Global Tectonics from SLR/VLBI Combined Solutions

by

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Greenbelt, Maryland

Introduction

- *Rationale:*

  - To provide tectonic motion results based on measurements from both VLBI and SLR technologies in a **unified geodynamic frame:** allowing intersite rates between **all** sites to be computed.

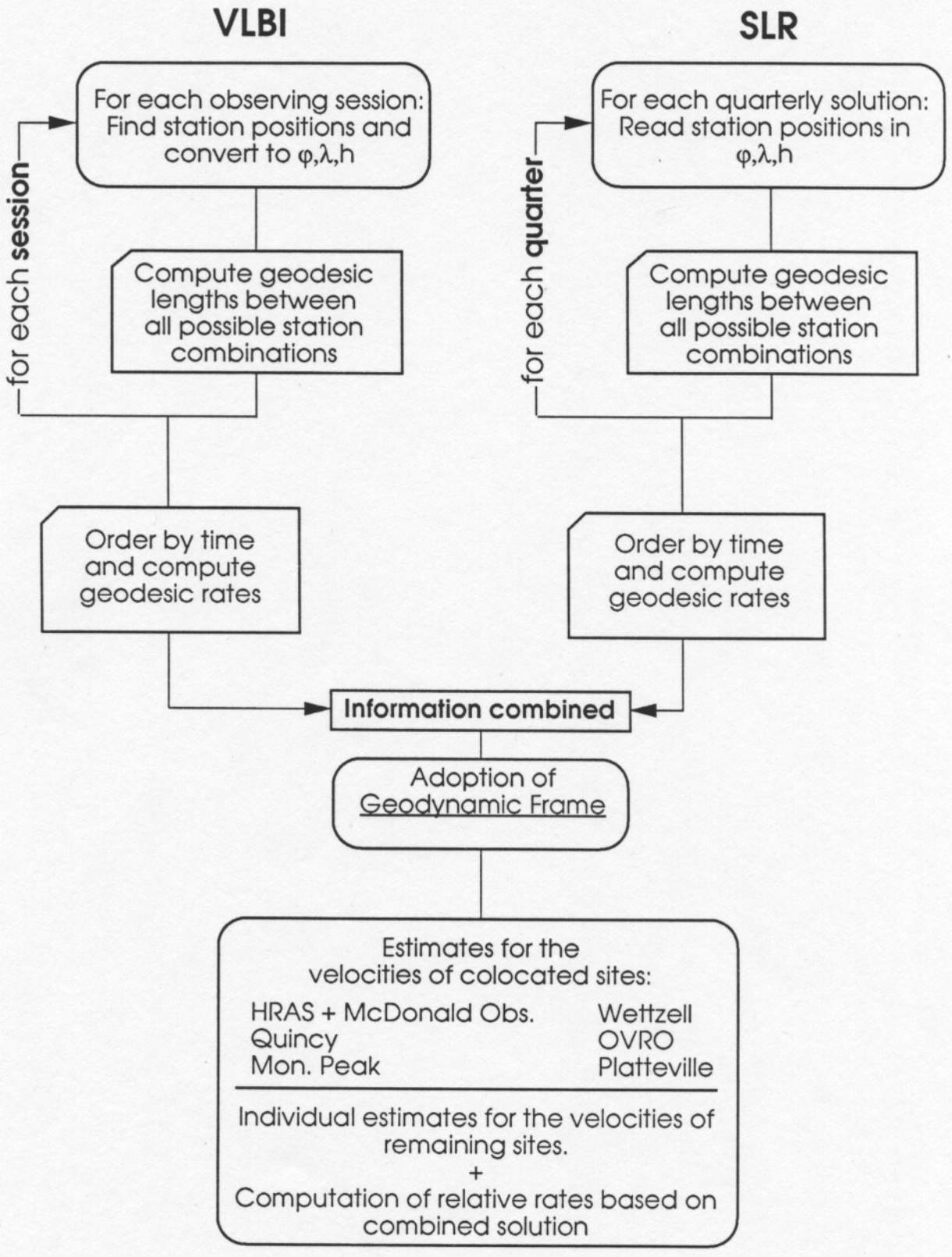
- *Emphasis:*

  - Update on the status of agreement across technologies via selected shared baselines and via sensitivity analysis on recovered site velocities at colocated sites.

  - Discussion of the velocities estimated for sites which are geographically close to one another and for which tracking technologies may differ.

  - Future directions & plans.

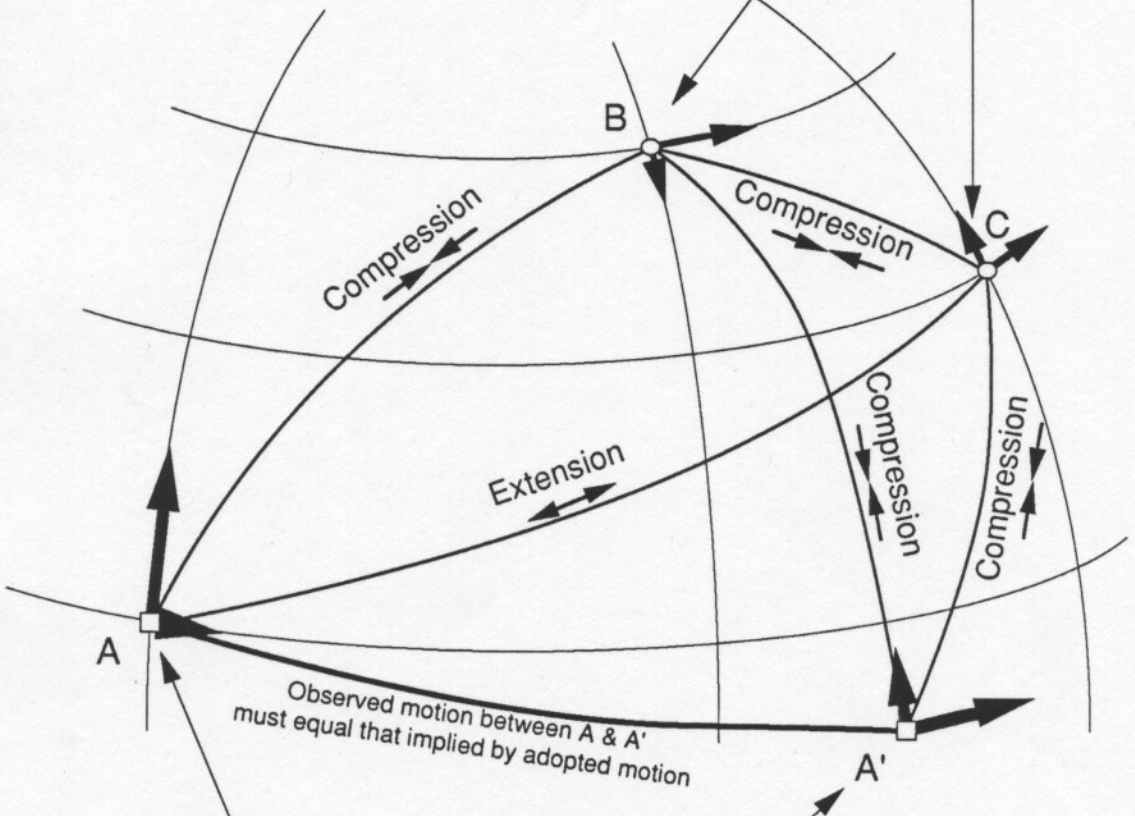
Combination Outline



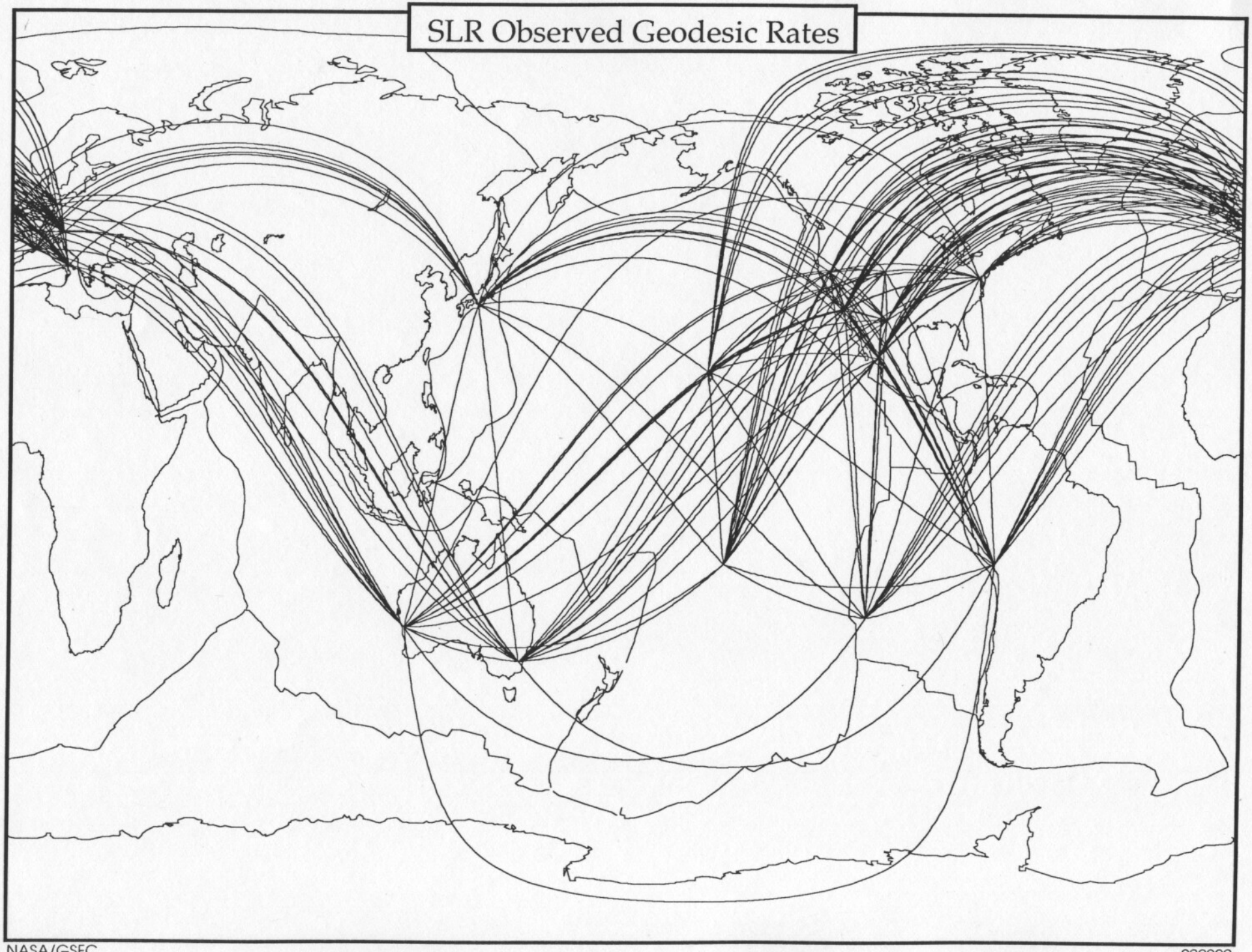
JWR - 901015

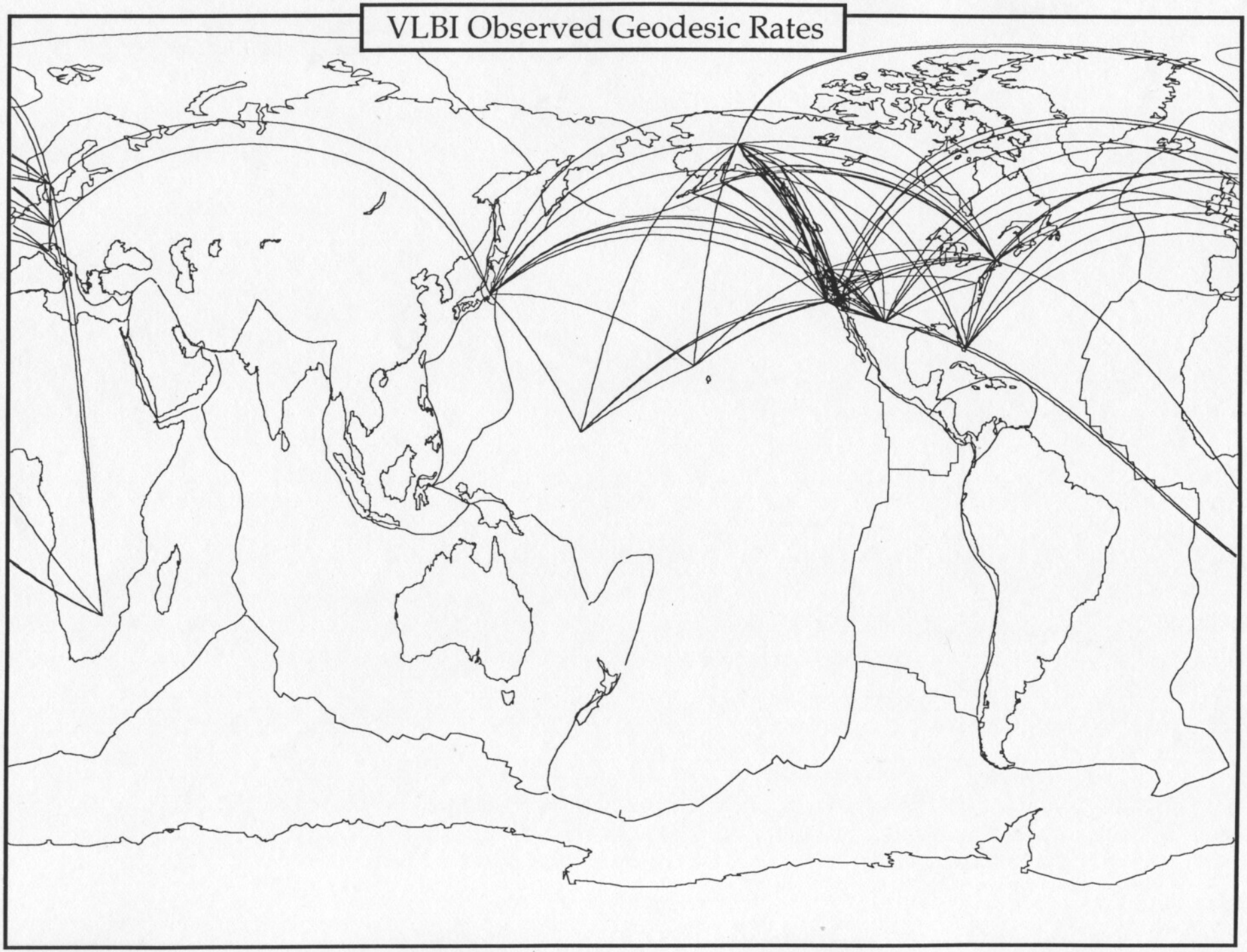
Estimation of Horizontal Motion

Vector components of horizontal motion are estimated for remaining sites in network on the basis of relative rates between all sites and the *a priori* motion assumption for sites A & A'.



Sites A & A' are assumed to move with pre-defined plate motion (e.g. NUVEL-1 NNR)


SLR Observed Geodesic Rates
NASA/GSFC
900920



NASA/GSFC

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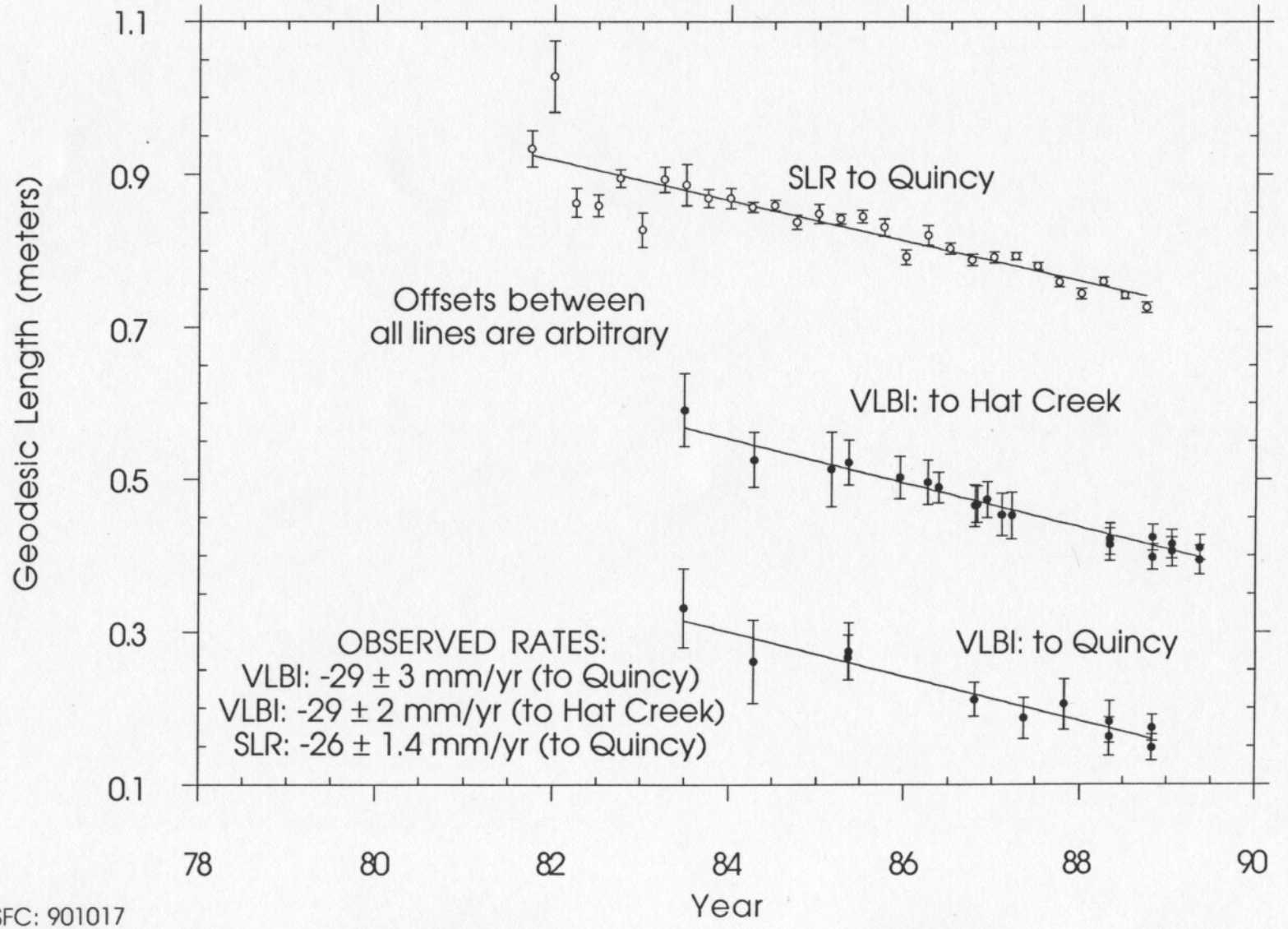
Monument Peak to Quincy/Hat Creek Geodesic Lengths



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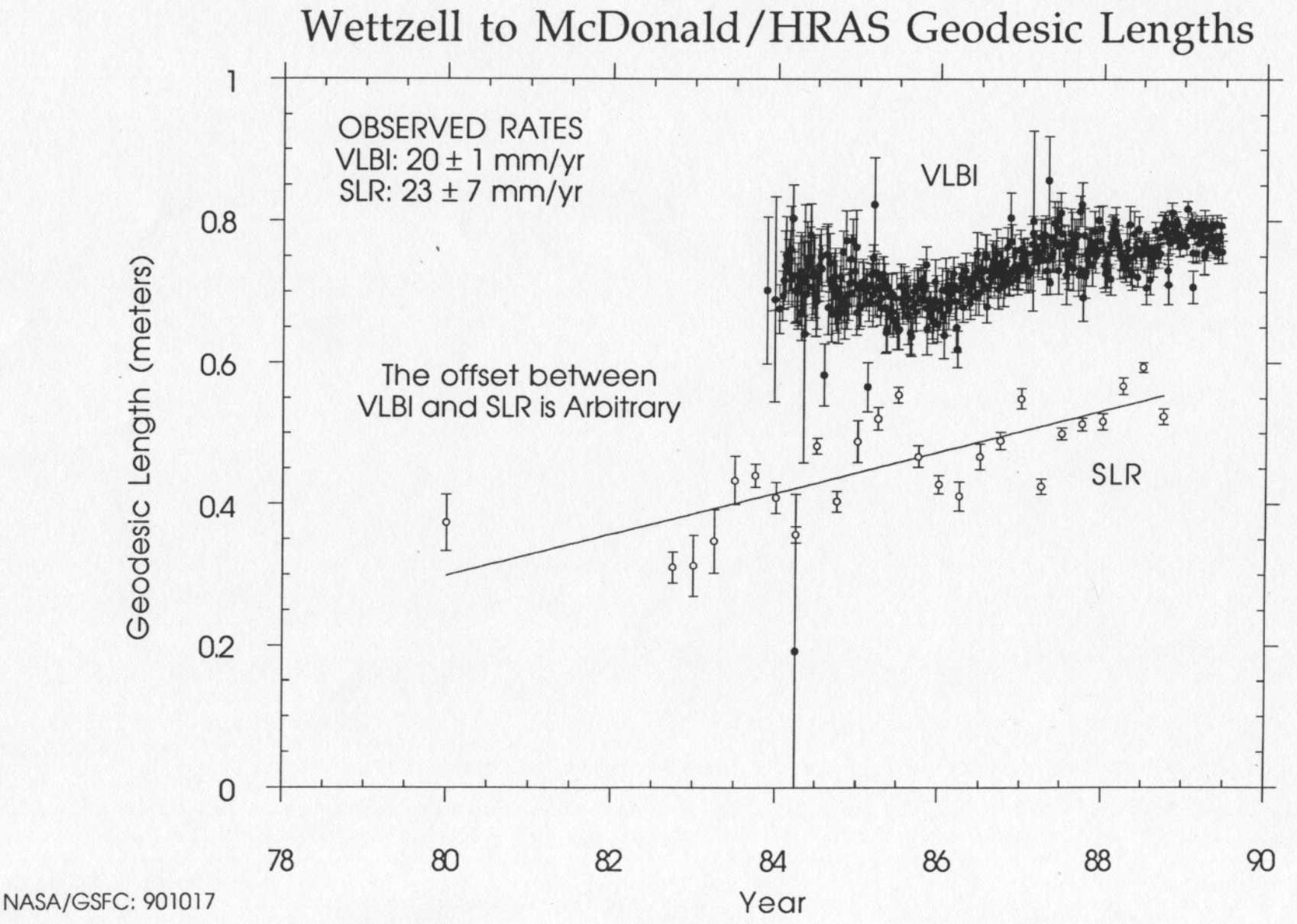

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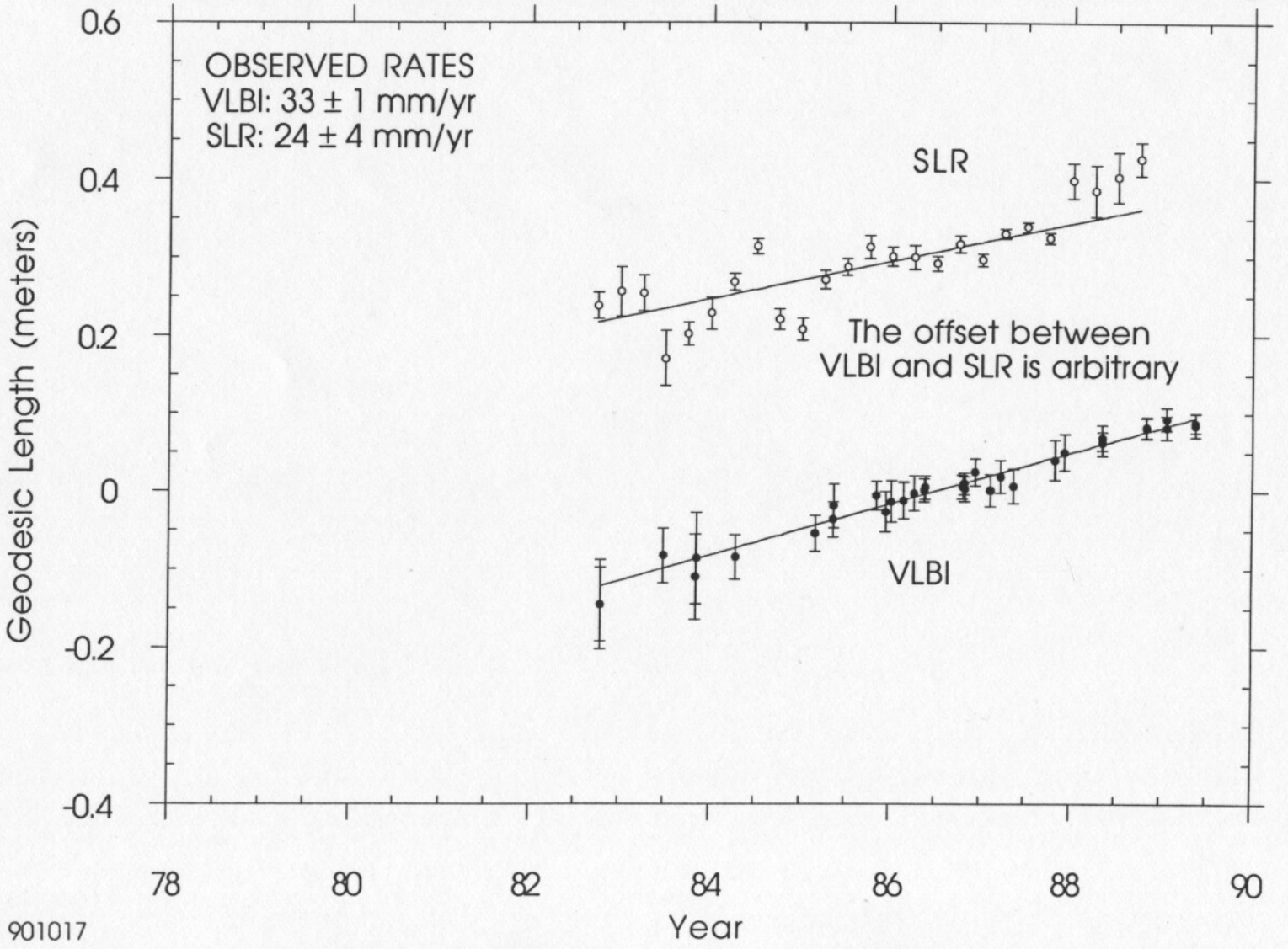
Monument Peak to McDonald/HRAS Geodesic Lengths



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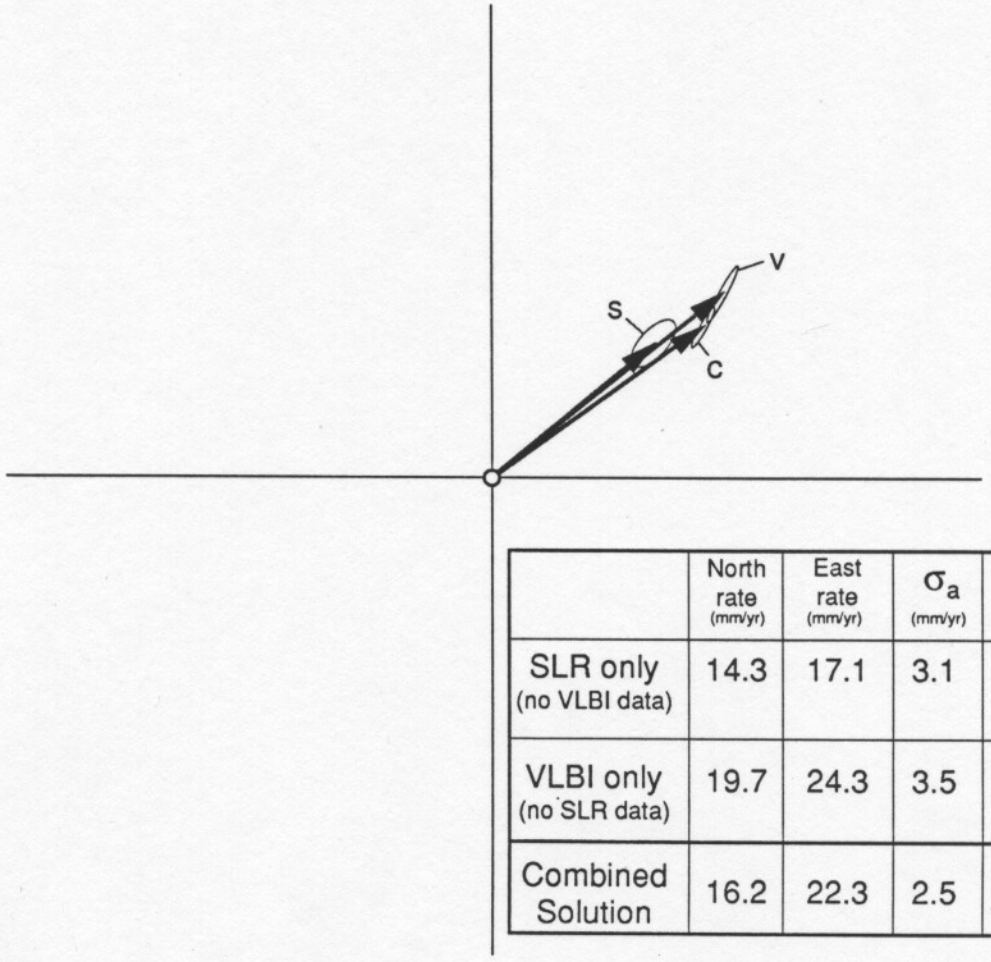
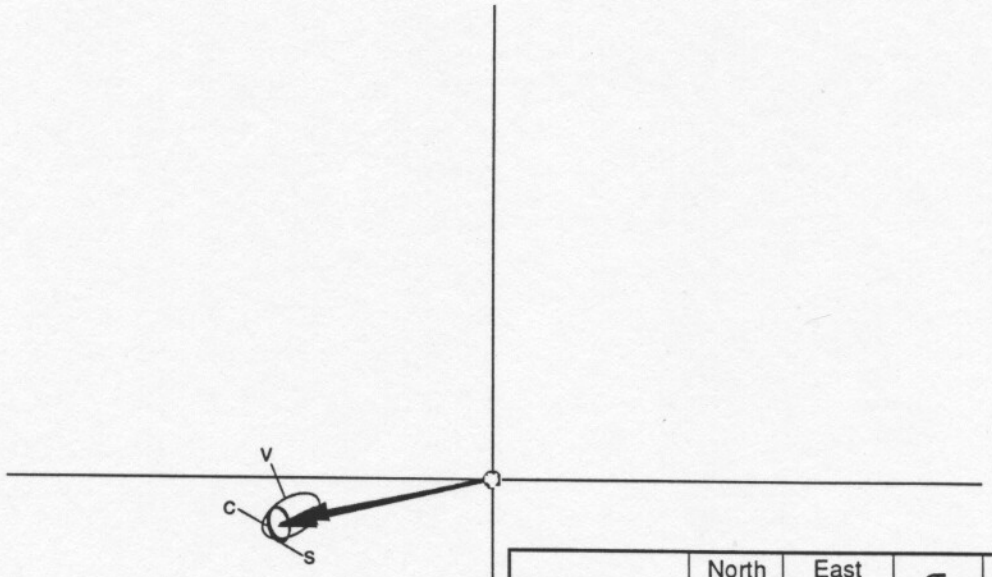
Wettzell



	North rate (mm/yr)	East rate (mm/yr)	σ_a (mm/yr)	σ_b (mm/yr)	σ_a orient.
SLR only (no VLBI data)	14.3	17.1	3.1	1.4	42.7°
VLBI only (no SLR data)	19.7	24.3	3.5	0.4	28.2°
Combined Solution	16.2	22.3	2.5	0.4	28.5°

Quincy



	North rate (mm/yr)	East rate (mm/yr)	σ_a (mm/yr)	σ_b (mm/yr)	σ_a orient.
SLR only (no VLBI data)	-5.2	-22.1	1.9	1.1	-14.8°
VLBI only (no SLR data)	-4.3	-20.9	3.3	1.9	56.6°
Combined Solution	-5.1	-22.0	1.7	1.0	-14.4°

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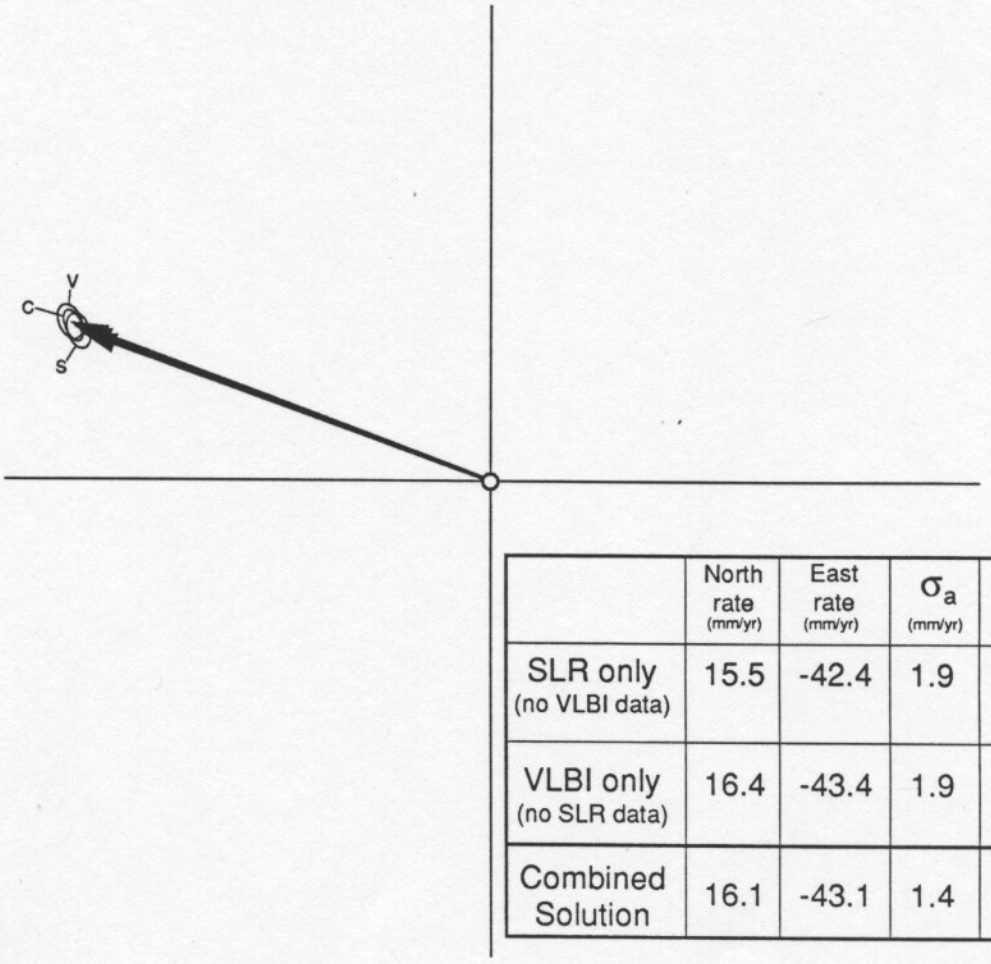
Monument Peak



	North rate (mm/yr)	East rate (mm/yr)	σ_a (mm/yr)	σ_b (mm/yr)	σ_a orient.
SLR only (no VLBI data)	15.5	-42.4	1.9	1.1	-19.4°
VLBI only (no SLR data)	16.4	-43.4	1.9	1.2	-23.8°
Combined Solution	16.1	-43.1	1.4	0.8	-23.1°

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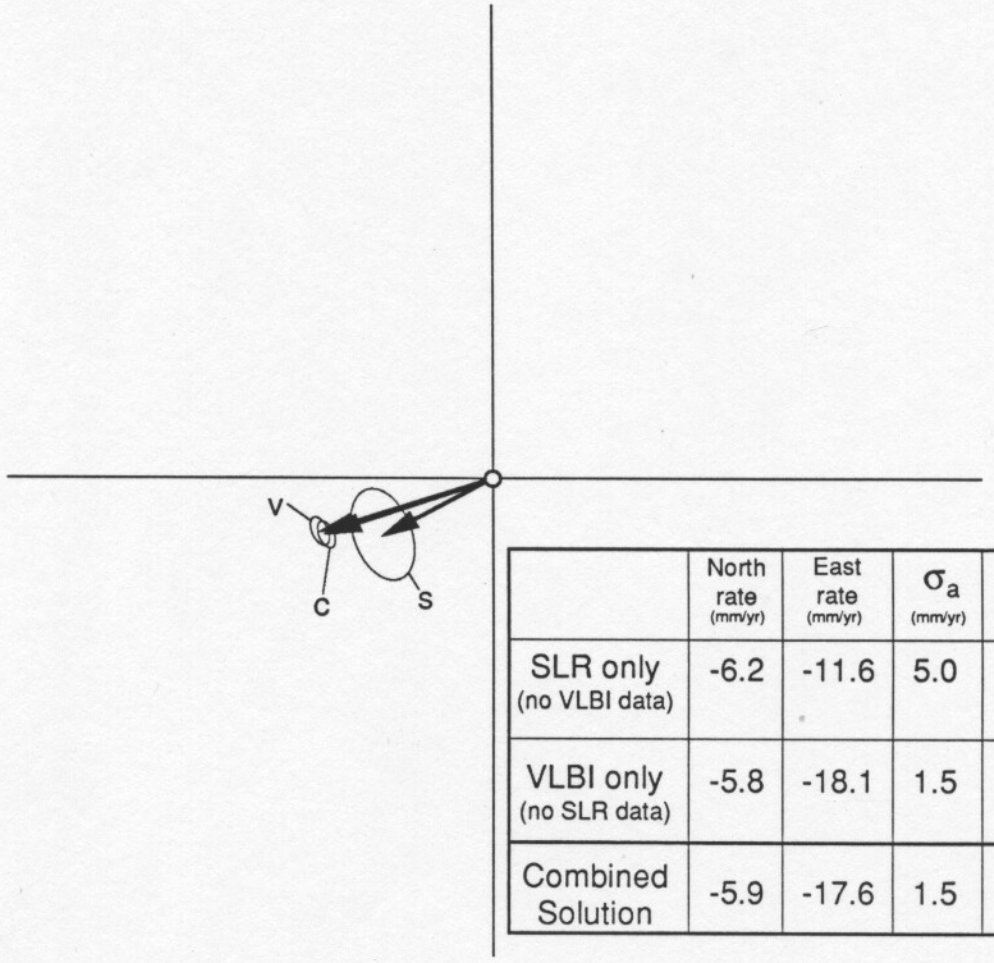
Platteville



	North rate (mm/yr)	East rate (mm/yr)	σ_a (mm/yr)	σ_b (mm/yr)	σ_a orient.
SLR only (no VLBI data)	-6.2	-11.6	5.0	3.0	-20.2°
VLBI only (no SLR data)	-5.8	-18.1	1.5	0.8	-24.0°
Combined Solution	-5.9	-17.6	1.5	0.8	-23.2°

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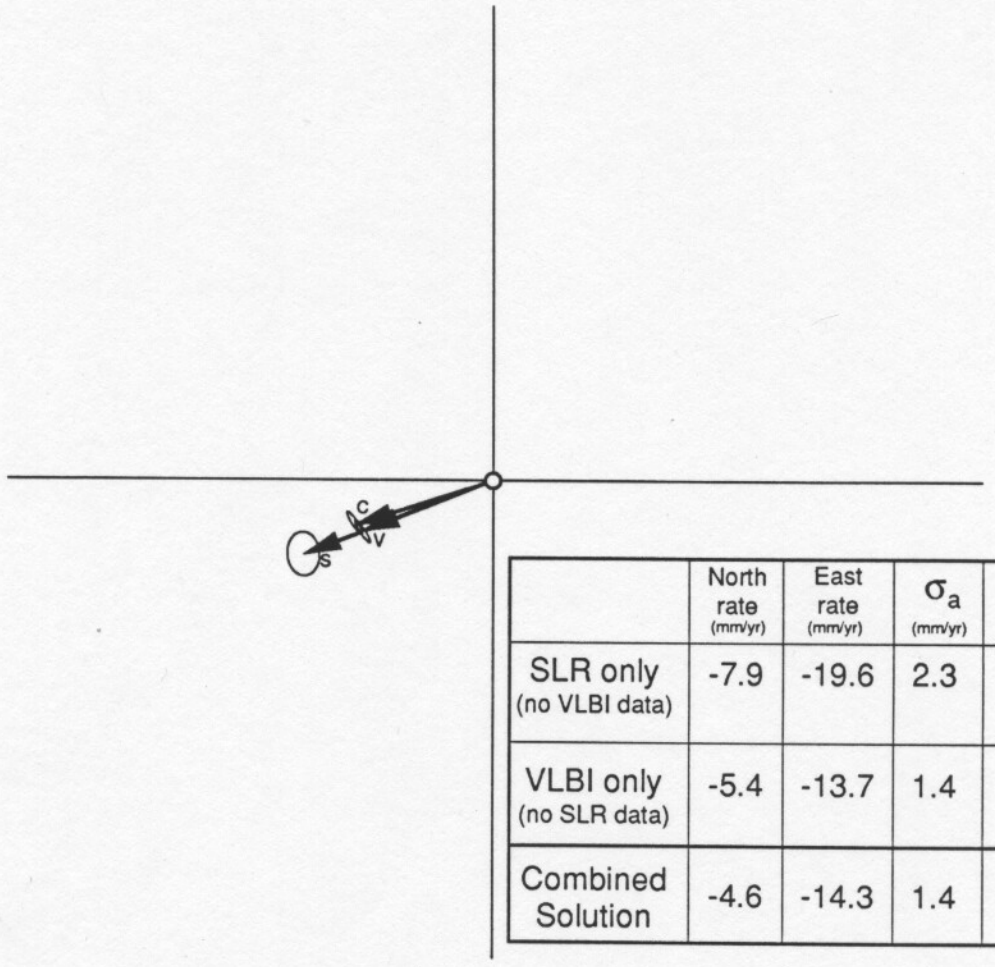
McDonald Obs. - HRAS



	North rate (mm/yr)	East rate (mm/yr)	σ_a (mm/yr)	σ_b (mm/yr)	σ_a orient.
SLR only (no VLBI data)	-7.9	-19.6	2.3	1.7	-3.8°
VLBI only (no SLR data)	-5.4	-13.7	1.4	0.3	-33.5°
Combined Solution	-4.6	-14.3	1.4	0.3	-33.3°

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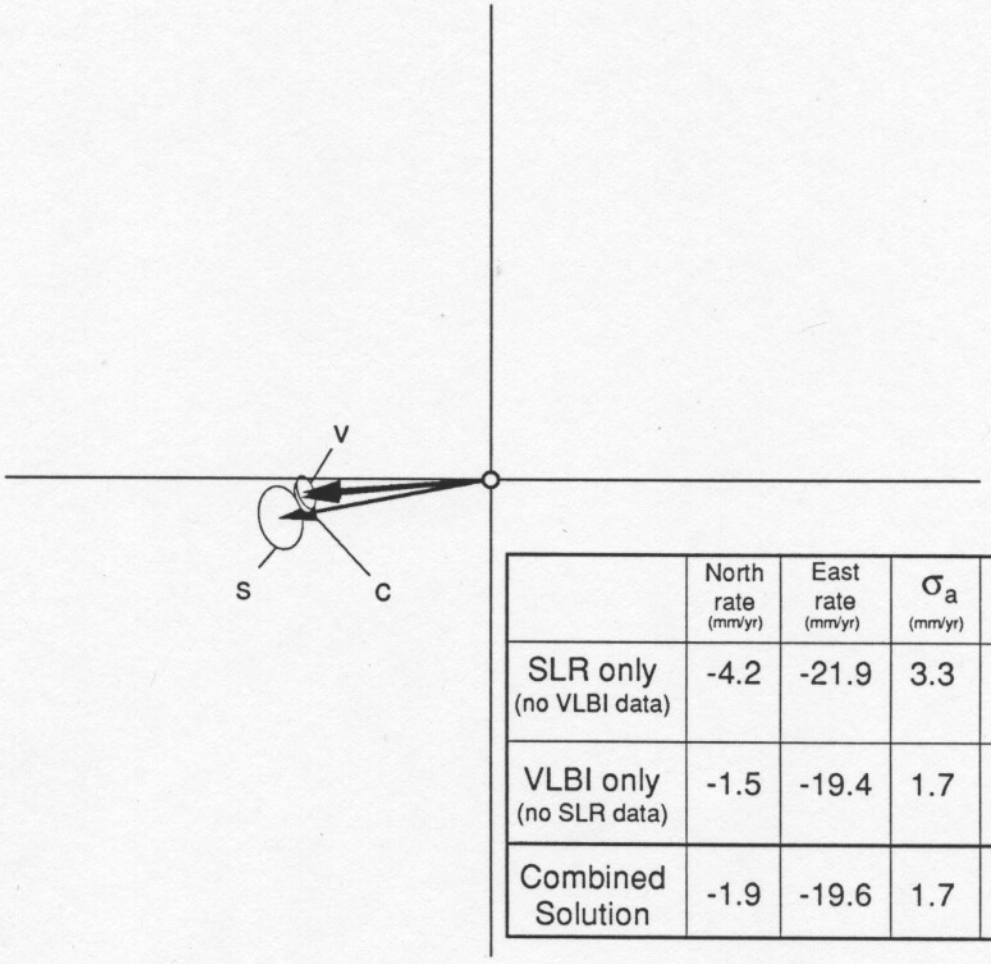
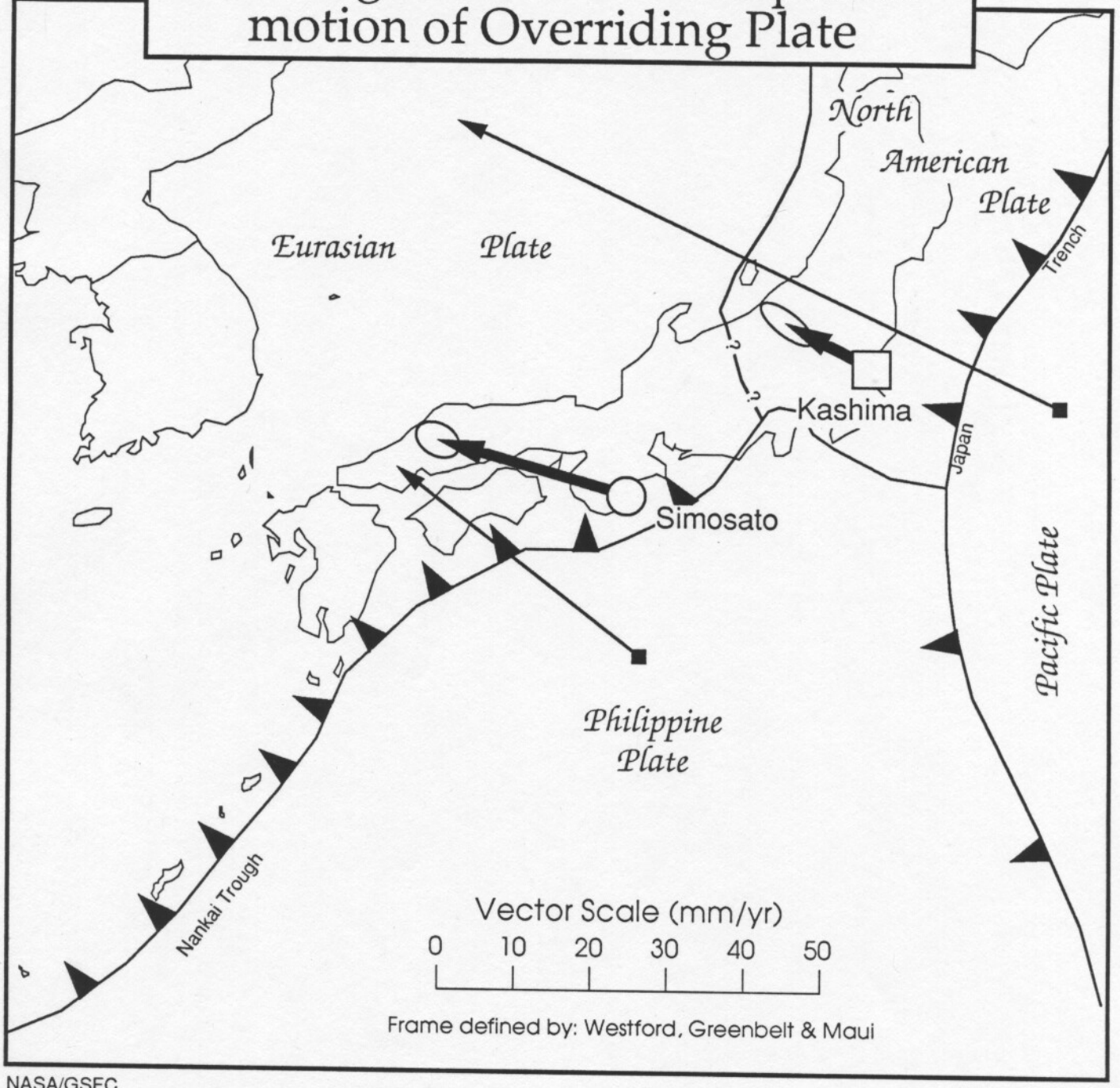
Owens Valley



	North rate (mm/yr)	East rate (mm/yr)	σ_a (mm/yr)	σ_b (mm/yr)	σ_a orient.
SLR only (no VLBI data)	-4.2	-21.9	3.3	2.2	-12.2°
VLBI only (no SLR data)	-1.5	-19.4	1.7	0.8	-20.5°
Combined Solution	-1.9	-19.6	1.7	0.8	-20.4°

Motion of Japanese Space Geodetic Tracking Stations with respect to motion of Overriding Plate



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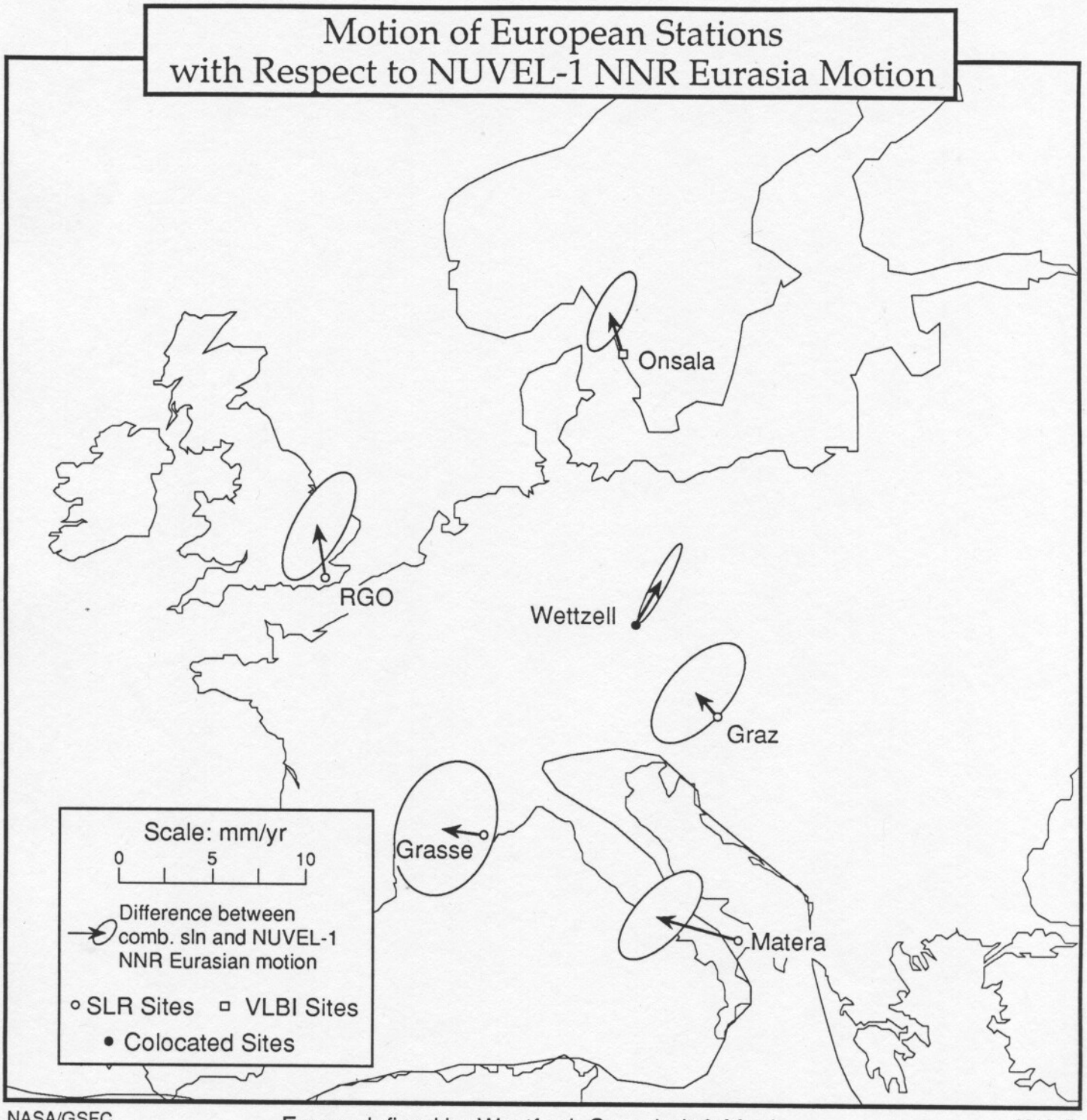
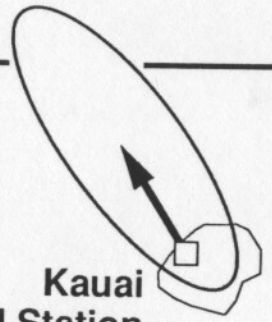

Motion of European Stations
with Respect to NUVEL-1 NNR Eurasia Motion
Onsala
RGO
Wettzell
Graz
Grasse
Matera
Scale: mm/yr
0
5
10
Difference between
comb. sln and NUVEL-1
NNR Eurasian motion
SLR Sites
VLBI Sites
Colocated Sites
NASA/GSFC
Frame defined by Westford, Greenbelt & Maui
901015

Motion of Hawaiian Stations with Respect to NUVEL-1 Model



Kauai
VLBI Station

Oahu

Molokai

Lanai

Maui
SLR Station
(Constrained)

Vector Scale (mm/yr)

0 2 4 6 8

Hawaii

Geodynamic frame defined by: Greenbelt, Maui & Westford

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901017

Conclusions

- SLR and VLBI geodesic rates between sites which share tracking technologies are largely in agreement at the single standard deviation level.

- A site-by-site sensitivity analysis indicates that the solution incorporates the strengths of each technology in estimating the site velocities.

- The sites in Japan clearly exhibit components of distributed strain associated with the offshore subduction of the Philippine and Pacific Plates.

- The residual motion of Maui and Kauai taken with respect to NUVEL-1 Pacific motion indicate that no significant motion is taking place at the one standard deviation level of uncertainty.

- Across Europe, no significant departure from NUVEL-1 Eurasian motion is detected at the one standard deviation level.

- This work is a "zeroth order" attempt. A more rigorous approach of combining normal equations in a solution to estimate site velocities is planned.