# Impact-based warnings and CAP

*Rainer Kaltenberger (EMMA/Meteoalarm PM)*

CAP Workshop Amsterdam

19-21 September 2022

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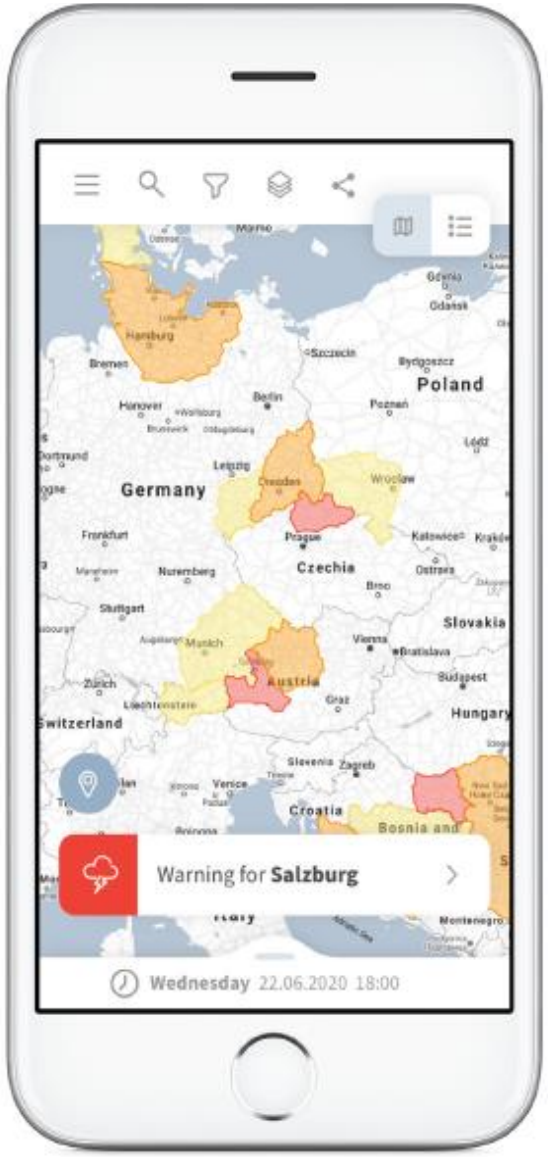
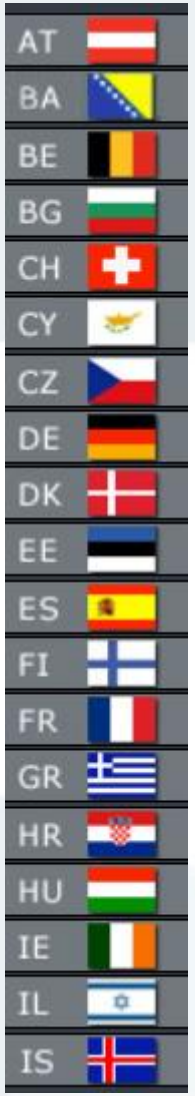
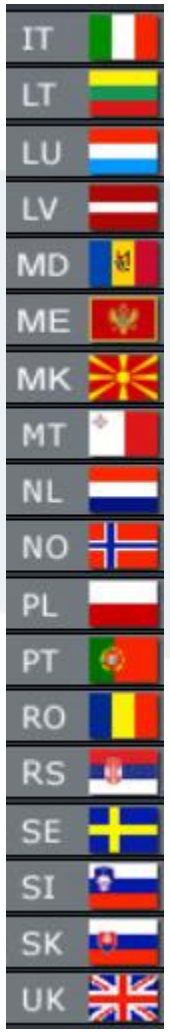
- Take home messages
- Reading tip

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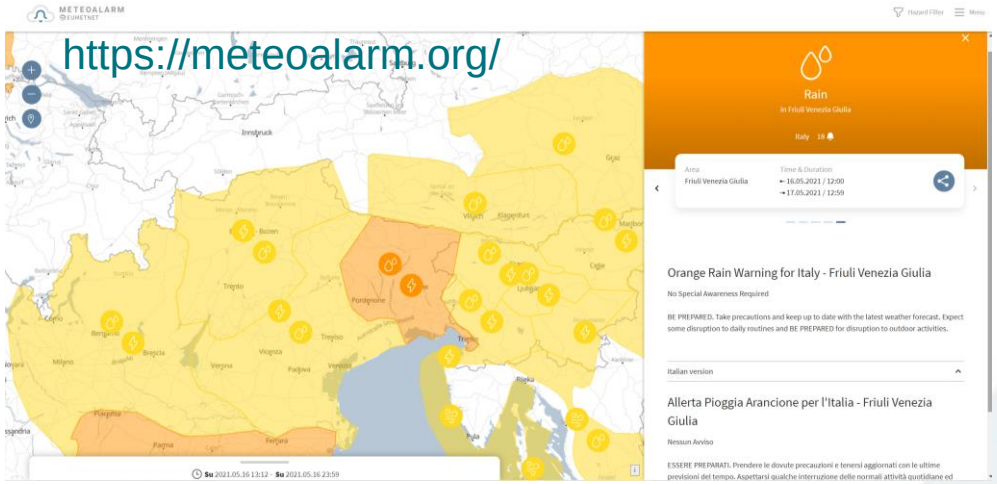
# What is Meteoalarm?

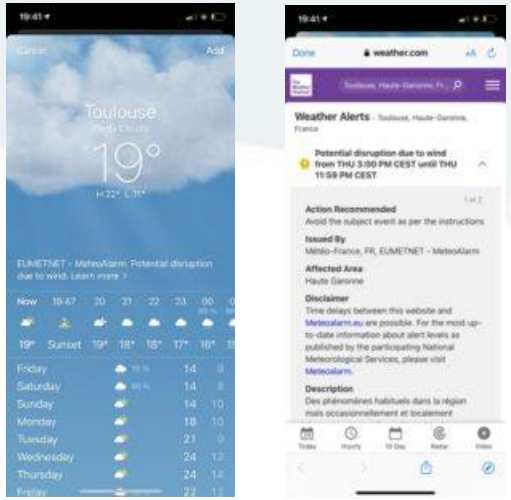


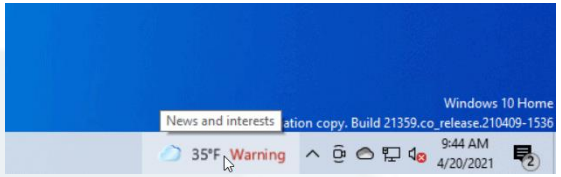

Meteoalarm Partner Group Meeting, Zagreb 2019

- An impact-oriented, common framework to **aggregate, display and make available** hydromet warnings of EUMETNET members in an **easy and understandable way** to the general public and to European (re)users
- Sources are 37 NMHSs and national partners
- **Multi-hazard programme** created in the mid 2000s
- Programme Management by ZAMG, NMS of Austria
- Meteoalarm 2.0 fully operational since June 2021

# Re-Users of CAP Warnings

- Hydromet warnings issued by Meteoalarm partners (NMHSs) via feeds published at meteoalarm.org are disseminated to **hundred of million end-users worldwide** via **large information providers and re-users**, including
  - Google
  - Apple
  - IBM/The Weather Company
  - AccuWeather, MeteoBlue, Foreca.com…
- Prominent **products and services** include
  - Apple and Android standard weather app
    https://www.eumetnet.eu/apple-standard-weather-app-eumetnet/
  - Windows 10 / 11 Weather Widget
  - Apple Watch standard Weather App




# Re-Users Needs – Lessons Learned

- Re-Users appreciate the **standardized technical format** („Meteoalarm CAP Profil“) across 37 countries and **harmonized warning levels**
- Warnings should entail **tangible description of the impact scenario** (CAP element <description>) and a clear, actionable **advice on what to do** (<instruction>)
- These and other CAP elements should be filled with **„rich“ textual** content
- Warnings should feature at least **all offical, national languages plus English** (tourists, expats,…)
- Re-Users request more **meta data** to be made available in a **machine readable format** (e.g. details on warning system such as warning criterias/thresholds/parameters, how warnings are generated, IbW; alerting organisation logo, links to offical websites of warnings, definition of „high priority“ alerts,…)
- They want to be **timely informed about changes**, not just by Meteoalarm, but also by **national partners** (e.g. new warning parameters to be introduced, changes in warning system, in geocodes etc.)
- Originators of warnings should switch over to **polygons** rather than using geocodes
- **Feedback** on representation / visualization of warnings from NMHSs in their products and services is appreciated

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# IbW and CAP
# Context, Terms and Definitions

# Sendai Framework for Disaster Risk Reduction 2015-2030[1]

- Published by UNISDR[2] 2015:
- **Paradigm shift** of national meteorological and hydrological services (NMHSs) in:
- Advancing from providers of forecasts and warnings to producers of:
  - ***impact-based forecasts and risk-informed warnings***
- Assuming active roles in all aspects of disaster risk management cycle
- Providing better risk-based decision support services.


[1] ratified by 197 governments at UN Assembly 2015
[2] UNISDR: United Nations Office for Disaster Risk Reduction

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# Sendai Framework for Disaster Risk Reduction 2015-2030[1]

Early warning criteria: **Users**

**Paradigm shift** of national meteorological and hydrological services (NMHSs) in:
To develop and strengthen:

- **people-centred** multi-hazard forecasting and early warning systems,
- tailor them to the **needs of users**, including social and cultural requirements
- and **broaden release channels** for disaster early warning information

Kaltenberger, Rainer, Andreas Schaffhauser, and Michael Staudinger. "“What the weather will do”–results of a survey on impact-oriented and impact-based warnings in European NMHSs." *Advances in Science and Research* 17 (2020): 29-38. https://asr.copernicus.org/articles/17/29/2020/

# IbW, IW and IoW

- **Impact-based warning (~ prod. process)** - Assessment of the expected impact scenario, often multi-hazard

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- **Impact-oriented warning (~ warning format)** ≡ A warning which has a *tangible and understandable* description of an expected damage scenario (*information on impacts*) and/or a clear advice what to do (*instructions/advisories*)
  (UNISDR Sendai Framework of Actions)
  - Generic term for all warnings adressing ***what the weather will do***
  - Depending on the production process, an IoW may be a climatology-based warning, an impact-based warning, or another type of warning

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  - Generic term for all warnings adressing ***what the weather will do***
  - Depending on the production process, an IoW may be a climatology-based warning, an impact-based warning, or another type of warning
- Our recommendation is, that NMHSs could start simple with generic damage <description>/<instruction> to tell people what the weather will do.
- Upgrade later to comprehensive IbW-production processes/dynamic texts

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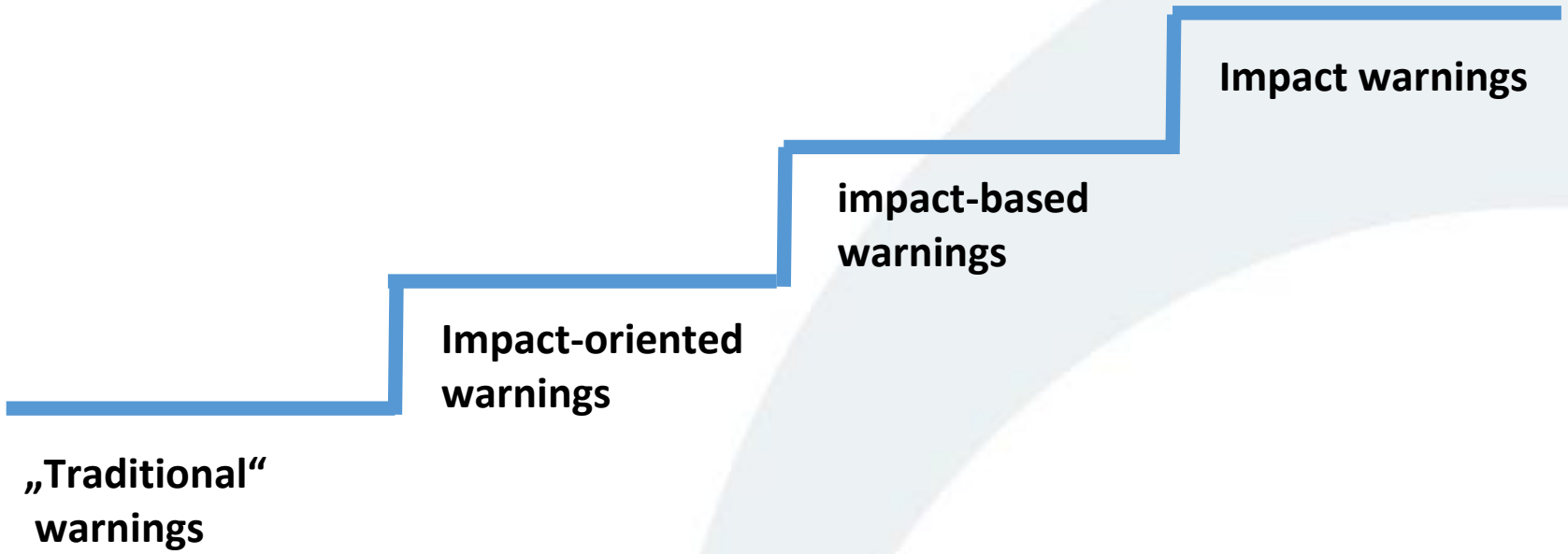
# Evolution of Hydromet Warnings



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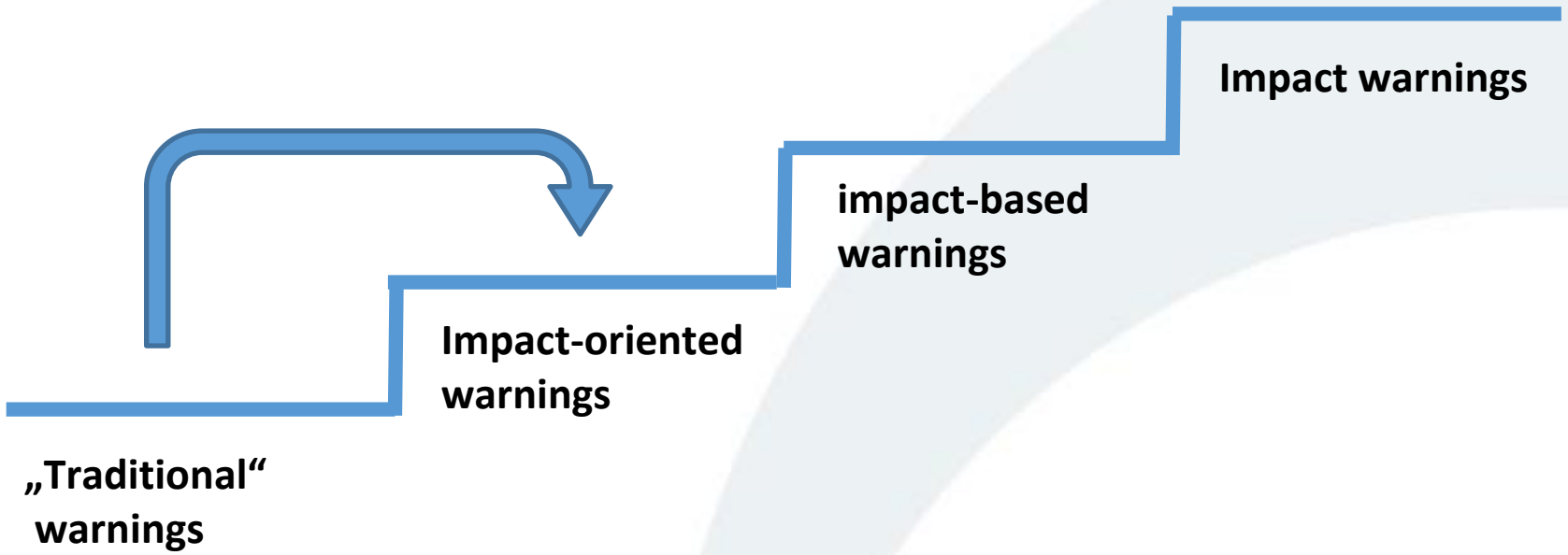
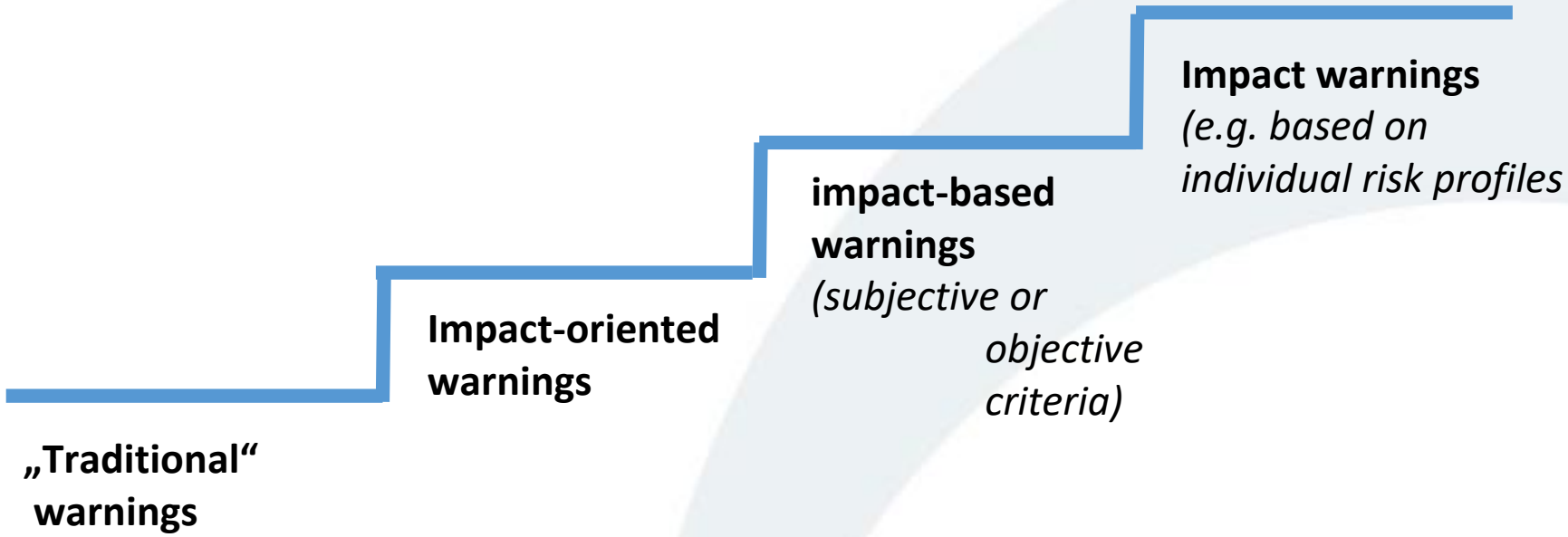



***Adding <description> and <instruction> to your CAP file, based on event type and warning level, as a jumpstart to make a warning impact-oriented, describing „What the weather will do“***

# Evolution of Hydromet Warnings – Target Audiences



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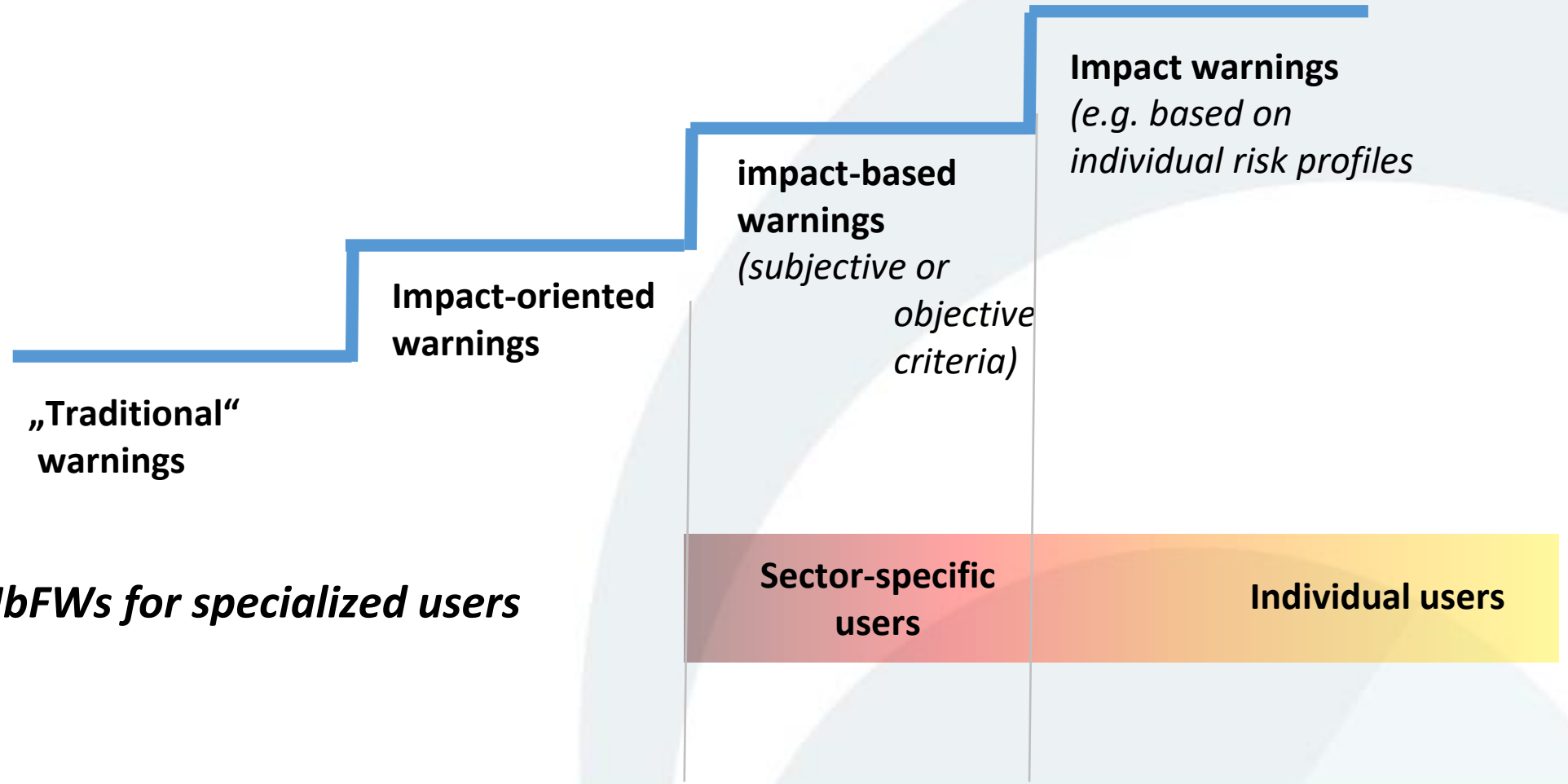


***IbFWs for specialized users***

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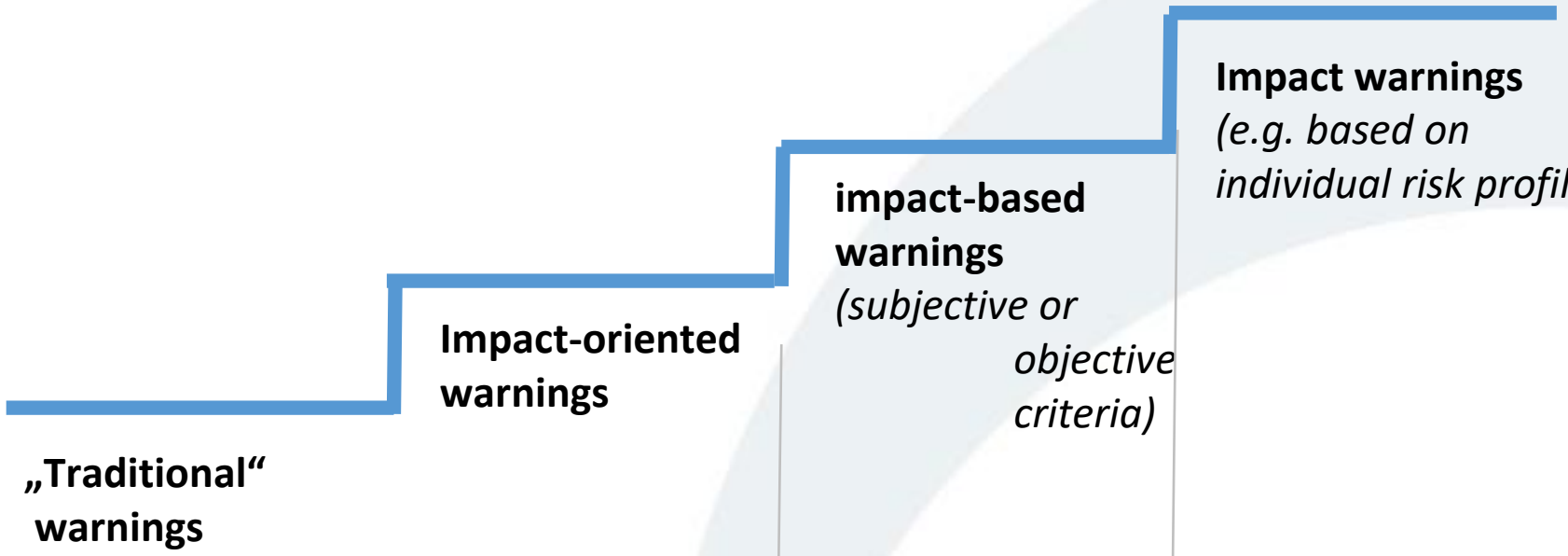
# Evolution of Hydromet Warnings – Target Audiences




***IbFWs for specialized users***

**Sector-specific users**

**Individual users**

***IbFWs for public***

**General public**

**Individuals of the public**

# Evolution of Hydromet Warnings – Target Audience


The good news is: CAP is suitable for all of these systems

*IbFWs for specialized users*

Sector-specific users

Individual users

*IbFWs for public*

General public

Individuals of the public

# Evolution of Hydromet Warnings – Target Audience


**The good news is: CAP is suitable for all of these systems**

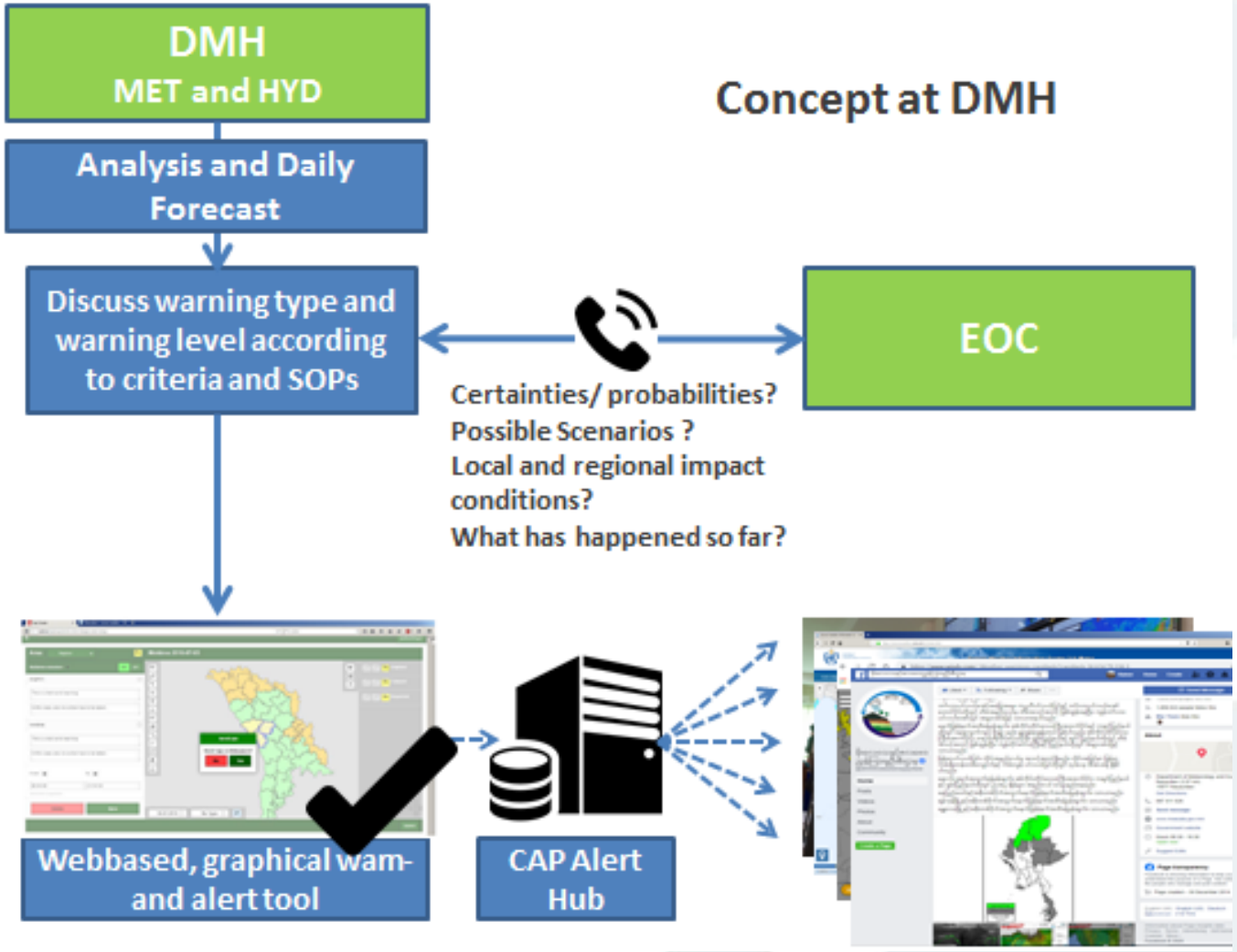
**NMHSs are doing an increasingly good job in delivering IbFWs for specialized/individual users**

**But how to tailor warnings for individuals of the public?**

| | | |
|---|---|---|
| ***IbFWs for specialized users*** | **Sector-specific users** | **Individual users** |
| ***IbFWs for public*** | **General public** | **Individuals of the public** |

# IbW systems co-design and CAP

# How to get the „impact“ into the warning? Example: Subjective-based IbW



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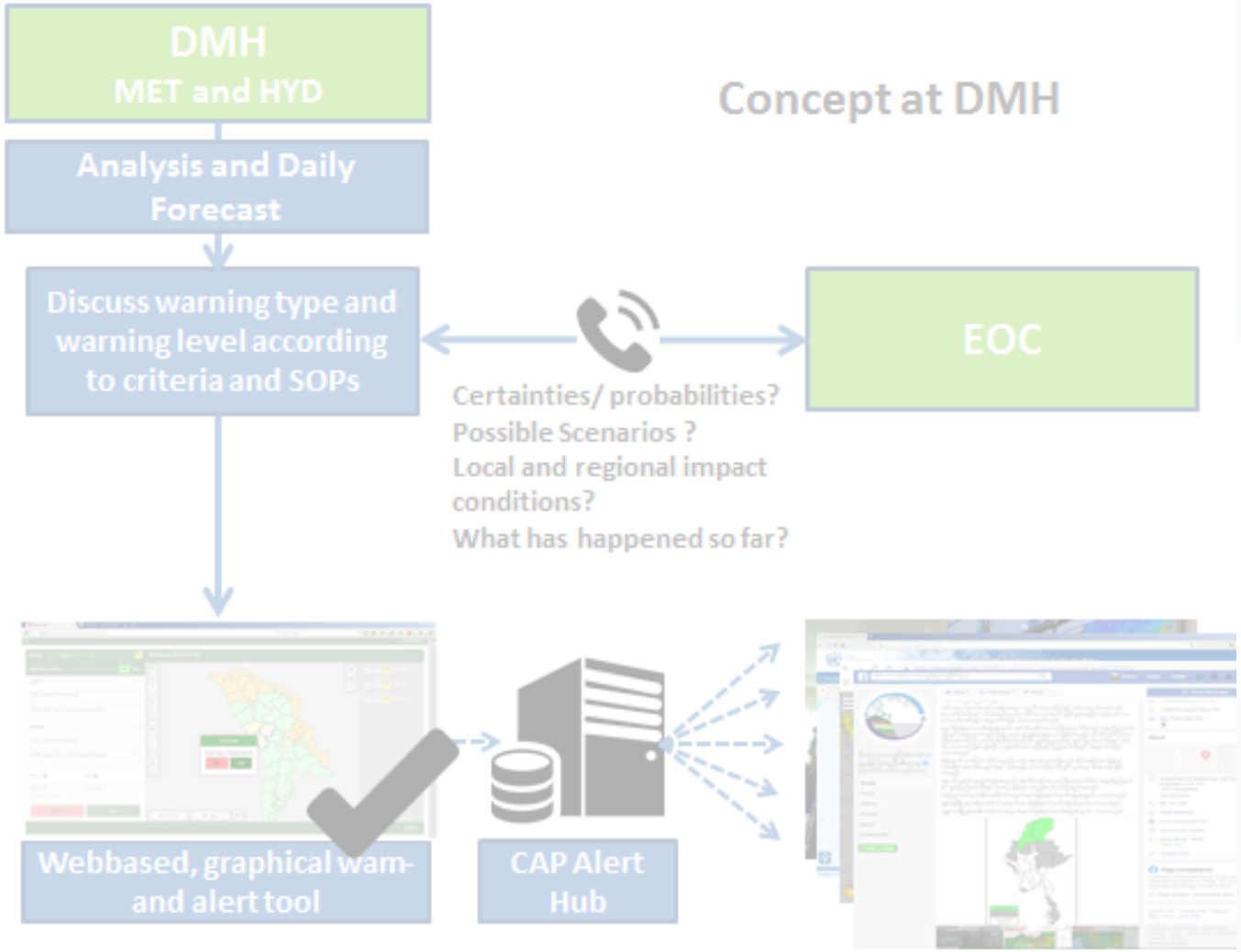
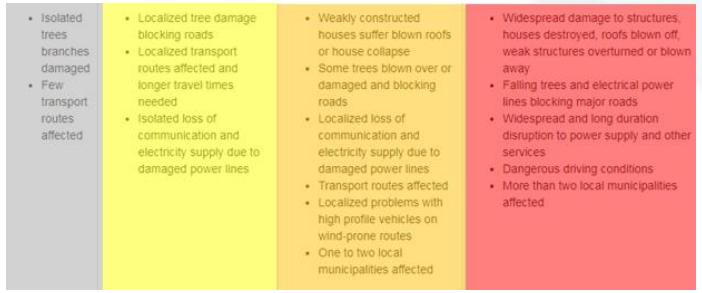



## Important CAP-related aspects:

- **Derive impact tables to get generic stock phrases for <description> and <instruction>**




- **IFRC PAPE messages help**
- **CAP output compliant to re-user needs (e.g. Google CAP), following good practices)**

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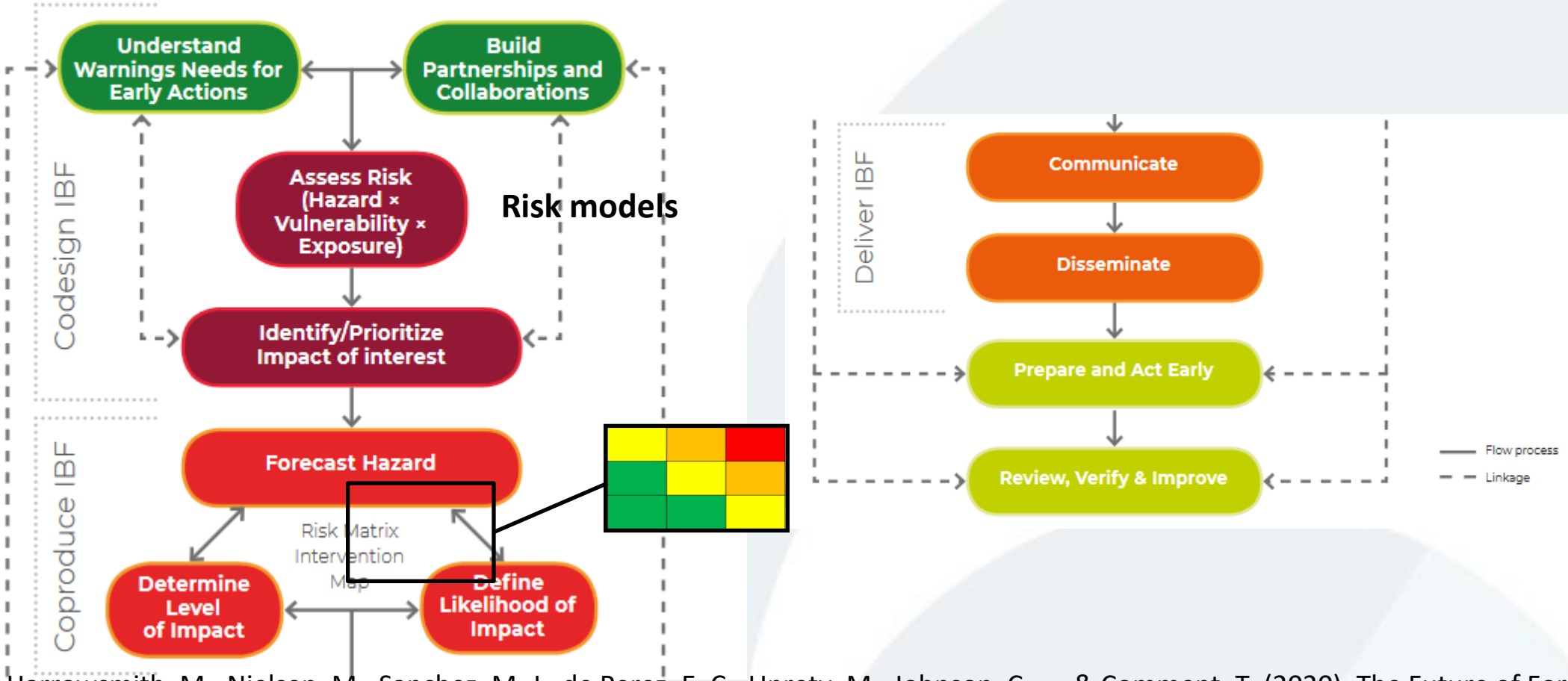
# How to design more objective IbW-systems

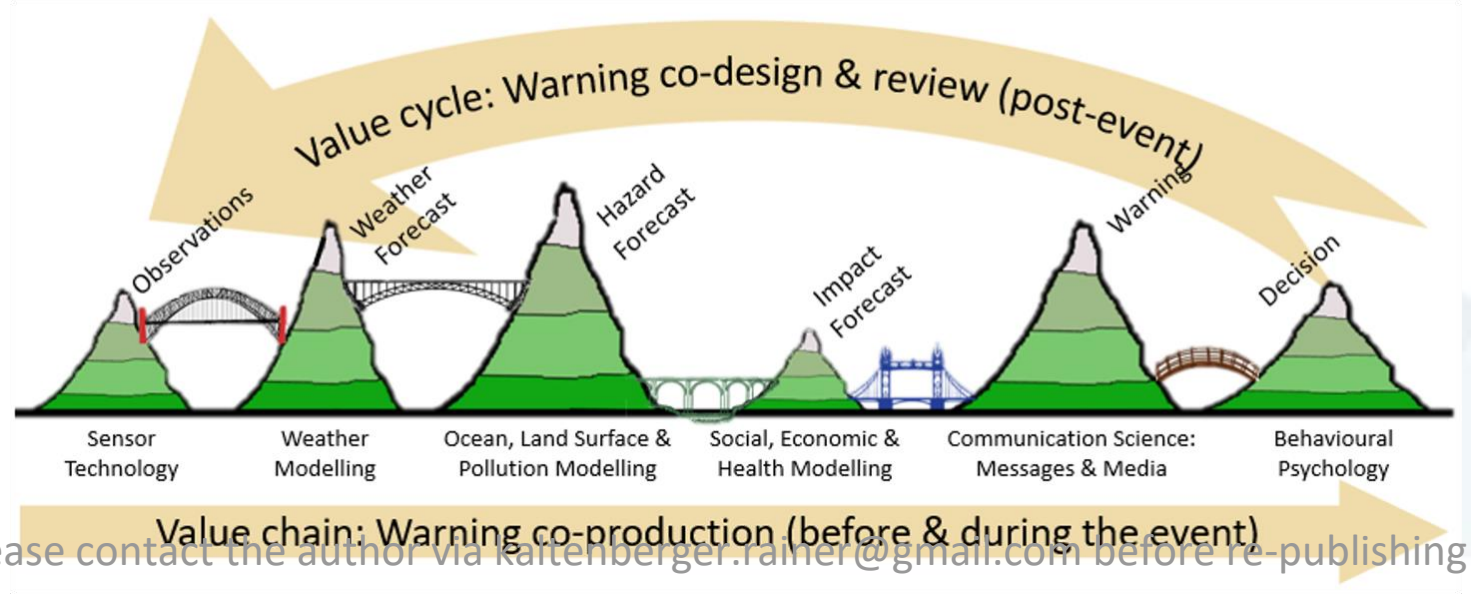
Methodological Framework of Impact-based Forecasting (IBF) and Warning Service




Harrowsmith, M., Nielsen, M., Sanchez, M. J., de Perez, E. C., Uprety, M., Johnson, C., ... & Comment, T. (2020). The Future of Forecast: Impact based Forecasting for Early Action. Avaialble at https://www.forecast-based-financing.org/wp-content/uploads/2020/09/Impact-based-forecasting-guide-2020.pdf

# How to design more objective IbW-systems

- Target audience: Specific sectors or users, e.g. NDMOs, humanitarian aid organizations
- Require specific information e.g. based on risk models (risk=(hazard x exposure x vulnerability)
- Co-design and partnerships important
- Use of CAP guidelines or profiles, eventually encoding of additional information (such as risk matrix, certainty) using key-value pairs
- Hybrid format (e.g. one CAP message fits all purposes) possible, as optional CAP elements (e.g. <parameter> and <eventCode>) are usually ignored by systems which don‘t require them




*Schematic value chain for high impact weather warning showing the capabilities and outputs (green "mountains") and information exchanges (bridges) linking the capabilities and their associated communities (from Golding et al. GAR2019).*

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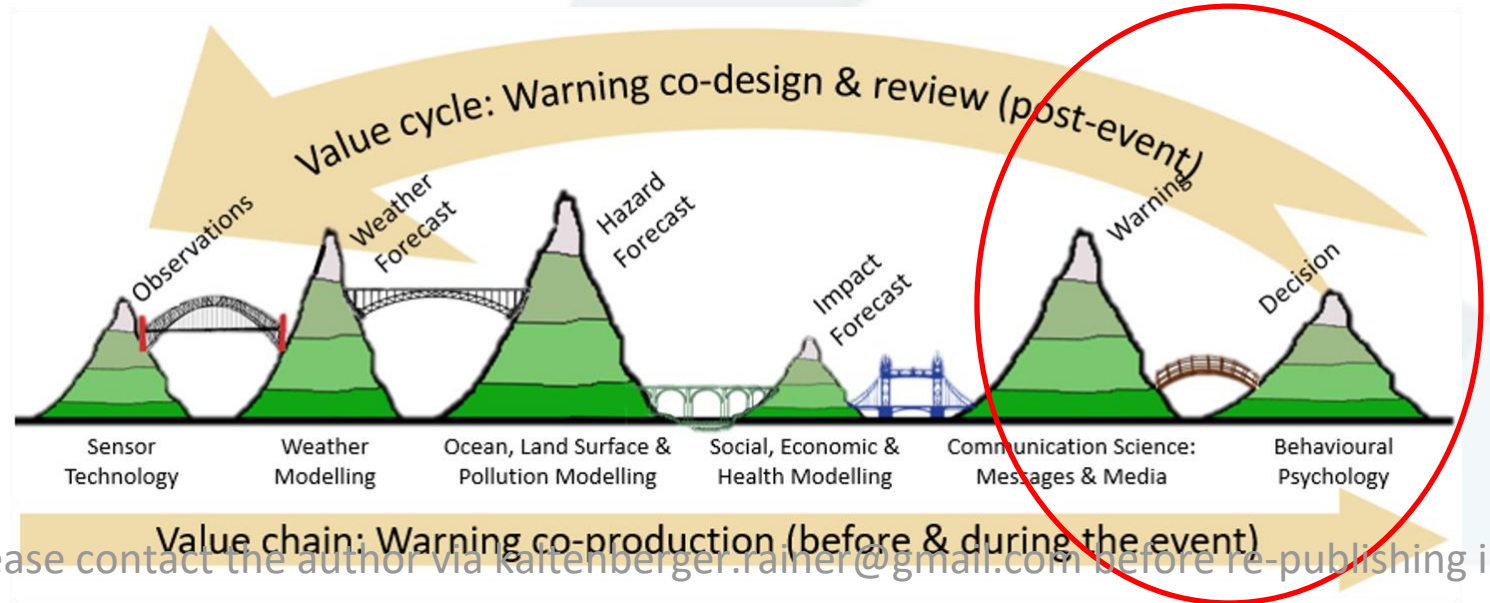


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**Last mile of warning delivery**

- **cellbroadcasting specifics**
- **re-user needs**
- **social science**

**Feedback loop important**

# IbW-related CAP elements

# IbW-related CAP Components

## Overview

- <severity>,<certainty>,<urgency> - Mandatory elements to distinguish high-priority alerts from low-priority alerts
- <description>,<instruction> very important regarding IoW/IbW („What the weather will be“)
- <responseType> important for IbW and alerting authorities; often beyond the legal scope of NMHSs (however: they could use „noncritical“ values such as „monitor“)
- <event>,<eventCode>,<headline> communicating the event, Google specifications (e.g. headline max 35 chars, list on events has to be submitted), note: free text field (e.g. <event>, <headline>) vs. machine readable <eventCode>)
- OASIS Event Terms List (2020)
- <category> ~Target community MET, GEO etc. (could be multiple – relevant also for sector-specific CAPs)
- Encoding of optional information using key-value pairs (e.g. quantification of <certainty>)
- And finally: The Risk Matrix

# CAP and Colors/Color Codes

- Important: Color or color code is not part of CAP
- Instead often the <severity> is translated into a colour-code (usually 4 or 5 alert levels)
- Sometimes also a combination of <severity>,<certainty> and <urgency> is being used
- ISO 22324:2015 - Guidelines for colour-coded alerts – Ample-like colour code range is recommended
- However: Some countries have other colours in place, e.g. blue and black in China, brown in Myanmar….
- It becomes even more complicated if event types or watches/warnings are matched with colours (not recommended)
- Icons for events desirable according to feedback from re-users – however, the event has to be machine readable (e.g. via <eventCode> element and OASIS Event Terms List, in current Meteoalarm profile via <parameter>)

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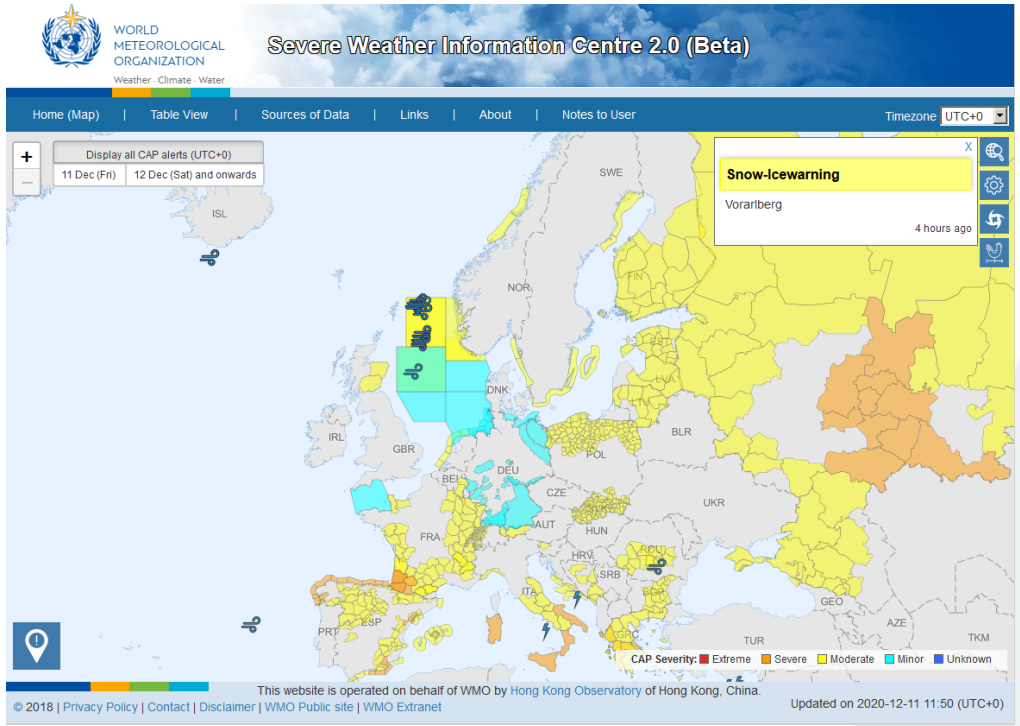
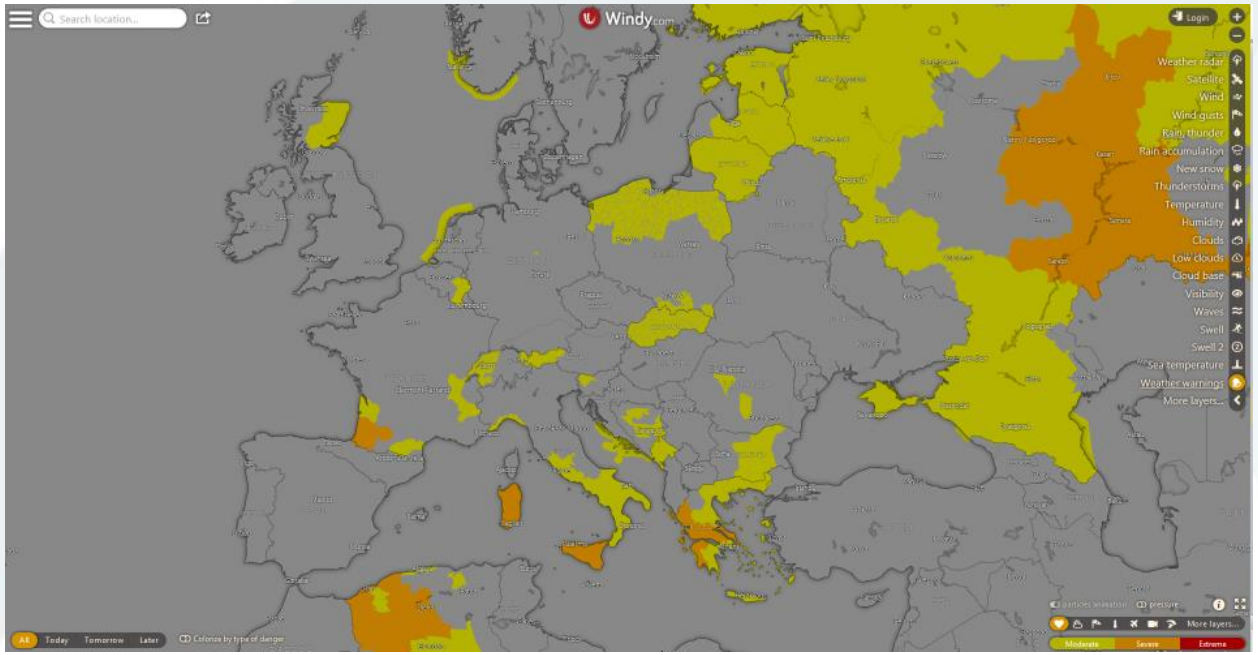
# Usually (but not always) <severity> is mapped to colour code






WMO SWIC: https://severeweather.wmo.int/v2/

Windy.com: https://www.windy.com/-Weather-warnings-capAlerts?capAlerts,48.546,16.743,5

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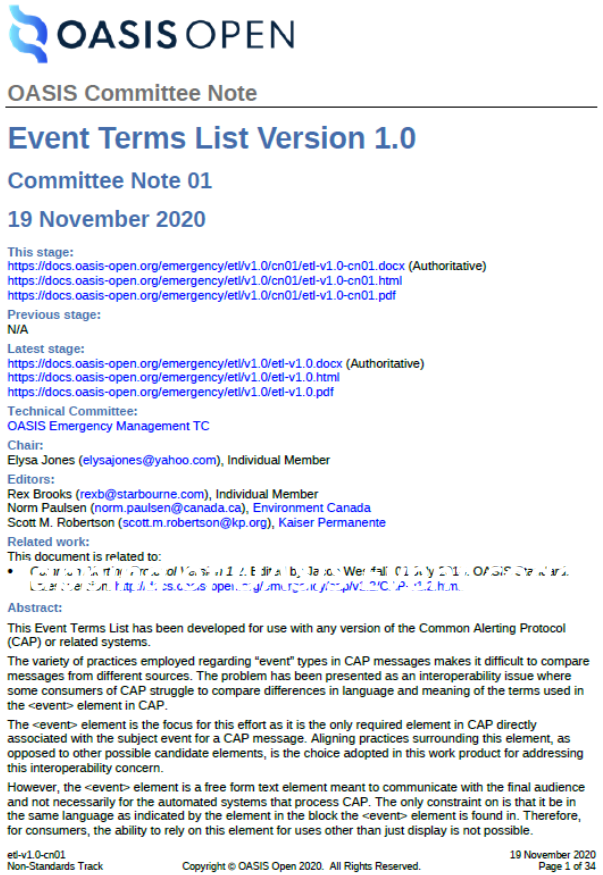
# OASIS Event Terms List



OASIS OPEN

OASIS Committee Note

## Event Terms List Version 1.0

### Committee Note 01

### 19 November 2020

This stage:
https://docs.oasis-open.org/emergency/etl/v1.0/cn01/etl-v1.0-cn01.docx (Authoritative)
https://docs.oasis-open.org/emergency/etl/v1.0/cn01/etl-v1.0-cn01.html
https://docs.oasis-open.org/emergency/etl/v1.0/cn01/etl-v1.0-cn01.pdf

Previous stage:
N/A

Latest stage:
https://docs.oasis-open.org/emergency/etl/v1.0/etl-v1.0.docx (Authoritative)
https://docs.oasis-open.org/emergency/etl/v1.0/etl-v1.0.html
https://docs.oasis-open.org/emergency/etl/v1.0/etl-v1.0.pdf

Technical Committee:
OASIS Emergency Management TC

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Editors:
Rex Brooks (rexb@starbourne.com), Individual Member
Norm Paulsen (norm.paulsen@canada.ca), Environment Canada
Scott M. Robertson (scott.m.robertson@kp.org), Kaiser Permanente

Related work:
This document is related to:

- Common Alerting Protocol Version 1.2. Edited by Jacob Westfall. 01 July 2010. OASIS Standard. [illegible] https://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2.html.

Abstract:

This Event Terms List has been developed for use with any version of the Common Alerting Protocol (CAP) or related systems.

The variety of practices employed regarding "event" types in CAP messages makes it difficult to compare messages from different sources. The problem has been presented as an interoperability issue where some consumers of CAP struggle to compare differences in language and meaning of the terms used in the <event> element in CAP.

The <event> element is the focus for this effort as it is the only required element in CAP directly associated with the subject event for a CAP message. Aligning practices surrounding this element, as opposed to other possible candidate elements, is the choice adopted in this work product for addressing this interoperability concern.

However, the <event> element is a free form text element meant to communicate with the final audience and not necessarily for the automated systems that process CAP. The only constraint on is that it be in the same language as indicated by the element in the block the <event> element is found in. Therefore, for consumers, the ability to rely on this element for uses other than just display is not possible.

etl-v1.0-cn01
Non-Standards Track
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19 November 2020
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- OASIS EMTC CAP SC has developed a list of “event” terms in a thesaurus approach for use in alert messaging systems
- The event terms list has been created at the request of international CAP users
- The event terms list will be large and every growing to accommodate a variety of interpretations.
- <event> element is a free form text element meant to communicate with the final audience and not necessarily for the automated systems that process CAP
- CAP event type codes can help support auto processing.
- The CAP category element also plays into the decisionmaking element in CAP

*Event Terms List Version 1.0*. Edited by Rex Brooks, Norm Paulsen, and Scott M. Robertson. 19 November 2020. OASIS Committee Note 01. https://docs.oasis-open.org/emergency/etl/v1.0/cn01/etl-v1.0-cn01.html. Latest stage: https://docs.oasis-open.org/emergency/etl/v1.0/etl-v1.0.html.

***How does it look like in the CAP file?***

# OASIS Event Terms List

*<eventCode>*

*<valueName>OET:v1.0</valueName>"*

*<value>OET-537</value> --a coded value for the closest EMTC event term*

*</eventCode>*

If a term does not closely resemble any EMTC term, then following is requested.

*<eventCode>*

*<valueName>OET:v1.0</valueName>"*

*<value>OET-000</value> --a coded value for the EMTC event term "other event"*

*</eventCode>*

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ys into

***Mapping of OASIS Event codes, application of pictographs (example: Meteoalarm)***

| OASIS Event code | OASIS CAP Event term | Grouping | *CAP category code(s)* | EMMA awareness_type |
|---|---|---|---|---|
| OET-018 | Avalanche | | *Geological* | Avalanches |
| OET-043 | Cold | Temperature hazard | *meteorological* | low temperature |
| OET-044 | Cold weather | Winter weather | *meteorological* | |
| OET-098 | Heat | Temperature hazard | *meteorological* | Extre high temperature |
| OET-182 | Snow | Winter weather | *meteorological* | Snow / Ice |
| OET-183 | Snow storm | weather | *meteorological* | |
| OET-088 | Freezing drizzle | winter weather | *meteorological* | |
| OET-089 | freezing rain | winter weather | *meteorological* | |
| OET-107 | ice | winter weather | *Meteorological* | |

Even 2020. OASIS Com https://docs.oasis-open

# Feedback from NMHSs on (additional) information to be encoded in CAP

*What information will your warnings contain now/likely contain in the next 10 years that could be of interest to be ingested/autoprocessed by re-users, other systems?*

- *Quantification (e.g m/s, %, and mm/cm for different durations)*
- *Color*
- *Cause*
- *Expected consequences, separate from <description>*
- *Geographic domain (e.g "marine" and "land")*
- *Specification and good examples for long lasting events (like forest fire)*
- *Total precipitation amount,  snow cover, total snow amount, max wind, Tsunami run-up*
- *Storm name (free text)*
- *Time of max sea level*
- *Differentiation Watch/Warning*
- *Certainty quantification (e.g. 35%)*
- *Certainty range (e.g. 30 to 50%)*
- *IbW/Risk Matrix format*
- *IbW/Risk Matrix position*
- *Warning colour (e.g. RGB value)*
- *Stock phrases damage descriptions/impacts*
- *Stock phrases instructions/advisories*
- *Meteorological parameter values (e.g. maxgust, precip. amounts)*

*Survey among 37 NMHSs (Meteoalarm partners) carried out in May 2021*

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# Scheme for encoding optional information using key-value pairs

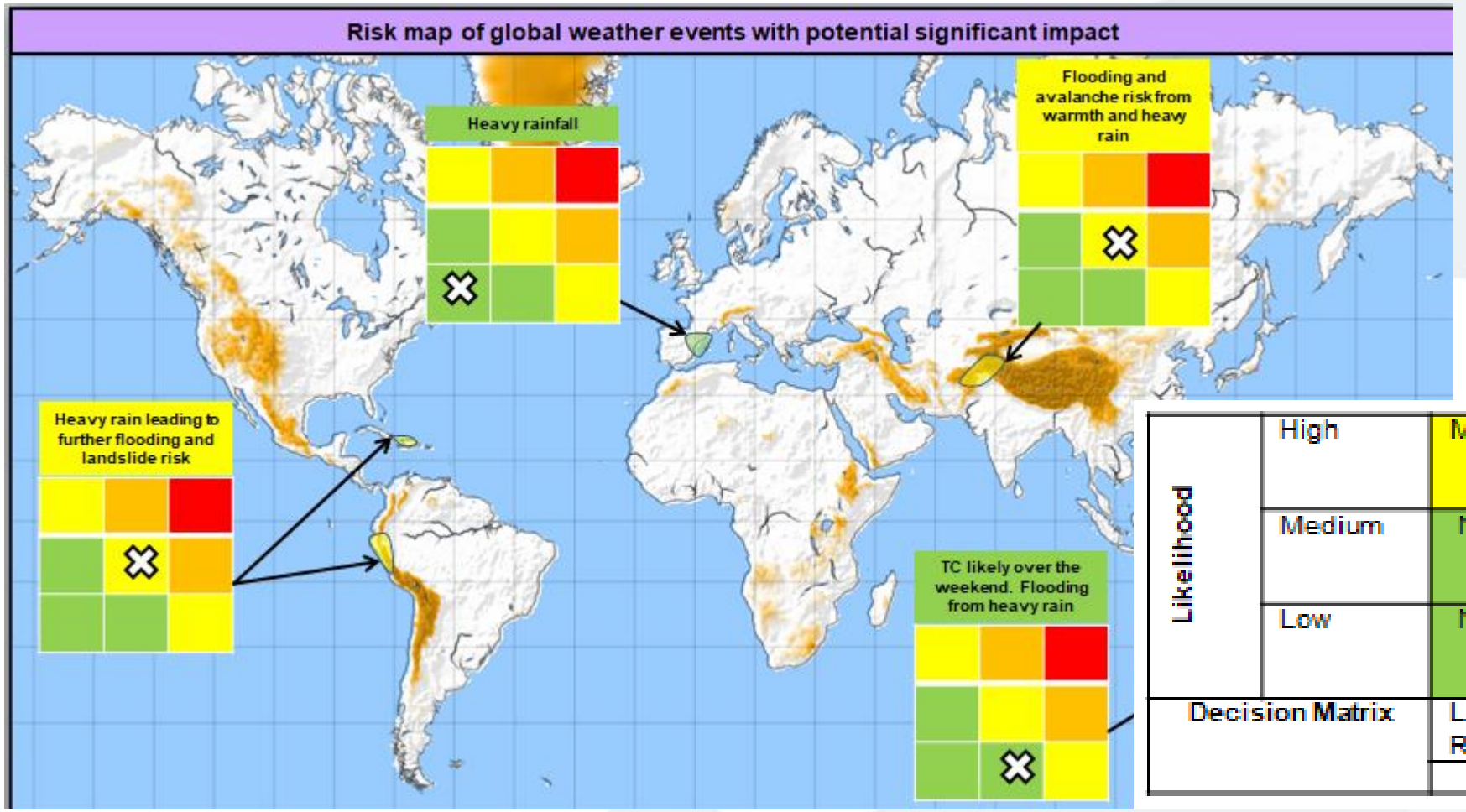
- CAP is a broadly defined standard – it's not designed to contain specific values for specific domains (Met. or Hyd.), e.g. quantification of certainty
- Instead it provides generic elements which basically work like key-value stores and may contain any value: It is possible to communicate any information
- Based on a good technical/syntactic basis we propose to build a scheme to encode **additional information**, which is considered as important by Meteoalarm partners
- Example:

```
<parameter>
    <valueName>urn:meteoalarm:maxgust:kph:number:2.0</valueName>
    <value>120</value>
</parameter>
```

Example of a key
<domain/layer>:[<domain/layerspecific parameter>]:<datatype>:<parameter version>
Contains all meta information to make following value machine readable

- Re-users can ingest this information and use it for displaying warnings or trigger alerts, e.g. value for maxgust
- Still: A CAP message needs to be valid and meaningful on it's own - No Partners/User should be forced to produce or read costumized parameters

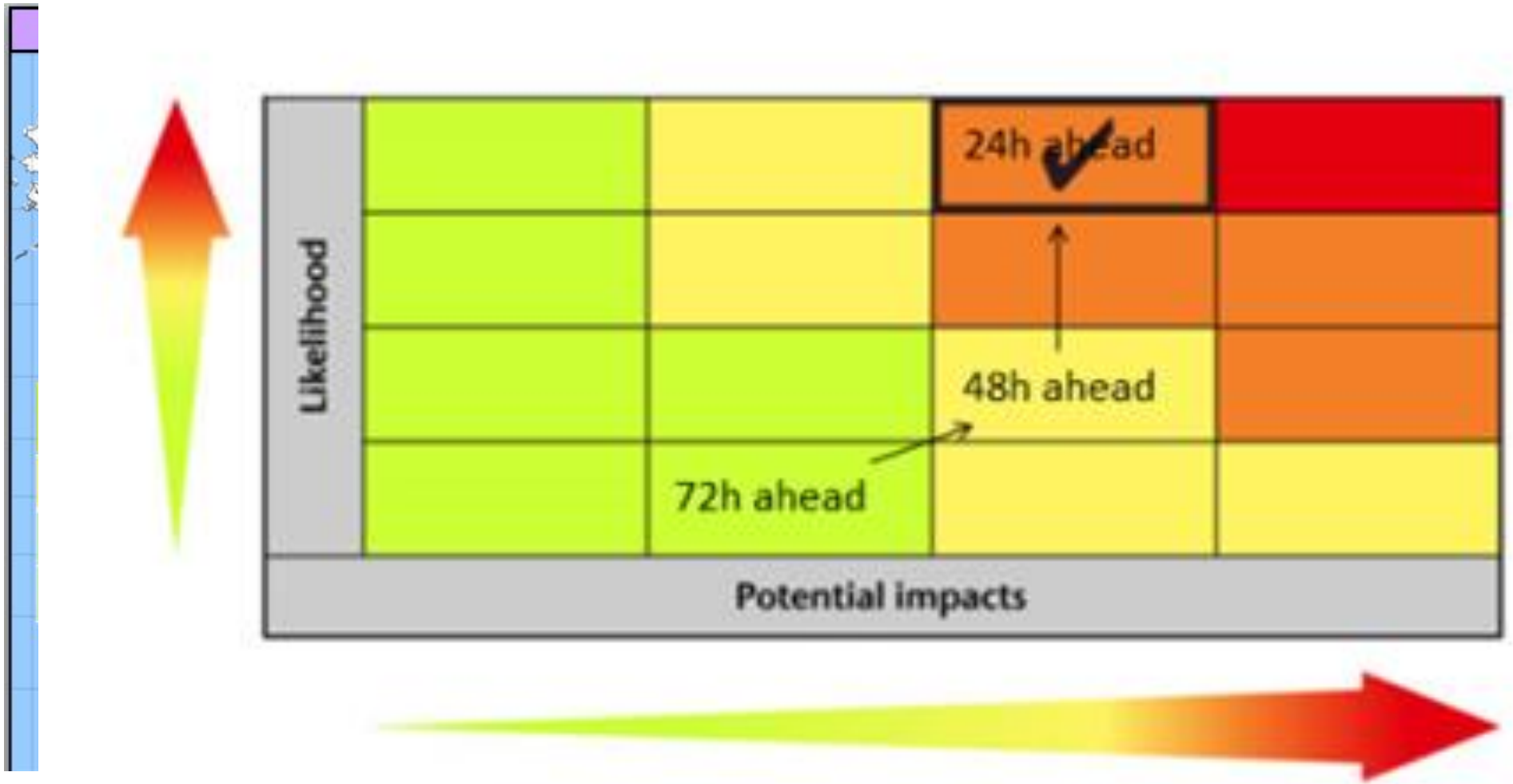
# IbW/Risk Matrix




| Likelihood | | | | |
|---|---|---|---|---|
| | High | Monitor | Prepare | Act |
| | Medium | Nil | Monitor | Prepare |
| | Low | Nil | Nil | Monitor |
| Decision Matrix | | Local Resources | National Resources | Internation Resources |
| | | Impact | | |

*„Basic“ IbW Risk Matrix as used for risk assessment in Aristotle project (funded by European Commission)*

# IbW/Risk Matrix




| | |
|---|---|
| Prepare | Act |
| Monitor | Prepare |
| Nil | Monitor |
| National Resources | Internation Resources |
| Impact | |

*„Bc*

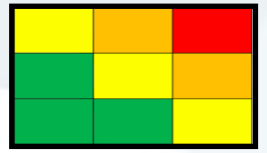
*European Commission)*

# IbW/Risk Matrix

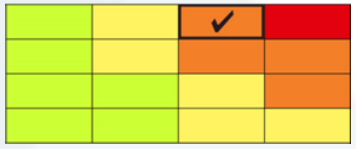
**The risk matrix is a key IbW concept for operational hydromet staff as well as DRM authorities (not necessarily end-users), best practice to determine warning levels and currently used for training all around the world**

**Three ways on how to incooperate the Risk Matrix into CAP**

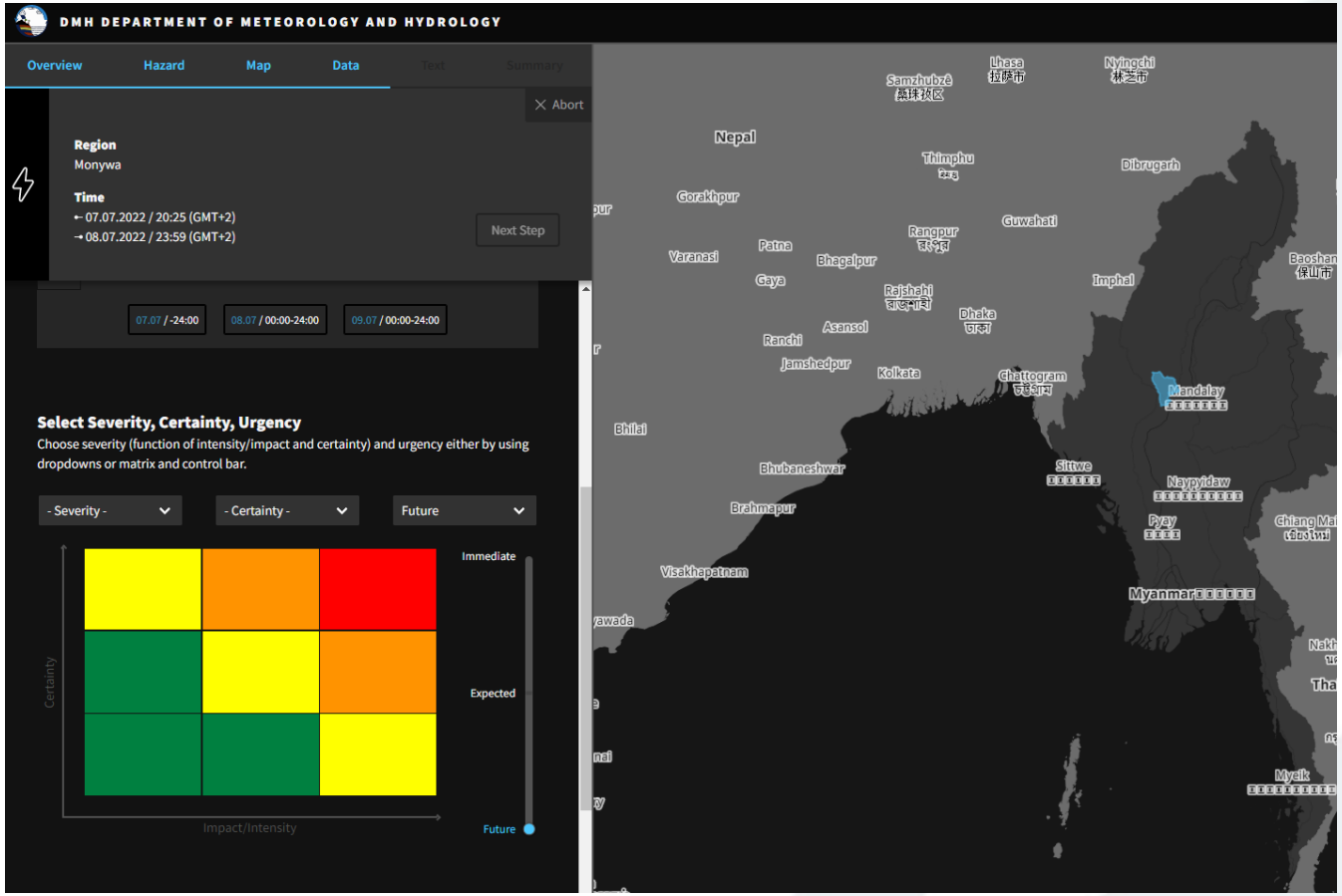
- **Using <severity>, <certainty> and <description>**
  - Advantage: Straightforward for „Basic“ 3x3 Matrix, machine readable if scheme is known
  - The values of certainty and severity allow a unique localization in the matrix for non-minor events
  - Disadvantage: Downstream systems need to „know“ the scheme to be machine readable

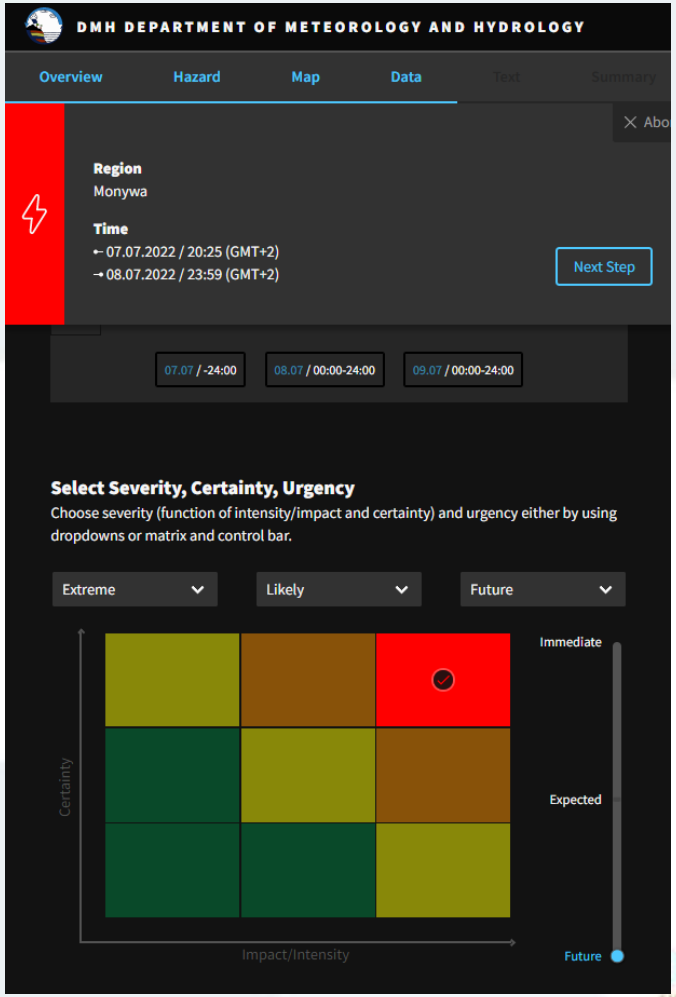


- **Using the <resources>-Element**
  - Link to an image which shows the matrix and the selected field
  - Advantage: Easy to implement and display
  - Disadvantage: Not machine readable
- **Using key-value pairs**
  - <eventType> and <parameter> (optional) have subelements <valueName> (key) and <value> (value) pair
  - To make information machine readable, <valueName> needs to contain all meta information how the value string is composed
  - #matrixformat and #matrixposition could be such optional elements
  - Advantage: Machine readable
  - Has to be part of CAP Guidlines/Profiles



# Risk Matrix in CAP Editors



# Take-home messages

- Using  <description> and <instruction>, based on event-type and warning level as a jumpstart to make a warning impact-oriented, describing „What the weather will do“
- CAP is sutiable for all of these systems: IbFWs for specialized users and IbFWs for public
- Connecting of communities who design these two branches is highly desirable
- Cooperation with large information providers needed for last mile of warning delivery (e.g. warnings tailormade for individual risk profiles based on social profiling, feedback loop)
- CAP elements are well designed for IbW, aspects and nuances needs to be considered when designing CAP-enabled IbFWSs
- Three different ways to incoperate IbW/risk matrix into CAP
- OASIS Event Type List is a great help - more EMTC guidance notes would help to encode additional information in a machine readable, standardized way/for AI
- We will see more guidance on CAP and IbFWs in future
    - Meteoalarm CAP WG
    - WMO CAP Helpdesk

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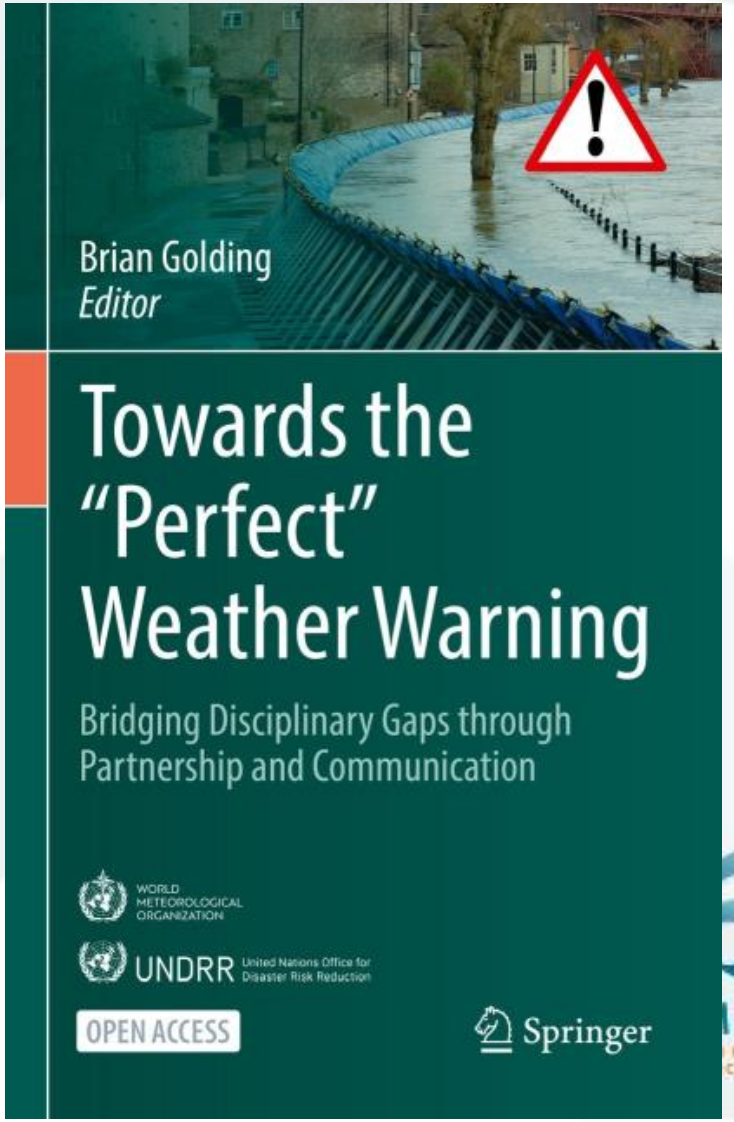
Reading tip:



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