UNIVERSITEIT
GENT

# ANNUAL REVIEW HPC-UGENT

2018

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# CONTENTS

# 1 ABOUT HPC-UGENT

**In scientific computing*, computers are used to solve complex problems.**
**(*aka: supercomputing or high-performance computing - HPC)**

## 1.1 Our mission

HPC-UGent provides centralised scientific computing services, training, and support for researchers from Ghent University, industry, and other knowledge institutes.

HPC-UGent is part of the central ICT department of Ghent University, and is a strategic partner of the Flemish Supercomputer Center (VSC).

## 1.2 Our vision

HPC-UGent offers a professional scientific computing environment that is stable, user-friendly, and serves the diverse purposes of researchers from Ghent University, industry and other research institutions.

We provide a structural training curriculum for new and advanced users, and provide supporting course material.

We present a supercomputing portfolio that is well known within Ghent University and beyond, and we establish ourselves in the international community via contributions to centralised solutions, such as EasyBuild.

## 1.3 Personnel

The HPC-UGent team at the start of 2018 consists of 8 people:
Alvaro Simon Garcia, Andy Georges, Ewald Pauwels, Jens Timmerman, Kenneth Hoste, Kenneth Waegeman, Stijn De Weirdt, Wouter Depypere.
In June 2018, Jens Timmerman left the team.

Tasks include:
- User support
- Training
- Infrastructure installation and upkeep (both hardware and software)
- Outreach and marketing
- Collaboration with other supercomputing centers

# 2 INFRASTRUCTURE

## 2.1 Overview

The Ghent University compute infrastructure (Tier-2) consists of several specialised clusters, jointly called Stevin, hosted in the S10 datacenter.

In 2018, several changes to the infrastructure were applied:

- cluster raichu was decommissioned
- new clusters victini and skitty were taken into production
- the SLURM job scheduler was introduced for clusters victini and skitty
- cluster victini was made the default cluster.

### 2.1.1 Compute clusters

| Cluster name | #nodes | CPU per node | Memory per node | Local disk per node | Network interconnect |
|---|---|---|---|---|---|
| **Raichu** | 56 | 2 x 8-core Intel E5-2670 (Sandy Bridge @ 2.6 GHz) | 32 GB | 400 GB | Gb Ethernet |
| | | | Decommissioned on 15 January 2018 | | |
| **Delcatty** | 124 | 2 x 8-core Intel E5-2670 (Sandy Bridge @ 2.6 GHz) | 64 GB | 400 GB | FDR InfiniBand |
| **Phanpy** | 16 | 2 x 12-core Intel E5-2680v3 (Haswell-EP @ 2.5 GHz) | 512 GB | 3 x 400 GB (SSD, striped) | FDR InfiniBand |

| | | | | | |
|---|---|---|---|---|---|
| **Golett** | 200 | 2 x 12-core Intel E5-2680v3 (Haswell-EP @ 2.5 GHz) | 64 GB | 500 GB | FDR-10 InfiniBand |
| **Swalot** | 128 | 2 x 10-core Intel E5-2660v3 (Haswell-EP @ 2.6 GHz) | 128 GB | 1 TB | FDR InfiniBand |
| **Skitty** | 72 | 2 x 18-core Intel Xeon Gold 6140 (Skylake @ 2.3 GHz) | 192 GB | 1 TB | EDR InfiniBand |
| **Victini** | 96 | 2 x 18-core Intel Xeon Gold 6140 (Skylake @ 2.3 GHz) | 96 GB | 1 TB | 10 Gb ethernet |

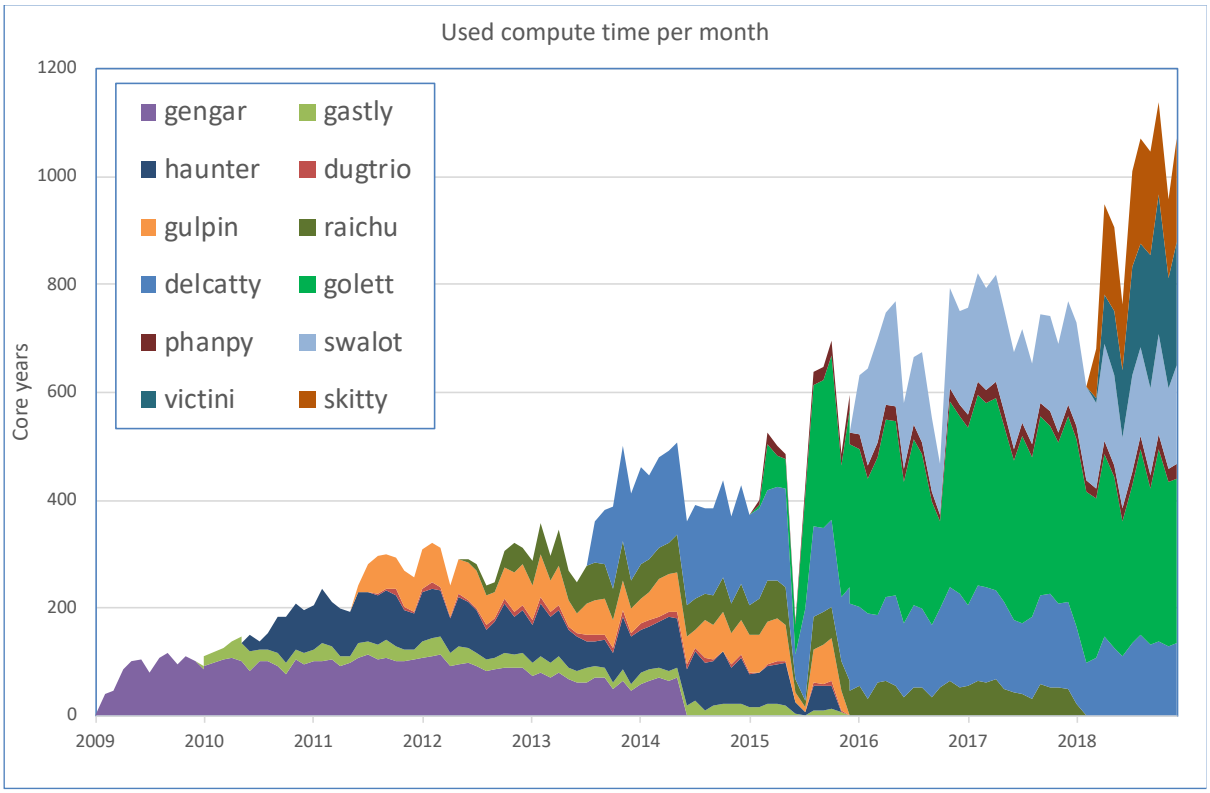
### 2.1.2 Shared storage

| Partition | Size |
|---|---|
| **$VSC_HOME** | 35 TB |
| **$VSC_DATA** | 702 TB (can grow to 1 PB) |
| **$VSC_SCRATCH $VSC_SCRATCH_KYUKON** | 1 PB |
| **$VSC_SCRATCH_PHANPY** | 35 TB SSD |

## 2.2 Usage

Modern CPUs contain many cores that are capable of running a computational task. In the graphs below, the used or available compute time on the compute clusters is typically expressed in *core years*, where 1 core year would correspond to the work done by one core in one year of time. (One core hour is the work done by one core in one hour of time.)

### 2.2.1 Historical perspective on used compute time

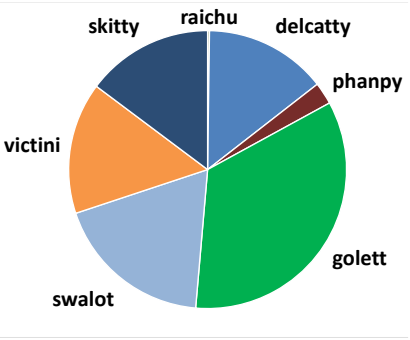



This plot gives a historical perspective on the amount of compute time that is used every month, coloured according to the cluster that does the work. All clusters together, since the start in 2009, have produced more than 464 million core hours. This is equivalent to 53.000 years of compute work on one core.

### 2.2.2 Consumed compute time in 2018

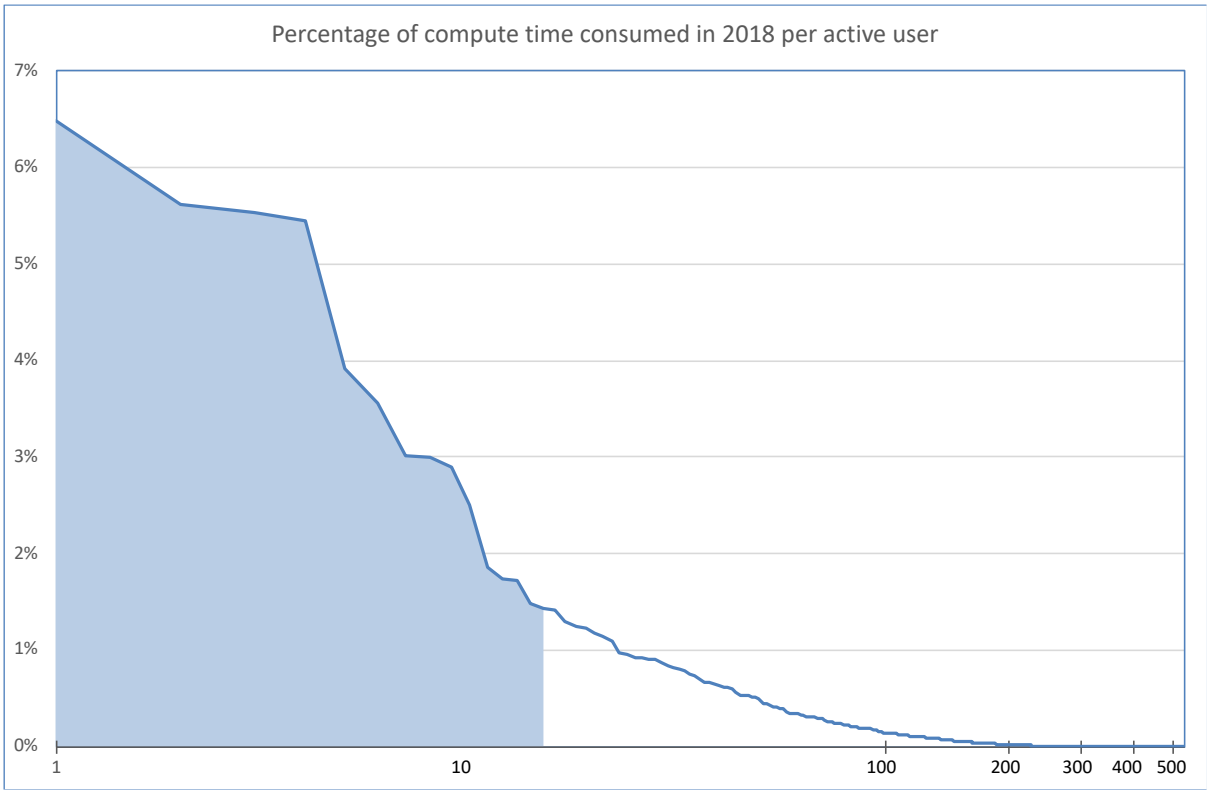
#### 2.2.2.1 Consumed compute time per compute cluster

| Cluster name | Compute time consumed (in core years) | Effective use percentage |
|---|---|---|
| **Raichu** | *(until 15/01/2018)* 24 | 65% |
| **Delcatty** | 1559 | 79% |
| **Phanpy** | 281 | 73% |
| **Golett** | 3753 | 78% |
| **Swalot** | 2026 | 79% |
| **Victini** | *(from 1/03/2018)* 1676 | 58% |
| **Skitty** | *(from 1/03/2018)* 1615 | 74% |
| **Total** | **10933** | **74%** |




In 2018, a total of 95.559.679 core hours has been consumed on the Tier-2 compute clusters of Ghent University. This corresponds to 10.933 core years.
The effective use percentage expresses how much of the theoretically available compute power in one year (#nodes x #cores/node) was used. Down-times were not taken into account, so the percentages represent a lower bound. Effective use percentages are quite high for typical HPC systems and indicate good economic usage of the infrastructure.

#### 2.2.2.2 Consumed compute time versus active users




In 2018, 602 persons actively used the Tier-2 compute clusters of Ghent University. The user base typically contains a limited number of power users in addition to

regular users with a lower usage profile. The plot above graphs per user (x axis) what percentage of all compute time produced in 2018 this user consumed. The blue area indicates that 50% of all Tier-2 compute time was consumed by 15 power users.

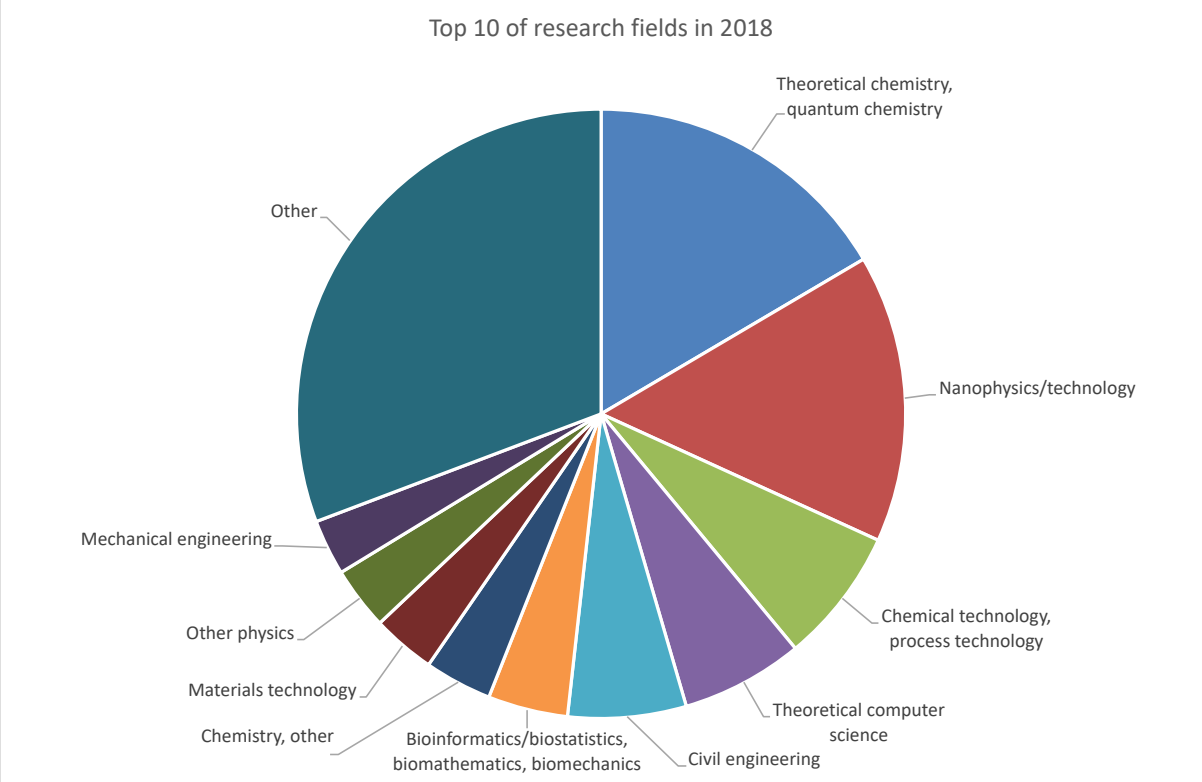
Everyone can get access to the Tier-2 compute clusters of Ghent University. The conditions that apply depend on the affiliation of the researcher. Researchers affiliated with Flemish university associations (constituting the Flemish Supercomputer Center – VSC) get free access. Other Flemish or federal research institutes can get access for their researchers on a contract basis, with 1500 euro worth of compute time given out free of charge per year. Industry can buy compute time in a pay-what-you-use model.

| Breakdown of consumed compute time by affiliation | |
|---|---|
| **UAntwerpen** | 0.251% |
| **VUB** | 0.000% |
| **UGent** | 97.647% |
| **KULeuven / UHasselt** | 1.886% |
| **Other research institutes** | 0.216% |
| **Industry** | 0.001% |
| **Total** | **100.000%** |

Master or Bachelor students enrolled in a Flemish university association can also get access to the Tier-2 compute clusters of Ghent University. Several teachers effectively rely on the infrastructure for training purposes, stimulating several students to become a user. Master students often rely on the infrastructure to perform research included in their Master thesis.

| Number of students/researchers versus breakdown of consumed compute time by category | | |
|---|---|---|
| **Ma/Ba students** | 118 | 0.001% |
| **Researchers** | 484 | 99.999% |
| **Total** | **602** | **100.000%** |

### 2.2.2.3 Consumed compute time versus research field

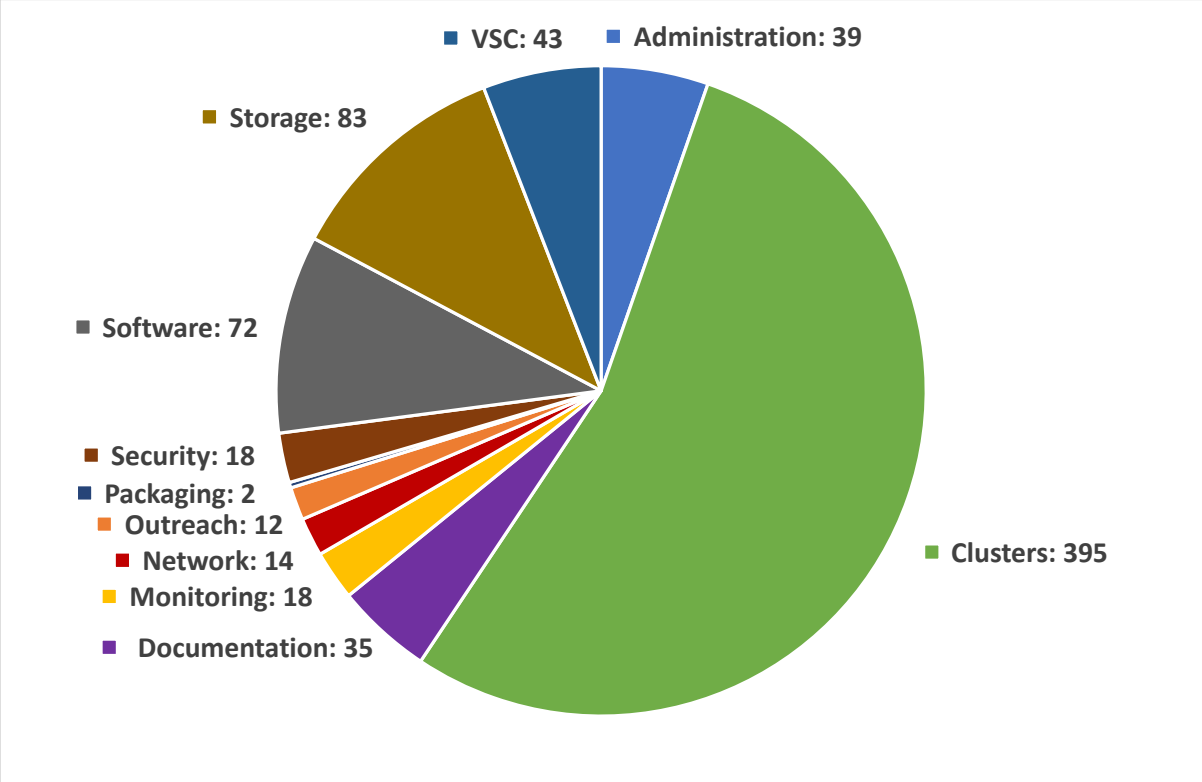



These are the research fields that users enter when requesting their account to access HPC-UGent resources. No doubt, there is overlap between certain fields and some users have not listed a research field at all. As such, the above distribution merely gives an indication of the top research fields that actively use scientific computing.

# 3 DEVELOPMENT AND MAINTENANCE

To maintain compute infrastructure capabilities, HPC-UGent continuously performs maintenance works. On hardware, such as installing new components or replacing broken ones, and on software, ranging from the operating system to higher-level software that enables services directly available to the end user. To report, plan and follow-up hardware and software bugs, issues or developments, these are managed with the aid of a tracker, JIRA. Larger developments, grouping many individual or interrelated issues are grouped as 'Epics'. These effectively track the main development and maintenance projects that HPC-UGent executes. Github services are used to facilitate software development and Jenkins services for continuous integration. The number of 'commits' by HPC-UGent staff to the various repositories is indicative of the effort spent over the last year.

## 3.1 Number of JIRA issues resolved in 2018, grouped per main component



## 3.2 Projects finalized in 2018

| Issue # | Title | Summary |
|---|---|---|
| HPC-346 | reboot-on-idle script/master cron | Automation of node management. |
| HPC-1797 | userwiki page way out of date | Outdated userwiki was scrapped, after alle relevant information was ported to user manual. |
| HPC-5435 | Account page: non-standard users | Adjustments to VSC accountpage to better accomodate non-academic users. |
| HPC-5864 | Ceph next stage: ncm-ceph and new ceph features | Implementation of new features in Ceph, in run-up to new Ceph storage. |
| HPC-6181 | Issues since running MOAB9.0.1 +Torque6.0.2 | Wrap up outstanding support issues for Moab, in run-up to switch to Slurm. |
| HPC-6184 | Our portal needs a major rewrite + cleanup | Rewrite and restructuring of our website https://www.ugent.be/hpc. |
| HPC-6630 | regular maintenance 2017Q4 | General maintenance of all Tier2 clusters and servers. Started end of 2017, last bits finished in 2018. |
| HPC-6677 | Evaluate potential Moab/Torque replacements | Examine usability of other job schedulers, including Slurm. |
| HPC-6703 | Tier 2 site update 2018Q2 | General maintenance of all Tier2 clusters and servers. |
| HPC-6778 | Install new tier2 infrastructure | Installation and integration of clusters skitty and victini. |
| HPC-6810 | Extend existing ceph storage | New additional Ceph storage. |
| HPC-6855 | Set up new scheduler to replace Moab + Torque | Set up new job scheduler Slurm on skitty and victini. |
| HPC-6906 | Tier2 site update 2018Q4 | General maintenance of all Tier2 clusters and servers. |
| HPC-6943 | Support for Victini Skitty clusters | Support actions for new job scheduler Slurm on skitty and victini. |
| HPC-7071 | Gpfs nodes to 7.5 | Update of GPFS on shared storage. |
| HPC-7199 | Storage maintenance: move to gpfs 5.x | Update of GPFS on shared storage. |
| HPC-7225 | Move to ceph mimic | Implementation of new features in Ceph. |
| HPC-7257 | replace misty with rundeck | Automation of node management. |
| HPC-346 | reboot-on-idle script/master cron | Automation of node management. |
| HPC-1797 | userwiki page way out of date | Outdated userwiki was scrapped, after all relevant information was ported to user manual. |

## 3.3 Github commits in 2018 by HPC-UGent staff, per repository

| github.com/hpcugent | |
|---|---|
| **Repository** | #commits |
| vsc_user_docs | 356 |
| vsc-administration | 118 |
| vsc-mympirun | 47 |
| vsc-base | 36 |
| vsc-utils | 25 |
| vsc-filesystems | 11 |
| vsc-ldap | 1 |

| github.ugent.be/hpcugent | |
|---|---|
| **Repository** | #commits |
| es-scripts | 29 |
| clusterbuildrpm-server | 28 |
| vsc-backup | 15 |
| reposnap | 3 |
| ONEconnector | 1 |
| vsc-rpms | 1 |
| vsc-project | 1 |
| vsc-cloud | 1 |

| github.com/easybuilders | |
|---|---|
| **Repository** | #commits |
| easybuild-easyconfigs | 846 |
| easybuild-framework | 393 |
| easybuild-easyblocks | 174 |
| easybuild | 89 |

| github.com/quattor | |
|---|---|
| **Repository** | #commits |
| configuration-modules-core | 171 |
| release | 29 |
| pan | 17 |
| CCM | 10 |
| CAF | 8 |
| ncm-ncd | 7 |
| aii | 7 |
| maven-tools | 6 |
| template-library-core | 6 |
| configuration-modules-grid | 5 |
| template-library-standard | 3 |
| quattor.github.com | 2 |
| ncm-lib-blockdevices | 1 |

# 4 TRAINING AND SUPPORT

## 4.1 Training overview and evaluations

### 4.1.1 Introduction to HPC @ Ghent University

Trainer: Kenneth Hoste (HPC-UGent)

| Date | #participants |
|---|---|
| 17/01/2018 | 13 |
| 28/03/2018 | 21 |
| 12/09/2018 | 19 |
| 09/11/2018 | 36 |

| Satisfaction scores[1] | |
|---|---|
| Training content | 98% |
| Lecturer | 99% |
| Hands-on | 60% |

Selected suggestions for improvement and remarks:

- Maybe make a step-by-step tutorial video?
- This is a very good manual, the courses are a good way of learning to use HPC.
- Give more example exercises and problems with solutions afterwards.
- This tutorial is great!
- Provide some exercises that participants could make next to the examples in the slides.

[1] These satisfaction scores indicate positive response of evaluation respondents on questions “The presentation gave me all the information I wanted” (Yes or Mostly), “The lecturer presented well” (Strongly Agree or Agree) and "The hands-on session was in accordance with my expectations” (Strongly agree or Agree).

### 4.1.2 Introduction to Linux

Trainer: Kenneth Hoste (HPC-UGent)

| Date | #participants |
|---|---|
| 21/02/2018 | 20 |

| Satisfaction scores[1] | |
|---|---|
| Training content | 100% |
| Lecturer | 100% |
| Hands-on | 93% |

Selected suggestions for improvement and remarks:

- Short pause in the afternoon.
- Ice breaker in the morning - self-introduction for all participants (department, why attending the course, etc.).
- Hands-on exercises that participants can submit online or email.

### 4.1.3 Specialist Workshops in Scientific Computing – Introduction to multithreading and OpenMP

Trainer: Reinhold Bader (Leibniz Supercomputing Centre LRZ, Germany)

| Date | #participants |
|---|---|
| 22-23/05/2018 | 16 |

| Satisfaction scores[2] | |
|---|---|
| Training content | 100% |
| Lecturer | 100% |

Selected suggestions for improvement and remarks:

- Good lecturer, up to date course
- The course covers a too wide range of topics. Concentrate on features that are most commonly used?
- Very competent and well-spoken lecturer.

### 4.1.4 Specialist Workshops in Scientific Computing – Introduction to MPI

Trainer: Jan Fostier (INTEC, IDLab, UGent & imec)

| Date | #participants |
|---|---|
| 30/05/2018 | 16 |

| Satisfaction scores[2] | |
|---|---|
| Training content | 100% |
| Lecturer | 100% |

Selected suggestions for improvement and remarks:

- Perfect introduction to MPI
- The methodology used by the lecturer was excellent.

[2] These satisfaction scores indicate positive response of evaluation respondents on questions “In general I judge this course as” (Very good or Good) and “The lecturer has the specialized expertise required to teach this course” (Fully agree or Agree).

### 4.1.5 Specialist Workshops in Scientific Computing – Modern Fortran

Trainer: Reinhold Bader (Leibniz Supercomputing Centre LRZ, Germany)

| Date | #participants |
|---|---|
| 3-4/10/2018 | 16 |

| Satisfaction scores[2] | |
|---|---|
| Training content | 100% |
| Lecturer | 100% |

Selected suggestions for improvement and remarks:

- The course met the expectations of the attendees and has lots of relevant examples.
- Expert in the field, good exercises
- The pace of course was sometimes a bit fast to follow thoroughly.

### 4.1.6 Suggestions from participants for new training sessions

- Intel inspector and analyzer
- Code optimization
- Code performance profiling
- Fortran Co-arrays
- Advanced Linux scripting
- Python
- Commercial software like ASPEN+
- Exception handling in Fortran
- Object oriented programming in Fortran
- Dynamic Link Libraries
- Best practices to construct Fortran projects
- Parallelization (C, C++)
- High-performance programming (C, C++)
- Porting of Fortran to C

## 4.2 Lectures and community meetings

### 4.2.1 Presentations by Todd Gamblin & Georg Rath

Lecturers:
Todd Gamblin (Lawrence Livermore National Laboratory, UK)
Georg Rath (National Energy Research Scientific Computing Center, US)

Topics:

- The Spack Project: State of the community and roadmap
- Performance Analysis is Data Science
- Slurm in Action: Batch Processing for the 21st Century

| Date | #participants |
|---|---|
| 1/02/2018 | 10 |

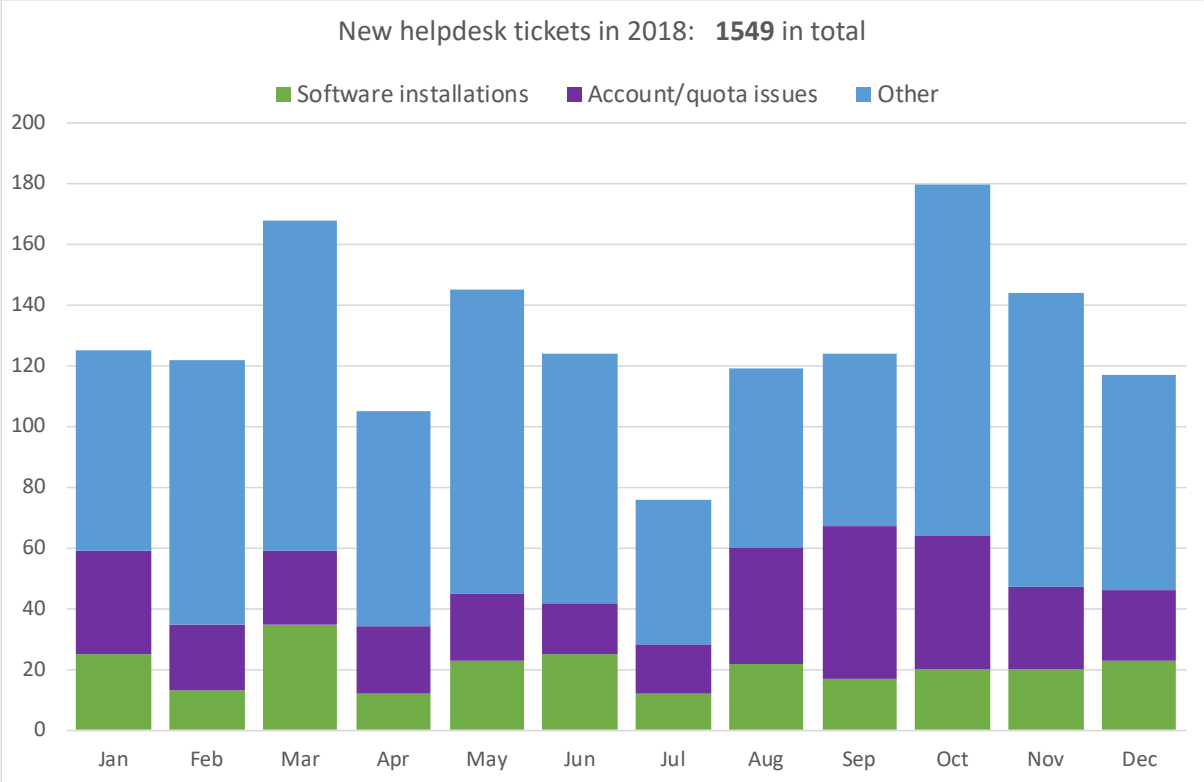
### 4.2.2 Tier1 information session

Learn more about the VSC Tier-1 infrastructure and how to write a good proposal.

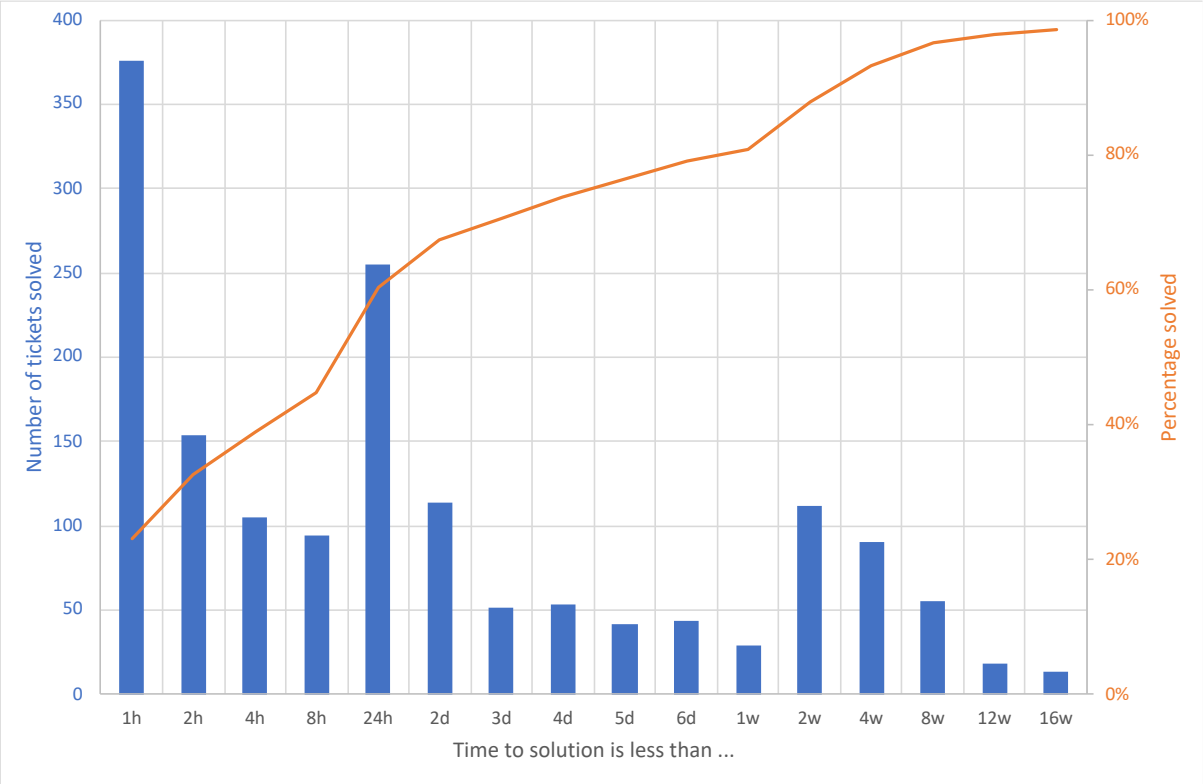
| Date | #participants |
|---|---|
| 9/01/2018 | 9 |

## 4.3 Helpdesk

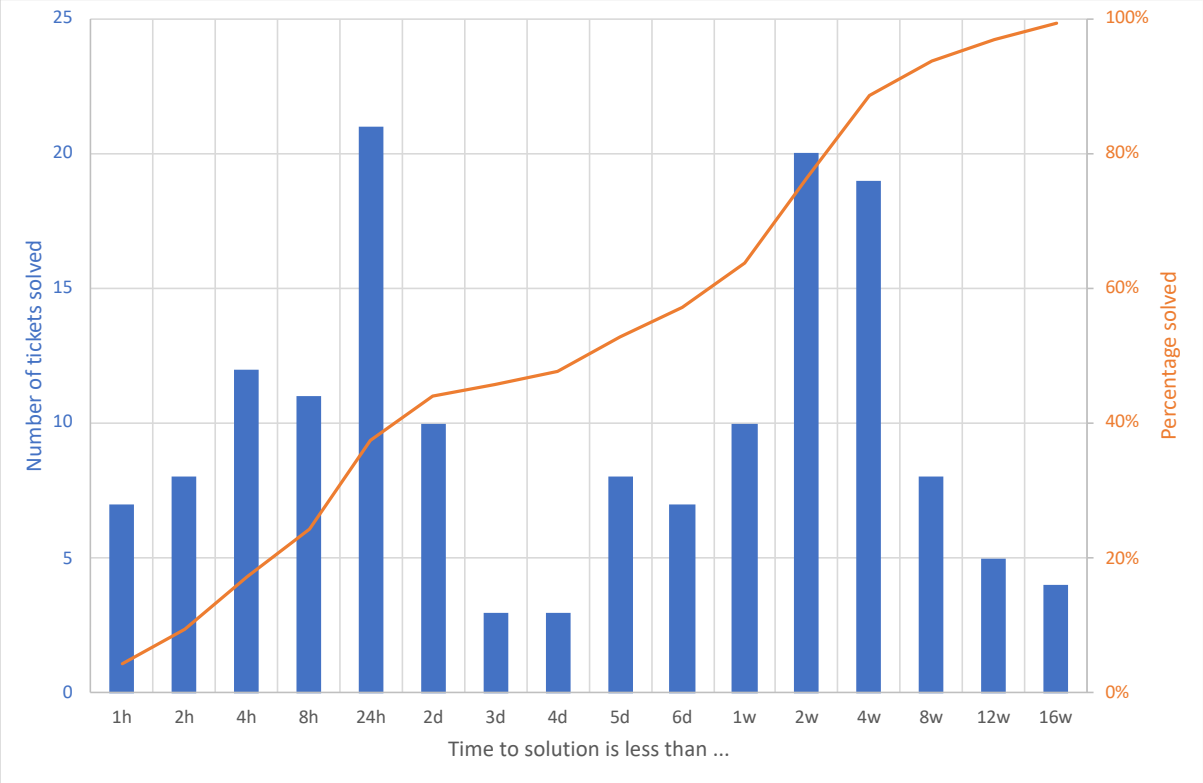
### 4.3.1 Number of new tickets per month



### 4.3.2 Average time to resolution – overall




### 4.3.3 Average time to resolution – software installation requests

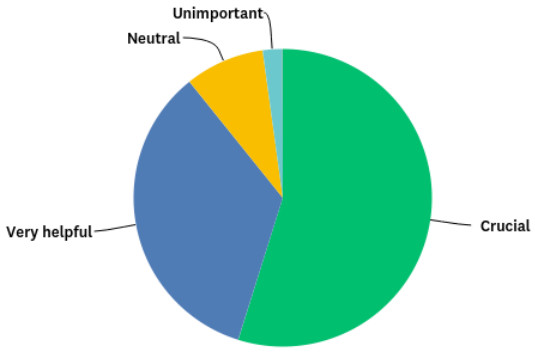


## 4.4 User evaluation

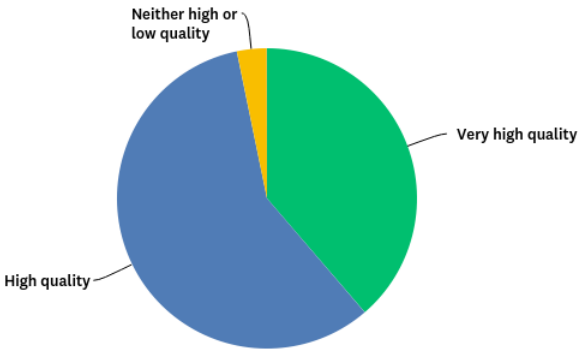
In order to improve HPC-UGent services, all current users were asked to complete a user survey. This survey was anonymous, short (average completion time 3 minutes) and in all 93 users responded. A selection of questions and responses is shown.

| How often do you use the HPC-UGent scientific computing infrastructure? | | |
|---|---|---|
| | *#responses* | *%* |
| On a daily basis | 30 | 32% |
| (More than) once per week | 28 | 30% |
| (More than) once per month | 20 | 22% |
| 1-2 times per year or less | 15 | 16% |

**How important is HPC-UGent for your research?**

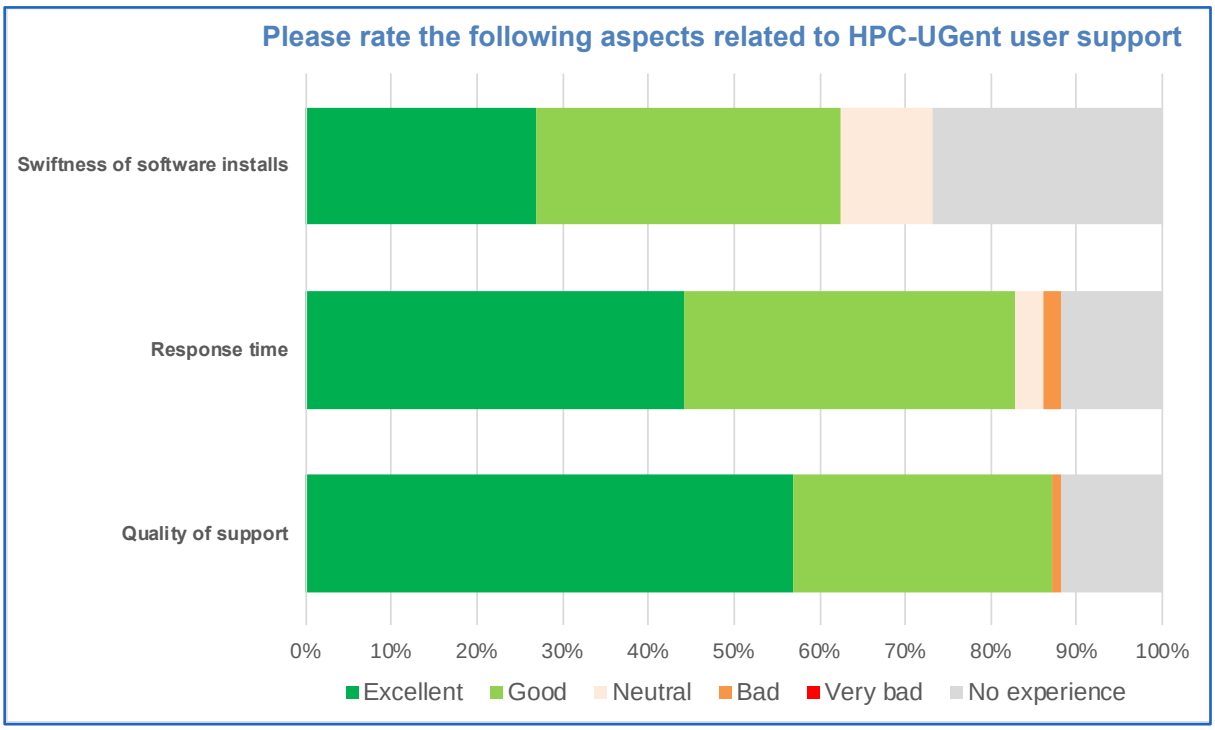


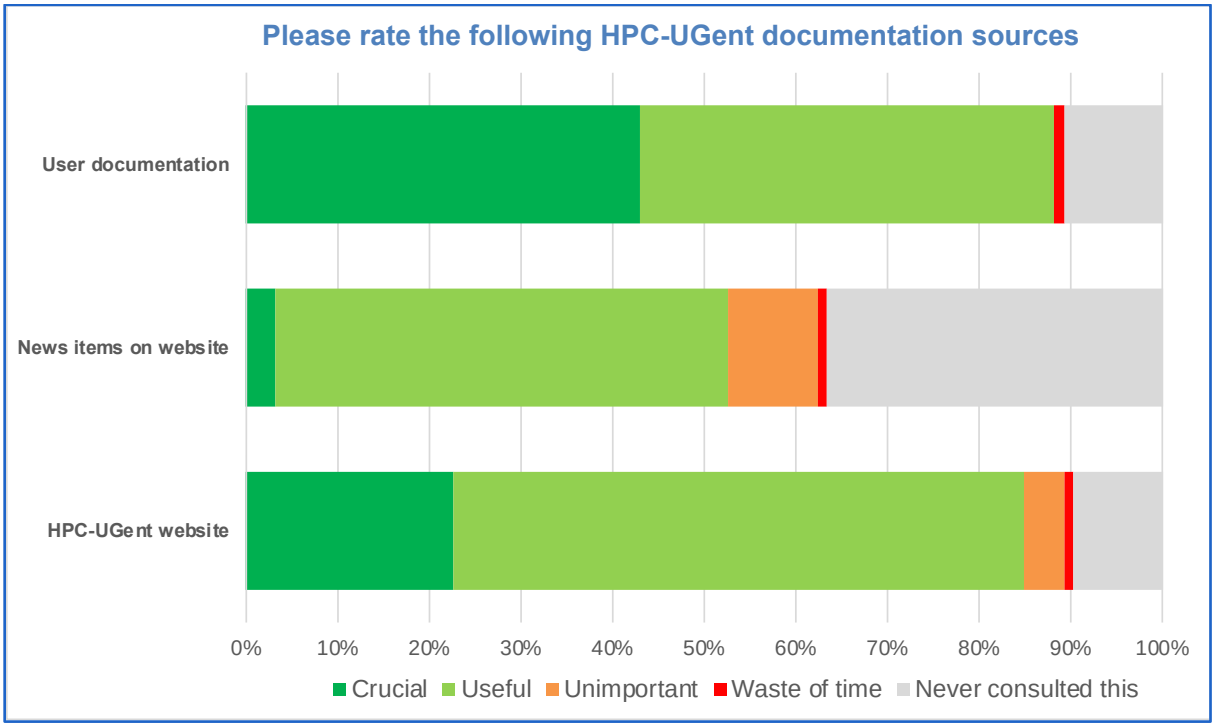

**How would you overall rate the services that HPC-UGent provides?**




| How important is HPC-UGent for your research? | | |
|---|---|---|
| | *#responses* | *%* |
| Crucial - I can't do my research without | 51 | 55% |
| Very helpful - It allows me to do my research at a faster pace and at a higher level | 32 | 34% |
| Neutral | 8 | 9% |
| Unimportant - I can just as well do my research in another way | 2 | 2% |
| Unnecessary - I don't need it at all to do my research | 0 | 0% |

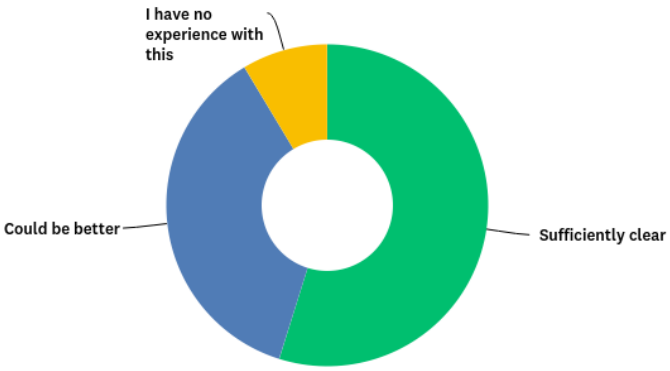
| How would you overall rate the services that HPC-UGent provides? | | |
|---|---|---|
| | *#responses* | *%* |
| Very high quality | 36 | 39% |
| High quality | 54 | 58% |
| Neither high or low quality | 3 | 3% |
| Low quality | 0 | 0% |
| Very low quality | 0 | 0% |


Please rate the following aspects related to HPC-UGent user support
Swiftness of software installs
Response time
Quality of support
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Excellent
Good
Neutral
Bad
Very bad
No experience


Please rate the following HPC-UGent documentation sources
User documentation
News items on website
HPC-UGent website
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Crucial
Useful
Unimportant
Waste of time
Never consulted this

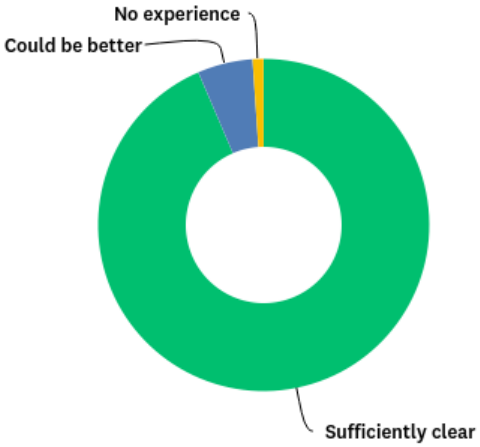
## Is the purpose of the diverse compute clusters sufficiently clear?

- multi-node jobs: skitty, swalot, golett, delcatty, phanpy
- single-node jobs: victini
- big memory jobs: phanpy

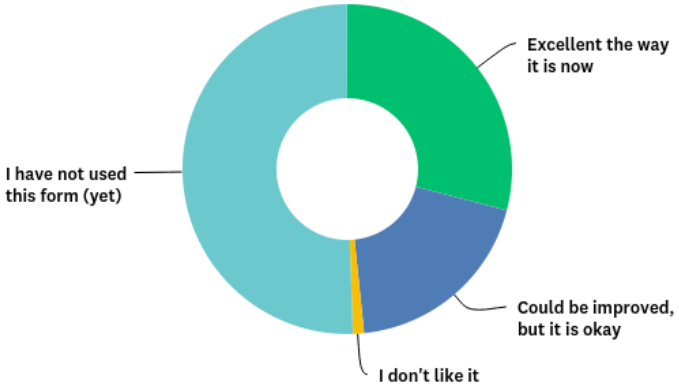



## Is our communication w.r.t. maintenance/downtime sufficiently clear?

- via VSC status page
- message-of-the-day login message on login nodes
- mail to hpc-announce




## How do you like the form for software installation requests?

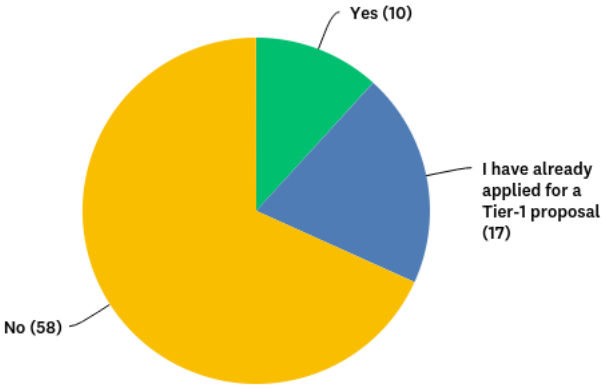


| Would your research benefit from specific IT hardware or services that HPC-UGent currently does not provide? | | |
|---|---|---|
| | *#responses* | *%* |
| No – The current compute platform suffices | 49 | 53% |
| I don't know | 32 | 34% |
| Yes – I need specific hardware/services | 12 | 13% |

- GPU
- Seamless integration with a big data repository
- More high-memory nodes
- Longer wall-clock time
- Dedicated servers for compiling and testing our code
- GUI
- A profiling service

| How could we further improve HPC-UGent services? |
|---|
| Documentation |
| • Expert items from the (defunct) userwiki, e.g. compile Java programs on login nodes<br>• Documentation better geared towards beginners<br>• Update and expand HPC manual<br>• More hands-on experience<br>• Monthly Q&A session<br>• Graphical scheme of clusters and storage organization |
| User experience |
| • Shorter queue times<br>• Way to estimate queue time<br>• Quota overview page of all clusters, including Tier-1 scratch quota<br>• Longer wall-clock time |
| Infrastructure |
| • More clusters<br>• GPU |
| Data |
| • Faster data transfer across campus<br>• Easier sharing of data between users collaborating on a project<br>• Lower latency on shared file systems<br>• VSC-wide shared storage capabilities, shared between institutes<br>• More storage volume per user |
| Training |
| • More programming courses |
| Policy |
| • Higher priority for multi-node jobs on MPI clusters |
| Software |
| • Possibility to perform MATLAB calculations on multiple nodes |
| User support |
| • Speed up software installation<br>• Debugging and profiling of codes as a service |

## Would you be interested in applying for a Tier-1 proposal?




## User encouragements

*"Keep up the good work and please continue as you have been doing the past years!"*

*"HPC-UGent services are awesome ☺!"*

*"Overall I am delighted by the service of the HPC team! Thanks for the support!"*

*"The user support via email is excellent!"*

*"Thanks for your good job in keeping the clusters up."*

# 5 OUTREACH

## 5.1 Within Ghent University

| Date | Event |
|---|---|
| 5/02/2018 | Information session FWO call 2018 for Research Grants, Research Projects and SBO |
| 29/03/2018 | HPC introduction and UGent datacenter tour for students in field of study of 'networks and IT' (Sint-Lievenscollege Business, Ghent) |
| 5/11/2018 | UGent datacenter tour for Zeus WPI, the student association for Computer Science at Ghent University. |

## 5.2 To policy makers, industry and general public

| Date | Event |
|---|---|
| 10-11/04/2018 | Participation in CESAER Task Force Research Infrastructures (TFRI) visit to Politecnico di Milano Milano, Italy http://www.cesaer.org/en/projects/task-force-research-infrastructures-tfri |
| 29-30/09/2018 | Participation in Open Days event at the Royal Meteorological Institute of Belgium (KMI) |
| 19/11/2018 | Innovation through supercomputing - Laboratory of Chemical Technology, Ghent University<br>Video-testimonial in collaboration with HPC-UGent<br>https://www.youtube.com/watch?v=hlH_s3cB6oQ |

Highlighted event:

**Open Days event at the Royal Meteorological Institute of Belgium (KMI)**
(29-30 September 2018)

Our cluster-on-wheels 'ditto' featured at the Open Days event at the KMI.

It attracted considerable attention as eye-catcher (and noise-maker) at the climate center exhibition.

In collaboration with the Atmospheric Physics research group of UGent, KMI frequently engages in computational research, both at HPC-UGent and at the Tier-1 level.

Links:

- KMI: http://www.meteo.be/
- Atmospheric Physics research group of UGent: https://www.ugent.be/we/physics-astronomy/en/research/atmophys

## 5.3 Within international HPC community

| Date | Event |
|---|---|
| 29-31/01/2018 | Workshop on Cloud Services for Synchronisation and Sharing<br>Krakow, Poland<br>http://cs3.cyfronet.pl |
| 30-31/01/2018 | 3rd EasyBuild User Meeting<br>Amsterdam, the Netherlands<br>https://github.com/easybuilders/easybuild/wiki/3rd-EasyBuild-User-Meeting |
| 3-4/02/2018 | FOSDEM'18<br>Co-organisation of HPC, Big Data and Data Science devroom<br>Brussels, Belgium<br>https://archive.fosdem.org/2018/schedule/track/hpc,_big_data,_and_data_science/ |
| 18-19/04/2018 | Spectrum Scale (GPFS) User Group 2018<br>London, UK<br>https://www.spectrumscaleug.org/spectrum-scale-uk-april-2018-report/ |
| 25-27/04/2018 | 25th Quattor workshop<br>Orsay-Ville, France<br>https://indico.cern.ch/event/718567/overview |
| 24-28/06/2018 | ISC High Performance 2018<br>Frankfurt, Germany<br>https://www.isc-hpc.com |
| 25-26/09/2018 | Slurm User Group meeting 2018<br>Madrid, Spain<br>https://slurm.schedmd.com/meetings.html |
| 22/10/2018 | EasyBuild HPC-SIG workshop<br>Birmingham, UK<br>https://www.eventbrite.com/e/easybuild-hpc-sig-workshop-tickets-51023835666 |
| 29-31/10/2018 | 26th Quattor Workshop<br>Ghent, Belgium<br>https://indico.cern.ch/event/757868/ |

# 6 BUDGET

| Budget line | UGent budget statement | Income |
|---|---|---|
| Central compute infrastructure | 1.200.000 | |
| Central compute infrastructure (wages) | 775.000 | |
| Central compute infrastructure training and events | 50.000 | |
| FWO subsidy for personnel (Tier1+2) | | 728.333 |
| FWO subsidy for investment and operations | | 1.198.150 |

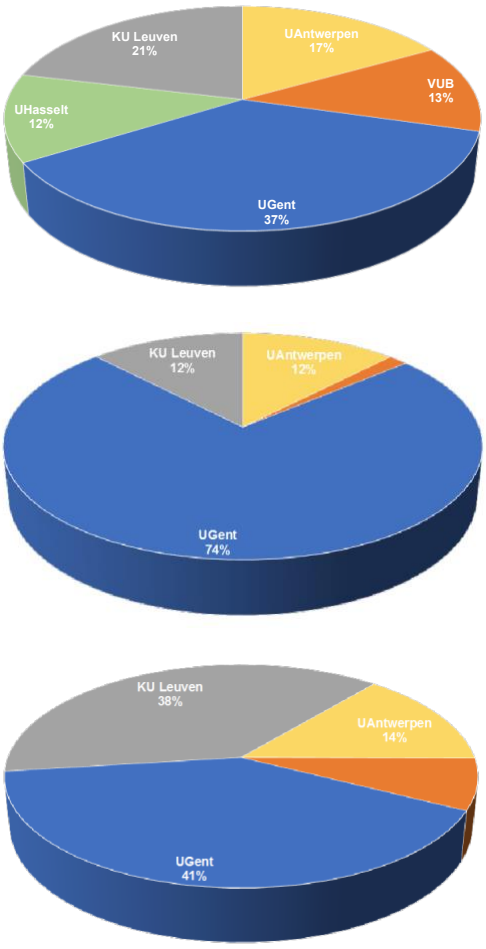
# 7 TIER-1 USAGE

Every year, three calls are open to apply for access to the Tier-1 system of the Flemish Supercomputer Center (VSC). HPC-UGent stimulates and assists researchers as much as possible to apply for access. The tables and graphs below give insight in the number of proposals (#proj) and the awarded compute time (#nd, expressed in Tier1 nodedays), listed per institute.

| Call 1 5/02/2018 | Requested | | Granted | |
|---|---|---|---|---|
| Institute | #proj | #nd | #proj | #nd |
| UAntwerpen | 4 | 19540 | 3 | 10950 |
| VUB | 2 | 8245 | 2 | 8245 |
| **UGent** | **9** | **28720** | **8** | **23856** |
| UHasselt | 2 | 8205 | 2 | 8205 |
| KU Leuven | 7 | 18286 | 5 | 13834 |

| Call 2 4/06/2018 | Requested | | Granted | |
|---|---|---|---|---|
| Institute | #proj | #nd | #proj | #nd |
| UAntwerpen | 2 | 8036 | 2 | 8036 |
| VUB | 2 | 6050 | 1 | 1000 |
| **UGent** | **18** | **51687** | **17** | **48115** |
| UHasselt | 0 | 0 | 0 | 0 |
| KU Leuven | 4 | 8002 | 4 | 8002 |

| Call 3 1/10/2018 | Requested | | Granted | |
|---|---|---|---|---|
| Institute | #proj | #nd | #proj | #nd |
| UAntwerpen | 3 | 14424 | 2 | 7862 |
| VUB | 3 | 9409 | 2 | 4180 |
| **UGent** | **7** | **29317** | **6** | **22768** |
| UHasselt | 0 | 0 | 0 | 0 |
| KU Leuven | 8 | 22735 | 7 | 21435 |




*Percentage of awarded compute time, listed per institute per call*

# 8 USER IN THE SPOTLIGHT

Dr Christophe Vandeviver (FWO, UGent-IRCP) uses supercomputing to study how offenders behave and better understand crime and offending. The HPC-UGent facilities proved crucial to examine how burglars in Flanders select a house to burglarize.

Christophe Vandeviver is a senior Postdoctoral Fellow Fundamental Research of the Research Foundation Flanders (FWO) at the Institute for International Research on Criminal Policy, a Ghent University based research group that conducts international research into criminal policy related issues. As an International Research Fellow, he is also affiliated with the Netherlands Institute for the Study of Crime and Law Enforcement, a world-leading Amsterdam-based criminology research institute that conducts fundamental interdisciplinary research into the interaction between crime and law enforcement.

“Understanding where burglars offend and how burglars decide on a suitable target for their burglary is a major concern to law enforcement and society. Burglaries do not only result in a material loss but also have a significant psychological impact on the victim. If we better understand what makes a house attractive for a burglar, we can improve crime prevention strategies and target those houses most at risk of burglary.”

“Previous research examined burglary target selection strategies exclusively at the neighborhood level and tried to find out why certain neighborhoods are more attractive for burglars by systematically comparing large samples of neighborhoods. But burglars ultimately select a house to burglarize. Therefore, I really wanted to systematically examine burglary target selection at the house level.”

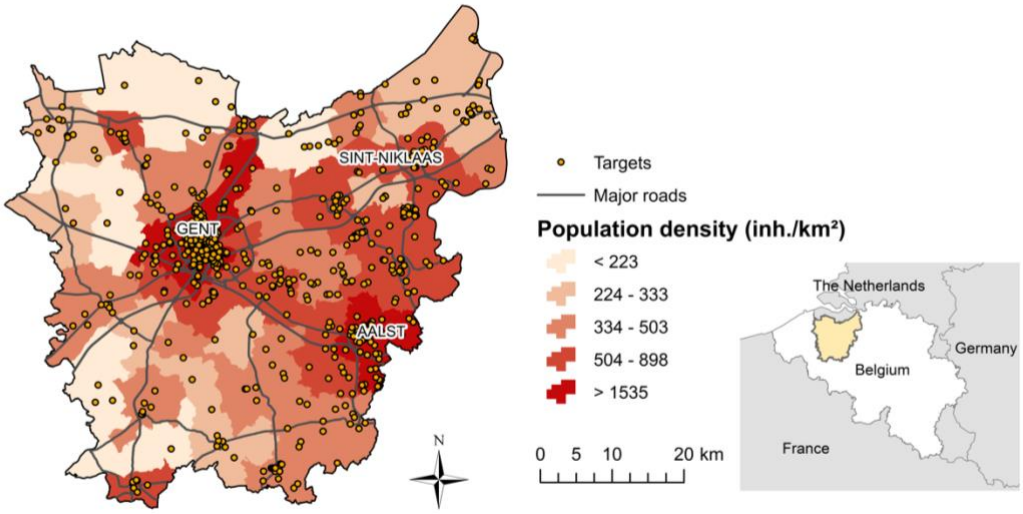
“It is not surprising that most previous studies focused on neighborhoods because the challenge with studying burglary target selection at the house-level is data. Not only is quality house-level data on burglary rare, but when you have data available it quickly becomes  too much to handle. The HPC-UGent resources proved crucial to help me handle the amount of data available and dramatically reduce my model computing times.”

“In my research, I have used police recorded crime data on a sample of 650 residential burglaries and Land Registrar data on more than 500.000 residences in East Flanders. For each of these burglaries, I have modeled which house characteristics of those 500.000 residences made them stand out for a burglar. While this might not seem much, this results in 325 million comparisons that must be simultaneously solved. Luckily, I managed to reduce this to approximately 41 million comparisons. But even after applying methods to reduce the number of

comparisons, the data still proved too large to be handled on my laptop. Moreover, it would simply take too much computing time."

"In the end, I established that terraced houses, houses without a garage, houses that have not been outfitted with a central heating and/or air-conditioning system and houses nearby burglars' residences are more significantly likely to be selected for burglary."

"As part of my senior FWO Postdoctoral Fellowship, I am currently extending my models to also include neighborhood characteristics. I am particularly eager to find out how the interaction of neighborhood and residence characteristics influence the decision of a burglar to burglarize a particular house. Again, the HPC-UGent resources will prove essential to estimate these models."




**Links**
IRCP (http://www.ircp.org)

**Publications**
Christophe performed his research as part of his PhD dissertation '*Understanding variation in distance to crime from within the rational choice perspective*', supervised by Prof. Tom Vander Beken and Dr. Stijn Van Daele.
(http://hdl.handle.net/1854/LU-5954294)

His research is published in Applied Geography:
Vandeviver, C., Neutens, T., Van Daele, S., Geurts, D., & Vander Beken, T. (2015). A Discrete Spatial Choice Model of Burglary Target Selection at the House-Level. Applied Geography, 64, 24-34. doi:http://dx.doi.org/10.1016/j.apgeog.2015.08.004
(http://hdl.handle.net/1854/LU-6914894)

Christophe also features in an engaging video testimonial for the Flemish Supercomputer Center (VSC):
https://www.linkedin.com/feed/update/urn:li:activity:6467708105542107136