Implementation of methods for the radiation fog prediction

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Abstract: - Fog formation is complex; its occurrence is widely variable in space and time, forming under a wide range of meteorological circumstances. This article is focused on prediction of radiation fog formation on territory of the Czech Republic. The radiation processes play most important role in fog formation but unfortunately other processes as for example advection or precipitation must be considered. The main goal is to develop method for radiation fog forecasting on territory of central Europe. For this purpose Craddock and Pritchard's method and methods based on its aproach hase been implemented.

Key-Words: - radiation fog, Craddock and Pritchard's method, meteorological data, true skill statistic, verification

1 Introduction

The formation of fog is a complex phenomenon and depends upon a delicate balance of events; although it is easily recognisable on most occasions by about midday that the following night is likely to be a radiation night, the problem of forecasting the occurrence of fog is often a very difficult one. The factors favourable for the formation of radiation fog might be specified as following:

1. Clear sky or just thin, high cloud,
2. Moist air in the lowest 100 m or so,
3. Moist ground (e. g. after rain or over marshes),
4. Slack pressure gradient, allowing the surface wind (preferably measured at 2 m) to decrease to near calm,
5. Favourable local topography.

Although it may seem that the rehearsal of terms for fog formation is complete, it is still necessary to bear in mind the importance of local factors such as surface moisture and topography because there is no substitute for a good knowledge of the specific characteristics of your area.

Radiation fog forms when radiative cooling of the ground causes the air close to it to become saturated. Once the ground temperature has cooled to the dew point of the air (T_d), dew deposition begins, causing a gradual decrease in dew point. Water vapour will diffuse from higher levels to replace that condensed out, leading to a drying out of the air over a considerable depth. Hence the temperature will normally have to fall significantly below the air mass dew point before fog forms. The temperature at which fog eventually forms is known as the fog point (T_f).

One of the most difficult meteorological phenomenons to predict is formation of fog even by help of numerical meteorological models it is not sufficiently precise. Therefore, statistics model has been played very important role using the better predictable quantities as an input. So, the regression model, fuzzy models and neuronal network are often implemented. This paper works Craddock and Pritchard's method with and the main goal has been this modification of this method, currently used in meteorological practise, for routine use in central Europe.

2 Fog occurrence observed on air meteorological station on territory of the Czech Republic

A number of techniques have been developed to enable T_f to be determined. The techniques used for forecasting of fog in this article are described below. These new methods then will be evaluated on real data. In order to forecast of fog the value of air temperature, dew point temperature in 12 UTC and minimum temperature (observed during forecasted period) were chosen as predictors. In extensive form also the visibility and relative humidity in 12 UTC and mean cloud coverage (taken from 18, 0 and 6 UTC) were included.

Occurrence of fog has been forecasted on all military air meteorological stations located in Prague-Kbely (WMO indicative 11567), Caslav (11624), Pardubice (11652), Namest (11692) and Prerov (11748). All data with view to obtain predictors were decoded meteorological reports SYNOP of these stations during the August 1997 to the May 2010. Existence fog has been was identified according to code described present and past weather state at the station. Table 1 shows which present weather code were accepted and figure 1 record relative frequency of weather state from table 1 during given period divided by stations.

Table 1: Present weather code table with fog

code figure	weather description
11	Patches of shallow fog. It is not thicker than about 2 metres above ground level, and the visibility above the shallow fog is 1000 metres or more
12	More or less continuous shallow fog. It is not thicker than about 2 metres above
28	Fog cleared in the last hour. Visibility must be now 1000 metres or more
40	Fog visible at a distance, but the visibility at the station is 1000 metres or more. there must have been no fog at the station during the preceding hour
41	Visibility less than 1000 metres in some directions but not in others
42	Fog getting thinner during the last hour, sky or clouds visible
43	Fog getting thinner during the last hour, sky or clouds not visible
44	No change in the fog during the last hour, sky or clouds visible
45	No change in the fog during the last hour, sky or clouds not visible
46	Fog getting thicker during the last hour, sky or clouds visible
47	Fog getting thicker during the last hour, sky or clouds not visible
48	Fog depositing rime, sky or clouds visible
49	Fog depositing rime, sky or clouds not visible

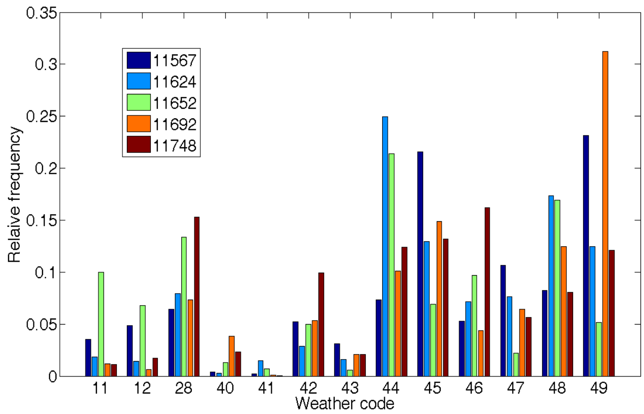

Fig. 1 Relative frequency of fog occurrence

The most frequent occurrence of fog has been observed at the station Namest (11692) and the opposite view has been on station Caslav as it is depicted on figure 2. The legend is described accordingly. Symbol 0 means fog has not been observed and visibility in all directions must be more than 1000 metres, symbol 1 means fog occurred and start up during night (18 – 06 UTC), symbol 2 means fog occurred, but had arisen before 18 UTC, symbol 3 means visibility has been less than 1000 metres. If the column on figure 1 is split, then the upper part belongs to cases when patches or shallow fog occurred (the same rule applies on following figures).

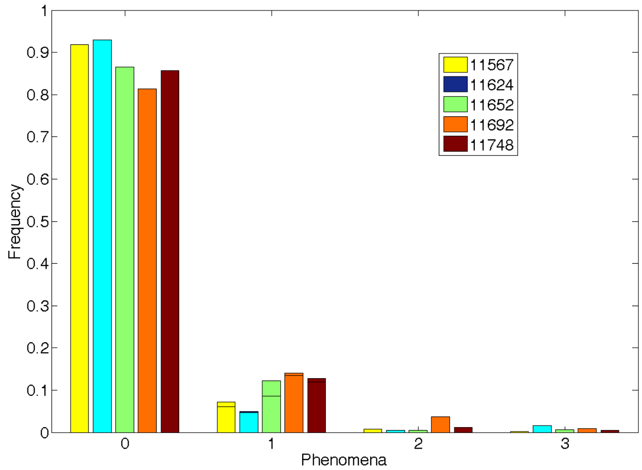

Fig. 2 Frequency of fog during period 18 – 06 UTC

On figure 3 there is depicted frequency of fog during the years in period 1997 - 2010, maximum in October and November, and minimum for June and July. Patches or shallow fog occurred mostly in Pardubice (11652); during in summer period forged almost 50% of whole cases of fog. These could be explained by presence of river Labe in vicinity of meteorological station. Here is also necessary to say all results are crucially dependent on quality of observations because visibility is temporarily and also spatially highly variable.

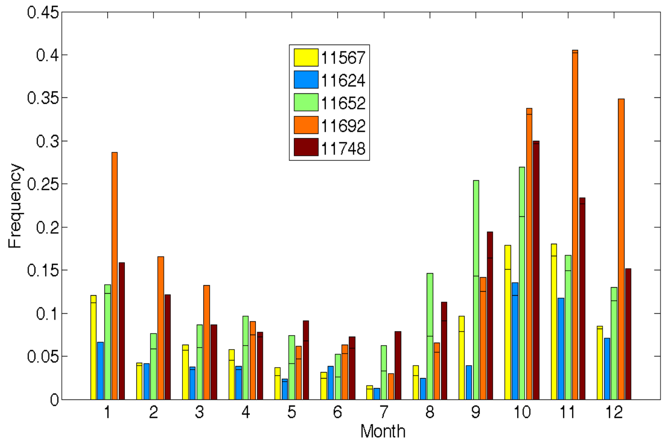

Fig. 3 Frequency of fog during years

On figure 4 is depicted ratio of cases when the precipitation (rain, snow etc.) has not been observed in period from 12 (18) UTC to 06 UTC on station. Those are exactly the cases of radiation fog we focused in.

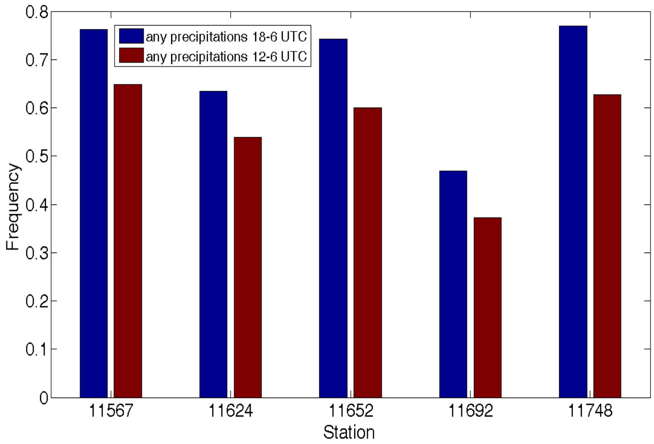

Fig. 4 Ratio of cases with fog but without precipitation

Relative frequencies of present weather codes in cases when the fog is observed are depicted on figure 5. Freezing fog was presented in 30% in Namest, when sky or clouds were not visible (together with visible sky or clouds above 40%). Cases 11, 12, 28 a 40 (fog in vicinity, fog patches etc) has been mostly observed in Pardubice, c. 35%, but frequency of phenomenon 40 (about 5%) is highest in Namest.

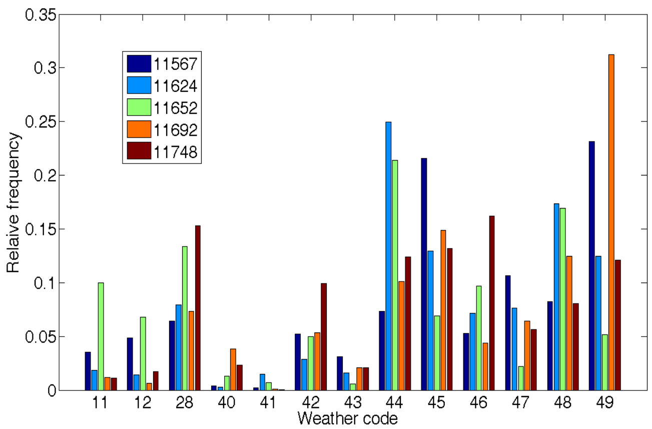

Fig. 5 Present weather code frequency

3 Equations for T_f calculation

Process to obtain the equation to set down temperature for formation of fog T_f has been prepossessed with Craddock and Pritchard's method for forecasting of fog. This method of assessment of T_f is based on measured values of air temperature T and dew point temperature T_d in 12 UTC. If the forecasting value of minimum temperature T_{min} will be lower than T_f then the fog could be presupposed, if it be to the contrary no.

For obtaining of prognostic equation only the nights in which the fog occurred have been involved. The exact value of T_f has been derived as temperature of air in term when fog occurred for the first time. Dependence on predictors was figured out by means of linear regression. The best results have been found in following expressions:

$$T_f = a_0 + a_1.T + a_2.T_d \quad (1)$$

$$T_f = a_0 + a_1.T_d \quad (2)$$

$$T_f = a_0 + T_d \quad (3)$$

$$T_f = -0{,}55 + 0{,}044.T + 0{,}844T_d \quad (4)$$

From introduced equations imply follows that fog will set in if applies to

$$T_f + A > T_{min} \quad (5)$$

Parameter A has been defined by maximum value of EQS (Hanssen and Kuipers discriminant) in given set of data for every station separately. The dependence EQS on selected values A for method 3 is depicted on figure 6. The big problem is big value FAR for optimal value A. For temperature about 5°C lower than T_f is value of FAR reaching above 0,3. Value of EQS remains almost the same (changes are only in rate of few percents) in interval 1°C around maximum values. POD values in dependence on A are similar for all stations. Most concurrencies of fog has been found in interval around 5°C of T_f value, but almost in 30% of all cases fog appears when minimum temperature was above T_f.

To obtain these equations for forecasting T_f, but especially of radiation fog, only days satisfactory next terms were accepted, therefore, no precipitations after 12 UTC together with no difference more than 5°C between dew point temperature T_d in 6 UTC (at the end prediction interval) and T_d of prior day, i.e. no change of air masses. Days with visibility bellow 1 km but without reported fog was not considered.

Following conditions were considered for determination of optimal value of parameter A and the same conditions were used also for verification of given method.

1) No precipitations after 12 UTC;
2) Dew point temperature (T_d) at 6 UTC (at the end of interval) did not differ more than 5°C from dew point temperature of previous morning (at 6 UTC);
3) Days with visibility bellow 1 km but without reported fog was excluded.

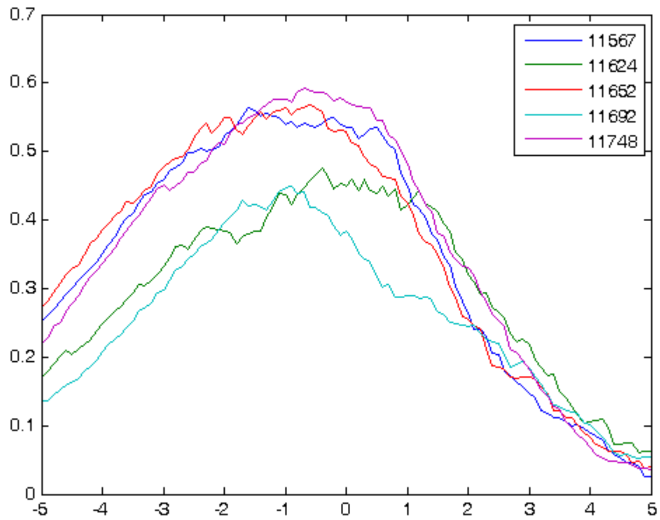

Fig. 6 Assessment of parameter *A* according to EQS

Other tested possibility consists in utilization of classes selected meteorological elements (table 2). Also for these selected elements were founded independent equations for T_f assessment. Consequential parameter *A* has been added on to the value of T_f.

Table 2: Classes of selected meteorological elements

meteorological element	chosen classes			
visibility at 12 UTC	< 1 km	1–2,5 km	2,5–10 km	>10km
relative humidity at 12 UTC	< 70 %	70 –90 %	90 –95 %	> 95 %
mean cloudiness (18-06 UTC)	< 2/8	3/8 – 4/8	5/8 – 6/8	> 6/8

The additional conditions (further in text ADD) were tested for above mentioned procedures.

1) Fog was forecasted in all cases when visibility at 12 UTC was lower than lowest visibility for which the fog was not observed.

2) Fog was not forecasted in all cases with relative humidity at 12 UTC below minimal value for which the fog was not observed.

One common equation for T_f for all stations was also tested. But optimal value *A* was in this case derived for each station separately.

4 Results

For evaluation of successfulness given methods with calculated parameter A were chosen statistical criteria EQS (true skill statistic), POD (probability of detection) and FAR (false alarm ratio).

Two following access for method validation were used:

1) Parameters of methods were derived with by use all available data and the same data were used for verification.

2) Parameters of methods were derived on array of data from 1997 to 2006 meanwhile for the verification of derived methods was used array of data from 2007 to 2010 (independent data).

These section will illustrated by the help of enclosed graphs. On graphs are depicted acquired values of EQS, FAR and POD for particular stations and every method. Crosses in graphs signify values without correction for relative humidity and visibility. Values of EQS belong to interval from 0,4 to 0,6. Expressive improvement with ADD is only on stations where fog is observed only rarely (improvement for 11624 about 0,15), on the contrary on stations where fog is frequent phenomenon (11692 and 11652 there is none progressive improvement noticeable.

The highest value of EQS we got for station 11748, the worst for 11692. Among methods the best results are provided mostly by method (2) and (3), the worst by method (1). Influence of utilization of selected meteorological elements classes is rather negligible crosswise all stations. POD achieving mostly about 0,8, i.e. 80% of all fog occurrence cases have been detected. On the other had high values of FAR are main insufficiency of all methods. Average values of FAR vacillate among 0,85 (11652) to best 0,6 for Prerov (11748).

Resulting values of EQS gained by testing of considered methods are stated in tables 3a-3e for all stations. The word "Basic" denotes methods with one equation is to be for all chosen classes, meanwhile methods considering classes of visibility is denoted by Gvis), relative humidity (Grh) and cloudiness (Gcld). If the methods are additionally marked by CTf then all meteorological stations were included in calculation and one common equation for forecasting T_f has been derived. Symbols M1-M4 represent the methods based on equations (1) – (4). On the other hand symbols M1A-M4A represent the situation when additional conditions ADD were considered. The maximum values are stressed by red cell background and minimum values by blue background.

EQS values are a little lower in comparison with verification on the depended values, but the differences are mostly bellow 0,1. Order of successfulness of given methods in some cases changes, e.g. for Prague Kbely is the worst mostly methods 2, which is comparable in previous test with the best method 1. The worst values are obtained again for station Namest (the best methods bellow 0,5) and the best in average for Prerov. The absolute highest EQS (almost 0,7) is obtained for station Caslav and method 3, when separate relations for groups of relative humidity and additional condition ADD has

been applied with. This method was the best also in previous test but the EQS value was only 0,6.
The highest POD values has been attained for stations Caslav and Prerov, almost about 0,9. On the other side for Namest the value of POD was only up to 0,75.
FAR values for Caslav are for some methods above 0,9, for Prerov are mostly about 0,6 and for rest of stations are mostly about 0,7 or 0,8.

Table.3a :EQS for Prague-Kbely (11567)

	M1	M2	M3	M4	M1A	M2A	M3A	M4A
Basic	0.45	0.51	0.39	0.50	0.51	0.55	0.46	0.53
Basic CTf	0.50	0.51	0.39	0.50	0.55	0.56	0.46	0.53
Gvis	0.48	0.51	0.42	0.50	0.52	0.53	0.47	0.53
Gvis CTf	0.54	0.55	0.54	0.50	0.55	0.55	0.54	0.53
Grh	0.33	0.54	0.37	0.50	0.44	0.54	0.44	0.53
Grh CTf	0.46	0.45	0.53	0.50	0.51	0.48	0.56	0.53
Gcld	0.39	0.53	0.43	0.50	0.45	0.55	0.48	0.53
Gcld CTf	0.37	0.48	0.41	0.50	0.40	0.48	0.48	0.53

Table 3b: EQS for Caslav (11624)

	M1	M2	M3	M4	M1A	M2A	M3A	M4A
Basic	0.53	0.50	0.54	0.48	0.57	0.52	0.60	0.51
Basic CTf	0.48	0.49	0.54	0.48	0.52	0.51	0.60	0.51
Gvis	0.46	0.48	0.56	0.48	0.61	0.51	0.60	0.51
Gvis CTf	0.50	0.55	0.56	0.48	0.57	0.59	0.60	0.51
Grh	0.56	0.56	0.65	0.48	0.63	0.63	0.69	0.51
Grh CTf	0.42	0.49	0.53	0.48	0.55	0.52	0.59	0.51
Gcld	0.45	0.47	0.55	0.48	0.53	0.53	0.55	0.51
Gcld CTf	0.43	0.57	0.56	0.48	0.51	0.60	0.58	0.51

Table 3c: EQS for Pardubice (11652)

	M1	M2	M3	M4	M1A	M2A	M3A	M4A
Basic	0.50	0.56	0.55	0.56	0.51	0.56	0.55	0.56
Basic CTf	0.56	0.55	0.55	0.56	0.56	0.55	0.55	0.56
Gvis	0.52	0.58	0.55	0.56	0.53	0.58	0.55	0.56
Gvis CTf	0.50	0.54	0.55	0.56	0.51	0.54	0.55	0.56
Grh	0.49	0.55	0.55	0.56	0.50	0.55	0.55	0.56
Grh CTf	0.47	0.55	0.63	0.56	0.48	0.55	0.63	0.56
Gcld	0.53	0.60	0.51	0.56	0.54	0.60	0.51	0.56
Gcld CTf	0.55	0.61	0.52	0.56	0.56	0.61	0.52	0.56

Table 3d: EQS for Namest (11692)

	M1	M2	M3	M4	M1A	M2A	M3A	M4A
Basic	0.22	0.42	0.44	0.41	0.31	0.42	0.43	0.41
Basic CTf	0.43	0.42	0.44	0.41	0.43	0.42	0.43	0.41
Gvis	0.25	0.40	0.40	0.41	0.26	0.39	0.40	0.41
Gvis CTf	0.42	0.44	0.40	0.41	0.42	0.43	0.39	0.41
Grh	0.21	0.37	0.38	0.41	0.23	0.37	0.38	0.41
Grh CTf	0.44	0.41	0.42	0.41	0.45	0.40	0.42	0.41
Gcld	0.21	0.38	0.38	0.41	0.32	0.40	0.40	0.41
Gcld CTf	0.26	0.40	0.38	0.41	0.36	0.40	0.38	0.41

Table 3e: EQS for Prerov

	M1	M2	M3	M4	M1A	M2A	M3A	M4A
Basic	0.52	0.56	0.57	0.55	0.59	0.60	0.61	0.59
Basic CTf	0.56	0.56	0.57	0.55	0.60	0.60	0.61	0.59
Gvis	0.65	0.61	0.60	0.55	0.65	0.61	0.62	0.59
Gvis CTf	0.54	0.60	0.60	0.55	0.57	0.61	0.61	0.59
Grh	0.54	0.58	0.60	0.55	0.61	0.62	0.63	0.59
Grh CTf	0.50	0.59	0.59	0.55	0.57	0.63	0.63	0.59
Gcld	0.48	0.49	0.57	0.55	0.53	0.55	0.61	0.59
Gcld CTf	0.45	0.51	0.54	0.55	0.51	0.55	0.58	0.59

5 Evaluation of method 3

As most successful method, according statistics criteria has been chosen the method 3. The parameters of final relations are stated in tables 4a-4e. There is column with values a_0 from equation (3) and columns with optimal parameter A for considered groups of weather condition (A1-A4). The F1-F4 columns contain final values, which are added to dew point temperature at 12 UTC (for considered group of conditions). The obtained value is then compared with expected minimum temperature. These values are computed using all available data.

In case of one relation for all weather conditions (Basic) are final values (F1) negative for all stations (formation of fog needs lower minimum temperature than dew point temperature at 12 UTC). Only for station Namest, is enough minimum temperature 0,2°C above midday dew point temperature. The lowest values are needed for station Prerov in contrast.

Table 4a: Prague-Kbely

	a_0	A1	A2	A3	A4	F1	F2	F3	F4
Basic	1.6	-2.3				-0.7			
Basic CTf	1.8	-2.5				-0.7			
Gvis	1.1	-0.7	-2.6	-2.6	-2	0.5	-1.5	-1.5	-0.9
Gvis CTf	1.3	-0.6	-1.8	-2.8	-2.6	0.7	-0.5	-1.5	-1.3
Grh	0.5	-1.6	-2.6	-2.5	-2.5	-1.1	-2.1	-2	-2
Grh CTf	1.3	-2.5	-3	-1.9	-1.8	-1.2	-1.7	-0.6	-0.5
Gcld	1.1	-2.4	-2.9	-1.7	-1.5	-1.3	-1.8	-0.6	-0.4
Gcld CTf	1.4	-3.2	-2.7	-2.1	-1.3	-1.8	-1.3	-0.7	0.1

Table 4b: Caslav

	a_0	A1	A2	A3	A4	F1	F2	F3	F4
Basic	0.4	-2.2				-1.8			
Basic CTf	0.8	-2.5				-1.7			
Gvis	-0.3	-0.9	-0.5	-2.3	-2.6	-1.2	-0.8	-2.6	-2.9
Gvis CTf	0.3	-0.6	-1.8	-2.8	-2.6	-0.3	-1.5	-2.5	-2.3

Grh	0.6	-2.6	-2.7	-0.3	-1.7	-2	-2.1	0.3	-1.1
Grh CTf	0.1	-2.5	-3	-1.9	-1.8	-2.4	-2.9	-1.8	-1.7
Gcld	1.4	-3.3	-3.1	-1.9	-0.8	-1.9	-1.7	-0.5	-0.6
Gcld CTf	-0.2	-3.2	-2.7	-2.1	-1.3	-3.4	-2.9	-2.3	-1.5

Table 4c: Pardubice

	a_0	A1	A2	A3	A4	F1	F2	F3	F4
Basic	0.6	-3.2				-2.6			
Basic CTf	0	-2.5				-2.5			
Gvis	0.5	-6.2	-2.4	-3.1	-3.3	-5.7	-1.9	-2.6	-2.8
Gvis CTf	0.2	-0.6	-1.8	-2.8	-2.6	-0.4	-1.6	-2.6	-2.4
Grh	1.2	-3.3	-3.3	-1.7	-2.8	-2.1	-2.1	-0.5	-1.6
Grh CTf	0.1	-2.5	-3	-1.9	-1.8	-2.4	-2.9	-1.8	-1.7
Gcld	0.8	-3.6	-3.6	-3.4	-1.9	-2.8	-2.8	-2.6	-1.1
Gcld CTf	0.5	-3.2	-2.7	-2.1	-1.3	-2.7	-2.2	-1.6	-0.8

Table 4d: Namest

	a_0	A1	A2	A3	A4	F1	F2	F3	F4
Basic	0.9	-0.7				0.2			
Basic CTf	2.7	-2.5				0.2			
Gvis	0.7	0.2	-0.2	-1.6	-0.4	0.9	0.5	-0.9	0.3
Gvis CTf	2.2	-0.6	-1.8	-2.8	-2.6	1.6	0.4	-0.6	-0.4
Grh	0.6	1	-2	-1.1	-0.5	1.6	-1.4	-0.5	0.1
Grh CTf	2.7	-2.5	-3	-1.9	-1.8	0.2	-0.3	0.8	0.9
Gcld	0.8	-0.5	-1	-0.8	-0.4	0.3	-0.2	0	0.4
Gcld CTf	3	-3.2	-2.7	-2.1	-1.3	-0.2	0.3	0.9	1.7

Table 4e: Prerov

	a_0	A1	A2	A3	A4	F1	F2	F3	F4
Basic	0.7	-3.6				-2.9			
Basic CTf	-0.4	-2.5				-2.9			
Gvis	0.8	-1.3	-2.5	-3.7	-3.8	-0.5	-1.7	-2.9	-3
Gvis CTf	-0.5	-0.6	-1.8	-2.8	-2.6	-1.1	-2.3	-3.3	-3.1
Grh	0.7	-3.6	-3.9	-3.1	-2.8	-2.9	-3.2	-2.4	-2.1
Grh CTf	-0.4	-2.5	-3	-1.9	-1.8	-2.9	-3.4	-2.3	-2.2
Gcld	1.1	-4.3	-3.7	-3	-1.8	-3.2	-2.6	-1.9	-0.7
Gcld CTf	0.3	-3.2	-2.7	-2.1	-1.3	-2.9	-2.4	-1.8	-1

The monotone trends were expected for considered weather classes. But it can be detected only for cloudiness classes. For classes based on relative humidity and visibility trend is not clear and differ from station to station. But the difference between constants can significantly differ also in these cases. A little better seems to be use of one common equation for T_f for all stations. This approach could be influenced by low number of cases for some considered classes for some stations.

The seasonal dependence (monthly values) of EQS, FAR and POD values is depicted on figures 7a-7c.

For all station is evident seasonal variation of FAR. The summer values are about 0,9. For station Caslav is FAR in May and June equal 1 (in these month the fog has never been observed). From November to January are lowest FAR values, but the fall of maximum values is different, e.g. for station Prerov in November is FAR only 0,3 for Caslav is still above 0,7. EQS values vary a lot. For stations Prague-Kbely and Namest is maximum in summer and minimum in colder part of year, for Prerov is maximum in November and April and minimum in summer. For stations Caslav and Pardubice is difficult to find seasonal rate. For Pardubice are EQS values negative in June (fog was observed only in one case and was not forecasted). Similar unsteady values as for EQS are obtained also for POD. In autumn and winter values of POD are above 0,6 (in November above 0,7), during spring and summer are values bellow 0,5.

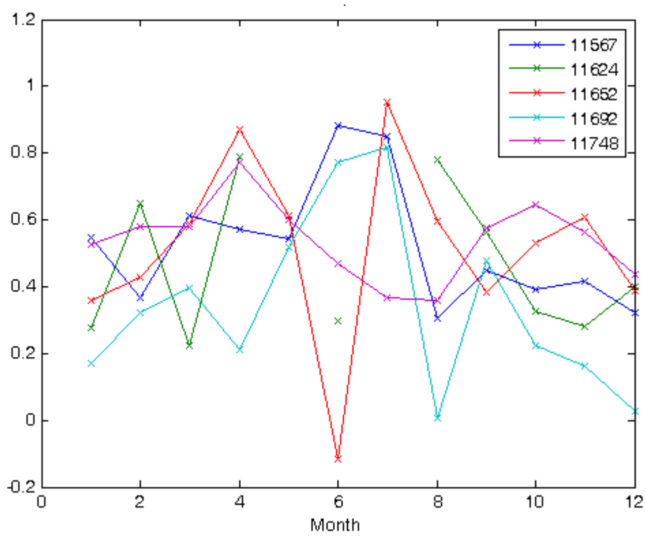

Fig. 7a Values of EQS

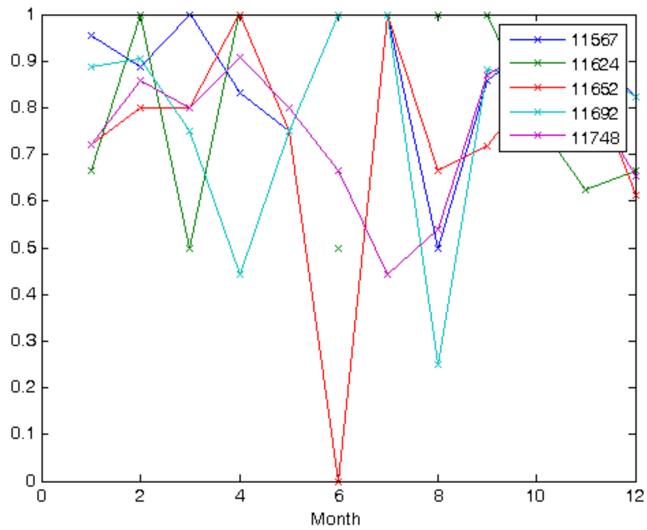

Fig. 7b Values of POD

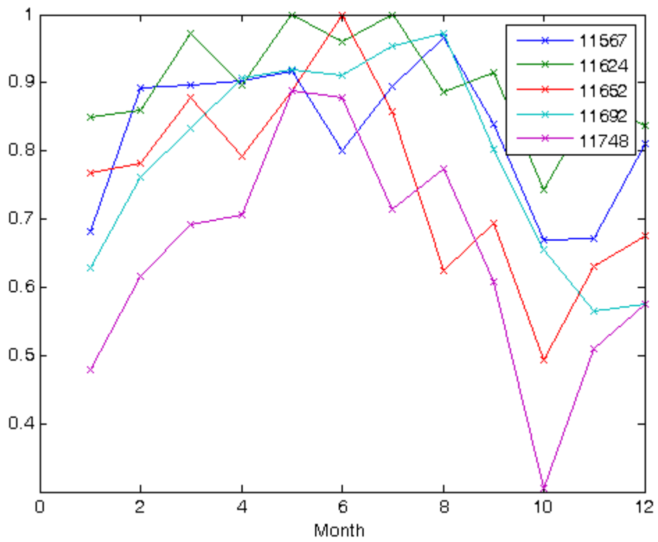

Fig. 7c Values of FAR

The dependence of minimum temperature T_{min} on dew point temperature at 12 UTC (T_d) for "Basic" approach is depicted on figures 8a - 8e. Blue circles (no) denotes all cases without observed fog, red crosses (y) days with fog that started in considered interval and green crosses (y2) days with fog that started before 18 UTC. The black lines shows limit values for fog forecast. The fog is not forecasted in cases when values are above line, so the fog is only forecasted in cases below line.

From the pictures is visible, that for similar pairs T_{min} and T_d, fog might be observed or not in some cases. That assessment is fully agreed with our prior statement, so the forecasting of fog is one of most difficult prediction of weather phenomenon. Sometimes fog occurs when T_{min} was more than 9°C higher than limit value for forecast (station Namest - 11692). It was term 22.4.2005, when started advection of warmer air mass. Dew point temperature increased during the afternoon and night about 10°C, but during the previous morning decreased about 6°C and therefore was not excluded from calculation. The fog was only visible at a distance and minimum reported visibility at station was 15 km. This demonstrates problem of used criteria and local character of visibility. Fog developed on places with more proper condition and their advection to station might be reason why the prediction is difficult for station Namest, especially.

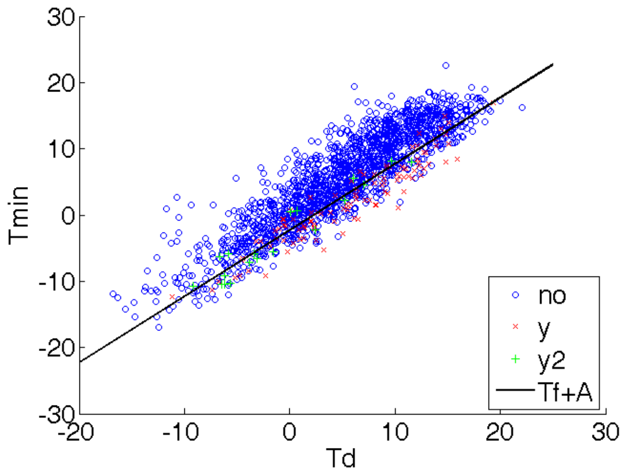

Fig. 8a Fog occurrence for T_d and T_{min} for Prague-Kbely (11567)

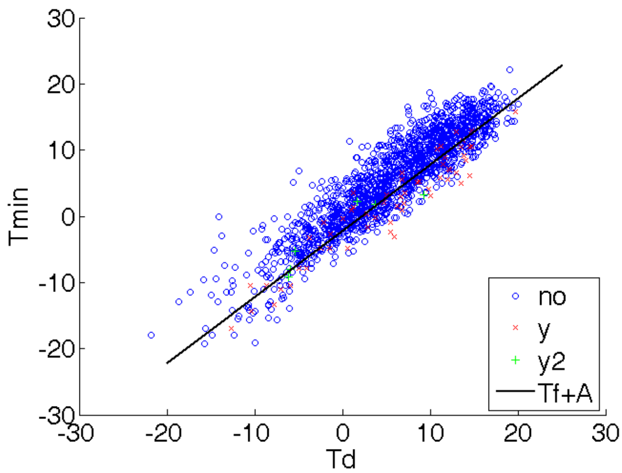

Fig. 8b Fog occurrence for T_d and T_{min} for Caslav (11624)

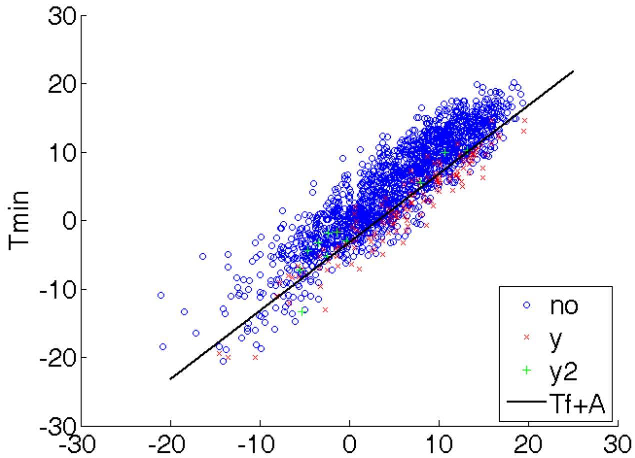

Fig. 8c Fog occurrence for T_d and T_{min} for Pardubice (11652)

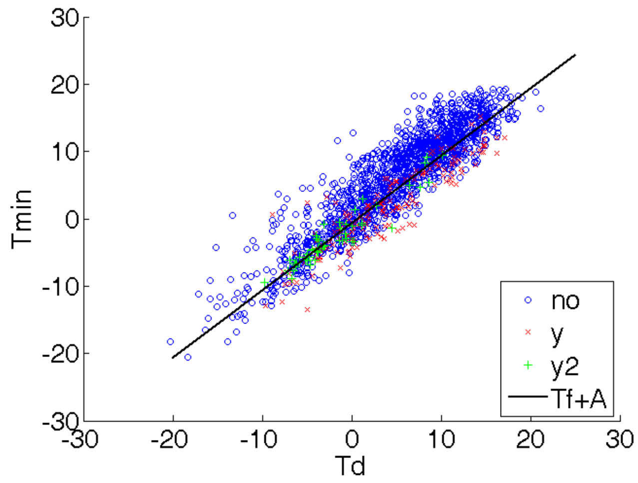

Fig. 8d Fog occurrence for T_d and T_{min} for Namest (11692)

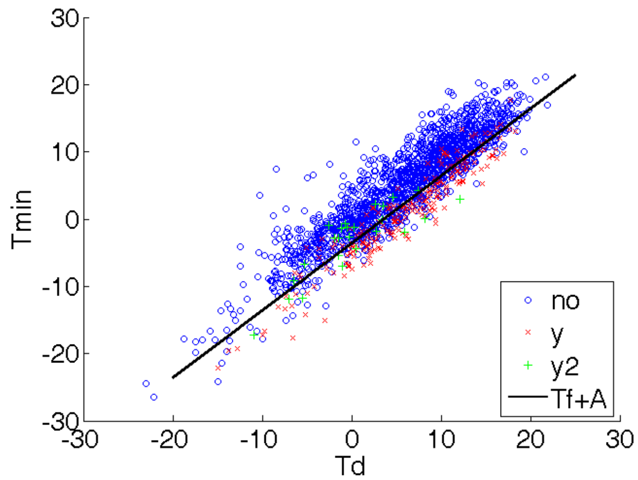

Fig. 8e Fog occurrence for T_d and T_{min} for Prerov (11748)

6 Conclusion

One of deficiencies of this work is that the conditions of fog formation have not been known sufficiently precisely. The term (with 1 hour frequency) temperatures and other quantities are used for their estimate. The surface conditions (dry, wet, with snow cover), which were not considered, are important also. We used only cases when any precipitations after 12 UTC were not observed and the surface could be probably dry in warmer period. But during the colder season the situation it is not so easy. The influence of midday visibility and relative humidity and cloudiness was considered but influence of wind we neglected.

Last but not least is fact that night length plays also important role in radiation balance, but we use 12 hour interval when we observed fog formation during all year.

The use of common equation for fog temperature T_f for all station leads to comparable results as separately T_f equations. The Cradock Pritchard's equation offer comparable results with other methods. The simplest equation 3 is sufficient for T_f forecast and provides the comparable or better result than other equations. But the results depend on parameter A which must be derived for each of given stations separately.

In this paper is shown how could be quite old Craddock and Pritchard's method for forecasting of fog adjusted for utilization on territory of the Czech Republic. Generally speaking, we supposed much better results. But it is obvious that fog formation is complex; its occurrence is widely variable in space and time, forming under a wide range of meteorological circumstances. In all cases it forms as a result of air near the surface becoming saturated and being cooled below its dew point. Unfortunately only this is easy to say regarding occurrence of fog.

7 Acknowledgement

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