Historical and Modelled Climate Data issues with Extreme Weather: An Agricultural Perspective

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When Crops are in the fields –it’s looking good:

Trend in Summer Temperature (L) & Summer Rainfall (R) 1948-2012

Mean Annual Temperature Has and is PROJECTED to Increase

Sequence:
- 1961-1990 Obs
- 1971-2000 Obs
- 1981-2010 Obs
- 2020s Projection
- 2050s Projection
- 2080s Projection

AR5, RCP8.5
ENSEMBLE AVG
Mean Annual Precipitation Has and is PROJECTED to Increase

Sequence:
1961-1990 Obs
1971-2000 Obs
1981-2010 Obs
2020s Projection
2050s Projection
2080s Projection

AR5, RCP8.5
ENSEMBLE AVG
Warmer and Wetter Appears BETTER - but isn’t the whole story

Growing Degree Days Change % 2050s

- +35%

- +32%

Summer (J-J-A) Water Deficit Change % 2050s

- +41%

- +68%
Then we have EXTREMES:

- It is *virtually certain* that *increases in the frequency and magnitude of warm daily temperature extremes and decreases in cold extremes* will occur in the 21st century at the global scale.

- It is *very likely* that the length, frequency, and/or intensity of *warm spells or heat waves* will *increase* over most land areas

- It is likely that the frequency of *heavy precipitation* or the proportion of total rainfall from heavy falls will *increase* in the 21st century over many areas of the globe

- Extreme events will have *greater impacts on sectors* with closer links to climate, such as water, *agriculture and food security*, forestry, health, and tourism

- Attribution of *single extreme events* to anthropogenic climate change is challenging

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**The growing season length & growing degree day averages are certain to increase, but these benefits can be completely erased by a likely increase in extremes**

Points above: IPCC (2012) SREX (Extremes Report)
Extremes: A Challenge for Climate Projection Models (Physics & Scale)

• The models are mathematical simplifications of our climate system and although getting better and more complex, they are approximations

We can’t forecast localized thunderstorm, windstorm, hailstorm, deluges from our much more detailed everyday forecast models – imagine trying to say something about specific locations for these events in the distant future

Seasonal forecasts (for the next few months ahead) have a dismal track record, yet this is perhaps the most useful for agriculture

• The models (no matter how ‘high resolution’), are ill-suited (temporally and spatially) for extremes (Importantly: high resolution models need coarse model data as their input)

Extremes tend to occur at small scales (often less than 1km) and short time scales (minutes)

We can safely say ‘models suggest an increase in extremes in certain regions’, but not exactly where and when
Confidence in climate change model results is not uniform.

Climate models are more effective at means and large-scale weather systems / storms.

More CERTAINTY:
- Warmer winters
- Longer growing season (frost-free)
- More heat waves
- More winter precipitation
- More intense rainfalls

Less CONFIDENCE:
- Difficult to resolve convective storms in climate models / historical analysis
- More ice storms
- Increase in wind extremes
Some Uncertainties to Consider:

A. Natural Variability of Climate (e.g. El Nino)

B. Future Emission Pathway

C. Model Physics and Scale... getting better
Extreme Projections – Useful for Agriculture?

• Yes – the models serve as good indications of increasing extreme events

• Trends in extreme events are consistent with what the models are projecting (so we have confidence)

• Model projections of extremes generate a wider range of outcomes, so multiple estimates are required – individual models or methodologies should not be the only guidance

• Methods such as using ‘model ensembling’, statistical downscaling or weather typing can help

Quantifying Uncertainty:

Our best proxy for uncertainty is the `model spread` of projections:

Model projections all relatively close: (more confidence)
Model projections very spread out: (less confidence)

We can only do this with ENSEMBLES – look at many model projections
There are many Future Impacts which can affect Agriculture:

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<td>Decreased Sea / Lake Ice Coverage</td>
<td>Increase of Rain versus Snow</td>
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<td>Increased potential for Ice Storms</td>
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<td>Changing Storm Tracks</td>
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<td>Biodiversity and invasive pests/disease</td>
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<td>Human Health (heat/flood/disease/infrastructure failure)</td>
<td>Insurance Sector</td>
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THANK YOU, shameless plug time:

Join RSI and me tomorrow at noon ROOM 209 for the launch of a new customized climate change projection tool

(CCHIP) ‘Climate Change Hazards Information Portal’

for practitioners of all sectors including AGRICULTURE

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