Analysis and Applications of Water Vapor-derived Multispectral Composites for Geostationary Satellites

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Introduction

• Analysis of multispectral (red-green-blue, RGB) satellite image composites can be used to improve understanding of thermodynamic and/or dynamic features associated with the development of significant weather events (cyclones, hurricanes, intense convection, turbulence, etc.).
• The enhanced water vapor imaging capabilities of the Advanced Baseline Imager on GOES-16-17 satellites provide a unique opportunity to demonstrate this capability through a comparison of the Air Mass (AM) and Differential Water Vapor (DWV) RGB image products for several case studies.

RGB Imagery

Air Mass RGB:
• Developed by the European Organization for Meteorological Satellites
• Used to evaluate temperature and moisture characteristics of the environment surrounding developing synoptic weather systems

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Differential Water Vapor RGB:
• Developed by Japan Meteorological Agency
• Used to understand variations in mid-upper level water vapor, horizontal moisture boundaries, trough / ridge patterns

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Limb Corrected Imagery

Variations in Mid-Level Moisture

Air Mass RGB (Fig 5)
• Tucson, AZ (TWC): Warm, tropical air mass offshore and inland. More orange tones indicate a decrease in upper-level moisture within the same air mass.
• Salt Lake City, UT (SLC): Low to mid level clouds and green tones indicate more low to mid level moisture

Differential Water Vapor RGB (Fig. 6)
• Tucson, AZ (TWC): Orange and blue colors offshore indicating upper level moisture over a thick dry layer. Increasing deep layer dryness inland.
• Salt Lake City, UT (SLC): Lighter orange, blue, and gray tones indicate increasing mid to upper level moisture

Mid-Latitude Cyclone

Air Mass RGB (Fig. 9)
• Jackson, MS (JAN): Warm, dry air in olive and orange tones representative of the dry slot
• Chanhassen, MN (MPX): Increase in upper level moisture in green tones where the dry slot is not influencing the region
• Wallops Is, VA (WAL): Warm, moist air offshore head of the advancing cold front

Differential Water Vapor RGB (Fig. 10)
• Jackson, MS (JAN): Deep orange tones indicate deep layer dry air also in Fig. 11
• Chanhassen, MN (MPX): Increased low to mid level moisture evidenced by the gray color and in Fig. 12
• Wallops Is, VA (WAL): Moister upper levels with dry air below also see Fig. 13

• The AM RGB indicates upper-latitude temperature and moisture characteristics and the DWV RGB provides information about the vertical distribution of the moisture.
• Assessing the horizontal and vertical distribution of dry air associated with the dry slot is important for anticipating changes in cyclone intensity due to stratospheric air

Summary

• Combined analysis of AM and DWV RGB is useful for assessing mid- to upper-level horizontal/vertical variations in moisture that impact the stability of the pre-convective environment and changes in cyclone intensity
• Applying limb correction to water-vapor derived RGB images can remove the false signal at high viewing angles and potentially improve application an interpretation
• Future work includes verification of results with radiative transfer modeling and obtaining forecaster feedback on the utility of limb-corrected imagery and application of these RGB products as complimentary tools

References


Quick Guides for RGBs: https://nasaqsporttraining.wordpress.com/quick-guides/