Queensland's fire weather

Part 2 seasonal severity

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Part 1 of this series looked at defining fire seasons in Queensland. Here I will discuss the relative severity of fire seasons, how this could be determined both for seasonal review and for forecasting, and what this means for improved fire management.

Firstly, what is a severe, normal or mild fire season? Logically a severe season has more and larger wildfires of greater severity and impact, compared to average fire activity. This usually results from dryer conditions extending longer than normal, and more frequent severe weather days. However there is a random nature to fire occurrences, and a few short sharp fire weather periods can result in major damaging fires, whereas good community awareness, suspension of burning permits, and drought conditions with limited pasture may result in relatively few fires, even in a long and difficult fire season. . While seasonal conditions such as rainfall probabilities can be predicted to some extent, fire ignitions in terms of location and timing cannot be predicted. Therefore predicting fire seasonal severity is more complex and difficult than what it would seem, and seasonal severity for the purposes of this discussion is defined in terms of weather and climatic conditions, not fire activity.

Some **measures for fire season severity** used interstate include the total cumulative daily Forest Fire Danger Index (FFDI) for the year, and length of fire season. Average daily FFDI is a similar measure to the annual total but is not affected by missing data, the number is more meaningful, and therefore is a better guide to average fire weather severity. Fire season length can be more easily determined in southern States where there is a fairly rapid transition and clearer commencement of severe weather days. In Queensland, fires can occur throughout the year and there is not a clear transition or season start point for fire weather, however use of the Keetch-Byram Drought Index (KBDI), which indicates soil dryness and the dry season, could make a suitable alternative indicator of fire season transitions.

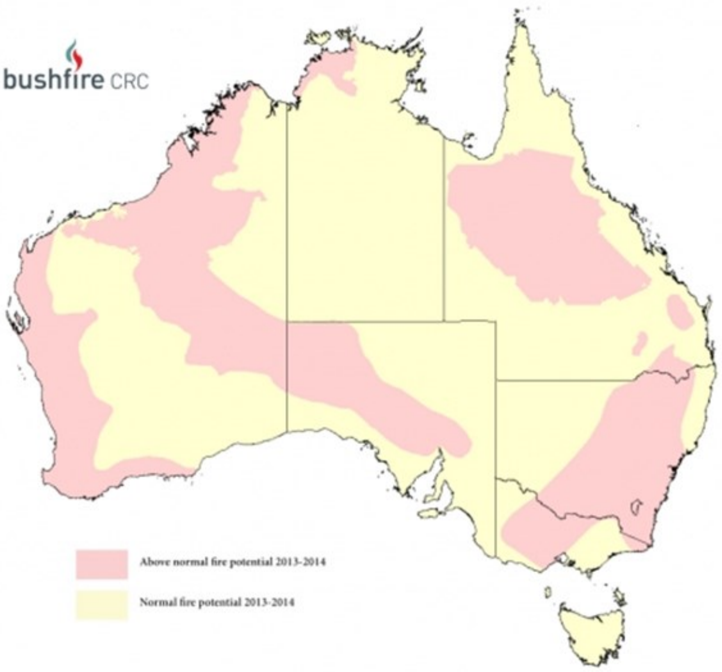

Figure 1 Example of seasonal severity prediction, Bushfire CRC seasonal bushfire outlook for 2013/14

Another indicator of fire season severity is the number of severe weather days, such as number of days over FFDI 25 or 50.

Predicting seasonal severity is intended to allow for better community or agency fire prevention, preparedness and response. The severity prediction will typically focus on current fuel hazards, current drying trends, and long term rainfall probabilities based on El Nino Southern Oscillation (ENSO) conditions. Dryer than normal is usually equated with a more severe fire season, however there are qualifiers to this. Grassland fuels in the grazing areas of western Queensland respond quickly to seasonal rainfall. In good wet years, grass cover develops quickly, and in the following fire season with abundant and continuous fuels, wildfires tend to be more extensive. In drought years, pastures are generally eaten out, and although dry, fires tend to be checked by discontinuous fuels. In contrast, coastal forests progressively accumulate litter fuel over many years, and short term effects from good wet seasons are less pronounced. During drought years, fires in forest fuels can be more severe with more available litter and shrub fuels, and fires tend to penetrate further into wetter vegetation types which are normally a barrier to fire spread.

By combining the seasonal rainfall and temperature outlooks with the fuel conditions, along with where fires were experienced the previous season, a potential seasonal fire severity outlook can be prepared. The outlook shows areas that have the potential for above normal bushfire activity. This has been coordinated since 2006 by the Bushfire Cooperative Research Centre for the guidance of fire agencies. From the 2014-15 bushfire season, the outlook will be coordinated by the new Bushfire and Natural Hazards Cooperative Research Centre. It should be noted that the outlook is prepared before the season based on predicted conditions, and while a severe season may be predicted, the ENSO phase and weather patterns can fluctuate quite dramatically soon afterwards. Also, as discussed above, fire activity may also vary, so it may be unfair to attempt to relate seasonal severity maps with actual fire activity.

Other methods for seasonal severity prediction relate to plotting current seasonal trends in comparison to a normal season. Queensland Forestry, now HQPlantations Pty Ltd, has a long standing practice of measuring cumulative rainfall from April through the winter and compare this to median figures and severe seasons as a guide to seasonal severity. Similarly, Qld Parks and Wildlife Service collate current KBDI available from BoM and other sites to track current drying against normal regional conditions. This allows for awareness of developing conditions and possibly early commencement of heightened fire preparations.

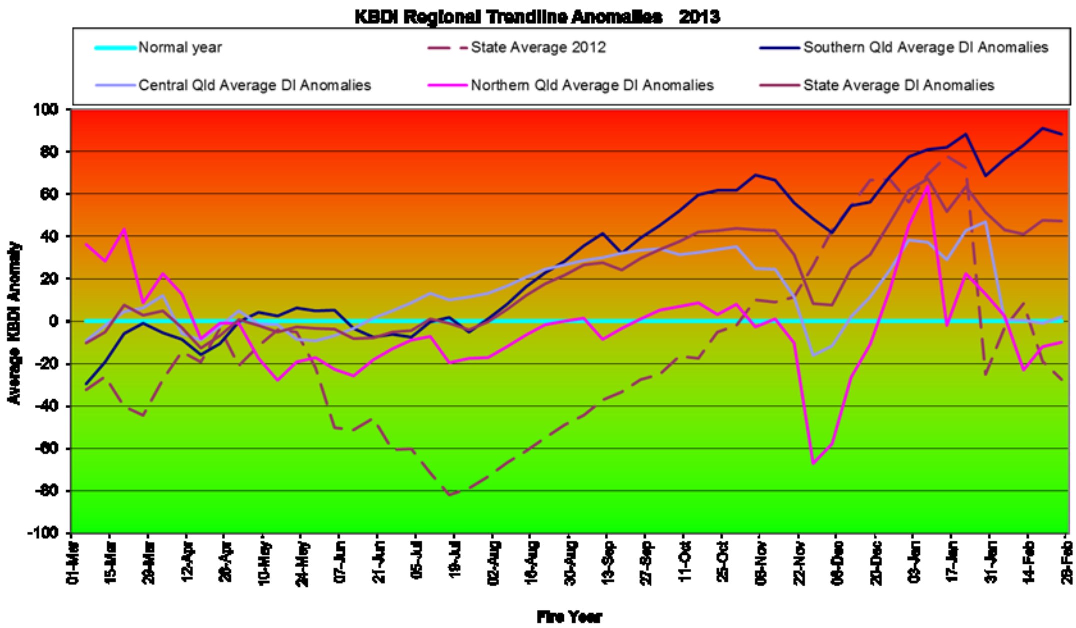

Figure 2 QPWS collation of Keetch-Byram Drought Index for Queensland 2013, indicating normal early drying but dryer than normal late season conditions, particularly for southern Queensland.

Seasonal severity analysis

Can predictions be improved? An analysis of the fire weather archive data for 19 Queensland sites (Lucas 2009), separating years into El Nino, neutral and La Nina phases, allows a comparison between average conditions. While short term and annual average conditions can vary, it is apparent that trends exist. In southern coastal Queensland for El Nino years, average daily FFDI is 1.4 times higher, there are twice as many severe fire weather days (FFDI exceeding 25 VH), and average daily KBDI is 1.4 times higher compared to La Nina years. The FFDI tends to rise earlier with a notable increase in severe weather in August, peaking in September. The KBDI (dryness) often shows a dry April and earlier drying through winter. La Nina years have only a moderate increase in FFDI through spring and no spring drying pattern, while neutral years have a shorter but clear dry spell and higher FFDI in September and October. An example of this is in the charts for Amberley. Amberley averages a daily FFDI of 9.2 in El Nino and 6.8 in La Nina years, and 18 days of FFDI exceeding 25 compared to 8 days in La Nina.

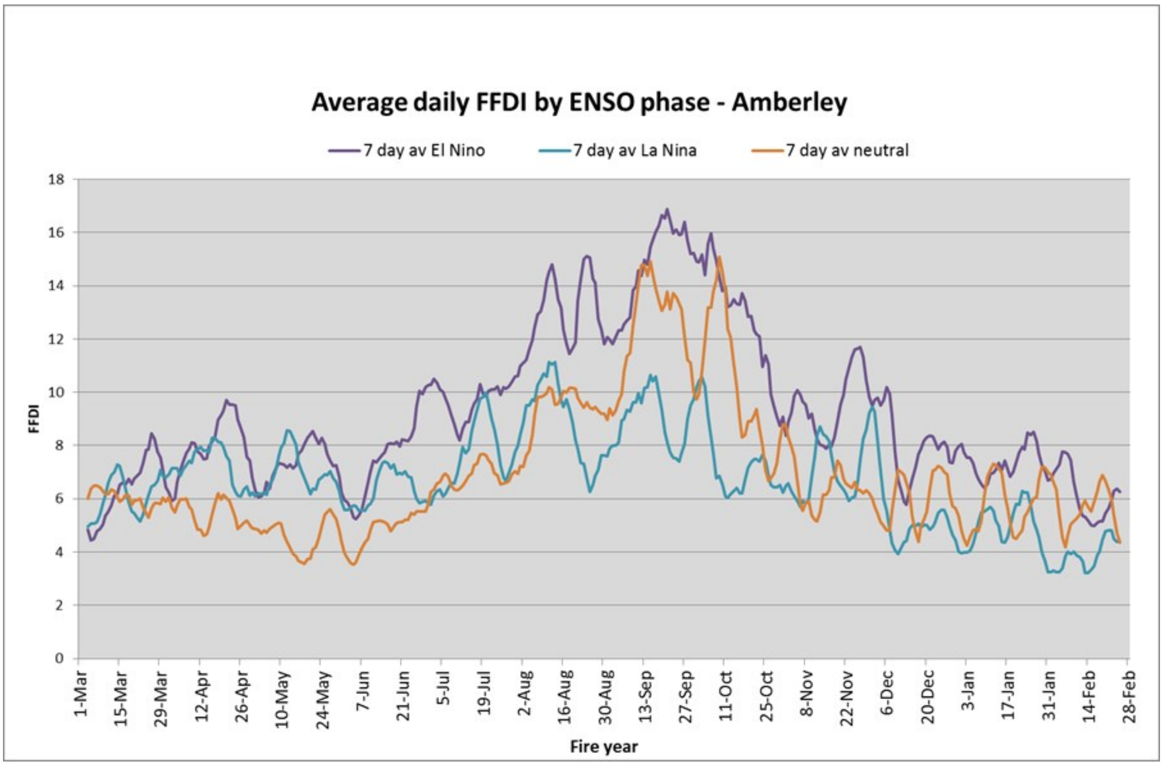

Figure 3 Amberley Forest Fire Danger Index by ENSO phase, showing higher average daily FFDI August to October in El Nino years compared to minor increases in La Nina years. (data source Lucas 2009)

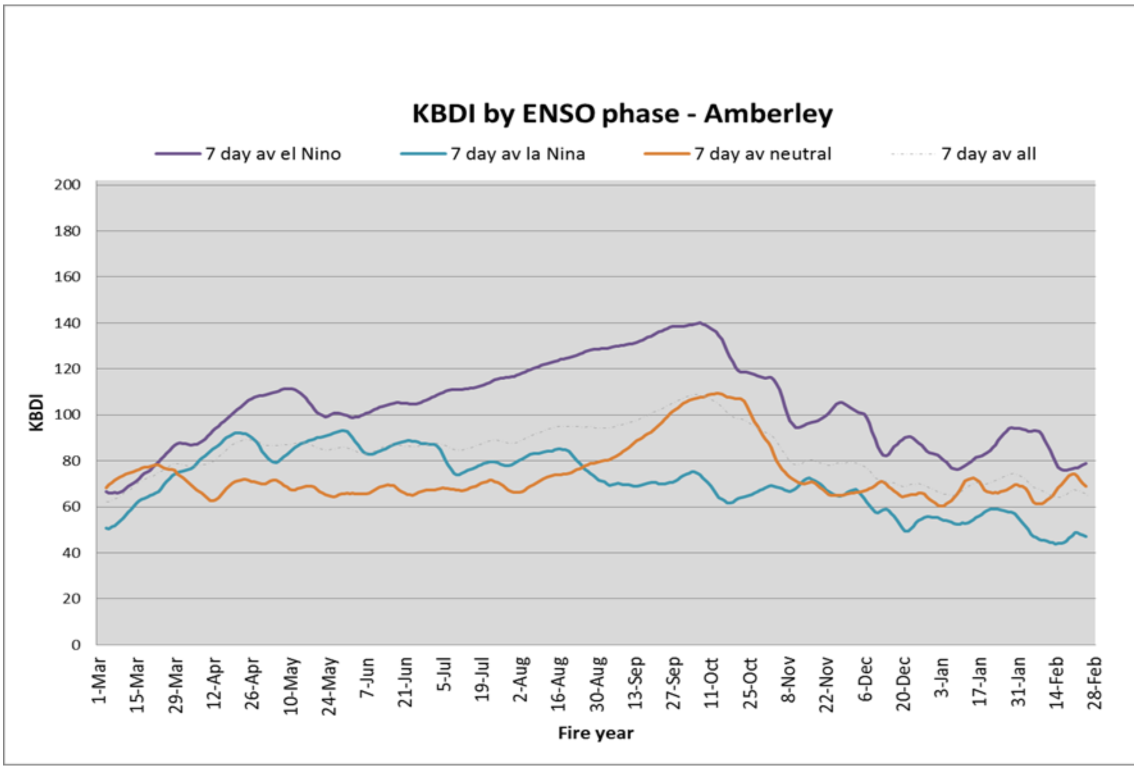

Figure 4 Amberley Keetch-Byram Drought Index by ENSO phase, showing dry April and higher drying trend through to October in El Nino years compared to a short drying September October in neutral years. La Nina shows no average drying. (data source Lucas 2009)

The effect is similar in western Queensland, but the higher FFDIs continue through January in El Nino and neutral years but tend to drop down in La Nina years. In the strongly monsoonal Cape and Gulf, The average differences are weakest but still apparent, with average daily FFDI and KBDI about 1.1 times higher in El Nino years compared to La Nina. The most obvious difference in the Cape is in the earlier start to the storms and wet, typically October /November in La Nina and November / December in El Nino. While average FFDI peaks in September / October in both phases, dry conditions and high fire dangers continue through November during El Nino, making a longer fire season.

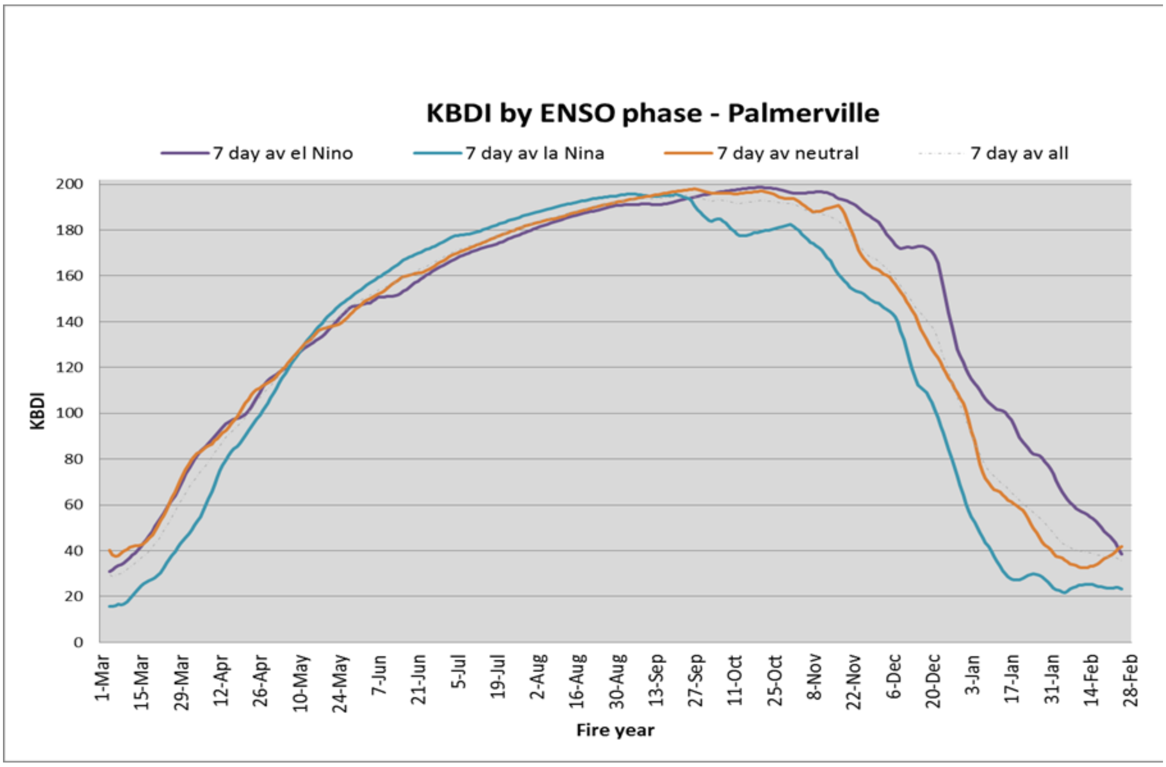

Figure 5 Palmerville Keetch-Byram Drought Index by ENSO phase, showing similar drying patterns but an earlier wet season in La Nina compared to a longer dry and fire season in El Nino. (data source Lucas 2009)

Are fire seasons getting worse? Climate experts will provide the best guidance on this and increasing severity is likely. However some perspective is also available from analysis of the average yearly trends in FFDI, KBDI and the numbers of severe fire weather days in the long term fire weather study. Typically there is an upward trend in these averages over 40 years, however the annual variation is very noisy. Some of the worst fire weather days occurred in the 1960s prior to this analysis period, and long term cycles such as the Inter-decadal Pacific Oscillation (IPO) and peaks in the early 2000's may suggest that over this 40 year period, we are looking at a single IPO wave.

Conclusions

Any year could be the worst for a long time, and we should guard against warning fatigue or "cry wolf". Fire season severity predictions are difficult, as seasonal conditions change rapidly, and actual fire activity is also dependent on ignitions and fuel hazard conditions. While some forward planning requires a prediction of fire season severity, planned burning activity and normal seasonal preparations should not be driven by seasonal predictions, but be attuned and responsive to current conditions and trigger points. Grassland curing and abundance assessment, KBDI trends, or rainfall deficit are useful techniques in monitoring current seasonal conditions. ENSO can help predict rainfall probabilities but cannot be relied on as a predictor of actual seasonal dryness conditions and fire severity.

In other words, it is more useful to focus on current seasonal conditions than forecasting possible future seasonal severity.

Useful links:
http://www.bom.gov.au/climate/enso/ninocomp.shtml
http://www.longpaddock.qld.gov.au/products/pdf/australiasvariablerainfall.pdf for ENSO phase, classification of years, and rainfall charts.
http://www.bushfirecrc.com/resources/firenote/southern-australia-seasonal-bushfire-outlook-2013-2014 for seasonal severity prediction.

Lucas C, 2009, On developing a historical fire weather data-set for Australia, Australian Meteorological and Oceanographic Journal 60 (2010) 1-14.