Met Office

RA2

Model Developments in the UM Regional Atmosphere Configuration

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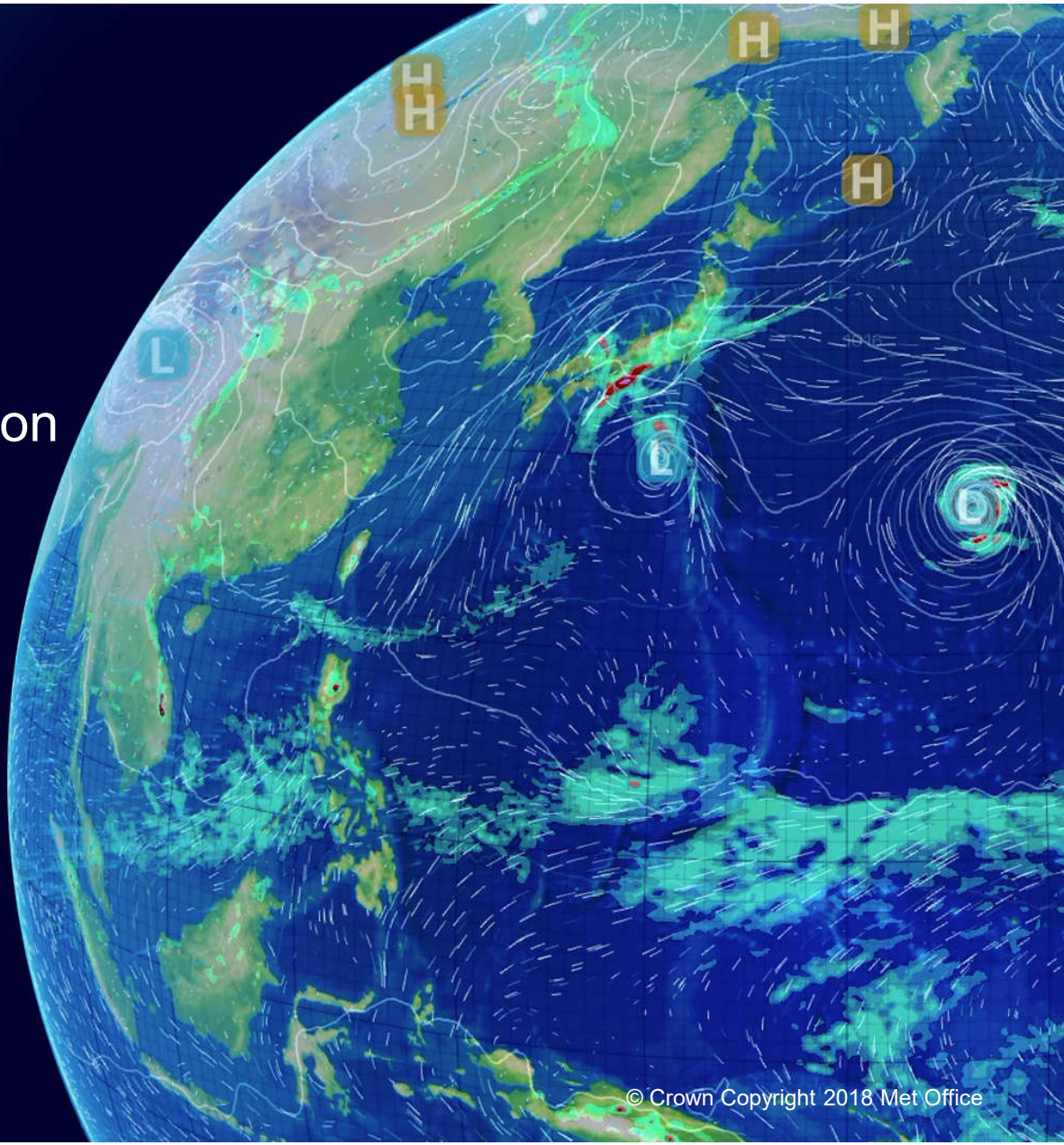
and contributions from many others



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RA - the “Regional Atmosphere” configuration

- Background and Motivation
- Looking back: RA1
  - Physics developments
  - Implementation in the operational model
- Looking forward: RA2
  - Physics developments
  - Current progress and future work
- Outlook
  - Plans beyond the current RA cycle

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Background and Motivation

- Large range of convection permitting models → risk of proliferation of model configurations
- Difficult to design a coherent programme of model development and ensure that research findings are relevant to the most up-to-date model configurations
- The aim: A single configuration for use in NWP operations, climate applications and research projects
- Currently focussing model development on two key model configurations distinguishing between mid-latitude and tropical configurations (RA-M, RA-T)
- Annual release cycle for RA configurations
- RA process is based on successful approach taken for global model development

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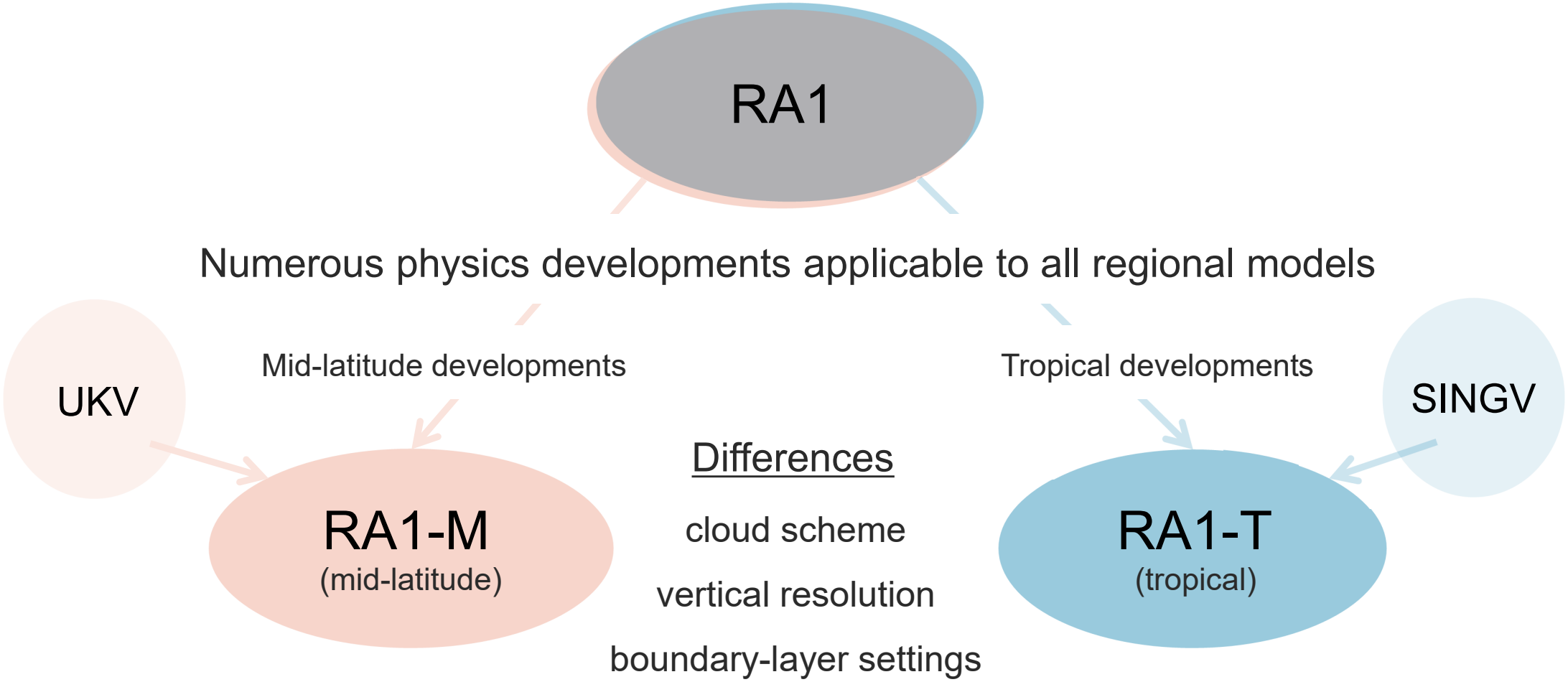
Looking back: RA1



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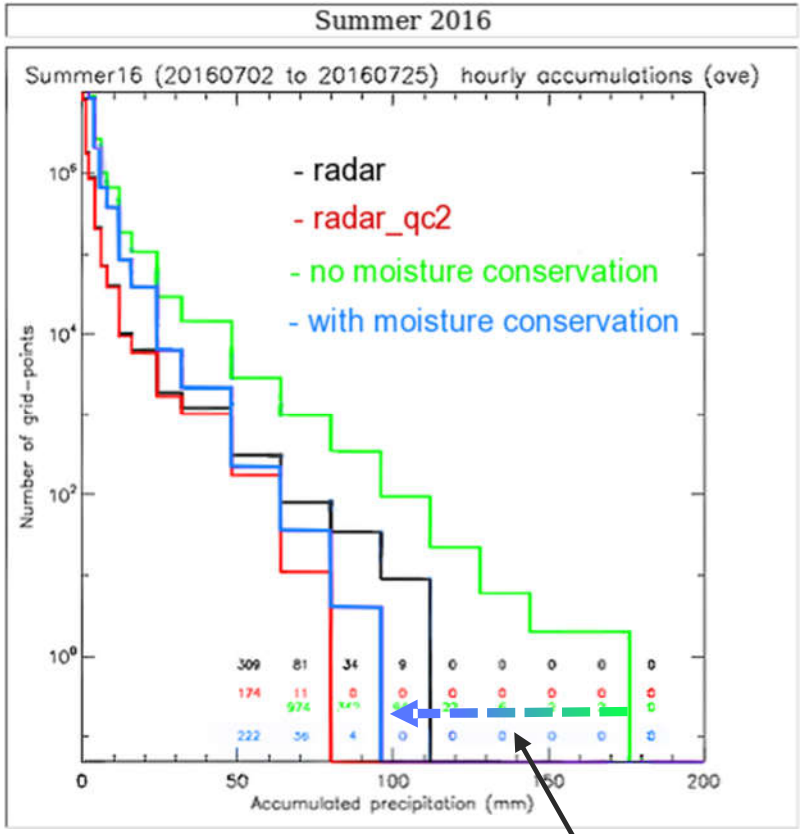
Looking back: RA1



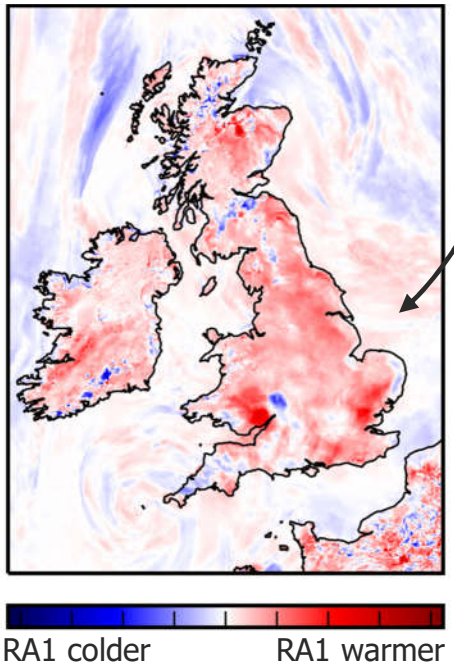
Excessive rain rates removed

Improved diurnal cycle

RA1 warmer during day

and colder during night

15Z temperature difference

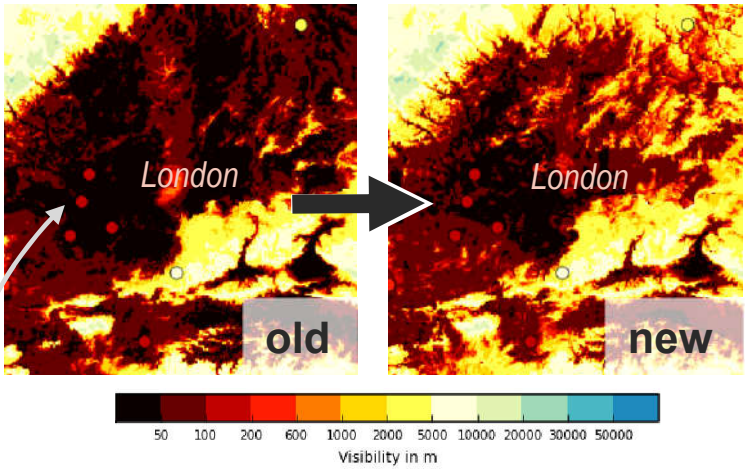


RA1 colder — RA1 warmer

Improvement to fog

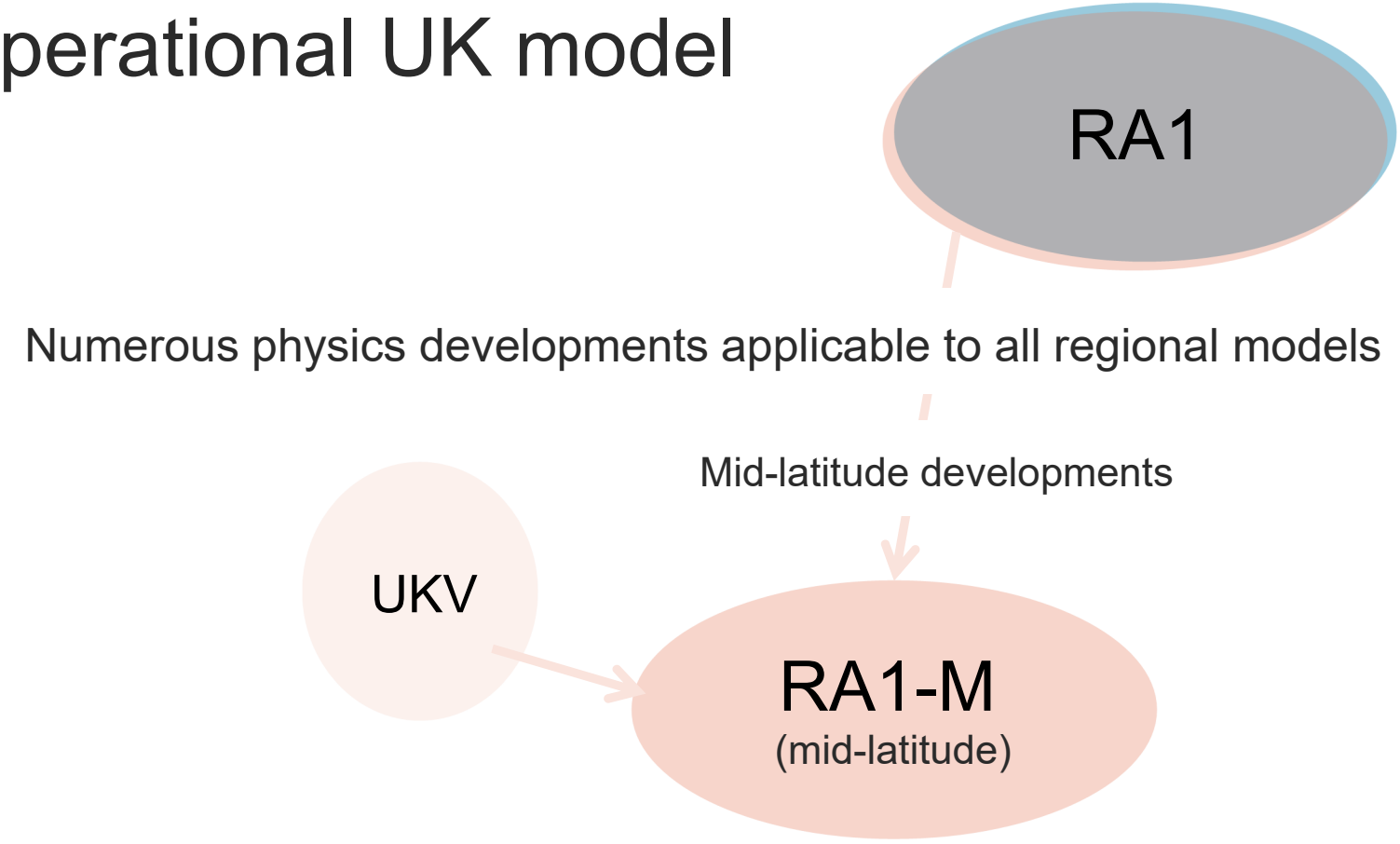
less optically thick

more realistic LW radiation properties



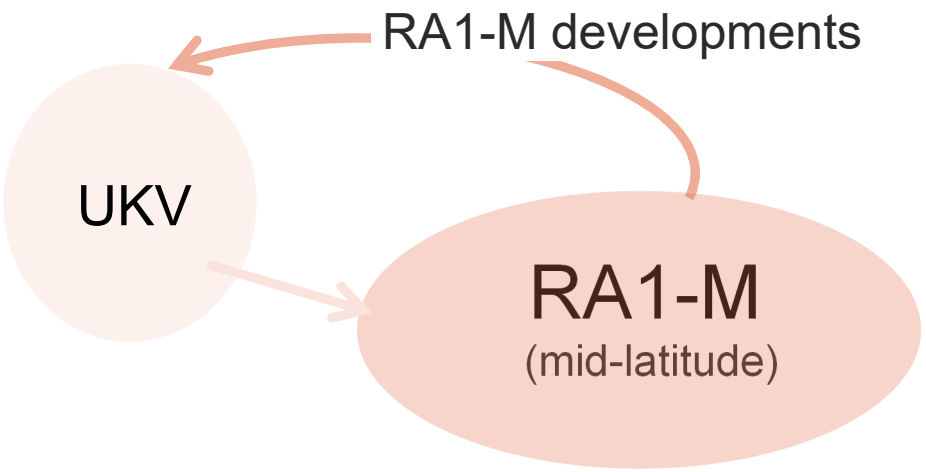
Heathrow Airport

RA1-M in the operational UK model

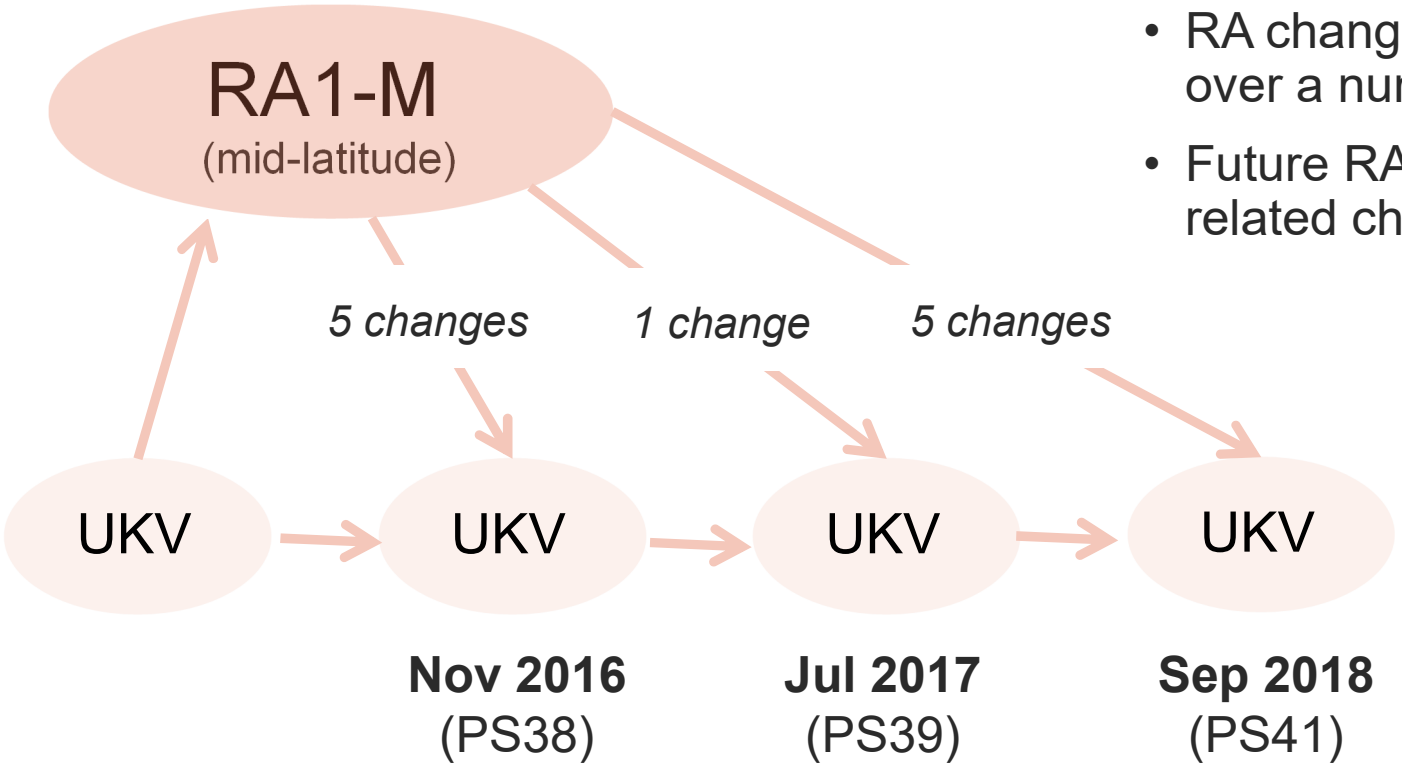


RA1-M in the operational UK model

- 11 Regional Atmosphere model changes for implementation in the UKV



RA1-M in the operational UK model



- RA changes progressively implemented over a number of upgrades
- Future RA releases: Aim to include all related changes in one operational upgrade

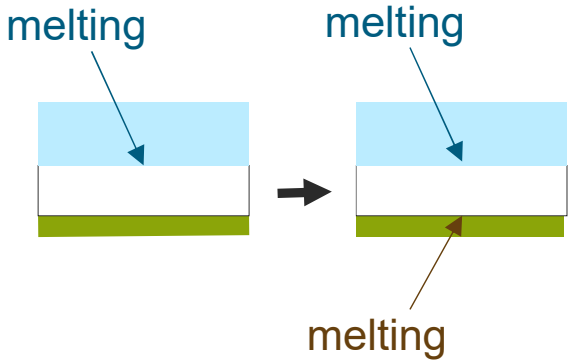
RA2 – the current development cycle

- Jan 2018 RA2 kick-off: Discussion and prioritisation of research tickets
- Feb 2018 Finalise standard suites and technical infrastructure for RA2 testing
- Feb-Sept 2018 Individual testing of RA2 research tickets
  - Standard tests over U.K with frozen RA1 science (both RA1-M and RA1-T) as controls
  - Standard tests over Darwin with frozen RA1 science (both RA1-M and RA1-T) as controls
  - Verification and diagnostics produced using RMED toolbox
- Oct 2018 Decision on change packages
- Oct-Dec 2018 Evaluation of change packages and decision on proto-RA2
- Dec 2018 Release of RA2 configuration
- early 2019 Preparations for RA3

RA2 research tickets

Improvements to the Treatment of Lying Snow

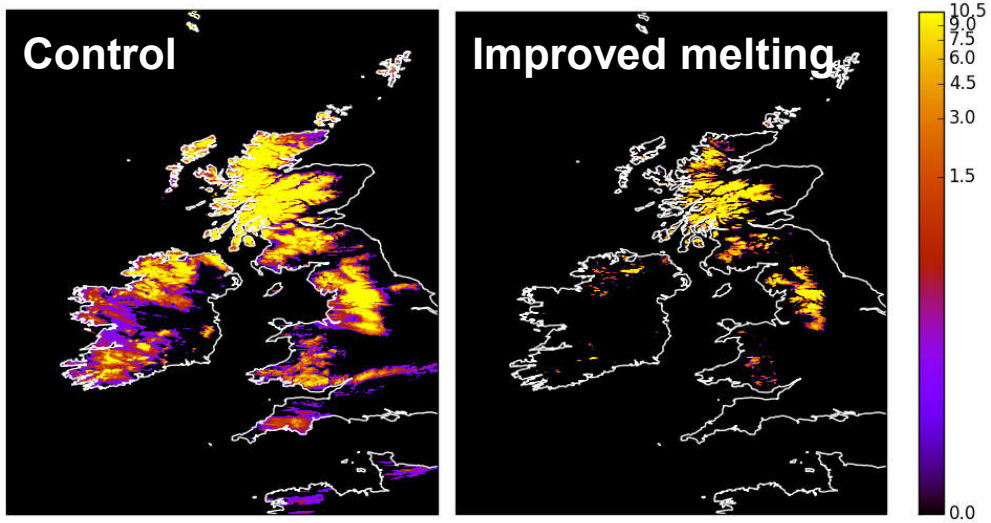
- Current configuration only allows snow pack melting from the top
- Delayed melting when snow falls on warm ground
- Change allows snow pack over warm ground to melt from the base



RA2 research tickets

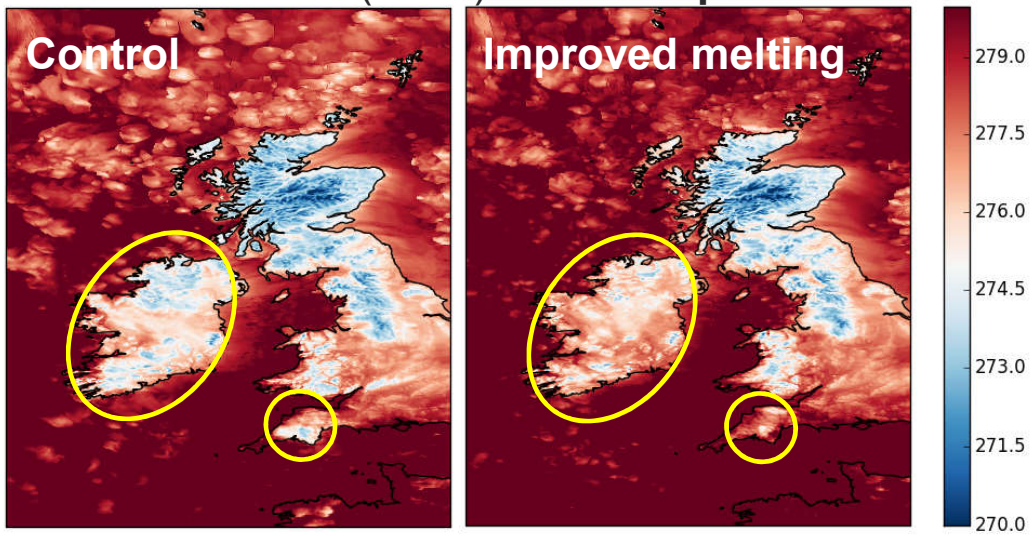
Improvements to the Treatment of Lying Snow

18/11/2016 12Z (T+60) **Snow**



spurious thin snow removed

18/11/2016 12Z (T+60) **1.5m Temperature**



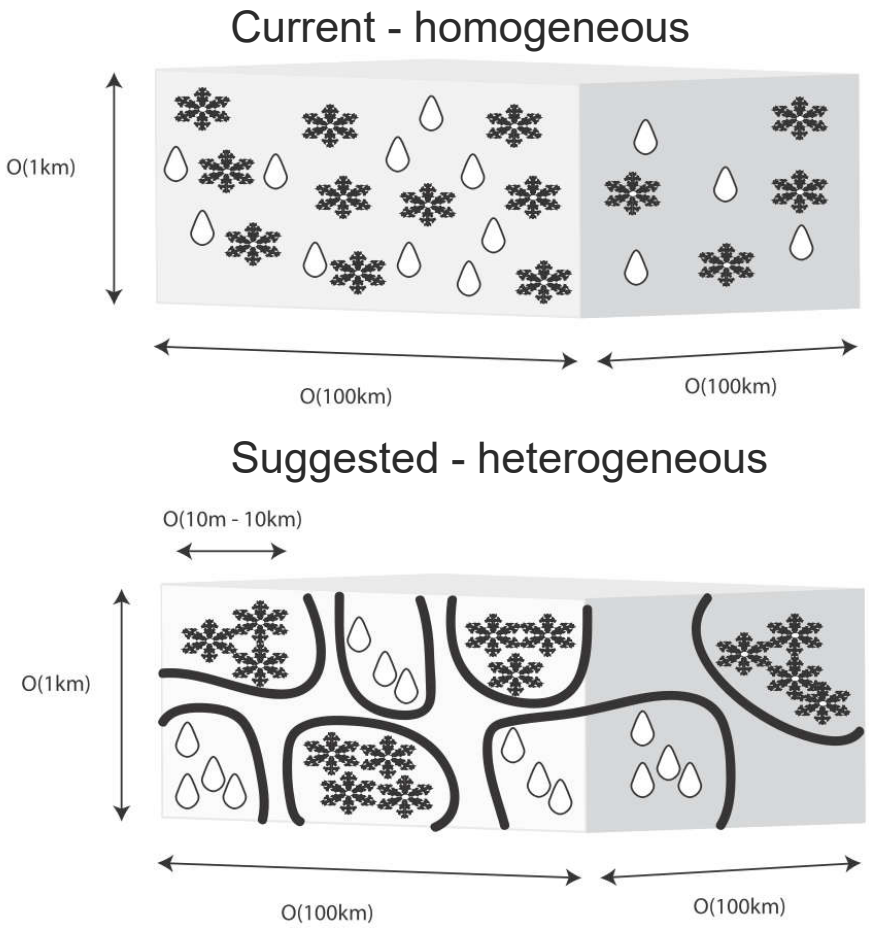
temperatures increased where snow has melted

courtesy of John Edwards

RA2 research tickets

Improved ice cloud fraction in mixed phase cloud

- Revised partitioning of liquid and ice prevents excessive depletion by riming in regions of supercooled liquid
- Improve rain-snow boundaries and delay outbreaks into snow showers
- Improve reflected SW radiation by increasing stratiform regions
- Modification to Smith cloud scheme used in RA-M only



Tan & Storelvmo (2016)

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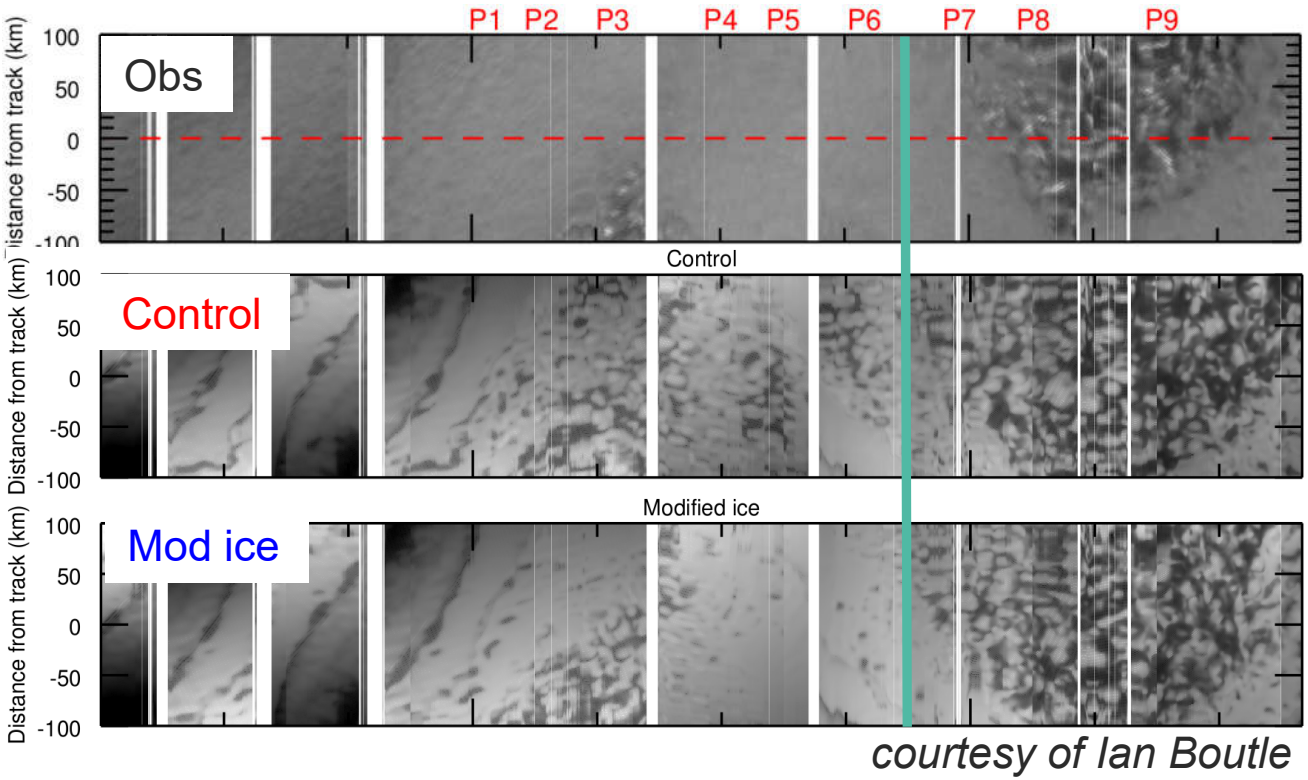
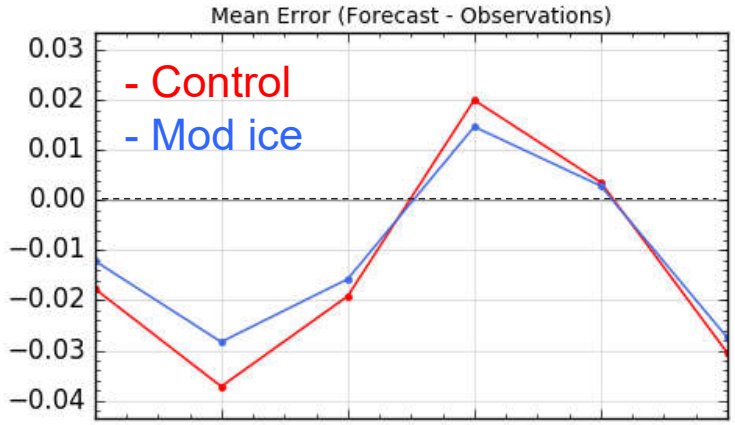
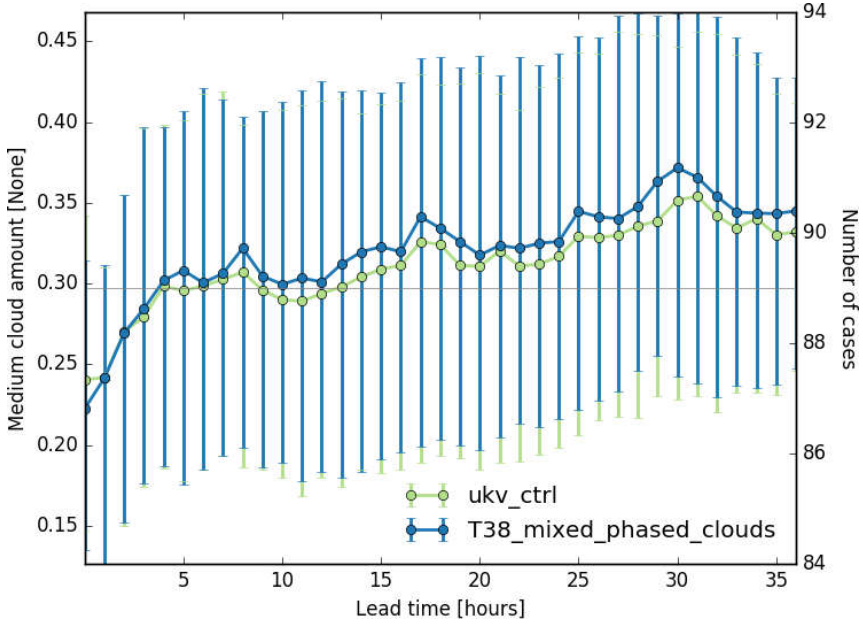
RA2 research tickets

Improved ice cloud fraction in mixed phase clouds



courtesy of Ian Boutle



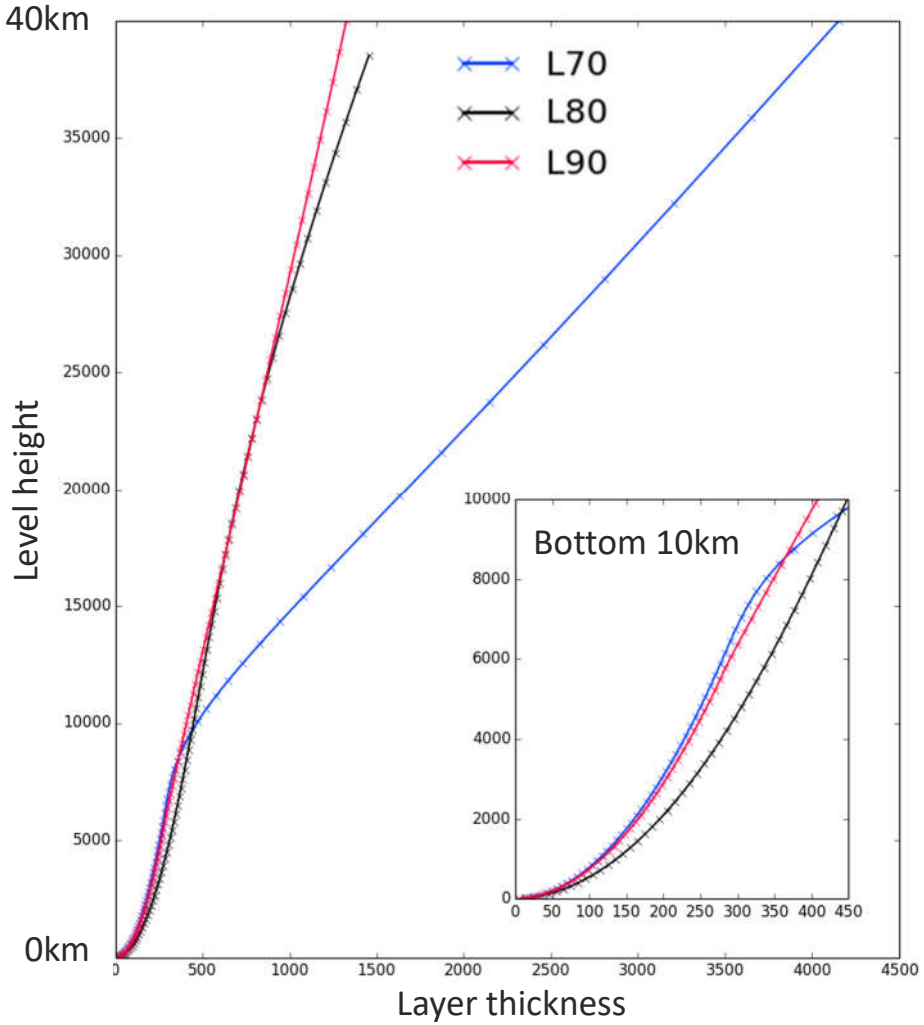


RA2 research tickets

Unification of Vertical Level Sets

in Mid-Latitude and Tropical

- Mid-latitude: **70 levels** with a finer boundary layer resolution
- Tropical: **80 levels** with increased resolution in the troposphere
- Unified RA2 level set: **90 levels**, combining the benefits of mid-latitude and tropical level sets into a “best-of”



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RA2 research tickets

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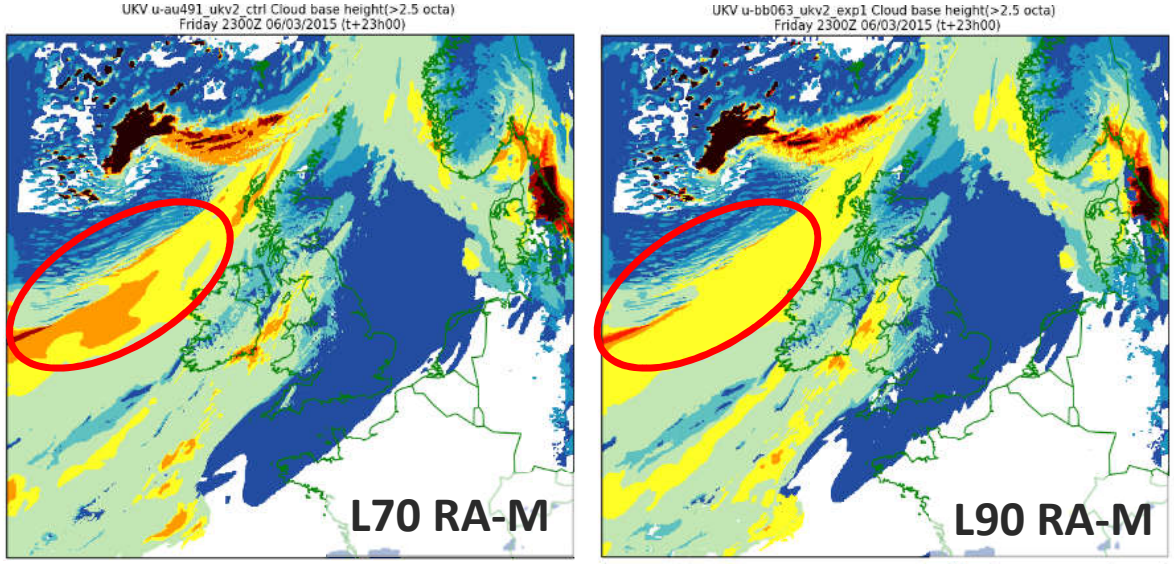
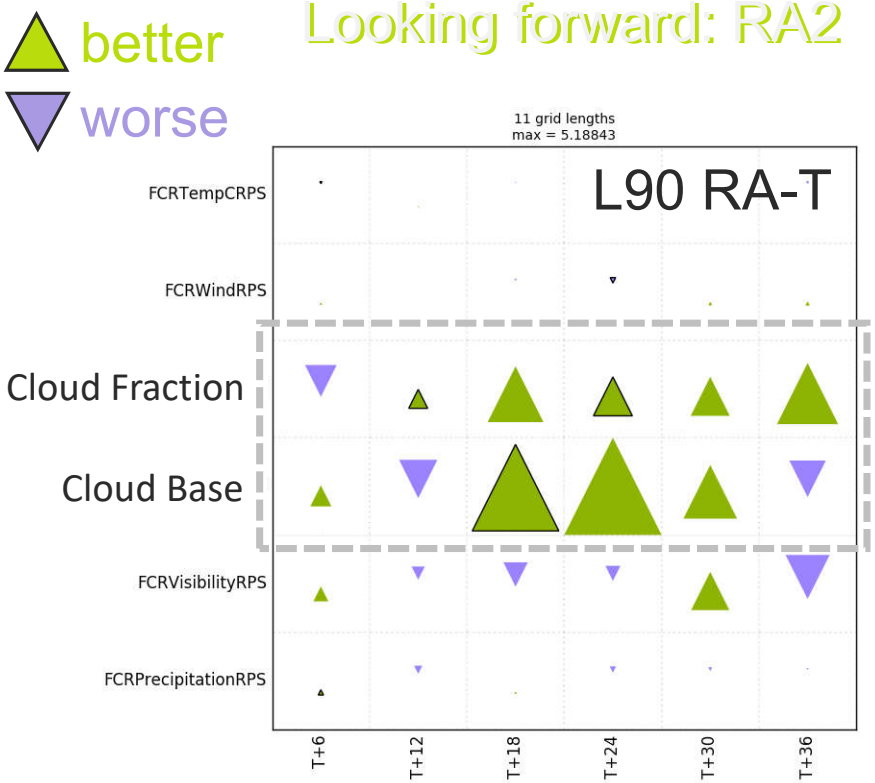


Looking forward: RA2



- Slight lifting of cloud base for stratocumulus
- Some positive impact on cloud verification

RA2 – the current development cycle

- Jan 2018 RA2 kick-off: Discussion and prioritisation of research tickets
- Feb 2018 Finalise standard suites and technical infrastructure for RA2 testing
- Feb-Sept 2018 Individual testing of RA2 research tickets
- Oct 2018 Decision on change packages
- Oct-Dec 2018 Evaluation of change packages and decision on proto-RA2
  - Case studies and DA trials
  - Mid-latitude and tropical testing
  - Climate runs optional
- Dec 2018 Release of RA2 configuration
- early 2019 Preparation for RA3

Beyond the current RA cycle

Several areas identified for future research and development

- Unification of cloud scheme
- Scale aware convection scheme
- Removing “legacy differences” between model configurations
  - → Mid-latitude vs Tropics
  - → Short-range NWP vs Climate
  - → Global vs Regional