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# *On the way to Ensemble Hydrological Forecasts: Lessons Learned from MAP D-PHASE*

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# Outline

- What is D-PHASE?

- Users & End users
  → Their involvement & participation
  → Feedback (questionnaires…)

- Outreach to real applications
  → a business case
  → an operational case


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# MAP D-PHASE essentials

Demonstration of Probabilistic Hydrological and Atmospheric Simulation of flood Events in the Alpine region

- Fourth phase of Mesoscale Alpine Programme (MAP)
- 2nd World Weather Research Programme (WWRP) Forecast Demonstration Project (FDP) after Sydney 2000 and before Beijing 2008
- Focuses on heavy precipitation, hydrology, high-resolution numerical modeling and ensembles
- D-PHASE Operations Period (DOP): June to November 2007 (COPS & “MAP season”)
- 9 countries involved
- 30 atmospheric models (7 ensembles) & 7 hydrological models in over 40 catchments


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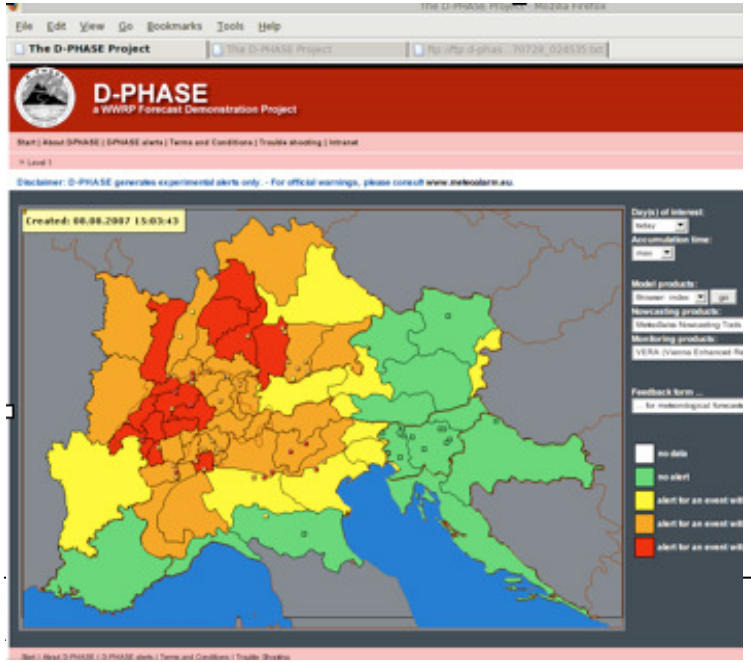
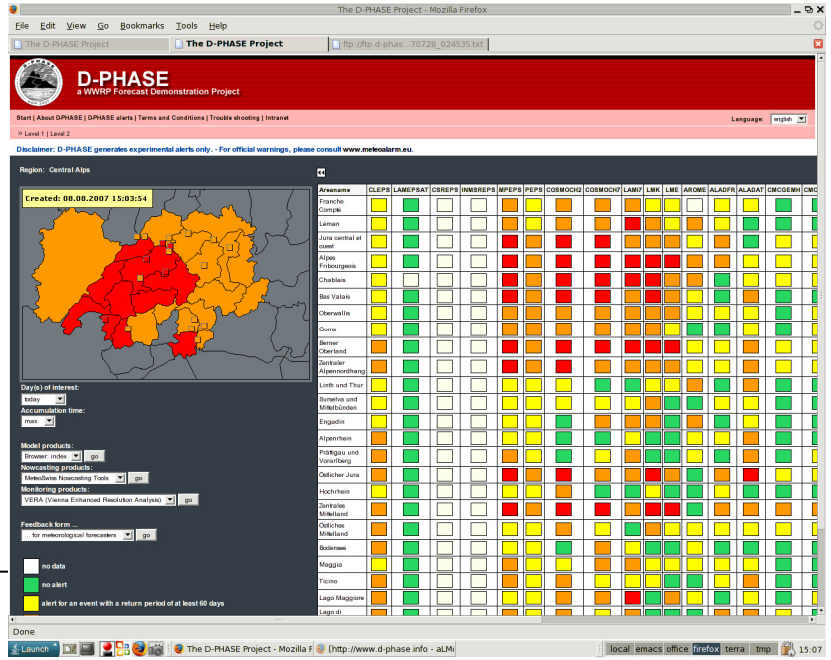
***BAMS** Paper, Sept 2009*

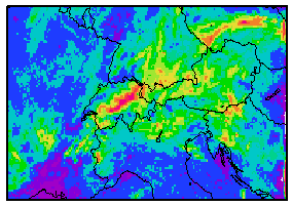
# Key elements of D-PHASE

- Centralised **Visualisation Platform (forecasts & alerts; in real-time)**
- Data **archiving** (→ research / analysis)
- **Nowcasting** tools
- Systematic integration of **end users**
- **Evaluation**, objective and subjective



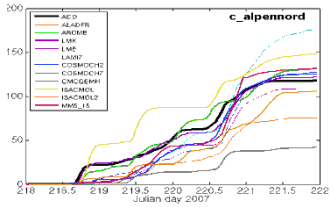



# Visualisation Platform: Alerts



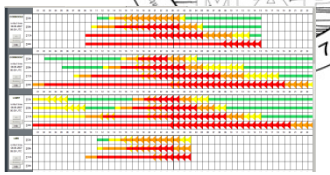
**Model output**

domain averages



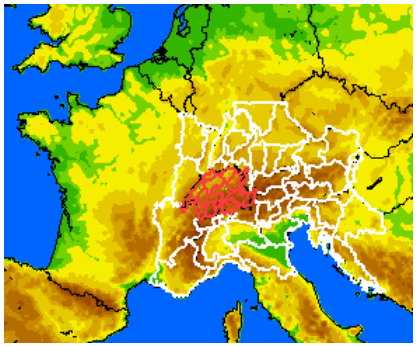

**RR time series**

apply warnlevels



**Alert time series**

> 40 catchments:

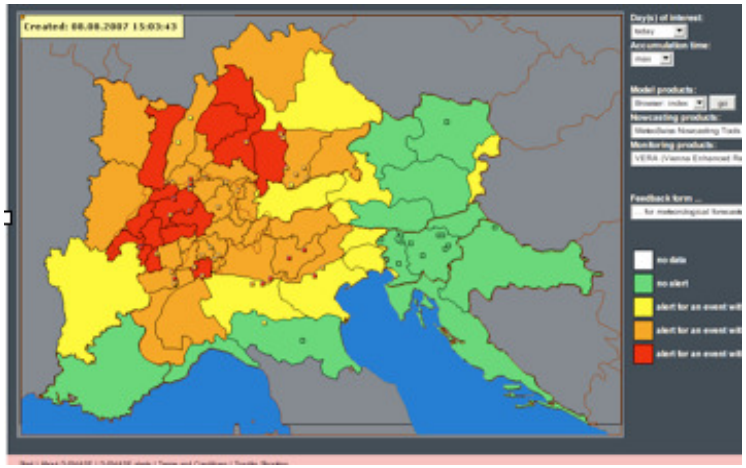


3 types of alerts:

| No alert | 6 times a year | Twice a year | Every 10 years |
|---|---|---|---|

(Accumulation times: 03h, 06h, 12h, 24h, 48h, 72h)

higest level

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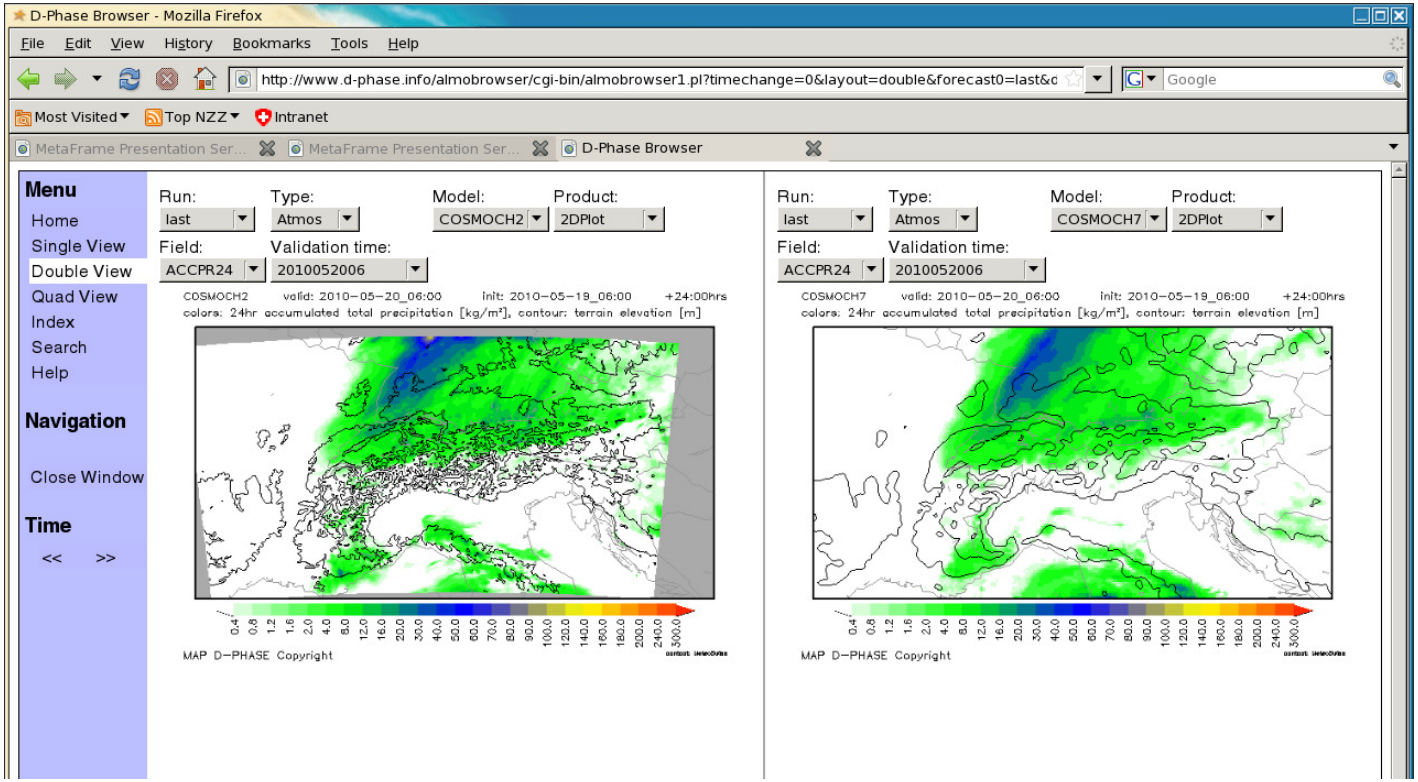
# Visualisation Platform: Models




Key element of success: **common formats**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# Users

- WWRP Joint Scientific Committee asked for ‘at least 1’
  → over 40 institutions!
  → forecasters (atmospheric & hydrological)
  → COPS (WWRP RDP) mission planning
  → **end** users: civil protection, water management, ...
- Quality
  → feedback
  → transfer to operations



# Forecaster feedback

- **Forecasters** (MeteoSwiss):

  (Fill in feedback forms every day)

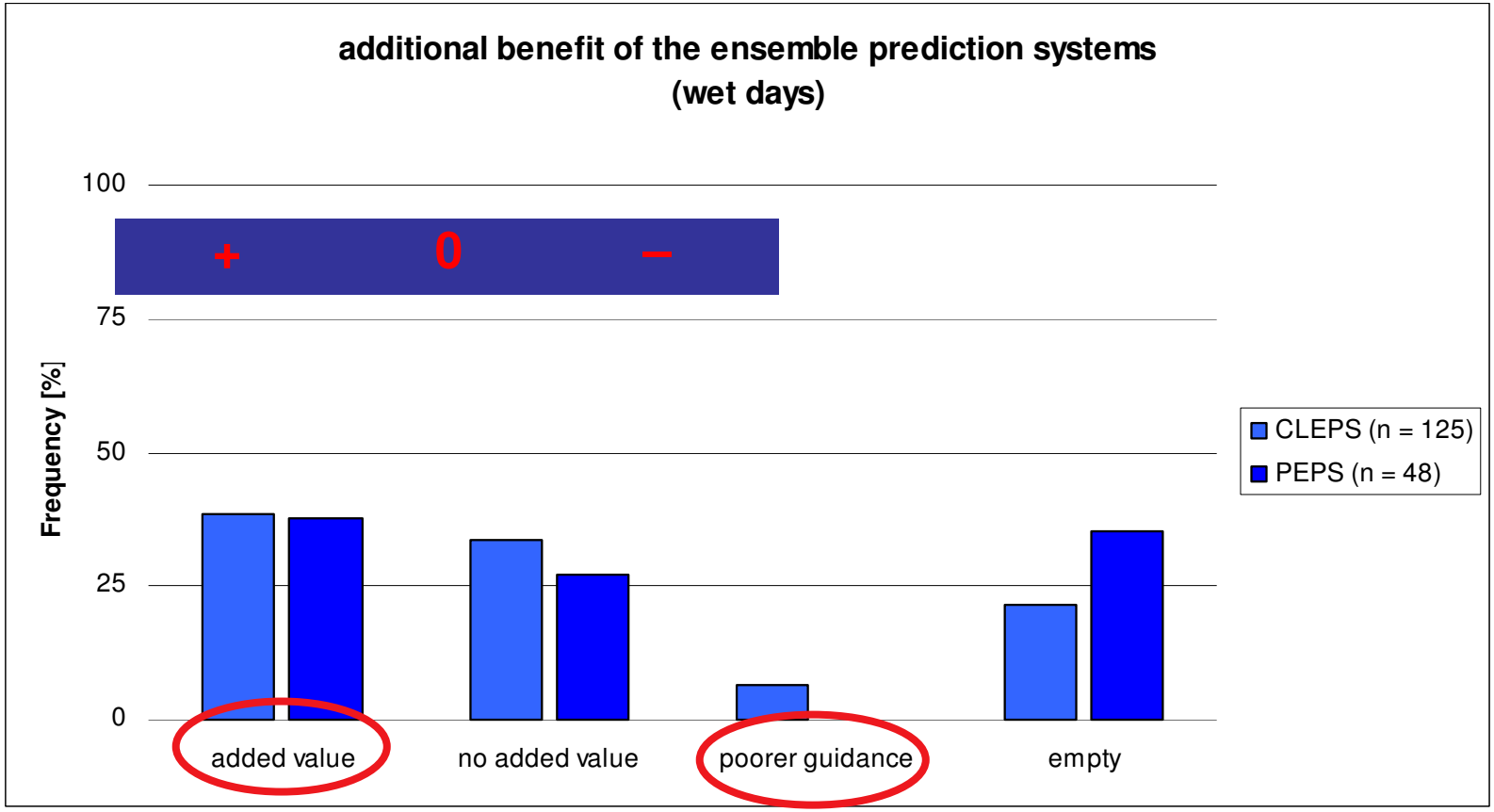
➢ Prefer nowcasting tools in the first forecast hours

# Forecaster feedback

- **Forecasters** (MeteoSwiss):

  (Fill in feedback forms every day)
- Prefer nowcasting tools in the first forecast hours
- ensemble prediction systems ✓

# Question III.3: Additional benefit of ensemble models as compared to established det. models?





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# Forecaster feedback

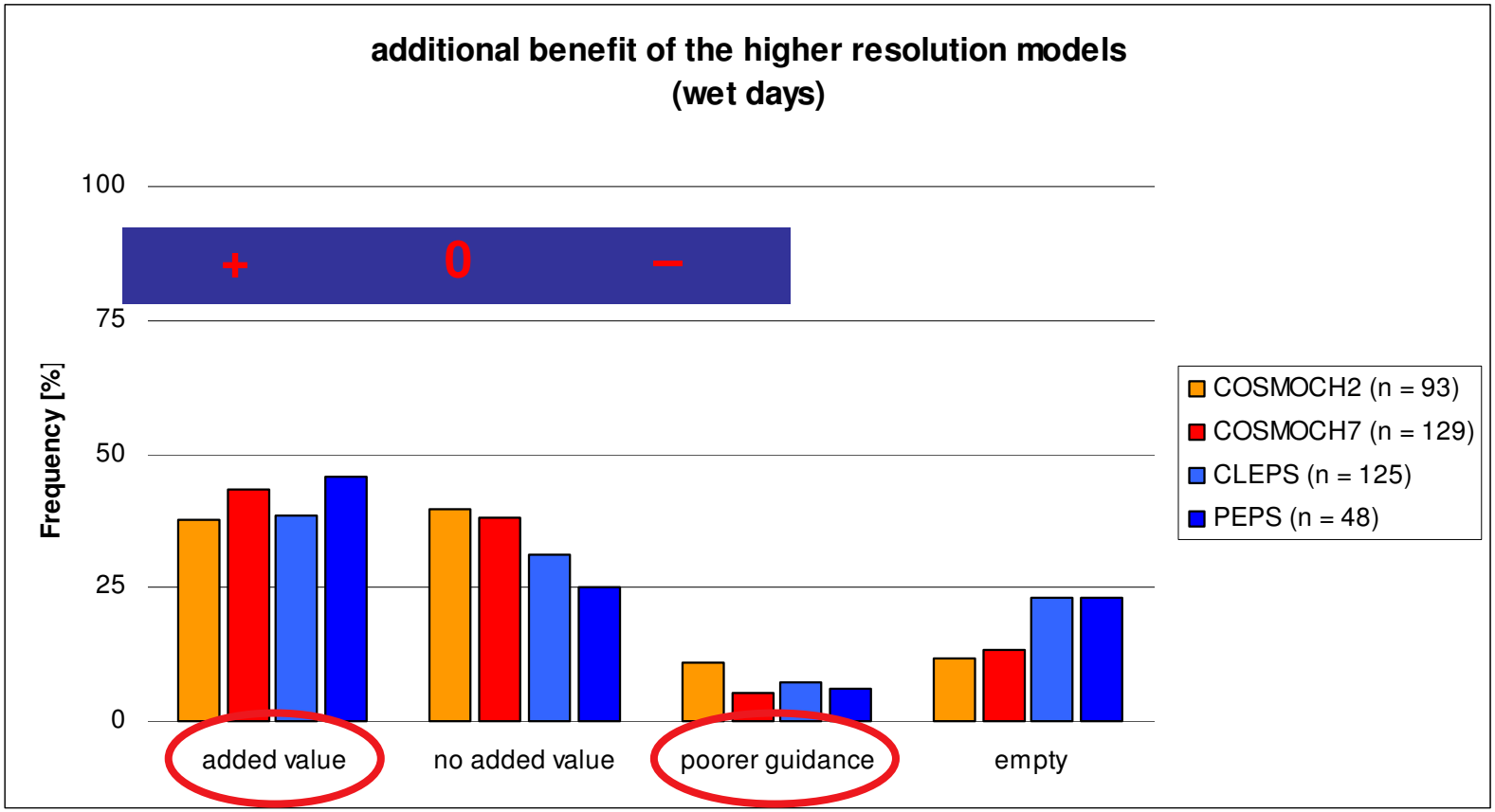
- **Forecasters** (MeteoSwiss):

➢ Prefer nowcasting tools in the first forecast hours

➢ Ensemble prediction systems ✓

➢ high-resolution models ✓

# Question III.2: Additional benefit of hires models as compared to coarser ones?





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# Forecaster feedback

- **Forecasters** (MeteoSwiss):
  - ➢ Prefer nowcasting tools in the first forecast hours
  - ➢ ensemble prediction systems ✓
  - ➢ high-resolution models ✓
  - ➢ appreciate large variety of models **But NOT too many!**
  - ➢ **Interaction** with hydrological forecasts ✓

# End user feedback

- **End users**:
  - ➢ workshops before / after DOP
  - ➢ O(30) participants
  - ➢ questionnaires before / after DOP
  - ➢ n rather small, no statistical tests done

*Frick and Hegg, submitted*


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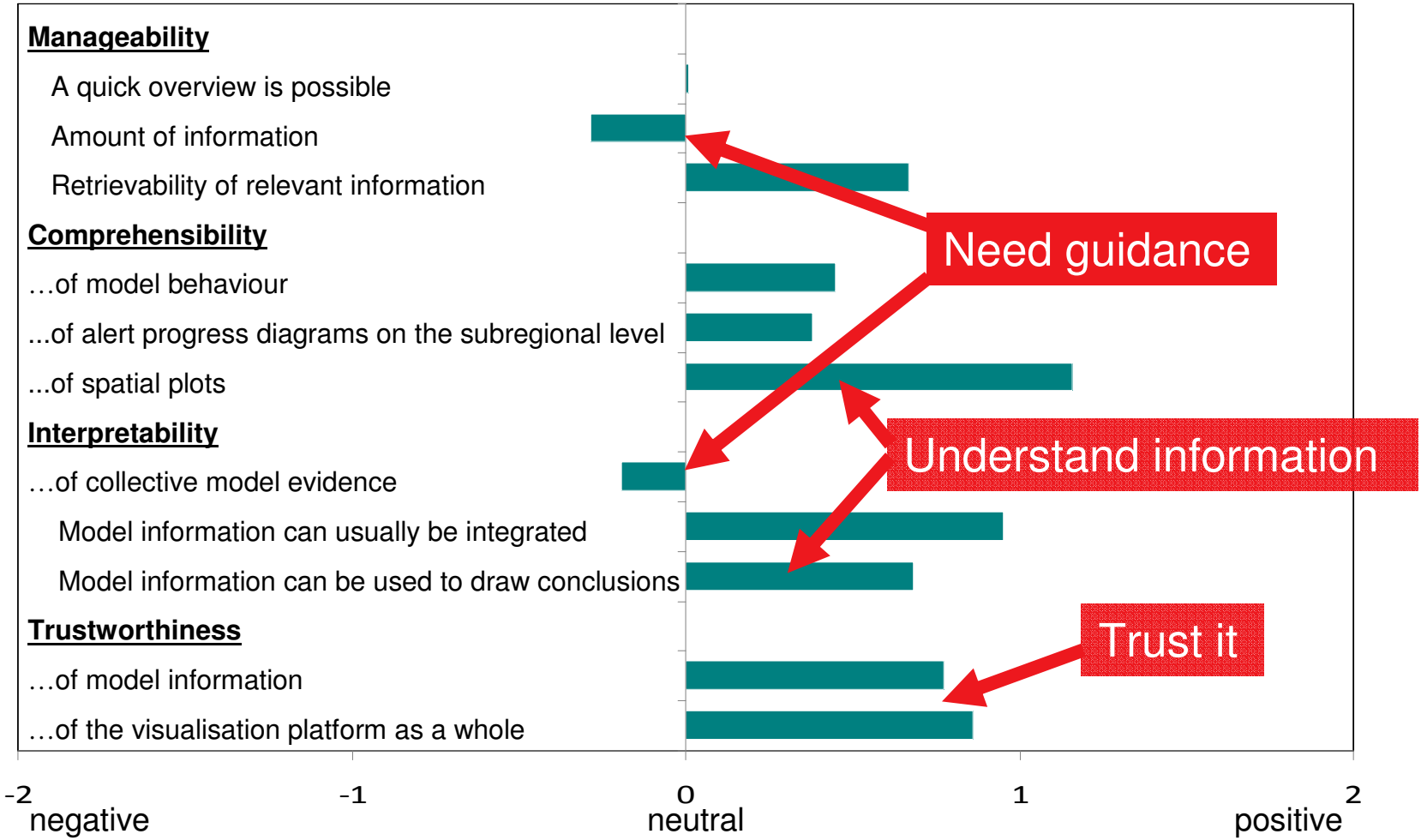
# Judgments about information




*N=24*

*Frick and Hegg, submitted*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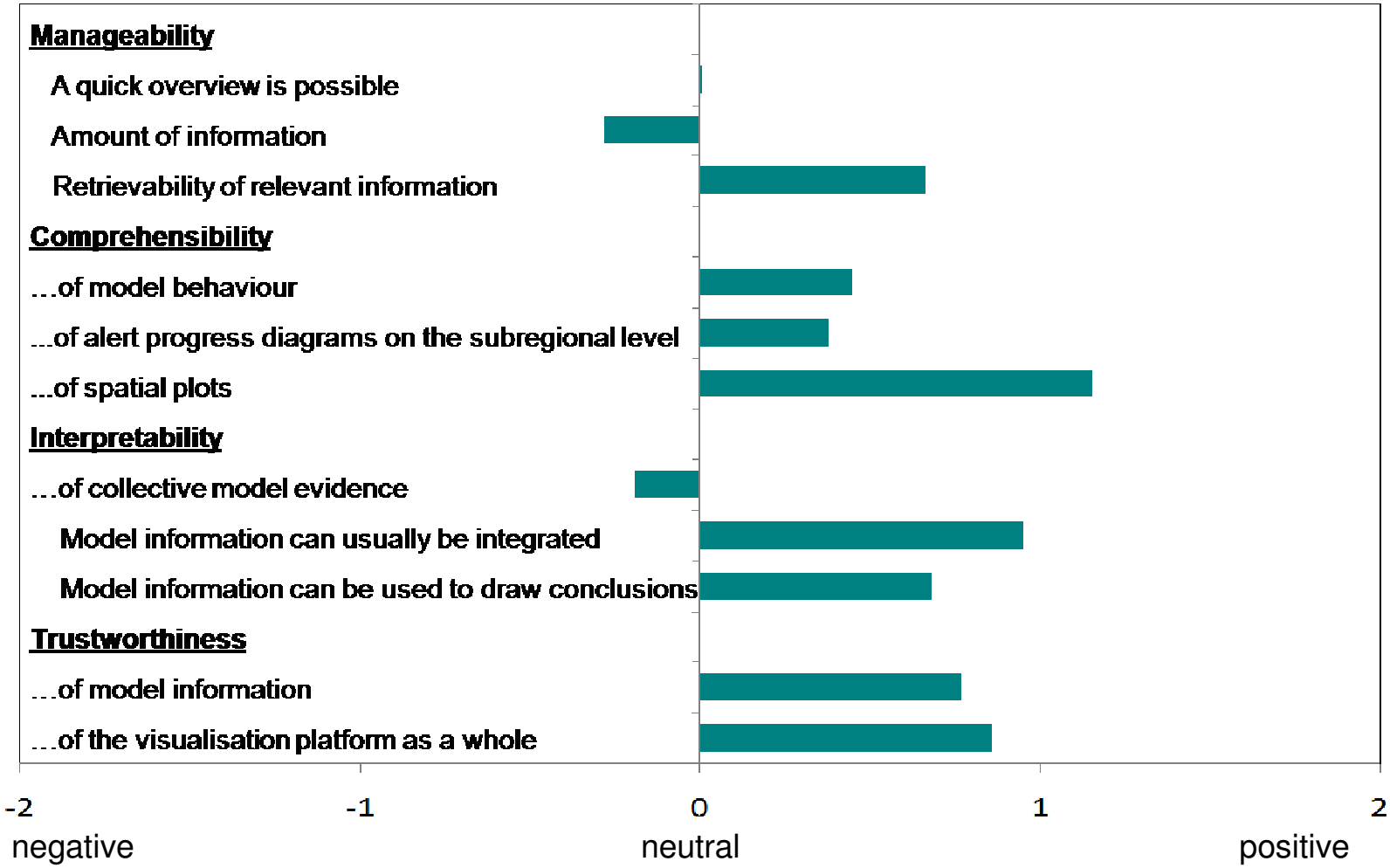
# Judgments about information




*N=24*

*Frick and Hegg, submitted*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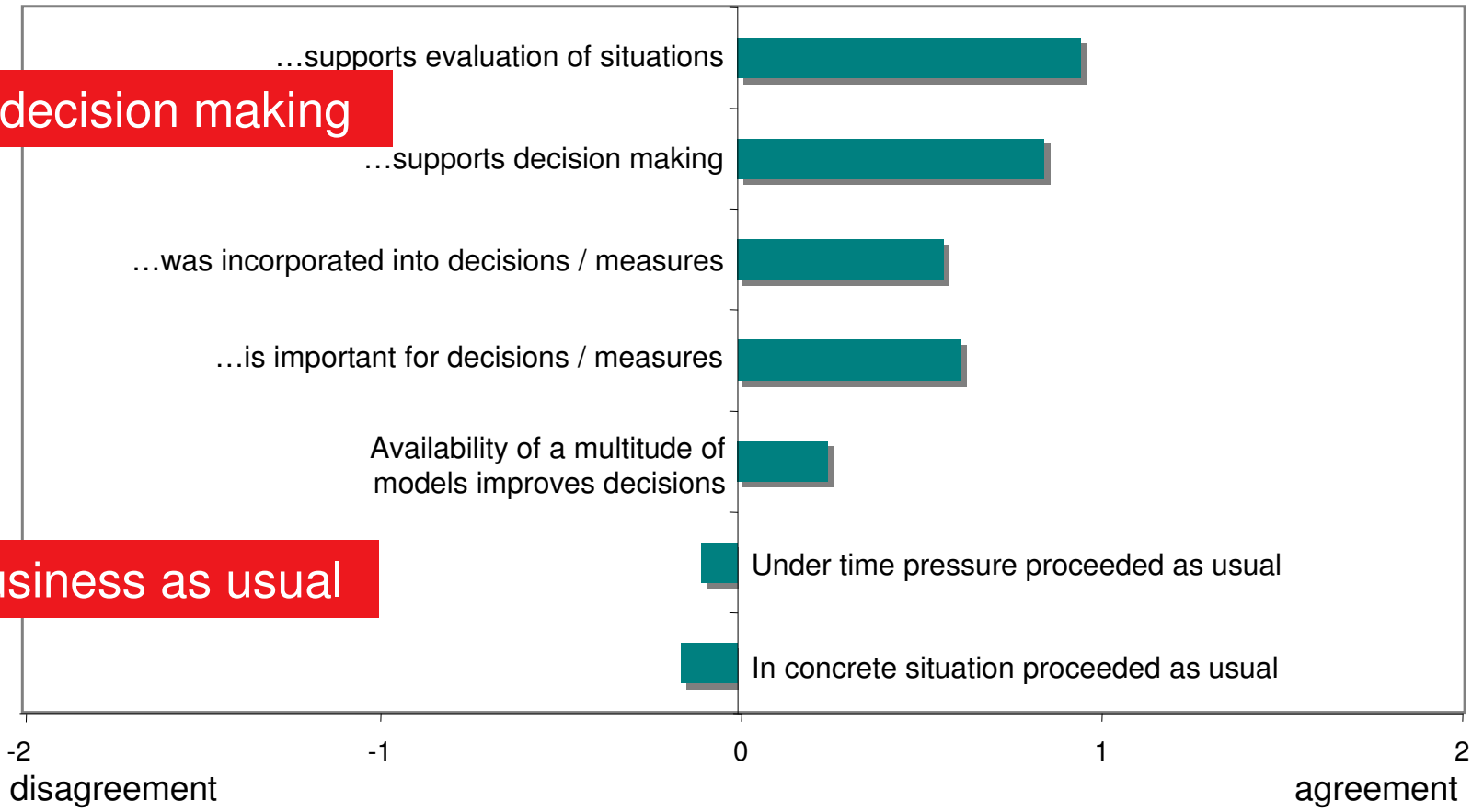
# Appraisal of benefit

*The visualisation platform ....*

Supports decision making

Action: business as usual

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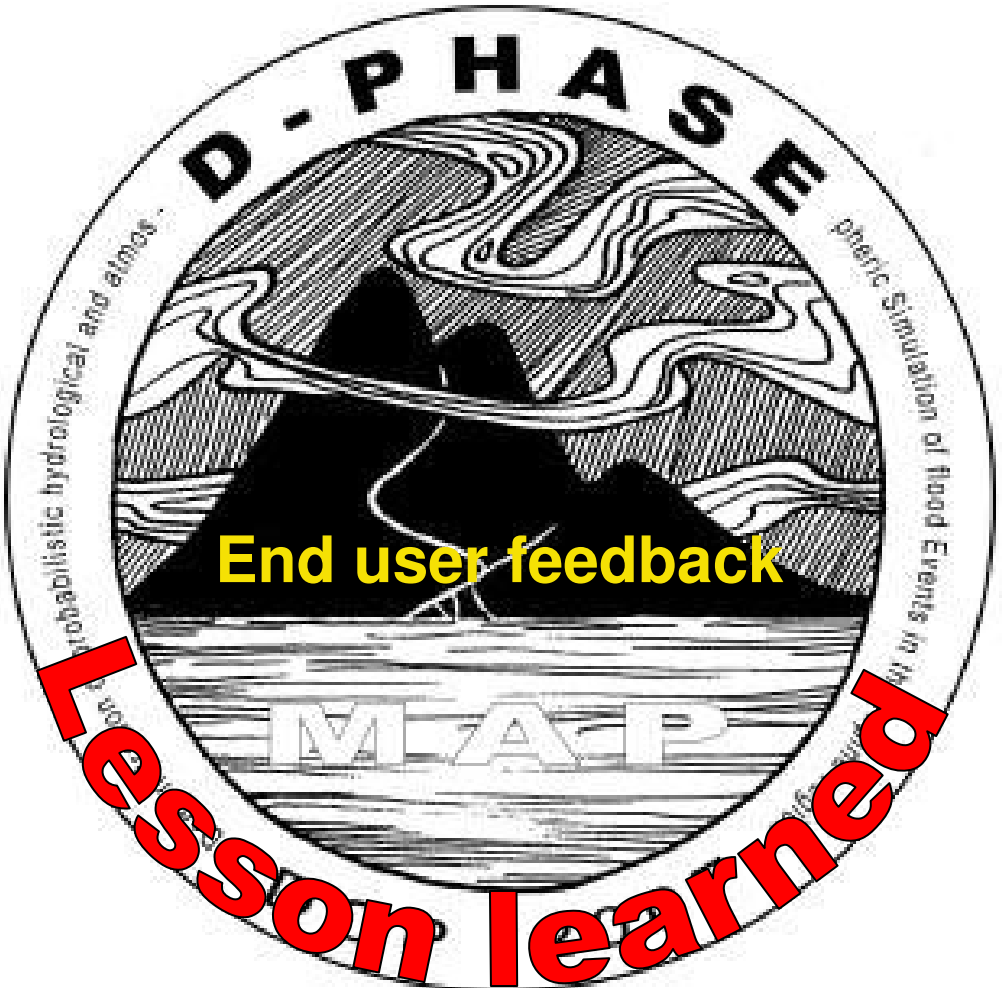



- Take end users early on board
- Resolution needs to further increase (and will)
- EPS's need careful support (for interpretation)
- *Ensemble thinking* for air pollution modelling, heat wave warnings, health impact (e.g., pollen), …

# Outreach to applications

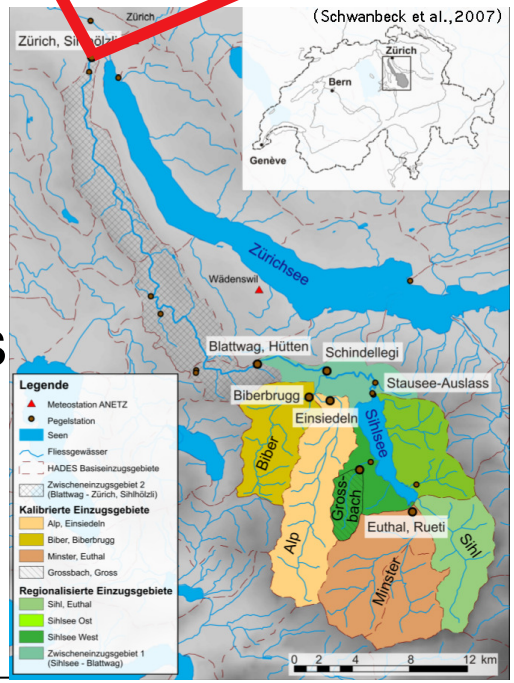
Business case:

→Construction of a new train station in Zurich

→ requires river duct partially be closed

# Outreach to applications

- Cost of opening the gates: 1 Mio CHF
- Damage if not opened: many billion CHF
- Flood wave to station: 2-6 hours
- Evacuation construction site: 2-4 hours
- Opening one gate: 1-2 hours





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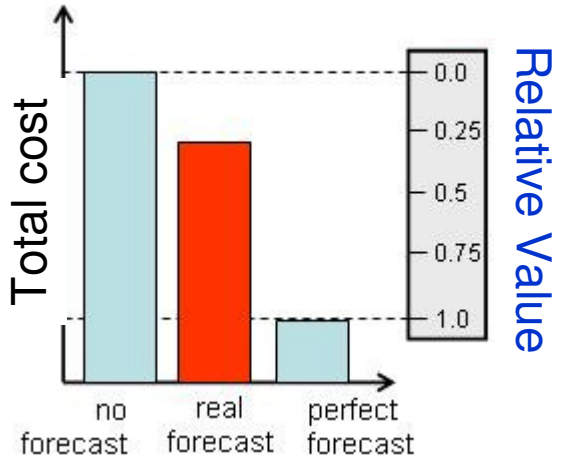
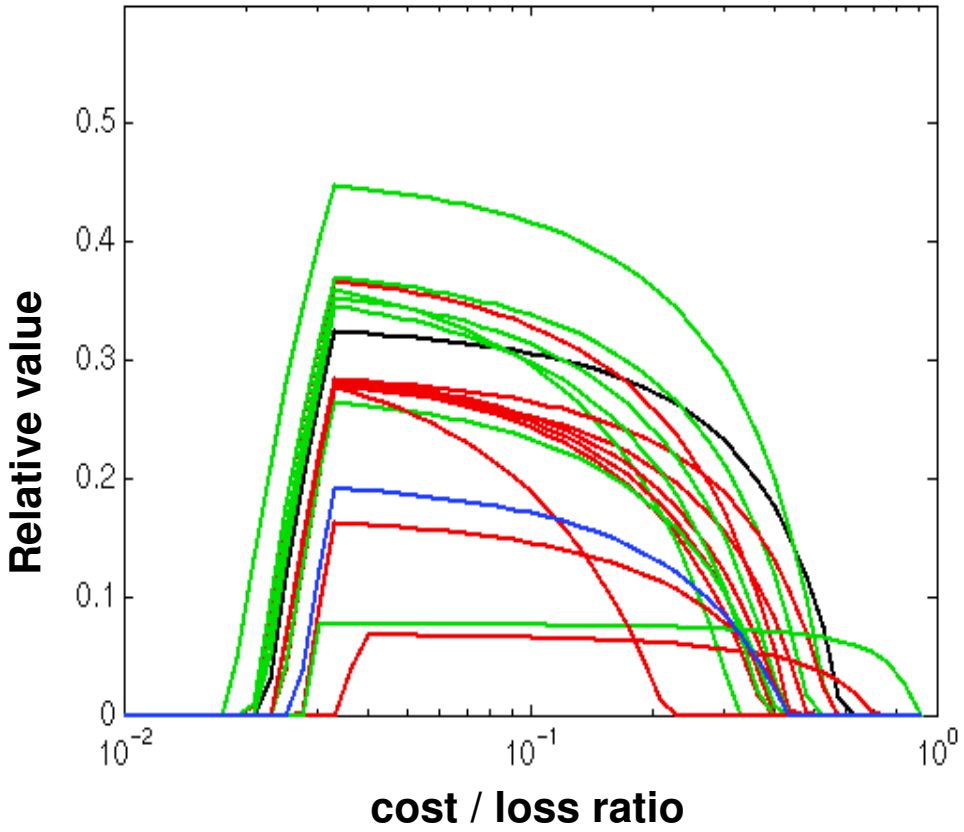
# Economic value of forecast




param. conv.

resolved conv.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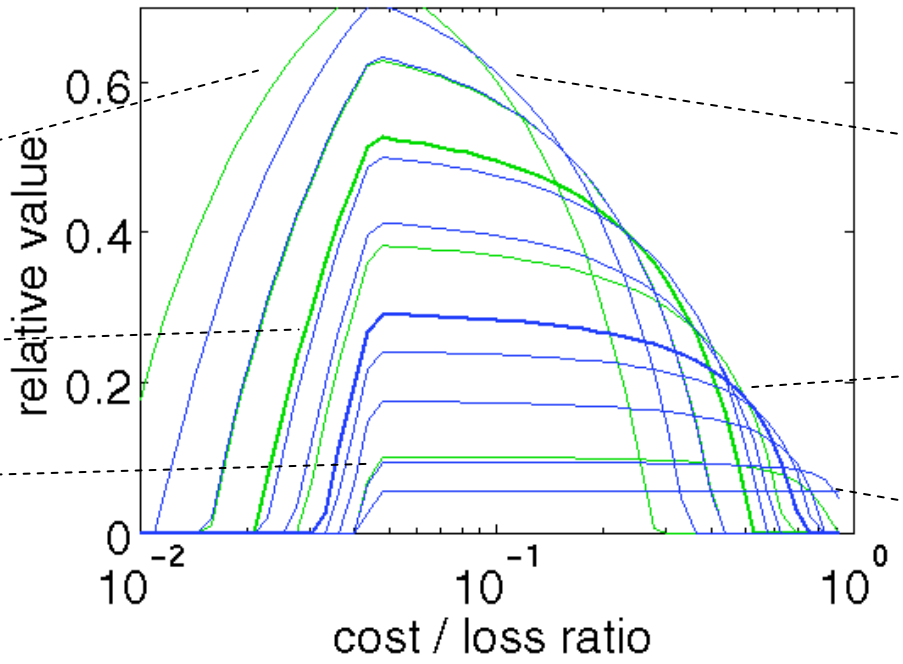
# Ensemble and/or Calibration

## Simple calibration of COSMO-2

Multiply COSMO-2 precipitation forecasts by a factor of

- 2.0
- 1.25
- **1.0**
- 0.8
- 0.5




## D-PHASE poor-men's ensemble

Issue an alert, if a certain fraction of models gives a warning

- 10%
- 20%
- 30%
- 40%
- **50%**
- 60%
- 70%
- 80%
- 90%

*Ament et al., in prep*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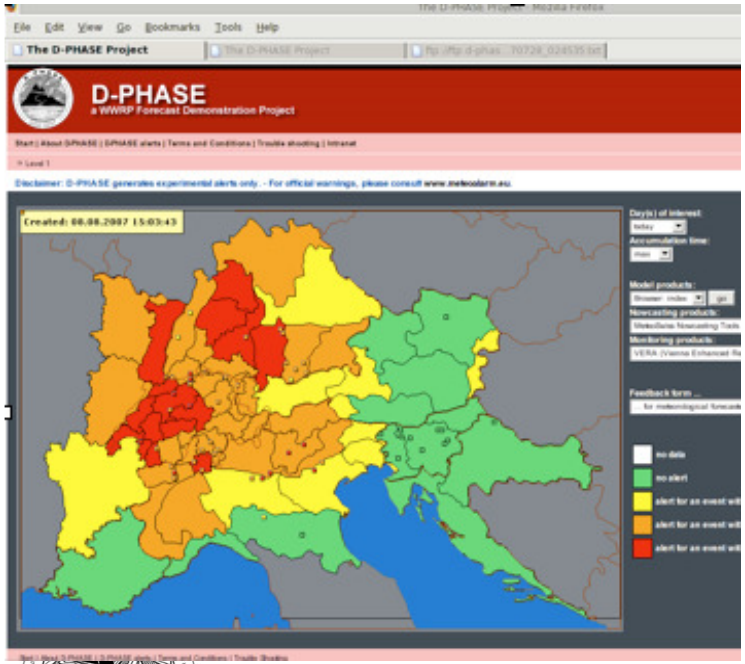
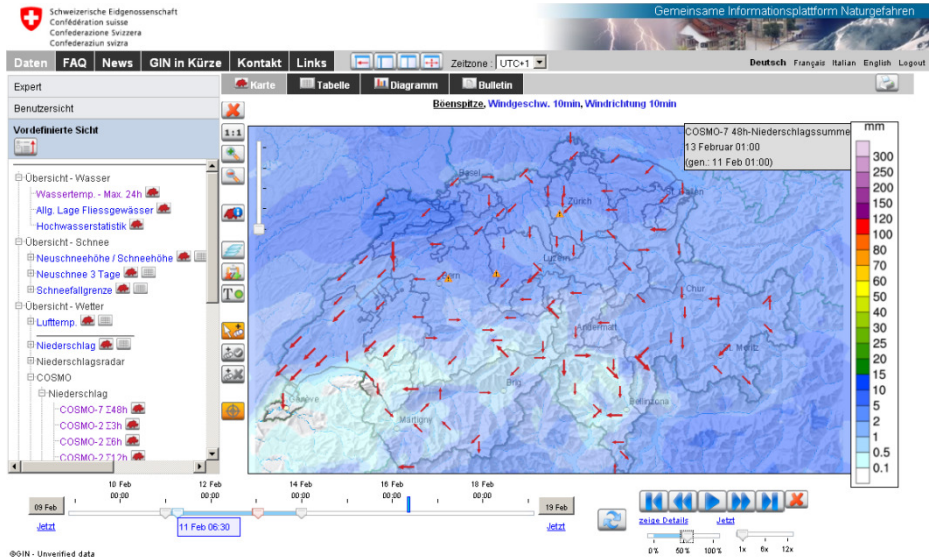
# Outreach to applications

→ D-PHASE inspired new operational information platform in Switzerland

→ D-PHASE platform up and running on user request to bridge time to completion





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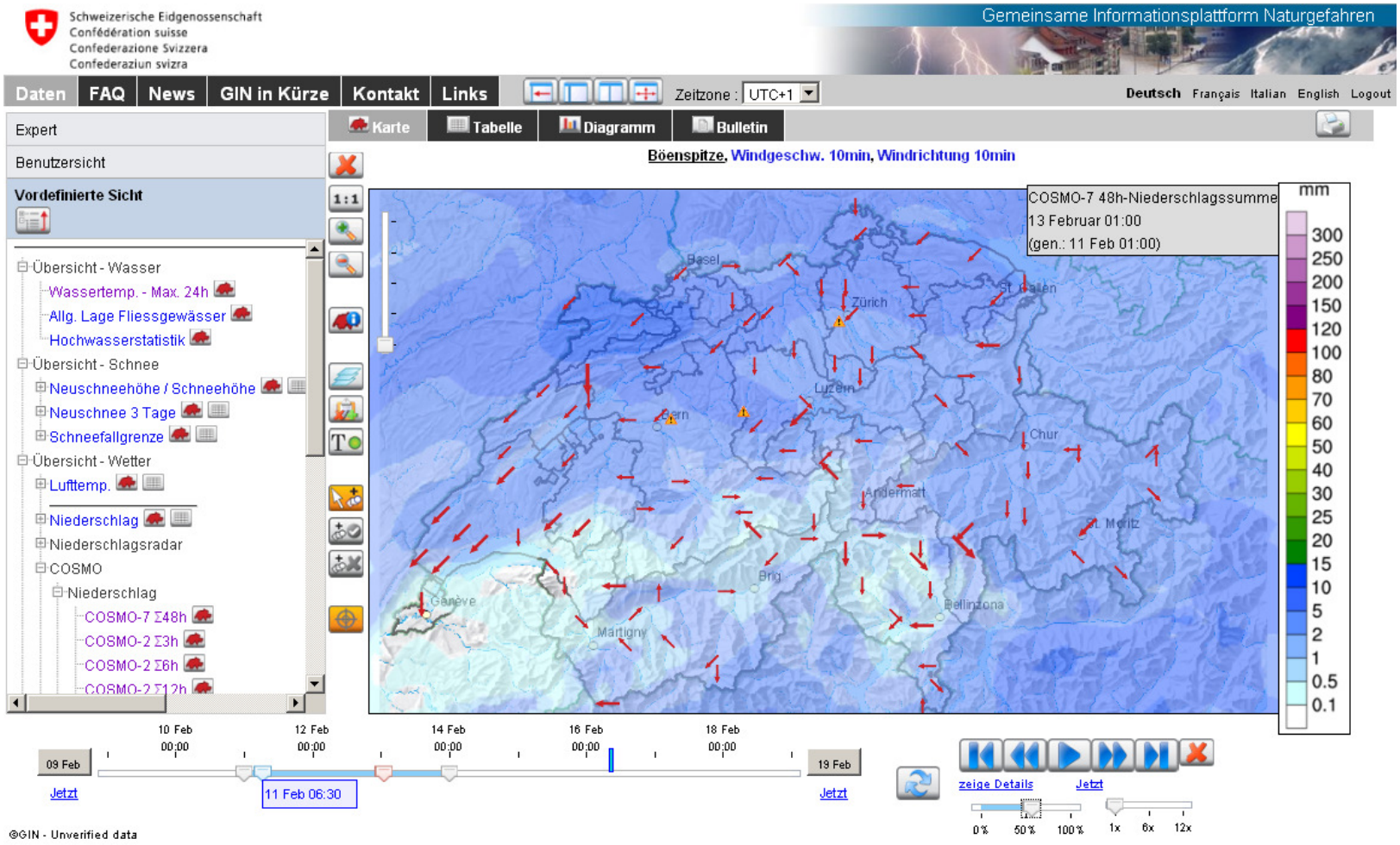
# Common information platform for natural hazards (GIN)





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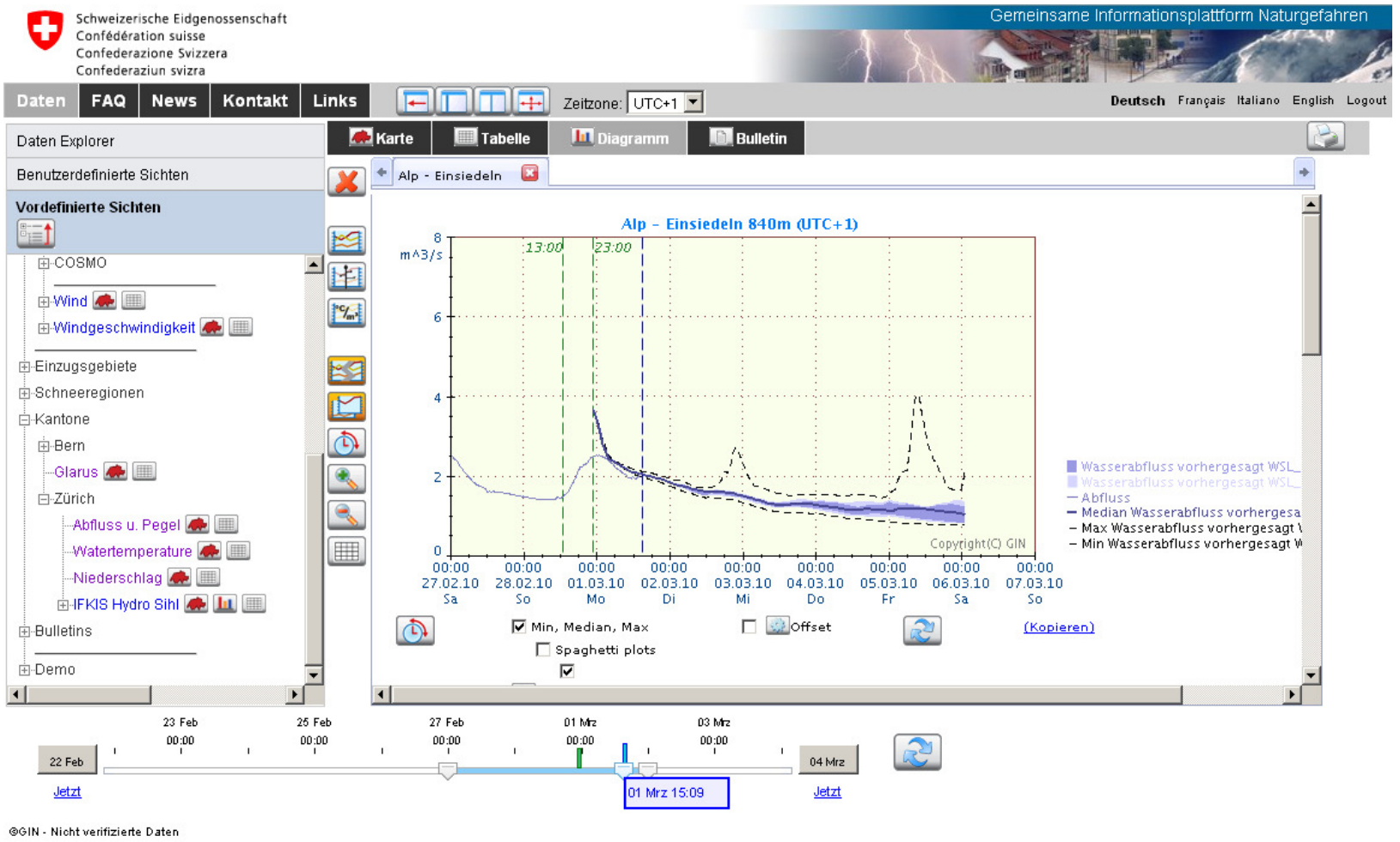
# GIN: Another example





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# Conclusions

For an FDP to be successful….

- Involve users

→ early!

→ feedback

- Commitment ‘pays back’

→ most  efforts / most rewards

- society profits

→ warning systems

→ business enabling


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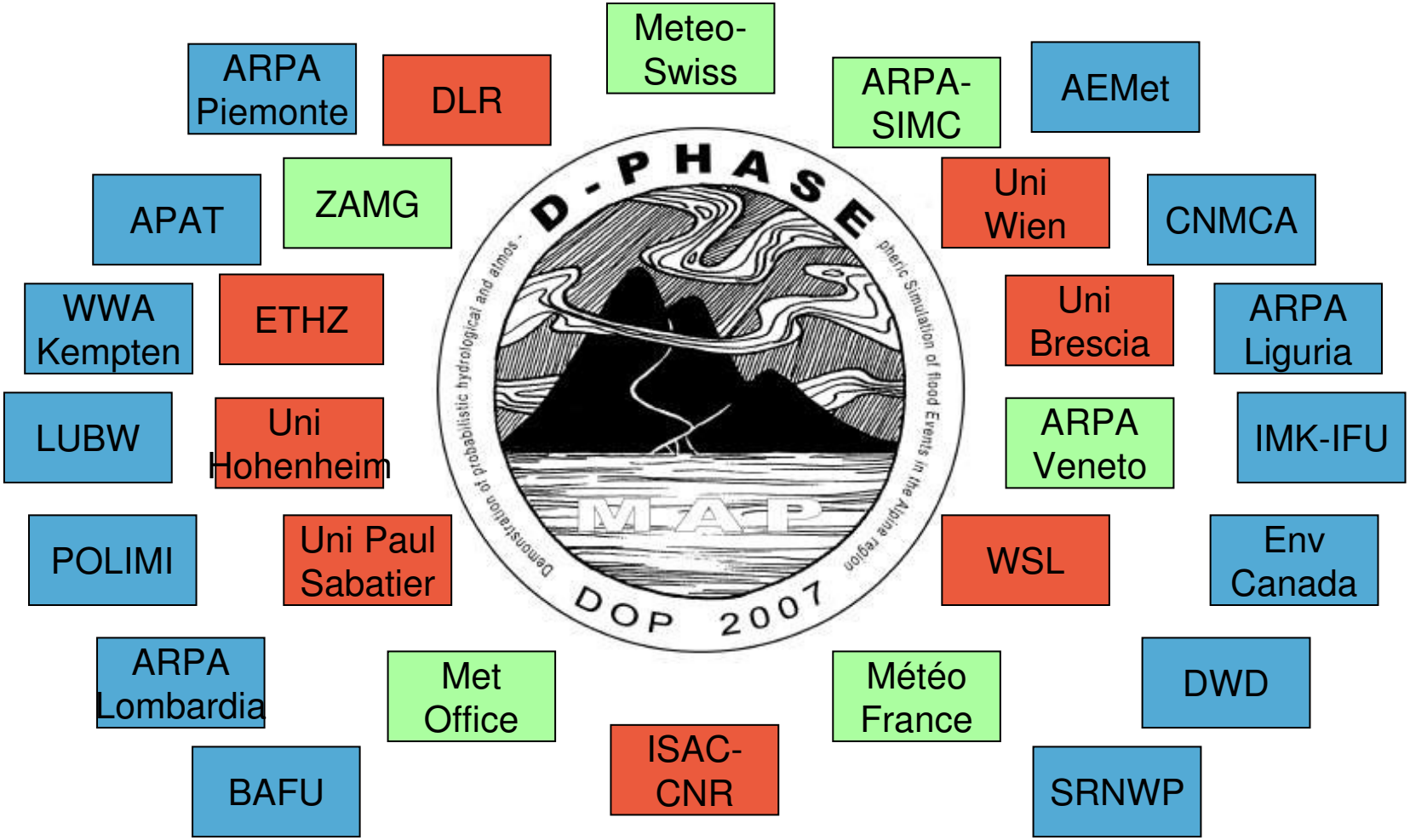
# Thanks!




**Steering Committee & WG chairmen**

Operational Service | University Res. Inst. | Data Provider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