ISMAR Retrieval Database

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Database description

The database consists of radiative transfer simulations of 1D-atmospheric profiles made with ARTS 2.2[1]. As the database should be the foundation of a retrieval, the database has to be consistent and self-standing, meaning each state of the database should be comparable with each other. So, following assumptions are made:

- All the different states of the database should be on common grids of pressure coordinates and looking direction.
- All states should have the same types of hydrometeors, hydrometeor sizes and shapes.
- All states should have the same spectral composition.

Therefore, the database has a static part with the grids, instrument and scatterer definitions and a variable part with the state variables changing for each case. So, the database consists of 6 grids, 2 instrument description, 5 descriptions for the scatterers and 13 state variables, which all will be described in the folowing parts.

Static part

Grids

- *case_index*, an index that names a specific case with a number.
- *pressure*, the vertical grid. It is as first try defined from 1000 hPa to 30 hPa with 75 logarithmic distributed steps.
- *channel_no*, the index of the channel, see table 1 for the description.
- *looking_direction*, the angular grid. It is as first try defined from 0° to 180° in steps of 5° (37 steps).
- *scattering_element_index*, an index that names a specific scattering_element with a number.
- *polarization*, a four element grid stating the polarization state. The first component is the I-component, the second is the Q-component, the second is the U-component and the second is the V-component of the Stokes vector.

Instrument description

- *channel_def* (*channel_no*), the channel description, it consists of the center frequencies, the offsets of the sidebands and the bandwidths, see table 1.

[1] ARTS 2.3 is still under strong development with a lot of changes,therefore the database will be defined according to ARTS 2.2

channel_no	Center frequency [GHz]	Side bands [GHz]	Bandwidths [GHz]	Instrument
1	23.8	±0.07	0.127	Deimos
2	50.1	±0.08	0.082	Deimos
3	89.0	±1.1	0.65	MARSS
4	118.75	±1.1	0.4	ISMAR
5	118.75	±1.5	0.4	ISMAR
6	118.75	±2.1	0.8	ISMAR
7	118.75	±3.0	1.0	ISMAR
8	118.75	±5.0	2.0	ISMAR
9	157.05	±2.6	2.6	MARSS
10	183.31	±1.0	0.45	MARSS
11	183.31	±3.0	1.0	MARSS
12	183.31	±7.0	2.0	MARSS
13	243.20	±2.5	3.0	ISMAR
14	325.15	±1.5	1.6	ISMAR
15	325.15	±3.5	2.4	ISMAR
16	325.15	±9.5	3.0	ISMAR
17	424.70	±1.0	0.4	ISMAR
18	424.70	±1.5	0.6	ISMAR
19	424.70	±4.0	1.0	ISMAR
20	448.0	±1.4	1.2	ISMAR
21	448.0	±3.0	2.0	ISMAR
22	448.0	±7.2	3.0	ISMAR
23	664.0	±4.2	3.0	ISMAR
24	874.4	±6.0	3.0	ISMAR

Table 1: Channel description, taken from: `http://www.sat.ltu.se/workshops/ismar/material/20140611_11_rule_ismar_overview.pdf`

- *calibration*, the used calibration, it is a string with either "PlanckBT" or "Rayleigh-JeansBT" indicating if the brightness temperature is calibrated using the Planck equation or using the Rayleigh-Jeans approximation.

Scatterer descriptions

- the properties of the scattering elements:
  - mass [kg]: $mass(scattering\_element\_index)$
  - maximum dimension [m]:$dmax(scattering\_element\_index)$
  - volume $[\mathrm{m}^3]$:$volume(scattering\_element\_index)$
  - type of scattering elemenent $scattering\_element\_type(scattering\_element\_index)$, an cell array with a tag for each $scattering\_element\_index$ according to the arts 2.2 method "ParticleSpeciesSet"
  - shape of the scattering element $scattering\_element\_shape(scattering\_element\_index)$, an cell array with a stringe for each $scattering\_element\_index$ describing the shape.

Variable part

State variables

- the atmospheric data:
  - temperature[K]: $temperature(case\_index, pressure)$
  - altitude [m]:$atltitude(case\_index, pressure)$
  - particle number density $[\mathrm{m}^{-3}]$: $pnd\_field(case\_index, pressure, scattering\_element\_index)$
  - water vapor as volume mixing ratio $x\,(case\_index, pressure)$
  - brightness temperature [K]: $t\_b(case\_index, pressure, channel\_no, looking\_direction, polarization)$. It is calculated by using the Planck equation or using the Rayleigh-Jeans approximation, which is shown by the variable *calibration*. If the Rayleigh-Jeans approximation is used, the conversion from specific intensity to brightness temperature will be done seperately for each component and for each simulated frequency before the mapping to the channels will be done. If planck is used only the I component will be converted to brightness temperature. The other components will be set to zero, because they are not defined for Planck brightness temperature. The mapping is done by taking the average brightness temperature of the frequencies belonging to the specific channel.
- the surface properties

  - surface altitude [m]: $surface\_altitude(case\_index)$
  - surface temperature [K]: $surface\_temperature(case\_index)$
  - surface type $surface\_type(case\_index)$, a cell array with a string defining the surface type of each $case\_index$.
  - surface reflectivity

    $$surface\_reflectivities(case\_index, channel\_no, looking\_direction, polarization, polarization)$$

    the two last dimensions are the 4×4 reflection matrices for a four dimensional stokes vector with the above mentioned components

- the simulated position in space and time
  - latittude [°]: $lat(case\_index)$
  - longitude [°]: $lon(case\_index)$
  - time $time(case\_index)$