ASR Vertical Velocity Focus Group

Steering Committee

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Mission statement

The mission of the ASR Vertical Velocity FG is to use ARM measurements to improve the understanding of the connection between cloud microphysics and cloud-scale dynamics and provide observational targets (vertical velocity products) suitable to evaluate Large-eddy simulations, Cloud-resolving models and aspects of large-scale model parameterizations.

Objectives

The science of cloud-scale vertical velocity retrievals from ground-based remote sensors is rapidly evolving. This presents new possibilities for modelers and observationalists within the framework of the VVFG to: i) analyze multi-year records of cloud-scale vertical motions and ii) utilize the new ARM sensors to develop new vertical velocity measurement techniques and products in unexplored cloud and precipitation regimes. Furthermore, vertical velocity retrievals are often coupled to microphysical retrievals. Thus, the VVFG is also interest in exploring the interaction between microphysics and dynamics and add to our understanding of cloud processes and lifetime. The primary objectives of the VVFG are to:

Investigate the potential of ARM measurements to retrieve the vertical motion in precipitating and non-precipitating clouds.

Develop retrieval algorithms of vertical air motion for a wide range of cloud and precipitation conditions (detailed below) with appropriate uncertainty estimates and validation strategy.

Deliver value-added products with vertical air motion measurements suitable for model evaluation and improvement

Improve our understanding on the role of cloud-scale dynamics on cloud microphysics and lifetime

Milestones – Measuring progress

Short-term (accomplished by the 2011 ASR Science Team Meeting)

Produce a white paper on the status of vertical velocity measurements produced using ground-based instrumentation. Identify retrievals/methods that can be applied to existing multi-year records from the ARM sites and retrieval/methods that can be applied to measurements from the new ARM instrumentation.

Prioritize the vertical velocity products with respect to:

a) Importance (in consultation with the ASR science team).
b) Maturity of the retrieval algorithms (requiring an extensive literature review).
c) Level of required effort (resources) to operationally produce these products
d) Available validation strategy

Identify a few vertical velocity products (with mature algorithms and minimum required effort) and document the process from research and development (paper studies, algorithm development) to production (VAP in the ARM archive) in the next year. This will help to identify challenges related to transferring knowledge (prototype software, documentation) to ARM infrastructure.

Finally, identify areas where additional research is first needed before vertical velocity retrievals are attempted. This could lead to a proposal for a field campaign.

Long-term (5-year)

Develop and validate a suite of algorithms suitable to run at the ARM fixed/mobile sites that retrieve vertical air motion in clouds (often this implies coordinated cloud microphysics retrievals).

Produce long-term records of vertical velocity for a wide range of cloud and precipitation conditions. Develop a framework (interface) to convey the vertical velocity products to modeling groups working on eddy resolving, cloud resolving and global climate models. Emphasis will be give to vertical velocity products from ARM IOP periods for which large-scale forcing is available. This will enable the modelers to evaluate how realistic the model produced vertical velocity fields are (either pdfs of VV from LES or CRM, or parameterized VV from SCMs).

Use the vertical velocity products in conjunction with microphysical retrievals (often the two are inseparable) to enhance our understanding on how cloud systems dynamics impact cloud microphysics and cloud lifetime.

Organizational structure

There is a wide range of cloud and precipitation conditions that will be targeted for vertical velocity measurement, all with differences in their underlying physics. In addition to the wide range of "targets", there is a large spectrum of remote sensors,

observational techniques and inversion methods that can be applied to derive vertical velocity. To better manage and coordinate these activities, the development of smaller "target" groups within the VVFG is proposed. Each "target" group is responsible for stimulating and coordinating collaborative research among the members of the VVFG that can identify their research interests with one of the "target" groups. Initially, six "target" groups have been identified (Table 1) and each target group has been assigned coordinators.

Target	Description	Approach	Leads
Liquid clouds	Shallow cumulus or stratocumulus clouds possibly including drizzle	Synergetic measurements, radar Doppler spectra	Virendra Ghate Edward Luke
Ice clouds	Stratiform ice clouds	Synergetic measurements, radar Doppler spectra	Jennifer Comstock Pavlos Kollias
Mixed-phase clouds	Low-level stratiform mixed-phase clouds (NSA)	Synergetic measurements, radar Doppler spectra	Hans Verlinde Edward Luke
BL - clear air	Lowest 2-3 km of the troposphere	Doppler lidar and radar wind profiler	Rob Newsom Edwin Campos
Deep convective clouds	Intense deep convection	Radar network, radar wind profiler	Scott Collis Ed Zipser
Large-scale precipitation	Widespread (with melting layer)	Profilers, cloud radars Doppler spectra	Scott Giangrande Chris Williams
Models/ Value Added Products/ IOP interface	Ensure that the VVFG efforts are stirred toward useful products, format etc.	Evaluate VV products from the target groups, interface with modelers and IOP's	Steve Klein* Anthony DelGenio Ann Fridlind* Matthew Shupe Pavlos Kollias

* Awaiting for confirmation for their participation

In addition to the target groups, the development of a Models/Products/IOP (MPI) interface group is proposed. The MPI interface group will be responsible for articulating modeling needs with respect to vertical velocity, desirable data products, resolution, accuracy, documentation, format etc. Another important function of the interface group is to connect existing and planned ARM IOP's with the VVFG and facilitate the development of targeted vertical velocity products from ARM field campaigns.

Participation

Participation in the ASR VVFG is open to all members of academic institutions, domestic and international (including graduate students), laboratory employees (especially ARM infrastructure), and ASR funded and unfunded scientists. Our goal is to achieve a healthy mixture of ARM infrastructure and ASR scientists. Strong participation of ARM infrastructure will facilitate the development of institutional memory for ARM as part of the critical path towards the transferring of prototype algorithms to well-documented software suitable to plug and play on existing ARM data streams. Another objective is to achieve strong participation of the modeling community. The most recent VVFG member list is available on: http://www.clouds.mcgill.ca/research/VVFG_members.pdf

Demonstration of progress

The key elements of the VVFG performance metric are:

i) number of vertical velocity retrieval algorithms run by ARM with appropriate validation strategy,
ii) number of vertical velocity products in the ARM archive with emphasis in ARM IOP's,
iii) number of publications by VVFG-affiliated scientists using vertical velocity data to understand processes in the atmosphere and clouds.

Progress shall be demonstrated by:

Physical meetings during the spring ASR science team meeting and the fall ASR working groups meeting where progress in the key areas outlined in table 1 will be presented.

The generation of a frequently updated (e.g., six months), living report available to ASR WG's steering committees and scientists. The report will articulate progress in the development of retrieval algorithms and availability of vertical velocity products at the ARM archive.

Maintenance of a web site with all presentations, research papers and reports produced by the focus group at the following address:
http://www.clouds.mcgill.ca/research/vertical_velocity.html