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# Is cruise tourism sustainable? The case of Palma

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# Table of Contents



# Index of Tables



# Index of Figures

## Abstract

Cruise tourism growth has raised awareness on its environmental and social impacts. In addition, the economic contribution of the industry, which has commonly been considered an advantage for the destinations, has lately been questioned. This paper compiles the studied impacts of the cruise industry and introduces specific the impacts in the city of Palma.

## 1. Motivation

Cruise tourism has been the fastest growing segment of the tourism industry since 1990, this leading to a significant growth during the last decade (CLIA, 2010). Indeed, in 2017, the cruise industry generated around 134 billion dollars throughout the global economy. Some authors assert that cruise tourism generates an important contribution to host economies, which is perceived to be bigger than the contribution made by tourists arriving by plane or other means of transport. In fact, in some studies local business as restaurants, tour agents and souvenir shops have stated that international cruise tourists tend to spend more than mass tourists. Moreover, they agree that the longer the cruise ships stay in the port, the more economic benefits they generate for the community (Chen et al., 2019).

Nonetheless, the arrival of cruise ships damages the environment in the host cities. One of the most significant impacts is the air pollution due to the emissions of CO2, PM10, PM2.5, NO2 and SO2 (Ruiz-Guerra et al., 2019). Other environmental impacts emerge from waste (both wastewater and solid waste) treatments. And, from a sociocultural point of view, cruise tourism also causes congestion in the city ports, reaching and exceeding its carrying capacity (Klein, 2011).

This is especially true for Mediterranean regions. Located in Europe, where almost 40% of the total cruise industry economic contribution is generated (CLIA, 2018), Mediterranean harbours receive approximately 20% of world's cruise arrivals (Barceló, Sastre & Valle, 2017). In particular, Italy and Spain, both located in the Mediterranean, are the European countries with more cruise passengers arrivals, with 4.8 and 3.5 million passenger arrivals respectively (Eurostat, 2020). Moreover, Mediterranean cities as Barcelona, Venice and Palma are the most polluted cities by cruises in Europe (Abbasov et al., 2019).

The cruise industry impacts in these regions have raised the question of how sustainable this industry is. In main city ports, social groups against the boom of the cruise industry have emerged. They demand for new regulations. These organizations are calling for a limitation of the number of cruises docking in their harbours per day. Furthermore, different organizations working in Mediterranean ports, as *Amics de la Terra* in Palma, *Entre Barris* in Valencia and *Comitato No Grandi Navi* in Venice, denounce that citizens haven't got enough information about the environmental effects of the growth of cruise tourism (Amics de la Terra, 2017)**.**

Among the main cruise destinations, Palma has some features which require a more in detail analysis. Palma is a city located in the Balearic Islands. Ecosystems in islands are more fragile than mainland's ecosystems. Besides, the main economic activity in Palma is tourism and visitors have only two options to arrive there: by plane or by boat. Although most tourists arrive traditionally by plane, cruise ships arrivals have become more and more important over the years. In 2018, more than 500 cruises docked in Palma (Ports de Balears, 2019), including some of the biggest cruise ships in the world.

The aim of this paper is to analyse the impacts generated by the cruise industry, displaying, in particular, the case of Palma as a climate change hotspot. Specifically, the research question that this paper tries to answer is:

- Is cruise tourism sustainable?

To assess sustainability many authors talk about three dimensions or pillars: economic, environmental and social (Purvis et al., 2019). In the case of the cruise tourism, economic and environmental impacts are widely studied, but resident reactions are also significant to study the sustainability of the industry in a destination as part of the social dimension (Chris Choi & Sirakaya, 2005). For this reason, this paper will include the analysis of the impacts related to the three dimensions.

Namely, this paper will first summarise the evolution of the cruise industry and its contribution to the global and local economy. Then, the main environmental impacts of the industry will be described. Later, solutions and improvements carried out by the companies to diminish the environmental impacts will be explained as well as the social reactions emerged. To illustrate this, the case of Palma will be presented with specific data. And finally, the sustainability of this industry will be discussed.

# 2. Cruise industry

The early stages of the cruise industry date back to the 1930s, although it didn't become a popular form of leisure travel until the 1960s (Cerchiello & Vera-Rebollo, 2019). In its beginnings as a new type of leisure travel, cruise industry was basically based in the Caribbean, but soon it arrived not also to maritime but also river and canal harbours all over the world (Wood, 2004).

Cruise ships have also varied during the last decades becoming bigger and bigger over the years (Wood, 2004) and including more facilities. In the 1970s, an average cruise ship could carry around 800 passengers (Stefanidaki & Lekakou, 2014). Today, almost 50 years later, an average cruise ship carries

3.000 passengers, and the biggest ones can even carry more than 6.000 passengers.

Nowadays, cruise ships are not only a mean of transport, but also a tourism establishment, a floating resort (UNWTO, 2010). Inside, tourists can find all kinds of facilities as theatres, restaurants, shops, spas, galleries, casinos, libraries etc. while they are travelling to their next destination. Cruise corporations try to have so many activities and entertainment on board for passengers that they decide not to leave the ship when they arrive to the port of call (Klein, 2011). Thus, sometimes the cruise ship is considered the destination itself, not the port cities.

## 2.1. Economic impacts

The dominant arguments in related literature, support that cruise tourism is a source of income but has negative non-economic effects (Stefanidaki & Lekakou, 2014). But other authors have specified that even in an economic sense, cruise tourism could have a limited positive impact and could be less beneficial than what is commonly thought for local communities (Bonilla-Priego et al., 2014).

In 2018, cruise tourism generated $150 billion, which entail an annual increase of 12% (CLIA, 2019). However, economic benefits are often not distributed in an equitable manner between the cruise ship and the port city (Klein, 2011). Port cities incur direct and indirect costs to host cruise ships and only if incomes received from the cruise activity are higher than these costs, it can be economically profitable for the port city.

Positive economic impacts at the destination are connected to an increase of tourist spending, job creation, seasonal adjustment, revenues of ancillary services, enhancement of the destination image, attraction of new services and repeat visits of satisfied visitors (Torbianelli, 2012). Economic impacts can be divided into direct, indirect and induced. In the cruise industry, direct economic impacts are the expenditures in the host community of cruise companies, its passengers and its crew; indirect impacts are generated through related companies as suppliers or others affected by the increase in demand; and induced impacts are generated through the increase household consumption and income (Stefanidaki & Lekakou, 2012).

Cruise lines have  some expenses that take place in every harbour (for example mooring), others that take place in some harbours where the ship stops longer and other expenses take place in determined places for convenience. For instance, some services purchased by cruise corporations as marketing services do not need to be offered in the port city or near the ship. In this case, expenses usually remain in convenient locations in terms of costs and not in ports of call. Overall, cruise line expenses account for the highest values but only a small part remains in the local economy, while passenger and staff expenses are smaller but have a higher impact in the local economy (Torbianelli, 2012).

On the other hand, cruise corporations' biggest operating costs emerge from repairs and ship maintenance (Wang et al., 2020), which, for obvious reasons needs to be performed where the boat is. However, even the supply of spare parts and some maintenance tasks could be performed in home ports if they are big enough, these tasks are usually carried out in the same port during all the lifespan of the ship.

Torbianelli (2012), also pointed out that the average expenditure per passenger (or crew member) depends on the type of cruise stop (home or port of call), the length of the additional stay in the case of home ports, the nationality of the passengers, the type and size of the ship, the attractions located at the destination and the intermediaries involved in the supply chain. Depending on the number of passengers embarking or disembarking in a port, we will talk about a home port or a port of call. Ports where more than 50% of passengers start or end their trip are considered home ports. Considering that passengers will need to travel to or from the home port it is likely that they will spend some more hours or days at the destination. And, consequently, the average expenditure of those cruise passengers will be higher. More precisely, when cruise trips are shorter, it is more possible that their passengers decide to stretch out their visit to a home port for a few more days.

At the destination, the purchasing habits of passengers and staff differ due to the differences on the reasons of their visit. In the case of staff, those which visit the city are enjoying a break while the ship is docked. Therefore, they spend mostly on food, beverages and "standard goods" (Torbianelli, 2012), while tourists spend more on tours and attractions. Even local business owners and employees are sure that the average tourist passenger spends more than mass tourists, Chen et al. (2019) stated that some crew members spend at least the same as cruise tourists in the ports of call.

To estimate passengers' expenditures, researchers use questionnaires, but it has been found that tourists tend to overestimate their expenditures by 35% when they are asked (Larsen et al., 2013). Hence it must be taken into account that passengers' expenditures data may be overestimated.

Cruise industry is mostly controlled by a few big corporations: Carnival Corporation (45% of market share), Royal Caribbean Cruises (25% of market share), Norwegian Cruises (9% market share) and MSC Cruises (6% market share). The rest of companies only account for a total 15% of market share (Barceló et al., 2017). This market concentration is explained by the existence of high barriers to entry and the usual presence of mergers and alliances in the industry (Stefanidaki & Lekakou, 2014). The economic benefits for these few companies are clear, but both these companies and associations as CLIA claim economic benefits are also perceived at a local level.

Cruise companies usually have a high control of the supply chain, selling excursions on board and retaining margins that otherwise would correspond to local business (Torbianelli, 2012). In this situation, cruise corporations retain more than 50% of the price paid by the passenger, so the operator that offers the tour receives less than the half of the price perceived by the tourists. Moreover, cruise corporations are beginning to build their own terminals, which means lower costs to the local community, but especially lower local incomes as incomes generated in the terminal will remain in the corporation (Klein, 2011).

In the same line, taxation in cruise lines is another big matter of study. Cruise lines usually use “flags of convenience”, which mean that the ships are registered and carry the flag of a country where taxes  are more lower and regulations are less stringent (e.g. working conditions laws) (Bonilla-Priego et al., 2014; Wang et al., 2020). For this reason, a significant amount of cruise ships carries the flag of Panama, Liberia, Malta, Bahamas or Jamaica.

To put it in a nutshell, it has been studied that the cruise industry is the source of a significant direct, indirect and induced incomes. Nonetheless, most of the incomes generated do not affect the destination. And, although cruise tourism is the responsible of many tourist arrivals, economic benefits are concentrated in a few hands (Klein, 2011). Hereupon, MacNeil & Wozniak (2018) found an actual negative impact with regards to employment and incomes in the nearest populated areas to cruise ship ports in comparison to other areas not affected by an increase in cruise arrivals.

## 2.2. Environmental impacts

Cruise industry is the responsible of several environmental risks affecting biodiversity and also human life. Some usual and even needed processes or activities performed on cruise ships damage directly marine biodiversity. That is the case of the use hull coatings. They are, precisely, treatments applied to the ships to prevent the transport of invasive organisms, but they contain hazardous chemicals that harm marine fauna (Bonilla-Priego et al., 2014).

Similarly, ballast waters, which are carried to maintain the ship stable, can transport invasive organisms that can be dangerous for humans and the destination’s environment (Bonilla-Priego et al., 2014; Caric, 2012). And, although these problems are less often mentioned in existent literature, ship engines produce underwater noises that disturbs marine life and cruises can even collide with big mammals that may result in death of the animals (Caric, 2012).

But, overall, three main drivers of environmental impacts are distinguished in the cruise activity: air emissions, wastewaters and solid waste. Due to their significance, these drivers will be described more in detail next:

Air Emissions

Ship emissions consist of sulphur oxide (Sox), nitrogen oxide (NOx), carbon dioxide ($CO_2$) and particulate matter (PM) and are determined by fuel type, speed, engine type, electricity production and manoeuvring (Caric, 2012). These emissions are a risk for the environment and human lives as they can cause and aggravate cardiovascular diseases, lung cancer, morbidity and asthma among others (Abbasov et al., 2019). In particular, PM emissions from ships were responsible of approximately 60,000 deaths every year around the world during the first years of the 21st century (Corbett et al., 2007).

Cruise ship emissions depend on the size of the ship, their age, the power they need and the type of fuel they use (Bonilla-Priego et al., 2014). Most cruise ships use heavy fuel oil (HFO), which is considered the dirtiest fossil fuel and is a highly sulphurous fuel (European Commission, 2009).

Moreover, cruise ship uses more fuel than regular ships as they incorporate leisure facilities that require an enormous amount of energy and also generates air emissions due to the incineration of waste on board produced in this facilities (Bonilla-Priego et al., 2014). In fact, the two biggest cruise corporations, Carnival Corporation and Royal Caribbean Cruises, emit 10 and 2 times more Sox than all European cars, respectively. (Abbasov et al., 2019).

Wastewaters

Life onboard, as land-based activities, generates wastewaters. This type of waste needs costly and space consuming treatment systems which are more difficult to install on a ship (Klein, 2011). There are three different types of wastewaters, which cause different impacts and should be treated in a different way: sewage, greywaters and oily bilge water.

Sewage or blackwaters are wastes from toilets, medical premises drainages and drainages from facilities containing living animals. According to the United States Environmental Protection Agency (2008), one cruise ship generates between 3,785 and 280,120 litres per day of blackwater or between 47 and 102 litres per passenger per day. Sewage must be treated before being discharged with a system approved by the country where they are registered (Bonilla-Priego et al., 2014) as *MSD* (which was proved not to meet the required specifications) or AWTS (Klein, 2011).

Greywaters come from sinks, showers, laundry, galleys and other similar facilities. One cruise ship generates between 136,275 and 942,568 litres of greywaters per day or between 136 and 450 litres per passengers per day (USEPA, 2008). The treatment of greywaters is not regulated (Bonilla-Priego et al., 2014) and, according to Klein (2011), that’s why most vessels discharge them untreated overboard.

Oily bilge water is the mixture of water and oily wastes. One cruise ship generates between 4,921 and 20,063 litres of oily bilge water per day which can be managed in two ways: being retained and then discharged on shore; or being treated with an "Oily Water Separator" and then being discharged overboard (USEPA, 2008).

Solid Waste

Cruise ships generate inorganic waste (plastic, glass, cans, paper, etc.), organic waste (e. g. food waste) and hazardous waste (aerosols, pharmaceutical products, batteries, etc.). It has been proved that consumption on cruises is 1.5 times bigger than average consumption patterns (Véronneau & Roy, 2009). Onboard, an average of 8 tons of solid waste is generated every week (Klein, 2011).

Organic waste is thrown overboard in international waters, while inorganic waste treatment depends on the ship and its material. In newer ships inorganic waste is incinerated and then the ash is thrown into the ocean, while in older ones it is kept and then left ashore (Caric, 2012). Nonetheless, the discharge of organic waste is not harmless. This action can cause an increase of biological and chemical oxygen demand, organic carbon, water turbidity and nutrient levels, a decrease in water and sediment quality and affect negatively marine life (USEPA, 2008).

However, it has been found out that some cruise ships treat inorganic waste as organic waste discharging it overboard (Caric, 2012). For instance, Klein (2011) stated that glass and aluminium residues are often discharged into the sea when there is no port in the itinerary with the pertinent facilities to recycle them. And, as it is totally forbidden to dump plastics into the ocean or seas, they are incinerated onboard when it is possible, resulting into an increase of damaging air emissions.

Another considered subtype of solid waste is hazardous waste, even though some of them can be liquids or fluids. According to U.S. Environmental Protection Agency (2008), examples of hazardous residues generated onboard include "paint waste, aerosol liquid waste from the crushing of aerosol cans, some incinerator ash, fluorescent and mercury vapor light bulbs, various types of batteries, and unused or outdates pharmaceuticals".

## 2.3. Responses to cruise industry's impacts

The evident negative impacts on the environment and the doubtful contribution to the local economy of the cruise industry, as well as an increasing aim of the population to fight climate change and protect the Earth ecosystems, have shown that some changes were necessary in the cruise industry.

Cruise corporations have started promoting their environmentally friendly and ethical behaviours and introducing new systems to reduce environmental impacts of their activities. Some social organizations have appeared to demand a more responsible behaviour and limitations of the cruise industry. In the case of governmental and international policies, some new regulations have been implemented in an area traditionally poorly regulated.

### 2.3.1. Cruise Lines Reactions

Some factors as the Costa Concordia accident in 2012 and the society's increased awareness of environmental impacts of the industry have resulted in the need of the corporations to show they are taking responsible decisions with the society and the environment (Bonilla-Priego et al., 2014).

In the beginnings of the $21^{st}$ century, "Advanced Wastewaters Treatment Systems" began to be used to treat blackwaters with higher levels of disinfection and waste removal (USEPA, 2008). However, the implementation of these systems hasn't been fast in the biggest corporations. One decade after the beginning of its use, *Carnival Cruises* had only one ship equipped with AWTS and *Royal Caribbean* had implemented it in half of the fleet, although they had assured they would implement it in all their ships (Klein, 2011).

Corporations are promoting their innovations to become environmental friendly, but they are not transparent with their non responsible practices (Klein, 2011). According to Bonilla-Priego et al. (2014), the industry seems to be in "the early stages of accepting responsibility" as only a few of the main cruise corporations report the impacts they generate and the sustainability policies they apply and they focus on "indicators away from the core business practices".

The biggest corporations in the industry, have widely promoted their innovations towards sustainability. In fact, all four main companies (Carnival Corporation, Royal Caribbean, Norwegian Cruises and MSC Cruises) have designed a specific section in their website where they present their measures and commitment for a sustainable development.

<u>Carnival Corporation</u>

The company offers in its website its sustainability report of 2018. This report expresses the goals the company has set regarding emissions, water and waste management and biodiversity protection, as well as the evolution it is following to achieve them.

Carnival sustainable strategy is based on the construction of new ships that will be the source of less air emissions in comparison to their regular ships. In 2018, the first cruise powered by liquefied natural gas (AIDAnova), which is expected to generate no sulphur dioxide emissions and reduce significantly PM, NOx and COx emissions, has been launched (Carnival Corporation & PLC, 2019).

In addition, Carnival has launched another liquefied natural gas propelled ship in 2019 (Costa Smeralda) and it is building 6 more ships that will use this system which are expected to start their trips between 2020 and 2022. However, company's old ships will still navigate around the world with no innovations to reduce their emissions and other ships that will be powered with the common heavy fuel oil are still being build.

Royal Caribbean

Royal Caribbean also publishes a yearly sustainability report (called "*seastainability"* by the company) available on its website. The company affirms having achieved already in 2018 seven of their eight 2020 goals to reduce environmental footprint (regarding emissions reduction, sustainable tours, sustainable seafood, public and private sustainable destinations, sustainable sourcing and plastics reductions) and being on track to achieve its goal of reducing waste by 85% in comparison with 2007 (Royal Caribbean Cruises Ltd., 2019a).

The corporation has chosen the same alternative to heavy fuel oil than his main competitor, but it will be combined with fuel cells, which generate electricity by chemical reactions. Its first liquefied natural gas (LNG) and fuel cells powered ship will start operating in 2020 (Royal Caribbean Cruises Ltd., 2019b).

Nonetheless, the report focuses much more on actions to solve problems away from the core business activities. For example, the corporation shows commitment to fight wildlife trafficking, to improve fishery projects and managing data privacy but gives limited information about its ships' emissions and waste discharges.

Norwegian Cruises

The corporation publishes a yearly sustainability report that can be accessed and download from its website.

One of the main objectives of the company is to minimize waste to landfills and one of the policies implemented has been to eliminate plastic straws from all their ships and their private islands (Norwegian Cruise Line Holdings Ltd., 2019). However, at the very end of the report the fine print states that actually not all the plastic straws have been eliminated from their cruises. The company maintains the plastic straws at onboard Starbucks.

In the report, the corporation also expresses its aim to enhance fuel and energy efficiency with measures as the implementation of "exhaust gas cleaning systems" which reduce Sox and PM emissions, new hull coatings that help propulsion efficiency, LED lighting upgrades and waste heat recovery systems to take advantage of heat from engines.

Nevertheless, the report fails to give data of actual emissions and waste generated and focuses on goals and strategies to reach sustainability.

MSC Cruises

*Mediterranean Shipping Company* divulges its sustainability report for all divisions, one of which is *MSC Cruises*. In the report, the company affirms being investing heavily to improve environmental performance. MSC Cruises has equipped its ships with "exhaust gas cleaning systems" and is developing liquefied natural gas engines for 4 cruise ships expected to be launched between 2022 and 2027 (Mediterranean Shipping Company S.A., 2018).

In addition, MSC feels proud of what they consider "one of the most environmentally-advanced cruise ships": MSC Grandiosa. The corporation states that the ship launched in October of 2019 generates 97% less sulphur oxide and 80% less nitrogen oxygen and reduces underwater noises and fuel consumption.

### 2.3.2 Social reactions

According to Ritter and Schafer (1998), cruise tourism in big cities has no social negative impacts as it is considered "harmless, sustainable and soft". However, the arrival of cruises generates congestion due to the movement of a big amount of tourists in a short period of time in a reduced area (Klein, 2011) and the high degree of concentration caused by cruise tourism generates negative perceptions of residents towards visitors (Brida & Zapata, 2010). As port cities get overcrowded, noise pollution, traffic congestion and costs of leaving increase (Klein, 2011).

In small cities cruise arrivals obviously affect residents lives as the city population can even be doubled during cruise stops. For example, in the city of Kotor (Montenegro), which is the home of 13,500 inhabitants, the daily influx of tourists disturb the usual routine and habits of its residents (Nikčević, 2019). However, social organizations have condemned the increase of cruise arrivals also in big cities. Cities as Venice with its *No Grandi Navi* movement, Barcelona and Dubrovnik have hosted big demonstrations against cruise tourism. The spread of these movements among the population has been explained by an increased awareness and visibility of cruise tourism impacts and dissatisfaction with local authorities (Vianello, 2016).

These organizations question the benefits of the cruise tourism in their home city and demand direct actions from the government to reduce the negative impacts, usually appealing for limitations on cruise arrivals. The requests are based on the scarcity of national and international legislation that has failed to protect marine environments from coastal population growth, fishery, merchant fleet growth and, now, cruise tourism growth (Caric, 2012).

Among transport sectors, maritime sector is the least regulated. During the last decade, some national governments have set SOx and NOx standards for fuels and ship engines to reduce air pollution and some concrete areas in Europe, North-America and China have been declared emission control areas (ECA) for air pollutants (Abbasov et al., 2019). In this regard, big cruise corporations as *Royal Caribbean* and *Carnival Cruises* have also been charged with discharging illegally waste waters and hazardous emissions. But fines are insignificant in comparison with cruise lines' revenues (Wang et al., 2020).

Upon this new situation, some local governments have decided to act. To solve the problem, authorities usually choose to incorporate new taxes (for example on the total number of passengers) which reflect an increase on revenues for the destination instead of the negative environmental impacts produced (Wang et al., 2020).

# 3. The cruise industry in Palma

The city of Palma, capital city of the Balearic Islands is a well-known port of call of cruises travelling in the Mediterranean Sea. Its location in the Mediterranean Sea, its weather conditions, its unique environment as an island and its port facilities make Palma into a desired destination for both passengers and cruise lines.

At the same time, as an island, its ecosystems are fragile, and some its resources are very scarce as in the case of water. Moreover, the space is limited and the arrival of huge amounts of tourists affects routines and habits of residents. And, more precisely, Palma is one of the three most polluted European city ports by cruise ships, along with Barcelona and Venice (Abbasov et al., 2019).

## 3.1. Economic impacts

Palma is the world's twelfth harbour with more cruise arrivals, which meant 2,4% of market share in 2013 (Barceló et al., 2017). But being one of the most visited ports around the world does not imply a significant economic contribution. Therefore, to measure the economic impact generated it is recommended to take into account the value added generated since this indicator removes non-local providers revenues and non-labour costs met by local providers to sell their goods and/or services (Torbianelli, 2012).

According to the study conducted by Barceló et al. (2017) the cruise industry generated in 2015 a direct gross value added (VAB) of € 128M and 2,943 job positions in the Balearic Islands. These incomes come mostly from transit (49%) and base passengers' purchases (22%), but also from cruise staff (11%) and cruise lines (13%) expenses, public investments (1%) and airport activity (4%) needed for turnaround cruise passengers.

The same study estimated the indirect and the induced VAB at € 129M and 2,790 job positions in the Balearic Islands. Thus, the total economic impact of the cruise industry in the Balearic Islands raise to more than € 250M, 224M of which correspond to cruise arrivals in Palma and 5,700 job positions, 5,000 of which are generated by the arrivals in Palma. The significance of these results is summarized as an average of € 325,000 of income and 7 job positions for every cruise call.

These economic figures seem significant, but they need to be compared with the VAB generated by other types of tourism. Comparing the VAB generated by the tourism sector in the Balearic Islands in 2015 according to IBESTAT (n.d.-a) represented in the **Table *1*** and the VAB generated by the cruise industry in the same year according to Barceló et al. (2017), it is observed that the cruise tourism does not contribute significantly in the local economy.

**Table 1: VAB generated by the tertiary sector in 2015**

| | VAB generated | Average Job Positions |
|---|---|---|
| Tourism Sector | 4,154,944,700 | 103,952 |
| Other Services and Commerce | 4,665,742,500 | 130,873 |
| **Total Tertiary Sector** | **8,820,687,200** | **234,825** |

Source: IBESTAT (n.d.-a)

According to this data, the total VAB (direct, indirect and induced) generated by cruise tourism in the Balearic Islands in 2015 represents 6.18% of the VAB of the tourism sector and 2.91% of the total VAB generated in the tertiary sector. The same situation is observed in terms of jobs positions, where cruise tourism represents only 5.52% of average job positions generated by the tourism sector and 2.44% of the jobs positions generated by the tertiary sector.

However, it must be mentioned that IBESTAT does not indicate the methodology followed to obtain their results, and this could lead to divergences calculating VAB between the two sources analysed. As IBESTAT does not specify if the VAB generated includes indirect and induced VAB and if it includes the VAB generated by the cruise industry, the cruise tourism economic contribution in the tourism sector and the tertiary sector could be even smaller.

To assess the economic data more in detail, authors usually distinguish between turnaround and transit cruises in economic reports as their passengers spend a different amount of time at the destination and have different consumptive habits.

Transit Cruises

From destination's point of view, transit cruises refer to those where most passengers do not initiate or finish their trip in its port. According to IBESTAT (n.d.-c), transit cruises passenger arrivals in Palma in 2019 accounted for more than 1M, most of them having arrived during summer as shown in the monthly distribution in **Table *2***.

**Table 2: Transit cruise arrivals in 2019**

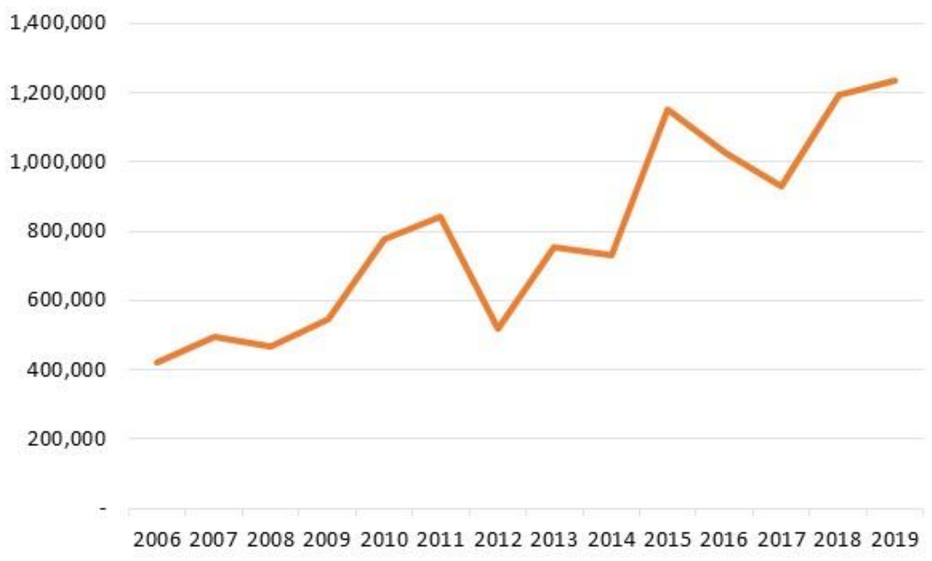
| Month | Passengers | Cuise Ships | Average Capacity |
|---|---|---|---|
| January | 25,997 | 8 | 3,250 |
| February | 19,443 | 8 | 2,430 |
| March | 29,031 | 8 | 3,629 |
| April | 64,419 | 22 | 2,928 |
| May | 147,047 | 45 | 3,268 |
| June | 168,491 | 46 | 3,663 |
| July | 207,214 | 52 | 3,985 |
| August | 205,436 | 51 | 4,028 |
| September | 167,740 | 44 | 3,812 |
| October | 130,897 | 51 | 2,567 |
| November | 54,814 | 26 | 2,108 |
| December | 15,672 | 3 | 5,224 |
| **Total** | **1,236,201** | **364** | **3,408** |

Own elaboration with data from IBESTAT (n.d.-c)

The number of passengers arrivals with this kind of cruises has been increasing almost every year, with an increase of 193% since the first data obtained and captured in **Figure *1***, and 126% during the last ten years. The number of cruises docking in Palma has also increased significantly since 2006 as reflected in **Figure *2***. Nevertheless, it seems to remain stable during last years or even having decreased.

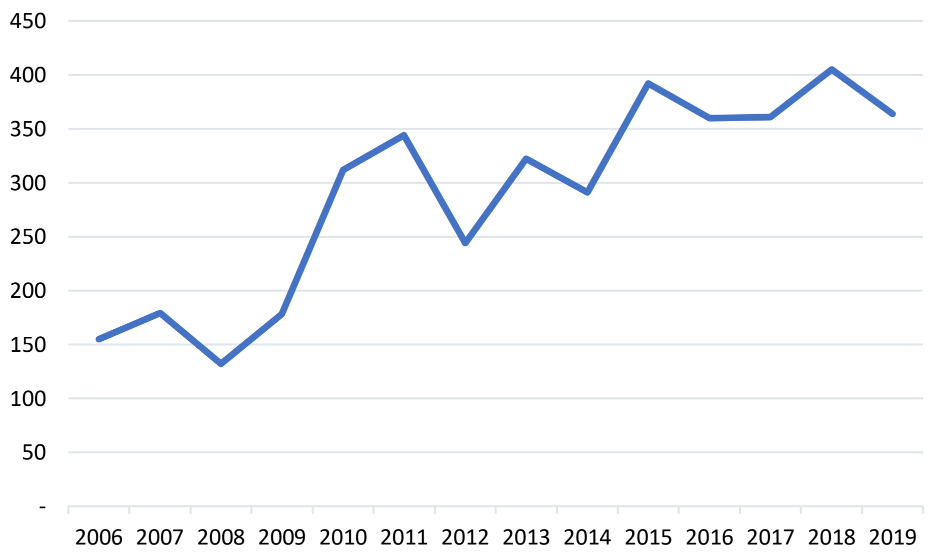
The reason why the number of passengers is still increasing while the number of cruises ships is not, is that cruises docking in Palma are bigger following the trend of an increase in the size of the fleet worldwide (Barceló et al., 2017). In 2012, the average number of passengers per cruise ship was 2,125, while in 2019 it was 3,396. An increase accounting for 60% explained by arrivals as the one of the biggest cruise ships in the world, the *Symphony of the Seas*, with a capacity of more than 6,000 passengers.

**Figure 1: Evolution of passenger arrivals**




Own elaboration with data from IBESTAT (n.d.-c)

**Figure 2: Evolution of cruise arrivals**




Own elaboration with data from IBESTAT (n.d.-c)

These cruises usually arrive in the morning and depart during the same day's afternoon. For this reason, according to the study conducted by Barceló et al. (2017), transit cruises passengers spend an average of 4 hours in the city choosing the oldtown as their destination mostly. This time limitation also influences passengers' expenditures in Palma, which the same study found that accounted for an average of 72€ per passenger. Finally, they also described that some passengers decide to book a tour to make the most of their time in the island. But more than 40% of passengers who decide to book these tours to visit

Palma or the nearest villages, purchase it on board, reducing the revenues of the local organizers.

Turnaround Cruises

Aside from transit cruises, turnaround cruises also dock in Palma. In most studies and statistics, authors distinguish between turnaround and transit cruises since base cruise passengers usually spend an additional stay of few more days in the destination before or after the cruise trip. In order to analyse their significance in Palma, **Table *3*** breaks down the number of turnaround cruises and passengers that arrived to the port in 2019.

**Table 3: Turnaround cruise arrivals in 2019**

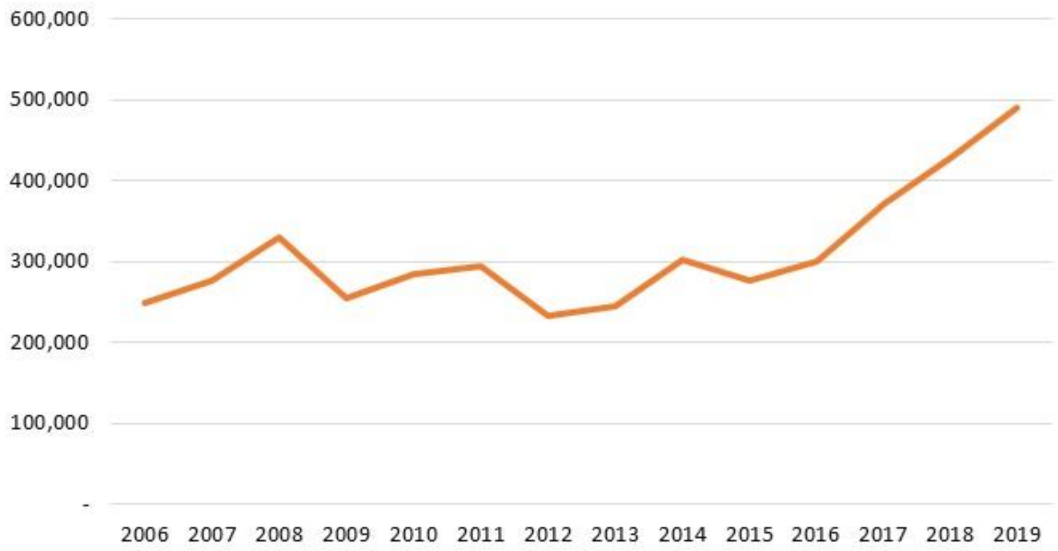
| Month | Passengers | | Cruise Ships | |
|---|---|---|---|---|
| | Start | End | Start | End |
| January | 21,420 | 22,148 | 10 | 10 |
| February | 17,879 | 19,125 | 8 | 9 |
| March | 19,281 | 17,594 | 9 | 8 |
| April | 45,310 | 44,081 | 19 | 19 |
| May | 54,797 | 53,111 | 27 | 28 |
| June | 52,465 | 51,149 | 24 | 24 |
| July | 52,470 | 51,834 | 26 | 26 |
| August | 55,176 | 55,613 | 24 | 24 |
| September | 54,608 | 54,844 | 27 | 27 |
| October | 74,041 | 74,400 | 32 | 32 |
| November | 18,856 | 23,349 | 8 | 10 |
| December | 26,014 | 21,730 | 12 | 10 |
| **Total** | **492,317** | **488,978** | **226** | **227** |

Own elaboration with data from IBESTAT (n.d.-b)

The number of turnaround cruise ships is much lower than transit cruises docking in Palma. However, during winter months there almost the same turnaround cruises than transit cruises. On the other hand, passengers arrivals have increased during the last decade (**Figure *3***), even the number of cruise arrivals did not. In a similar way than with transit cruises passenger arrivals, this would be explained by the increase of the fleet size.

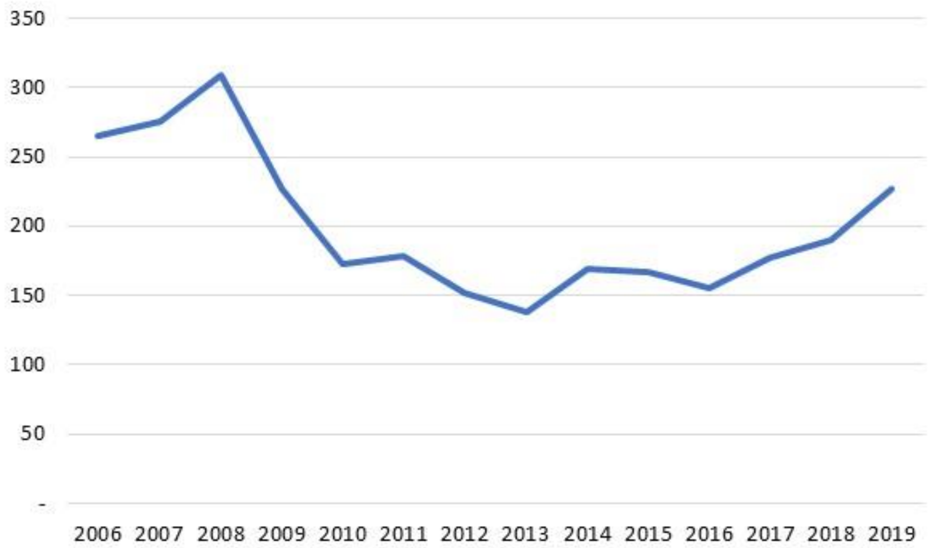
Nonetheless, the arrival of turnaround cruises has followed a quite different trend in comparison to transit cruise arrivals which increased almost every year. Turnaround cruises arrivals evolution detailed in **Figure *4***, shows a decrease in the number of arrivals.

**Figure 3: Evolution of passenger arrivals**




Own elaboration with data from IBESTAT (n.d.-b)

**Figure 4: Evolution of cruise arrivals**




Own elaboration with data from IBESTAT (n.d.-b)

Until 2009, the number of turnaround cruise ships in Palma was higher than the number of transit cruises. In 2010 this trend got inverted, and although turnaround cruise ships arrivals have increased since 2010, there are still fewer turnaround cruises arrivals than transit arrivals. This could show an increasing preference of cruise corporations for using Palma as a port of call but not as a home port.

Regarding individual expenditures, according to Barceló et al. (2017), turnaround cruise passengers spend an average of 155€ (including day of arrival, day of departure and days of additional stay). This expenditure doubles the average expenditure of transit cruise passengers and it is caused by the longer duration of their stay in Palma.

## 3.2. Environmental impacts

According to the study conducted by Abbasov et al. (2019) for the European Federation of Transport and Environment, an average cruise ship is responsible of the same SOx emissions as 2,816 cars in Palma. In Europe, sulphur content is now limited to 0,1% in emission control areas and ports and 0,5% outside emission control areas since the beginning of 2020. Before the implementation of these new regulations, the sulphur content limit outside the ECAs was 1,5%, which explains why Spain and Italy, located outside the ECA, and particularly cities as Palma, Barcelona and Venice are the locations more polluted by cruises.

Environmental impacts in a specific port are difficult to calculate. For this reason, 4 sensors were installed in the port of Palma in 2017 in order to identify and monitor air emissions. In September of 2019, 4 more sensors were installed and the average hourly emissions of CO, NO2, O3, SO2 and PM10 are published in the website of the port authority every hour. In the same website, they also publish the daily arrivals of cruises and other ships to the port.

With both data, this paper will analyse if there is a relation between the arrival of cruises and air pollutants indicators. The presence of pollutants will be assessed according to the intervals displayed in **Table *4***, which are also used by the port authority. Nonetheless, the data obtained corresponds to the period between 1st September and 31st January, which as shown in **Table *2*** and ***Table* 3**, are months with fewer cruise arrivals than summer months.

**Table 4: Air Quality Indicators**

| Quality | CO (mg/m³) | NO2 (µg/m³) | O3 (µg/m³) | PM10 (µg/m³) | SO2 (µg/m³) |
|---|---|---|---|---|---|
| Excellent | 0-3.3 | 0-13 | 0-60 | 0-16 | 0-41 |
| Good | 3.4-6.6 | 14-27 | 61-120 | 17-33 | 42-82 |
| Fair | 6.7-10 | 28-40 | 121-180 | 34-50 | 83-125 |
| Poor | >10 | >40 | >180 | >50 | >125 |

Own elaboration with data from Gobierno de España (2011)

At first sight, there is no correlation (or even a negative correlation) between average daily pollutants indicators and the number of cruises arrived. However, pollutant emissions can also come from ferries and other ships, and it must be taken into account that a cruise ship usually remains less than 24h in a port. For this reason, the data of days with higher number of cruise arrivals will be analysed more in detail.

**Table 5: Days with more cruise arrivals**

| Date | Number of Cruise Arrivals |
|---|---|
| 01/10/2019 | 5 |
| 22/10/2019 | 5 |
| 02/09/2019 | 4 |
| 16/09/2019 | 4 |
| 06/10/2019 | 4 |
| 12/10/2019 | 4 |
| 25/10/2019 | 4 |
| 26/10/2019 | 4 |
| 27/10/2019 | 4 |

Own elaboration with data from Autoritat Portuària de Balears (n.d.)

These days with more cruise arrivals during the period with data available (days with five or four arrivals) are displayed in **Table *5***, and the specific time of arrival and departure of each of these cruises are presented in **Appendix 1**.

For the days observed, CO and O3 emissions remain all day in excellent or good conditions; SO2 emissions get fair values one of the days analysed at the average time of arrival of the cruises; and PM10 emissions get fair and poor values one of the days during the afternoon coinciding with the departure of 4 cruises. But the worst data is related with NO2 emissions. For all the days observed, NO2 indicators reach fair or poor values most of them during the early morning when cruises arrive to the port and in the late evening when they departure. The data observed is displayed in the **Appendix 2**.

In addition, some of the ships considered as eco-friendly by the corporations launched in 2019, have docked in Palma during the period of time analysed. Costa Smeralda and Aidanova which are powered by liquefied natural gas have docked 5 and 9 times respectively in Palma during this period, and, MSC Grandiosa which is supposed to generate 97% less sulphur oxide and 80% less nitrogen oxygen than a regular cruise ship, docked in Palma for the first time on Christmas Day.

Aidanova docked in Palma every Saturday until the 2$^{nd}$ November. But in this case, at least 3 other cruises were in the port arriving and leaving at similar time. Thus, in this case it is difficult to prove if the ship does pollute less than a regular cruise.

MSC Grandiosa was the only ship docked in Palma during Christmas day, what makes it easier to relate the data observed to the cruise activity. In effect, SO2 indicators are considered excellent on this day, although they are higher than the average daily SO2 indicator. Nonetheless, quite high NO2 values were observed before and after the time of the departure (19:42).

**Table 6: NO2 and SO2 indicators during MSC Grandiosa stay**

| Time | NO2 (µg/m³) | SO2 (µg/m³) |
|---|---|---|
| 10:00 | 11.488 | 15.850 |
| 11:00 | 5.263 | 10.263 |
| 12:00 | 11.325 | 8.063 |
| 13:00 | 19.363 | 8.950 |
| 14:00 | 12.750 | 4.475 |
| 15:00 | 6.800 | 4.738 |
| 16:00 | 6.875 | 6.488 |
| 17:00 | 15.575 | 11.763 |
| 18:00 | 51.250 | 44.963 |
| 19:00 | 47.250 | 58.338 |
| 20:00 | 36.125 | 43.213 |
| 21:00 | 36.750 | 53.350 |
| 22:00 | 41.000 | 75.225 |
| 23:00 | 39.500 | 69.913 |

Own elaboration

In the case of Costa Smeralda, it arrives every Tuesday to the port of Palma, and, although there were other ships in the port, it was the only cruise docked during the days the data was collected. Costa Smeralda arrives around 7:30 and leaves the port at around 18:00 while the other ships leave earlier.

**Table 7: Average NO2 indicators during Costa Smeralda stays**

| Time | Average NO2 (µg/m³) |
|---|---|
| 07:00 | 37.513 |
| 08:00 | 37.775 |
| 09:00 | 30.223 |
| 10:00 | 17.965 |
| 11:00 | 11.678 |
| 12:00 | 9.955 |
| 13:00 | 6.705 |
| 14:00 | 3.170 |
| 15:00 | 4.788 |
| 16:00 | 10.025 |
| 17:00 | 23.485 |
| 18:00 | 34.185 |
| 19:00 | 36.035 |
| 20:00 | 37.511 |
| 21:00 | 33.596 |

Own elaboration

The average NO2 indicators have increased during the average time of arrival and departure of Costa Smeralda, reaching an average of fair level. The average NO2 indicators per hours during Costa Smeralda stays are displayed in **Table 7**.

**Table 8: Average indicators of pollutants (01/09/2019-31/01/2020)**

| CO (mg/m³) | NO2 (µg/m³) | O3 (µg/m³) | PM10 (µg/m³) | SO2 (µg/m³) |
|---|---|---|---|---|
| 0.2085 | 18.8104 | 28.4314 | 20.5412 | 13.4368 |

Own elaboration

**Table 9: Average polluntant indicators during "eco-friendly" cruises stays**

| | CO (mg/m³) | NO2 (µg/m³) | O3 (µg/m³) | PM10 (µg/m³) | SO2 (µg/m³) |
|---|---|---|---|---|---|
| MSC Grandiosa | 0.233 | 25.897 | 7.465 | 8.429 | 38.171 |
| Costa Smeralda | 0.240 | 18.108 | 28.099 | 13.713 | 8.594 |

Own elaboration

To sum up, during the stop of both “eco-friendly” considered cruise ships, PM10 and O3 indicators have reach lower values than average. However, during both stop, CO levels were a little bit higher than average, and, during MSC Grandiosa stop NO2 levels were not only not reduced but also did increase significantly.

## 3.3. Social reactions

In Palma there are no limitations in terms of size and capacity for cruise ships (Barceló et al., 2017) and neither a daily limit of cruise ships arrivals. For this reason, during high season, some days more than 20,000 passengers disembark at the city. On 3rd May 2016, 22,000 tourists arrived via 8 different cruise ships and on 3rd August 2016, 7 cruises brought 25,000 tourists (Mas, 2017). In this situation, social organizations demanding for changes in the tourism model have emerged.

One example of these associations is Terraferida. They demand to set up a maximum of one cruise ship at the same time in Palma, better monitoring of air emissions, fuel operations at the port and environmental certificates of the ships. In addition, they consider that more information of the air emissions should be available for the population and that cruise activity should be regulated in the regional “Climate Change Law” (Terraferida, 2019).

Some are ecologist organizations, as *GOB*, but there are more groups as neighbourhood associations. In June 2019, 20 entities wrote and signed a manifesto against “megacruise ships” demanding new measures from the government as a limitation of 4,000 visitors per day from cruise ships, an increase of € 5 in the tourism tax (*Ecotaxa*) and the declaration of the Mediterranean Sea as an Emission Control Area (GOB, 2019).

# 4. Discussion and conclusion

It is clear that the current situation of the industry is damaging marine ecosystems and boosting air pollution that contributes to climate change. The installation of sensors in ports can be a useful tool to monitor air pollution. With this preliminary analysis of the levels of air pollutants in the port of Palma, it can be seen that NO2 emissions increase to non-desired levels during arrival and departure operations. In addition, “eco-friendly” new ships, don’t appear to be a significant improvement.

Nevertheless, it is difficult to draw conclusions as the data available nowadays does not include high season. But it could be interesting and advisable to study these indicators when there is all year around information available. The analysis and publication of a yearly study of the emissions indicators could help governments implement new policies and restrictions and would also answer the information transparency asked by some organizations. The same analysis could assess whether new ships with promoted innovations have reduced air emissions or not.

Research studies have commonly talked about these multiple environmental impacts produced by cruise activity, but economic incomes have usually been seen as the strong point for the destinations. However, most economic benefits remain in big corporations and are not significant for the local economy. In some cases, we can even talk about negative economic impacts the destination.

On the other hand, cruise corporations manage to get high profits using strategies as flags of convenience to pay less taxes and be subject to less restrictive regulations in terms of working conditions and environmental impacts. However, it is difficult to get reliable economic data, since as MacNeill & Wozniak (2018) explain, most economic information available comes from cruise industry self-reporting and is not transparent.

In the case of Palma, cruise passenger arrivals have increased rapidly during last years. Even so, the economic contribution of cruise tourism is not significant in comparison with other kinds of tourism and other services contribution and neither generates a significant number of job positions. Moreover, the trend that shows a constant increase of the size of the ships and its capacity does not seem favourable for Palma since passengers have all kind of facilities inside the boat. Therefore, some passengers will spend more time inside the boat and spend less money in local businesses and also remain closer to the boat, visiting the old town and not moving to other villages. To sum up, the increasing size of the fleet contributes to higher concentration rates in the city and lower expenditures per passenger.

Citizens and organizations who are worried about the protection of the environment are strongly criticising cruise activities and demanding for new regulations to limit cruise tourism and its impacts. As a response, the biggest cruise corporations have started to publish annual sustainability reports. Despite this corporation's new attitude, this reports usually are mere promotion leaflets and do not mention impacts produced by the core activities of the corporations.

In conclusion, it can be stated that cruise tourism is not a significant participant in Palma's economy, or more precisely, it is not as significant as some sectors think. And, both citizen dissatisfaction and the new tools to monitor cruise impacts could be a stimulus for authorities to act and regulate the sector with the aim to reach a sustainable development of the city.

Finally, although we have analysed specifically the cruise industry in the case of Palma in this paper, the results could probably be extrapolated to other Mediterranean cities and lead to further research studies in other cruise destinations around the world.

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## Appendix 1: Cruise arrivals in days with more than 4 cruises arrivals between 01/09/2019 and 31/01/2020

| Cruise Ship | Arrival | Time | Departure | Time |
|---|---|---|---|---|
| OASIS OF THE SEAS | 02/09/2019 | 7:23 | 02/09/2019 | 16:39 |
| COSTA FORTUNATA | 02/09/2019 | 8:03 | 02/09/2019 | 22:48 |
| MSC FANTASIA | 02/09/2019 | 9:26 | 03/09/2019 | 0:25 |
| CELEBRITY INFINITY | 02/09/2019 | 9:56 | 02/09/2019 | 22:14 |
| COSTA FORTUNA | 16/09/2019 | 8:17 | 16/09/2019 | 23:06 |
| MSC FANTASIA | 16/09/2019 | 9:02 | 17/09/2019 | 0:13 |
| OASIS OF THE SEAS | 16/09/2019 | 7:34 | 16/09/2019 | 16:04 |
| COSTA MAGICA | 16/09/2019 | 7:24 | 16/09/2019 | 18:08 |
| COSTA DIADEMA | 01/10/2019 | 8:38 | 02/10/2019 | 0:42 |
| LE LYRIAL | 01/10/2019 | 7:43 | 01/10/2019 | 17:50 |
| CELEBRITY REFLECTION | 01/10/2019 | 6:42 | 01/10/2019 | 17:03 |
| MARELLA DREAM | 01/10/2019 | 5:35 | 01/10/2019 | 23:44 |
| MEIN SCHIFF | 01/10/2019 | 3:20 | 01/10/2019 | 22:07 |
| AIDANOVA | 12/10/2019 | 6:52 | 12/10/2019 | 22:07 |
| MARELLA DISCOVERY | 12/10/2019 | 5:47 | 12/10/2019 | 21:55 |
| NORWEGIAN EPIC | 12/10/2019 | 12:26 | 12/10/2019 | 20:25 |
| LE LYRIAL | 12/10/2019 | 7:48 | 12/10/2019 | 18:41 |
| COSTA DIADEMA | 22/10/2019 | 8:40 | 22/10/2019 | 16:59 |
| MARELLA DREAM | 22/10/2019 | 5:35 | 22/10/2019 | 22:08 |
| BLACK WATCH | 22/10/2019 | 8:25 | 22/10/2019 | 18:01 |
| LE PONANT | 22/10/2019 | 9:35 | 22/10/2019 | 19:00 |
| SEADREAM II | 22/10/2019 | 7:04 | 22/10/2019 | 17:56 |
| AIDAPRIMA | 25/10/2019 | 4:42 | 25/10/2019 | 22:33 |
| MSC SEAVIEW | 25/10/2019 | 12:51 | 25/10/2019 | 22:51 |
| MEIN SCHIFF | 25/10/2019 | 3:21 | 25/10/2019 | 22:20 |
| SEA CLOUD | 25/10/2019 | 13:56 | 26/10/2019 | 21:22 |
| AIDANOVA | 26/10/2019 | 4:37 | 26/10/2019 | 22:18 |
| MARELLA DISCOVERY | 26/10/2019 | 5:50 | 26/10/2019 | 21:55 |
| NORWEGIAN EPIC | 26/10/2019 | 12:28 | 26/10/2019 | 19:59 |
| NAUTICAMALTA | 26/10/2019 | 8:20 | 26/10/2019 | 17:52 |
| AIDACARA | 27/10/2019 | 5:01 | 27/10/2019 | 22:30 |
| AIDASTELLA | 27/10/2019 | 4:20 | 27/10/2019 | 22:19 |
| SEA CLOUD II | 27/10/2019 | 18:06 | 28/10/2019 | 13:33 |
| STAR FLYER | 27/10/2019 | 8:52 | 27/10/2019 | 18:02 |

## Appendix 2: Emissions indicators in the days with higher influx of cruise arrivals

| Date | Time | CO (mg/m³) | NO2 (µg/m³) | O3 (µg/m³) | PM10 (µg/m³) | SO2 (µg/m³) |
|---|---|---|---|---|---|---|
| 01/10/2019 | 00:00 | 0.2225 | 9.0375 | 34.5 | 6.825 | 2.975 |
| 01/10/2019 | 01:00 | 0.21375 | 5.825 | 35 | 6.2875 | 2.7 |
| 01/10/2019 | 02:00 | 0.22125 | 8.875 | 32.3625 | 6.6625 | 2.7 |
| 01/10/2019 | 03:00 | 0.21875 | 7.45 | 27.375 | 7.125 | 2.7 |
| 01/10/2019 | 04:00 | 0.2225 | 12.25 | 15.7 | 6.675 | 3.15 |
| 01/10/2019 | 05:00 | 0.2725 | 22.25 | 8.1625 | 6.6875 | 6.6 |
| 01/10/2019 | 06:00 | 0.38875 | 38 | 2.05 | 8.525 | 16.0875 |
| 01/10/2019 | 07:00 | 0.50625 | 46.5 | 2 | 9.725 | 32.2125 |
| 01/10/2019 | 08:00 | 0.475 | 37.9 | 10.9375 | 11.675 | 16.7375 |
| 01/10/2019 | 09:00 | 0.2725 | 11.3875 | 33.5 | 11.0125 | 2.7 |
| 01/10/2019 | 10:00 | 0.26125 | 7 | 37.75 | 9.55 | 9.3625 |
| 01/10/2019 | 11:00 | 0.2675 | 5.6125 | 37.875 | 9.85 | 2.7 |
| 01/10/2019 | 12:00 | 0.27625 | 11.475 | 35.4875 | 8.975 | 2.7 |
| 01/10/2019 | 13:00 | 0.26125 | 8.9375 | 41.5 | 9.4375 | 2.7 |
| 01/10/2019 | 14:00 | 0.25875 | 11.2625 | 36.075 | 9.375 | 2.7 |
| 01/10/2019 | 15:00 | 0.25 | 12.975 | 36.2625 | 11.1 | 2.7 |
| 01/10/2019 | 16:00 | 0.2425 | 14.375 | 35.875 | 10.4 | 2.8625 |
| 01/10/2019 | 17:00 | 0.23125 | 19.3625 | 34.875 | 9.2 | 2.7 |
| 01/10/2019 | 18:00 | 0.235 | 19.325 | 39.125 | 10.0125 | 2.7 |
| 01/10/2019 | 19:00 | 0.23625 | 13.3 | 46.125 | 9.65 | 2.7 |
| 01/10/2019 | 20:00 | 0.2525 | 13.75 | 40.625 | 10.0375 | 2.7 |
| 01/10/2019 | 21:00 | 0.2425 | 9.15 | 50.625 | 10.6875 | 2.7 |
| 01/10/2019 | 22:00 | 0.2325 | 8.1375 | 57.25 | 11.875 | 2.7 |
| 01/10/2019 | 23:00 | 0.23625 | 10.1875 | 50.375 | 11.675 | 2.7 |
| 02/09/2019 | 00:00 | 0.27625 | 5.7 | 58.75 | 10.775 | 2.7 |
| 02/09/2019 | 01:00 | 0.26375 | 2.075 | 58.5 | 11.4375 | 2.7 |
| 02/09/2019 | 02:00 | 0.25875 | 2.875 | 54.5 | 13.125 | 2.7 |
| 02/09/2019 | 03:00 | 0.2575 | 2.4875 | 50.125 | 14 | 2.7 |
| 02/09/2019 | 04:00 | 0.25125 | 2.225 | 50.125 | 21.75 | 2.7 |
| 02/09/2019 | 05:00 | 0.235 | 2.4375 | 42.125 | 24.875 | 2.7 |
| 02/09/2019 | 06:00 | 0.24625 | 10.8875 | 27.4 | 28.125 | 2.7 |
| 02/09/2019 | 07:00 | 0.2625 | 35.5 | 7.7 | 27.5 | 2.7 |
| 02/09/2019 | 08:00 | 0.24875 | 40.25 | 8.75 | 14 | 3.45 |
| 02/09/2019 | 09:00 | 0.2525 | 25 | 15.4 | 13 | 2.7 |
| 02/09/2019 | 10:00 | 0.26625 | 10.9375 | 23 | 16.75 | 2.7 |
| 02/09/2019 | 11:00 | 0.28125 | 2.7 | 29.125 | 19.125 | 2.7 |
| 02/09/2019 | 12:00 | 0.29625 | 2.4375 | 24.425 | 13.5 | 2.7 |
| 02/09/2019 | 13:00 | 0.30375 | 2 | 34.375 | 14.75 | 2.7 |
| 02/09/2019 | 14:00 | 0.30875 | 5.4375 | 37.5 | 17.875 | 2.7 |
| 02/09/2019 | 15:00 | 0.3125 | 19.6125 | 38.375 | 16.375 | 3.0875 |
| 02/09/2019 | 16:00 | 0.295 | 38.2875 | 36.5625 | 12.2875 | 2.7 |
| 02/09/2019 | 17:00 | 0.2925 | 24.4 | 43.25 | 14.4625 | 11.6125 |

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|---|---|---|---|---|---|---|
| 02/09/2019 | 18:00 | 0.28625 | 14.9625 | 38 | 15.0625 | 2.7 |
| 02/09/2019 | 19:00 | 0.27875 | 16.3875 | 35.625 | 16.375 | 7.9875 |
| 02/09/2019 | 20:00 | 0.2675 | 11.2 | 36.875 | 15.625 | 2.7 |
| 02/09/2019 | 21:00 | 0.26875 | 14.7125 | 26.475 | 13.475 | 3.1875 |
| 02/09/2019 | 22:00 | 0.27125 | 13.0375 | 24.9125 | 17.375 | 2.7 |
| 02/09/2019 | 23:00 | 0.27875 | 15.125 | 18.9875 | 18.625 | 2.7 |
| 06/10/2019 | 00:00 | 0.25875 | 20.2375 | 14.8 | 19 | 3.2875 |
| 06/10/2019 | 01:00 | 0.25 | 17.6625 | 15.2375 | 16.375 | 3.85 |
| 06/10/2019 | 02:00 | 0.2175 | 15.7375 | 19.25 | 16.625 | 4.4875 |
| 06/10/2019 | 03:00 | 0.21875 | 16 | 13 | 13.5 | 5.65 |
| 06/10/2019 | 04:00 | 0.21125 | 13.675 | 19.6375 | 12.8125 | 5.3125 |
| 06/10/2019 | 05:00 | 0.22375 | 15.875 | 17.75 | 12.85 | 6.2375 |
| 06/10/2019 | 06:00 | 0.2375 | 22.25 | 8.0375 | 11.1375 | 11.975 |
| 06/10/2019 | 07:00 | 0.24625 | 19 | 11.625 | 9.65 | 8.8 |
| 06/10/2019 | 08:00 | 0.28625 | 9.3125 | 25.75 | 11.2375 | 3.775 |
| 06/10/2019 | 09:00 | 0.27125 | 4.1375 | 34.5 | 12.5 | 2.7 |
| 06/10/2019 | 10:00 | 0.28875 | 6.5125 | 37.875 | 15.125 | 2.7 |
| 06/10/2019 | 11:00 | 0.2625 | 11.2125 | 40.875 | 13.225 | 5.8625 |
| 06/10/2019 | 12:00 | 0.25875 | 16.6375 | 46 | 11.725 | 6.2375 |
| 06/10/2019 | 13:00 | 0.2525 | 10.65 | 50.875 | 12.8625 | 2.7 |
| 06/10/2019 | 14:00 | 0.25625 | 4.3875 | 44.25 | 11.6125 | 2.7 |
| 06/10/2019 | 15:00 | 0.2525 | 7.45 | 40.45 | 11.575 | 2.7 |
| 06/10/2019 | 16:00 | 0.255 | 11.525 | 44 | 12.5125 | 2.7 |
| 06/10/2019 | 17:00 | 0.2525 | 7.0125 | 43.625 | 12.1 | 2.7 |
| 06/10/2019 | 18:00 | 0.2625 | 17.8625 | 26.475 | 12.8 | 2.7 |
| 06/10/2019 | 19:00 | 0.28625 | 24 | 15.8125 | 9.65 | 2.7375 |
| 06/10/2019 | 20:00 | 0.27125 | 27.125 | 13.5125 | 8.3375 | 3.525 |
| 06/10/2019 | 21:00 | 0.2725 | 33.125 | 10.95 | 8.8875 | 5.2125 |
| 06/10/2019 | 22:00 | 0.285 | 36.875 | 4.45 | 7.7375 | 6.6875 |
| 06/10/2019 | 23:00 | 0.28875 | 43.5 | 2.6375 | 7.7625 | 16.45 |
| 12/10/2019 | 00:00 | 0.23875 | 17.7125 | 20.5375 | 11.05 | 3.4125 |
| 12/10/2019 | 01:00 | 0.205 | 10.9625 | 27.025 | 9.3 | 2.825 |
| 12/10/2019 | 02:00 | 0.1975 | 11.4 | 29.8625 | 10.225 | 2.9375 |
| 12/10/2019 | 03:00 | 0.1825 | 10.7375 | 32.875 | 10.525 | 2.7625 |
| 12/10/2019 | 04:00 | 0.19 | 12.2625 | 30.4375 | 11.775 | 3.1625 |
| 12/10/2019 | 05:00 | 0.2075 | 17.8625 | 26.0625 | 12.4 | 6.525 |
| 12/10/2019 | 06:00 | 0.21125 | 25.875 | 17.3875 | 12.125 | 7.475 |
| 12/10/2019 | 07:00 | 0.23125 | 27.8625 | 15.375 | 13.375 | 5.0875 |
| 12/10/2019 | 08:00 | 0.2475 | 24.575 | 18.4375 | 15.625 | 3.0625 |
| 12/10/2019 | 09:00 | 0.24375 | 7.8125 | 41 | 16.25 | 2.7 |
| 12/10/2019 | 10:00 | 0.22375 | 3.425 | 42.375 | 15.375 | 2.7 |
| 12/10/2019 | 11:00 | 0.2575 | 2.7625 | 38.875 | 15.375 | 2.7 |
| 12/10/2019 | 12:00 | 0.2725 | 2.3625 | 34.625 | 15.875 | 2.7 |
| 12/10/2019 | 13:00 | 0.28375 | 4.775 | 38.375 | 21.5 | 2.7 |
| 12/10/2019 | 14:00 | 0.2675 | 33.2375 | 24.1875 | 26.75 | 2.7 |
| 12/10/2019 | 15:00 | 0.26 | 34.225 | 26.375 | 26 | 2.7 |

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|---|---|---|---|---|---|---|
| 12/10/2019 | 16:00 | 0.24625 | 36.6125 | 24.85 | 26.625 | 2.7 |
| 12/10/2019 | 17:00 | 0.2375 | 18.525 | 37.3875 | 23.125 | 3.7375 |
| 12/10/2019 | 18:00 | 0.22 | 12.35 | 44.75 | 22.625 | 2.7 |
| 12/10/2019 | 19:00 | 0.22125 | 15.625 | 40.125 | 20.875 | 2.9125 |
| 12/10/2019 | 20:00 | 0.22375 | 13.7 | 42.125 | 18.5 | 2.7 |
| 12/10/2019 | 21:00 | 0.23875 | 17.5875 | 34.875 | 18.875 | 2.7 |
| 12/10/2019 | 22:00 | 0.24 | 18.375 | 34.25 | 17.625 | 2.7 |
| 12/10/2019 | 23:00 | 0.26875 | 20.0375 | 29.125 | 17.25 | 2.7 |
| 16/09/2019 | 00:00 | 0.24375 | 4.05 | 41.75 | 13.5 | 2.7 |
| 16/09/2019 | 01:00 | 0.24125 | 5.475 | 39.75 | 12.7875 | 2.7 |
| 16/09/2019 | 02:00 | 0.235 | 10.625 | 43.875 | 14.25 | 2.7 |
| 16/09/2019 | 03:00 | 0.22625 | 16.125 | 37.75 | 15.5 | 2.7 |
| 16/09/2019 | 04:00 | 0.23625 | 24.25 | 32.625 | 16.75 | 2.7 |
| 16/09/2019 | 05:00 | 0.26375 | 36.875 | 35.875 | 20.625 | 2.9375 |
| 16/09/2019 | 06:00 | 0.28375 | 36.375 | 35.3125 | 20.875 | 2.7 |
| 16/09/2019 | 07:00 | 0.3075 | 34.25 | 33.25 | 18.125 | 2.7 |
| 16/09/2019 | 08:00 | 0.295 | 13.55 | 52.125 | 17.375 | 2.7 |
| 16/09/2019 | 09:00 | 0.29875 | 5.0125 | 53 | 20.75 | 3.4375 |
| 16/09/2019 | 10:00 | 0.37375 | 7.3625 | 47.9125 | 21.5 | 2.7 |
| 16/09/2019 | 11:00 | 0.335 | 16.875 | 44.625 | 21.75 | 2.7 |
| 16/09/2019 | 12:00 | 0.32875 | 22.475 | 43.25 | 23.625 | 3.8625 |
| 16/09/2019 | 13:00 | 0.3475 | 22.175 | 44.375 | 24.5 | 2.725 |
| 16/09/2019 | 14:00 | 0.32875 | 23.025 | 43 | 23.625 | 3.2625 |
| 16/09/2019 | 15:00 | 0.3225 | 21.275 | 43 | 21 | 2.7 |
| 16/09/2019 | 16:00 | 0.3175 | 17.275 | 46.9875 | 20.125 | 2.7 |
| 16/09/2019 | 17:00 | 0.315 | 18.2125 | 41.3625 | 17.625 | 2.7 |
| 16/09/2019 | 18:00 | 0.31375 | 13.1375 | 42.75 | 18 | 2.7 |
| 16/09/2019 | 19:00 | 0.32 | 15.8625 | 38.125 | 23.125 | 2.7 |
| 16/09/2019 | 20:00 | 0.325 | 18.6125 | 35.375 | 24.5 | 2.7 |
| 16/09/2019 | 21:00 | 0.33125 | 21.5125 | 25.925 | 24.5 | 2.7 |
| 16/09/2019 | 22:00 | 0.31 | 22.4 | 16.375 | 25.5 | 2.7 |
| 16/09/2019 | 23:00 | 0.28375 | 14.7375 | 19.3 | 22.375 | 2.7 |
| 22/10/2019 | 00:00 | 0.090875 | 5.2625 | 49.375 | 2.2125 | 6.5125 |
| 22/10/2019 | 01:00 | 0.10275 | 3.6125 | 46 | 5.5125 | 6.1125 |
| 22/10/2019 | 02:00 | 0.0995 | 8.575 | 32.425 | 9.2625 | 7.0125 |
| 22/10/2019 | 03:00 | 0.108375 | 18.35 | 25.375 | 23.75 | 8.875 |
| 22/10/2019 | 04:00 | 0.11425 | 17.5 | 25.975 | 3.9875 | 13.3 |
| 22/10/2019 | 05:00 | 0.125875 | 14.6625 | 30 | 2.6 | 11.5 |
| 22/10/2019 | 06:00 | 0.139875 | 15.175 | 26.975 | 5.4125 | 7.975 |
| 22/10/2019 | 07:00 | 0.146 | 20.6 | 22.0625 | 12.0125 | 9.15 |
| 22/10/2019 | 08:00 | 0.16125 | 14.6875 | 25.4625 | 16.5 | 7.775 |
| 22/10/2019 | 09:00 | 0.18125 | 12.0125 | 29.4125 | 22.625 | 2.7625 |
| 22/10/2019 | 10:00 | 0.22375 | 15.2 | 22.8625 | 29.375 | 2.7 |
| 22/10/2019 | 11:00 | 0.25125 | 15.3625 | 20.9375 | 28.75 | 3.5 |
| 22/10/2019 | 12:00 | 0.25875 | 13.0625 | 23.6875 | 57.75 | 2.7 |
| 22/10/2019 | 13:00 | 0.24875 | 9.5625 | 29.65 | 44.625 | 2.7 |

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| 22/10/2019 | 14:00 | 0.25 | 11.6875 | 42.25 | 39.625 | 2.7 |
| 22/10/2019 | 15:00 | 0.23875 | 15.0875 | 43.2875 | 40.125 | 2.7 |
| 22/10/2019 | 16:00 | 0.2575 | 27.0625 | 24.2625 | 36.25 | 2.7 |
| 22/10/2019 | 17:00 | 0.2625 | 27.0625 | 19.0125 | 39.75 | 2.7 |
| 22/10/2019 | 18:00 | 0.26625 | 22.25 | 17.2625 | 35.25 | 2.7 |
| 22/10/2019 | 19:00 | 0.225 | 20.9 | 18.8375 | 43.25 | 3.2875 |
| 22/10/2019 | 20:00 | 0.225 | 34.575 | 14.9375 | 34.125 | 5.725 |
| 22/10/2019 | 21:00 | 0.188571429 | 16.77142857 | 23.42857143 | 25.375 | 9.928571429 |
| 22/10/2019 | 22:00 | 0.125 | 16.6 | 26.8 | 19.8 | 11.02 |
| 22/10/2019 | 23:00 | 0.105666667 | 5.633333333 | 37.16666667 | 8.94 | 10.18333333 |
| 25/10/2019 | 00:00 | 0.128142857 | 12.02857143 | 30.71428571 | 6.2375 | 10.07142857 |
| 25/10/2019 | 01:00 | 0.110285714 | 9.957142857 | 31.57142857 | 6.625 | 10.47142857 |
| 25/10/2019 | 02:00 | 0.114285714 | 9.2 | 32.28571429 | 7.125 | 11.32857143 |
| 25/10/2019 | 03:00 | 0.112428571 | 15.72857143 | 22 | 6.175 | 13.94285714 |
| 25/10/2019 | 04:00 | 0.113714286 | 24.85714286 | 12.57142857 | 5.8125 | 19.07142857 |
| 25/10/2019 | 05:00 | 0.148571429 | 40 | 5.428571429 | 7.2125 | 42.14285714 |
| 25/10/2019 | 06:00 | 0.262571429 | 49.71428571 | 2.314285714 | 7.775 | 47.08571429 |
| 25/10/2019 | 07:00 | 0.434285714 | 62.71428571 | 2 | 14.175 | 97.85714286 |
| 25/10/2019 | 08:00 | 0.612857143 | 56.14285714 | 2.142857143 | 20.125 | 110.7142857 |
| 25/10/2019 | 09:00 | 0.44 | 30.71428571 | 8.4 | 13.625 | 31.81428571 |
| 25/10/2019 | 10:00 | 0.198571429 | 5.914285714 | 20.85714286 | 7.6375 | 14.88571429 |
| 25/10/2019 | 11:00 | 0.185714286 | 6.628571429 | 22.11428571 | 7.6625 | 21.02857143 |
| 25/10/2019 | 12:00 | 0.174285714 | 5.485714286 | 29 | 7.125 | 13.02857143 |
| 25/10/2019 | 13:00 | 0.17875 | 5.2 | 30.125 | 6.5375 | 11.4875 |
| 25/10/2019 | 14:00 | 0.185 | 5.05 | 28.225 | 6.8625 | 11.8625 |
| 25/10/2019 | 15:00 | 0.1775 | 5.475 | 30.875 | 6.8625 | 5.4875 |
| 25/10/2019 | 16:00 | 0.16 | 9.2125 | 35 | 6.0125 | 3.7375 |
| 25/10/2019 | 17:00 | 0.17125 | 10.625 | 31.75 | 5.1875 | 6.8125 |
| 25/10/2019 | 18:00 | 0.19875 | 26.9625 | 16.3625 | 5.2625 | 10.3875 |
| 25/10/2019 | 19:00 | 0.23875 | 39.625 | 8.4625 | 4.925 | 28.6375 |
| 25/10/2019 | 20:00 | 0.21125 | 36.9875 | 16.25 | 6.05 | 24.925 |
| 25/10/2019 | 21:00 | 0.19375 | 27.75 | 17.625 | 5.725 | 15.975 |
| 25/10/2019 | 22:00 | 0.20625 | 27.375 | 14.25 | 5.5 | 15.1125 |
| 25/10/2019 | 23:00 | 0.23125 | 34.875 | 5.35 | 6.0125 | 21.2125 |
| 26/10/2019 | 00:00 | 0.15725 | 23.125 | 12.3875 | 4.25 | 15.5875 |
| 26/10/2019 | 01:00 | 0.182125 | 27 | 9.4875 | 4.325 | 14.425 |
| 26/10/2019 | 02:00 | 0.1645 | 24.2625 | 9.775 | 4.1625 | 14.1375 |
| 26/10/2019 | 03:00 | 0.140875 | 23.875 | 10.5625 | 3.7875 | 17.35 |
| 26/10/2019 | 04:00 | 0.135375 | 24.8 | 8.2875 | 4.0125 | 16.05 |
| 26/10/2019 | 05:00 | 0.18725 | 36.5 | 5.65 | 5.15 | 31.925 |
| 26/10/2019 | 06:00 | 0.205625 | 49.125 | 2.3625 | 5.925 | 40.6 |
| 26/10/2019 | 07:00 | 0.2975 | 46.375 | 2 | 8.0625 | 47.1125 |
| 26/10/2019 | 08:00 | 0.30375 | 30.375 | 5.625 | 13.6125 | 20.9 |
| 26/10/2019 | 09:00 | 0.265 | 7.3125 | 20.9625 | 11.5125 | 2.9 |
| 26/10/2019 | 10:00 | 0.2275 | 3.525 | 23.5 | 6.675 | 2.7375 |
| 26/10/2019 | 11:00 | 0.18875 | 3.7625 | 30.125 | 6.4 | 2.7 |

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| 26/10/2019 | 12:00 | 0.18125 | 3.55 | 36.1375 | 5.9375 | 2.7 |
| 26/10/2019 | 13:00 | 0.18125 | 9.8125 | 31.875 | 4.775 | 2.7 |
| 26/10/2019 | 14:00 | 0.2025 | 13.25 | 39.125 | 6.0625 | 2.7 |
| 26/10/2019 | 15:00 | 0.21625 | 9.1375 | 43.875 | 5.3875 | 2.7 |
| 26/10/2019 | 16:00 | 0.2125 | 20.8625 | 37.55 | 6.7125 | 2.7 |
| 26/10/2019 | 17:00 | 0.20375 | 29.875 | 30.625 | 8.8625 | 5.1 |
| 26/10/2019 | 18:00 | 0.20125 | 36.25 | 22.625 | 9.4125 | 7.525 |
| 26/10/2019 | 19:00 | 0.23125 | 37.75 | 16.075 | 9.7875 | 8.875 |
| 26/10/2019 | 20:00 | 0.28125 | 38.625 | 9.9625 | 10.1625 | 20.2125 |
| 26/10/2019 | 21:00 | 0.37125 | 47 | 2.4375 | 9.875 | 40.05 |
| 26/10/2019 | 22:00 | 0.32 | 34.125 | 7.375 | 9.6875 | 27.15 |
| 26/10/2019 | 23:00 | 0.2875 | 28.75 | 8.4625 | 9.225 | 21.25 |
| 27/10/2019 | 00:00 | 0.255 | 26.25 | 6.4625 | 9.7125 | 16.5625 |
| 27/10/2019 | 01:00 | 0.1875 | 18.4875 | 21.5375 | 10.25 | 11.375 |
| 27/10/2019 | 02:00 | 0.159875 | 15.7375 | 26 | 9.725 | 10.6125 |
| 27/10/2019 | 03:00 | 0.1585 | 19.45 | 11.875 | 8.125 | 12.9375 |
| 27/10/2019 | 04:00 | 0.131875 | 15.2375 | 16.3375 | 7.8625 | 13.8875 |
| 27/10/2019 | 05:00 | 0.138375 | 16.2375 | 18.375 | 7.95 | 11.625 |
| 27/10/2019 | 06:00 | 0.153375 | 21.4625 | 12.5125 | 7.55 | 15.025 |
| 27/10/2019 | 07:00 | 0.223875 | 25.625 | 6.4 | 7.7125 | 29.0375 |
| 27/10/2019 | 08:00 | 0.21625 | 14.2125 | 13.2375 | 6.425 | 19.975 |
| 27/10/2019 | 09:00 | 0.2175 | 3.85 | 35.3625 | 8.7375 | 3.0625 |
| 27/10/2019 | 10:00 | 0.2075 | 2.4375 | 39.375 | 8.95 | 2.7 |
| 27/10/2019 | 11:00 | 0.21875 | 4.2125 | 37.125 | 9.6 | 2.7 |
| 27/10/2019 | 12:00 | 0.2 | 2.0375 | 39.625 | 8.0375 | 2.7 |
| 27/10/2019 | 13:00 | 0.17375 | 1.9625 | 50.375 | 9.6125 | 2.7 |
| 27/10/2019 | 14:00 | 0.17875 | 4.95 | 59.25 | 9.2 | 2.7 |
| 27/10/2019 | 15:00 | 0.1925 | 11.35 | 53.125 | 10.225 | 2.7 |
| 27/10/2019 | 16:00 | 0.18875 | 15.4375 | 46.25 | 10.55 | 2.7 |
| 27/10/2019 | 17:00 | 0.18375 | 16.975 | 43.75 | 9.9375 | 3.3625 |
| 27/10/2019 | 18:00 | 0.2125 | 26.125 | 27.3625 | 10.6125 | 6.8625 |
| 27/10/2019 | 19:00 | 0.29375 | 40.875 | 5.875 | 9.525 | 13.1875 |
| 27/10/2019 | 20:00 | 0.27125 | 35.875 | 8.175 | 8.8375 | 16.3875 |
| 27/10/2019 | 21:00 | 0.23625 | 31.125 | 12.4875 | 8.7125 | 16.0375 |
| 27/10/2019 | 22:00 | 0.27375 | 34.5 | 7.1125 | 8.05 | 26.35 |
| 27/10/2019 | 23:00 | 0.19875 | 19.5 | 18.7125 | 7 | 13.625 |