

# NatCat Risk Management in Reinsurance

08.12.2023

Dr. Daniel Bölinger



The  
Foundation  
of  
NatCat Risk  
Management ~~in~~  
~~Reinsurance~~

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Exposure  
data



# Exposure Data - Agenda

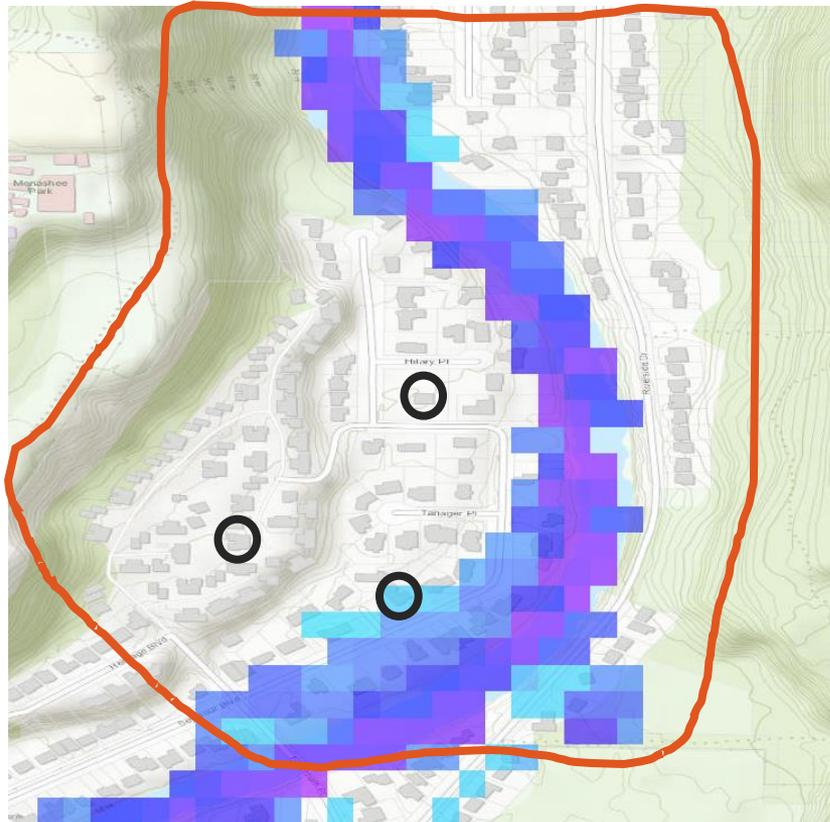
1. Quality
2. Quality
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7. Quality
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9. Quality
10. Quality
11. Quality

# Exposure Data - Agenda

1. Quality 1: Where am I? – Geo Information
2. Quality 2: Who am I? – Risk Attributes
3. What am I, and how many? Data Format
4. Quality 3: Me, myself, and I! – Consistency
5. Should I or shouldn't I? Compliance

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# Modelling with uncertain geodata



Exposure with  
coordinate-level or street-  
level address data



Coordinates are used

Exposure with  
geographical location  
accuracy less than  
street-level address data



Stochastic disaggregation



**Location sampling  
can have strong  
effect due to high  
hazard gradient**



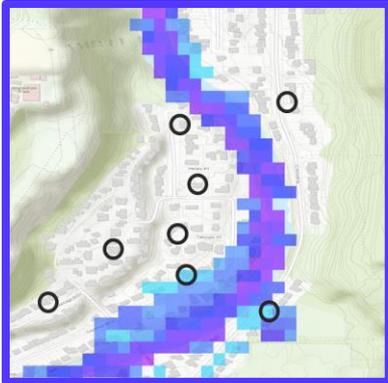
Example risk coordinates



Example administrative zone  
for stochastic disaggregation

- Sample portfolio: high fraction of location accurate data
- Select only risks with location accurate information (i.e. coordinate or street level)

**Model run A:** use location as is (coordinate)

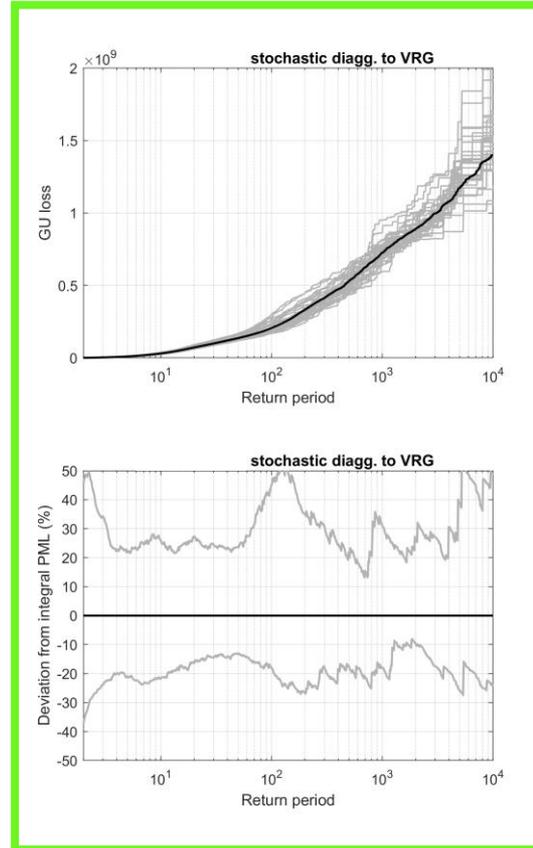
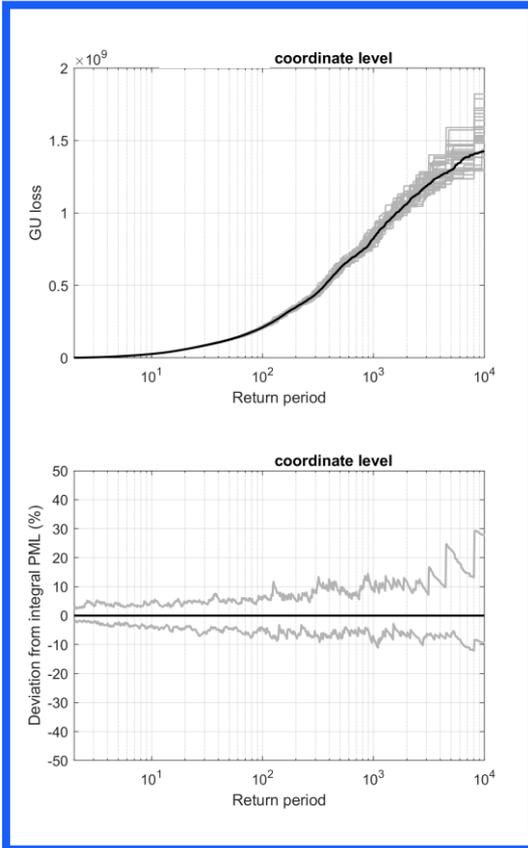


**Model run B:** delete coordinate → stochastic disaggregation to VRG using „geozone best level“

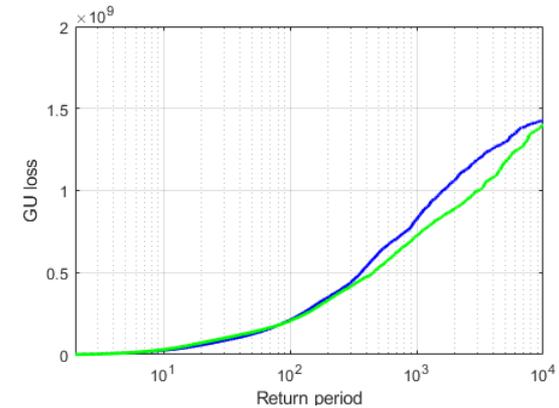


Portfolio characteristics	Portfolio
nRisks	100 k
Variability in TIV among risks	high
Occupancy	Detailed COM / IND

# Effect of location information in Flood models for Australia



— Integral LFC  
— LFC per sample



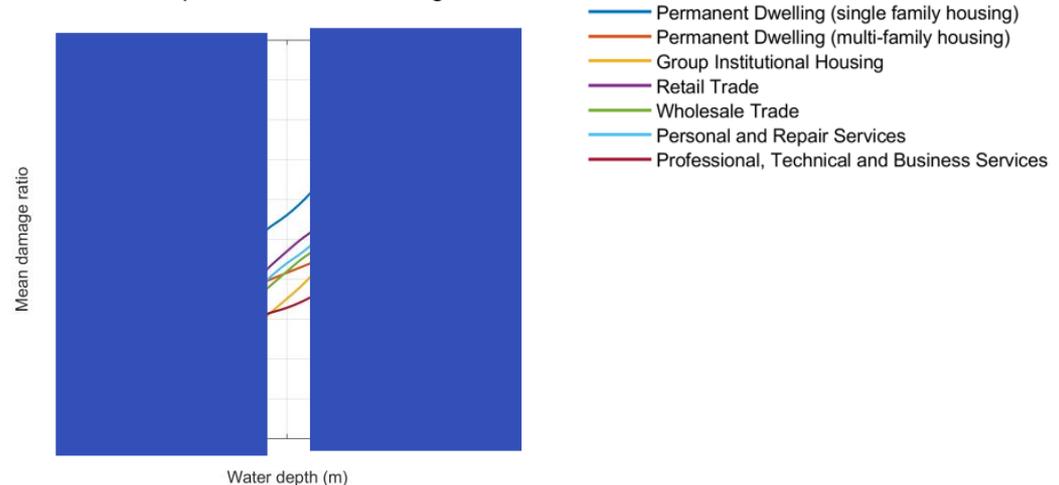
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## Example: Flood Models

- Basis vulnerability curves are selected based on **occupancy class**
- > 70 detailed Flood vulnerability classes

Vulnerability Class	Description
1	Unknown
2	Permanent Dwelling (single family housing)
3	Permanent Dwelling (multi-family housing)
4	Group Institutional Housing
5	Retail Trade
6	Wholesale Trade
7	Personal and Repair Services
8	Professional, Technical and Business Services
9	Health Care Service
10	Entertainment and Recreation
11	Parking
12	Heavy Fabrication and Assembly
13	Light Fabrication and Assembly
...	

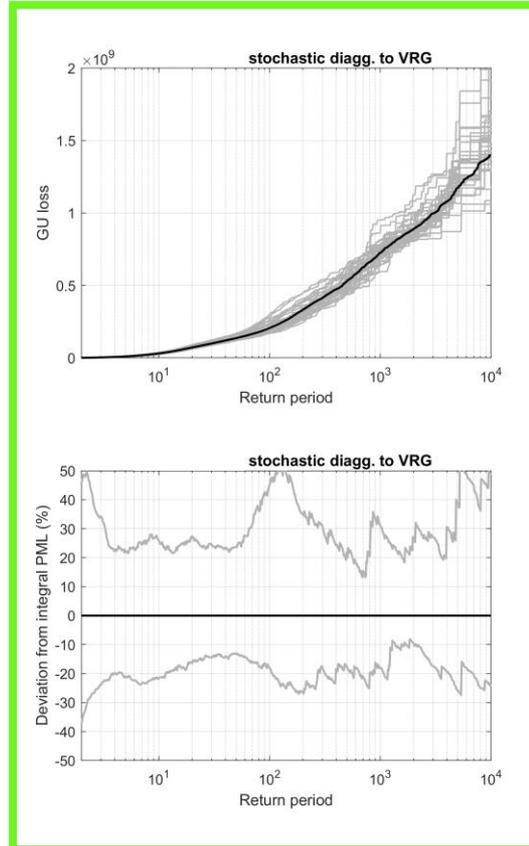
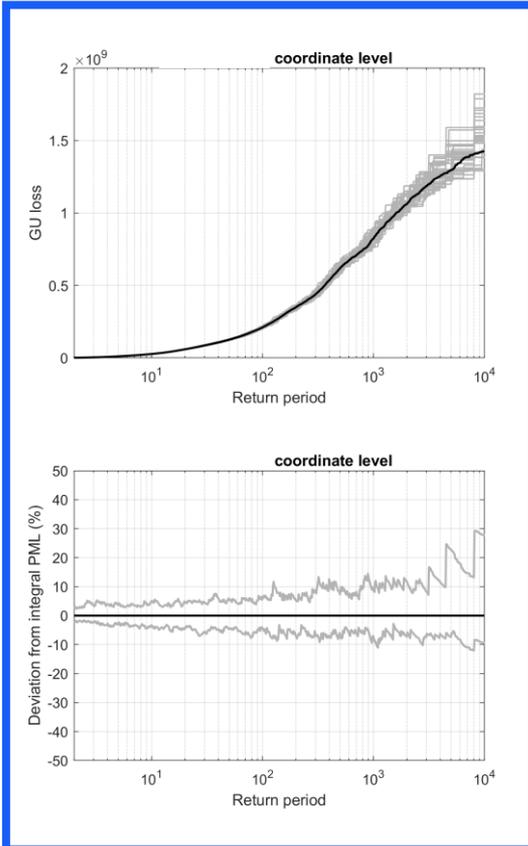
Example curves for Building



- Basis curves are scaled based on vulnerability modifiers: **number of stories**, **construction class**, and **basement**

## Other Models

- ...use other exposure characteristics:
  - e.g. for Earthquake Models **construction class** is the main characteristic of the risk
  - or roof types, no of stories, .....

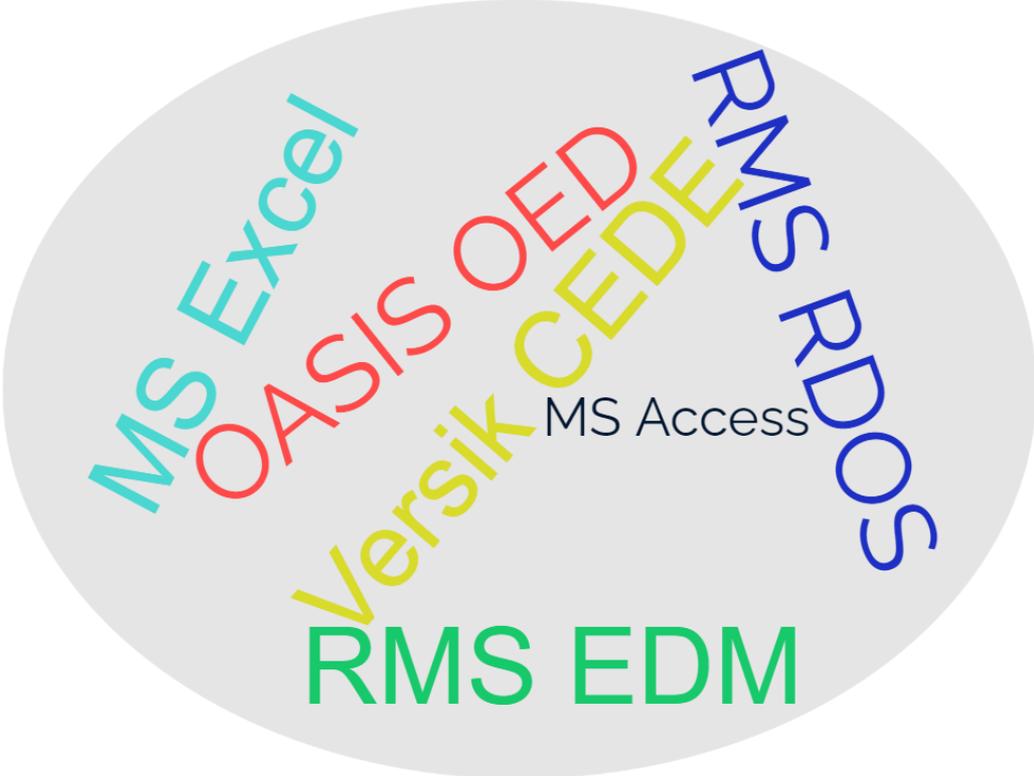


## Sampling / Convergence

- Gaps in scientific understanding and random effects will always lead to a spread of possible losses per event
- **Shitty exposure data widens this distribution most significantly!**
- Convergence needs to be ensured: Picking a random subset of generated samples, is the sub-set LFC close enough to the overall LFC
- The bigger the exposure data uncertainty, the more samples are needed! Increased UW uncertainty, Runtime, Compute, CO2!

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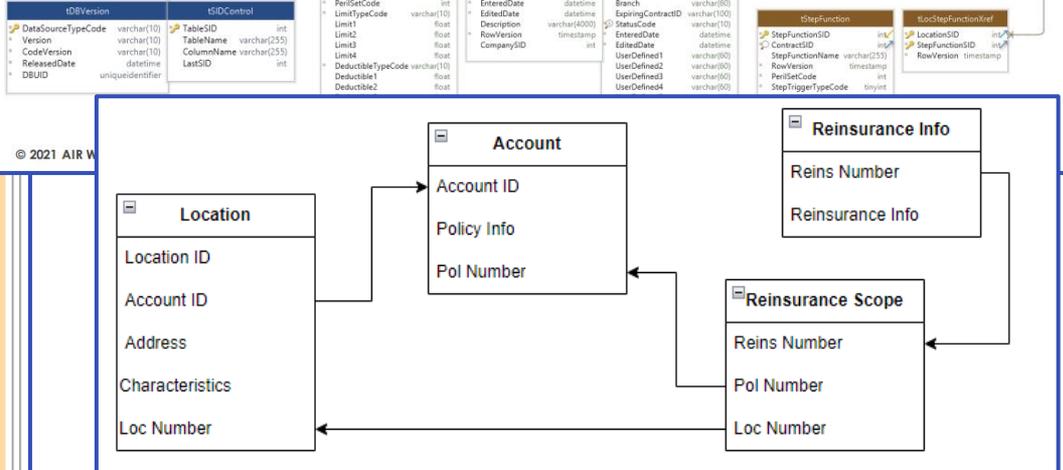
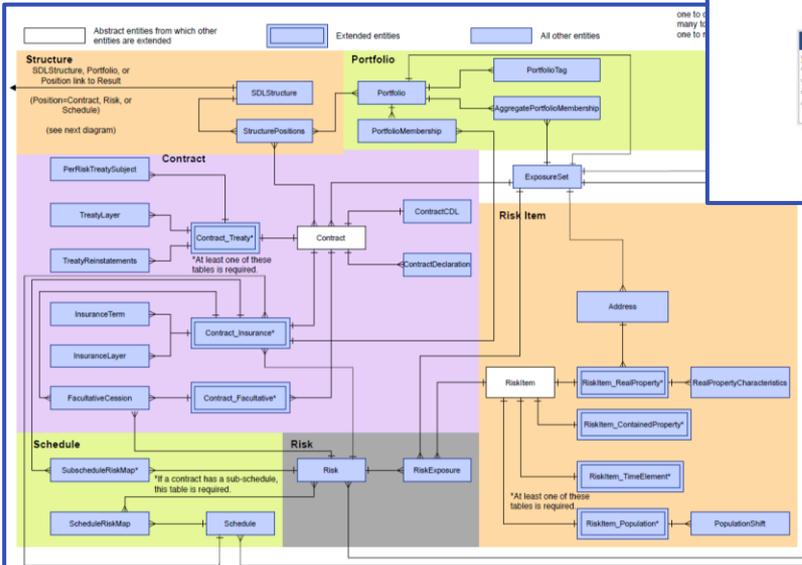
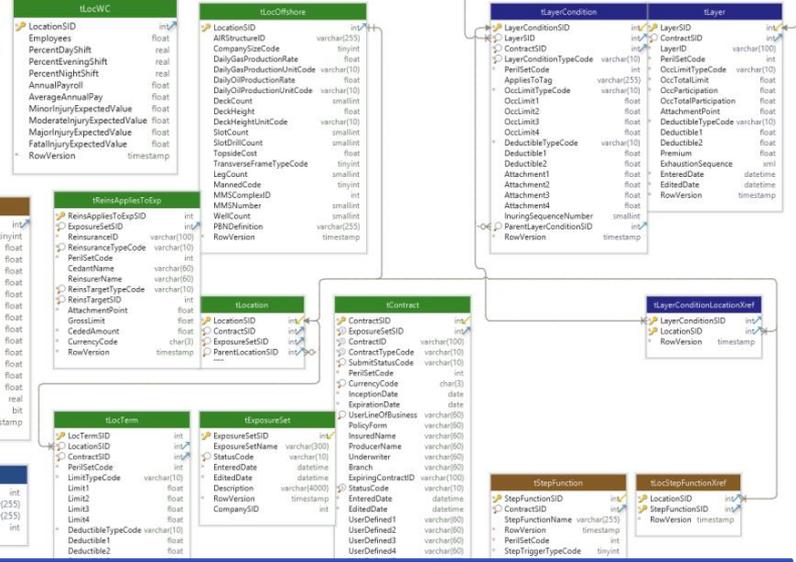


# Exposure Data Format

## Variety of Data Formats

- Complex
- Consumer(i.e. Model)-specific
- Not standardized

## Schema Diagram



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# Exposure Data Format

## Why not just use a Flat File Format?

- Huge
- Redundant
- Unefficient

CountryCode	CountryRMSCode	Admin1GeoID	Admin1Code	Admin1Name	Admin2GeoID	Admin2Code	Admin2Name	Admin3GeoID	Admin3Code	Admin3Name	CityGeoID	CityCode	CityName	PostalCodeGeoID	PostalCode	StreetAddress
CN	CN	12578018	53	Yunnan	28358936	5301	Kunming	12687481	530121	Chenggong Xian	20261027	Muyu	28368221	650053	Majipu B-3-6	
CN	CN	12578012	31	Shanghai	28358740	3101	Shanghai (Districts)	28359246	310108	Zhabei Qu	2151849	Shanghai	0	200000	Shenkun Lu 1500	
CN	CN	12577994	32	Jiangsu	28358746	3205	Suzhou	20071127	320586	Wuxian Shi	2135697	Puzhuang	28391088	215103	Wuzheng Dadao 4467	
CN	CN	12578012	31	Shanghai	28358740	3101	Shanghai (Districts)	28359246	310108	Zhabei Qu	2151849	Shanghai	28392549	200072	Hengfeng Lu 329	
CN	CN	12578011	11	Beijing	28358666	1101	Beijing (Districts)	28359014	110103	Chongwen Qu	20247504	Qianmendajie	28390312	100050	Taiping Jie 6	
CN	CN	12578012	31	Shanghai	28358740	3101	Shanghai (Districts)	28359246	310108	Zhabei Qu	2151849	Shanghai	0	201906	Fulan Er Lu 118	
CN	CN	12578012	31	Shanghai	28358740	3101	Shanghai (Districts)	28359246	310108	Zhabei Qu	2151849	Shanghai	0	201906	Fulan Er Lu 118	
CN	CN	12578012	31	Shanghai	28358740	3101	Shanghai (Districts)	28359246	310108	Zhabei Qu	2151849	Shanghai	0	201906	Fulan Er Lu 118	
CN	CN	12577994	32	Jiangsu	28358746	3205	Suzhou	20071127	320586	Wuxian Shi	2134367	Changqiao	28391085	215100	Xinqing Road 71	
CN	CN	12578012	31	Shanghai	28358741	3102	Shanghai (Counties)	12686930	310230	Chongming Xian	2151453	Changjiang	28381123	200255	Tui Xia Gang Lu 118	
CN	CN	12578017	12	Tianjin	28358668	1201	Tianjin (Districts)	28359026	120110	Dongli Qu	2159670	Huangcaotuo	28392649	300240	Dabizhuang Metro 6 Project	
CN	CN	12578017	12	Tianjin	28358668	1201	Tianjin (Districts)	28359026	120110	Dongli Qu	2159670	Huangcaotuo	28392649	300240	Dabizhuang Metro 6 Project	
CN	CN	12578006	45	Guangxi	28358886	4501	Nanning	28359679	450102	Xingning Qu	2166473	Nanning	0	530028	Zhuxi Dadao 14-2	
CN	CN	12578019	44	Guangdong	28358867	4403	Shenzhen	28359545	440303	Luohu Qu	2161853	Shenzhen	0	518000	Z28 industrial zone Heng Gang 5 Manufactory building	
CN	CN	12577994	32	Jiangsu	28358742	3201	Nanjing	28359255	320105	Jianye Qu	2137123	Shengxinhe	28390857	210017	Jiangdong Zhong Lu 109	
CN	CN	12578012	31	Shanghai	28358740	3101	Shanghai (Districts)	28359246	310110	Yangpu Qu	2151748	Wujiaochang	28390679	200020	Huai Hai Zhong Road 381	
CN	CN	12578014	37	Shandong	28358804	3702	Qingdao	28359393	370203	Shibei Qu	2188606	Qingdao	0	266000	Dong Hai Yi Lu S-A	
CN	CN	12578019	44	Guangdong	28358865	4401	Guangzhou	28359536	440105	Haizhu Qu	2161838	Guangzhou	0	510000	Li Fung Lu Li Fung Districentre	
CN	CN	12578019	44	Guangdong	28358865	4401	Guangzhou	28359536	440105	Haizhu Qu	2161838	Guangzhou	0	510000	Li Fung Lu Li Fung Districentre	
CN	CN	12578017	12	Tianjin	28358668	1201	Tianjin (Districts)	28359020	120101	Heping Qu	2159908	Tianjin	28391240	300051	NanJing Lu 189	
CN	CN	12578017	12	Tianjin	28358668	1201	Tianjin (Districts)	28359020	120101	Heping Qu	2159908	Tianjin	28391240	300051	NanJing Lu 189	

We spend significant time just converting data formats back and forth!

- Quality Loss
- Longer turn-around
- Energy and CO2 wasted
- Unhappy people

➔ The Cat Market is still a long way from communicating efficiently!

- Agreement on Data Standard
- Well designed (why not actually talk to IT guys?)
- Well documented
- Consumer-Independent, no implicit assumptions how the model will interpret the data (possible?)

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# Inconsistent storage of exposure data for one and the same risk leads to potential mismanagement

## Clients

Factors (% in # of locations)		A	B	C
Geocoding Resolution		<b>07%</b> = Coordinate <b>93%</b> = Street Address/ Parcel/ Building	<b>98%</b> = Coordinate <b>02%</b> = Street Address/Parcel/Building	<b>02%</b> = Coordinate <b>91%</b> = Street Address/ Parcel/Building <b>02%</b> = Block Group/Census Tract <b>04%</b> = Postal code
Occupancy		<b>100%</b> = ATC 12 (Heavy Fabrication and Assembly)	<b>100%</b> = RMS IND 3051 (Light Industrial – General Manufacturing)	<b>28%</b> = ATC 8 (Professional, Technical and Business Services) <b>22%</b> = ATC 30 (Electrical) <b>15%</b> = RMS IND 1051 (Heavy Industrial – General)
Construction		<b>96%</b> = RMS (Steel) <b>04%</b> = RMS 3 (Reinforced Concrete)	<b>74%</b> = RMS IND 6 (Steel Frame) <b>15%</b> = RMS IND 3 (Reinforced Concrete) <b>11%</b> = RMS IND 5 (Reinforced Masonry)	<b>50%</b> = RMS 0 ( Unknown) <b>13%</b> = RMS 3 (Reinforced Concrete) <b>09%</b> = RMS 4 (Steel) <b>09%</b> = RMS IND 0 (Unknown)
Year Build	<1995 1995–2001 Unknown	<b>07%</b> <b>04%</b> <b>89%</b>	<b>87%</b> <b>13%</b> <b>00%</b>	<b>33%</b> <b>11%</b> <b>57%</b>
TIV total		1.475.387.227	1.475.387.227	1.475.387.227
Thereof TIV Building		118.319.171	118.319.171	118.319.171
<b>GU Loss (US\$)</b>		<b>2.500.000</b>	<b>600.000</b>	<b>1.000.000</b>

### Example

**Big Industrial  
Account**  
Florida, USA

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## We need better data!

- But we need to take into account GDPR (DSGVO)
- Protect customers
- **Better data AND Compliance** creates effort. **But it's worth it!**

Thank  
you

