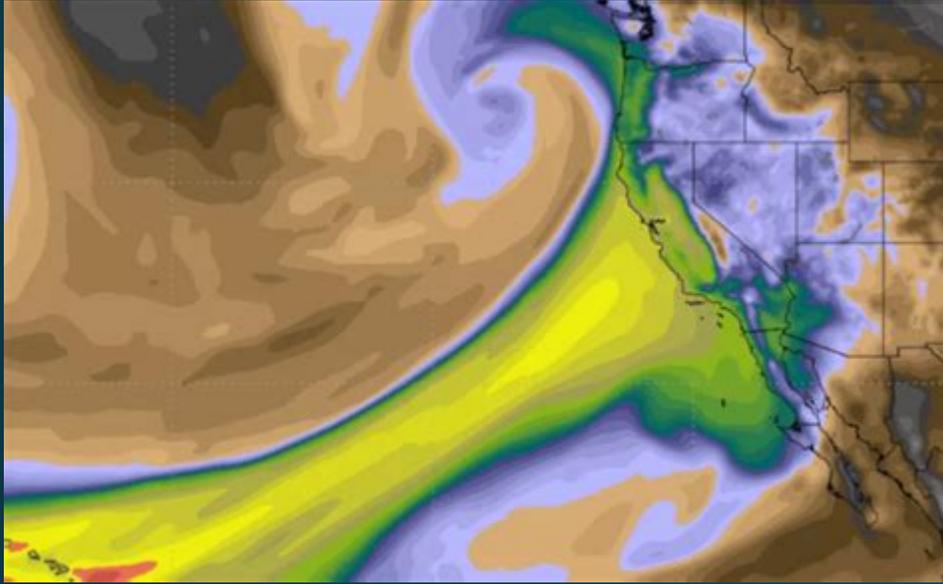


Advancing the Dynamical Understanding of Tropical Storms and Atmospheric Rivers with Hyperspectral IR Atmospheric Motion Vectors and Radiance



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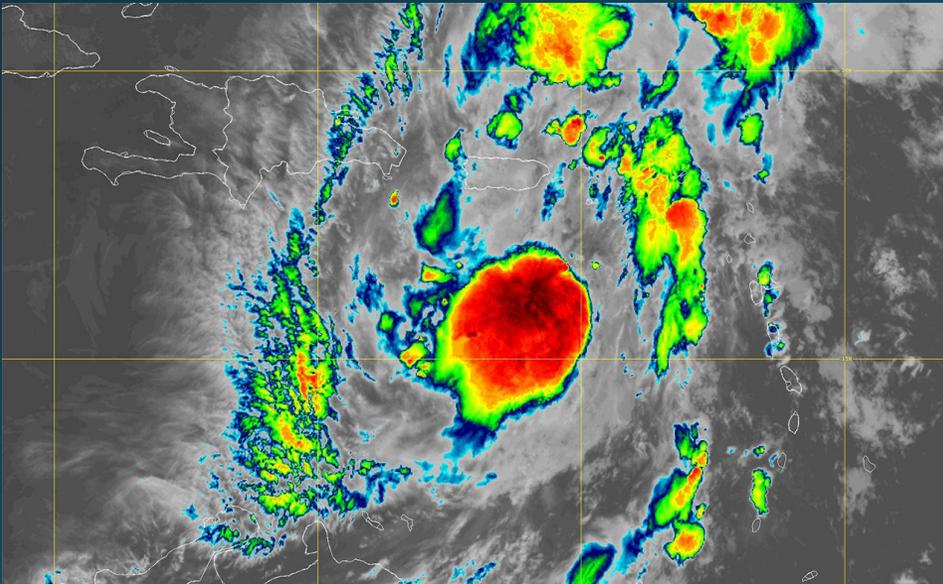
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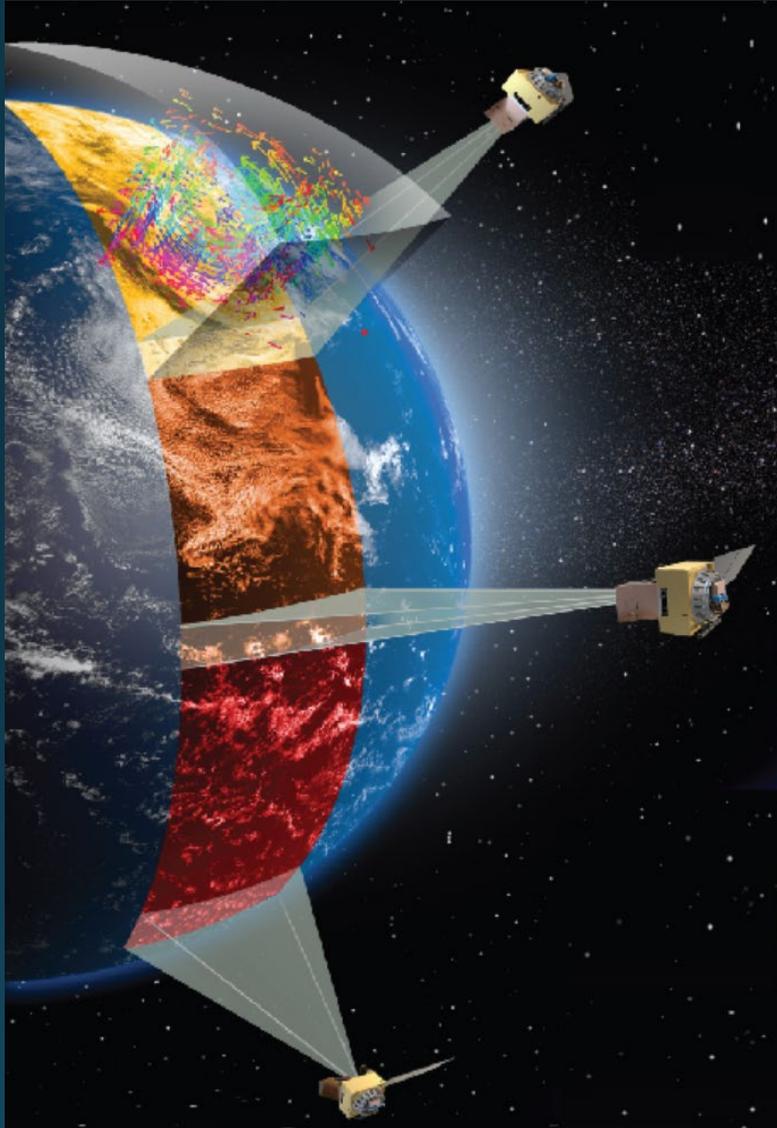
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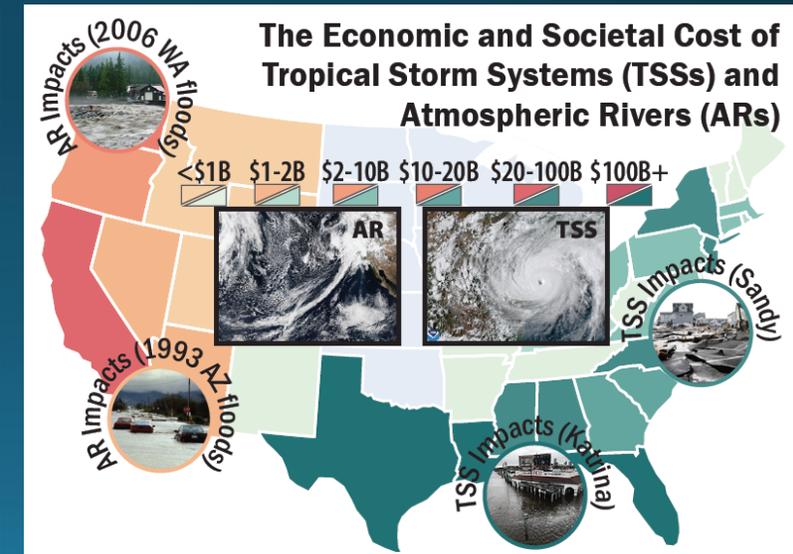
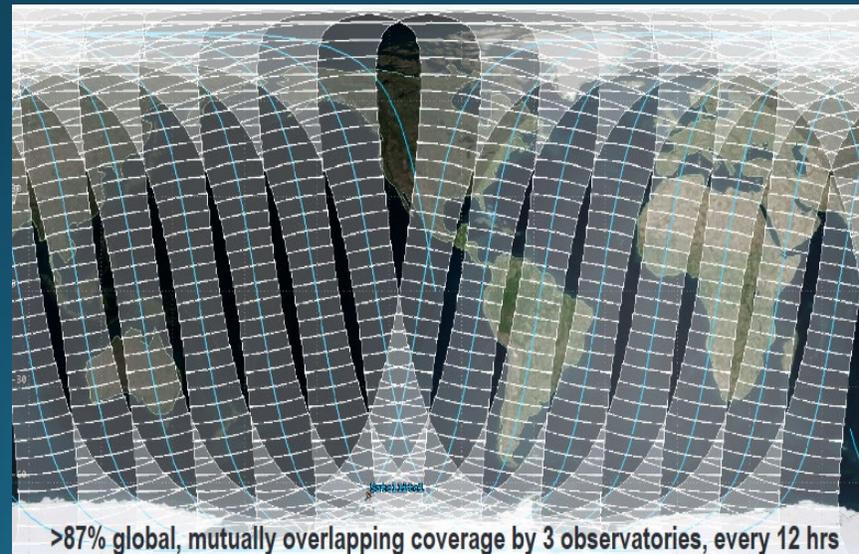
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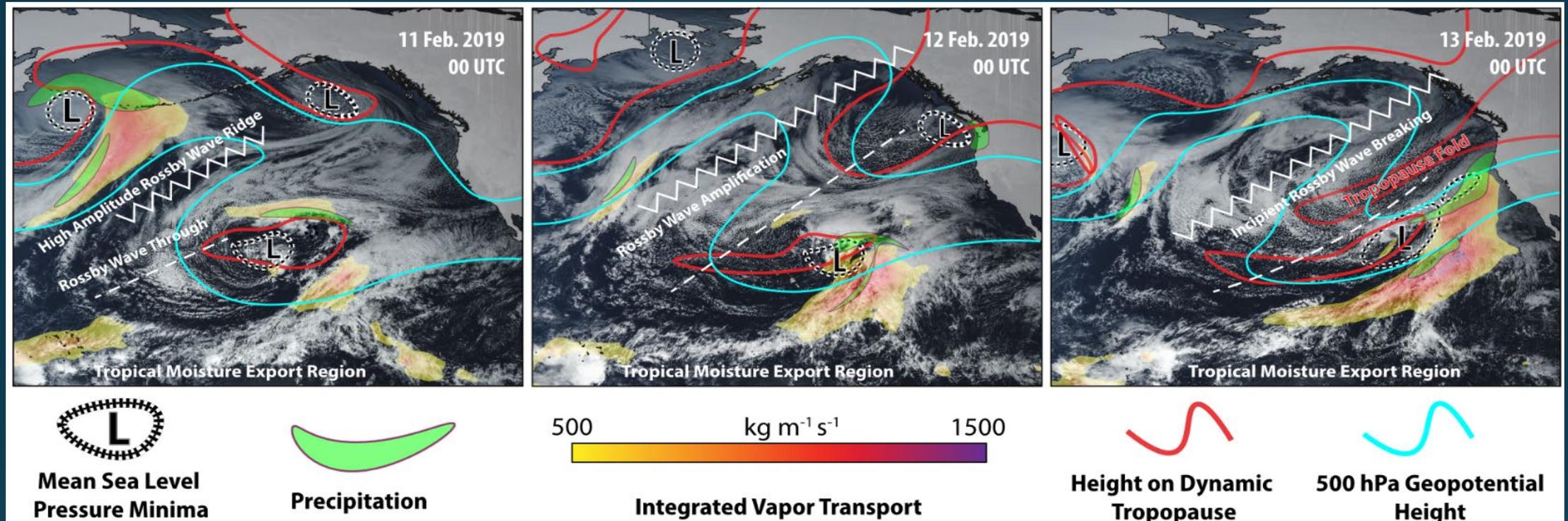
IR Radiance and AMVs for Dynamical Studies



- Consider a train of three small satellites with MISTiC Winds® capabilities: compact hyperspectral midwave IR imaging sounder (Maschhoff et al., 2019; Session 5).
- Investigate the ability to return key kinematic and thermodynamic info on high impact atmospheric rivers and tropical storm systems.
- Utilize high-resolution model output as proxy data.

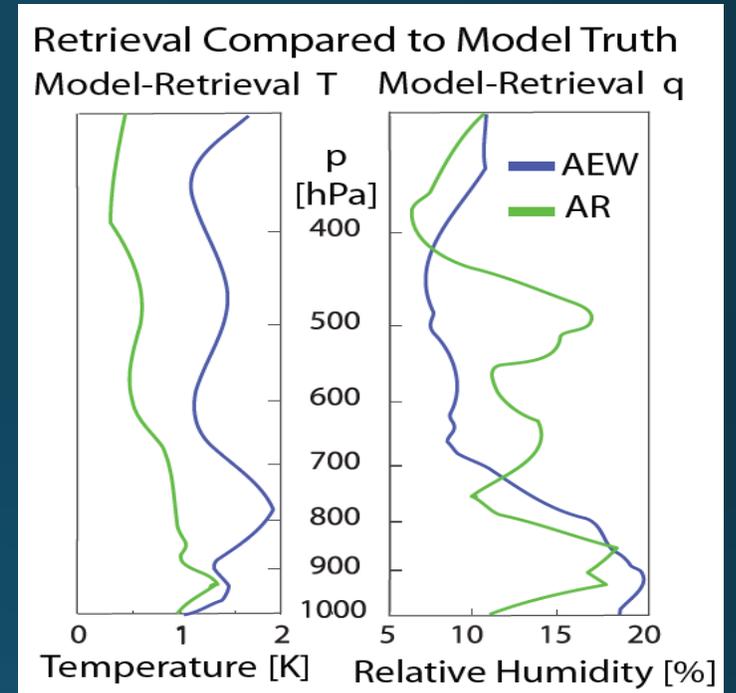
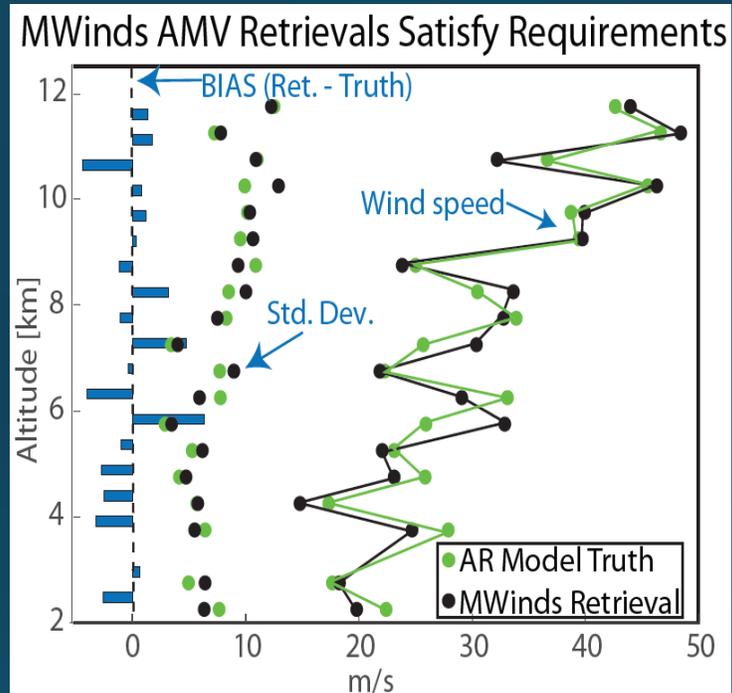
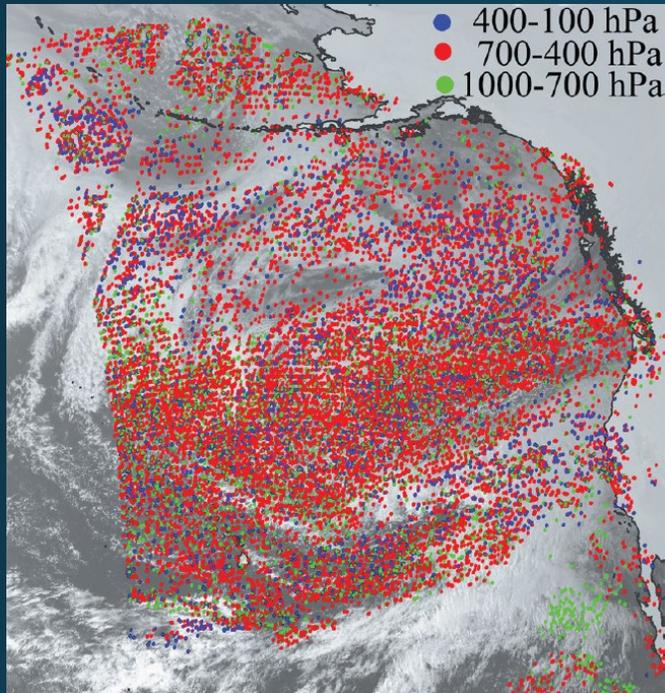


Atmospheric Rivers: A Complex Dynamical System at Multiple Scales



- Oceanic \rightarrow paucity of data.
- Tropical moisture export region \rightarrow unbalanced dynamics \rightarrow need simultaneous winds and T.
- Strong diabatic forcing \rightarrow diagnosed through PV \rightarrow need winds and T.
- Upscale mesoscale growth and forcing \rightarrow high spatial resolution/ground sampling distance.
- Strong shear \rightarrow need accurate AMV height assignment.
- Important mid tropospheric dynamics \rightarrow Need mid-tropospheric sensitivity.

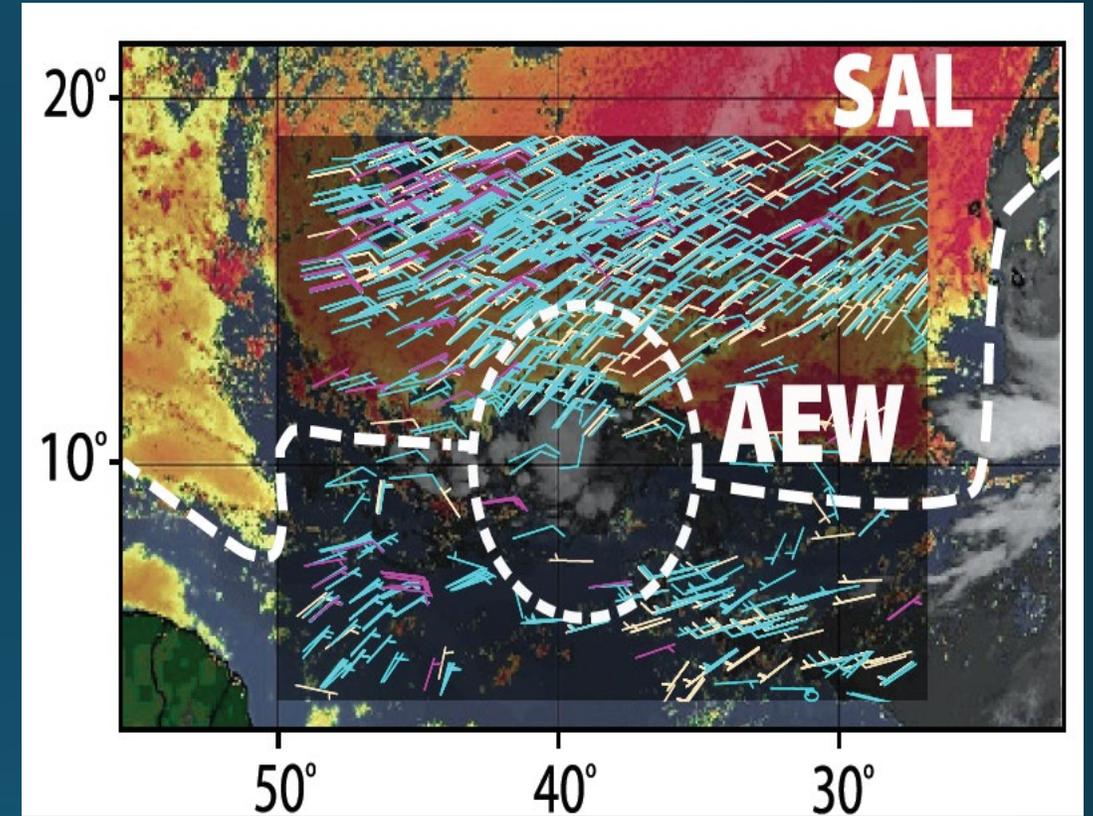
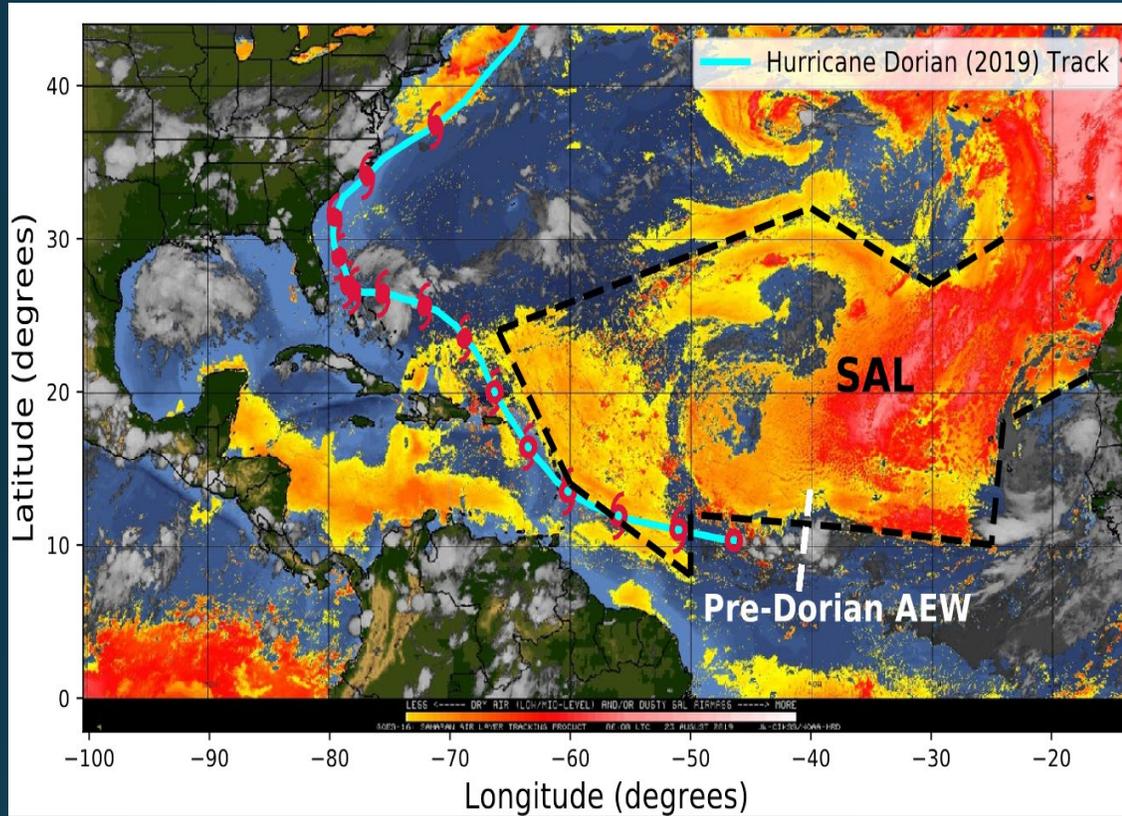
Atmospheric River Results



- Abundance of mid-tropospheric water vapor AMVs, precisely where current methods are limited.
- Accurate AMV height assignment captures vertical wind structure
- Variations (std. dev) of winds also reproduced.

- T accuracy of $<2\text{K/km}$ comports with interagency requirements.
- Captures information along the edge of the Atmospheric River core where NWP impact is greatest.

Atmospheric Easterly Waves: The Seeds of Destruction



- ~70% of Atlantic hurricanes begin as AEWs.
- Large cloud-free areas preclude AMV cloud-tracking → IR water vapor
- Dynamical interaction with Saharan Aerosol Layer (SAL) important but poorly understood.

- Fundamental questions about top-down/bottom-up growth.
- Vertical structure of the vertical wind shear is crucial.

Conclusion: Extremely Valuable Data

- High performance, compact, midwave IR imaging sounders in a small satellite configuration provide key missing info for oceanic ARs and tropical storm systems.
- Spectral resolution and stability permit accurately assigned water vapor AMV heights and accurate T, q retrieval.
- High spatial resolution increases clear/partly cloudy pixels and improves feature identification.
- Temporal spacing between spacecraft can be optimized for AMVs.
- Gap-filling observations of T, q, and winds are highly complementary to existing global observing system.

