



ARTS 2.2

Overview of new features

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DER FORSCHUNG | DER LEHRE | DER BILDUNG

ARTS Workshop

Kristineberg, 09-11 June 2014



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Background

- ▶ triggered by ESA project “*Microwave propagation toolbox for planetary atmospheres*”
 - ▶ revision & adaptation for non-Earth planets
 - ▶ radio links: active technique
 - ▶ additional physics
 - ▶ further revisions (stability, consistency, accuracy, user friendliness, ...)



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Background

- ▶ triggered by ESA project “*Microwave propagation toolbox for planetary atmospheres*”
- ▶ Further parallel developments
 - ▶ Zeeman (polarized absorption)
 - ▶ line mixing
 - ▶ Cloud radar
 - ▶ in-ARTS Mie/T-Matrix & size distributions
 - ▶ ...
- ▶ well, and... bug fixes



I won't talk about... (today!)

- ▶ revision & adaptation for non-Earth planets
- ▶ radio links: active technique
- ▶ Zeeman, line mixing

⇒ Wednesday

- ▶ in-ARTS Mie/T-Matrix & size distributions, Cloud radar

⇒ Thursday



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- ▶ revision & adaptation for non-Earth planets (Jana)
- ▶ radio links: active technique (Patrick)
- ▶ Zeeman, line mixing (Richard)

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New features & capabilities I

- ▶ more convenient usage:
 - ▶ named arguments of WSM
 - ▶ named GriddedField grids
 - ▶ further check methods
 - ▶ zeropadding of atmospheric fields
 - ▶ copying of agendas
- ▶ improved RT functionality:
 - ▶ appended RT output
 - ▶ MC supports refraction (ppath_step_agenda)
 - ▶ more flexibility in surface characterization



New features & capabilities

- ▶ convenient usage: named WSM arguments
 - ▶ more robust (renamed variables)
 - ▶ shortened calls of WSM (generic or non-standard input)
- ▶ example:



New features & capabilities

- ▶ convenient usage: named WSM arguments
 - ▶ more robust (renamed variables)
 - ▶ shortened calls of WSM (generic or non-standard input)
- ▶ example:

```
AtmFieldsCalc(  
t_field, z_field, vmr_field,  
p_grid, lat_grid, lon_grid,  
t_field_raw, z_field_raw, vmr_field_raw,  
atmosphere_dim,  
interp_order, vmr_zeropadding, vmr_nonnegative )  
1                0                0
```



New features & capabilities

- ▶ convenient usage: named WSM arguments
 - ▶ more robust (renamed variables)
 - ▶ shortened calls of WSM (generic or non-standard input)
- ▶ example – using defaults:

AtmFieldsCalc



New features & capabilities

- ▶ convenient usage: named WSM arguments
 - ▶ more robust (renamed variables, changed order or number)
 - ▶ shortened calls of WSM (generic or non-standard input)
- ▶ example – old (zeropadding on):

```
AtmFieldsCalc(  
t_field, z_field, vmr_field,  
p_grid, lat_grid, lon_grid,  
t_field_raw, z_field_raw, vmr_field_raw,  
atmosphere_dim,  
1, 1 )
```

1

1 1

0



New features & capabilities

- ▶ convenient usage: named WSM arguments
 - ▶ more robust (renamed variables, changed order or number)
 - ▶ shortened calls of WSM (generic or non-standard input)
- ▶ example – new (zeropadding on):

```
AtmFieldsCalc( vmr_zeropadding=1 )
```

1

1

0



New features & capabilities

- ▶ convenient usage: named GriddedField grids
 - ▶ avoid data mix-up or misuse

```
<?xml version="1.0"?>
<arts format="ascii" version="1">
<GriddedField3>
<Vector name="Pressure" nelem="2">
110000
0.06900000000000000001
</Vector>
<Vector name="Latitude" nelem="1">
0
</Vector>
<Vector name="Longitude" nelem="1">
0
</Vector>
<Tensor3 name="Altitude" npages="2" nrows="1" ncols="1">
-7.282161e+02
9.500000e+04
</Tensor3>
</GriddedField3>
</arts>
```



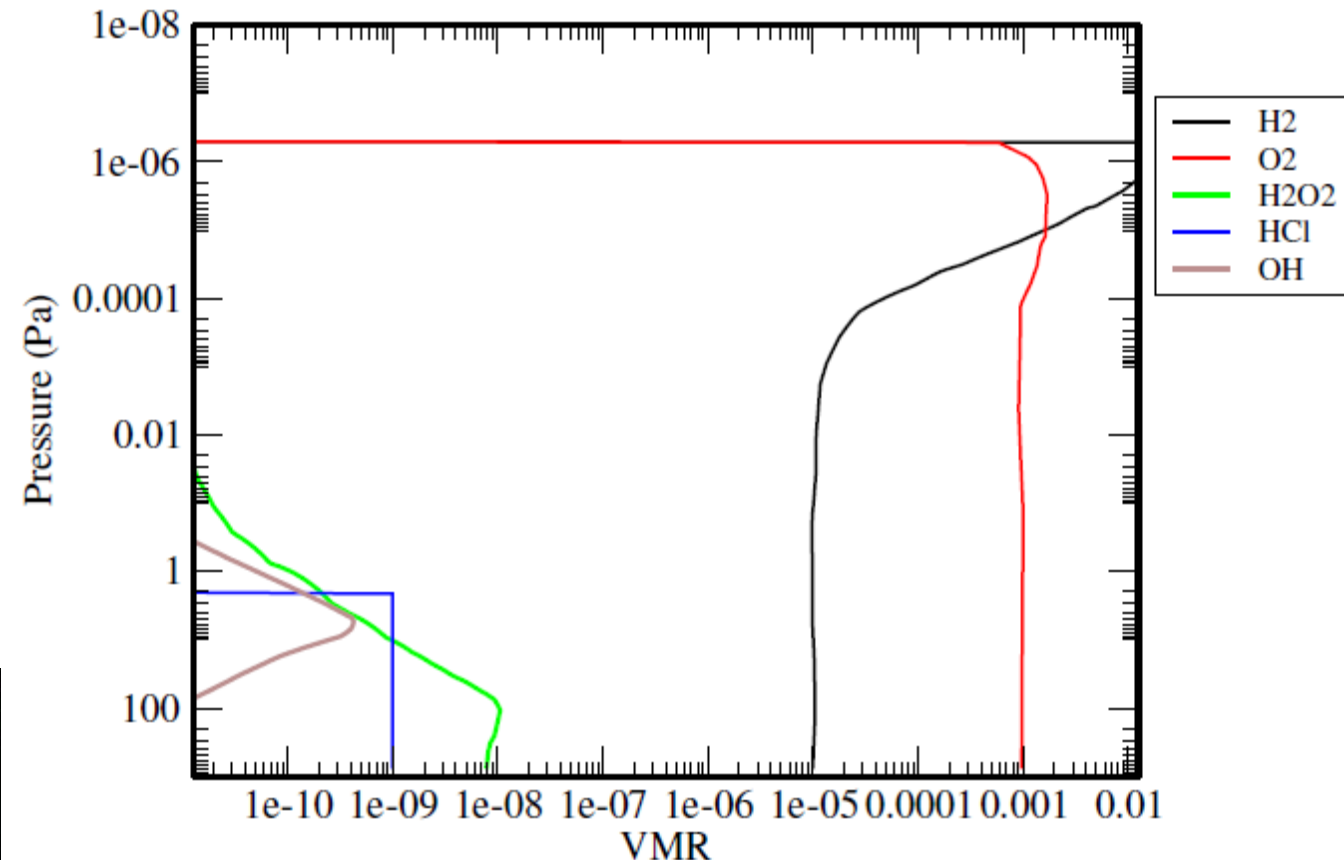
New features & capabilities

- ▶ convenient usage: further check methods
 - ▶ `atmfields_checkedCalc`
 - ▶ `atmgeom_checkedCalc`
 - ▶ `sensor_checkedCalc`
 - ▶ `propmat_clearsky_agenda_checkedCalc`
 - ▶ `abs_xsec_agenda_checkedCalc`
- earlier:
`basics_checkedCalc`



New features & capabilities

- ▶ convenient usage: zeropadding of atmospheric fields
 - ▶ species known/relevant in limited atmo. region only
 - ▶ more freedom (e.g. upper atmo extension)



New features & capabilities

- ▶ convenient usage: copying agendas
 - ▶ allows predefinitions

(provided in **general/agendas*.arts**)

```
AgendaCreate( ppath_step_agenda__GeometricPath )
AgendaSet( ppath_step_agenda__GeometricPath ){
  Ignore( t_field )
  Ignore( vmr_field )
  Ignore( f_grid )
  Ignore( ppath_lraytrace )
  ppath_stepGeometric }

```

```
AgendaCreate( ppath_step_agenda__RefractedPath )
AgendaSet( ppath_step_agenda__RefractedPath ){
  ppath_stepRefractionBasic }

```

```
Copy( ppath_step_agenda, ppath_step_agenda__GeometricPath )

```



New features & capabilities

- ▶ appended RT output
 - ▶ merged output from successive RT calcs
 - ▶ useful when
 - ▶ combining data from different instruments (different observation types and observation angles)
 - ▶ varying sensor response
- ▶ for **y** and **jacobian**
- ▶ **yCalcAppend** replaces **yCalc**



New features & capabilities

- ▶ refraction supported by MonteCarlo scattering solver
 - ▶ refracted paths via **ppath_step_agenda**
 - ▶ refraction index via **refr_index_agenda**
- ▶ now also MC makes use of this functionality



New features & capabilities

- ▶ more flexibility in surface characterization
 - ▶ in-place parameters from global/regional fields
 - ▶ surface refractive index
 - ▶ scalar/polarized surface reflectivity



New features & capabilities II

- ▶ extended atmospheric characterization
 - ▶ magnetic field, electron density, wind...
- ▶ Doppler shifts
 - ▶ wind, planet rotation, (sensor movement)
- ▶ polarized gas absorption: Faraday rotation
- ▶ active measurements: transmitter-receiver-paths
- ▶ auxiliary output
- ▶ n²-law of radiance
- ▶ dispersion



Summary

- ▶ quite a bunch of new features
- ▶ more details on Wednesday
- ▶ ... work in progress
 - ▶ particles & scattering (ICI / ISMAR related)
 - ▶ ...

