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Web based access to hydrological risk data and model simulations in Denmark – how can participatory EWMS support new groundwater and nature based solutions

Peter van der Keur, Hans Jørgen Henriksen, Jacob Kidmose

Geological Survey of Denmark and Greenland (GEUS)

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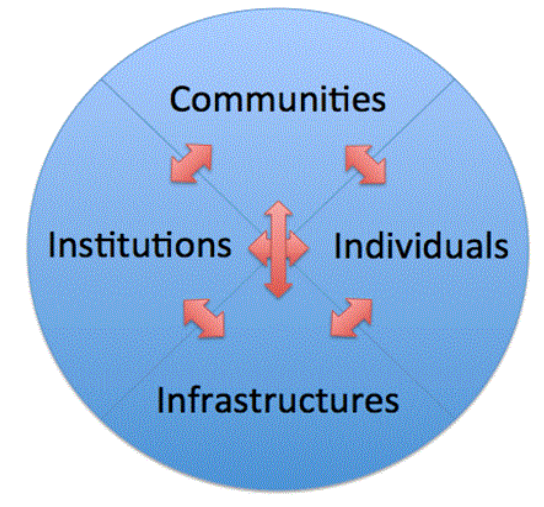
NORDRESS Resilience model



Resilience: the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and resoration of essential basic structures and functions through risk management (UNISDR/EEA 2017)

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Early warning and monitoring systems (EWMS) are defined as: "*The set of capacities needed to generate and disseminate timely and meaningful information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss" (UNISDR 2009)*

Participatory EWMS:

(1) risk knowledge (hazard knowledge, vulnerability of people and society);

(2) monitoring and warning services (technical capacity to monitor, model and forecast);

(3) dissemination and communication (risk communication, understandable warnings and awareness raising);

(4) response capability (capacities of individuals and communities, plans and capacities for timely and appropriate actions by authorities and those at risk).

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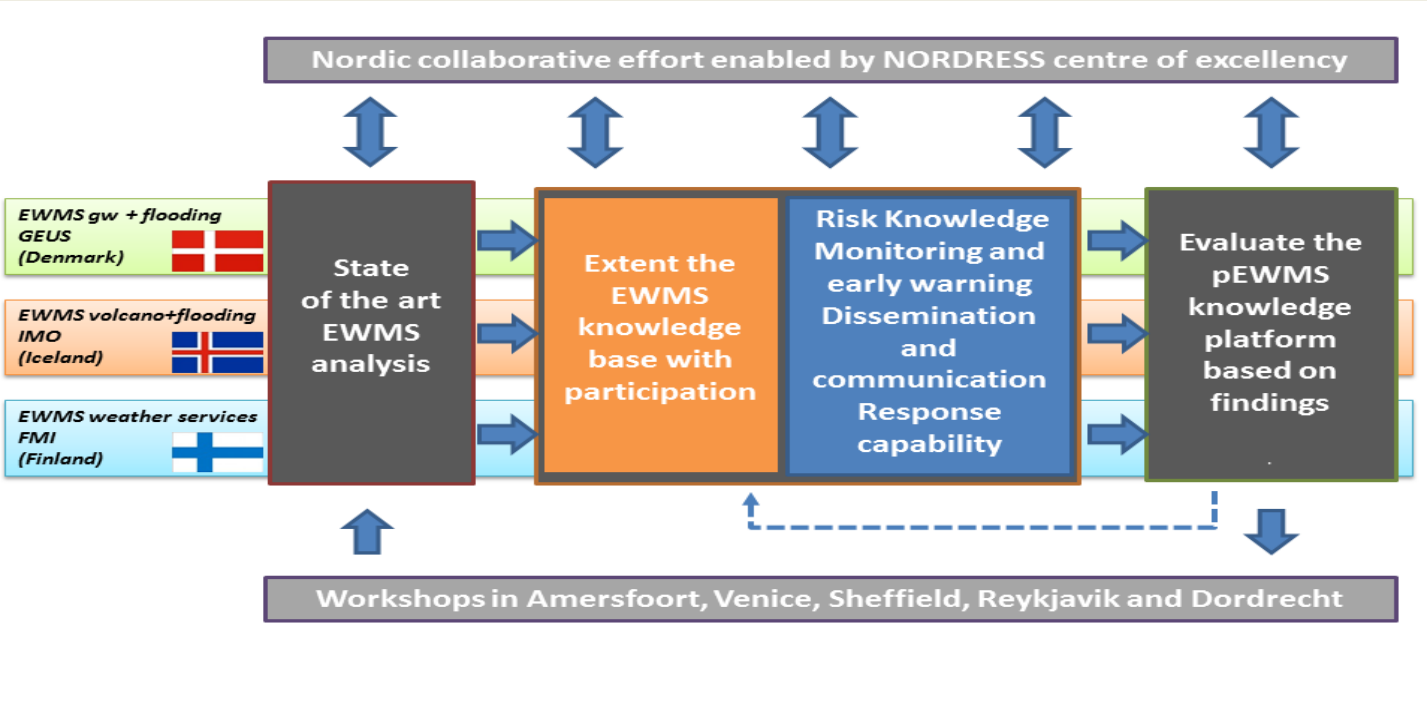
Overview of the pEWMS approach



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Example from Iceland pEWMS for volcanic eruptions

Why do observations from the public matter? Verification of impact!

Icelandic Met Office

Public observations can be incorporated into existing monitoring networks and forecasting systems so that:

i. more timely and accurate warnings can be issued;

ii. more comprehensive compilations of damage impacts are received; and

iii. hazard awareness and perception of risk are improved.

Flash flooding in Siglufjörður, 28 Aug 2015

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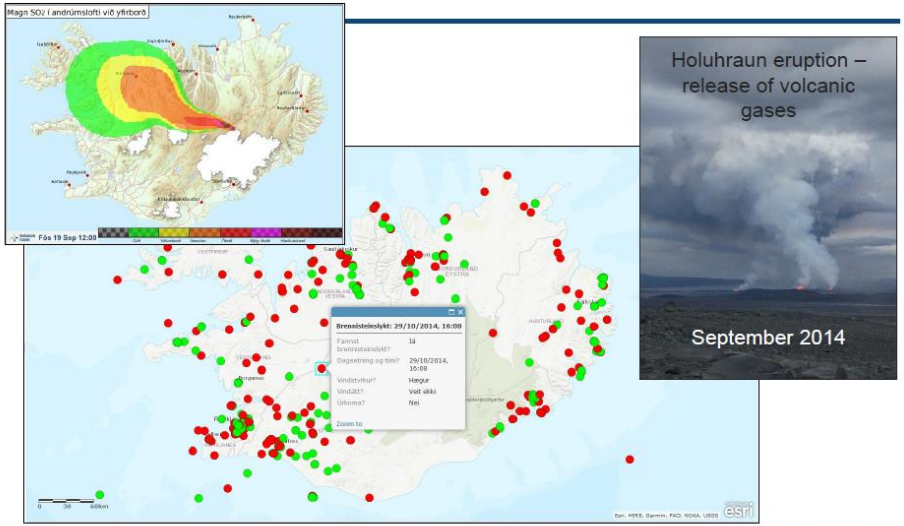
NORDRESS results from Iceland (IMO)

Geo-form used during the 2014–2015 eruption at Holuhraun

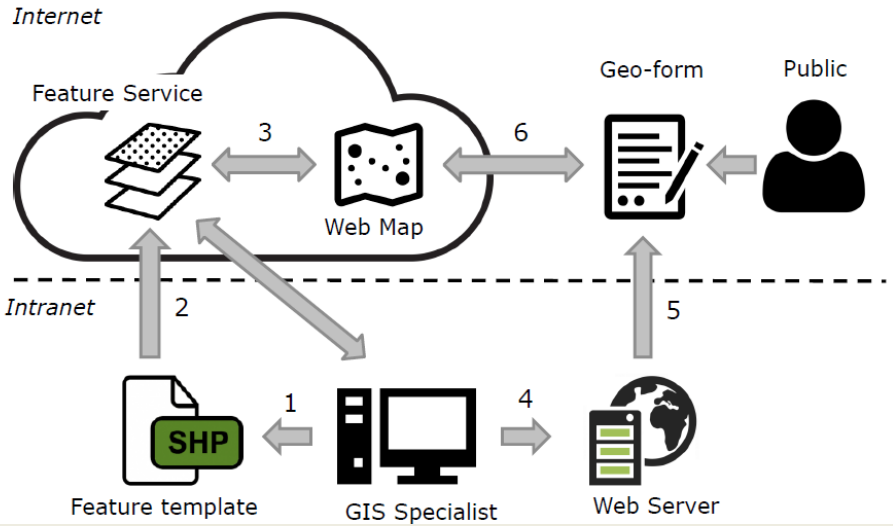
Icelandic Met Office



Hundreds of reports received during the eruption

Components of a geo-form registration page

Icelandic Met Office



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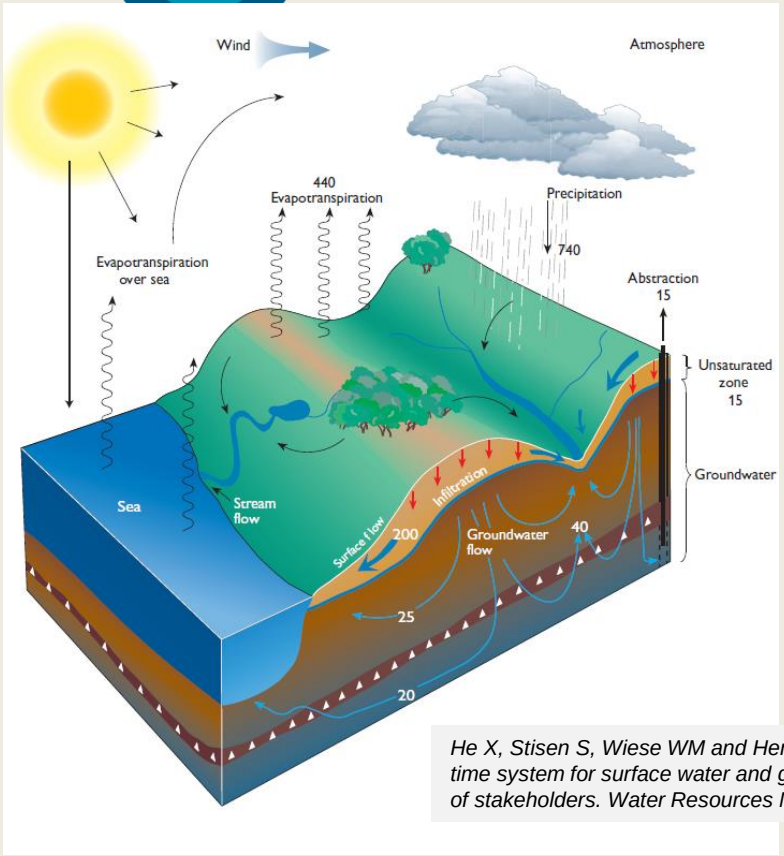

He X, Stisen S, Wiese WM and Henriksen HJ. Designing a hydrological real-time system for surface water and groundwater in Denmark with engagement of stakeholders. Water Resources Management. 30, 2016,1785-1802

National Level

Local level

Updated DK-model
Real time simulation
latest DMI climate data
Pure modeling
No monitoring
No data assimilation
Simple uncertainty assessment

DK-model Forecast
Based on DMI weather forecast
5-7 day Forecast
3-6 month Forecast
Pure modeling
Uncertainty/skill score analysis
No monitoring or DA

Decision support
Simple system support tool
Combination of:
DK-model output
Monitoring data
Local knowledge
Bayesian network
Decision tree

Complex local model
Combination of:
Detailed model
MIKE 11 / MIKE URBAN
DK-model output
Monitoring data
Data assimilation

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Denmark: New vision for Hydrological Information and Prognosis system (HIP)

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- Historical data and **real time observations**
- Nationwide hydrological simulations and forecast
- Calculated hydrological indices
- **Copernicus Emergency Management Services** (event data, remote sensing)
- **Two-way information** system platform (upload of photos etc., valuation, local knowledge)
- **Web-based interface** for exhibiting and download of data and model results

ScienceNordic article January 5, 2016

”Near” real time: groundwater + runoff

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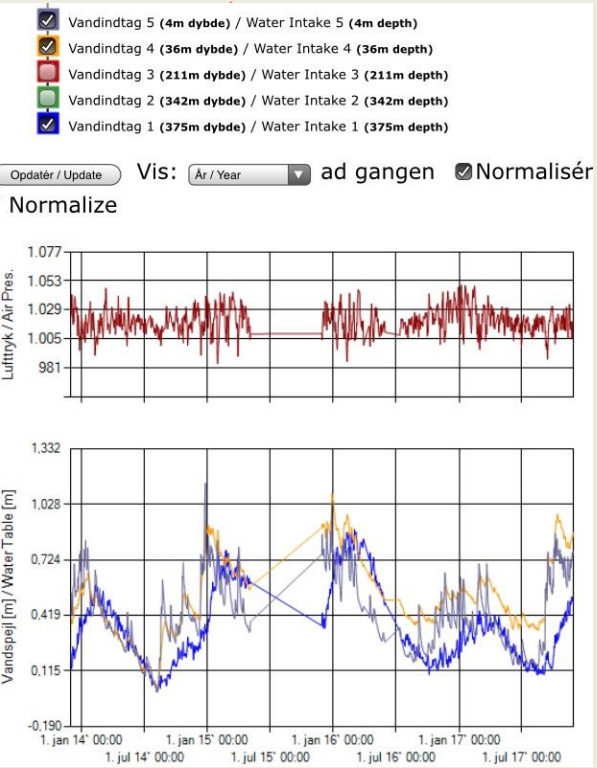
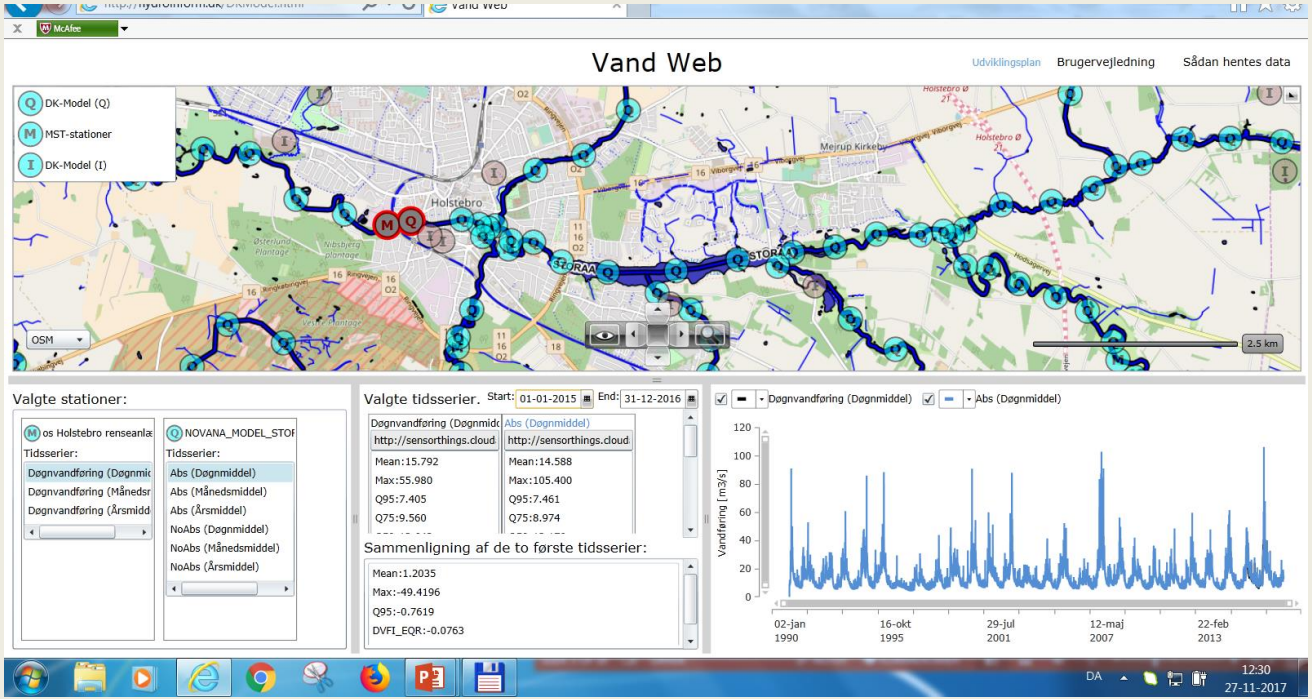


Vand Web : http://hydroinform.dk/DKModel.html



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Ambiguity and conflicts in rural areas in Denmark – how can we increase (current) lack of institutional trust?

With the increased pressure on water resources, and the challenges faced with the implementation of the existing regulatory framework, **we experience a lack of trust about models and knowledge** used by authorities to assess the environmental status of water bodies and the potential impacts of new measures… (example: Agricultural Act on competitive and sustainable agriculture, Landbrugspakken)

Adaptive modelling and 2-way information

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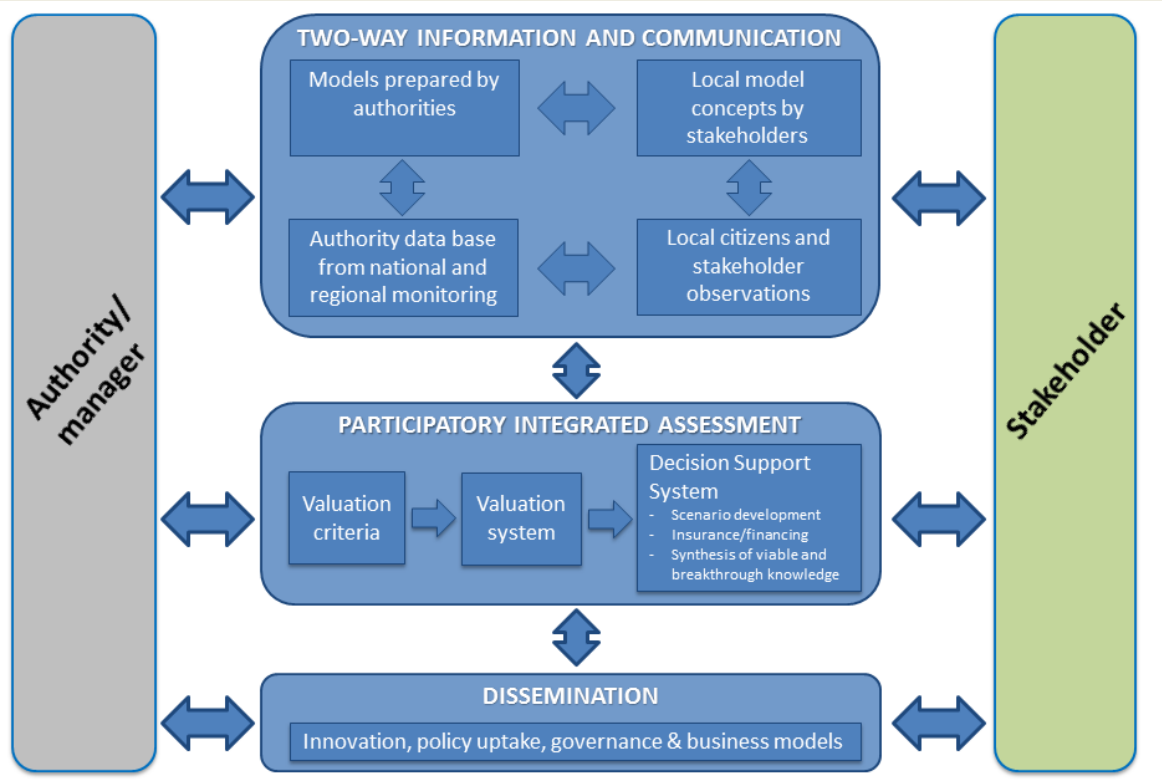

Water management decisions are usually based on data bases, models and information systems.

These systems are traditionally constructed by the competent water authority, while stakeholders typically are informed and sometimes consulted.

Economic assessments are often provided without considering externalities related to social and ecological sustainability.

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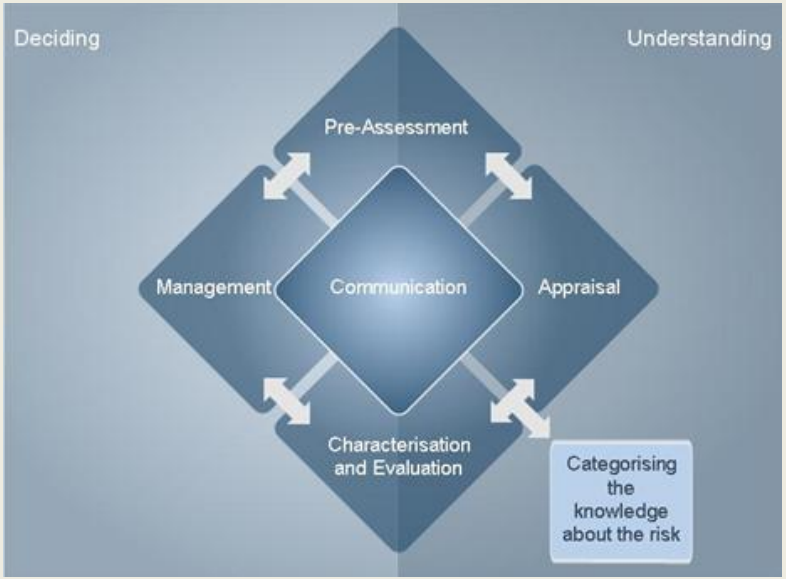
Adaptive modelling & Risk governance process (2/2)



Source: Ortwin Renn 2017 (IDRIM/Reykjavik)

- Focus on balance between precautions responses (urban planning, flood retention areas) <> pro-active prevention (technical protection, resilience based planning)
- New governance strategies combining effectiveness (experts), efficiency (corporate sector), resilience (governments) and fairness (NGOs) to achieve legitimacy and public support
- Inclusion of stakeholders, different agencies, local communities and affected residents
- More effective educational programs and convincing narratives that make people understand their opportunities and risks and prepare them for their role in the new information age

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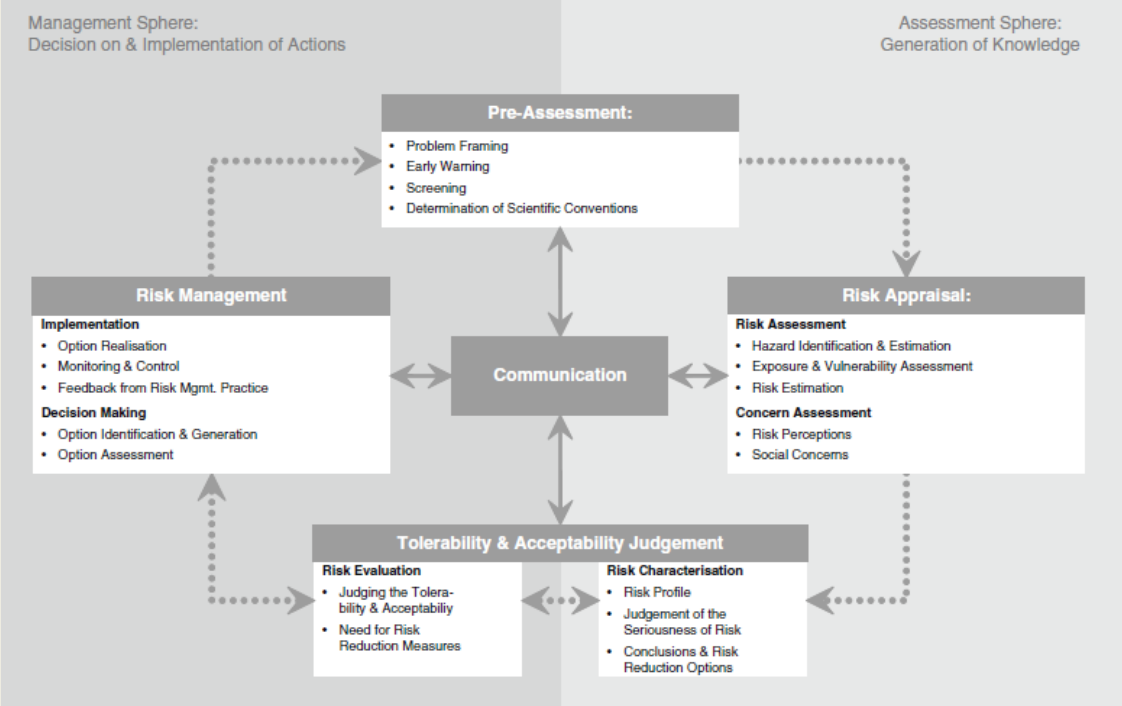
Adaptive modelling & Risk governance process (2/2)



Source IRGC, 2005

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Keypoints

Groundwater flooding can have many causes: cloudburst, sea level rise, coupled rain, decreased groundwater abstraction, renovation of sewage systems, infiltration of rain water etc.
On-line GIS services are clearly a viable and effective way of gathering non-technical information from the public.
Public participation in key stages of the warning process can help to validate forecasts and provide early recognition of potentially harmful changes.
Public reporting of unusual or damaging natural events not only provide scientists and first-responders with valuable local information and context, they also help to increase public awareness of natural hazards

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Conclusion

- In the need for vulnerability and risk informed mapping of groundwater flood risk, instead of simply providing hazard maps, pEWMS enable risk information, that integrate scientific and local knowledge, past, present and future (DRR, CCA + water management/risk governance)
- pEWMS enable increased risk awareness, and as a two way information system (for water & emergency management, CCA and DRR) can increase societal security and efficiency of flood risk management (required for implementing of new measures)
- Risk and territorial governance add new insights from adaptive management, add local knowledge and place based risk perception, into adaptive and integrated catchment based management which is key for handling complex flooding risks from groundwater & rivers

Acknowledgement

NORDRESS www.nordress.hi.is
VAND WEB http://hydroinform.dk/DKModel.html
NAIAD www.naiad2020.eu

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Realtime modelling project (GEUS)

Further reading:

Van Well, L., van der Keur, P., Harjanne, A., Pagneux, E.P., Perrels, A., Hans Jørgen Henriksen, H.J.(2018). Resilience to natural hazards: An analysis of territorial governance in the Nordic countries. International Journal of Disaster Risk Reduction, xx (2018) xxx–xxx.

Henriksen, H.J., Roberts, M.J., van der Keur, P., Harjanne, A., Egilson, D., Alfonso, L. (2018). Participatory early warning and monitoring systems: A Nordic framework for web-based flood risk management. International Journal of Disaster Risk Reduction, xx (2018) xxx–xxx.

van der Keur, P., van Bers, C., Henriksen, H.J., Nibanupudi, H.K., Yadav, S., Wijaya, R. Subiyono, A., Mu-kerjee, N., Hausmann, H-J., Hare, M., Terwisscha van Scheltinga, C., Pearn, G., Jaspers F. (2016). Identification and analysis of uncertainty in Disaster Risk Reduction and Climate Change Adaptation in South and Southeast Asia. International Journal of Disaster Risk Reduction, 16 (2016) 208–214.