



ELDAS radiation & heating rates from METEOSAT

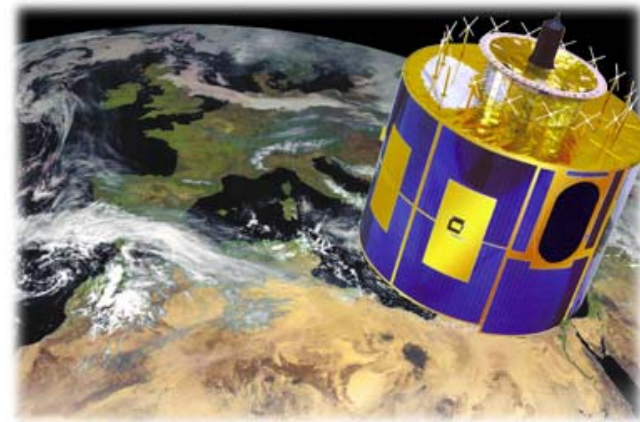
Bart van den Hurk,
Dirk Meetschen,
Han The





METEOSAT

- Long programme of METEOSAT 1-7 (since late 70's)
- Meteosat Second Generation launched August 2002
- Long commissioning phase
 - Calibrated data available since Sep 2003
- Operational since Jan 2004



ELDAS/ECMWF land data assimilation workshop





ELDAS & METEOSAT

- Prepare database for 2000 of
 - Surface radiation ✓
 - Surface heating rates ✓
- Evaluate their use in Land Data Assimilation ✓
- Evaluate benefits of MSG
 - Prepare METEOSAT heating rate data base for 2003 ✓
 - Compare to MSG ✗





The ELDAS radiation: ELDORADO

(Meetschen et al, 2004)

- Blend of METEOSAT data ...
 - TOA net shortwave
 - METCLOCK cloud cover data
- ...and model profiles
 - ECMWF radiation code embedded in RACMO limited area model
- Using a simple data combination technique





The ELDORADO scheme

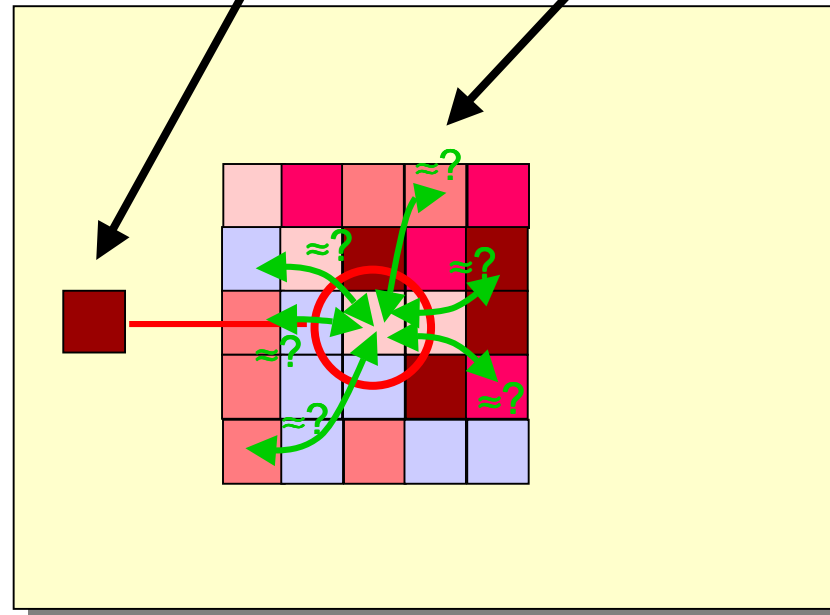
- 4-step procedure
 - Bias removal
 - Assume model TOA SWnet of cloudfree area unbiased
 - Correct METEOSAT SWnet per location and month (up to 10%)





The ELDORADO scheme

- 4-step procedure
 - Bias removal
 - Moving model grid boxes: find model grid box best matching METEOSAT TOA net SW

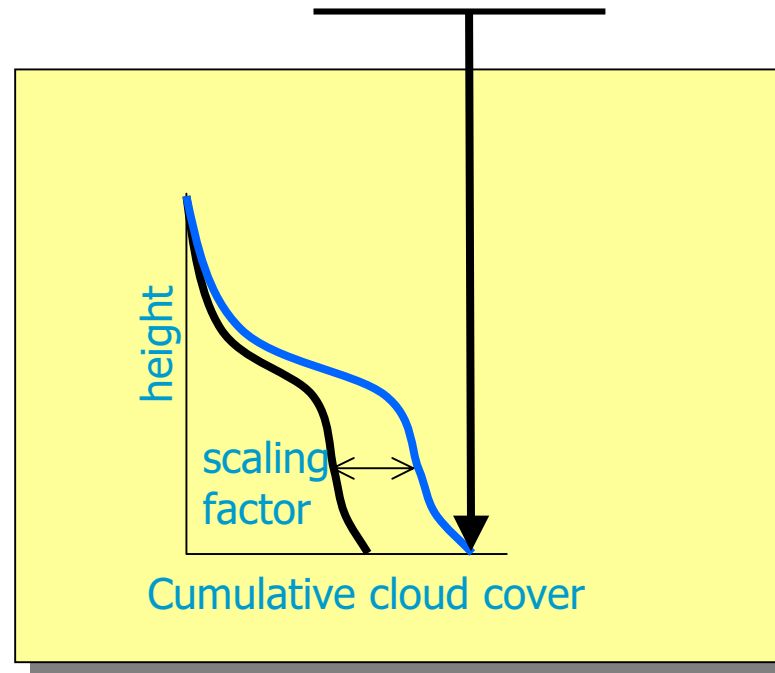


ELDAS/ECMWF land data assimilation workshop



The ELDORADO scheme

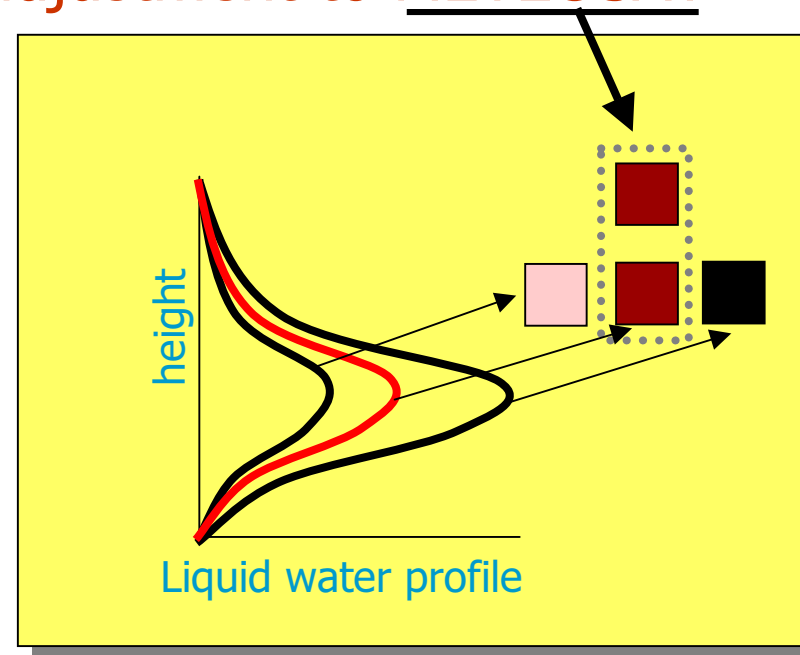
- 4-step procedure
 - Bias removal
 - Moving model grid boxes
 - Cloud profile adjustment to METCLOCK observation



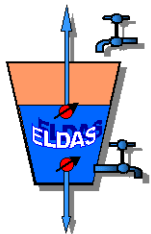


The ELDORADO scheme

- 4-step procedure
 - Bias removal
 - Moving model grid boxes
 - Cloud profile adjustment
 - Liquid Water Profile adjustment to METEOSAT TOA SWnet



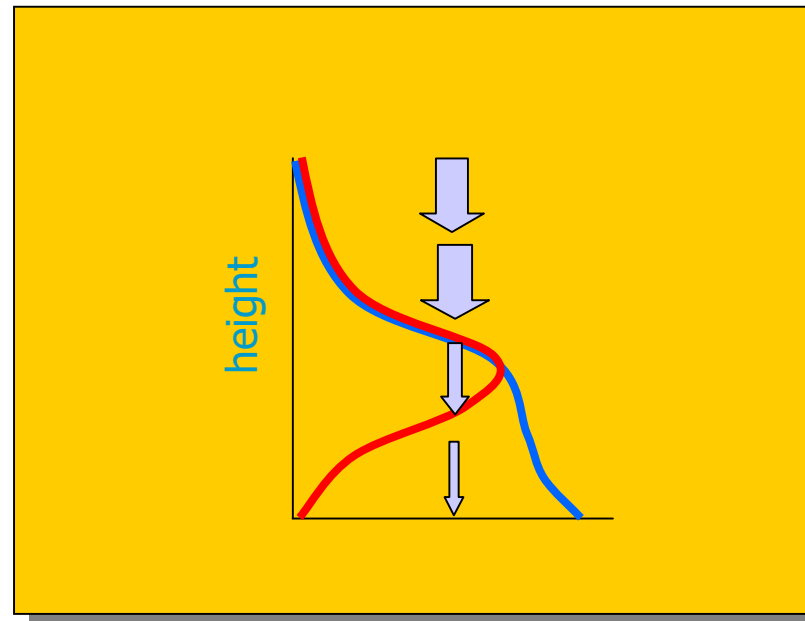
ELDAS/ECMWF land data assimilation workshop





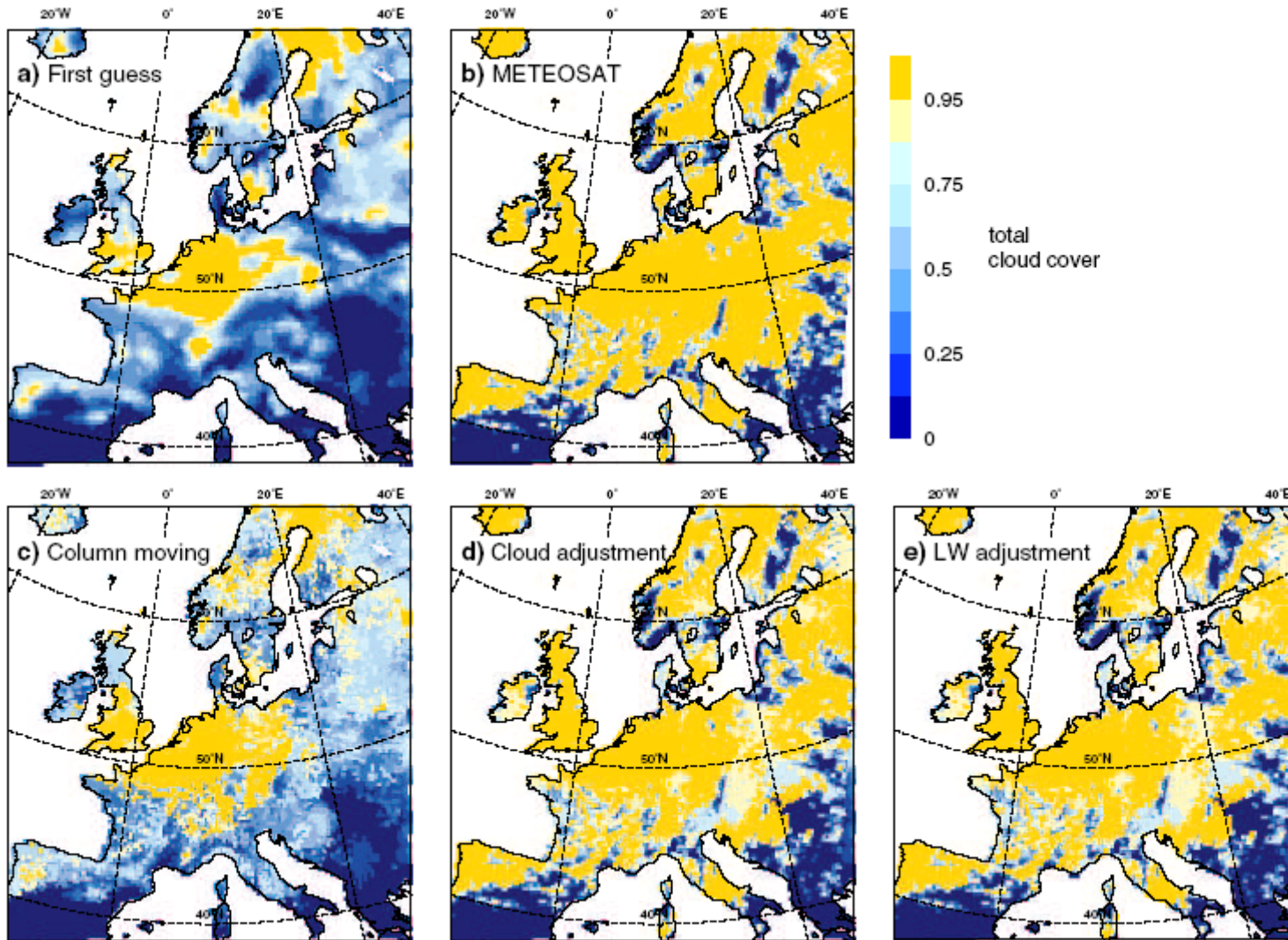
The ELDORADO scheme

- 4-step procedure
 - Bias removal
 - Moving model grid boxes
 - Cloud profile adjustment
 - Liquid Water Profile adjustment
- Result: model simulated surface values



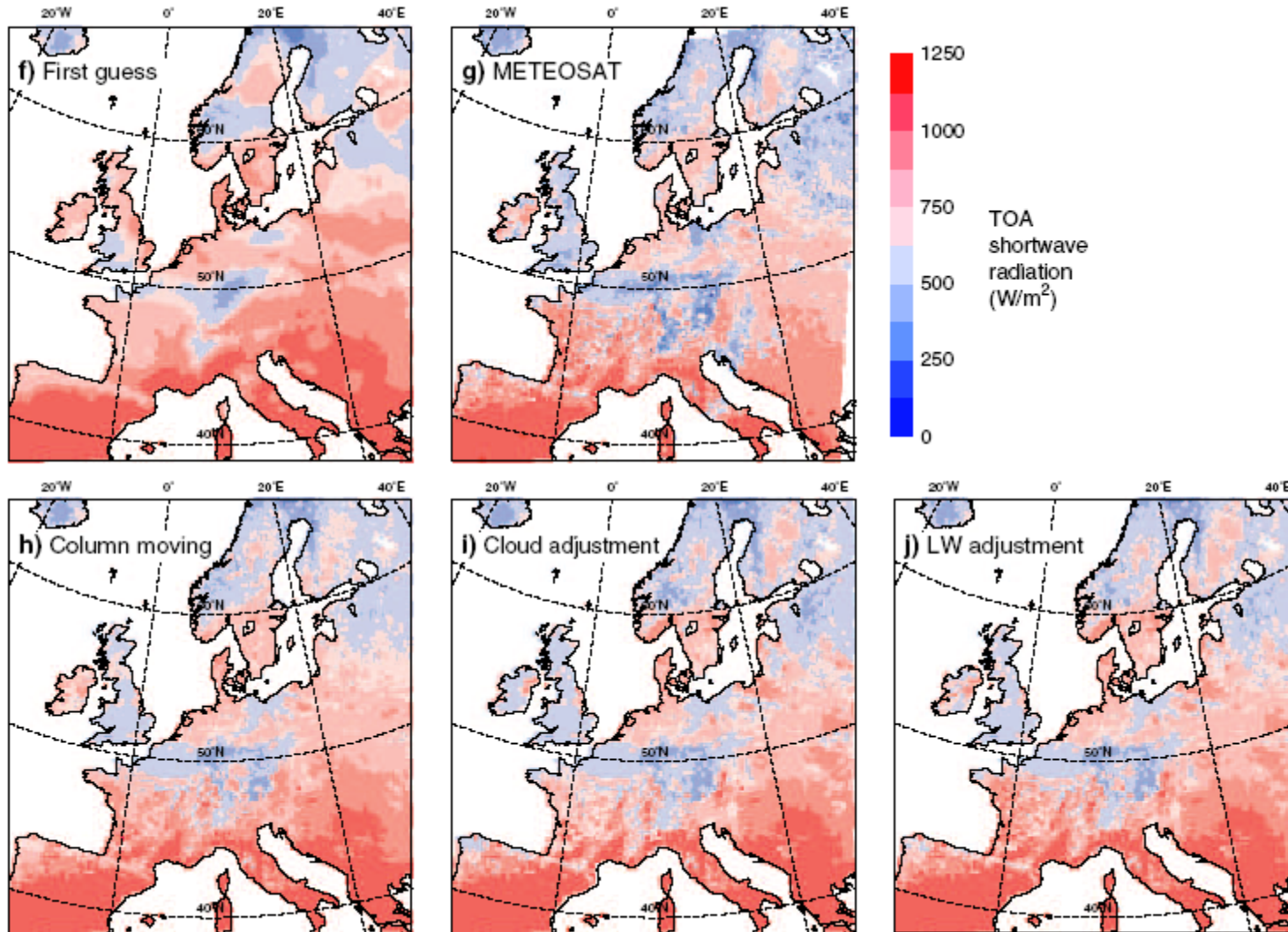
simulation workshop

An example: total cloud cover



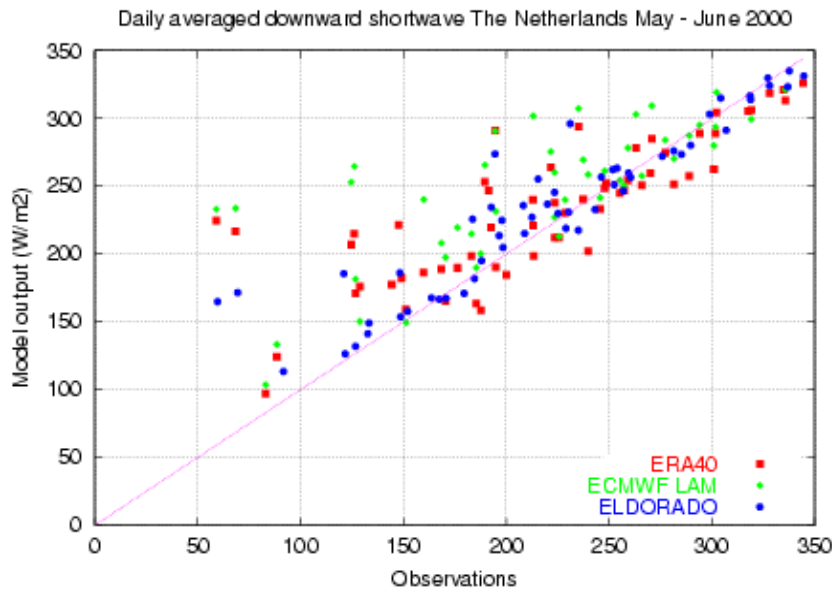


An example: TOA SW

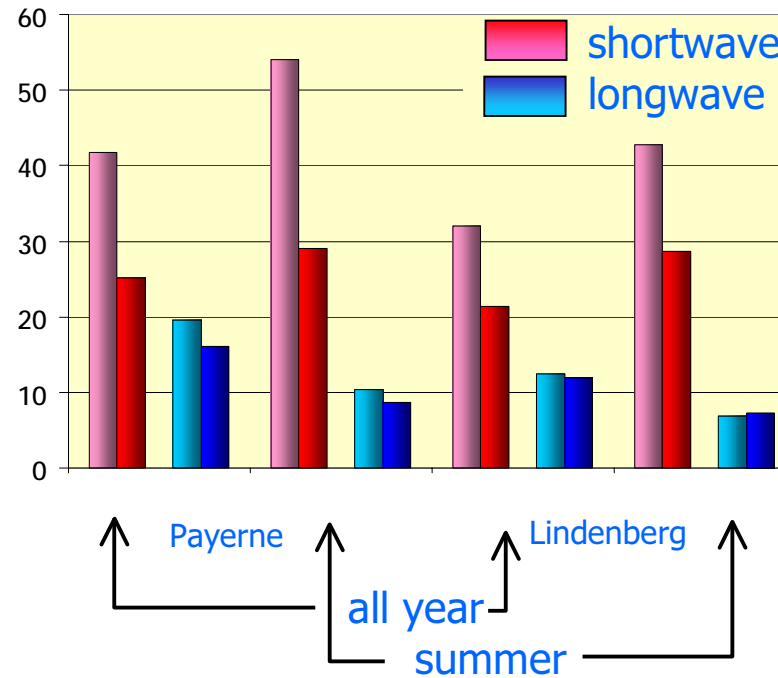


Verification results

- Meetschen et al
 - 30 ground stations in The Netherlands
 - LW and SW at 2 BSRN stations

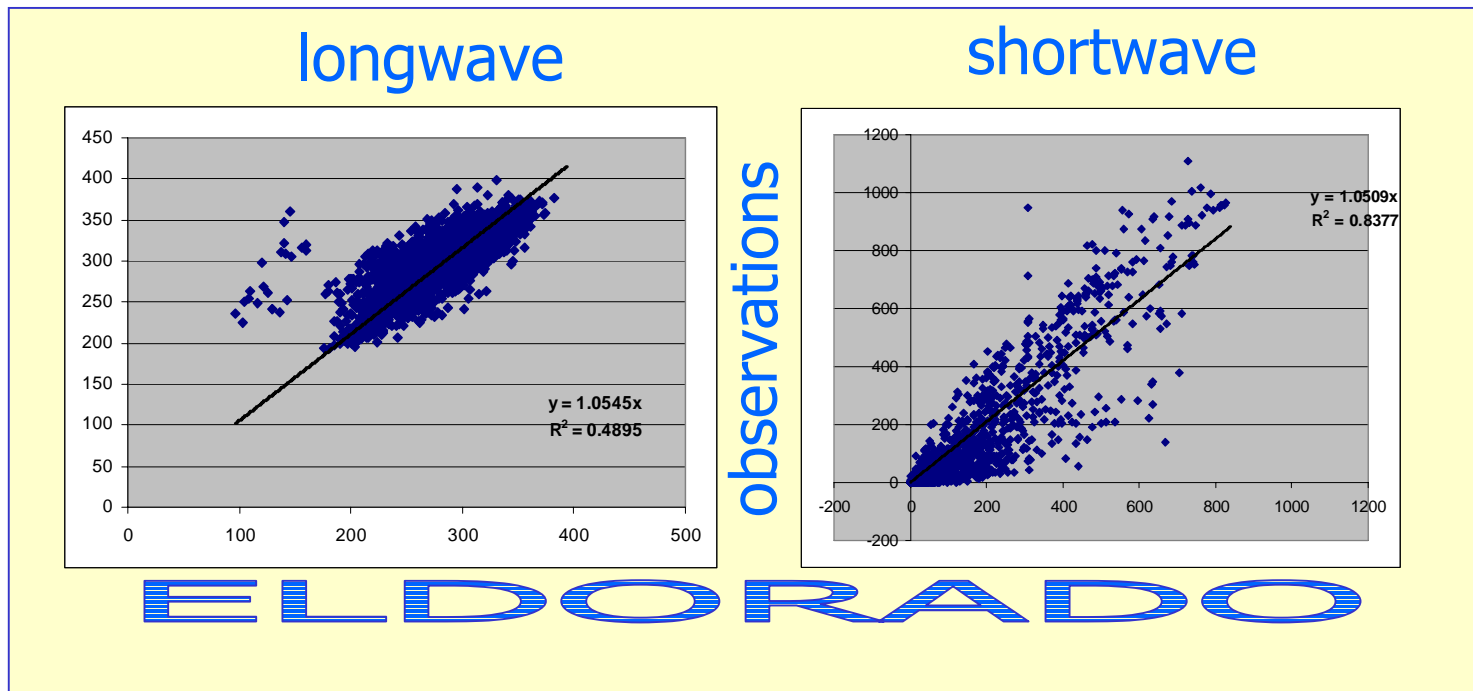


RMS at BSRN stations



Verification results

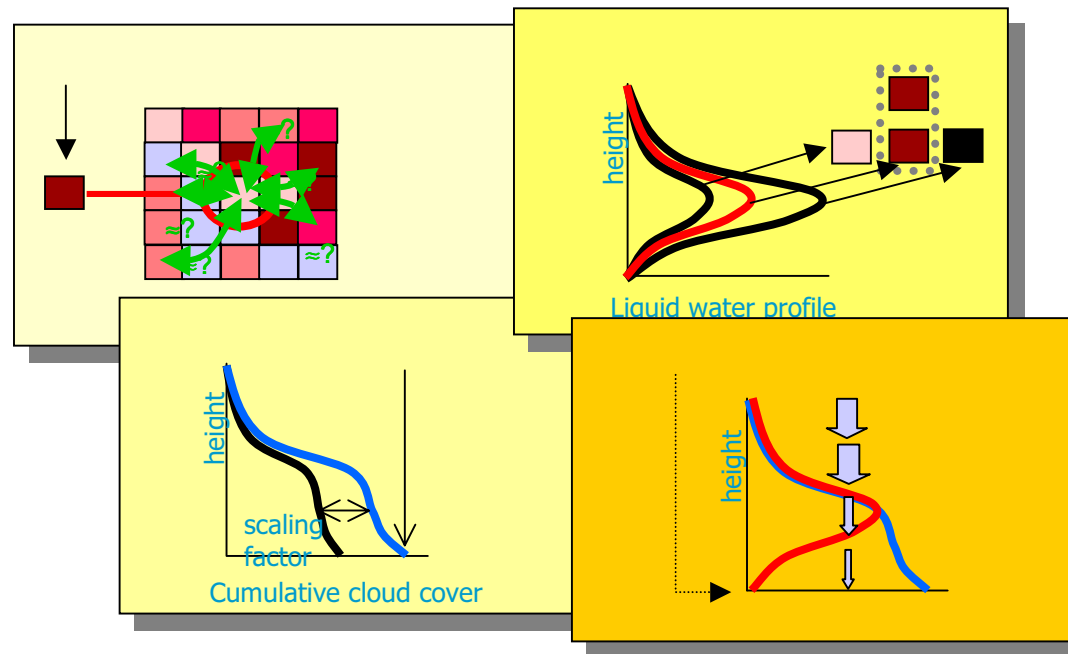
- Meetschen et al
 - 30 ground stations in The Netherlands
 - LW and SW at 2 BSRN stations
- ALTERRA group
 - LW & SW at Col de Porte





The ELDORADO database

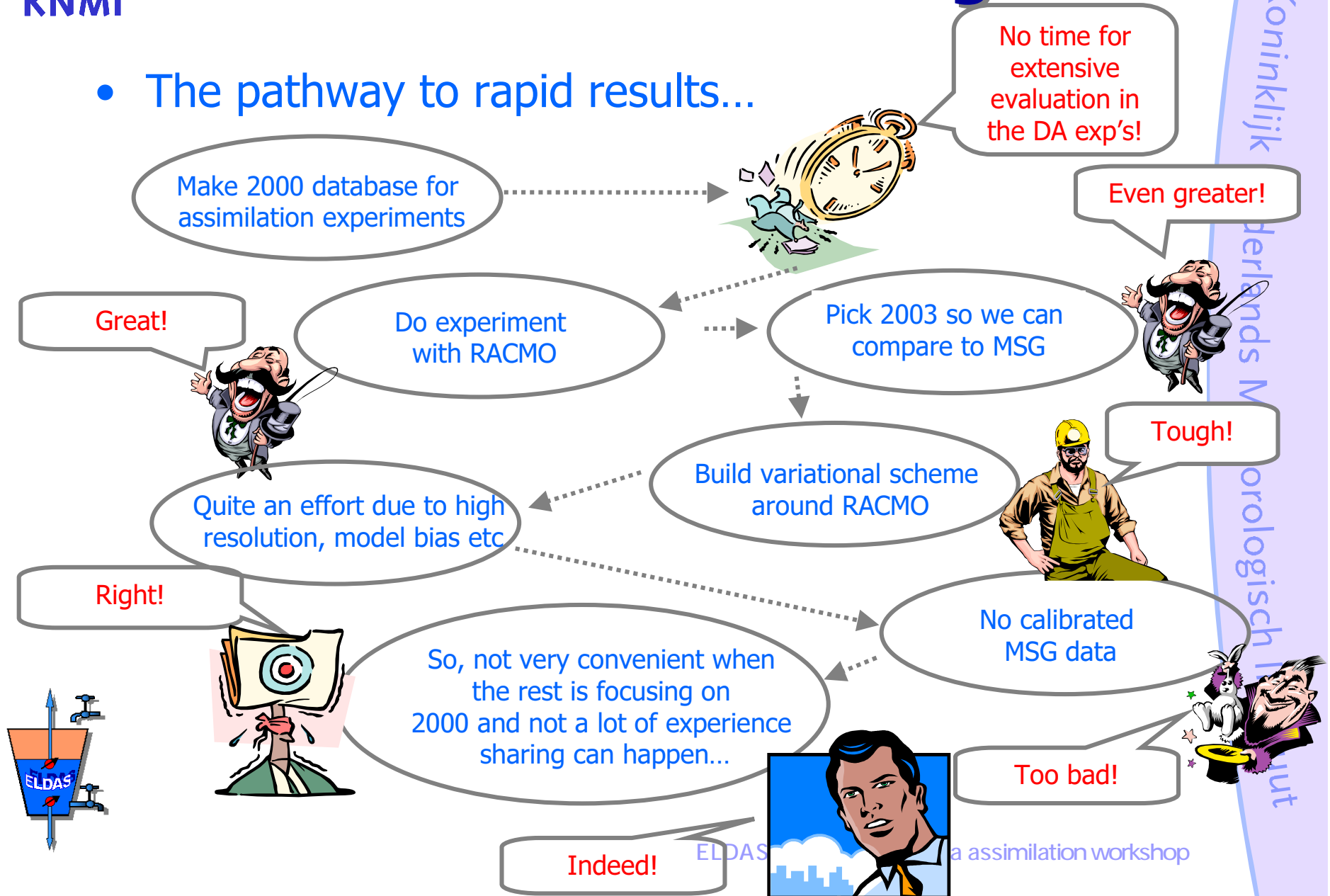
- Cleaned, gap-filled
- Submitted to ECMWF for MARS storage
- Used by ECMWF data assimilation experiments
- Published by Meetschen et al (2004)



ELDAS/ECMWF land data assimilation workshop

The METEOSAT heating rates

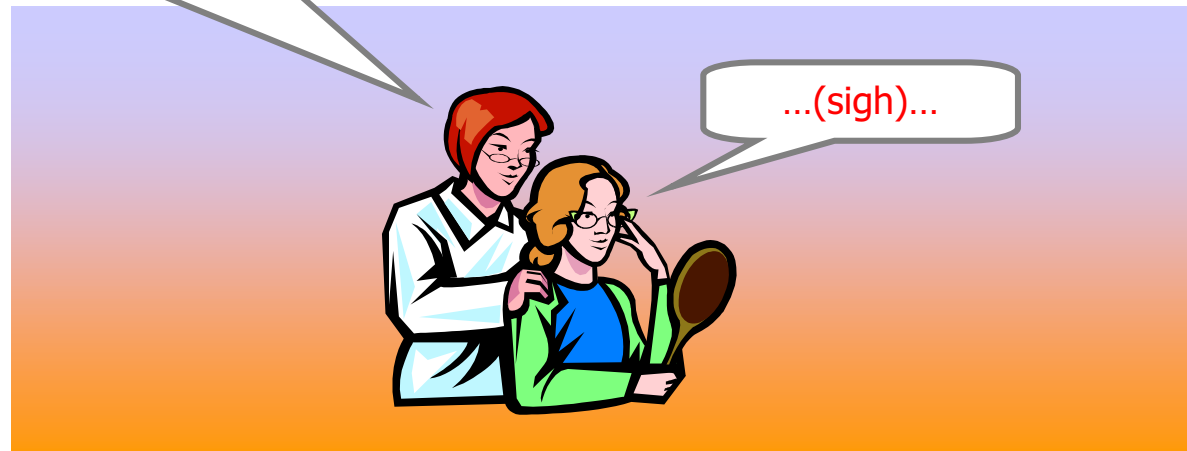
- The pathway to rapid results...





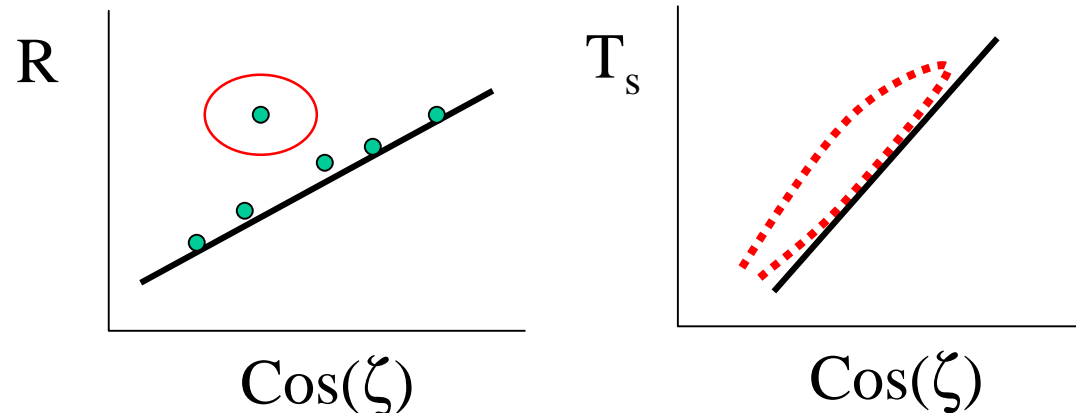
...and the route to would-have-been-better-land

Hey, use this neat single column setup of ECMWF to do millions of experiments on all kinds of heating rate data you can get your hands on!



The heating rate definition

- Heating rates defined as
 - $\partial T_s / \partial \cos \zeta$
 - ...with atmospherically corrected T_s
 - ...over enough subsequent cloud free time slots
 - ...before local noon
 - ...at sufficiently high solar elevation
 - ...with expected increase of T_s with time



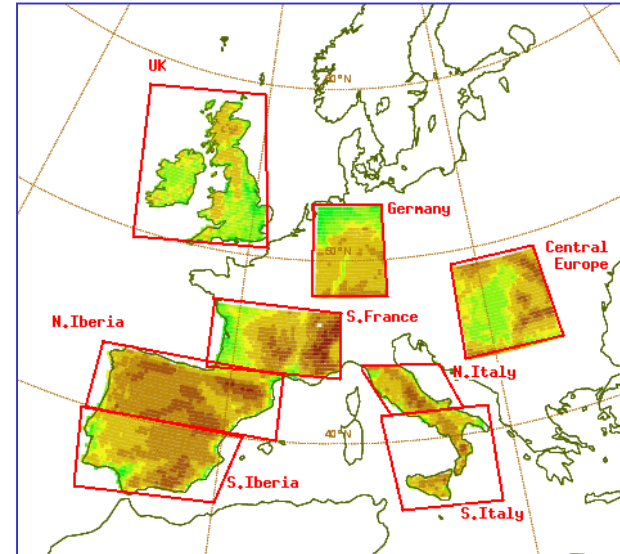
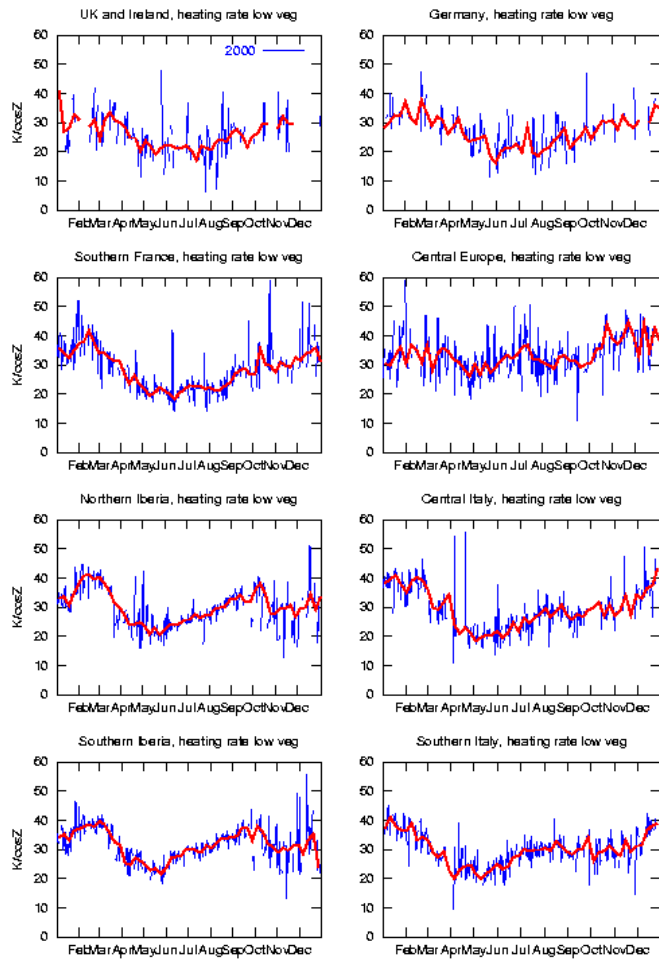
From METEOSAT to an ELDAS database

- Separation for low and high vegetation
 - Define for each ECOCLIMAP **1 × 1 km** vegetation type: high or low?
 - In each METEOSAT **5 × 7 km** pixel: decide whether high or low is dominant → assign pixel to high or low
 - In each ELDAS **0.2 × 0.2°** grid box: average high and low METEOSAT pixels
- Low vegetation present in nearly all ELDAS grids, high vegetation not



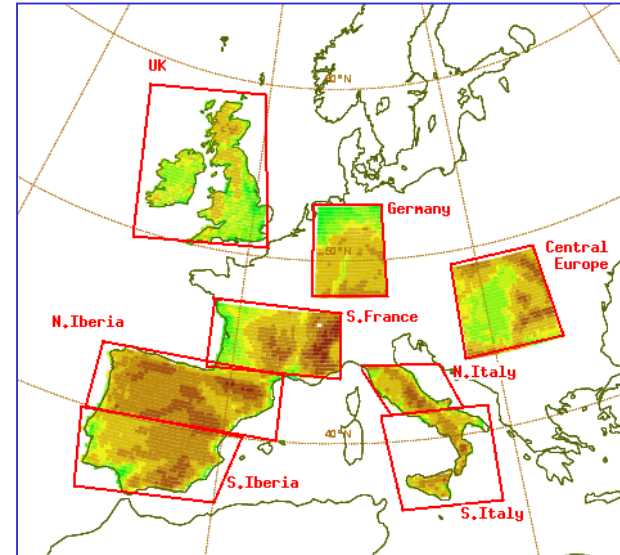
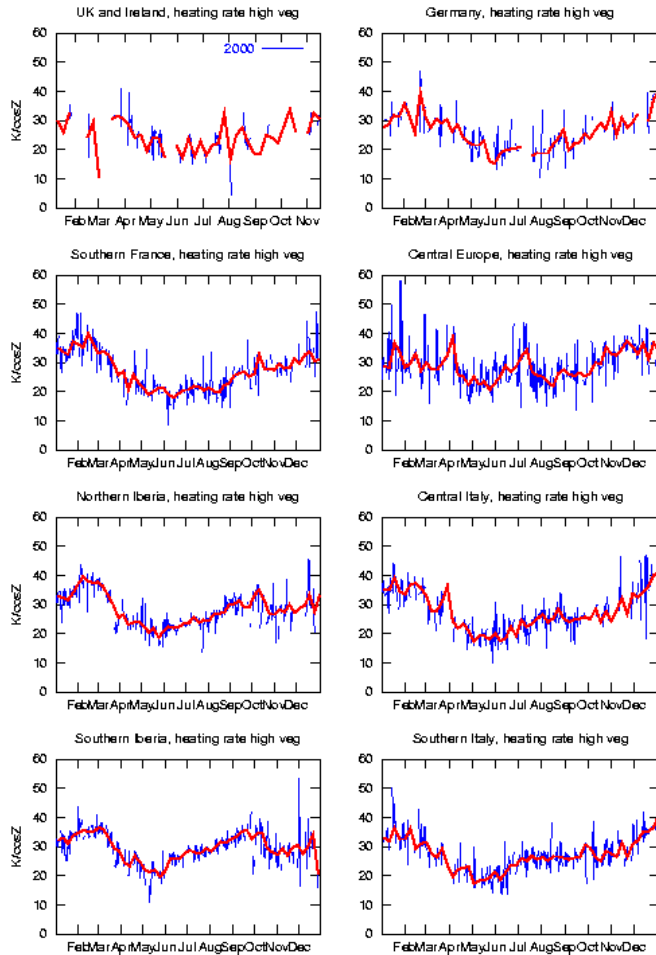
Exploration of 2000 database

- Low vegetation



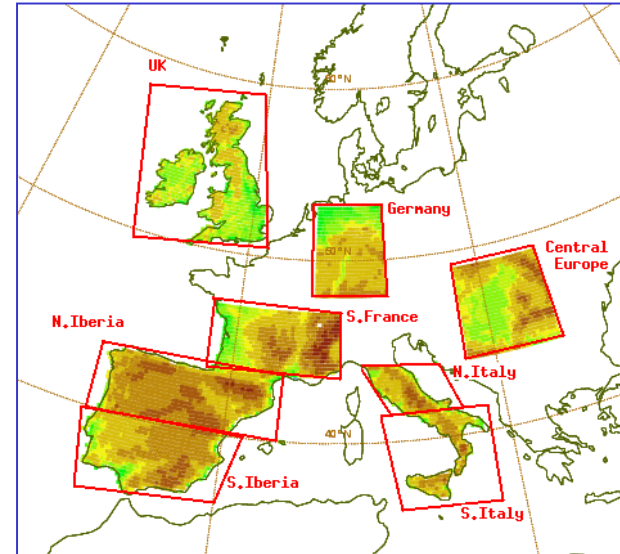
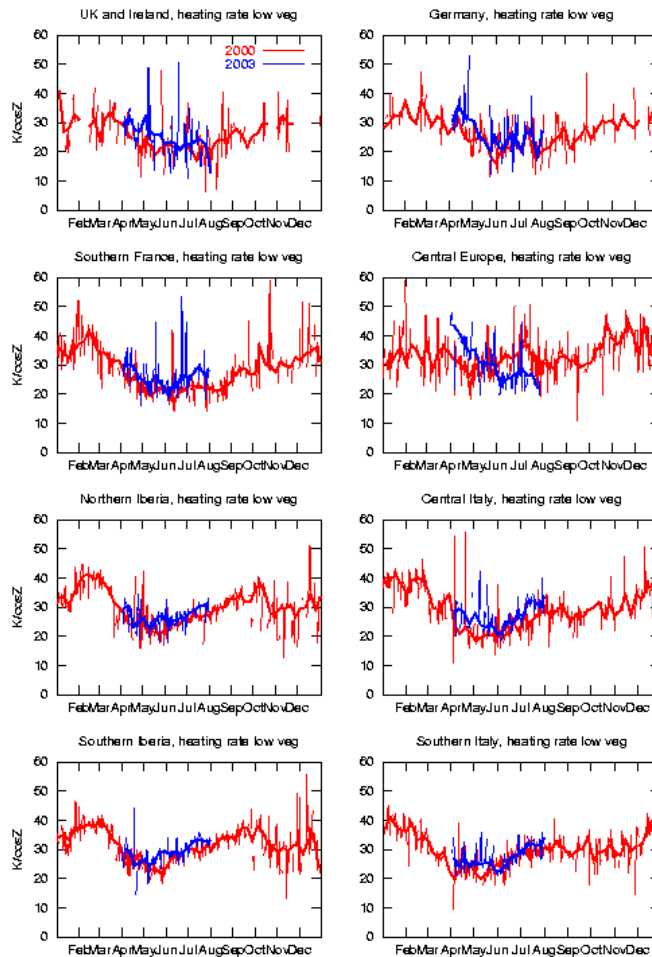
Exploration of 2000 database

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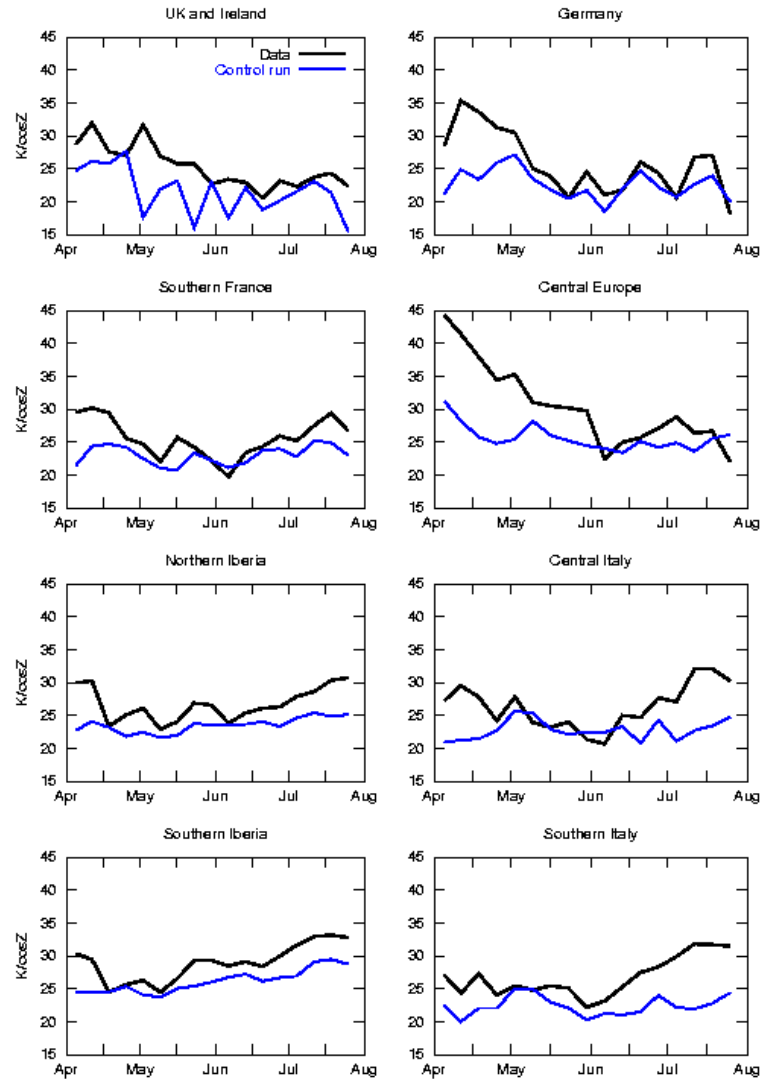
Difference 2000 and 2003

- Low vegetation



Modelled heating rates

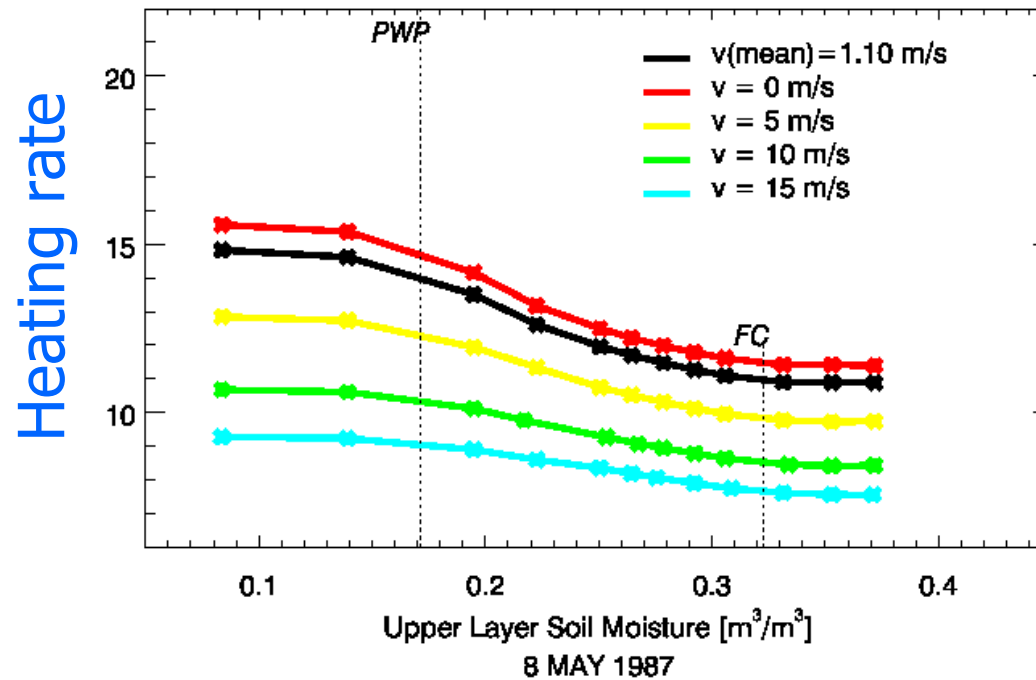
- AMJJ 2003





Impact of aerodynamics (I: wind speed)

- One day in the life of FIFE

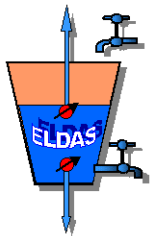
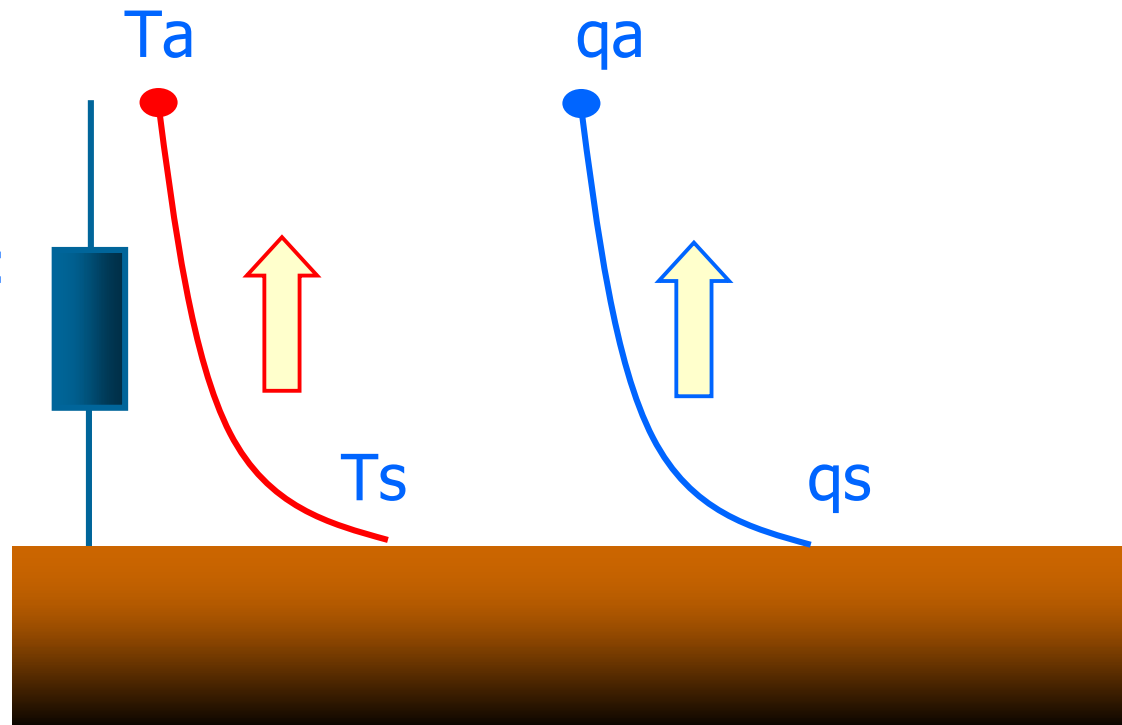


(LandSAF preparation study; MIUB)

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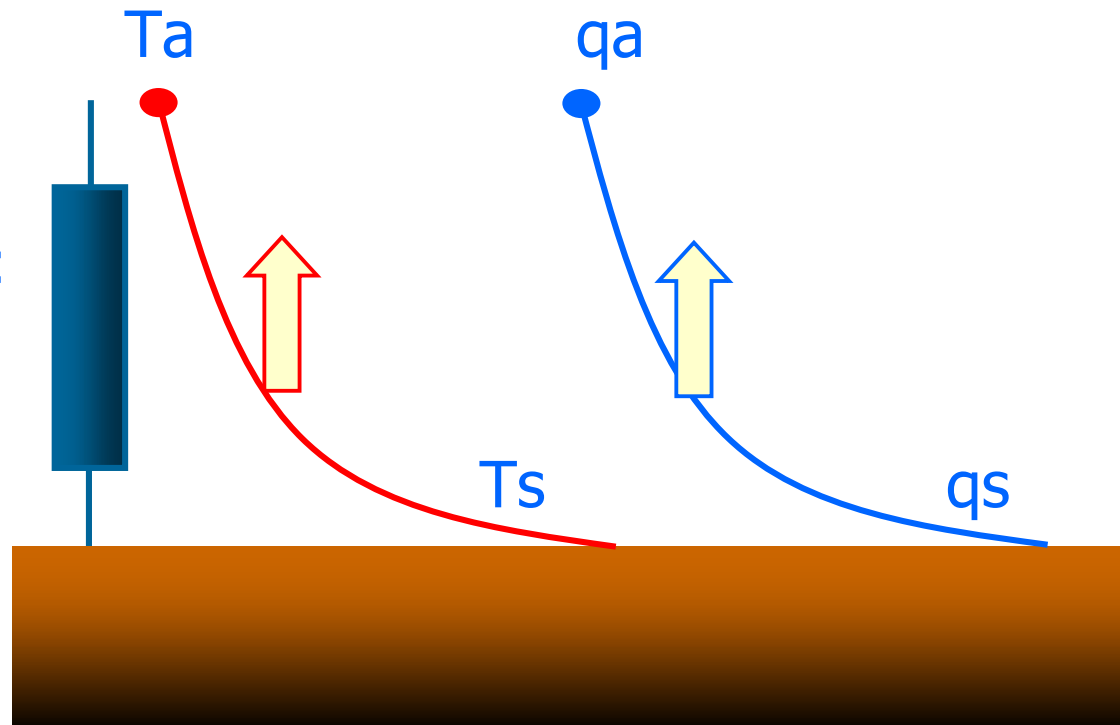
Impact of aerodynamics (II: z_0h)

aerodynamic
resistance
 $= f(z_0h)$

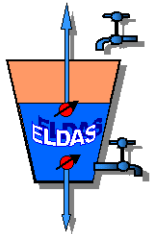


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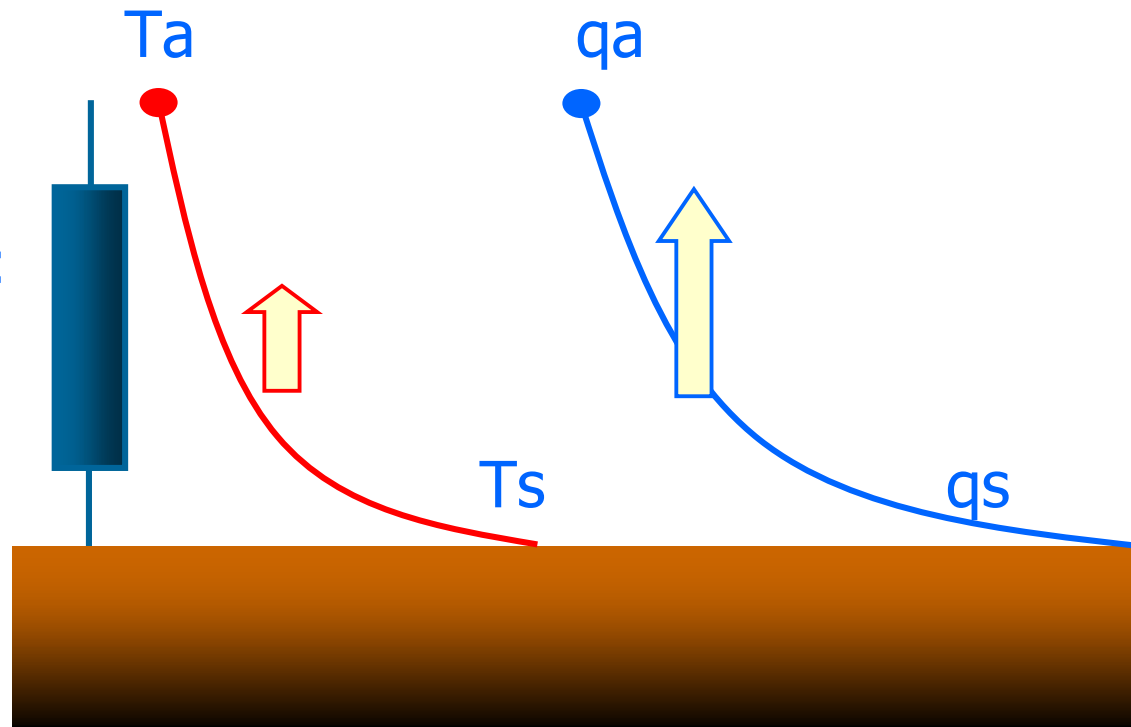


$$\Delta(q_s - q_a) \approx \Delta(T_s - T_a)$$

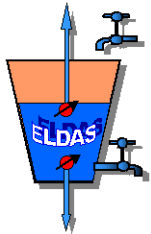


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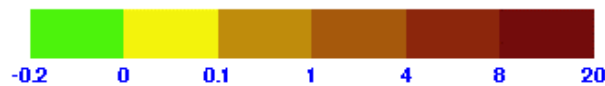
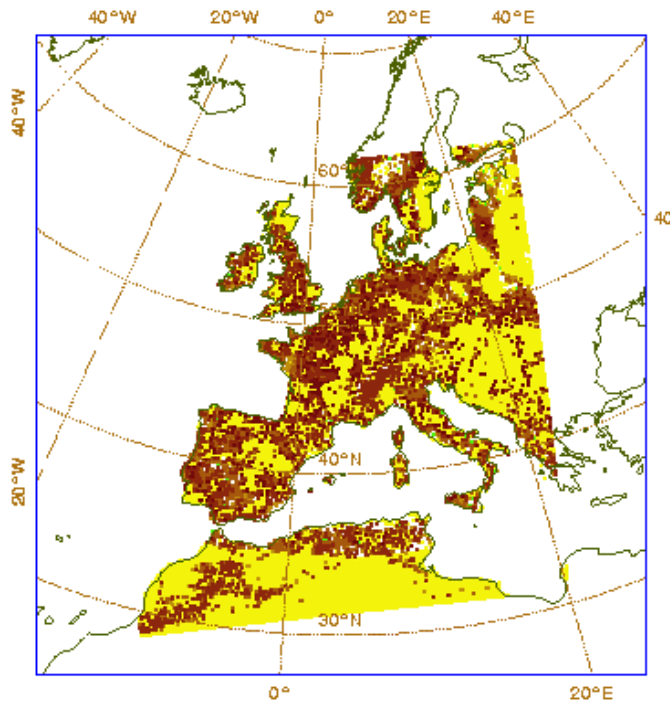
$$\Delta(q_s - q_a) > \Delta(T_s - T_a)$$



New thermal roughness map

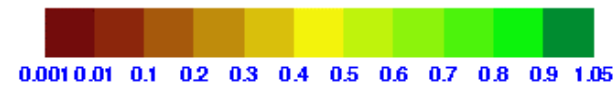
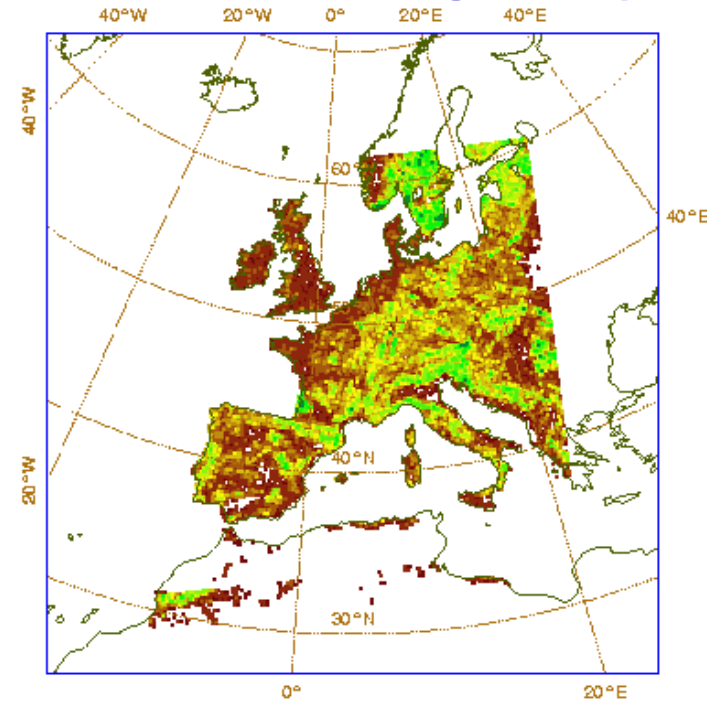
- Choose z0h giving smallest bias in April

z0h-modification

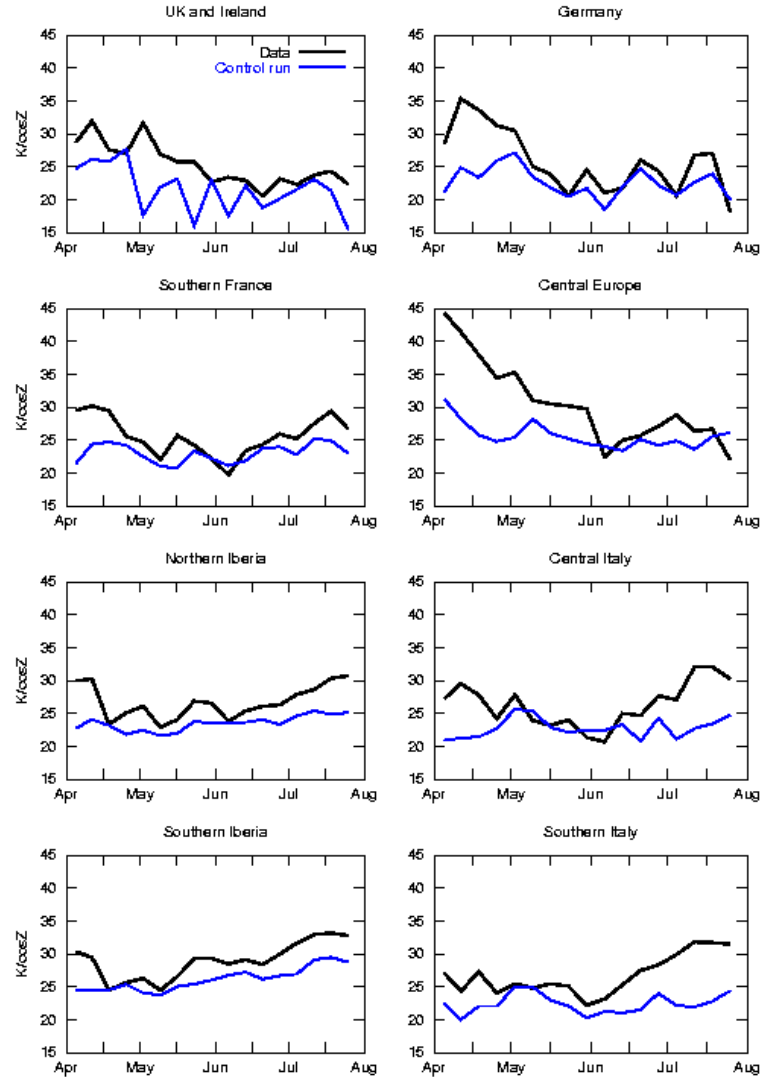


small ← correction → large

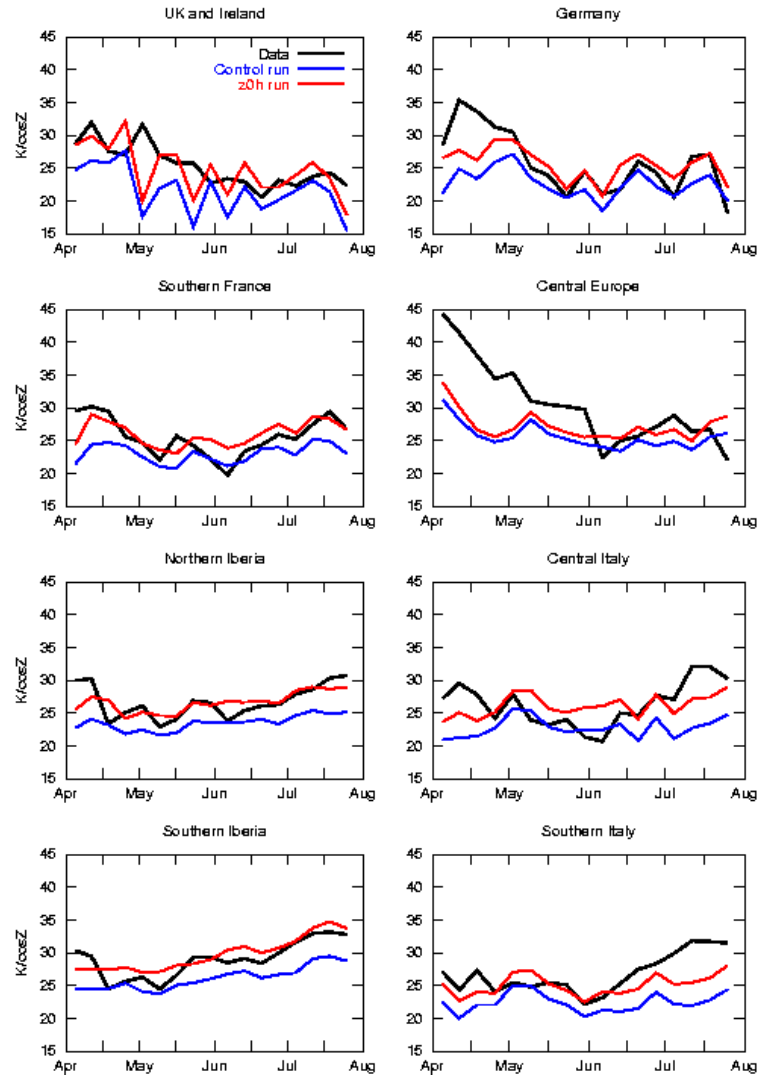
Forest coverage map



Modelled heating rates

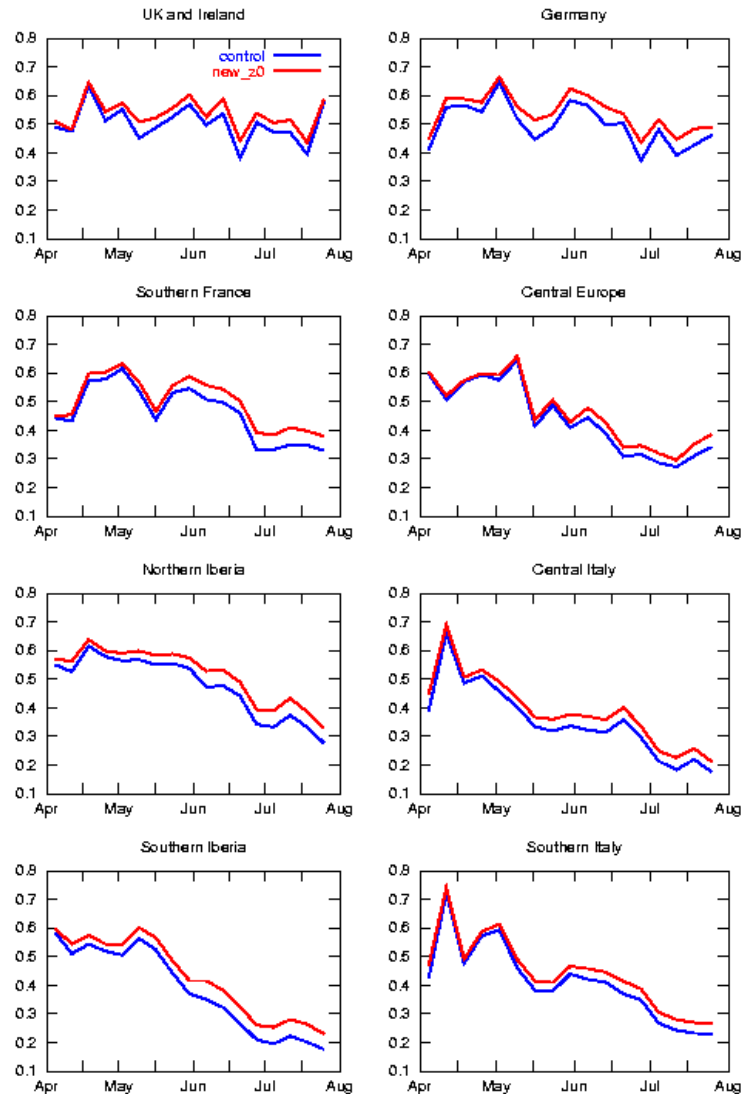


Changing z0h changes modelled heating rates...



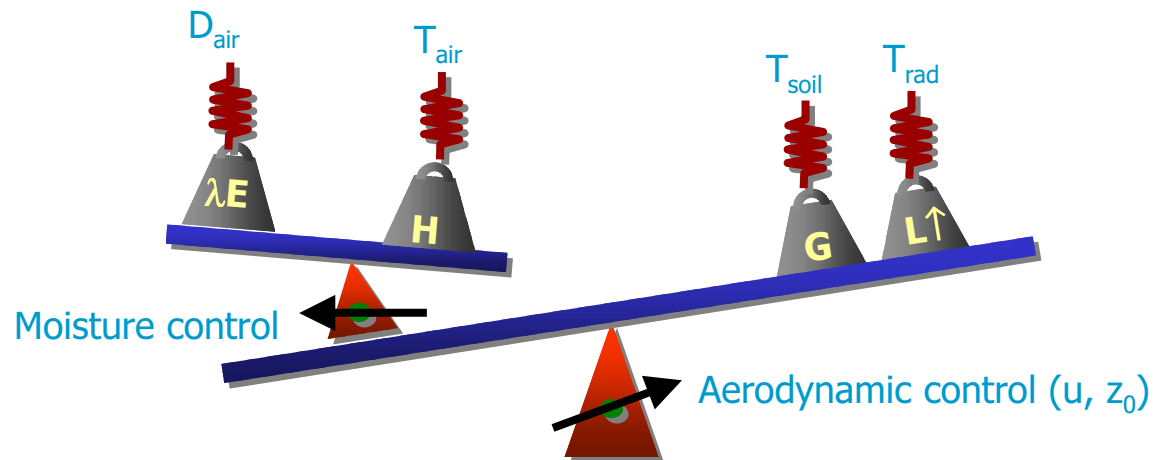
...but also evaporation

Evaporative fraction
 $LE/(H+LE)$



Summary

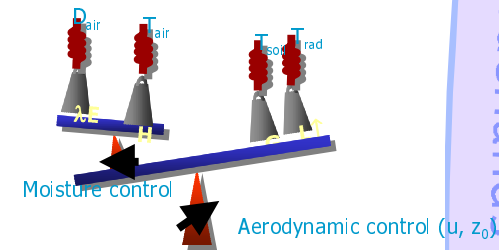
- ELDORADO
 - Database ready for use & further evaluation
- Assimilation of heating rates
 - Surface temperature sensitive to multiple processes





Summary

- ELDORADO
 - Database ready for use & further evaluation
- Assimilation of heating rates
 - Surface temperature sensitive to multiple processes
 - Aerodynamic effects partly calibrated away by updating z_0 during spring
 - Soil moisture assimilation experiment is underway
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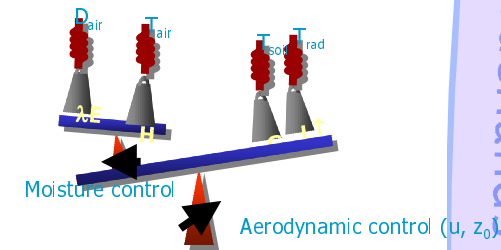
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Thank you