

MOSES

Modular Observation Solutions for Earth Systems

Events and Trends: Impact of Disturbances on Earth Systems



Helmholtz-Gemeinschaft - Forschungsbereich Erde und Umwelt

Scientific Case

Overarching Research Question

Interactions of short-term **EVENTS** and long-term **TRENDS** across Earth compartments

Events

- **Heatwaves**
- **Hydrologic Extremes**
- **Ocean Eddies**
- **Thaw Events Permafrost**

Event-driven Observation Concept

Captures processes and impacts by an “event chain” approach

Evaluation Concept **EVENTS & TRENDS**

Integrates **MOSES** event data into large-scale and long-term monitoring networks which serve as reference systems

MOSES Reference Systems

Helmholtz Observatories: Cape Verde, COSYNA, Lena Delta, TERENO

- Central sites for MOSES implementation phase
- Target areas for MOSES operation phase

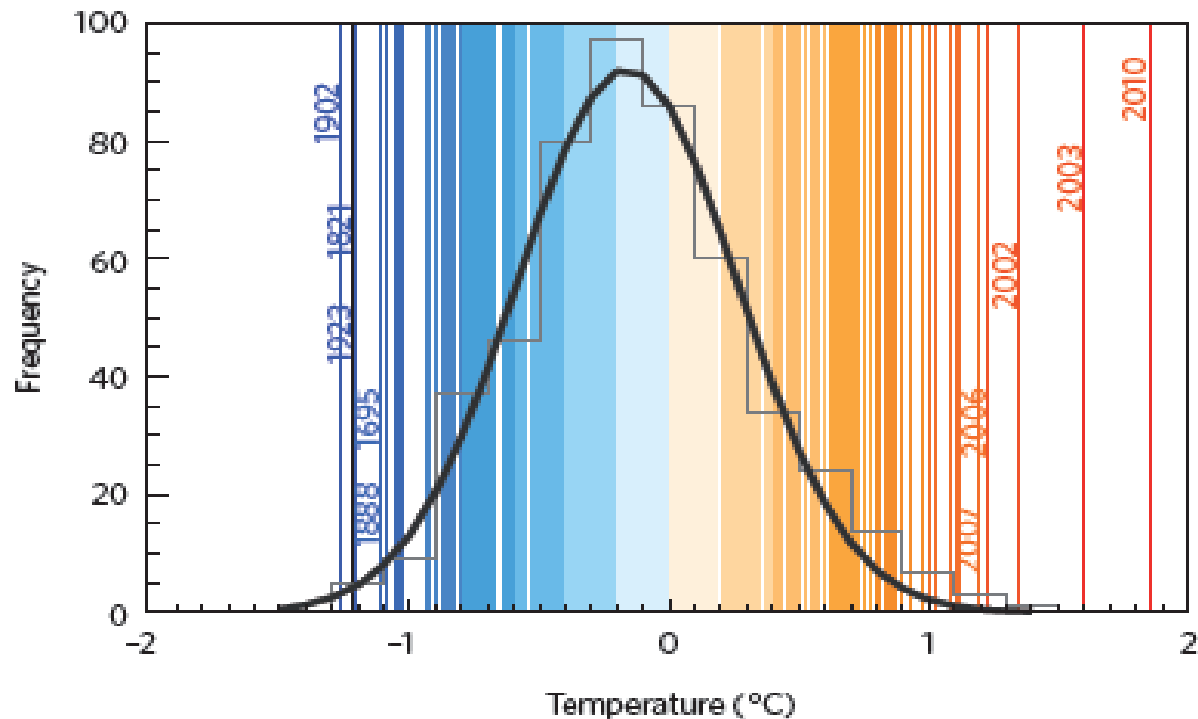
International Monitoring Networks: ICOS, FLUXNET, LTER, EuroGOOS, ...

- Long-term monitoring data
- Target areas for MOSES operation phase
- MOSES extends and complements the existing observation capabilities by event-oriented observation systems

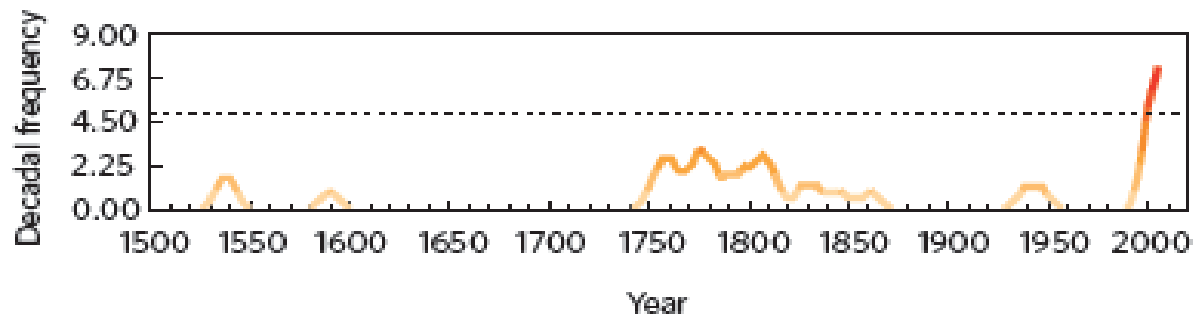
Satellite Missions: MODIS, Sentinels, EnMAP, GRACE-FO, TANDEM-L, ...

- Large scale monitoring data
- Multi-parameter monitoring data
- ACROSS + HGF Alliance “Remote Sensing” link in-situ with satellite data

Example: Heatwaves in Europe

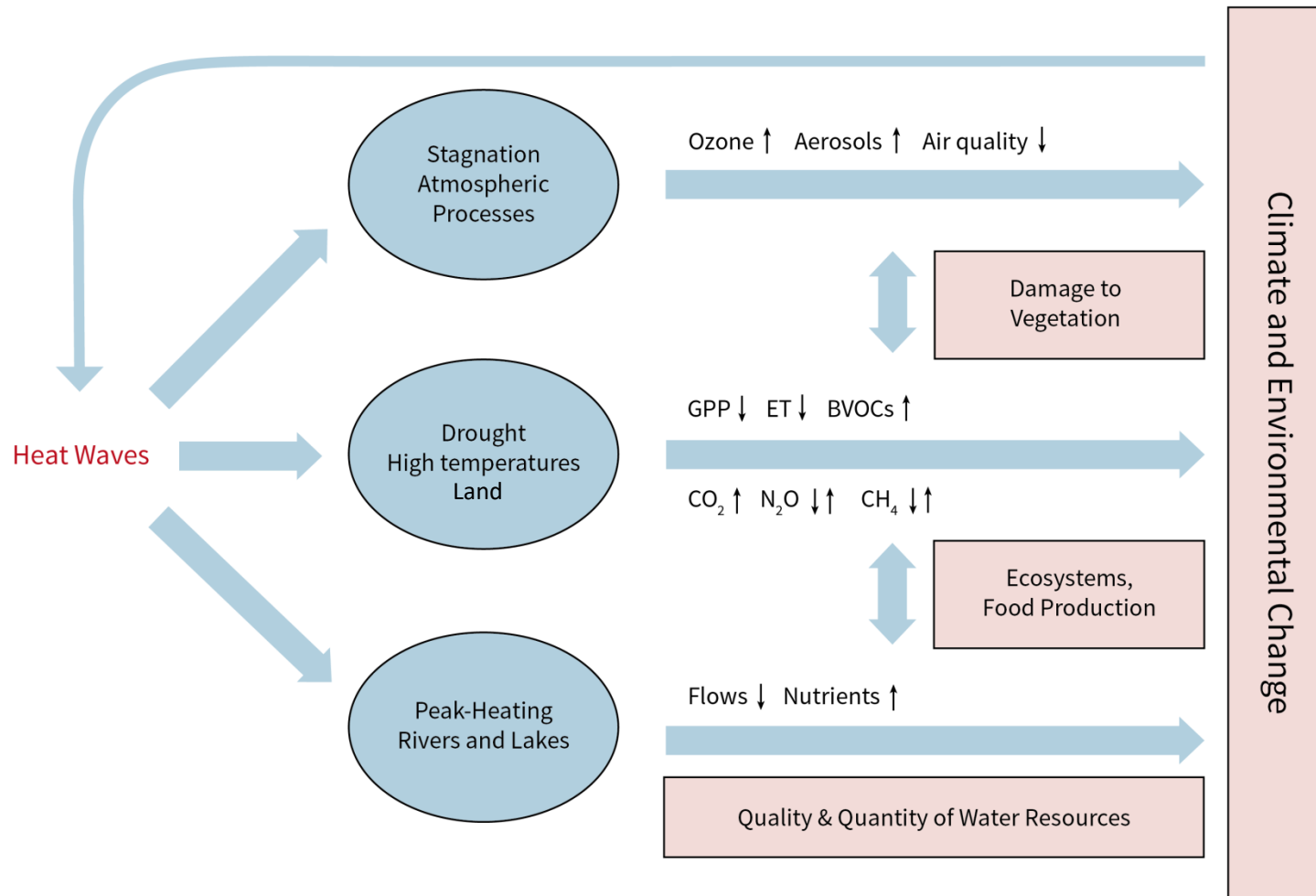


recent heatwaves
in Europe:
- 2015
- 2017



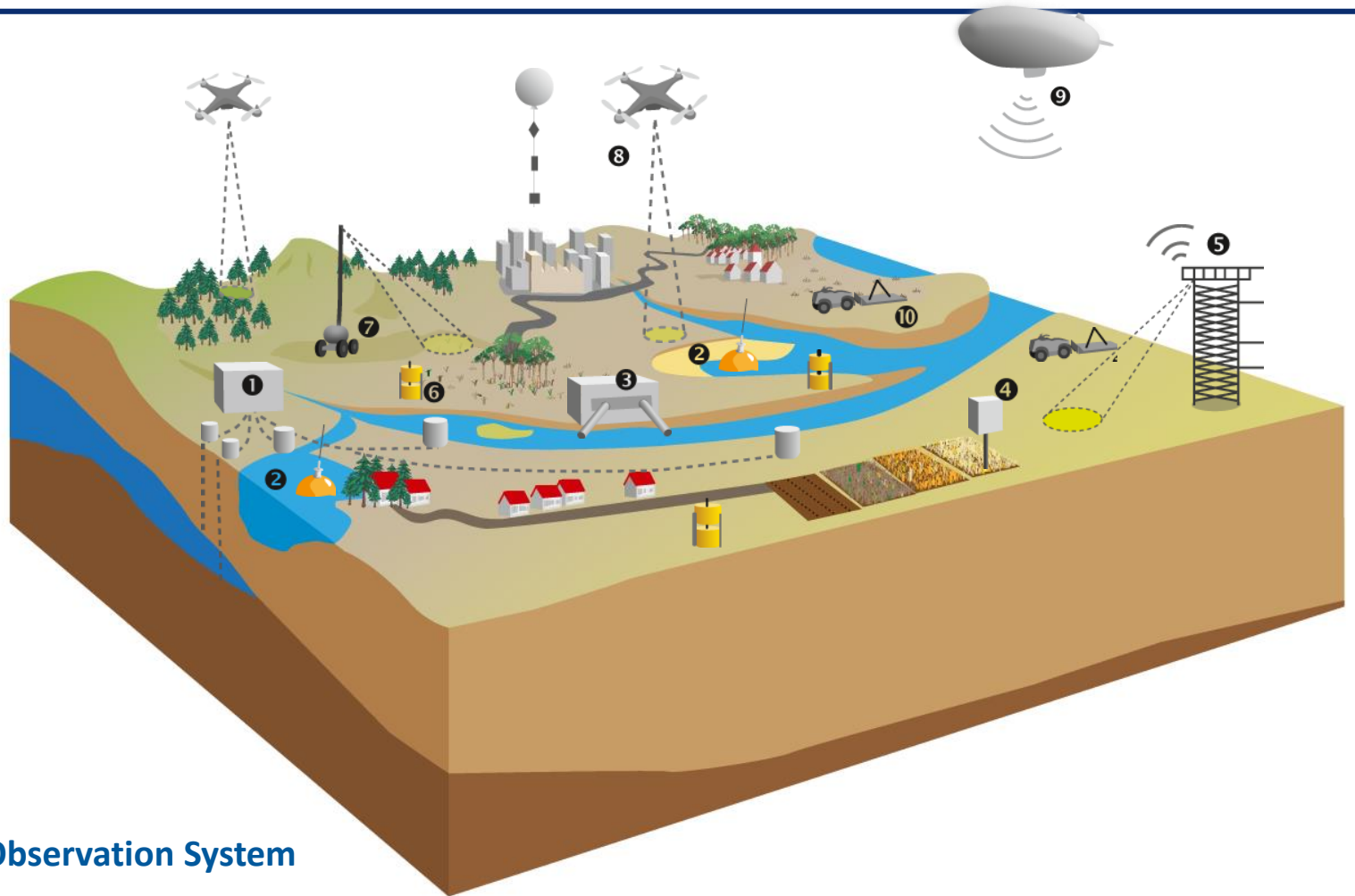
Coumou and Rahmstorf,
A Decade of Weather
Extremes, Nature Climate
Change, 2012

Event Chain Heatwaves



blue: direct impacts and possible long term feedbacks
red: socio economic impacts

MOSES Campaign Heatwaves



The Modular Observation System

- **Water Balance Module:** Gravimeter (6), Cosmic Ray Sensors (4), mobile Geophysics (10), Flux Towers (5,7)
- **Biota Module:** Hyperspectral and IR Sensing of Vegetation (8,9), mobile Mesocosms (3), online Metagenomics (1)
- ...

MOSES Modules

MOSES Module	Consortium	Heat Waves	Hydrologic Extremes	Ocean Eddies	Thaw Events Permafrost
Autonomous Vehicles	GEOMAR, HZG		X	X	X
Fixed Point Observatories	AWI, GEOMAR, HZG		X	X	X
Coastal and Marine Mobile Systems	AWI, GEOMAR, HZG		X	X	X
Permafrost Thaw and Subsidence	AWI, GFZ	X	X		X
Flow and Sediment Dynamics	AWI, GFZ, UFZ	X	X		X
Biota	AWI, HMGU, UFZ, KIT, FZJ	X	X		
Water Balance	GFZ, FZJ, UFZ	X	X		X
Soil and Water Quality	HMGU, UFZ	X	X		
Land-Atmosphere Fluxes	KIT, FZJ, UFZ, GFZ	X	X		X
Atmospheric Dynamics	FZJ, KIT	X	X	(X)	
Atmospheric Chemistry	FZJ, KIT	X	X		X

DLR will run an airborne TANDEM-L System

Technical Innovation

Improvement and Adjustment of Existing Systems

For modular and multi-purpose use

Minimization of Sensor Systems

For installation on mobile carriers and building multi-sensor systems

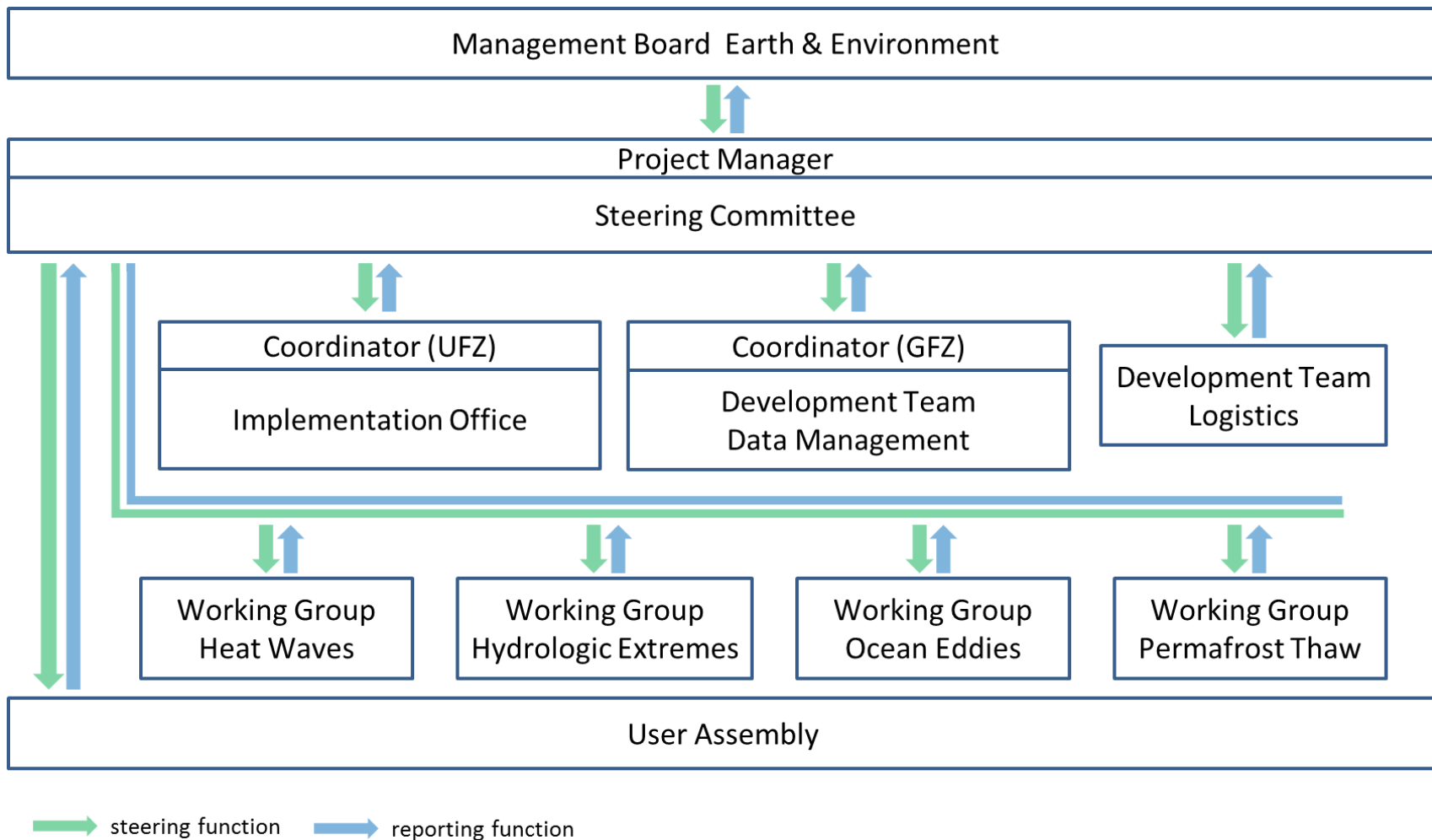
Automation of Observation Systems

For intensive field campaigns and use in areas of difficult access

Cost Efficient Observation Systems

By developing low cost systems and multi-purpose operation

MOSES Governance



MOSES Steering Committee

Center	Representative	2nd Member
AWI	Philipp Fischer	Julia Boike
FZJ	Harry Vereecken	Martin Riese
GEOMAR	Jens Greinert	Arne Körtzinger
GFZ	Bruno Merz	Jörn Lauterjung
HMGU	Jörg-Peter Schnitzler	Christian Griebler
HZG	Burkard Baschek	Holger Brix
KIT	Hans-Peter Schmid	Christoph Kottmeier
UFZ	Peter Dietrich	Sabine Attinger
DLR	Irena Hajnsek	Andreas Reigber

Concept (!) for MOSES Campaign Management

1. Conception and Planning

- **MOSES Campaign:** Concept and operational plan are developed bottom up by a HGF consortium + partners
- **Steering Committee:** checks quality and feasibility, assigns time frame



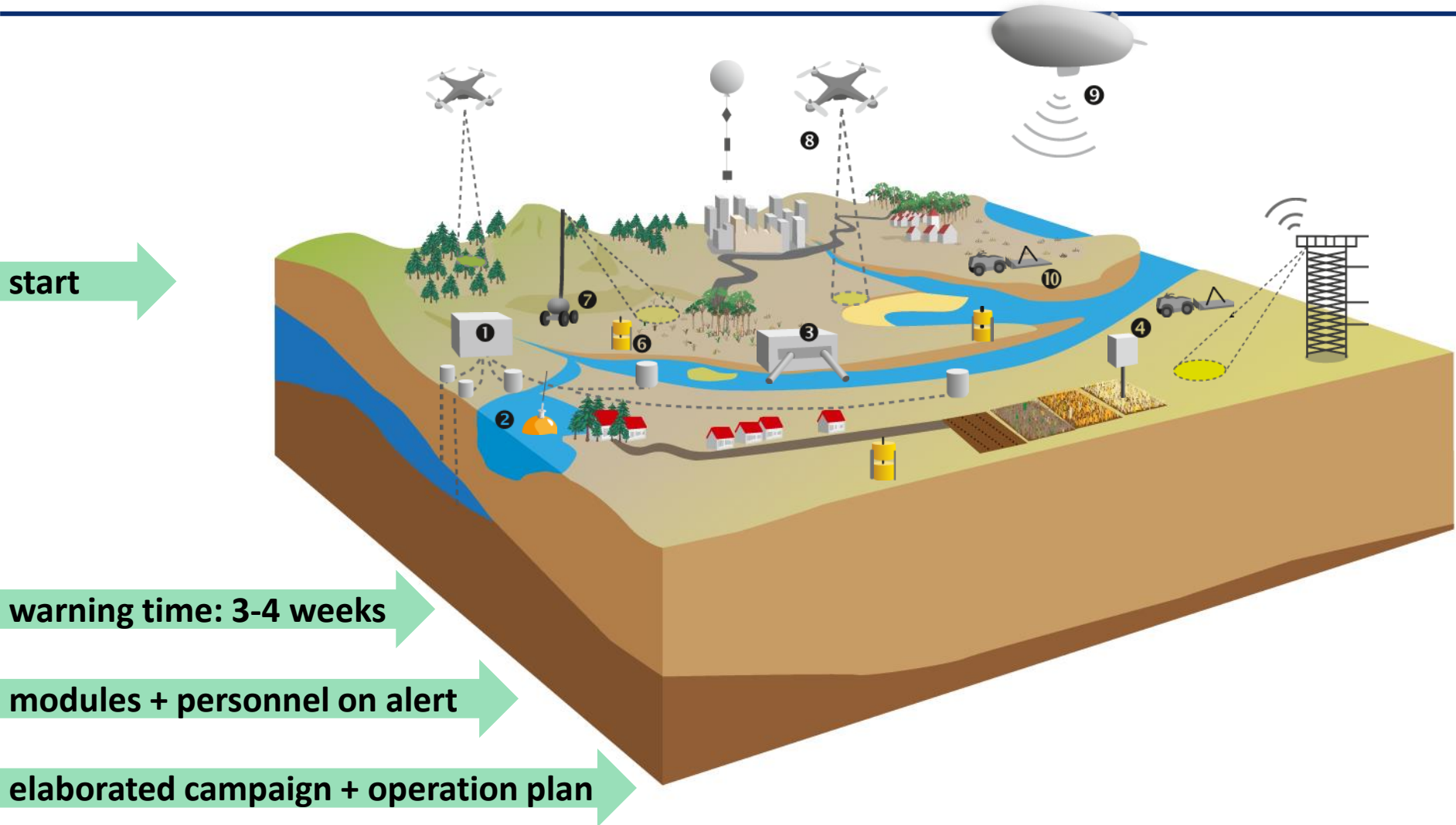
elaborated + approved
MOSES campaign

2. Operation

- **Ocean Eddies and Permafrost:** reliable time frame
- **Heatwaves and Hydrologic Extremes:** reserved timeframe, observation systems and personnel are on alert
- **Campaign duration:** several months
- **1-2 full campaigns per year**

A coordinated use of observation systems might be possible during idle times

Concept (!) for Conducting a MOSES Heatwave Campaign



MOSES Goals

technical and scientific

- **Implement a novel observation system for dynamic events: highly mobile, flexible, high resolution, along and across compartments**
- **Complement and extend the existing international monitoring networks**
- **Improve process knowledge: Impacts auf distinct events on regional to global Earth- and Environment development**
- **Improve models and forecasts: Integration of highly dynamic events and their feedbacks in Earth System Modelling**

societal

- **Improve early warning and direct actions**
- **Improve forecasts and scenarios on Global Change**

building capacity

- **Offer a transdisciplinary and cutting edge research infrastructure**

Overview

System of Systems

mobile, flexible, cross-compartment

Operation

various events and regions

Challenges

development of modules for flexible operations,
conduct event-driven campaigns

Milestones

2017

2018

2019

2020

2021

develop modules

develop and extent data management

conduct and optimize test-campaigns

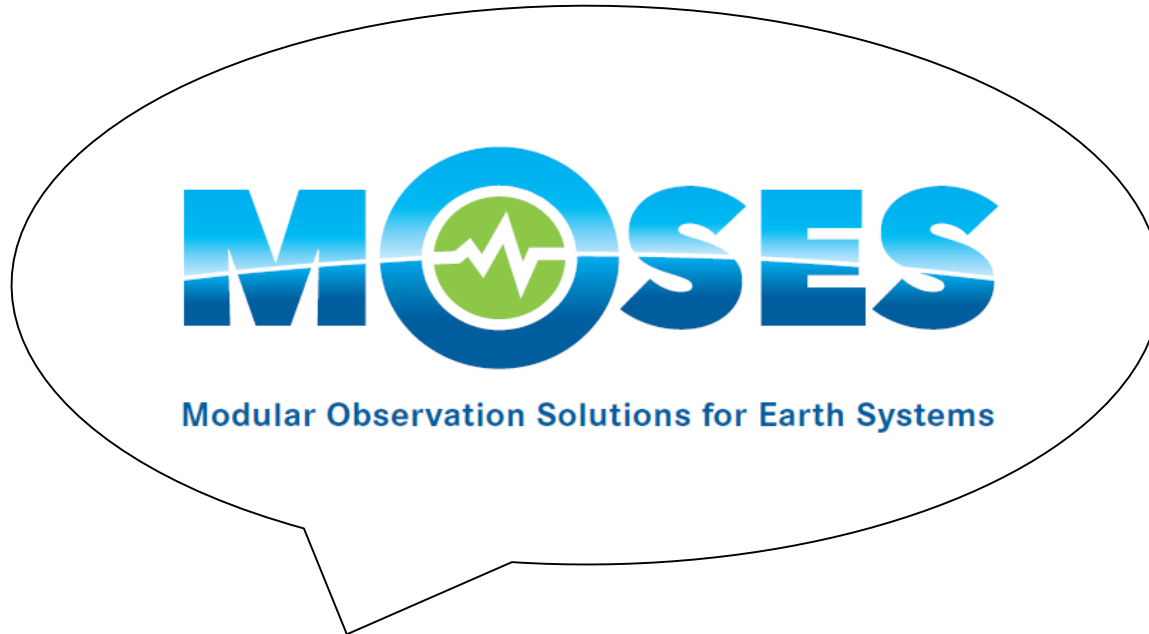
→operation

vision: extension via national roadmap

Costplan

28 Mio.€, 8 centres + DLR, 5 years for implementation

Thank You for Your Attention



questions?