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University of Fribourg, Switzerland

MEMcaf

MEteorological Metadata CombinAtion Framework

Master thesis of Lorenzo Clementi

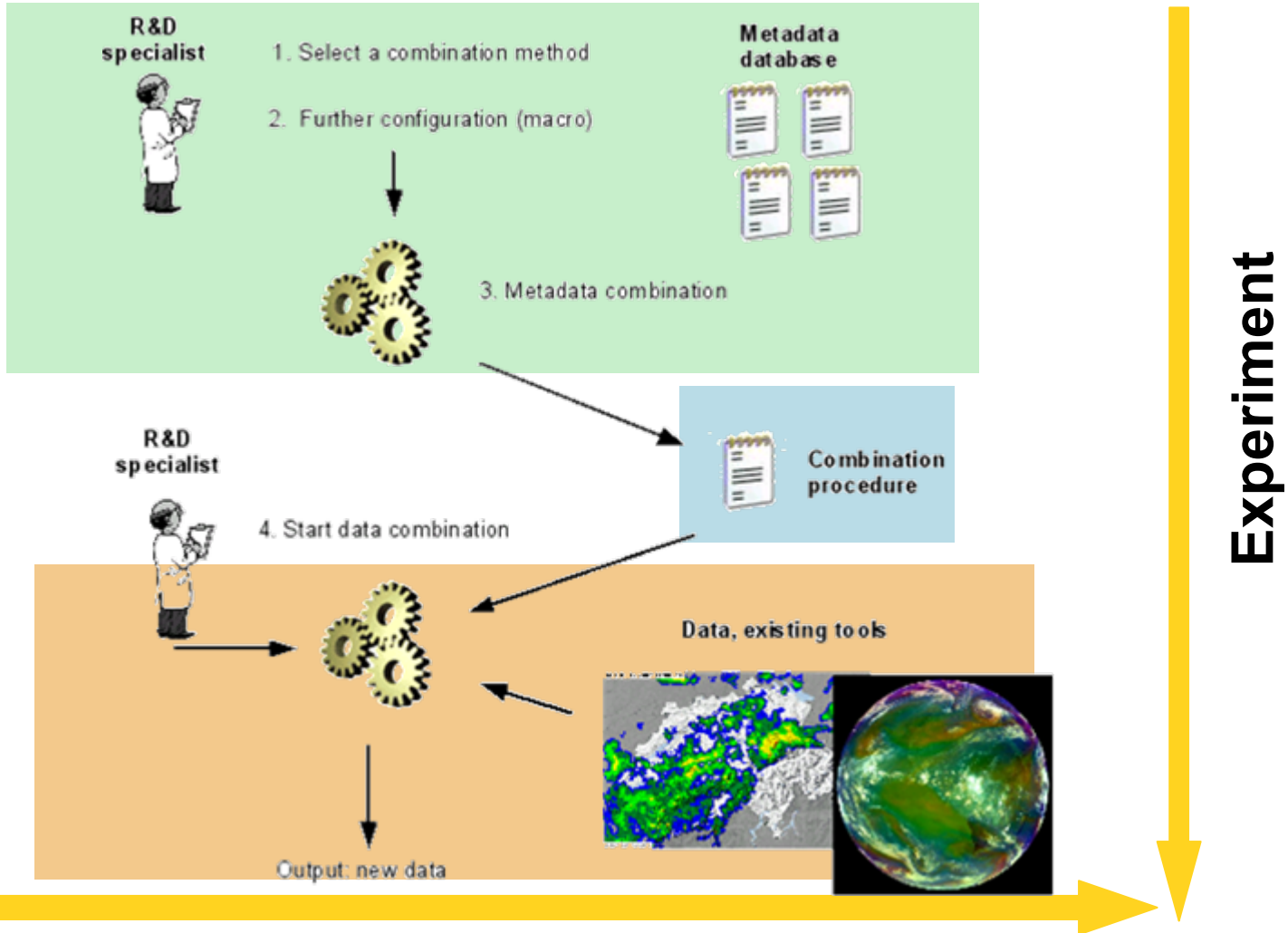
Second mid-term presentation

February 8, 2008

Presentation outline

- Framework architecture: reminder
- Use case description
- Demo
- Result discussion
- Conclusion

Architecture



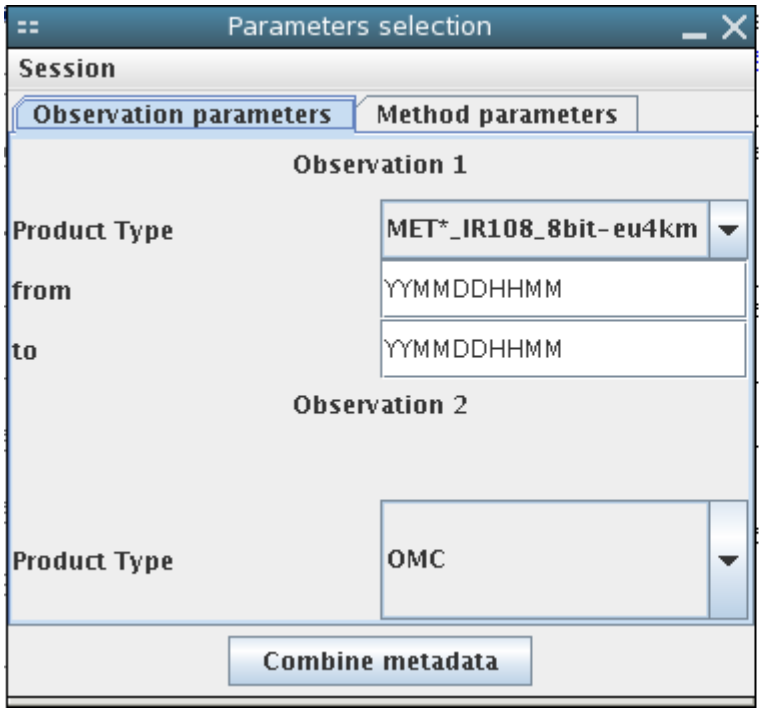
Use case: overview

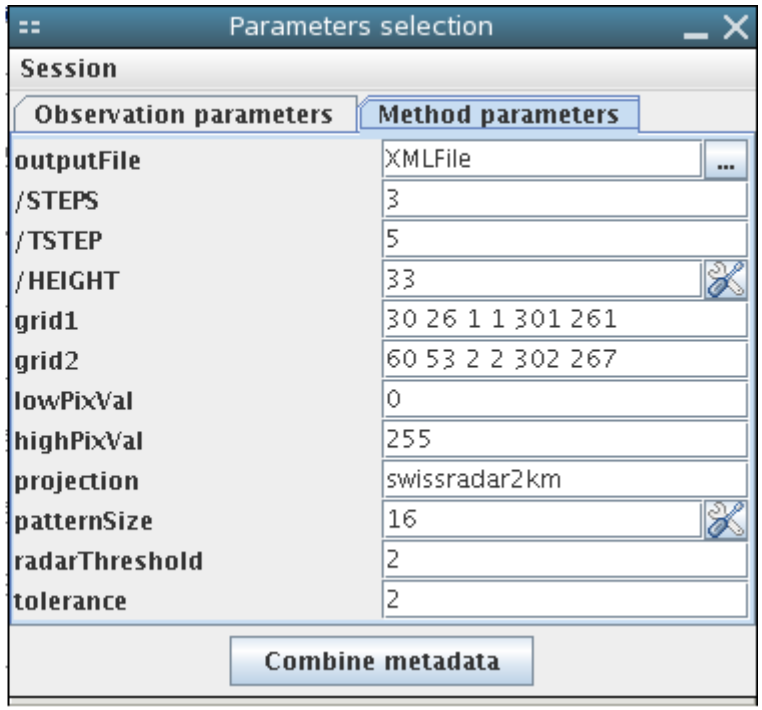
- **Precipitation field extrapolation based on satellite displacement vectors**
- Goals
  - First assessment of extrapolation reliability
  - First optimization experiments
- *“Nowcast validation and comparison with extrapolation is incomplete”* [J.W.Wilson, National Centre for Atmospheric Research, Boulder]

Use case: some details

- Atmospheric motion field (AMF) and extrapolation are computed by **CineSat** based on satellite images
- Satellite channel: **IR 10.8 µm** (cloud top temperature)
- Radar products: **OMC** (reflectivity), **PJC** (precipitation)
- Projection: Switzerland Composite, 2 km resolution
- Note that other satellite and radar products over different resolutions could be used **(metadata extensibility)**

Demo


Parameters selection
Session
Observation parameters
Method parameters
Observation 1
Product Type
MET*_IR108_8bit-eu4km
from
YYMMDDHHMM
to
YYMMDDHHMM
Observation 2
Product Type
OMC
Combine metadata


Parameters selection
Session
Observation parameters
Method parameters
outputFile
XMLFile
/STEPS
3
/TSTEP
5
/HEIGHT
33
grid1
30 26 1 1 301 261
grid2
60 53 2 2 302 267
lowPixVal
0
highPixVal
255
projection
swissradar2km
patternSize
16
radarThreshold
2
tolerance
2
Combine metadata

Studied events

- July 18, 2005
- July 6, 2006
- July 12, 2006

} Convective precipitation

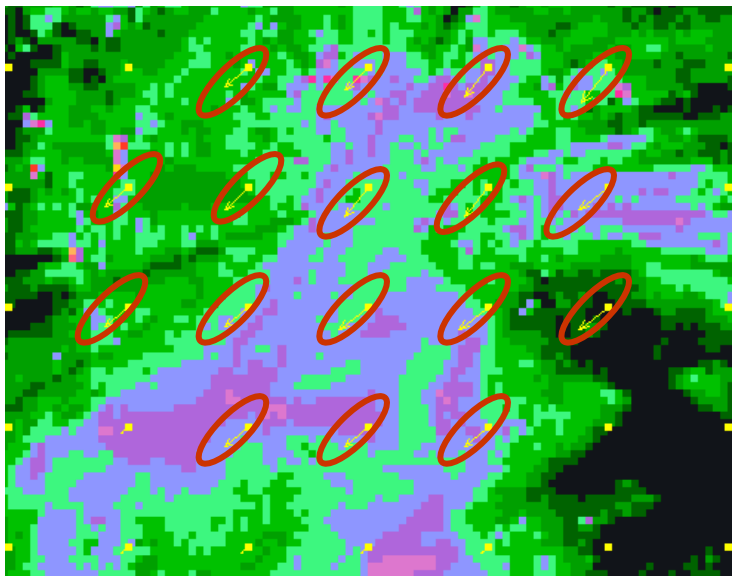
- March 3, 2006
- March 8, 2006
- October 25, 2007

} Stratiform precipitation

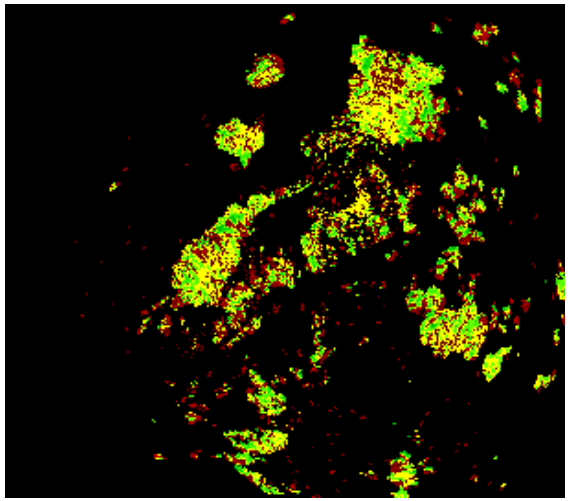
- Questions
  - Are there differences between the 2 radar-products (OMC, PJC)?
  - What is the best value for the pattern size?
  - How does the quality decrease over time?

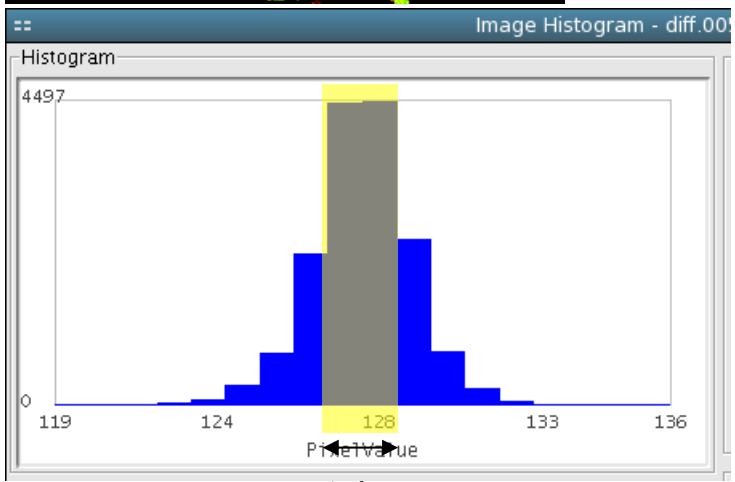
Result evaluation: AMF

- AMF between measured and extrapolated data
- Visual analysis
- Systematic shift → **synchronization, parallax (?)**



Result evaluation: quality flag





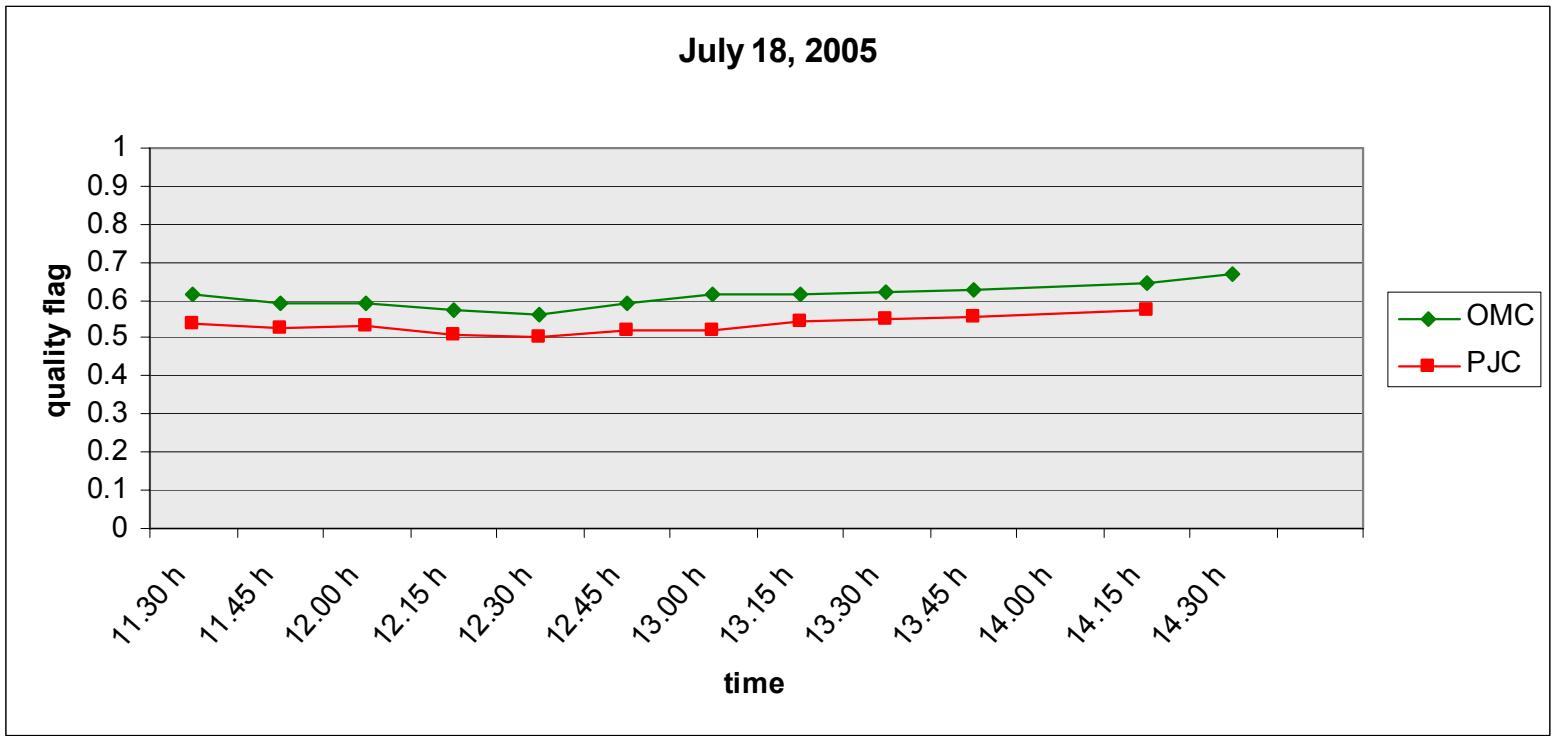
tolerance

Difference between the extrapolated image and the measured one.

$$q = N_{good} / (N_{good} + N_{bad})$$

- Simple approach
- In testing: std dev
- In preparation: TRT
- More refined method: **CRA**

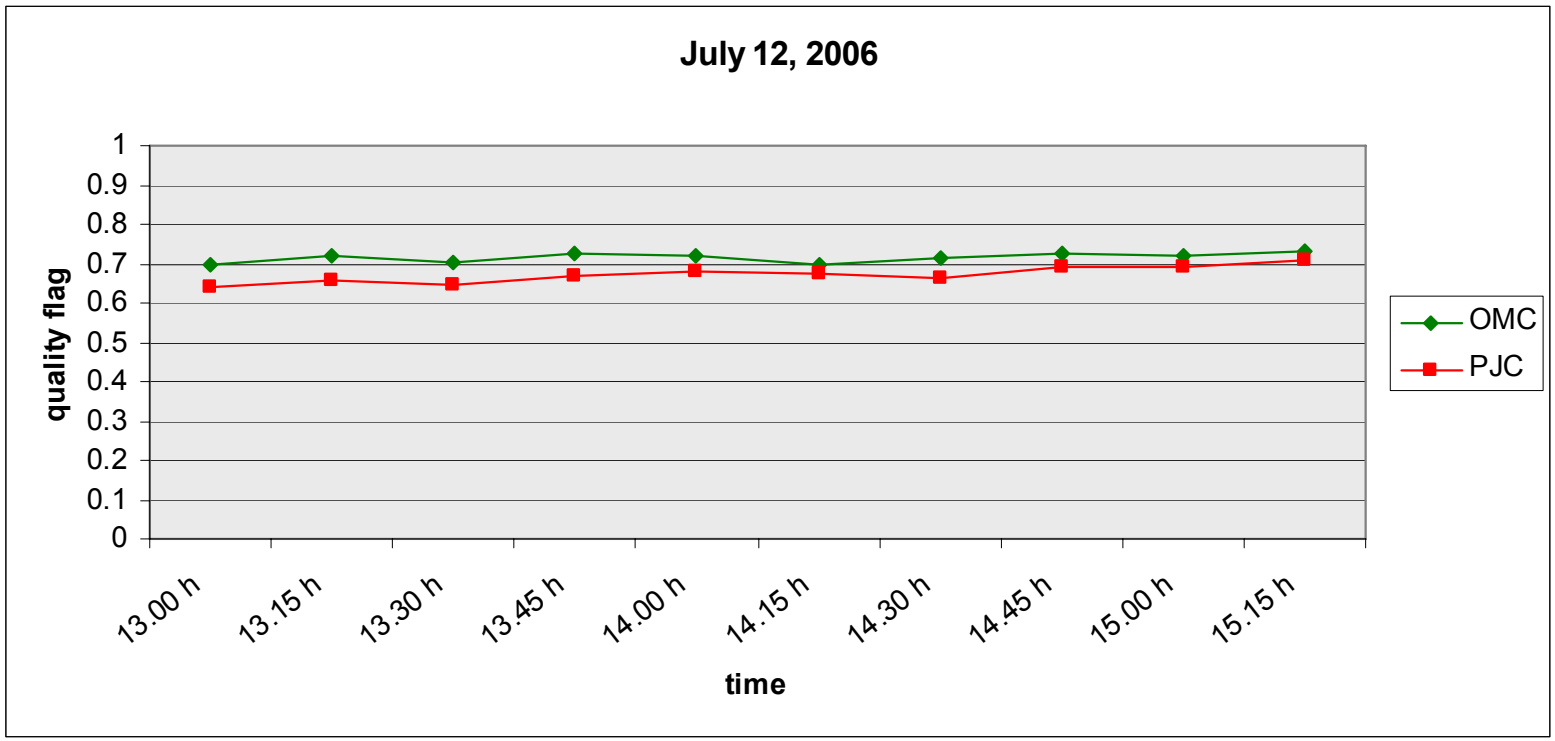
OMC versus PJC



Tolerance ± 1

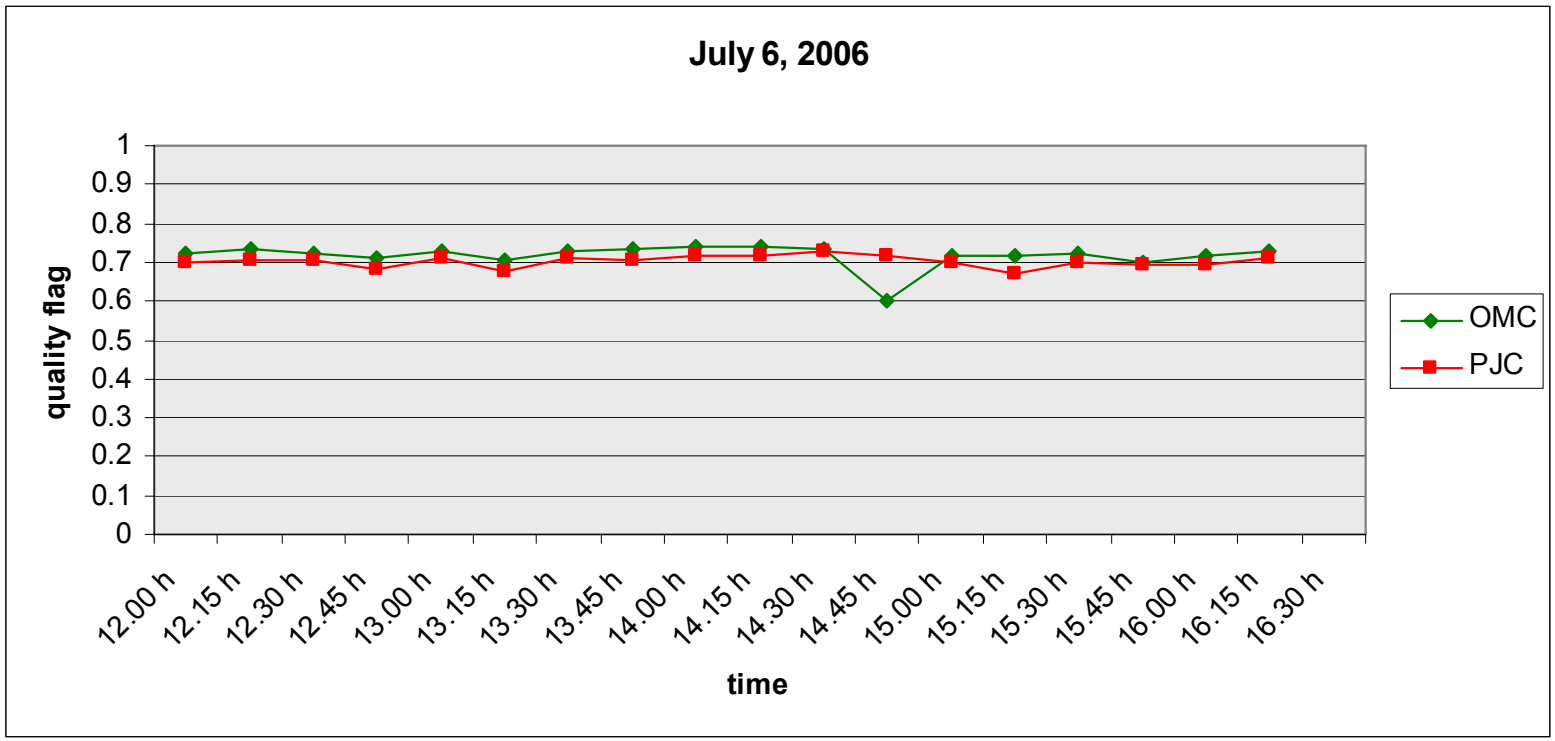
Mean difference: 0.08

OMC versus PJC



Tolerance ± 1
Mean difference: 0.04

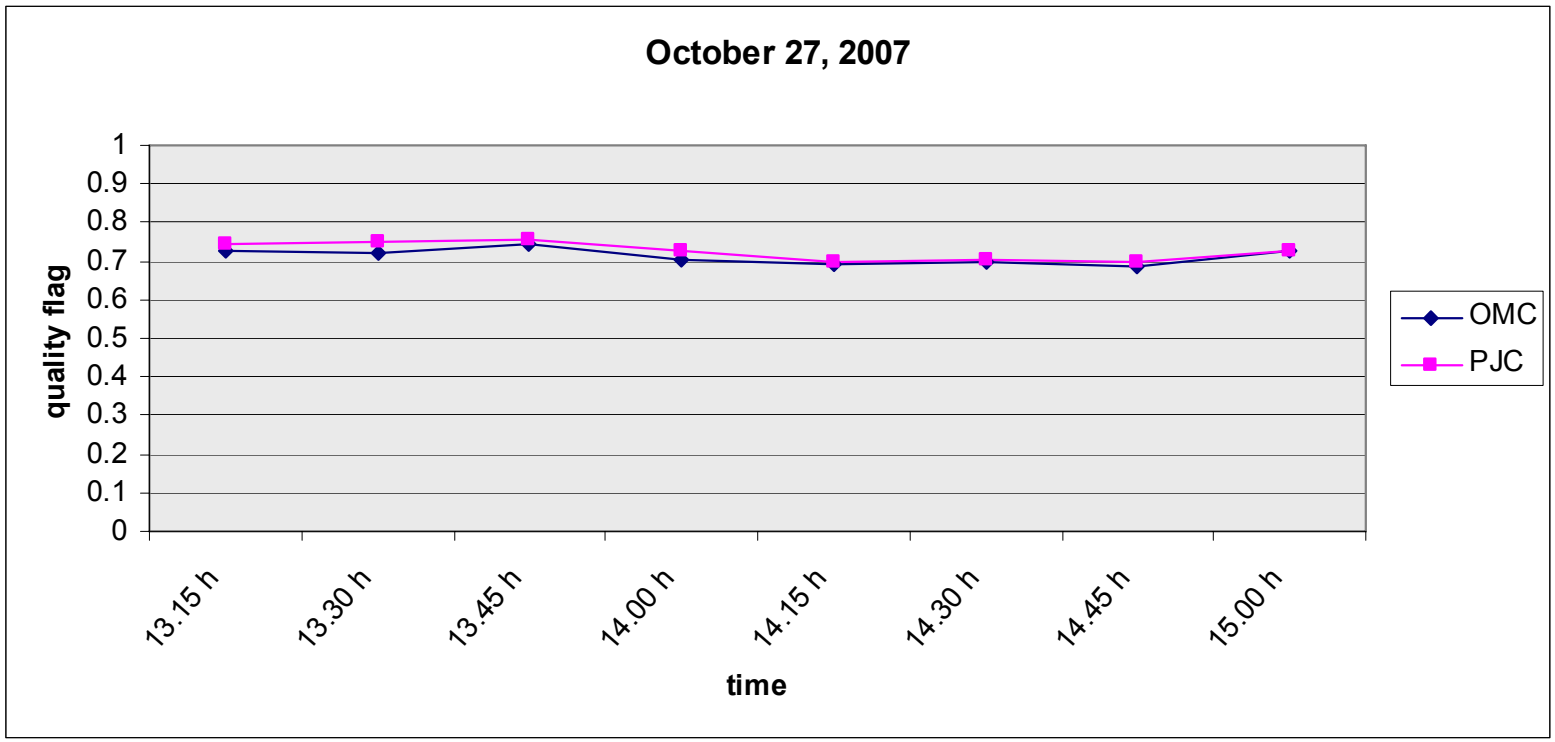
OMC versus PJC



Tolerance ± 1

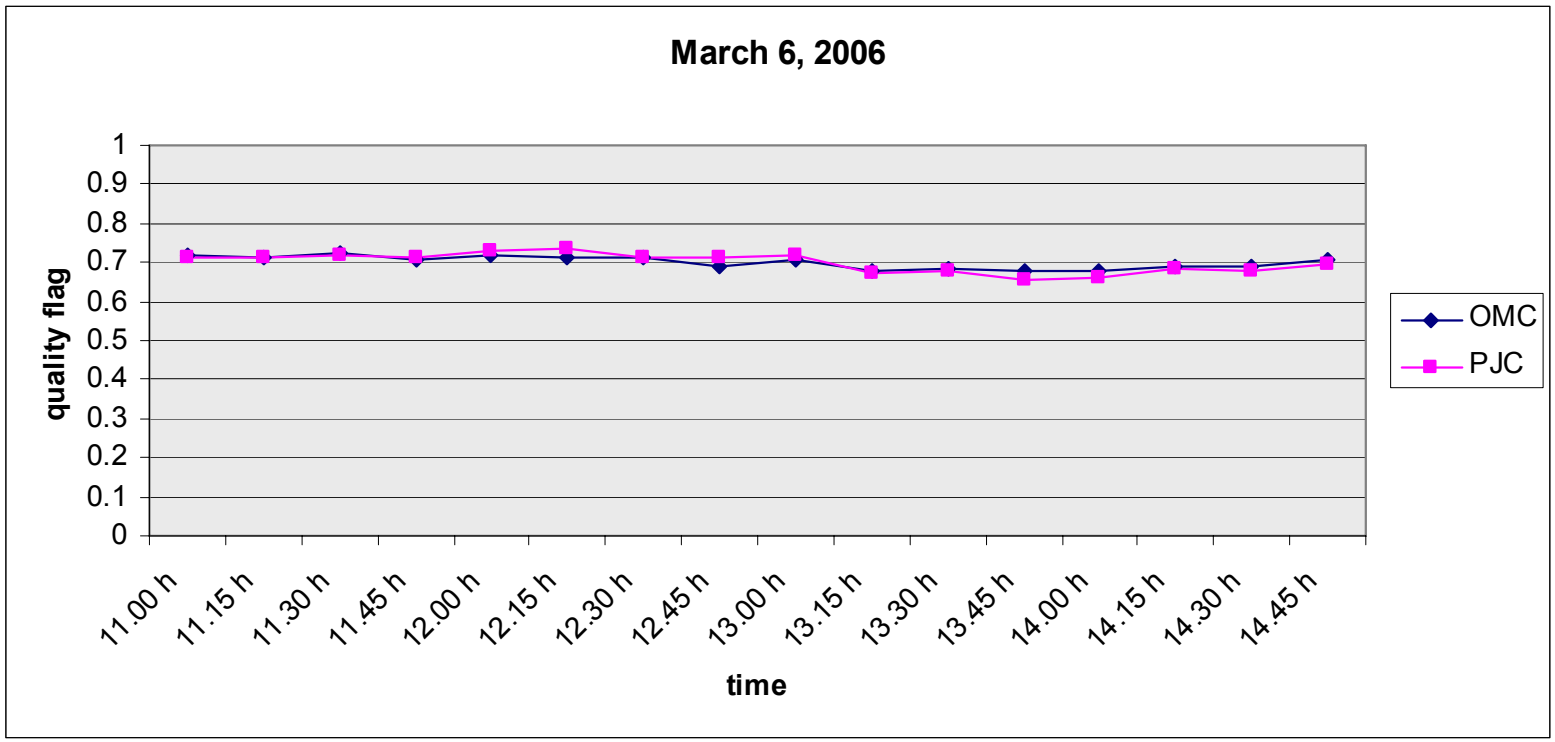
Mean difference: 0.01

OMC versus PJC



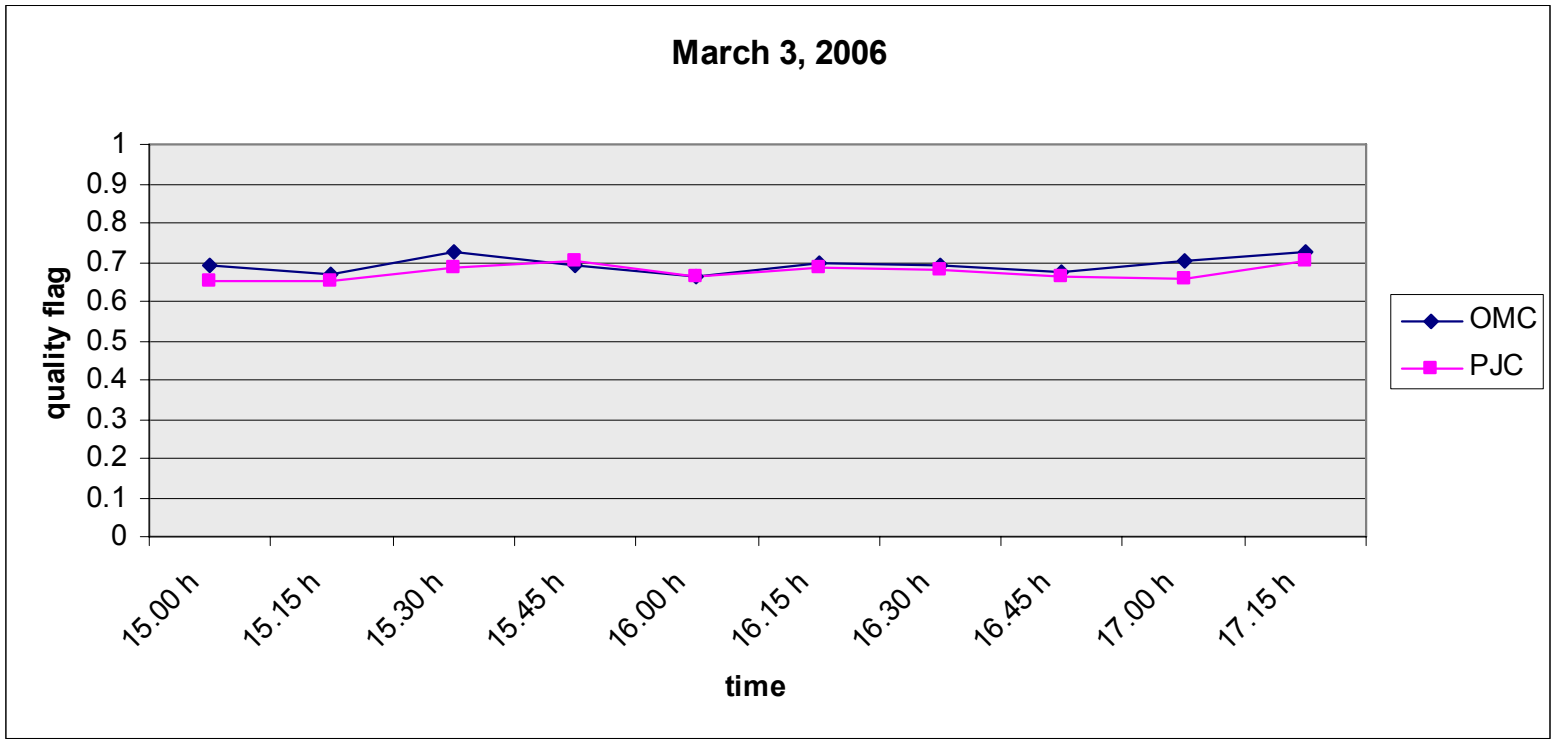
Tolerance ± 1
Mean difference: - 0.01

OMC versus PJC



Tolerance ± 1
Mean difference: 0.00

OMC versus PJC

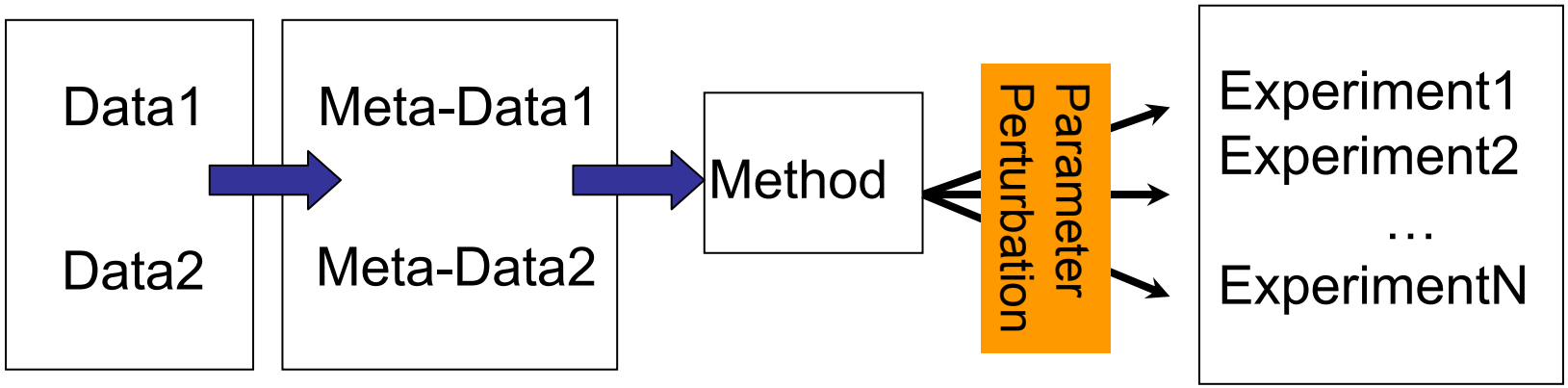


Tolerance ± 1
Mean difference: 0.02

OMC versus PJC

- In 5 cases out of 6, **OMC** produces the best extrapolation
- Higher differences for stronger convective precipitation events.

Pattern size perturbation

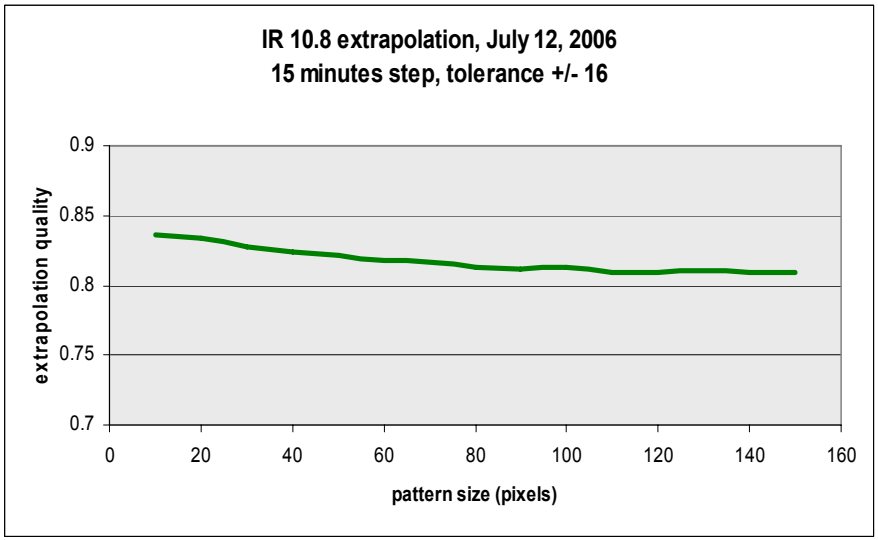


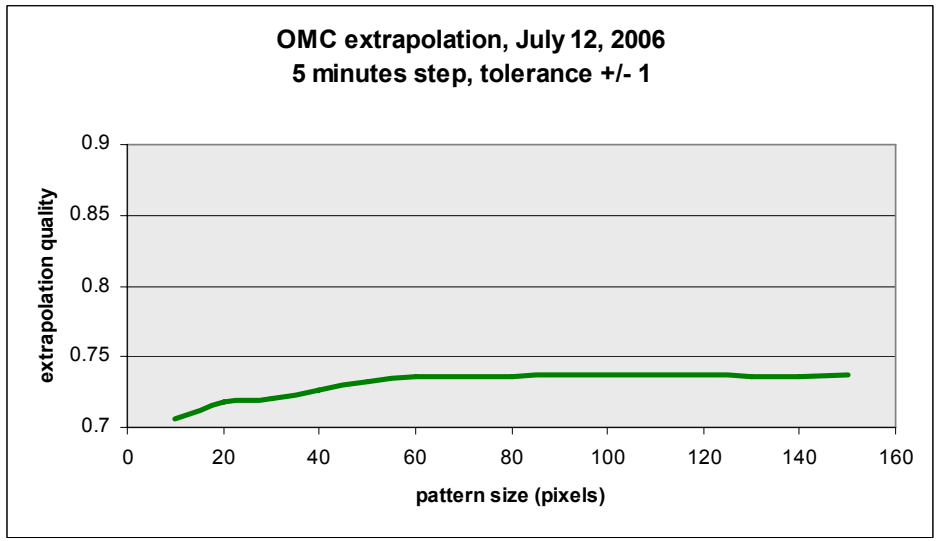
- Example: impact of 1 algorithm parameter “pattern size” on extrapolation skills?

Procedure:

- Pattern perturbation, value range: 10 – 150 pixels
- IR 10.8 AMF → IR 10.8 extrapolation (15 minutes)
- IR 10.8 AMF → OMC extrapolation (5 minutes)

Pattern size perturbation





Trends

- IR 10.8, IR 10.8 → small pattern, best result
- IR 10.8, OMC → pattern of size 60 - 80, best result

Pattern size perturbation

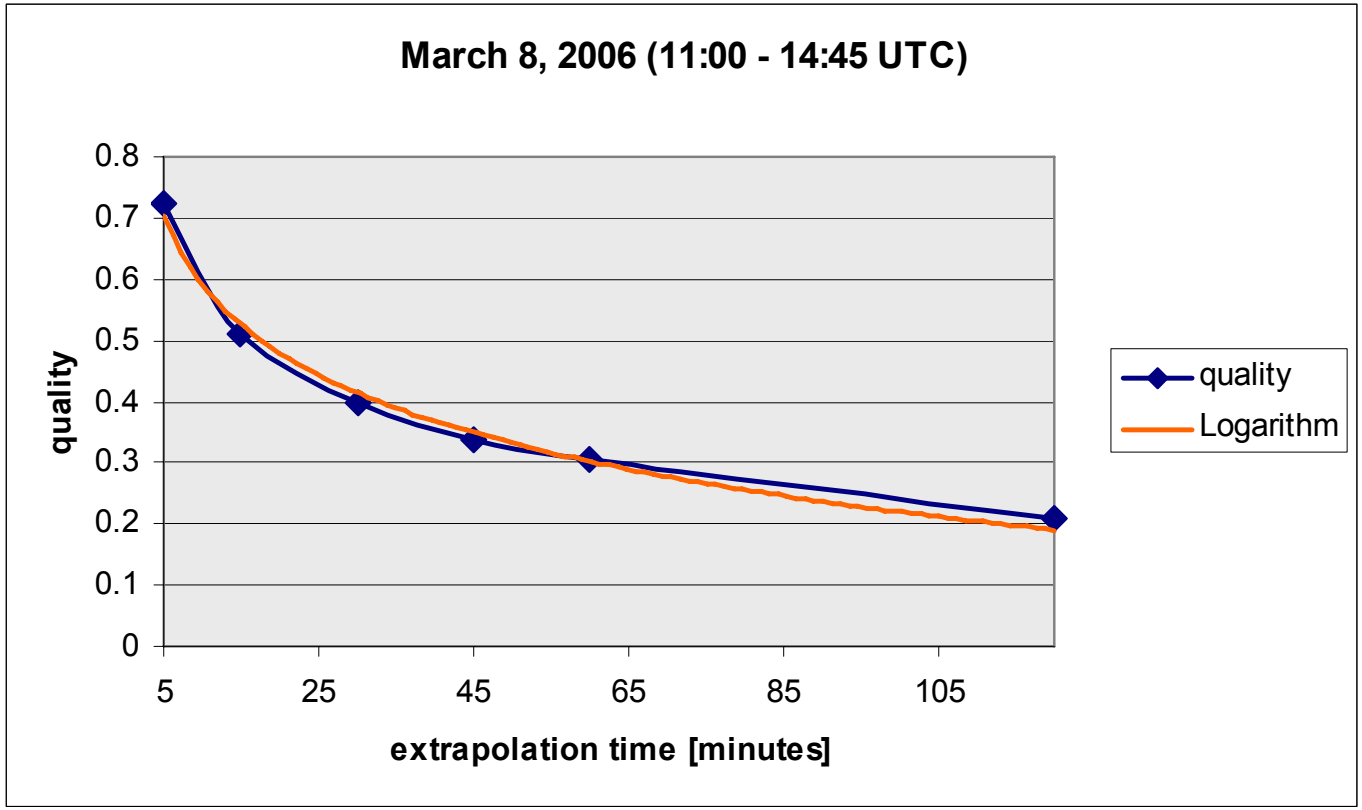
- Pattern size: **cost - benefit**
- The AMF algorithm uses a pattern matching technique
- Computational **complexity**:

$$\mathbf{O(m^2 \cdot n)}$$

m: pattern size
n: number of grid points

- Outside optimum:
  - Big effort (computational **resources**)
    but small benefit (quality increase)

Prediction reliability over time



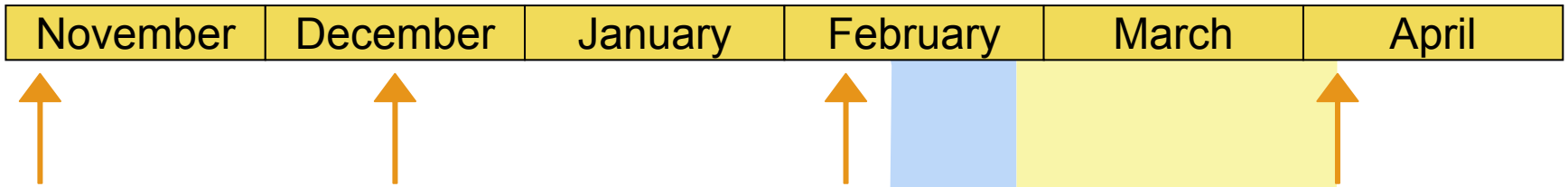
Exponential relation

Outlook

- Use case:
  - Assess impact on **TRT**
  - Improve access to archive-facilities
  - Further radar or satellite data (Rapid scan, SAF/NWC, …)
  - Further parameters **optimization** (e.g. grid size)

- Tool:
  - Simultaneous perturbation of several parameters (→ assess **correlations**)
  - Machine learning approach

Timeline



November 5

Project start

December 14

1st milestone
- Literature study
- Implementation choices
- First prototype

February 8

2nd milestone
- End to end use case

April 4

Final deadline
- Project delivery

Feb. 8 – end of February

-Framework consolidation
- Additional result analysis
- Extensions

Beginning of March – April 4

- Thesis writing

Conclusion

- First result are promising.
- Soon the development phase will be closed.
- Next phase: thesis editing.

Thank you!

Questions?