

Research Article

Double Cote's Spiral in M83 Galaxies, NGC 1566 and Cyclone in the South Georgia and South Sandwich Islands

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One comparative analysis of the shape of spiral galaxies and the subtropical cyclone that formed north of Georgia Island and passed north of the South Sandwich Islands, in the South Atlantic Ocean. Subtropical cyclones with double spirals appear to be common in these areas of the South Atlantic. A subtropical cyclone is a weather system that has some characteristics of a tropical cyclone and some characteristics of an extratropical cyclone. They can form between the equator and the 50th parallel. In mathematics, a spiral is a curve, which emanates from a point, moving farther away as it revolves around the point. The characteristic shape of hurricanes, cyclones, typhoons is a spiral. The characteristic equation of which spiral the Extratropical Cyclone (EC) Its double spiral shape, whose mathematical equation has already been defined as Cote's spiral, Gobato et al. (2022) and similarly Lindblad (1964) show shape of double spiral galaxies, already studied among others is discussed here [44].

The South Georgia Group lies about 1,390 km (860 mi; 750 mi) east-southeast of the Falkland Islands, at 54°-55°S, 36°-38°W. It comprises South Georgia Island itself by far the largest island in the territory, and the islands that immediately surround it and some remote and isolated islets to the west and east-southeast. It has a total land area of 3,756 square kilometers (1,450 sq. mi), including satellite islands, but excluding the South Sandwich Islands, which form a separate island group [53,56]. A cyclone is a large air mass that rotates around a strong center of low atmospheric pressure, counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere as viewed from above (opposite to an anticyclone) [1-4,27,29]. A subtropical cyclone is a weather system that has some characteristics of a tropical cyclone and some characteristics of an extratropical cyclone. They can form between the equator and the 50th parallel [1-9,26,27].

These storms usually have a radius of maximum winds that is larger than what is observed in purely tropical systems, and their maximum sustained winds have not been observed to exceed about 32 m/s (64 knots). Subtropical cyclones sometimes become true tropical cyclones, and likewise, tropical cyclones occasionally become subtropical storms. Subtropical cyclones in the Atlantic basin are classified by their maximum sustained surface winds: Subtropical depressions have surface winds less than 18 m/s (35 knots), while subtropical storms have surface winds greater than or equal to 18 m/s [9-21,26,27,29].

In mathematics, a spiral is a curve, which emanates from a point, moving farther away as it revolves around the point [23-25]. The characteristic shape of hurricanes, cyclones, typhoons is a spiral [26,27,29,34-41]. There are several types of turns, and determining the characteristic equation of which spiral the cyclone bomb (CB) [28] fits into is the goal of the work. Spiral galaxies form a class of galaxy originally described by Edwin Hubble in his 1936 work *The Realm of the Nebulae* and, as such, form part of the Hubble sequence. Most spiral galaxies consist of a flat, rotating disk containing stars, gas and dust, and a central concentration of stars known as the bulge. These are often surrounded by a much fainter halo of stars, many of which reside in globular clusters [54].

The core of cyclone presents the form of a double spiral, Figure 1, in the same way the study of the spiral of the galaxies of Lindblad, (1964) [32]. This spiral is denoted from Cotes Spiral Gobato et al. (2000) [7-11,18-20,22-25,44].

The very fine image quality of this camera, coupled with the huge light-collecting power of the VLT, reveals vast numbers of stars within the galaxy. The images were taken in three different parts of the infrared spectrum and the total exposure time was eight and a half hours, split into more than five hundred exposures of one minute each. The field of view is about 13 arcminutes across [49,55].

The Figure 2 show Hubble image captures hundreds of thousands of individual stars, thousands of star clusters and hundreds of supernova remnants in the spiral galaxy M83. Also known as the Southern Pinwheel, this galaxy is located 15 million light-years away from Earth in the constellation Hydra. It was discovered in 1752 by the French astronomer Nicolas Louis de Lacaille. With an apparent magnitude of 7.5, M83 is one of the brightest spiral galaxies in the night sky. It can be observed using a pair of binoculars most easily in May [49,50].

NGC 1566, sometimes known as the Spanish Dancer, is an intermediate spiral galaxy in the constellation Dorado, positioned about 3.5° to the south of the star Gamma Doradus (Figure 3). It was discovered on May 28, 1826 by Scottish astronomer James Dunlop. At 10th magnitude, it requires a telescope to view. The distance to this galaxy remains elusive, with measurements ranging from 6 Mpc up to

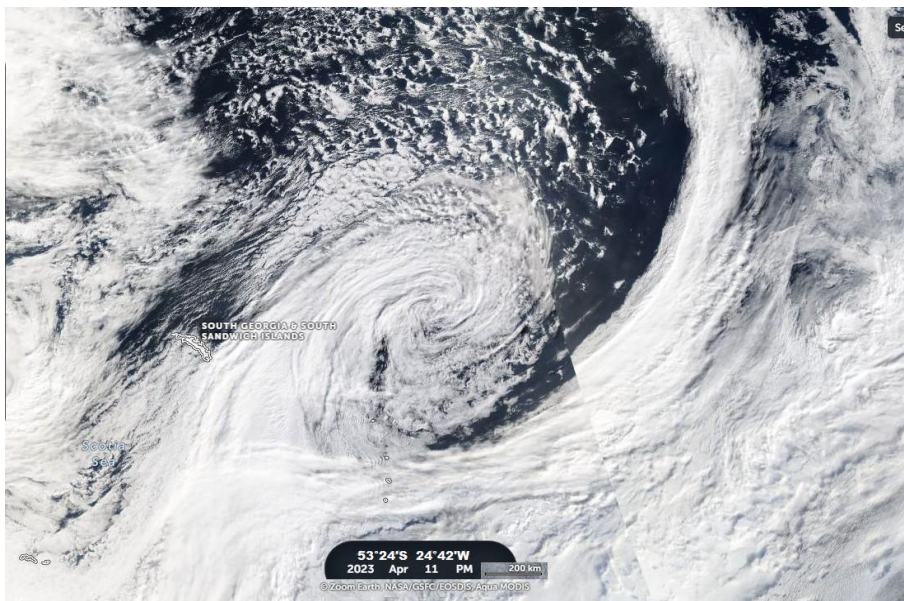


Figure 1: Image of Georgia, scale 1:200, on April 11, 2003, PM, and nucleus at the coordinates given in the image [46] [Authors].

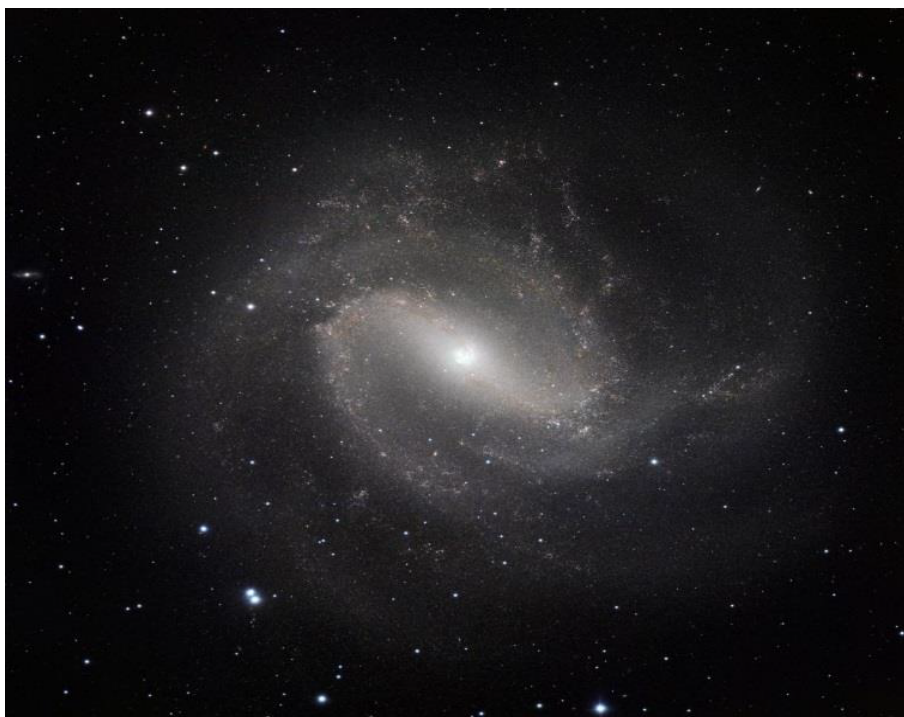


Figure 2: Spectacular spiral galaxies using the impressive power of the HAWK-I [49,50].

21 Mpc [50,51]. The small but extremely bright nucleus of NGC 1566 is clearly visible in this image, a telltale sign of its membership of the Seyfert class of galaxies. The centers of such galaxies are very active and luminous emitting strong bursts of radiation and potentially harboring supermassive black holes that are many millions of times the mass of the sun [50,51].

NGC 1566 is not just any Seyfert galaxy; it is the second brightest Seyfert galaxy known. It is also the brightest and most dominant member of the Dorado Group, a loose concentration of galaxies that together comprise one of the richest galaxy groups of the southern

hemisphere. This image highlights the beauty and awe-inspiring nature of this unique galaxy group, with NGC 1566 glittering and glowing, its bright nucleus framed by swirling and symmetrical lavender arms [50,51].

NGC 1566 is an intermediate spiral galaxy, meaning that while it does not have a well-defined bar-shaped region of stars at its center like barred spirals it is not quite an unbarred spiral either [50,51]. The Figure 1 show the image of Georgia, scale 1:200, on April 11, 2003, PM, and nucleus at the coordinates given in the image. The Georgia, on April 11, 2003, PM and nucleus at the coordinates given in the



Figure 3: Hubble image shows NGC 1566, a beautiful galaxy located approximately 40 million light-years away in the constellation of Dorado (The Dolphinfish). NGC 1566 is an intermediate spiral galaxy, meaning that while it does not have a well-defined bar-shaped region of stars at its center like barred spirals it is not quite an unbarred spiral either [50,51].

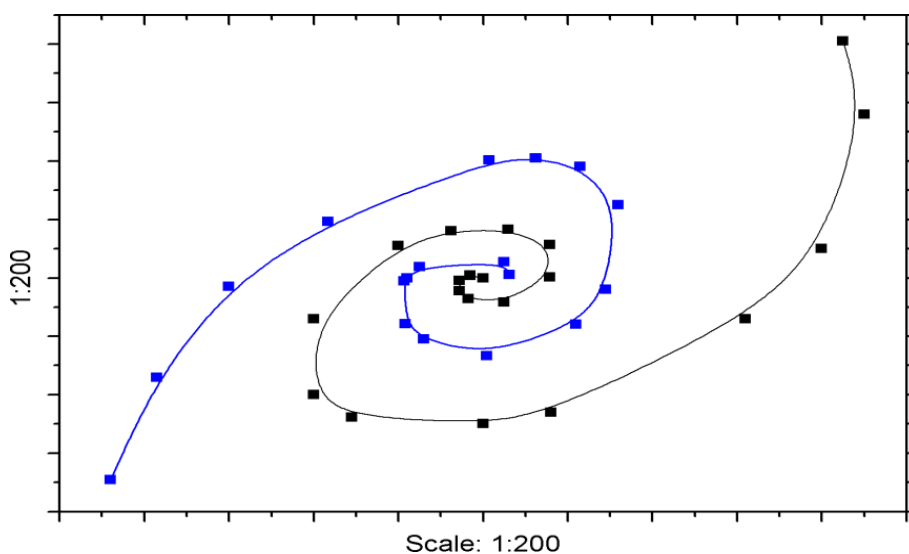


Figure 4 : Image of Georgia, scale 1:100, in surface wind model generated by the Zoom Earth system, on April 11, 2003, 12:00 with 5 km/h WSW, and nucleus at the coordinates given in the image.

image. The of Georgia, in an atmospheric pressure gradient model generated by the Zoom Earth system, on April 11, 2003, 12:30, with 951 mbar, and whose core was located at approximate coordinates of image. The image of Georgia, in surface wind model generated by the Zoom Earth system, on April 11, 2003, 12:00, with 5 km/h WSW, and nucleus at the coordinates given in the image.

The model of wind currents for the displacement of air masses observed in the images is consistent with that observed which presents a great turbulence in the vortex. The highlighted cyclone vortex still in turbulent formation presents two linear containment barriers, in an L shape. The subtropical cyclone that formed northwest

of South Georgia and South Sandwich Island is here called Georgia. It moved 237 km in 12 h towards the West, when it was 589 km from South Georgia Island, to 809 km from the center of the coast of the South Georgia Island. During this time interval, it maintained an atmospheric pressure at sea level at its vortex close to 951 hPa. It presented rotational winds of 5 km/h approximately 8 km from the central vortex (Figure 4).

The analogous shape of Georgia and the galaxies Messier 83 and NGC 1566, studied here, is clear. These present a double spiral, as studied by Lindblad [47], but with the Cote's spiral form, Gobato et al. (2022) [8,9,11] (Table 1).

Table 1: Subtropical Cyclone Georgia: Location/Pressure.

April 11, 2023	Coordinates	Pressure (hPa)
AM	53°13'09"S 27°45'05"W	951
PM	53°16'42"S 24°00'38"W	951

The subtropical cyclone that formed northwest of South Georgia & South Sandwich Island is here called Georgia. It moved 237 km in 12 h towards the West, when it was 589 km from South Georgia Island, to 809 km from the center of the coast of the South Georgia Island. During this time interval, it maintained an atmospheric pressure at sea level at its vortex close to 951 hPa. It presented rotational winds of 5 km/h approximately 8 km from the central vortex. With an approximate dimension of 1,000,000 km², and an area of direct influence of 3,500,000 km², the subtropical cyclone Georgia moved at an average speed of 19.75 km/h.

The mathematical model for the atmospheric pressure gradient used by ZoomEarth [43] matches the correct way to scale the atmospheric pressure, as can be seen in the comparison of the satellite images. The model of wind currents for the displacement of air masses observed in the images is consistent with that observed in which presents a great turbulence in the vortex. The image of Georgia, scale 1:20, on April 11, 2003, PM and nucleus at the coordinates given in the image. The image of Georgia, on a 1:100 scale, in an atmospheric pressure gradient model generated by the Zoom Earth system, on April 11, 2003, 12:30, with 951 mbar, and whose core was located at approximate coordinates of image, and image of Georgia, scale 1:100, in surface wind model generated by the Zoom Earth system, on April 11, 2003, 12:00, with 5 km/h WSW, and nucleus at the coordinates given in the image. The highlighted cyclone vortex still in turbulent formation presents two linear containment barriers, in an L shape. The have Georgia's double spiral Cote's shape. The analogous shape of Georgia and the galaxies Messier 83 and NGC 1566, studied here, is clear. These present a double spiral, as studied by Lindblad (1964) [47], but with the Cote's spiral form, Gobato et al. (2022) [8,9,11,44].

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