Intercomparison of ATLID, CPR and synergistic target classifications

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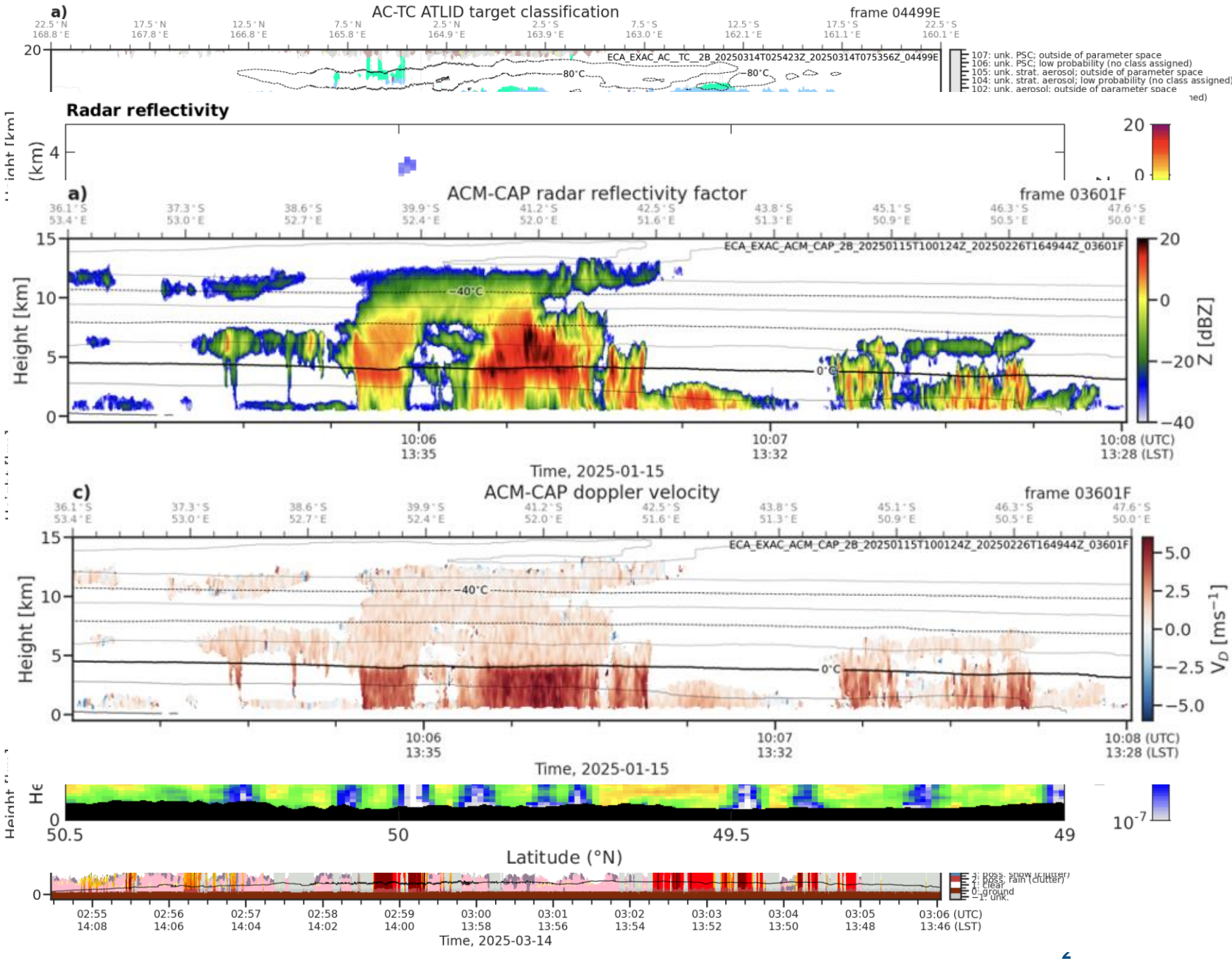
ESA L2 target classification products

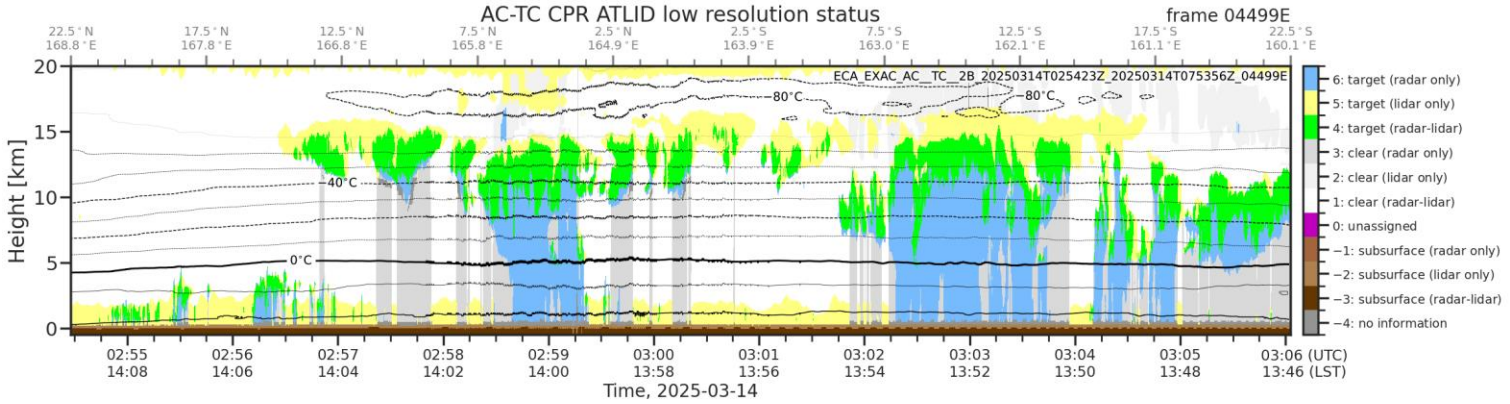
- AC-TC includes A-TC & C-TC classifications, projected onto JSG
- Synergistic target classification is *mostly* a simple merging, but some interpretation still required
  - Unknown presence of liquid cloud once ATLID is extinguished: synergistic retrievals & radiative closure can be sensitive to liquid cloud even layered and complex scenes
  - “insects” class detected by CPR but not ATLID (currently assigned when A-TC is clear, but would often be collocated with aerosols in PBL).
  - Supercooled drizzle & rain: know its likely to occur, but hard to classify

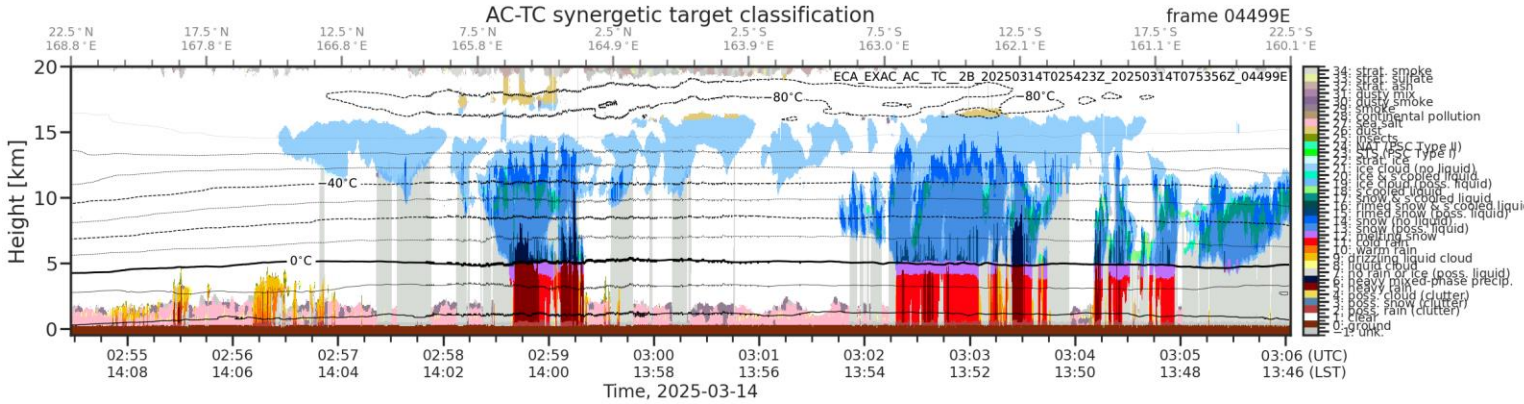


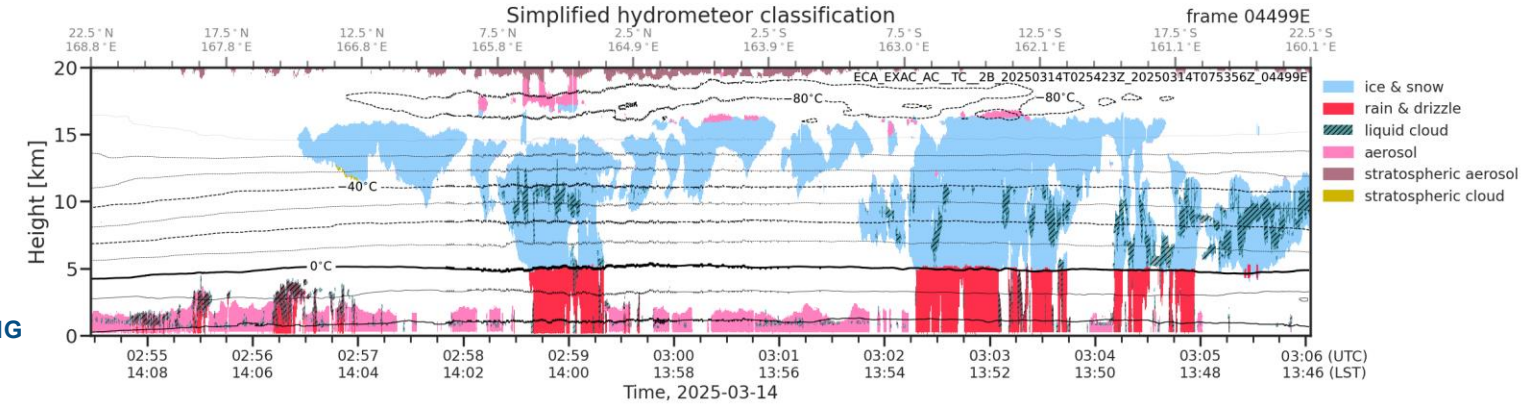
Synergy status & simplified classifications

- “CPR_ATLID_status” variables show which targets are seen by lidar, radar, or both

- Still helpful to reduce target classification to a “simplified classification” (not yet included in product):
  - Ice cloud & snow
  - Rain & drizzle
  - Liquid clouds (may coexist with above)
  - Aerosols
  - Stratospheric aerosols & clouds

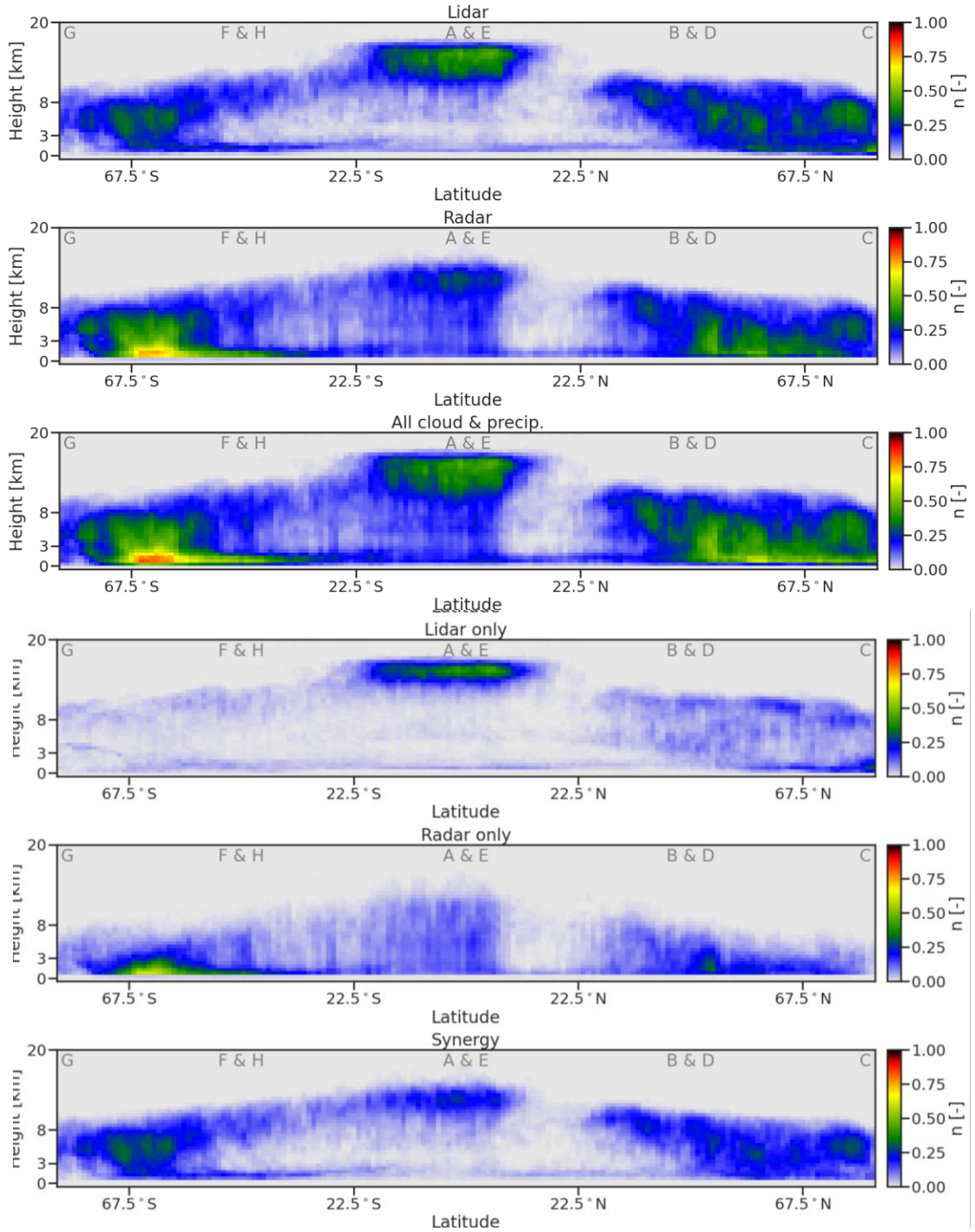






Global detection of cloud & precipitation

- Combined cloud & precipitation fraction avoids ambiguity of ice clouds vs snow
- Synergistic classification :
  - Lidar-only detections dominated by tropical cirrus & optically thin cloud-tops everywhere
  - Lidar-only detection of near-surface non-precipitating liquid clouds
  - Radar-only detection mostly once lidar is extinguished: drizzle, rain & snow.
  - Radar-lidar region is relatively limited: are synergistic observations sufficiently representative to inform retrievals?



Cloud and precipitation structure and phase regimes

- A macrophysical equivalent to ISCCP cloud optical-thickness and cloud-top temperature regimes
- Clustering on profiles of cloud & precipitation fraction (ice & snow, rain, liquid cloud); easily applied to
  - Weather & climate model cloud and precipitation fractions
  - Ground-based (e.g. CloudNet) or CloudSat-CALIPSO (DARDAR-MASK) target classification products
- Can always fine-tune the details, but helpful for discretizing large amounts of data into a few basic classes:
  - CPR Z & Doppler velocity
  - ACM-CAP retrievals of ice & rain

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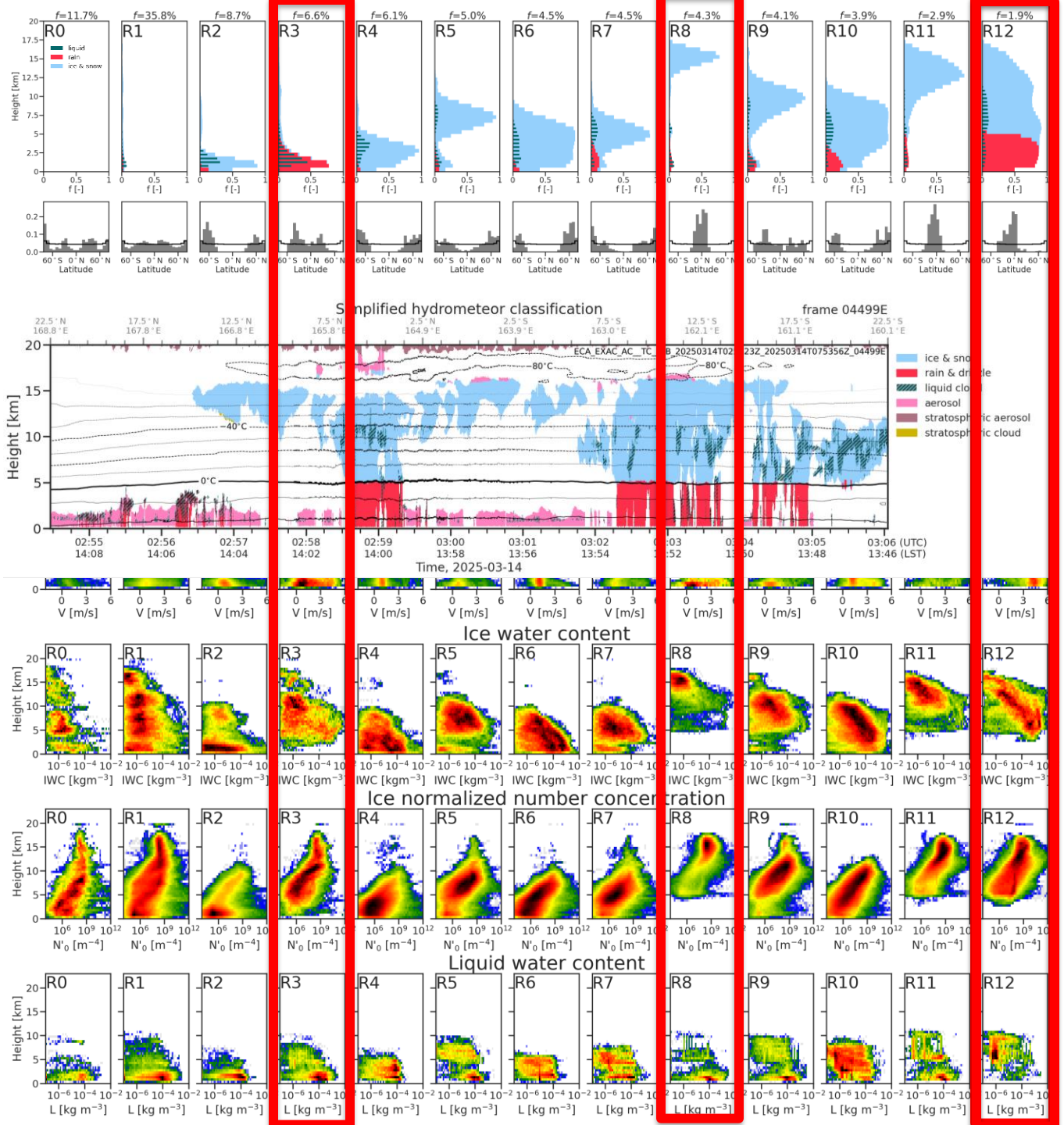

Summary & validation needs

- Synergistic target classification combines ATLID and CPR target classifications: a relatively simple product, but very information-dense. Encapsulates cloud & precipitation macrophysical structure and phase, as well as strengths & weaknesses of the active instruments.
- Target classifications provides the “zeroeth order” cloud & precipitation retrieval: determines what our retrievals algorithms will attempt to do. Known uncertainties in relatively rare cases: insects detected by radar, supercooled drizzle & rain; and in very frequent cases such as unknown liquid cloud when lidar is extinguished
- Validation needs from surface-based observations:
  - Cloud base height, especially in precipitating scenes
  - Impacts on retrievals: interpretation of profile of radar reflectivity as evaporation vs attenuation
  - Impacts on radiative transfer & profiles of heating rate
  - Land/sea differences
- From aircraft campaigns:
  - Presence and physical thickness of supercooled & mixed-phase layers in complex and layered scenes; **supercooled drizzle?**
  - Impacts on retrievals & radiative closure: supercooled liquid cloud layers contribute to optical thickness of clouds even when much deeper into a cloud than the lidar beam penetrates