Convection

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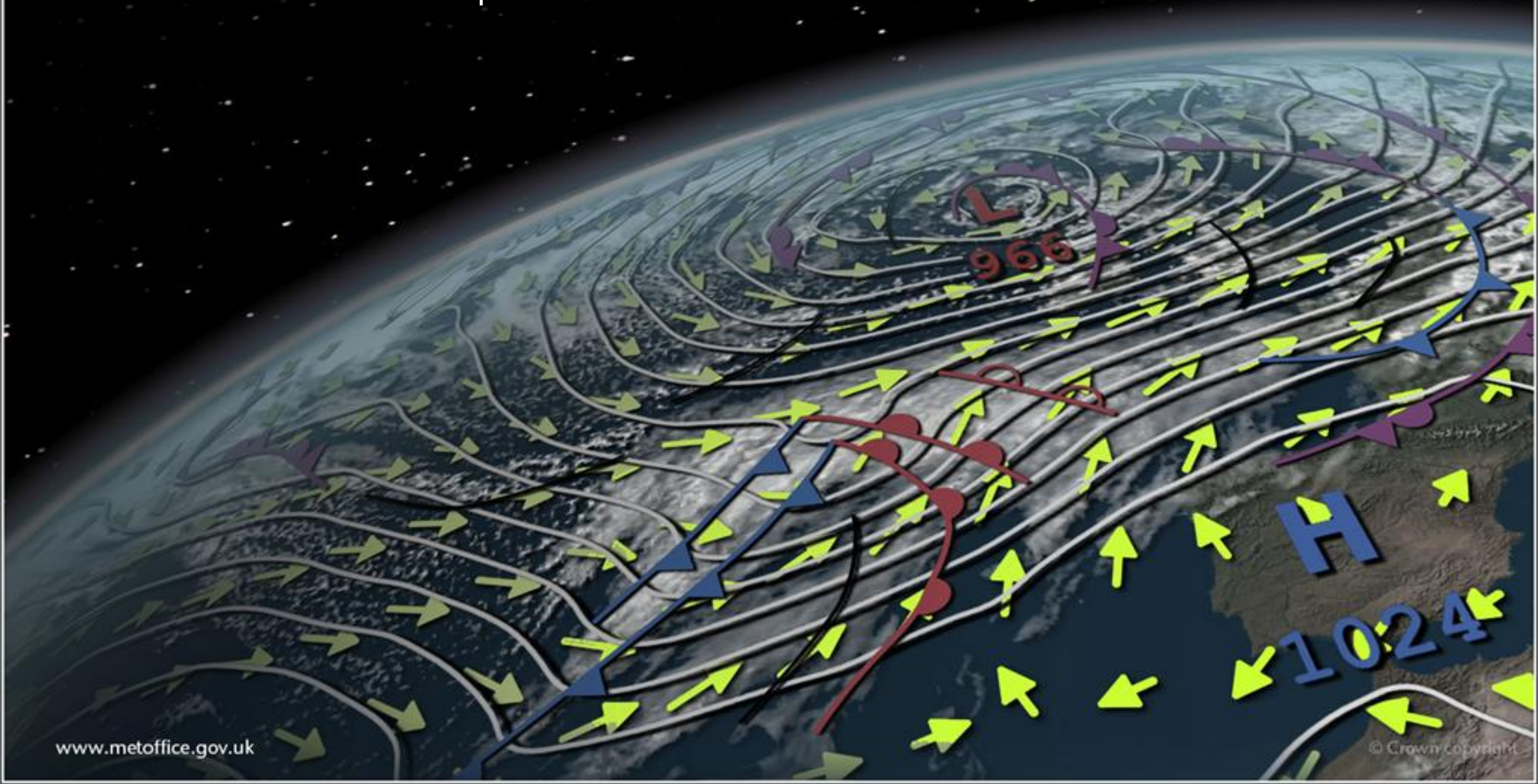
21st September 2015



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1. Verification measures for forecasts (Michael Whitall)

2. Representing convection-wave interactions (some background)

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Verification measures for forecasts

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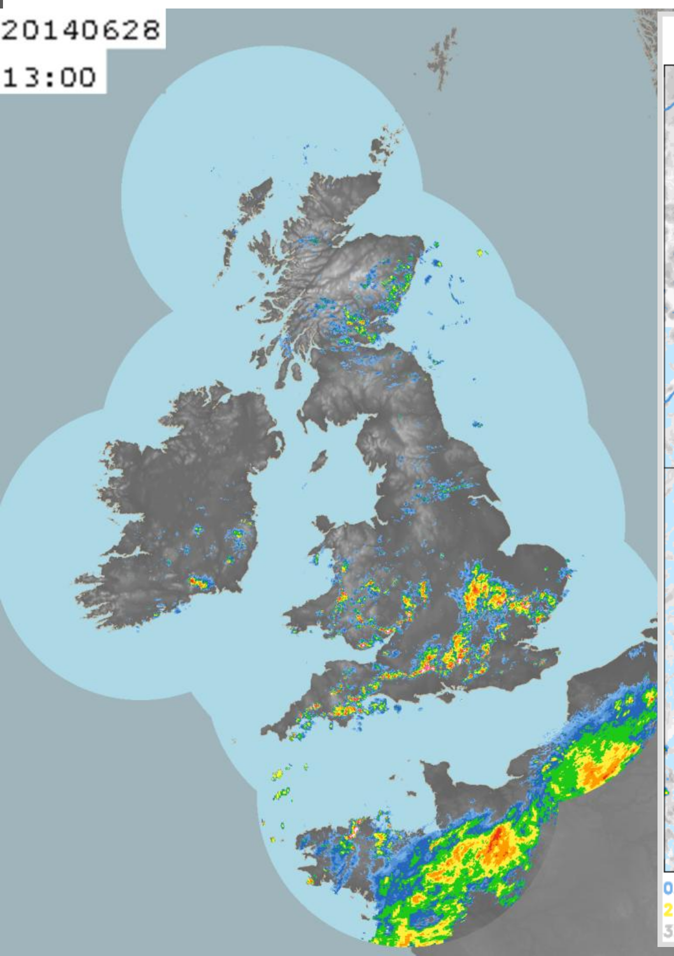
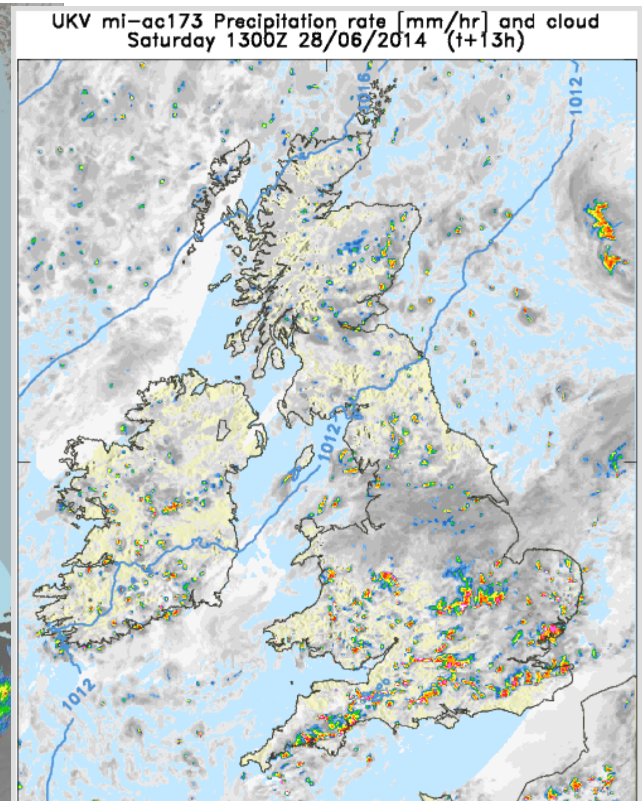
Rainfall on 28th June 2014

Radar

Model 1

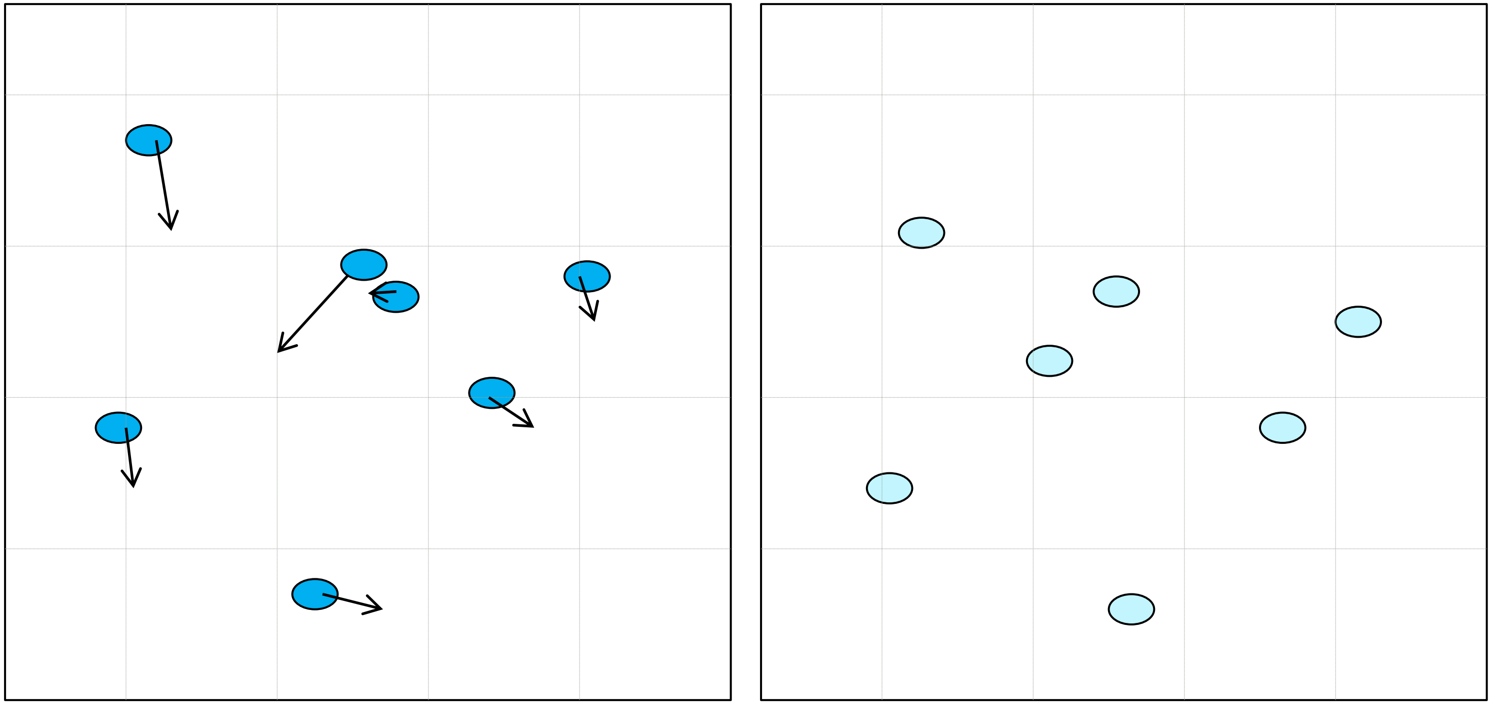
Model 2





Which model is better?

Metric for rainfall displacement?



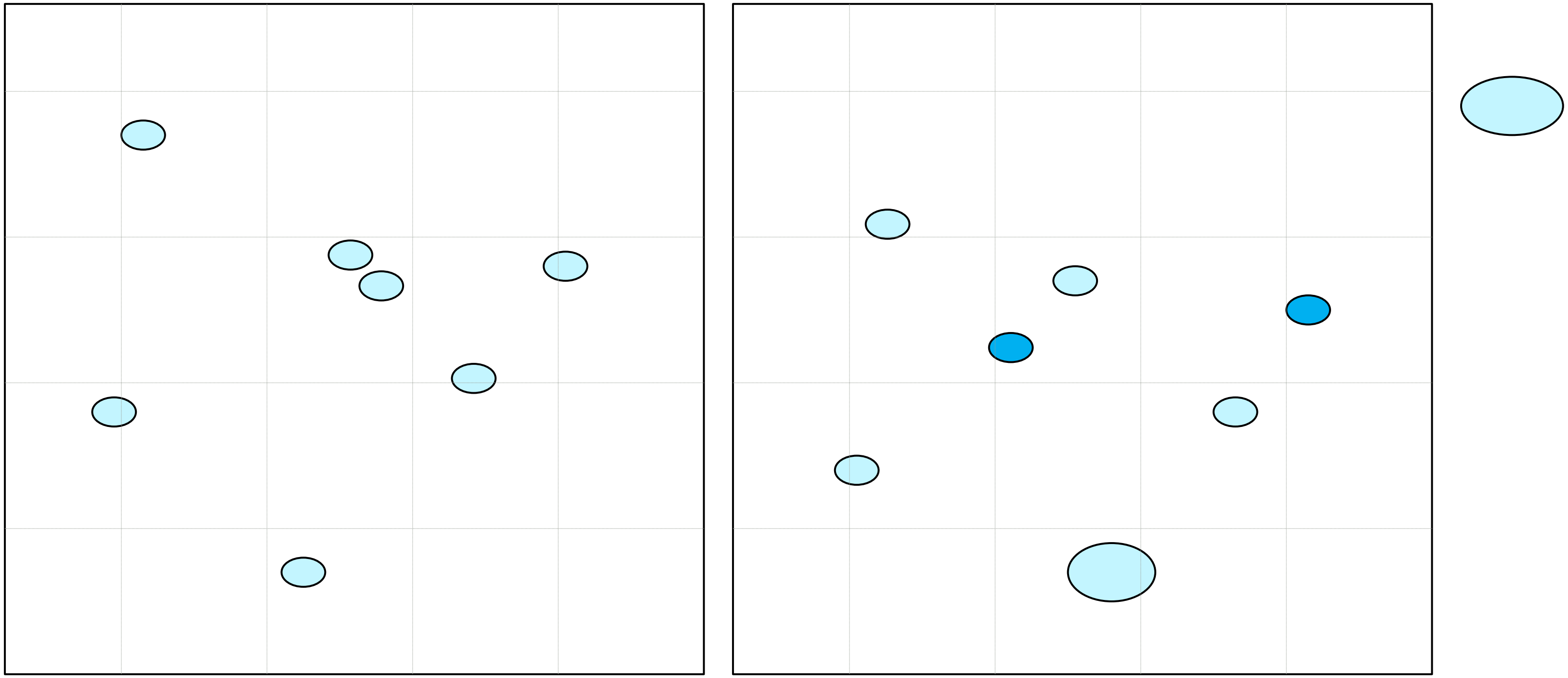
observations model

Needs to account for:

Different rainfall intensities and spatial extents of rainfall systems

Differing total rainfall amount, a) due to errors in representing the systems present, b) additional systems present in the domain

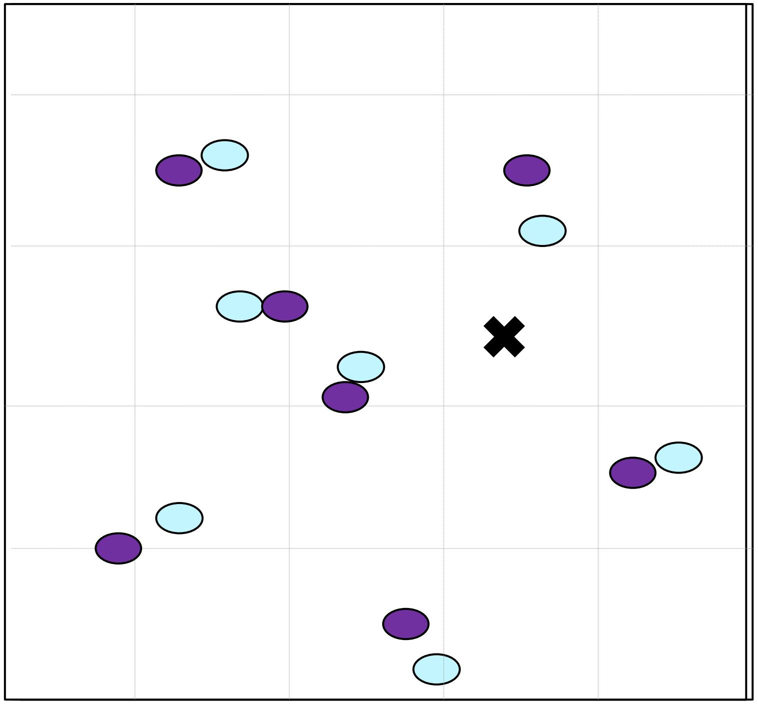
Rather than a *distance* metric, it needs to be a product of distance And precipitation amount – a bit like a flux.



observations model

Next part of the problem:

What is the probability of rainfall at a given location?



Ensemble member 1

Ensemble member 2

Ensemble member 3

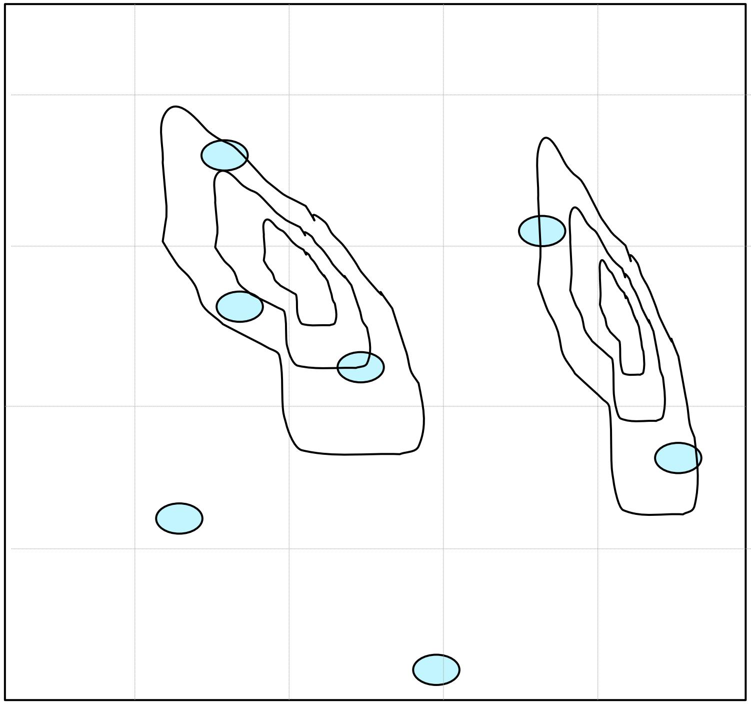
We can’t run enough of these to build up a smooth probability pattern in the domain!

MW asks : Is there a way of using the ‘flux’ metric between different ensemble members to generate new members with similar flux properties to the modelled members?

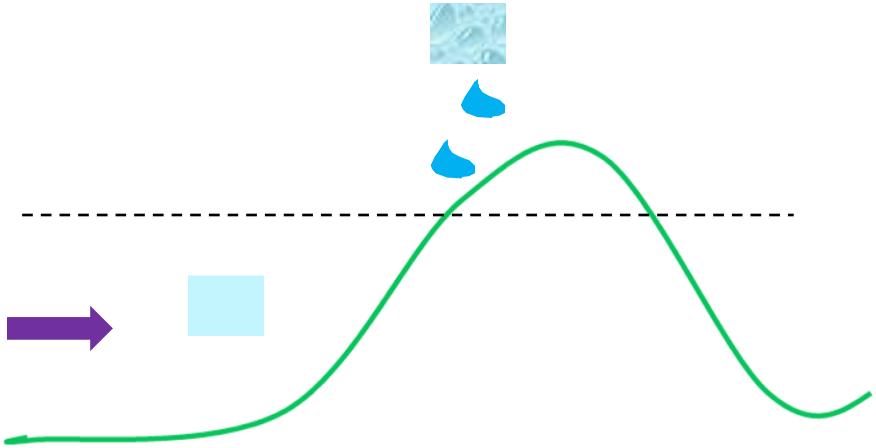
We could then generate enough members to calculate a smooth probability field.

Something else to take into account...

Orography...



Rain preferentially occurs over hills:



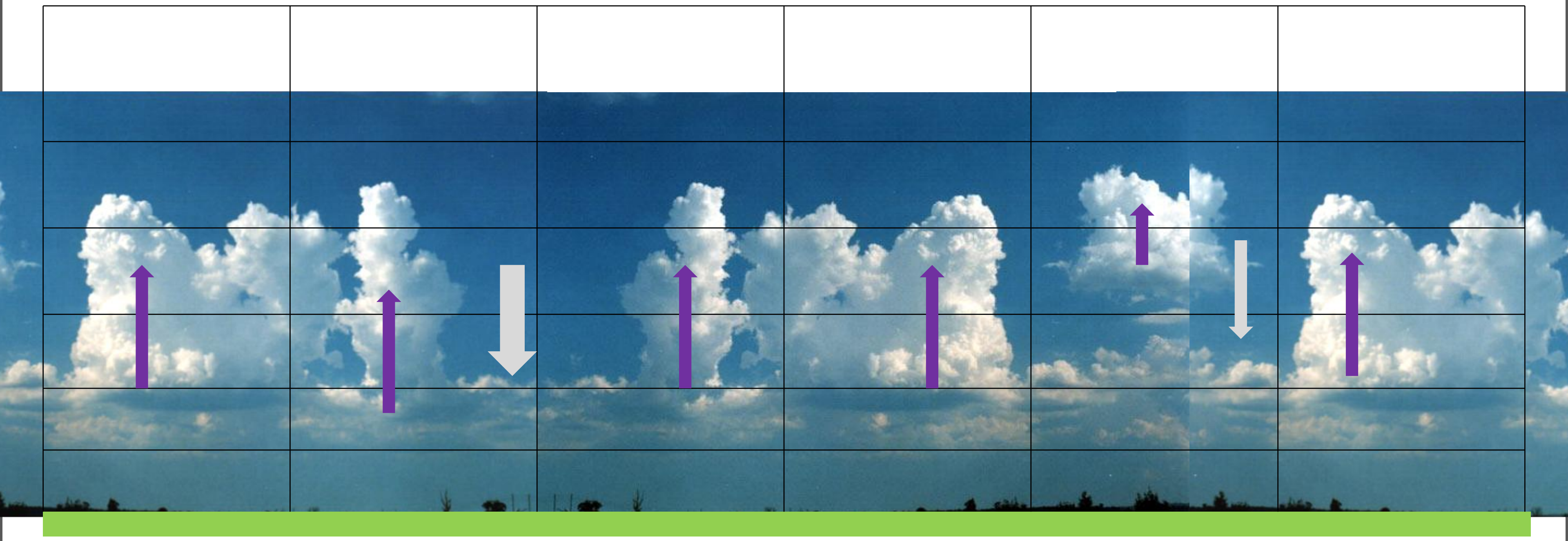
How could the flux metric take account of this a) in developing a measure for model performance; and b) in generating fake ensemble members?

Some background about convection parametrisation.

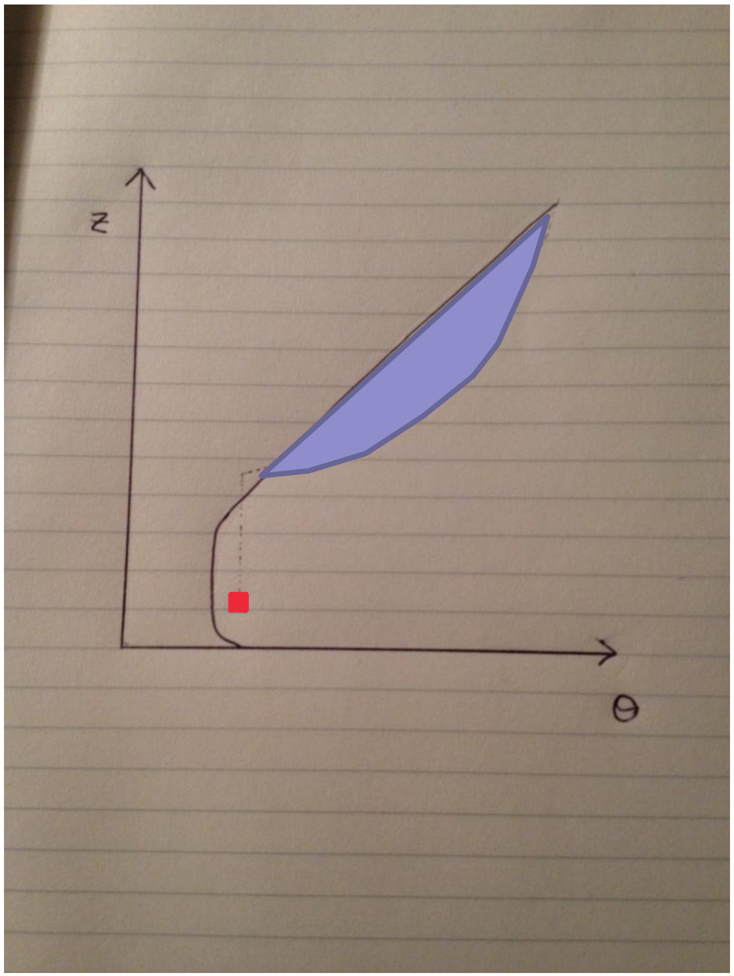
An introduction to Mike Cullen’s challenges.

Representing convection in climate models

Parametrisation



When does convection occur?



Convective Available Potential Energy

If there is CAPE, then atmosphere can support convection

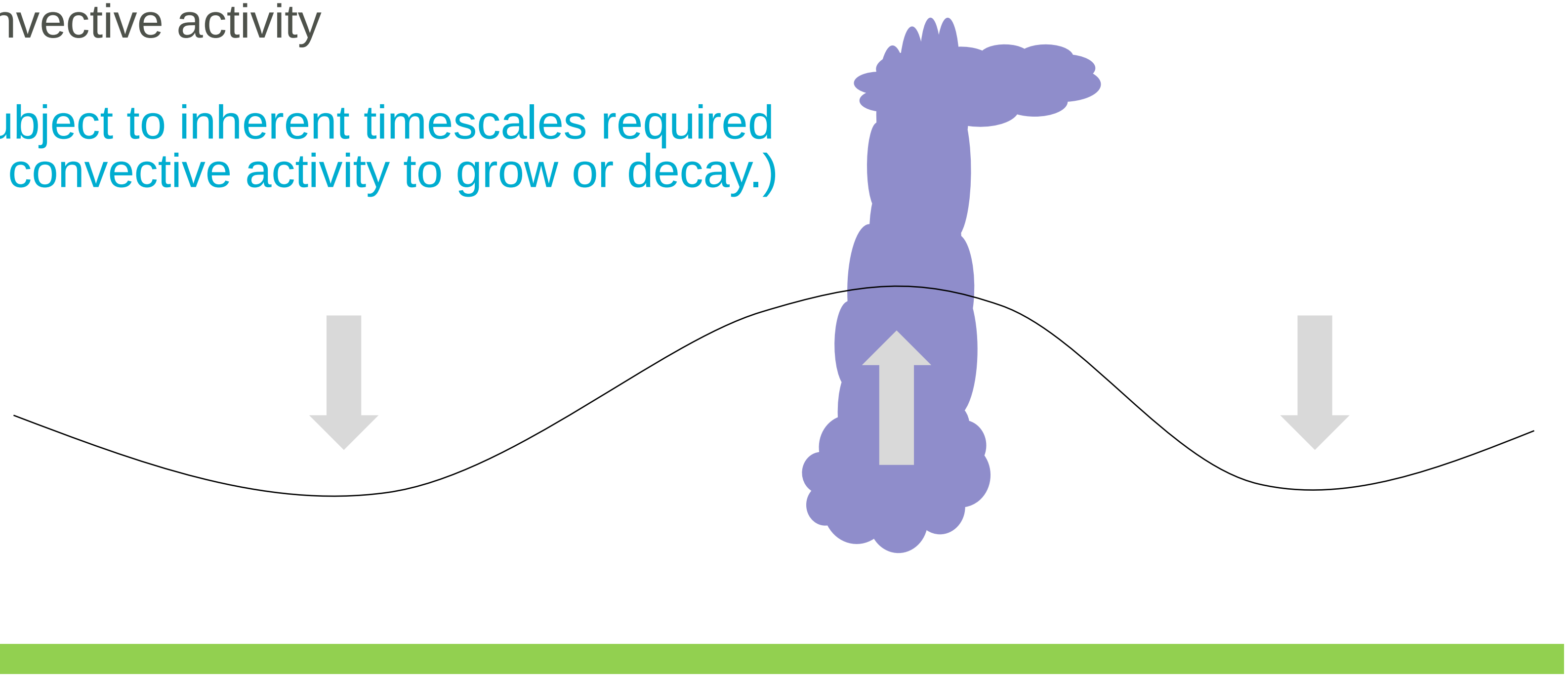
$$CAPE = \int_{LFC}^{LNB} g \frac{\theta_v^{\,p} - \theta_v^{\,env}}{\theta_v^{\,env}} dz$$

Influence of waves on convection

Large-scale ascent destabilises the atmosphere to convection (increases CAPE) Gives rise to convergent motions low down which enable air to reach its level of free convection.

Conversely large-scale descent stabilises the atmosphere and suppresses convective activity

(Subject to inherent timescales required for convective activity to grow or decay.)

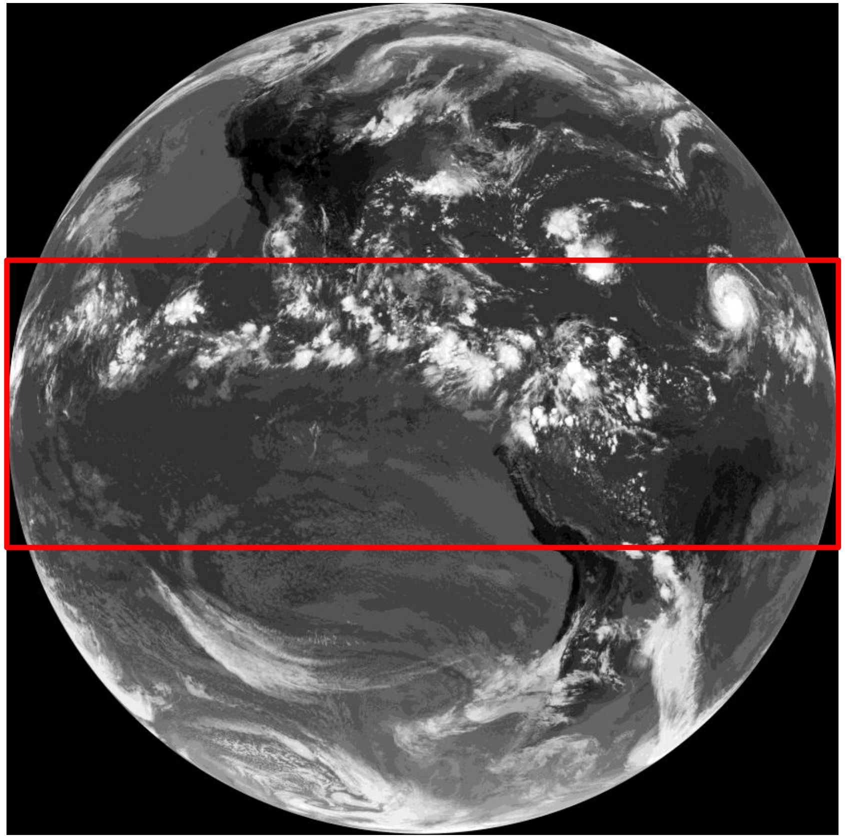


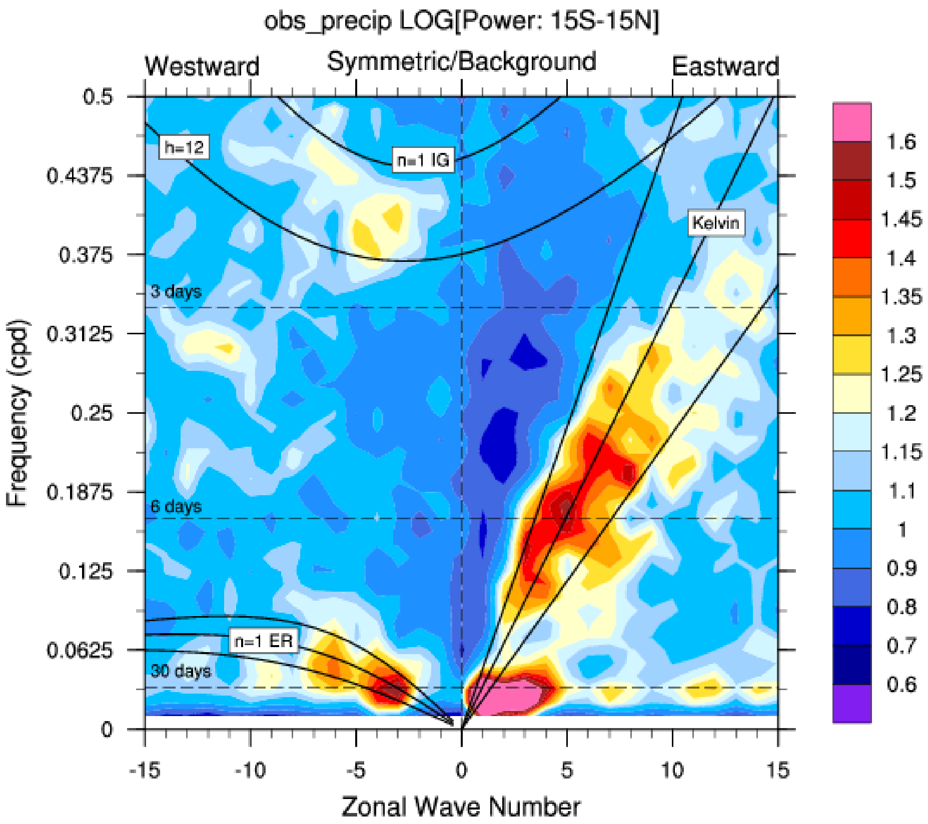
Convection parametrisation (currently) responds to waves purely via their influence on the thermodynamic profile of the atmosphere.

Observations

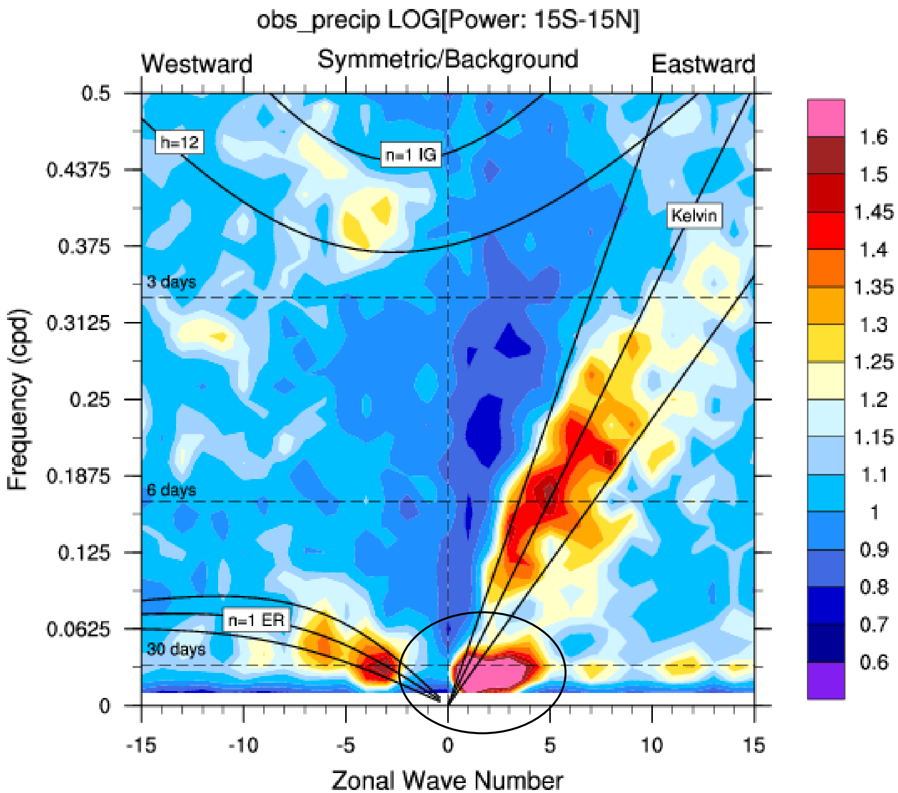
Convection-wave coupling

We can observe the coupling between tropical waves and convection by looking at the time-space structure of convective precipitation (or indirect measures of this (e.g. Outgoing long-wave radiation).

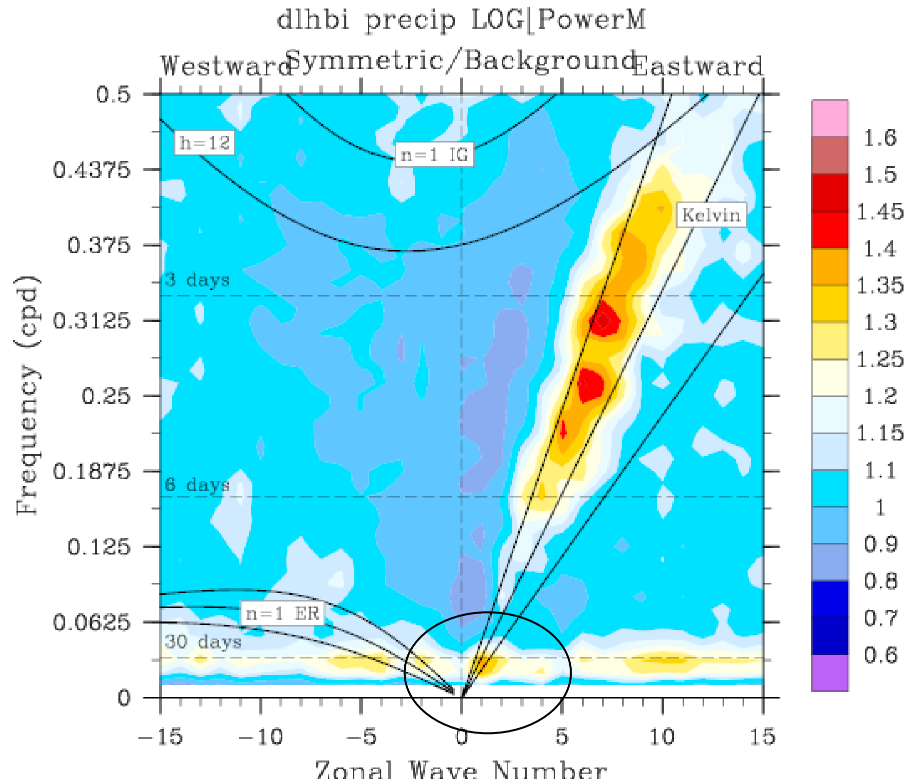




Observations vs model



Observations

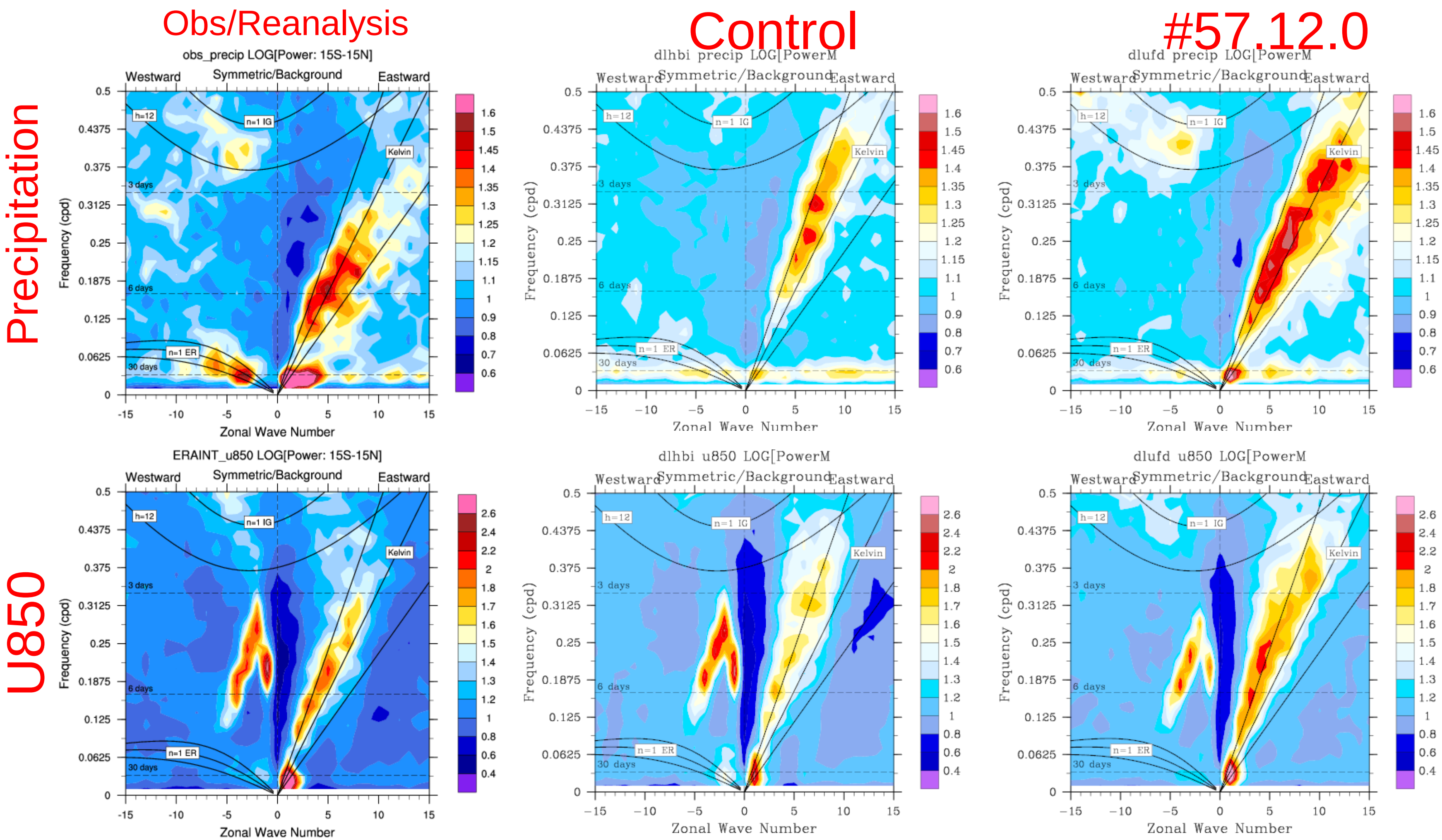


Model

Convection couples to waves that are too fast compared with observations.

Very limited representation of the MJO – what kind of waves are these??

We can alter the response of convection to waves...mainly by increasing the sensitivity of convection to the atmospheric profile, and by slowing down the rate of convective response, e.g. via a memory in entrainment (Martin Willett)



Tropical wave challenge

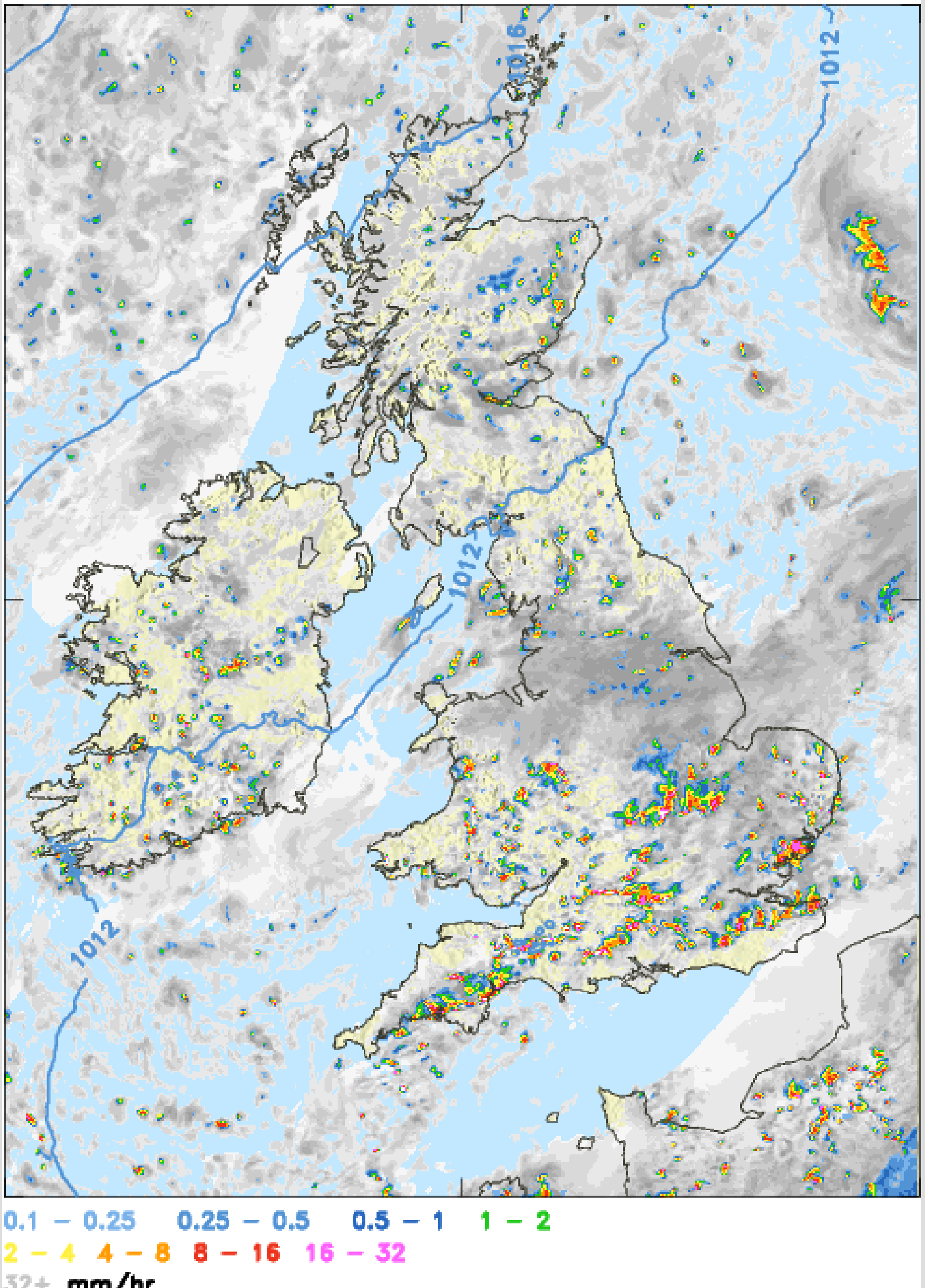
... But how do tropical waves respond to the convective regions?

(and do we get this response right in climate models?)

Met Office

Questions and answers

UKV mi-ac173 Precipitation rate [mm/hr] and cloud
Saturday 1300Z 28/06/2014 (t+13h)



UKV mi-ac200 Precipitation rate [mm/hr] and cloud
Saturday 1300Z 28/06/2014 (t+13h)