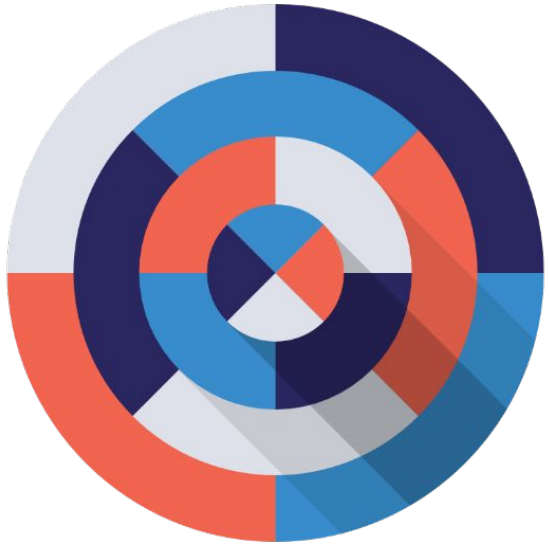


VSAE

Actuarial Expertise in Large-Scale Disasters

Bas Kolen

Professor Enterprise Risk Management, UvA
Scientific Director HKV consultants

National risk assessment Netherlands

	Very unlikely	Unlikely	Somewhat likely	Likely	Very likely
Catastrophic		• Flooding from the sea	• Pandemic caused by a virus transmissible from human to human		
Very serious	• IS seizes power in Morocco • Deployment of nuclear weapons in the Iran and Saudi Arabia conflict • Induced earthquake	• Chain effects of a power outage • Reunification of China and Taiwan • Temporary occupation of an EU Member State	• River flood • Flu pandemic • Collapse of the Venezuelan state • Disintegration of NATO • Systemic actor in the finance sector facing great difficulty	• Hurricane • Heat/drought • Import of fossil energy • Attack on a cloud service provider	
Serious	• Borssele nuclear plant • Train disaster with flash fire • Ransomware attack on telecommunications provider	• Trade war involving Europe • Multiple terrorist attacks • Disruption of payments • Foreign state acquiring a stake in a major telecommunications provider • Infiltration of public administration	• Snow storm • Crisis in the South China Sea • Rift within the EU • Criminal violence targeting media and government • Foreign interference diaspora communities • Assault on and hostage-taking in parliament	• Nationwide blackout • (Covert) influencing by China • Social polarisation surrounding conspiracy theories • Break-up of Bosnia-Herzegovina	• Hybrid operations by Russia – exploiting societal debate • Flu epidemic • Trade disruption due to production issues abroad • Wildfires
Substantial	• Radiation accident in Europe • Failure of an ammonia storage tank	• European debt crisis • ICS cyber attack - chemical industry • Ransomware attack in the healthcare sector • Terrorist attack using a bioweapon	• Disintegration of the OSCE • Attack on pride event • Naturally occurring earthquake • Escalation of violence by right-wing extremists • Anarcho-extremism • Foreign regulation of tech companies • Subversive enclaves	• Cyber espionage target at public authorities • Organised crime throughout the Netherlands • Outbreak of foot and mouth disease among cows • Traditional state espionage • Innovation of nuclear delivery systems • Adjustment of the value of financial assets • Misconfiguration at major ISP • Criminal interference in business • Anti-government extremism	• Collateral damage
Limited			• Outbreak of a zoonotic variant of avian flu	• Shortages of key raw materials • Acquisition of a company whose products include dual-use goods	• Lone actor • Foreign venture capital investment in start-ups
	Very unlikely	Unlikely	Somewhat likely	Likely	Very likely

Source: RIVM 2022

National risk assessment Netherlands

Pandemic & Flood

- Low Frequent
- Catastrophic impact

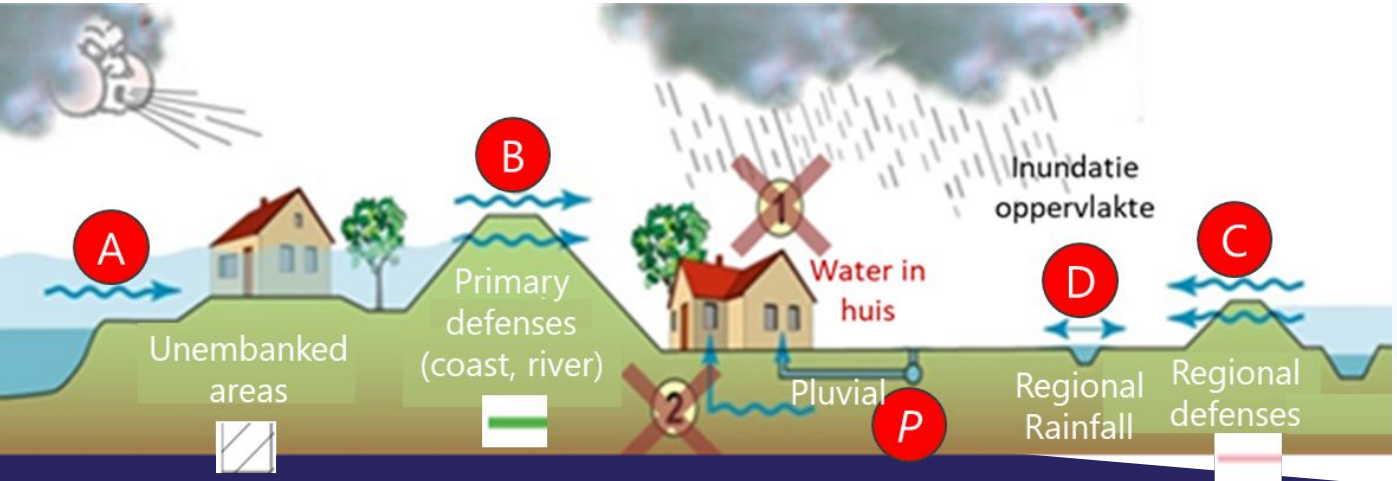
- Also other floods and pandemics are possible

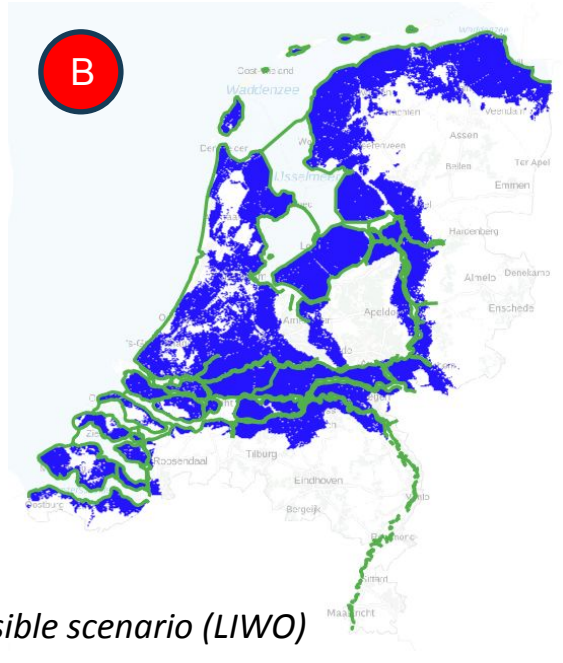
	Very unlikely	Unlikely	Somewhat likely
Catastrophic		 Sea flood (worst case)	 Virus from human to human
Very serious	• IS seizes power in Morocco • Deployment of nuclear weapons in the Iran and Saudi Arabia conflict • Induced earthquake	• Chain effects of a power outage • Reunification of China and Taiwan • Temporary occupation of an EU Member State	• River flood • Flu pandemic • Collapse of the Venezuelan state • Disintegration of NATO • Systemic actor in the finance sector facing great difficulty

Source: RIVM 2022

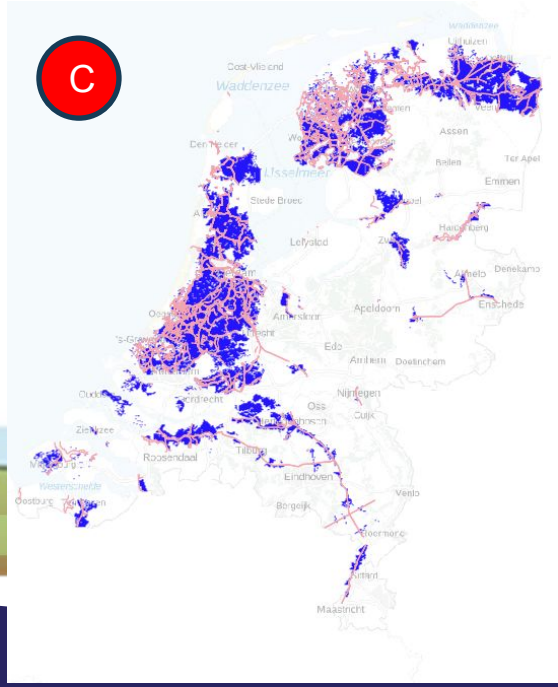
Different causes of flooding

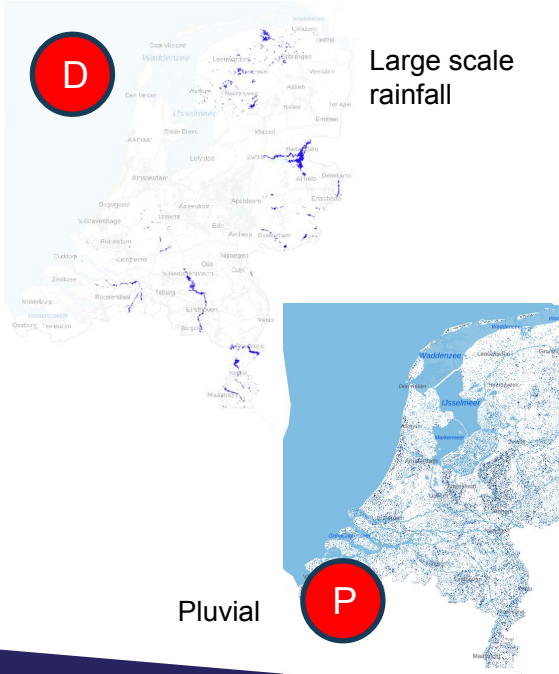
- Sea (storm surge) (A,B)
- Rivers (extreme discharge) (A,B)
- Rainfall
  - Regional levees (C)
  - Large scale events (D)
  - Local thunderstorms (P)





> 1000 Possible scenario (LIWO)





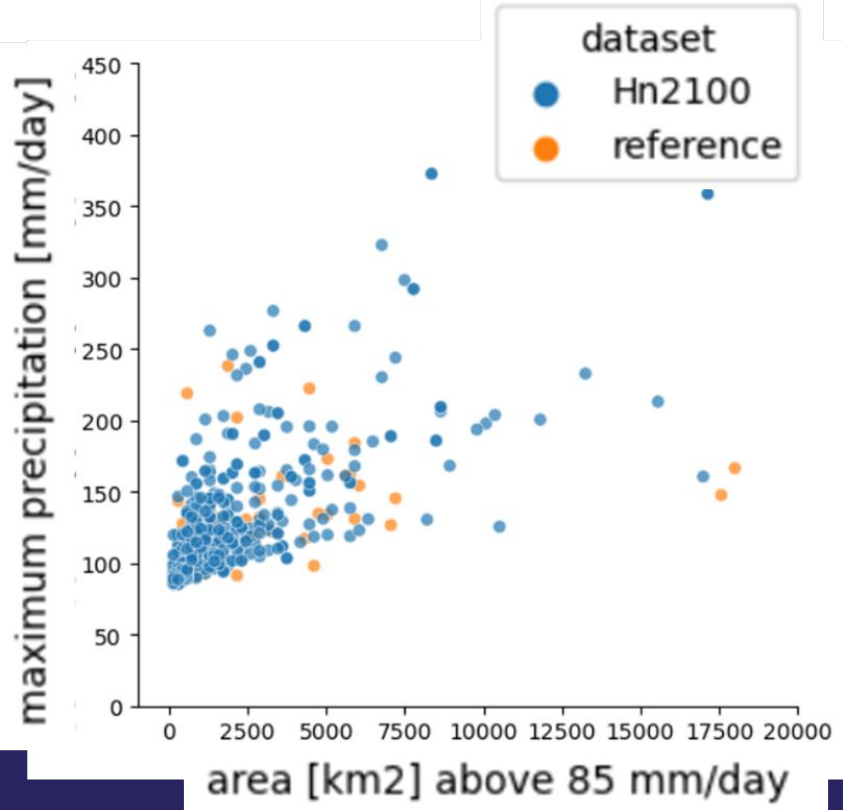
Climate change

Extreme rainfall

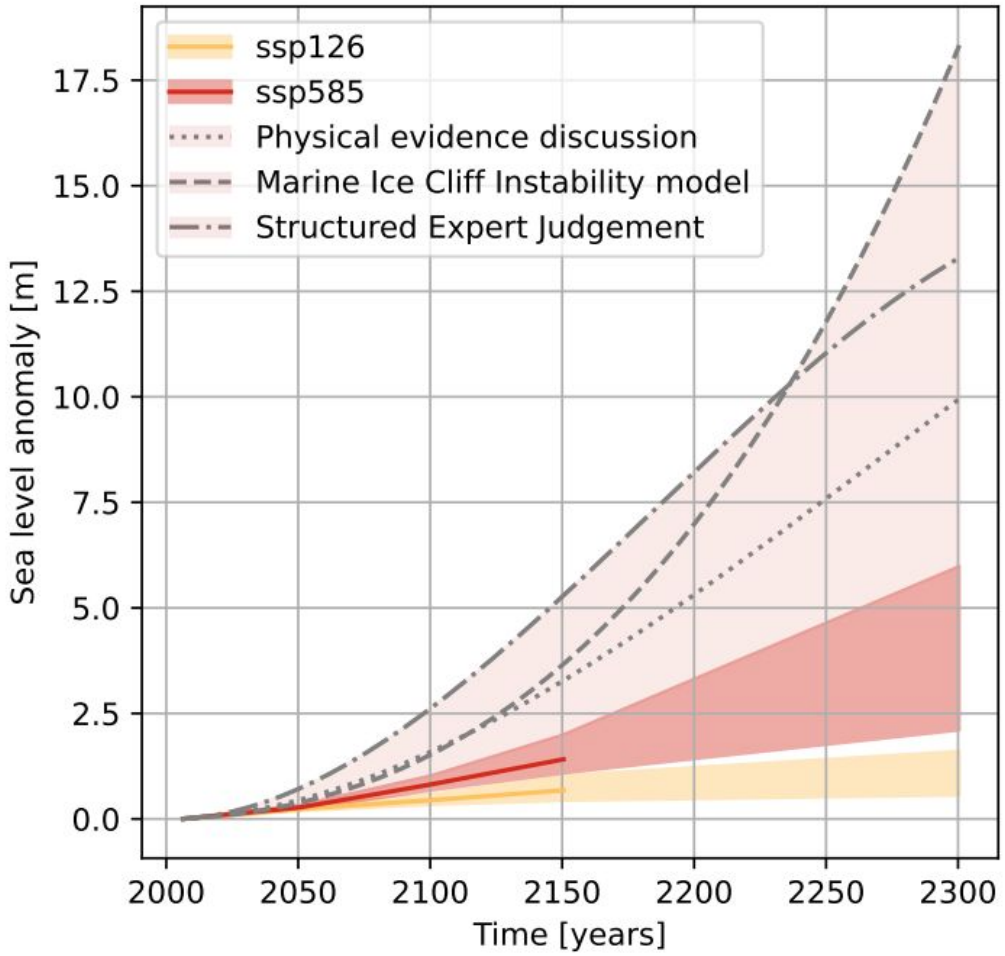
Statistics *for a location* in NL based on KNMI 2023 ‘High’ (meteobase.nl)

- 1Hour 2025: 58mm, 2100: 71 mm
- 4Day 2025: 128 mm, 2100: 144 mm

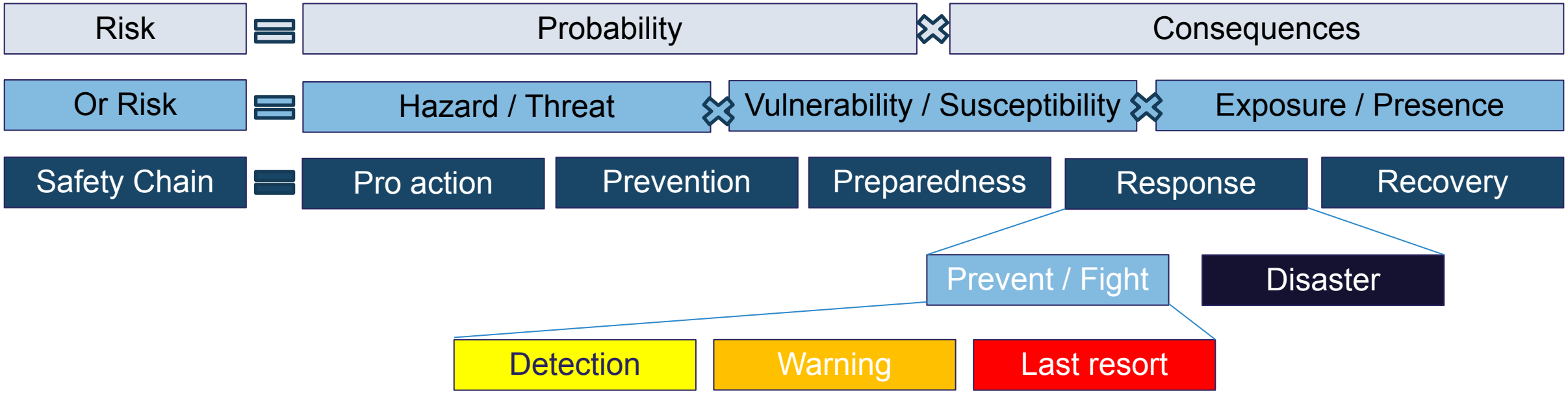
2025: New extreme – large scale scenarios



Possible scenarios for Sea Level Rise (SLR)



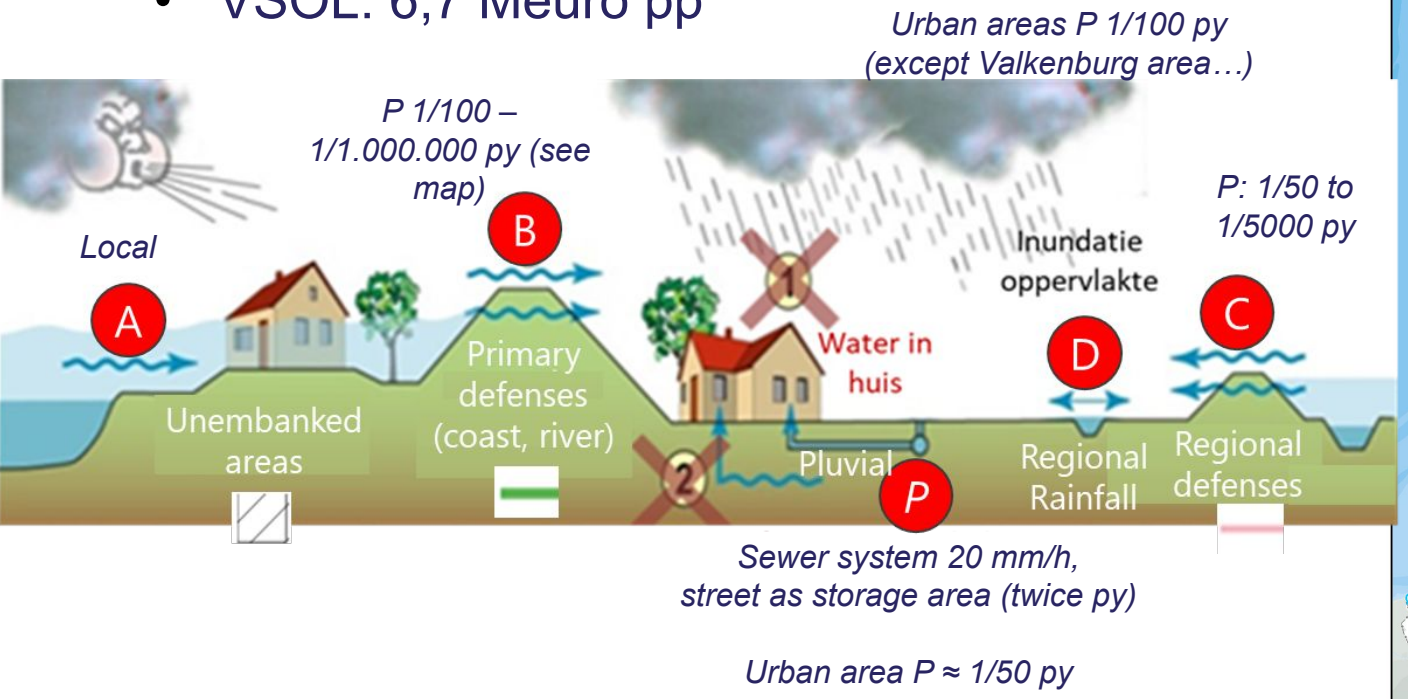
Risk perspective



- Flood or Pandemic event: no society is designed to deal with the consequences
- The risk is never zero, the ‘precautious principle’ does not apply
- Societies already accept risks (eg individual risk of 10-6 per year in external safety)

Flood: Safety standards
(layer probability / prevention)

- Using SCBA
- VSOL: 6,7 Meuro pp



Pandemic
(layer probability / prevention)

Hospitals capacity

Ventilation in buildings

Sewer system

QALY (quality adjusted life year)
- €80.000 per year for a healthy person

Time line Flood event (1)

Prevent & Fight (response)

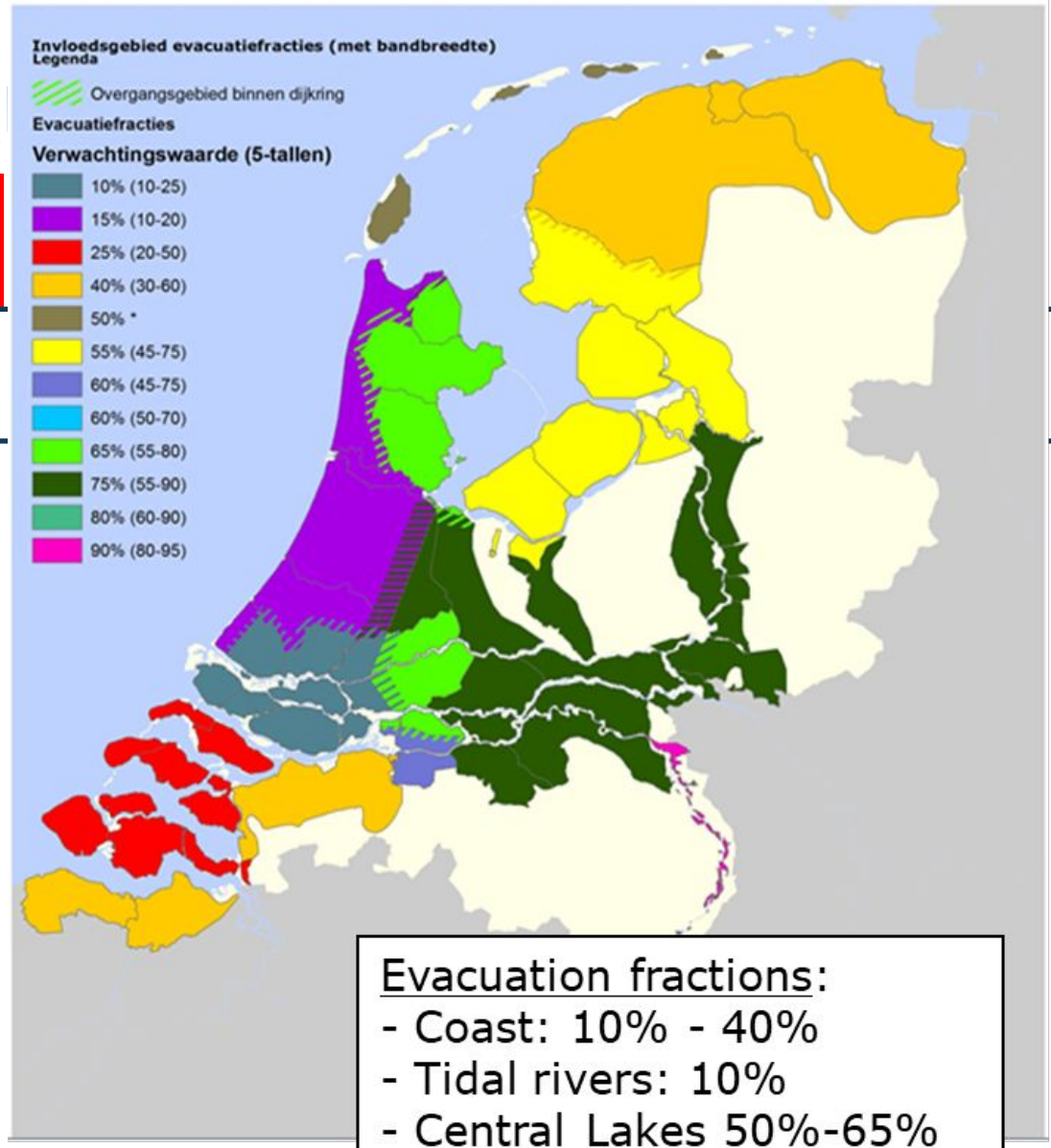
Normal day to day life	Detection and forecast	Warning and fighting	Last resort: Evacuation

T=0

3-7 days

1–3 days

Water management & levees Forecasting systems Land use planning	Monitor water levels Forecasts for weather and water levels Detection potential threat	Warn public Mobile flood barriers Remove cattle in unembanked areas	To avoid loss of life Prior to a flood

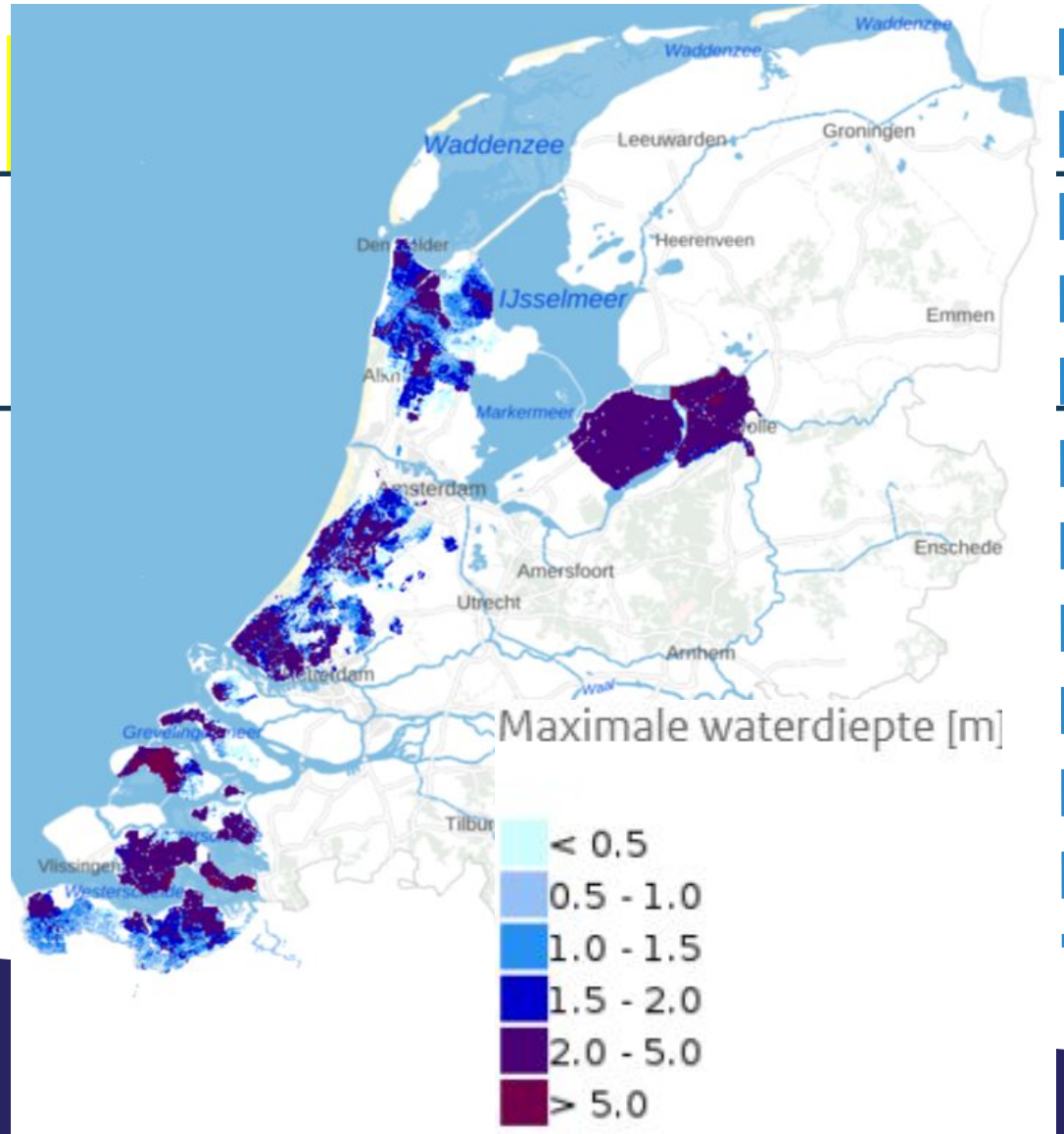


Evacuation fractions:
- Coast: 10% - 40%
- Tidal rivers: 10%
- Central Lakes 50%-65%
- Upper Rivers: 75%-90%

Time line Flood event (2)

Normal day to day life

Timeline



Disaster (response)

Flood	Removal of flood water	Recovery

Days / week → Months → Years

Worst Credible Flood

- *Damage: 121 Billion € (2006)*
- *Loss of life >10.000 people*

Close breaches

Pumping water out

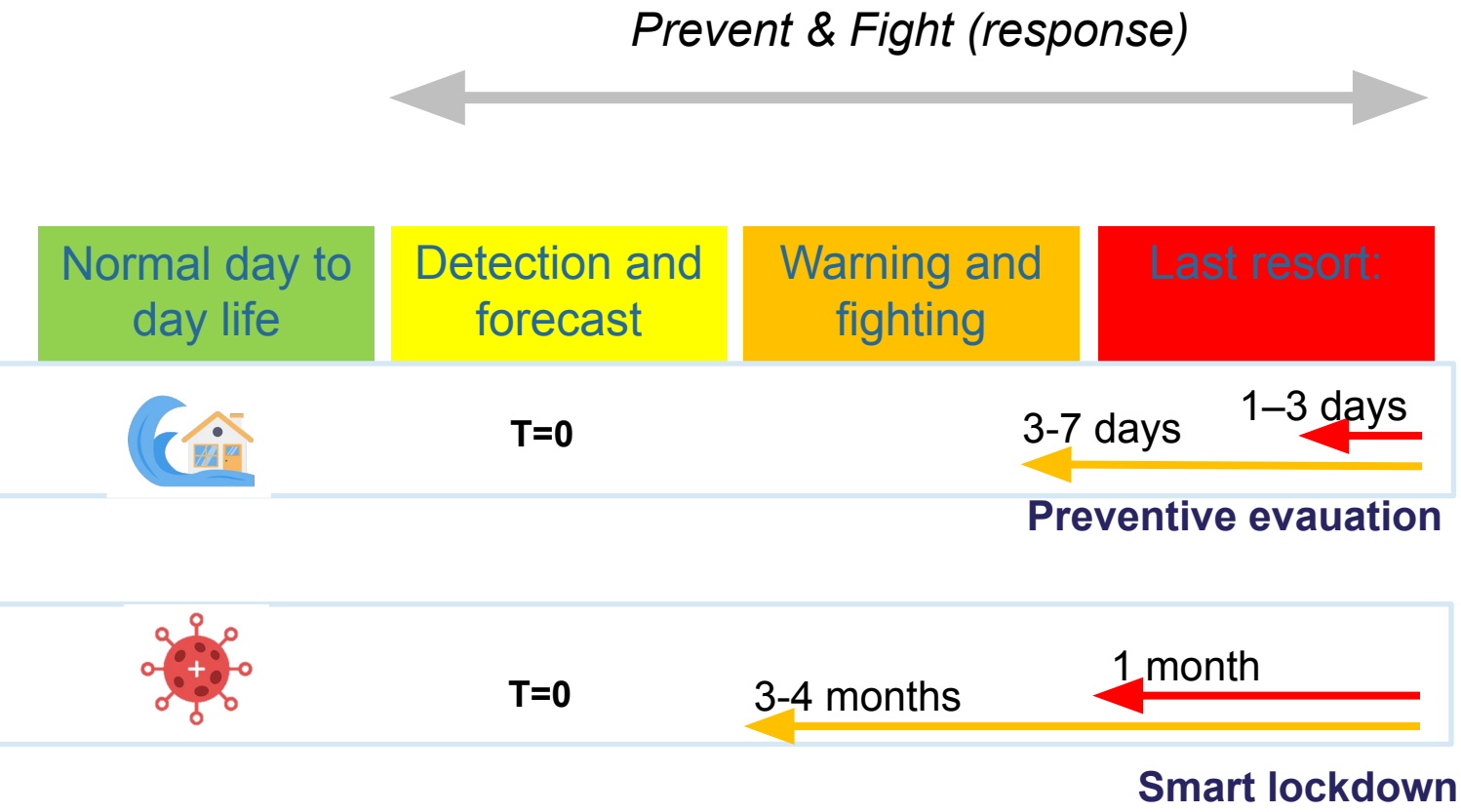
Damage compensation

Reconstruction

Social aspects

Breach o f levee
Start of flood

Flood & Pandemic



Similarities

- Low frequent events
- No to limited data / experience => uncertainty (will reduce over time)
- Early warning

- Risk trade-offs in:

A. Normal life (levees, IC, medicine)

B. Crisis (accept some costs to prevent possible worse)

C. No decision is also a decision

Differences

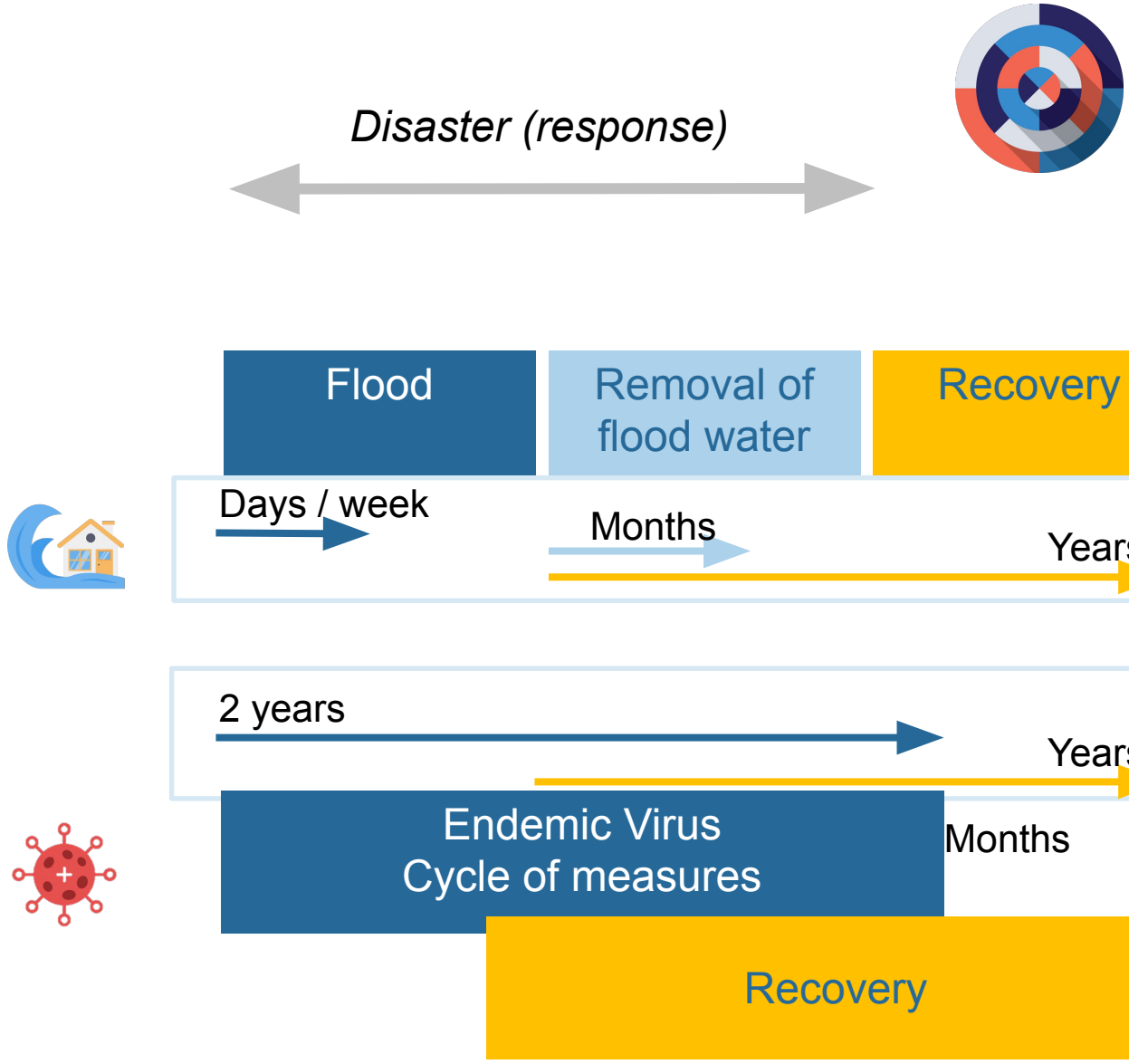
- Duration
- Type of measures

Flood & Pandemic

Similarities
- High Impact and long recovery
- Damage compensation / Insurance

Differences
- Duration

- Pandemic: Real time data collection => over time data improve,
  But: the virus will change as measures and perceptions …



Woordwolk

What are similarities between a pandemic and flood?

Woordwolk

What can (or should) an actuary add to crisis teams during the start of pandemic (until the virus becomes endemic) or a flood (before the levee fails)?

If the measures is specific for a pandemic or a flood please mention this.

Woordwolk

What can (or should) an actuary add to crisis teams from the endemic phase of a pandemic or in the recovery phase of a flood?

If the measures is specific for a pandemic or a flood please mention this.

Challenges and opportunities for actuary in response and recovery

Challenge: limited data (health, climate), uncertainty, decisions are made anyway

Added value:

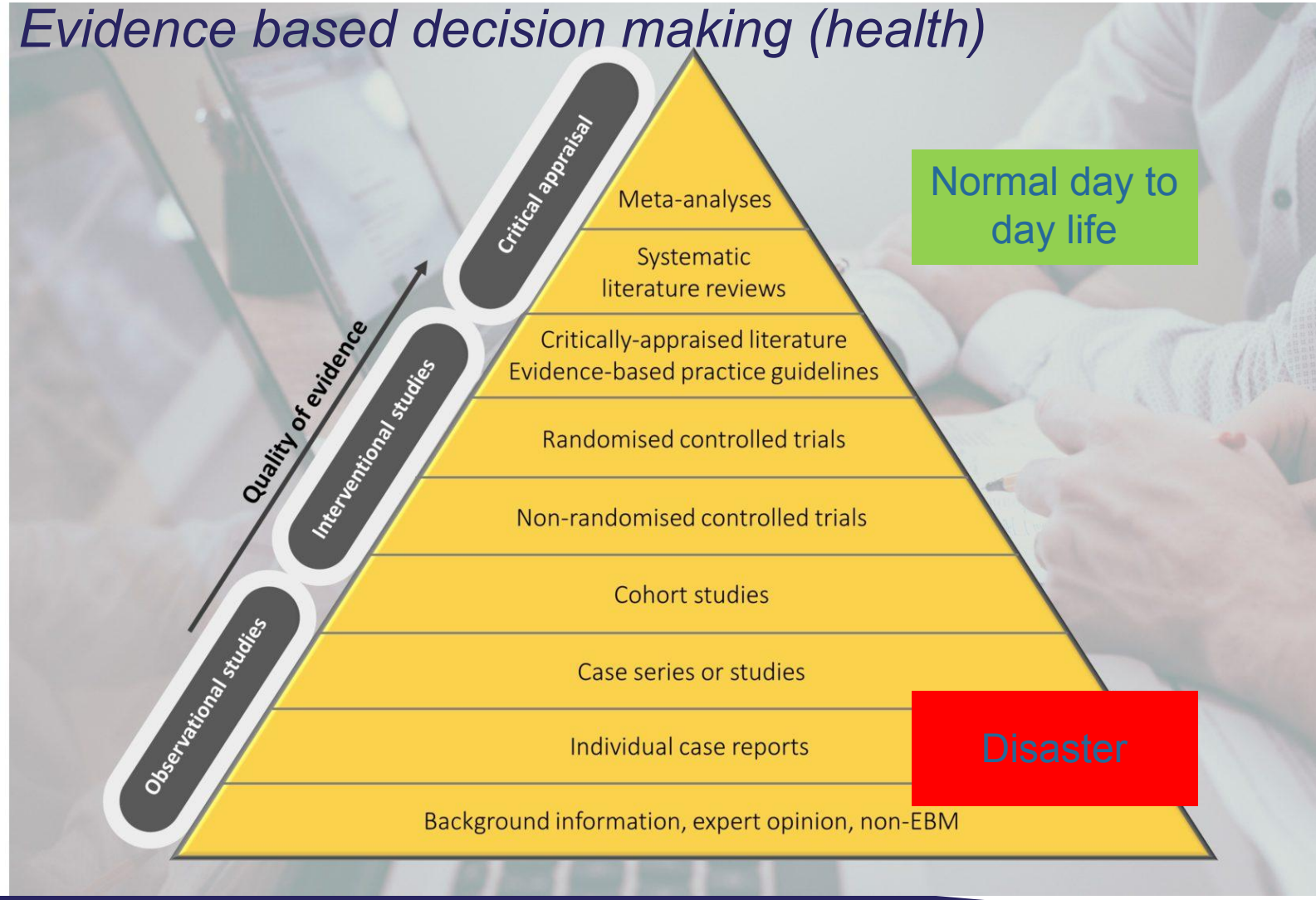
1. Risk expertise focusing on the

   - Order of magnitude of risk (economic, loss of life, …)

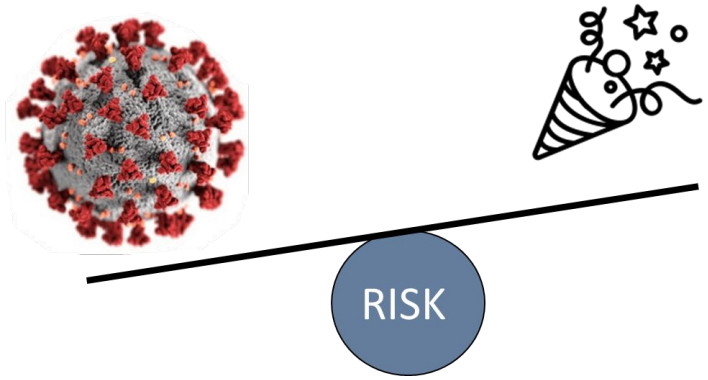
   - Identify (not) important components of risk

2. Damage compensation during disasters

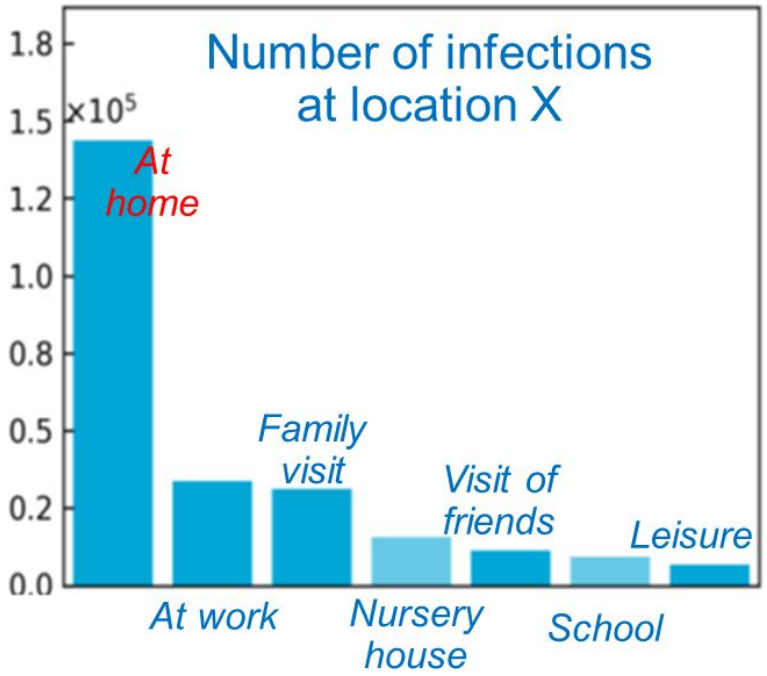
3. Building back better



Example: (Covid-19) Risk taxation model for Field Lab events

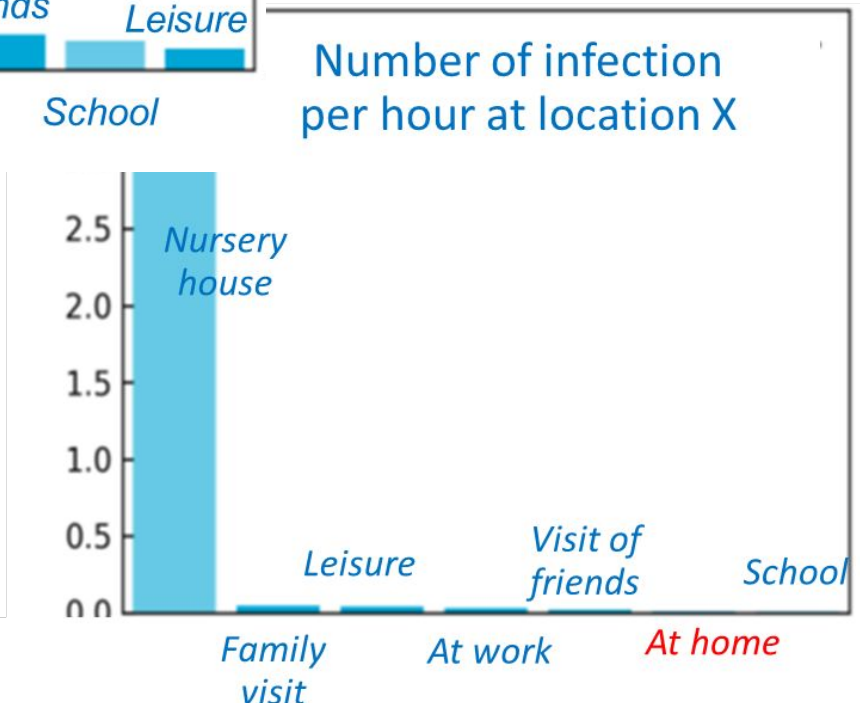


Can we reduce the infection risk at an event (per hour) so it is less than 'at home'?

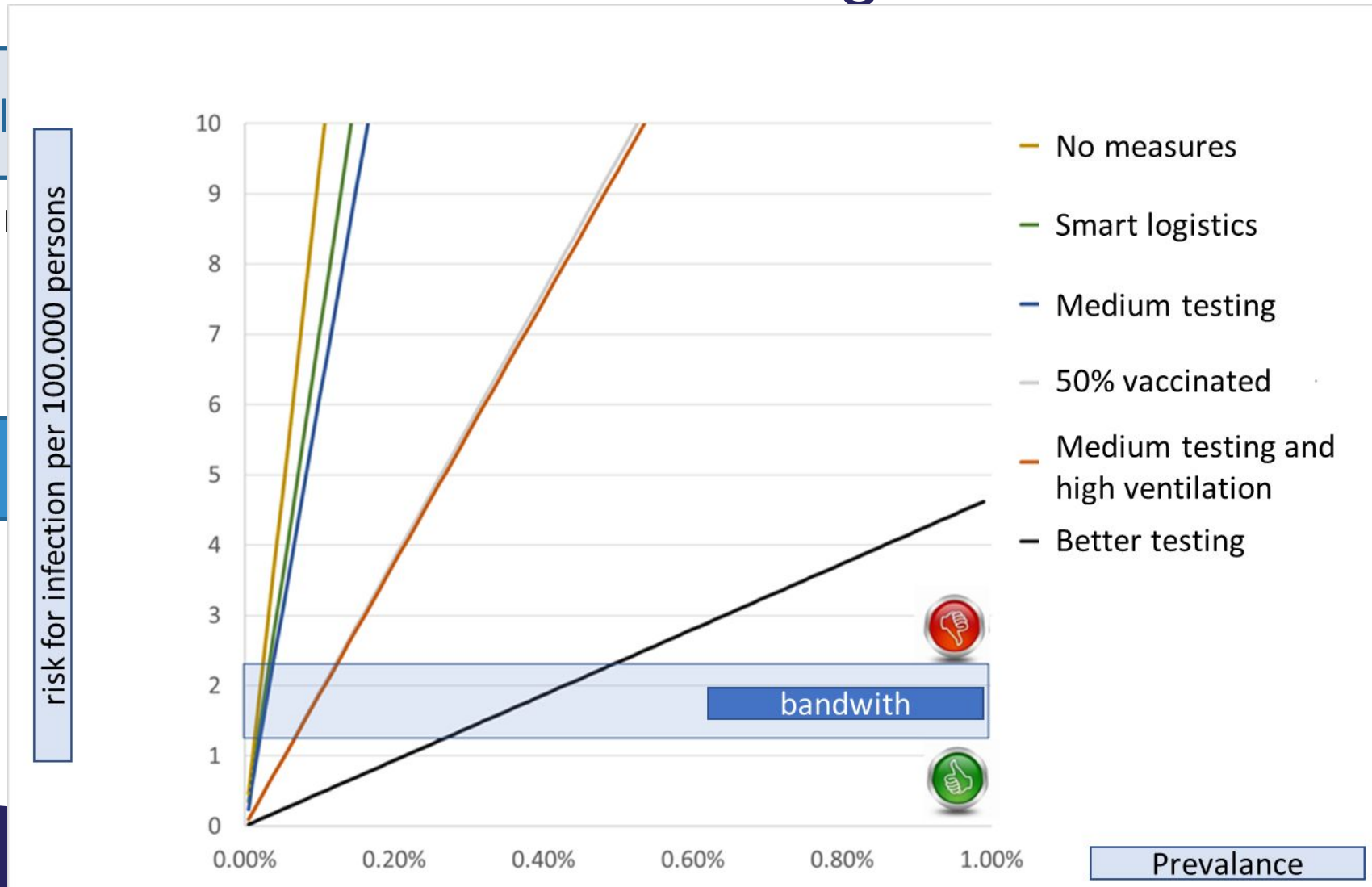


GGD data published by RIVM)

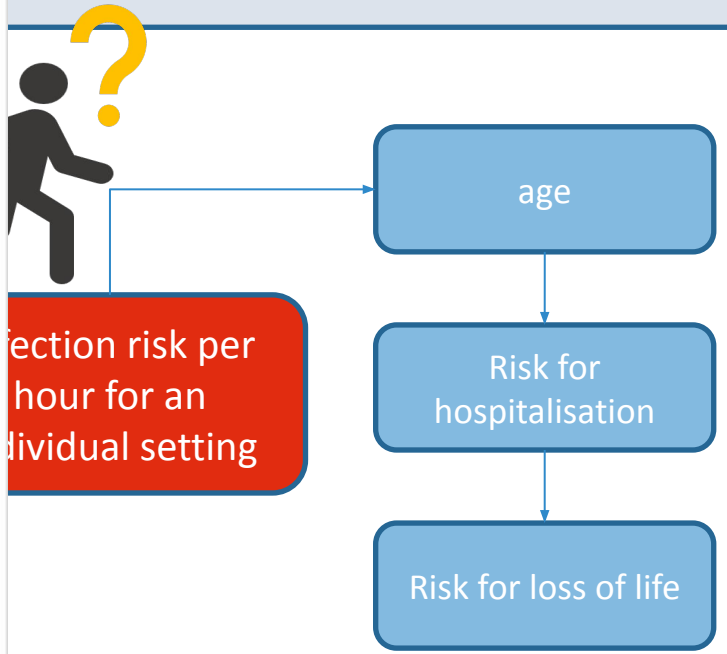
Corrected for time spend at a location



(Covid-19) Risk taxation model for Field Lab events based on risk modeling



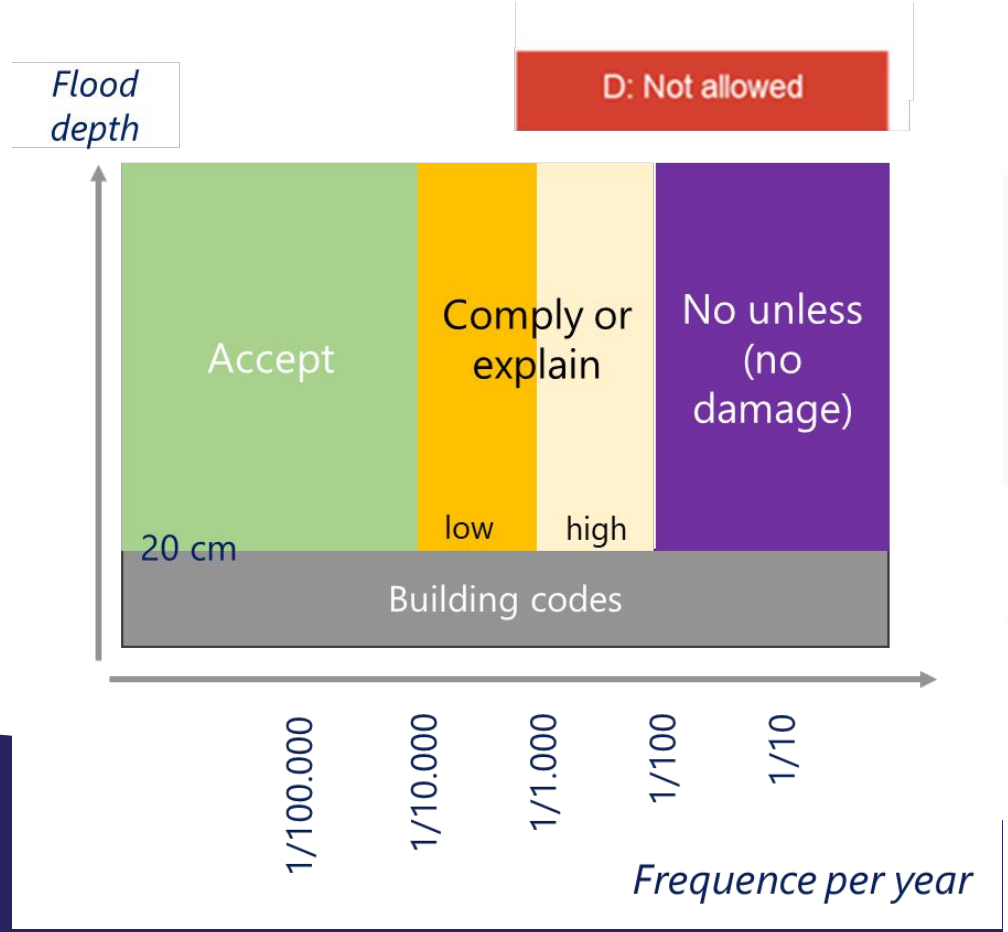
https://www.medrxiv.org/content/10.1101/2022.01.10.21268254v2.full.pdf

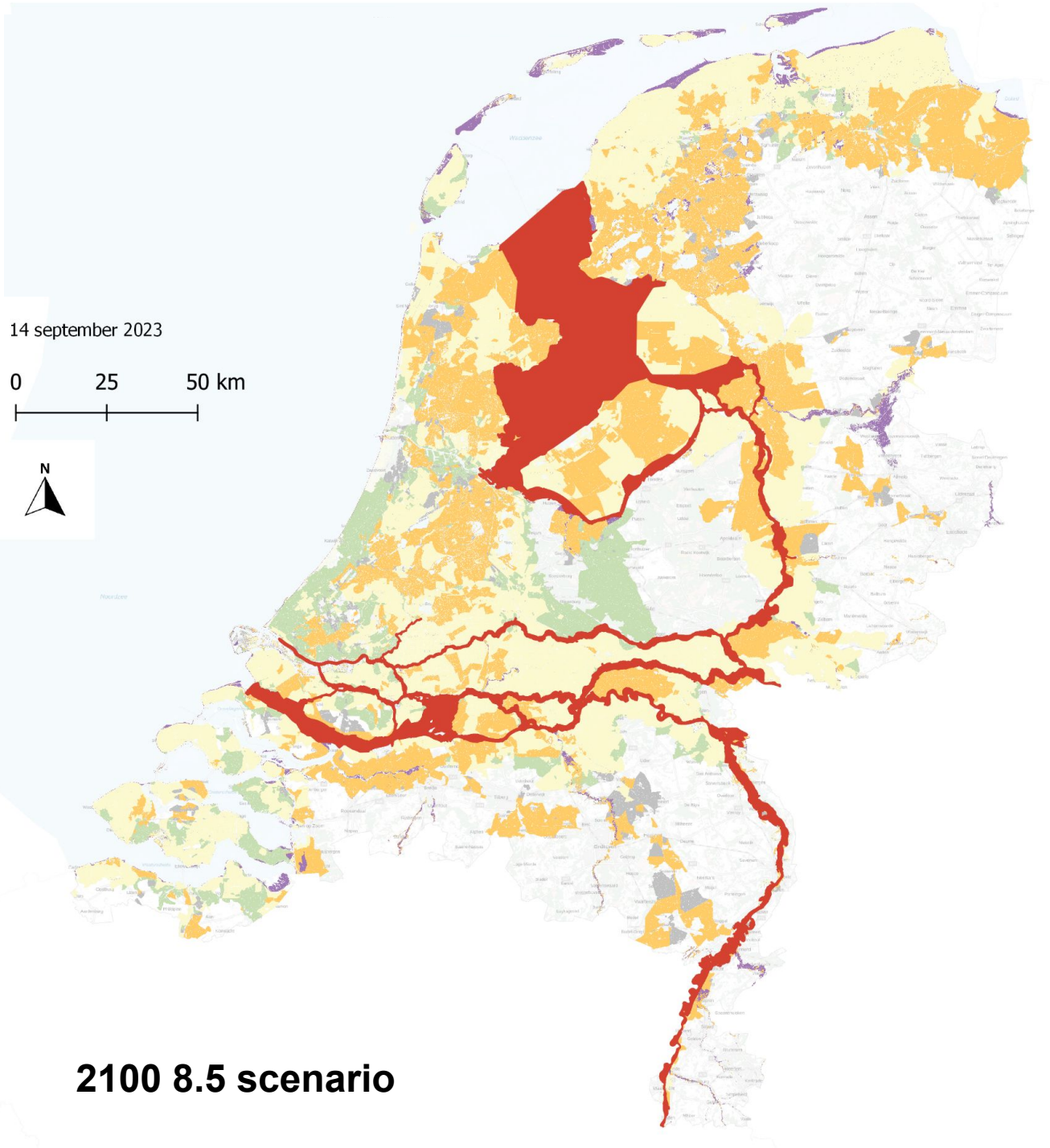


Courage is needed for experts and decision makers

Where and how to build (climate change)

- Additional criteria needed?
- Which climate scenario?
- Sustainable insurance?





2100 8.5 scenario

Time line of a pandemic event (COVID)
Phase 1: Prevent / Fight

Normal day to day life	Detection and forecast	Warning and fighting	Last resort: Lockdown

Timeline

Start (T0)	Months	1 month

Hospitals

Forecasting systems

Ventilation

Sewer system

Patient 0.

China: nov 2019

(NL: feb 2020)

Quarantine

Warn public

1,5 m distance

Work at home

NL: Smart lockdown

Aim to stop the virus (which succeeded with SARS

RUTTE

Kijk, we weten nog niet alles van het virus. En ik heb het eerder gezegd, we hebben 50% van de kennis waarmee we 100% van de besluiten moeten nemen. En dat is eigenlijk nog steeds

Time line of a pandemic event
Phase 2: Disaster

Normal day to day life	Detection and forecast	Warning and fighting	Last resort: Lockdown

Virus is Endemic

Measure cycle up / down

Recovery

Timeline	Start (T0)	Months	1 month	2 years	Years

Hospitals

Forecasting systems

Ventilation

Sewer system

SCBA

Patient 0.

China: nov 2019

(NL: feb 2020)

Quarantine

Warn public

1,5 m distance

Work at home

NL: Smart lockdown

Aim to stop the virus (which succeeded with SARS

Temporarily full Lockdowns

Events possible / not possible

…..

Damage compensation