AIR Storm Surge and Inland Flood Models for the US

Presented to the FCHLPM Flood Standards Development Committee

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AIR WORLDWIDE®

Agenda

- Status of U.S. flood models at AIR
- Expertise and data sources used to construct models
- Considerations for flood models and their validation
- Flood modeling processes
- Flood modeling compared to hurricane modeling

Status of AIR's U.S. Flood Models

- AIR's U.S. storm surge model has been in the market for over two decades
- AIR's U.S. inland flood model was released in October, 2014

Expertise Needed to Construct Flood Models

- Meteorologist
- Hydro-meteorologist
- GIS Analyst
- Hydraulic Engineer
- Exposure Development Expert
- Actuary
- Statistician
- Computer Scientist
- Hydrologist
- Coastal Engineer
- Structural Engineer

Data Sources Used to Construct Flood Models

- Physical properties data – publically available
  - Digital terrain
  - Bathymetry
  - Land use and land cover, soil and terrain
  - River network
  - Flood defense structures
  - Dams and water bodies
- Meteorological data – mix of public and proprietary
  - Historical rainfall and hurricanes
  - Sea surface temperature
  - Global reanalysis
  - Tidal gauge
- Hydrological data – publically available
  - River flow
  - Water level

Data Sources Used to Construct Flood Models, Cont.

- Historical data - proprietary
  - Losses
  - Claims
- Building attribute inventory data – mix of public, proprietary
  - Tax assessor
  - U.S. Census
  - Residential energy consumption survey
  - ISO Specific Property Information

- AIR can provide a list of resources for both the surge and inland flood models to the Committee

Validation of Flood Models

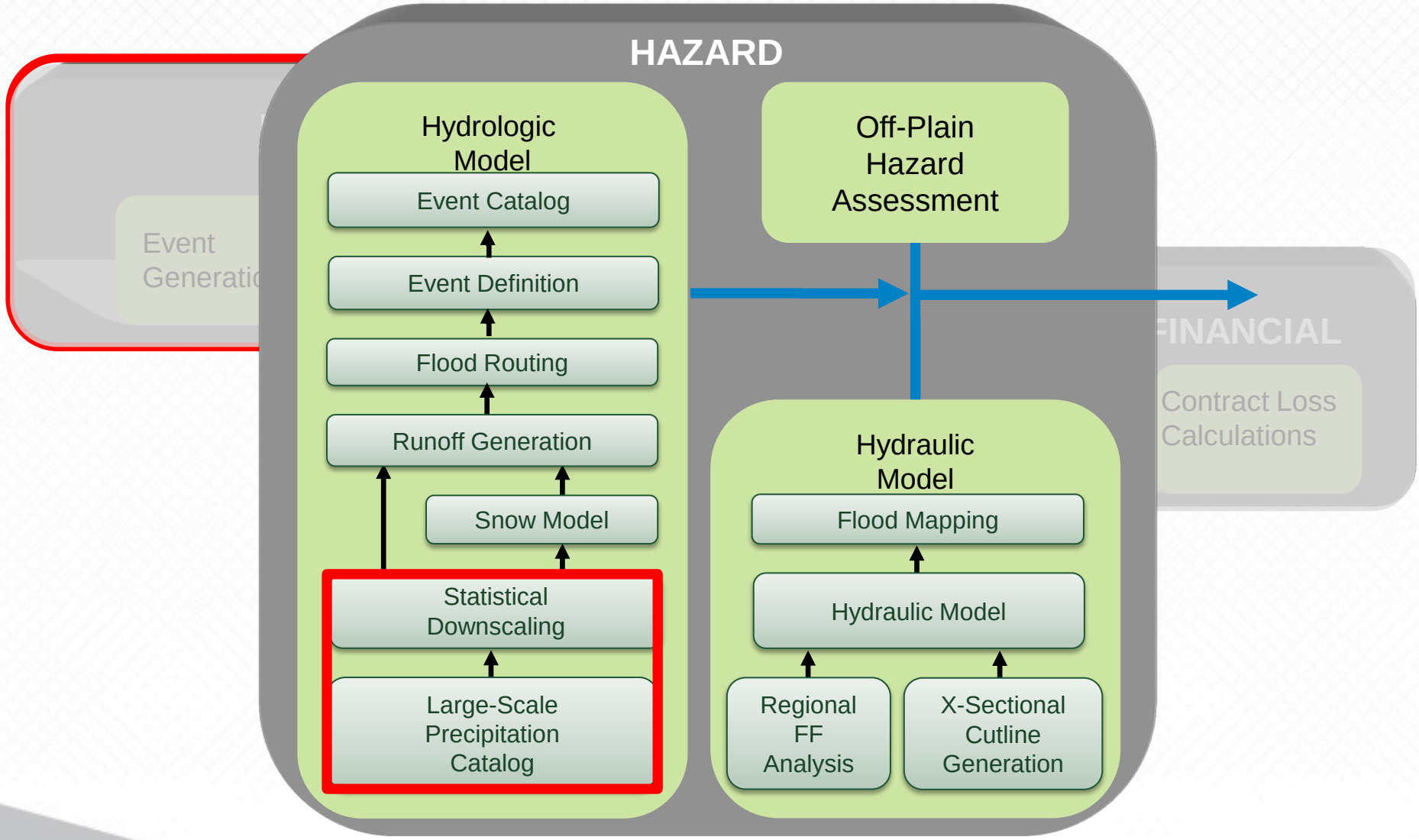
- AIR has validated, and will continue to validate its flood models with insurance claims data
- We continually work with our partners and clients to gather insurance claims data
- We validate the model components independently and complement with top-down validation

Factors that Impact the Flood Models

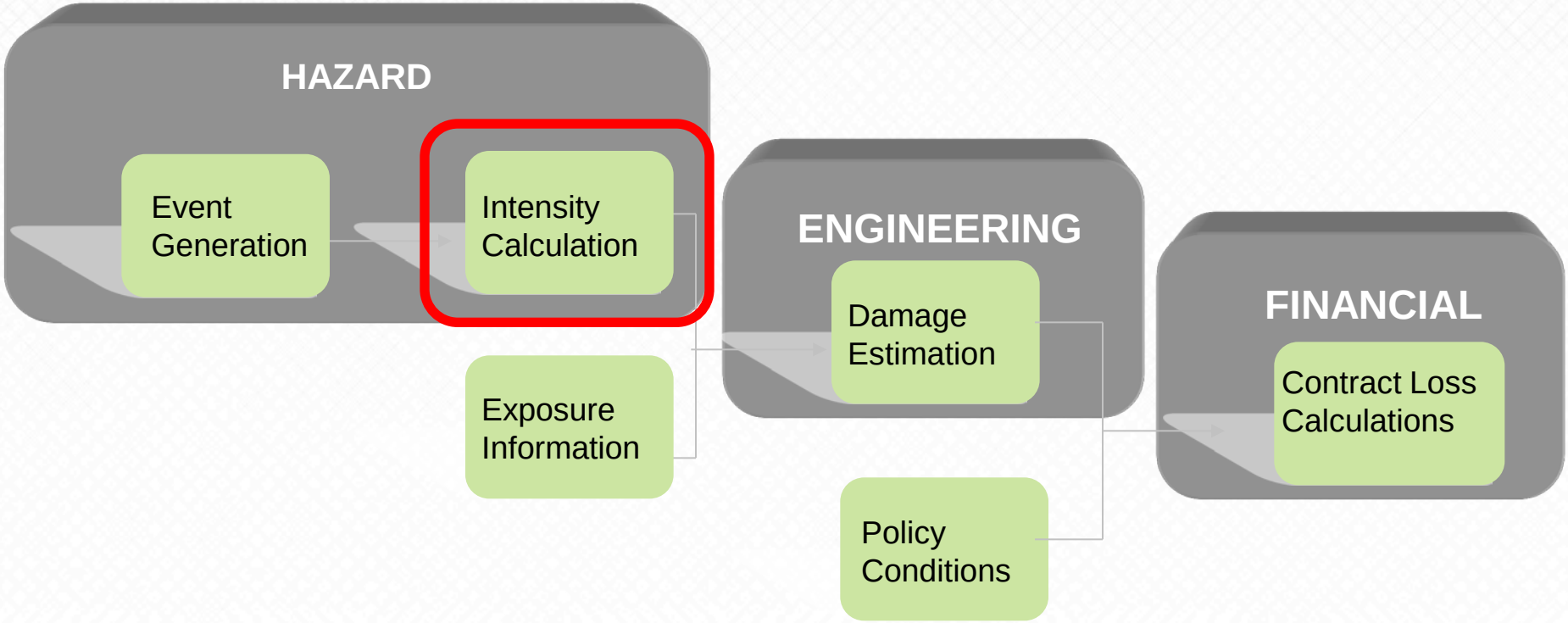
- Accuracy of the digital terrain map
- Robustness of the river gauging station data
- Presence and quality of insurance claims data
- Capturing rainfall and water flow in a physically realistic way
- Capturing wide-reaching spatial effects of storm surge

- AIR conducts uncertainty and sensitivity tests to evaluate the various factors

AIR's Flood Modeling Processes – Inland Flood

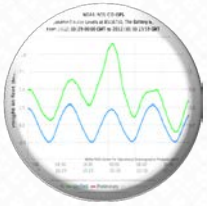


AIR's Flood Modeling Processes – Storm Surge



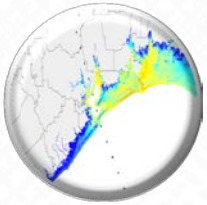
AIR's Flood Modeling Processes – Storm Surge, Cont.

Surge Estimation Module: Hydrodynamically models storm surge at a regional level, accounting for impacts of the associated storm parameters



Tide Module: Includes adjustments to simulation that account for tidal contributions

Spatial Integration Module: Combines information into a storm surge event footprint



Local Downscaling Module: Creates location-specific view of surge by using high resolution elevation information

Vulnerability Module: Using given surge hazard information, determines damage based on building characteristics

Ways that Flood Modeling Differs from Hurricane Modeling

- Temporal component of inland floods is much longer (hurricanes: hours-days; inland floods: days-weeks)
- Characterization of event
  - Inland flood model – multiple physical processes to translate rainfall to flood extent
  - Hurricane model – relatively few parameters define the complete windfield
- Sensitivity to terrain data
  - Inland flood model – more sensitive to the accuracy of terrain data
  - Hurricane model – less sensitive
- The inland flood model is more sensitive to the accuracy of the exposure geocoding
- Damage mechanisms differ
  - Inland flood model – flooding damages more at the lower levels of building
  - Hurricane model – wind damage tends to concentrate more toward upper part of building