

FLEXDUST exercise

On behalf of Christine Groot Zwaaftink (NILU)




Groot Zwaaftink, C. D., Arnalds, Ó., Dagsson-Waldhauserova, P., Eckhardt, S., Prospero, J. M., and Stohl, A.: Temporal and spatial variability of Icelandic dust emissions and atmospheric transport, Atmos. Chem. Phys., 17, 10865-10878, <https://doi.org/10.5194/acp-17-10865-2017>, 2017.

**FLEXDUST slides kindly provided by
Christine Groot Zwaaftink (slides adapted)**

The code is in **DEVELOPMENTAL** stage still.

- The code is freely available to anyone.
- So far only NILU (developers) and ZAMG have tested it.
- Warning: some settings may NOT have been considered yet.
- Available at: <https://git.nilu.no/christine/flexdust> (tar file)
 - “git clone git@git.nilu.no:christine/flexdust.git” to get the code

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Name	Last commit	Last update
 INPUT	Added sand and clay files	2 years ago
 src	Correction of wind field reading in case the start of the simulation ...	1 week ago
 README	Updated README	8 months ago



- FLEXDUST re-uses the FLEXPART routines to handle the ECMWF data (that means, FORTRAN and usual FLEXPART libraries are required)- **NOTE: ONLY ECMWF DATA CAN BE USED.**
- The module flex_dust.mod is the file that requires editing to define input and output

```
!Input files/settings
/*****

!Windfields and properties
/*****

character(*) , parameter :: ECMWF_input='./xnilu_wrk/flex_wrk/WIND_FIELDS/AVAILABLE_ECMWF_OPER_fields_global'
character(*) , parameter :: ECMWF_input_nest= '/home/christine/AVAILABLE_ECMWF_OPER_fields_05_global' !FLEXPART AVAILABLE file for nested wind field
integer, parameter      :: numberOfNests = 0 !Number of nested wind fields, if more than 1 remember to change path and length! NOT tested...
integer, parameter      :: time_step_wind = 3 !time step wind fields in hours, default 3
/*****

!properties of the clayContent & sand file
/*****

character(*) , parameter :: clayFile= './INPUT/Clay.srf'           !File with clay content
character(*) , parameter :: sandFile= './INPUT/Sand.srf'          !File with sand content
real, parameter         :: dx_c= 0.0833, dy_c=0.0833            !Resolution sand/clay grids
real, parameter         :: xlon0_c= -180.00, ylat0_c=-56.50      !Lower left corner of clay/sand grids
integer,parameter       :: nx_c=4320 , ny_c=1686                !Size sand/clay grids
real, dimension(0:nx_c-1,0:ny_c-1) :: clayContent, sandContent !Sand and clay should be equal grids!!!
/*****

!global landuse file and properties
/*****

integer, parameter      :: landuse_file_type=2                    !1>same as flexpart 2>MODIS
logical, parameter      :: landuse_binary=.true.                 !Is the landuse file already converted from ASCII to binary file?
character(*) , parameter :: landuse_file= './INPUT/landcover_GLCNM0_l.bin'
integer, parameter      :: nx_landuse=86400, ny_landuse=43200     !Size landuse file
real, parameter         :: dxdy_degr_landuse=15./3600            !Resolution landuse file
/*****

!Nested landuse file and properties
/*****

integer, parameter      :: numbnests_landuse=0 !Developed and tested for only 1 nested field (sandy deserts Iceland or Antarctic),
!requires further changes in the source code if other fields are used!
!(Adjust code for bare land and possibly soil fraction calculation.)
```

- The module flex_dust.mod is the file that requires editing to define input and output

```
!Output files/settings
!*****

!output time frame
integer, parameter :: start_date_day = 20161201
integer, parameter :: start_date_hour = 010000
integer, parameter :: time_step = 6
real, parameter :: releaseDays = 0.5!
!*****

!output grid
!*****
character(*),parameter :: output_directory = '../output/dump/'
real, parameter :: lat_bottom = 3
real, parameter :: lon_left = -9
real, parameter :: dx_dy_out = 0.75 !resolution of emission calculation in degree, should be larger than resolution of global land
integer, parameter :: release_dx dy_step = 1 !Interval of x and y in which release file should be written
! (2 means that calculated emission of 4 grid cells with resolution dx_dy_out will be combined i
integer, parameter :: ny_lat_out = 40/dx_dy_out!180/dx_dy_out!5/dx_dy_out
integer, parameter :: nx_lon_out = 40/dx_dy_out!360/dx_dy_out!14/dx_dy_out
!*****

!Output files
!*****
character(*), parameter :: release= 'RELEASES_FLEXDUST'
character(*), parameter :: summary_file=output_directory//'Summary.txt'
character(*), parameter :: nc_file_out=output_directory//'FLEXDUST_out.nc'
!*****

!Switches output
!*****
logical, parameter :: RELEASEFILE=.true. !Write a FLEXPART release file
logical, parameter :: writeGridEmission=.true. !For each output time step, write a grid with emission flux (kg m-2),
!practical for splitting in regions and doing FLEXPART simulations with changing number of part
!*****
```

- Simulation start 2017101500, simulation end: 2017101600
- Check in dust_mod.f90:
 - start_date_day = 20171015
 - start_date_hour = 000000
 - time_step = 3
 - releaseDays = 1.0
- cd ./flexdust-master/src/
- ./FLEXDUST
 1. Generates *RELEASES* if „RELEASEFILE = .true.“ In dust_mod.f90. Be sure to have deleted old RELEASES file before (due to appending output to RELEASES)
 2. Generates file *FLEXDUST_out.nc* if „writeGridEmission=.true.“
 3. File *Summary.txt*

To be found in /flexdust-master/output/ and /options/

- Make plots of cumulative emission over whole simulation period, the bare soil fraction as well as the emission integrated over the individual time steps

INPUT

Wind fields:../../ECMWF_meteorological_input/Ophelia_Dust/0.5_global/AVAILABLE
Nested wind fields:../../ECMWF_meteorological_input/Ophelia_Dust/0.2_-30_40_30_75/AVAILABLE

Time step wind fields: 3

Land use file:../INPUT/landcover_GLCNMO_L.bin

OUTPUT

Modelled period: 20171015 0 + 1.00000000 days

Time resolution: 3

Grid location: -90.0000000 -179.500000

Grid resolution: 0.500000000

Grid dimension: 360 720

MODEL SETTINGS

Mobility threshold: 0.300000012

Size distribution: 3

Junge index: 0

Scaling factor: 4.7999998787418008E-004

Emission scheme: 2

Topographic control erodibility: T

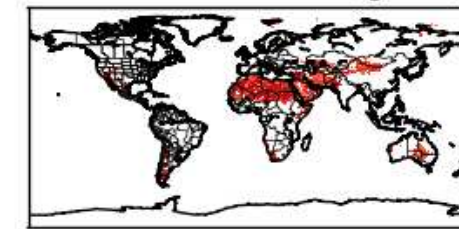
Precipitation blocking mobil.: F

Soil moisture: T

Corr. land/sea: T

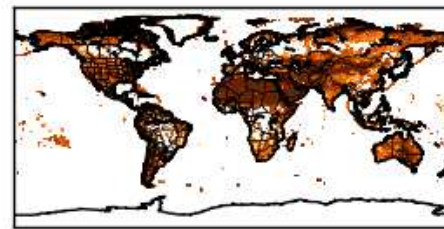
Summary.txt

Cumulative emission [gm^{-2}]



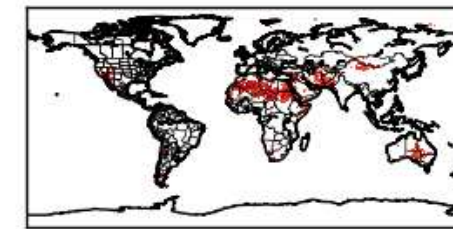
10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2}

Bare soil fraction



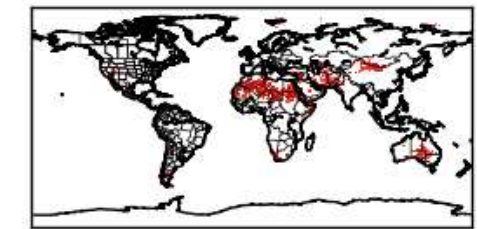
10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2}

Integrated emission [gm^{-2}] between 20171015 000000 and 20171015 030000 UTC



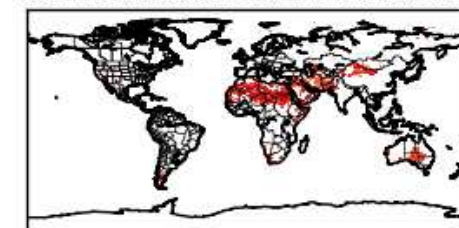
10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3}

Integrated emission [gm^{-2}] between 20171015 030000 and 20171015 060000 UTC



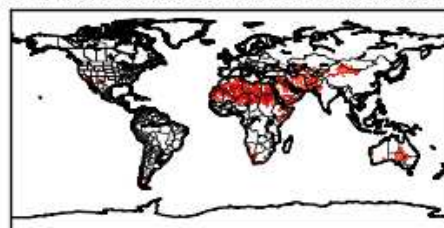
10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3}

Integrated emission [gm^{-2}] between 20171015 060000 and 20171015 090000 UTC



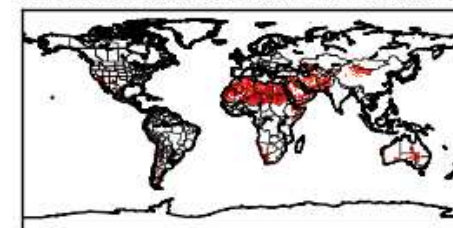
10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2}

Integrated emission [gm^{-2}] between 20171015 090000 and 20171015 120000 UTC



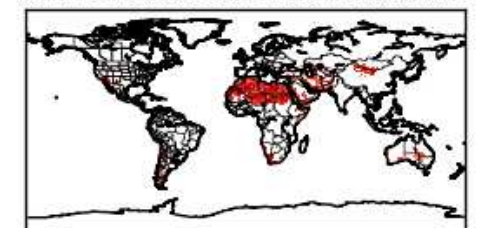
10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3}

Integrated emission [gm^{-2}] between 20171015 120000 and 20171015 150000 UTC



10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3}

Integrated emission [gm^{-2}] between 20171015 150000 and 20171015 180000 UTC

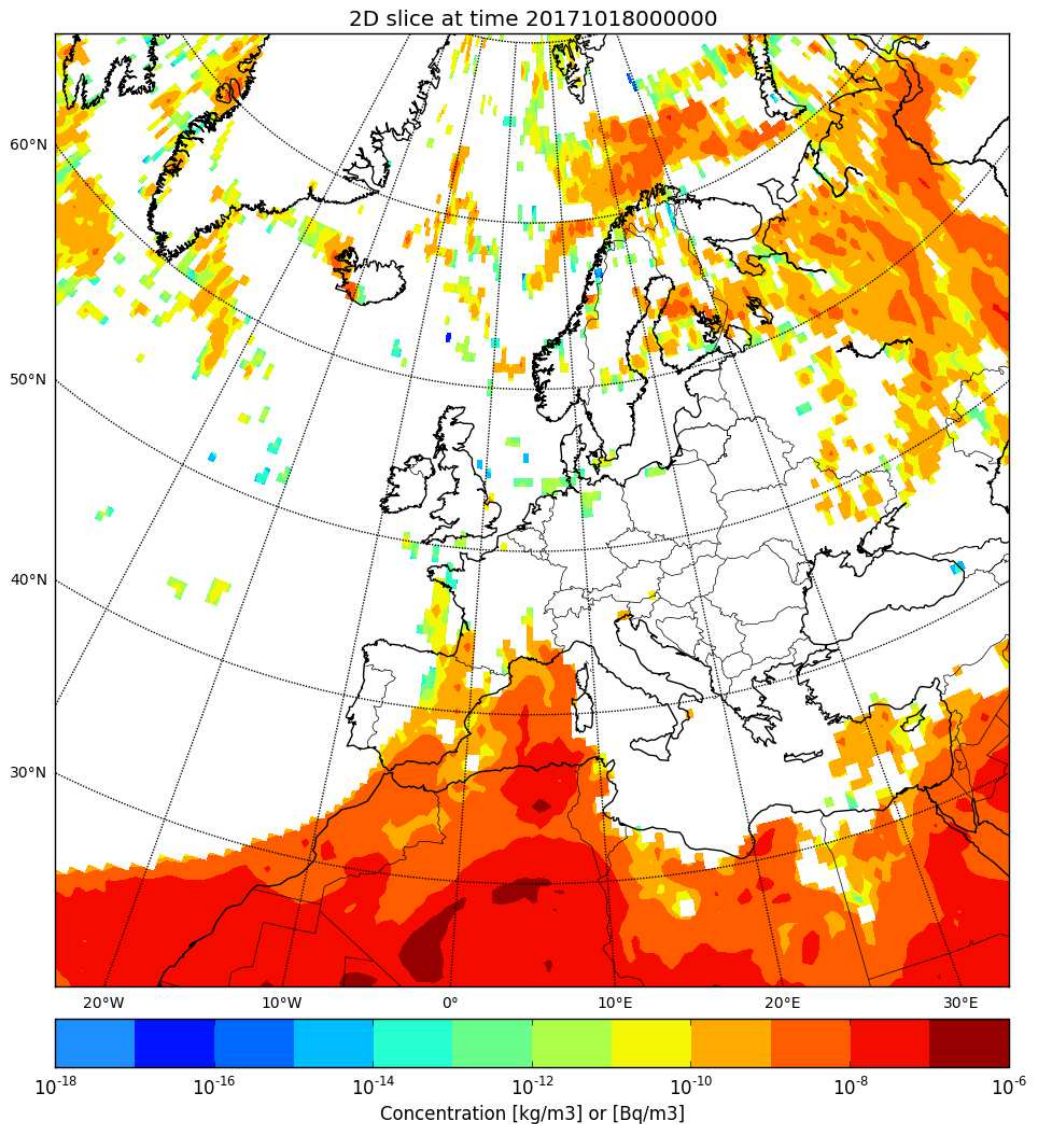
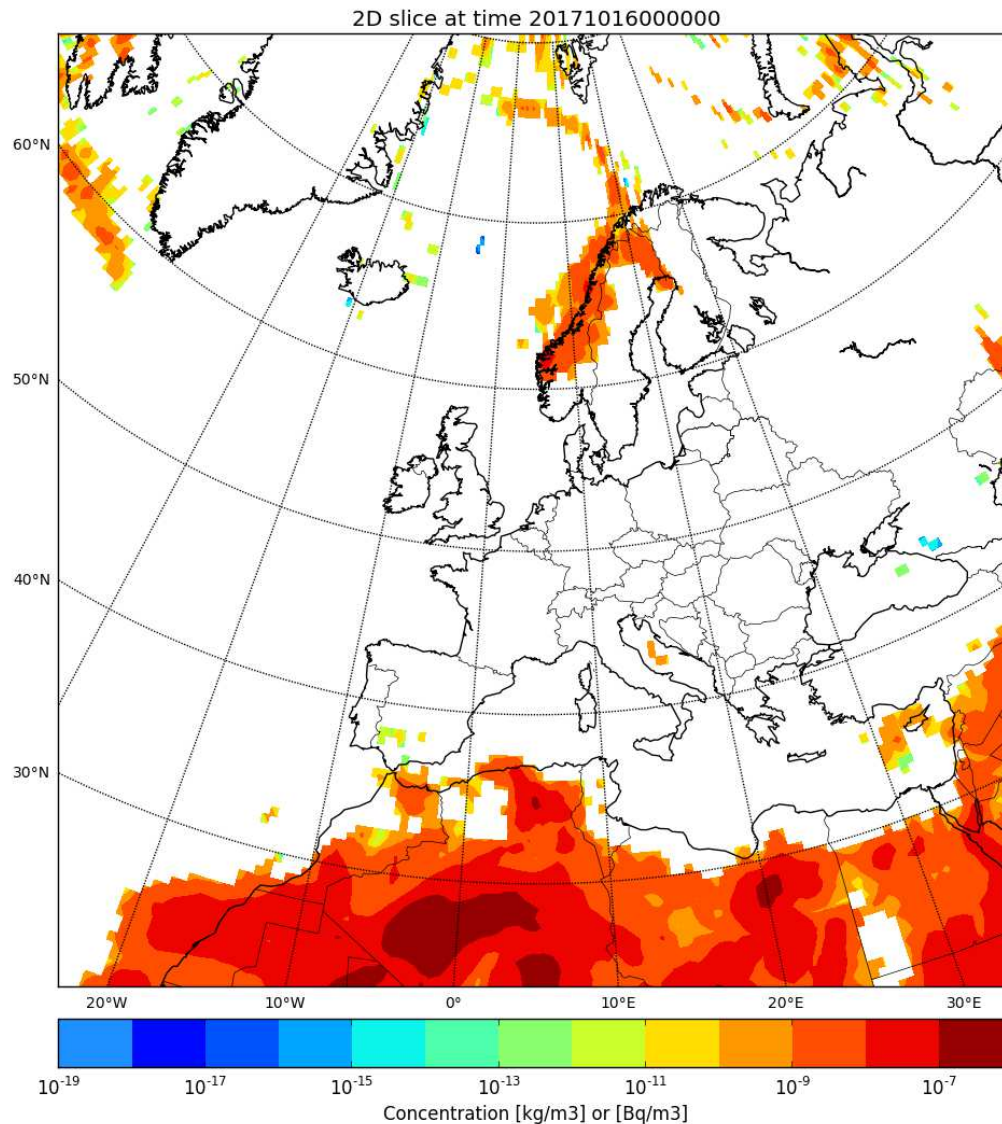


10^{-10} 10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3}

- **COMMAND:**
 - Forward run from 20171015 000000 to 20171016 000000
 - Hourly output
 - Convection
 - Subgrid terrain effect parametrization
 - Nested concentration output
 - No adaption to TL
- **OUTGRID:**
 - Resolution: 0.5 degree
 - LLC: -90 ° N, -179.5° E
 - 360 x 720 grid cells
 - Two output layers: 500 m and 5000 m a.g.l.
- **OUTGRID_NEST:**
 - Resolution: 0.25 degrees
 - LCC: 30° N, -30° E
 - 180 x 280 grid cells
- **RELEASES:** Written by FLEXDUST!
- **SPECIES** as used by FLEXDUST: DUST-401 to DUST-410; particles with average diameter of 0.2, 0.5, 1.0, 1.5, 2.5, 5.0, 7.5, 12.5, 15.0 and 20 μm

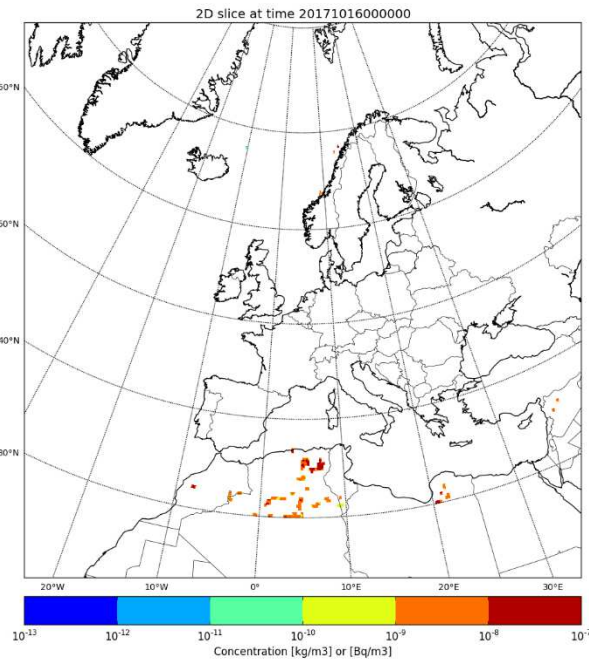
Plot the Ophelia event (mother, 500-5000 m a.g.l.)

```
./plot_FLEX_binary.py ./output/ False 1,2,3,4,5,6,7,8,9,10 1 0 alldates lcc False -30,40,30,75  
contour False
```



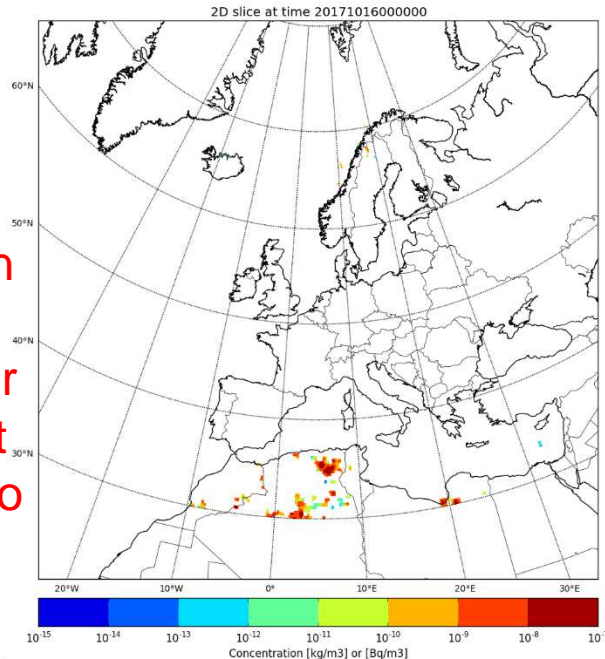
Plot the Ophelia event (nest, 0-500 m a.g.l.)

Finest particles
(0.2 μm)



Coarsest particles
(20 μm)

Contribution
in terms of
mass bigger
for coarsest
compared to
finest
particles



Sum over all 10
particle sizes

