Simulating Doppler Wind Lidar Observations for Use in OSSEs and Technology Trade Studies

G. D. Emmitt

Joint OSSE Meeting

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Overview

- General discussion of DLSM (previous presentation and online session) www.swa.com/ald/DLSM4.2/index.htm)
- Use of DLSM in SIVO's Sensor Web Simulator (includes video of adaptive targeting)
- Calibration of DLSM using GLAS and CALIPSO data (general description of ongoing work)
- The role of temperature in DWL simulations
- Simulating ADM in preparation for assimilating ADM data (ROSES07)

Simulating DWL winds and CMVs for OSSEs

G. D. Emmitt, S. Greco, S. A. Wood and C. O'Handley

Simpson Weather Associates

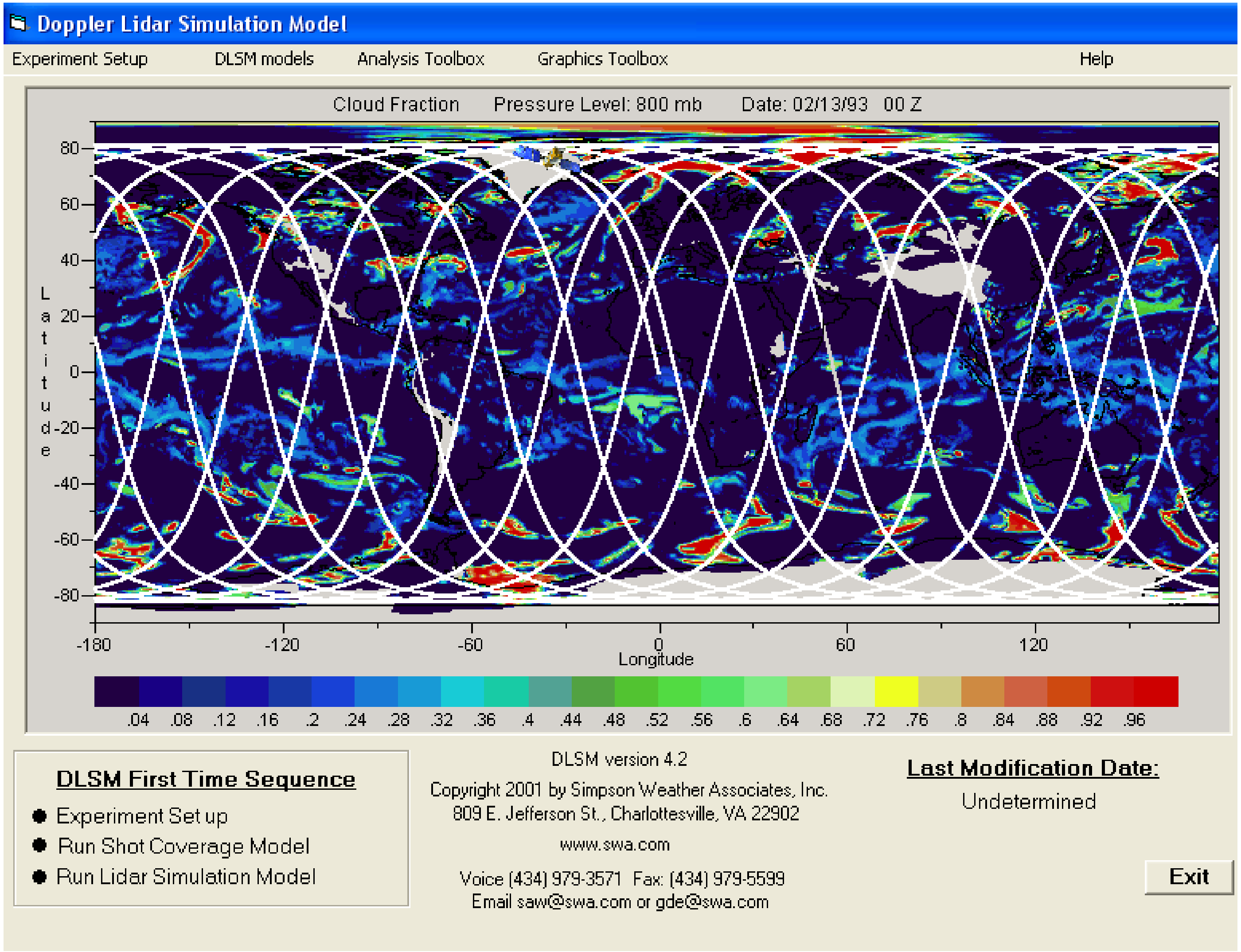
Background

- Simulating Doppler Wind Lidar(DWL) data for use in OSSEs began in 1989 (Emmitt and Wood).
  - Used Nature Run T106 Nature Run to conduct first series of NWP impact studies.
  - Followed with T213, MM5, GEOS (25km) and now T511 and T799.
- Simulating Cloud Motion Vectors (CMV) began in 2003 (O’Handley, Emmitt and Greco) using Nature Run clouds.

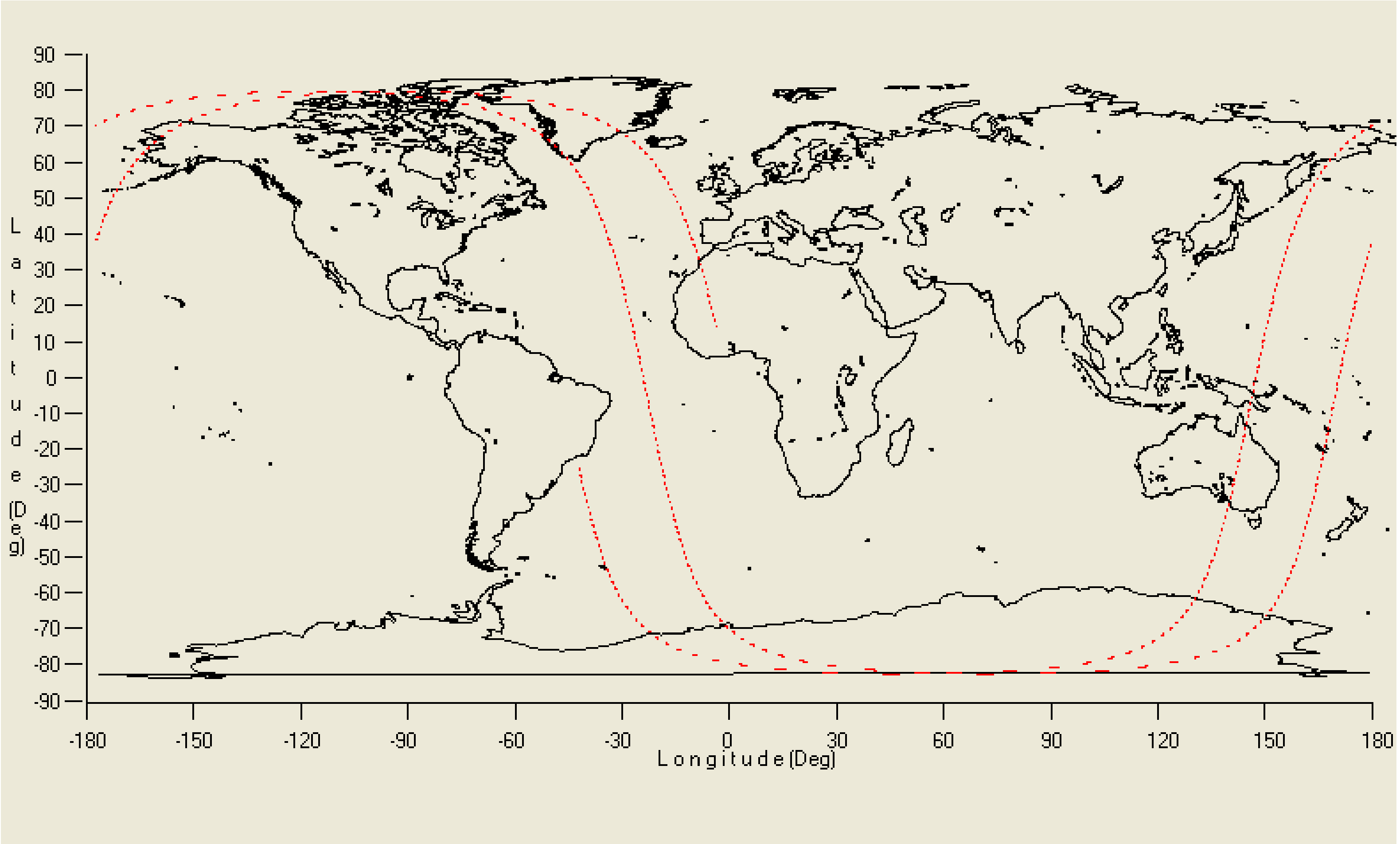
The Doppler Lidar Simulation Model

- Allows configuration of mission including orbits, DWL instruments and data processing
- Allows choice of input Nature Runs and atmospheric optical properties
- Subgrid scale turbulence and cloud properties are dealt with in ways best suited for sampling with a <100m diameter beam.

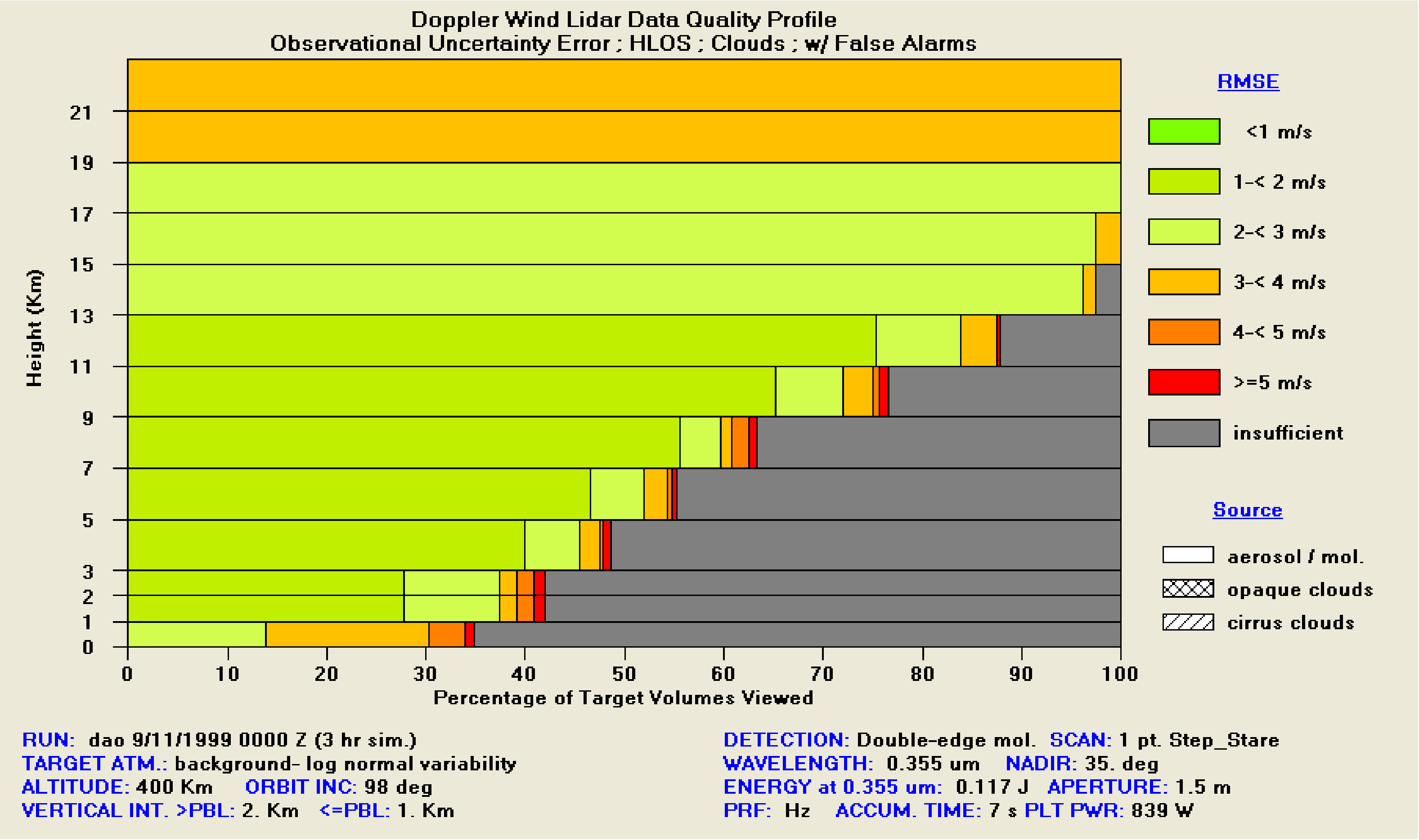
Doppler Lidar Simulation Model



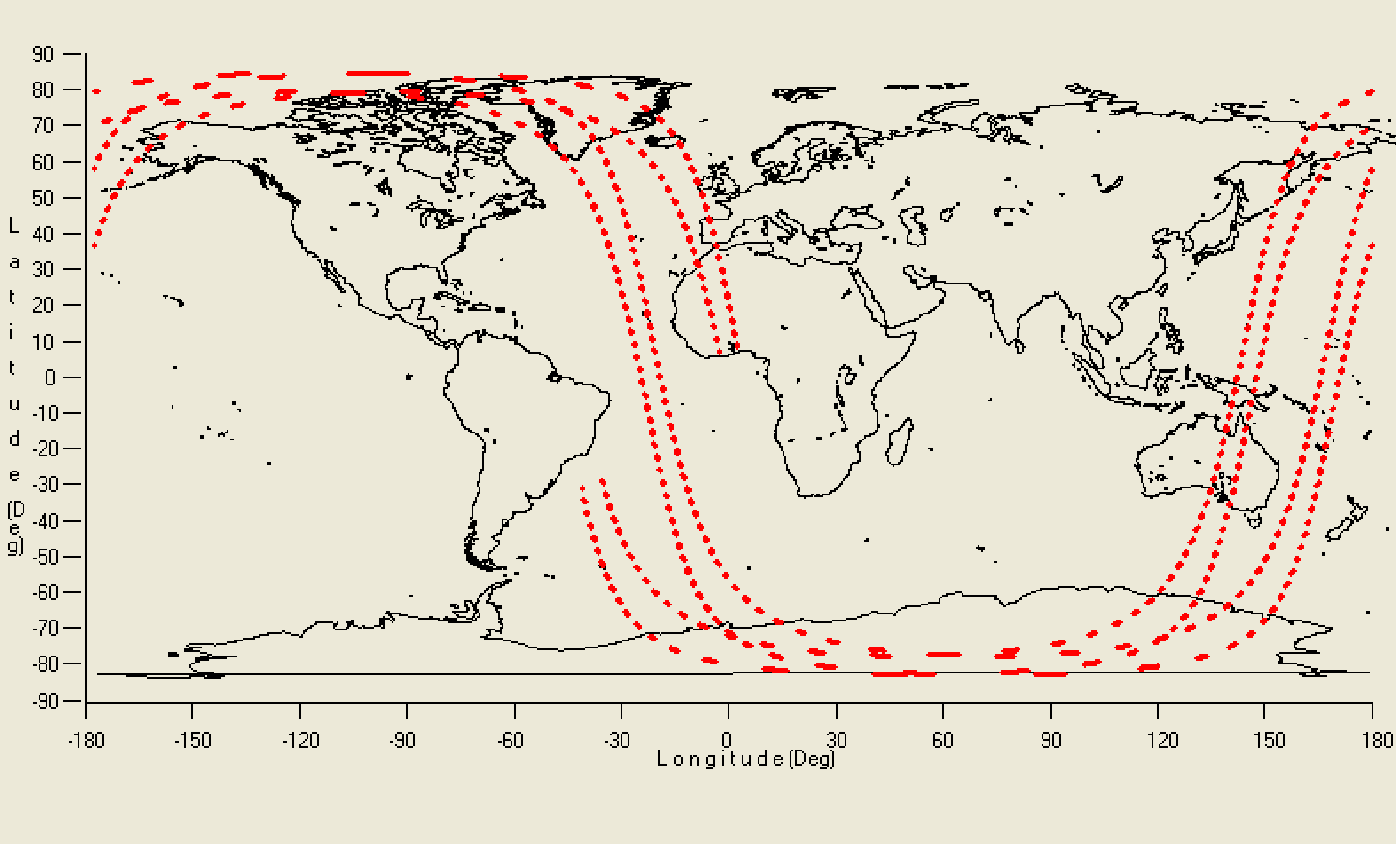
ADM coverage



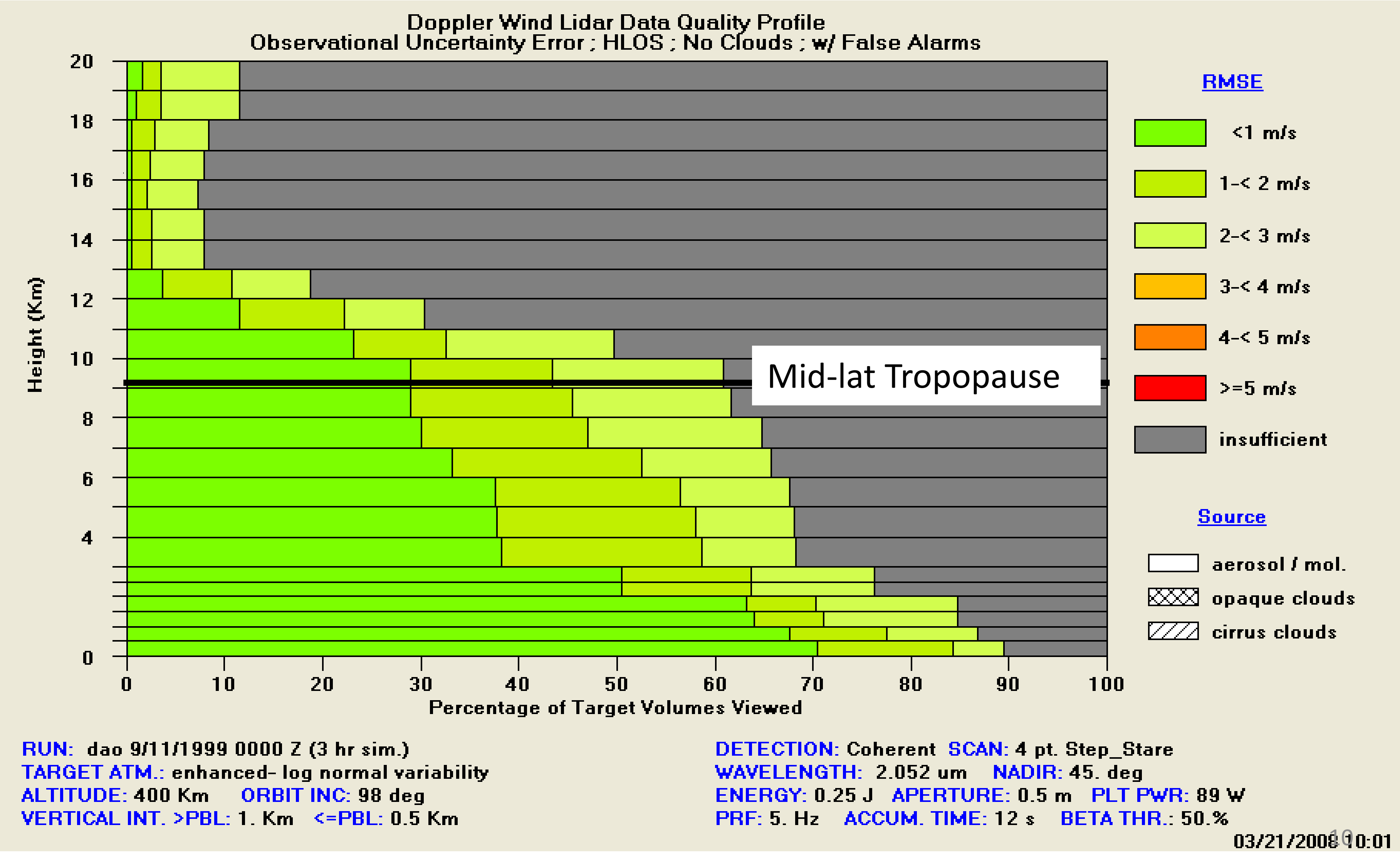
ADM Molecular



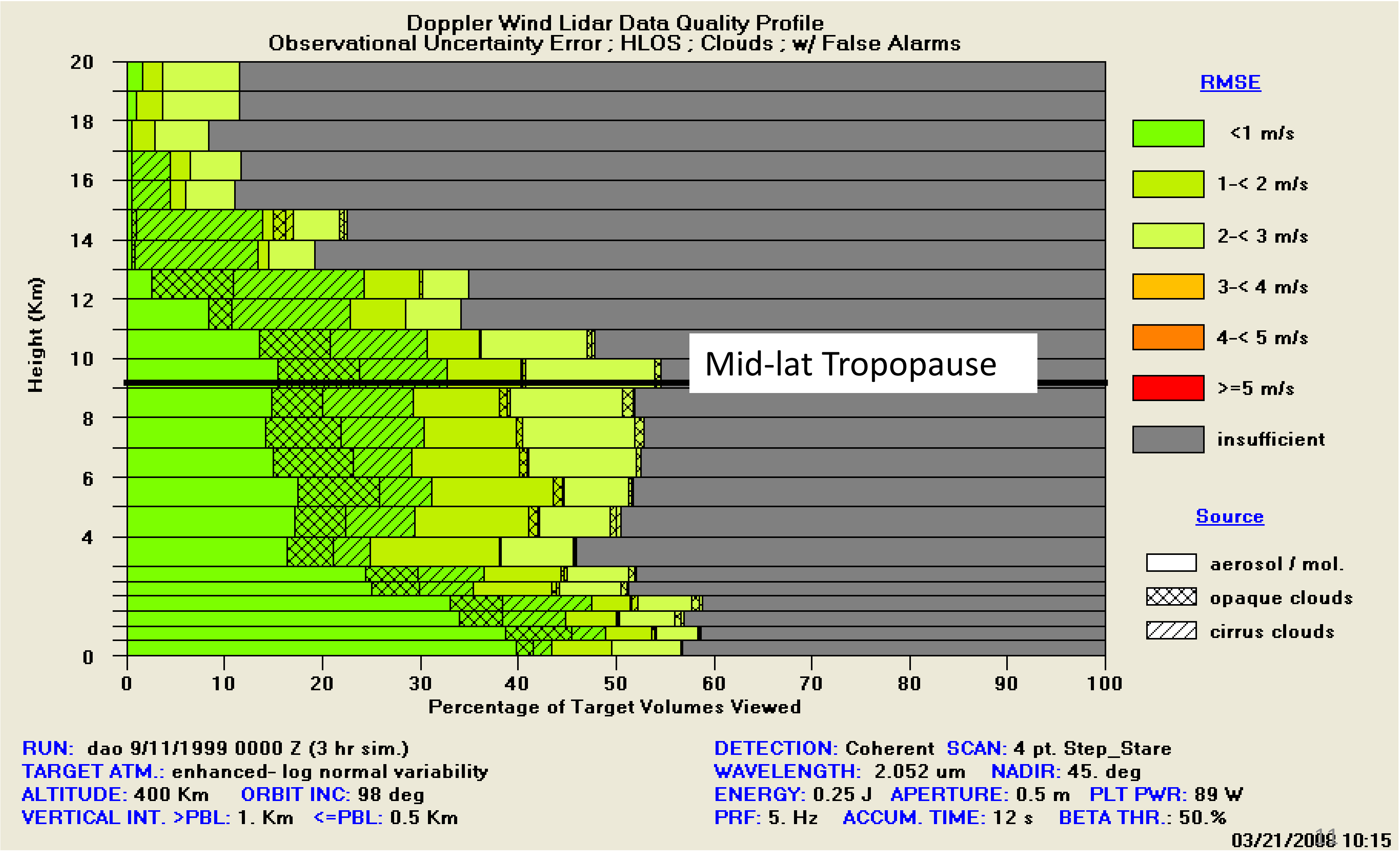
GWOS 4 beam coverage



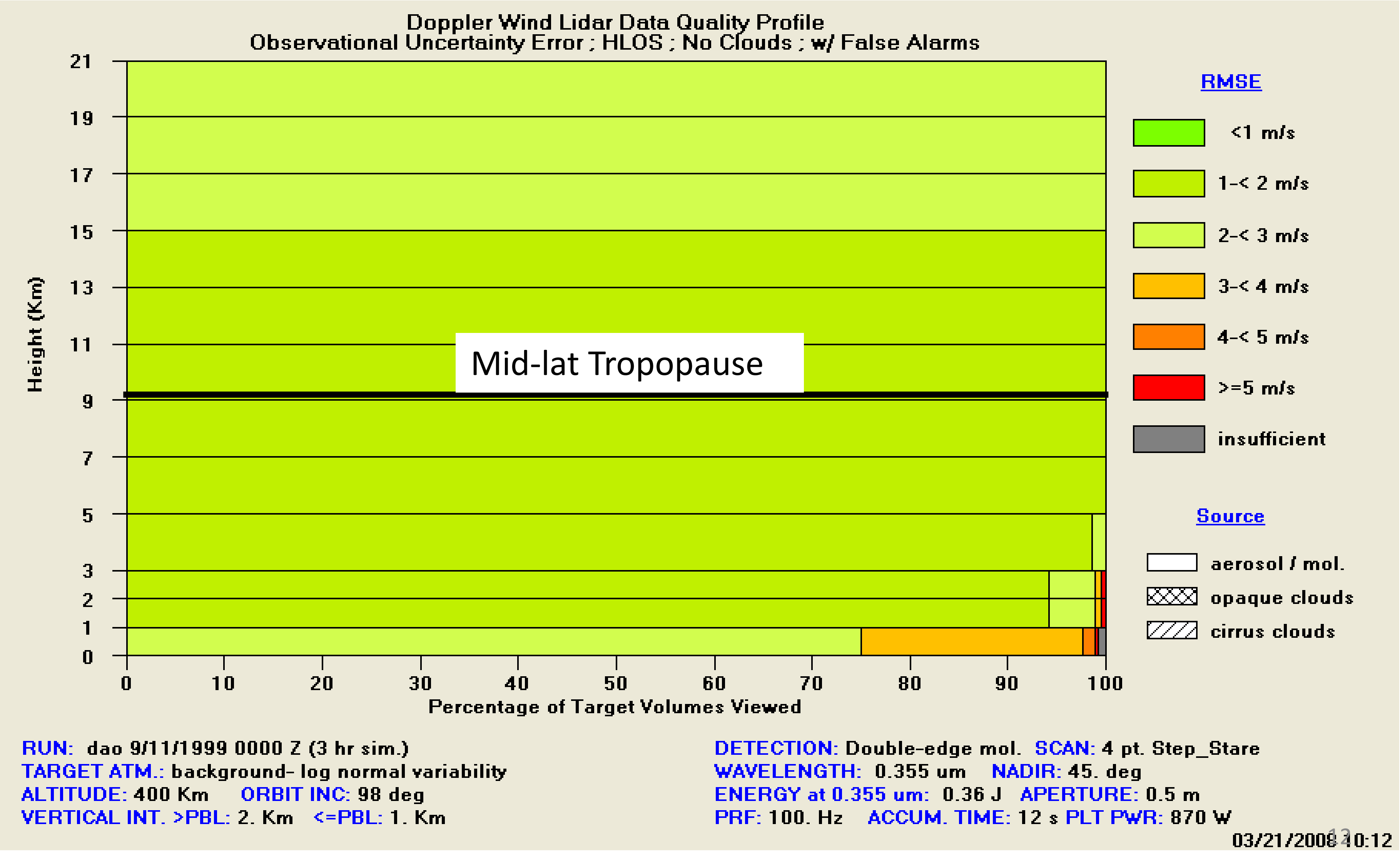
GWOS Coherent: no clouds



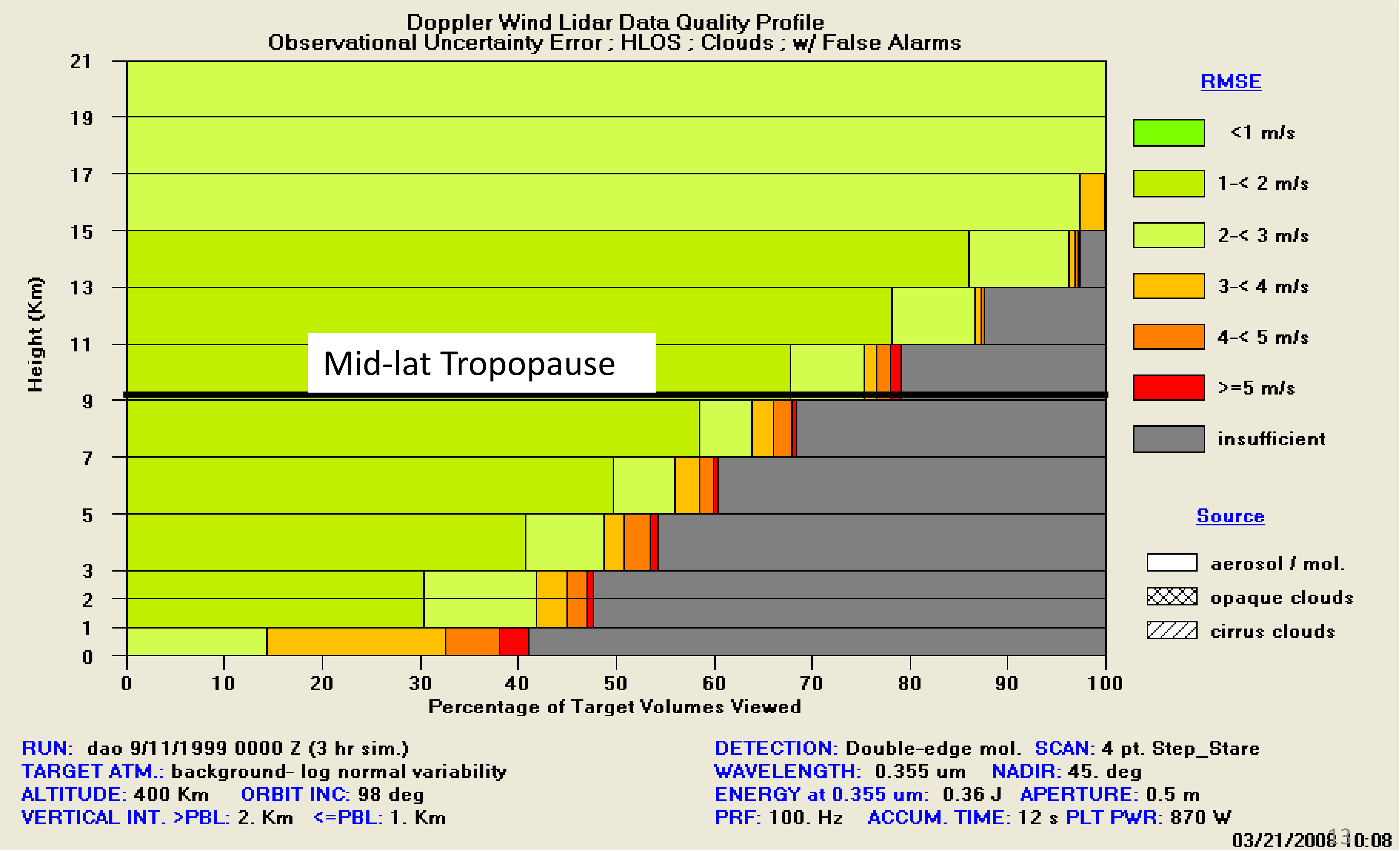
GWOS Coherent: w/clouds



GWOS Direct: no clouds



GWOS Direct: w/clouds



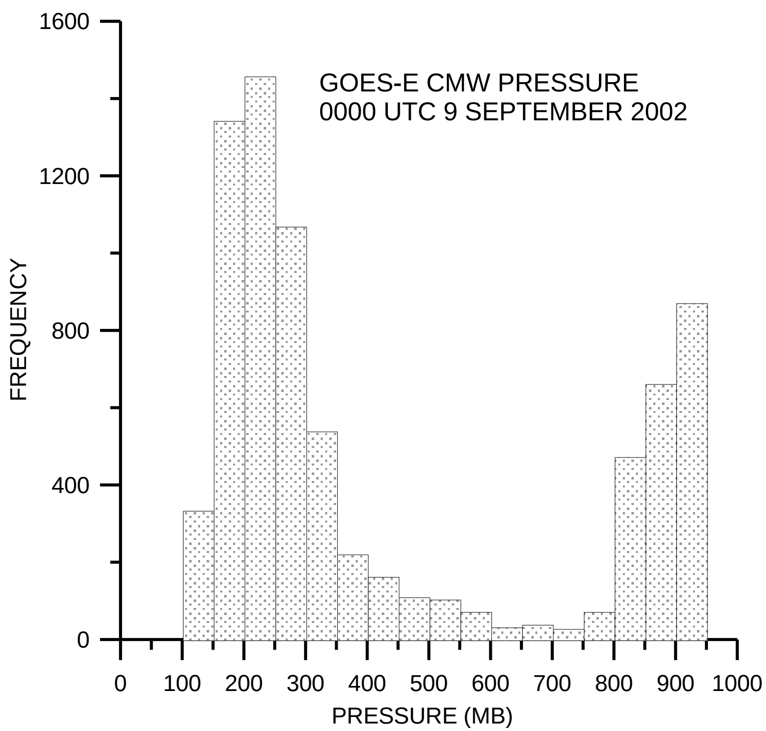
Cloud Motion Vectors

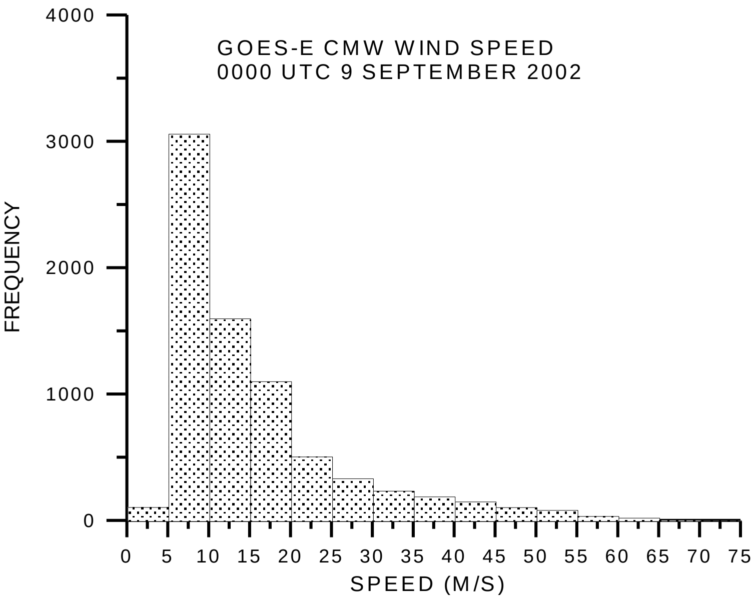
- Challenge was to determine subset of model clouds that would be suitable for use by CMV algorithms.
- Simulation of navigation errors and height assignment errors produced CMVs with both the random (~ 3 -5m/s) and bias (~ 1.5 m/s slow) errors.
- Number of CMVs available to DA is controlled by simple random thinning.

Objectives

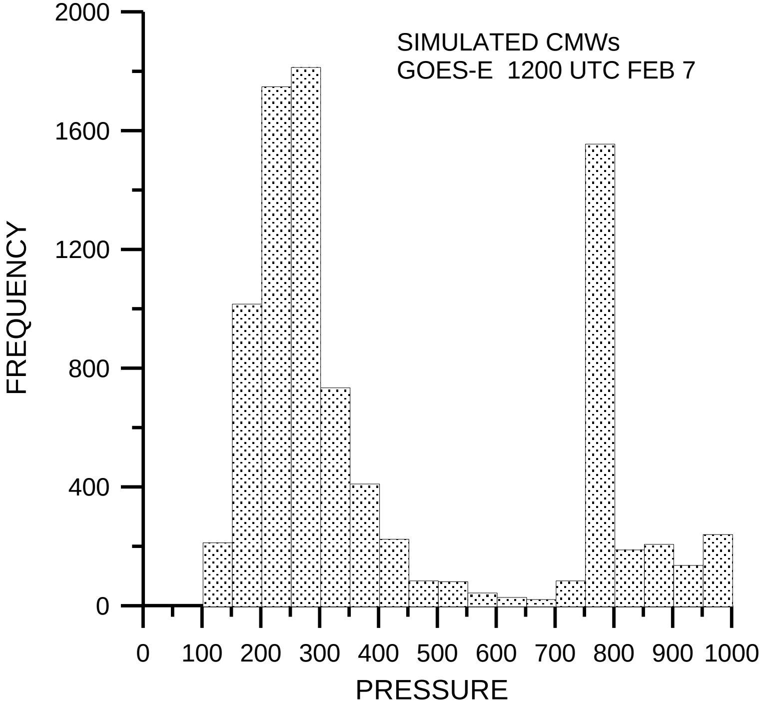
- Generate simulated Cloud Motion Winds (CMW) using a “Nature Run” from a global numerical model
- Provide CMW where the model indicates “trackable” cloud targets
- Produce velocity errors (e.g. slow speed bias) similar to those experienced with real CMWs
- Apply similar approach to simulating WVMW

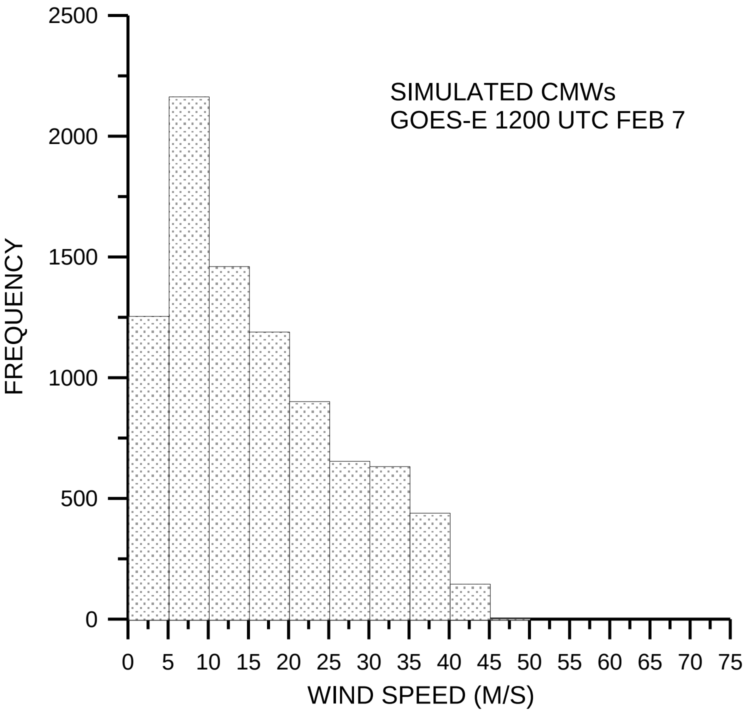
GOES-E observed CMWs for 0000 UTC Sep 9, 2002.
(a) distribution of CMWs by pressure
(b) distribution of CMWs by wind speed.





Distribution of GOES-E simulated CMWs by pressure for 1200 UTC Feb 7





Speed Bias

- Identify trackable clouds
- Determine physical thickness of cloud
- Assign wind speed from middle of cloud to the height of the cloud top (limited to 300 mb thickness)

TABLE III: Speed bias (m/s) for all simulated CMWs listed in TABLE II.

	BIAS VS CMW SPEED		BIAS VS RAOB SPEED	
Wind Speed (m/s)	BIAS (m/s)	Pct of Winds	BIAS (m/s)	Pct of Winds
0 – 10	-0.52	49	-0.02	45
10-20	-1.73	32	-1.65	31
20-30	-3.50	14	-3.25	14
30-40	-3.97	4	-5.02	8
40-50	-3.85	1	-6.50	2
TOTAL	-1.48		-1.48	

Results consistent with published values:(exception is the reported "fast bias" in the mid-levels of the tropics)

- Tomassini et al, 1999
- Bormann et al 2001
- Lalaurette and Garcia-Mendez 2001
- Rao et al 2002

Current DWL/CMV effort at SWA

- Simulating realistic and proposed DWL instrument concept(s) for use in SIVO (NASA/GSFC) experiments and NCEP OSSEs.
  - Currently producing data products from a hybrid DWL as endorsed in the NRC Decadal Survey and various DWL advisory groups
- Simulating CMVs for SIVO and NCEP.
- Simulating various ADM follow-on missions.

SIVO Slides