FLAMO FLEXIBLE ATMOSPHERIC MODEL

A NEW 3D ATMOSPHERIC MODEL TO STUDY ATMOSPHERIC PROCESSES IN THE PLANETARY BOUNDARY LAYER

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Nucleation is one of several scientific phenomena which are presently under investigation. A lot of complex chemical and aerosol dynamical processes occur in the Atmospheric Boundary Layer (ABL) and it is essential to have a thorough understanding of these processes. To achieve a better understanding in this crucial scientific fields we have developed a spatial and temporal high resolution 3 dimensional model FLAMO which attempts to reconstruct the emissions, transport, chemistry and aerosol processes in the mixed layer. FLAMO integrates a meteorological module, an emission module, a chemical kinetics module and an aerosol dynamics module.

Implementation

We have successfully implemented MPI into FLAMO and made use of virtual MPI topologies to attain higher efficiency. One core is dedicated to write out the output files. This is done by making a new communicator which excludes the last core (or process) from the given number of processes Figure 1. gives a pictorial depiction of the parallelization technique which is implemented in FLAMO.

Main objective of the interface FLAMO is to allow the user with the flexibility to include or exclude various modules and to run as a 0-, 1- or a 3-dimensional model depending on the scientific topic and available computer time. Figure 2. gives a schematic representation of FLAMO explaining the flexibility it provides.

Future implementation includes writing output files into NetCDF or HDF5 data formats to achieve a faster and easier handle of the high amount of output data sets.

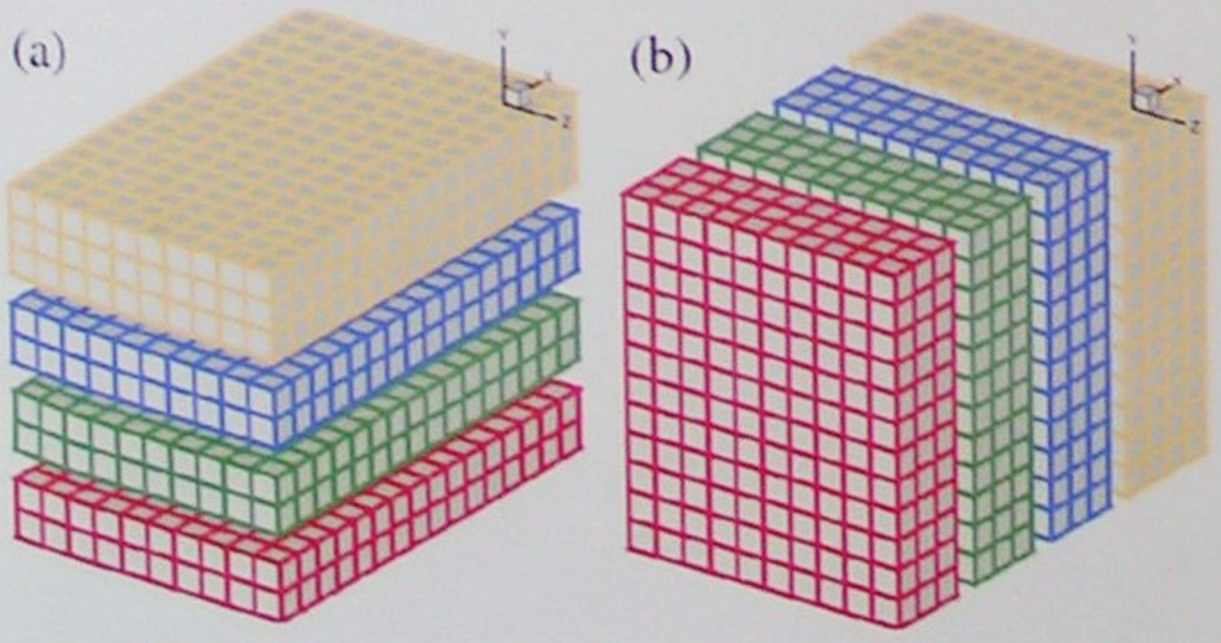

Figure 1. MPI 1D Decomposition as implemented in FLAMO

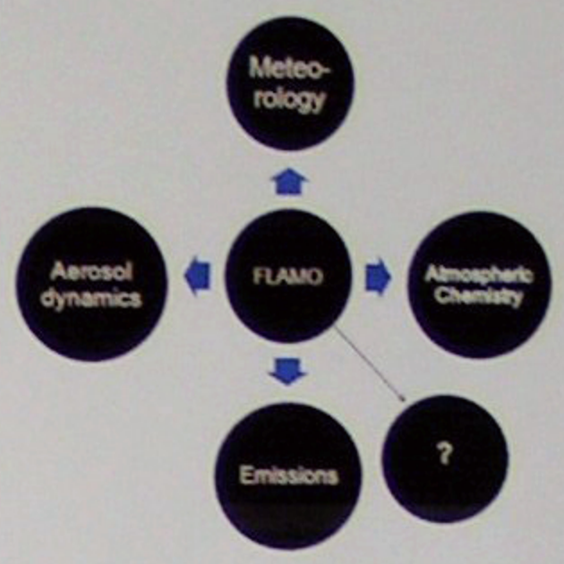

Figure 2. Schematic Representation of FLAMO

Modules

- Emissions from the canopy are simulated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN). This is a system for estimating the net emissions of gases and aerosols from terrestrial ecosystems in to the atmosphere.
- The chemistry which accounts for most of the simulation time is taken from the Master Chemical Mechanism (MCM). MCM is a near explicit chemical mechanism that describes the degradation of hundreds of volatile organic compounds (VOC). This mechanism is implemented into Fortran 90 using KPP (The Kinetic PreProcessor).
- The University of Helsinki Multicomponent Aerosol model (UHMA) for implementing aerosol dynamics. The main objective of this module is to study new particle formation under clear sky condition in the troposphere.
- The meteorological module will be a hydrostatic meteorological model used to simulate the meteorological conditions in the subscribed area. This atmospheric module will be infused with a canopy model so as to simulate the canopy conditions for neutral, stable and unstable atmospheric stratification.
- This Model would be used to simulate the process of nucleation in and over the ABL over Hyytiälä station in Finland (Figure 3)

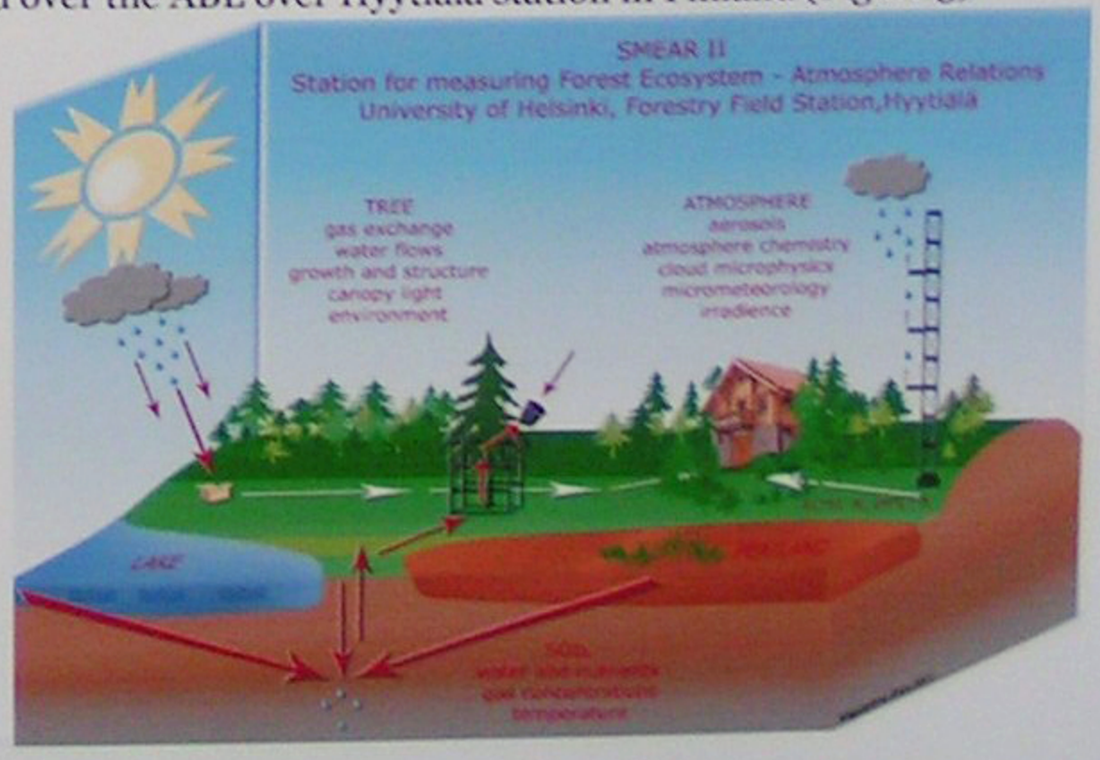

Figure 3. Applying FLAMO to SMEAR –II station (Hyytiälä) in Finland