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► **To cite this version:**

Olivier Cantat, Edwige Savouret. A catalog of ‘weather types’ in metropolitan France. *Climatologie*, 2014, 11, pp.65-71. 10.4267/climatologie.584 . hal-01699201

HAL Id: hal-01699201

<https://hal.univ-lorraine.fr/hal-01699201v1>

Submitted on 27 May 2021

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A CATALOG OF ‘WEATHER TYPES’ IN METROPOLITAN FRANCE *

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Abstract

Weather types allow the reality of atmospheric conditions to be understood on a regional scale and their potentialities and risks envisaged. This summary presents the results for one of metropolitan France’s sixty weather stations from 1991 to 2010.

Keywords: weather types, spatial diversity, temporal variability, metropolitan France.

Introduction

This extended summary outlines the concept of a catalog of ‘weather types’ whose spatial distribution, frequency, length and succession enable the concrete reality of atmospheric conditions over a given land area to be understood and their consequences for the geographical space envisaged. The catalog aims firstly to provide a knowledge base for the whole of France, among other reasons useful for defining climatic regions ‘*since it is frequency which in the end determines the contrasts between regional climates*’ (Godard & Tabeaud, 2009). It could also be useful for environmental and planning actors because of the global nature of the information it provides (with possible applications in farming, tourism, health, transportation and so on).

Our presentation is accompanied by a brief commentary of four daily data sheets covering the period between 1991 and 2010 from Caen weather station, Normandy, taken as an example from among the sixty stations in metropolitan France.

1. Classification of ‘weather types’ and complete catalog description

A study of ‘weather types’ was envisaged based on a classification comprising four essential meteorological-climate elements: the cloud cover, temperature, precipitation and wind. The four parameters were differentiated on the basis of frequency analyses of eight stations representative of the major French climatic tendencies for lowland areas (oceanic, continental and Mediterranean). The resulting classes are displayed in the middle graph in figure 1; values for each station are compared to the national mean calculated for the eight reference stations (cf. the two right-hand columns on each line).

* This paper was also published in French in the Conference Proceedings of AIC 2014 (Dijon).

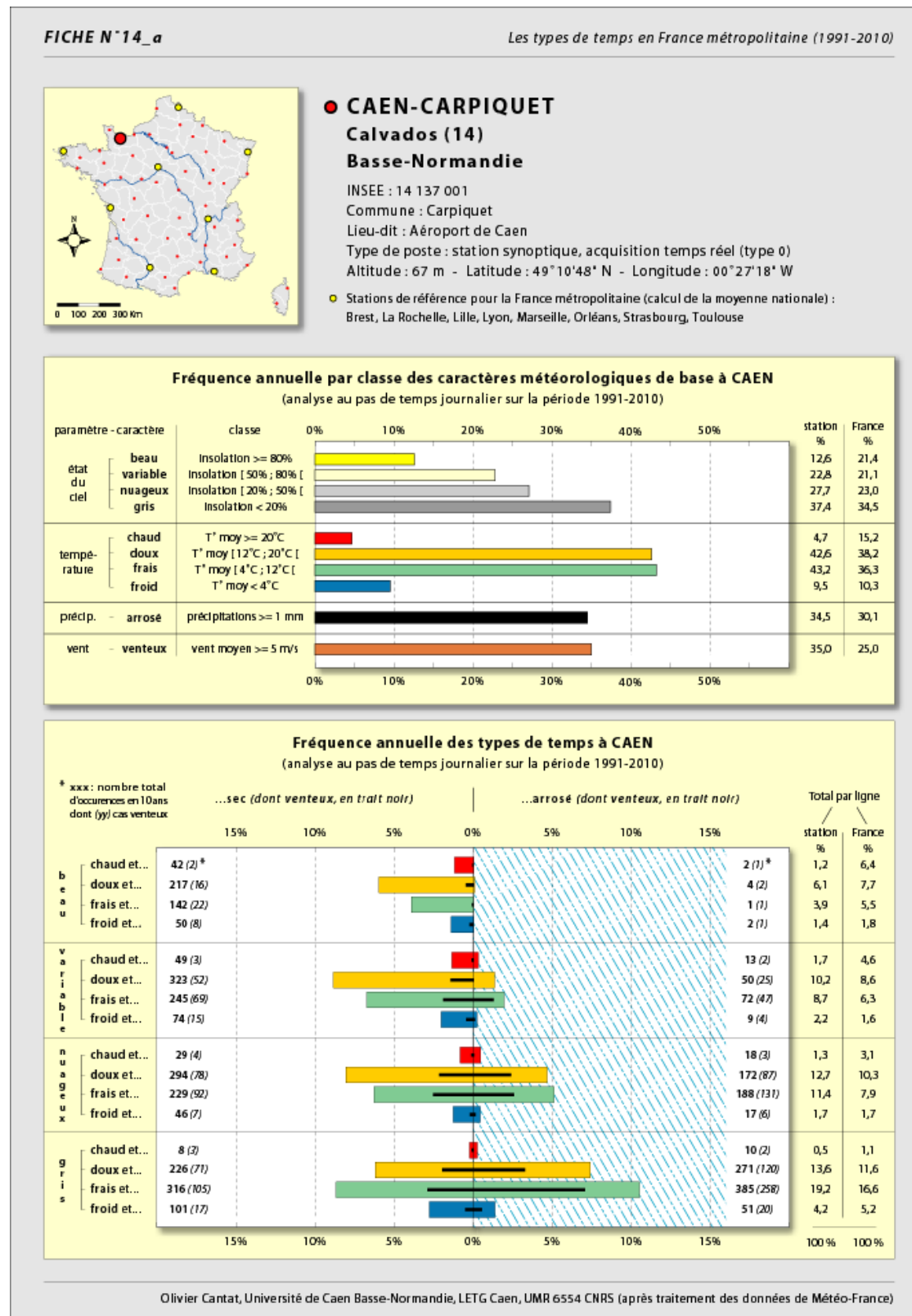


Figure 1: Weather station details (top), basic climate parameters (middle), and 'weather types' (bottom), 1991-2010, (Caen-Carpiquet weather station, Normandy).

In order to make as accurate a distinction as possible of French climatic diversity, sixty criteria were selected in accordance with their intra-regional geographical representativeness (i.e., the role of local factors), the availability of data over the last two decades (i.e., with no significant gaps), and the stability of the landscapes around the

stations and in the immediate vicinity of measuring instruments so as to ensure the homogeneity of the data series (cf. the dot distribution on the map in figure 1).

Concretely, the typology was obtained by combining the different classes, giving sixty-four possible combinations ($4*4*2*2$). Certain combinations occur frequently (e.g., *overcast, cool, wet* weather, typical of maritime polar air masses), while others are very occasional, as they associate atmospheric conditions *a priori* unlikely to occur simultaneously but nevertheless possible (e.g., *clear, warm, rainy, windy* weather, corresponding to a fine summer's day with a southerly wind, preceding the arrival of an active disturbance in the evening or of thunderstorms). Such rare combinations need to be taken into account, however, as they often signify environmental and/or human risks, due to the unpreparedness of the places in question for this type of atmospheric constraint.

In sum, the first data sheet provides an overall approach to 'weather types' for each station (figure 1), while the other three sheets show respectively their seasonality (figure 2), year-to-year variations (figure 3), and area of influence and temporal persistence (figure 4).

2. Example of the analysis for Caen-Carpiquet weather station (Normandy)

In the graph at the bottom of Figure 1, the Caen station's combinations appear to be extremely varied, reflecting the region's geographical exposure to all kinds of air masses. The most common is '*overcast and cool*' weather (19.2%), half the time with showers and very often wind. This combination is followed by four typical types for North-West France: '*overcast and mild*' (13.6%), with a slight prevalence of accompanying rain and wind; '*cloudy and mild*' (12.7%), preferably dry and not as windy; '*cloudy and cool*' (11.4%), with a fairly even distribution between dry or wet and windy or calm; and finally '*changeable and mild*' (10.2%), with a strong prevalence of neither rain nor wind.

Such typical conditions do not exclude the occurrence of more contrasted episodes linked to rare synoptic weather configurations (Cantat, Savouret & Bensaid, 2013). For example, the '*clear and warm*' weather type, – sometimes leading to a heatwave and/or drought – occurs on average in 1.2% of situations (or 4.4 days p.a.). On the other hand, the '*overcast, cold, rainy*' type – with its concomitant risk of landslips – accounts for 1.4% (5.1 days p.a.), along with a likelihood of snowdrifts in high winds in 0.6% of cases (2.0 days p.a.).

Figure 2 shows that the season is a factor in determining key risk periods according to the various 'weather types', from the most to the least common. Figure 3, with year-by-year values over twenty years, shows climate variability and illustrates different possible circulation types (zonal and meridian). The map in Figure 4 shows clear spatial coherence in North-West France, with over 50% of identical types on a given day, and confirms the distinct dichotomy with the Mediterranean region (15 to 18%). The number of consecutive days with the same 'weather type' shows the extremely changeable nature of the atmosphere, with a continuous maximum series of seven days in Caen, compared with 28 at Ajaccio and 12 in Dijon, for example.

Conclusion

Since '*every type is the result of a classification, ...weather types can quite rightly be distinguished according to their "use"*' (Carréga, 2004). In order to go beyond the predefined structure of this typology, we have also developed a supervised classification module of 'weather types' (with free selection from among 12 parameters), thus enabling a variety of key subject areas to be focused on more precisely (Cantat & Savouret, 2013).

FICHE N°14_b Les types de temps en France métropolitaine (1991-2010)

CAEN-CARPIQUET
Calvados (14)_Basse-Normandie

Saisonnalité des types de temps
(moyenne du nombre de jours sur la période 1991-2010)

		JAN	FEV	MAR	AVR	MAI	JUN	JUL	AOU	SEP	OCT	NOV	DEC	total ANNEE	
état du ciel : BEAU (f >= 80%)	Beau chaud sec <i>dont beau chaud sec et venteux</i>					0,2	0,5	1,2	1,8	0,6				4,3 0,2	
	Beau chaud arrosé <i>dont beau chaud arrosé et venteux</i>							0,1		0,1				0,2	
	Beau doux sec <i>dont beau doux sec et venteux</i>	+		+	0,5	3,1	4,5	3,8	3,9	4,4	1,5	+		21,8 1,6	
	Beau doux arrosé <i>dont beau doux arrosé et venteux</i>			+				+	+	+	+	0,1		0,4 0,3	
	Beau frais sec <i>dont beau frais sec et venteux</i>	0,7	1,6	3,2	3,5	1,3	0,3			0,4	1,8	1,2	0,4	14,2 2,2	
	Beau frais arrosé <i>dont beau frais arrosé et venteux</i>	0,1	0,3	0,3	0,5	0,4					0,3	0,2	0,2	0,1 0,1	
	Beau froid sec <i>dont beau froid sec et venteux</i>	1,4	1,1	0,5	0,1							+	0,7	1,4 0,8	
	Beau froid arrosé <i>dont beau froid arrosé et venteux</i>		+											+	0,2
															+
état du ciel : VARIABLE (50% <= f < 80%)	Variable chaud sec <i>dont variable chaud sec et venteux</i>					0,1	0,8	1,5	2,1	0,5	+			4,9 0,3	
	Variable chaud arrosé						0,3	0,6	0,3	0,2				1,3 0,2	
	Variable doux sec <i>dont variable doux sec et venteux</i>	+		0,6	1,5	4,4	6,4	4,5	5,7	6,0	3,2	0,3		32,3 5,2	
	Variable doux arrosé <i>dont variable doux arrosé et venteux</i>			0,2	0,3	0,5	0,6	0,8	0,9	1,0	1,0	0,1		5,0 2,6	
	Variable frais sec <i>dont variable frais sec et venteux</i>	2,1	2,3	4,5	4,6	2,6	0,4			0,4	2,8	3,2	1,8	24,5 6,9	
	Variable frais arrosé <i>dont variable frais arrosé et venteux</i>	0,8	0,9	0,7	1,3	0,5					0,9	1,3	0,9	7,2 4,8	
	Variable froid sec <i>dont variable froid sec et venteux</i>	2,1	1,3	0,8	+							+	0,7	2,5 1,6	
	Variable froid arrosé <i>dont variable froid arrosé et venteux</i>	0,6	0,2	0,4										0,4	
		0,2	0,4	+									0,1	0,3	
		0,1	0,2										+	0,1	
état du ciel : NUAGEUX (20% <= f < 50%)	Nuageux chaud sec <i>dont nuageux chaud sec et venteux</i>						0,4	1,0	1,5	0,2				3,0 0,4	
	Nuageux chaud arrosé <i>dont nuageux chaud arrosé et venteux</i>					+	0,2	0,7	0,8	0,1				1,8 0,3	
	Nuageux doux sec <i>dont nuageux doux sec et venteux</i>		0,2	0,5	1,7	3,7	5,2	5,8	5,0	4,2	3,0	0,4		29,4 7,9	
	Nuageux doux arrosé <i>dont nuageux doux arrosé et venteux</i>		0,2	0,2	0,4	0,4	1,1	1,5	1,7	0,8	0,9	0,1		17,2 8,8	
	Nuageux frais sec <i>dont nuageux frais sec et venteux</i>	2,5	2,6	4,2	3,5	2,1	0,2			0,3	1,4	4,4	2,0	22,9 9,2	
	Nuageux frais arrosé <i>dont nuageux frais arrosé et venteux</i>	1,6	1,3	1,5	1,7	0,8				+	0,4	1,8	0,7	18,8 13,2	
	Nuageux froid sec <i>dont nuageux froid sec et venteux</i>	2,1	2,3	2,7	3,3	0,6	0,2			0,1	1,6	3,4	2,6	4,6 0,7	
	Nuageux froid arrosé <i>dont nuageux froid arrosé et venteux</i>	1,6	1,0	0,3	+								0,4	1,3 0,2	
		0,4	0,6	0,2	+									0,5	
		0,2	0,3	0,1										+	
état du ciel : GRIS (f < 20%)	Gris chaud sec <i>dont gris chaud sec et venteux</i>							0,4	0,3	0,1				0,8 0,3	
	Gris chaud arrosé <i>dont gris chaud arrosé et venteux</i>					+	+	0,4	0,5	+				1,0 0,2	
	Gris doux sec <i>dont gris doux sec et venteux</i>	0,2	0,2	0,9	0,9	2,2	3,1	4,3	3,0	3,1	3,6	1,1	0,2	22,6 7,2	
	Gris doux arrosé <i>dont gris doux arrosé et venteux</i>	0,2	0,2	1,1	1,2	3,1	4,3	3,5	3,1	3,9	4,4	1,5	0,9	27,1 12,1	
	Gris frais sec <i>dont gris frais sec et venteux</i>	6,0	5,2	5,3	3,1	1,9	0,2	+		0,3	1,7	4,0	4,2	31,7 10,6	
	Gris frais arrosé <i>dont gris frais arrosé et venteux</i>	2,9	1,5	2,1	0,9	0,8	+			+	0,4	0,8	1,2	38,5 25,9	
	Gris froid sec <i>dont gris froid sec et venteux</i>	6,2	5,2	4,4	3,6	2,5	0,2			0,5	2,7	6,2	7,2	10,1 0,6	
	Gris froid arrosé <i>dont gris froid arrosé et venteux</i>	5,3	4,3	2,8	2,3	1,2	+			0,3	1,4	3,2	5,4	1,8	
		3,3	2,3	0,5	+							0,5	3,6	5,1	
		0,7	0,3	0,2								+	0,2	0,8	

nota : un signe + indique une occurrence non nulle mais < à 0,1 jour ; valeurs arrondies au dixième supérieur (total annuel parfois différent du total des mois)

Occurrences mensuelles (cas venteux ou non) : □ < 2,5 jours □ [2,5 ; 5 jours[□ [5 ; 7,5 jours[□ [7,5 ; 10 jours[□ >= 10 jours

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Figure 2: Seasonal nature of 'weather types', 1991-2010 (Caen-Carpiquet weather station, Normandy).

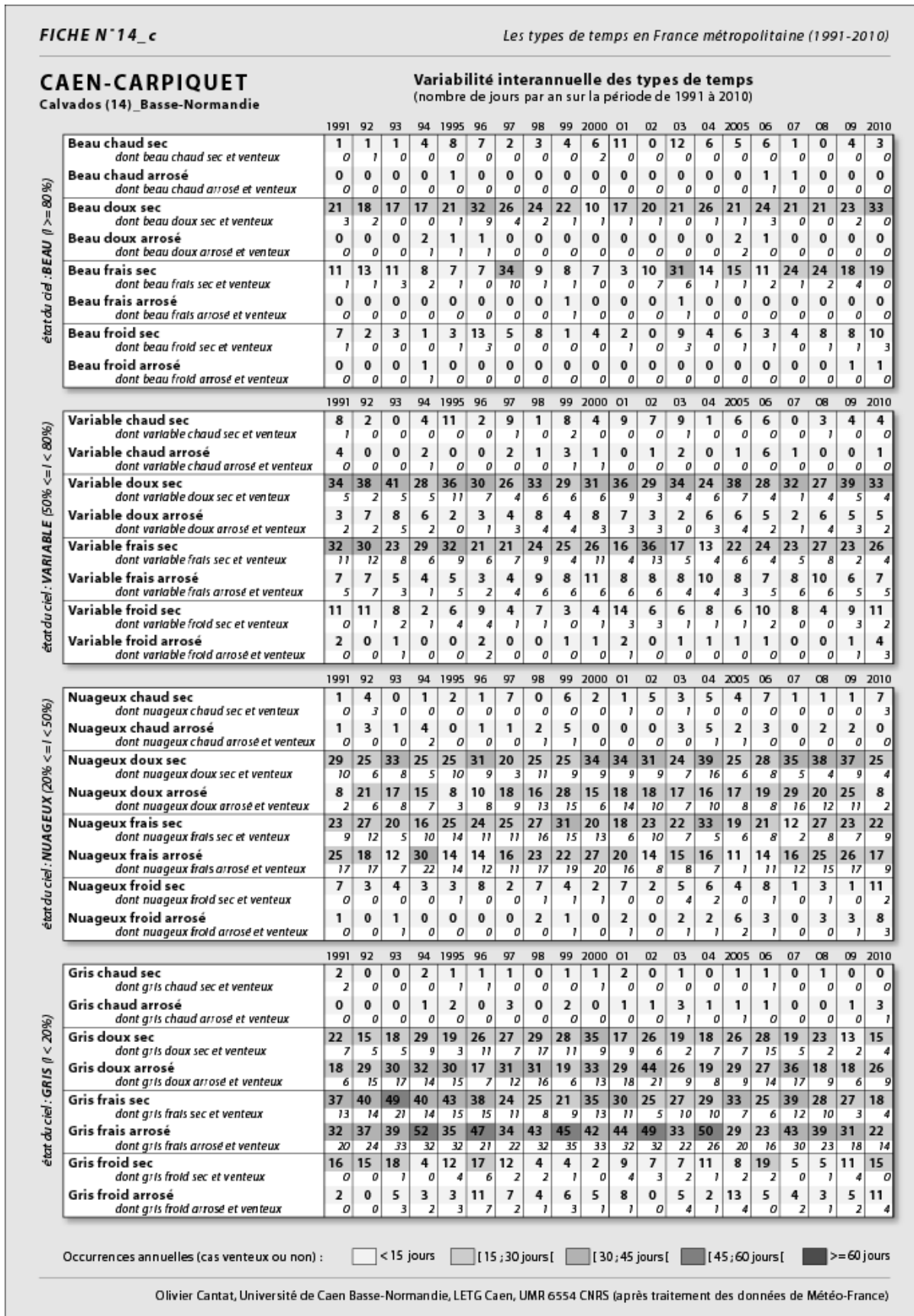


Figure 3: Year-to-year variability of ‘weather types’, 1991-2010 (Caen-Carpiquet weather station, Normandy).

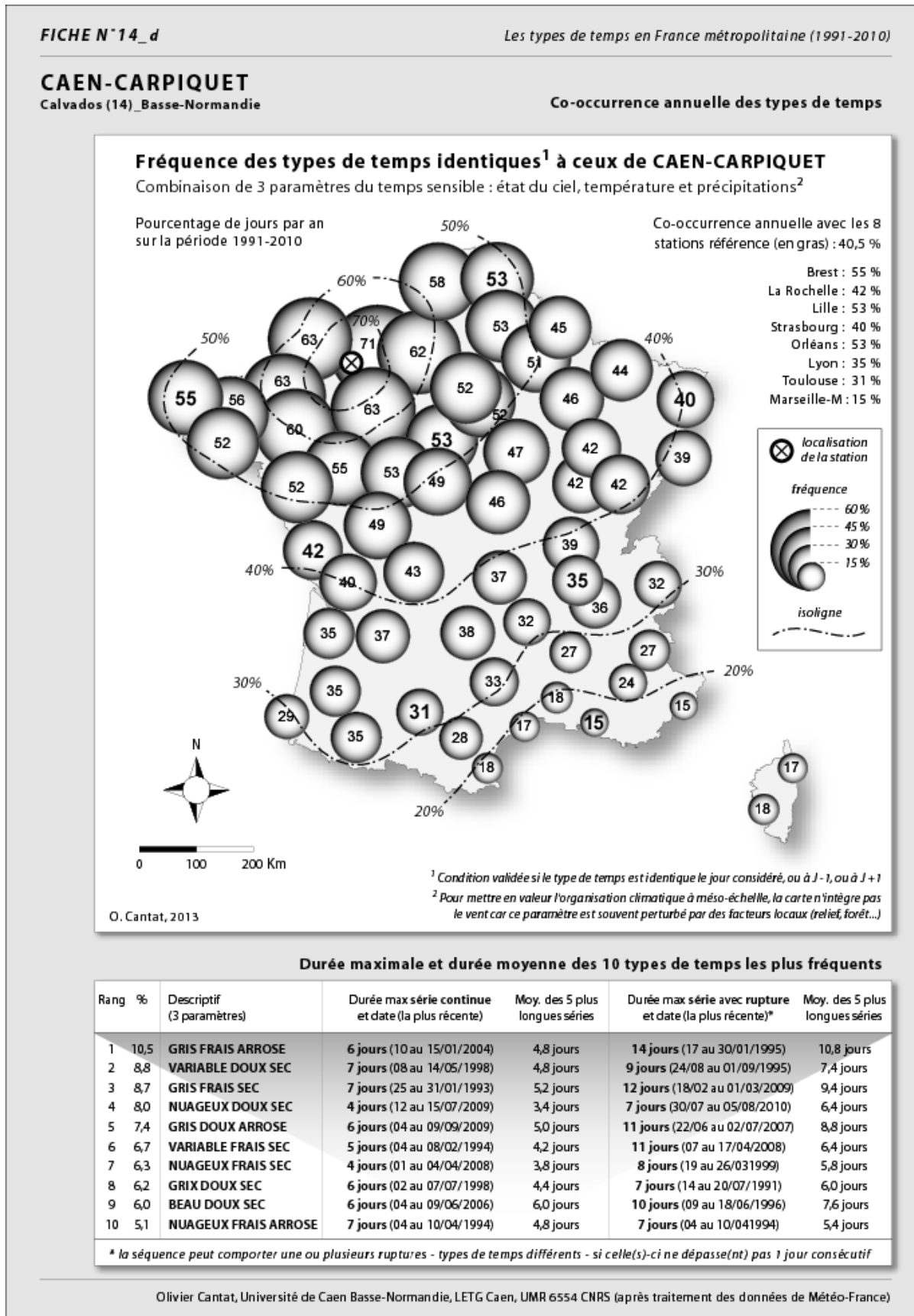


Figure 4: Annual concurrent occurrences (top) and duration (bottom) of the most frequent 'weather types', 1991-2010 (Caen-Carpiquet weather station, Normandy).

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