During a heavy thunderstorm on the Peninsula of Parata (Corsica, France). Contrary to the appearance, this picture was taken in the night, with the lighthouse to prove that fact. A strong lightning struck behind me and permitted to reveal this incredible cloud structure and to show how powerful this place is. The Genoan tower seems to be an impregnable castle taken out of a tale.

Tony Le Bastard - 2009-23-06

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Dear readers,

Another year passed, time flies like it seems to do every year within a more hasty and complex world around us. As I look at my institute, and also from the signals I get from colleagues abroad, National Met services are often and more frequently in the midst of political discussions while the media tend to put a magnifying glass over their performances after any severe event. During last year at KNMI we had many discussions, more or less politically driven, on the false alarm ratio for our severe weather warnings. This was one of the reasons why we did put in a new warning strategy in which the probability threshold on a severe event expected to happen, before issuing the severe weather warning, is lifted. However one should never forget that this change will increase the risk of missed alarms, which is at the end much more tricky than having a false alarm.

The 2009-2010 winter that was dominated in our part of Europe by the shortage of salt, to prevent roads from wintry conditions, makes us look back at a very busy but externally highly appreciated winter season from a meteorological point of view. After this season we expected that our services would get back to normal procedures and activities in the Spring season.

And then the volcanic eruption in Iceland took place. This event really shuttered the whole of Europe. After shutting down more or less the complete European airspace, a next intense effort was asked from the Met services in giving added value to the products of the VAAC services. Together with many experts from the VAAC, the WMO and nearly all the National Met services we succeeded to exchange and share all LIDAR observational data and reconnaissance flight information within Europe. We also managed to highlight the reconnaissance of ash within satellite imagery and were able to define the critical values for ash concentrations in the atmosphere. The combination of improved critical dispersion modelling lead to the VAAC plus product. Together with enhanced observational techniques (as mentioned above), exchanged within the European domain, we are now able to offer a very dedicated and improved service for Airliners, ATCs and National authorities. This volcano event did proof the ability of European NMHSs to react in a very rapid and professional way which had never been possible without multi lateral co operation between our services.

Now we are preparing for the Summer season, new events will certainly happen for which high quality meteorological services are needed. New co operation will be seen, in which our Working Group on Co operation between European Forecasters plays an important role. Our network of operational colleagues that gathers once a year to exchange and share experiences in the “European Forecaster” is also of high importance during real events. It makes it easy to get in touch with colleagues elsewhere when we seek for special knowledge or additional observations.

Again this beautiful coloured edition of the European Forecaster newsletter, the 15th edition lies in front of you. All topics discussed in Toulouse during our last meeting can be read. Again I call up on all of you to recommend this edition to all our colleagues. I also call up on all readers to send in new contributions for the next (16th) edition. Again all articles were reviewed by Will Lang (from the UKMO). Bernard Roulet and Météo France made it possible to present you this high quality printed edition. Many thanks also to André-Charles Letestu (Météo Suisse) who updated our website www.euroforecaster.org with actual information on the Working Group together with website links. Our web archive shows the previous editions of the Newsletter.

I wish you many inspiring reading hours and hope to see you during our next WgCEF meeting in Dublin, Friday 1st October 2010.
Welcome by Bernard Roulet

17 members attended the meeting
Frank Kroonenberg, Herbert Gmoser (minutes), Bernard Roulet, Jean Nemeghaire, Knud Jakob Simonson, Seren Brodersen, Anti Pelkonen, Klaus Baehnke, Chryssoula Petrou, Evelyn Cusack, Arturo Pucillo, Claude Sales, Karen-Helen Doublet, Janez Markosek, Andre-Charles Letestu, Will Lang, Manfred Kurz

Matha Sallai (Hungary), Teodoro La Rocca (Italy), Lola Olmenda (Spain), Merike Merlain (Estonia) told the chairman they cannot attend the meeting.

Welcome and agreement on agenda

Introductions and report of the chairman of the WGCEF by Frank Kroonenberg

Until now not much impact on NMS’s can be seen due to financial crisis, certainly effect will occur in the (near) future. Reduction of budget and staff is than to be expected.

New working structures will be needed to cope with future reductions. At KNMI preparation can be seen towards more automated production in future and a more dedicated weather dependable shift strategy. Less staff under easy going weather conditions (than mostly automated production) and full staff during high impact weather.

In order to support this type of working more attention should be paid to training and learning. E-learning and simulation training could be amongst solution to this.

The list of representatives had been updated

Actions of last meeting
Topics for the meeting in Toulouse
Changes in the NMSs
Verification of meteorological products

Possible topics for the next meeting
Limited area ensemble forecasting
High resolution NWP models in operational use

Some discussion was done on
Examples of high resolution NWP-model use and E-learning facilities now and in the future.
Newsletter
Thanks to Bernard, Will and Andre-Charles taking care of the newsletter and the web site. Meteo France will also produce the next newsletter
Web site statistics would be useful, feedback is necessary
Deadline of the contributions for the newsletter 1 December 2009

Short EMMA/Meteoalarm update – Frank Kroonenberg
More cooperation between NMS's and National Hydro services is encouraged in order to include warnings for river flooding. Heat rate index will be made available by ECMWF as guidance to NMS's. Meteoalarm will extend its membership area towards the Southeast, including Turkey. Coastal warnings will be included. The lead time period will be extended until Day 2 till 5 for special users, such behind usercode/ password. User feedback might be possible, by sending reactions and pictures of occurring events to the web site.

Contributions from WGCEF members
Chrysoula Petrou:
"New working structures and upcoming plans in Hellas"
(new automated systems will replace the common observation system in all meteorological branches)

Jean Nemeghaire:
"The present situation and the upcoming plans in the area of weather forecasts in Belgium (RMI)"
(3 forecasters at daytime, 2 forecasters during nighttime, nowcasting texts every 3 hours, daily operational checking list of main parameters for estimating the risks for warning)

Andre-Charles Letestu:
"New production process at MeteoSwiss"
(Met-conference twice a day, EPS at T+72h, daily a matrix up to day 8 is initialised (editing fixed areas) by the leading centre Zürich alternative with Geneva, the matrix can be amended at any time, postal code areas are driven by the matrix with a more or less automated weather, daily verification of the matrix in progress, text prognoses are not of importance anymore)

Klaus Bähnke:
"The future structure of the weather warning service at DWD"
(Future staff number 2015, AUTOWARN, strategy 2015: all the warnings are done by central forecasting office, 2 warning sections (north and south), single voice policy, weather forecasts of regional advisory offices are coordinated by central forecasting office, shift times 00-24h central office, 05:30-22h/24h regional advisory offices, forecasters are degraded to lower levels, regional offices are degraded in staff)

Karen-Helen Doublet:
"The PROFF-project-new tools, new methods" “PROFF" professional products to the public.
(More than 70.000 pages of text per year, automation is asked, hit rate of web visits for pictograms was growing rapidly 2007-2009 (more than 10 times), this was the feedback for working in figures also in the future, reorganization of the workflow, models have improved so much, model editing tool, first experiences are very good, automated text generation next action, verification in progress)

Herbert Gmoser:
"The future role of the human forecaster - a change in the philosophy?"
(The primary role of the human forecaster should be to develop and maintain a shared weather-object database that uses a sequence of composite depictions that evolve through time the current and future
states of the atmosphere. The emphasis would be on the sensible weather near the surface, since that region of the atmosphere has the greatest influence on the activities of the public. Basic activities are based in nowcasting and warnings for the public.)

**Bernard Roulet:**
“Aims of reorganisation of forecasting at Meteo France”
(New forecasting principles: chief forecaster decide the model, than the data fill the system and the chain of products, forecaster could correct the track of a thunder storm system, local centres should be closed in the future (500 jobs will be closed), the reorganisation has started 3 years ago)

**Will Lang:**
“The philosophy of the Met Office forecasting review”
(A business driven activity, what is required by the customer, make the best of the capabilities, flexible, scalable, simpler forecasting and production process)

**Frank Kroonenberg:**
“Short overview on E-learning activities at KNMI and in Europe (Eumetcal)”

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**Verification of meteorological products**

**Claude Sales:**
“Aconcagua 2009 meteorological assistance to get to the summit”
Weather forecast for an expedition in February 2009 to the highest mountain of the western and southern hemisphere.

**Herbert Gmoser:**
“Objectives in evaluation of warnings”
Probability of detection, False Alarm Rate, Success Rate, Equitable Threat Score

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**Plan of actions for 2010**
Limited area ensemble forecasting for short range forecasting
High resolution NWP models in operational use (less than 10 km resolution)
Short update of new developments and applications in the NMSs

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**Date and place of the next meeting**
Dublin, Friday 1st + Saturday 2nd October 2010, starting time 09.30 loc time, Irish Met Office

**AoB and closure of the session**
No AoB

Overall feeling:
There will be a new approach in doing weather forecasting in the future, the weather forecasting work will change in NMSs.

End of the meeting 17:40 loc time.
The human factor in issuing severe weather forecasts

Introduction

I have been a forecaster now for about 25 years. During the first years in this wonderful job, the job structure was based mainly on the knowledge gained during my meteorological study and the practicing period as an apprentice whilst being defined by the working instructions available on shift. These aspects could be seen as essential objective background features to perform as a junior forecaster.

As the years went by, I became increasingly aware that besides an objective part there were also other more subjective elements involved. These more human related and psychological subjective elements become really important when the forecaster is preparing to issue severe weather forecasts, probably even more so after a growing number of working years/experience.

I have always been fascinated with this human and psychological factor. Having discussed this subject from time to time, I noticed some reluctance from colleagues who tended to think that forecasters should only work objectively. It is my belief that it is impossible to erase this human factor while forecasters remain responsible for issuing severe weather forecasts. Let us accept this fact.

We should therefore take more advantage from this human factor. Looking at things from this perspective it is even possible to improve the skills of your service in this field. This article is meant to give you a better feeling for the elements involved and for solutions that will optimise the most important feature in your service - your human factor.

Shaking the worst meteorological cocktail

Every operational forecaster will encounter many occasions during their career when the weather could go one way or the other. Uncertainty can increase dramatically as lead times increase and this does influence the actions of the forecaster. For this reason we rely more and more on probabilistic ensemble scenarios for the medium range forecast period: D+3 to D+10. From experience we know that uncertainties may enter the forecast at a much earlier stage and this is why many weather services are developing short range ensemble models and techniques. We also know that the largest ‘added value’ gained from the forecaster, as the expert on weather forecasting, is expected within the first 24 hours of the forecast. In most services this H+24 period more or less corresponds to the period in which severe weather forecasts and warnings are issued. Looking at my service, particularly for this H+24 period, we are currently not very well equipped with tools to assist in assessing uncertainties or alternative scenarios. The best we can do is look at the ECMWF EPS for short lead time periods, but EPS perturbations are optimised for much longer lead times. Another possibility is to apply poor mans ensemble techniques, such as PEPS or a combination and comparison of other models that are available to your service. The forecaster then has to consider if there are uncertainties in synoptic-scale developments and/or related to more mesoscale phenomena such as CB-clusters and MCS features. For this crucial H+0 to H+24 forecast period, the lack of objective tools will put more pressure on the forecaster especially during potential severe weather situations. This combination of having poor additional support to estimate uncertainties together with time pressures and a high level of responsibility is the worst cocktail one can shake for the forecaster. On the other hand, however, it can focus the forecaster on achieving optimal skill performance based on meteorological knowledge and experience.
The risks in risk assessment

Experience is gained in a number of ways. It will involve both good and bad forecasts and warning events from the past. This kind of experience together with non-meteorological facts will trigger all kinds of psychological effects for the forecaster in charge. I will give a list of examples below.

However, there is one particular scenario that is worth highlighting initially. I have always thought that a poor forecast of a severe weather event (ranked as a “missed warning with high impact on society”) would raise utmost caution within the forecast room during any similar event that followed. In other words, there would be heightened awareness in order not to miss such an event again. This is certainly true, but referring to Mr. Marco Gaia’s presentation during the 2007 EMS/ECAM meeting in El Escorial, the converse can also occur in dramatic fashion. MeteoSwiss had model evidence to suggest a potentially high impact weather situation that would lead to a high risk of flash floods in Central Ticino. The forecaster on duty issued a warning of extreme weather but the event did not occur and the warning was subsequently verified as a false alarm. Not long after the same forecaster neglected a much clearer signal from the model, due to the psychological impact of their previous experience. This time a high impact event actually occurred and a missed alarm was noted (The article from Gaia and Fontannaz can be found in the 13th edition of The European Forecaster, the WGCEF Newsletter).

Listing some triggering examples for human behaviour in forecasters

This “human factor” was promoted as the central topic for the 2008 WGCEF meeting at DMI in Copenhagen. Within the 14th edition of this “European Forecaster” you will find the spin off from this interesting meeting.

When preparing for the 2008 WGCEF meeting, an interesting e-mail exchange with Will Lang (Met Office) took place. Will had compiled a short summary of possible human factors that might influence the issuing severe weather forecasts and warnings (additional comments by the author are in italics):

• There can be problems regarding consistency of decision-making from event to event. For example, an earlier false alarm might bias interpretation of the next event even though the events are totally independent, tending to under forecast next time (the Gaia example). Also an earlier missed alarm will greatly influence the decision making process in a subsequent similar situation, with a tendency to over-forecast.

• How to achieve a consistent approach from different forecasters (one forecaster could be more prudent than the other).

• Eyes being drawn to one particular event (perhaps a day or two ahead) which may distract from a potentially more disruptive event on a smaller scale in the near future.

• ‘Holding ones nerve’ versus ‘when to give up on an event that becomes increasingly unlikely’.

• Dealing with conflicting model guidance. A so-called ‘rogue’ model run may be leading the way to a different evolution and a change of emphasis.

• Handling a decision once it has been made and the ‘roller-coaster’ effect when the media latch onto the story. It is often difficult to backtrack on a severe event once a warning has been issued.

• Warnings may not be a true reflection of real probability criteria. Related to the previous point… Once the media are in full flow, the severe weather story can assume a life of its own and be difficult to control. Consequently there is a temptation not to issue a warning until a high degree of certainty exists – much higher than the defined probability threshold for issuing the warning.

• Pressure from senior management – different personalities and interests often come into play. Collaborative decision-making spreads responsibility but can delay the issue of a warning significantly by the time various parties have been consulted.

• End of shift syndrome – human nature can sometimes mean that insufficient weight is attached to new information that runs counter to earlier ideas. For this reason warnings can be missed.

• Model guidance with respect to convection can often be erratic (mesoscale events).

• Lack of relevant observational data can compound problems especially with respect to marginal rain/snow and freezing rain events (small spatial scale events).
• IT issues – dissemination problems can be an added source of delay and pressure.
• Awareness of the possibility of post-event criticism can create pressure.

Some other human factors
(added by the author)
• Workloads too high, inadequate technical facilities and poor accommodation can have a negative effect on the quality of forecaster output.
• Pressure upon your service, whether from governmental origin or due to competition from other services might influence forecaster decisions.
• Strong media attention and criticism is likely to influence your next decision.
• Forecasters tend to look merely at meteorological thresholds when issuing severe weather warnings. These thresholds are normally linked to expected social disruption but the vulnerability of society may be dynamic, meaning that at certain times the environment can be more vulnerable such that lower meteorological thresholds and/or lower probability thresholds are more applicable. Forecasters and procedures should encompass a greater sensitivity to such issues.
• In general too much stress can distract forecaster concentration and sharpness. A WGCEF survey performed during 2008 and involving almost 30 European National Met Services (NMS's), proved that the stress factor for 68% of respondents is sometimes (too) high. Forecasters from the 22 responding NMS's all felt stress. The amount of stress was ranked as: Neutral stress by 1 NMS, Moderate stress by 6 NMS's, High stress by 12 NMS's, Very High stress by 3 NMS's.
• For the survey question “If forecasters are aware of the impact warnings or inadequate warnings can have in terms of damage and loss of life” - 21 out of 22 answered with a clear YES. This means that there is a very high awareness amongst all forecasters of the impact that their warnings have on society, in terms of helping the authorities to take mitigating action. This feeling of high responsibility, shared by all forecasters, is a stress factor in itself.

Advantages within these Human factors

In principle these human factors are strongly related with:
• Earlier job related experiences within meteorology
• Personal sensitivity to external factors
• Individual character structure

If you look at this simplified listing there seems to be a substantial learning issue involved. Learning will enrich your meteorological forecasting capability and will also make you more sensitive to the outside world for which your forecasts and warnings are meant. One problem with the human factor is that on the one hand, it can help to serve the more tailored needs of society but on the other hand, it might also override common sense or neglect other objective information from models, methods and consistency. So if we want to take full advantage out of these human influences we should equalize peak emotions.

Optimising your severe weather warning system
and taking advantage of the human factor at the same time;
“An ideal warning system”

In general
It could be a wise decision to try to separate meteorologically induced stress from the everyday stresses of life. In this way forecasters will only focus on stress related directly to the weather, model outputs and so on. They should try to form objective choices and output through good shift co-operation and structured shift discussions. A team of experts can deal with the everyday stress outside the forecast room but this expert team should interact with the forecaster(s) on shift.
Collaborative decision making

- Shift meteorologists should have discussions if severe weather warning thresholds are likely to be exceeded. By sharing this meteorological discussion, focusing on the (un)certainties and assessing the risk of the ‘worst case scenario’, the human factor will not get lost but will be more equalized without overlooking the essential points.
- Once the meteorological expert judgement from the operational shift is made, an Expert Team can become involved in the decision making process. The added value of this Expert Team is to assess the initial vulnerability of society and to judge other relevant information relating to potential impacts from the expected severe weather event.
- The final “yes or no” decision for the issue of the severe weather warning can be made within this Expert Team. It can be an internal expert team from your institute or a mixed team where you involve people from your national civil protection agencies as well. You might also use video conferencing to support the Expert Team.

The Expert Team will make an initial impact assessment on the expected situation for:

1 - Initial vulnerability: depending on rush hours, weekdays or weekends, national holidays, etc. Your meteorological thresholds might need to be more flexible at this time if you want to link them to changing initial vulnerability. Lower thresholds or lower confidence percentages may be set to trigger the warning.
2 - Has similar weather been experienced already over many days during a recent period or is a new event expected? Too many high impact warnings for the same phenomenon over short time periods are overdone and will devalue the external trust in your severe weather warnings. Alternative ways of warning, by using lower colour codes for instance, might be more applicable here.
3 - Is the expected event really exceptional in a climatological sense? In such cases the outside world will not be used to it and will be less prepared for proper action as well.
4 - Is there any specific political and/or media attention on your institute that could influence a final “yes or no” decision? This might be the case due to a recently missed alarm or perhaps a recent false alarm as well. Also commercial competitors watching closely might be an important factor.
5 - Is there any additional media strategy required from your institutional Press officer, perhaps to enhance the awareness in the outside world if a warning is issued? Or if you do not issue, is it necessary to take any other action?
6 - Are there any potential problems within your IT-system? They can badly influence the image of your institute during warning episodes.
7 - In general is there any need to bring in additional staff on shift or elsewhere (Press department, IT, …)
8 - Taking all these aspects into account, a final decision should be taken on whether or not to issue the warning. If you decide not to issue an alternative way of warning, perhaps on a lower (yellow) level, should be considered. If there is disagreement within the Expert Team there should be one person who will take the final decision.
9 - The decision making process within the Expert Team should be documented in a short report and communicated to the operational shift.

KNMI Experiences after three years of collaborative decision making

- Shift discussion on exceeding meteorological thresholds at the end of the operational forecasters discussion we make the outcome transparent by letting each of the meteorologists give their personal confidence percentage that the warning threshold will be exceeded within the lead time period. The result of this judgement will trigger the Expert Team.
- To make the initial impact assessment the KNMI Expert Team consists of: the Head of Operations (chairman), the Shift leader in charge, a Climatological expert, the Press officer, an IT-department representative, perhaps a model specific expert and an expert on agreed warning procedures.
• During the first year there was a great deal of reluctance and criticism from the meteorologists who generally felt less responsible and less competent. However, once forecasters became more aware that the Expert Team were making decisions based on mainly non-meteorological and strategic aspects, there was a much better feeling of acceptance. The fact that operational meteorologists are sharing their responsibilities with others is also leading to less stress on shift
• System is better balanced towards Hit/Miss/False alarm ratios
• There is less criticism from society and civil protection agencies, probably due to a better linkage between severe weather and expected impacts in the outside world
• At this moment the Expert Team consists of only KNMI experts. For the “Red” warnings we have to link with civil protection (CP) agencies by phone. In future we also want better linkage to CP for orange warnings, in order to improve our impact assessment within the Expert Team

Warning and Decision scheme

General specification for warning thresholds
• Criteria for each parameter, impact/damage related
• Minimum affected area size to be defined
• Criteria should link to differences from climatology
• Lead time definition for each warning
• Warnings should be categorized with colours, according to meteoalarm.eu definition
• A minimum likelihood percentage should be defined on which warnings will be triggered and colours will be assigned

Decision scheme

Meteorological elements
Exceeding of thresholds within agreed lead times should be discussed by the meteorologists on shift. This collaborative decision process is managed by the senior-forecaster and should equalize subjective choices and human factors

Other elements (external)
• Triggered by the meteorological discussion if thresholds are expected to be exceeded
• An expert team could be the decisive trigger for the final issuance of the severe weather warning
• This decision can be taken on impact assessment and other external factors

Frank Kroonenberg, KNMI
The Meteoalarm programme is a long established programme started after the December 1999 storms, Lothar and Martin. Together with over 20 European countries a website was developed that became operational in 2007.

www.meteoalarm.eu now gives online warning information originating from the European National Meteorological Services (NMSs) for more than 30 countries. The website presents the actual and forecast warning and awareness situation for both today and tomorrow. Due to its multilingual and graphical way in presenting the information the website is easily understandable, at a glance, by non-professional users. European citizens and the national civil protection services are the target audience for the information. In particular, while travelling throughout Europe awareness for severe weather and its impact across the route is of high importance.

Meteoalarm Phase III, Eumetnet programme in progress until 2012

The Meteoalarm project is initiated and implemented by Eumetnet, the network of European weather services. Since 2009 the EMMA/Meteoalarm Phase III programme is underway. Programme management is performed by ZAMG (Michael Staudinger) in close co-operation with KNMI (Frank Kroonenberg). Eumetnet maintains and funds the operational system for its members, the NMSs. In this way the website’s technical and operational configuration is guaranteed to be up and running on a 365x7x24-hourly basis. New hardware and software maintenance is foreseen, due to the high and rising hit rates. Since its creation, the site has received over 1.5 billion hits. A new version of the website’s home page is expected to be launched by April 2010. The new 2.0 version of Meteoalarm will give the Europe of regions page as the website’s home page.

Meteoalarm Extended Features (EF) funded by European Commission

Besides just keeping the website up and running, there was more ambition within the Meteoalarm community. Since Meteoalarm offers a coherent and integrated European footprint on Weather awareness, it receives substantial attention from civil protection authorities across Europe. In particular the Monitoring Information Centre (MIC), responsible for civil protection at the European level, has great interest in our information. This is why the European Commission, DG Environment, decided to accept the project proposal for the Meteoalarm Extended Features (EF) programme. This Meteoalarm EF programme will run from December 2009 until December 2010 and is undertaken by ZAMG, FMI and KNMI.
The content of the Meteoalarm EF programme

Prolonging the awareness lead time

This augments the websites technical structure to offer Day 2 up to Day 5 awareness information. This information will be made available within a user and password protected area on the website. The awareness information presented will be colour-coded in the same way as the other Meteoalarm public information for Day 0 and Day 1. Targeted user groups for Day 2 up to Day 5 information are civil protection agencies both at National- and European level. The MIC is very interested in this information for logistical reasons.

Introduction of the new parameter “Coastal warnings”

Many people enjoy sea shore activities such as yachting, windsurfing, kite surfing and paragliding, and there is a growing interest from our visitors in receiving awareness information for coastal areas. the Meteoalarm EF programme will implement the technical structure to offer these new parameters on the website. Already many Meteoalarm member countries have offered their willingness to deliver their awareness data on coastal warnings.
Introduction of the new parameter “Flooding”

At the start of the website in 2007 we introduced “Rain” as an important awareness parameter in Meteoalarm. In 2010 the new parameter “River flooding” will be introduced. The need to introduce this parameter was felt because a country might be “Green” for rain, while at the same moment severe river flooding is expected. To give proper national input on this new parameter the Meteoalarm programme team is strongly encouraging National co-operation between Met services and Hydrological services within the member community. It is likely that a common Meteoalarm conference will be organised in 2010 to enhance the co-operation between these services.

Extension of the Meteoalarm domain towards Southeast Europe

Also in co-operation with the WMO we will seek an extension of the Meteoalarm domain within the Balkan area and towards Turkey. The WMO is willing to help the “New countries” in further upgrading their warning infrastructure in order to be able to join the Meteoalarm community.

Implementing RSS feeds and Common Alert Protocol (CAP) XML codes

New techniques like RSS feeds and CAP format messages will be made available. RSS feeds will enlarge possibilities for users to make best use of the available information on the website. Also professional users from the Media are taking advantage of RSS feeds. The CAP-format messages will allow governmental authorities to send out SMS messages targeted at people in a certain geographical area and is adopted by the WMO as an important format for NMSs to deliver their warning information.

Frank Kroonenberg, KNMI
Introduction

The idea behind Proff is to establish a new forecasting system, changing from manual production to products monitored by the forecaster and generated automatically on-demand by the user. This is a challenging task, involving development along unknown paths. But eventually it will change the meteorological service and bring it up to date.

History

Plans for the system emerged in 2004, resulting in many different projects dealing with different aspects of the new production line from development of new tools to management of all the data and the forecaster’s new role in the system.

In 2007, when the project was still under development, www.yr.no was launched. During 2008 we were in the process of preparation for implementation of Proff-tools. In 2009 Proff gradually entered full use in the three operational offices of met.no.

Why changes in forecasting were needed?

We realised that the users had access to very little information from the available data present in the forecasting process. Text forecasts were resource demanding; more than 70 000 pages of text were produced per year! The forecaster was left with little time to monitor weather and evaluate all available information. There was a “distance” between the weather forecaster and researchers with a potential to improve cooperation and understanding. And very importantly, there was a need for a flexible and automated verification system.

Figure 1/ Product example from www.yr.no
**Proff – a new forecasting system**

The basics of Proff are 1) The Human forecaster, 2) High resolution models, 3) Ensemble prediction systems, 4) Statistical corrections. The system generates products automatically from a gridded database, accessed through our web portal yr.no. In the future most likely all products will link to the Proff production line. We need to develop dialogue with user-groups to meet the users’ needs. We foresee development of new products arising from this dialogue. We also expect the need to continuously adapt to new technology.

![Figure 2: Shows the work flow in Proff. The forecaster choose one model, adds corrections to that model, later managing all data in the database. Finally there is automatic generation of products.](image)

**Do we need to correct the models?**

Models have improved a lot over the last 10 years, but there are still difficulties in significant areas such as underestimated wind speed in coastal areas, fjords and mountain areas. Other examples can be polar lows that often need adjustments; peak values in extreme events sometimes are underestimated; and deterministic precipitation forecasts are difficult.

The largest benefits from editing the fields are in the nowcasting range 0-12h, but further correction up to 36h is valuable.

To correct the model we use the Proff field editor, capable of interpolation in time and space, visualising it in Diana. Operating the Proff field editor, a forecaster will add field corrections on the chosen model field by defining objects that capture topography or threshold values.

**The work flow (session)**

In an editing session the forecaster chooses the “best” model among four different models. The forecasters cooperate within our three regional offices as a team, with one leader. Then the forecasters correct some key parameters (such as wind, precipitation and cloud cover), using the Proff field editor, when needed. Only significant model errors are corrected. Forecasters in all three operational offices take part in the correction. The team leader approves the session when ready. The corrections are saved in a database, which in the next step automatically generates the products for yr.no.
PROFF – current state, 2009

During 2009 Proff was gradually implemented into operational service. Preliminary results from a manual verification show that the forecasters seem to be good at selection of “today’s model”. The success rate of editing varies more. High resolution editing of temperature is very difficult. Direct verification and feedback to the forecaster is needed, and through Proff we have experienced increased cooperation between forecasters and researchers on verification.

Coming up

It is a goal to automatically correct systematic errors in the models, reducing the need for manual corrections. Automatic text generation for sea forecasts is under development. Some old production will be phased out. Additional automatic verification with feedback is also under development. And from December 2009 Proff-data was used in yr-products! This year the Proff2 project started, with focus on monitoring tools and verification, probability forecasts, nowcasting, interaction with user groups and further development and utilisation of the forecasters skills.

Figure 3: Shows weekly users of www.yr.no

Conclusions

The public is very content with yr.no, having access to detailed weather information at any time they need it, with significant corrections made by the forecaster. The number of weekly users is around 2.2 million in a country with less than 5 million people. Development of the Proff system will continue, and the forecaster will have to prove that he/she can add something to the model through verification. In the near future it is likely that the models will show improved skill in “normal” weather without manual corrections. The forecaster skills will most likely still be important in dangerous weather events, being responsible for corrections and for selecting the severity level of the gale warnings and other products in the nowcasting range.

References: http://diana.met.no
www.yr.no
The new generation of training methods include such developments as e-learning, blended learning, serious gaming and training with the help of 4D tools.

Introduction

About 15 years ago within the meteorological training world we were talking about CAL, or Computer Aided Learning. The CAL module was a course or training in which the multimedia training material was offered to the trainee via a computer. The training material came on CD-ROMs and had no links to external sources. The computer used had no connection to a network. Nowadays we are talking more about e-learning which is basically the same as CAL, but we use training material from sources online.

E-learning

E-learning is associated with learning activities which make use of the interactive possibilities of computers connected to a network. The computer network can be used to distribute the material, communicate between the trainer and the trainee and to facilitate the course. E-learning is a good method to make distance learning possible because it makes learning independent of time and place. E-learning is aimed at:

- The learning process itself: both individuals and groups
- The development and control of training material and training processes
- The organization of learning activities

Blended learning

Blended learning is a mixed course in which two different types of training are used, usually:

- An online phase with distance training and
- A residence phase with classroom lessons

For the online phase the trainer uses e-learning material and, apart from the online classroom lessons, the trainees can work at their own location and in their own time with the material given by the trainer. After two or three months of virtual life, teachers and students finally gather for the classroom session. Thanks to the distance phase the trainees have a solid and common background understanding at the moment the trainer starts with the classroom phase. The classroom phase is like a large real-life forum and is a natural continuation of the virtual distance phase.

Serious gaming

Serious gaming is a simulation exercise which can have the look and feel of a game, but corresponds to non-game events or processes. The serious games (simulations) provide an engaging, self-reinforcing context in which to motivate and educate the players. Well known examples include train or flight simulators. KNMI has developed simulation modules for its maritime forecasters and for people at the Storm Surge and Warning Centre within the Netherlands.

3D and 4D visualization tools

At KNMI we have started to explore our 3D numerical weather prediction model, called HIRLAM, with the help 3D visualization tools and virtual reality. We found that exploring atmospheric models with the help of 3D visualization and virtual reality helps to improve our insights into atmospheric structures and the underlying atmospheric processes.
Advantages and disadvantages of these training methods

Advantages of e-learning:
The trainees have flexibility in training possibilities because the material is personalised and available 24/7. And they can do their training at self-chosen moments and places. The organization can save costs as no travel time, travel costs and accommodation expenses are required for the training. There are many sources available with very good training material made by experts or you can repurpose existing training material to create your own training.

Disadvantages of e-learning:
Learning and reading from a screen is tiring and the trainees need to be open to this type of individual education. They need to have self-discipline and cognitive skills for this type of training. The danger is that the trainee is not learning consciously but only works through the training material without the learning process having a lasting effect. When working with international e-learning solutions language may be an extra barrier and the training material is not tailor-made for the particular area or learner.

Advantages of blended learning:
Blended learning makes it easier to work with international groups. Just as with e-learning, your organization can train their people with the help of experts and it can save costs. A local trainer doesn’t have to give training outside his expertise area and the organization is saving money because their trainees have to spend less time on travel and have limited travel and accommodation expenses. The online distance phase is used to bring the knowledge level of the trainees to the same level before the classroom phase starts. This makes it possible to handle more advanced material during the classroom training.

Disadvantages of blended learning:
Problems that occur during blended learning courses mostly occur during the distance phase. The distance phase is vulnerable to technical problems. You work with different local times, especially if people from different continents participate. This makes the distance phase an individual phase and the trainees of your organization should be able to cope with it.

Advantages of serious gaming:
Training with serious gaming and/or simulators allows the possibility to bringing people very close to the reality of extreme situations and to train them in new skills. Research has shown that training skills with the help of simulators works more effectively than the more traditional way of training. It also allows you to train close to reality without disturbing your operational working process. Furthermore serious gaming can be used to simulate emergency situations which are too costly and too complex to simulate otherwise.

Disadvantages of serious gaming:
Traditional simulators were very expensive and needed specialised hardware. But the developments in this area are very rapid and the first available and affordable solutions are there. People who are not used to this way of training find this way of training a little overwhelming the first time. So preparation time can be needed.

Advantages of 3- and 4-D visualization tools:
As stated before, exploring weather prediction models with the help of 3D visualisation and virtual reality helps the scientists to get a better insight in the processes going on in their models. At the moment within KNMI we try to use this new technique to create a physical learning environment for modellers and forecasters where they can gather and learn from each other. Next to the models KNMI want to put observations like radar and satellite imagery into the system. The 3D visualization and virtual reality technique is still in a development stage, but in the future might be very valuable to train the next generation of meteorologists and forecasters.

Disadvantages of 3- and 4-D visualization tools:
To undertake 3D visualization with virtual reality requires significant investment in workstations, special projectors and special projection screens. A permanent set up of these tools in a separate room saves considerable time and effort. The danger of working with 3D visualization and virtual reality is that the virtual world will be mixed up with the real word.
Organisations developing this type of training

Internationally there are several groups developing training material for various target audiences within meteorology. Worldwide, these groups gather once every two years at the CALMet conference (http://www.calmet.org/index.htm). Within Europe, EUMETCAL (http://www.eumetcal.org/) works on and develops the new generation of training tools. EUMETCAL is financed by EUMETNET and EUMETSAT and in the past years it has extended through affiliations from COMET from the US, the Meteorological Service of Canada and the Bureau of Meteorology of Australia. The EUMETCAL community gathers annually. More information on the new generation training material can be found at the above named groups and examples of training material can be found on the above named websites and on http://www.meted.ucar.edu/index.htm. Clicking through the various websites with their modules shows the development of the new generation e-learning training material during the past years.

The MetEd website has some modules on mesoscale meteorology and EUMETCAL is well known for its experience with blended learning.

The use of 3D visualisation and virtual reality described here has been developed at KNMI and has not been distributed elsewhere yet, but you are welcome to visit us and experience this new way of working.

Techniques used for the new generation training material

In the world of CALMet and EUMETCAL the open source course management system Moodle is frequently used to create a training platform for their students. Moodle can also be used as a tool to create online dynamic websites. Nowadays most of the new e-learning modules are made with Adobe Flash or a combination of Adobe Flash (for the interactive elements) and HTML (for the simple plain text). For the group lessons during the online phase of EUMETCAL training with blended learning course packages like Saba Centra, Elluminate and Skype is used.

As Adobe Flash and ActionScript (its programming language) are generally found not to be the easiest computer environment to work with it might be advisable to take a local course in Flash and ActionScript to start with. For Moodle there is considerable documentation available on the web and in books. And when this is not enough, within the EUMETCAL network courses and workshops are given on how to work with Moodle, Adobe Flash and Centra or Elluminate.

Examples

As already mentioned, the advantages of e-learning are that people can learn at a moment that is most convenient for them and learn at their own pace. The training can be dedicated in the sense that specific courses can be selected which are most appropriate in relation to the existing knowledge of the trainee and the specific task the trainee has.

In Figure 1 a screen dump from http://www.meted.ucar.edu/ shows information on horizontal resolution in the module “How mesoscale models work”. The trainee can ask for more background information or continue the course when he or she is ready.

Acknowledgements

The authors wish to thank Dr. Ian Bell and Mr. Vesa Nietosvaara for critically reading this article and making helpful suggestions.
Figure 1: Example of The Simulator as it is used at KNMI for training Maritime Forecasters and people at the Storm Surge and Warning centre.

Figure 2: The blended learning phase. The top picture shows the online phase with a Centra meeting running on the desktop. The bottom picture shows the residence phase with a classroom lesson (picture taken from an EumetCal PPT presentation).

Figure 3: The virtual reality laboratory at KNMI. The top picture shows the setup. In the middle picture people with passive depolarizing glasses are looking into the virtual world (picture taken by Maarten Sneep at the KNMI science day). The bottom picture shows the instructor explaining a mesoscale feature in Theta-W forecast field (picture taken by Michal Koutek).
The debate over a forecaster’s role in the forecast production process has raged for many years. Historically, forecasters have tended to demonstrate their worth by pointing to their ability to ‘add value’ to model-derived forecasts. But increasing accuracy and resolution of NWP output, in combination with rapidly improving post-processing techniques, means that value added in this way is often marginal and will continue to decrease with time. The case for continued human intervention here is often weak from a cost/benefit perspective, though some customers – particularly those with high sensitivity to the weather - will still require human intervention of some form in the short term. In addition, many tasks for forecasters have been reduced to filling in boxes with numbers, or to routine document creation. Work of this kind is poor for staff morale and does not represent an effective use of an expensive and highly-skilled resource, the forecaster.

Over the coming years, it is accepted that many European public bodies, including NMSs, will have to deliver significant cost savings and efficiencies to their governments. This efficiency drive may represent an ideal opportunity to ensure our production systems make best use of resources while continuing to ensure quality of output.

During 2009, the Met Office’s Forecasting Review was established to help align forecasting and science capabilities to the future requirements of our governmental and commercial customers. It will achieve this by setting a strategic direction for forecasting, and by providing working structures and resources which enable flexibility, continuous development and evolution in forecast provision. The Review has been, from the outset, a people-centred activity with a focus on clearly defining the future role of the forecaster. It has also endeavoured to be an inclusive and comprehensive activity, with input sought from science, IT and business staff, along with all forecasters.

It was quickly established that there was a vital future role for forecasters at the centre of a knowledge and advice-based organisation. But the emphasis of their roles will shift from production tasks towards activities which are best performed by a skilled forecaster: interpretation, decision-making and communication.

Some key themes of the Review are as follows:
• Defining how best to use the respective strengths of the forecaster and NWP models for each set of products and customers.
• Making best use of our forecasters, with increased emphasis on customer-facing expert advisory roles, and involvement in Met Office projects outside operational forecasting.
• Removal of ‘routine’ or otherwise inappropriate production tasks from forecasters, mainly via automation.
• Minimising the need for forecaster intervention on model data, by use of Business Rules and ‘change once, use many’ approaches.
• Making best use of our science, though increased automation, stronger links with operational forecasting, and development of advanced post-processing techniques.
• Exploiting new technology to deliver the new science, and to facilitate both new and traditional forecasting techniques.

The Future of the Forecaster
Roles and Responsibilities

The human and machine elements of the forecasting and forecast production process have their respective strengths and weaknesses. It makes sense to focus the activities of forecasters on what they do best, and what cannot be easily automated.

In the future, it will not be a forecaster’s role to ‘add value’ by intervening on model data to achieve improvements in accuracy. These improvements should be achieved by developments in model performance and post-processing.

Production processes should be automated as much as possible. For some services it will be appropriate to automate the process completely. For others, which are agreed to have vital input from a human forecaster, we can automate the rest of the process around this input (by providing ‘first guess’ model data, for example), and support the forecaster’s activity by ensuring they have appropriate tools and skills.

Given forecasters’ increasing use in expert advisory roles, we must develop or alter our production systems to allow ‘automation by default’; if the forecaster chooses not to intervene in the process then the product should be created and issued automatically. With these systems, it becomes simple to gradually decrease, and then completely withdraw, manual input as the automated output meets customer requirements for quality by itself. It also becomes much simpler to determine when this move to full automation should occur. To describe this temporary phase of forecaster intervention we have used the analogies of ‘safety nets’, or ‘stabilisers’ (on a child’s bicycle), which can be removed when they are no longer needed.

Such a move towards automation via a controlled, phased withdrawal of forecaster input is shown schematically in Fig 1 below.

Many production processes in the Met Office are now moving, or have plans to move, towards greater automation in this manner. And the common requirement for automated production systems has informed design of our new production platforms, along with tools such as automatically generated warnings and text forecasts.

Figure 1: Moving in stages towards automation for appropriate products.
Developing Forecasters and Advisors

Forecasting advisor roles have already proven a highly effective means of communicating weather and its impacts to local government and civil protection authorities within the UK. Some of our commercial and military forecasting activities have also made use of deployed ‘on site’ forecasters to great effect, and there will be increased demand for forecasters to operate in this way in the future.

Our scientific capability has reached the point where our NWP data can be indistinguishable from real, observational data (see Fig 2). This level of detail allows opportunities for greatly increased forecast accuracy, but also brings an increased risk of misinterpretation. Forecasters and advisors add the often vital level of interpretation required for some customers, informed by in-depth knowledge of their requirements, operations and sensitivities.

In the coming years, advisor, rather than production, roles will become the norm. We must ensure that advisors have the skills and information available to them to be able to give rapid, authoritative guidance to customers based on their changing circumstances. This need has defined a coordinated programme of development, incorporating communication skills training, mobile information systems and new monitoring and forecasting tools.

Figure 2: Sample output from the Met Office UKV model, which has 1.5km resolution across most of the UK. Increasing model detail means there is an increasing need for expert interpretation.

Summary

The changed production process described here will deliver the following benefits to the Met Office:
- Reduced production costs.
- Best use of forecasters and science capability.
- Greater reactivity to changing customer needs and changing weather.
- A more flexible, multi-skilled forecasting staff actively engaged with customers and the rest of the organisation.
- Established systems on which to base new product development.
- Increased job satisfaction amongst forecasters.

Will Lang & Bob Turner, Met Office
New Forecasting Structure at Deutscher Wetterdienst (DWD)

Introduction

The warning process at DWD is currently managed and coordinated by the Central Forecasting Office in Offenbach. Warnings are issued and disseminated by 7 Regional Forecast Centres.

With DWD strategy plan 2015 the Central Forecasting Office and Regional Forecast Centres will be reorganized. This will lead to a better development of very short range and short range forecasting and supporting tools, as well as automation and a decentralised advisory service. In the end this will improve weather forecasting and warnings. Centralisation of the warning process will further help to reduce the number of established posts at DWD, which has already reduced from over 3000 employees in 1991 to about 2400 in 2008.

Current Forecasting and Warning Structure

Weather warning at DWD is carried out in a temporal three-level warning system.

The multi-level structure of the warning system guarantees that the warning issued includes increasing detail the nearer a weather event approaches.

First level-warnings (3 to 7 days before the event) on a national scale are issued by the Central Forecasting Office. Second level-warnings (12 to 48 hours before the event) on a federal-state scale are issued by the Regional Forecasting Offices. Third level-warnings, i.e. the actual warnings for over 350 small districts, are issued by the Regional Forecasting Offices.

Figure 1: Three-level warning system

The principle: Three-level warning system of DWD

Level 1 - Early Warning Level:
Based on the results of numerical weather models (incl. EPS) - for the coming 3 to 7 days

Level 2 - Prewarning Level:
Based on numerical forecasts ans follow-up statistical procedures - fo the coming 12 to 48 hours

Level 3 - Warning management system, small district related:
Based on local models, nowcasting techniques and observations - for up to 12 hours ahead.
Currently the warning process at the German Weather Service is regionally organized in 6 Regional Forecasting Offices and 1 (plus 1 regional annex) Central Forecasting Office in Offenbach. The regional offices are responsible for their affiliated federal states. The Central Forecasting Office manages guidance and coordination of the regional offices within the "Single Voice Policy" of DWD.

Future Forecasting and Warning Structure

With the DWD strategy plan 2015 the weather- and forecasting process will be further developed, reorganized and centralized. Most effort will be applied to the very short range and short range forecasts. Medium range forecast and beyond that time will be managed by using ECMWF products.

Because of the centralisation and reduction of established posts, supporting tools and a higher level of automation will be developed.

The key project for supporting the warning process will be "AutoWarn".

"AutoWarn" is a computer-based Expert System which uses all the available data: observations, radar, nowcasting and statistical products as well as numerical products.

In addition it monitors the data and generates warning proposals, which can be released or modified by the forecaster. Finally dissemination of the warnings is done by "AutoWarn" automatically.

In future the whole warning process will be assisted by "AutoWarn" and will be shifted from the 6(1) regional offices to a newly established "National Warning Centre" (NWC) in Offenbach.

The whole national warning process will then be done by 2 forecasters around the clock.
The 6 Regional Forecast Offices will be transformed into 6 Regional Weather Advisory Offices.

While they currently still issue regional forecasts and warnings, under guidance and coordination of the Central Forecasting Office, this will only be done by the National Warning Centre in the coming structure. Regional Weather Advisory Offices will mainly monitor their regional weather and serve and advise their clients with regional weather information that is based on the forecast products and warnings of the central office.

Figure 4: Expert system using every numerical and observed information for generating warning proposals automatically.

Figure 5: Future forecasting structure.

Figure 6: 2 proposals for regional areas.

Figure 7: Current cooperation of central and regional offices.

Figure 8: Future guidance of regional offices.
At present regional and central offices are working 24 hours a day.

In future regional offices will work from 05.30 to 22.00 h. In case of severe weather warning in their region their working hours will be extended to 24.00 h.

**New shift structure**

![Diagram showing new shift structure]

**Future Work Force in the Forecasting and Warning Process**

With the new structure of the forecasting and warning process the number of established posts will be reduced. This is a follow-up reduction after integration of the Meteorological Service of the GDR into DWD after German unification. The number of employees jumped from about 2000 to over 3000 before dropping to nearly 2400 in the year 2008. This process will be continued by the new structure.

![Graph showing number of established posts 1990-2008 at DWD]

**Figure 9:** Current working hours.

**Figure 10:** Future working hours.

**Figure 11:** Development of the workforce.
By the end of 2015 the workforce in the forecast and warning process will be reduced from nearly 140 to about 80.

<table>
<thead>
<tr>
<th>Class I Meteorologist (higher civil service)</th>
<th>6 Regional Forecast Office</th>
<th>6 Regional Weather Advisory Offices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class II Meteorologist (higher intermediate civil service)</td>
<td>48</td>
<td>6</td>
</tr>
<tr>
<td>Class III Meteorologist (intermediate civil service)</td>
<td>6</td>
<td>30</td>
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<td>Σ</td>
<td>84</td>
<td>42</td>
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*Figure 12: Current vs. future workforce at regional offices*
Introduction

The forecast organization of Meteo France will change in the coming years from a system based on three levels of forecasting centre (with national, regional and local centres) to a new system with only two levels of centre with forecasting responsibilities: one national centre and seven regional centres.

The aims of this reorganization are to improve the quality of forecast especially at very short range for dangerous phenomena, and to offer services more fitted to consumer needs with forecasting advice and help with decision-making. Of course, an improvement in efficiency is expected and also a significant reduction of cost.

Concepts in forecasting process: upstream and advice forecast

In the forecasting process, two different concepts can be distinguished, the upstream forecast and the advice forecast.

Upstream forecast

This is mainly the forecasting tasks done without focusing on a particular use. For general forecasts these are: running the models, observations analysis, forecast creation, filling databases, conference calls etc. For marine and aviation forecasts the tasks also include, wave modelling, and use of post-processing tools for icing and turbulence forecasts etc.

Forecast advice

Definition: activities derived from the upstream forecast in order to help external customers make decisions that depend on meteorological conditions, including meteorological bulletins, phone calls, assistances (example: road icing), participation in crisis cells, etc. This is not a new notion but it is an important motivating factor for use of forecasters.

Current forecast organization at Meteo France

Upstream forecast

There are three levels of forecasting centre, all of which do upstream forecasts.

The national centre gives a daily synoptic reference track from short range to medium range, consisting of the models that should be followed at different ranges and the guidance for the expected weather at these different ranges.

The regional centres focus on nowcasting and short range forecasts, and they fill the database of forecast weather over France.

The local centres also have an input into this database for their own area of responsibility (typically a French Department).
**Advice forecast**

The regional centres enter the initial input to the vigilance chart. Then the national centre coordinates the regions in order to get a vigilance chart in good agreement with synoptic guidance and possible meteorological impacts of the situation. Finally the national centre dispatches the vigilance chart to the authorities and customers. The advice forecast is the main task in local centres.

This workflow, between the three levels of forecast centres, has the advantages of good interactivity, but there is also a risk of inconsistency. Furthermore the reactivity of the system to customer needs is relatively weak. Good knowledge of local climatology has been developed in local centres to improve the forecasts, but with very fine mesh models already arriving in operational work, this advantage is less and less notable.

**New organization principles**

The upstream forecast will no longer be done in local centres (the number of which will be progressively reduced) and will be organized between the national centre and the regional centres.

No fundamental change will occur in advice forecast organization but all tasks will be optimized with an increase in automated and supervised production. Forecaster expertise will remain critical in crisis situations and for intelligent customers. Interactivity between upstream and advice forecasts should be maintained.

**Upstream forecast chain**

Upstream forecast tasks in regional centres will be the supervision of the automated nowcasting database and the filling up of the new database for production, SYMPOSIUM 2, following guidance given by the chief forecaster in Toulouse with graphical and interactive tools.
Advice forecasts and assistance to authorities

The advice forecaster in regional centres will have an important leading role. His main tasks will be assistance to authorities (civil protection, etc...) through the vigilance procedure - in environmental emergencies. And in potentially dangerous situations, he must keep close contact with customers such as motorway management and electricity companies who are relevant to civil protection.

He also has to coordinate the upstream forecasters because the vigilance system should be in close agreement with the database of forecast weather.

Conclusion

The reorganization of forecast of Météo-France will be based on the concept of separation between basic forecast activities made independently of users and customers, and forecast production activities for end-user products and services (especially advice to customers).

Basic forecasts will be made on a limited number of geographic domains taking into account climate characteristics (mountainous areas, etc.) and will include all time ranges from nowcasting to medium range forecasting. This should allow more efficiency and reactivity especially in crisis situations.

Due to this new organizational structure, the number of Météo-France territorial offices should be reduced to 40. A significant reduction of cost is expected.
Forecasts’ tasks and upcoming plans at the Royal Meteorological Institute of Belgium (RMIB)

Introduction

The present status of the main operational tasks of the forecasters at the RMIB (Belgium) will be presented first. There is no doubt that in the last ten to fifteen years forecasters have to rapidly consider more and more raw data issued from systems of observations and meteorological models to make more realistic forecasts (at global and regional scales, from deterministic model and ensemble Prediction System (EPS)). So the problem of how best to reorganize forecasters’ tasks is raised. A few methods to approach this problem are developed hereafter for different forecast ranges including the weather warnings.

Main forecasters’ tasks

A short survey of the operational tasks and their organization at Day- and Night-times at the Royal Meteorological Institute of Belgium (RMIB) is presented in Figure 1. Two forecasters collaborate to make the (very) short-term forecast products. The first one is responsible for nowcasting over our regions; this nowcasting includes a mesoscale analysis and a forecast of the “sensible” weather expected for the next three hours. The other one elaborates a short-term forecast for today (D) and tomorrow (D1) up to the following night making use of the synoptic and mesoscale analysis and model outputs. This forecaster is also responsible for the issue and the update of short term weather warnings (D, D1) which are elaborated for ten Belgian sub-regions (called “provinces”).

A third forecaster exploits the global model data to produce medium range forecasts from D2 to D10. To achieve it, deterministic and probabilistic forecasts (EPS) issued from global models (mainly ECMWF) are compared to least the last three runs and interpreted by the forecaster to produce consistent medium range products targeted over our regions.

Figure 1: operational tasks presently achieved by forecasters during Day- and Night-times
Nowcasting

Surface and upper-air observations including teledetection (satellite, radar, lightning) are regularly processed to be visualized on the forecasters' workstations over pre-defined domains centred over Belgium (illustrated in Figure 2). Direct and derived products from the teledetection covering our areas are produced, such as a few combined RGB satellite pictures for MSG (mainly severe convection and microphysics), a set of twelve SAF Nowcasting products (mainly cloud and precipitation products), a radar network composite image (mainly PPI to estimate precipitation intensities) and Doppler products and a lightning image based on our detection system (SAFIR). All these teledetection products available every five or fifteen minutes are interpreted by forecasters in connection with the surface and upper-air data to make a mesoscale analysis over our areas and its close surroundings. The forecaster puts the emphasis on the main elements of his analysis to describe every three hours in a short text description of weather situation over our areas. An additional text is also created by the forecaster to present the next three hours of the forecast for the same regions. To achieve it the forecaster takes advantage of his analysis, the SAF Nowcasting products and of the first steps of the Limited Area Models outputs (mostly ALARO and UKmeso). A real time verification of raw model forecast compared to observations and to the forecaster' analysis, and a deep knowledge of the main conceptual models are essential to produce a better nowcast (Figure 2 : illustration of a rapid upper-air wind at 500 hPa observed on the western part of our areas, and verification of the raw ECMWF forecast at the same date).

The future objective is to improve the quality of nowcasting. To achieve it the INCA system (Integrated Nowcasting through Comprehensive Analysis) has recently been chosen and will be installed and configured at the RMIB in 2010. Several meteorological fields like temperature, humidity, wind, cloudiness, precipitation and precipitation type, and some derived fields like icing potential, wind chill, gusts and visibility will be processed in a mesoscale domain centred over Belgium, every hour at a resolution of one kilometre. Training will be required to test and use the INCA system operationally. We expect that this more objective tool will be a benchmark to help forecasters in their nowcasting tasks.

Short Range forecasts

For short range forecasts (D, D1) forecasters mostly make use of raw data issued from the ECMWF model at a grid resolution of 25 km and from Alaro. This latter is a Limited Area Model (LAM) presently coupled to Aladin France which is run at the RMIB four times a day (at 00, 06,12 and 18h00 u.t.c.) in a mesoscale domain centred over Belgium, respectively at grid resolutions of 4 and 7 kilometres. The
model data are regularly treated, updated and visualized on the forecasters’ workstations; in Figure 3 two surface forecasts charts are illustrated for the ECMWF and Alaro models, respectively. Radiosonde forecasts and meteograms at different stations are also available for these models. Furthermore forecasters can compare these models with a selection of raw data issued from the DWD and the UKmeso models.

In 2010, a new flow of raw data issued from the 15 kilometre grid resolution ECMWF model will be implemented and disseminated over a large part of Western Europe and the near ocean. The first version of our Alaro model will also be implemented. Alaro will be soon coupled to Arpege and new derived parameters requested by forecasters will be tested like temperature and vorticity advection, instability indices and wind shear. Furthermore we plan to use a diagnostic scheme called SURFEX to improve the “local” forecasts; to do it an adaptation to the real orography and the physiographic characteristics will be performed with an Alaro model forcing at a grid resolution of four kilometres.

The introduction of probabilistic forecasts at short range (up to D2) has also been planned (GLAMEPS project). A few tens of LAM forecasts (issued from Aladin and Hirlam runs) will be computed at high resolution into a large domain defined over North Atlantic and Europe. Perturbed analysis will be built taking into account a downscaling or an assimilation of data and the singular vectors computed with the ECMWF model targeted for this domain.

Medium Range forecasts

Medium range forecasts rely basically on deterministic and probabilistic (EPS) data issued from the ECMWF model between D2 and D10 (a few raw products from the GFS model are also provided). These raw model data are processed daily by forecasters to produce weather forecasts which focus over our areas in the range D2 to D10.

A methodology has recently been introduced to forecasters, giving guidelines for exploitation of deterministic and particularly EPS data at the RMIB.
That methodology presently leads to the issue of a few products for our areas:
– text describing the most probable weather scenario for the next week, between D2 and D7, including an estimation of its uncertainties and a confidence index
– text in which an estimation of the evolution for the next days is reported, between D7 and D10
– an internal report (to the attention of successive forecasting teams) which aims at pinpointing the main sources of uncertainty in surface parameters forecasts, appropriate to the weather situation
– a table giving a day by day (from D2 to D10) set of values (the most probable value and the most probable interval of values) for a few surface parameters (minimum and maximum temperatures, wind speed and probability of precipitation) at three Belgian stations

To improve medium range forecasts the higher resolution deterministic (15 km grid) and EPS (30 kilometre grid) model from ECMWF will be tested as a matter of priority. As far as EPS is concerned our main objective is to process more raw data for our regions to upgrade the “local” spread of the forecasts for different weather situations or “regimes”. We plan to produce probabilistic forecasts for a larger number of surface parameters in order to produce more realistic and consistent medium range forecasts, pre-warnings and a better estimation of the forecast departure from climatology and/or persistence. Our products (texts, tables, charts and graphs) will certainly be updated to use these probabilistic forecasts. To achieve that purpose a reorganization of the role of the forecaster is needed to treat the medium range raw model forecasts in a more relevant way. We are also aware of the necessity to train forecasters to better interpret, illustrate and comment on probabilistic forecasts available for the general public (web site), media and specific users.

**Warnings**

Warnings are currently made for ten sub-regions (“provinces”) in Belgium and a short-range period (D, D1). They are classified in close relation to the impact of a set of weather parameters on life; conditions like wind (heavy gusts), precipitation (high amounts), snow (depth, freezing rain and ice), thunderstorms (severe convection), cold spells and heat waves. These warnings are regularly exchanged with our European colleagues via Météoalarm. Furthermore more privileged discussions on the alarm level choice (orange and red levels) have been established with Météo-France (Lille) and the KNMI (De Bilt), and soon with the DWD (Essen and perhaps Offenbach). A dispersion model developed at the RMIB is also used (Figure 4); this model is forced by ECMWF and/or LAM (Aladin and ETA) model data to produce for a given source a predicted plume which tends to reflect the total distribution of pollutants at successive time steps over European areas.
A future target is to introduce new tools like INCA and new model data to help forecasters to issue warnings as soon as possible for regions where the impact would be the highest. For example to estimate the risk of severe thunderstorms at short term (D, D1) an interactive “meteorological checklist” will be used by forecasters for “winter” and “summer” periods. The production of flash warnings (valid for the next 3 to 6 hours) and pre-warnings (valid for the next 2 to 5 days) will be encouraged as soon as the newly appropriated nowcasting and EPS tools are be tested for our areas.

A FLEXTRA model is currently used to compute trajectories for pre-defined localizations taking the ECMWF model forecasts (Figure 5: illustration of forward trajectories). Further implementations with a forcing of ECMWF and Alaro models are under development to interactively compute backward and forward trajectories from any location in Europe, mostly for short-term forecasts.

Conclusions

Many experiments and case studies have shown that the “human side” is a very important component to produce more realistic weather forecasts. To enhance the quality of their products forecasters have to treat raw data with a critical eye. A few tools and methods have been proposed at the RMIB to help forecasters to make better use of these data while keeping a major role to in the analysis and forecasting process.
The organization of the work and the information exchange between the Swiss weather centres hasn’t changed significantly for many years. With the constant development of new products and in order to rationalize the production, the former way of working had to be improved. Moreover, all three weather centres had a different forecast production schedule. The new organization is based on guidance and a matrix. The former, prepared by the leading centre describes the 7 day synoptic evolution. The latter, completed by the regional centre, provides a local forecast according to the guidance. The advantages of this new working method are; an improved coherence between the centre and the products and increased efficiency. The parameters forecast by all centres are stored in a unique database. A new fully automatic verification method will measure the added value of the forecaster compared to persistence or climatology.

Previous organization

Three weather centres are present in Switzerland; one for each national language (French, German and Italian). Fig 1 shows the partition based on the three languages. Zurich’s weather centre is the headquarters of MeteoSwiss and issues the forecast for the largest area in German. The weather centre of Geneva is located within the WMO building and is responsible for the French speaking area. Finally, Locarno’s weather centre produces the forecast in Italian. It covers the smallest area and is open between 7am and 6pm. An aerologic centre in Payerne, an ozone measurement station in Arosa and aeronautic briefings at Zurich and Geneva airport are also part of the structure of MeteoSwiss.

In order to produce a coherent national forecast, a telephone conference was scheduled twice a day. A summary of the forecast was sent earlier to the three centres in German, Italian and French.

It consisted of a short range forecast for day d+0 and d+1 and a medium range forecast for day d+2 until day d+5. Previously, Zurich’s weather centre issued the medium range forecast for all Switzerland.

After the discussion, an official forecast was delivered by the centres in the national languages.

Verification

Each of the five official bulletins was regularly verified. The OPKO (objective control of the forecast) verification was used for the short term forecast and the KOMIFRI for

Figure 1: Map of Switzerland with the regions covered by the forecasts supplied by the three weather centres.
the medium range forecast. The method consisted of decoding the text of the bulletin, comparing it with the measurements of automatic weather stations and converting it into scores using a contingency table. For example, for the sunshine verification, the word overcast means between 0% and 4% of sunshine duration; cloudy means between 5% and 30% of sunshine duration, etc …

Each parameter contributed to a different weight to the final score; the weight depended on the synoptic situation.

**New organisation**

Even though the previous approach to work has been successful for many years, with the increase of products for different users, we needed a system which would improve the efficiency and coherence between outputs.

This new approach to working consists of two parts, guidance which is the synoptic scale of the forecast and the matrix, the local forecasting.

**The Guidance**

This consists of a spreadsheet filled by either Zurich and Geneva weather centres which entitle them to be the leading centre. A unique synoptic scale analysis is carried out for Switzerland.

The forecaster at the leading centre chooses a synoptic scenario for the next 7 days. It is sent before the telephone conference to the other centres. They in turn produce a summary of the local forecast according to the guidance.

Practically, the guidance is an Excel spreadsheet (fig 2). Firstly, the model is chosen. It is by default the operational version on the the ECMWF's model. The charts displayed on the spreadsheet show the 500 hPa geopotential and the 850 hPa isotherm lines. Other information is also displayed, such as forecast rainfall, snow limit, etc… for chosen locations in Switzerland.

Scenarios amongst the most representative clusters can also be chosen; the guidance shows one member of the cluster. Each range is treated separately. In the future, other models will be added such as the GFS model. Once the synoptic scenario is chosen, a short text is added to describe briefly other features not shown or the reason why this particular version as been preferred. Finally, a confidence index is suggested according to the EPS meteograms and an outlook warning.

*Figure 2: The lay out of the guidance, a cluster from the ensemble is chosen as the synoptic scenario. A short explanatory text is added as well as a confidence index and a warning outlook.*
The Matrix

After the morning telephone conference, the main version of the matrix is initialised and completed according to the guidance. The matrix is initialized once a day but it can be updated at any time.

Initialization

At 3 am UTC, the initialization of the matrix is automatically generated with a first guess. The best source for each parameter has been chosen; it is unique and does not depend on the synoptic situation. All of the sources are retrieved from the DWH (DataWareHouse). Up to day 3, the local model COSMO 7 model (00z analysis) is used, thereafter; the matrix is initialised by the operational ECMWF model (the 12z analysis from the day before). The temperatures are filtered using a Kalman filter, the confidence index is determined using the EPS.

Edition

The Matrix is a unique and common tool to all the centres, only the regions under the responsibility of the centre are editable by that centre. A validation is carried out automatically at 10h30 am and it can then be validated manually at any time. The validation means that the updated data from the matrix are written into the DWH.

The matrix GUI is shown in fig 3. Fig 3a, 3b and 3c show respectively the display day0 to day 4, day 5 to day 7 and day 7 and day 8. The further ahead the forecast range, the larger the forecast regions become. The edited parameters include; minimum and maximum temperature, the 6h accumulated precipitation, 12 hour average cloud cover, the confidence index, the gust and rainfall probabilities and the temperature, and wind at upper levels. Before the validation, a coherence test is performed.

Figure 3: The matrix editor display, each box is associated with an automatic station; the grey boxes are not editable being the responsibility of another centre.

a - Forecast for day 0 up to day 2, the parameters display the 6h precipitation, the sunshine duration, the snow limit, the altitude of the top of the stratus or fog, type of weather.

b - Forecast for day 3 to day 5, the forecast regions are larger; the parameters displayed here are the minimum and maximum temperature, the wind (direction and speed) and the 0° isotherm.

c - Forecast for day 6 and 7, two regions for each centre remain. The parameters displayed here are the probabilities of precipitation (more than 1 mm, 10 mm and 30 mm), the probabilities of wind (more than 45 km/h and 75 km/h) and the confidence index (1 to 10).
Once the forecast is stored into the DWH, it is easily accessible with a retrieve command or using a visualisation tool (CLIMAP) which allows display of observed data (past and present) and forecasting data.

A function library has been developed to ease the retrieval of data; it contains algorithms which produce for example symbols for forecasts shown on television. Another application for the library is the postcode forecast (fig 4). On the MeteoSwiss web site, it is possible to enter a location postcode and a forecast is automatically generated by interpolating the nearest forecast point from the matrix. Previously, the forecast was generated using direct model output. The result was not satisfactory in the case of fog or low cloud for example, and often it was not coherent with the official bulletin. Now, the matrix output is used which produces far better results. The library function is used as an interface between the matrix and the final product.

**Verification, Quality control**

Previously, the forecaster's score corresponded to the accuracy of the prediction. The new approach to verification is to estimate the added value of the forecaster. The former verification scheme had many disadvantages: a comparison with the model was not possible, it was performed manually which could be subjective, the scores were available only after a delay. And it led to standard text; forecasters were using banal terms which would be understood by the person in charge of the checking (irrespective of their regional language). The OPKO verification was completed only for 14 regions up to day 1 and 3 regions up to day 7 while the new verification scheme contains 27 regions up to day 2, 11 regions up to day 5 and 6 regions up to day 7. An extended number of parameters are now checked.

**MOVI (MeteoSwiss Objective Verification Index)**

The verification for continuous data is achieved differently than for those variables with values which fall naturally into classes. Eventually, both will be included in the same index.

**Verification for the continuous variable**

This is applied to the minimum and maximum temperature variables. The variance reduction (RV) is performed on the parameters; it reflects the quality of the forecast compared to a reference value. In our case, the persistence is used as reference up to day 2 and the climatology is used between day 3 and 7.

\[
RV = 1 - \frac{\text{RMSE}_{\text{Fct}}}{\text{RMSE}_{\text{Ref}}}
\]

Where RMSE\text{Fct} : Root Mean Square Error of the Forecast.
RMSE\text{Ref} : Root Mean Square Error of the Reference value.

Figure 4: Example of a forecast by postcode available from the MeteoSwiss web site.
**Verification for variable classes**

This applies to sunshine duration, precipitation and wind (average speed and direction). The score used in this case is the Equitable Threat score (ETS). It measures the fraction of observed and/or forecast events that were correctly predicted, adjusted for hits associated with random chance.

\[
ETXS = \frac{(a - ar)}{(a + b + c - ar)}
\]

Where: \(ar = \frac{(a + b(a + c)}{n}\)  \(n: \) number of forecasts; \(ar: \) hits expected by chance.

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The MOVIs score is an adaptation of the UK index UNI. It is defined as:

\[
MOVIs = \frac{S}{SO} \times 100
\]

Where \(S = \frac{1}{\Sigma w_i} \left( \Sigma (w_i SS_i) \right) \)

SSi are the RV and ETS values.

\(S_0\) is a reference value of the MOVIs score. It can be set as an arbitrary value or as a mean sliding quantity of \(S\) during 2 or 3 years. In this later case, The MOVIs score will represent the evolution of the forecast quality.

**Conclusions**

The new working method has been used for over a year. It represents a great innovation for forecasters, the methods used and for the organization of the Swiss weather services.

The regional responsibilities and competences are clearly defined and developed; the leading centre alternates between the different regions. Only the synoptic evolution is established, the local weather is generated by the local centre. Previously, the medium range forecast was produced by one centre.

The work organization has also been modified. With the new organization all the three centres are working together with the same schedule; the data from the matrix are automatically saved at a fixed time.

The forecasts are stored in the DWH. The generation of new forecast layouts is easy to produce. This also guarantees the coherence between forecasts delivered to different customers. Clients who currently receive raw model data for instance related to Energy business can improve the quality of the data by using information modified by the forecaster.

The new verification method (MOVIs) is now objective and is produced accurately and instantaneously. The forecaster can monitor his forecast’s score immediately instead of having to wait a few weeks.

To sum up, the new way to work is more time consuming than before but the benefits are important for the forecasters, the clients and the general organization of the weather service.

André-Charles Letestu
In 2003, the Meteorological Service of Canada (MSC) began a significant restructuring of its forecasting operations in response to financial pressures.

**Senior management proposed that MSC could be more cost effective**
- continuing to provide quality services by pursuing a more centralized forecasting approach
- and increasing the automation of forecasts via numerical weather prediction (NWP).

As a result regional public forecasting centres were reduced in number from 14 to 5 and renamed in Storm Prediction Centres (SPC).
Aviation forecasts were centralized to two Canadian Aviation Centres in Edmonton and Montreal.

**To reach the goal a new methodology for operational forecasting was introduced**
- Specifically, automation of “routine weather” forecasts would be increased to allow the forecaster to concentrate their efforts on “high-impact weather” (HIW).
- There would also be greater emphasis on science in operations, including improved forecaster knowledge, and tools incorporating the latest research.
- National laboratories were to be established at each Storm Prediction Centre (SPC), focusing the flow of knowledge and technology between operations and research, and developing new approaches to meteorological problems with national applications.

Three forecaster forums took place in 2003, 2004 and 2005 and were attended by more than 450 participants.

**The presentations on these forums included**
- the new Meteorological Service of Canada (MSC) structure and forecasting methodology,
- defining “high-impact weather” (HIW),
- the future role of the human forecaster at MSC,
- forecast tools of the future,
- forecaster training and development,
- links between operational meteorology and research,
- the future of NWP
- the communication of uncertainty via probabilistic approaches.

The new MSC forecast methodology – that routine weather forecasts would be automated and forecasters would focus on “high-impact weather” (HIW) – was well understood and was accepted by most participants.
There was an agreement on definition of “high-impact weather” (HIW) in order to provide a basis for determining local and regional variations and to imply differences between single and cumulative events which can have significant impacts on safety, health, environment and economy.

**Most participants thought that**
- the human forecaster should be the heart of weather prediction, meaning the forecast process would be driven by the forecaster rather than automated NWP systems.
- Furthermore it was expressed that to do an adequate job of predicting “high-impact weather” (HIW) the forecaster must go through the analysis, diagnosis and prognosis process to have an opportunity to recognize potential “high-impact weather” (HIW) events and maintain skills.
NWP was considered to be a good tool offering important guidance, and there will be increasingly sophisticated methods of viewing NWP by comparing it with observational data.

- Ensemble forecast systems should be used by the forecaster to improve on deterministic products.
- Additional forecaster training was needed to reach a better level of familiarity with ensemble concepts.
- More probability information should be included in public forecasts.
- Free-form text was identified as the best way for forecasters to express uncertainty to the public.

The Meteorological Service of Canada (MSC) has completed the implementation of its restructuring strategy and has worked towards addressing many of the Forecasters Forum recommendations and concerns:

- The forecaster of the future would not be able to maintain the analysis, diagnosis and prognosis skills
- His/her only role is occasional intervention when automated forecast processes go awry.
- It is recognized that there will be skill in knowing when to intervene.
- It is stated that it is becoming increasingly difficult for human forecasters to add value to NWP forecasts.

However to add value to NWP is at those times when NWP does poorly and the weather is typically of critical importance to the public. Under these circumstances expert forecasters can increase forecast skill considerably. The human forecaster will have a crucial role in producing the best possible forecast for “high-impact weather” (HIW). This role should be recognized and resources devoted to better facilitating it.

Taking all the above into account, it is suggested that the primary role of the human forecaster should be to develop and maintain a shared weather-object database that uses a sequence of composite depictions that evolve through time the current and future states of the atmosphere. The emphasis would be on the sensible weather near the surface, since that region of the atmosphere has the greatest influence on the activities of the public. Basic activities are based in nowcasting and warnings for the public. The main idea is that the daily activity of the forecaster would be focused on meteorology, not on details in generating products. That means maintaining shared situational awareness at all times. This would likely require a forecaster with specific task of maintaining the “big picture” of the atmosphere and coordinating the more detailed activities of the mesoscale weather activities.

**The question now is how the to optimise the human-machine mix**

- The human forecaster currently plays a vital role at MSC weather offices and could continue to contribute towards significant improvements in “high-impact weather” (HIW) forecasting if supported by tools that are designed to achieve an optimal human-machine mix.
- This would be accomplished using an area-based, object-oriented analysis / forecast system with a toolbox of NWP guidance.
- The forecaster’s work would be focused on “high-impact weather” (HIW) events, mainly in the short term but also in the longer term if necessary.
- Products would be automatically generated from the weather object database, allowing the forecaster to focus on “hands-on” analysis, diagnosis and prognosis, and to maintain shared situational awareness at all times.

**See also the feedback in the general discussion of the WGCEF meeting in Toulouse 2009**

There will be a new approach in doing weather forecasting in the future; the weather forecasting work will change in NMSs.
At the end of the Year 2008 a group of alpinists asked me to assist them with meteorological information for the ascent of Aconcagua. At 6,962 meters (22,841 ft), Cerro Aconcagua is the highest mountain in the Americas and the highest mountain outside Asia. It is located in the Andes mountain range, in the Argentine province of Mendoza. The climbing period is between late November and late February. Aconcagua generates its own weather. There is a wide range of temperatures, from warm days to freezing nights. Snow and winds (some strong) are usual on Aconcagua, and storms may occur at any time of the year. The low humidity and strong winds are the most prominent characteristics of the weather of this mountain. At the summit the temperature may drop to -30°C with frequent strong winds, which gives a windchill of about -55°C.

Mount Aconcagua is some 160 km from the Pacific Ocean (which can be seen from the summit during sunny days). Storms and “bad” weather are mainly due to the moist winds originating in the Pacific Anticyclone. The winds go South and rise to the West and then against the mountain range, cooling down such that the humidity gives snow on the high peaks of the Andes.

The ascension was scheduled between the February 01st and 08th with two spare days until the 10th. Each year, about 4000 people try to climb Aconcagua. The ascent is technically not extremely difficult. That’s why it can attract people who are inadequately prepared, mentally and physically, for high altitudes. During the 2008/09 season, there were five times more casualties than in the years before. The wind was extremely fierce and never stopped roaring. The periods of stable weather situations only lasted one or two days, which is not enough for a safe ascent. Very few people made it to the summit. In January, 4 Italians with an Argentine guide got caught in a blizzard near the summit. During the descent they became lost and disoriented in extremely low visibility and were suffering from low temperatures. Only three of them survived the disaster and were brought down safety. One Italian climber and the Argentine guide died trapped in the storm and could not be rescued.

Two days at “Confluencia” valley in order to start the acclimatisation, admiring the 2700m high South Face which is to be climbed by experts only.
Weather Analysis for 1st February 2009

High pressure over the Pacific along the Chilean coast, low pressure west of Cape Horn and another low pressure east of Argentina. Some instability with associated cold front and thunderstorms situated north-east of the Aconcagua area. The 12 hr forecast corresponds well to the GOES-East satellite imagery.

The measured wind speed and direction at different altitudes is in good agreement with the forecast winds.
Meanwhile acclimatisation continues around “Plaza de Mulas” which is a real city of tents. Many companies provide services such as guides, tent rentals, stoves, dining and restrooms, hot-water showers and internet connections. There is, in addition, a coordinated service which includes specialized medical care, a rescue patrol and park rangers.

**Forecast for a possible summit day**

Before an attempt on the summit it is necessary to have weather conditions that permit safe walking on the top, with winds less than 15 kts and gusts of no more than 30 kts. It is also vital to have finished the acclimatisation. A GFS 180hrs forecast meteogram indicated the 6th February would be the only day with weather conditions permitting access to the top. No precipitation was expected until the 9th February. On the 6th, the sky would be practically clear and the winds in the morning at the altitude of about 7000 m was forecast at 35 kts with gusts of 40 kts, diminishing to 15 kts during the day. The only possible summit day was the 6th. The problem at that moment was that acclimatisation for getting safely to 7000 m would only be complete for the 7th.

The main meteorological problem was to follow the formation of the area of low winds, and to communicate the information to the group by sat phone because the only internet access in the area is at Plaza de Mulas. During the following days the forecast was really consistent.
For “Camp Cholera” at 5800m well protected against the westerly winds the ascension was without any major problem. In spite of that the acclimatisation for the summit was not achieved for the 6th, the risk was taken to skip a day and to schedule the ascension to the summit for that day, due to the general weather conditions. During the 6th in the morning after a stormy night the area of lower wind speed reached the Aconcagua. As the winds were rather strong in the night the physical recuperation at 6400m was impossible. The stormy night plus the incomplete acclimatisation made the alpinists aborting the attempt to the summit.

Upcoming altitude sickness made it impossible to climb up the remaining 500 m to the top. The weather conditions were good this day for descending from 6300 m. Another alpinist group with some altitude sick people and had to be rescued the same day, which at this altitude is not easy.

**Conclusion**

The 7 days forecast of the GFS was quite excellent the wind speed compared with the measured winds of the upper air soundings of Sto. Domingo and Mendoza had been between 15 and 20kts during the day, very close to the forecast data. The wind speed and the direction were accurate during the whole week. Unfortunately the summit was not reached because of acclimatisation problems. Following the forecasts, the wind was strengthening the day after and from the 8th until the 10th strong winds and moderate snow made a second attempt for the year 2009 impossible.

Thanks to Nathalie Mathgen for the Aconcagua photos and all the climbing information.

Claude Sales