MODELLING TYPHOONS IN JAPAN

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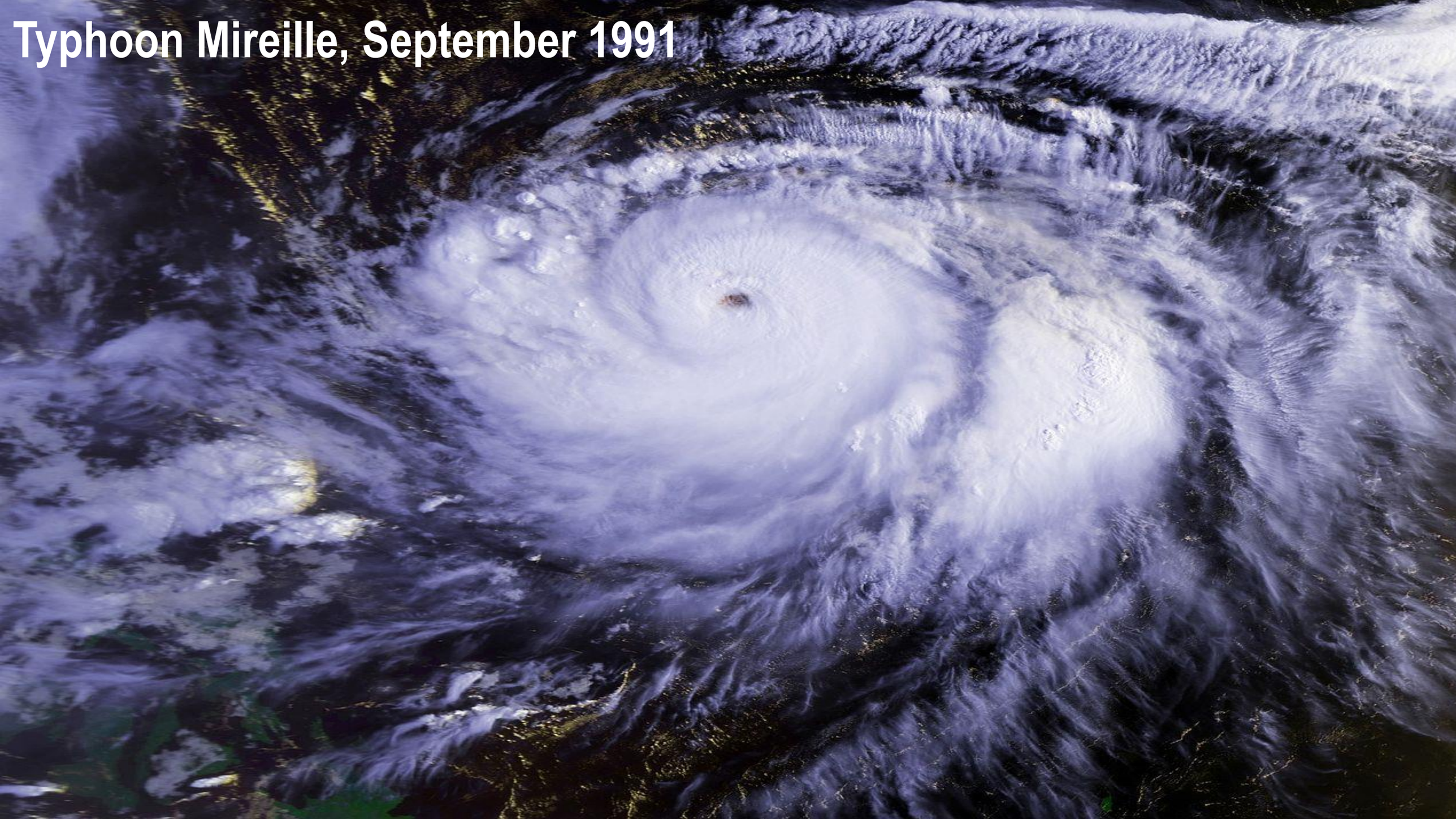
CAS Asia Regional Affiliate (ARECA) Singapore August 2016


Typhoon Mireille, September 1991

WHAT IS A TYPHOON?

Tropical cyclones are known as typhoons in the western North Pacific, hurricanes in the Atlantic, and Cyclones in Australian waters

Damaging perils include;

Typhoon Wind

Typhoon Flood (Inland and Coastal)

Typhoon Namtheun (2004)

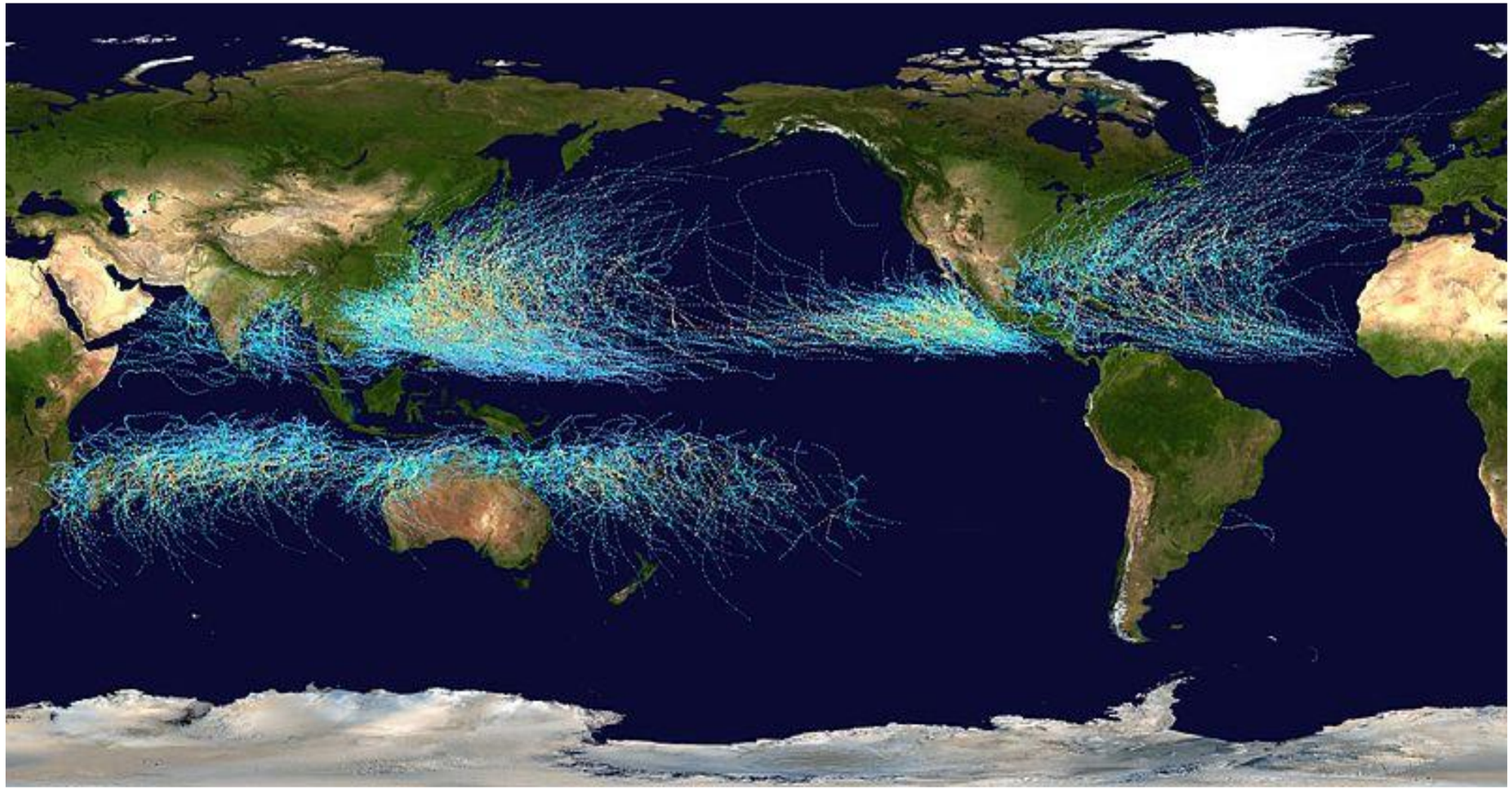
WESTERN NORTH PACIFIC TYPHOONS

western North Pacific:

Most active basin on the planet in terms of tropical cyclone activity

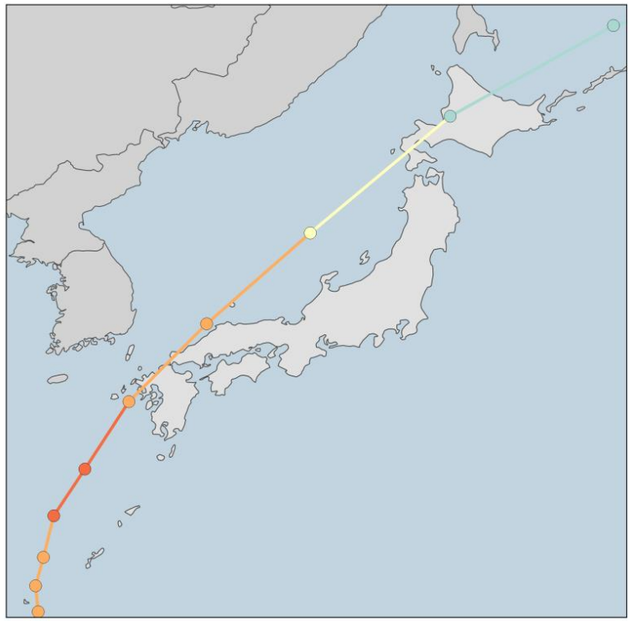
90% of the world's Cat 5 tropical cyclones are in the wNP.

30% of global total ACE

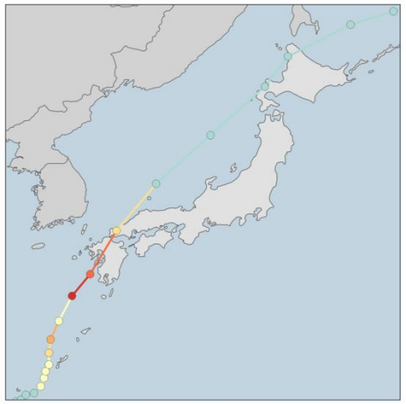


NASA, 1985-2005

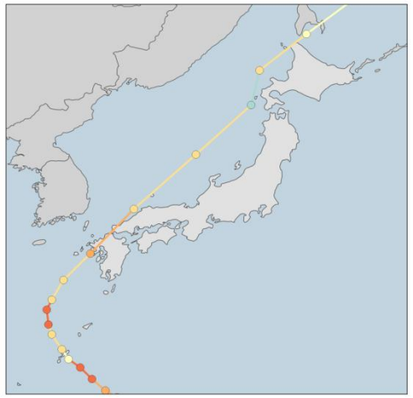
HISTORICAL TYPHOON LOSS IN JAPAN



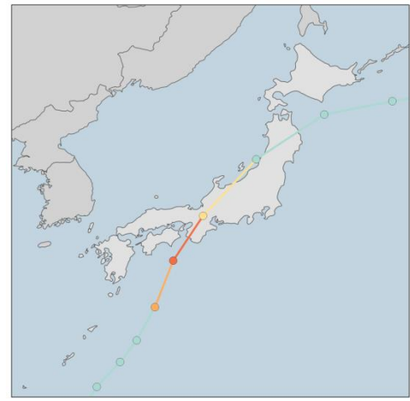
Typhoon Mirelle (1991)
USD9.82bn



Typhoon Bart (1999)
USD5.75bn



Typhoon Songda (2004)
USD4.5bn



Typhoon Vicki (1998)
USD 1.86bn

Year	Event	Economic Loss (USD billions, 2015 Values)	Insured Loss (USD billions, 2015 Values)
2011	Tohoku EQ	221.19	36.86
1991	Typhoon Mireille	17.4	9.82
1999	Typhoon Bart	7.11	5.75
2004	Typhoon Songda	8.99	4.5
1995	Kobe EQ	128.11	3.84
2014	Japan Snowstorm	5.01	2.5
1998	Typhoon Vicki	2.18	1.86
1993	Typhoon Yancy	2.06	1.44
2004	Typhoon Tokage	4.05	1.4
2000	Typhoon Saomai/Tokai Floods	10.24	1.36

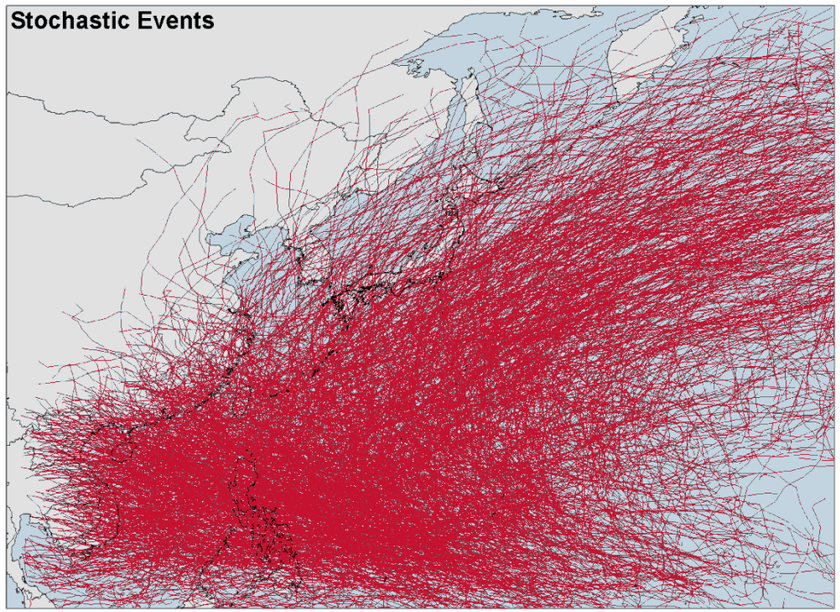
Damaging perils include;

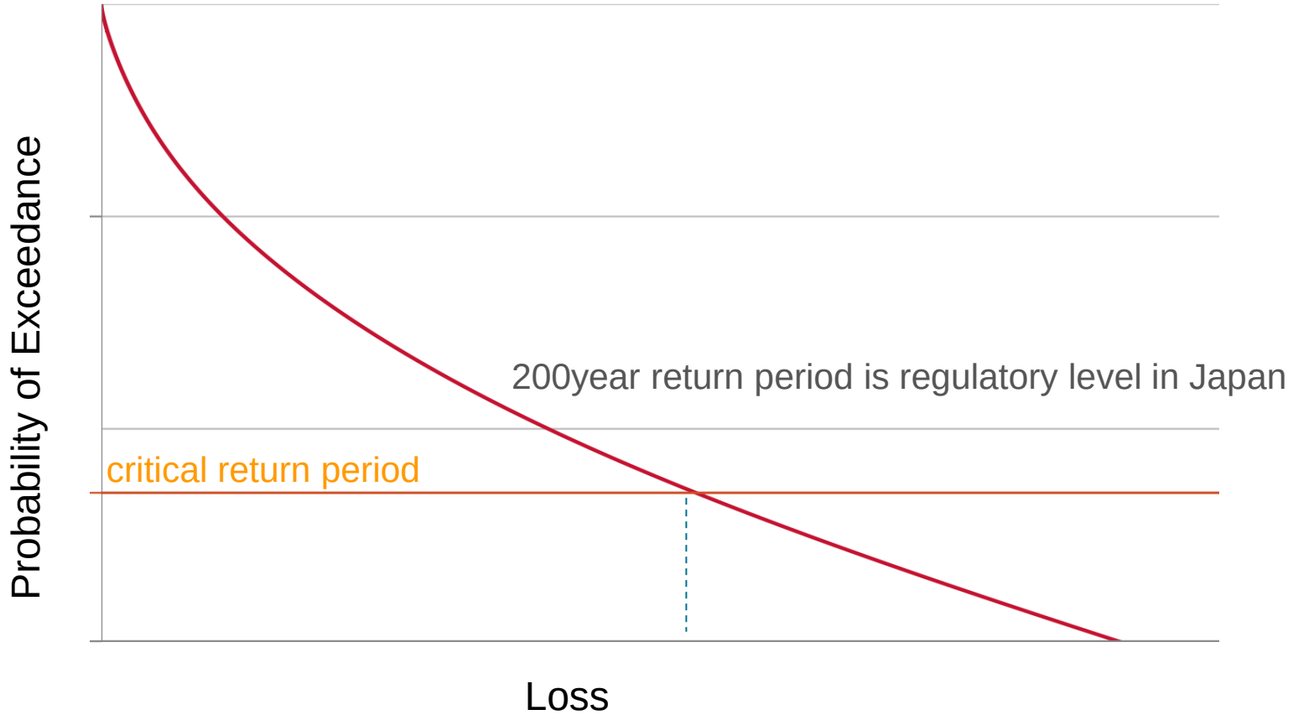
Typhoon Wind

Typhoon Flood (Inland and Coastal)

CATASTROPHE MODELING - MODELING BEYOND HISTORY

- Limited historical record, both hazard and claims
- Catastrophe modeling simulates a larger event set than history
- Catastrophe modeling looks at all possible losses that extend beyond the historical record

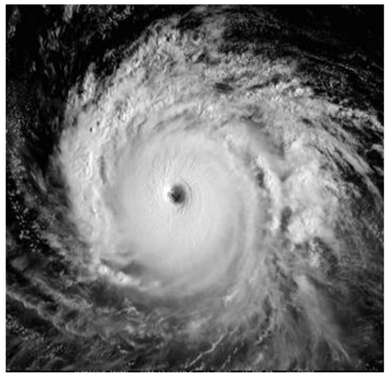




Simulation of larger event set, beyond the historical data
Japan Typhoon – from ~50years to ~50,000 years

Probabilistic loss assessment
Calculation of loss and quantification of uncertainty

RMS CATASTROPHE MODELING FRAMEWORK



Stochastic Event Module

Define peril and generate stochastic track set

Hazard Module

Assess local hazard

Exposure Module

Apply Insured Details

Vulnerability Module

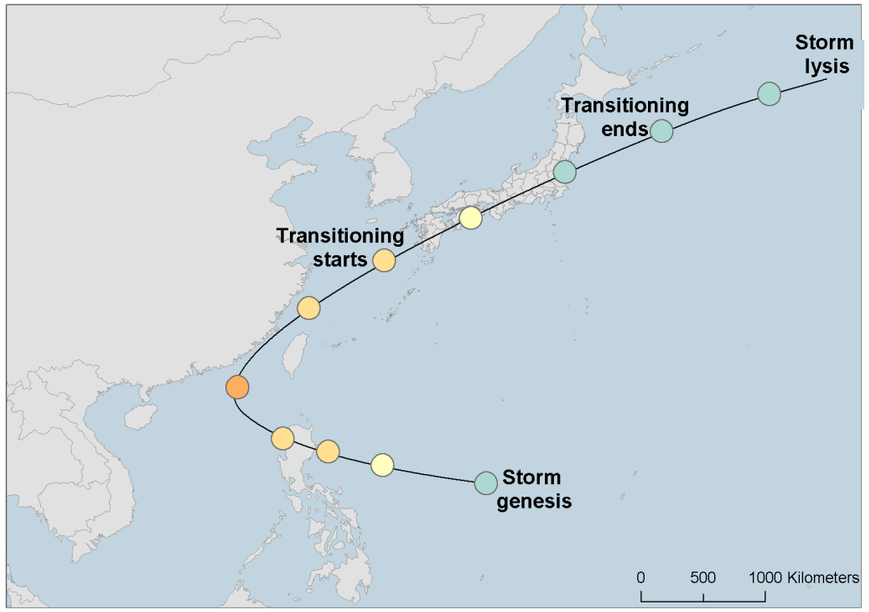
Calculate Damage

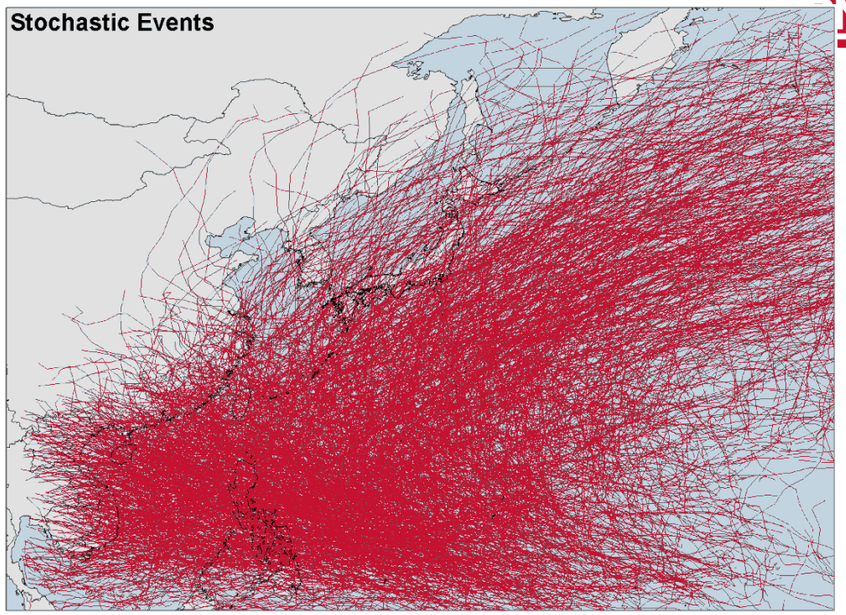
Financial Analysis Module

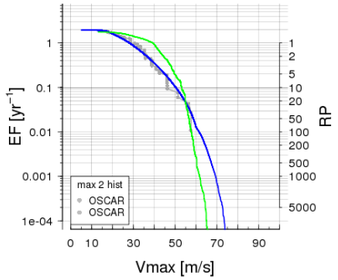
Quantify Financial Loss

STOCHASTIC TRACK SET

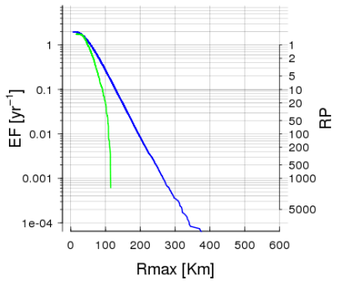
50,000 years of typhoon activity



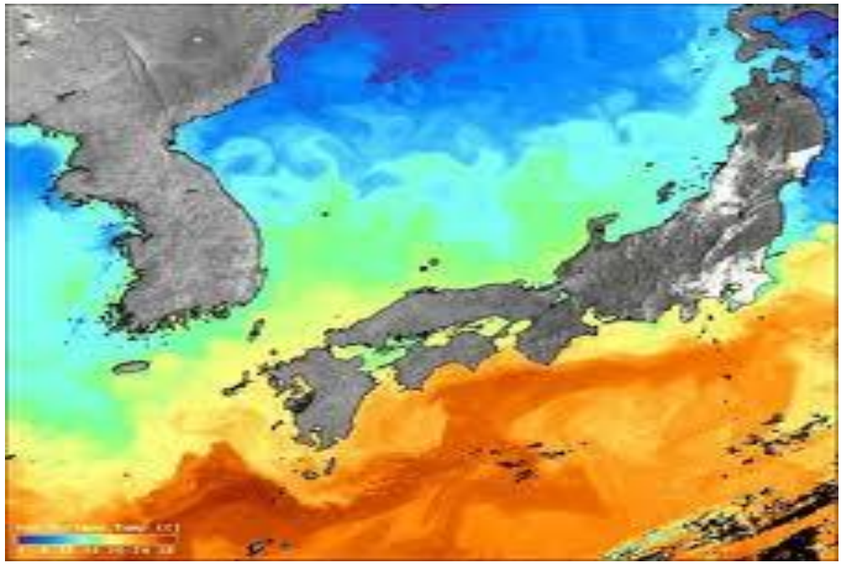




E_Chubu+Kanto_(C)



Historical Set
Calibrated Stoc. Set
Current model (JPTY)



Define peril and generate stochastic track set

STOCHASTIC HAZARD

Wind Hazard

Flood Hazard

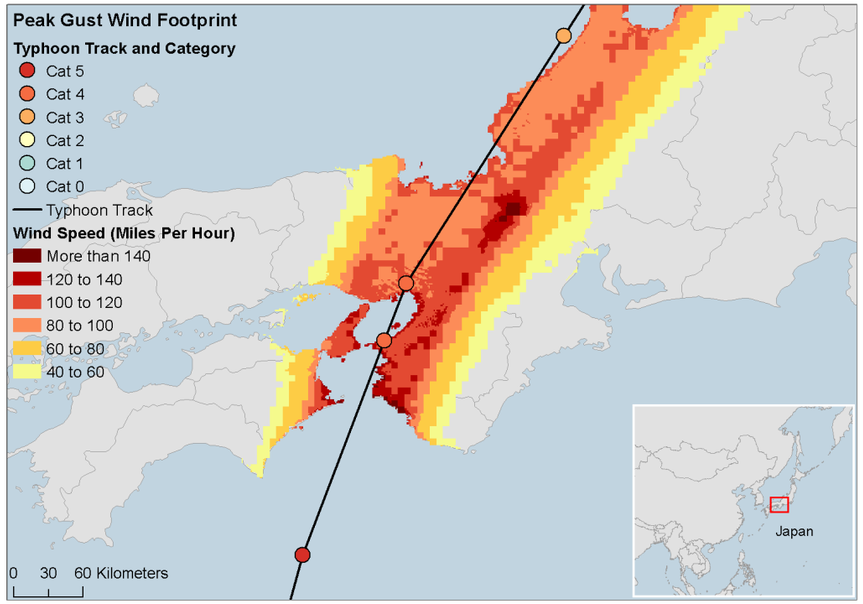
- Inland – fluvial and pluvial
- Coastal - storm surge and tide, and wave

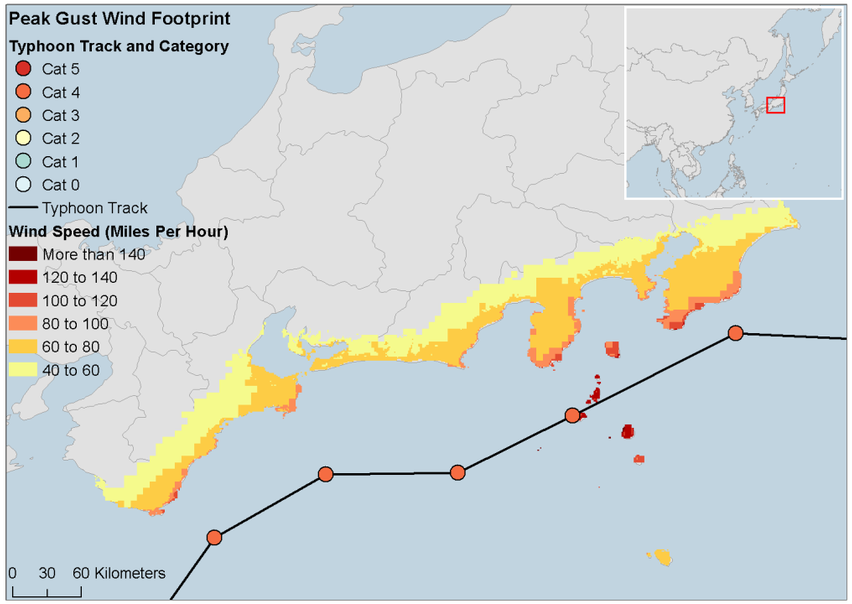
Assess local hazard

Wind modeling – time-stepping windfield, with most advanced extra-tropical transitioning model on the market.

Inland Flood – typhoon precipitation driven hydrological (and hydraulic) simulation that captures fluvial and pluvial flooding.

Coastal Flood - hydrodynamic modeling of storm surge and wave





VULNERABILITY

Wind Vulnerability

Flood Vulnerability

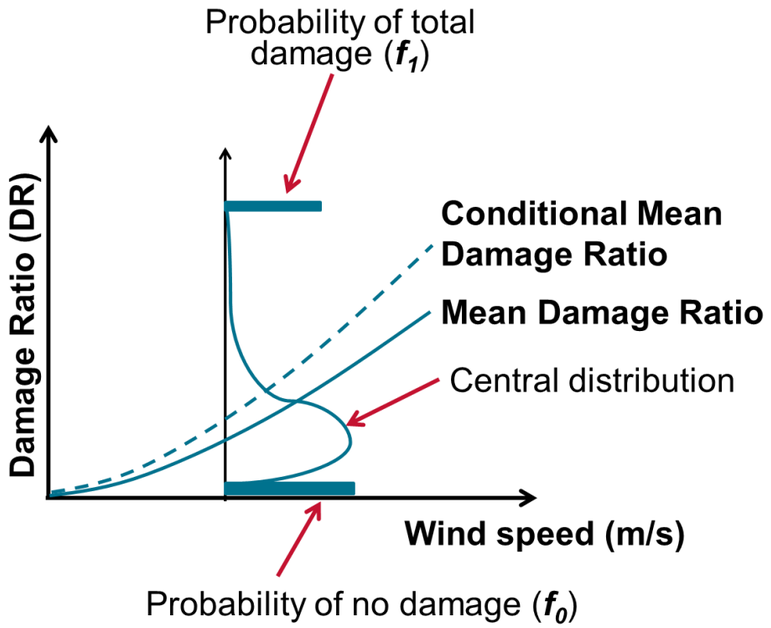
Over 5,000 vulnerability functions across lines of business, building characteristics, regions, and peril.

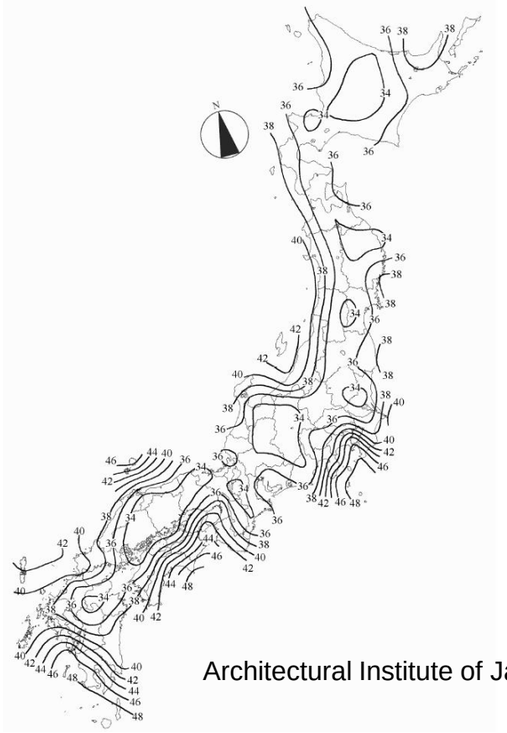
Calculate Damage

Relates the expected physical damage to the modeled hazard (three-second peak gust / flood depth)

Wind vulnerability-empirical and engineering based wind damage model

Flood vulnerability – component based flood damage model





Architectural Institute of Japan (AIG) design wind speeds (2004)







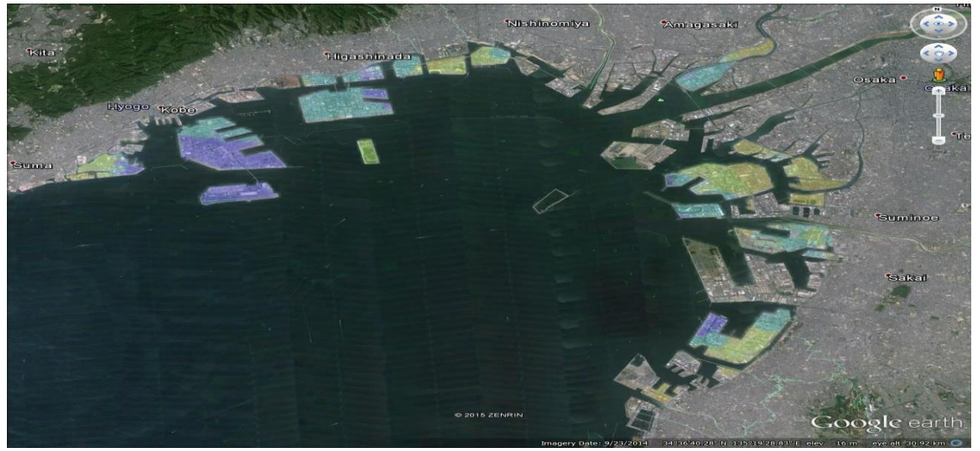

RMS JAPAN TYPHOON HIGH-DEFINTION MODEL……

- Fully coupled typhoon wind and typhoon flood model
- Explicit modeling of typhoon wind, and typhoon inland flood and typhoon coastal flood
- Incorporates the latest RMS innovations in wind and flood modeling, including the most advanced extra-tropical transitioning model on the martket
- Provides modeling at high geographic resolution
- Model built in collaboration with local industry partners (including Tokio Marine and Sompo Japan)
- And in collaboration with scientific leaders, both in Japan and internationally

INSIGHT INTO TYPHOON RISK THROUGH DIFFERENTIATION BY PERIL

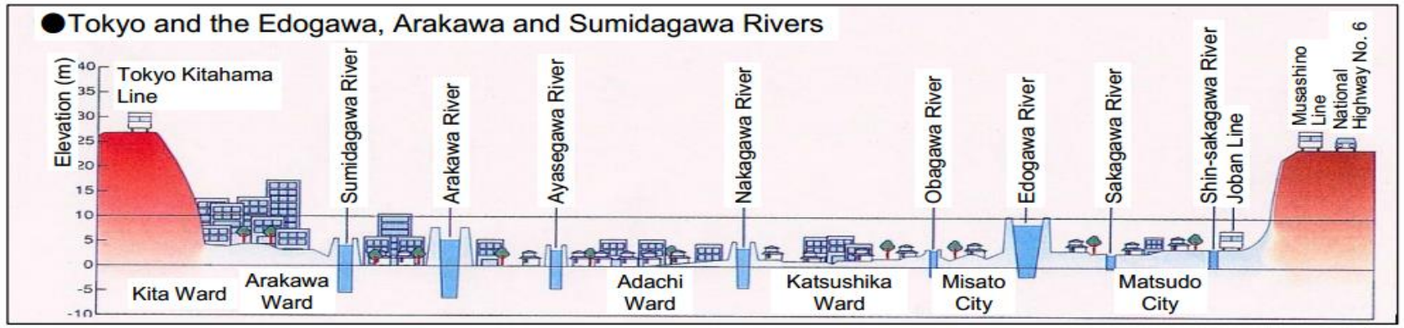
Inland Flooding in central Tokyo

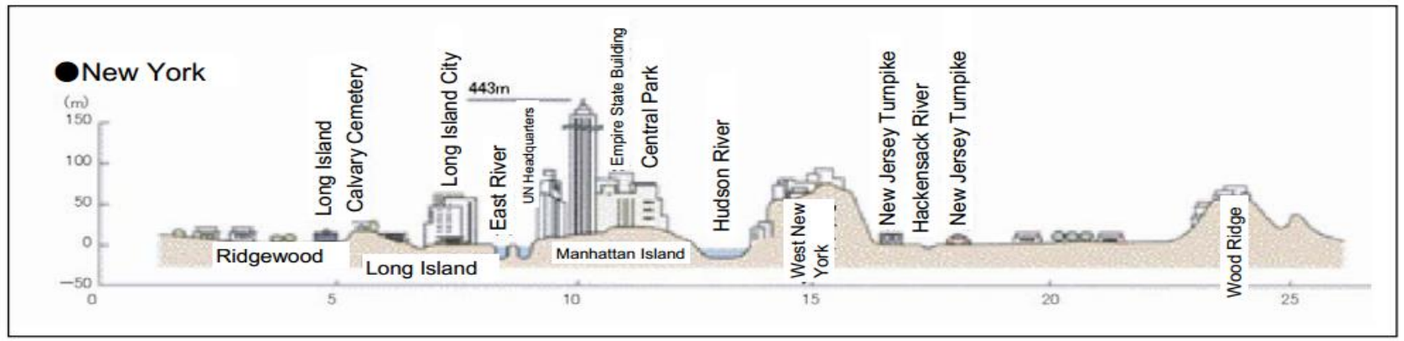
Coastal Flooding in Osaka and Hiroshima Bays



MODELING FLOOD INVOLVES DETAILED DEFENCE MODELING

Major cities spread in areas below the design high water levels



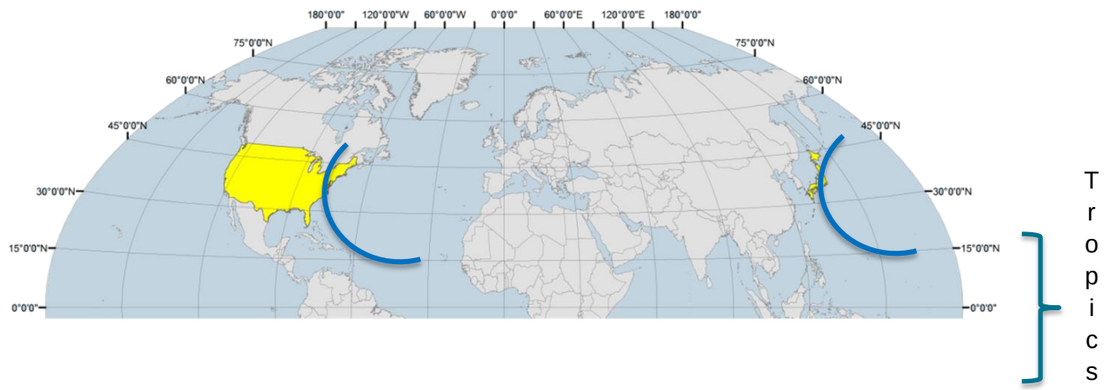


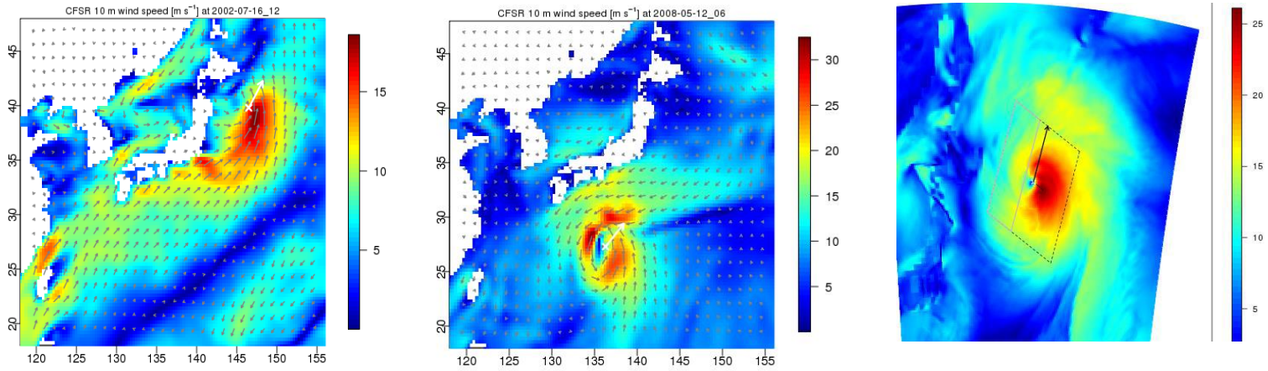
River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan, 2009

Overtopping

Breaching

MOST SCIENTIFICALLY ADVANCED TYPHOON MODEL



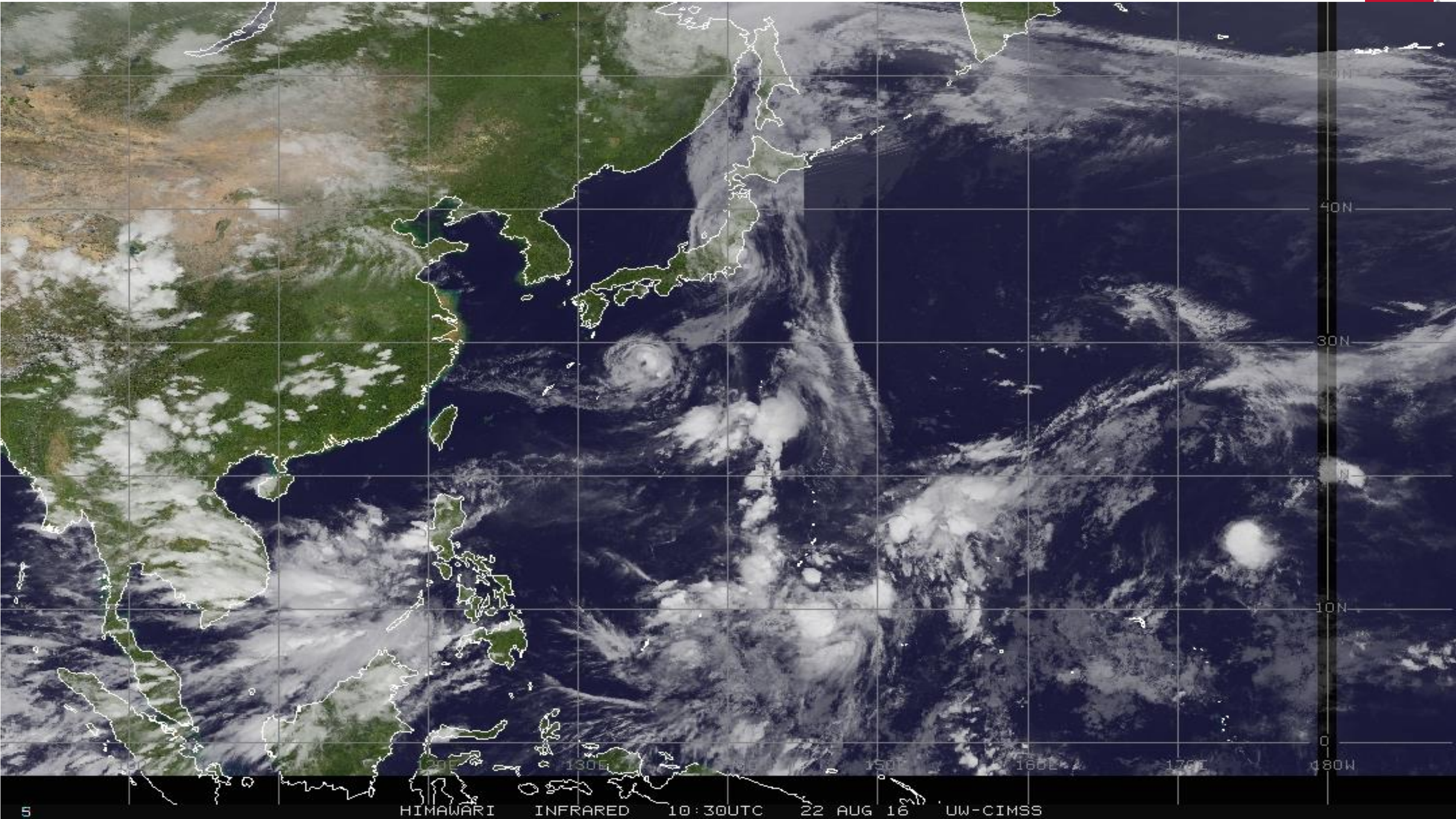


More than 50% of typhoons that make landfall over Japan undergo extra-tropical transitioning

RMS Research / Peer Reviewed Scientific Papers

Cyclone Wind Field Asymmetries during Extratropical Transition in the Western North Pacific
T. Loridan, E. Scherer, M. Dixon, E. Bellone and S. Khare
Journal of Applied Meteorology and Climatology
Volume 53, Issue 2 (February 2014) pp. 421-428

Parametric Modeling of Transitioning Cyclone Wind Fields for Risk Assessment Studies in the Western North Pacific
T. Loridan, S. Khare, E. Scherer, M. Dixon and E. Bellone
Journal of Applied Meteorology and Climatology
Volume 54, Issue 3 (March 2015) pp. 624-642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ABOUT RMS

RMS is the world's leading provider of products, services, and expertise for the quantification and management of catastrophe risk. More than 400 leading insurers, reinsurers, trading companies, and other financial institutions rely on RMS models to quantify, manage, and transfer risk. As an established provider of risk modeling to companies across all market segments, RMS provides solutions that can be trusted as reliable benchmarks for strategic pricing, risk management, and risk transfer decisions.