ERA-CLIM:

A collaborative project to prepare a new atmospheric reanalysis covering the 20th century

Dick Dee (ECMWF)

3rd ACRE Workshop, Baltimore, 3-5 Nov 2010

ERA-CLIM

European Reanalysis of Global Climate Observations

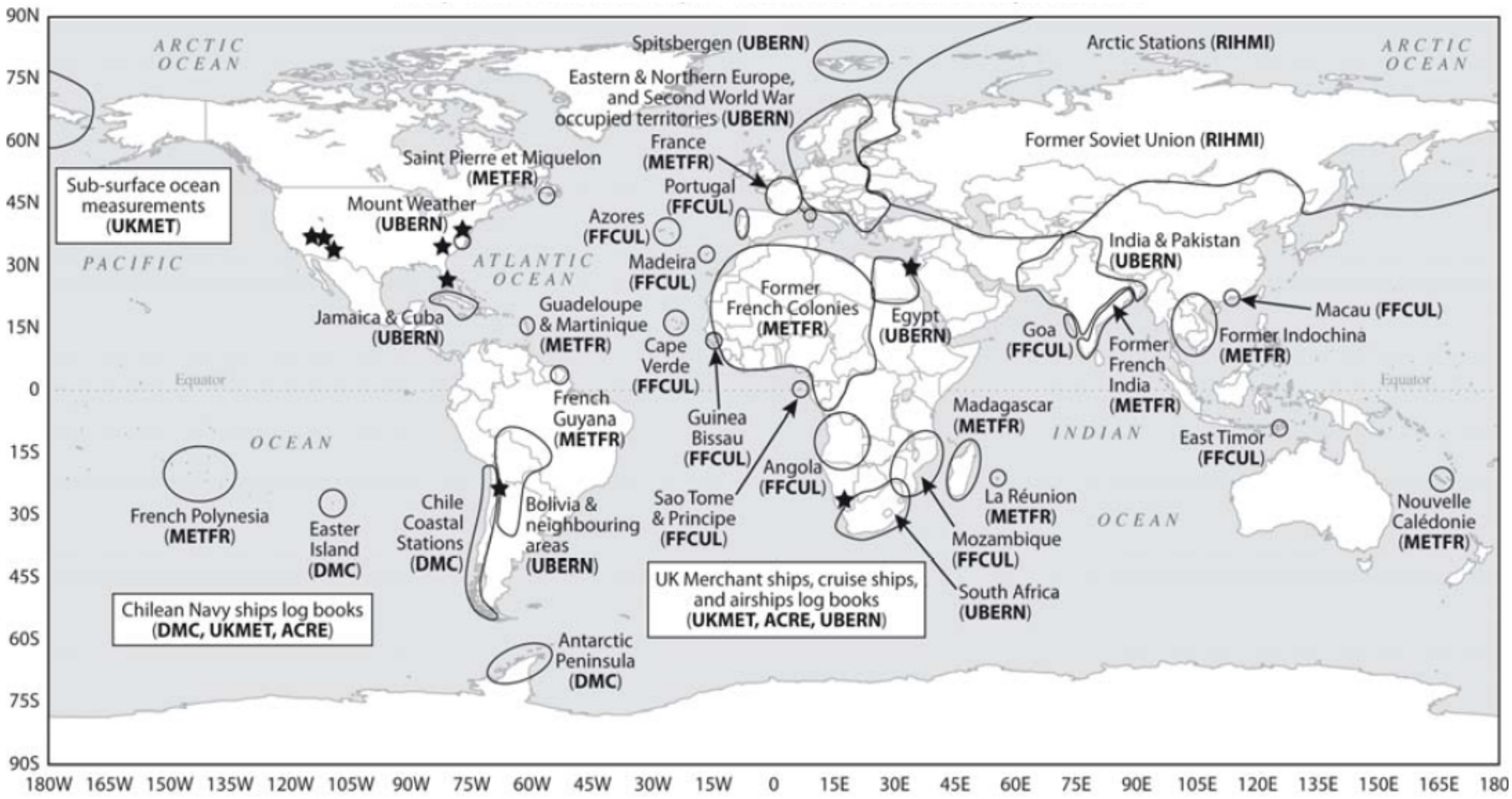
A 3-year EU-FP7 project starting January 2011

Integration and improvement of the 20th-century instrumental record

- Concerted effort in **data recovery** (mainly pre-1957 upper-air data) and preparation of input **satellite data** sets for reanalysis
- An ambitious set of **pilot reanalyses** to be produced at ECMWF:
  - Low-resolution atmosphere from 1900 (~125km, only surface obs)
  - High-resolution land-surface from 1900 (~25km)
  - Moderate-resolution atmosphere from 1979 (~40km)
- **Open access** to all input data + reanalysis data + quality feedback
- **Consortium**: ECMWF, Met Office, Météo-France, EUMETSAT, Un.Vienna, Un.Bern, Un.Lisbon, RIHMI-WDC (Russia), DMC (Chile)

ERA-CLIM data recovery and digitization

focus on pre-1957 meteorological data in sensitive regions



ERA-CLIM production schedule

	What	Period	Resolution	Ens	When	Vol
ERA-Int	Interim reanalysis	1989-NRT	T255L60	1	ongoing	33 Tb
ERA-P0	AMIP ensemble	1900-2011	T159L91	10	Jun 2011 (9M)	
ERA-P1	EDA using sfc obs only	1900-2011	T159L91	10	Sep 2011 (15M)	655 Tb
ERA-S1	Land surface using ERA-P1	1900-2011	T799	1	Sep 2012 (9M)	77 Tb
ERA-P2	Reanalysis using all obs	2 early decades	T511L91	1	Sep 2012 (9M)	180 Tb
ERA-E2	As ERA-P2 but with SST/sea-ice perturbations	2 early decades	T159L91	10	Jan 2013 (9M)	180 Tb
ERA-P3	To replace ERA-Interim	1979-NRT	T511L91	1	Jan 2012 (24M+)	234 Tb
ERA-20C	20th-century reanalysis	1900-NRT	T511L91	1	2014 (36M+)	1062 Tb

ERA-P0

ERA-CLIM

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ERA-P0:

- Model only – no data assimilation (similar to 20CR)
- Using HadISST2 – ensemble of equally likely realizations
- Other boundary conditions and atmospheric forcing from CMIP5

ERA-P1, ERA-S1

ERA-CLIM

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ERA-P1:

- Atmospheric reanalysis from 1900 at ERA-40 resolution (~125km)
- Assimilation of surface pressure observations
- Using EKF or EDA (Ensemble of 4D-Var reanalyses)

ERA-S1:

- Land surface reanalysis driven by ERA-P1
- High resolution (~25km)

ERA-P2, ERA-E2

ERA-CLIM

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ERA-5	To replace ERA-Interim	1979-NRT	T511L91	1	Jan 2012 (24M+)	234 Tb
ERA-C	20th-century reanalysis	1900-NRT	T511L91	1	2014 (36M+)	1062 Tb

ERA-P2:

- Short reanalysis to test early data impact (~40km)

ERA-E2:

- Ensemble of ERA-P2 at lower resolution (~125km)

ERA-P3

ERA-CLIM

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ERA-P3:

- Replacement for ERA-Interim, from 1979 (~40km)

ERA-20C

ERA-CLIM

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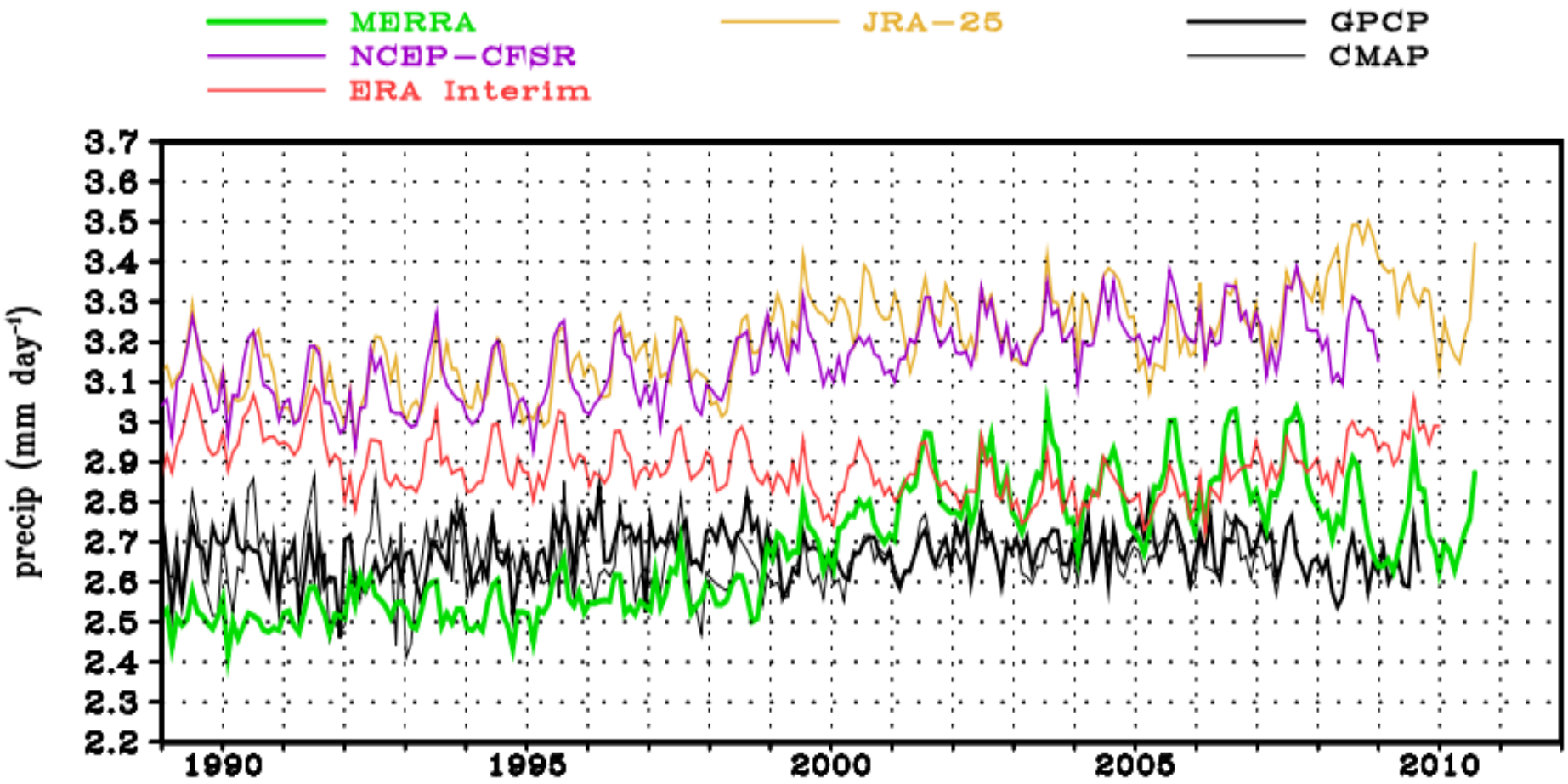
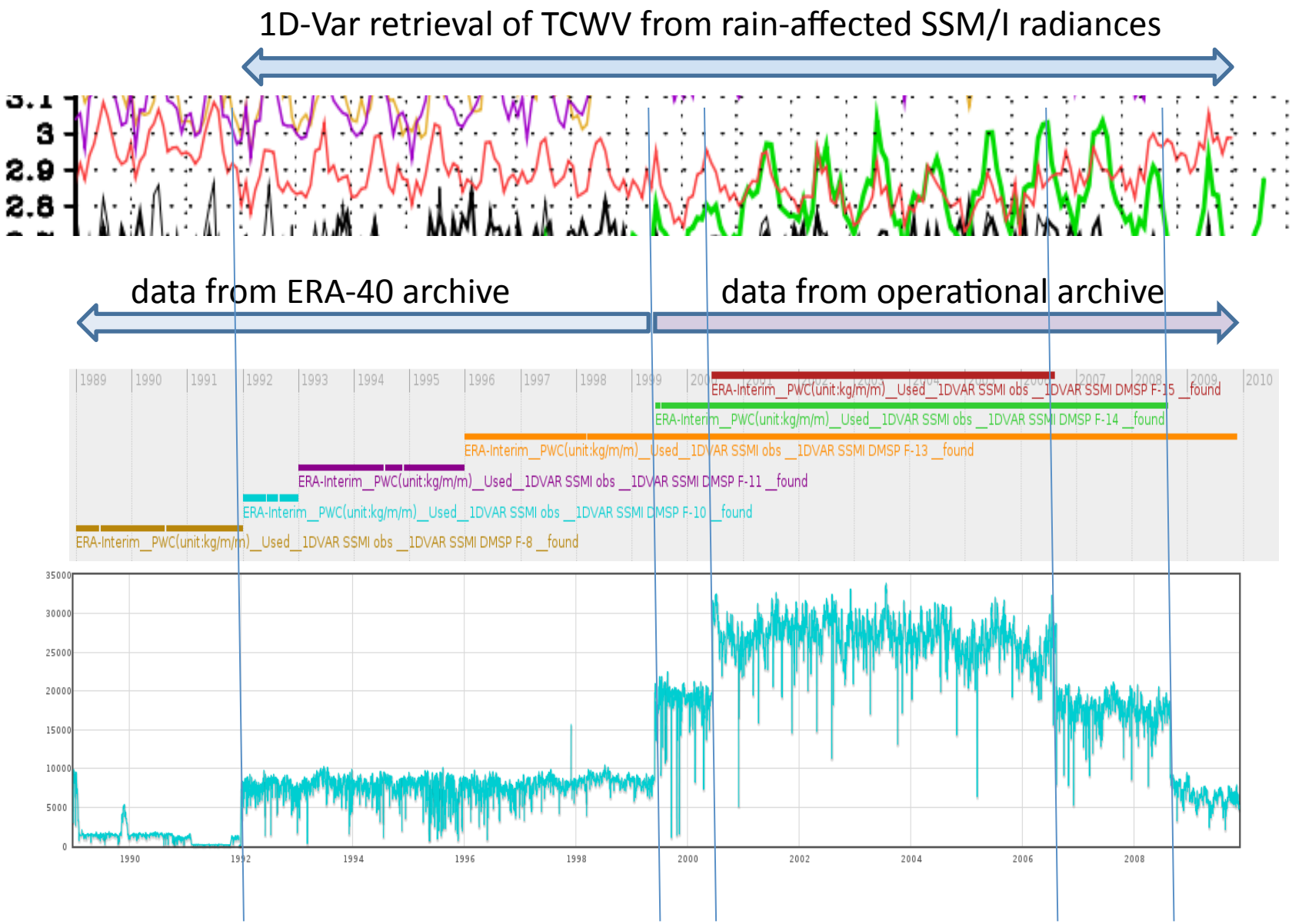
Progress in key areas

ERA-40	ERA-Interim	ERA-20C (targets)
1957–2002	From 1989	From 1900
	Continues in real time	
T159L60 (~125km)	T255L60 (~80km)	T511L91 (~40km)
	Improved model physics	Improved land surface model
		Improved boundary and forcing fields (HadISST2, CMIP5)
3D-Var, 6h window	4D-Var, 12h window	Weak-constraint 4D-Var Longer window
	Revised humidity analysis	Background errors from EDA
	Variational bias correction of satellite radiances	VarBC of aircraft temperature data, radiosonde winds, …
		Revised land-surface analysis
		Newly recovered pre-1957 observations
		Reprocessed satellite observations

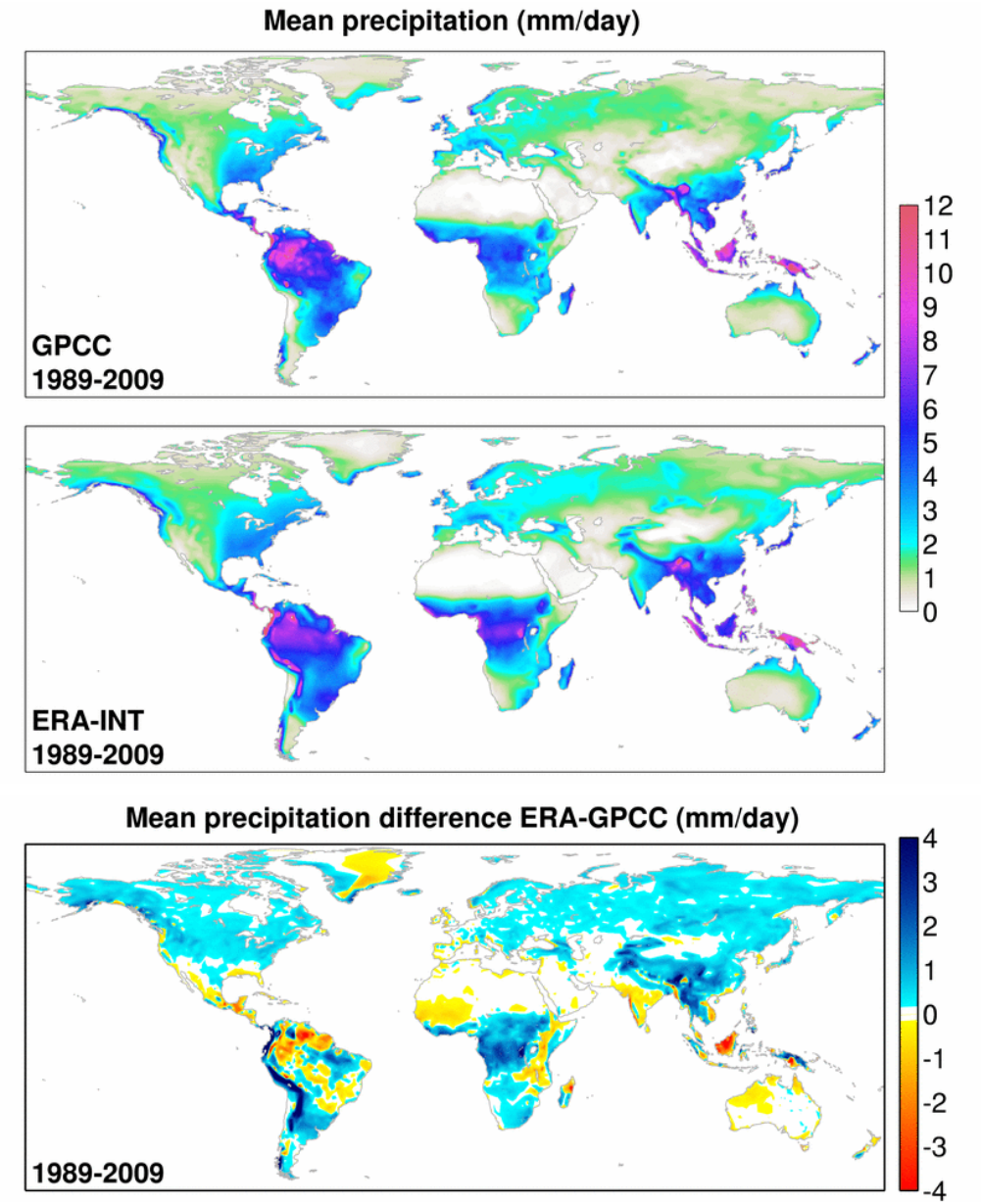
Potential for progress:
Global mean precipitation



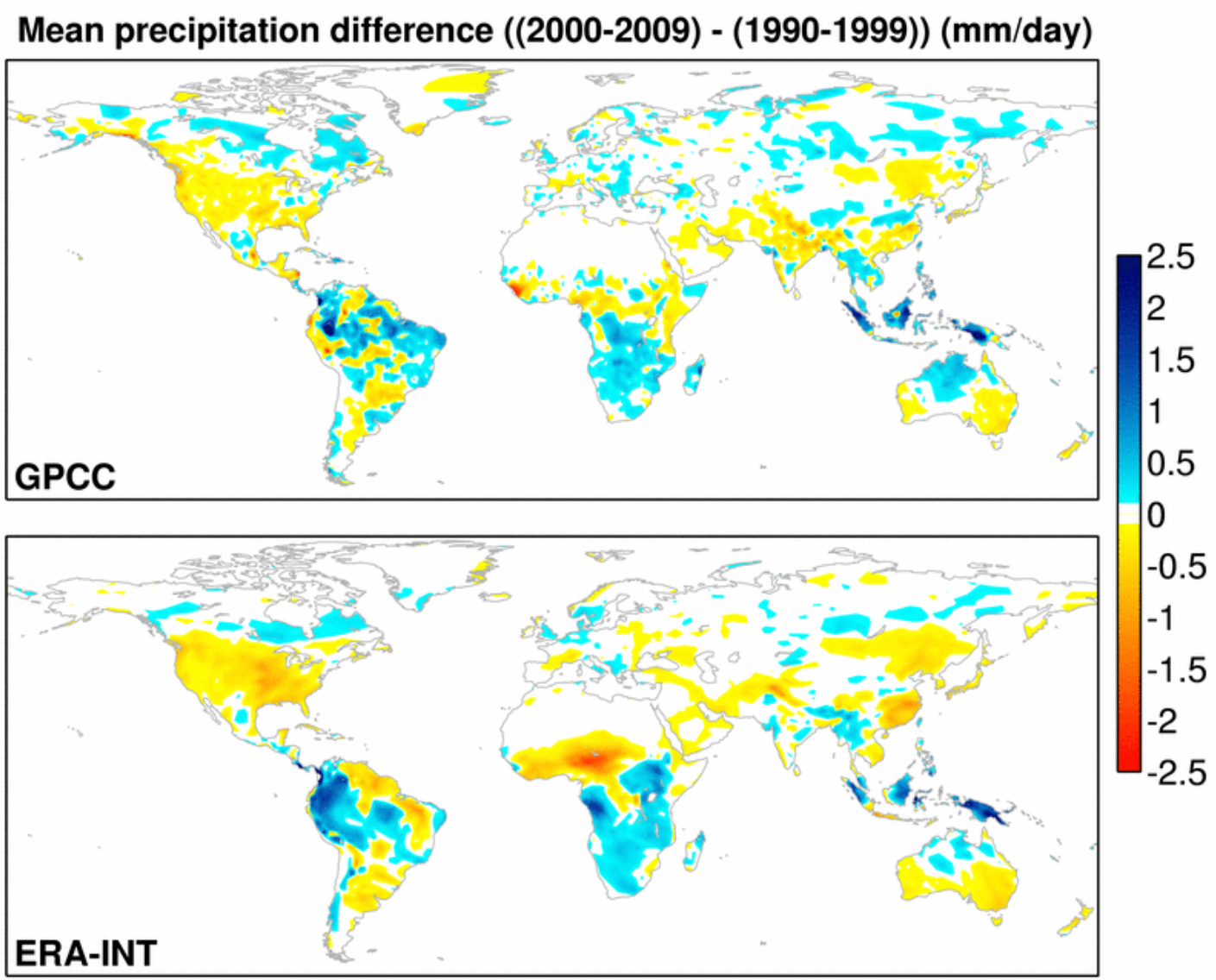
Global mean precipitation



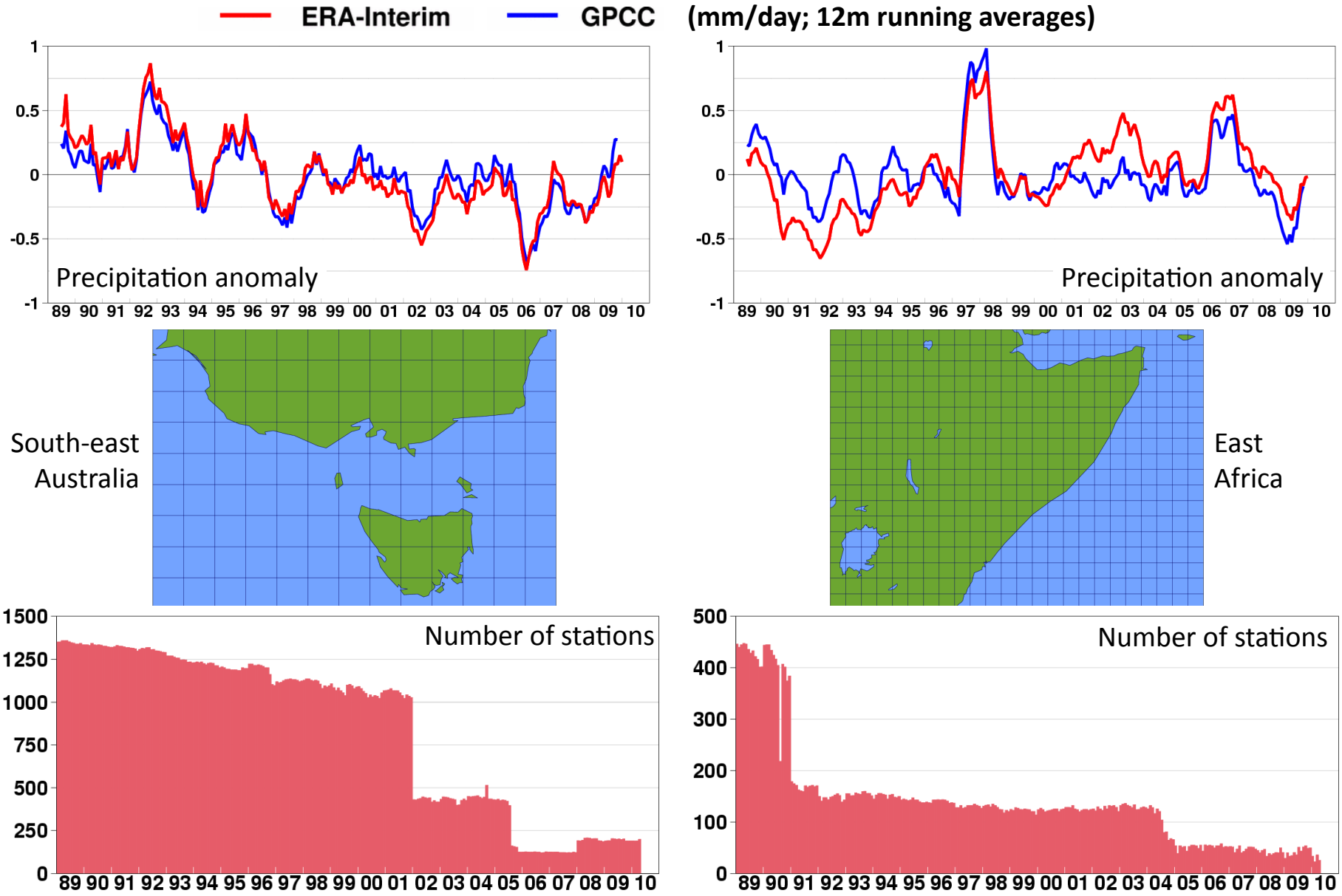
Mean precipitation rates (1989-2009)



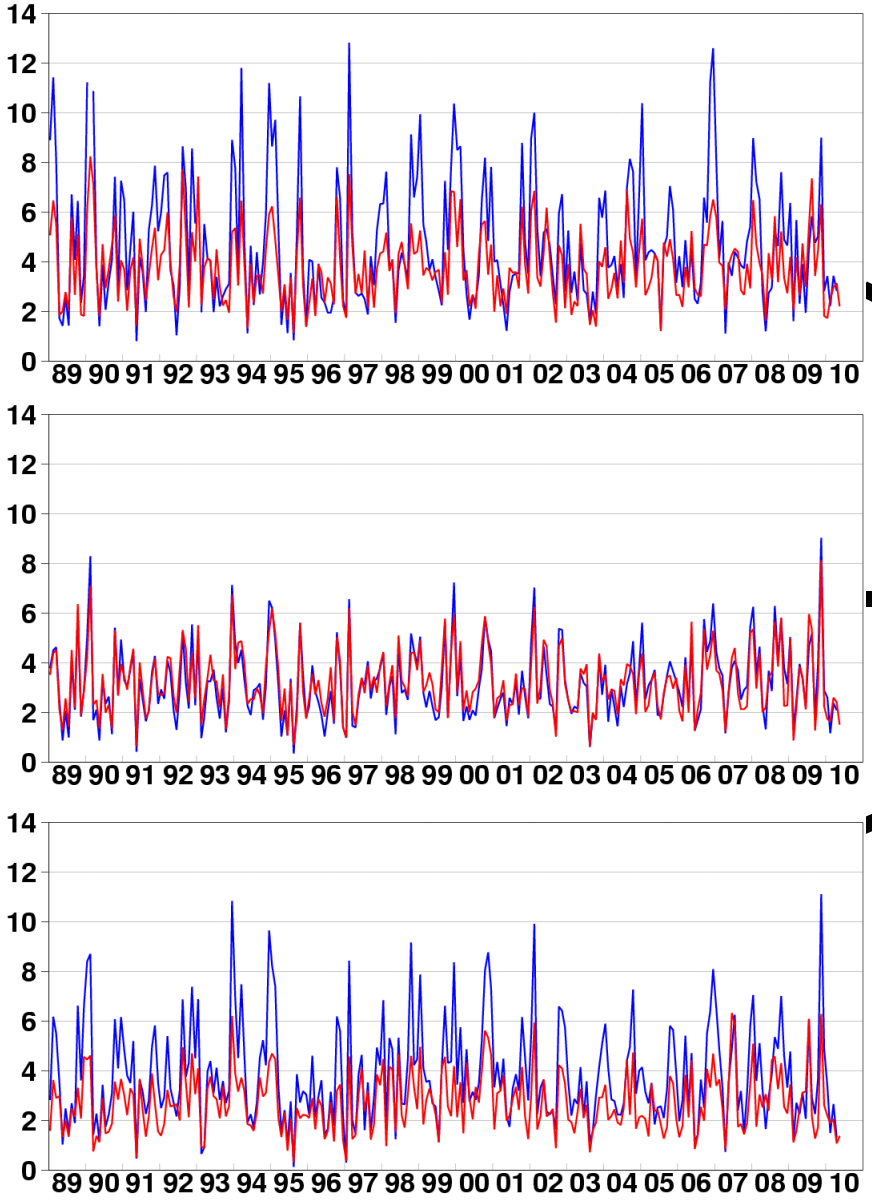
Decadal change in precipitation rate



ERA and GPCC precipitation anomalies

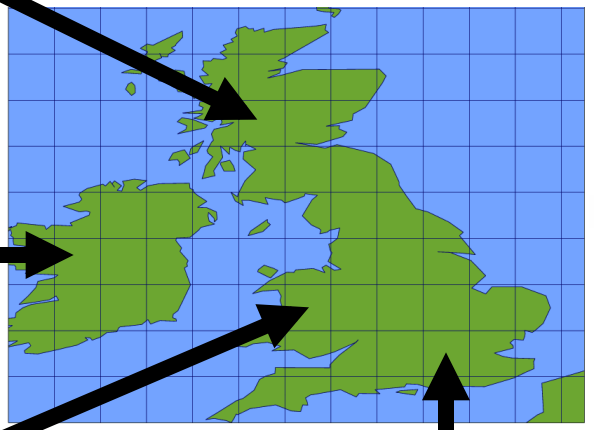


Monthly precipitation rates for 1^{O}x1^{O} grid boxes

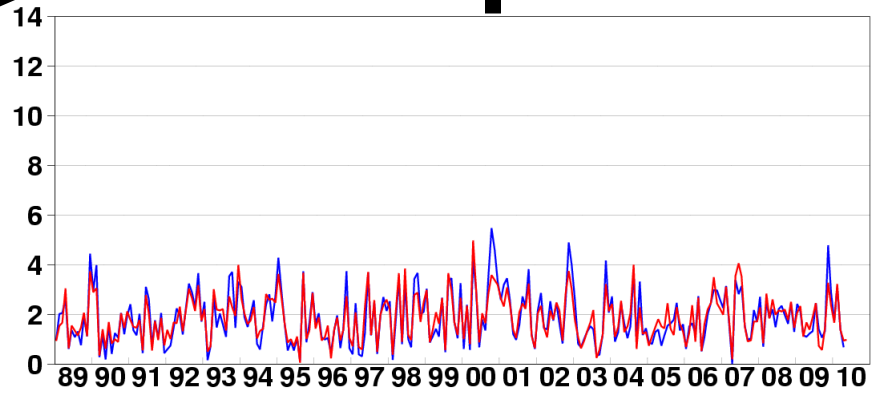


ERA values are interpolated from ~80km model grid to 1^{O} grid of GPCC product

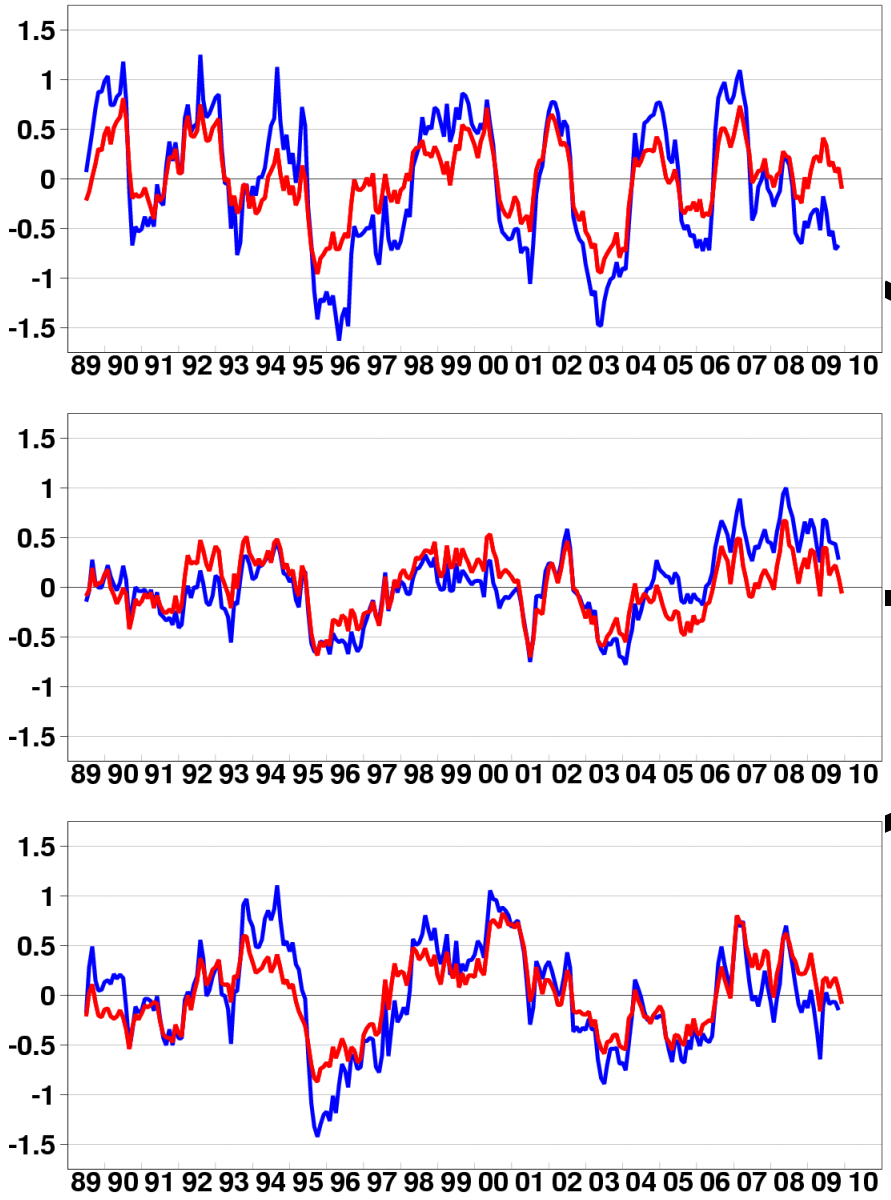
ERA values underestimate precipitation maxima for mountainous regions of Wales, Scotland and northern England



ERA-Interim
GPCC
(mm/day)

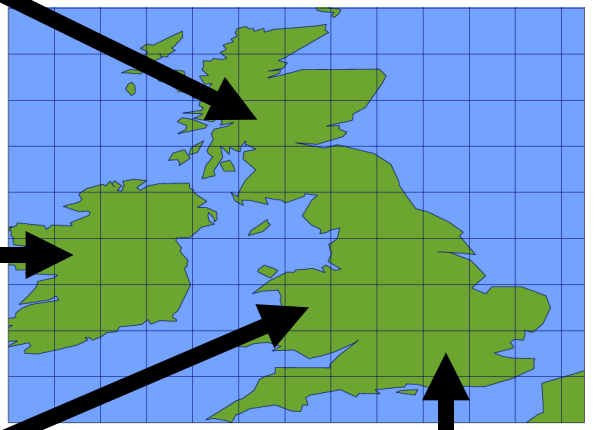


Precipitation anomalies for $1^{O}x1^{O}$ grid boxes



Anomalies are computed with respect to (1989-2009) means for each month from ERA and GPCC respectively.

Time series of 12-month running means are shown here.



ERA-Interim
GPCC
(mm/day)

ERA data policy

- ERA will generate 2 Pb data products by 2017 (not including forecasts)

- We can expect a large number of users for these products
  - (old) ERA-40 public data server had 12000 registered users
  - ERA-Interim data server now has ~5000 registered users – now adding 300 per month

- We will provide unrestricted access to full-resolution data products
  - ERA-CLIM commitments: GEO data sharing principles
  - ECMWF is no longer required to apply an information charge
  - Data handling cost is substantial, but spread over a large number of users
  - We don't know yet how best to organize this

- Data products will include observation feedback
  - Analysis and background departures
  - Prior error estimates for the observations
  - Bias estimates, quality control flags, etc.

- ERA-CLIM will not use observations unless they can be redistributed

Summary

- ERA-CLIM: our goal is to prepare a next-generation comprehensive reanalysis of the 20th century
- Includes data recovery and digitisation, using the ACRE framework and the major international data centers
- All input data sets will be revisited: early instrumental data; recalibrated satellite data sets; boundary conditions and atmospheric forcing
- We will provide full access to observations and reanalysis products
- Reanalysis is the best tool for getting the most out of precious observations, and offers the best potential for generating climate quality data products