Improving Innovative Mathematical Model for Earthquake Prediction

By: Suganth Kannan
President, MathforUS LLC
Florida, USA

Objective

The objective of this research is to improve upon a previously developed Innovative Mathematical Model for Earthquake Prediction.

Background Research

- M8-algorithm
- Vapor theory and the earthquake cloud for prediction
- Geoelectrical signals near Wak-Air and Boe-Air Dipoles during Izu Island Earthquake cluster

Background Research

- Richter Scale - Logarithmic
- Epicenter – Point on surface above origin of earthquake
- Intensity - Depends on distance from epicenter and earthquake's magnitude

Background Research

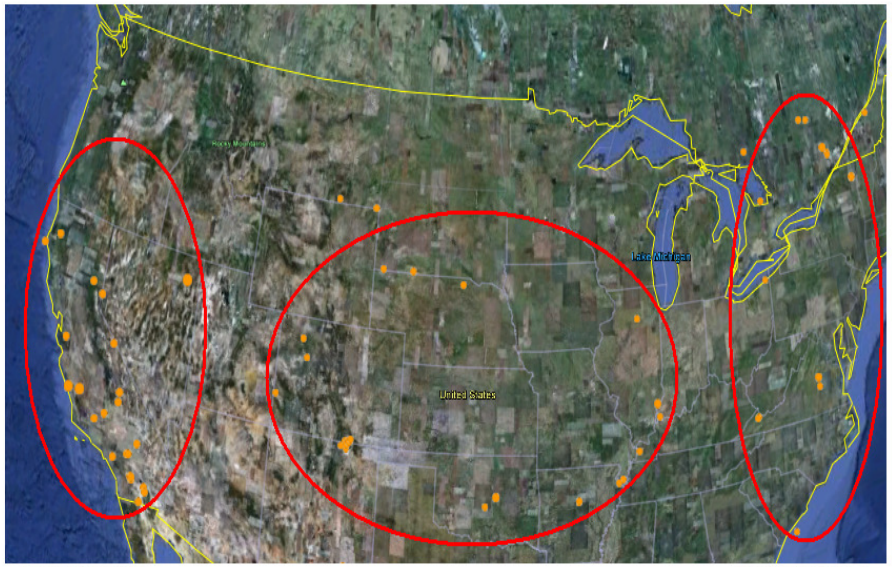
- Spanish Researcher Earthquake Correlation Theory and Magnet Theory
- Low levels of Dilatancy before major earthquakes
- US, EU, Japan experiment on factors - Land deformations, Seismic wave velocities, Geomagnetic/electric phenomenons

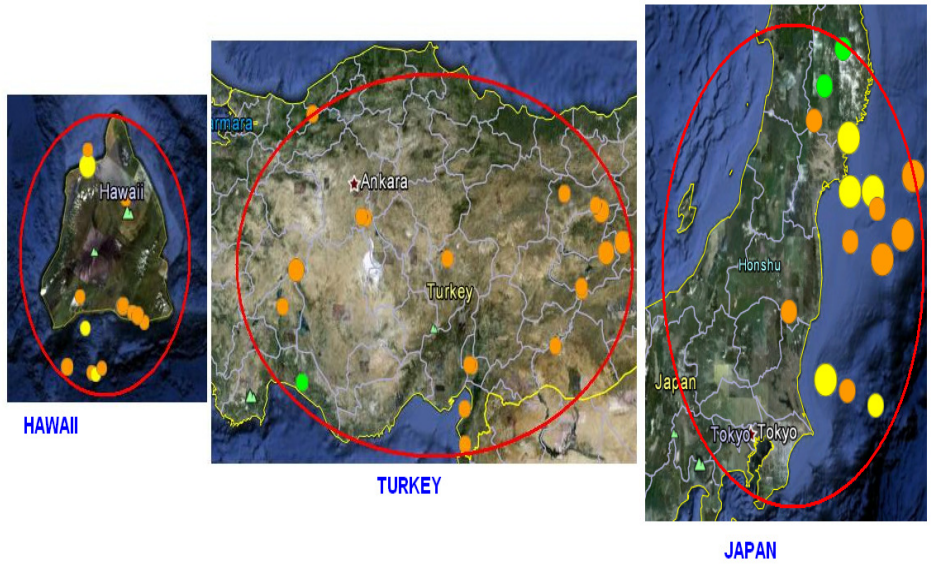
Materials

- Personal Workstation with 1 GB Graphic Card
- USGS NEIC Data on past earthquakes
- Google Earth Program
- KML earthquake data files
- Microsoft Excel
- Photoshop Program

Past Research

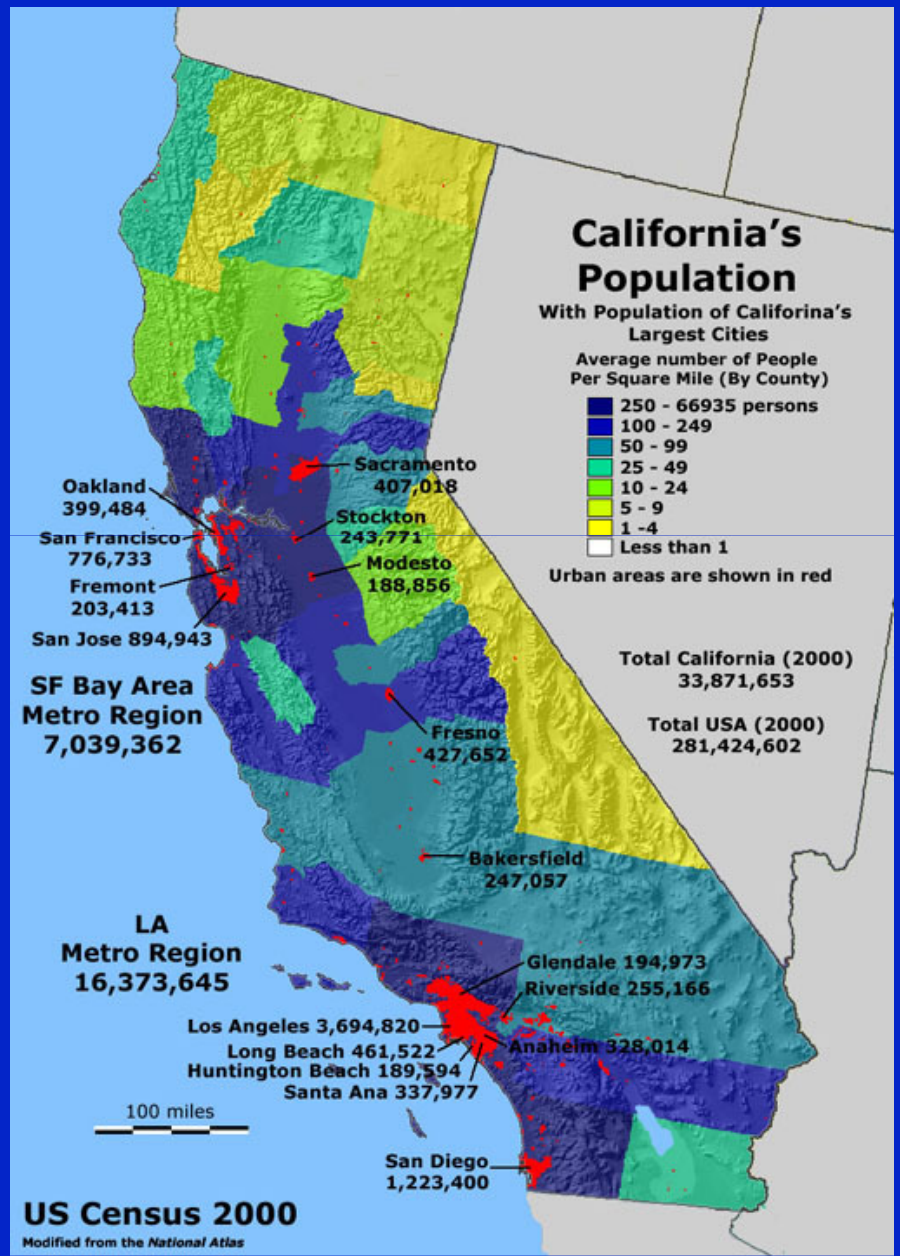
- California, Central USA, Northeast USA, Hawaii, Turkey, and Japan
- Spatial Connection Model
- Poisson Range Identifier (Pri) Function
- Distance Factor (Df)





Current Research

- California Zone Split into Two for Validation
- Incorporation of Population Centers



Zonal Limits

Table 1 Earthquake Metadata

Earthquake Metadata							
Zone	North Longitude	South Longitude	East Latitude	West Latitude	Magnitude Range	From Year	To Year
North California	42	36	-127	-118	5 to 9	January 1 2006	December 31 2013
South California	36	30	-124	-115	5 to 9	January 1 2006	December 31 2013

Procedure

- Using NEIC database, earthquake data collected in KML files
- Analyzed using Spatial connection model - Based on logical assumption that all earthquakes in a fault zone are related to one another

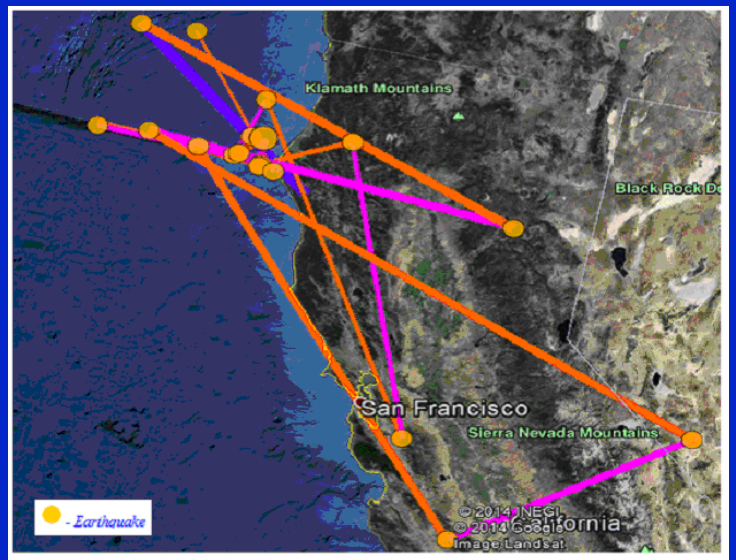


Figure 2 North California Spatial Connection Model

Procedure

- Range Identifier Function

  f(ri) = {[x1 * time lag 2] / [Cos(Ɵ) * x2 * time lag 1]}

- Relationship exists based on Angle, Distance, and Time

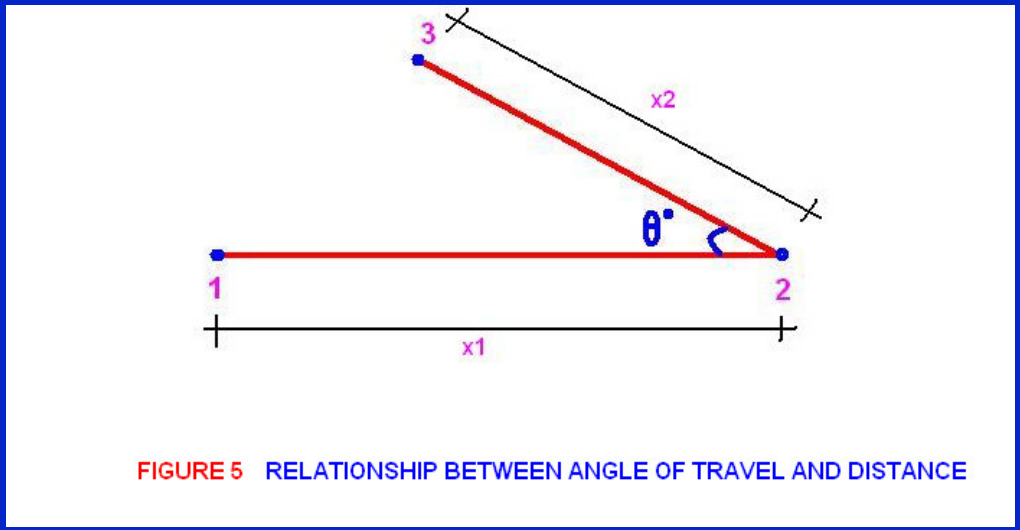


FIGURE 5 RELATIONSHIP BETWEEN ANGLE OF TRAVEL AND DISTANCE

Procedure

- Poisson Distribution operation applied for all Pri values
- Utilizing Distance Factor, Pri value for set is determined

CALIFORNIA REGION (2006-2013) EARTHQUAKE DATA FOR MAGNITUDE 5 TO 9									
Year	Month	Day	Quake number	Distance	Time Lag (Days)	Angle	cos(Angle)	Poisson Range Identifier	Distance Factor (Df)
2006	5	24	1-2	2.91	626	155	0.91	0.01	0.10
2008	2	9	2-3	175	171	70	0.34	4.01	0.92
2008	7	29	3-4	96.9	130	75	0.26	2.83	0.60
2008	12	6	4-5	110	108	180	1.00	2.61	0.60
2009	3	24	5-6	69.9	179	5	1.00	0.09	0.10
2009	9	19	6-7	247	58	5	1.00	0.76	0.10
2009	11	16	7-8	246	44	110	0.34	133.87	1.00
2009	12	30	8-9	11.6	95	89	0.02	10.79	1.00
2010	4	4	9-10	46.7	72	160	0.94	0.25	0.10
2010	6	15	10-11	59.6	22	10	0.98	1.65	0.33
2010	7	7	11-12	115	69	170	0.98	29.52	1.00
2010	9	14	12-13	9	157	25	0.91		
2011	2	18	13-14						
							Cumulative	23.00	3.84
							Mean	2.30	**0.38**

Procedure

- Exponential Distribution operation applied for all Range Identifier values
- Utilizing Distance Factor, Exponential value for fault zone is determined

CALIFORNIA REGION (2006-2013) EARTHQUAKE DATA FOR MAGNITUDE 5 TO 9									
Year	Month	Day	Quake number	Distance	Time Lag (Days)	Angle	cos(Angle)	Range Identifier	Distance Factor (Df)
2006	5	24	1-2	2.91	626	155	0.91	0.01	0.00
2008	2	9	2-3	175	171	70	0.34	4.01	0.83
2008	7	29	3-4	96.9	130	75	0.26	2.83	0.71
2008	12	6	4-5	110	108	180	1.00	2.61	0.68
2009	3	24	5-6	69.9	179	5	1.00	0.09	0.04
2009	9	19	6-7	247	58	5	1.00	0.76	0.28
2009	11	16	7-8	246	44	110	0.34	133.87	1.00
2009	12	30	8-9	11.6	95	89	0.02	10.79	0.99
2010	4	4	9-10	46.7	72	160	0.94	0.25	0.10
2010	6	15	10-11	59.6	22	10	0.98	1.65	0.51
2010	7	7	11-12	115	69	170	0.98	29.52	1.00
2010	9	14	12-13	9	157	25	0.91		
2011	2	18	13-14						
							Cumulative	23.00	4.14
							Mean	0.43	**0.41**

Results

Earthquake Prediction Results Table for North California and South California

Zones	Possion Range Identifier Factor	Exponential	angle	cos of angle	last distance (miles)	last time (days)	prediction time (days)	prediction distance (miles)	
North California	2.99	-	20	0.94	323	90	180	230	219
North California	-	3.3	20	0.94	323	90	180	208	
South California	0.38	-	25	0.91	9	157	180	30	29
South California	-	0.41	25	0.91	9	157	180	28	

Discussion-Interpretation of Results

- Fault zones have identifiable patterns in a predictable fashion
- Future Predictions can be made using the improved model

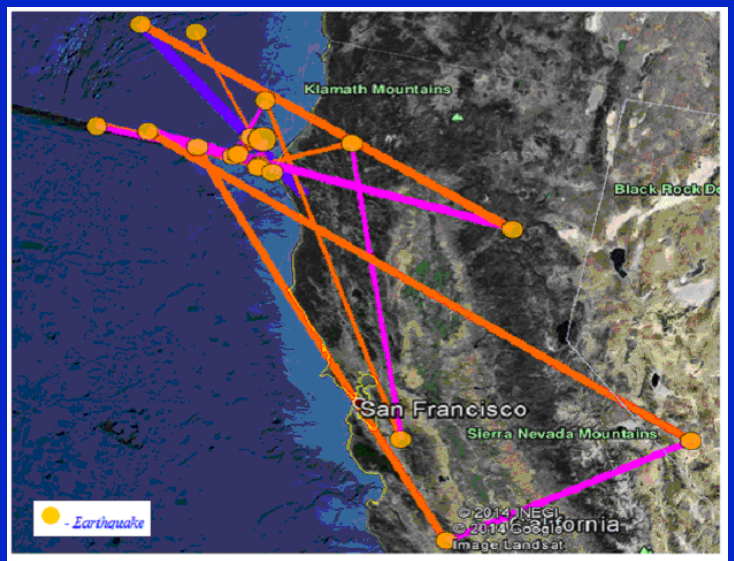


Figure 2 North California Spatial Connection Model

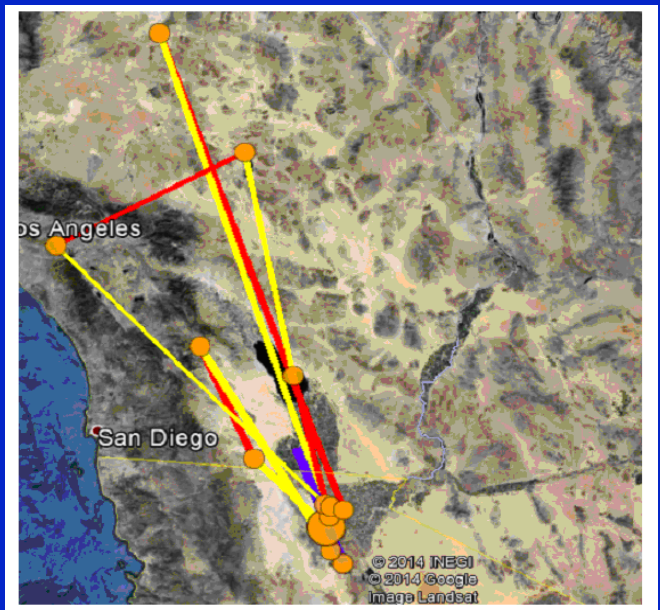


Figure 3 South California Spatial Connection Model

Significance of Study

- Major Improvement
- Greater accuracy in combination
- FEMA can allocate necessary resources

Applications and Future Research

- Save millions of lives by creating an evacuation timeframe
- Fewer Insurance claims
- Save money for various industries
- Potentially could save billions of $$$$ for economy.
- Team up with Leading Seismology Departments and utilize developed software

Q & A?

Thank You for listening to my Presentation.

Are there any questions?