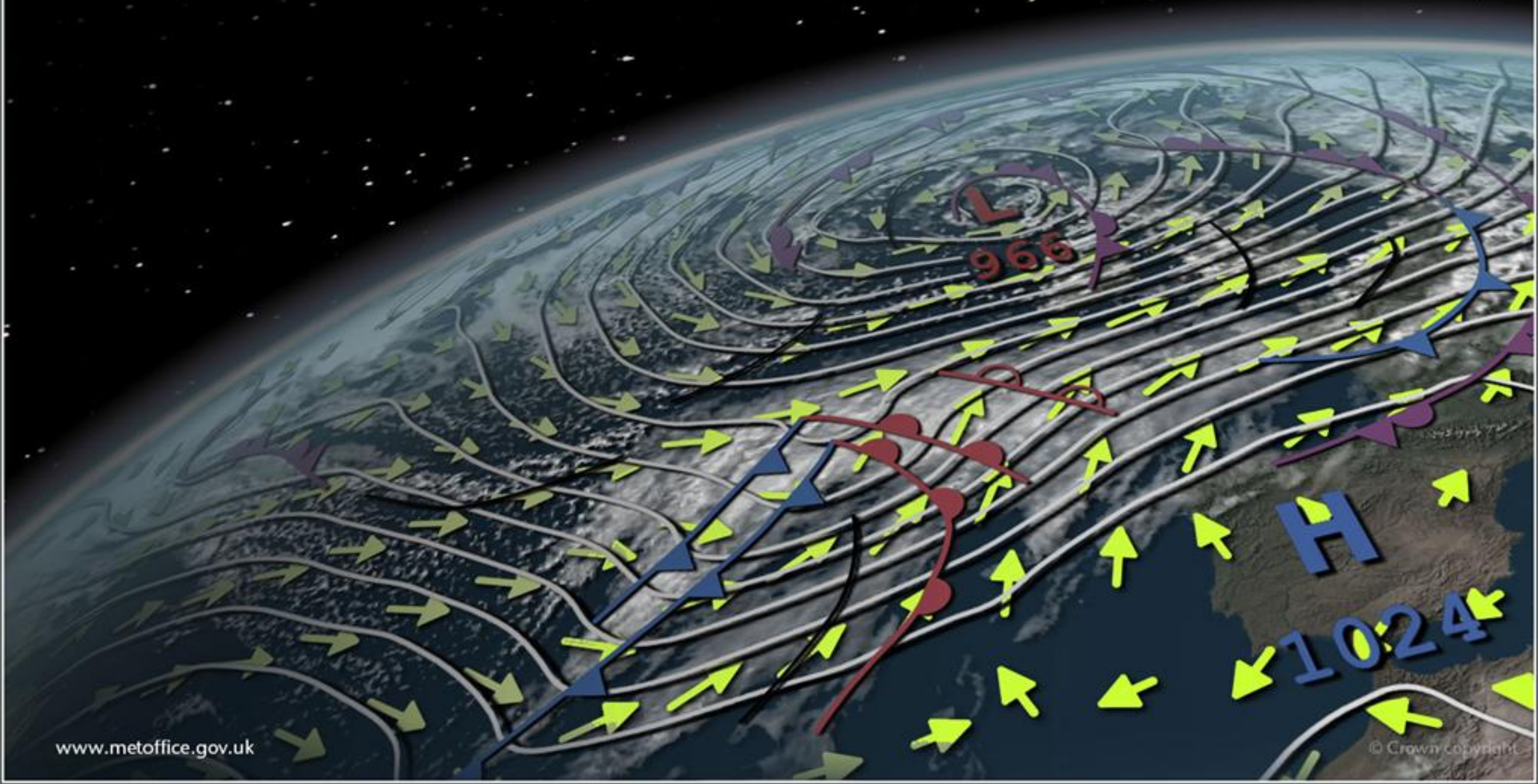
Met Office

Theme 5: Climate risk assessment & user engagement

The WP10 & WP11 team

PRIMAVERA kick-off meeting, November 2015



Who are we?

WP10:
Lead – Gerard van der Schrier (KNMI)
Co-lead – David Brayshaw (University of Reading)
Other contributing organisations: SMHI, Met Office, BSC

WP11:
Lead – Isadora Jimenez & Mel Davis (BSC)
Co-lead – Erika Palin (Met Office)
Other contributing organisations: KNMI, Predictia, University of Reading

Role of WP10 & WP11

- Do the high-res climate model simulations capture processes / metrics of most interest to users?
- What diagnostics do we need from the high-res climate model simulations in order to address user-relevant topics?

- What questions are end users asking?
- About which processes / phenomena do end users want information?
- What outputs do end users want?

1	Dev't & application of metrics
2	Benefits of high resolution
3	Role of model physics
4	Frontiers of climate modelling
5	Drivers of variability & change
6	Flagship simulations
7	Project management
8	Scientific coordination
9	HPC & data management
10	Climate risk assessment
11	User eng't & dissemination

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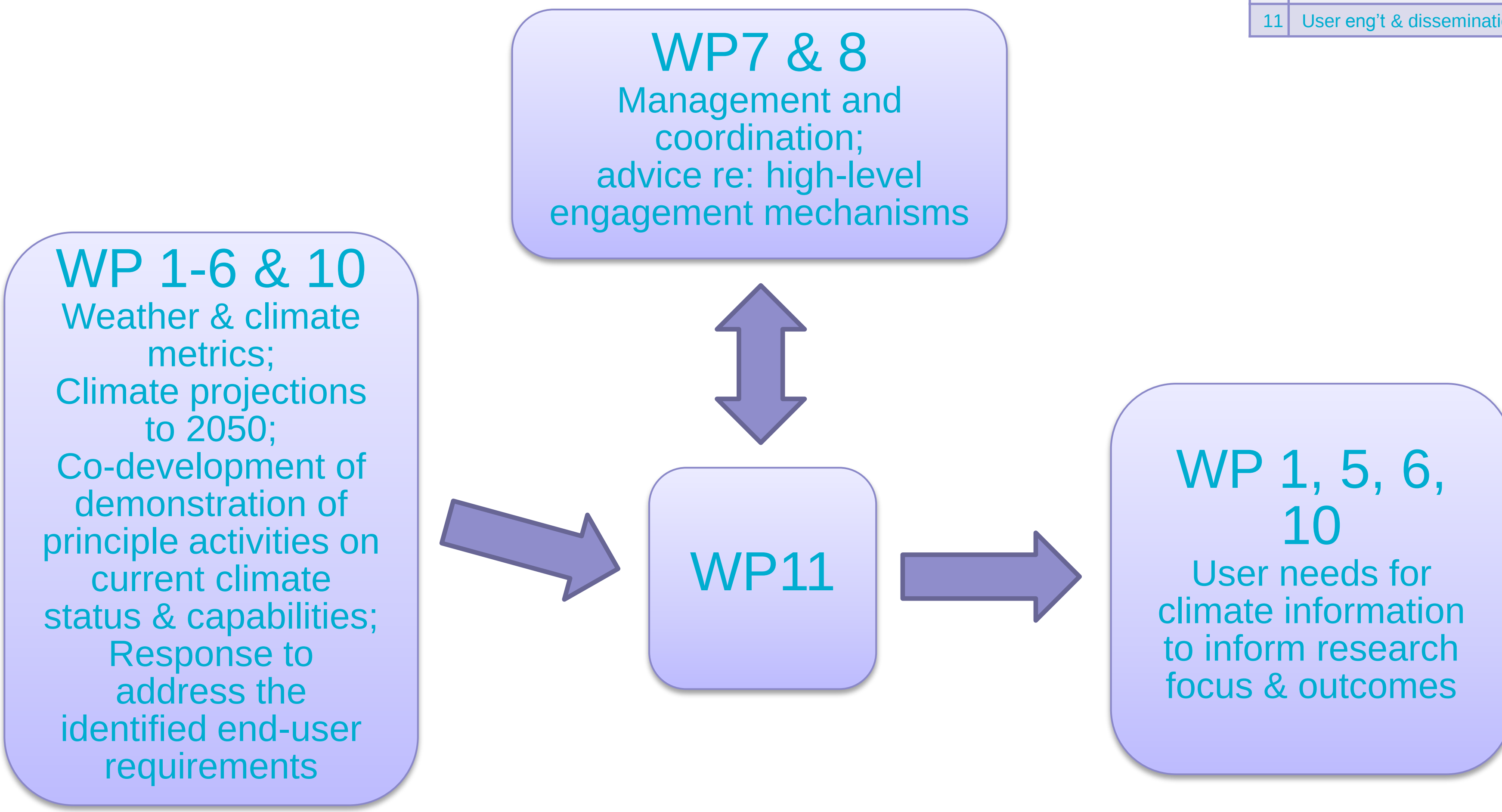
WP11 interactions within PRIMAVERA

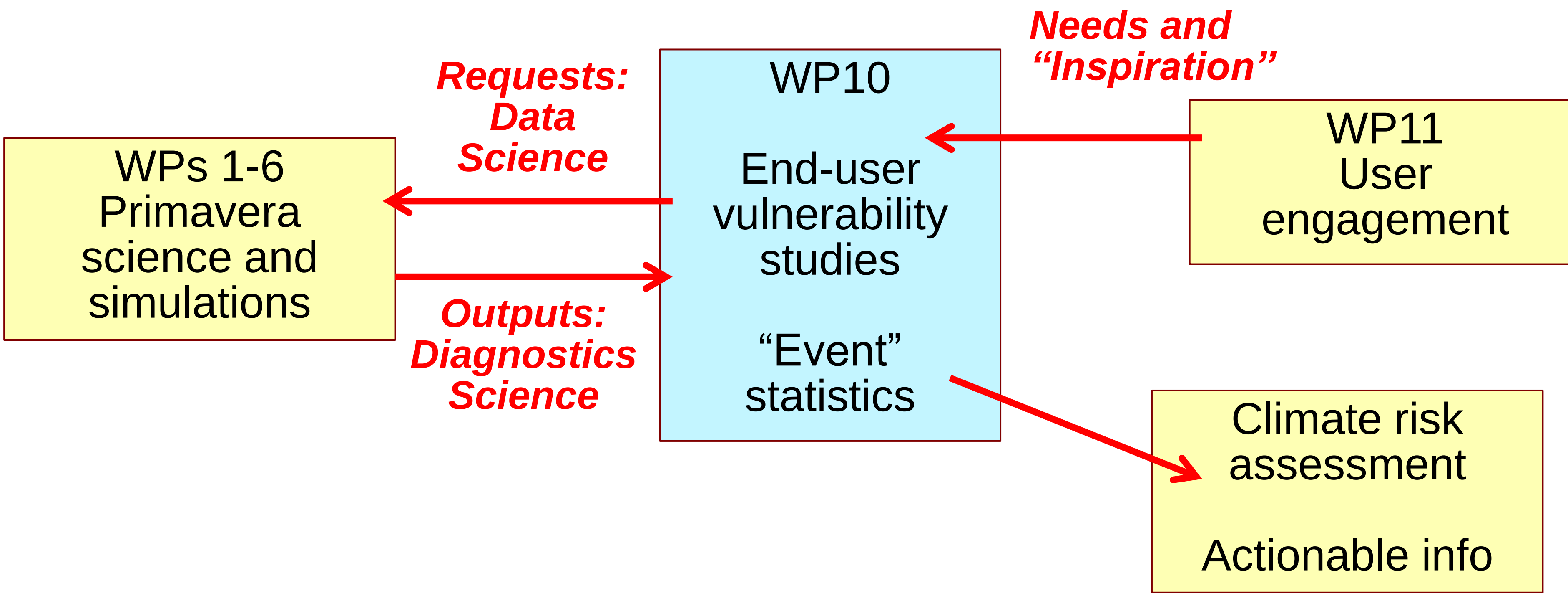


Some topics for WP11

- Who are “end users”?
  - Other scientists, academics, industry, policy-makers…
- How will we engage with end users?
  - Different mechanisms needed for different types of user
- How will we identify user needs?
- Which sectors?
- What are the opportunities / risks?

WP10 – Climate Risk Assessment

Gerard van der Schrier (KNMI, lead), David Brayshaw (UReading, co-lead)



WP10 – Climate Risk Assessment

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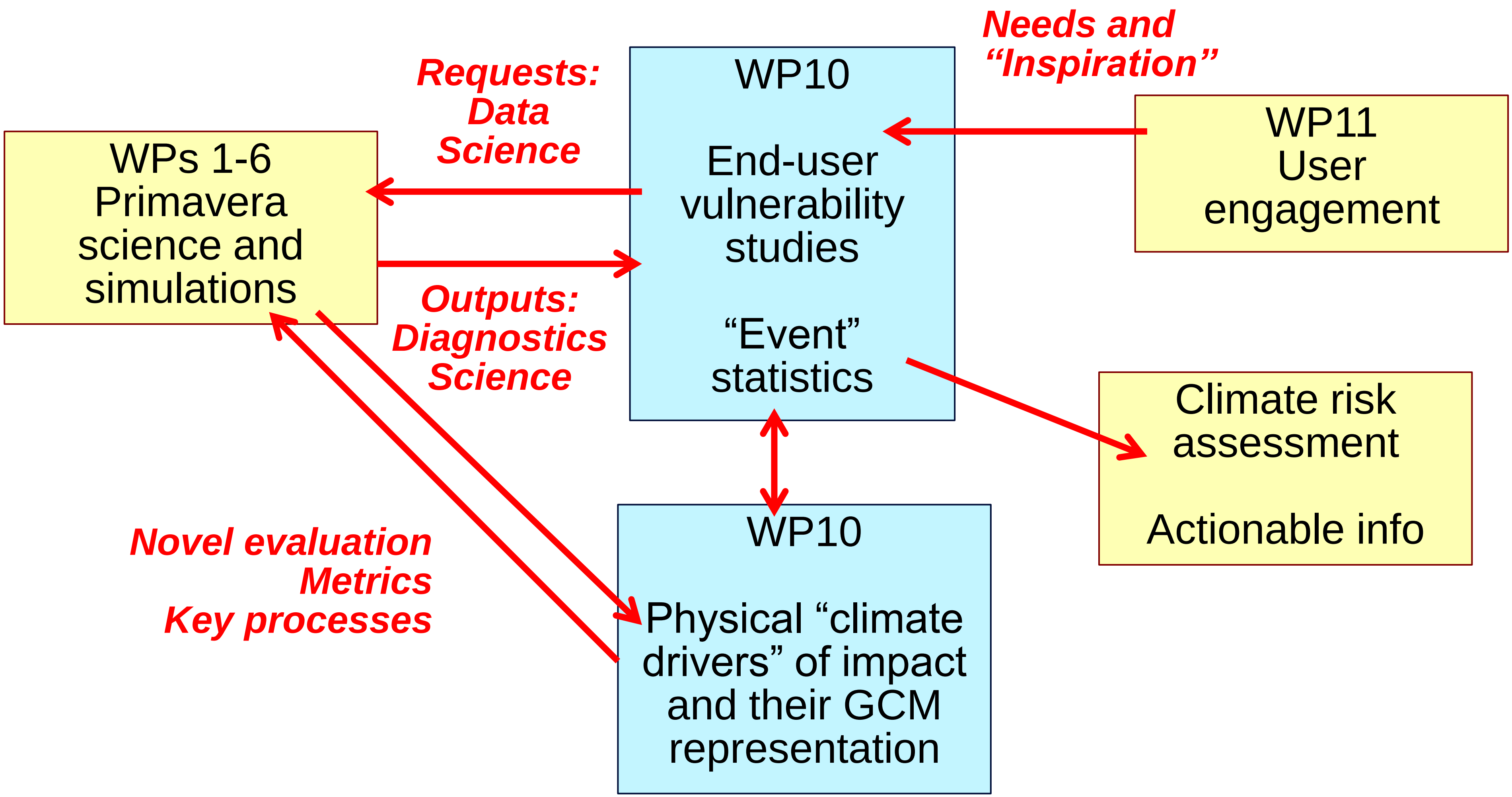
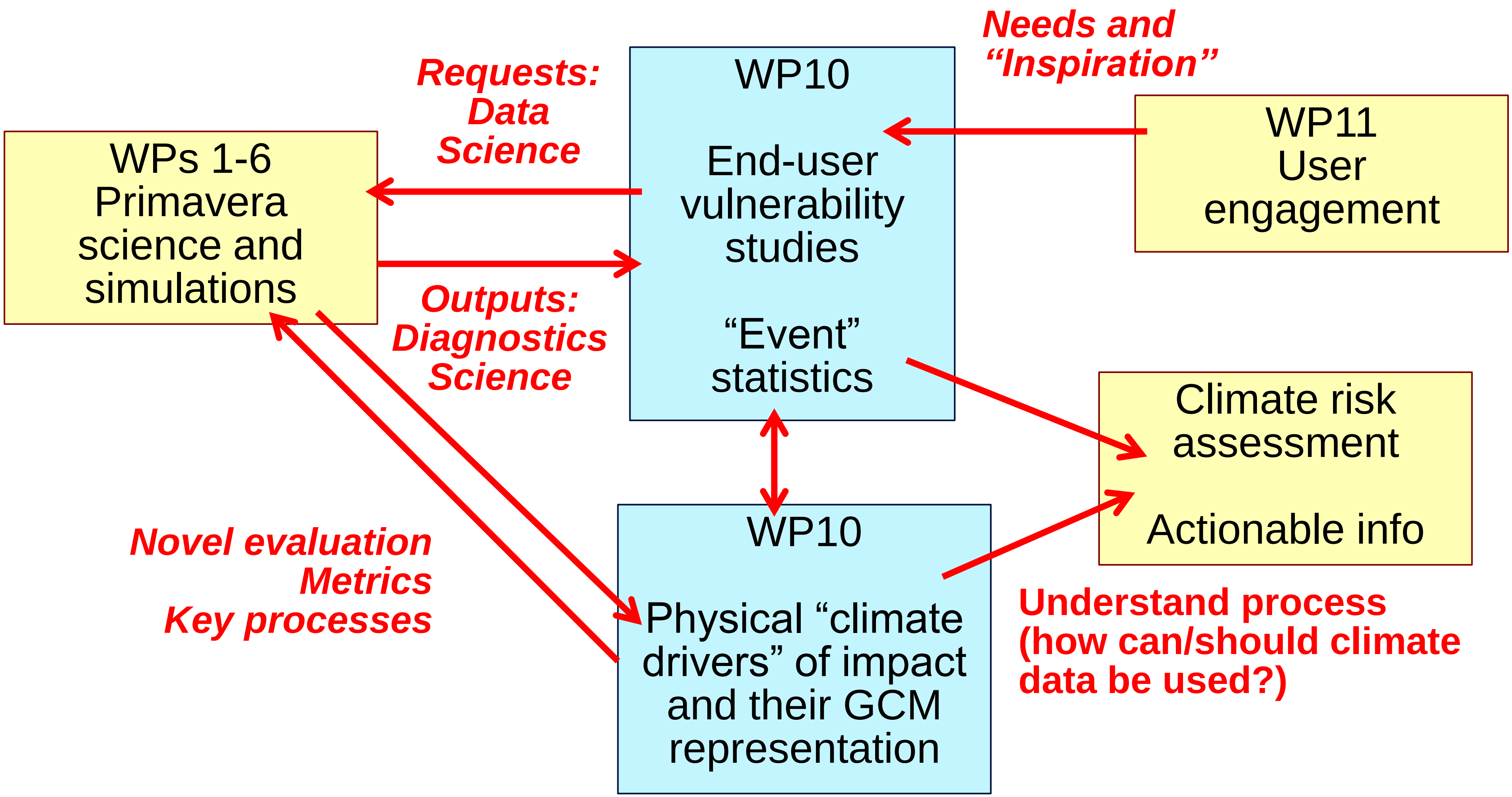


What "value" does increased resolution add?

WP10 – Climate Risk Assessment

Gerard van der Schrier (KNMI, lead), David Brayshaw (UReading, co-lead)



What “value” does increased resolution add?

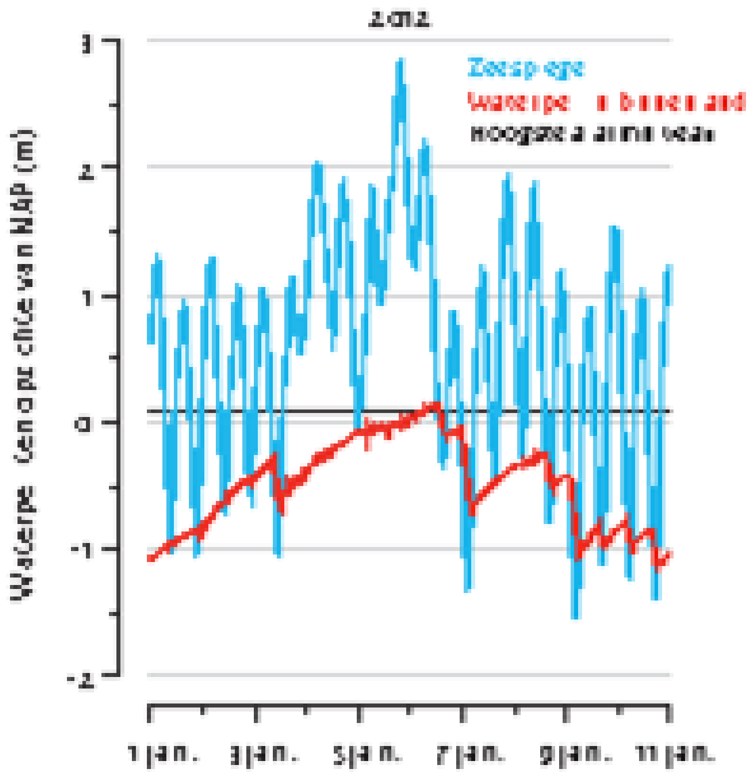
Example: storm surge

- An example of a compound extreme event
- Storm surges are relevant for Holland
- System of dikes protects below-sea level Holland
- *Outside* the dikes – surprises do happen!

Horses trapped on a small island outside the sea dike,
farmer overtaken by surprise

Example: storm surge

- Early Jan. 2012: heavy precipitation followed by a storm surge
- Low-lying areas could not drain to the Waddensea



sea level, inland water level, highest alarm level

- KNMI scenario's: will this occur in the future more often?

Example: storm surge

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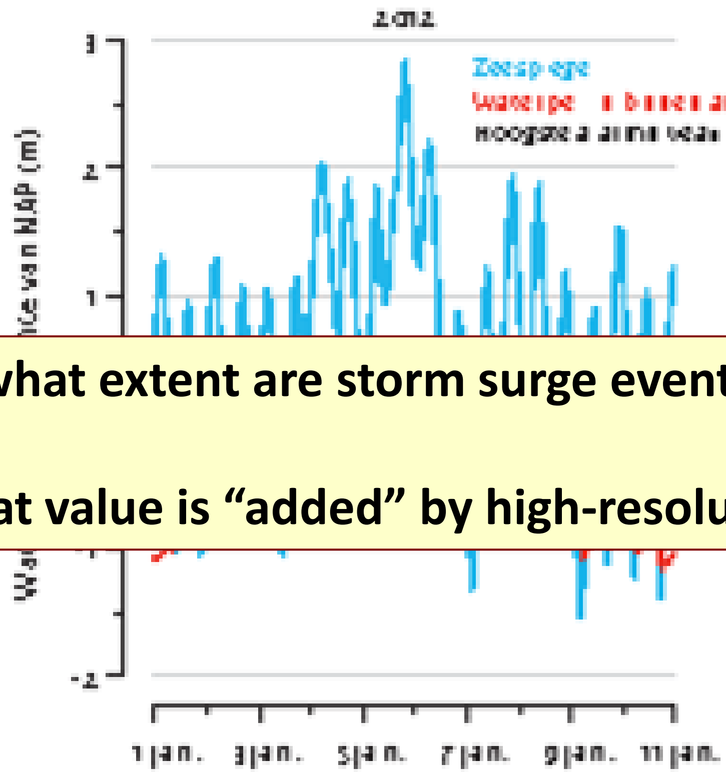
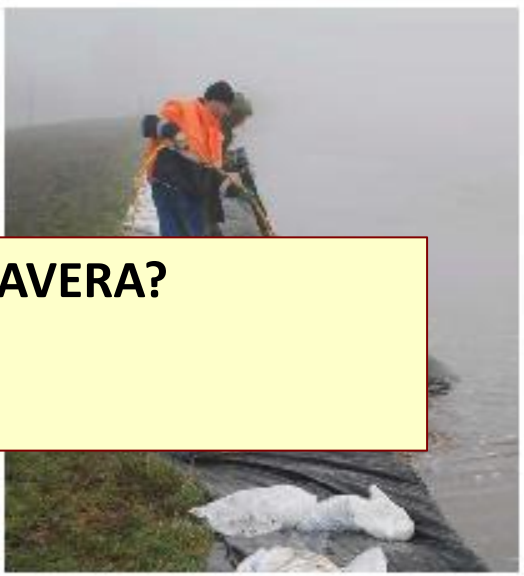




To what extent are storm surge events captured in PRIMAVERA?

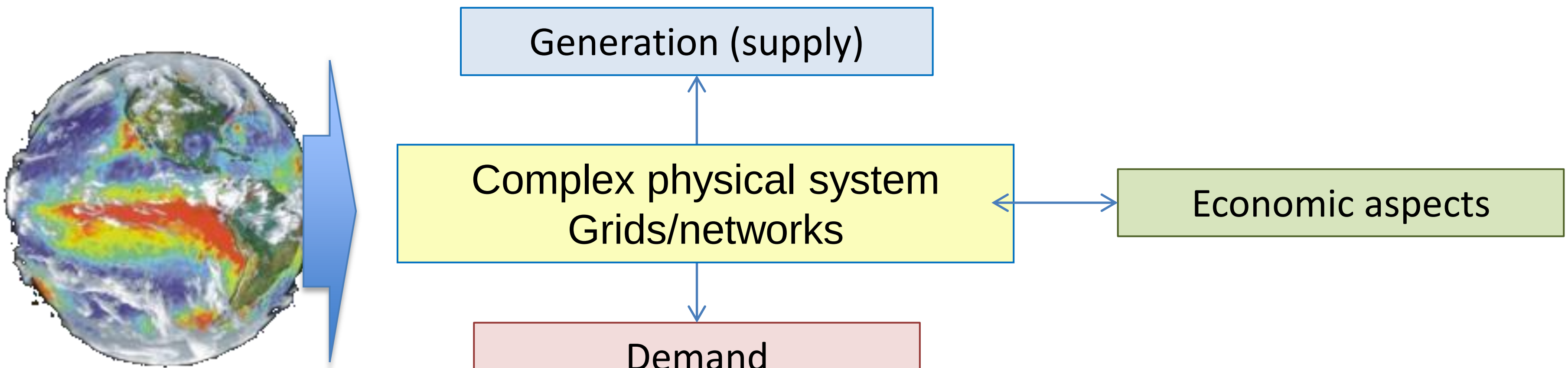
What value is "added" by high-resolution?

sea level, inland water level, highest alarm level

- KNMI scenario's: will this occur in the future more often?

Impact *functions* vs Impact *simulations*

- Climate impacts should not be viewed as a static mapping: weather extreme => impact
- Better to incorporate climate science (models, knowledge, data) into *simulations* of system behaviour (sea level, power systems, economy, finance, insurance, water resources, transport, …)
- Power/energy sector as an example



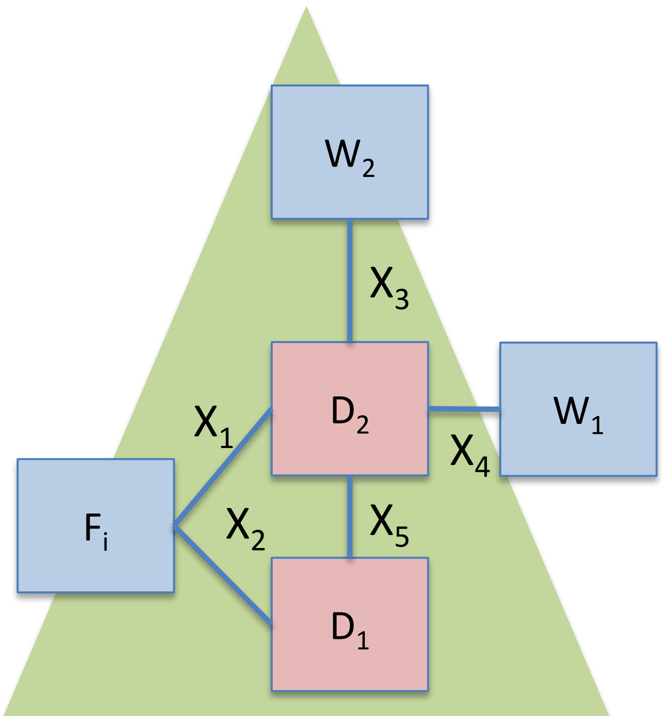
Climate data

Sample questions:

- What is wholesale price, *P*, of electricity at a given time?
- How much controllable (fossil) plant is needed to ensure supply adequacy?
- If more wind power capacity is installed, to what extent does transmission capacity need to be uprated?

Introduction: the power system

Great Britain power system



Generation:

- $F_{1,2,\ldots N}$: Controllable power stations
  - "inflexible" nuclear plant
  - "cheap slow" coal plant
  - "expensive fast" gas plant
- W_1, W_2: Wind power, $W(u, \rho)$

Demand:

- D_1, D_2: Demand, $D(T, u)$

Transmission:

- $X_1, \ldots, X_N$: Limited maximum power transmission, L_i

Challenge:

- W_1, W_2, D_1, D_2 all depend non-linearly on weather
- For every time, t, require:
  - Balance constraint: $\Sigma_i F_l(t) = D_1(t) + D_2(t) - W_1(t) - W_2(t)$
  - Ramping constraint: For each F_i require $|F_i(t+1) - F_i(t)| < R_i$
  - Transmission constraint: For each X_i, require $X_i < L_i$
- Such that $\Sigma_i \Sigma_t c(F_i(t))$ is minimized, where $c(F)$ is the cost of using resource F

Introduction: the power system

Great Britain power system

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Sample questions:

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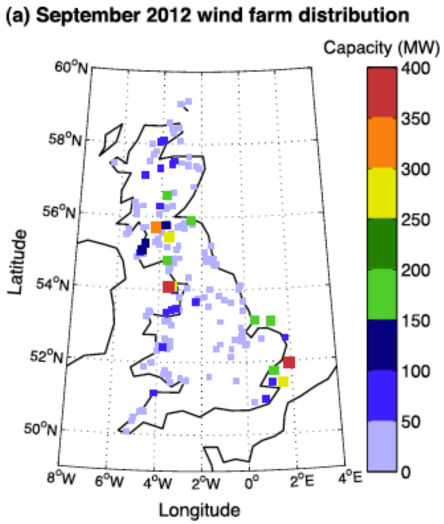
Answers:

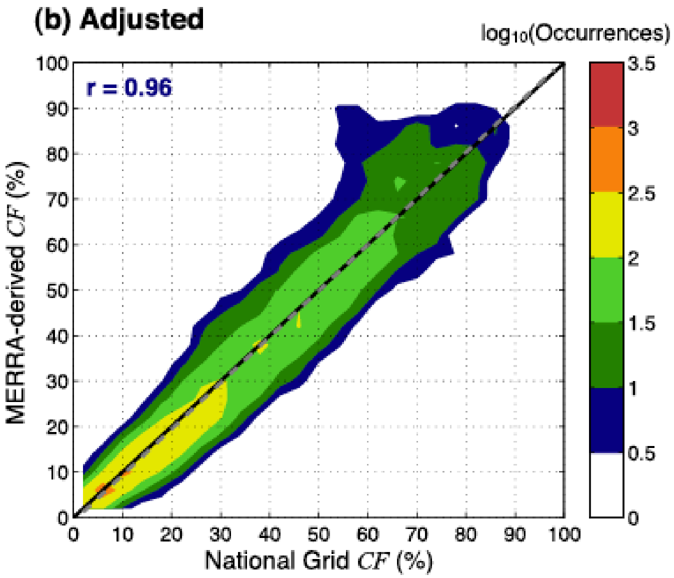
- *P* set by the most expensive F_i in use at time *t*
- $Max(\Sigma_i F_i)$ set by spatio-temporal covariability of D and W given constraints *R* and *L*
- Required *L* depends on required power flows between nodes

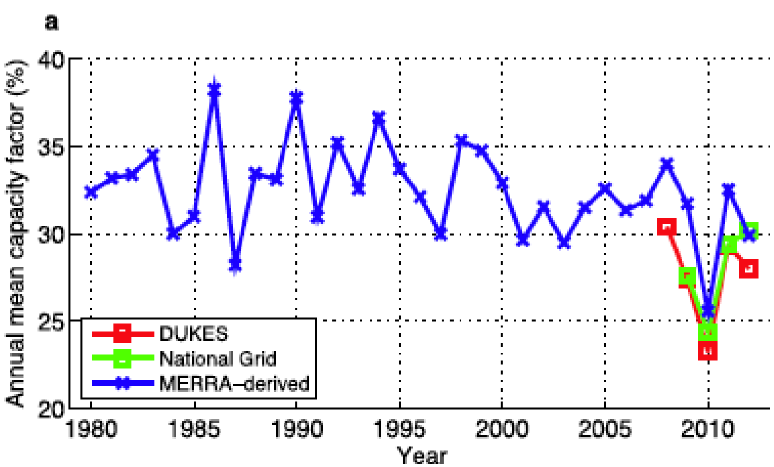
Corollaries:

- To estimate the climate *impact* you need to be able to *simulate* the target system

Questions for PRIMAVERA







GB wind power

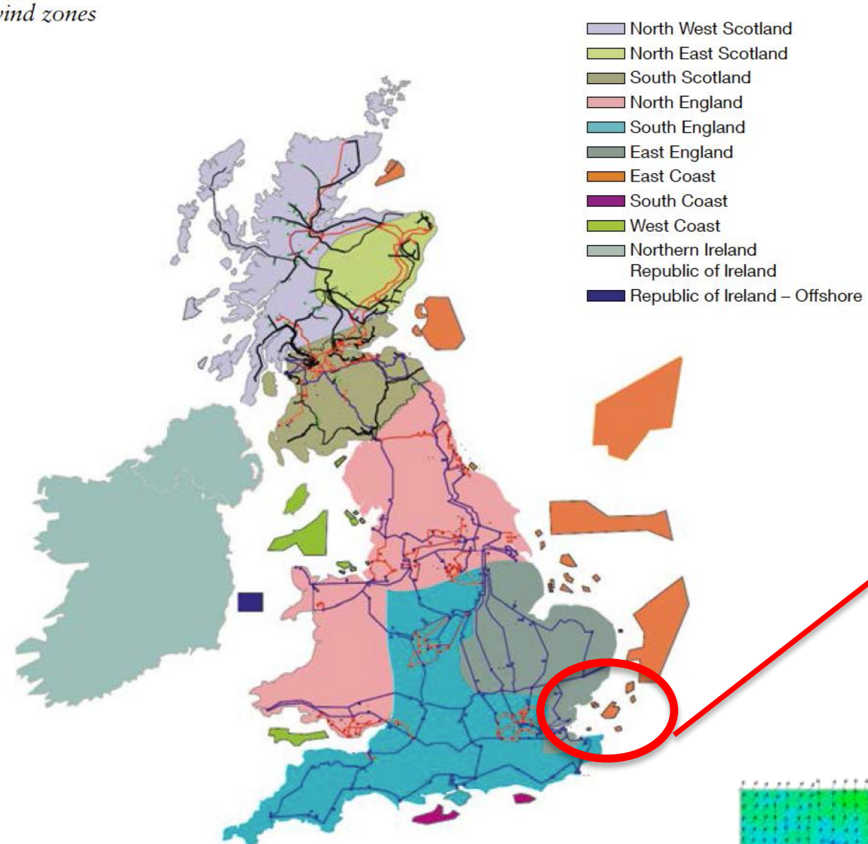
Reanalysis data used to massively extend record

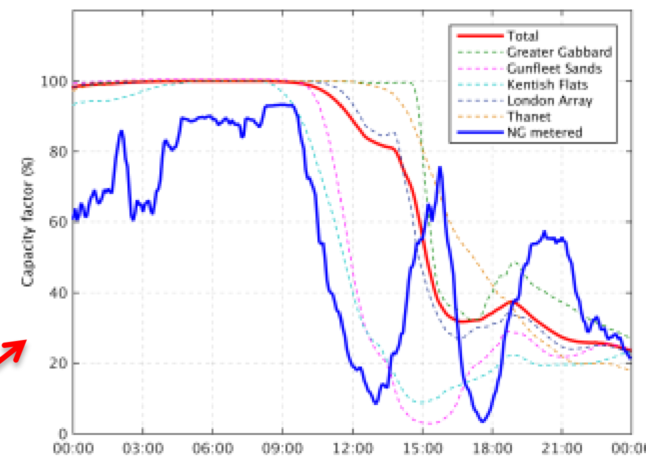
- Useful for understanding extremes in output an **rapid changes in output**
- Limited to 30y – GCM to extend?

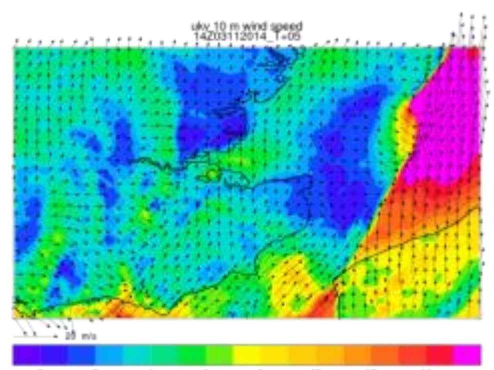
Figs: Cannon et al (2015).

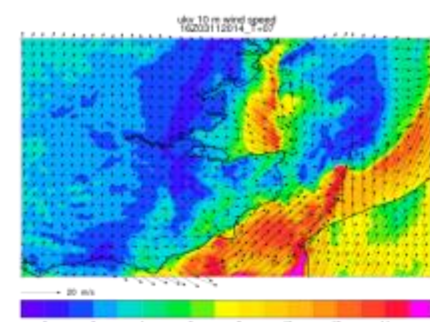
Questions for PRIMAVERA

Figure 2.19
ELSI wind zones









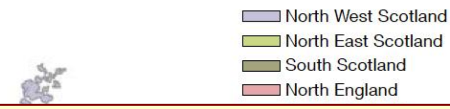
Regional wind power

- Fronts (resolution)
- Secondary structures
- Diurnal cycle of boundary layer

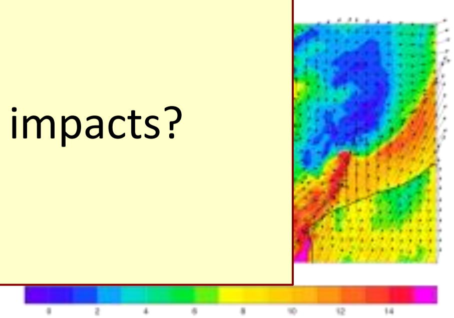
Figs: LHS – National Grid 10 year statement 2014. RHS – courtesy Dan Drew.

Questions for PRIMAVERA

Figure 2.19
ELSI wind zones



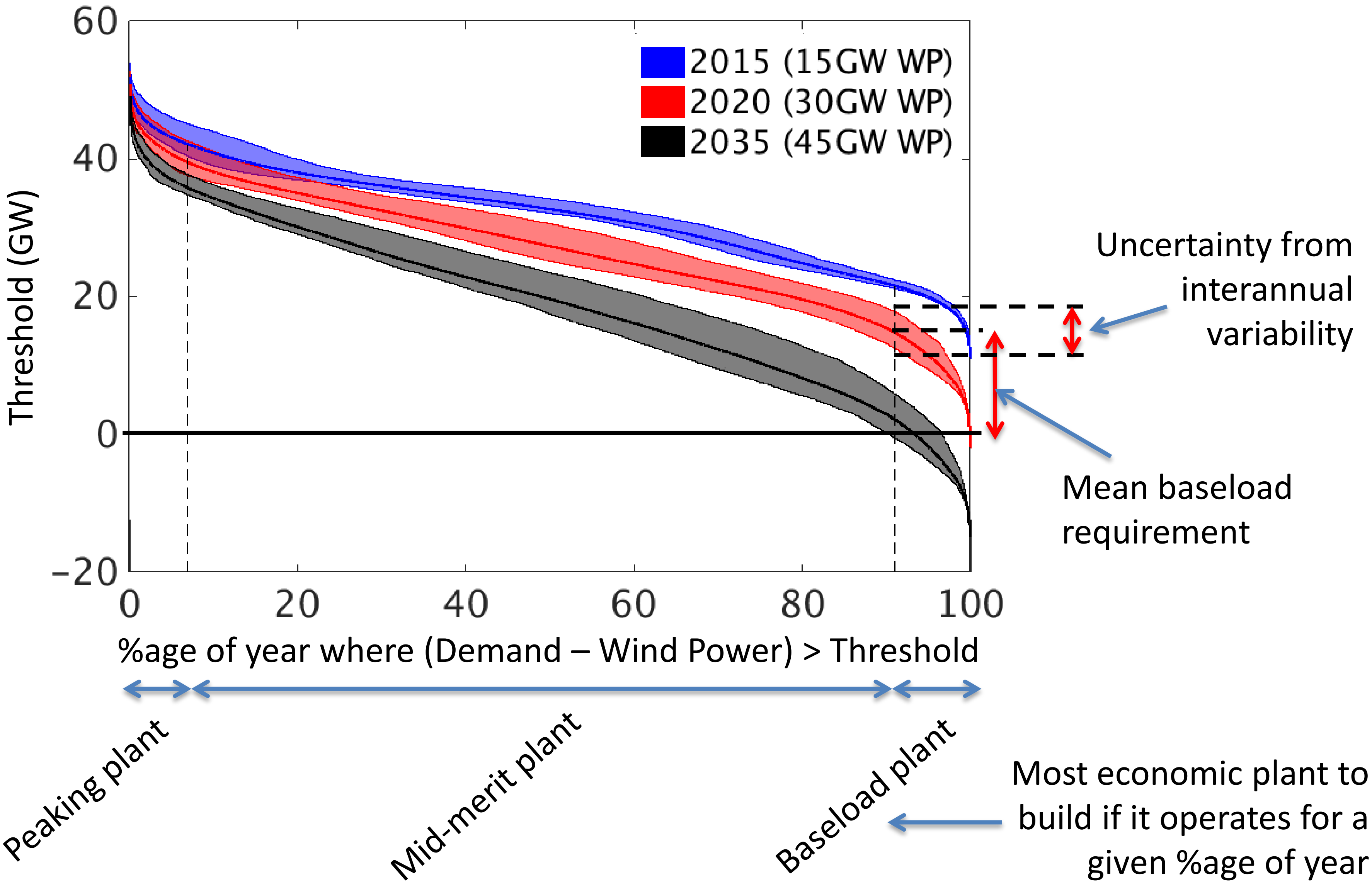
- To what extent can high-res GCMs represent the physical processes responsible for small-scale, high-frequency meteorological properties and their spatio-temporal structure?
- To what extent can these behaviours be captured efficiently in diagnostics (volume of data)?
- To what extent can deficiencies be corrected through post-processing?
- To what extent should/can this understanding feedback on model development and model evaluation?
- (Practically) What GCM information do we need to study impacts?



Figs: LHS – National Grid 10 year statement 2014. RHS – courtesy Dan Drew.

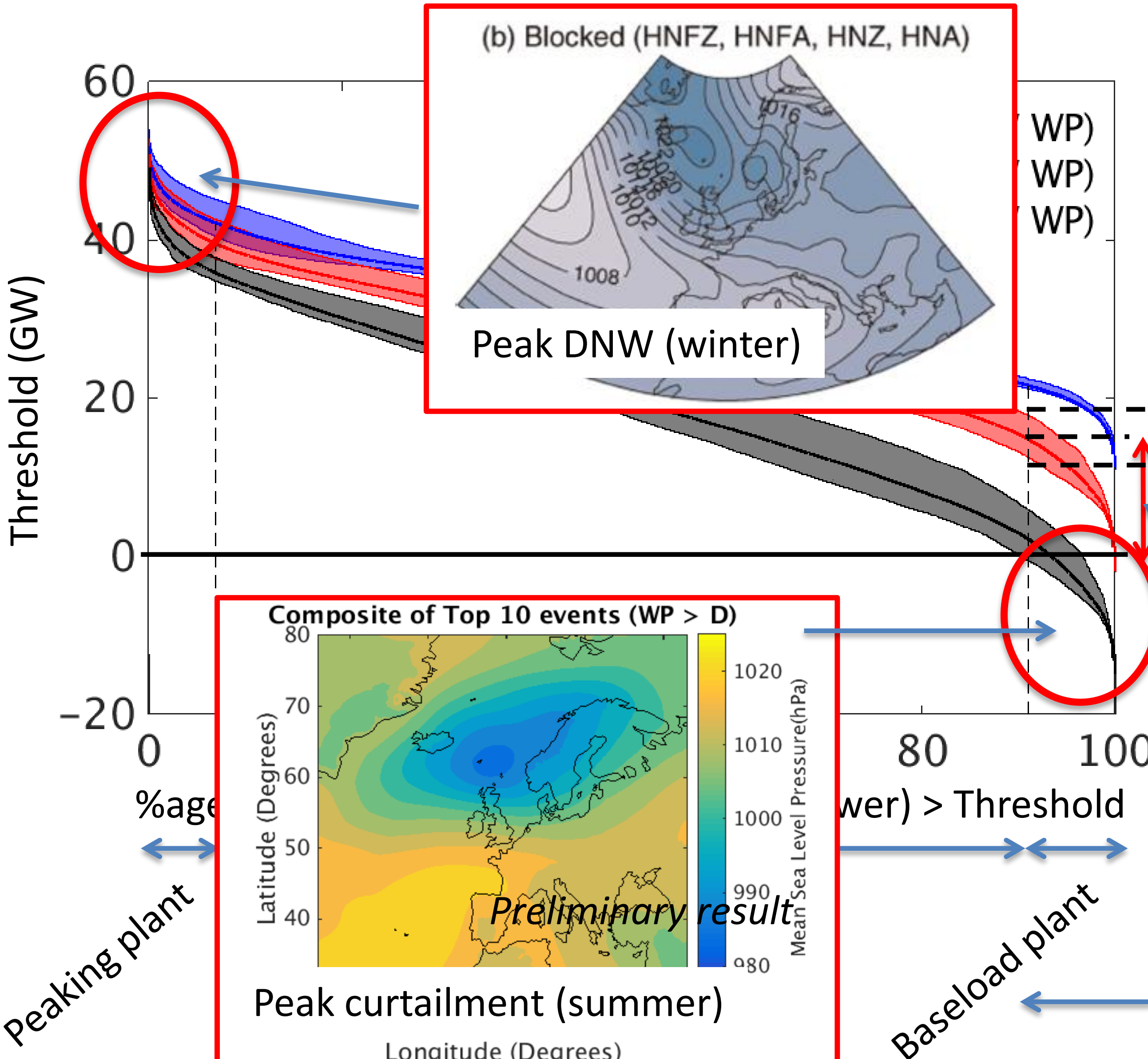
Questions for PRIMAVERA

Fig: Courtesy Hannah Bloomfield.



Questions for PRIMAVERA

Fig: Courtesy Hannah Bloomfield also Brayshaw et al (2011).



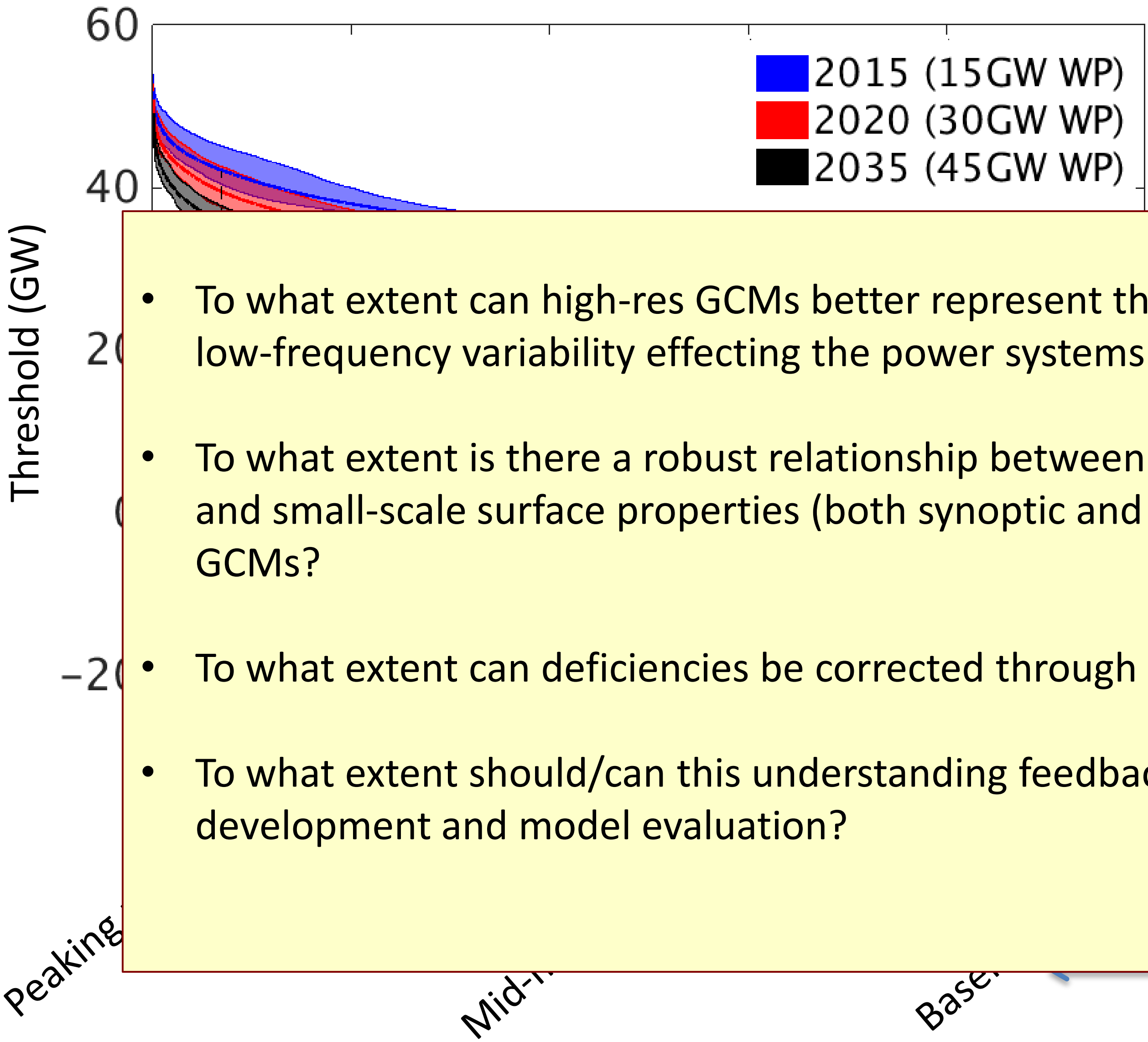
Uncertainty from interannual variability

Mean baseload requirement

Most economic plant to build if it operates for a given %age of year

Questions for PRIMAVERA

Fig: Courtesy Hannah Bloomfield.



- To what extent can high-res GCMs better represent the synoptic and low-frequency variability effecting the power systems?
- To what extent is there a robust relationship between large-scale LFV and small-scale surface properties (both synoptic and HFV) in high-res GCMs?
- To what extent can deficiencies be corrected through post-processing?
- To what extent should/can this understanding feedback on model development and model evaluation?

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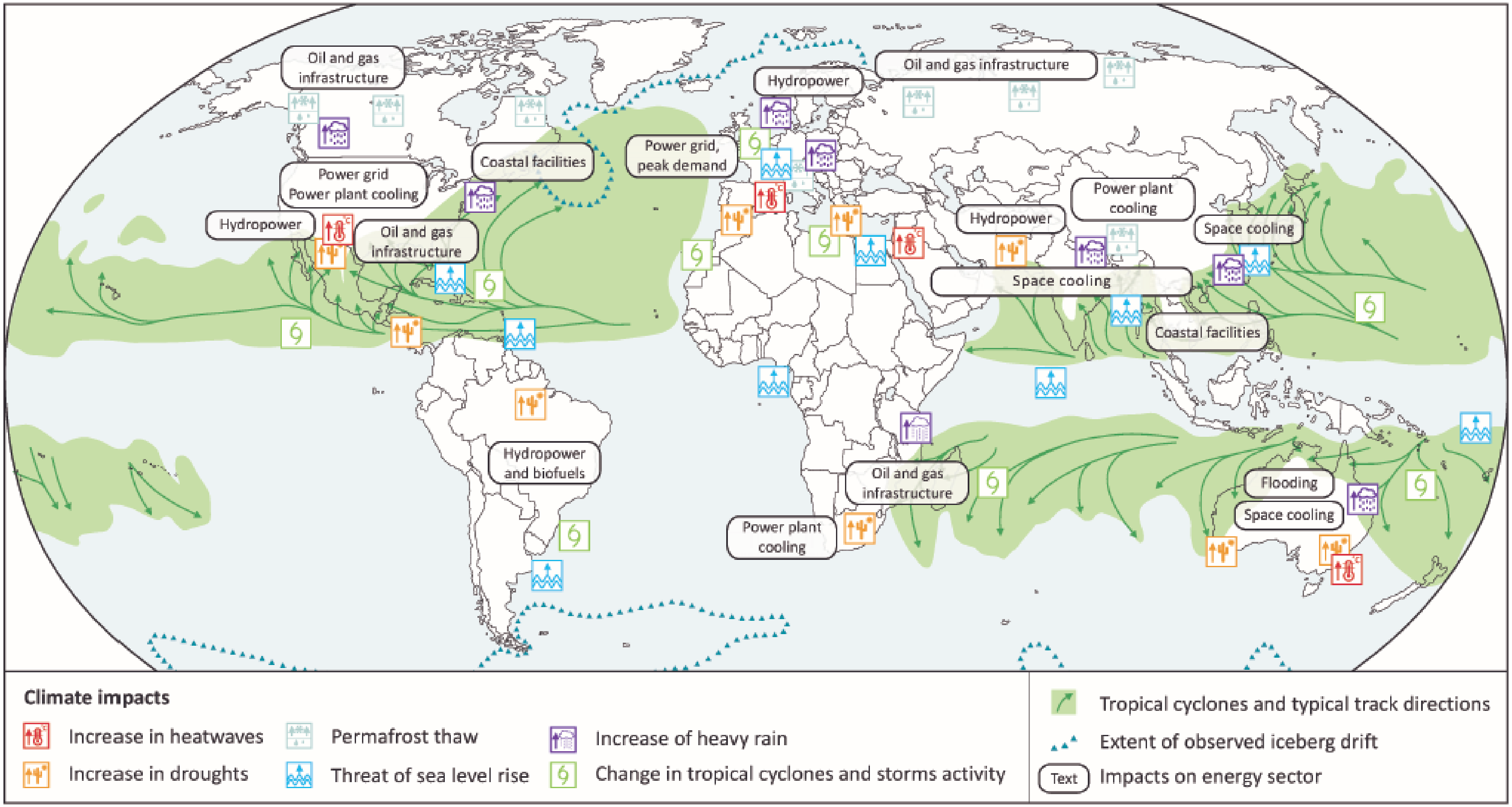
Globally interconnected

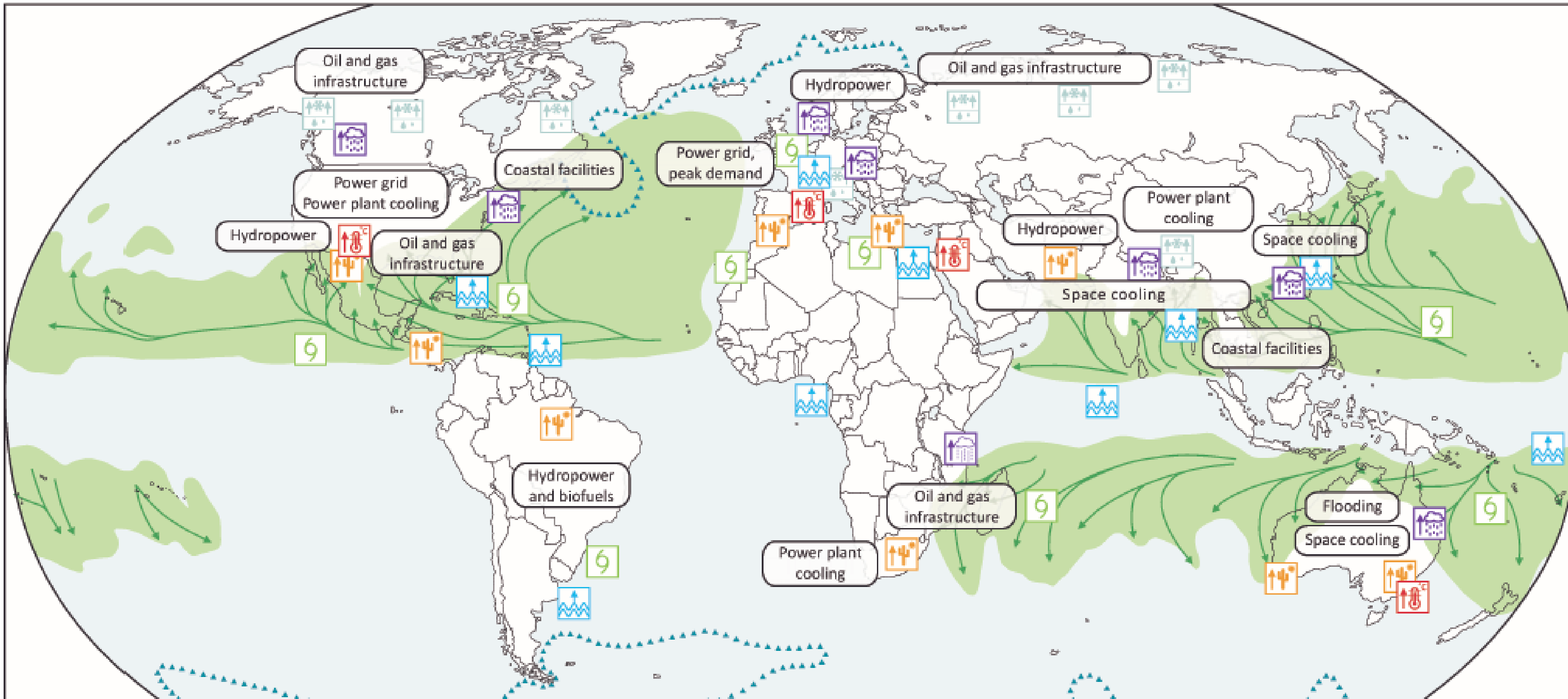


This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

Sources: Based on ©Munich RE (2011), with information from Acclimatise (2009), Foster and Brayshaw (2013), Schaeffer, *et al.* (2012) and IEA analysis.

Fig: IEA 2013 Redrawing the Energy Climate map

Globally interconnected



- Engaging with energy-sector researchers (academic as well as industry) vital in “translating” climate to impact

Fig: IEA 2013 Redrawing the Energy Climate map

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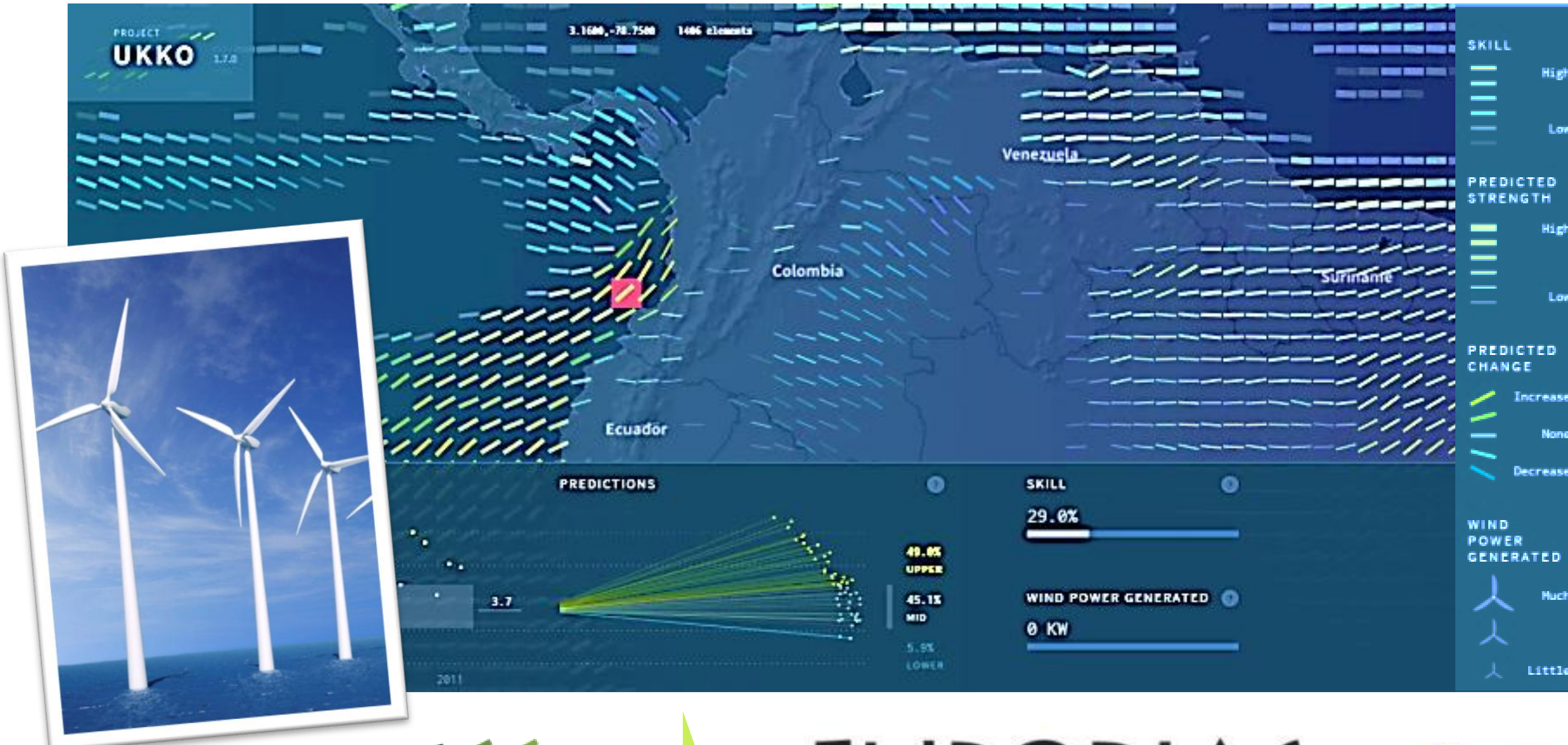
WP10 & WP11 deliverables & milestones

No.	Deliverable / milestone	Due month	
D11.1	End-user **dissemination & communication plan**	M3	Jan '16
D10.1	**Report** describing the **use cases**, identified by policymakers and end-user needs for **information on future extremes and compound events**	M12	Oct '16
MS27	*End-user requirements for climate information and their preferred delivery and visualisation methods documented*	*M12*	*Oct '16*
D11.2	PRIMAVERA **user interface platform**	M20	Jun '17
MS26	*Provide first results of scientific assessments to WP11*	*M24*	*Oct '17*
D10.2	**Report** on **statistics and representation of relevant extreme and compound events** in CMIP5, CORDEX and from first PRIMAVERA output	M24	Oct '17
D11.3	**Communication material**: sector-specific case studies, climate projection fact sheets, via UIP	M30	Apr '18
D10.3	**Report** on **physics of extreme and compound events** from PRIMAVERA output	M36	Oct '18
D11.4	Answering user needs via a **visual prototype (energy sector)**	M36	Oct '18
D10.4	**Report** with **scientific input for risk assessments** for policymakers and each end-user	M46	Aug '19
D11.5	**Evaluation of project outcomes** by users	M48	Oct '19

Seasonal wind speed predictions



RESILIENCE PROTOTYPE

EUPORIAS + SPECS

EDF
edp renewables
ALSTOM
VORTEX
natural power
EnBW

Met Office

WP11-specific slides

WP11 risks

Risk	Proposed mitigation
Disconnect between what simulations provide and what end-users want	Poll scientists and end-users promptly to ensure effective communication of end-user needs and what is practically achievable
End-users unable to understand or use project outputs	Provide information and outputs in a range of formats and via a range of platforms; seek regular feedback from users regarding format, style, language of proposed outputs
Ineffective communication between WPs 10 and 11	Schedule monthly WP10/11 update teleconferences
Ineffective communication between WP10/11 & other WPs	Regular participation in project-wide meetings
End-users not sufficiently motivated to participate in project	Produce and enact engagement & dissemination plan (D11.1)

WP11 desired outcome

Communication of high-quality climate information

covering user-relevant phenomena, processes and metrics

in a range of user-relevant formats

via a range of user-relevant platforms & initiatives

to advance users' knowledge of, and response to, climate change

and support their competitiveness and growth

Questions & answers