ADJUSTMENTS FOR OEH NORTH COAST REGIONAL CLIMATIC PROJECTIONS

Downscale climatic modelling provided by the NSW Office of Environment and Heritage is valuable in emergency planning but a uniform modelling process applied across NSW leads to a number of problems when applied to the north coast.

1. Thresholds and Distribution Analysis
   OEH modelling has concentrated on incremental change in seasonal averages. Emergency Management is not about response to average conditions but to extremes. Distributional analysis shows that small changes in average conditions often reflects a large change in the frequency of extreme conditions.
   OEH models forecast an average increase of 5 days per year above 35 degrees at Murwillumbah by 2030. This is actually a doubling of the 1990-2009 average and so the frequency of heat waves can be expected to double by 2030. At 70% humidity, 35 degrees is equivalent heat stress to 44 degrees in drier locations. Average rainfall is projected to increase by 5-10% in Autumn by 2030 which would double number of monthly falls above 400mm.

2. Topology Equations
   OEH climatic modelling (NARCliM) has been downscaled to 10km grid scale but is based on relatively widespread records. There are only two meteorological recording stations in the Tweed, at Bray Park and Coolangatta 23km. While there is a network of automatic rain and flood gauges this data is not used in the models. To produce climatic forecast maps for west of Murwillumbah or south of Tweed Heads, mathematical adjustments were made called topology equations. The adjustments are based largely on elevation and distance from the ocean but no actual records are used to confirm accuracy. For this reason forecasts to the west of Murwillumbah have been underestimating temperature and rainfall. In upper reaches of the Tweed, models have been consistently underestimating rainfall intensity by a factor of five i.e. If 5mm of rain is forecast the result is commonly around 25mm.
   It should be assumed that the frequency of days over 35 degrees west of Murwillumbah will be around double the model projection and flood frequency in Summer and Autumn will be higher than that implied by NARCliM.

3. Calendar Seasons
   On the far north coast the driest period of the year spans calendar season boundaries meaning that the modelled change is diluted by being split into two different seasons.
   OEH season projections for 2020-2039 forecast a 5-10% decrease in rain for Winter (JJA) and a 5-10% increase in rainfall for Spring (SON). The driest period on the north coast is actually July to September and rainfall in this period has already declined 36% from the 100 year average.
   A similar effect relates to El Nino events which are not considered to have significant effect on rainfall in the northern rivers. However the records for Murwillumbah over the July to September period records show 32% lower rainfall compared to La Nina years with a statistical significance of 96.7%. Rain days are also 50% fewer in this period in El Nino years.

4. Seasonal Drift
   This year has been unusually warm. In fact every month from October 2015 to May 2016 broke the record for warmest average temperatures globally. Though 2017 is unlikely to be as warm, the long term trend is for increasing temperatures. An important effect not noted in the OEH projections is the drift in APPARENT seasons. Summers are getting longer, compressing autumn into winter. Spring is starting earlier, further compressing winter and heralding an earlier summer.
   Using CSIRO analysis techniques, by 2030 apparent summers in Murwillumbah will be 5 months long and spring temperatures will begin in early August. Winters will be mild with continued grass growth and no frosts.
   Fire danger periods will extend from August to January and to March in El Nino years.

5. Cycle Averaging
   The OEH modelling necessarily applies to lengthy periods of time in order to take into account climatic cycles such as Southern Oscillation Index (SOI) and Indian Ocean Dipole (IOD).
   Averaging the forecast over a long period eg 2020 to 2039 improves the overall accuracy but implies incremental change over 20 years. In reality much of the total impact will be concentrated in 4 or 5 years coinciding with climatic cycles.
   For example if winter rainfall is projected to decline by 10% averaged over 20 years but most of the decline is concentrated in four El Nino years then in those years winter rainfall might be 50% below average.
   Hot days are more frequent in El Nino years due to drier soils and clearer skies. The OEH regional projection for 2020-2039 forecasts an average increase of 5 days per year over 35 degrees but if concentrated in El Nino years this could mean up to 25 extra days above 35 degrees. The same would apply to the projected increase in fire danger index, particularly in years where summer rains fail.
   Severe flooding in the Northern Rivers tends to occur with positive cycles in the SOI (La Nina) or with a negative Indian Ocean Dipole. Modelled increases in average rainfall are likely to be concentrated in such events. As temperature rises so does moisture load in the atmosphere, leading to more intense rainfall events and higher flood peaks.

6. Exclusion of Long Cycles
   Modelling to date has not incorporated the effect of long cycles such as the Pacific Decadal Oscillation. Currently the PDO is in its low cycle which suppresses atmospheric warming but evidence is mounting that the cycle will switch in the early 2020's. It is expected that global warming will accelerate and so will the effects on climate. OEH projections were made in a low point in the PDO cycle tending to reduce estimates of future change caused by greenhouse gases. The combined effect means that OEH projections are likely to be reached much sooner than expected.

7. Near Point Referencing.
   OEH modelling uses a relatively near reference period 1990 to 2009. Using a recent reference period is useful for comparing to current conditions and for continuity of data records. However, using a recent reference point masks change that has already taken place and down plays comparative estimates of forecast change. For instance, during the reference period the frequency of days over 35 degrees in Murwillumbah increased by 20% and summer rainfall increased by 26%.

Summary

Compared to the Regional forecast for 2030:

Temperatures:

- In El Nino years there will be up to an additional 25 days above 35C in town.
- The frequency of heatwaves will double.
- The days over 35 degrees west of Murwillumbah will be twice as many again.
- At 70% humidity, 35 degrees is equivalent heat stress to 44 degrees in dry climates.
- Coordination will be needed with hospital services and heat refuges designated.

Rainfall:

- Flood frequency in Autumn will be significantly higher than projected.
- Flooding in any season will be faster with less warning and higher peaks.

Fires:

- Fire danger periods will extend from August to January and in dry years, into March with a concentration of extreme fire days in El Nino years.
- Grass fires will be an increasing problem coming out of winter.

The pace of climate change is likely to accelerate after 2020 causing projections to be exceeded years earlier than expected.

While emergency services have been able to cope so far, more frequent and intense extremes will impose greater demands on emergency service resources and volunteers. Increases to resources will be in response to an outcry after they have been found to be inadequate and sometimes after they have been reduced. It would be wise to coordinate with community groups that might act as reserves to free emergency personnel for more vital tasks.

Greg Reid, May 2016 , Tweed Climate Action