Wind retrieval performance on synthetic GOES-R ABI imagery

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Introduction

One of the instruments on board the future GOES-R satellite will be the Advanced Baseline Imager (ABI). It is designed to have more spectral channels, finer spatial resolution and the ability to scan faster than the GOES I-M imagers. One VIS, four NIR and five IR bands will be added to the current GOES spectral suite. The spatial resolution will be 2 km for the infrared and 0.5 km for the visible bands. The scanning mode is still to be determined, but 5 and 15 minute full disk scans are among the considered modes.

Two synthetic ABI imagery data sets created at the Cooperative Institute for Research in the Atmosphere (CIRA) and the Cooperative Institute for Meteorological and Satellite Studies (CIMSS) are used to explore the performance capability of the automated wind retrievals algorithm developed by CIMSS. The RAMM and WRF mesoscale models are used to produce synthetic top of the atmosphere radiances (TOA) and brightness temperature imagery for the heritage and some of the new IR and WV spectral channels, at the ABI spatial resolution anticipated for the corresponding channel. The CIMSS/NESDIS atmospheric motion vector (AMV) extraction algorithm is applied to the synthetic imagery to assess the algorithm performance on the ABI spectral channels at 5, 15 and 30 min temporal resolution.

Preliminary results show the total number of AMVs derived from synthetic ABI IR images is consistent with those derived from current satellite data. Simulated WV images lack contrast; hence less wind vectors are extracted. The use of new ABI spectral channels increases the density of retrieved winds in vertical extent. A thorough analysis against the mesoscale model U and V wind fields shows improvement in the mean bias and vector RMS statistics. All results in this study are valid for AMVs with quality indicator (QI) larger or equal to 60.

ABI bands for wind retrieval

ABI bands (IR and WV)	8	9	10	11	12	13	14	15	16
Central wavelength (μm)	6.19	6.95	7.34	8.5	9.61	10.35	11.2	12.3	13.3
Corresponding GOES	6.5	-	-	-	-	-	10.7	12.0	13.3
								(G11)	(G12)

Heritage channels

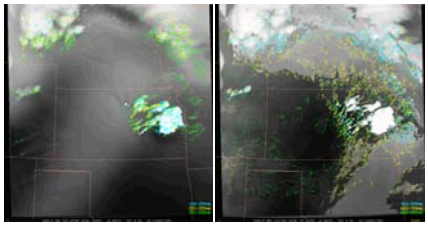
Tracking / Height Assignment::
- A) 8 / 8, 14, 16 (WV winds)
- B) 14 / 8, 14, 16 (IR winds)

New channels

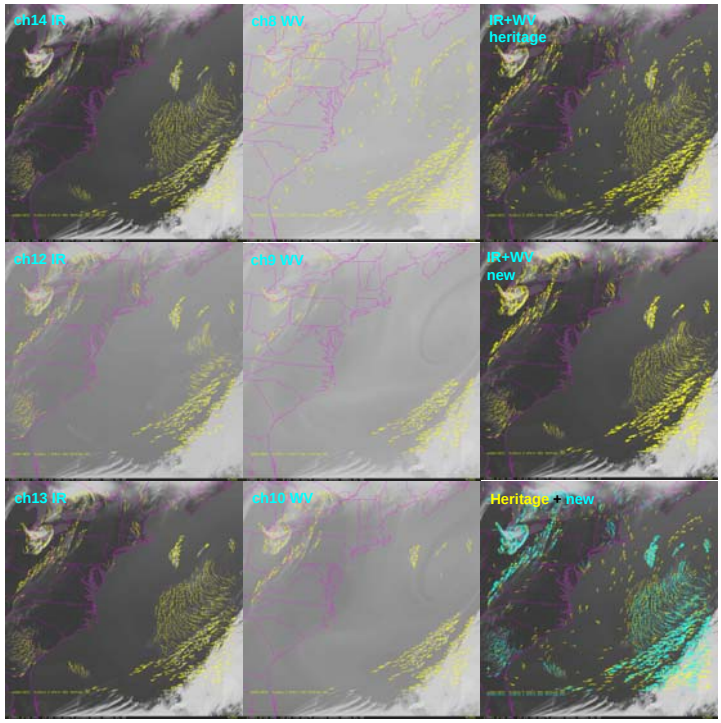
Tracking / Height Assignment::
- A) 9 / 9, 14, 16 (WV winds)
- B) 10 / 10, 14, 16 (WV winds)
- C) 12 / 8, 12, 16 (IR winds)
- D) 13 / 8, 13, 16 (IR winds)

CIRA RAMS Simulation

The CIMSS/NESDIS wind retrieval algorithm was used to track AMVs for a simulated thunderstorm from the CIRA RAMS model. As this was our first proof of concept GOES-R ABI AMV proxy set, it was used to develop the engineering aspect of assimilating new data into the AMV software. To the right are shown mid to upper level winds using the IR (left panel) and WV (right panel) channel.



Winds from CIMSS WRF 15 min Simulation



Wind retrieval performance using CIMSS WRF Simulation

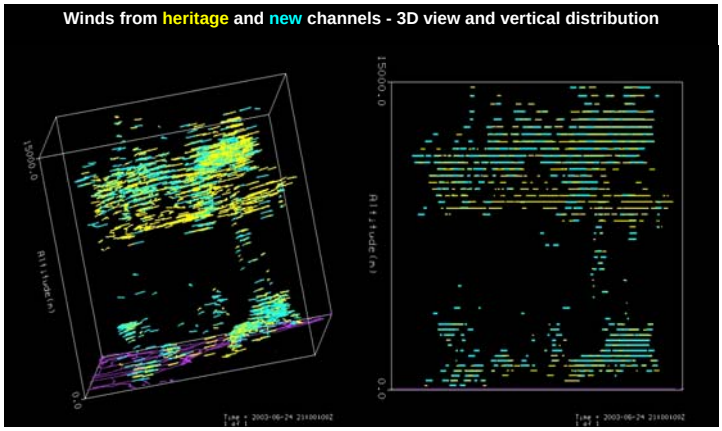
Channels	Time Step	Winds Count	SPD Bias (m/s)	Vector RMS (m/s)
Heritage-IR	5 min	765	-1.75	8.93
New bands-IR	5 min	1130	-2.89	9.51

Channels	Time Step	Winds Count	SPD Bias (m/s)	Vector RMS (m/s)
Heritage-all	15min	1350	-0.40	8.94
Heritage-IR		671	-0.91	6.79
Heritage-WV		729	0.06	10.34
New bands-all	15min	1657	-1.54	7.30
New bands-IR		1068	-1.63	7.05
New bands-WV		597	-1.11	7.22
All bands	15min	3025	-1.0378	8.14

Channels	Time Step	Winds Count	SPD Bias (m/s)	Vector RMS (m/s)
Heritage-all	30min	1226	-0.42	7.20
Heritage-IR		536	-0.74	5.79
Heritage-WV		690	-0.16	8.13
New bands-all	30min	1395	-0.69	6.19
New bands-IR		861	-0.82	5.96
New bands-WV		537	-0.42	6.34
All bands	30min	2632	-0.57	6.77

Wind retrieval performance was assessed in a comparison against WRF model U and V fields used as truth. Heritage channels proved to be a good choice for deriving AMVs from imagers with limited number of spectral bands. However, with the advent of new imagers with an abundance of channels, i.e. 12 channels on MSG, 16 channels on the future ABI, etc., it will be beneficial to utilize more spectral channels. The presented study carries the promise of improved AMVs in terms of vertical and spatial coverage, as well as improved quality.

Winds from heritage and new channels - 3D view and vertical distribution



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