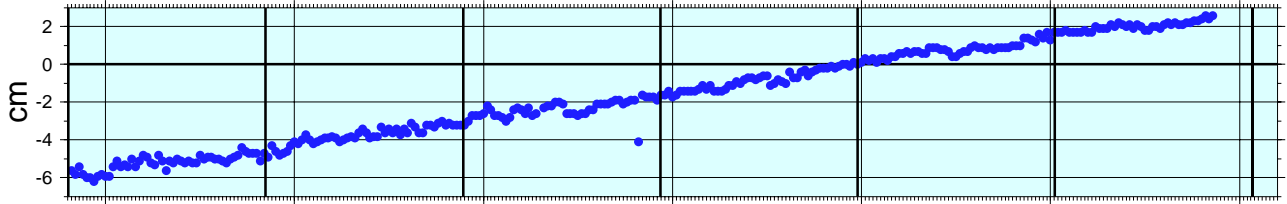


GPS Week

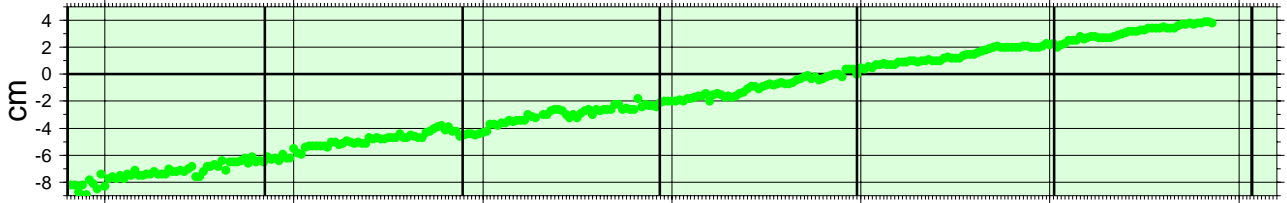


### SANTIAGO DE CHILE

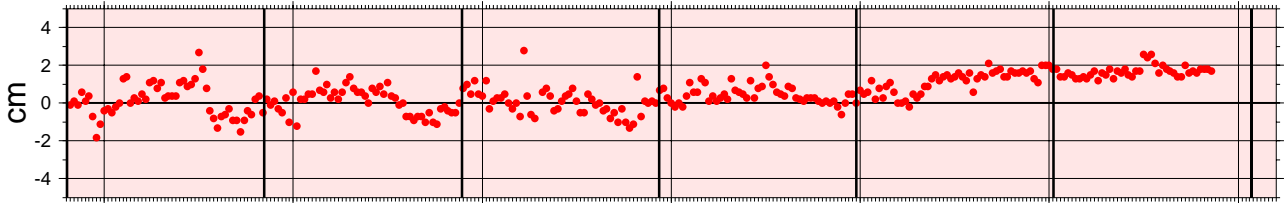
NORTH



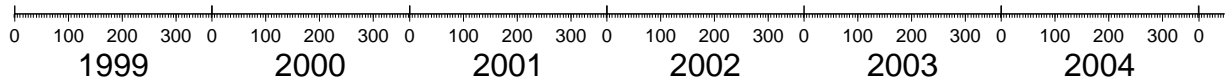
EAST



UP

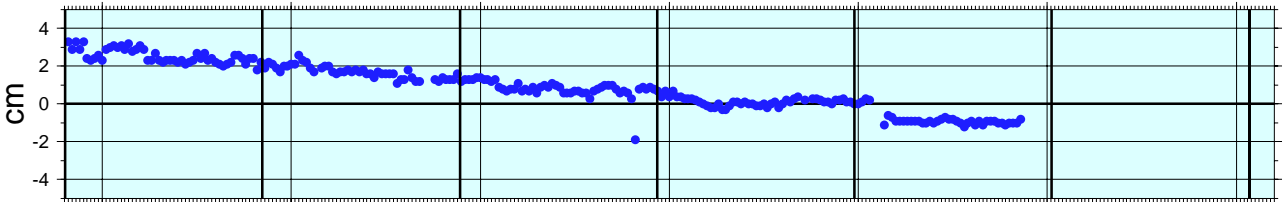


GPS Week

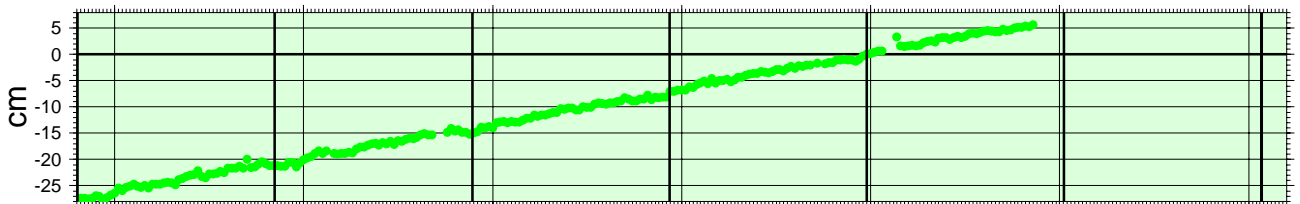


### EASTER ISLAND

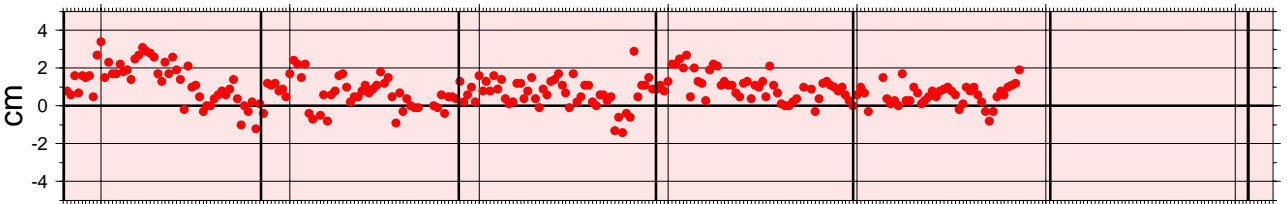
NORTH



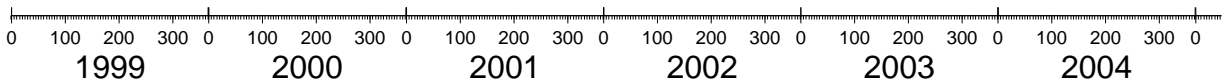
EAST

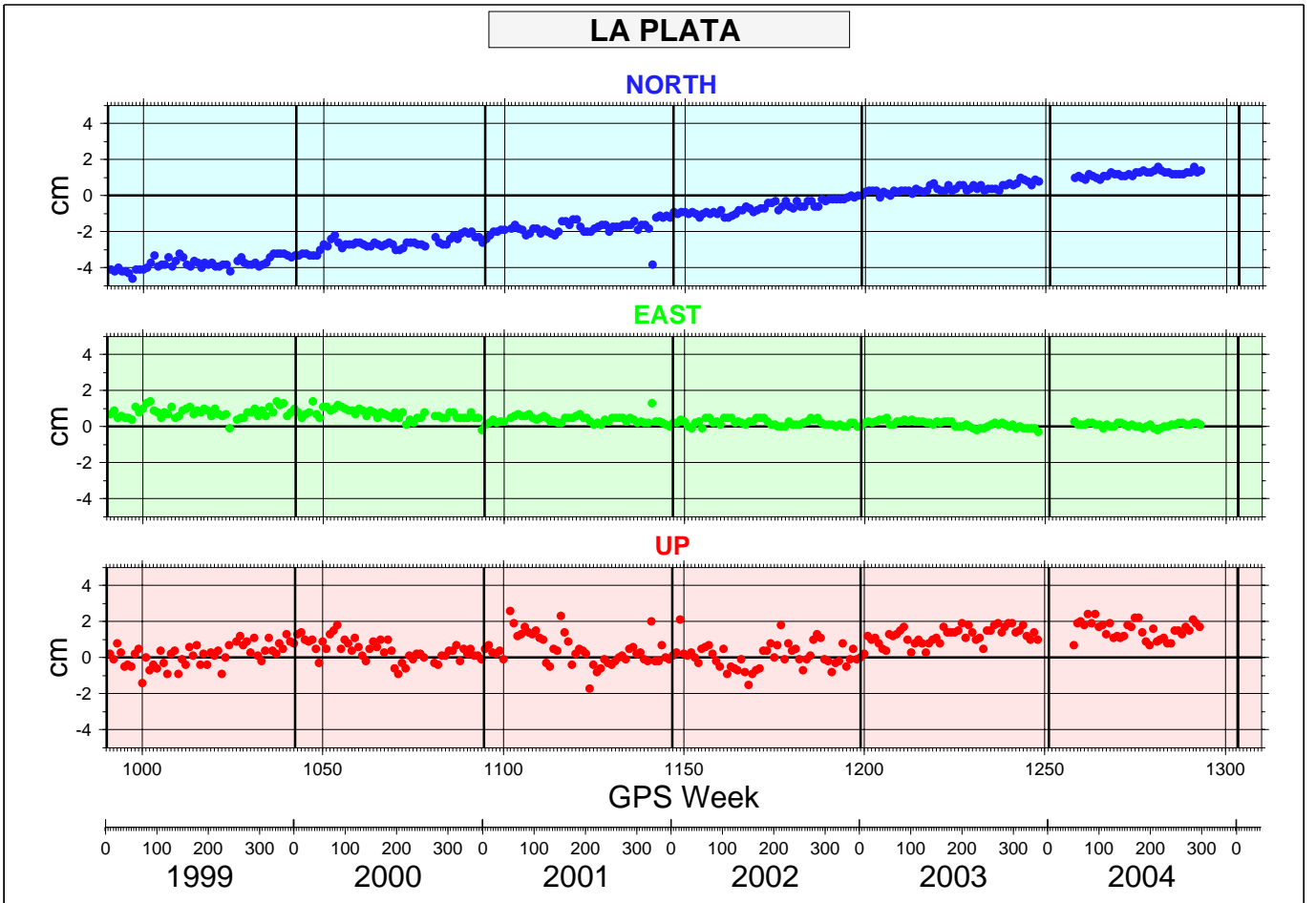
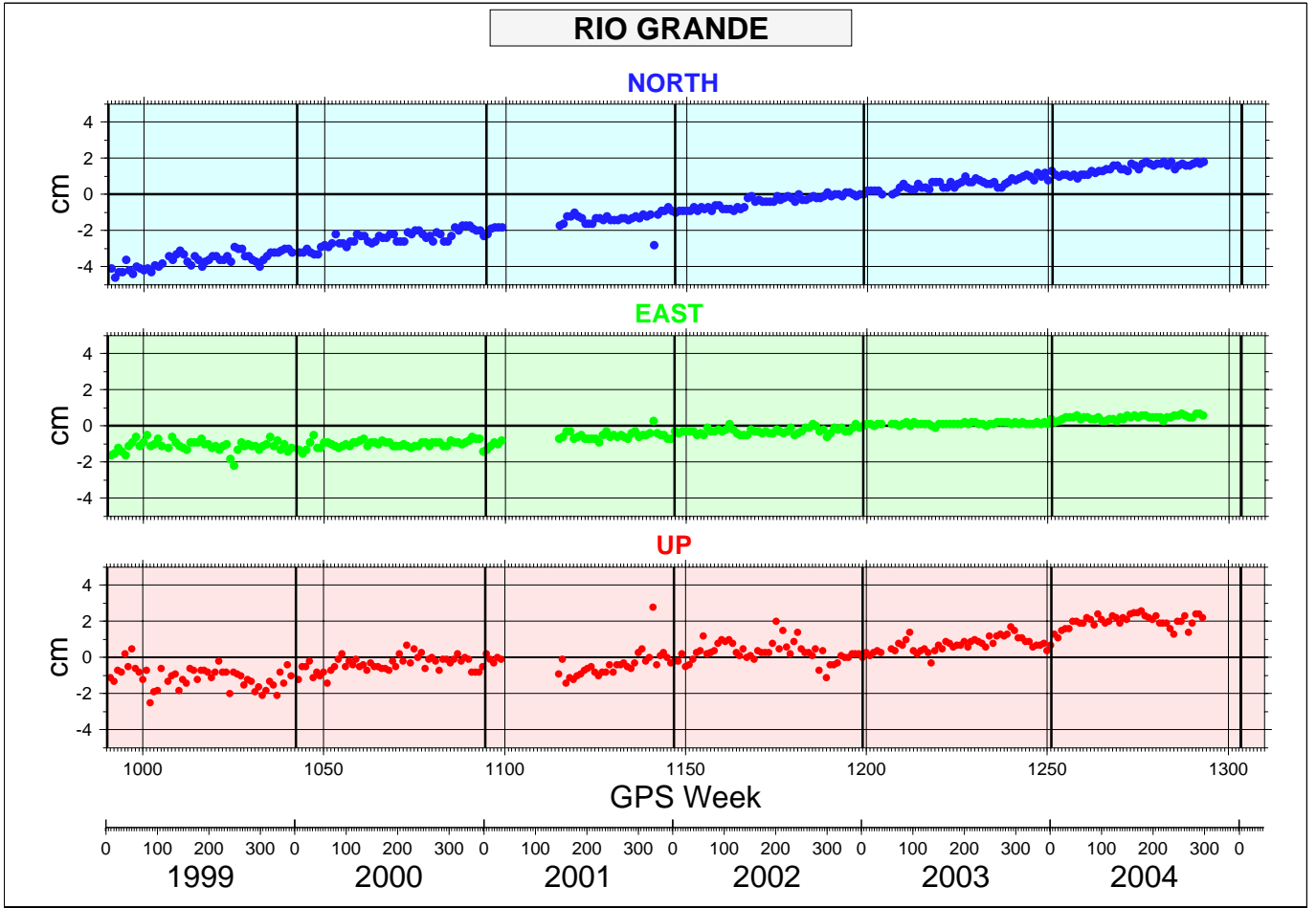


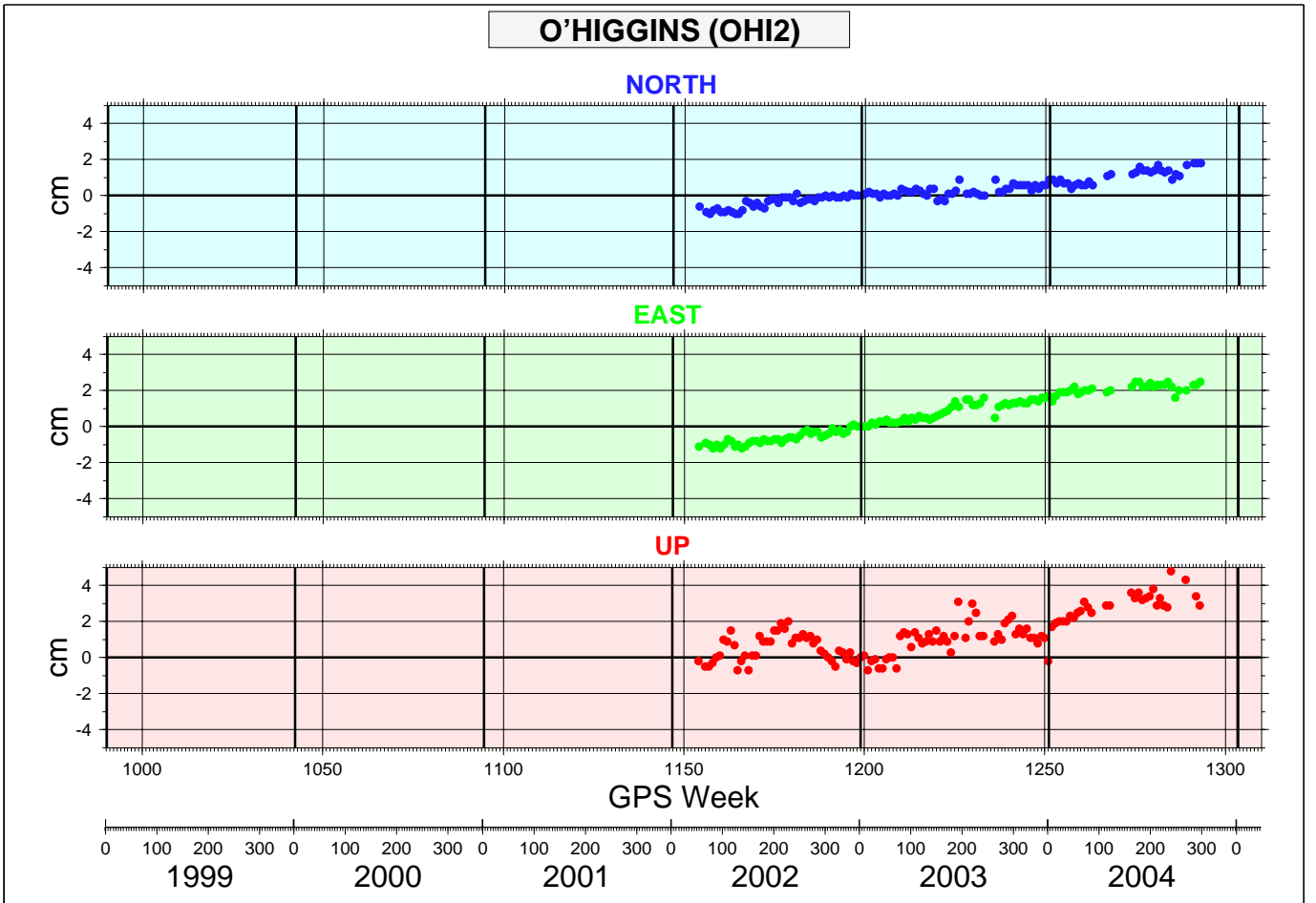
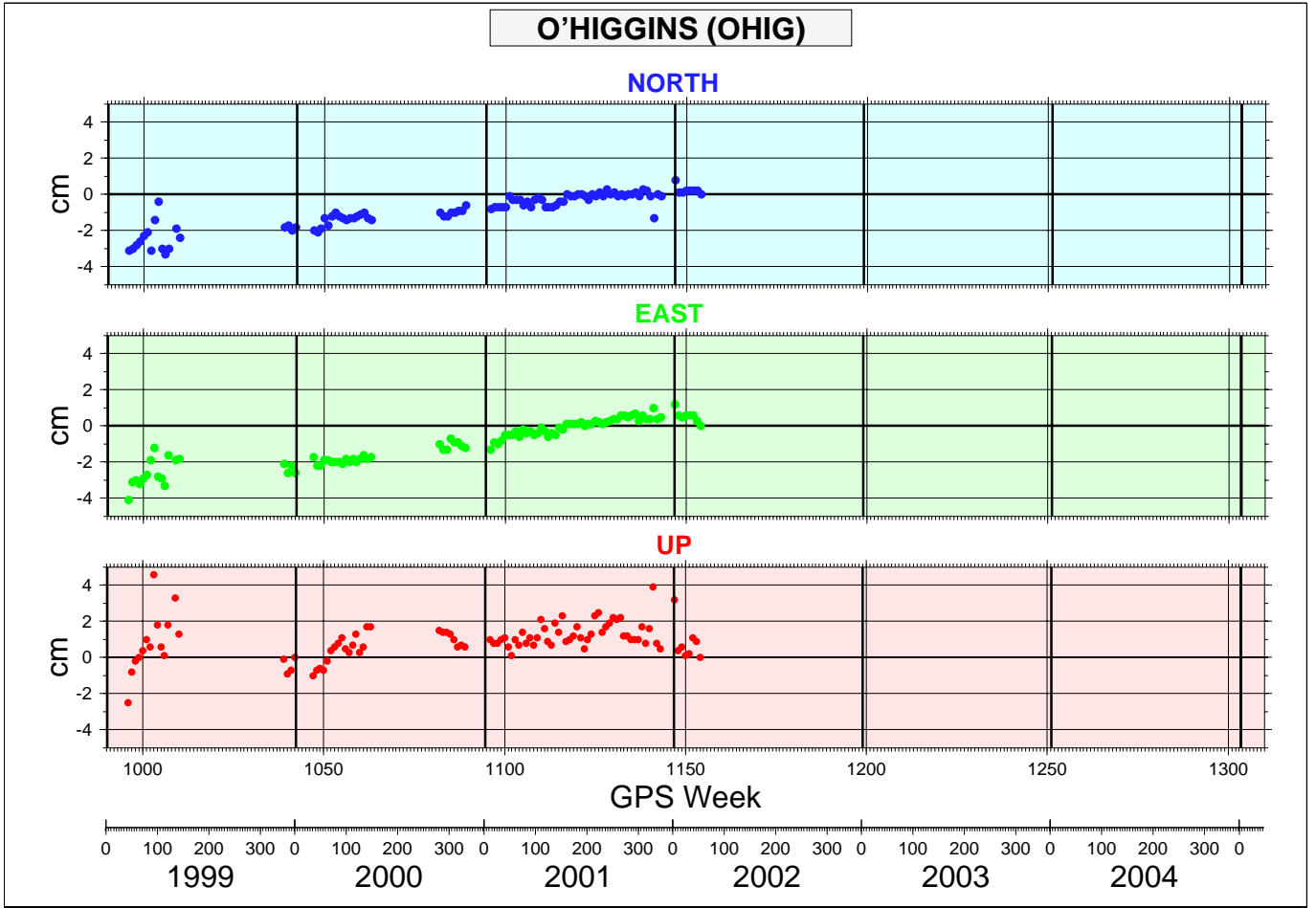
UP

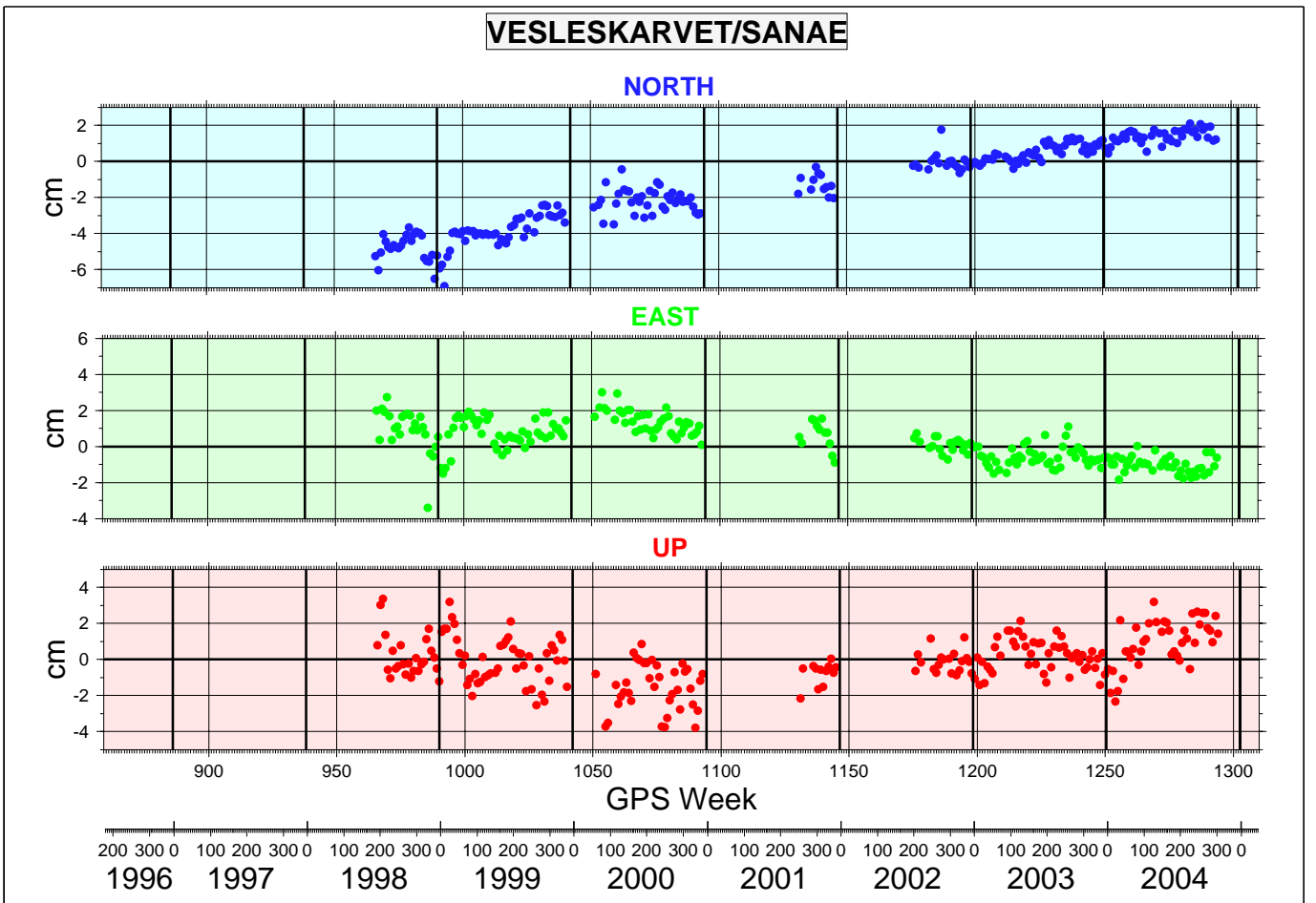
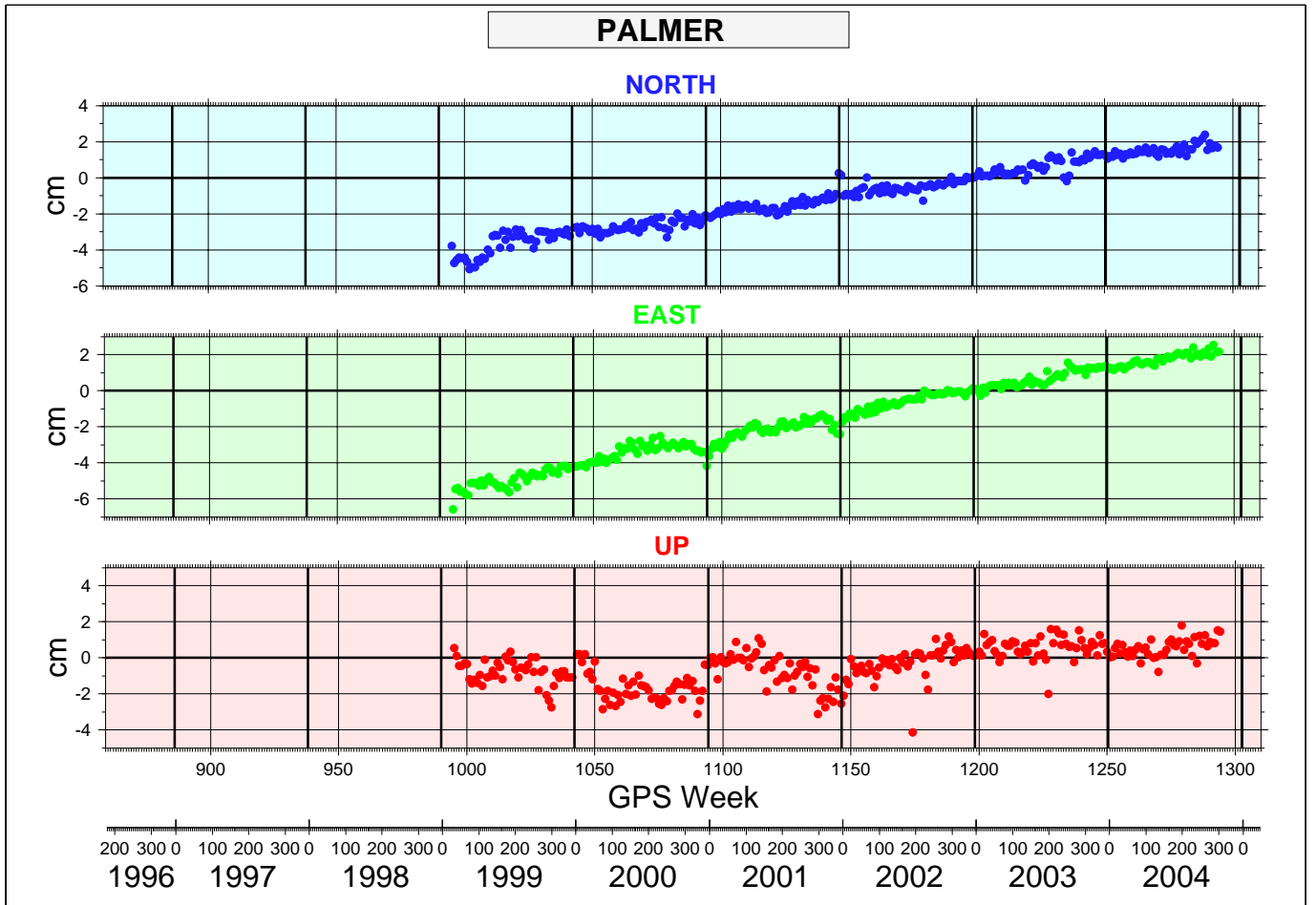


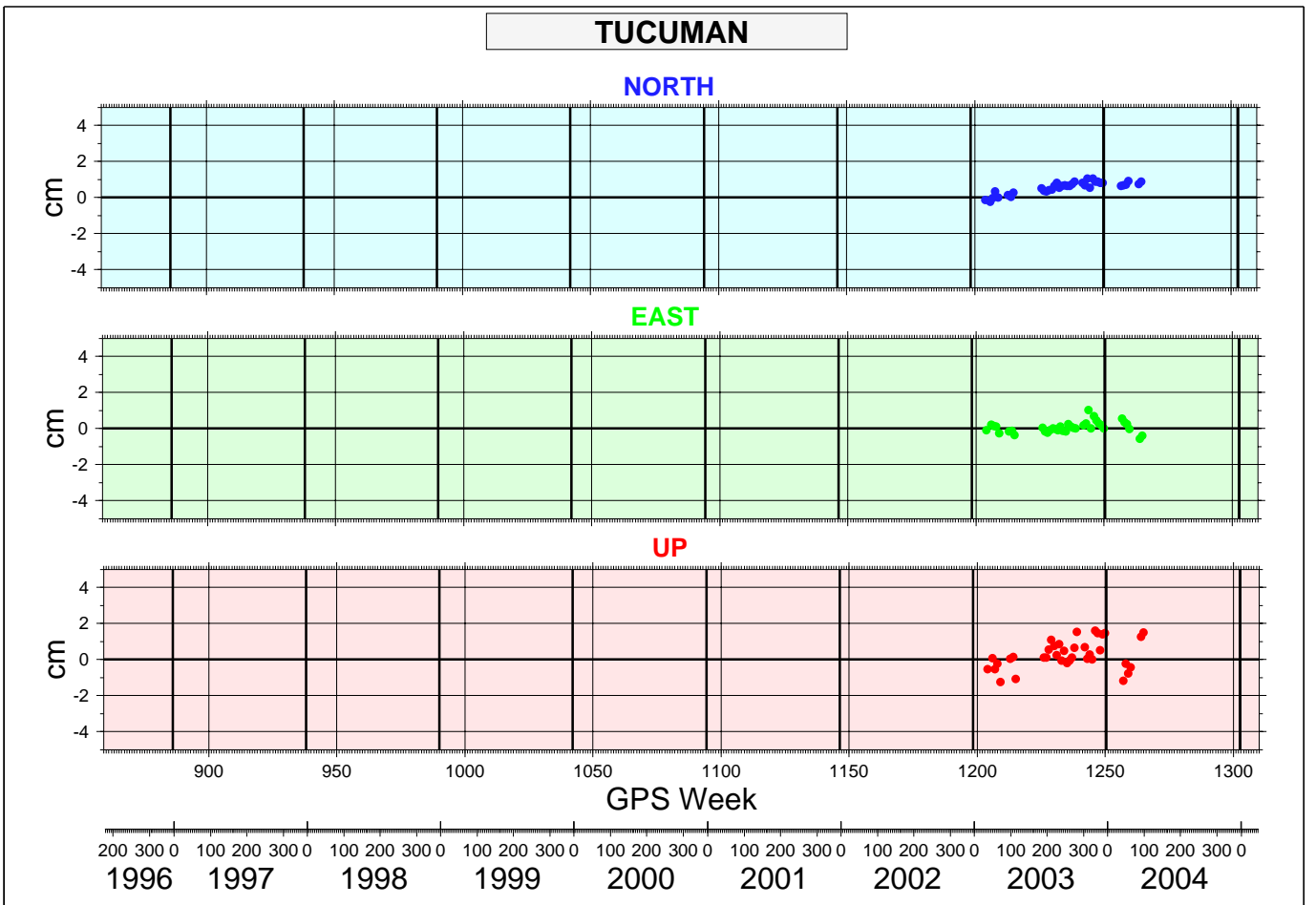
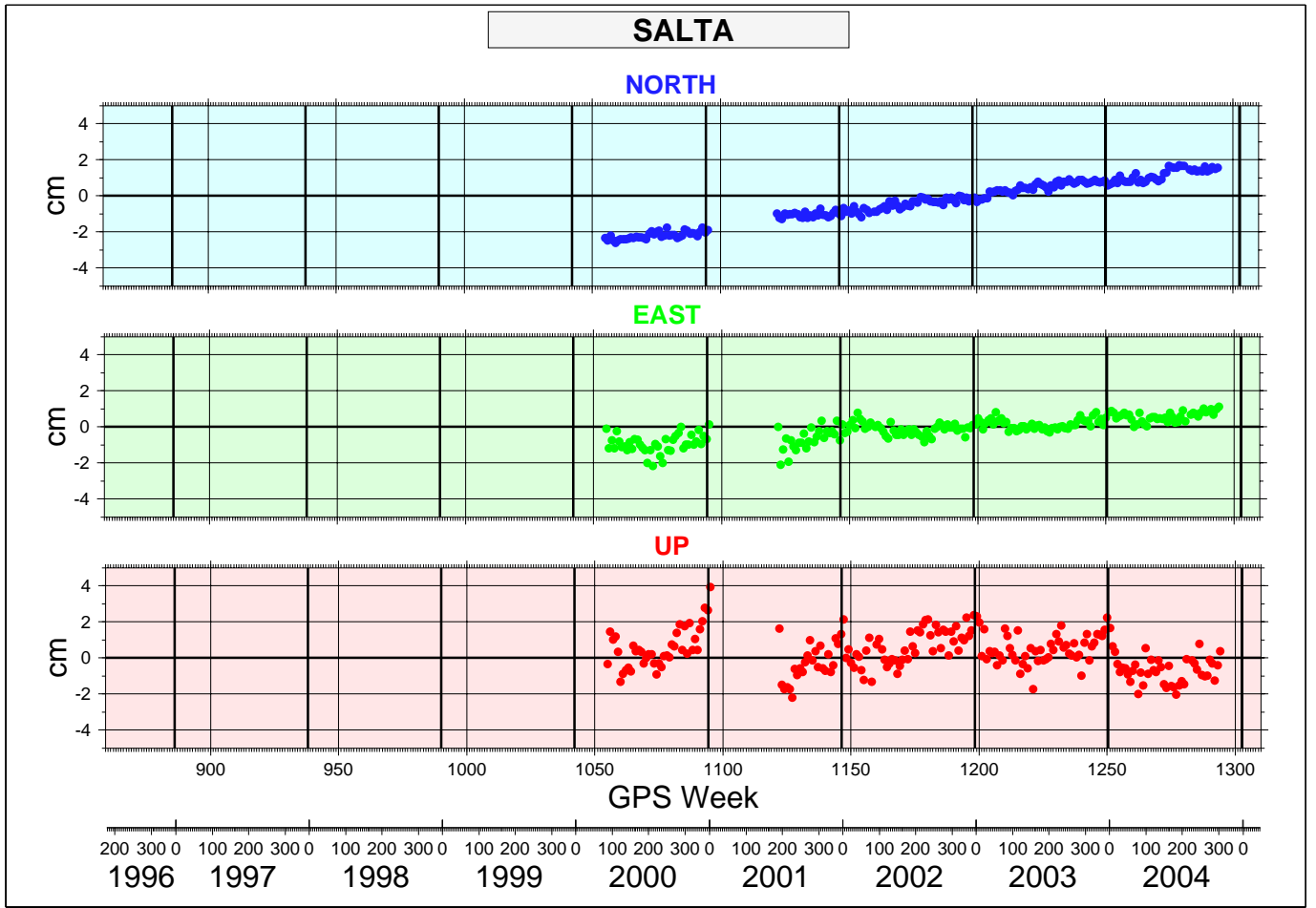
GPS Week





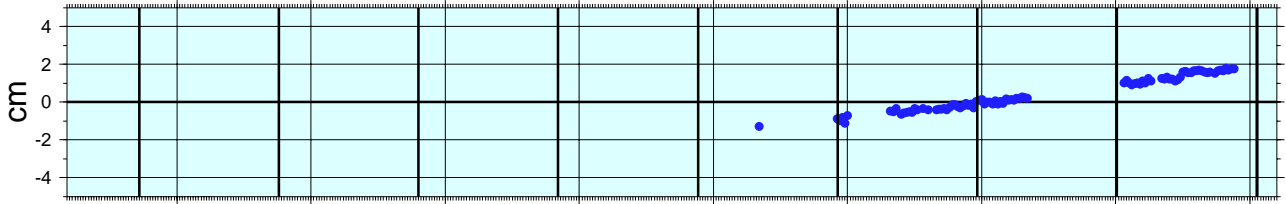




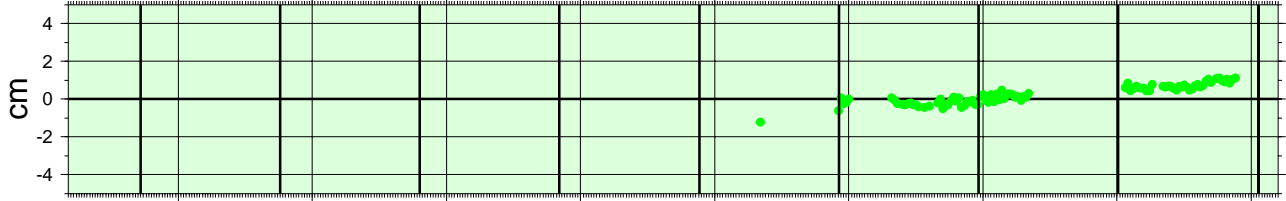


# CAUCETE

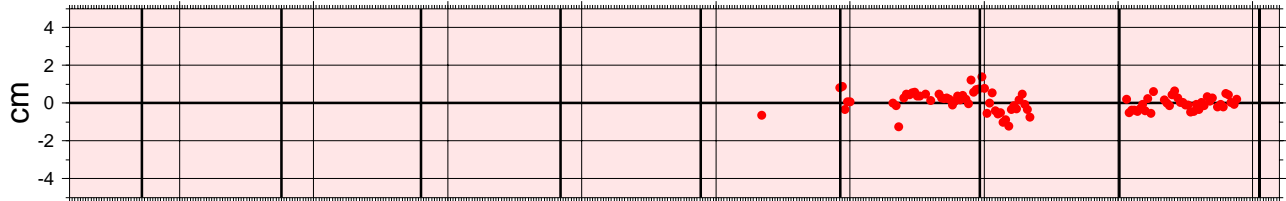
NORTH



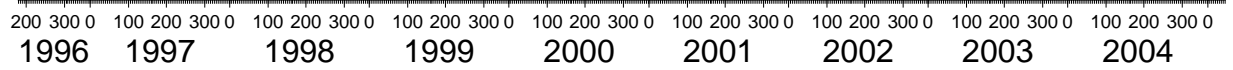
EAST



UP

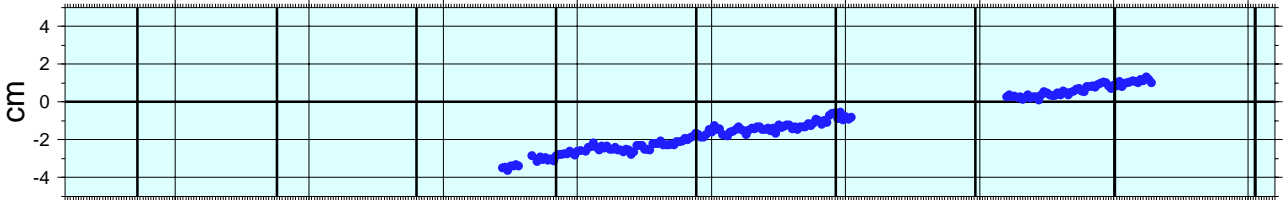


GPS Week

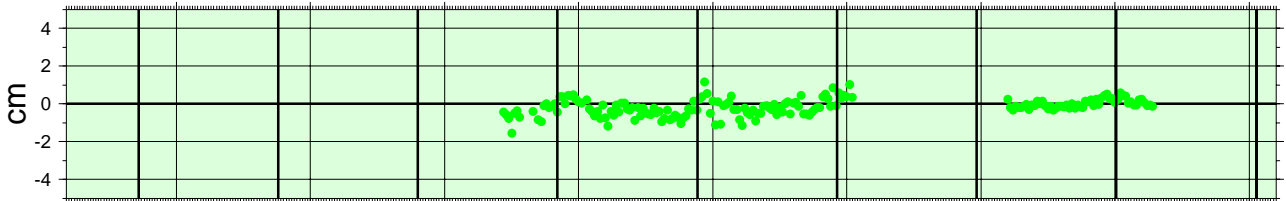


# CORDOBA

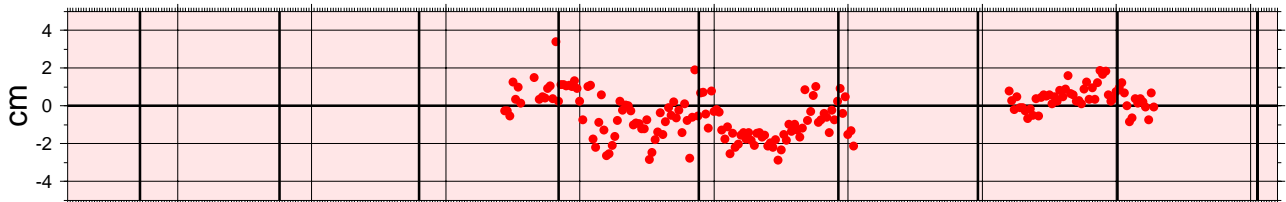
NORTH



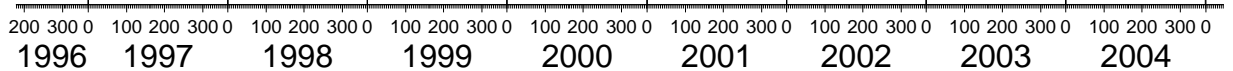
EAST



UP



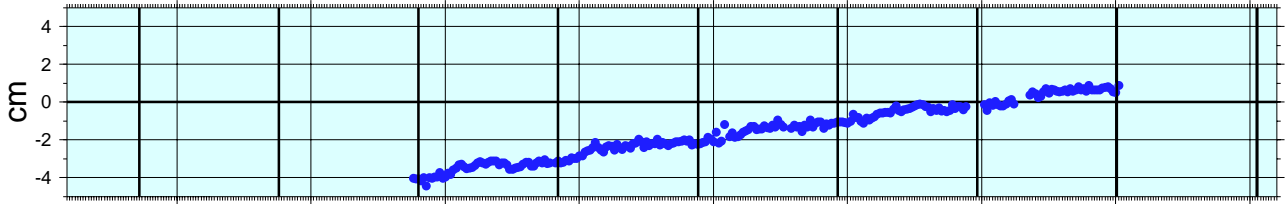
GPS Week



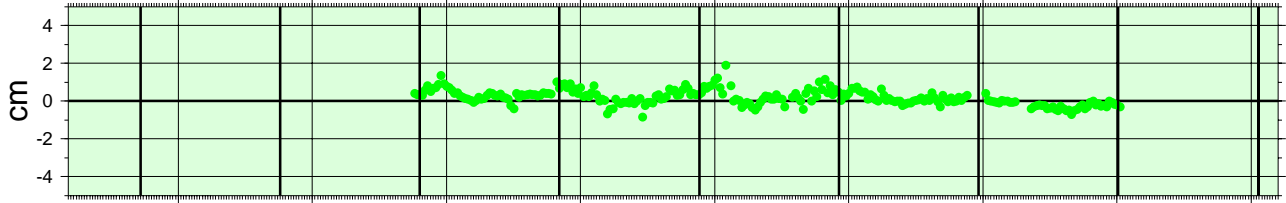


### BUENOS AIRES (IGM0)

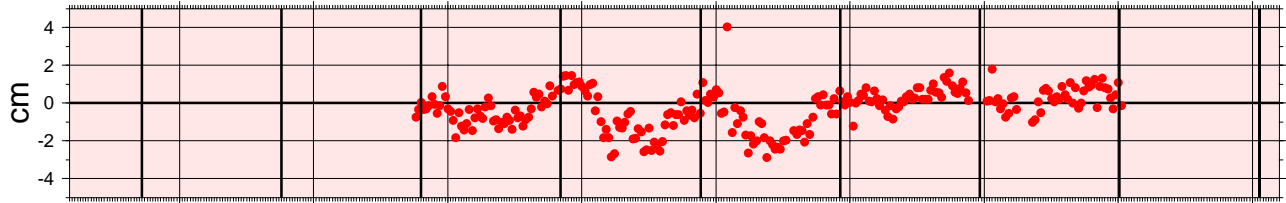
NORTH



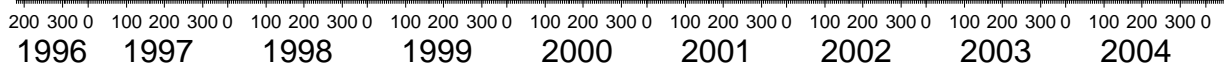
EAST



UP

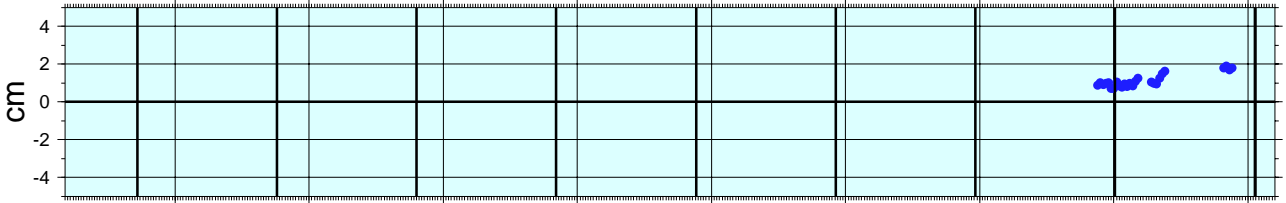


GPS Week

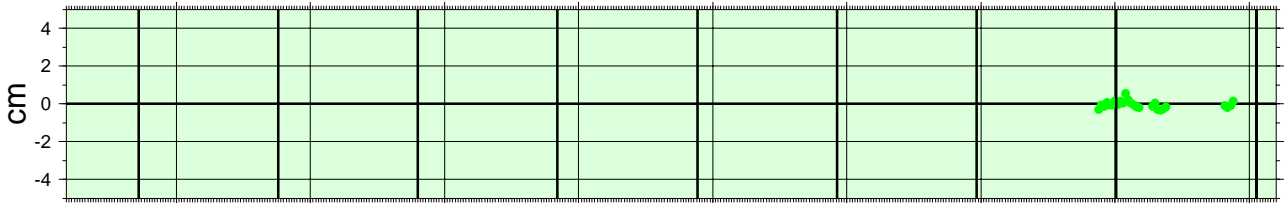


### BUENOS AIRES (IGM1)

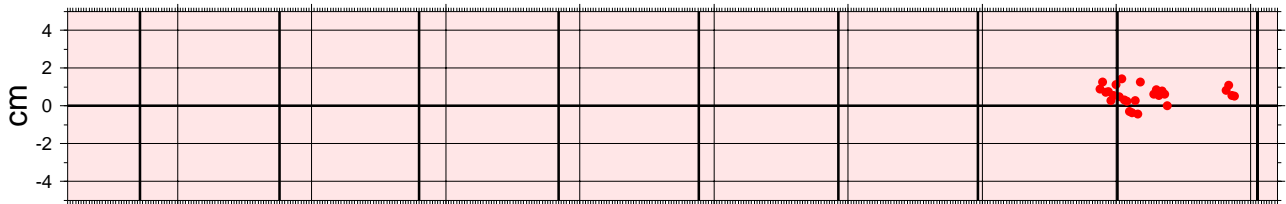
NORTH



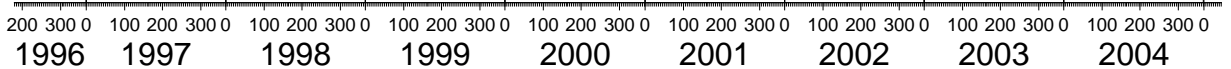
EAST



UP

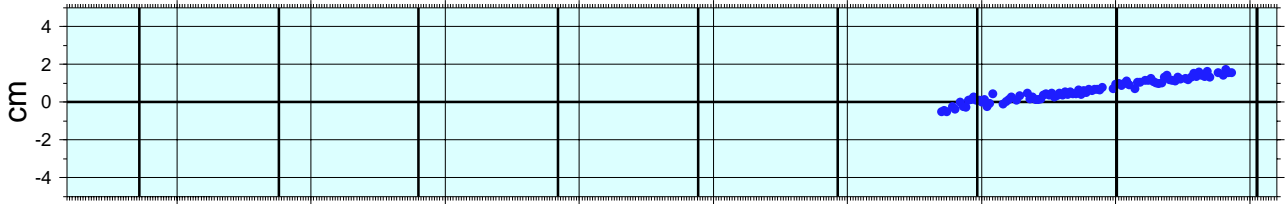


GPS Week

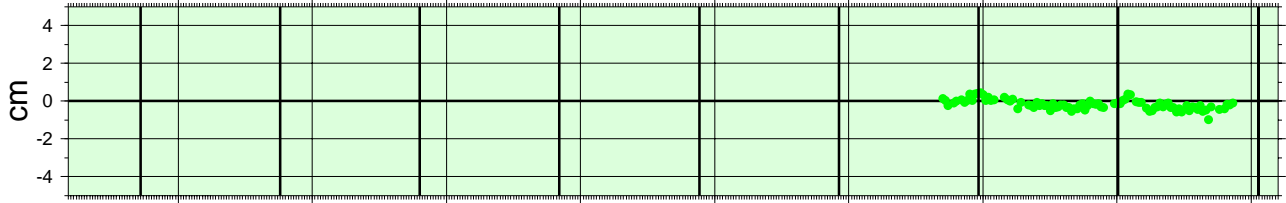


### MAR DEL PLATA

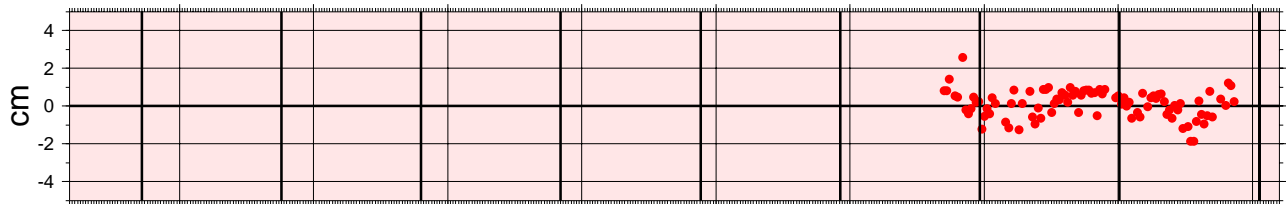
NORTH



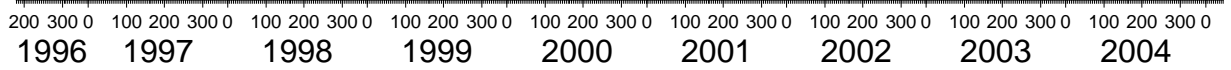
EAST



UP

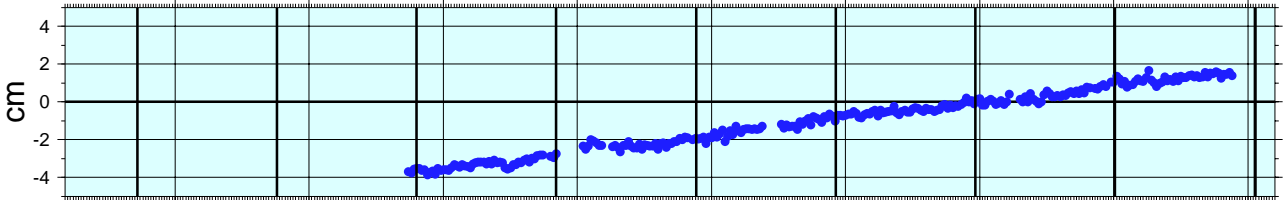


GPS Week

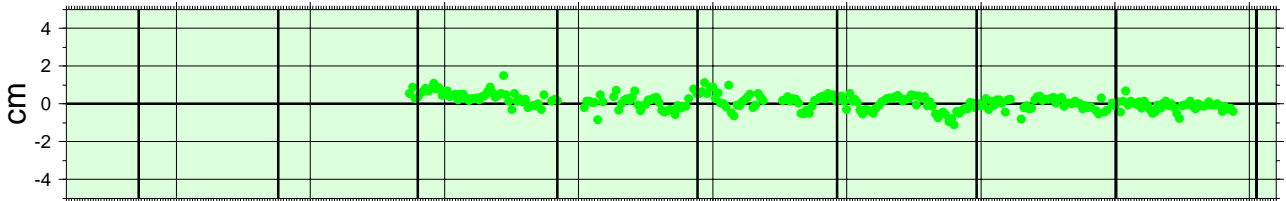


### BAHIA BLANCA

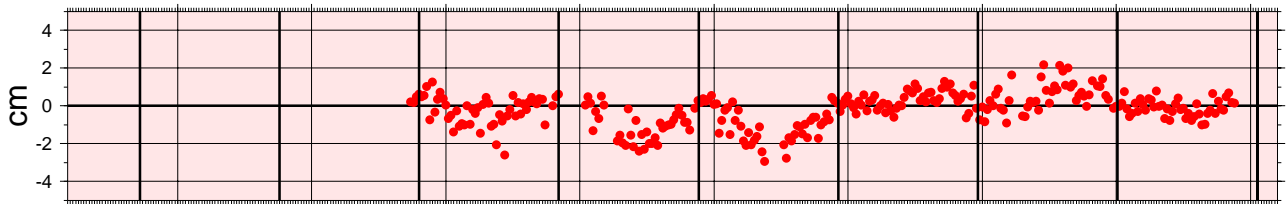
NORTH



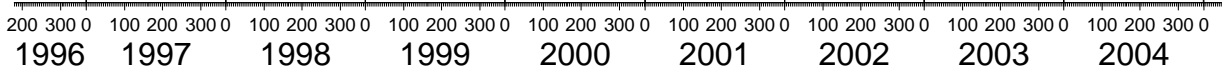
EAST

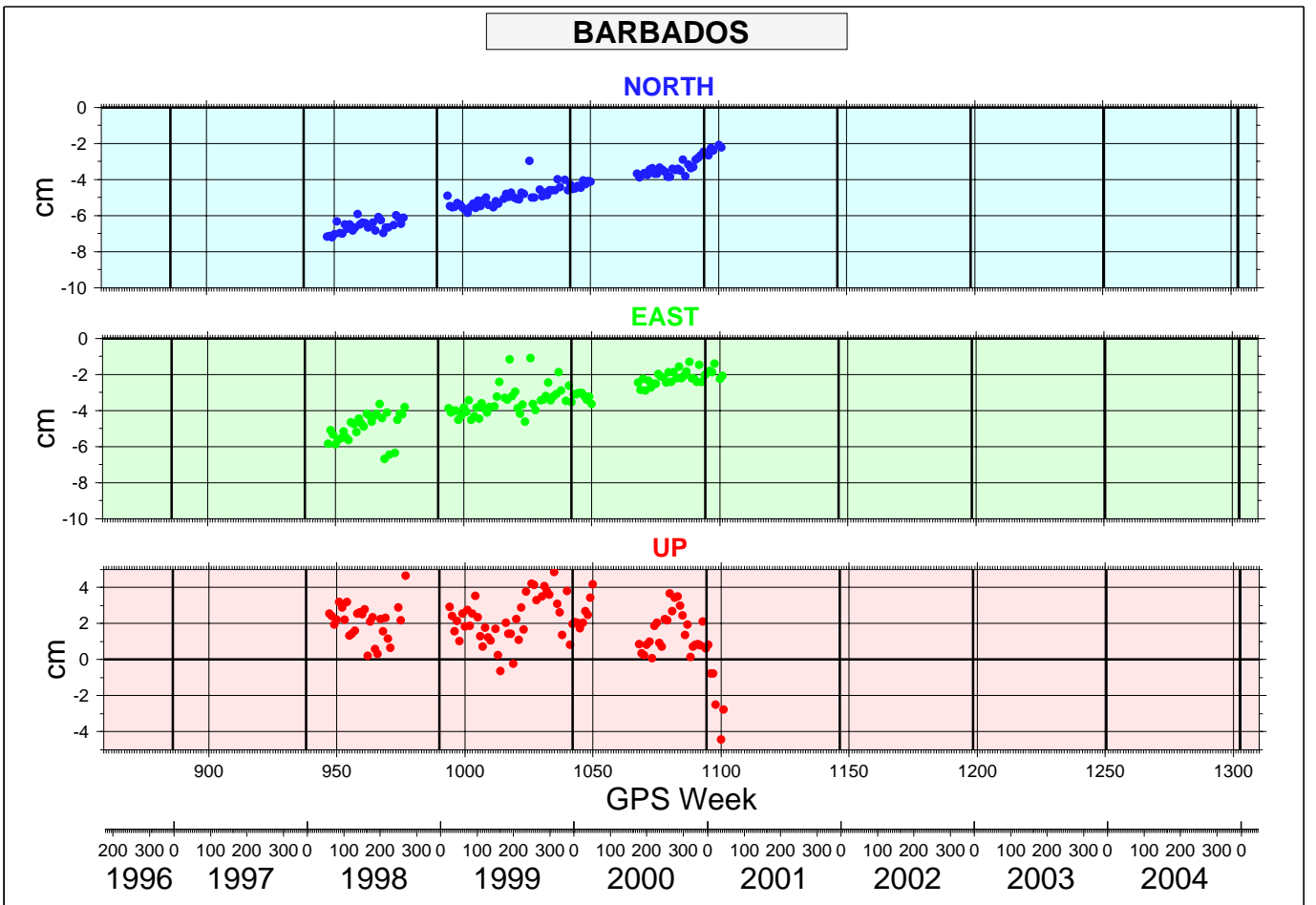
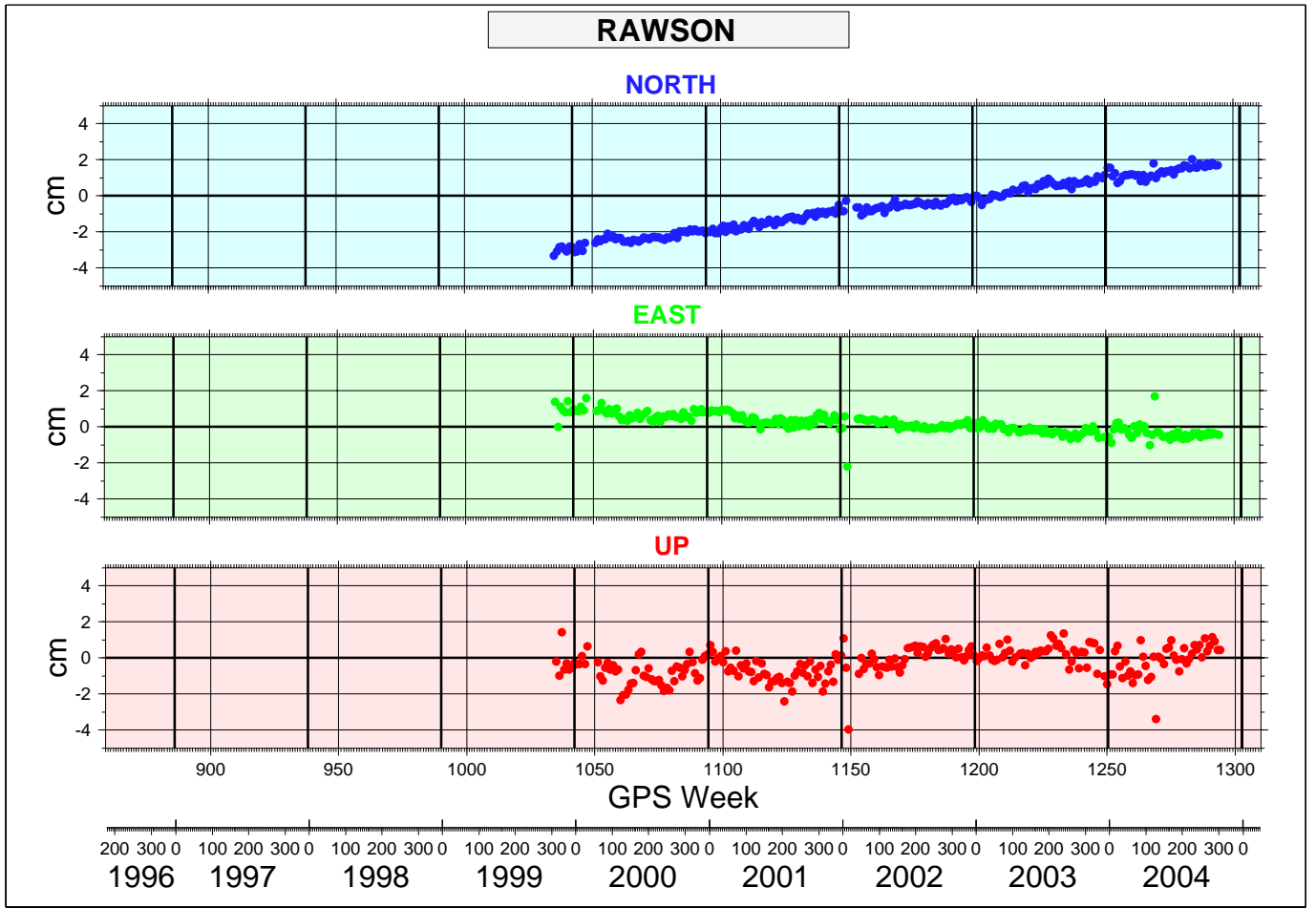


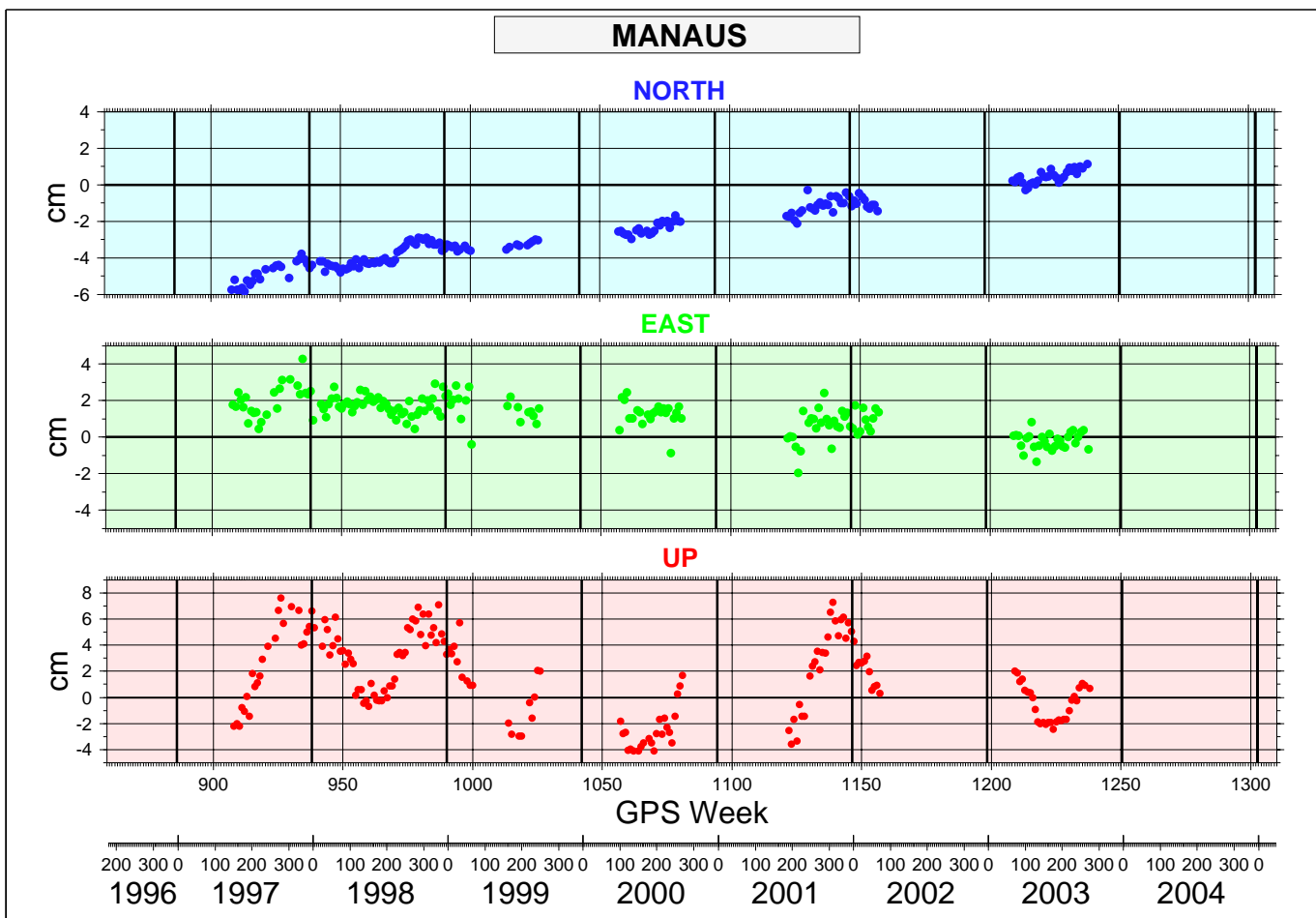
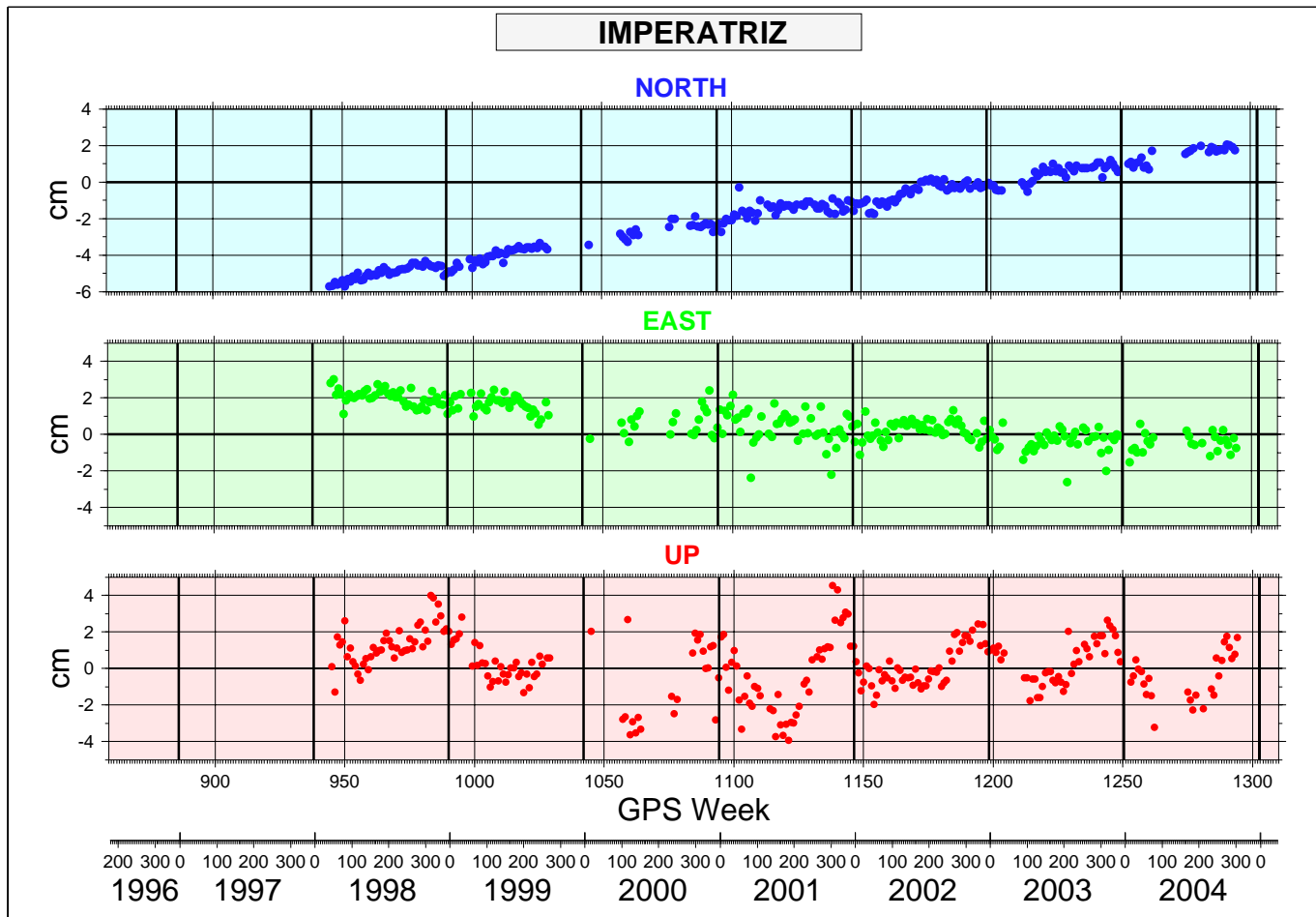
UP

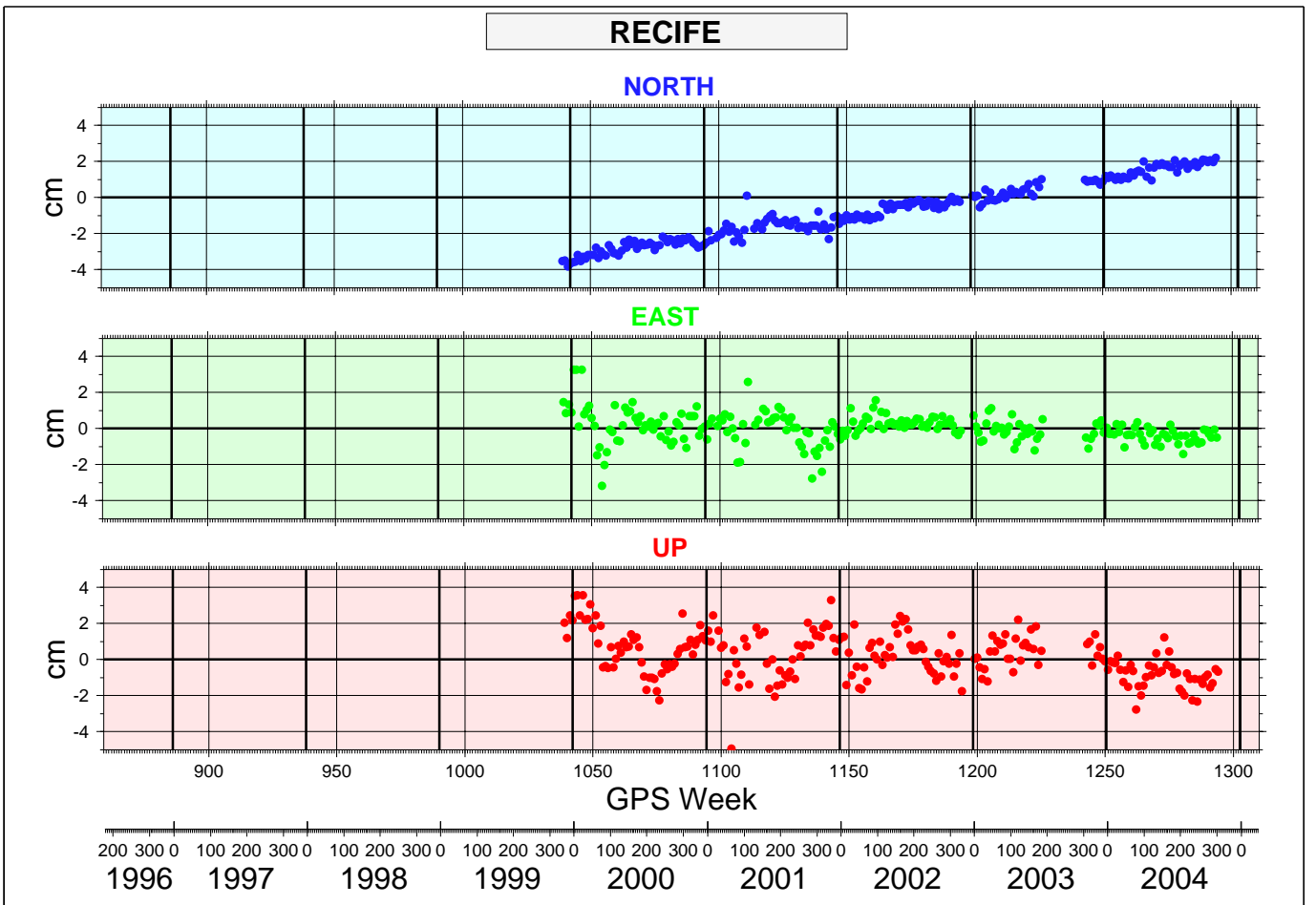
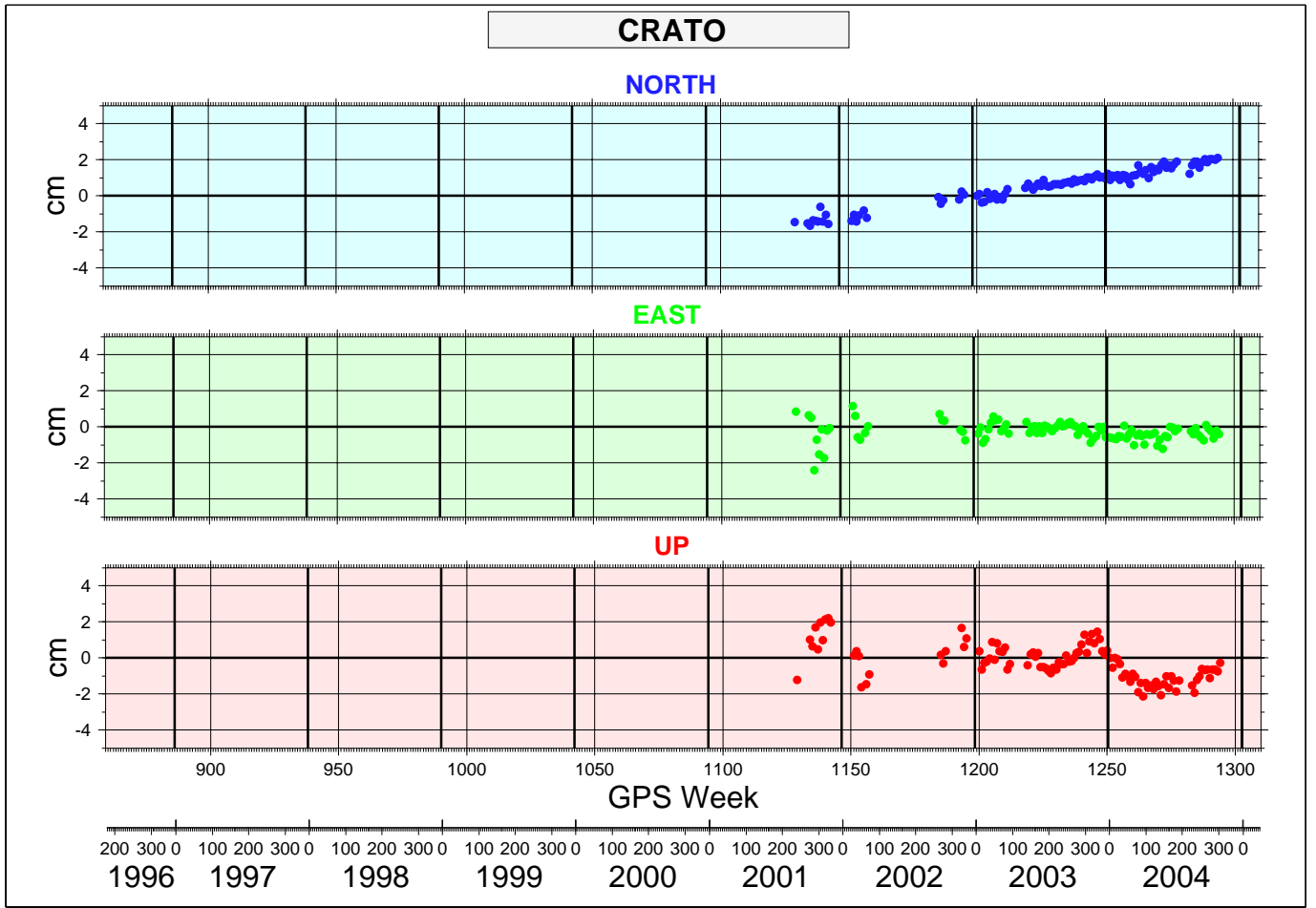


GPS Week

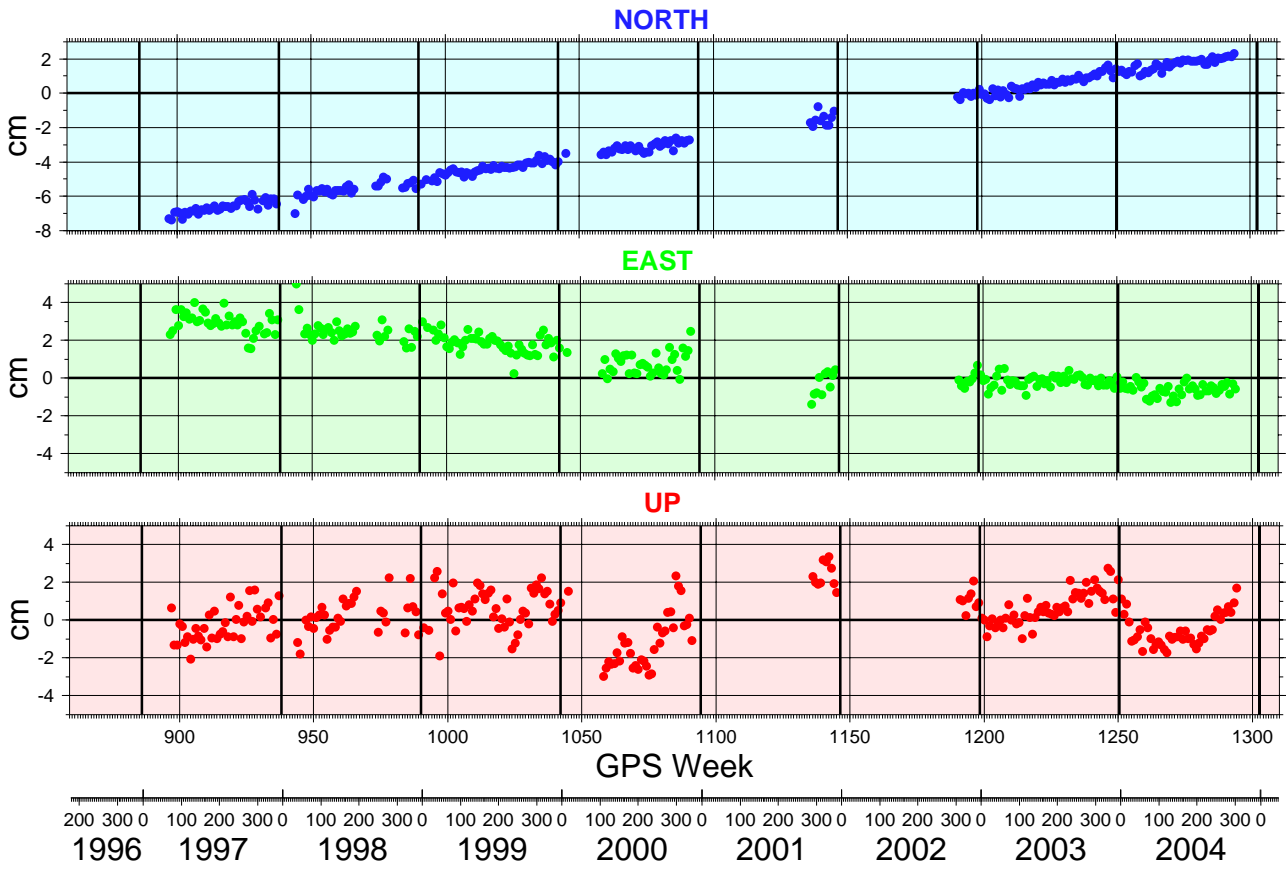




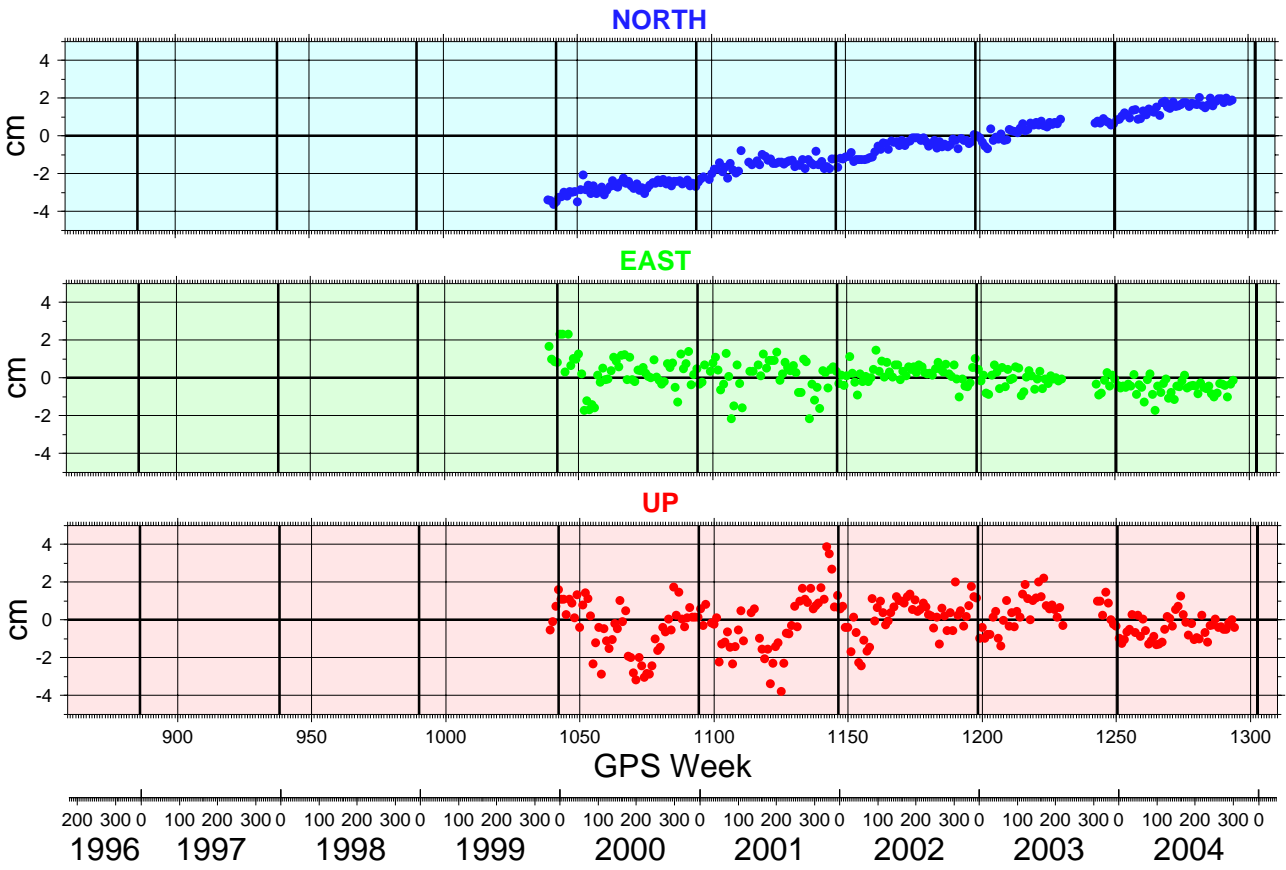


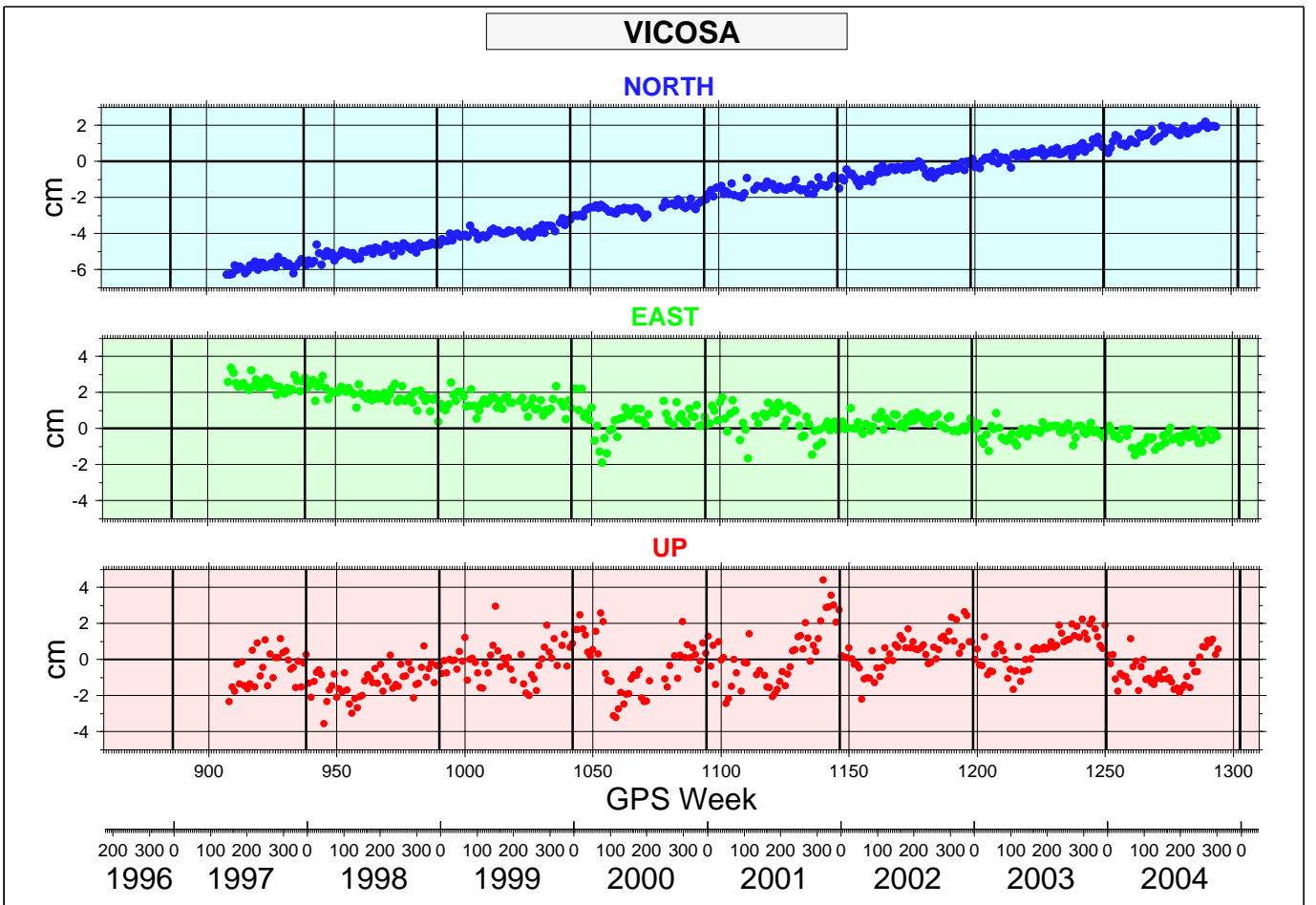
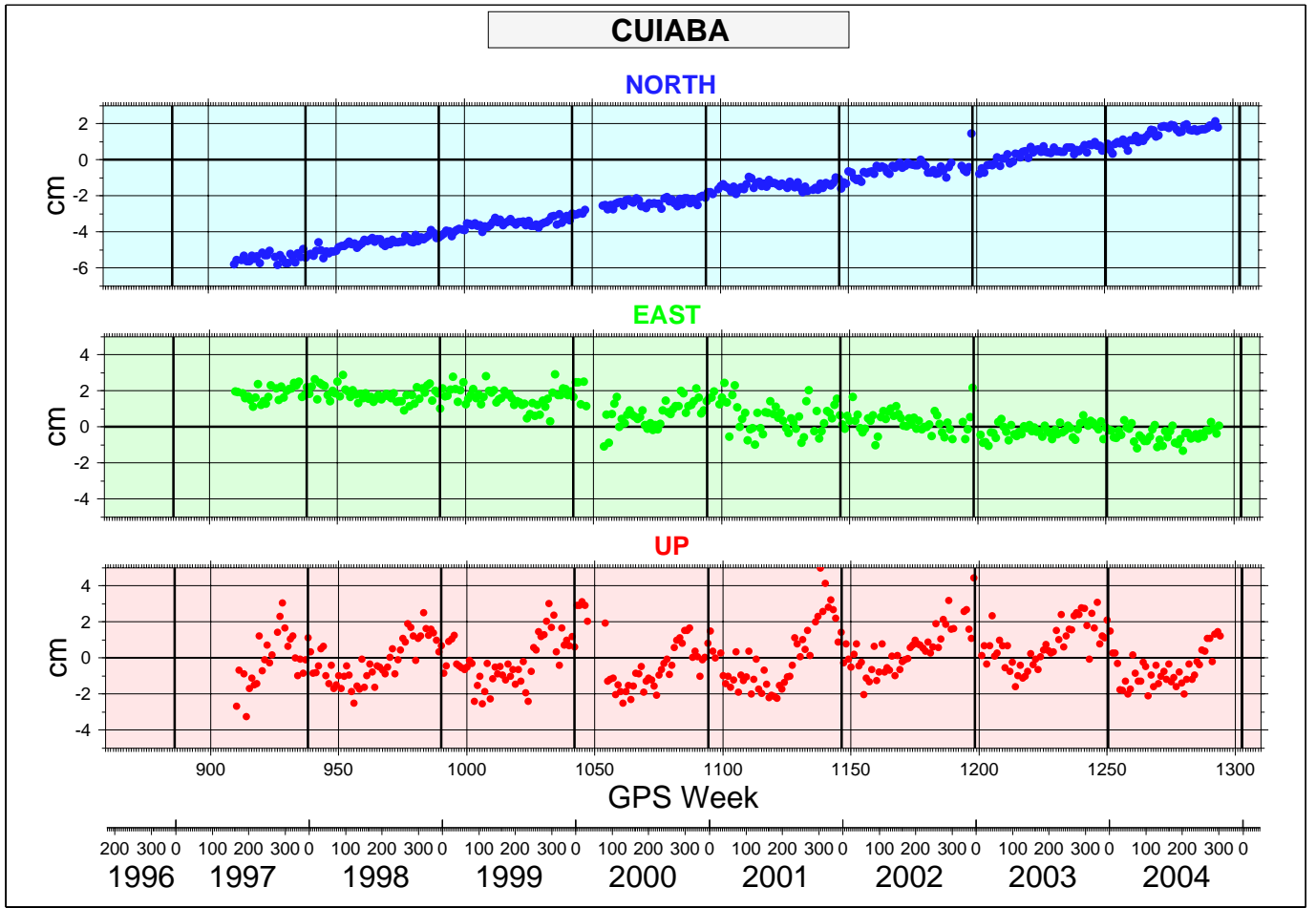


### BOM JESUS DA LAPA



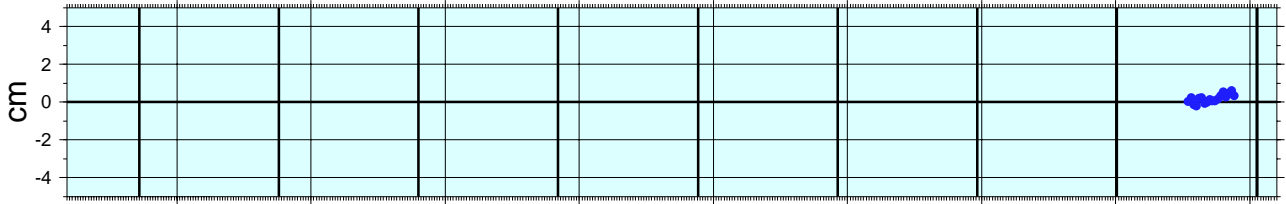
### SALVADOR



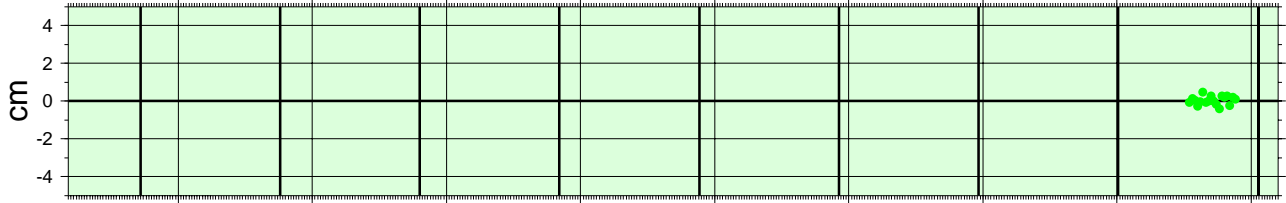


### MONTES CLAROS

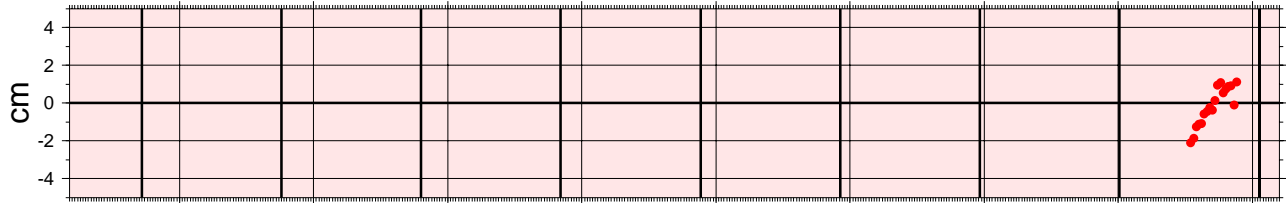
NORTH



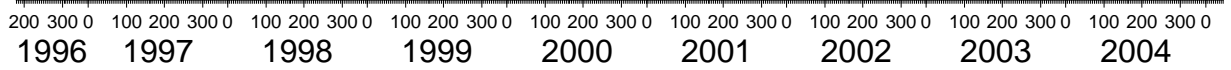
EAST



UP

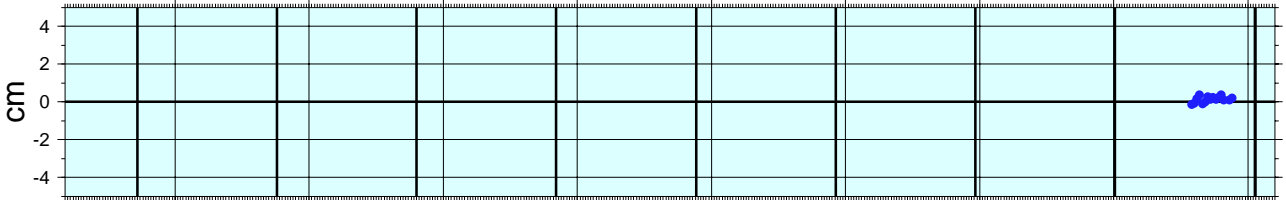


GPS Week

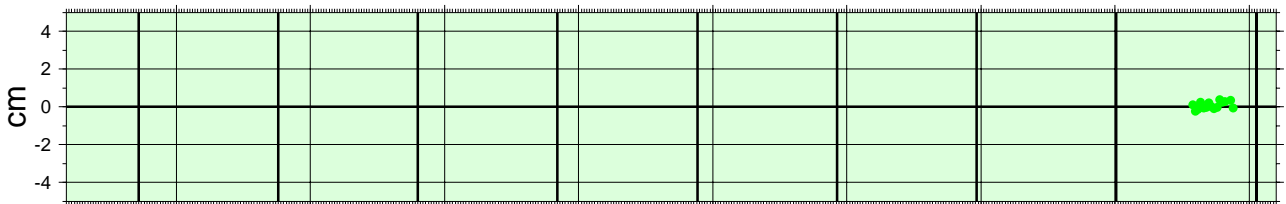


### UBERLANDIA

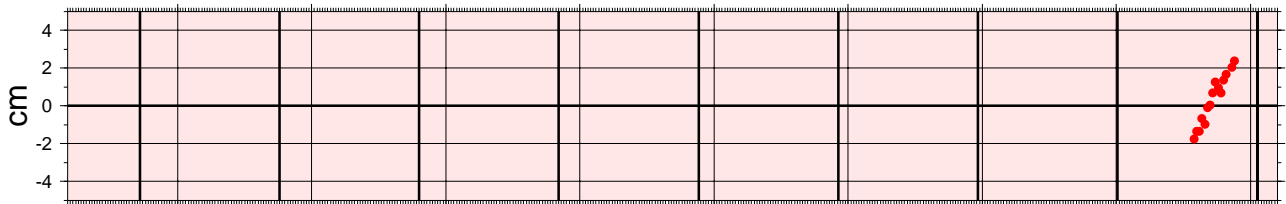
NORTH



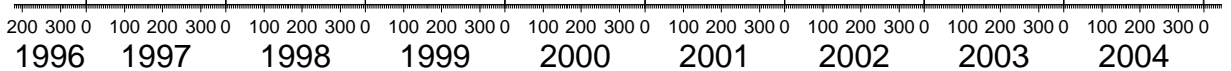
EAST



UP



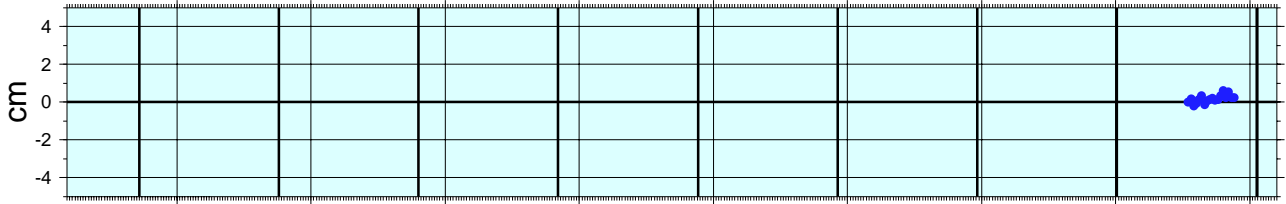
GPS Week



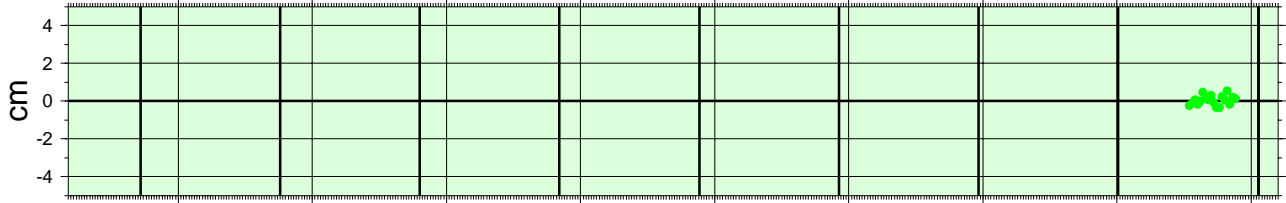


# GOVERNADOR VALADARES

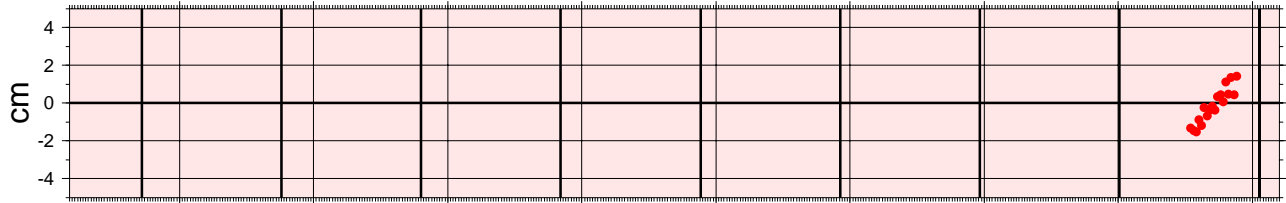
NORTH



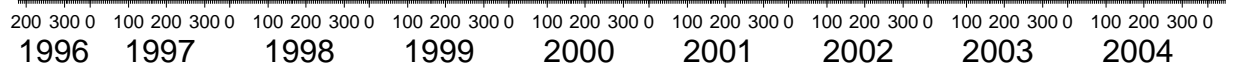
EAST



UP

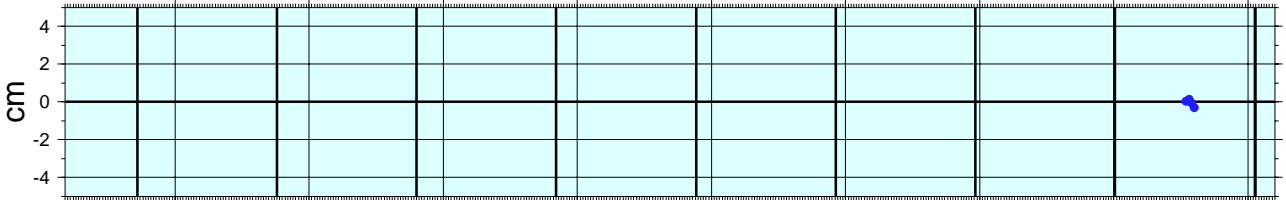


GPS Week

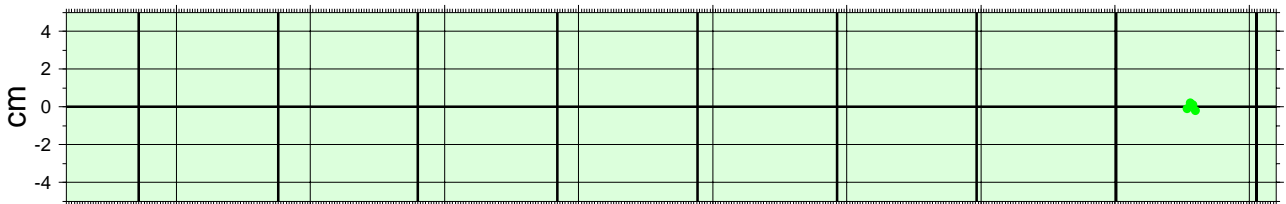


# VARGINHA

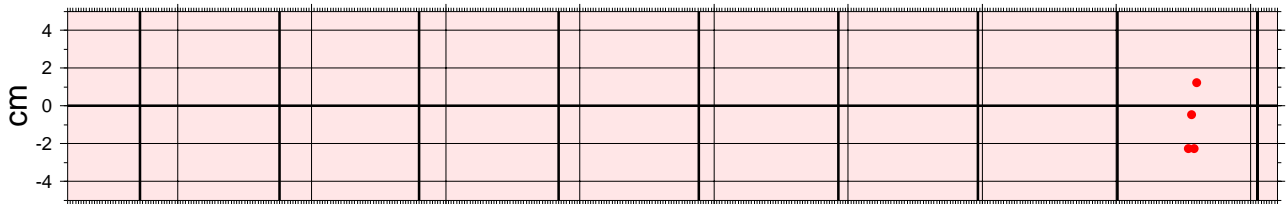
NORTH



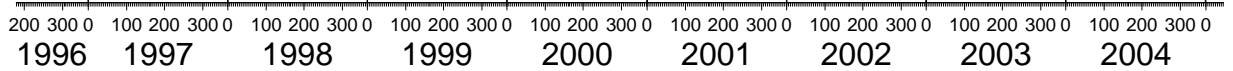
EAST



UP

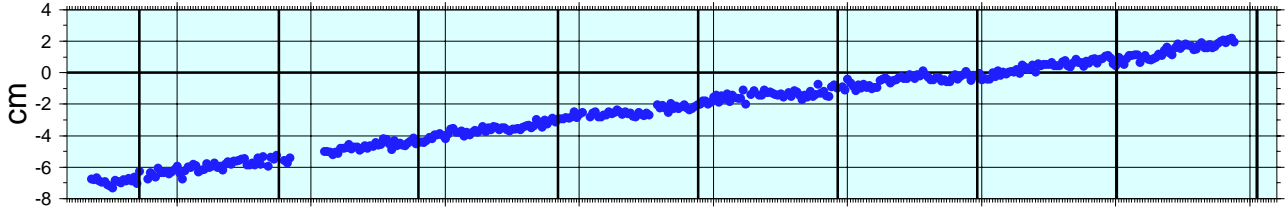


GPS Week

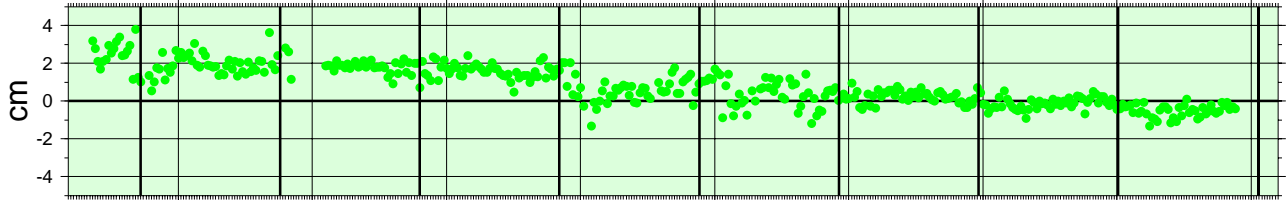


# BRASILIA

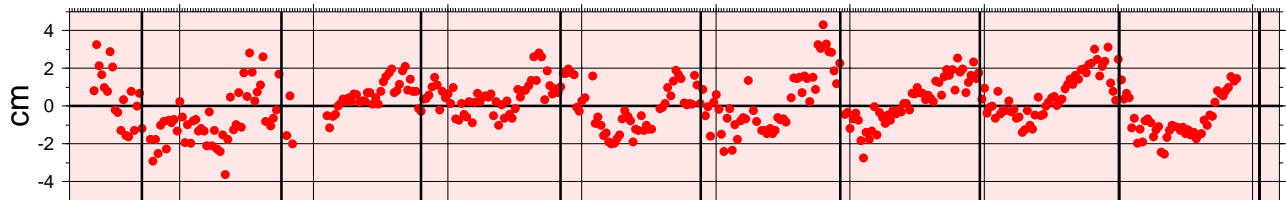
## NORTH



## EAST



## UP

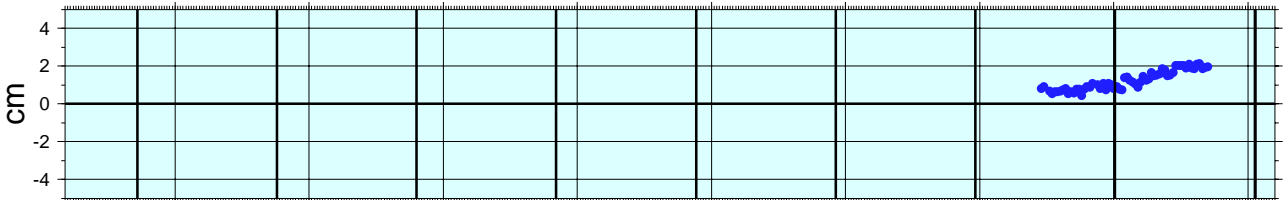


GPS Week

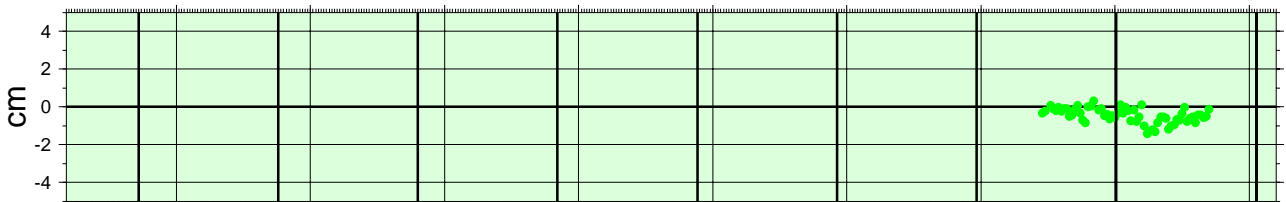
200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0  
1996 1997 1998 1999 2000 2001 2002 2003 2004

# CACHOEIRA

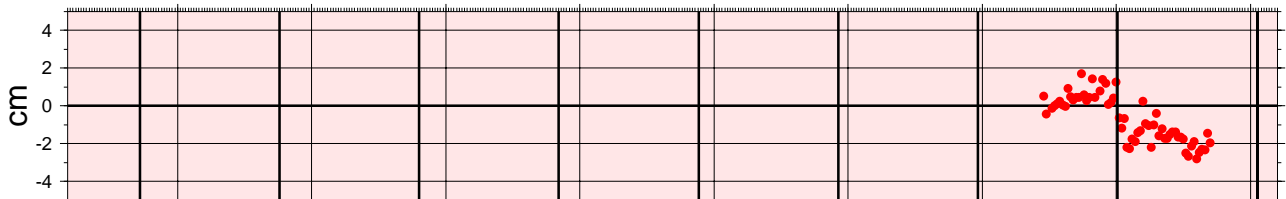
## NORTH



## EAST

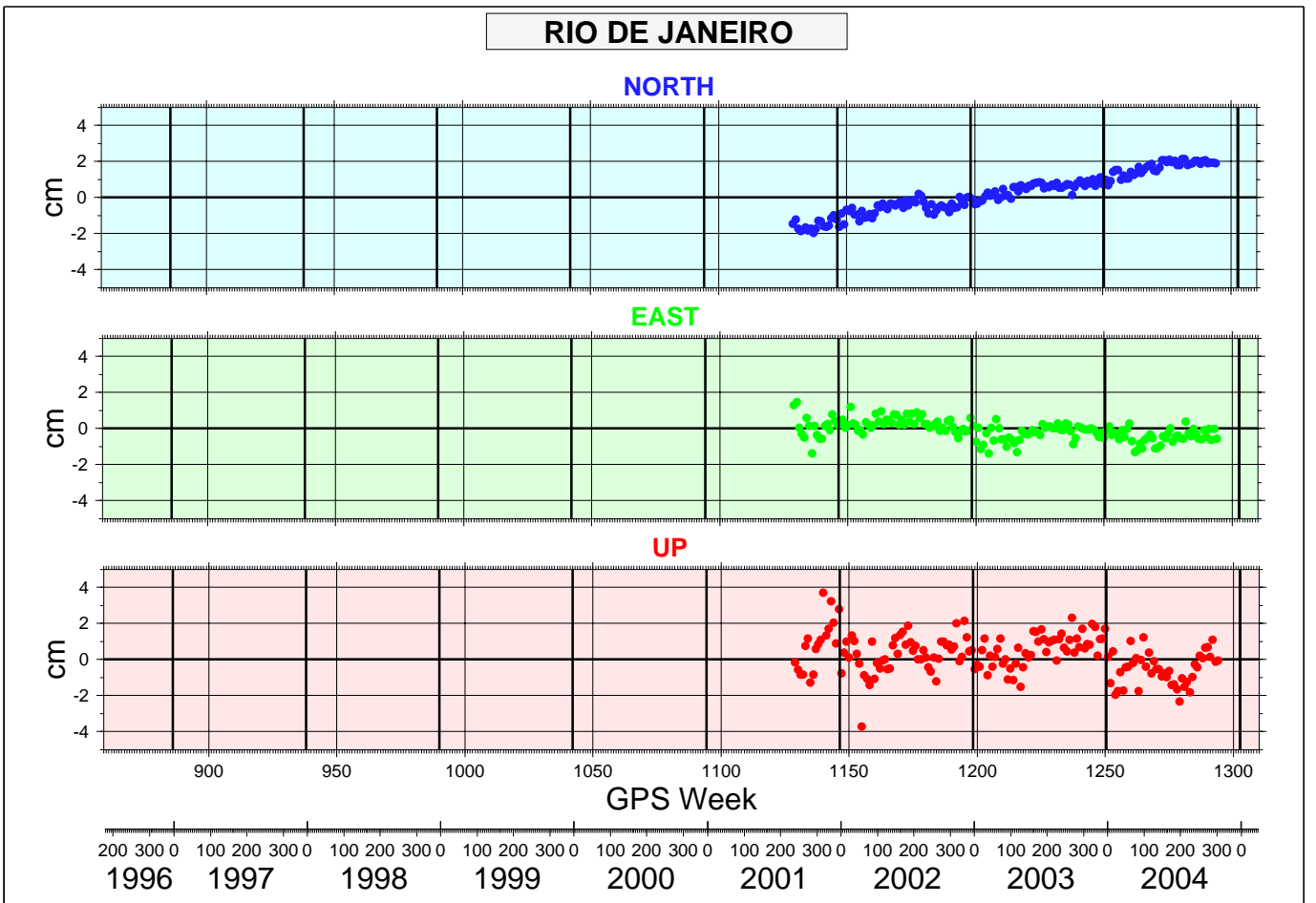
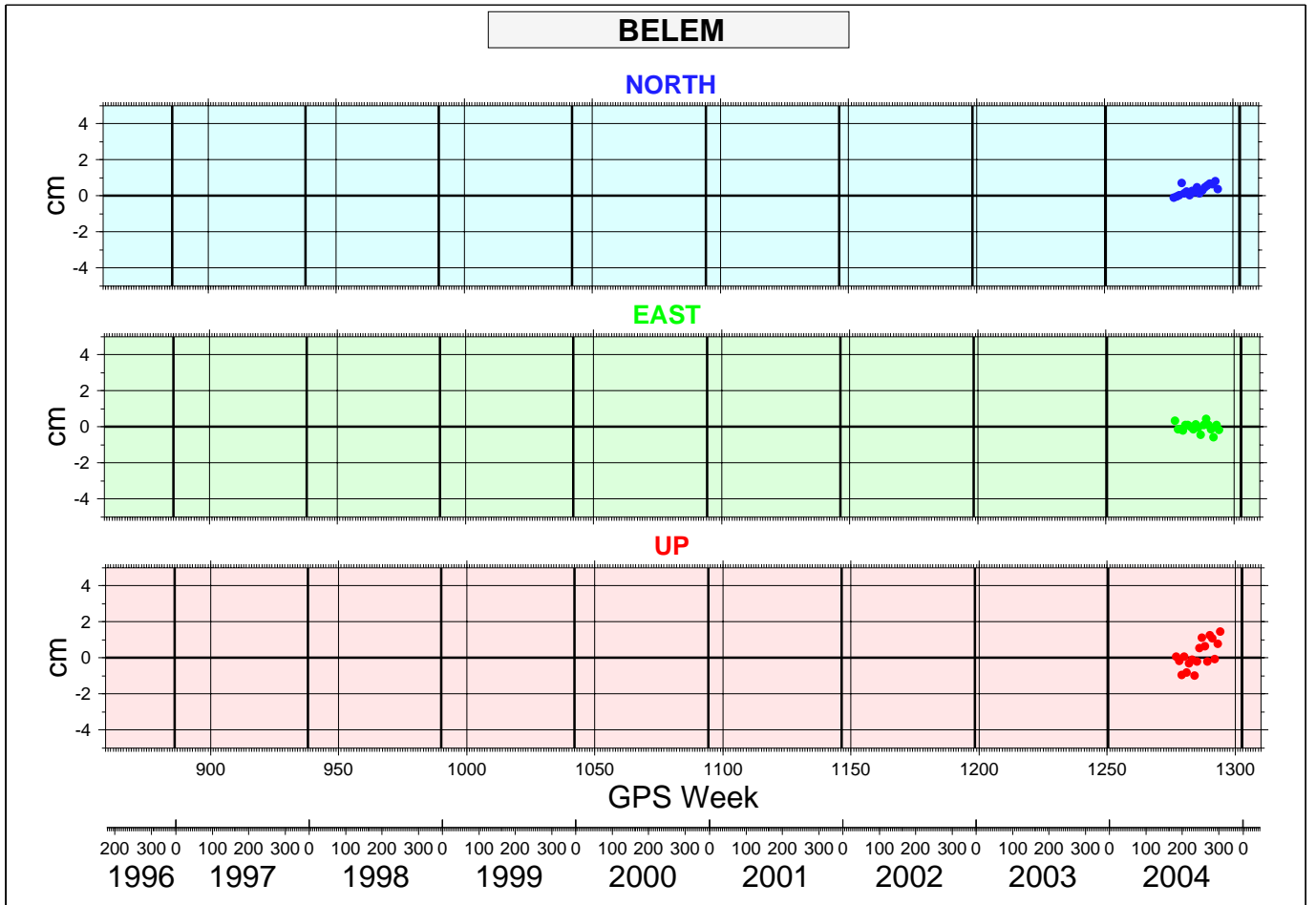


## UP



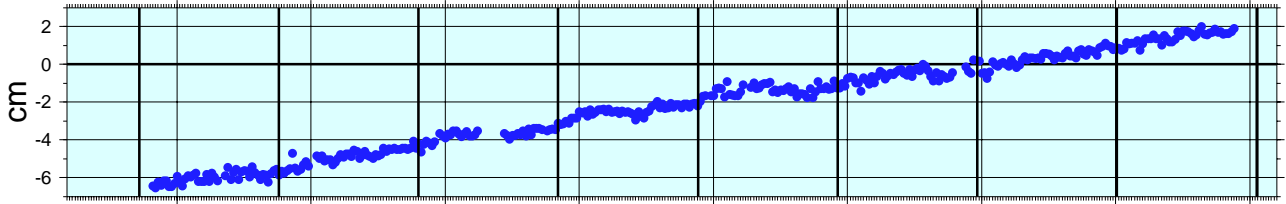
GPS Week

200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0  
1996 1997 1998 1999 2000 2001 2002 2003 2004

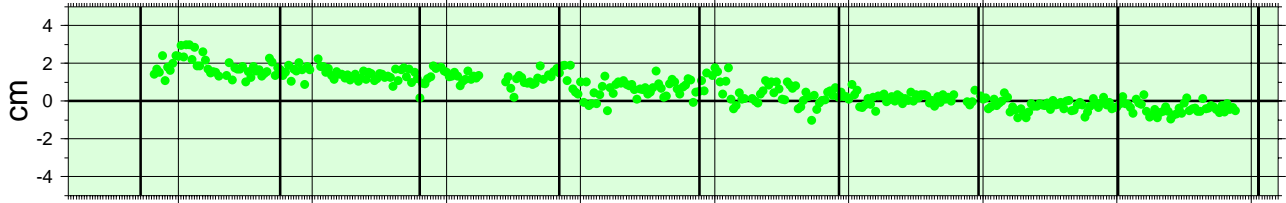


### CURITIBA

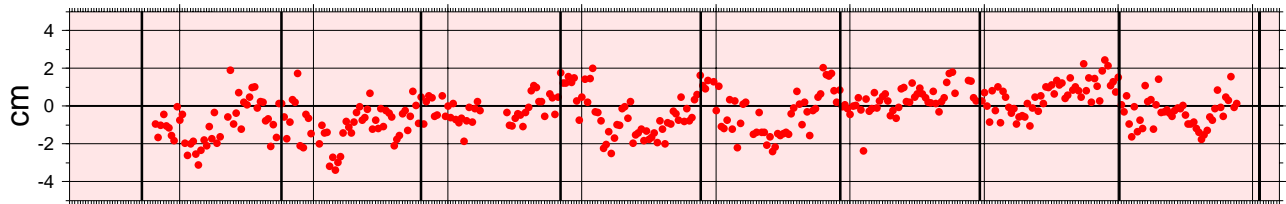
NORTH



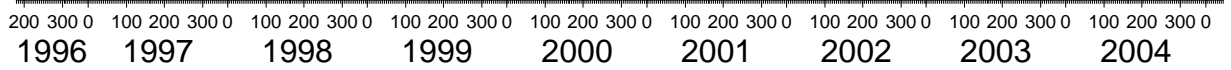
EAST



UP

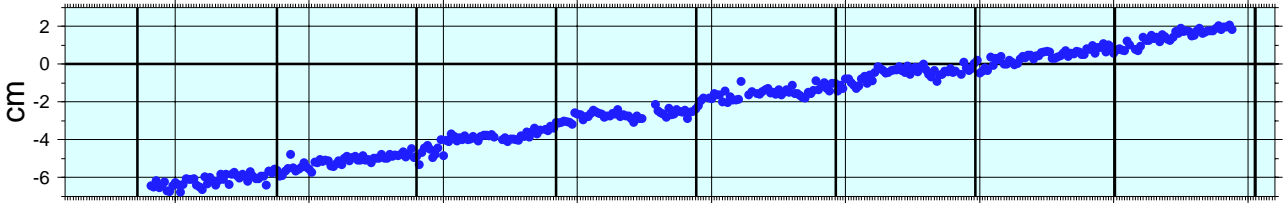


GPS Week

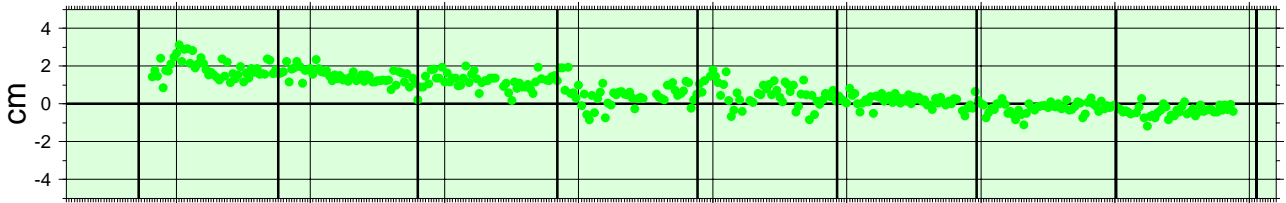


### PRESIDENTE PRUDENTE

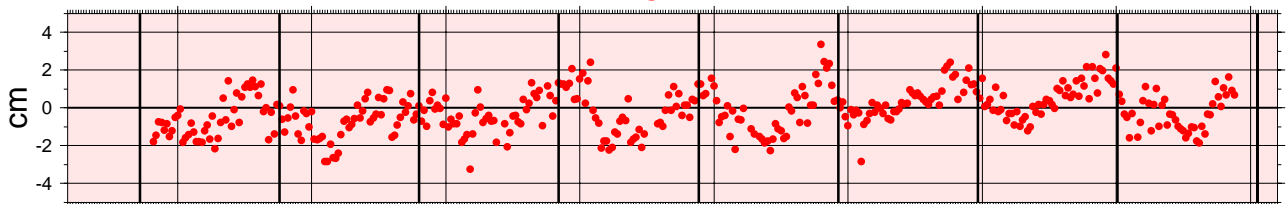
NORTH



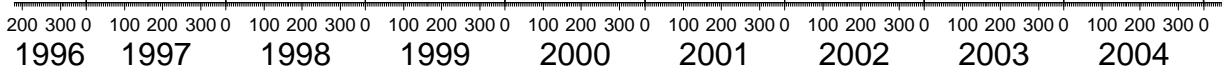
EAST



UP

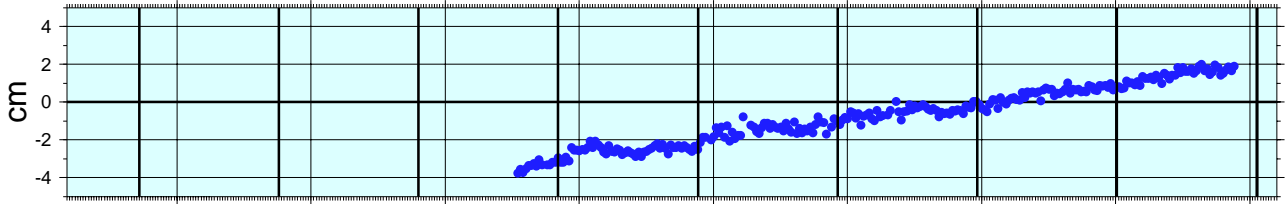


GPS Week

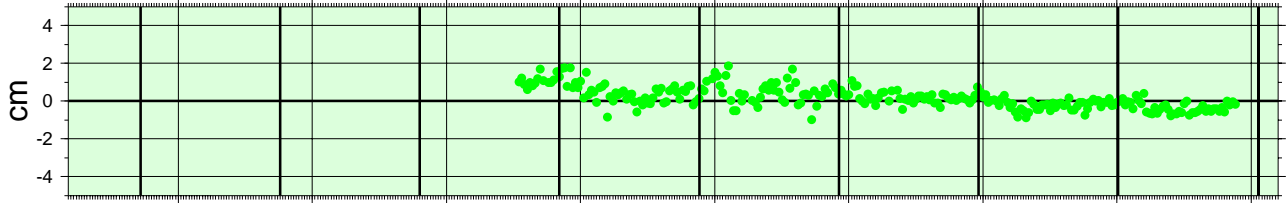


### PORTO ALEGRE

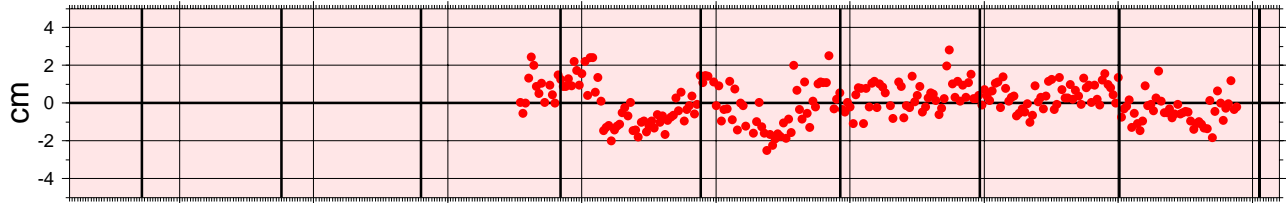
NORTH



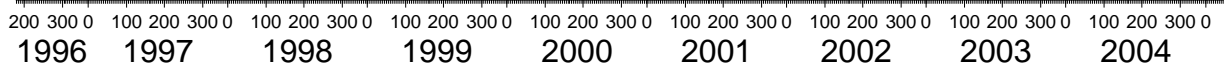
EAST



UP

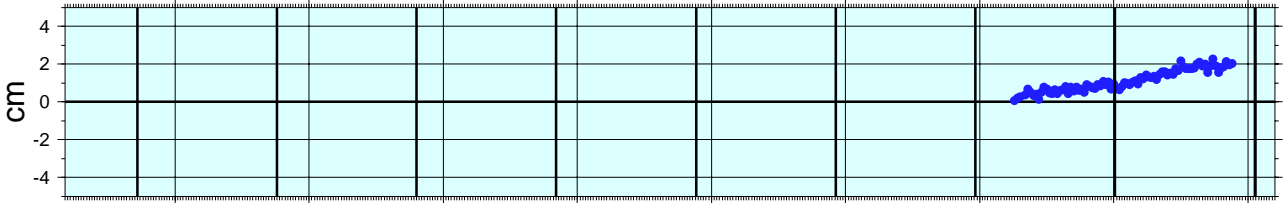


GPS Week

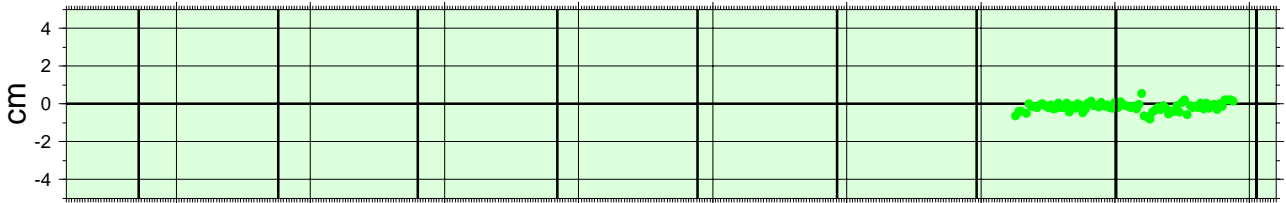


### SANTA MARIA

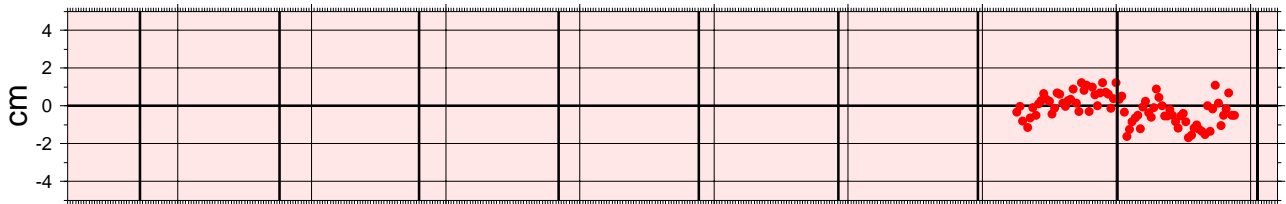
NORTH



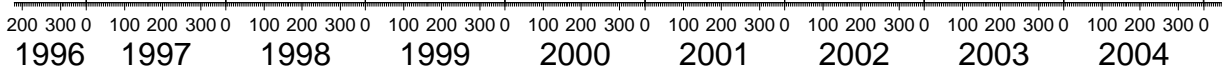
EAST

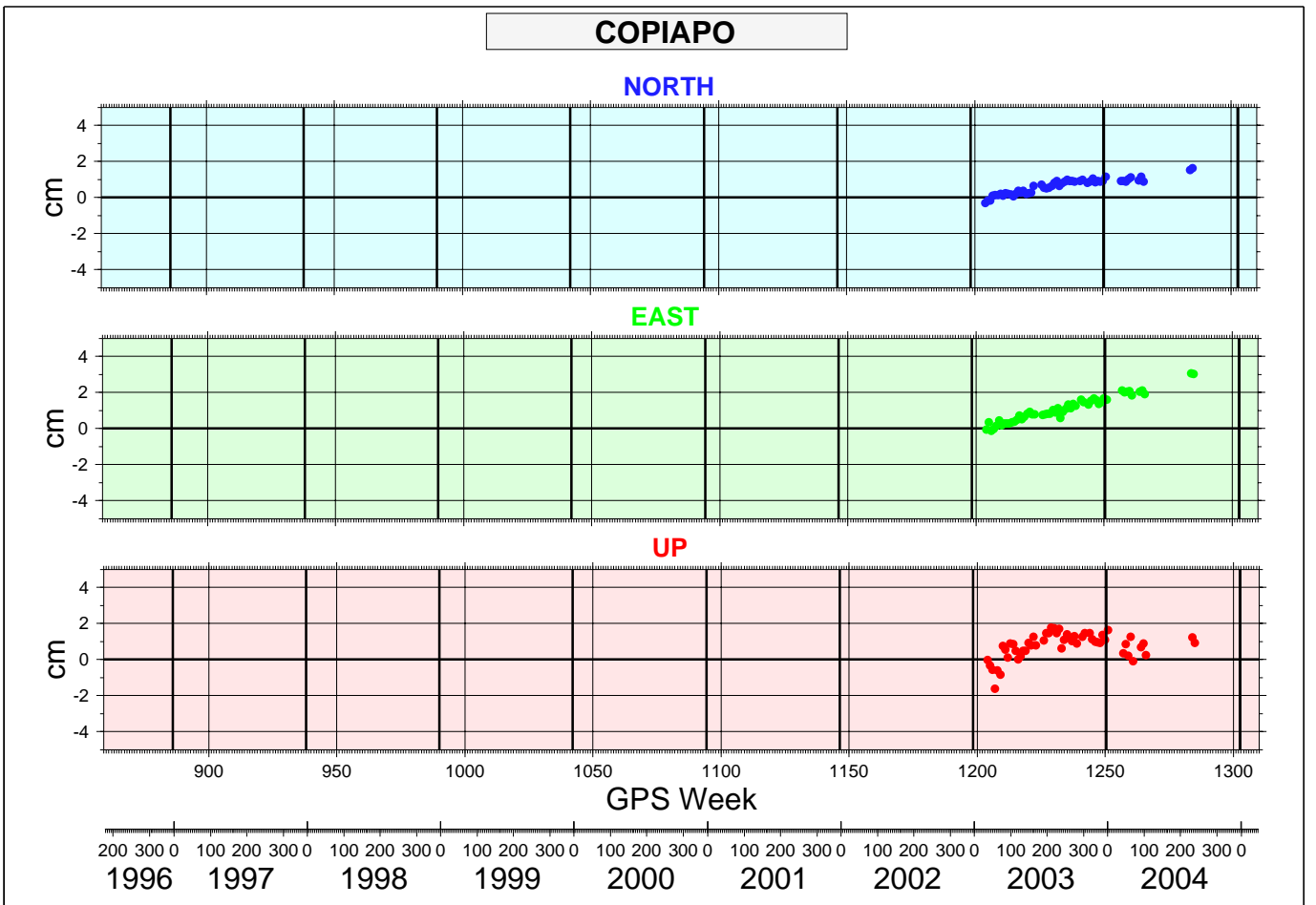
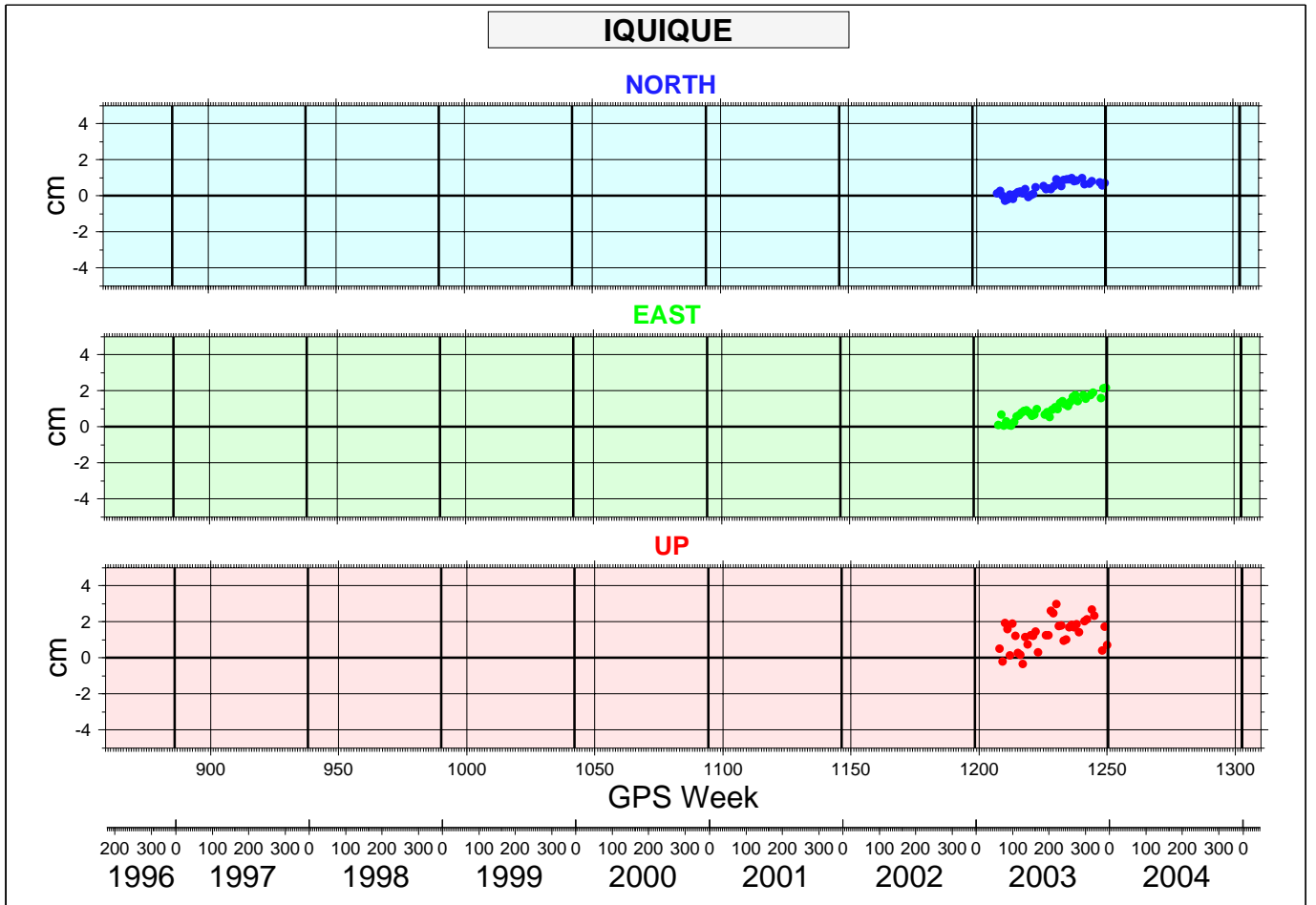


UP



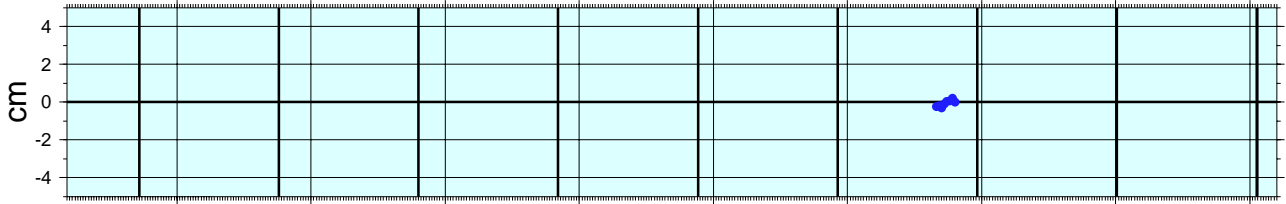
GPS Week



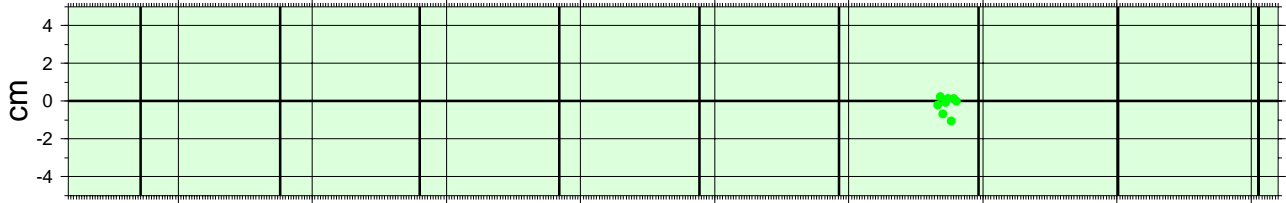


# VALPARAISO

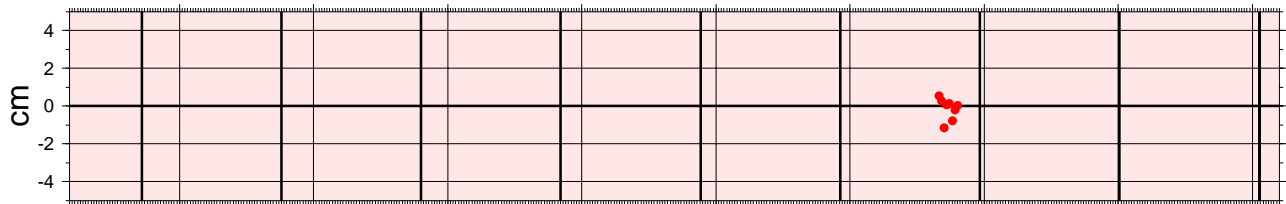
NORTH



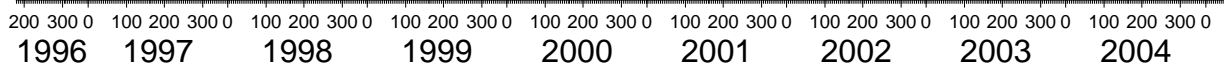
EAST



UP

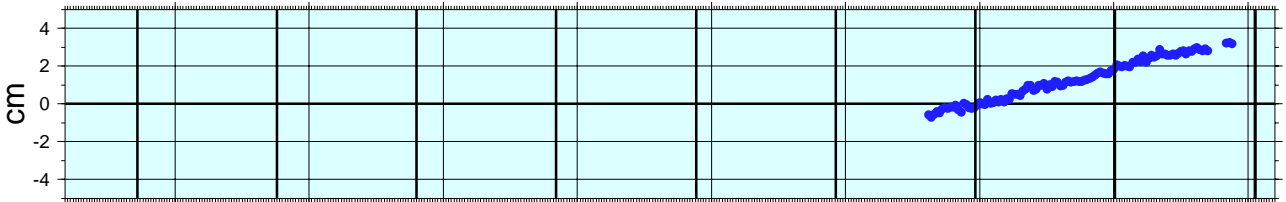


GPS Week

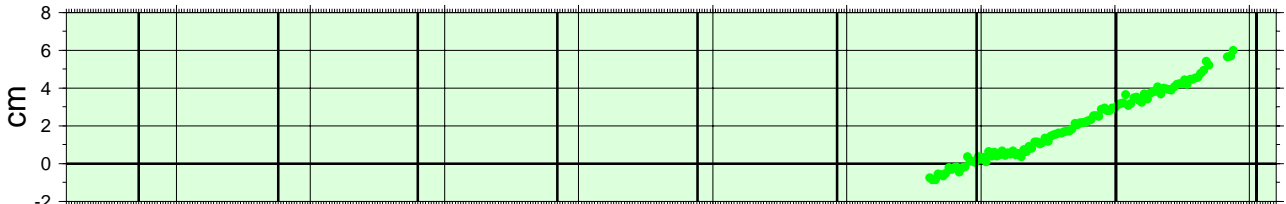


# CONCEPCION

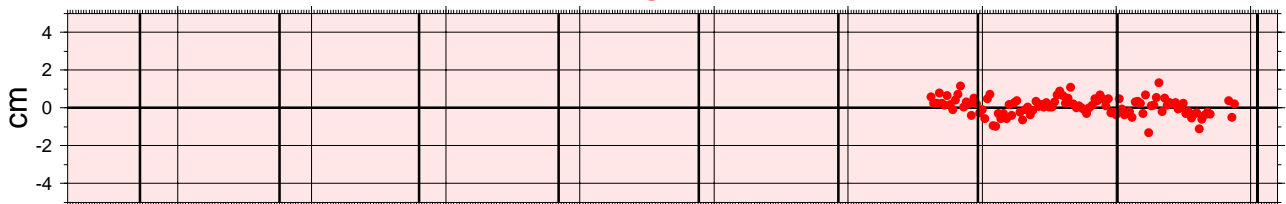
NORTH



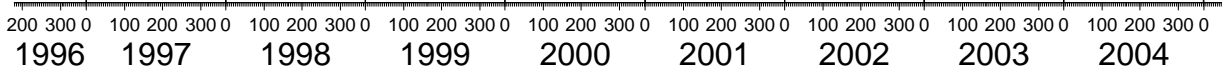
EAST



UP

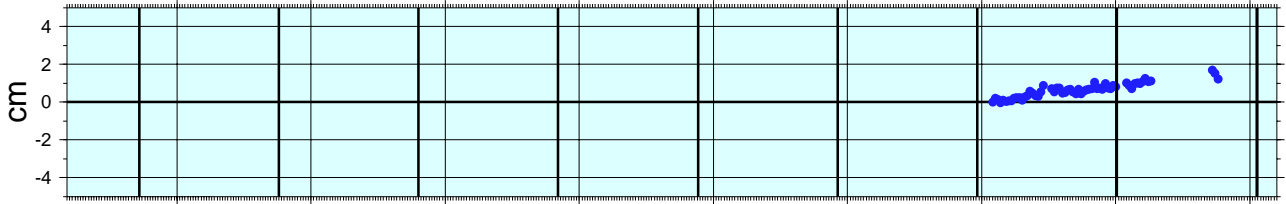


GPS Week

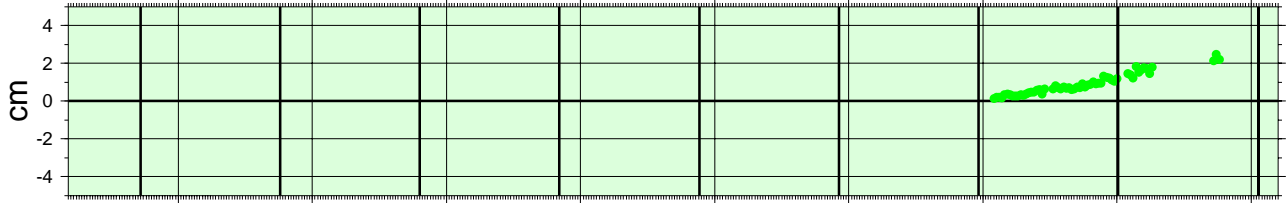


### ANTUCO

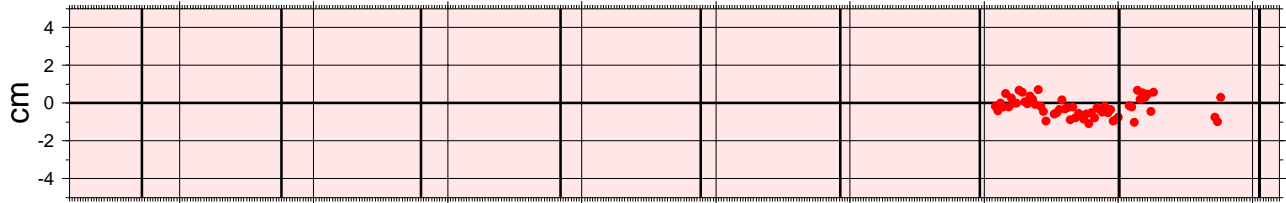
NORTH



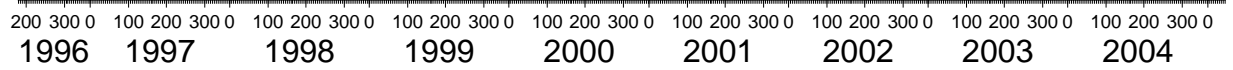
EAST



UP

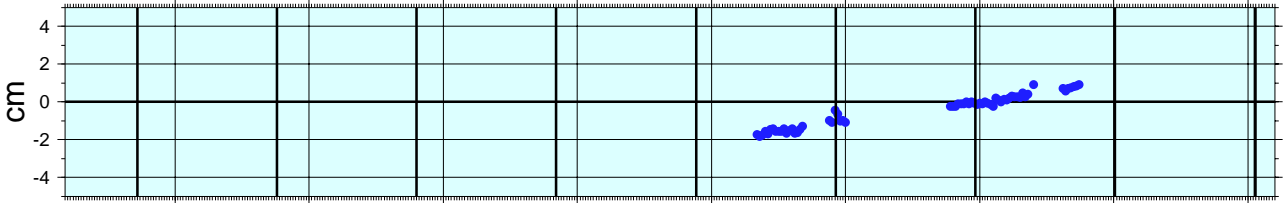


GPS Week

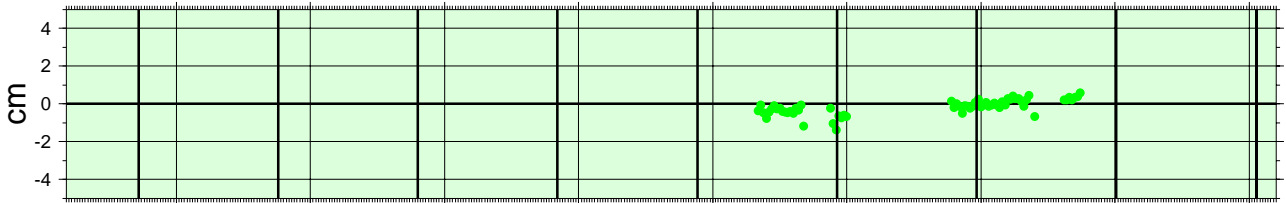


### PUNTA ARENAS

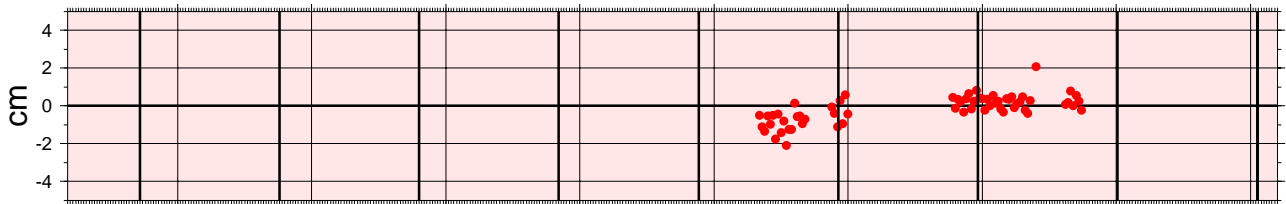
NORTH



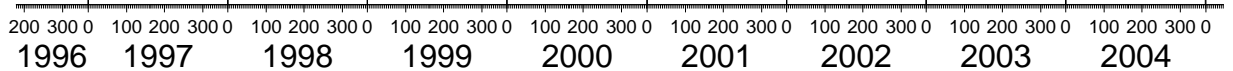
EAST



UP



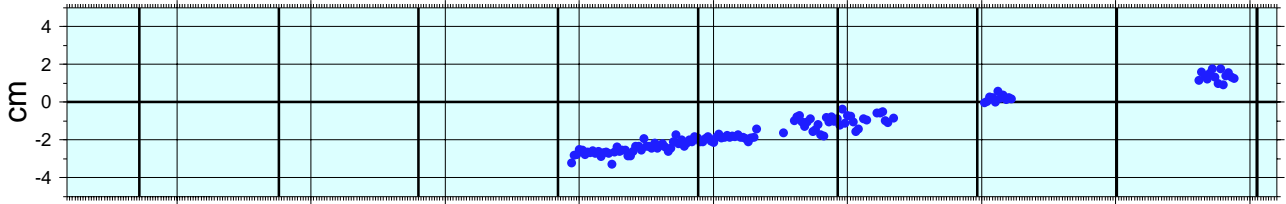
GPS Week



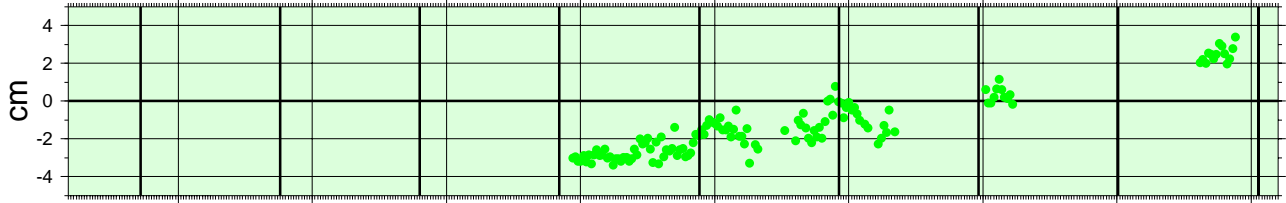


### CARTAGENA

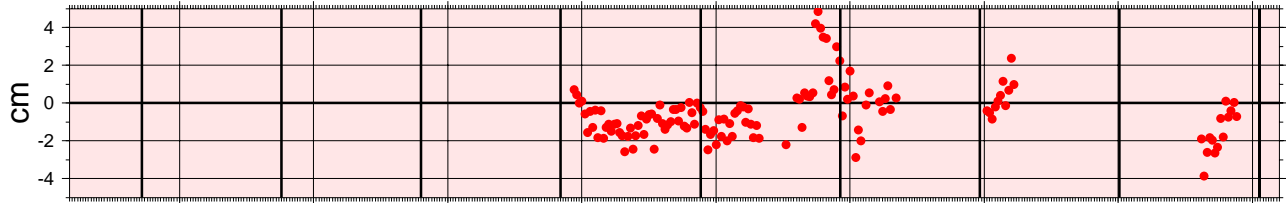
NORTH



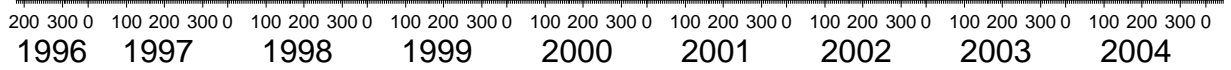
EAST



UP

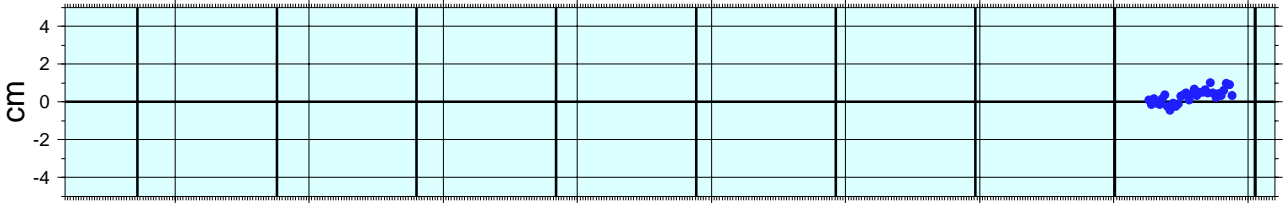


GPS Week

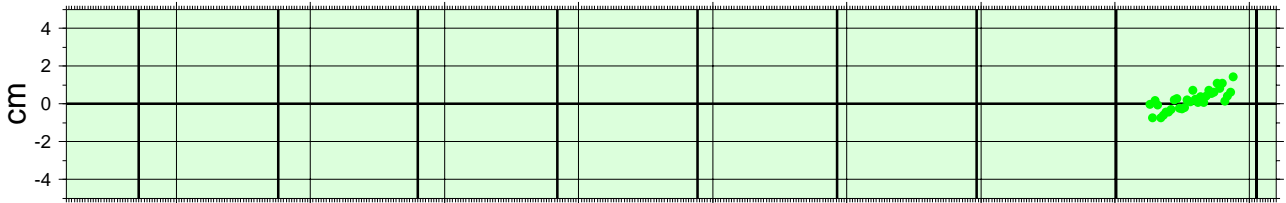


### VALLEDUPAR

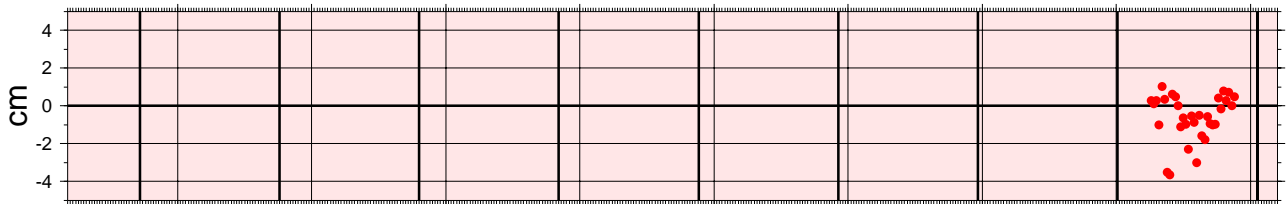
NORTH



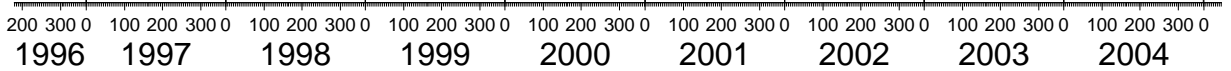
EAST

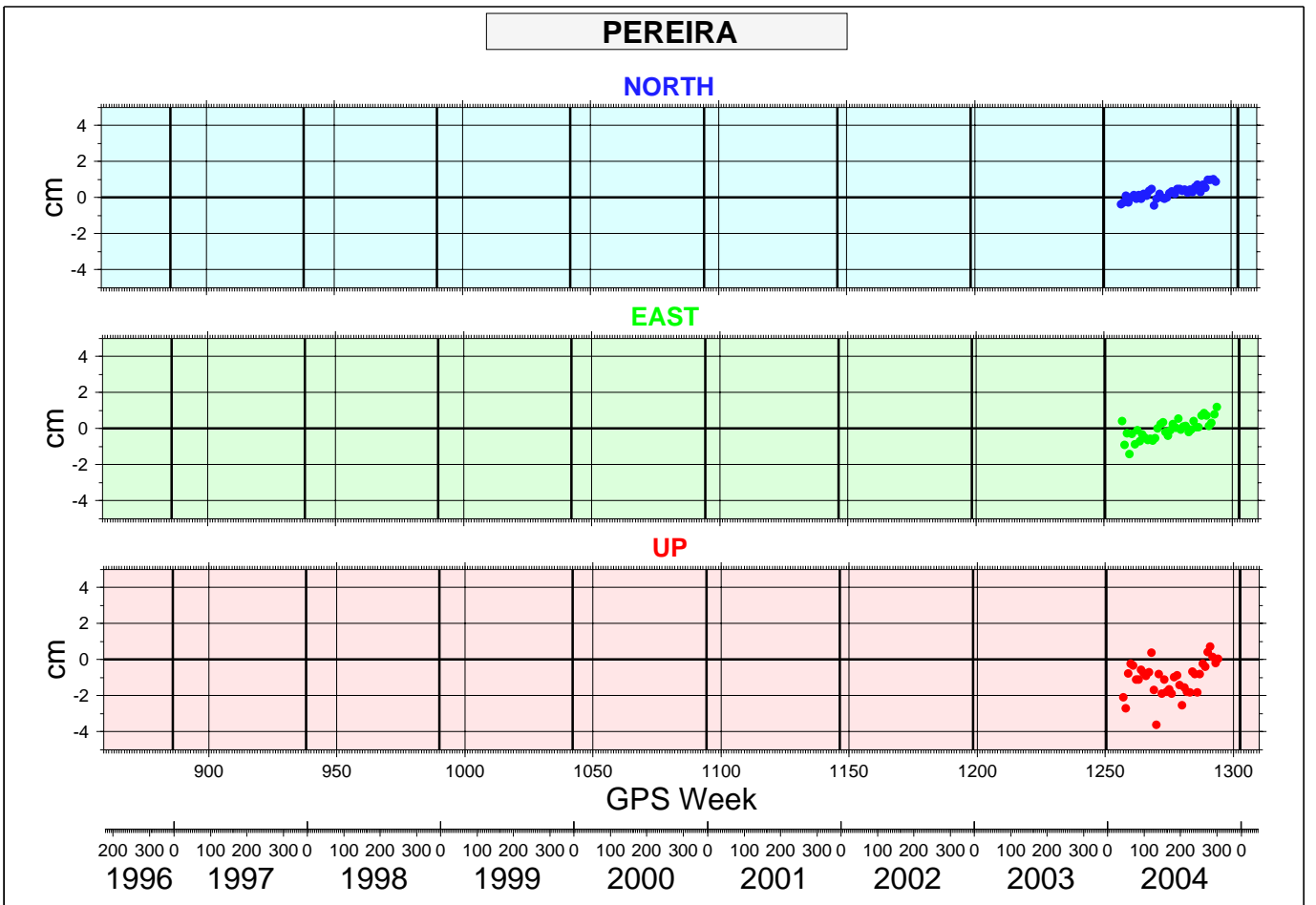
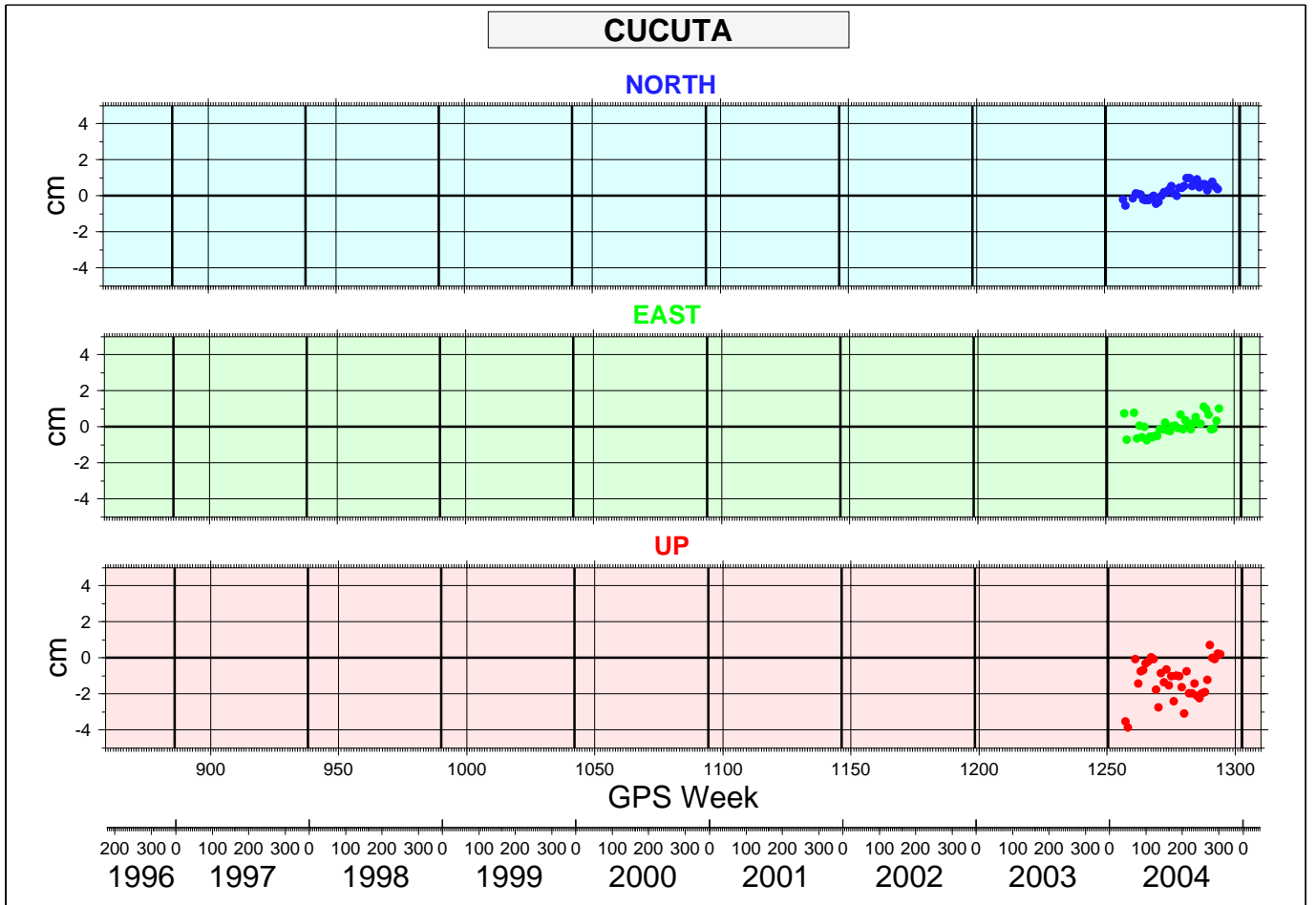


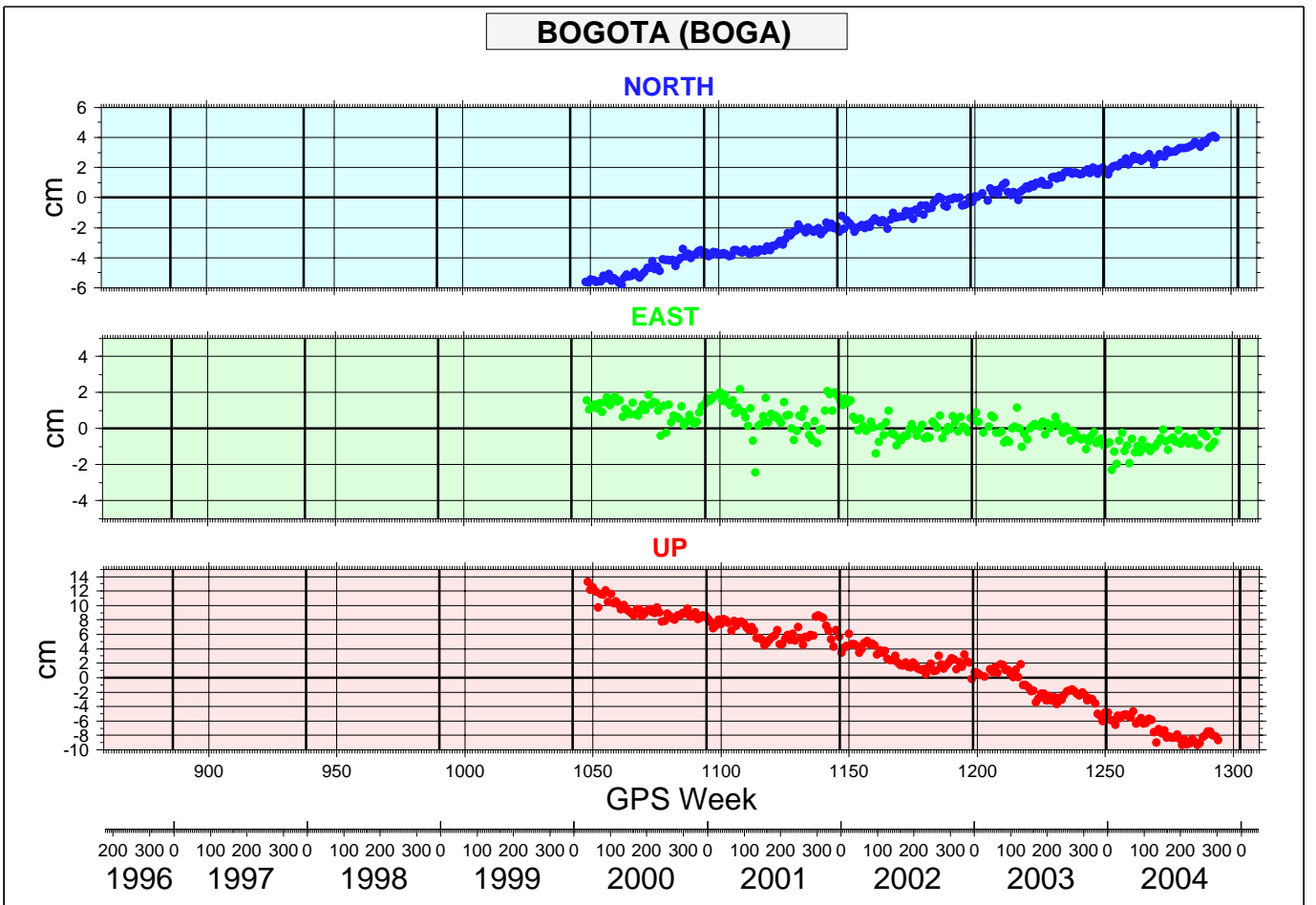
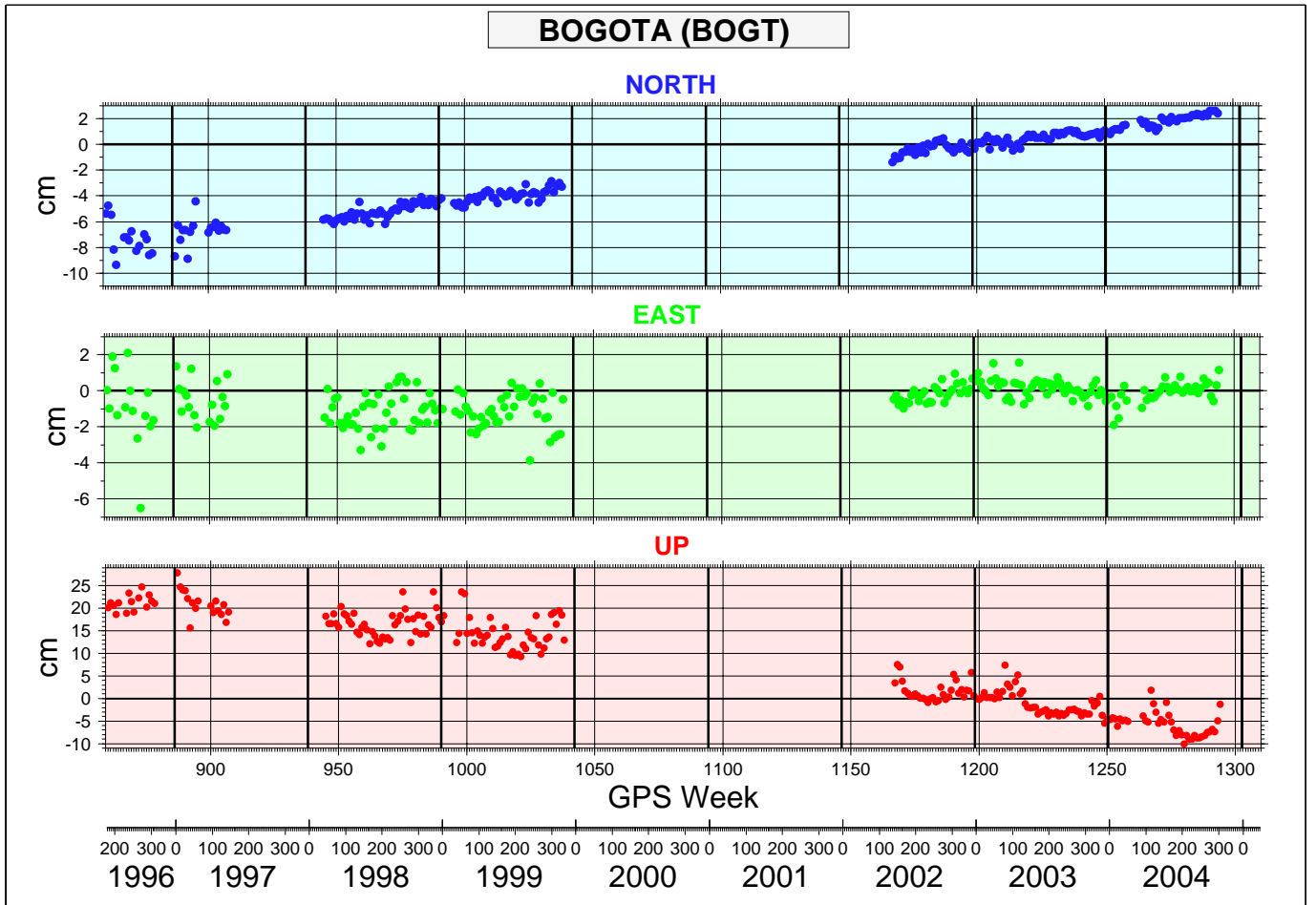
UP

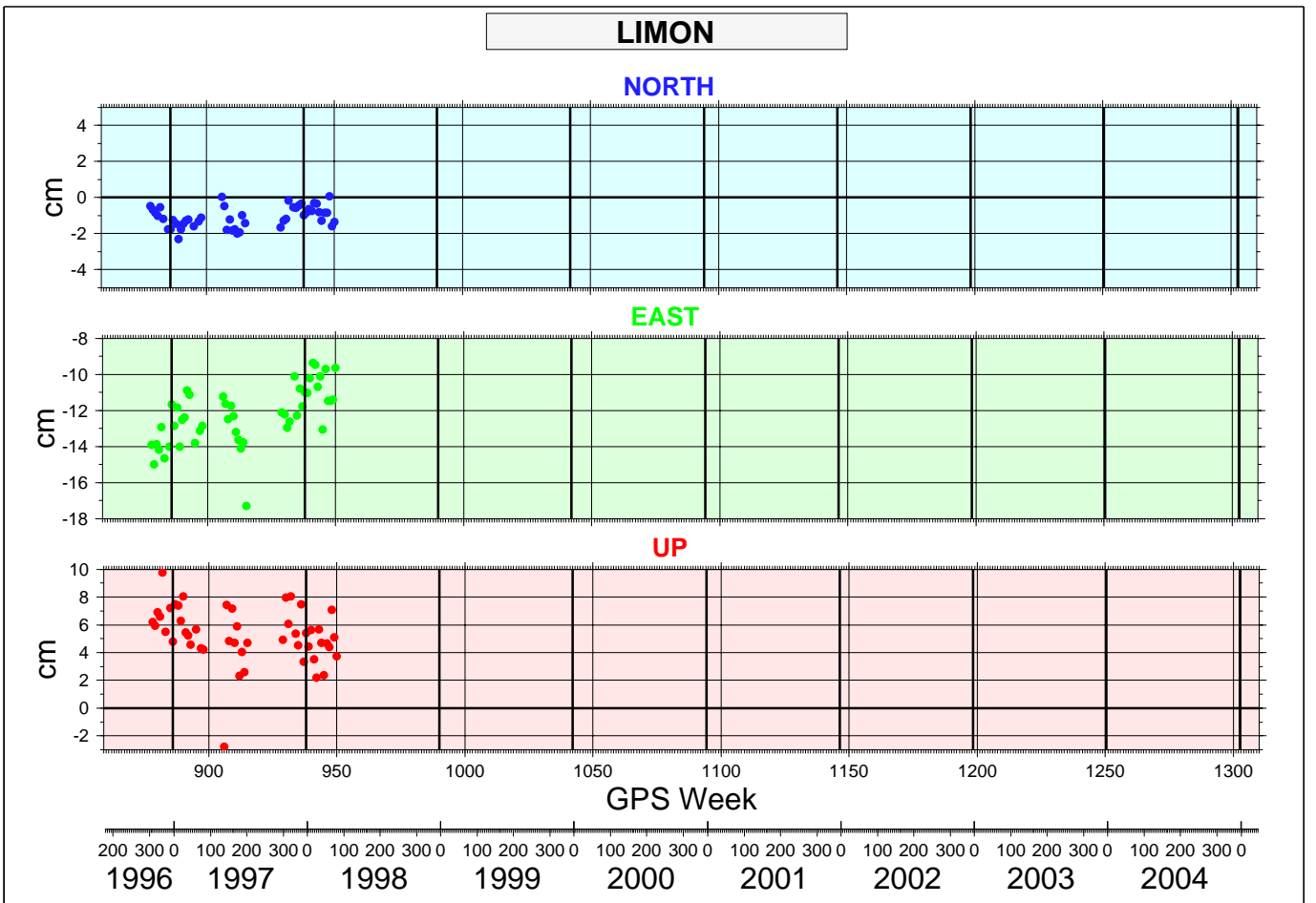
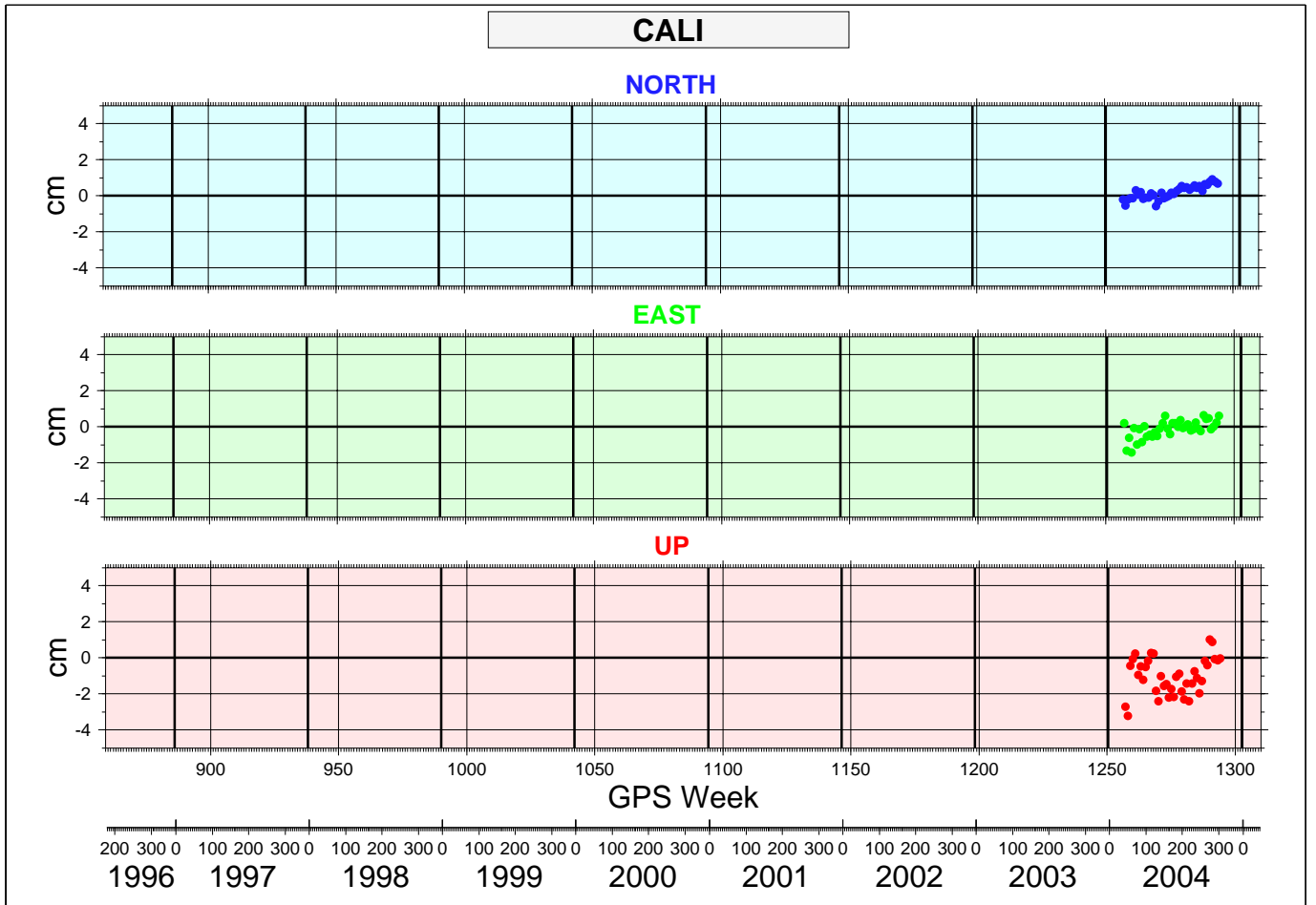


GPS Week



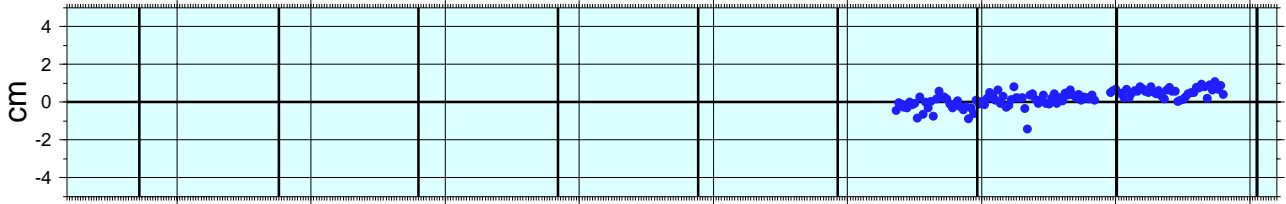




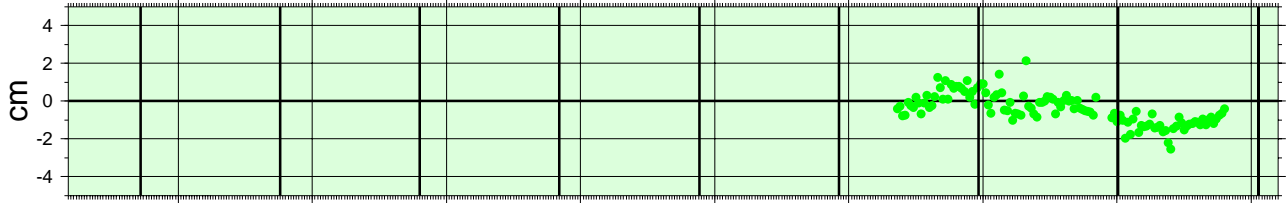


### SANTIAGO DE CUBA

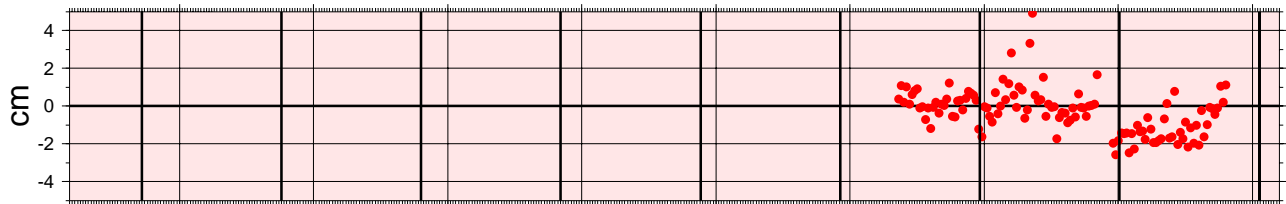
NORTH



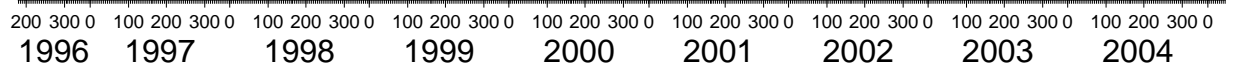
EAST



UP

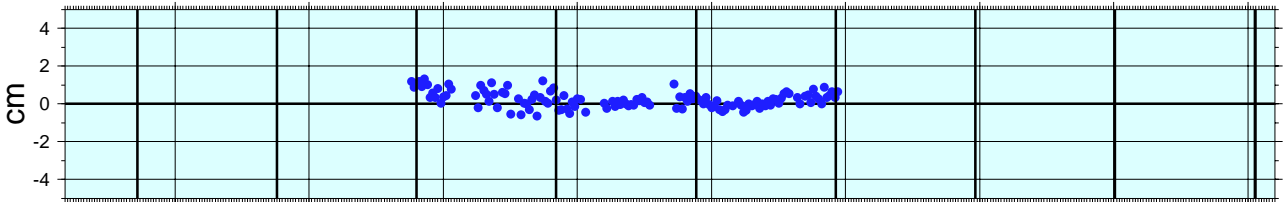


GPS Week

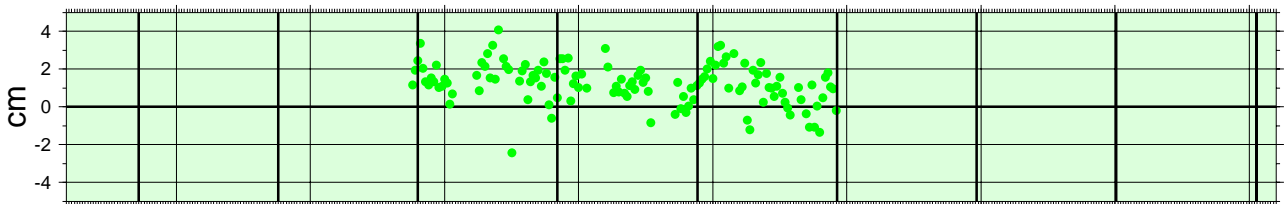


### RIOBAMBA

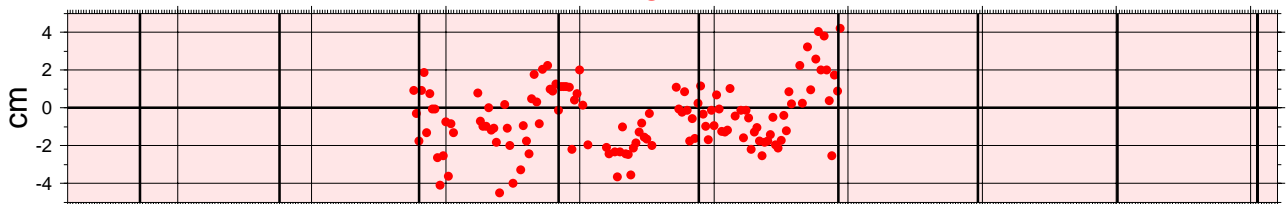
NORTH



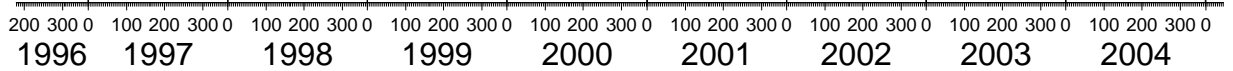
EAST



UP

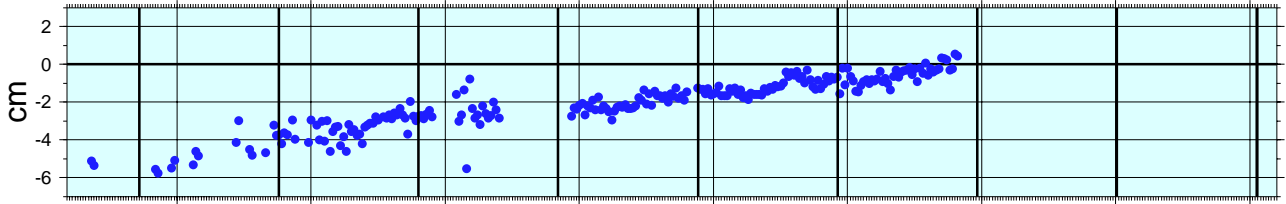


GPS Week

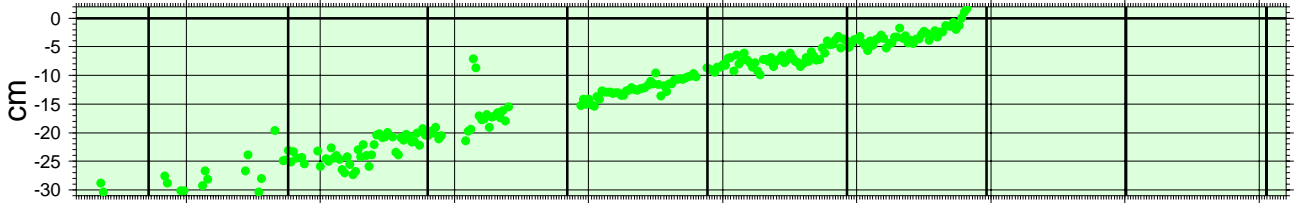


### GALAPAGOS (GALA)

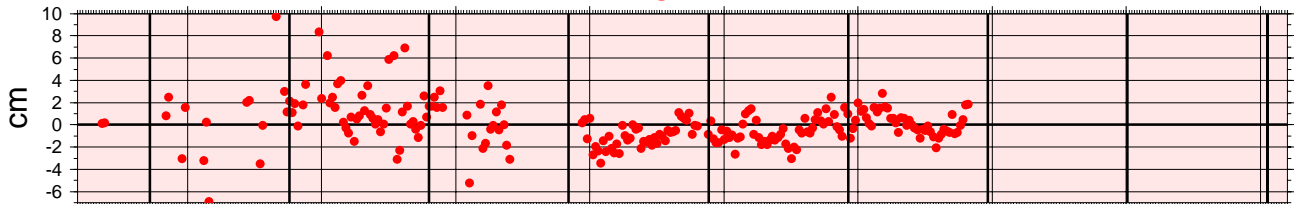
NORTH



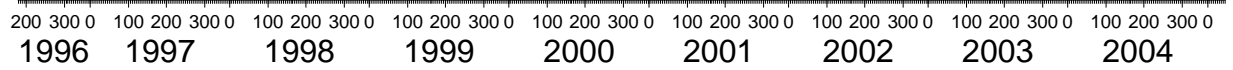
EAST



UP

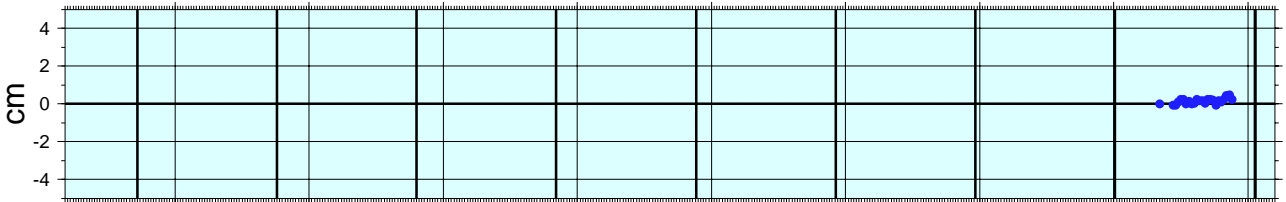


GPS Week

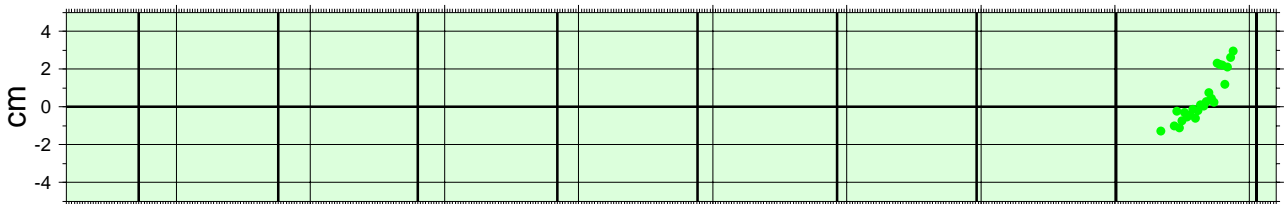


### GALAPAGOS (GLPS)

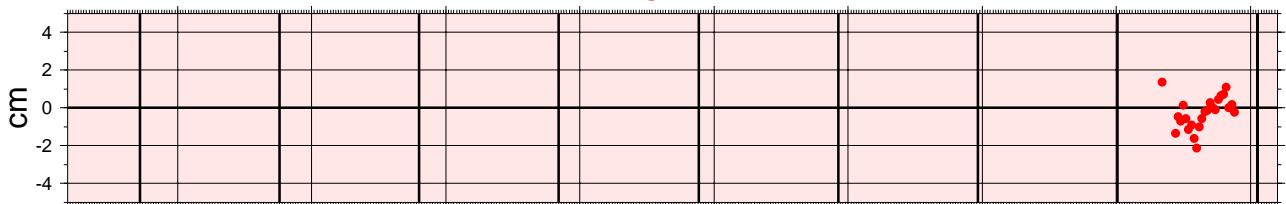
NORTH



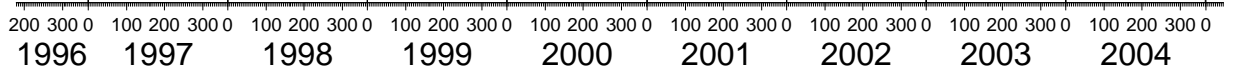
EAST



UP

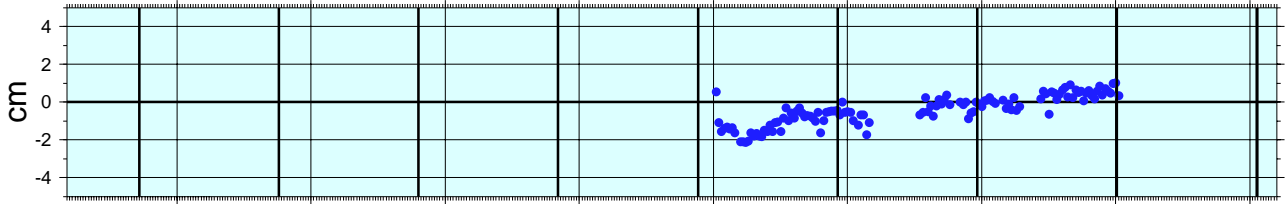


GPS Week

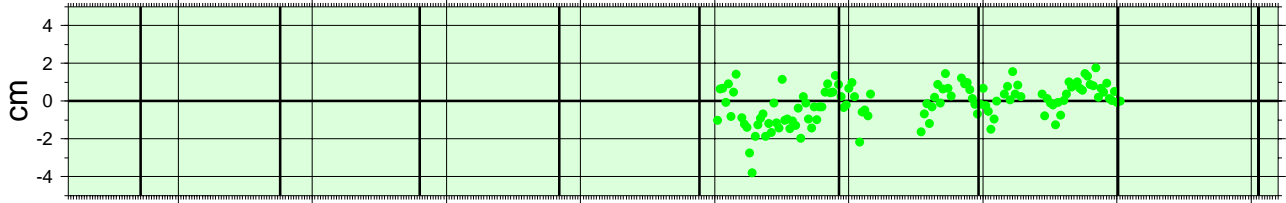


# SAN SALVADOR

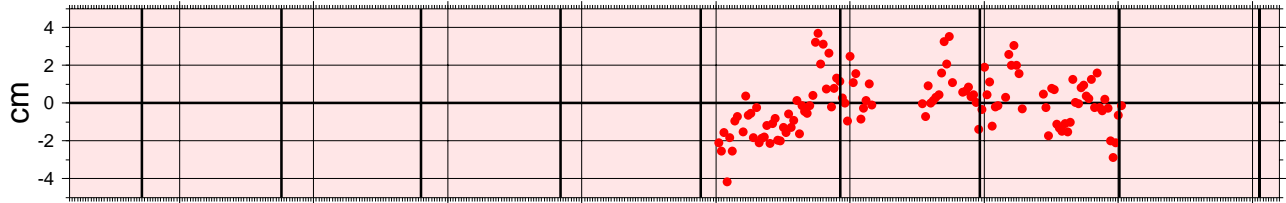
NORTH



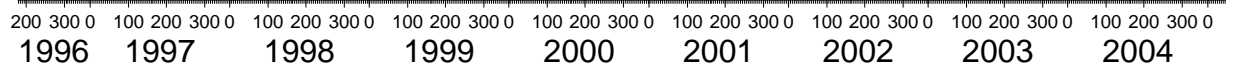
EAST



UP

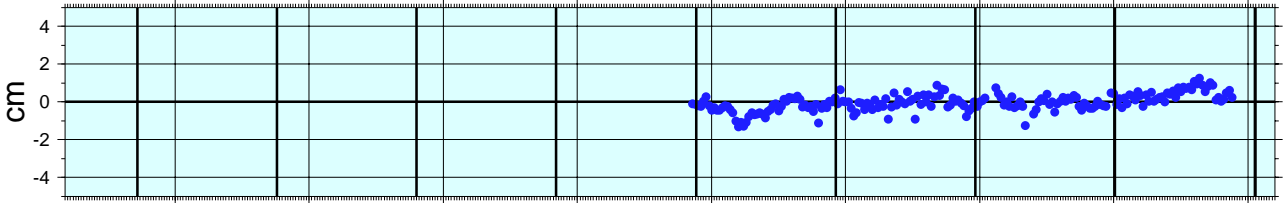


GPS Week

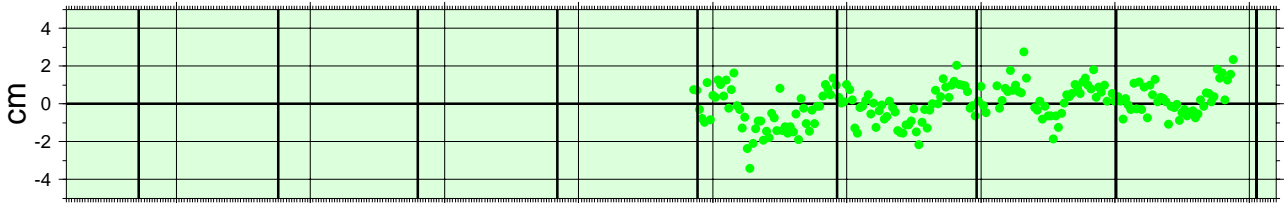


# GUATEMALA

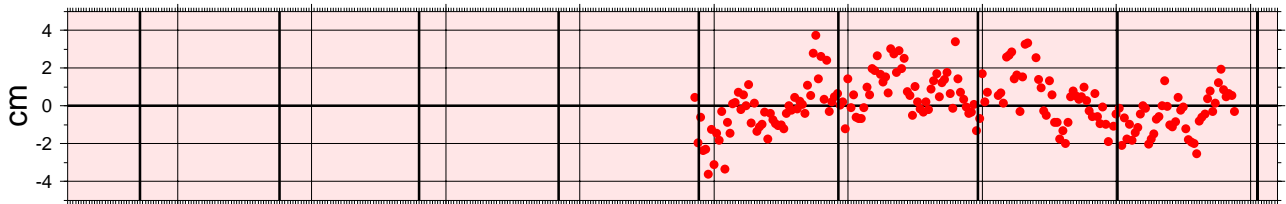
NORTH



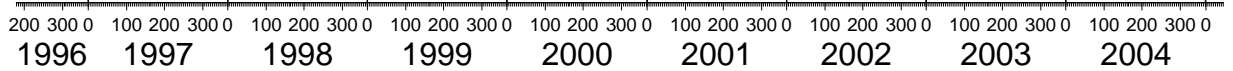
EAST



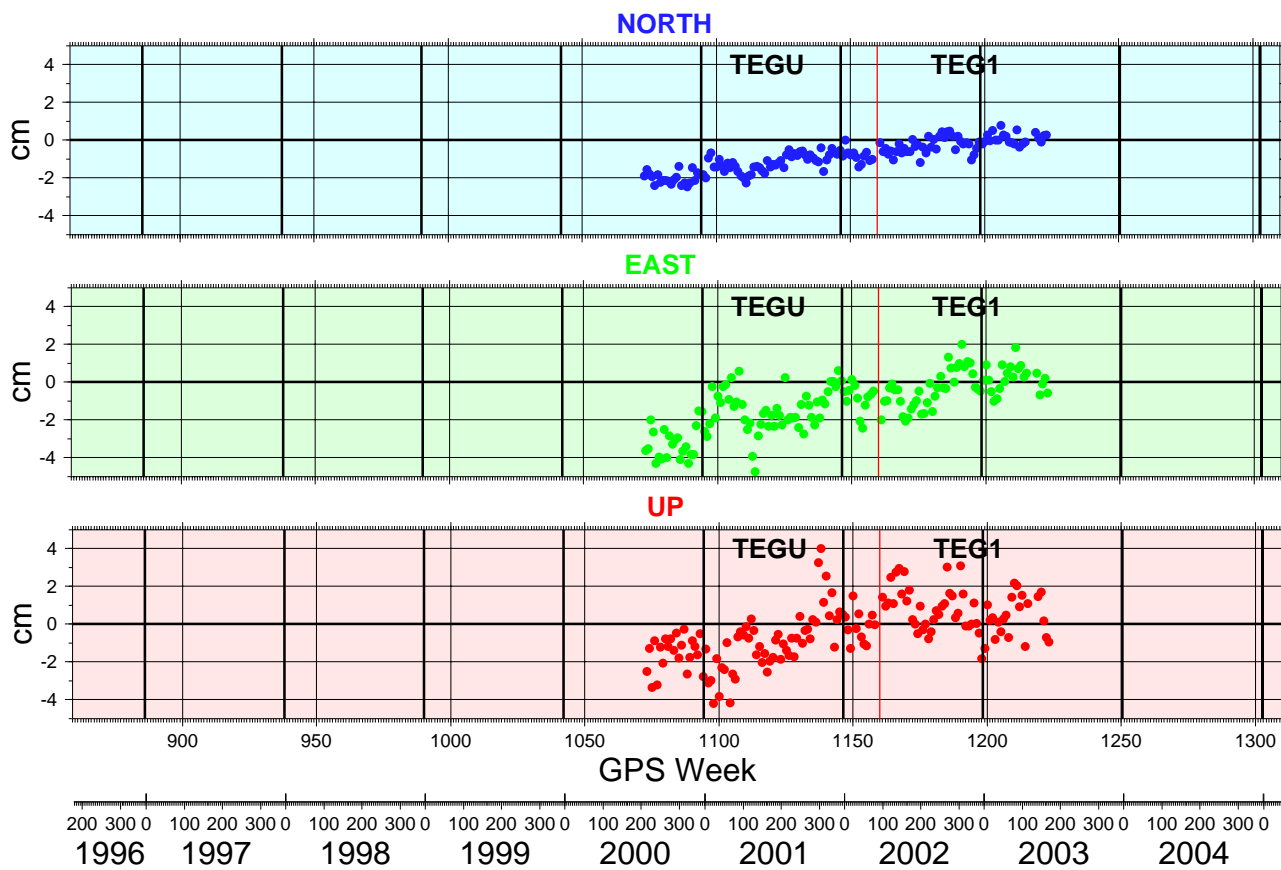
UP



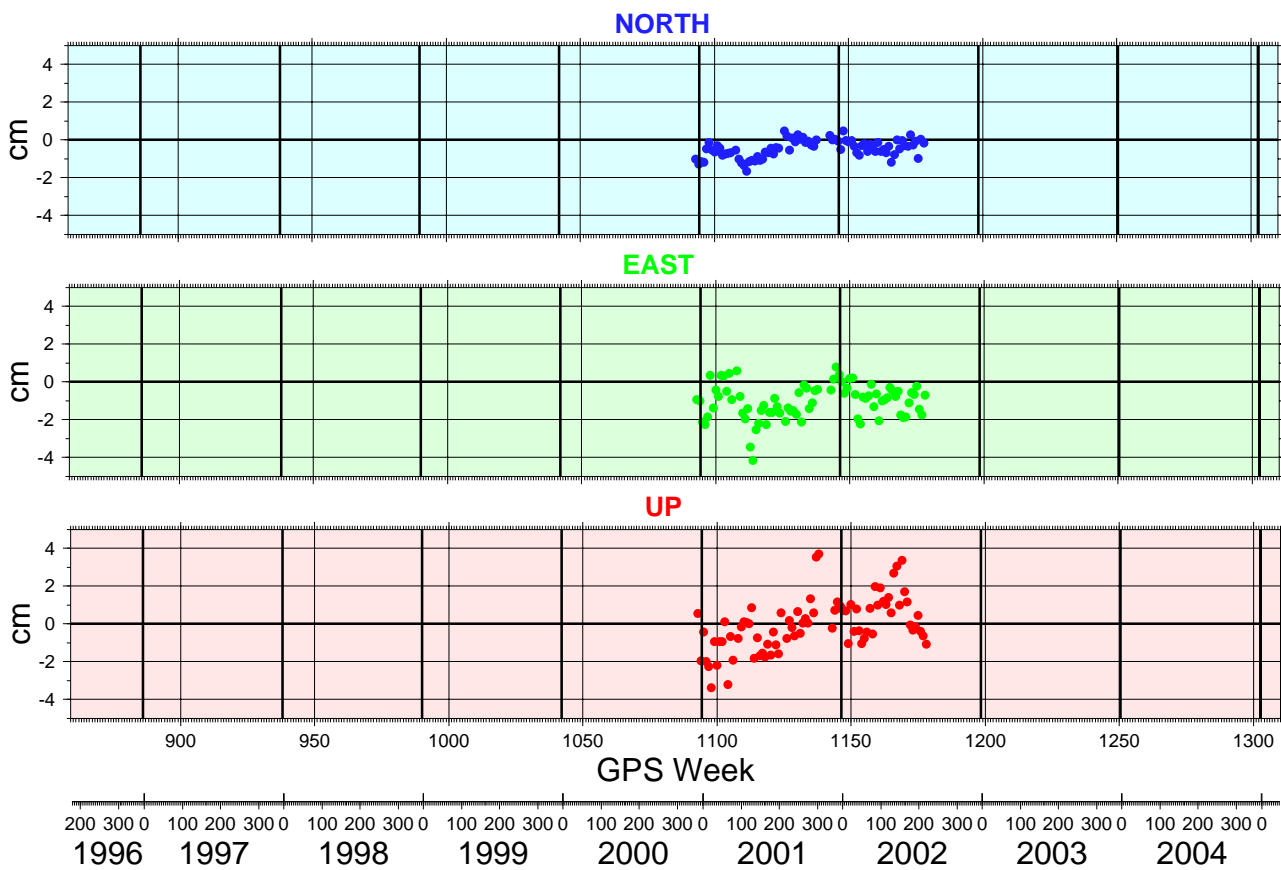
GPS Week



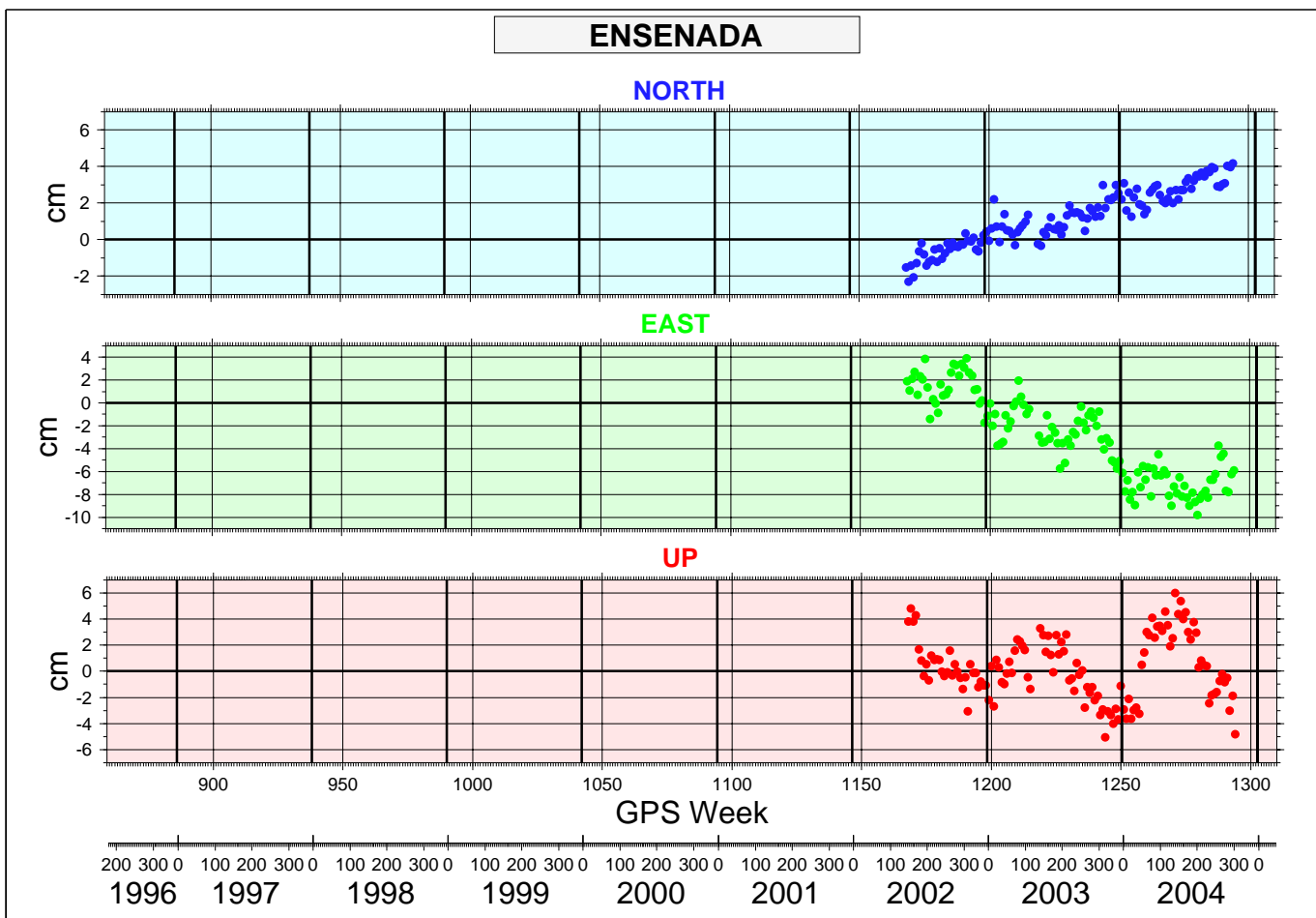
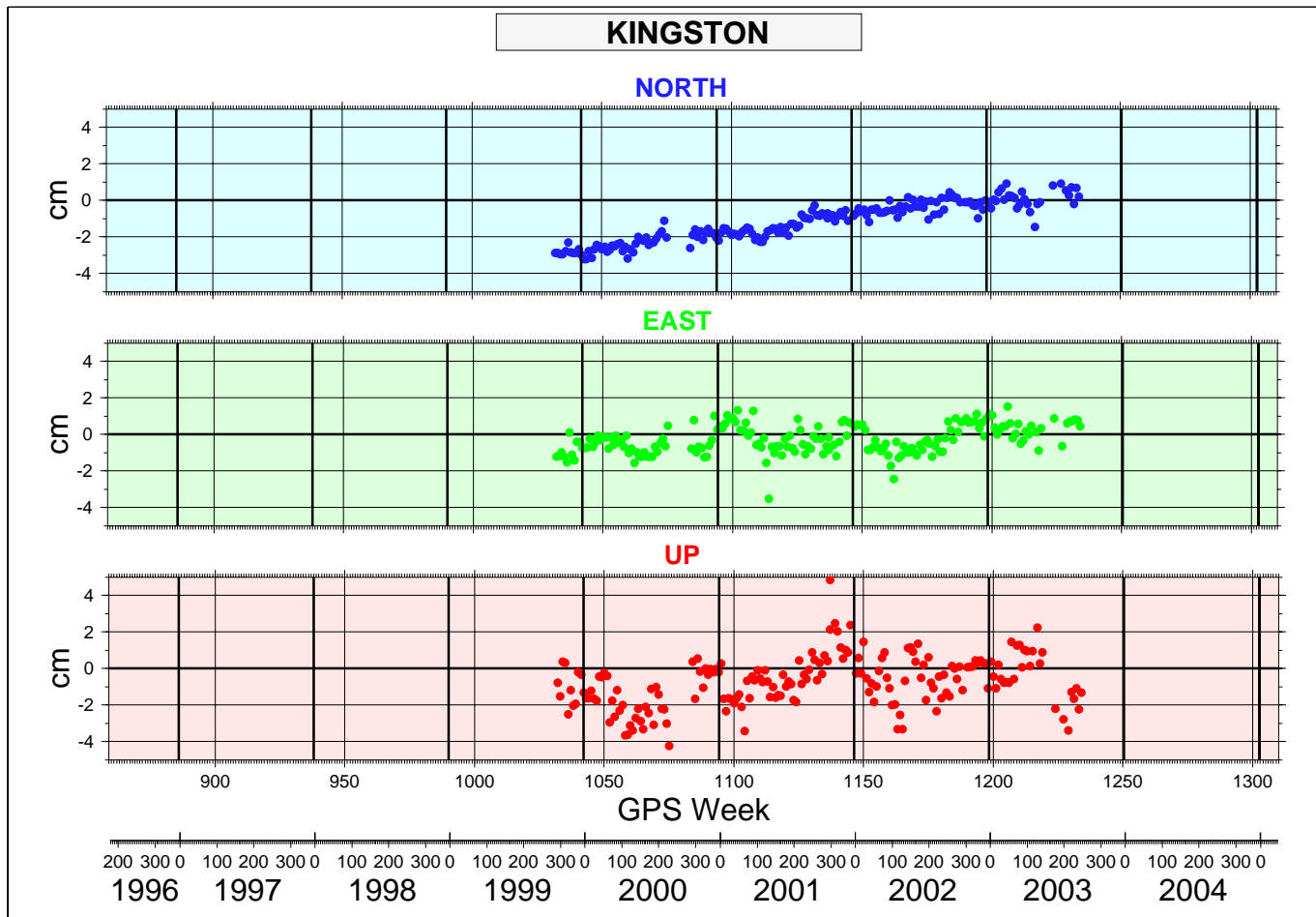
### TEGUCIGALPA (TEGU/TEG1)



### SAN LORENZO

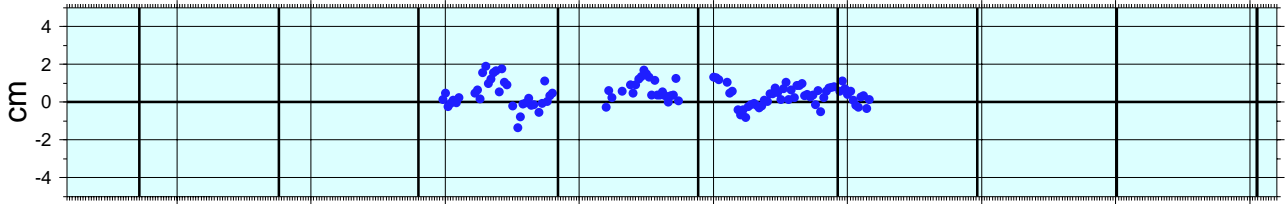




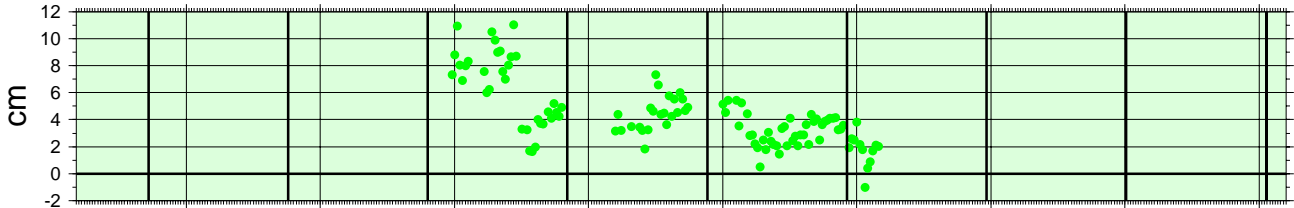


# AGUASCALIENTES

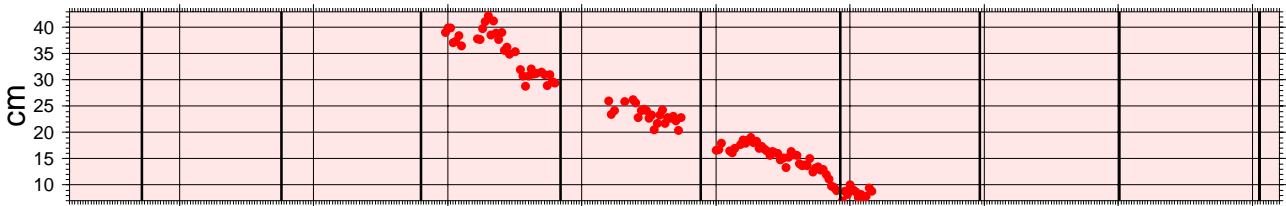
NORTH



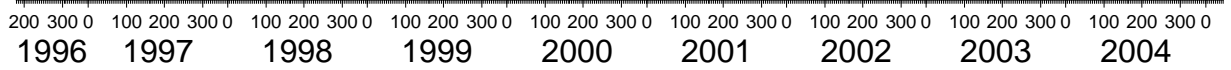
EAST



UP

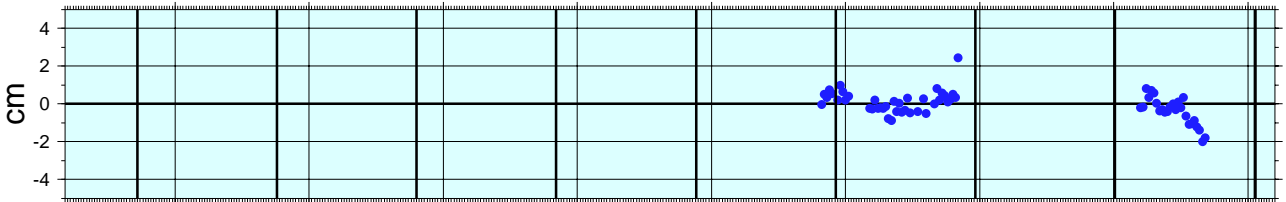


GPS Week

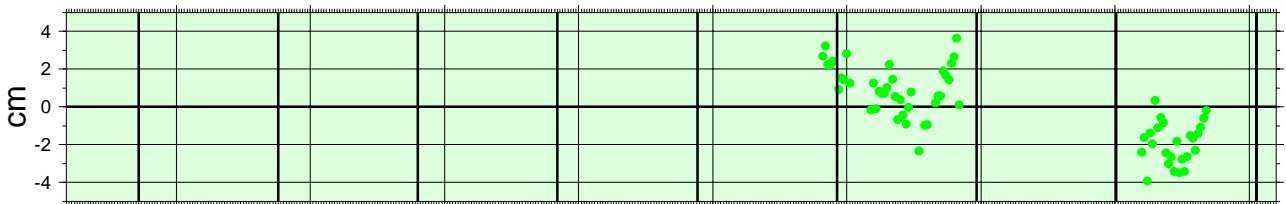


# MANZANILLO

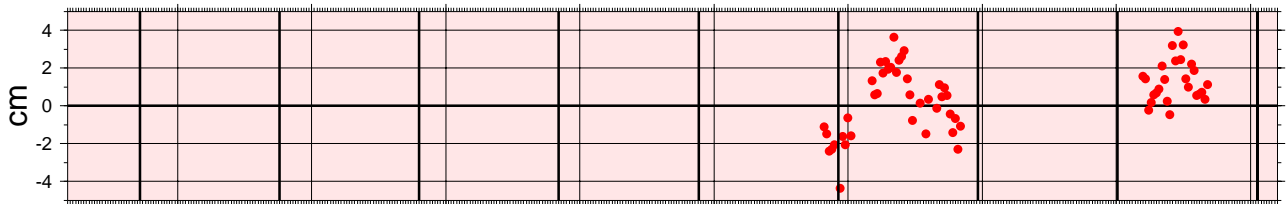
NORTH



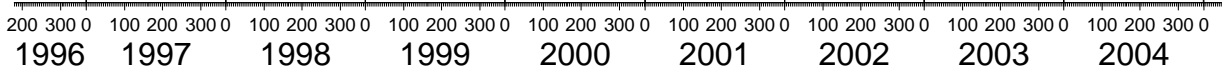
EAST



UP

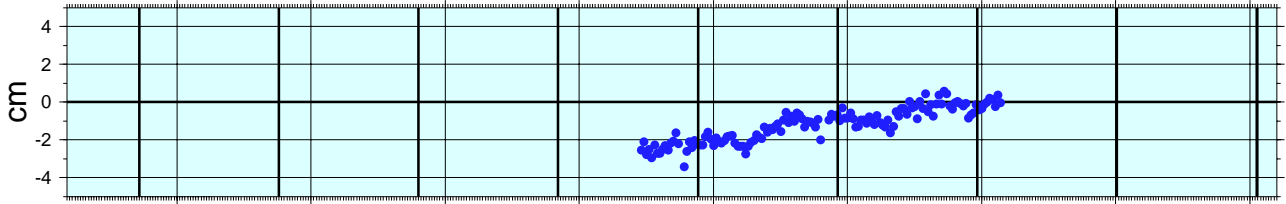


GPS Week

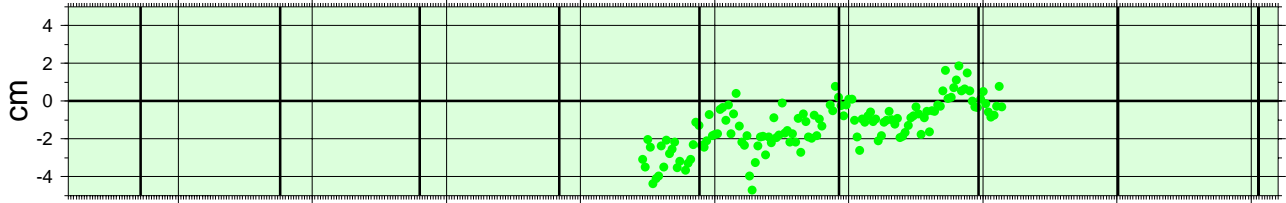


# ESTELI

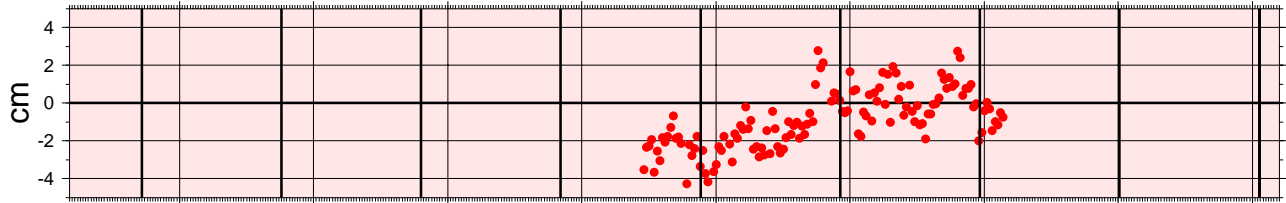
NORTH



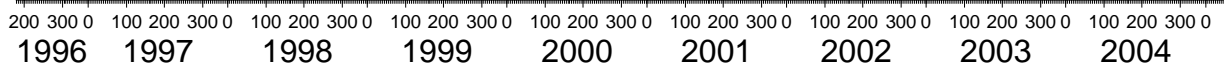
EAST



UP

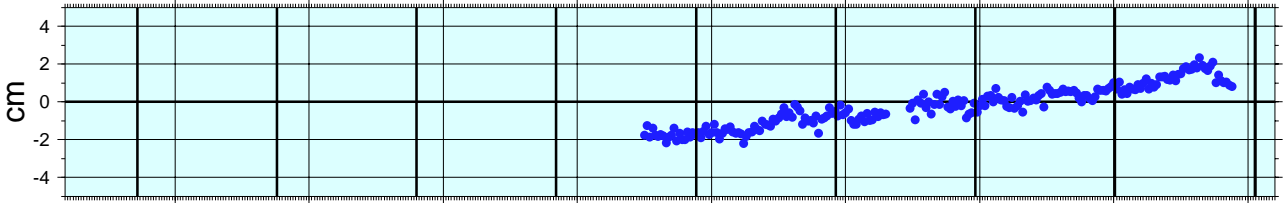


GPS Week

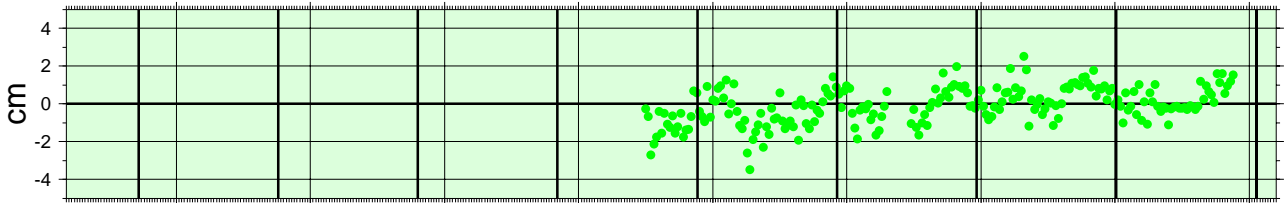


# MANAGUA

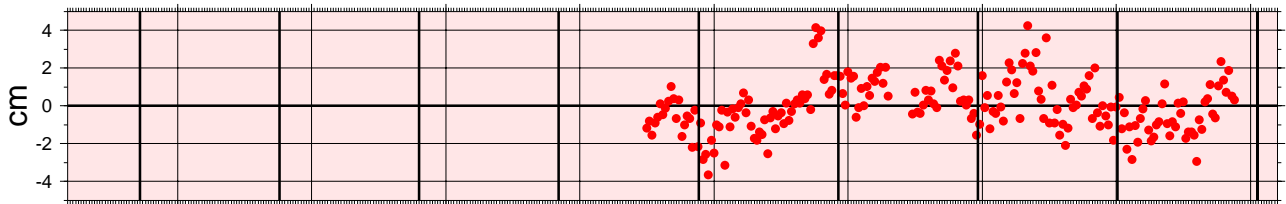
NORTH



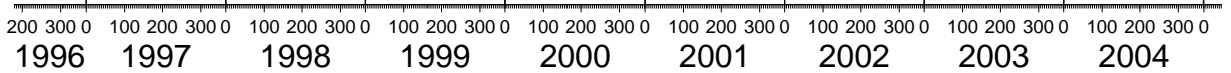
EAST



UP

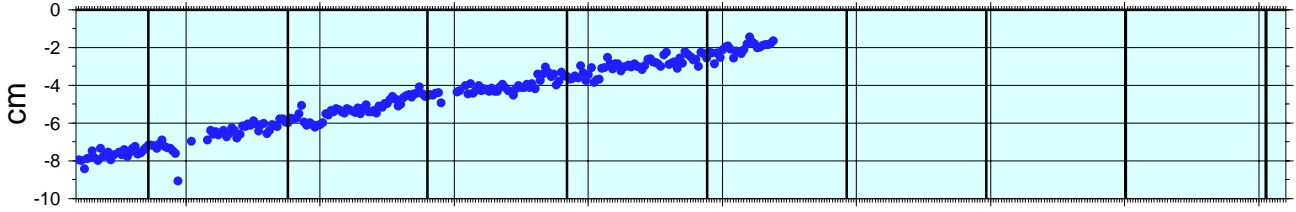


GPS Week

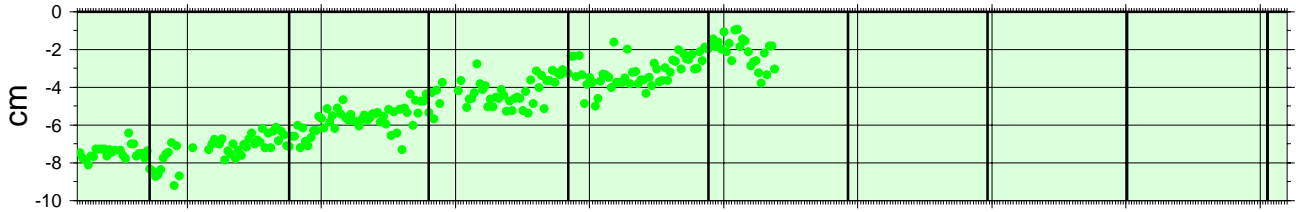


### AREQUIPA (AREQ)

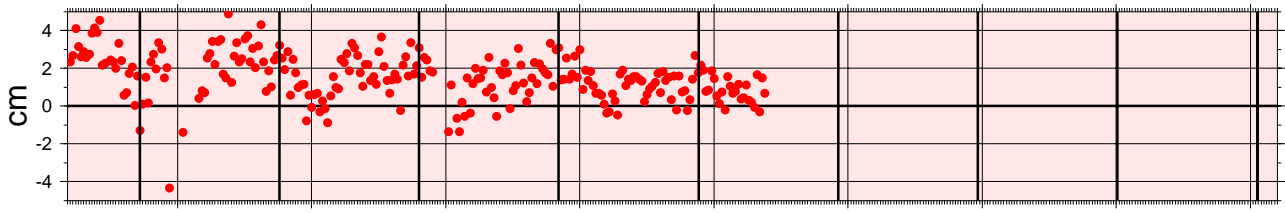
NORTH



EAST



UP

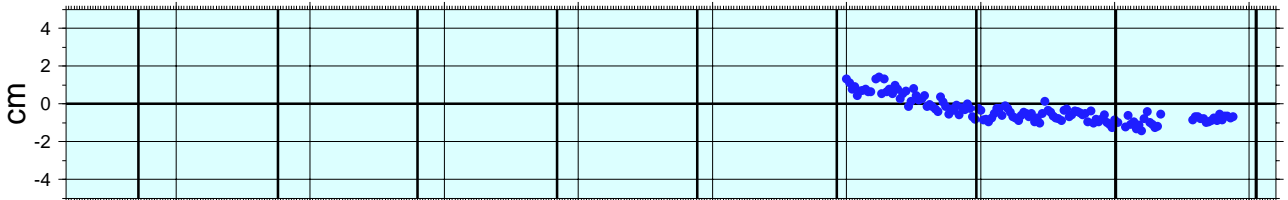


GPS Week

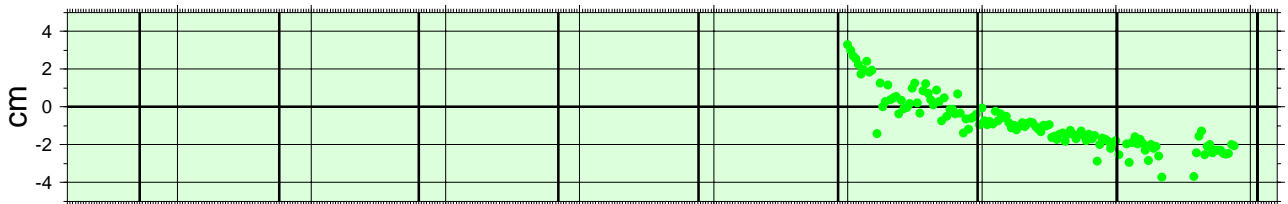
200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0  
1996 1997 1998 1999 2000 2001 2002 2003 2004

### AREQUIPA (ARE2)

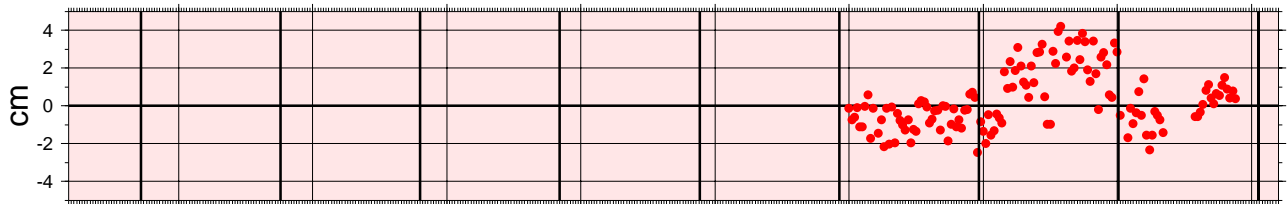
NORTH



EAST



UP

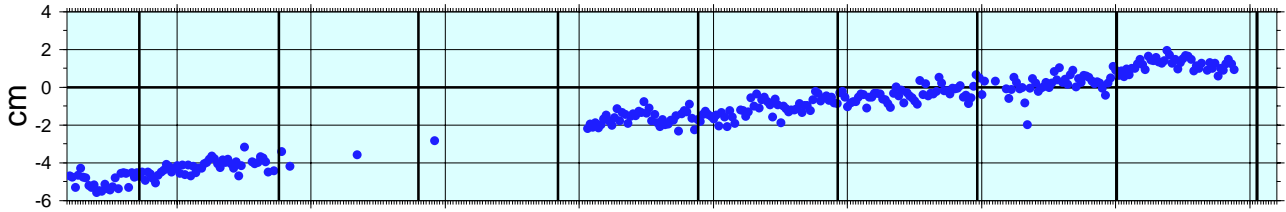


GPS Week

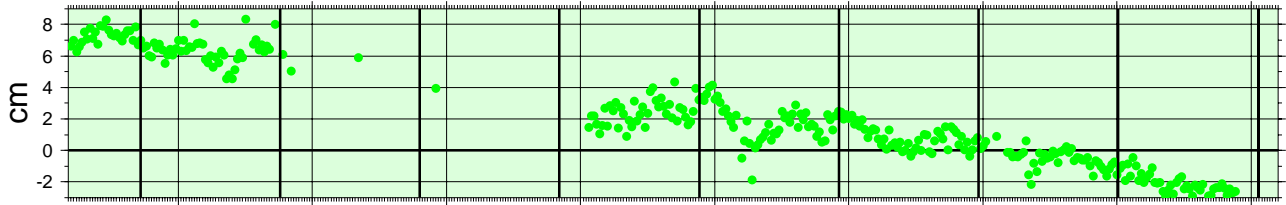
200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0 100 200 300 0  
1996 1997 1998 1999 2000 2001 2002 2003 2004

# BERMUDA

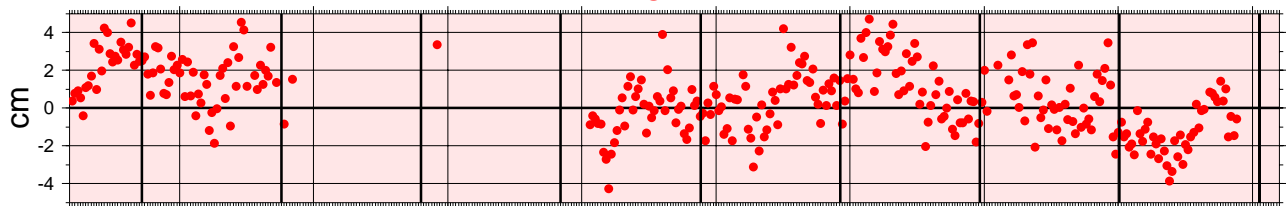
## NORTH



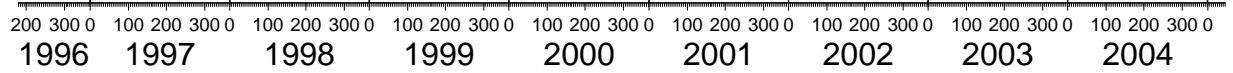
## EAST



## UP

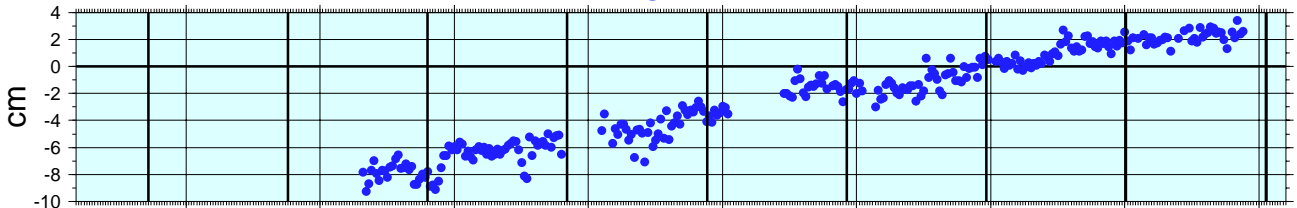


GPS Week

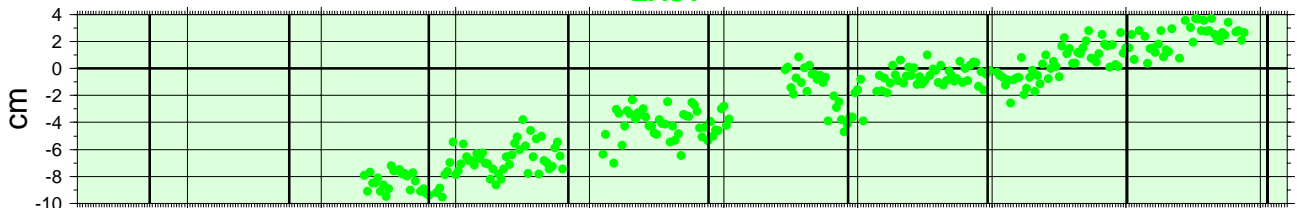


# GOUGH

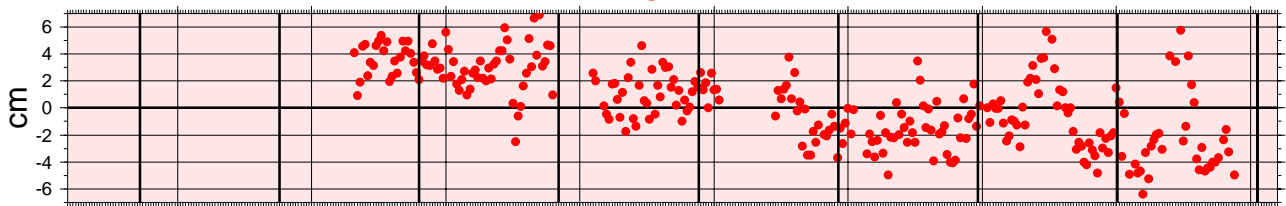
## NORTH



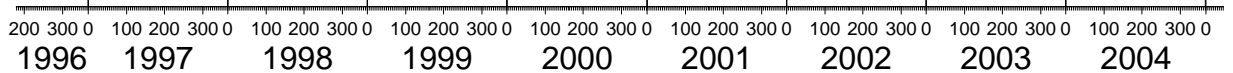
## EAST



## UP

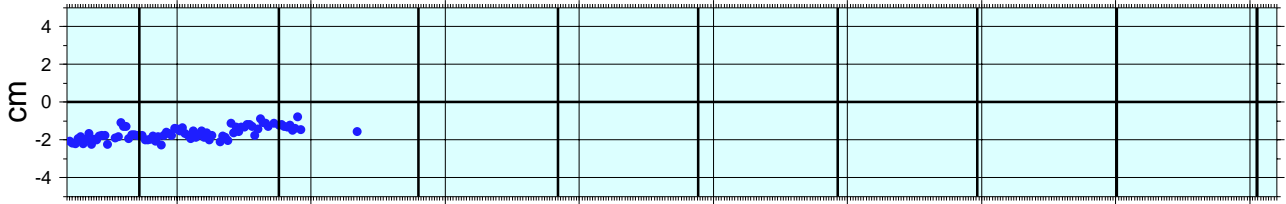


GPS Week

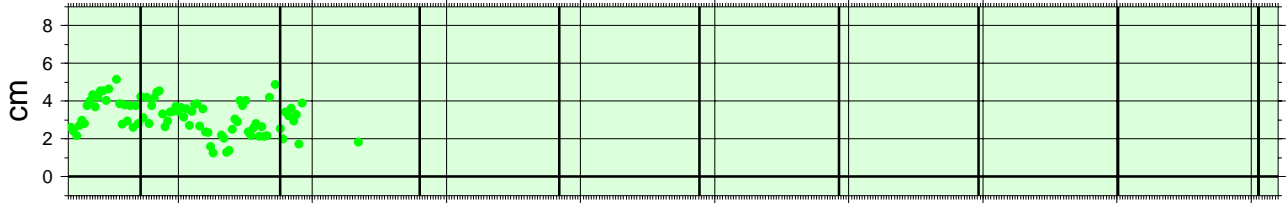


### RICHMOND (RCM5/6)

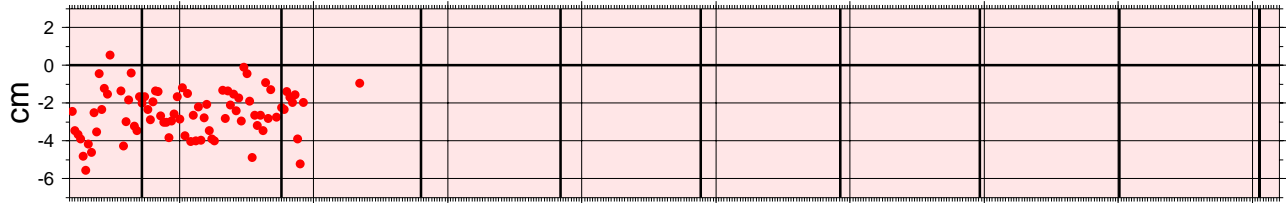
NORTH



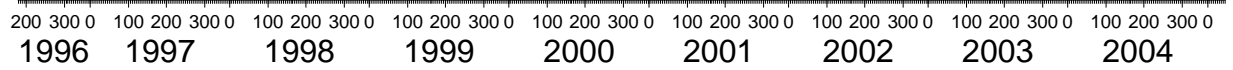
EAST



UP

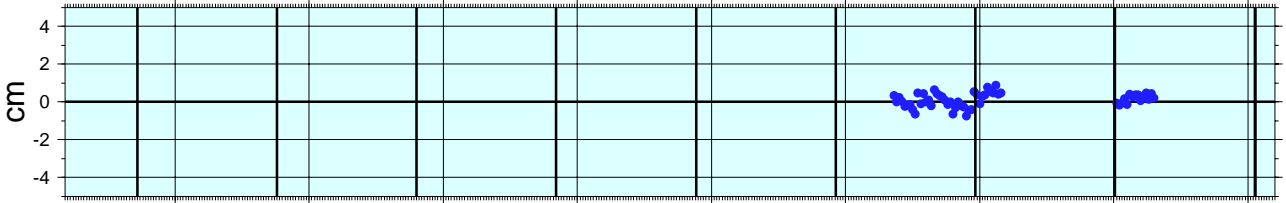


GPS Week

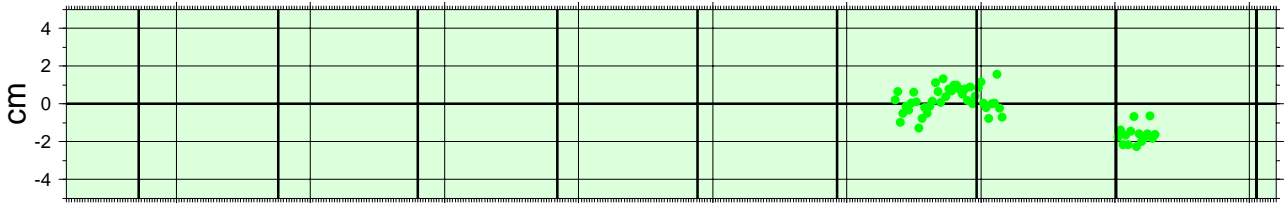


### KEY BISCAYNE

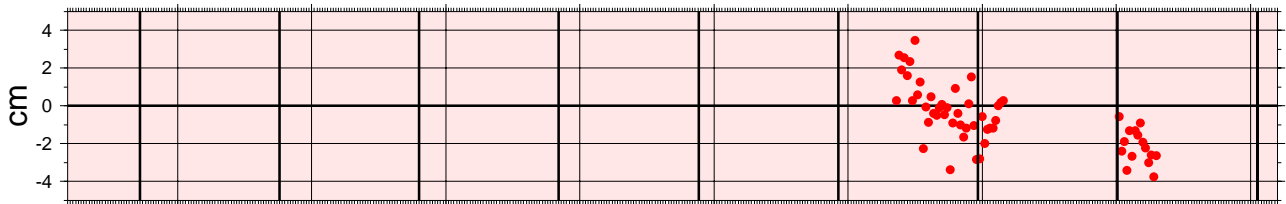
NORTH



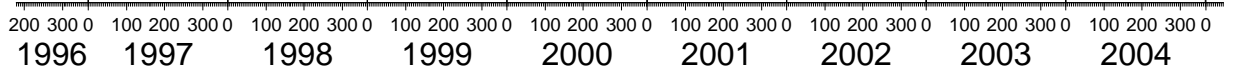
EAST



UP

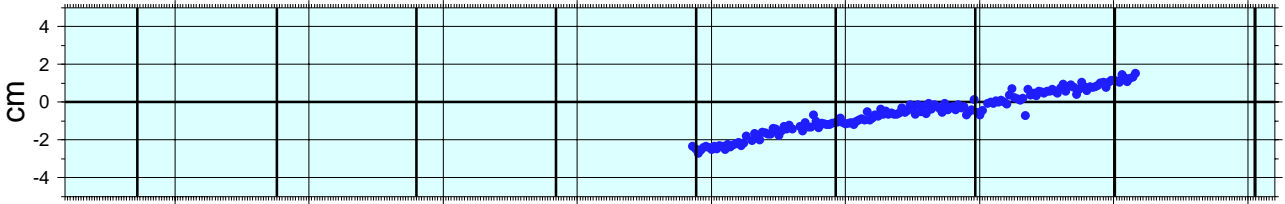


GPS Week

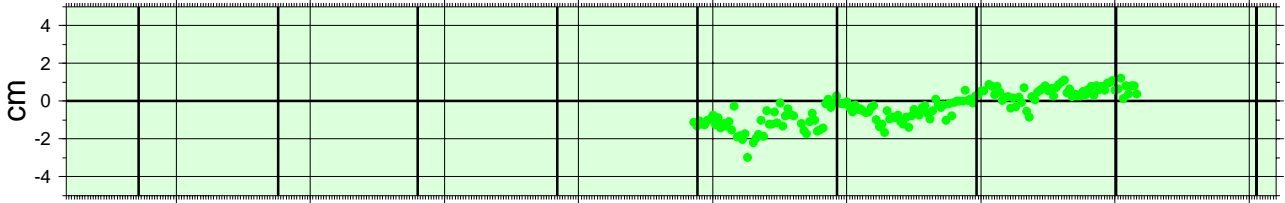


**PUERTO RICO 3**

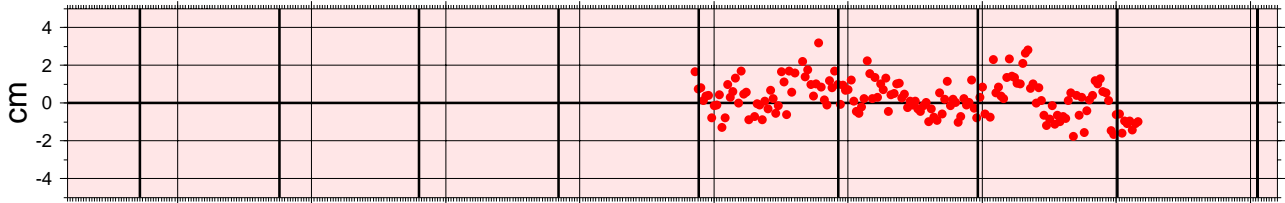
**NORTH**



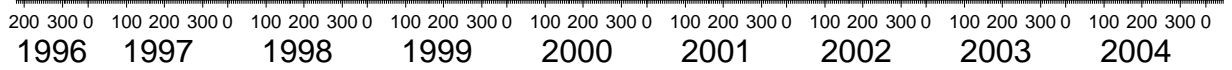
**EAST**



**UP**

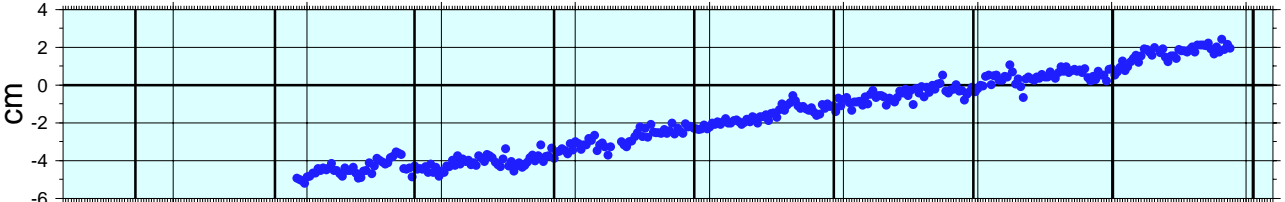


GPS Week

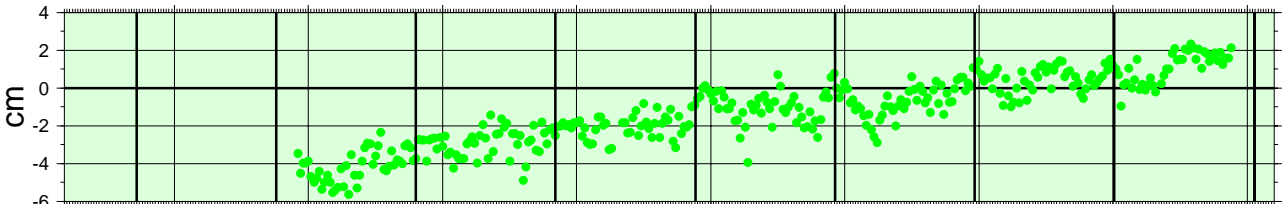


**MARACAIBO**

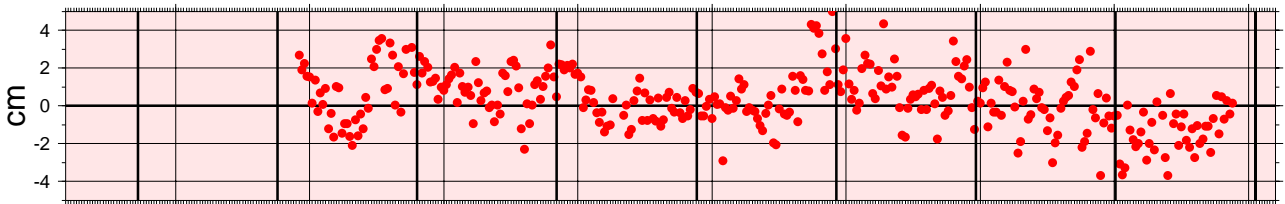
**NORTH**



**EAST**



**UP**



GPS Week

