A variety of multi hazard early warning systems (MHEWS) have been developed and successfully implemented over the last decades at the national, regional and European levels.

International organizations and partnerships have long history and proven record of performance in establishing national and cross-border MHEWSs.

The successful implementation always relies on a close cooperation between the NHMSs and all relevant actors, especially the civil protection agencies and the authorities.

Legal agreements, governing structures and regulations (structure, responsibilities, operational resources) are essential for effective, successful and sustainable MHEWS.

The multi hazard approach is becoming increasingly popular. Considering cascades of events, bringing together experts from different fields and the seamless linking of alerting systems.

We will take a short look on the French Vigilance, EUMETNET Meteoalarm, Aristotle-eENSHP and the SEE-MHEWS as examples for successful implementations of MHEWSs in Europe.
Meteorology and hydrology demand extensive international cooperation.

Timely, accurate local weather forecasts require observations of the initial state of the atmosphere from around the globe.

NMHSs and their partners collect and exchange standardized Earth system data as input into numerical weather prediction models.

Global prediction products are downscaled to regional then to national and local levels by NMHSs.

NHMSs generate forecasts, warnings and advisory products and provide/deliver the services to users.

These NMHS activities are the first step in providing early warning services.

But effective decision making and action requires a further step.

Source: Alliance for Hydromet Development
• Emergency response and disaster risk reductions efforts provide a further step.

• Need to establish strong partnerships for disaster risk reduction to enhance disaster preparedness and improve decision-making.

• Legal frameworks that define the scope of work and the complementary relationship between all national agencies that are essential partners in emergency situations.

• These include the NMHS, disaster risk management authority, hydrological service, environment protection agency, health care coordinators and many others.

• In the crossborder context, number of actors is multiplied, the need for a comprehensive governance and operating procedures is even greater.

• A regional framework, supported by cross-border agreements, is necessary to harmonize operations and the production of warnings and to coordinate emergency response.
Paradigm shift in national or local agencies (NMHSs) in:

- Advancing from providers of forecasts and warnings to producers of impact-based forecasts and risk-informed warnings
  From what the weather will be to what the weather will do
- Assuming active roles in all aspects of the disaster risk management cycle and providing better risk-based decision support services.

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

Imagine how your user thinks, feels and what she/he reacts on!
In December 1999, storm Lothar caused devastating damages in Western Europe. Météo-France launched Vigilance in 2001. The system provides 24-hour advanced warnings of weather-related risks to citizens and public authorities. Key factors for success are:

- **Simple, easy-to-understand** information (four warning levels: Red/Orange/Yellow/Green)
- Using most **up-to-date information** – real-time updated information is provided at least twice a day using latest observations and the most recent forecast.
- **Continuous evolvement** – adjustments are made based on user feedback and on yearly assessments (observations and impacts).
- A **multi-user-oriented system** - same information for all (citizens, media and civil protection).
- Progressively integration of new warning parameters (hazards).

The systems served as **best practice example** for the development and the implementation of the national warnings systems of the European NHMSs.
The standardization, aggregation and dissemination of warnings across Europe would take much more coordination. That task was assigned to **EUMETNET**.

**Meteoalarm**, operational since 2007, is an impact-oriented, common framework to aggregate, display and make available meteorological and hydrological warnings of EUMETNET members in an easy and understandable way to the general public and to European (re)users.

Meteoalarm **extended warnings** to add expected impacts and advisories. UNDRR Sendai Framework compliant (priority 4: “people centred multi-hazard early warning systems”).

Impact-based warning decision done on a national basis.

Uses **unified symbols** for different hazards, **polygons** to designate affected areas

Easily readable output in **Common Alert Protocol** (CAP) format. Dissemination of warnings to (re)users via RSS/ CAP feeds and APIs.

**Meteoalarm 3 C’s**: Content, Communication and Co-operation
**Hard facts**

- **Integrated regional warning system** in 33 languages.
- **Authoritative warning information** from 37 NMHSs in WMO Region VI.
- Operational since 2007.
- **Easy and understandable** four level colour code.
- 12 warning parameters.
- Supports impact descriptions and instructions/advisories.
- Added common value through consistent warning philosophy.
- Easy access to information for all, including technical platforms.
- Considered as best practice.

**Community building**

Communication with civil protection on national and European basis (ERCC), integration of national partners (hydro services,...)

Joint development of guidelines and warning concepts

Enhance cross-border collaboration through workshops and communication tools

Exchange of best-practices: „How is it done in your country“?

Yearly partner group meetings
EUMETNET Meteoalarm – Flow of information

Producers

Meteoalarm hub

Consumers

Country 1

Country 2

Country 3

Country 4

Country 5

Interfaces

SOAP, REST

Data Hub

QM

Alert Hub

Archive

DB

API

general public

Re-Users

Authorities

NHMS

ERCC

International Organisations

European MHEWS

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An **operational multi-hazard expert advice system** to support the monitoring and analysis functions of the Emergency Response Coordination Centre (ERCC) of the European Commission.

**Partners:** Consortium of mandated European research and service institutions providing natural hazard information at national level.

**Aim:** To deliver to the ERCC global 24x7 multi-hazard scientific advice in a single and unified multi-hazard scientific assessment of the ongoing and future events.
ARISTOTLE-eENSHP: Operational modes and products

Emergency response mode (ERM)

- +3 hours after activation by ERCC (reactive or proactive)
- Multi-hazard impact oriented reports
- Verbal interaction with the ERCC

Routine monitoring mode (ROM)

- Provided 3 times a week
- Information on potential events developing or updates or those which occurred/are occurring
- (Possible) Verbal interaction with the ERCC

Scientific and Technical Advisory Facility (STAF)

- Remote expert advice service to DG ECHO/SAS (Situational Awareness Sector) during an event
- Provide scenario-based medium-term support to SAS (e.g., impact studies)
SEE-MHEWS (South-East European Multi-Hazard Early Warning Advisory System)

- Frequent severe **hydrometeorological events** have led to substantial loss of life, livelihoods and extensive damages events in South-East Europe.
- In response, in 2016 WMO initiated a **transboundary approach** for the development of the South-East European Multi-Hazard Early Warning Advisory System (SEE-MHEWS).
- The aim was to **strengthen capacity** in the region and provide operational forecasters with **effective tools** to improve forecasts and warnings.
- An advanced **policy framework** was required to facilitate collaboration and effective functioning between entities at the national and regional levels, especially in transboundary context.
- Forecasters from different countries to **work together** on the identification of potential hazards and their impacts on a **collaborative platform**.
- **Collaborative supports** of national authorities in making harmonized decisions on early actions to mitigate potential impacts.
- A **prototype operational advisory system** was implemented. NMHSs were active in the implementation of the system components, including data preparation and exchange.
- The aim of the third phase is to **fully operationalize** the system. To move form the pre-operational (demonstration) phase to full operations.
Major Challenges and Future

- The **successful implementation** always relies on a **close cooperation** between the NHMSs and all relevant actors, especially the civil protection agencies and the authorities.

- Many of European NMHSs already provide **IBWs**. Nevertheless, most if NMHSs are still in the transition phase from using fixed thresholds or climatology-based thresholds to impact-based warnings using subjective or objective criteria.

- The **technological advances** are quite impressive (e.g. cell broadcasting). But we still have to tailor the systems to the needs of users, including social and cultural requirements and broaden all relevant release channels including social media for sharing disaster early warning information.

- The huge potential benefits of multi hazard early warning systems can only be realized with a **successful crossing of the last mile** - that the warnings, and other related information generated are received, understood, and acted upon by the different user groups or individual users in future.

- We have to ensure the consistent and timely **flow of information** from the producers of the warnings to the decision makers, various user groups and the general public.

- **GMAS** can make extensive use of cooperation principles and technical solutions that have been successfully implemented.