Groundwater changes related to the 2011 Off the Pacific Coast of Tohoku Earthquake (M9.0)

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CONCLUSIONS

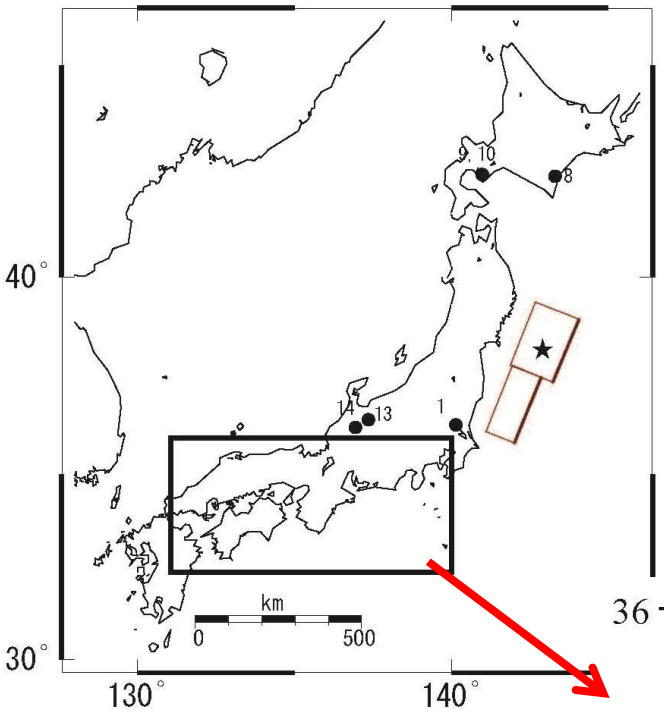
*We examined changes in confined groundwater at 72 observation wells of Geological Survey of Japan, AIST, whose epicentral distances range from 300km to 1100km.

*There was no clear precursory groundwater change.

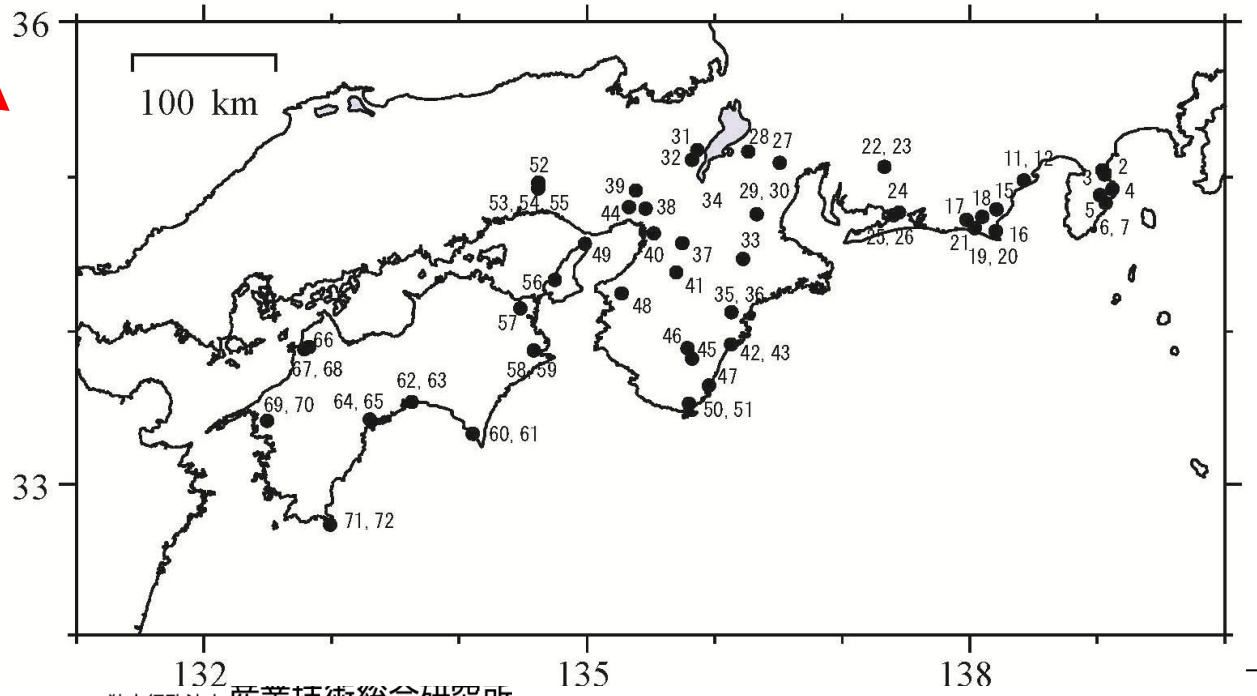
・There were 62 postseismic persistent changes. 45 postseismic drops and one postseismic rise can be explained by the static volumetric strain changes due to the fault slip of the earthquake. However 16 postseismic rises cannot be explained by it.

*Probably ground shaking caused the 16 postseismic rises.

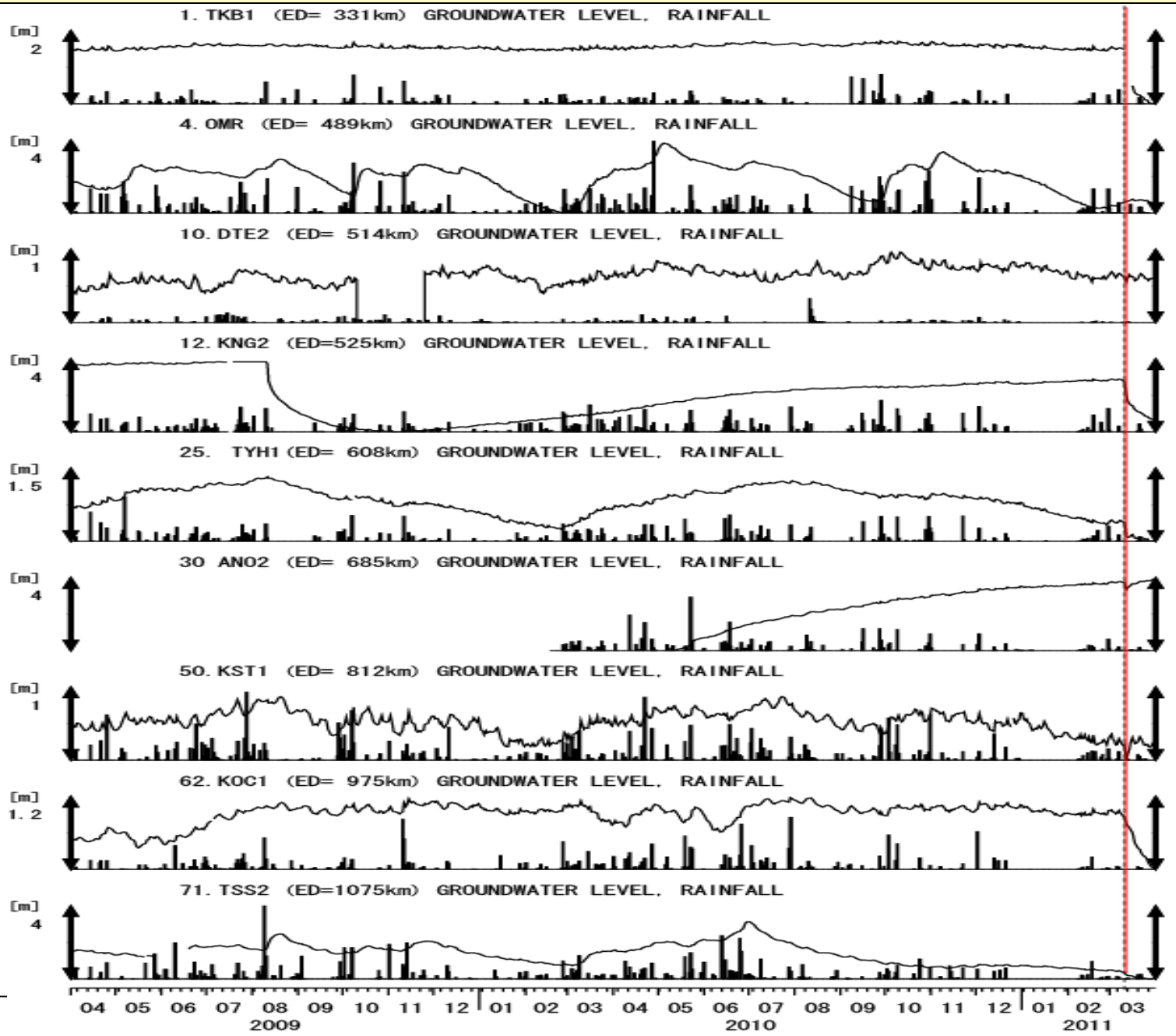
OBSERVATION



No. of Wells are 72.
(Confined Groundwater)
(Depth >=50m)
Most of Our Wells are not near the Focal Region.
(E.D.=300-1100km)



Groundwater Level Change (Apr.2009–Mar.2011:Original data)



331km

489km

514km

525km

608km

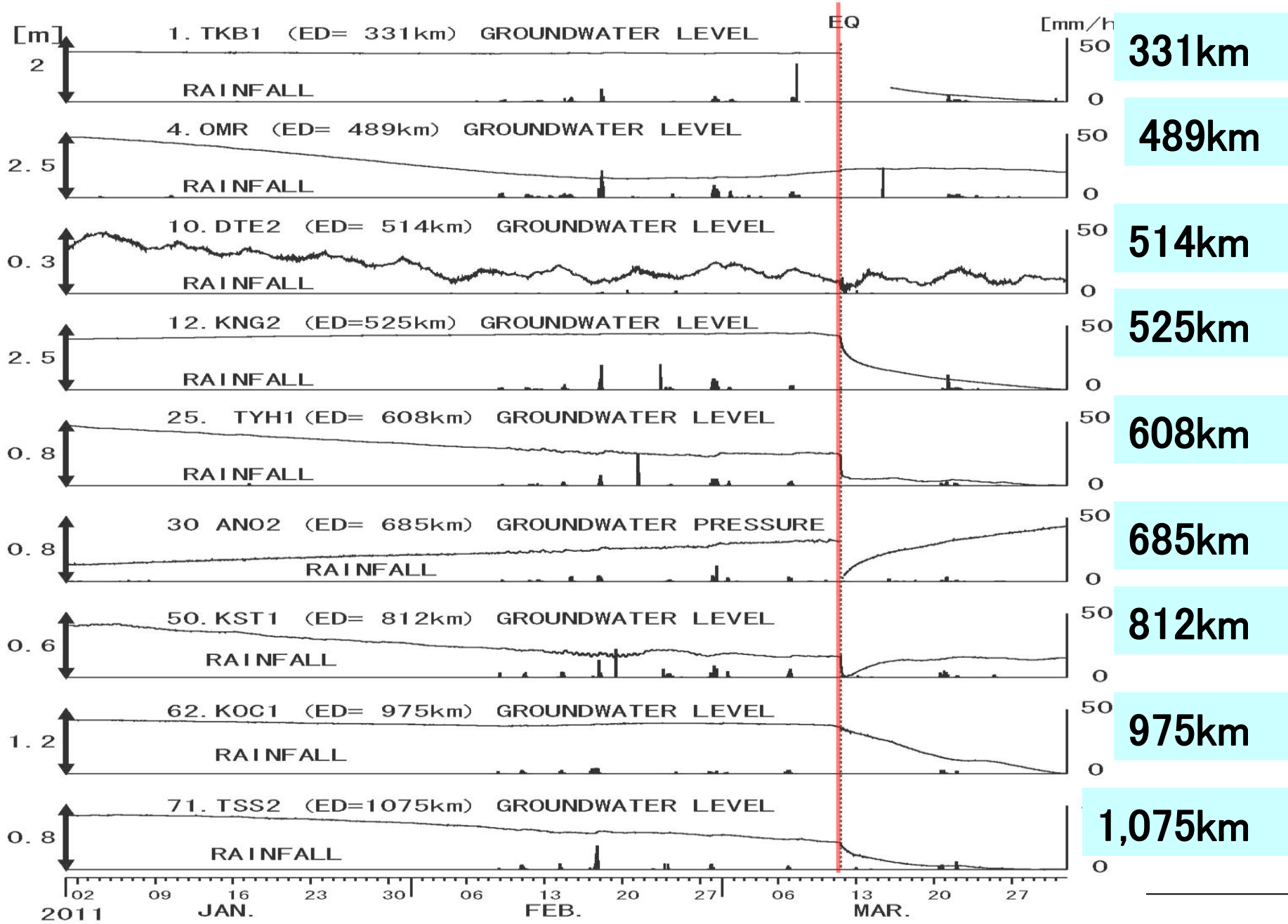
685km

812km

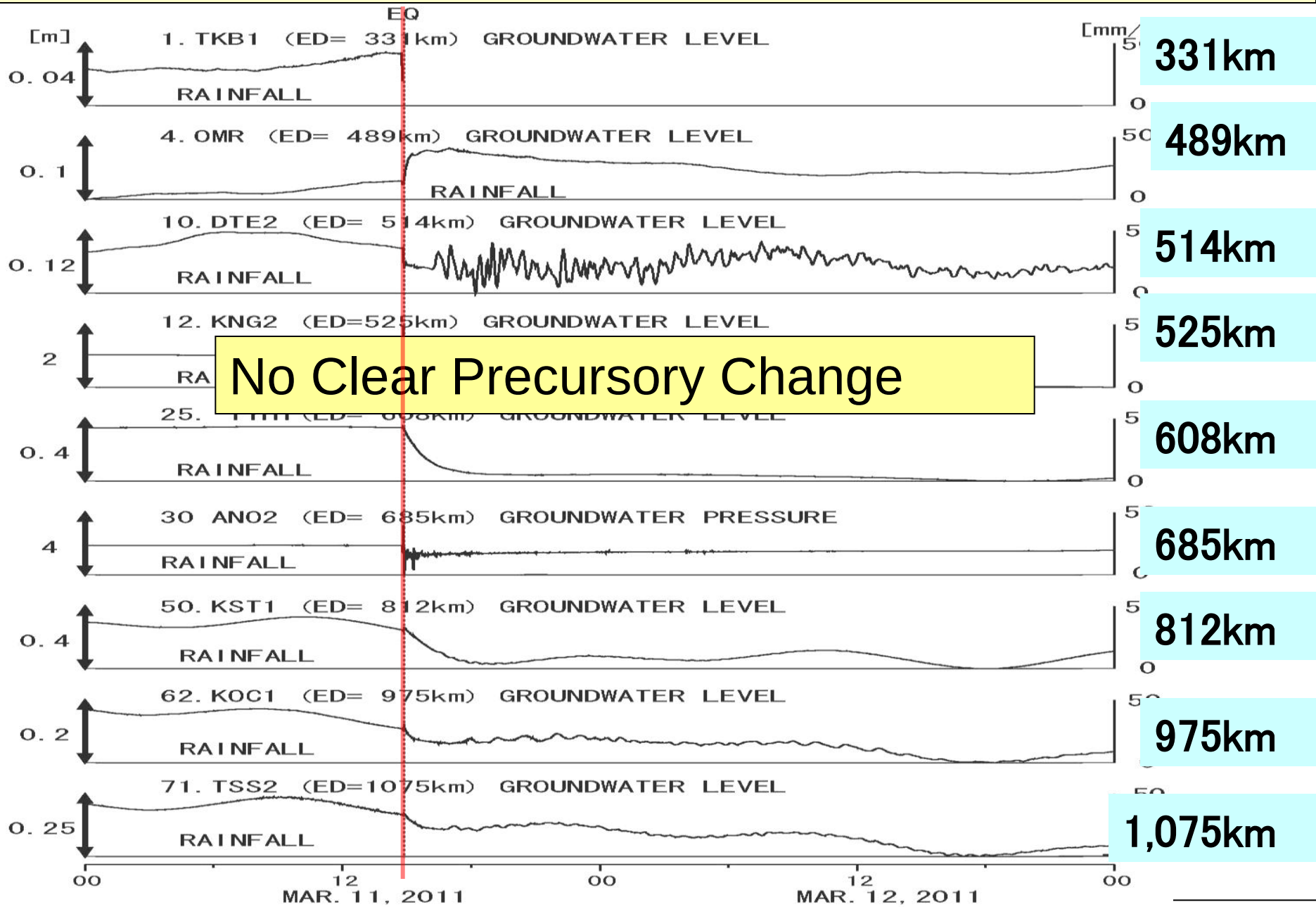
975km

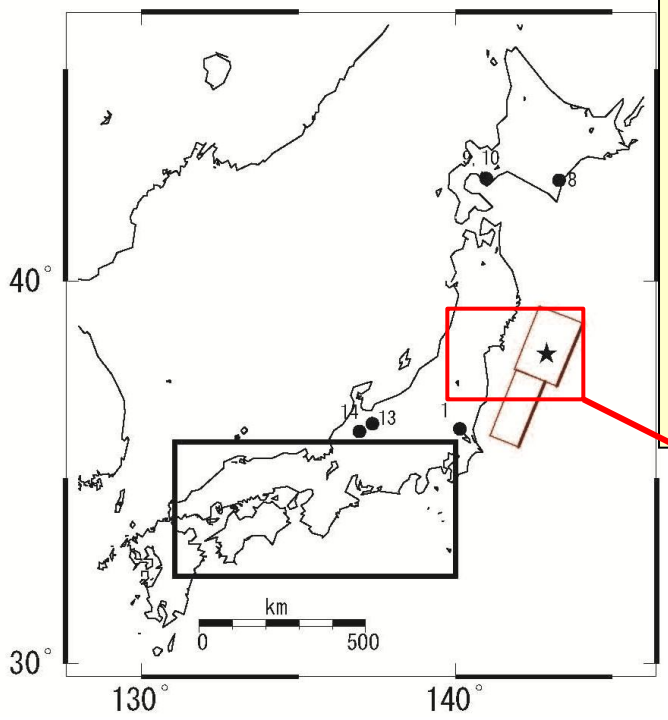
1,075km

Groundwater Level Change (Jan.2011-Mar.2011:Corrected)

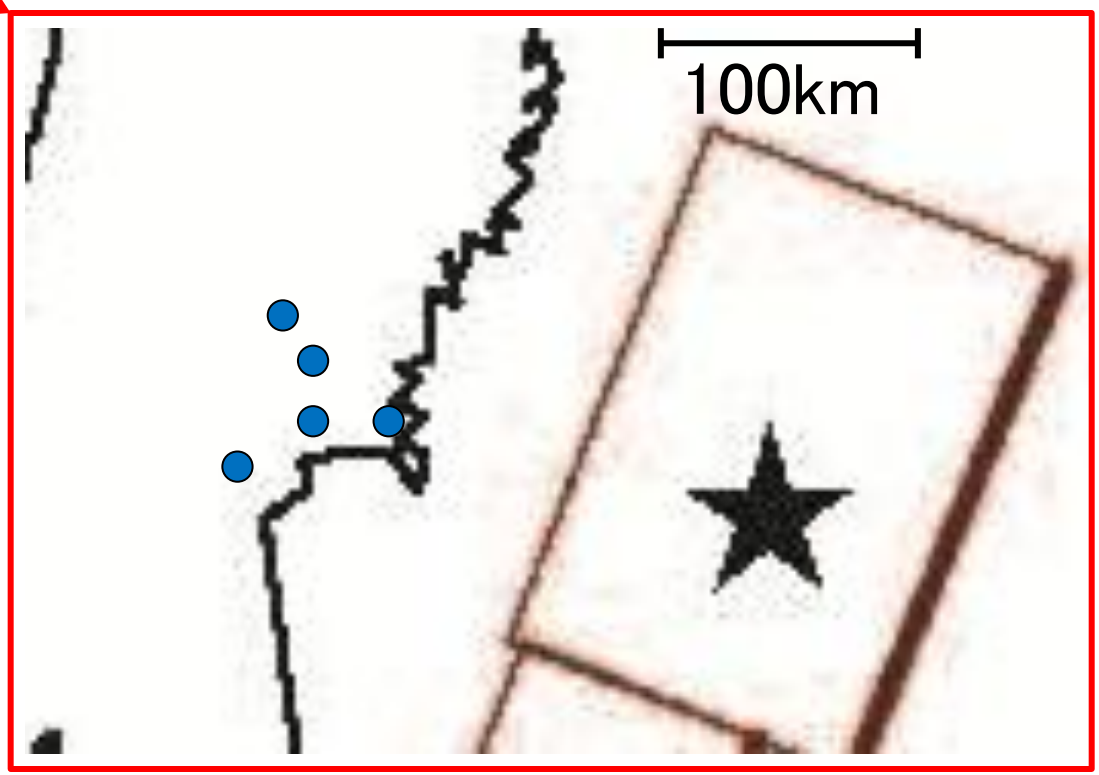


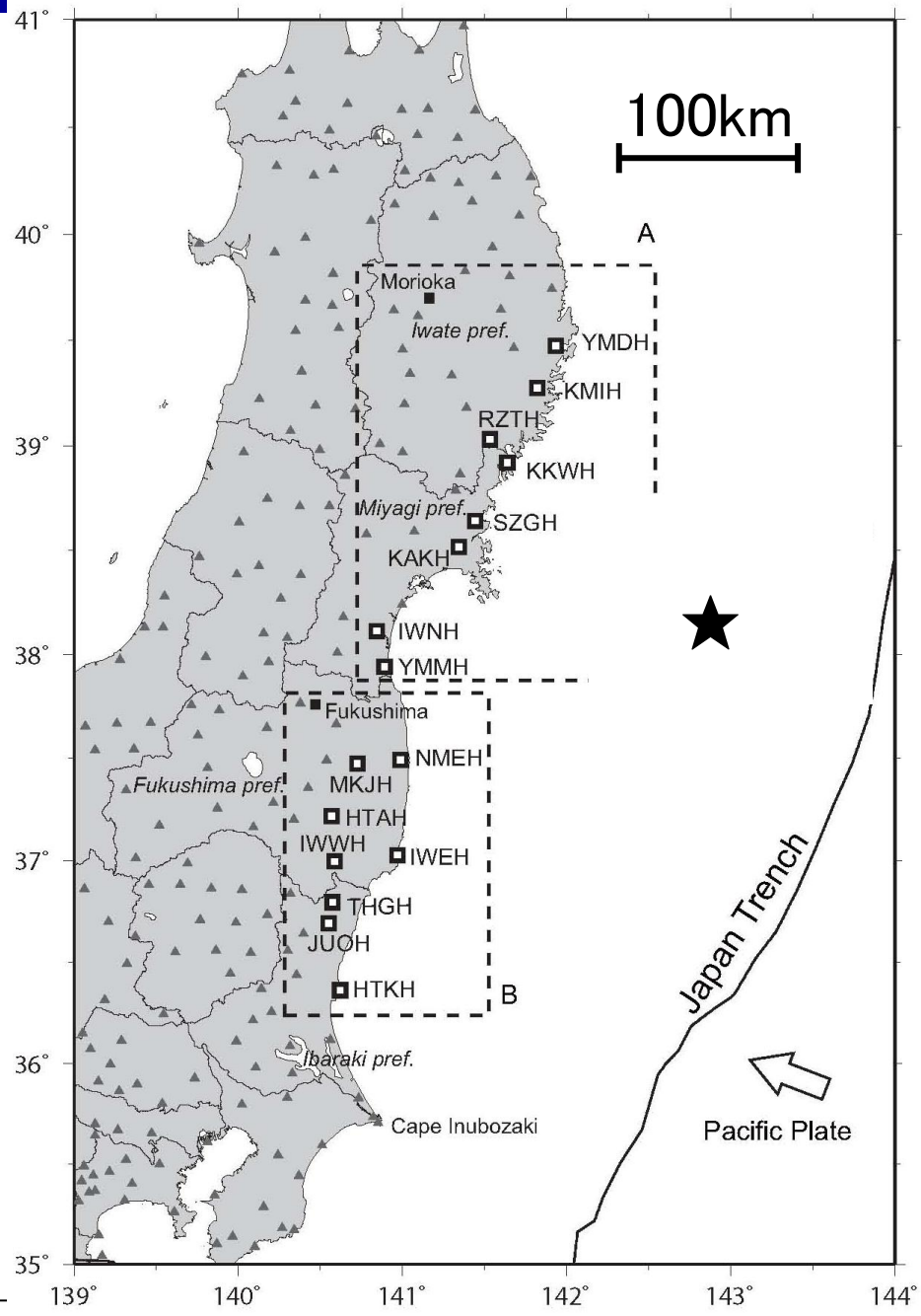
Groundwater Level Change (Mar.11-12: Original,S.I:1-2min)





5 Wells near the Focal Region.
(E.D.= 100 – 200 km)
There Was Also No Clear Precursory Change.
(Otsuki,2011,Personal Communication)





16 Tilt Observation Stations. There Was Also No Clear Precursory Tilt Change. (Hirose, 2011).

Just Under the Stations
No Preslip >Mw 6.2

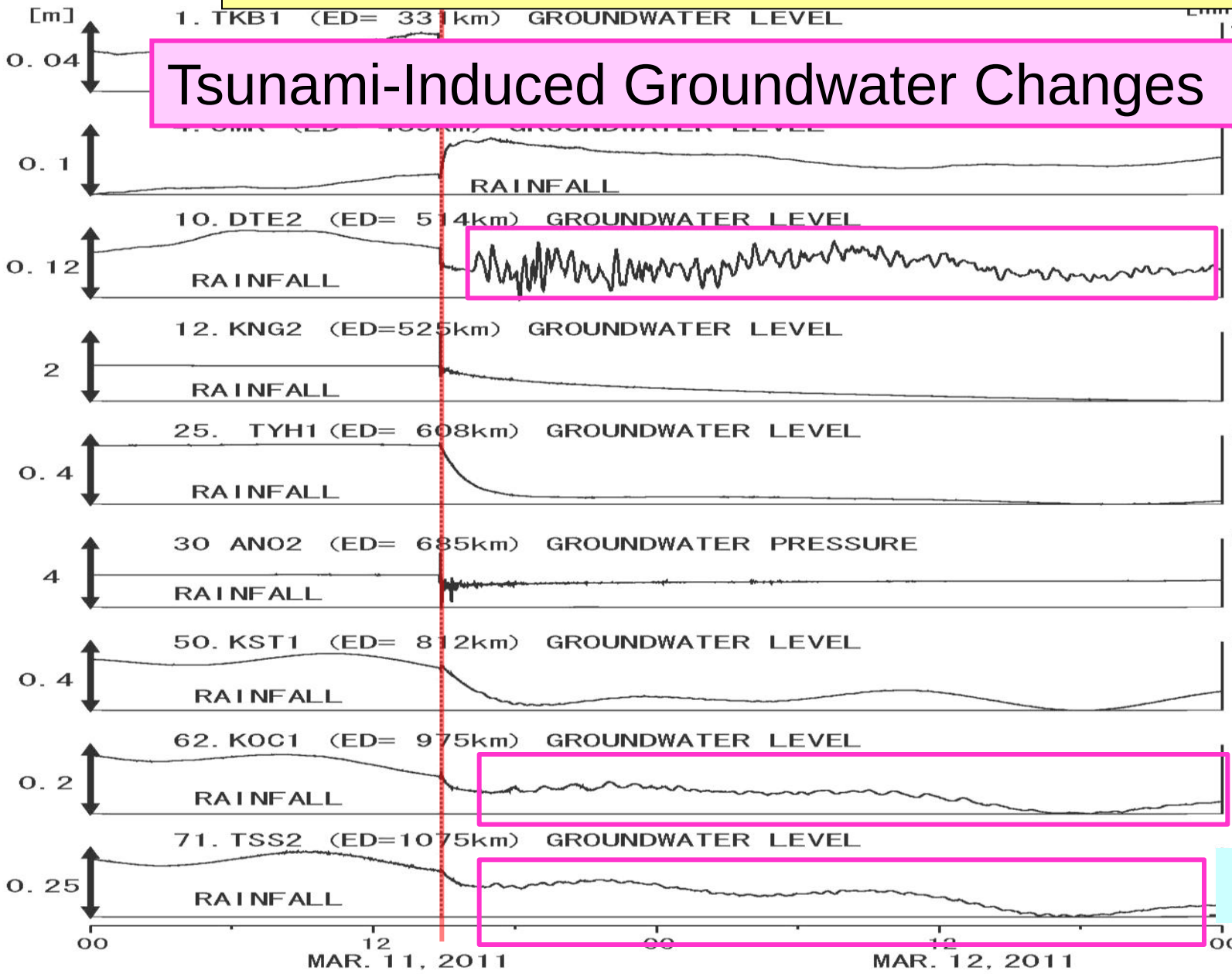
Near the Focal Region
No Preslip >Mw 7.3

Possible Precursors at Present

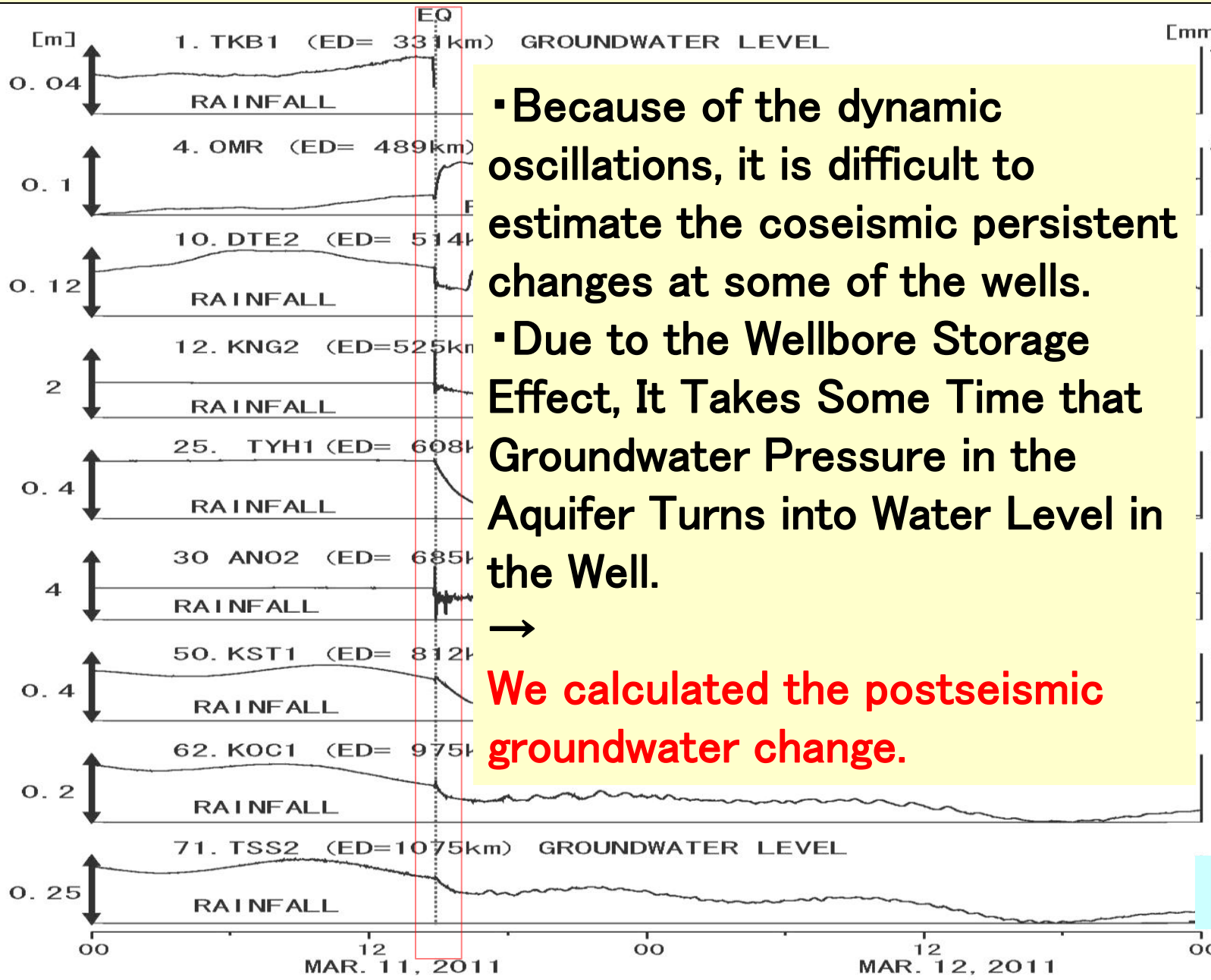
- Foreshock (M7.3) on Mar.9, 2011.
- Ionospheric Electron Enhancement (Heki,2011)

Clear Coseismic/Postseismic Changes

Tsunami-Induced Groundwater Changes



Groundwater Level Change (Mar.11-12: Original,S.I:1-2min)



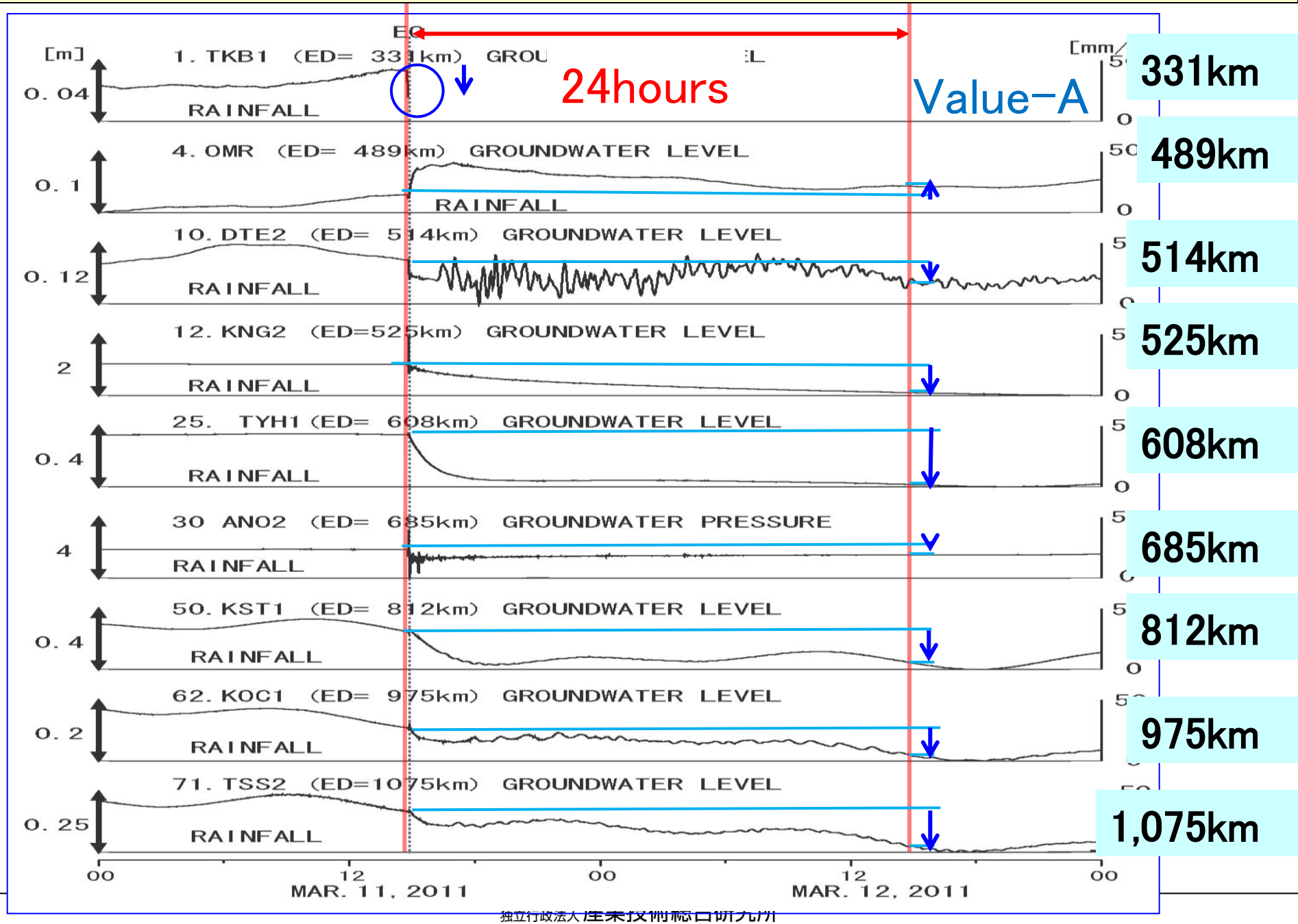
- Because of the dynamic oscillations, it is difficult to estimate the coseismic persistent changes at some of the wells.
- Due to the Wellbore Storage Effect, It Takes Some Time that Groundwater Pressure in the Aquifer Turns into Water Level in the Well.

→

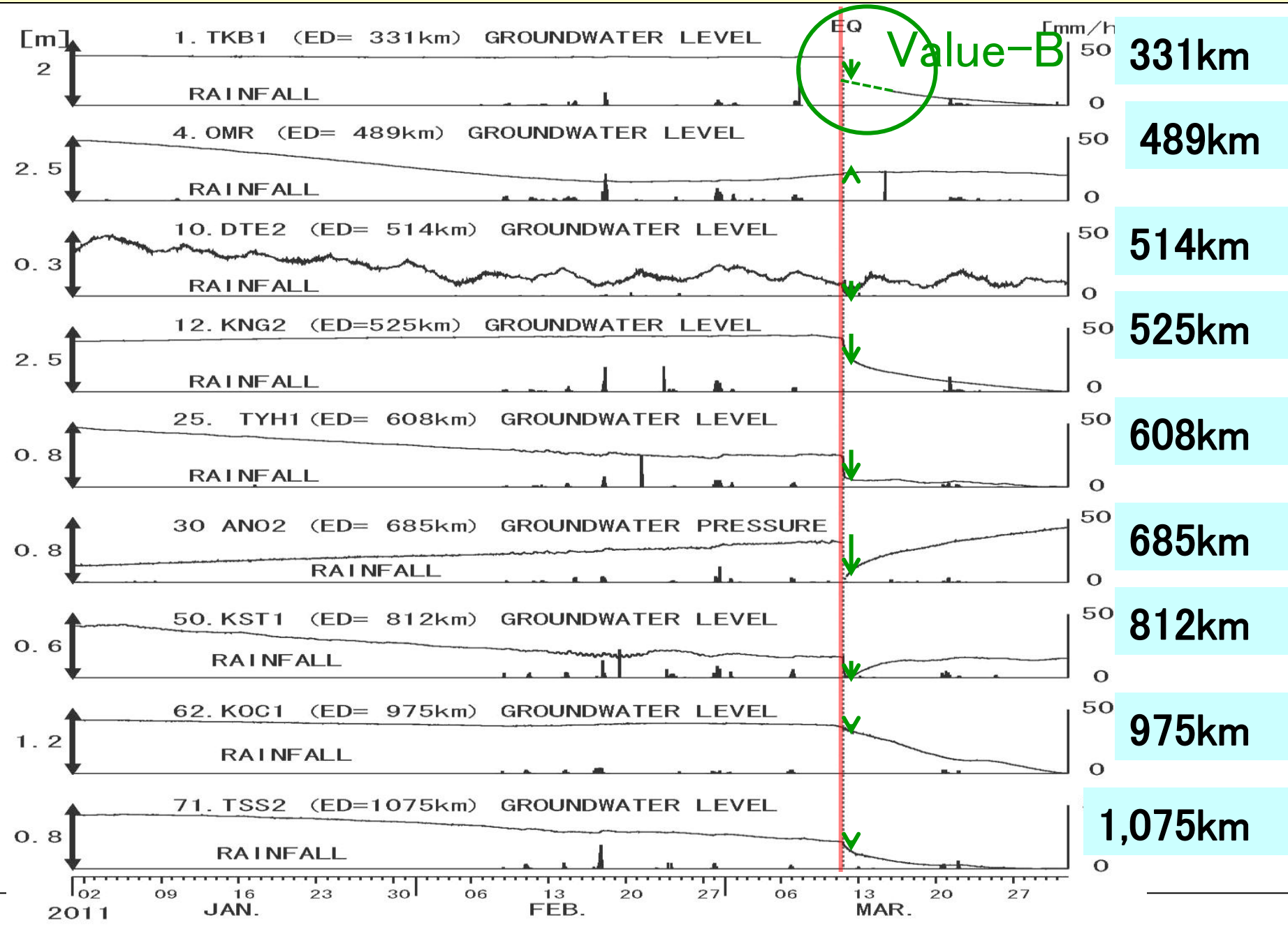
We calculated the postseismic groundwater change.

331km
489km
514km
525km
608km
685km
812km
975km
1,075km

Groundwater Level Change (Mar.11-12: Original,S.I:1-2min)



Groundwater Level Change (Jan.2011-Mar.2011:Corrected)



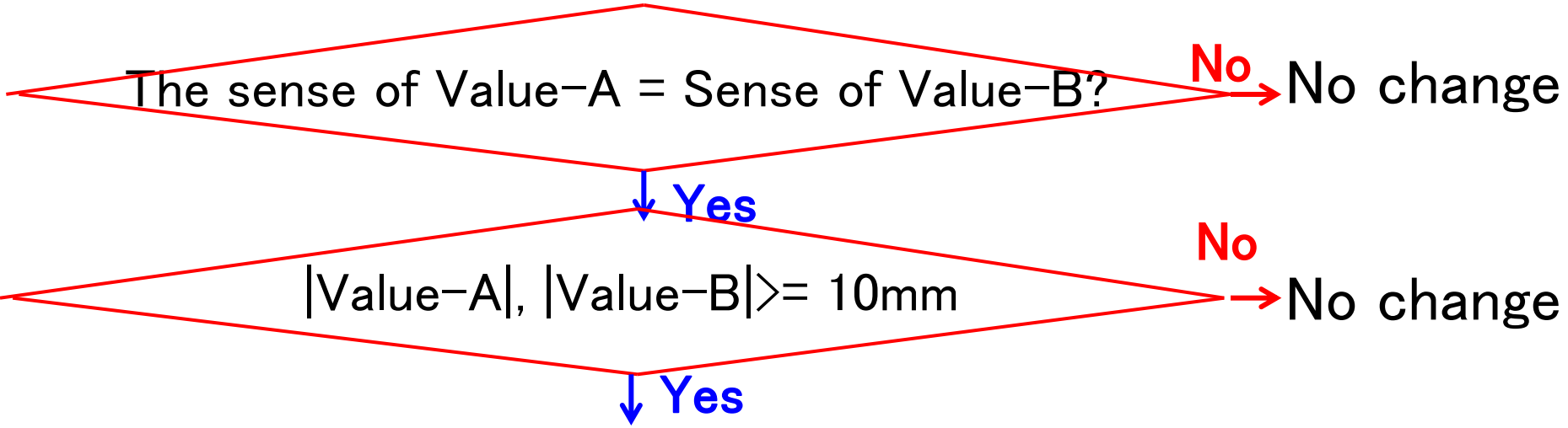
Earthquake Occurrence: 14:46 on Mar.11,2011

Value-A :(Original Data, Sampling: 1 or 2min)

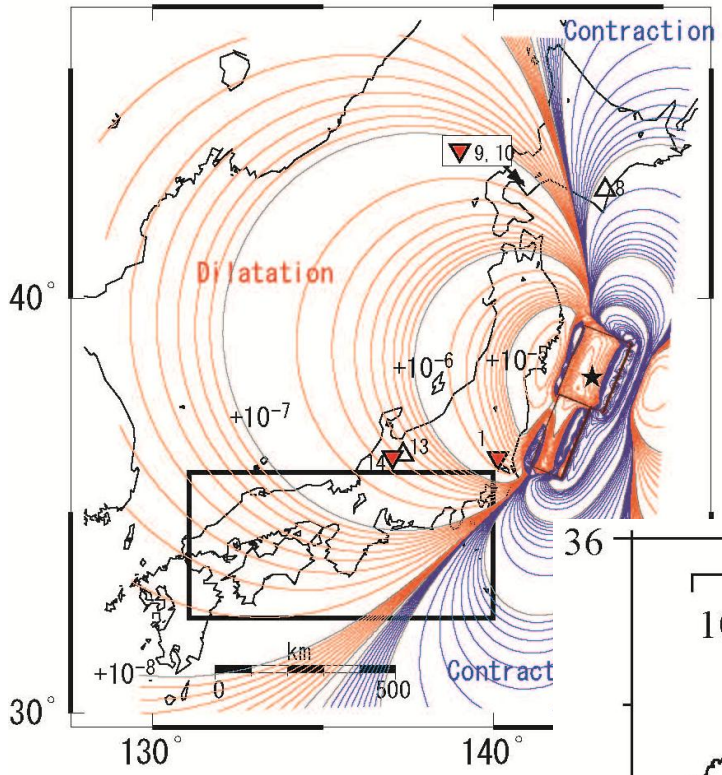
Average (14:35-14:45 on Mar.12)- Average (14:35-14:45 on Mar.11)

Value-B:(Corrected Data, Sampling: 1hour)

(14:00 on Mar.11)- (14:00 on Mar.11)



Distribution of the Postseismic Changes

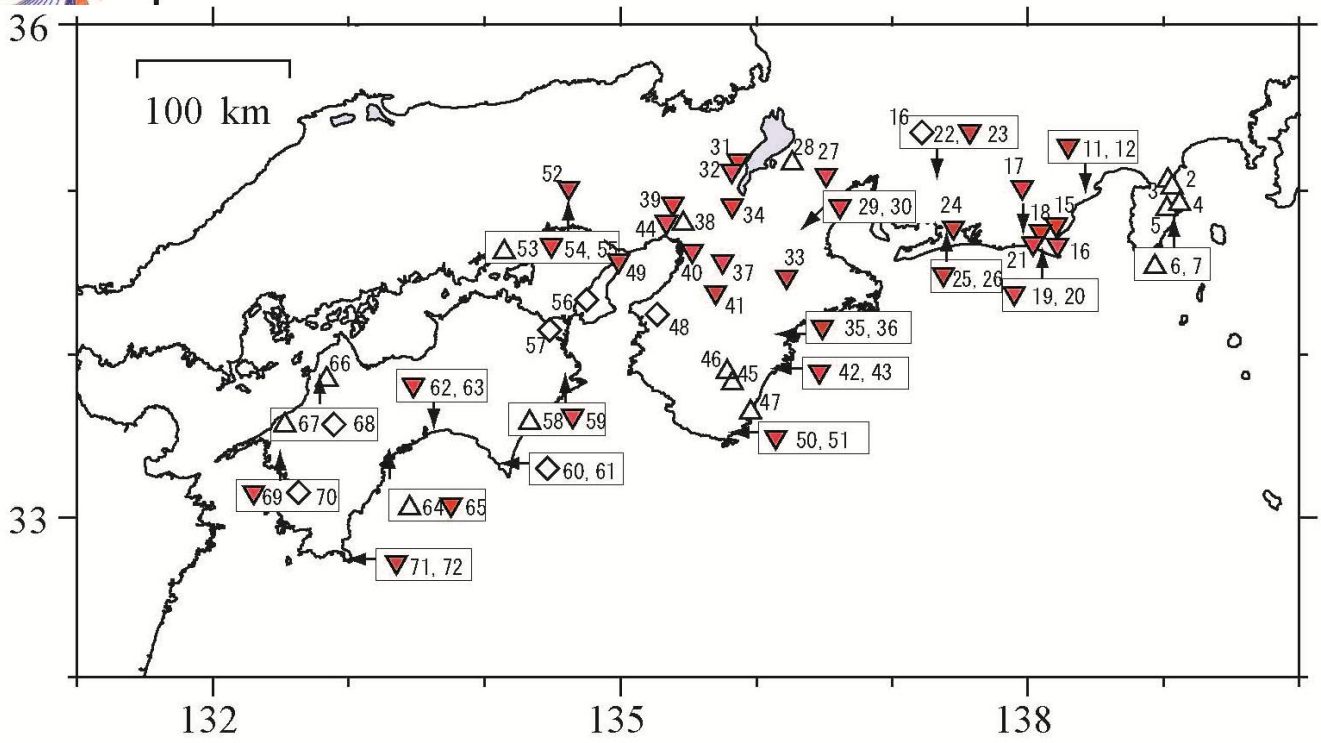


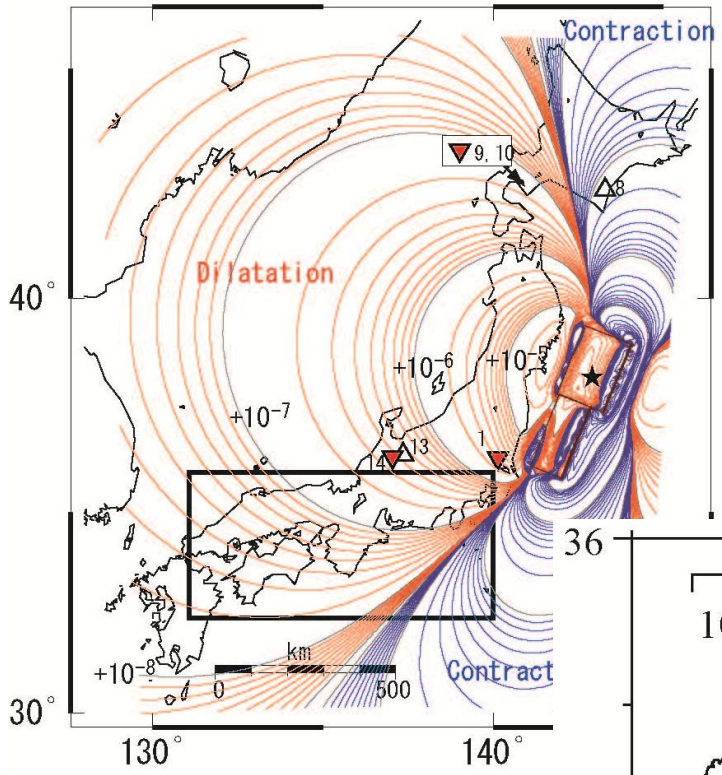
- All Wells Except No.8 are in the Dilatation Area.
- The 45 drops and 1 rise can be explained by the static volumetric strain changes.

▼: Drop:45

△: Rise:17

◇:No Change:10





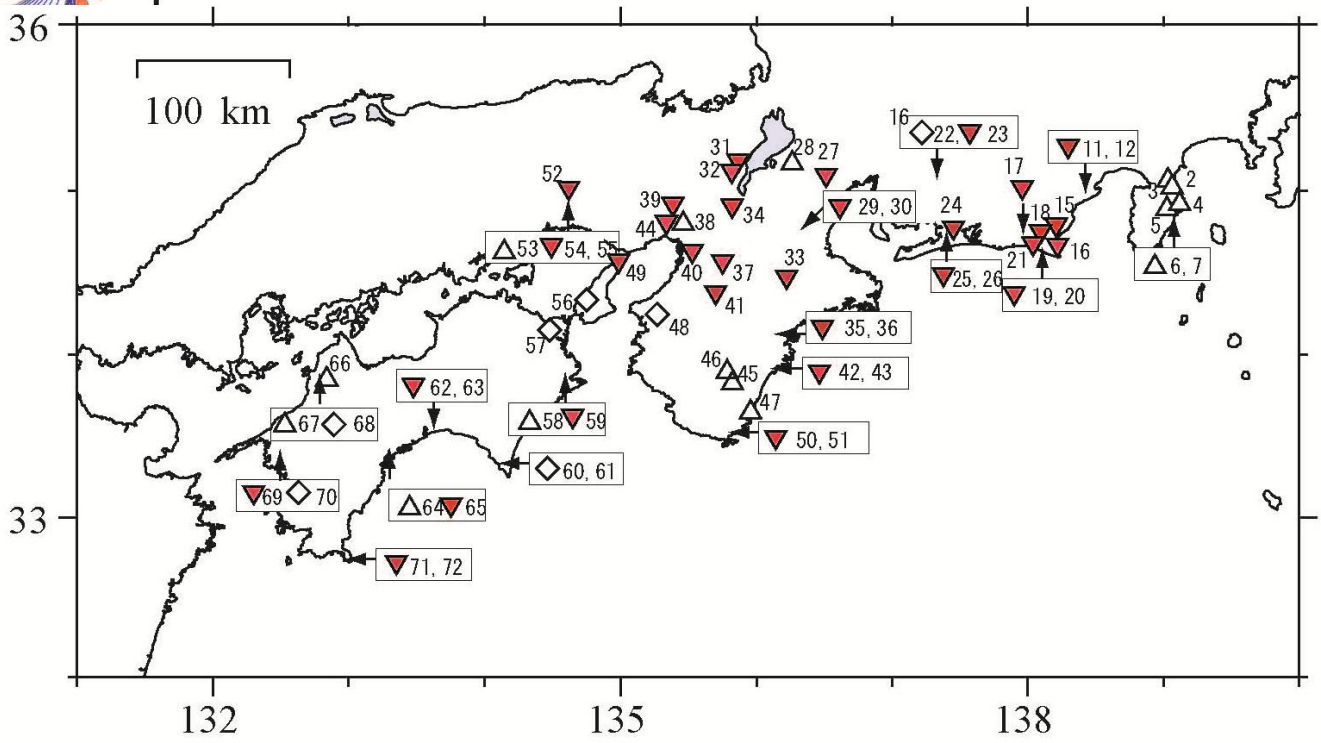
The Factor for the 16 Rises?

- Liquefaction: △
- Removal of the Barrier in a Fracture by Seismic Wave (Brodsky et al.,2003): Possible

▼: Drop:45

△: Rise:17

◇:No Change:10



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