

“WINTER-CLOUDS”

Clouds in the sky of PUJATO during the winter 2018



School: Escuela Primaria Particular Incorporada N°1345

“Nuestra Señora del Carmen”

9 de julio 860 C.P. S2122 Pujato (Pcia: Santa Fe) – Argentina

Phone: +54 3464 494552 **email:** prim1345_pujato@santafe.edu.ar

School Director: Poggiani, Rosalía Inés

GLOBE Teachers:

Schoenfeld, María de Luján lujipujato@hotmail.com

Flores, María Luz luz.16.07@hotmail.com

González, Camila Belén camilabgm@hotmail.com

Students of Lower Primary (ages 5-8)

Surname and Name	Age
Baldomá, Luciano E.	Eight
Bengolea, Federico J.	Eight
Biscoglio, Tomás	Eight
Donda, María Lucía	Eight
Fagiani, Santiago L.	Eight
Federico, Máximo	Eight
Malénica, Bianca	Eight
Marelli, Ignacio	Eight
Peralta, Ezequiel M.	Eight
Salto, Facundo D.	Eight
Sensacore, Gennaro	Eight
Aranda, Juan Cruz	Seven
Celestre, Benjamín L.	Seven
Dichiara, Lisandro	Seven
Ferraro, Franco	Seven
Fiori, Benicio	Seven
Lo Menzo, Santino A.	Seven

Marelli, Facundo	Seven
Masera, Lucas L.	Seven
Quiroga, Tobías R.	Seven
Sensacore, Juan Segundo	Seven
Torres, Daniel A.	Seven
Andrada, Solange	Seven
Berto, Ornella C.	Seven
Colman, Tatiana	Seven
Coria Graciosi, Maura	Seven
Craia, Lourdes L.	Seven
De Marco, Ana Paula	Seven
Emiliozzi, Lara S.	Seven
Marín, Felicitas	Seven
Natali, Juliana	Seven
Parucci, Victoria	Seven
Poggiani, Lucía	Seven
Salman, Brianna	Seven
Villada, Maia M.	Seven
Bengolea, Santino	Six
Biscoglio, Ignacio	Six
Bordignon, Bruno J.	Six
Brizzola, Agustín M.	Six
Callegari, Vittorio	Six
Camillozzi, Dante	Six
Cristianson, Tiago	Six
Fagiani, Martín O.	Six
Francescutti, Tomás	Six
Lambertucci, Vito	Six
Machado, Galo	Six
Marilungo, Mateo	Six
Marín, Teo	Six
Martinángeli, Bruno	Six
Donda, Bianca	Six
Gatti, Luz	Six
Gonzalez, Milagros	Six
Longoni, Maia E.	Six
Natalini, Sophía	Six
Rolt, Mía R.	Six
Senzacore, Paula M.	Six
Toscanelli, Delfina	Six

Teacher of English: Grosso, Natalia

GLOBE zone coordinator for Santa Fe's province: Romagnoli, Claudia María

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ABSTRACT

This work is proposed from the Natural Sciences subject by students of the first cycle of Primary School (E.P.P.I) N°1345 "Nuestra Señora del Carmen" from Pujato, Santa Fe Province, Republic of Argentina, who, during the winter of 2018, while waiting for the bell so as to enter the classroom, they are watching the sky in the playground and playing to discover clouds and figures hidden in them. It is by this way, how the interest in the sky, clouds and their origin, appears.

The above-mentioned situation of observation and with the antecedent that the school participates in the GLOBE Program¹ with the protocols of atmosphere, in particular related to the cloudiness, arises the present project whose research problem is: How are the clouds on the sky visible from the E.P.P.I. N° 1345 "Nuestra Señora del Carmen" from the town of Pujato during the winter months of the year 2018 in terms of shape, height and percentage of coverage?

The same allows you to start the exploration activities, where they began to identify the shapes of the clouds, their colors, heights, percentage of coverage and its variables among other activities that allow to enunciate the following hypothesis: *The clouds present in the sky of Pujato, particularly those seen from the E.P.P.I N° 1345 "Nuestra Señora del Carmen", during the winter of 2018 undergo visible changes with the naked eye, that is to say, changes in shape, different heights and coverage which varies according to the passing of days, the evidence is that in this part of the planet and during the winter the three main groups of clouds (cumulus-stratus and cirrus) can be observed being the sky an ideal place to understand and study the clouds, their transformations and mysteries.*

The development of the investigation begins. It is the phase of observation, inquiry and interpretation of data that allows to verify the hypothesis. Throughout the project different activities are performed in order to give an answer to the research question.

Finally, the hypothesis was verified, through the application of resources, collaborative and interdisciplinary work and exploratory activities motivated by the interest and curiosity to know about cloudiness that accompanies us every day and connect us with reality.

Keywords: Types of clouds. Cloud Coverage. GLOBE protocols.

¹ GLOBE (The Global Learning and Observations to Benefit the Environment): International program, sponsored by NASA that promotes the learning and teaching of Science for the benefit of the environment. School 1345 participates in this program with different protocols since 2002. Website: www.globe.gov

INTRODUCTION

The E.E.P.I N°1345 "Nuestra Señora del Carmen" in the village of Pujato, is located in the south of the province of Santa Fe in Argentina, as shown in Figure 1.



Figure 1: Pujato in America

The school has a large playground that allows students to enjoy recreation, in addition, it is an ideal place to observe the sky during both day and night.



Figure 2: EPPI N°1345 playground photo. East view

This work is developed including the Natural Sciences subject of the lower primary grades (children between 5 and 8 years old), in the E.P.P.I N°1345 of the town of Pujato, during the winter period 2018, while the students wait for the bell to enter the classroom, they watch the sky from the

playground and play to discover clouds and figures hidden in them. As a result , their interest in the sky, clouds started.

Research Question:

In this context of playing and observation arises the following research question that guided this project: **How are the clouds on the sky visible from the E.P.P.I. No. 1345 "Nuestra Señora del Carmen" in the town of Pujato during the winter months of the year 2018 in terms of shape, height and percentage of coverage?**

Hypothesis

In order to answer the research question arises the following **hypothesis**:

The clouds present in the sky of Pujato, particularly over the E.P.P.I N°1345 "Nuestra Señora del Carmen", during the winter of 2018 undergo visible changes with the naked eye, that is to say, changes in shapes, different heights and coverage which varies according to the passing of days, the evidence is that in this part of the planet and during the winter the three main groups of clouds (cumulus, stratus and cirrus) can be observed being the sky an ideal place to understand and study the clouds.

Considering the interest that motivates the development of the present work the following objectives are proposed:

General objective

- ✓ To characterize the clouds seen in the sky of Pujato, particularly above the school N°.1345, during the winter of 2018.

Specific objectives

- ✓ To know, analyze and understand what is a cloud, how it is formed, which is its importance.
- ✓ To study the formation, the classification of the clouds according to height and shape, and the cloud coverage.
- ✓ To recognize the visual conditions that presents the cloudiness in the sky of Pujato during the winter months.

Relationship with curricular content

Curricular content according to the Nuclei of Priority Programming (NAP):

Natural Sciences

In relation to the Earth, The Universe and its changes:

- ✓ The realization of observations, the record in different formats (charts, written, audio) and the communication about diversity, characteristics, and changes or cycles of living beings, the environment, the materials and the mechanical actions.
- ✓ The recognition of the diversity of landforms present in the landscapes and the understanding of the changes, the cycles and the constant aspects of the landscape and the sky.
- ✓ The approach to the concept of landscape as the set of observable elements of the environment (including water, air, earth, sky, living beings), recognizing their diversity, some of your changes and possible causes, as well as the use that people make of them.

Mathematics

- ✓ Interpretation of information presented orally or in writing (contexts, tables, drawings, graphs).

Language

- ✓ The assiduous participation in talks to plan tasks, making contributions that conform to content and purpose of the communication.
- ✓ Listening comprehension and enjoyment of texts expressed orally by the teachers and other adults.
- ✓ The writing of various types of texts that can be understood by them and by others.

Ethics and Citizenship Education

- ✓ The exercise of dialogue and its progressive valuation as a tool for the construction of agreement.

Theoretical framework

Once everything was worked up and analyzed the following concepts gave rise to the framework that underpins the present work:

Meteorology: Meteorology is a scientific and technical discipline that is responsible for studying and predicting the various phenomena that occur in the atmosphere, to understand on the one hand its operation, composition, structure and evolution, and on the other hand to have important daily predictions very useful for different human activities.

For this reason, the fundamental activity that took place in the project, was to *observe*: To look at something or someone with a lot of attention and detail to acquire some knowledge about their behavior or their characteristics, to be more specific, *observing with the naked eye* observation or to the behavior *naked eye* which is made without optical instruments that help to perceive with more

details objects in the sky, using just the eyes, *Sky*: Part of the atmosphere and outer space seen from Earth, in which the sun, moon and stars are seen, clouds are "A portion of air clouded by the condensed water vapor in the form of numerous small liquid droplets in crystallites of ice or in frozen spheres or by mixing of both elements ".

It is the physical and visual materialization of the atmospheric water vapor that, when changing phase (liquid or solid) and grouped, forms structures that cover the sky totally or partially.

The interaction of sunlight with ice droplets and crystallites causes the clouds to be seen with different colors, that is to say, sometimes they appear white, grayish and even black before the eyes.

Components of the clouds:

Air: Gaseous, transparent, odorless and tasteless substance that envelops the Earth and forms the atmosphere; it consists mainly of oxygen and nitrogen, and by varying amounts of argon, water vapor and carbon dioxide.

Steam: Gaseous state that the fluids adopt by the action of heat.

Water: Liquid substance without smell, color or flavor found in nature in a more or less pure state forming rivers, lakes and seas, occupies three quarters of the planet Earth and is part of living beings; It is constituted by hydrogen and oxygen (H_2O).

Drops: Rounded particle that comes off a liquid.

Ice crystals: Type of precipitation composed of unbranched crystals in the form of needles, columns, or sheets, usually they have a very smooth downward movement, they can fall from a cloudless sky.

Water states: water can occur in three states or phases:

Solid phase: The particles in a solid are strongly bound together. The ice cubes keep their shape independently of the container that contains them.

Liquid phase: The particles are no longer ordered. The bond between the molecules breaks down and the water can thus take the shape of the container that contains it. The particles are very close to each other, and thus the liquid is practically noncompressible.

Gas phase: The agitation and the disorder are maximum. Water vapor occupies the entire space of the container. The distances between the molecules are large and a gas is thus compressible. We noticed that water vapor is invisible.

Taking into account the aforementioned information, the specific objective is also to understand the importance of *clouds in the water cycle*.

The water on earth is always moving, changing from liquid to vapor and back to liquid, and to snow or ice near the poles and mountains.

The process is called the water cycle or hydrological cycle in our land, bringing water to the ground and from one region of the globe to another.

To complement the project, the Experimentation was carried out: A set of tests to which something is subjected to prove its efficacy and validity or to examine its characteristics.

Formation of a cloud:

As the sun's energy reaches the Earth, the process of cloud formation begins with the evaporation of water from the surface. The water vapor contained in the air rises heated by terrestrial irradiation. As it warms up, water vapor rises, it rises, it cools and condenses. If that water vapor finds condensation nuclei in the atmosphere (mostly any particle or aerosol in the atmosphere) it will adhere to them forming very small drops of water or ice crystals. These droplets, which have a spherical shape and measure between 0.004 and 0.1 mm, are in continuous movement when suspended in the air and when subjected to updrafts, so they collide with one another and group together. Depending on the atmospheric conditions, an increase in its thickness may occur in order to precipitate them.

Condensation cores: Particles on which condensation of water vapor in the atmosphere occurs. The nuclei can be presented in solid or liquid state. They are small particles such as dust, smoke, salt, aerosols or water droplets. Without the condensation nuclei the clouds would only form if the temperature reaches 40° below zero.

Condensation: Condensation is the change in matter from a substance to a denser phase, such as gas (or vapor) to liquid. Condensation usually occurs when a vapor cools, but it can also occur if it is compressed (that is, if the pressure is increased) or subjected to a combination of cooling and compression.

Evaporation: Evaporation is a physical process by which water or other liquid substances pass from the liquid state to the gaseous state.

Precipitation or rain: form of water in a liquid or solid state that falls directly on the surface of the Earth or another planet. This includes rain, drizzle, freezing drizzle, freezing rain, hail, granulated ice, snow, small hail, and snow sticks.

Clouds that produce precipitation: Precipitating clouds have a name with prefix / nimbus suffix.

The precipitation can be of any form, like rain, snow or hail. *Cumulonimbus* clouds (Figure 3) are known as storm clouds and are sometimes called anvil clouds because of their shape. The *nimbostratus* clouds (Figure 4) often bring continuous and constant precipitation.



Figure 3: Cumulonimbus



Figure 4: Nimbostratus

To carry out the observation of the sky, the following observable aspects of the clouds were taken into account:

As regard height:

- ✓ *low clouds* are those that are close to the ground and reach up to 2-3 km in height
- ✓ *average clouds* occupy an intermediate level between 3 and 7 km
- ✓ *high clouds* are those that occupy the upper level of the troposphere and can reach up to 14 km or more.

As regard the form:

In 1803 Luke Howard used Latin terms to classify the main types of clouds. *Cumulus* means heaps and are described as heaped and thick clouds (Figure 5). *Cirrus* means hair and they are described as clouds that are at a high level and appear thin, like a lock of hair (Figure 6). Clouds that look like layers, with a uniform base, are called *Stratus* (Figure 7).

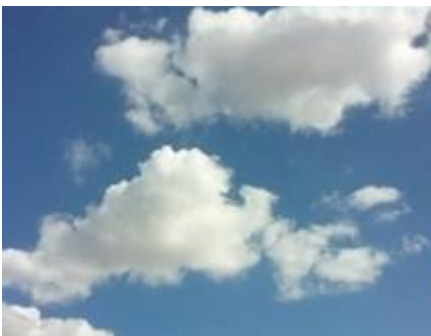


Figure 5: Cumulus



Figure 6: Cirrus

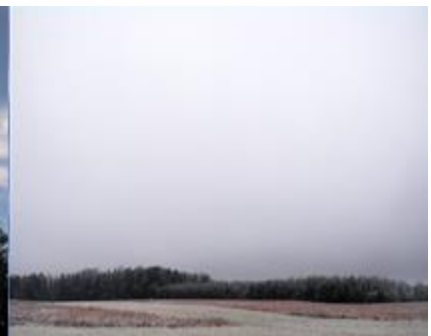


Figure 7: Stratus

As already noted, the term *Nimbus* refers to clouds with rain, which are low and gray. *High* is used to describe clouds that are at medium level.

Finally, *convective* clouds have a vertical development which extends through large portions in the atmosphere.

Contrails: special clouds that form when water vapor condenses and freezes around small particles (aerosols) present in the exhaust of an airplane.

Part of that water vapor comes from the air that surrounds the plane and the escape.

All contrails are formed by the same materials and in the same way, but they remain for different periods of time. In Figure 8 you can see examples of contrails.



Figure 8: Contrails

As for the height of these types of clouds, cirrus and contrails are high clouds; the cumulus and the stratus are low.

Regarding the visual conditions of the sky

- ✓ *Transparent*: thin clouds, through which the light passes easily and you can even see the blue sky. Milky, bluish-whitish appearance.
- ✓ *Translucent*: medium thickness clouds that let in some sunlight. There may be some milky white, bluish near the edges and a little grey; but these clouds are mostly bright white.
- ✓ *Opaque*: thick clouds that do not allow light to pass directly, although light can diffuse through it. They look grey.

Regarding the percentage of total cloud cover

- ✓ Without clouds
- ✓ Clear (0% - 10%)
- ✓ Asylee (10% - 25%)
- ✓ Scattered (25% - 50%)
- ✓ Fragmented (50% - 90%)
- ✓ Cloudy (90% - 100%)

Winter: it is one of the four seasons of temperate climate, like in which Pujato (Santa Fe) is located. From an astronomical point of view, in the southern hemisphere begins with the winter solstice, on June 21, and ends with the spring equinox, around September 21, varying the dates slightly according to the year. In 2018 the winter solstice occurs on June 21 and the spring equinox on September 22. Winter is characterized by being the coldest season of the year; During the winter days the temperatures are lower and there are fewer hours of sunlight.

MATERIALS AND METHODS

The activities of this project are carried out in weekly Integration workshops. All the work detailed below is meticulously developed in the field folder.

- **START OF THE PROJECT:**

In the month of April, of this school year, at 13:30 local time (16:30 universal time) the members of the present project observe the sky from the school playground and play to discover figures hidden in the clouds. By expressing concern for the shapes, colors and the "artistic" name that are placed on these forms. As they discover the clouds, the interest in deepening and investigating the subject also increases. In this context and under this situation arise the bases and the problem that underlie this exploratory research.

- **INFORMATION SEARCH:**

The students bring from their home informative material about the clouds, obtained from books, magazines and the internet. The youngest read the images and the older ones read the texts previously selected according to the age of those involved in the observation process. Then the most relevant information is selected and recorded in the field folder as a first approach in order to know more about the object of study: THE CLOUDS.

While the students were doing this research, the advisory teachers participated in the meeting of GLOBE schools where topics related to Meteorology were developed by the Master Trainer GLOBE, Claudia Romagnoli. On that occasion the teachers of the E.P.P.I 1345 exchanged information about clouds with members of other GLOBE schools, including the High School 241 of Pujato and the Primary School 6371 of Zavalla whose students also complete cloud protocols. These exchanges allow to deepen knowledge.

- **DEFINITION OF THE STUDY SITE**

It is selected as a study site: the playground of the E.P.P.I. N°1345, called "Schoolyard" whose coordinates are: *33,02° south latitude; 61,04° west longitude*

The geographical coordinates of study site were determined with a GPS and were indicated on a satellite image of the locality obtained from "Google maps" (Figure 9).



Figure 9: Satellite image of Pujato where the study site is located

The E.P.P.I. N°1345 participates in the activities of the GLOBE program since 2002, the data of the institution can be found on the website

<https://www.globe.gov/es/web/escuela-primaria-particular-incorporada-n.-1345/home>.

This site "Schoolyard" is inside another GLOBE greater atmosphere site of the same school, whose name is Atmospheric Research: ATM01; Using the visualization tools of the GLOBE program, at https://vis.globe.gov/GLOBE/?site_id=152, information about that site can be obtained, within

GLOBE Visualization System

Measurements | Data Counts | 2018-12-11

School: Escuela Primaria Particular Incorporada N°1345 Nuestra Señora del Carmen

Site: Investigación Atmosférica:ATM-01

Measurements	Data Counts	School Info	Site Info	Photos
Longitude	-61.043°			
Elevation	57.4m (ellipsoidal)			
Location Source	gps			

Atmosphere Site

Comments
Es importante aclarar que los instrumentos no se encuentran en una caseta sino que son sensores de una central meteorológica automática que, con la orientación de meteorólogos del Servicio Meteorológico Nacional se ubicaron, dadas las condiciones edilicias de la escuela, sobre el techo de la sala de Ciencias de la Escuela Primaria N°1345..

Activated At
2018-04-15 16:52:50.836894

Obstacles
other

Surface Cover
other

Surface Description
Los sensores se encuentran sobre el techo de la sala de Ciencias, justo en el límite por lo que mayormente la superficie reflectante es la del suelo con gramíneas de menos de 10 cm, además de la pequeña parte de techo

Figure 10: Screen capture with information from the study site "Atmospheric Research" -ATM01

which the cloud observations of this project were made (Figure 10).

As for the obstacles, it should be noted that, towards the North, South and West directions, there is the school building and to the East there is a fence that separates with neighboring buildings; but being low constructions, they do not hinder the vision of the sky.

The new site "Schoolyard" is defined in the GLOBE site, within the Particular Private School No. 1345 "Nuestra Señora del Carmen", as shown in Figure 11

The screenshot shows the GLOBE PROGRAM 'Entrada de datos CIENCIA' interface. The page title is 'Definición del sitio'. On the left, there is a sidebar with categories: 'Añadir tipo de sitio', 'Atmósfera' (with 'Atmósfera' checked), 'Hidrosfera', 'Biosfera', 'Pedosfera', and 'Fotos'. The main form area contains the following fields: 'nombre de sitio' (with the value 'Patio escolar'), 'ID de sitio' (with the value '143565'), 'Coordenadas' (with 'Latitud' set to -33.02 and 'Longitud' set to -61.04), and 'Elevación' (set to 75 m). There are also radio buttons for 'norte' and 'sur' under 'Coordenadas', and 'Oriente' and 'Oeste' under 'Elevación'. A 'Set elevation' button is present. Below the form is a map of South America with a red pin indicating the location in Argentina. The map includes labels for 'Mapa' and 'Satélite'.

Figure 11: Screen capture with information from the study site

● OBSERVATION OF CLOUDS AND DRAWING IN THE CALENDAR:

The naked eye observation of the sky is done from the school yard where students recognize the types of clouds by their shape and height. As the project is carried out by the children (ages 5-8), these observations are organized as shown later in the results table. The dates were from June 22 to September 14, considering that winter starts on June 21 and ends on September 21. It is also important to clarify that during this period the children had winter vacations (from 9 to 20 July) so they did not attend school.

Being the observation of the sky with the naked eye the starting point, students draw a picture of the type of cloud observed each day, in the calendar of the winter months: June, July, August, September.

- RECORD OF OBSERVATIONS ACCORDING TO THE GLOBE DATABASE:

All the observations were carried out at 1:30 pm local time, which corresponds to 4:30 pm universal time. For the record the Data Sheet of clouds in Spanish that is included in the ANNEX I (page 33) is used. In turn, a simple table is prepared (Table 1) in which the data is tabulated.

Tabla 1: Clouds observations record form

Month	Date	Cloud Cover						Cloud Type				Sky		Surface Condition					
		No Observable Cloud	Few	Isolated	Scattered	Broken	Overcast	Cumulus	Cirrus	Stratus	Contrails	Color	Visibil- ity	Snow/ice	Standing water	Muddy	Dry ground	Leaves in trees	Raining/ snowing

- COMPARISON OF THE TYPES OF CLOUDS:

Considering the age of the children investigators, the three main types of Cumulus, Cirrus and Stratus clouds, and the presence of Contrails are studied. In terms of height, only that of those types of clouds are taken into account. In this way the study is limited. For the comparison of the cloud records, a new table (Table 2) derived from the previous one is prepared and adapted to the age of the children, it is completed taking into account its form and taking from the data record only some aspects. Likewise, the days in which no CLOUDS are observed are included within the coverage.

Tabla 2: Form for comparing Cloud records

MONTH	DATE	CLOUD TYPE				COVER CLOUD	
		CUMULUS	CIRRUS	STRATUS	CONTRAILS	CLOUDS OBSERVED	NO CLOUDS OBSERVED

- PRACTICAL TALK "*Clouds in the kitchen*"

Eliana Sabina Cándido, professor of the E.P.P.I. N° 1345, makes an informative talk about **Cloud Formation and classification**.

In addition, she explains what is the international program on clouds, in which the school participates since 2005 with 2nd cycle students (ages 8-13), what are the objectives, foundations and importance: Students' Cloud Observations Project (S'COOL), clarifying that NASA Cloud Observations program has joined forces with the GLOBE Program, thus creating a larger community of cloud observers. An experiment is carried out to understand how clouds are formed and the processes involved (Figures 12 and 13).

EXPERIMENT *Clouds in the kitchen*.

Objective: To verify the processes of evaporation, condensation and precipitation in the form of rain using everyday materials and some laboratory elements.

Materials: Precipitated beaker, Matches, Plate, Ice, Warm water.

Procedure:

- ✓ Fill the beaker with warm water and stir.
- ✓ Light a match, turn it off and put it inside the beaker.
- ✓ When the smoke clears, put the plate with ice on the jar.
- ✓ Observe carefully and you can discover a cloud at the top of the precipitated glass.
- ✓ Explain the processes that have occurred.



Figure 12: Experiment



Figure 13: Experiment

● **READING OF IMAGES:**

With the idea of understanding that the clouds are not always the same different images taken at the same time, the same day are shown in different locations: Pujato, Casilda, Arnold, Soldini and Chosmalal (Neuquén). These observations were taken by people who live in those places and sent by whatsapp so as to compare them.

- ACTIVITIES TO DEEPEN THE STUDY

- ✓ *Educational video projection: "How are clouds formed?",* Giving rise to the exchange of opinions among the participants (Figure 14).

The video is obtained from the site https://www.youtube.com/watch?v=GNxNdlQA_C, it allows to put in images the topics that were addressed for a better visualization and understanding.



Figure 14: Video projection

- ✓ *Didactical games*

Games are shared to consolidate the developed concepts and familiarize themselves with the names of the clouds according to their characteristics.

- **MEMORY GAME** (Cloudscape. A Learning Activity For Do You Know That Clouds Have Names? p.4) Create cloud "memory" games to practice identification skills. Have each student create a set of index cards that includes each of the ten cloud types. A second set of cards includes illustrations of each type. Have pairs of students turn the cards face down. Partners alternate turning over two cards at a time, attempting to locate a match. A successful match results in another turn; play continues until all cards have been matched. The student with the most matches pairs wins.
- Another game that interested children was the **CLOUD TELLER** which is included among the activities of the SCOOOL program (https://science-edu.larc.nasa.gov/pdf/resources-games/SCOOOL_Cloud_Teller3_small.pdf) The objective of Cloud Teller is to practice

vocabulary, learn different cloud types, and help with cloud observations. The students made it in Spanish (https://scool.larc.nasa.gov/lesson_plans/SCOOL_Cloud_Teller-8.2015-V2-sp.pdf) (Figure 15)



Figure 15: Student playing with Cloud Teller

- USING THE GLOBE OBSERVER APPLICATION

The GLOBE Observer App was used, which allowed to consolidate knowledge about the clouds and to be part of the global community of the GLOBE Program. The current version of GLOBE Observer includes three protocols: Clouds, Mosquito habitat mapper and Land Cover. The students used the first of these protocols: GLOBE Clouds that allows regular observations of the Earth's cloud layer to compare it with NASA's satellite observations. In Figure 16 The Application used is



Figure 16: GLOBE Observer. Clouds

shown:

In other words, this application records the conditions of the sky and the atmosphere at a certain time of day.

This App was used together with the Forms for observations and daily records.

By using the GLOBE Observer application, in this particular case the Clouds protocol, is joining the GLOBE community and providing important scientific data to NASA and GLOBE, and through it the entire community, students and scientists from all over the world since the observations recorded and sent with this application are used by scientists to validate, interpret and understand the satellite data collected from space.

In the following Figure 17 two of the students are observed using the application.

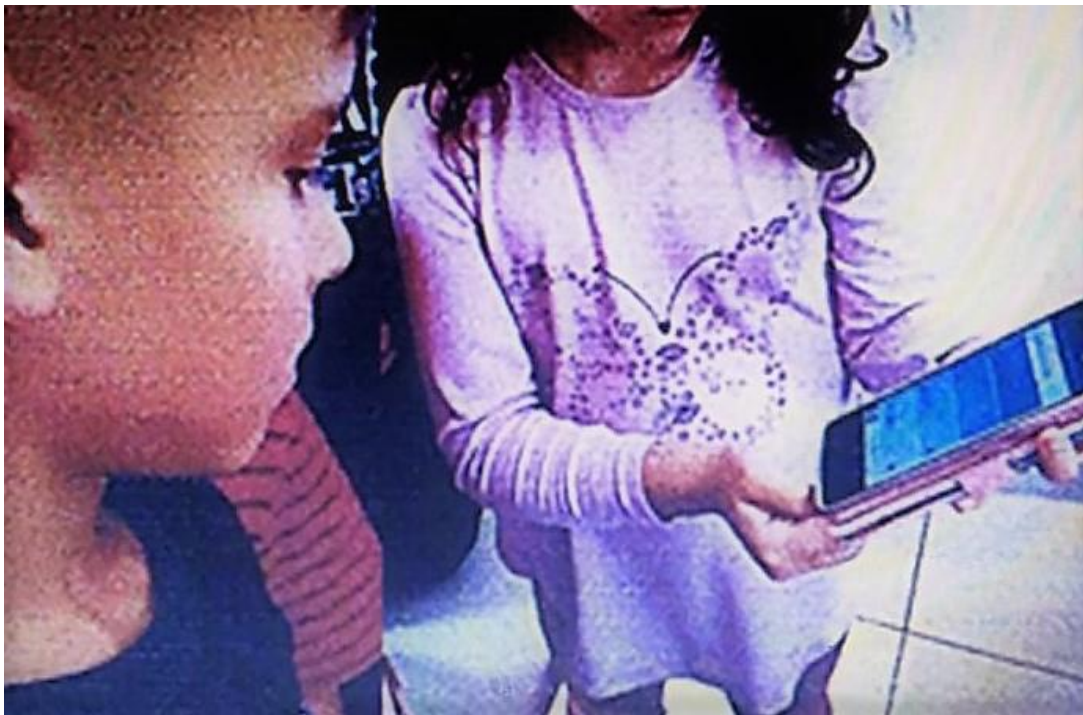


Figure 17: Students using GLOBE Observer App

- CONDUCT OF SURVEYS:

Spaces are generated so that each student can pose the questions and try to find answers in the participants. The purpose of the survey is to collect information about the knowledge and opinions held by the families of the children of E.P.P.I 1345 who participate in this project.

Figure 18 shows the instrument that was applied and that each family, not including the children who carry out this project, had to answer:

E.P.P.I N° 1345 “Nuestra Señora del Carmen” – Pujato
WINTER-CLOUDS PROJECT
Survey to families of students
WHAT DO YOU KNOW ABOUT CLOUDS?

Do You know ...?

What is a cloud?	YES	NO
Which are the elements that make up a cloud?	YES	NO
... that clouds have names?	YES	NO
(In case your answer is YES, write an example)		
Can you recognize the types of clouds?	YES	NO
... that the clouds are at different heights and for that reason they receive different names?	YES	NO
What does it mean to " <i>observe with the naked eye</i> "?	YES	NO

Figure 18: Survey: What do you know about the clouds?

- **DESIGN AND CHOICE OF REPRESENTATIVE LOGO OF THE PROJECT**

The students and their family design and propose a logo that identifies the project. All the drawings are shown on the blackboard and the logo is chosen democratically (Figure 19).



Figure 19: Students selecting the logo

RESULTS

Results according to the activities mentioned in the previous section.

- **OBSERVATION OF CLOUDS AND DRAWING IN THE CALENDAR:**

The Figures (20, 21, 22 and 23) correspond to the calendars of the winter months in which the children drew the different types of clouds that they could identify with a "naked eye" in the sky of Pujato the days of observation.

It was recorded in 16 days, 3 days the sky was clear, without clouds.

The graphs below were made in each of the calendars corresponding to the months of June, July, August and September 2018. Where the winter period is from June 21 to September 21.

June 2018						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21 Beginning of Winter	22 CUMULOS ESTRATOS CIRROS	23
24	25	26	27	28	29 NUBLADO ESTRATOS	30

Figure 20: Cloud drawings observed in June

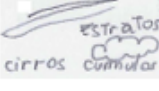
July 2018						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6 	7
8	9	10	11	12	13	14
15	16	17	18	19	20 	21
22	23	24	25	26	27 	28
29	30 	31 				

Figure 21: Cloud drawings observed in July 2018

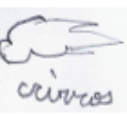
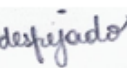
August 2018						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3 	4
5	6	7	8 	9	10 	11
12	13	14	15 	16	17 	18
19	20	21	22	23	24	25
26	27	28	29	30	31 	

Figure 22: Cloud drawings observed in August 2018

September 2018						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3	4 CÚMULOS 	5	6	7 Estratos NUBLADO	8
9	10	11	12	13	14 NO SE OBSERVAN CIELOS AZUL	15
16	17	18	19	20	21 End of Winter	22
23	24	25	26	27	28	29
30						

Figure 23: Cloud drawings observed in September 2018

- REGISTRATION AND COMPARISON OF DATA

Table 1 is filled with the records, as they have been uploaded to the GLOBE site, are tabulated in ANNEX II (page 34). It should be noted that, given the age of the children, it was not always possible to observe the color and visibility, also focusing on three types of Cirrus, Cumulus and Stratus clouds, and the presence of Contrails. All records have been uploaded to the "Schoolyard" site of Primary School No. 1345 in the GLOBE Program, as shown in Figure 24.

 THE GLOBE PROGRAM <i>Entrada de datos CIENCIA</i>	
datos Inicio / Escuela Primaria Particular Incorporada N°1345 Nuestra Señora del Carmen / Patio escolar / nubes	
Observaciones previas para nubes	
From	2018-06-21 
To	2018-09-21 
Medido a la hora UTC	
1	2018-06-22 16:30 UTC
2	2018-06-29 16:30 UTC
3	2018-07-06 16:30 UTC
4	2018-07-20 16:30 UTC
5	2018-07-27 16:30 UTC
6	2018-07-30 16:30 UTC
7	2018-07-31 16:30 UTC
8	2018-08-03 16:30 UTC
9	2018-08-08 16:30 UTC
10	2018-08-10 16:30 UTC
11	2018-08-15 16:30 UTC
12	2018-08-17 16:30 UTC
13	2018-08-31 16:30 UTC
14	2018-09-04 16:30 UTC
15	2018-09-07 16:30 UTC

Figure 24: Clouds observations on the site "Schoolyard"

As indicated, the children construct a simpler table (Table 3) derived from the main one where they could summarize the results obtained that make it possible to compare records.

Table 3: Spreadsheet for comparison of clouds records

MONTH	DATE	CLOUD TYPE				CLOUD COVER	
		CUMULUS	CIRRUS	STRATUS	CONTRAILS	CLOUDS OBSERVED	NO CLOUDS OBSERVED
JUNE	22	1	1	1		1	
	29			1		1	
JULY	6	1	1	1		1	
	20		1			1	
	27	1	1	1		1	
	30	1			1	1	
	31		1			1	
AUGUST	3			1		1	
	8		1			1	
	10	1	1	1	1	1	
	15						1
	17						1
	31		1			1	
SEPTEMBER	4	1				1	
	7			1		1	
	14						1
TOTAL	16 days	6	8	7	2	13	3
		38%	50%	44%	13%	81%	19%

Within the 16 days in which naked-eye observations were made of Pujato's sky, it can be commented that:

1) 81% of the days there were clouds in the sky, only 19% the sky was totally clear. The distribution is shown in the following graphic (Figure 25):

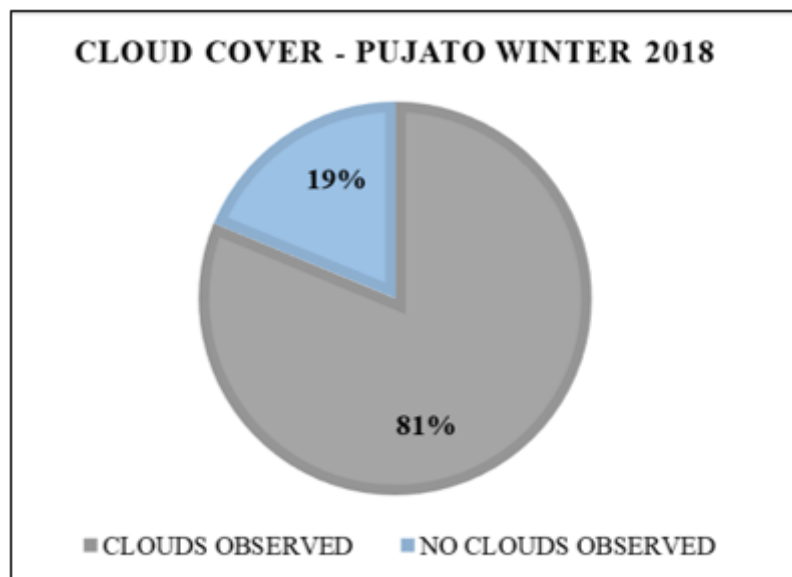


Figure 25: Cloud cover on winter observation days in Pujato 2018

2) Within the days when clouds could be observed (81%) the type of cloud cover recorded is represented in the following graph (Figure 26)

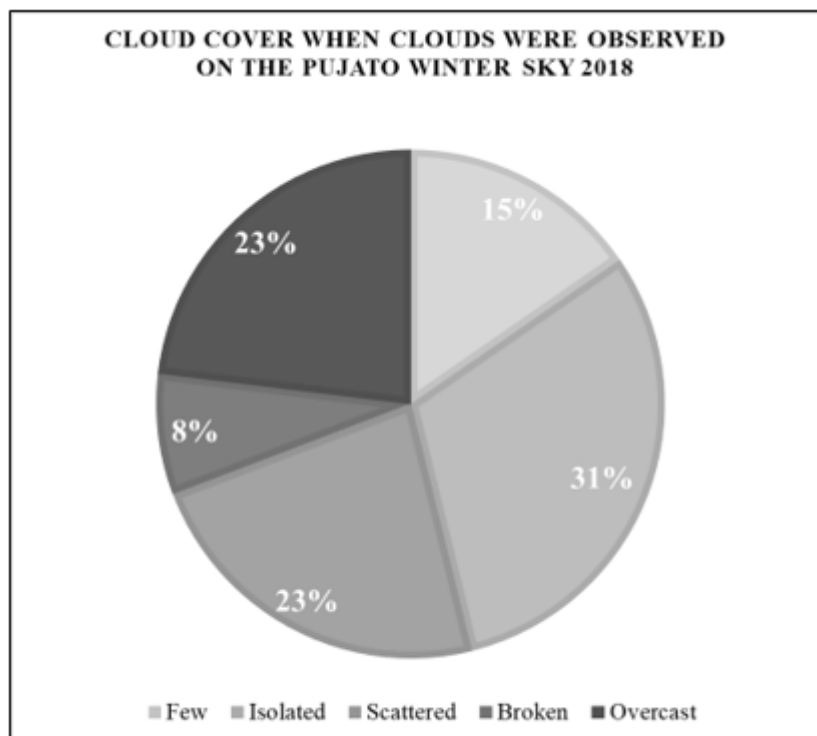


Figure 26: Cloud cover winter 2018

When considering the distribution shown in the graph it can be seen that the highest percentage corresponds to the Scattered cloud cover (25% to 50%) and the lowest percentage to Few (less than 10%).

3) Within the days in which clouds could be observed, in Figure 27 the types of clouds present in the sky of Pujato during winter 2018 are shown:

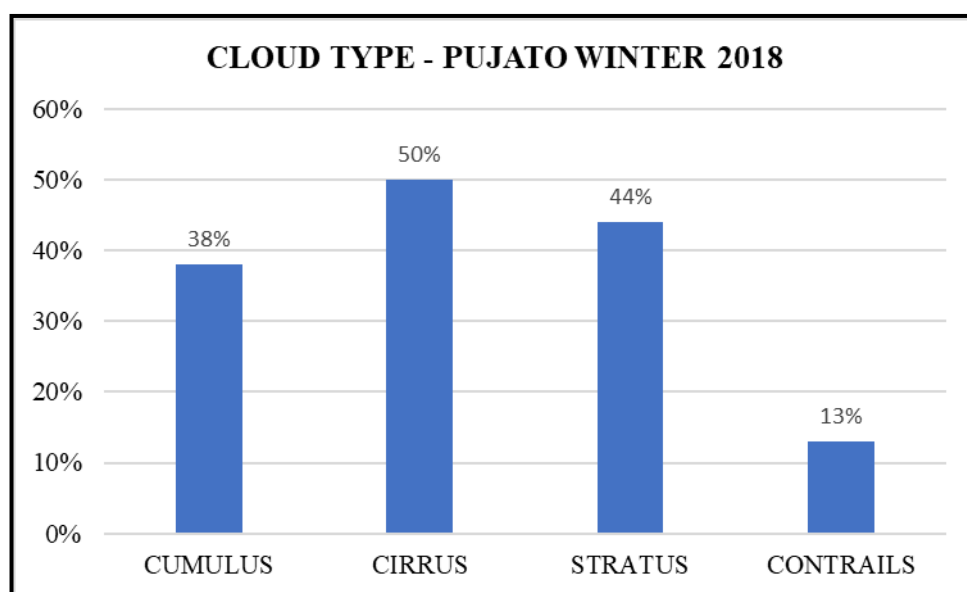


Figure 27: Cloud type on winter observation days in Pujato 2018

In other words, cirrus, cumulus and stratus were observed; the most observed type of cloud has been the cirrus. As for the contrails, their presence was rare. Also, it is possible to affirm that low clouds have predominated: cumulus and stratus.

4) As regard the conditions of the surface the days in which the observations were made, it can be said that never snow nor ice was observed, neither stagnant water nor mud on the surface. The soil remained dry, only one day, on August 3, it started to rain when the observation was made, in that case, in addition to the stratus that the children observed, nimbostratus should be added because of the rain. As for the leaves in the trees, it is important to clarify that most of the trees that are found in the yard are not deciduous, for this reason they keep their leaves in winter.

- PRACTICAL TALK "Clouds in the kitchen"

What did happen during the experiment?

The warm water forms the water vapor, this process of changing water to gas is called *evaporation*. The water vapor cools when it rises and approaches the plate with ice.

The smoke particles from the match provide a surface (condensation core) so that water can condense and form droplets.

It was observed that:

Evaporation is the opposite of condensation.

If we move the plate, the cloud disappears when mixed with the water that surrounds the air. This same event occurs with our environment, the evaporated water condenses in the *condensation* nuclei, forming clouds, which can produce rain. The rain procedure is known as *precipitation*.

- READING OF IMAGES

It was observed that there are differences between the clouds of different geographical points for the same time, consequently the results of the observations in Pujato are valid for this definitive environment.

- CONDUCT OF SURVEYS:

The instrument corresponding to the survey was applied (Figure 18) to forty (40) families.

Considering the answers obtained, we have been able to tabulate the data shown below (Table 4)

Table 4: Answers to the survey

Questions: Do you know...	YES	NO
I: What is a cloud? Which are the elements that make up a cloud?	90%	10%
II: ... that the clouds have names?	60%	40%
III: Can you recognize the types of clouds?	70%	30%
IV: ... that the clouds are at different heights and for that reason they receive different names?	40%	60%
V: What does it mean to "observe with the naked eye"?	40%	60%

In order to visualize them in a better way, the following graphic is made (Figure 28)

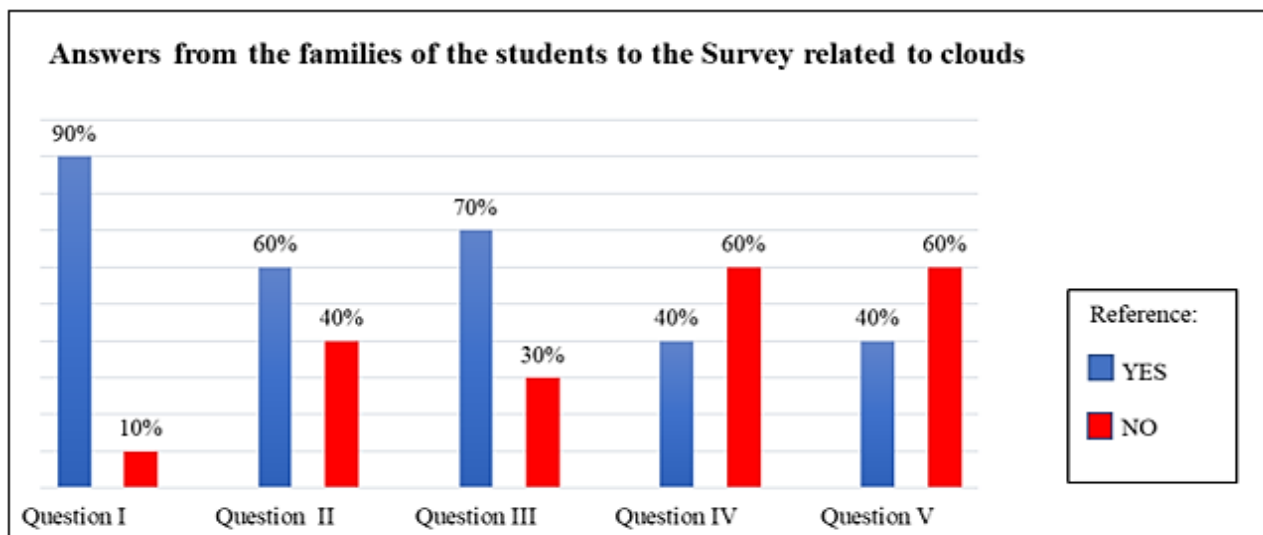


Figure 28: Results of the Survey

From the recorded data it is possible to affirm that most of the families know what cloud is and the elements. The answers given include drops of water, water vapor, gases and water crystals. Among the families that manage to recognize some types of clouds, they identify mostly cumulus and then cirrus. In turn, those who claim to know that at different heights the clouds receive different names, do not indicate any example.

- **DESIGN AND CHOICE OF THE LOGO:**

After the election made by the students, the selected logo is the following (Figure 29):



DISCUSSION

This project is based on exploratory research based on the observation of clouds in a specific place and time, guided by the interest of knowing more about them.

Some of the facts that emerge from the dialogues between the students are the following:

- ✓ The clouds are variable, they are not the same everyday.
- ✓ Some days there are no clouds, the sky is clear.
- ✓ Clouds sometimes cover a part of the sky and sometimes it is completely covered; that is, the cloud cover is variable.
- ✓ There was not rain within the winter days when the observations were made.
- ✓ The clouds change their shape and color.
- ✓ The change of the clouds is not equal or even, they do not respond to a pattern.
- ✓ The clouds change most of the days, regardless of the season.
- ✓ The process of cloud formation is repeated day after day and is related to the water cycle.
- ✓ We do not see the same form for a certain cloud. However, there are types that respond to certain characteristics: cirrus, cumulus and stratus.
- ✓ Some clouds are higher and others lower depending on the conditions of the atmosphere.
- ✓ Sometimes there are contrails that plow through the sky.

There is also an exchange of opinions in relation to the survey made to the families. The answers given make it clear that families, like the members of the project do not have enough information about the clouds, their scientific names and what it means to observe with a "naked eye".

The results obtained, which show lack of information on topics related to the clouds, are surprising taking into consideration that in this area, the economic activities have a direct relationship with weather conditions and people tend to be aware of it, especially from the rains and pay close attention to weather forecasts.

CONCLUSIONS

The project confirms the hypothesis raised, since it could be verified through resources such as observations, along with comparison, registration, investigation and the activities carried out, which have allowed to affirm that on the sky of the EPPI No. 1345 "Ntra. Sra. del Carmen" of the town of Pujato during the winter months of 2018 there are different types of clouds, within which can be distinguished: the cumulus, stratus and cirrus; and contrails whose origin is artificial and less frequent. The clouds not only vary in shape, but also their color, quantity and height are modified, there are even days where there are no clouds in the sky.

Within the description that can be made of the sky of Pujato during the observations made in the winter of 2018, it was observed that, when clouds were present, in height the cirrus predominated and between the lower layers of the atmosphere the stratus had a preponderance, followed by the cirrus. It was also important the absence of rain on the days of observation, only one day it rained during the registration hours.

Finally, it is important to highlight the students motivation, interest and curiosity in the phenomenon of clouds formation which occurs every day in the sky of Pujato: this observation has allowed them to connect with the nearby reality and from there with scientific knowledge, in particular Meteorology.

Projection:

During the 2019 school year it will be interesting to observe the sky during other seasons, for example, during autumn, since students start their classes in March. It will also be possible to do it during spring. They can also deepen issues related to the color and visibility of the sky.

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- ✓ To the Zonal Coordinator for the province of Santa Fe, Master Trainer Claudia Romagnoli, for the collaboration in the management for the participation in the Virtual Symposium 2019.

ANNEX I

Nombre de Escuela/Observador				Sitio	
Fecha (ej. 2017 01 13): Año ____ Mes ____ Día ____					
Hora: (ej. 24 horas, Reloj 14:26) Local: ____ Minutos ____		Universal: ____ Minutos ____			



1. ¿Qué hay en tu cielo?

Cobertura total de nubes/estelas:

☐ Cielo oscurecido →

☐ Nada (Ir al casillero 2) ☐ Dispersas (25-50%)
☐ Despejado (<10%) ☐ Fragmentadas (50-90%)
☐ Aisladas (10-25%) ☐ Nublado (90-100%)

☐ Niebla ☐ Arena
☐ Lluvia intensa ☐ Bruma
☐ Nieve intensa ☐ Humo
☐ Nevizca ☐ Polvo

☐ Calina
☐ Cenizas volcánicas

Si puede observar el color o la visibilidad del cielo ir al casillero 2

Ir al casillero 8

2. Color y visibilidad del cielo
3. Nubes de nivel alto

de corta duración
 persistente
 persistente que se expande

Cobertura nubosa:
☐ Despejado (<10%)
☐ Aislado (10%-25%)
☐ Dispersas (25%-50%)
☐ Fragmentadas (50%-90%)
☐ Nublado (>90%)

Opacidad visual
☐ Opaco
☐ Translúcido
☐ Transparente

4. Nubes de nivel medio

Cobertura nubosa:
☐ Despejado (<10%)
☐ Aislado (10%-25%)
☐ Dispersas (25%-50%)
☐ Fragmentadas (50%-90%)
☐ Nublado (>90%)

Opacidad visual
☐ Opaco
☐ Translúcido
☐ Transparente

5. Nubes de nivel bajo

Cobertura nubosa:
☐ Despejado (<10%)
☐ Aislado (10%-25%)
☐ Dispersas (25%-50%)
☐ Fragmentadas (50%-90%)
☐ Nublado (>90%)

Opacidad visual
☐ Opaco
☐ Translúcido
☐ Transparente

6. Condiciones de la superficie

Obligatorio:

Nieve/Hielo	Si ☐	No ☐	Tierra seca	Si ☐	No ☐
Agua estancada	☐	☐	Hojas en los árboles	☐	☐
Fangoso	☐	☐	Lloviendo/Nevando	☐	☐

Opcional:

Usted puede completar una o todas:

Temperatura: ____ °C
 Presión atmosférica: ____ mb
 Humedad relativa: ____ %



Month	Date	Cloud Cover						Cloud Type			Sky		Surface Condition					
		No Observable Cloud	Few	Isolated	Scattered	Broken	Overcast	Cumulus	Cirrus	Stratus	Contrails	Color	Visibil ity	Snow/ice	Standing water	Muddy	Dry ground	Leaves in trees
June	22				1			1	1	1			0	0	0	1	0	0
June	29						1			1			0	0	0	0	1	0
July	6			1				1	1	1			0	0	0	0	1	0
July	20		1						1			Deep Blue	0	0	0	0	1	0
July	27				1			1	1	1		Pale Blue	0	0	0	0	1	0
July	30				1			1	1		1	Light Blue	0	0	0	0	1	0
July	31			1					1			Pale Blue	0	0	0	0	1	0
August	3						1			1			0	0	0	0	1	1
August	8		1						1			Blue	0	0	0	0	1	0
August	10					1		1		1	1		0	0	0	0	1	0
August	15	1										Deep Blue	0	0	0	0	1	0
August	17	1										Blue	0	0	0	0	1	0
August	31			1					1			Light Blue	0	0	0	0	1	0
September	4			1				1					0	0	0	0	1	0
September	7						1			1			0	0	0	0	1	0
September	14	1										Blue	0	0	0	0	1	0

BADGES SELECTED

Be a **Collaborator**:

For the development of the research some members of the community where the school is located have collaborated. A teacher advised the students on the clouds's formation and on the process of cloud observation with the naked eye. In addition, a Master Trainer GLOBE collaborated in the definition of the site and in the application of the GLOBE protocols. In addition, a technician from Pujato and a GLOBE Alumni (former student of this school) advised the students on the use of App GLOBE Observe. Another teacher collaborated to write the research report.

There was also an exchange of information about clouds with members of the High School 241 of Pujato and the Primary School 6371 of Zavalla.

The work with these collaborators gave the possibility of improving the scientific skills to apply them to the research project.

Be a **Data Scientist**

These small children researchers, who are in the first grades of primary school, have made observations and recorded a series of data, they have analysed them with the tools according to their age, they have discussed the data themselves and obtained conclusions about them.

So with these data they were able to give an answer to the research problem raised with which they started this study, so that each of the students can be a data scientist.

Be a **STEM Professional**

The teacher in Mathematics and Physics, and Graduate in Technological Education, Eliana Cándido, collaborated with this research work, guiding the students by dictating a talk related to Cloud formation and classification. In addition, she carried out experiments and practical demonstrations with the students that contribute to the interpretation of the results.

Likewise, the GLOBE Atmosphere Master Trainer, Claudia Romagnoli, who is also a Magister in Science-Physics Didactics, collaborates in the coordination of the project; Professor of Mathematics, Physics and Cosmography and Professor of Technological Education.

These collaborations with STEM professionals improved the research methods and contributed to the analysis of the results in order to give support to the conclusions obtained.