Evaluation of coarse aerosol scattering in the longwave spectrum through the use of ecRad with the ARPEGE-Climat 7.0 CNRM atmospheric model

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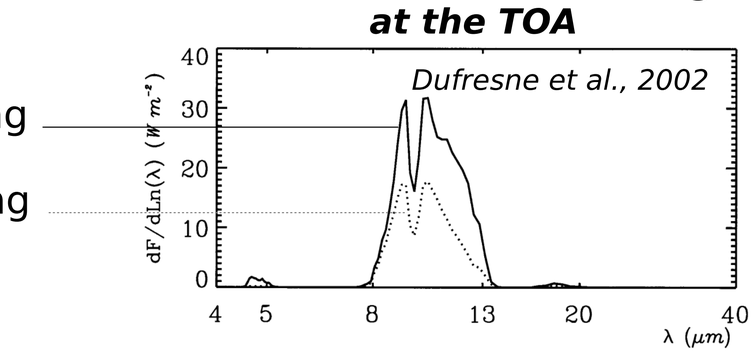
1 | A process often neglected in climate models

- LW coarse aerosols scattering could increase the LW DRE at the TOA by 50 % *(Dufresne et al., 2002 ; Osipov et al., 2015 ; Sicard et al., 2014)*
- But most global and regional models do not include it in their radiative scheme *(Di Biagio et al., 2020)*
- Few studies try to account it by artificially augmenting the retrieved TOA DRE *(Miller et al., 2006 ; Kok et al., 2017)*

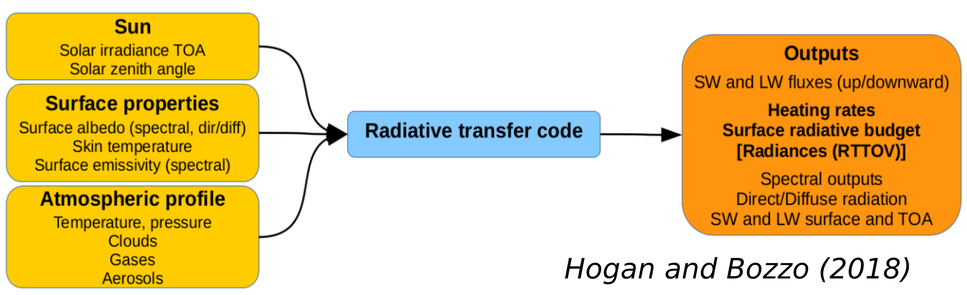
Aerosol radiative forcing at the TOA



Dry tropical atmospheric profile, homogeneous aerosol layer between the surface and 3km (effective radius : 2 µm, optical thickness at 500 nm : 1)

2 | Methodology

What is ecRad?



Hogan and Bozzo (2018)

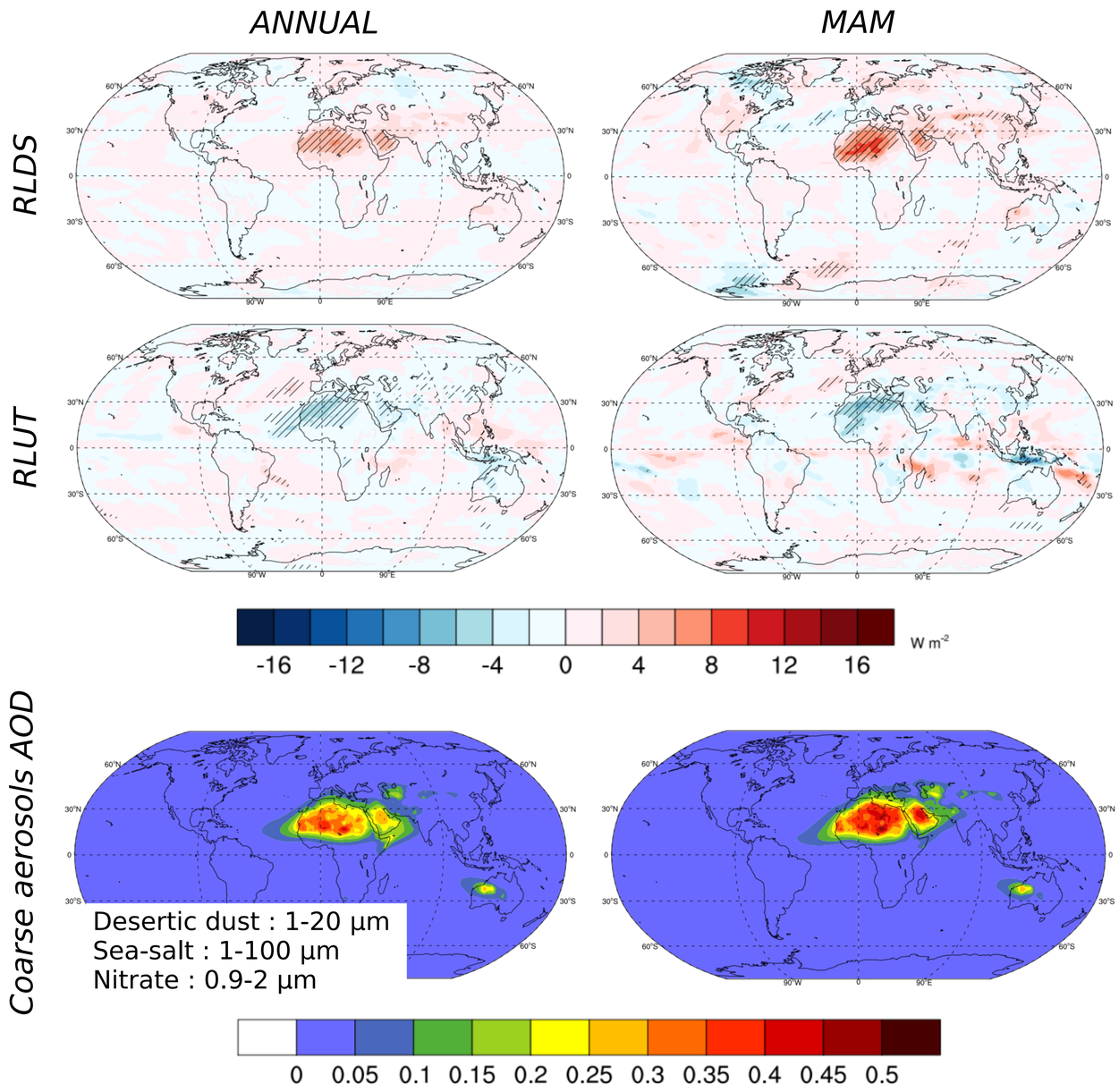
- A radiative code dedicated to atmospheric models (rather large scale) operational for instance in the ECMWF NWP model
- A library gathering many possible parameterizations and databases (optical properties of aerosols and clouds)
- A well organized code: separation of parameterizations into distinct routines
  – > Ability to activate or not the LW scattering process

ARPEGE-Climat Model

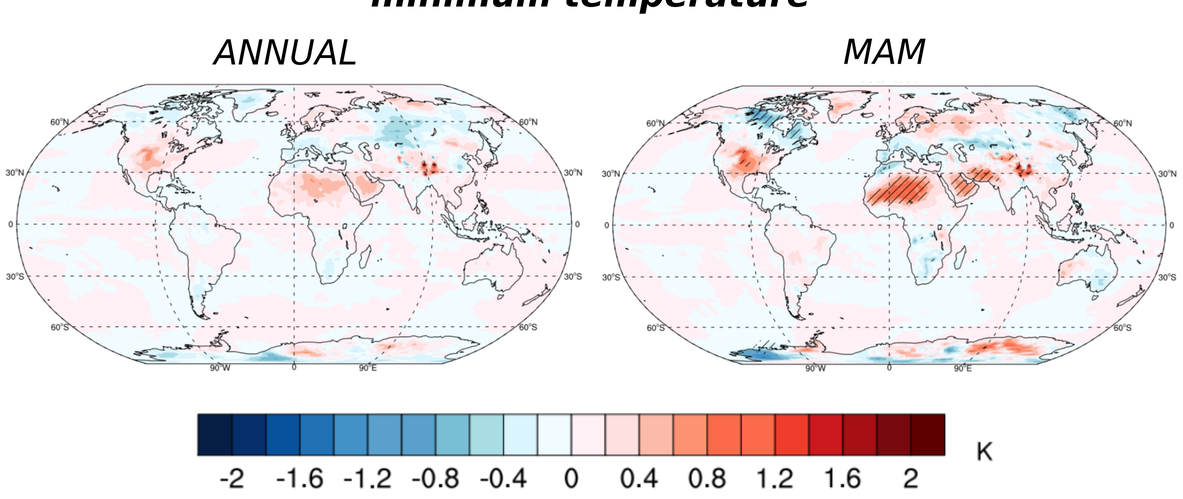
- Atmospheric model
- ARPEGE-Climat 7.0 (closely linked to the ARPEGE/IFS NWP model cycle 48)
- Use of ecRad
- TACTIC climatological aerosols
- Simulations with and without LW scattering over the 1985-2014 period

3 | Radiative and climatic impact of the LW coarse aerosol scattering (1985-2014 average)

Difference, with - without LW scattering, of the downward LW radiation at surface (RLDS) and upward LW radiation at TOA (RLUT)



LW radiation impact on surface minimum temperature



- Significant minimum temperature increase of about 1.2 degrees during the spring over North Africa

- Significant annual and spring increase (decrease) of the downward LW radiation at the surface (upward LW radiation at TOA) due to the LW aerosols scattering
- Well localized with coarse aerosols AOD maximums

4 | Conclusion and perspectives

First encouraging results on the importance of taking into account the coarse aerosol scattering in the longwave spectrum but need to go further:

- Coarse aerosol AOD evaluation with different AERONET stations over North Africa and Middle-East
- LW radiation comparison with different satellite data (CERES, …)
- Analysis of the impact of the aerosol LW scattering process on other climate parameters
- Use of interactive aerosols
- Further literature analysis

This project has received funding from the EU Horizon 2020 Research and Innovation programme under GA n° 101003536