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
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)
- 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
MAP D-PHASE
Real-Time Demonstration of Weather Forecast Quality in the Alpine Region

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A six-month project successfully tested real-time, end-to-end multi-model hydrometeorological forecasts for heavy precipitation and related flooding events in many different catchments in the Alps.

As the first research and development project (RDP) of the World Weather Research Programme (WWRP), the Mesoscale Alpine Programme (MAP) made important contributions to our knowledge on atmospheric processes determined by and influencing weather in mountainous terrain between 1994 and 2005 (Bougeault et al. 2001). A wealth of scientific results (Volkart and Gutermann 2007) was produced in research areas ranging from atmospheric dynamics to mountain
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

> 40 catchments:

domain averages

RR time series

apply warnlevels

Alert time series

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
Key element of success: common formats
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?
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?

![Bar chart showing additional benefit of the higher resolution models (wet days)]

- COSMOCH2 (n = 93)
- COSMOCH7 (n = 129)
- CLEPS (n = 125)
- PEPS (n = 48)

Legend:
- added value
- no added value
- poorer guidance
- empty
**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
D-PHASE lessons learned
CHR Alkmaar, 25-26 May 2010
André Walser (andre.walser@meteoswiss.ch)

Judgments about information

Manageability
- A quick overview is possible
- Amount of information
- Retrievability of relevant information

Comprehensibility
- ...of model behaviour
- ...of alert progress diagrams on the subregional level
- ...of spatial plots

Interpretability
- ...of collective model evidence
  - Model information can usually be integrated
  - Model information can be used to draw conclusions

Trustworthiness
- ...of model information
- ...of the visualisation platform as a whole

Need guidance
Understand information
Trust it

Frick and Hegg, submitted

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N=24

Frick and Hegg, submitted
Appraisal of benefit

The visualisation platform ....

Supports decision making

...supports evaluation of situations
...supports decision making
...was incorporated into decisions / measures
...is important for decisions / measures
Availability of a multitude of models improves decisions

Action: business as usual

Under time pressure proceeded as usual
In concrete situation proceeded as usual

N=24

Frick and Hegg, submitted
End user feedback

- 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
Economic value of forecast

- Total cost
  - no forecast
  - real forecast
  - perfect forecast

Relative Value

- resolved conv.
- param. conv.

cost / loss ratio

Relative value

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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
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
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
Thanks!

Steering Committee & WG chairmen

- DWD
- SRNWP
- ISAC-CNR
- Met Office
- ARPA Lombardia
- Uni Paul Sabatier
- Uni Hohenheim
- ETHZ
- WWA Kempten
- LUBW
- POLIMI
- AEMet
- Uni Wien
- Uni Brescia
- ARPA Veneto
- IMK-IFU
- CNMCA
- ARPA Liguria

Data Provider

University Res. Inst.

Operational Service

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