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DIVA Group
University of Fribourg, Switzerland

Cometa

Meteorological Metadata Combination Framework

Master thesis of Lorenzo Clementi

Second presentation

Fribourg, 17th April 2008

Presentation outline

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

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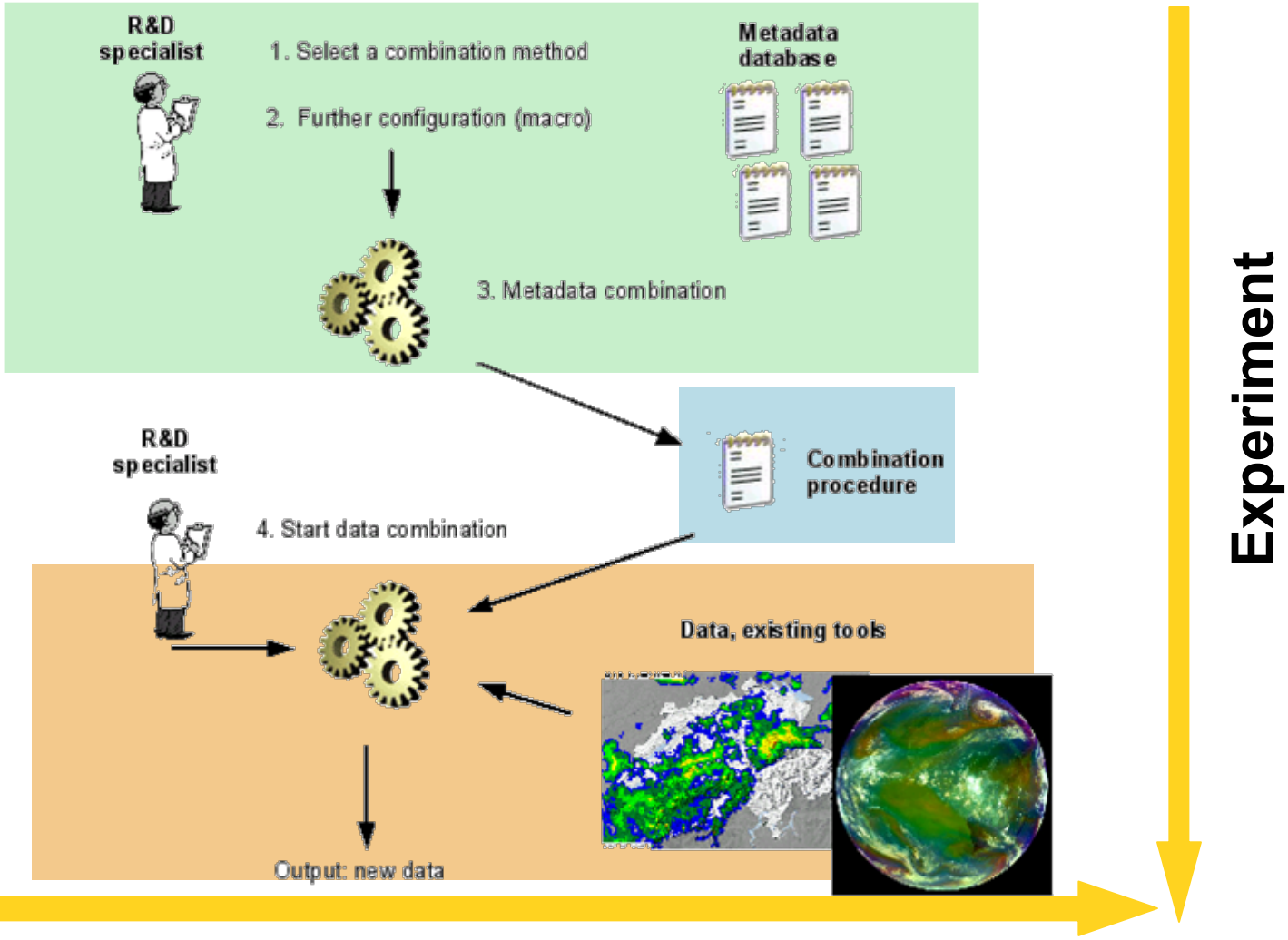
Architecture (1/2)

- Goals of the framework
  - Support for **combining meteorological data**
  - Help in **developing and validating nowcasting algorithms**

- Use of **metadata** to describe **data types** and **processing information**

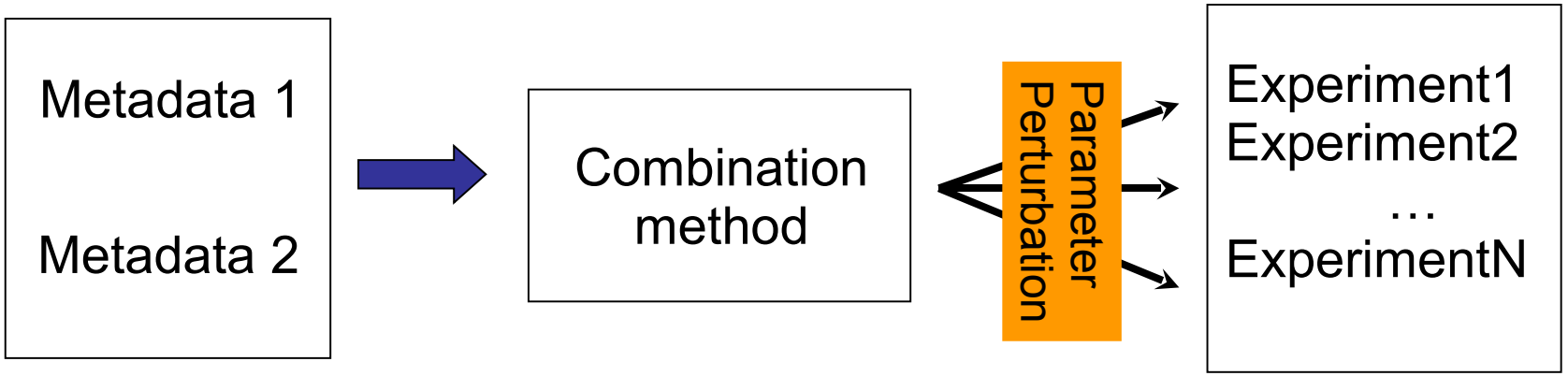
- *"Nowcast validation and comparison with extrapolation is incomplete"* [J.W.Wilson, National Centre for Atmospheric Research, Boulder]

Architecture (2/2)



Key features

- Products metadata **hierarchy** / inheritance
- Metadata: XML to Java mapping thanks to **JAXB**
- **Parameter perturbation**



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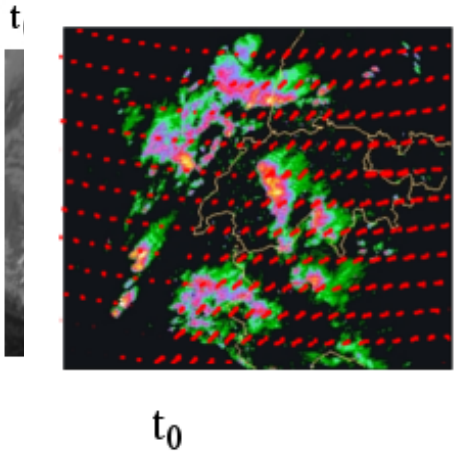
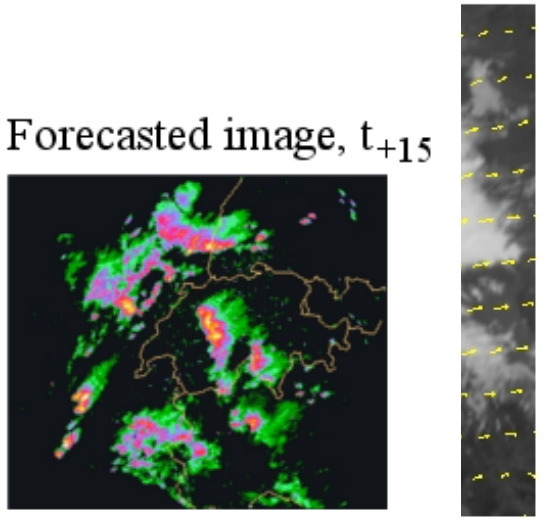
Use case: overview

- **Precipitation field extrapolation based on satellite displacement vectors in the Alpine region**





- Goals
  - Illustrate the contribution of the Cometa framework
  - First assessment of forecast reliability
  - First optimization experiments

Use case: some details

- **Atmospheric motion field** (vector field) is computed on satellite images (external software) and then applied onto radar images to generate a forecasted image

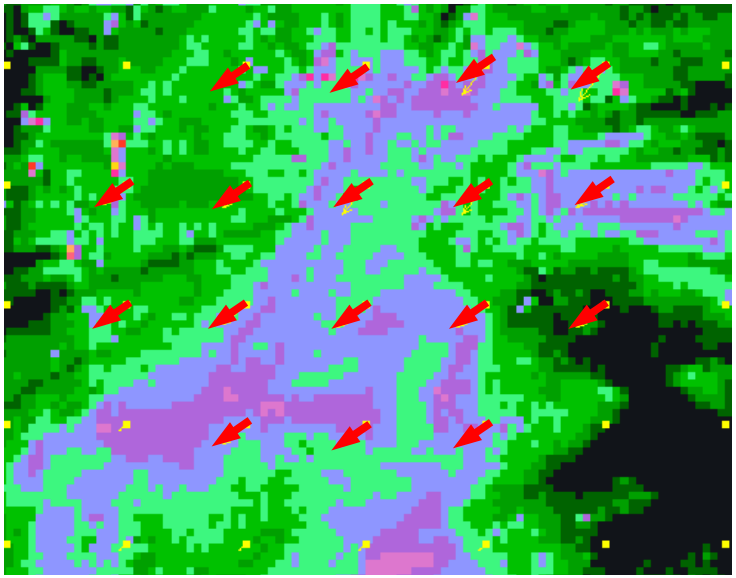
- Satellite channel: **IR 10.8 µm** (**cloud top temperature**)

- Radar products
  - **OMC** (reflectivity)
  - **PJC** (precipitation estimate)

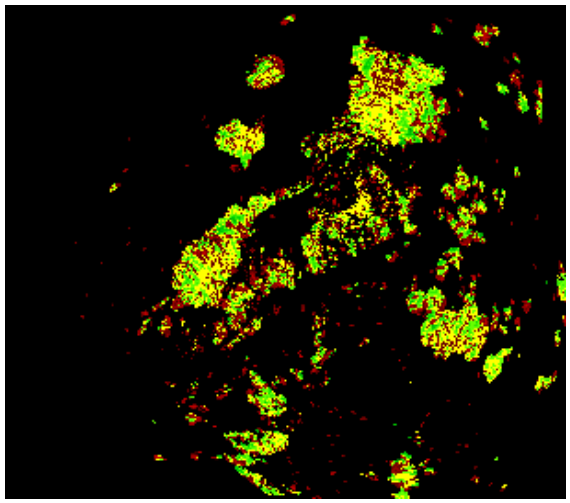
- Note that other satellite and radar products over different resolutions could be used **(metadata extensibility)**

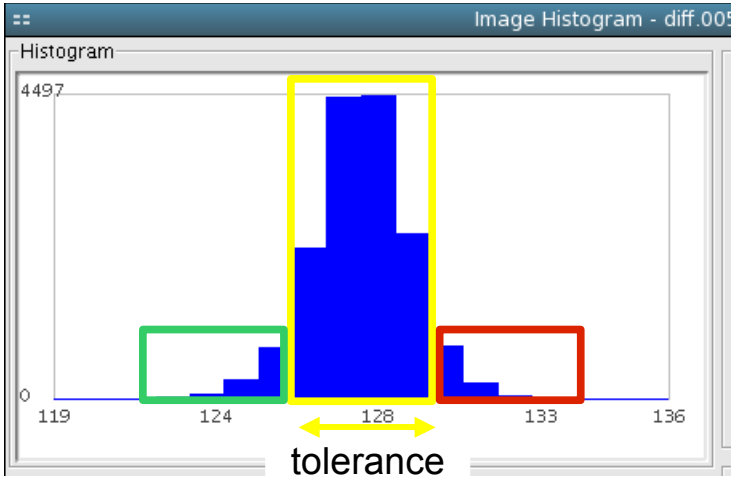
Evaluation: visual inspection

- Residual vectors: AMF between forecasted and extrapolated images
- Visual inspection
- Systematic shift → **synchronization, parallax** (limb view)
  - Speed and direction analysis (RMS)



Evaluation: quality flag





Difference between the extrapolated image and the measured one.

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

- Simple approach
- **Improvements**:
  - CRA
  - Root mean square error

$$q = \sqrt{Mean\left(\left(\frac{\Delta f(x,y)}{f(x,y)}\right)^2\right)}$$

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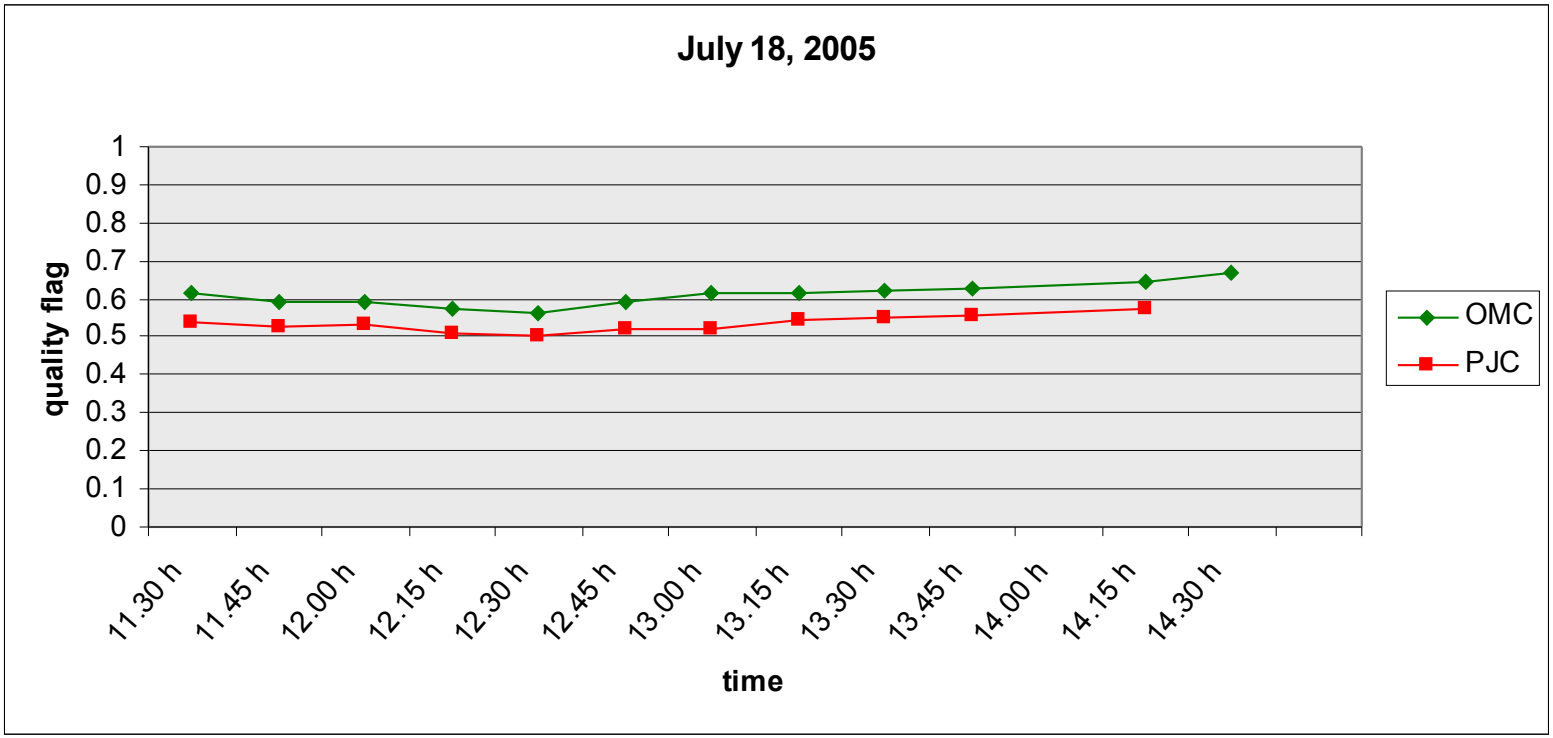
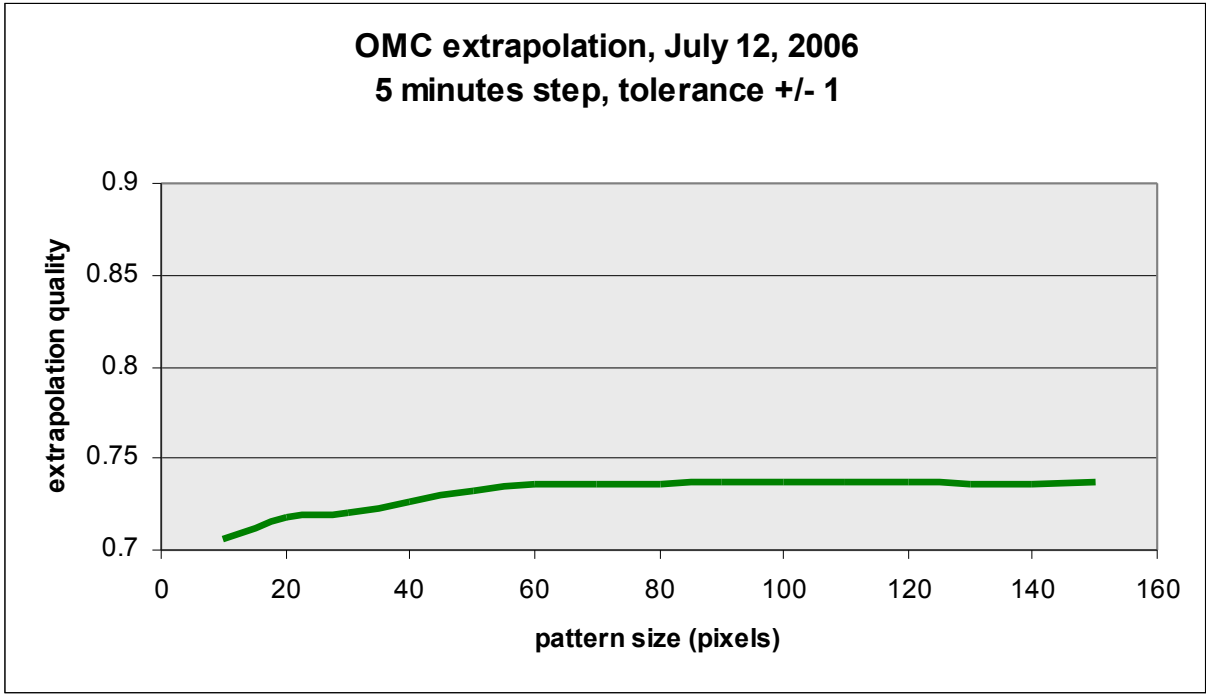
OMC versus PJC



Tolerance ± 1
Mean difference: 0.08

Pattern size perturbation



Pattern = window used for the pattern matching algorithm

- Pattern of size 60 to 80 pixels, best result

Pattern size perturbation

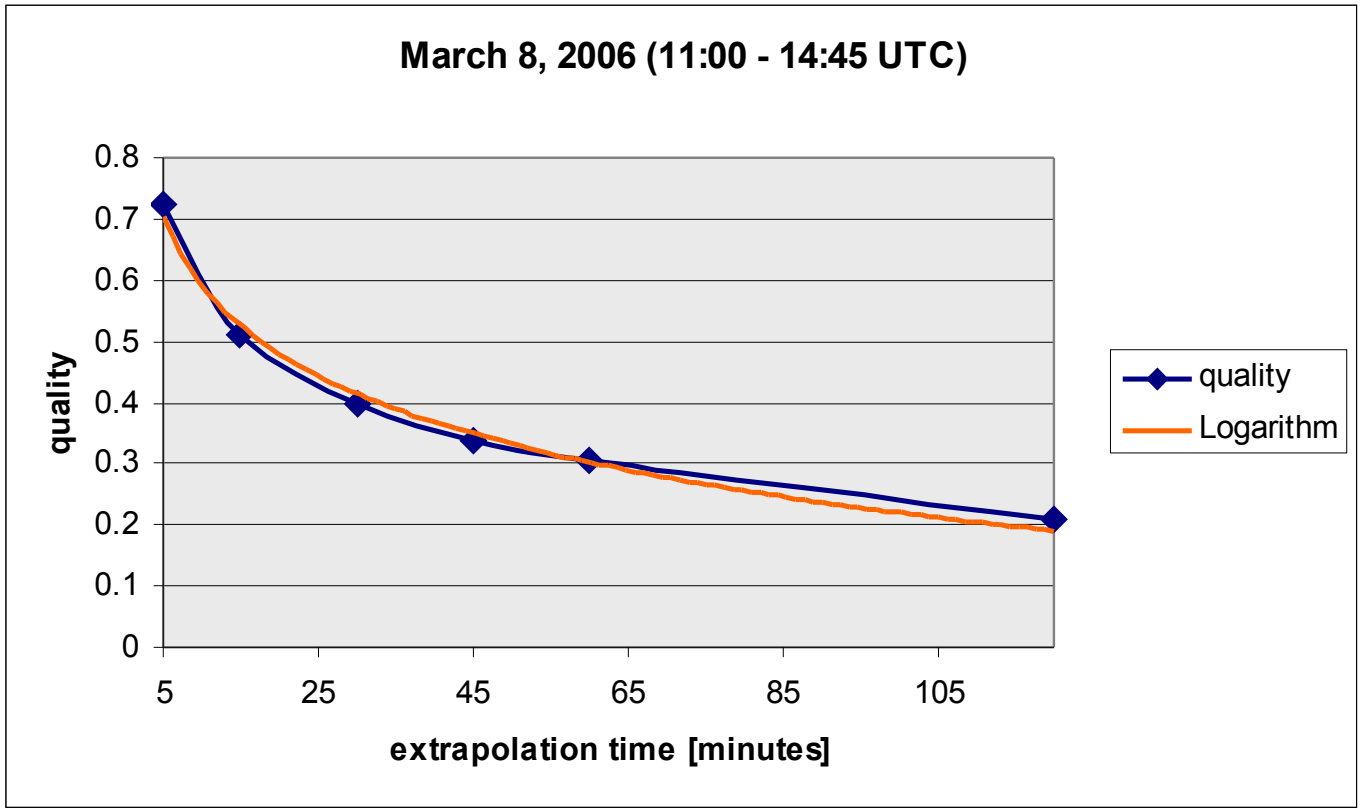
- Pattern size: **cost - benefit**
- The AMF algorithm uses a pattern matching technique
- Computational **complexity**:

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

m: pattern size
n: number of grid points

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

Prediction reliability over time



Strong relation: $R^2 > 0.9$

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Outlook

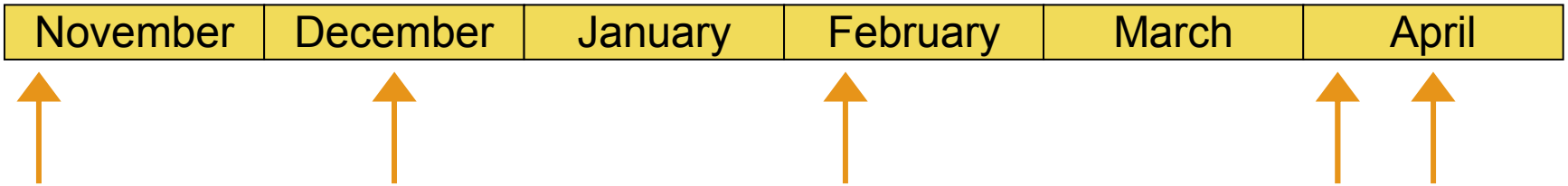
Limitations

- Quality flag needs to be improved
- The creation of metadata files has to be done manually

Future works

- Simultaneous perturbation of several parameters
  - Assess **correlations**
  - **Combinatorial** problem
- **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 (source code + thesis)

April 17

Final presentation
- in Fribourg

Conclusion

- The use case proved the validity of Cometa
- We have found some interesting result
- There is place for improvement

Thank you!

Questions?