

Cyclic Pattern of Nankai Trough Earthquakes and the Tasks in its Modeling

- Primary Uncertainty in Earthquake Hazard/Risk Model -

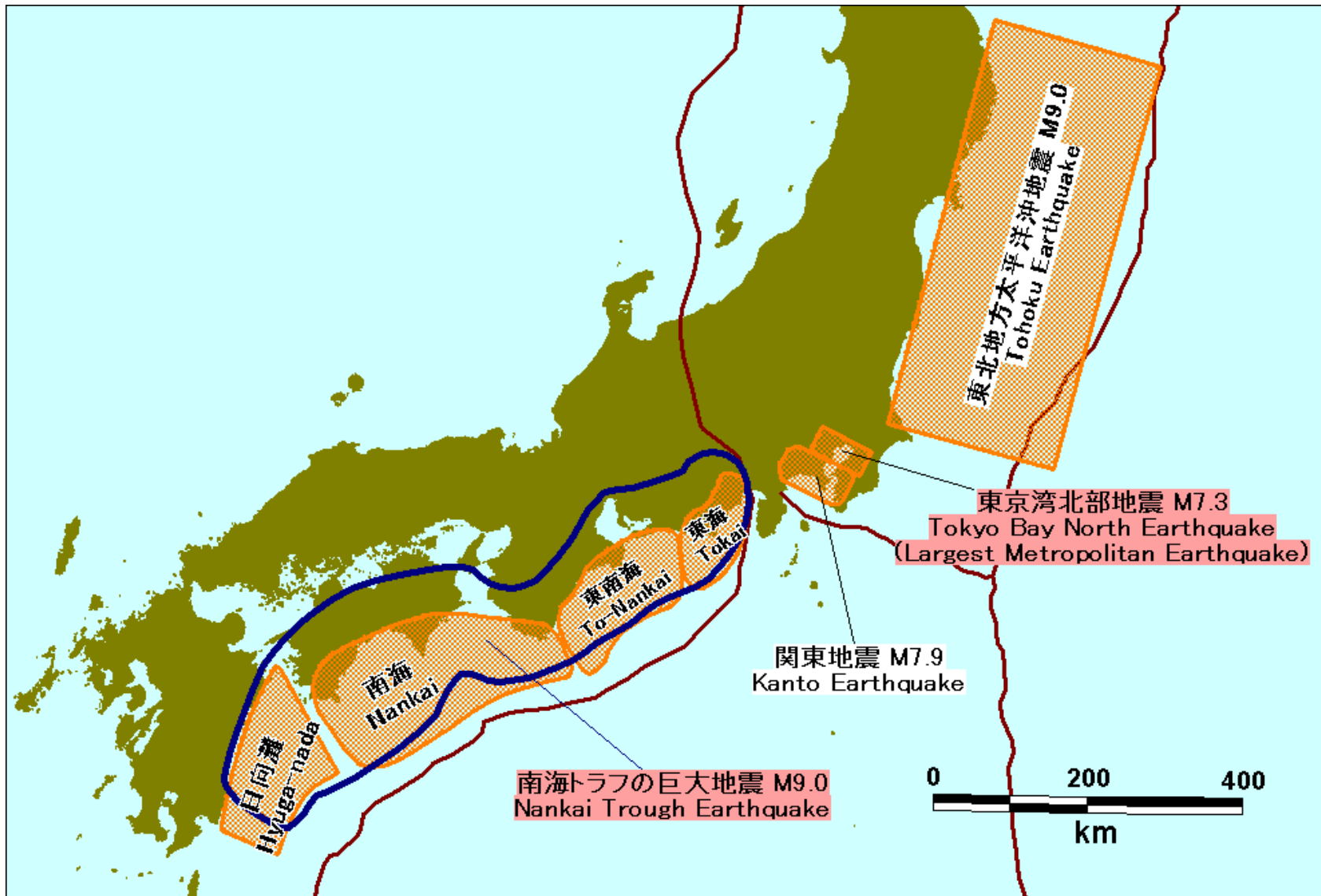
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Outline

- It is concerned that the “**Nankai trough Earthquake**” and the “**Metropolitan Earthquake**” will occur in the near future (*see Page 3*) .
 - Losses by those earthquakes are estimated larger than the Tohoku Earthquake (*see Page 4*) .
 - Some fear that those earthquakes are triggered by the Tohoku Earthquake.
- The Central Disaster Prevention Council of Japan studied the Nankai trough Earthquake of **Magnitude 9** after the Tohoku Earthquake (*see Page 3*) .
 - Recently, site surveys, such as a survey of inland tsunami deposit or trace of liquefaction, are used for specifying the damaged area by an earthquake besides historical literature research.
 - Recent research indicates that Tokai, To-Nankai and Nankai earthquakes are likely occur within a short span or at the same time (*see Page 5*).
- Based on the above background, we tried to visualize the **cyclic pattern of Nankai Trough Earthquakes** with surrounding earthquakes using Usami catalog.

Focal Region of the Earthquakes



Comparison of Historical/Scenario Earthquake

	Historical Earthquake		Scenario Earthquake	
	Tohoku Earthquake	Kobe Earthquake	Nankai Trough Earthquake (2003)	Metropolitan Earthquake (2005)
	2011 Great East Japan Earthquake	1995 Great Hanshin-Awaji Earthquake	Tokai, To-Nankai, Nankai	Tokyo Bay North Earthquake (M7.3)
	Cabinet Office	National Land Agency	Central Disaster Prevention Council	Central Disaster Prevention Council
Buildings (residence, office, factory, machine and equipment etc.)	¥ 10.4 trillion	¥ 6.3 trillion		¥ 55.2 trillion
Lifeline (water supply, electric power, city gas etc.)	¥ 1.3 trillion	¥ 0.6 trillion		
Infrastructure (highway, river, port, sewer, etc.)	¥ 2.2 trillion	¥ 2.2 trillion		
Other	Agriculture, Forestry and Fisheries	¥ 0.5 trillion		
	Other		¥ 1.1 trillion	
Direct Loss	¥ 16.9 trillion	¥ 9.6 trillion	¥ 40 ~60 trillion	¥ 66.6 trillion
Indirect Loss			¥ 13 ~21 trillion	¥ 45.2 trillion
Total			¥ 53 ~81 trillion	¥ 112 trillion

Updating

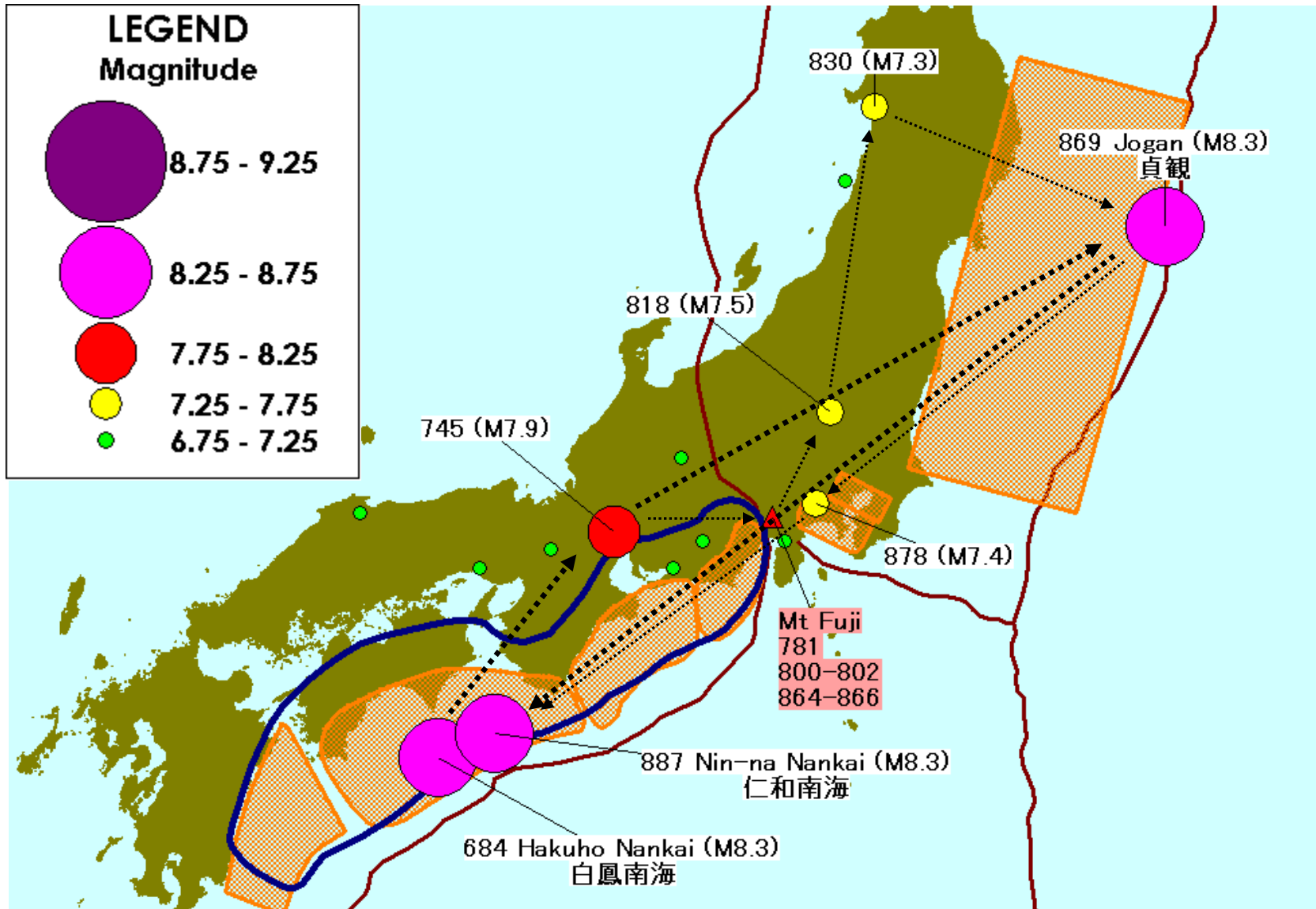
Historical Nankai Trough Earthquakes

Name of an Era	南海 Nankai	東海 Tokai	
		東南海 To-Nankai	東海 Tokai
昭和 Showa	1946	1944	Not Occurred
安政 Ansei	1854 (Next Day)	1854	1854
宝永 Hoei (simultaneous occurrence)	1707	1707	1707
慶長 Keicho	1605	1605	?
明応 Meio	1498 (Date unknown)	1498	1498
正平 Shohei	1361	?	?
永長・康和 Eicho-Kowa	1099 (Kowa)	1096 (Eicho)	1096 (Eicho)
仁和 Nin-na	887	? ⇒ ▲	? ⇒ ▲
白鳳 Hakuho	684	? ⇒ ▲	? ⇒ ▲

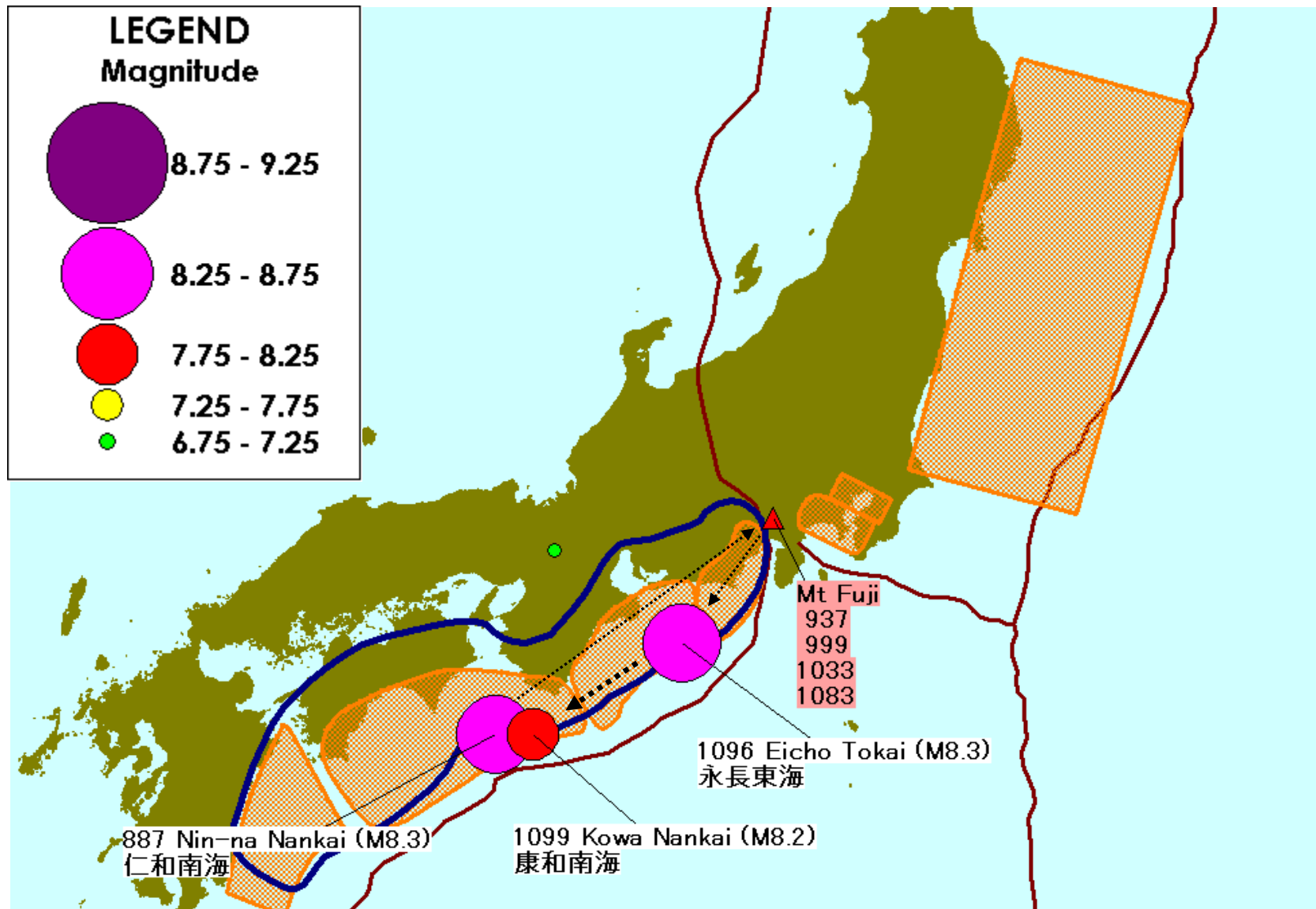
? = Occurrence is not recorded in the literature

▲ = tsunami deposit was found by the site investigation

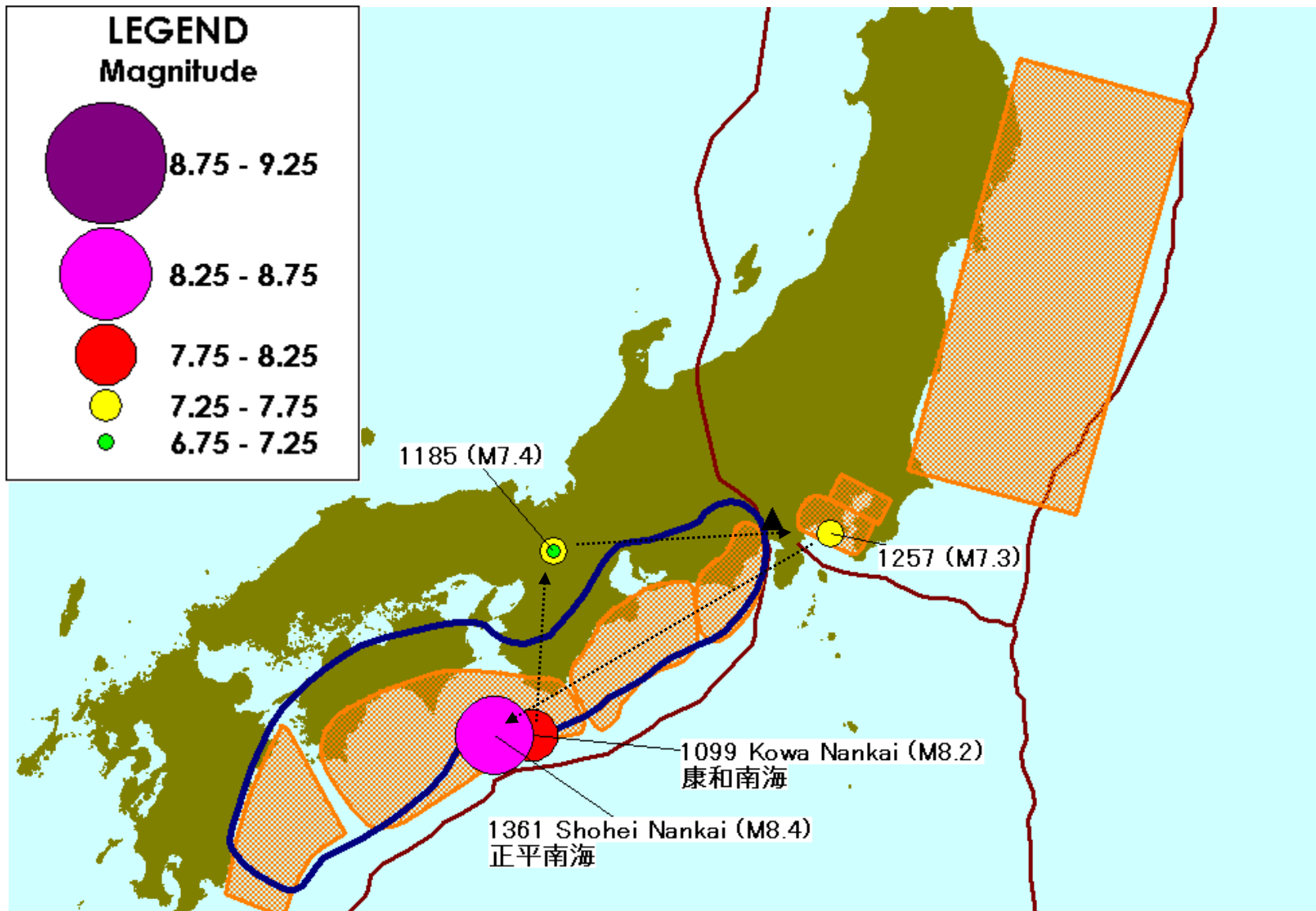
684 Hakuho EQ - 887 Nin-na EQ



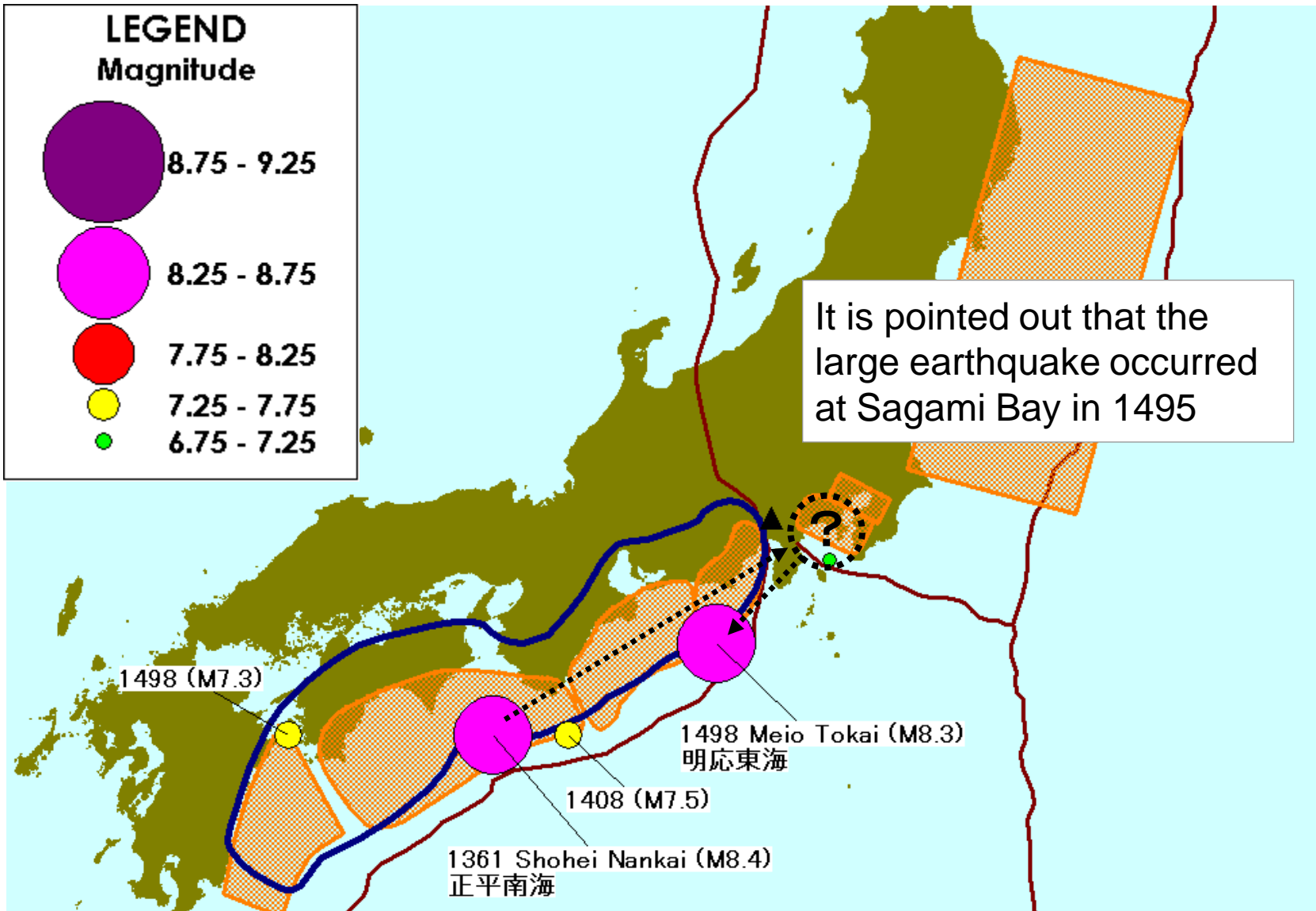
887 Nin-Na EQ – 1099 Kowa EQ



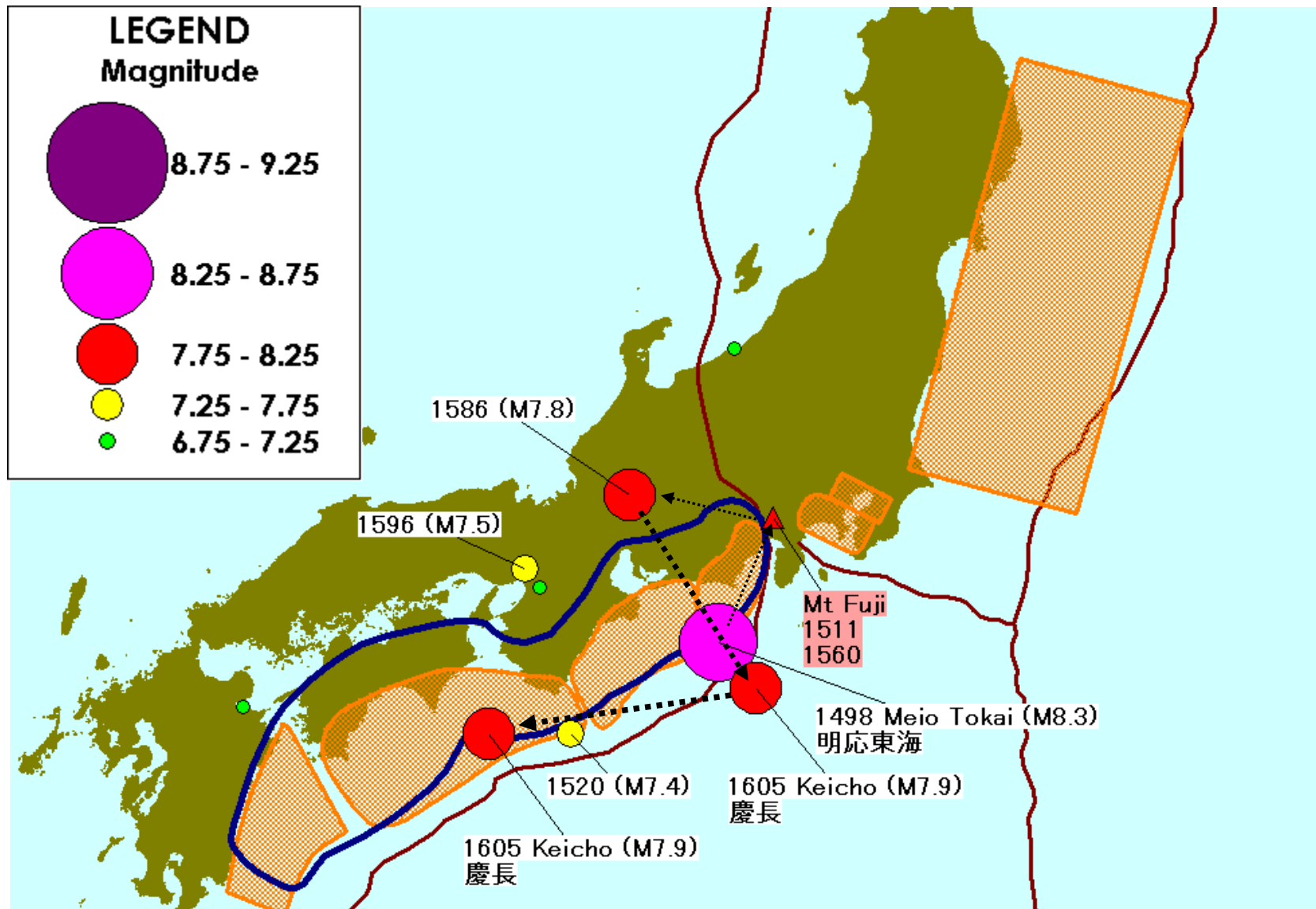
1099 Kowa EQ – 1361 Shohei EQ



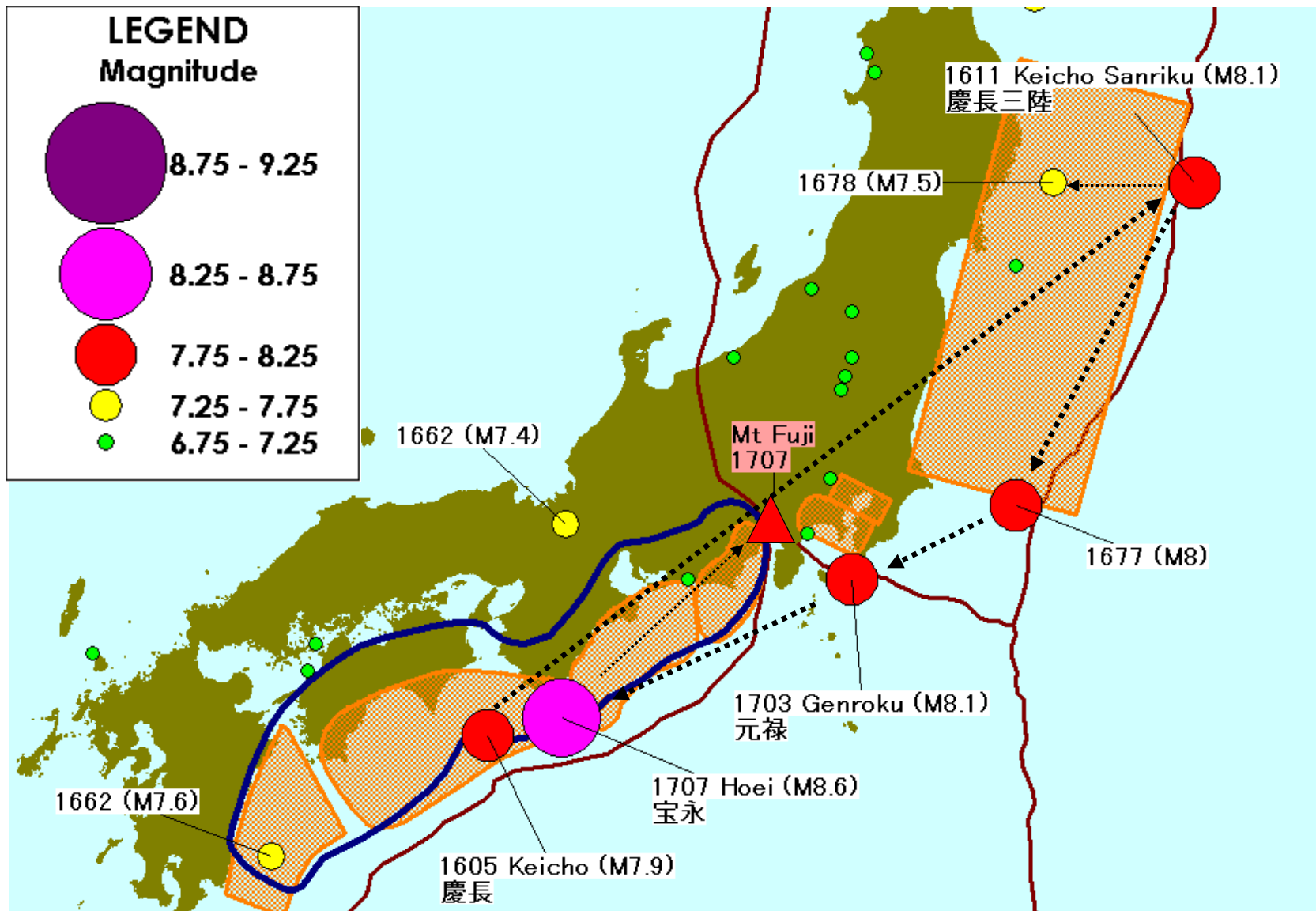
1361 Shohei EQ – 1498 Meio EQ



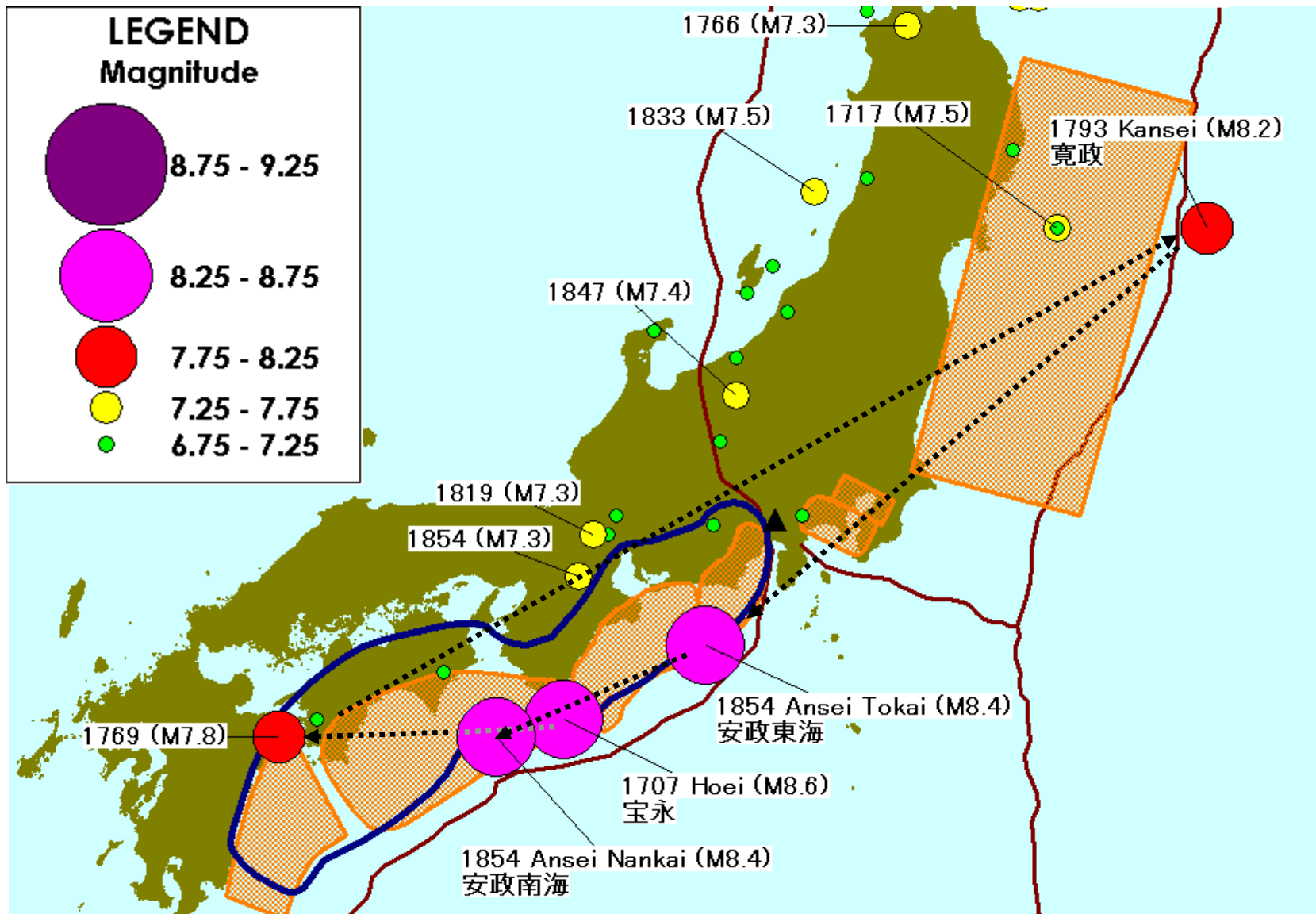
1498 Meio EQ – 1605 Keicho EQ



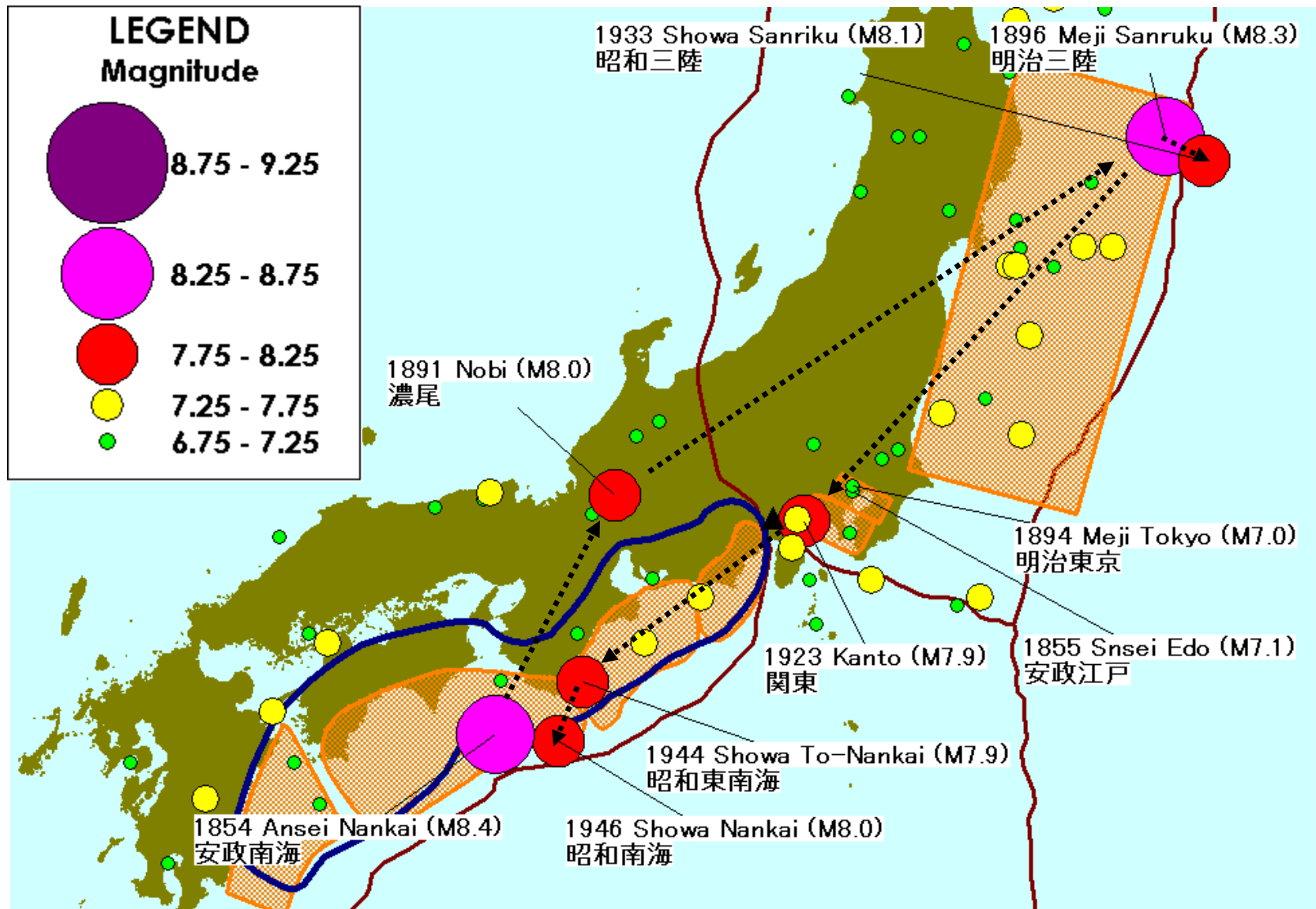
1605 Keicho EQ – 1707 Hiei EQ



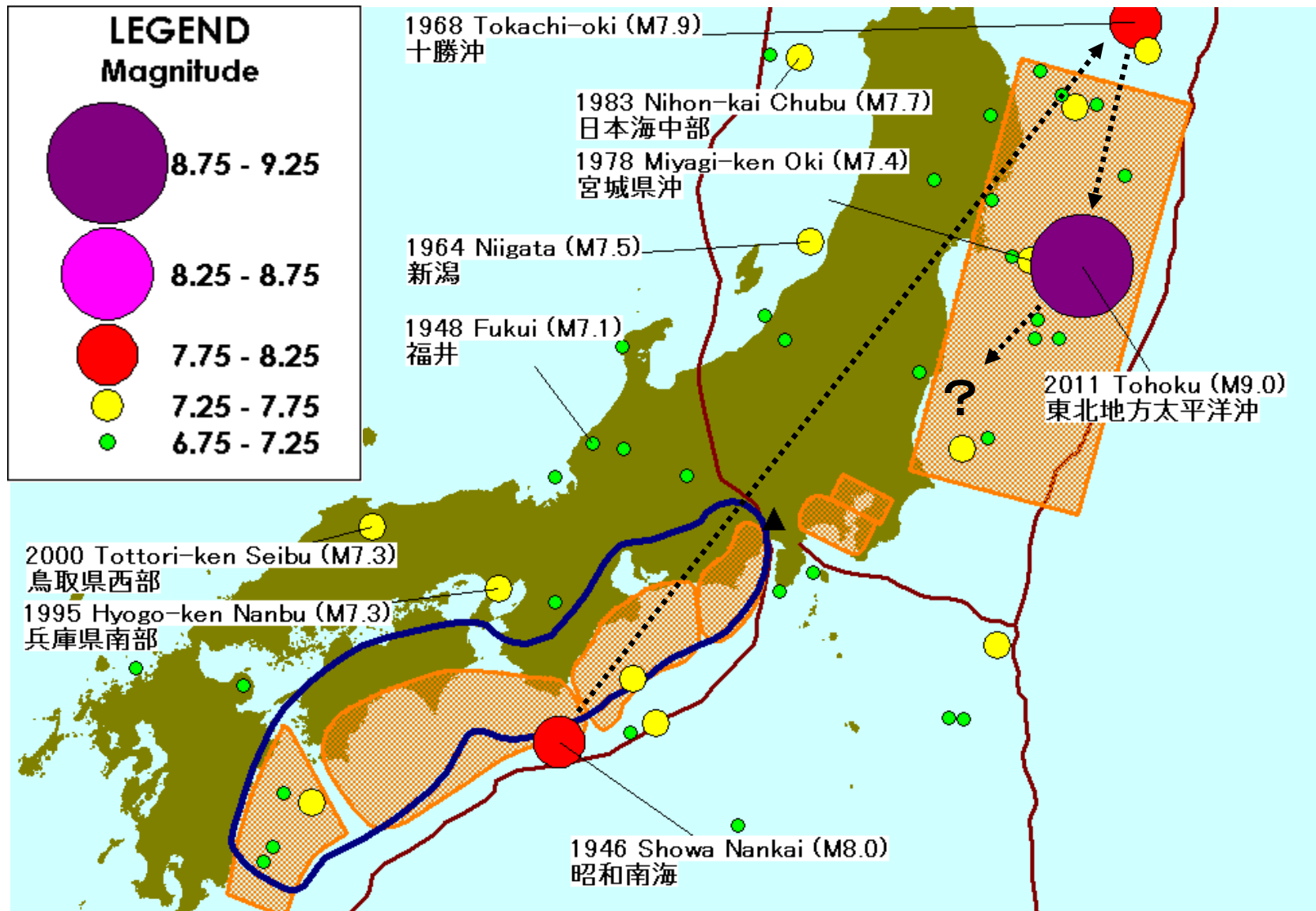
1707 Hiei EQ - 1854 Ansei Tokai/Nankai EQ



Ansei Tokai/Nankai EQ – Showa To-Nankai/Nankai EQ



After Showa To-Nankai/Nankai EQ



Summary

- 18 years after **869** Jogan Earthquake, **887** Nin-na Earthquake occurred.
- During **887** Nin-na Earthquake and **1605** Keicho Earthquake, there are few records of large earthquakes around Tohoku and Kanto regions.
- After **1611** Keicho Sanriku Earthquake, **1677** Off-Boso Earthquake, **1703** Genroku Earthquake and **1707** Hoei Earthquake occurred in order.
- After **1896** Meiji Sanriku Earthquake, **1923** Kanto Earthquake, **1944** Showa To-Nankai and **1946** Showa Nankai Earthquake occurred in order.
- Between a series of Nankai Trough Earthquakes, large earthquake often occurred around Tohoku region.
- Space-time relation among earthquakes will be considered in the “future” Generation Map.