

Tropical Weather Systems in MPAS With and Without Resolved Convection

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METEOROLOGY

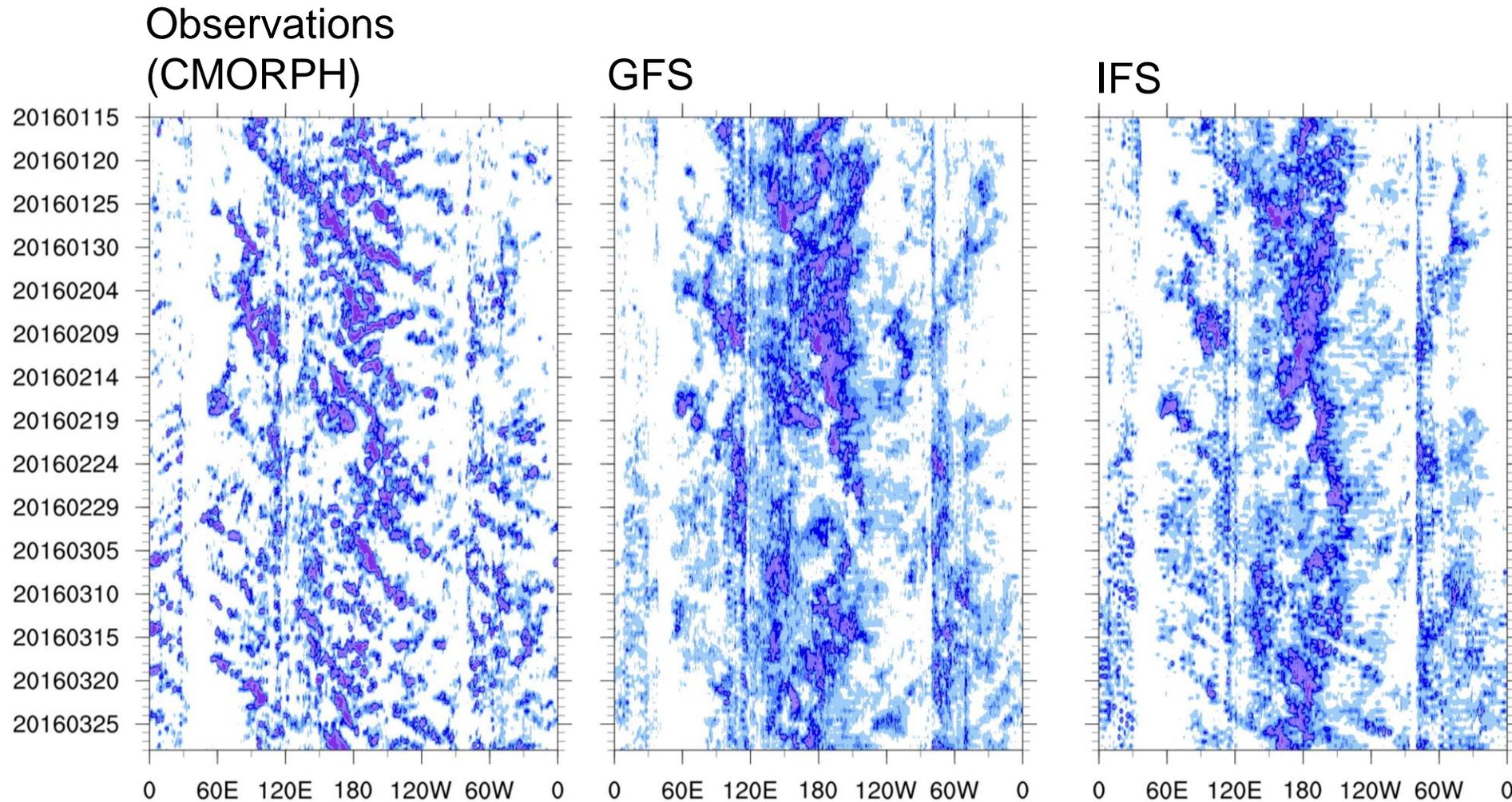


What would Earth look like from space?
(as imagined from before satellites)



Inspired by Mapes (2021, JMSJ)

Current NWP models struggle with simulating tropical weather



MPAS Resolution Ensemble (DYAMOND)



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- “resolution ensemble” with 10 simulations
 - min dx: 3.75 km (convection mostly resolved)
 - max dx: 480 km (convection mostly parameterized)
- 40 days (1 Aug–10 Sep 2016)
- Initial conditions & SST from ECMWF



3.75 km

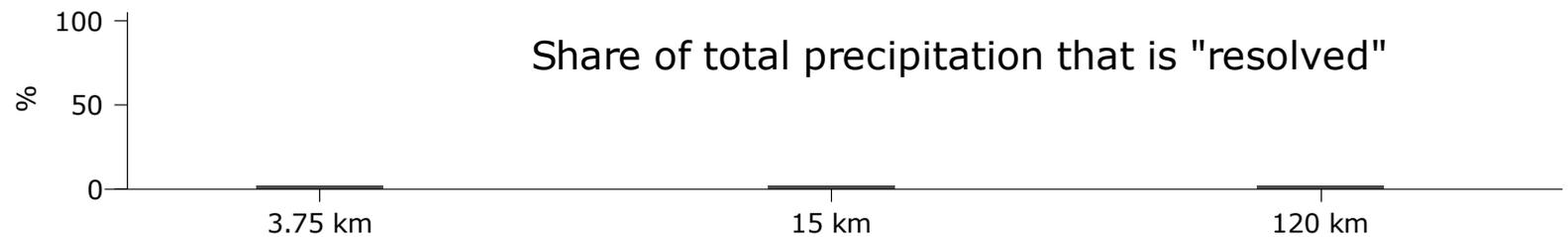


15 km

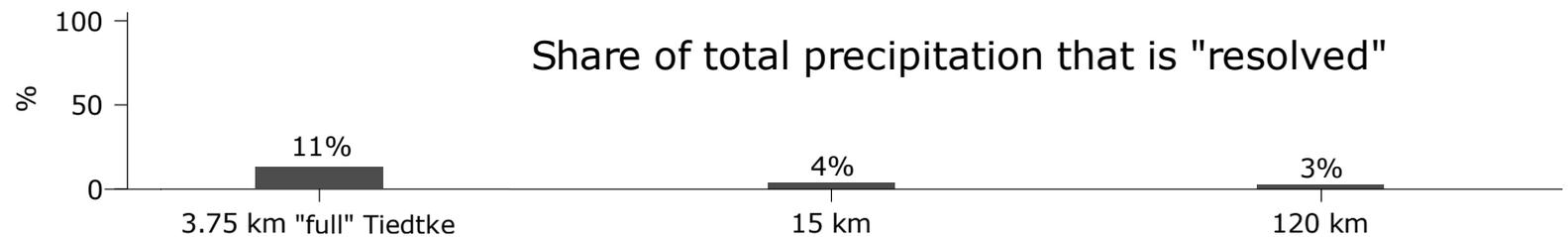
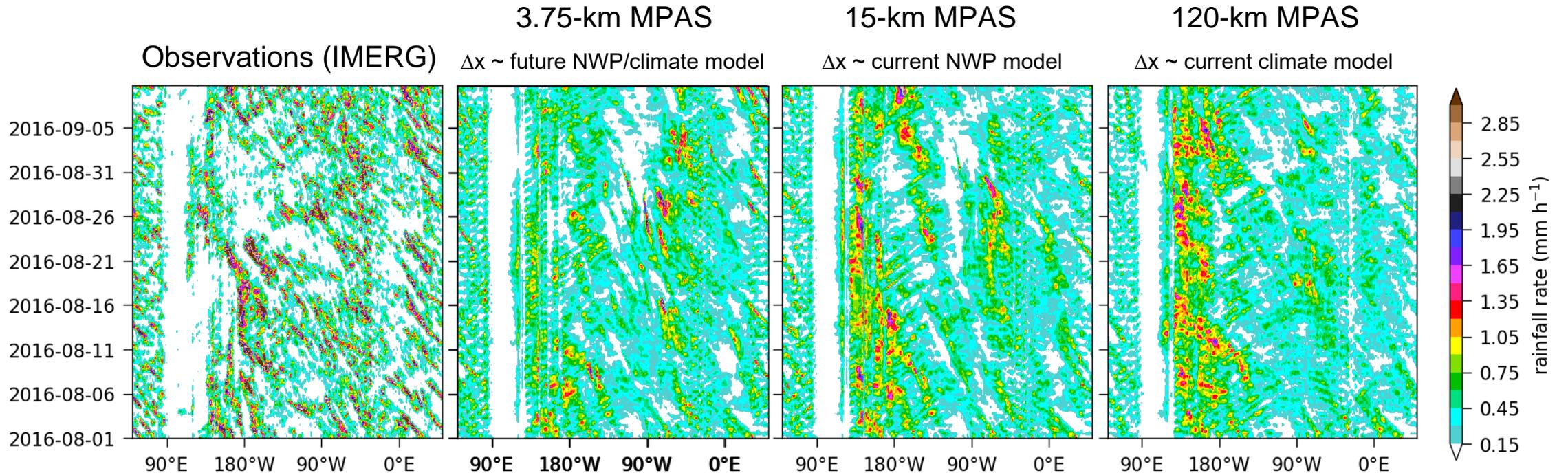


120 km

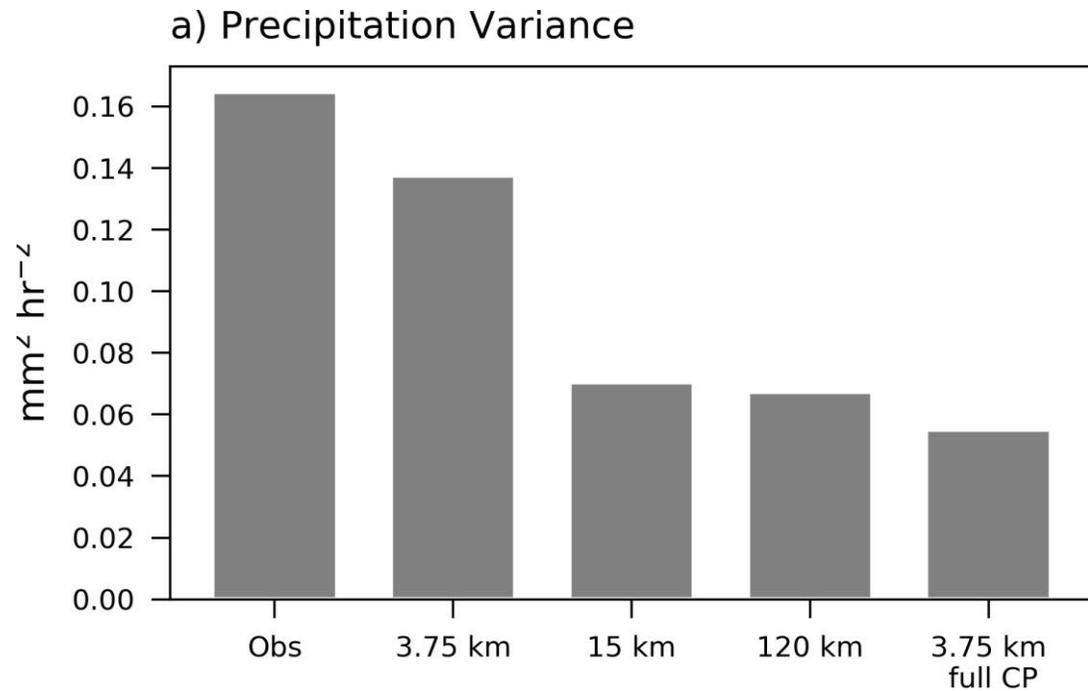
Explicit convection → more realistic rainfall patterns



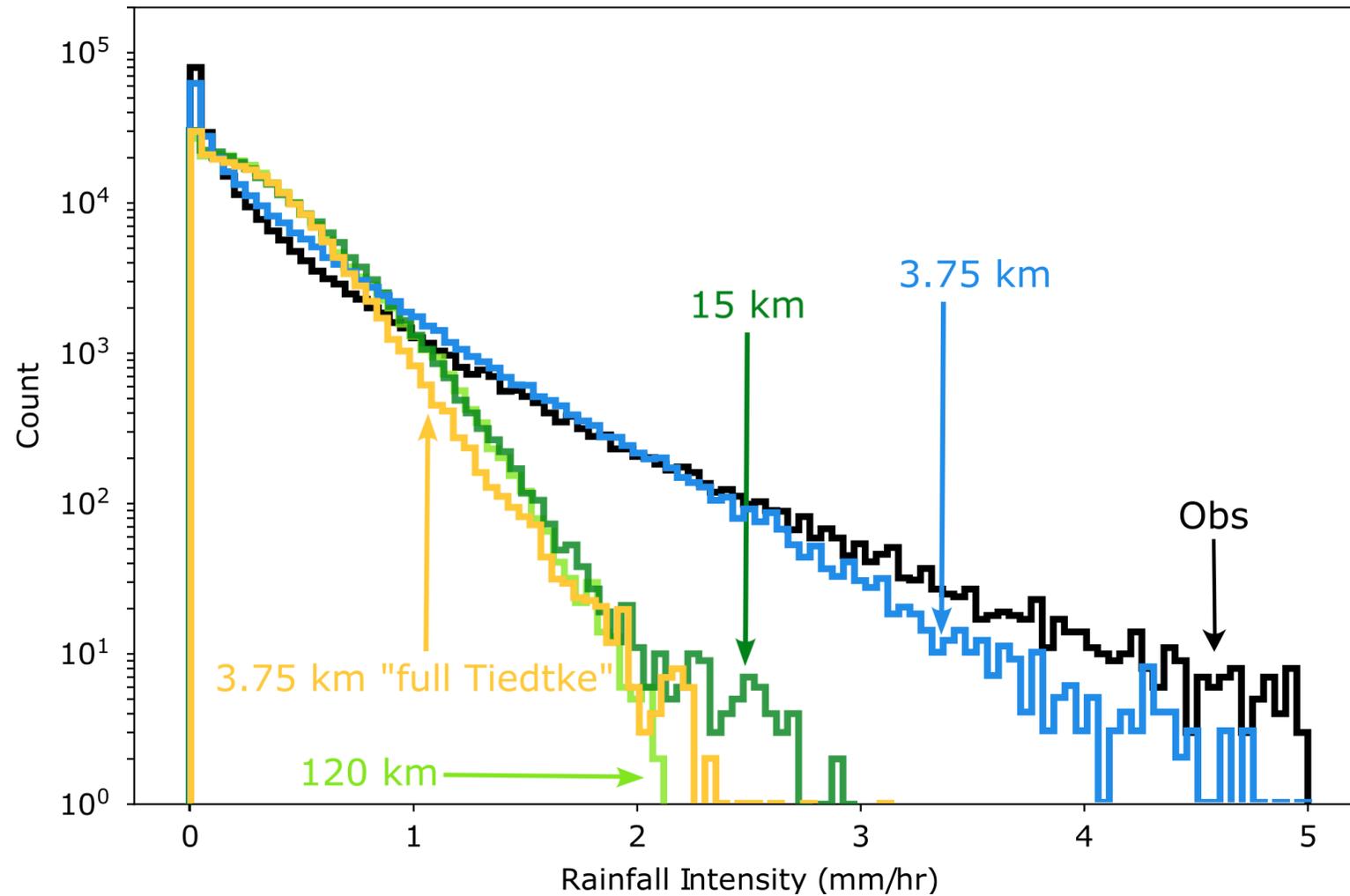
Explicit convection → more realistic rainfall patterns



Explicit convection → more realistic rainfall patterns and waves



Explicit convection → *much* improved rainfall intensity distribution

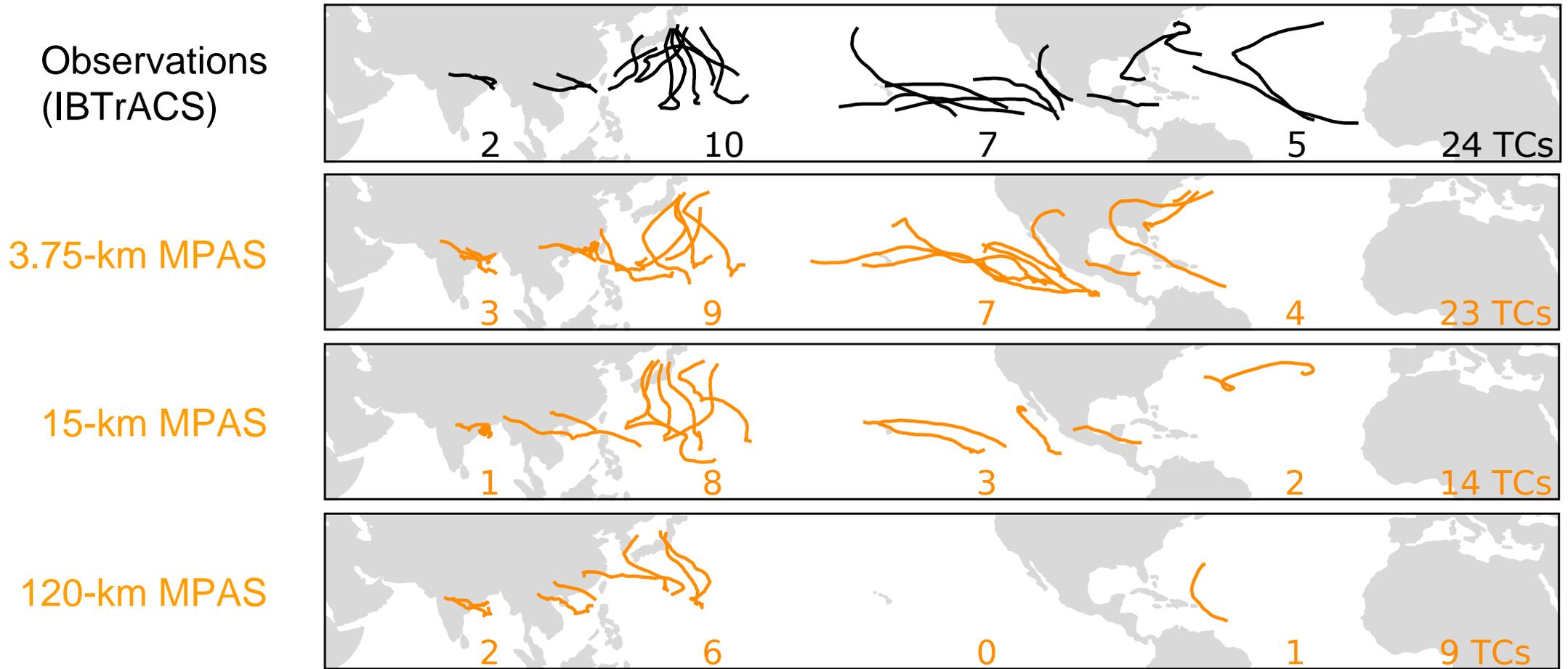


Tropical Cyclones

3.75-km MPAS
DYAMOND run

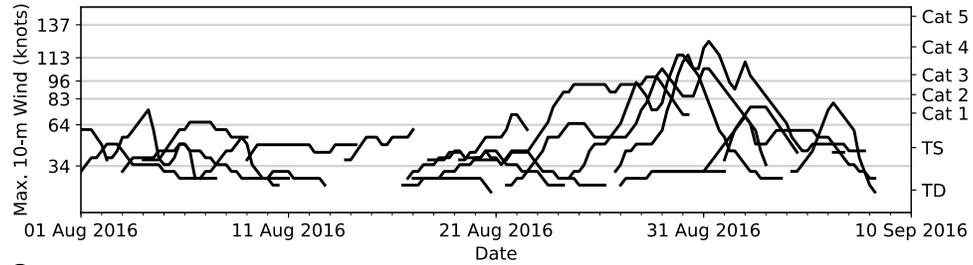


Higher resolution → more accurate number of TC

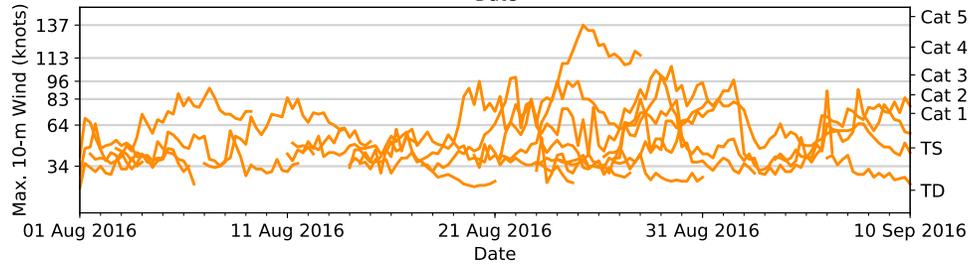


Higher resolution → better representation of TC intensity

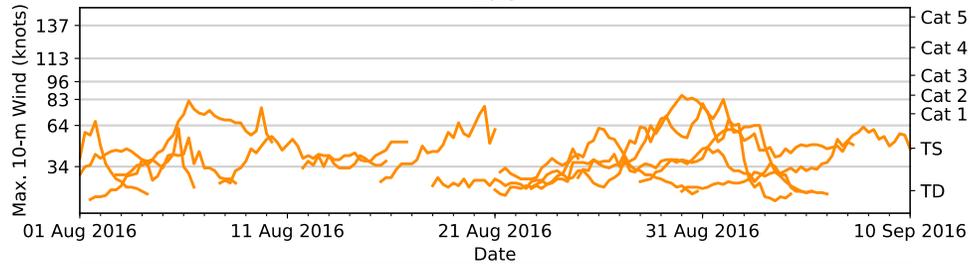
Observations
(IBTrACS)



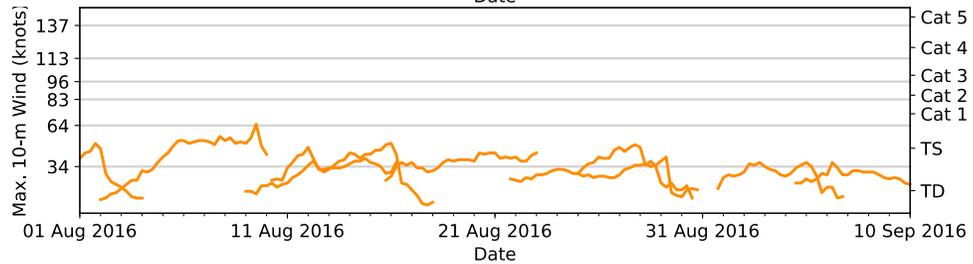
3.75-km MPAS



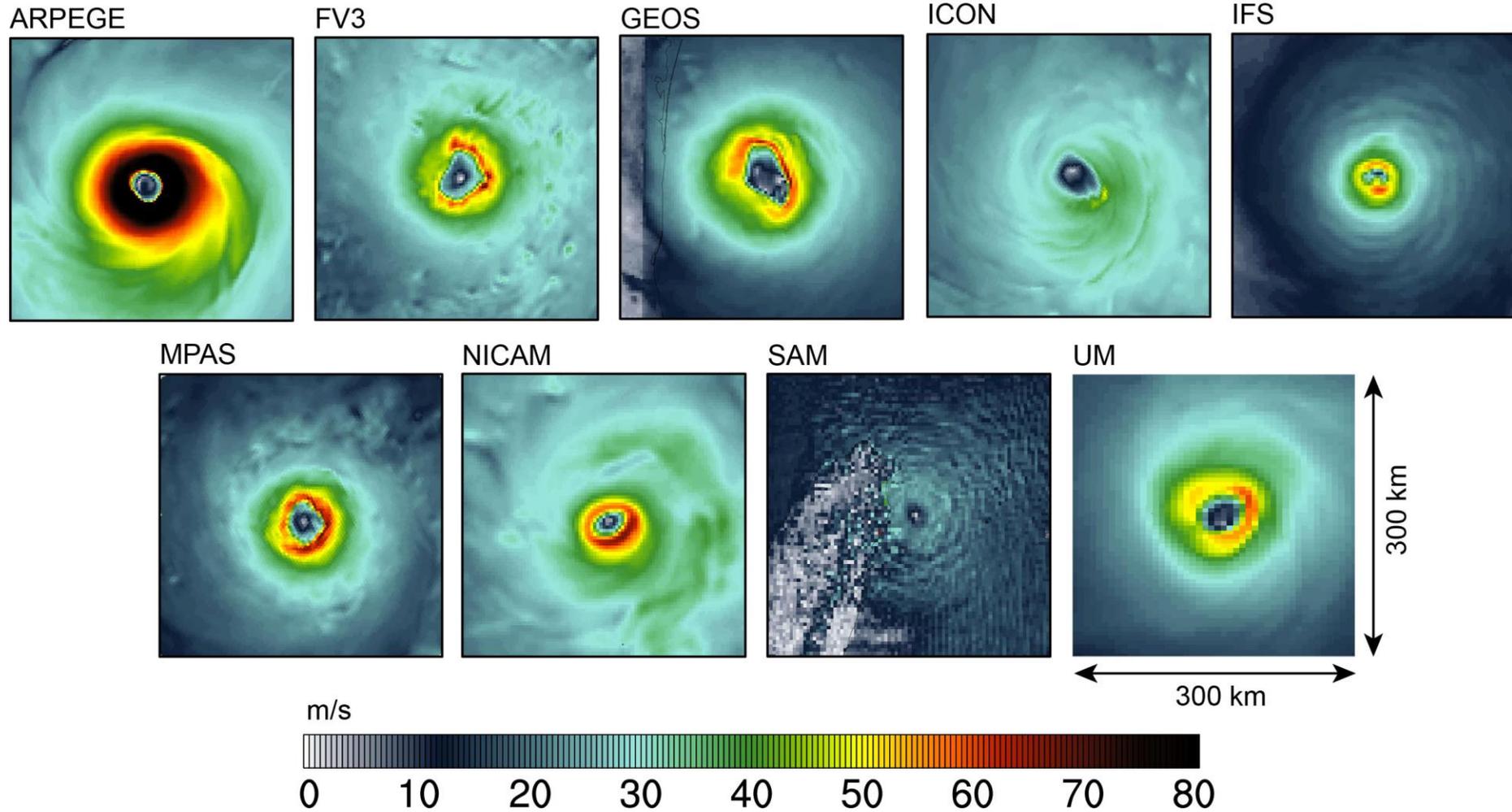
15-km MPAS



120-km MPAS

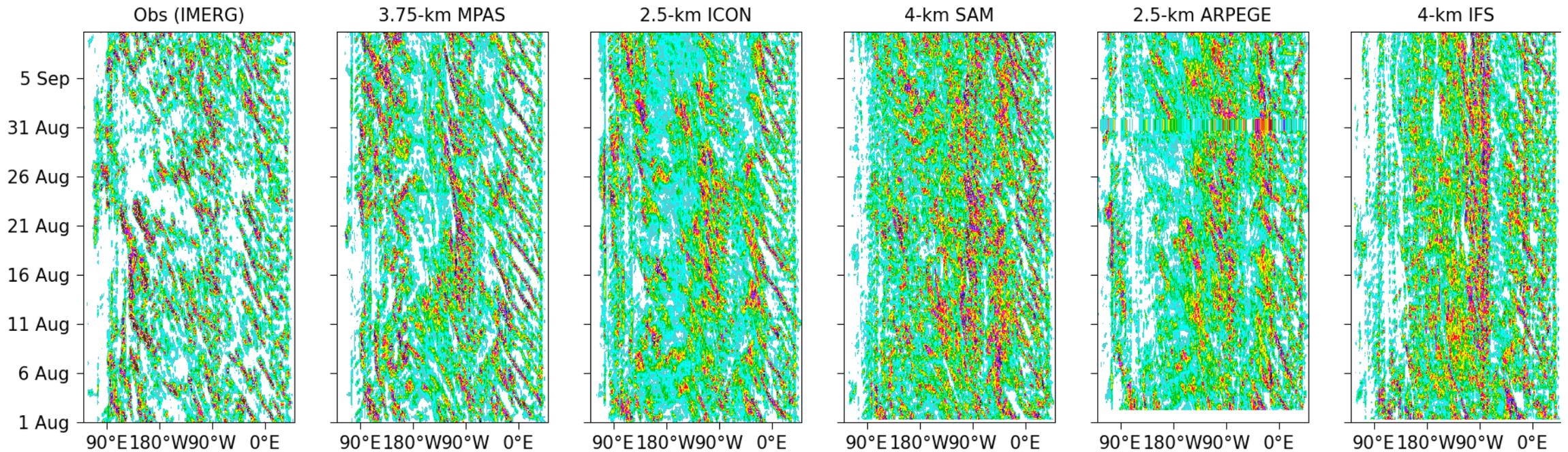


The Hurricanes of DYAMOND



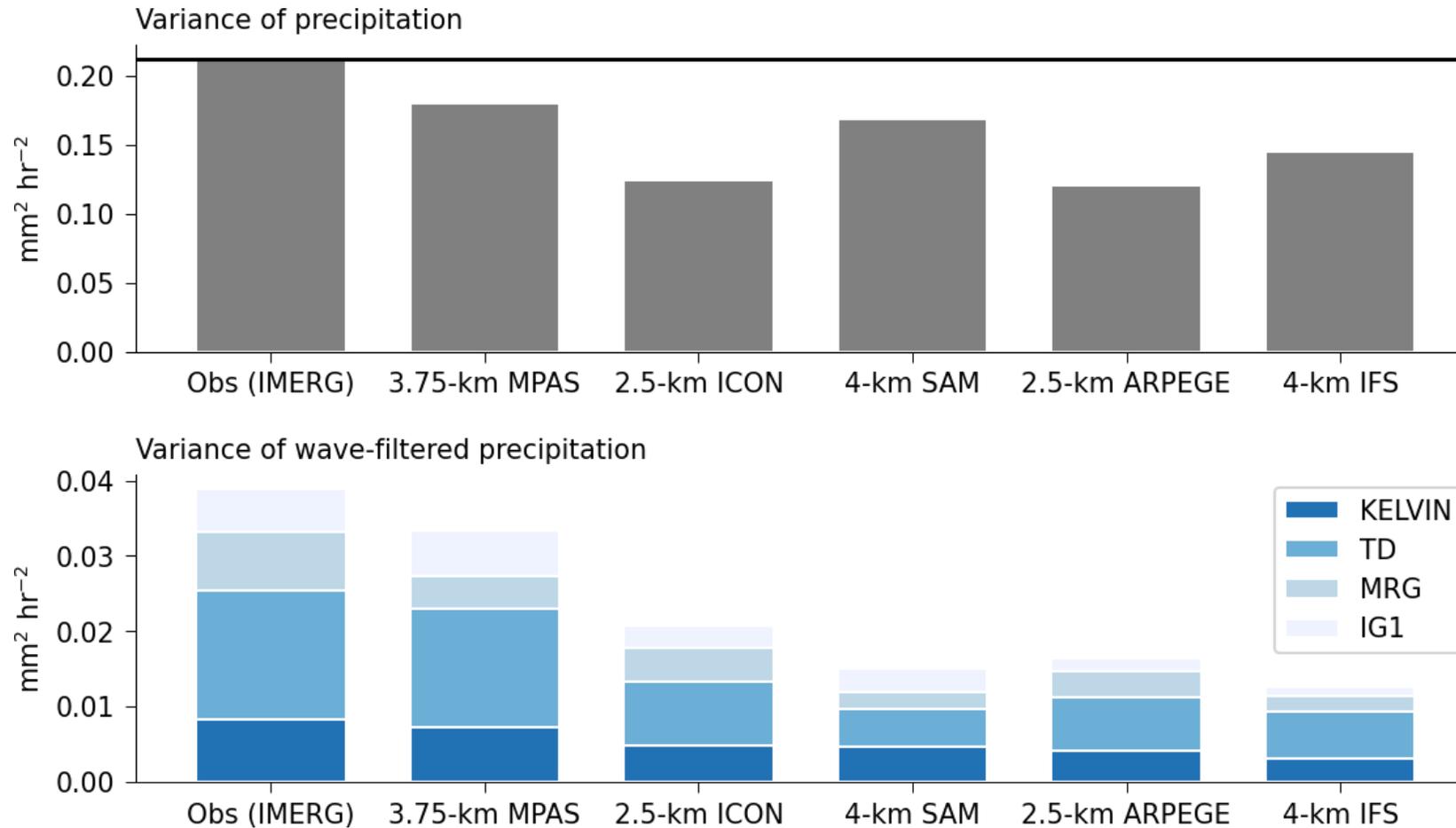
The Tropical Waves of DYAMOND

- DYAMOND models better than coarse models with parameterized convection
- Large inter-model differences



The Tropical Waves of DYAMOND

- Some models capture tropical waves better than others
- All models: waves too weak



Concluding remarks

- Resolved convection improves tropical rainfall variability and tropical waves.
- High-res global models have smaller tropical cyclone-related biases, such as low intensity.
- Computational cost is immense and model differences remain substantial

