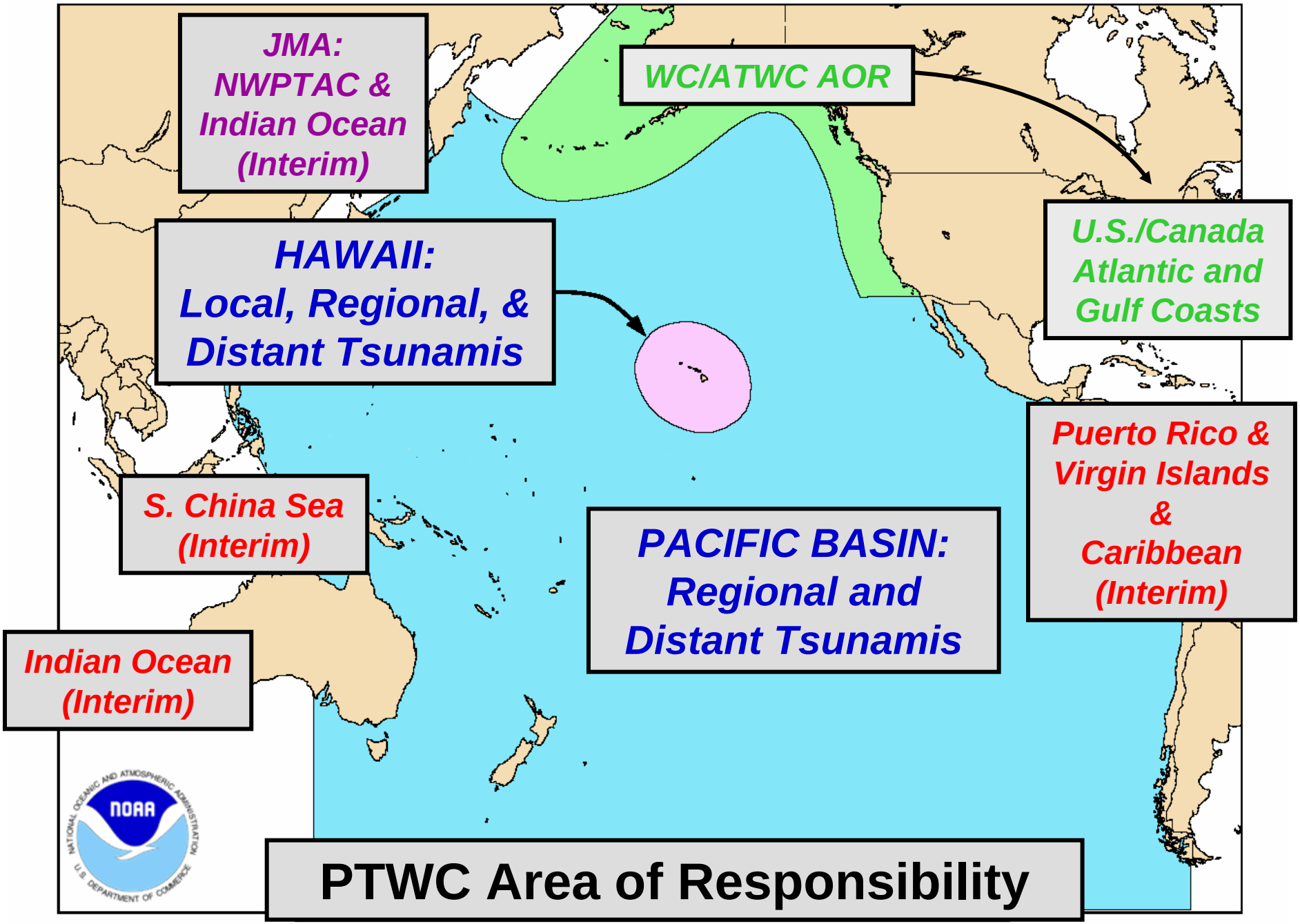
Richard H. Hagemeyer
Pacific Tsunami Warning Center

Regional/National Level of TARNS System CONOPS in the United States

Charles S. McCreery, PTWC Director

TSUNAMI ALERT RAPID NOTIFICATION SYSTEM (TARNS)
FIRST WORKSHOP: SYSTEM DESIGN AND PLAN

24-27 May, 2006, Sailom Hotel in Hua Hin, Thailand


JMA:
NWPTAC &
Indian Ocean
(Interim)
WC/ATWC AOR
U.S./Canada
Atlantic and
Gulf Coasts
HAWAII:
Local, Regional, &
Distant Tsunamis
Puerto Rico &
Virgin Islands
&
Caribbean
(Interim)
S. China Sea
(Interim)
PACIFIC BASIN:
Regional and
Distant Tsunamis
Indian Ocean
(Interim)
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
PTWC Area of Responsibility

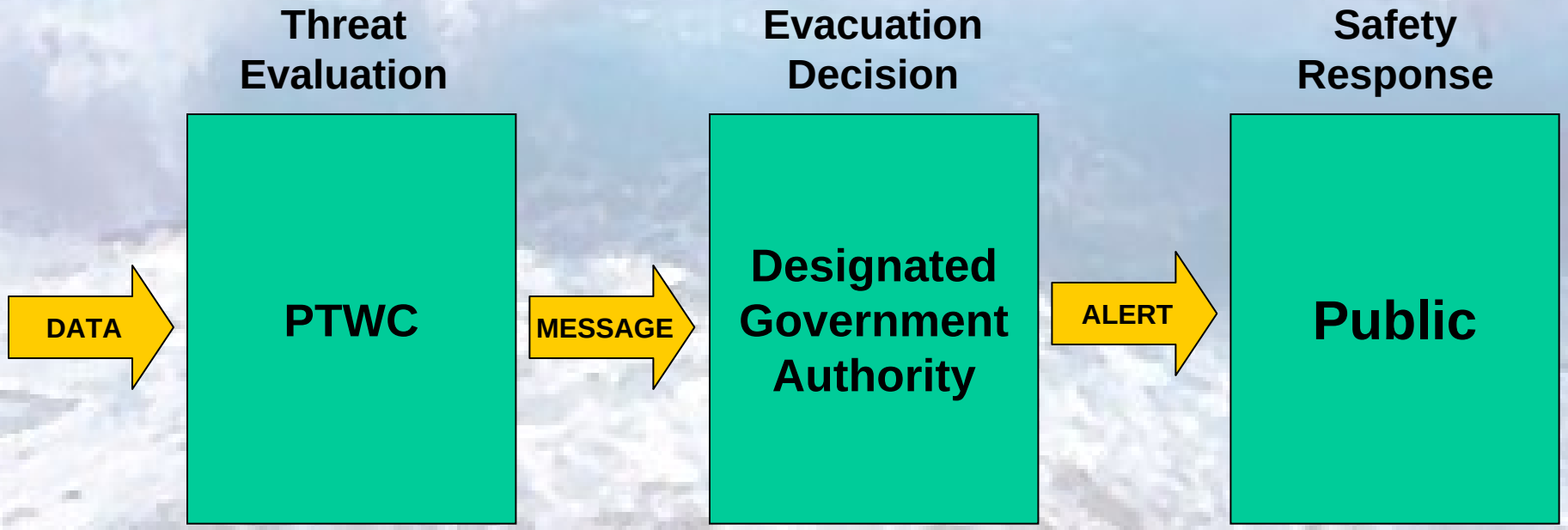
PTWC KEY OPERATIONAL ACTIVITIES

- SEISMIC DATA COLLECTION & ANALYSES
- TSUNAMI WAVE MEASUREMENTS
- DECISION-MAKING PROCESSES
- MESSAGE CREATION & DISSEMINATION

KEY OPERATIONAL GOALS

- FASTER
- MORE ACCURATE
- MORE RELIABLE
- MORE EFFECTIVE

THE GENERAL CONCEPT



TWO GENERAL CASES

Local Tsunami

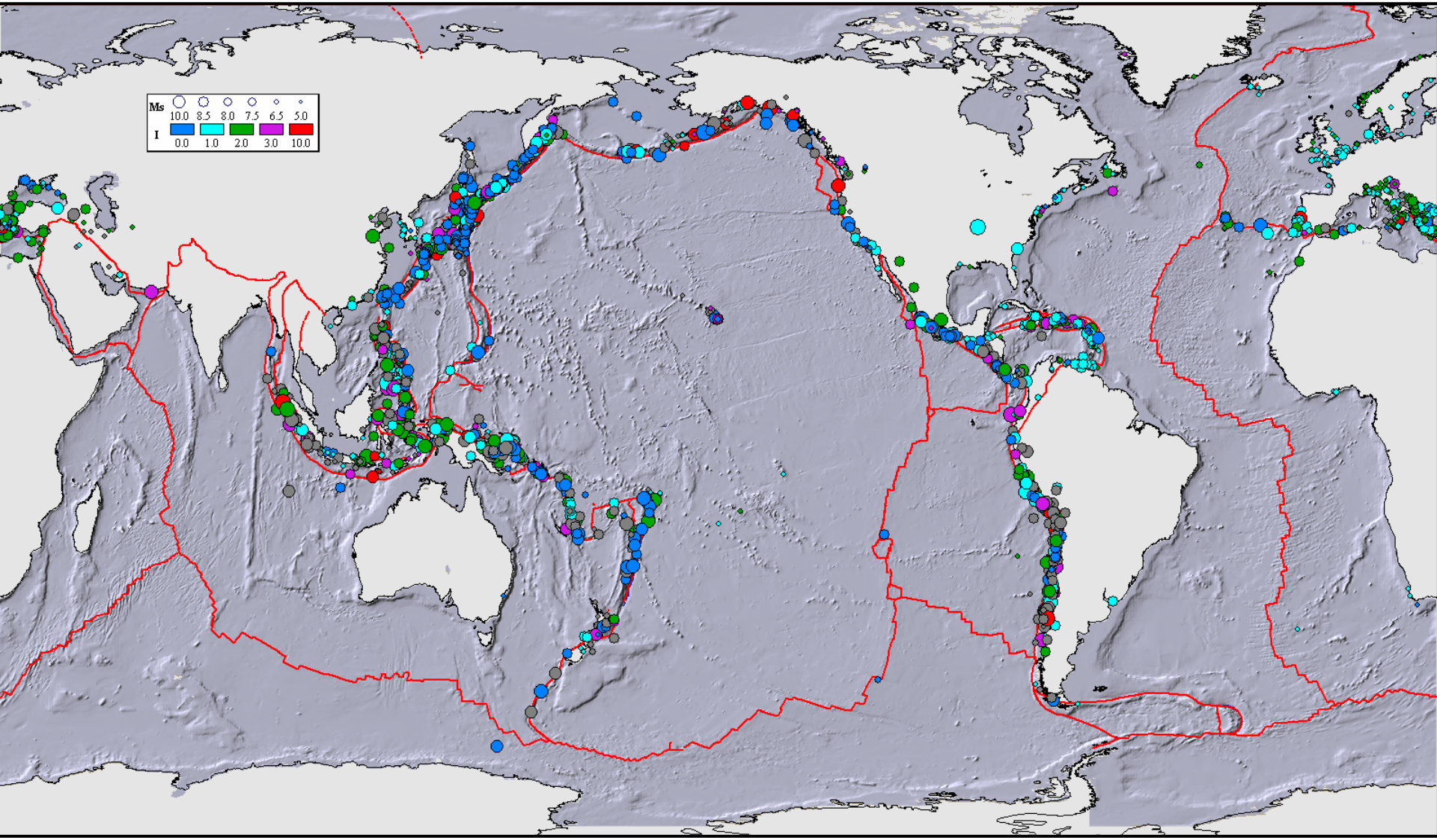
- Must Respond in Minutes from Earthquake
- No Time for Official Decisions
- Immediate Public Alerting Necessary
- Automatic Public Evacuation Required

Regional or Teletsunami

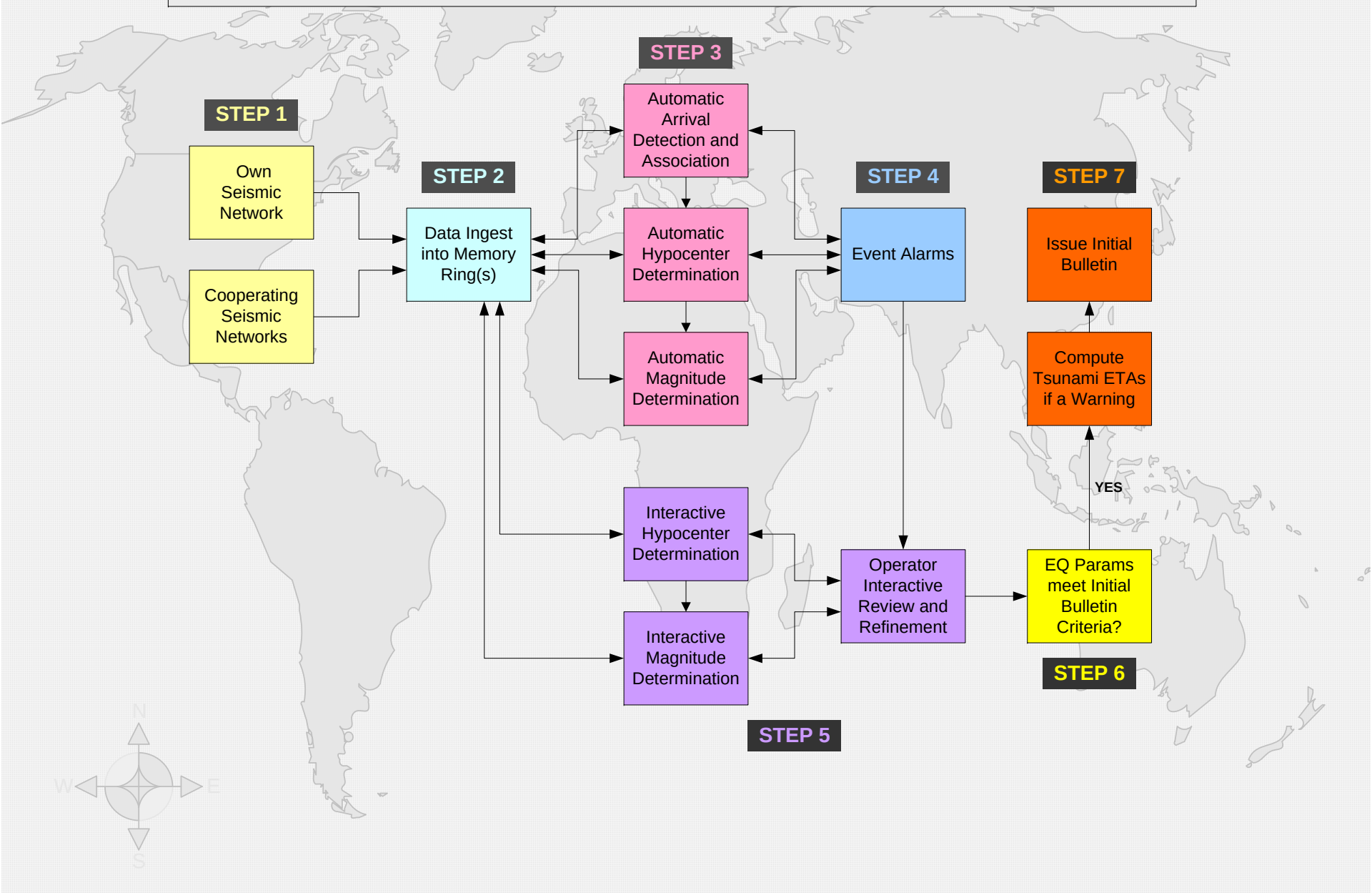
- Must Respond within a Few Hours at Most
- More Time for Official Decisions
- More Time to Alert and Instruct Public
- Organized Evacuation Possible

PTWC OPERATIONS FOR A TELETSUNAMI

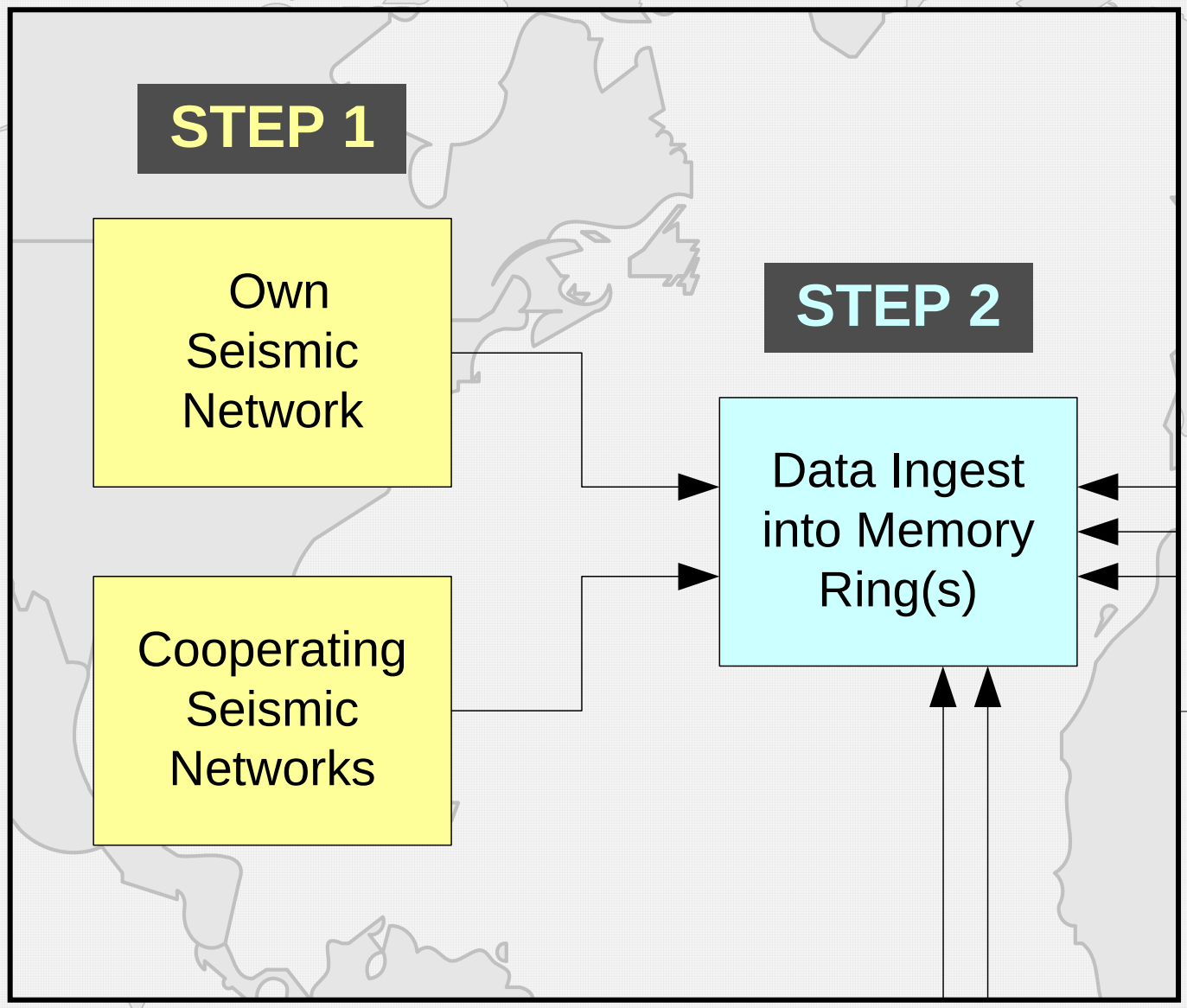
Historical Tsunami Epicenters

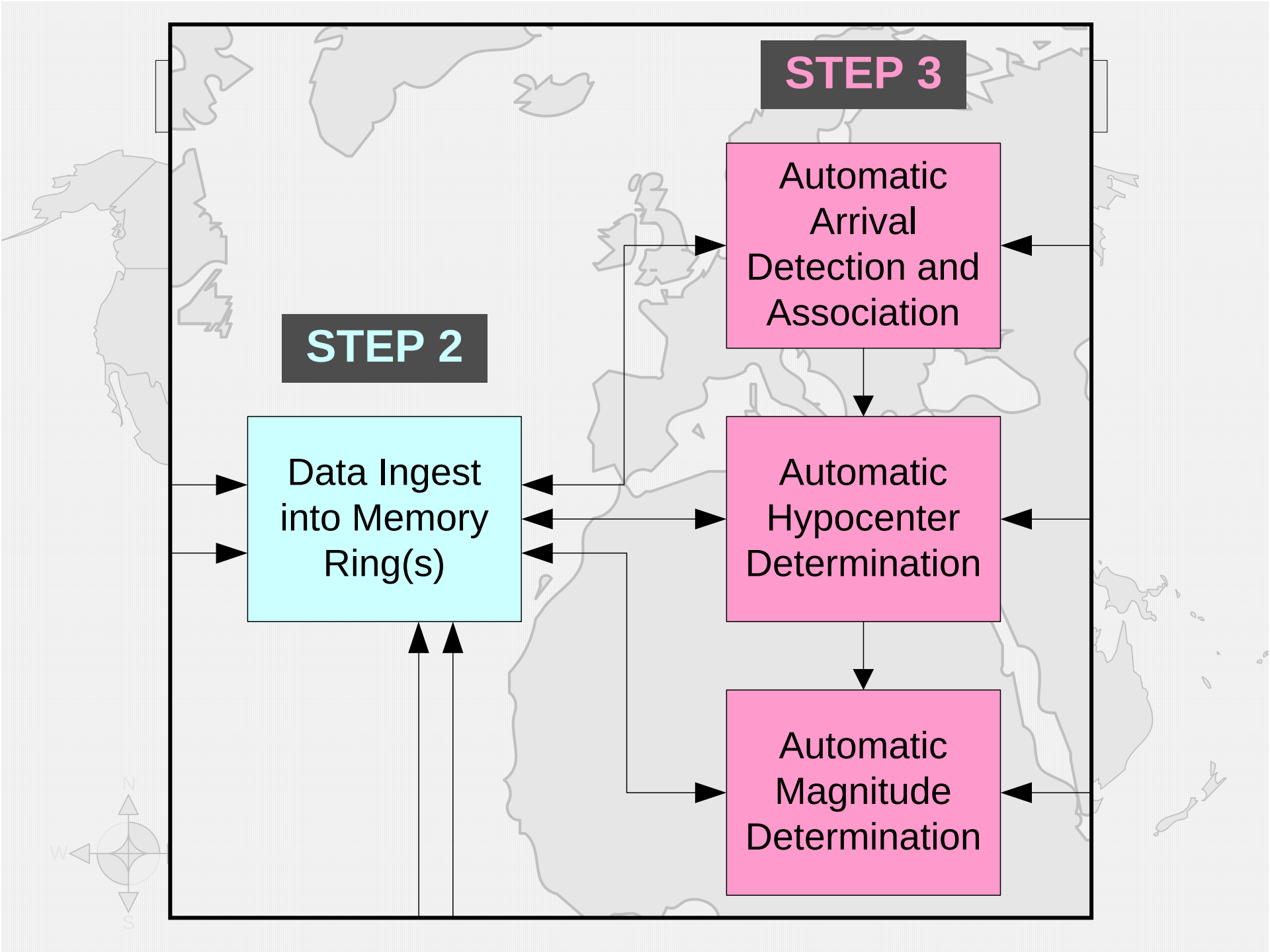


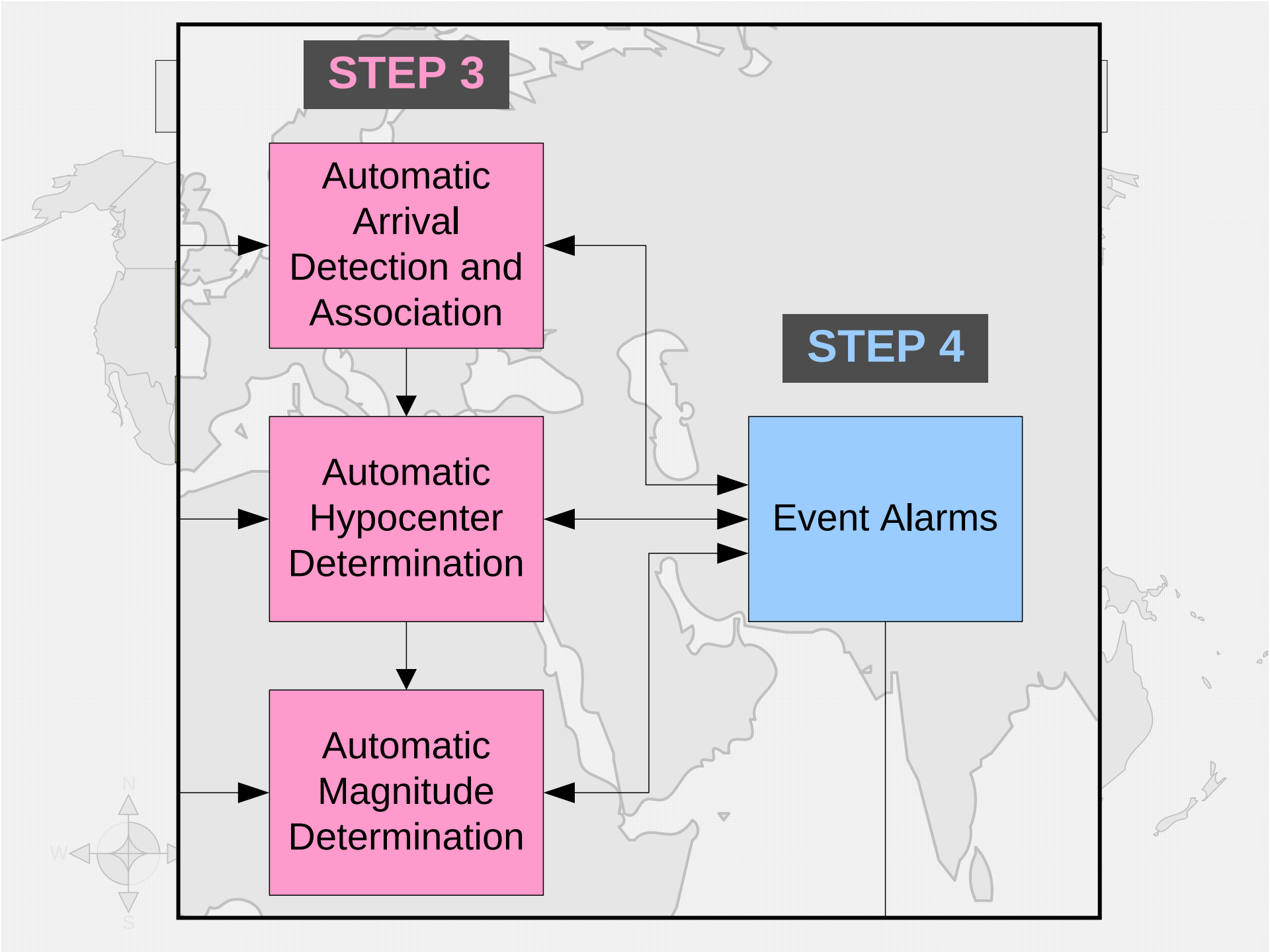
PTWC General Processes and Procedures for Initial Tsunami Bulletins



PTWC General Processes and Procedures for Initial Tsunami Bulletins



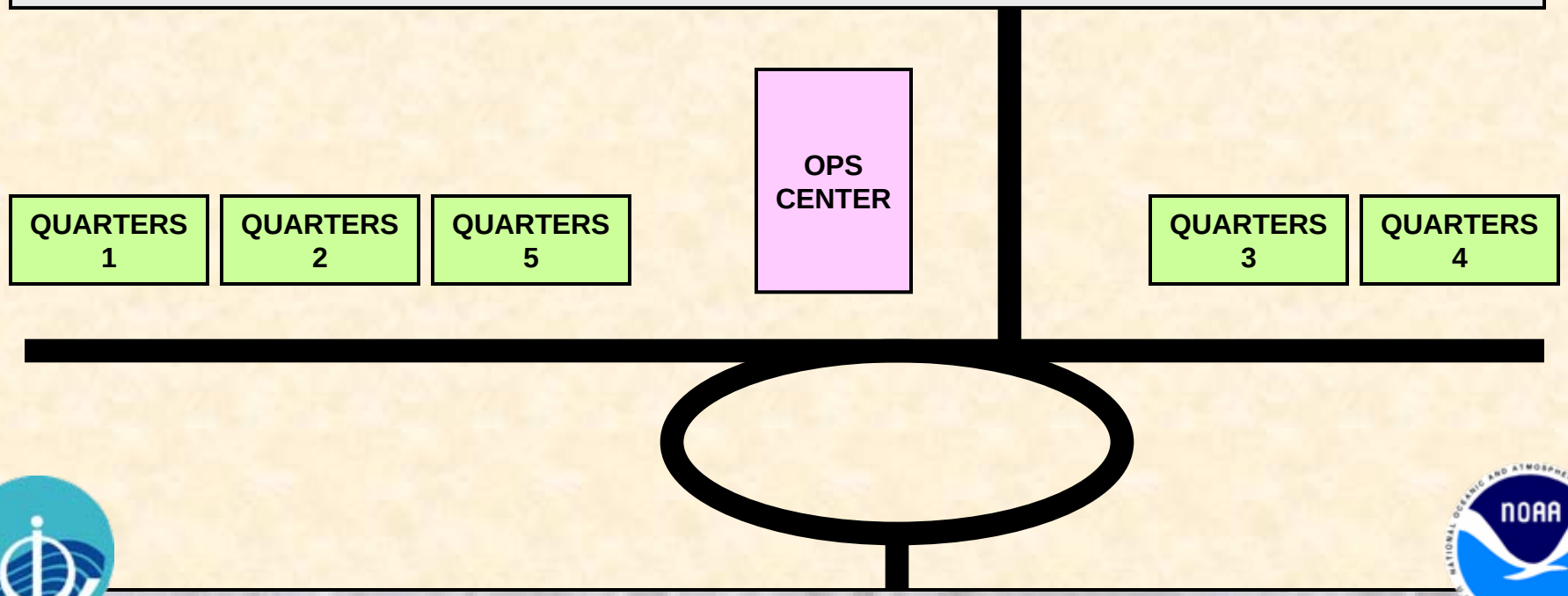

STEP 3
Automatic Arrival Detection and Association
STEP 2
Data Ingest into Memory Ring(s)
Automatic Hypocenter Determination
Automatic Magnitude Determination


STEP 3
Automatic Arrival Detection and Association
Automatic Hypocenter Determination
Automatic Magnitude Determination
STEP 4
Event Alarms

RESPONSE TIME TO ALARMS

2005: 30 SEC DURING NORMAL WORK HOURS
2 MIN DURING AFTER HOURS (FM QUARTERS)

2006: 30 SEC AT ALL TIMES (24X7 STAFFING)

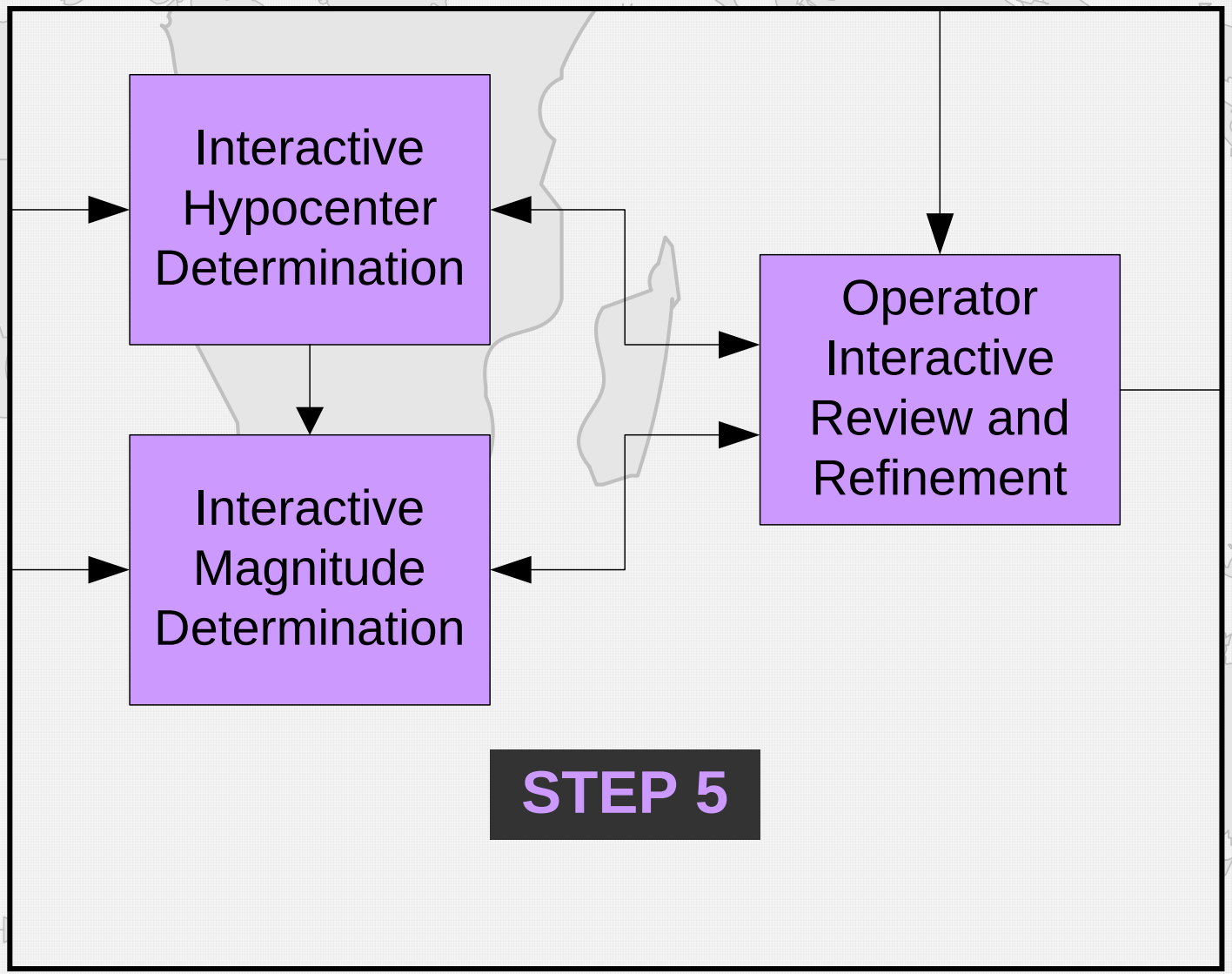


PACIFIC EVENT ALARMS

	TYPE	DATA	TIMING
SEISMIC	Big Island Amplitude	GSN / IMS Broadband	2-7 min
	Automatic Loc & Mag	PTWC and HVO SP	5-15 min
	HON LP	PTWC HON LP	7-20 min
SEA LEVEL	Coastal Sea Level	NOS Gauges	15 min – 1 hour*
	Deep Ocean Sea Level	Hawaii DART	15 min – 2 hours*

** for areas with coverage*

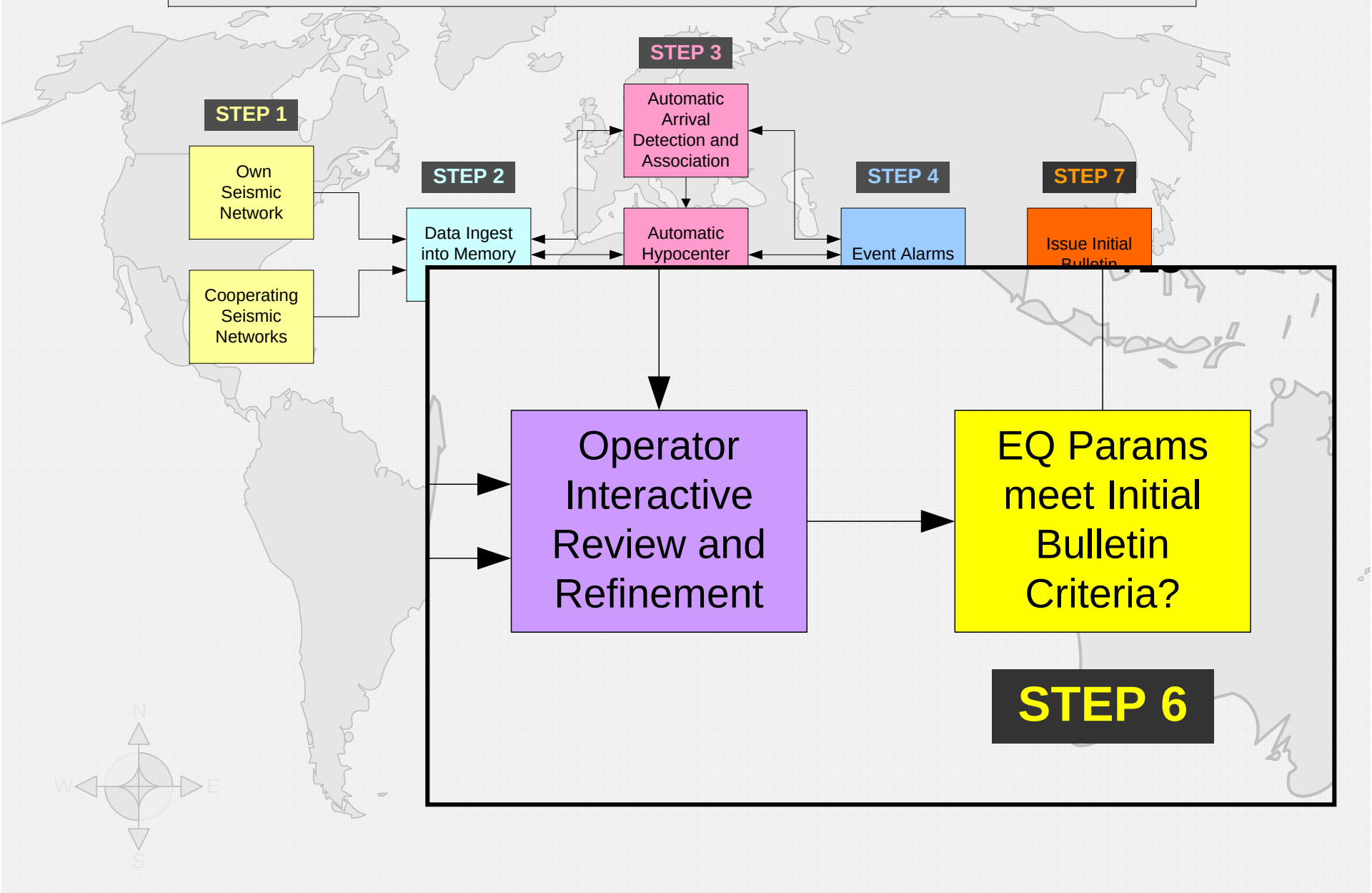
PTWC General Processes and Procedures for Initial Tsunami Bulletins



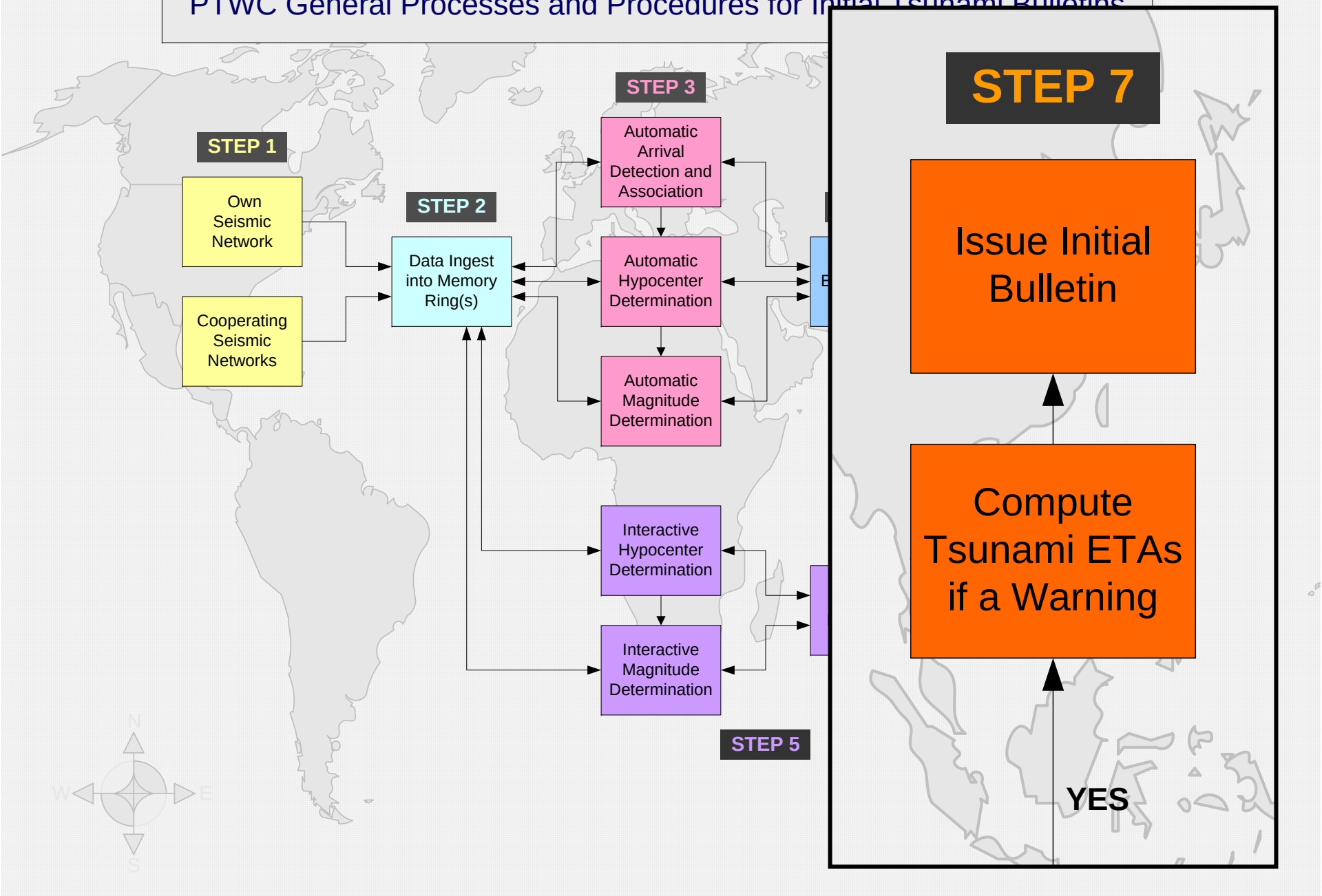
ANALYSTS REVIEW & REVISION (1-3 MIN)

- VERIFY ITS A LARGE PACIFIC EARTHQUAKE.
- SELECT FROM AUTOMATIC HYPOCENTERS.
- REVISE HYPOCENTER WITH ADDITIONAL DATA.
- INTERACTIVELY COMPUTE MAGNITUDES.
- DECIDE BEST HYPOCENTER AND MAGNITUDE.
- COMPARE TO CRITERIA AND ISSUE MESSAGE.

PTWC General Processes and Procedures for Initial Tsunami Bulletins



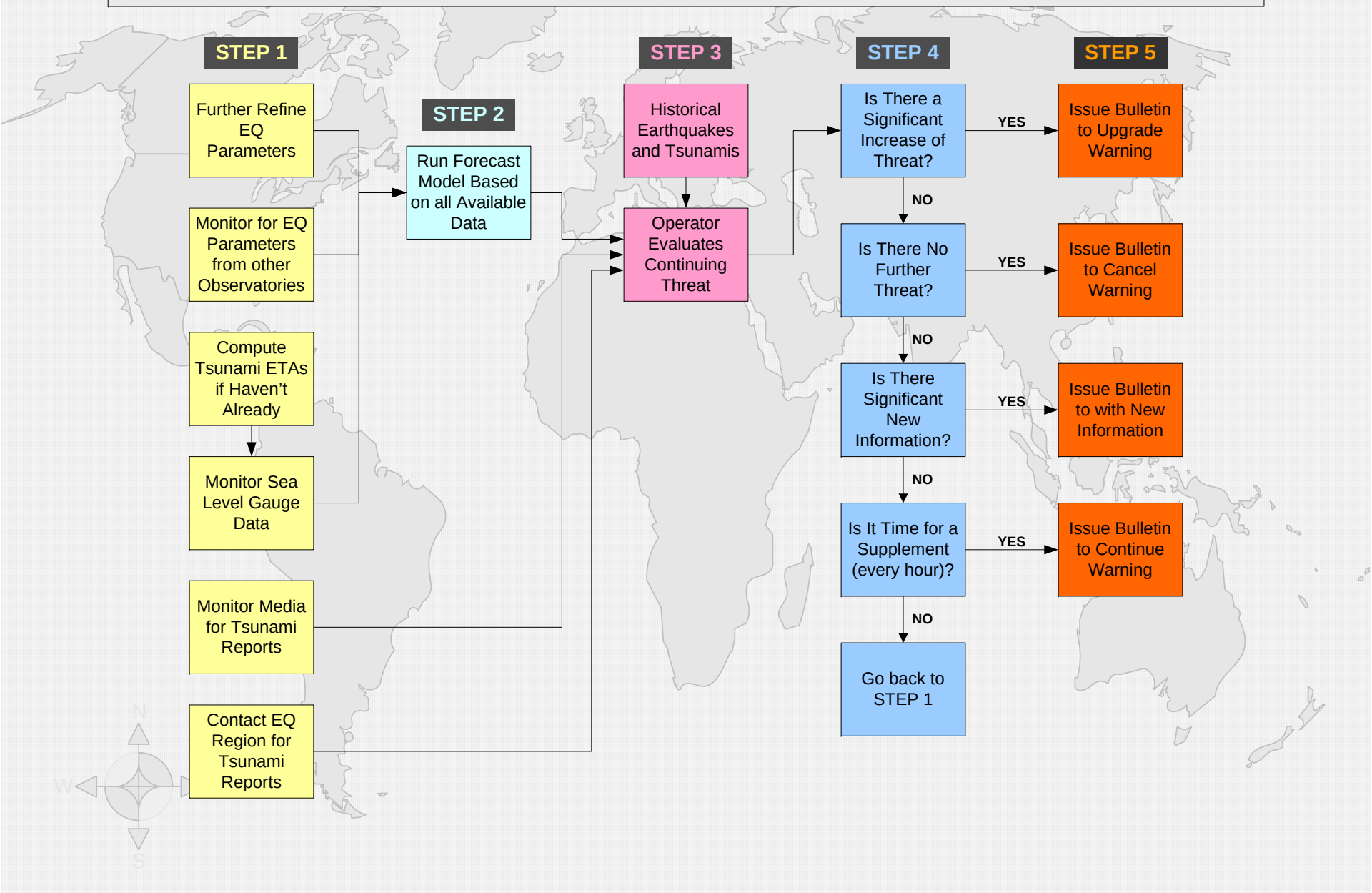
PTWC General Processes and Procedures for Initial Tsunami Bulletins

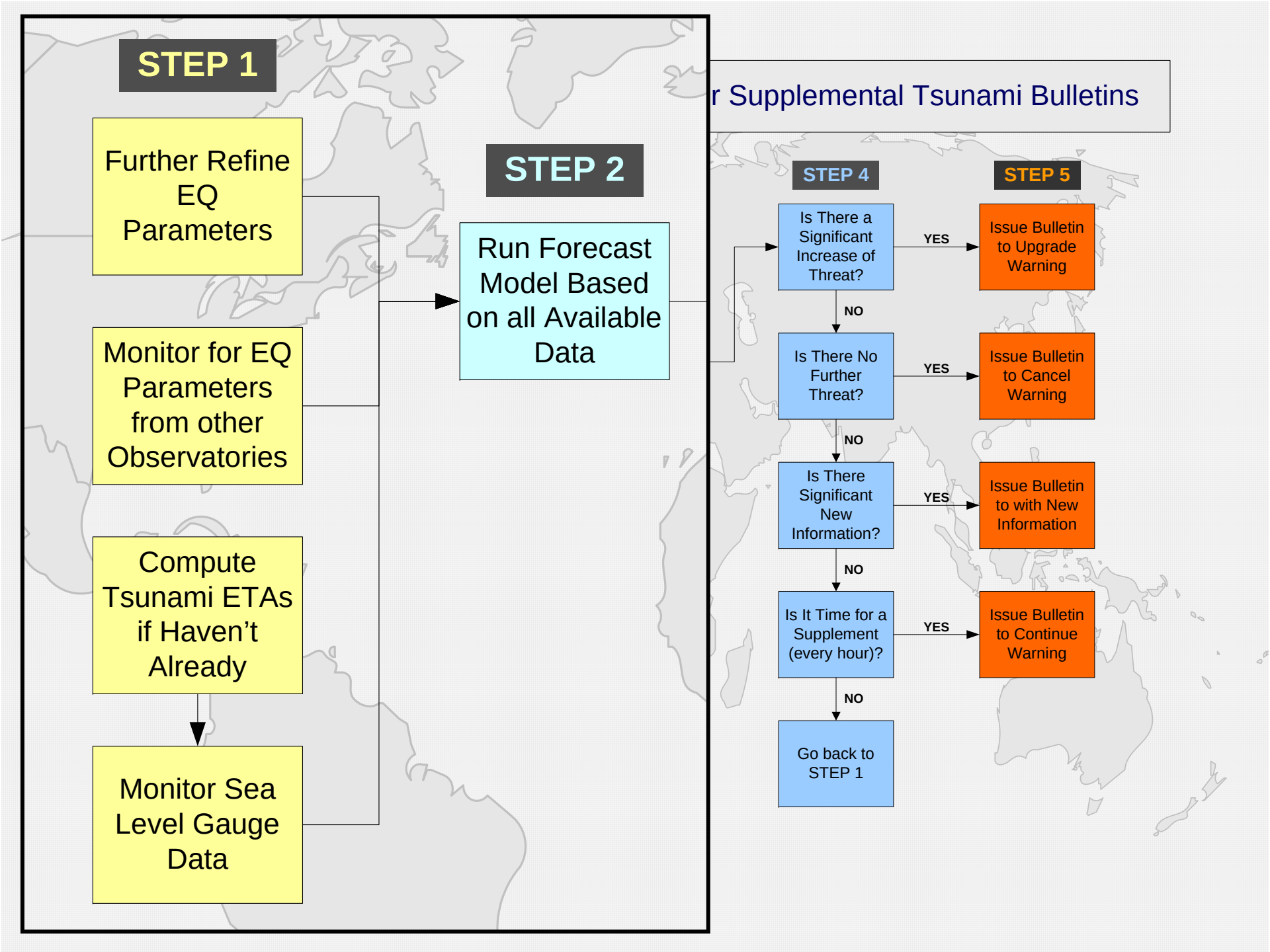


PTWC PACIFIC BULLETIN CRITERIA

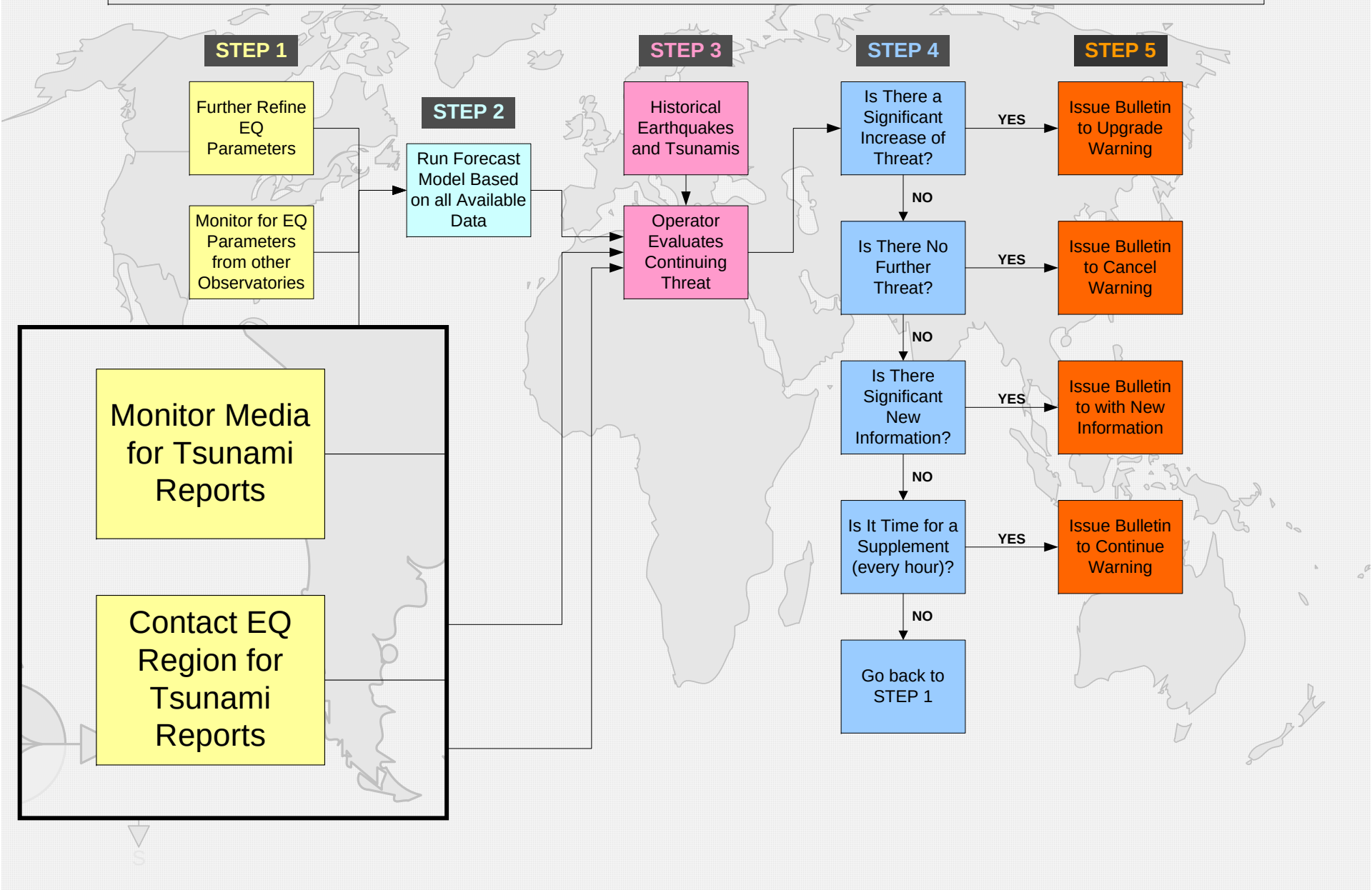
Mw less than 6.5 *(Mw: Moment Magnitude)*	**Earthquake Message Only**
Mw 6.5 to 7.5	**Tsunami Information Bulletin**
Mw 7.6 to 7.8	**Regional Tsunami Warning (1000-km Limit)**
Mw > 7.8	**Expanding Warning / Watch**
Confirmed Teletsunami	**Pacific-Wide Warning**

PTWC General Processes and Procedures for Supplemental Tsunami Bulletins

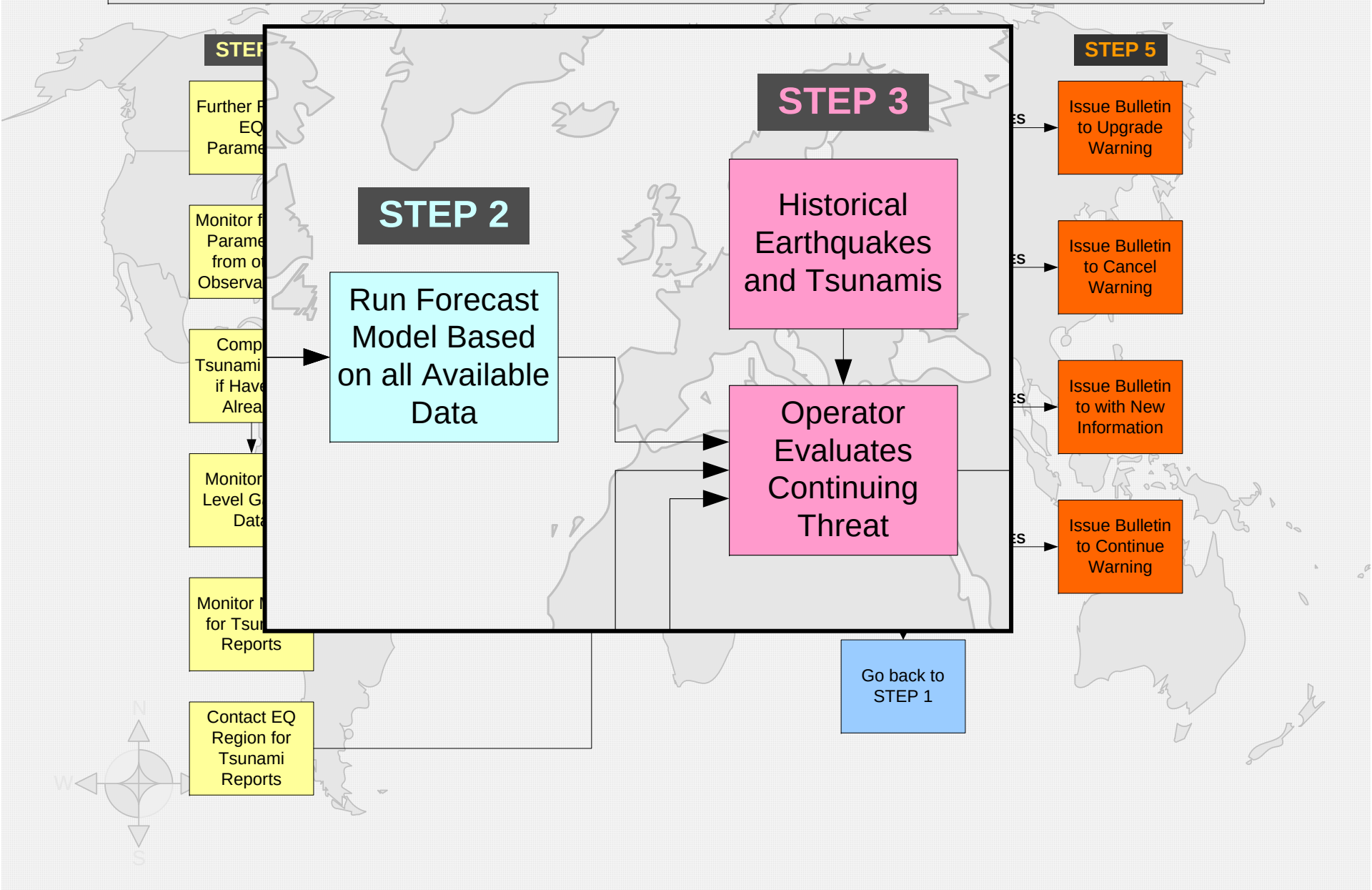



STEP 1
Further Refine EQ Parameters
Monitor for EQ Parameters from other Observatories
Compute Tsunami ETAs if Haven't Already
Monitor Sea Level Gauge Data
STEP 2
Run Forecast Model Based on all Available Data
r Supplemental Tsunami Bulletins
STEP 4
STEP 5
Is There a Significant Increase of Threat?
YES
Issue Bulletin to Upgrade Warning
NO
Is There No Further Threat?
YES
Issue Bulletin to Cancel Warning
NO
Is There Significant New Information?
YES
Issue Bulletin to with New Information
NO
Is It Time for a Supplement (every hour)?
YES
Issue Bulletin to Continue Warning
NO
Go back to STEP 1

PTWC General Processes and Procedures for Supplemental Tsunami Bulletins



PTWC General Processes and Procedures for Supplemental Tsunami Bulletins



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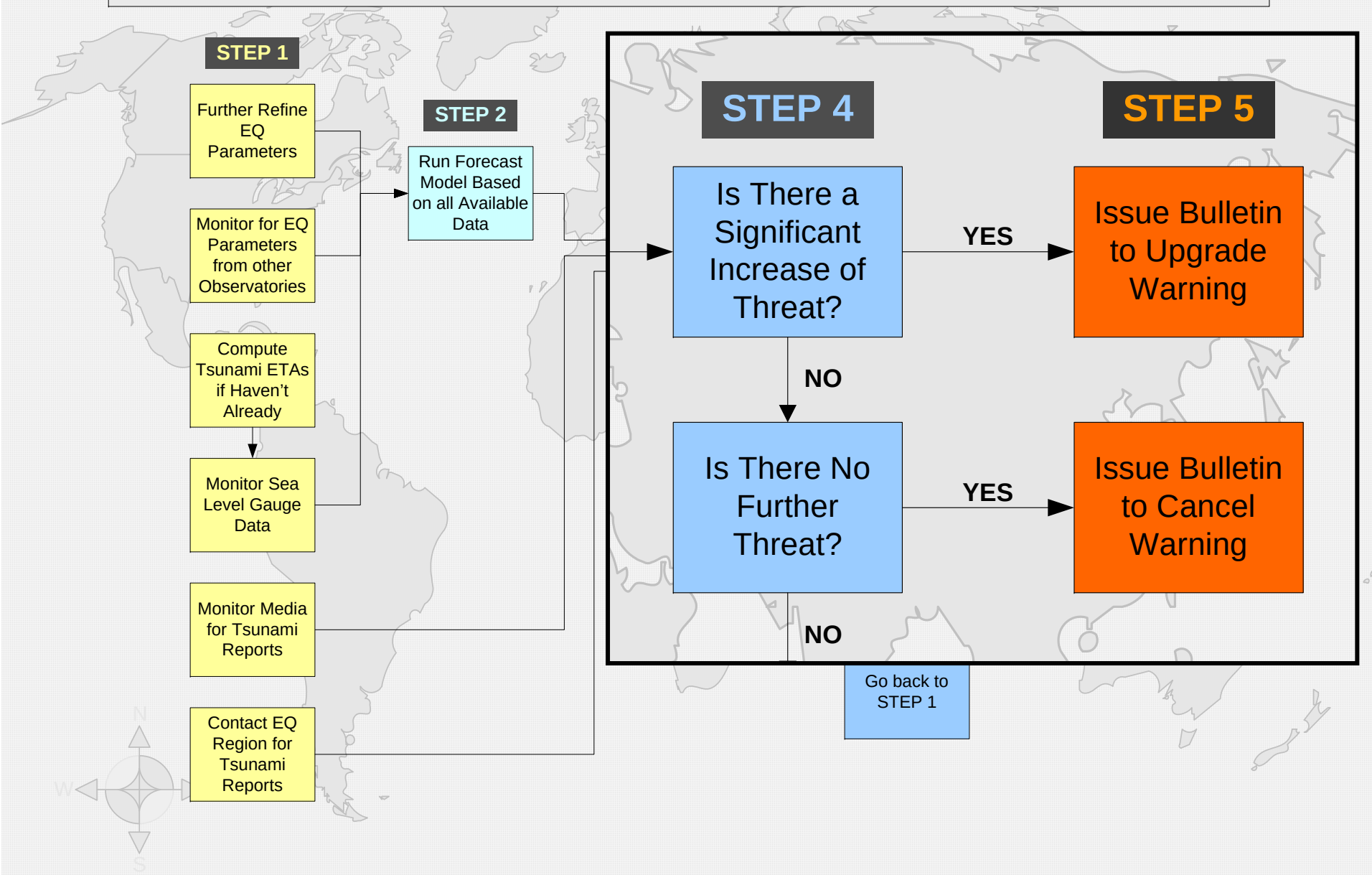
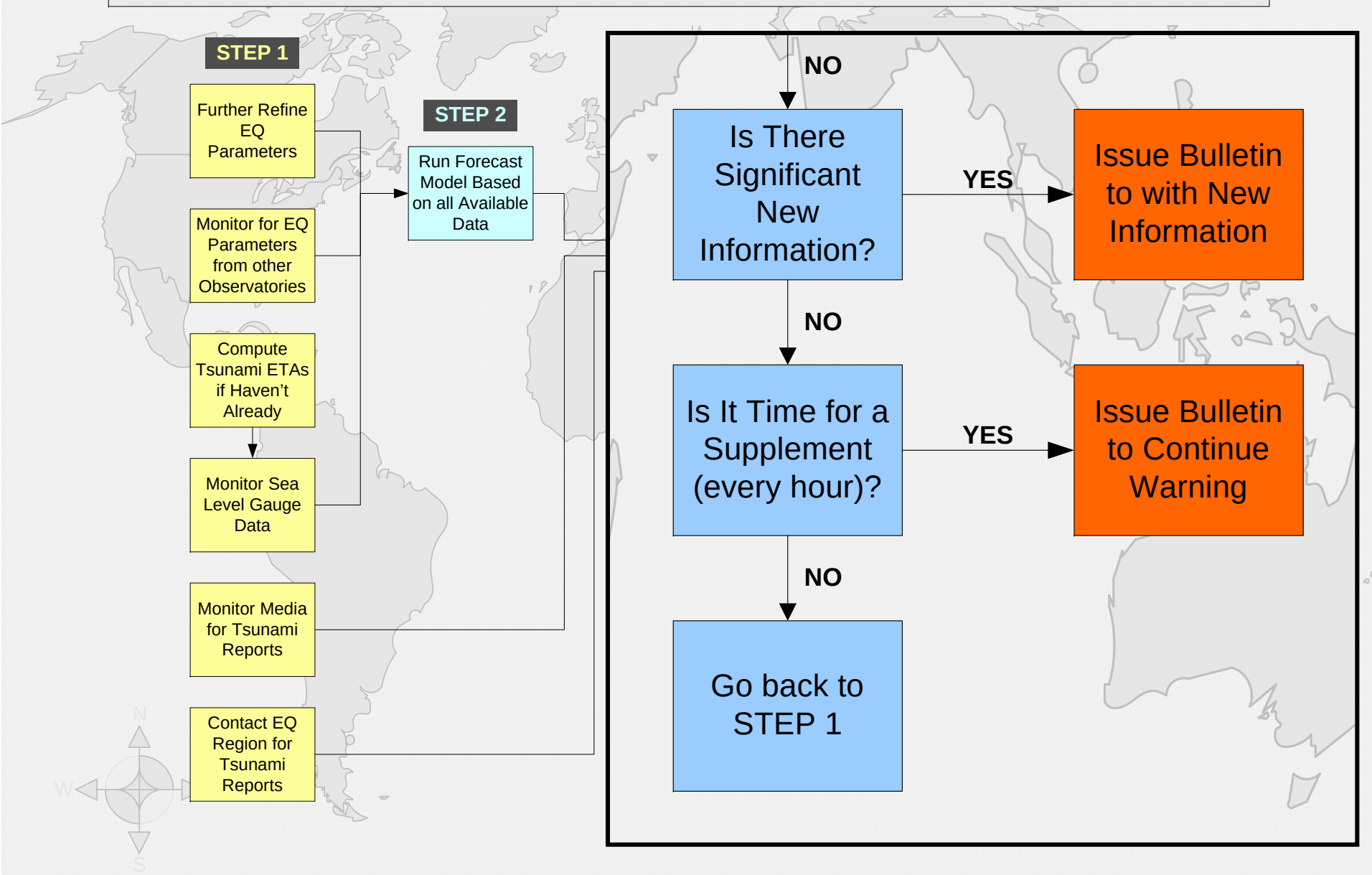
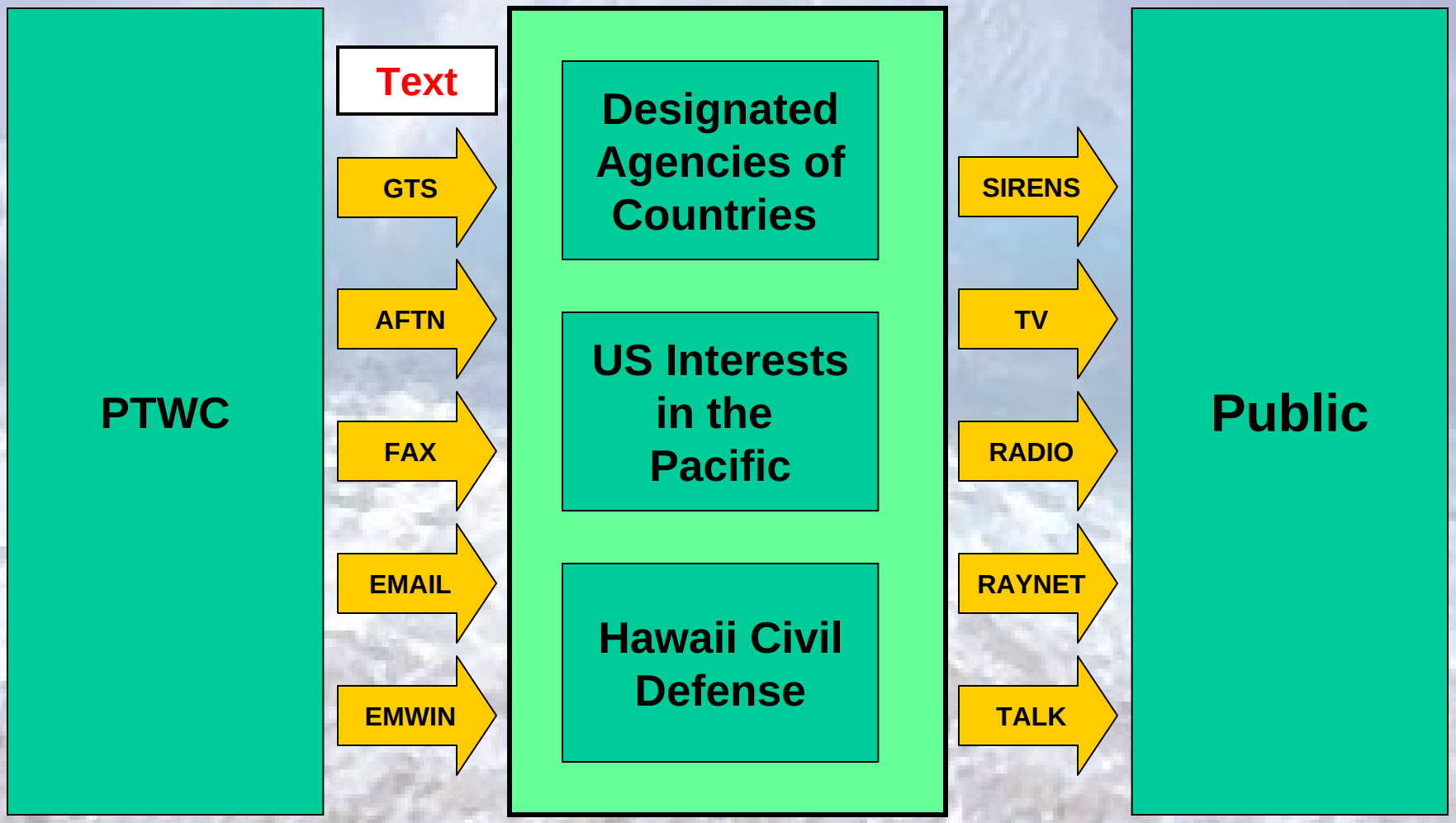


PTWC General Processes and Procedures for Supplemental Tsunami Bulletins

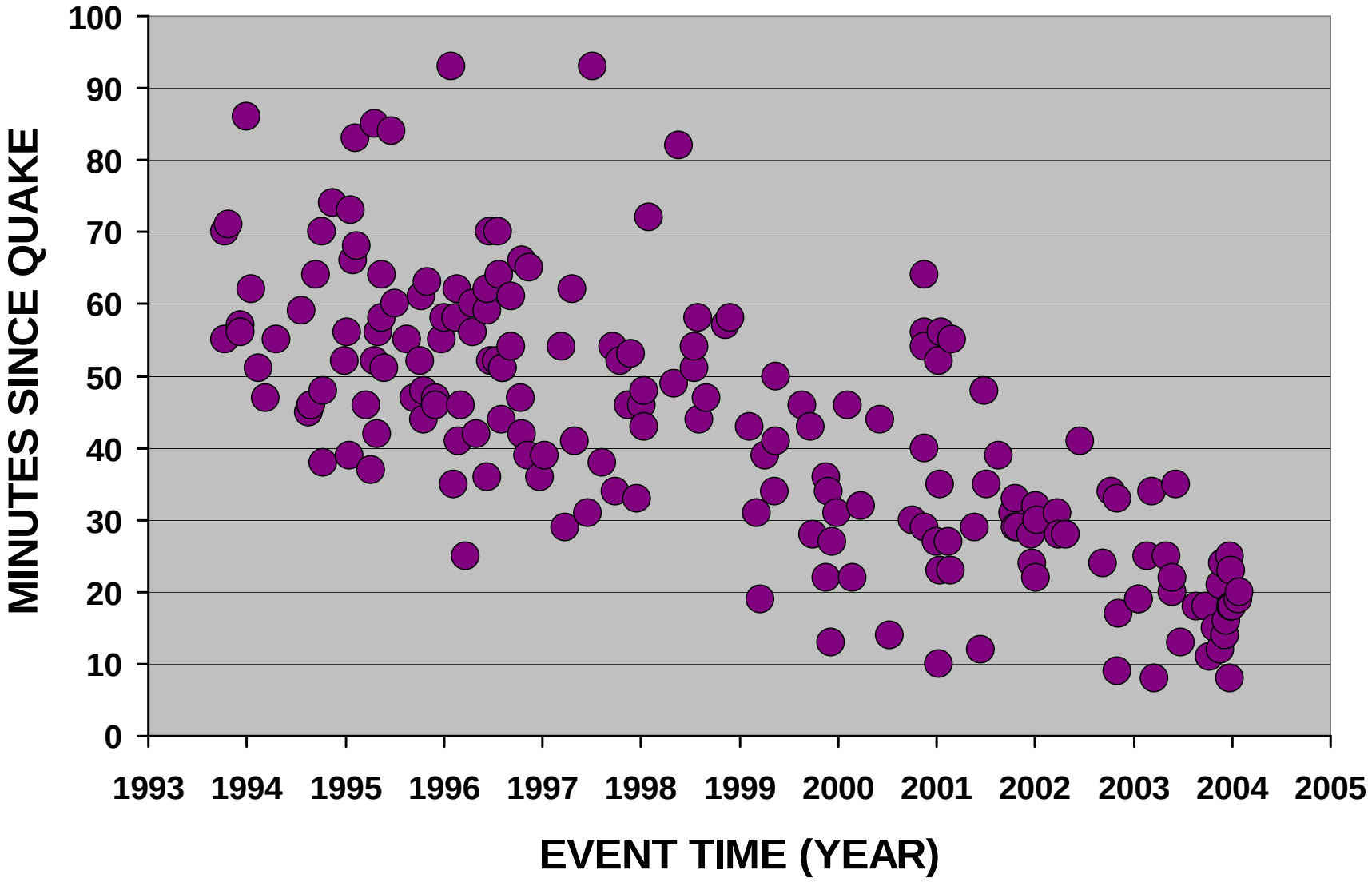


ISSUE MESSAGE & ALERT PUBLIC



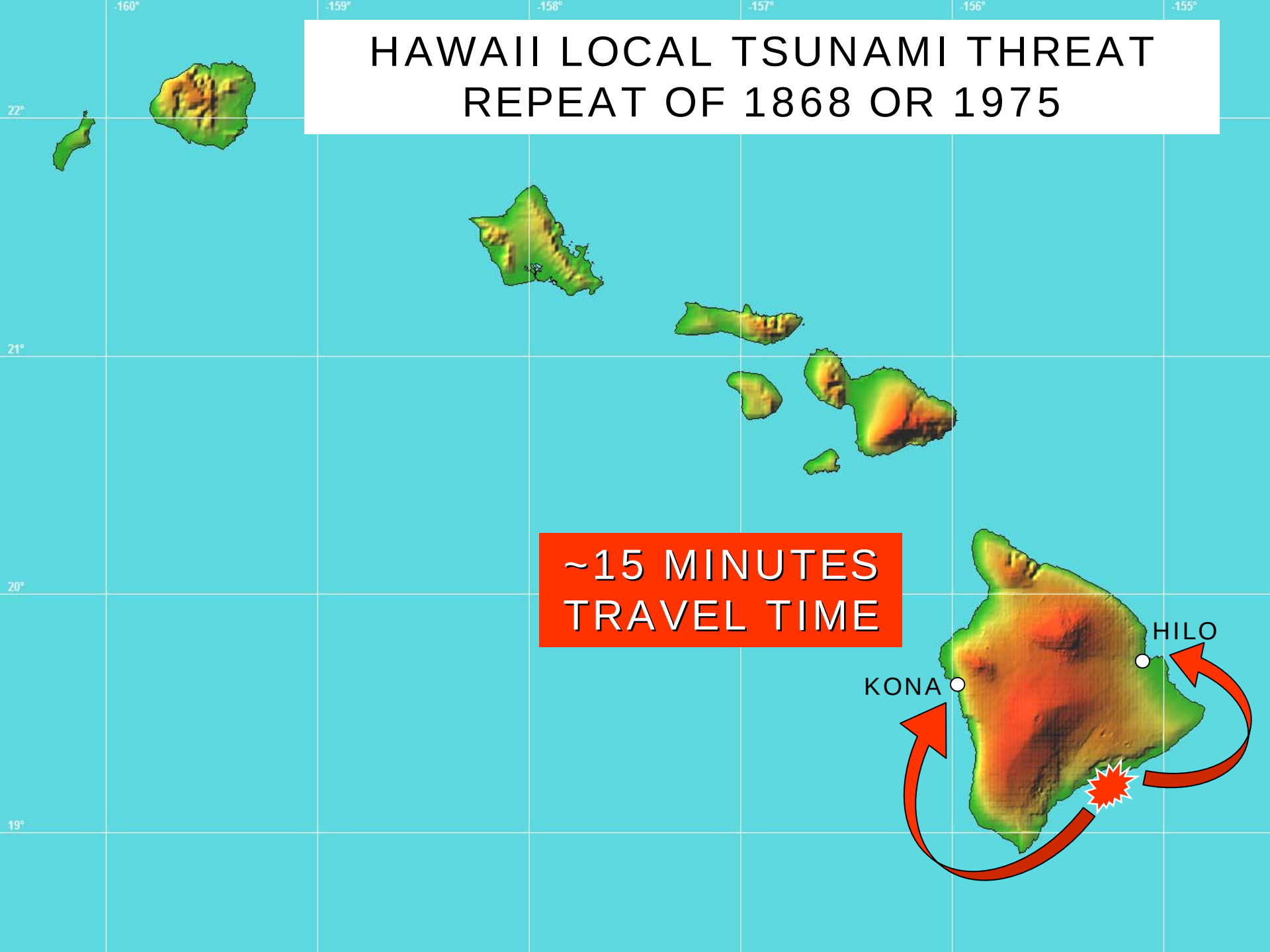
Designated Agencies must be prepared with an Operations Plan to respond quickly and alert the public when necessary based upon the information received from PTWC and any supplemental data or information they may receive. This could include advice from local experts.

ISSUE TIME OF PTWC INITIAL BULLETINS FOR TELESEISMS

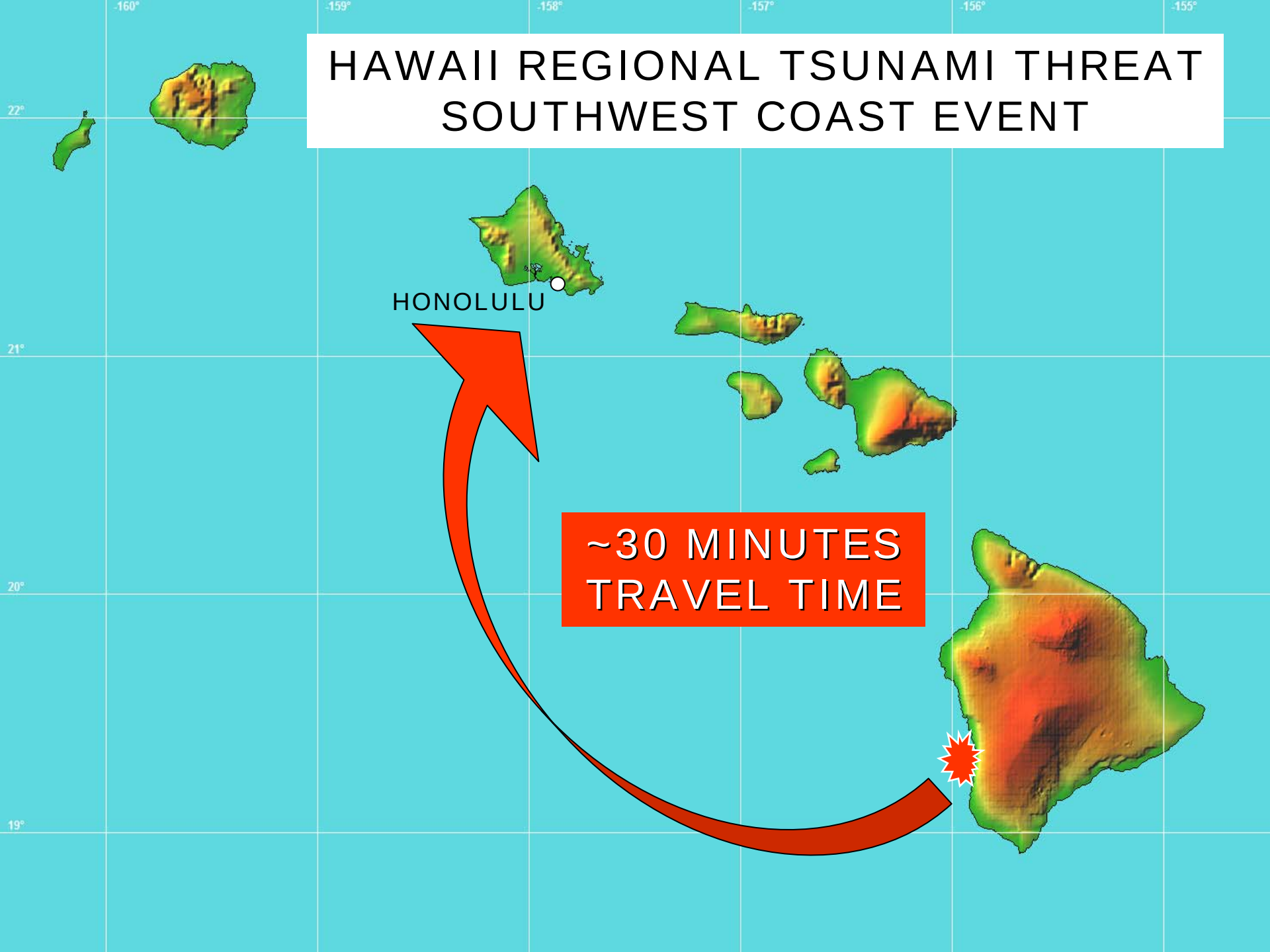


PTWC OPERATIONS
FOR A
LOCAL HAWAII TSUNAMI

HAWAII LOCAL TSUNAMI THREAT
REPEAT OF 1868 OR 1975



HAWAII REGIONAL TSUNAMI THREAT
SOUTHWEST COAST EVENT



HAWAII EVENT ALARMS

	TYPE	DATA	TIMING
SEISMIC	Big Island Amplitude	CREST Broadband	20-30 sec
SEISMIC	Automatic Loc & Mag	PTWC and HVO SP	20-30 sec
SEISMIC	HON SP/LP	PTWC HON SP & LP	1 min
SEA LEVEL	Runup	Runup Detectors	2-10 min
SEA LEVEL	Coastal Sea Level	NOS Gauges	5-10 min
SEA LEVEL	Deep Ocean Sea Level	Hawaii DART	5-10 min

RESPONSE TIME TO ALARMS

NOW: 30 SEC DURING NORMAL WORK HOURS
2 MIN DURING AFTER HOURS (FM QUARTERS)

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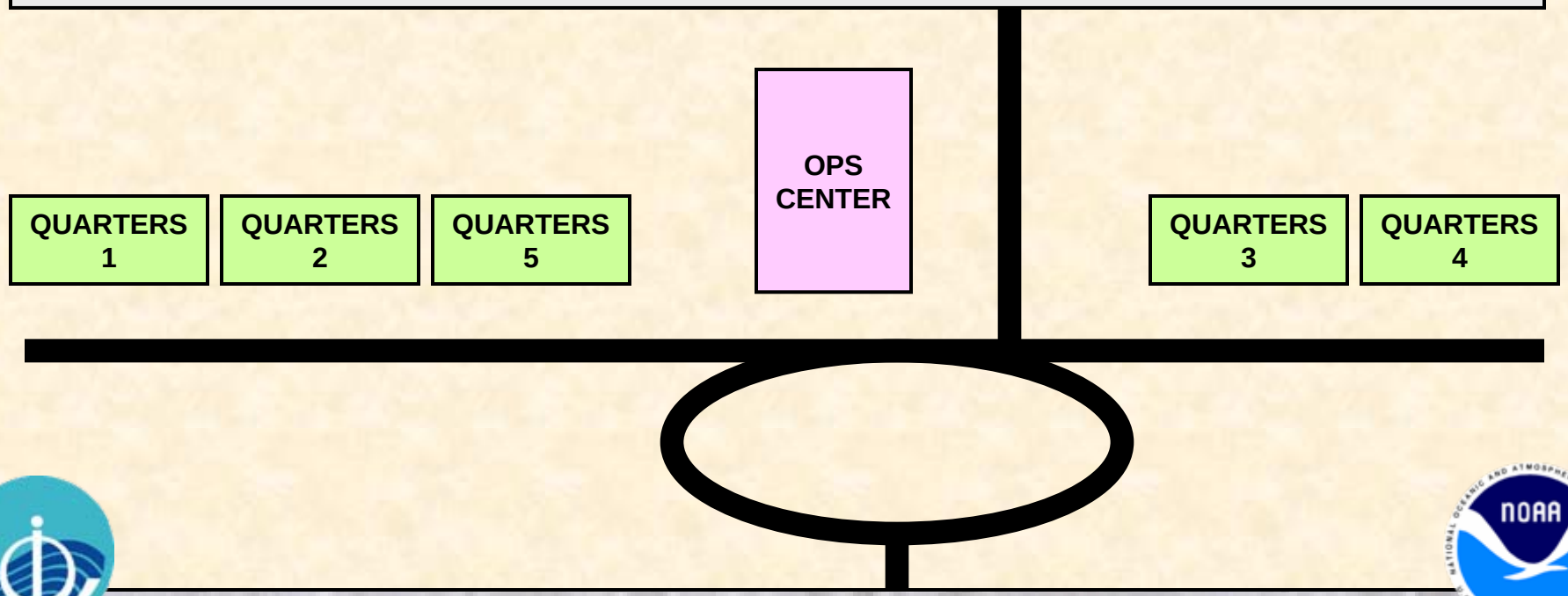

ANALYSTS REVIEW & REVISION (1-3 MIN)

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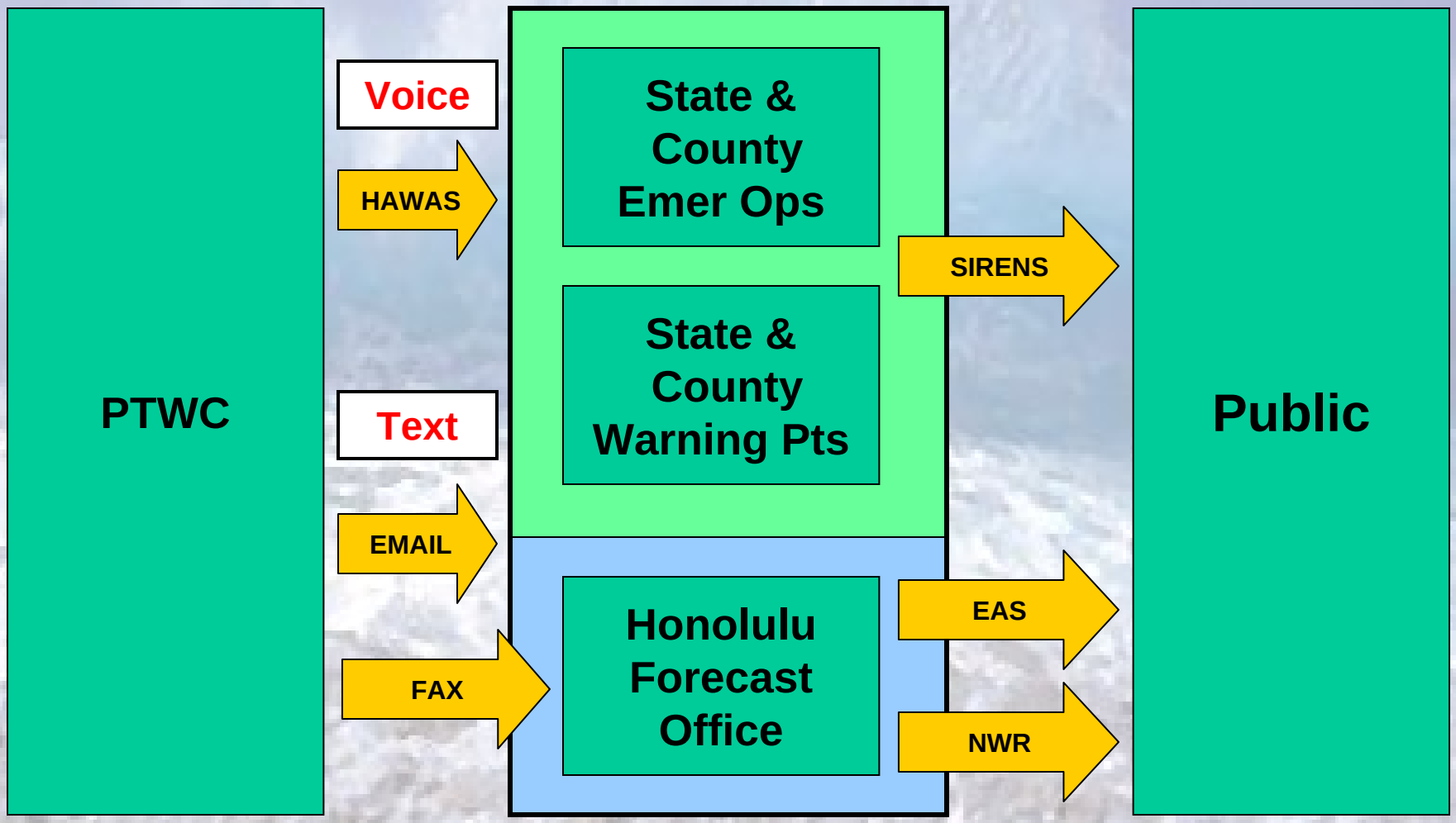
- SELECT FROM AUTOMATIC HYPOCENTERS.
- REVISE HYPOCENTER WITH ADDITIONAL DATA.
- INTERACTIVELY COMPUTE MAGNITUDES.
- DECIDE BEST HYPOCENTER AND MAGNITUDE.
- CHECK RUNUP AND SEA LEVEL DATA.
- COMPARE TO CRITERIA AND ISSUE MESSAGE.

HAWAII BULLETIN CRITERIA

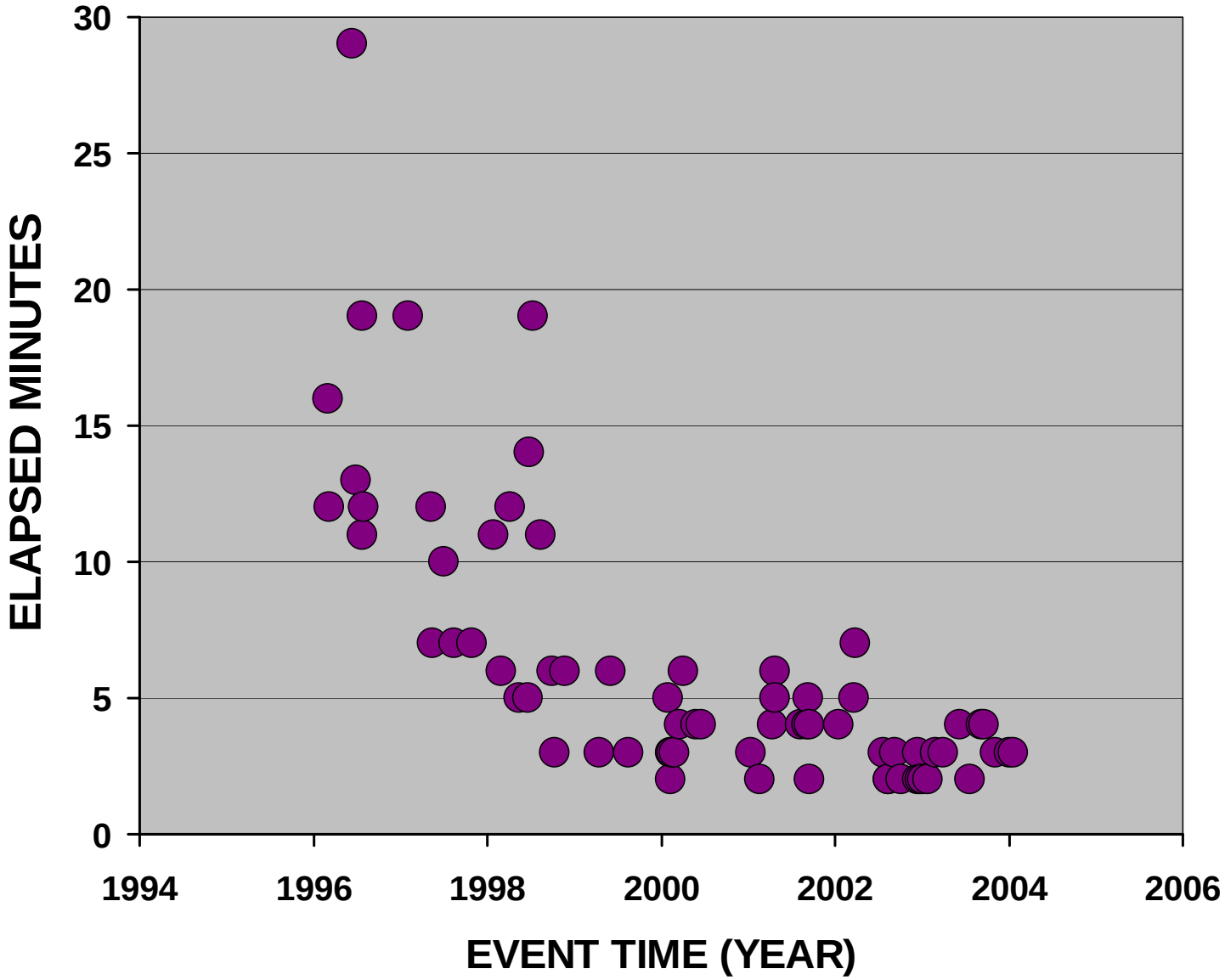
Mag 4 - 6.8	Earthquake Message Only
Mag 4 - 6.8 with runup or coastal gauge signal	Warning to nearest counties
Mw 6.9 – 7.5	Warning to nearest counties
Mw > 7.5	Statewide Warning
Confirmed Major Local Tsunami	Statewide Warning

ISSUE MESSAGE & ALERT PUBLIC



The Public must be educated to respond immediately based upon having felt shaking from the earthquake and upon hearing sirens, EAS, or NWR alerts. There is no time to verify the warning or wait for instructions.

ISSUE TIME OF PTWC BULLETINS FOR HAWAII EVENTS



100% OPERATIONAL RELIABILITY

- **POWER**: All operational systems on a central UPS backed up by a generator with one week of fuel.
- **CENTER HARDWARE**: Hardware duplicated into primary and redundant systems.
- **DATA SOURCES**: Seismic and sea level data come from multiple sources.
- **DATA COMMUNICATIONS**: Data is sent to PTWC over multiple links whenever possible.

100% OPERATIONAL RELIABILITY

- **DATA PROCESSING**: Multiple algorithms for EQ detection, alerting, locations, magnitudes, and model guidance.
- **MESSAGING**: Multiple dissemination methods to reach designated contact points by multiple means.
- **DUTY PERSONS**: Two persons always on duty on the Center compound.
- **BACKUP CENTER**: PTWC and WC/ATWC provide backup service for each other.

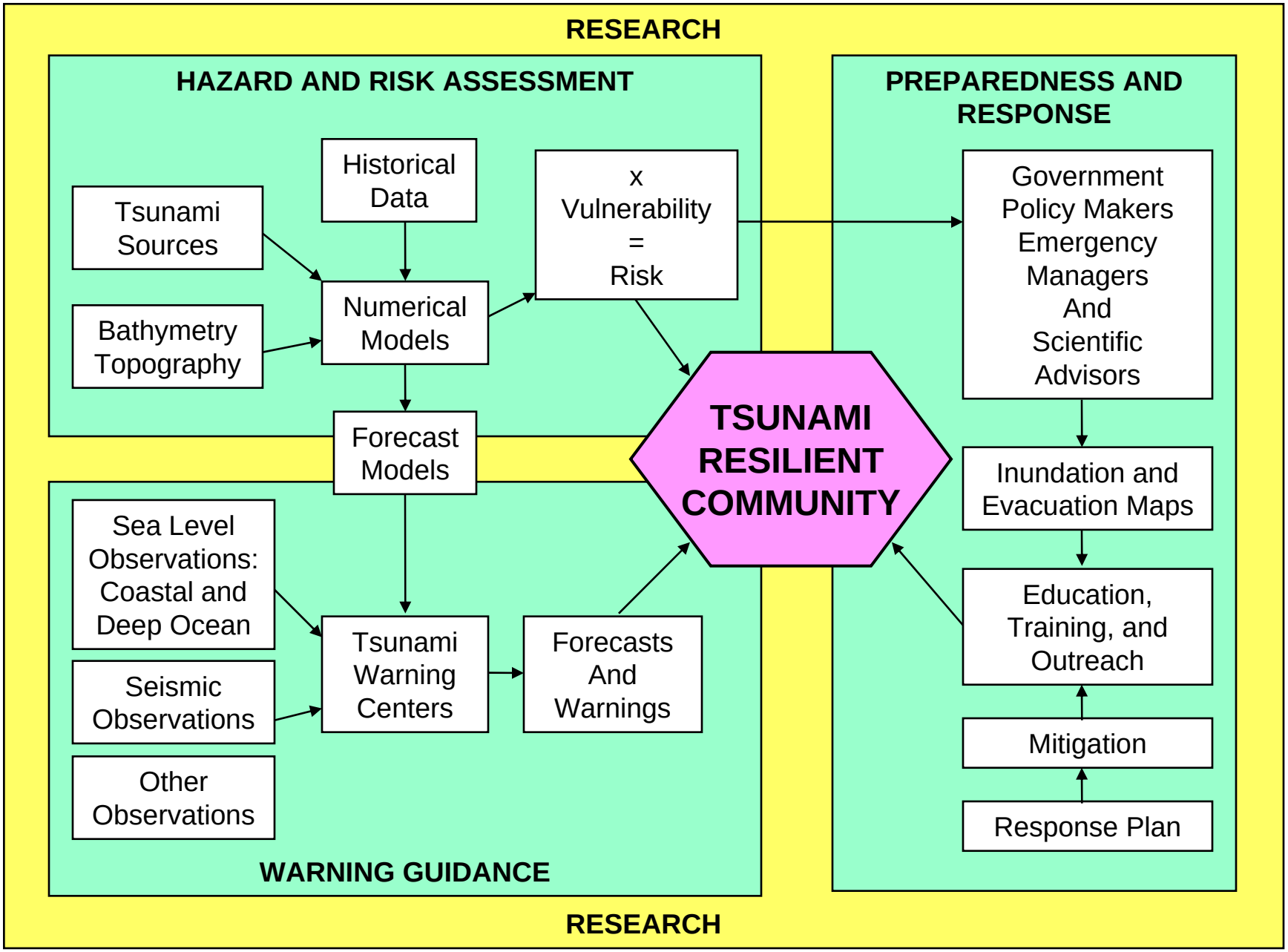
LONG TERM SUSTAINABILITY

- **NATIONAL SUPPORT**: National commitment to Center operations. As a part of the US National Weather Service, certain resources and expertise are shared with this organization that also does 24x7 monitoring of the environment and issues advisories, watches, and warnings.
- **ORGANIZATIONAL SUPPORT**: Organizations of stakeholders such as ITSU (international), NTHMP (national), and TTRC (local) that include emergency managers, warning center operators, and scientists provide authoritative sustained focus on tsunami issues.

LONG TERM SUSTAINABILITY

- **MULTI-FUNCTION SEISMIC**: Seismic stations operated by multiple organizations for multiple purposes including earthquake monitoring, volcano monitoring, and geophysical research.
- **MULTI-FUNCTION SEA LEVEL**: Sea level stations operated by multiple organizations for multiple purposes including tides, storm surge, El Niño, and long-term sea level rise.
- **MULTI-FUNCTION COMMUNICATIONS**: Data communications methods shared when possible. Message disseminations over multi-purpose circuits such as GTS, AFTN, EMWIN.

Components of a Tsunami Resilient Community



THANK YOU