

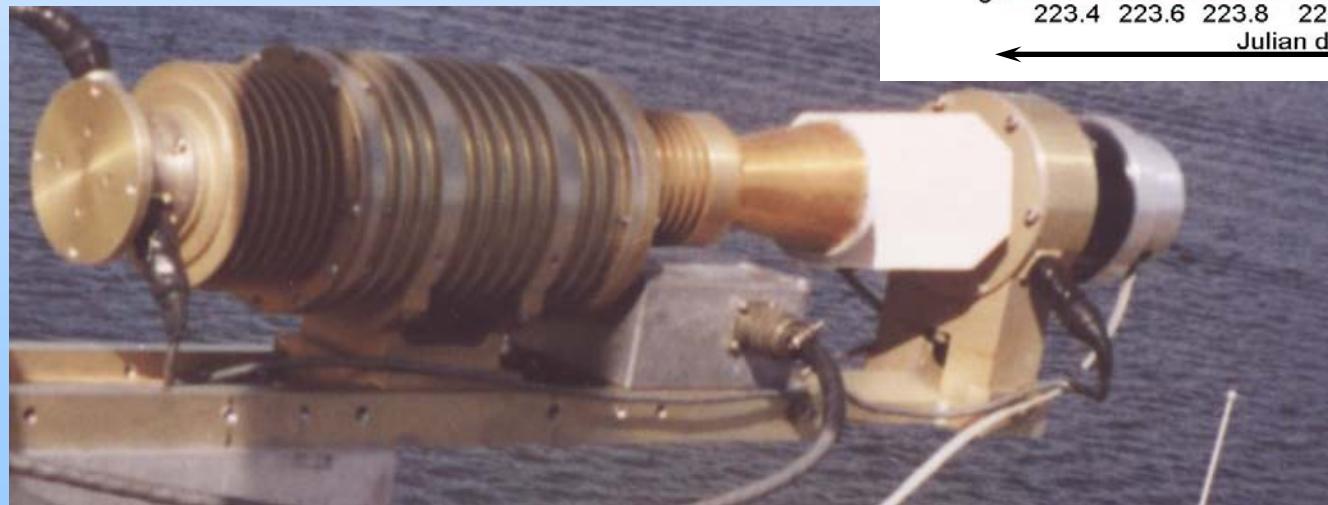
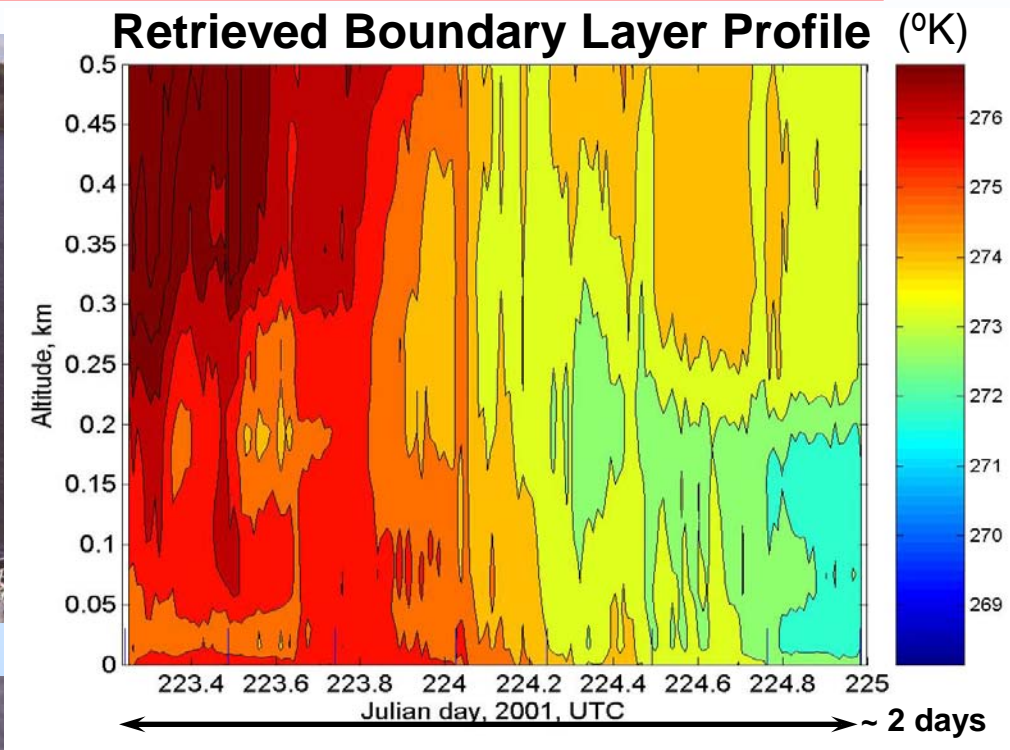


The Profiling Radiometer for Atmospheric and Cloud Observation PRACO

Marian Klein, Vladimir Irisov, Vladimir Leuski

- Established in 2006
- Passive microwave remote sensing
- Long experience with airborne, ship-borne, ground based microwave radiometers

60 GHz Boundary Layer Temperature Profiler



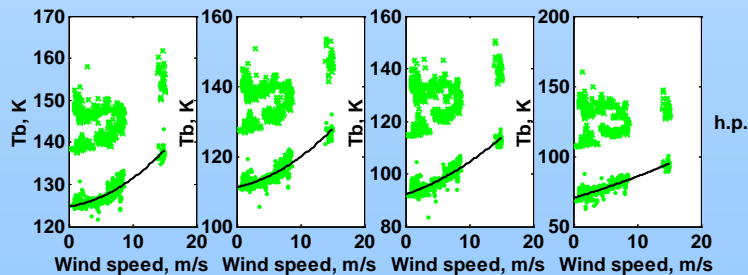
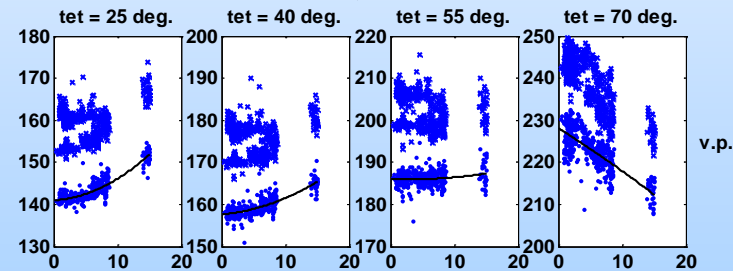
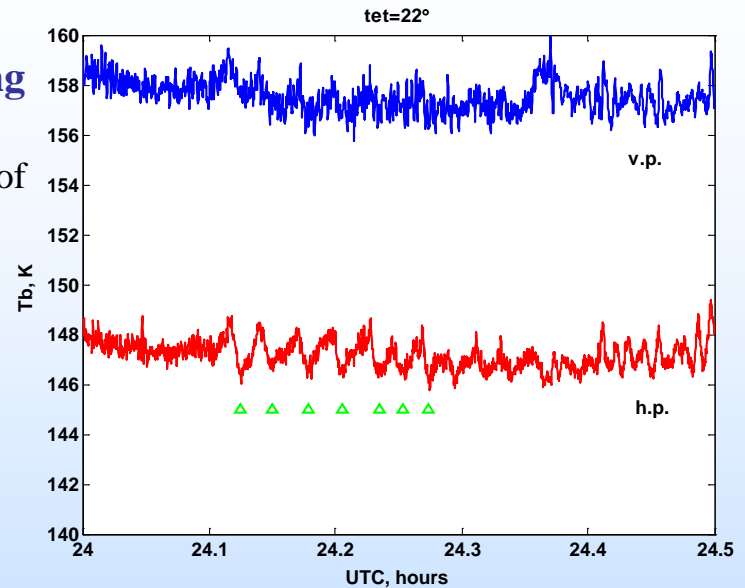
Successful operation in several extreme environments:

Ship, Aircraft, Ice-breaker, Arctic ground site, and Dirigible

37 GHz Airborne Polarimeter

Coastal Ocean Probing Experiment (1995) (radiometric observations of oceanic internal waves)

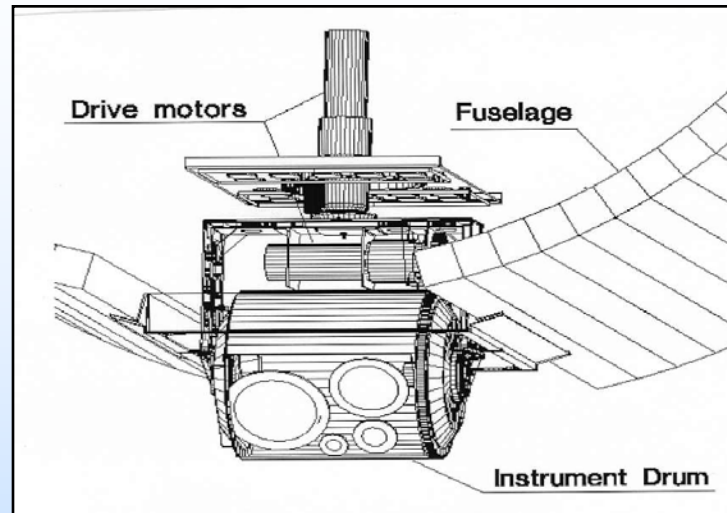
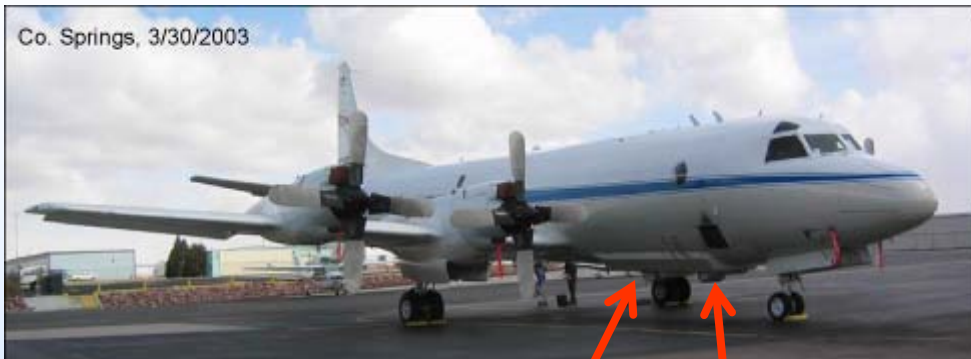
(radiometric observations of oceanic internal waves)



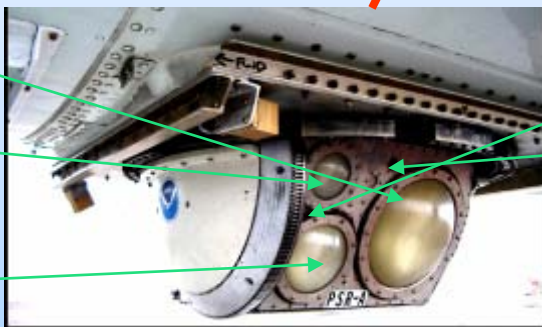
Shoaling waves experiment (1999) (observation of wind waves)

(observation of wind waves)

PSR Installation on NASA P-3



- 10.7 GHz
- 37.0 GHz
- 89.0 GHz
- 18.7 GHz
- 21.5 GHz



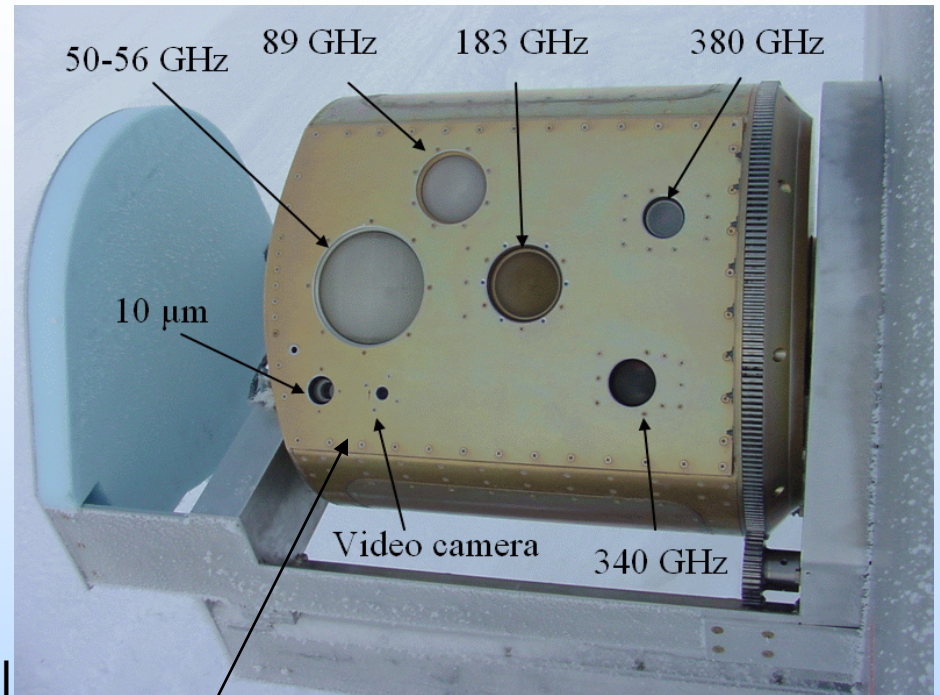
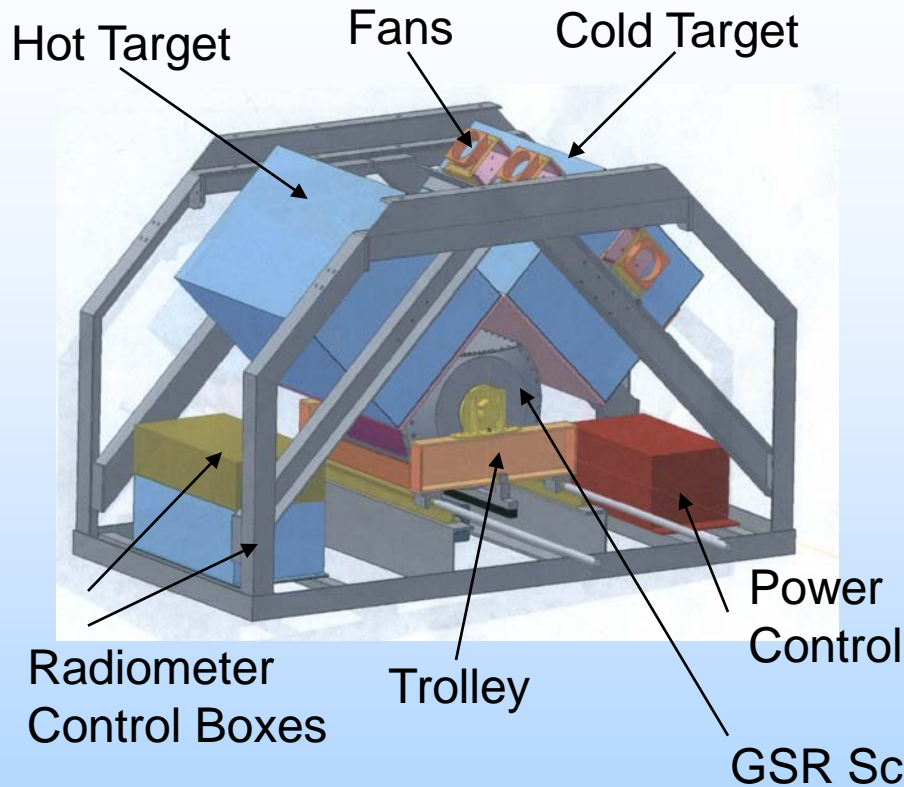
Video

10 μ m IR

- 6.7 GHz
- 10.7 GHz



Ground-based Scanning Radiometer

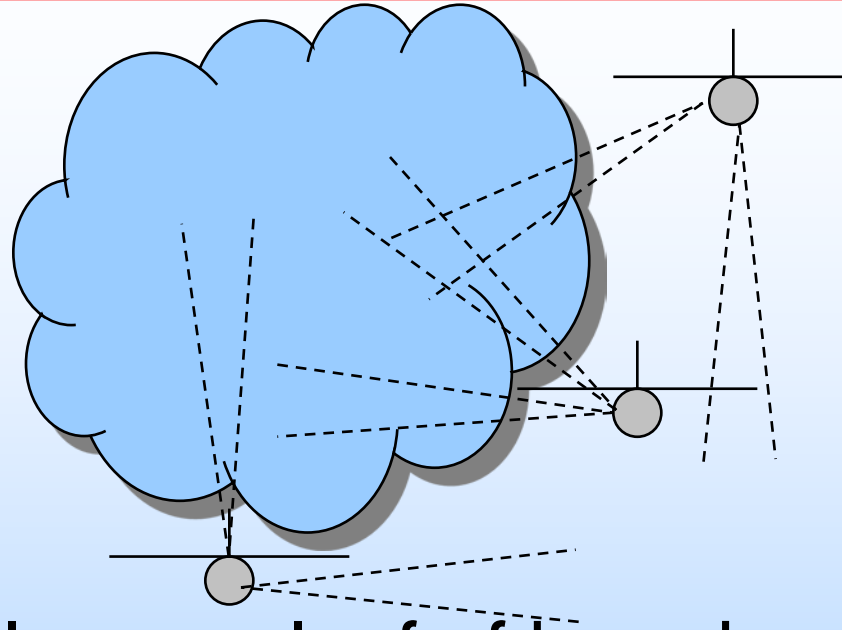


Principal features:

- 25 channels, horizon-to-horizon scanning
- High sensitivity to water vapor & clouds
- Three levels of calibration, high accuracy
- Designed for decadal Arctic observations

- Founded for Phase I feasibility study from DOE SBIR
- Microwave radiometer with multiple frequency bands is considered
- Modeling, design phase
- Great opportunity for feedback from future customers

Concept of PRACO



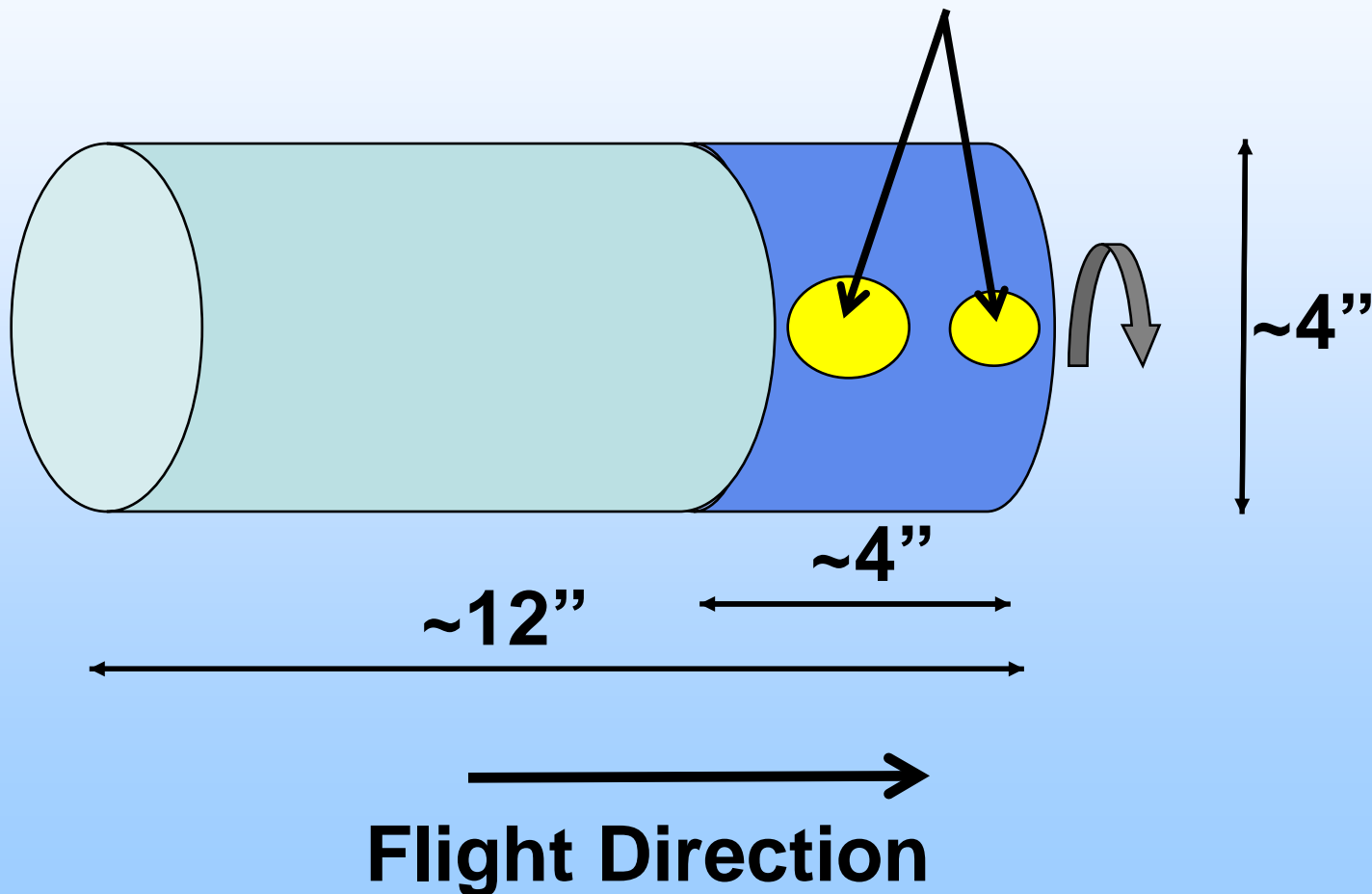
- Small volume, ~ loaf of bread
- 360° scanning, perpendicular to the line of flight
- Able scan without polarization mixing
- Installed in a nose of an airplane, or in front of a leading edge of a wing

Concept of PRACO

Radiometric bands:

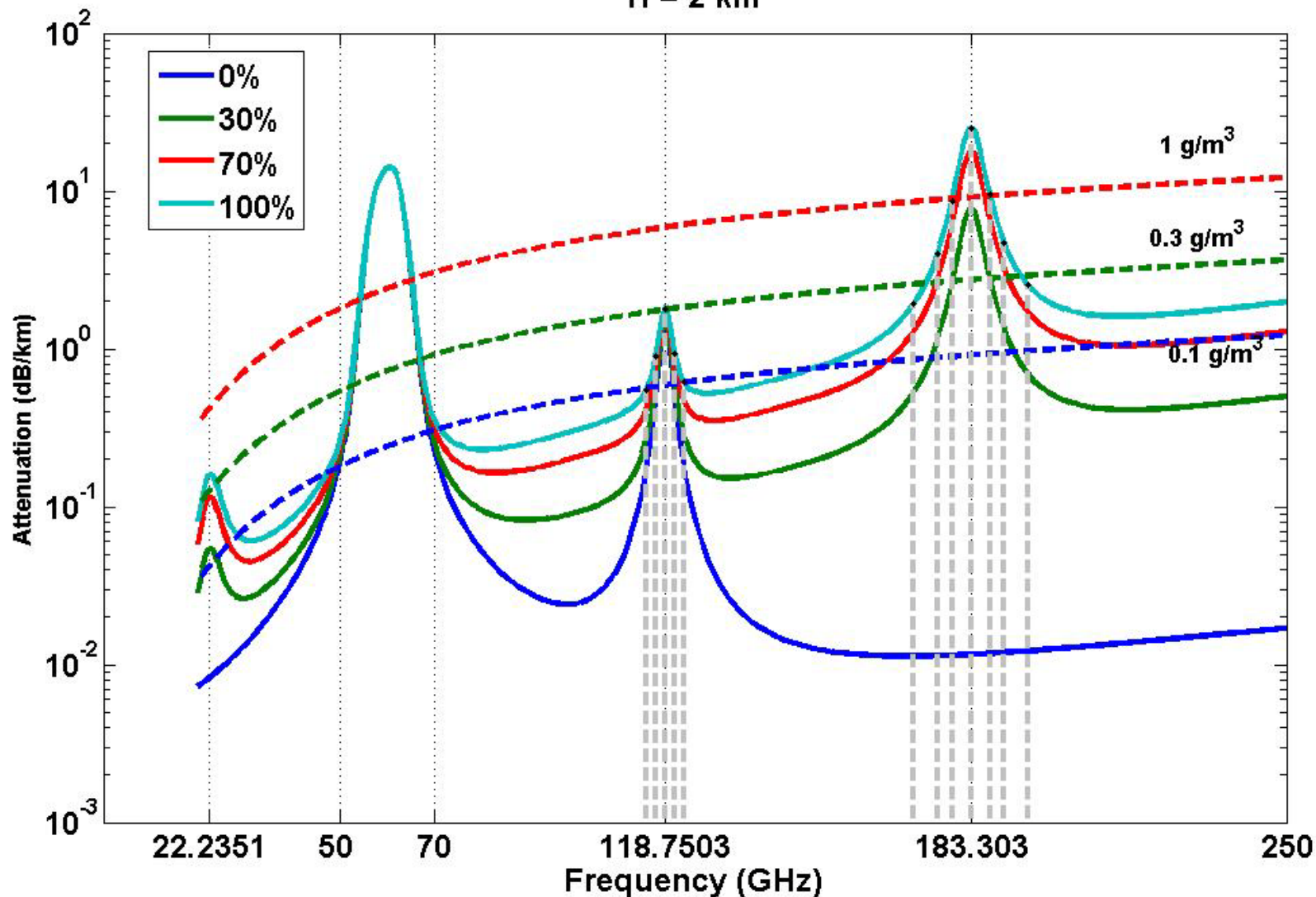
- 22 GHz
- 40 GHz
- 56 GHz
- 118 GHz
- 183 GHz

Antennae lenses



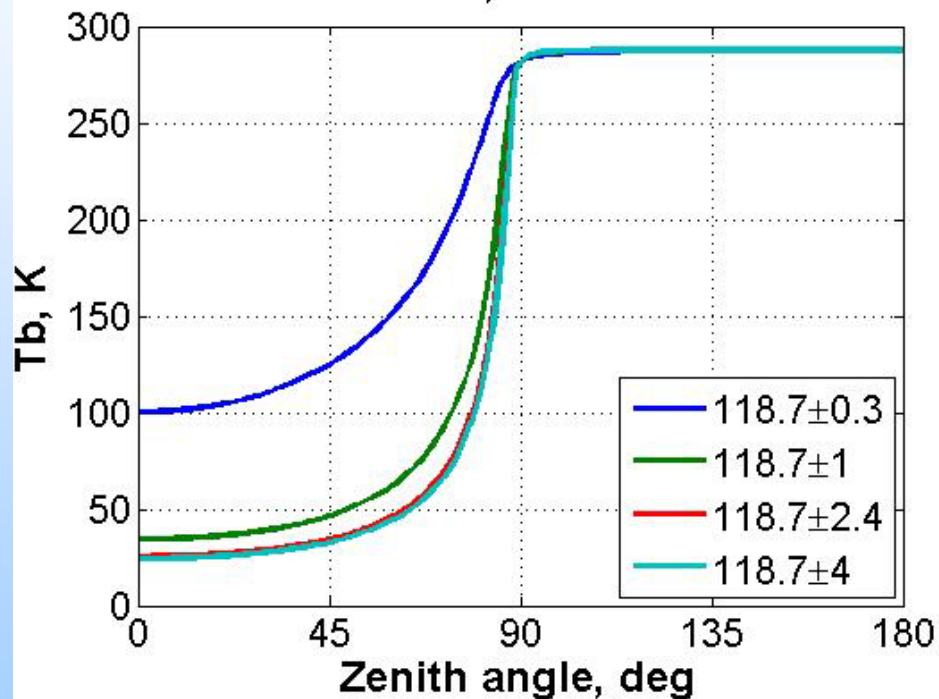
Atmospheric attenuation

H = 2 km

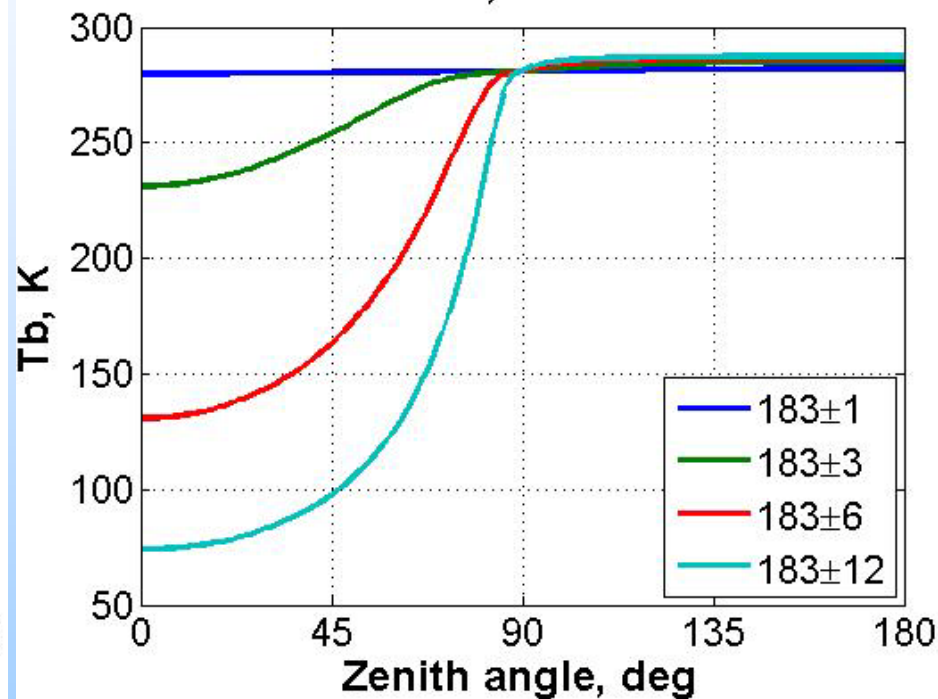


PRACO clear air

H = 1.1 km, distr. "clear"

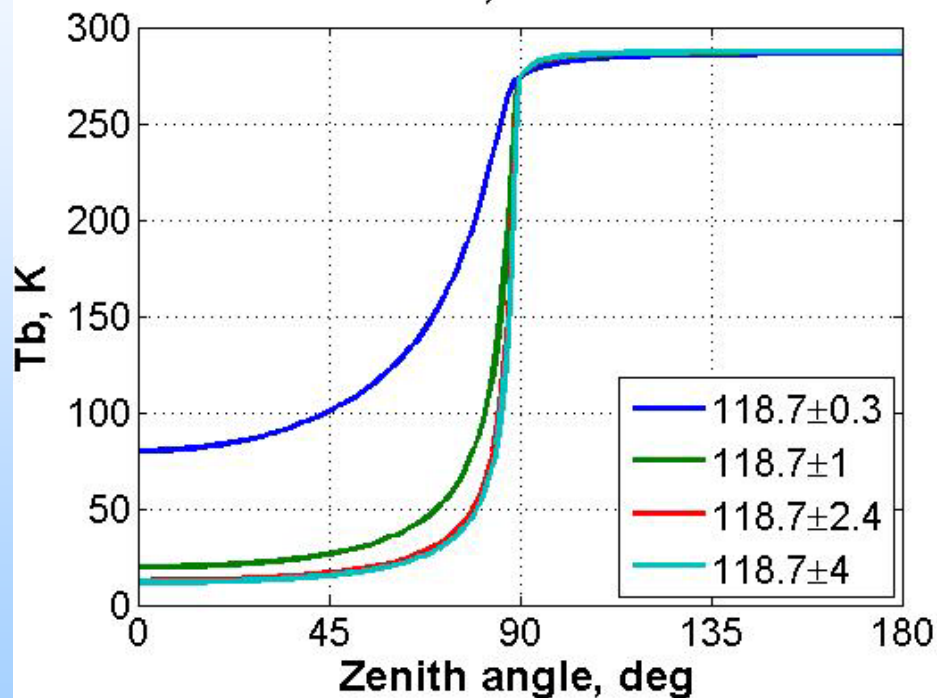


H = 1.1 km, distr. "clear"

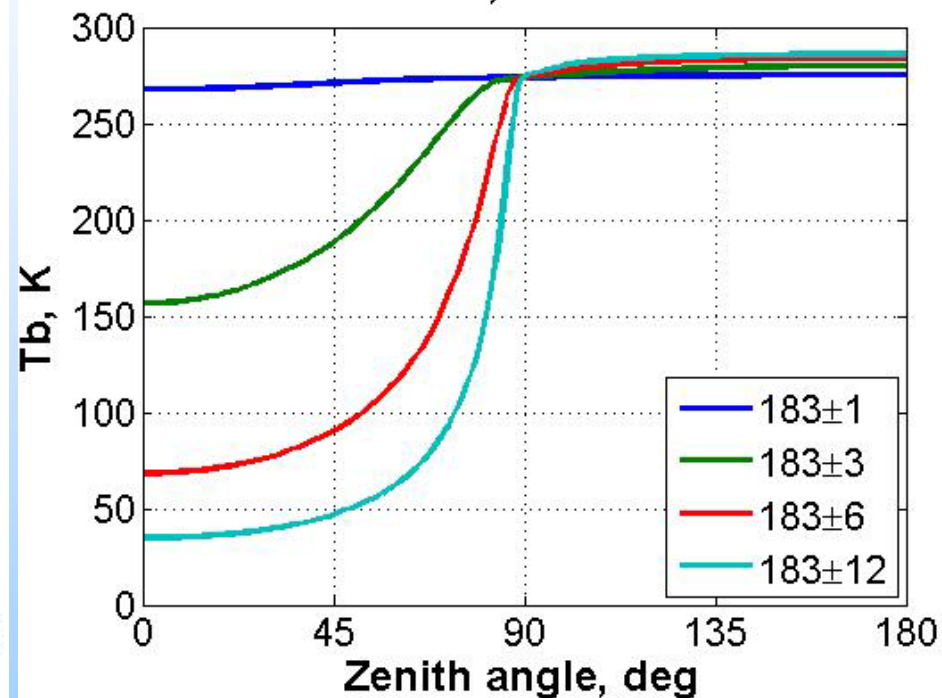


PRACO clear air

H = 2.2 km, distr. "clear"

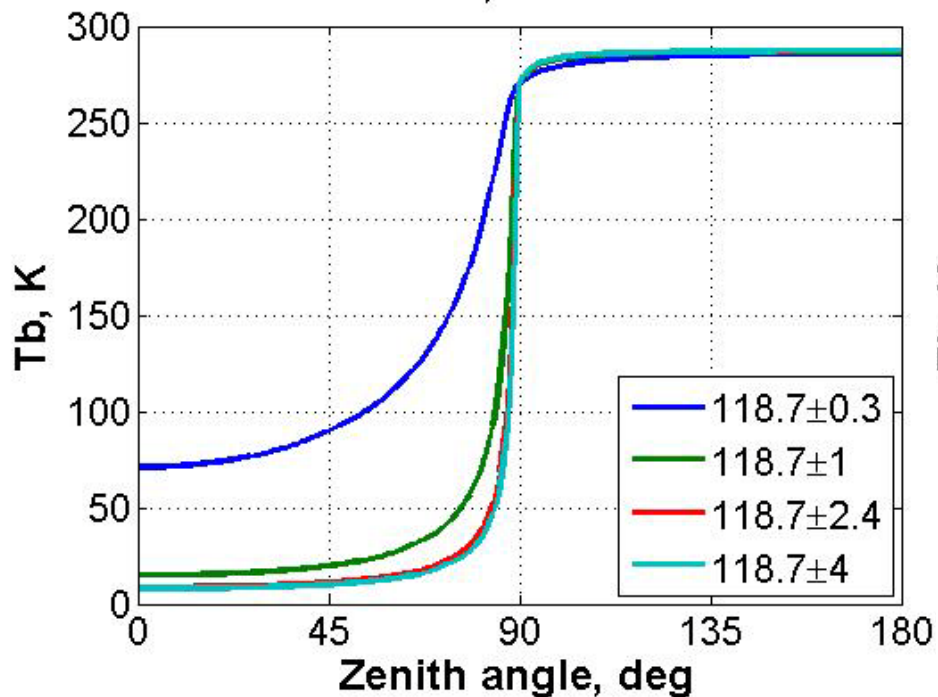


H = 2.2 km, distr. "clear"

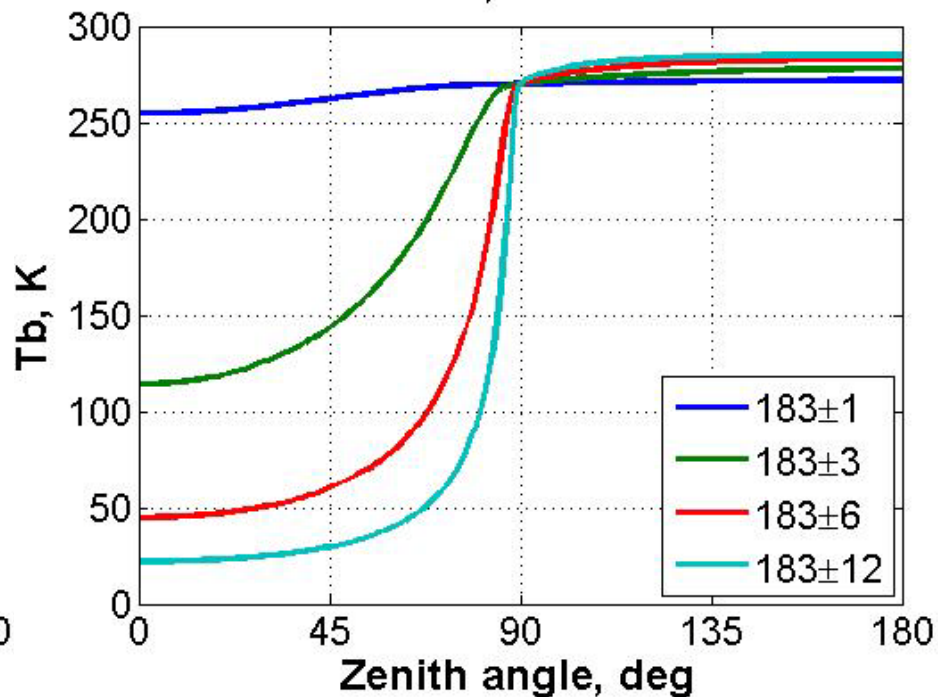


PRACO clear air

H = 2.8 km, distr. "clear"

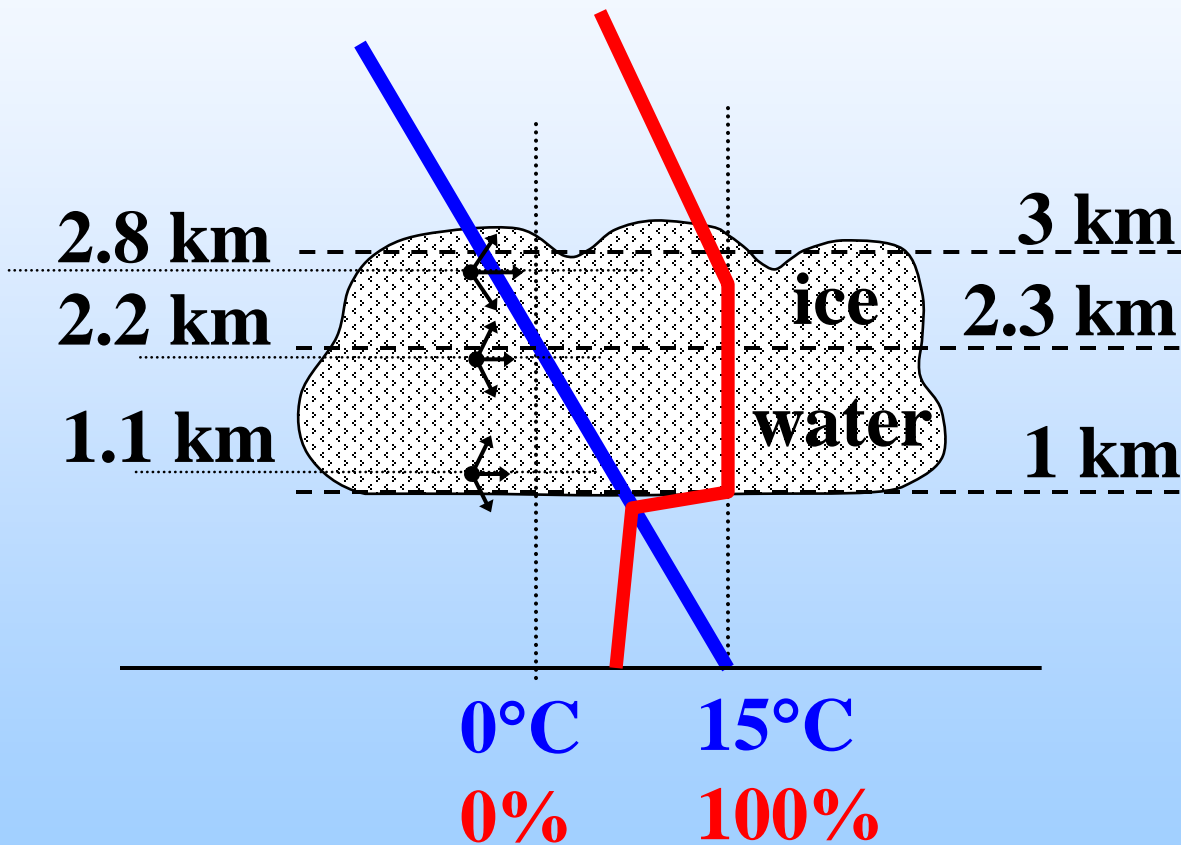


H = 2.8 km, distr. "clear"

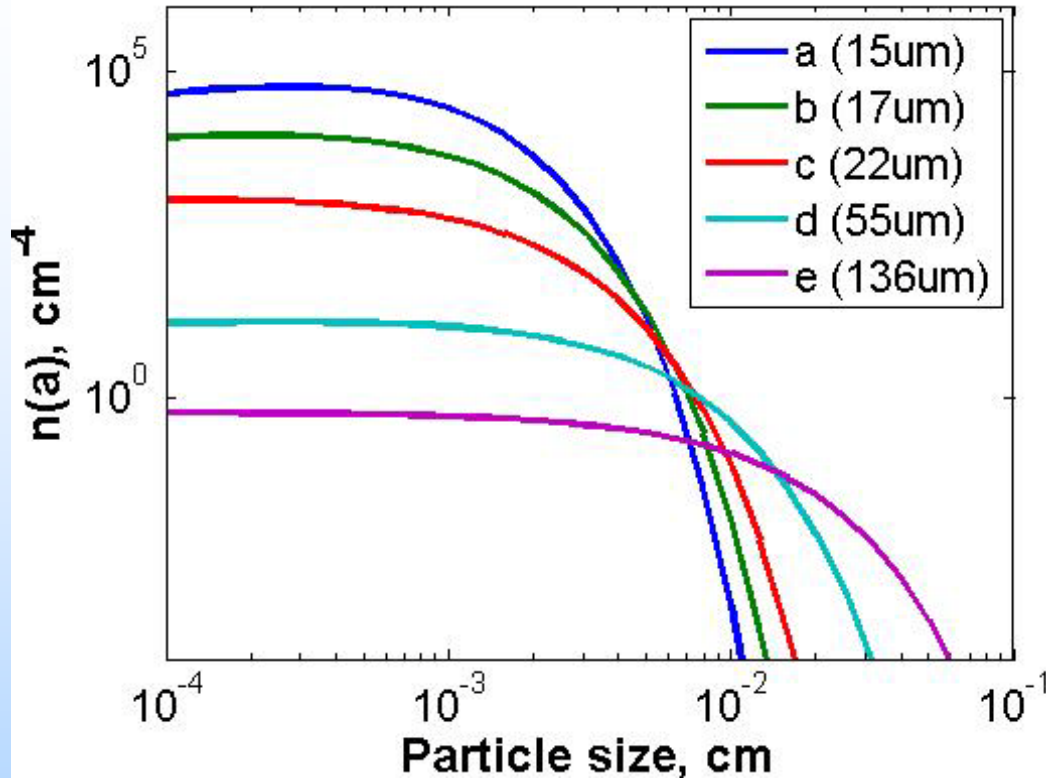


Cloud model

Temperature Humidity



Particle size distribution



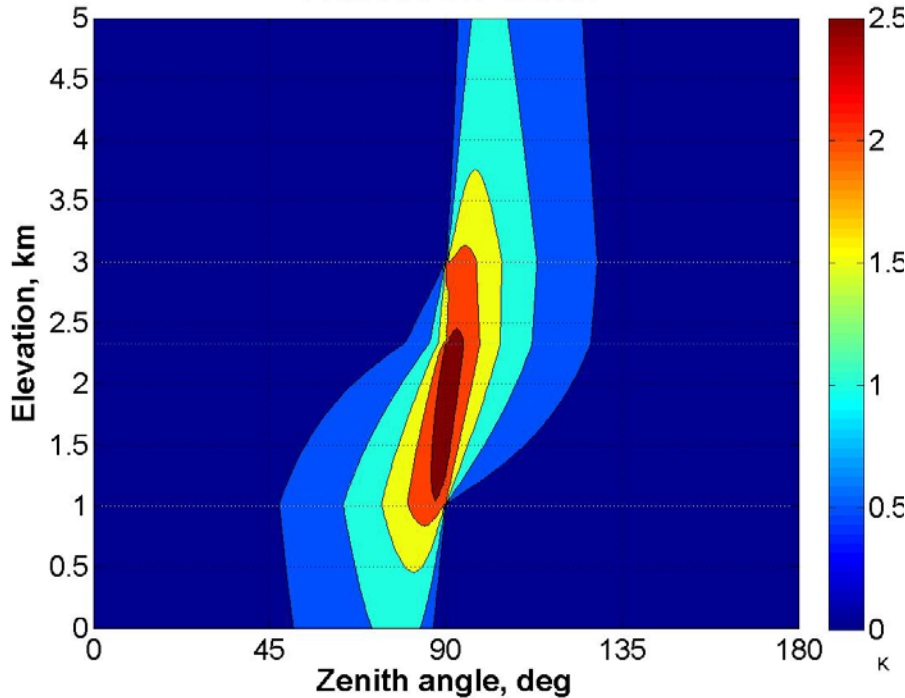
$$n(a) = A(\Lambda a)^{\alpha-1} \exp(-\Lambda a)$$

		"a"	"b"	"c"	"d"	"e"
Concentration	cm^{-3}	60.4	12.0	1.43	0.048	0.0041
Water content	g/m^3	0.41	0.15	0.043	0.022	0.033
Mean diameter	μm	15	17	22	55	136
A	cm^{-4}	1.42e5	2e4	1.5e3	20	0.6
α	1	1.6	1.3	1.1	1.1	1.0
Λ	cm^{-1}	2100	1500	1000	400	147

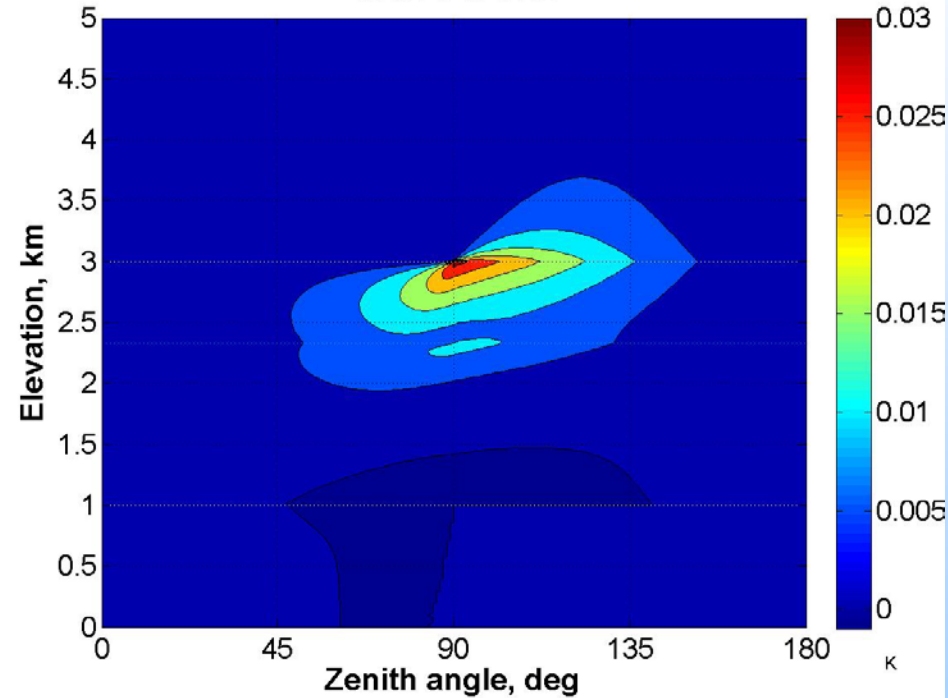
PRACO

$T_{BV} - T_{BH}$ vs. scanning angle and elevation

118.7503±0.325 GHz



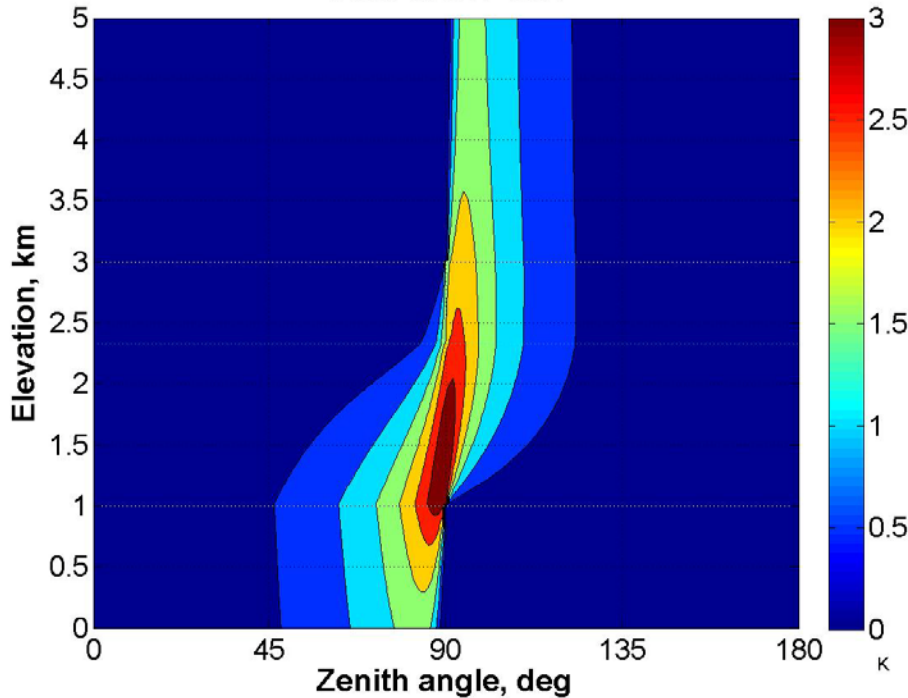
183.31±1 GHz



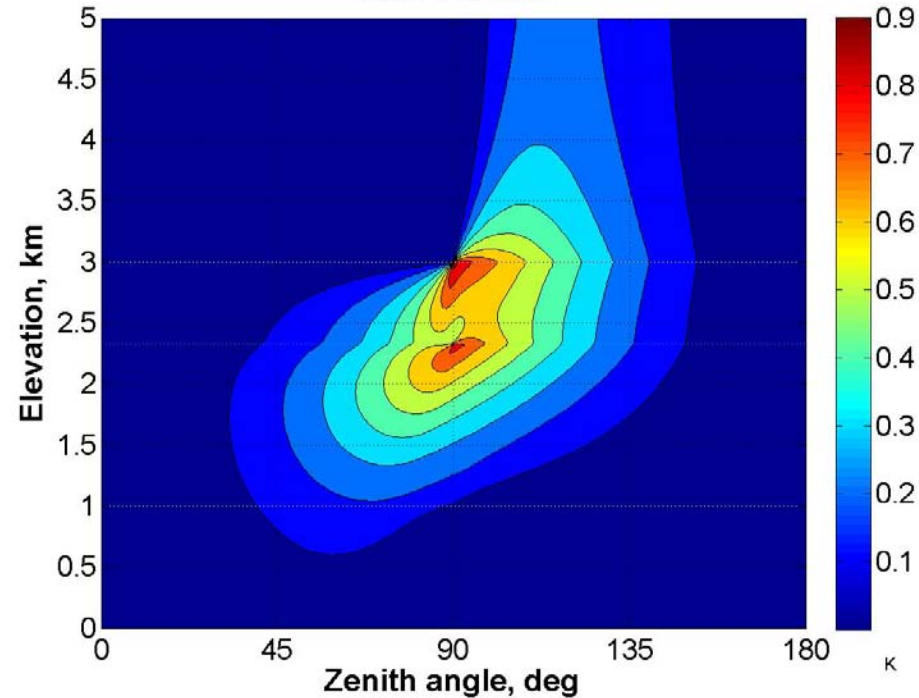
PRACO

$T_{BV} - T_{BH}$ vs. scanning angle and elevation

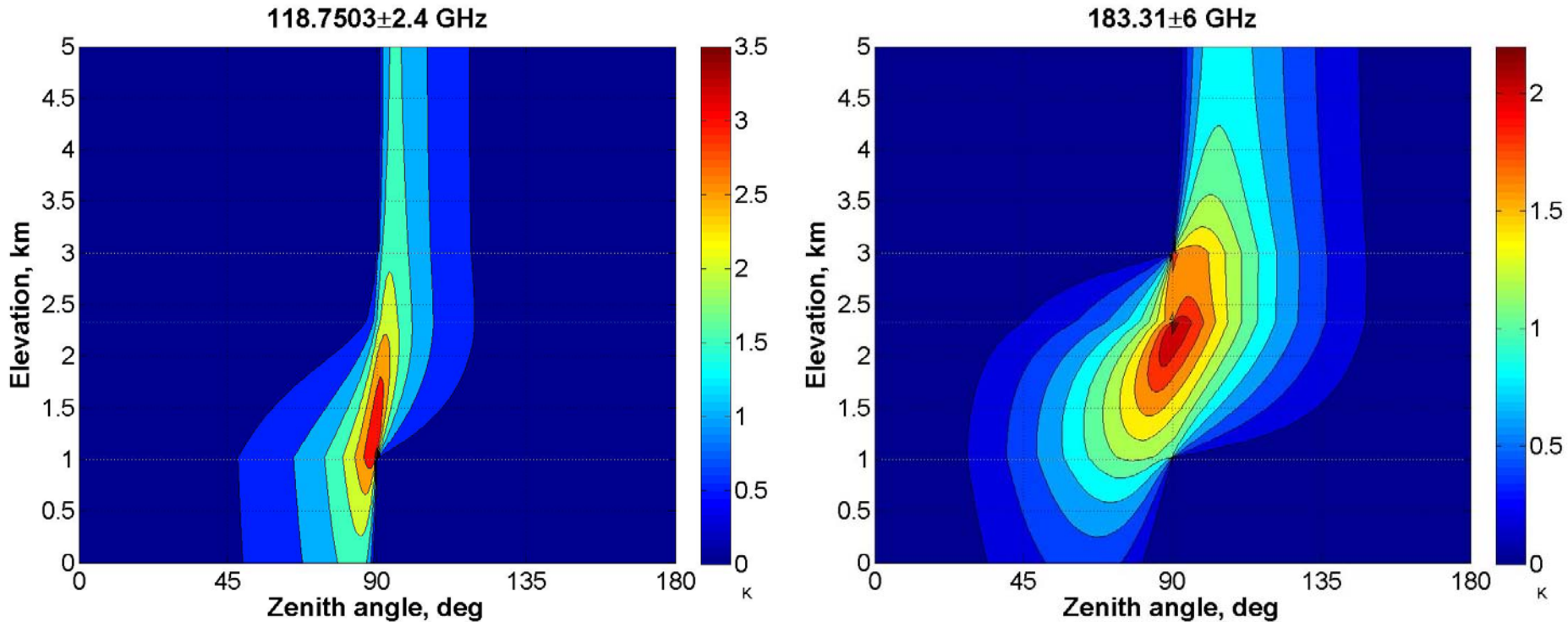
118.7503±1 GHz



183.31±3 GHz

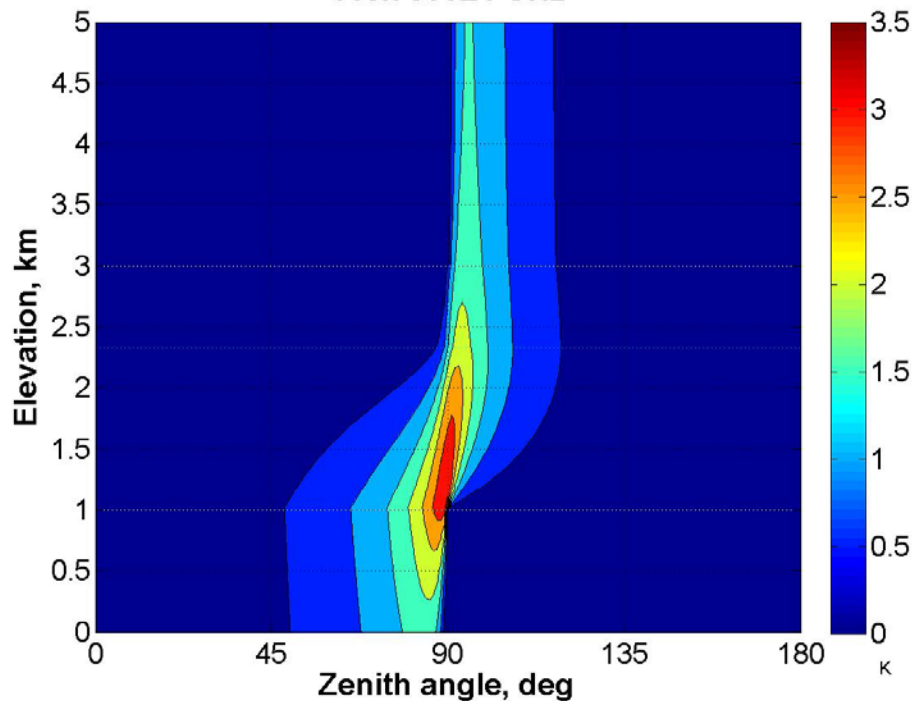


$T_{BV} - T_{BH}$ vs. scanning angle and elevation

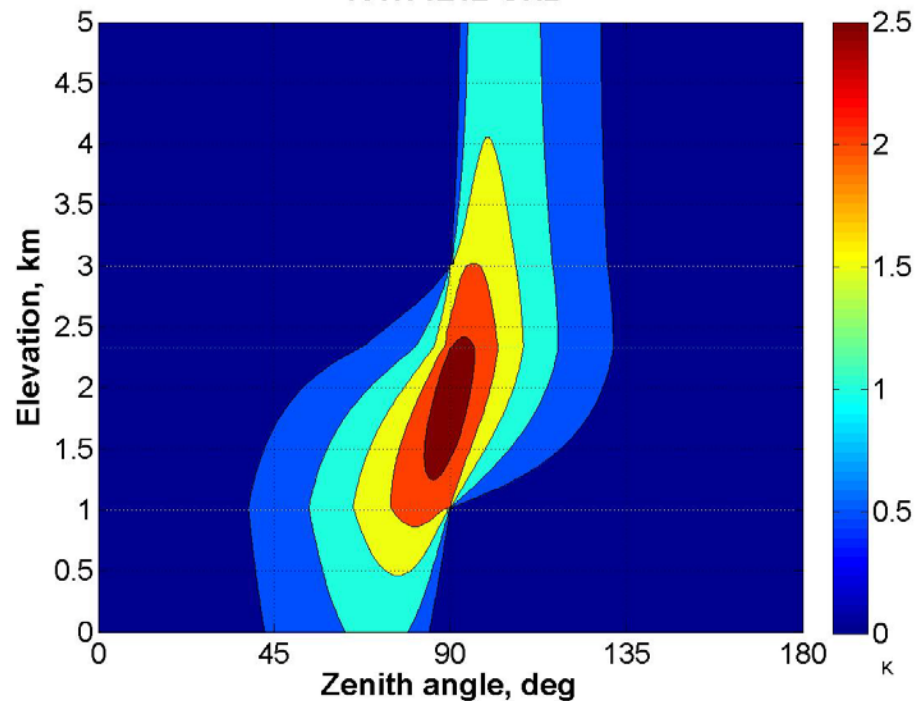


$T_{BV} - T_{BH}$ vs. scanning angle and elevation

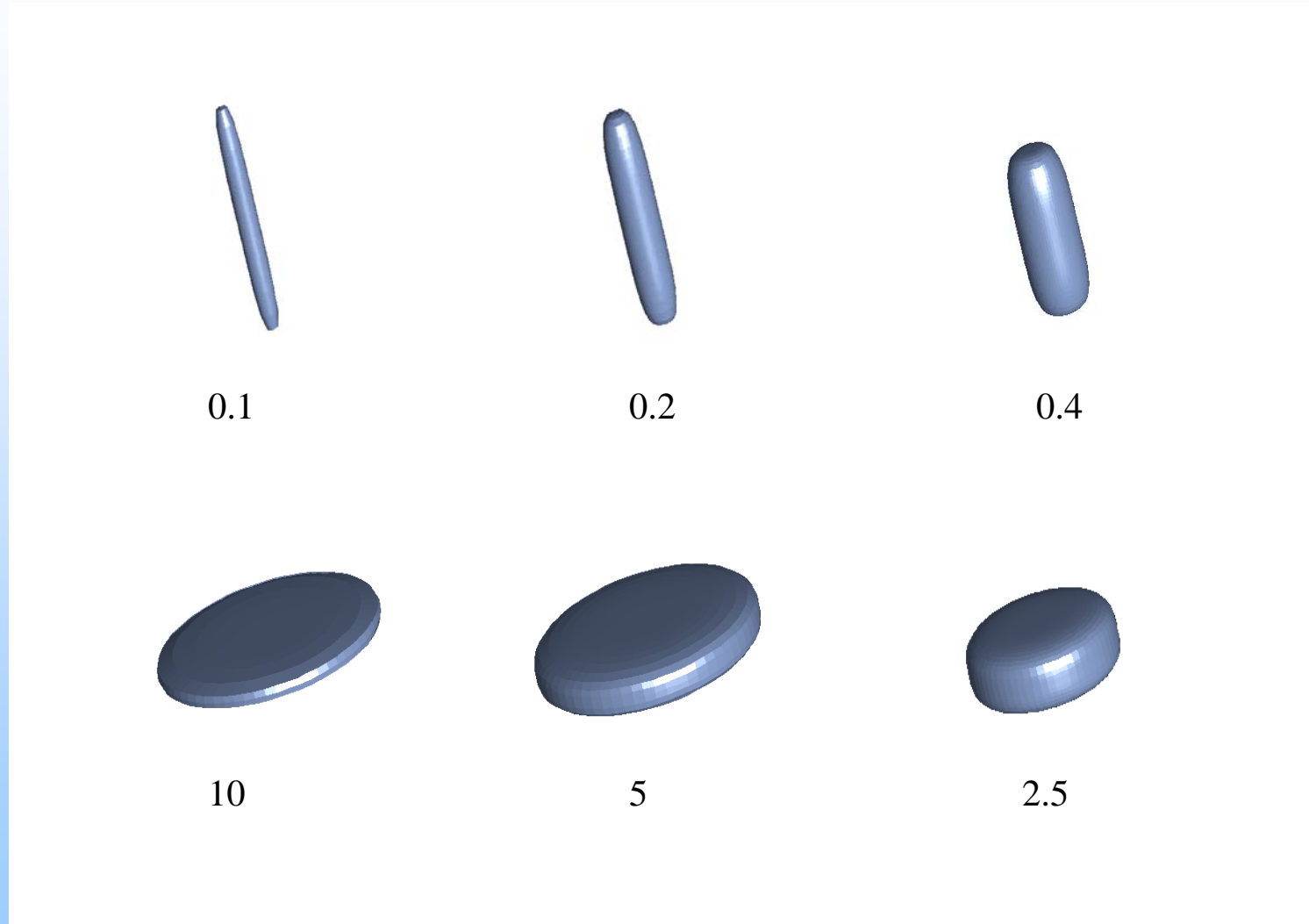
118.7503±4 GHz



183.31±12 GHz



Non-spherical ice particles scattering



Expected products

- Temperature profiles
- Water vapor profiles
- Liquid water profile
- Liquid water path
- Estimate parameters of particle distribution
- Water and ice particles discrimination

- Questions, comments, other feedback