



# Neue Entwicklungen im IVS-Daten- und Analysezentrum

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## Aufgaben des BKG Daten- und Analysezentrams im IVS:

### **IVS-Datenzentrum** (GSFC, OPAR, BKG)

Erstellung der **X- und S-Band Datenbasen** für den IVS aus dem Output des Korrelators in Bonn (IVS-T2, EUROPE, OHIG u.a.); Erstellen von **NGS-Files**

Die Datenanalyse im BKG geht immer vom Korrelator-Output aus (Version 1 Databases).

Kontinuierliche Weiterführung von **EOP-Zeitreihen** aus 24h-Experimenten bzw. aus Intensive-Experimenten (1h) für IVS und „Bulletin B“

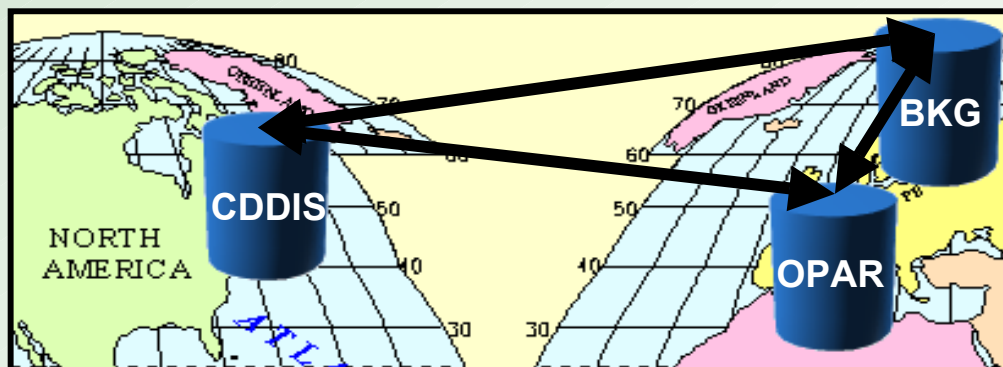
vierteljährliche Lieferung von **TRF, CRF-Lösungen** an den IVS

kontinuierliche Lieferung von **Troposphärenparametern** an den IVS  
(„total zenith delay“, „wet zenith delays“ einschl. Stand.Abw., „tropospheric gradients“)

Lieferung von **„daily SINEX files“** an den IVS

Teilnahme an Projekten zur **Weiterentwicklung der Auswertesoftware** (REPA, VMF, ...), Zielstellung ist die Übertragung der gesamten Calc/Solve Software von UNIX auf **LINUX**

Weiterentwicklung der **Analysetechnologie**



Spiegelung der drei  
IVS Datenzentren

## VLBI – Sessions

**IVS-R1 and IVS-R4:** The purpose of the IVS-R1 and IVS-R4 sessions is to provide [twice weekly EOP results](#) on a timely basis. These sessions provide continuity with the previous NEOS and CORE series. (NyWfMaOnWzGc, ApFtKkWzNyMa, R=,rapid serv.“)

**IVS-T2:** The purpose of the IVS-T2 sessions is to [monitor the TRF via monthly sessions](#). All geodetic stations participate in at least three T2 sessions each year. These sessions replace the IRIS-S sessions observed in previous years.

**IVS-E3:** The purpose of the IVS-E3 sessions is to provide an [additional monthly EOP monitoring session](#). These sessions will use S2-technology for recording and processing. (Ap-Yk-CTVA-Tc)

**IVS-INT1 and IVS-INT2:** The INT1 and INT2 sessions are 1-baseline, 1-hour "intensive" sessions to monitor UT1. These sessions are designed to provide [rapid service UT1 results](#). Sessions for INT1 are observed four times weekly. Sessions for INT2 are observed twice per week. (Wz-Kk, Wz-Ts)

**APSG:** The primary purpose of the APSG sessions is to continue monitoring the [relative motions of the plates in the Asia-Pacific region](#).(NorthAmerica:Ts-Fb,Australia:Ho,Eurasia:Ur-Sh,Pacific:Kk)

**EUROPE:** The purpose of this experiment is to determine the [station coordinates and their evolution in the European geodetic VLBI network](#).

**Ohiggins:** The purpose of the IVS-OHIG (Southern Terrestrial Reference Frame) sessions is to tie together optimally the sites in the [southern hemisphere](#).(Oh-Ft-Hh-Ho)

**Syowa Anarctica:** These experiments were designed to strengthen the [reference frame in the southern hemisphere](#), and to detect plate motion, in close collaboration with the JARE (Japanese Antarctic Research Expedition) project.

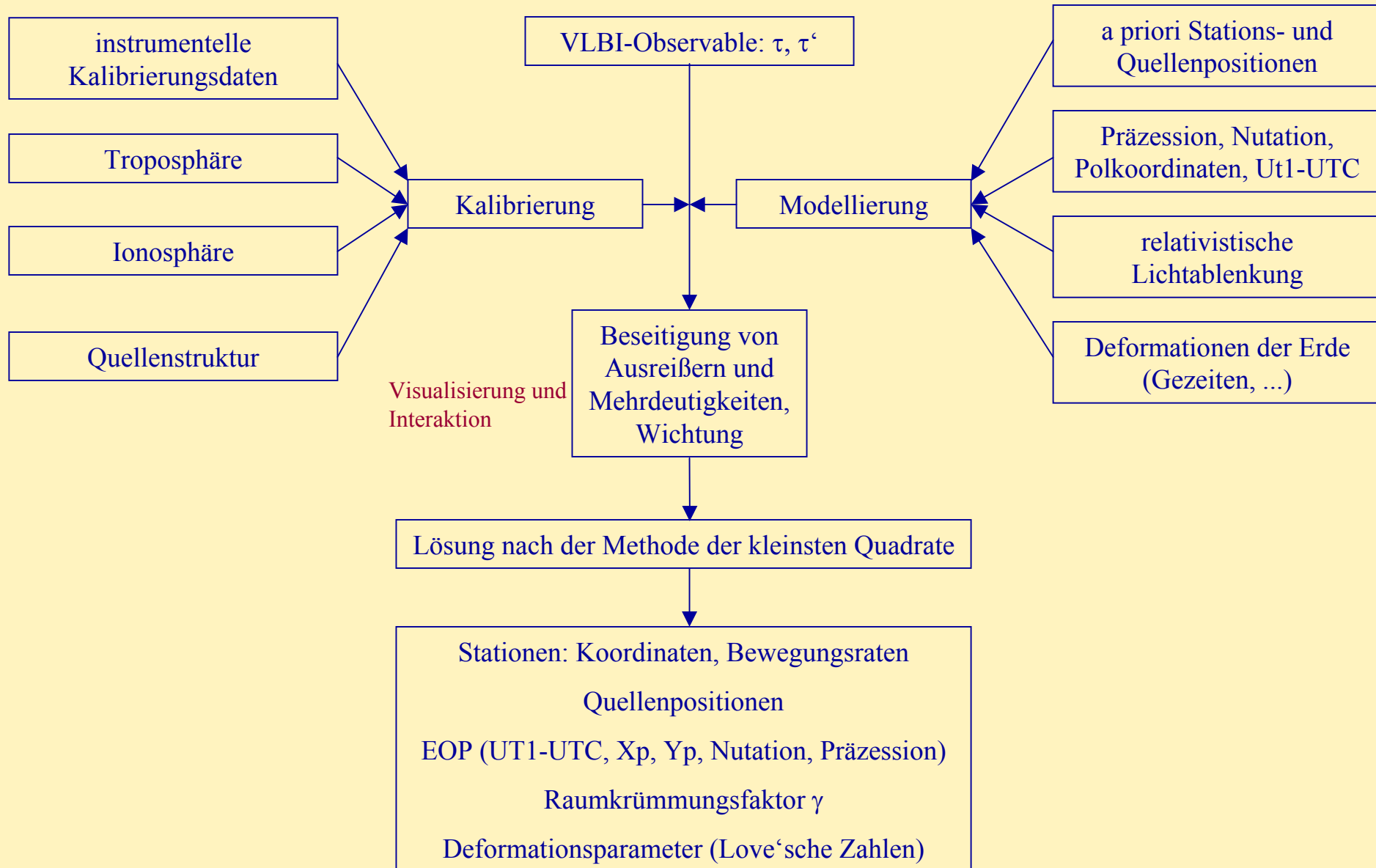
**VLBA:** There are six bi-monthly coordinated [astrometric/geodetic experiments](#) each year that use the full 10-station VLBA plus up to 10 geodetic stations.(br-fd-hn-kp-la-mk-nl-ov-pt-sc + up to 10 geod.stat.)

**IVS-CRF:** The Celestial Reference Frame (CRF) sessions are intended purely to provide astrometric observations useful in [improving the current CRF](#), and in extending and densifying the CRF by observing "new" sources. CRF sessions are scheduled roughly 4 times per year.

**IVS-R&D:** The purpose of the R&D sessions is to investigate methods for improving the [VLBI technique](#). This may include studies of instrumental effects or other systematic effects. The sessions occur nominally every month but may be changed depending on the design of the sessions.

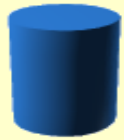
**IVS-CONT02:** The weekly R1 and R4 sessions will be observed plus another 10 CONT02 days to [cover a two week period](#).

# Auswertung von VLBI-Experimenten



# Datenanalyse im BKG

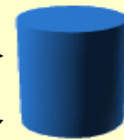
Analysis Center



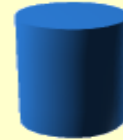
OPAR



CDDIS



Correlator



input

mirror

mirror

mirror

input

Zugriff von außen  
auf das Datenzentrum



automatisierte Prozeduren für  
Spiegelung, Datenfilterung und  
Vorauswertung

öffentlich

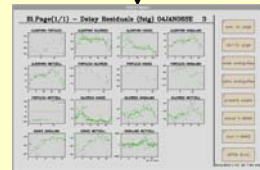
intern

## PRODUKTE:

EOP  
TRF  
CRF  
trop. Parameter  
Daily Sinex Files  
Databases  
NGS-Files  
Kalibr.-Dateien (met,cab)



BKG



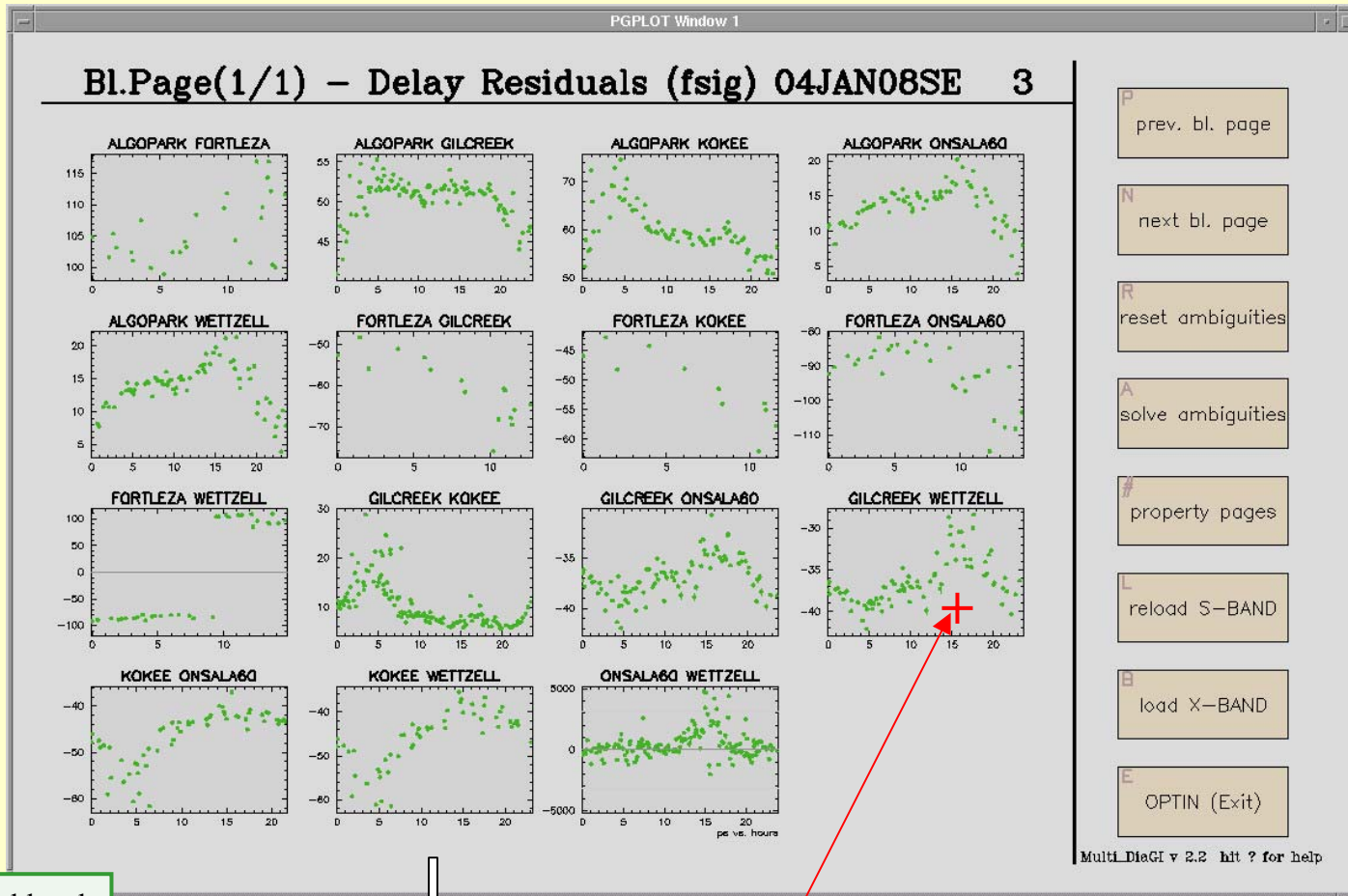
Interaktion (Calc/Solve)  
(ausgehend vom Korrelator-Output)  
Ausreißer, Ambiguities,  
Gewichtung, Uhrensprünge,  
Parametrisierung



IVS-PRODUCTS

automatisierte Prozeduren zur  
Erstellung der IVS-Produkte

# Residual Plotting and Ambiguity Resolution (REPA)



2nd level

Go to the previous or next „BASELINE PAGE“ by pressing the <prev. bl. page> or <next bl. page> button (if there are more then one pages) or go to a baseline plot by clicking into one of the small plots.

„BASELINE PAGE“  
The **headline** of the „BASELINE PAGE“ includes the name of the chosen database including version number and the chosen „property“.

The **maximum number of appearing baselines** in the „BASELINE PAGES“ depends on a parameter which can be modified by user in the REPA parameter file.

The user can **leaf through „BASELINE PAGES“** by pressing <next bl. page> or <prev. bl. page>

The headlines of **small plots** contain station names.

By pressing the <**reset ambiguities**> button all ambiguities of all baselines in the chosen band can be changed to the original state.

After pressing <**solve ambiguities**> the ambiguities of all baselines will be solved in one step.

By pressing the <**property page**> button the user can jump back to „PROPERTY PAGES“.

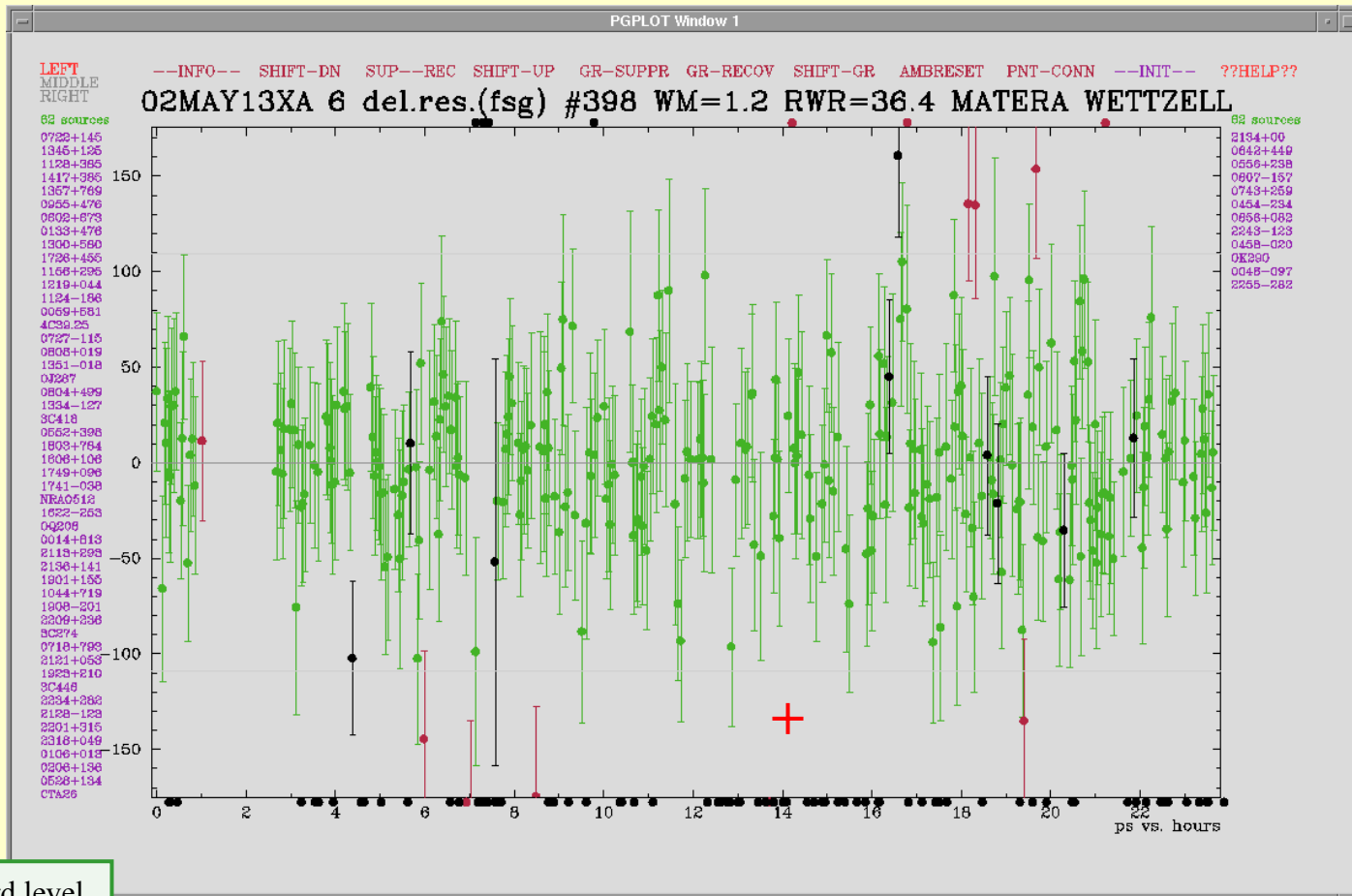
The <**load ?-BAND**> button leads to the the same baselines as in the current „BASELINE PAGE“ but loads the complementary database band (in the example it would be 04JAN08SE) if available.

The <**reload ?-BAND**> button can be used to re-adjust the appearance of small plots

To go to a **single baseline** the user has to click into the small plot of interest.

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3rd level

## „BASELINE PLOT“

The „BASELINE PLOT“ shows all available observations in the so-called overplot style. The plot area is fitted to the „good“ (green) observations. The „bad but recoverable“ observations are displayed in red colour and the „bad and not recoverable“ observations in black colour. All observations which are outside of the initial plot area are displayed at the edges. Colours are user parameters.

The **headline** consists of database name, property name, total number of observations, weight.mean, RMS weighted residual and station names.

The **time axis is horizontal** and shows hours related to the beginning of the session.

The plot includes a „**zero line**“ (dark gray) and two „**3 sigma lines**“ (light gray)

The user has several possibilities to **manipulate** observations, to **get information** for specific observations or to **change the plotting area**.

The user can **leaf through baseline plots** by pressing PgUp/PgDn keyboard keys

A short **helptext** can be displayed by pressing the <??HELP??> button in the upper right corner. A more detailed description is available in the SOLVE help directory.

The user can choose **user functions** by left mouse click onto the buttons in the upper line. This action binds the chosen function to the left mouse button. In one case three functions are binded to the three mouse buttons and in one case the left and the right buttons are binded. If the middle mouse button is unbinded it can be used for changing the plotting area. Colours and styles can be changed by using the DiaGi functionality (different keyboard keys). The binded mouse buttons are indicated by red colour in the upper left corner of the plot.

Alternatively to the mouse buttons **keyboard keys** can be used (see helpfiles).

Up to 100 **source names** can be displayed in two columns. The name buttons can be used interactively to connect observations belonging to the same source.



## **VLBI-Datenanalyse im BKG für den IVS:**

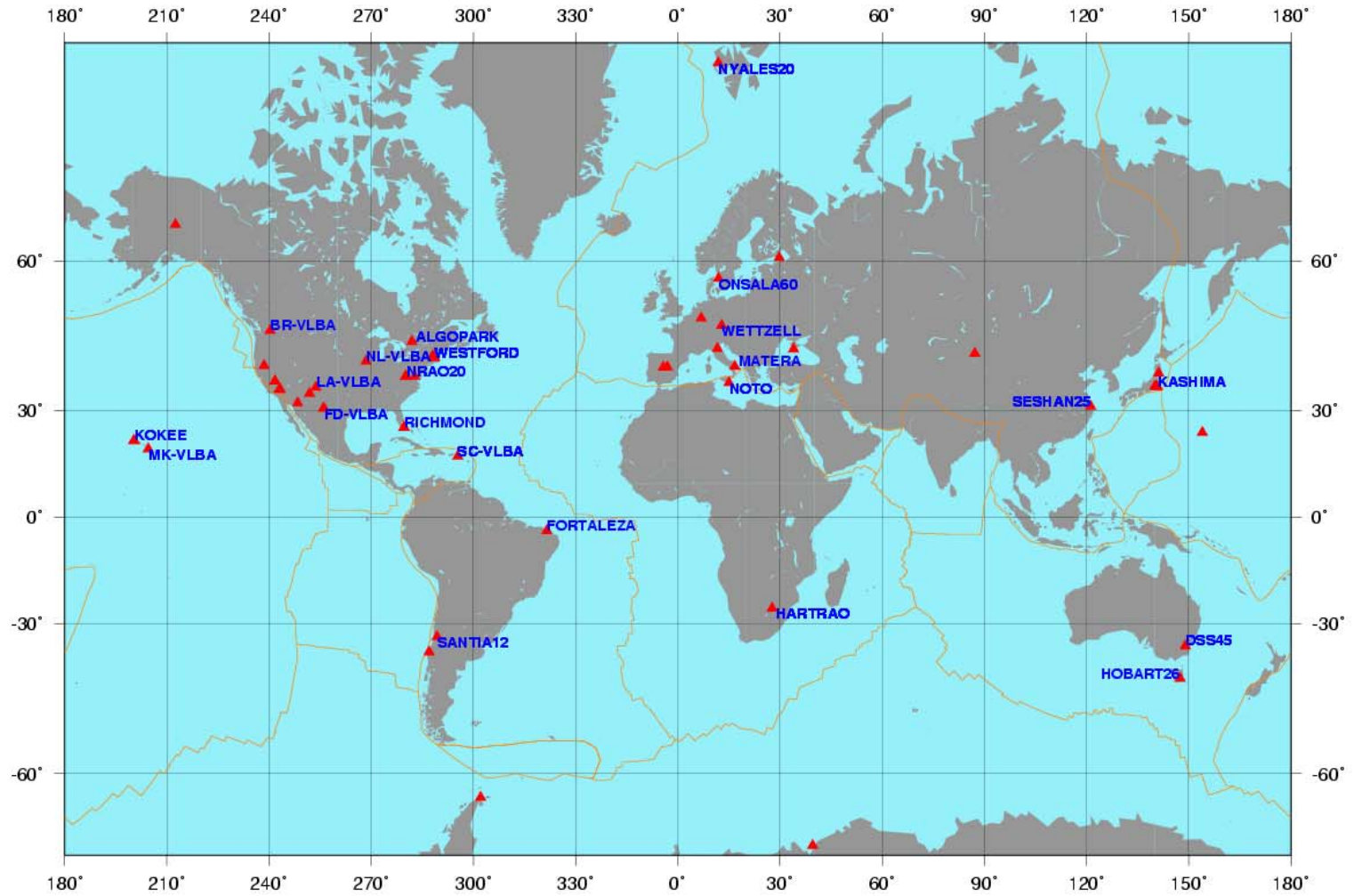
### **1. EOP-Zeitreihe aus 24h-Experimenten (bkg00006)**

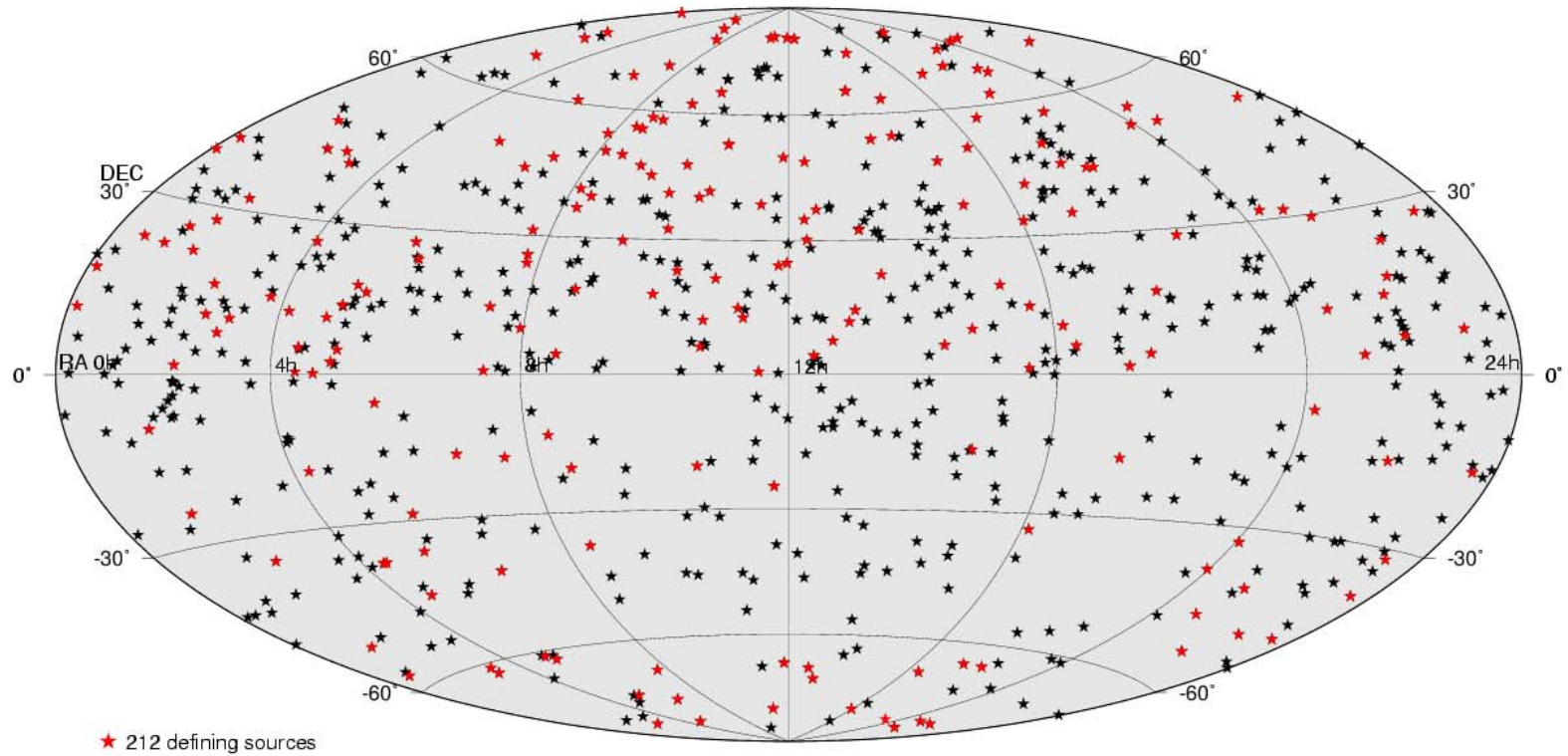
- EOP (Xpol, Ypol, UT1-TAI, Psi, Eps) je Session extrahiert aus Globallösung mit VLBI-Daten ab 1984
- globale Stationskoordinaten und Geschwindigkeiten sowie Radioquellenpositionen
- Datum TRF: NNR, NNT für 26 ausgewählte Stationspositionen und Geschwindigkeiten in Bezug auf das VTRF2003
- Datum CRF: NNR für 212 „defining sources“ in Bezug auf das ICRF-Ext.1
- Stationskoordinatenreihe von TIGOCONC (Chile) ab Mai 2002 und SVETLOE (Rußland) ab März 2003 abgeleitet aus den entsprechenden Sessionen

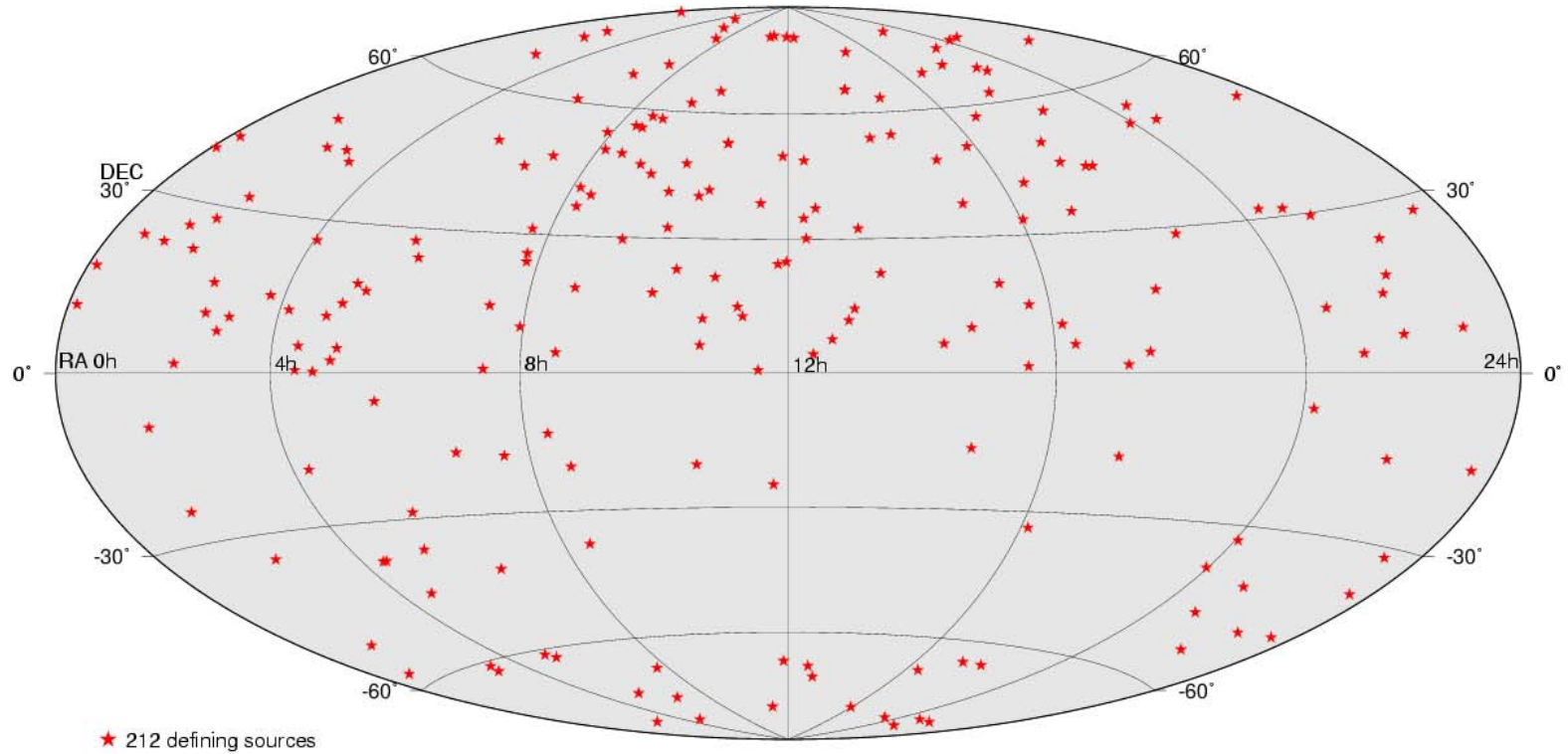


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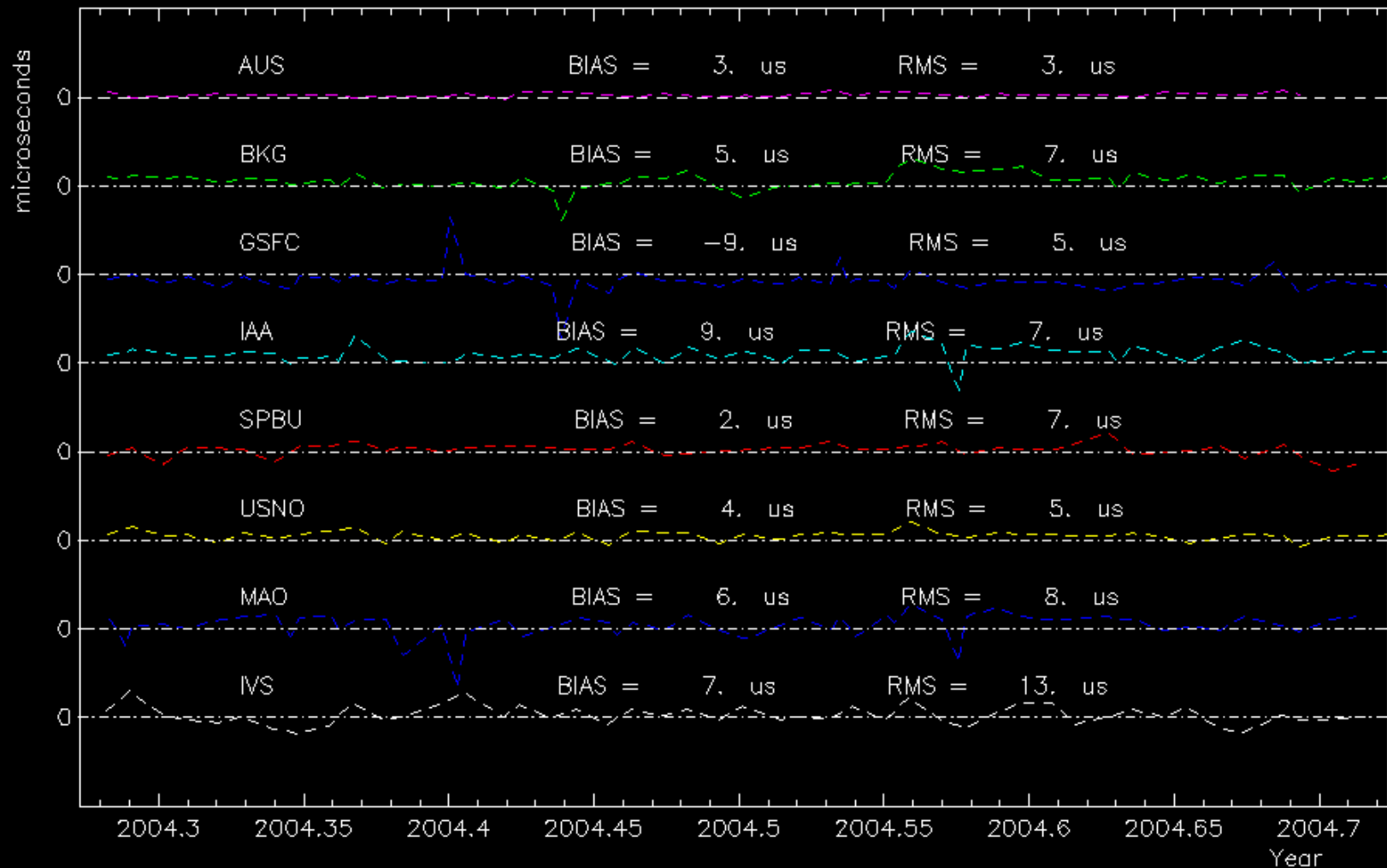




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UT1 (VLBI): AUSLIG, BKG, GSFC, IAA, SPBU, USNO, MAO and COMB – (IERS) C04, UNIT = 100 micro

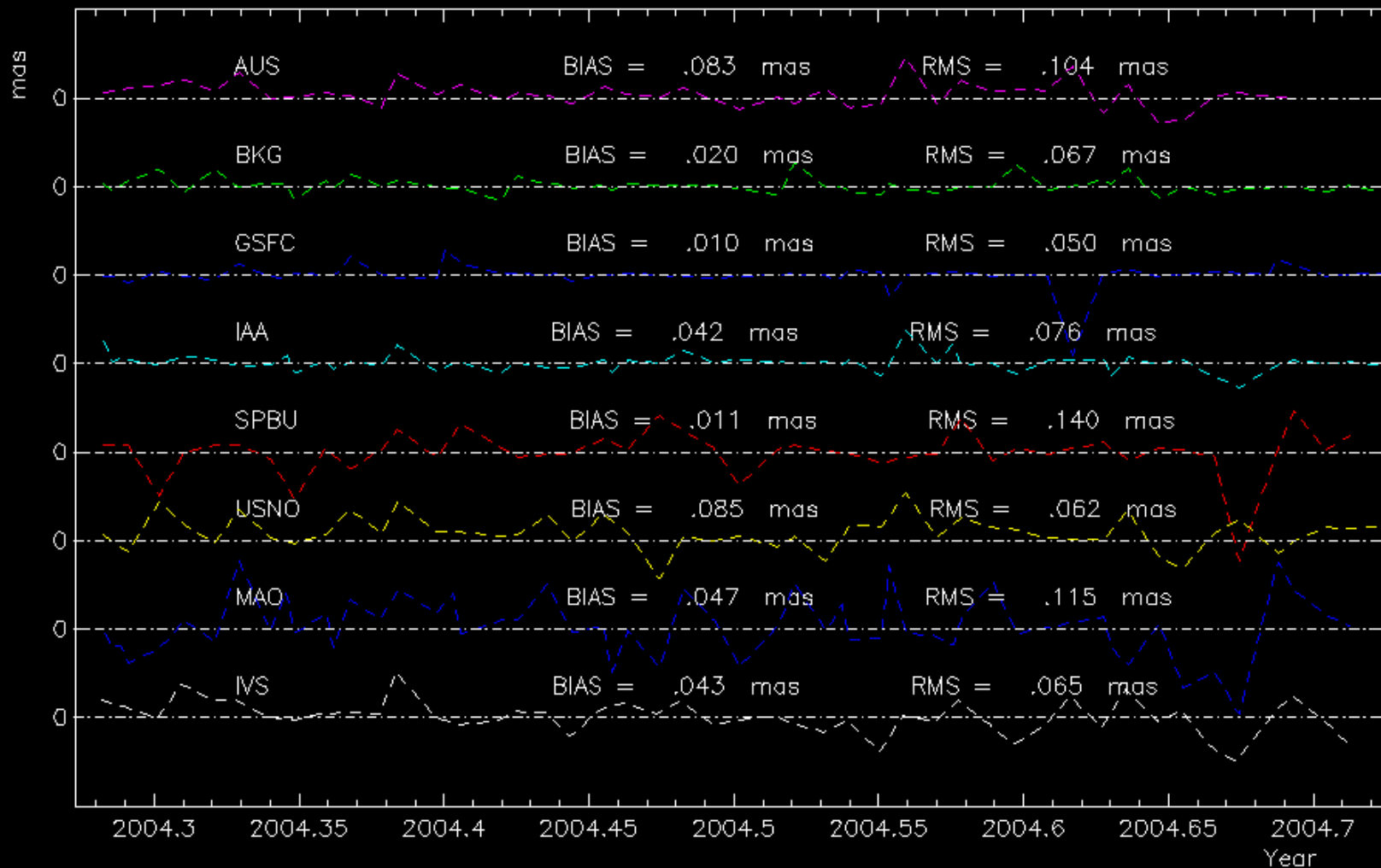




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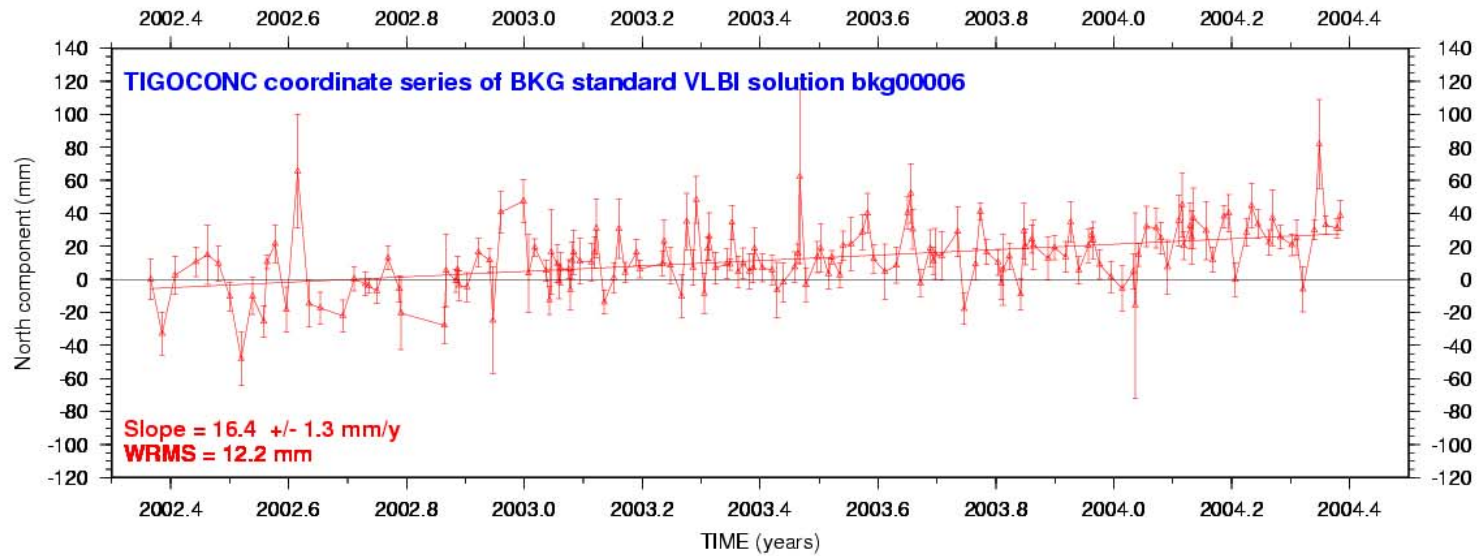
$d\psi_i \cdot \sin(\epsilon_i)$  (VLBI): AUSLIG, BKG, GSFC, IAA, SPBU, USNO, MAO and COMB – IERS C04, UNIT = 1

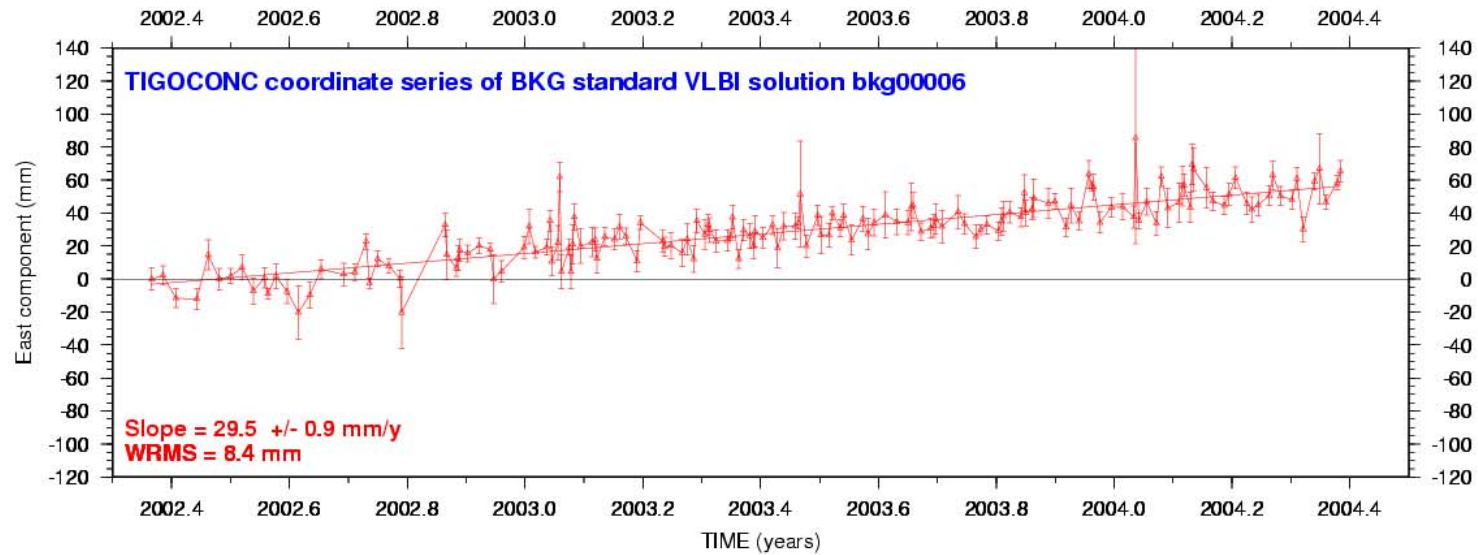




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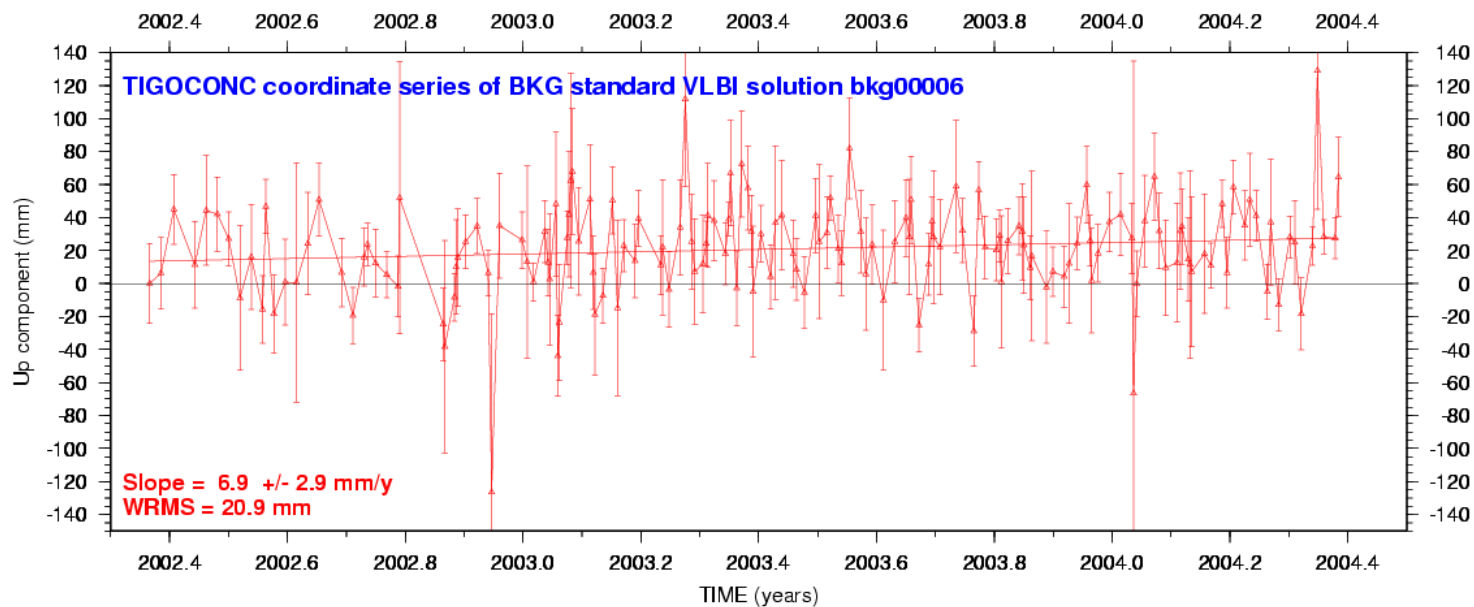






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## VLBI-Datenanalyse im BKG für den IVS:

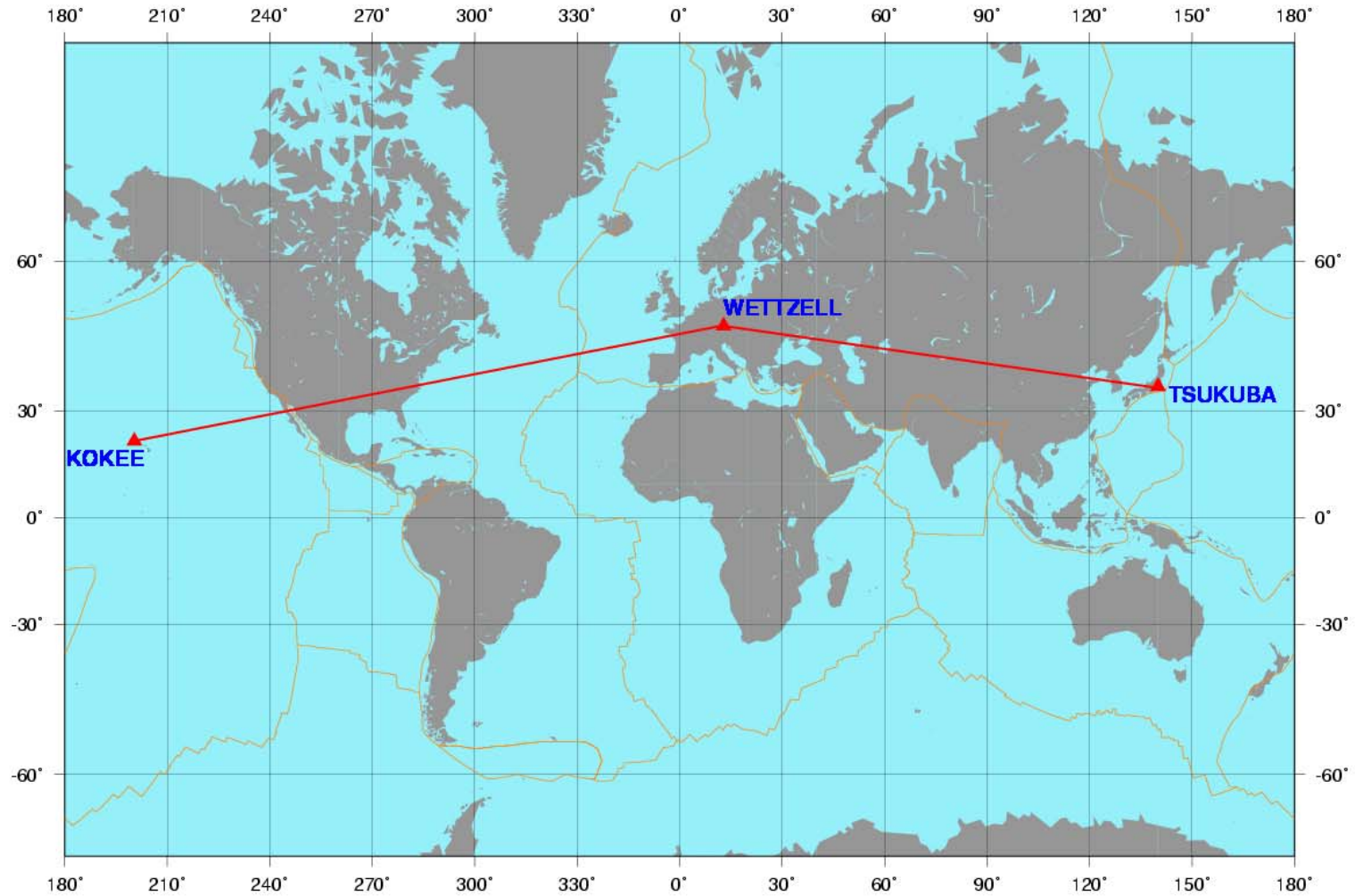
### **2. EOP-Zeitreihe aus Intensive-Experimenten von ca. 1h (bkgint03)**

- Basislinie WETTZELL-KOKEE ab 1999
- Basislinie WETTZELL-TSUKUBA ab Mitte 2002
- Parameter: UT1, Stationsuhr, Troposphäre
- Datum: VTRF2003, CRF abgeleitet aus BKG-Globallösung (bkg00006)



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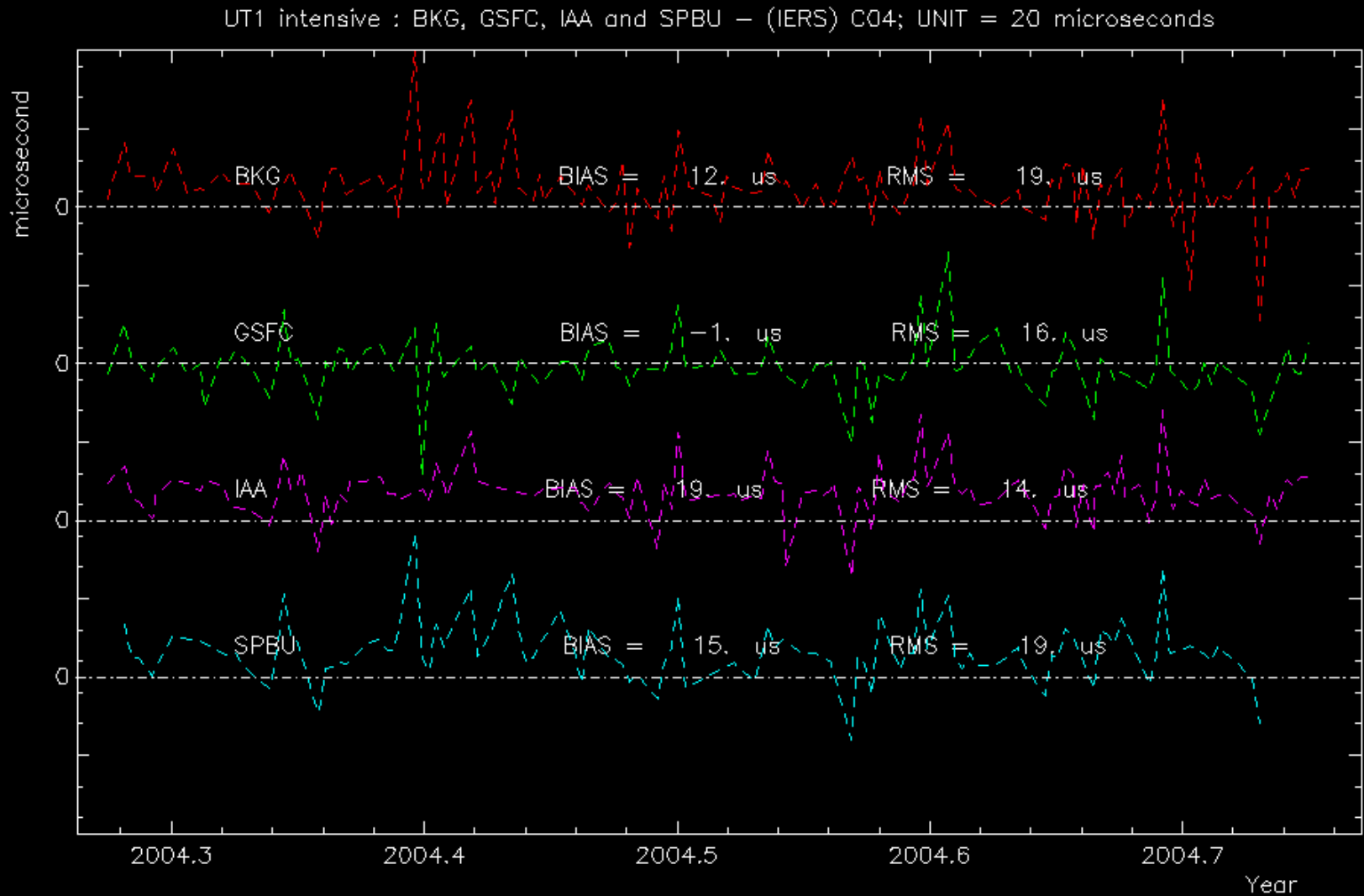
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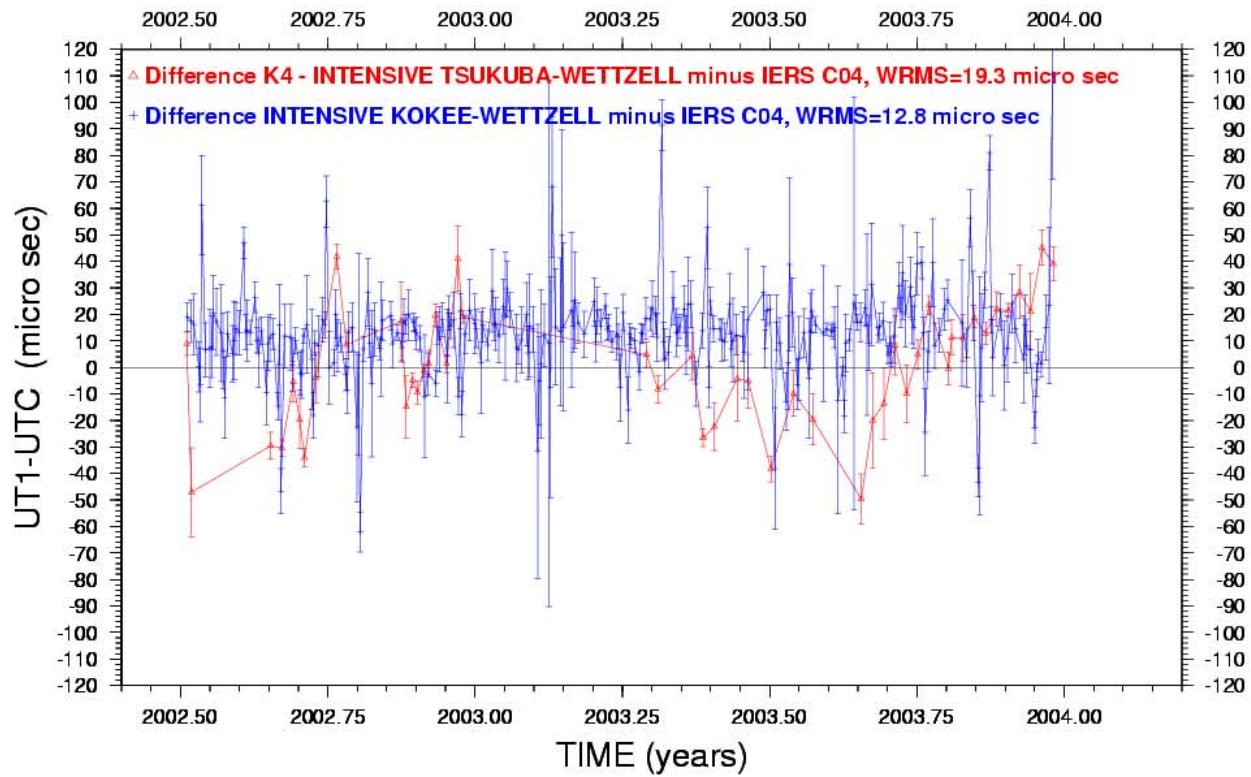
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# FGS Workshop 2004

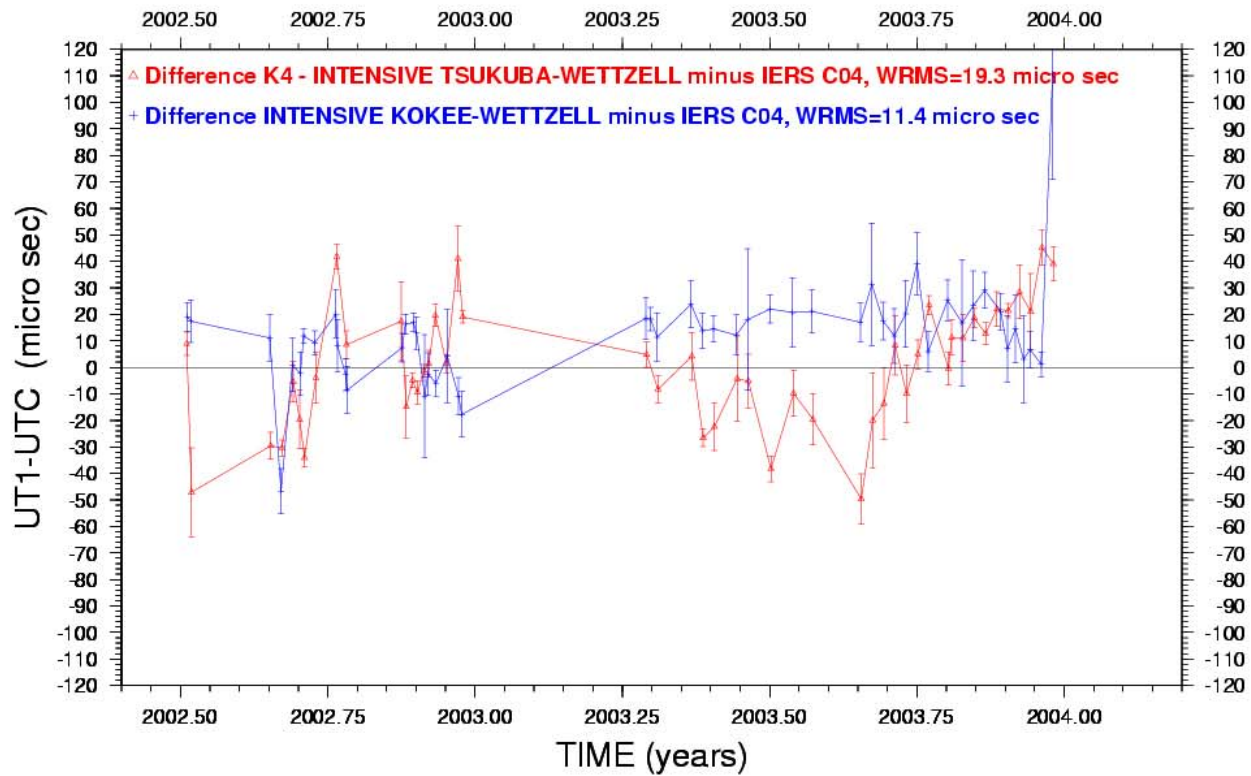
27-29 Oktober 2004, Höllenstein/Wetzell





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# Beitrag zum Bulletin B des IERS

IERS, B 200 (4)

## 6 - SUMMARY OF CONTRIBUTED EARTH ORIENTATION PARAMETERS SERIES

This section gives the average precision of the individual series contributing to the combination and their average agreement with it. The periods covered start at the beginning of the first month in Section 1 and end with the last available value in the individual series considered.

The complete list of measurements is available in the electronic-mailed version of Bulletin B in section 7.

Units : 0.001" for x,y , 0.0001s for UT1, 0.001" for dPsi, dEpsi.

EOP series		Mean formal uncertainty							Data Number
Periods covered		Weighted RMS agreement with Bulletin B							
		x	y	UT	D	dPsi	dEpsi		
VLBI									
EOP(AUS)	1 R 01	.09	.09	.04	-	.31	.12	12	
53220.20 to 53258.27		.12	.26	.02	-	.34	.15		
EOP(BKG)	3 R 04	.12	.11	.04	-	.22	.08	14	
53220.20 to 53265.27		.27	.25	.06	-	.14	.10		
EOP(BKG)	3 R 02	-	-	.11	-	-	-	47	
53219.79 to 53276.79		-	-	.19	-	-	-		
EOP(GSFC)	4 R 02	.16	.18	.08	-	.30	.11	16	
53220.20 to 53272.27		.24	.10	.06	-	.19	.11		
EOP(GSFC)	4 R 01	-	-	.13	-	-	-	36	
53219.79 to 53275.79		-	-	.19	-	-	-		
EOP(IAA)	3 R 04	.11	.10	.04	-	-	-	13	
53220.20 to 53265.27		.18	.14	.08	-	-	-		
EOP(IAA)	3 R 03	-	-	.12	-	-	-	57	
53219.79 to 53274.33		-	-	.18	-	-	-		
EOP(SPBU)	3 R 03	.37	.39	.22	-	.15	.06	13	
53220.20 to 53265.27		.21	.13	.09	-	.33	.19		
EOP(SPBU)	2 R 01	-	-	.14	-	-	-	35	
53219.79 to 53271.79		-	-	.16	-	-	-		
EOP(MAO)	3 R 01	.11	.11	.04	-	-	-	14	
53220.25 to 53265.28		.19	.19	.10	-	-	-		
EOP(USNO)	4 R 01	.10	.09	.03	-	.21	.08	13	
53220.20 to 53265.27		.14	.11	.06	-	.20	.09		
EOP(IVS)	0 R 01	.09	.09	.04	-	.16	.08	14	
53220.00 to 53265.00		.20	.14	.09	-	.15	.08		



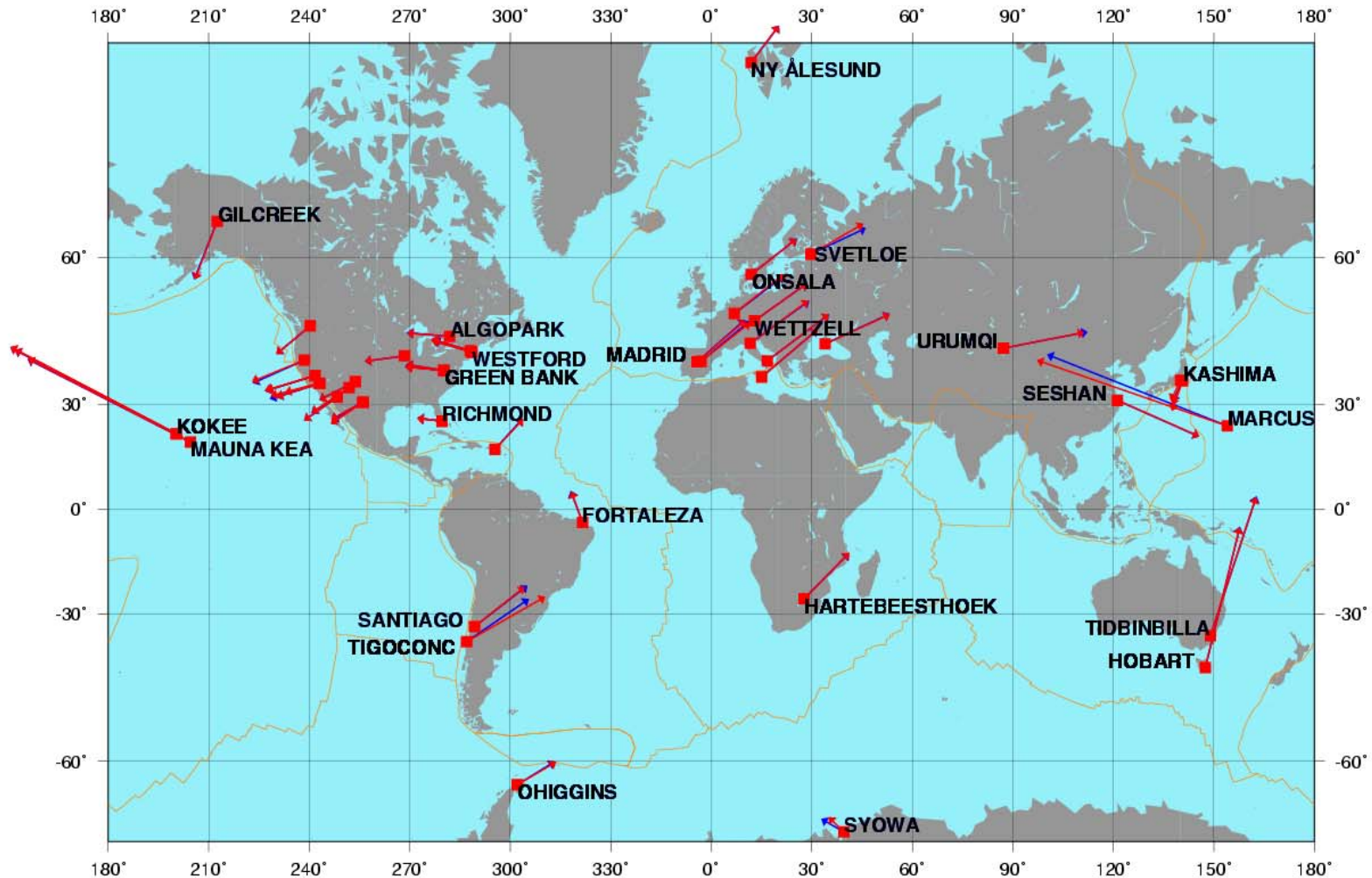
## VLBI-Datenanalyse im BKG für den IVS:

### **3. Vierteljährliche TRF, CRF-Lösungen**

- **Keine Unterschiede zur Lösungsstrategie der Globallösung zur Ableitung der EOP-Zeitreihe (bkg00006)**
- **SINEX-Format für Stationskoordinaten und Geschwindigkeiten**
- **IERS-Format für Radioquellenpositionen**



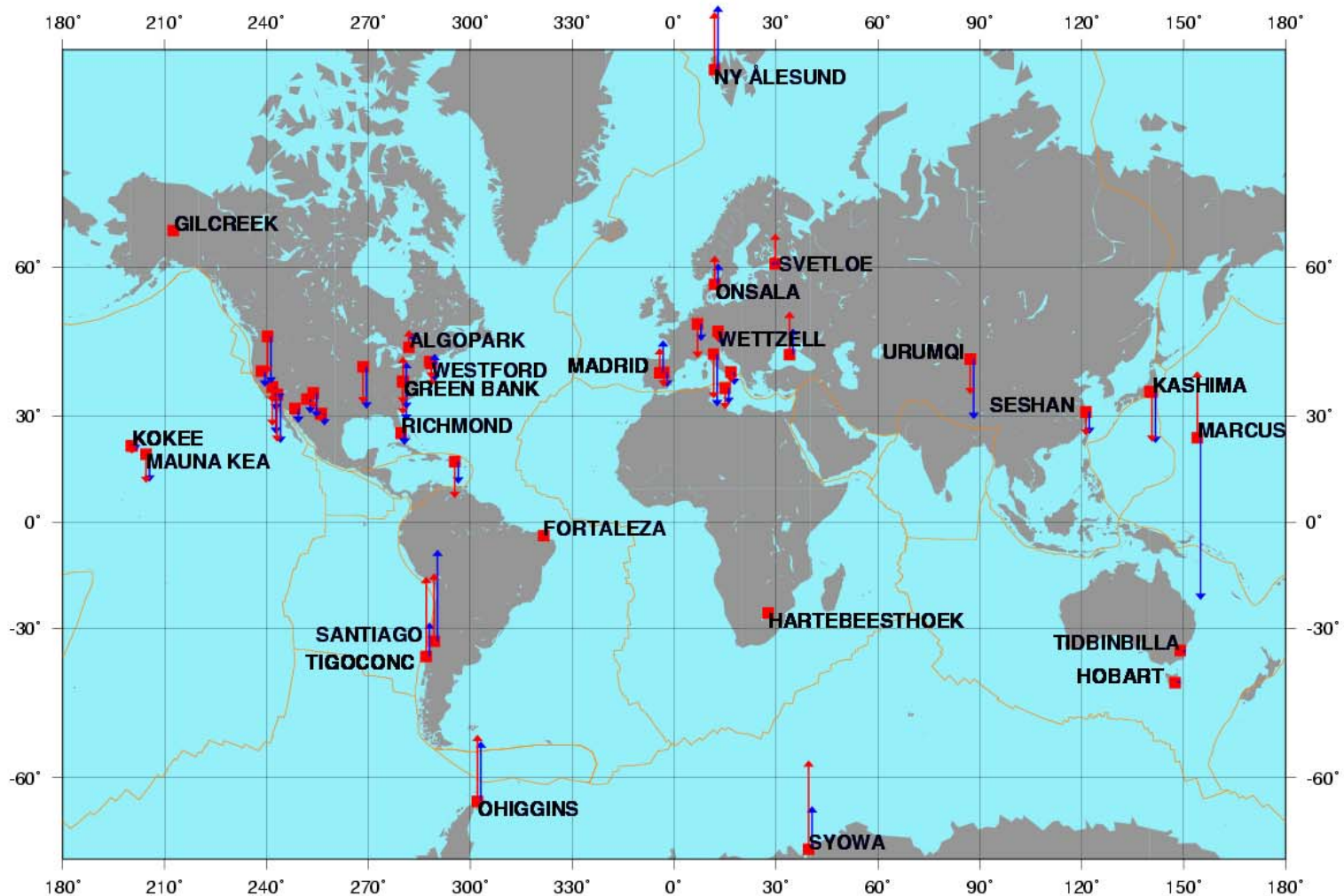
## Global solution of BKG (bkg00006) with VLBI data 1984.0 - 2004.6



- 1 cm/year (horizontal station velocities of BKG solution in the VTRF2003)
- 1 cm/year (horizontal station velocities of the VTRF2003)



## Global solution of BKG (bkg00006) with VLBI data 1984.0 - 2004.6



- 2 mm/year (vertical station velocities of BKG solution in the VTRF2003)
- 2 mm/year (vertical station velocities of the VTRF2003)



## VLBI-Datenanalyse im BKG für den IVS:

### **4. Troposphärenparameter und „daily SINEX files“**

- Troposphärenparameterschätzung mit stückweisen linearen Funktionen je Stunde für feuchte Laufzeitverzögerung in Zenitrichtung je Session ab 1984
  - Troposphärenparameter, a priori Werte und Standardabweichungen extrahiert aus der Globallösung zur Ableitung der EOP-Zeitreihe (bkg00006) und umgeformt in SINEX-Format für Troposphärenparameter je Session
  - Schätzung von Laufzeitverzögerungsgradienten (N,E) je Session und Ablage in SINEX
- „daily SINEX files“ zusätzlich zu der Globallösung in Form von unabhängigen Sessionslösungen für die Parameter Stationskoordinaten und EOP



## Stabilität von Radioquellen

**Testgrundlage:** “Selecting stable extragalactic compact radio sources from the permanent astrogeodetic VLBI program”, Martine Feissel-Vernier, Tabelle 6 mit 162 nicht stabilen Quellen (Stabilitätskriterium 3, Werte 3 und 4)

**Analysestrategie:** Lineare Schätzung der Raten von Rektaszension und Deklination von 162 nicht stabilen Quellen.

Vergleich mit Routinelösung bkg00006:

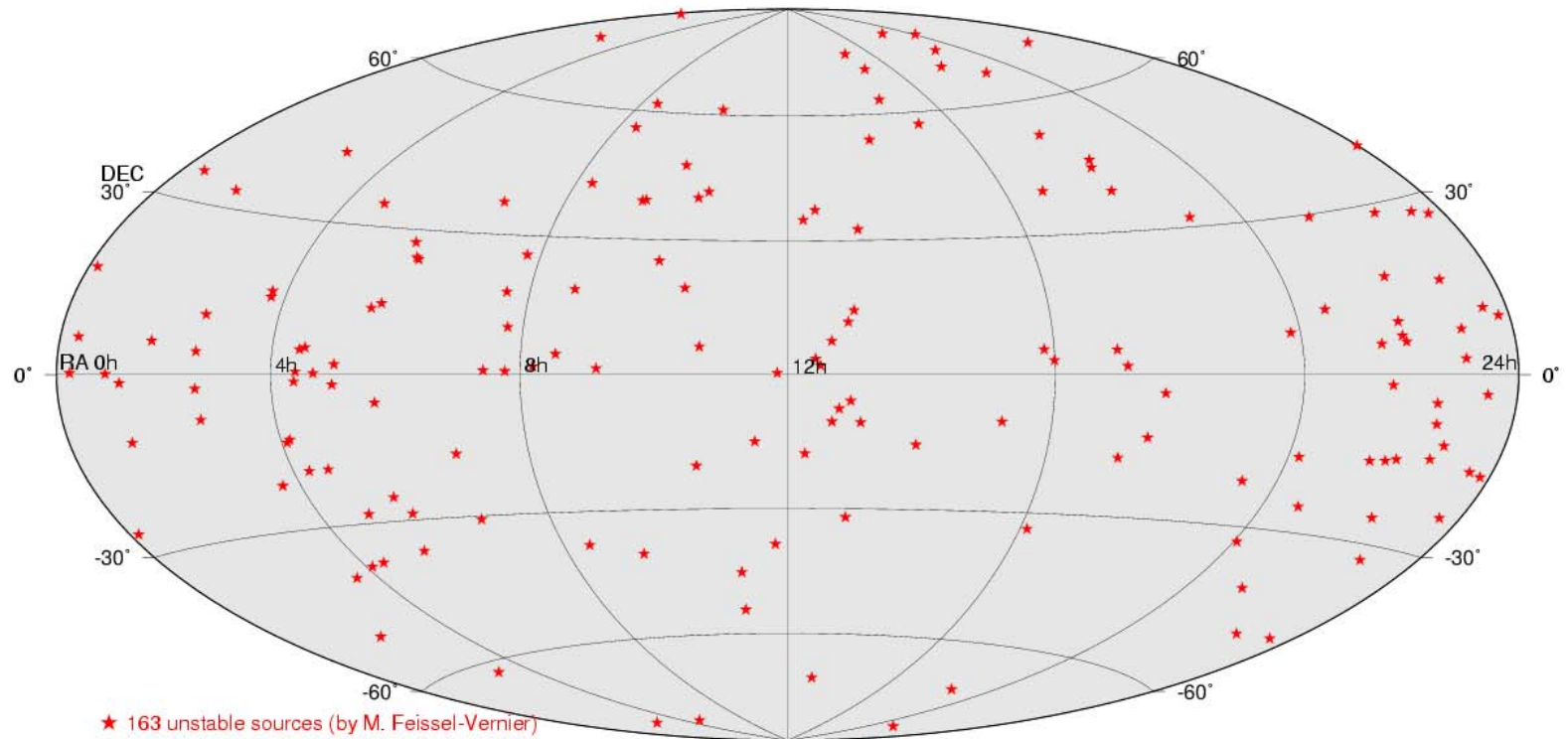
Schätzung von 162 nicht stabilen Radioquellenpositionen als globale Parameter und ihrer Bewegungen mit einer “no-net-rotation” Bedingung für 81 stabile “defining sources” bzgl. des ICRF-Ext.1.

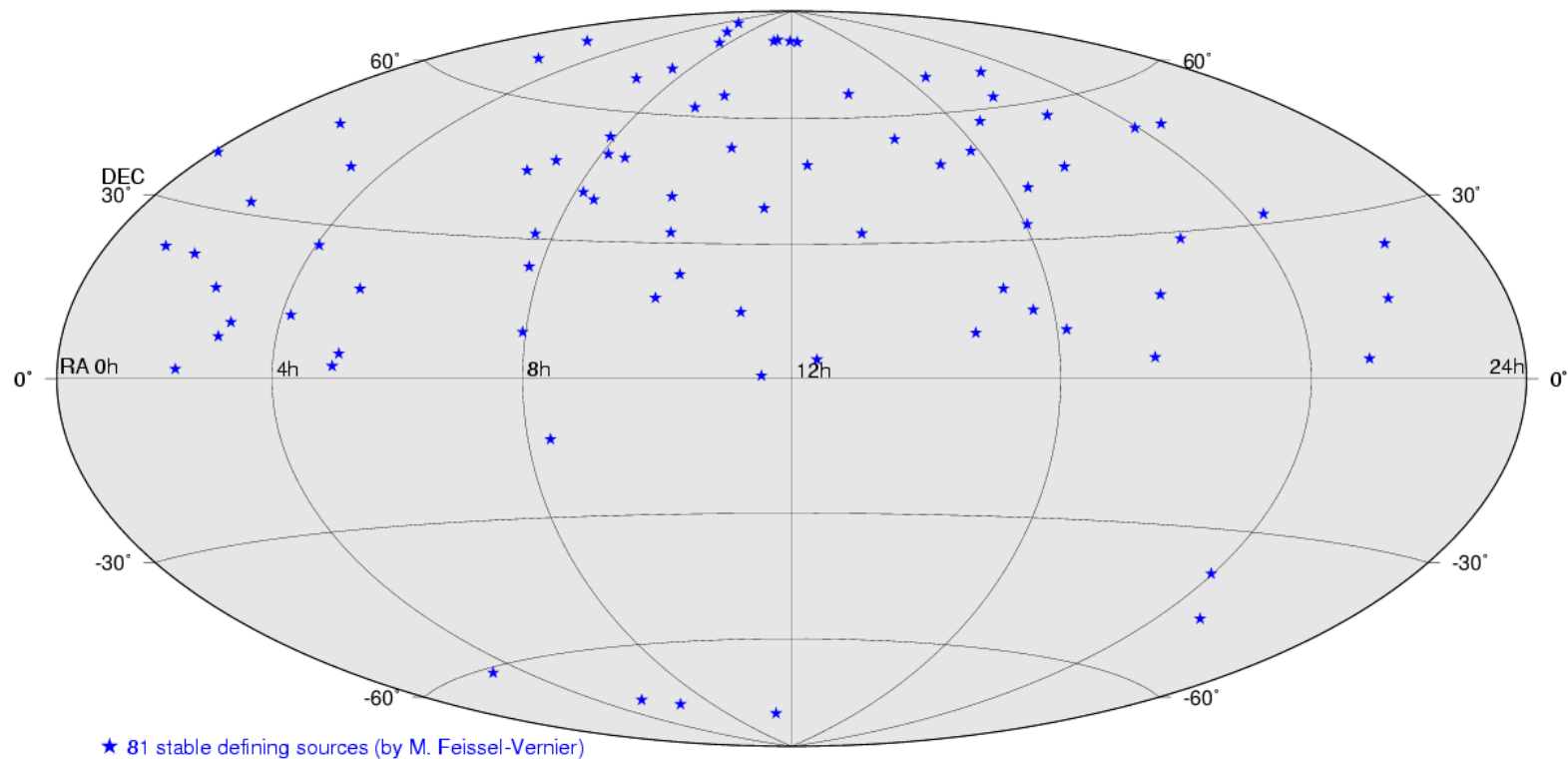
### Ergebnisse:

	Radioquellenbewegung	
	> 3 sigma	> 2 sigma
-----		
Anzahl der Quellen für RA + DEC	24	32
Anzahl der Quellen für RA or DEC	42	61
Total	66	93
“defining sources”	19	34
-----		

Beispiel für “defining source” 2145+067 (1814 VLBI-Experimente 1984-2003 mit 67881 Beobachtungen):

REKT. Geschw. -0.028 mas/Jahr +/- 0.0009 mas/Jahr  
DEKL. Geschw. 0.012 mas/Jahr +/- 0.0013 mas/Jahr







## Stabilität von Radioquellen

### Vergleich der geschätzten EOP mit IERS C04

**Bias und WRMS, abgeleitet aus der Differenz zu C04, sind nur geringfügig gegenüber der BKG Standardlösung bkg00006 verändert.**

#### EOP Komponenten

	Xpole	Ypole	UT1-UTC	Psi	Eps
1984-2003	mas	mas	us	mas	mas
-----					
<b>bkg00006</b>					
Bias bzgl. C04	-0.110	0.247	3.4	-0.079	-0.005
WRMS	0.239	0.216	17.3	0.373	0.171
<b>Testlösung mit Quelleneigenbewegungen</b>					
Bias bzgl. C04	-0.103	0.243	4.4	-0.107	0.002
WRMS	0.238	0.211	17.4	0.378	0.171
-----					



## VLBI-Datenanalyse im BKG für den IVS:

### Ausblick

**Verfeinerung der Lösungsstrategie durch:**

- **Schätzung von Achsen-Offsets**
- **Nutzung der VMF**
- **Berücksichtigung von nicht stabilen Radioquellen**