Radiation fogs at two experimental sites in Europe: CIBA (Spain) and CESAR/Cabauw (The Netherlands)

C. Román-Cascón (1), C. Yagüe (1), G-J. Steeneveld (2), M. Sastre (1) and G. Maqueda (3)

(1) Depto. de Geofísica y Meteorología. Universidad Complutense de Madrid, Spain. (carlosromancascon@ucm.es); (2) Meteorology and Air Quality Section. Wageningen University, The Netherlands; (3) Depto. de Astrofísica y Ciencias de la Atmósfera. Universidad Complutense de Madrid, Spain.

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1. INTRODUCTION

SEVERAL PHYSICAL PROCESSES INFLUENCING FOG CYCLE → NO ACCURATE FOG FORECASTING [1, 2] → PROBLEMS OVER DAILY LIFE → A BETTER KNOWLEDGE OF THESE PROCESSES IS NEEDED

THIS WORK

- -Analysis of two complete 6-yr datasets at two different experimental sites
- -Determination of main features of RADIATION fogs at both places (statistics)
- -Determination of favorable conditions for fog formation (as in Menut et al. 2013 [3]) *
- -Determination of favorable conditions for fog dissipation

* In Menut et al. 2013 the pre-fog conditions in Paris area were determined using ParisFog data

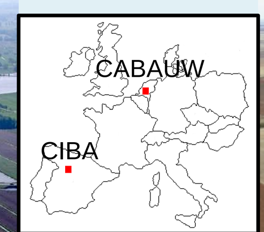
* Threshold values of the meteorological variables driving the formation of radiation fogs (T, ws, rh and net IR rad) were given in order to check if a numerical model (WRF) was able to reproduce these conditions

* The use of these thresholds after the correctly forecast of the pre-fog conditions (not the fog itself) led to the detection of 87% of fogs in their work

• In our work we calculate these threshold values at CIBA (Spain) and Cabauw (The Netherlands) and we add more variables

2. EXPERIMENTAL SITES & FOG STATISTICS

- The Netherlands, below sea level
- Humid terrain with water canals
- Land use: Grass land
- Homogeneous terrain
- Moderately populated area, sea 50 km away



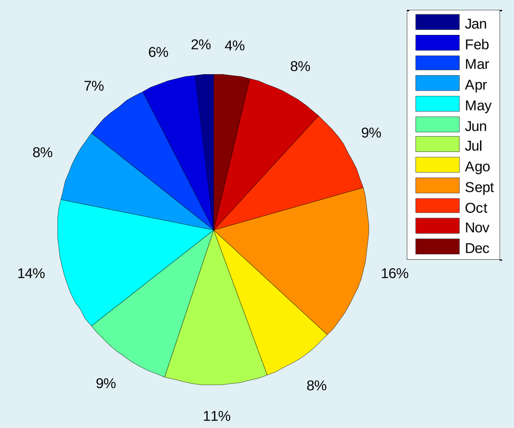
- Spain, 840 m asl.
- Dry terrain (when no precipitation)
- Land use: Pastures, dry land
- Homogeneous terrain
- Sparsely populated area, sea 200 km away

	CABAUW	CIBA
Hours VIS < 1000m	663	578
Fog events**	343	231
Radiation fogs	160***	102****
Precipitation fogs	37	?
Cloud-base lowering fogs	38	?
Advection fogs	29	10
No determined	79	119

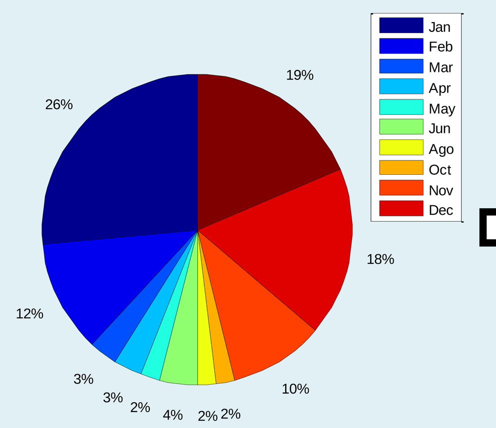
** Fog event defined as VIS<1000m for more than 1 hour and with 3/5 of period with fog

*** Classification following Tardif and Rasmussen, 2007 [4]

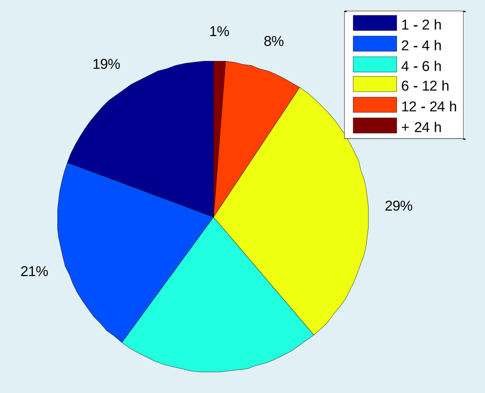
**** Tardif and Rasmussen, 2007 [4] classification when possible



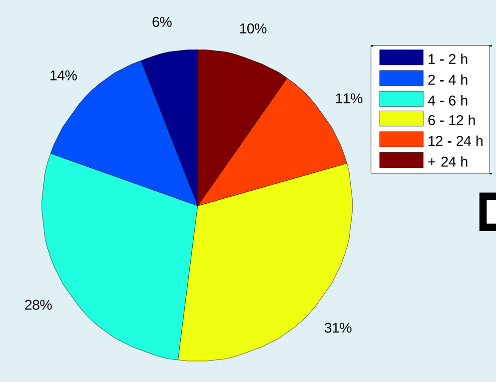
RADIATION FOGS MONTLHY DISTRIBUTION



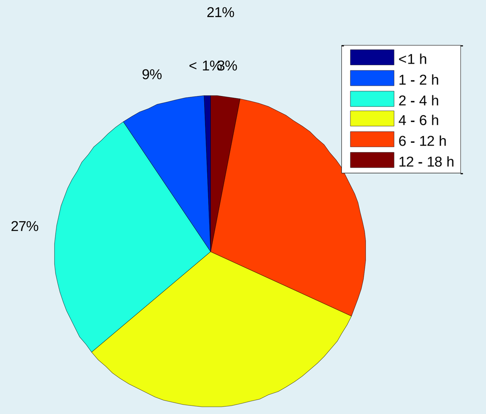
- CABAUW → Radiation fogs distributed over the whole year, fewer cases in winter
- CIBA → Radiation fogs mainly in winter months



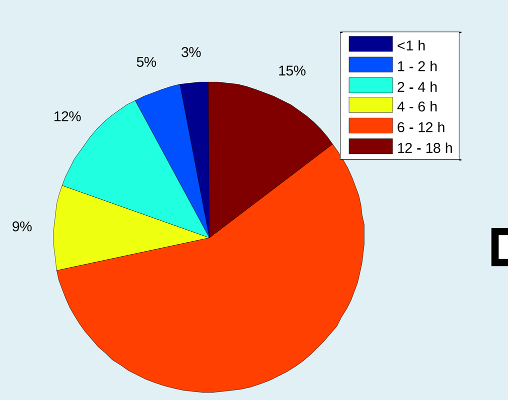
RADIATION FOGS DURATION (PERSISTENCE)



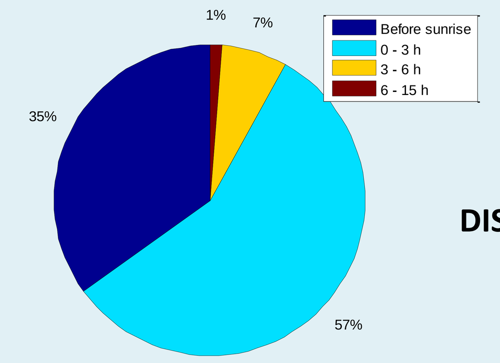
- In general, radiation fogs more persistent at CIBA



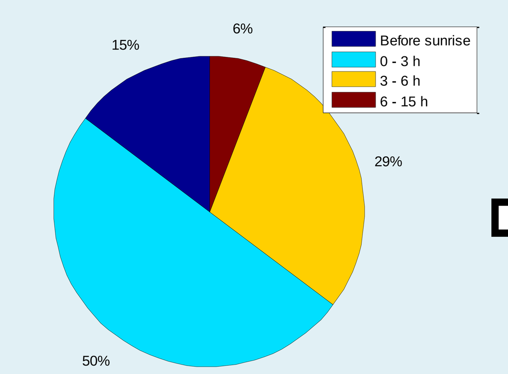
RADIATION FOGS ONSET (regarding sunset)



- CABAUW → Radiation fogs formed some hours after sunset
- CIBA → Radiation fogs need more cooling hours (it is more difficult to reach saturation)



RADIATION FOGS DISSIPATION (regarding sunrise)

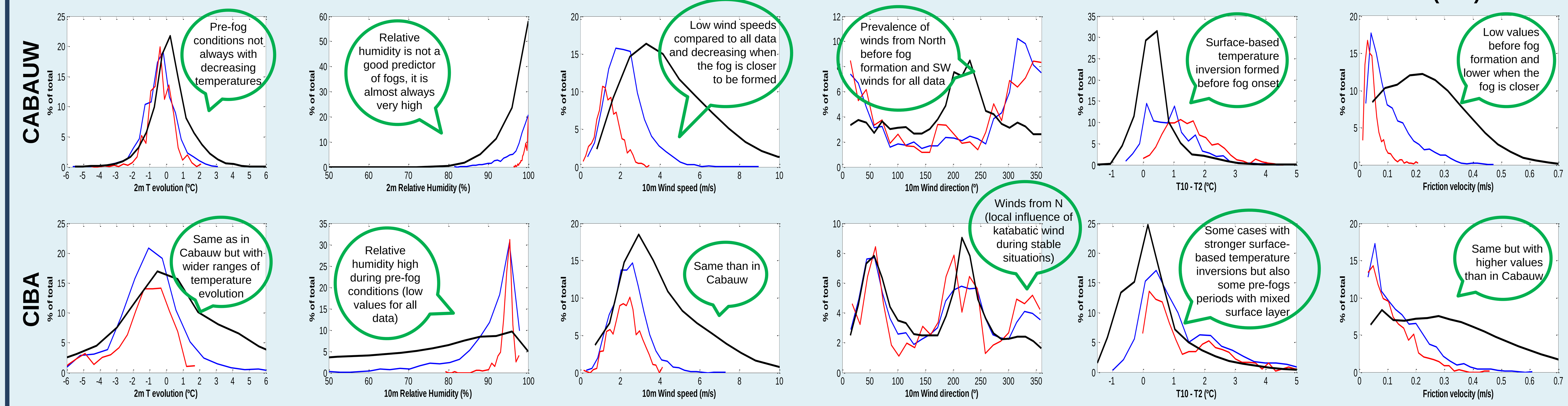


- CABAUW → Most radiation fogs dissipated around sunrise
- CIBA → Radiation fogs persist more during daytime

3. PRE-FOG CONDITIONS

FIGURES EXPLANATION: "All data" → Frequency distribution of each variable for all data (6 years); "Pre-fog" → Frequency distribution for each variable for 6h (blue) or 1 h (red) before fog onset (data from all cases of radiation fogs)

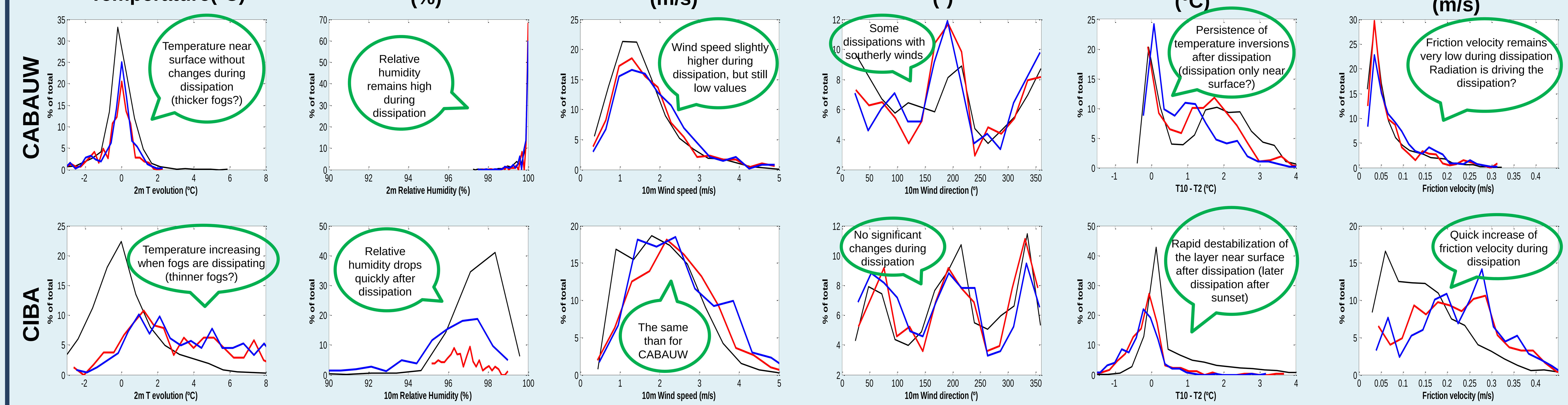
Time evolution Temperature(ºC) | **Relative Humidity (%)** | **Wind speed (m/s)** | **Wind direction (º)** | **T10 – T2 (ºC)** | **Friction velocity (m/s)**



4. DISSIPATION CONDITIONS

FIGURES EXPLANATION: "FOG" → Frequency distribution of each variable during radiation fogs; "Dissipation" → Frequency distribution for each variable 2 h before (red) or 2 h after (blue) fog dissipation (all cases of radiation fog)

Time evolution Temperature(ºC) | **Relative Humidity (%)** | **Wind speed (m/s)** | **Wind direction (º)** | **T10 – T2 (ºC)** | **Friction velocity (m/s)**



5. CONCLUSIONS

- Statistics of 6-years show significant differences between CIBA and CABAUW, mainly influenced by humidity availability and location
- Differences between Paris [3], CIBA and Cabauw. The use of same thresholds for determining pre-fog conditions at different places is not valid
- Dissipation conditions are different for each place
  - CABAUW → Thicker fogs or transformation into low clouds? Dissipation driven by radiation, less turbulence
  - CIBA → Quick dissipation stage. Dissipation driven by turbulence
- Physical processes affecting fog formation are influenced by site characteristics (location, humidity, local influences)

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[4] Tardif R., Rasmussen R., *Appl Meteor Climatol* 46: 1141:1167.

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