CAMAERA

HIGH RESOLUTION SIMULATIONS WITH IFS-COMPO

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PROGRAMME OF THE EUROPEAN UNION

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INTRODUCTION

In the context of WP9, high resolution IFS-COMPO runs are carried out with cycle 49R1, at a $T_{CO}1279$ resolution (approx. 9km grid cell), without data assimilation. The objectives are:

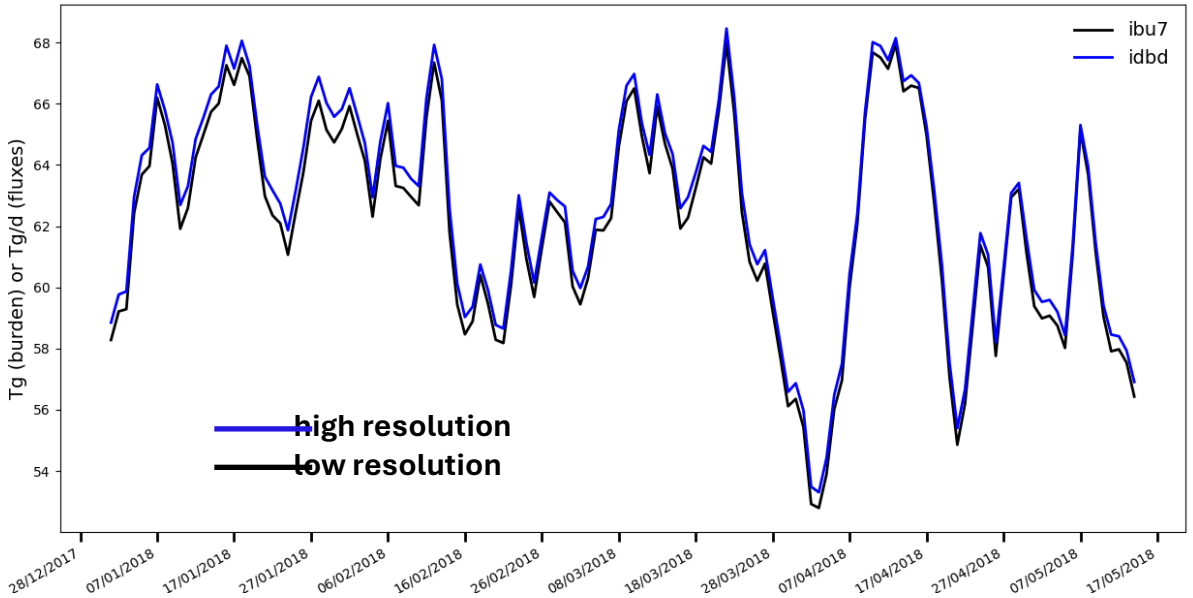
- To compare fields and diagnostics with regional models, using similar emissions and resolution
- Assess the impact of a (large) resolution upgrade on simulated fields and on the skill of the forecasts.

Two experiments are ongoing, using regional or global emissions (over Europe). Here we compare only the low resolution and high resolution IFS-COMPO runs using global emissions. The runs compared use the following resolution:

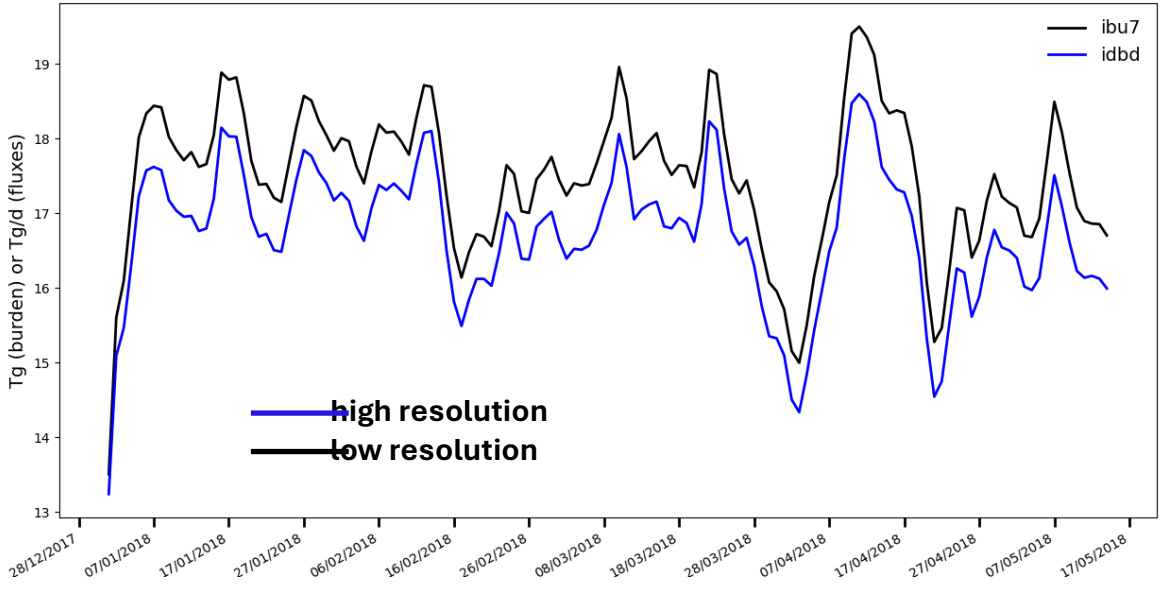
- T_L511, the current operational resolution (~40 km grid cell)
- $T_{CO}1279$, the current deterministic NWP resolution (~9km grid cell)

A PEEK AT GLOBAL BUDGETS : SEA-SALT AEROSOLS

- Bin 3 (super coarse) budget shown here
- Production depends on wind (power 2) and SST
- Higher emissions – but lower burden! More so for bin 1 and 2



Emissions



Tropospheric burden

DGETS : SEA-SALT AEROSOLS

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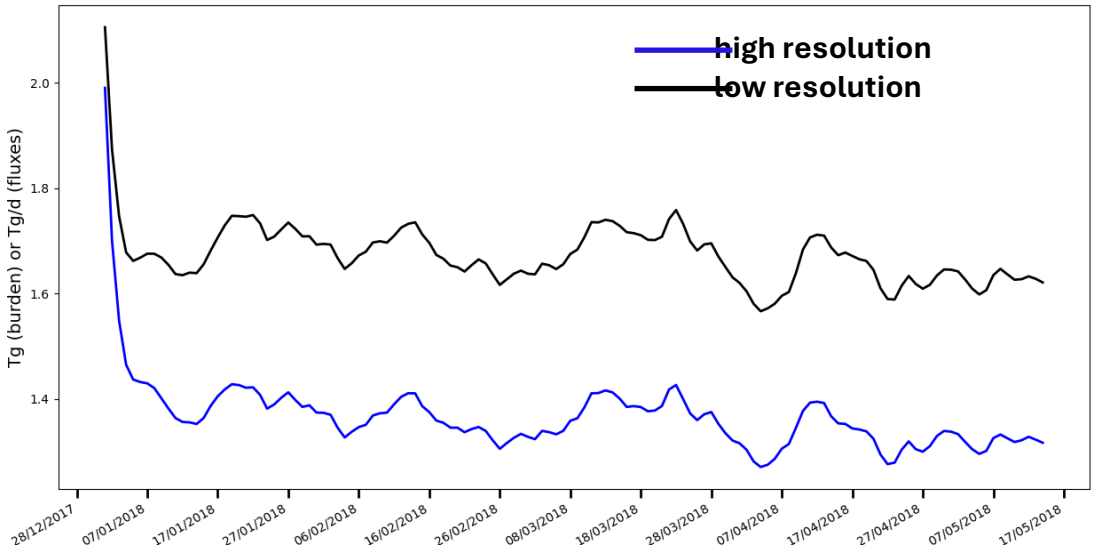
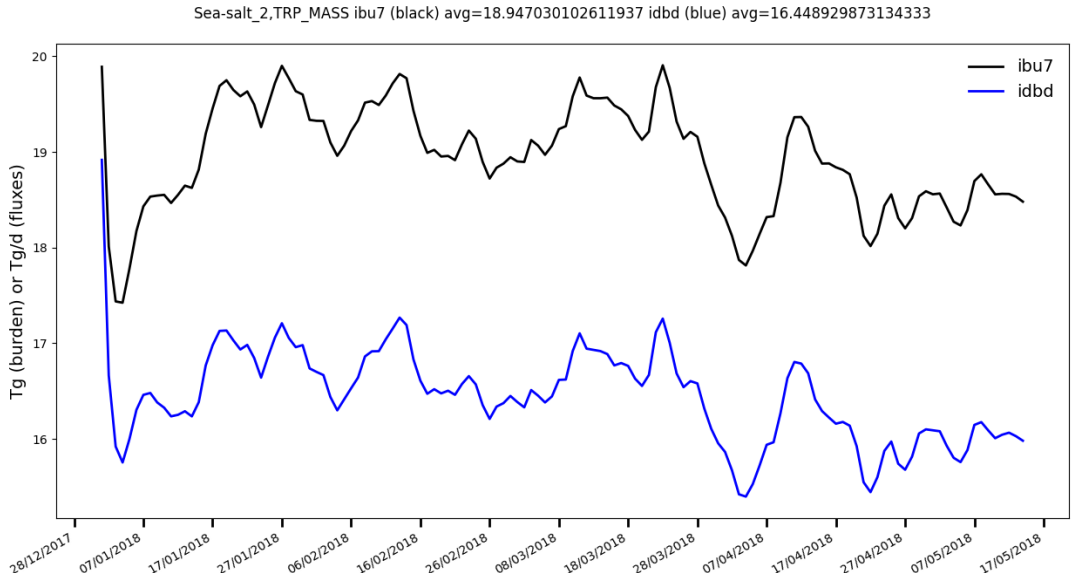
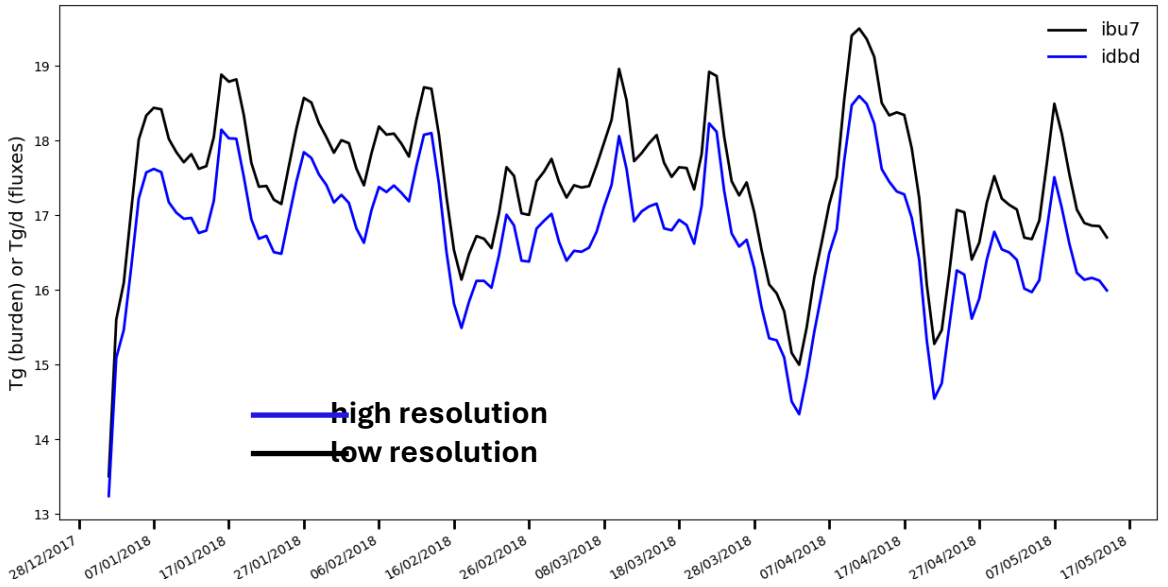


Tropospheric burden bin 1



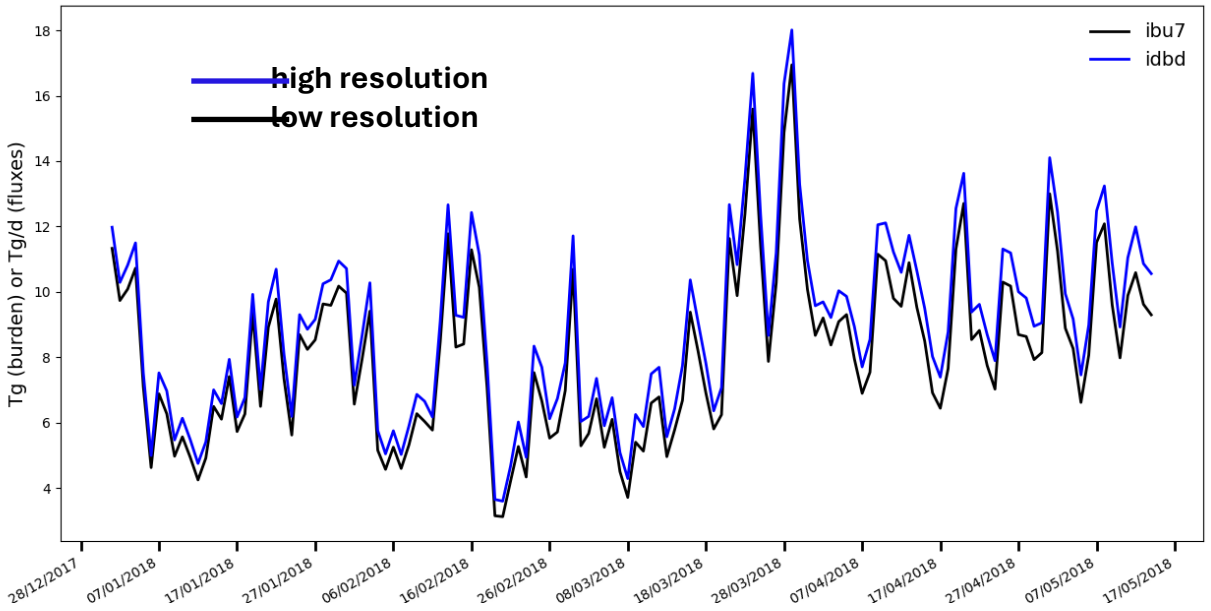
Tropospheric burden bin 2



Tropospheric burden bin 3

A PEEK AT GLOBAL BUDGETS : DESERT-DUST

- Production depends on wind (power 3), soil wetness and typology, dust source function
- Higher emissions and burden



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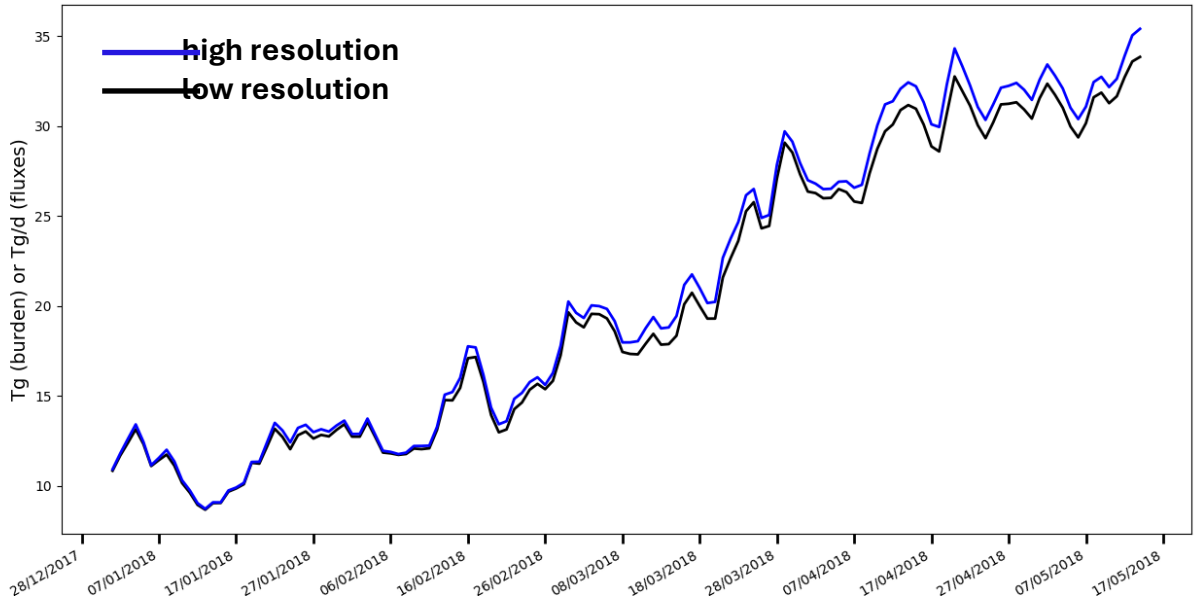
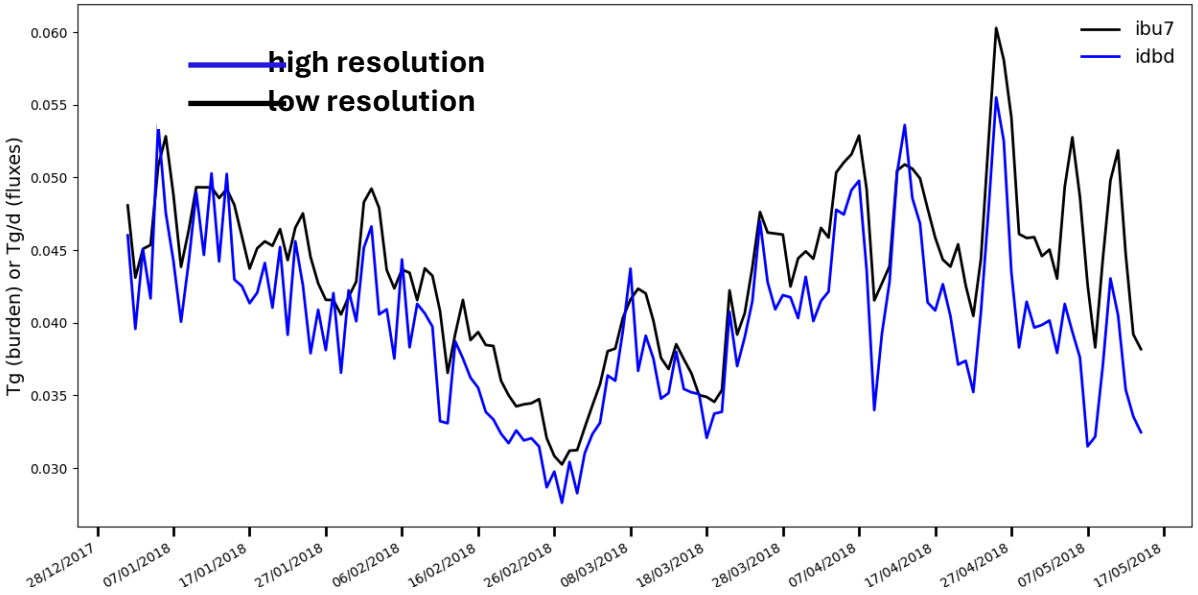


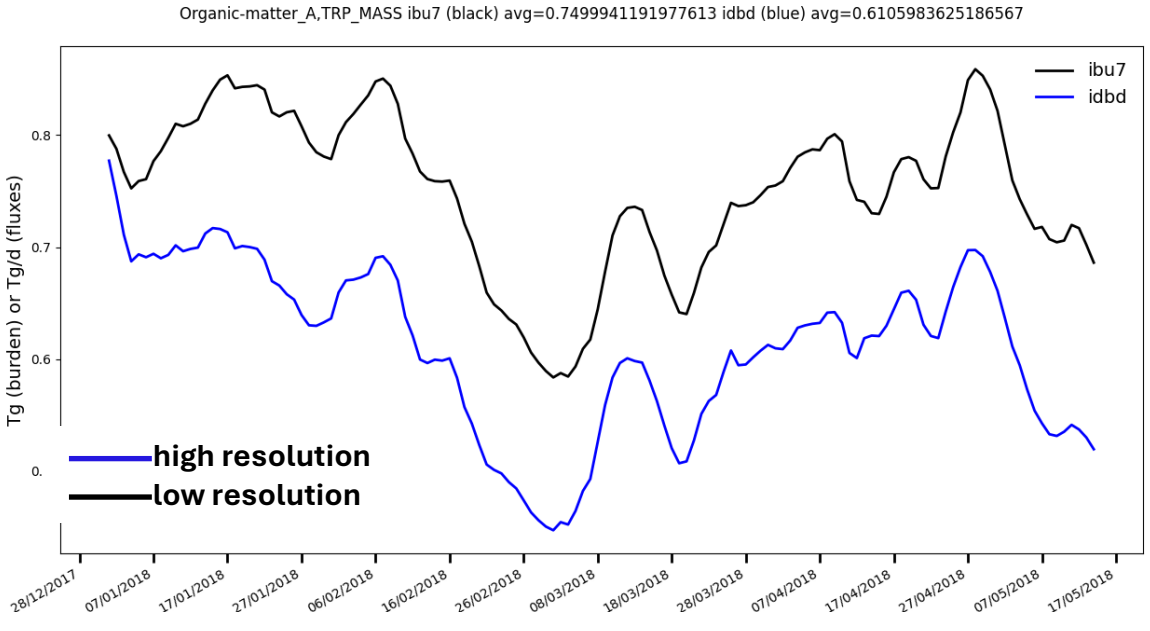
Tropospheric burden

A PEEK AT GLOBAL BUDGETS : ORGANIC MATTER

- Lower emissions with high res – although emissions are not dynamic, they are the sum of anthropogenic (CAMS_GLOB_ANT) and biomass burning (GFAS) emissions
- Significantly lower burden



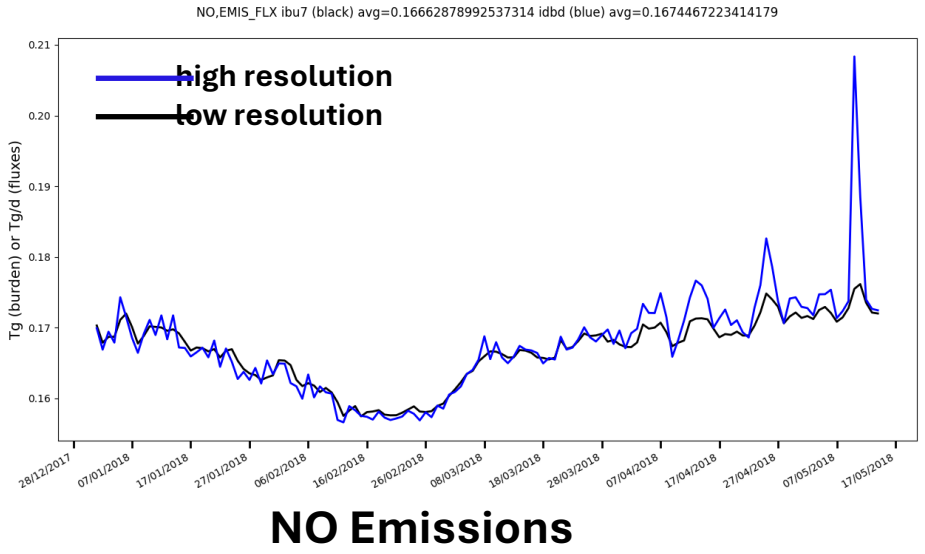
Emissions



Tropospheric burden

A PEEK AT GLOBAL BUDGETS : CHEMICAL SPECIES

- Some extreme emissions occur for all species
- Not investigated yet – associated with BB emissions?



NO Emissions

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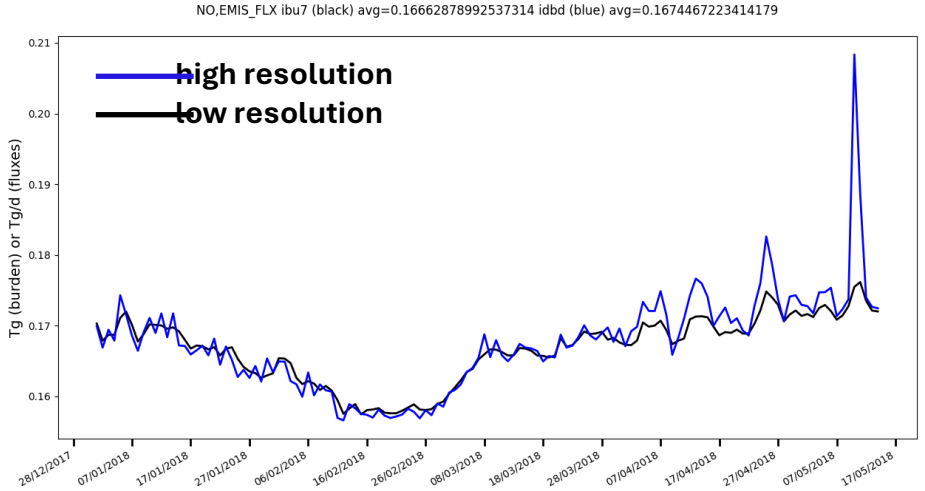
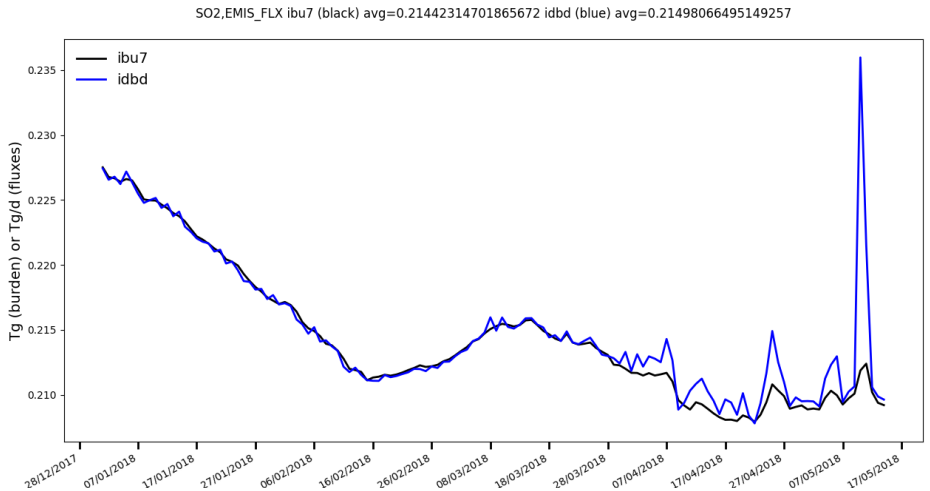


NO Emissions



SO_2 Emissions

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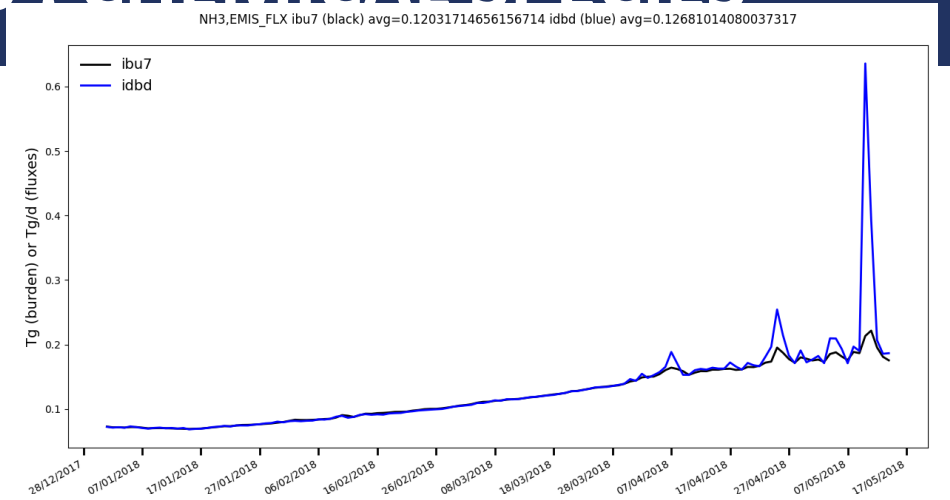
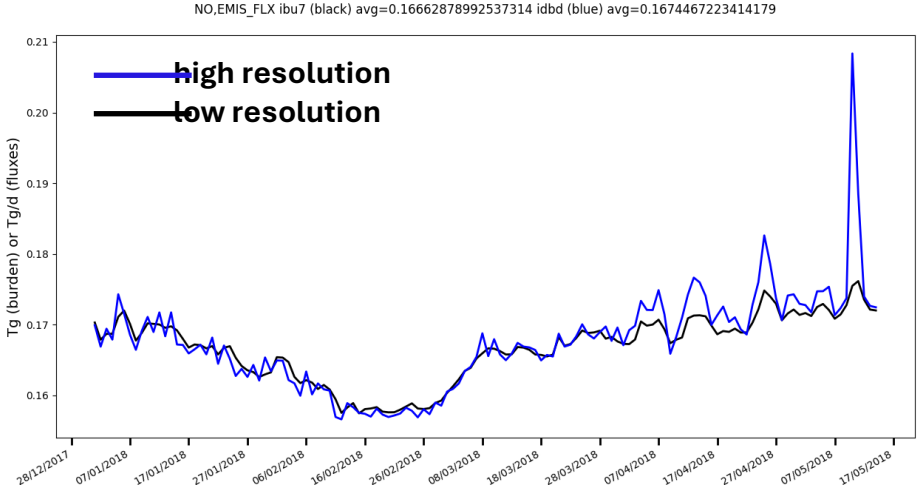
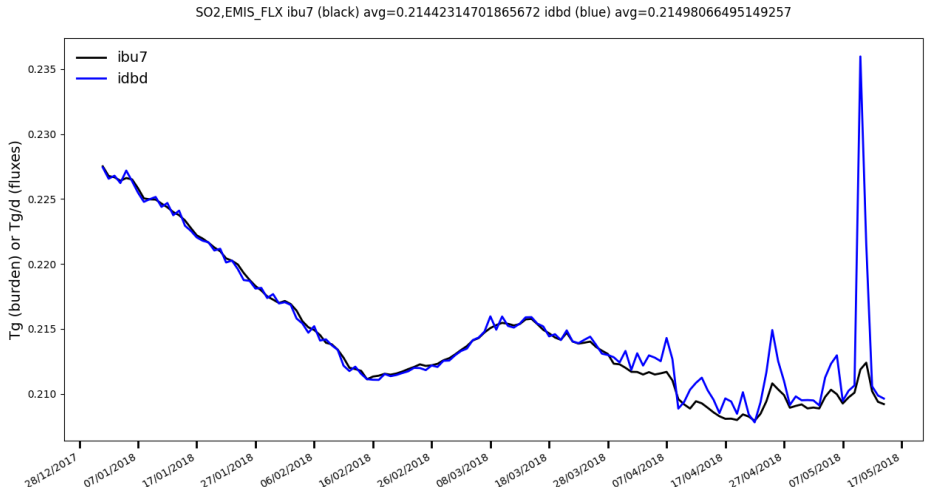


NH_3 Emissions



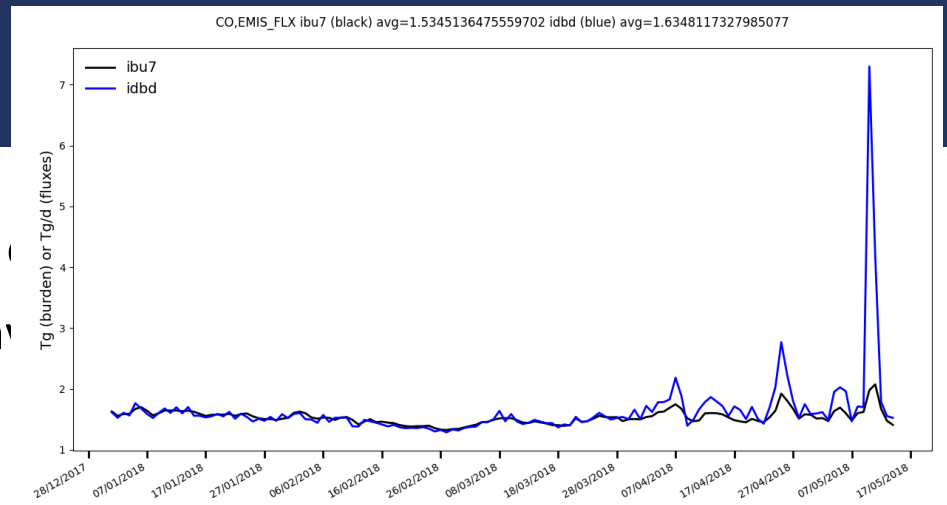
NO Emissions



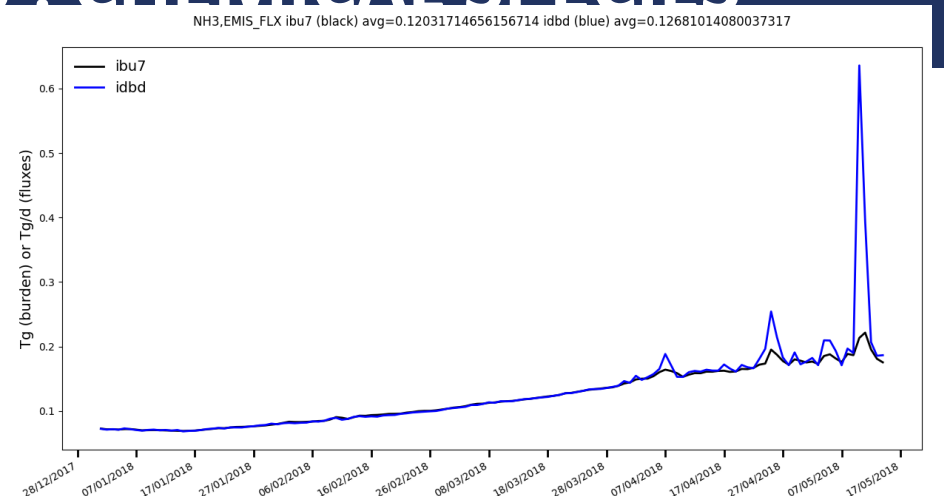
SO_2 Emissions

ETS : CHEMICAL SPECIES

- Some
- Not in



CO Emissions



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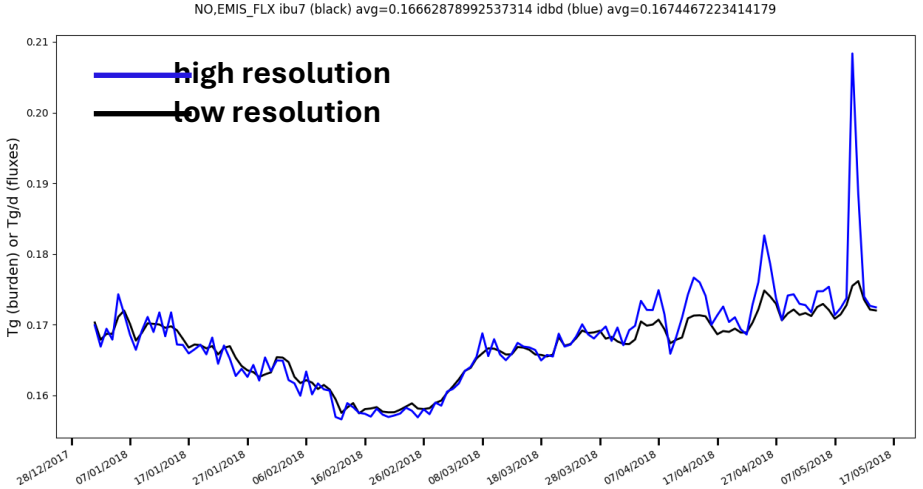

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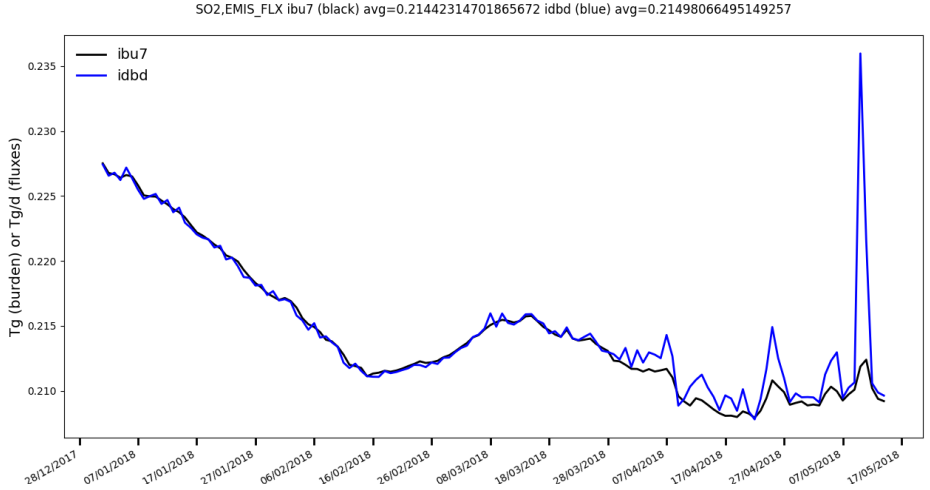
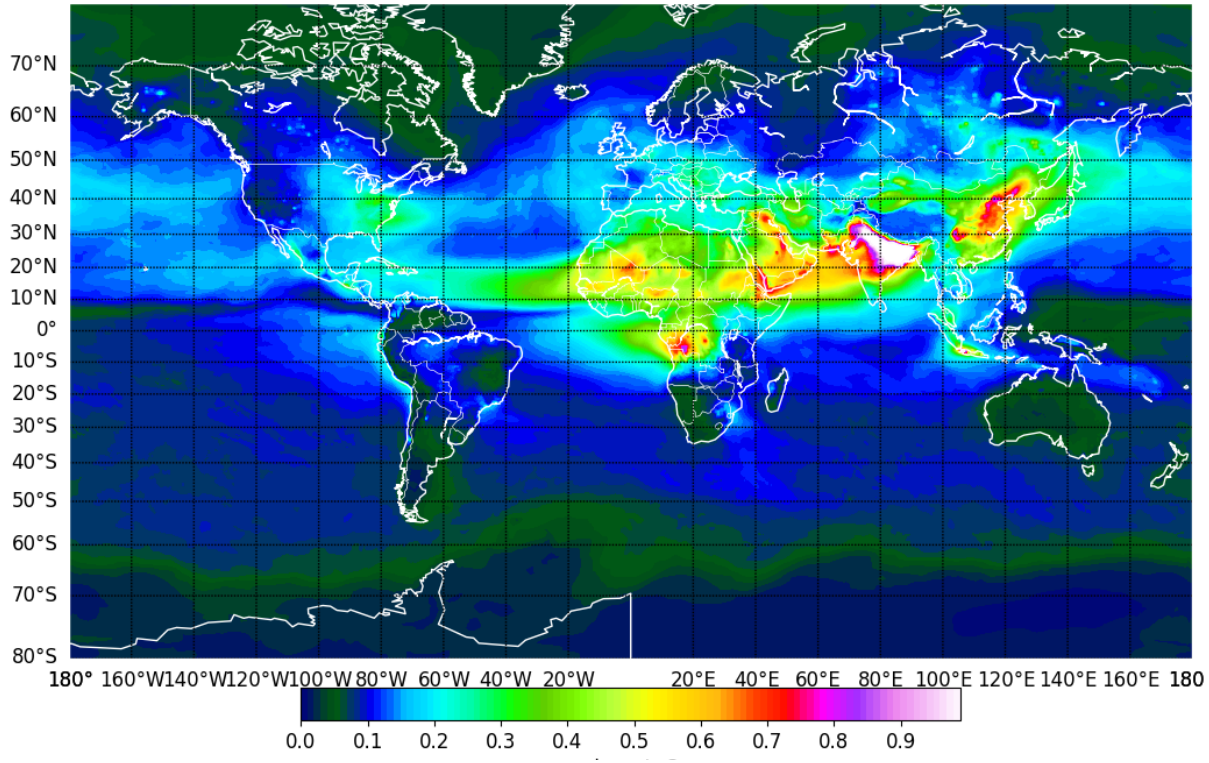
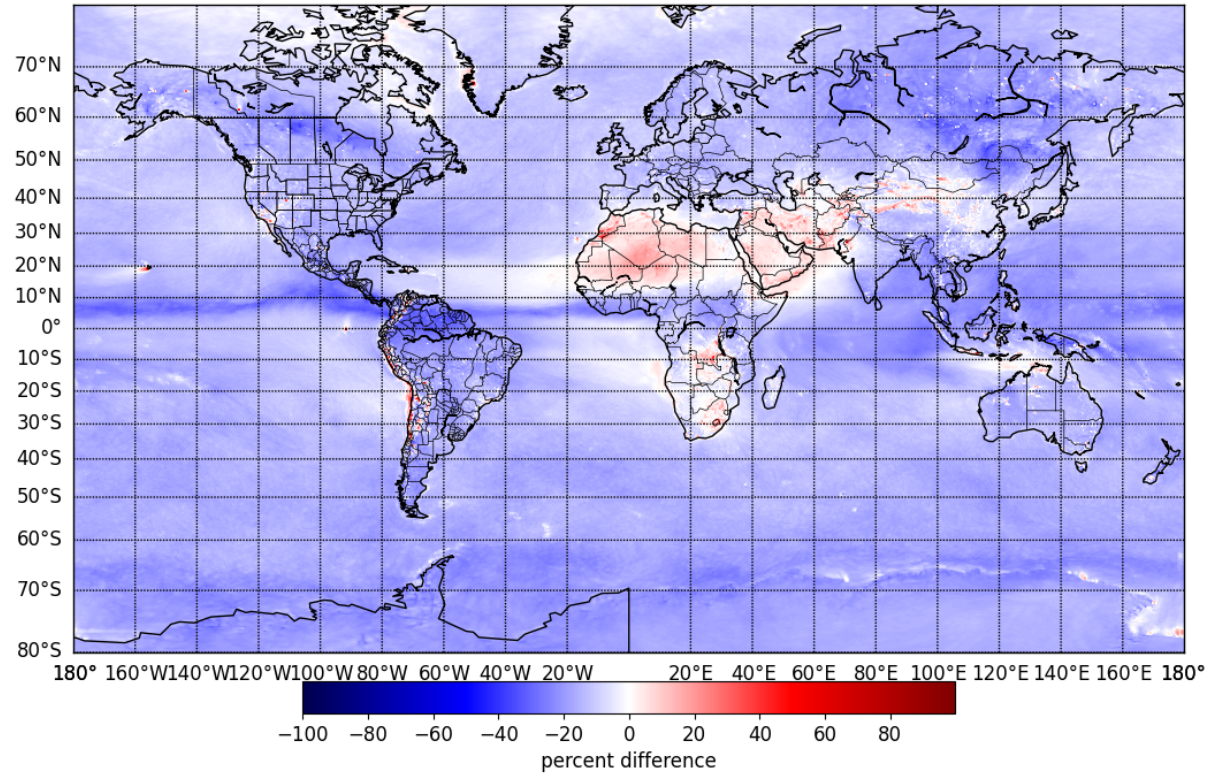


SO_2 Emissions

IMPACT ON SIMULATED AOD AT 550NM

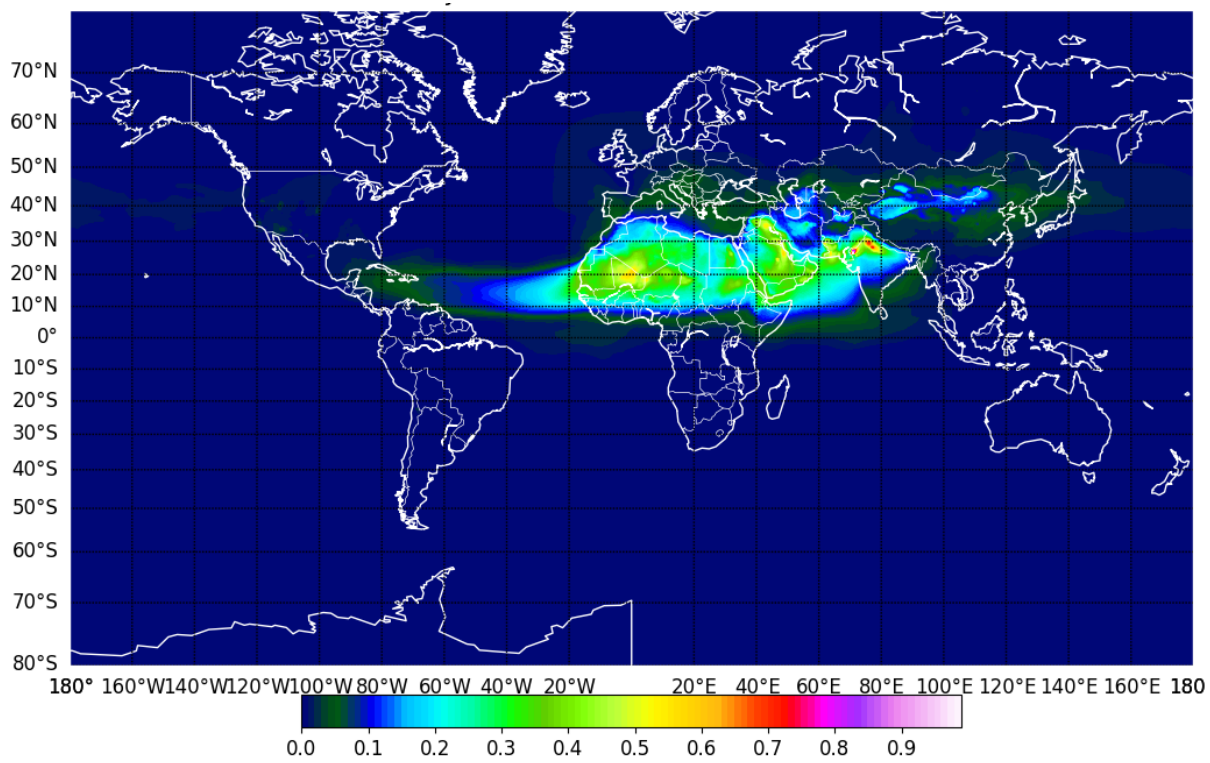
- June 2018 average and relative difference
- High res 15-25% lower in general except over dusty regions
- ITCZ clearly visible – enhanced wet deposition with high resolution?

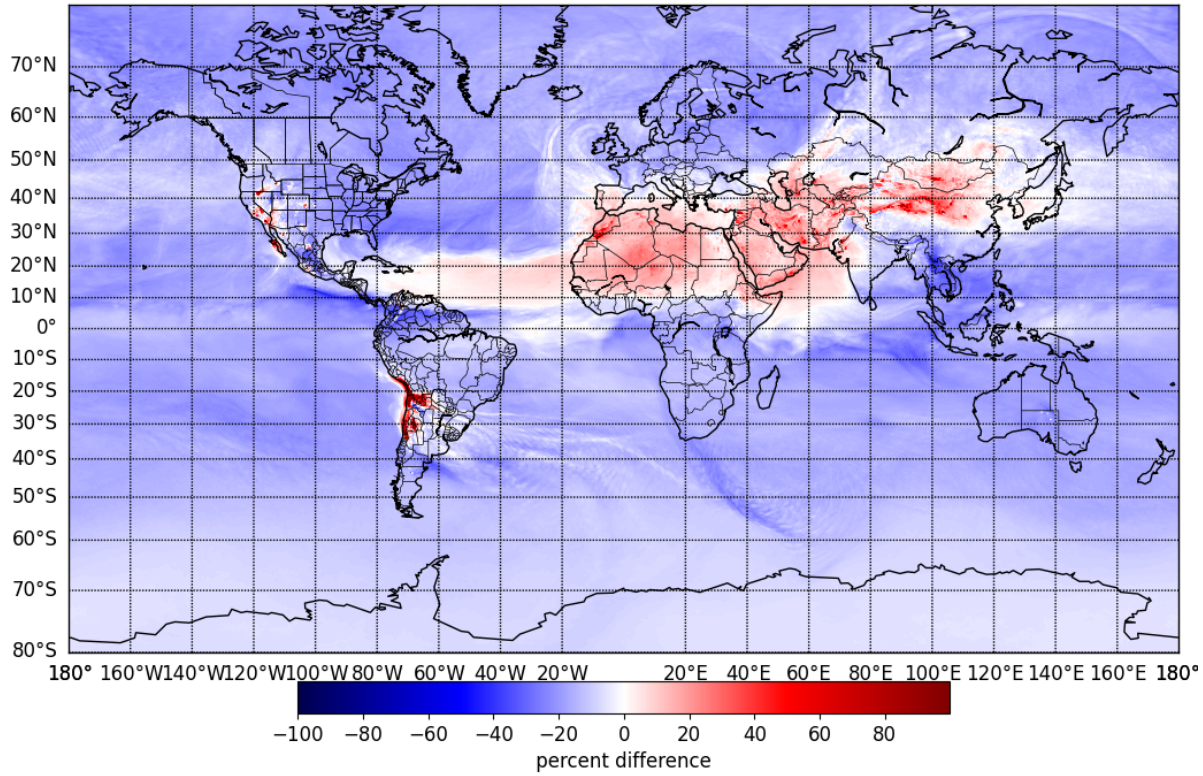




IMPACT ON SIMULATED DUST AOD AT 550NM

- June 2018 average and relative difference
- High res 10-20% higher over source and outflow regions, lower elsewhere
- Orography brings larger increase

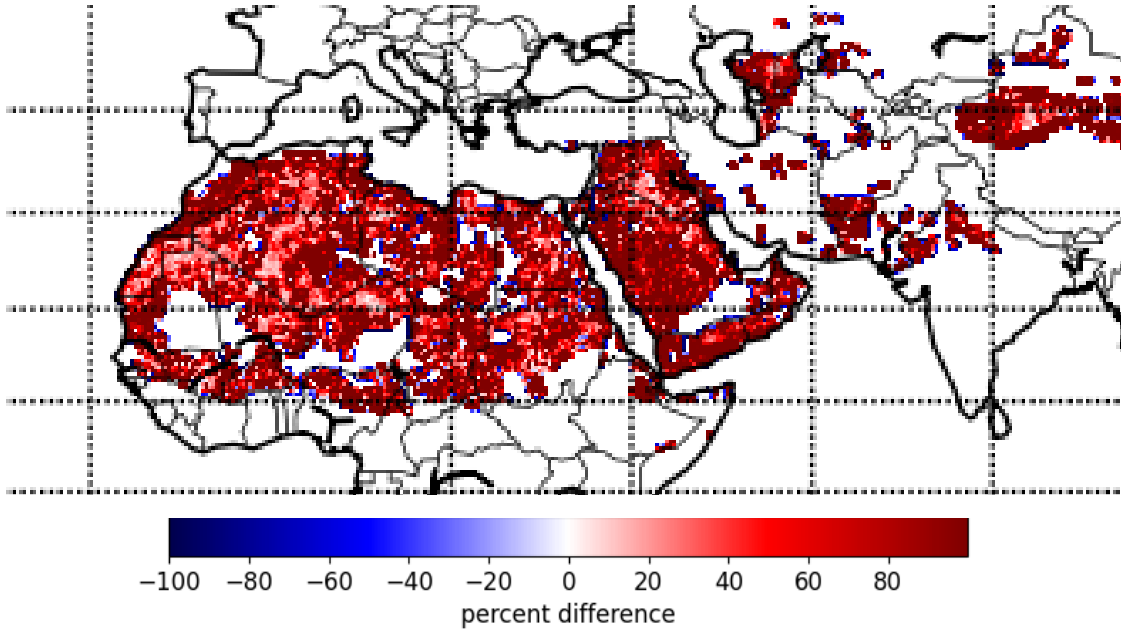




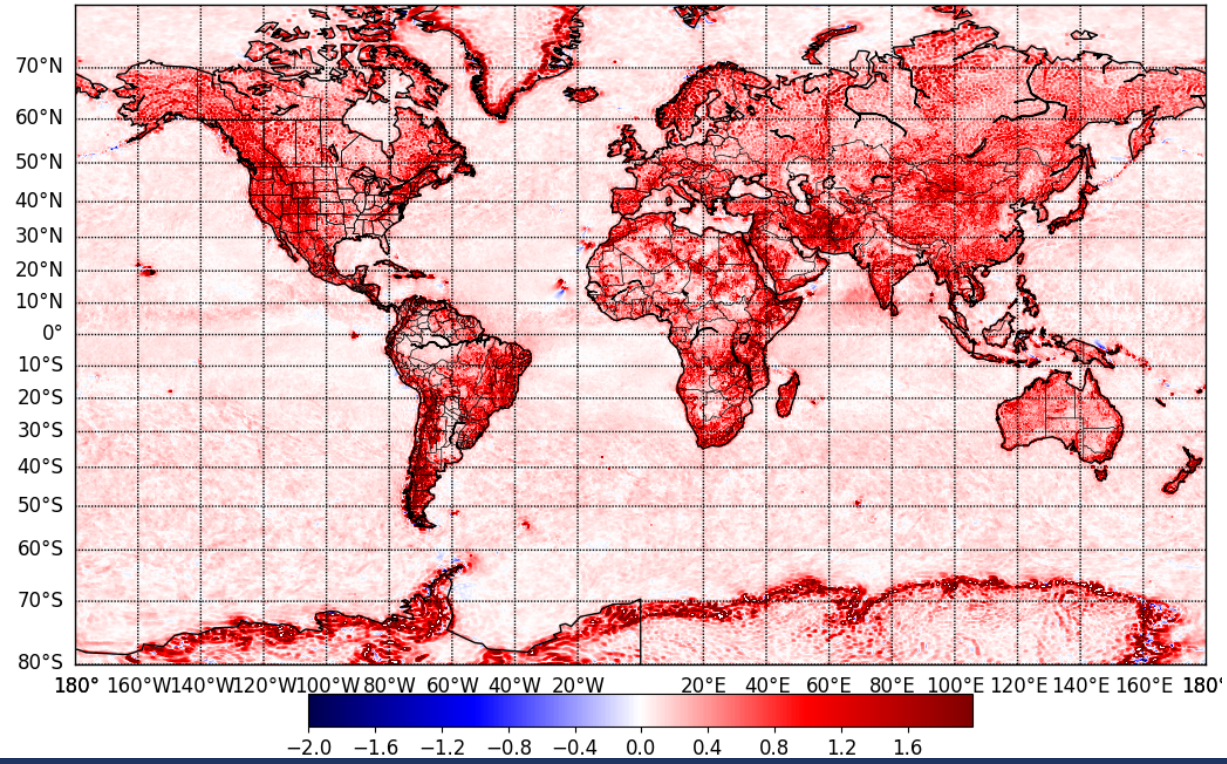
IMPACT ON SIMULATED DUST EMISSIONS

- June 2018 dust emissions and wind speed
- Higher wind speed brings higher emissions and also dry deposition
- Increased emissions particularly over areas with mountain features : the inputs of the dust emission scheme (dust source function) are still at 0.5° resolution

Dust emissions relative difference (high res – low res



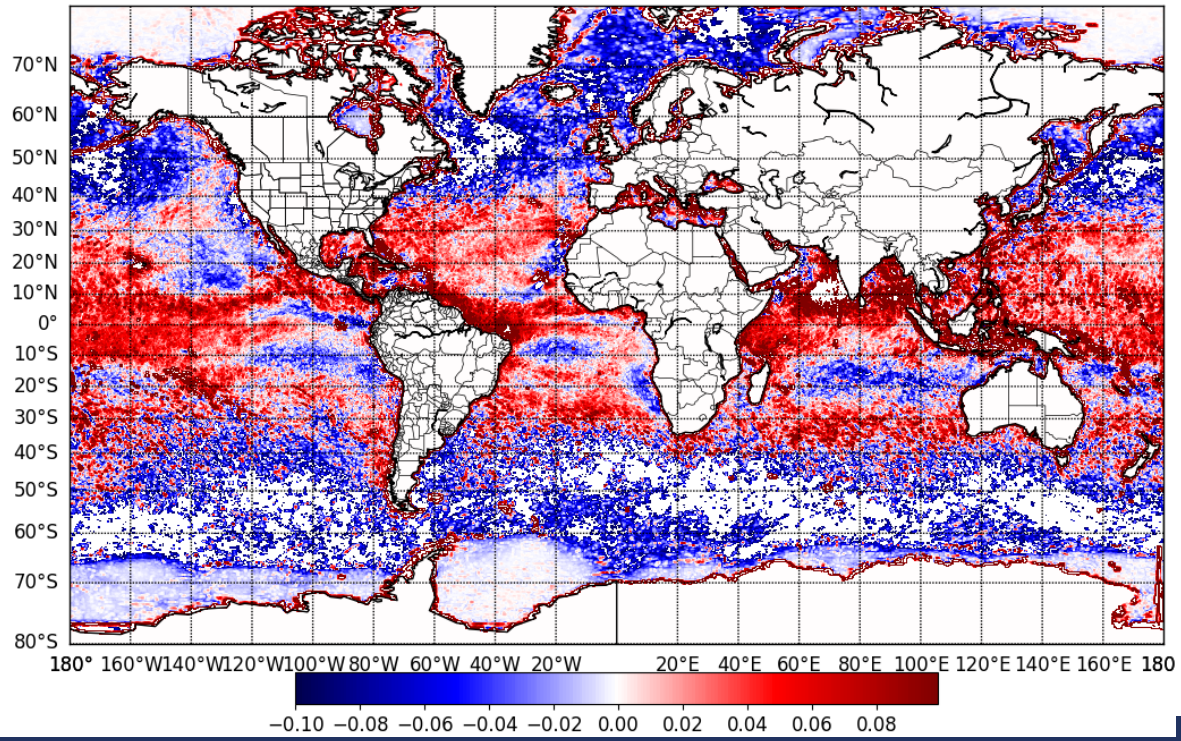
Wind speed difference (high res – low res



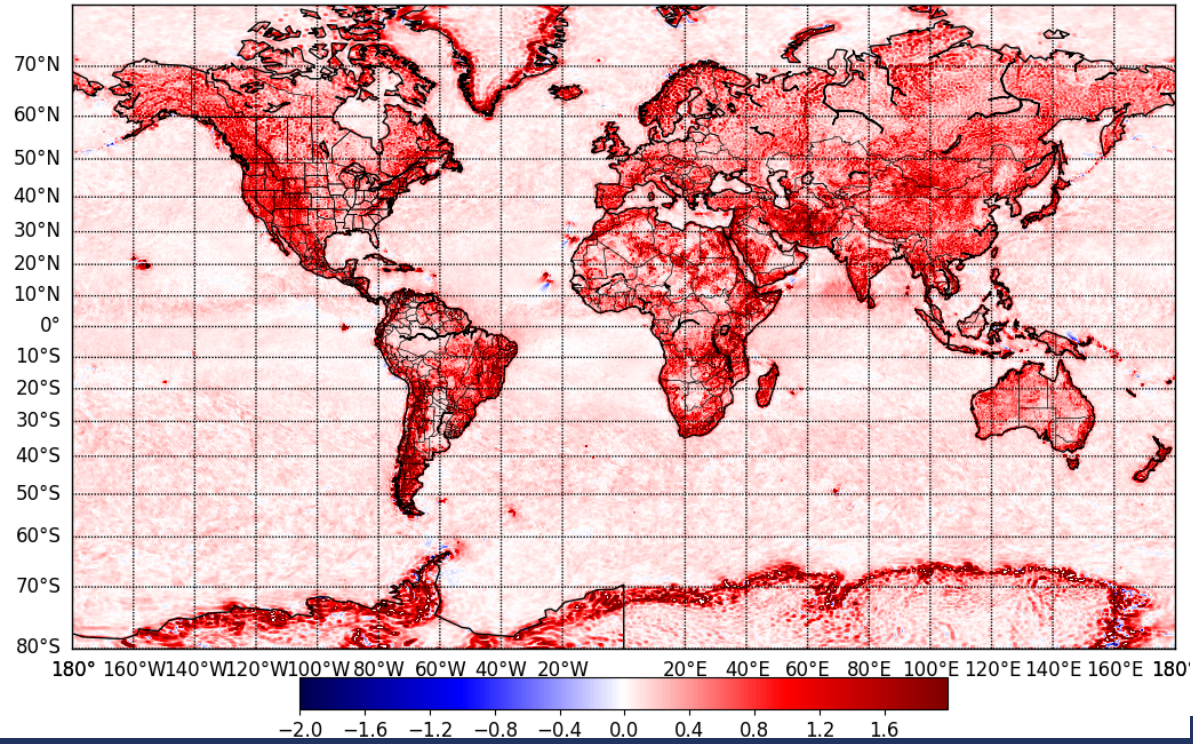
IMPACT ON SIMULATED SS EMISSIONS

- June 2018 sea-salt emissions and wind speed
- Areas with higher wind speed brings higher emissions
- SS emissions are lower at places – impact of SST?
- Lower SS burden because of increased dry deposition (relatively more significant for smaller bins

SS emissions difference (high res – low res)

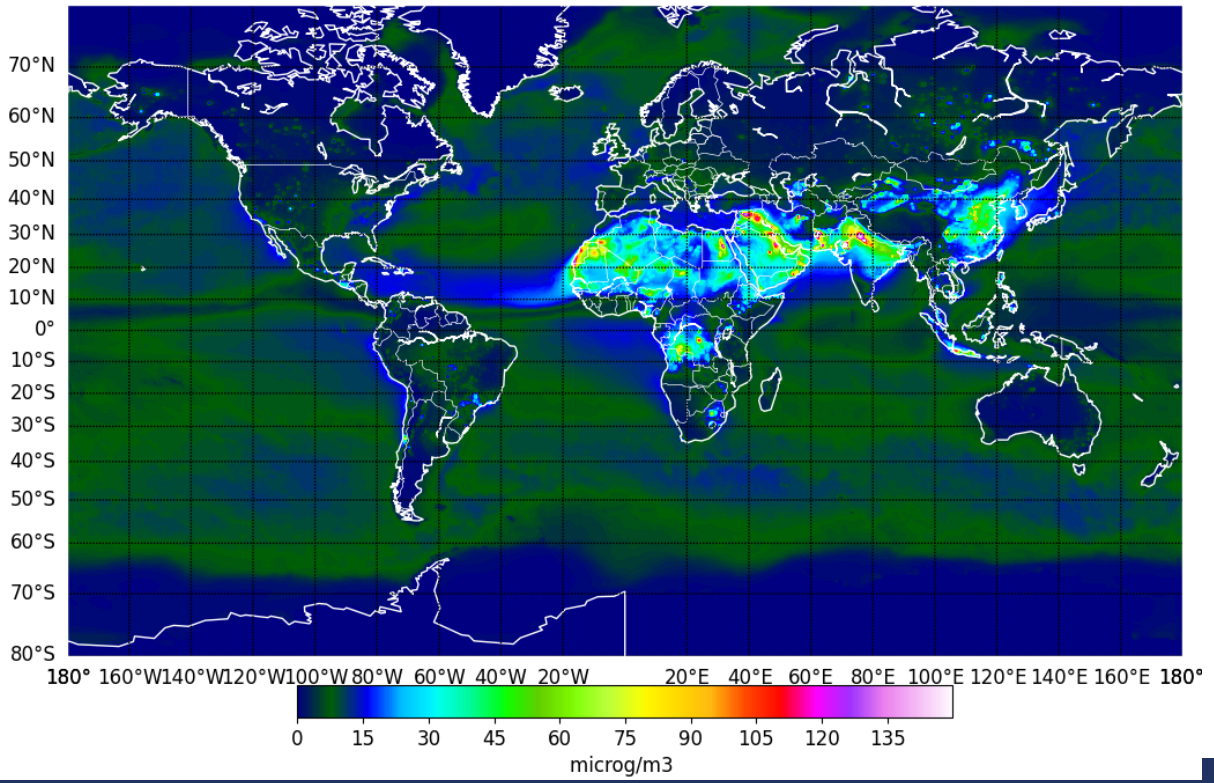


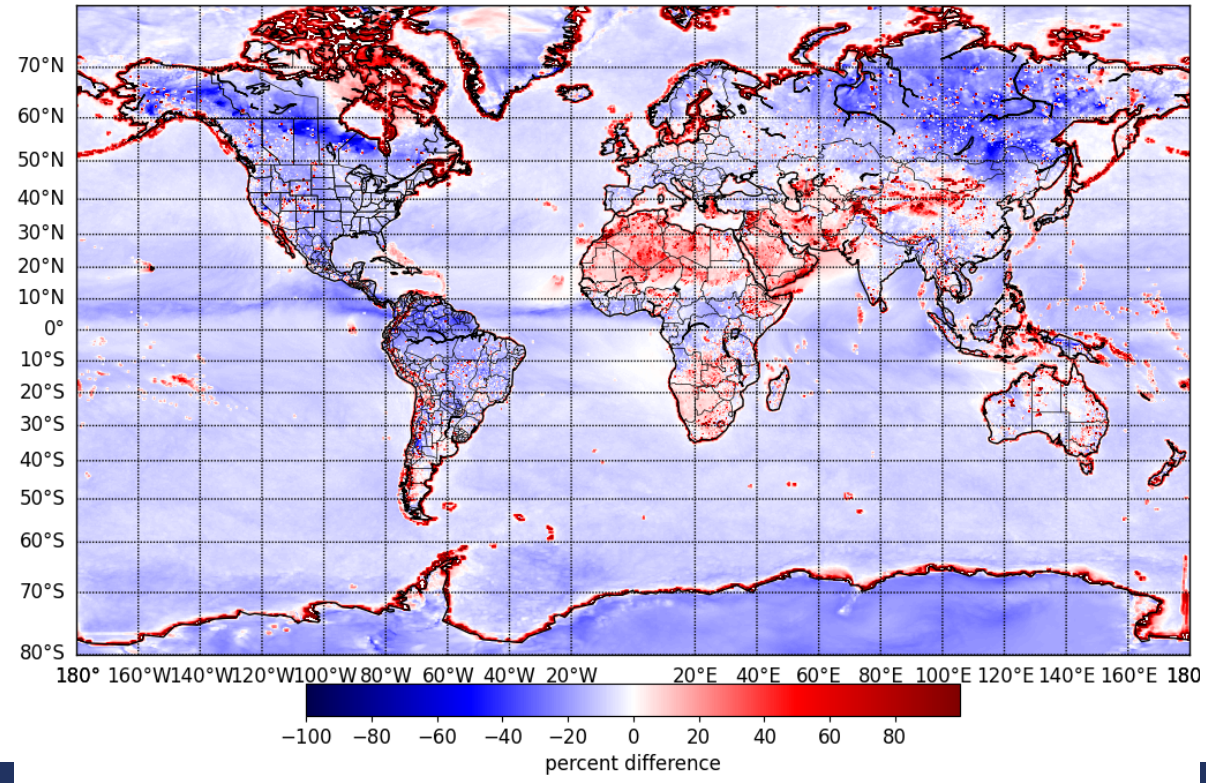
Wind speed difference (high res – low res



IMPACT ON SIMULATED PM2.5

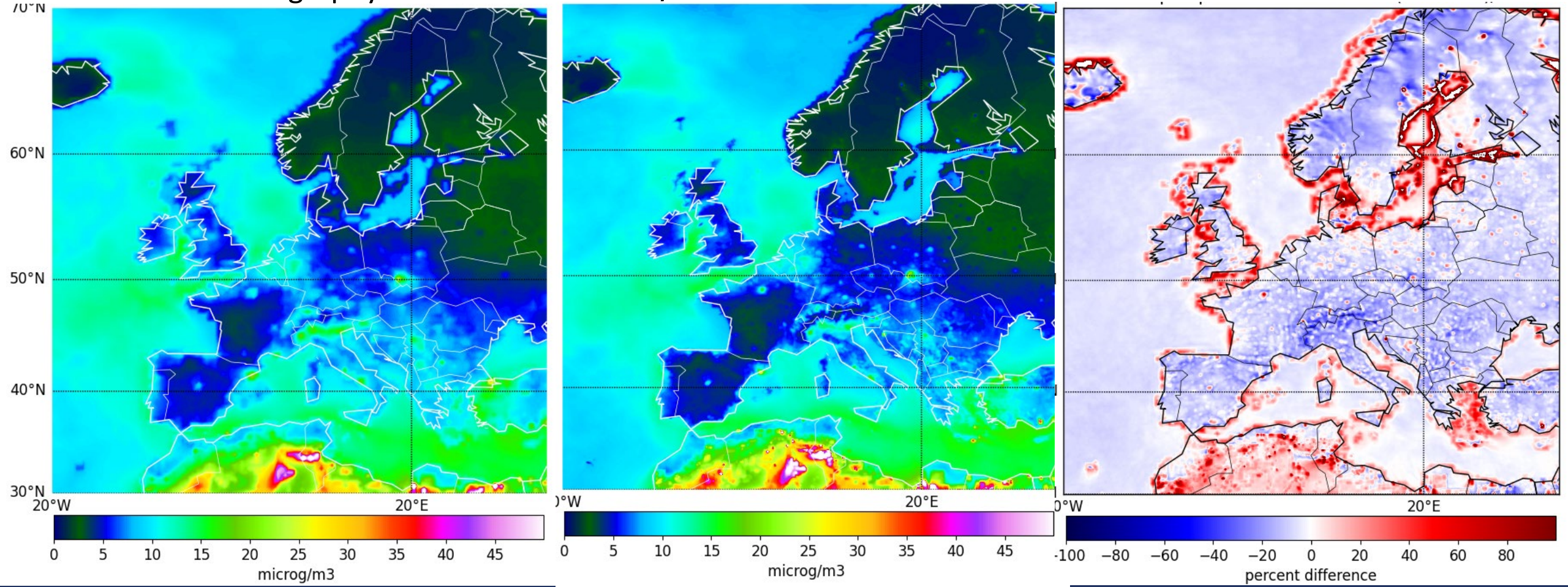
- June 2018 average and relative difference
- High res 10-20% lower in general except over dusty regions and coastal areas/islands
- The coastline feature emphasize the importance of smooth/routh terrain for dry deposition and PM2.5 simulation





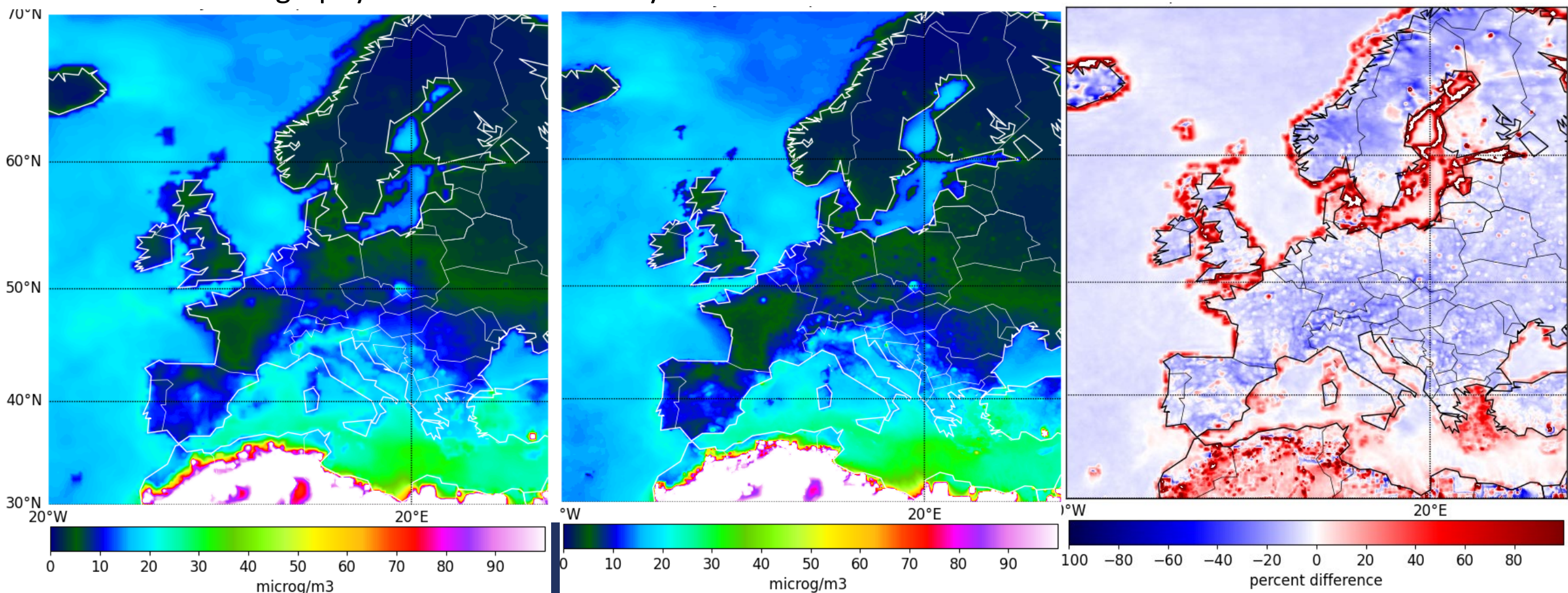
IMPACT ON SIMULATED PM2.5 – FOCUS ON EUROPE

- June 2018 average and relative difference
- Higher values over cities and lower background values with high res
- Orography and coastlines clearly visible



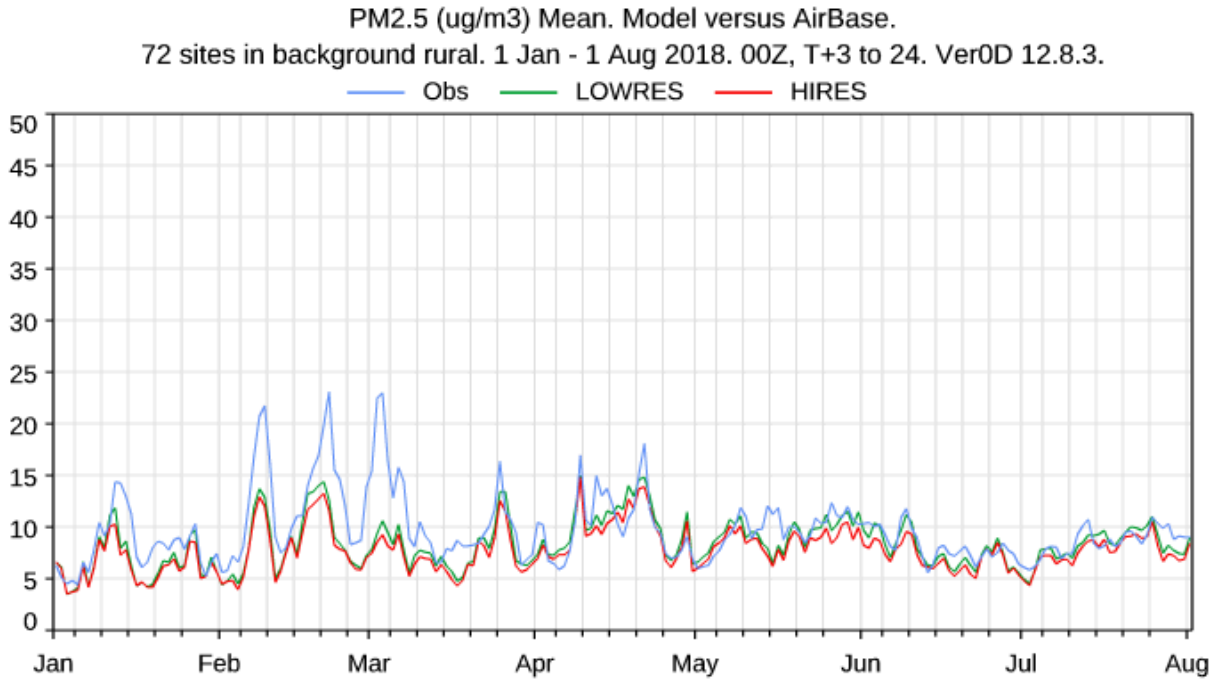
IMPACT ON SIMULATED PM10 – FOCUS ON EUROPE

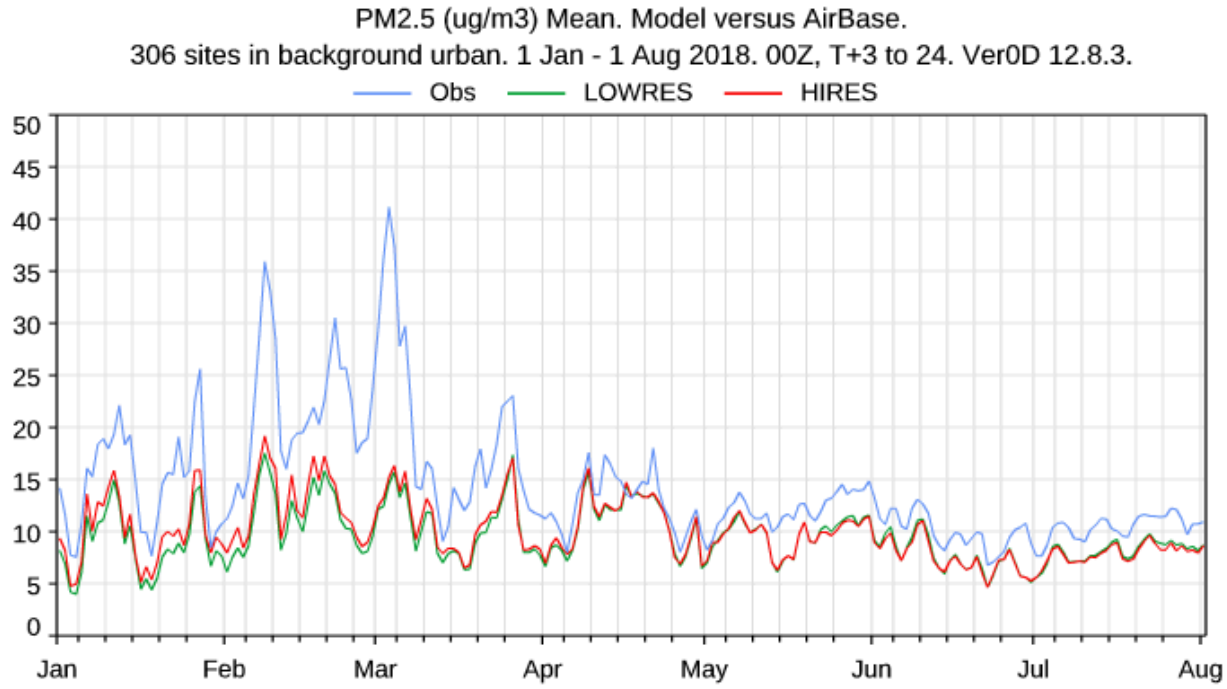
- June 2018 average and relative difference
- Higher values over cities and lower background values with high res
- Orography and coastlines clearly visible



WHAT ABOUT SKILL SCORES? PM2.5 OVER EUROPE

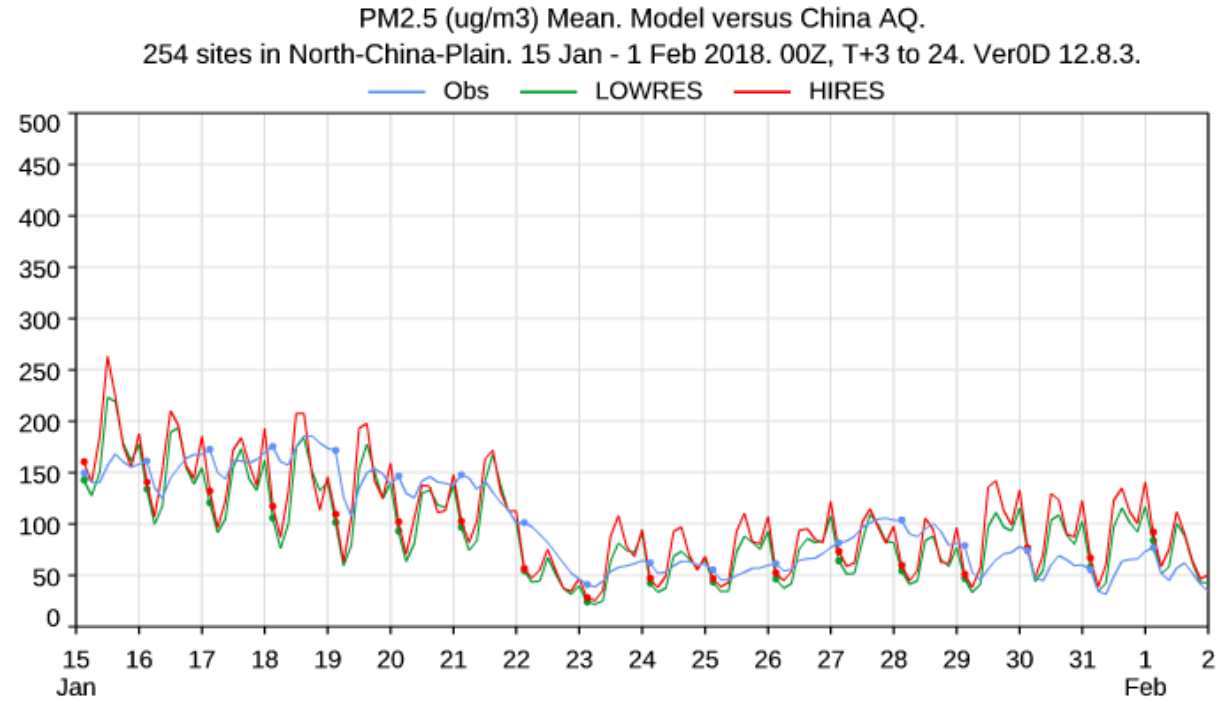
- Impact small and mostly positive in wintertime over cities
- Small and negative over background rural areas

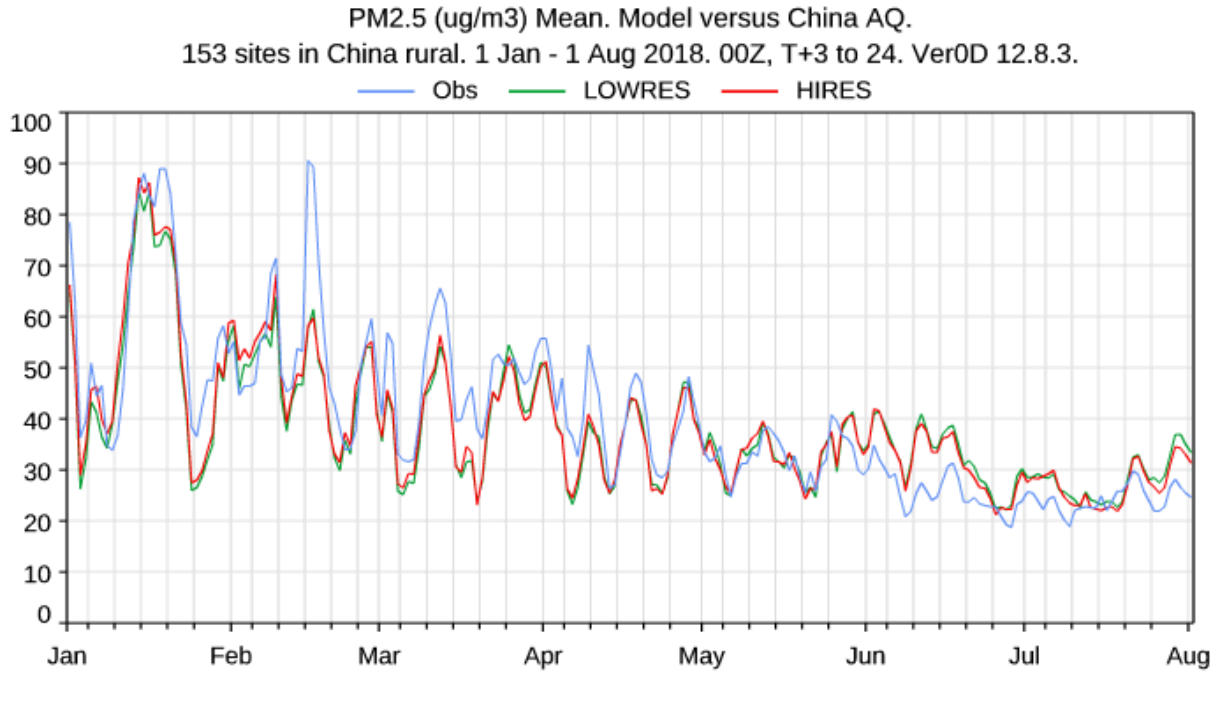




WHAT ABOUT SKILL SCORES? PM2.5 OVER CHINA

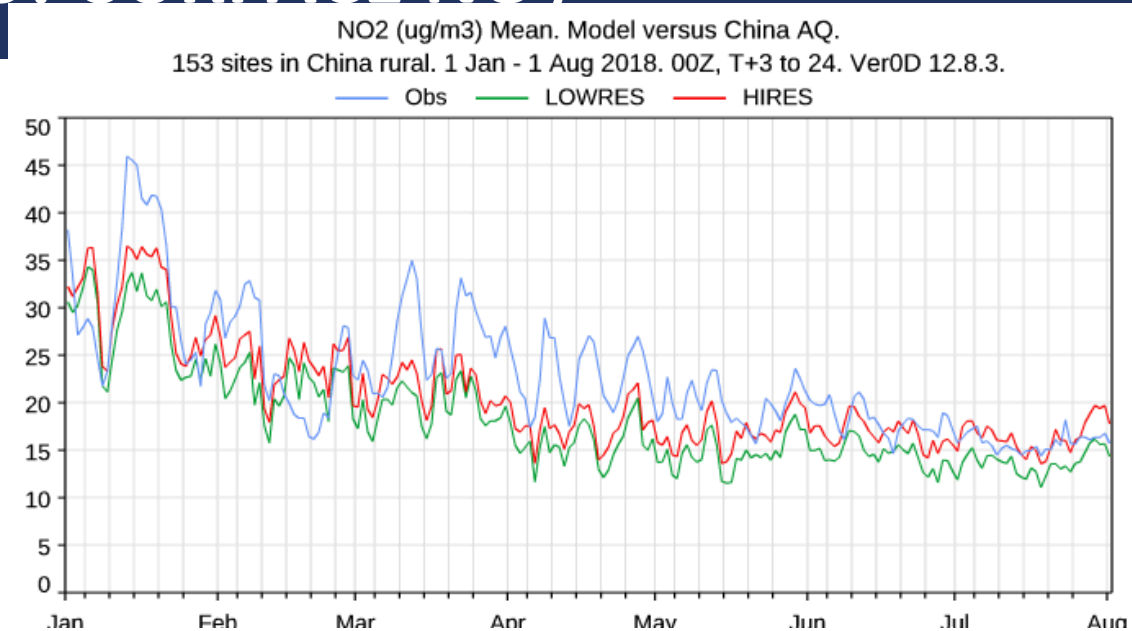
- Background rural : small positive impact in winter time and summertime
- Diurnal cycle issue is exacerbated with high res – night time values are higher
- => diurnal cycle issue partly caused by land use category?

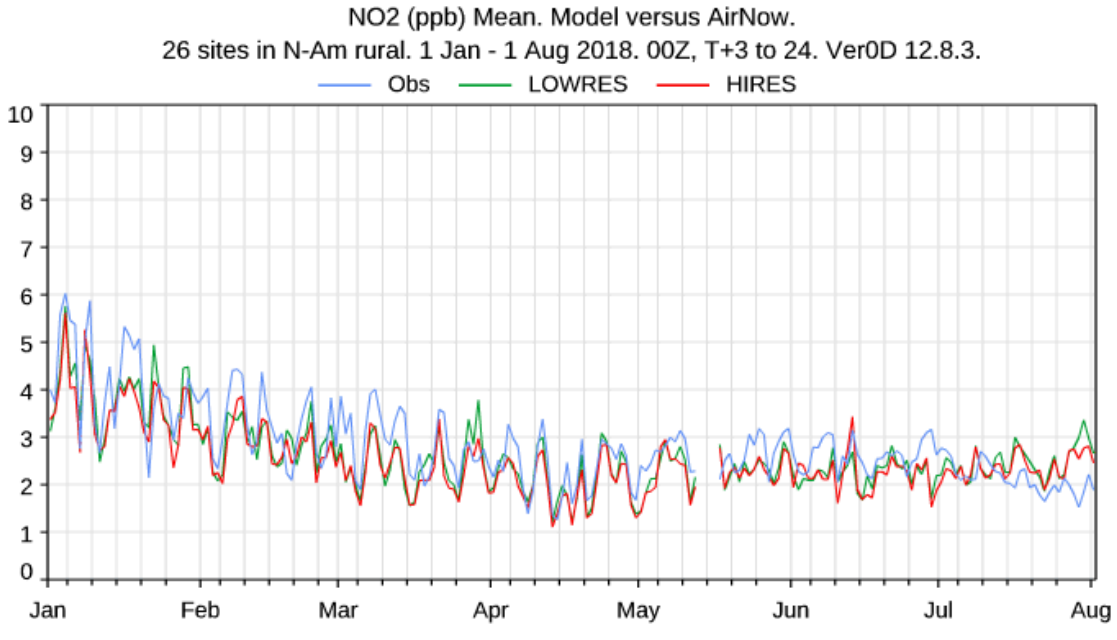


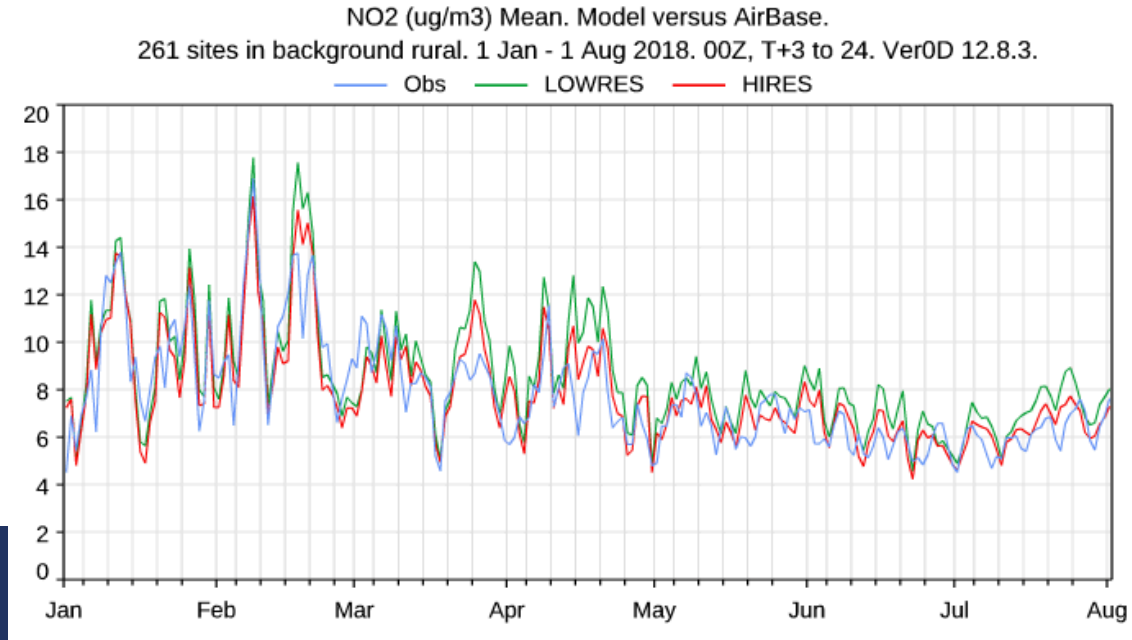


WHAT ABOUT SKILL SCORES? SURFACE NO_2

- Increase over China
- Decrease over US/Europe
- Impact mostly positive

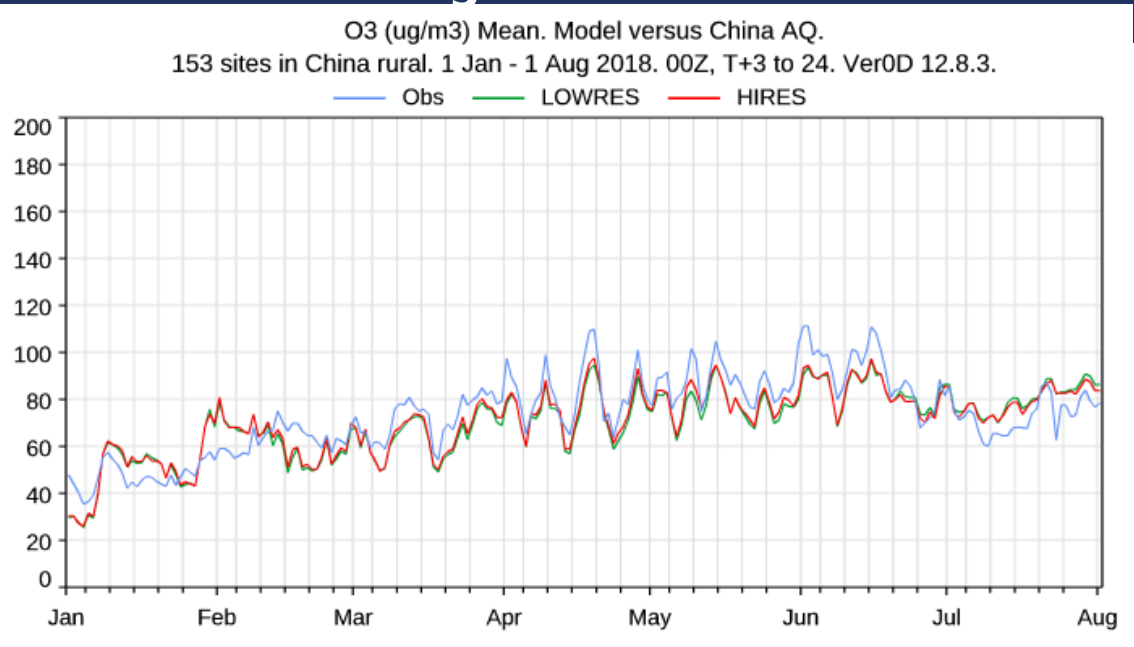


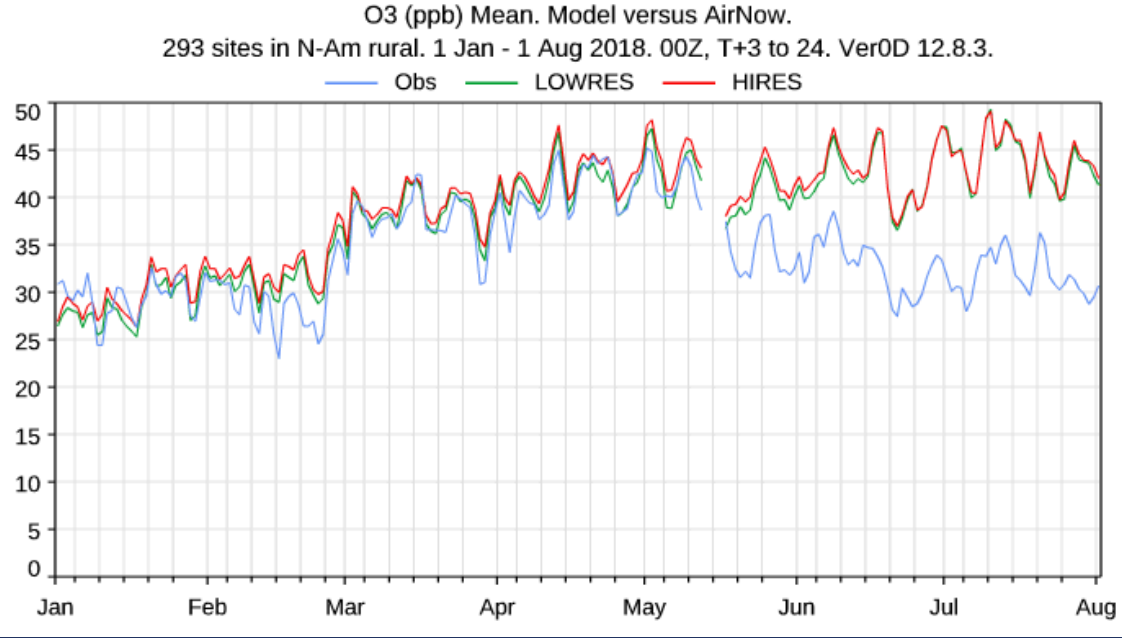


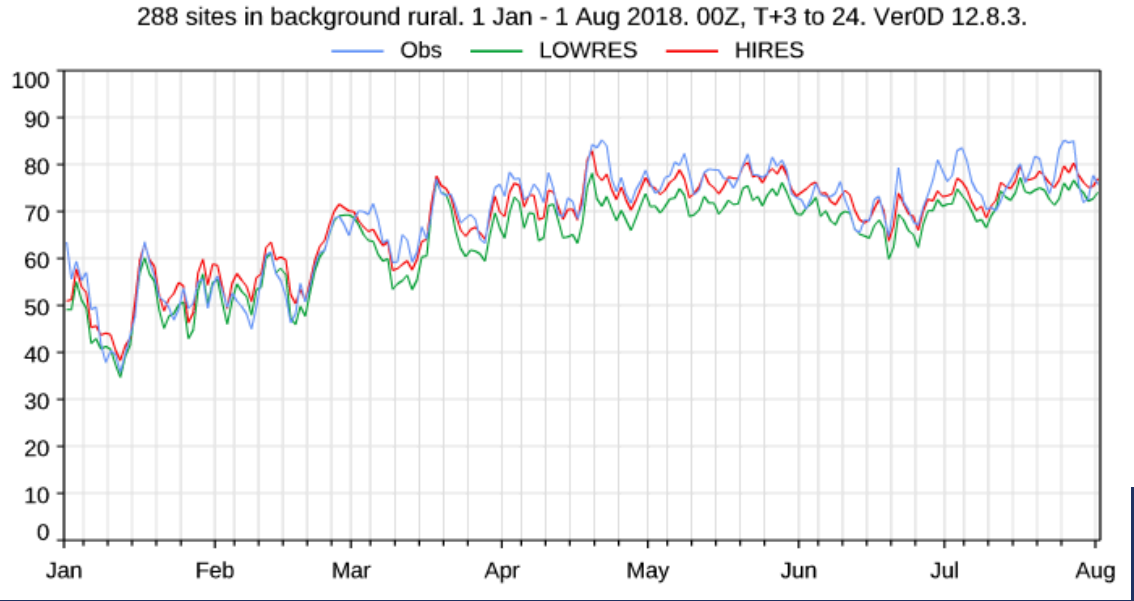


WHAT ABOUT SKILL SCORES? SURFACE O_3

- Significant increase over Europe all seasons and US in wintertime

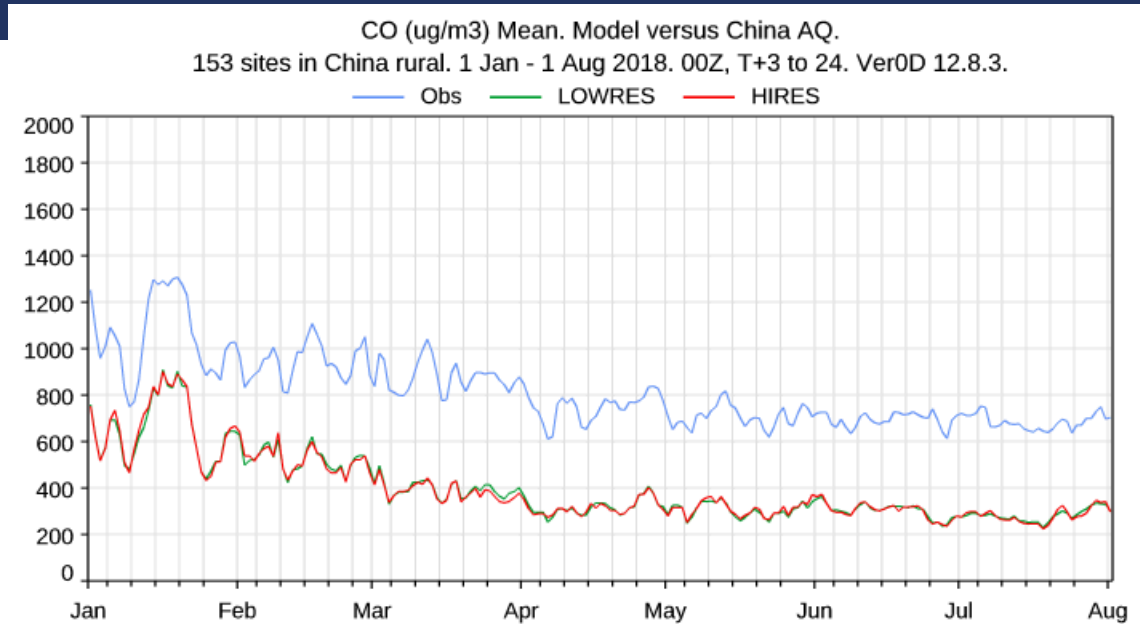


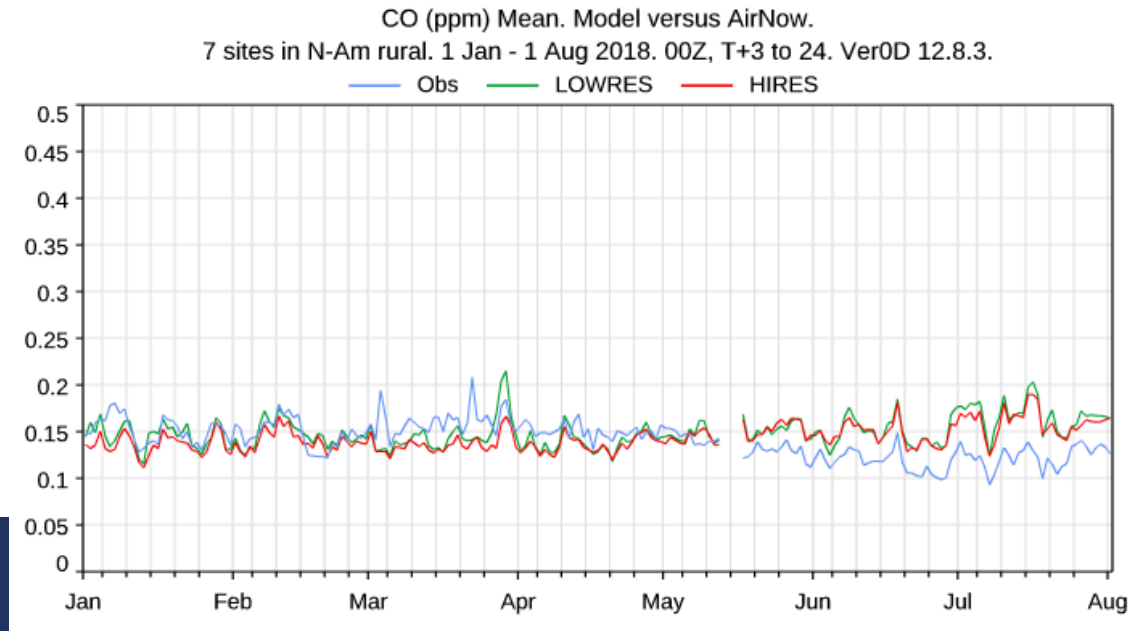


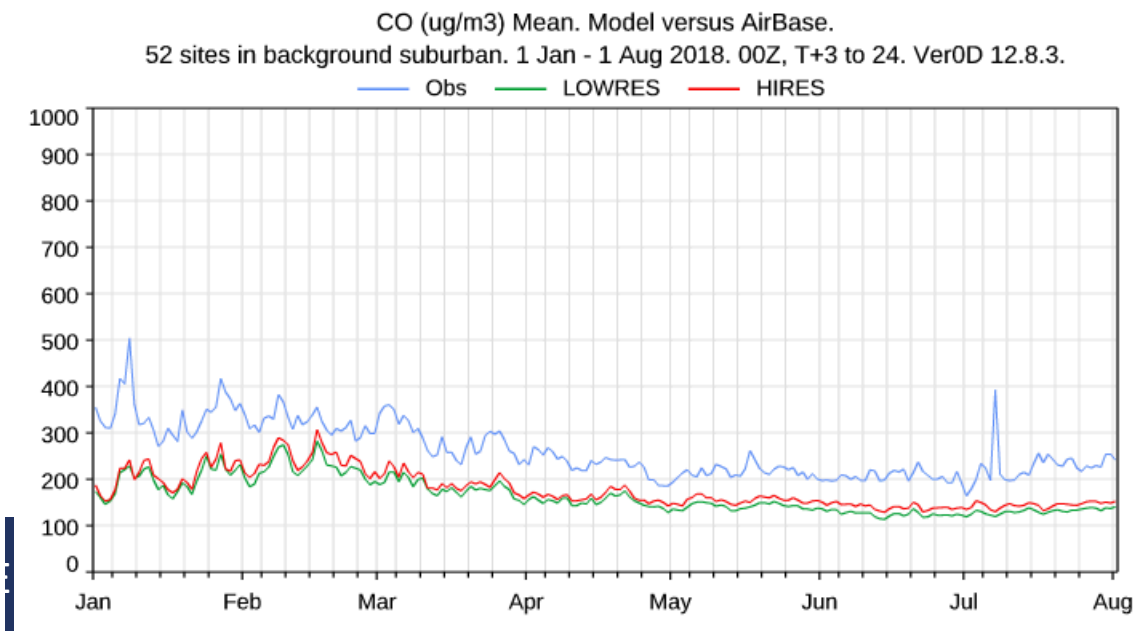


WHAT ABOUT SKILL SCORES? SURFACE CO

- Small decrease over US
- Increase over Europe







CONCLUSION

- Very high resolution IFS-COMPO simulations are running but:
  - Emission peaks of chemical species not explained yet,
  - Need to increase the resolution (and recompute for some of them) of the input fields of IFS-COMPO : dust source function, calcite fraction, silt/sand/clay fraction etc.
- Significant differences are driven by changes in meteorology (wind, precipitation) and land use category:
  - Higher dust and SS emissions because of higher wind speed
  - Higher dry deposition for all species for the same reason
  - Coastline changes in PM
- For PM/AOD the impact on skill scores is neutral – some improvements, particularly over urban areas, some degradation