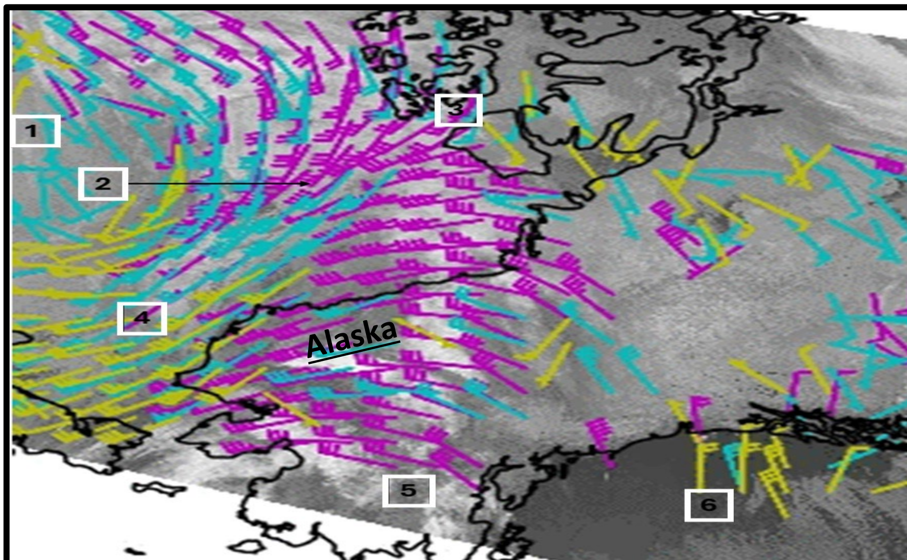
Derived Motion Winds - LEO

Quick Guide

Why are LEO - Derived Motion Wind Vectors Important?

Derived Motion Wind Vectors from Low Earth Orbit (LEO), are produced using sequential VIIRS images from combination of JPSS satellites, and as such they can provide important information about winds at different levels during asynoptic times. Areas of wind shear or jet maxima can be identified. Wind vectors are computed using infrared imagery (M15, 10.76 µm) at 750 m resolution. In the example at right, 1) Counter-clockwise rotation indicating the axis of trough of low pressure. 2) Divergent flow, cyclonic curvature, veering winds, all indicative of strong upward vertical motions. 3) Strong deceleration and diffluence in jet exit region. 4) Strong mid to low-level WSW flow 20-30 m/s beyond the main storm system. 5) clockwise flow indicating location of axis of positive tilted ridge. Also indicative of strong downward vertical motion downstream. 6) Strong low level offshore flow.



Derived Motion Wind Vectors: 250-400mb (pink), 400-700mb (cyan), and >700mb (yellow) at 2055 UTC on 20 November 2024. Wind barbs in meters per second (m/s). This product can be displayed in different ways with different pressure layer thresholds. The above example is from a Python plotting routine.

JPSS VIIRS Domain	Resolutions and Latencies	Algorithm
Polar Stereographic - Arctic and Antarctic	**Temporal:** 50.5 minutes (NOAA-20 and NOAA-21), 101 minutes (NPP). **Spatial:** 750 meters. **Latencies** - *Direct Broadcast (DB)***:** 75 to 90 min, *Non-DB Sources:* 4-5 hours.	JPSS Enterprise Framework (Algorithm Theoretical Basis Document, ATBD)

Impact on Operations

Primary Application: Identify regions of strong winds or wind shear to confirm model forecasts and/or to anticipate the result of strong winds or shear. For pressure level plots, vectors are plotted over a range of values centered on the pressure level. For channels, vectors are plotted at different levels depending on the retrieved cloud top temperature (when cloud features are tracked).

Application: Infer Bulk Layer Shear by comparing surface wind observations to Derived Motion Wind vectors.

Application: Derived Motion Winds are one of the most important products assimilated into many Numerical Models.

Limitations

1) The product requires features to track. Individual wind vectors are retrieved at a single level.
2) The technique requires 3 sequential images that are 50 to 51 minutes apart, which are needed for consistency checks between sub-vectors.
3) Observation coverage is limited to the overlap between three successive orbits.
4) Due to need of successive orbits, product has higher latency than GOES winds (50-minutes).
5) VIIRS does not have water vapor channels, therefore, clear sky wind observations do not exist. VIIRS winds are limited to cloud tracking in the IR clear-window channel (10.76 µm).
6) Dependency on upstream cloud products for height assignment.
7) Due to no complimentary satellite, NPP winds are done singularly and therefore have greater lag.

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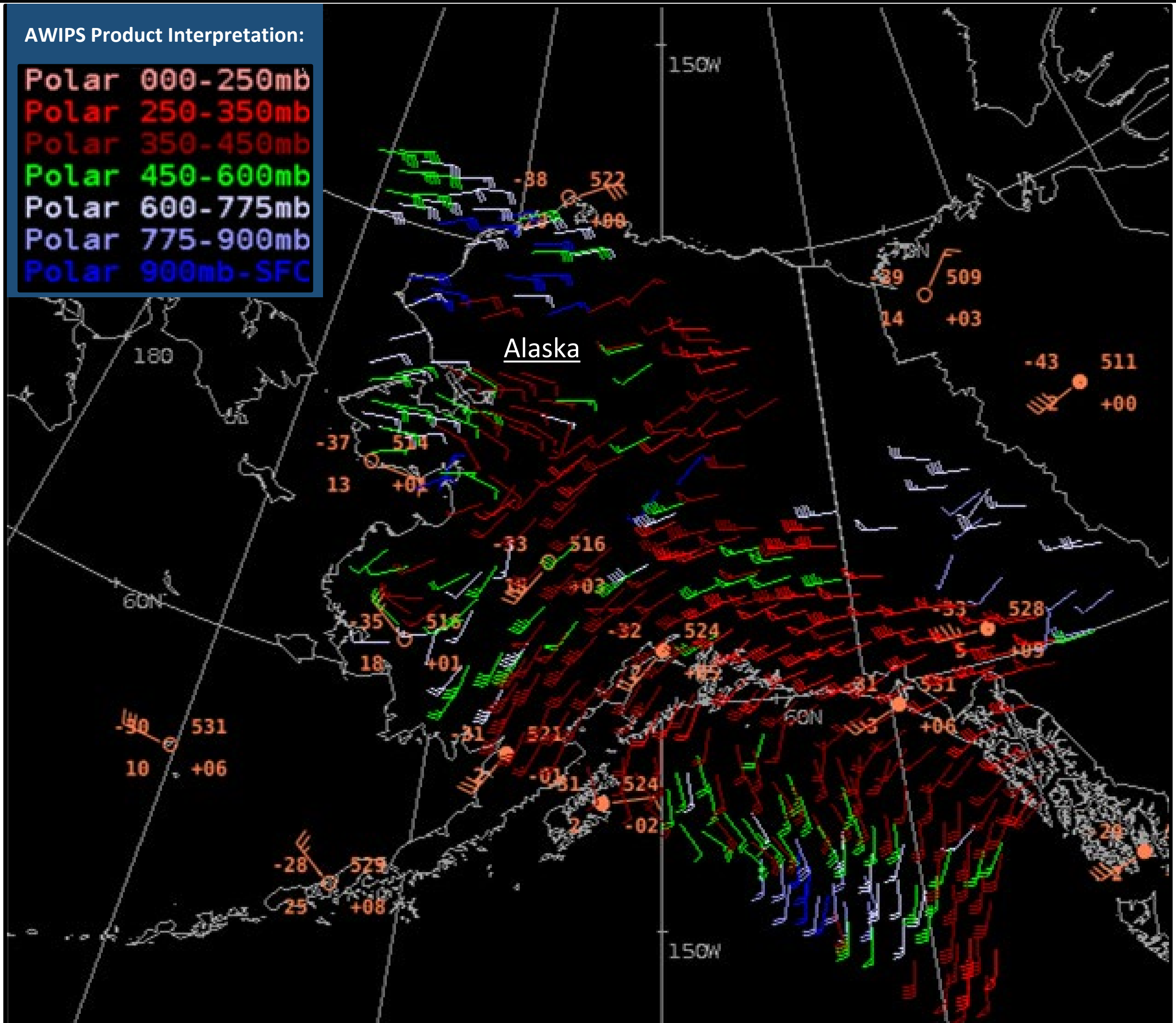

AWIPS example of Derived Motion Wind Vectors from VIIRS Direct Broadcast on 18 March 2025 at 12:15 UTC and raob winds at 500 hPa (orange) from 12 UTC launch. In AWIPS, units are in knots. Note, the product can be partitioned by forecaster preference with recommendation that there is a common color coding procedure in place.

Resources

Journal of Applied Meteorology and Climatology

New Methods toward Minimizing the Slow Speed Bias Associated with Atmospheric Motion Vectors

SSEC

Near-Real-Time (NRT) Polar Winds from VIIRS and other sensors

NRT Polar Winds from Direct Broadcast Antenna

JPSS STAR Webpage

VIIRS Polar Winds: Resources and ATBD

16th International Winds Workshop

Experimental VIIRS Atmospheric Motion Vectors (AMV)