Horizontal Motions from Combining SLR & VLBI Intersite Rates

GSFC SLR & VLBI
Analyses Groups

Presented to
The 17th Crustal Dynamics Working Group Meeting
Greenbelt, MD
October 24-25, 1989

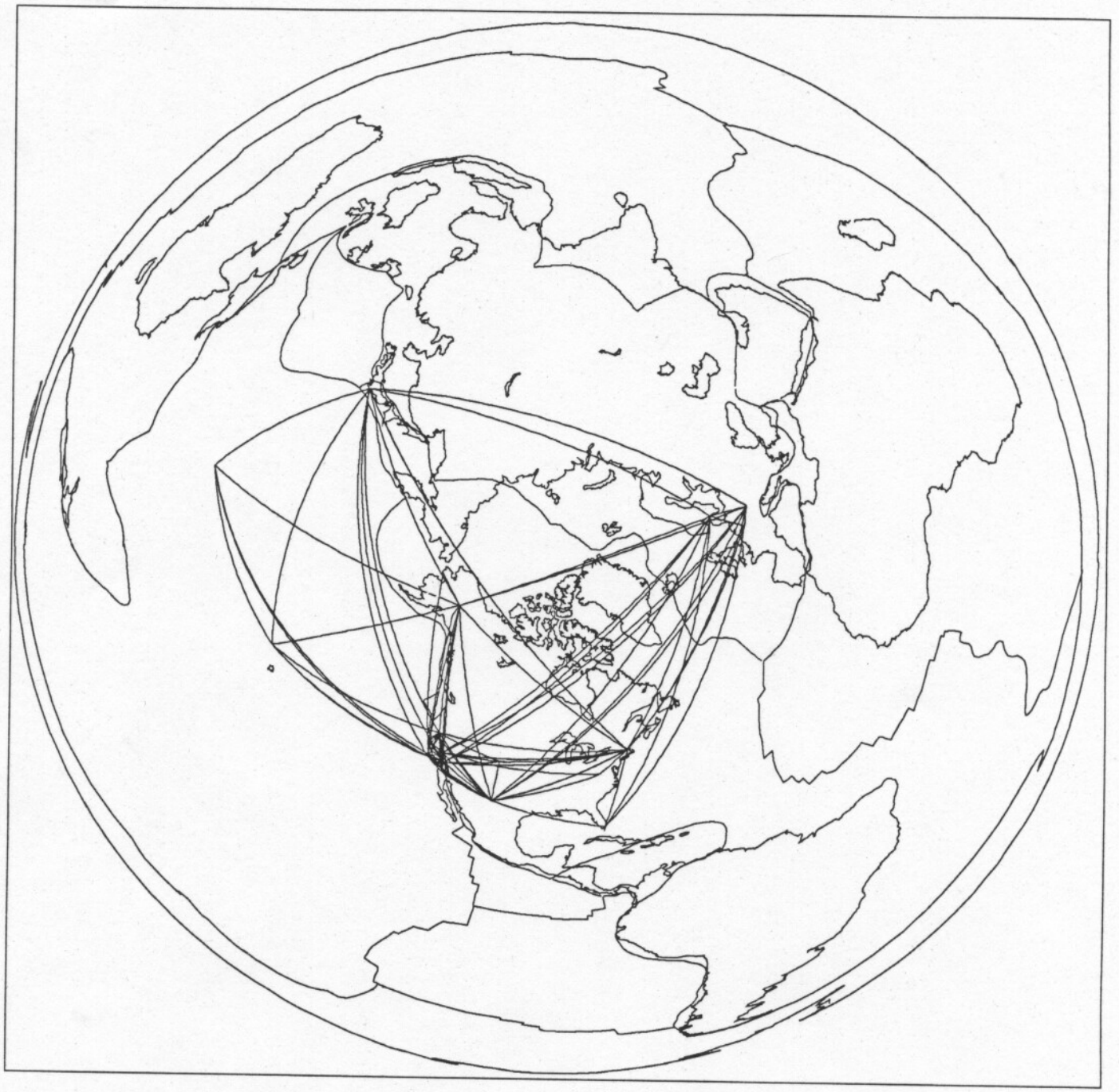
Introduction

- In this study, intersite rate information from SLR and VLBI is combined in a least-squares adjustment to yield velocity vectors in a unified reference frame.
- This study utilizes "raw" baseline rate information from the SL7.1 - CAN1 SLR solution and the GLB405 VLBI solution.

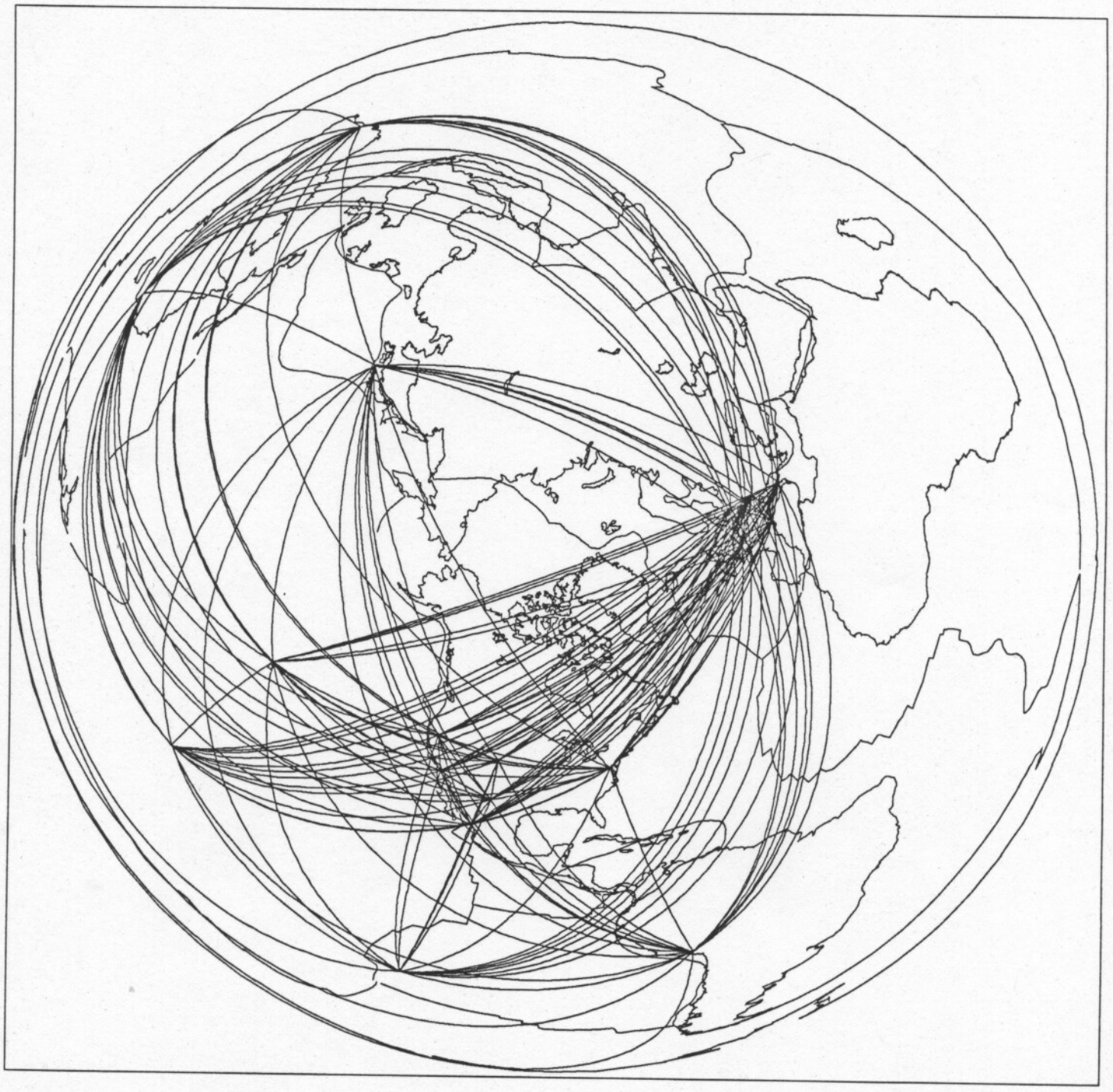
Assumptions

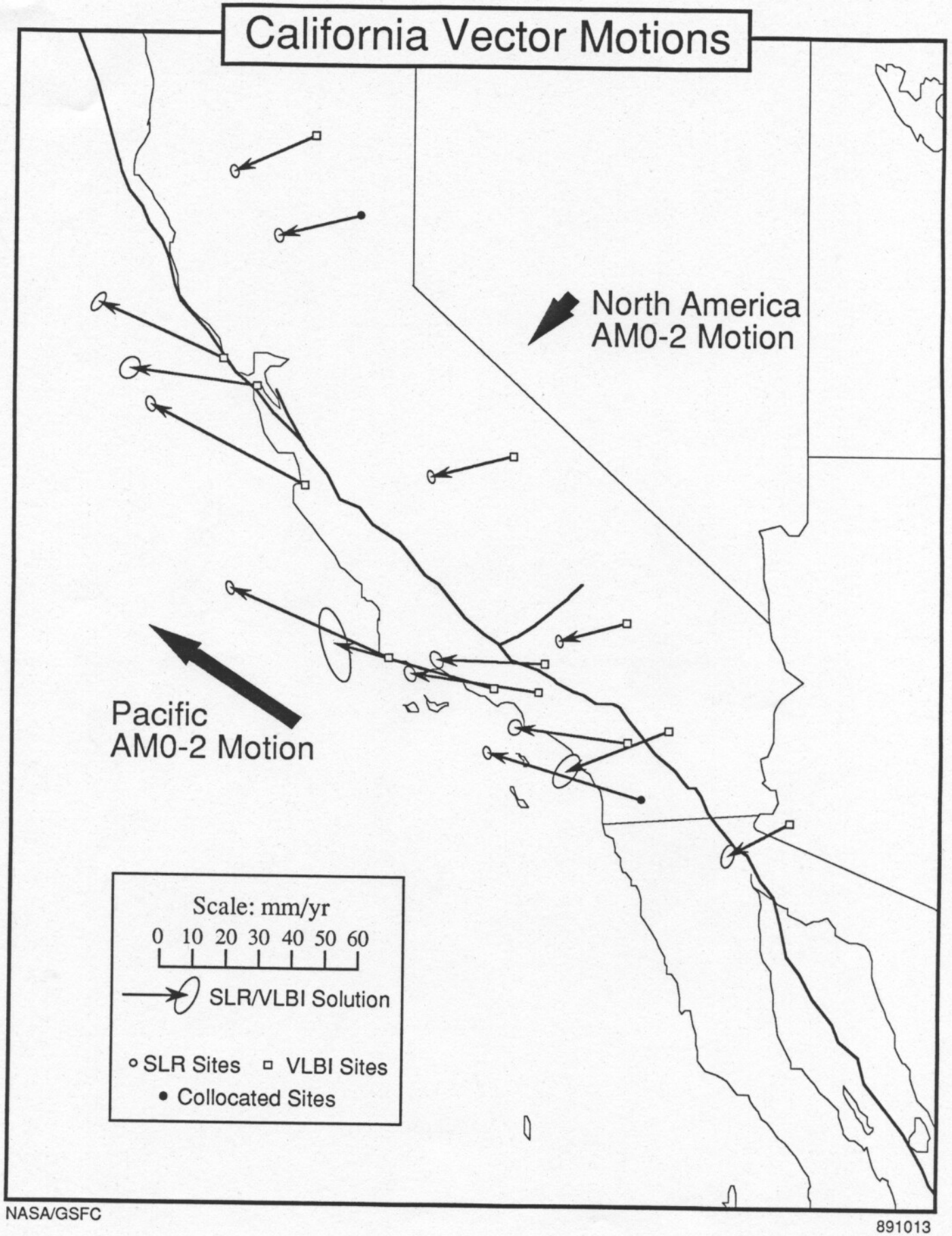
- Five sites link the SLR and VLBI networks: McDonald-HRAS, Platteville, Quincy, Monument Peak and Wettzell.
- Reference frame adopted is similar to that used in previous SLR reports: AM0-2 motion adopted at Greenbelt, Maui and Kauai. Motions for the remaining 41 SLR and VLBI stations are referenced in this frame.

Lines connecting VLBI stations for which
there is rate information from the GLB405 solution



Lines connecting SLR stations for which
there is rate information from the QRA1CAN1 solution





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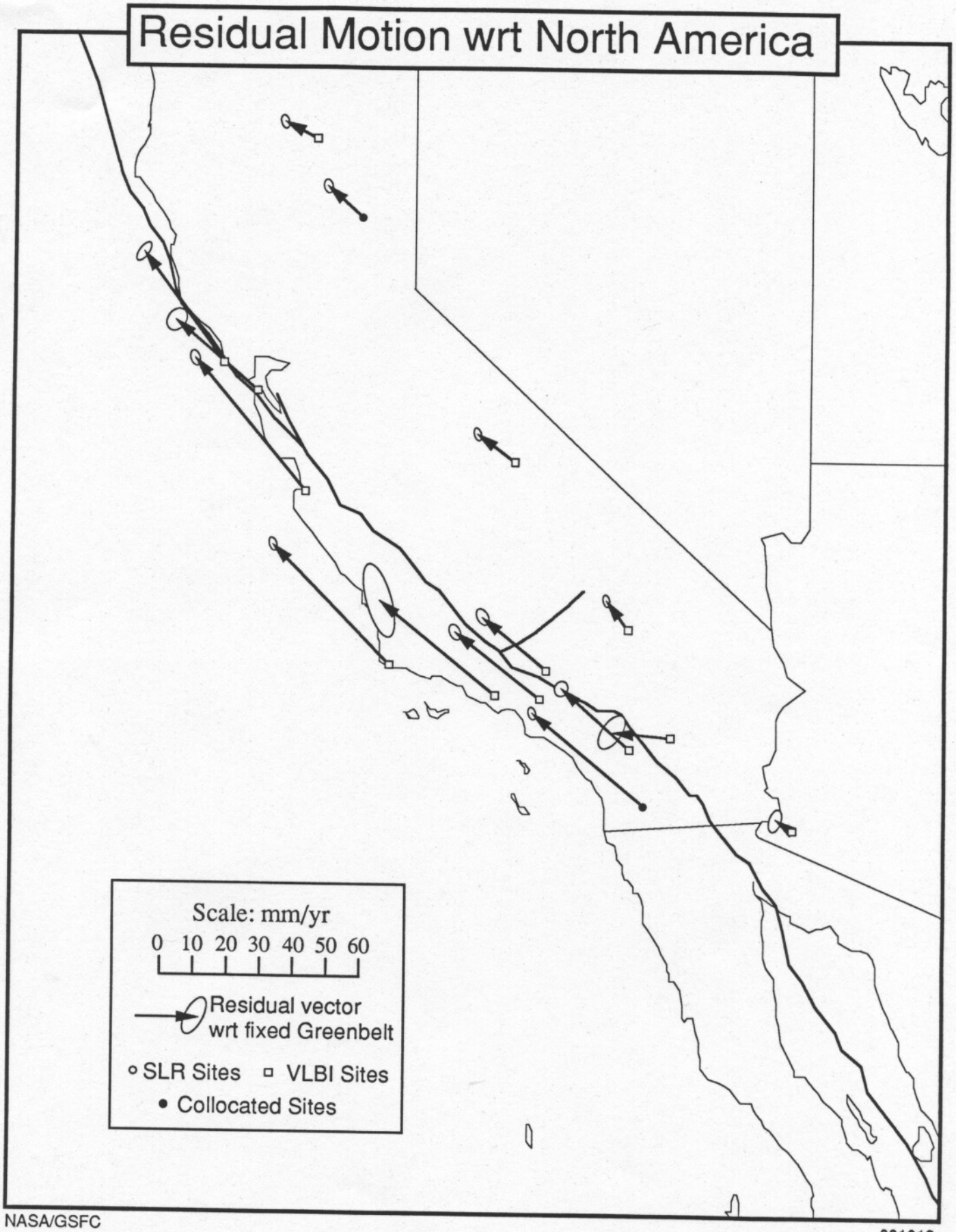
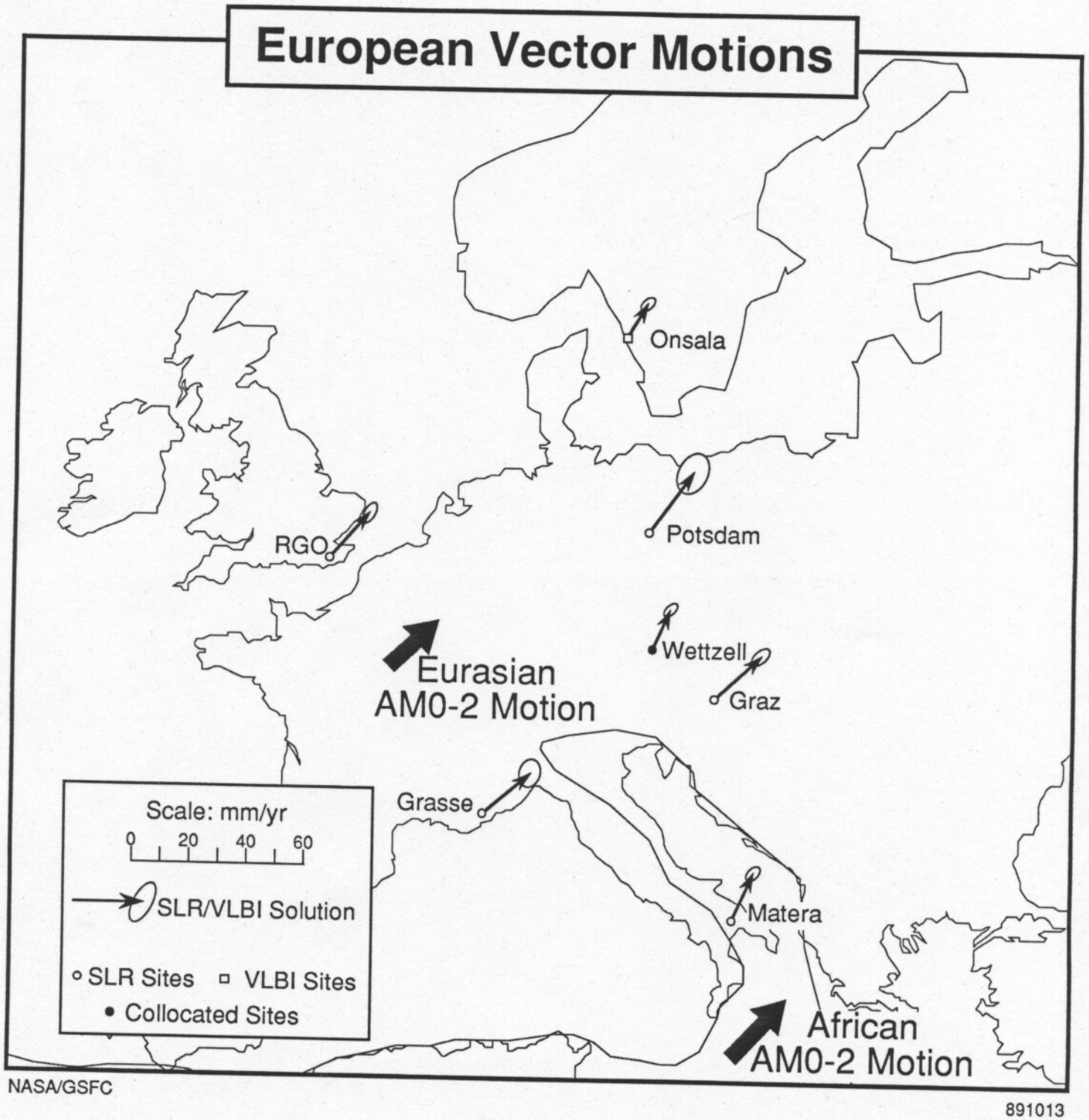

Residual Motion wrt North America
Scale: mm/yr
0 10 20 30 40 50 60
Residual vector
wrt fixed Greenbelt
SLR Sites
VLBI Sites
Collocated Sites
NASA/GSFC
891013


European Vector Motions
Onsala
Potsdam
RGO
Wettzell
Graz
Eurasian
AM0-2 Motion
Grasse
Matera
African
AM0-2 Motion
Scale: mm/yr
0 20 40 60
SLR/VLBI Solution
SLR Sites
VLBI Sites
Collocated Sites
NASA/GSFC
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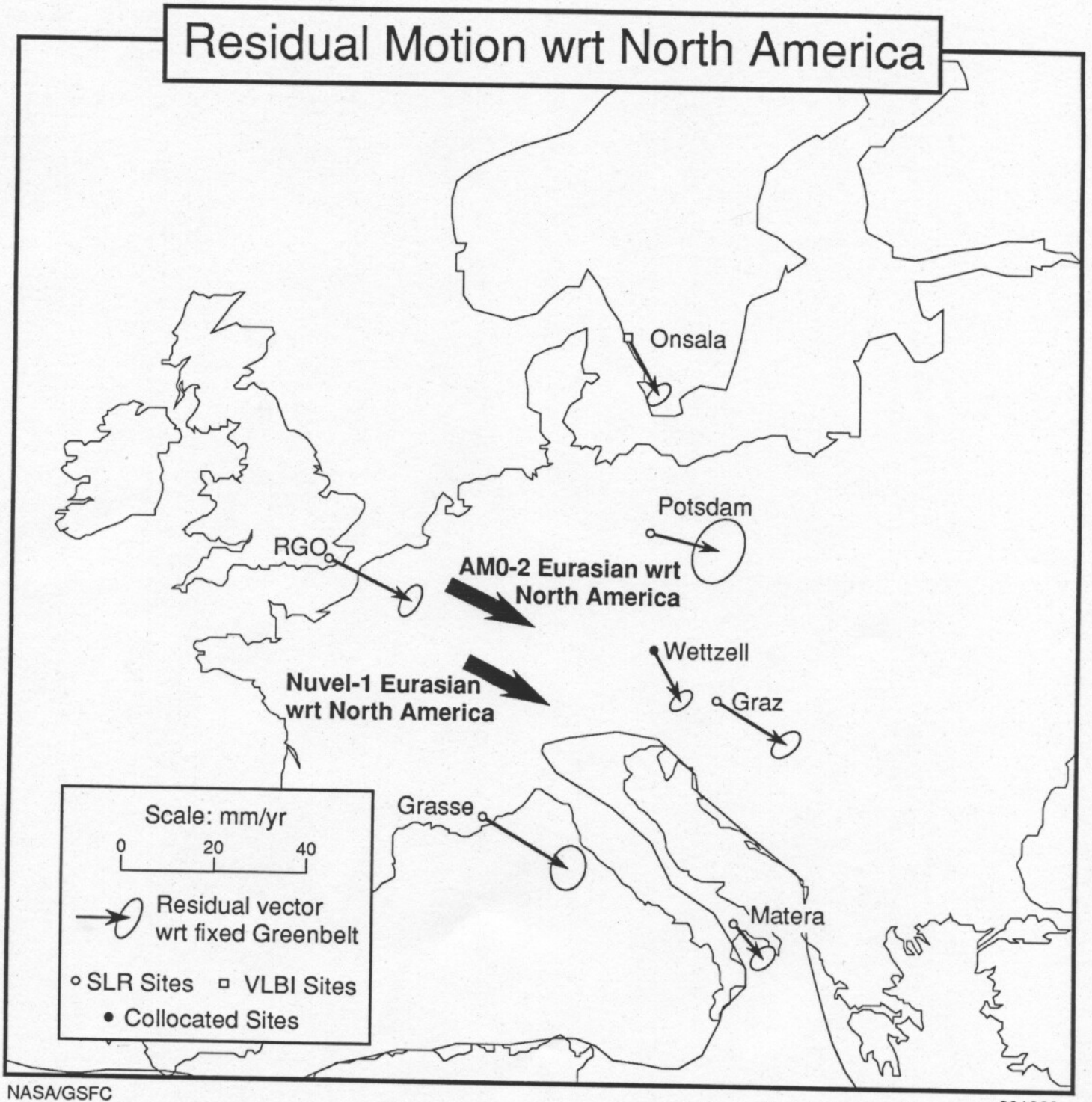
Residual Motion wrt North America
Onsala
Potsdam
RGO
AM0-2 Eurasian wrt
North America
Wettzell
Graz
Nuvel-1 Eurasian
wrt North America
Grasse
Matera
Scale: mm/yr
0
20
40
Residual vector
wrt fixed Greenbelt
SLR Sites
VLBI Sites
Collocated Sites
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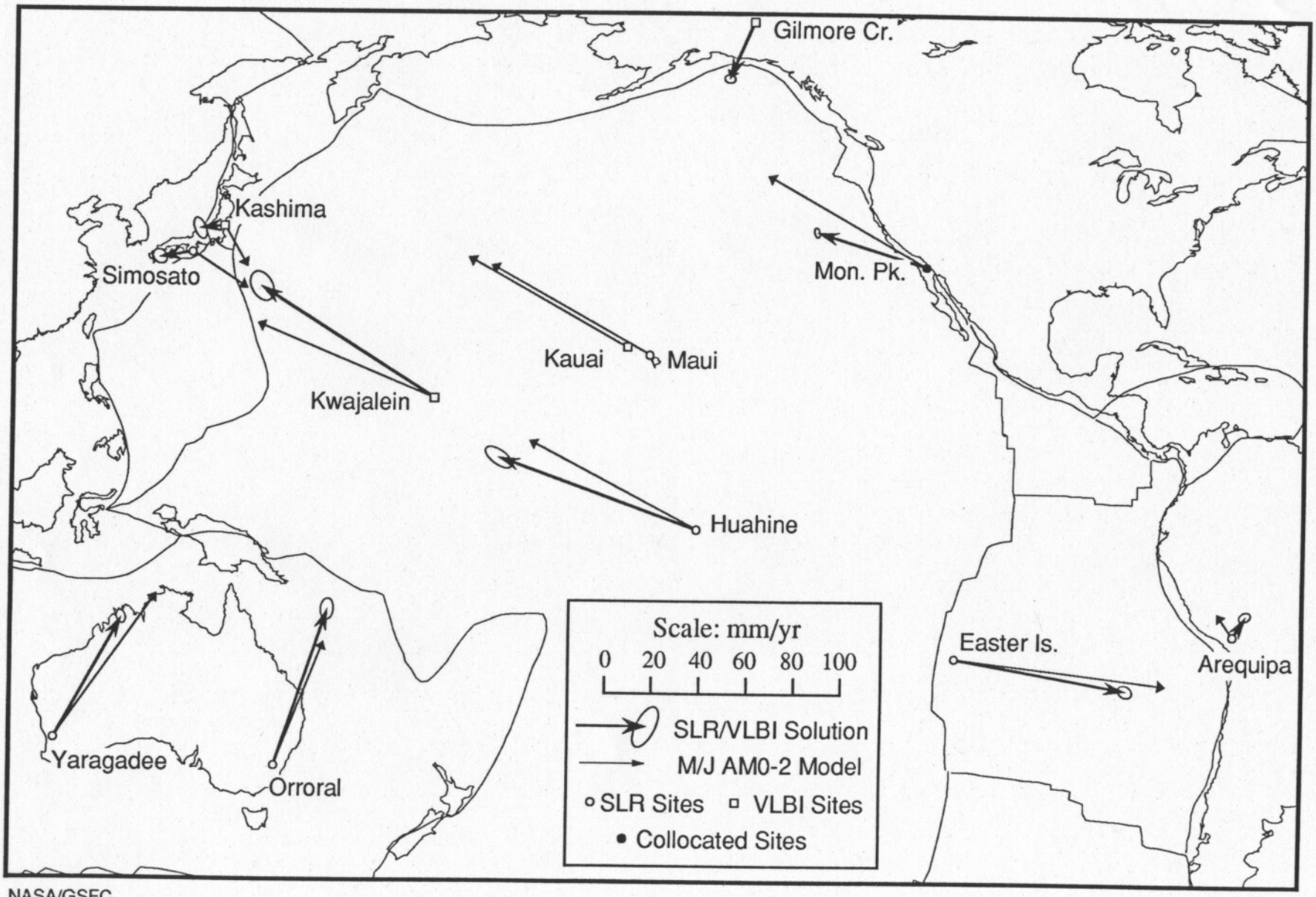
Pacific Basin Vector Motions



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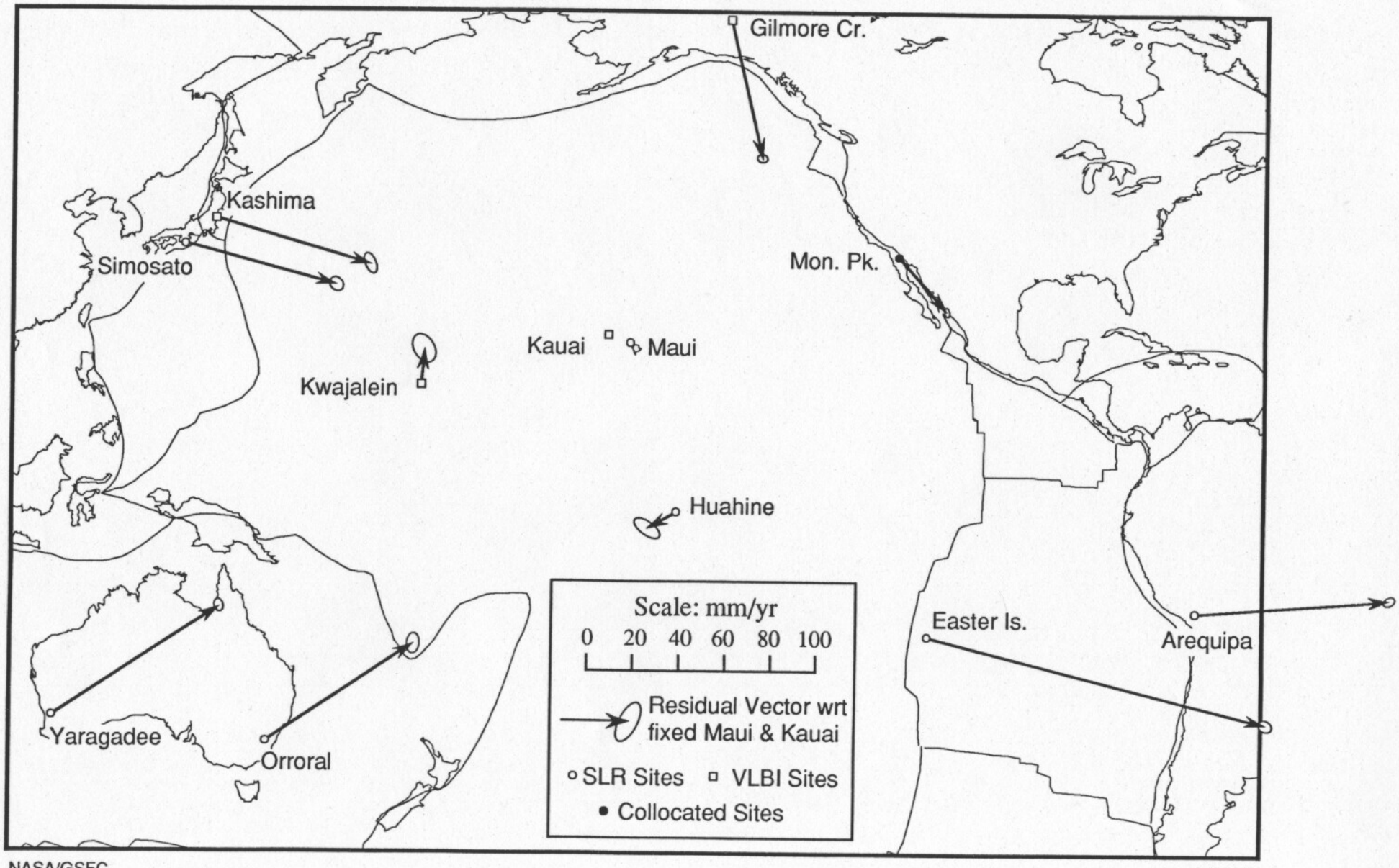
Residual Motion wrt Fixed Maui & Kauai



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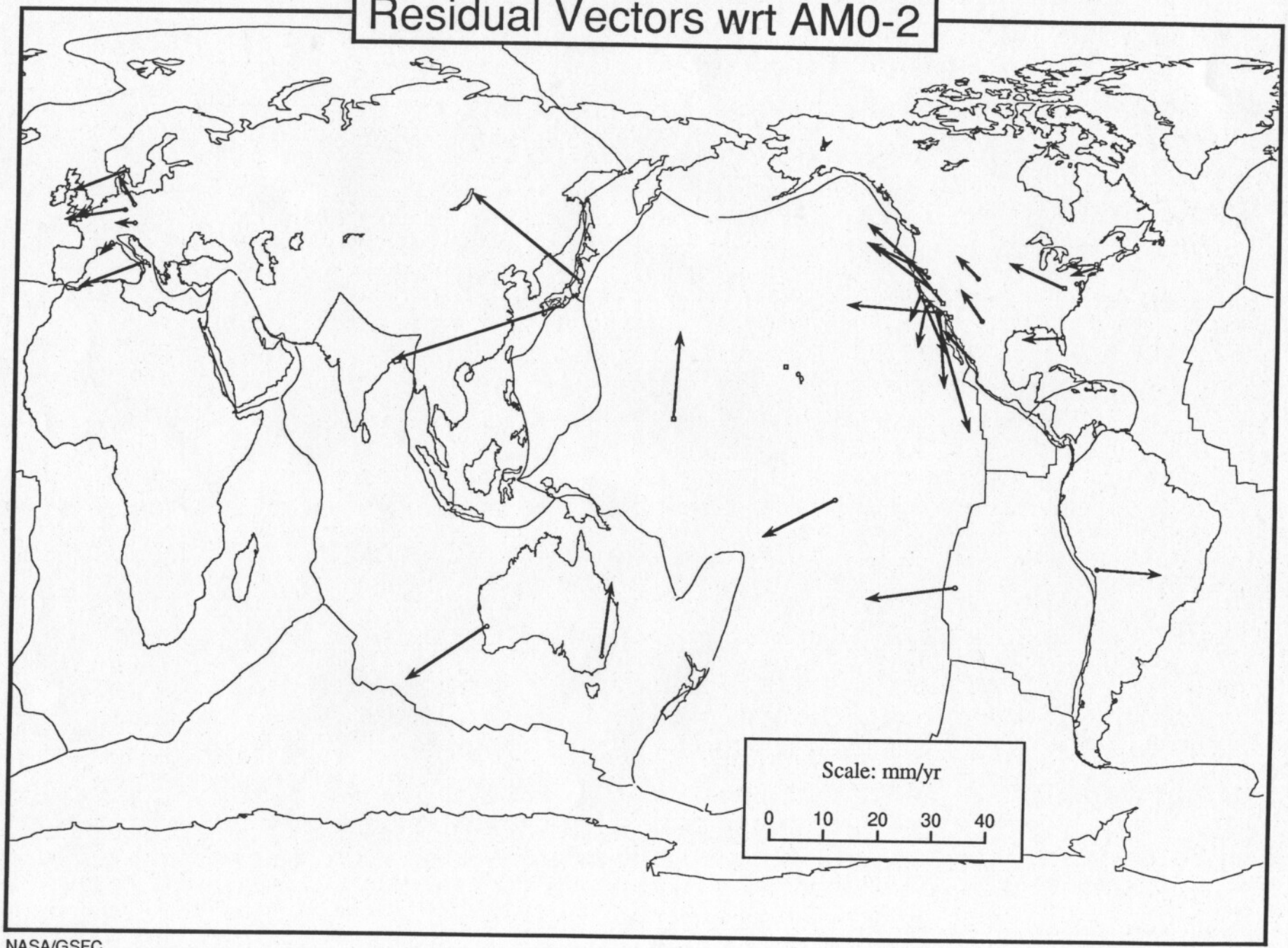
Residual Vectors wrt AM0-2



NASA/GSFC

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Summary & Conclusions

- Relative rate information from SLR & VLBI is combined in a least-squares determination of vector motions given in a uniform reference frame.
- In California, the VLBI network is quite dense and shows the change of motion as one goes across the North America-Pacific Plate boundary zone.
- In Europe, the VLBI rate information to Onsala and Wettzell differ from the SLR rate information and is causing deviations of these two sites with respect to other SLR sites. The root of this problem is currently under investigation but could be due to weighting conflicts. The remaining sites in Europe show very stable behavior.
- In the Pacific Basin, the Japanese sites exhibit substantial similarities in direction. Slight extension between Simosato and Kashima is implied from their recovered vectors.
- Kwajelein and Huahine exhibit motion which is faster than predicted by the AM0-2 model and indicate a small rotation with respect to Kauai and Maui.
- The residual motion for global network shows that most of the sites are undergoing some level of motion with respect to AM0-2 with the largest residuals occuring near plate boundaries.

1 & 2) These figures illustrate the geographic extent of the relative rate information used in the combined solution for both the VLBI network (top) and the SLR network (bottom). The VLBI network is especially dense in Calfornia. The SLR network provides additional sites on the Nazca, South America and Australia-India Plates. The map projection is a Lambert Azimuthal Equal Area projection centered on the North Pole.

3) This figure is dominated by VLBI sites, with SLR sites located at Quincy and Monument Peak. The heavy vectors denote the general direction and magnitude implied by the AM0-2 model. Note the transition between North American motion and Pacific motion for sites that are close to the fault. Error ellipses are shown at the 67% confidence level.

4) Seen here is the residual motion for sites in California taken with respect to Greenbelt which is constrained to move with AM0-2 motion. The residual motions illustrate the transition between North American motion and Pacific motion.

5) Similar to the figure at left, this map shows the behavior of the European SLR & VLBI sites in the adopted reference frame. Wettzell and Onsala exhibit somewhat deviant behavior with respect to the remaining SLR sites. Error ellipses are shown at the 67% confidence level.

6) This figure, like Fig. 4, shows the residual vector taken with respect to Greenbelt moving with North American AM0-2 motion. The two heavy vectors show the relative motion for the Eurasian Plate with respect to North America for both the AM0-2 model and the Nuvel-1 model.

7) Vector motions for sites in and around the Pacific Basin are shown. The directions of the vectors at Kashima and Simosato are remarkably similar. They both depart dramatically from AM0-2 North American and Eurasian plate motion respectively. Kwajalein and Huahine exhibit motion which is faster than that implied by AM0-2. Gilmore Creek, Alaska exhibits AM0-2 motion within its error ellipse. Error ellipses are shown at the 67% confidence level.

8) Residual motion vectors are shown in this figure, much like those seen in Figs. 4 & 6 except now they are plotted with respect to Maui and Kauai's adopted AM0-2 motion. A slight rotation within the Pacific is implied by the residual vectors at Huahine and Kwajelein. Also, the collision of the Pacific with Japan, Australia and Alaska is easily inferred. Spreading in the East Pacific Rise is dramatically illustrated by the rapid relative motion of Easter Island.

9) On this map, the residual motion as taken with respect to each site's corresponding motion implied by the AM0-2 model is plotted. The diagram provides a qualitative means to assess the misclosure; e.g., if all of the SLR & VLBI sites were behaving exactly as implied by AM0-2, then the resulting vectors would appear as dots.