Changing the Way we Warn for Weather

Elín Björk Jónasdóttir, Group leader for weather services, IMO

Iceland's weather is in general rather violent, at least compared to most of Europe. In general, it is windy, relatively cold and often wet. This is not new to those of us who live here, but to the two million tourists that travel to Iceland every year, weather and the effect it can have on holiday plans often comes as a surprise.

Familiar with the weather or not, many Icelanders are dependent on the weather. Fishermen, drivers, the aviation industry, the tourism industry and farmers all depend heavily upon weather forecasts and warnings. In the past decade or so, with widespread sources of weather information it has become clear that a single message warning for weather and the effect it can have is the best way to communicate the impact of weather and the necessary precautions people need to make. It is also safe to say that the literacy of weather has decreased among the population and many have difficulty making decisions given a general forecast. With all this in mind the Icelandic Meteorological Office developed a new impact-based colour coded warning system based on the Common Alerting Protocol (CAP) recommended by WMO.

The system was developed by the IMO IT-Development team in cooperation with the Division for Forecasting and Warnings. The system is based on CAP 1.2. We issue warnings for up to 5 days, for rain, wind, blizzard, snow and lightning. Colours are based on EMMA tradition, yellow, amber and red and for the first version the warnings go out for pre-established forecasting areas, 10 in total. All warnings are issued in Icelandic and English simultaneously and the warnings are open via XML repository available for anyone to consume and visualise. Warnings are visualized on the IMO's webpage as well as in the IMO app. The impact based system replaced the older system which was strictly based on climatological thresholds.

One of the major improvements made in preparation of launching the new system was that Icelandic Civil Protection Authorities as well as other stakeholders such as the Road Administration and Aviation authorities now join the team of forecasters and natural hazard sepcialists at IMO in a daily meeting held in the monitoring room at IMO. It was also clear from the start that the impact factor would have to be estimated by Civil Protection personnel along with the meteorologists, as societal impact has not been the focus point of forecasting until now. Single message warnings are also likelier to get a reaction from the public as well as decrease confusion or mixed messages from different sources. During the time the system was in development it was decided among the stakeholders that IMO will never issue a red (very high likelihood, very high impact) warning without the consent of the Civil Protection Authorities. This relieves some of the pressure from the forecasters among other things.

First winter experiences

The warning system was launched on 1. November 2017 with a small media campaign and introduction for the public. Introducing the system turned out to be made easier than anticipated by the weather itself as the first deep low-pressure area of the winter was fast approaching. Before noon on the first day the first warnings were out. During the next 48 hours all forecasts converged on a deep cyclone close to Greenland with a very sharp front passing Iceland from southwest to northeast.

Considering time of year and week it became clear that upgrading the warning to high impact was necessary as the traffic towards the capital area is often quite dense on Sunday evenings. Other impacts considered were delays to take-off and landing at KEF Airport, the major international airport in Iceland. In



Figure 1: The forecasting areas of Iceland

collaboration with Civil Protection and the Road administration the upgrade to high impact – high likelihood was made on Friday, with 48 hours lead time to the actual event. This led to an amber warning for the southwest and west of Iceland and yellow warnings for the rest of the forecast areas. The main reason for escalating to amber so far in advance was the fact that the impact would happen during a weekend and it was important to get the information out sooner rather than later so that travellers would know to change their plans for the returning trip towards the capital area. During a meeting with all stakeholders on Friday 3rd November it was briefly discussed what would need to happen for this weather event to escalate to a red warning. Consensus was reached among the participants that since this was not during rush hour, the timing would almost completely exclude the possibility of a red warning, with one exception. If lightning were to strike the high voltage lines from the Reykjanes peninsula towards the capital, taking out power for thousands of homes for an extended period we might reconsider. Lightning in Iceland is not exactly rare, but not common either.



🔺 Figure 2 ECMWF forecast +118h Valid Sunday 5th Nov. 2017 at 18Z



▲ Figure 3 ECMWF forecast +66h Valid Sunday 5th Nov. 2017 at 18Z Valid Sunday 5th Nov. 2017 at 18Z



Figure 4 ECMWF forecast +18h valid Sunday, Nov. 5 *** 2017 at 18Z



▲ Figure 5 Visualisation of CAP warnings on IMO's website 5th November 2017

As the weather approached it became clear that the warnings were justified, maximum 10 min. windspeeds exceeded 20 m/s in all areas of the country and wind gusts exceeded 35 m/s widely. Search and rescue teams were called out to control damage at construction sites, help stranded travellers on roads. While the inner edge of the front was passing, lightning did strike the Reykjanes peninsula and a high voltage power line. Power outages were extensive and included the main radar for the airport, parts of the airport and the towns close to it as well as parts of the capital area. All in all around 40.000 people are thought to have been out of power for a while during the evening. Power was restored just as the front passed, the southwestern most point at round 23Z in the evening. We did not go to red, and as it turned out no warnings went to red the entire winter.



 Figure 6 High resolution Harmonie-Arome forecast for 10 m winds valid 18Z on 5. Nov. 2017

Yellow fatigue and unexpected consequences

The warning system was well regarded and accepted by the public and stakeholders. The change from a strict climatological threshold system to a more flexible impact-based system was challenging for everyone, not least the forecasters. Forecasters do not issue press releases regarding especially dangerous weather or jumps in forecasts anymore, but the additional work of issuing warnings for all of the forecasting areas added quite heavily to the work load for the on-duty forecasters. The first storm provided a good example, but as the winter wore on a certain misunderstanding became obvious. The public seems to only rely on the colours and do not read the whole warning text, which can often be specific, or look at where in the matrix of impact and likelihood the warning actually lies. In addition, yellow warnings started to miss their mark when weather was such that IMO issued yellow warnings for wind, snow or blizzard for days - indicating that without proper caution and preparation the weather could be hazardous, so on days 5-10 of these stretches of bad weather the Search and Rescue teams were deployed more often to help travellers who had taken a chance on mountain passages etc.

It was also brought to our attention that school districts, fire departments and others were using the system as guidelines to when to close schools, ask parents to accompany children or issue reduced services of some sort. Most often amber warnings were used as guidelines, which in some cases is too late. Cases can be made for schools asking parents to accompany young children to school much earlier than during an amber warning, and sometimes during amber warnings, it is not necessary to limit the services of home health care professionals or other services.

Some complaints were communicated to IMO, mostly regarding the complexity of the system, lack of documentation or other things that mostly fixed themselves as everybody got more used to the new system. An unexpected complaint was that some lcelanders found the use of the colour amber objectionable. Amber or orange, is in Icelandic "appelsínugulur" – which, granted, is a rather difficult word to say. It has however been in the Icelandic language for some 150 years, or since oranges first appeared in letters and books. Some complaints are always expected with dramatic changes to a system that has been the same for years, but this one certainly was not and just shows that one can never be completely prepared.

Next steps in development of the system will be to include free-drawn warning areas and thus limiting the area under warning. Some minor adjustments will also be done on the forecasters interface as well as the production of a handbook with well worded warnings but IMO still counts the launch of this new system a success.