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Flood Risk: Lessons Learned from Hurricane Sandy

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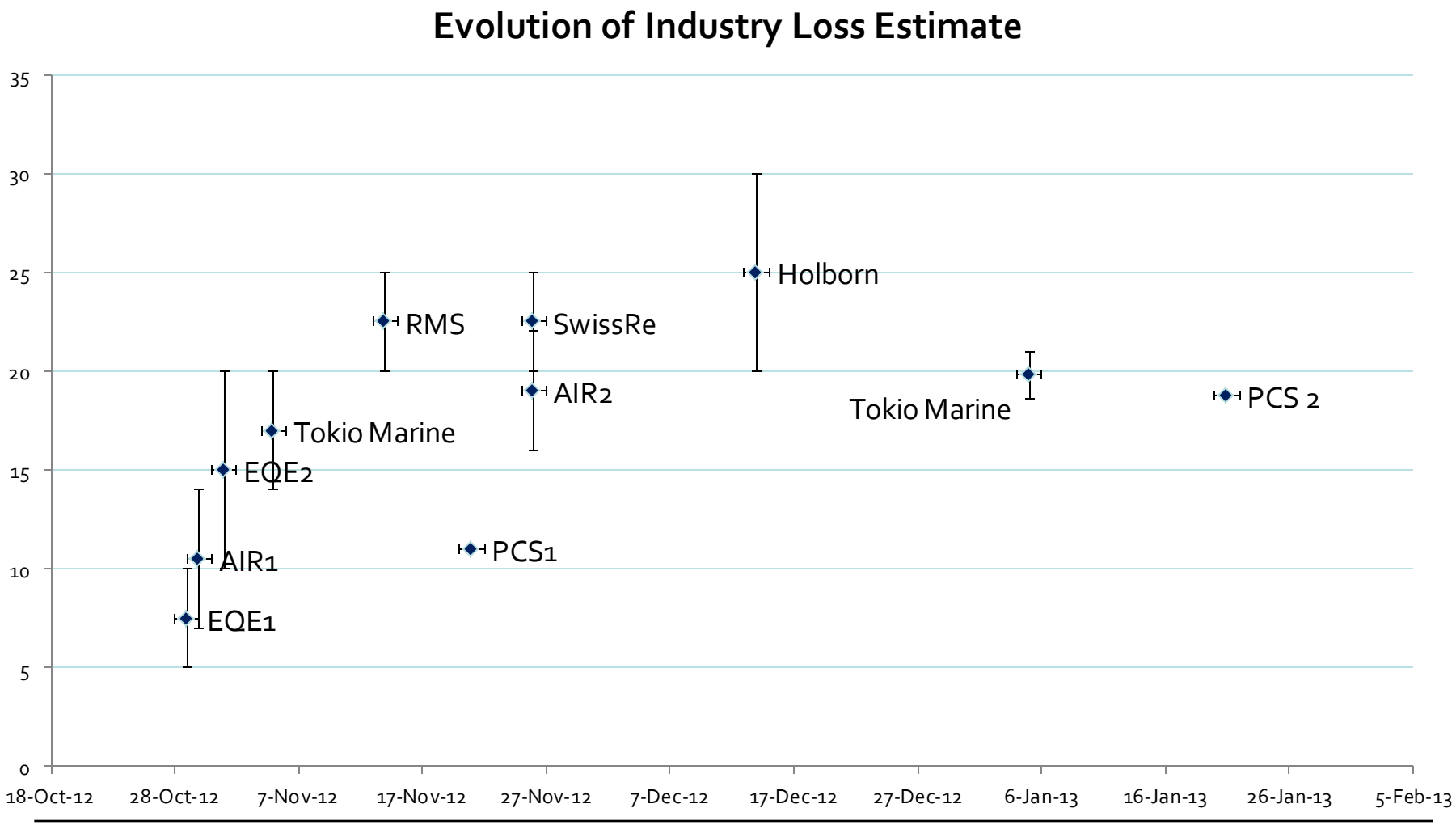
2013 Seminar on Reinsurance
Southampton, Bermuda
June 6-7, 2013

Hurricane Sandy Industry Loss Estimates



Source: PCS, RMS, EQE, AIR, Holborn, Swiss Re

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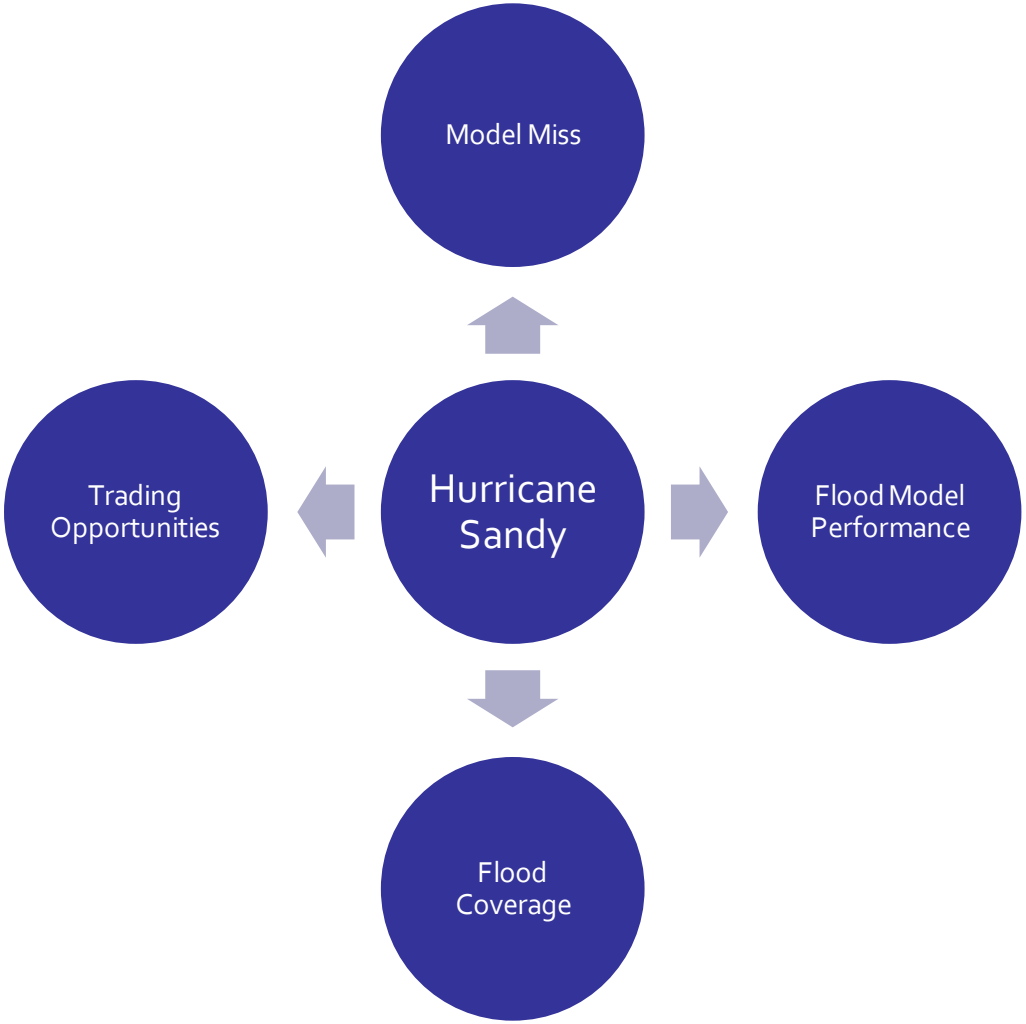
Lessons Learned



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Industry Loss Estimates

States	PCS Re-survey Loss Estimate (millions)	Model A View (millions)	Model B View (millions)
Connecticut	$ 500	$ 250	$ 432
New Jersey	$ 6,300	$ 12,750	$ 8,420
New York	$ 9,600	$ 9,750	$ 10,795
Pennsylvania	$ 700	$ 1,500	$ 1,727

Line of Business	PCS Re-survey Loss Estimate (millions)	Model A View (millions)	Model B View (millions)
Personal	$ 7,017	$ 8,000	$ 10,614
Commercial	$ 8,927	$ 16,250	$ 9,785
Auto	$ 2,716	$ 750	$ 1,190

Modeled overall losses can be right for the wrong reasons

Source: PCS, Model A, Model B

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How Good is the PCS Loss Estimate?

Date	Total Auto Loss NJ
11/16/2012	$ 274,841,513
11/30/2012	$ 489,026,673
12/14/2012	$ 621,017,992
12/28/2012	$ 658,321,463
1/11/2013	$ 679,643,697
1/28/2013	$ 682,792,570
2/14/2013	$ 683,377,873
2/28/2013	$ 683,523,850
3/14/2013	$ 683,560,235
3/28/2013	$ 683,569,302

PCS loss estimate is $700 million for NJ auto, loss based on multiple sources for NJ auto is $684 million, a difference of 2.3%

Close enough…

Source: PCS, Multiple Sources

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Flood Loss Modeling

Hazard

- Surge Modeling
- Rain Component
- Flood Velocity Modeling
- Flood Duration

Vulnerability

- First Floor Elevation
- Location of Contents
- Flood Velocity-Damage Curves

Loss Calculation

- Wind vs. Flood Policy Language
- BI/CBI

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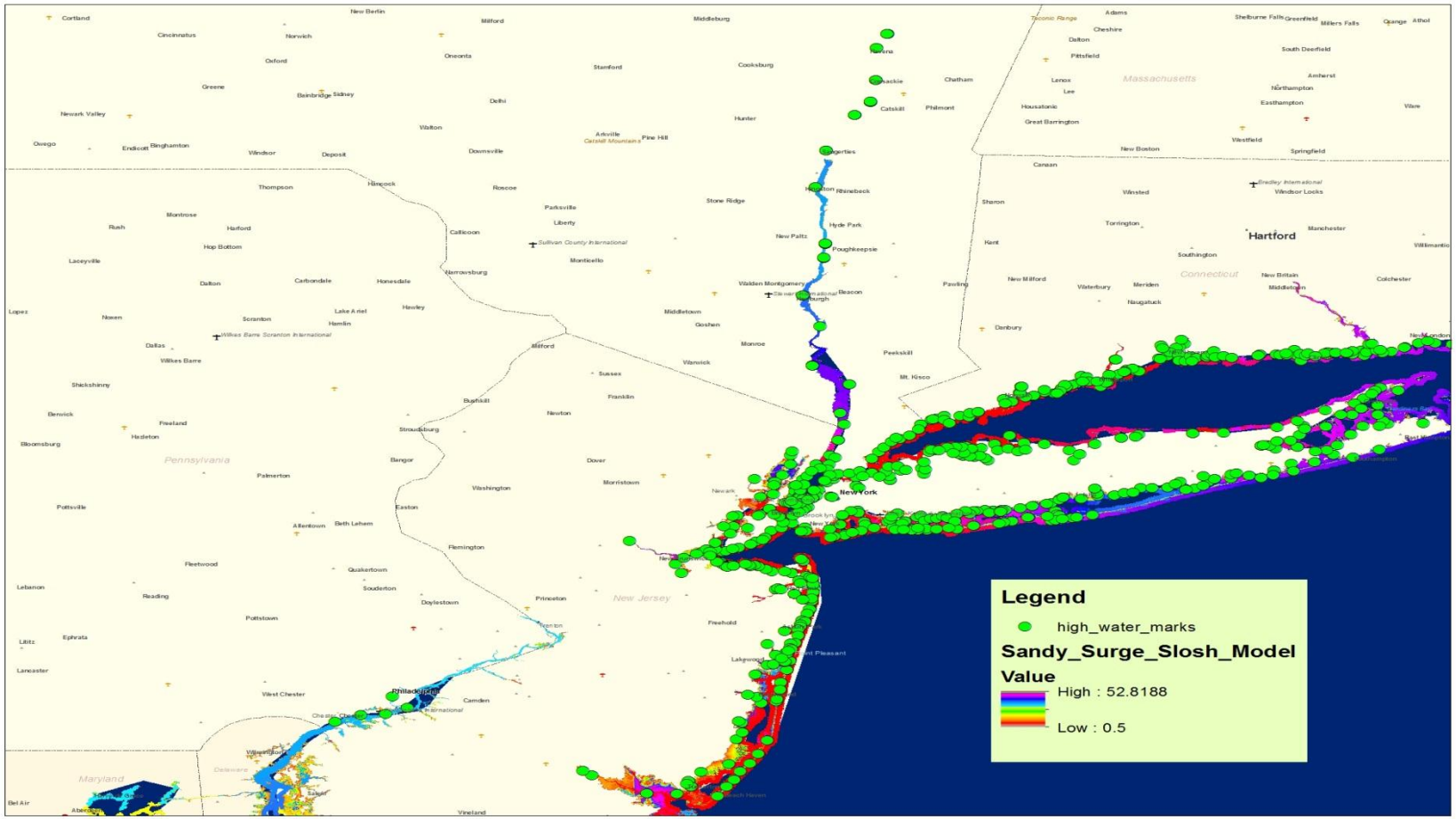
Model Comparison with High Water Marks



Source: USGS

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Model Comparison with High Water Marks

HWM_ID	HWM Survey Elevation (ft)	Modeled Elevation (ft)	Absolute Difference (ft)
HWM-NJ-ATL-103	7.7	10.1	2.4
HWM-NY-NAS-903	8.0	7.3	0.7
HWM-MA-DUK-253	7.0	7.2	0.2
HWM-NJ-MON-215	5.1	10.7	5.6
HWM-NY-RIC-717	16.9	1.7	15.2
HWM-NJ-OCE-314	5.3	10.9	5.6
HWM-NJ-CPM-004	6.9	8.9	2.0
HWM-NJ-CPM-005	6.7	8.9	2.2
HWM-NY-NAS-001	9.8	1.0	8.8
Mean Absolute Difference			**3.4**
Maximum Absolute Difference			**15.2**

Source: USGS

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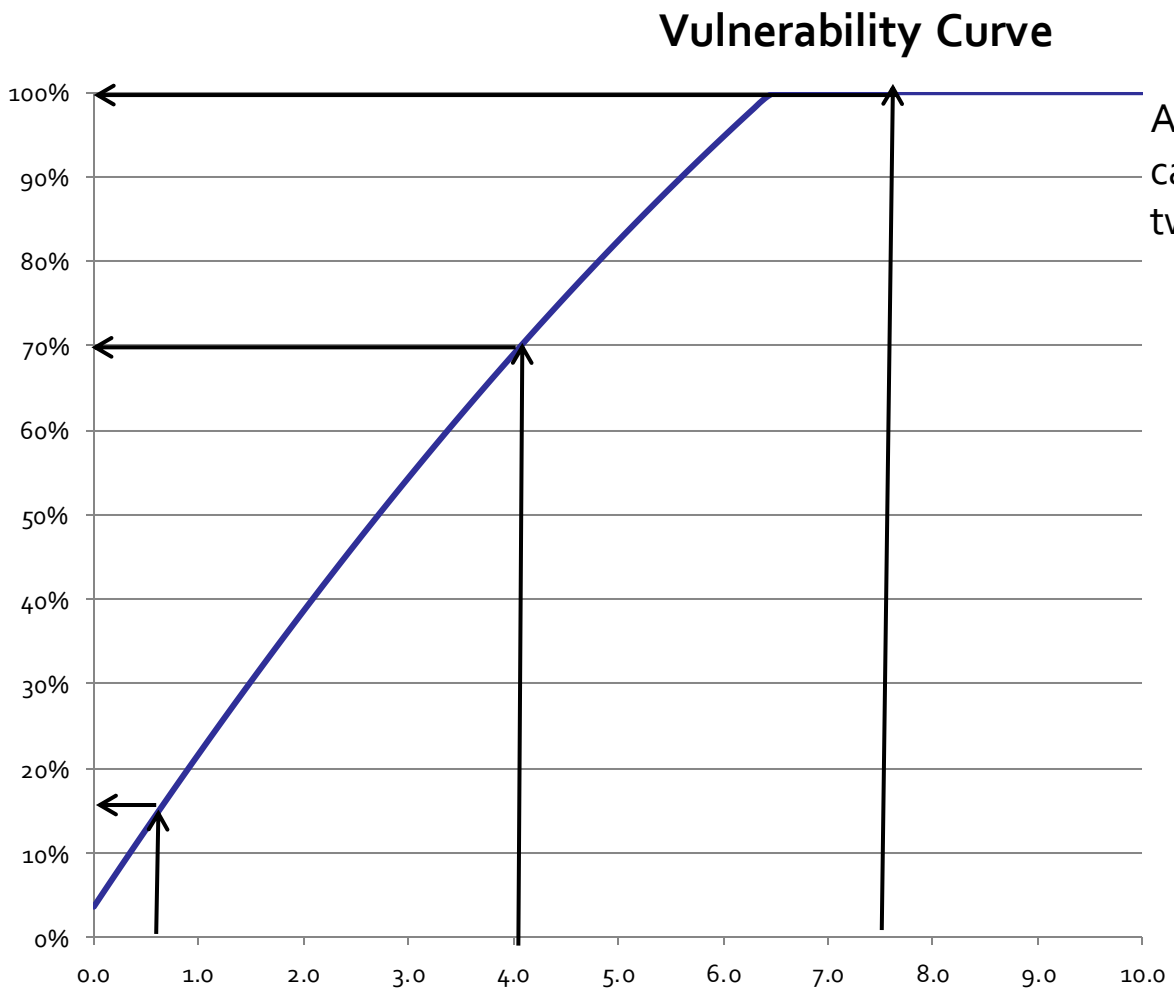
Vulnerability to Depth of Water



Absolute difference means error can go in either direction. Maybe two wrongs make a right?

Source: USACE

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Exposure Data

Elevated house, First Floor Elevation above BFE

How good is the exposure data?

First Floor Elevation below BFE

Source: Google Image Search

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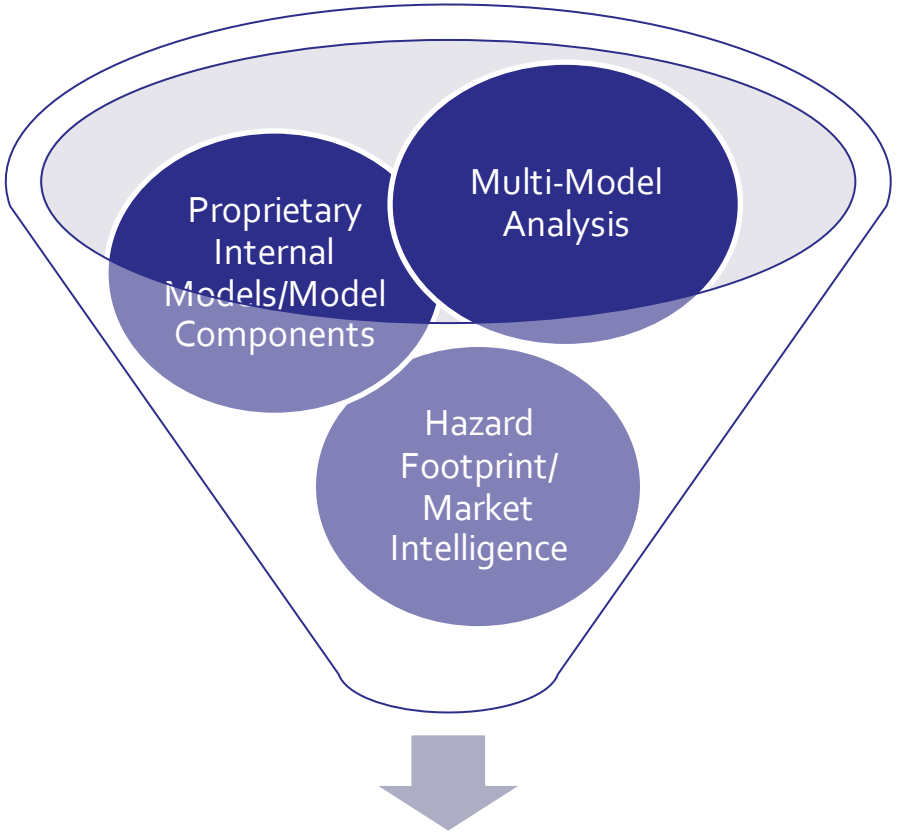
Loss Estimation Process



Industry Loss Estimate

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Hedging Opportunities

Source: Insurance Insider

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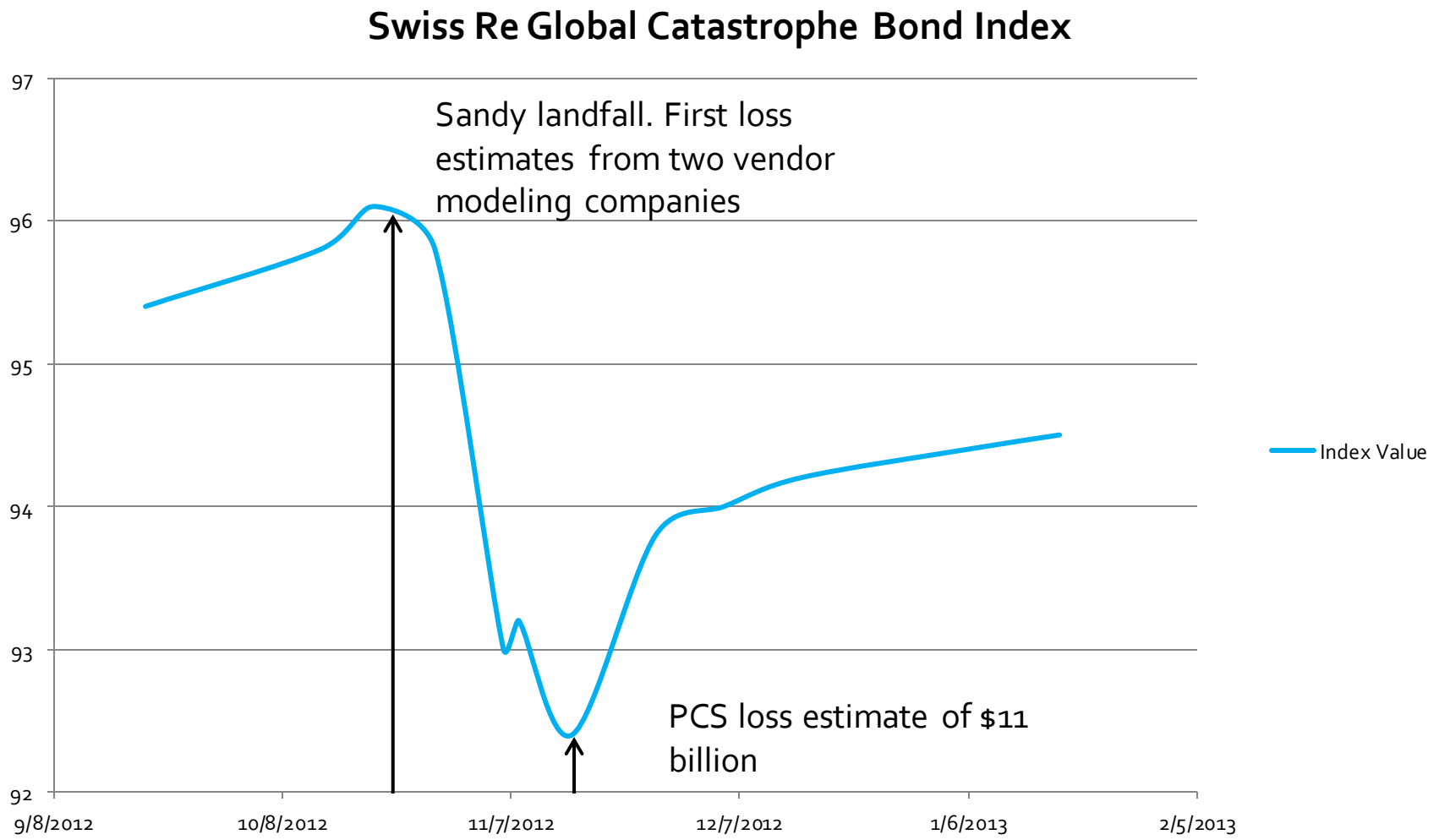
Trading Opportunities



Source: Swiss Re, Artemis

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Challenges Remain

Hazard	• Modeling Flood Velocities • Modeling Impact of Debris
Vulnerability	• Velocity-Damage Curves • Exposure Data
Loss Calculation	• Policy Language • BI/CBI

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Challenges Remain

No physical damage at UPS or any of its customers

Revenue impacted by power outages for consumers

Concluding Remarks

- Model miss needs to be investigated in detail.
- Underlying flood model evaluation and appropriate modeling techniques can, to some extent, alleviate model miss.
- First floor elevation of a structure is an important parameter that needs to be leveraged for flood loss estimation.
- Challenges including understanding of commercial flood policy terms, damage due to flood velocity, flood duration and accurate exposure data, among others remain in flood modeling.