# Professional Team Report to the Florida Commission on Hurricane Loss Projection Methodology on Commission Inquiries
## September 2017

The Commission, at its December 13, 2016 meeting, identified the following inquiries to be addressed by the Professional Team and the modeling organizations during the 2017 on-site reviews:

1. Investigate the condo-unit floor location impact on loss costs. How is lack of floor location treated?

2. Investigate aspects of the model and inputs that could lead to the greatest reduction in the uncertainty in model outputs (e.g., hurricane frequency, damage functions, incorrect data input, granularity of exposure location (ZIP Code centroid versus street address) data input).

3. Investigate how contamination of claims data (flood loss counted as wind loss) impacts validation and model output.

4. Investigate how the treatment of inland versus coastal exposures has an effect on the spatial evaluation of vulnerability functions.

The Professional Team was charged with preparing a report to the Commission on the inquiries after discussions with all the modeling organizations in preparation for the 2017 hurricane standards committee meetings. A preliminary draft report was provided in May 2017 before the September 2017 hurricane standards committee meetings in response to the Commission's request on May 12, 2017.

Each of the inquiries is discussed in turn.

Note to the Commission: The above summary of modeling organization input on these issues reflects non-attributable comments from modeling organizations following completion of the on-site review under the 2015 standards.

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## Condo-unit Floor Location

The issue presented to each modeling organization was, "Investigate the condo-unit floor location impact on loss costs. How is lack of floor location treated?"

The responses ranged from fairly detailed engineering analyses to a non-inclusion position pending the acquisition of detailed loss data for condo-units – particularly loss by floor location. The modeling approaches used in some cases were deemed proprietary so that the report here is deliberately general.

Two existing standards from the *Report of Activities as of November 1, 2015* concern this topic. These are:

> Standard M-4, Hurricane Windfield Structure, Part D. With respect to multi-story buildings, the model windfield shall account for the effects of the vertical variation of winds if not accounted for in the vulnerability functions.
>
> Standard V-1, Derivation of Building Vulnerability Functions, Part D. Building height/number of stories, primary construction material, year of construction, location, building code, and other construction characteristics, as applicable, shall be used in the derivation and application of building vulnerability functions.

The original genesis of these standards is the recognition that windspeeds increase with increasing elevation above ground. A top-floor condo-unit in a high rise could experience much stronger winds than a lower floor unit.

Wind by height is not the only consideration here as other damaging mechanisms occur during hurricane events, such as roof collapse or leakage, envelope damage or breach due to debris penetration, and water infiltration. The debris impact depends on the neighboring structures and damage field so that this aspect is challenging to incorporate into the hurricane model. The debris field depends on a building's surroundings. There tend to be many sources of material for lower floor debris impacts, while higher floors could depend, for example, on a neighboring upwind structure with a gravel roof or containing unanchored equipment.

A major difficulty in modeling the effects of floor location is that insurance claims data of losses by floor location is very limited. Proceeding forward, it would be very desirable to collect data on floor location in the claims data.

Obviously, in order to deal with the lack of floor location or equivalently, floor location unknown, the case of floor location known must be developed. With an understanding of the impacts of floor location, a straightforward weighting scheme could be used to estimate losses in cases of unknown floor location (with weights tied to the exposure distribution by floor location). As in many other discussions related to developing enhancements to catastrophe models, historical loss data is a limiting factor.

One could argue that in the absence of any loss data for condominiums, it would be pre-mature to incorporate floor effect into a model. A theoretical or engineering approach could arrive at loss estimates but would lack validation with actual loss data.

## Uncertainty Reduction

The issue presented to each modeling organization was: "Investigate aspects of the model and inputs that could lead to the greatest reduction in the uncertainty in model outputs (e.g., hurricane frequency, damage functions, incorrect data input, granularity of exposure location (ZIP Code centroid versus street address) data input)."

The modeling organizations noted several areas where uncertainty was inherent with other areas targeted for reduction with the acquisition of relevant data.

Uncertainty in the hazard component of catastrophe modeling and especially the frequency and severity of events are inherently problematic. Uncertainty in the frequency can be characterized and quantified but not really reduced.

It was agreed by the modeling organizations that the frequency of hurricane events (landfalls and severity) is a major driver to the uncertainty in modeled losses.

> "Uncertainty" itself is not a one-dimensional concept. It is useful to recognize the distinction between parameter uncertainty within a specified, detailed model (i.e., aleatory uncertainty) and the uncertainty associated with model component selections (i.e., epistemic uncertainty; for example, windfield model aspects such as the parametric form of windspeed as a function of distance from the center of the hurricane). The terminology of aleatory and epistemic uncertainty captures the distinction in these uncertainties.

Form S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis, was discussed and recognized as a useful mechanism for investigating parameter uncertainty with respect to a specific model.

Where possible, modeling organizations incorporate emerging research in refining their models and in so doing, attempt to reduce uncertainty. For example, wind-driven rain has been recognized as having an impact on losses as demonstrated with recent wind-tunnel research. Wind-driven rain particularly impacts structures with soffits, resulting in enhanced water infiltration.

Among areas or items that could lead to some uncertainty reduction of various sorts, the following were collected during the on-site reviews:

1. Granularity of the exposure data poses opportunities for improvement. The Florida Hurricane Catastrophe Fund (FHCF) exposure data is at the ZIP Code level of resolution, rather than street level or lat/lon resolution customarily employed in insurance rate filings. The aggregation of data induces uncertainty.

2. Besides aggregation, several key exposure characteristics are either missing (number of stories) or lead to unknown designations of structures (Year Built with FHCF Code of 0 means "Unknown or Mobile Home"). The latter designation can lead to weighted loss costs across categories, thus introducing a further variance component.

3. Errors in the data also introduce uncertainties. For example, year built may be given, but if the roof has been replaced, the “effective” year built could be much more recent.

4. Loss cost data has built in uncertainties; for example, with major events having both wind and flood losses, losses could be reported as wind losses, as claims adjusters rush to accommodate their customers.

5. Uncertainty across modeling organization loss costs could be addressed more directly if Citizens Property Insurance Corporation claims data and mitigation data from the 2004 and 2005 hurricane seasons were made available to all the modeling organizations.

## Claims Data Contamination of Flood and Wind Losses

The issue presented to each modeling organizations was, “Investigate how contamination of claims data (flood loss counted as wind loss) impacts validation and model output.”

Flood level losses leaking into wind peril losses are embedded in the historical claims data. Given loss data in regions in which flood losses could be occurring, there is frequently a feeling that the wind losses include flood losses as well. A natural approach to sorting out this leakage quantitatively is to identify comparable exposures with one experiencing both wind and flood perils while the other experiences only wind peril. Such a comparison relies on having detailed exposure data to recognize the comparable properties.

Validation of modeled losses against actual losses is a major problem. Although insurance companies assert that they do not pay for flood losses under wind policies, this assertion is not consistent with actual practice. In order to expedite the settlement of hurricane claims, payments are issued under the wind peril for properties that may have sustained damage by storm surge. This makes model development based on claims data problematic.

Claims data for Hurricane Ivan (2004), for example, most likely contain useful flood loss data; however, losses are contaminated with both wind and flooding effects. While cleaning this data could be attempted by removing claims which are within the storm surge footprint, these claims would also tend to be in the high wind areas for which loss data is critical for validation.

## Inland versus Coastal Exposures

The issue presented to each modeling organization was, “Investigate how the treatment of inland versus coastal exposures has an effect on the spatial evaluation of vulnerability functions.” As the issue is stated, there was some confusion as to what was the nature of the inquiry – what exactly is the Commission interested in here? The statement as given was the Professional Team’s best attempt at the time to articulate the discussion at the December 2016 Commission meeting. Some modeling organizations interpreted the inquiry as having considerable overlap with Standard V-1, Audit Item 7,

> Documentation and justification for all modifications to the building vulnerability functions due to building codes and their enforcement will be reviewed. If year of construction and/or geographical location of building is used as a surrogate for building code and code enforcement, complete supporting information for the number of year of construction groups used as well as the year(s) and/or geographical region(s) of construction that separates particular group(s) will be reviewed.

the content of which is in the proprietary realm. As a generic response, the inquiry ties to vulnerability functions, which in turn are related to the structure location and the relevant building code (well-designed structures on the beach versus less stringent building requirements in the center of the state).

The Professional Team did not obtain much public domain feedback on this topic. Any ordering of inland versus coastal losses presents issues of confounding (other factors interfere with a comparison), such as the prevalence of new construction on the coast, higher end construction on the coast, quality construction proportional to Coverage A, better design with newer construction, and so forth. Further, the location of properties along the coast is very relevant (why geocoding is used on specific properties) whereas some exposure data is not at the specific resolution including distance from coast.