

Background to the Soils Mapping project

Jim McAdam



Overview

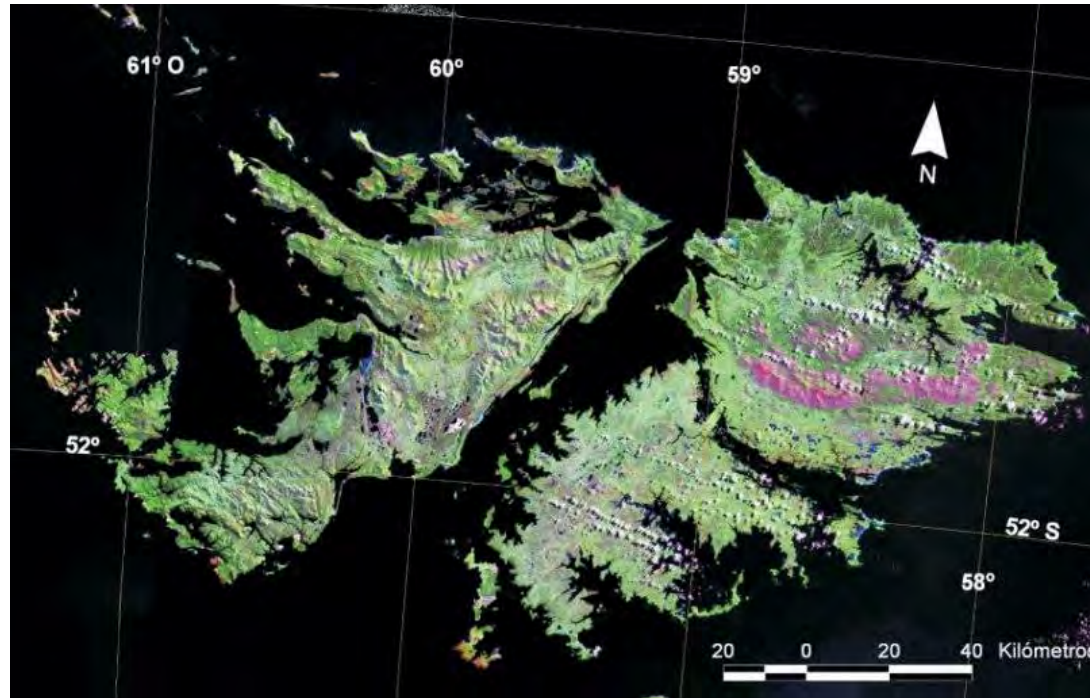
1. Climate change predictions for the Falklands

2. Potential risks, impacts and adaptations–

- *wild plants*
- *pests and diseases*
- *wildfires*
- ***Evapotranspiration and soil moisture***
- ***soil carbon***
- ***erosion risk***

3. The soil mapping project

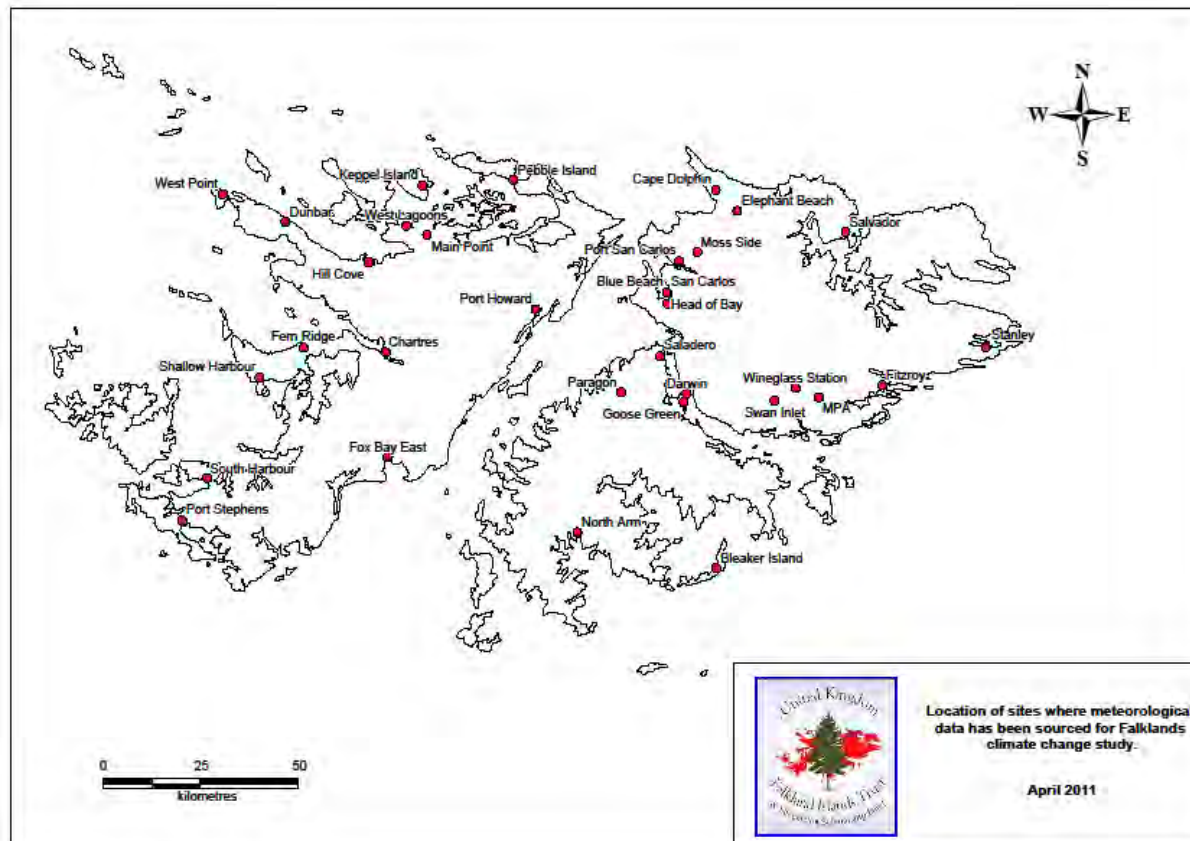
Climate Change Predictions for the Falklands



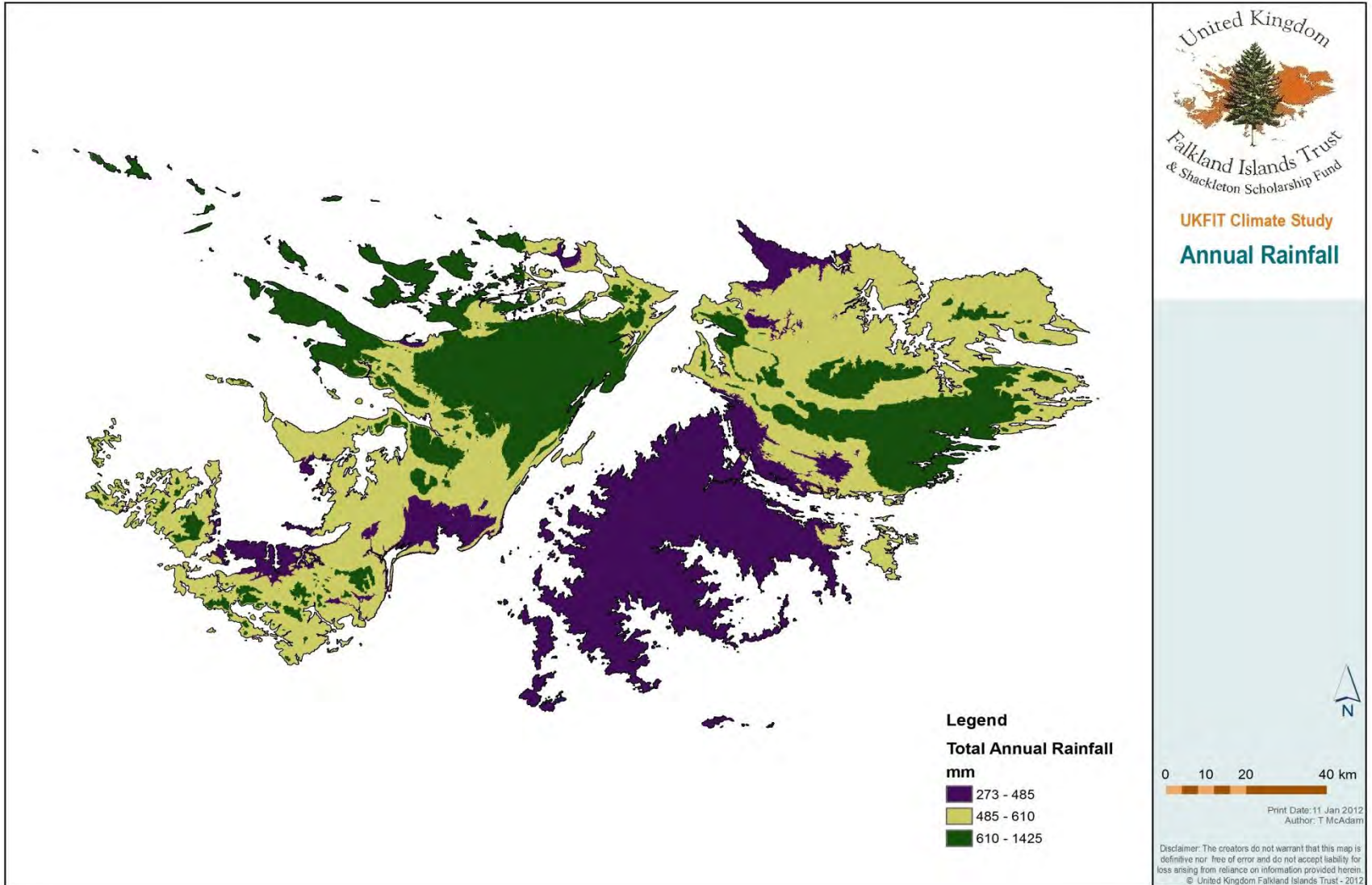
From the report (2013) “Construction of high spatial resolution climate scenarios for the Falkland Islands and Southern Patagonia” by Phil Jones et al, Climate Research Unit, University of East Anglia

Weather records for the Falklands

- Limited number of long-term sets of records and distribution of stations

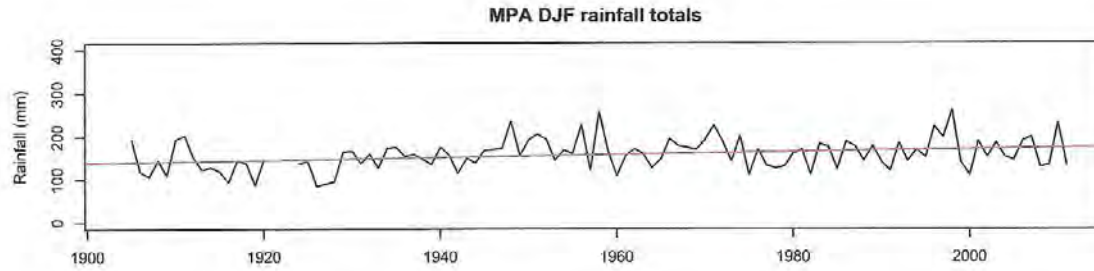


Falklands Rainfall-adjusted for elevation

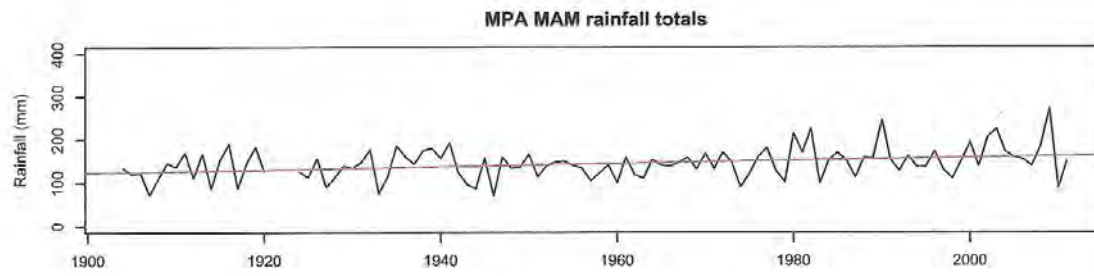


RAINFALL

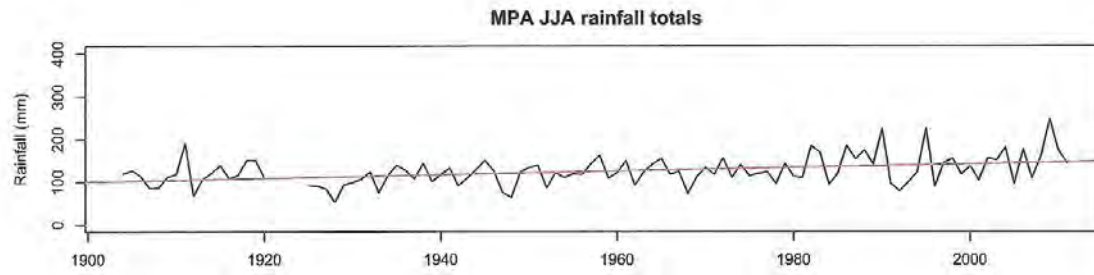
SUMMER



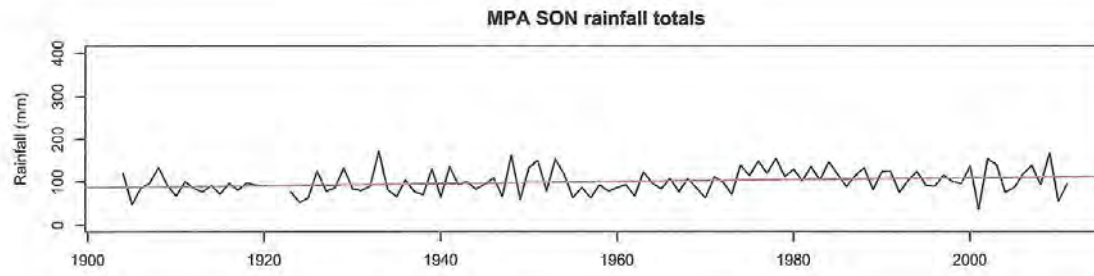
AUTUMN



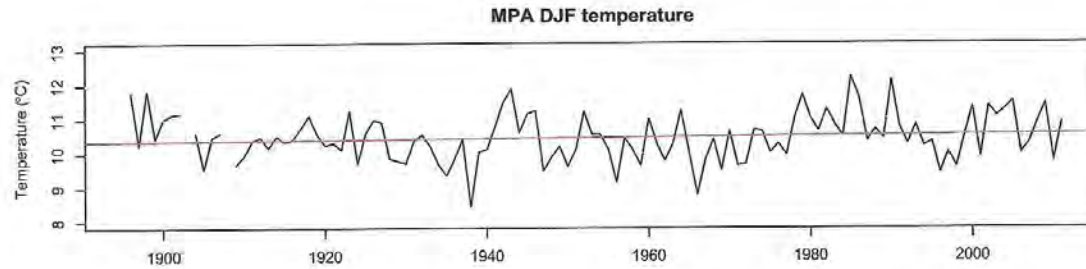
WINTER



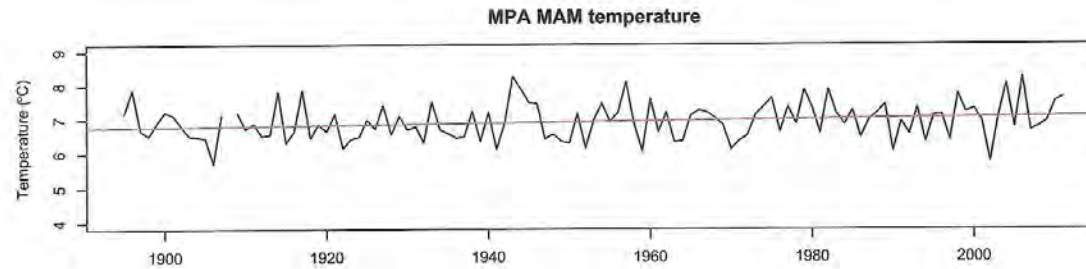
SPRING



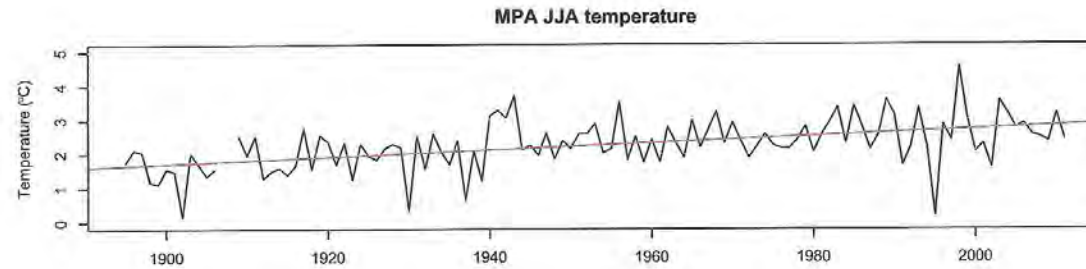
TEMPERATURE



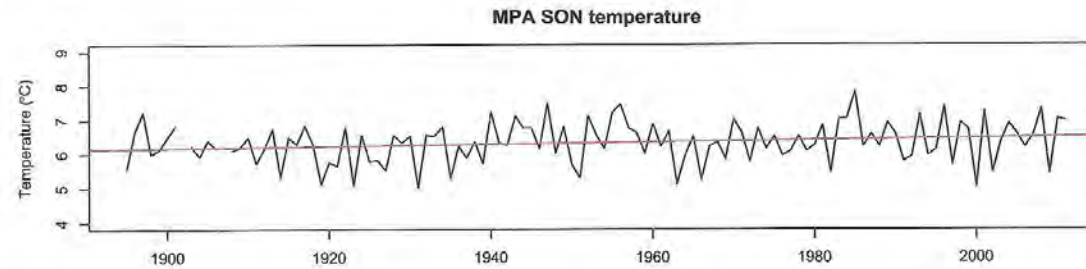
SUMMER



AUTUMN

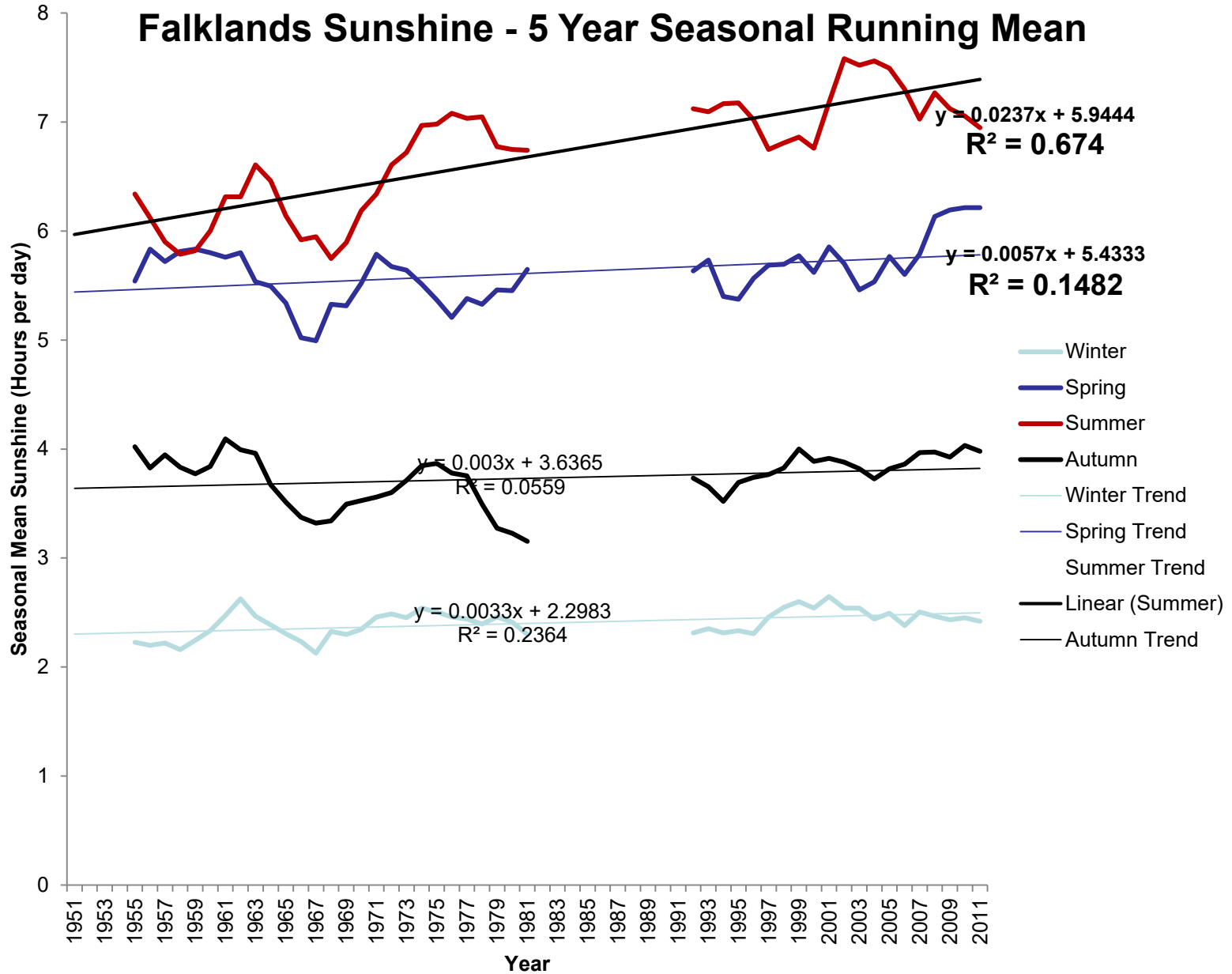


WINTER



SPRING

Falklands Sunshine - 5 Year Seasonal Running Mean



STORMINESS INDEX

Long-term trends in Gale Days and Storminess for the Falkland Islands

Philip D. Jones, Colin Harpham and David Lister (2015)

Climatic Research Unit

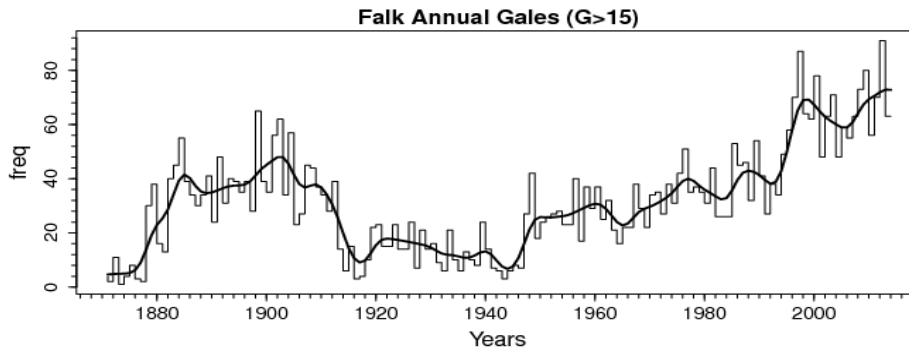
School of Environmental Sciences

University of East Anglia

Annual counts of Gale, Severe and Very Severe Gale days for the Falklands (1871 to 2013)

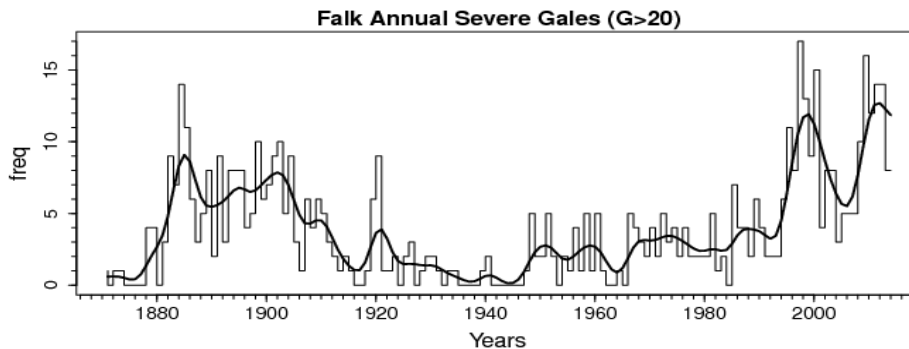
Falklands – 20CR (1871–1947) & NCEP (1948–2014)

80



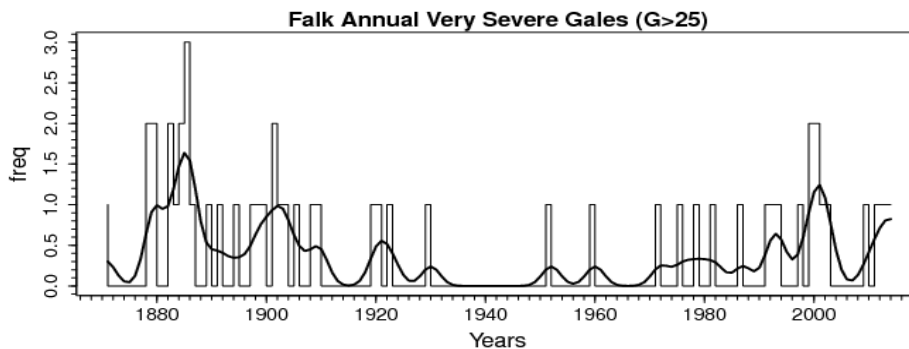
Gales

15



Severe gales

3.0



Very severe gales

Temperature projections

Assuming base line mean 1961-1990 - **6.57 ° C**

	2011-2040	2041-2070	2071-2111
Mean Prediction (°C)	7.18	7.67	8.40
Mean predicted temp increase	0.61	1.10	1.83 (27.8%)
Predicted upper bounds of temp increase	0.85	1.33	2.16 (33%)
UK Prediction			5-7° C

Rainfall projections

Assuming base line mean annual pptn - 1961-1990 **559.2mm**

	2011-2040	2041-2070	2071-2111
Mean Prediction (mm)	561.0	561.6	538.4
Mean predicted pptn change	+1.8	+2.4	-20.8 (3.7%)

Warmer air holds more moisture so increasing temperatures and fixed rainfall means more episodic heavy rains and flash floods.

Summary

- Climate fairly constant since records began
- Predicting a significant temperature rise (+2.2 C)
- No change in overall DTR or Precipitation
- Seasonality-can't predict but warmer air holds more moisture so heavier rain likely
- Likely that storminess will become less predictable and more extreme

Overall message-increased temperature makes weather and climate less predictable and extremes more frequent

Priority Impacts on terrestrial ecosystems

- **Increased soil moisture deficits and erosion**
- **Changes in soil carbon content**
- Changes in plant pests, diseases + invasive plants
- Changes in the ranges of native plants
- Habitat disturbance by extreme events – wildfire occurrence



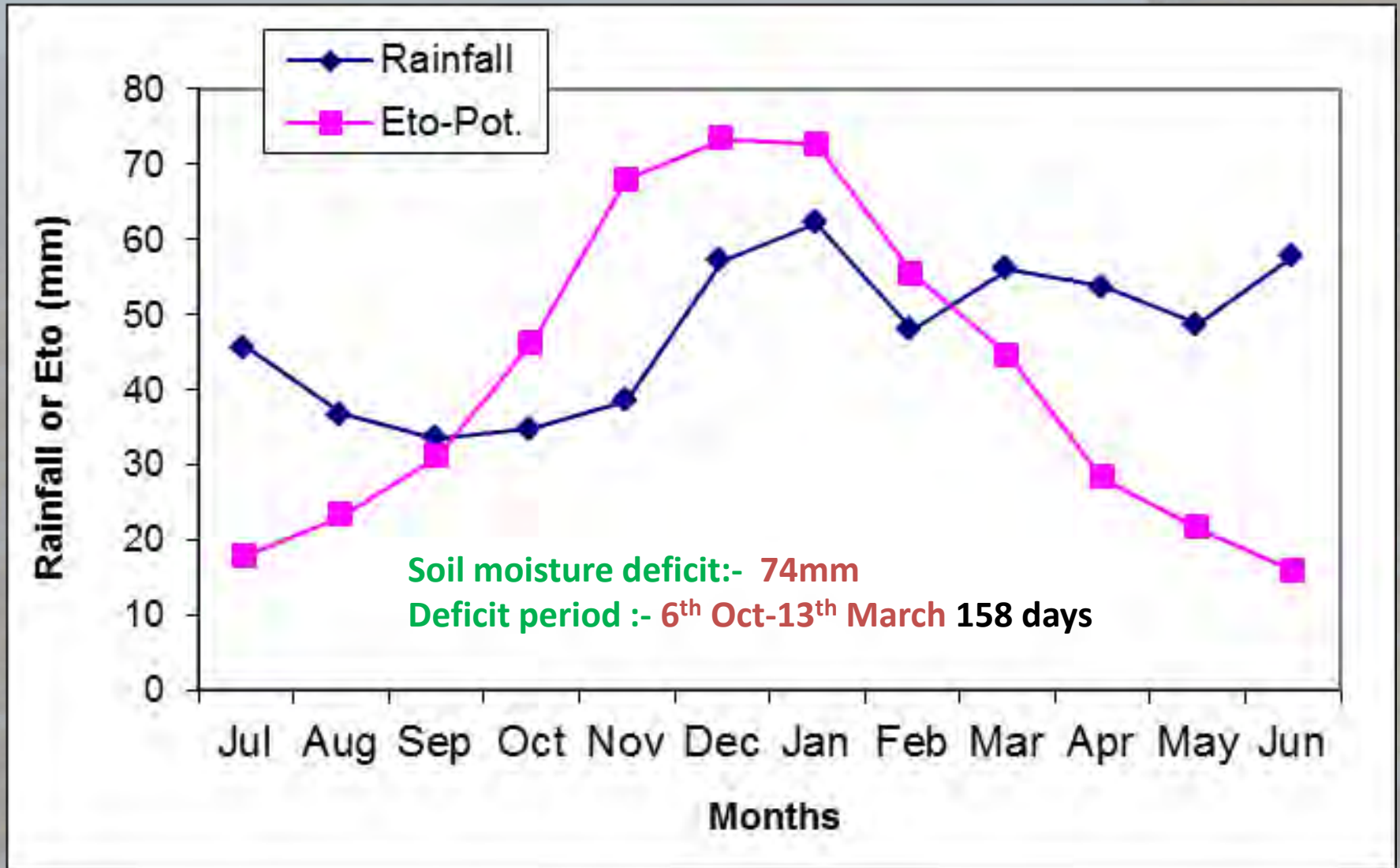
Impact on Soils

- Evapotranspiration and soil moisture deficit
- Soil carbon
- Soil erosion

Evapotranspiration

- Evapotranspiration is the combination of two separate processes whereby water is lost on the one hand from the soil surface by evaporation and on the other hand from the crop by transpiration.
- **The soil water deficit is based on the difference between evapotranspiration and rainfall and the carry-over of deficit from one month to the next.**

Rainfall and potential evapo-transpiration-**current** situation.
(Based on MPA rainfall mean **573mm** PET 497)



Soil moisture deficit

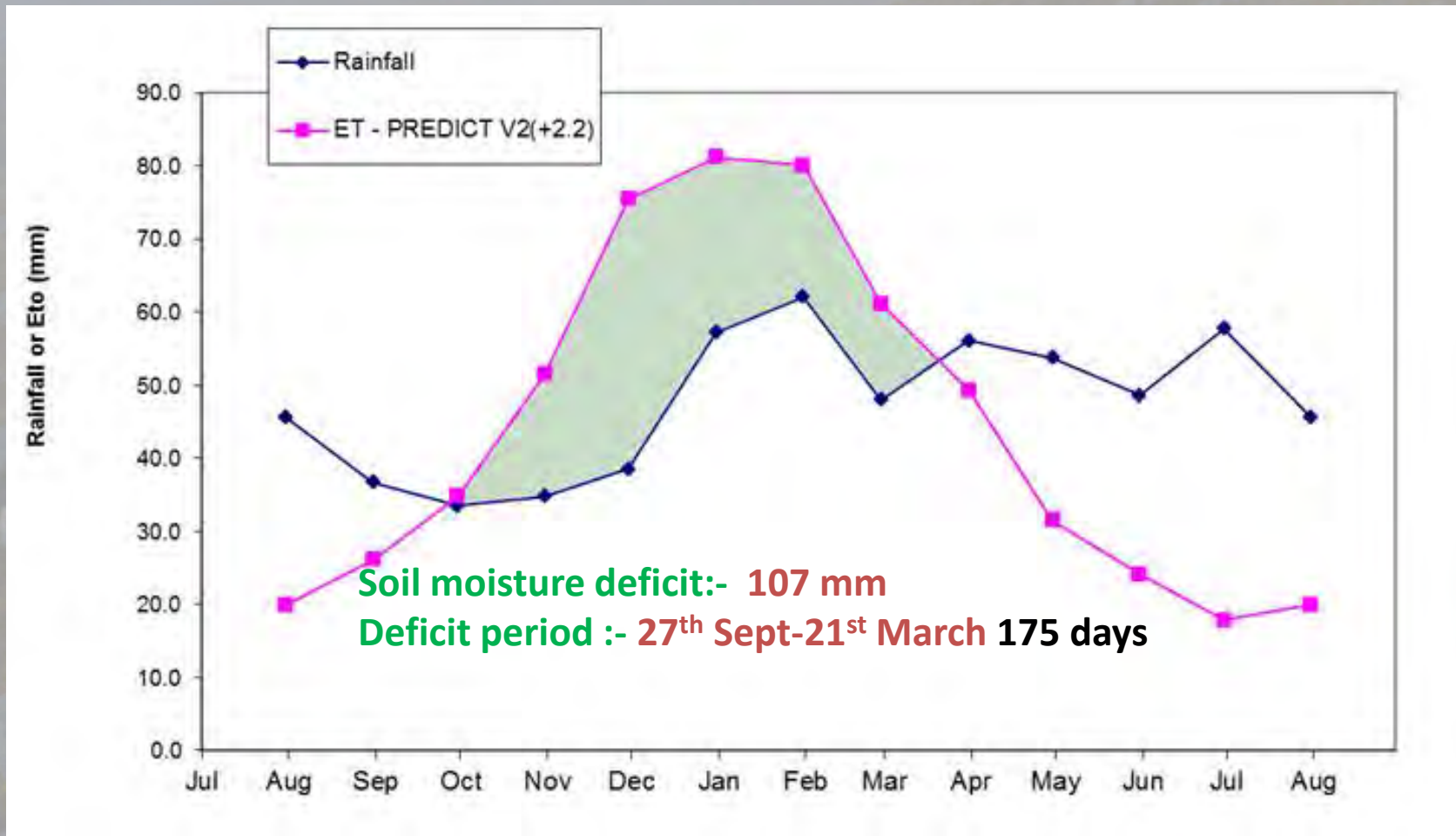
- There are approximately 5 summer months (October to February) when evapotranspiration exceeds rainfall – this is therefore potentially a **soil moisture deficit period**.
- This is a key issue for the Falklands

Predicted change in ET

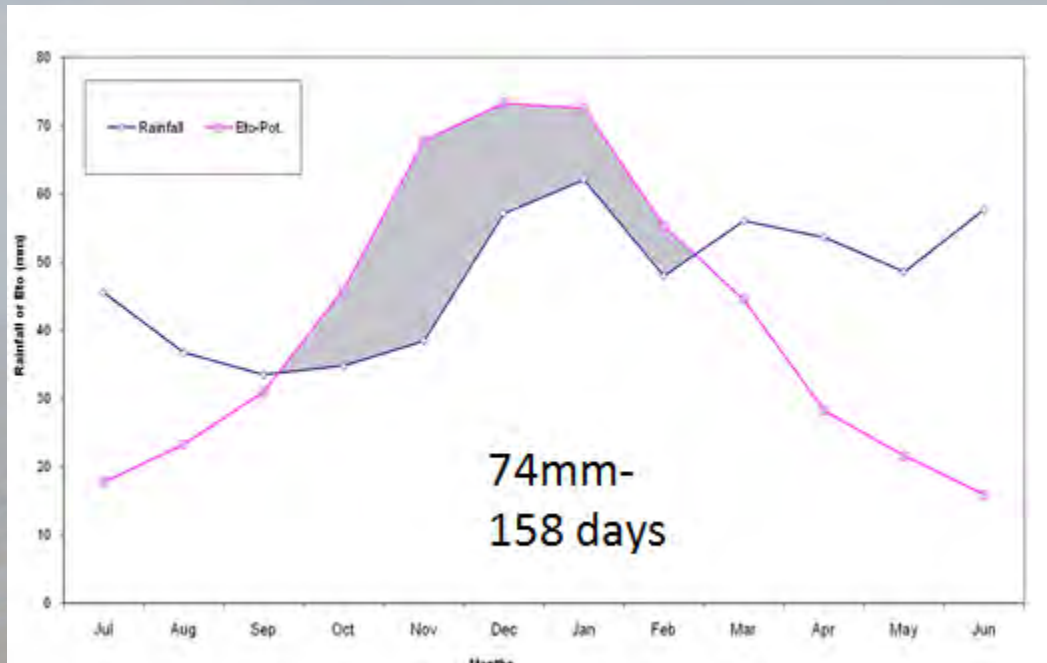
Not straightforward-not a direct measurement.

For the Falklands we substituted the UEA temp and rainfall predictions

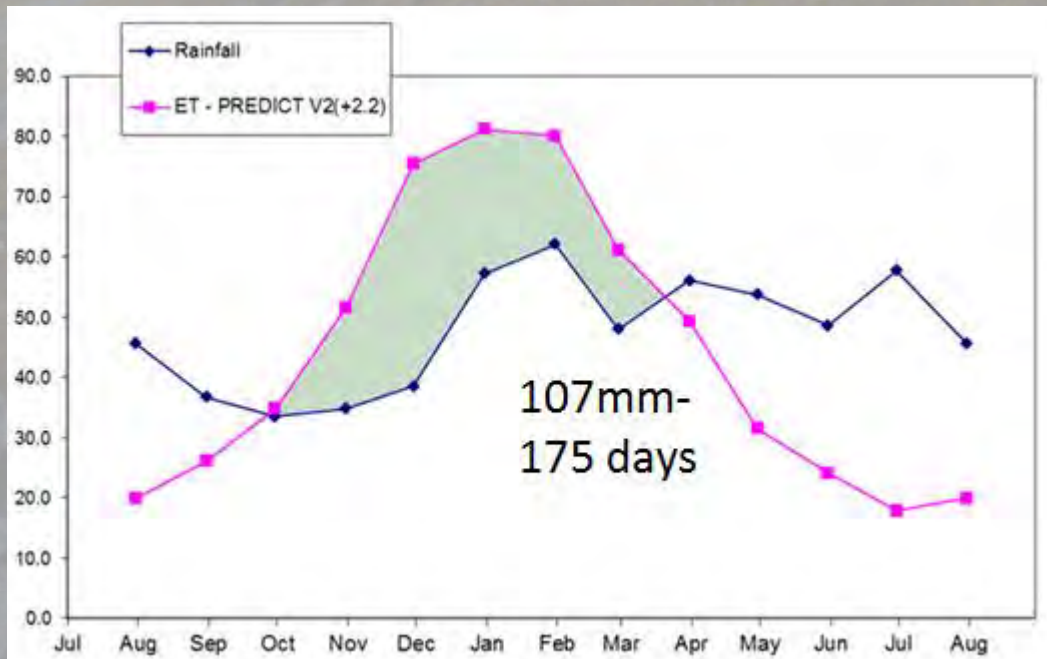
The predicted profile assuming no change in rainfall and ET predictions by substituting UEA temp data (+2.2 deg C).



CURRENT



PREDICTED



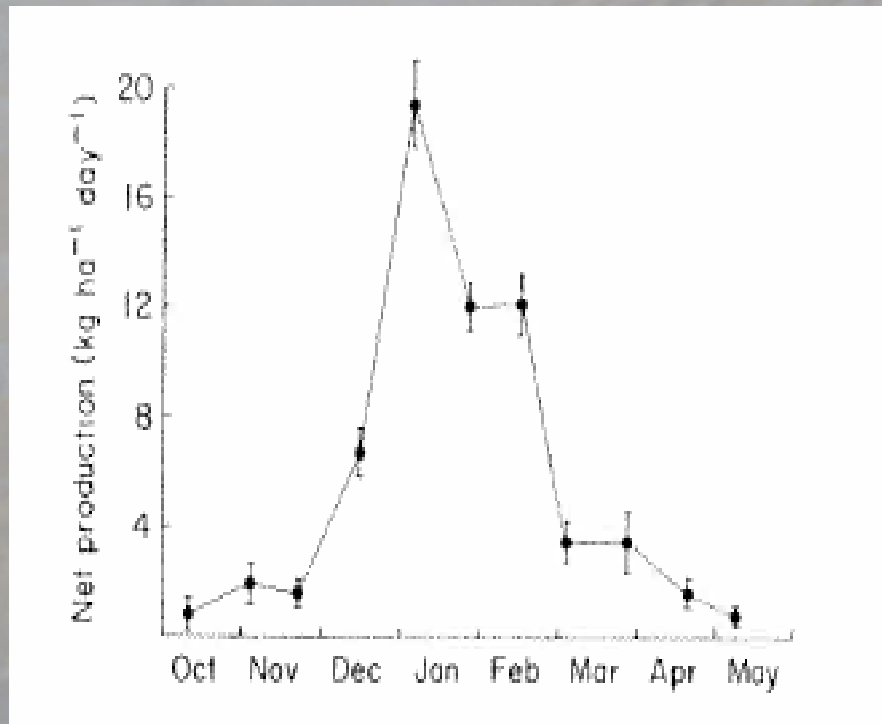
Summary of predictions to 2110

- potential increase in the seasonal soil moisture deficit period would be between **8-17 days**. The predicted increase in **overall ET** is about 10%.
- predicted change in the **soil moisture deficit**, is approximately **27mm (a 37% increase)** If simulated change rainfall data are added, the change is approximately **36mm (a 48% increase)**.
- Predictions tend to indicate **a swing towards more increase in the spring soil deficit rather than later in the growing season.**

Potential Implications

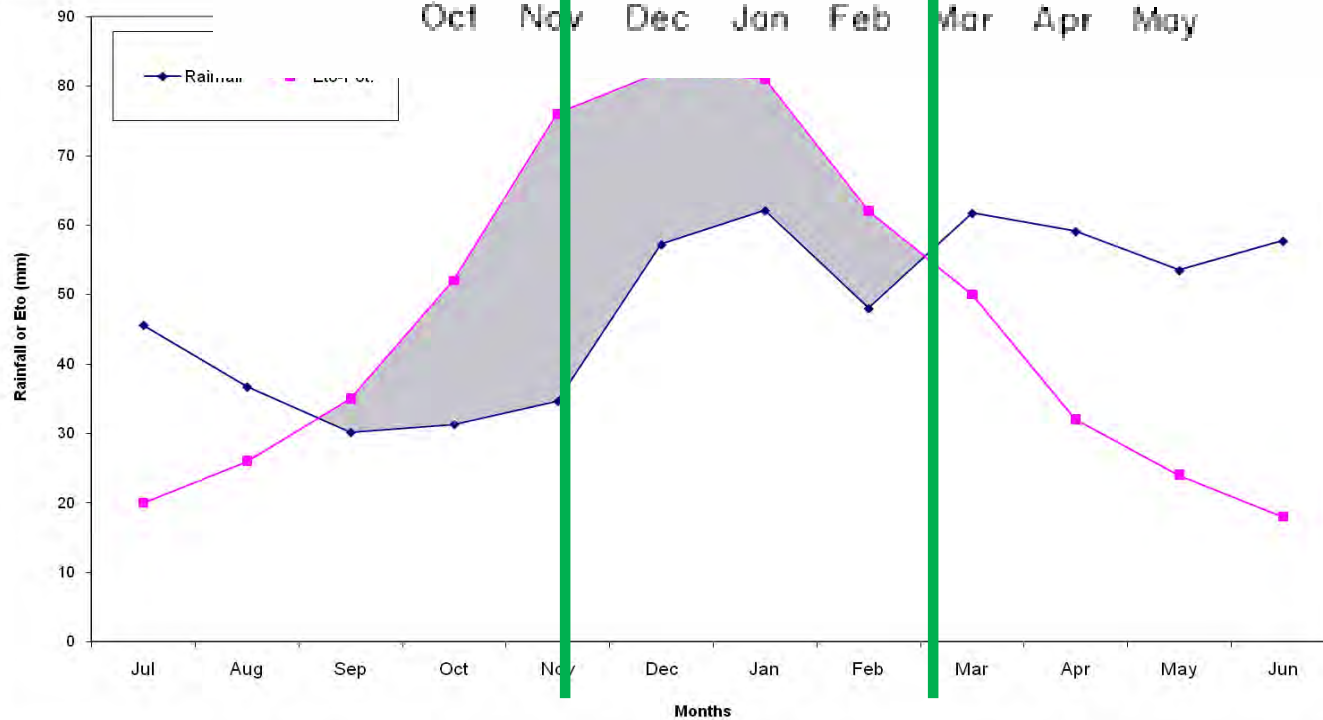
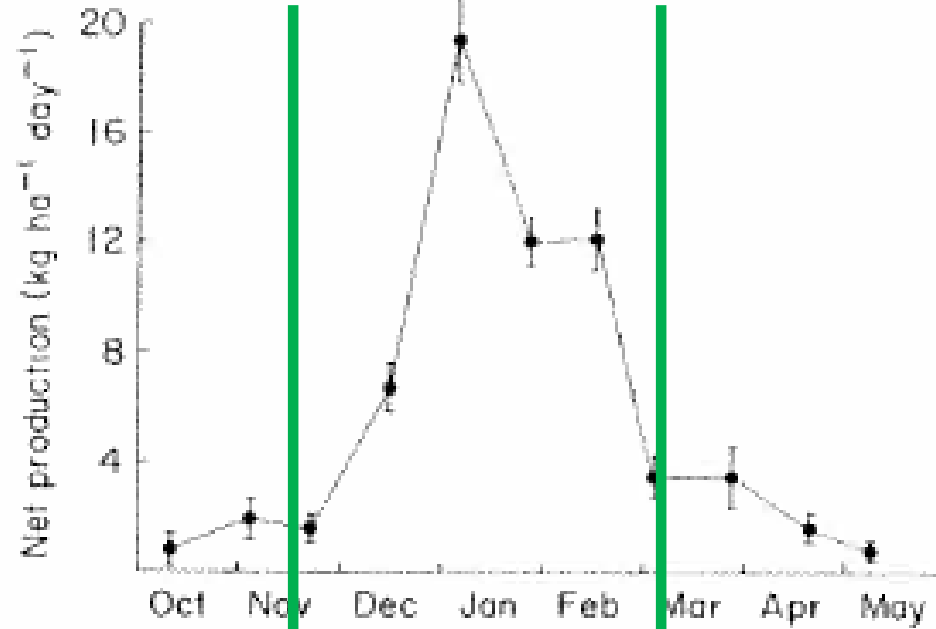
for pasture growth and cropping.

- The increase in soil moisture deficit, particularly in spring will impact on grass growth



The net production of Whitegrass cut at 45-day intervals over the growing season.

Whitegrass growth and ET



Potential Impacts and mitigation

-wildfires



Nov 2012



Burning of hard/dry camp

- Munro(1924), Davies (1939), Davies et al (1971) all caution against burning dry/hard camp. The risk of erosion is great.
- The risk of fire will increase under CC scenarios- longer soil moisture deficit risk period in spring; Greater risk of erosion from flash floods/ extreme rainfall events
- The habitats that will be most vulnerable are those that are driest and most flammable such as:

Diddle dee, tussac and bogged whitegrass

Soils

- Soils are fundamental to the determination of habitats and the range and success of agriculture
- A knowledge of the soils and their distribution has become the norm in most countries to the understanding and well-being of both
- Soils tend to be shallow, acid (pH 4-5), weathered and infertile. We know virtually nothing about the biological potential of soils here-fundamental to soil fertility and soil health
- The Falkland Islands have no existing soil map despite a series of proposals made to produce one since 1967

Changes in soil carbon content

- Based largely on proxy research on similar northern hemisphere peaty soils, predicted climate changes are likely to decrease soil organic carbon through
 - **Increased decomposition relative to plant productivity**
 - **Irreversible desiccation and drying out of peat**
 - **Increased erosion**
 - **Increased fire risk**
- **It is important to retain Litter production and a “crust” at ground surface (depending for e.g. on moisture balance)**

Summary-impacts of loss of soil carbon

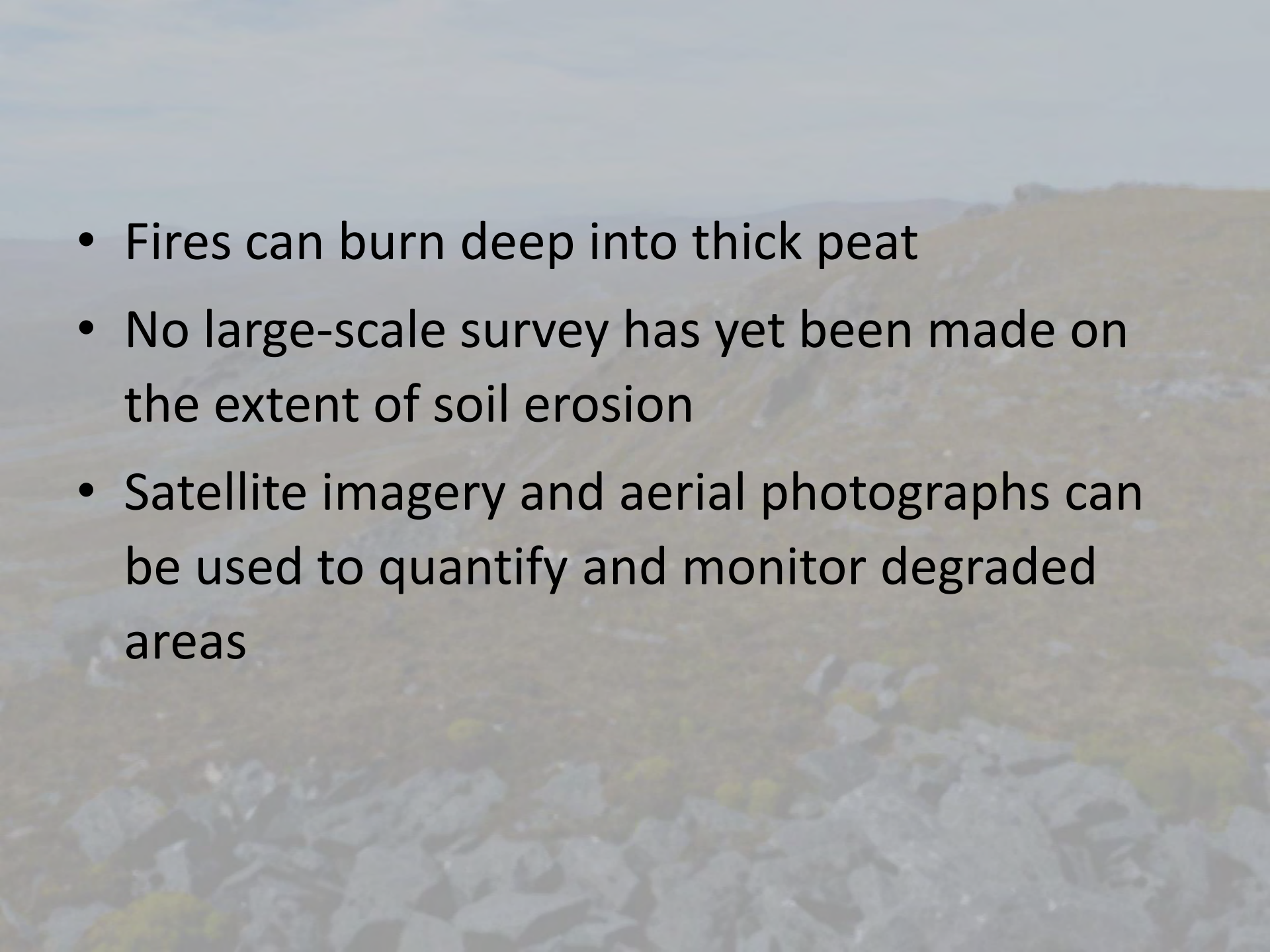
Loss of soil organic carbon would have major implications for soil quality as it is known to improve these soil characteristics-

- the physical (e.g. soil aggregation, soil strength, soil water retention),
- chemical (e.g. pH)
- biological (e.g. through its role as the energy source for microbial processes). A key element of this project

Harmful reductions in soil carbon can lead to a loss of soil structure leading to increased erosion, compaction and flooding risks.

Soil Erosion

- Erosion instigated by fire, both natural (lightning) and planned (pasture improvement and/or overgrazing)
- Uncontrolled, fire commonly results in destruction of surface peaty horizon, stopped by mineral soil or pan
- Pasture improvement can fail, with erosion of the fragile peat by wind and water

- 
- Fires can burn deep into thick peat
 - No large-scale survey has yet been made on the extent of soil erosion
 - Satellite imagery and aerial photographs can be used to quantify and monitor degraded areas

Heavier rainfall events

- Flash floods
- Bog bursts
- Erosion risk



Bog burst, Glenelly, Co Tyrone, N. Ireland





The need....

- In the context of climate change mitigation, adaptation and resilience, there is a need for a soil/peat map of the Falklands.

Soil Mapping Project

Dr. Stefanie Carter



Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL