

Mission design of 6U CubeSat PRELUDE to elucidate  
the DEMETER results

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**Prelude**



2010 Mw7.0 Haiti Earthquake

2004 Mw9.3 Sumatra Earthquake

CNN

Present EQ prediction is helplessness.  
Earthquake (EQ) suddenly occurs for us.

Short-term prediction obviously  
provides disaster mitigation.

It requires precursor detection.

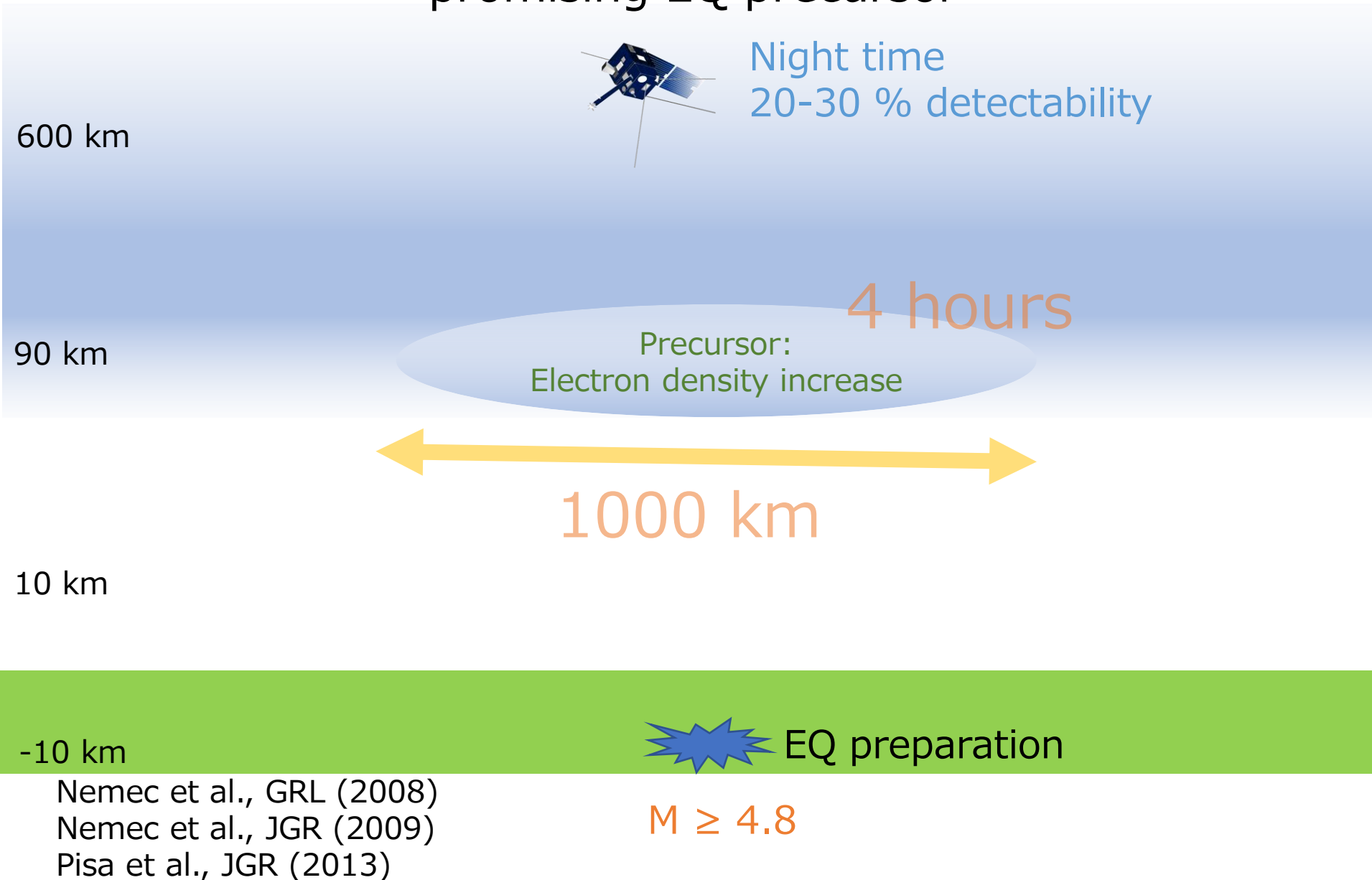
BBC

The  
Mainich

2005 Mw7.6 Kashmir Earthquake

2011 Mw9.0 Tohoku Earthquake

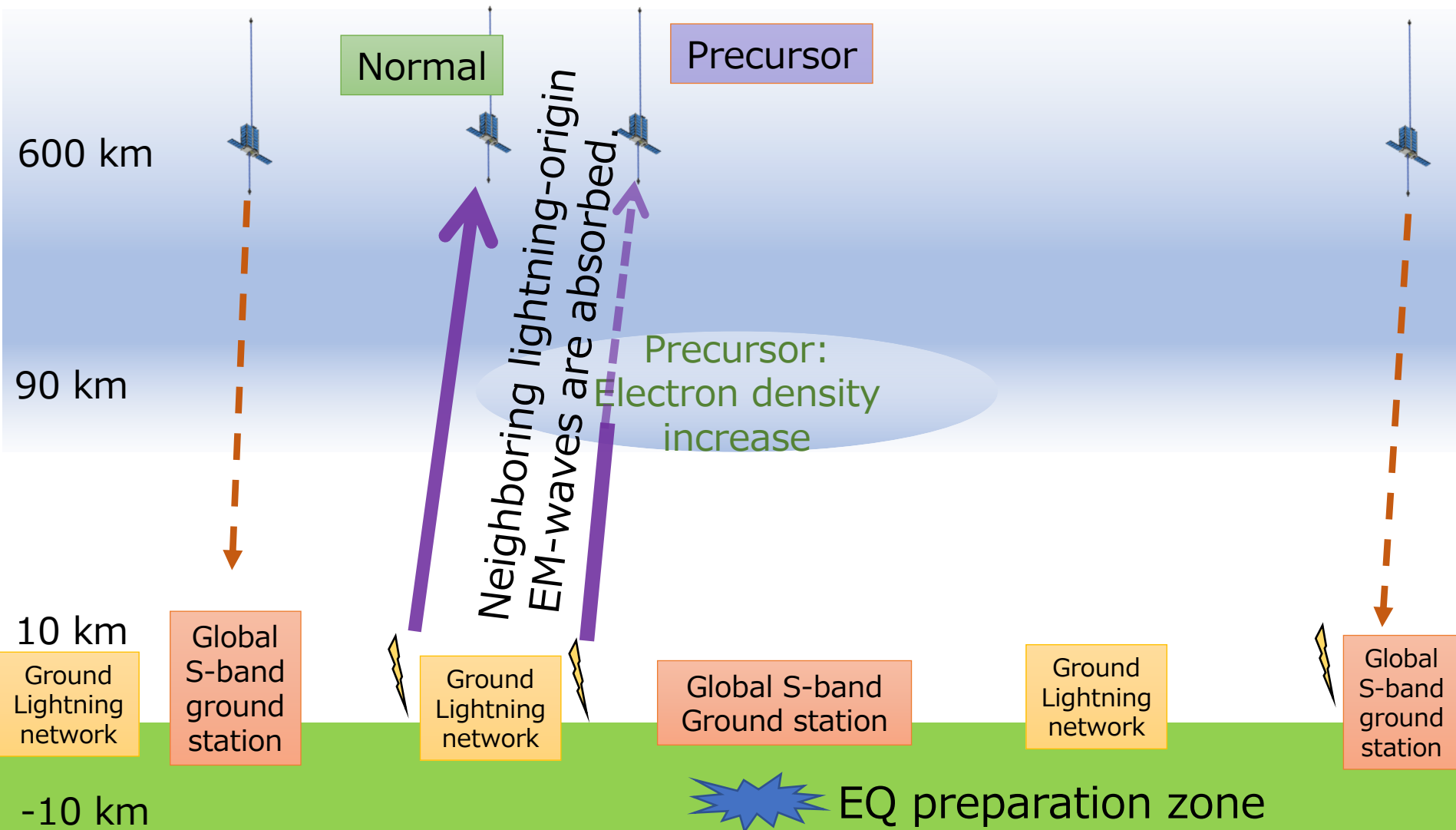
# French DEMETER satellite (2004-2010) statistically found promising EQ precursor



# Comparison among earthquake precursor satellite

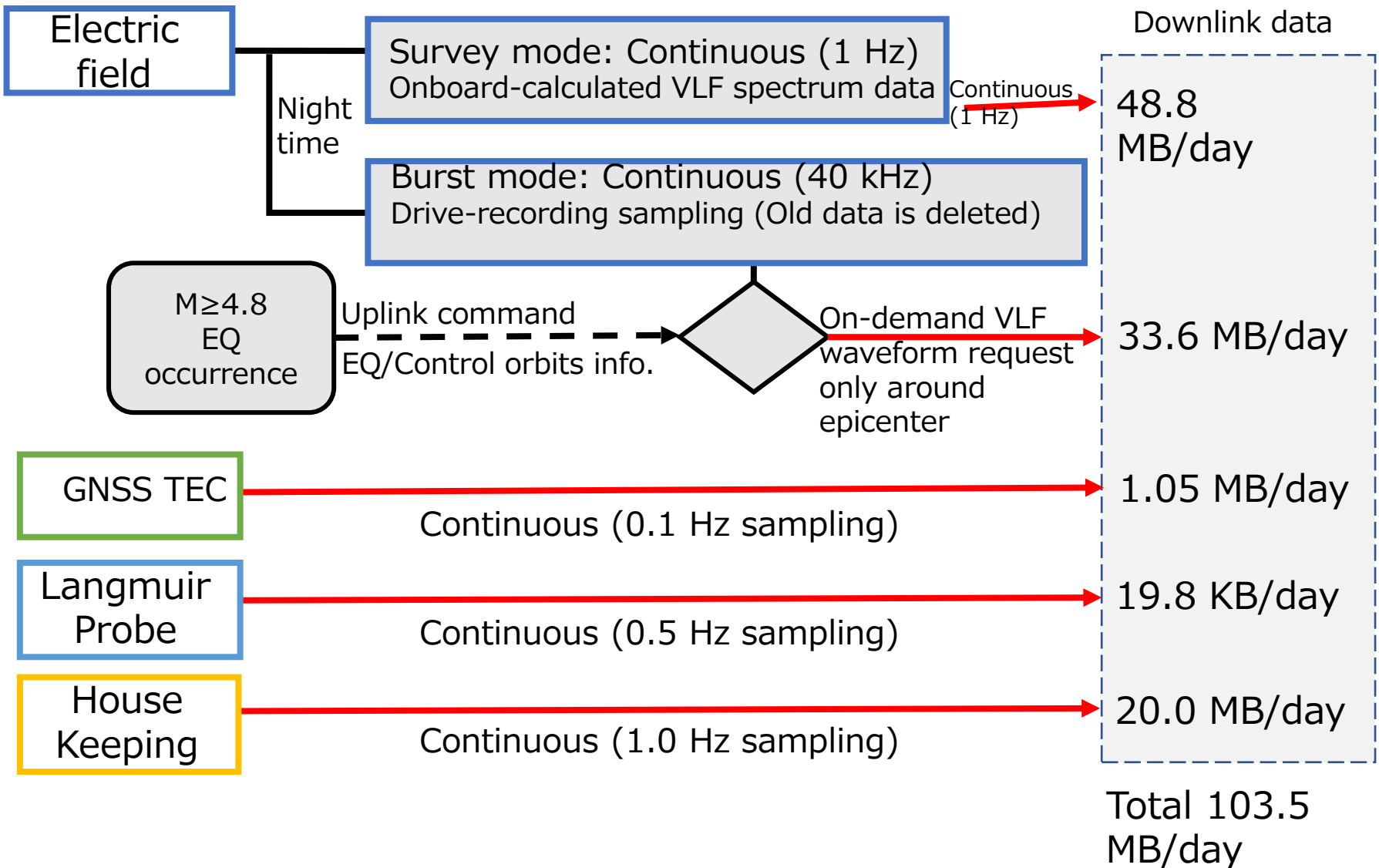
	Weight (kg)	Launch cost/ Rocket (million US\$)	Satellite cost (US\$)	Communication Ground station	Feature
DEMETER (CNES, France)	130	300 (Dnepr rocket)	300	X-band 1 ground station in France	First practical satellite dedicated to EQ- precursor study (2004~ 2010) Plausible EQ-precursor was found (Nemec et al., GRL, 2008)
CSES (China Earthquake Administration · China National Space Administration)	730	Possibly 200- 400 (Long March rocket)	Possibly more than 1000	X-band 4 ground stations in China	Finally total 5 satellites launch. First satellite (Feb. 2018-). Second satellite (2023- expected)
KazSciSat-1 (Kazcosmos)	4.5	0.1 (SpaceX Falcon-9/ rideshare)	Possibly less than 1	UHF (Amateur radio)	No electric field measurement (Only magnetic)
<b>PRELUDE</b>	<b>10</b>	<b>Free (Epsilon/ Piggyback)</b>	<b>0.5</b>	<b>S-band Cloud ground stations (Global stations)</b>	<b>Dedicated to the study of DEMETER's result. Expected launch: JFY2024-</b>

# Methodology of EQ precursor observation from space

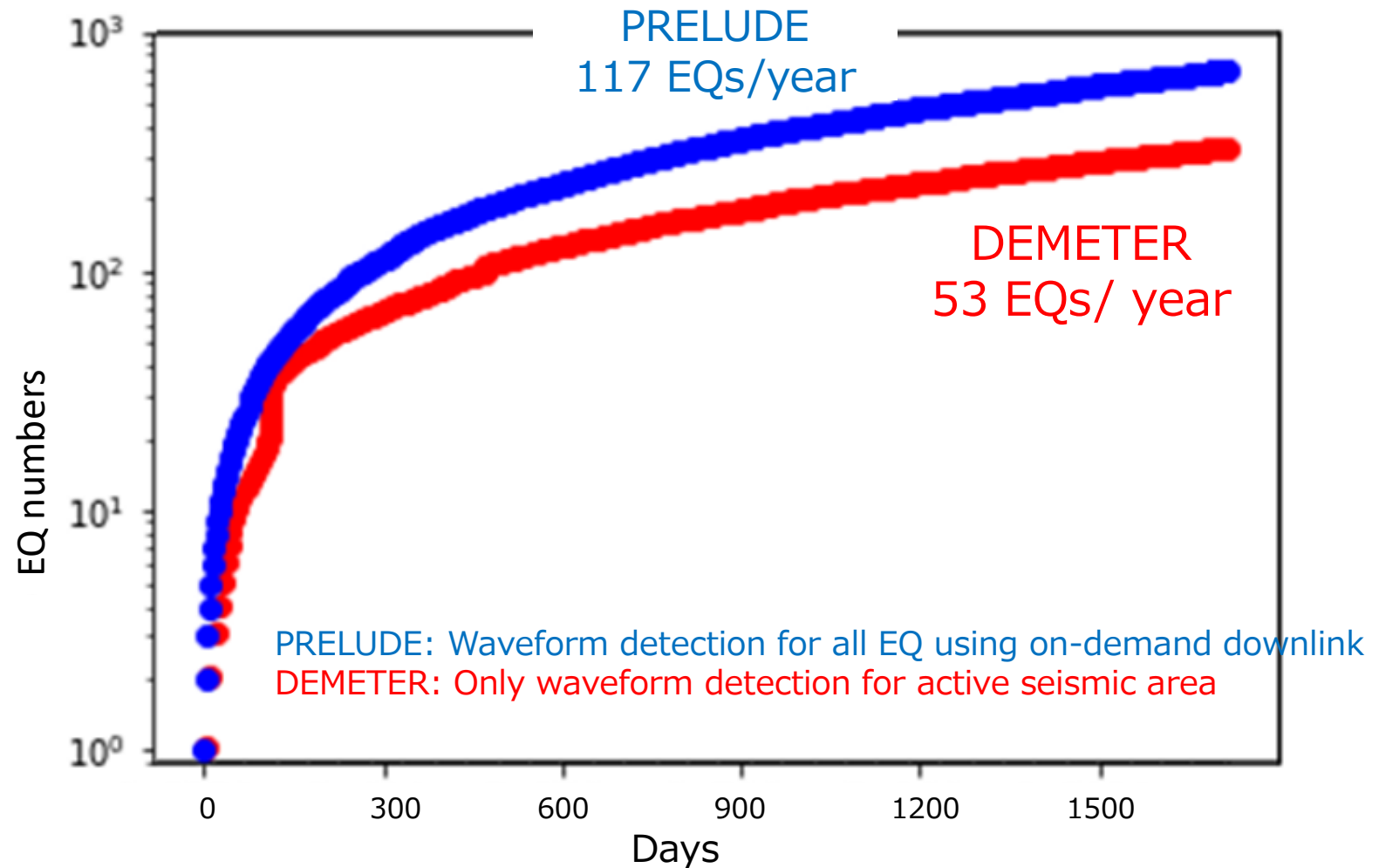


- ✓ **Lightning**-origin EM waves are used as a **natural radar** for precursor monitor.
- ✓ Cloud ground-stations provide **real-time** precursor monitoring.
- ✓ Burst mode (Waveform sampling) clearly identify the precursor.

# Data acquisition

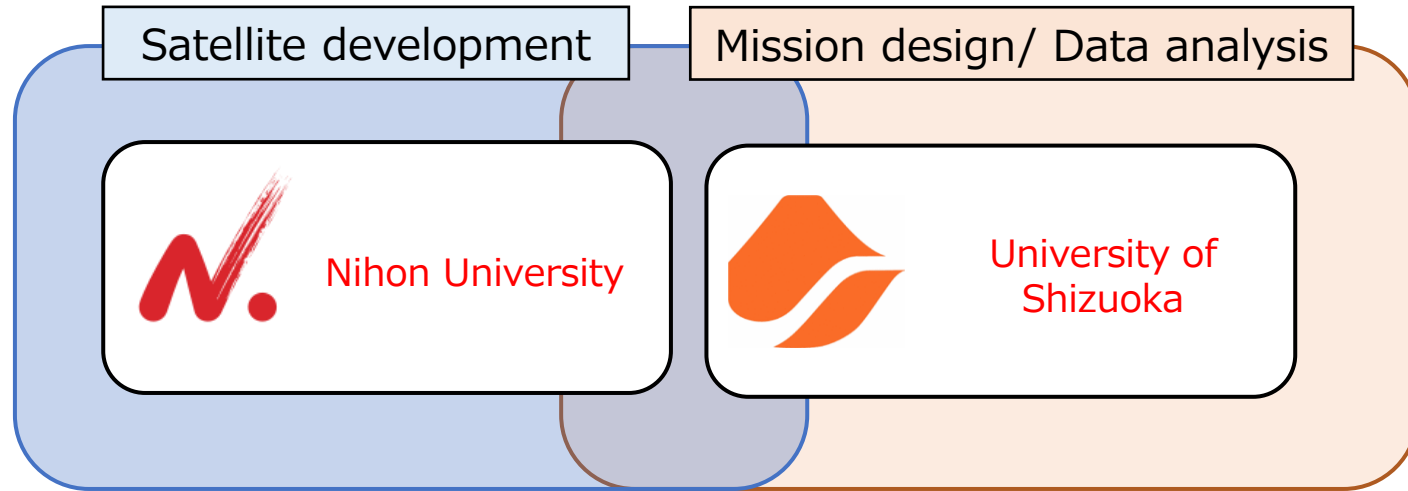


# Comparison between PRELUDE and DEMETER for precursor detection in Burst mode

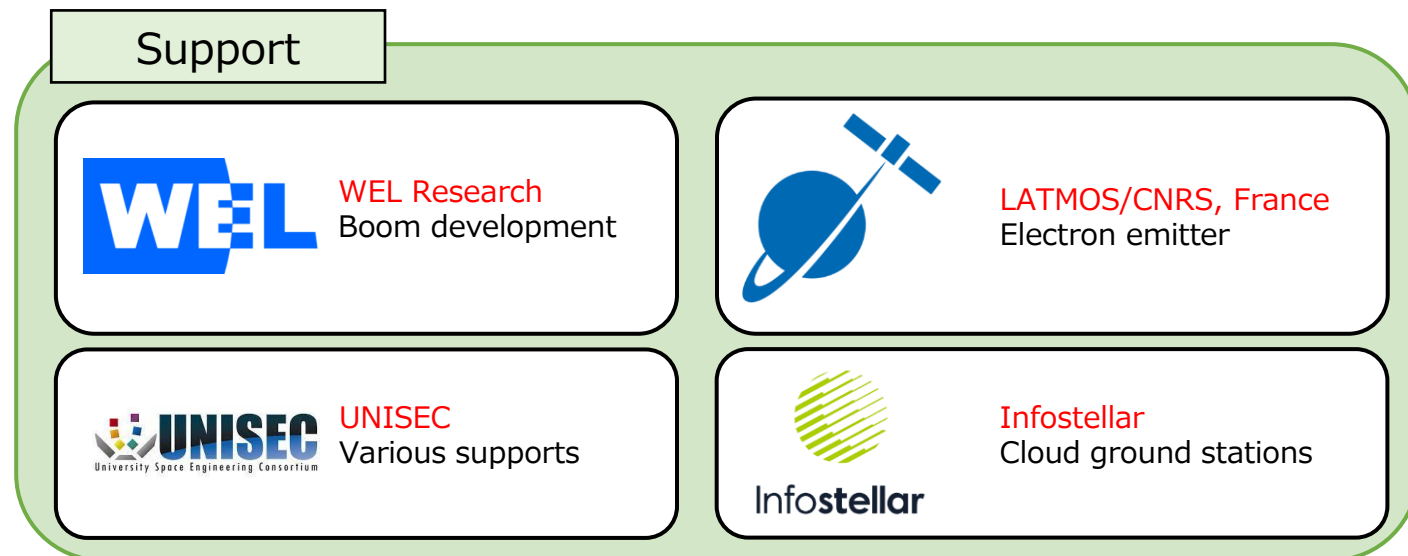




## Main team



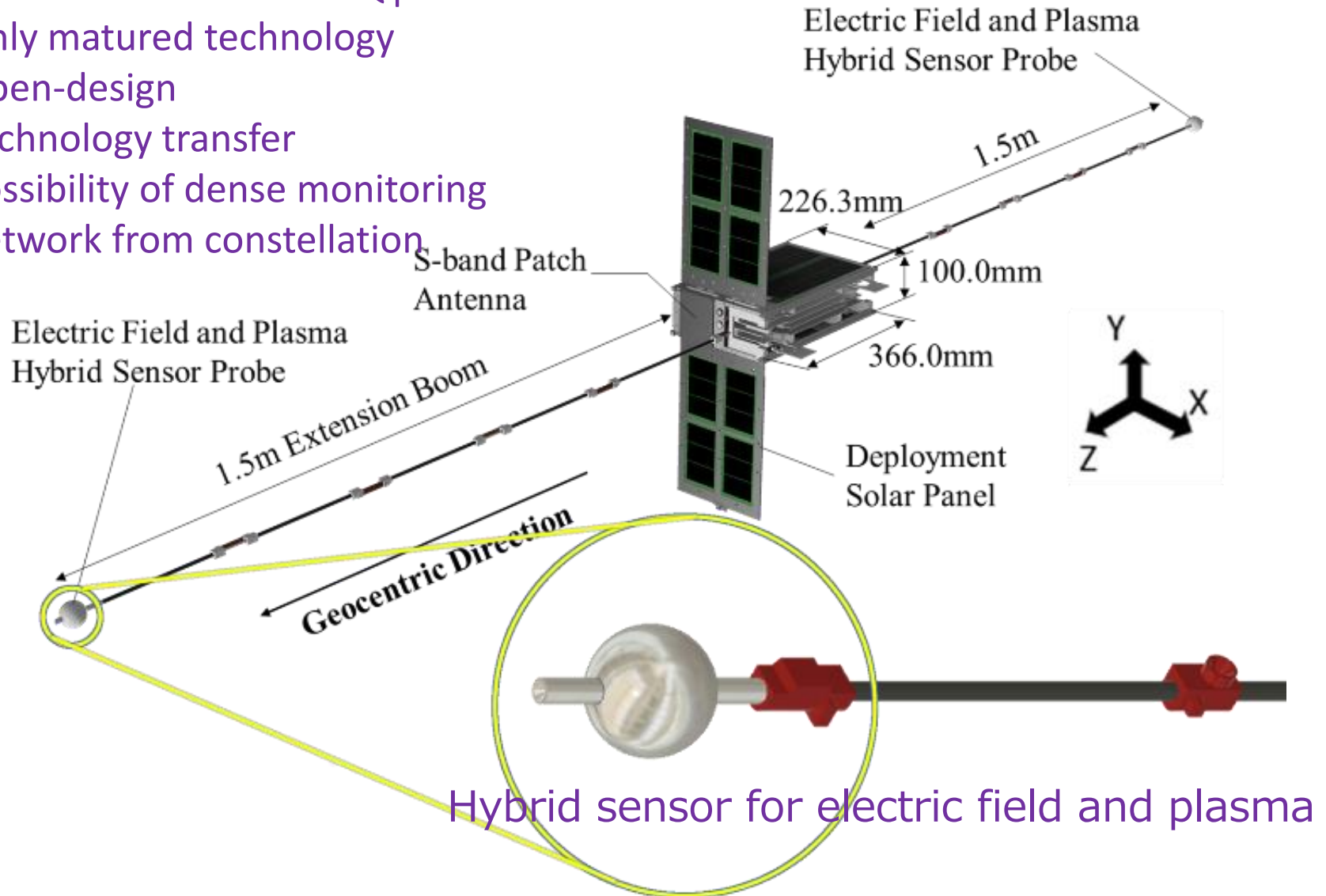
## Support



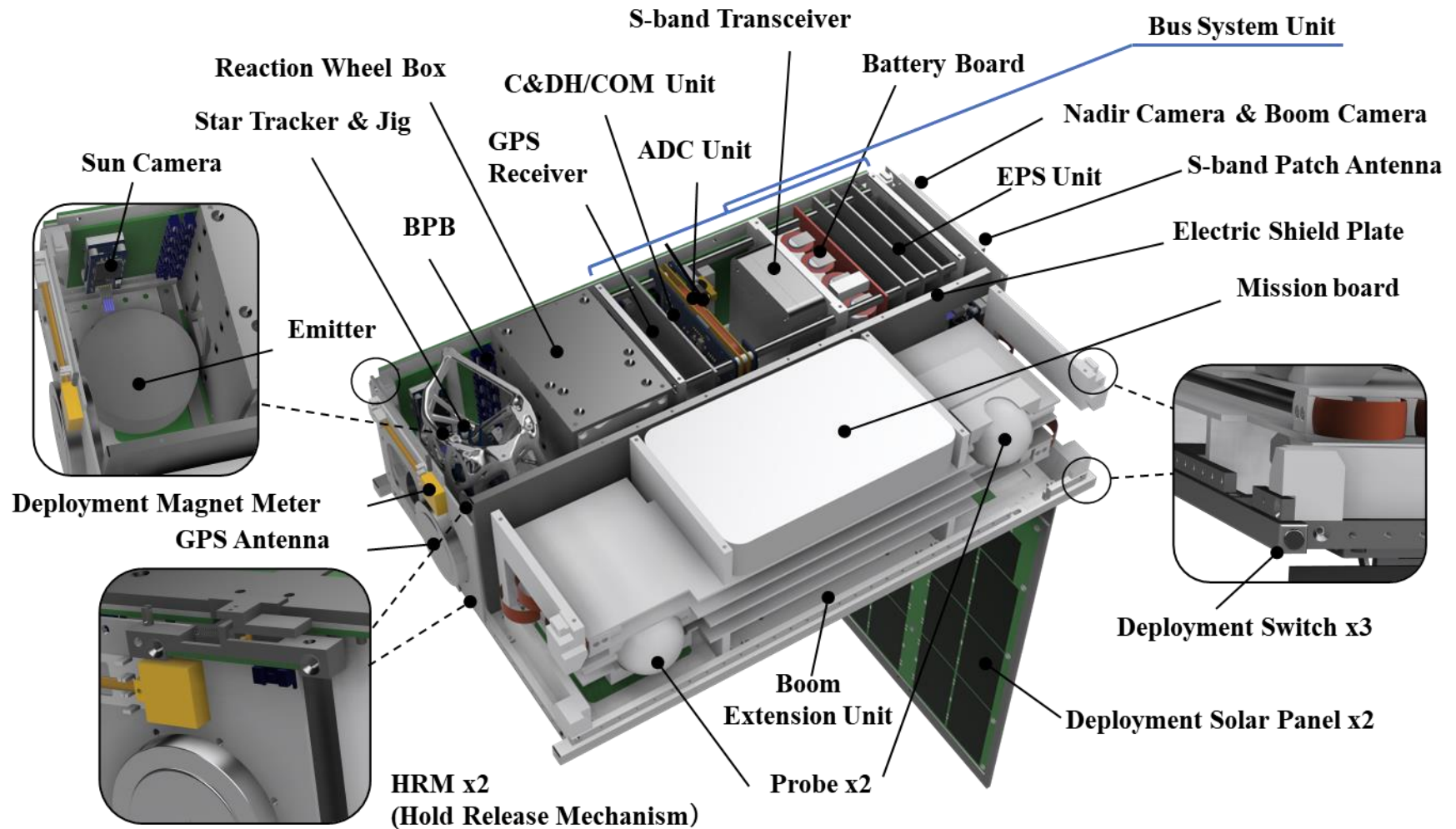


# The whole view

- ✓ CubeSat dedicated to EQ prediction
- ✓ Only matured technology
- ✓ Open-design
- ✓ Technology transfer
- ✓ Possibility of dense monitoring network from constellation

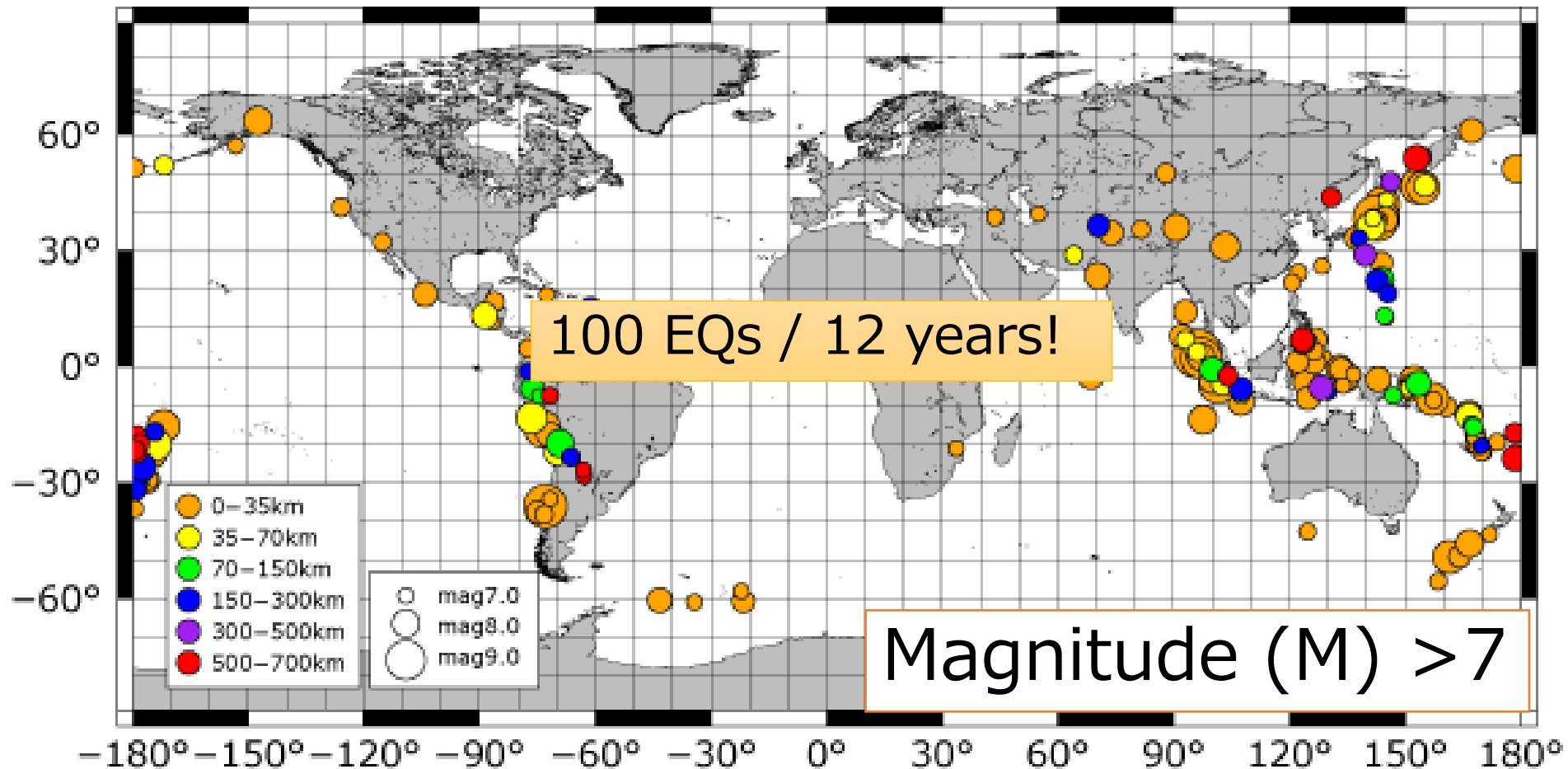


# Configuration



[Future plan] Most large EQ occurred inside land and near ocean.

(USGS, 2000-2011)



Large EQs are a major risk for human being.

# Why don't you join space EQ prediction project?

