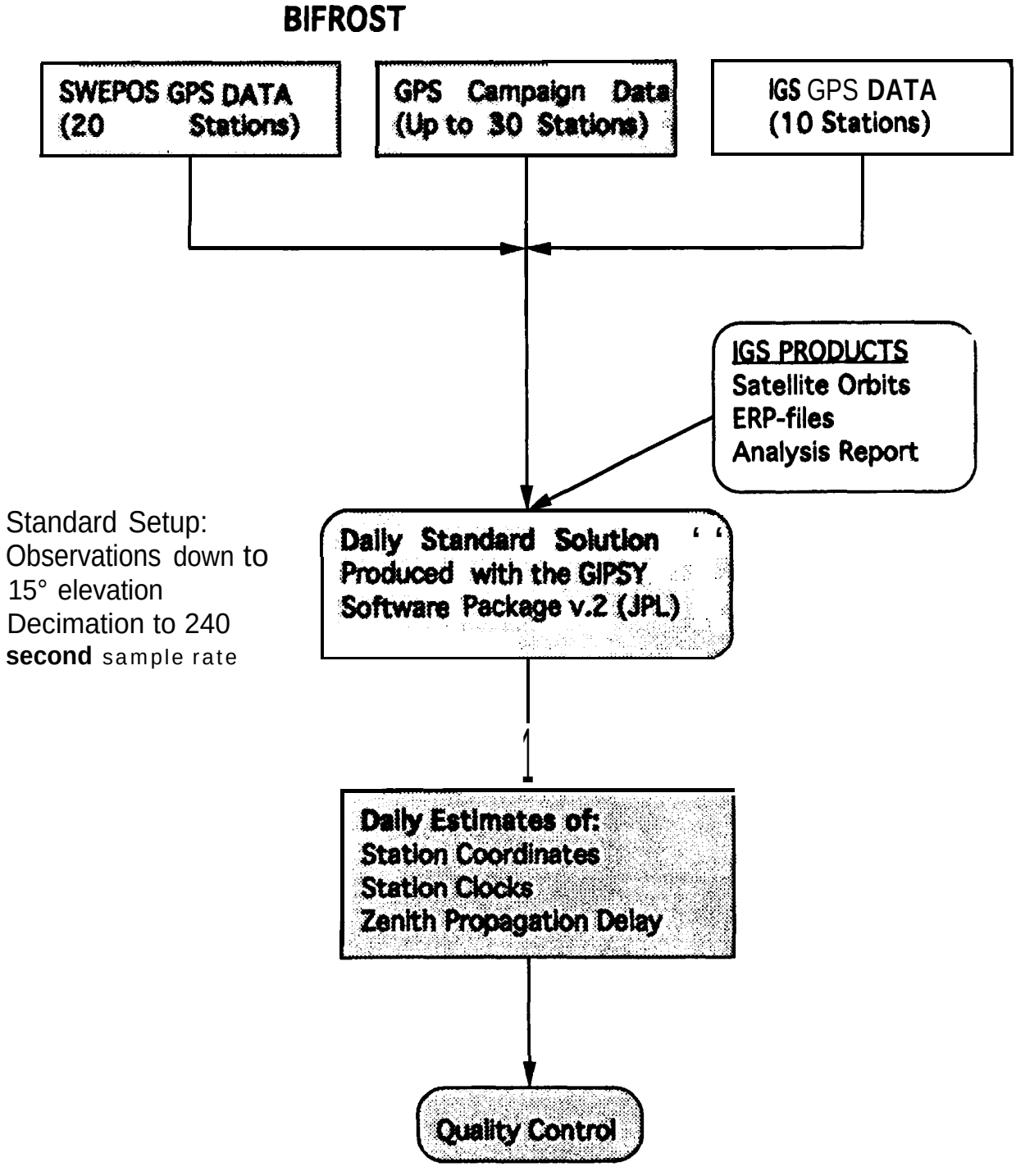
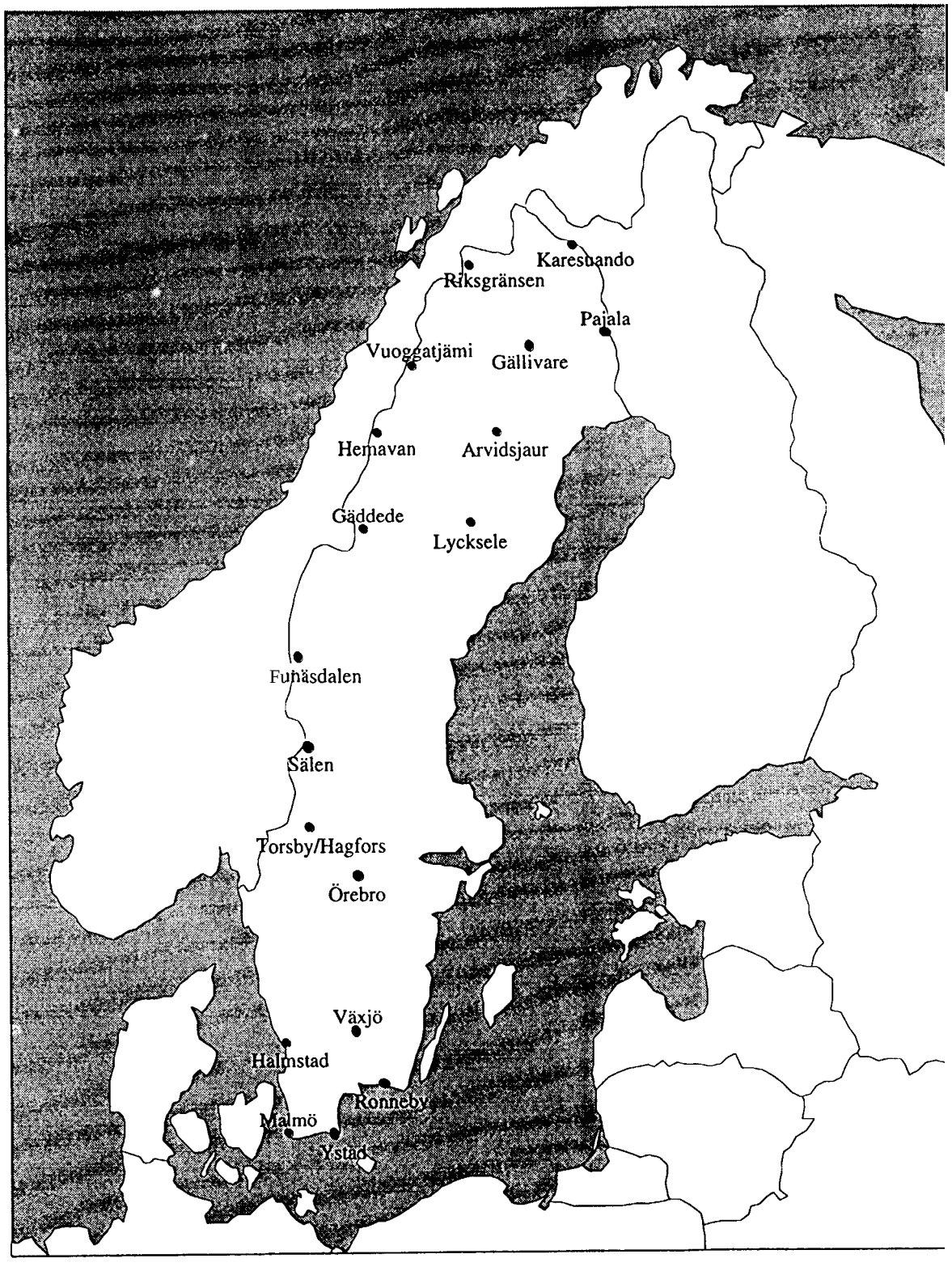
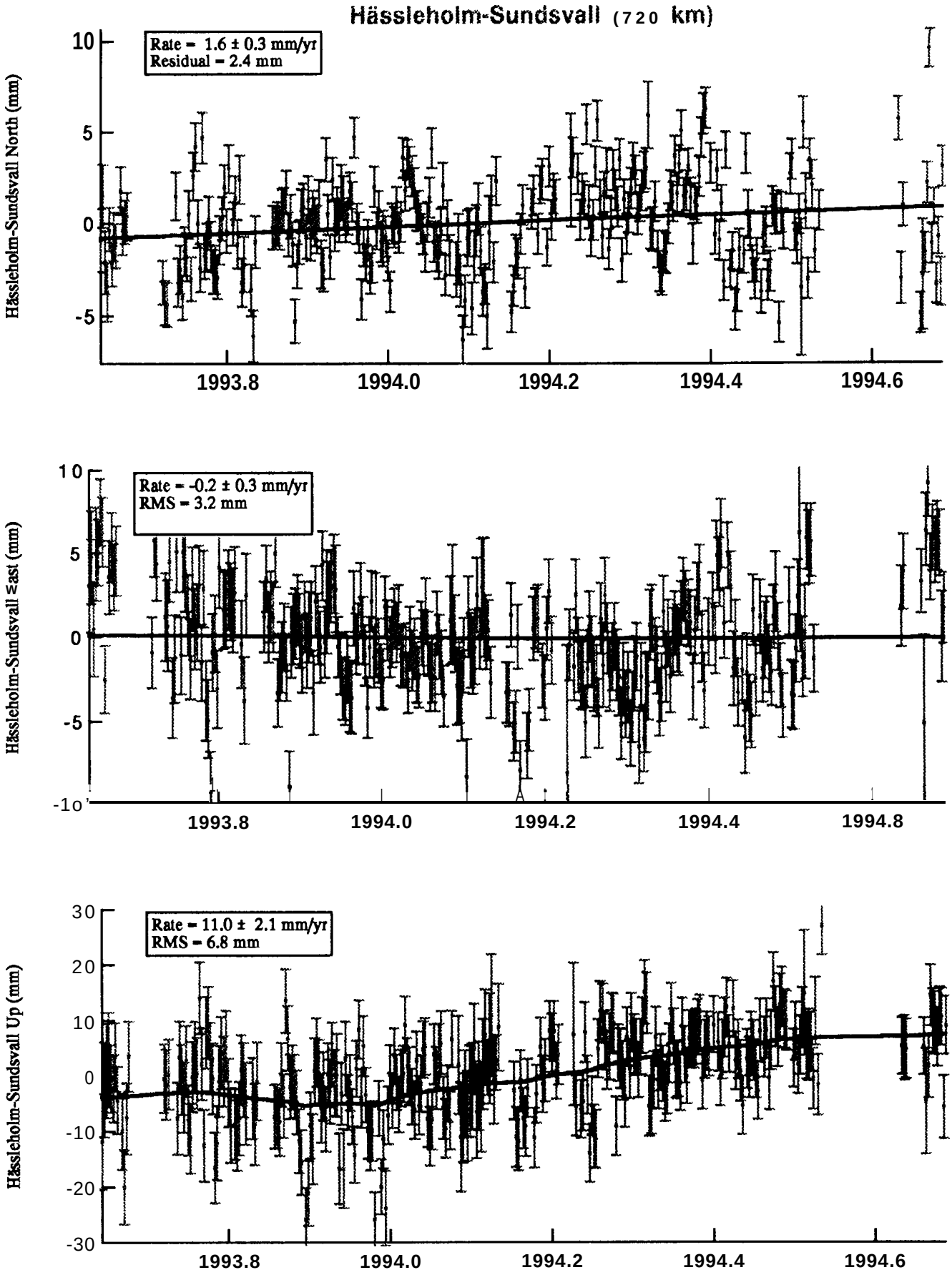
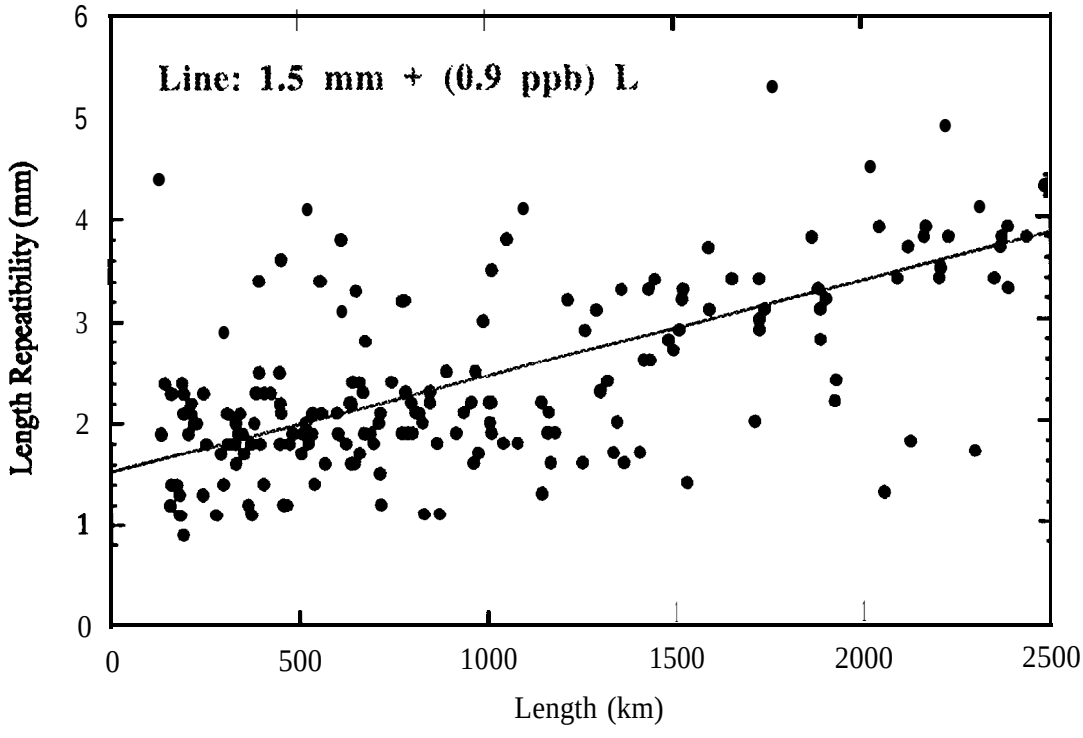
STANDARD **ANALYSIS AND PRODUCTS**



Standard Setup:
Observations down to 15° elevation
Decimation to 240 **second** sample rate


Karesuando
Riksgränsen
Pajala
Vuoggatjämi
Gällivare
Hemavan
Arvidsjaur
Gäddede
Lycksele
Funäsdalen
Sälen
Torsby/Hagfors
Örebro
Växjö
Halmstad
Ronneby
Malmö
Ystad


Hässleholm-Sundsvall (720 km)
Rate = 1.6 ± 0.3 mm/yr
Residual = 2.4 mm
Hässleholm-Sundsvall North (mm)
10
5
0
-5
1993.8
1994.0
1994.2
1994.4
1994.6
Rate = -0.2 ± 0.3 mm/yr
RMS = 3.2 mm
Hässleholm-Sundsvall East (mm)
10
5
0
-5
-10
1993.8
1994.0
1994.2
1994.4
1994.8
Rate = 11.0 ± 2.1 mm/yr
RMS = 6.8 mm
Hässleholm-Sundsvall Up (mm)
30
20
10
0
-10
-20
-30
1993.8
1994.0
1994.2
1994.4
1994.6

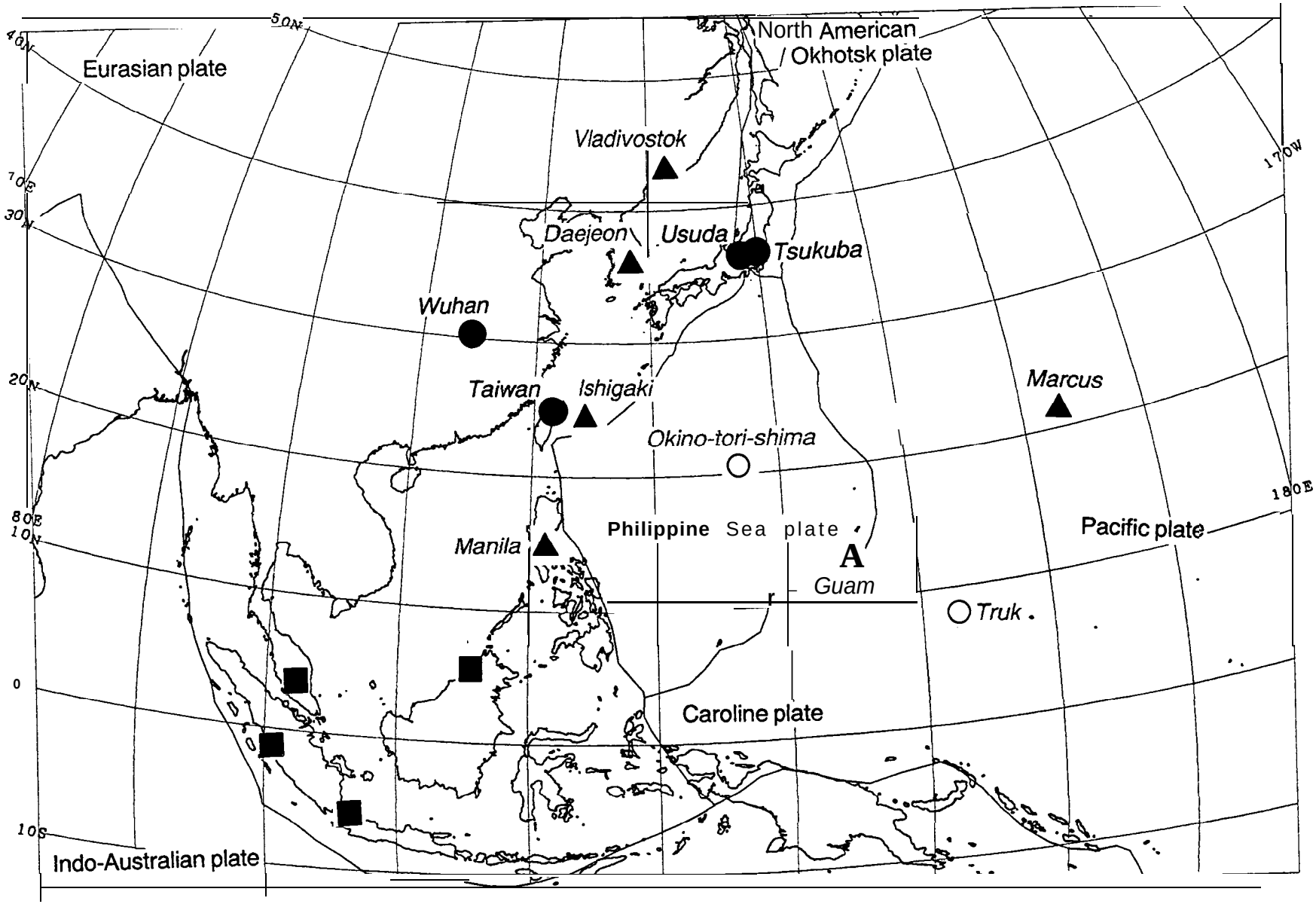

Line: 1.5 mm + (0.9 ppb) L
Length Repeatibility (mm)
0
1
2
3
4
5
6
0
500
1000
1500
2000
2500
Length (km)

Other Contributions to Position Paper 1 Appendix

TERUYUKI KATO

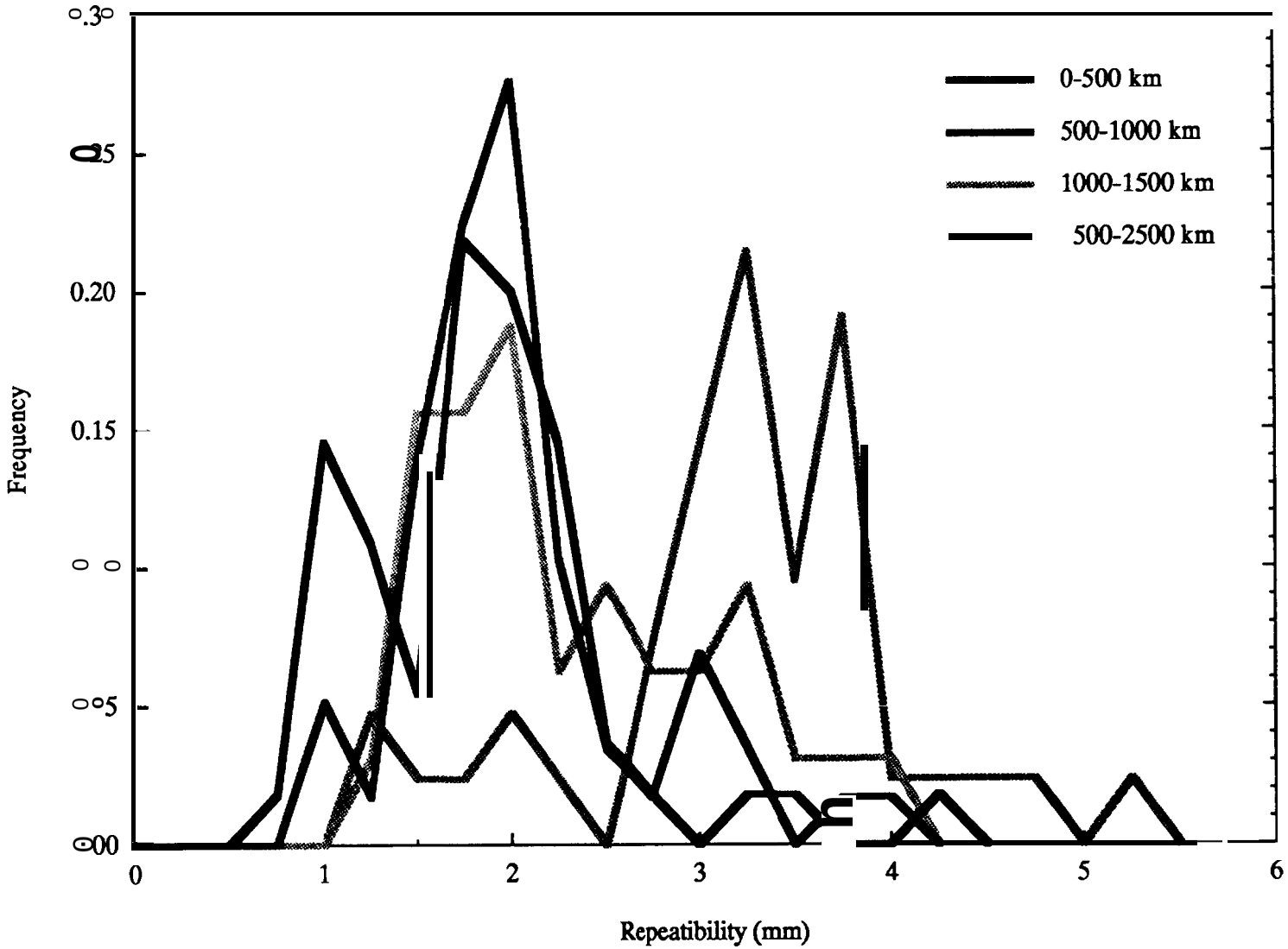
Tokyo University

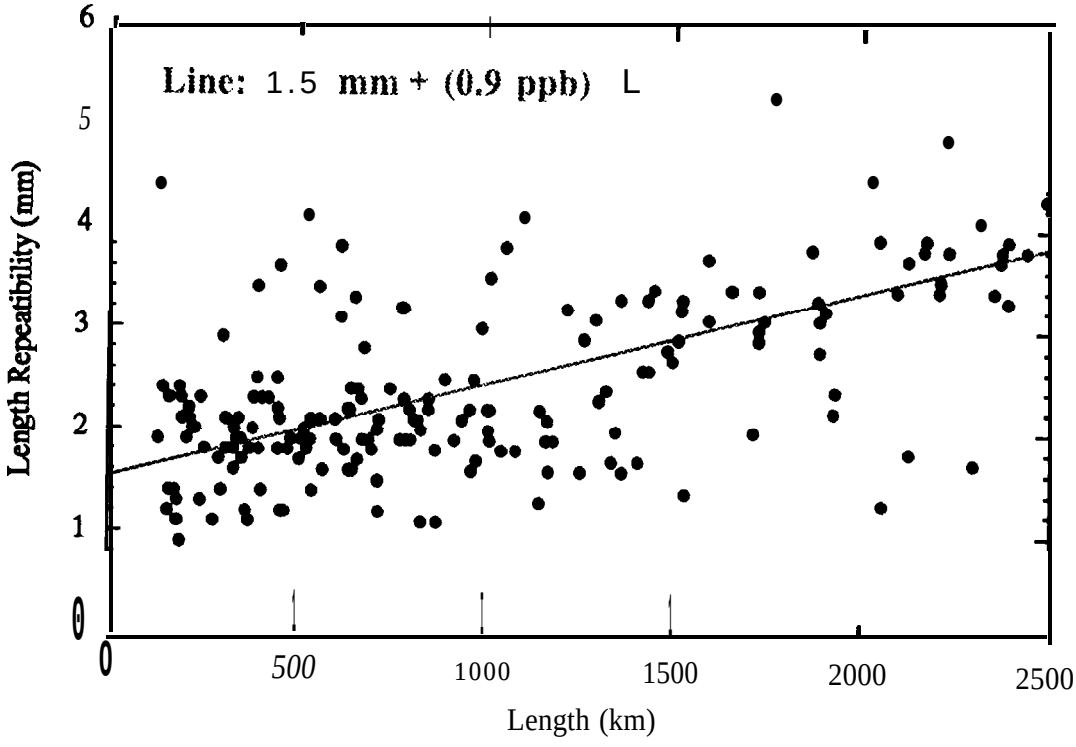
Western Pacific Integrated Network of GPS (WING)



.: IGS/CIGNET operational site ▲: Soon-to-be-operational site

○: Potential site ■: Future plan


0-500 km
500-1000 km
1000-1500 km
500-2500 km
Frequency
Repeatibility (mm)
0
1
2
3
4
5
6
0.20
0.15


Line: 1.5 mm + (0.9 ppb) L
Length Repeatibility (mm)
6
5
4
3
2
1
0
0
500
1000
1500
2000
2500
Length (km)

Other Contributions to Position Paper 1 Appendix

JAN KOUBA

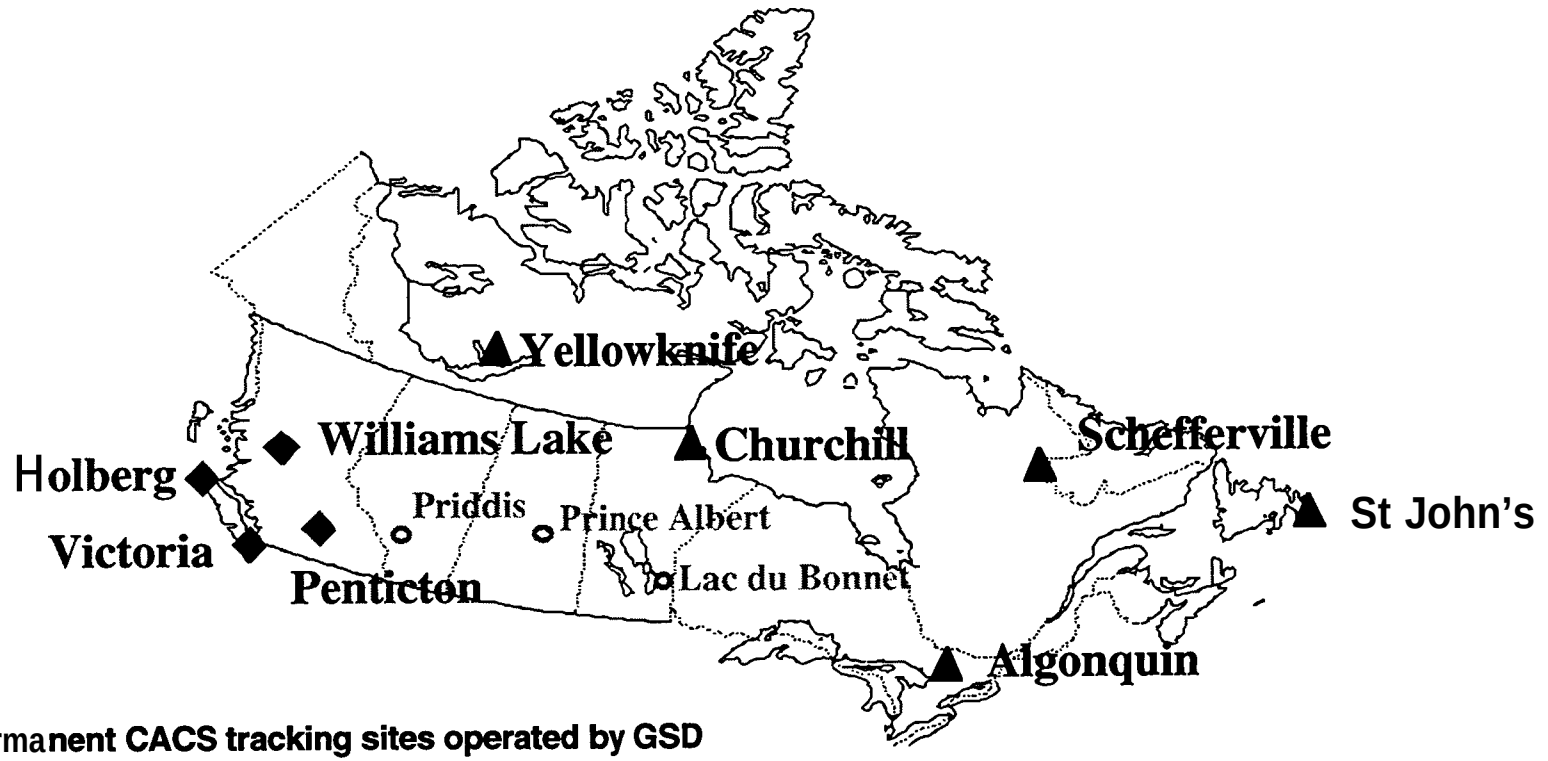
Natural Resources Canada

INTEGRATION OF REGIONAL GPS STATIONS AND NETWORKS IN THE IGS FRAMEWORK

A8

J. Kouba, R. Ferland, P. Héroux and P. Tétreault
Geodetic Survey Division, Natural Resources Canada
Ottawa, Canada
Internet: kouba@geod.emr.ca

Canadian Active Control System Network Configuration



A permanent CACS tracking sites operated by GSD

● Western Canada Deformation Array (WCDA) - sites operated by GSC

o Monumented temporary CACS tracking sites

ITRF INTEGRATION STRATEGIES

Global processing

Includes globally distributed IGS stations.
Estimated EOP, orbits, station coordinates, station and satellite clock parameters.
At cm or ppb precision level

Regional baseline processing

Uses IGS orbits.
Processes regional network using differential carrier phase.
For special geodetic and geodynamic applications.
At mm or ppb precision level.

Point positioning processing

Uses CACS/IGS orbits and clocks.
Processes code and carrier with single point approach.
For wide area positioning and navigation.
Precision currently at the meter level.

Other Contributions to Position Paper 1 Appendix

WOLFGANG SCHLÜTER

Institut fur Angewandte Geodäsie

Permanent GPS-Stations for Densification

Institut für Angewandte Geodäsie

. **Wettzell**

- TI 4100 (Nov. 1987)
- Minimac 2816 (May 1989)
- ROGUE SNR800 (July 1991)

. Ankara

- Minimac 2816 1989

. 7 Turbo Rogues now available

- Replacement
  - Wettzell
  - Ankara
- Installation (global coverage)
  - O'Higgins/Antarctica
  - Lhasa/Tibet
  - 2 in Russia
- Installation WEGNER-Network
  - Cypros
  - Tunesia (Medennine) collab. with IGN & OTC

. more planned for

- futher densification
- installation of a German reference network

. Transportable Integrated Geodetic Observatory

Fundamentalstation Wettzell, Nov. 94

Other Contributions to Position Paper 1 Appendix

SURIYA TATEVIAN

Russian Academy of Sciences

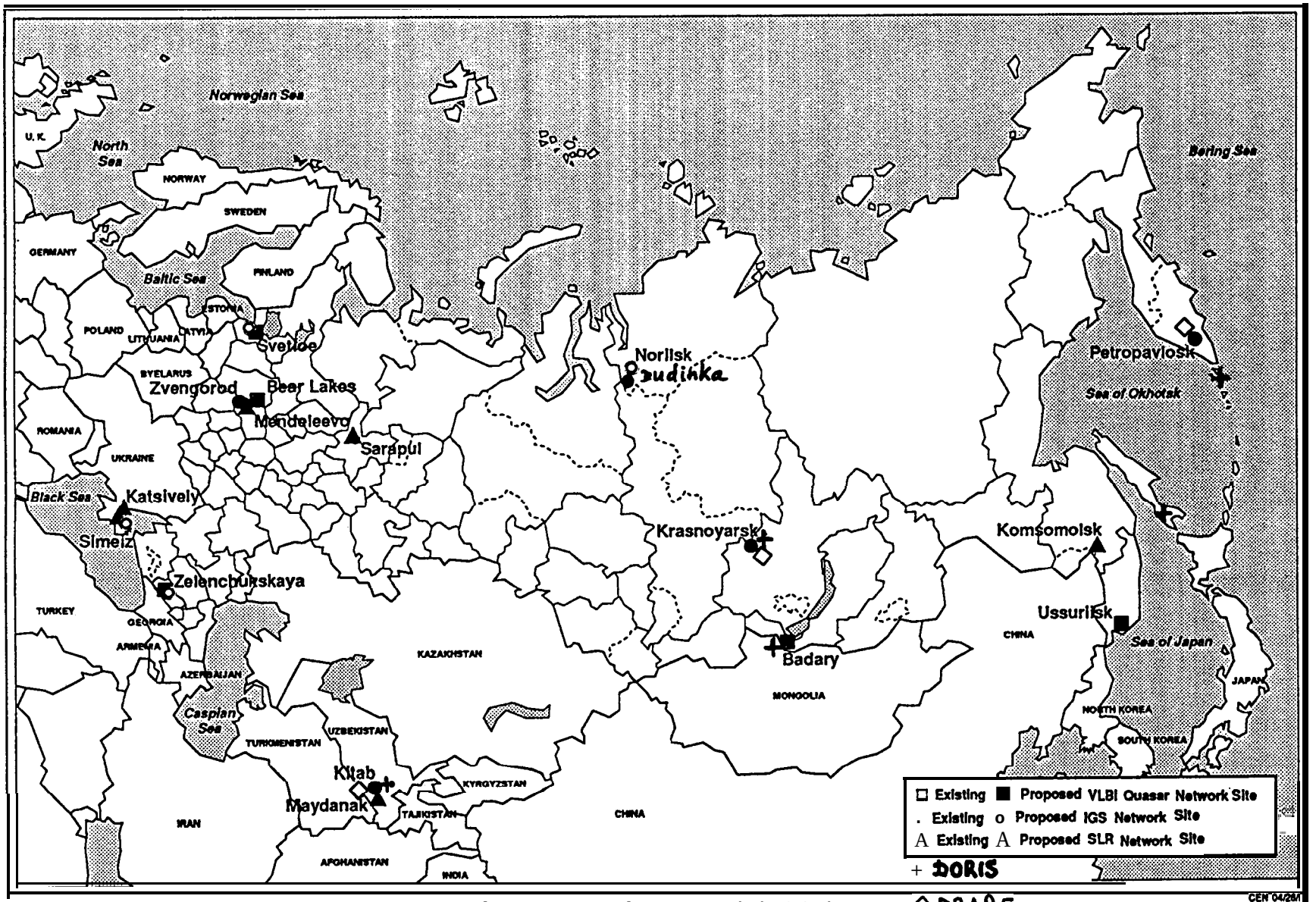


Figure 1. Russian Network (DOSE)

Draft.

CIS Regional Network

IGS Global net.

core stations

T.-Rogachevo — Zvenigorod (48h → 24h) NASA Sc. Internet; Krasnoyarsk (daily when connect. to N.Sc. Int.); Kitab (INMARSAT); Dudinka (E-M) — GFZ - Analys. Center

fiducial sites (IGS densified network)

T.-Rogachevo Petropavlowsk (candidate for the core st.)
Zelenchukskaya (WEGENER) - Quasar.
Simeiz (IGS-91,92) - SLR, VLBI
Svetloe (IGS-91.92) - Quasar
Mendeleevo (State Time Service)
Irkutsk (State Time Service)
Maydanak (SLR)

special local and regional networks

- Tienchan - Pamir Project
- N-W Pacific area (Sakhalin - Kamchatka)
- sites of Federal Geodetic Survey
- Caspian - sea geodynamics

oth....

IGS epoch campaigns.

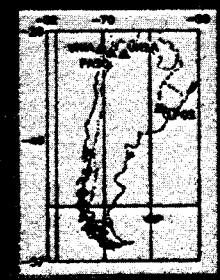
Type 1 Associate Analysis Center (T1's) - „R-SINEX"
IGS orbits, GFZ-data
[Institute of Astronomy, RAS and Moscow Geodetical Univ.]

Other Contributions to Position Paper 2 Appendix A

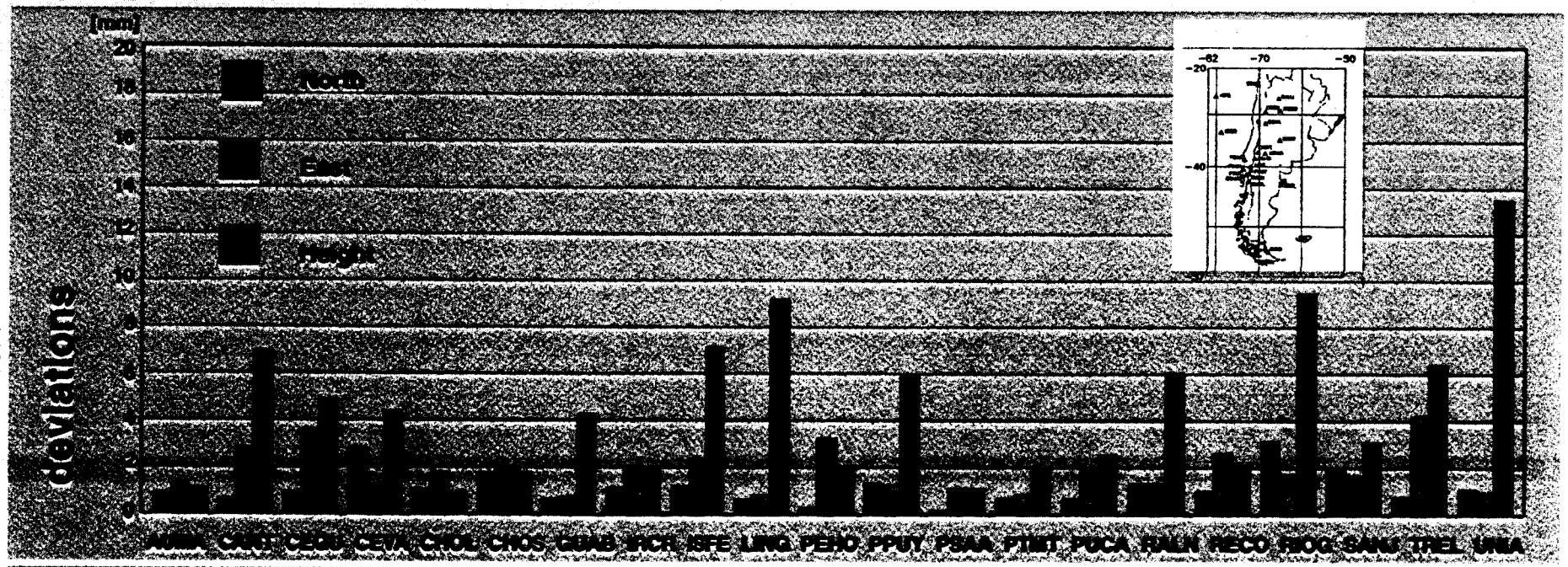
DETLEF ANGERMANN

GeoforschungsZentrum Institute

SAGA 93
Repeatability of global coordinates



SAGA 94
Repeatability of network components



Comparison of the network geometry of one 3-day-session of SAGA 94. All station coordinates are computed without constraints as daily solutions with fixed IGS orbits and ERP from GFZ. Shown are the mean residuals of a Helmert-transformation of the daily solutions to the campaign solution.

Campaigns

SAGA '93
27.10. – 07.11

800 km W–E
Latitude S 22° – S 27°
600 km N–S

24 Trimble SSE

72 sites
24 teams
66 participants
4 sessions á 3 days

▼

60 – 70 h
observation per site

17 Mio. observations

RED AUSTRAL '94
17.01. – 17.02

500 km W–E
Latitude South of S 42°
1700 km N–S

22 Trimble SSE
11 from UNAVCO
11 from GFZ

41 sites

4 sessions á 7 days

▼

31 Mio. observations

SAGA '94
08.03. – 31.03

1 000 km W–E
Latitude S 27° – S 43°
2 000 km N–S

34 Trimble SSE

102 sites
32 teams
82 participants
4 sessions á 3 days

▼

52 – 67 h
observation per site

27 Mio. observations

Other Contributions to Position Paper 2 Appendix A

DETLEF ANGERMANN

GeoforschungsZentrum Institute

Analysis Strategy

- Processing is performed with the GFZ Software EPOS (Earth Parameter & Orbit System) on the basis of daily solutions, sessionwise and campaignwise
- The network data processing is carried out in form of a regional and a global dynamic computation
  - For the regional network analysis the IGS orbit and ERP solutions from GFZ are fixed. All station coordinates are solved without constraints.
  - The global dynamic solution is performed simultaneously with the IGS core network data. The reference system is defined by the coordinates of the IGS core stations.

Partner Institutions

Chile

- Instituto Geografico Militar de Chile
- Armada de Chile
- Departamento Geofisico de Universidad de Chile
- Universidad de Antofagasta
- Centro de Estudio Espaciales

Argentina

- Observatorio Astronomico Universidad La Plata
- Instituto Geonorte, UN Salta
- Instituto of Enviromental Studies, Universidad de Mendoza
- Instituto Nacional de Prevencion Sismica, San Juan
- Direccion de Tierras de Neuquen
- Direccion de Catastro de Neuquen
- Instituto Geográfico Militar Argentina
- Instituto de Fisica, UN Tucuman

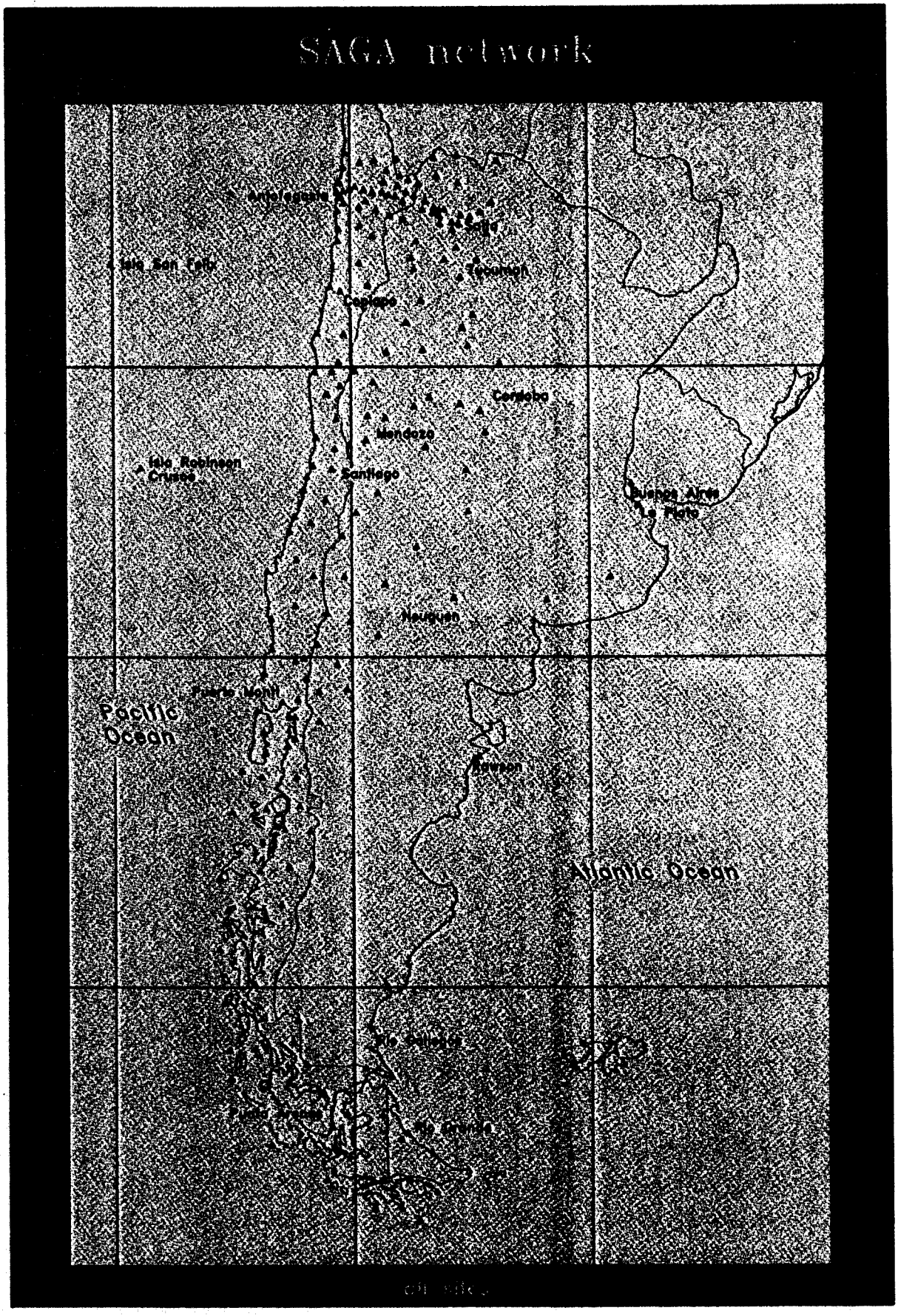
Partner Institutions

Chile

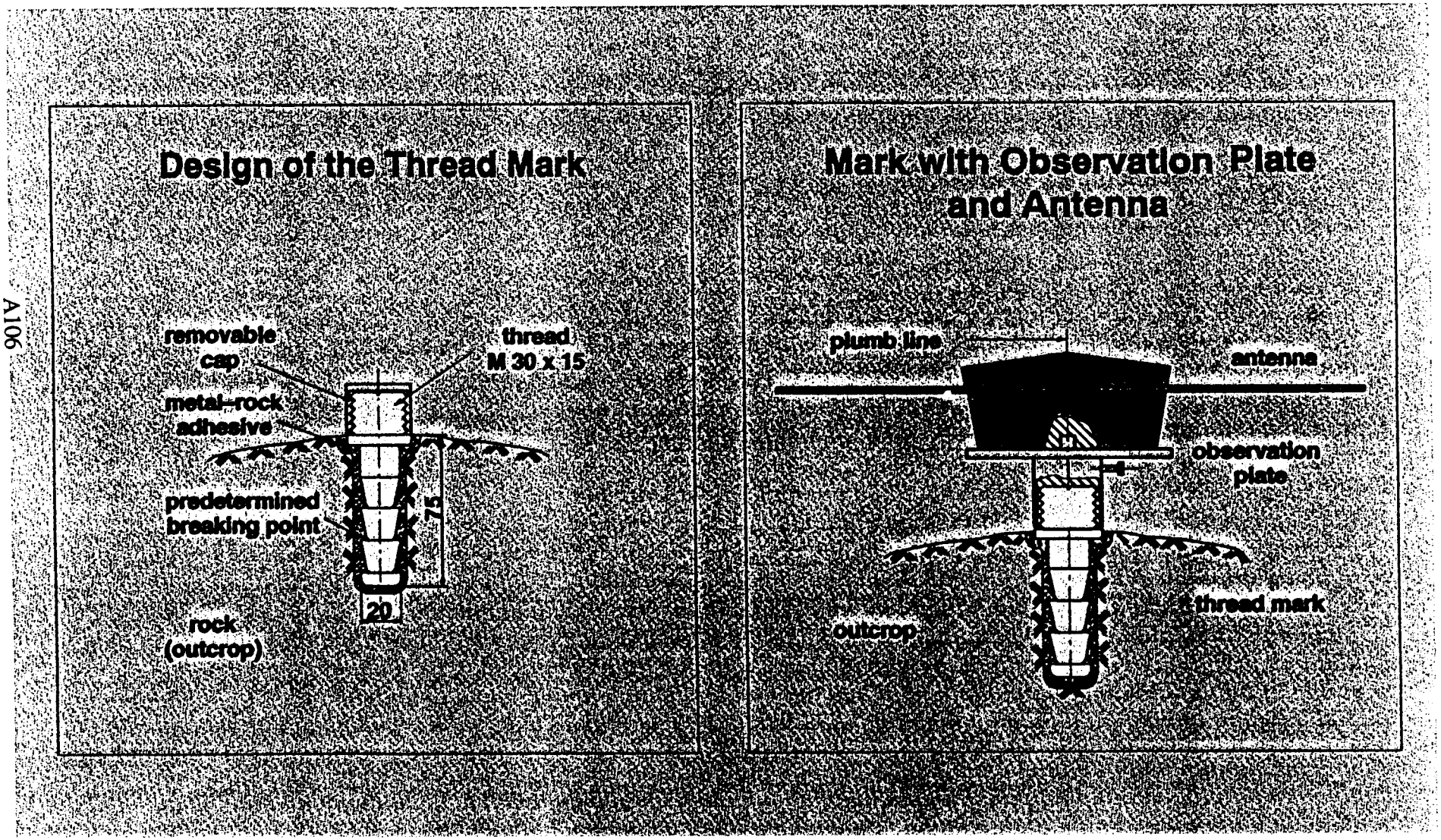
- Instituto Geografico Militar de Chile
- Armada de Chile
- Departamento Geofisico de Universidad de Chile
- Universidad de Antofagasta
- Centro de Estudio Espaciales

Argentina

- Observatorio Astronomico Universidad La Plata
- Instituto Geonorte, UN Salta
- Instituto of Enviromental Studies, Universidad de Mendoza
- Instituto Nacional de Prevencion Sismica, San Juan
- Direccion de Tierras de Neuquen
- Direccion de Catastro de Neuquen
- Instituto Geográfico Militar Argentina
- Instituto de Fisica, UN Tucuman


SAGA network
Isla San Felix
Copiapo
Cordoba
Mendoza
Isla Robinson Crusoe
Santiago
Buenos Aires
La Plata
Neuquen
Puerto Montt
Pacific Ocean
Atlantic Ocean

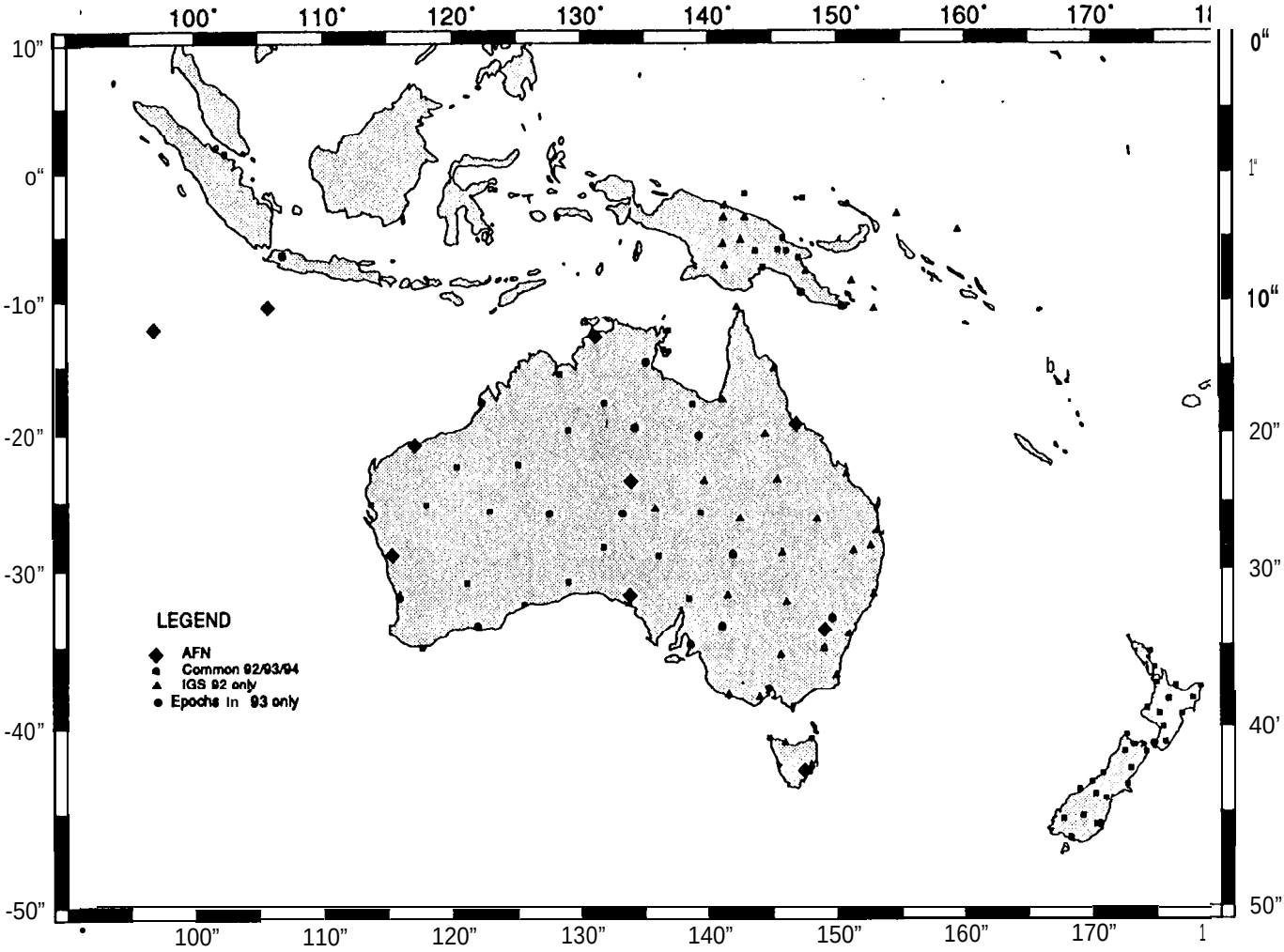
Monumentation



Other Contributions to Position Paper 2 Appendix A

PETER MORGAN

University of Canberra

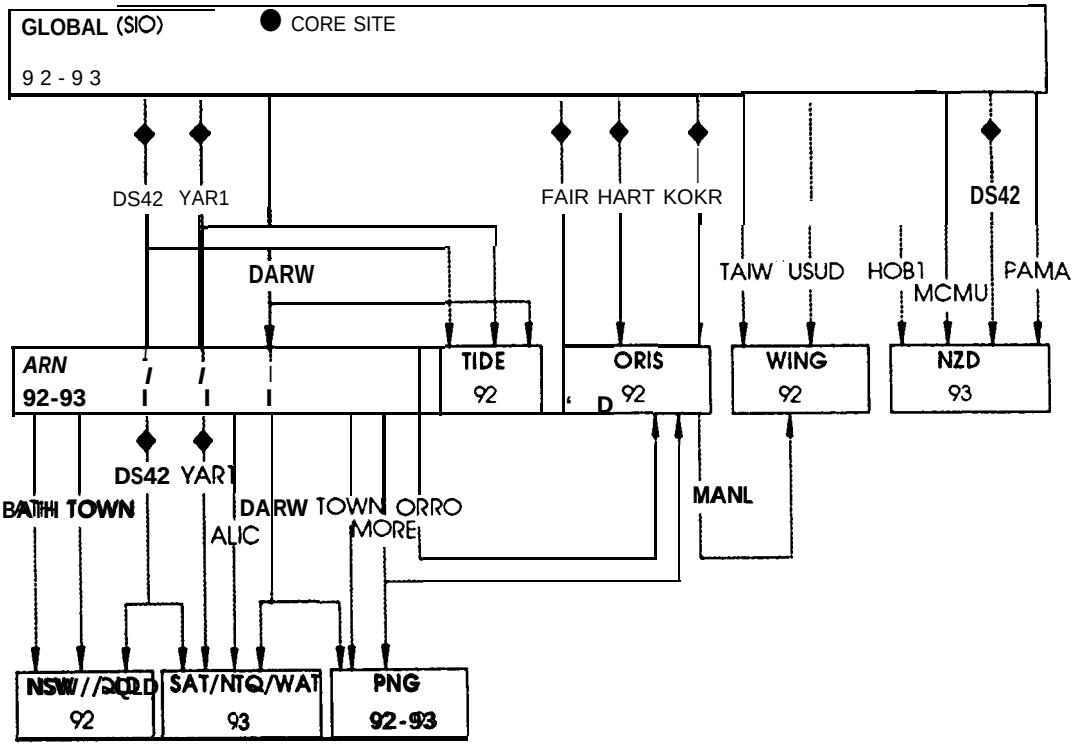

100°
110°
120°
130°
140°
150°
160°
170°
10"
0"
-10"
-20"
-30"
-40"
-50"
LEGEND
AFN
Common 92/93/94
IGS 92 only
Epochs in 93 only

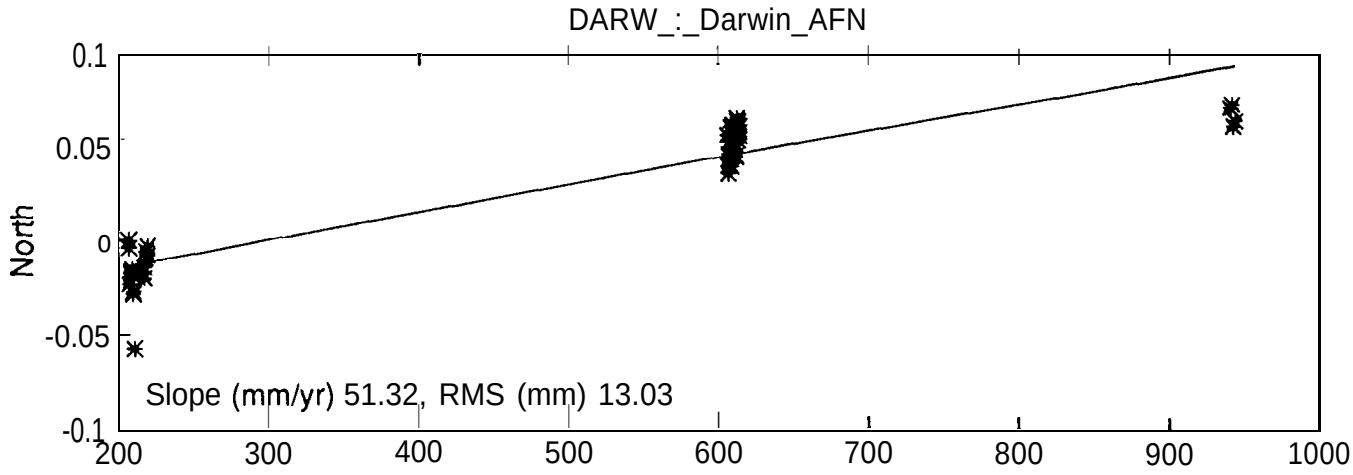
Some Important Issues

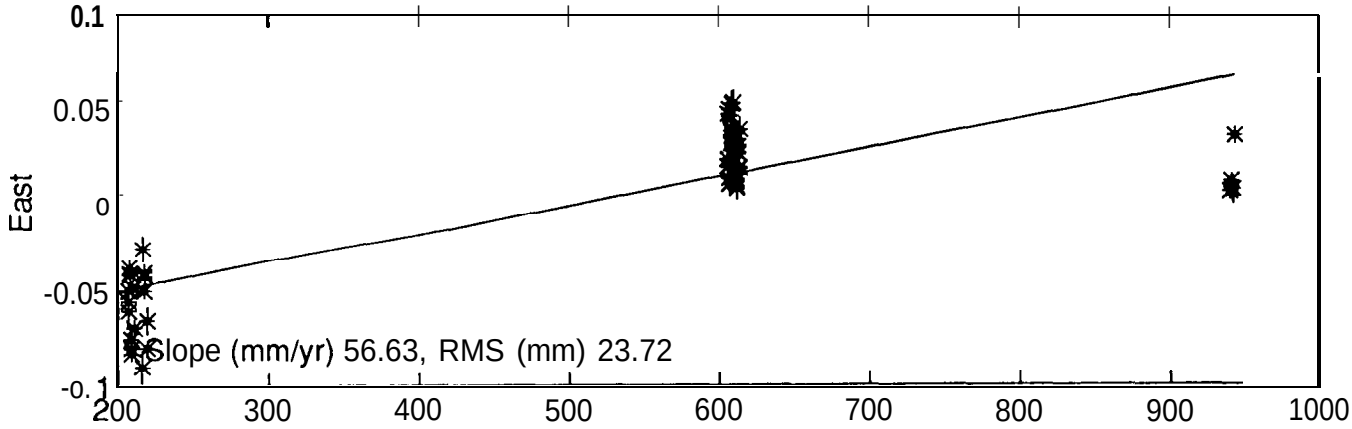
- How are the connections made between the levels eg GLOBAL → REGIONAL + LOCAL

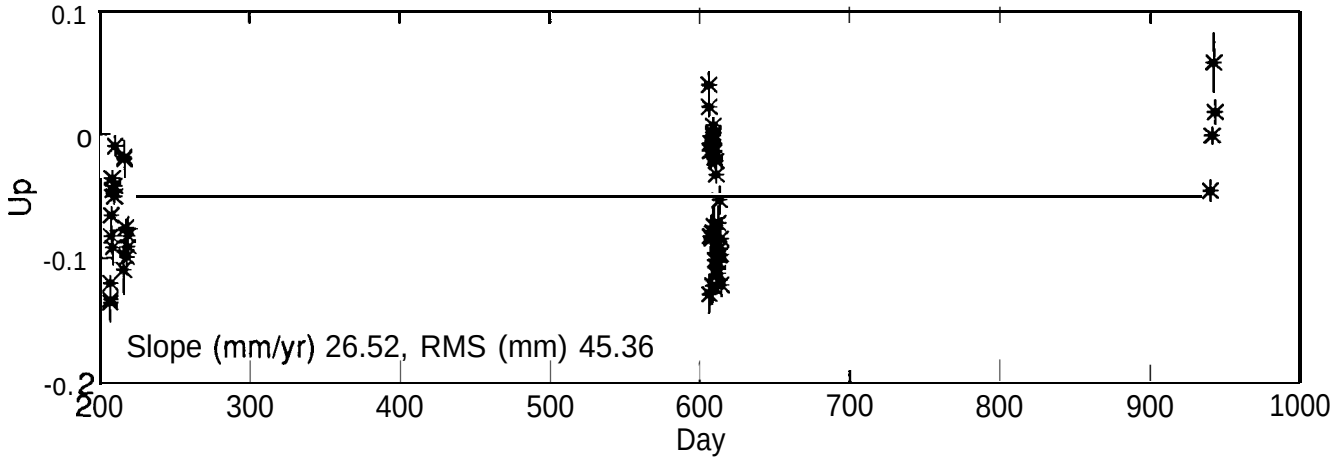
- What technical specifications are appropriate
  - antennas
  - permanent vs episodic
  - pillars vs tripod set ups
  - level of modelling [tides, atmosphere etc]

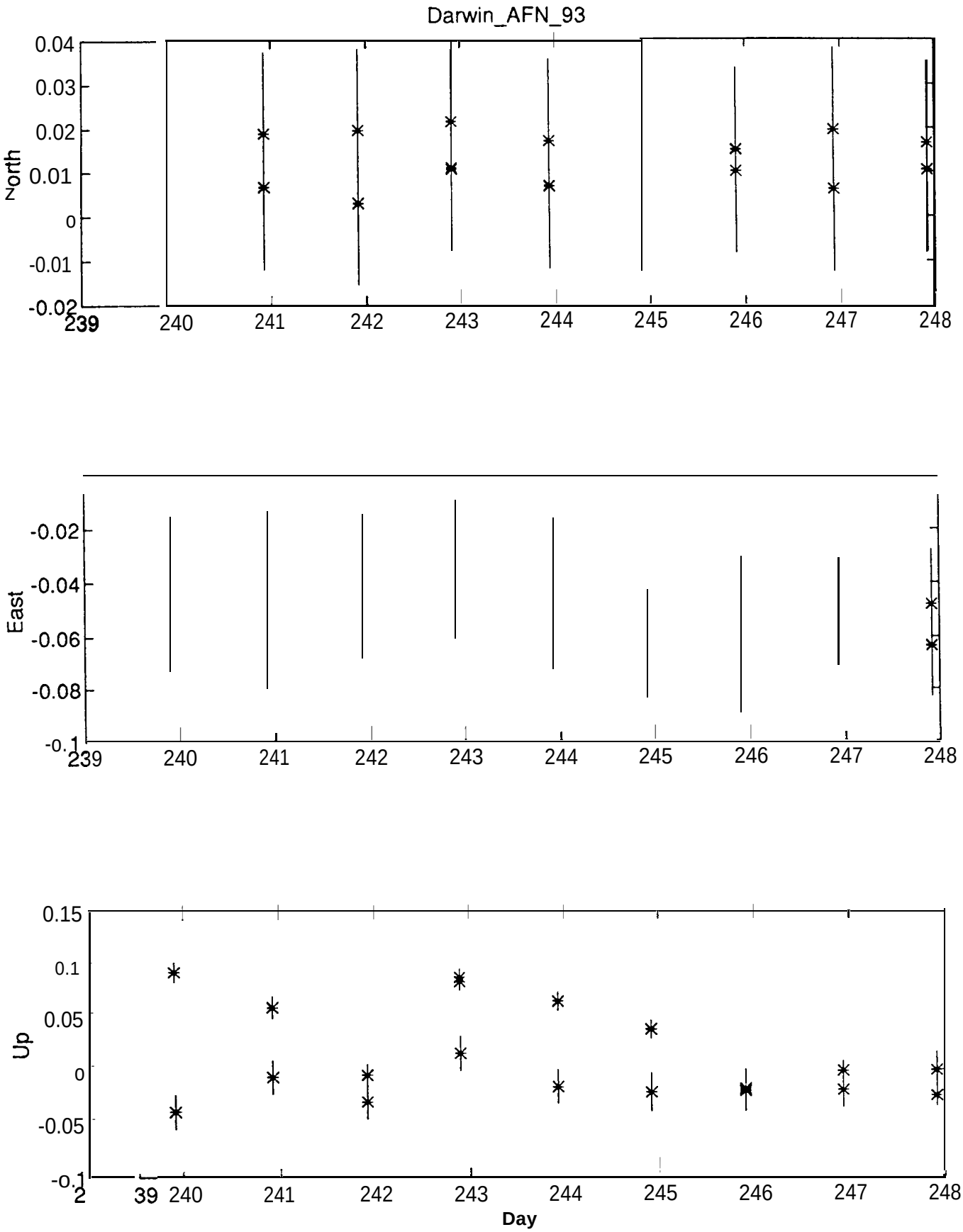
- What level of agreement is required between the networks at the tie points.

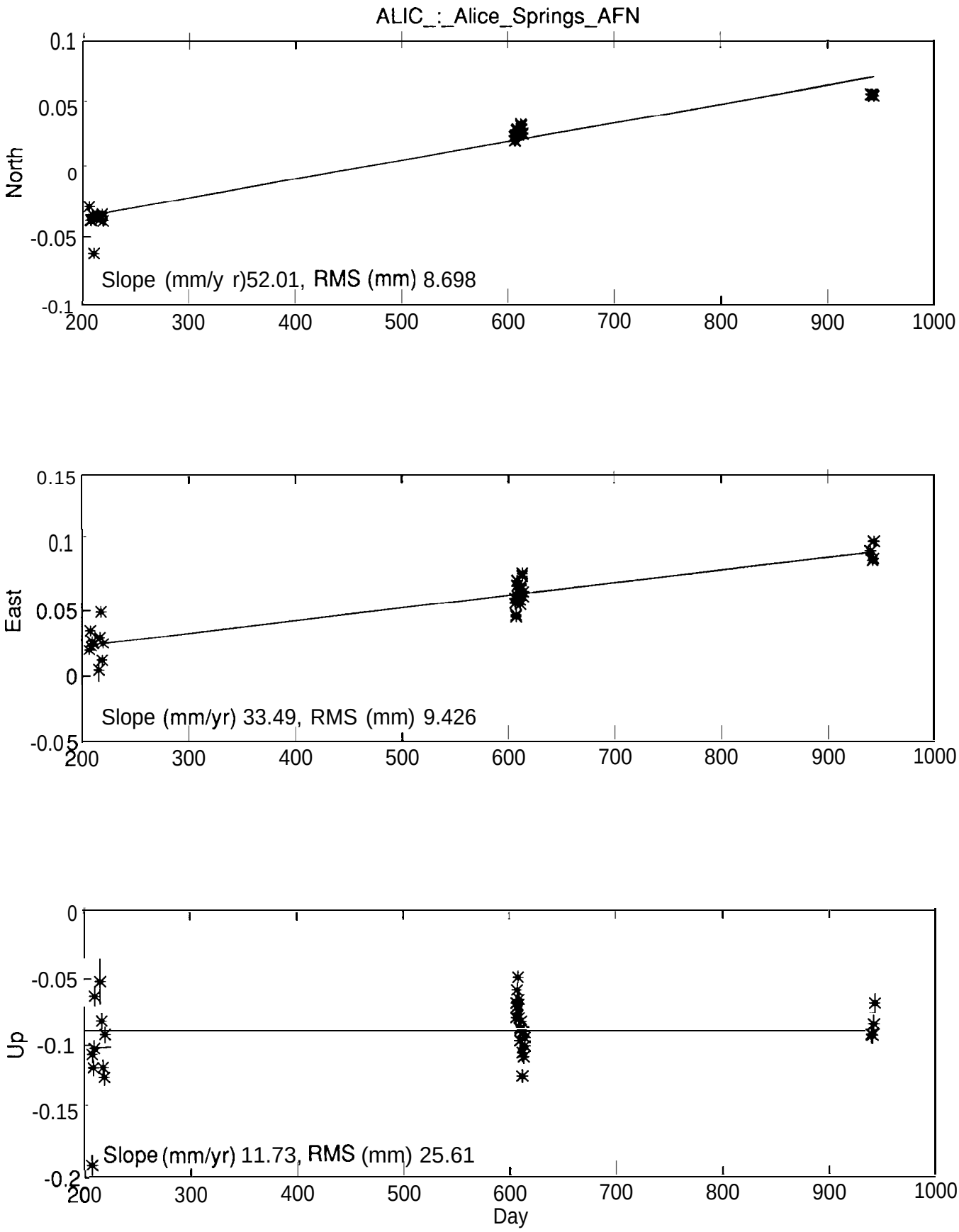

GLOBAL (SIO)
CORE SITE
92-93
DS42
YAR1
FAIR
HART
KOKR
DS42
DARW
TAIW
USUD
HOB1
MCMU
PAMA
ARN
92-93
TIDE
92
ORIS
92
WING
92
NZD
93
DS42
YARI
BATH
TOWN
DARW
TOWN
ORRO
ALIC
MORE
MANL
NSW/QLD
92
SAT/NTQ/WAT
93
PNG
92-93

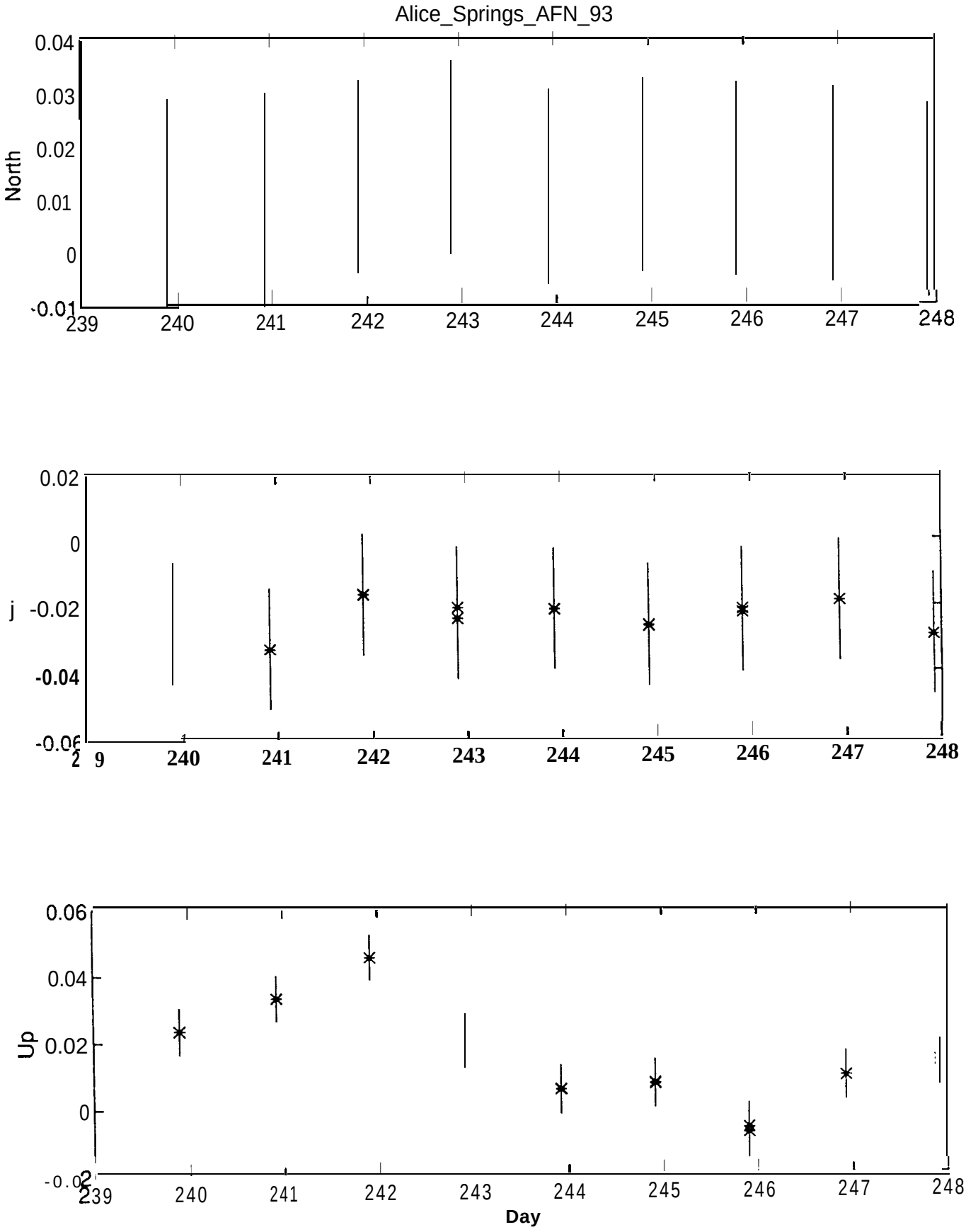

DARW_:_Darwin_AFN
North
Slope (mm/yr) 51.32, RMS (mm) 13.03
0.1
0.05
0
-0.05
-0.1
200
300
400
500
600
700
800
900
1000

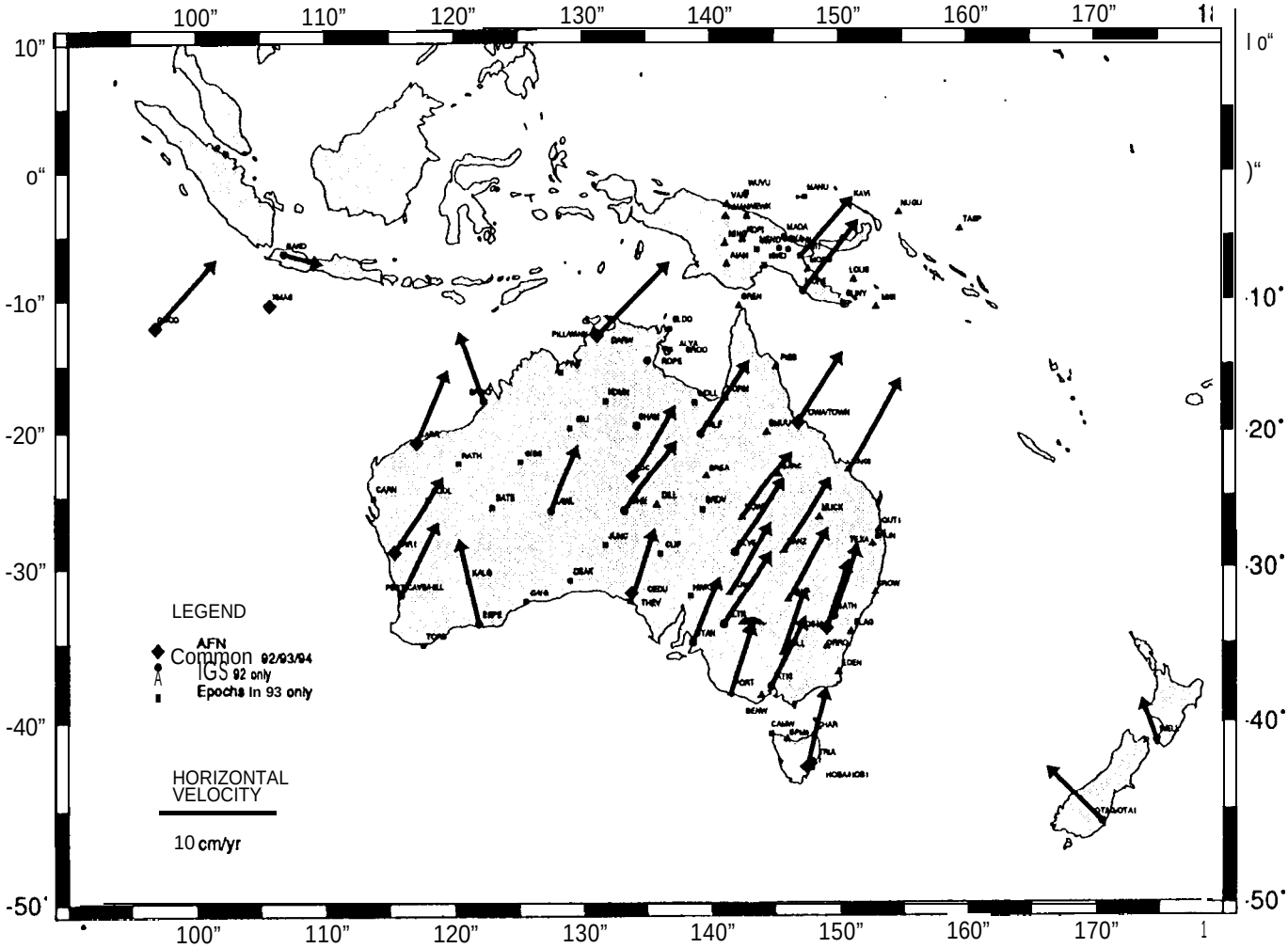

East
Slope (mm/yr) 56.63, RMS (mm) 23.72
0.1
0.05
0
-0.05
-0.1
200
300
400
500
600
700
800
900
1000

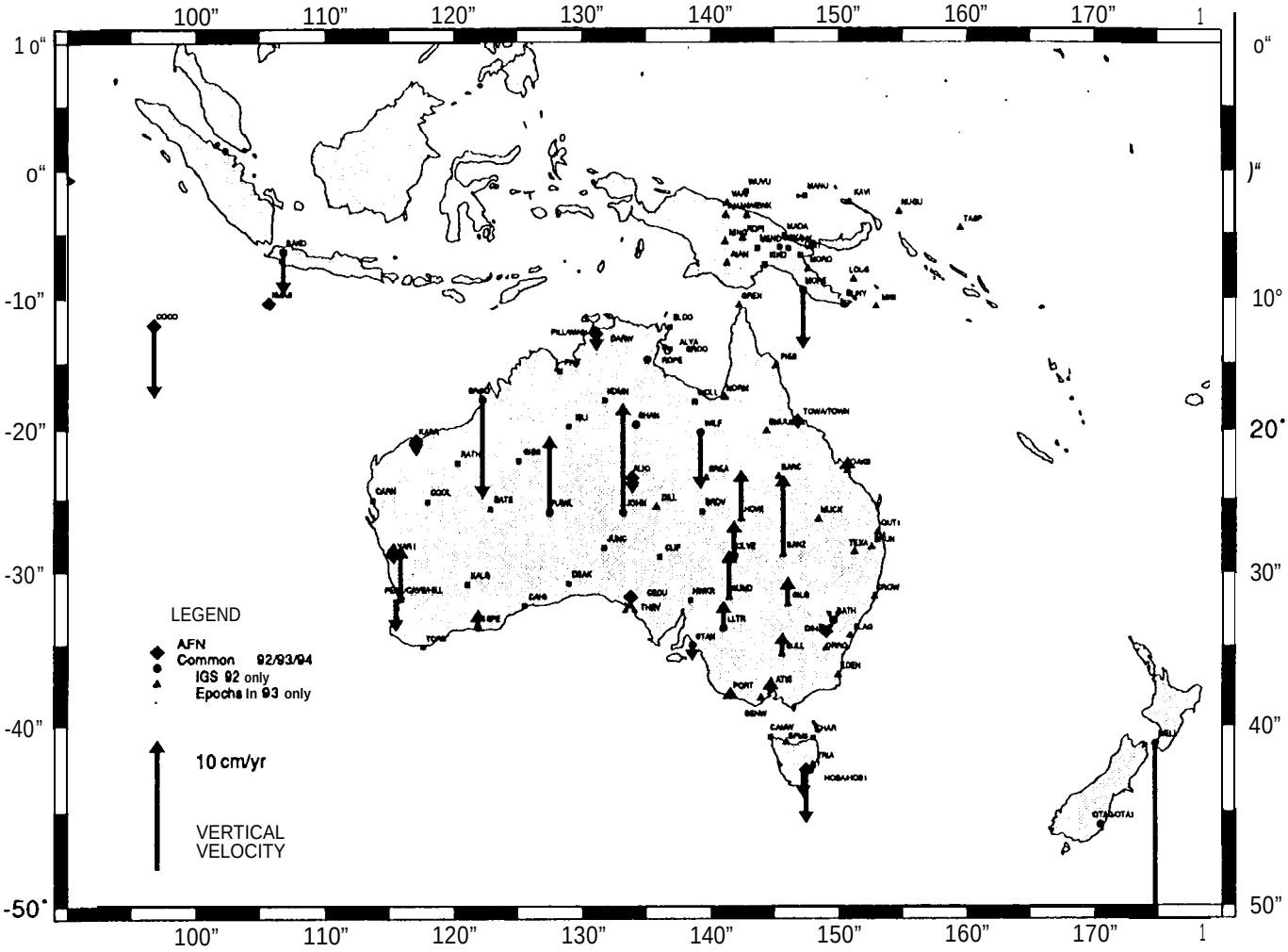

Up
Slope (mm/yr) 26.52, RMS (mm) 45.36
0.1
0
-0.1
-0.2
200
300
400
500
600
700
800
900
1000
Day


Darwin_AFN_93
North
East
Up
Day
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.04
-0.06
-0.08
-0.1
0.15
0.1
0.05
-0.05
239
240
241
242
243
244
245
246
247
248

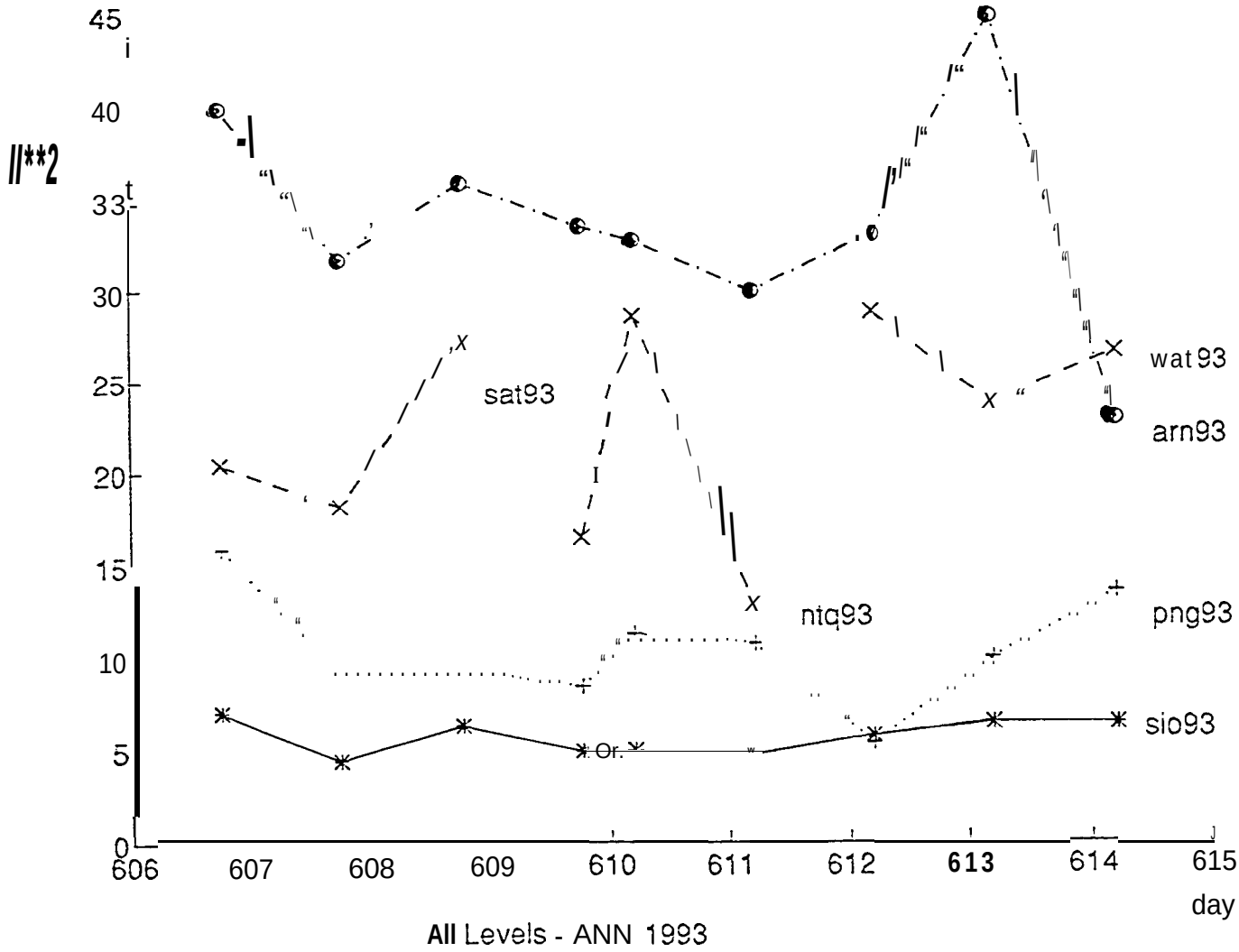

ALIC_:_Alice_Springs_AFN
North
Slope (mm/y r)52.01, RMS (mm) 8.698
East
Slope (mm/yr) 33.49, RMS (mm) 9.426
Up
Slope (mm/yr) 11.73, RMS (mm) 25.61
Day


Alice_Springs_AFN_93
North
0.04
0.03
0.02
0.01
0
-0.01
239
240
241
242
243
244
245
246
247
248
j
0.02
0
-0.02
-0.04
-0.06
Up
0.06
0.04
0.02
0
-0.02
Day


100”
110”
120”
130”
140”
150”
160”
170”
10”
0“
-10”
-20”
-30”
-40”
-50”
LEGEND
AFN
Common 92/93/94
IGS 92 only
Epochs in 93 only
HORIZONTAL
VELOCITY
10 cm/yr


100”
110”
120”
130”
140”
150”
160”
170”
1 0“
0“
-1o”
-20”
-30”
-40”
-50°
10°
20°
30”
40”
50”
LEGEND
AFN
Common 92/93/94
IGS 92 only
Epochs in 93 only
10 cm/yr
VERTICAL
VELOCITY

	X	Y	Z
DS60	039	026	-035
SANT	-018	107	-140
ALGO	-005	023	-024
YELL	-006	-027	068
DS1B	-086	031	-075
DS10	-037	-010	-007
FAIR	-014	-009	034
KOKR	-004	"002	002
DS42	054	032	-044
YAR1	-089	103	-118
HART	-171	112	-118
TROM	009	003	025
WTZ1	-009	038	-046
KOSG	-006	-001	-008



All Levels - ANN 1993

Other Contributions to Position Paper 2 Appendix A

SUSANNA ZERBINI

University of Bologna

WHAT-A-CAT project
West Hellenic Arc Tectonics
And
Calabrian Arc Tectonics

- DGFI, Munich

- Dept. of Physics, Univ. Bologna
  and other Italian Institutions

- ETH, Zürich
  Inst. for Geodesy and Photogrammetry

- NTU, Athens
  Dionysos Satellite Observatory

Depa me Ph
U e ty B og a

SITE	1987 MAY OCTOBER TI WM TRI	1988 EPTEMBER TI MINIM	1989 JUNE SEPTEMBER TI WM MIN	1990 JUNE TI WM MIN	1991 SEPTEMBER WM	1992 SEPTEMBER RO WM LE	1993 MARCH SEPTEMBER LE200
MEDICINA							X
WETTZELL	X	X	X	X	X		
BASOVIZZA			X		X		
NAPOLI				X		X	
MATERA	X	X	X	X	X	X	X
PUNTA SA MENTA		X	X	X	X	X	X
SPECCHIA C.			X	X	X	X	X
STROMBOLI	X			X		X	X
USTICA		X		X		X	
PORO	X			X			
PANAREA	X			X			
LIPARI	X			X			
VULCANO	X			X			
MILAZZO	X	X		X			
ELIA	X			X		X	
PACE	X			X			
FOSSA	X			X			
DINNAMARE	X						
S. APOSTOLI	X						
P. ARENA	X						
M. SCRISI	X						
F. SPURIA	X						
MILO		X		X			
NOTO		X	X	X			
PANTELLERIA		X		X			
GOZO				X			
MALTA				X			
LAMPEDUSA	X	X	X	X			
KARITSA			X				
OTHONOI			X	X			
CHANIA TEROVOU			X				
PANTOKRATOR			X	X		X	X
AGIOIS MATHEOS			X	X		X	
PARGA			X	X		X	
GAIOS			X	X		X	
KARPENISSI			X				
VONITSA			X				
KAVALLOS			X	X		X	
LEPENOU			X	X			X
MYTICAS			X				X
VASILIKI			X	X			X
ASTAKOS			X				X
EXOGI			X	X			X
KALLITHEA			X				X
ASSOS			X	X			X
MESSOLONGI			X				X
SARAKINIKO			X	X	X	X	X
KAMINARATA			X	X	X		X
LAKITHRA			X				X
TSARKASIANOS			X	X		X	X
LAKA			X				X
SKINARI			X	X	X		X
SANDOMERI			X		X		X
CHLEMOUTSI			X				X
KASSIDIARI			X	X			X
LOGOS			X				X
DOXA			X				X
DIONYSOS			X				X
ZAHARO			X				X
AETOS			X				X
STROPHADES			X				X
CHRISOKELLARIA					X		X
SPARTA							
GEROUIMENAS							
MONEMVASSIA							
KHYTIRA							
ROUMELI							
GAVDHOS							
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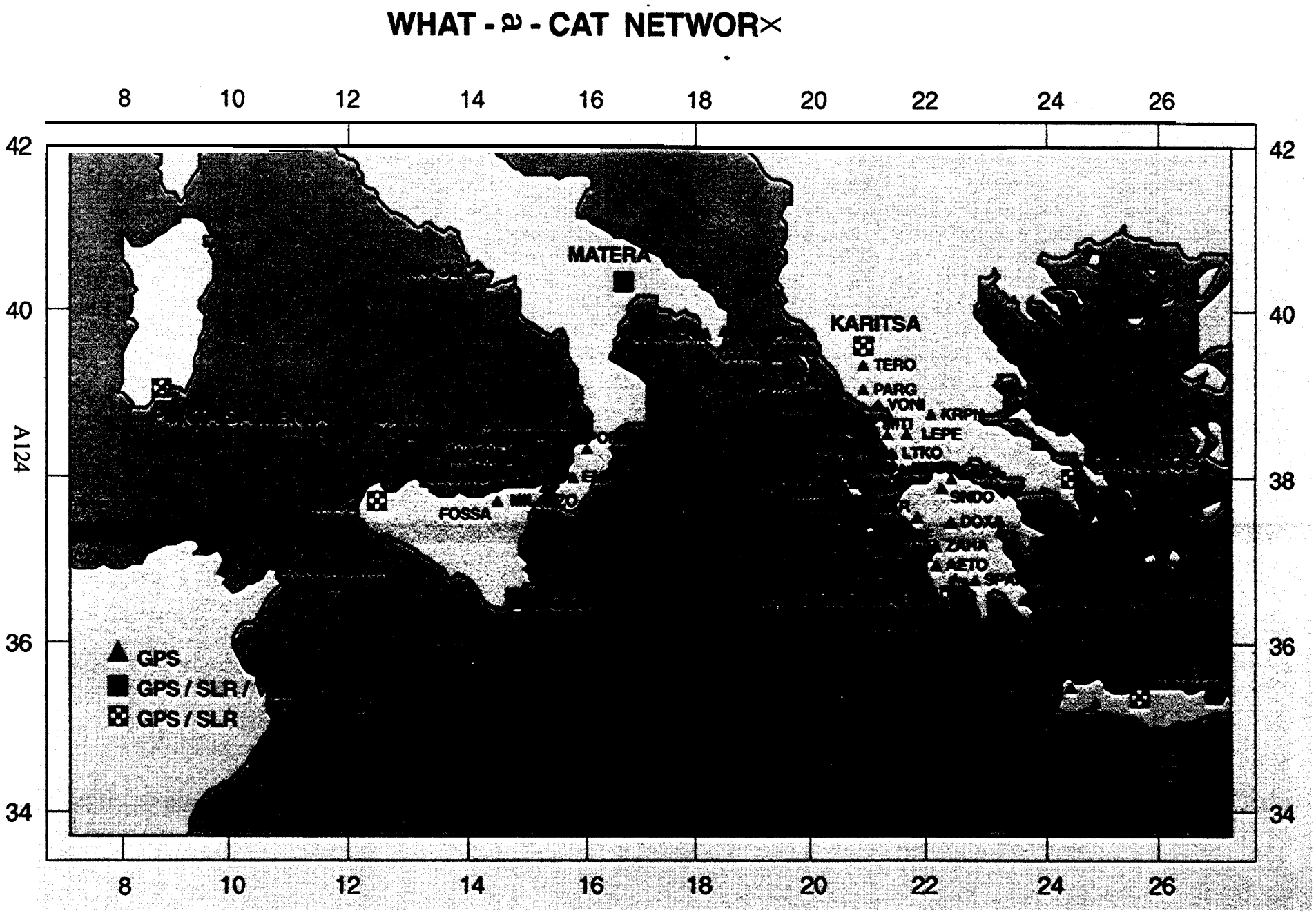
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GPS / SLR

SELF PROJECT

The SELF **Project** (SEa Level **Fluctuations:** geophysical interpretation and environmental impact) **is** funded by the CEC in the framework of the Environment **Programme.**

THE PARTICIPATING INSTITUTIONS ARE:

- University of Bologna, Italy
  Prof. Susanna Zerbini, Coordinator of the Project
- **ETH** Zurich, Switzerland
  Prof. Mans 6. Kahle
- **NTU** Athens, **Greece**
  Prof. George Veis
- **IFAG** Frankfurt, Fed. Rep. of Germany
  Dr. Bernd Richter
- **Proudman** Oceanographic{ Lab., **Birkenhead,** UK
  Dr. Trevor Baker
- Inst. Meteorology and Water Management, **Gdynia,** Poland
  Dr. Marzenna Sztobryn

A125

Department **of Physics**
University of Bologna

OBJECTIVES OF THE PROJECT:

- To select, in the Mediterranean region, fiducial reference stations and well established tide gauges and to provide GPS links between the fiducial stations and the tide gauges;

- To improve GPS measurement procedures by using Water Vapor Radiometers to reduce vertical uncertainties to 1 cm for baselines greater than 100 km;

- To perform measurements of absolute-g both at fiducial sites and tide gauge to monitor, with an independent system, vertical surface elevation changes;

- To perform, in selected areas of the Mediterranean basin, observations of geologic sea level markers of the past;

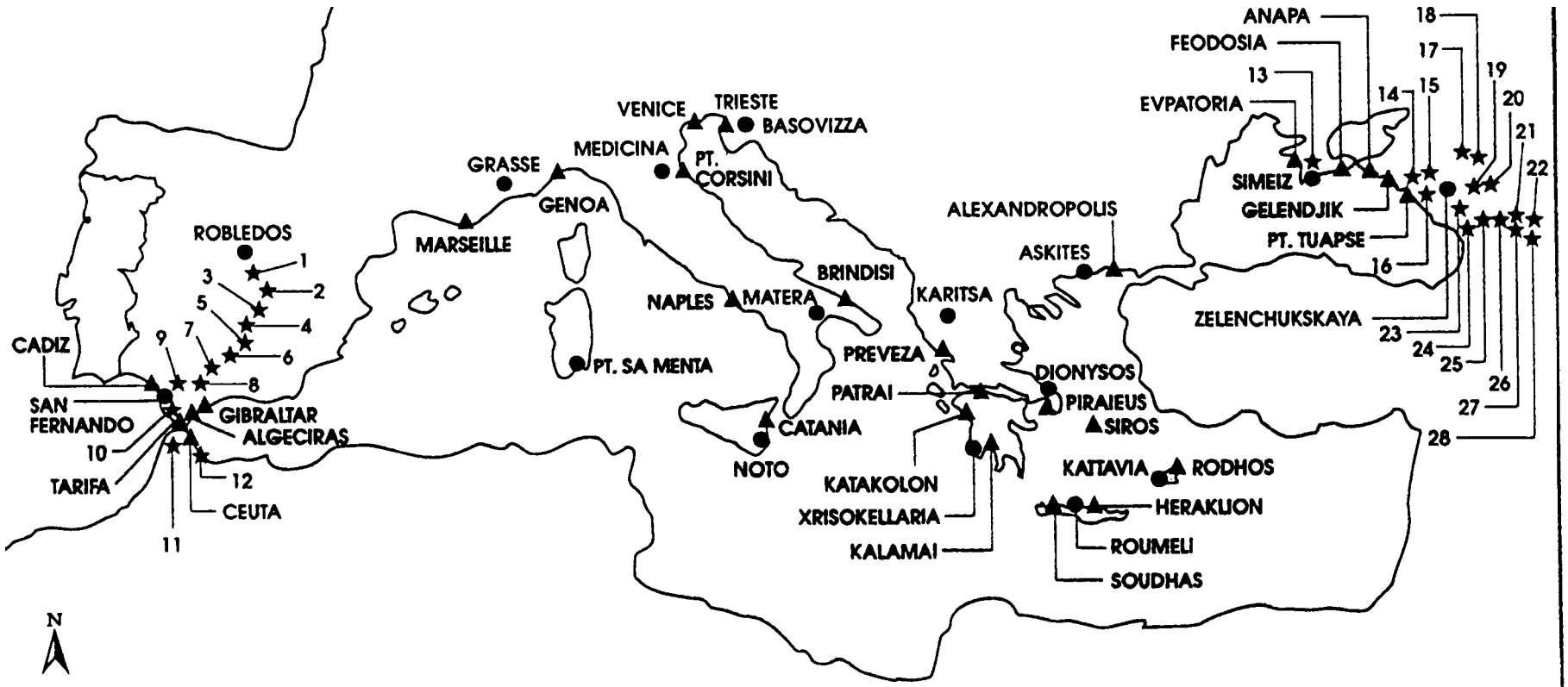
- To collect, analyze and interpret tide gauge data;

- To develop realistic models for tidal loading and tectonics in the Mediterranean region;

- To define corrections for the Earth's surface deformation due to exogenic causes and to study long-term variability of relative sea level.

Dipartimento di Fisica
University di Bologna

SELF PROJECT



● SLR/VLBI STATIONS

▲ TIDE GAUGES

★ ADDITIONAL GPS SITES:

1) Valparaiso
2) Carboneras
3) Palo
4) Brazatortas
5) Eucalipto
6) Morena
7) El Zorro
8) Espejo
9) Arcos
10) Vejer
11) Ksar es Sghir
12) Cabo Negro
13) Simferapol
14) Goitx
15) Podskanly
16) Beskes
17) Salonij
18) Zuravskaya
19) Gumbaschy Escarpment
20) Essentuki
21) Tyrnyauz
22) Matsoota
23) Teberda
24) Dombay
25) Kuban
26) Terskol Observatory
27) Cheget
28) Odola

Other Contributions to Position Paper 2 Appendix A

BOB SCHUTZ

University of Texas at Austin

B. Schutz
Univ. of Texas

CAP-93

(BEVIS ET AL.)

B. SCHUTZ

CAP-93

DAYS 041–049 REPEATABILITY

ORBIT: FIXED TO JPL PRODUCTS

SITE	ABSOLUTE POSITION REPEATABILITY $\sigma_{N/S}$ (mm)	$\sigma_{E/W}$ (mm)	σ_h (mm)
ARIC	3	4	8
CALD	2	5	9
FLIX	2	4	16
FTRN	2	6	9
MORR	2	6	8

16 BASELINES (INCL. SANT)

LENGTH REPEATABILITY: $a + b * l$

$a = 2.73$ mm

$b = 0.9$ ppb

BASELINES RANGE FROM 484 km TO 2393 km

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

JPL Publication 95-11