Overview of the C3S Windstorm Climate Service (WISC)

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Introduction

- Overview of WISC in C3S (Copernicus Climate Change) context
- WISC value add
- WISC approach
- Tracks and footprints
- Event set
- Vulnerability and loss
- Status
- Data use and interfaces
- Case studies
**Objectives:**
- Be an authoritative source of climate information for Europe
- Build upon massive European investments in science and technology
- Enable the market for climate services

**Architecture:**
- Proof of Concept SIS
- Provides data to CDS
- Portal / demonstrator
- Case studies
WISC - Value Add

Historical
• Longer comprehensive time series (back to 1940)
  – 1900 to 1939 not considered suitable for release
• Sourced from up to date, reference reanalysis datasets
• Lower track thresholds – many more storms available
• Additional downscaling – 4km storm footprint resolution
  – Previously 25km resolution publicly available
• Transparency of methods applied
• Improved validation, re-calibration and bias correction of data

Probability and extreme values
• Event set to provide cross checks with commercial cat models

Vulnerability and loss
• European-wide exposure and vulnerability assessment with losses
• Reference products to support in-house simulation platforms
• Comprehensive end to end data to support users with limited in-house capabilities
WISC Approach

- WISC provides transparent, authoritative data to improve understanding of windstorm risk from Extra-Tropical cyclones
- Approach and outputs:

Team:

<table>
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<tr>
<th>Products</th>
<th>Temporal coverage</th>
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<tbody>
<tr>
<td>Historical Storm Tracks</td>
<td>1900 to 1979 (ERA-20C)</td>
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<td>1979 to 2016 (ERA-INT)</td>
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<td>2010 to 2016 (ERA-5)</td>
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<tr>
<td>Historical Storm Footprints</td>
<td>1900 to 1939 (TBC)</td>
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<td>1940 to 2016 (ERA-20C / ERA-INT)</td>
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<td>2010 to 2016 (ERA-5 sample)</td>
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<tr>
<td>Synthetic Event Set</td>
<td>7600 significant storm events</td>
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<tr>
<td>Historic Indicators (Tier 1)</td>
<td>Number of Windstorms 1940 to 2015</td>
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<td></td>
<td>Ave Max Wind Speed 1940 to 2015</td>
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<td>Average Storm Severity 1940 to 2015</td>
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<td>Decadal variability 1940 to 2015</td>
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<td>Historic Indicators (Tier 3)</td>
<td>Total Sectoral Insured Losses 1990</td>
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<td>Total Windstorm Loss per Sector; 1990 to 2015</td>
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**Tracking Method**

Hodges (1994,1995) tracking algorithm

- Based on 850hPa relative vorticity at T42 resolution
- Vorticity centres used to calculate trajectory of individual extra-tropical cyclones (cyclones north of 30N)

Extra fields referenced back to vorticity fields at full resolution at each timestep

- Minimum MSLP within 6 degrees of vorticity centre
- Maximum wind within 6 degrees of vorticity centre
- Maximum land-wind within 3 degrees of vorticity centre (XWS ranking metric)

**Footprint Downscaling Method**

Event identification

- Extract data for +/- 36 hours from maximum wind value on track
- Select nearest 00:00 (12:00) as start time (ST)
- Where no track available, use user-specified start/peak date/time

Boundary conditions for UKMO Unified Model from ERA-INT / 20C between ST-6 and ST+30h
Remove ‘spin-up’ period (ST-6 to ST+0)
Repeat 3 or 4 times
Concatenate into 72-hour footprint
Output as appropriate (geo-referenced and NetCDF)
• UPSCALE (1985 to 2011), based on HadGEM3 GA3 and GL3 configurations of Met Office Unified Model
  – UK on PRACE - weather-resolving Simulations of Climate for globAL Environmental risk
  – PaRtnership for Advanced Computing in Europe

• 5 ensembles
  – Different resolutions
  – Present & RCP 8.5 climate (only present used)

• Spatial resolution: 25km (also 60km & 130km)
• Temporal resolution: 6 hours
• 7600 significant storms

• Met Office illustration of Event Set 7660 UPSCALE storms
  – Each ensemble a different colour
  – Severity shown by area

Event set
### WISC - Vulnerability and Loss

**Hazard – Event Set**
- CORINE – 45 land classes
- PAGER – 106 construction types – aggregated to 6 types
- Fragility curves applied for these 6 types
- Fragility curves to vulnerability curves via reconstruction costs
- GDP per NUTS3 region applied

**Exposure / Vulnerability**
- Datasets clipped to NUTS3 regions before loss calculations applied (EU: 276 NUTS 2 & 1,342 NUTS3 regions)
- Loss per hazard (max gust speed) from fragility curves
- Loss ratio multiplied by reconstruction cost per building type
- Losses adjusted by GDP per region
- Validate losses vs actuals

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**Process for Loss Assessment**

1. **Prepare**
   - Max. wind gust speed
   - Corine Land Cover

2. **Combine**
   - Building construction types
   - GDP levels per NUTS2 (Eurostat)
   - Reconstruction cost per building type per country (JRC)

3. **Extract**
   - GDP per NUTS3 region applied

4. **Assess losses**
   - Validate losses vs actuals
Climate Change

### WISC Status in CDS context

**Status**
- Tracks, footprints, event set complete
  - awaiting final metadata adjustments
- Tier 1 and Tier 3 indicators expected end June
- Portal – about to go live
- Case studies – expected to start shortly

**Possible WISC updates:**
- Regular periodic updates
- Specific updates – eg:
  - Full use of ERA-5 with ensembles
  - Development / expansion of event set (eg with Primavera outputs)
  - Use in adaptation
  - Visualisation of ensembles

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**WISC Product Development**

**WISC Updates**
- 1st. Year
- 2nd. Year

**WISC Demonstrator**
- Integration or transition to CDS

**WISC Products via CDS**

**CDS Operations**

**Stage 0/I** - Proof of Concept/Pre-Operational

**Stage II** - Operational ~20 ECVs, ~5-6 Sectors

**Stage III** - Operational ~30 ECVs, ~10 Sectors

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**Data Integration**

**CDS Beta v.1.0 (July)**
Expected insurance sector use of WISC

Hazard
- Stochastic event sets from catastrophe models are primary hazard source
- Necessary for extreme value assessments
- Transparency issues
- WISC historic data and event set
  - Prefer direct use of ‘raw’ data (ie tracks, footprints, event set)
  - Used for comparison / calibration with existing information
  - WISC historic tracks & footprints valuable as updated & high resolution
  - WISC event set physically based => useful comparator
  - Availability in OASIS LMF helpful
  - Ability for bulk download helpful

WISC indicators
  - Tier 1 useful for high level information
  - Derived so can be self generated from other WISC inputs

Vulnerability and loss
- WISC indicators
  - Tier 3 indicators provide direct comparison to insurer assessments
  - Lower level information used to derive Tier 3 indicators also of direct use
  - Indicators and historic data also of value to smaller users with less in-house capabilities
Next stage - Case study application areas

1. Use of WISC historical footprints, vulnerability and exposure data to calibrate and compare with other models.
2. Use of WISC Event Set, Vulnerability and Exposure within OASIS to address insurance company needs for independent loss modelling
3. Sensitivity analysis of the WISC Vulnerability assessments
4. Insurance company use of Event Set to complement/calibrate their business information
5. Use of WISC data to support development of cat model.
   - Comparison of WISC Event Set with Cat Modellers’ own event sets
   - Seeding of event set with WISC data. Possible use of vulnerability/exposure data.
6. Assessment of the wider potential of ERA-5 based tracks and footprints to provide uncertainty information for the event set
7. Informed extension/expansion of the event set, to improve coverage, while keeping a direct physical basis.
8. Case study using the historical storm tracks
9. Climate Adaptation modelling using event set – eg in Climada (ETH)