On apple scab simulations for extreme and mean years

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- **Comparison of ASCHORF model output from extreme and mean years of the last two decades (1983 – 2002)**

- **comparison of ASCHORF model output from extreme and mean years of two decades of a climate change scenario (2036 – 2055)**

- **intercomparison between these historical and future data model results**

- **conclusions**

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Introduction

In our working group it has been recommended at Ponta Delgada meeting to look after model results for extreme years and in this connection with climate change effects. The following comparison of different apple scab seasons refers only to ASCHORF model results. A spring season for apple scab infections was set to Julian day no. 80 to 160.

Comparison of mean and extreme seasons of recent years

The mean relevant climatological data of a period of 20 years for Hamburg (1983 – 2002) for a spring season are: 10.4°C and 165 mm of rain. For all comparisons below see Table 1.

Out of these 20 years (1) the warmest dry spring, (2) the wettest one and (3) a spring near to the mean conditions above have been chosen. Although the wettest year shows the highest number of wetness hours, infection hours and Scharringa-Meijneke index (SMI) periods as might be expected, the warm and dry year has more of those than in the mean condition year.

Comparison of mean and extreme seasons of climate scenario years

From the Hamburg Klimarechenzentrum the climate scenario the 2036 – 2055 period data were taken for the Hamburg area. The daily data were artificially broken down by us to hourly data, as hourly data files are needed by the ASCHORF model.

This new 20 year period has a 1.1 K higher mean temperature and –26mm less rain for the spring period considered. Again the warmest (and dryest) year, near mean value and wettest year have been chosen for model calculation. The number of wetness hours increased from dry to wet season as to be inspected, but not the infection hours. The number of SMI phases increases with wetness, but not the calculated infection events. Simulations of meteorological conditions with the old mean values (near 10.4°C, 165 mm) and with the new (2036-2055 scenario) mean values (11.5 °C, 139 mm) shows a reasonable shift to less wetness hours, less infection hours and consequently fewer SMI and infection events.

Intercomparison of results for last decades seasons and for climate scenario years

Comparing the recent decades mean of 1989 for spring with a very similar mean climate scenario (of 2037) we see the following differences inspite of the same precipitation sum:

The future spring season (2037) shows more wetness hours, but fewer infection hours, nearly double of SMI periods, but nearly no difference in infection events.

Looking at the wettest seasons (1985 and 2045) the climate scenario shows lower number of such wetness and infection events except in SMI periods which are considerably higher.

Again for the very dry and warm years the climate change scenario yields lower numbers of critical events for apple scab, but again an increase in SMI phases.

Conclusions

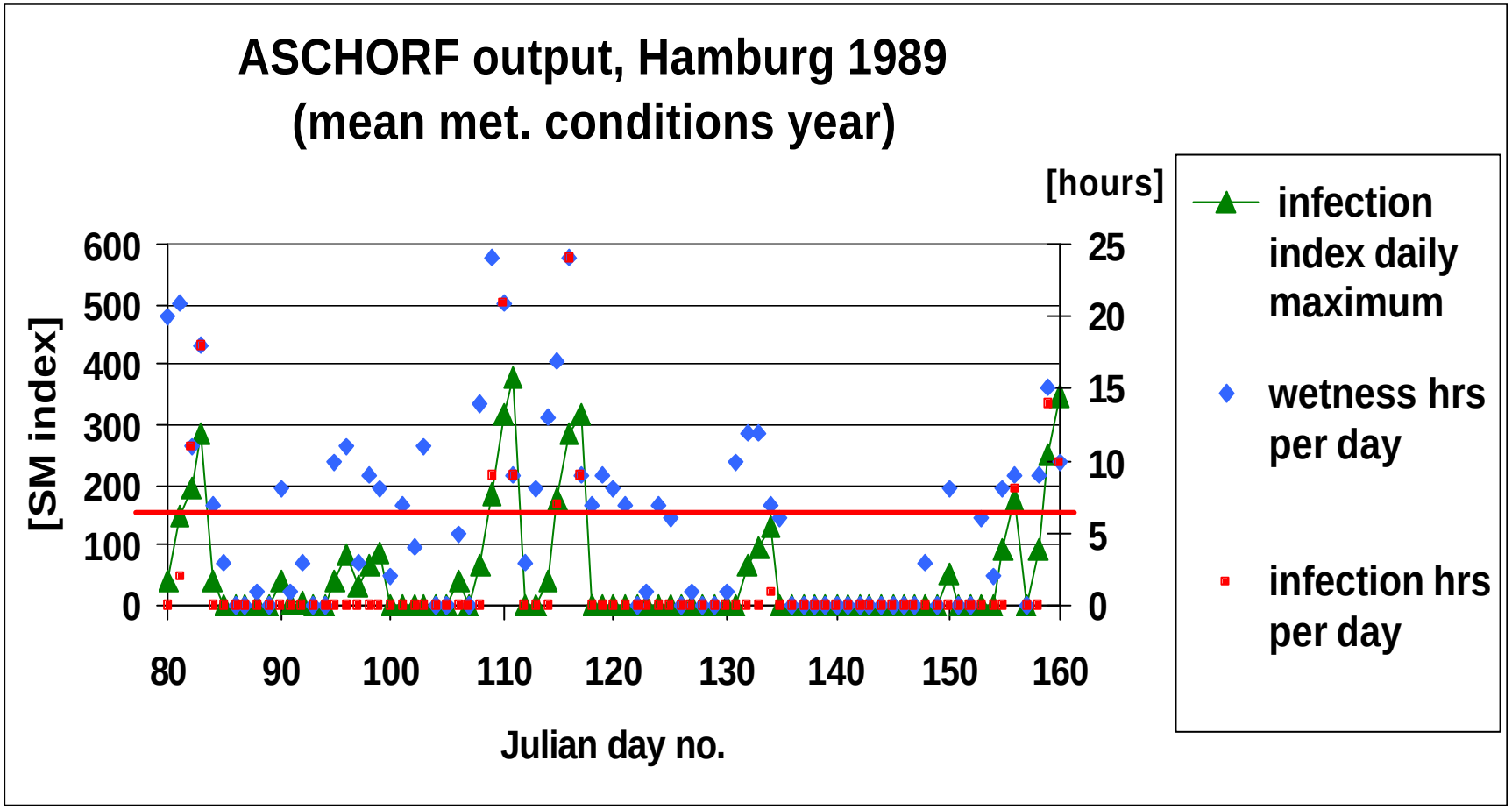
It has to be kept in mind that we look not to reality in great parts, but to simulation results. This refers to the apple scab model output and to the climate scenario data as well.

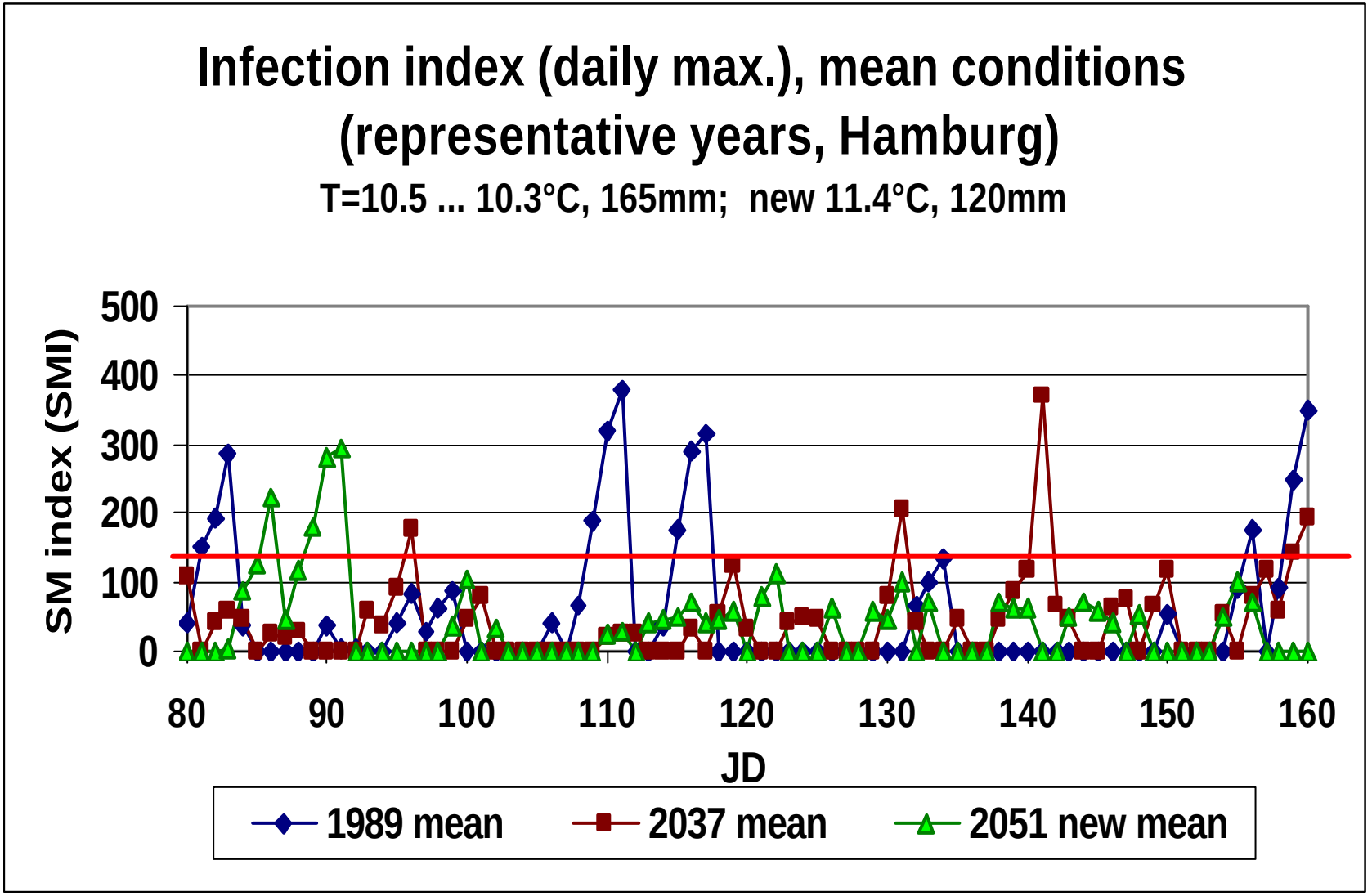
From the recent decades analysis we can learn from this example for Hamburg that even a warmer and dryer year (compared with a mean year) can lead to more wetness and infection hours and eventually to higher disease pressure. This has to be explained by the very different types of rain events (intensity, time of the day, temperature during wetness event) in certain spring seasons.

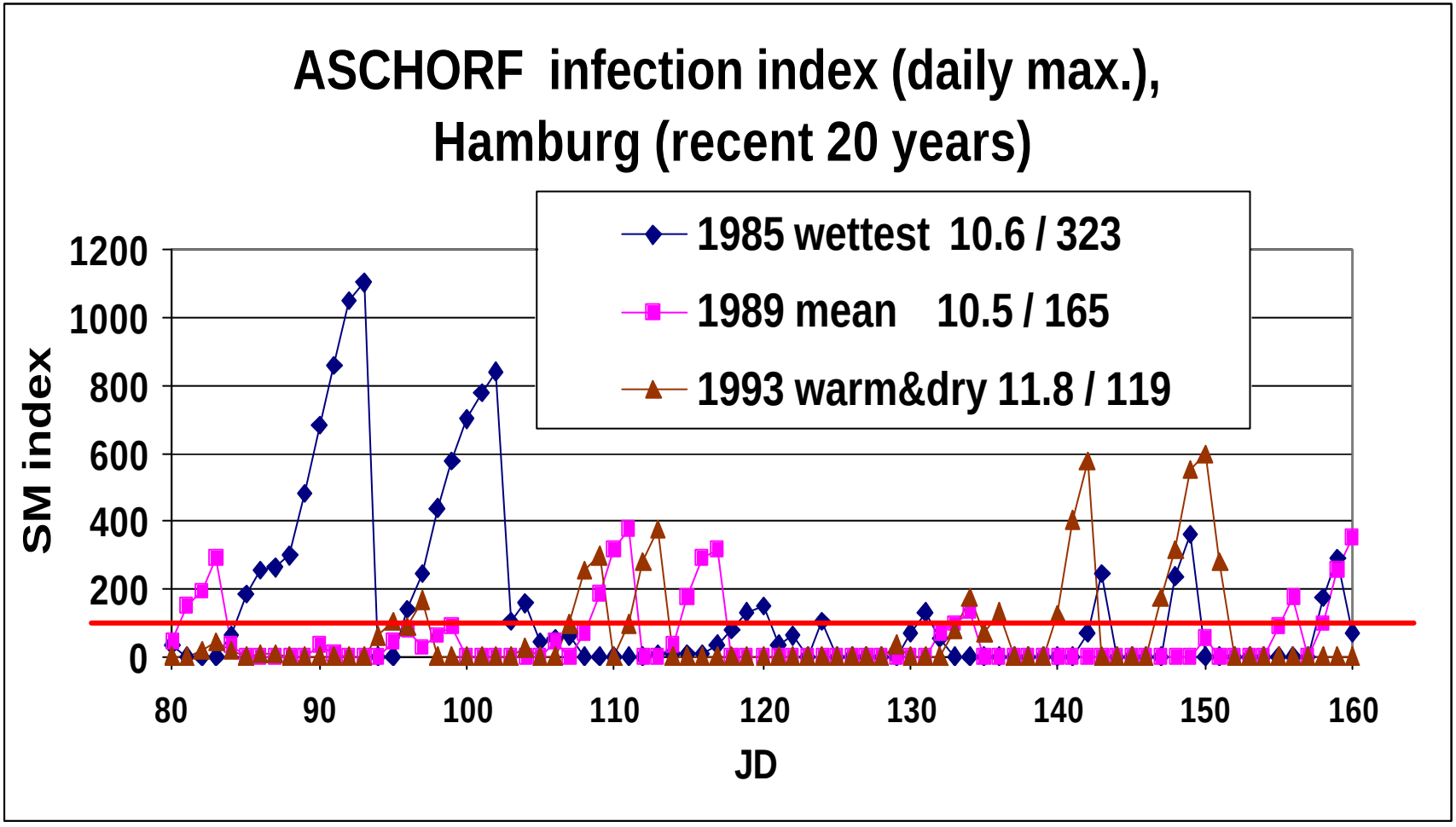
The analysis of the forecast warmer and dryer climate shows a meaningful tendency between the dryest and wettest year only in the number of wetness hours and SMI periods, but not with number of infection hours and infection events. The important intercomparison of the same mean meteoro-logical condition years has shown considerable variations due to rain events characteristics. In addition for the climate scenario years the model ASCHORF reacts to the artificial distribution of daily rainfall to 3 hours after noon. Also hourly temperature and relative humidity show a sine curve distribution through the day. This of course influences the outcome of a model calculating in hourly time steps.

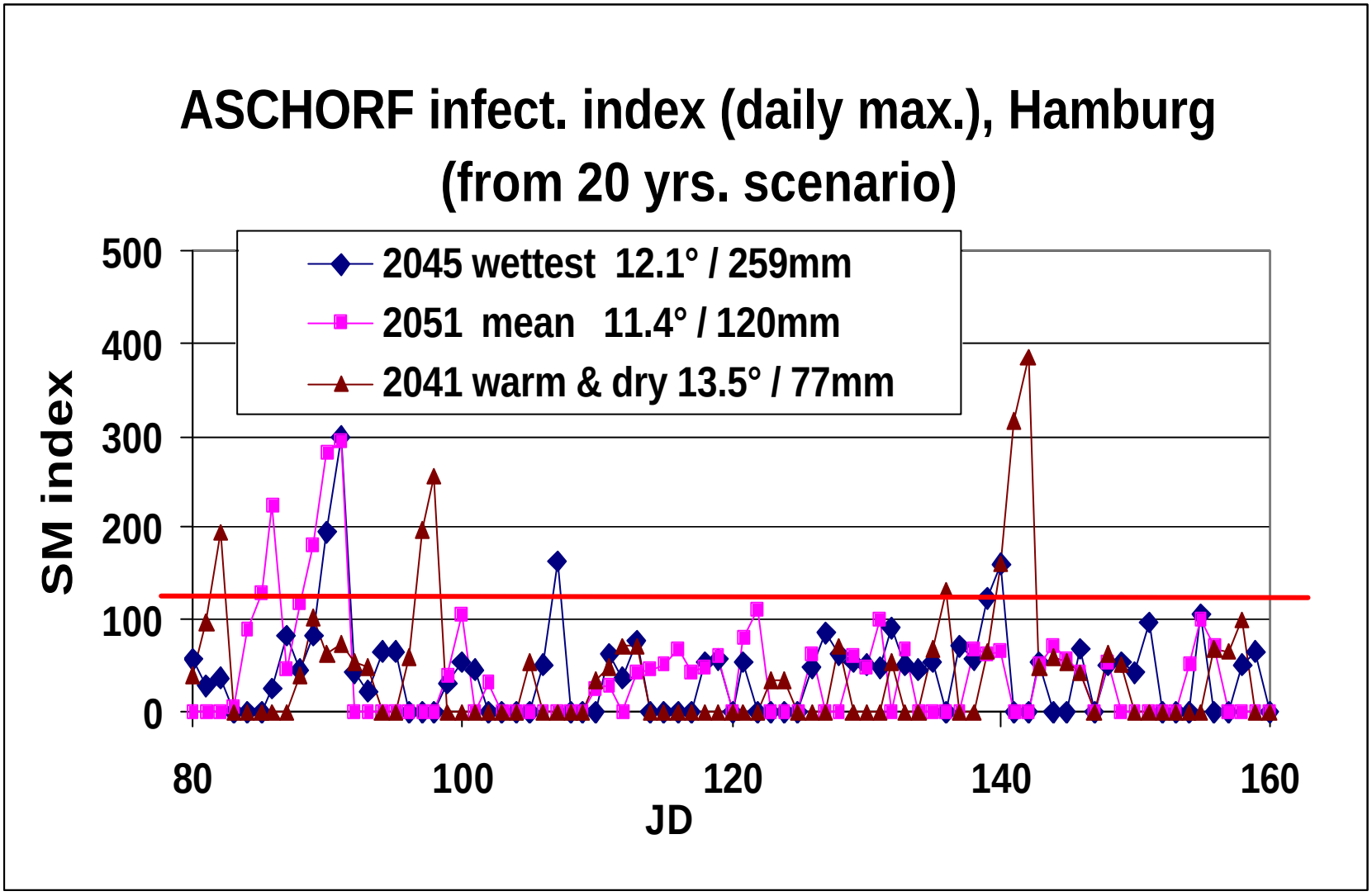
Neverless it can be concluded, if the scenario trend of about + 1 degree and – 26 mm is true after 30 years, that there will be a clear trend to fewer wetness and infection hours and to fewer infection events from the model. The increased number of SMI periods has to be considered as an artefact due to data handling. So, good historical data sets of extreme seasons might be of better use for judging model outputs for climate change effects.

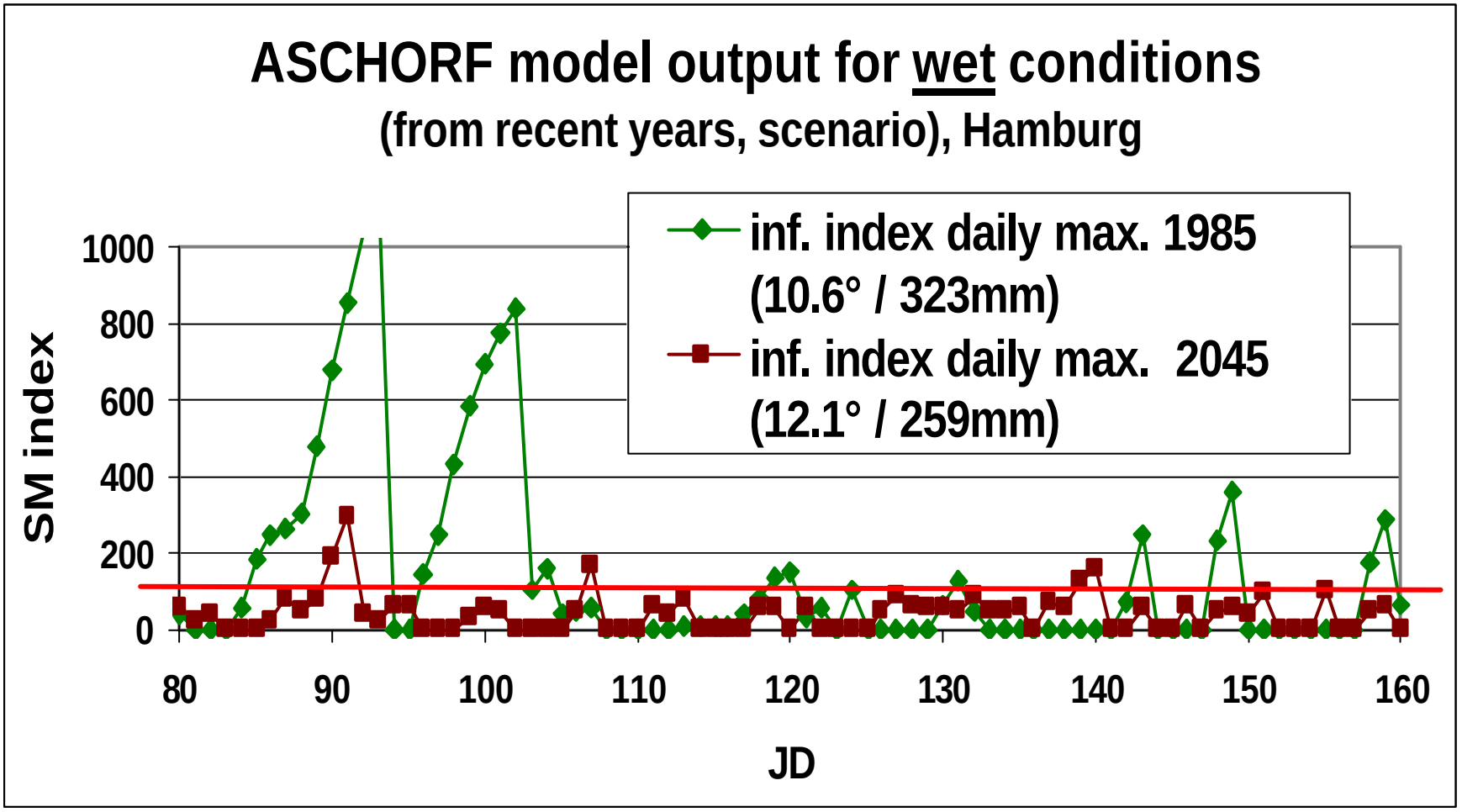
10.9.2003

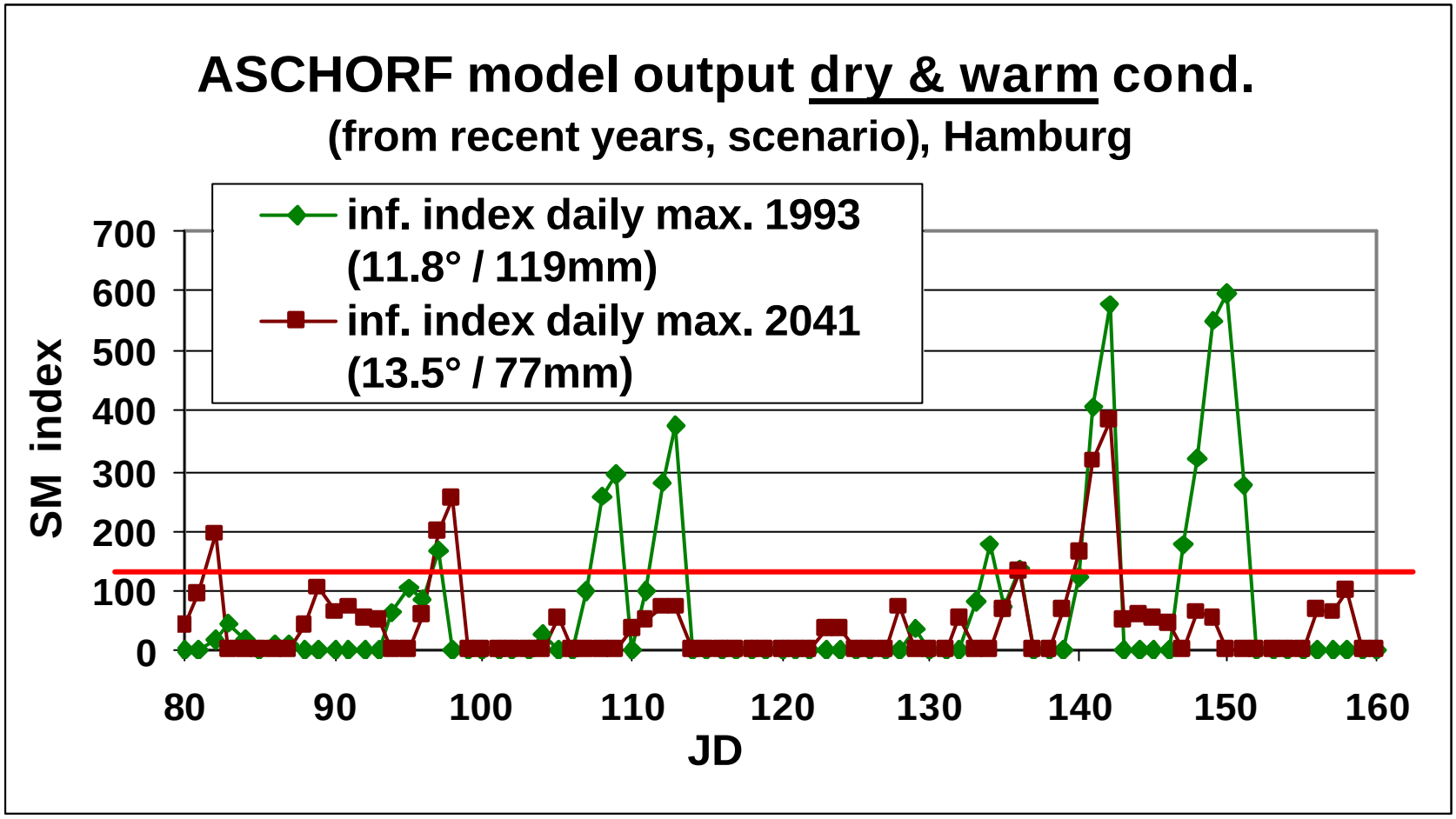

ASCHORF output, Hamburg 1989
(mean met. conditions year)
[SM index]
[hours]
600
500
400
300
200
100
0
25
20
15
10
5
0
80
90
100
110
120
130
140
150
160
Julian day no.
infection index daily maximum
wetness hrs per day
infection hrs per day


Infection index (daily max.), mean conditions
(representative years, Hamburg)
T=10.5 ... 10.3°C, 165mm; new 11.4°C, 120mm
SM index (SMI)
500
400
300
200
100
0
80
90
100
110
120
130
140
150
160
JD
1989 mean
2037 mean
2051 new mean


ASCHORF infection index (daily max.),
Hamburg (recent 20 years)
1985 wettest 10.6 / 323
1989 mean 10.5 / 165
1993 warm&dry 11.8 / 119
SM index
1200
1000
800
600
400
200
0
80
90
100
110
120
130
140
150
160
JD


ASCHORF infect. index (daily max.), Hamburg
(from 20 yrs. scenario)
2045 wettest 12.1° / 259mm
2051 mean 11.4° / 120mm
2041 warm & dry 13.5° / 77mm
SM index
500
400
300
200
100
0
80
100
120
140
160
JD


ASCHORF model output for wet conditions
(from recent years, scenario), Hamburg
inf. index daily max. 1985
(10.6° / 323mm)
inf. index daily max. 2045
(12.1° / 259mm)
SM index
1000
800
600
400
200
0
80
90
100
110
120
130
140
150
160
JD


ASCHORF model output dry & warm cond.
(from recent years, scenario), Hamburg
inf. index daily max. 1993
(11.8° / 119mm)
inf. index daily max. 2041
(13.5° / 77mm)
SM index
700
600
500
400
300
200
100
0
80
90
100
110
120
130
140
150
160
JD

Apple scab calculations by ASCHORF

TABLE 1

comparison of extreme and mean spring periods (21 March to 9 June = JD 80 to 160) for Hamburg

1983 – 2002 mean: 10.4°C 165 mm				2036 – 2055 mean: 11.5°C (+ 1.1 K) 139 mm (- 26 mm)			
year out of 20 years	sum no. of hrs	no. of SM – index, infect. periods	max. daily SMI	year out of 20 years	sum no. of hrs.	no. of SM – index, infect. periods	max. daily SMI
1993 = warmest & rather dry 11.8°C 119 mm	470 wetn. 162 inf.	14 8	596	2041 = warmest & dryest 13.5°C 77 mm	263 wetn. 47 inf.	24 4	385
				2051 = mean (new) 11.4°C 120 mm	320 wetn. 31 inf.	24 2	294
1989 = mean conditions 10.5°C 165 mm	272 wetn. 143 inf.	14 6	379	2037 = mean (old) 10.3°C 166 mm	347 wetn. 50 inf.	27 5	371
1985 = wettest 10.6°C 323 mm	622 wetn. 315 inf.	18 8	1107	2045 = wettest 12.1°C 259 mm	364 wetn. 29 inf.	33 3	300

HAMBURG data

	June		July		August	
	T	precip.	T	precip.	T	precip.
climate normal	15.5	74	16.8	82	16.6	70
scenario 2003	14.6	32	20.3	58	18.3	64
2003 real data	17.7	38	19.4	38	19.4	43
	[°C]	[mm]	[°C]	[mm]	[°C]	[mm]

Summary and conclusions

The Hamburg examples of historical and scenario years show that

- even a dry and warm season can have more infection periods than a mean condition spring season

- also for climate scenario seasons the wettest year shows lower numbers of infection hours than a normal or dry year

- model results for future seasons:
  - * lower wetness and infection hours,
  - * lower no. of infection periods,
  - * higher numbers of Scharringa-Meijneke index periods,
  - * mean condition years: small change

- agromet. models should be tested on historical events (uncertainty of future rain structure, variability of precipitation events). Nevertheless scenario indicates: less infections

- results should be handled with care: output of only one model and for only one place