

Data rescue of upper wind data obtained from pilot balloon observations in Spain: Preliminary works

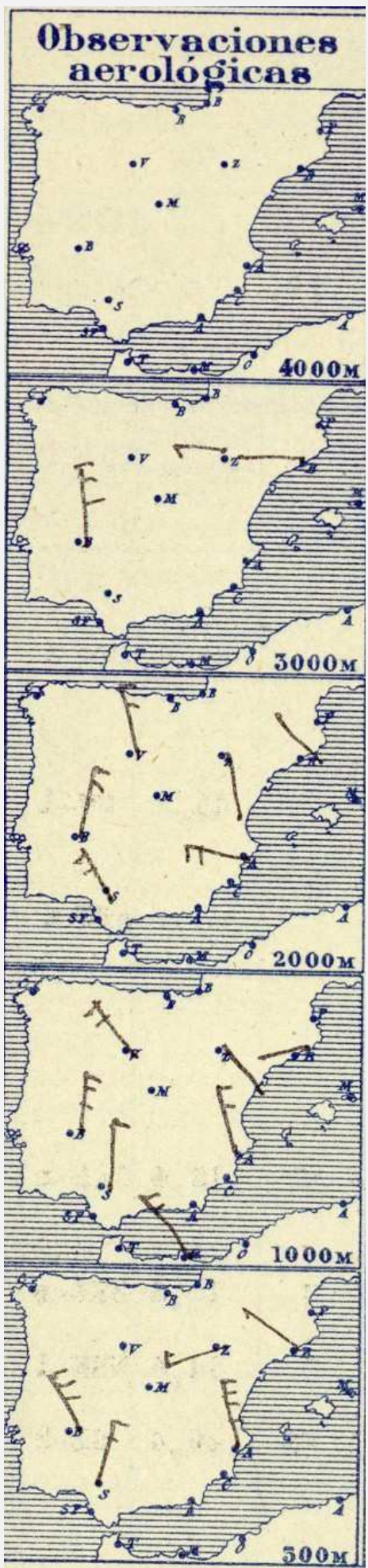
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In 1912 first steps to set an aerological observation network in de Spanish National Weather Service (OCM) were given. That year, the chief of OCM, **Mr. Galbis**, attends the **ICSA** meeting in Vienna and visits, among others, Strasbourg Observatory where learns from **Dr. Hergesell** the theory and practice of aerological observation. Daily observations begin in **Madrid** in 1913/04/01 and sounding balloons during *international days*. Same year **Dr. Fontseré** starts observations in **Barcelona**.

Earlier, army had begun to make aerological observations. Coronel Vives attended **2nd ICSA** meeting in Berlin in 1902, and in 1904 begun in **Guadalajara** observations with pilots balloons and sounding balloons and aerostats in *international days*. In 1908 non regular observations started in **Tenerife-Izaña** and on a regular basis from 1913.

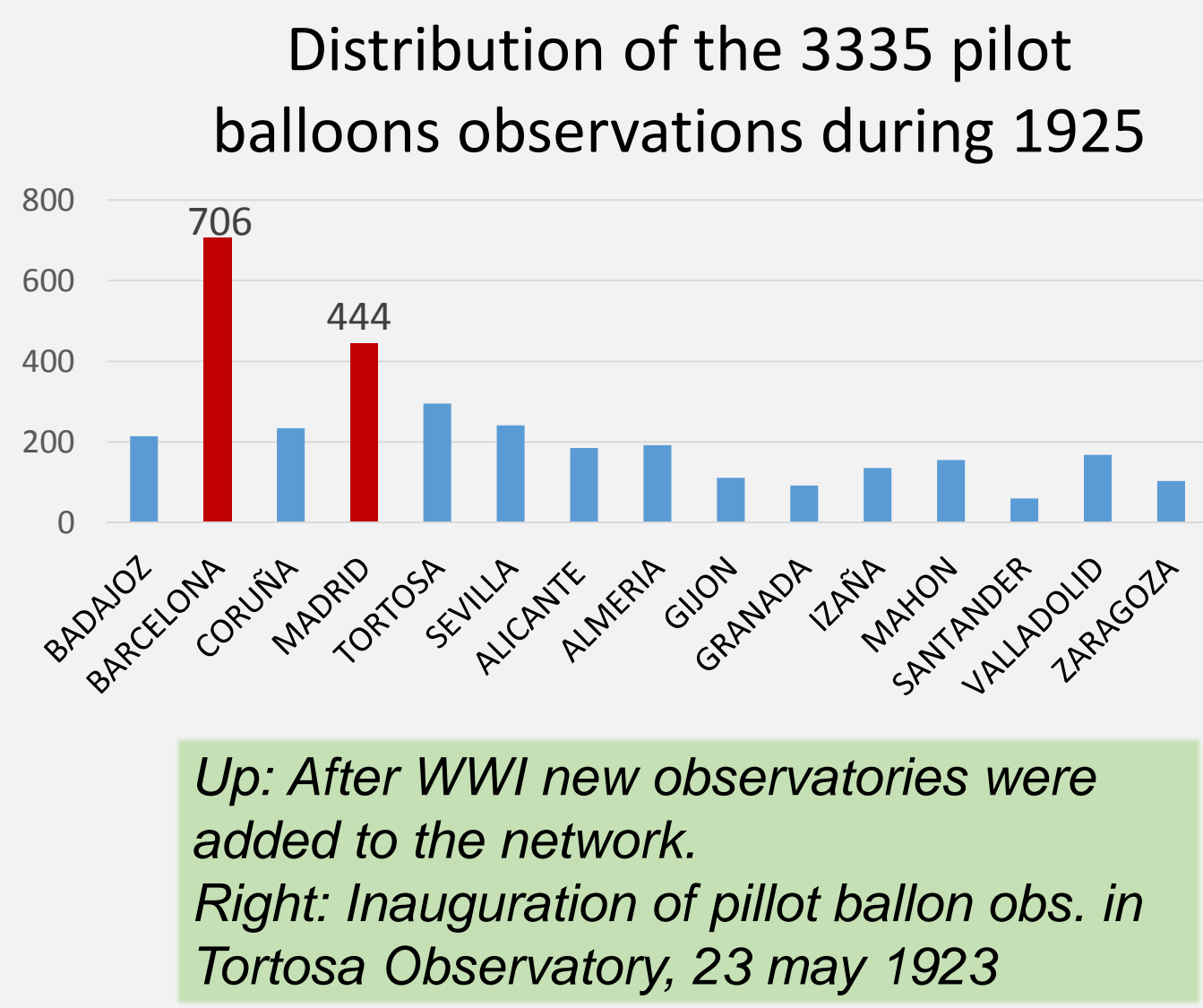
On the right. Plots of upper winds from pilot balloon network were included in Daily Bulletin. This one is from 28 november 1924

Overview

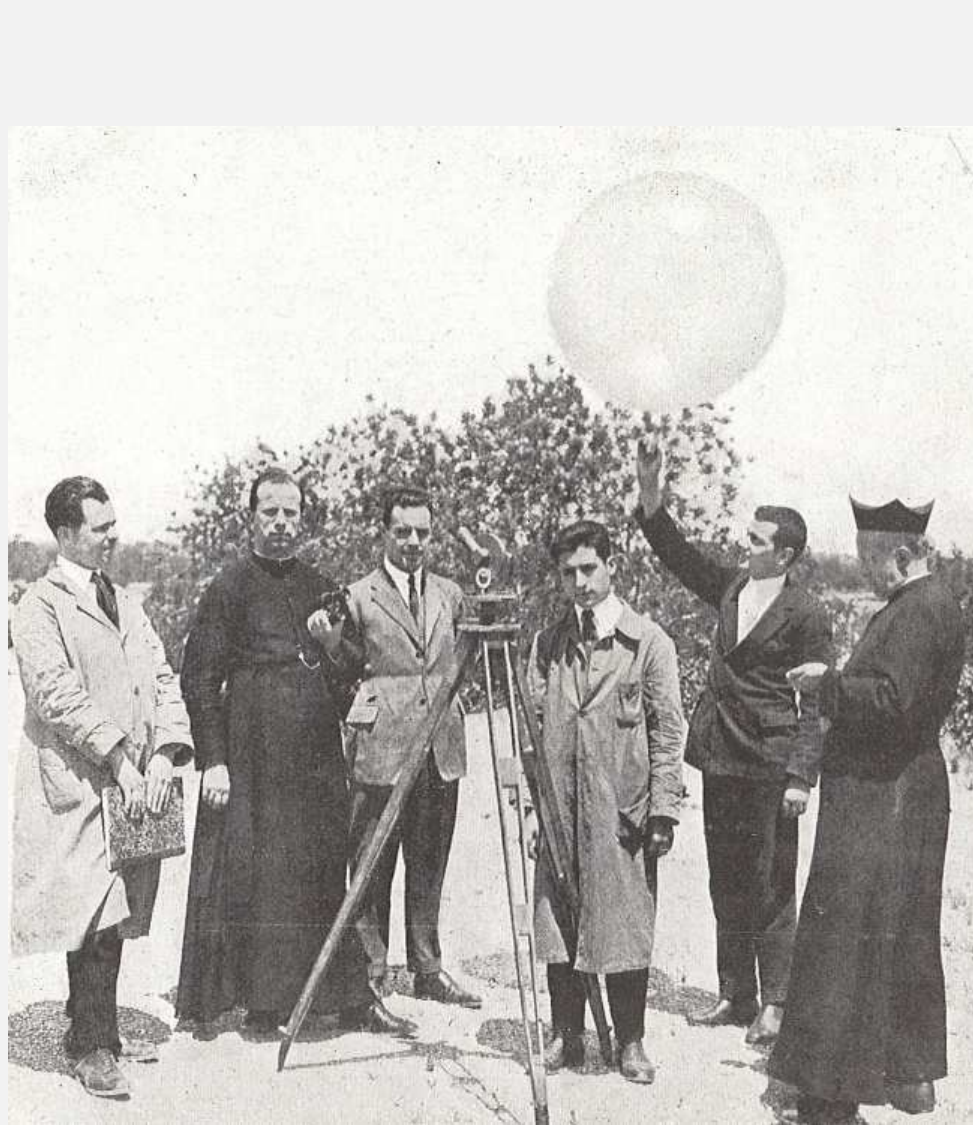


WARS were the main enemy of this network due to its dependence of rubber and hydrogen. During WWI the rubber trade was forbidden and the balloons scarcity owed, first, to make observations only in *international days* and eventually to stop them. Spanish civil war (1936-1939) and WWII also caused interruptions in the observations.

One theodolite method was chosen; this implies to asume the vertical velocity as constant. Some sources states this hipothesis as true until 10.000 m, although others states that at this height the real velocity is 20% higher than nominal. The standard vertical velocity was set to 200 m/min for ~100 gr balloons, but velocities of 150 and even 100 m/min have been found for observations with lighter balloons. **Height clouds** could be a byproduct.



Up: After WWI new observatories were added to the network.
Right: Inauguration of pillot ballon obs. in Tortosa Observatory, 23 may 1923



Spanish aerological network in 1944, from "Resumen de las observaciones aerológicas de 1944", published in 1949. Tenerife-Izaña and Badajoz do not appear

Method of observation, transmission and archive

Step 1. Weigh the balloon. Known the weight of the balloon, and the wished vertical speed, Hergesell abacus is used to determine the upward lift force.

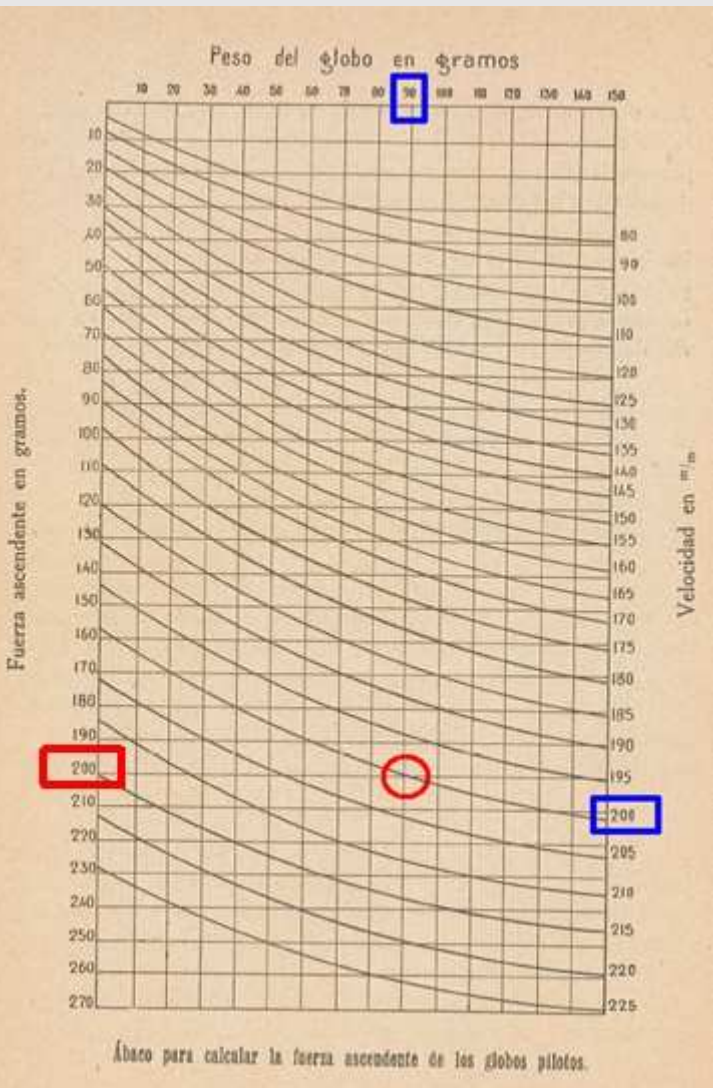
Step 2. Inflate the balloon with hydrogen (!!) until achive the wished uplift. A balance and a set of calibrated weights is used.

Step 3. Once the theodolite is set up, the balloon is released. Angular observations are made every 30 s first 5 min, and every min afterthat. That means obs. are made every 100 m until 1000 m, and every 200 m thereafter, if the standard 200 m/min is used. Two people were needed.

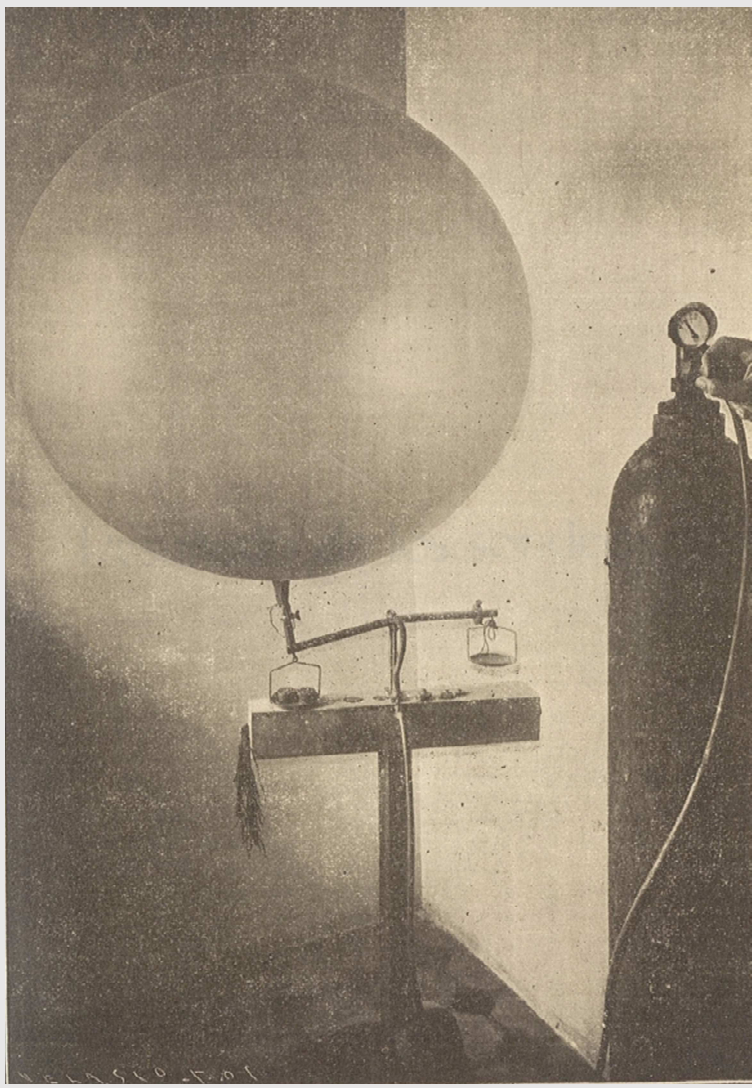
Step 4. Horizontal velocity determination using **graphics methods**. Transcription of the results to the logbook.

Step 5. Transmision in almost real-time, **pilot code**. Data reduction and archive. Mail monthly summary to headquarters (Madrid).

PILOT = IIIGG HHddv₅
C₁C₂M₁HMM 44444 m₁m₂m₃m₄m₅m₆m₇xxx



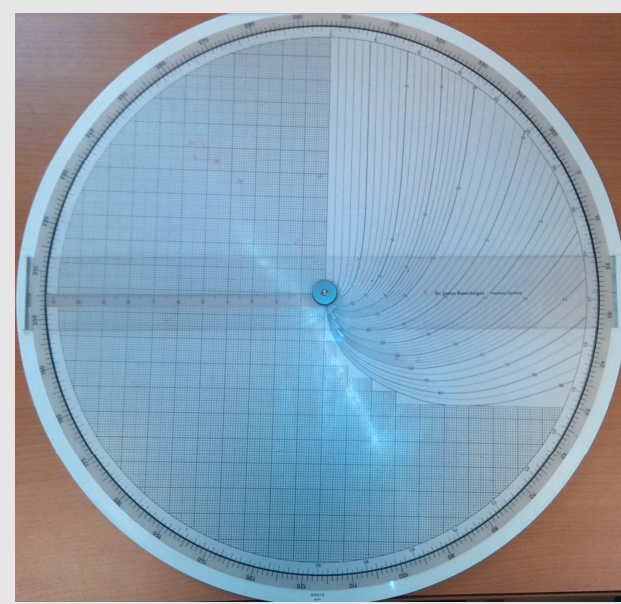
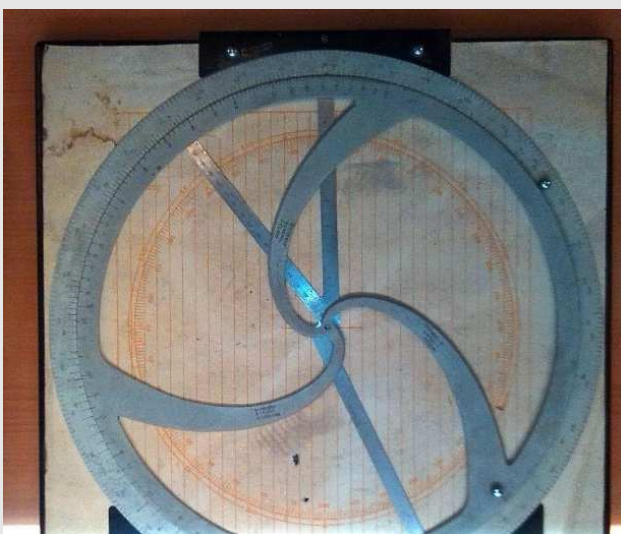
Hergesell abacus, from "Tablas para el calculo de observaciones con globo piloto", E. Miquel, 1927. The highlighted values belong to Badajoz balloon No.2



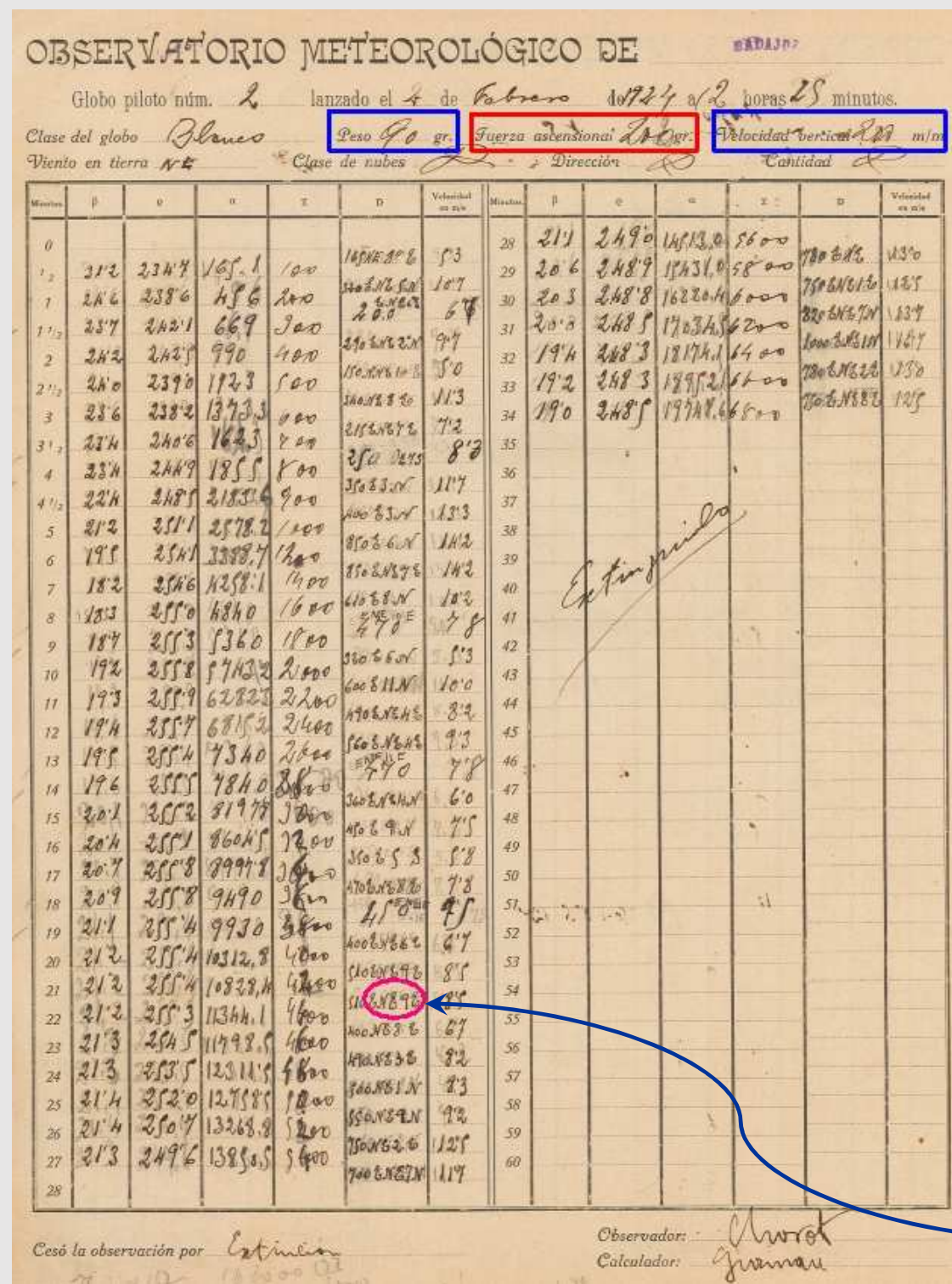
From "Trabajos del Observatorio de Igueldo" No. 3, 1929



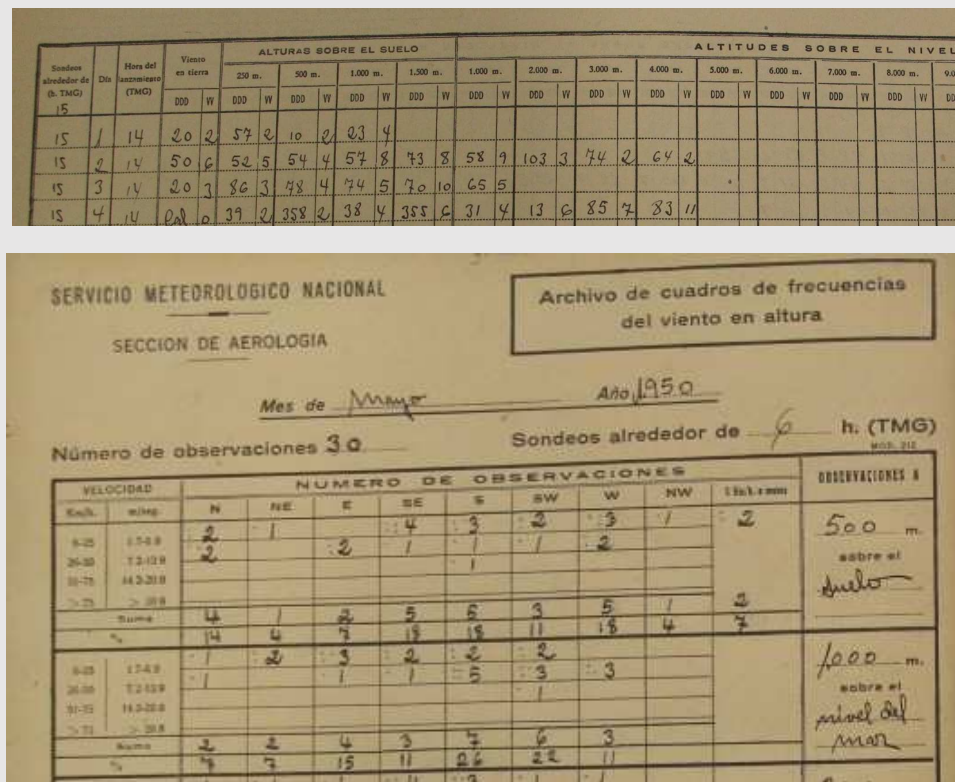
Antonio Chorot being about to release a pilot balloon. Obs. Badajoz, circa 1925



Two different set of rules to compute graphically the horizontal velocity found in Zaragoza. The second one was called "The Molchanoff board"



Badajoz balloon No.2 1924/02/02, by Chorot and Guzman. It reached 6800 m above the ground.



Up: Monthly summary, mod. 210.
Down: Monthly frequency table velocity-direction for several heights, mod 212. Local archive

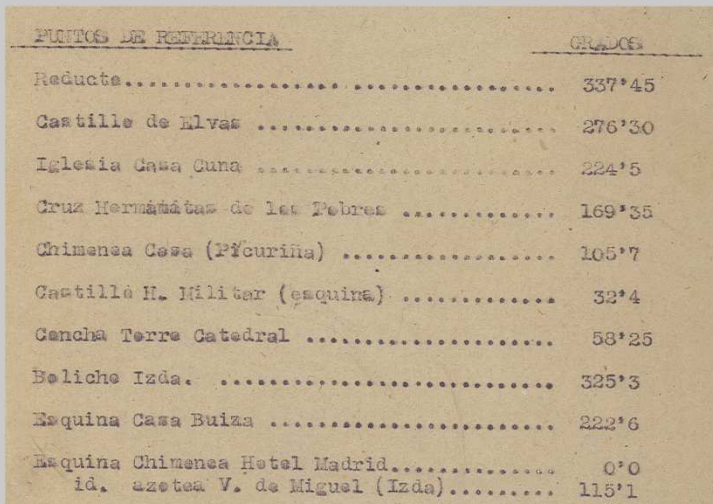
Which direction is ENE9E? And ENE9N ?
ENE = 67.5° → ENE9E = 67.5 + 9 = 76.5°
ENE9N = 67.5 - 9 = 58.5°

Badajoz and Zaragoza Observatories

Badajoz Obs. (38°52'38", 06°58'24", 195m) was created in 1864 at a not very suitable urban site. In 1924 A. Chorot started pilot balloon observations. Since 1954 the observations were made in the nearby Air Base of Badajoz/Talavera la Real. 26 original logbooks have been found, 1924-1953, with records of **2262 balloons**. It is known by several sources that observations continued, at least until end sixties, but no other logbooks have been found.



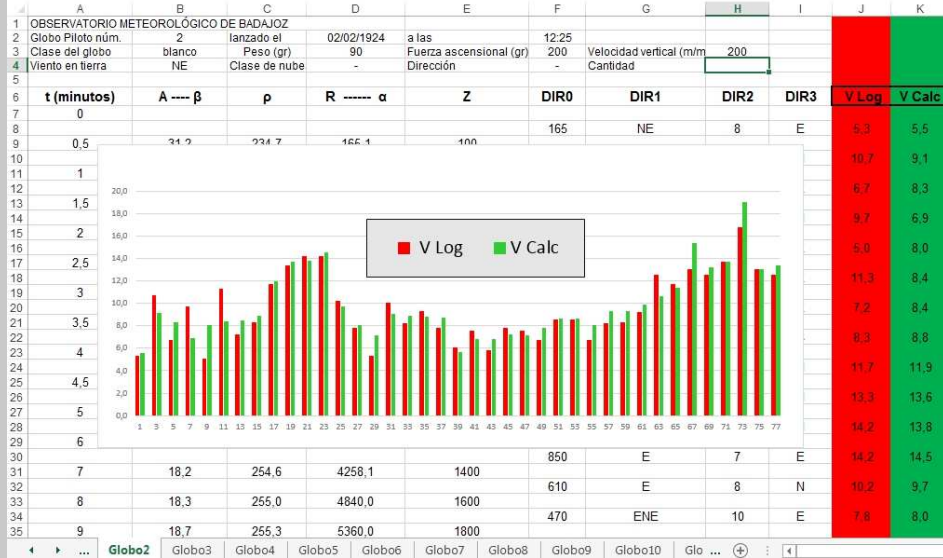
Badajoz Observatory circa 1925



Angular references found in logbook No.25

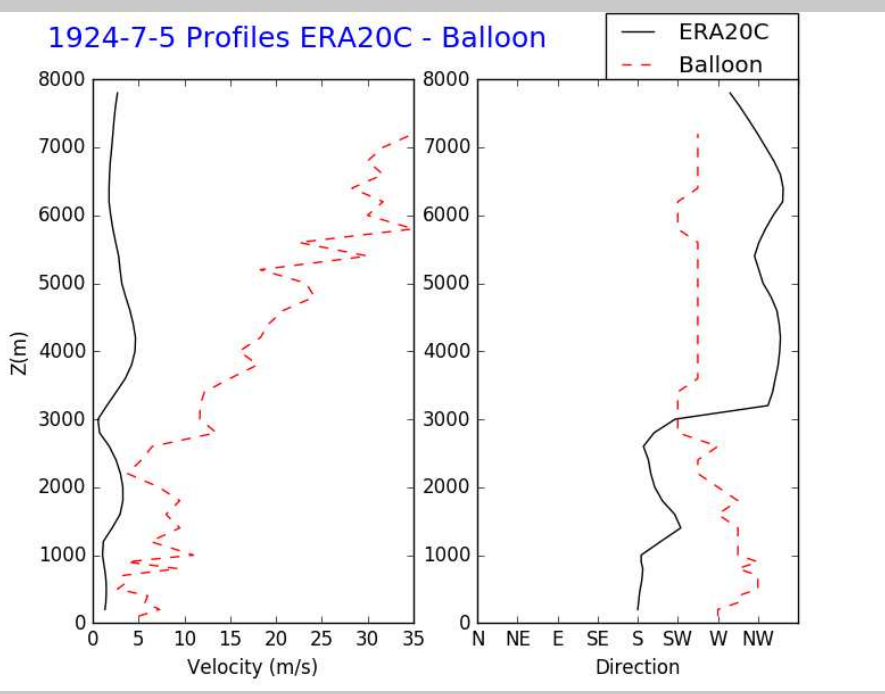
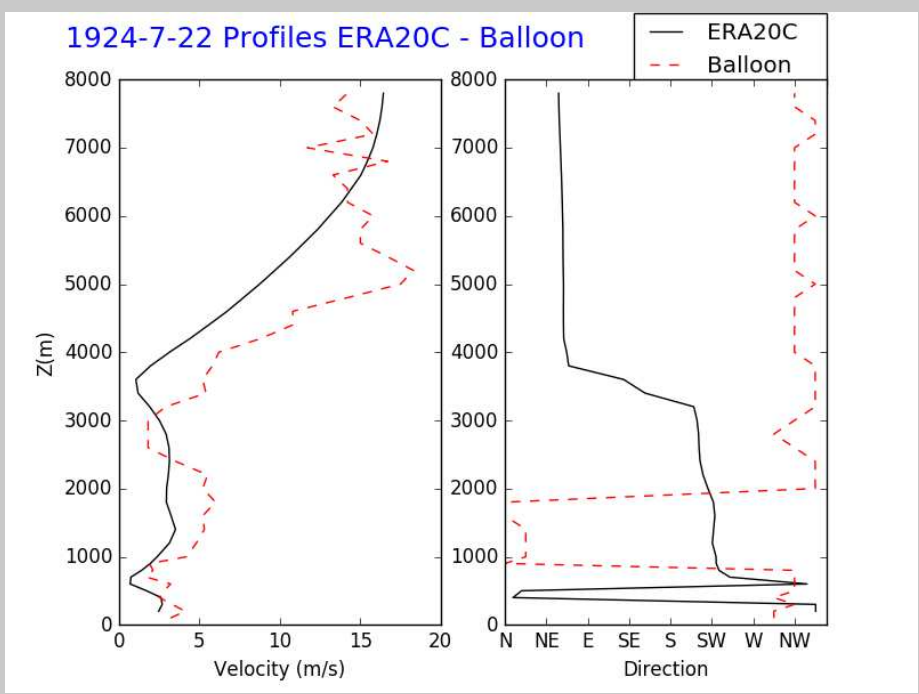
In **Zaragoza** 17 original logbooks have been found, 1924-1959, with a change of site from the Faculty of Science to Sanjurjo aerodrome (1949). The format of these is logbooks is the same that the ones found in Badajoz.

First year of Badajoz data, **481 balloons**, were recorded in an Excel template that proved to be quite inefficient for recording but very good to set **filters** and **plot graphics** for **QC**, e.g., the template computes **exact values for velocity** from angular data that are compared with the logbook ones, graphically obtained.



Excerpt from Badajoz balloon No.2 record. Column in red is for the value of velocity in the logbook; green column for "exact" velocity values. There are small differences but no bias has been found.

A non-systematic comparison between **ERA-20C** reanalysis and balloons profiles shows, sometimes good (left), sometimes bad (right) agreement.



Summary ...

- ✓ Network was quite big, although suffered from interruptions
- ✓ The method of observation has been reviewed. Graphic methods worked out well
- ✓ Original logbooks remain not located in many cases. Data were published only for a few years and not for all heights.
- ✓ In spite of gaps, these data can be valuable for future reanalysis

... an a lot of work to do

- Keep searching original logbooks and other documents with no original data (e.g. pilot messages)
- Search in ICSA, and Spanish Army archives
- Inventory
- Planning for massive digitalization
- Research about the need to adjust for high level data
- ... and much more

Acknowledgements:
✓ **Candido Chorot** provided his father's picture, Antonio Chorot, and other valuable pictures
✓ **The students Jorge Ramos, Ignacio Rodríguez y Sergio Bolaños** recorded a year of observations (481 balloons) and, with the support of Guadalupe Saenz and of the author, downloaded ERA-20C reanalysis and interpolated to Badajoz coordinates
✓ **Juan Carlos Tudela and Samuel Buisan**, from AEMET Aragón, found the logbooks of Zaragoza