Comparison of Satellite Laser Ranging Station Motion with Geological Predictions

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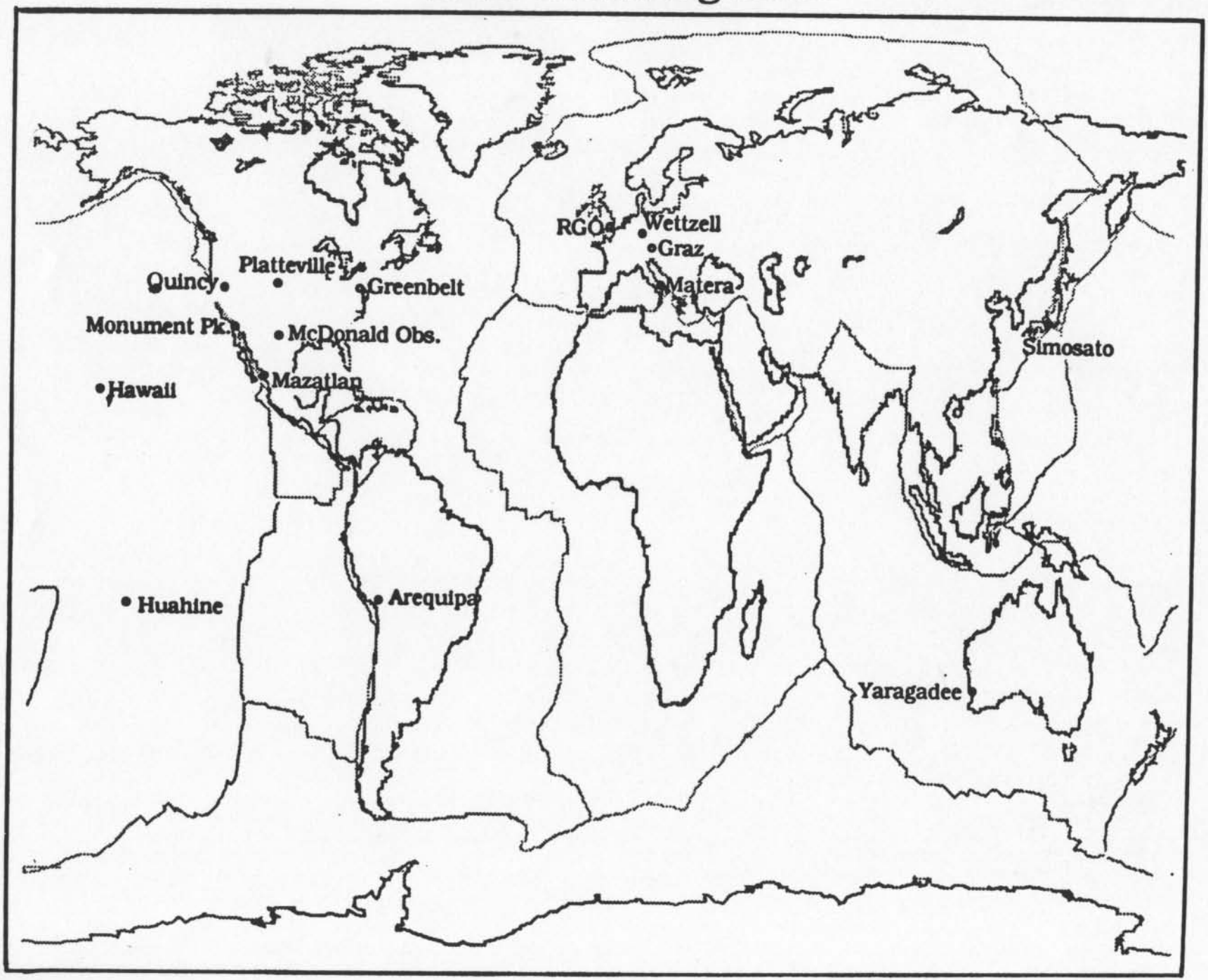
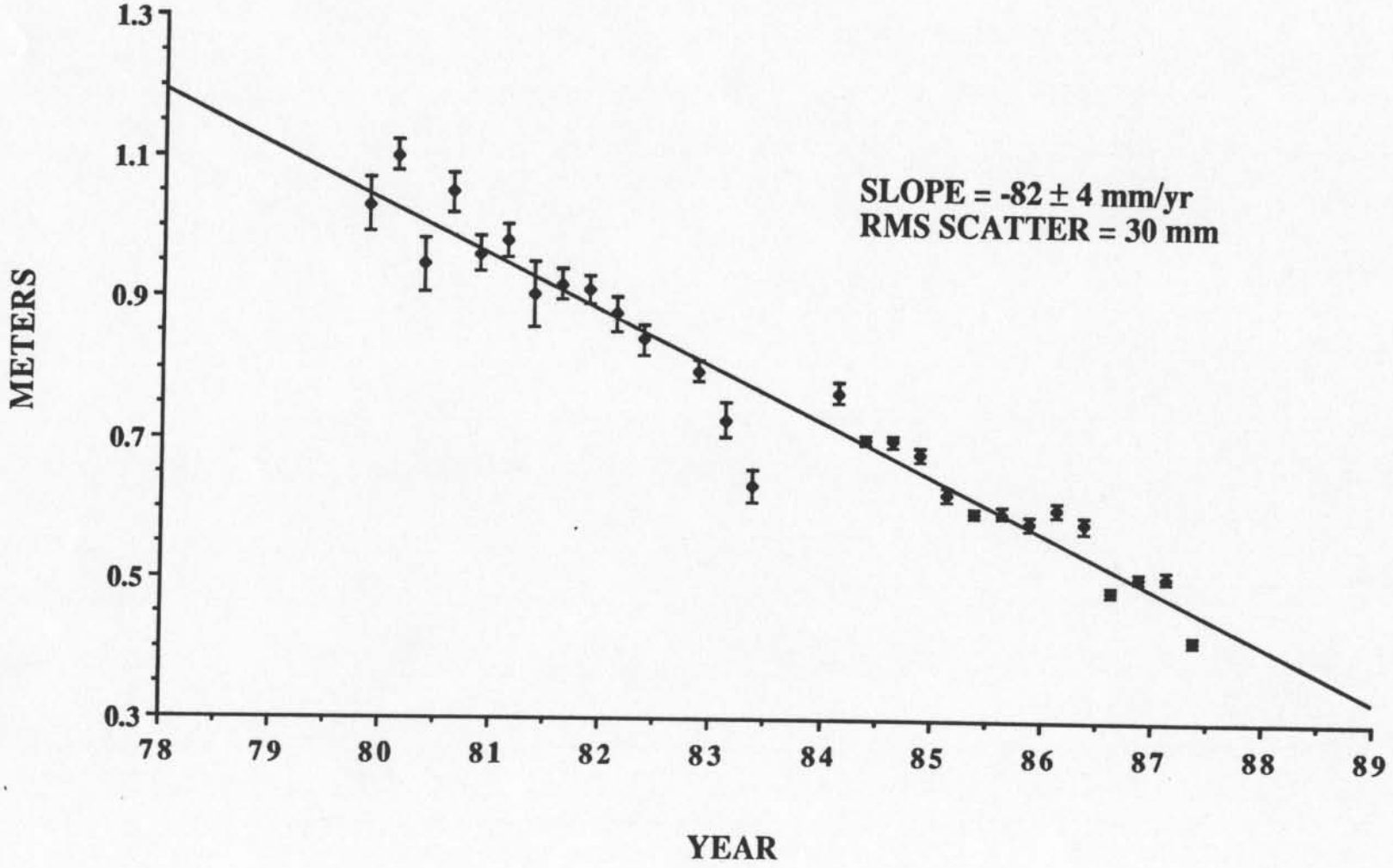
The global network of LAGEOS satellite laser ranging (SLR) stations includes a dozen sites which have collected enough observations to establish their relative rate of motion to better than 10 mm/year. They are located on the North American, Austro-Indian, Pacific, European, and South American tectonic plates, and their movements have been compared with those predicted by the Minster Jordan AM0-2 tectonic motion model. Discrepancies of more than 20 mm/year between the SLR measurements and the geological model predictions are observed in the Southern Pacific and in the Western United States. General agreement between the observations and the model are found elsewhere, and less than 10 percent of the inter-station baselines differ by more than 20 mm/year. The locations at which there are significant differences with the predictions have provided alternative motion models for those regions.

SLR Tracking Sites



YARRAGADEE TO GREENBELT

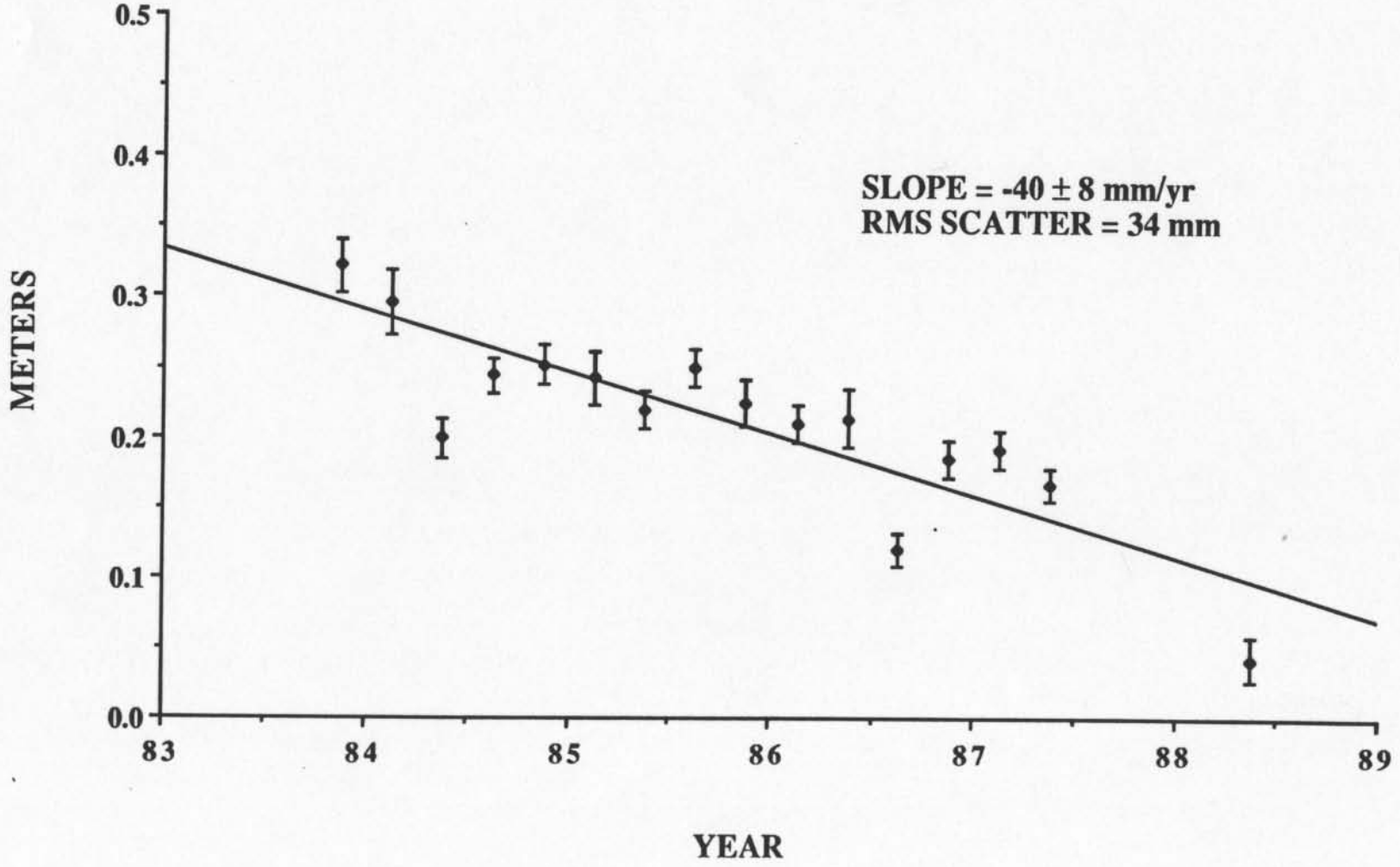
GEODESIC DISTANCE



SL7.1 QRA1BAN1 EDT

SIMOSATO TO GREENWICH

GEODESIC DISTANCE



SL7.1 QRA1BAN1 EDT

YARRAGADEE TO GREENBELT
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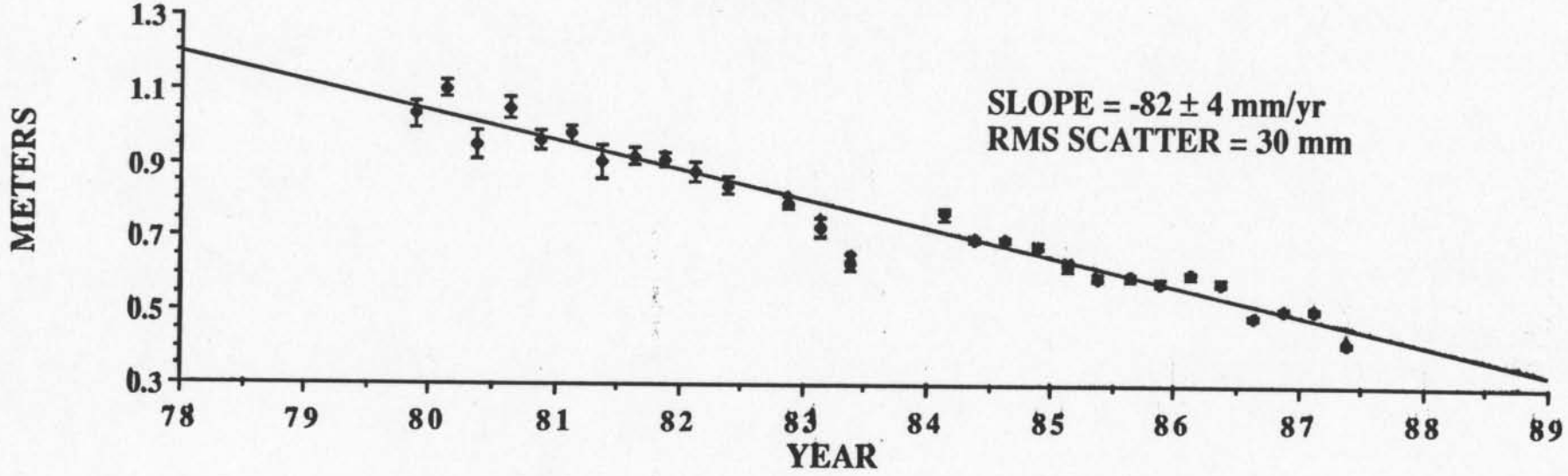
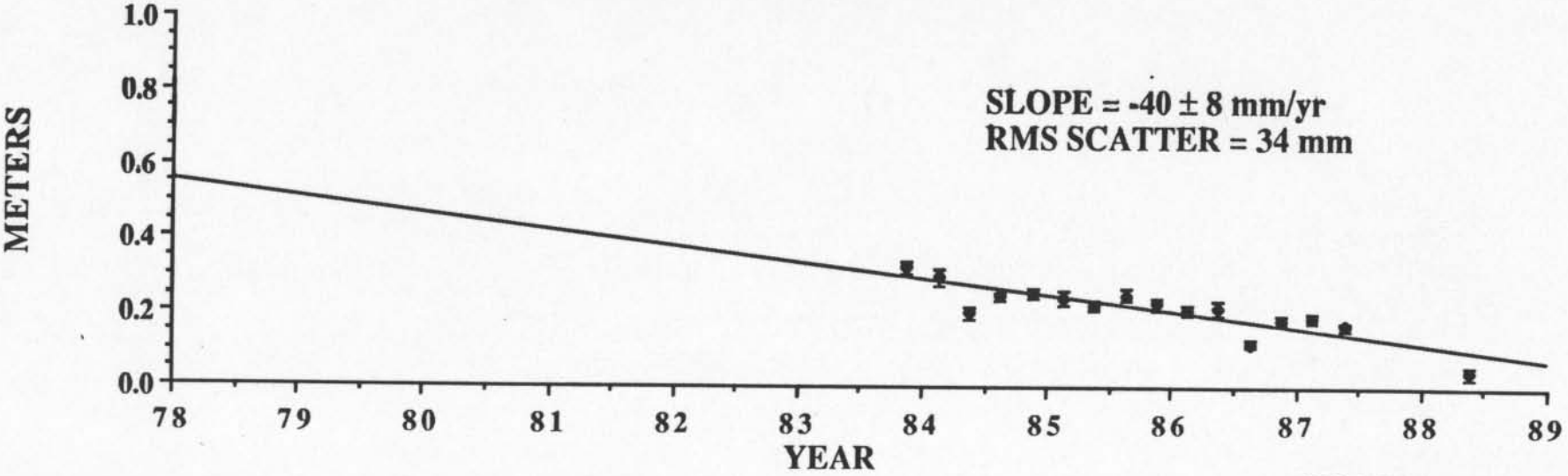


SIMOSATO TO GREENWICH
GEODESIC DISTANCE



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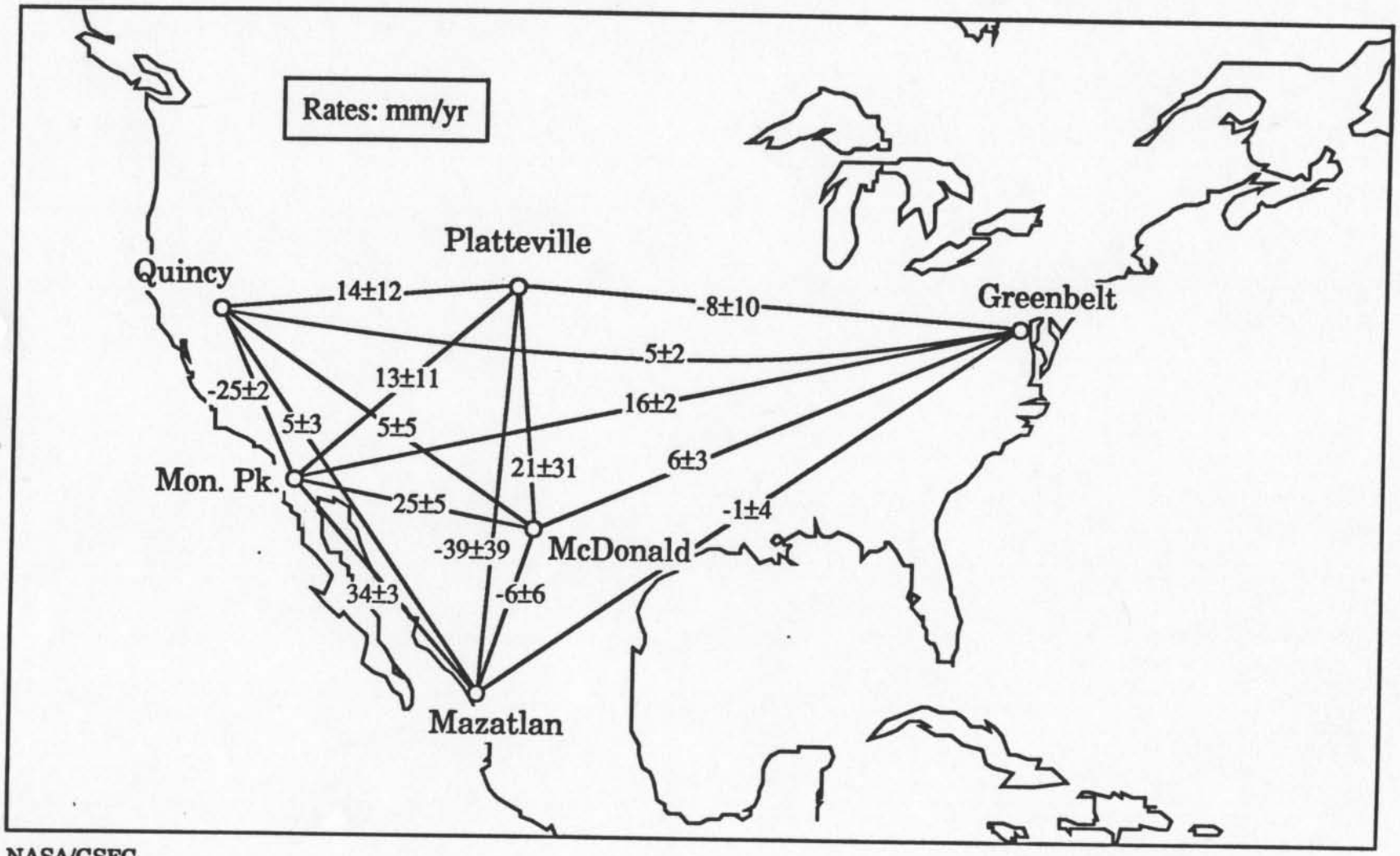
Observed Geodesic Rates



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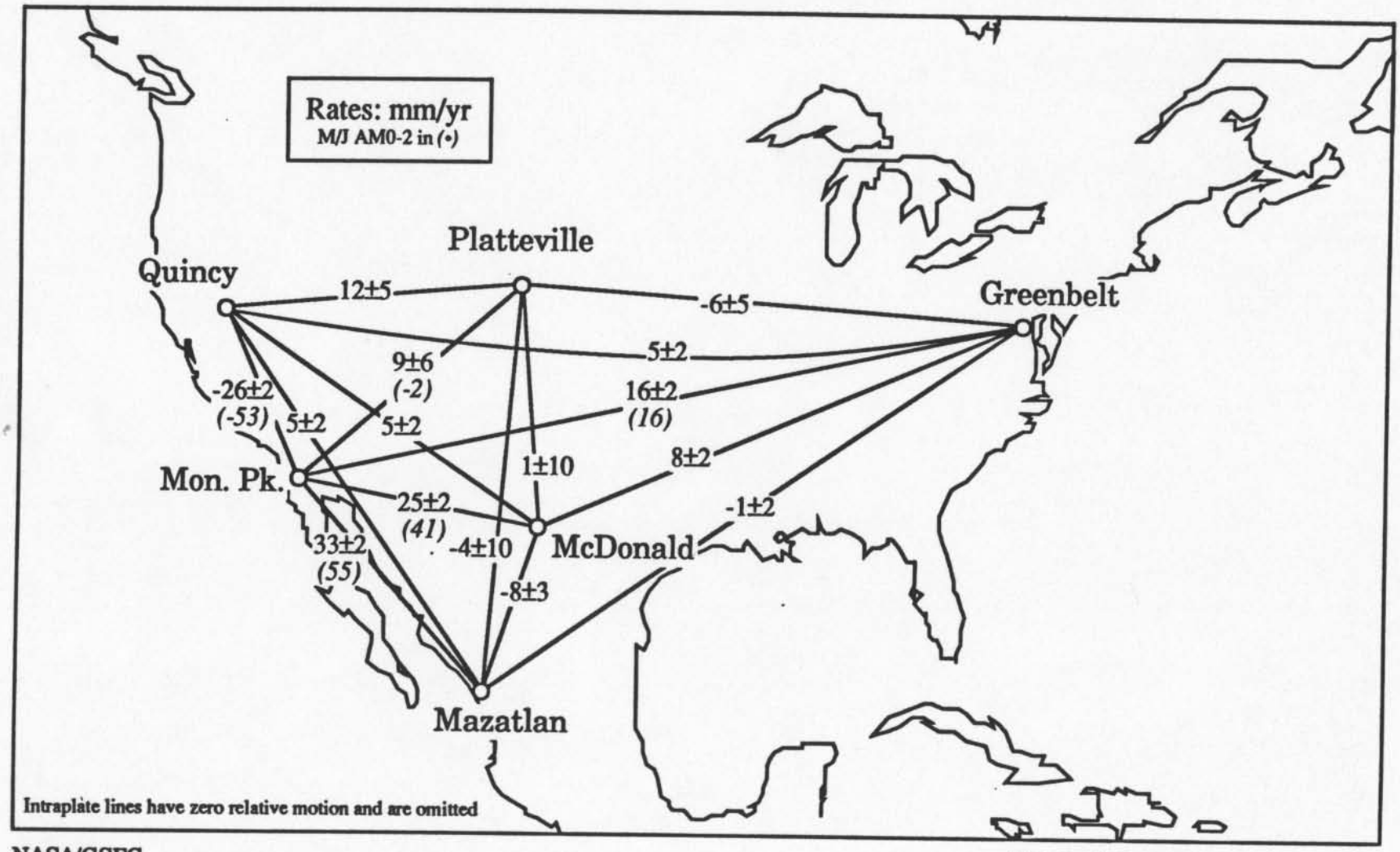
Geodesic Rates from SLR



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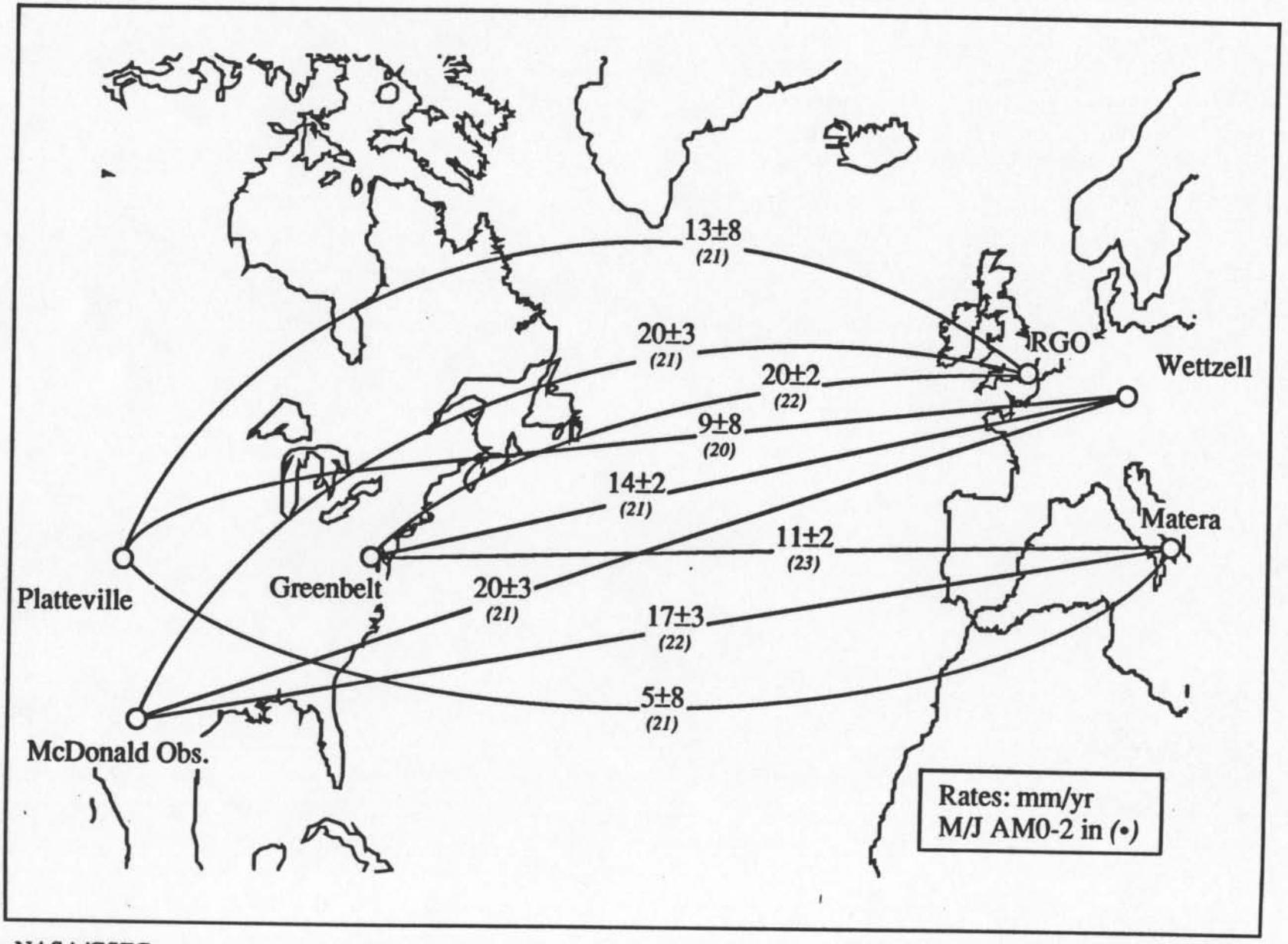
Geodesic Rates from SLR



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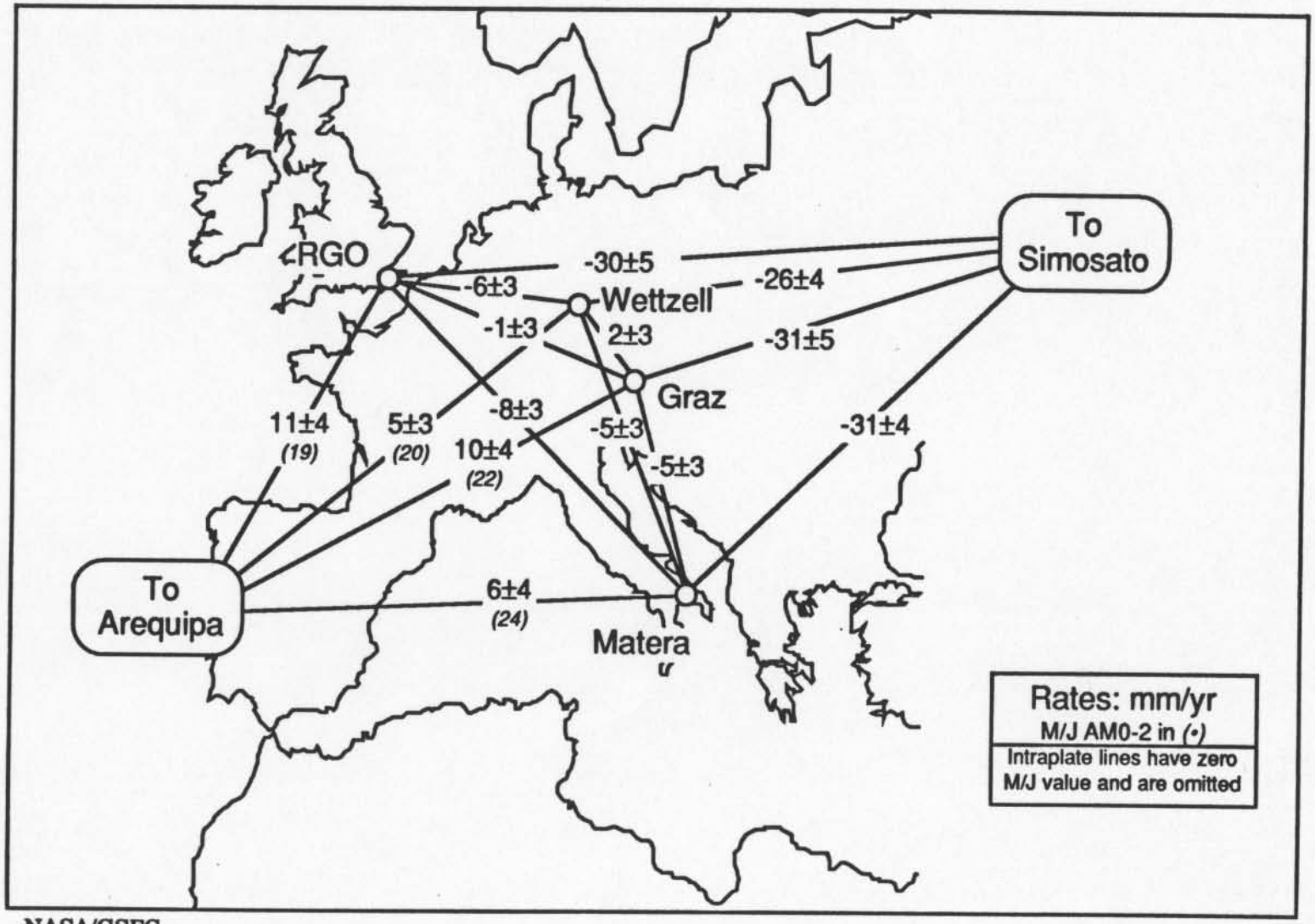
Geodesic Rates from SLR



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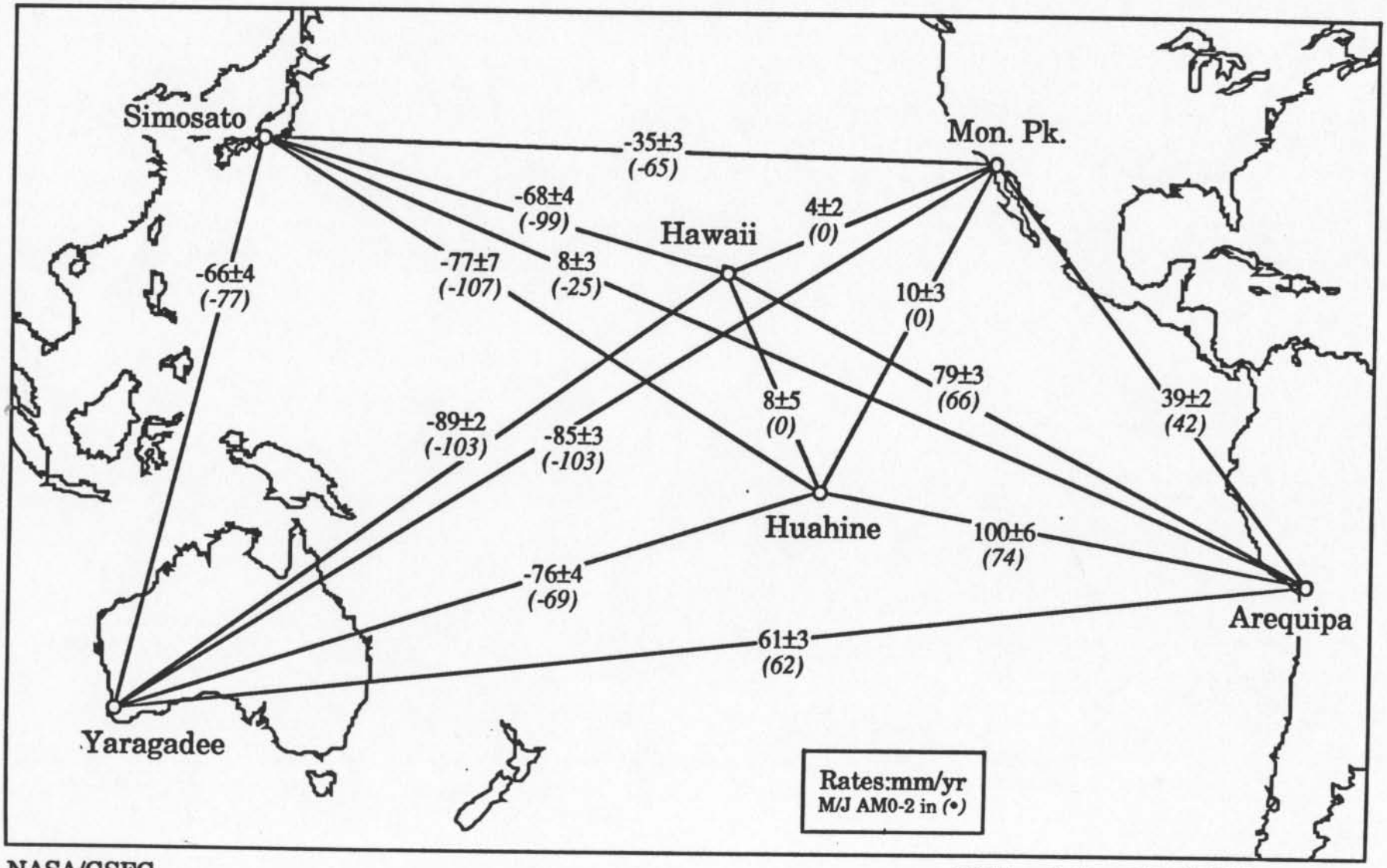
Geodesic Rates from SLR



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SLR Station Velocity Model

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Station Name	SLR Model Azimuth (°)	SLR Model Rate (mm/yr)	Error Ellipse Parameters S. Major (mm/yr)	S. Minor (mm/yr)	Orient. (°)	M/J AM0-2 Model Azimuth (°)	M/J AM0-2 Model Rate (mm/yr)
Quincy	257.14	22	2.7	1.6	-11.22	220.90	21
McDonald Obs.	246.51	25	2.9	2.0	-10.11	234.32	17
Mazatlan	256.30	16	2.7	2.1	-19.67	225.07	15
Platteville	233.93	13	9.7	5.1	-6.71	238.77	19
Greenbelt	277.26	18	*	*	*	277.26	18
Monument Pk.	289.10	45	2.7	1.6	-16.24	300.13	55
Huahine	287.21	91	7.0	2.8	-52.77	297.42	80
Hawaii	298.82	77	*	*	*	298.82	77
Wettzell	35.56	22	4.3	2.2	38.44	50.24	26
RGO	36.45	26	4.9	2.1	26.87	43.10	24
Graz	45.11	26	5.0	2.4	47.07	52.16	26
Matera	29.90	26	4.6	2.2	46.78	54.08	27
Simosato‡	268.51	9	4.4	3.0	-47.36	122.54	28
Arequipa	37.28	12	3.4	2.0	69.48	325.76	12
Yaragadee	28.13	63	3.5	2.4	-18.30	35.37	74

* Greenbelt and Hawaii are constrained to move as M/J AM0-2,

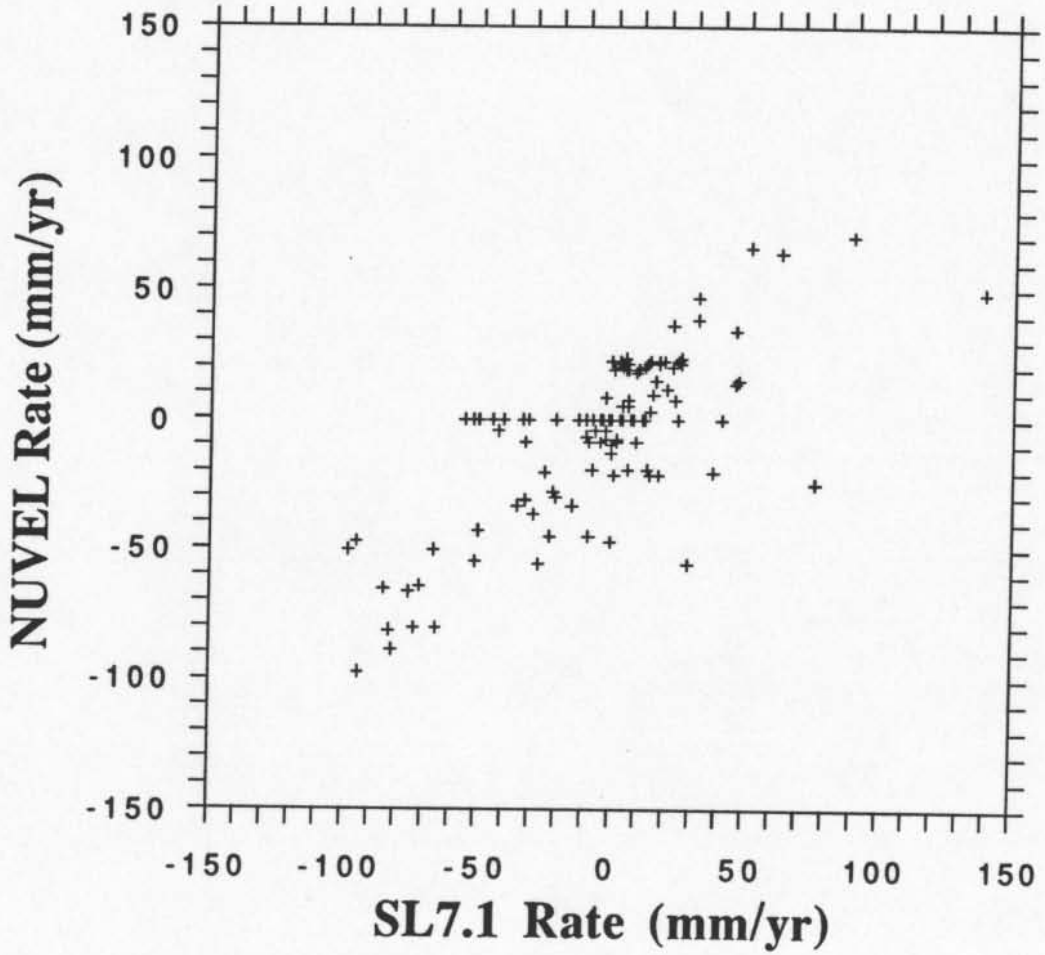
‡ The plate upon which Simosato resides is under question.

COMPARISON OF SL7.1 WITH NUVEL GEODESIC RATES

STATIONS		GSFC SLR (mm/yr)	NUVEL (mm/yr)
QUINCY	SIMOSATO	-8 ± 3	-9
MON. PEAK	SIMOSATO	-35 ± 3	0
QUINCY	HAWAII	6 ± 2	-22
MON. PEAK	HAWAII	3 ± 2	0
HAWAII	SIMOSATO	-68 ± 4	0
PLATTEVILLE	QUINCY	12 ± 5	0
McDONALD	QUINCY	5 ± 2	0
MON. PEAK	QUINCY	-26 ± 2	-45
MON. PEAK	PLATTEVILLE	9 ± 6	0
MON. PEAK	McDONALD	25 ± 2	36
McDONALD	PLATTEVILLE	1 ±10	0
WETTZELL	PLATTEVILLE	9 ± 8	20
WETTZELL	McDONALD	20 ± 3	21

QRA1BAN1 NAP 881130

CORRELATION: SL7.1 VERSUS NUVEL



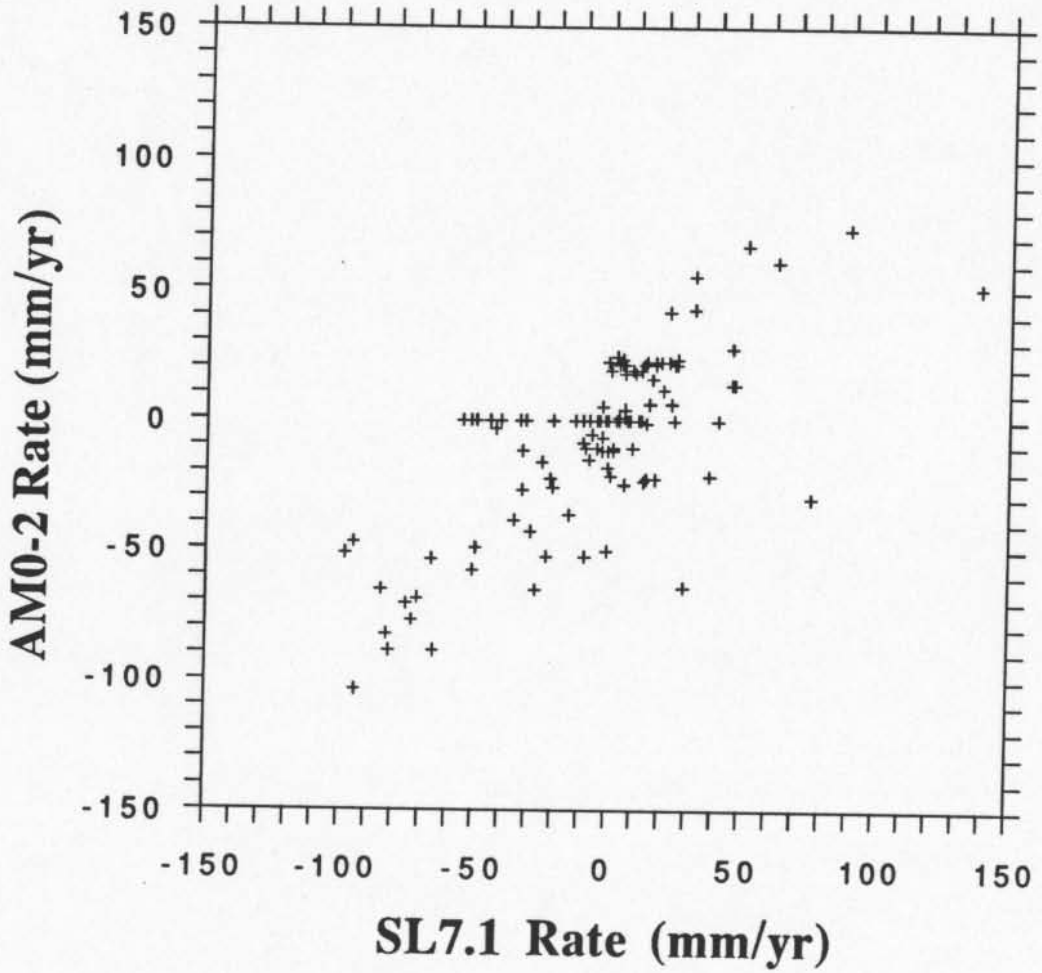
QAN1BAN1 881202

COMPARISON OF SL7.1 WITH AM0-2 GEODESIC RATES

STATIONS		GSFC SLR (mm/yr)	AM0-2 (mm/yr)
QUINCY	SIMOSATO	-8 ± 3	-11
MON. PEAK	SIMOSATO	-35 ± 3	0
QUINCY	HAWAII	6 ± 2	-22
MON. PEAK	HAWAII	3 ± 2	0
HAWAII	SIMOSATO	-68 ± 4	0
PLATTEVILLE	QUINCY	12 ± 5	0
McDONALD	QUINCY	5 ± 2	0
MON. PEAK	QUINCY	-26 ± 2	-53
MON. PEAK	PLATTEVILLE	9 ± 6	0
MON. PEAK	McDONALD	25 ± 2	41
McDONALD	PLATTEVILLE	1 ±10	0
WETTZELL	PLATTEVILLE	9 ± 8	20
WETTZELL	McDONALD	20 ± 3	21

QRA1BAN1 NAP 881130

CORRELATION: SL7.1 VERSUS AM0-2



QAN1BAN1 881202

COMPARISON OF SL7.1 WITH GSFC VLBI GEODESIC RATES

STATIONS		GSFC SLR (mm/yr)	GSFC VLBI (mm/yr)
QUINCY*	JAPAN*	-8 ± 3	-3 ± 2
MON. PEAK	JAPAN*	-35 ± 3	-32 ± 2
QUINCY	HAWAII	6 ± 2	6 ± 2
MON. PEAK	HAWAII	3 ± 2	2 ± 2
HAWAII	JAPAN*	-68 ± 4	-65 ± 3
PLATTEVILLE	QUINCY†	12 ± 5	7 ± 2
McDONALD	QUINCY†	5 ± 2	8 ± 2
MON. PEAK	QUINCY†	-26 ± 2	-29 ± 2
MON. PEAK	PLATTEVILLE	9 ± 6	2 ± 2
MON. PEAK	McDONALD	25 ± 2	31 ± 2
McDONALD	PLATTEVILLE	1 ±10	1 ± 2
WETTZELL	PLATTEVILLE	9 ± 8	12 ± 2
WETTZELL	McDONALD	20 ± 3	13 ± 2

QUINCY*	SLR: QUINCY	VLBI: HAT CREEK
QUINCY†	SLR: QUINCY	VLBI: QUINCY
JAPAN*	SLR: SIMOSATO	VLBI: KASHIMA

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SUMMARY

- **86% OF SLR QUARTERLY OBSERVED INTERSITE RATES AGREE WITH THE NUVEL PLATE MODEL WITHIN 20 mm/yr**

- **83% OF SLR QUARTERLY OBSERVED INTERSITE RATES AGREE WITH THE AM0-2 PLATE MODEL WITHIN 20 mm/yr**

- **THERE IS EXCELLENT AGREEMENT BETWEEN SLR AND VLBI RATE OBSERVATIONS EVEN IN INSTANCES OF DISAGREEMENT WITH GEOLOGIC PREDICTION**

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