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Impact assessment of Aeolus-2 with the global NOAA OSSE system

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Objective

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- Provide input for the workshop for EUMETSAT member states and ESA delegates regarding the selection of an Aeolus-2 mission.
- The workshop is scheduled for 8-9 September 2022.

- Run an Observing System Simulation Experiment (OSSE) using the NOAA system and simulated observations
- Assess the additional value of Aeolus-2, e.g., relative to Aeolus

NOAA OSSE system

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- New OSSE system based on the ECMWF ECO1280 (~ 9km) nature run 14 months (00 UTC Sep 30, 2015 – Nov 30, 2016)
  - 137 levels in the vertical; up to 80km
  - 1 hour temporal resolution for the first month, 3-hour temporal resolution for the rest of the nature run
- Consolidated Observing Systems Simulator (COSS) package to simulate perfect observations; Explicit errors (biases and standard deviations) added to perfect observations
- Simulated observations based on the June/July 2020 observing system
  - Capability to simulate conventional, GNSS Radio Occultation profiles and MW/IR radiances under cloudy conditions – modifications to CRTM (Community Radiative Transfer Model)
- Working towards the simulation of 3D AMVs and DWL observations by LIPAS (KNMI)
- Calibration and experimentation done with NOAA FV3GFS v16.1 model

- OSSE time period: June 1 – July 30, 2020

OSSE preparations

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- The virtual June-July (2016) from the Nature Run was selected as the two-month period for the OSSE

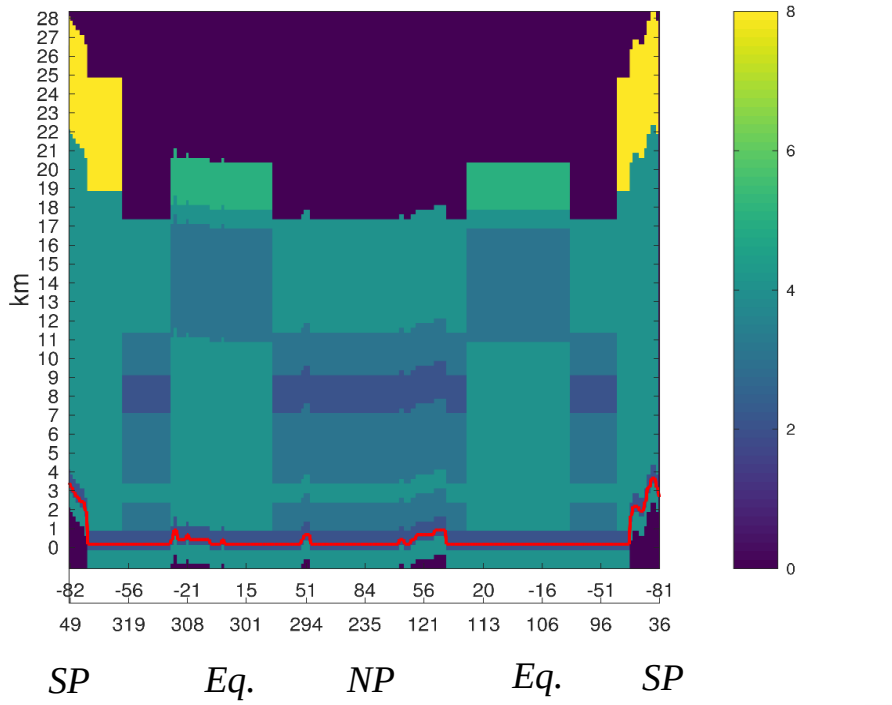
- Observation simulation
  - All observing systems (minus Aeolus), including observation errors are available
  - Simulation of Aeolus and Aeolus-2

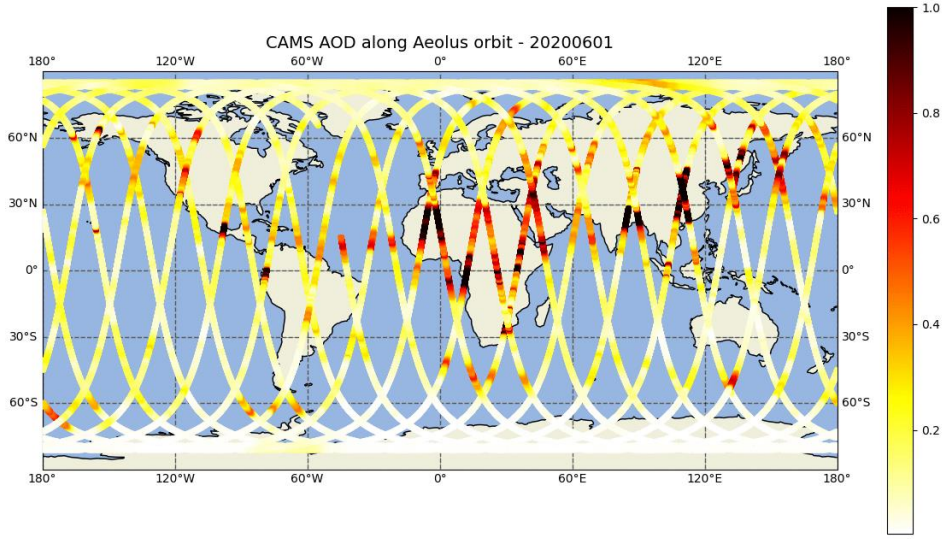
- OSSE calibration
  - Run OSE w/o Aeolus with the NOAA system
  - Run OSSE w/o Aeolus with the NOAA system
  - ➢ Impact of Aeolus in both setups should be similar
  - ➢ some observation error tuning may be needed

Aeolus simulation

- Aeolus operational period: June/July 2020
- LIPAS = LIdar Performance Analysis Simulator
  - used in a number of scientific studies in preparation for Aeolus
- Simulates Mie and Rayleigh HLOS winds and errors, given
  - Instrument characteristics
  - Atmospheric conditions
    - ECMWF Nature Run (*pressure*, *temperature*, *wind*, *humidity*, *clouds)*
    - *aerosol* from CAMS (Copernicus Atmosphere Monitoring Service) database)
  - Range Bin Setting scenario (RBS)

Aeolus RBS in June/July 2020





6 hours – 4 orbits

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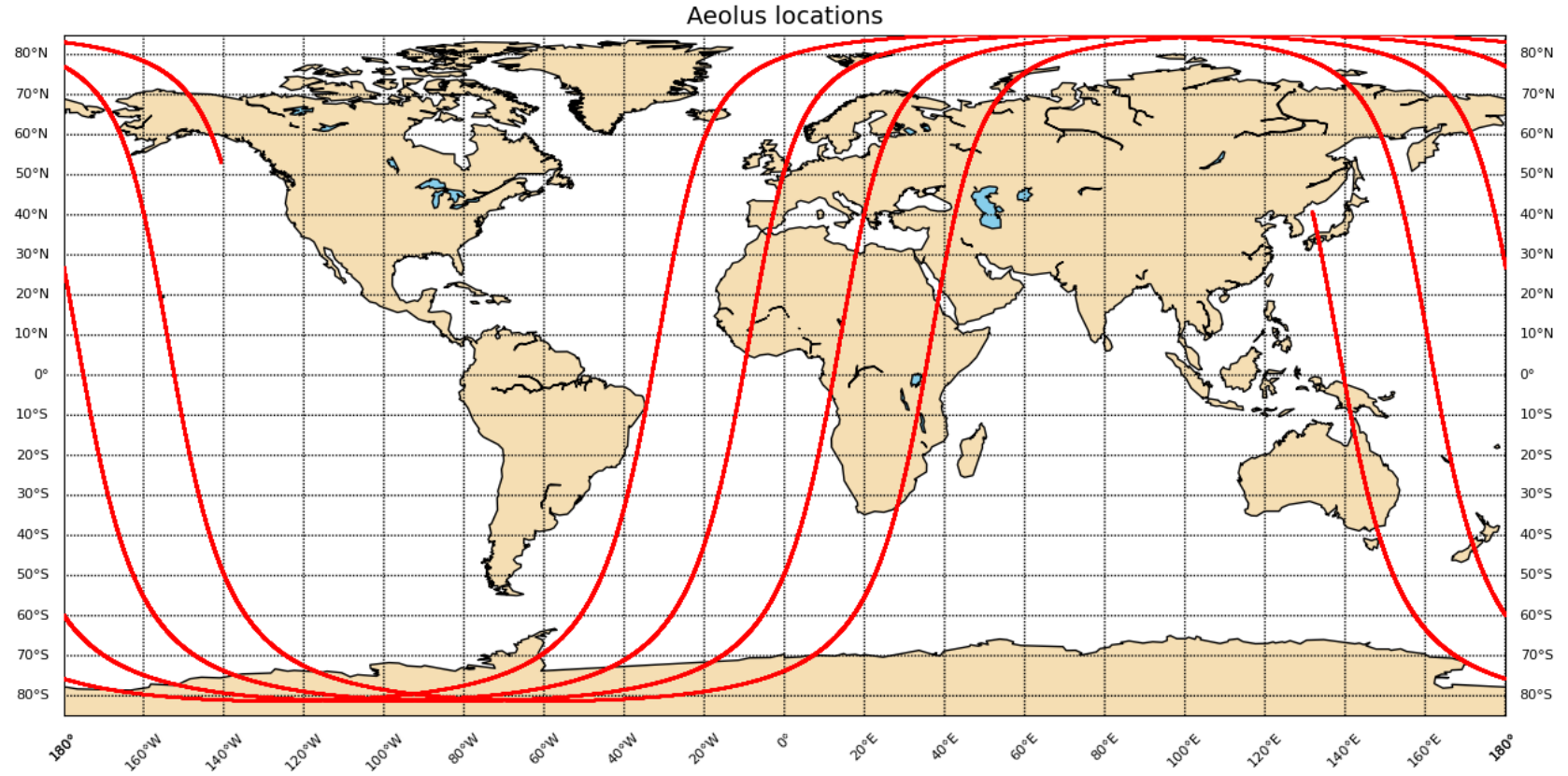

Nature Run truth – 1 orbit

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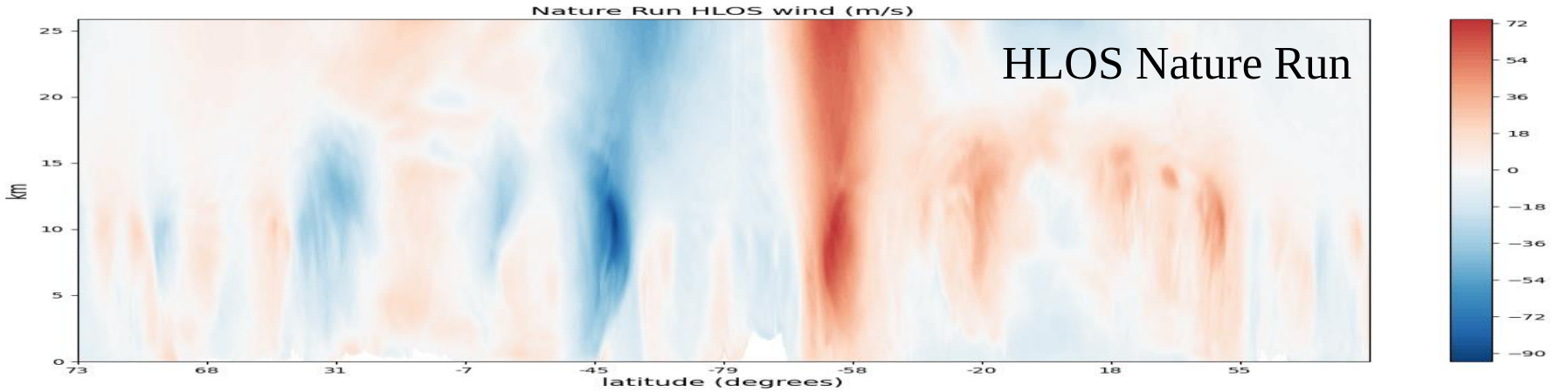

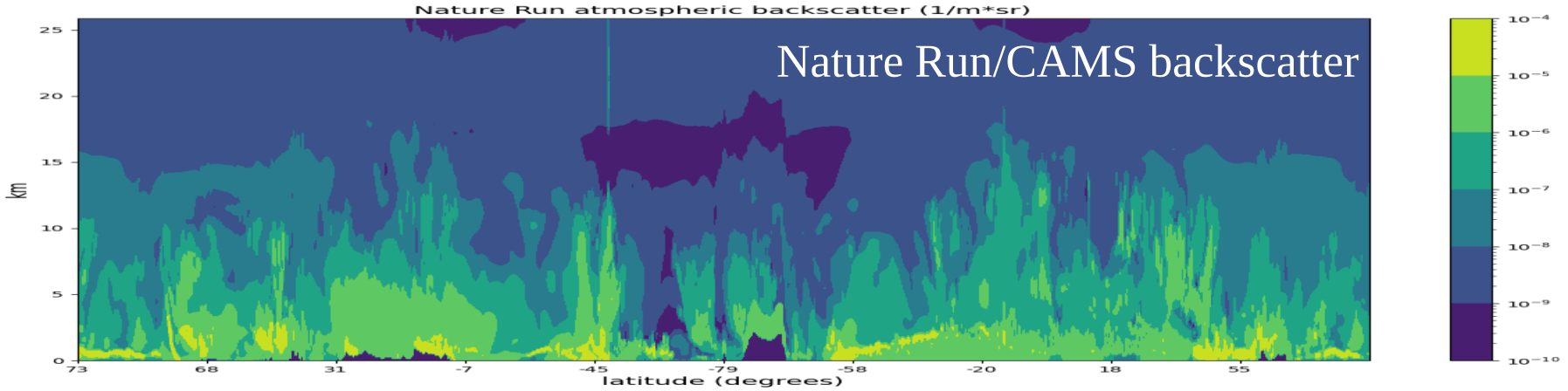

LIPAS simulated winds

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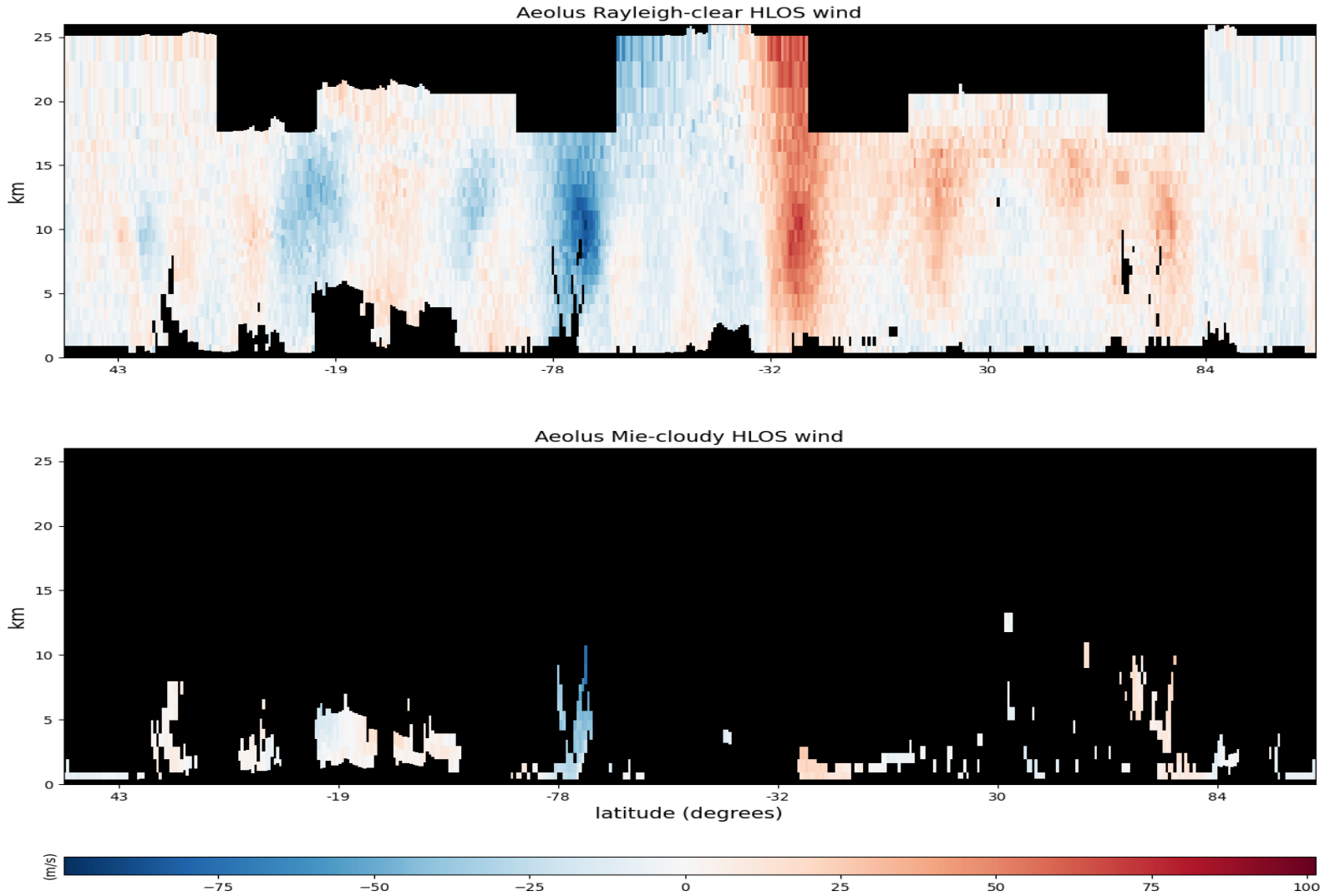

Rayleigh wind

Mie wind

Wind statistics

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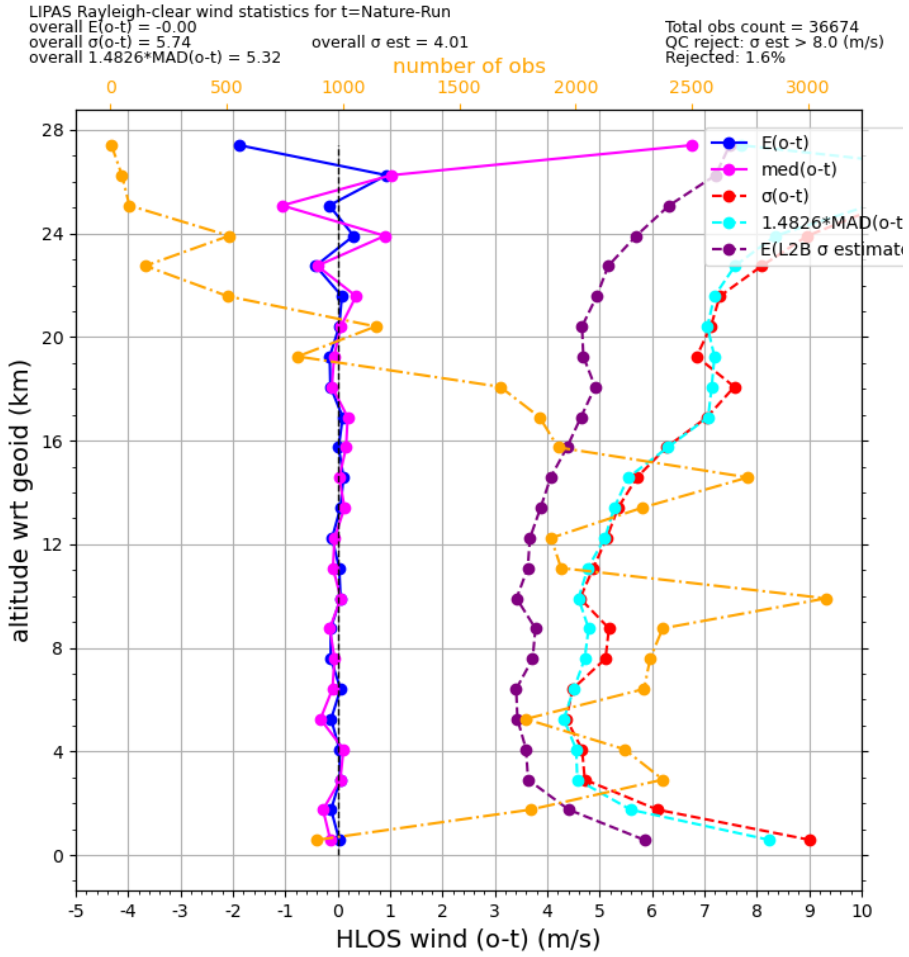
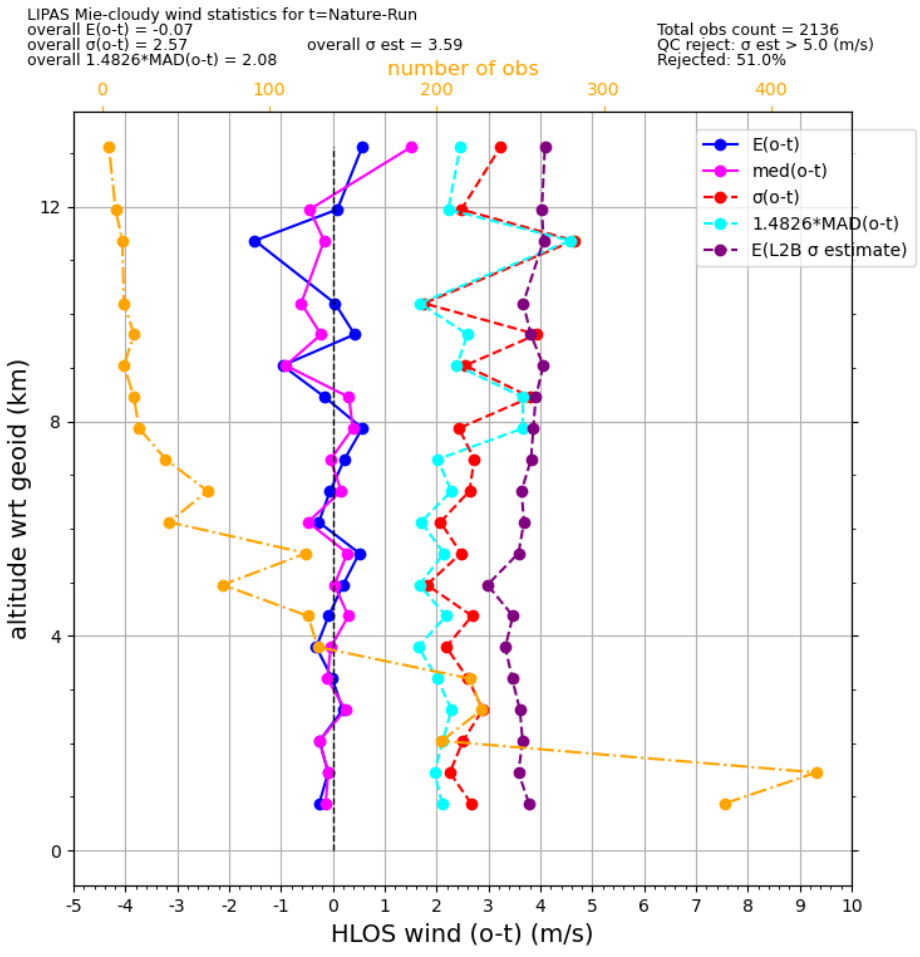
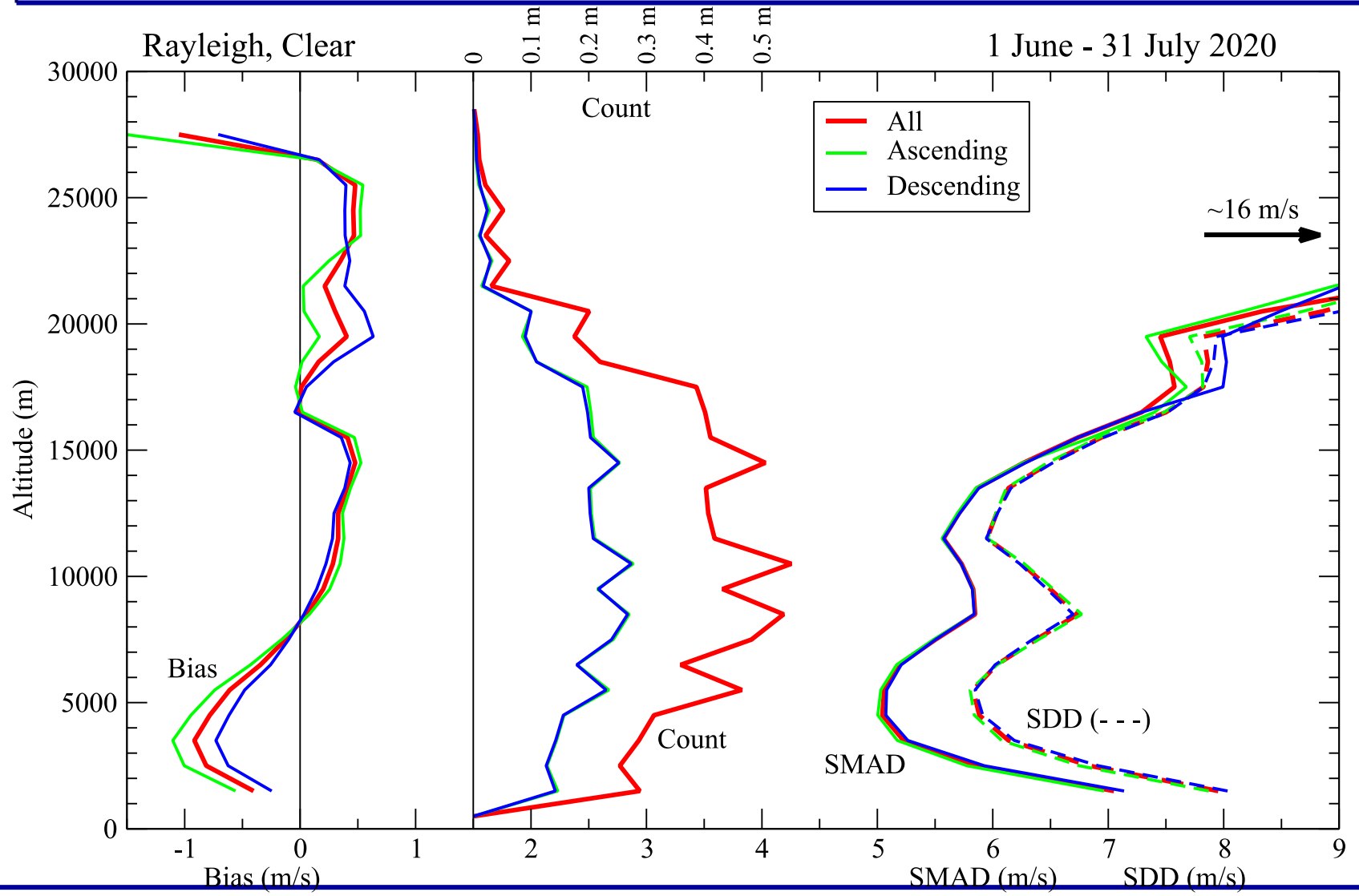
Rayleigh-clear



Mie-cloudy



Error statistics 2nd reprocessing Rayleigh-clear



Courtesy ECMWF

Error statistics 2nd reprocessing Mie-cloudy

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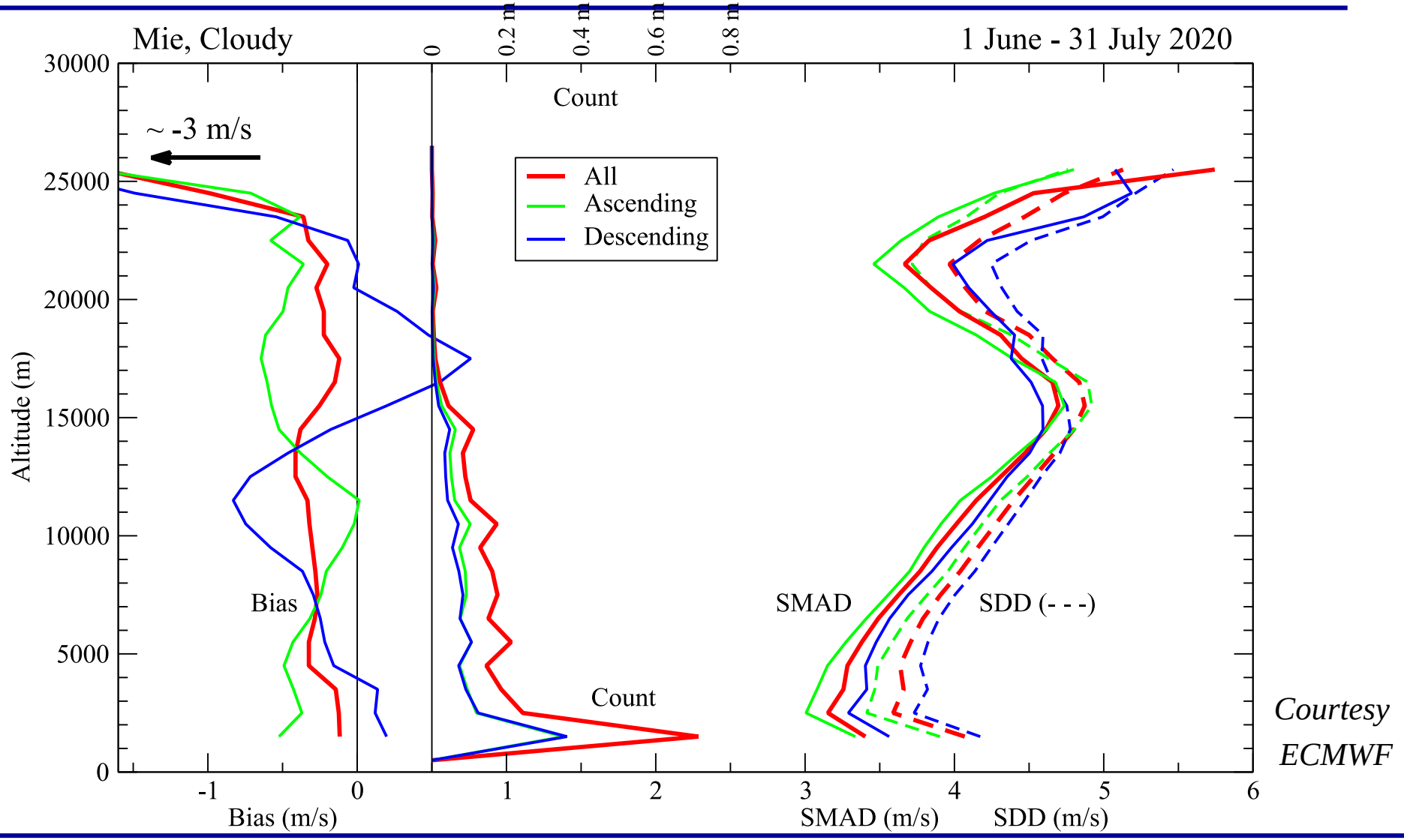

Courtesy ECMWF

Aeolus-2 simulation

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- Take EURD (End User Requirement Document) as starting point
- Similar sampling as Aeolus but with better quality winds
- Same vertical sampling (RBS scenario) as for Aeolus
  - Note. Aeolus-2 has more vertical bins than Aeolus
- LIPAS accumulation is fixed to 30 measurements (~87km along track) for both Rayleigh-clear and Mie-cloudy winds
  - Note. Operational Aeolus Mie-cloudy winds is the result of accumulating 4-5 measurements

Status and schedule

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- LIPAS has been tuned on KNMI side and delivered to NOAA
- Run a short Control + Aeolus with preliminary errors (March 2022)
- Run a short real-data experiment with Aeolus to estimate realistic representativeness errors (March/April 2022)
- Estimate realistic observation errors for Aeolus and generate error-added Aeolus observations, 2-month period (April 2022)
- Run Aeolus experiment and quantify impact over Control (May 2022)
- Analysis of error sensitivity (June 2022)
- If analysis shows favorable results, run an additional OSSE with new error configuration (June/July 2022)

- Present results at the workshop for EUMETSAT member states and ESA delegates, 8-9 September 2022.