From: s 9(2)(a)
Sent: Wednesday, 9 December 2020 4:34 pm
To: s 9(2)(a)
Cc: Drew Bingham <xxxx.xxxxxxx@xxx.xxxx.xx>
Subject: RE: Question from MfE on their OAC2020 Report

Hi s 9(2)(a) & Drew

Regards correct citation, the Pearce et al. (2011) report does include a statement (on pg 29 – see below) that the average increase in fire danger (days of VH+E) across all models and station locations is around 70% (62% to the 2050s, and 74% to the 2080s). However, with hindsight, this result wasn't highlighted as prominently as it should have been in other parts of the report, such as the Exec. Summary and Conclusion (where there was a clear lack of quantitative results!).

However, perhaps a better and more up-to-date reference is actually the Watt et al. (2019) paper in Forestry – see attached. This is the source for the Scion Connections article cited in the OAC report. In the fire risk section, Watt et al. contains the statement: "When averaged over all sites, the number of days with VH + E fire risk was projected to increase by 71 per cent by 2040, and by a further 12 per cent by 2090" – see below. It also says in the abstract that: "The average season length with 'very high and extreme' climatic fire risk increases by 71 per cent up to 2040 and by 83 per cent up to 2090", which isn't necessarily the tidiest way as saying the same thing (for no. days of VH+E, not fire season length which is a different measure that wasn't looked at in this paper).

The key difference between the two analyses was that Watt et al. used results for only 12 of the 17 GCMs used by Pearce et al., to be comparable with the other CC impacts they looked at.

Scion (and FENZ) are happy to stick with the current text on pg 64 of the OAC report around the above, with the citation corrected. The issue was more about the how discussion around this projected future increase can be related to the discussion of observed current trends on pgs 44-45, especially given the section title of "The risk of wildfires is changing". This might be achieved by including an introductory sentence or two clarifying this distinction in the objectives of the studies, e.g. around whether the observed trends over recent years are showing any evidence of the increases projected. This would also lead nicely into the section that follows around natural climate variations, which provides one possible explanation of why the more widespread increases projected with climate change aren't being seen yet.

Hopefully this helps clarify what we were suggesting by way of changes to the report.

Regards, s 9(2)(a)

2080s. For some models and at some locations, fire climate severity exhibits a tendency to peak by the 2050s and then remain at about the same level for the 2080s. This is the case at Kaikoura (KIX) for the IPCM4 model, where the SSR and number of days of VH+E fire danger increase significantly to the 2050s (by 161% and 310%, respectively), but then stay the same or even decrease slightly by the 2080s (164% and 304%), indicating little or no change between the two projection periods (-18% and -3%). Kaikoura (KIX) also shows a similar tendency under the HADGEM model, as does Dunedin (DNA) under the MIMR model. Some locations and models also show a greater decrease in fire climate severity from the 2050s to 2080s. Examples of this Dunedin Aero (DNA) under the ECHOG and GIEH models, where SSR increases by 59% & 26% and VH+E by 160% & 264% to the 2050s, and then decreases by -135% & -402% for SSR and -40% & -120% for VH+E from the 2050s to the 2080s, for each model respectively. Wellington (WNA) under HADGEM and MRCGCM, and again Kaikoura (KIX) under a number of models including GFCM21, GIAOM, MIHR, MPEH5 and MRCGCM, also show similar trends.

These variances in trends are further evidenced by differences in the rate of change in fire climate severity projected for the two periods. When averaged across all 17 models and station locations, the number of days of VH+E fire danger during the fire season is projected to increase by 62% from current values for the 2050s and 74% for the 2080s, but only 12% (based on current values) from the 2050s to the 2080s. There is obviously much variability between models in these rates of change, although model ranges for the 1990s to 2050s period (-12% to +490%) are less variable than those for the 2050s to 2080s (-16% to +460%). In real terms, these average changes correspond to an average increase of 3.6 day/season of VH+E fire danger from the 1990s to 2050s (range -2 to +35 days/season), and just 0.81 days/season for the 2050s to 2080s (range -10 to +16 days/season). The rates of change in SSR for the two projection periods vary less, at 26% for the 1990s to 2050s (and 30% for 1990s to 2080s), and 29% from the 2050s to 2080s, although the ranges in these rates between models are much less variable for the 1990s to 2050s (-5% to +160%) than 2050s to 2080s (-400% to +770%)

Variation Between Models

The individual Global Circulation Models (GCMs) are different representations of the climate system with different model sensitivities, rates of warming and interannual variability derived from differences in modelling resolution and the way the represent interactions between the atmosphere, oceans and land surface (and the effects of factors such as the reflective and absorptive properties of atmospheric water vapour, greenhouse gas concentrations, clouds, annual and daily solar heating, ocean temperatures and ice boundaries) (MfE 2008). The advantage of utilising an increased number of GCMs that each model climate slightly differently is that together they encompass a wider range of possible future climate outcomes, and also potentially better capture future climate variability. While the GCMs show some consistency in the relative amplitude and spatial pattern of their respective changes, there is also considerable variability (e.g. in the multi-decadal rates of warming) that results in widely varying estimates of the climate changes that influence fire danger.

2090 showed that the AEP increased on average by 0.066, and for four of the six scenarios, the AEP was >0.2 (Table 2).

The risk of wind damage for the unpruned regime was very similar to the risk for pruned stands in both 1990 and 2040. However, for projections to 2090, the risk of wind damage for the unpruned regime was substantially higher than for the pruned regime due to the higher ratio of height to diameter for this regime. These increases were particularly marked for emission scenarios that assumed a full response to increasing CO_2 (Table 2). The risk of wind damage was markedly higher for the carbon regime than for the other two regimes due to the higher height to diameter ratio of trees. The carbon regime had very high sensitivity to increasing CO_2. For projections made to 2090, scenarios that assumed a full response to increasing CO_2 had an AEP that was on average 0.33 higher than those that assumed no response, and the AEP of these three scenarios ranged from 0.639 for the B1 to 0.922 for the A2 emission scenario (Table 2). Stands grown on a carbon regime tended to be overstocked, particularly in the latter part of the rotation and the increased risk of wind damage in such situations is consistent with experiences in other regions of the world (Mitchell, 2000; Gardiner, 2002).

The relative contributions of different factors on AEP at 2040 and 2090 were determined using previously described methods (Hawkins and Sutton, 2009, 2011; Mote et al., 2015). Figure 4 shows that currently, most of the variation in AEP is attributable to location, with stand age and silvicultural regime also being important. Under future climates, mean values of AEP for a 30-year-old stand ranged from 0.18 to 0.79 across locations (data not shown). Stand age accounted for 27 per cent of the variance in AEP under future climates (Figure 4). The change in mean AEP for increasing stand age from 20 to 30 years ranged from 0.09 to 0.33 in 2040 and from 0.12 to 0.49 in 2090.

Silvicultural regime was relatively important (Figure 4), under future climates, accounting for 19 per cent of the variance in AEP (Figure 4). Mean AEP ranged from 0.21 under the pruned regime to 0.24 under the unpruned regime and 0.50 under the carbon regime (Table 2). The growth response to increasing CO_2 had relatively little impact on AEP in 2040 but a greater impact in 2090, at which time it was equal in importance to the silvicultural regime. Relative to other factors, both emissions uncertainty and increasing wind speed had very little effect on AEP, and together, they accounted for less than 4 per cent of the total variance during both 2040 and 2090 (Figure 4).

Table 2 AEP of wind damage in 30-year-old stands as a function of simulation year, emission scenario and CO_2 concentration for three silvicultural regimes. Values shown represent the means across seven bio-geo-climatic zones defined by their current wind climate. Values of AEP are differentiated by colour into the categories of AEP < 0.20 (green), 0.2–0.5 (orange) and >0.5 (red).

Year	Emission scenario	Inc. CO_2	Silvicultural regime		
			Pruned	Unpruned	Carbon
1990			0.110	0.094	0.166
2040	B1	N	0.152	0.143	0.262
2040	A1B	N	0.164	0.155	0.291
2040	A2	N	0.230	0.154	0.288
2040	B1	Y	0.150	0.172	0.419
2040	A1B	Y	0.164	0.203	0.507
2040	A2	Y	0.164	0.197	0.493
2090	B1	N	0.186	0.182	0.344
2090	A1B	N	0.238	0.242	0.443
2090	A2	N	0.272	0.278	0.483
2090	B1	Y	0.191	0.256	0.639
2090	A1B	Y	0.267	0.431	0.850
2090	A2	Y	0.321	0.522	0.922

Fire risk

Under the baseline climate, dryland areas on the west coast had the highest average number of VH + E fire danger days per year, while many areas on the west coast had very few, or no VH + E days. There was widespread spatial variation in the degree of change in frequency of VH + E days between baseline and future climate (Figure 5). The regions with the most notable VH + E increases were located on the eastern coast in the southern half of both islands.

Examination of the fire risk by location demonstrates the high variation between sites with the frequency of VH + E fire risk under the baseline climate ranging from 0 to 40 days (Figure 6). When averaged over all sites, the number of days with VH + E fire risk was projected to increase by 71 per cent by 2040, and by a further 12 per cent by 2090. All sites on the east coast showed increases under climate change. The locations with highest current fire risk, Christchurch and Gisborne, had significant further increases in VH + E fire risk by 2090 to 44 and 48 days, respectively. However, the most marked relative changes occurred in Wellington (lower North Island) and Dunedin (south-eastern South Island) where VH + E fire risk increased to 2090 by, respectively, 89 per cent to 32 days and 207 per cent to 18 days (Figure. 6).

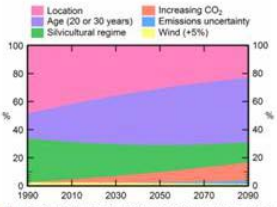

Figure 4 Relative contribution of location, stand age, silvicultural regime, increasing CO_2, emissions scenario and wind speed to AEP. Values of relative importance used in the figure were extracted from Table 2 and relative importance was interpolated between years using second-degree polynomials.

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Scion
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Web http://www.ruralfireresearch.co.nz

From: s 9(2)(a)
Sent: Wednesday, December 9, 2020 2:26 PM
To: s 9(2)(a)
Cc: Drew Bingham <xxxx.xxxxxxx@xxx.xxxx.xx>
Subject: Question from MfE on their OAC2020 Report

Hi s 9(2)(a)

I trust this finds you well.

I have been in touch with Drew Bingham at MfE regarding our recommendations. One of the recommendations I sent was a "correction is required in the OAC2020 (Our Atmosphere and Climate 2020) report; such that the MAF report from 2011 and the results it presents (attached) are used as the citation on pg 64 of OAC2020. According to s 9(2)(a) , these are the most recent and relevant research results available on this topic."

In response, Drew asks:

"I just wanted to clarify with you on the third point – is the recommendation that only the citation on p64 needs to be changed and everything else is fine, or that the entire paragraph needs to be changed to reflect the new citation? I can't really tell if he's saying that the MAF report is the basis of the statements on the web page that we originally cited, or that the statements on the Scion webpage that we cited are incorrect and that we should be citing the report instead, and updating the paragraph as well with different findings.

I had a look through the report and did not see any sections that appear to readily support the material on the Scion web page (and subsequently in our report), but there is a lot of technical information, so if the author tells me to use that report to support the statements on the webpage and report, I'm happy to do so.

s 9(2)(a) - Can you please let us know your response to the query above? I've Cc'd Drew Bingham here so he can receive your thoughts directly – rather than me risk miscommunicating them by being the messenger.

Many thanks, s 9(2)(a)

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