# DYNAMIC COMMUNICATION OF WEATHER RISK: A USER-CENTERED DESIGN APPROACH

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# MOTIVATION

- HURRICANE HAZARD COMMUNICATION IS CHALLENGING!
  - THE TRACK FORECAST CONE (OPERATIONAL SINCE 2002) IS CONFUSING TO MANY PEOPLE, INCLUDING SOME DECISION MAKERS... BUT IS VERY POPULAR AND WIDELY USED
    - PERCEPTION THAT OUTSIDE THE CONE IS SAFE
    - MANY PEOPLE DON'T KNOW THE DIFFERENCE BETWEEN WATCH/WARNING
  - HURRICANE THREATS AND IMPACTS (HTI) GRAPHICS (OPERATIONAL SINCE 2015) ARE INTUITIVE TO PEOPLE BUT HARD TO FIND AND NOT WIDELY USED
    - PROVIDES 4 THREAT LEVELS FOR 4 HURRICANE HAZARDS
    - Requires NHC and WPC forecasts then WFO coordination... Very hands-on





# Goal & Methodology

- IDENTIFY DESIGN FEATURES THAT ARE EFFECTIVE ACROSS MULTIPLE HAZARDS AND IMPACTS OVER MULTIPLE FORECAST PERIODS.
  - EXPLORE THE IMPACT OF RISK ATTRIBUTES TO INFORM THE VISUALIZATION DESIGN OF A REDESIGNED HTI-LIKE GRAPHICAL PRODUCT



# DESIGN CHARRETTES

- 33 PARTICIPANTS IN LOCAL COMMUNITY ORGS.
- INTRODUCTIONS & STUDY PURPOSE
- UNDERSTANDING/REACTIONS TO HURRICANE IRMA HTI GRAPHIC
  - "WHAT DOES THIS FORECAST PRODUCT TELL YOU? WHAT DO YOU LIKE/DON'T LIKE?"

Design

- "CREATE A NEW VISUAL(S) THAT CONTAINS AN INTEGRATED MAP, SEVERAL MAPS, TEXT, GRAPHICS AND/OR ANY COMBINATION OF ELEMENTS THAT HELPS COMMUNICATE ABOUT THE HURRICANE AND ASSOCIATED THREATS SO YOU CAN PREPARE."
- Sharing & Discussion











eas at risk of exe





McNoldy: 18A.3

## Ideation Sessions & Prototype Design

- COLORS AND LABELS FOR THREAT LEVELS
- CLEAR INDICATION OF TIMING OF HAZARDS
- MODERNIZATION OF AESTHETICS
- ACCESSIBILITY AND LANGUAGE
  BARRIERS
- COMMUNICATING INLAND IMPACTS
- COMMUNICATING MULTIPLE THREATS

- RETHINK WATCHES AND WARNINGS
- TIMING OF ISSUANCE OF INFORMATION
- EXAMPLES OF IMPACTS FROM HAZARDS ON HOUSES, STREETS ETC.
- SUPPLEMENTING GRAPHICS WITH ICONS AND TEXTUAL INFORMATION
- INCORPORATING FORECAST
  UNCERTAINTY
- UTILIZING LONGER FORECASTS OF WIND, FLOODING RAIN, & SURGE (72 HOURS)

# General Design Features & Updates

- Color Scheme: Transitioned to a sequential scheme, ranging from yellow to dark red.
- **GEOGRAPHIC REFERENCE**: ADDED MAJOR CITIES TO THE MAPS FOR BETTER ORIENTATION.
- EXPLANATORY TEXT: INTRODUCED TITLES AND SUBTITLES TO EACH MAP FOR CLARITY.
- **MODERN AESTHETICS:** UPDATED THE OVERALL LOOK AND FEEL OF THE GRAPHICS TO A MORE CONTEMPORARY STYLE.
- Exclusion of Tornado Hazard: Tornado HTI graphic was intentionally left out from the design updates.



## Interviews: Emergency Managers & Broadcast Meteorologists

- Goal: Elicit perspectives on prototype HTI graphics, including Likely uses and feedback on areas for improvement
- SAMPLING: FOCUSED ON HURRICANE FORECAST & WARNING SYSTEM PROFESSIONALS IN HURRICANE-PRONE REGIONS, AT LOCAL AND STATE/REGIONAL LEVELS
- 20 INTERVIEWS TOTAL
  - 10 broadcast meteorologists + 10 emergency managers
- APPROACH: SEMI-STRUCTURED ONLINE INTERVIEWS

### NTERVIEWS: Emergency Managers & Broadcast Meteorologists

8 **OVERALL DESIGN / IMPROVEMENTS** 

### 3 Hazards

### 





outages lasting weeks or more, and loss of clean water.

Winds 74-110 mph. Significant damage to trees and

power lines. Large flying debris. Widespread power outages lasting days. Severe roof damage possible.

Winds 58-73 mph. Severe tree damage, power

Major damage to poorly-constructed buildings.

SLIGHT

roof shingles and siding

outages, larger objects and debris become projectiles

Water levels 6-9 feet above normal. Severe flooding of coastal areas, large waves with destruction of some bridges, piers, roads, and properties.

destruction of most bridges, piers, roads, and properties.

Water levels 3-6 feet above normal. Significant flooding of coastal areas, large waves, coastal properties and roads damaged or destroyed

on some roads will not be possible. SLIGHT Isolated flash floods possible. Localized flooding. especially in urban areas and areas with rapid runol

EXTREM

property in great danger.

Lives and property in danger.

ODERATE

Orlando

Fort Myers .

Key Wes

Widespread flash floods expected. Severe flooding of

areas that don't normally experience flooding. Lives and

Numerous flash floods likely. Significant flooding

especially in urban areas and near streams and rivers

Scattered flash floods possible. Localized flooding.

especially in urban areas and near small streams. Travel

Title and

HEADER

### ADDING 6 **FIMING**

7 local INFO

### LEGEND / 5 DESCRIPTORS

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Winds 39-57 mph. Tree damage, power outages, Water levels 1-3 feet above normal. Flooding of flying lightweight objects and debris. Minor damage to low-lying areas especially near high tide, increased surf. mild beach erosion, and some infrastructure damaged.

SLIGHT

ODERATE

8

### Interviews: Emergency Managers & Broadcast Meteorologists

 OVERALL, THE INTERVIEWEES RECOGNIZE AND APPRECIATE THE IMPACT OF THE IMPROVED DESIGN

accessible modern very simple clean not cluttered well-organized digestible more complete easier to easy to read understand more consumer clear friendly easy on eyes less "sciency" more uniform

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## INTERVIEWS: Emergency Managers & Broadcast Meteorologists

- BEST PRACTICES IN RISK VISUALIZATION DESIGN GENERALLY YIELD POSITIVE RESULTS, BUT IMPORTANT CONTEXTUAL KNOWLEDGE NEEDS TO BE TAKEN INTO ACCOUNT AS WELL
  - GEOGRAPHIC, PLACE-BASED KNOWLEDGE
  - Knowledge of their constituents and what they need / understand
  - HIGHLIGHTS THE IMPORTANCE OF INCORPORATING USER FEEDBACK AS PART OF VISUALIZATION DEVELOPMENT
- No one graphic can accomplish all communication goals diverse portfolio of visualizations needed for different purposes, different audiences
  - TENSIONS BETWEEN NEEDS AMONG KEY STAKEHOLDERS, AS WELL AS WITH THE PUBLIC
  - BUILDING IN FLEXIBILITY WHILE MAINTAINING CONSISTENCY

### EVALUATIVE RESEARCH: PUBLIC

- EXPLORATORY STUDIES: EXPLORE THE IMPACT OF THE FOLLOWING ATTRIBUTES TO INFORM THE VISUALIZATION DESIGN OF A NEW WEATHER RISK GRAPHICAL PRODUCT
  - ES1: THREAT LEVEL COLORS AND LABELS (368 PARTICIPANTS IN FL, ½ COASTAL, ½ INLAND)
  - ES2: WIND ARRIVAL TIMES
  - ES3: COMBINED THREAT INFORMATION PRESENTATION (TEXTUAL VS. ICONIC)
- MAIN EXPERIMENT: EVALUATE IMPACT OF WEATHER RISK VISUALIZATION DESIGN (NEW, EXISTING) ON COMPREHENSION, RISK PERCEPTION, AND BEHAVIORAL INTENT.
- EXPERIMENTS CONDUCTED REMOTELY & ASYNCHRONOUSLY

### EXPLORATORY STUDY 1: LOWEST THREAT LABEL



### EXPLORATORY STUDY 1: HIGHEST THREAT LABEL

![](_page_12_Figure_1.jpeg)

### EXPLORATORY STUDY 1: NUMBER OF LEVELS

![](_page_13_Figure_1.jpeg)

## EXPLORATORY STUDY 1: KEY FINDINGS

### RISK PERCEPTION

- INFLUENCED BY BOTH THE NUMBER OF RISK CATEGORIES AND THE RISK LABELS.
  THIS AREA NEEDS FURTHER EXPLORATION
- PREPARATORY ACTIONS
  - DECISIONS ARE BASED ON STORM CHARACTERISTICS, NOT DESIGN
- THREAT LEVEL LABELS:
  - PARTICIPANTS PREFERRED "LOW" FOR THE LOWEST THREAT LEVEL BUT DESIRED MORE GRANULARITY FOR LEVELS.
  - PARTICIPANTS PREFERRED "EXTREME" FOR THE HIGHEST THREAT LEVEL

# NEXT STEPS

- EXPLORATORY STUDY 2: SURVEY COMPLETE, ANALYSIS IN PROGRESS
  - TIME OF ARRIVAL CONTOURS ON OR OFF WIND HTI MAP
- EXPLORATORY STUDY 3: THIS SUMMER
  - INCLUSION OF ICONS
- MAIN EXPERIMENT: THIS FALL
  - Utilize information gathered from ES 1-3 and from EM/BM interviews to guide final design
  - EVALUATE AGAINST MOST-SIMILAR EXISTING PRODUCTS

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