

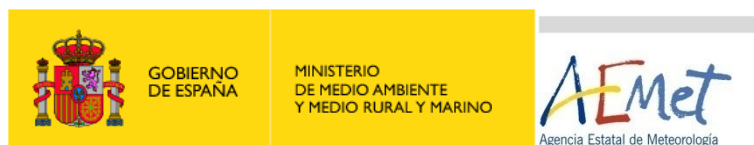


“Last-6-years lightning network evaluation”

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Outline

- Portuguese lightning detection network (IM, Portugal)
 - Description of network
- Summary of data (Portugal, 2003 – 2008)
 - Flash distribution: by hour, by month
 - Flash density over mainland
- Spanish lightning detection network (AEMET, Spain)
 - Average Number of Storms per day (Iberian Peninsula, 2000-2007)
 - Storm characterization by province (Portugal+Spain, 2008)
- Conclusions and outlook

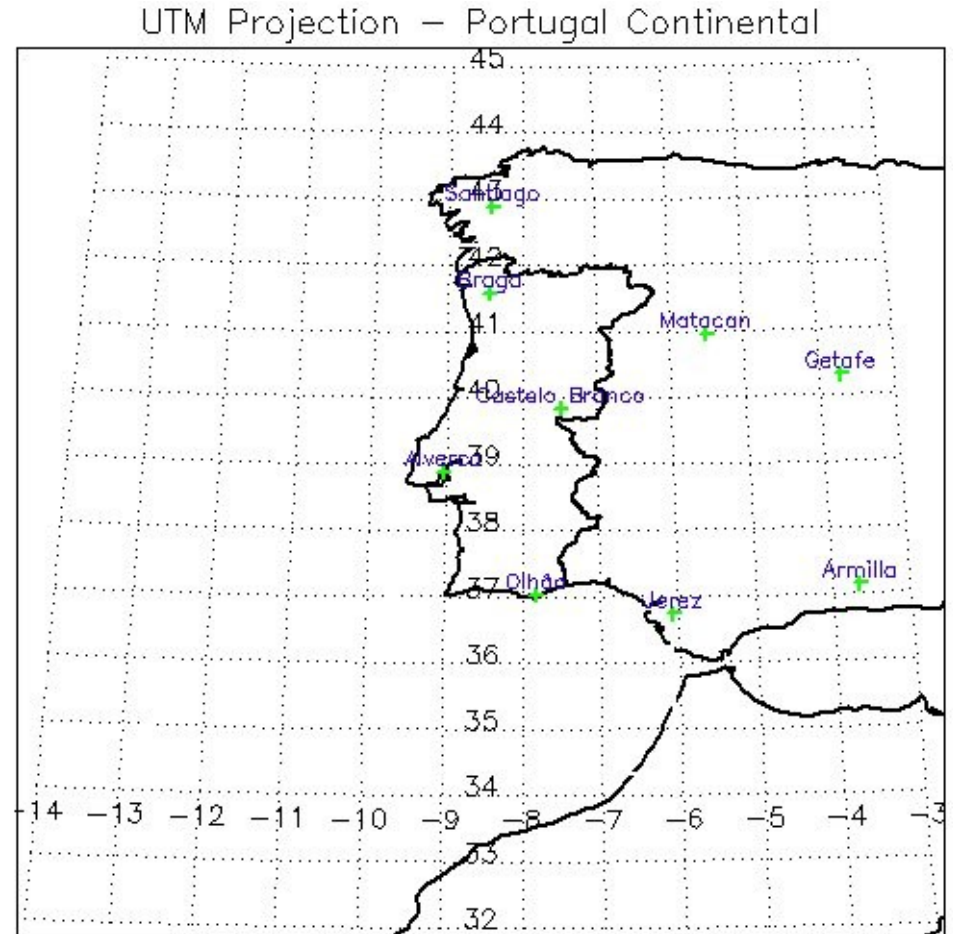


Portuguese Lightning Detector network

Operations started in July 2002

- Braga (north)
- Castelo Branco (east)
- Alverca (west, Lisbon)
- Olhão (south, Faro)

Network from Spain (5 of 9 stations used):
Jerez, Armilla, Getafe, Mataban, Santiago



*Vaisala IMPACT detectors, model 141T-ESP:
GPS time (T.O.A.) + radiogoniometer (M.D.F.) +
VPN network for data transmission*

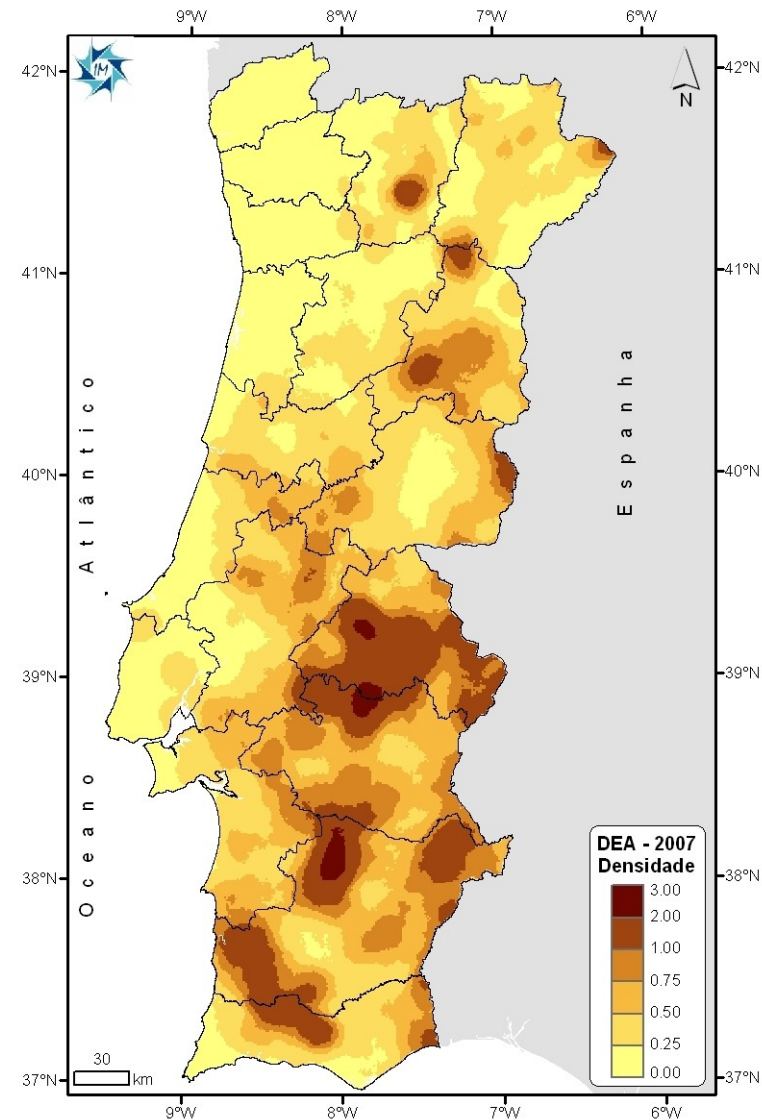


Portuguese Lightning Detector network

Network usage in surveillance.

Users:

- ※ Meteorology
- ※ Civil aviation
- ※ Services for public and private companies:
 - ❖ REN (national electric power network)
 - ❖ GALP (fuel)
 - ❖ Insurance companies



Example: Lightning density for 2007



Portuguese Lightning Detection Network: 2003 – 2008

Results in this presentation:

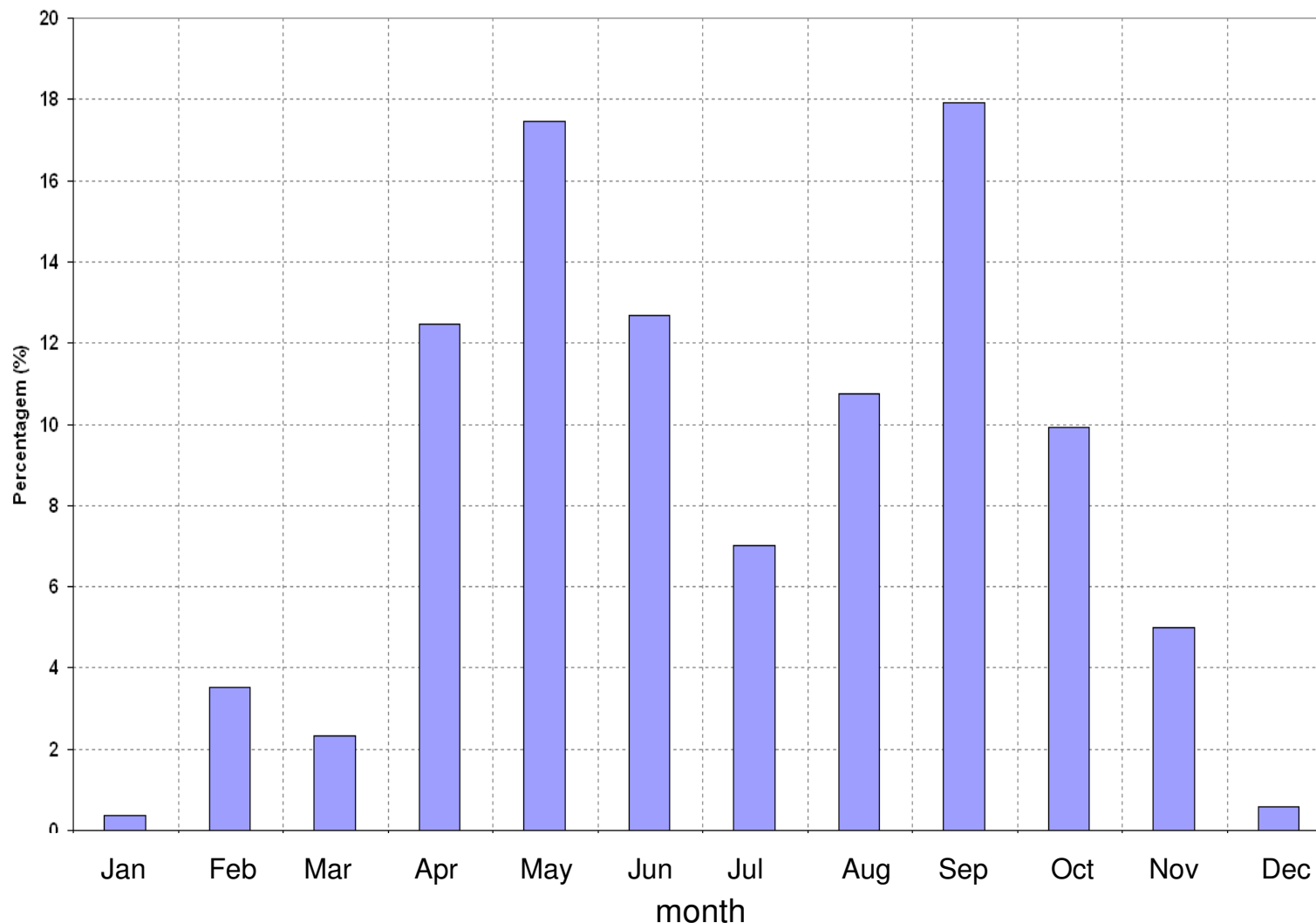
- ※ Hourly and monthly distributions
- ※ Spacial distribution
 - ❖ Comparison with AEMET network results for 2008
- ※ Flashes' current distribution

Limitations:

- ※ Event dates: January 2003 to December 2008
- ※ Limited over Portuguese mainland territory
- ※ Only CG flashes were analysed



Portugal mainland (2003-2008): flashes per month (averaged)



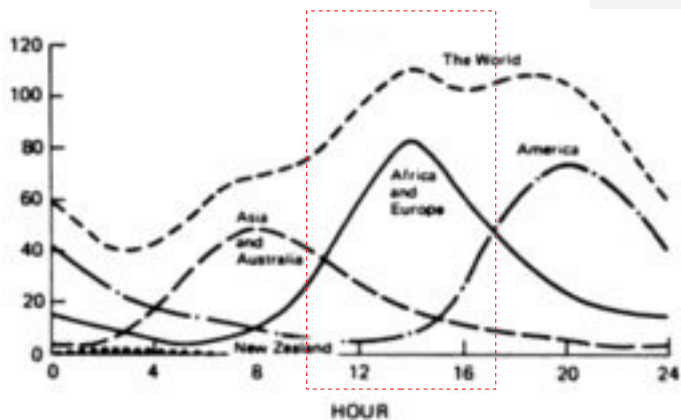
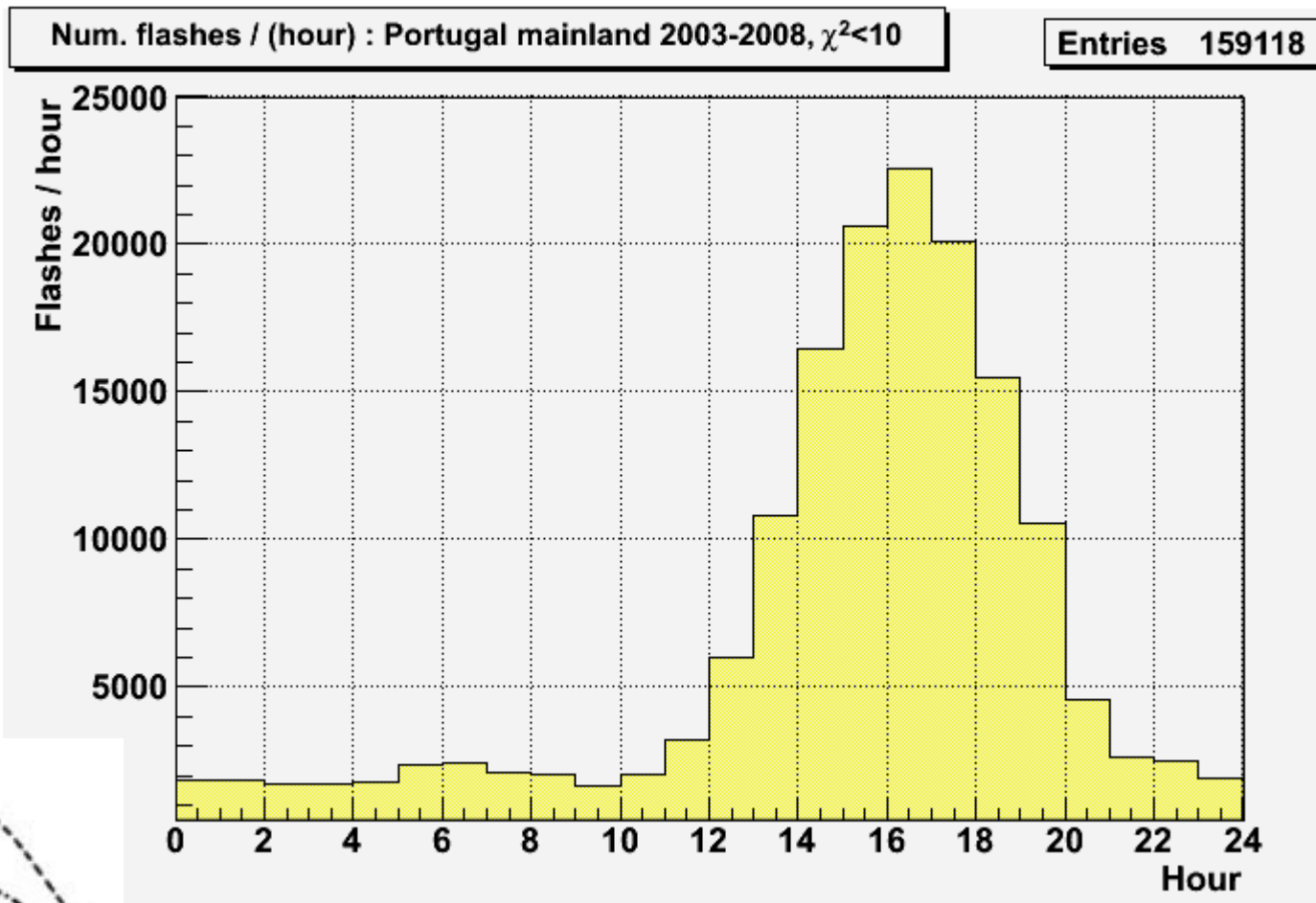
- ※ Each month is averaged over the six years
- ※ Maxima at May and September



Flashes per hour (2003-2008)

Accumulated values per bin (# flashes / hour)

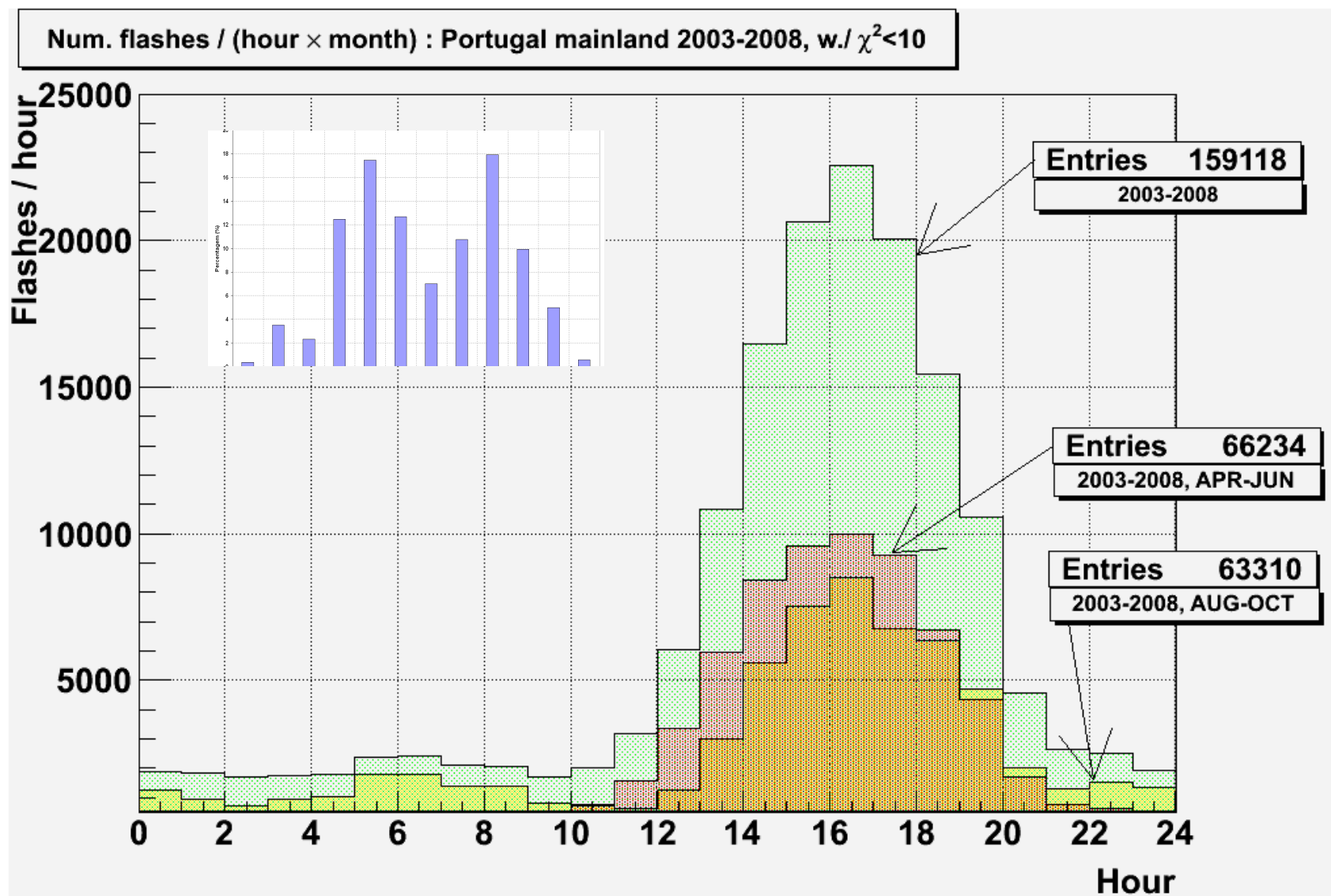
Distribution similar to results in literature, viz. region covering Europe



← Whipple & Scrase, *Met. Off. Geophys. Mem. London*, **68** (1936), 1-20.

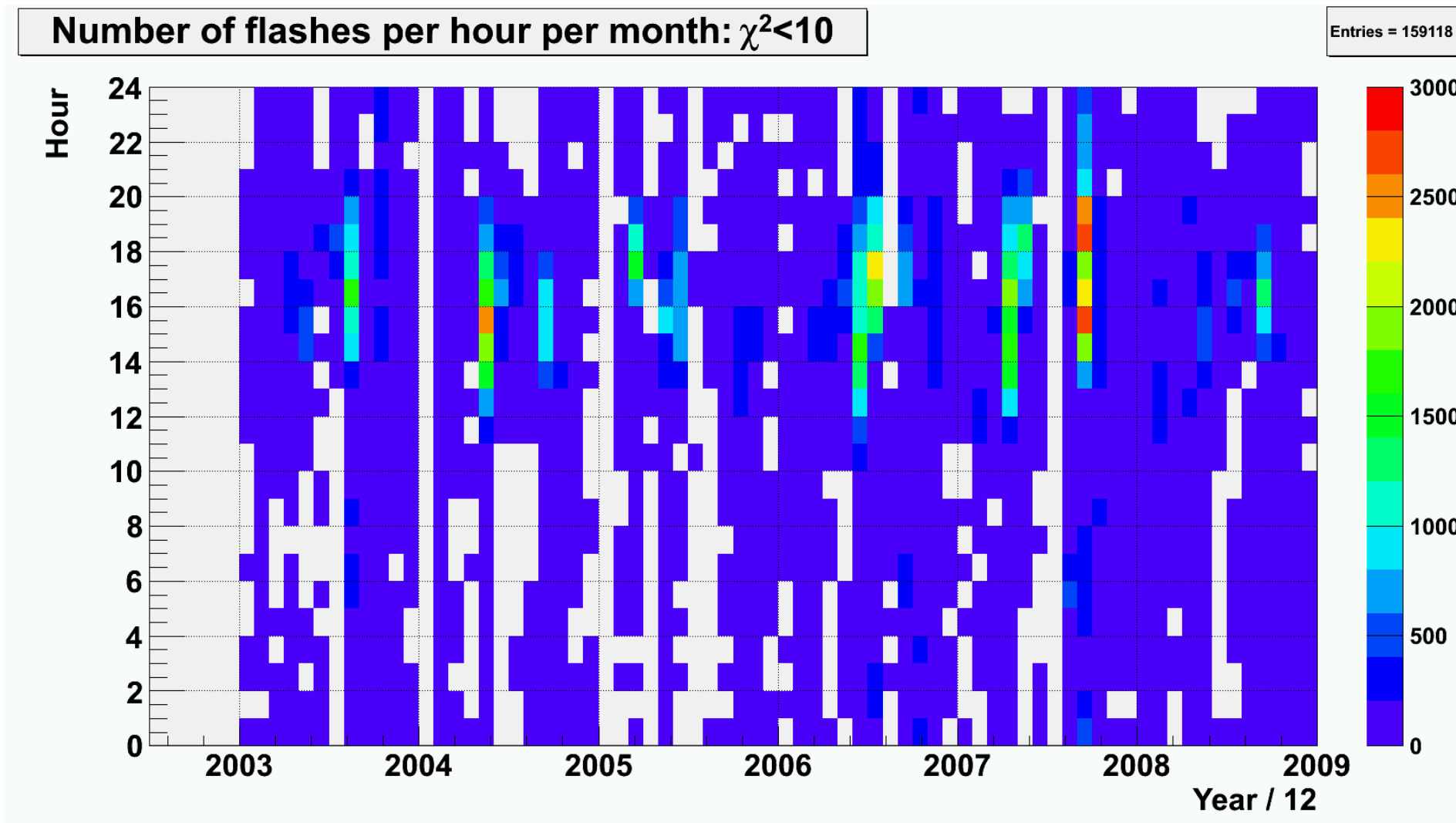


Portugal mainland (2003-2008): flashes per hour





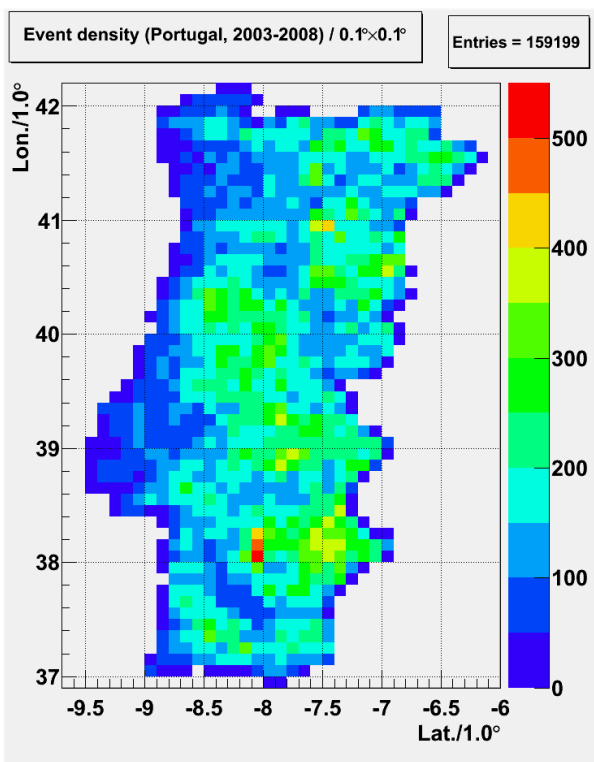
Portugal mainland (2003-2008): flashes per hour



※ Maxima at mid-spring and mid-summer months, mid-afternoon



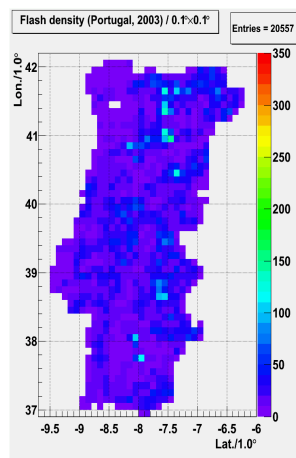
Flash density (2003-2008)



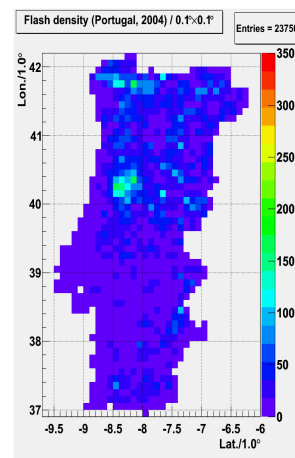
Accumulated 2003 – 2008

- 159×10^3 flashes
- 6 years (2003-2008)
- Area: $89 \times 10^3 \text{ km}^2$

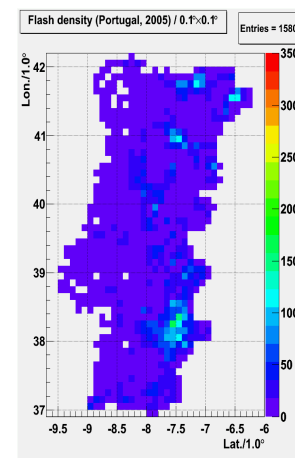
$$\sim 0.3 \text{ km}^{-2} \text{ y}^{-1}$$



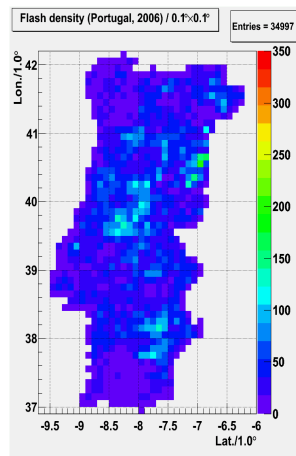
2003



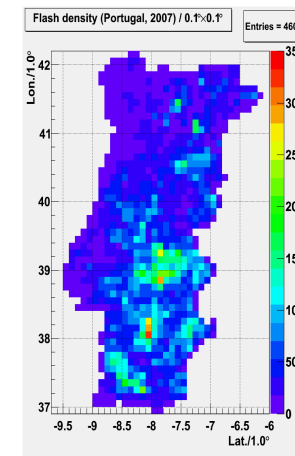
2004



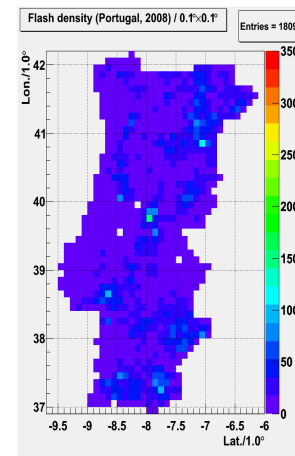
2005



2006



2007



2008

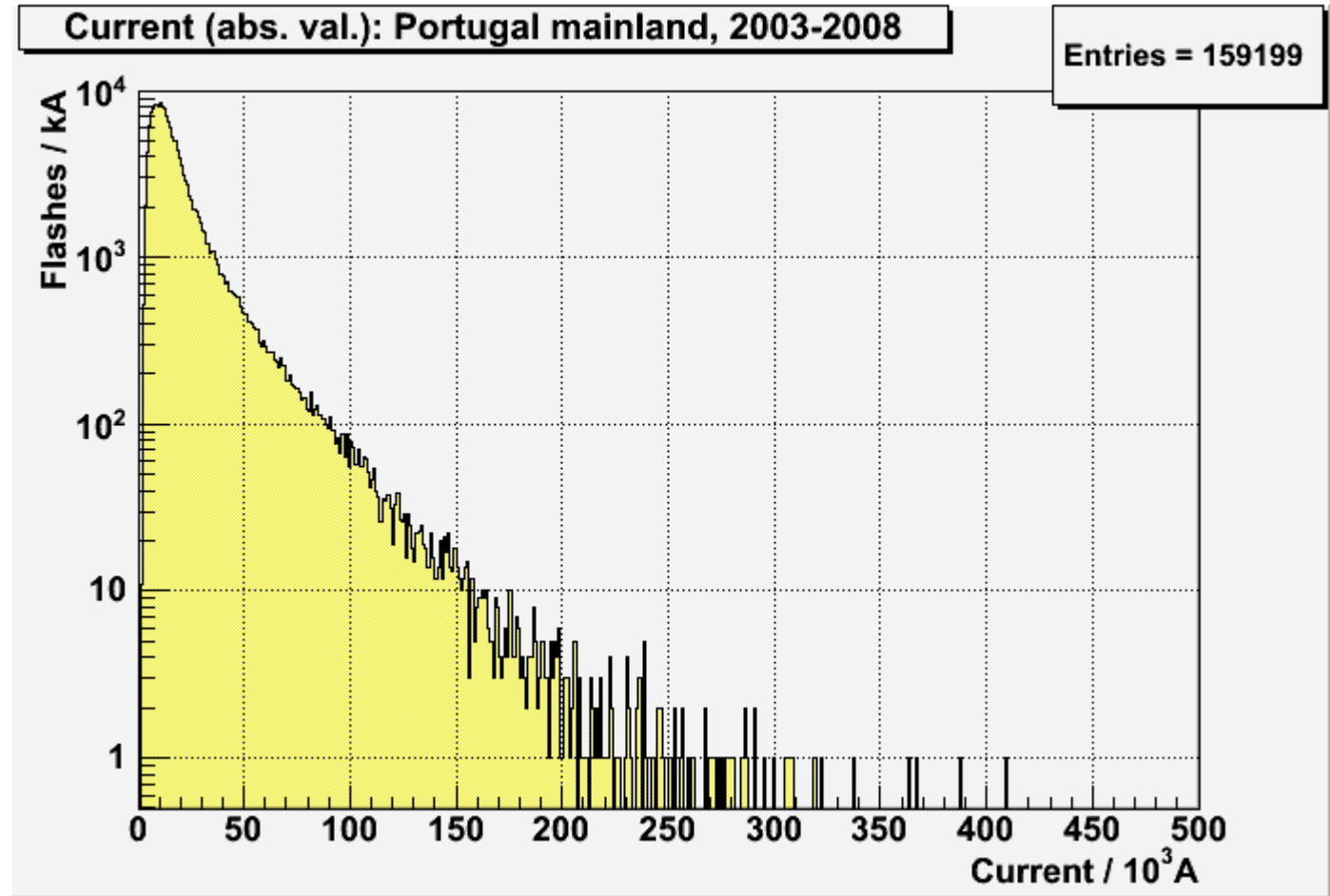


Flash current (absolute values, 2003-2008)

Flashes with current > 1kA

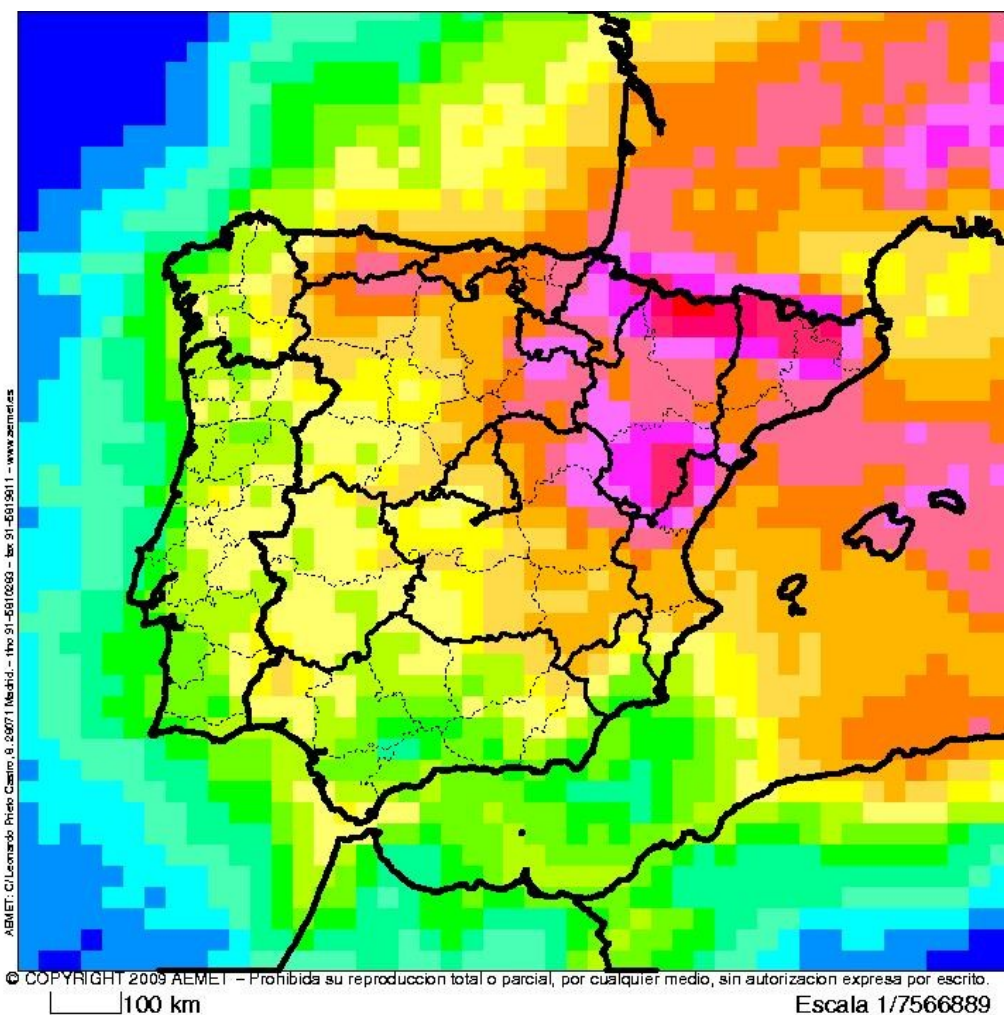
The distribution peaks at 10kA

Polarity:
81.3% negative,
18.7% positive





Flash density (2000-2007, AEMET Spain)



Días de tormenta por año

AÑO COMPLETO

01/01/2000 00:00:00
31/12/2007 23:59:59

Periodo=2000-2007

- más que 30.00
- desde 26.00 a 30.00
- desde 23.00 a 26.00
- desde 20.00 a 23.00
- desde 18.00 a 20.00
- desde 16.00 a 18.00
- desde 14.00 a 16.00
- desde 12.00 a 14.00
- desde 10.00 a 12.00
- desde 9.00 a 10.00
- desde 8.00 a 9.00
- desde 7.00 a 8.00
- desde 6.00 a 7.00
- desde 5.00 a 6.00
- desde 4.00 a 5.00
- desde 3.00 a 4.00
- desde 2.00 a 3.00
- desde 1.00 a 2.00
- desde 0.00 a 1.00
- 0.00 menor que

Promedio de días de tormentas por año
paso 30.00 x 30.00 km



F. Puebla, C. Rodríguez

※ Number of days with flashes (per year, per 30x30 km²)



Conclusions and outlook

Results with the portuguese
4-sensor lightning network,
2003 – 2008

- ※+ comparison with Spain's
lightning network (AEMET)

Averaged hourly distribution
reproduces results in literature for
similar longitudes, viz. maximum
at mid-afternoon

Two maxima in monthly
distribution:

- ※April-June
- ※August-October

Future work:

Possible network upgrades:

- ※Network connection

Weather type characterization
(synoptic) vs. lightning

Graduation/post-graduations:

- ※S. Correia (M. Sc.)
- ※J. Batista (Ph. D.)