

Supporting Change in Farming Systems Research

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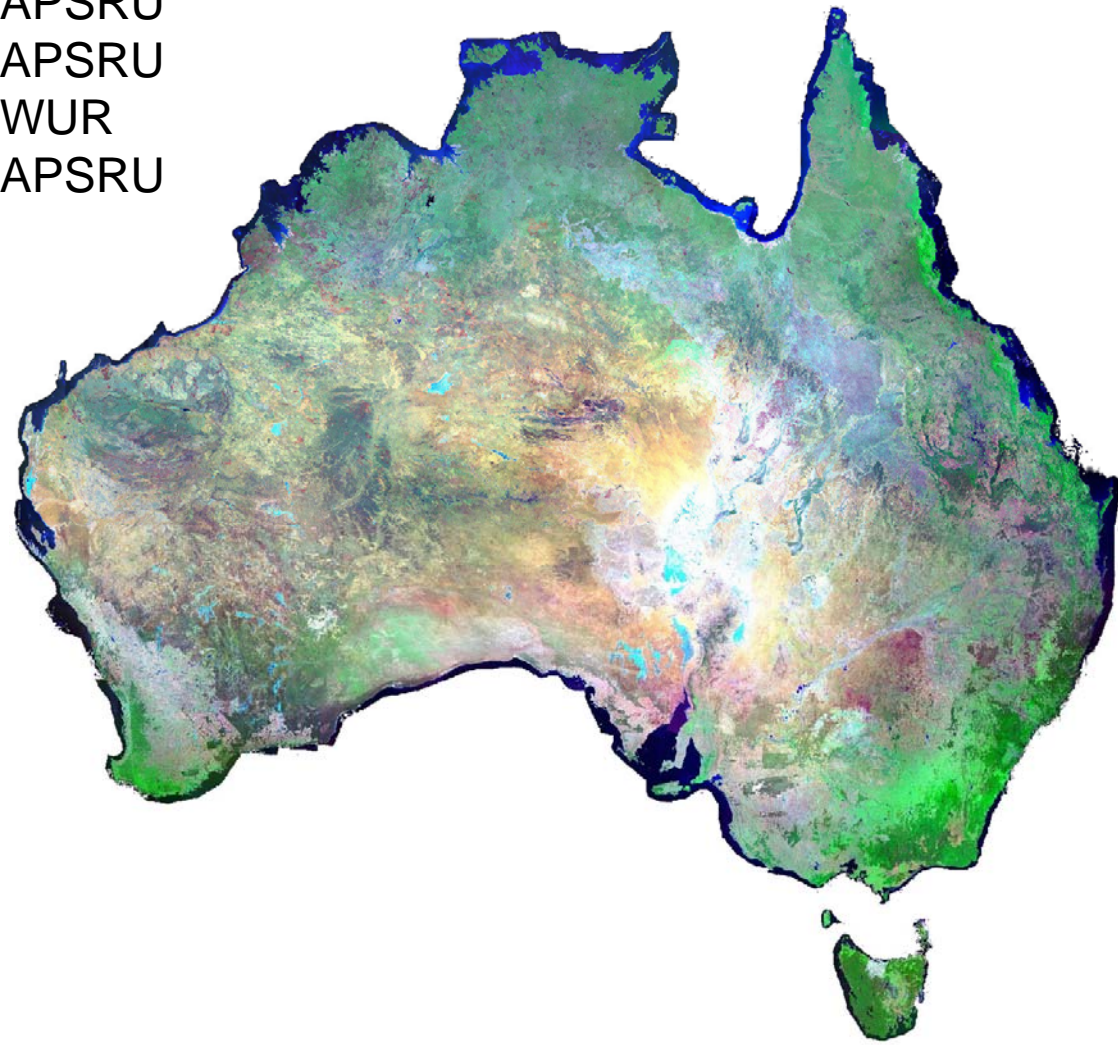
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Brendan Power

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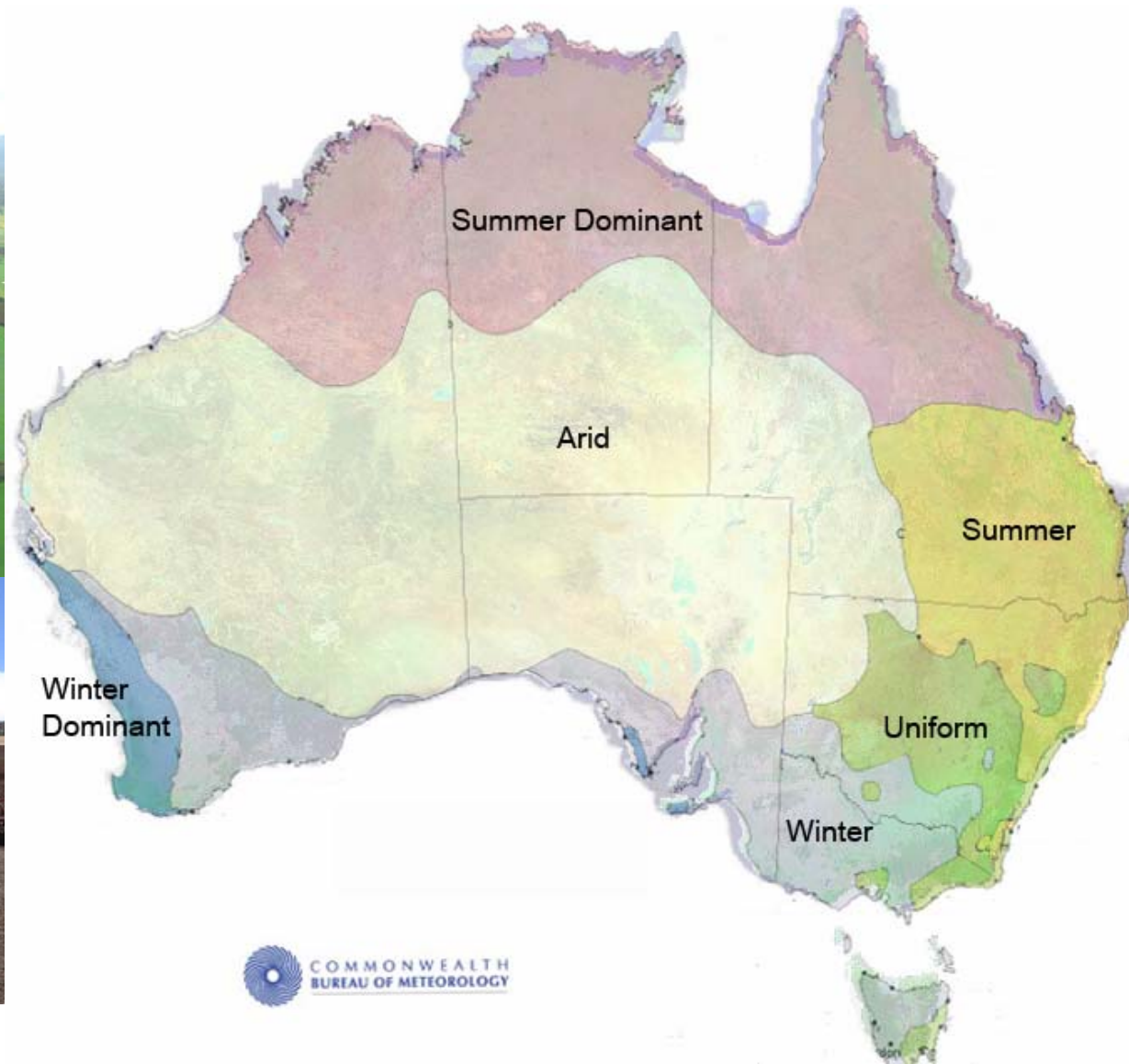
AGRO2010, Montpellier.



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- Apsim & farm scale management
- Component based design
- Samples of WFM applications
- Informed Change

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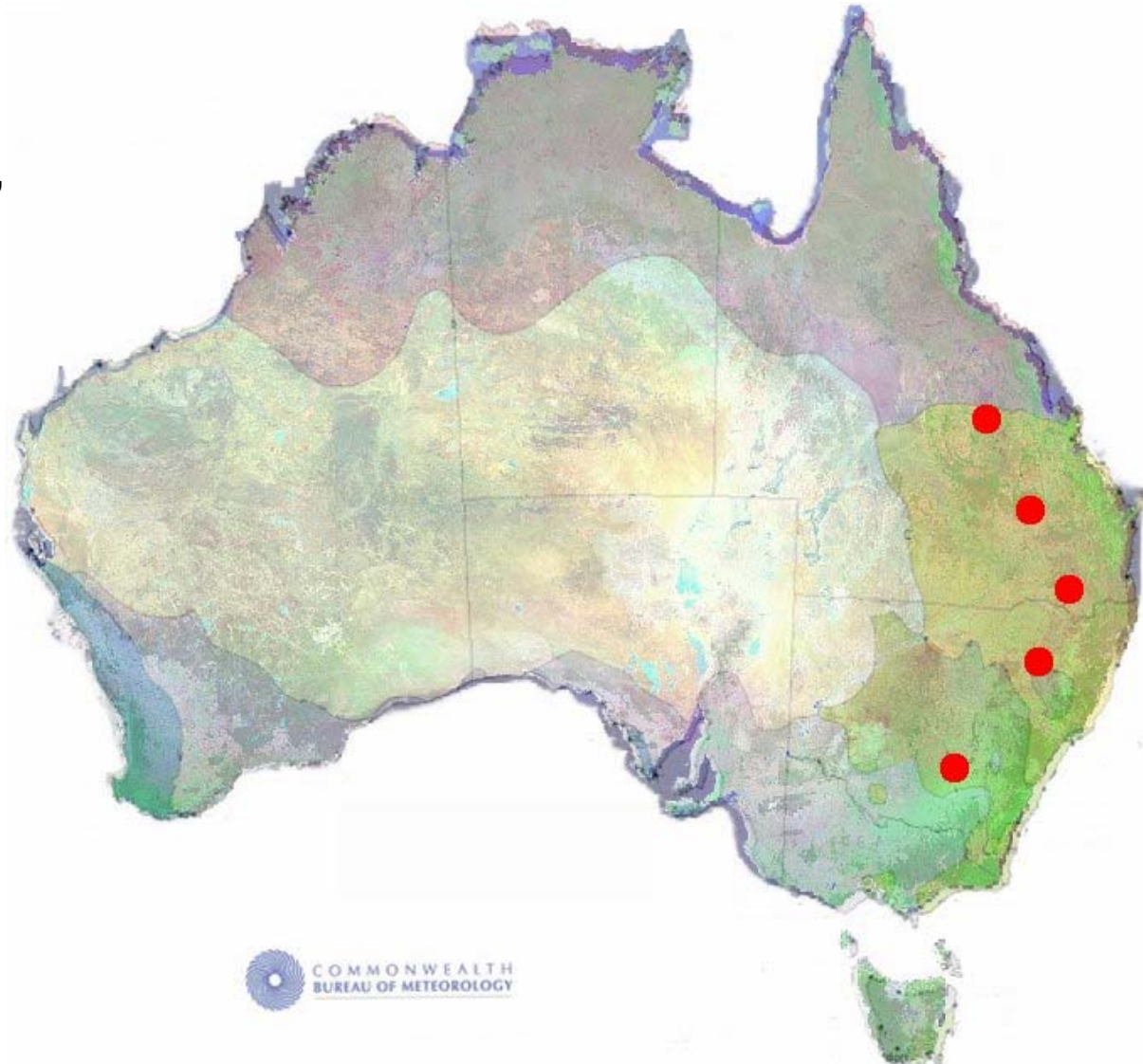


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Case studies:

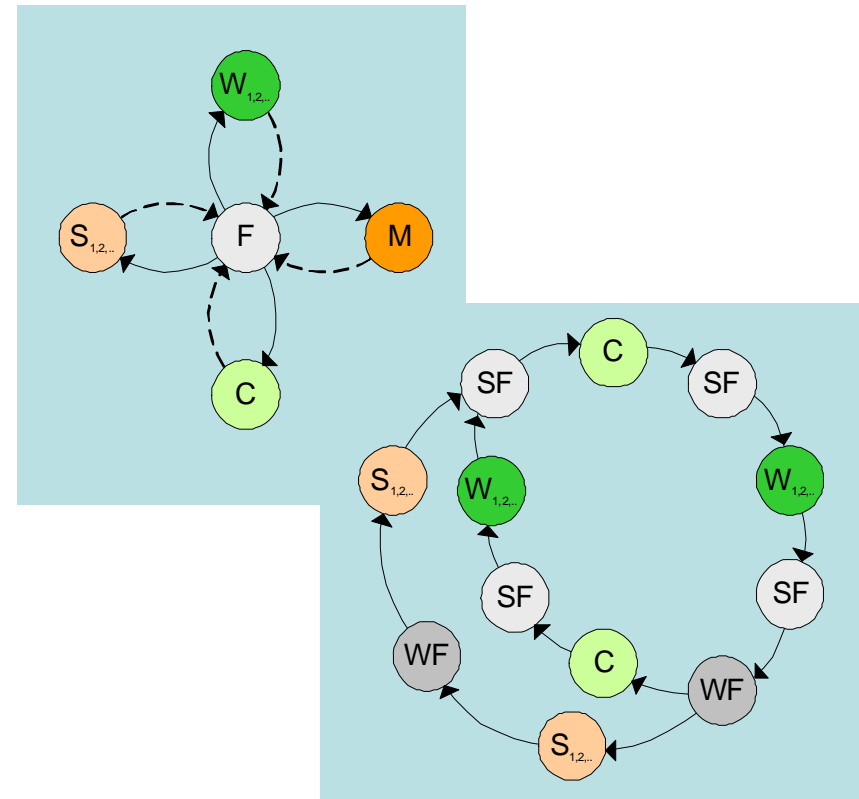
Long growing season(s),
High rainfall variability

Irrigation
Broadacre Dryland
Mixed Grain & Grazing



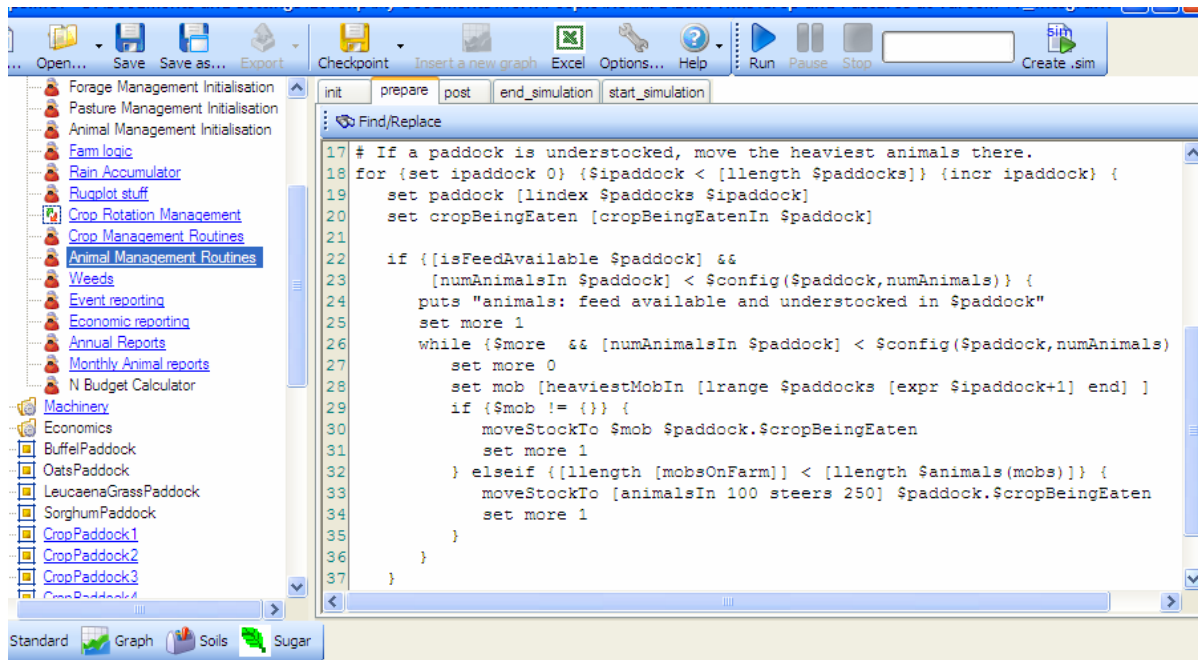
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Climate variability → Dynamic (responsive) management.



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Dynamic (responsive) management:



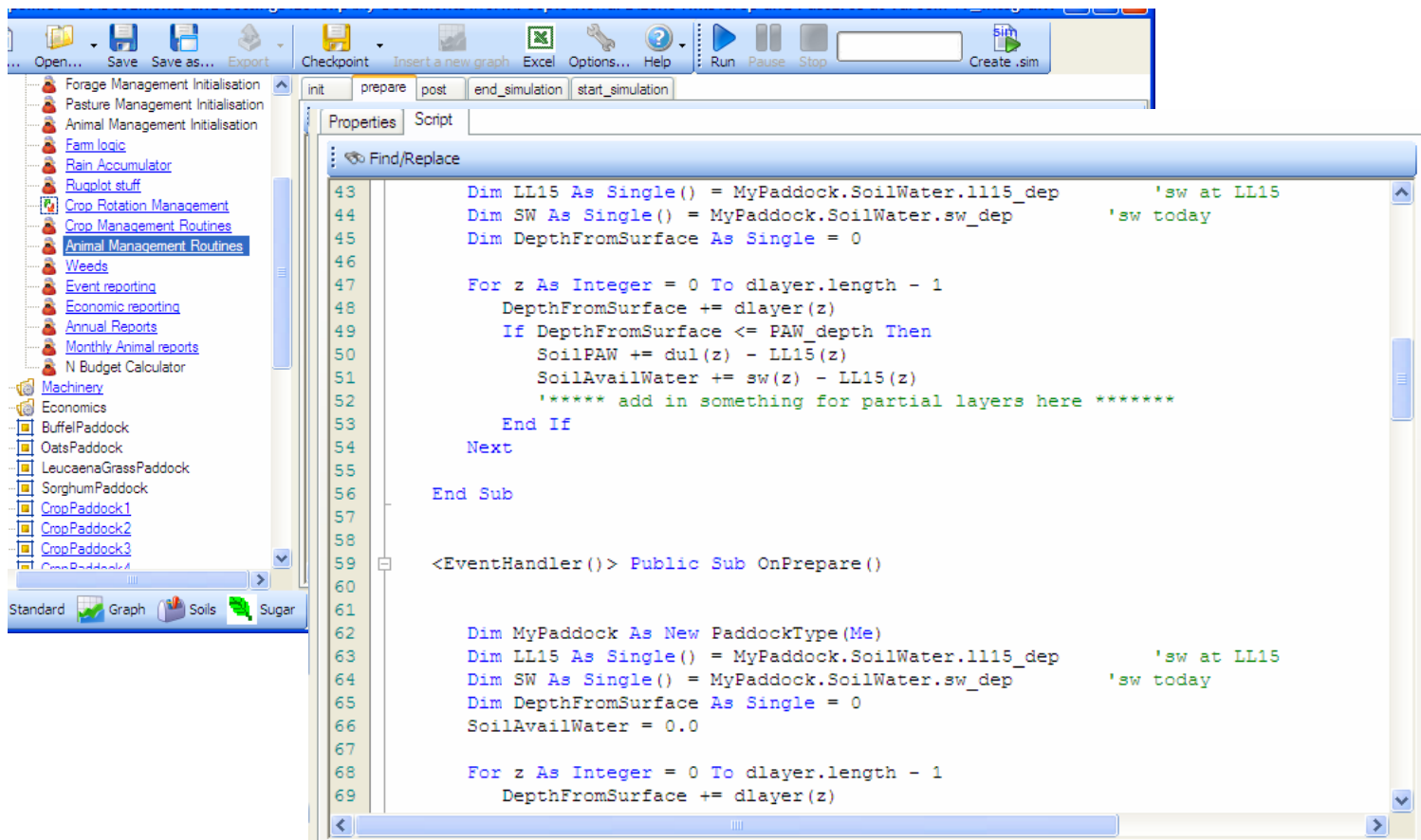
The screenshot shows a software interface for managing a simulation. On the left is a tree view of various management routines, including 'Forage Management Initialisation', 'Pasture Management Initialisation', 'Animal Management Initialisation', 'Farm logic', 'Rain Accumulator', 'Rugplot stuff', 'Crop Rotation Management', 'Crop Management Routines', 'Animal Management Routines', 'Weeds', 'Event reporting', 'Economic reporting', 'Annual Reports', 'Monthly Animal reports', 'N Budget Calculator', 'Machinery', 'Economics', 'BuffelPaddock', 'OatsPaddock', 'LeucaenaGrassPaddock', 'SorghumPaddock', 'CropPaddock1', 'CropPaddock2', 'CropPaddock3', and 'CropPaddock4'. The 'Crop Management Routines' folder is expanded. On the right is a code editor window with a 'Find/Replace' bar at the top. The code editor contains a Tcl script with the following content:

```
17 # If a paddock is understocked, move the heaviest animals there.
18 for {set ipaddock 0} {$ipaddock < [llength $paddocks]} {incr ipaddock} {
19     set paddock [lindex $paddocks $ipaddock]
20     set cropBeingEaten [cropBeingEatenIn $paddock]
21
22     if {[isFeedAvailable $paddock] &&
23         [numAnimalsIn $paddock] < $config($paddock,numAnimals)} {
24         puts "animals: feed available and understocked in $paddock"
25         set more 1
26         while {$more && [numAnimalsIn $paddock] < $config($paddock,numAnimals)} {
27             set more 0
28             set mob [heaviestMobIn [lrange $paddocks [expr $ipaddock+1] end] ]
29             if {$mob != {}} {
30                 moveStockTo $mob $paddock.$cropBeingEaten
31                 set more 1
32             } elseif {[llength [mobsOnFarm]] < [llength $animals(mobs)]} {
33                 moveStockTo [animalsIn 100 steers 250] $paddock.$cropBeingEaten
34                 set more 1
35             }
36         }
37     }
```

www.tcl.tk

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Dynamic (responsive) management:



```
43 Dim LL15 As Single() = MyPaddock.SoilWater.ll15_dep 'sw at LL15
44 Dim SW As Single() = MyPaddock.SoilWater.sw_dep 'sw today
45 Dim DepthFromSurface As Single = 0
46
47 For z As Integer = 0 To dlayer.length - 1
48     DepthFromSurface += dlayer(z)
49     If DepthFromSurface <= PAW_depth Then
50         SoilPAW += dul(z) - LL15(z)
51         SoilAvailWater += sw(z) - LL15(z)
52         '***** add in something for partial layers here *****
53     End If
54 Next
55
56 End Sub
57
58
59 <EventHandler()> Public Sub OnPrepare()
60
61
62 Dim MyPaddock As New PaddockType(Me)
63 Dim LL15 As Single() = MyPaddock.SoilWater.ll15_dep 'sw at LL15
64 Dim SW As Single() = MyPaddock.SoilWater.sw_dep 'sw today
65 Dim DepthFromSurface As Single = 0
66 SoilAvailWater = 0.0
67
68 For z As Integer = 0 To dlayer.length - 1
69     DepthFromSurface += dlayer(z)
```


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Software Architecture

- Component based design based around 4 simple entry points (get, set, publish, subscribe)
- Separation of functionality (via components) essential for re-use
- Modern byte-compiled languages support rapid prototyping of new components in the existing systems framework

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Case studies

- Participatory approach to describe change and adaptation to change
1. “What do you do”
 2. What would change “what you do”
 3. What adaptations are possible in “what you do”

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Case 1: Mixed grain & graze in Southern Queensland

- 4000ha farm
- 5 cropping fields 220ha = 1100ha
- Buffel (pasture) fields = 2000ha
- Leucaena/grass = 400ha
- Oats = 400ha
- Forage sorghum = 100ha
- 1 Forage legume in cropping rotation

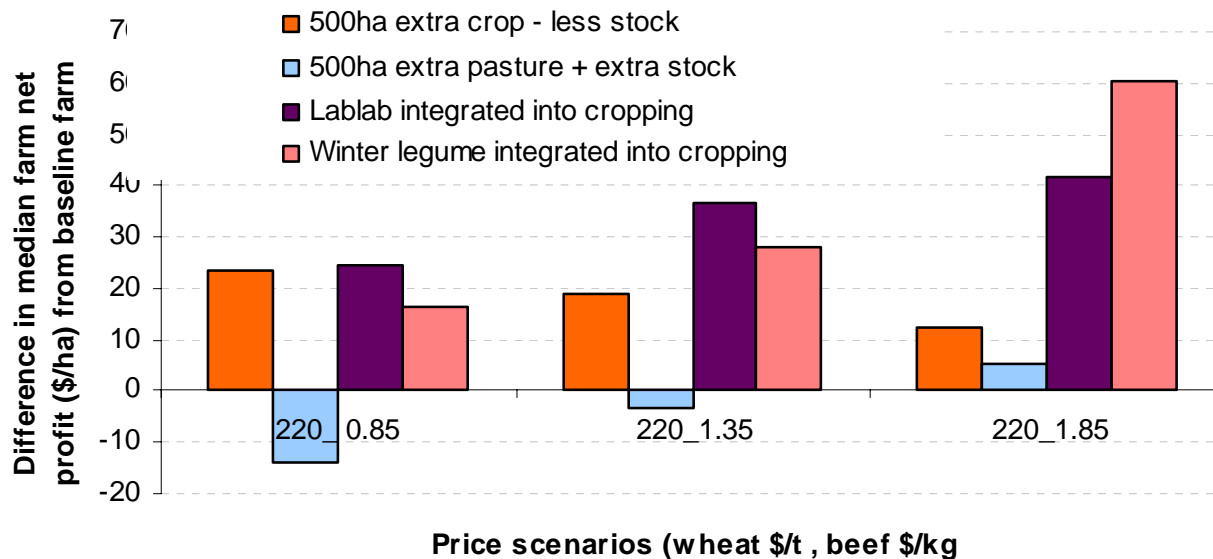


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Case 1: Mixed grain & graze in Southern Queensland

“...What adaptations are possible”

- Large change in proportion of crop and pasture
- Integrating summer legume into cropping area
- Integrating winter legume into cropping area

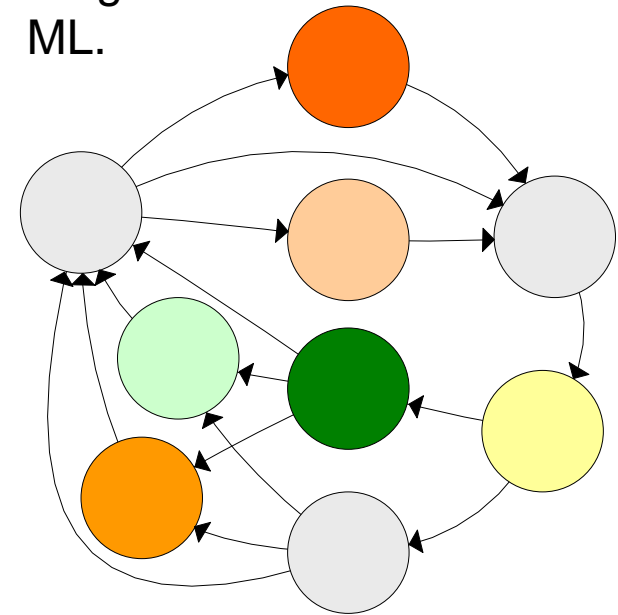


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Case 2: Irrigated cotton & grain



- ~800 ha cropping area
- 3 storages with combined capacity of 1350ML
- 600ML annual bore allocation
- Captured overland flow ranges between 0 – 1450 ML.



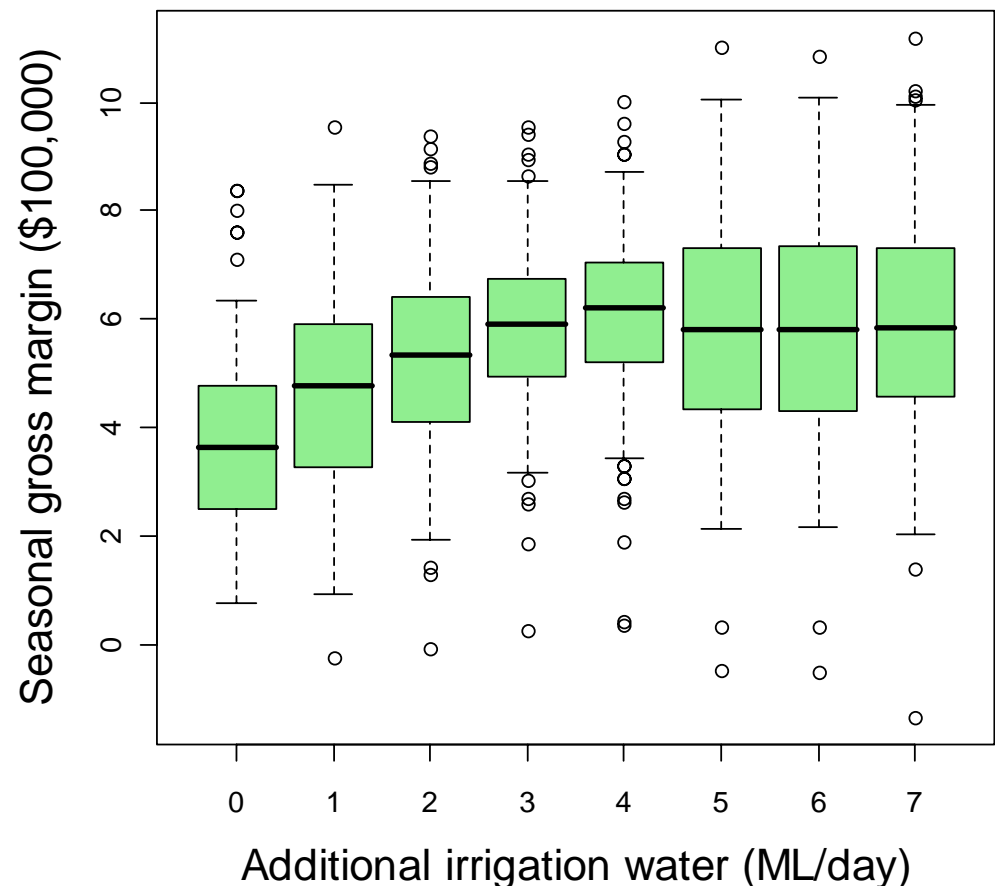
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Case 2: Irrigated cotton & grain

What is the additional income from reverse osmosis treated water (a coal seam gas extraction byproduct).

Farm profitability increases until system capacity is reached at 4 ML/day

Whole farm gm increases by approx. \$60 000 /(ML*day) (ie \$164/ML) up to 4ML/day



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Case 2: Irrigated cotton

“...What adaptations are possible”

- What will be the likely impact of reduced bore allocations on long term profitability?
- Compare the profitability of a cotton monoculture with a cotton and maize and/or sorghum and/or soybeans and/or wheat rotation.
- Compare storing “out of season” water for use on cotton (high losses due to evaporation and seepage) against using the water immediately on a current (non-cotton) crop



In Summary

- APSIM model framework has been successfully applied to several WFM problems
- Each time is easier than the last
- Participatory nature of these adaptation case studies produces diverse study areas – interdisciplinary approach is unavoidable.

www.apsim.info

APSIM - Functional issues

- 2 broad areas: development and maintenance
 - New developments overseen by a reference panel composed of science and software specialists
 - Maintenance the task of SEG:
 - Regular indoctrination sessions training workshops
 - Continuous integration cycle
 - Regular “point” releases
-
- WWW (ie accessible) tools for source code, data repositories, tracking bugs, helpdesk and user groups



Models and frameworks

- Why reuse or share models? To avoid hard work!
- Adaptation is easier than starting over

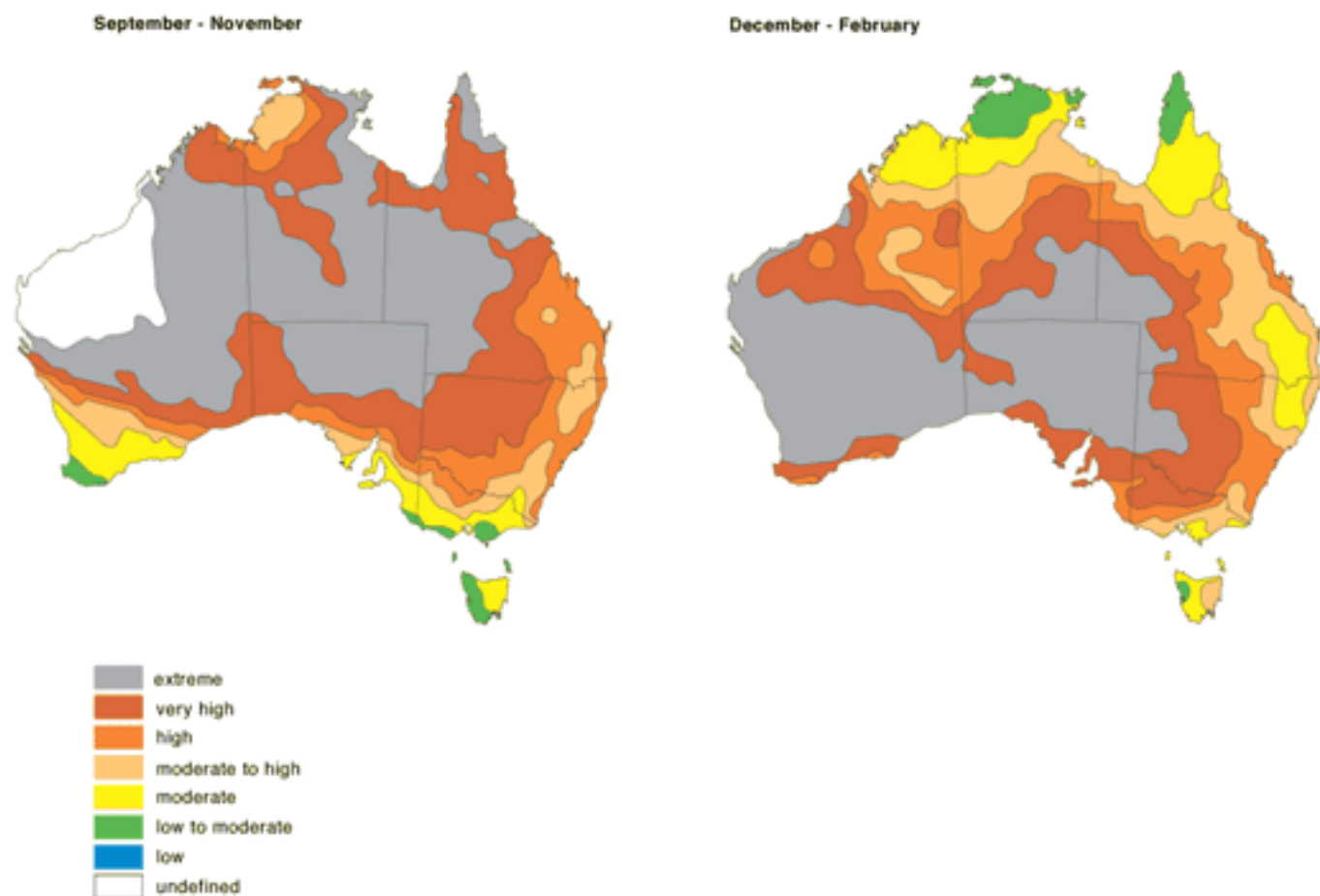
How:

- Keep it simple – your conceptualisation, and your tools
- Adaptive means reuse – and the framework changes too

Open Source

- Openness begins with open source
- Scientific legitimacy – no more “black boxes”
- Wish to form genuine, 2-way relationships
- Earlier experiences are confidence building on our part as well
- Rigorous control → openness

Figure 1.9 Variability of Australian rainfall, for September-November (spring), December-February (summer), March-May (autumn) and June-August (winter)



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Case 2: Irrigated cotton

