Customizing GRASP general retrieval software for specific high-performance applications

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Generalized Retrieval of Aerosol and Surface Properties (GRASP) is an algorithm that allows retrieving detailed aerosol and surface properties from remote sensing observations. The code uses modern methodologies as for example the multi-pixel constraints that help to use a priori constraints on the variability of retrieved aerosol and surface parameters in space and time. GRASP is based on generalized inversion scheme which uses different modules that can be enabled or disabled depending the specific application. As a result, the algorithm is versatile and can be applied to many different sensors from ground-based instruments to satellites. Realization of all these concepts in efficient computational routine is a challenge from the technical point of view: the software must be flexible enough to be adapted to all instruments without degradation in performance. Additionally, utilization of a priori constraints on time and space variability of parameters must be carefully developed to be efficient in memory usage.

All challenges have been adequately addressed in current GRASP code by transforming the retrieval algorithm into a library surrounded by modules that manage common operations such as: input, output, definition of inversion strategy, etc. These modules are highly optimized for standard operations and they have the interfaces that easily can be extended by allowing the generalized inversion core of the code to work for specific instruments. Additionally, an extra layer that allows the code to communicate with Python has been developed allowing the users to execute a highly optimized code from a very convenient language for analysis of the results.

These features are essential for optimizing performance of the GRASP retrieval production environment where large datasets, as for example satellite images, have to be processed. General concepts such as the geometry of the measurements, type of measurements (radiance, backscattering profile, polarization, etc.) are encapsulated into the core of GRASP while all instrument-specific features are defined in the extensions. This creates an ecosystem of extensions that simplify the use of the code for diverse specific cases generating a convenient structure for further developments. Additionally, the open-source platform allows the participation of scientific community in evolution of GRASP by implementing new features or extensions.

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