Aquarius Instrument and Salinity Retrieval

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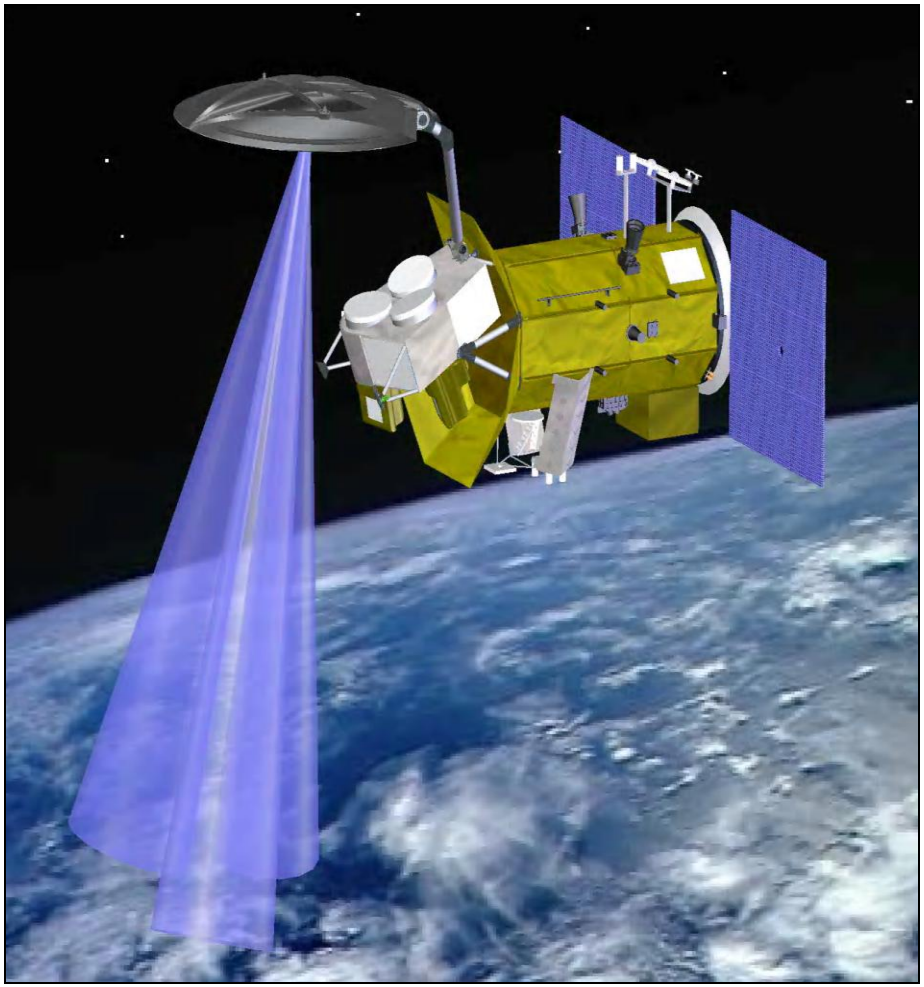
Outline

- Introduction
  - Instruments
  - Science Objectives
- Measuring Salinity
  - How
  - Real world issues
- Configuration
  - Instruments
  - Optimize salinity retrieval

Aquarius/SAC-D observatory ready for closure of the fairing



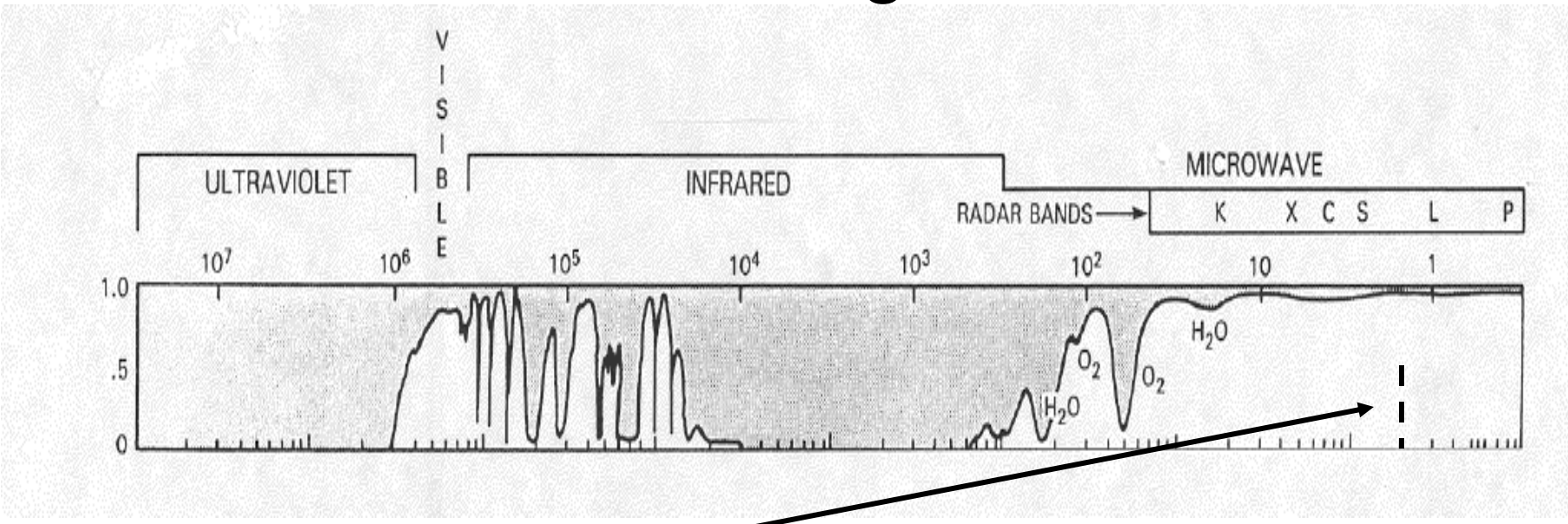
Aquarius

- ***Instrument***
  - ***L-band***
  - ***Radiometer and Radar***
  - ***3 Beam Pushbroom***
  - ***Polarimetric***
  - ***Stable***
- ***Mission***
  - ***Sun-synch orbit 6 am/6pm***
  - ***Night time look***
  - ***675 km Alt; 7 day revisit***
- ***Science***
  - ***Global maps of Sea Surface Salinity***
  - ***Accuracy: 0.2 psu; 150 km; monthly***
  - ***Seasonal and annual variations***

How Salinity is Measured

- Salt changes water chemistry (conductivity)
- This changes thermal emission at the water surface
- At microwave frequencies (1.4 GHz) this change in emission can be measured
- Microwave Radiometer: Instrument for making this measurement

Remote Sensing at L-Band



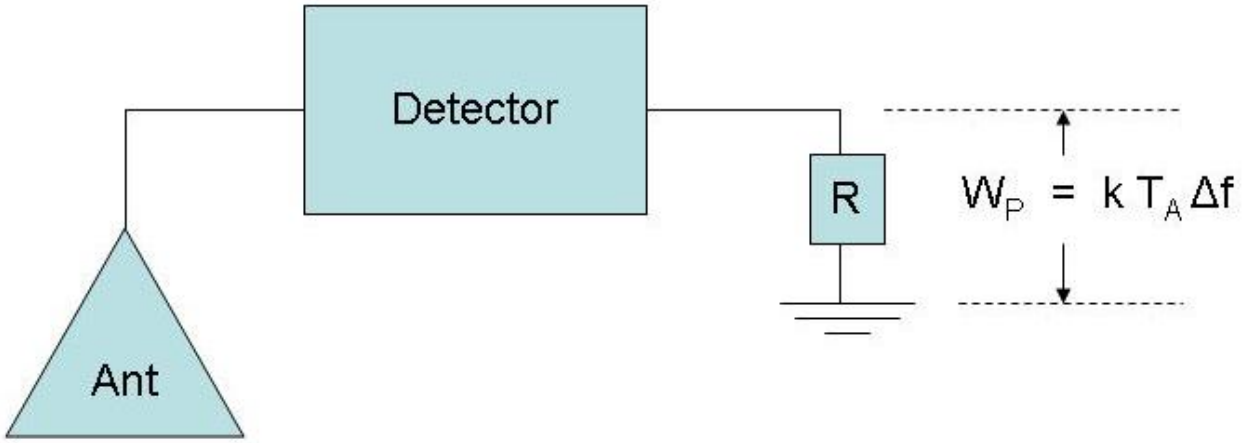
L-Band

- **Window for passive use only (1.413 GHz)**
- **Near peak sensitivity to changes in salinity**
- **Clear view of surface (transparent atmosphere)**

Other considerations

- **Faraday rotation is important**
- **Spatial resolution is a problem**
- **Optimum window for monitoring soil moisture**

Microwave Radiometer



$B = 2 k T_B / \lambda^2$

$T_B = e T_{phys}$

Ocean

Ideal Case: Smooth Ocean

$T_B = e\,T$

e = Emissivity

T = Physical Temperature

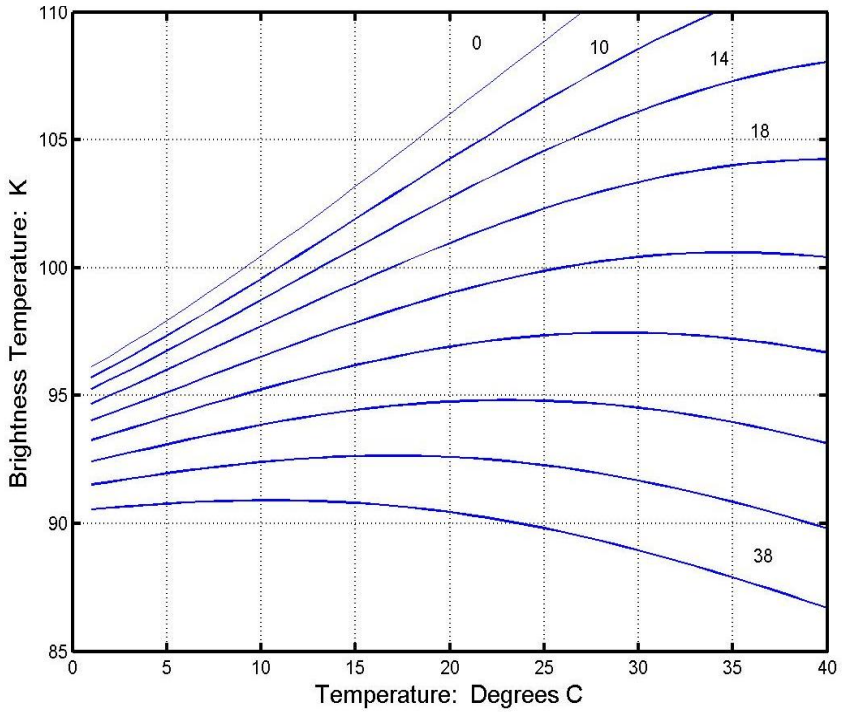
$e = 1 - \left[(1-\sqrt{\varepsilon}) \,/\, (1+\sqrt{\varepsilon}) \right]^2$

(normal incidence)

ε = Relative Dielectric Constant

$= \varepsilon(\mathbf{f}, \mathbf{T}, \text{salinity})$

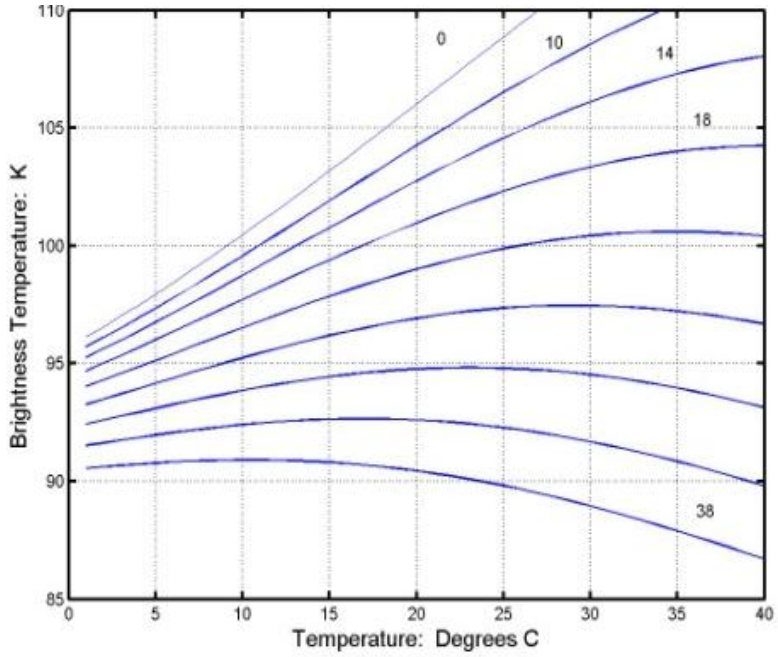
$T_B = e\,T$

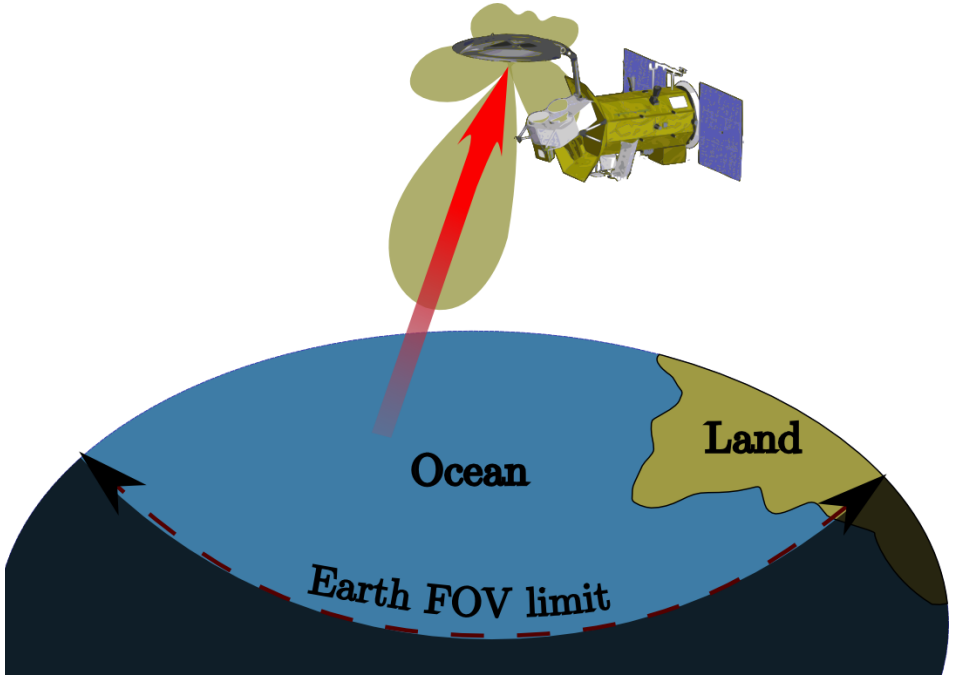


L-Band (1.413 GHz)

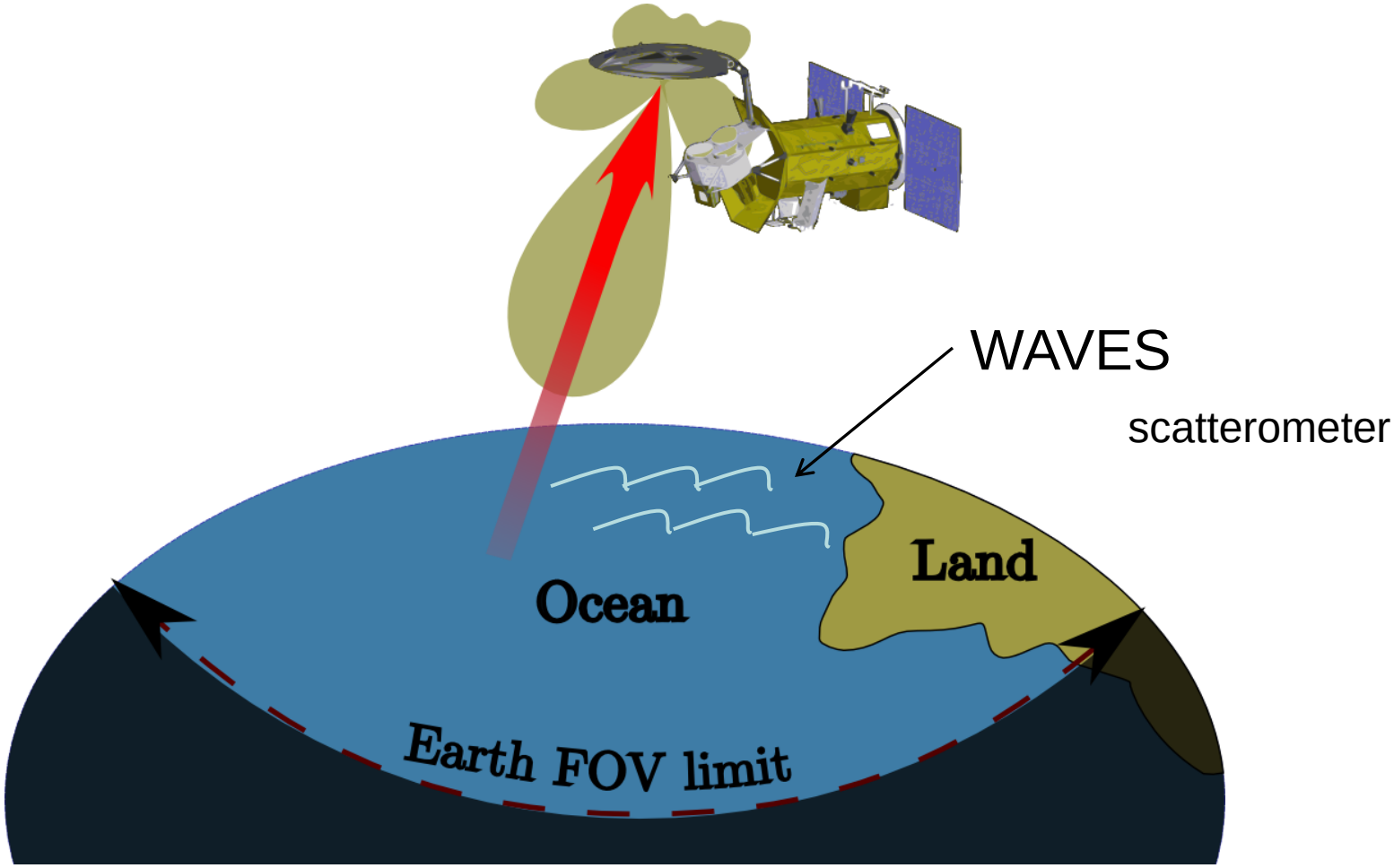
Remote Sensing

$T_B = e\,T$





Remote Sensing of Salinity



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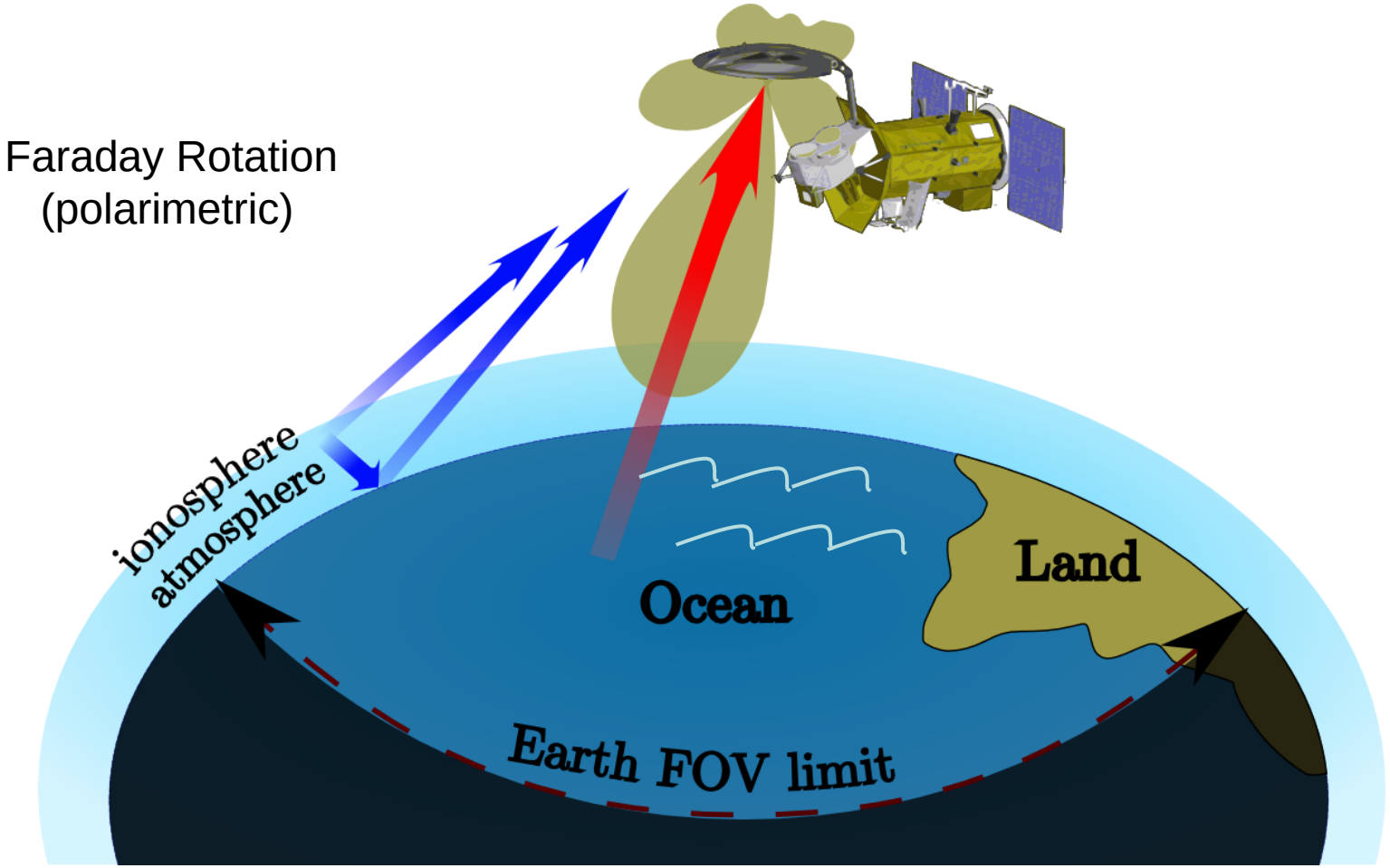
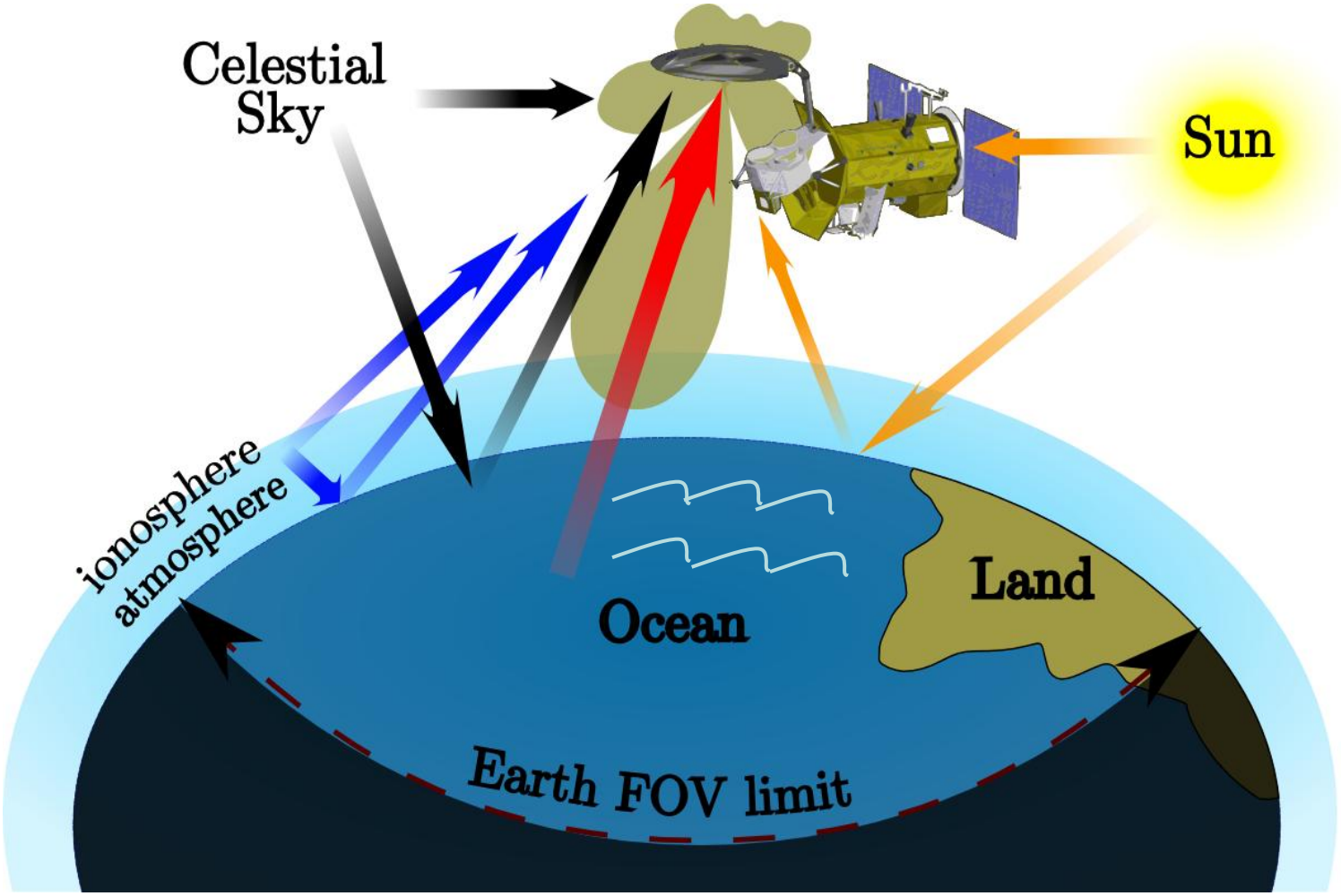
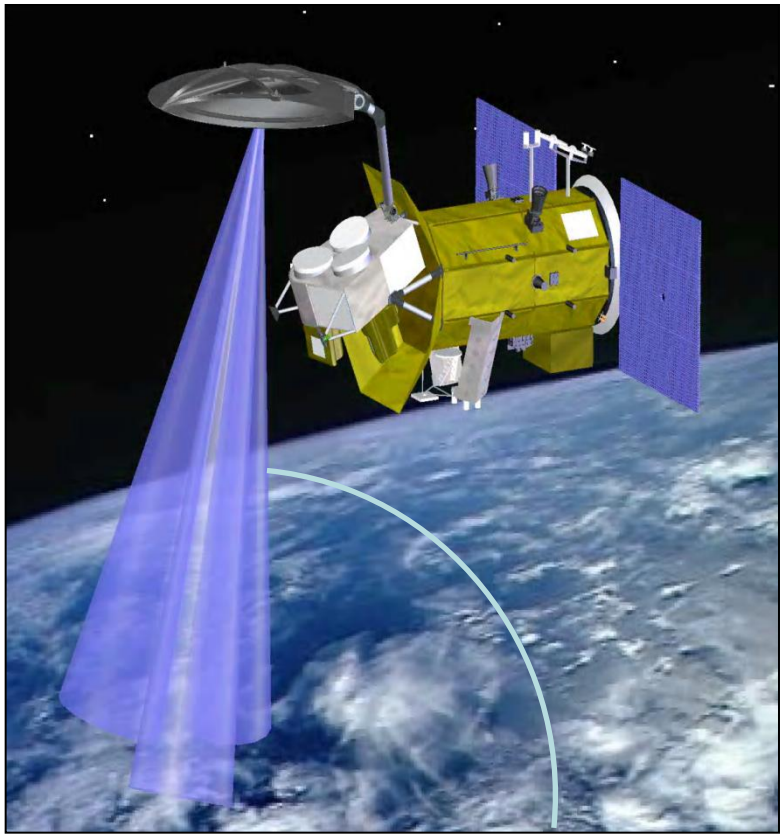


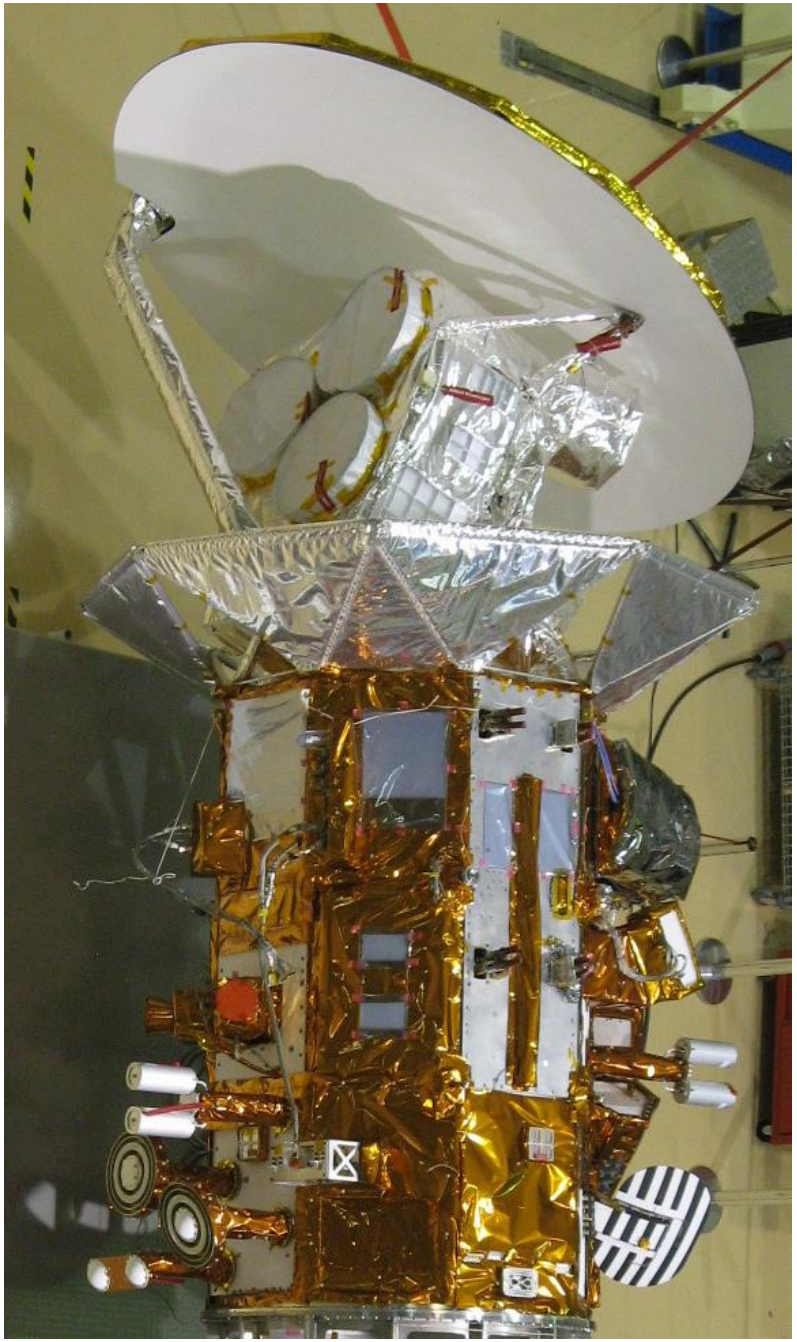
Real World


Celestial
Sky
Sun
ionosphere
atmosphere
Ocean
Land
Earth FOV limit

Aquarius: Designed to address remote sensing in the real world

- **Avoid Sun**
  - Fly on terminator and look toward night time side
  - Antennas specially designed to minimize side lobes in direction of the sun
- **Correct for Faraday Rotation**
  - Third Stokes to measure rotation angle
  - Correlation between polarizations
- **Correct for waves (roughness**)
  - Include Scatterometer
  - Radar instrument that responds to roughness
- **Average to reduce noise**
  - Three beams to get complete coverage in 7 days
  - Average measurments to produce monthly maps
- **Design for stability**
  - Internal calibration
  - Careful thermal design
- **Avoid RFI**
  - Rapid sampling





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Conclusion

- Remote Sensing of Ocean Salinity is a challenging task
- Aquarius is designed to optimize success