
MONT-MÉGANTIC INTERNATIONAL DARK SKY RESERVE

2020 ANNUAL REPORT



General Information

For everyone around the world, 2020 will be remembered as anything but a normal year. The ongoing pandemic forced us to change our habits, renew our way of working and forced us to modify our plans. But while travelling was more difficult and public health measures limited the ways we could welcome visitors, we did our best to bring the dark sky of Mont-Mégantic to the public through live streaming... and it was an incredible success!

On an administrative point of view, the MMIDSR is now better financed thanks to our partners, namely the Haut-Saint-François Regional Municipality Council, the Granit Regional Municipality Council, the City of Sherbrooke, the SÉPAQ and the Mont-Mégantic Observatory. The MMIDSR now receives 300 000\$ for a period of 3 years to put forward actions for better enforcing of the dark sky regulations on the territory, continuing to share our expertise and help our partners inside the Reserve, building new outreach tools and monitoring light pollution. The action plan is discussed and agreed on by a committee that unites the MMIDSR team, the two RCMs and the City of Sherbrooke.

Conversions and installations of dark sky outdoor lighting are numerous throughout the Reserve, thanks to both the regulations and the new initiatives from the MMIDSR team and municipalities.

We are also continuing our partnerships outside the boundary of the Reserve to raise awareness about light pollution and the protection of the night, especially within Québec's national parks network.

Contacts

The Mont-Mégantic IDRS team and activities are tightly woven between the Mont-Mégantic National Park (SÉPAQ) and the ASTROLab corporation. Last year, Mélina Dubois-Verret was officially added to the team and the multiple partnerships with the municipalities and Regional Municipalities Councils (RCM) she worked on have produced very positive results that can be seen in this report.

2020 also brought us a new administrative director. Nathaël Bergeron left the Mont-Mégantic national park and the Mont-Mégantic IDSR to pursue her work in marine conservation at the Saguenay–St. Lawrence Marine Park (Canada Parks). While it's always sad to see people go, we are pleased to welcome Dany Gareau on our team. Coming to join our ranks after leading the recently opened Opémican national park, Dany will bring new ideas to the table and keep on building on the strong relationships that the ASTROLab, the Mont-Mégantic national park and the International Dark Sky Reserve have forged within our community.

The Mont-Mégantic International Dark Sky Reserve Team :

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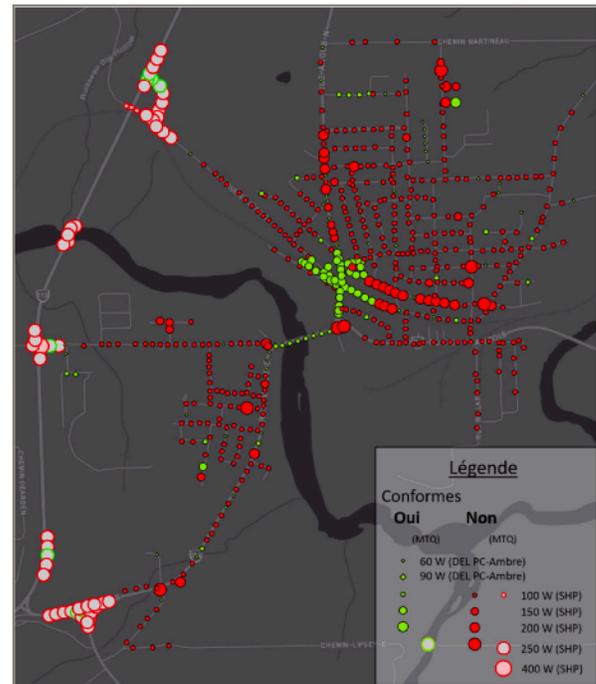
Lighting

What started last year as a student project about the cost and economy of PC-amber LED conversion for municipalities of the IDSR morphed into real actions this year. In 2019, Aude Kalcina did the pilot project for East Angus, where approximately 450 old HPS cobra head luminaires are still present. The municipal officials responded very positively to the analysis and this year they went ahead with a tendering to change all of East Angus non compliant luminaires. If all goes according to plan, these old drop lens fixtures should be changed to full cutoff PC-Amber LED in October 2020. These luminaires account for approximately a quarter of the remaining non-complaint fixtures scattered across the IDSR territory, excluding the city of Sherbrooke.

East Angus is part of the "zone 2" (the buffer zone) of the Mont-Mégantic IDSR, and there were no conversion project in this area when the Reserve was created in 2007. The idea was that these municipalities would gradually change their luminaires with the dark sky regulations in place. More than a decade later, the conversion ratio was very different between the municipalities inside the zone 2. Some had already converted to full cutoff HPS years earlier, some had a few PC-Amber LED and flat lens HPS, and others were still running with their old drop lens HPS fixtures.

In a desire to initiate a move in reducing the number of non-compliant luminaires and using the best technology to reduce light pollution, we selected some of those municipalities and proposed them a similar study as the one we did for East Angus. The analyses of electricity and maintenance savings were made by Maude Larivière, a student part of our team for the summer, and supported by Mélina Dubois-Verret and Rémi Boucher. As of September 2020, here are the results so far:

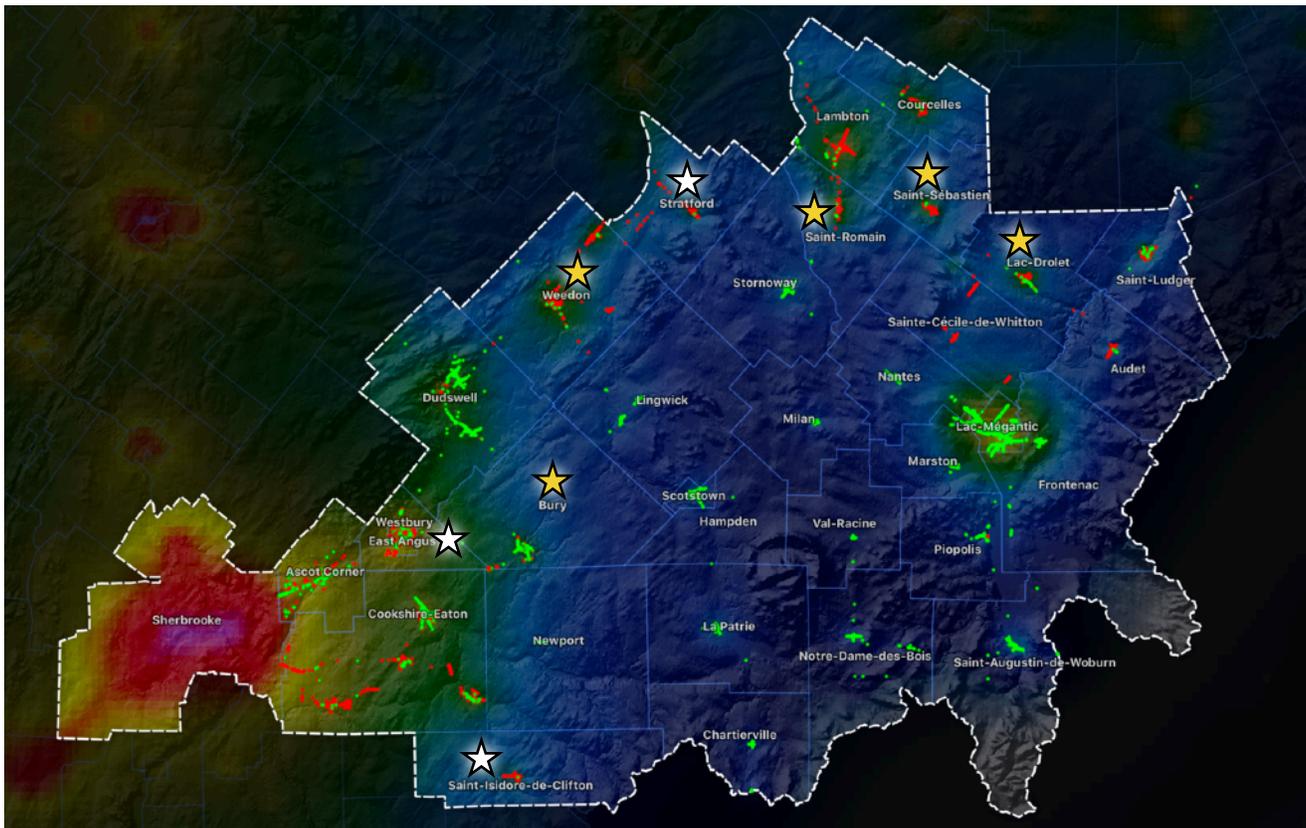
- St-Romain, a town of ~700 inhabitants, is currently using a total of 48 HPS luminaires, with more than half being 250W. The municipality should go ahead with the conversion of all their



East Angus luminaires during the 2019 study. Green dots are dark sky compliant fixtures already in place and red ones are old HPS that will be changed.

luminaires to PC-Amber LED. While the study did show options to spread the conversion on different number of years, the city council is leaning toward a fast transition to benefit from better energy savings and a better light uniformity.

- Bury was a bit of an exception for the Reserve's core zone. While it is technically in zone 1, it wasn't completely converted in 2006-2008, during the initial conversion project. Today, there is still a mix of flat and drop lens HPS. Following the presentation of our analysis, they showed interest in changing their 92 luminaires to PC-Amber LED.
- St-Sébastien has shown interest following the presentation of the analysis, but they have not yet confirmed if they will go ahead with a conversion in the near future. At least, they now have all the information to help them in converting their 74 street lights.
- The results were presented to Weedon and Lac-Drolet just before submitting this report. Lac-Drolet already made good progress of conversion in the last years and had approximately 1/3 of their street lights in PC-Amber LED.



Municipalities part of this year study are marked with a yellow star. White stars are showing municipalities that should complete their conversion to PC-Amber LED by 2020 or 2021 at the latest.

Two municipalities were not chosen for the study because they were already well advanced in the conversion of their public lighting but their efforts deserve to be mentioned. Stratford started the move to PC-Amber and 2000K LED in 2017 and, at the time of writing, have converted 65 of the 90 luminaires in total. The remaining 25 will be changed before the end of this year. The small town of St-Isidore-de-Clifton will also be completely converted by next year at the latest. Currently, 27 of the 37 fixtures are PC-Amber LED. Lastly, Lambton also reached to us because they are planning to convert their ~150 HPS fixtures. We wish to do a complete inventory of public luminaires in zone 1 and zone 2 luminaires in 2021, after the different conversion projects will be completed.

This project shows that municipal officials really appreciated and benefit from the technical expertise and advices that the Mont-Mégantic IDSR team can provide them.

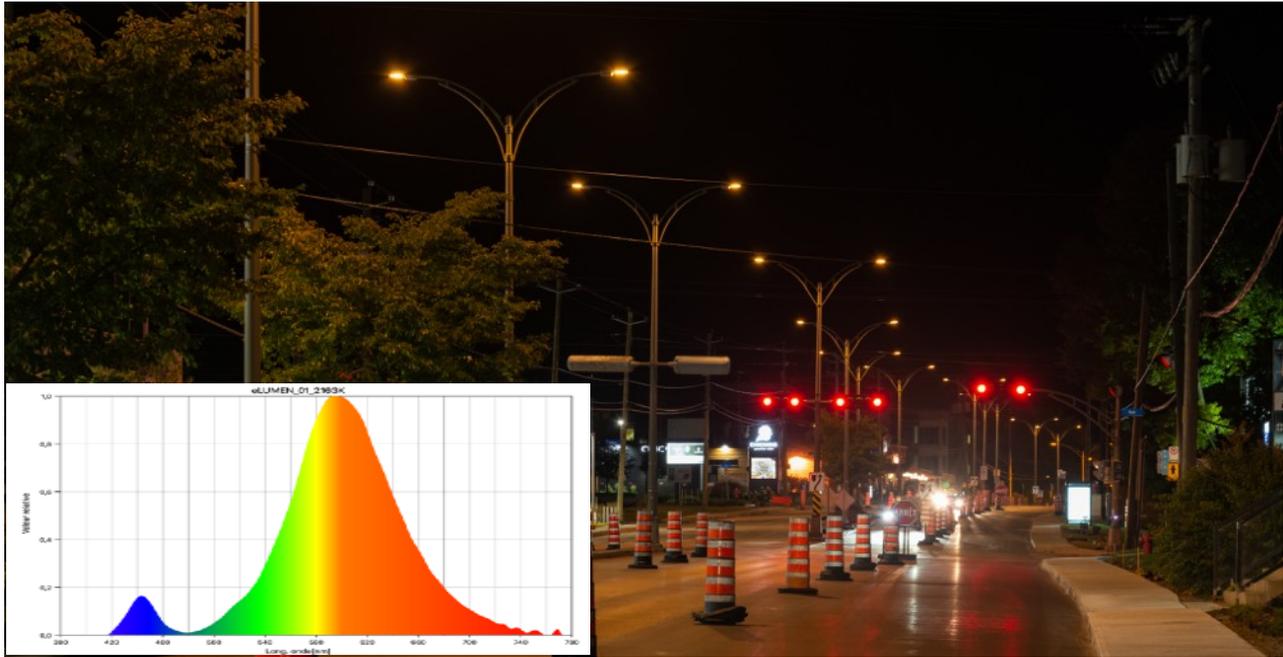
Inside the city of Sherbrooke, it is now becoming more and more difficult to follow new installations and conversions because of its size and the large number of places where dark sky compliant lights are installed. Beside Sherbrooke's street lights, one of the largest installations of PC-Amber LED this year was made at the new Costco building at the Plateau St-Joseph area, a commercial area of the city that has been steadily growing in the last decade. The building and the parking lot are completely lit by PC-Amber LED, except for the gas pump canopy and the signs, which are both using warm-white LED.



The newly constructed Costco building and parking lot using PC-Amber LED luminaires.

Hydro-Sherbrooke is still installing and replacing fixtures in the city streets when old lights need repair, when a new road is constructed or when other work in the area gives an opportunity to do the installation. Nearly 900 luminaires were installed since last year's report. The last tendering for Sherbrooke's street lights was won by a company ([eLumen](#)) with 2200K LED luminaires. The regulations in the Mont-Mégantic IDSR allow a colour temperature of up to 2200K or less than 10% of blue light ("blue" meaning between 405 and 530nm). While PC-Amber LED of 1800K were the first kind of compliant products offered by manufacturers beside HPS, we now see more and more

diversity of options in the 1800K to 2200K range. PC-Amber LED are still preferred for their very low impact on light pollution and very low blue content (<2%), but these new 2200K models still offer low glare and emit less than half the blue light emitted by 3000K LED.



A 2.3 km portion of King Street, Sherbrooke's main arterial road, where 2200K LED luminaires are being installed while pavement work is being done. Insert is showing the spectrum of the new luminaires.



2200K LED streetlights installed on a new road for an expanding industrial area in Sherbrooke.

Here are a few photographic examples of new commercial, institutional and residential buildings using 1800K-2200K LED in Sherbrooke :



A new gas station and convenience store using 2200K LED luminaires from Lumenpulse. In Sherbrooke, commercial installations are required to use outdoor lights with a maximum of 10% of blue light (405-530nm) for parking and perimeter. The gas pump canopy can use lights emitting a maximum of 30% of blue light (equivalent to 4000K LED) for colour rendering.



École du Boisé-Fabi. This school, which holds both elementary and high school classes, was inaugurated in 2015 but we only saw it this year while visiting a residential area of Sherbrooke that grew substantially in the last years. The new streets in this neighbourhood are also lit with PC-Amber LED.



A recently completed condominium complex using outdoor PC-Amber LED. Now it's only up to a few residents to learn about the adverse effects of using blue light in the evening ;)

Another installation in the Dark Sky Reserve that is worth mentioning is Ascot Corner's new fire station and municipal garage. PC-Amber LED are used for the parking and building perimeters, and warm-white LED and used for the fire station entrance. The newly built road that is adjacent to the fire station is also using PC-Amber streetlights.



OUTSIDE THE DARK SKY RESERVE : LOW-BLUE LIGHT LED FOR EVERYBODY

And last but not least, a very big step forward in reducing light pollution not only inside the Mont-Mégantic IDSR but elsewhere in the Province of Québec, is currently underway. In the last years, the Fédération Québécoise des Municipalités (FQM), which represent more than a thousand municipalities in Québec, partnered with Energere, an energy services company, to offer preferential terms to municipalities for turnkey project of street lighting modernization. Energere was first offering 4000K LED, but then gradually started to offer 3000K options after the city of Montréal and Québec both decided to go ahead with this warmer colour temperature. Sadly, this still was not low enough for municipalities of the MMIDSR and other regions that wanted to take substantial actions in reducing light pollution. We are pleased to report that, following our recommendations and with our collaboration, a new tendering from the FQM will provide the option of low blue light LED luminaires that should not exceed 2200K of colour temperature. This is a major move that will enable many municipalities across the Province of Québec to take part in the dark sky protection and offer superior quality lighting to their citizens.

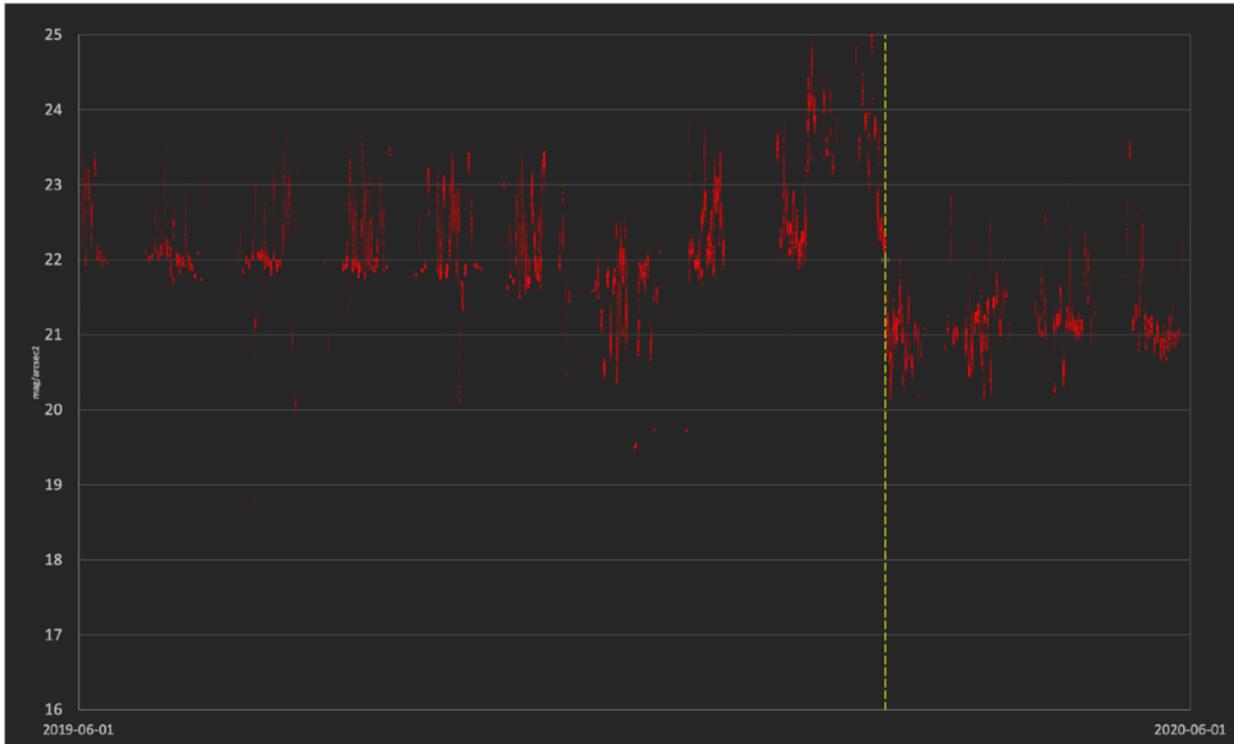
Sky Quality

ZENITHAL SKY BRIGHTNESS

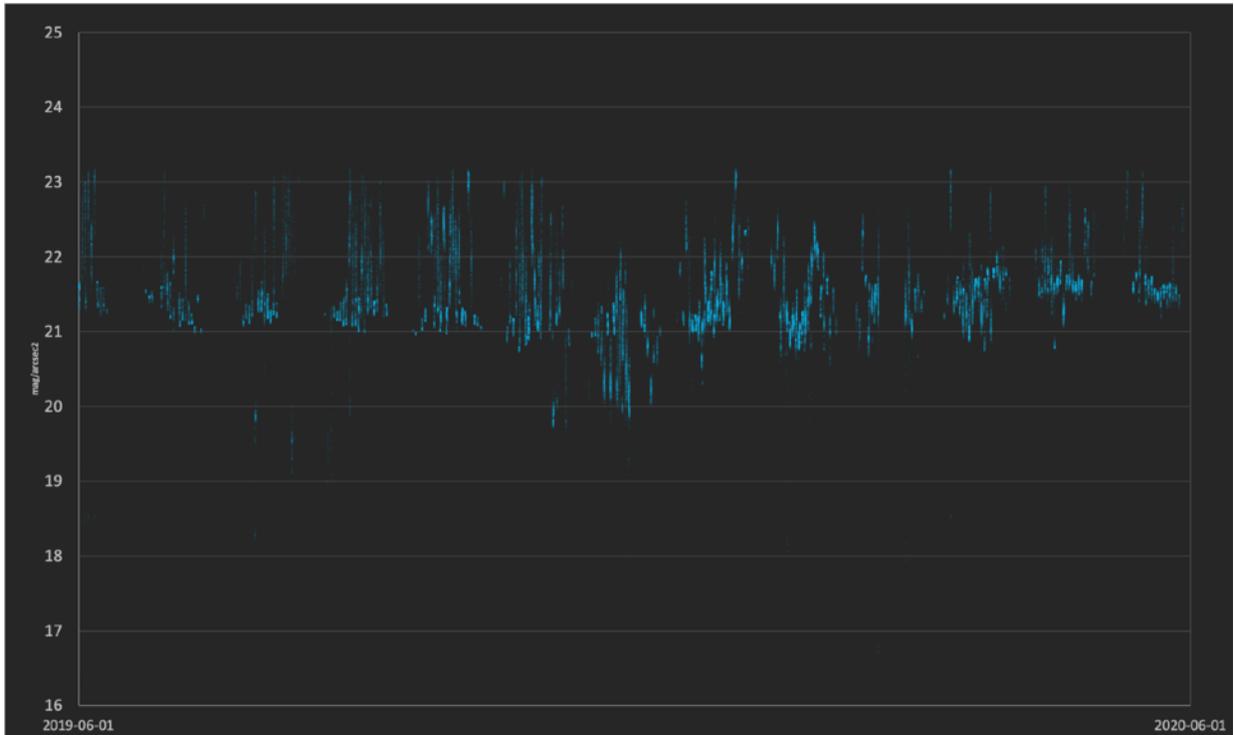
We discussed in previous annual reports our methods of monitoring the night sky brightness from Mont Mégantic — essentially involving SQM and TESS-W photometers — and how natural light sources are affecting the measurements. We are normally reporting the most frequent values measured during the astronomical night, when the Moon is more than 5° below the horizon, and when the SQM is pointing toward a galactic latitude of at least 45° . Unfortunately, we won't be able to do the same this year and compare it with previous years due to an anomaly with the SQM.

By reviewing the data, it can be seen that something went wrong in February 2020 and that the SQM started to give brighter than normal readings. This was not obvious at first because the SQM readings are varying a lot in the winter months, with frequent snow covering the enclosure, and the brighter readings started after removing a thick layer of ice on the SQM. After a few months, and without the snow and ice effect, it is now clear that the SQM is reporting values at least a magnitude brighter, without any changes to nearby lights. By investigating deeper inside the SQM, we found that the IR filter was knocked off the lens assembly during the February maintenance, thus explaining the brighter readings. The SQM is currently being sent to the manufacturer (unihedron.ca) for repair and re-calibration. Even if the spectrum with and without the IR filter is different, we hope to be able to salvage some of the data by taking into account the difference in sensitivity made by the filter.

Fortunately, we do have a TESS-W photometer installed just beside the SQM since January 2019. The measurements of the TESS are not directly comparable to the SQM because the two photometers each have their own light response spectrum, with the spectrum of the TESS being more wide and flat. Still, we will be able to use the TESS to follow the zenithal sky brightness over the years, just like we started to do with the SQM since 2016. Not only will this give us a backup to the SQM, but the open access to the data and the autonomous operation of the TESS makes it an ideal choice to extend the network of night sky brightness monitoring in the Mont-Mégantic IDSR and elsewhere in the Province of Quebec. When comparing the TESS and the SQM data, it is obvious when the SQM started to act weirdly. While the readings in mag/arcsec^2 were usually slightly brighter than the SQM, they were darker after the February ice removal (see vertical yellow line in the SQM graph). The TESS also has the advantage of having IR and temperature sensors to approximate the cloudiness, allowing us to analyse data from clear nights only. By using the same technique we used with the SQM, we can add the Sun and Moon altitudes and the galactic latitude to each measurement.



SQM readings in $\text{mag}_{\text{SQM}}/\text{arcsec}^2$ between June 2019 and May 2020, during the astronomical night and when the Moon was $>5^\circ$ below the horizon. The yellow vertical line represent the date when the IR filter was accidentally knocked off during an ice removal maintenance.



TESS-W readings in $\text{mag}_{\text{TESS}}/\text{arcsec}^2$ during the same period and with the same Sun and Moon parameters. The behaviour of the zenithal sky brightness is representative of what we saw in the previous years, with darker measurements in the months were the Milky Way is away from the zenith (February to June).

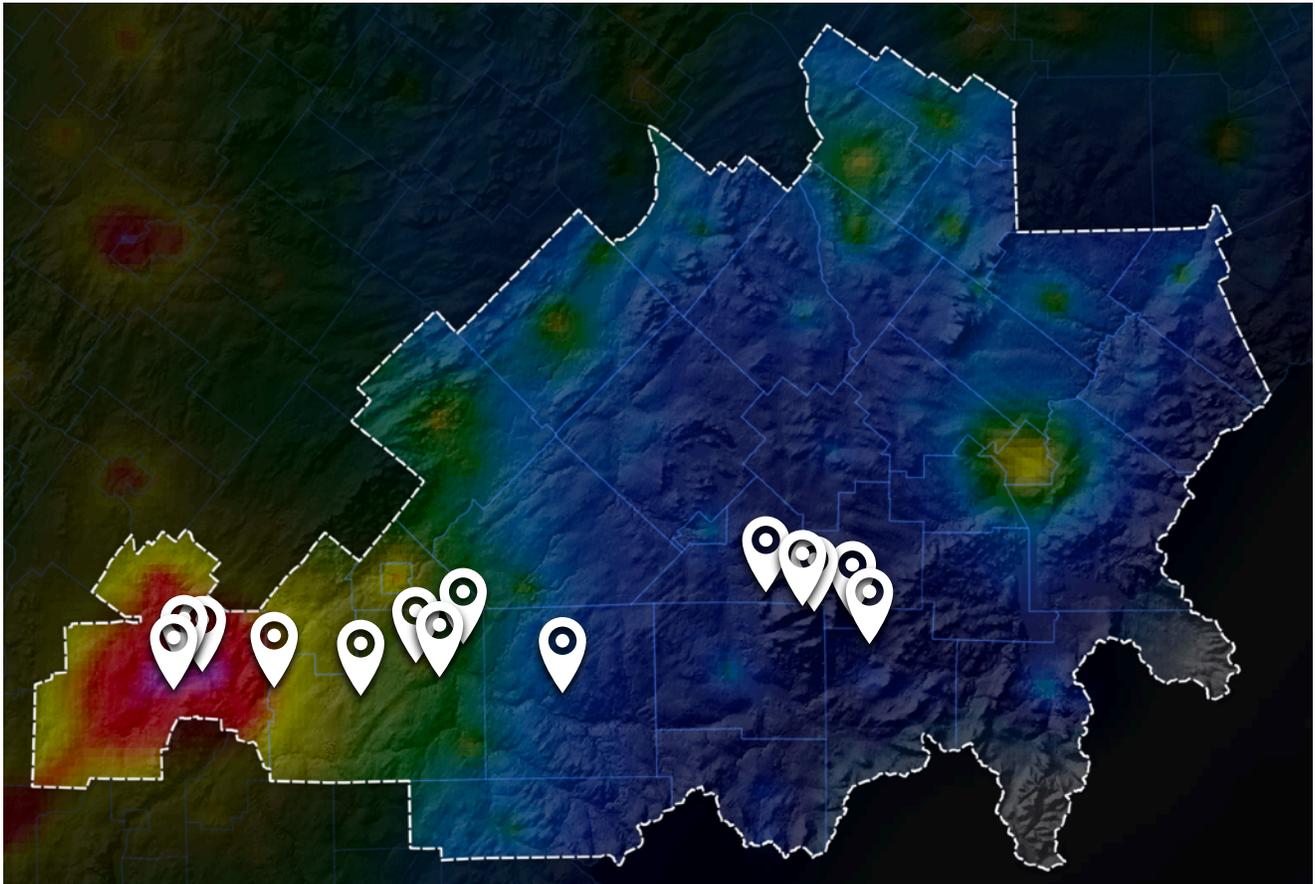
Most frequent SQM readings (mag_{SQM}/arcsec²)		
	Sun below -18° Moon below -5°	Sun below -18° Moon below -5° Galactic latitude >45°
June 2016 to May 2017	21,60	22,00
June 2017 to May 2018	21,70	22,10
June 2018 to May 2019	22,05 <i>*(missing July and August)</i>	22,20
June 2019 to May 2020	21,95* <i>*(including ~ 4 months with defective SQM)</i>	21,15* <i>*(most readings taken with defective SQM)</i>
Most frequent TESS readings (mag_{TESS}/arcsec²)		
June 2019 to May 2020	21,25	21,70

ALL-SKY BRIGHTNESS

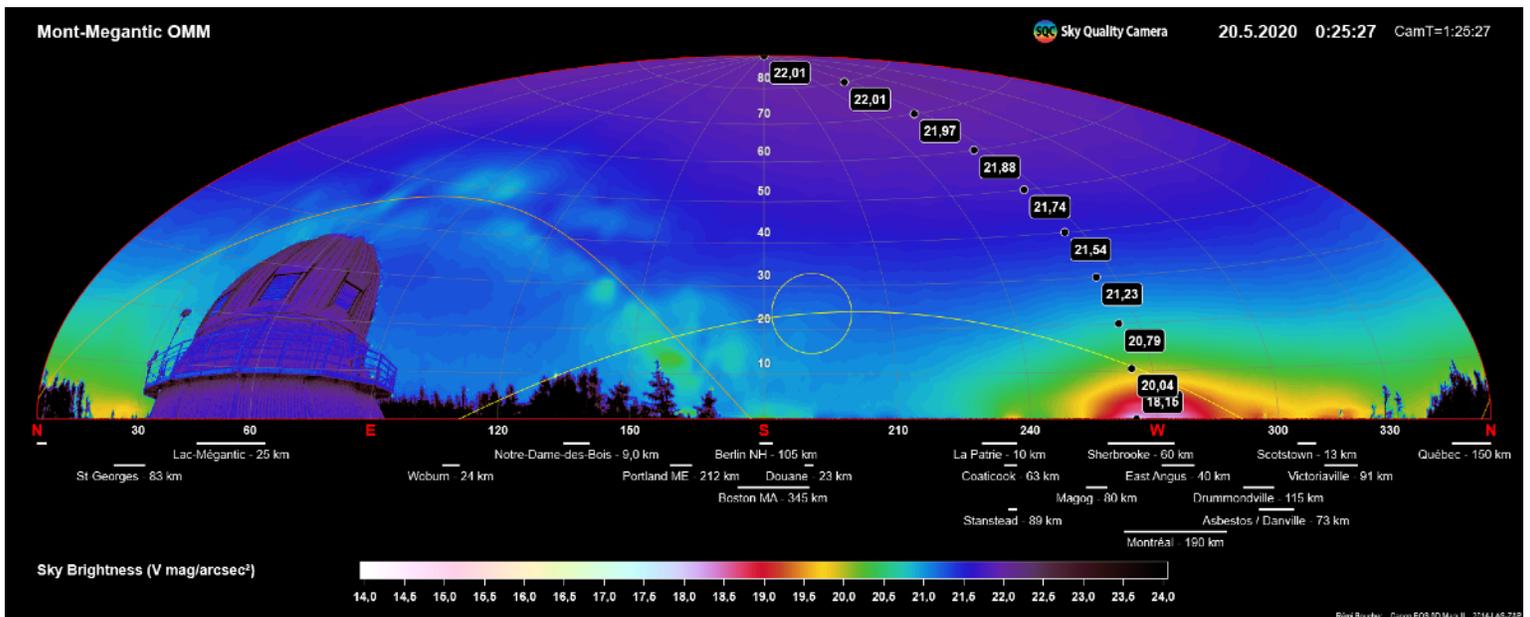
We are continuing to use the SQC to acquire all-sky data inside the Mont-Mégantic IDSR. Locations vary from the very dark area near the mountain, to the much brighter streets in Sherbrooke's downtown.

Even if we mostly use the SQC when the sky is clear and after astronomical twilight, we are also diversifying the conditions under which the measurements are done to better characterize and show the effect of the clouds, the snow or the Moon. We also started to look at the time-dependent changes in all-sky brightness, but need to do more data acquisition. We wish to show more of our data and findings in future conferences or publications.

Meanwhile, we are collaborating with researchers and are sharing some of the measurements for pending publications.



SQC measurements inside the Mont-Mégantic IDSR during the last year.



Hammer-Aitoff projection of the night sky brightness at the Mont-Mégantic Observatory. The skyglow from Sherbrooke and the cities beyond (including Montréal at ~190 km) represent the brightest part of the night sky. Values closer to the zenith reach the natural sky brightness of 22 mag_v/arcsec². Skyglow coming from as far as Boston (345km) can be seen.

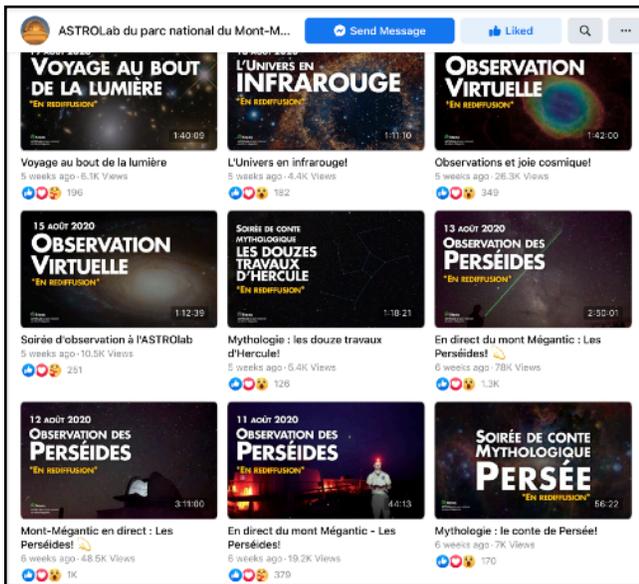
Outreach

Adapting our activities to the social distancing measures in place meant that we could not give our normal astronomy evenings with telescopes at the ASTROLab and the Popular Observatory. Instead, people were invited to visit the exhibition room of the ASTROLab and watch the 4K movie "Emergence" that was inaugurated last year. Between the reopening in July to mid-September, almost 8000 people came to ASTROLab during the day and 3000 during the evening. Less representations were available in the evening, but those that came during these hours could stay around the ASTROLab and benefit of the nice view of the stars. Even if those numbers are less than what we can normally welcome to the ASTROLab during the warm season, especially during the Perseids meteor shower and the Astronomy Festival, they are way above what we expected at the beginning of the summer.

Our real success was online, with our live presentations. Very early when the confinement started in march, we started to give freely available online astronomy presentations and Q&A sessions on our Facebook page. The themes of the presentations ranged from the bodies of the Solar system to how to measure light pollution at home, with the mandatory ones about black holes, astronauts in space and the northern lights. Also, April is normally a slow month at Mont-Mégantic and there are no activities at the ASTROLab at that time of the year. For the first time, we could really put the Dark Sky Week forward with themed presentations and live observations.

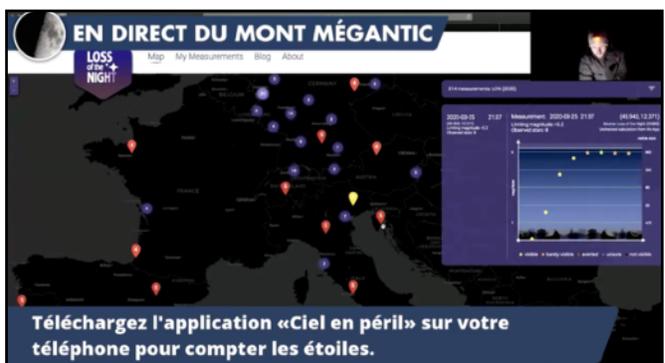
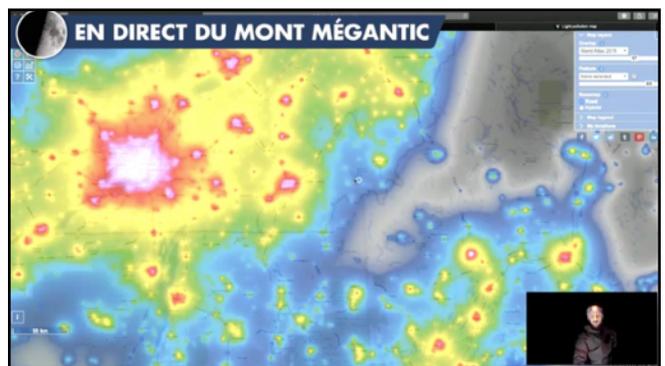
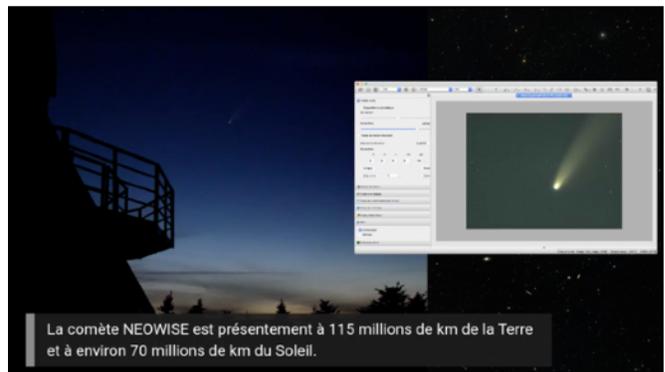
A lot of kids were watching our presentations since they were not at school at that time, and many of them were present every day to follow us. We received many touching testimonials from grateful parents doing school at home and others who needed to leave their kids home while they were working on the front line in the health system. We also did live observation with one of our telescopes equipped with a very sensitive camera. Galaxies could appear on the screen in only 5 seconds and people were amazed to see the rings of Saturn.

The reactions from the people watching were numerous and incredible! With a total of 95 live streaming sessions on Facebook, we got a "reach" of more than 2 million people, and more than 70 000 interactions. Our Facebook page's followers exploded and went from a just under 20 000 to more than 33 700 people in 6 months, an increase of 68%! These presentations are all available in the videos section of our [Facebook page](#) and we are already engaged with hundreds of school classes for private session this autumn.



Before the pandemic, we also gave a few conferences about light pollution and the International dark Sky Reserve :

- A webinar for park directors and conservation managers of the SÉPAQ network, the government entity responsible of the national parks of Québec. The presentation showed the impacts of light pollution, the need to address this problem and possibility for new Dark Sky Parks in the province of Québec.
- A public presentation at St-Isidore-de-Clifton, a small town part of the Mont-Mégantic IDSR.
- A presentation to the city council of Sherbrooke, to show what was already done and what could be done in the future about light pollution in the largest city of the Dark Sky Reserve.



A few samples of our live presentations.

Conservation and Research

We are still continuing our support with Mont Tremblant national park bid to become an International Dark Sky Park. The park started the conversion of its outdoor lights to dark sky compliant fixtures in line with the recommendation of the MM IDSR that exceeds the IDA's guidelines. The use of amber and red light will be emphasized everywhere in the park and this transformation is being deeply integrated inside the methods of the infrastructure and maintenance team.

We are also bringing new centralized tools and training for the other national parks in the SÉPAQ network to adopt good lighting practices. Parks interested will be able to do a complete characterization of their outdoor luminaires and be better equipped should they decide to go ahead with dark sky certification or simply to adopt good lighting practices.

TESS-W photometers will be installed in Mont Tremblant (2), Hautes-Gorges-de-la-Rivière-Malbaie (1) and Grands-Jardins (1) national parks in the coming weeks. Following this pilot project, we hope to extend the light pollution monitoring network of TESS in Québec's national park. We will also add new TESS photometers inside the Mont-Mégantic IDSR by installing one in the Frontenac national park, which sits on the border of the Dark Sky Reserve, and one at Mont Bellevue in Sherbrooke to report data from a much brighter part off the Reserve. These additions will greatly improve the coverage of night sky brightness monitoring in this part of the world. Currently, only two TESS photometers (including ours) are installed in Canada and only five in the United-States.

Community and Media Relations

The creation of two giant sculptures was commissioned to the local artist Matthieu Binette to emphasize the presence of the Mont-Mégantic International Dark Sky on the roads leading to the core of the IDSR.

Installed at the center of two busy roundabouts, one in Sherbrooke and one in Lac-Mégantic, the bronze, granite and aluminum sculptures illustrate our relationship to the celestial vault and symbolize what we transmit to future generations. Binette is known for its meticulous use of small metal sticks and drop-by-drop welding techniques to create these magnificent art pieces.

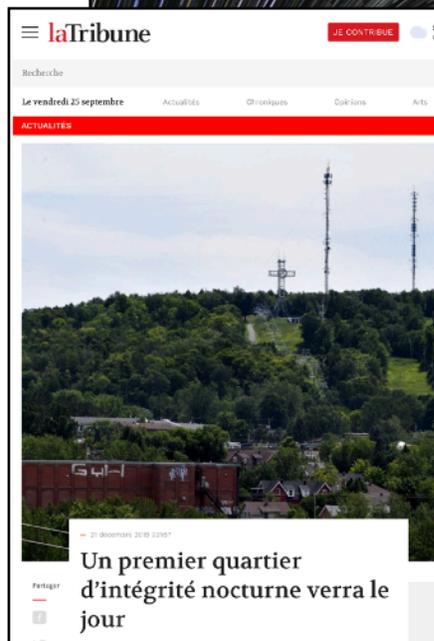
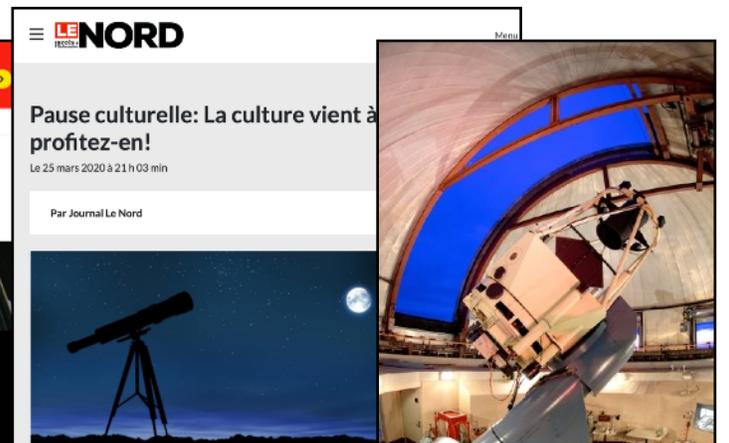
We are truly honoured that the work and accomplishments of the Mont-Mégantic International Dark Sky Reserve be represented by these great artworks. May the "Porte des étoiles" stay open forever.



The two giants bronze sculptures, called "La Porte des étoiles" (or "stargate" in english) representing the Mont-Mégantic International Dark Sky Reserve with artist Matthieu Binette and Marie-Georges Bélanger from the IDSR.

Some media appearances that we are aware of since the last annual report :

- LaTribune newspaper, about the creation of a "dark sky neighborhood" next to the Mont Bellevue in Sherbrooke, December 2019.
- Newsweek Magazine, listed in a top 10 "Best Stargazing Spots Around the Globe", March 2020.
- Journal LeNord, a mention about our live streaming events during the confinement, March 2020.
- South China Morning Post, in an article called "Coronavirus silver lining: less pollution means more night sky – view it from home while you plan trips to world's best dark-sky destinations", April 2020.
- Multiple mentions of the installation of the giant sculptures "La Porte des étoiles" by artist Matthieu Binette, in national and local media, September 2020.



Lastly, due to COVID-19, we could not hold our large annual meeting with our regional partners. We are currently reporting it to next year and will adapt to the situation at that time. We do continue with virtual meetings of the regional committee that includes elected officials and administrative staff members from the Municipality Regional Counties of the IDSR. Our action plan is full of projects and we are looking forward to accomplish them.

We hope this report meets the IDA's expectation and show that, even during strange times like the ones we are living now, the Mont-Mégantic IDSR is still working very hard on protecting the nocturnal environment and the world heritage that is the night sky.

**- RÉMI BOUCHER, SCIENTIFIC COORDINATOR AND SPOKESMAN, ON BEHALF OF
THE MONT-MÉGANTIC INTERNATIONAL DARK SKY RESERVE TEAM**