PHENOMENON OF NONTIDAL PLUMB LINE VARIATIONS OBSERVED WITH HELP OF THE QUARTZ HORIZONTAL PENDULUMS AND LONG WATER-TUBE TILTMETER

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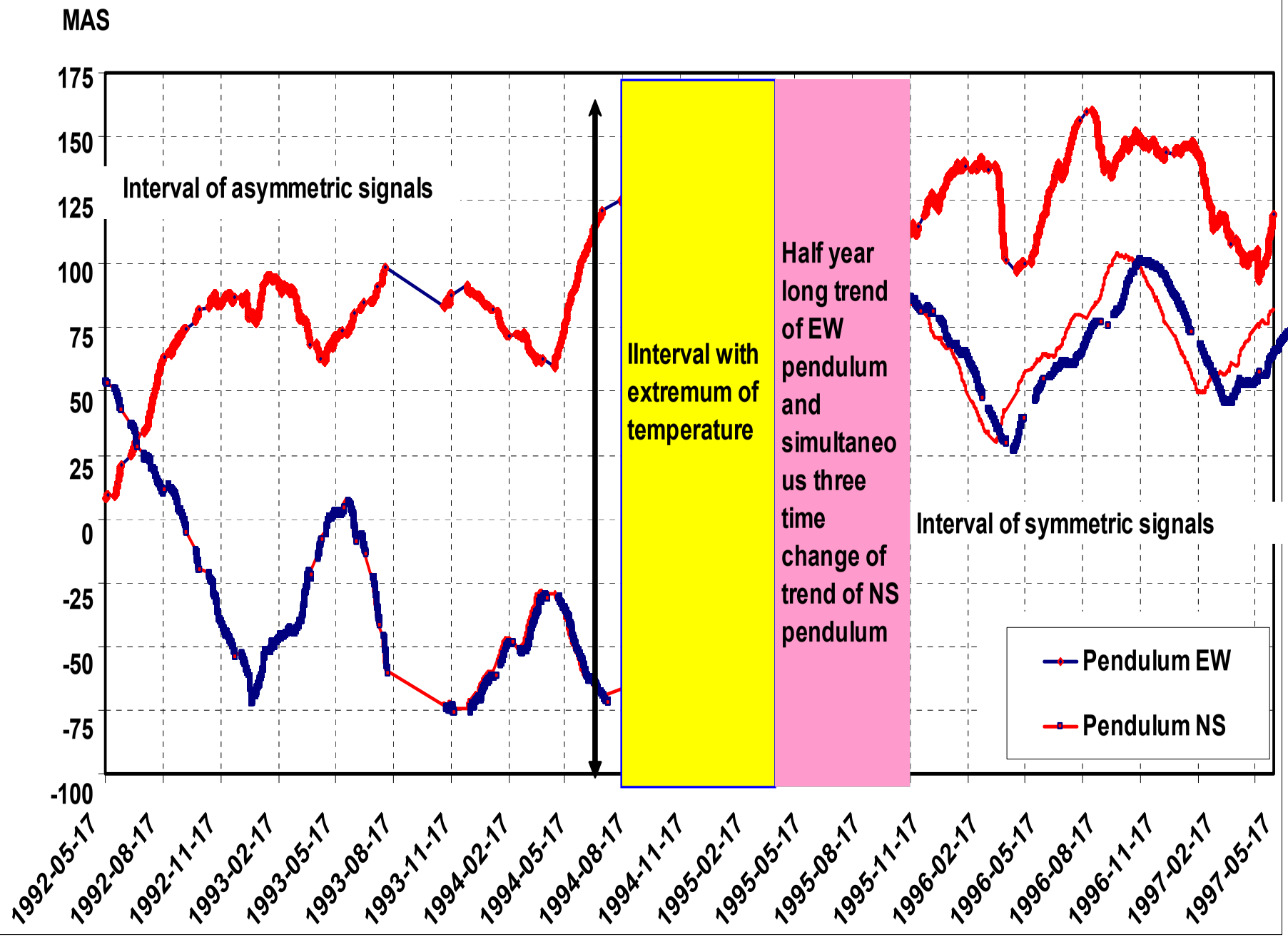
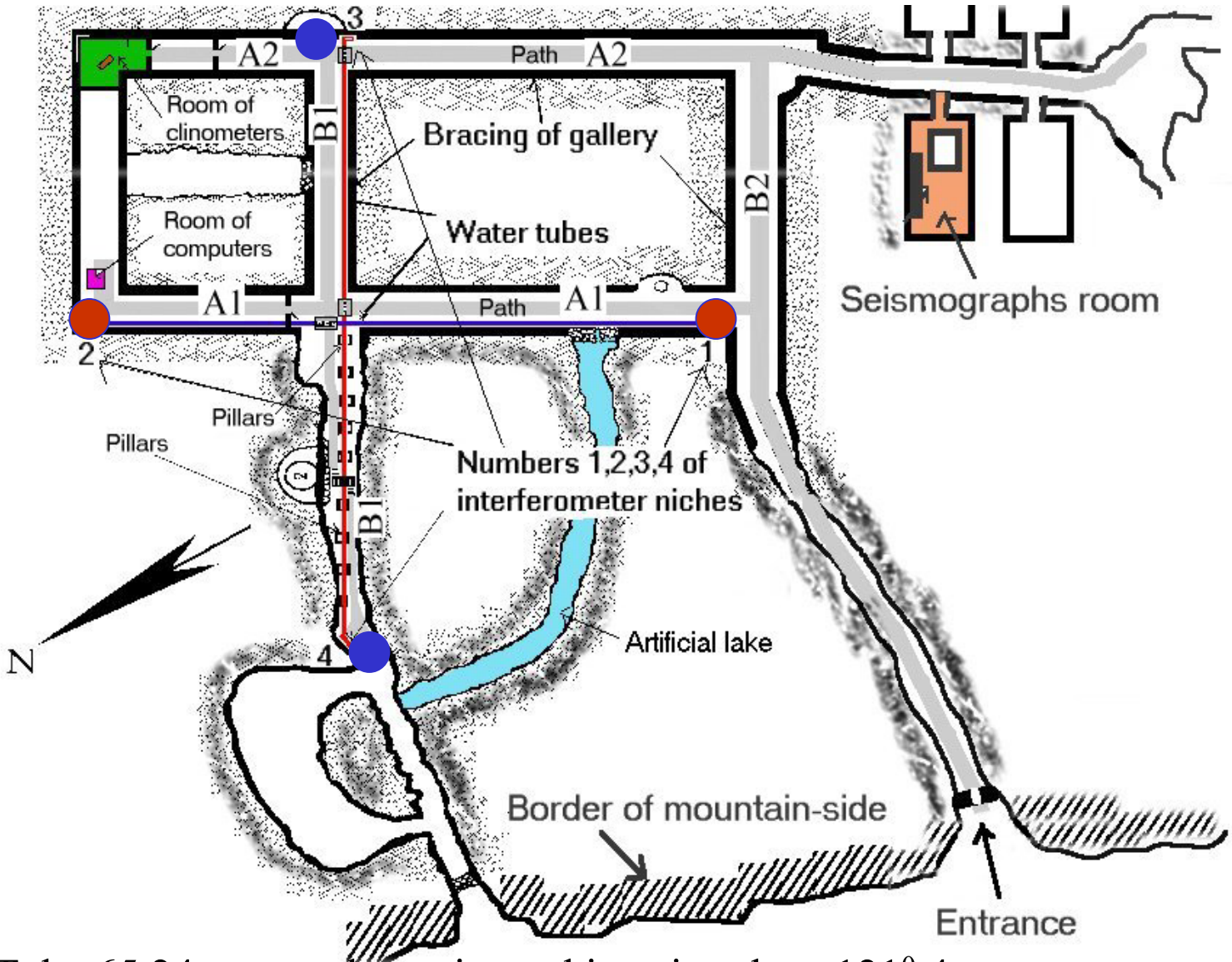
Five years long series of variations of pendulums azimuths





Tube 65.24 meters long situated in azimuths $-121^0.4$

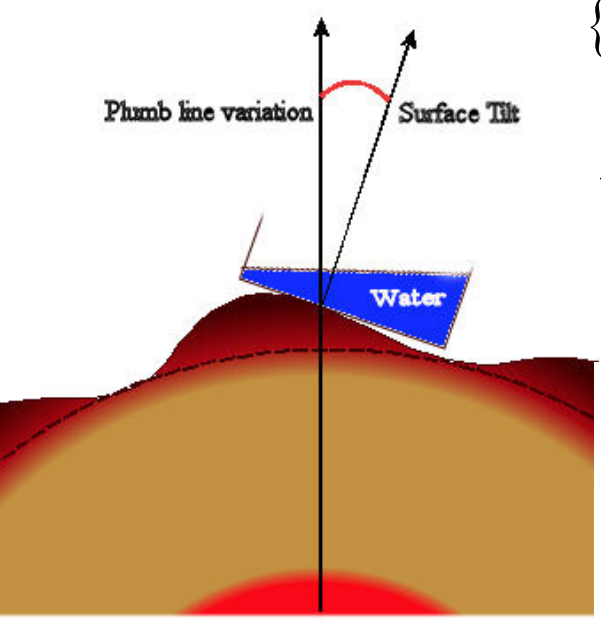
Tube 83.51 meters long situated in azimuths $-31^0.4$

The difference method of plumb line variations measurements

Large scale geodynamic signals produce exactly correlated phases of water level variations at ends of the tube (exactly opposite phases variations).

Local signals originated from the surrounding of the instrument or inside hydrodynamic system of the instrument produce signals of conformable phases or signals occurred only in one end of the tube.

Large scale geodynamic signals affecting water in the tube:



We obtain time series of plumb line variations from differences :

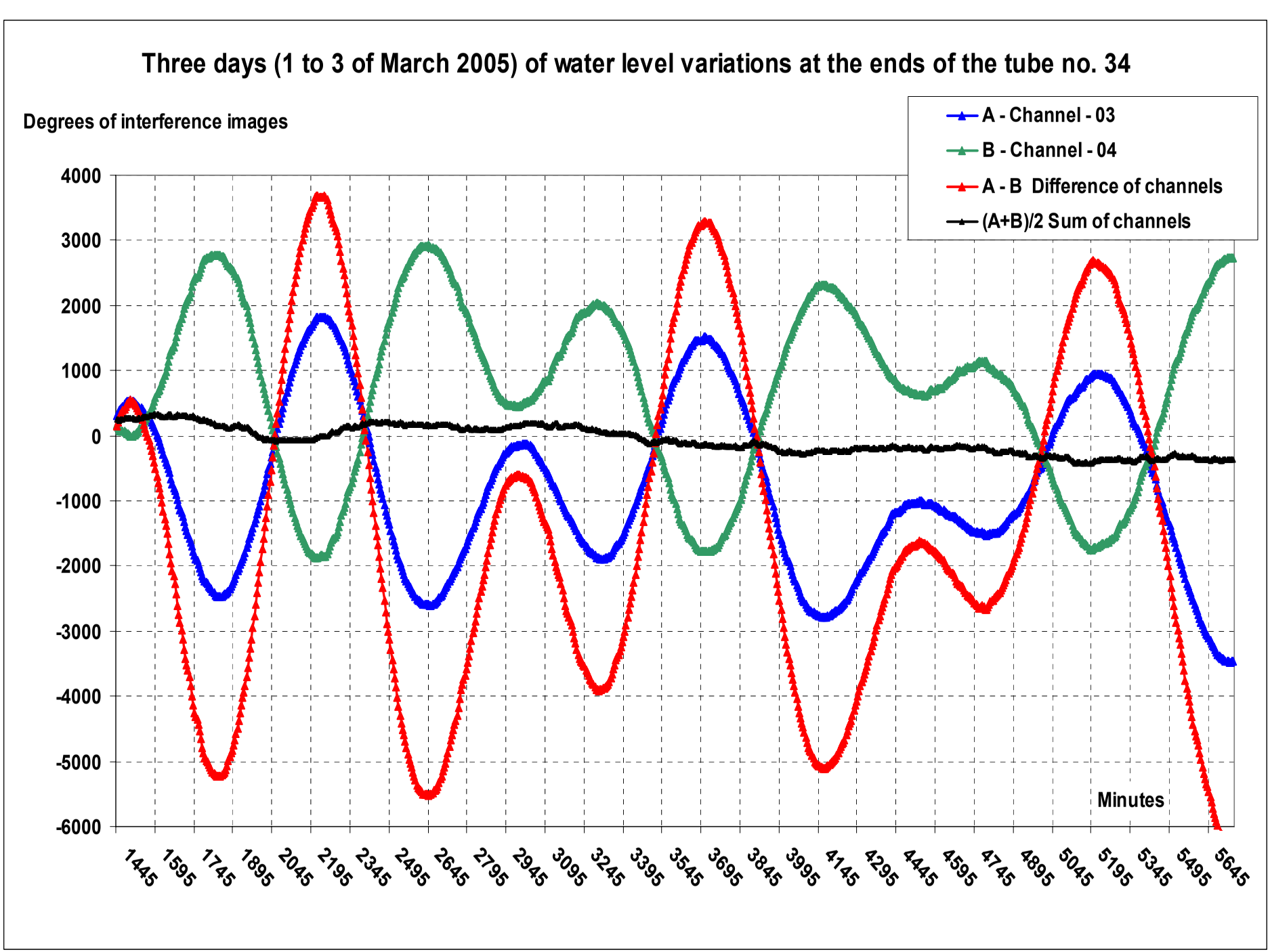
$$\{T_n(t)\}_{A12} = 2.089\ \ 10^{-3}\left[\frac{mas}{\deg}\right]\ \frac{\{S_n(t)\}_{A11} - \{S_n(t)\}_{A12}}{2}$$

$$\{T_n(t)\}_{B12} = 1.632\ 10^{-3}\left[\frac{mas}{\deg}\right]\ \frac{\{S_n(t)\}_{B11} - \{S_n(t)\}_{B12}}{2}$$

The time series of errors without large scale geodynamic signals are given by formulas :

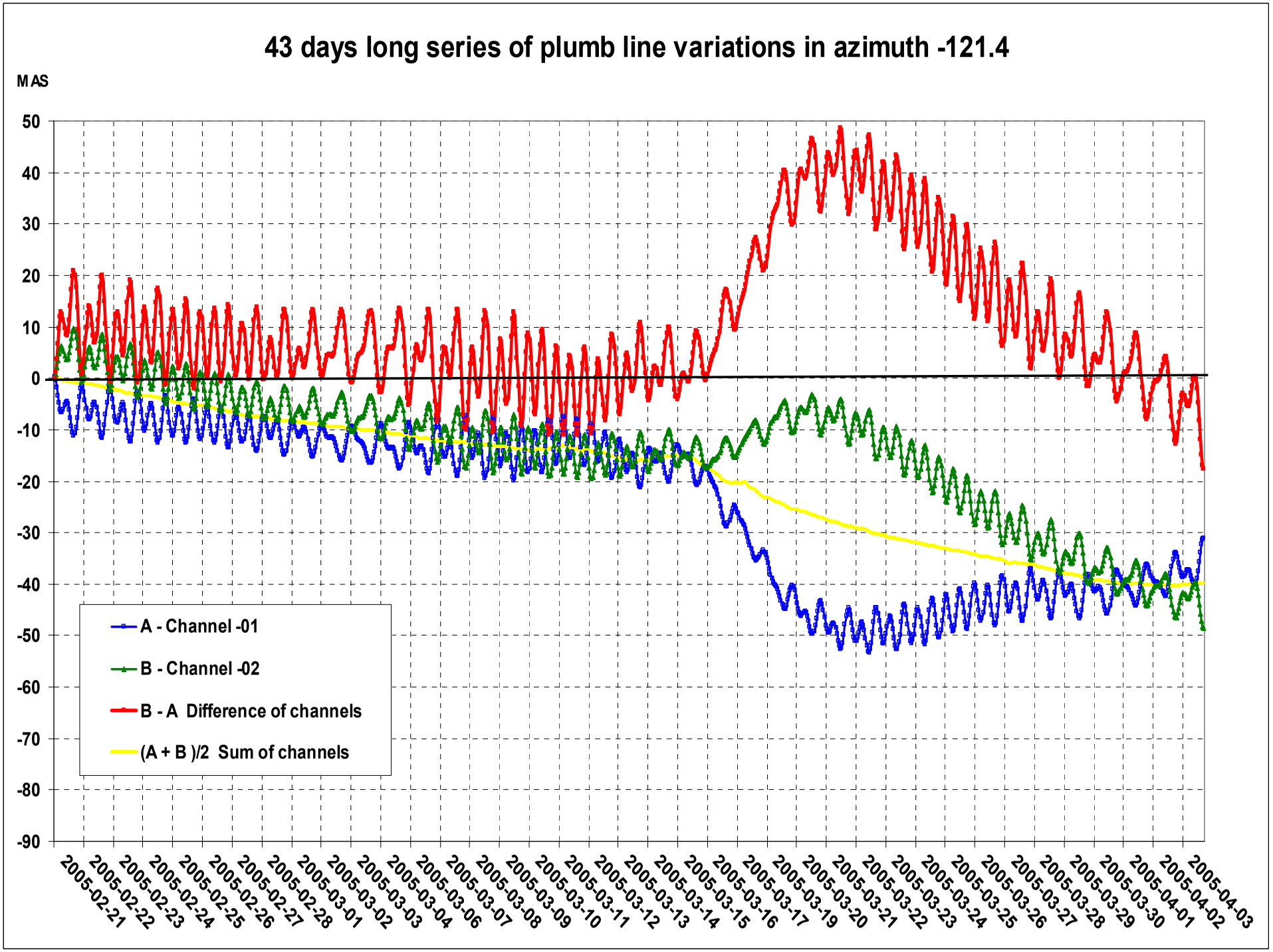
$$\{\varepsilon_n(t)\}_{A12} = 2.089\ \ 10^{-3}\left[\frac{mas}{\deg}\right]\ \frac{\{S_n(t)\}_{A11} + \{S_n(t)\}_{A12}}{2}$$

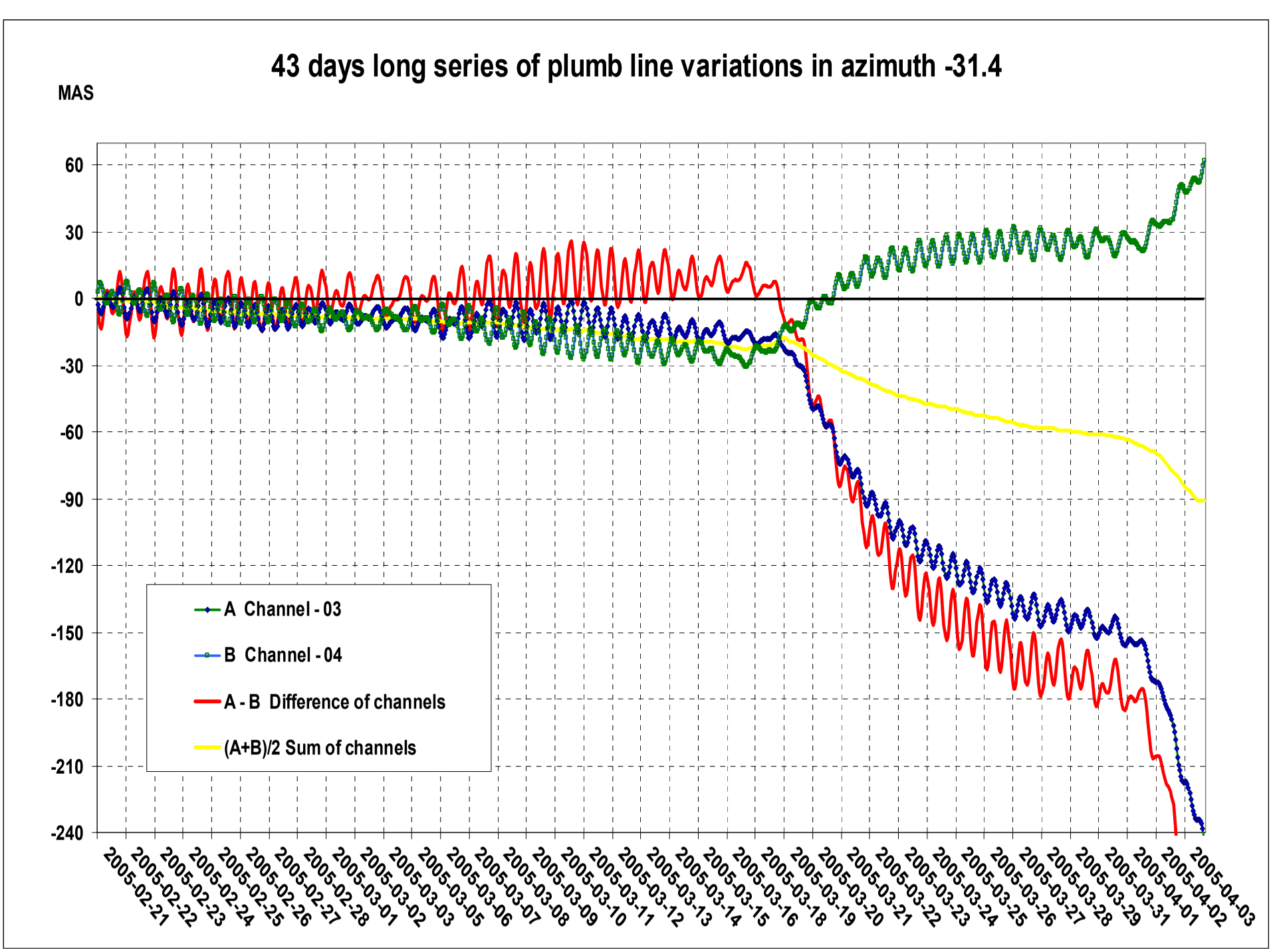
$$\{\varepsilon_n(t)\}_{B12} = 1.632\ 10^{-3}\left[\frac{mas}{\deg}\right]\ \frac{\{S_n(t)\}_{B11} + \{S_n(t)\}_{B12}}{2}$$

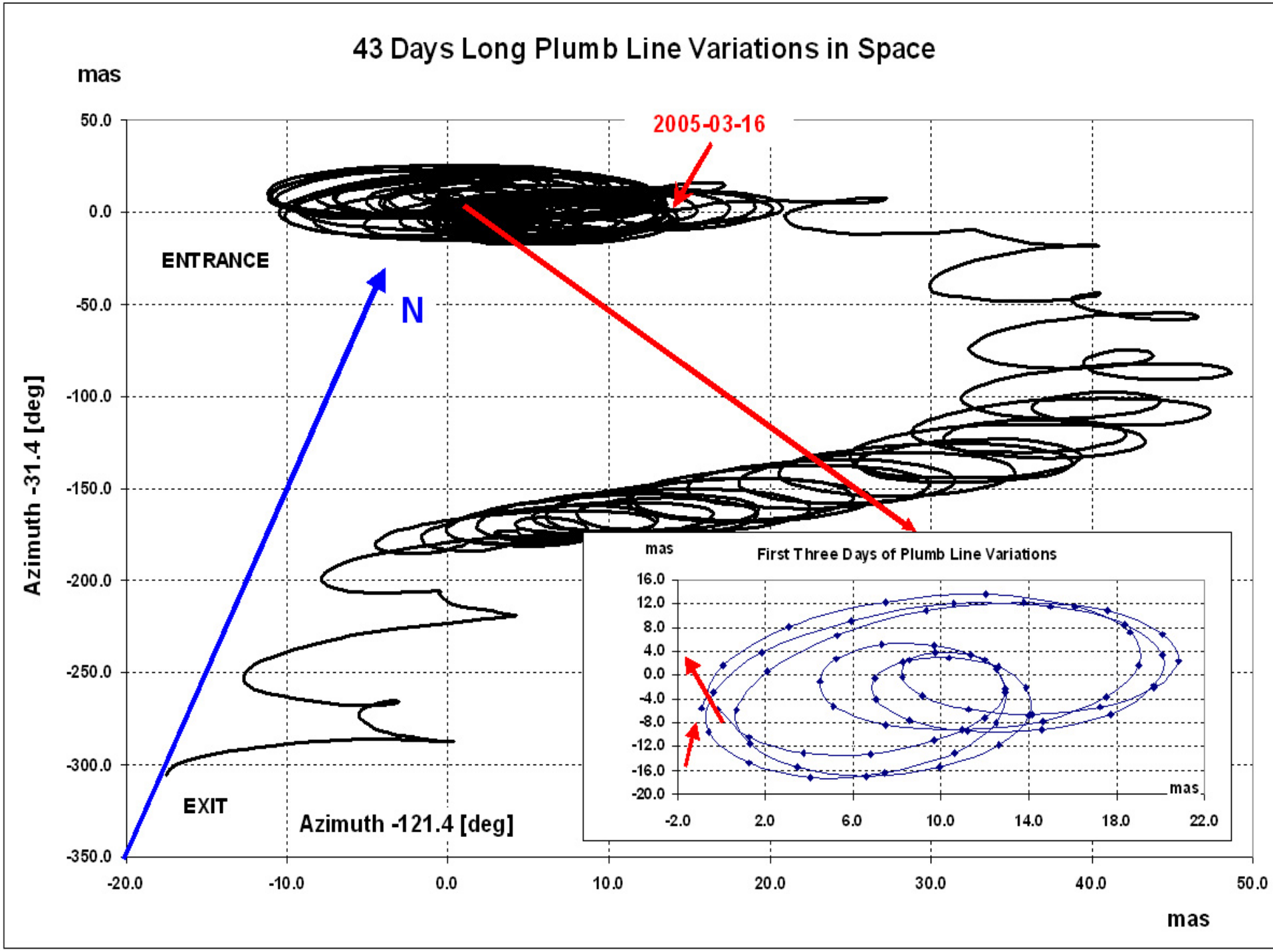

Three days (1 to 3 of March 2005) of water level variations at the ends of the tube no. 34
Degrees of interference images
A - Channel - 03
B - Channel - 04
A - B Difference of channels
(A+B)/2 Sum of channels
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
-6000
Minutes
1445
1595
1745
1895
2045
2195
2345
2495
2645
2795
2945
3095
3245
3395
3545
3695
3845
3995
4145
4295
4445
4595
4745
4895
5045
5195
5345
5495
5645

Results of tidal adjustment of the sum of signals from both ends of the tube

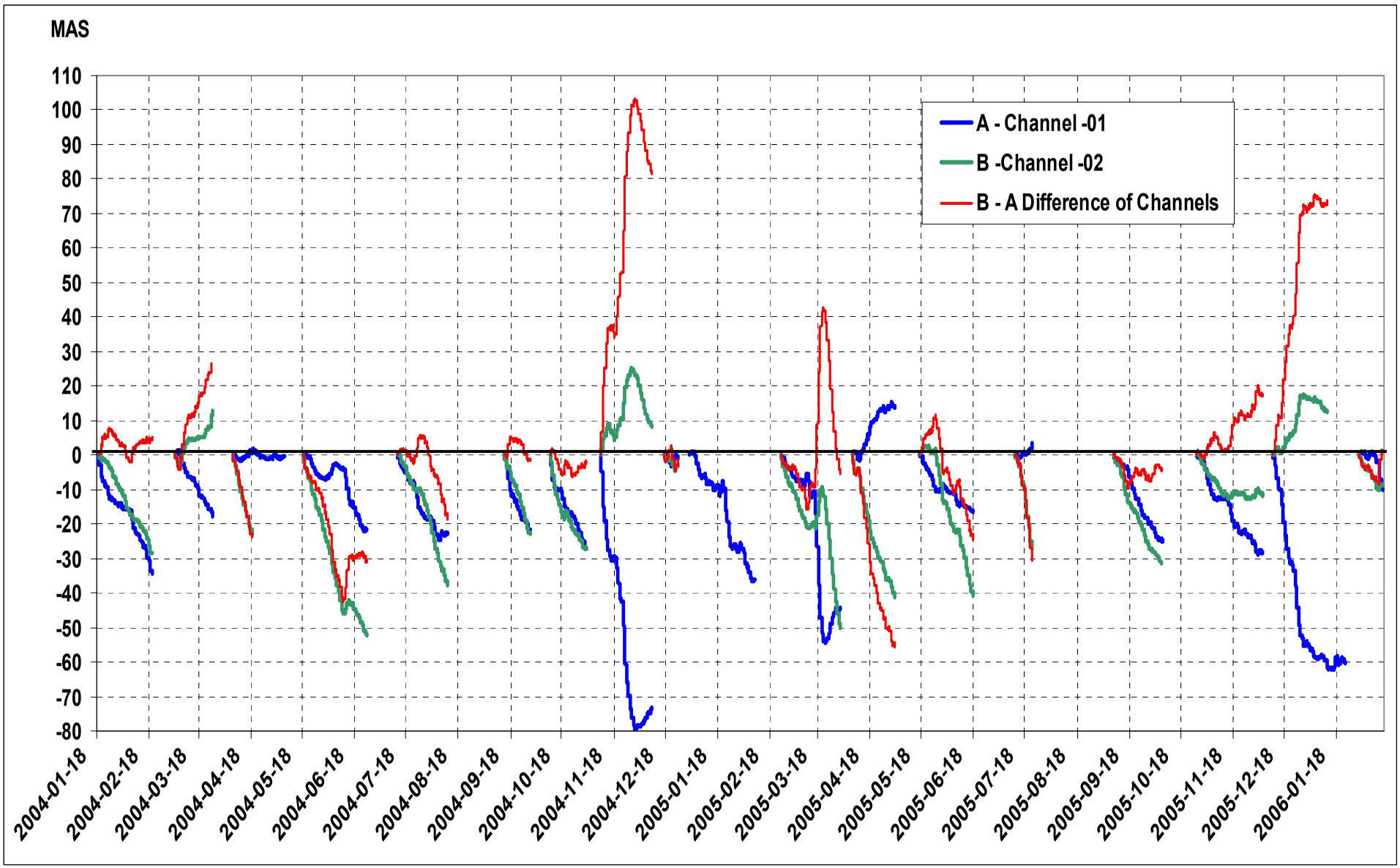
Frequency		Waves	Theoretical	Amplitude		Phase	
from	to	Group	Amplitude	Factor	stdv.	lag	stdv.
[cpd]	[cpd]		[mas]			[deg]	[deg]
0.501370	0.911390	Q1	0.8356	**0.02773**	0.01549	-118.1920	31.9824
0.911391	0.947991	O1	4.3641	**0.01024**	0.00302	-66.2480	16.9023
0.981855	1.023622	K1	6.1350	**0.00710**	0.00226	-122.7329	18.2751
1.880265	1.914128	N2	1.8048	**0.01324**	0.00579	-134.7552	25.0520
1.914129	1.950419	M2	9.4260	**0.00670**	0.00101	-150.1601	8.6142
1.984283	2.451943	S2	4.3851	**0.02013**	0.00194	162.2026	5.5115


43 days long series of plumb line variations in azimuth -121.4
MAS
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
A - Channel -01
B - Channel -02
B - A Difference of channels
(A + B)/2 Sum of channels
2005-02-21
2005-02-22
2005-02-23
2005-02-24
2005-02-25
2005-02-26
2005-02-27
2005-02-28
2005-03-01
2005-03-02
2005-03-03
2005-03-04
2005-03-06
2005-03-07
2005-03-08
2005-03-09
2005-03-10
2005-03-11
2005-03-12
2005-03-13
2005-03-14
2005-03-15
2005-03-16
2005-03-17
2005-03-19
2005-03-20
2005-03-21
2005-03-22
2005-03-23
2005-03-24
2005-03-25
2005-03-26
2005-03-27
2005-03-28
2005-03-29
2005-03-30
2005-04-01
2005-04-02
2005-04-03

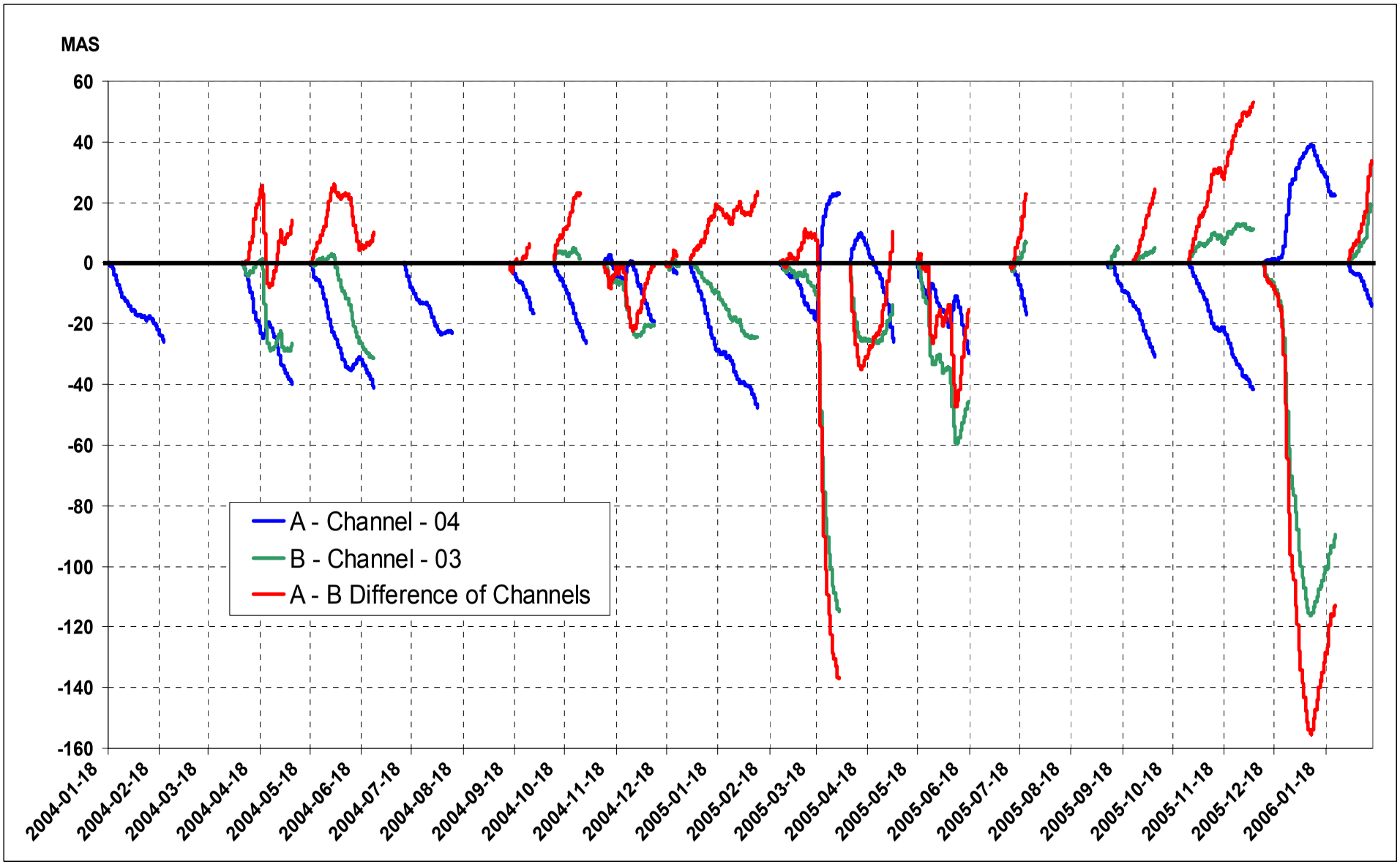

43 days long series of plumb line variations in azimuth -31.4
MAS
60
30
0
-30
-60
-90
-120
-150
-180
-210
-240
A Channel - 03
B Channel - 04
A - B Difference of channels
(A+B)/2 Sum of channels
2005-02-21
2005-02-22
2005-02-23
2005-02-24
2005-02-25
2005-02-26
2005-02-27
2005-02-28
2005-03-01
2005-03-02
2005-03-03
2005-03-05
2005-03-06
2005-03-07
2005-03-08
2005-03-09
2005-03-10
2005-03-11
2005-03-12
2005-03-13
2005-03-14
2005-03-15
2005-03-16
2005-03-18
2005-03-19
2005-03-20
2005-03-21
2005-03-22
2005-03-23
2005-03-24
2005-03-25
2005-03-26
2005-03-27
2005-03-28
2005-03-29
2005-03-31
2005-04-01
2005-04-02
2005-04-03


43 Days Long Plumb Line Variations in Space
mas
2005-03-16
ENTRANCE
N
EXIT
Azimuth -121.4 [deg]
Azimuth -31.4 [deg]
50.0
0.0
-50.0
-100.0
-150.0
-200.0
-250.0
-300.0
-350.0
-20.0
-10.0
0.0
10.0
20.0
30.0
40.0
50.0
mas
First Three Days of Plumb Line Variations
mas
16.0
12.0
8.0
4.0
0.0
-4.0
-8.0
-12.0
-16.0
-20.0
-2.0
2.0
6.0
10.0
14.0
18.0
22.0
mas

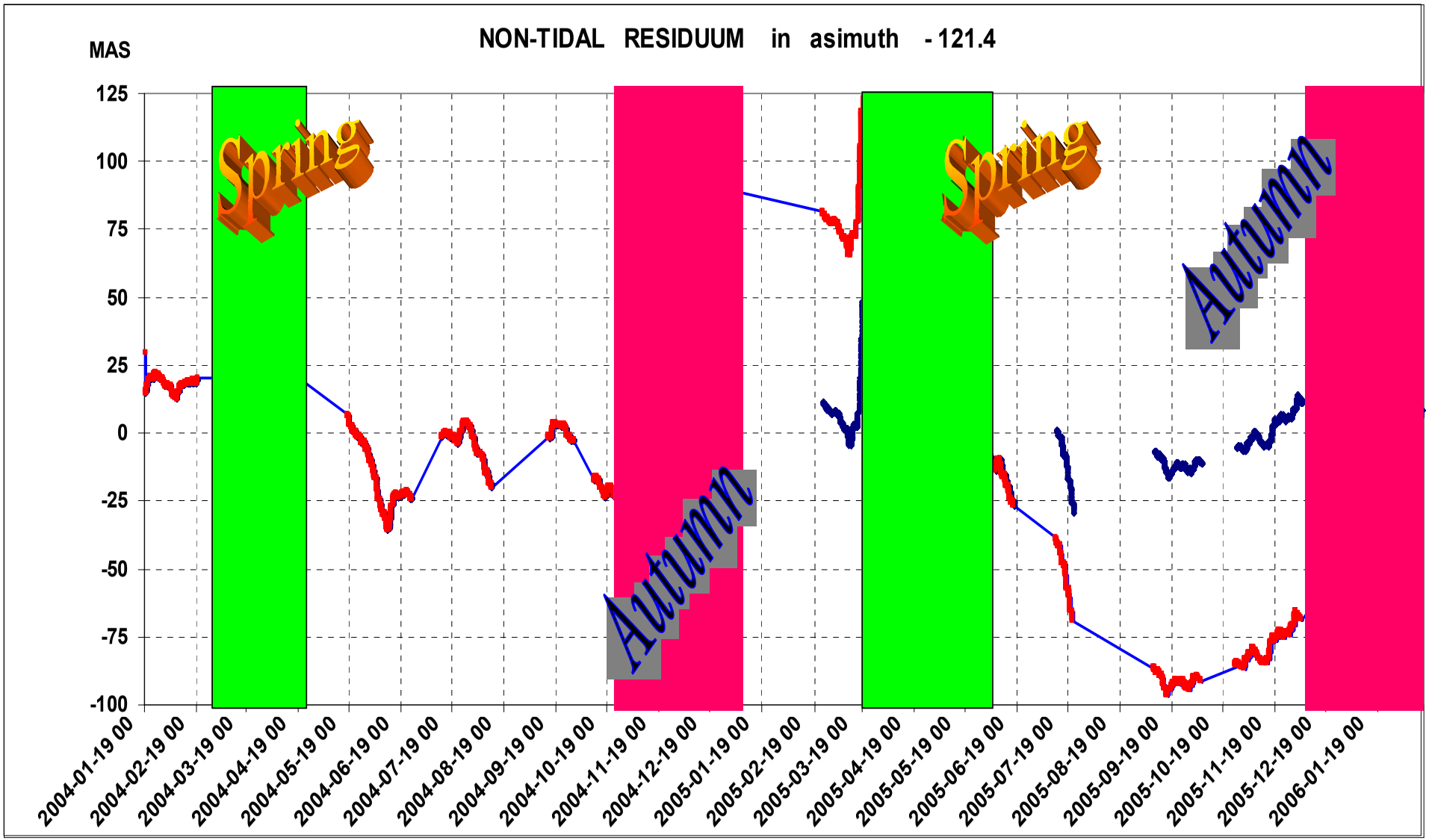
Series of plumb line variations since 2004 to 2006 in azimuth - 121.4 degree after low-pass filtration.



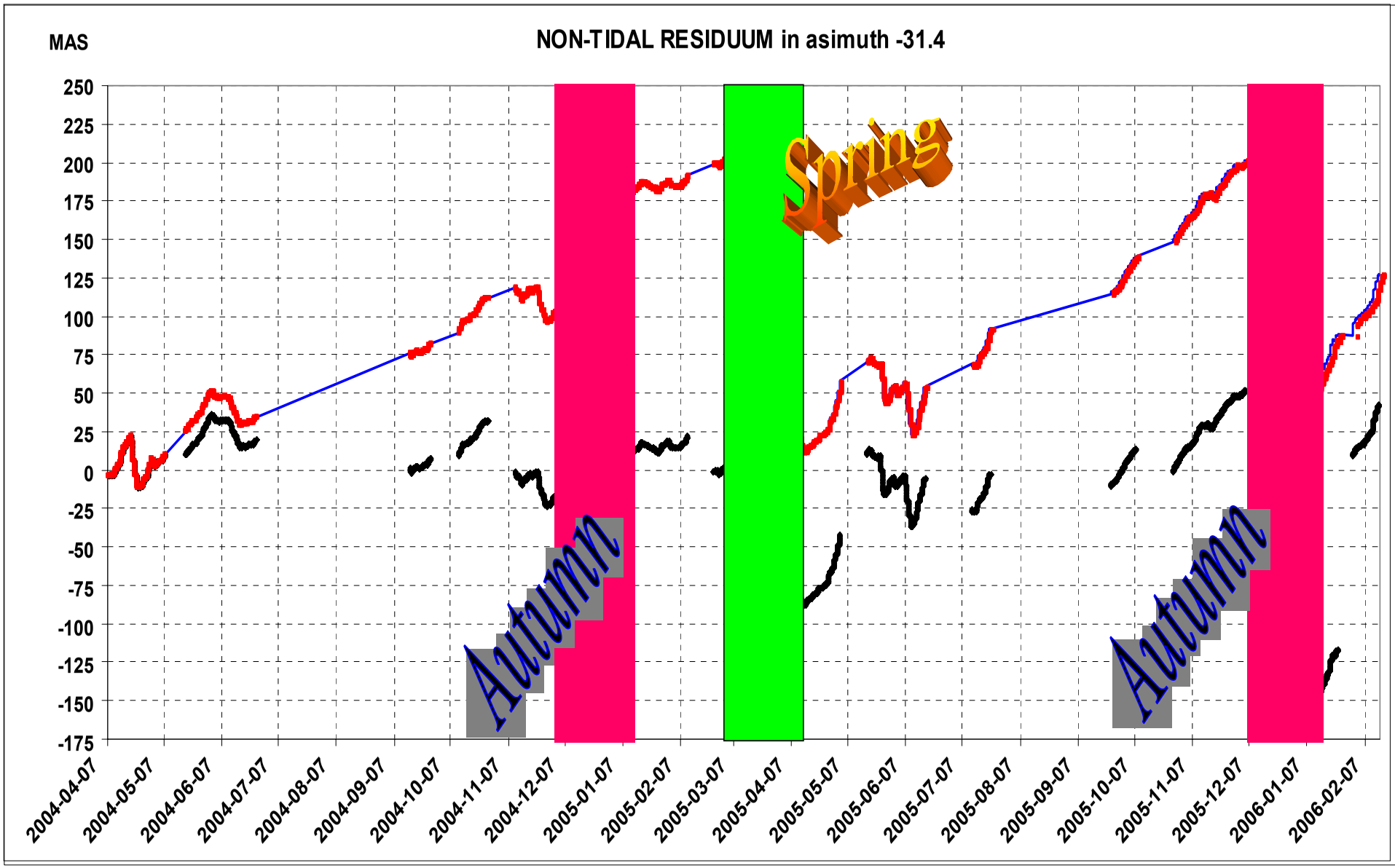
Series of plumb line variations since 2004 to 2006 in azimuth -31.4 degree after low-pass filtration.



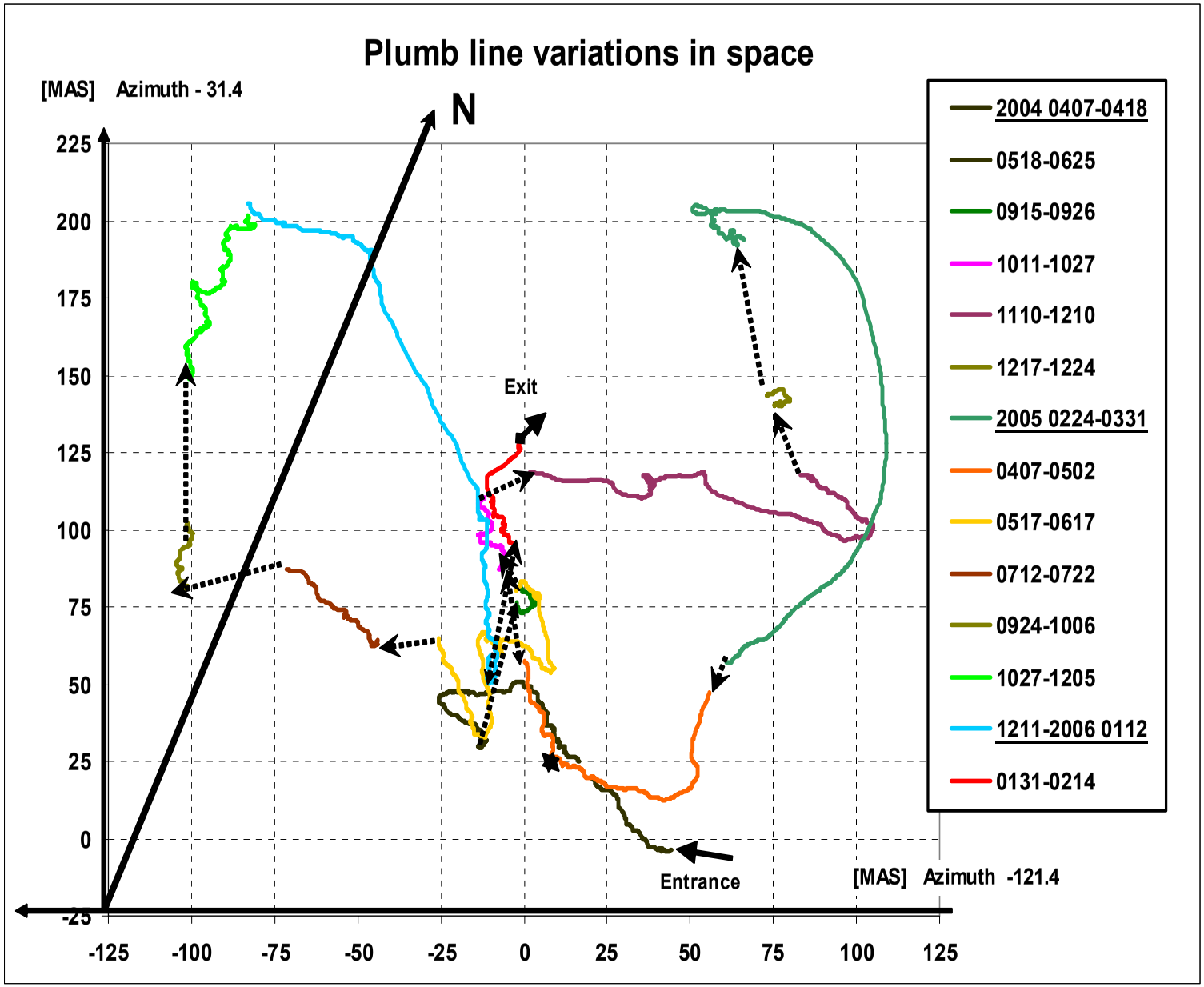
Channels 01-02

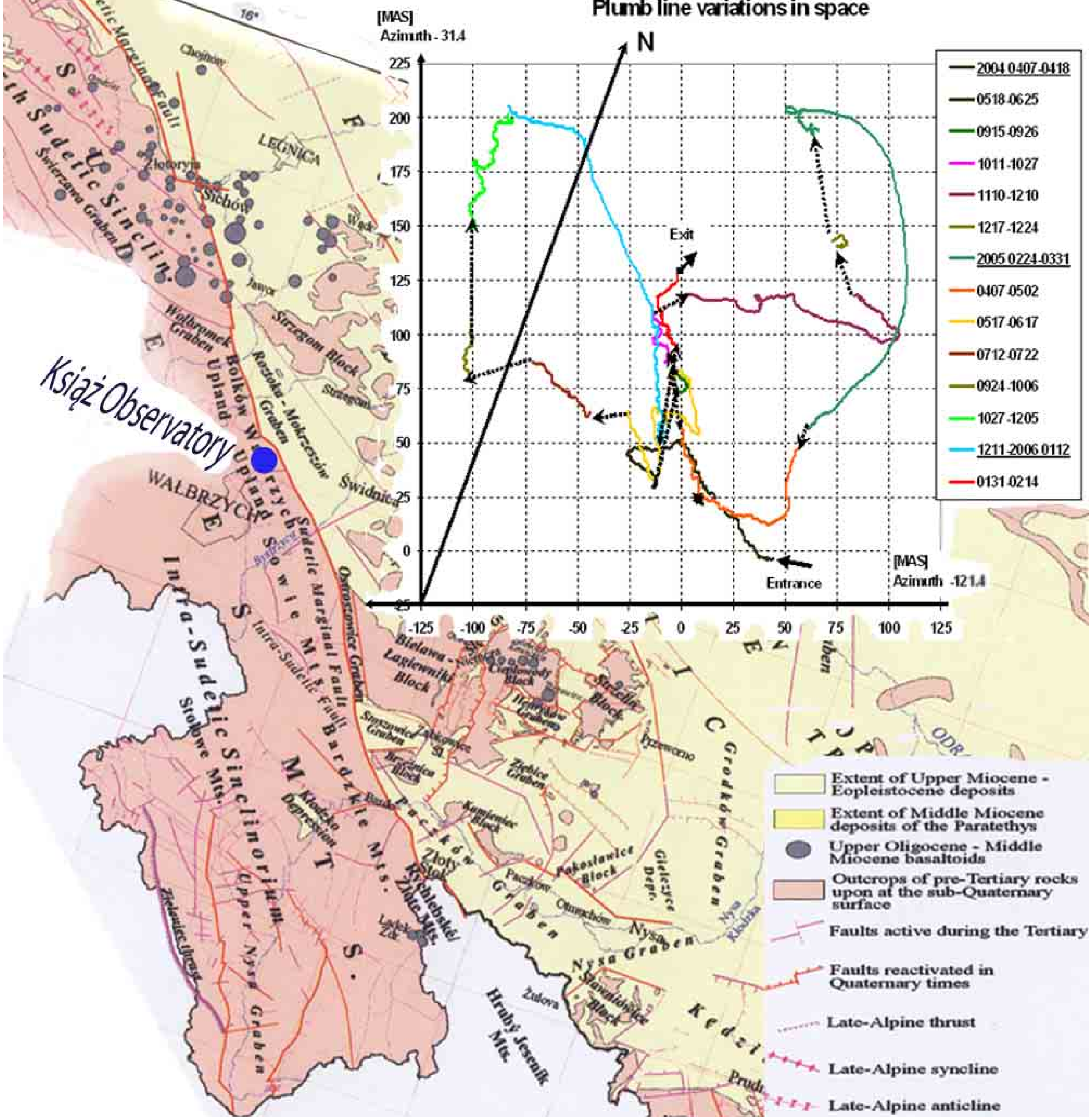


Channels 03-04



Plot of plumb line variations since 2004 to 2006 after low-pass filtration.





Plumb line variations in space
[MAS]
Azimuth - 31.4
[MAS]
Azimuth -121.4
N
Exit
Entrance
225
200
175
150
125
100
75
50
25
0
-25
-125
-100
-75
-50
-25
0
25
50
75
100
125
2004 0407-0418
0518-0625
0915-0926
1011-1027
1110-1210
1217-1224
2005 0224-0331
0407-0502
0517-0617
0712-0722
0924-1006
1027-1205
1211-2006 0112
0131-0214
Książ Observatory
LEGNICA
WAŁBRZYCH
Świdnica
Strzegom Block
Rozłoka - Mokrzeszów Graben
Bolków Wałbrzych Upland
Sudetic Marginal Fault
Intra-Sudetic Fault
Sowie Mts.
Bardzkie Mts.
Ostroszowice Graben
Intra-Sudetic Sinclinorium
Stołowe Mts.
Upper Nysa Graben
Kłodzko Depression
Grodków Graben
Gielczyce Depr.
Nysa Graben
Hrubý Jeseník Mts.
Extent of Upper Miocene - Eopleistocene deposits
Extent of Middle Miocene deposits of the Paratethys
Upper Oligocene - Middle Miocene basaltoids
Outcrops of pre-Tertiary rocks upon at the sub-Quaternary surface
Faults active during the Tertiary
Faults reactivated in Quaternary times
Late-Alpine thrust
Late-Alpine syncline
Late-Alpine anticline

Conclusions:

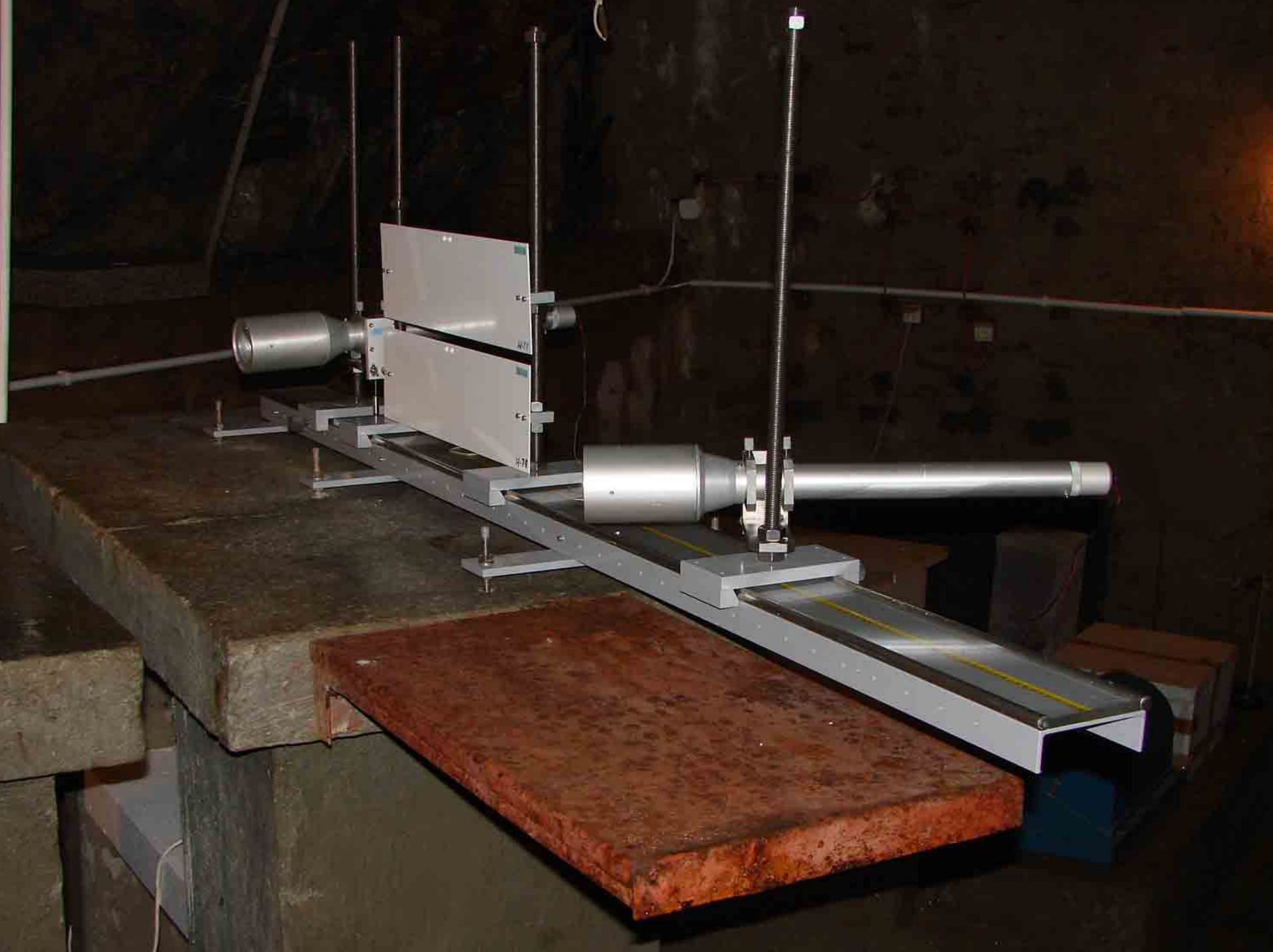
- We do not known any instrumental effects such as drift or errors of data elaborations which could produced observed effects of changes of azimuth of horizontal pendulums as well as water level variations in long water-tubes tiltmeter.

- Non-tidal changes of azimuths of quartz pendulums as well as plumb line variations observe with help of long water tube tiltmeter we can not explain by temperature or pressure variations inside or outside the underground.

- Distance from Ksiaz Geodynamic Laboratory to the North Sea and Atlantic Ocean is too large to explain hundred [mas] of plumb line variations by ocean effects such as loading or Newtonian.

- The hypothetic reasons of large plumb line variations are tectonic motions of blocks in Sudeten Mountain area.

- In 2007 we resume measurements of plumb line variations with help of horizontal pendulums. Common measurements of quartz pendulums and long water-tube help as to understand the mechanism of generation so large effects of plumb line variations.




H75
H74


Thank you for attention