

ECMWF reanalysis activities update

Hans Hersbach

and many colleagues

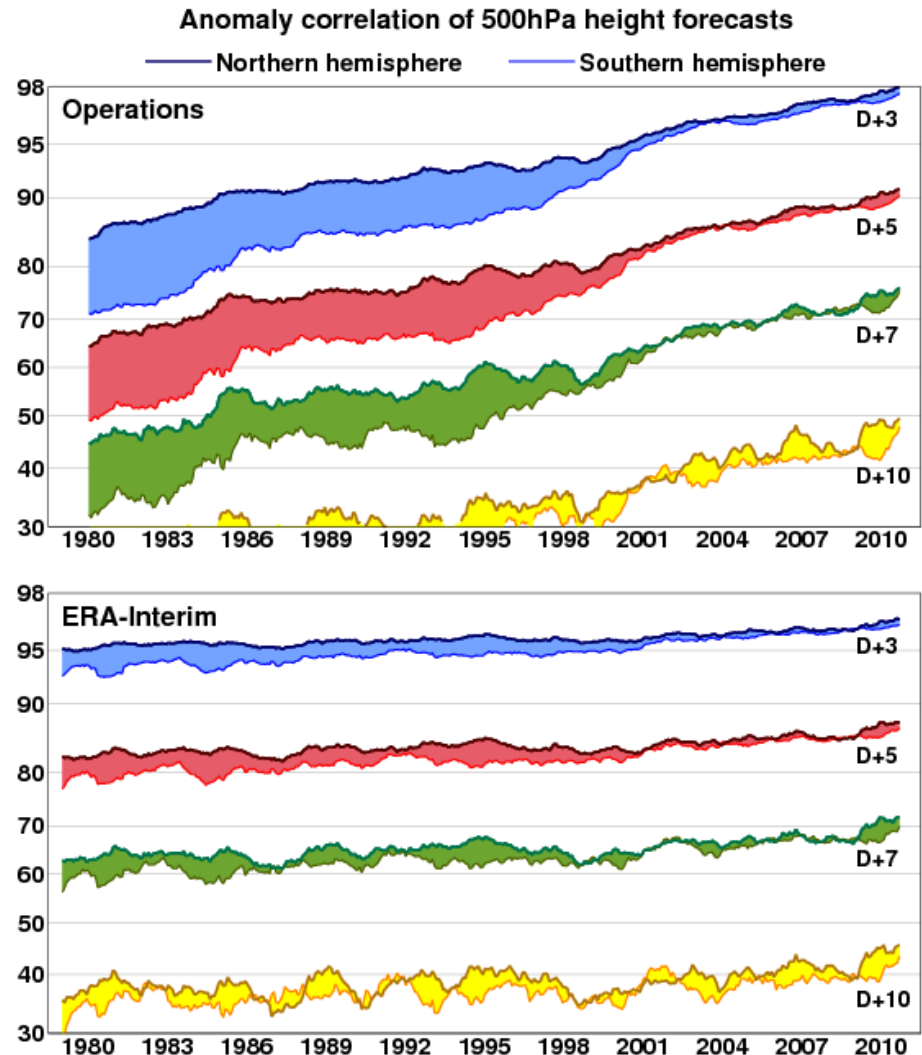


Rationale behind reanalysis

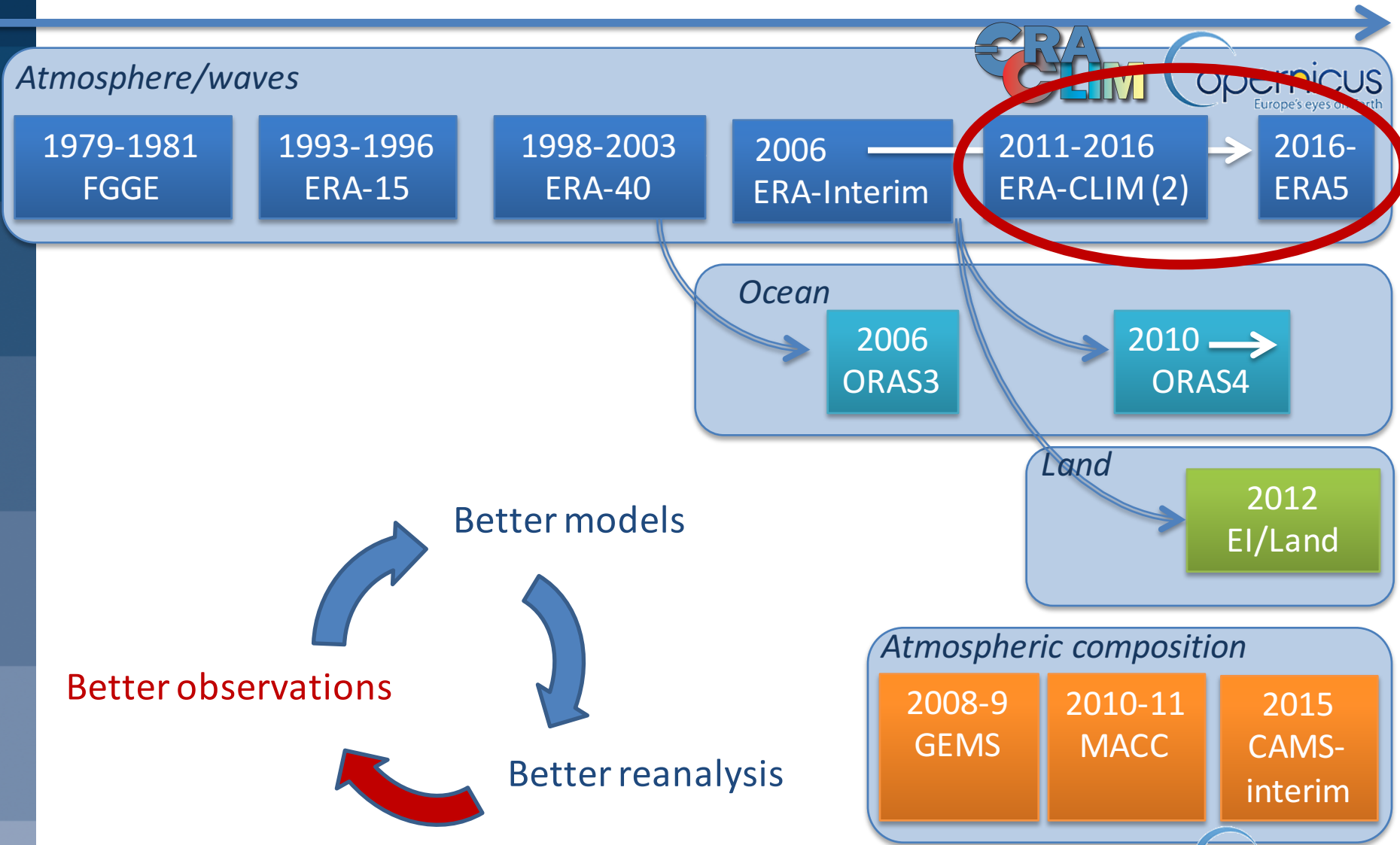
Consistent reconstruction of the atmosphere (and ocean):

- glue together observations from different nature and origin into *global fields*,
- using the *laws of physics* of the atmosphere
- with an appropriate *bias correction* scheme
- using the *same system* over the entire reanalysis period.

At lower resolution to *keep affordable*



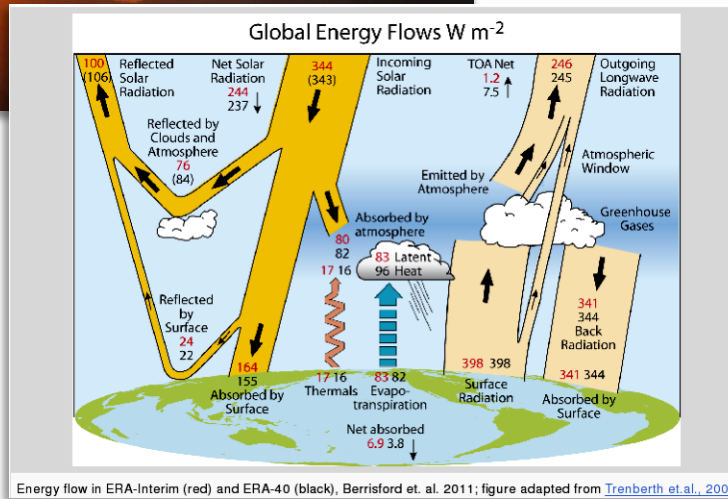
Global reanalyses produced at ECMWF



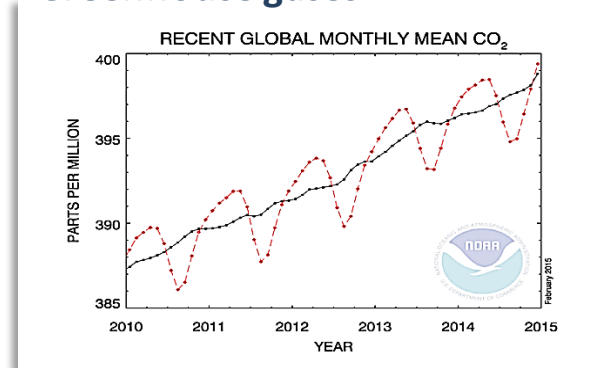
ERA-20C climate reanalysis forcing: You need realistic energy budgets for the atmosphere

And it needs to reflect the 20th century evolution

Solar forcing

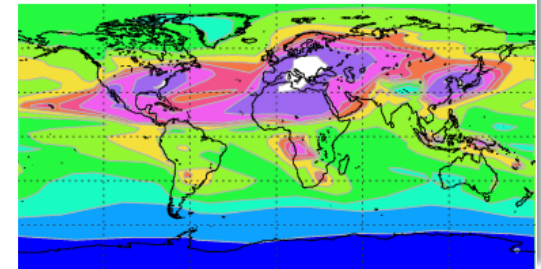


Greenhouse gases

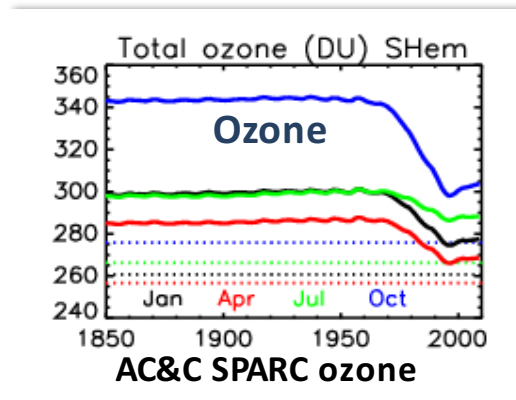


Aerosols

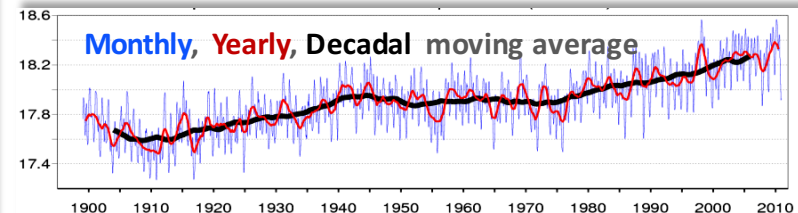
SO_4 (mg/m^2) Mean 4.833, August 1980-1989, HIST



Volcanic eruptions



SST and sea ice



ERA-CLIM climate pilot reanalyses

Configuration

- ✓ IFS Cy38r1: Atmosphere and ocean-wave component
- ✓ T159 (~125km), 91 levels in the vertical (up to 1 Pa)
- ✓ CMIP5 forcing
- ✓ 10-member ensemble
- ✓ 1900-2010

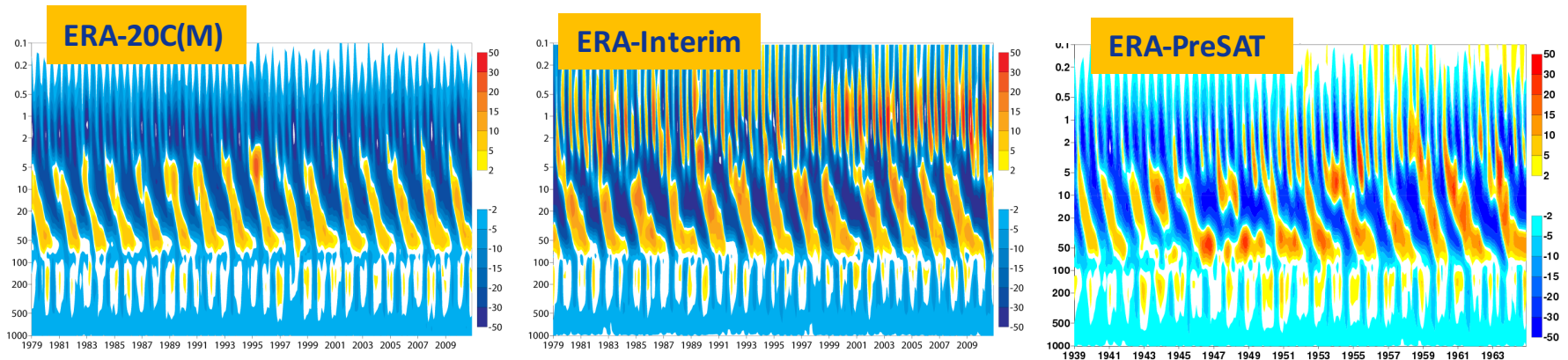
ERA-20CM: *model only*

ERA-20C: *surface observations only*

ERA-PreSAT: *in addition early upper-air data (1939-1967 only)*

CERA (to be started soon; Cy41r2): *coupling with the ocean*

The QBO in ERA-CLIM

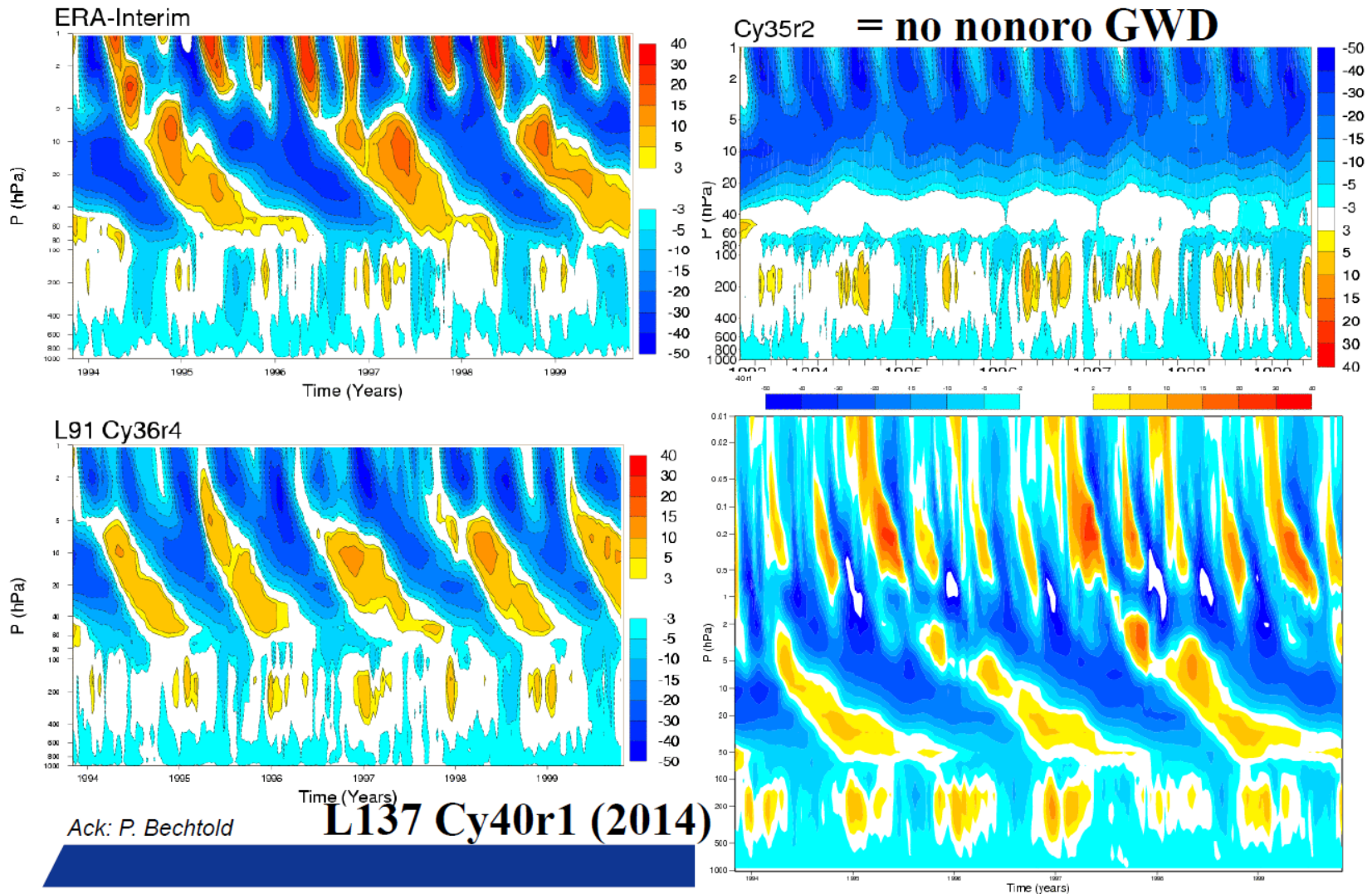


ERA5: the ERA-Interim replacement

	ERA-Interim	ERA5
Start of production	August 2006 IFS Cy31r2	End 2015, reach NRT end before 2017 IFS Cy41r2
Model input (radiation and surface)	As in operations, currently OSTIA (<i>inconsistent SST</i>)	Appropriate for climate (CMIP5 including AC&C SPARC ozone , blend HadISST.2.1.0 and OSTIA)
Analysis method	12h 4D-Var	12h 4D-Var on 10-member EDA (T319, 63km)
Spatial resolution	79 km global 60 levels to 10 Pa	31 km global (T639) 137 levels to 1 Pa
Output frequency	6-hourly Analysis fields	Hourly (three-hourly for the EDA), Extended list of parameters ~ 5 Peta Byte
Time period	1979 - present	1979 - present
Extra Observations	Mostly ERA-40, GTS	Various reprocessed CDRs, including for ozone
Radiative transfer	RTTOV7	RTTOV11+ CO2, SSU cell-pressure correction
Variational bias corrections	Satellite radiances	Also ozone, aircraft, surface pressure

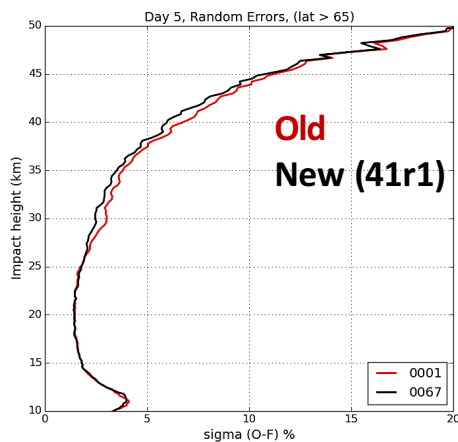
ERA5 will use 137 levels in the vertical

QBO : Hovmöller U from free 6y integrations



ERA5 will benefit from the latest IFS cycle 41r2

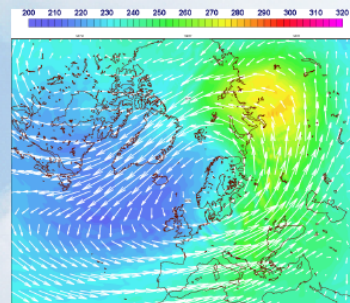
Example: updated semi-Lagrangian departure scheme significantly improves the forecasts of sudden stratospheric warming events



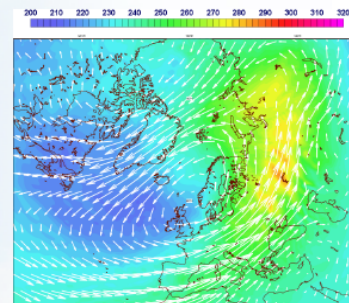
Day-5 verification vs GPSRO

Michail Diamantakis

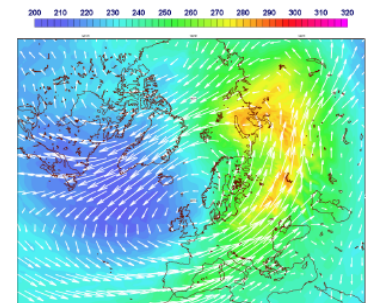
SSW case: SETTLS (row 1) vs MODIFIED (row 2)



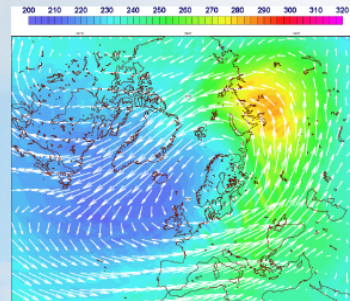
(a) anal 14 Jan 12



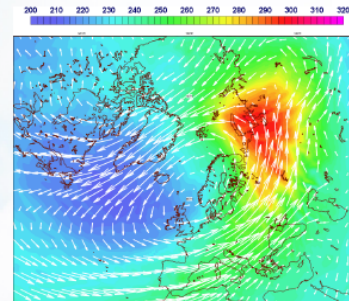
(b) T+24 fc AT 15 Jan



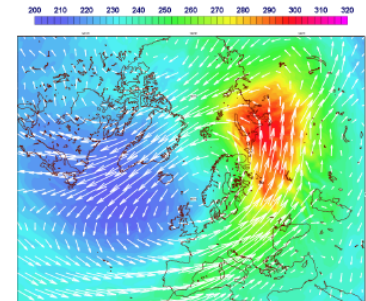
(c) anal 15 Jan



(d) anal 14 Jan 12



(e) T+24 fc AT 15 Jan



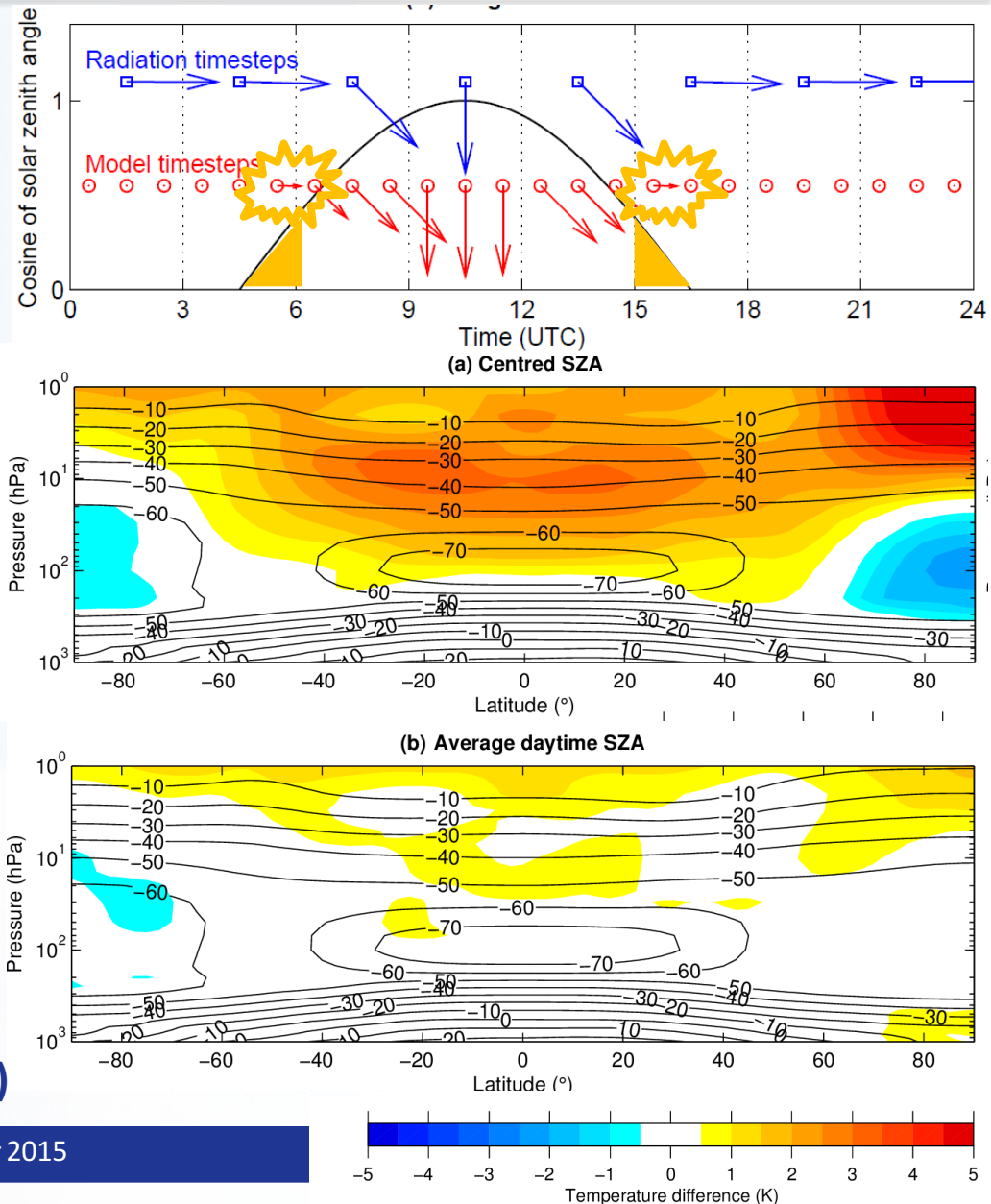
(f) anal 15 Jan

Temperature 5 hPa

Climate errors due to infrequent calls to radiation scheme

- All but one operational IFS configurations call radiation scheme only every 3 h
- At dawn & dusk, sun angle at centre of 3-h period too shallow: absorption *too high*
- Stratosphere too warm by 3-5 K (compared to running radiation scheme every timestep)
- “Wiggles” in mean fluxes versus longitude (Zhou et al 2015)
- Fix by averaging cosine of solar zenith angle over *sunlit part* of radiation timestep
- This is in 42R1, will be in ERA5

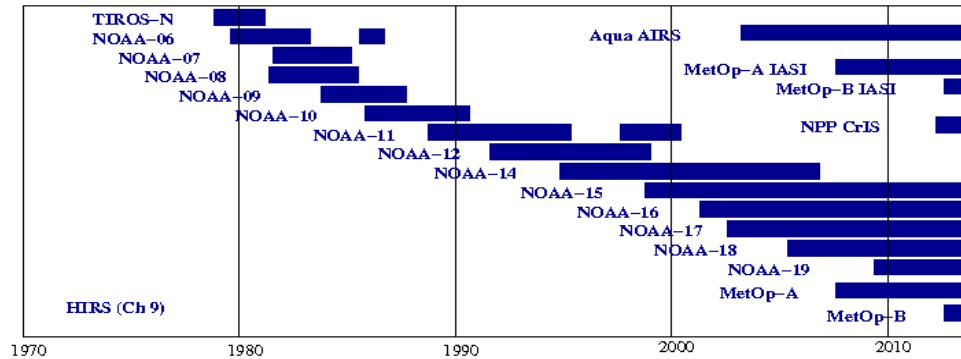
Hogan & Hirahara (ECMWF memo 2015)



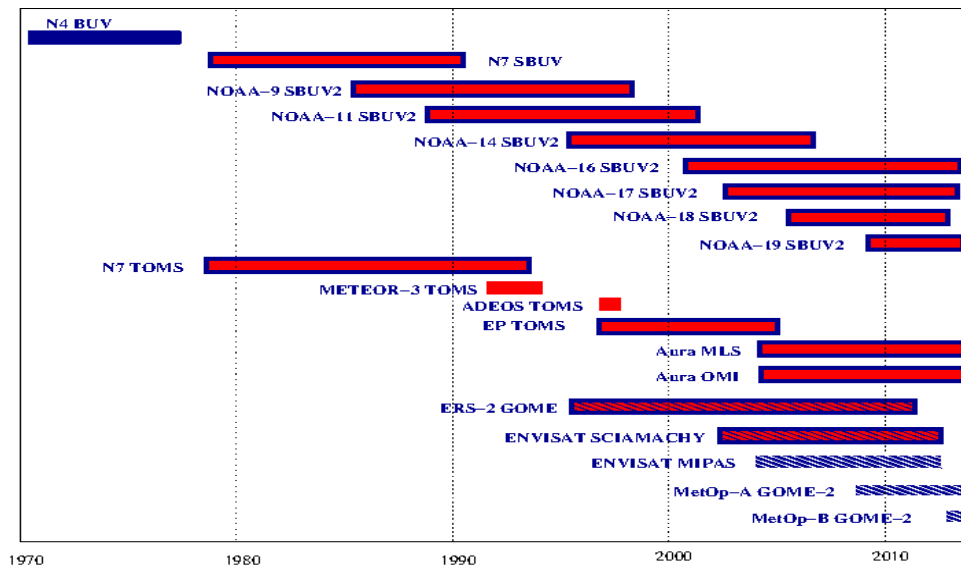
Improved observing system

Example: Ozone, ERA-Interim vs ERA5

Level 1b



Level 2



Used / same version

Used / new version

Never used

Available from CCI

Rossana Dragani

Plus variational bias correction

Access to *ECMWF* reanalysis data



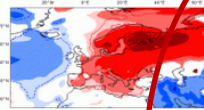
About Forecasts Computing Research Learning

Datasets

Forecasts, analyses, climate re-analyses, reforecasts and multi-model data are available from our archive (MARS), via dedicated data servers or via point-to-point dissemination.

You can browse all our data in this section:

Operational



Operational datasets are the forecasts output by our current model.

Medium range

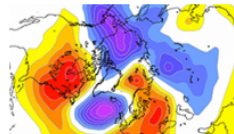
Extended range

Long range

Commercial catalogue

Browse our archive

Climate reanalysis



ECMWF uses its forecast models and data assimilation systems to 'reanalyse' archived observations, creating global data sets describing the recent history of the atmosphere, land surface, and oceans.

Browse reanalysis datasets

Atmospheric composition



Data sets for atmospheric composition from the MACC-II project combine atmospheric modelling with Earth observation data to provide information covering European air quality, global atmospheric composition, climate forcing, the ozone layer, UV and solar energy, and emissions and surface fluxes.

MACC-II

MACC data

If you experience any difficulties, please check our data FAQ first

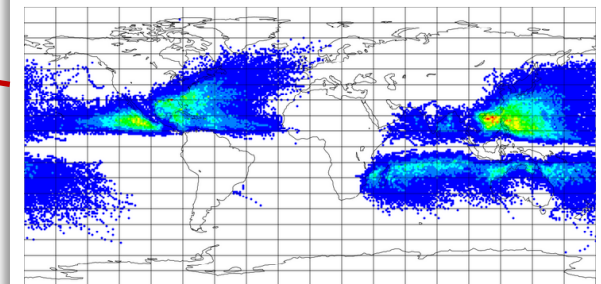
Request abstract:

Atmospheric model, Tropical cyclone bogus, 1607, ERA-CLIM pilot reanalysis of the 20th-century using surface observations only, select* where (source=ISPDv2.2) and (vanno=110); all, 1851-06-01...2010-12-31, ODB feedback, 17

The status of the job is: complete

Acknowledgement

Support for the International Surface Pressure Databank is provided by the U.S. Department of Energy, Office of Science Innovative and Novel Computational Impact on Theory and Experiment (ONCE) program, and Office of Biological and Environmental Research (BER), and by the National Oceanic and Atmospheric Administration (NOAA) Climate Program Office. The Twentieth Century Reanalysis Project is supported by the Earth System Research Laboratory Physical Sciences Division of NOAA and the Climate Diagnostics Center (CDC) of the University of Colorado's Cooperative Institute for Research in Environmental Sciences (CIRES).

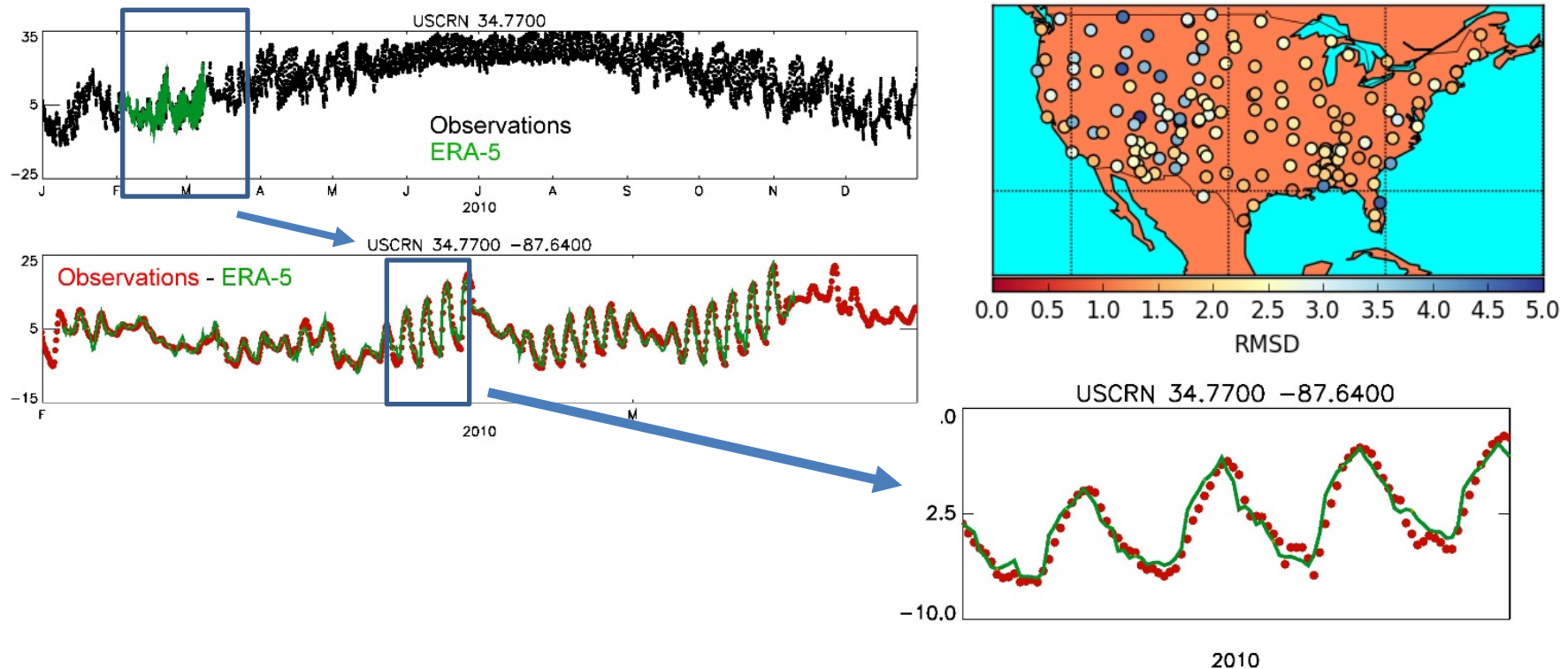


!New: access to observation feedback!



ERA5 will produce hourly archiving

Example: t2m vs. *Independent Observations* (from Clement Albergel)



Concluding remarks

On behalf of the European Commission **ECMWF** has been entrusted to operate the:

- ✓ Copernicus Atmosphere Monitoring Service **CAMS**
- ✓ Copernicus Climate Change Service **C3S**



within a newly formed Copernicus department at ECMWF

As part of **C3S** ECMWF will conduct **ERA5** (2016-2017)

- ✓ state-of-the art reanalysis, operational service, cycle ~5 years
- ✓ higher resolution, ensemble, latest model cycle, reprocessed data

As part of **CAMS**, a reanalysis of atmospheric composition 2003-present will be produced

ERA-Interim is currently being continued

A number of century-long 'climate' reanalyses have been conducted within the **FP7 ERA-CLIM** project and a coupled reanalysis, **CERA**, is to be conducted soon within the **ERA-CLIM2** project.

