Severe convection checklist for warning operations at the MeteoSwiss forecasting offices

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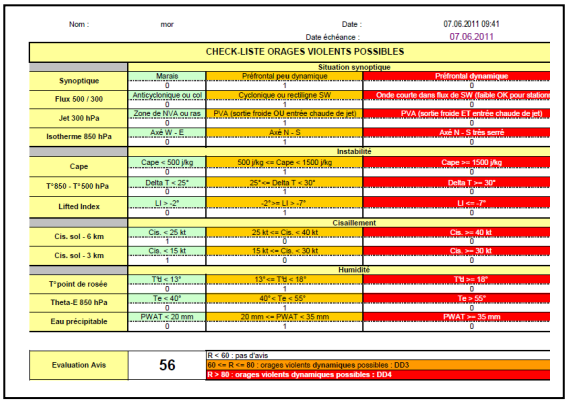
I. INTRODUCTION

Severe convective storms regularly affect Switzerland during the warm season. The Alpine region is subject to a wide range of convective modes spanning the entire thunderstorm spectrum from airmass thunderstorms to supercells. In order to better anticipate the convective mode and virulence of upcoming convective events, MeteoSwiss has developed a severe convection checklist. The checklist is ingredient based and is meant to determine whether severe thunderstorm watches are warranted in the next 12 to 36 hours. It is broken up into 4 sub-sections, each representing a key convective ingredient: synoptic configuration, instability, wind shear and humidity. Each sub-section contains several parameters and/or indices spanning a range of representative values and deemed most relevant to measure the type and severity of the forecasted convection. In order to better differentiate non-organized from organized convection and to better estimate the overall convective threat, different weights are attributed to each ingredient as well as to each parameter's ranges of values. The checklist was utilized operationally for the first time during the 2011 convective season.

II. METHODS

In order to best represent the threat of severe convective storms, the checklist is broken down into 4 sub-sections, each one representing a key convective ingredient. Ingredient one is the synoptic configuration used to access the amount of large-scale lift both aloft and close to the surface. Ingredient two and three are instability and vertical wind shear, respectively, necessary for storm organization, severity and likelihood of severe wind gusts and significant hail. The fourth ingredient is humidity used to better access the probability of significant rainfall with the convection. Each subsection contains 2 to 3 parameters chosen to quantify each ingredients contribution to the overall convective threat for a given day. The range of plausible values attributed to each parameter is broken down into 3 columns each representing an expected severity level of the forecasted convection. These ranges of values were chosen based on comparisons with past severe convective events and take into account local climatology. Each parameter and range of values are attributed different weights as a function of their estimated overall importance/role in contributing to the severity of the storms expected. The maximum possible numerical value a forecaster can obtain in filling out the checklist represents the highest severe convective threat and is assigned a normalized value of 100. This method theoretically allows a forecaster to distinguish between slightly severe and significantly severe thunderstorms, depending on the final value obtained. Forecasters are however strongly encouraged to integrate and synthesize all the pertinent data at their disposal in the forecast office in order to establish their final decision regarding the overall convective threat for the period in question.



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CHECK-LISTE ORAGES VIOLENTS POSSIBLES

Situation synoptique			
Synoptique	Marais 0	Préfrontal peu dynamique 1	Préfrontal dynamique 0
Flux 500 / 300	Anticyclonique ou col 0	Cyclonique ou rectiligne SW 1	Onde courte dans flux de SW (faible OK pour stations 0
Jet 300 hPa	Zone de NVA ou nse. 0	PVA (sortie froide OU entrée chaude de jet) 1	PVA (sortie froide ET entrée chaude de jet) 0
Isotherme 850 hPa	Axe W - E 0	Axe N - S 1	Axe N - S très serré 0
Instabilité			
Cape	Cape < 500 j/kg 0	500 j/kg <= Cape < 1500 j/kg 1	Cape >= 1500 j/kg 0
T°850 - T°500 hPa	Delta T < 25° 0	25°<= Delta T < 30° 1	Delta T >= 30° 0
Lifted Index	LI >= -2° 0	-2°>= LI >= -7° 1	LI <= -7° 0
Cisaillement			
Cis. sol - 6 km	Cis. < 25 kt 0	25 kt <= Cis. < 40 kt 1	Cis. >= 40 kt 0
Cis. sol - 3 km	Cis. < 15 kt 0	15 kt <= Cis. < 30 kt 1	Cis. >= 30 kt 0
Humidité			
T°point de rosée	Td < 13° 0	13°<= Td < 18° 1	Td >= 18° 0
Theta-E 850 hPa	Te < 40° 0	40° < Te < 55° 1	Te > 55° 0
Eau précipitable	PWAT < 20 mm 0	20 mm <= PWAT < 35 mm 1	PWAT >= 35 mm 0
Evaluation Avis	56	R < 60 : pas d'avis 60 <= R <= 80 : orages violents dynamiques possibles : DD3 R > 80 : orages violents dynamiques possibles : DD4	

FIG. 1 : MeteoSwiss severe convection checklist

III. RESULTS

Conclusive results concerning the efficiency and helpfulness of the severe thunderstorm checklist have at the time of the extended abstract submission not been fully accessed for the first convective season for which it has been implemented. Preliminary data seems to indicate that the range of certain parameter values in the thunderstorm intensity columns will have to undergo some modifications in order to better represent the convective threat. Due to important moisture inhomogeneities at low-levels within the heterogeneous terrain encompassing the forecast area of responsibility, more often than not, the severe convective threat as highlighted via the checklist's final value was exaggerated, especially over the western half of Switzerland. While isolated severe convection often initiated along the orography during marginal organized convective events where checklist values surpassed the

first severe threshold, the second threshold often had to be attained in order to generalize the threat to the juxting low-lying plain regions. In some specific cases, at least, this outcome seems to have been a result of levels of free convection being particularly elevated in the marginal cases where low-level humidity values were a bit low, thereby restricting convective activity over the topography, the only regions where lift was sufficient for air parcels to overcome the convective inhibition. Overall, however, the operational implementation of the checklist seems to have had a beneficial influence so far on the forecasters final decisions concerning the convective threat and has helped introduce a more objective method for convective forecasting within the regional offices.

IV. IMPORTANCE OF HUMANS IN THE FORECAST PROCESS

The need and construction of such a checklist at MeteoSwiss raised the issue of the importance of the human in the forecast process. In an age where human intervention in the forecast chain is more and more questioned and debated for both political and economic reasons specific to each forecasting institution, a need to address this issue seemed more than pertinent. It is of the author's opinion that humans should stay central to the forecasting process, since they are able to synthesize great amounts of data from various platforms simultaneously and apply varying importance to different incoming data based on knowledge of various conceptual models and forecasting experience. No numerical model today can seemingly claim to be able to integrate that complexity. Moreover, as much importance as possible should be put on continuing on-the-job forecaster training in order to maintain sufficient forecaster expertise in relation to the constant numerical model improvements. Doing so will assure that forecasters utilize numerical models as a complimentary forecasting tool and not as a clutch for forecast generation. Assuring this can perhaps help convince decision makers in the various worldwide national weather service forecast offices that humans clearly contribute added value to numerical weather forecasts. Recent history via the Air France Rio-Paris flight disaster clearly reminds us of the importance of qualified human intervention in an automated environment.

V. FUTURE WORK

In depth analysis of each convective event as it related to the values entered into the severe convection checklist will take some time. In addition to adapting the range of values of certain parameters in the checklist, future work will involve setting a minimum final threshold value necessary per ingredient, since the lack of sufficiently high values of just one of the four ingredients can effectively prevent severe convection from occurring altogether. Normalizing the final values of each ingredient row may also be a means to better quantify each ingredients role in a particular convective event.

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