INSAFS : Climate – Pests/Diseases

- Early Warning of Pests/Diseases for Selected Crops Using Climate Information and Crop Simulation Modelling Approach Under Climate Change Scenarios (Page 11, Abstract)

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Climate change and pests

- World food production is under constant threat by pests and diseases
- This is likely to be exacerbated by climate change, which has potential to increase pest populations and have impact on crop yield, quality, and environmental health
- The potential effects of pathogens on changing systems not clearly understood

Recent Efforts

- Our recent efforts enabled universities, government and non government institutions to work together to initiate the process in the
- identification
- modification and
- testing of appropriate models

with capacity to include short and medium range weather and climate variation along with historical crop, climate, disease and management data

Risk Communication

- Elements of risk communication with a view to informing communities of impending pests and disease occurences and receiving relevant crop management feedback are essential components of this approach

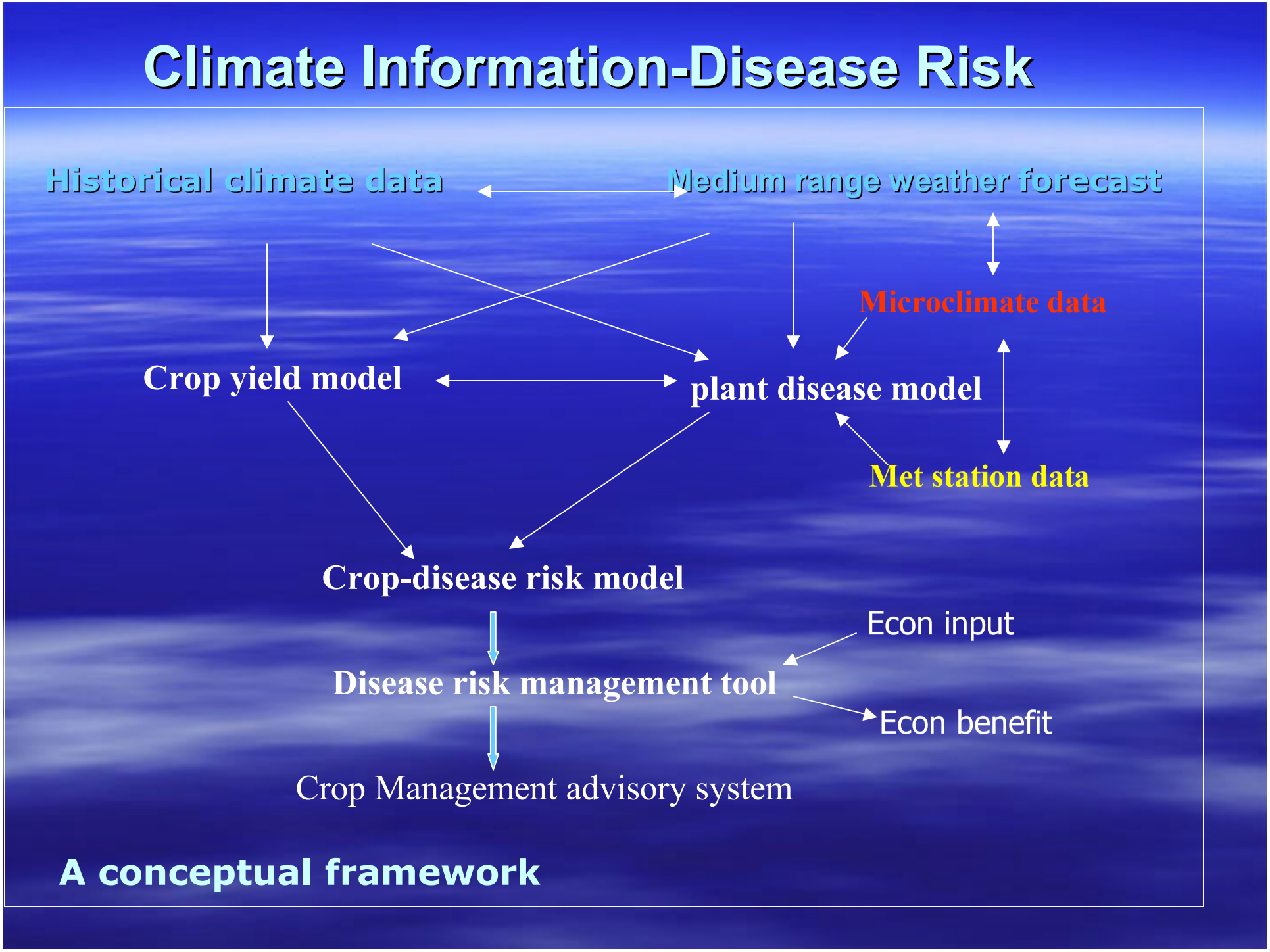
Minimising pesticide application

- Application of models to minimise pesticide application by predicting upsurges in epidemic cycles and by avoiding application prior to rainfall events
- Leading to achieve cost reduction and minimise pesticide runoff into ecologically sensitive environments or potable water sources

Our Approach: Integrated Crop Management

- Climate and Crop Disease Risk Management Network
- agronomy
- agroclimatology
- plant protection
- Policy makers
- community

Climate Information-Disease Risk



A conceptual framework

Economic estimates on Sclerotinia

- Net returns from Sclerotinia control (Canola)
  - Rovral, Sumisclex and Corvette
  - Based on
    - 2 t/ha potential yield
    - Chemical/application costs of $82/ha for Rovral

Rovral	yield loss (t/ha)	On Farm Price Canola ($/tonne)													
% yield loss	at 2 t/ha potential	$270/t	$280/t	$290/t	$300/t	$310/t	$320/t	$330/t	$340/t	$350/t	$360/t	$370/t	$380/t	$390/t	$400/t
5	0.1	-$55	-$54	-$53	-$52	-$51	-$50	-$49	-$48	-$47	-$46	-$45	-$44	-$43	-$42
10	0.2	-$28	-$26	-$24	-$22	-$20	-$18	-$16	-$14	-$12	-$10	-$8	-$6	-$4	-$2
15	**0.3**	-$1	$2	$5	$8	$11	$14	$17	$20	$23	$26	$29	$32	$35	$38
20	0.4	$26	$30	$34	$38	$42	$46	$50	$54	$58	$62	$66	$70	$74	$78
25	0.5	$53	$58	$63	$68	$73	$78	$83	$88	$93	$98	$103	$108	$113	$118
30	0.6	$80	$86	$92	$98	$104	$110	$116	$122	$128	$134	$140	$146	$152	$158

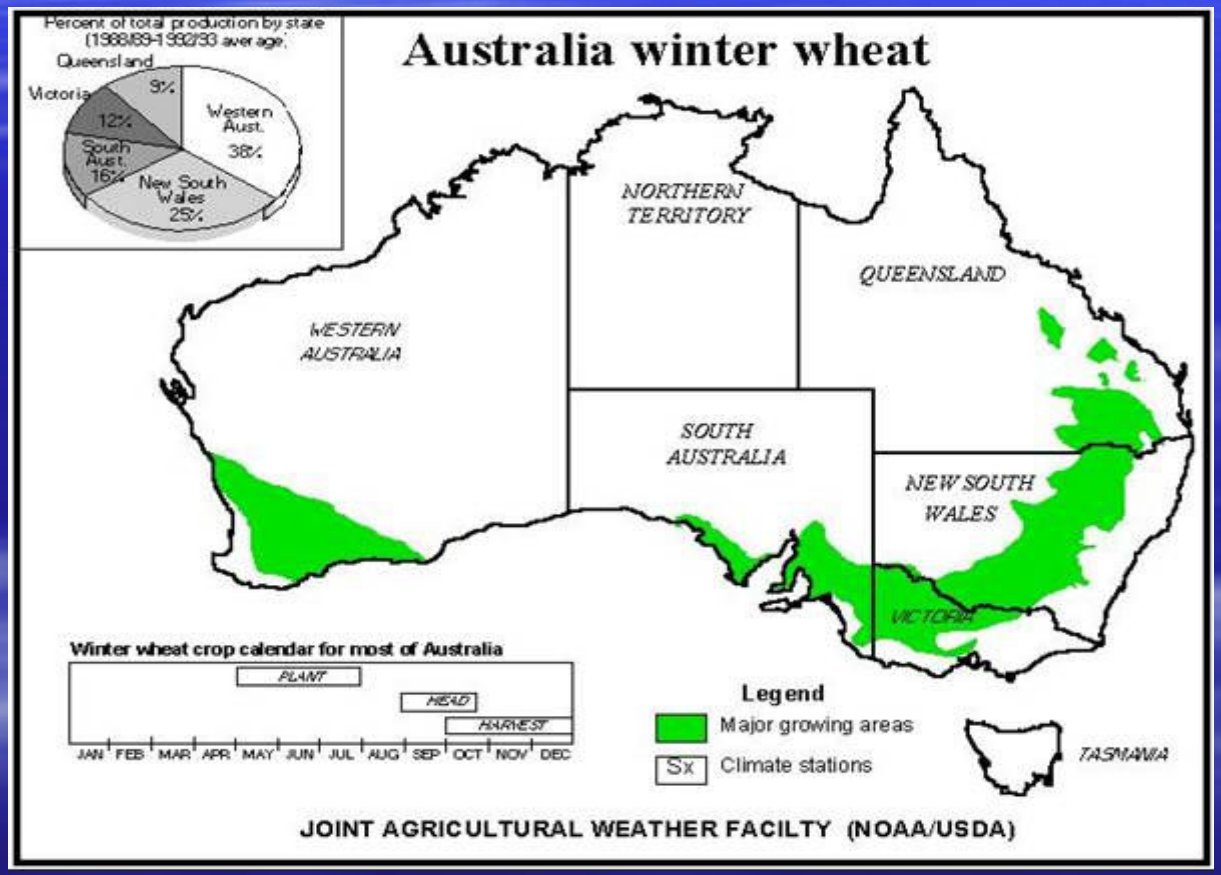
What can be modelled?

- Pathogen/disease incidence/severity
- Onset of spore maturity
- Progression and termination of spore maturity
- Spread of spores
  - Incorporating changes relating to spore-load
- Economics
  - Incidence/severity versus yield loss

Two Climate Sensitive Diseases

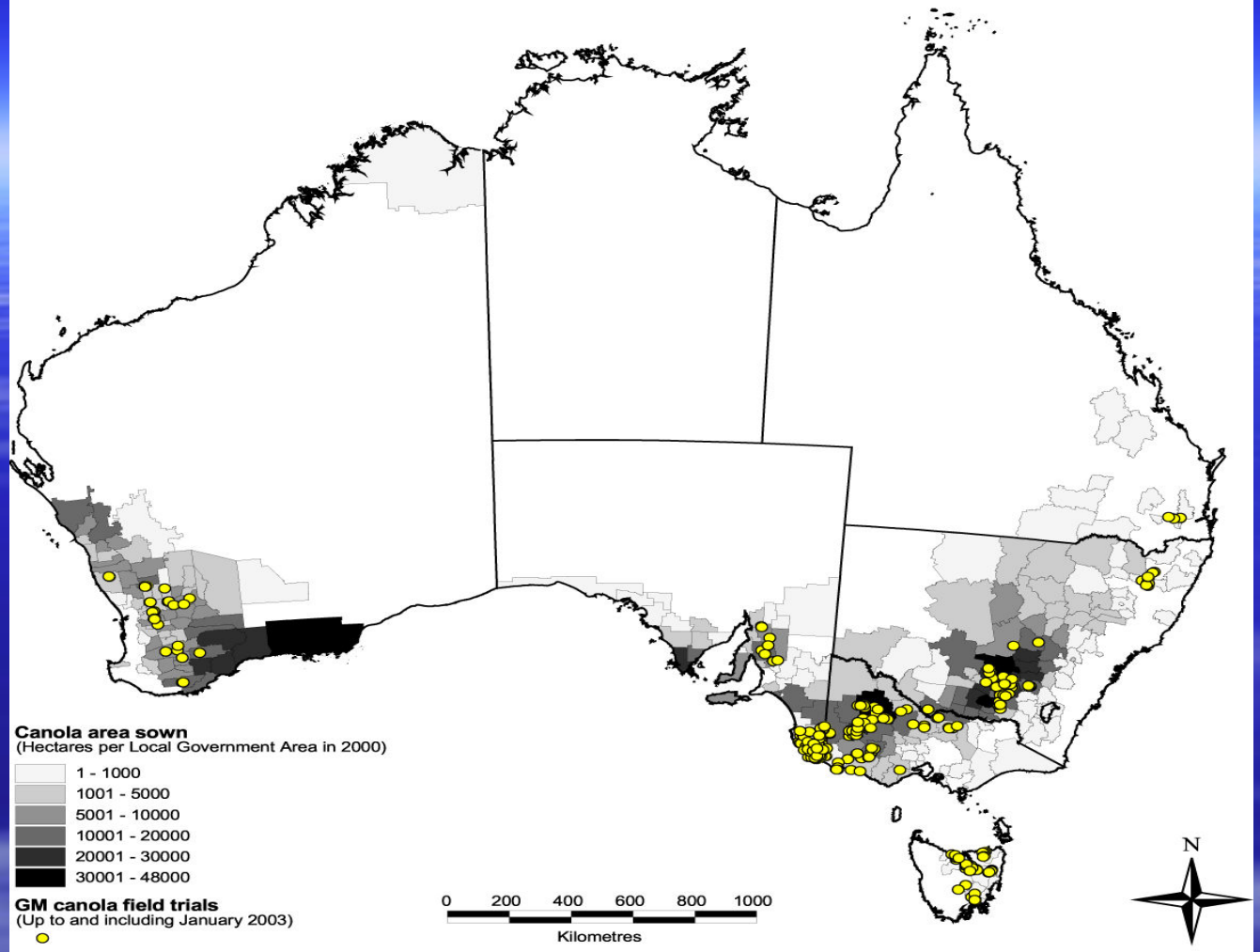
- Two climate-sensitive diseases of Australian field crops are stripe rust of wheat and Sclerotinia rot of canola
- Both diseases having a high risk-ranking on the list of Australian crop diseases
- Stripe rust of wheat is estimated to cause a loss of AU$ 181 million per annum (Brennan and Murray 1998), and stem rot a loss of up to AU$ 47 million in a favourable year (Hind-Lanoiselet 2006)

Wheat Growing Areas in Australia





Canola in Australia



Map derivation

Canola data reported as totals per Statistical Local Area (SLA) were converted to totals per Local Government Area (LGA), except unincorporated LGAs in South Australia which were depicted as SLAs. In some cases, one LGA represents the sum of more than one SLA.

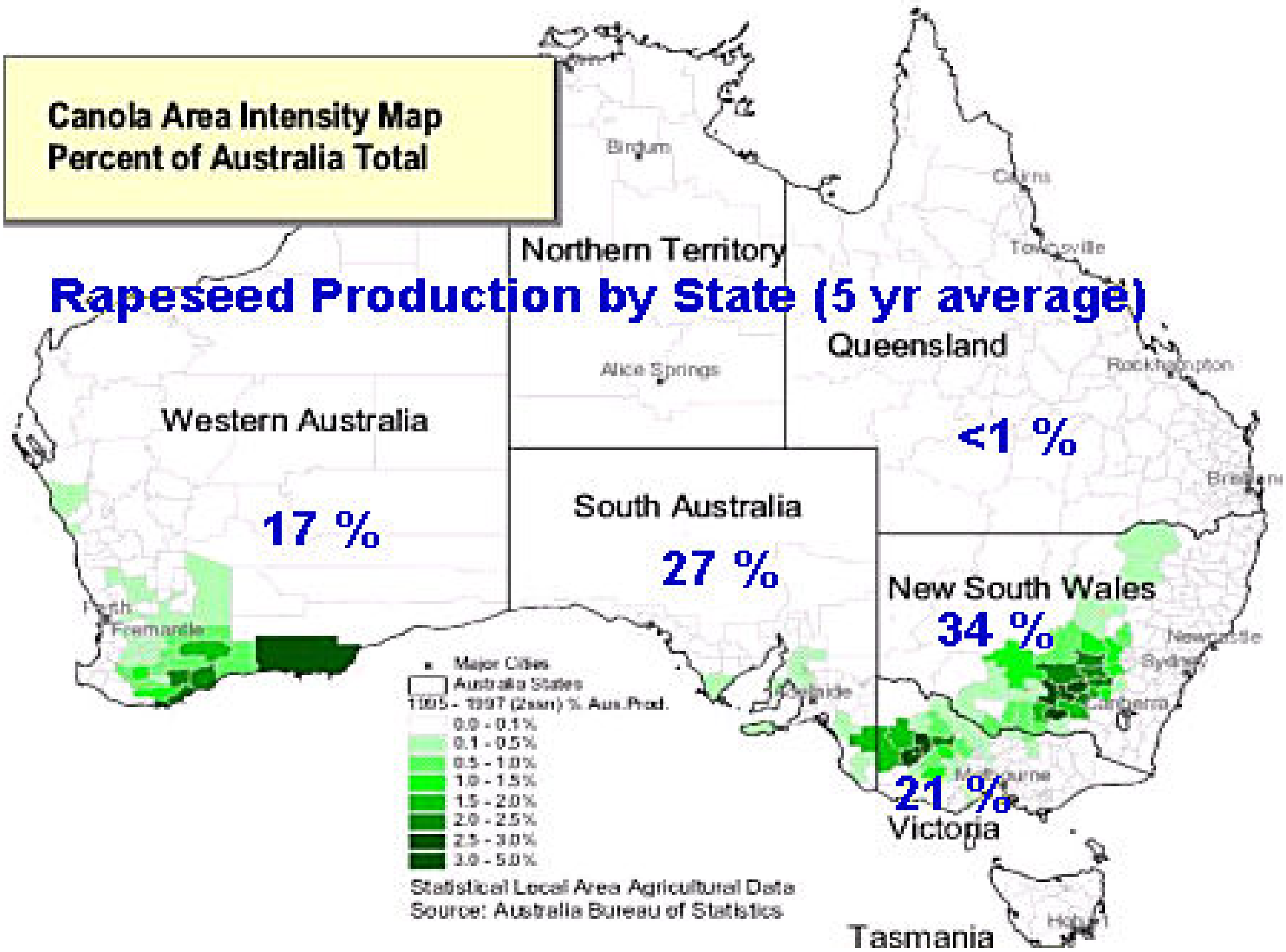
Information on locations of field trials has been provided by the Office of the Gene Technology Regulator (OGTR) on 30 January 2003 for visualisation purposes only. Mapping coordinates are provided by Accredited Organisations as part of applying for and managing requirements under a licence for GMO field trials. There is on-going validation of the data as part of the OGTR's monitoring activities, and updated coordinates are provided on the OGTR internet site Intentional Release Record (http://www.ogtr.gov.au/gmorec/ir.htm) linked within interactive maps (http://www.ogtr.gov.au/maps/index.htm).

Data sources

Canola statistics: Australian Bureau of Statistics Agricultural Census 2001 (published 2002).
LGA and SLA boundaries: Australian Bureau of Statistics, Australian Standard Geographic Classification (2001).
Analysis and mapping: Bureau of Rural Sciences (2003).

The Bureau of Rural Sciences is the scientific bureau of the Commonwealth Department of Agriculture, Fisheries and Forestry - Australia.

Department of AGRICULTURE FISHERIES & FORESTRY – AUSTRALIA


Canola Area Intensity Map
Percent of Australia Total
Rapeseed Production by State (5 yr average)
Northern Territory
Queensland
<1 %
Western Australia
17 %
South Australia
27 %
New South Wales
34 %
Victoria
21 %
Tasmania
Major Cities
Australia States
1995 - 1997 (2ean) % Aus.Prod.
0.0 - 0.1%
0.1 - 0.5%
0.5 - 1.0%
1.0 - 1.5%
1.5 - 2.0%
2.0 - 2.5%
2.5 - 3.0%
3.0 - 5.0%
Statistical Local Area Agricultural Data
Source: Australia Bureau of Statistics

KEY ISSUES THAT MUST BE UNDERSTOOD AND ADDRESSED

- decision makers
- decision options
- climate prediction
- communication
- institutional and policy environment

Climate and Crop Disease Risk Management: An International Initiative in the Asia-Pacific Region

Supported by Asia-Pacific Network for Global Change Research (APN)

APN

- The project has been timely in terms of the growing importance of climate change and climate variability scenarios in developing a network to examine international relationships for sustained operational support for better forewarning of crop disease occurrence.

APN

- The project now draws on and integrates a diverse body of knowledge that includes agrometeorological modelling, risk analysis, crop disease impact and community interaction.

Research Sites for Asia-Pacific Network (APN) Project : Climate and Crop Disease Risk Management



Timeline: Climate and Crop Disease Risk Management (: ARCP2007-06CMY)

Activity	12-month project continuation timeline from 2007 May											
	M	J	J	A	S	O	N	D	J	F	M	A
Finalise Hyderabad proceedings	■	■										
Test initial model with existing data	■	■	■	■								
Conduct field experiments	■	■	■	■	■	■	■					
Develop communication strategies	■	■	■	■	■	■	■					
Refine model in terms of new data			■	■	■	■	■	■				
Validate model for regional application						■	■	■	■			
Prepare workshop discussion document							■	■	■			
Prepare workshop presentations							■	■	■			
Linkage with policy makers/institutions							■	■	■	■	■	■
Dhaka review and planning workshop										■		
Prepare refereed publications										■	■	■
Prepare/submit final report											■	■

Acknowledgements

- Asia-Pacific Network for Global Change Research (APN)
- Australia-India Council, Department of Foreign Affairs and Trade (DFAT), Government of Australia
- Bangladesh Science Foundation
- University of Western Sydney
- New South Wales Department of Primary Industries (NSW DPI)
- Victoria Department of Primary Industries
- World Meteorological Organization (WMO)
- Indian Council of Agricultural Research
- National Centre for Medum Range Weather Forecasting, India
- Cambodian Agricultural Research and Development Institute
- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
- Agromet Vision
- University of Florida
- National Soil Tilth Laboratory, Iowa

Columbia University

Dhaka Workshop

- **Workshop objectives:**
- Review research findings and to explore future funding opportunities to ensure project viability, and regionalisation of the project,
- Share model validation results to ensure efficient application at regional level,

Project Outcomes

- Progress in relation to the specific objectives :
- develop and adapt predictive models for selected crops and climate-sensitive diseases (late leaf spot in peanut, Sclerotinia rot and Alternaria blight in canola and mustard), integrating existing climate, crop and epidemiological knowledge
- evaluate the predictive performance of crop and disease models, using existing data and new data generation

- identify and evaluate improved crop disease management strategies based on climate information and predictive models
- assess information needs and propose communication strategies (e.g., climatic and disease risk, disease forecasts, advisories)
- engage appropriate institutions and policy linkages that are in a position to provide support for climate-sensitive crop disease management in each target country

- Baseline publications arising from the 2006 workshop to guide the way ahead included those on innovative modelling for connecting climate, crop and pest disease management, coping strategies for agrometeorological risks, agrometeorological services, regional data needs, linking short and medium term climate forecasting and institutional and stakeholder collaboration.

- Some results have appeared in *Managing Weather and Climate Risks in Agriculture*, a Springer publication under the auspices of the World Meteorological Organisation.

- Huda, A.K.S., Hind-Lanoiselet, T., Derry, C., Murray, G., and Spooner-Hart, R.N. 2007. Examples of coping strategies with agrometeorological risks and uncertainties for Integrated Pest Management. Chapter 16 in " Managing Weather and Climate Risks" (eds. Sivakumar and Motha), Springer, Pages 265-280.

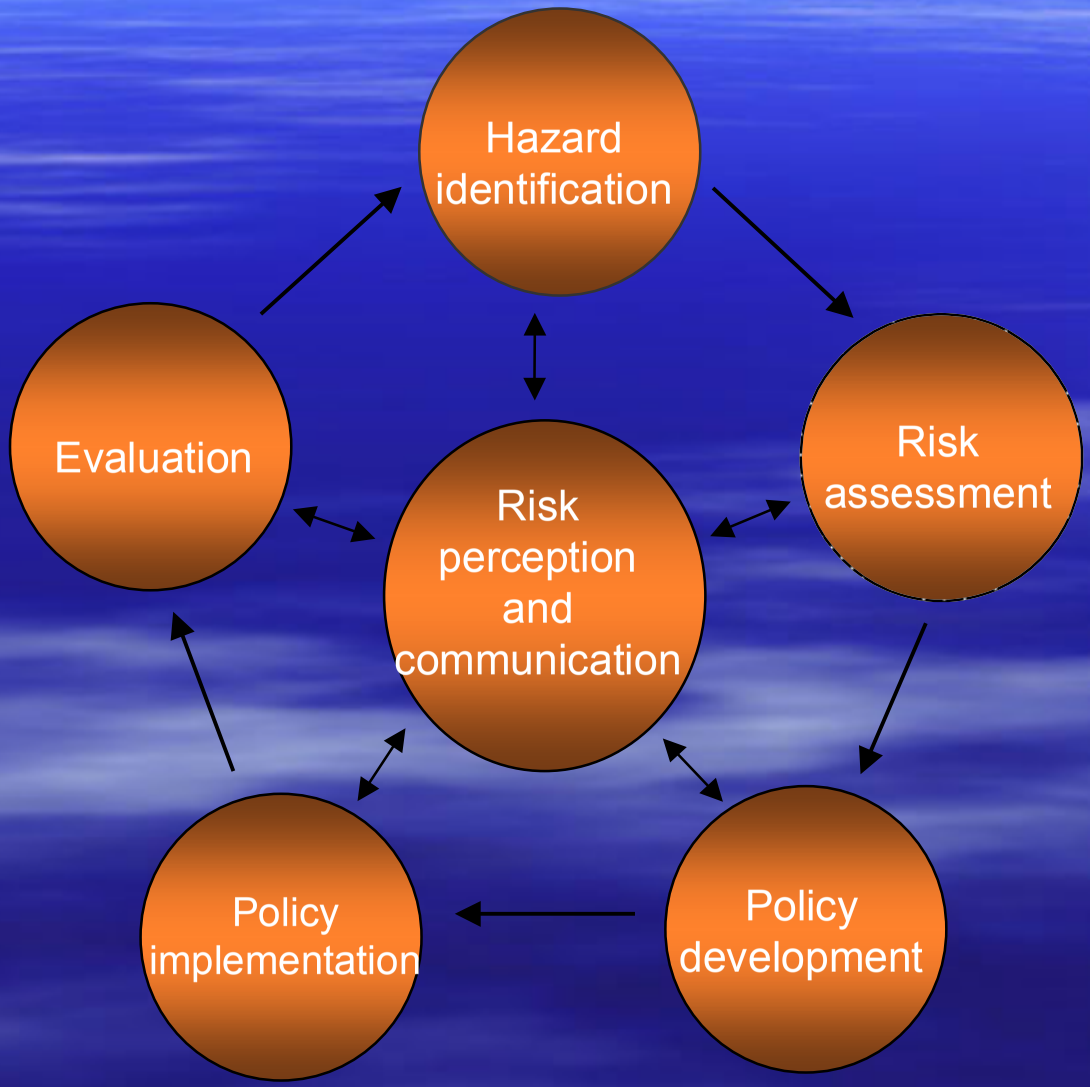
- Rathore, L.S. and Stigter, K. 2007: Challenges to Coping Strategies with Agrometeorological Risks and Uncertainties in Asian Region. Chapter 4 in “Managing Weather and Climate Risks” (eds. Sivakumar and Motha), Springer, Pages 53-69.

- Field experiments and data analysis for peanut, mustard and canola have indicated the importance of functional relationships between observatory and canopy weather in the development of models for weather-based forewarning systems.
- Results from these field experiments will be discussed during the Review and Planning Workshop

- Facilitate improvement in agricultural decision making through capacity building; via co-learning between researchers and decision makers (e. g. policy makers), and engaging, equipping and transferring ownership to those groups and institutions providing forecast information and support to Government,
- Ensure final data gathering at selected case study sites resulting from ground-truthing with existing data, in order to bring the project to successful completion in the allotted time,

- Expand linkages with policy makers and institutions to ensure that findings are accountable and put into effect in the region,
- Discuss the relevant issues in completing the final report and publications to ensure dissemination of research findings to a wide audience of scientists and policy makers.

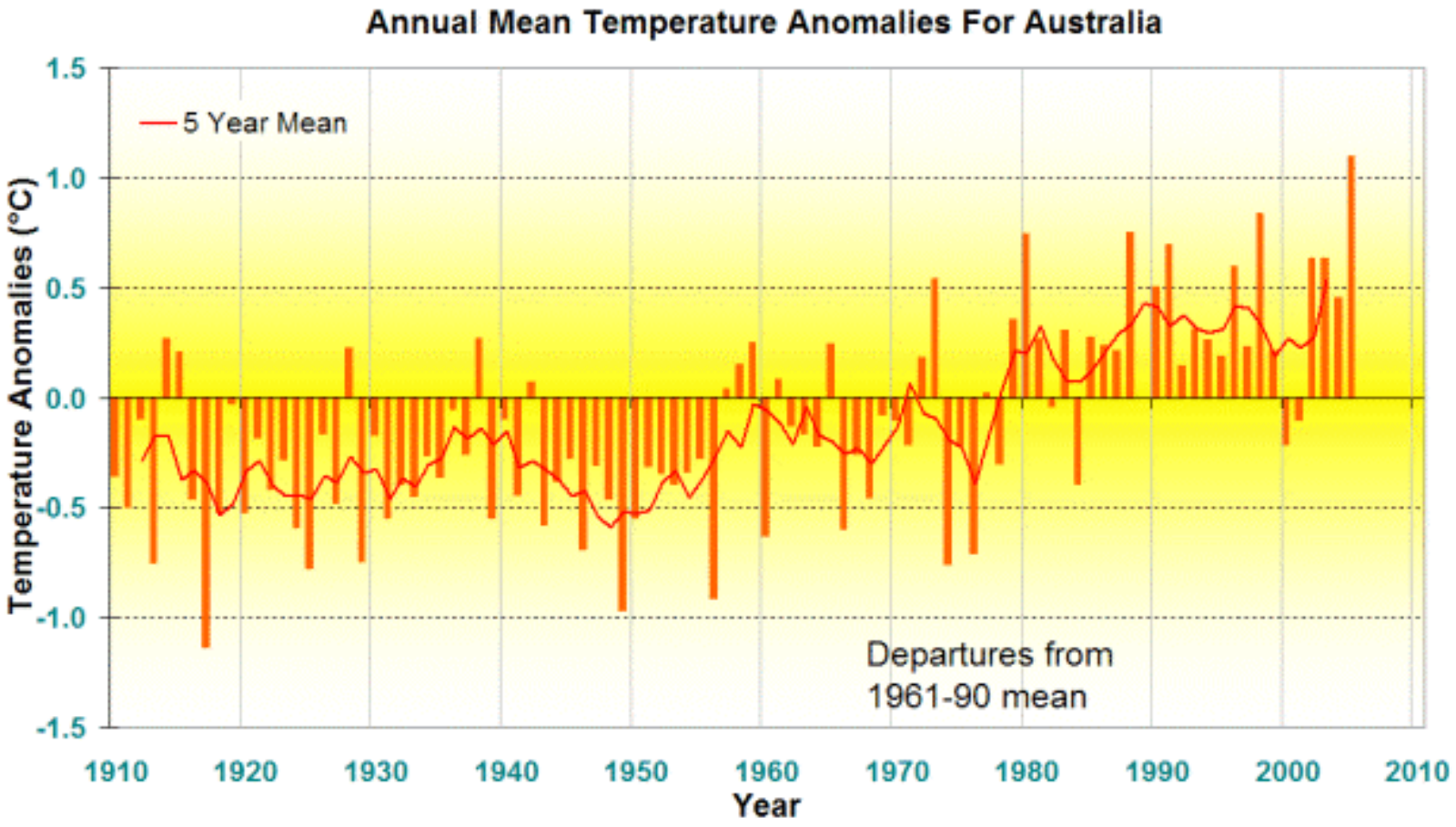
Risk Management Cycle



Macro and Microclimate

- The relationship between macro- and microclimate, and the effects on the cycles of disease agents, needs special attention if quantity of applied pesticide is to be minimised, while optimising disease control outcomes.

2005 climate summary (BoM 2006)



Climate Change Effects on Plant Disease

- Genomes to Ecosystems
- K. A. Garrett, S. P. Dendy, E. E. Frank, M. N. Rouse, and S. E. Travers

- Kansas State University
- Annu. Rev. Phytopathol. 2006.44:489-509. Downloaded from arjournals.annualreviews.org

- This review evaluates adaptive potential as a feature that may often prove to be the most important in determining the success of organisms under climate change scenarios

- More recently, Scherm has identified three continuing problems with the application of models for predicting climate change effects on disease.

- First, model inputs have a high degree of uncertainty. For example, data on the geographic distribution of disease are still surprisingly difficult to acquire.

- Second, nonlinear relationships and thresholds in the relationship between climatic variables and epidemiological responses make it difficult to collect sufficient data for a clear predictive understanding.

- Third, the potential for adaptation by plants and pathogens is another complicating factor that is often ignored in models.

Future work

- Climate and Crop Disease Risk Management Network continues to work building on our achievements including
- Addressing the issues related to enhancing nutrient efficiency in response to climate variability for improved plant health and crop production

- Thank you