A dynamic and generic cloud computing model for environmental analysis using in-situ sensing data applied to glacier mass balance

(Mer de Glace, Chamonix; East Loven Glacier, Spitsberg)

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Summary

Introduction
I. Snow cover and glacier evolution
II. In-situ sensing constraints
III. Cloud computing and Web Services
IV. Tasks architecture
V. Model
Conclusion
Introduction

• Hydro Sensor FLOWS project, supervised by M. Griselin (C. Marlin and D. Laffly)
  – Map the temporal evolution of the snow cover
  – Couple it with a hydrologic model
• East Loven glacier: experimental field
  – 4 years of different readings
  – Generate a huge data base

How can Cloud Computing improve the processing of the data base?
East Loven glacier
Snow Cover and Glacier Evolution

- **Remote sensing**: daily satellite imagery is not always accessible
  - Cost
  - Poor weather conditions (heavy cloud cover)
  - Fast events not visible
- **In situ sensing**: Ground based autonomous automated digital camera
  - 3 pictures / day
  - Huge data base
  - Reconstruct the satellite view

(D. Laffly et al., Cambridge 2010)
Six digital cameras are positioned around the glacier basin, providing complete glacier coverage.
In-situ sensing: image processing

- Projection of the picture, from the oblique view to a plan view
- Construction of a mosaic
- Classify the different phenomena (snow, ice)
- Constraints processing
In-situ Constraints: Atmospheric Disturbance

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In-situ Constraints: Electronic Deficiency

- Poor weather conditions
  - Microcontroller “asleep” for several days
- Electromagnetic perturbation: reset of the microcontroller
  - 6 pictures / day
- Discharge of the camera intern battery
  - Loss of the picture’s date
In-situ Constraints:
Geometry Variations

- Modification of the shooting’s parameters

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**In-situ constraints adjusted by computer**

- Manually process all the pictures (over 30 000)
- Specific and heterogenous tools

**Real need to provide an application:**
- dynamically change the processing
- be as generic as possible to fit other needs
- avoid human operations as much as possible

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Cloud Computing

Set of resources, servers and applications offered “as a service” over a network.

• Advantages:
  – Easiness of access
  – Large storage capacity
  – Lightness of application
  – Modular: add, remove, modify services
  – Scalable
    • Increase of users connected to the service
    • Increase the computing capacity according to the needs
    • Fault tolerance

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Web Services

• Software offered as a service (SAAS)
• Multiple tasks
  – Cleaning / Usability
  – Dating
  – Cropping
  – Projecting
  – Constructing a mosaic
  – Classify glacier’s phenomena (ice, snow …)
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Planner and Scheduler

Planner:
• define a workflow
• achieve a goal
• satisfy constraints

Scheduler:
• organize workflow
• temporal constraints

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Example: Cropping Service

List of control points, Picture → Cropping Service → Picture cropped
Conclusion

• Model:
  – Generic (web services)
  – Dynamic (planner and scheduler)

• The environmental sciences and the geoengineering generate a huge data base (Big Data). Cloud computing is an answer to some processing constraints and storage constraints.

• Evolution of the languages and paradigms of computer science.
Thank you