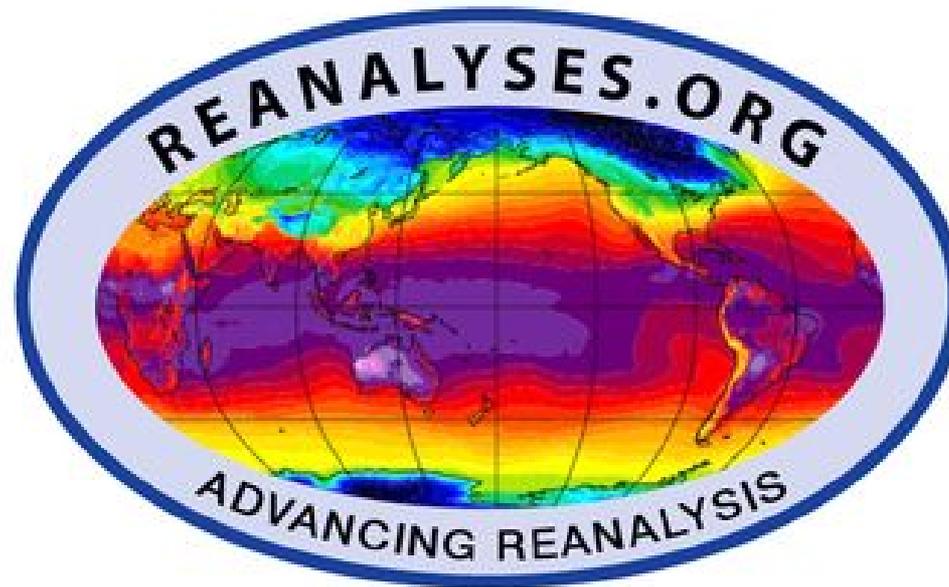


# Reanalysis: an overview

UERRA Partners  
Adrian Simmons  
+ many others

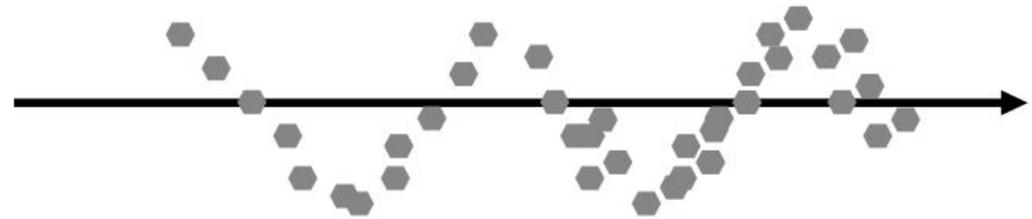


“Reanalysis is a scientific method for developing a comprehensive record of how weather and climate are changing over time.”

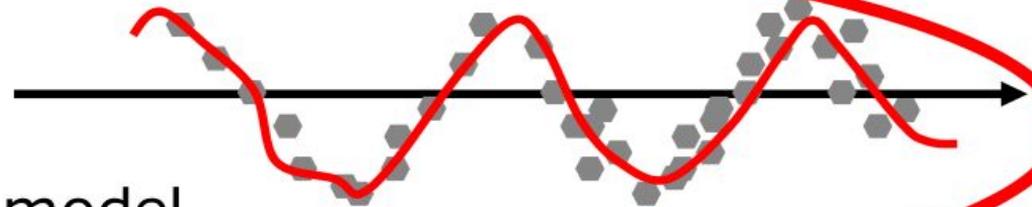
# Reanalysis

## Reconstruct past weather/climate – methods

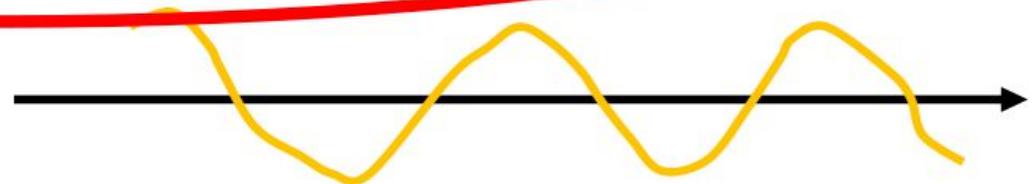
- Observations only
  - No dynamical model
  - Interpolation



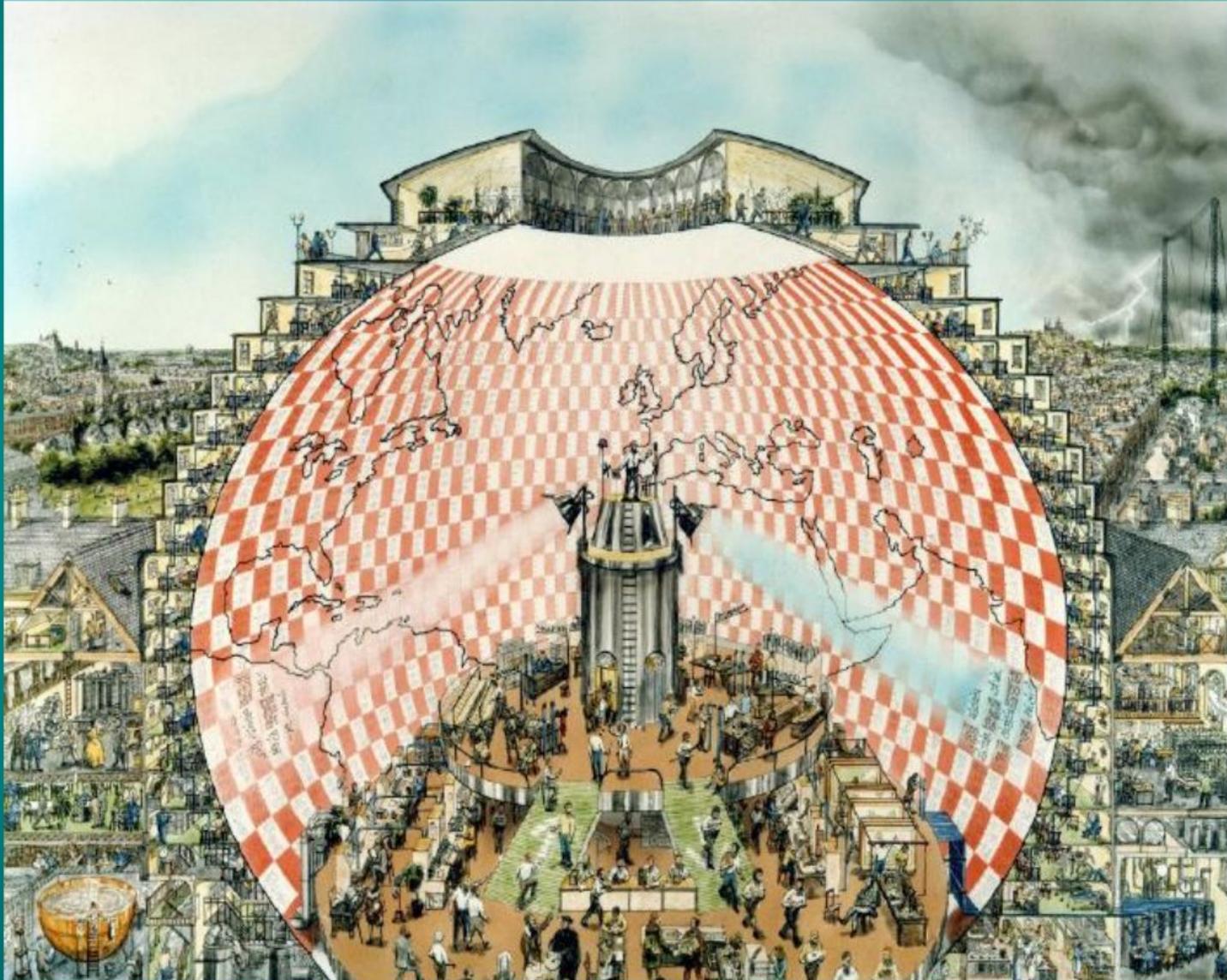
- Reanalysis
  - Observations + dynamical model



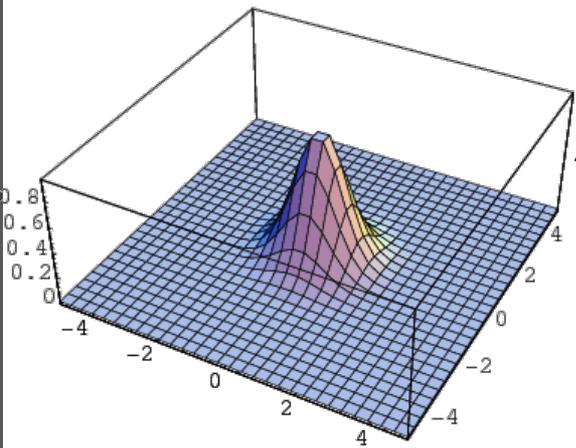
- Model only
  - Dynamical model only
  - Atmospheric forcings



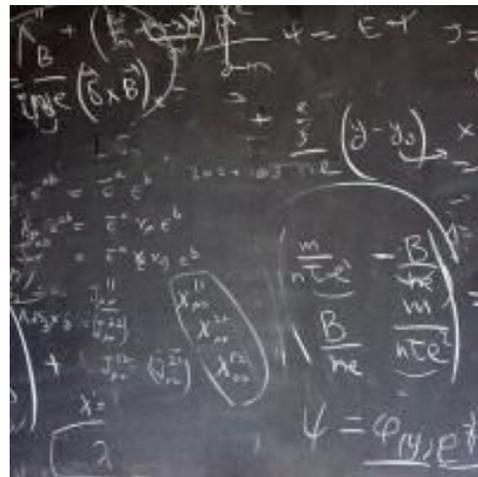
# Richardson's Forecast Factory



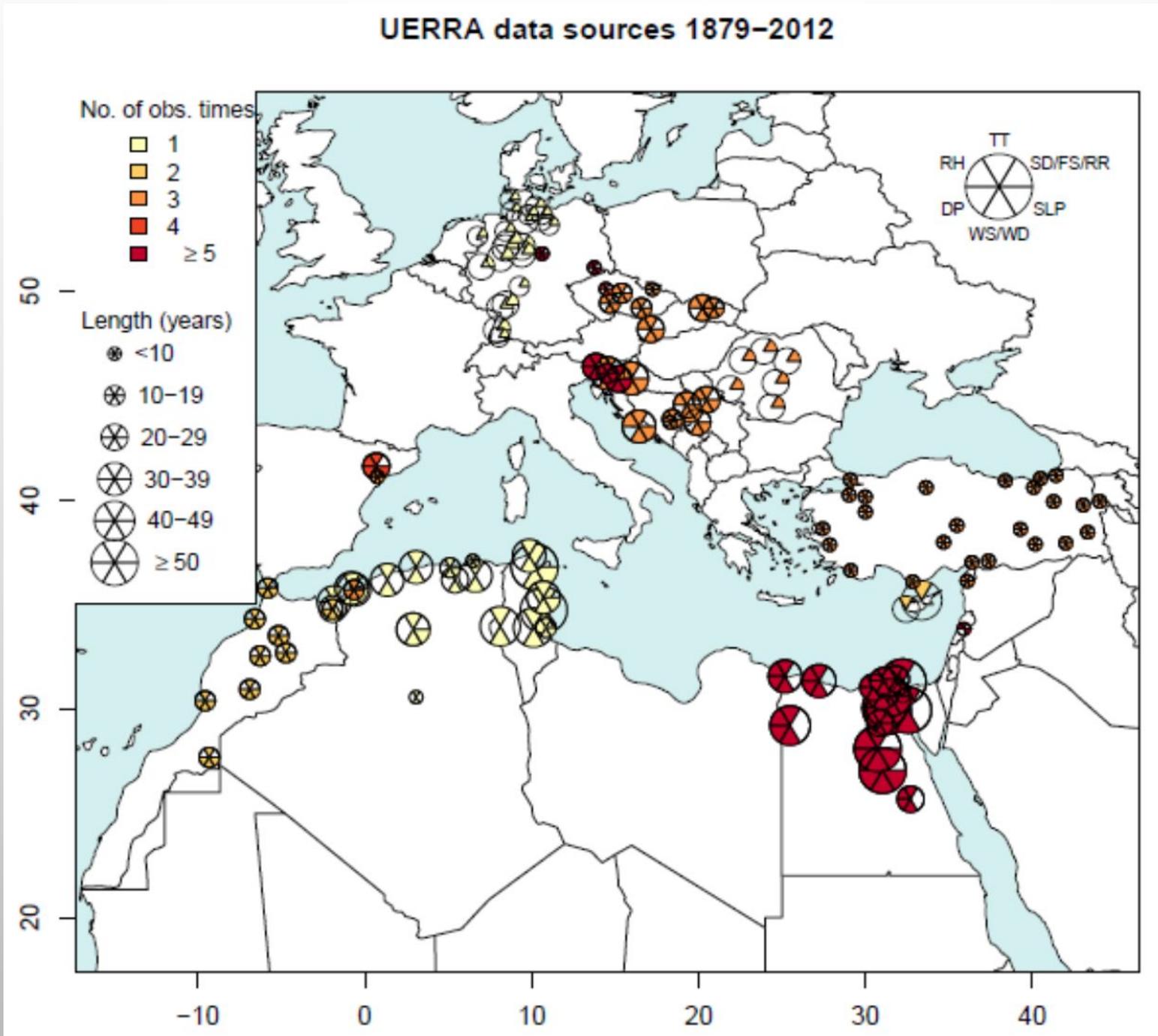
(© Stephen Conlin, 1986 - on the commission of Prof. John Byrne, then Head of the Department of Computer Science in Trinity College, Dublin)



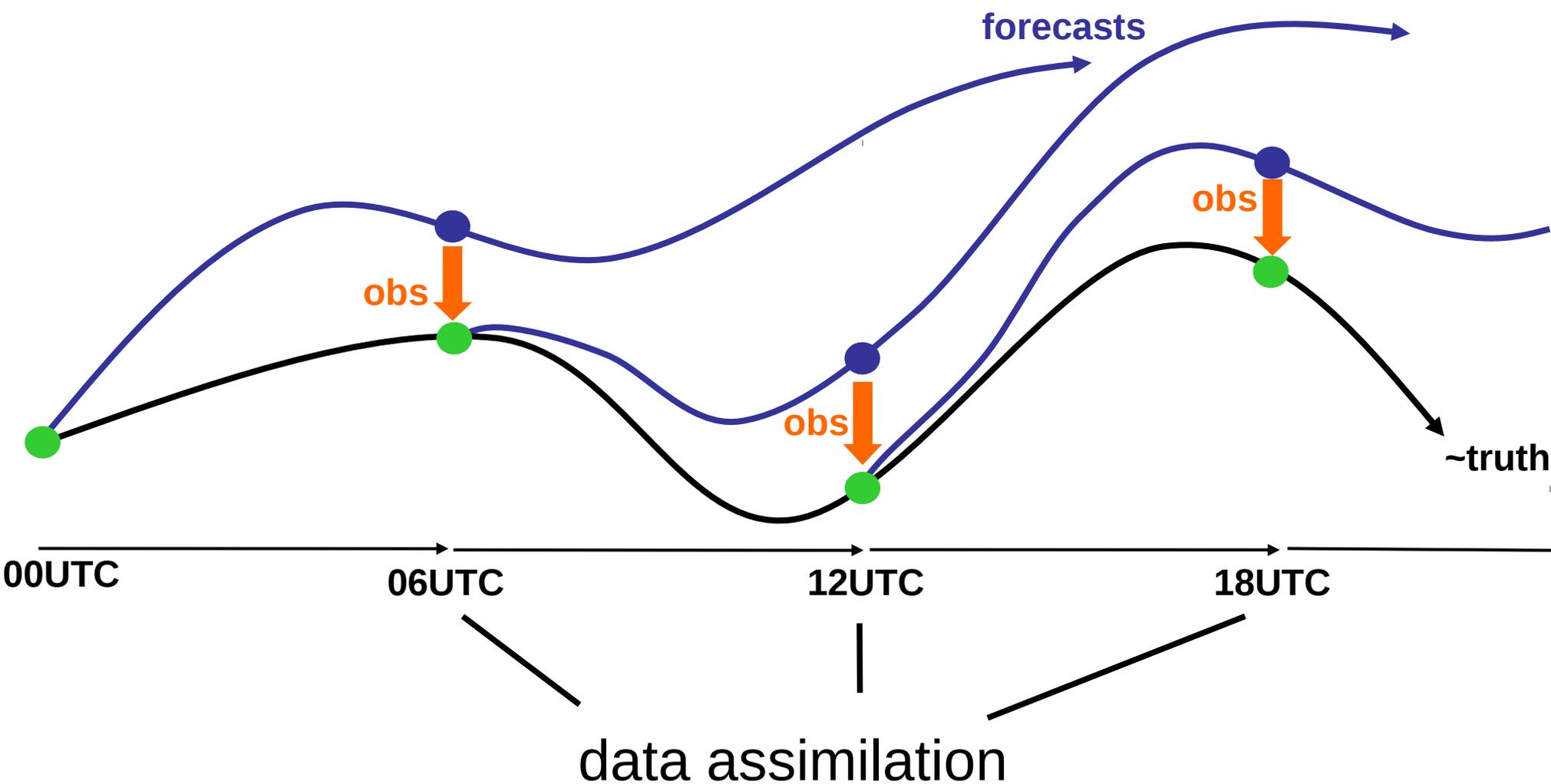
# Reanalysis

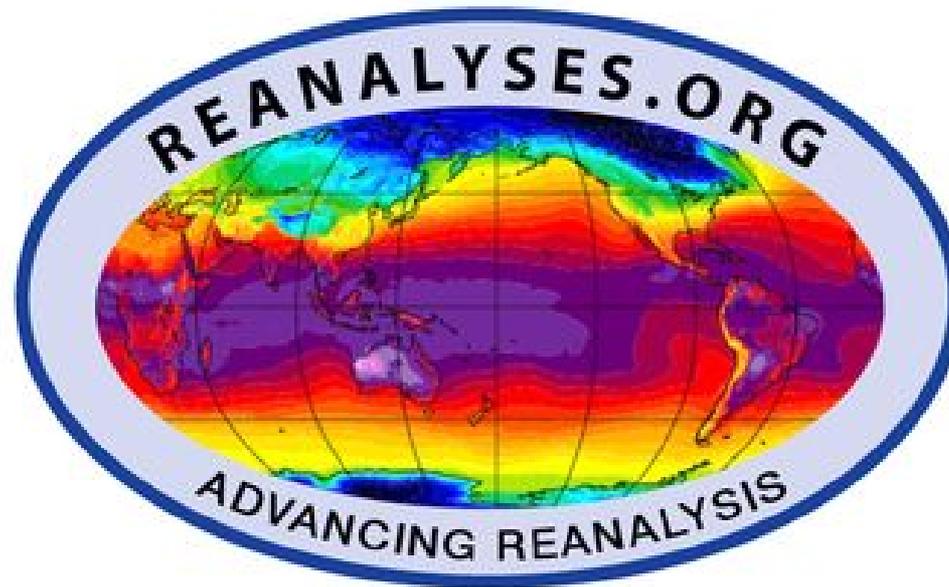


# URV DIGITISATION EFFORT (MANOLA BRUNET)



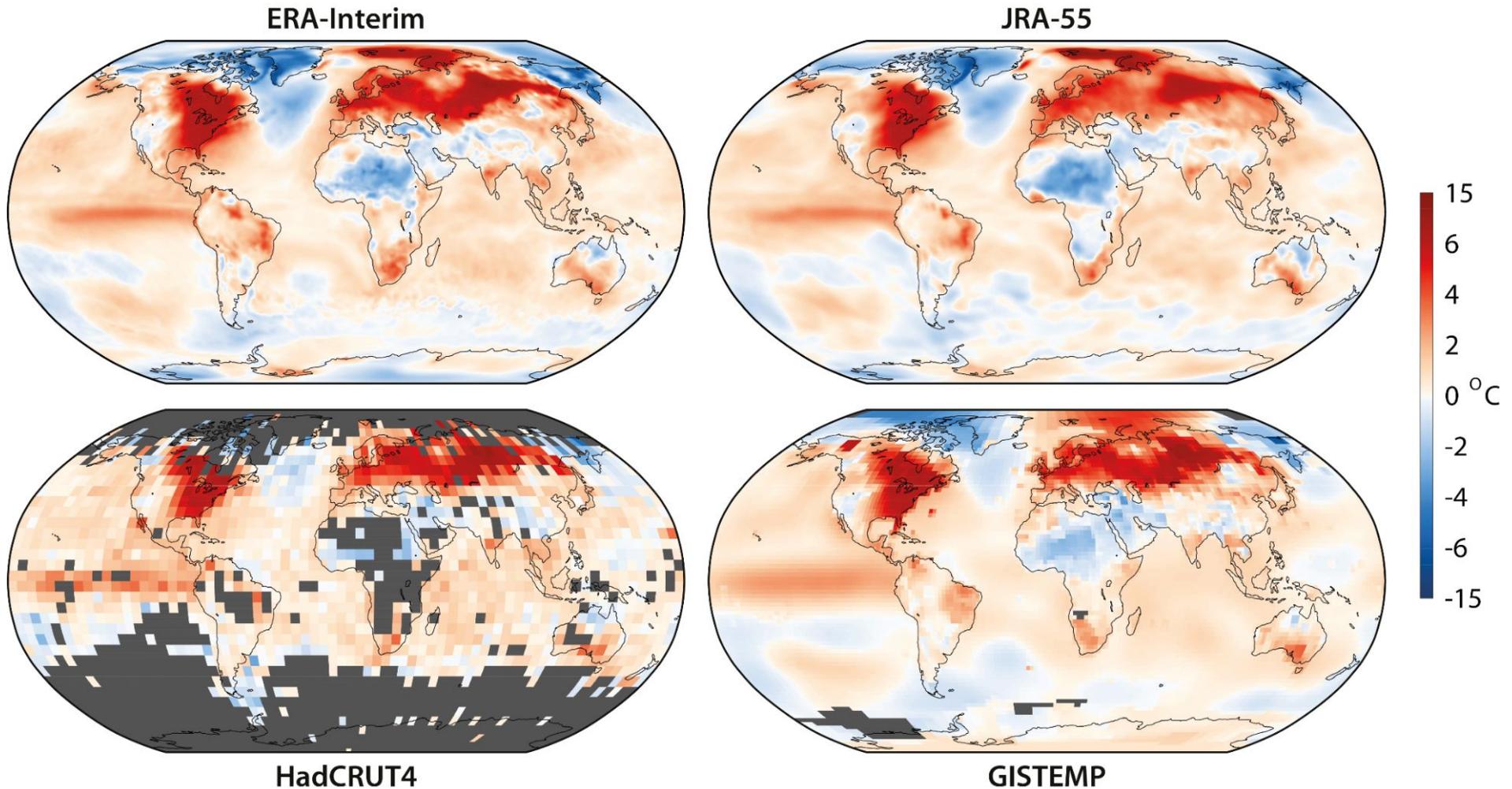
# Forecast Cycling





“Reanalysis is a scientific method for developing a **comprehensive** record of how weather and climate are changing over time.”

Reanalyses based on comprehensive data use, including synoptic observations



Conventional analyses based on *in situ* data, from monthly climatological reports over land, one without and one with infilling

# Why would anyone want a reanalysis ?



- Gridded data
- Based on observations
- Incorporates model equations
- Physically and dynamically coherent
- Full set of meteorological fields
- We can estimate accuracy

## The first three global reanalyses were in the early to mid 1990s

⇌ ERA-15 (1979 - 93), NASA/DAO (1980 - 93) and NCEP/NCAR (1948 - ...)

## A second round of production followed

– ERA-40 (1958 - 2001), JRA-25 (1979 - 2014) and NCEP/DOE (1979 - ...)

## And a third

– ERA-Interim (1979 - ... ), JRA-55 (1958 - ...), MERRA (1979 - 2015) and CFSR (1979 - 2011; extended to present with CFSv2 system)

## A fourth round has begun

- MERRA-2 (1979 - ...) is now up-to-date and continued close to real time
- ERA5 has entered production, under the auspices of Copernicus/ECMWF
- JRA-3Q is planned to enter production in Japanese Fiscal Year 2018

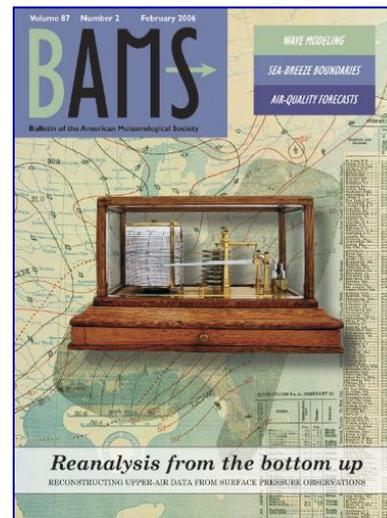
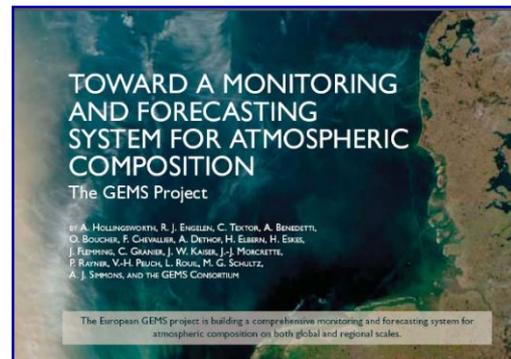
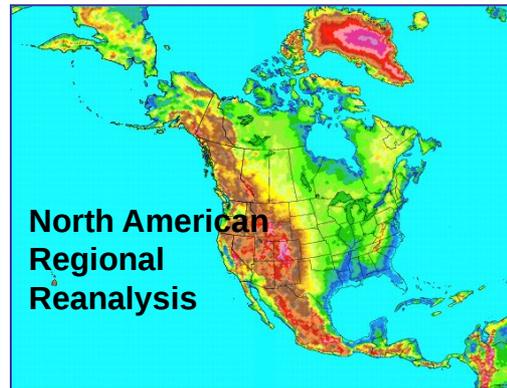
Regional atmospheric reanalysis

Ocean and land-surface reanalysis

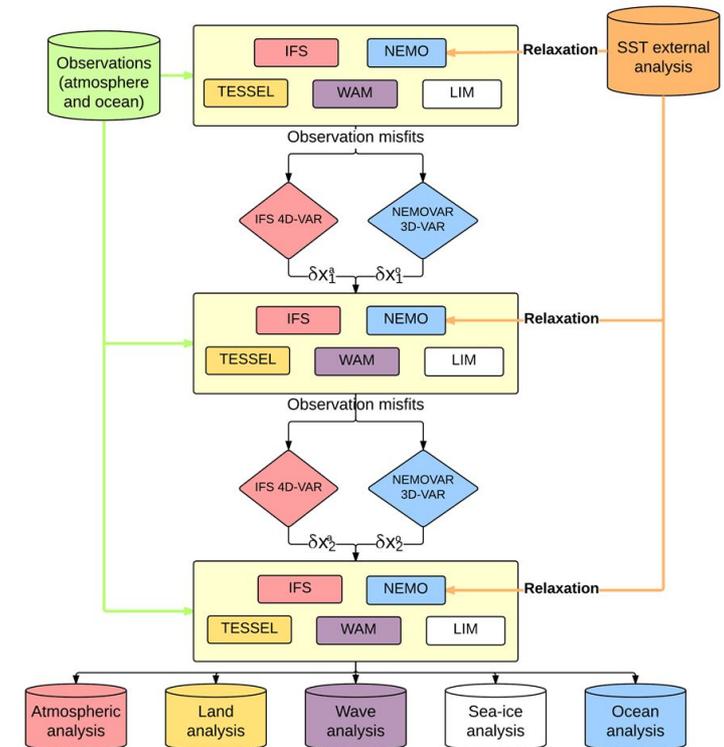
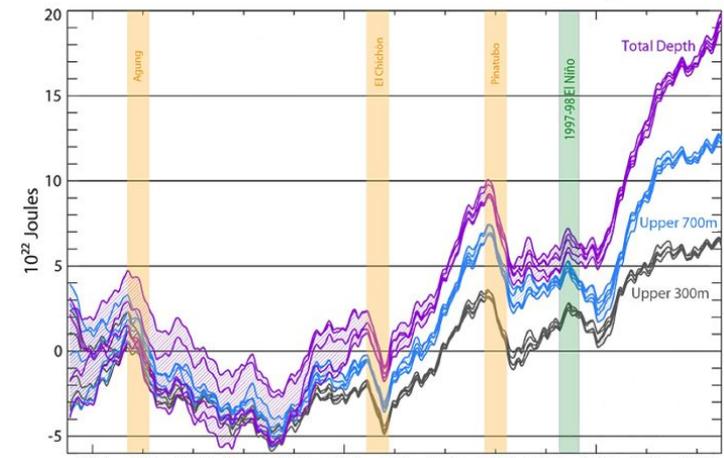
Coupling atmosphere, ocean and more

Including aerosols, greenhouse gases, and reactive gases that influence air quality

Century-scale reanalysis assimilating only surface observations



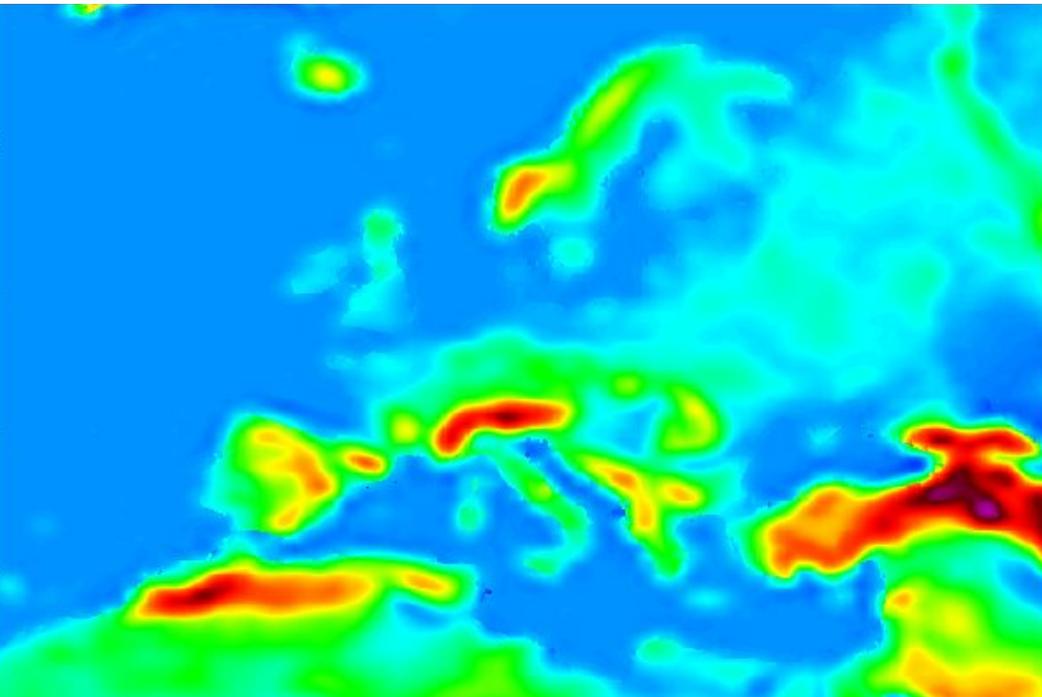
Ocean heat content from ORAS4 reanalysis



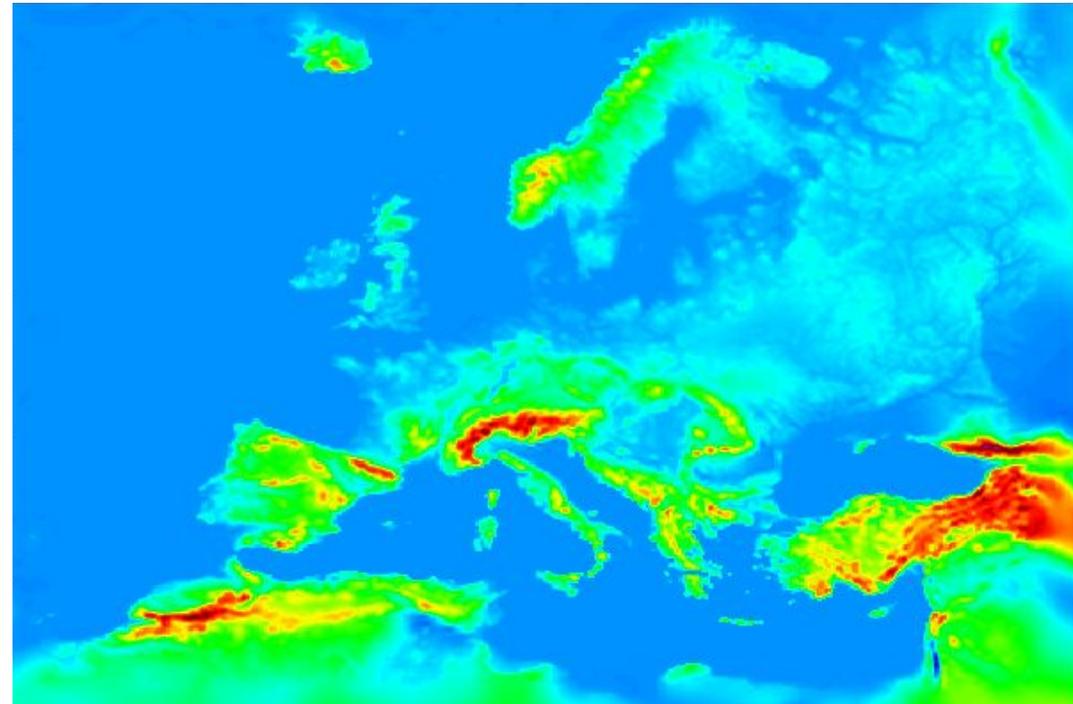
Why would anyone want  
a **regional** reanalysis ?



# Increase in resolution

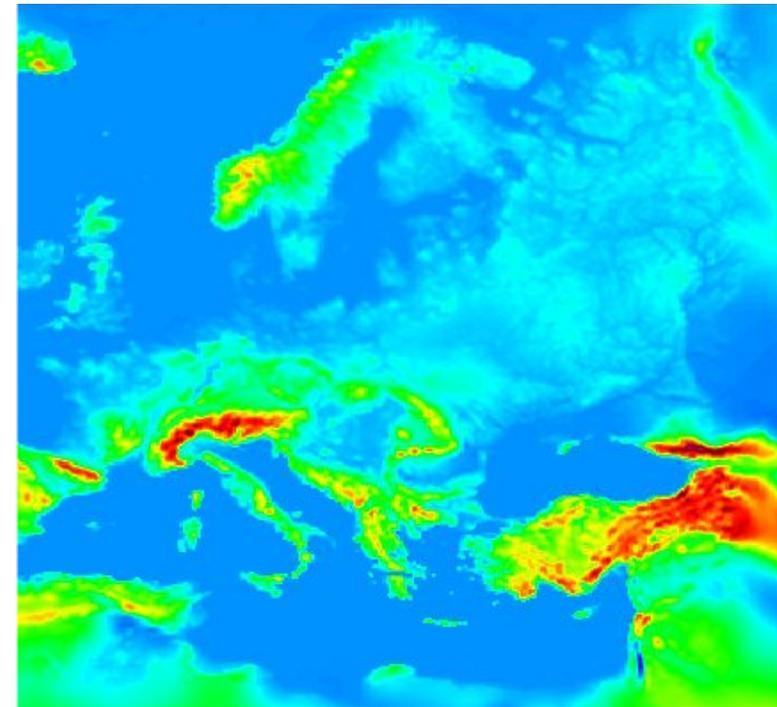
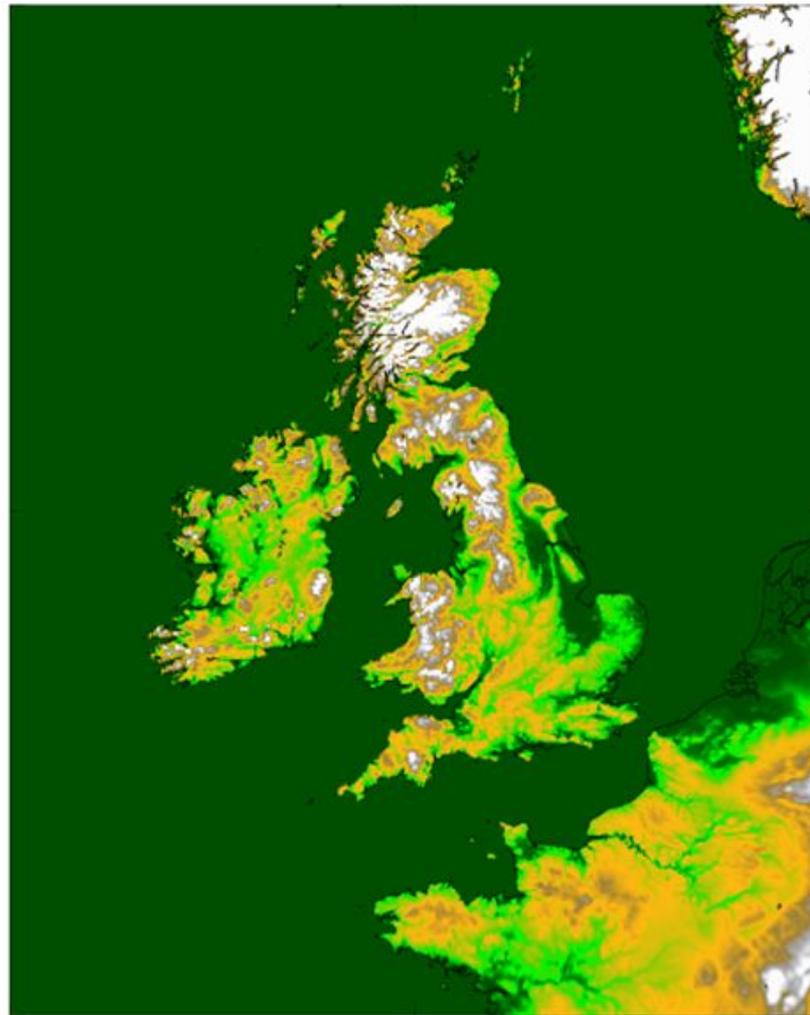
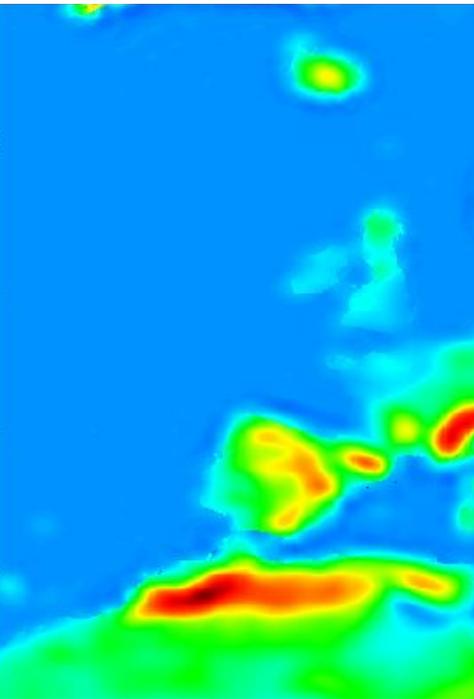


**ERA-Interim:** Model/DA 80/125km



**EURO4M:** Model/DA: 12/24km

# Increase in resolution



**ERA-Interim: Model/DA: 25/25km**

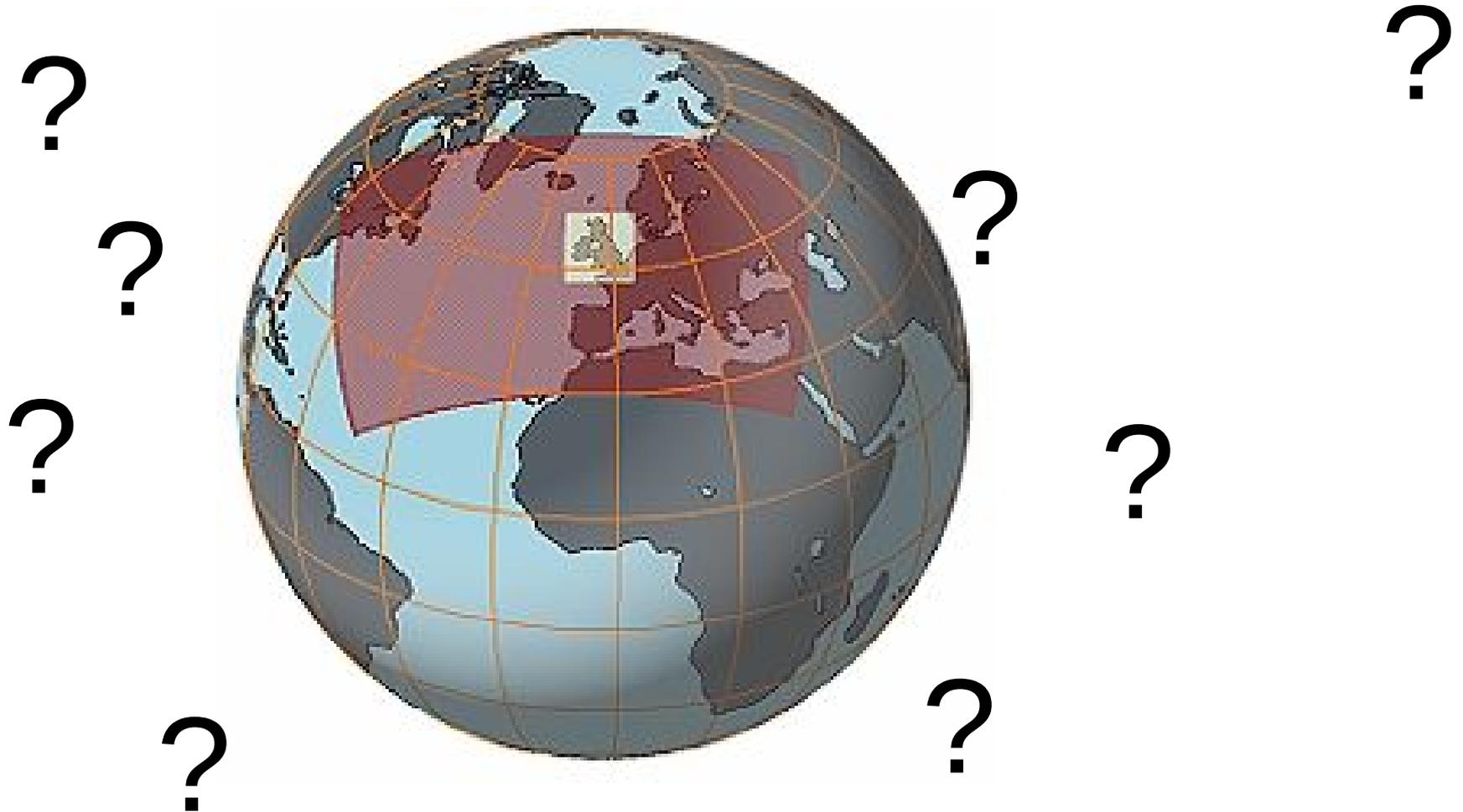
**UKV: 1.5km**

**I: Model/DA: 12/24km**

# Adding detail to Global



Why would anyone want  
an **ensemble** of reanalyses ?



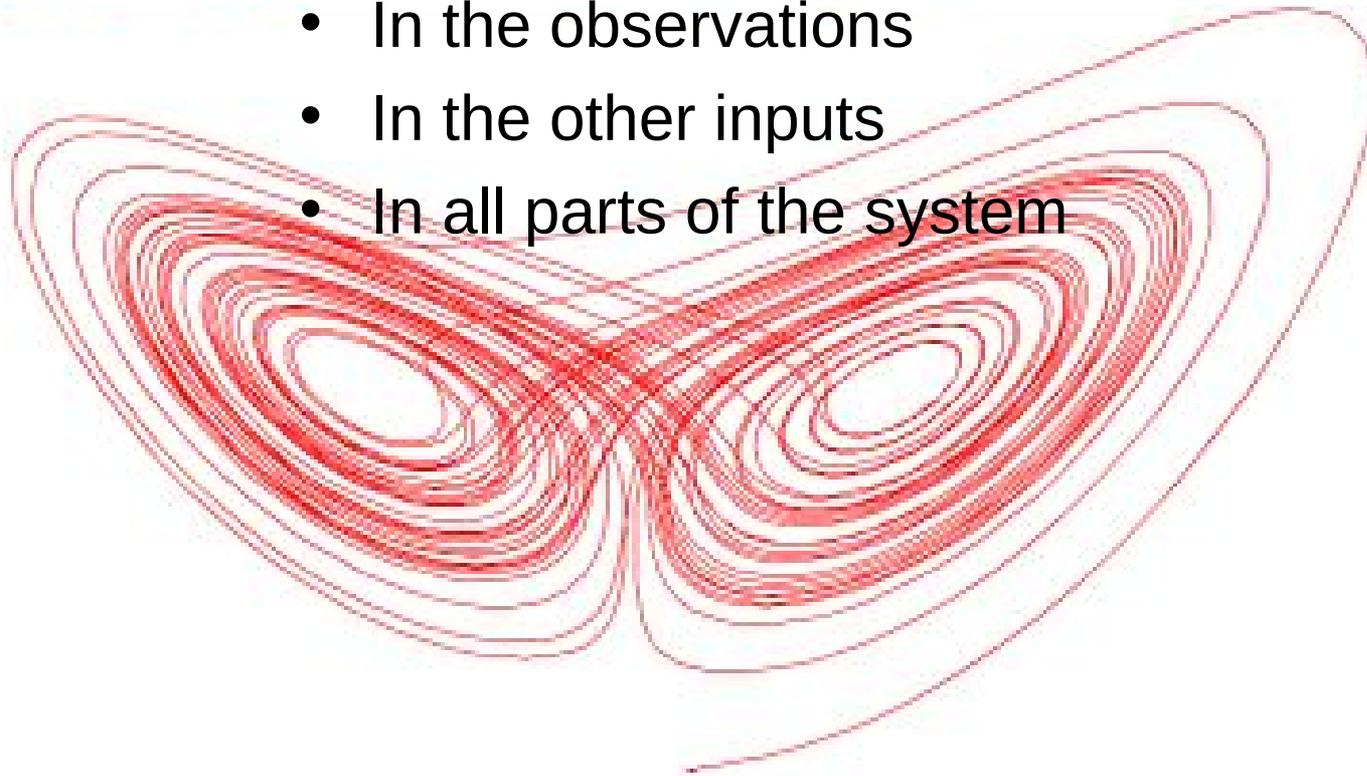


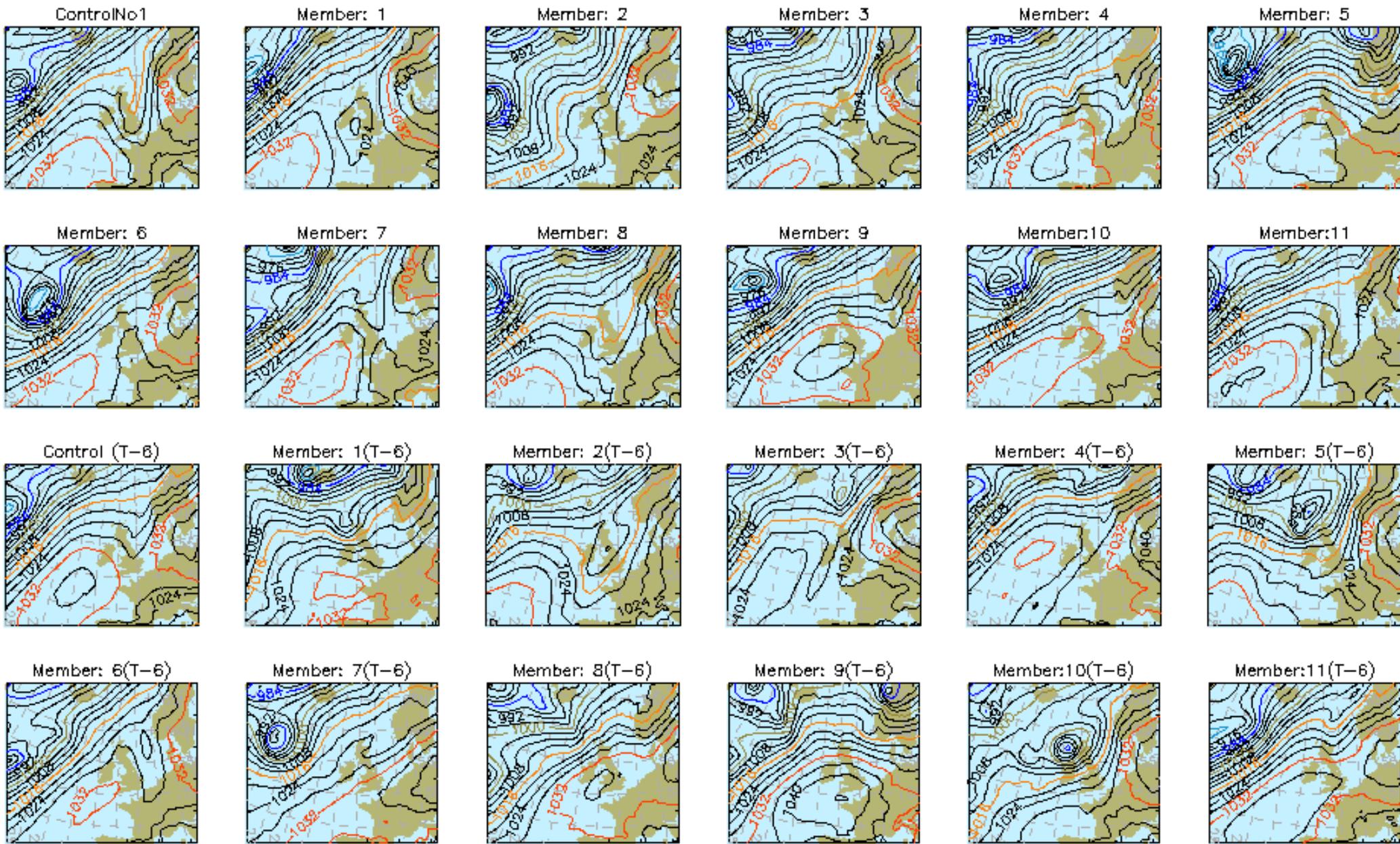
# Errors & *...uncertainty...*

- In the forecast model
- In the observations
- In the other inputs
- In all parts of the system

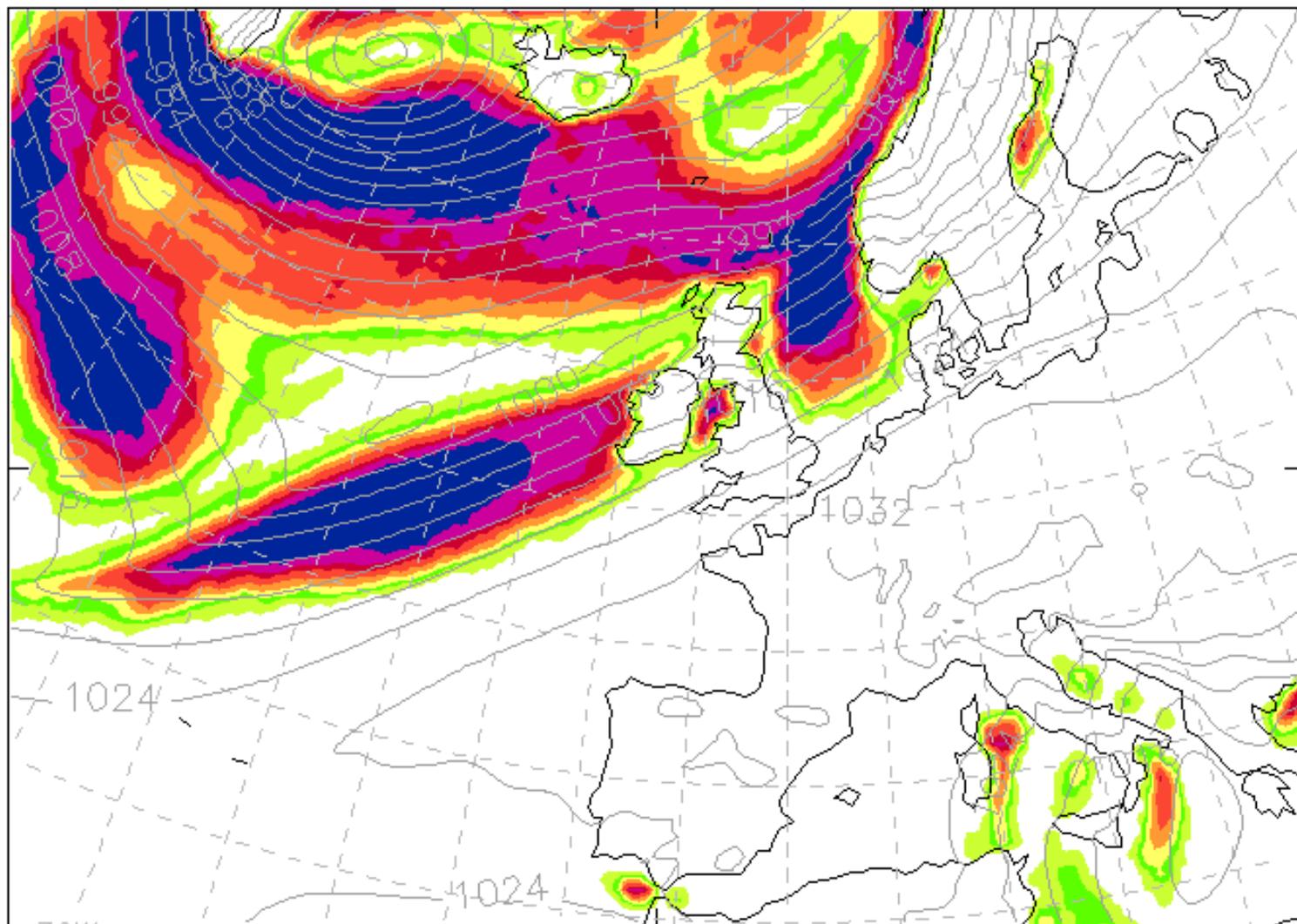
# Errors & *...uncertainty...*

- In the forecast model
- In the observations
- In the other inputs
- In all parts of the system



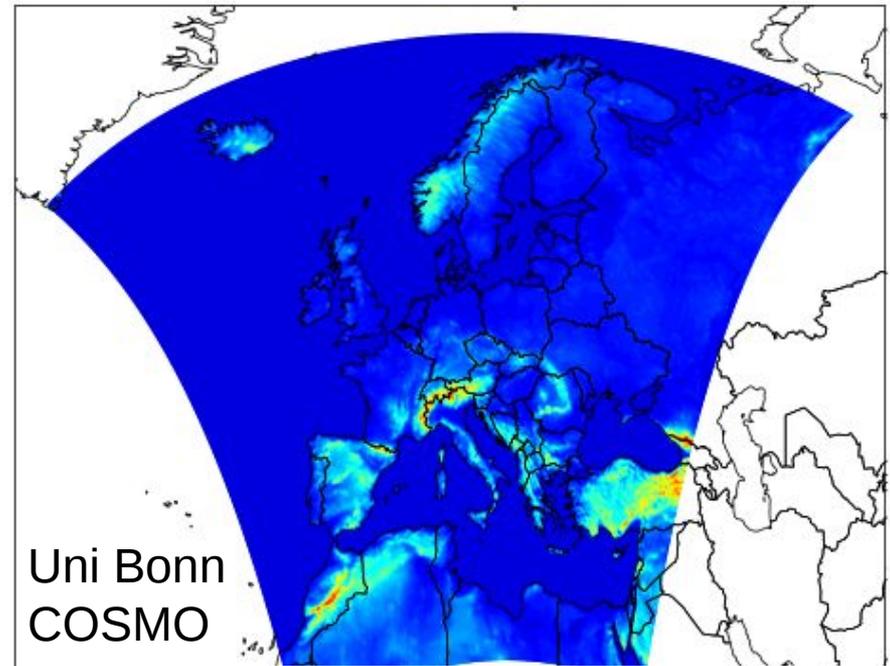
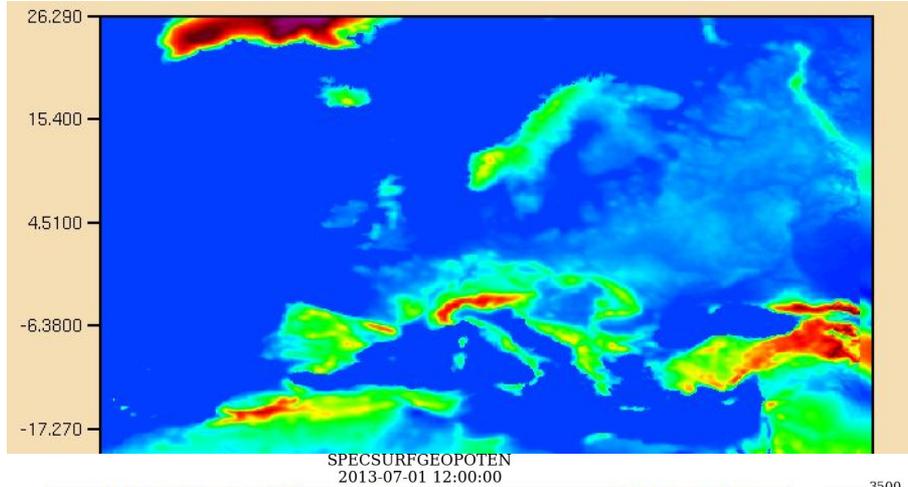


MOGREPS (Global) Probability map for 10mWindSpeed > 28.0knots  
MOGREPS CT 06Z on Fri 06/03/2015 VT 06Z on Sat 07/03/2015 lead time 024h  
(Ensemble Mean PMSL plotted as faint background)

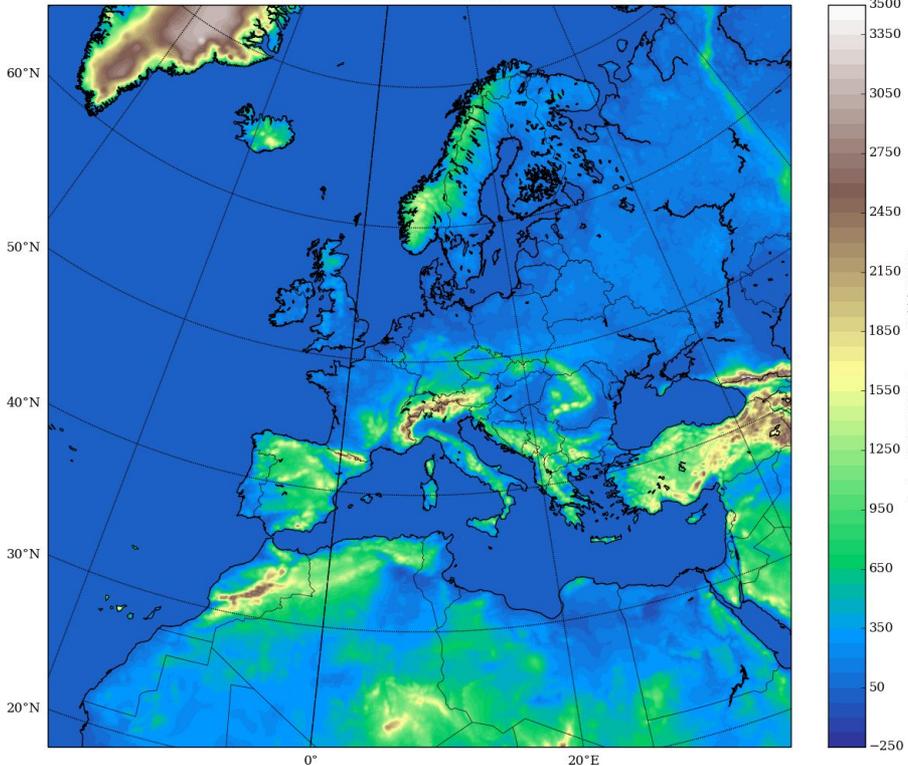


# UERRA Domain & projections

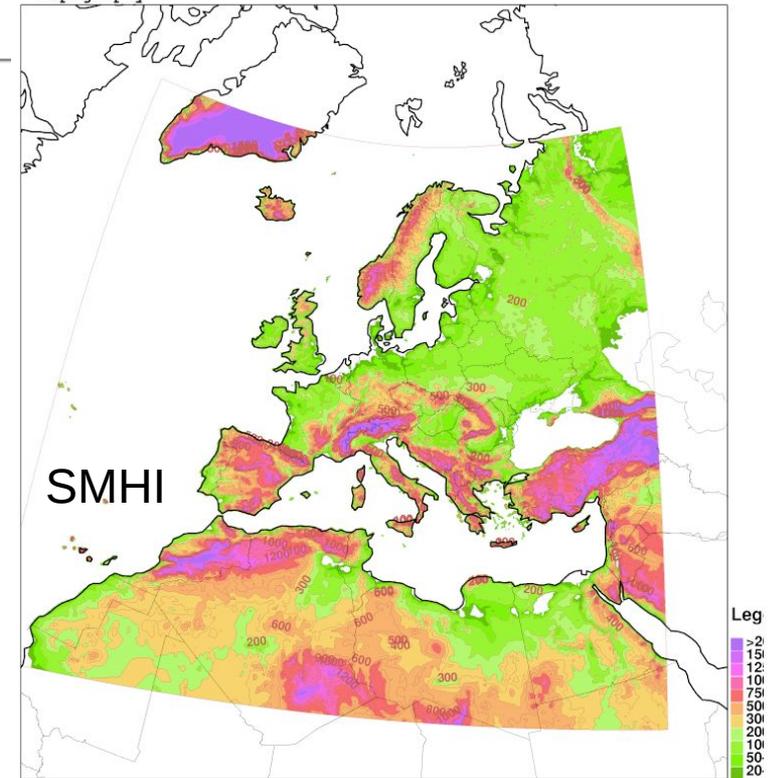
Met Office  
CORDEX  
EU 11 km



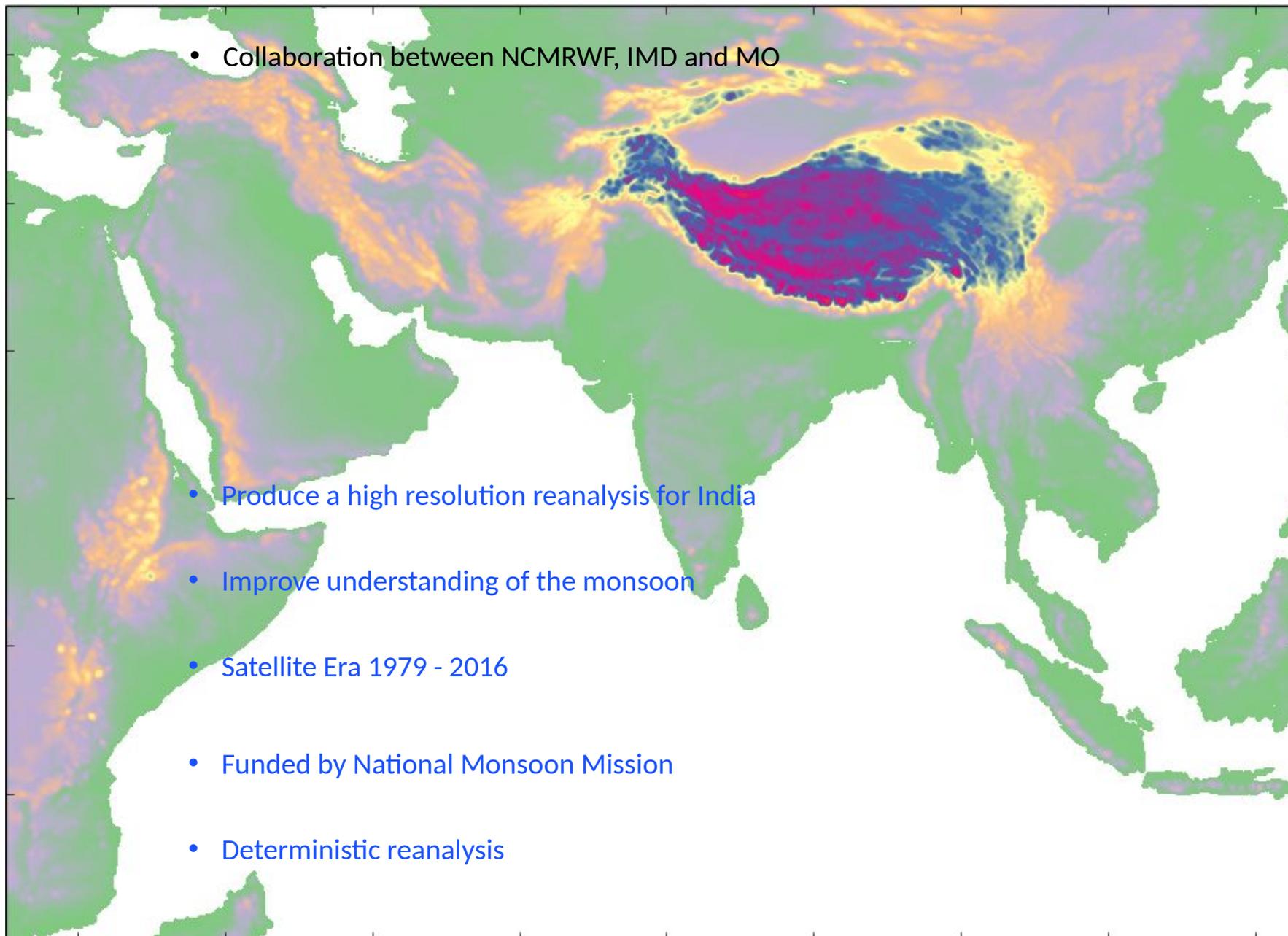
MF



Alaro UERRA  
Topography

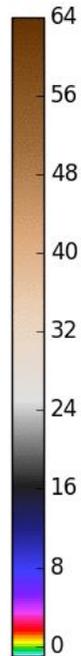
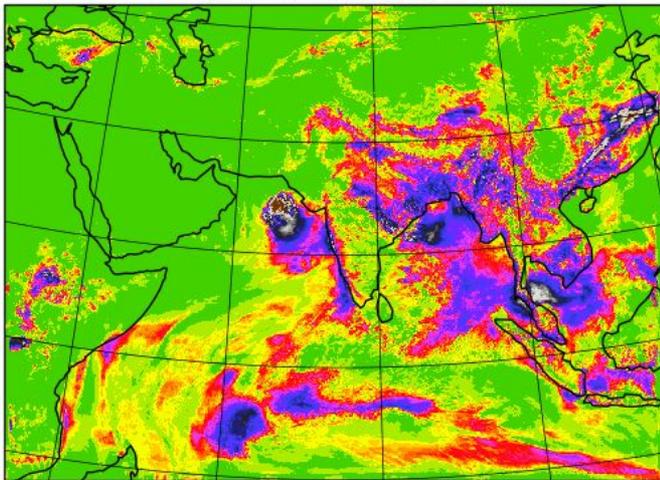


Mon 1 Jul 2013 00Z +06h  
valid Mon 1 Jul 2013 06Z

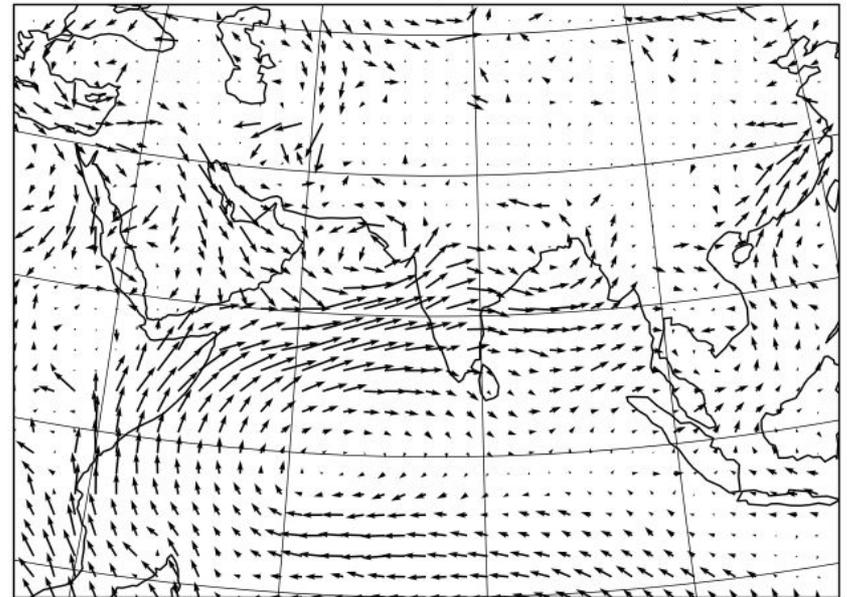


# IMDAA Movie loop 10-18 June 2008

IMDAA precipitation amount  
(20080610T0000Z)



IMDAA 850hPa wind (20080610T0000Z)



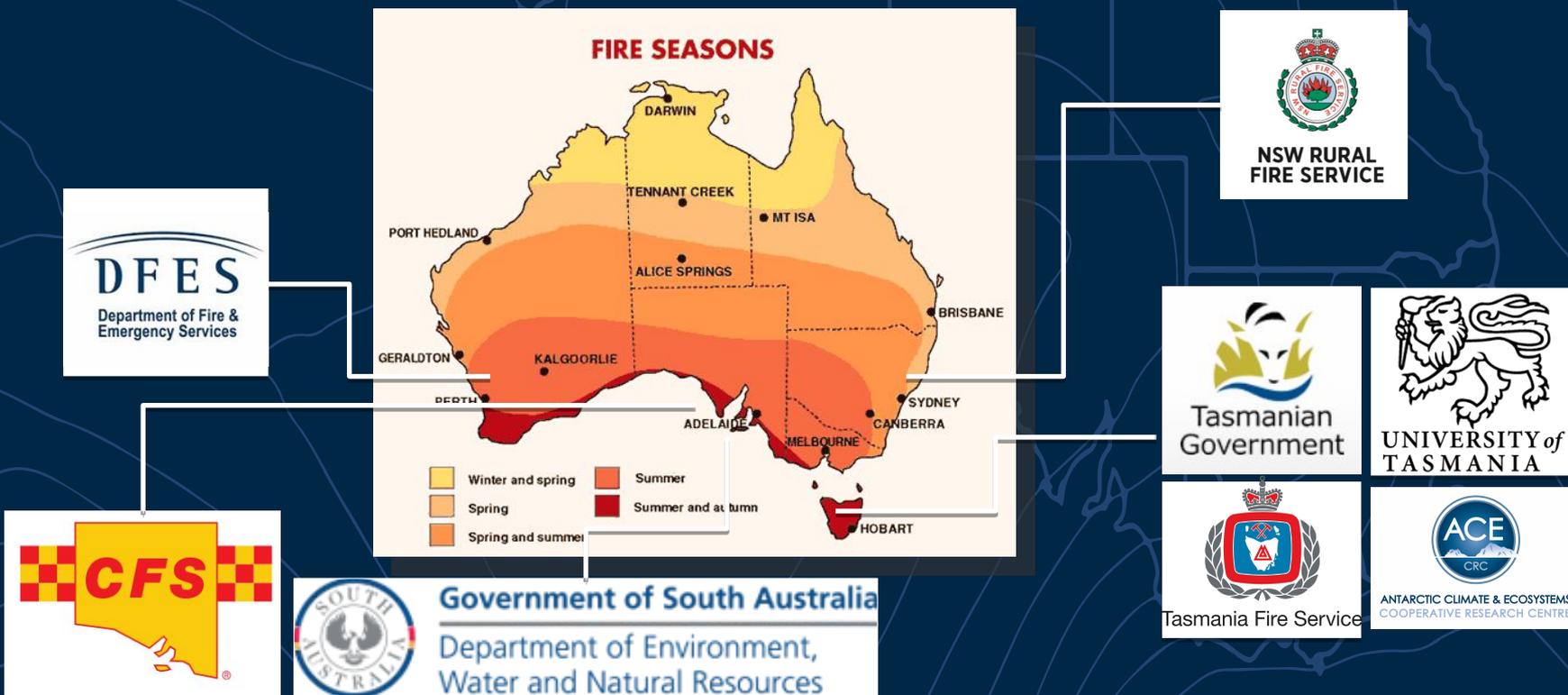


Australian Government  
Bureau of Meteorology

# BARRA: Bureau of Meteorology Atmospheric high-resolution Regional Reanalysis for Australia

Chun-Hsu Su, Nathan Eizenberg, Greg Kuciuba, Peter Steinle, Doerte Jakob, Paul Fox-Hughes, Stuart Moore

Co-funded by State-level fire & emergency and environmental agencies:

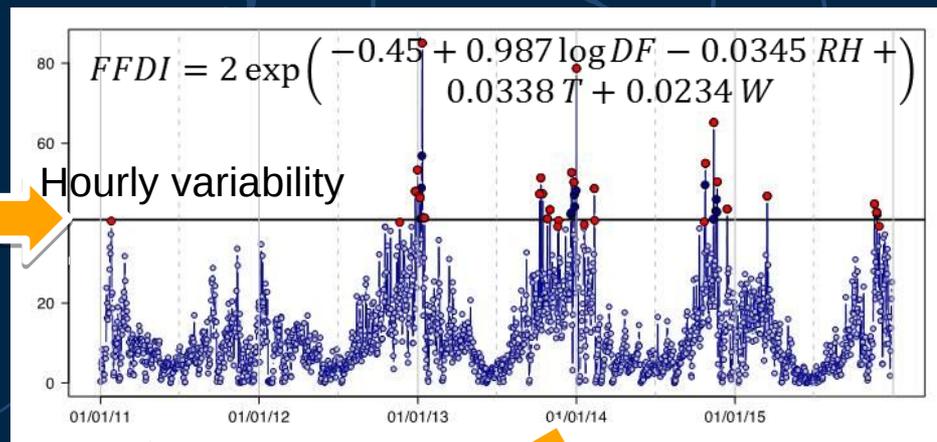
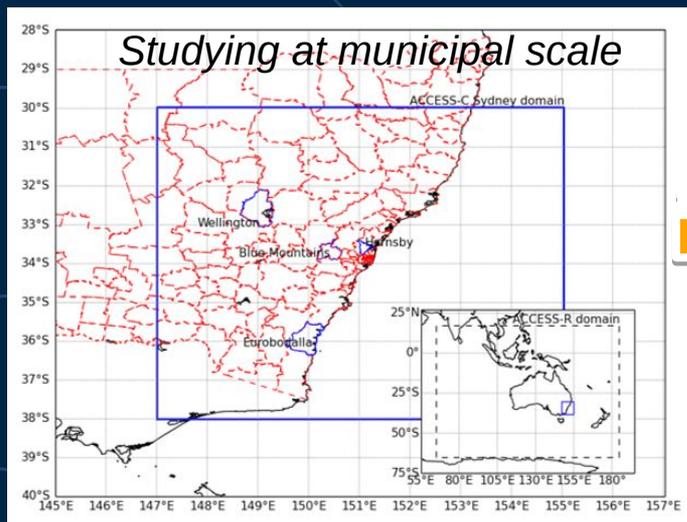




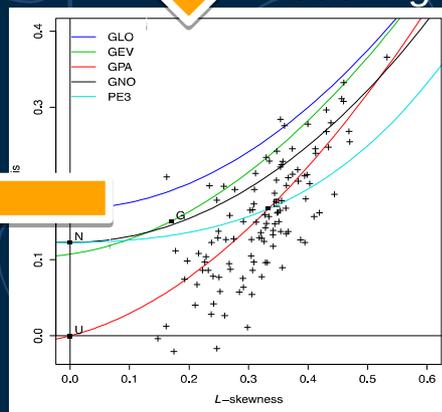
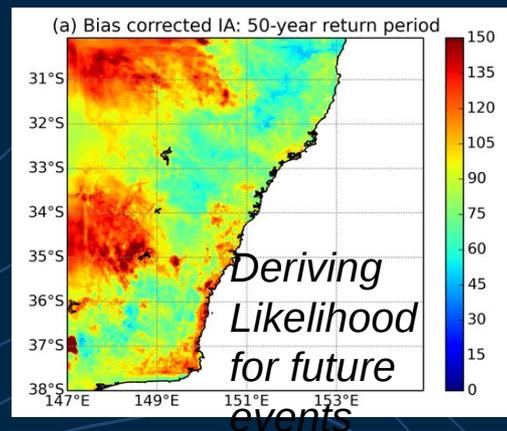
Australian Government

Bureau of Meteorology

# Value of regional reanalysis: Extreme event perspectives



Identifying extreme events



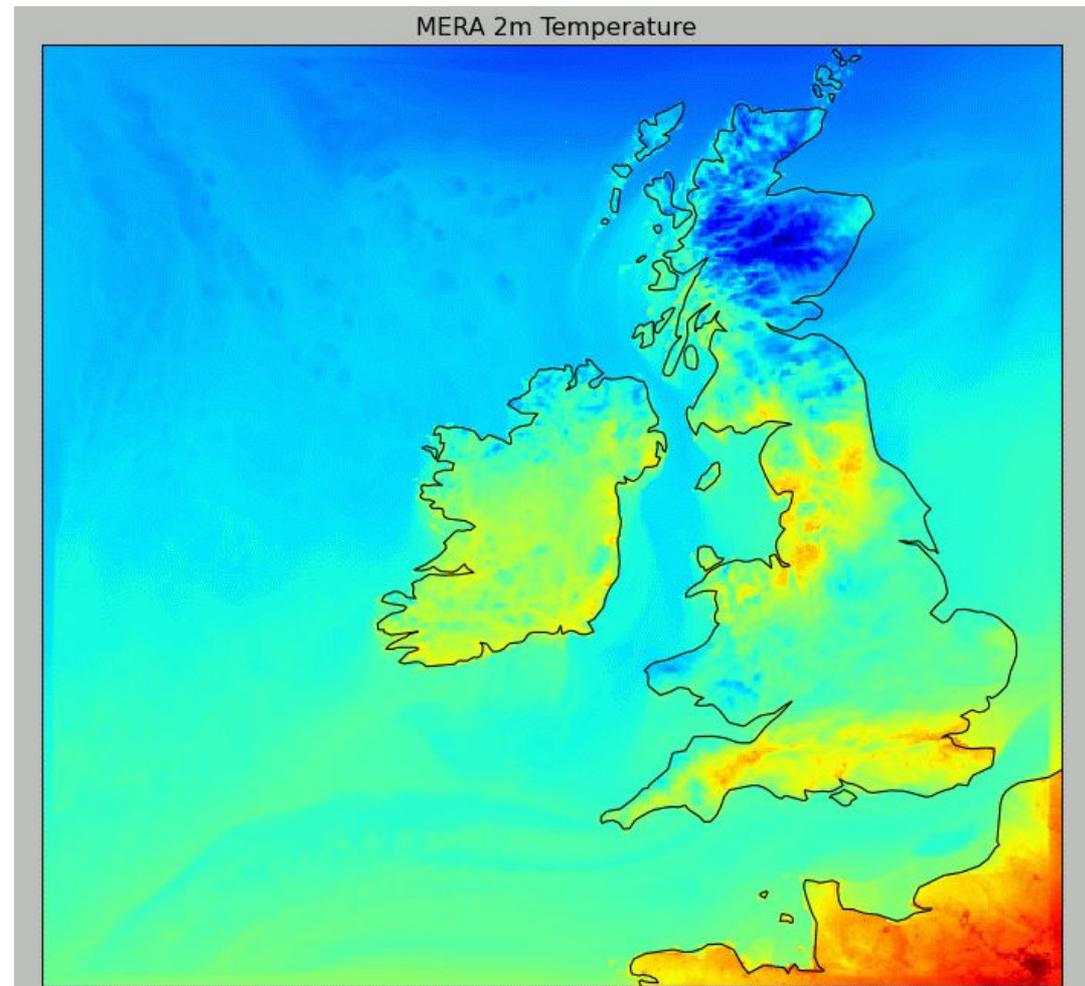
# MERA



## (Met Éireann ReAnalysis) 1981-2015

HARMONIE-AROME  
2.5km resolution

Emily Gleeson



# Users Workshop 2018

- Day of presentations by users of the MÉRA data
- Date and venue TBD (probably May 2018)
- Special edition of a peer reviewed journal

[mera@met.ie](mailto:mera@met.ie)





Climate Change

# Copernicus Regional Reanalysis for Europe

ICR5, Rome, 14/11/2017

Semjon Schimanke, Per Uden and colleagues





Climate  
Change

## What's the service about?

- Operational production of a regional reanalysis (RRA) for Europe in near real-time
- Long series of freely available RRA
  - Starting 1961 with a horizontal resolution of 11km
  - Starting in the early 1980s with a resolution of 5.5km (under development)
- User support and guidance

SMHI

ECMWF Copernicus  
Europe's eyes on Earth

European  
Commission



Climate  
Change

# Time line of production

2017

2018

2019

2020

2021

UERRA system in near real time  
(11km resolution)

Development of the new system

New system in operational mode  
(5.5km resolution)



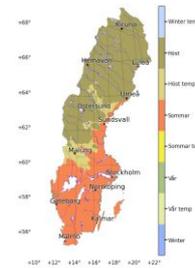
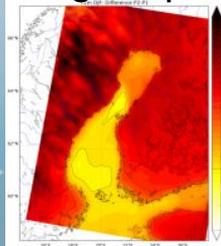


Climate  
Change

# User support and guidance

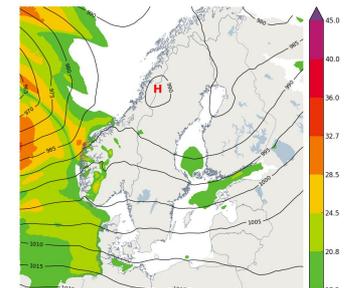
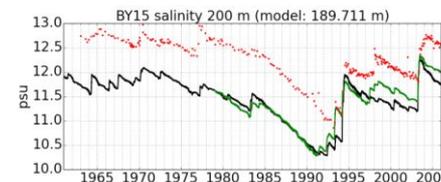
- Technical support will be available through CDS
- Training material as well as a collection of best practice examples
- There are plenty of possible usage ideas. However, we are looking for user!
- Two user workshops (first November 2018)

Regional climate  
change reports



Climate related  
products, e.g.  
season maps

Forcing data for  
models, e.g. regional  
ocean models



Investigations of  
historical storms

## C3S 322 Lot 2 :

# Copernicus Arctic Regional Reanalysis

Goal: Generation of regional reanalysis products for the Arctic

- Led by Met Norway. Partners: The Nordic countries and Météo-France.
- Project started September 2017, 4 years duration
- New consortium with no «precursor» research project – exploits synergies with other reanalysis projects and operational Arctic NWP systems in Norway and Denmark
- Will run production at ECMWF HPC facility, giving opportunities for sharing and synergies with the European regional reanalysis and also with the ERA team at ECMWF
- Reanalysis period July 1997 – June 2021 (24 years)



Climate  
Change

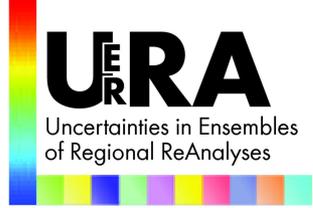
## C3S 322 Lot 2: Copernicus Arctic Regional Reanalysis

- Warming in the Arctic (observational records and future scenarios) roughly twice as high as global average
- Need for understanding and management of change processes
- Increased economic activity in the region

(Animated gif: NASA)



- Coverage in two domains, main areas of interest in the European sector of the Arctic
- High resolution (2,5 km) adds value to global products
- Extensive use of satellite data
- Use of local surface observation datasets available in the partner countries
- Special emphasis on NWP schemes and observations for the handling of “cold surfaces”: Snow, sea ice, glaciers



Thank you