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CGIAR CCAFS

Info Note

Which forecast represents the local weather best?

Preliminary case study findings from My Loi village, northcentral Vietnam

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Key messages

- All three forecasts under-predicted temperatures, while AccuWeather overestimated and Windyty underestimated the total rainfall (for the two months, by 100 mm); however no systematic error could be determined to reduce the error.
- As uncertainties are rapidly increasing with longer lead time than two days ahead, the researchers advise to follow several forecast sources to get a range of scenarios.

Web-based weather forecasts are progressively available for free. This is good news for farmers and agricultural advisors who can get instant updates. However, the information presented may be contradictory and insufficient for decision-making purposes, as forecasts always involve degrees of uncertainty.

The urgency for timely and accurate seasonal climate information in Vietnam was emphasized during the El Niño-induced droughts that left 18 provinces in emergency status in the spring of 2016[1].

The purpose of this study was to evaluate three available sources of weather forecasts against the observed weather for two months (May – July 2016). Specifically, the researchers:

- assessed systematic differences between forecasts and weather observations of rainfall, minimum, maximum and mean temperatures; and
- analysed the extent to which the forecast sources vary when predicting the same weather variable for different lead times (up to ten days).

Agro-meteorological information in Vietnam

In Vietnam forecasts are produced at the national level for eight major regions. The approaches to downscale the regional forecasts vary by province. For example, in Ha Tinh province the seasonal forecast (for three months) are derived as an average based on all meteorological stations in the province with an ENSO index, followed up with 10-day-forecasts updated every 5 days.

Farmers in My Loi village typically get weather forecast information through television, the village loudspeakers, and to a lesser extent, the agriculture extension service. Currently, as forecast information is at best given at the province level, farmers consider the forecasts to be unreliable (CARE and ICRAF 2016). Referring to signs in nature during spring 2016, they were also sure that the El Niño drought would end by autumn. Others said these signs were becoming more difficult to interpret, as the weather is becoming more variable.

Data and analysis

The following data on rainfall, minimum and maximum temperatures was recorded between May 8 and July 8, 2016:
Observed daily meteorological data was taken from the automatic weather station in My Loi village. Forecasts were also recorded on a daily basis. Windyty (2016) and AccuWeather (2016) were selected as data sources due to: (i) the easy navigation and functionality of the

[1] http://www.un.org.vn/en/publications/cat_view/226-emmergency-situation-report.html

websites, (ii) availability in a range of languages, including Vietnamese, and (iii) that meteorological staff frequently consult Windyty for comparison. Forecast data was recorded for the reference point closest to My Loi[2,3]. The maximum lead time provided with Windyty is 12 days for temperature and 5 days for rainfall while AccuWeather provides 90 days forecasts. The Centre for Hydrometeorological Forecasting (NCHMF) under Vietnam National Hydrometeorological Service (NHMS) provides the official forecast online. NCHMF (2016) provided forecasts for Ha Tinh province for 1 to 3 three days ahead[4]. Forecasts for 'the same day' and amount of rainfall were unavailable. Rainfall was recorded as a logical expression "rainy day" for an icon with a cloud with rainfall and "dry day" for cloud without rain drops or sunshine.

AccuWeather and NHMS both present the information in a written format with simple iconographics while Windyty has an animated global map of wind, temperature, pressure, clouds and precipitation with a sidebar legend. Windyty had been tested during participatory scenario planning meetings with farmer groups, who found the animated maps easy to interpret.

Paired sample T-test was used for assessing the variance of means of the observed temperature data and forecasted data for different lead times. Forecast skills were analysed as the difference between the forecasted and observed values.

Rainfall forecasts versus observations

The total observed rainfall in My Loi during the two months was 150 mm over 19 'rainy days' (data was missing for two days). The highest observed rainfall in 24 hours was 40 mm (Table 1).

Table 1. Observed and forecasted rainfall May 8-July 8, 2016

Rainfall	Obs My Loi	Forecast for same day	
		Windyty	Accu Weather
Total rainfall (mm)	150	46	263
Number of dry days	41	37	21
Max rainfall in one day (mm)	40	5	32

For the same-day forecasts (Table 1), Windyty had a similar number of dry/rainy days to the observations, but forecasted only 70% of the total rainfall amount and under-predicted the maximum rainfall in one day (5 mm). Conversely, AccuWeather over-predicted the total rainfall amount and number of rainy days, although the maximum rainfall in one day (32 mm) was under-predicted by 25%. NHMS also over-predicted the number of rainy days (28) compared to the observations, but had the highest number of correct predictions of whether the next day(s) would be rainy or dry. The NHMS had 62% correct forecasts for the same day and 50% three days ahead (Figure 1). Both AccuWeather and Windyty had above 60% correct forecasts for the same day, but the number of correct forecasts dipped below 50% from two days ahead. At all investigated lead times, Windyty forecasted lower rainfall amounts and fewer rainy days than AccuWeather.

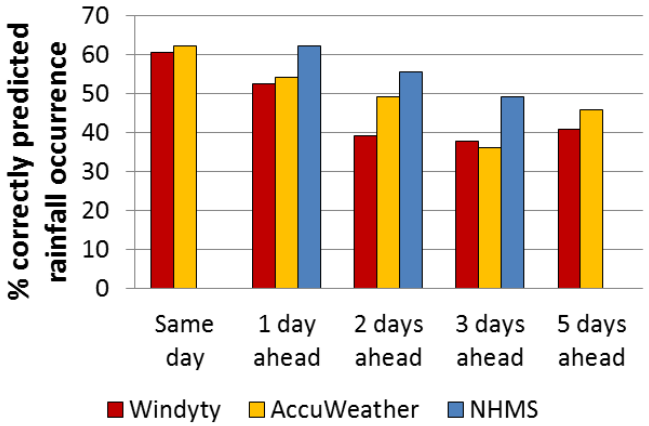

Figure 1. Percent of correctly predicted rainy days by three forecast sources for different lead times (n=61 days)

Temperature forecasts

The average observed and forecasted temperatures for the three forecast sources at two lead times is summarised in Figure 2. Windyty and AccuWeather had 9 and 7 out of 12 successful T-Tests, respectively (75% and 58%, respectively) and NHMS 6 out of 9 (67%).

Maximum temperatures were generally under-predicted. The average difference between forecast and observation was 1.68°C for AccuWeather, 2.66°C for Windyty, and 2.96°C for NHMS. Windyty had overestimated maximum temperatures for only three days. Maximum temperatures were similar across all sources and lead times up to ten days ahead.

[2] https://www.windyty.com/17.995/106.193?17.995,105.616,9
[3] http://www.accuweather.com/en/vn/ky-anh/353426/daily-weather-forecast/353426
[4] http://www.nchmf.gov.vn/web/en-US/62/20/28/map/Default.aspx

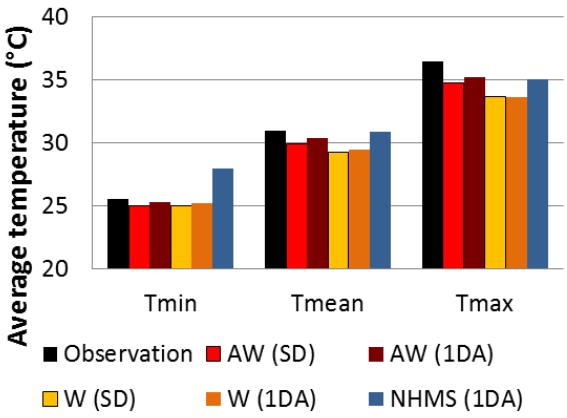

Figure 2. Average minimum, mean and maximum temperatures for two months (May 8 – July 8, 2016) for observations, forecasted for same day (SD) and one day ahead (1DA) for AccuWeather (AW), Windyty (W) and National met office (NHMS)

AccuWeather and Windyty forecasts under-predicted the observed minimum temperatures by an average of 0.50 and 0.57°C respectively, while **NHMS over-predicted** in all but three days by on average of 2.43°C. Minimum temperatures were forecasted correctly by NHMS up to three days ahead, while AccuWeather and Windyty only correctly forecasted them the same day.

Mean temperatures were under-predicted in all forecasts. AccuWeather and Windyty under-predicted most days by an average of 0.99 and 1.74°C, while NHMS forecasts had a 0.10°C difference. Windyty had acceptable forecasts of up to seven days ahead, AccuWeather for two days ahead, and NHMS failed completely.

Why are the forecasts so different?

Although there was no clear systematic difference, the forecasts underestimated minimum temperatures by an average of 0.5°C, and maximum temperatures by over 2°C during the 2-month period. Furthermore, with longer lead times the diverging forecast patterns between Windyty and AccuWeather depend on methods and techniques used to produce the forecasts. Towards a lead time of seven days and longer periods, temperature forecasts by AccuWeather approached a (near-) constant, probably a climate baseline. Windyty had more variable day-to-day forecasts, which may represent process-model behaviour,. This uncertainty is problematic for rain-fed agriculture systems, such as those in My Loi.

A gap exists between farmers' need for detailed long-term (seasonal) forecasts and the extent to which such information is available. The addition of details should also be balanced with the incurrence of errors. A study by Hansen and Hansen (2007) of eleven web-based forecasts highlights the frustration experienced when forecasts give mixed messages, regardless if it is for planning holidays or managing livelihoods. Hence, while the prediction skills of various forecasts concern many, such analyses require certain skills in statistics and meteorology, and access to long datasets.

Conclusions

Limited conclusions can be made from a short study period of two months and one observation point. Hence, the specific recommendations here are primarily relevant for My Loi village and Ky Son commune. Further, the study was conducted during the dry period, therefore results may differ for the rainy season, which is particularly important for flood and storm warnings, such as in the heavy rain and floods in the autumn of 2016[5].

- Temperature forecasts were generally under-predicted but we could not find systematic errors that would help downscaling. Forecasts became less trustworthy after only two days' lead time. No single source could sufficiently forecast for all the weather variables and lead times.
- It is important to clearly communicate the limitations and uncertainties of various forecasts (especially at what lead time the certainty drastically reduces) to users, such as agricultural advisors and farmers. This involves identifying which forecasts work better for which weather indicator, type of weather situation, and at what lead time, e.g. one source may work better during "normal" conditions and another under "extreme weather" events, or different seasons.

Recommendations

The strength of national forecasts is in combining forecasts with locally relevant advice. Working with the national met-office on further analyses to correct systematic errors would be most beneficial in the long run. The national forecasts by NCHMF would better meet farmers' needs by (i) extending the lead time in online forecasts to seven or 10 days and providing seasonal outlooks with regular updates, (ii) indicating rainfall amounts as a range or probability, (iii) visualising more weather variables on animated maps. Engaging provincial meteorology staff in Monsoon Forums may also provide better informed seasonal forecasts.

Local forecasters need to be trained in using and evaluating the performance of different forecasts. The study shows the importance of systematic and continuous evaluations of forecasts and observations,

[5] http://unosat-sdn.web.cern.ch/unosat-sdn/samir/Vietnam/UNOSAT_A3_FL20161109VNM_HaTinh_Landscape.pdf

before making general recommendations based on a particular forecast for a particular area, or under what conditions such recommendations are representative, e.g. one forecast may perform better than another for a certain indicator, area, season or lead time. Understanding how to best use different sources, and updating the evaluations as forecasts are improved are important tasks for local weather forecasters.

Given the uncertainty with current forecasts, a variety of sources should be used.
The NHMS forecasts can be compared with AccuWeather (especially for temperature) and Windyty (for rainfall). Windyty is also useful for making synoptic interpretations of pressure patterns.

Further Reading

This brief builds on Antika Roy's MSc thesis "A statistical assessment of variations between weather observations and forecast sources available to farmers in the village of My Loi, Vietnam, to facilitate climate-smart agriculture interventions", at University of Leeds, UK, August 2016.

- AccuWeather. 2016. Ky Anh, Vietnam Local Weather, http://www.accuweather.com/en/vn/ky-anh/353426/daily-weather-forecast/353426.
- CARE and ICRAF. 2016. Enhancing Adaptive Capacity of Women and Ethnic Minority Smallholder Farmers through Improved Agro-Climate Information in South-East Asia (ACIS) – project, Baseline Survey: Findings and Recommendations. in M. Coulier (ed.) CARE Vietnam and World Agroforestry Centre (ICRAFVietnam), Hanoi, Vietnam.
- Hansen, K. and B. U. Hansen. 2007. Internet Weather Forecast Accuracy. Omninerd, http://www.omninerd.com/articles/Internet_Weather_Forecast_Accuracy.
- NCHMF. 2016. Weather forecast Ha Tinh province, northcentral Vietnam http://www.nchmf.gov.vn/web/en-US/62/20/28/map/Default.aspx.
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This brief summarizes findings among the initiatives to address climate-related risks under the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). The study was conducted as a part of the project Agro-climate Information Services for Women and Ethnic Minority farmers in South-East Asia (ACIS)[6], implemented by World Agroforestry Centre (ICRAF) and Care in Vietnam, Laos and Cambodia. It is hoped that the research will contribute to co-investments in improved agro-climate information systems.

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[6] http://www.worldagroforestry.org/sea/Publications/files/brochure/BR0034-15.pdf

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