# Natural hazard experiences and countermeasures in Japanese railways

***East Japan Railway Company (JR East)***

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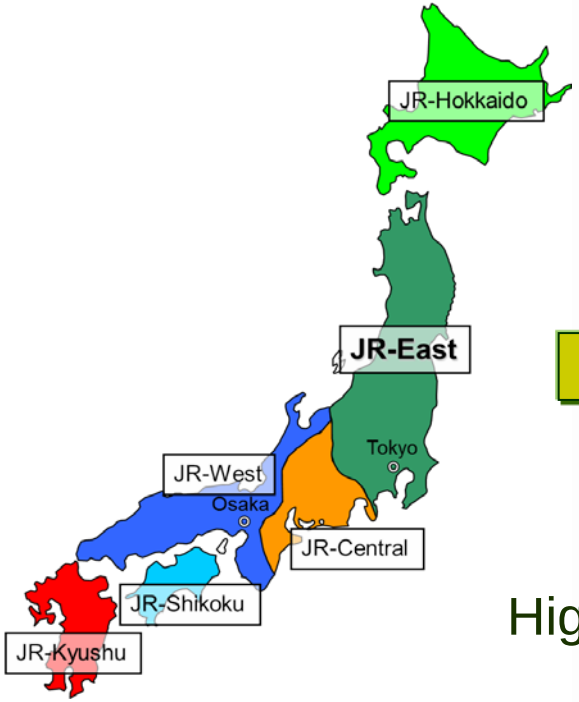
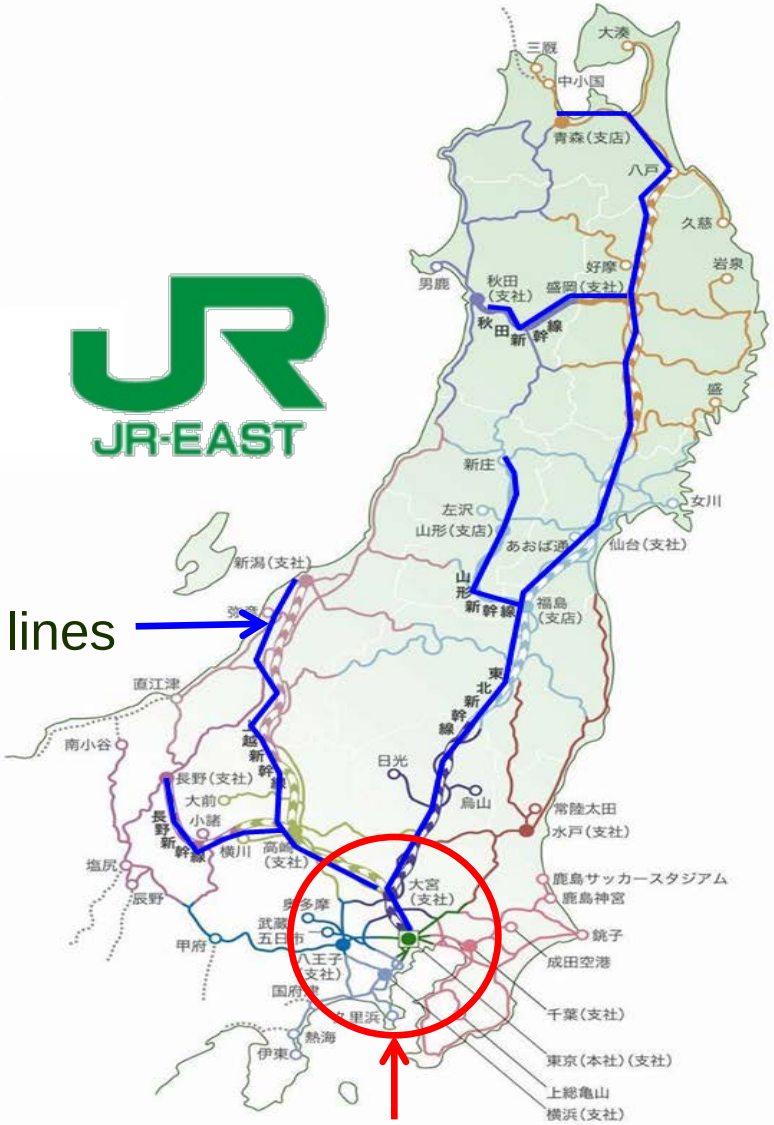
- **Natural hazards experienced by Japanese railways**
- **JR East's countermeasures against Natural hazards**

# About JR East




JR-EAST

High-speed lines




Tokyo Metropolitan Area

- Established in 1987
- 7,512km network
- 1,689 stations
- 70 lines
- 17million passengers/day
- 13,000 trains/day

# Natural hazards for railways

1 **Rain**: Landslide, Flooding, Scouring

2 **Wind**: Derailment, Flying Obstacles, Fallen leaves

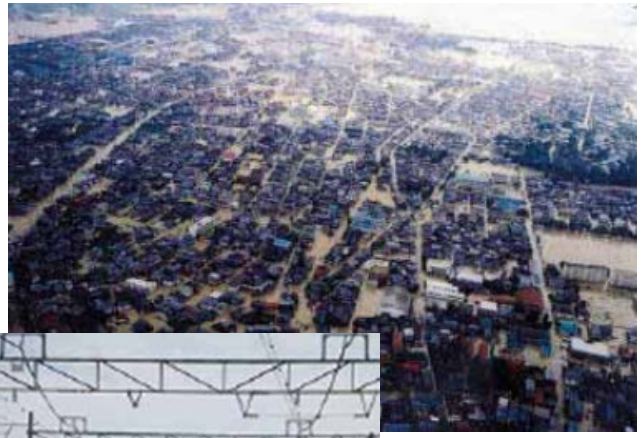
3 **Waves**: Shoreline erosion

4 **Snow**: Fallen trees, Avalanche

5 **Others**: Heat wave, High or low temperature, Thunder, Fog, Earthquake…

# Hazard of Rain 1

- Heavy rain (427mm for 2 days)
- Landslide, Flooding
- Niigata (JR East)
- 12-13 July 2004



# Hazard of Rain 2

- Tokyo (Tokyo Metro)
- 4 October 2004
- Typhoon and heavy rain ( 400mm in 3 days)
- Rain water flooded a subway station

# Hazard of Rain 3

- Long rain (500mm in 2 months)
- Rise of the groundwater level
- Floating of the structure of semi-underground station
- Tokyo (JR East)
- 11 October 1991

# Hazard of Rain 4

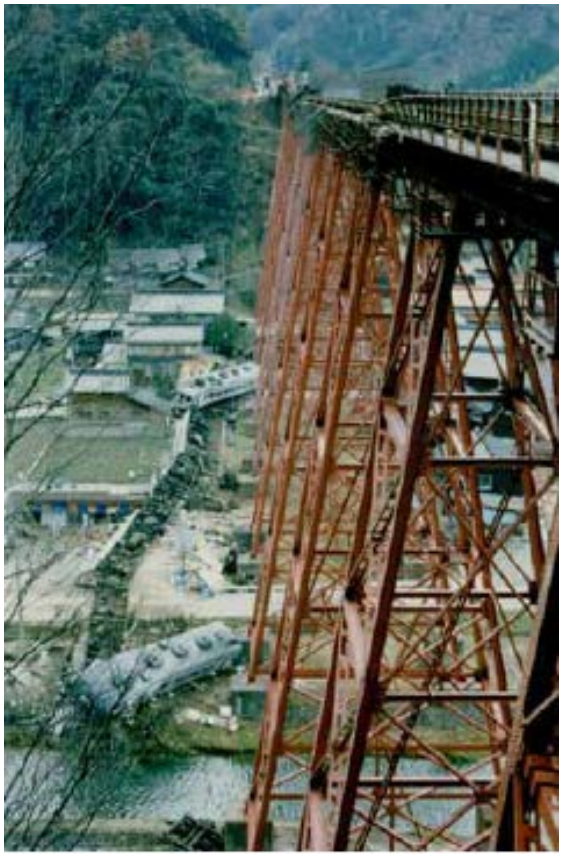
- Strong typhoon
- Scouring, pier collapsed, two spans washed away
- Single-track operation on parallel bridge for 75 days
- Shizuoka (Japanese National Railways)
- 2 August 1982

Source: Yomiuri New Paper

Source: Fuji City

# Hazard of Wind 1

- Strong wind (over 30 m/s)
- Derailment, train falling from the bridge
- 6 fatalities: 5 general public and the train conductor
- Hyogo (Japanese National Railways)
- 28 December 1986

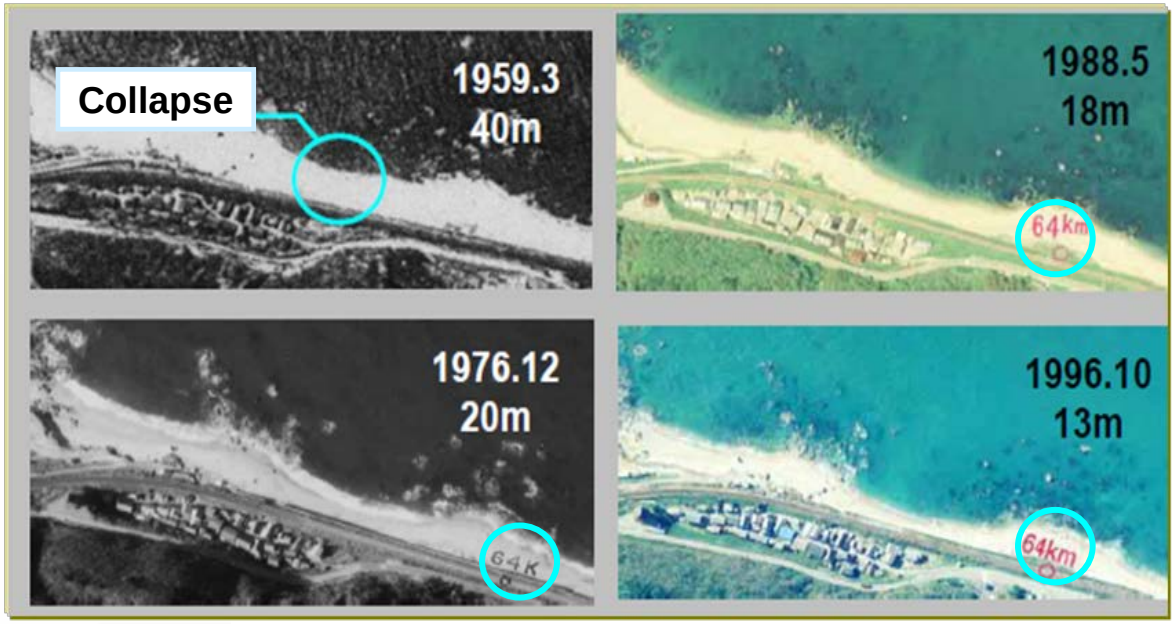


# Hazard of Wind 2

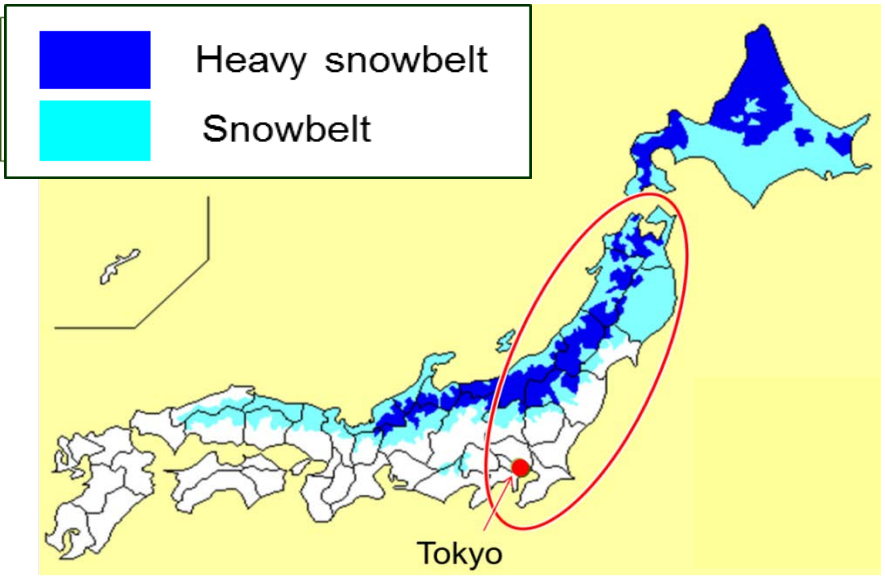
- Tornado or Downburst
- Derailment
- 5 passengers killed, 32 passengers seriously injured
- Yamagata (JR East)
- 25 December 2005

# Hazard of Waves

- High waves, Coastal erosion
- Collapse of shore protection wall
- Yamagata (JR East)
- 19 December 2000



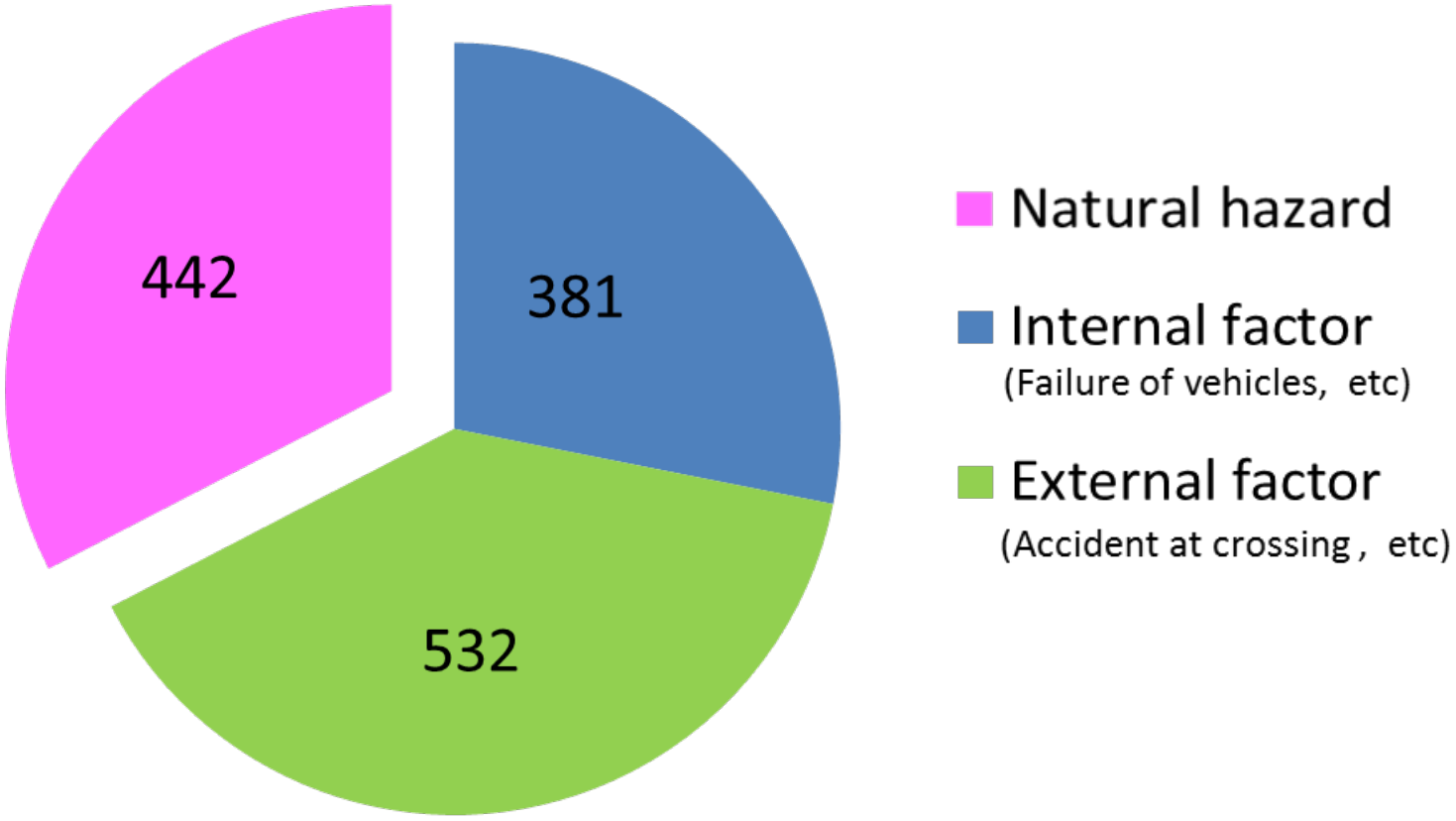

# Hazard of Snow




- Half of the main island is in the snowbelt
- Snow damage occurs often in Japan
- Fallen trees, Avalanche

# Traffic disruptions by cause

1/3 of traffic disruptions in JR East are caused by natural hazards.




Data FY2010

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- Natural hazards experienced by Japanese Railways

- **JR East's countermeasures against Natural hazards**

# Countermeasures by JR East

**1 Greater resilience of network**

**2 Installation of monitoring system**

**3 Education and training**

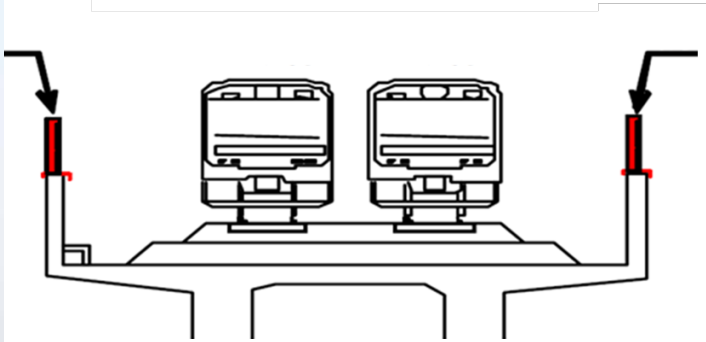
**4 Research and development**

# Greater resilience of network: rain

- Slope reinforcement
- Scouring protection

# Greater resilience of network: wind

- Windbreak fence/screen
- Windbreak forest



# Greater resilience of network: snow

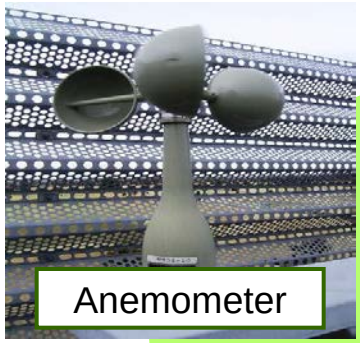
- Anti-avalanche facilities
- Snow removal equipment
- Anti-snow measures on trains
- Snow protection forests



Snow removal equipment

# Installation of monitoring system

## Monitoring and restrictions

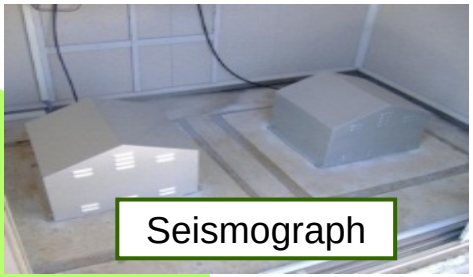



Rail temp. gauge

Snow gauge

Scouring detector

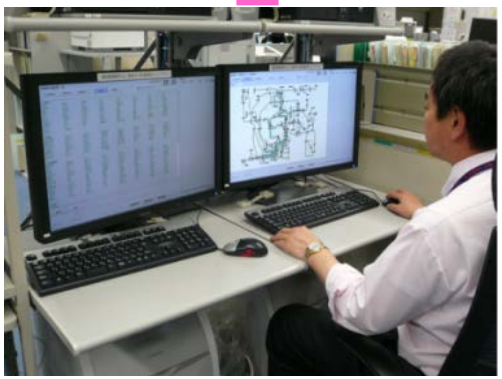
Network







- Speed restrictions
- Traffic suspension



Operation Control Center

March 2010

| | High-speed line | Conventional line | Total ( per 100km) |
|---|---|---|---|
| Rain gauges | 29 | 537 | 566（7.5) |
| Water gauges | 0 | 592 | 592 (7.9) |
| Anemometers | 158 | 699 | 857 (11.4) |
| Seismographs | 97 | 196 | 293 (3.9) |

# Education and training

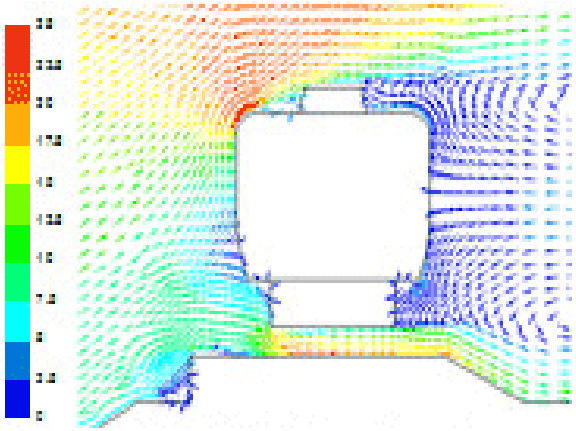
Training center

Training at depot

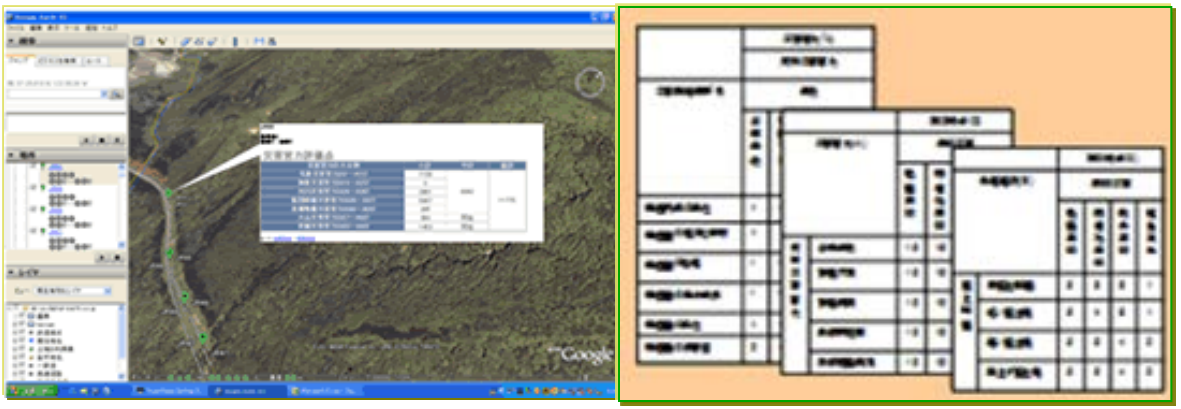

The Accident History Exhibition Hall

# The Disaster Prevention Research Laboratory

- Study on mechanism of natural disasters and risk evaluation
- Development of observation and detection methods
- Development of countermeasures and technical standards



Simulation

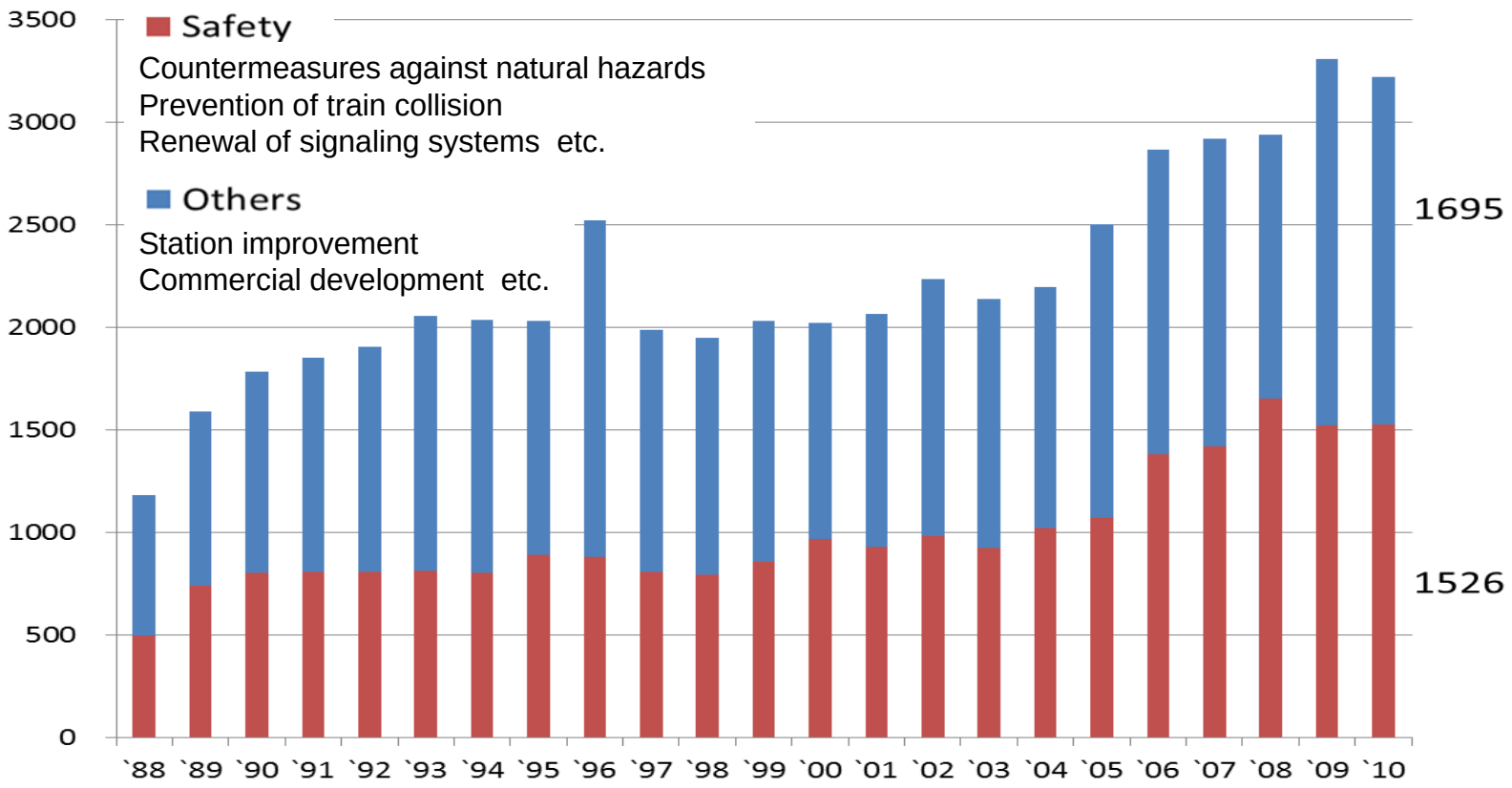


Hazard map

# Capital investment of JR East

(Million euro)

€1＝￥110




- Half of JR East's investment is for safety.
- In 2010, 20% of the safety investment is for the countermeasures against natural hazards, which is equivalent to about 40K euro/km.
- Total annual investment is within the limits of cash flow.

# Governmental funding for railway

€1＝￥110　　FY2011

| Subject | Euro（million) |
|---|---|
| New high-speed lines | 1,363.6 |
| Main intercity lines | 7.6 |
| Urban lines | 158.0 |
| Technology development | 3.5 |
| Safety prevention | 12.6 |
| Natural disaster prevention | 1.8 |
| Others | 2.4 |

# Conclusion

- One of the most important missions of a railway company is to run trains safely. However, it is impossible to predict natural hazards accurately.
- Therefore, we have been taking practical measures by learning from past experiences.

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# *Thank you for your attention*