New ARTS features
(new = added after last workshop)

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Third open ARTS workshop

Outline

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ARTS is now also a retrieval tool

- ▶ 1DVAR / OEM is now integrated into ARTS
  - ▶ Jacobian calculations existed before, but
  - ▶ actual inversions could only be done by Qpack
- ▶ Core OEM functionality is stand-alone:
  - ▶ the invlib package
  - ▶ several iteration options
- ▶ Creation of synthetic covariance matrices
  - ▶ in development, so far just 1D
- ▶ More in presentation of Simon

- ▶ Still limitations, such as selection of a priori state

- ► Absorption species
- ► Atmospheric temperatures
- ► Winds
- ► Magnetic fields* (RL)
- ► Spectroscopic parameters* (RL)
- ► *Particle size distribution parameters**
  - ► exists for radar/lidar single scattering module (PE)
  - ► in development for passive (JM+RL+PE)

- ► Polynomial and sinusoidal baseline fit
- ► Instrument zenith angle pointing
- ► Instrument frequency shift and stretch

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Outline

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The ARTS scattering database

- ▶ Beta version released as part of workshop
- ▶ Main characteristics
  - ▶ totally random orientation
  - ▶ 33 ice crystal, aggregate and fully rimed habits
  - ▶ 34 frequencies between 1 to 886 GHz
  - ▶ 190, 230 and 270 K
- ▶ Ongoing/plans
  - ▶ oriented particles (MB)
  - ▶ melting particles
  - ▶ semi-rimed particles
  - ▶ fully official release
- ▶ More in presentation of Robin

- A module handling radar multiple scattering added
  - `MCRadar`
- More in presentation of Ian

Side note:
- `iyCloudRadar` renamed to `iyActiveSingleScat`
  - (bug fix, range binning wrong for broad bins)

New passive scattering solvers

- ▶ Interfaces to DISORT and RT4 now at hand
  - ▶ both reasonable fast, but only 1D and "flat Earth"
- ▶ DISORT
  - ▶ stable with respect to number of streams
  - ▶ only scalar RT
  - ▶ only Lambertian surface
- ▶ RT4
  - ▶ selection of n-streams not straightforward
  - ▶ vector RT
  - ▶ works with "ARTS surface"

- ▶ More in presentation of Jana

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New scheme for particle bulk properties

- ▶ To allow input model fields etc.:
  - ▶ Input: particle masses/fluxes and/or PSD data
  - ▶ Output: particle number density fields
 - ▶ If retrieval also partial derivatives

- ▶ Free naming scheme for input bulk properties:
  - ▶ `particle_bulkprop_field` and `particle_bulkprop_names`
- ▶ PSD and size binning specified by:
  - ▶ `pnd_agenda_array` and `pnd_agenda_input_names`
- ▶ WSM is `pnd_fieldCalcFromParticleBulkProps`
  - ▶ creates `pnd_field` and `dpnd_field_dx`
- ▶ More in group work? (PE+JM)

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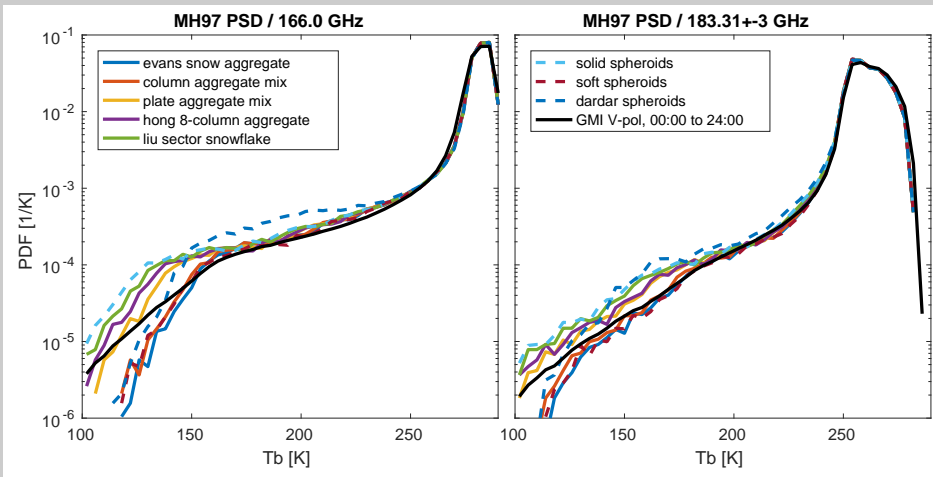
Independent beam approximation (IBA)

- ▶ Basic idea:
  - ▶ replace full 3D scattering solution with a 1D solution for each pencil beam

- ▶ Activated by including `iyIndependentBeamApproximation` in `iy_main_agenda`
- ▶ 1D scattering solver not fixed
  - ▶ specified by `iy_sub_agenda`
- ▶ Works also for 2D atmospheres
- ▶ More in group work? (PE)
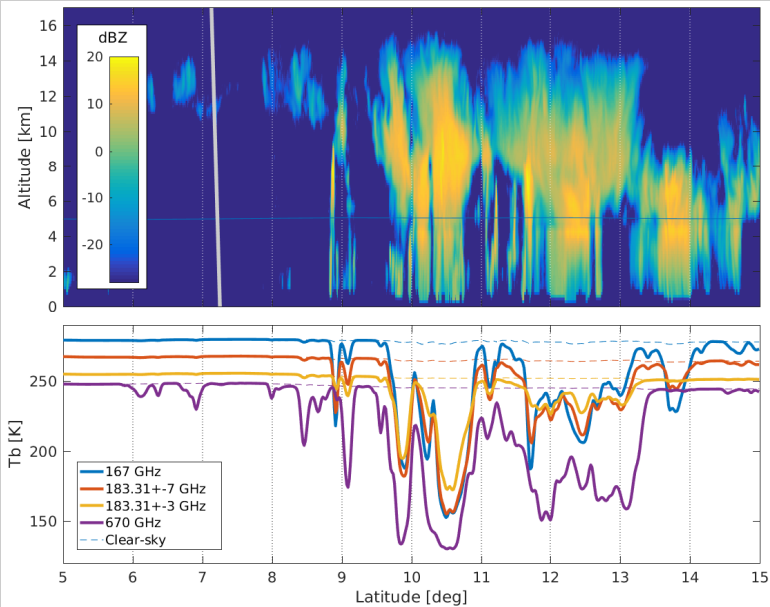
Mimicking tropical GMI measurements

▶ Relatively low spread consistent with Kulie et al., 2010

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Outline

1. Retrievals

2. Scattering calculations

3. Various

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- ► Line mixing
- ► Non-LTE
- ► Hartmann-Tran lineshape
  - ► all beta features

- ► More in presentation of Richard

ARTS features

- New WSM group: ArrayOfAgendas (OL)
- Improved scheme for pre-defined instrument set-ups
  - known as MetMM (Alex + ...)
  - a demo session?
- Surface types (PE)
  - will be revised to make use of ArrayOfAgendas
- Geo-positioning (PE)
  - `y_geo` is set based on `ppath`, e.g. lowest altitude
- Pencil beam identifier (PE)
  - `iy_id` is a 9 position index: xxxyyyabc
  - helps to keep track of output files:
    `WriteXMLIndexed("binary",iy_id,...,9)`
  - powerful together with IBA,
    e.g. 1D views and intensity fields can be extracted

Ongoing and planned work

- ▶ OEM
  - ▶ allowing retrieval in transformed spaces (e.g. PCA)
  - ▶ user support around input and output
- ▶ "Hybrid scattering solver"
  - ▶ in development
  - ▶ approximate Jacobian by analytic expressions
  - ▶ semi-fast
- ▶ Expressing scattering properties in terms of harmonics
- ▶ Surface properties
  - ▶ adding models (TELSEM, TESSEM, . . .)
  - ▶ allowing retrieval of surface properties

Final comments

- ▶ ARTS v2.2 article will be submitted soon

- ▶ Beta parts: preferably used in collaboration with us
    - ▶ scattering database, OEM, "new physics",
      hybdrid scattering solver, . . .

- ▶ In general: feedback and requests welcome
    - ▶ handled on best effort basis