Recent and planned NWP developments at ECMWF

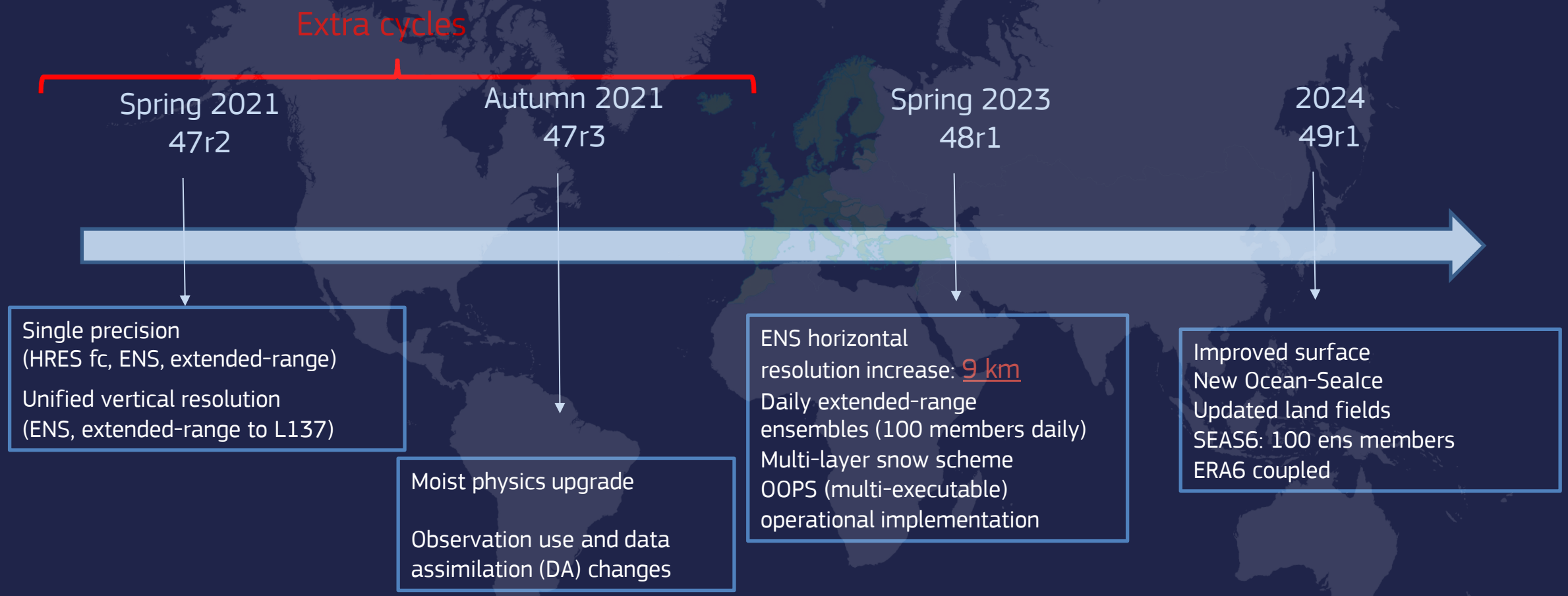
Andy Brown, **Phil Browne**, Steve English, Florian Pappenberger, and Florence Rabier

Becoming a European multi-site organisation

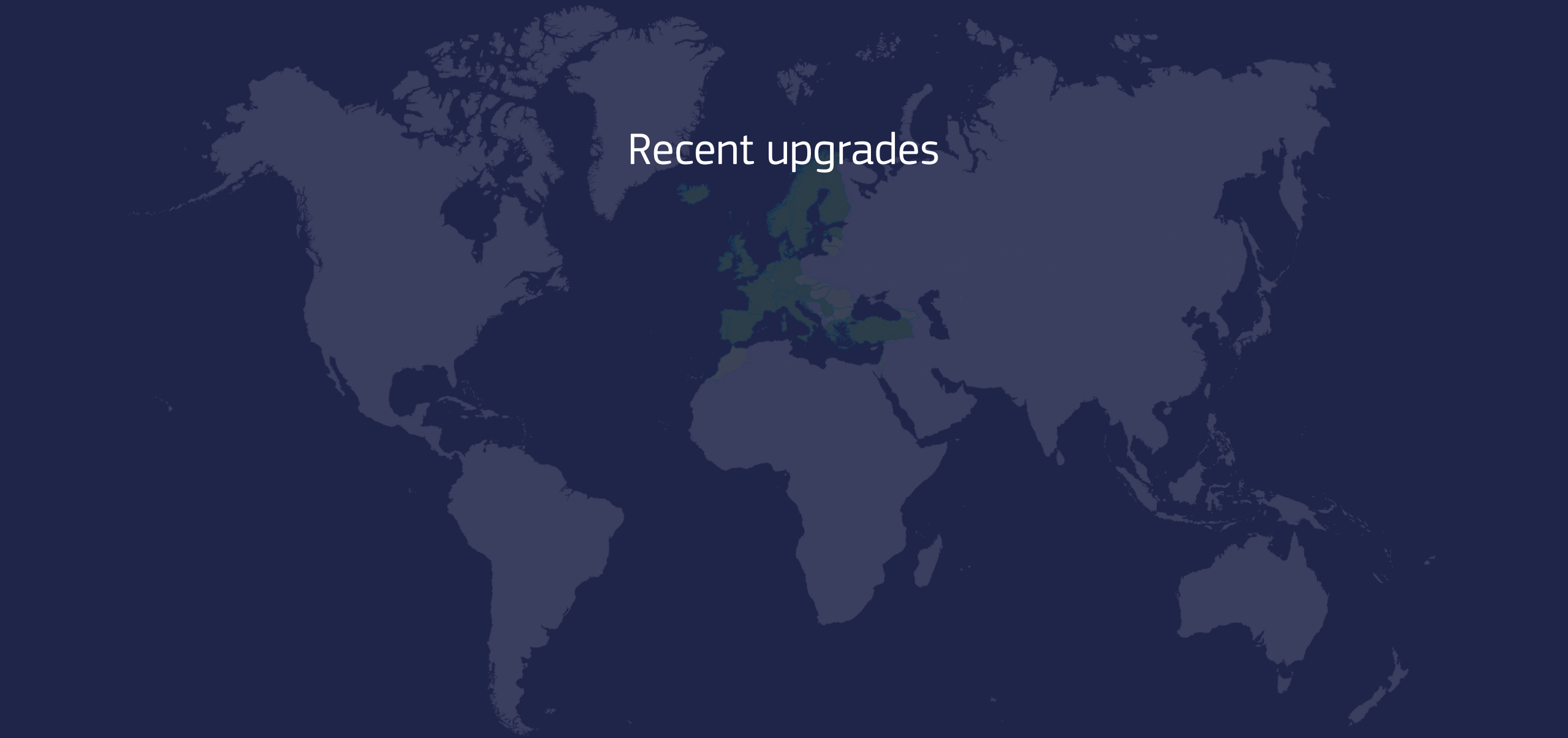
Playing a unique role

ECMWF's role is to address the critical and most difficult research problems in medium-range NWP that no one country could tackle on its own

Integrated Forecasting System (IFS) cycle upgrades



Recent upgrades



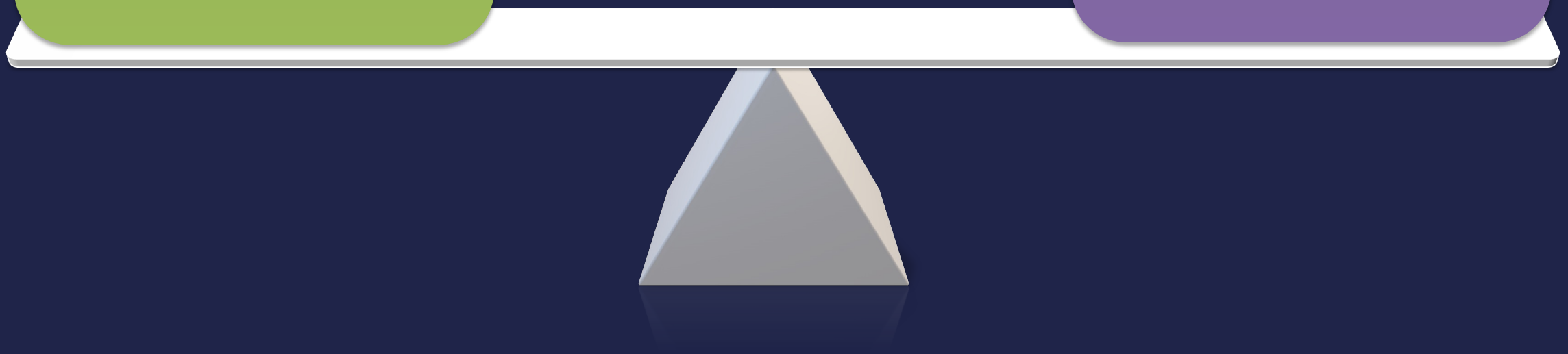
IFS Cycle 47r2

Saving of computational cost through implementation of single precision

Neutral impact

Investment to take ENS (medium and extended-range) from L91 to L137

Positive impact

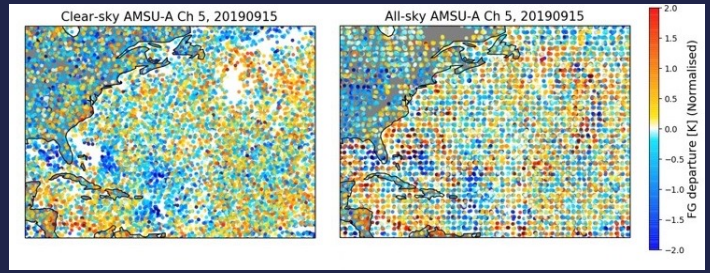


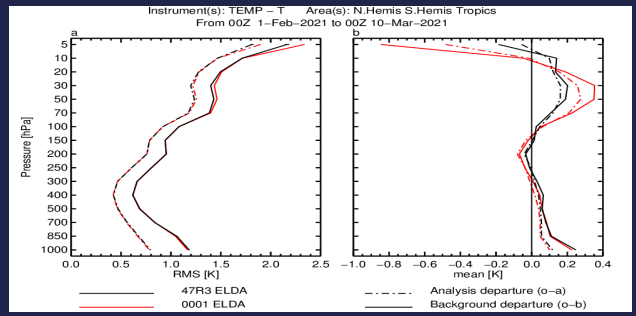
IFS Cycle 47r3

1. Changes to observation usage in the assimilation
   (infra-red, microwave, atmospheric motion vectors, Aeolus winds)

2. Weak constraint 4DVar for stratosphere in EnsembleDA

3. Major revision to improve the physical and numerical basis for moist processes in the IFS



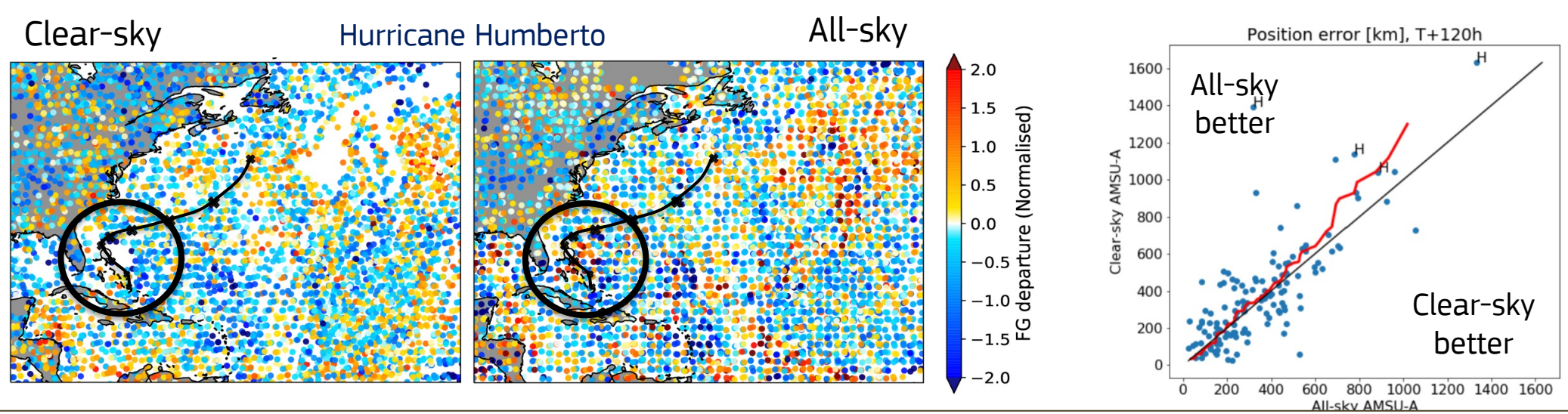


Observations: Assimilation of all-sky AMSU-A

Satellite	Launch	EOL	Broken Channels
NOAA-15	1998	-	6, 11, 14
NOAA-16	2000	2014	8, 9
NOAA-17	2002	2003	N/A
Aqua	2002	-	1, 2, 5, 6, 7, 14
NOAA-18	2005	-	8, 9
Metop-A	2006	2021	7, 8
NOAA-19	2009	-	7, 8
Metop-B	2012	-	15
Metop-C	2018	-	-

AMSU-A channels 5 to 14 are actively assimilated. These are channels with primary sensitivity to temperature from the mid-troposphere through upper stratosphere

In 47r3, “clear-sky” assimilation is replaced by “all-sky”, treating satellite radiances in all atmospheric conditions

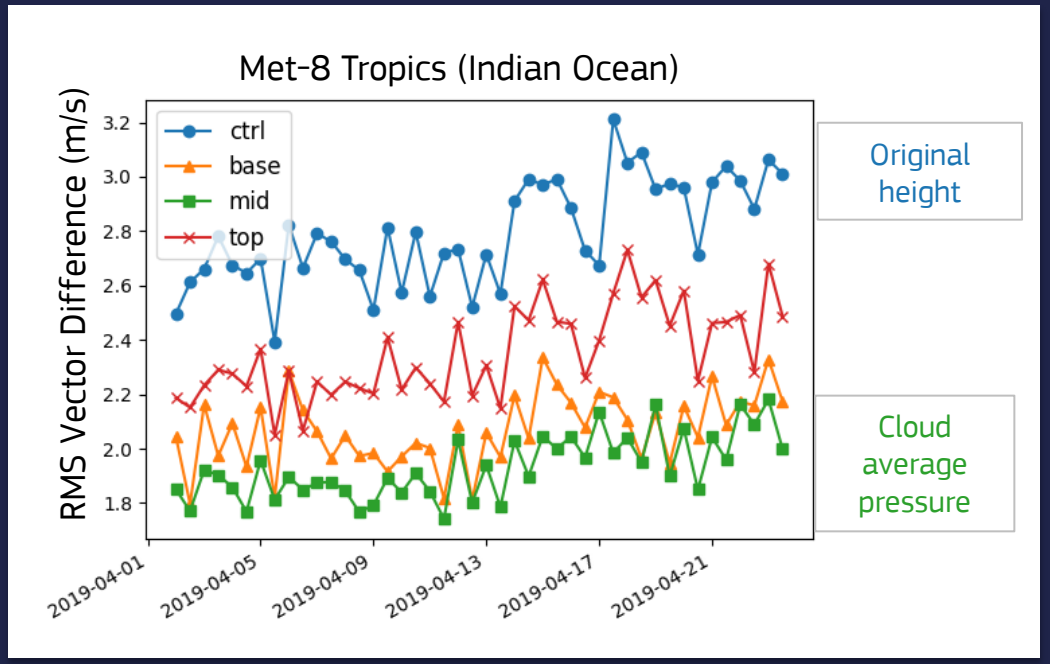


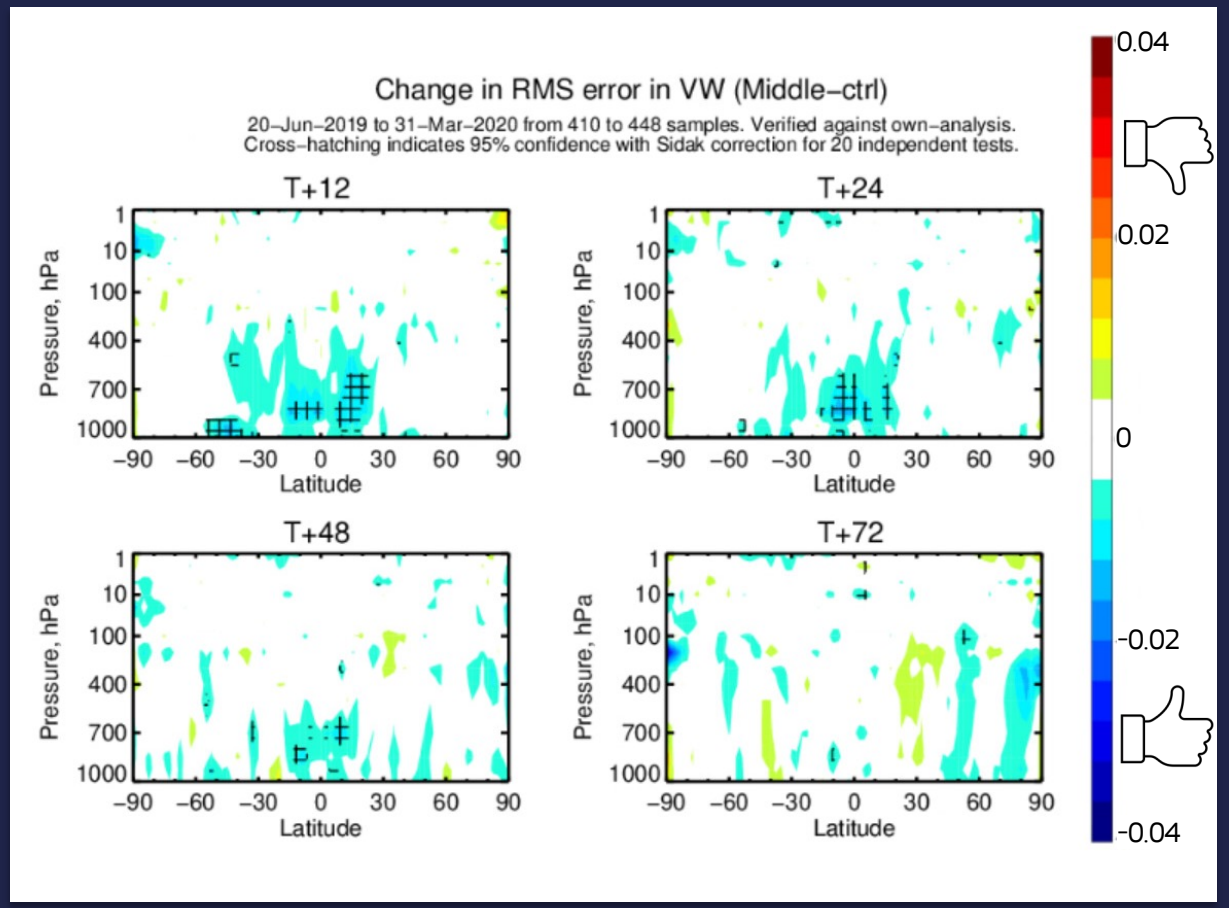
➔ Assimilation of all-sky AMSU-A: Increases use of microwave sounder data in areas of cloud and precipitation (+12% global increase for Channel 5)

➔ Provide critical observations near Tropical Cyclones (example: Hurricane Humberto)

Data assimilation: Improved wind analysis

1. Heights of low level Atmospheric Motion Vectors (AMVs) diagnosed above the model cloud are reassigned to the cloud average pressure



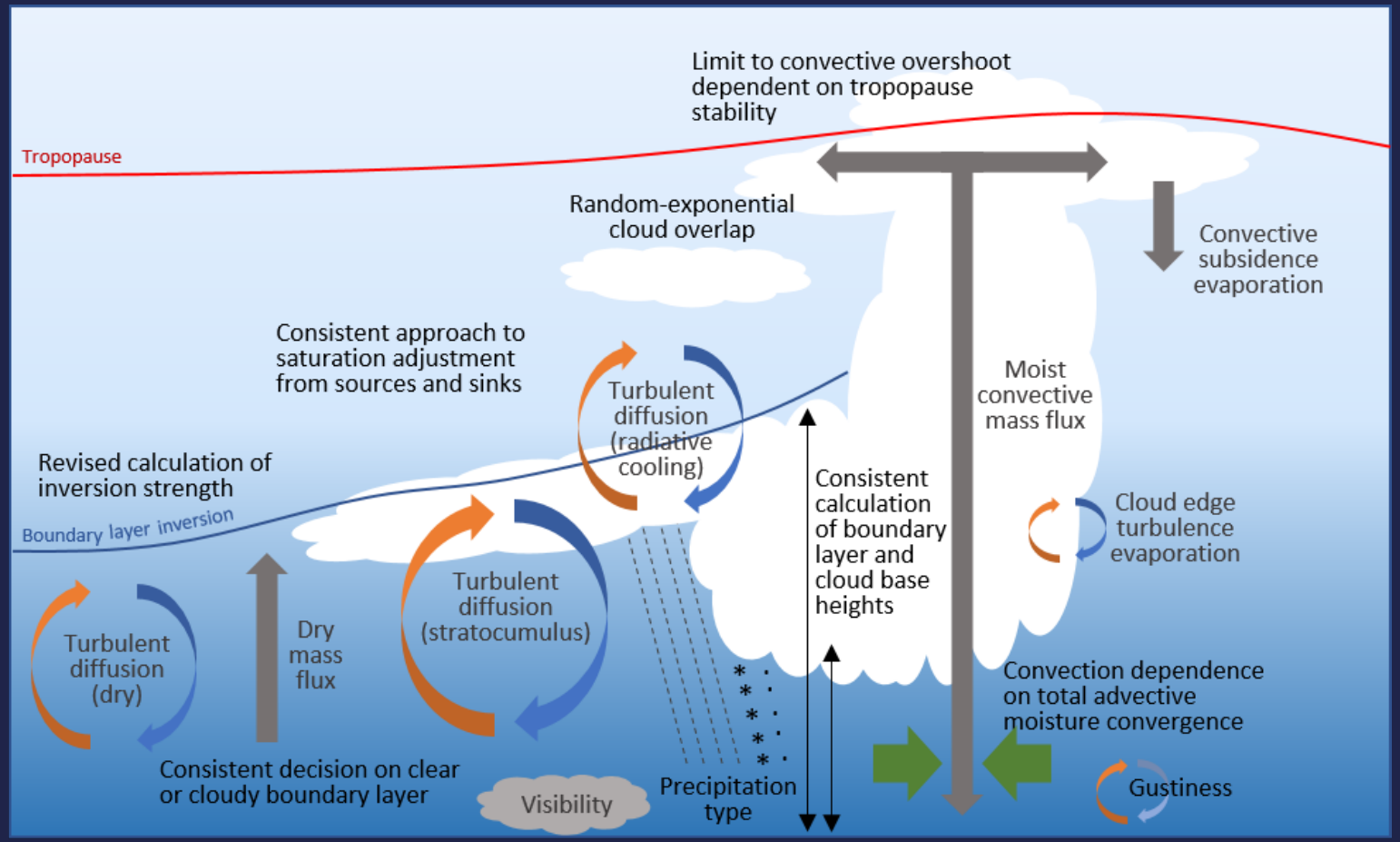


2. Representativeness error added into the total observation error for Aeolus (lidar winds)

Moist physics upgrade in IFS Cycle 47r3

- Major development to moist physics parametrizations (cloud, convection, turbulent mixing, microphysics)
- Simpler interactions, more consistency, improved physical processes, better numerics

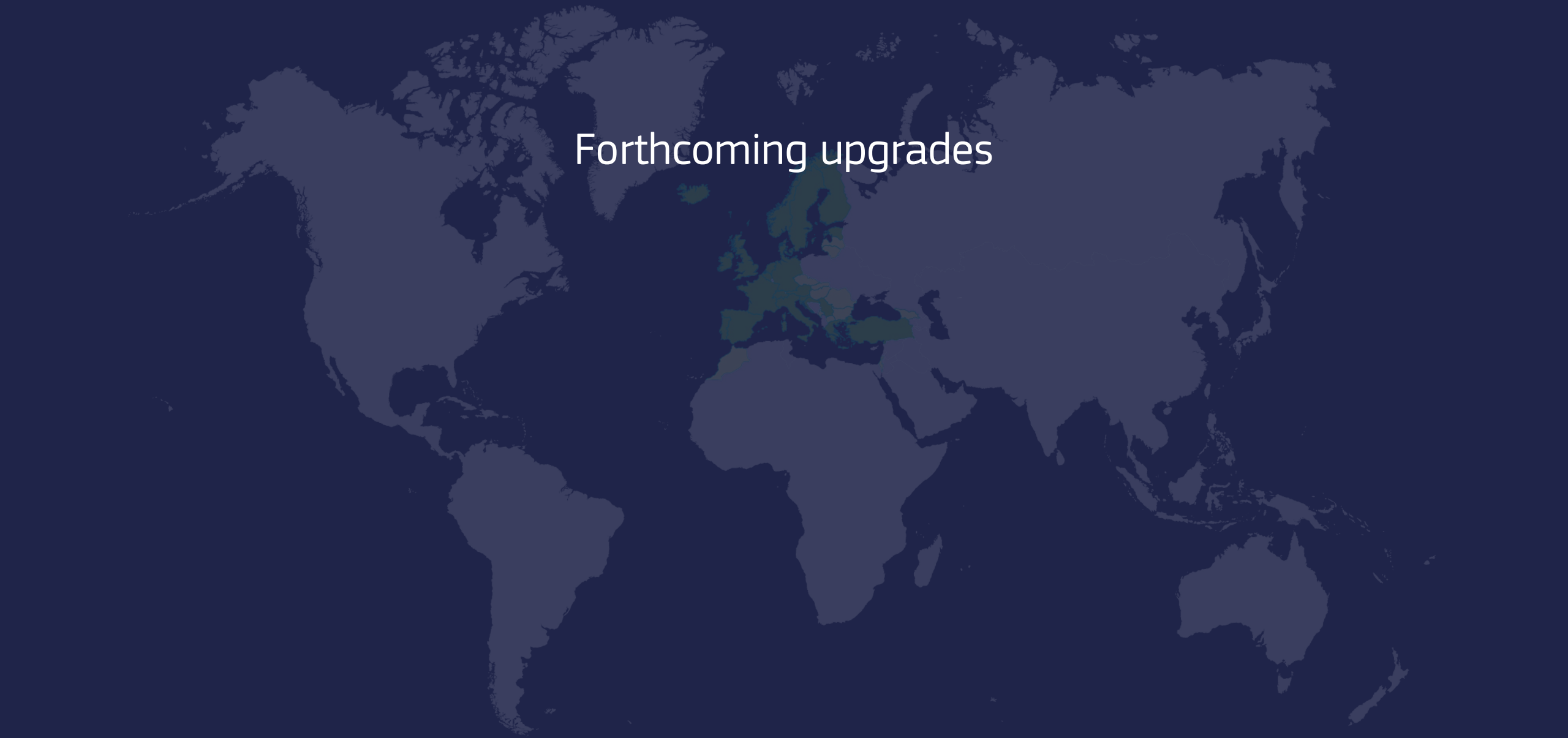
Changes to many different aspects of the moist physics…



More details in…

ECMWF Newsletter 164 (Summer 2020)
(www.ecmwf.int/en/publications/newsletters)

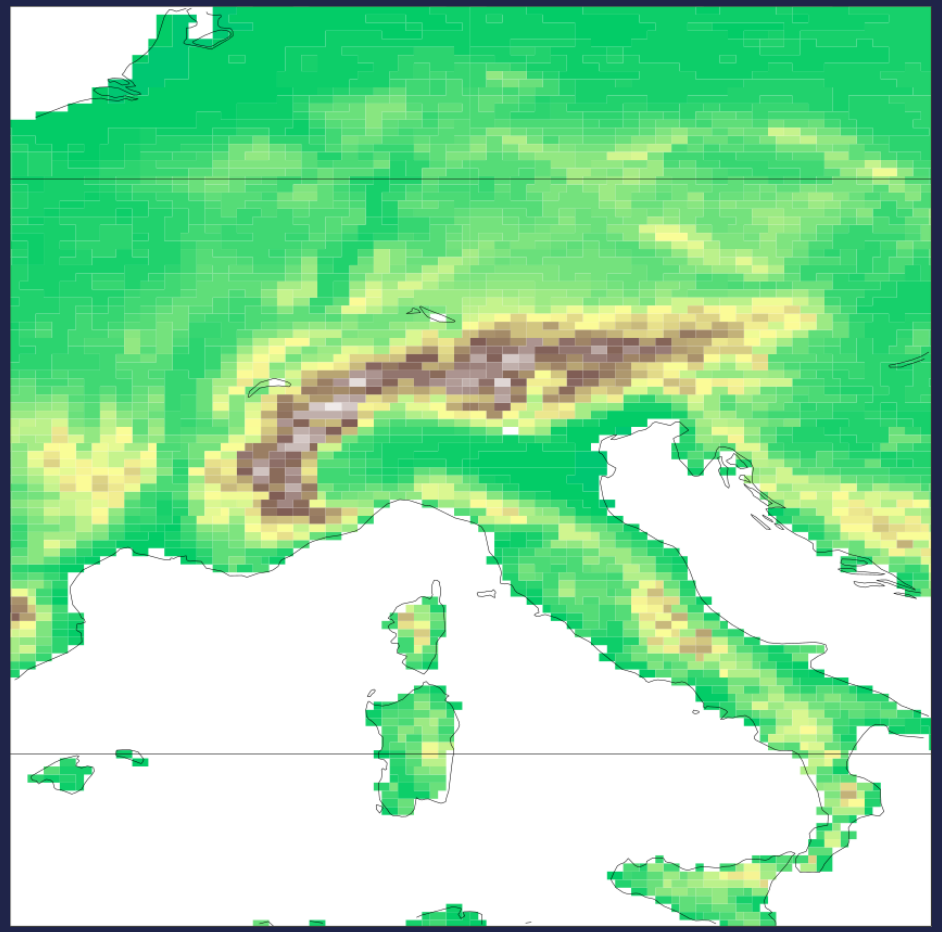
Forthcoming upgrades



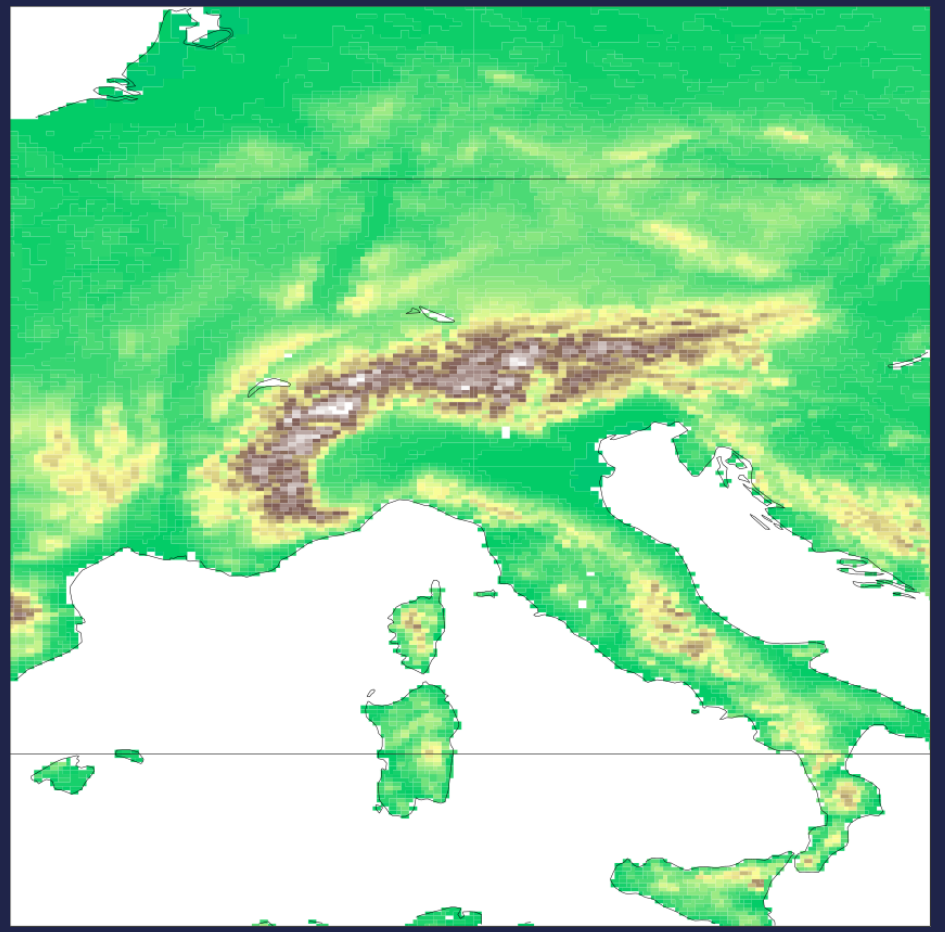
Acceptance of Atos supercomputer

Upgrade of ENS resolution

TCo639 – 47r3 ENS resolution

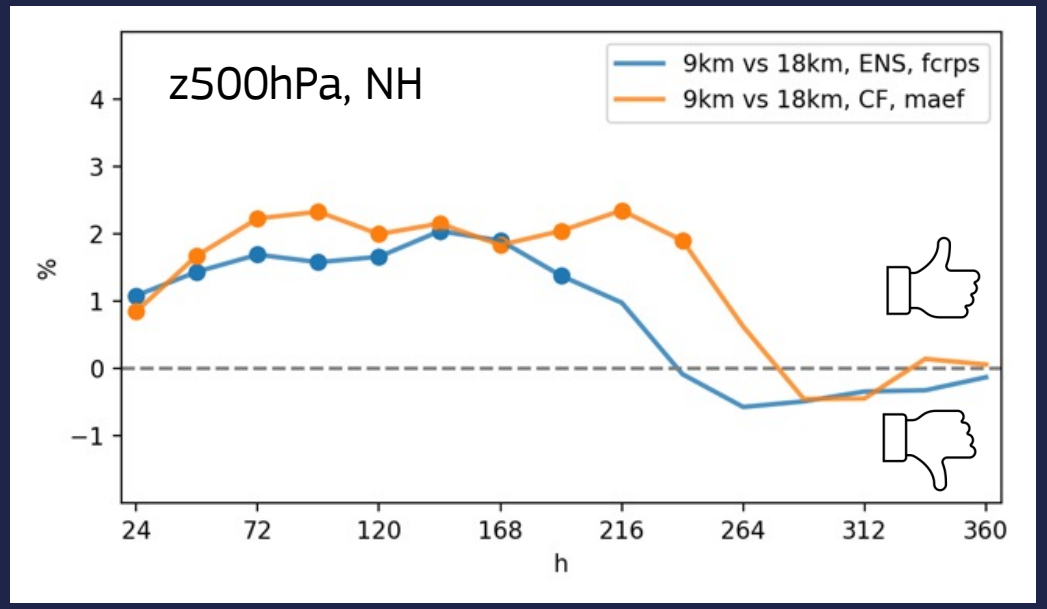


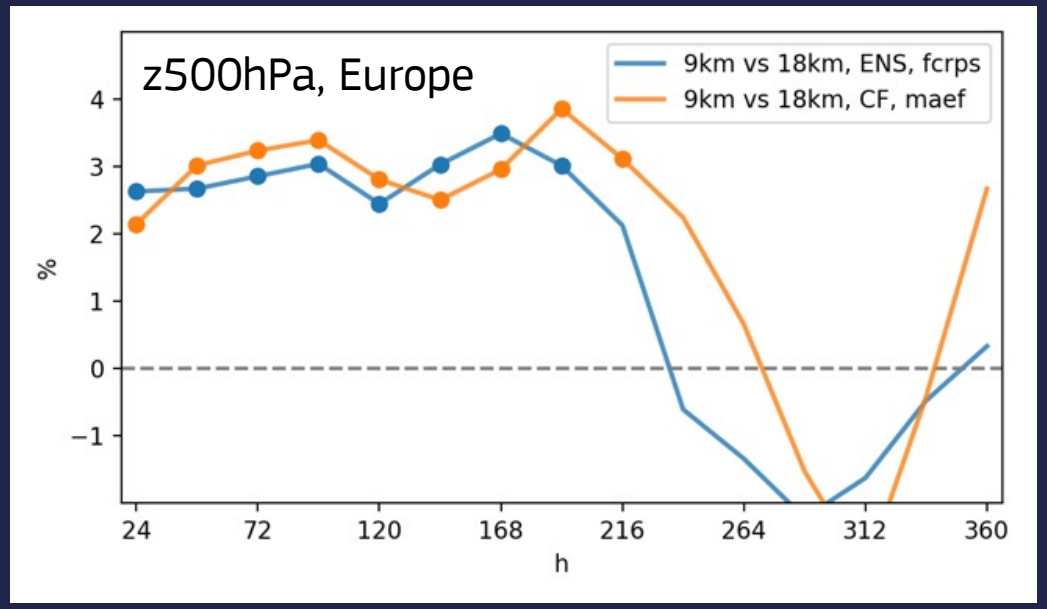
TCo1279 – 48r1 ENS resolution

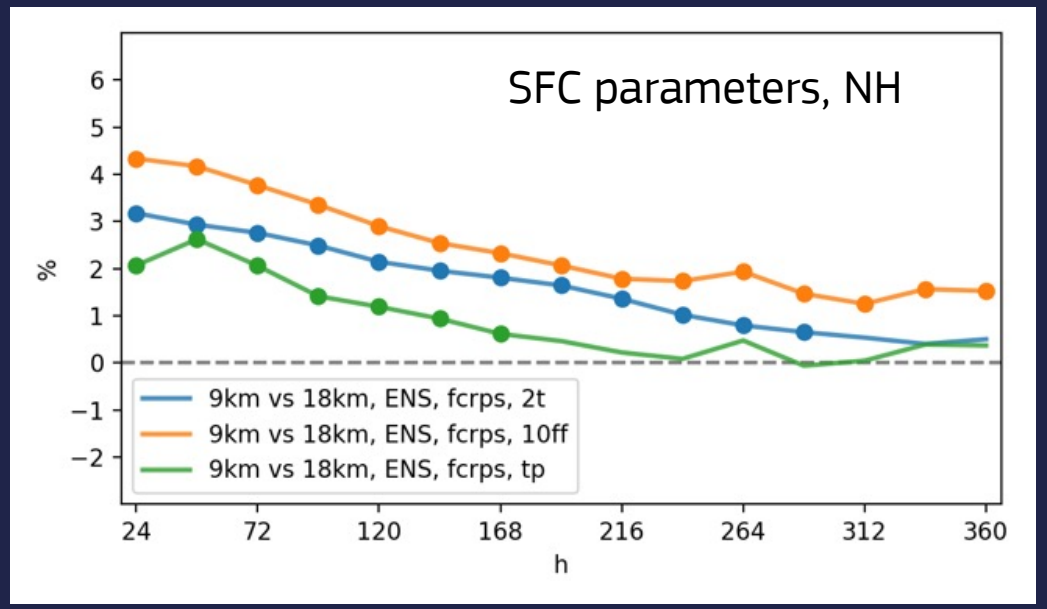


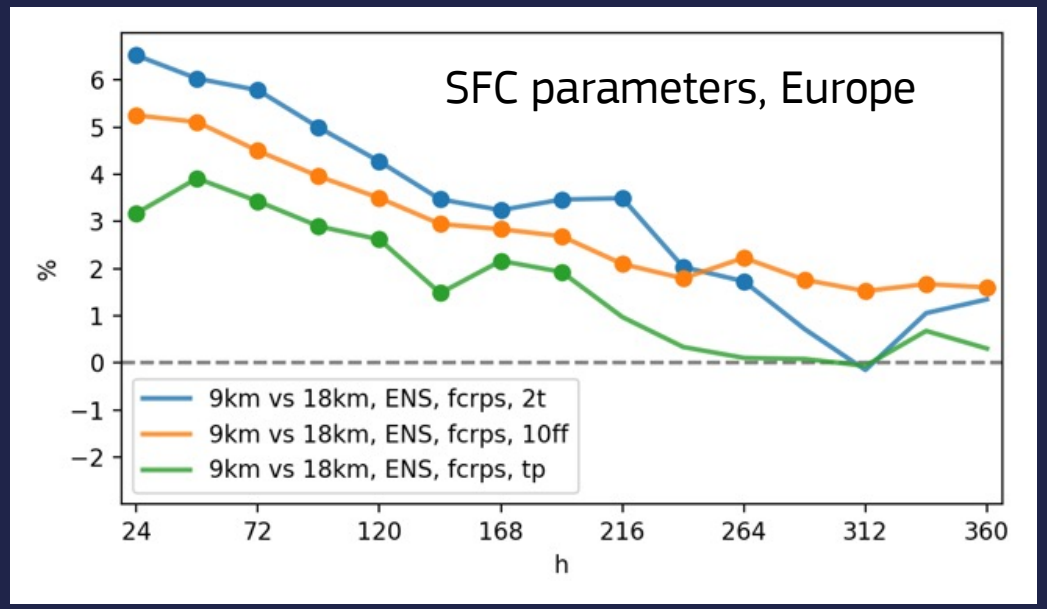
TCo1279L137 vs TCo639L137 (obs), dots indicate stat. signif. (95%)

Positive values -> scores improved







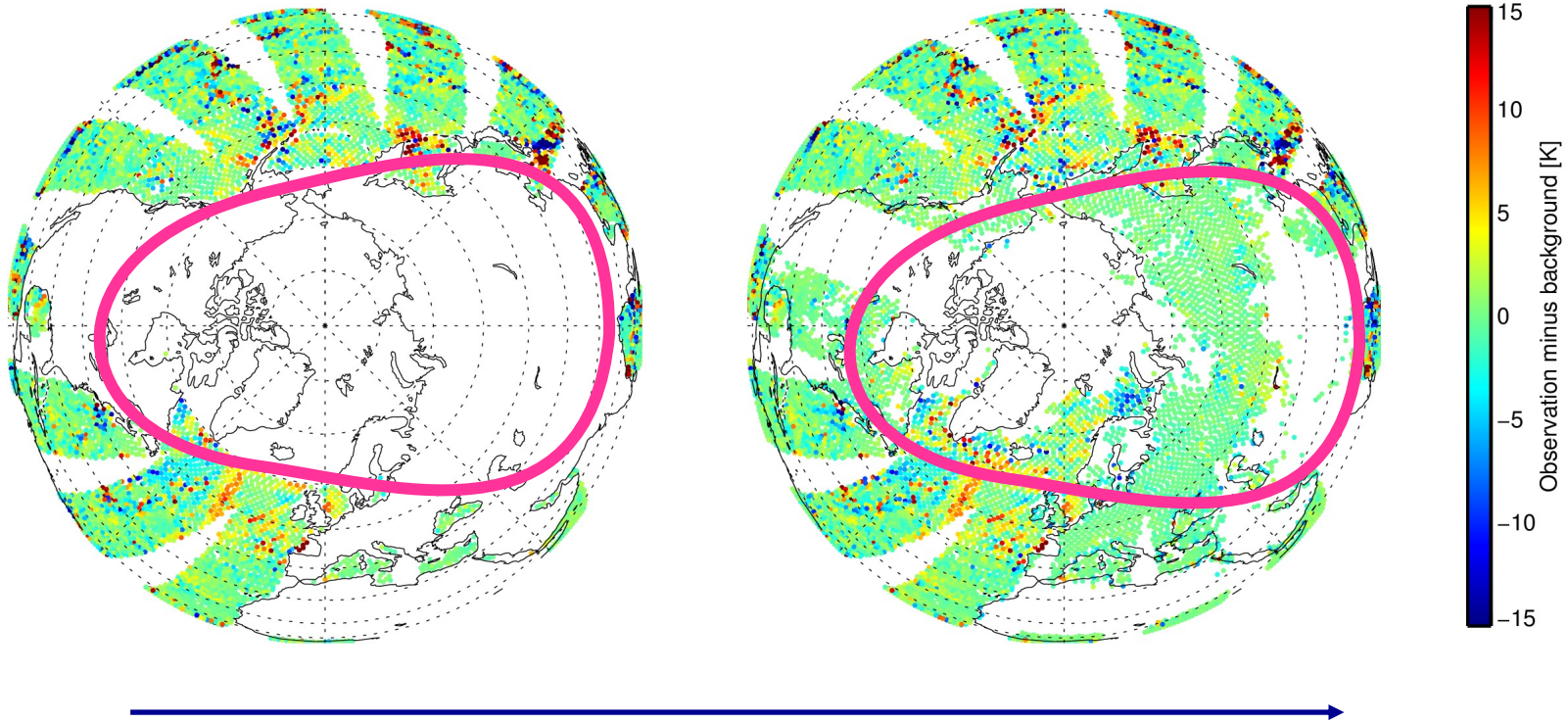


Ongoing developments for surface-sensitive microwave channels

Active channel 10
(36.5 GHz, v-polarised)
observations from AMSR2 during
00 UTC analysis cycle,
26 June 2019

NOW
(all-sky but not all-surface)

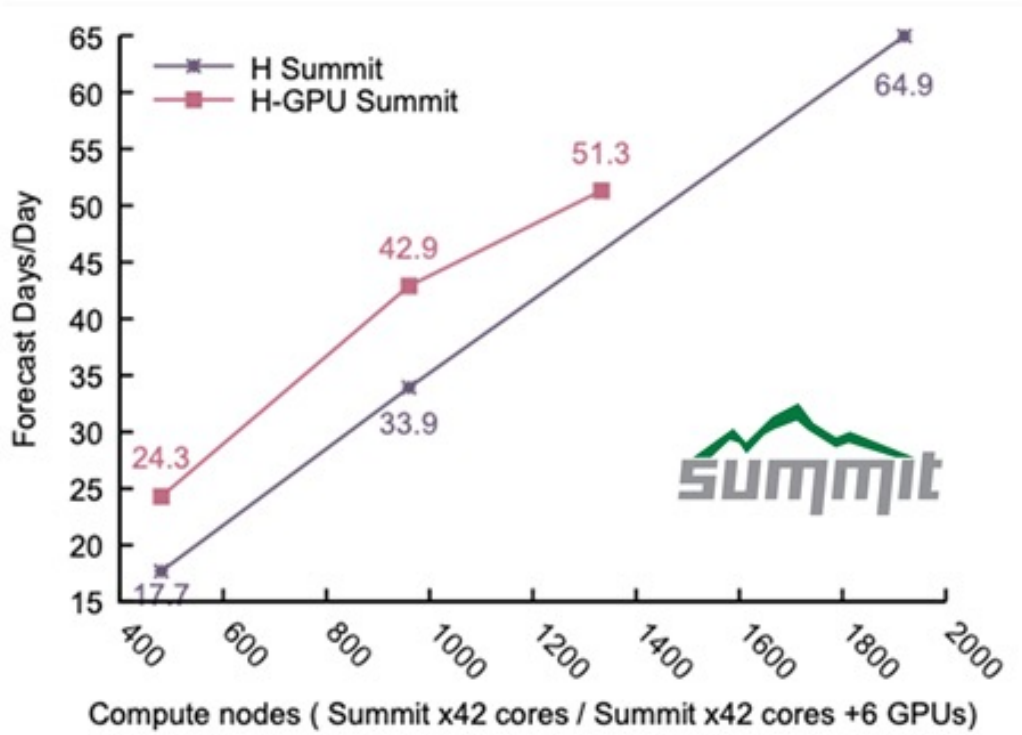
UPGRADE

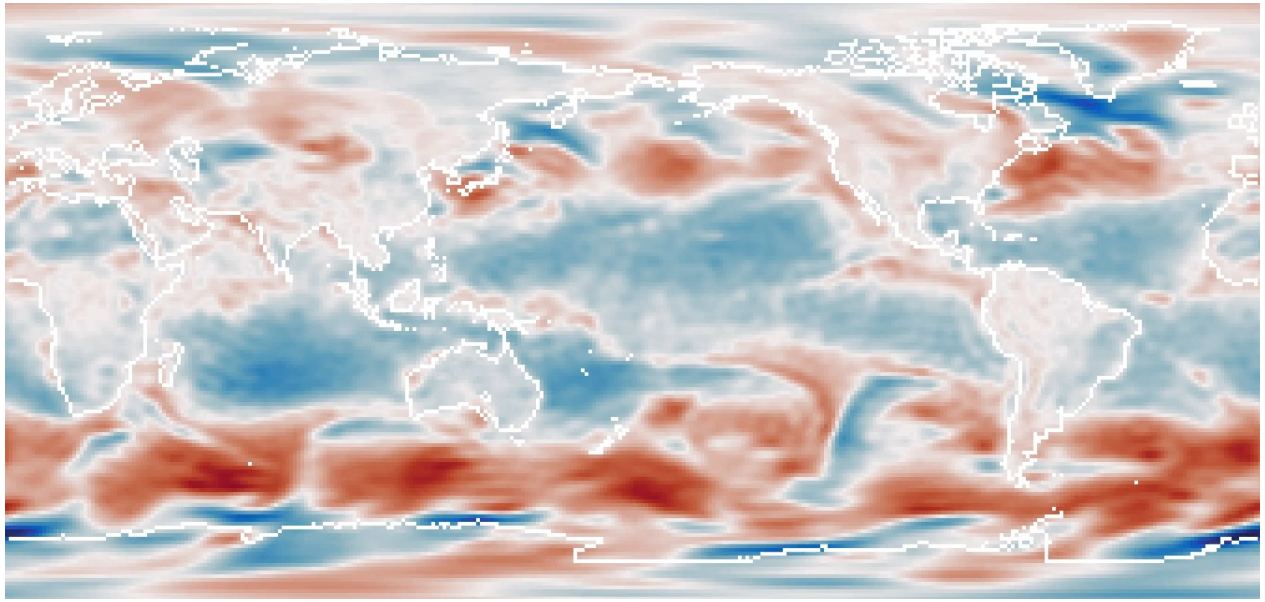


- Adding higher latitudes, land surfaces, mixed scenes (land – water) (but excluding sea-ice, snow, high altitudes, desert soils)

Longer term developments

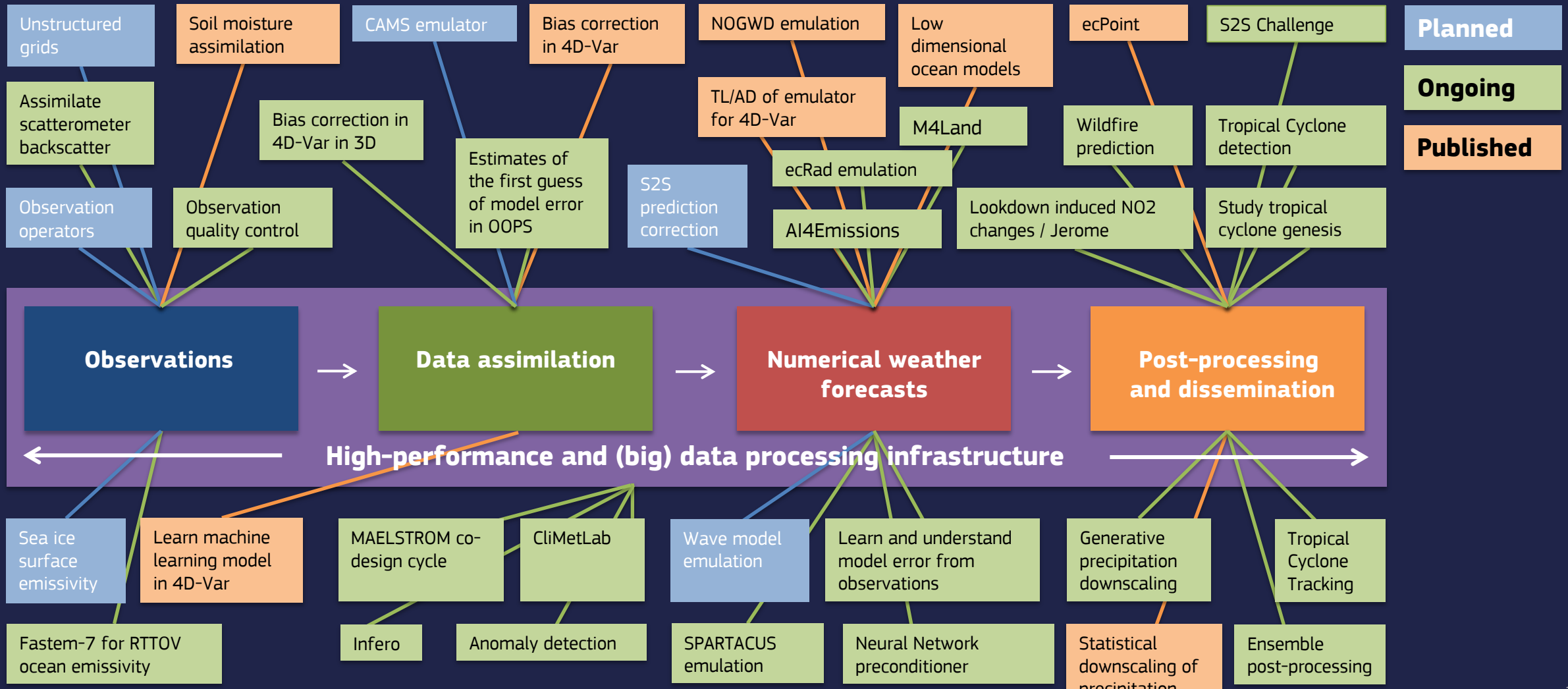
Performance of IFS at 1 km on Summit and first tests on Fugaku





Fugaku, RIKEN Center for Computational Science

Status of machine learning at ECMWF



THE STRENGTH OF A COMMON GOAL