ANALYSIS UNDER UNCERTAINTY *for* DECISION MAKERS (AU4DM) NETWORK

1. **Tobias Pforr**
2. Vicky Pope
3. David Viner
4. Emily Black
5. Ricardo Barcelona

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Problem Statement

- What problem does your organisation face?
  - To improve how a decentralised network of humanitarian organisations delivers relief around the world for any kind of disaster
- How is this problem complicated by elements of uncertainty?
  - In every way imaginable
    - Reliability of weather predictions
    - Importance of values
    - Moral Hazard, Principal-agent issues
    - Unplanned events
    - Emotional and institutional dynamics
- How significant is this problem for your team or organisation?
  - Crucial in every single decision.

Approach

- How does your organisation make decisions in light of the uncertainty it faces?
  - Aim: How to keep in mind uncertainties while still having conviction to act!
  - Pretence that more is certain and known than actually is
  - Wish that some expert exists that could solve problem in a uniquely correct way
  - Some Uncertainties cannot be reduced. They can only be managed!
- E.g. What decision-making tools did your organisation introduce to make better decisions despite risk/uncertainty?
    - Attempt to move away from single data point predictions/expectations
    - Use of scenario mind-set
    - Greater focus on urging decision makers to study results of decisions
    - Empowering individuals to admit to mistakes and admit to not knowing answers

Results and Feedback

- What decision did your organisation make, and how was this informed by the preceding uncertainty analysis?
  - Piecemeal, incremental improvements which are constantly subject to further potential improvement
- What challenges or limits did your organisation experience in implementing the decision-making process?
  - Getting people on-board; resources necessary; takes away focus from “main business”
- How can the research community support improvements in your decision-making process?
  - Less dogmatism; no one rule fits all; process as important as outcomes.

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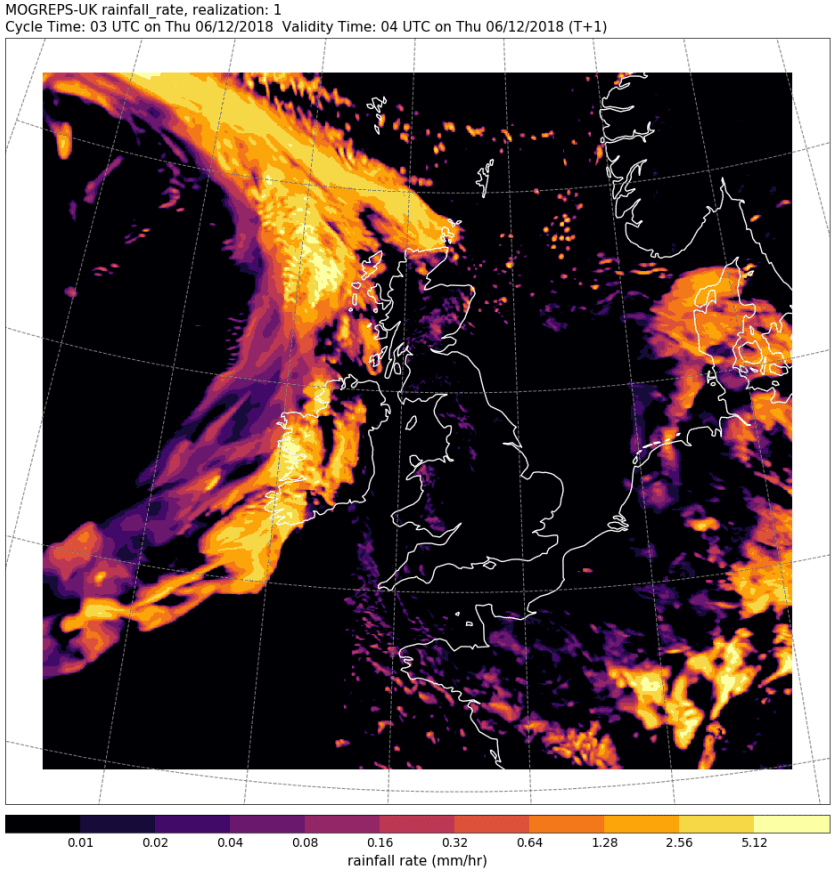
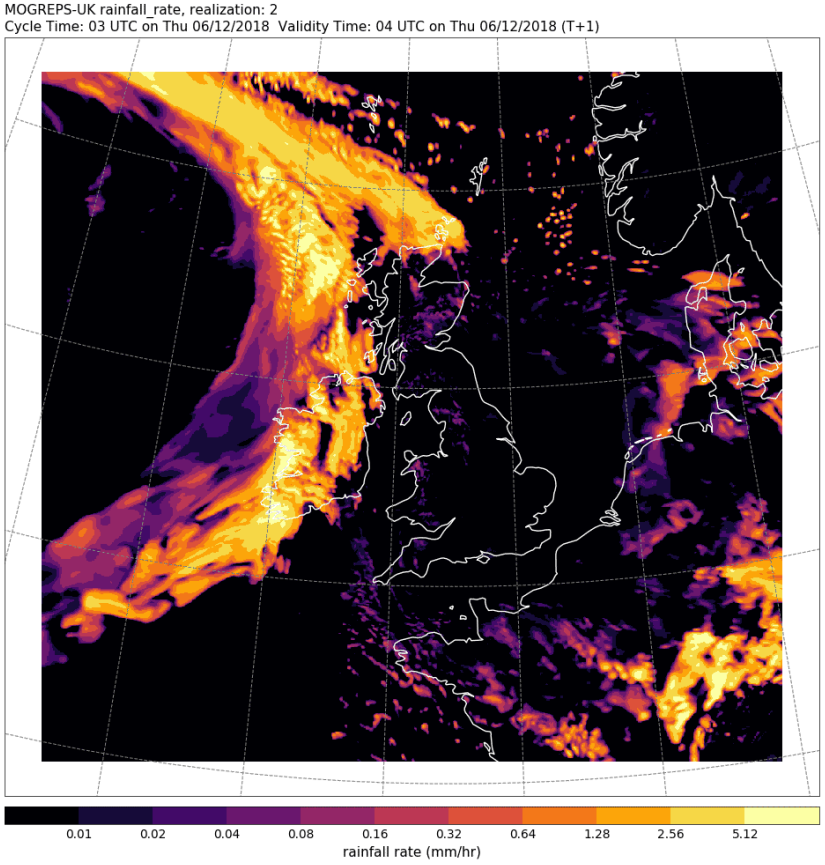
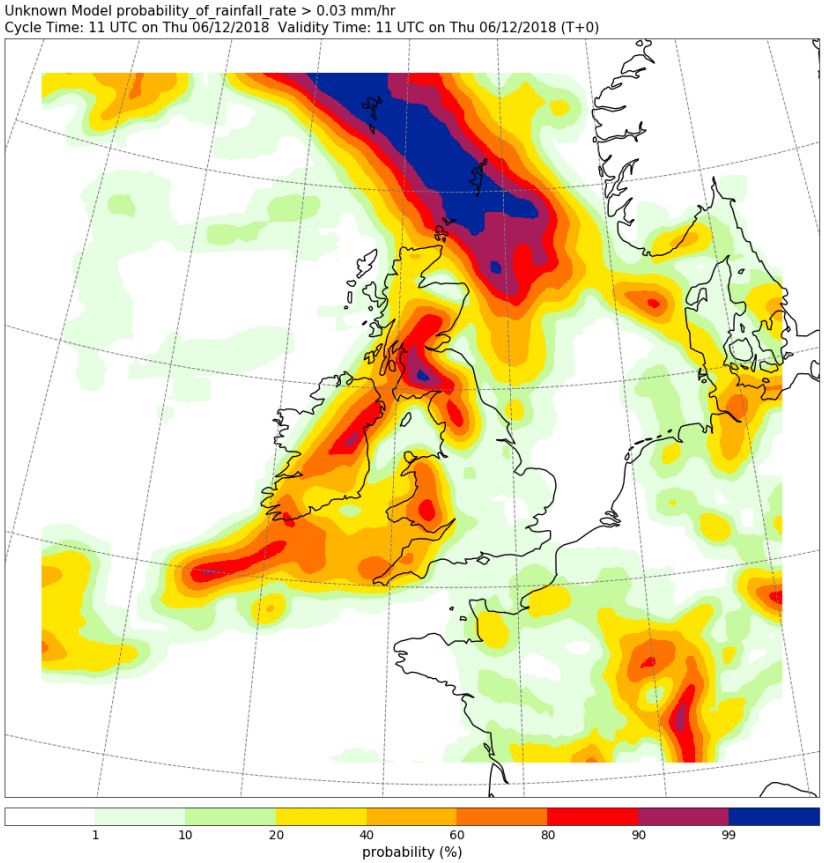
Two individual ensemble forecasts



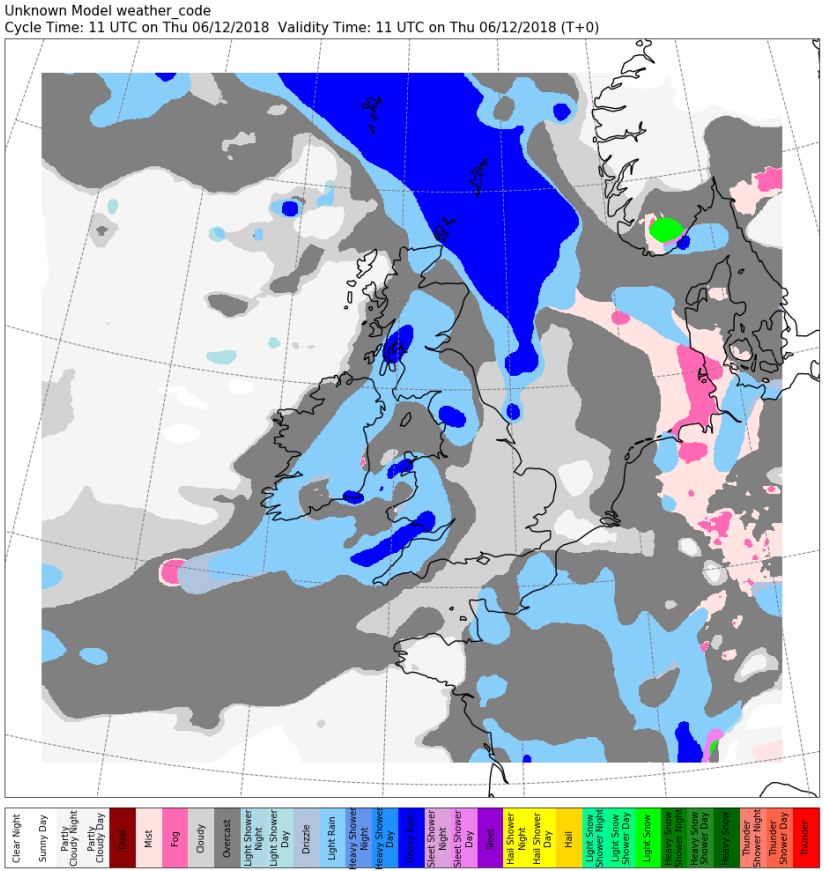


Combining multiple model forecasts

Chance of rain



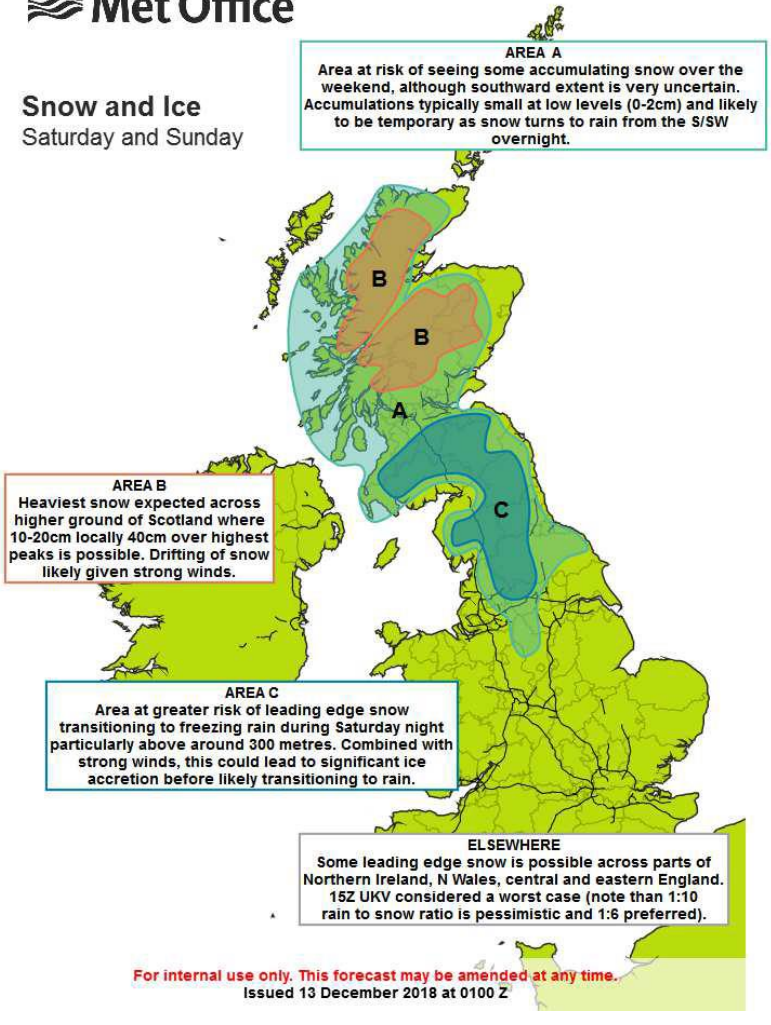
Weather Symbols



Met Office

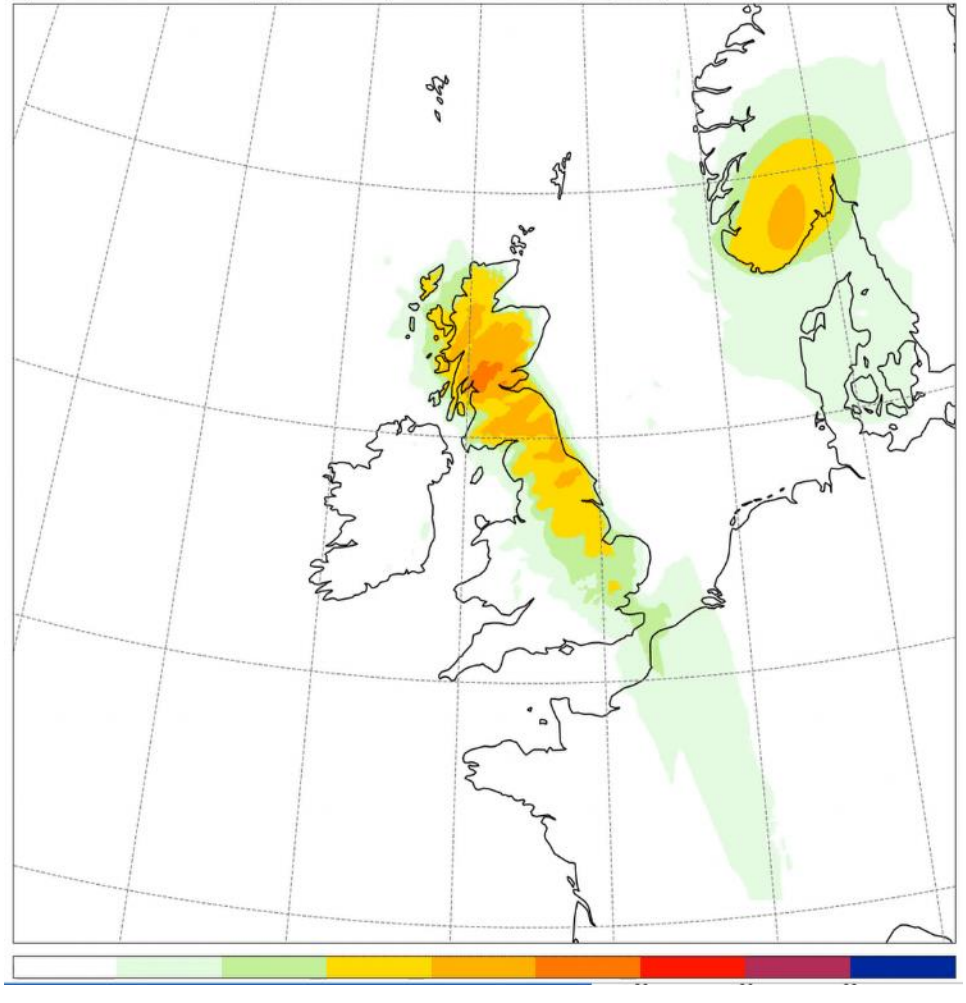
Snow and Ice

Saturday and Sunday

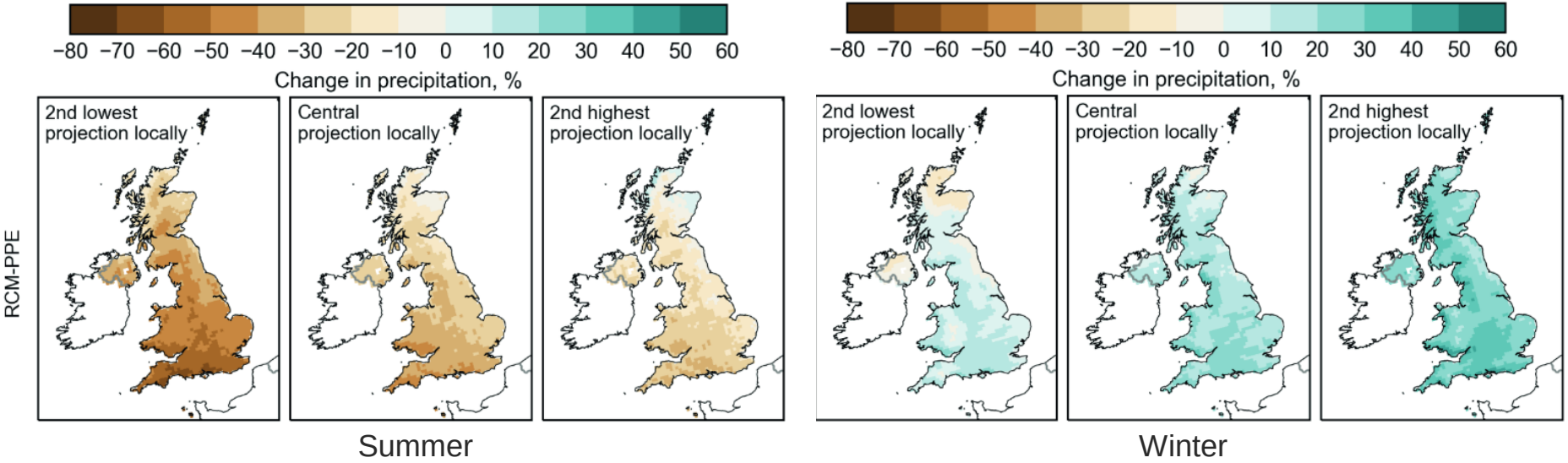


For internal use only. This forecast may be amended at any time.
Issued 13 December 2018 at 0100 Z

MOGREPS-UK probability_of_lwe_snowfall_rate > 0.03 mm/hr
Cycle Time: 18 UTC on Wed 12/12/2018 Validity Time: 18 UTC on Sat 15/12/2018 (T+72)



Pattern of precipitation change



The spatial pattern of change to 2061-2080 shows detailed structure over the UK (RCP8.5). Compare SE England and N Scotland.

TAMSAT: Tropical applications of meteorology using satellite based data

Societal impact

Early warning bulletins,

Financial products

Other climate services

Research

Decadal variability in rainfall

Predictability of drought

Land-surface data assimilation methods

Operations

Routine TAMSAT rainfall estimation

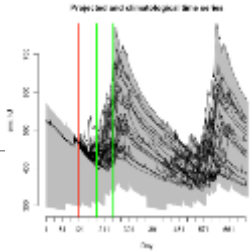
Application implementation

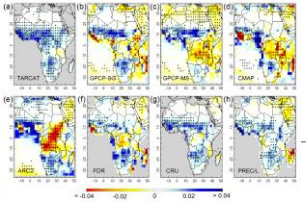
System development/new products

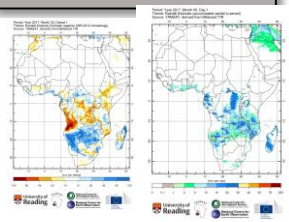
Applications

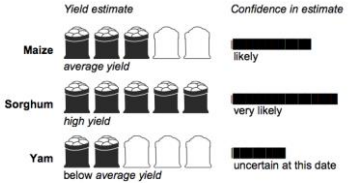
Pluvial flood risk estimation using gauges and imagery

Real time agricultural drought forecasting









For further details, contact Emily Black
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Background and Problem Statement

- Remotely sensed observations can support agricultural livelihoods in Africa by guiding decision making on aid allocation, insurance pay outs and farm management
- Much of our work deals with quantifying uncertainty in our products and services. We deal with two major issues:
  - In regions without ground observations, how accurate is satellite based rainfall?
  - Given multiple sources of environmental information, what is the risk of agricultural drought?

Approach to these two problems:

<u>New datasets and software tools</u>

In regions without ground observations, how accurate is satellite based rainfall?

- Novel methods for understanding the situations in which satellite based rainfall estimates perform well/badly.
- Development of a new rainfall dataset that includes calibrated uncertainty (to be released by the end of 2019)

Given multiple sources of environmental information, what is the risk of agricultural drought?

- New general framework for risk assessment that uses a modelling approach to address the question (TAMSAT-ALERT)
- Decision support tools that applies this framework to seasonal drought and planting date

<u>Transparency</u>

- All code publicly released on github
- Developing a web interface

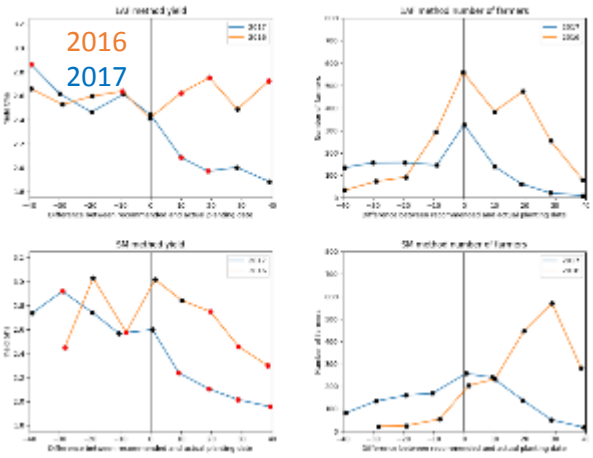
Results and Feedback

Example of ex ante study of planting date

Don't delay planting any further!

Rainfall only

New soil moisture forecasting method



Number of farmers

Outcome for farmers who didn't heed the advice

- Using multiple streams of environmental data to quantify risk and uncertainty would have resulted in better outcomes for farmers in Kenya during 2016 and 2017
- Work being taken forward into field trials by the One Acre Fund (>500,000 farmers)
- Decision support needs to be integrated in a wider context of risk management tools, including planting insurance. Working with PULA consultants on this.

TAMSAT: Tropical applications of meteorology using satellite based data

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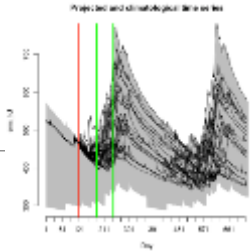

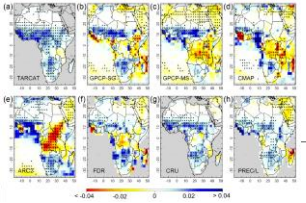

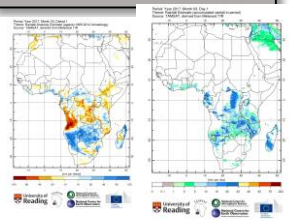

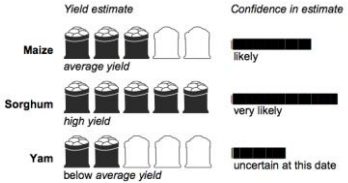

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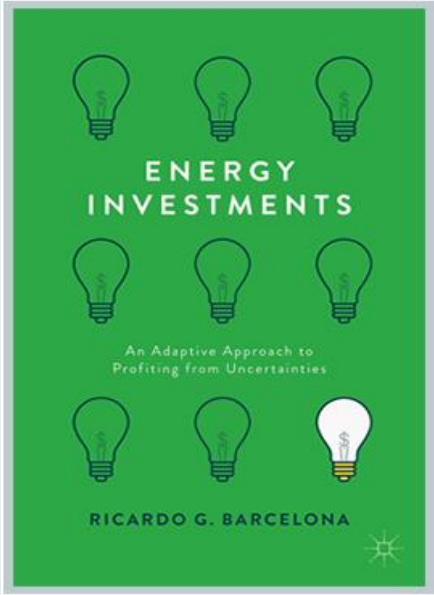

Energy Investments

An Adaptive Approach to Profiting from Uncertainties

-Ricardo Barcelona

palgrave
macmillan

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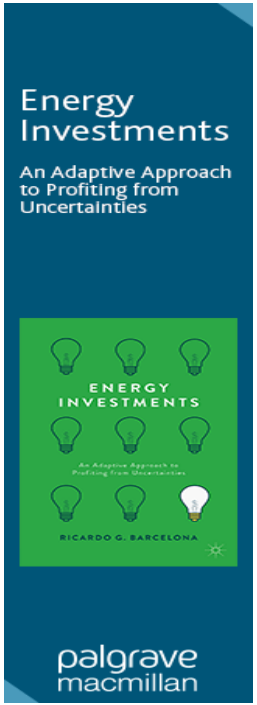
Honorary Research Fellow - CCFI
Imperial College Business School

PhD (King's College London), MBA (IESE), BA Economics (UPSE)

www.researchgate.net/profile/Ricardo_Barcelona

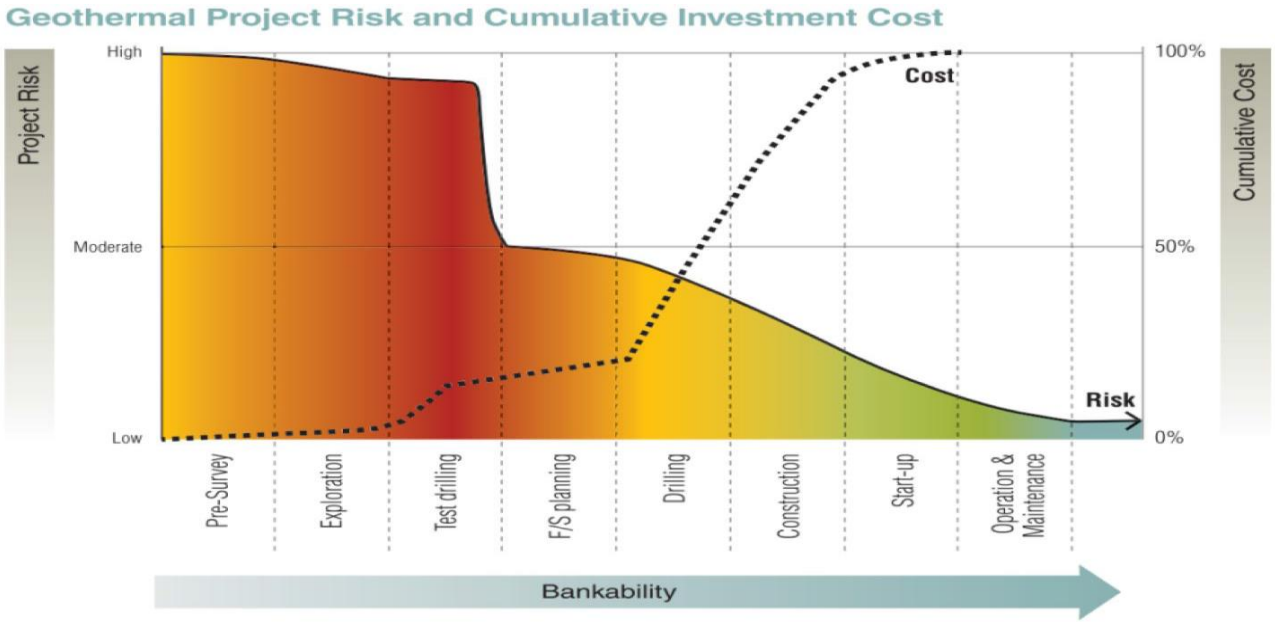


Financing Geothermal under uncertainties

Analysis under Uncertainties for Decision- makers Network (AU4DM)

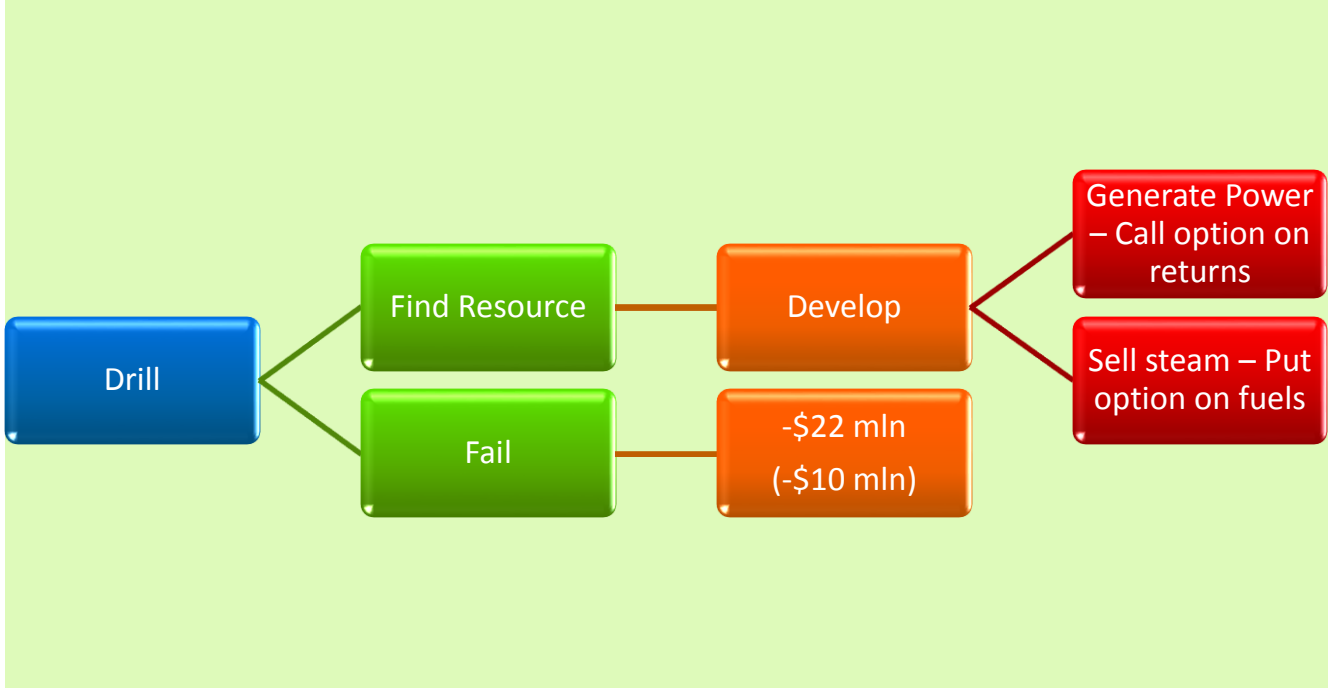
March 5, 2019, St James, London, United Kingdom

Geothermal Venture



Source: ESMAP, WB

Flexible commitments



Resource Insurance

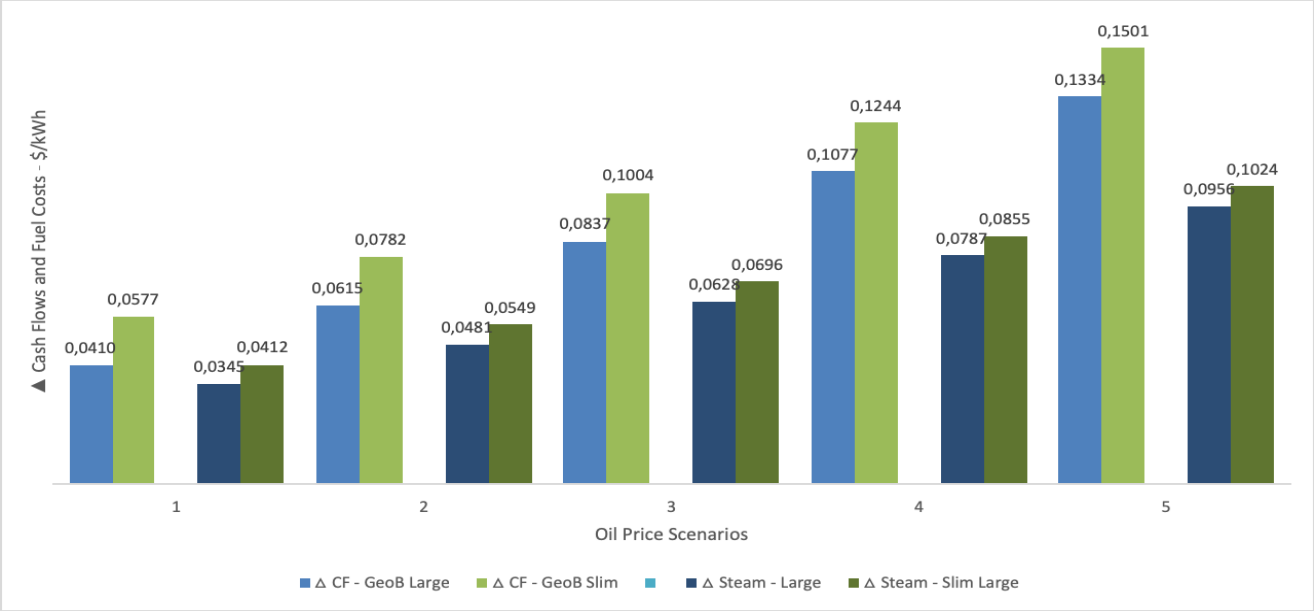
Large Hole Geothermal Drilling and Exploration	Units	Number	Preparatory costs	Mobilisation	Drilling	Well Testing	Site Operation	Total
Field or portfolio size	MW	55						
Number of wells drilled	Units	4						
Drilling depth	Meters/Well	2.500						
Drilling costs	$/Meter	3,00						
Uninsured costs	$ mln		**3,75**	**19,00**	**0,00**	**0,00**	**0,00**	**22,75**
3 G Initial survey	$ mln		0,00	1,50	0,00	0,00	0,00	
Access roads, pads, land	$ mln		0,00	15,00	0,00	0,00	0,00	
Logisitics and rig mobilisation	$ mln		0,00	2,50	0,00	0,00	0,00	
Insured resource costs	$ mln		**0,00**	**0,00**	**30,00**	**0,00**	**0,00**	**30,00**
Drilling costs	$ mln		0,00	0,00	30,00	0,00	0,00	30,00
Others	$ mln		**0,00**	**0,00**	**0,00**	**2,00**	**4,00**	**6,00**
Segment Total	$ mln		**3,75**	**19,00**	**30,00**	**2,00**	**4,00**	**58,75**

Slim Hole Geothermal Drilling and Exploration	Units	Number	Preparatory costs	Mobilisation	Drilling	Well Testing	Site Operation	Total
Number of wells drilled	Units	16						
Drilling costs	$/Meter	1,20						
Uninsured costs	**$ mln**		**3,75**	**6,75**	**0,00**	**0,00**	**0,00**	**10,50**
3 G Initial survey	$ mln		0,00	1,50	0,00	0,00	0,00	
Access roads, pads, land	$ mln		0,00	4,50	0,00	0,00	0,00	
Logistics and rig mobilisation	$ mln		0,00	0,75	0,00	0,00	0,00	
Insured resource costs	**$ mln**		**0,00**	**0,00**	**19,20**	**0,00**	**0,00**	**19,20**
Drilling costs	$ mln		0,00	0	19,2	0,00	0,00	
Others	**$ mln**		**0,00**	**0,00**	**0,00**	**2,00**	**1,2**	**3,20**
Segment Total	**$ mln**		**3,75**	**6,75**	**19,20**	**2,00**	**1,20**	**32,90**

Sources of raw data: Authors' calculations based on API project costs presented to Indonsia's Ministry of Energy, Mining and Resources, November 2018.

Costs shared by public funding

Embedded Option Values



Source of raw data: EIA

Risks to Opportunities