

CERA-SAT

Proof-of-concept coupled reanalysis of the satellite era

Dinand Schepers,
Eric de Boisséson, Phil Browne, Roberto Buizza, Giovanna De Chiara, Per
Dahlgren, Dick Dee, Reima Eresmaa, Yuki Kosaka, Patrick Laloyaux, Cristina
Lupu, Patricia de Rosnay



Deliverable 1.3

A pilot for a higher-resolution coupled reanalysis of the satellite era



The CERA system



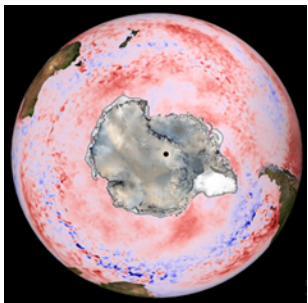
Full observing system

- including reprocessed datasets



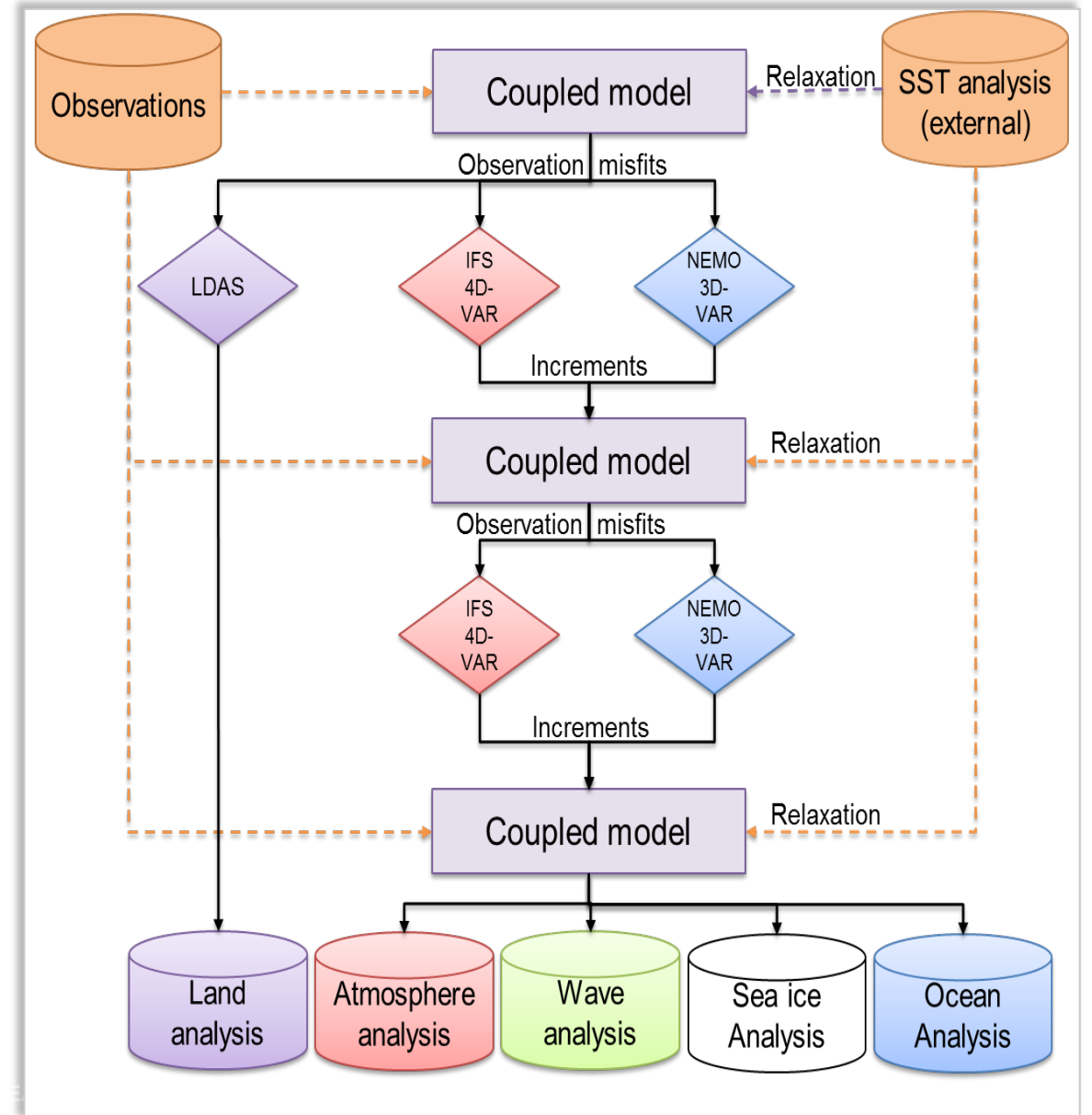
Salinity and Temperature

- Subsurface profiles
- EN4.1.1 dataset



SST and sea ice analysis

- OSTIA 0.05° product
- Used for
Sea ice concentration
assimilation &
SST nudging



CERA-SAT – A coupled reanalysis



Atmosphere/Land

- **Model:** IFS (CY42R1_esuite, April 2016)
- **Atmosphere Resolution:** TL319 (~60 Km); 137 levels
- **Assimilation:** 24-hour window 4D-Var
- **Full observing system** (including reprocessed datasets)
- **Land surface analysis** weakly coupled



Ocean/Sea ice

- **Model:** NEMO / LIM2 (CY42r1_nemo_E28)
- **Resolution** (1/4 degree; ORCA025) ~30 km; 75 levels
- **Assimilation:** 24-hour window 3D-Var FGAT
- **Observations:** salinity and temperature profiles, SSH, SI analysis (OSTIA L4)



Wave

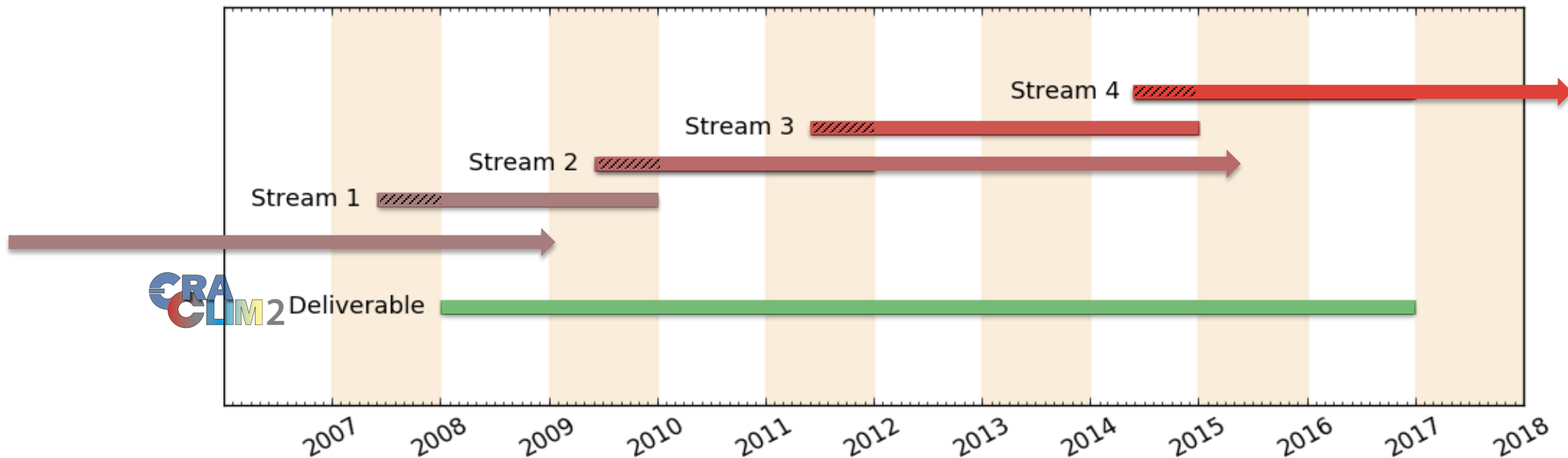
- **Model:** WAM (CY42R1_esuite)
- **Resolution:** 0.5 degree
- **Assimilation:** 24-hour window
- **Observation:** ERA5 observing system

CERA-SAT - Production

CERA-SAT was produced in 4 streams

- 8 years research dataset (2008 - 2016)
- Produced in ~11 months
- Half year 'spin-up' per stream
- Extend beyond 2017
- Extend *stream 2* for spin-up studies
- Pre-extend from 2005

 deliverable in Dec 2017



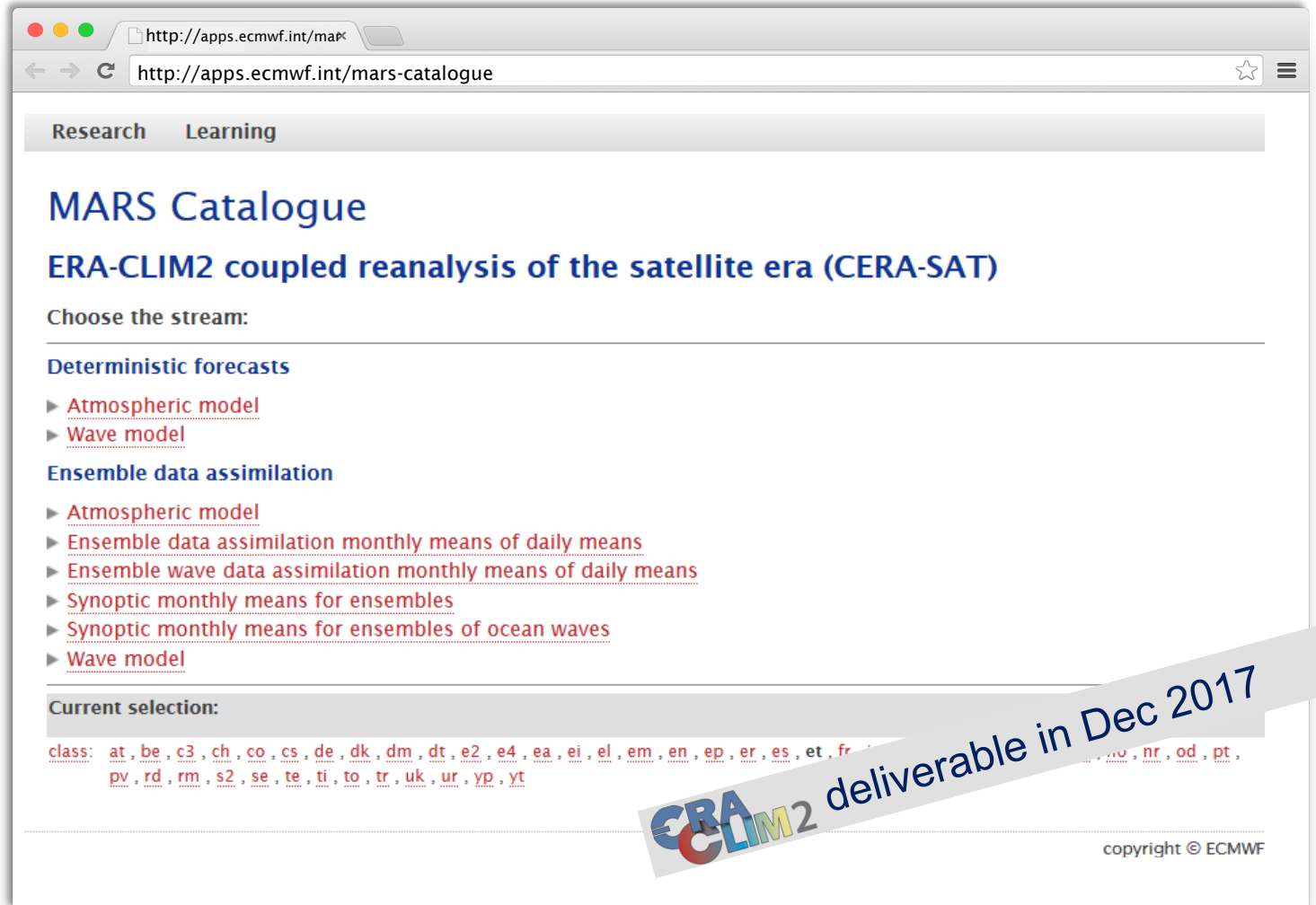
CERA-SAT – Data access

Fields in GRIB

- 3-hourly analysis, forecast fields
 - Atmosphere
 - Sea ice
 - Waves
 - Land surface
- Monthly mean fields

Ocean fields in netCDF

Observation feedback in ODB

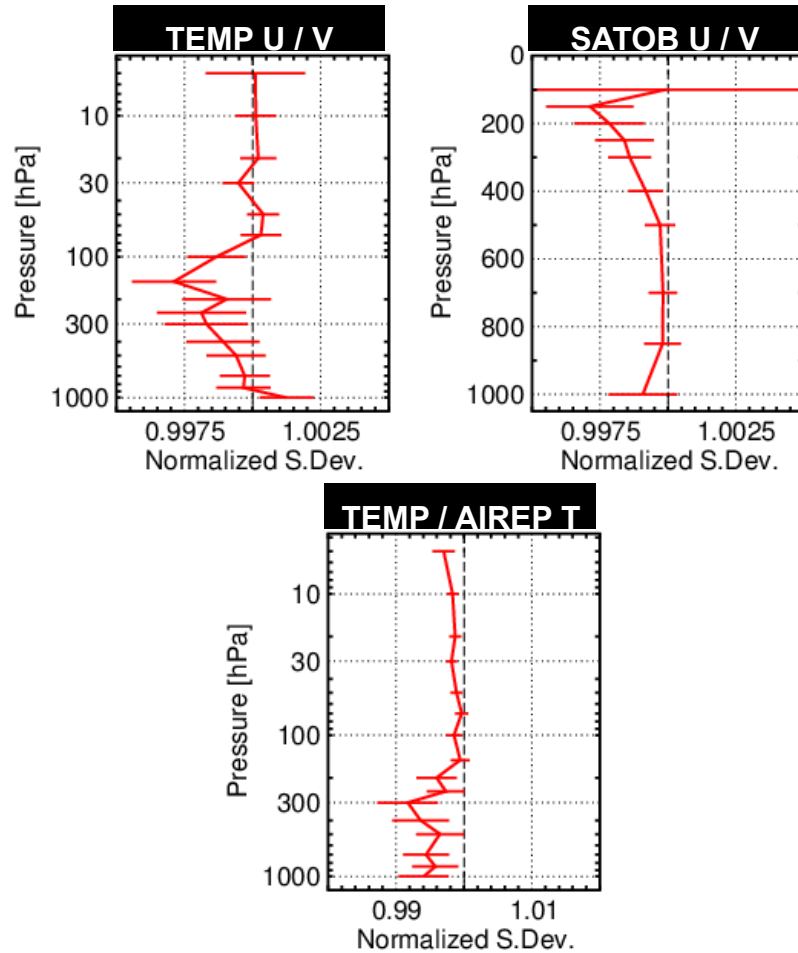


The screenshot shows a web browser window with the URL <http://apps.ecmwf.int/mars-catalogue>. The page title is "MARS Catalogue" and the subtitle is "ERA-CLIM2 coupled reanalysis of the satellite era (CERA-SAT)". Below the title, there is a section "Choose the stream:" followed by two main categories: "Deterministic forecasts" and "Ensemble data assimilation". Under "Deterministic forecasts", there are two links: "Atmospheric model" and "Wave model". Under "Ensemble data assimilation", there are five links: "Atmospheric model", "Ensemble data assimilation monthly means of daily means", "Ensemble wave data assimilation monthly means of daily means", "Synoptic monthly means for ensembles", and "Synoptic monthly means for ensembles of ocean waves". Below these links, there is a section "Current selection:" followed by a list of country codes: "at, be, c3, ch, co, cs, de, dk, dm, dt, e2, e4, ea, ei, el, em, en, ep, er, es, et, fr, ...". At the bottom right of the page, there is a logo for "ERA-CLIM2" and a copyright notice "copyright © ECMWF". A diagonal banner at the bottom right of the screenshot reads "ERA-CLIM2 deliverable in Dec 2017".

Coupled analysis – Background fit to tropospheric observations

Change in standard deviation of B/G departures

(1 Sept 2015 – 31 Aug 2016; Global)

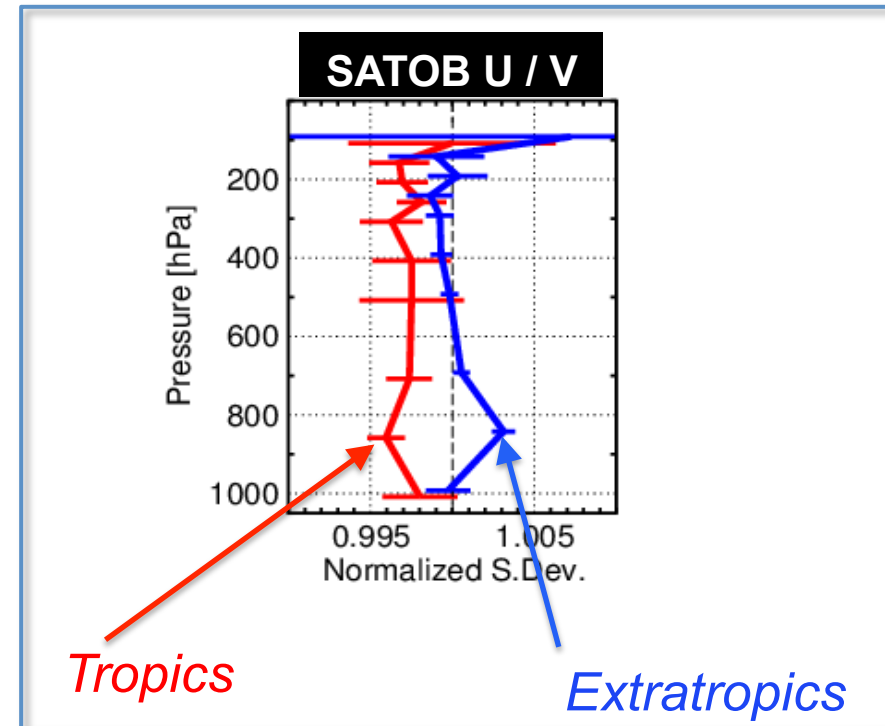


Improvement ←

→ Degradation

Improved background fit to observations data

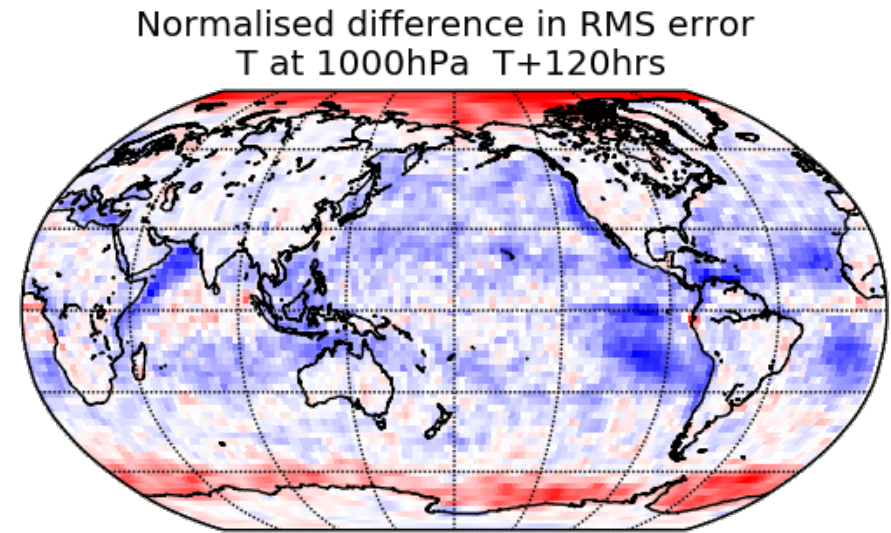
- **Wind:** 100—300 hPa
- **Temperature:** 300—1000 hPa



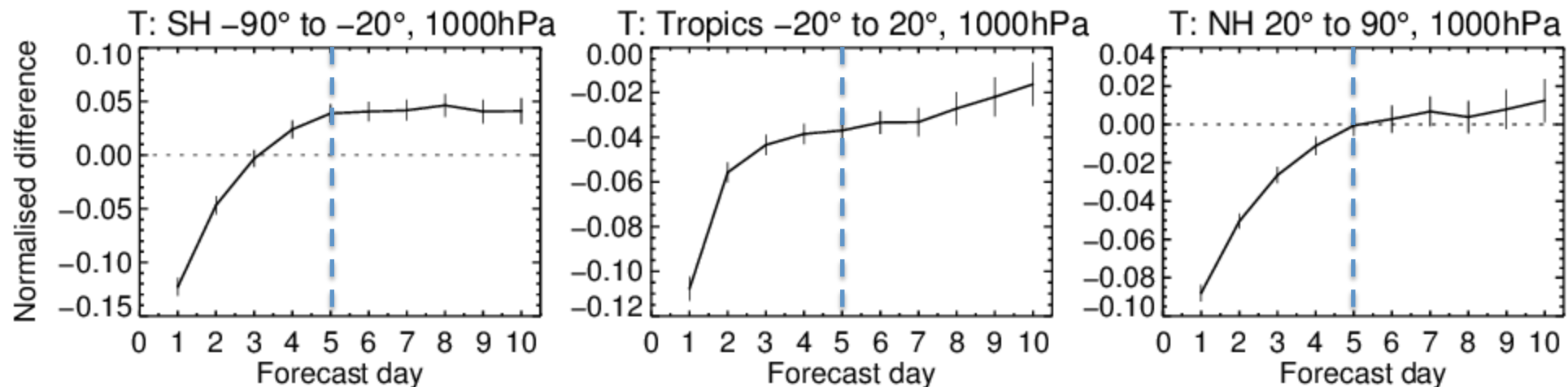
Coupled assimilation & forecast – forecast scores

Forecast improvements 1000hPa Temperature

- Strong reduction in forecast RMSE – especially over oceans
- Apparent degradation over sea-ice
 - Suspected validation artifact



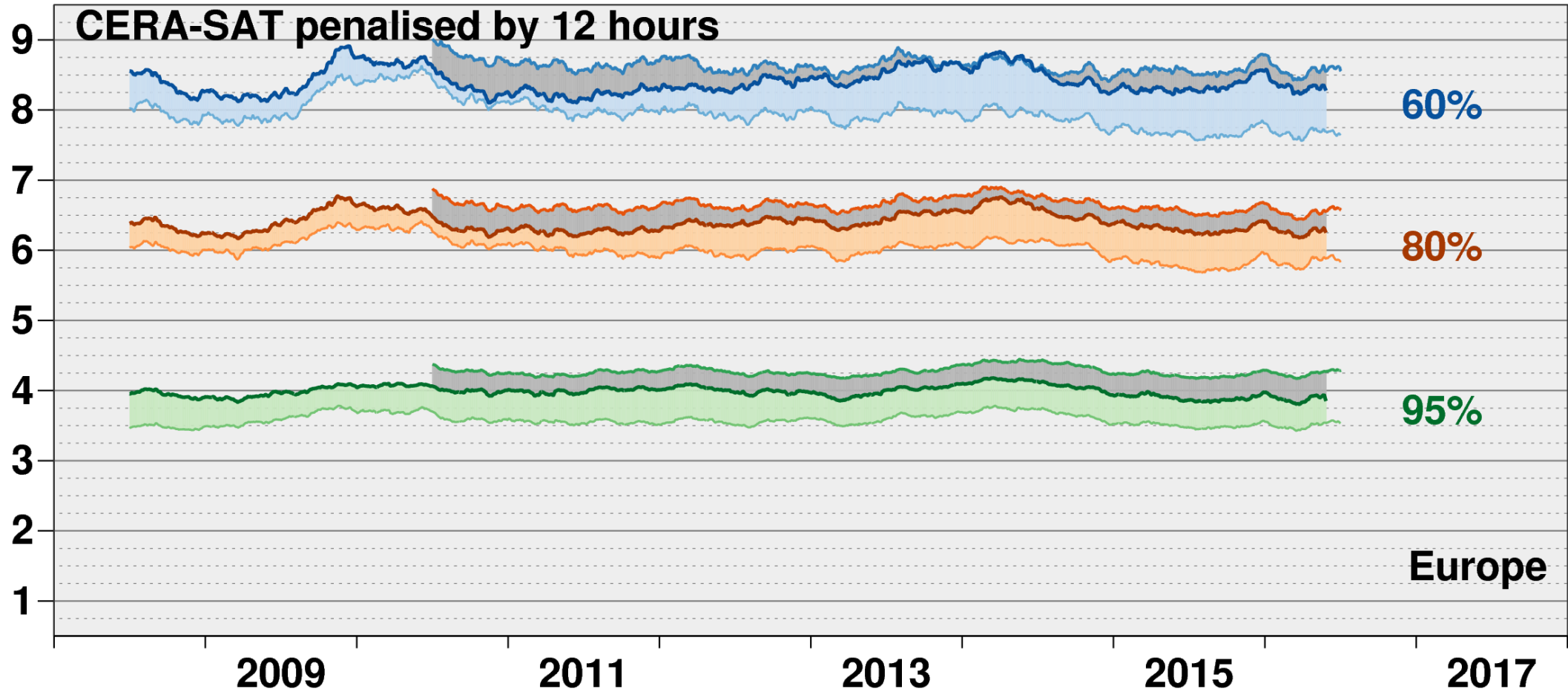
Normalized difference in standard deviation of error
(May 2015 – Aug 2016, own analysis)



Forecast scores (AC) – Europe; 500 hPa height

Range (days) when 365-day mean 500hPa height AC (%) falls below threshold

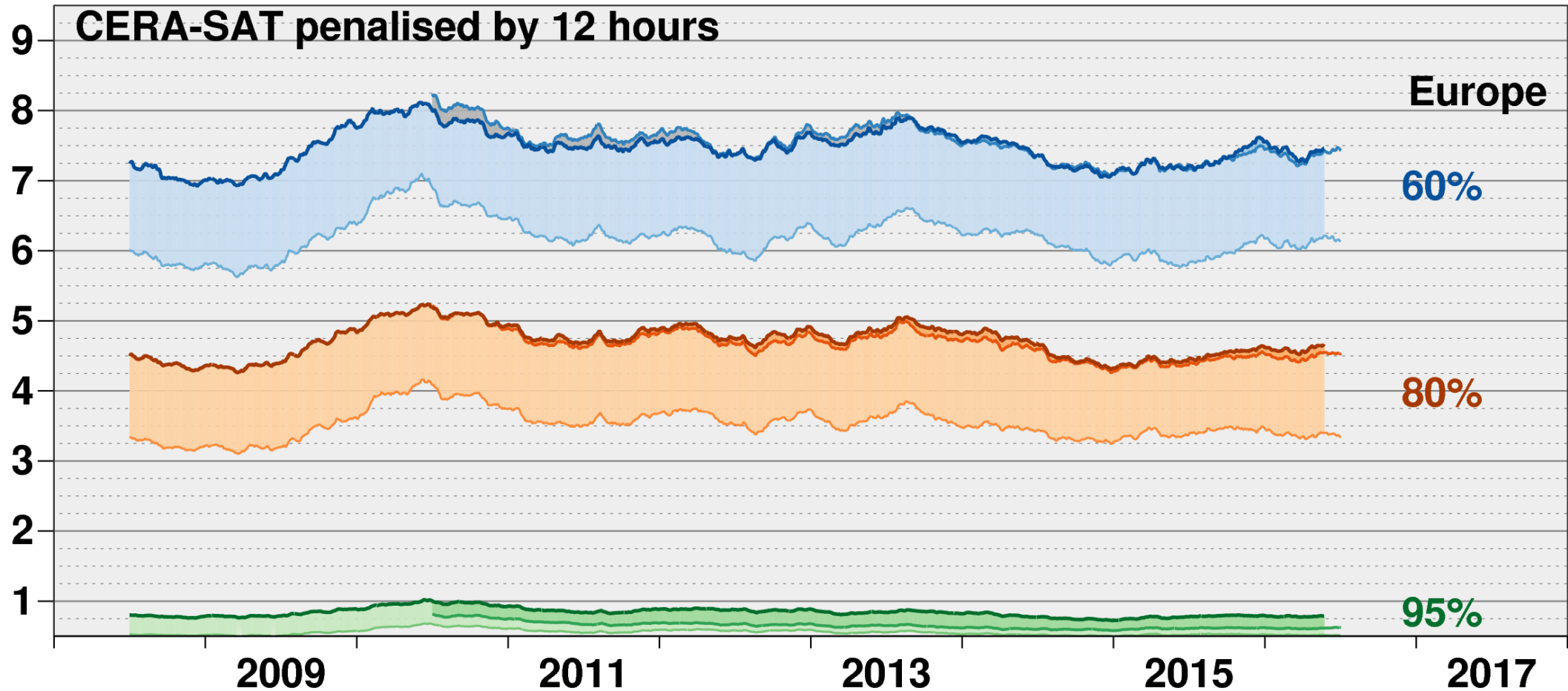
— ERA-Interim — ERA5 (EDA) — CERA-SAT



Forecast scores (AC) – Europe; 2-metre temperature

Range (days) when 365-day mean 2-metre temp. AC (%) falls below threshold

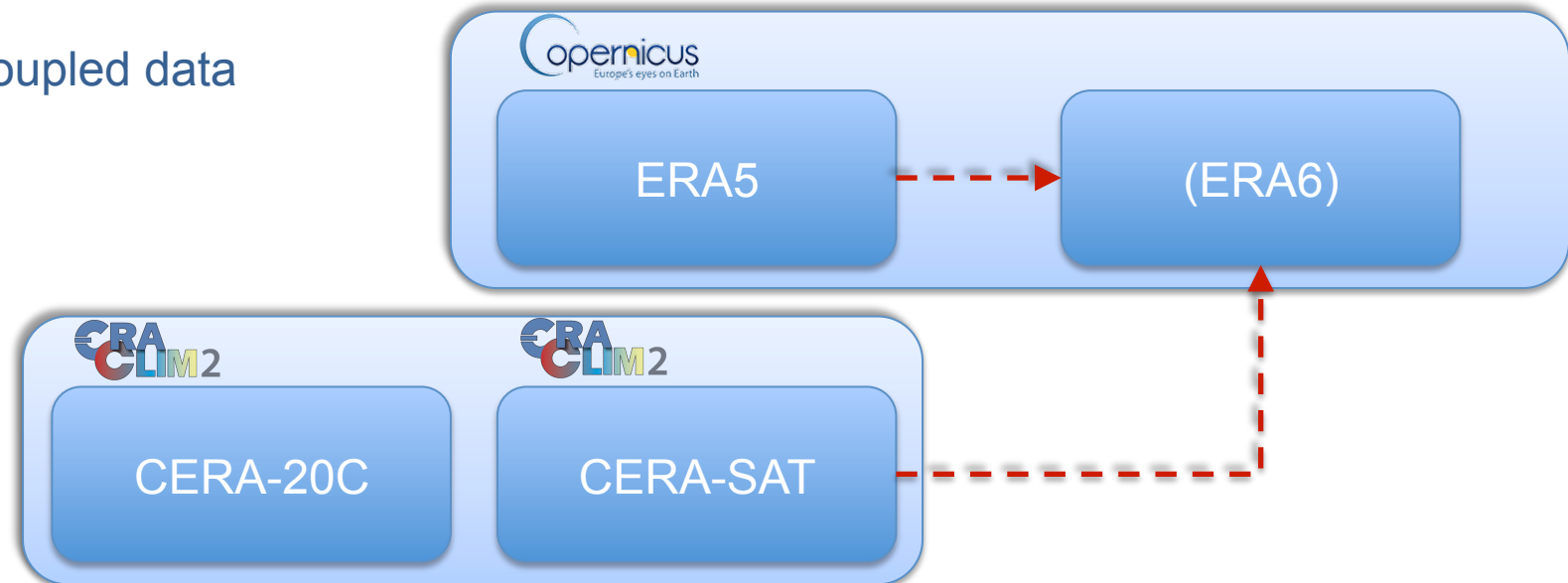
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Concluding remarks

CERA-SAT is a *proof-of-concept* coupled reanalysis of the satellite era

- **Assess** the application of the CERA system for coupled data assimilation
- **Research** the effects of using the CERA system for coupled data assimilation
- **Aid further development** of coupled data assimilation

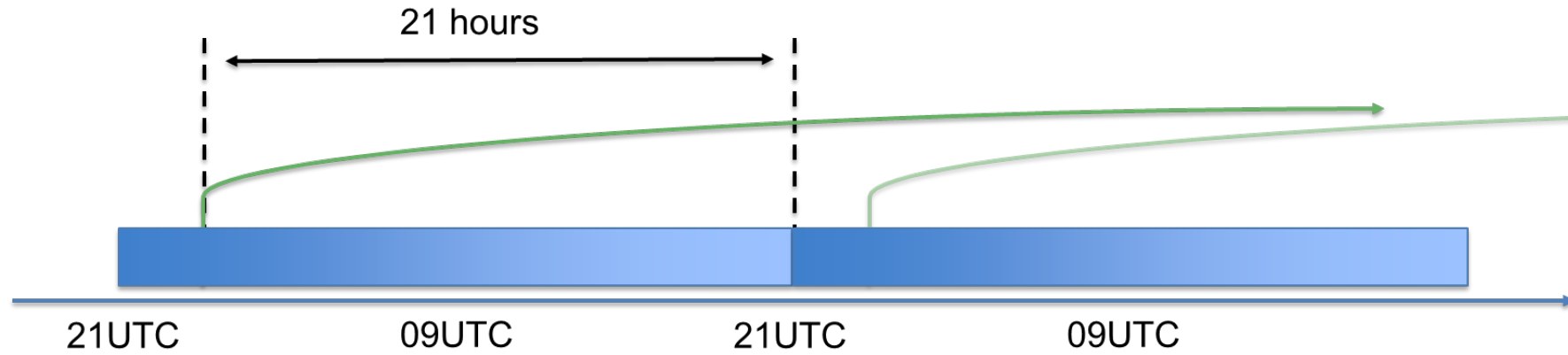


Thank you

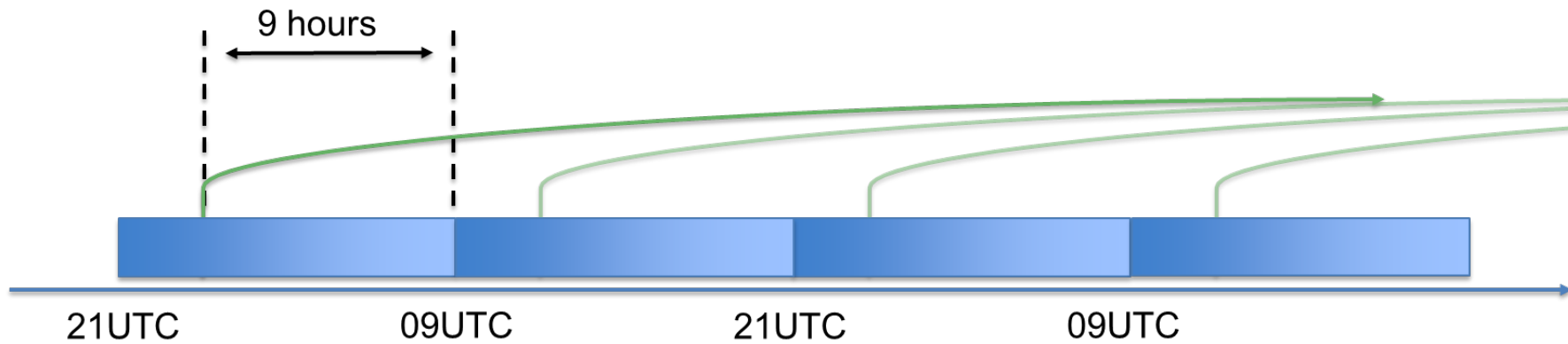
Dinand.Schepers@ecmwf.int

Assimilation window & forecast scores

24-hour window

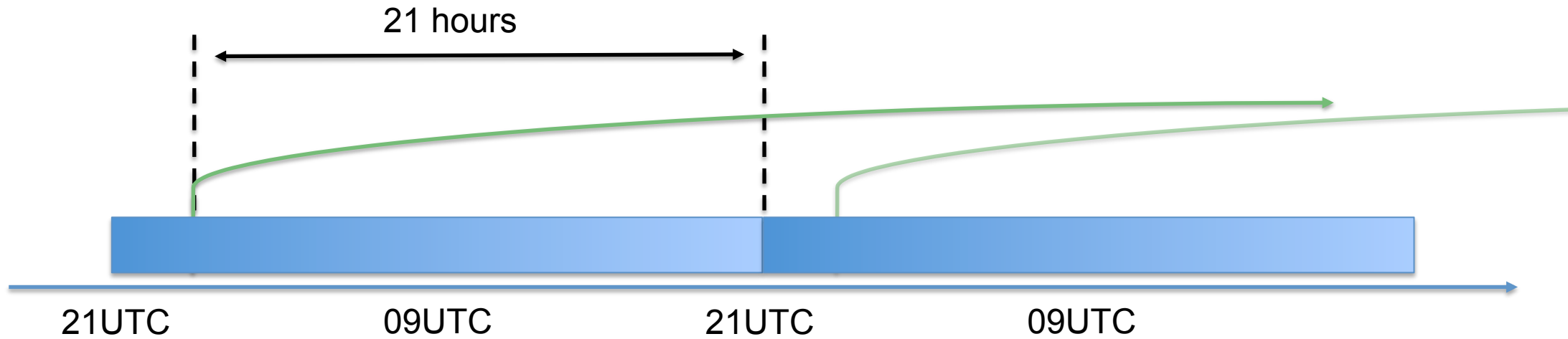


12-hour window

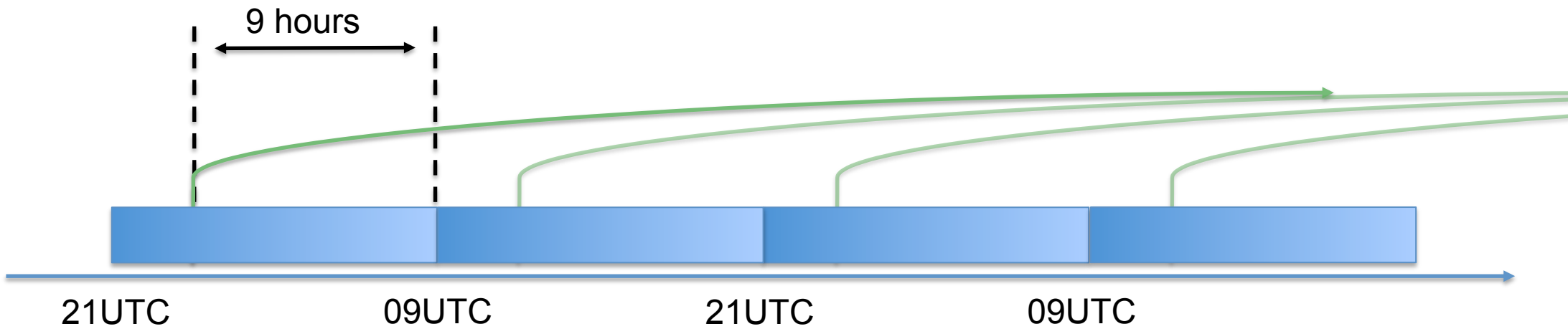


Forecast score & Assimilation window

24-hour window



12-hour window



The CERA system



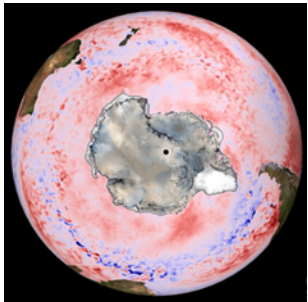
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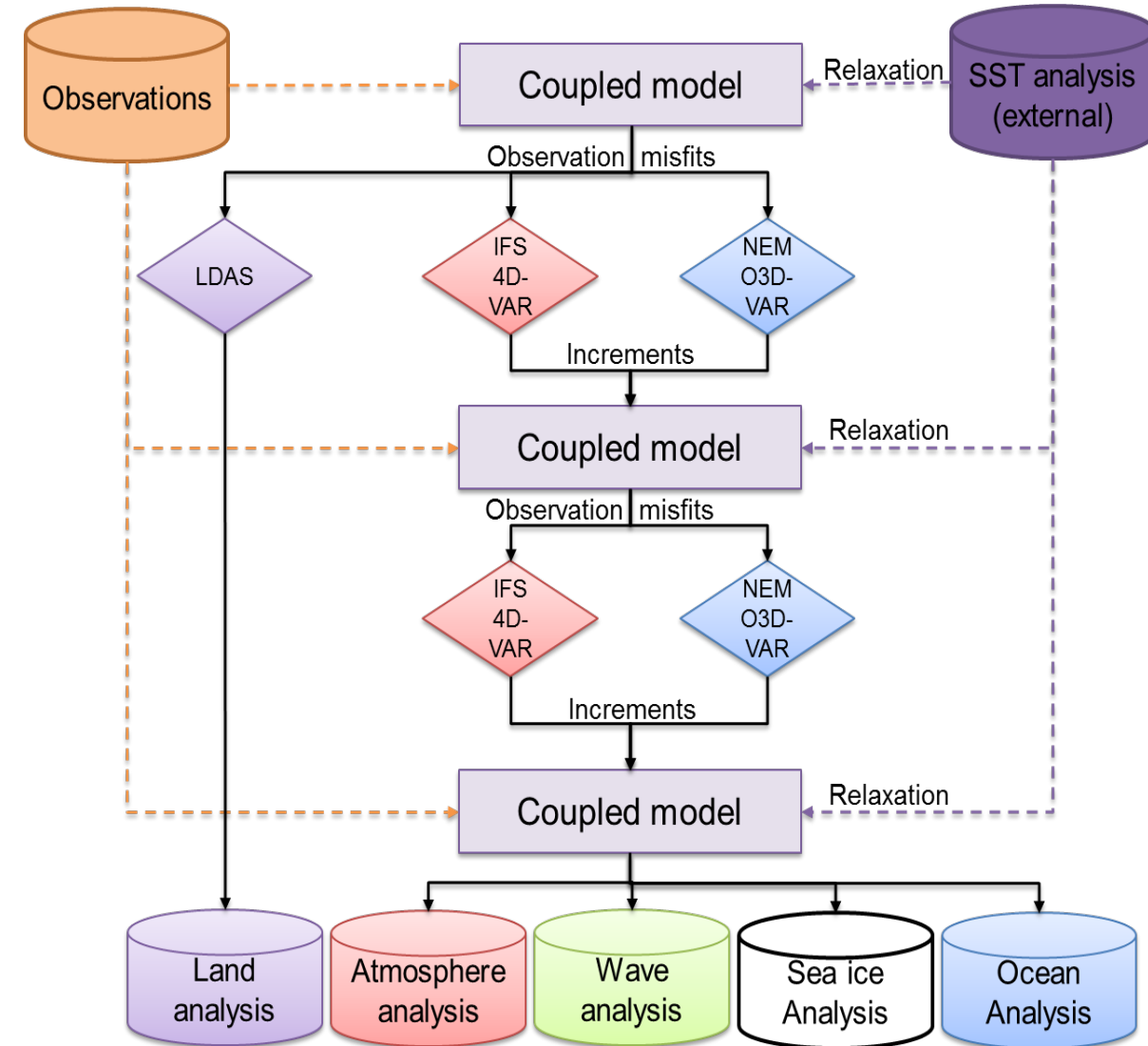
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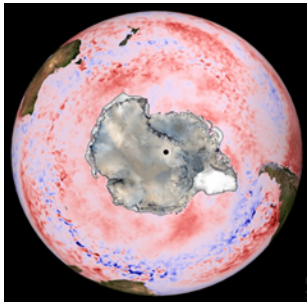
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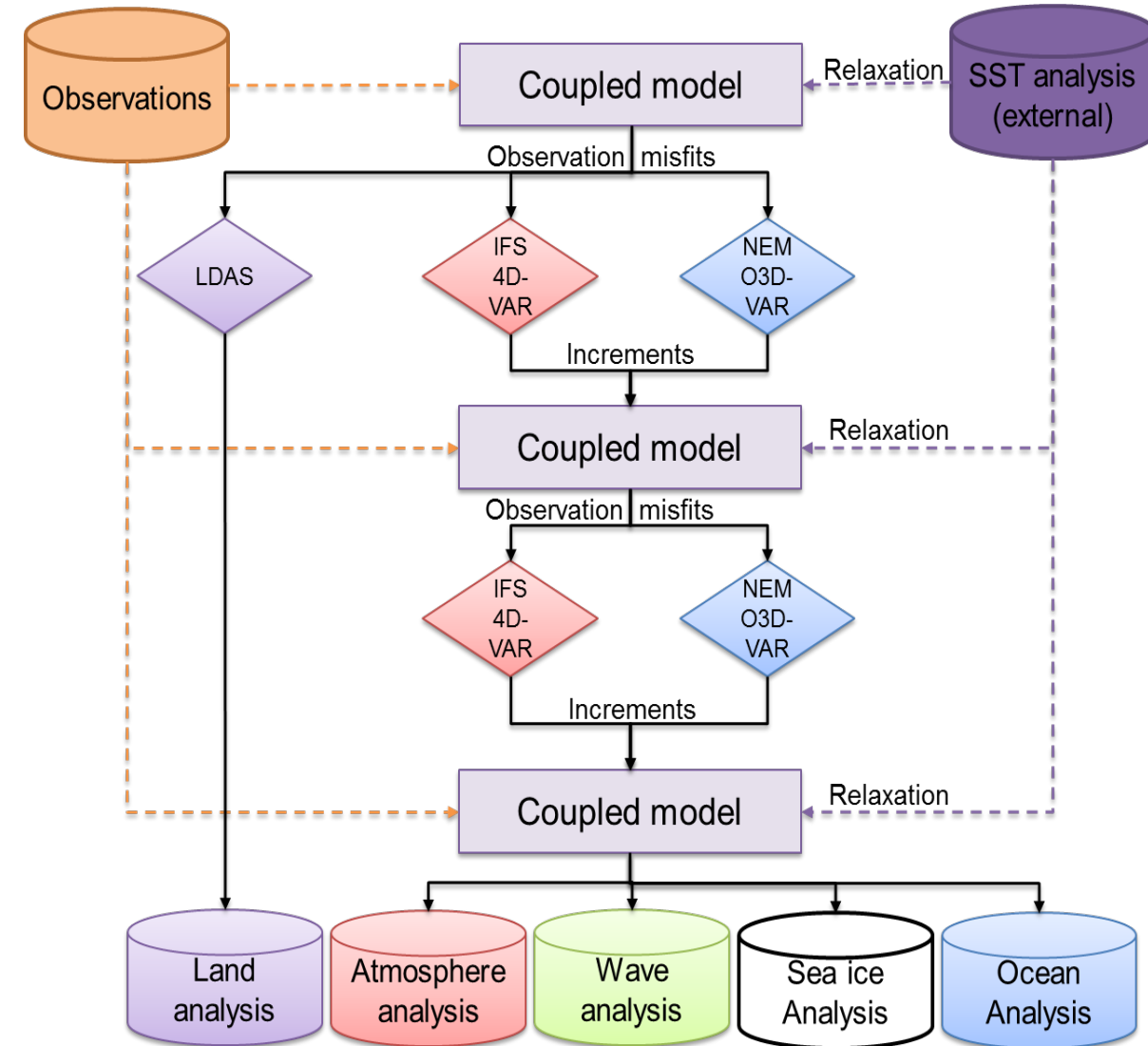
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Towards an Earth system approach

“Whilst Earth system modelling is already in its early stages, its application to data assimilation is very novel and results could be ground-breaking”

Roadmap to 2025

