The use of NHC Data in the Risk Transfer Industry

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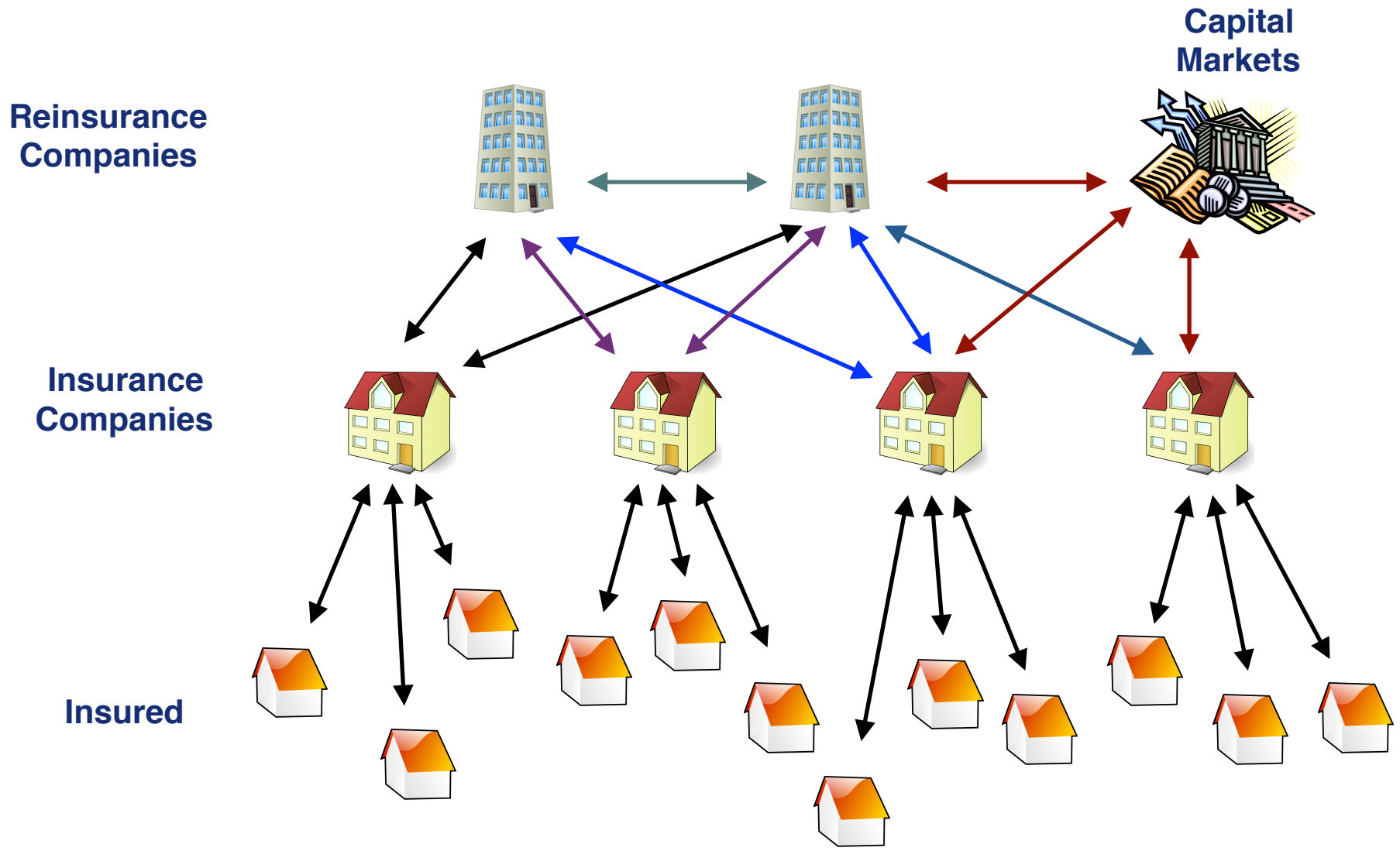
The Risk Transfer Industry - Overview



Why Capital Markets?

Advantages for both sides

- Further distribution of the risk beyond the insurance and reinsurance industry, i.e. higher security for insurers

- Investments uncorrelated to the financial markets, i.e. uncorrelated source of income for investors, less risk of losses.

Further Players in the Market

Brokers

- Most reinsurance contracts are facilitated by brokers.

Cat Modelling Companies

- Reinsurers and large insurers use catastrophe models to assess the risk of natural hazards.

Insurance Regulators

- Government bodies to ensure insurers and reinsurers can come up for the risk they take.

Rating Agencies

- Rating insurance and reinsurance companies regarding their financial stability.

Asset Managers

- Specialized asset managers managing investments in ILS (Insurance Linked Securities).

Reinsurance peculiarities

Reinsurance is the insurance of insurance companies

- Most catastrophe *reinsurance* contracts last for one year, they are renegotiated every year.

- Most catastrophe contracts cover event losses exceeding a certain loss threshold, some cover the sum of all annual losses (aggregate contracts).

- Typically, the reinsurance industry cares about intense, strong, and rare events causing significant damage.

What the risk transfer market needs to know

What is the risk of hurricane losses

- At current climate conditions.
- For the next season.
- Out to remote return periods.

Before a hurricane makes landfall

- Will it affect our portfolio.
- What is the cost to the market / to us.

After hurricane landfall

- What is the cost to the market / to us.

Catastrophe Modelling

Purpose of catastrophe modelling

- Pricing of insurance and reinsurance
- Risk management and exposure control for insurance and reinsurance

Model output needed

- Monetary losses to a portfolio of buildings or individual buildings
- Expected average annual loss
- Expected losses at certain return periods, e.g. 100, 250, 500, 1‘000 years

Catastrophe Modelling

Hazard

- Includes intensity and frequency of events
- Usually achieved by stochastic modelling of thousands of years of events with their intensities based on historic data
- Wind fields for hurricanes around tracks taking intensity, size and surface roughness into account
- Shaking at surface calculated for earthquakes taking magnitude, depth and soil properties into account

Vulnerabilities

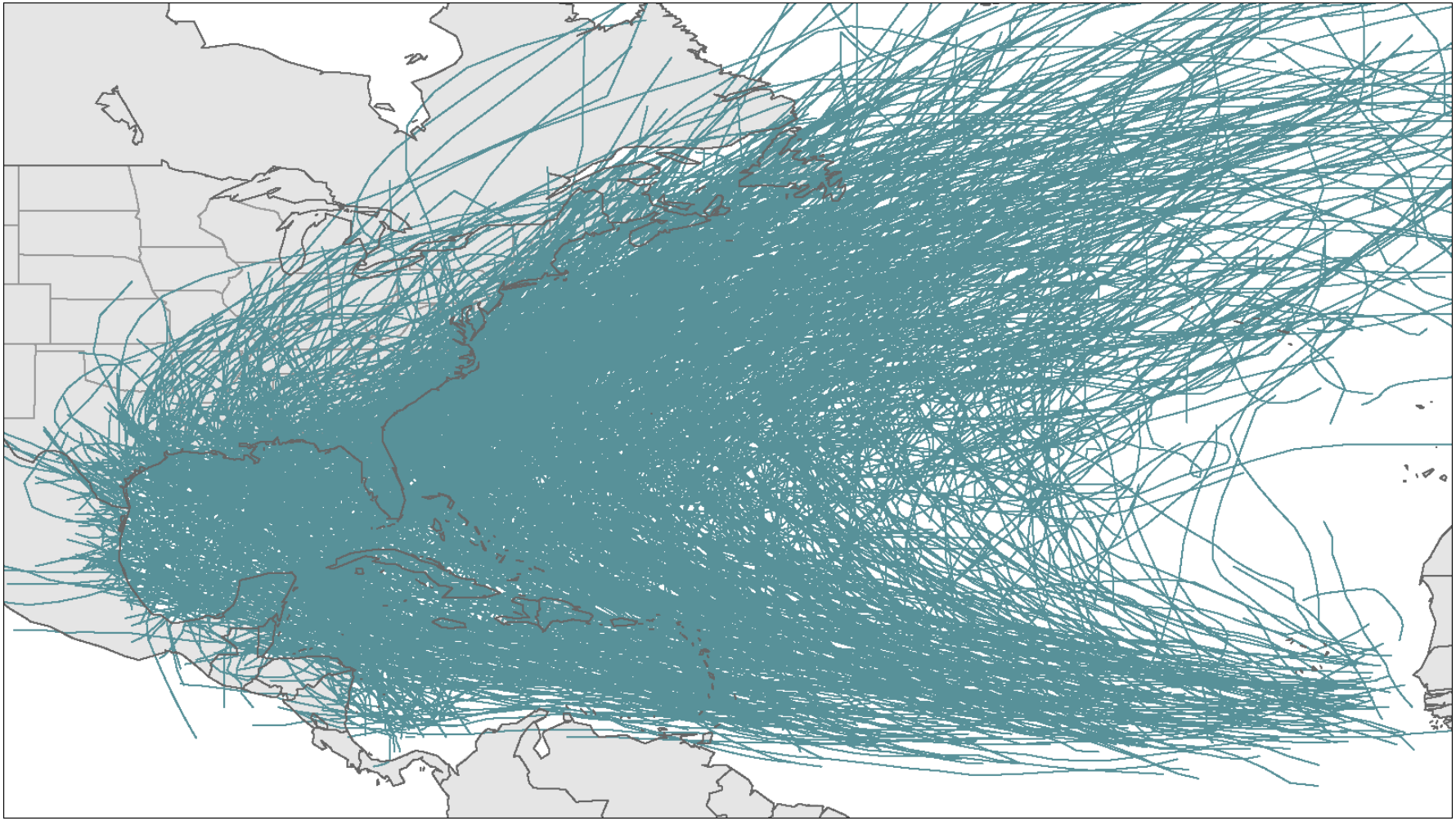
- Calculate financial loss to buildings, contents, and business interruption, depending on hazard intensity

Financial module

- Include insurance conditions for each building / location
- Calculate loss to the entire portfolio
- Include reinsurance conditions

Why stochastic models?

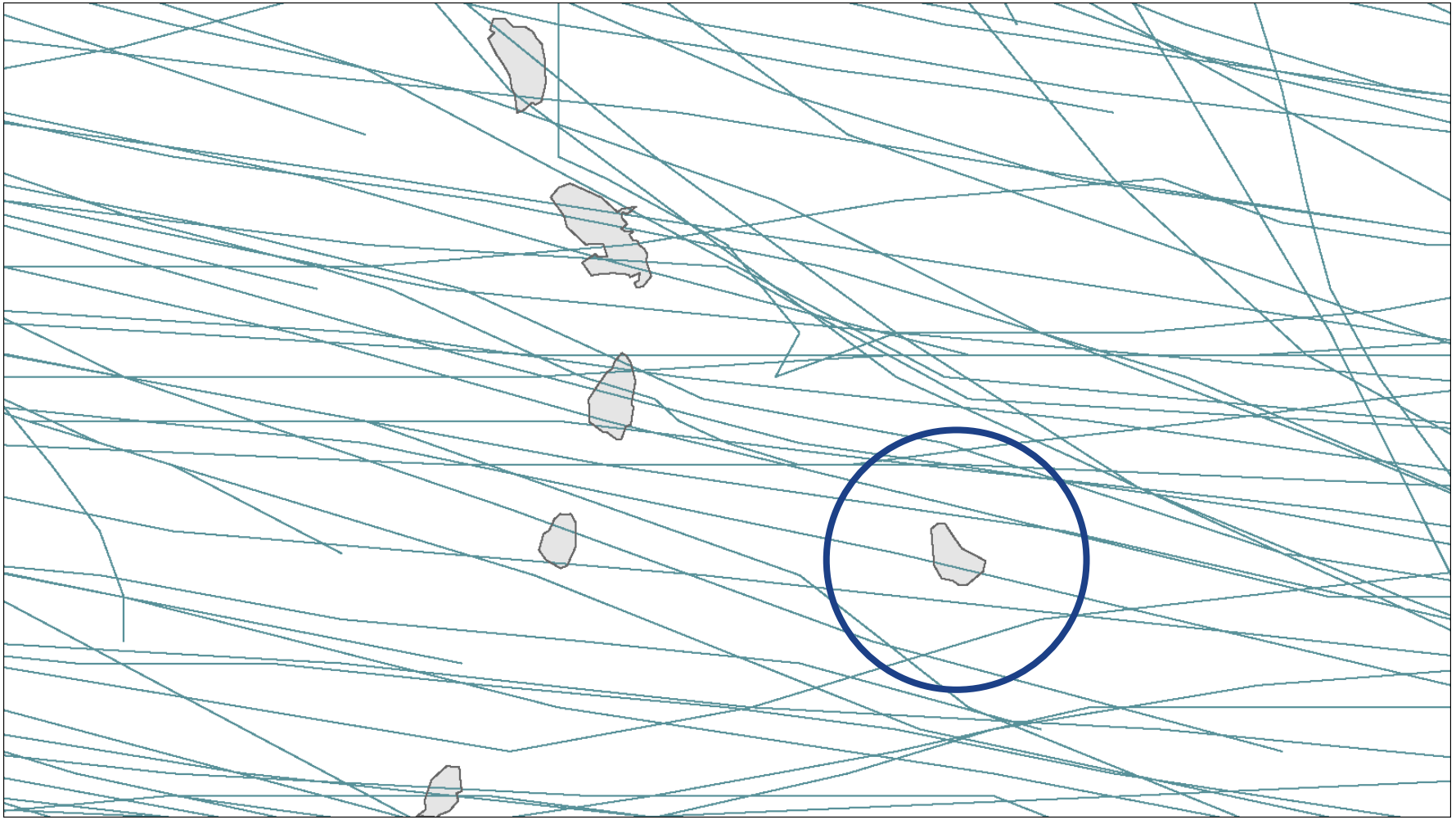
Aren‘t historic data enough?
All Atlantic storms from HURDAT since 1851



Data source: NHC/NOAA

Why stochastic models?

160 years of data is not enough for certain regions!



Data source: NHC/NOAA

Challenges of Stochastic Track Modelling

Older data

- How reliable is older data?
- Should older data be used for catastrophe modelling?
- Should older data be adjusted for catastrophe modelling?

Climate stationarity

- Is the hurricane climate stationary?
- What is the current risk?

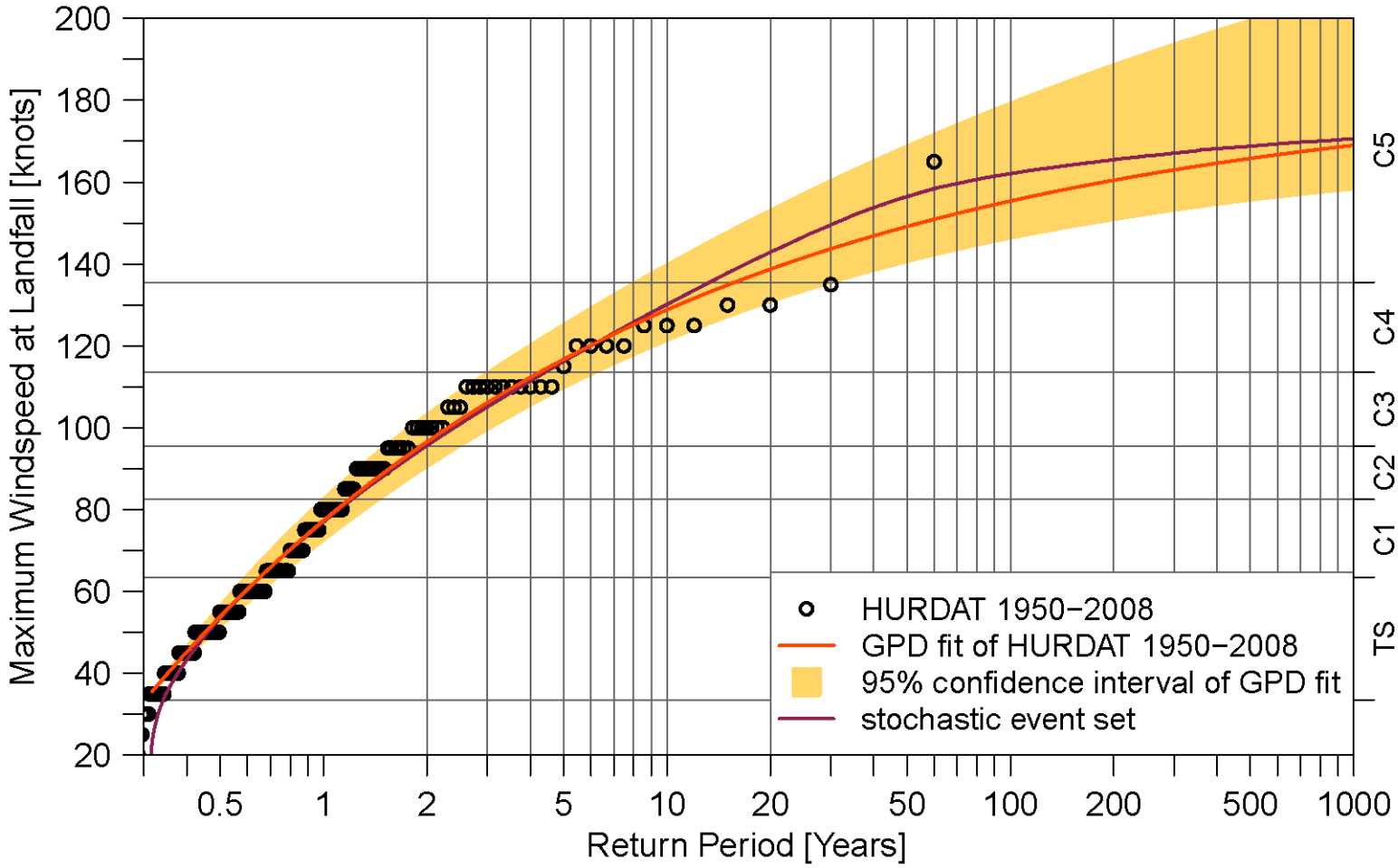
Data completeness

- Is the hurricane data representative of the risk distribution?
- Where are physical limits to extreme events?

How to validate stochastic models?

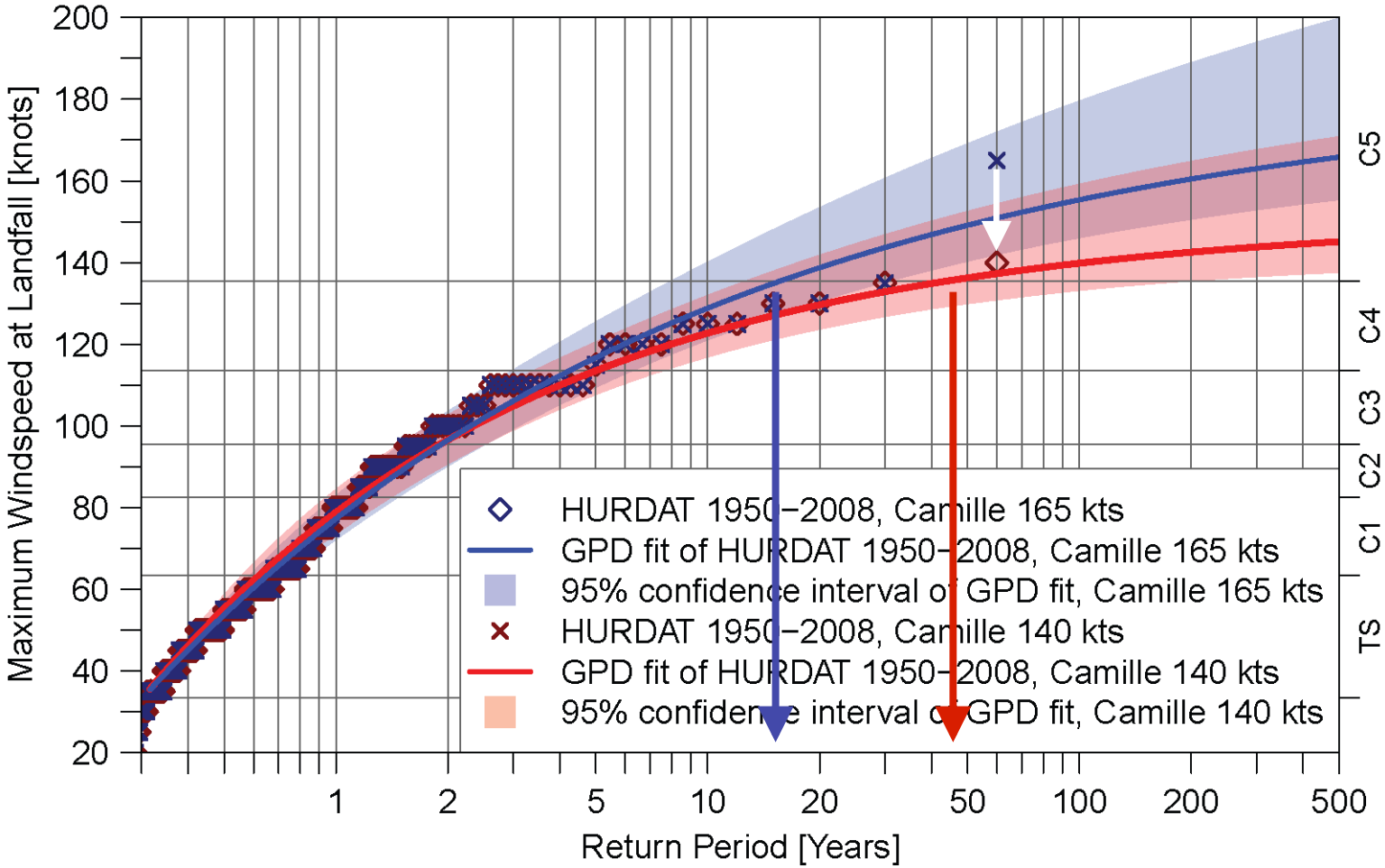
How to validate stochastic models?

By means of extreme value statistics



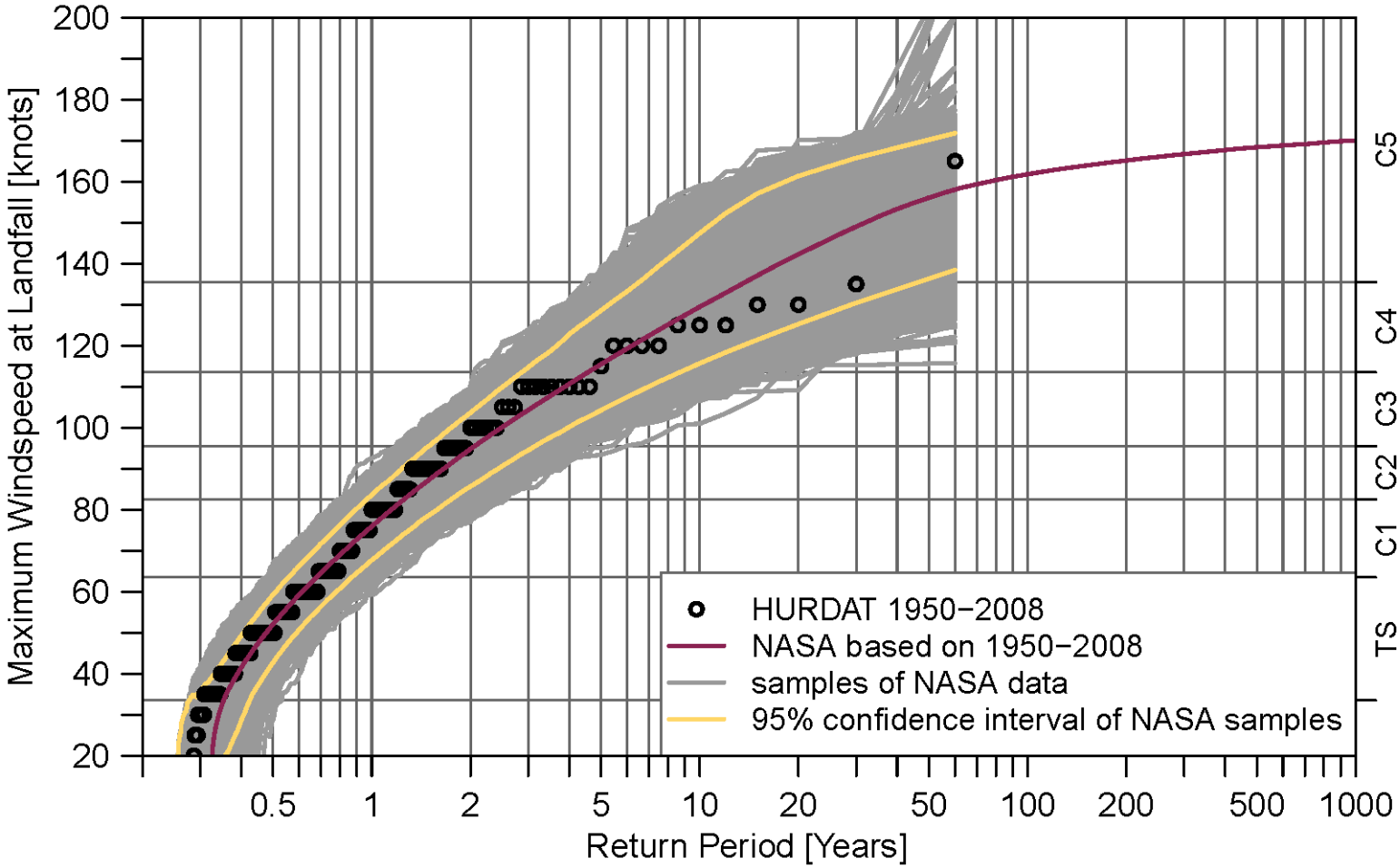
How to validate stochastic models?

Extreme value statistics is very sensitive to extreme events



How to validate stochastic models?

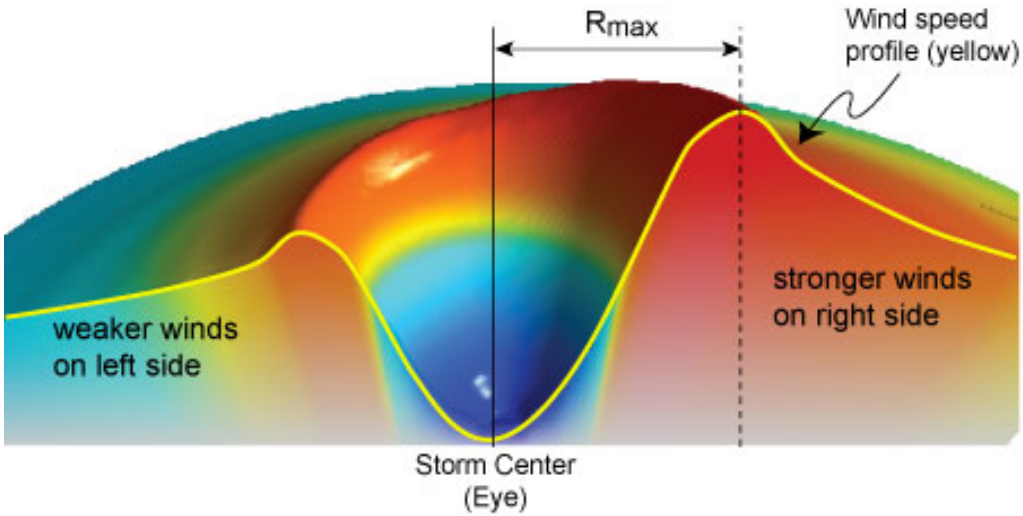
By means of sampling



Hurricane Windfield Modelling

Hurricane Cross-Section

- Hurricane wind fields are stronger to the right of the center (in the northern hemisphere) due to the combination of rotation and forward movement



Resulting Wind Field for Wilma

- Includes asymmetry of wind field
- Includes surface roughness due to land use

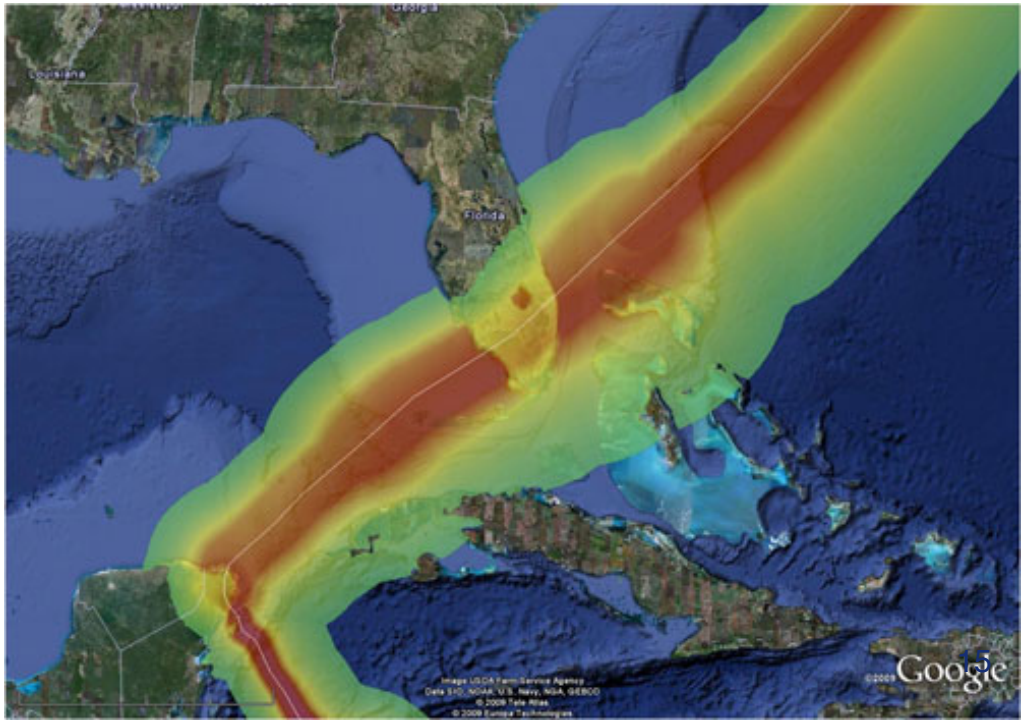


Image source: AIR

Combining Exposure Data with Hazard

Damage to building is calculated depending on

- Hazard intensity, e.g. wind speed or shaking,
- Line of business and occupancy (residential, commercial, industrial, …),
- Building type (masonry, concrete, wood frame, …),
- Further building properties as number of stories, roof structures, year of construction, …

Partly based on historic loss data, partly on engineering approaches.

Calculating the loss to the portfolio

- Ground-up loss to each building
- Including the insurance conditions of each building
- Loss to the entire portfolio
- Including the reinsurance conditions
- ...

Advantages of Cat Models

Advantages of current catastrophe models

- Spatial correlation of events is taken into account, portfolio view is therefore possible.
- Losses beyond historic data can be taken into account.
- Current portfolio of exposure is considered in the modelling.
- Losses of historic events to current portfolio can be calculated.

Perils currently covered

- Tropical cyclones (hurricanes, typhoones, cyclones, …)
- Extratropical storms (US and Canada winter storms, European storms)
- Severe convective storms (tornadoes, hail, straight-line wind)
- Earthquakes including fire-following and tsunami
- Floods
- Terrorism

Key Players in Cat Model Market

Three big ones

- RMS: Risk Management Solutions
- AIR Worldwide (AIR = Applied Insurance Research)
- EQECAT
- All founded in 1980s.

Niche players by region

- Risk Frontiers (Australia)
- ERN (Latin America)

Niche players by peril

- JBA: Flood models
- ARA: US hurricane model

“Public domain” models

- HAZUS by FEMA (requires proprietary GIS software)
- TCRM, EQRM and ANUGA by Geoscience Australia
- OASIS Loss Modelling Framework

Issues and Challenges

Hazard Modelling Challenges

- What is the „current“ hazard?
- Limited historic data for model development
- How to evaluate / validate stochastic models?

Reinsurance Challenges

- Spatial Correlation
- Temporal Correlation and Clustering
- Vulnerabilities and how they change over time

Combined Challenges

- Optimum resolution of exposure data and hazard
- Uncertainties: how to account for them, how to communicate them, what to do with it?

Seasonal Forecasting

Seasonal Forecast challenges in the risk transfer industry

- We all want to be better than our competition in choosing our risk.
- We‘re interested in losses not number of storms in the basin.
- Risk changes by region (e.g. by state) would allow adjusting our portfolio.
- We would need to know in November already as a number of reinsurance contracts incept January 1.
- Detailed forecasts are provided by private companies, even if they‘re scientifically questionable.

Storm Forecasting

During an active storm

- Management wants to be informed about potential losses.

- ATCF allows generation of customized graphics.
  Plotting all forecast model tracks makes it easier to commicate forecast uncertainty.

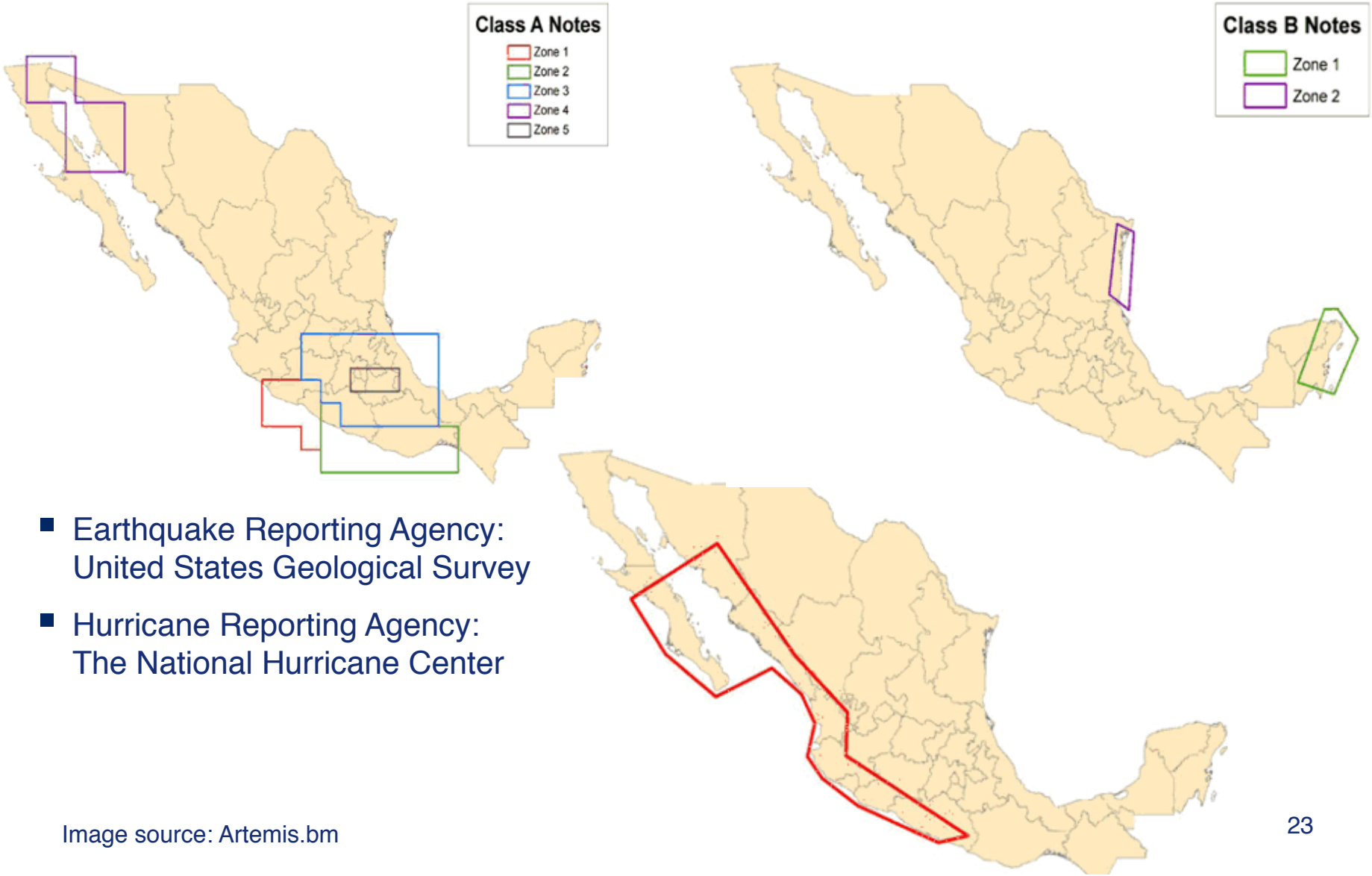
After landfall

- Best track data used for first impact assessments.

- HWIND unfortunately not freely available anymore for more detailed assessment.

Hurricane Odile

The story of a special case due to a catastrophe bond.



- Earthquake Reporting Agency:
  United States Geological Survey
- Hurricane Reporting Agency:
  The National Hurricane Center

Image source: Artemis.bm

Bond Triggers

Class A - Earthquake

Triggers	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Magnitude (Mw)	≥ 7.9	≥ 8.1	≥ 7.4	≥ 7.6	≥ 7.0
Depth (km)	≤ 200	≤ 200	≤ 70	≤ 200	≤ 80

Class B – Atlantic Hurricane

Triggers	Zone 1	Zone 2
Central Pressure (mb)	≤ 920 mb	≤ 920 mb

Class C – East Pacific Hurricane

Triggers	Zone 1 50% payout	Zone 1 100% payout
Central Pressure (mb)	≤ 932 mb and > 920 mb	≤ 920 mb

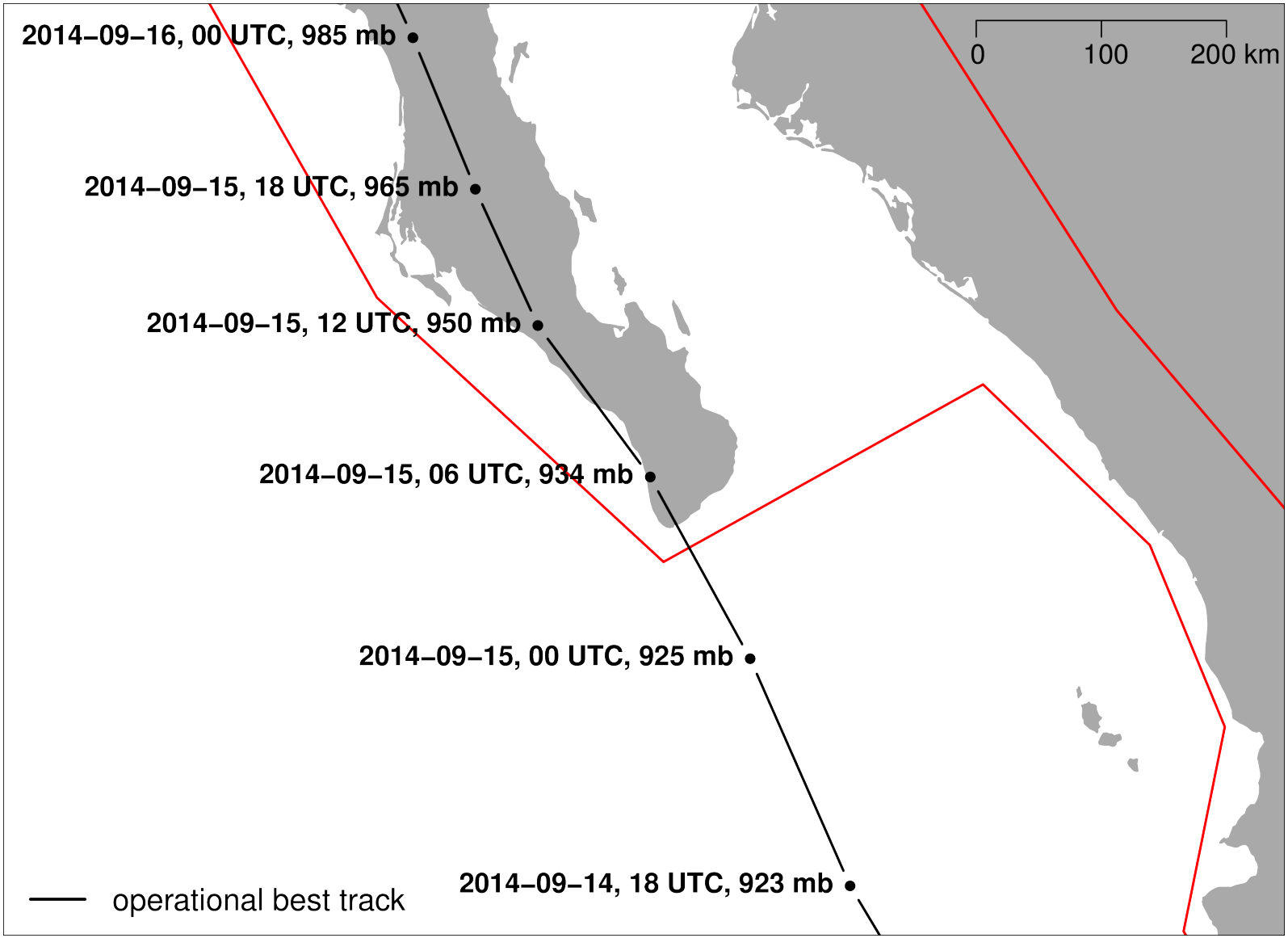
Contract Definitions

The contract defines

- Hurricane Reporting Agency
- Minimum Central Pressure
- Track Points
- Storm Track
- Calculated Central Pressure
- Hurricane Event Parameters
- Hurricane Event Parameters Date
- Tropical Cyclone Report
- …

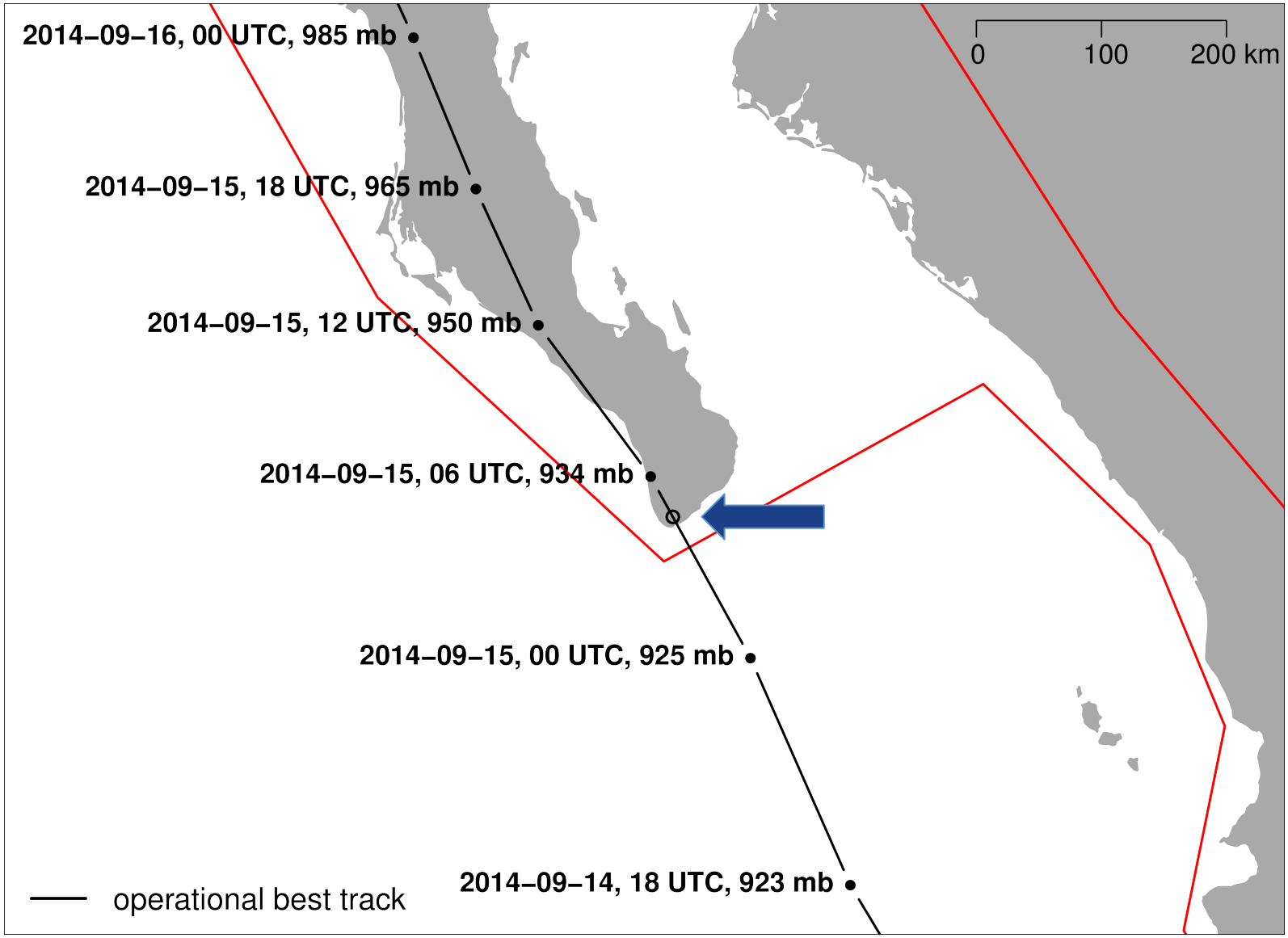
Hurricane Odile

Just after landfall – based on operational best track data.



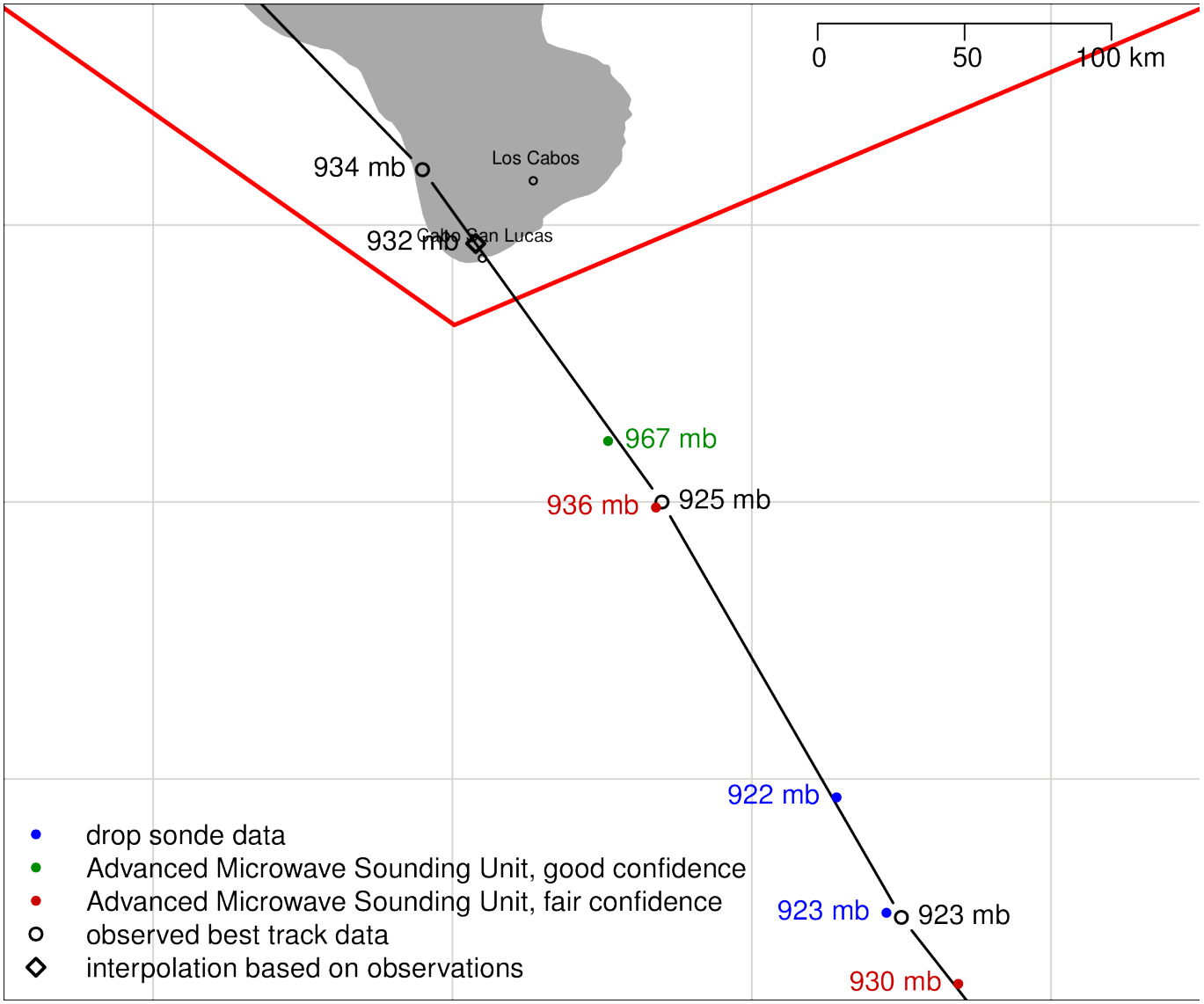
Hurricane Odile

Trigger threshold of 932 mb within the polygon!



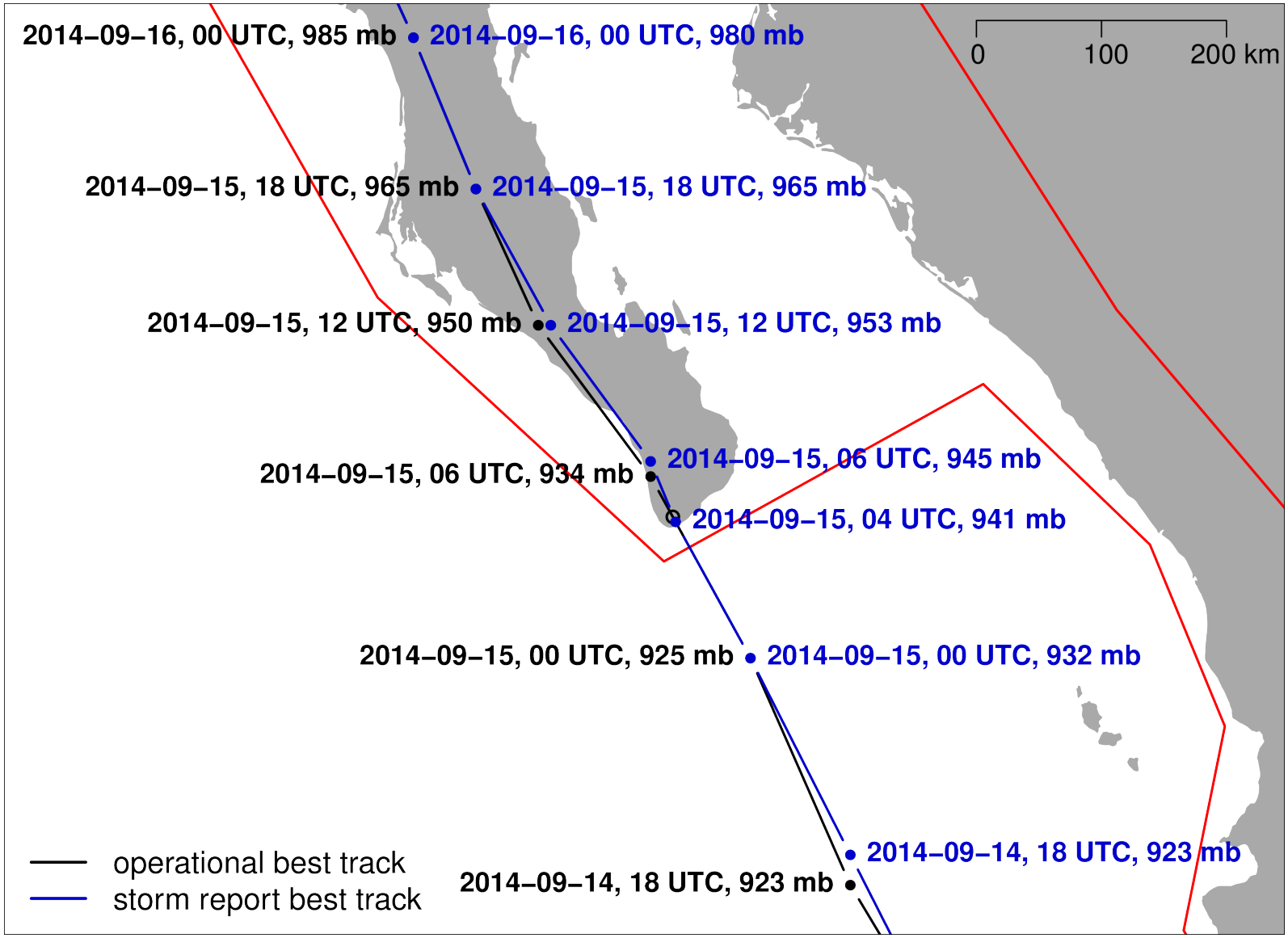
Hurricane Odile

How reliable is central pressure in operational best track?



Hurricane Odile

After release of tropical storm report.



Thank you …

… for your great work at the NHC, it is highly appreciated in the industry !

… for your attention !

“All models are wrong, but some are usefull.”

C. Chatfield (Journal of the Royal Statistical Society, 1995)