iCeBOUND : Cloud Based Design Support System for Urban Numeric Data

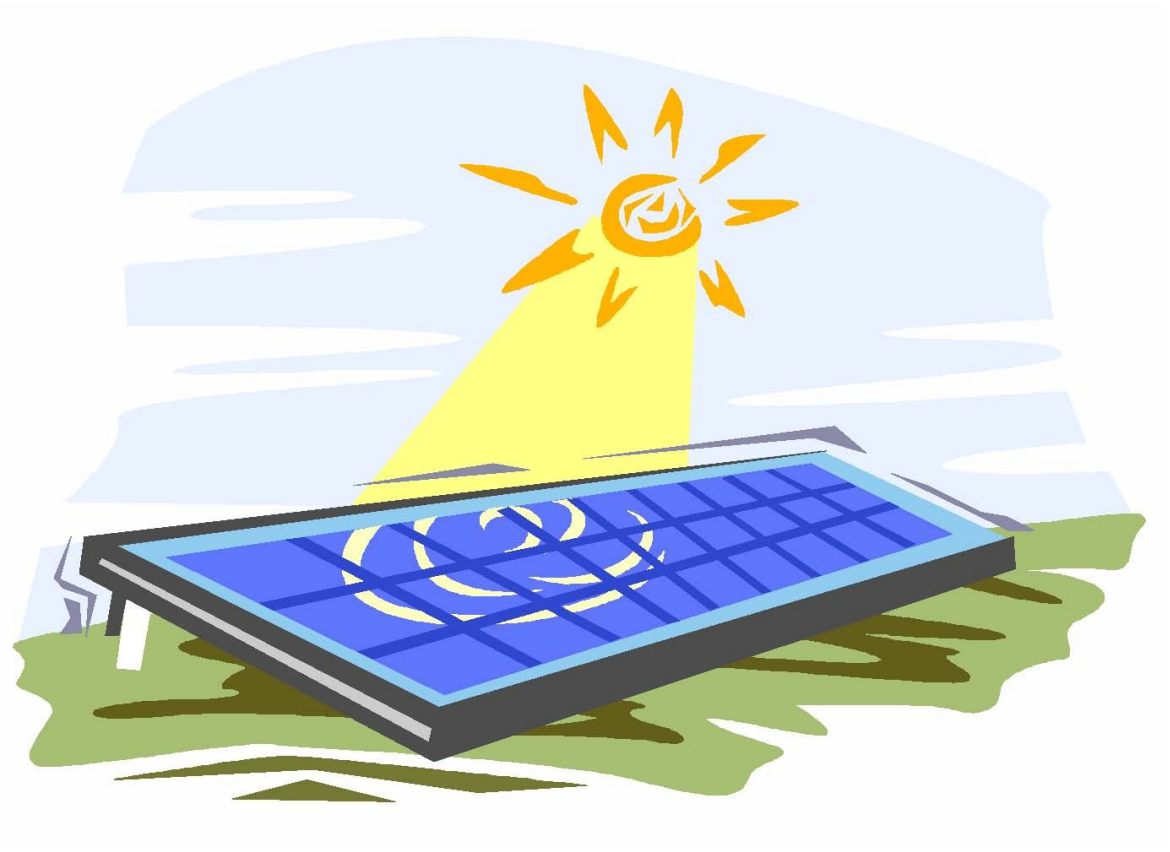
Boulmier Anthony, HES-SO

L'avenir est à créer

h e p i a

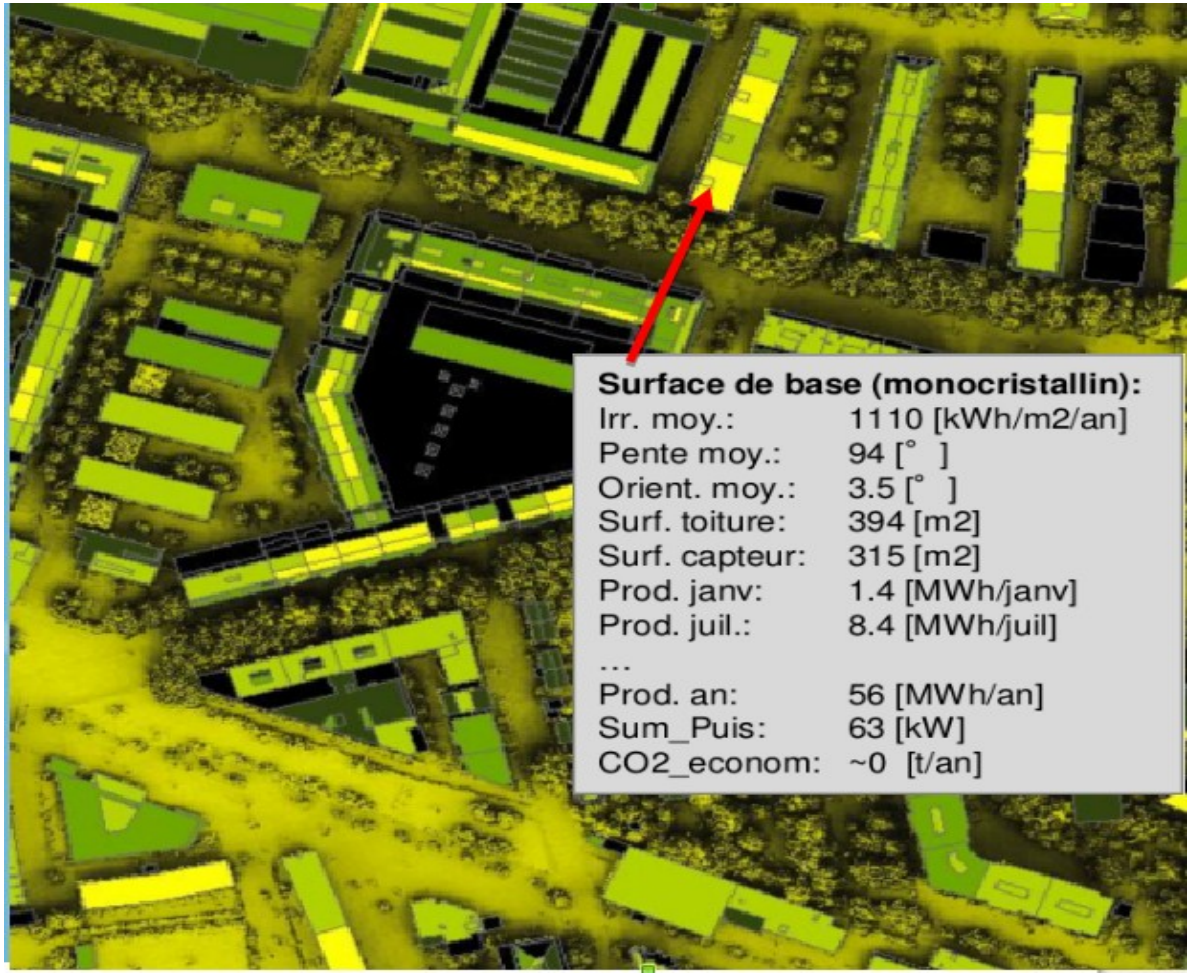
Haute école du paysage, d'ingénierie et d'architecture de Genève

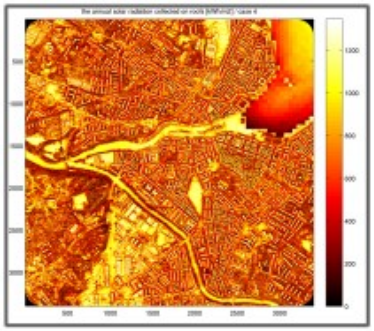
Introduction to iCeBOUND



http://www.zoombd24.com/wp-content/uploads/2015/09/Solar.jpg

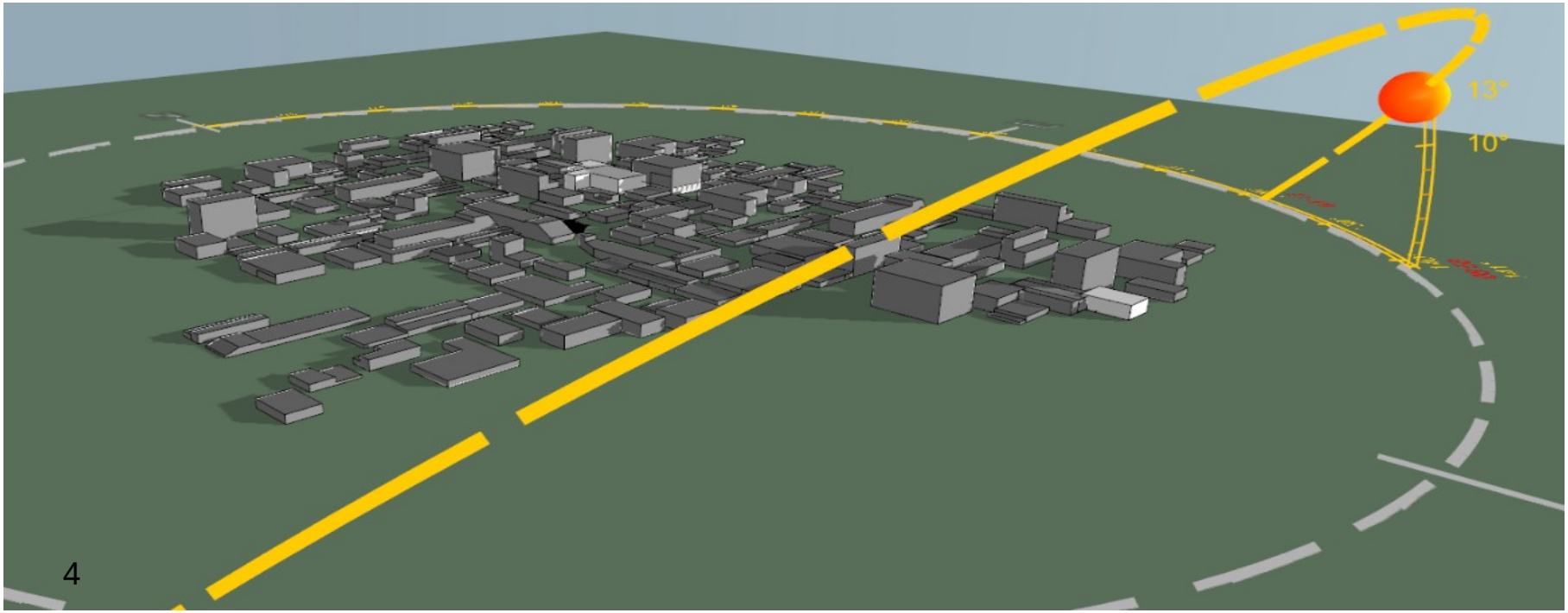
Goal and use case



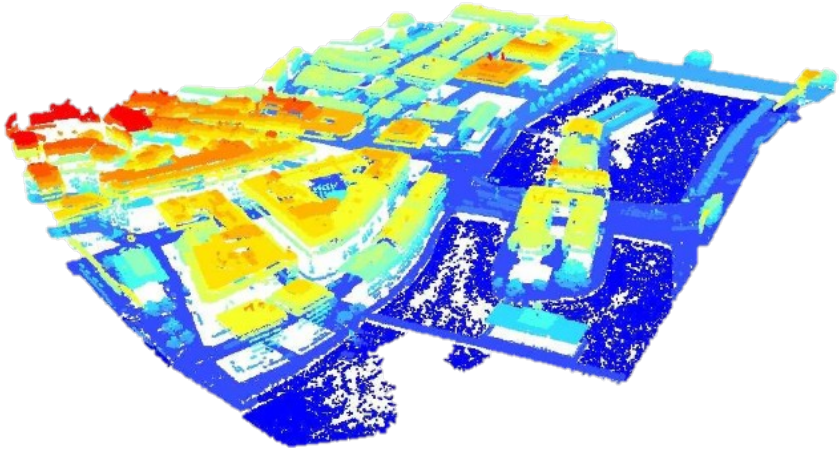


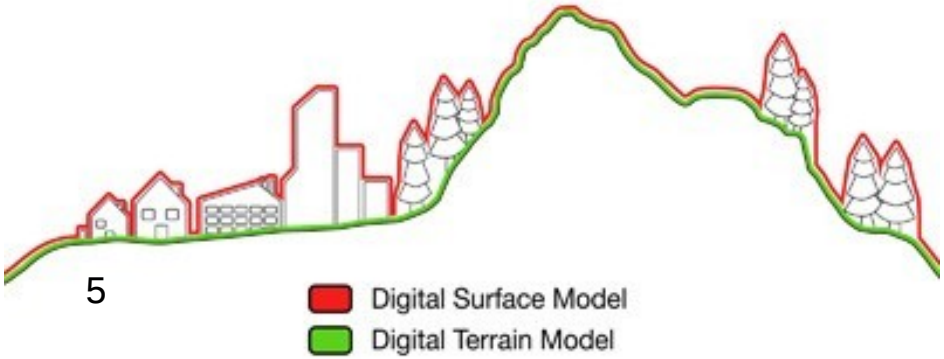
Input data

- Sun positions
- 3D digital urban datas



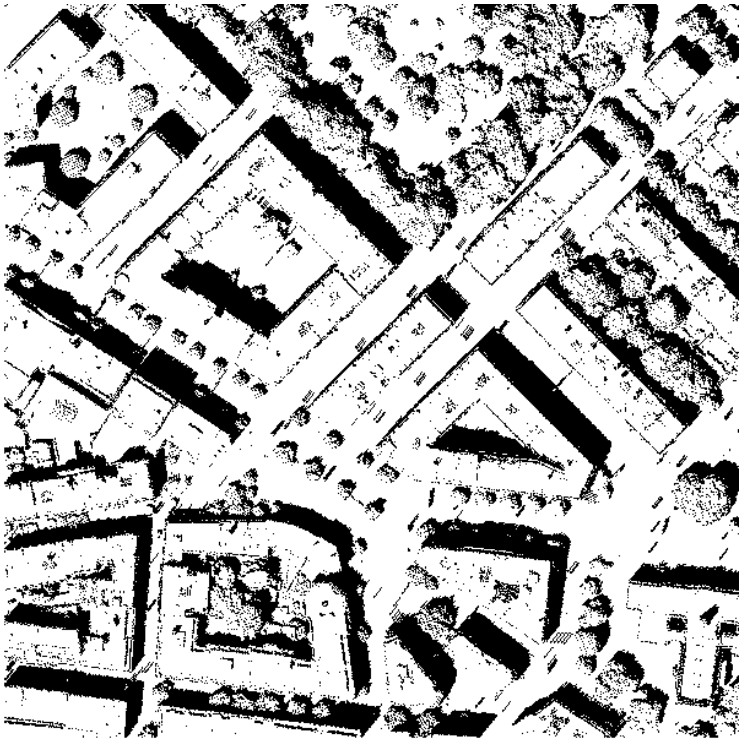
3D urban numeric model





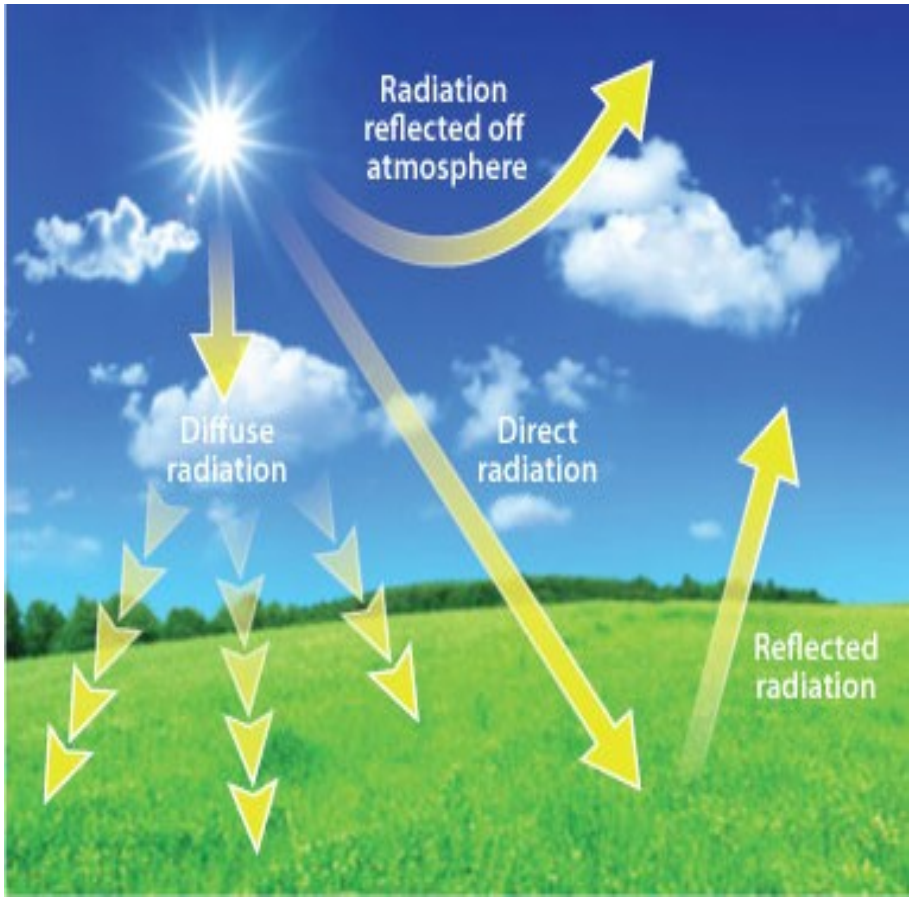
Shading calculation

- Result of a shadow process at 8am and 2pm on July



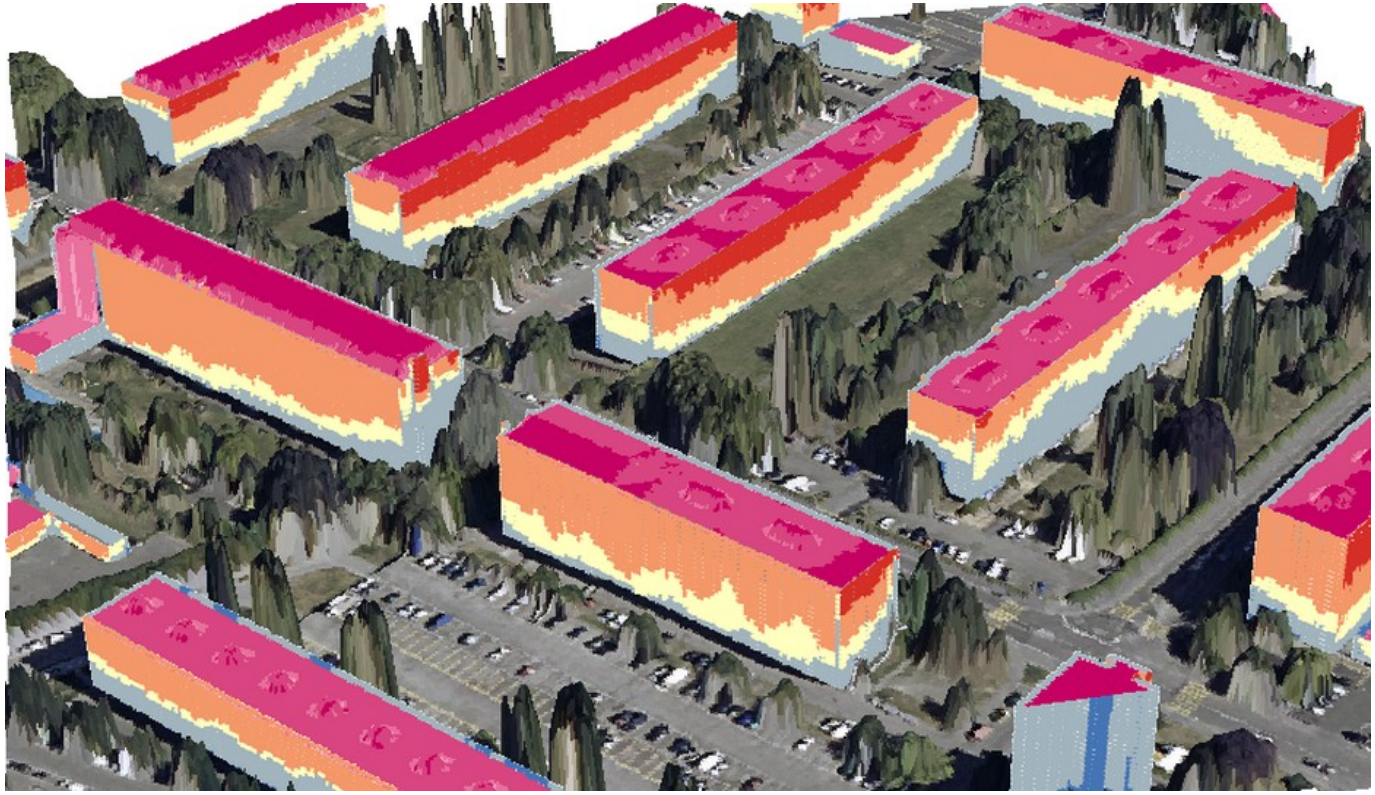
Solar radiation components

- Direct (depends on the sun visibility) radiation
- Diffuse (depends on the sky visibility ratio) radiation
- Reflected radiation



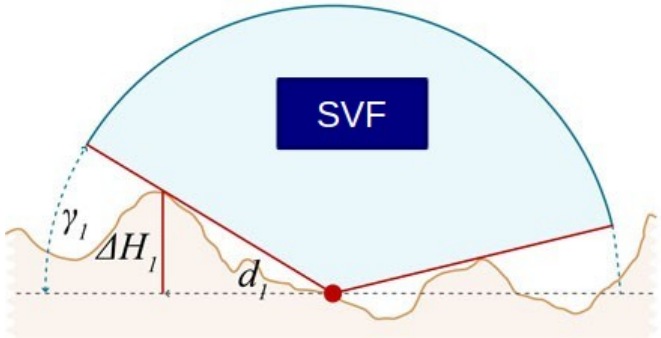
Solar radiation calculation

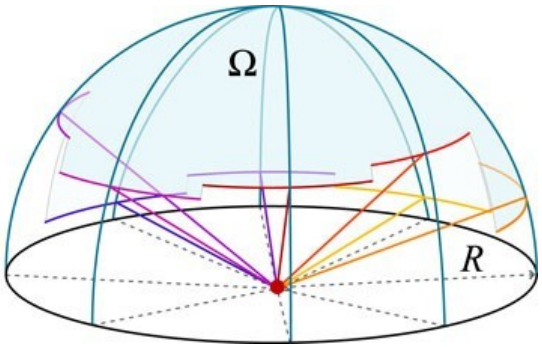
- Residential zone of Meyrin, 2015

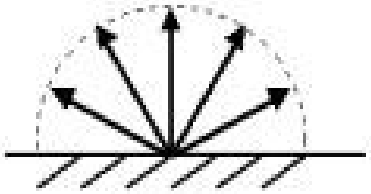


Sky view factor (SVF)

- Determines the ratio of visible sky from a point
- Input data : Sky model composed of 400 suns
- Output data : the ratio of visible sun from each point of the urban model
- Highly parallelizable

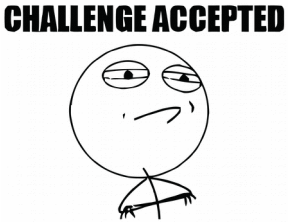






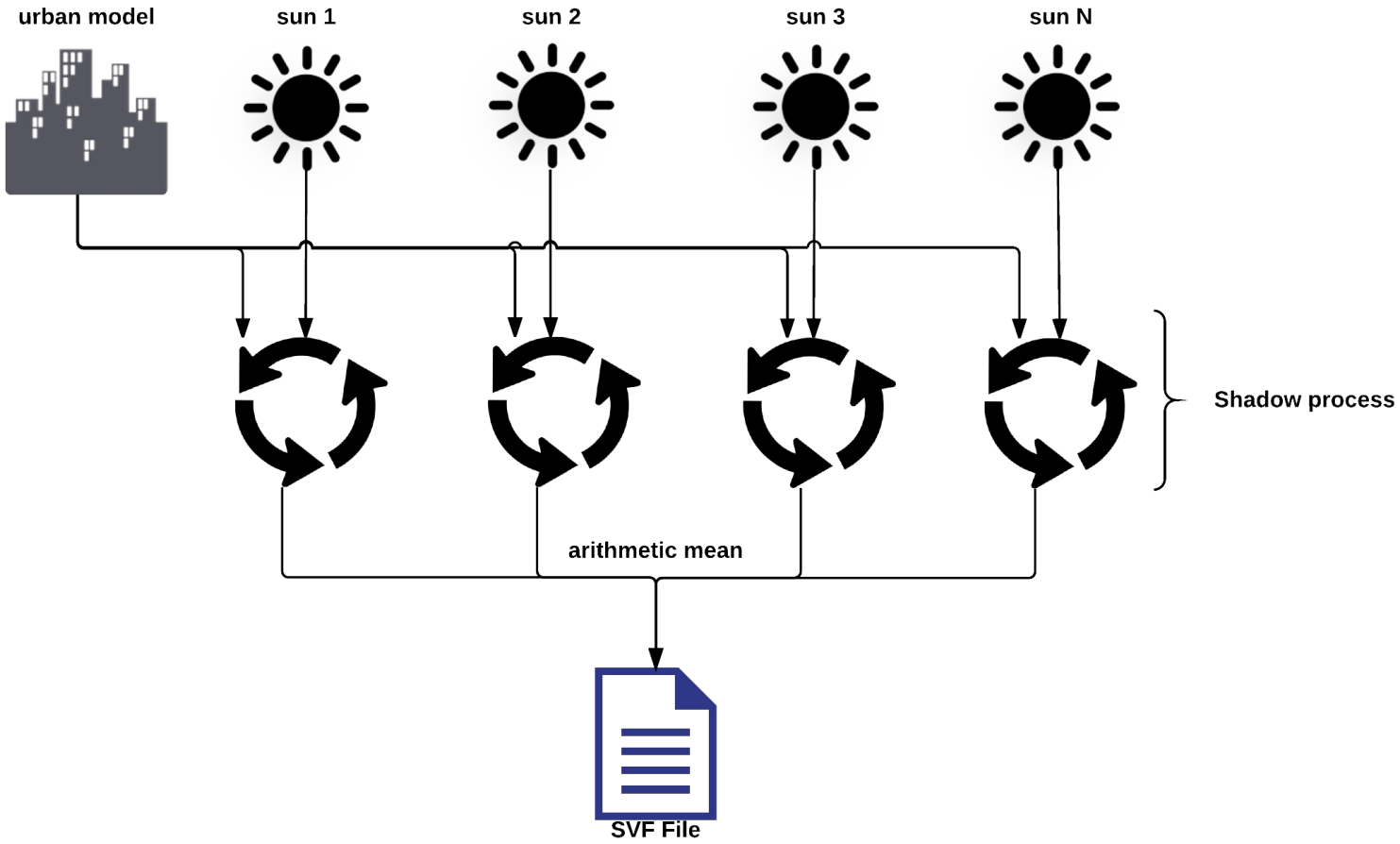
SVF parallelization : challenges

- Reducing the time taken from an execution on a real urban area (3.4 * 3.4 [km]) compared with the original Matlab software
- Optimization in term of execution cost
- Integrating the distributed computation system into the current decision support system



http://www.andescyclechallenge.com/wp-content/uploads/2014/10/Challenge_accepted.png

SVF parallelization : principle

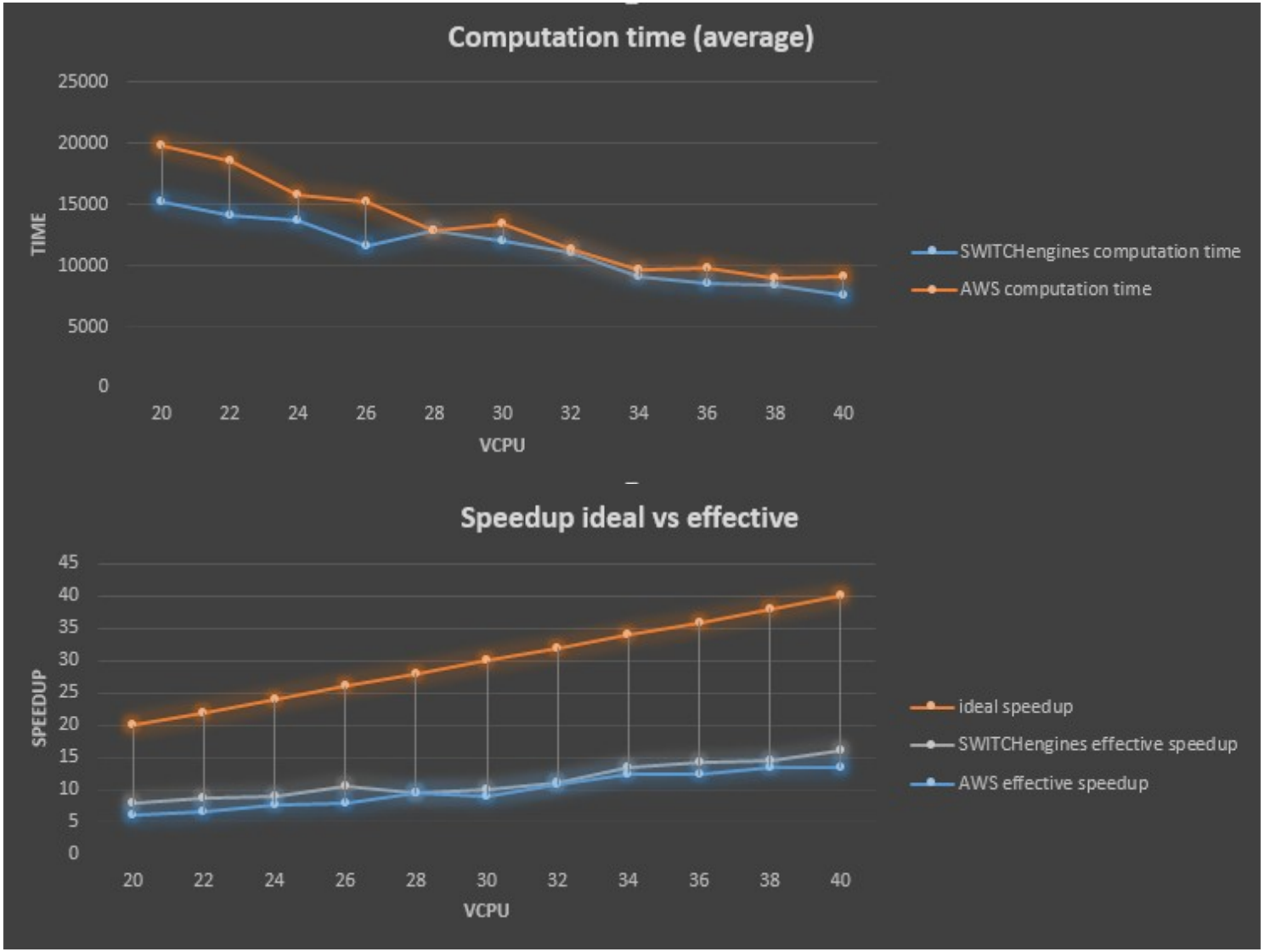


SVF parallelization : tools

- Two targeted providers : AWS & SWITCHengines
  - AWS flavor : r3.large : 2 VCPU 20GB of RAM
  - SWITCHengines flavor : r3.medium : 2 VCPU 10GB of RAM
- Cluster software : HTCondor
- Multicloud library : Apache libcloud
- Our own python orchestration library on top of condor

https://janikvonrotz.ch/wp-content/uploads/2014/03/Amazon-AWS-Logo.png
https://engines.switch.ch/horizon/auth/login/?next=/horizon/project/instances/
https://libcloud.apache.org/images/media/libcloud-logo-with-text-medium.png
https://research.cs.wisc.edu/htcondor/images/white_bird_logo.png

SVF parallelization : results



SVF parallelization : costs

- Total cost : 236.6 $US
- Total number of hour : 1352

SVF parallelization : conclusions

- Decreasing the computation time from 2 days to 2 hours
- Irregular application: Execution time depends on sun position and 3D urban model
- Open problem : Load balancing and dynamic scheduling

Questions ?

http://www.chambre-21.notaires.fr/data/photo/16.jpg