



PROGRAMME OF
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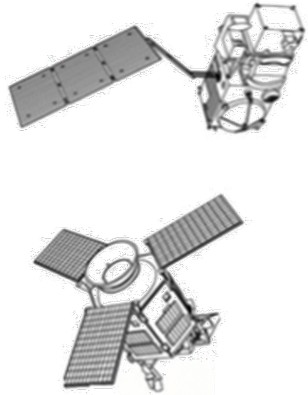
Pre-operational testing of dust scheme with high latitude dust

HLD 2026 Workshop, 12/2/2026

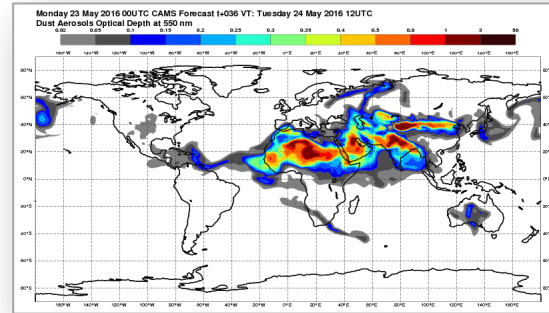
**Samuel Remy, Rose-Cloé Meyer,
and CAMAERA/CAMS2_35_bis teams**



CAMS in a nutshell

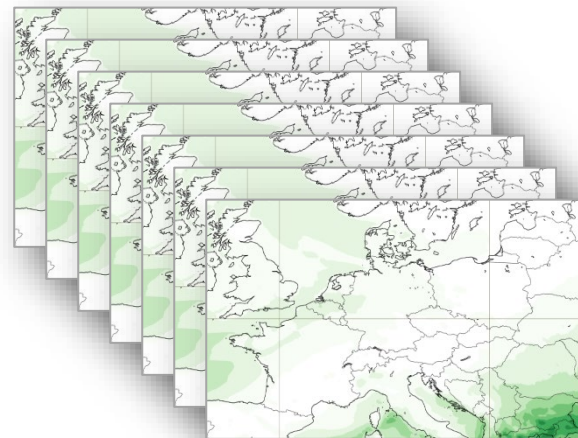


Earth Observation from satellite (>75 instruments) and in-situ (regulatory and



IFS-COMPO 40km (oper) / 80km (reana) Global

CAMS main operational data assimilation and modelling systems



PREVAIR L'air en France aujourd'hui et demain

La qualité de l'air Le dispositif français Analyses et bilans Actualités A propos de PREVAIR

Zone géographique Europe, Meropole, Outre-mer

Type de carte Qualité de l'air Indices

Pour la journée - 17/05/2017

Représentation Carte de pollution Mesures aux stations

Type de données Maximum journalier Moyenne journalière

Polluant PM10 - Particules en suspension

PM10, moyenne journalière, zone France, le 17/05/2017

Carte de prévision optimisée pour les stations. Associer des ASSTO

Pollution forecast provided by the Met Office

Today Air pollution levels will be mainly Low today with only localised pockets of Moderate.

View full 5 day air pollution forecast @DefraUKair daily forecasts

Enter your location: Search

1 2 3 4 5 6 7 8 9 10

Low Moderate High Very High

Health advice for moderate, high or very high pollution >

NEW YORK

FRESH

19:30

Low Air Quality

Dominant Pollutant: High concentrations of PM2.5

21 Air Quality Index





IFS-COMPO Cycles; Changes in operational system

Q2-2026

Q2-2027, tbc

CY49R1

CY50R1

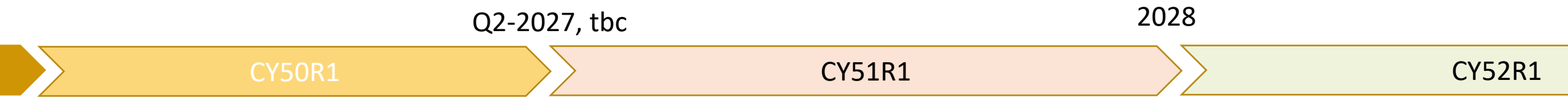
CY51R1

CY50R1:

- Online BVOC emissions
- Weekly cycle in emissions
- Use of CAMS-GLOB-ANT MOSAIC emissions
- Update het. chem in troposphere
- Sedimentation velocity from Stokes formula
- Updated SOA/Am/Nitrate growth factors



IFS-COMPO Cycles; Changes in operational system



CY51R1

- HDD modulation of residential sector emissions
- 6 bin dust scheme
- New dust scheme from CAMAERA
- Updated dry deposition
- Updated aerosol optics (desert dust, black carbon)
- Updated VOC chemistry
- Update to E4C input
- Improved photolysis in stratosphere
- coupling of aerosol SAD in strato het. chem

(note: activation by Q2-2027 means that development needs to be ready by Q2 2026, i.e. now)



IFS-COMPO Cycles; Future directions in modeling

2028

CY51R1

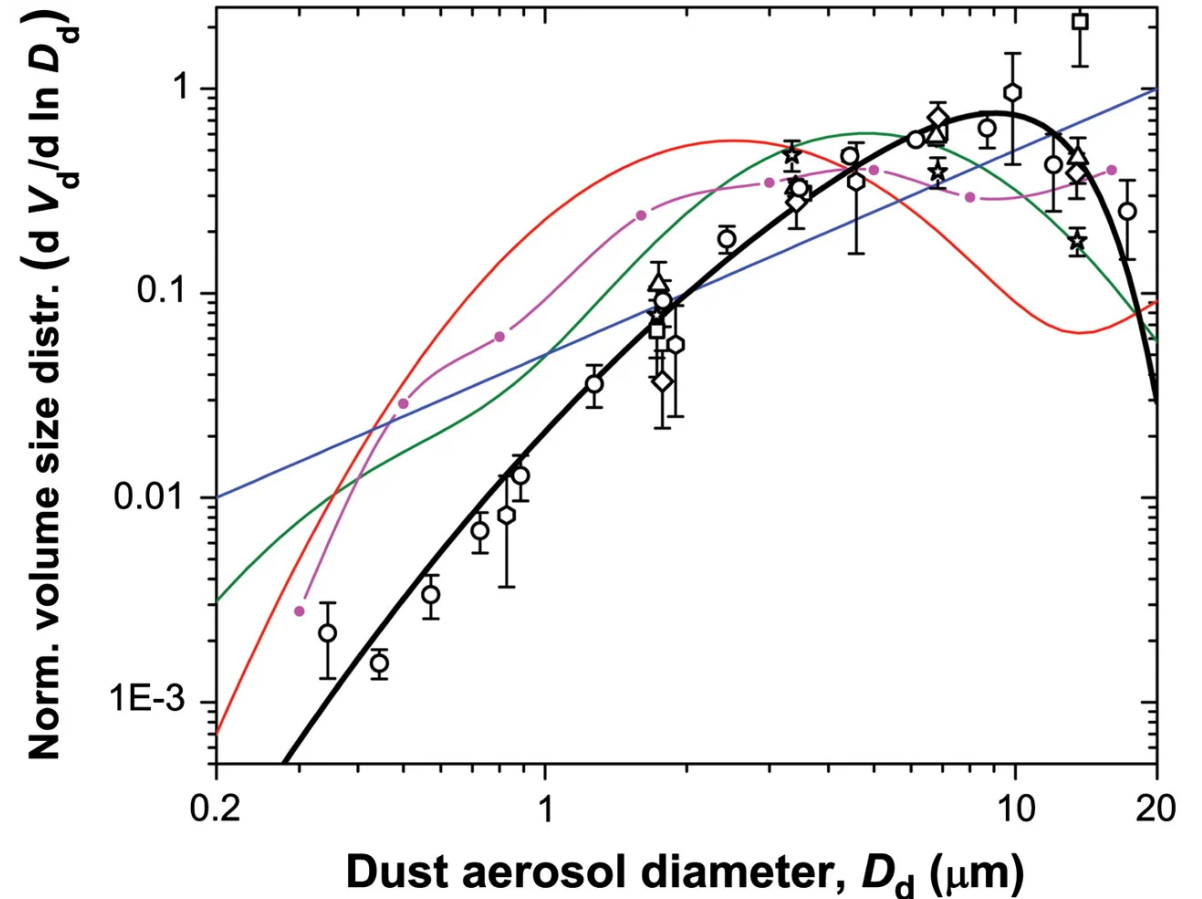
CY52R1

CY52r1 & beyond: ongoing research activities

- Halogen chemistry in troposphere; unified chemistry mechanism
- Online DMS / soil NO_x emissions
- (optional) Fungal spores and pollen
- Updated SOA scheme
- Fine/coarse bin for sulphate/OM/BC/SOA
- Development of modal aerosol scheme (HAMM7)

IFS-COMPO – issues with dust bins definition

- Dust bins are defined in IFS-COMPO as $[0.03 - 0.5]$, $[0.5 - 0.9]$, $0.9 - 20]$ micron radius since the 2000s
- Back then, the size distribution of dust was assumed to be evenly distributed between these bins
- Brittle Fragmentation Theory (Kok et al 2011, 2017, Meng et al 2022) updated the assumed size distribution of dust at emissions => much coarser than before!
- Since cycle 46R1 (2019), BFT is used for the size distribution of dust emissions in IFS-COMPO



From Kok11: the normalized volume size distribution of emitted dust aerosols used in 4 GCM studies [magenta line and circles, and blue, green, and red lines]. The thick black line denotes the theoretical PSD of Eq. 6, and symbols and error bars denote measurements

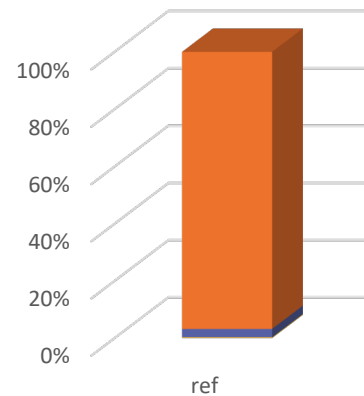


IFS-COMPO – issues with dust bins definition

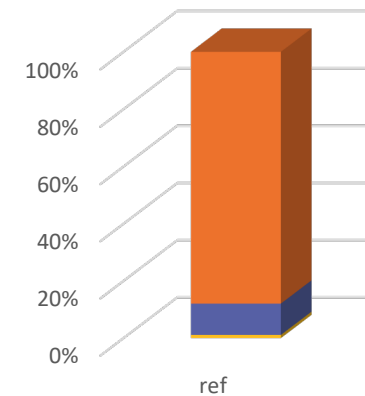
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- Since cycle 46R1 (2019), BFT is used for the size distribution of dust emissions in IFS-COMPO

- **As a result, strong unbalance in the distribution of dust emissions and mass between the three size bins since cycle 46R1!**

Distribution of emissions into dust bins



Distribution of mass into dust bins



bin1 bin2 bin3 bin4 bin5 bin6

bin1 bin2 bin3 bin4 bin5 bin6

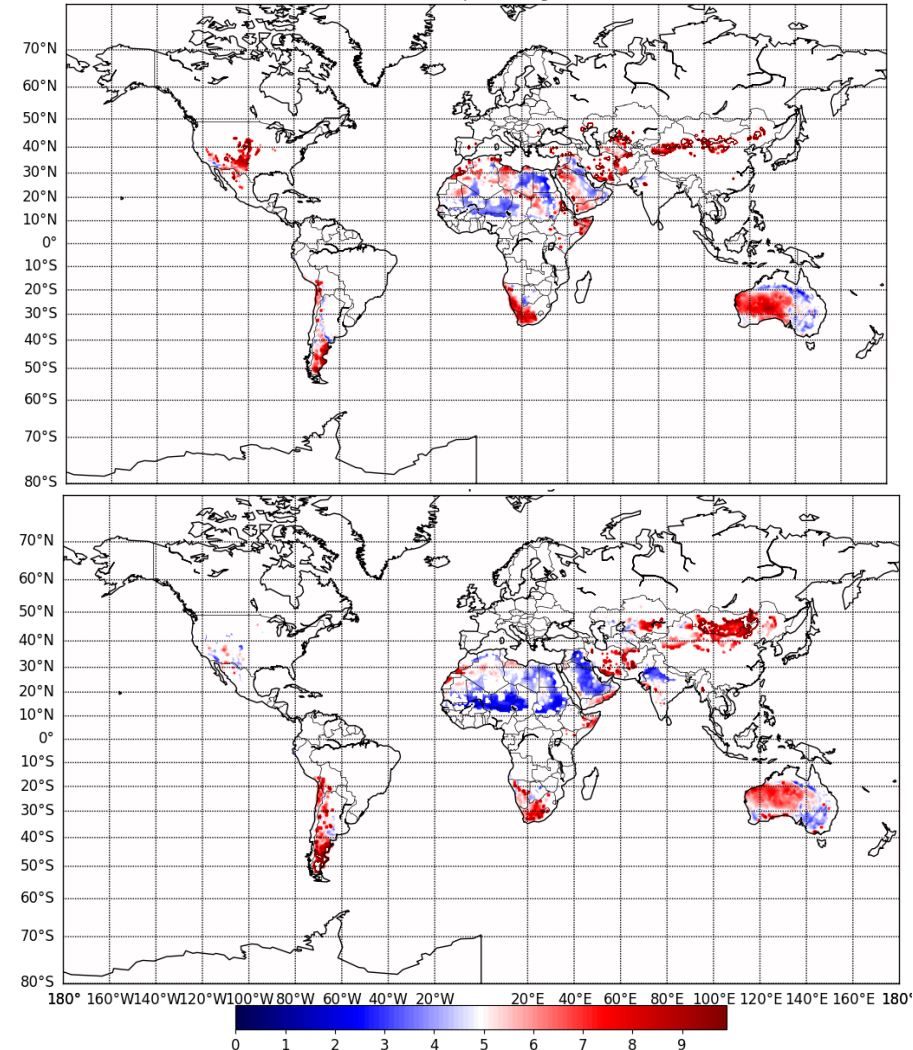


“dust package” proposed for 51R1 – what is it?

- New dust emission scheme from CAMAERA, adapted from SILAM dust emission scheme:
 - Threshold velocity for dust emissions from remote sensing (Pu et al 2020)
 - Use of a specific surface roughness input from remote sensing
 - Further tuned/optimized for high latitude dust



CAMAERA



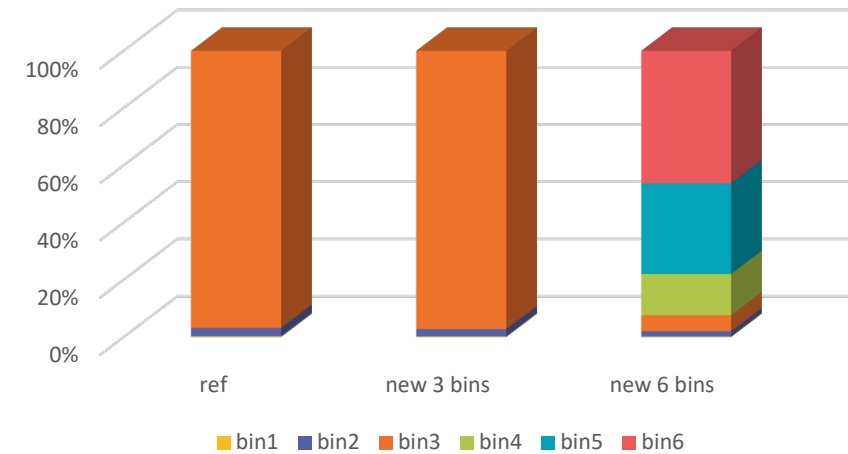
Threshold velocity from Pu et al (2020), gap-filled with 5 m/s & value. January (top) and May (bottom).



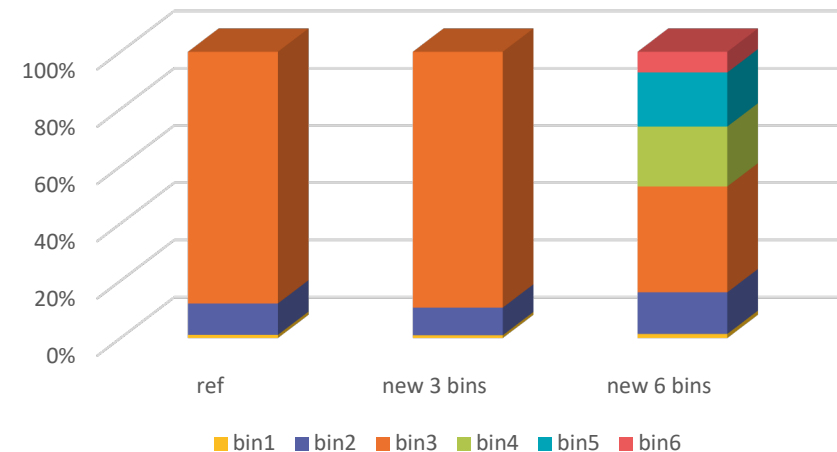
“dust package” proposed for 51R1 – what is it?

- 6 bins for dust scheme : size bins defined as (in radius, micron) :
 - 0.03 – 0.5
 - 0.5 – 0.9
 - 0.9 – 2.5
 - 2.5 – 5
 - 5 – 10
 - 10 – 20
- Allows for a better representation of desert dust size distribution and processes that depend on it (sedimentation in particular)
- Could make it easier for regional models to map the simulated desert dust mass into their own bins/modes

Distribution of emissions into dust bins



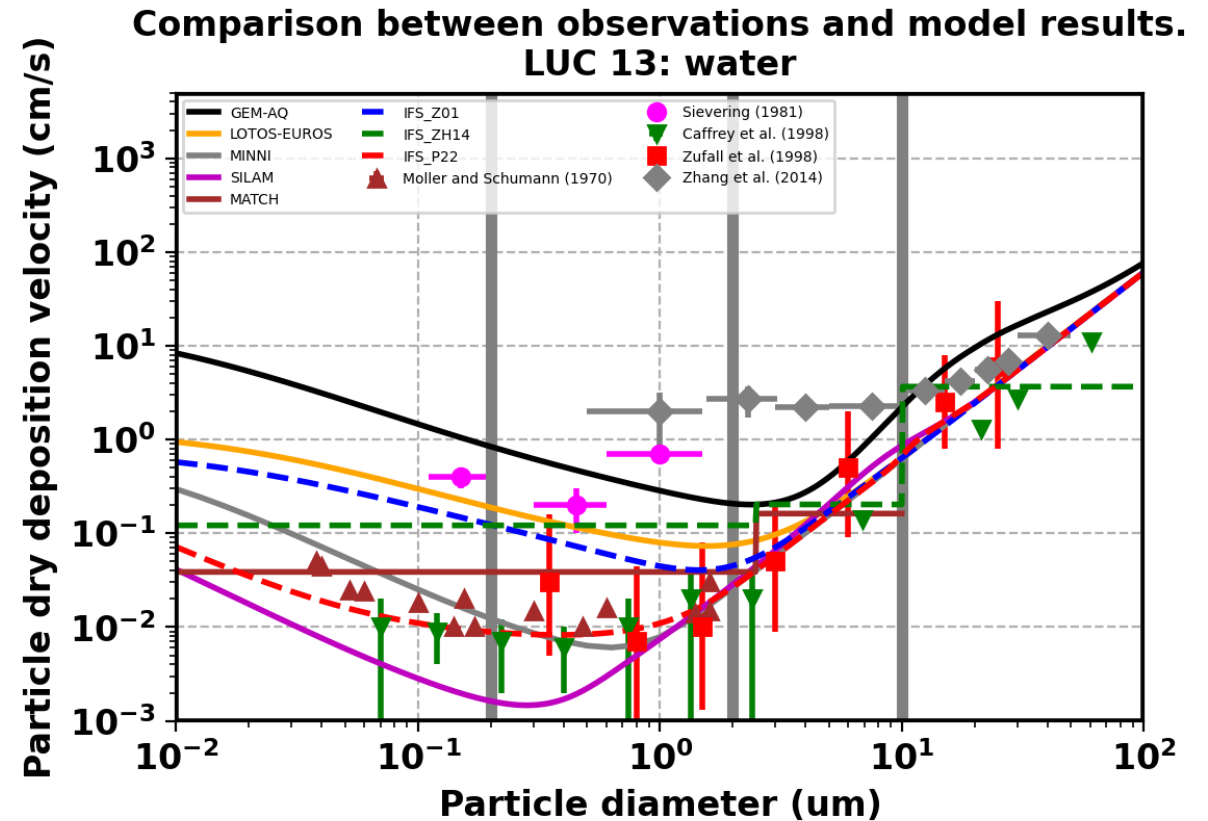
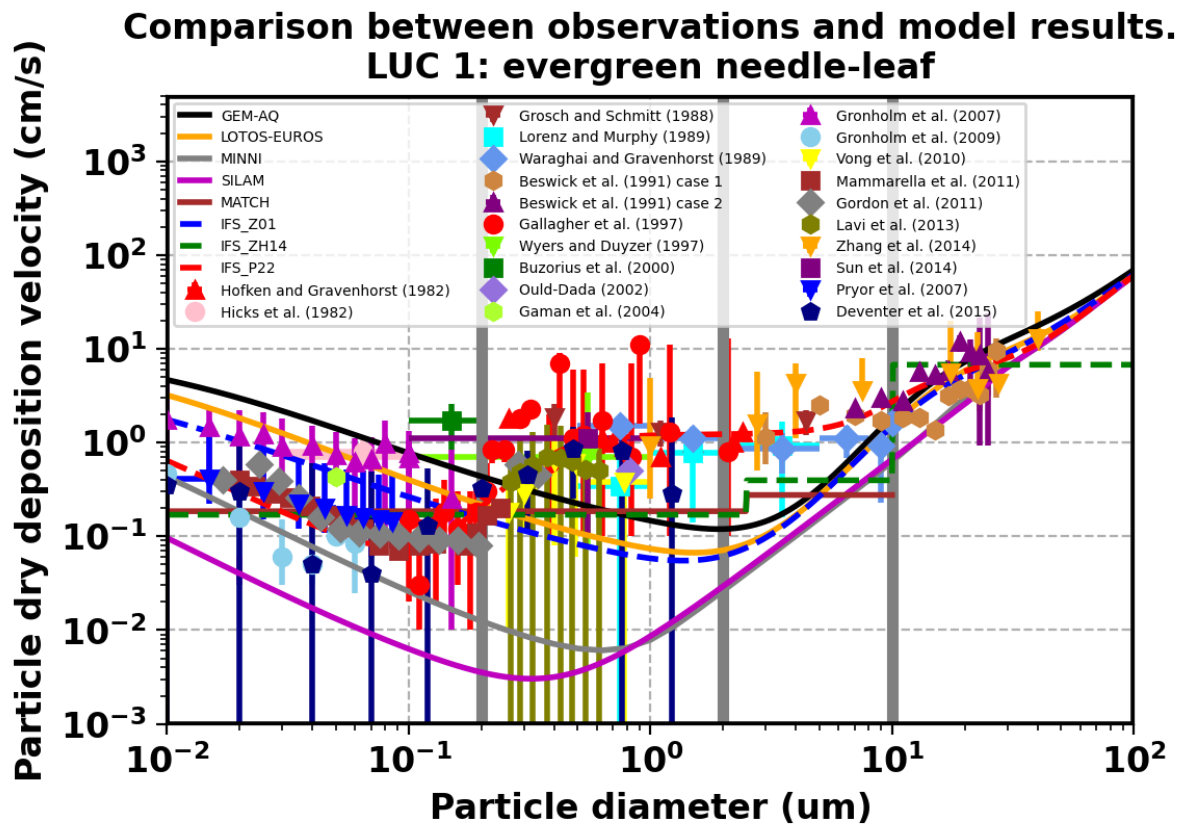
Distribution of mass into dust bins





“dust package” proposed for 51R1 – what is it?

- Pleim et al (2022) dry deposition, following CAMAERA dry deposition intercomparison





Testing of proposed IFS-COMPO 51R1 contribs

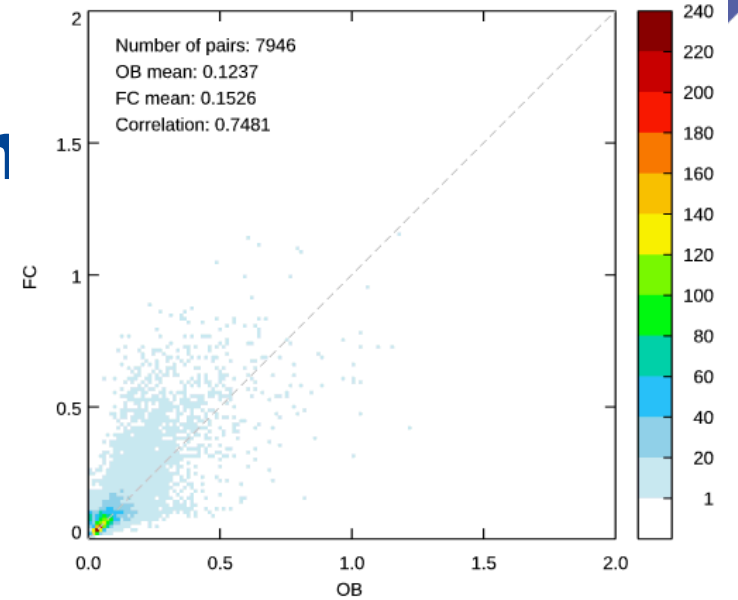
- Forecast only (without data assimilation of aerosols/chemistry) for 2017, 2019, 2023, 2025
- With data assimilation of aerosols/chemistry (much slower!) for June/July 2025, intended up to January 2026
- Tests all use 6 desert dust bins, with the new dust emission scheme (DUST experiment), and also the new dry deposition scheme on top (DUST_DDEP)



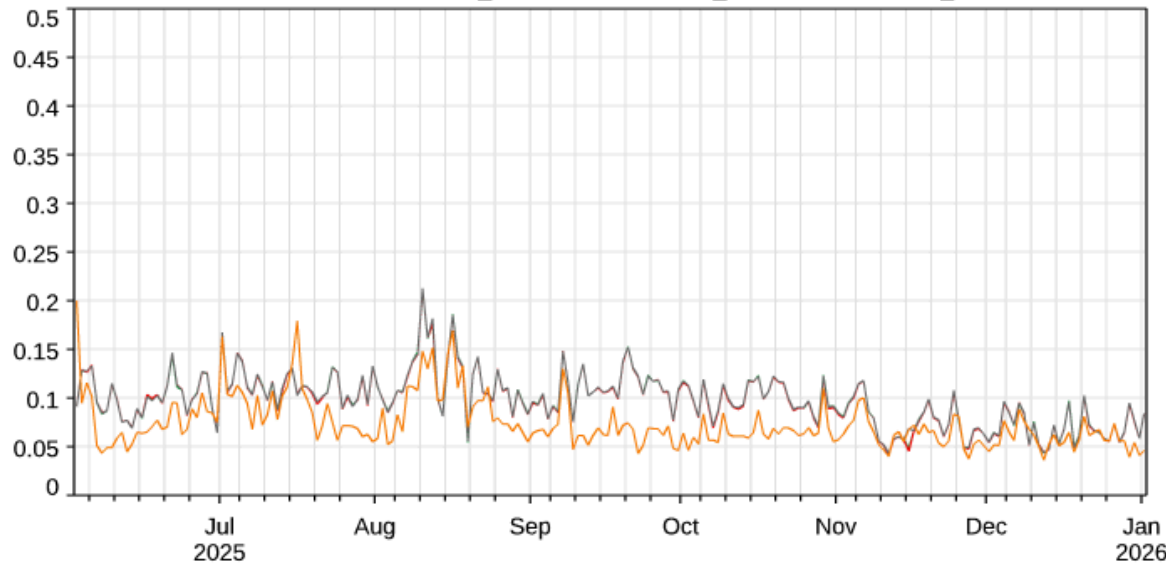
Impact of 51R1(fc only) changes on

- Over Africa, nice improvement by DUST_DDEP (desert dust and dry deposition changes)

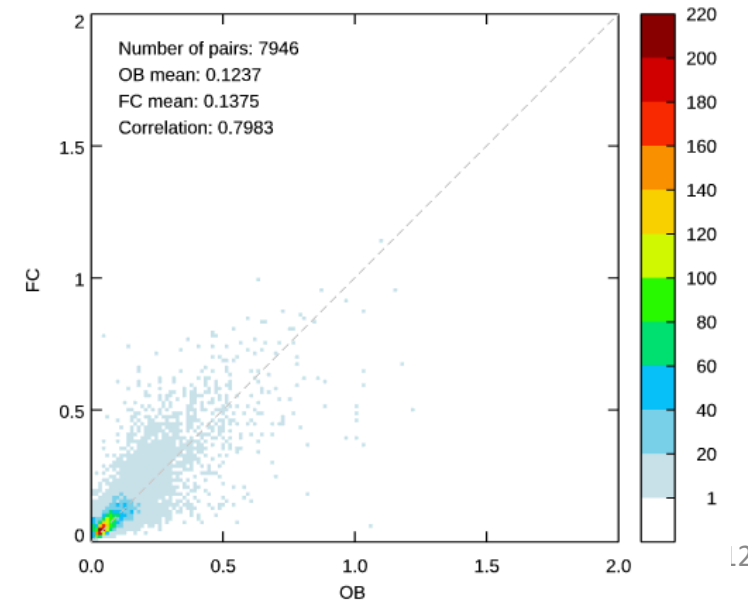
Model (CY50R1) vs L1.5 Aeronet Any AE @ 1020nm
2 Jun 2025 - 1 Jan 2026. 64 sites in Africa.
Daily means using 00Z, T+3 to 24. Ver0D 12.17.5.



RMS error. Model against L1.5 Aeronet AOT at 1020nm.
64 sites in Africa. 2 Jun 2025 - 1 Jan 2026. 00Z, T+3 to 24. Ver0D 12.17.5.
— CY50R1 — E4C_INPUT — VOC_UPD — DUST_DDEP



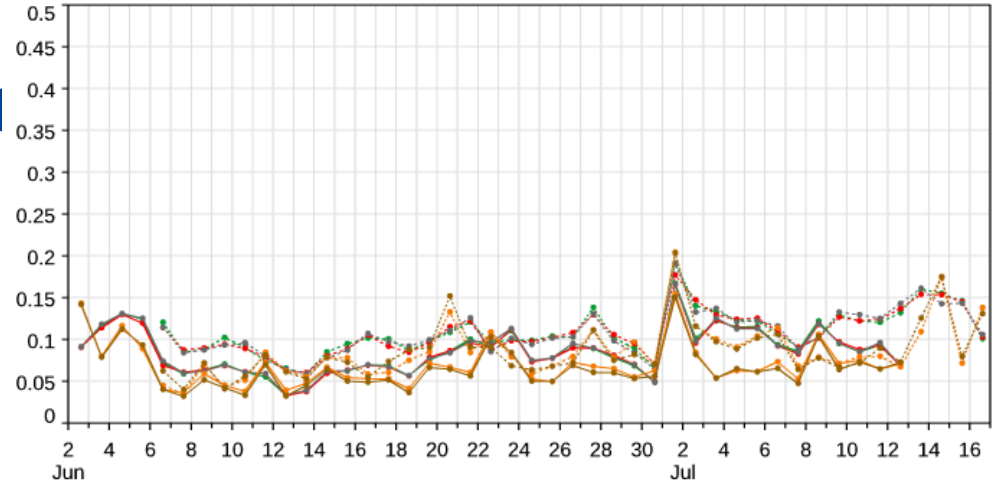
Model (DUST_DDEP) vs L1.5 Aeronet Any AE @ 1020nm
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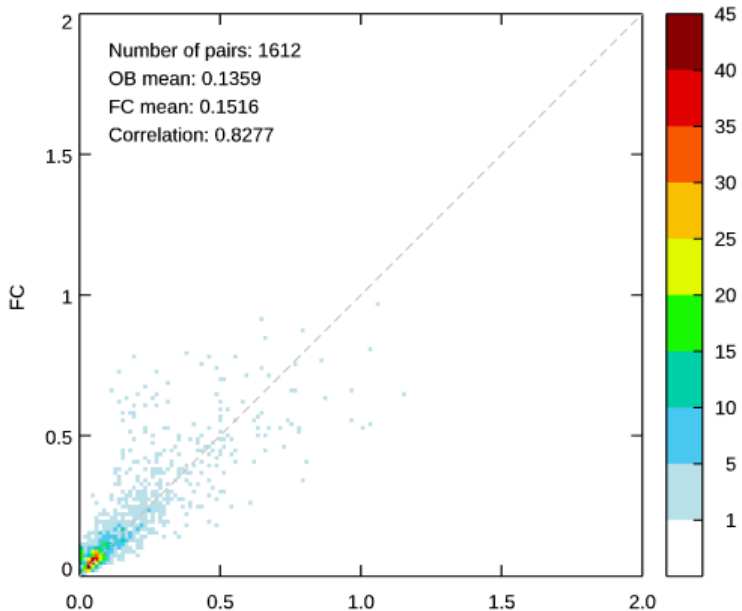
Impact of 51R1(DA) changes

- Large improvement over Africa (both 500 and 1020nm) in terms of bias, error and correlation with DUST and DUST_DDEP

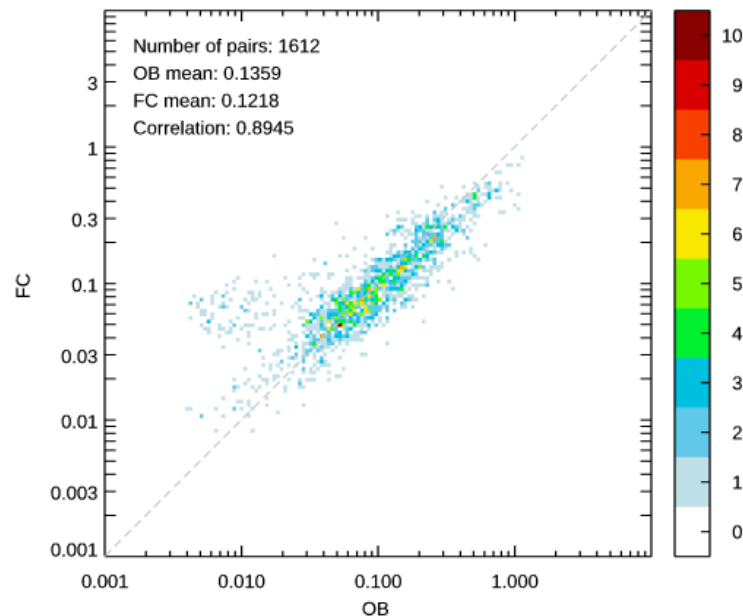
RMS error. Model against L1.5 Aeronet AOT at 1020nm.
59 sites in Africa. 2 Jun - 12 Jul 2025. 00Z, T+6 to 120. Ver0D 12.17.5.



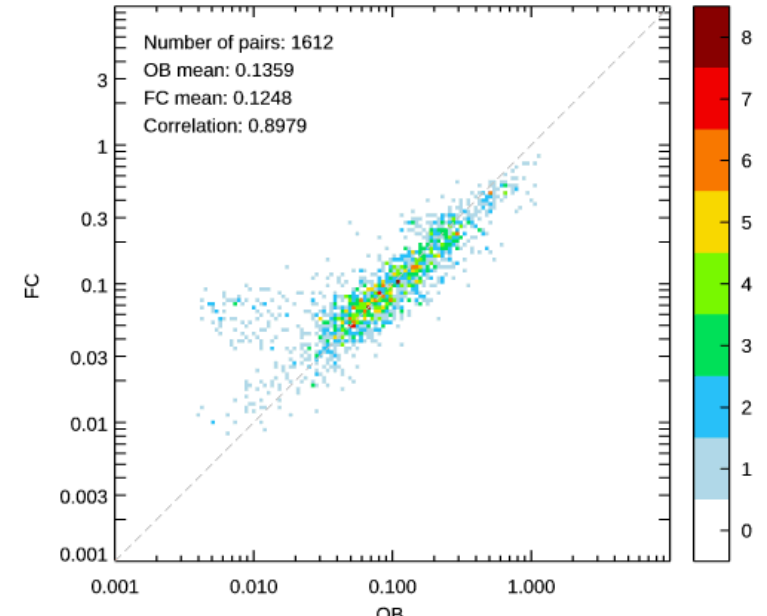
Model (CY50R1) vs L1.5 Aeronet Any AE @ 1020nm
2 Jun - 12 Jul 2025. 58 sites in Africa.
Daily means using 00Z, T+6 to 24. Ver0D 12.17.5.



Model (DUST) vs L1.5 Aeronet Any AE @ 1020nm
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Daily means using 00Z, T+6 to 24. Ver0D 12.17.5.



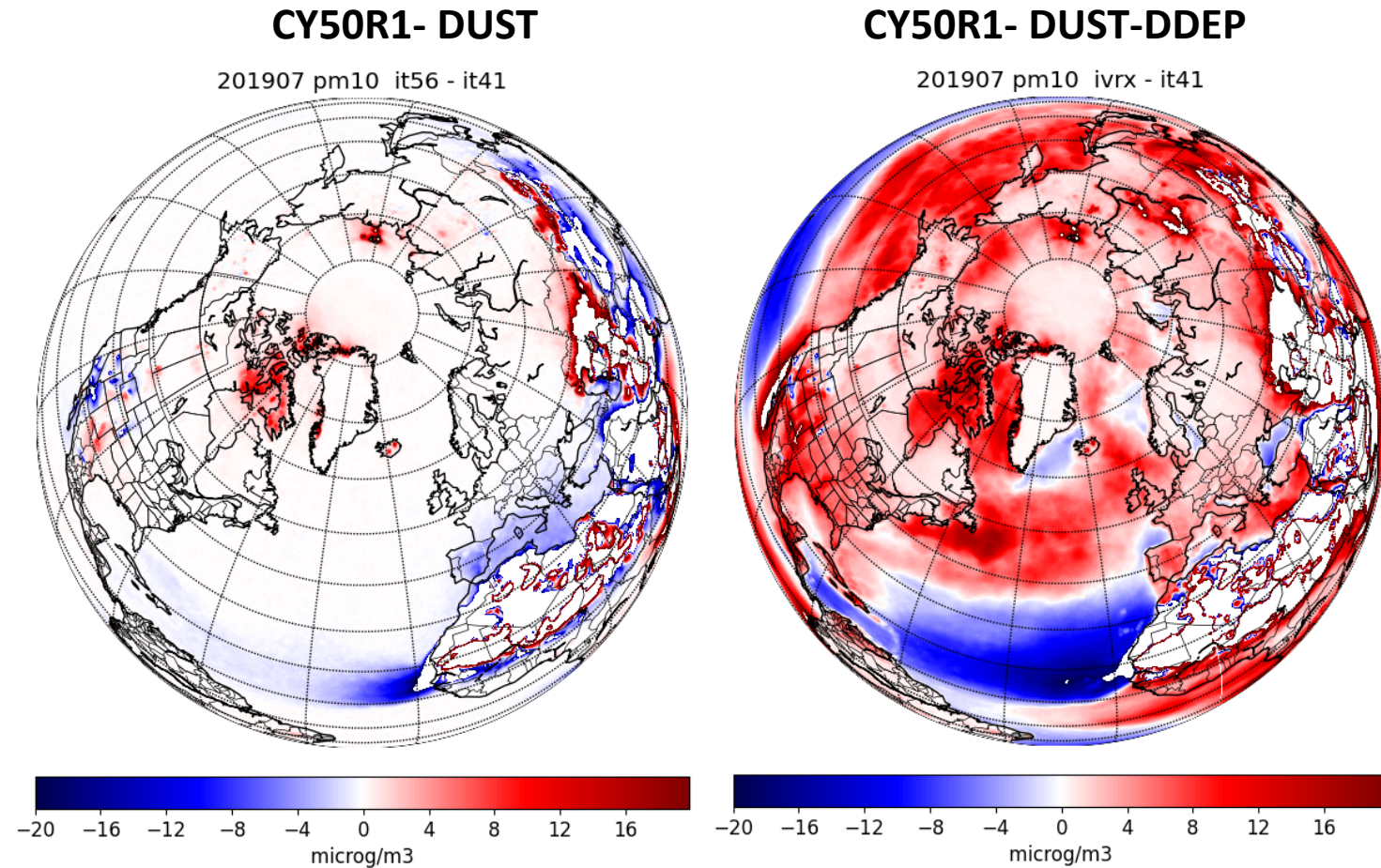
Model (DUST_DDEP) vs L1.5 Aeronet Any AE @ 1020nm
2 Jun - 12 Jul 2025. 58 sites in Africa.
Daily means using 00Z, T+6 to 24. Ver0D 12.17.5.





Impact of 51R1(fc only) changes on PM10

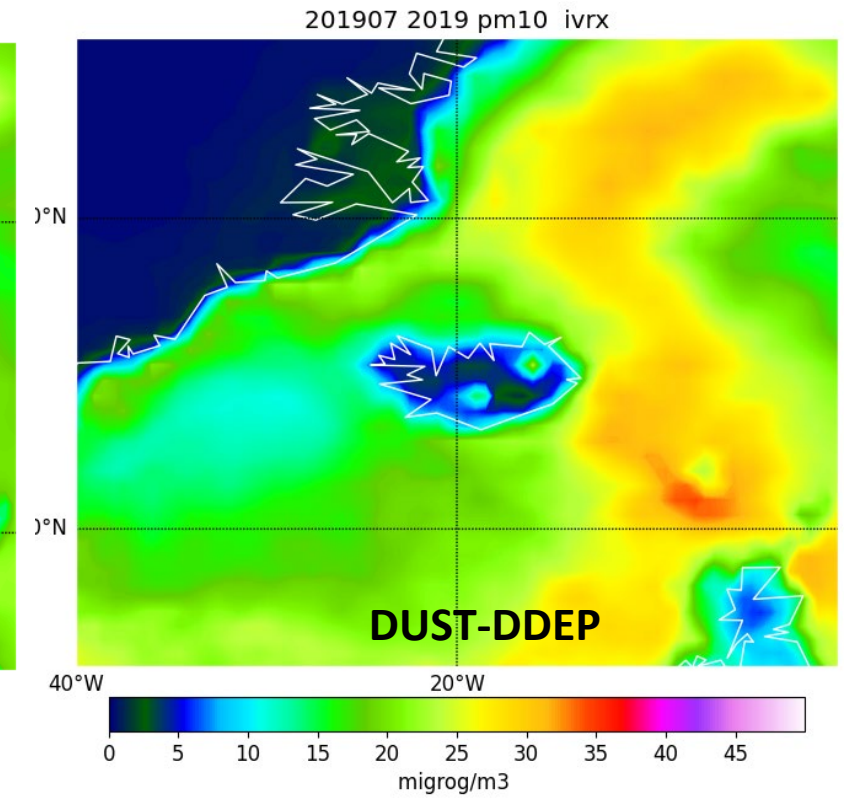
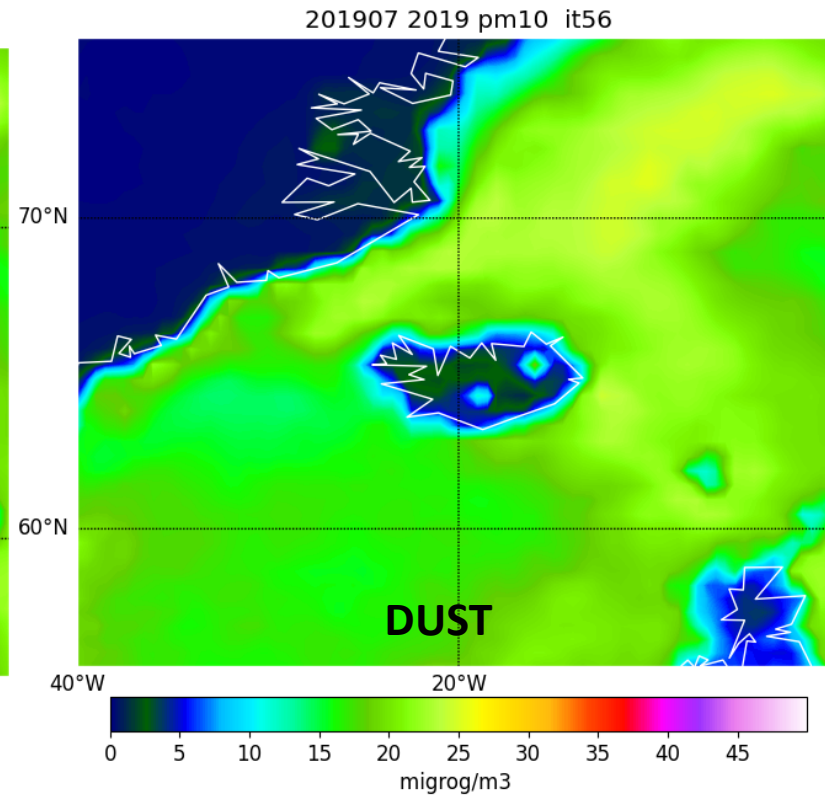
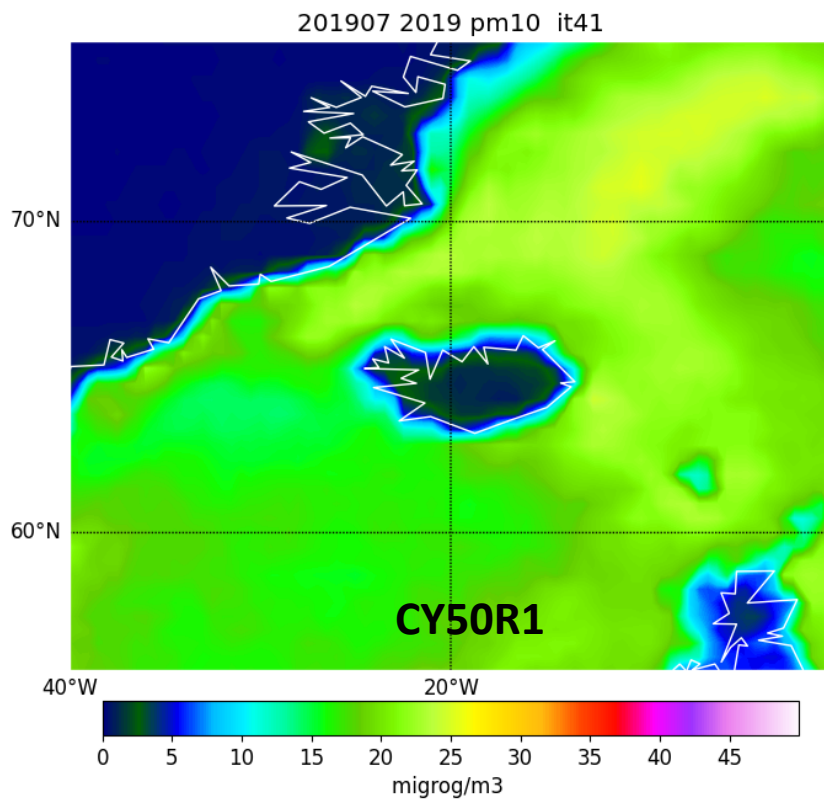
- Simulated PM10 difference in July 2019 as compared to CY50R1
- With the new desert dust emission scheme, enhanced emissions over some polar regions





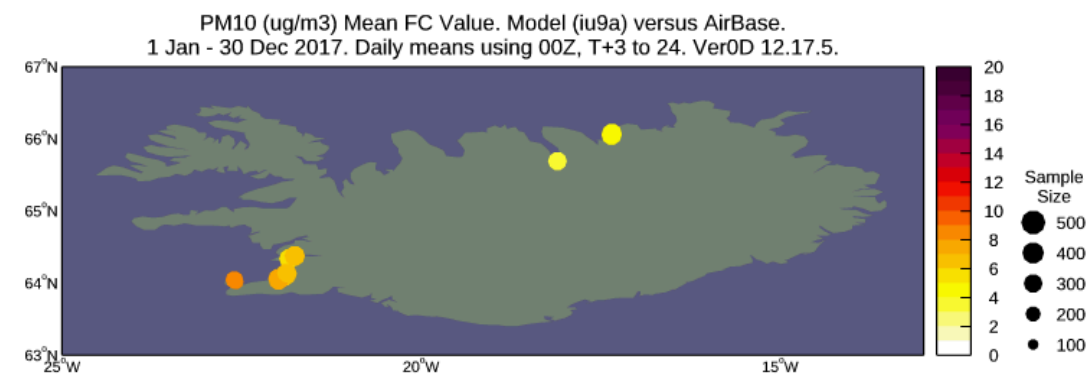
Impact of 51R1(fc only) changes on PM10

- Simulated PM10 in July 2019 as compared to CY50R1
- Some local dust emission sources over Iceland



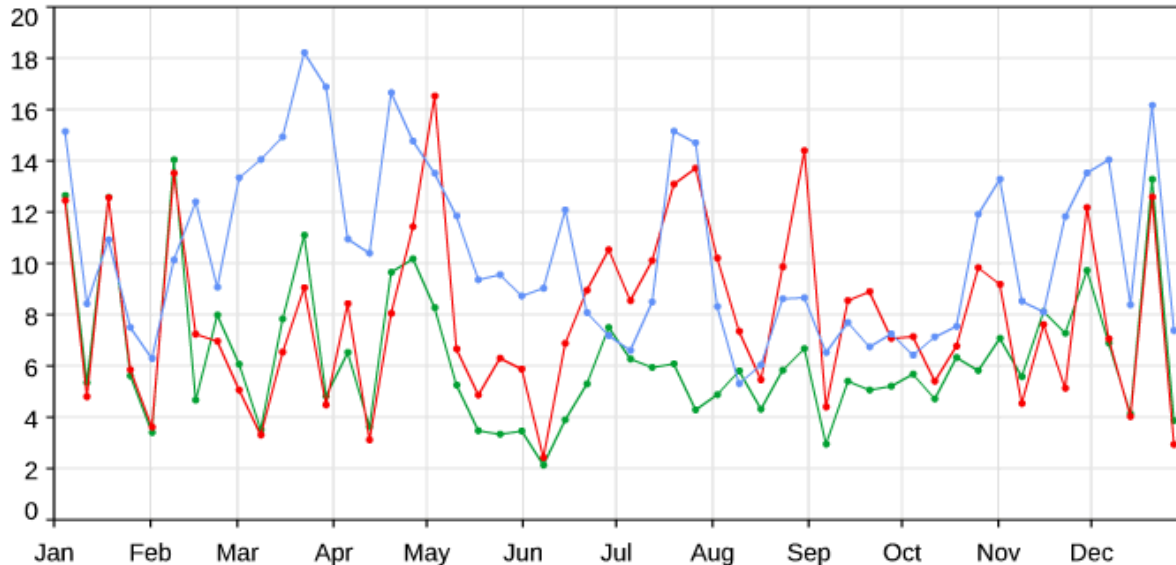
PM10 evaluation versus obs

- Some dust episodes are simulated
- Very partial evaluation



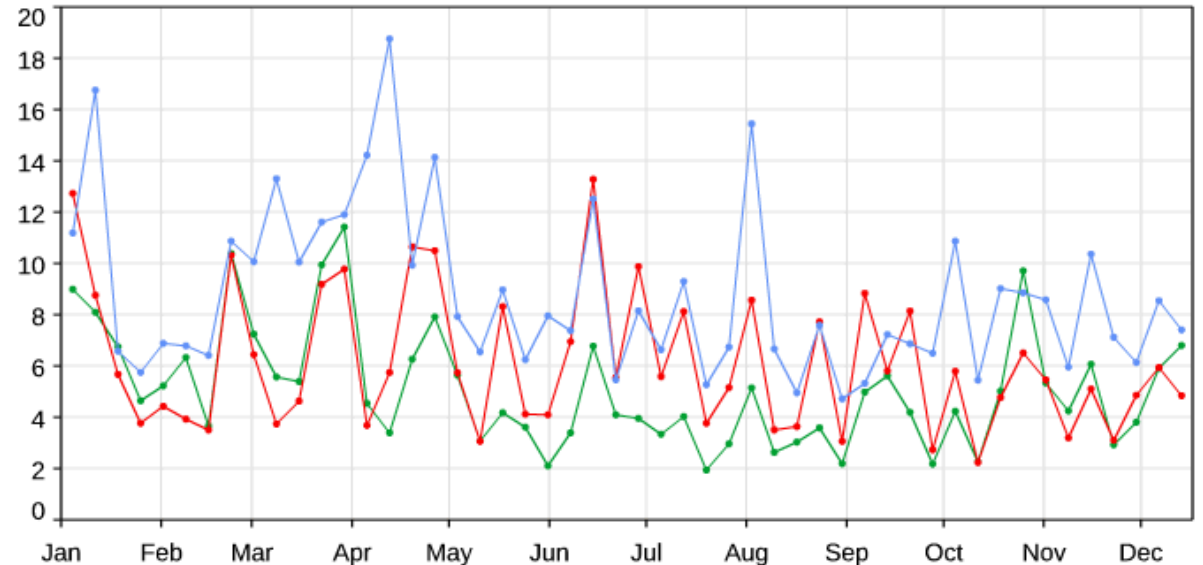
PM10 (ug/m3) Mean. Model versus AirBase.
12 sites in Iceland. 1 Jan - 30 Dec 2017. 00Z, T+3 to 24. Ver0D 12.17.5.

— Obs — iu9a — ivzv



PM10 (ug/m3) Mean. Model versus AirBase.
9 sites in background Iceland. 1 Jan - 16 Dec 2019. 00Z, T+3 to 24. Ver0D 12.17.5.

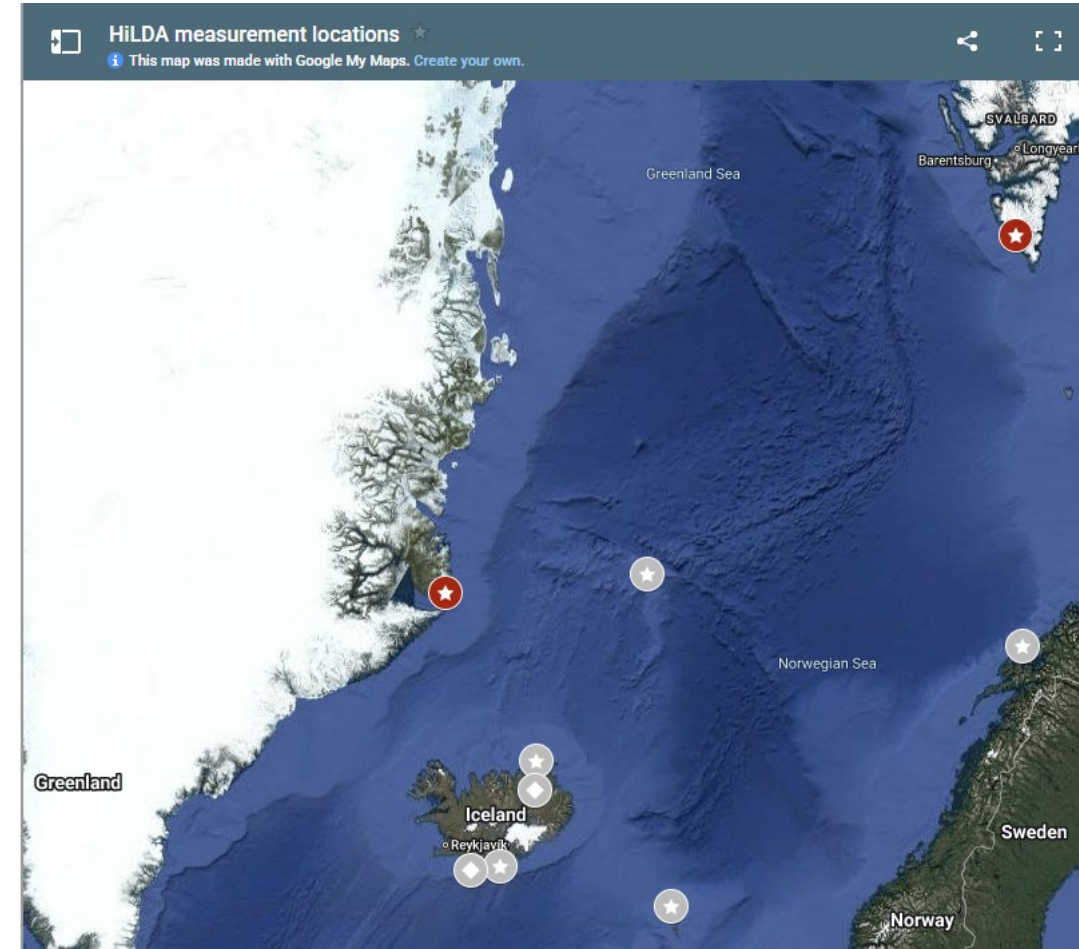
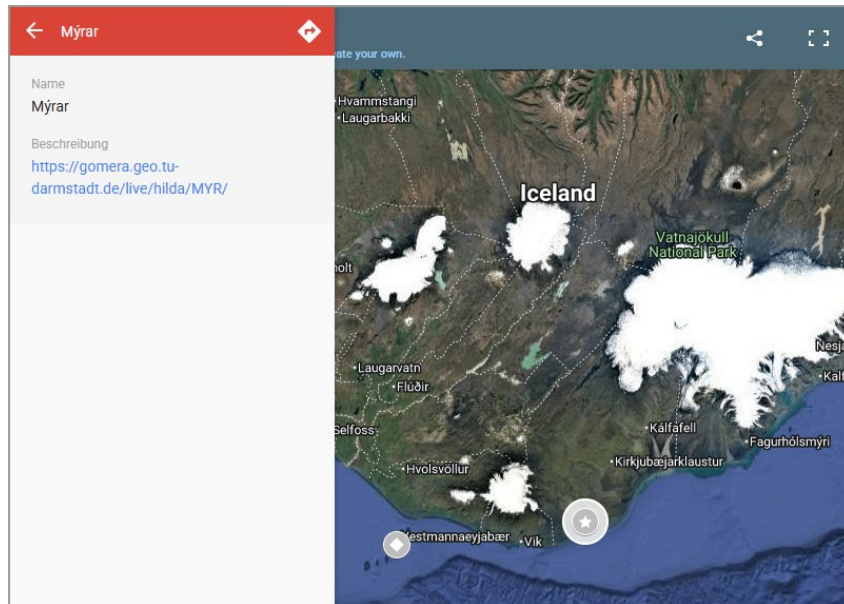
— Obs — it41 — ivrx





PM10 evaluation versus obs from HILDA network

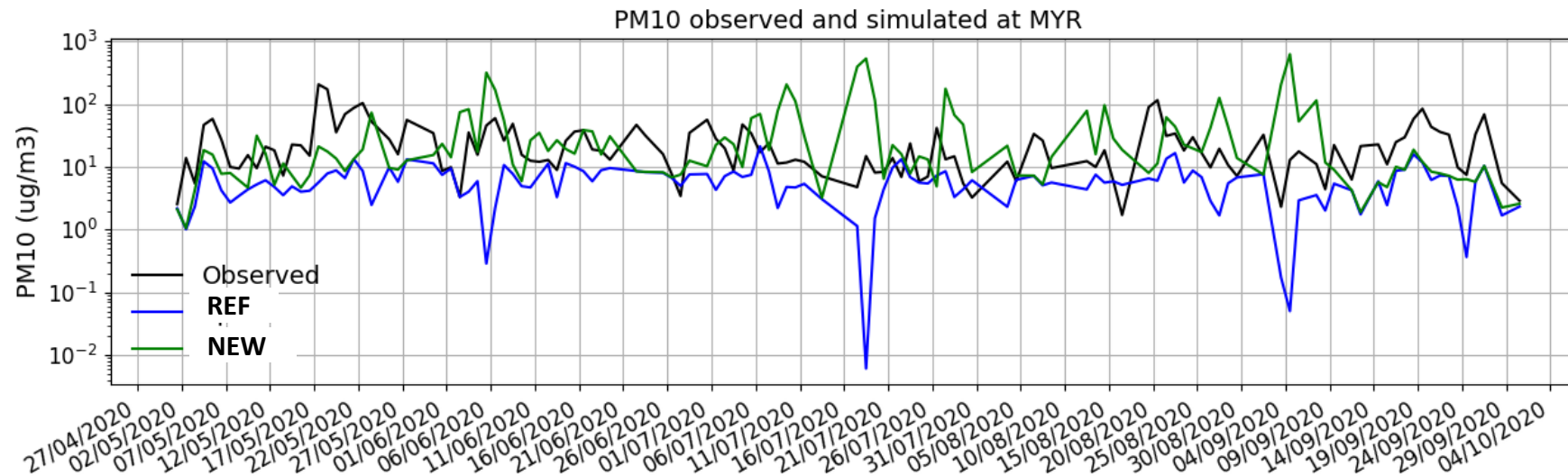
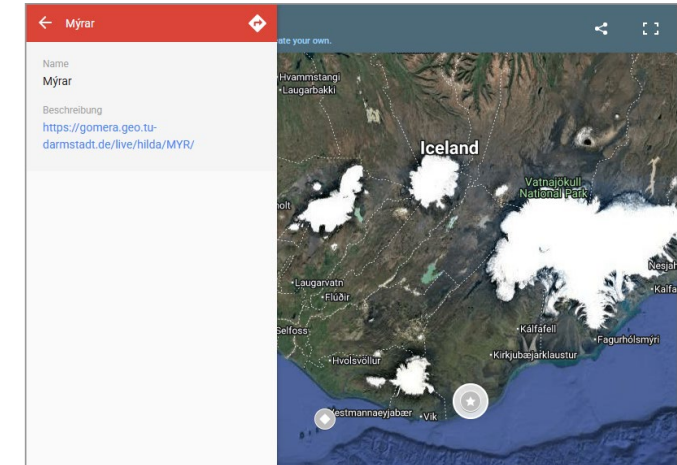
- PM observations over several high latitude stations
- Provided by K. Kandler – Thanks!
- Focus on Myrar station in S. Iceland





PM10 evaluation versus obs from HILDA network

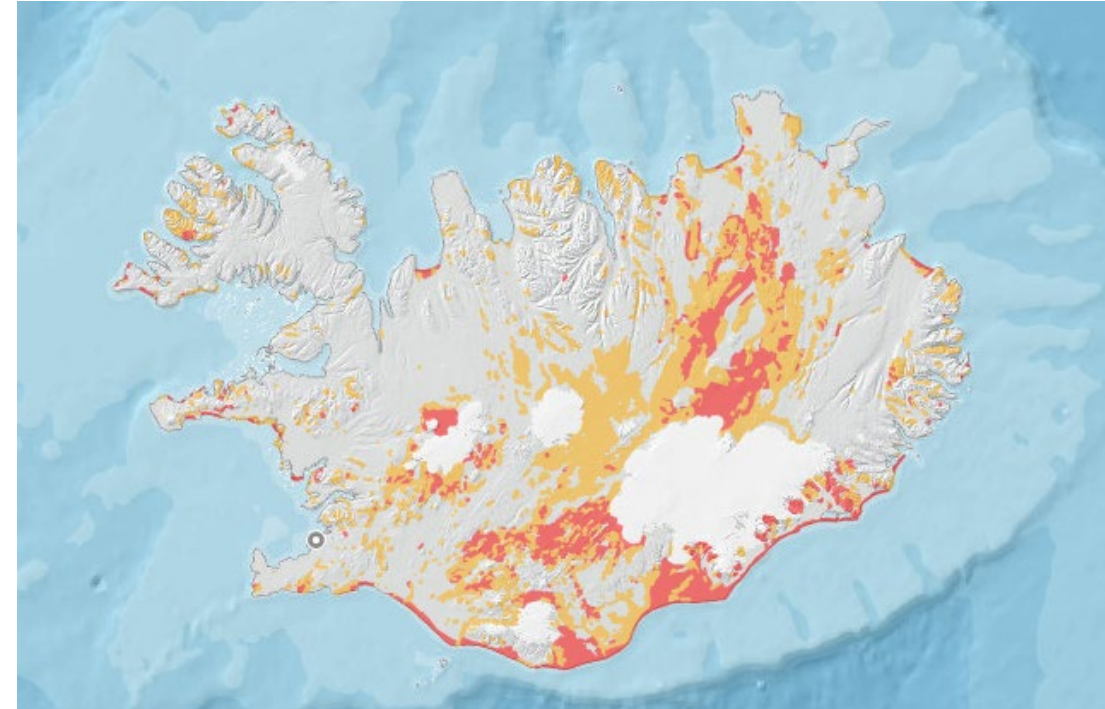
- Focus on Myrar station in S. Iceland – Summer 2020
- Desert dust episodes are simulated with the new dust emission scheme
- Way too many false alarms!





Conclusions

- Following work in the CAMAERA project, a simple representation of high latitude dust is to be introduced in cycle 51R1 of IFS-COMPO
- Discrepancy between the model resolution (40km) and the typical scale of high latitude dust emitting regions
- Evaluation is very sketchy
- Feedback welcome!





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Thank you



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