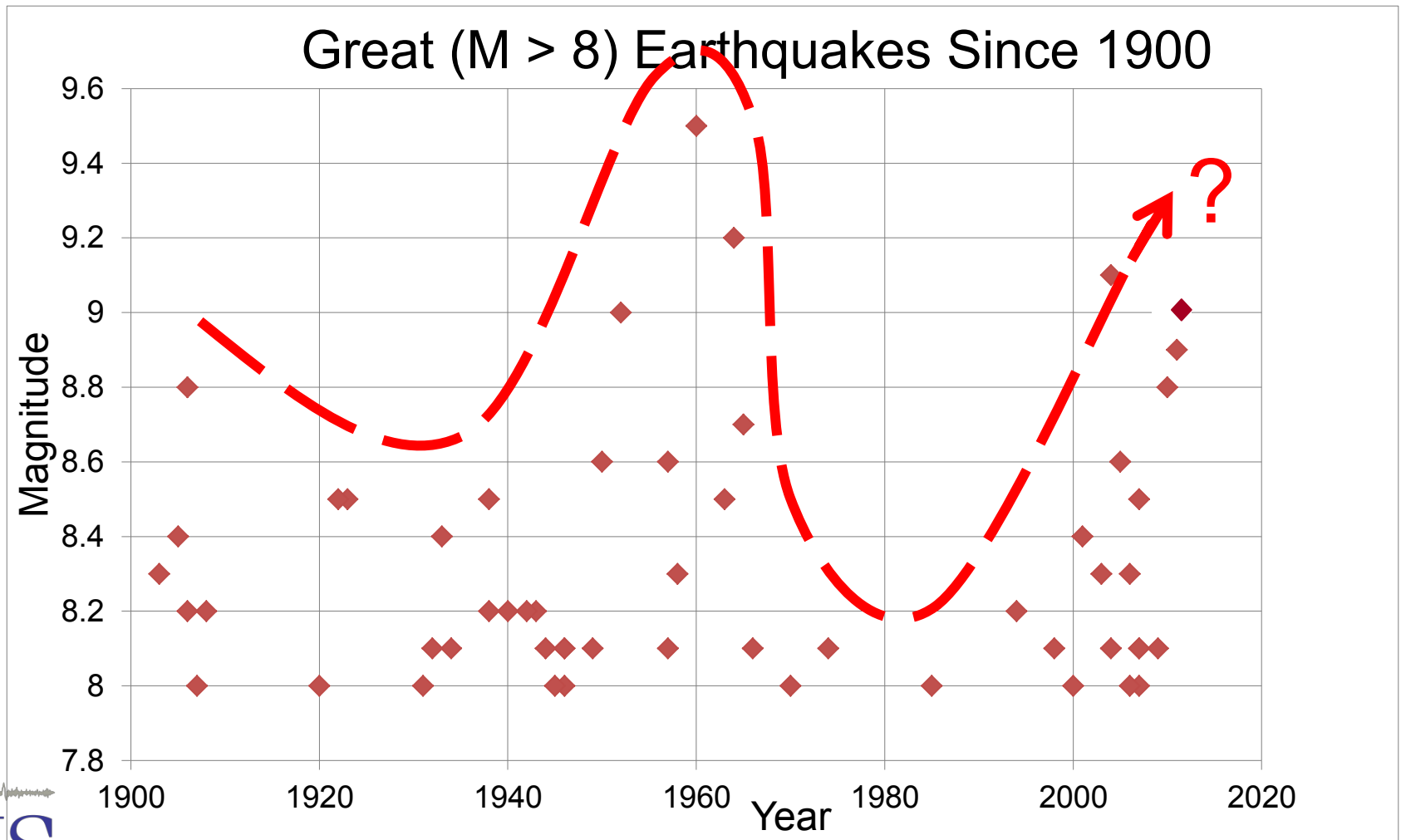


# CaMRA 2011: Geoscience perspectives on Vulnerability

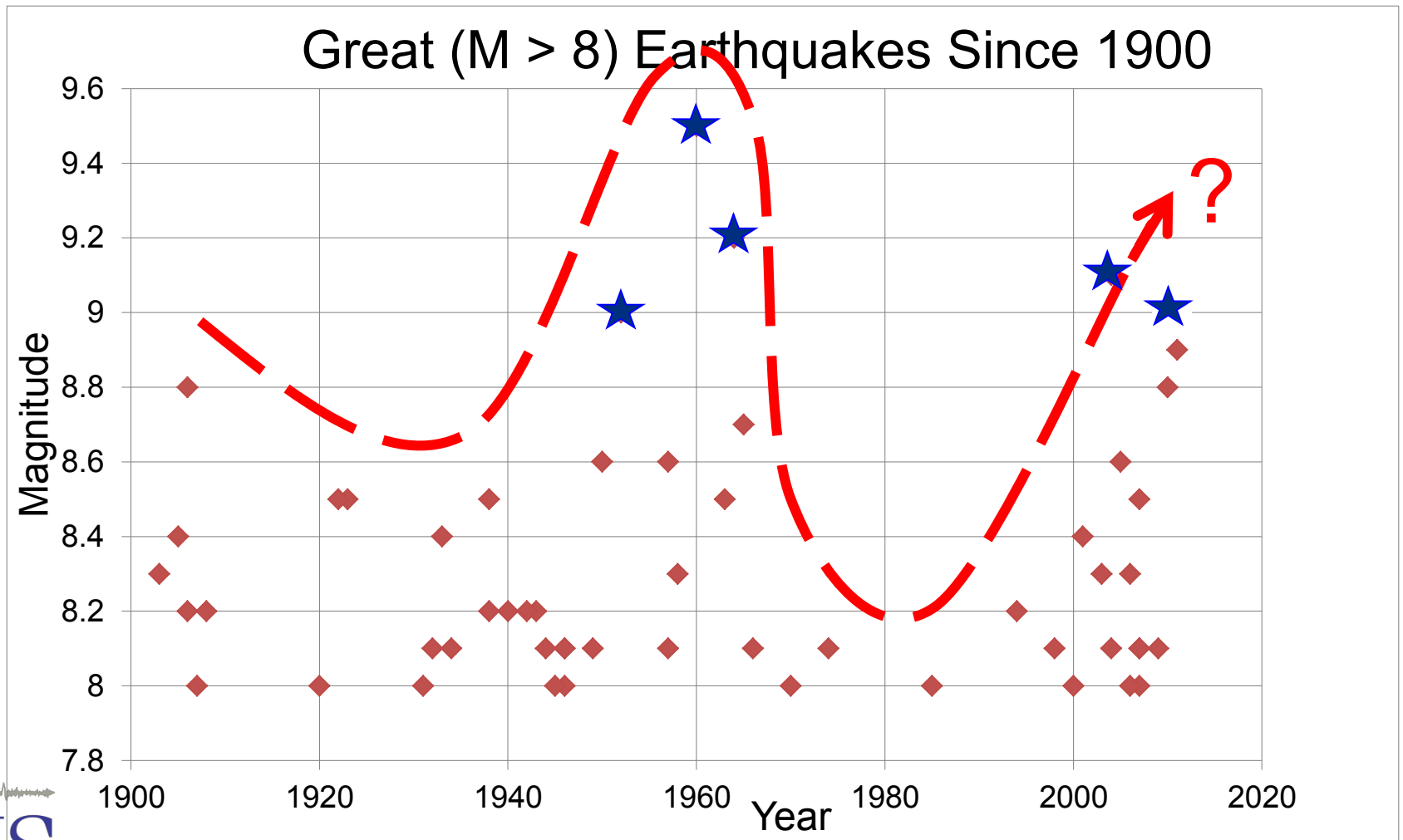
1. Infrequent events
2. Multi-hazard events
3. Long-lived events
4. Escalating events
5. Ill-characterized event types (Limits of knowledge)



# 1. Infrequent events: magnitude



# 1. Infrequent events: type

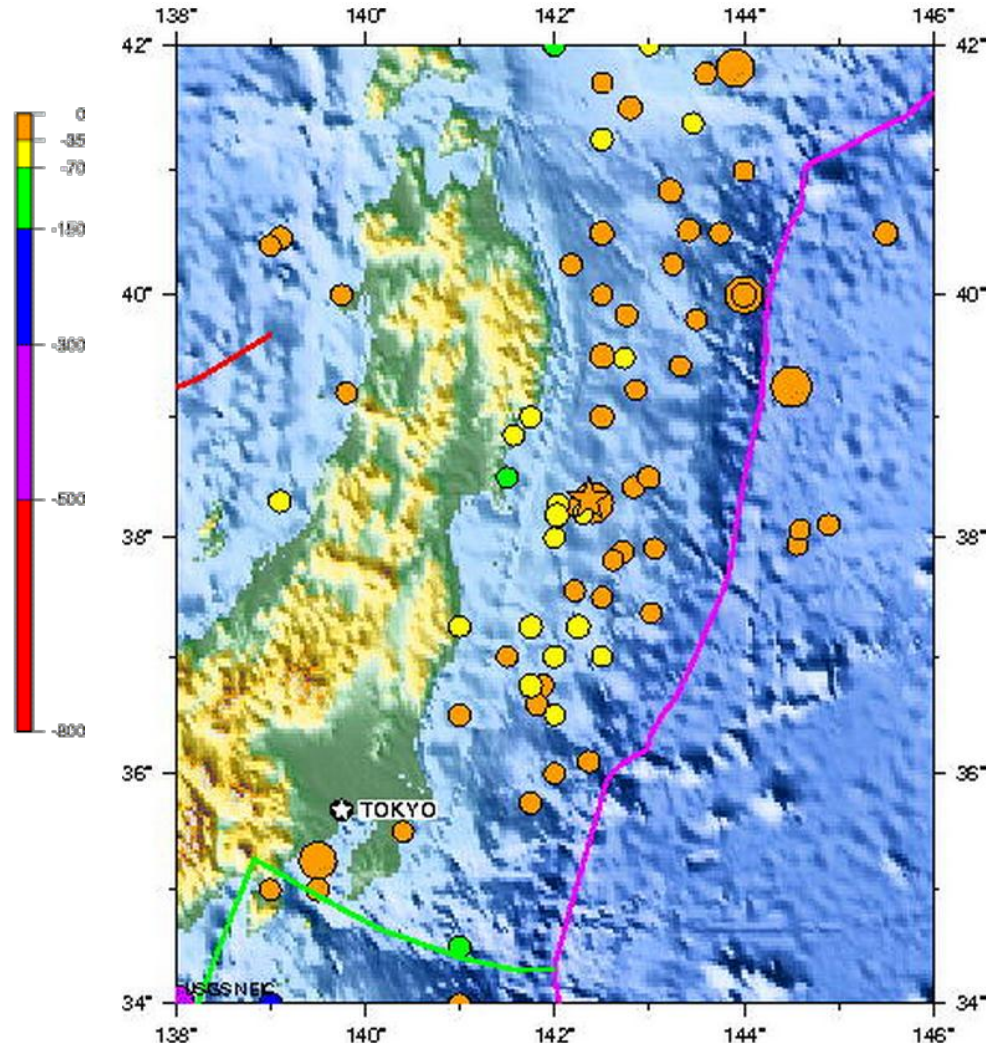


# Earthquakes $M > 7$ since 1990

## 2. Multi-hazard events

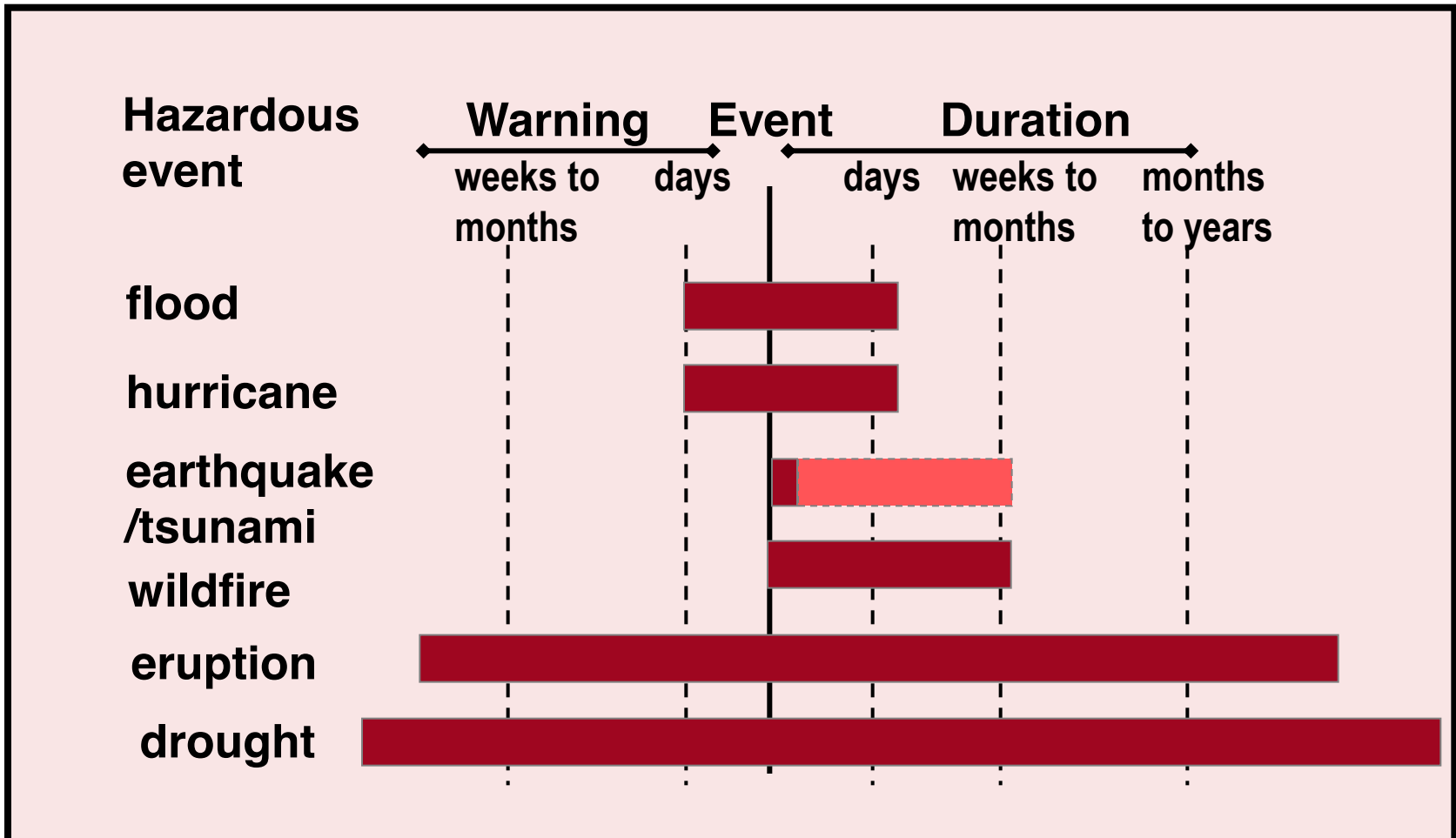
### Tsunami since 1990

2011	(+18000)
1993	(330)
1983	(103)
1952	(33)
1944	(40)
1933	(3000)
1923	(2144)
(1986)	(26360)

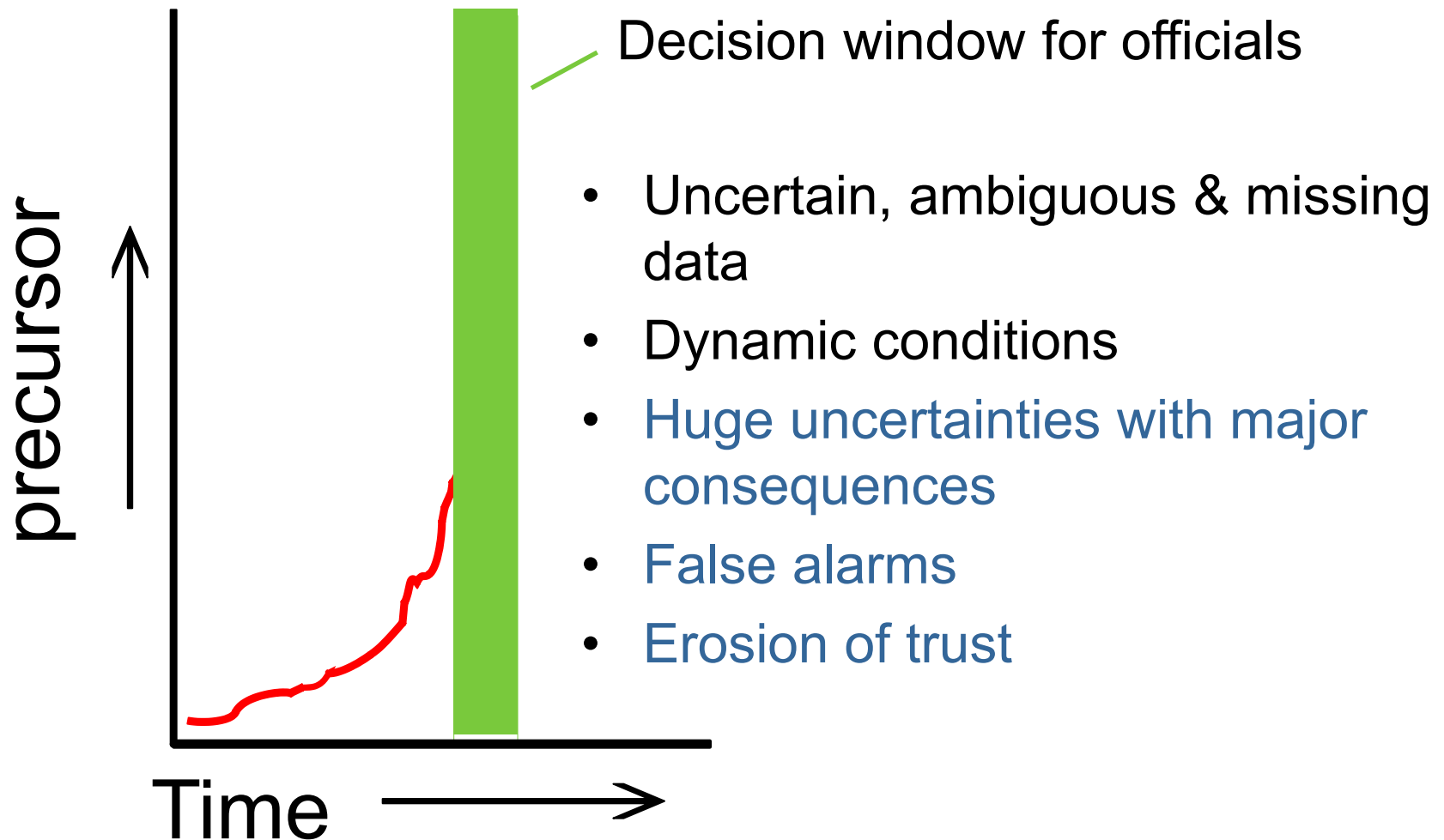


# 3. Long-lived events

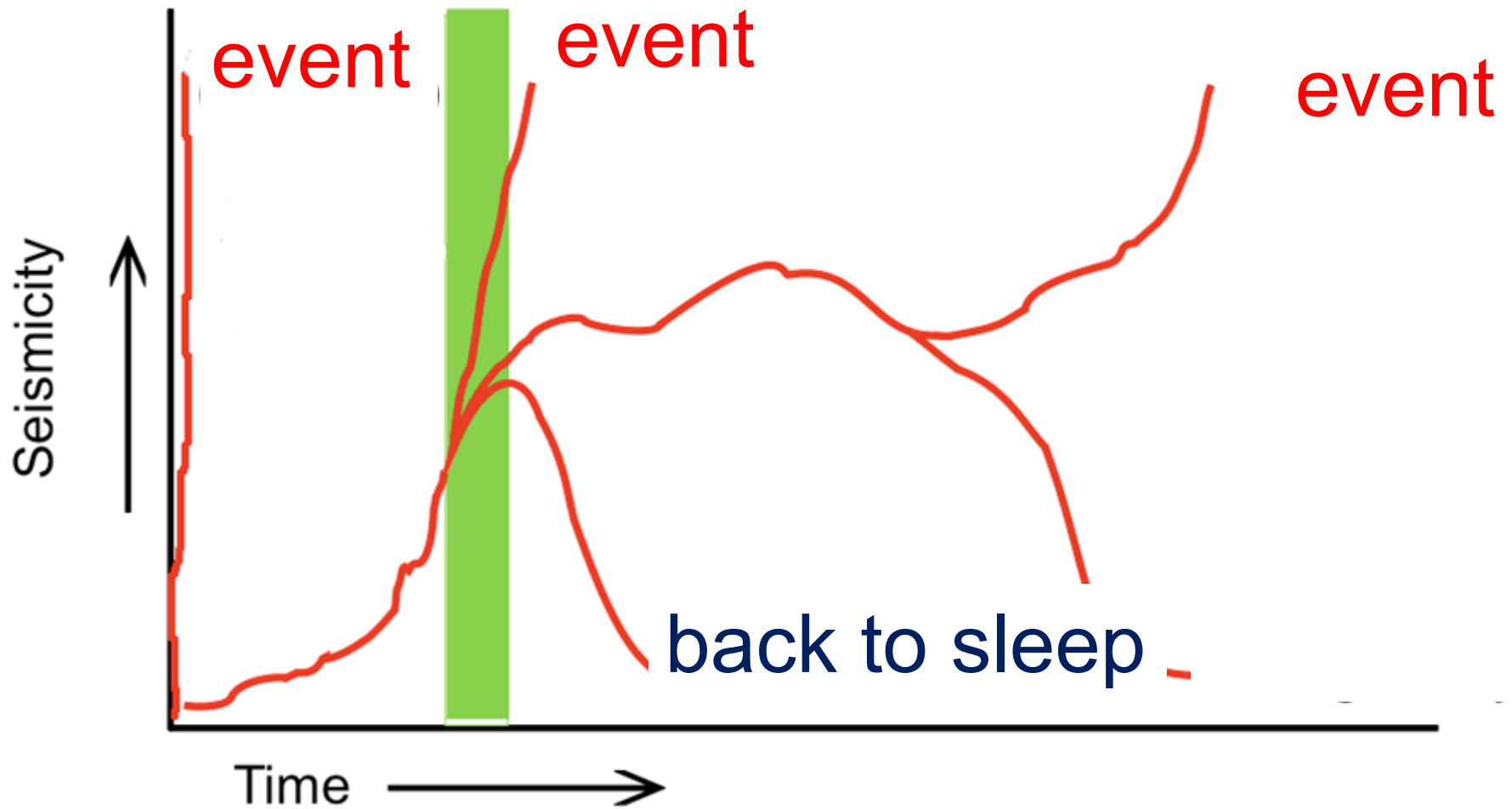
- Prolonged durations
- Warning times
- Funding delays
- Prolonged high demand/stress



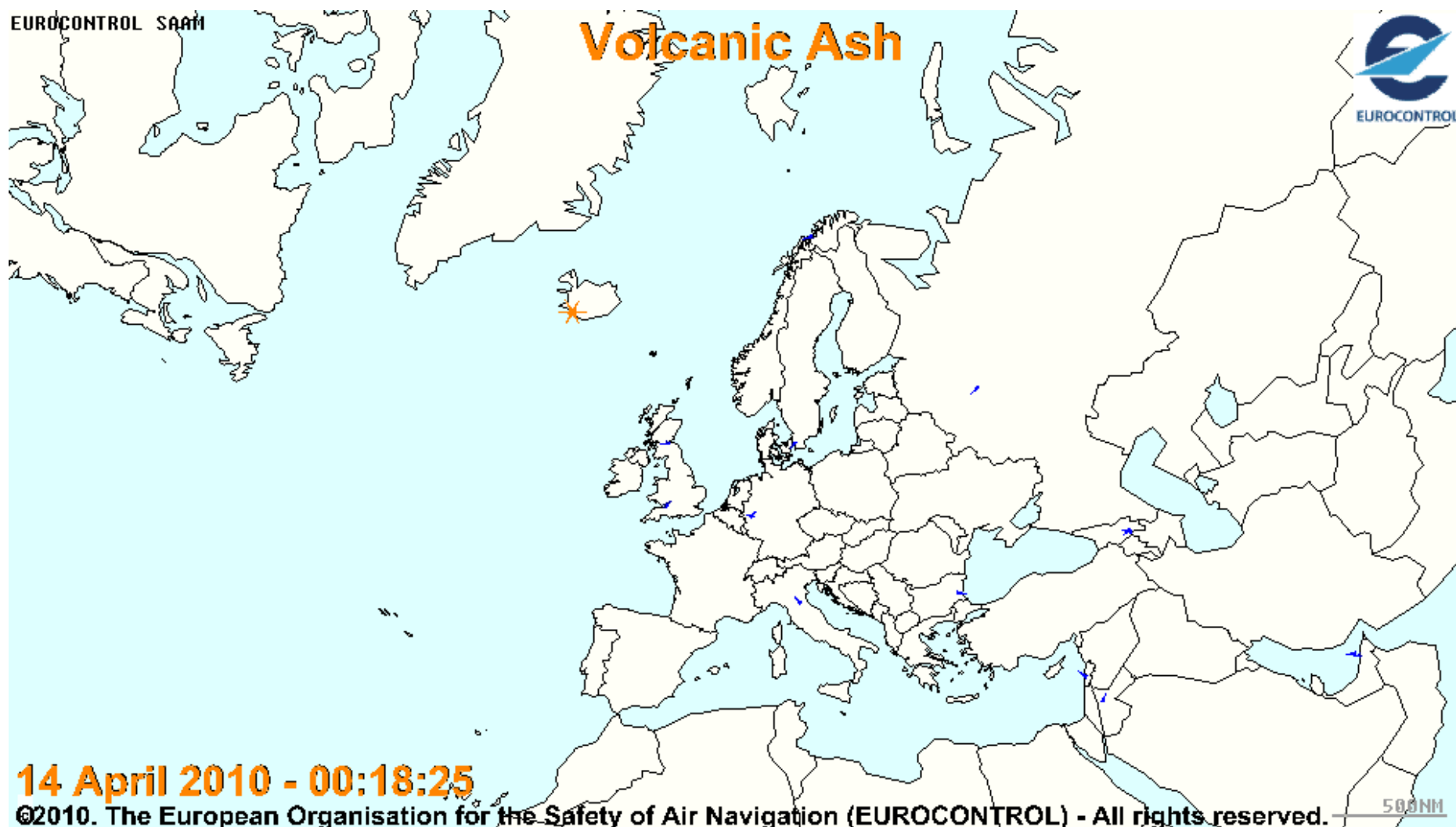
# 4. Escalating events



# 4. Escalating crises: uncertainty



# 5. III-characterized events





# 5. Knowledge limits: Eyjafjallajökull

- Unprecedented breakdown of global airspace, \$5B loss
- No way of measuring ash concentration in plumes.
- “Zero-ash tolerance” policy designed for dense short-lived ash plumes close to volcanoes.
- Result was closure of air space with exceptionally low ash concentrations.

“we will never get any academic presentation to hold to the 5 minute limit.” W.G. Peacock 2011.

