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The RainCloud project: Harnessing Cloud Computing for a meteorological application at the Tyrolean Avalanche Service

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April 8th, 2013, EGU Vienna

funded by *Standortagentur Tirol*

Outline

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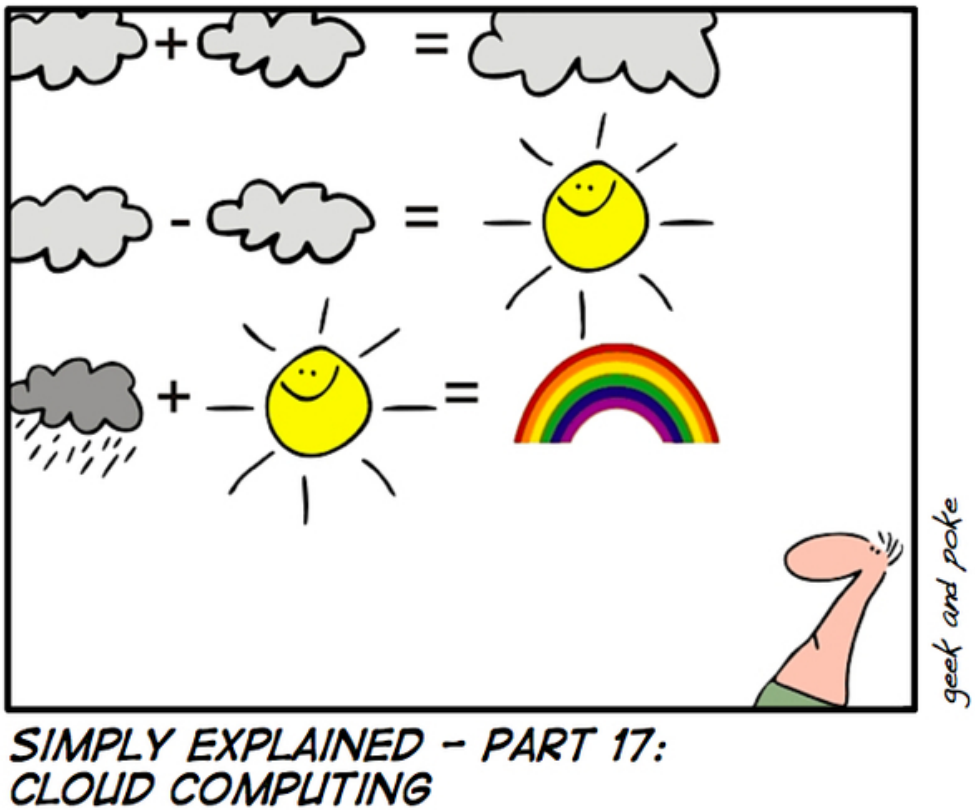

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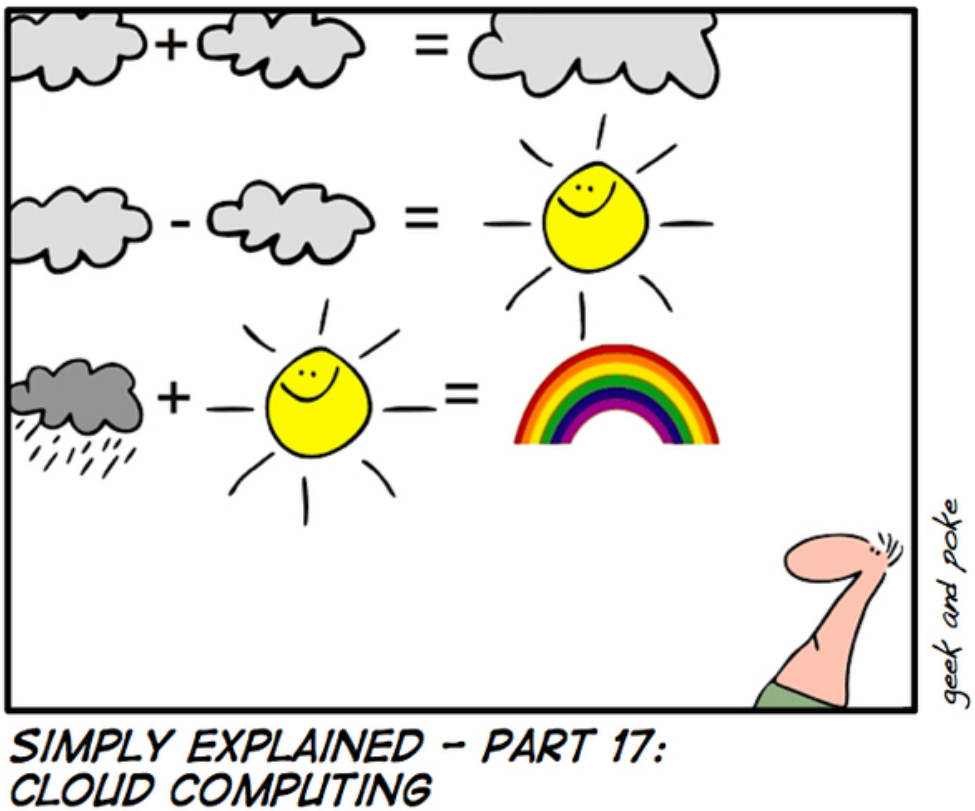

Aim

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Research topic:

Forecast uncertainties for *precipitiation* over *complex* terrain.

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Research topic:

Forecast uncertainties for *precipitiation* over *complex* terrain.

Method:

Determine uncertainties with many, slightly different forecasts using a specialized precipitation model

Linear Model of orographic precipitation

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$$P = \frac{1}{1 + \sigma^0 \tau_f^0} \left[\frac{S^0}{1 + \sigma^0 \tau_c^0} + \frac{S^1}{(1 + \sigma^1 \tau_c^1)(1 + \sigma^1 \tau_f^1)} \right]$$

Barstad, Schueller 2011

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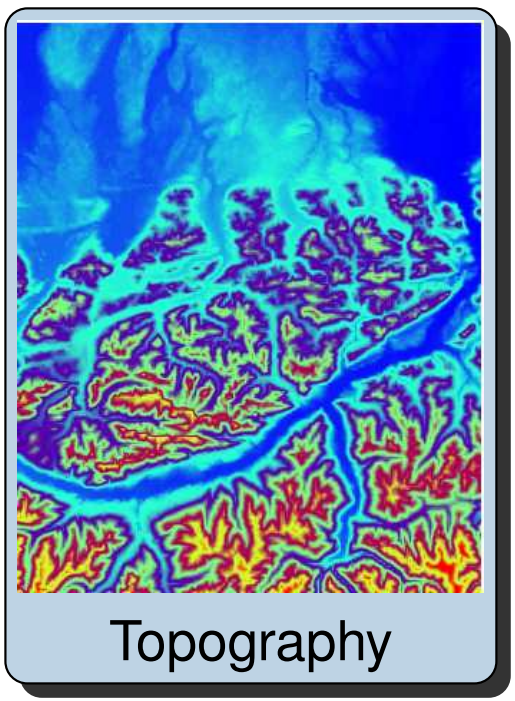

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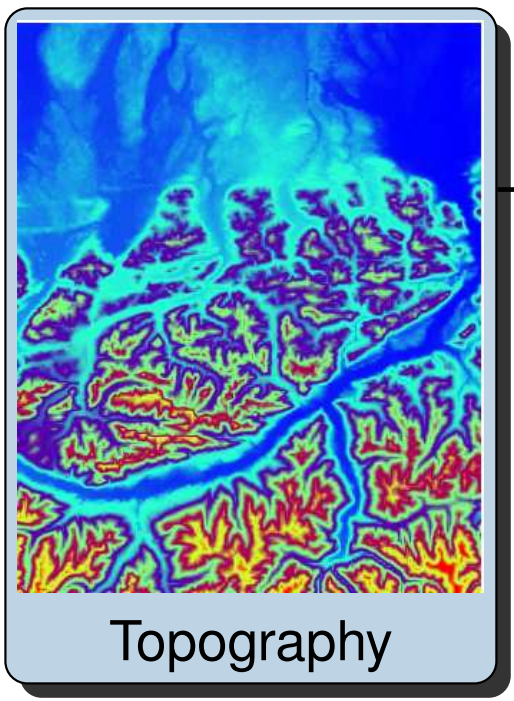

Topography

Upstream profile
Temperature
Wind
Moisture
...

Barstad, Schueller 2011

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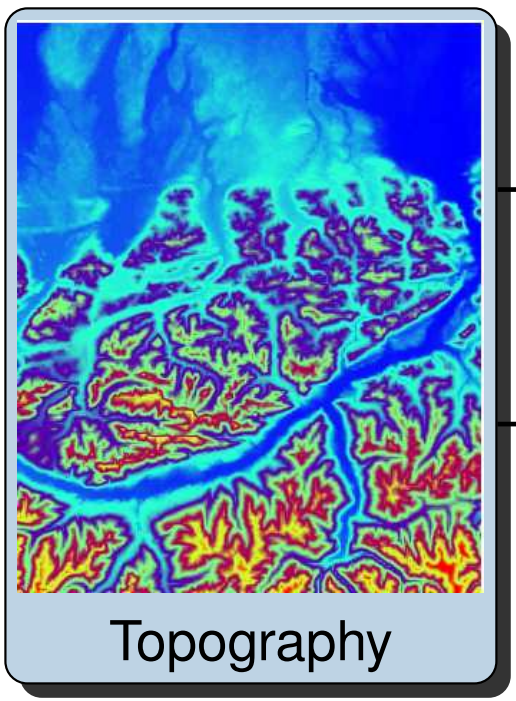

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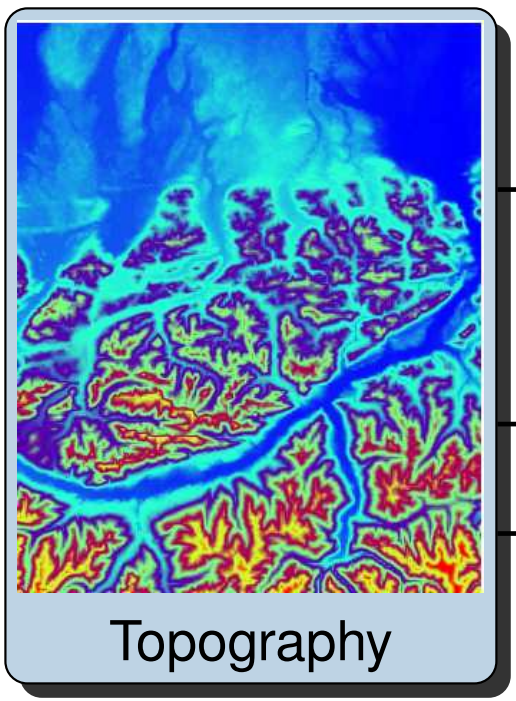

Topography

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Airflow Dynamics

Microphysics

Barstad, Schueller 2011

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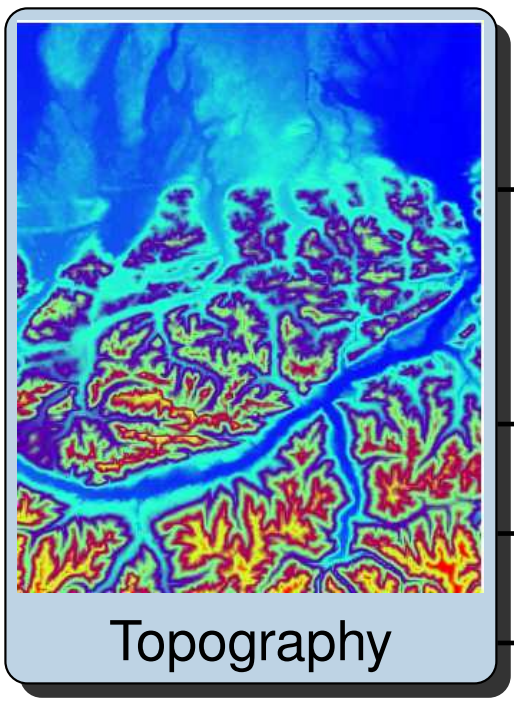

Topography

Upstream profile
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Moisture
...

Airflow Dynamics

Microphysics

2 vertical layers

Barstad, Schueller 2011

Linear Model of orographic precipitation

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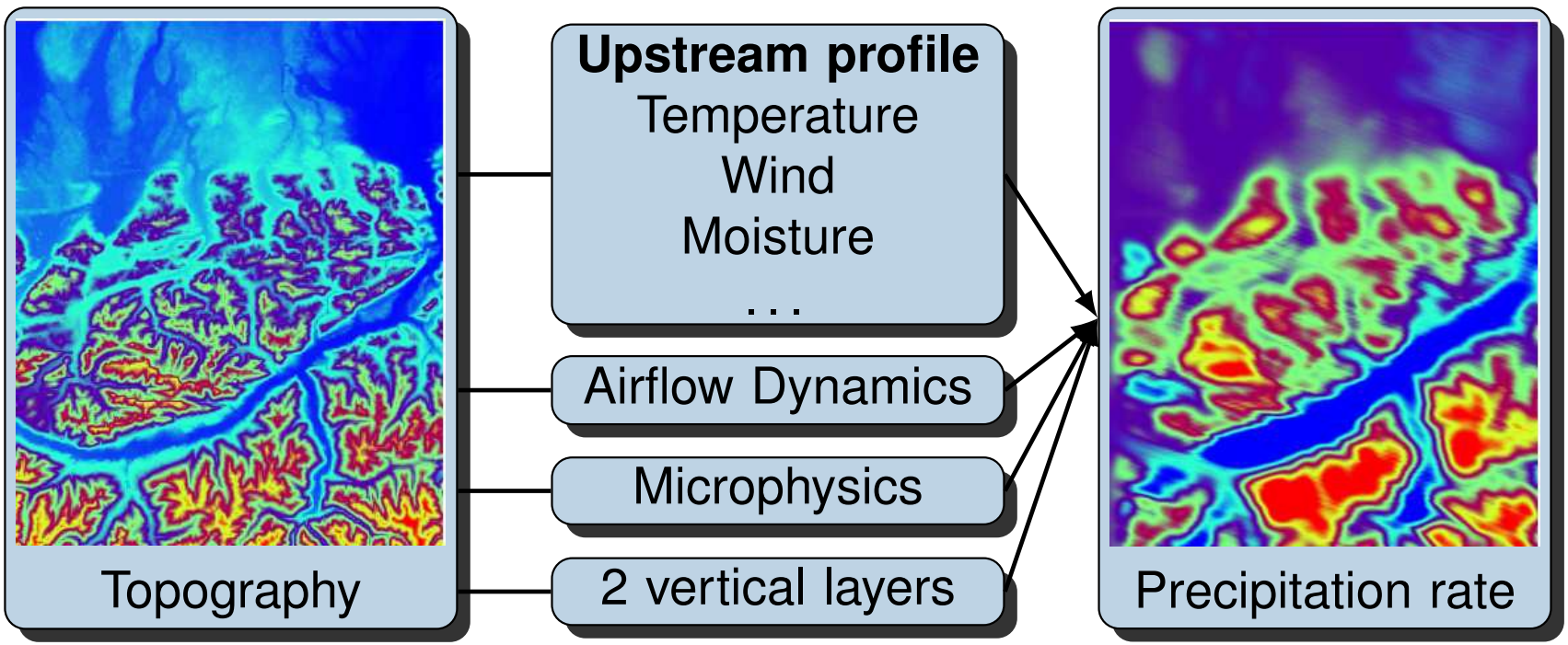

Barstad, Schueller 2011

Linear Model advantages

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- easy to achieve a higher horizontal resolution
- very fast compared to current complex models
- 1000+ instances in a short amount of time
  - to sample probability distribution

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- easy to achieve a higher horizontal resolution
- very fast compared to current complex models
- 1000+ instances in a short amount of time
  - to sample probability distribution

Allows for

probabilistic forecasts through a significant number of experiments

But: only for stratiform precipitation (winter)

Example Tyrolean avalanche service

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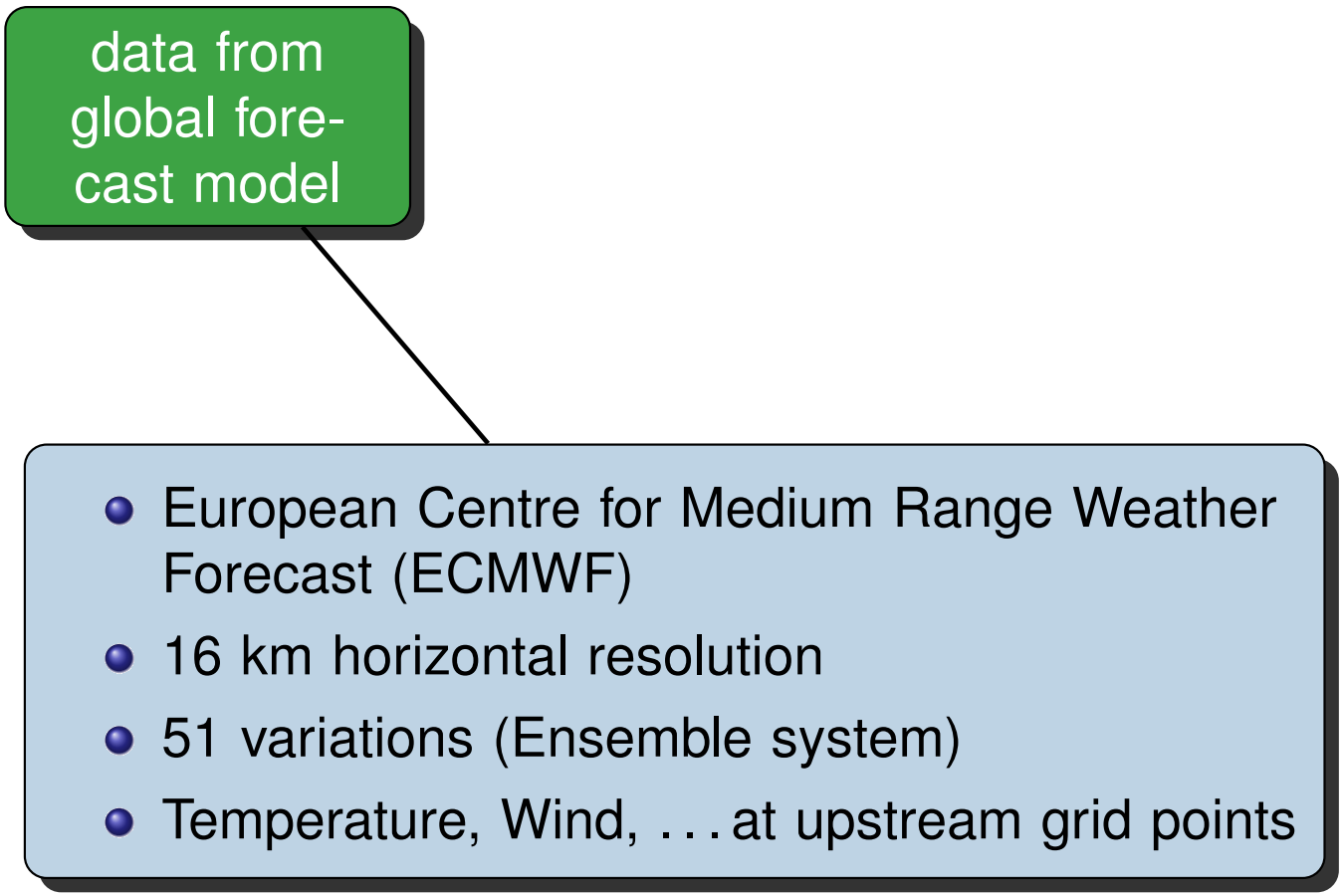

Example Tyrolean avalanche service

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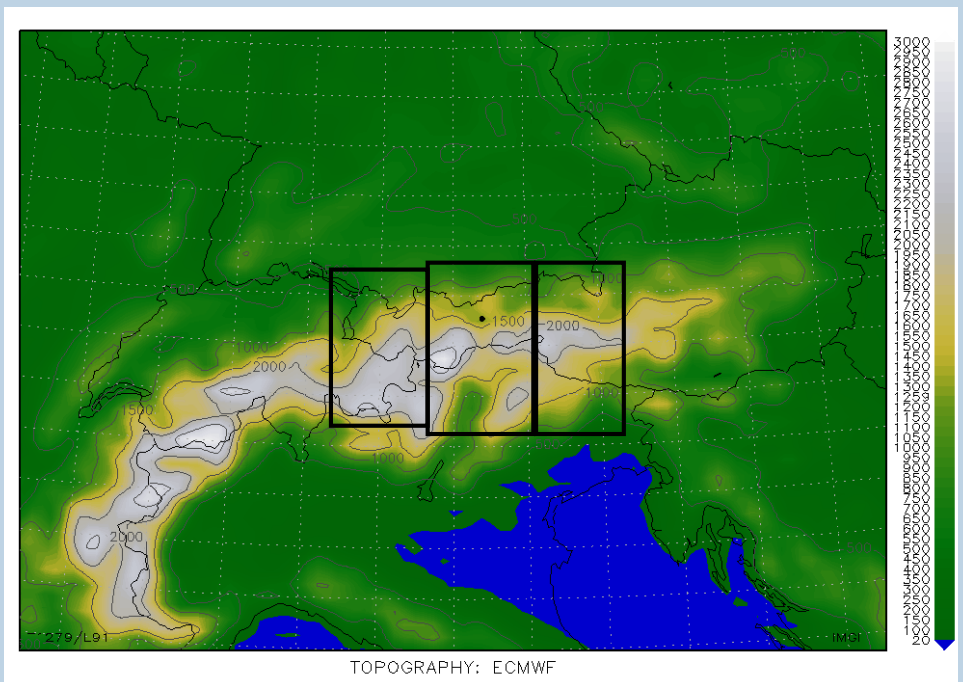
data from global fore-cast model → split Alps in sub-domains



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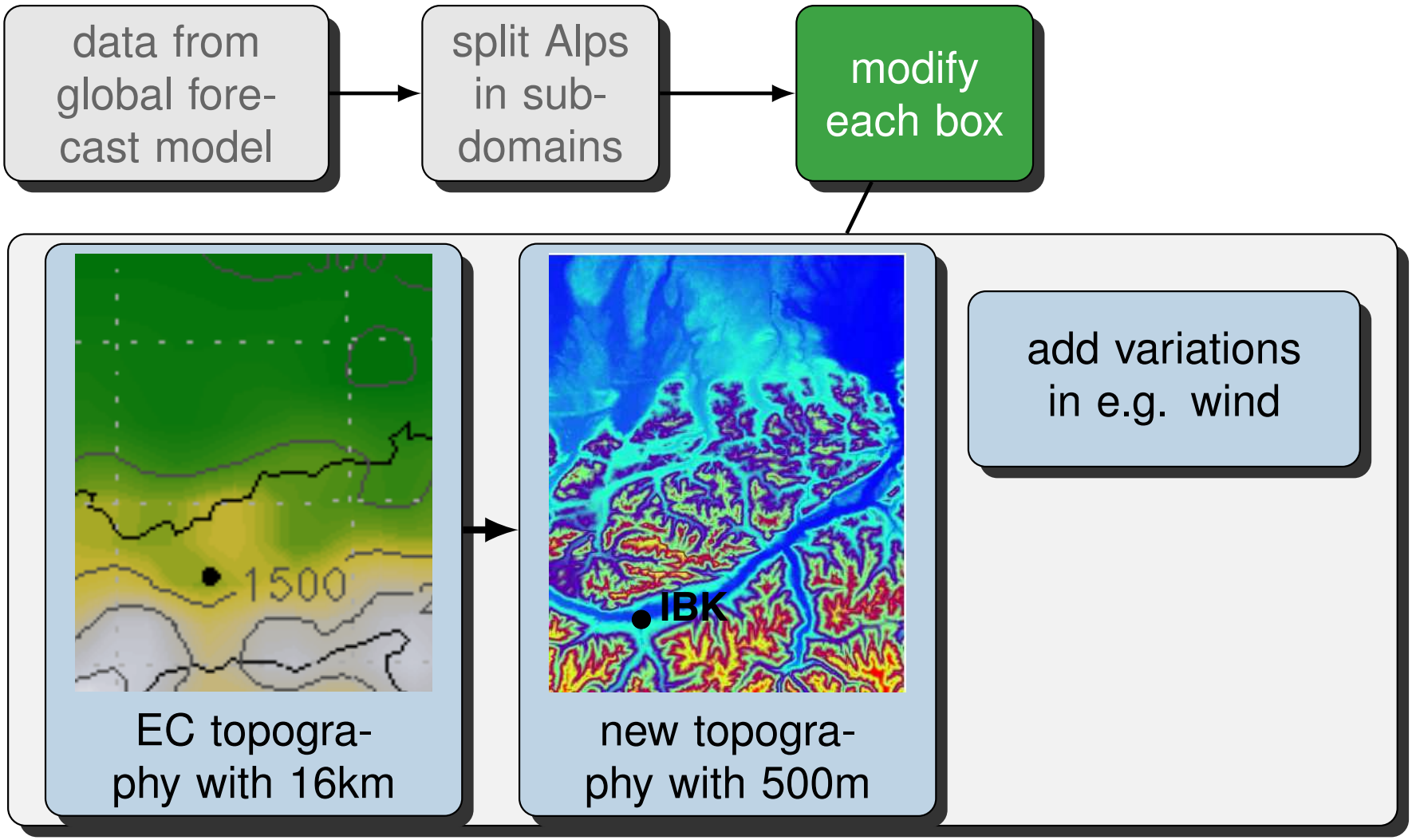

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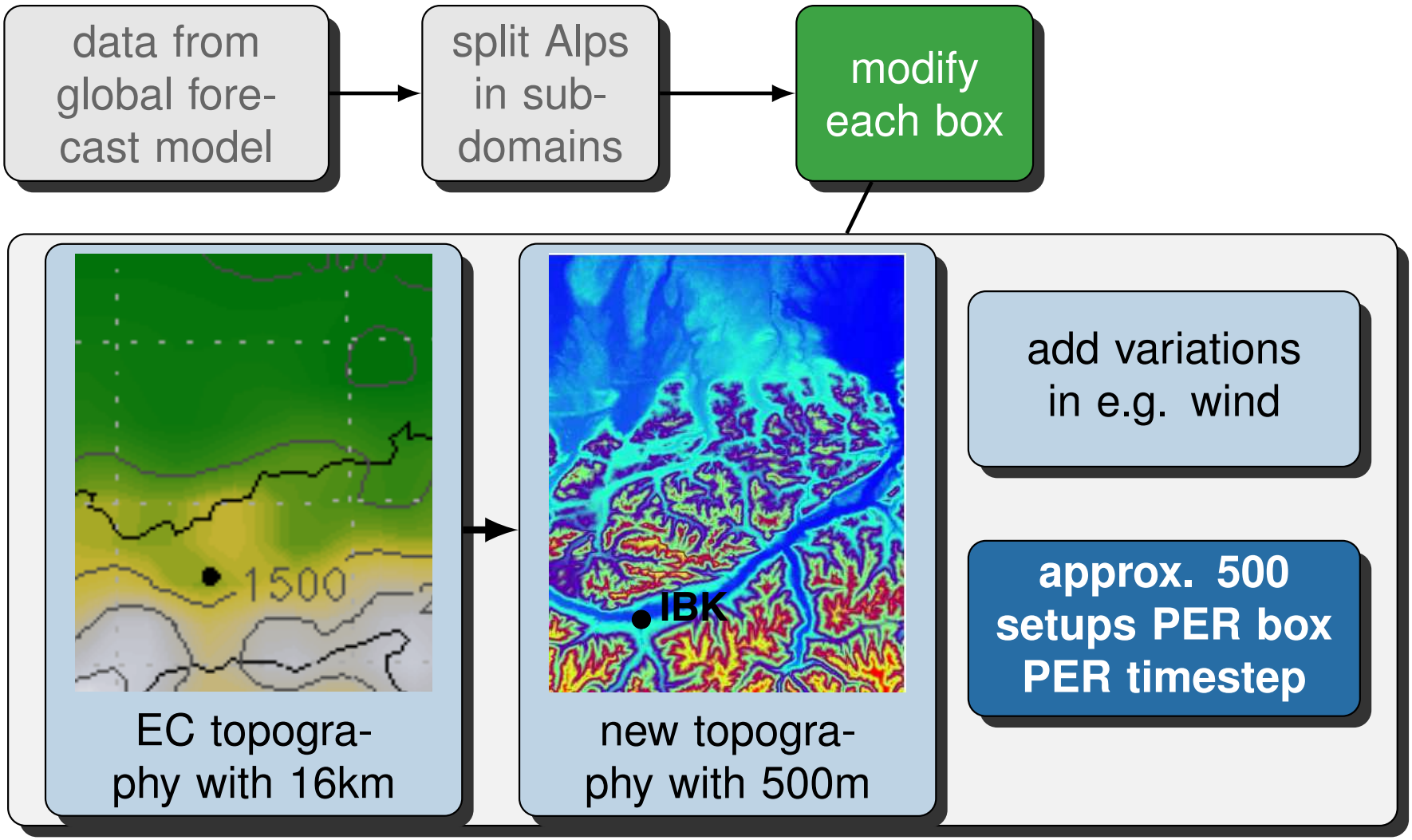

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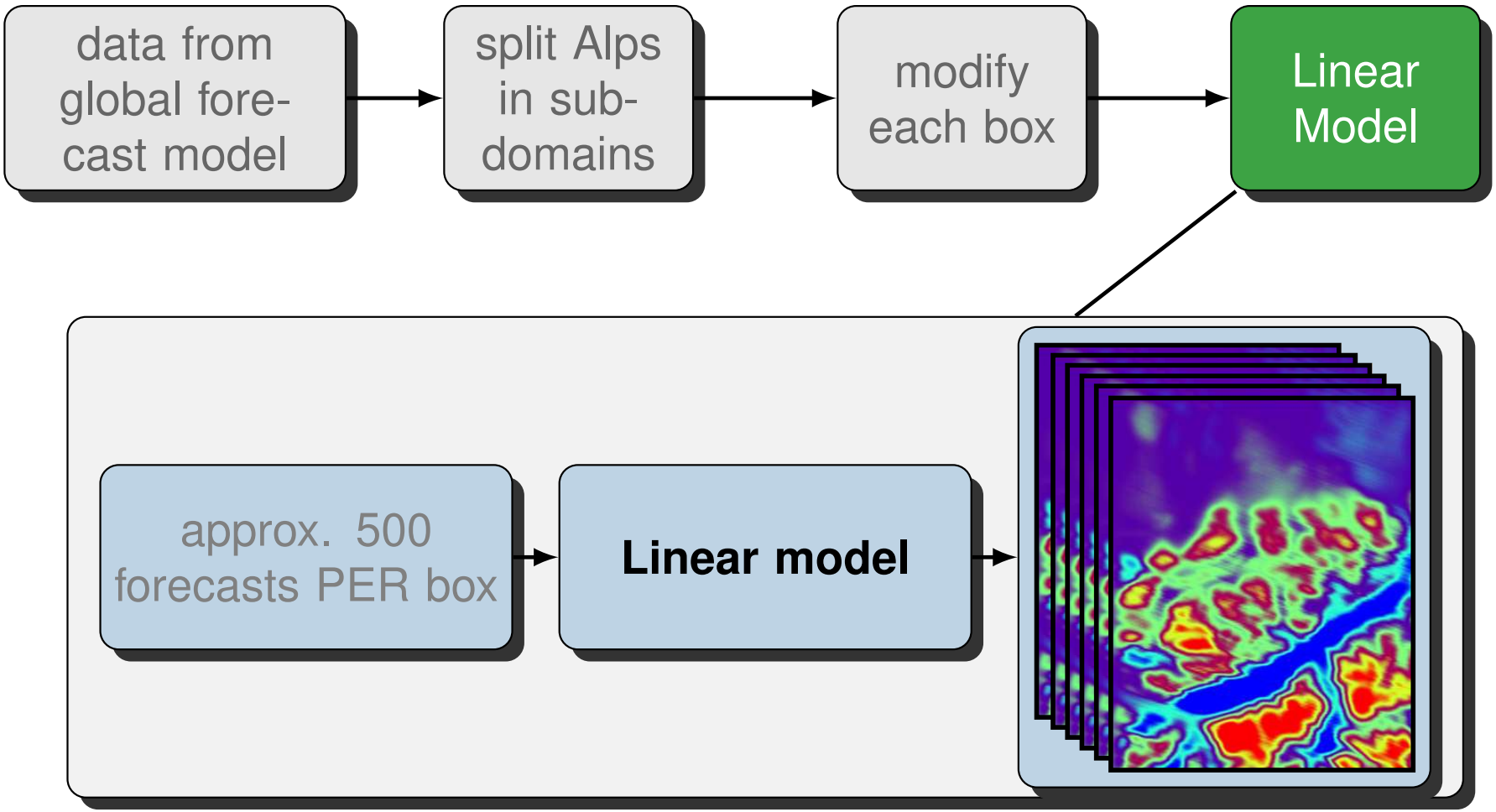

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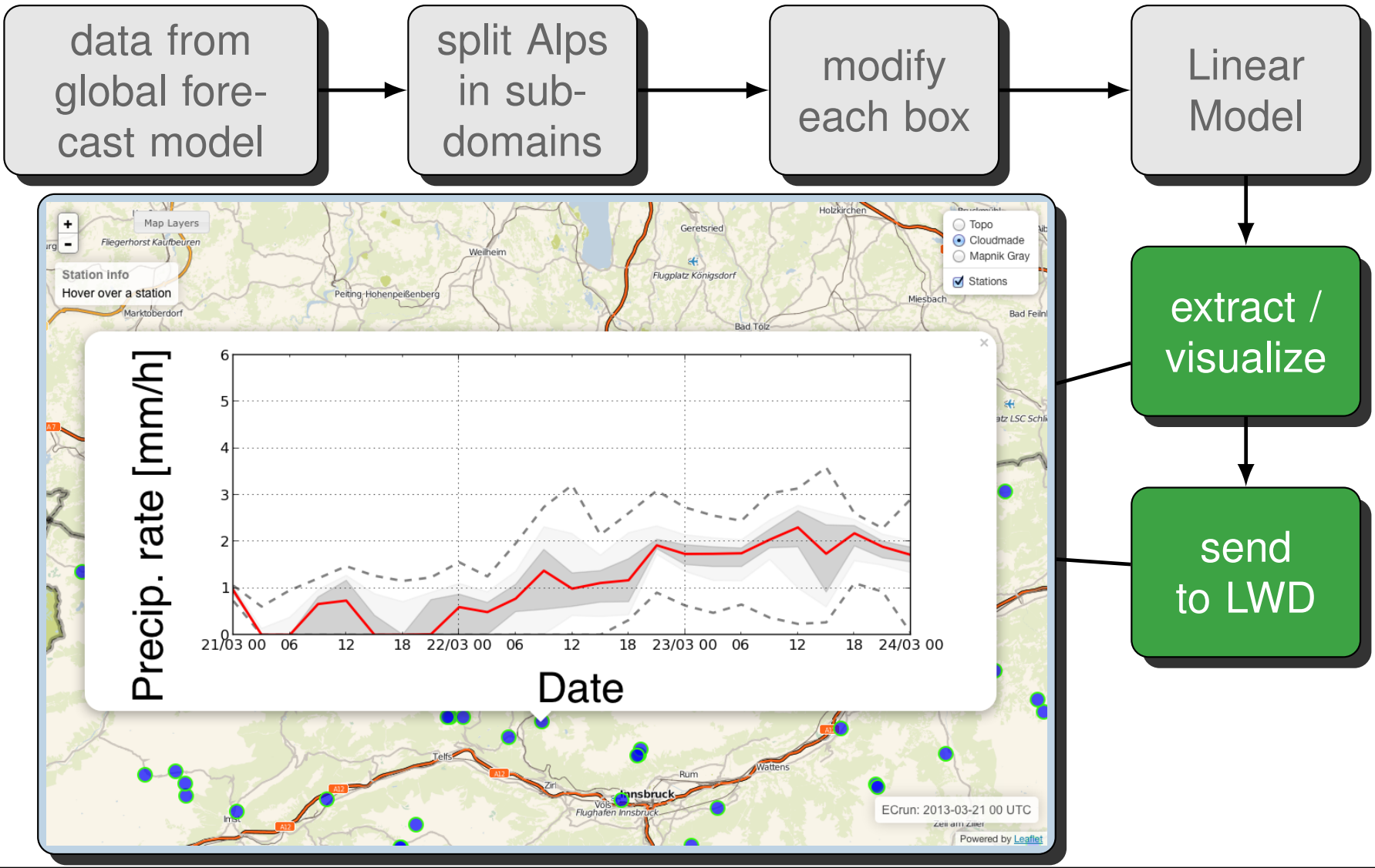

A suitable infrastructure: Cloud Computing

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Cloud provider
e.g.:
Amazon
Lunacloud
...

A suitable infrastructure: Cloud Computing

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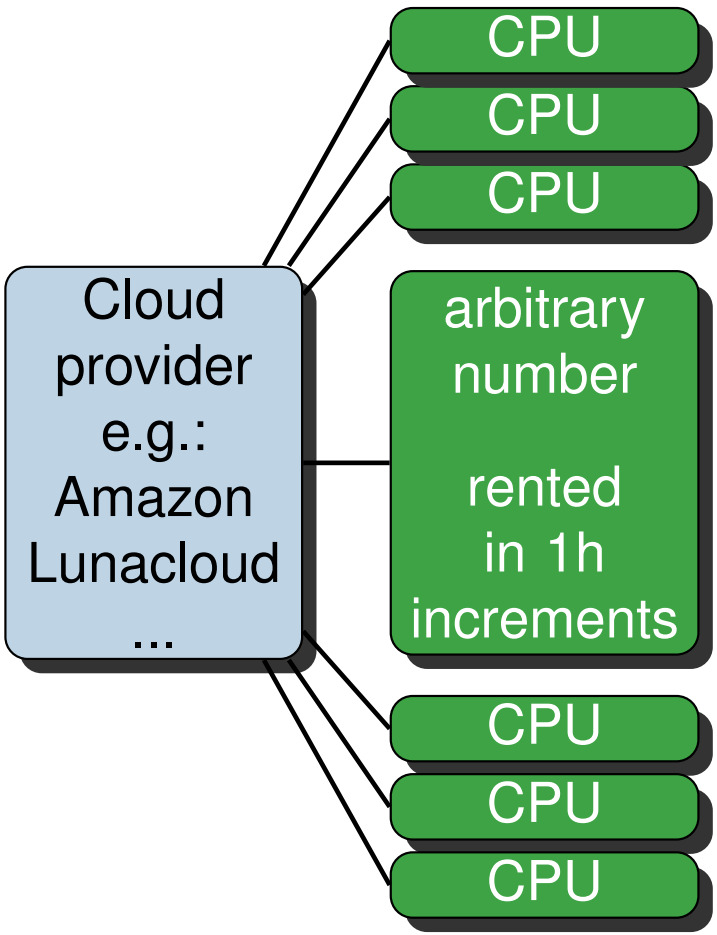

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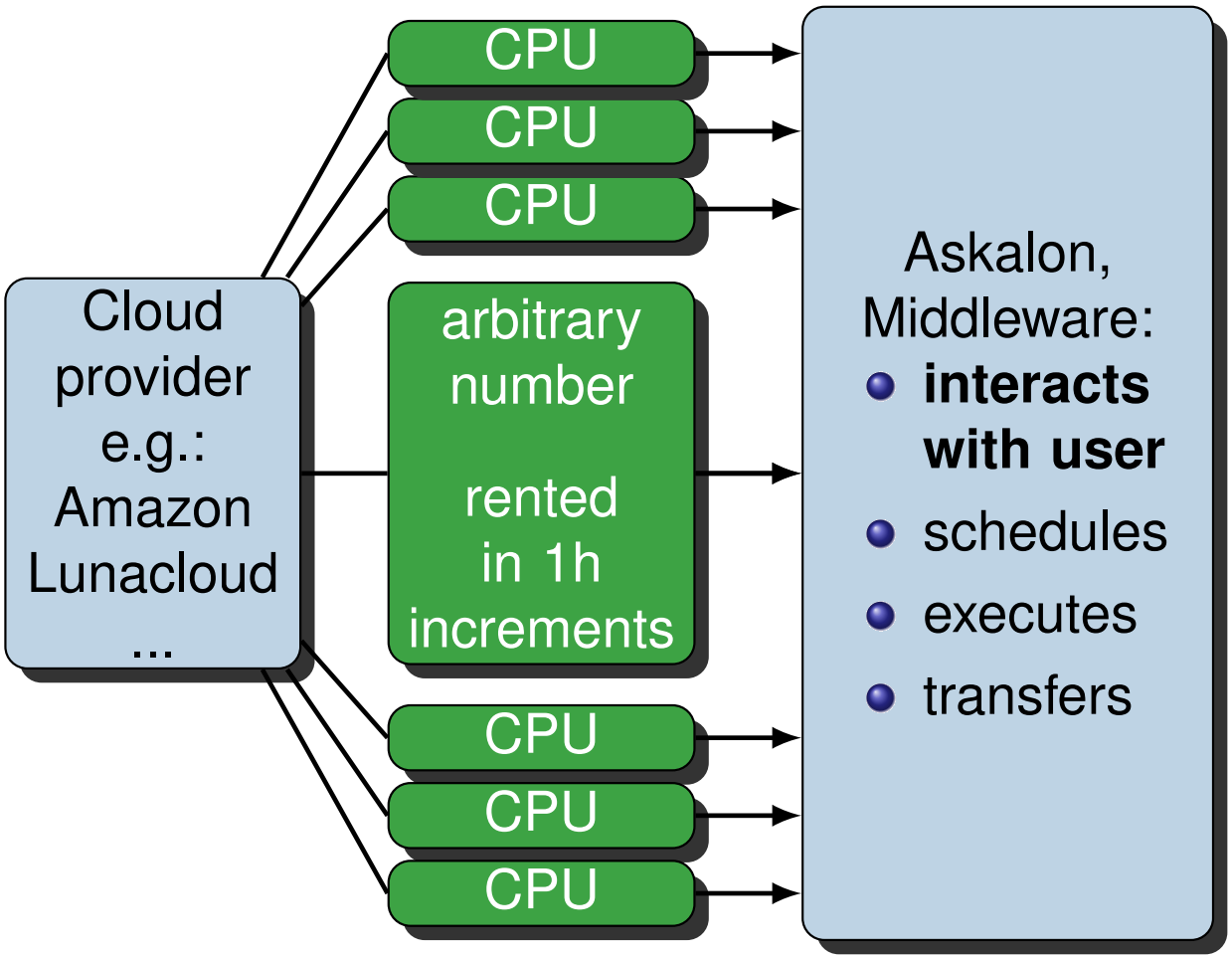

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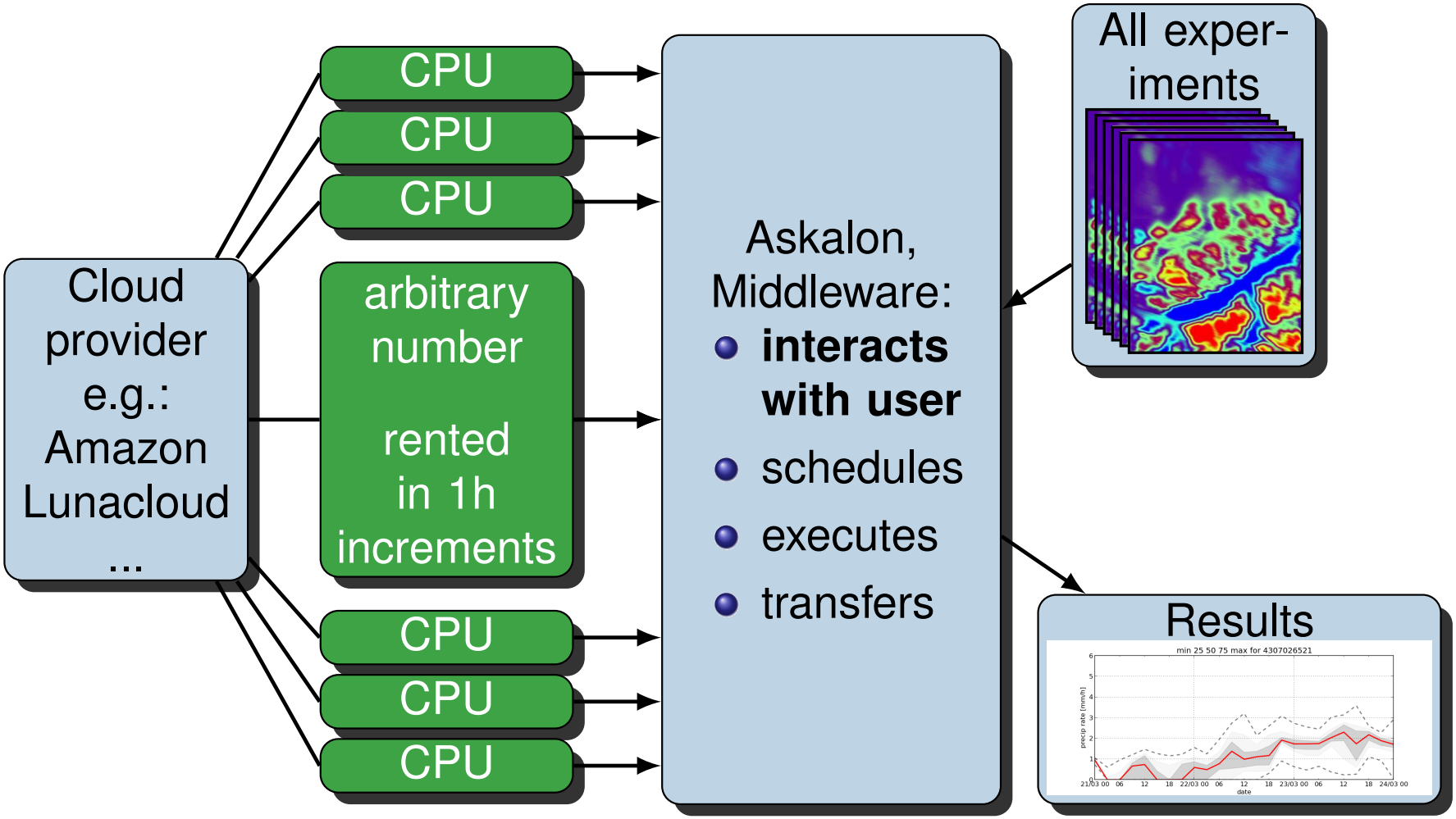

Test results

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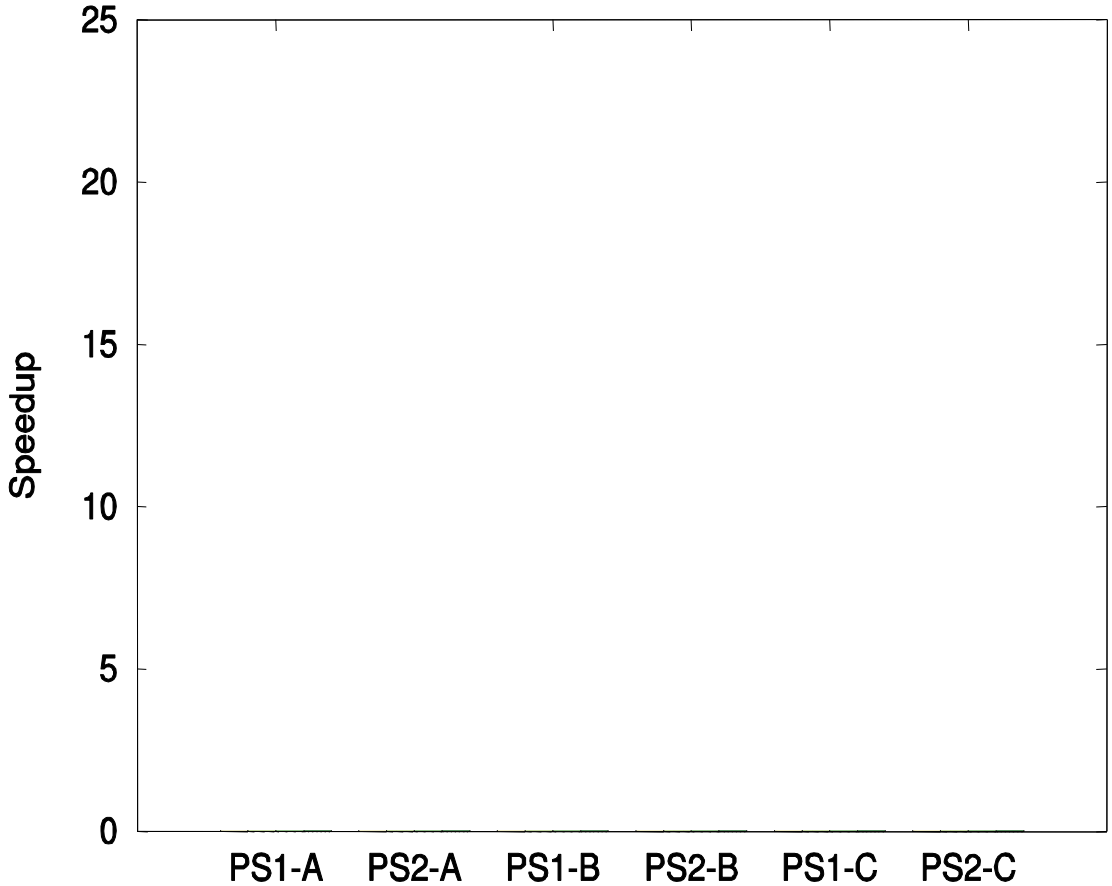

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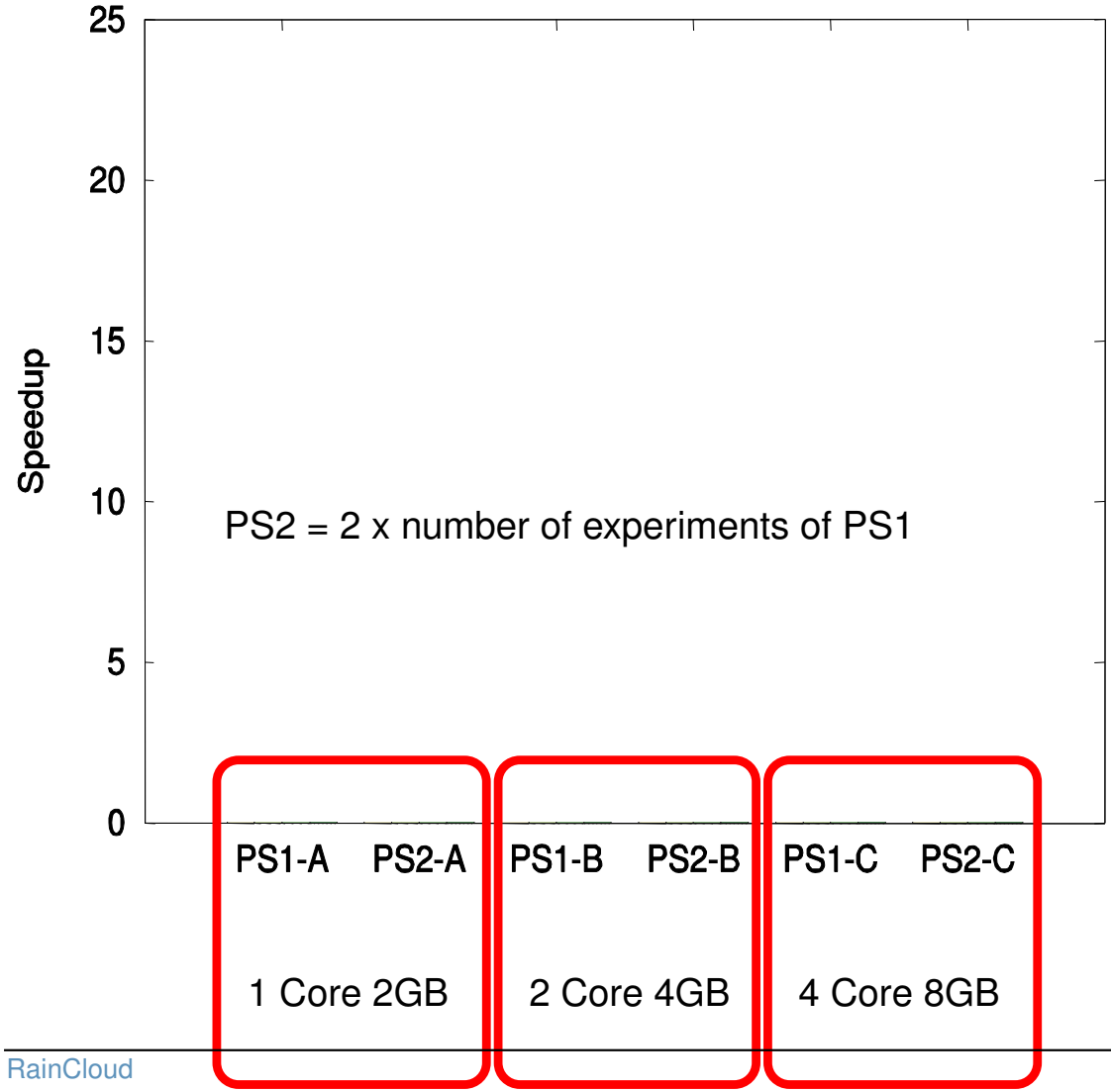

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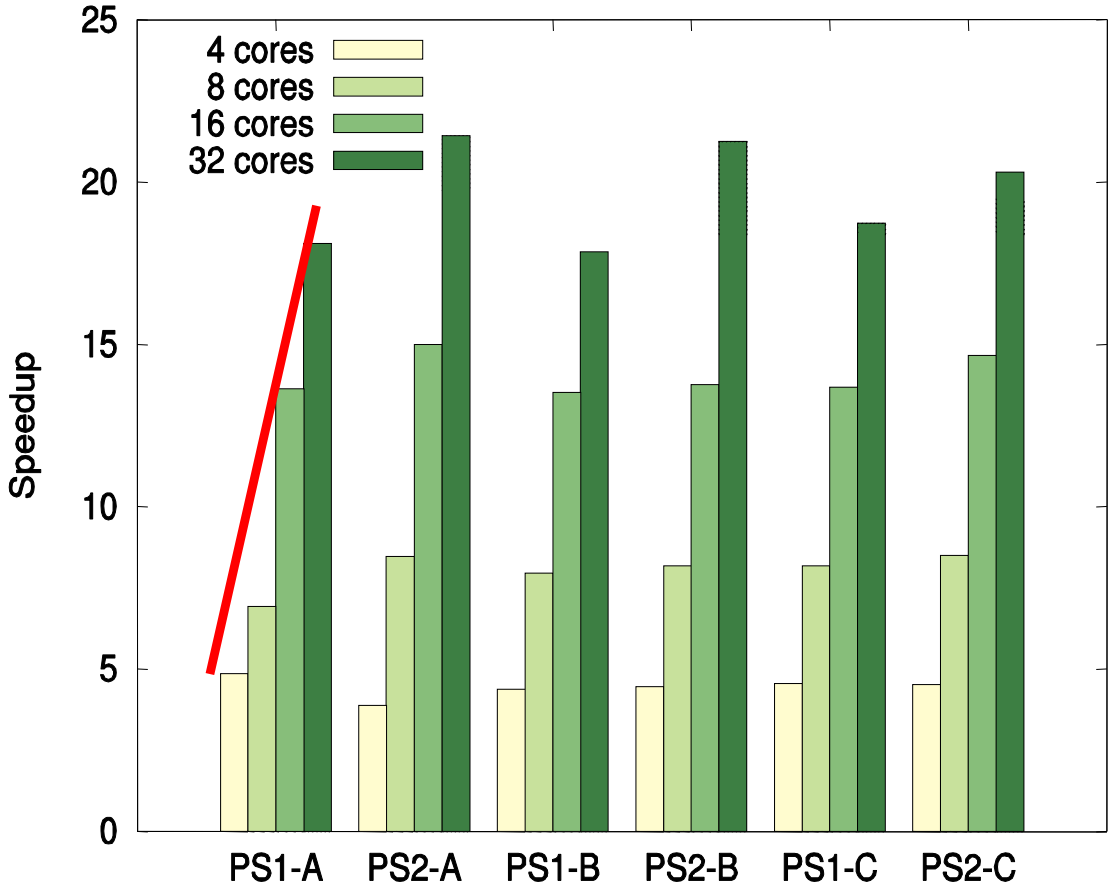

application is scalable

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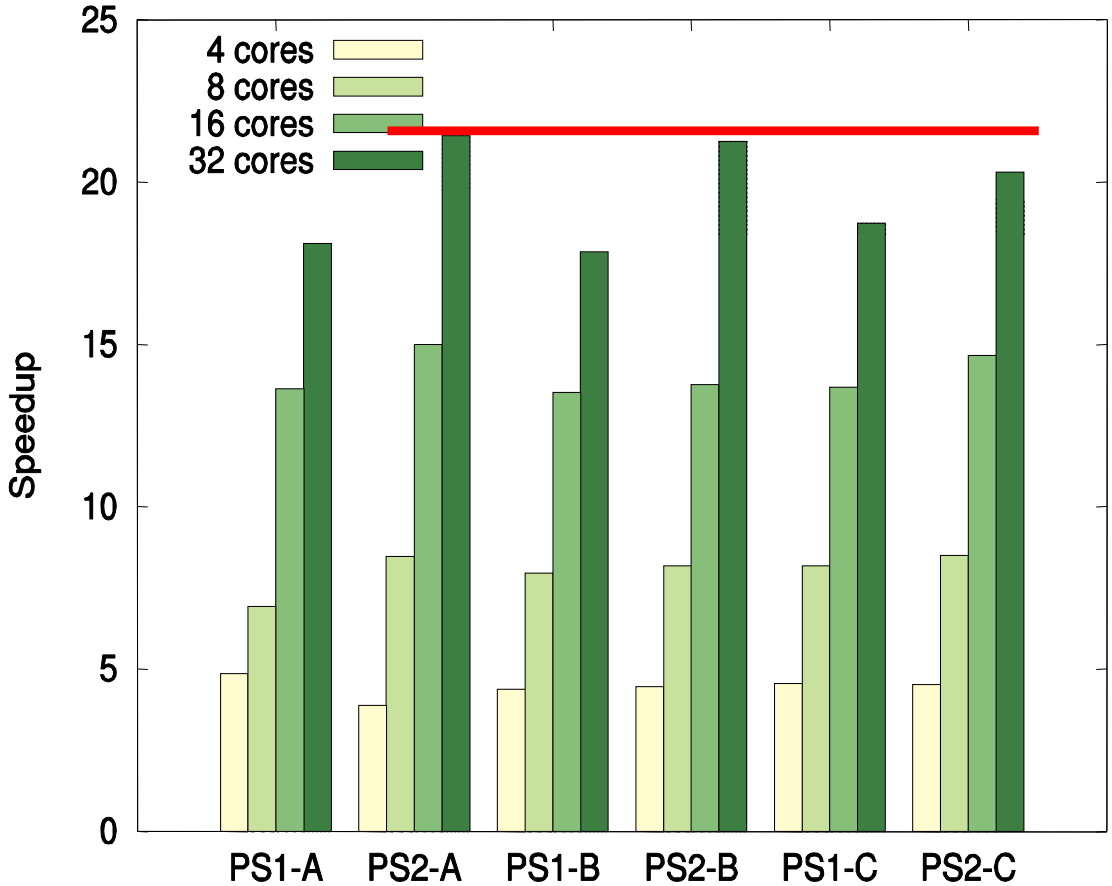

application is scalable

max speedup: ~ 21

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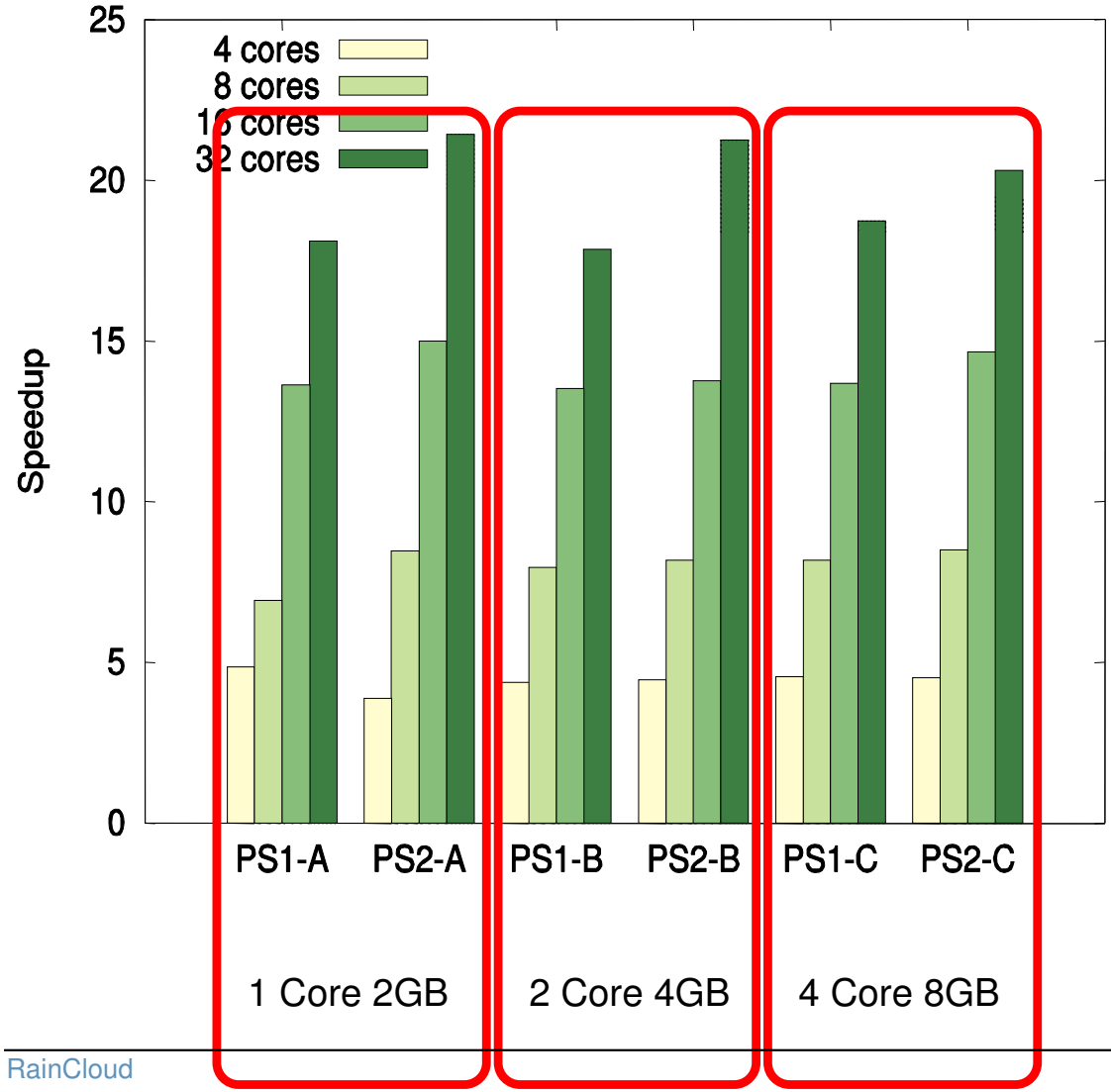

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small effect of varying instance types

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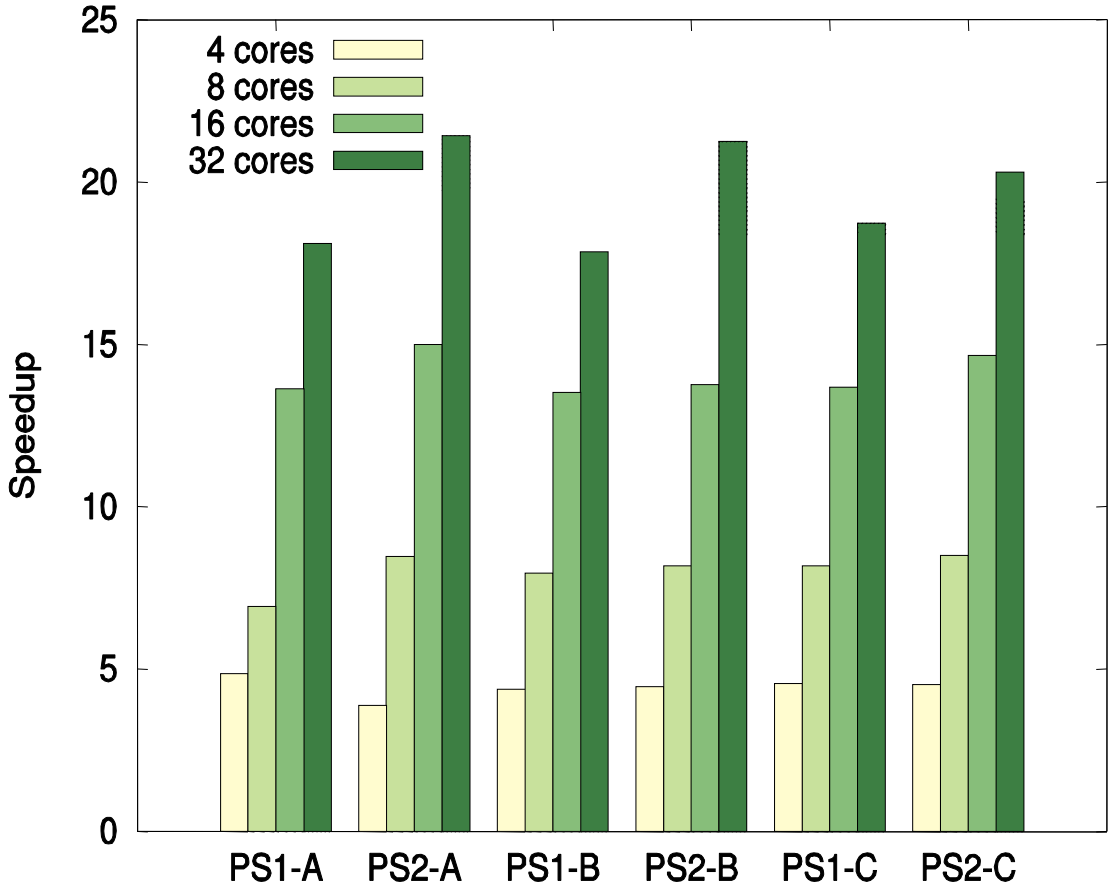

application is scalable

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small effect of varying instance types

private and public Cloud show similar performance

Conclusion

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cost effective

very flexible, suits operational and research aspects

full control of software environment

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- full control of software environment
- data transfers not as fast
- data security
- MPI/OpenMP just emerging

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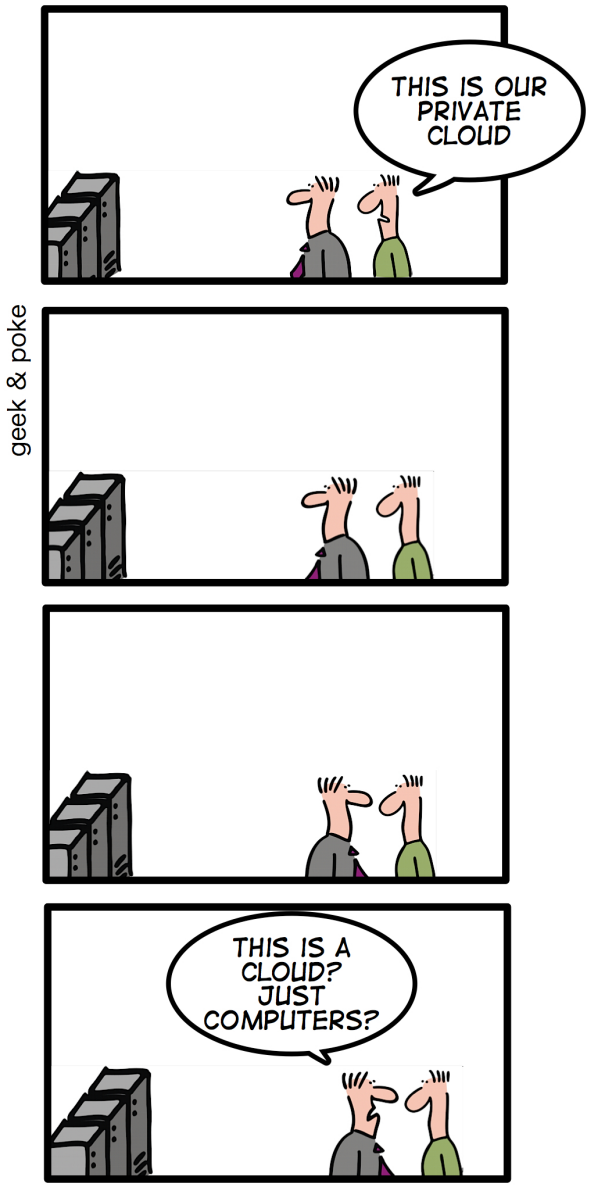
Cloud Computing

Cheap and flexible alternative to self-owned computational resources for certain types of meteorological applications

HOW TO DISILLUSION YOUR BOSS



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- Austrian Academy of Sciences (DOC grant)

Cartoons by the awesome
http://www.geek-and-poke.com/