EGSIEM

Title: WP6 (Hydrological Service)

Presenter: Andreas Güntner and Hendrik Zwenzner

Affiliation: GFZ and DLR

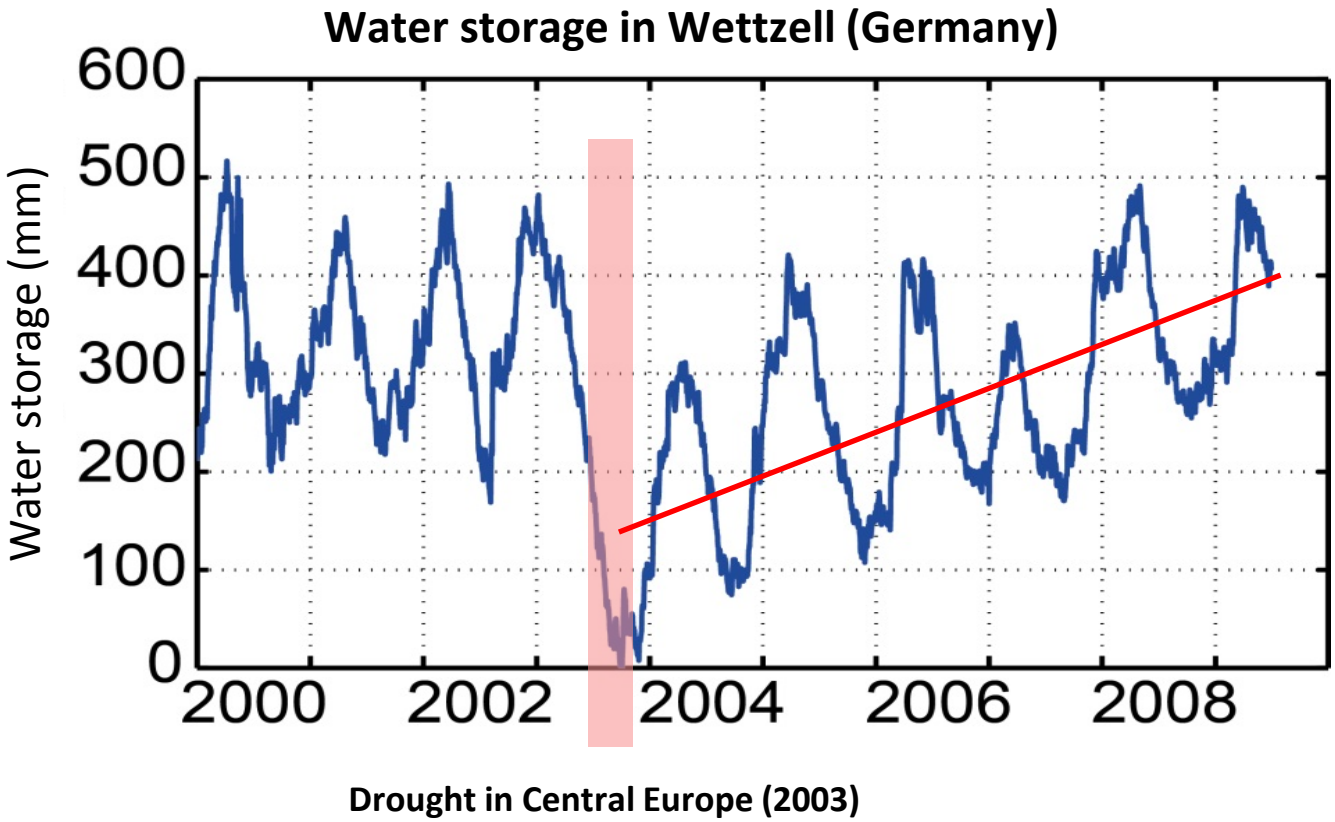
EGSIEM Kick Off Meeting
University of Bern
January 13. – 14. 2015

WP6 Motivation

- Gravity-based time series of ***total*** water storage anomalies are an integral descriptor of the wetness status of river basins
- Possible added value for monitoring and forecasting hydrological extreme events (floods and droughts)
  as compared to standard indices based on precipitation or soil moisture

WP6 Motivation

Hydro-meterological extremes and their impact on water storage



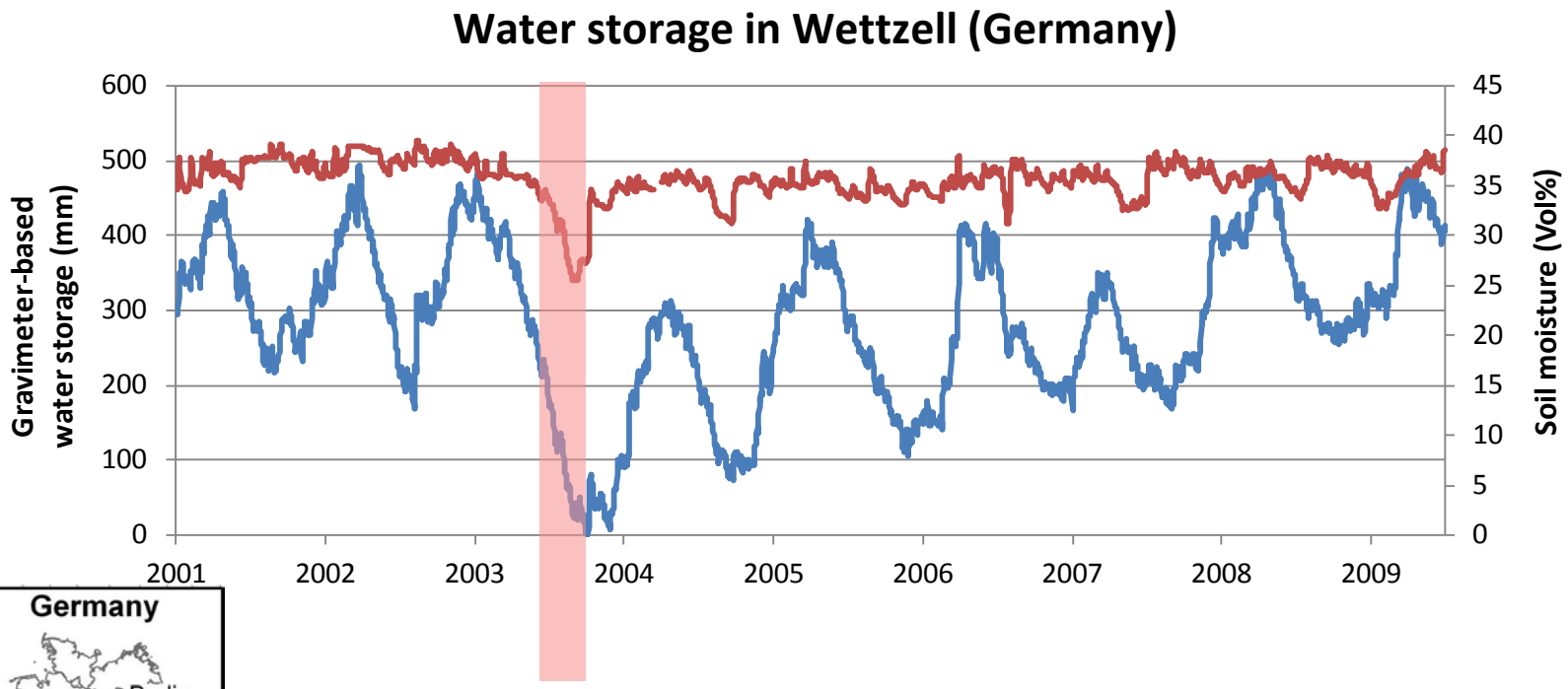
Drought in Central Europe (2003)

Gravimeter-based water storage

Creutzfeldt et al. (2013), JGR

WP6 Motivation

Hydro-meteorological extremes and their impact on water storage



Soil moisture

Gravimeter-based water storage

WP6 Objectives – Hydrological service

- **Evaluation** / validation of the new combined, regional and NRT gravity products for historical flood events

- Gravity-based **flood and drought indicators** for monitoring and forecasting of hydrological extreme events with lead times of several months up to near real time

- Improved mechanisms for automatic **satellite-based flood services** – satellite tasking and rapid mapping

WP6 – T6.1 Evaluation of historical flood events

- **Required input**: The new combined, regional and NRT gravity products of WP4 and WP5

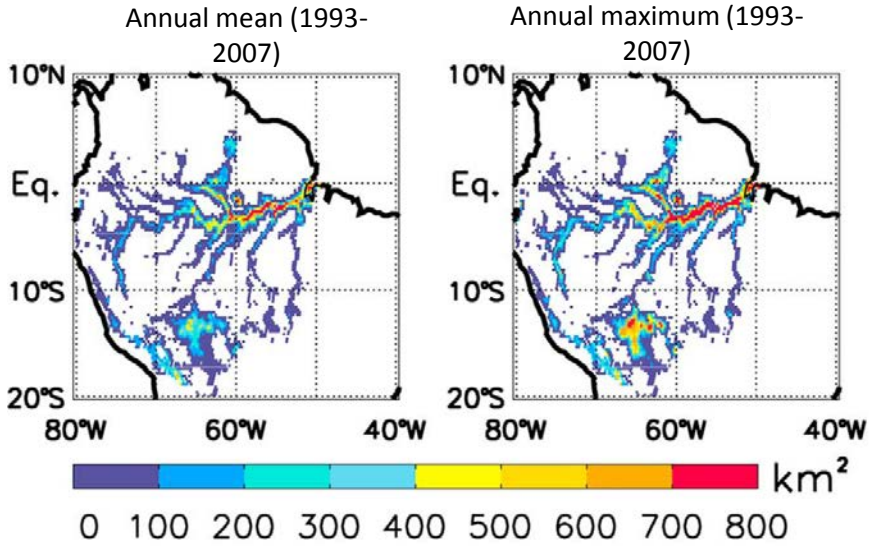
- Preparation of a **flood data catalogue** to summarize the suite of multi-method data sets for the selected extreme events
  - Selection of events (T3.9): Which are the criteria?

- Compilation of **independent validation data**
  - Flood masks and water levels (WP3)
  - Flood volumes from a combination of the above observations?

WP6 – T6.1 Evaluation of historical flood events

Surface water storage variations as independent evaluation data (?)

Global Inundation Extent from Multi-Satellite data (GIEMS)
based on AVHRR, SSM/I, ERS (monthly)



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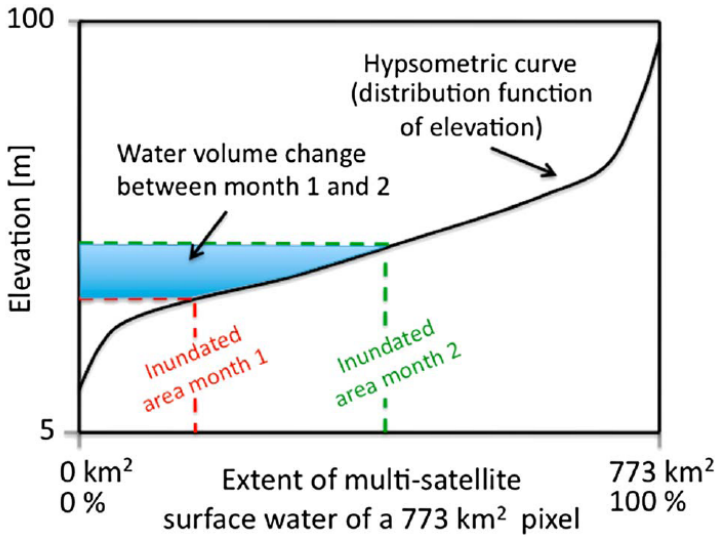
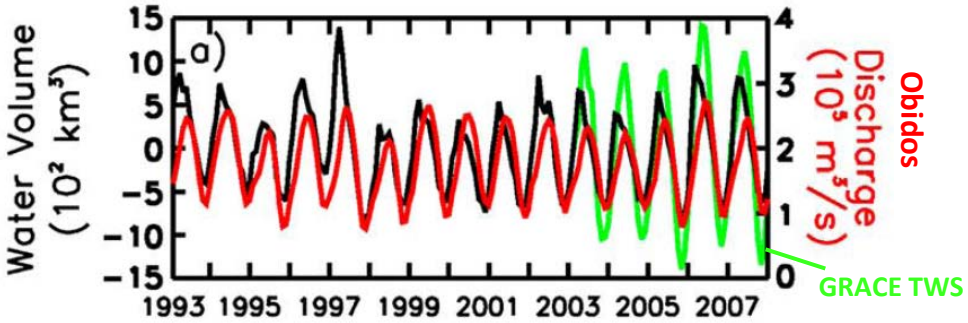
Hypsographic approach
based on ASTER GDEM



Amazon surface water storage



Papa et al. (2013), JGR
Güntner et al. (2009), EGU

EOSIEM

Surface freshwater storage and variability in the Amazon basin from multi-satellite observations, 1993–2007

Fabrice Papa,[1,2] Frederic Frappart,[3] Andreas Güntner,[4] Catherine Prigent,[5] Filipe Aires,[5,6] [illegible] 2015
Augusto C. V. Getirana,[7] and Raffael Maurer[8]
JOURNAL OF GEOPHYSICAL RESEARCH: ATMOSPHERES, VOL. 118, 1–15, doi:10.1002/2013JD020500, 2013

Horizon2020

WP6 – T6.1 Evaluation of historical flood events

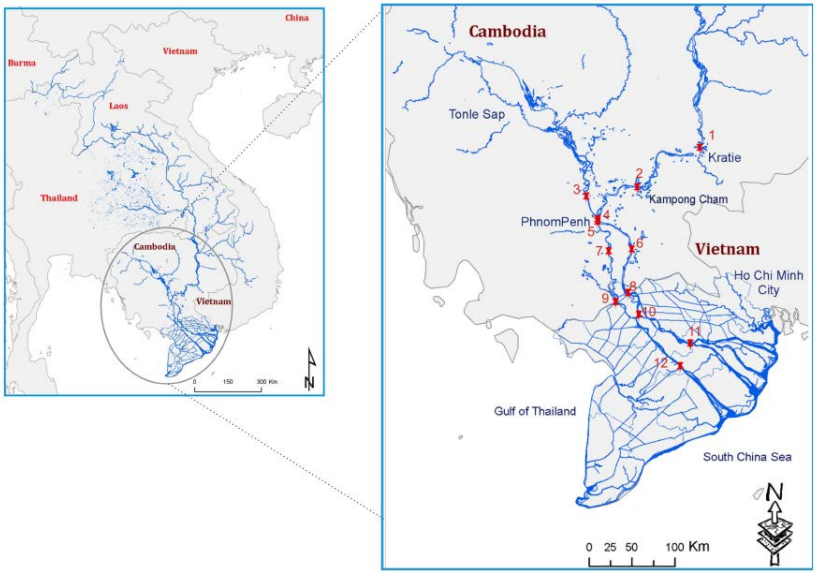
- **Required input**: The new combined, regional and NRT gravity products of WP4 and WP5

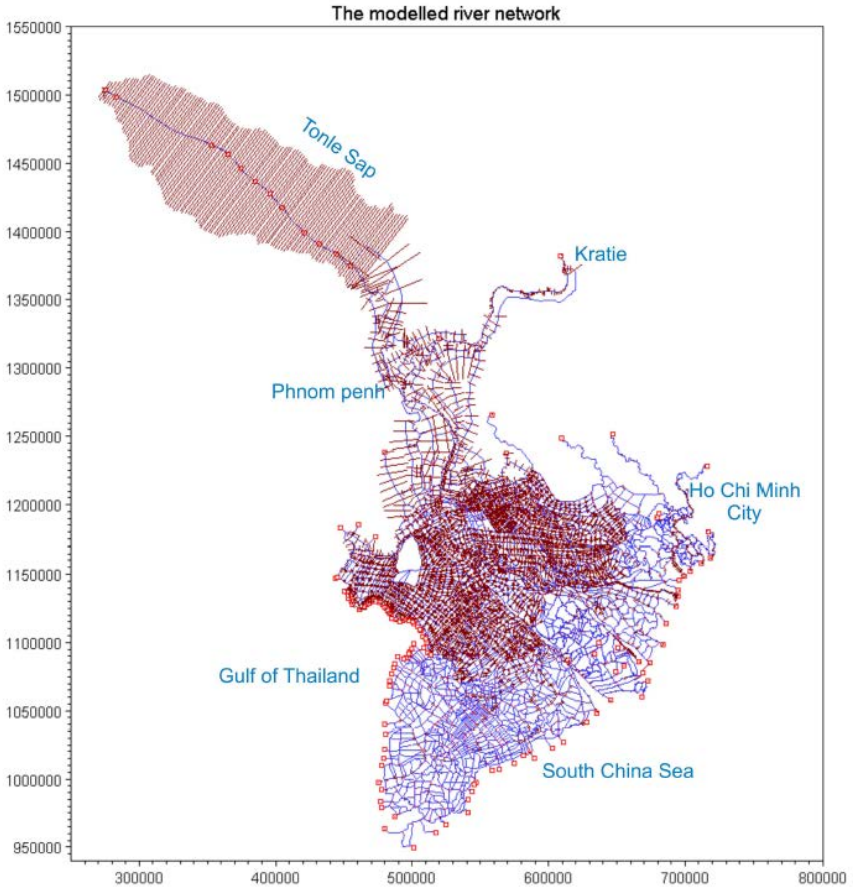
- Preparation of a **flood data catalogue** to summarize the suite of multi-method data sets for the selected extreme events
  - Selection of events (T3.9)

- Compilation of **independent validation data**
  - Flood masks and water levels (WP3)
  - Flood volumes from a combination of the above observations?
  - Surface water storage volumes based on Papa et al. (2013) (?)
  - Simulation results of hydrological and hydraulic models

WP6 – T6.1 Evaluation of historical flood events

Regional hydraulic model for the Lower Mekong





Dung et al. (2011) HESS

EOSIEM

Multi-objective automatic calibration of hydrodynamic models utilizing inundation maps and gauge data

N. V. Dung[1,3], B. Merz[1], A. Bárdossy[2], T. D. Thang[3], and H. Apel[1]

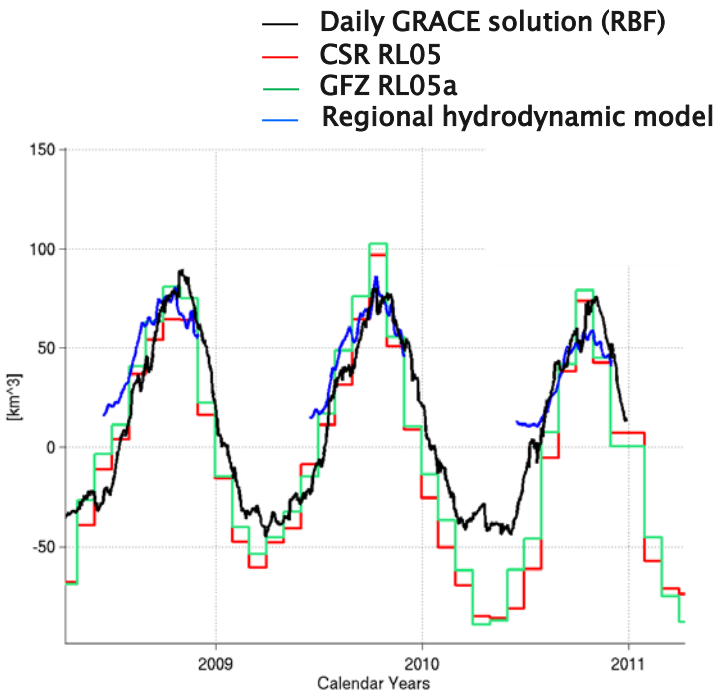
Hydrol. Earth Syst. Sci., 15, 1339–1354, 2011

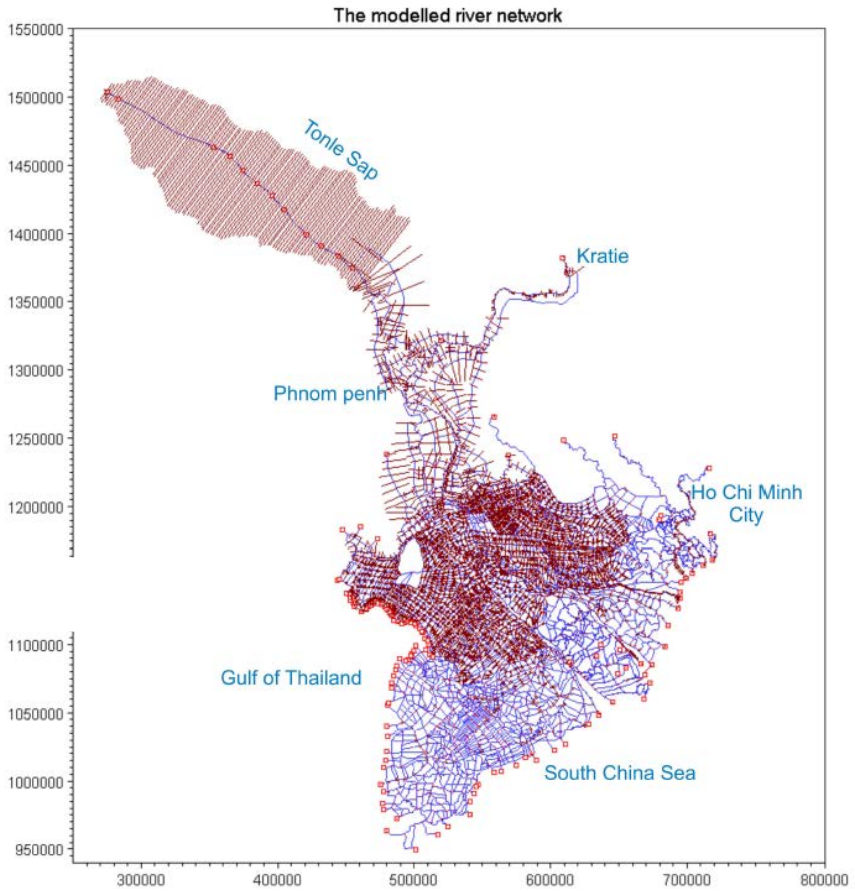
Horizon2020

WP6 – T6.1 Evaluation of historical flood events

Regional hydraulic model for the Lower Mekong

Flood volumes in the Lower Mekong

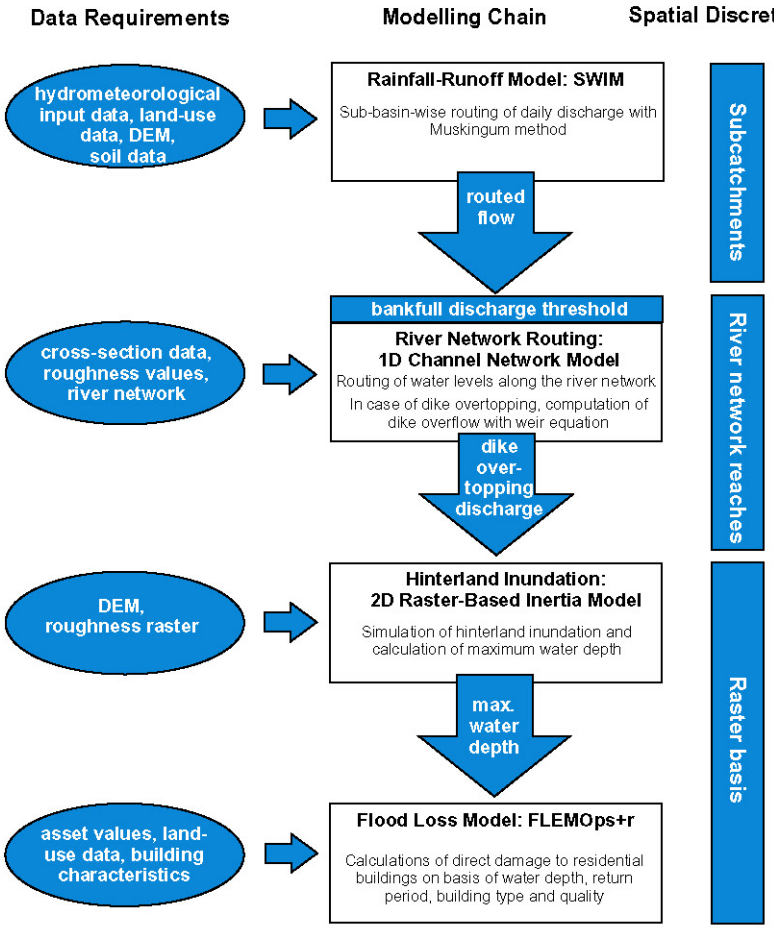


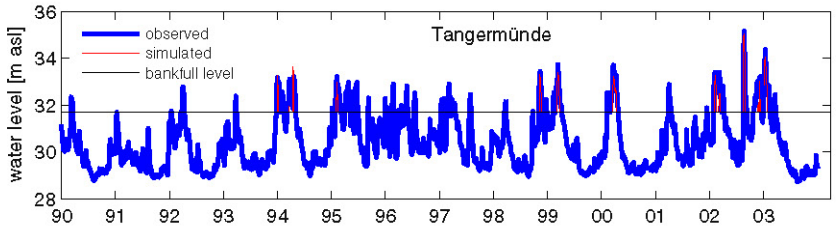


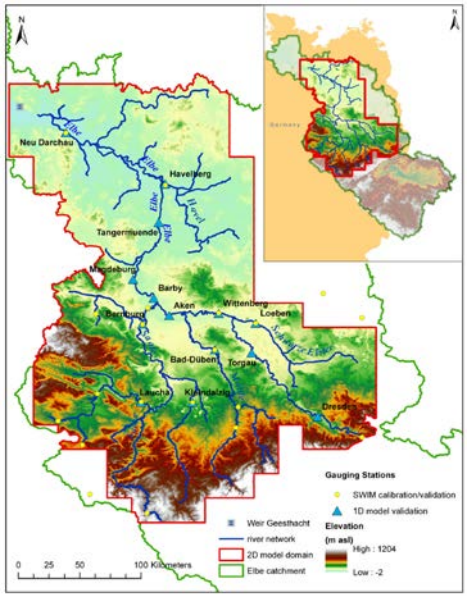
Dung et al. (2011) HESS

WP6 – T6.1 Evaluation of historical flood events

Regional flood model for Germany





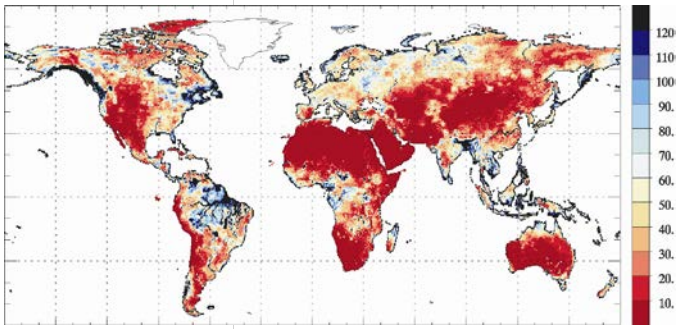


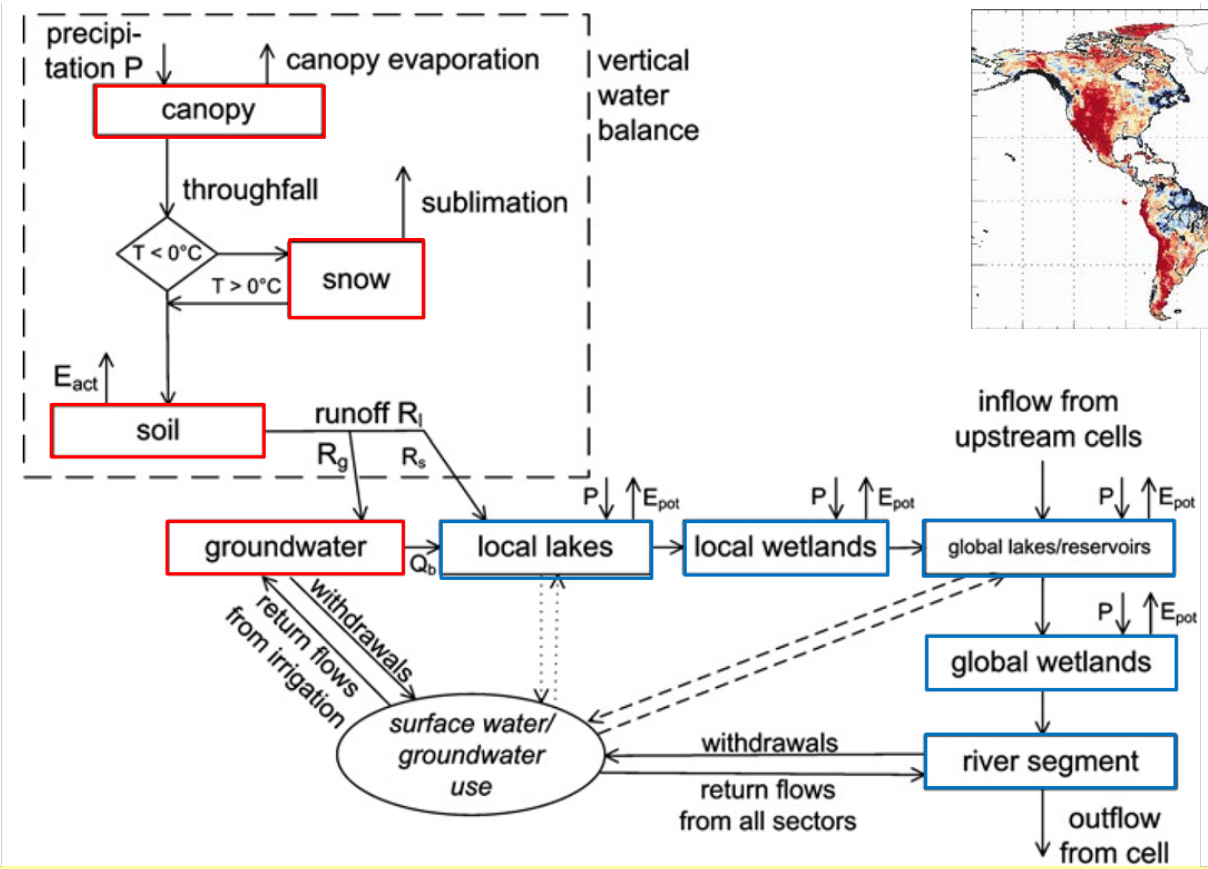
Falter et al. (2014) J.Flood Risk Managem.

WP6 – T6.1 Evaluation of historical flood events

Global hydrological model WGHM

Variations of continental water storage





Total continental water storage change

$\Delta S = \Delta S_{canopy} + \Delta S_{snow} + \Delta S_{soil} + \Delta S_{gw} + \Delta S_{lakes} + \Delta S_{wetl} + \Delta S_{river}$

WP6 – T6.2 Flood and drought indicators

Development of indicators as a measure of catchment wetness from gravity-based water storage anomalies

Floods

- Reager and Famiglietti (2009): flood potential index based on a saturation deficit approach
- Reager et al. (2014): autoregressive model for monthly streamflow with water storage as additional predictor, seasonal lead times

Droughts

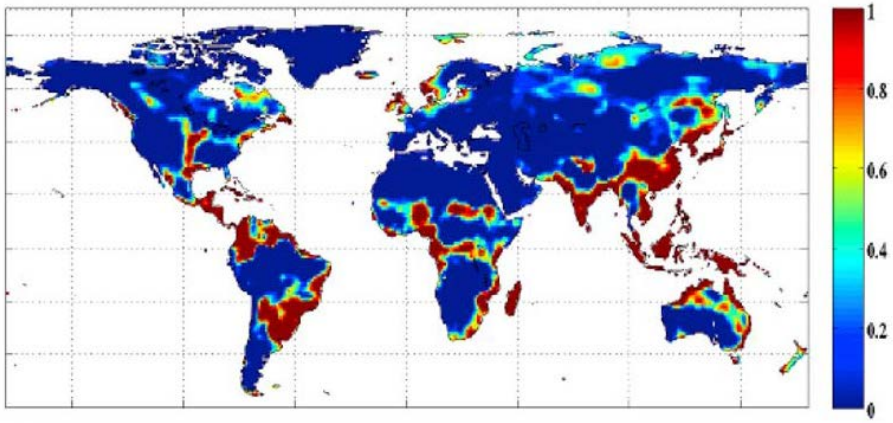
- Thomas et al. (2014): storage-deficit approach for drought occurrence and severity
- Houborg et al. (2012): drought indicators based on assimilated GRACE data into the CLSM hydrological model

→ The only quasi-operational application
(in the U.S. National Drought Mitigation Centre / Drought Monitor)

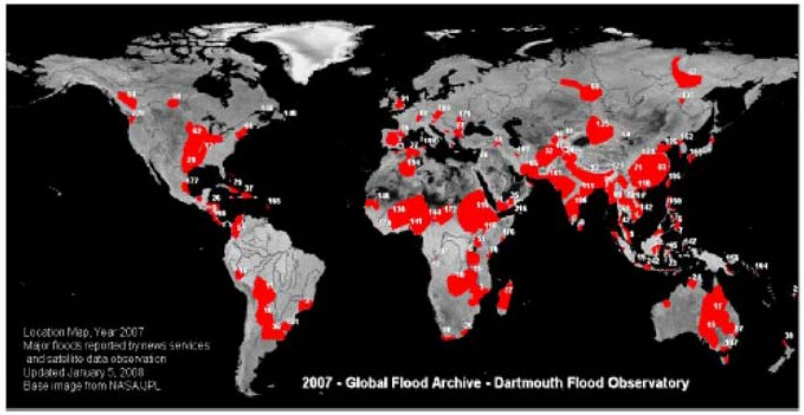
WP6 – T6.2 Flood and drought indicators

Reager and Famiglietti (2009): flood potential index based on a saturation deficit approach

2007 flood index maxima



2007 Dartmouth Flood Observatory



WP6 – T6.2 Flood and drought indicators

Required input: The new combined, regional and NRT gravity products of WP4 and WP5

Evaluation of performance for modelling and forecasting hydrological extreme events

(1) by calibration and data assimilation schemes for hydrological models (Regional Flood Model Germany, Global Hydrology Model WGHM)

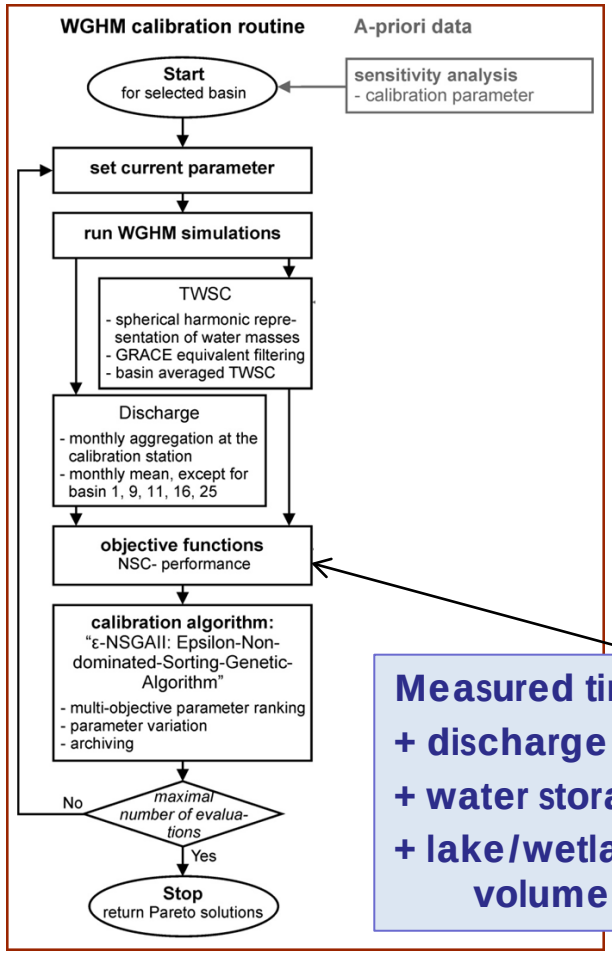
(2) by statistical forecasting approaches

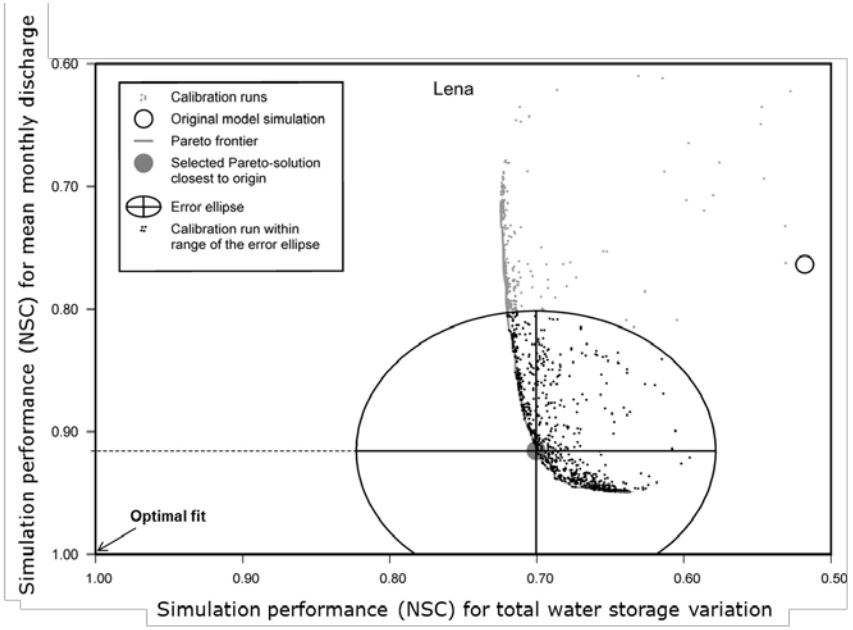
Contribution to early-warning services for hydrological extremes

- Definition of user requirements for flood and drought indicators in monitoring and forecasting systems
- Proof of concept by implementation into existing systems such as **EFAS**, the European Flood Awareness System (operational service as a part of the Copernicus Emergency Management Service since 2012), **GloFAS** and/or the European Drought Observatory (**EDO**).

WP6 – T6.2 Flood and drought indicators

Evaluation in the multi-criterial calibration scheme of the WaterGAP Global Hydrology Model (WGHM)



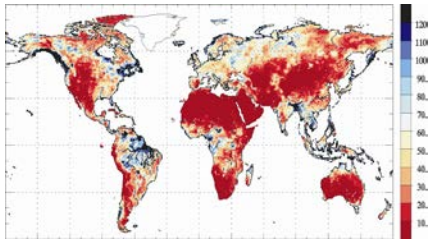


Measured time series:

+ discharge

+ water storage variations GRACE)

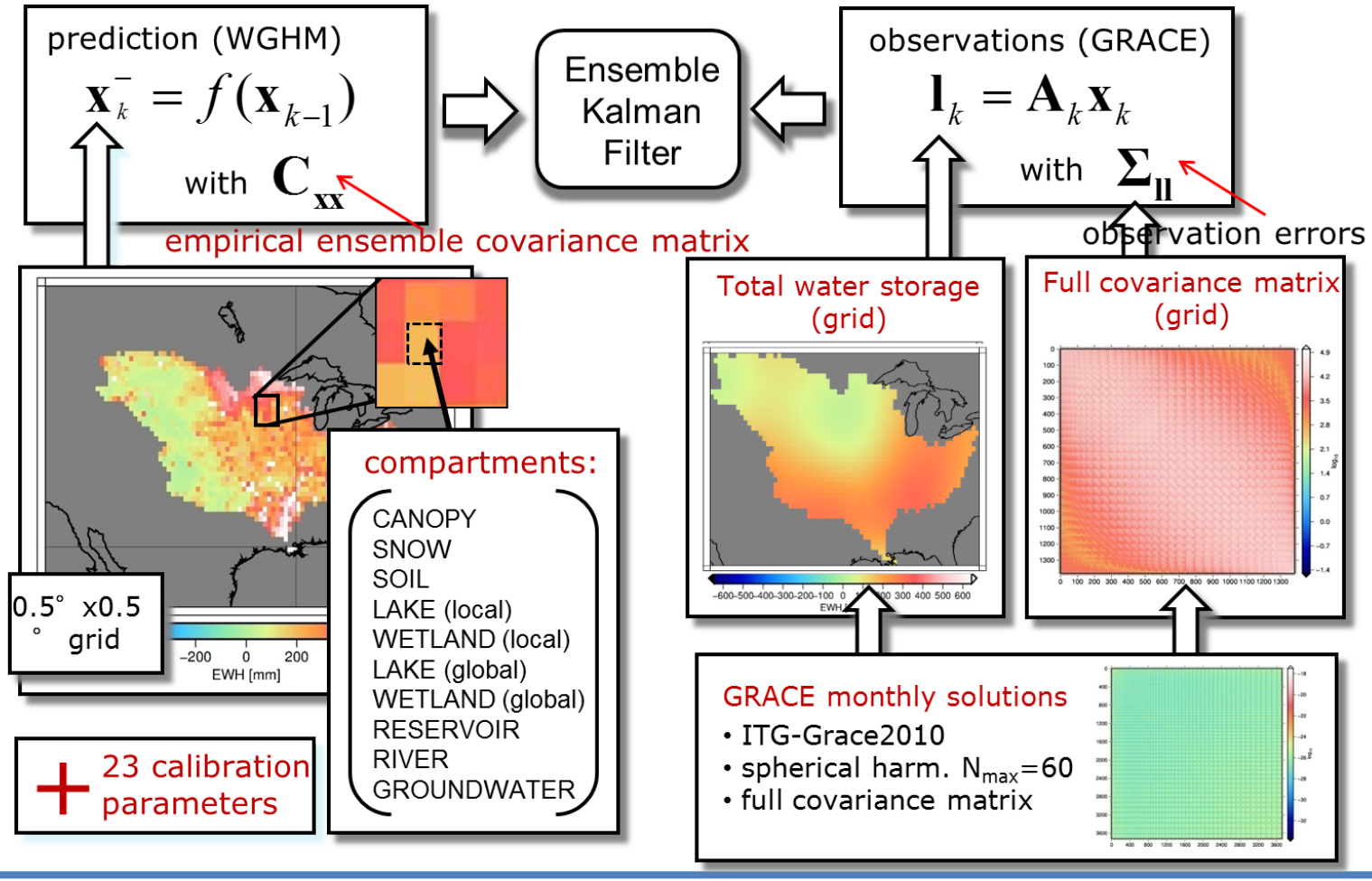
+ lake/wetland/river level, area, volume



Werth & Güntner (2011) HESS

WP6 – T6.2 Flood and drought indicators

Evaluation in a data assimilation scheme of the WaterGAP Global Hydrology Model (WGHM)

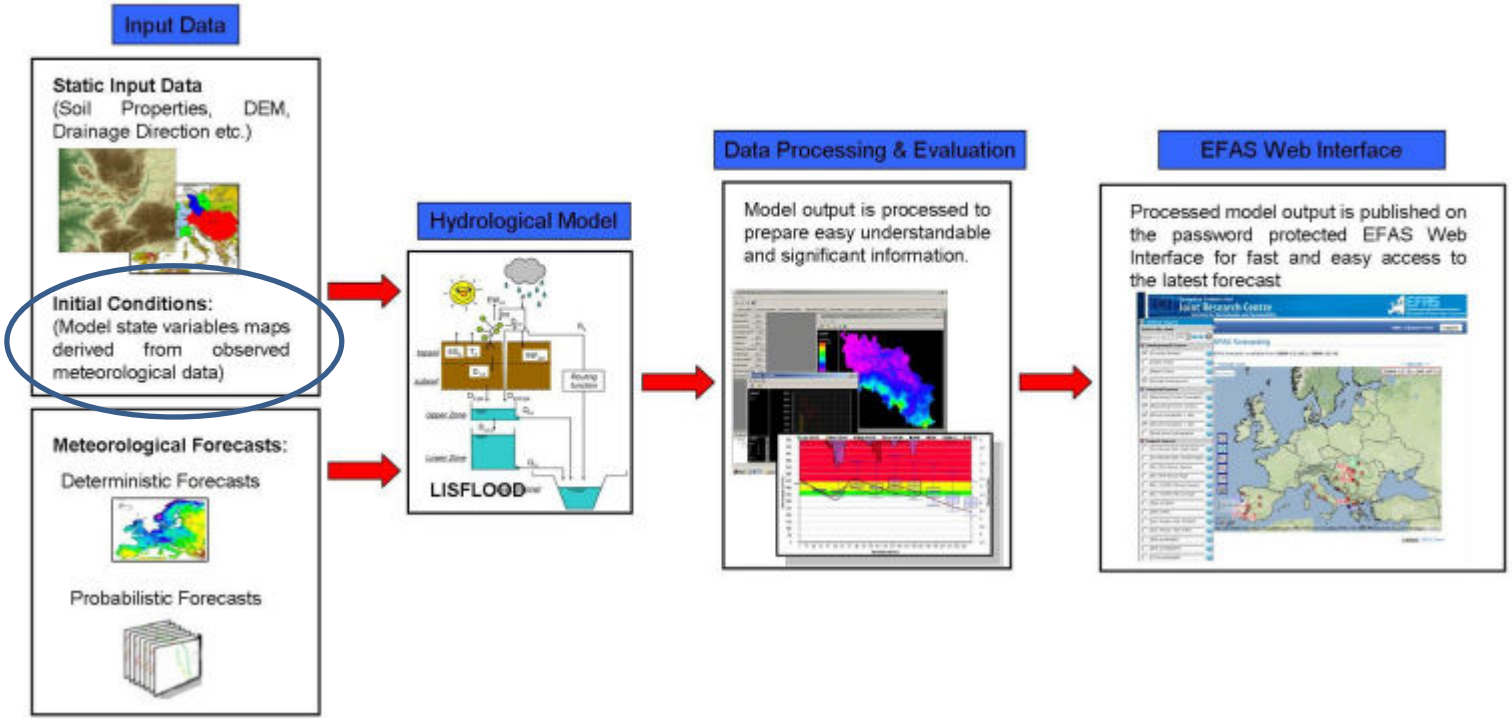


Eicker et al. (2014) Surv. Geophys.

WP6 – T6.2 Flood and drought indicators

Proof of concept / evaluation in the European Flood Alert System (EFAS)

GRACE-based water storage anomalies

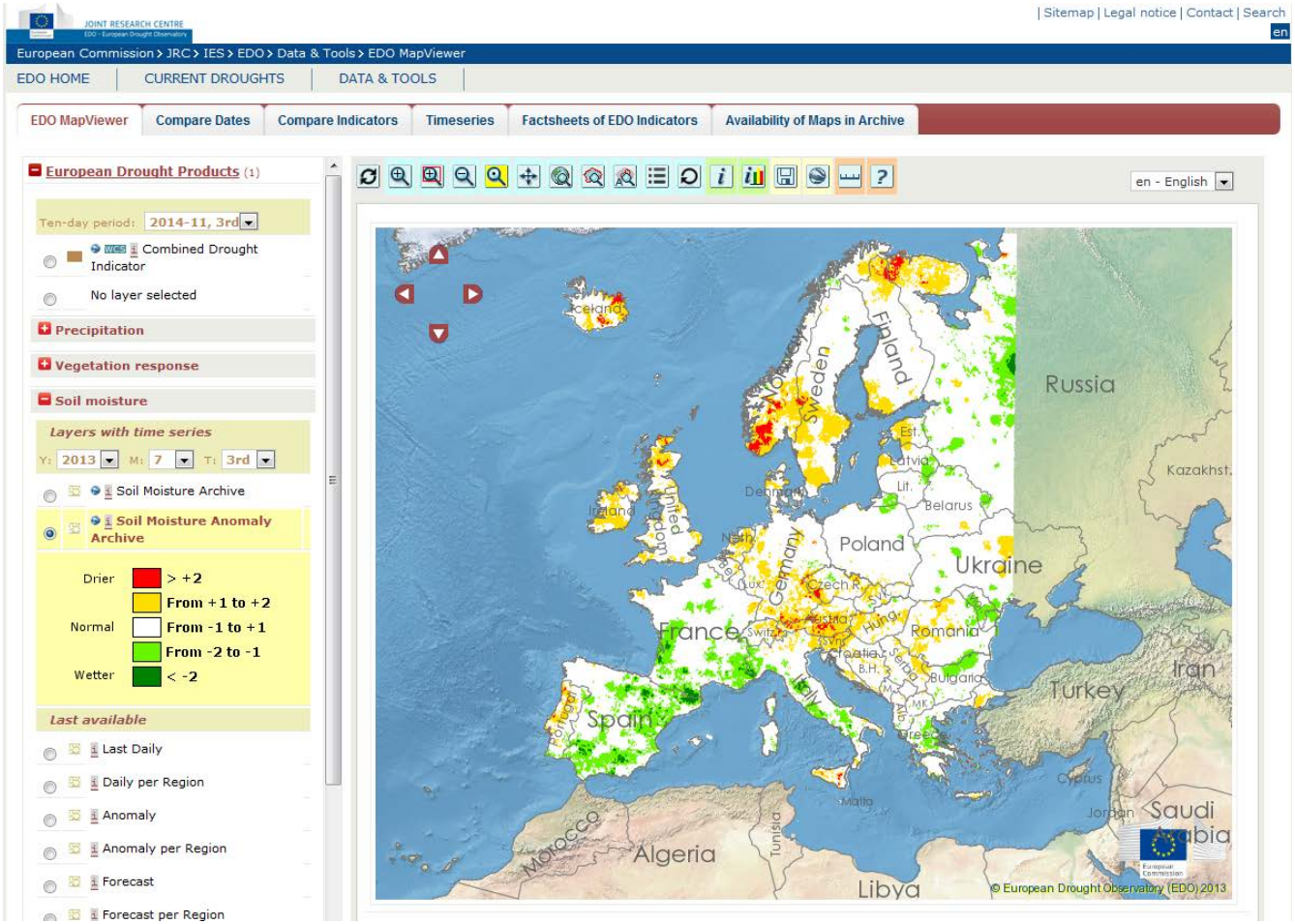


Thielen et al. (2009) HESS

WP6 – T6.2 Flood and drought indicators

Evaluation in the European Drought Observatory (EDO)

GRACE-based total water storage anomalies as part of drought indicators / mapping



http://edo.jrc.ec.europa.eu/

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WP6 – T6.3 Rapid mapping concept

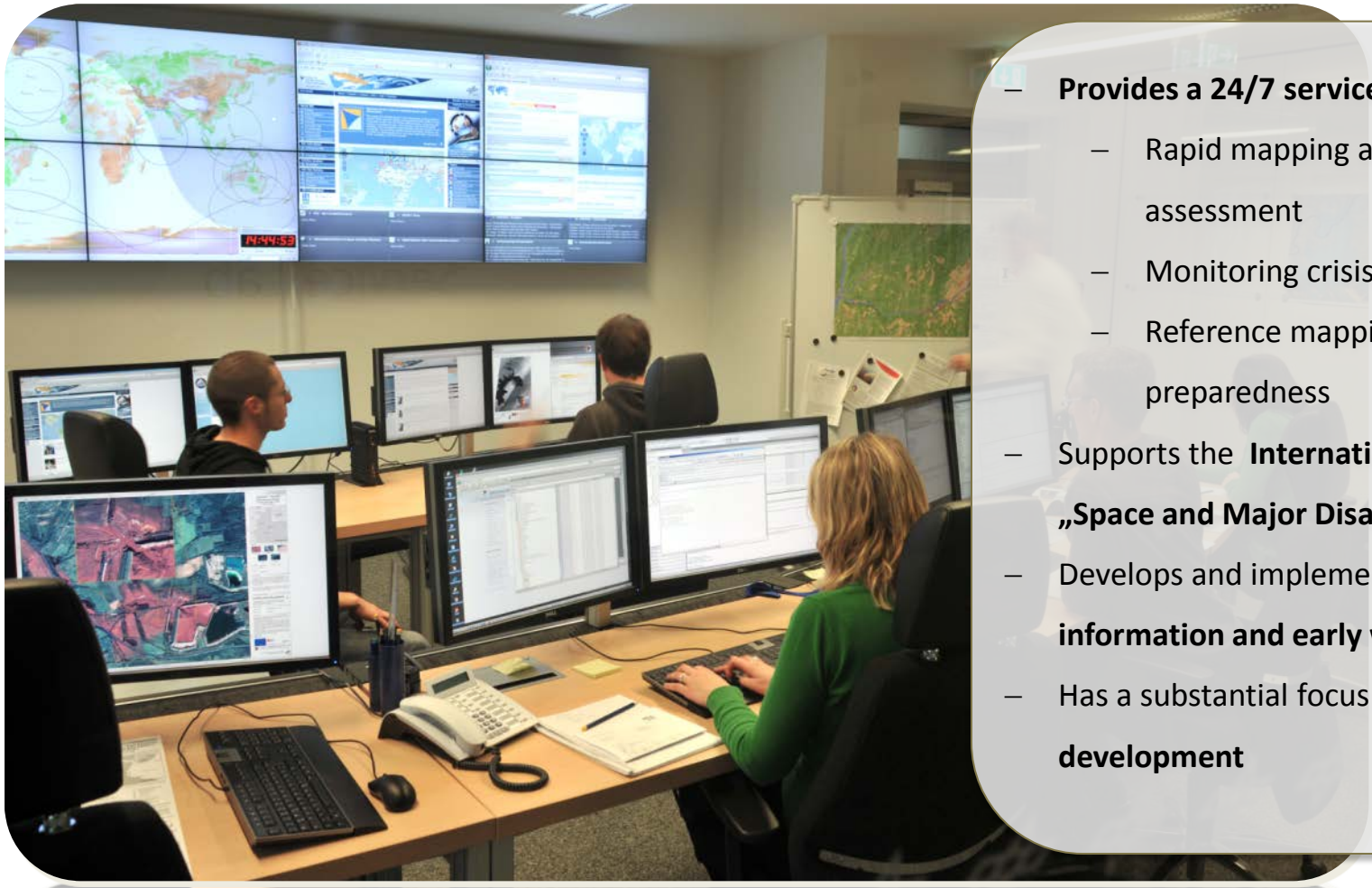
Presenter: Hendrik Zwenzner

Affiliation: DLR

Center for Satellite Based Crisis Information
– Emergency Mapping & Disaster Monitoring –

a service of DFD

ZKI by DFD/DLR



ISO 9001 DNV Certified Company

- **Provides a 24/7 service** for
  - Rapid mapping and damage assessment
  - Monitoring crisis situations
  - Reference mapping for disaster preparedness
- Supports the **International Charter „Space and Major Disasters“**
- Develops and implements **crisis information and early warning systems**
- Has a substantial focus on **research and development**

ZKI activities on national and international level

Research and Development

Algorithms, Methods, Procedures and Systems

National Public Agencies

Emergency Mapping Service Provision within a national mandate for the German Federal Ministry of Interior

Bundesministerium des Innern

European Users

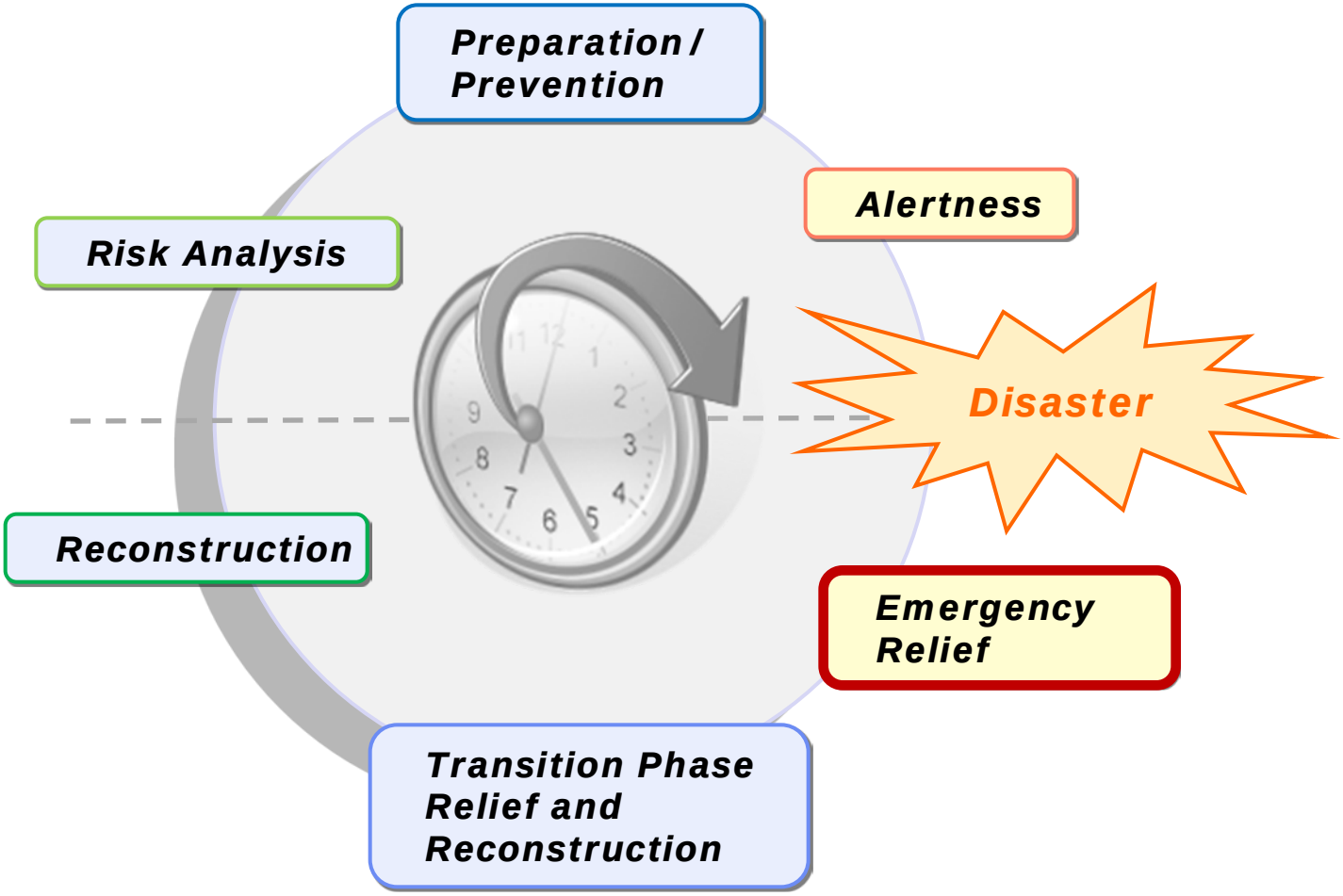
Contribution through research projects, pre-operational and operational services

International Users

DLR as member of the International Charter ‚Space and major disasters'

International Charter Space & Major Disasters
Charte Internationale Espace et Catastrophes Majeures

Disaster Management Cycle



Scenario / Portfolio


Flood


Landslide


Major Event


Earthquake


Vulcanic Eruption


Evacuation and Preparedness


Wild Fires and Burn Scars


Technical Accident


Personal Security, Kidnapping

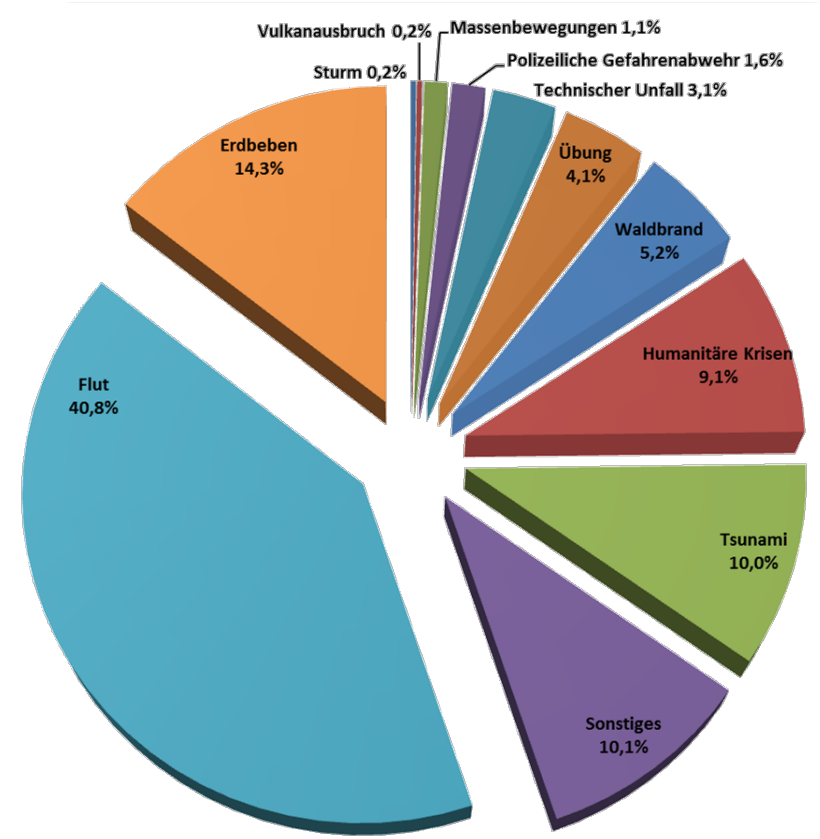

Tsunami


Humanitarian crisis


Police Investigation


Severe storm

ZKI Activations 2004-2014



Since 2004:

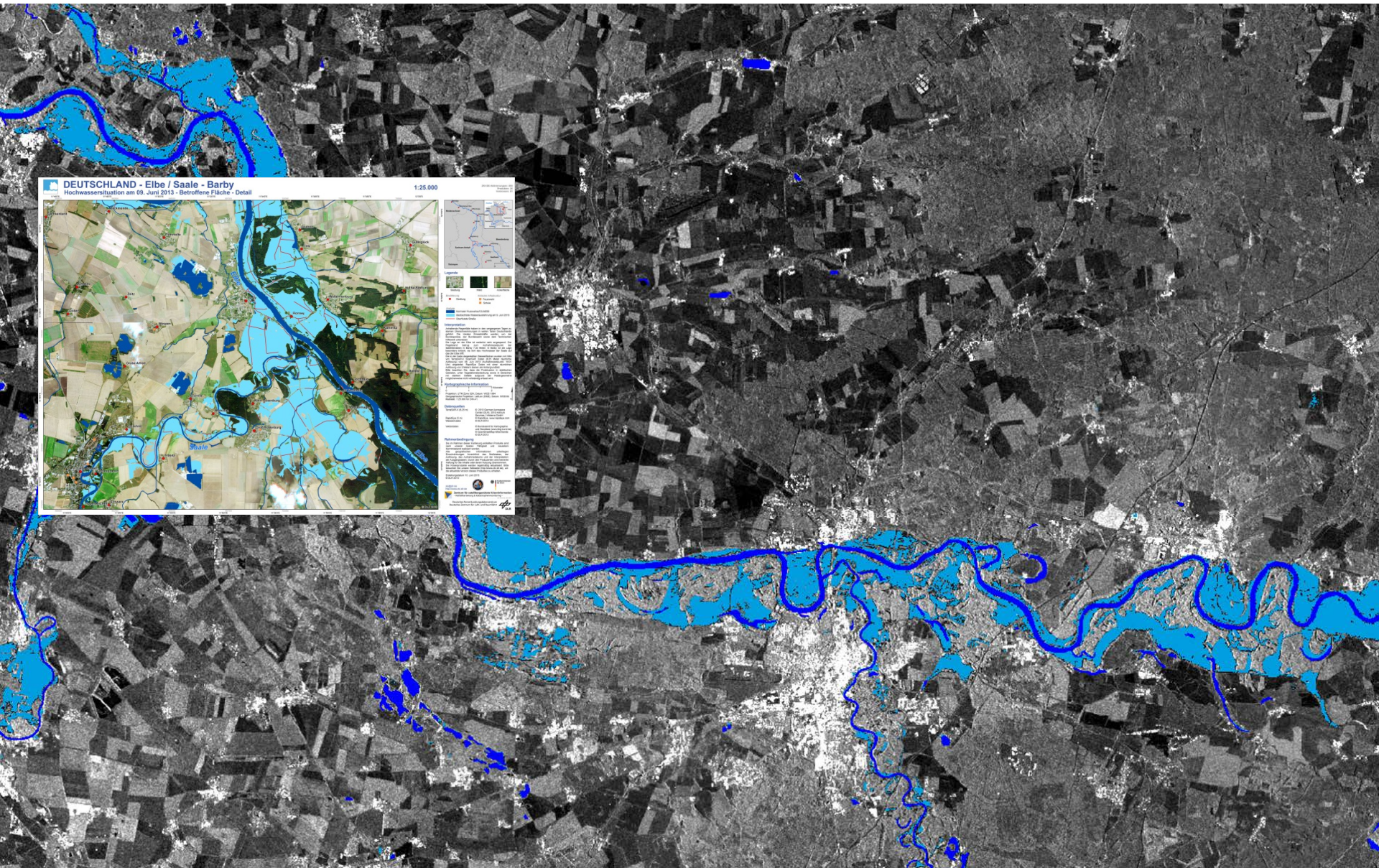
> **150 Activations & Trainings**

> **120 Activations** of the International Charter „Space and Major Disasters“

> **900 Products** generated

> **90 requests** from **Public Authorities**

Floods in Germany, June 2013



Rapid Mapping Workflow

Crisis or Disaster

①Mobilization

- *triggering process*
- *situation briefing*

②Data acquisition

- *satellite tasking*
- *archive search*
- *auxiliary data*

③Pre-Processing

- *geometric correction*
- *image enhancement*

④Analysis

- *data fusion*
- *information generation*

Integration of auxiliary data

⑤Map Production

- *quality control*
- *maps (printed; online)*
- *GIS-ready geodata*
- *information dossiers*

Integration in collaborative platform

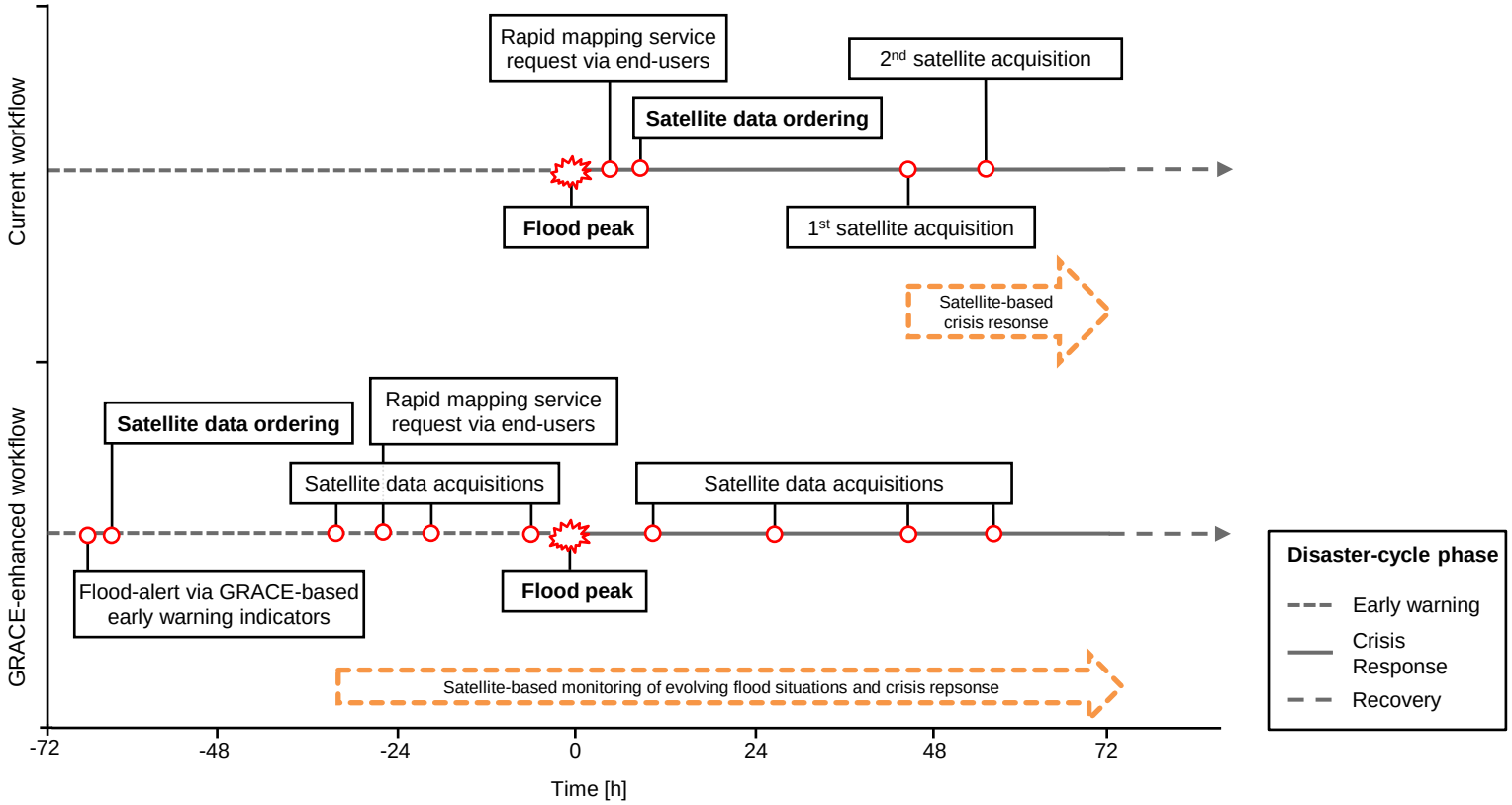
⑥Dissemination

- *Cooperation with national/local authorities*
- *Relief organisations, NGOs*
- *Public,…*

Planning and Decision Support

within 8 hours

Improved satellite tasking by using GRACE measurements as flood early warning indicators



Horizon2020

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