ARTS-2.2: Radio link budget calculations

Patrick Eriksson

Earth and Space Sciences, Chalmers University of Technology, Sweden

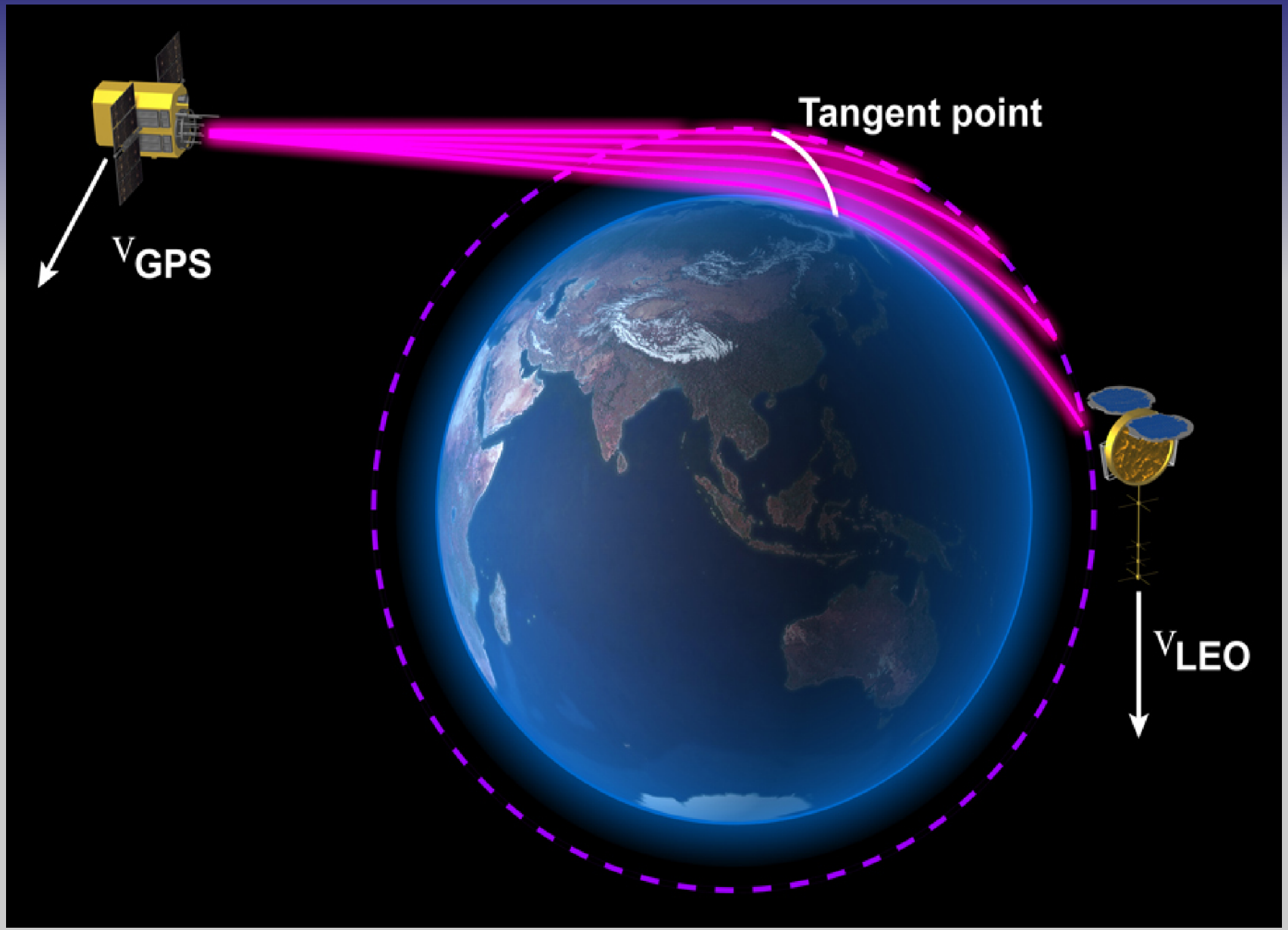
Kristineberg, June 11, 2014

Background

- Basic treatment of radio link budgets required in ESA microwave toolbox study

- We have also a general interest in radio occultation
  - i.e. active microwave limb sounding

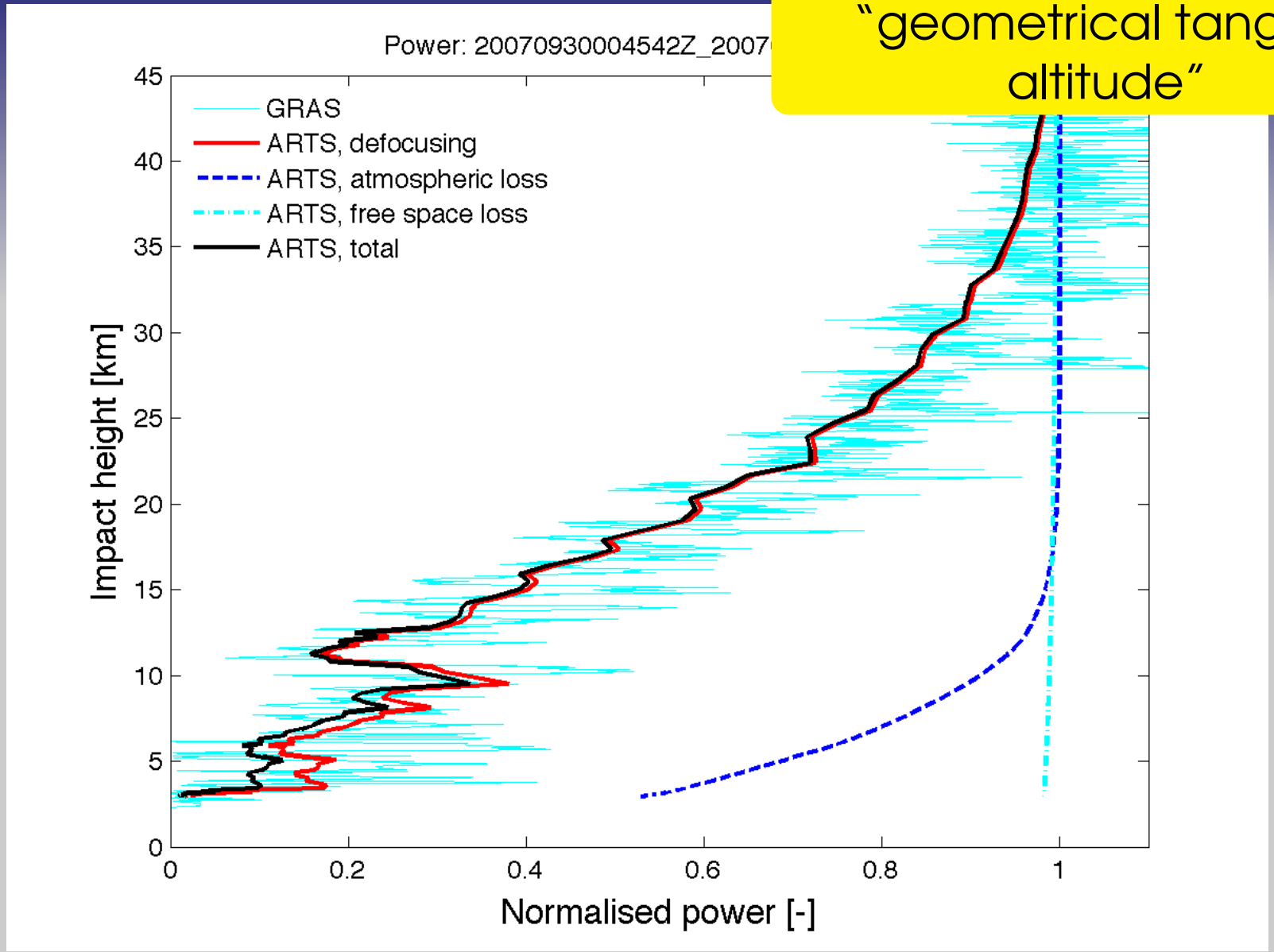
Radio occultation



Example on attenuation calculations

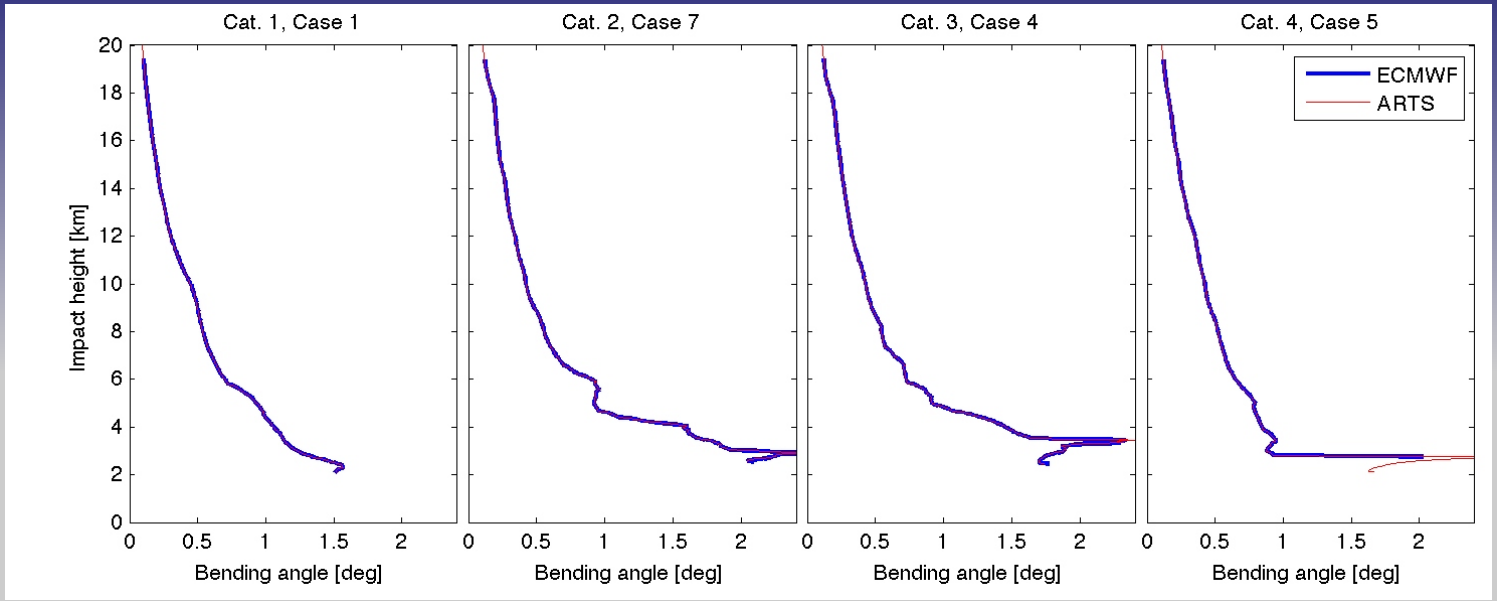
Rough comparison to GRAS observations

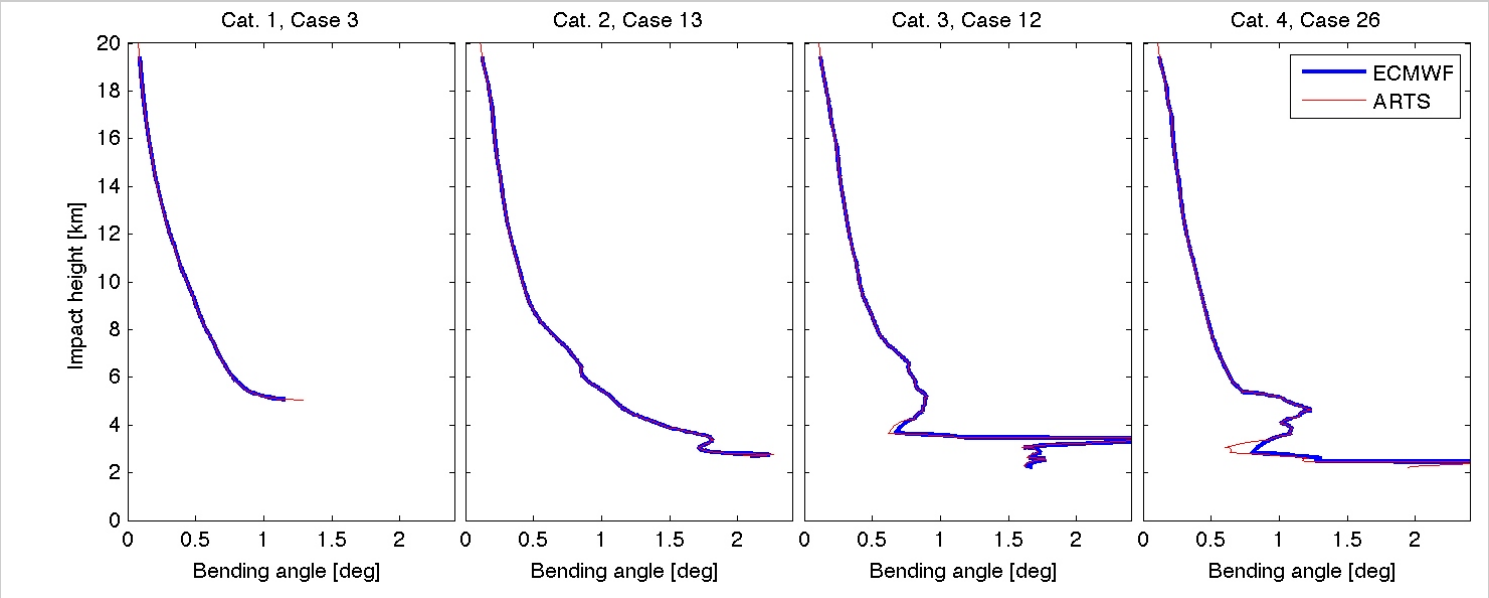
Impact height = "geometrical tangent altitude"



Validation of bending angles

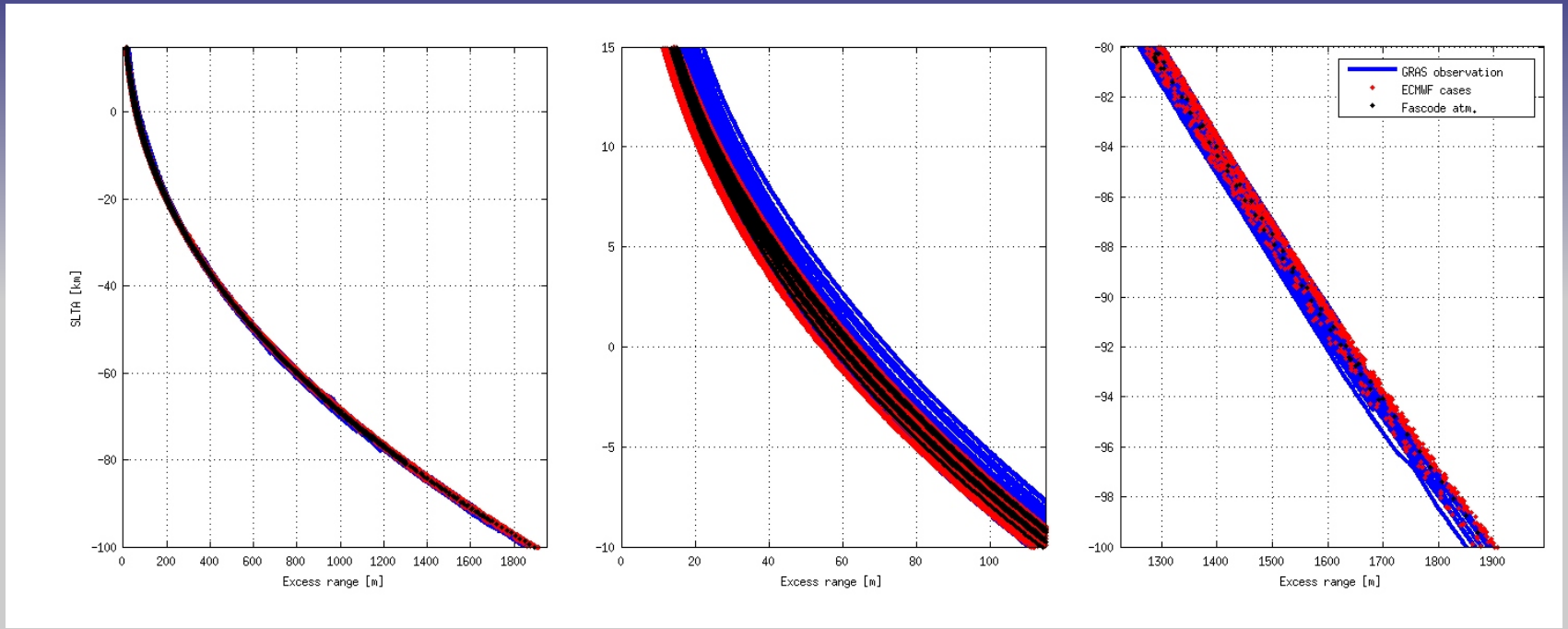
Comparison to ECMWF Abel transform calculations





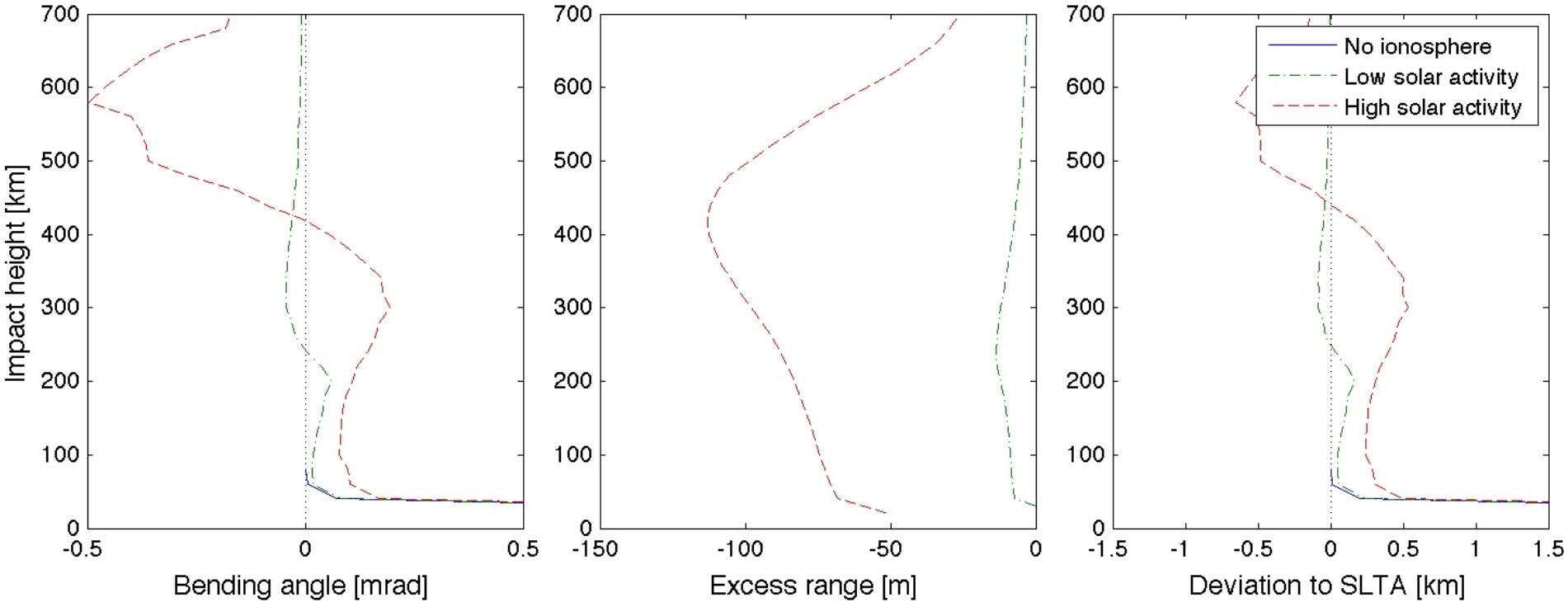
Determination of excess range

Comparison to GRAS observations



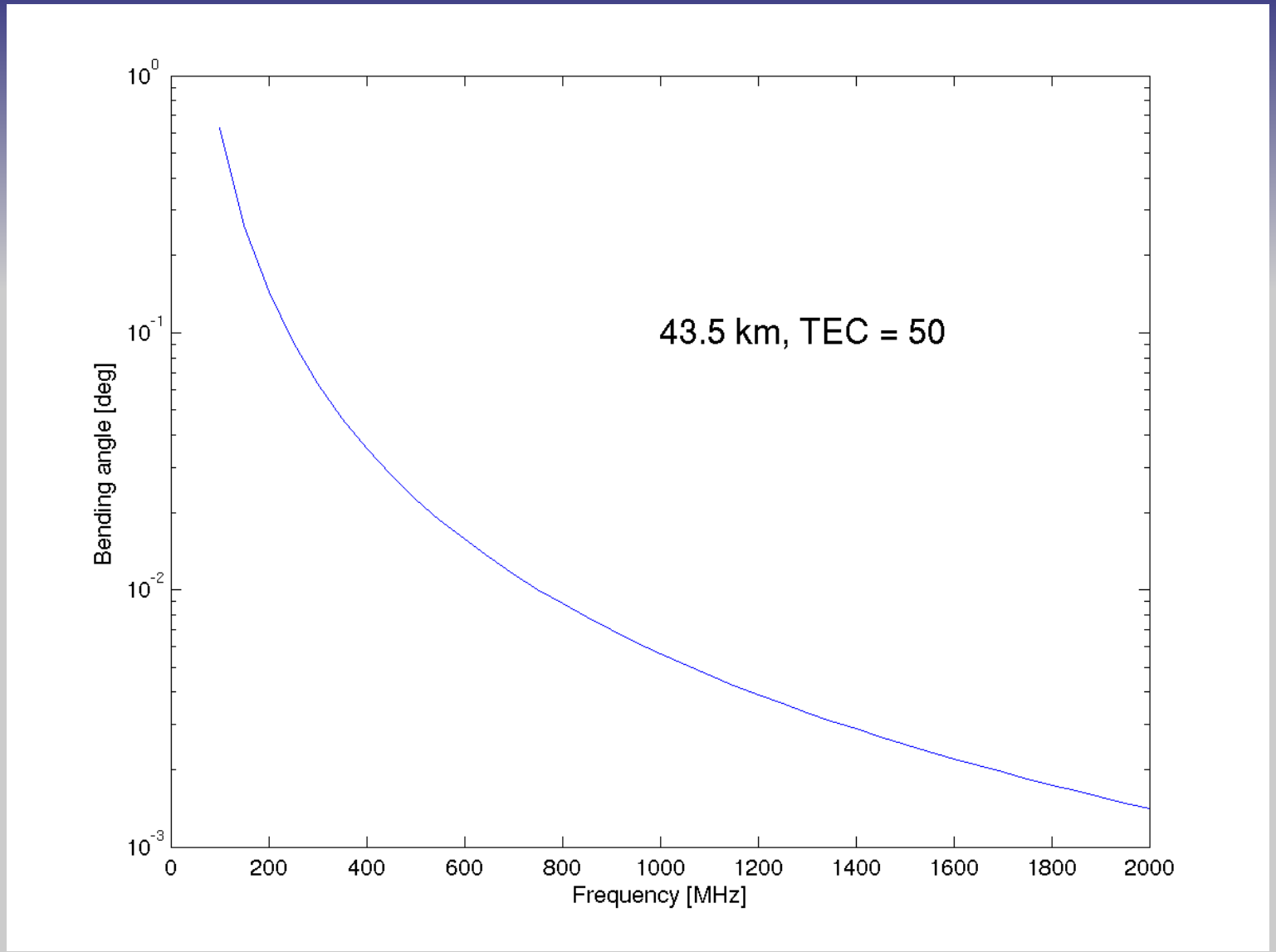
- SLTA = straight-line tangent altitude
- Excess range = optical path - geometrical distance
- Deviations around SLTA = 0 km should be due to imperfect compensation of ionospheric impact

Ionospheric effects



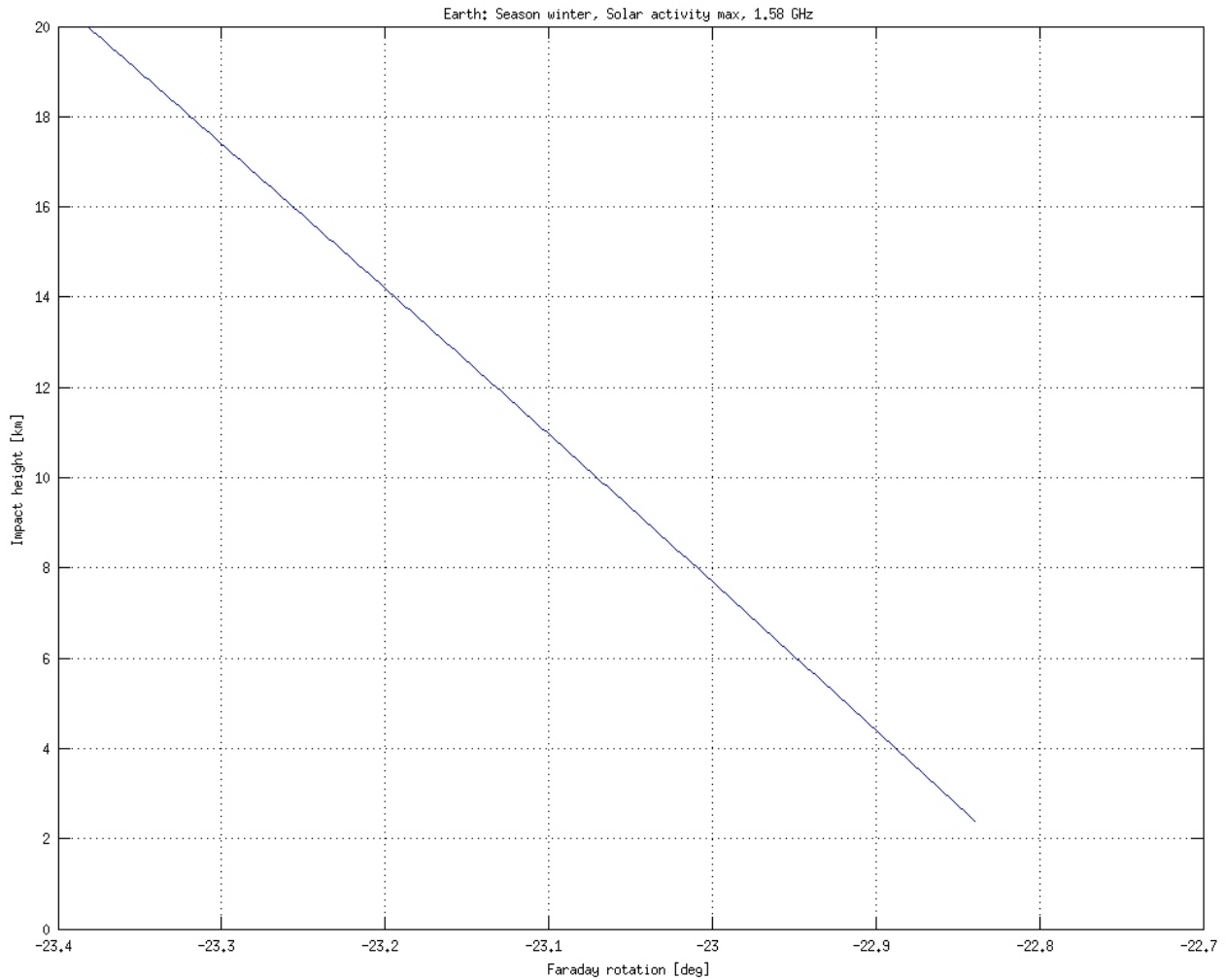
Dispersion

Exemplified by ionospheric bending

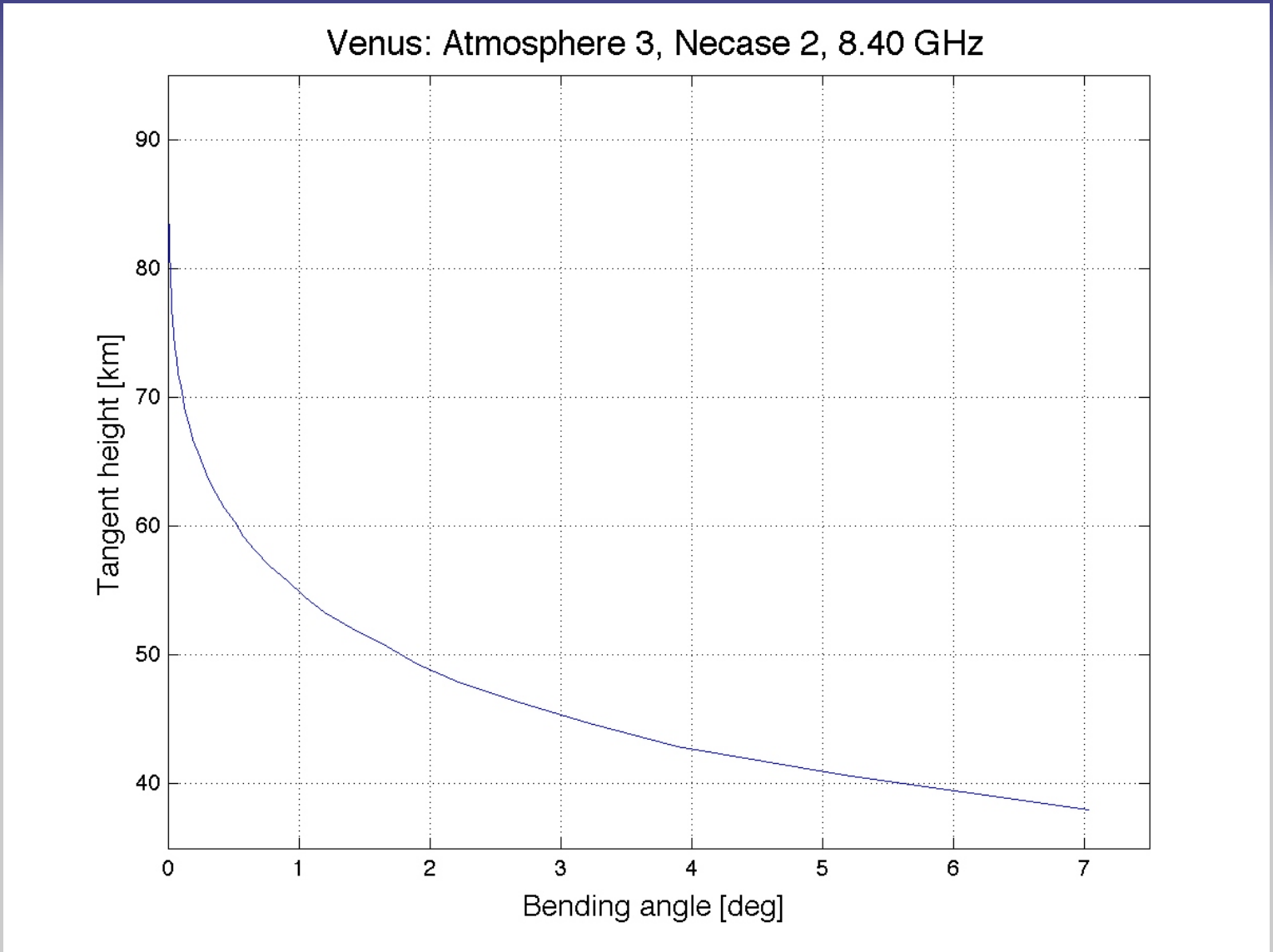


Faraday rotation

Exemplified for radio occultation

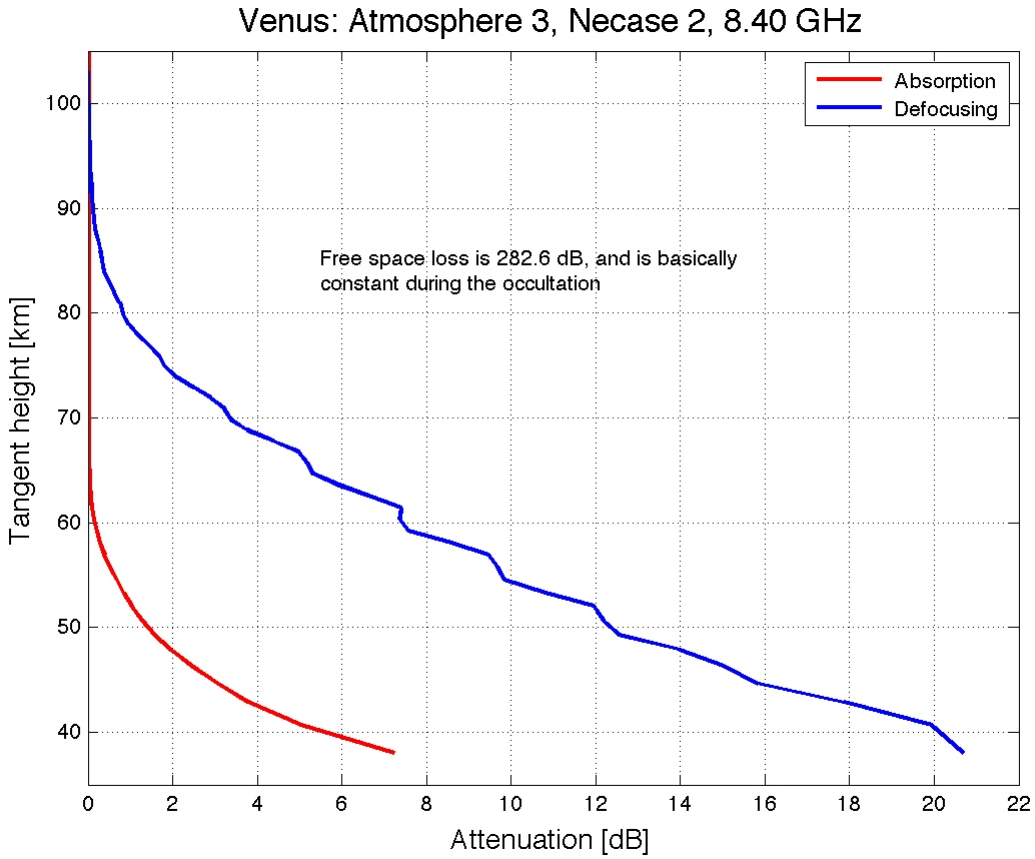


Venus: bending angles

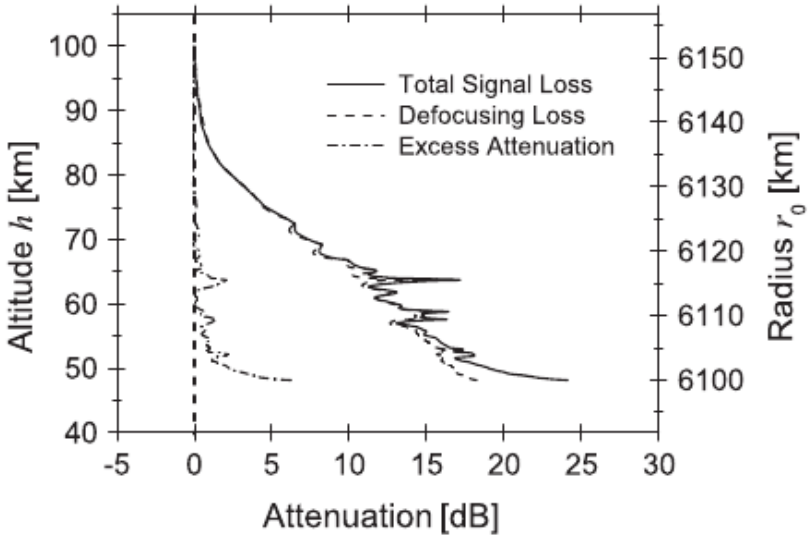


Venus: attenuation

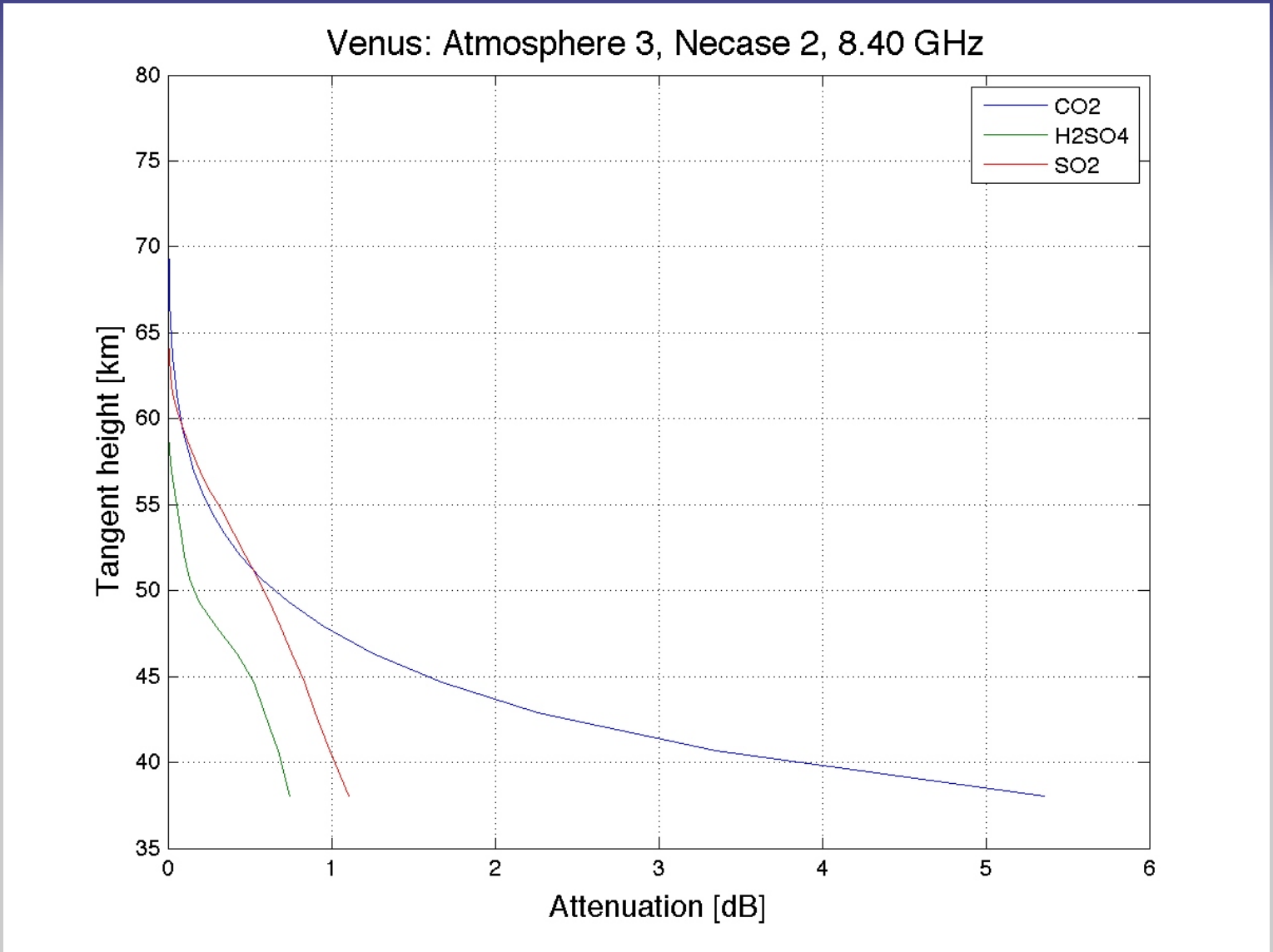
Rough comparison to Oschlisniok et al. (2012)



- Zigzag pattern in defocusing due to unsmooth input profiles



Venus: gas attenuation per species



Summary

Effects handled:

- Attenuation by gases and particles
- Free space loss
- Defocusing
- Bending angle
- Faraday rotation

- ARTS assumes that geometrical optics apply
  - limitations of geometrical optics?
- A Wave Optics Propagator (WOP) is in development