Medium range forecasts at METEO-FRANCE with the Ensemble Prediction System (EPS)

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Since May 1998 METEO-FRANCE provides daily forecasts until day+7, using the output of the ECMWF EPS (i.e. the forecasters use the EPS data until +192h). A new method of classification of ensemble forecasts, the tubing, has been designed to be the basis of the forecasters interpretation of the EPS data, and allows them to give an estimation of a confidence index for their forecast. On this occasion, and according to the concepts of predictability in the medium range (day+4 to day+7) a new approach has also been defined, considering a larger scale than the synoptic one, the « supra synoptic scale ».

1 - Predictability in the medium range

It's well known that the predictability depends on the range and the scale of the phenomenon. The uncertainty in Numerical Weather Prediction Forecast generally grows with the forecast range, and synoptic scale phenomena are more often unpredictable after day+3. In the medium range, only long waves are still foreseeable. From day+4, a new scale is defined, larger than the synoptic one, called « supra synoptic scale ». Considering this scale, several flow types are identified, slowly variable over a period of 2 or 3 days. Four main flow types have been accepted :
- Perturbed flow : PE
- Undulating flow : OND
- Warm block : BCA
- Cold block : BFA

The main characteristics of the weather, associated with each type of flow, are depending on the season and on the geographical localisation, but are generally well identified.

2 - Classification of the EPS : the tubing

This method of classification of ensemble forecasts is based on the assumption that ensemble distributions can generally be considered as monomodal, and that the verification is most likely to be found in the vicinity of the ensemble mean.

A central cluster is obtained by grouping the members lying around the ensemble mean. The radius of the central cluster is limited according to the season.

The member which is the most remote from the ensemble mean becomes the first extreme and defines the tube n°1, grouping the members lying between this extreme and the central cluster. The radius of the tube is the same as for the central cluster.

The process is iterated until all members are classified, with the constraint that a member belonging to a tube can't become an extreme.

The tubing provides a complete set of information :

- The central cluster mean field is the basis of the deterministic component of the forecast.
- The number of tubes gives the level of confidence of the deterministic forecast.
- The extremes indicate the possible meteorological variants.

3 - Production by forecasters

Every day, the medium range forecaster of the Central Forecast Department in Toulouse, is provided with three sets of classification of the EPS, representing the central cluster and a variable number of tubes (generally less than 5 or 6). Each set for a period of 72 hours, based on +96H, +144H and +192H forecasts. The fields used are 500 hPa height and temperature, mean sea level pressure and 850 hPa temperature, on the N Atlantic and W Europe domain. Other deterministic fields and also probabilistic fields of some weather parameters like temperature anomalies and rain are used, too. These probabilities are based on the 51 members of the EPS. Calibration is used to improve the quality of probabilities.

The central cluster field is represented by an average of its members. On the contrary, each tube is represented by its extreme member (which defines this tube). This implies a difficulty for the forecaster's analysis because averaged fields cannot be interpreted like simple fields, especially when the radius of the central cluster is large, in winter.

The forecaster describes the most likely forecast evolution by interpreting the central cluster mean. He supplies a « supra-synoptic scenario » for D+4/D+5 (D+5/D+6 model range) and the evolution expected for D+6/D+7 (D+7/D+8 model range), with associated comments, and a graphical document named PRESSYME (PREvision Supra SYnoptique Moyenne Echéance) for each of these two periods. The kind of weather expected for France is then defined in the technical guidance, with some precision for parameters like wind, temperatures and rain intensity.

In addition, a confidence index is given (confidence in the supra synoptic scenario), one for the D+4/D+5 period forecast, one for D+6/D+7. This index is based on the number of tubes, or more precisely, on the number of significant meteorological variants or deviations for the country, illustrated by the different tubes. It is evaluated in a subjective way, on a scale of 1 to 5:

- 4 if the confidence is strong (0 or 1 tube)
- 3 if the confidence is normal (2 or 3 tubes)
- 2 if the confidence is weak (more than 3 tubes)

The extremes of the scale (5 and 1) are rarely used and only in very specific cases : very strong confidence, which is more often very difficult to appreciate, or on the opposite, very weak confidence due to a great number of tubes with significant variants for the country.

Finally this index can also be modified (by adding or deducting one point) according to the kind of weather expected. For example, the forecaster may have a very strong confidence for a warm block, but a lower confidence for the corresponding kind of weather (generally fair), due to a possible presence of low clouds (in Winter especially).

Recently, a new graphic product (still experimental) has been added to the technical medium range guidance, for the national media. The weather is represented by means of pictograms, designed to take into account the specific context and possibilities of the medium-range forecasting.

For this new product, a special day was chosen to begin. It was the 11th of August when a total solar eclipse could be seen on a large part of France. At this time, the requirement of forecasting was greatly increasing. This example is illustrated below by figures.

A subjective control of the medium-range for the whole year 1998 is also presented.
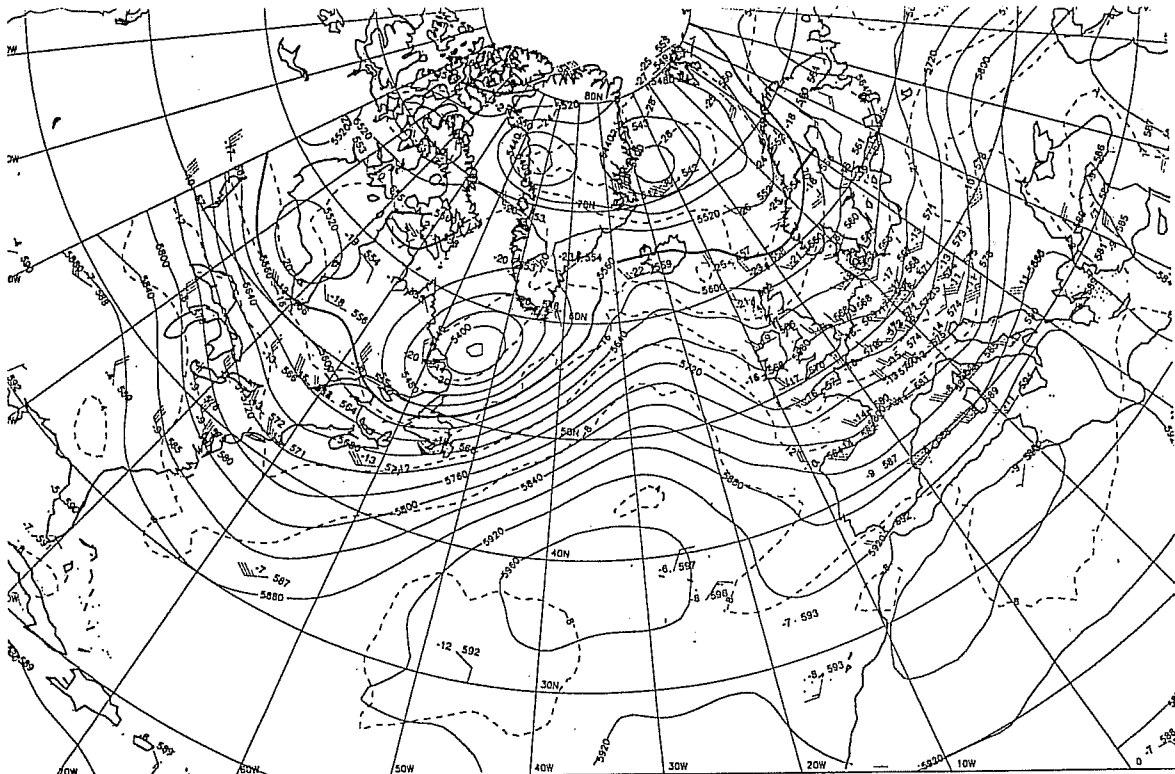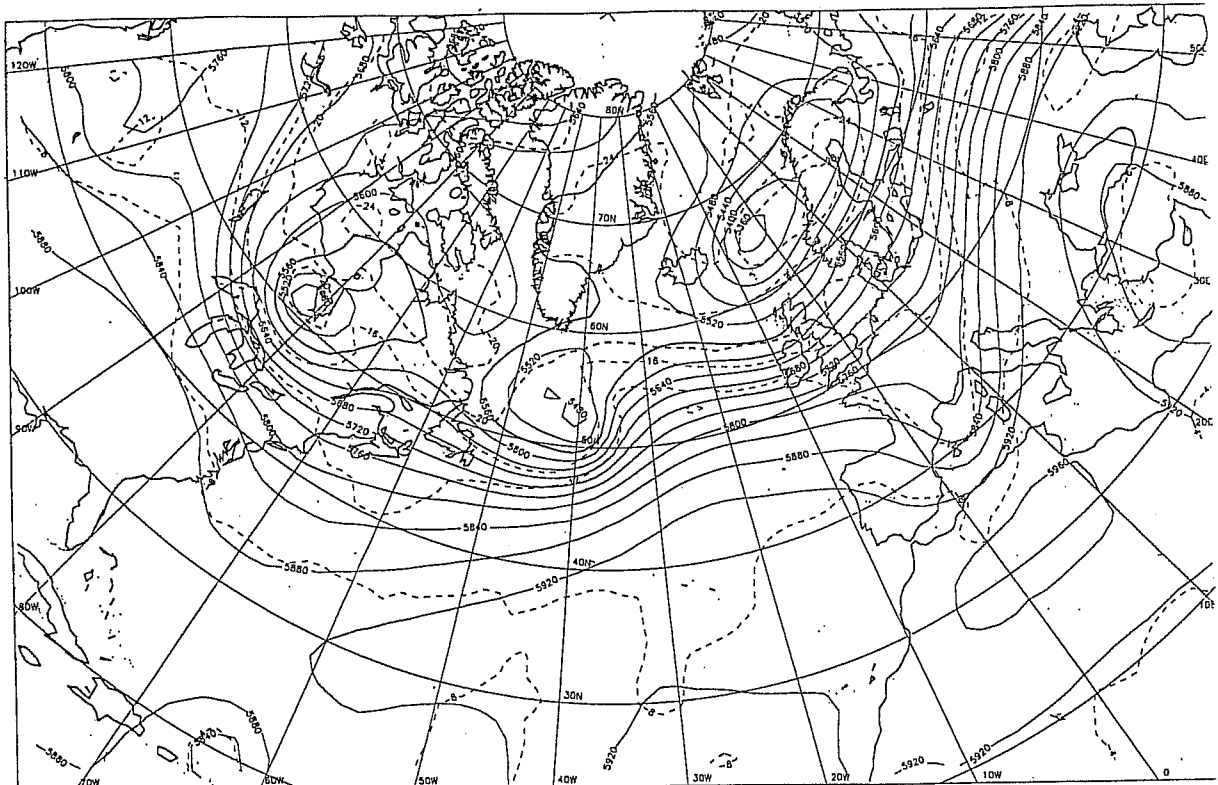
Figure one : comparison between the analysis on 11th august 1999 and the T319 ECMWF model +192h. Z+T500hPa.

Date modele : 1999-08-03 12:00:00 - reference : 192 - param. : Z500 / T500
moyenne amas central - echeance : 192 h (date de validite : 1999-08-11 12:00:00)
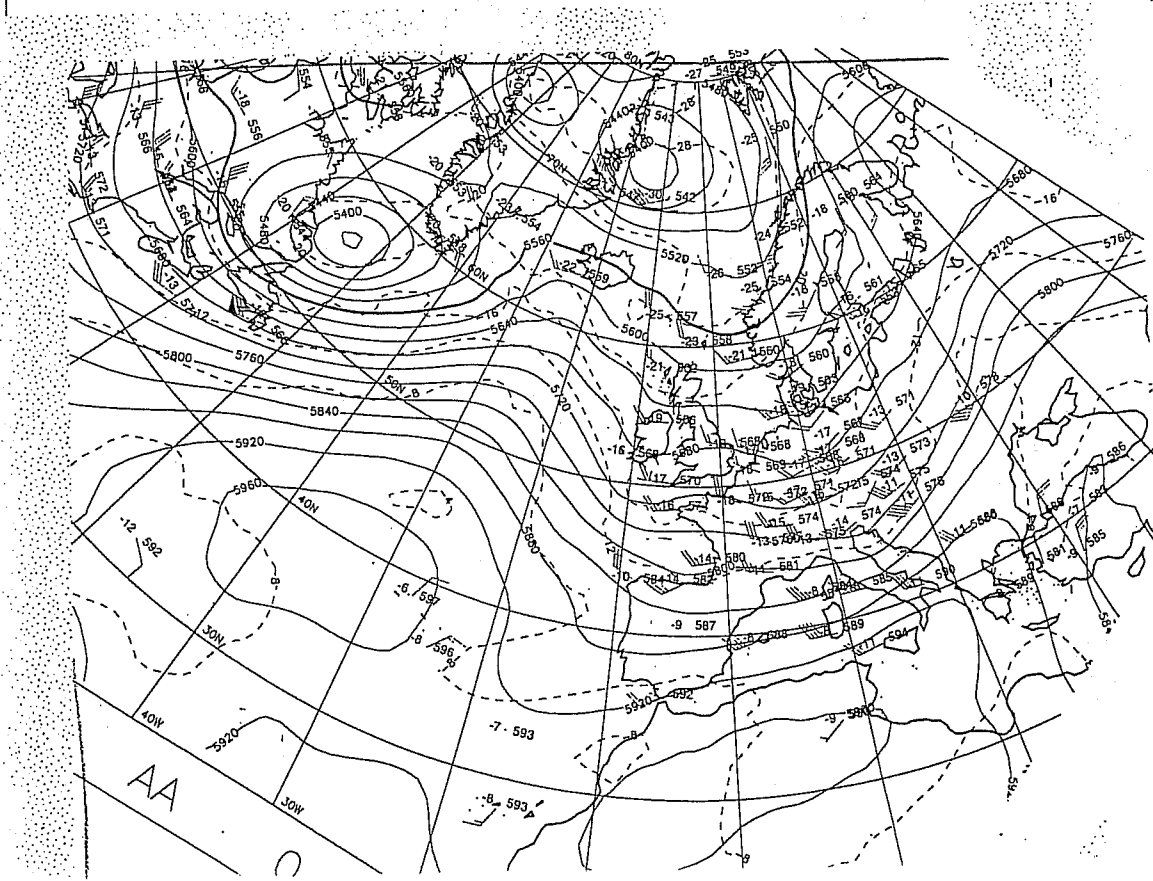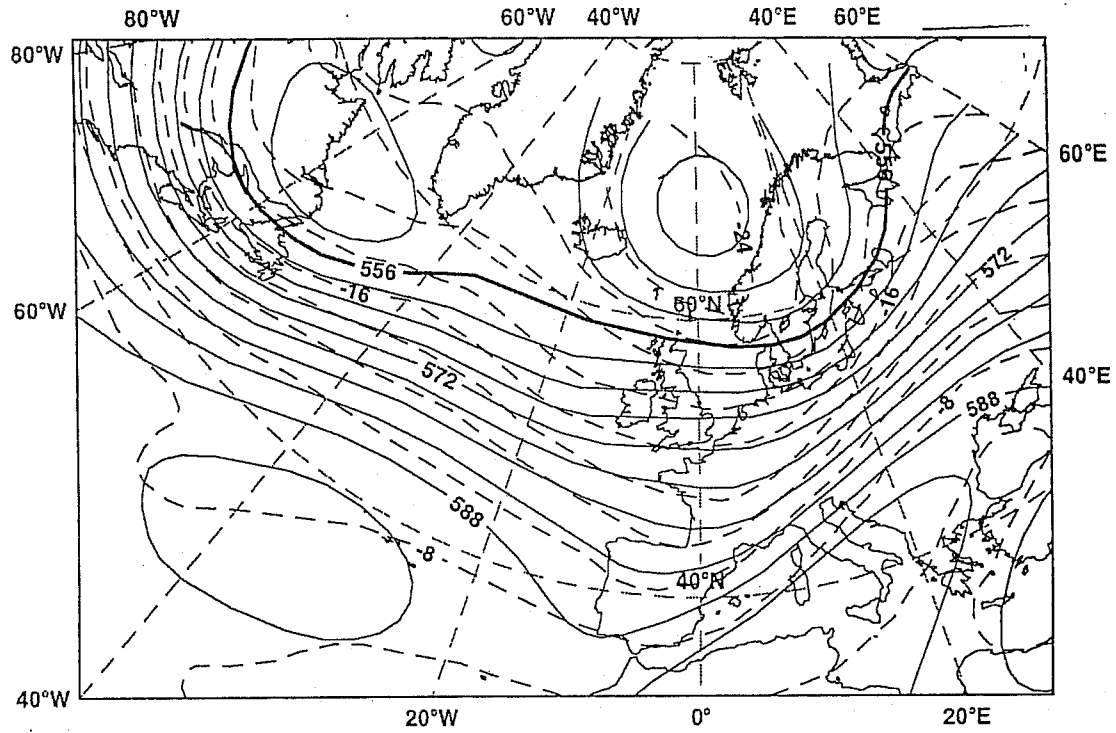
Figure two : comparison for the same data and parameters between analysis (below) and central cluster of tubing range 192h. You can see too more details on the T319 model forecast.
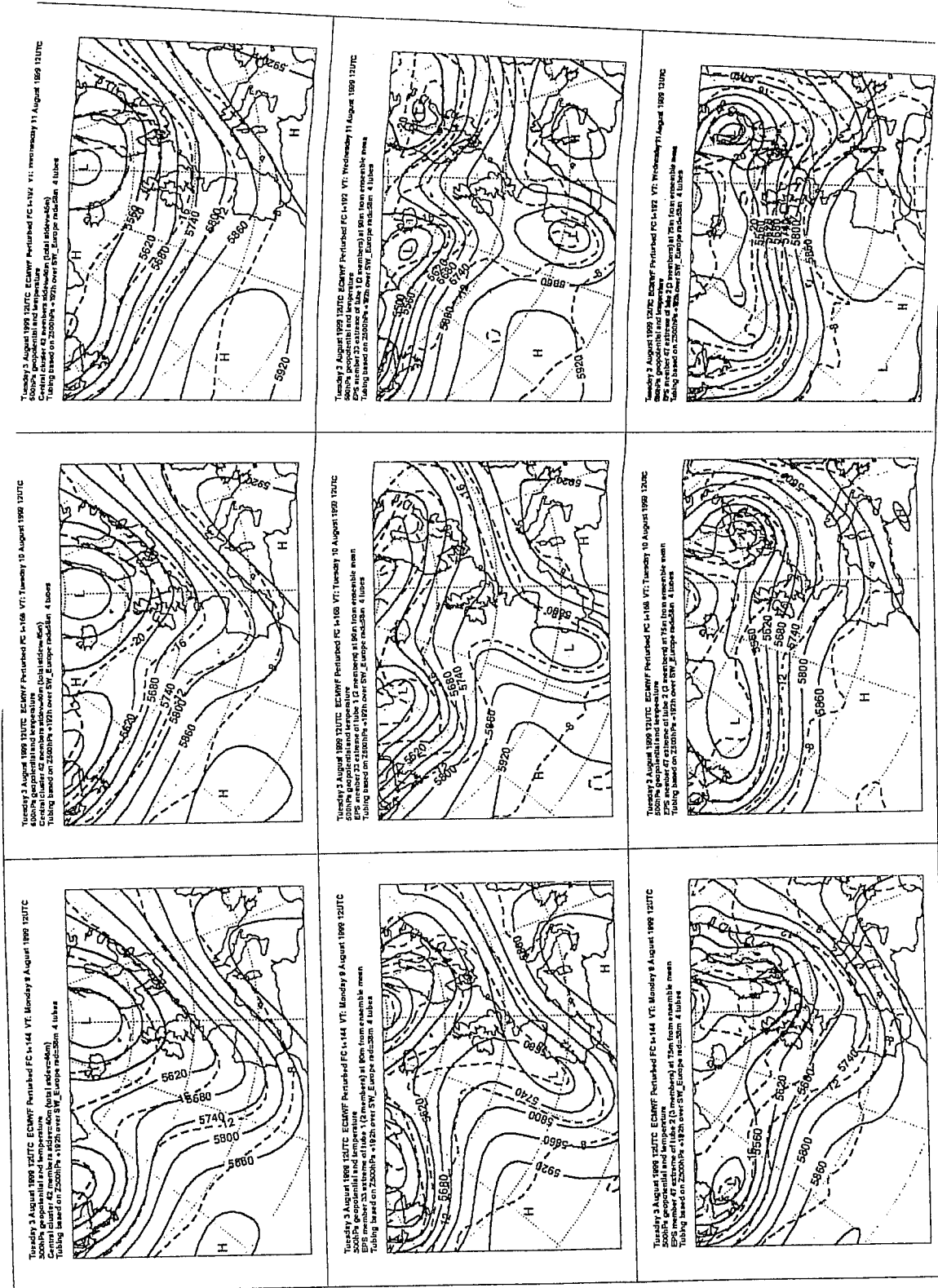
61

Figure three : presentation of the tubing based on +192h. The central cluster and the two first tubes.

PRESSYME J+6 / J+7

Base modèle : PE 3/8/99

(support technique
moyenne échéance)

Valable du : Mardi 10/8
au : Mercredi 11/8

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ind. de confiance sur la France

LEGENDE

BFA	Bloc froid d'altitude
BCA	Bloc chaud d'altitude
PE	Perturbé
REC	Rectiligne
OND	Régime Ondulant
H	Hauts géopotentiels
B	Bas géopotentiels

Courant de grande echelle

Déplacement des Centres d'action
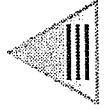
(Les zones sont représentées en traits lisses.)
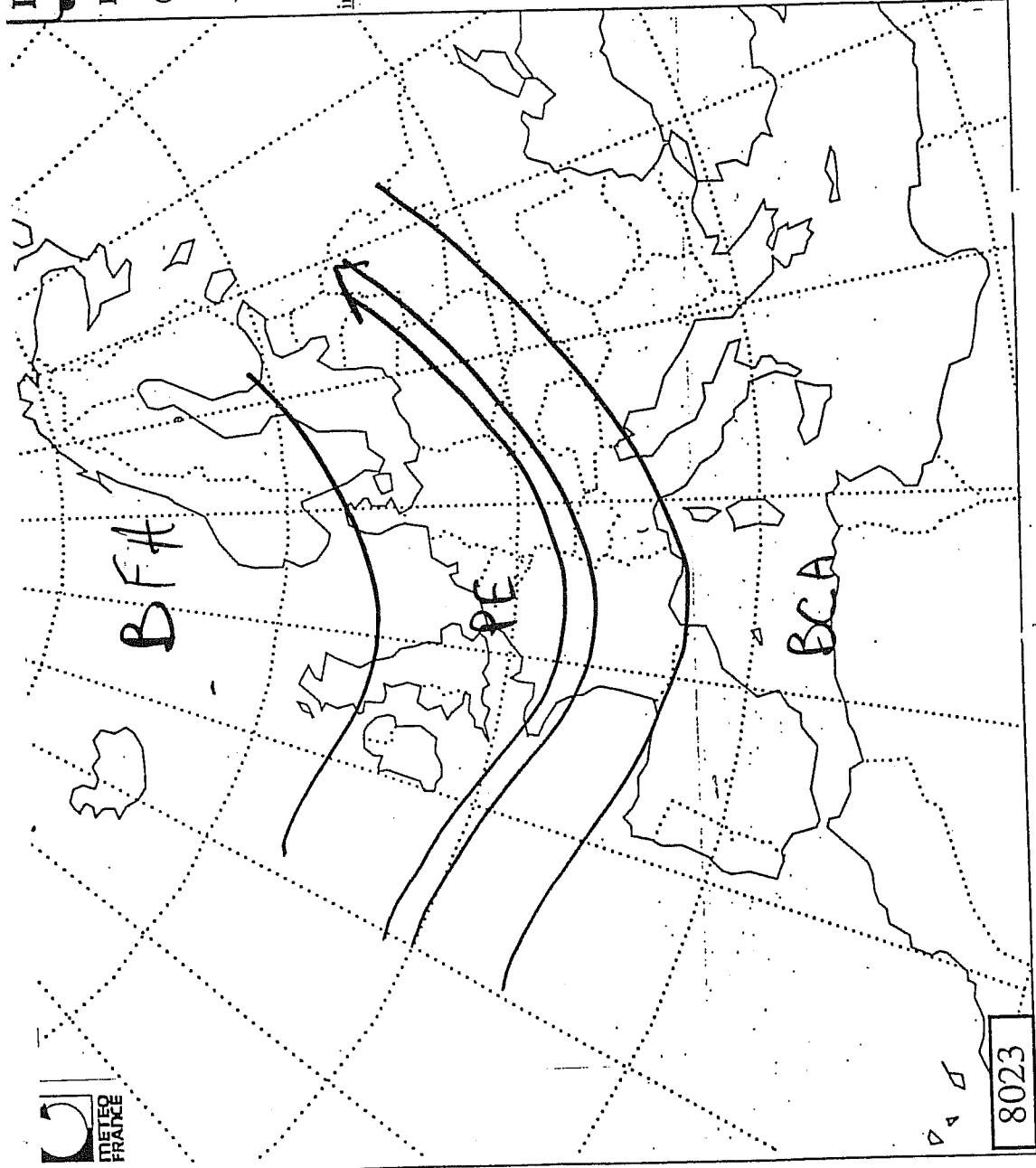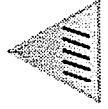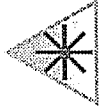
Figure four : the technical schema forecast and its media translation based on tubing.

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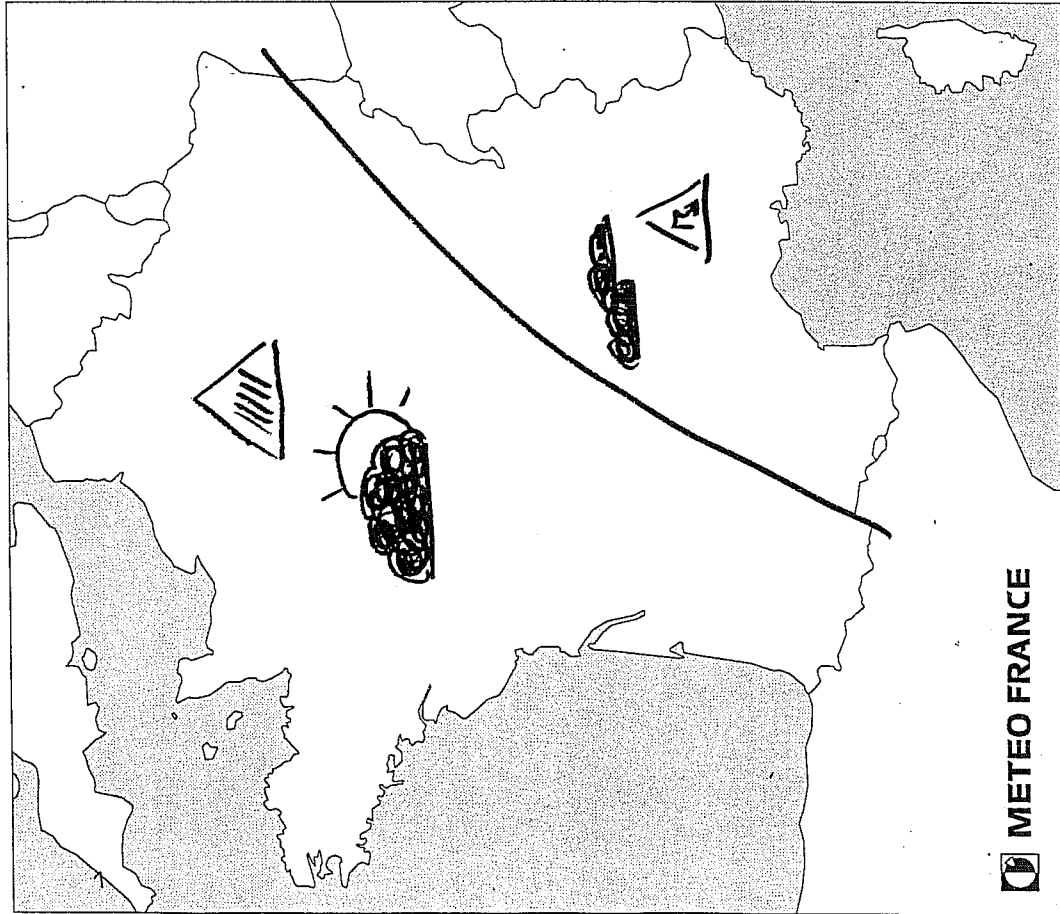
Nébule MEDIA j+6 / j+7

Prévisions pour le 10 eru /08

Symbol	Description
	Soleil dominant sur la période
	Variable sur la période
	Nuages dominants sur la période

Risques

Pluie		Neige	
Orage		Brouillards	
Vent fort			

Indice de confiance : 3/5

METEO FRANCE

Figures five and six : the tubing based on +144h three days after, and the forecast elaborated on it. For media forecasts, D+4 and D+5 can be separated, according to the weather regime, and a subjective confidence. You can see that we not use the same symbols and words for D+4/D+5, than for D+6/D+7, in order to indicate that the scales of time and space are not the same according to range forecast.
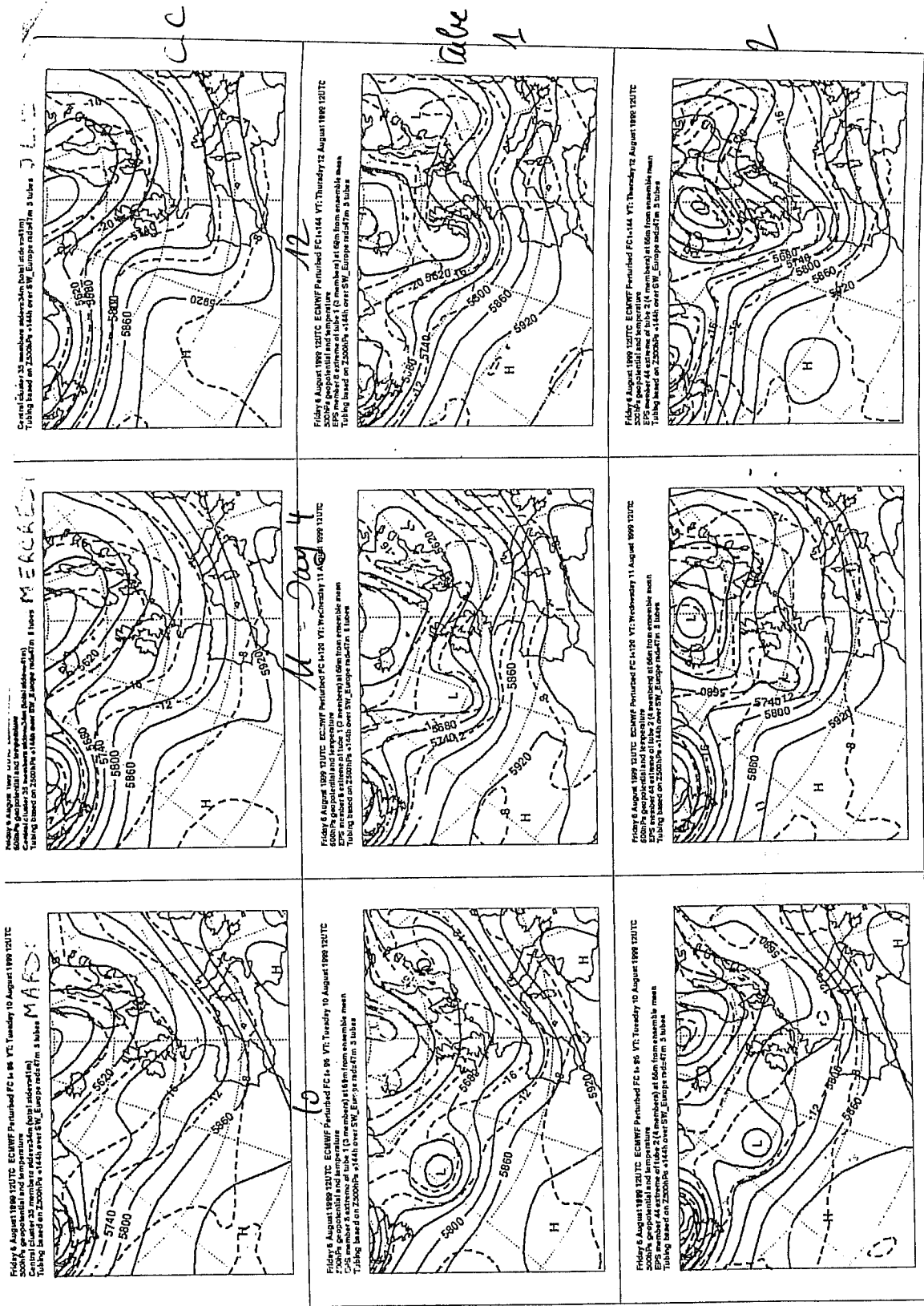
Figure seven : a part of results of one year supra-synoptic subjective control of the central cluster on France, with an overlook to real weather. The « good or « very good » supra-synoptic fields during two days are dispatched on the confidence index. This index does not seem to be accurate for this first year.

PRESSYME J+4 / J+5

Base modèle : **6.8.99**

(support technique, moyenne échéance)

Valable du : **MER 11 AOÛT**
au : **JEU 12 AOÛ.**

ind. de confiance sur la France [**3**]

LEGENDE

BFA	Bloc froid d'altitude
BCA	Bloc chaud d'altitude
PE	Perturbé
REC	Rectiligne *(NOT USEI)*
OND	Régime Ondulant
H	Hauts géopotentiels
B	Bas géopotentiels
⟰	Courant de grande echelle
↑	Déplacement des Centres d'action
⟫	Devenant durant la Période

(Les zones sont représentées en traits festonnés.)

8010

66
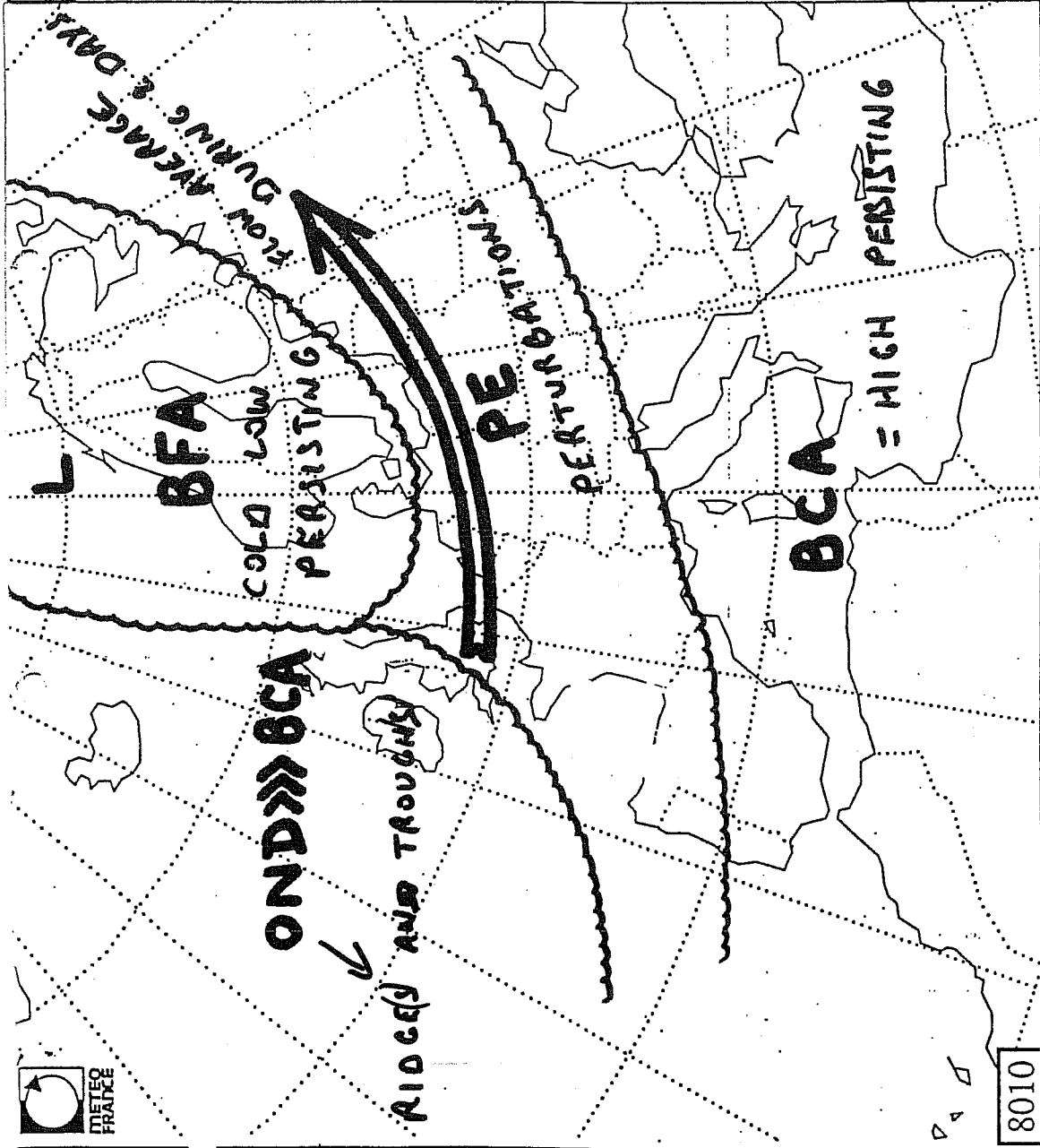
Nébule MEDIA j+4

Prévisions pour le *11 . 01 . 95*

Prévisions pour le
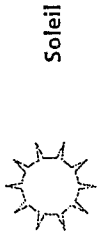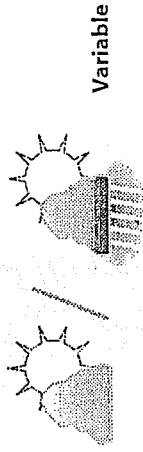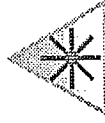
Soleil

Brouillards

Nuages

Variable

Pluie

Risques
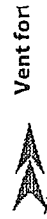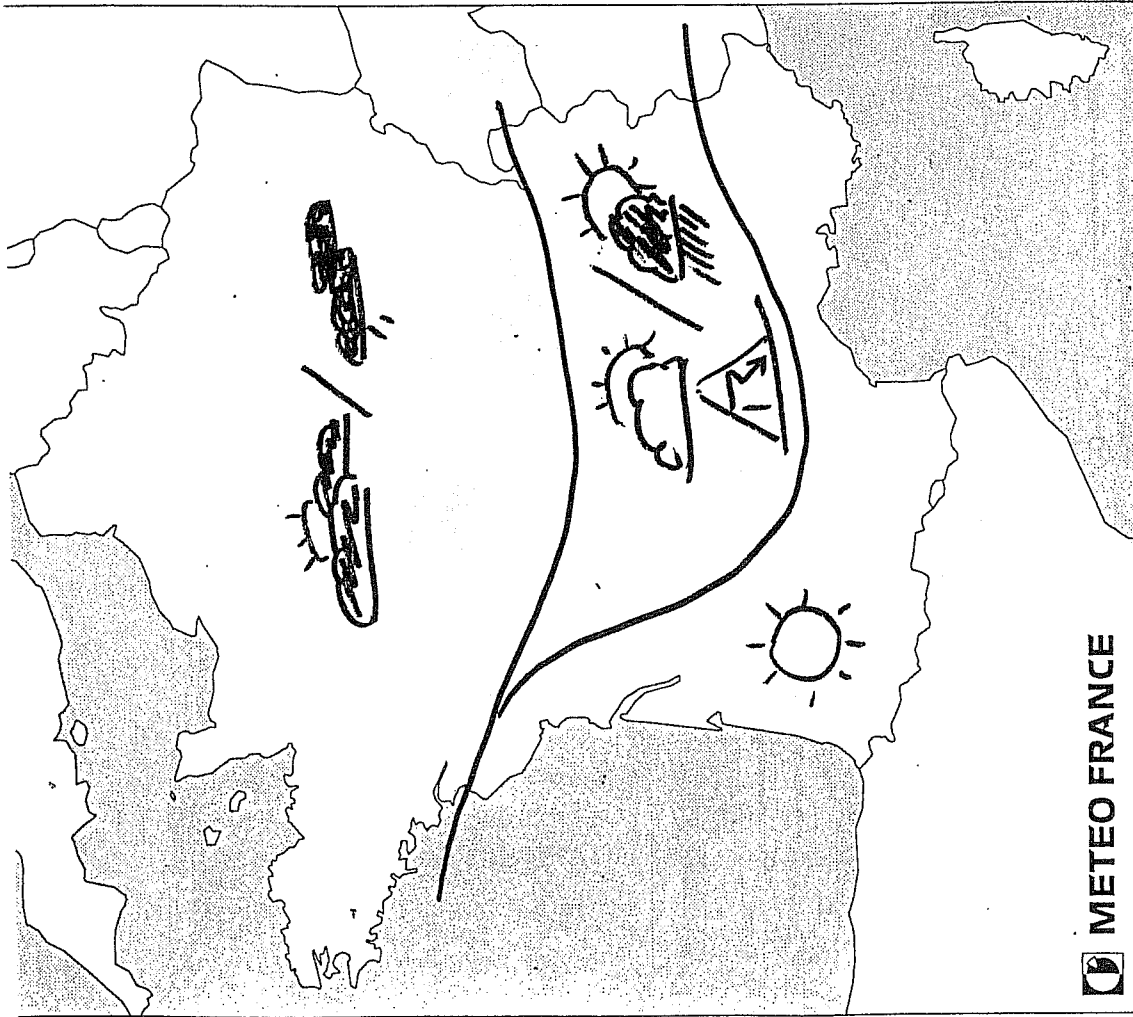
Orage

Neige

Vent modéré

Vent fort

Indice de confiance : 3/5

METEO FRANCE

Prévision moyenne échéance

Indicateur de justesse de la prévision (Année 1998)