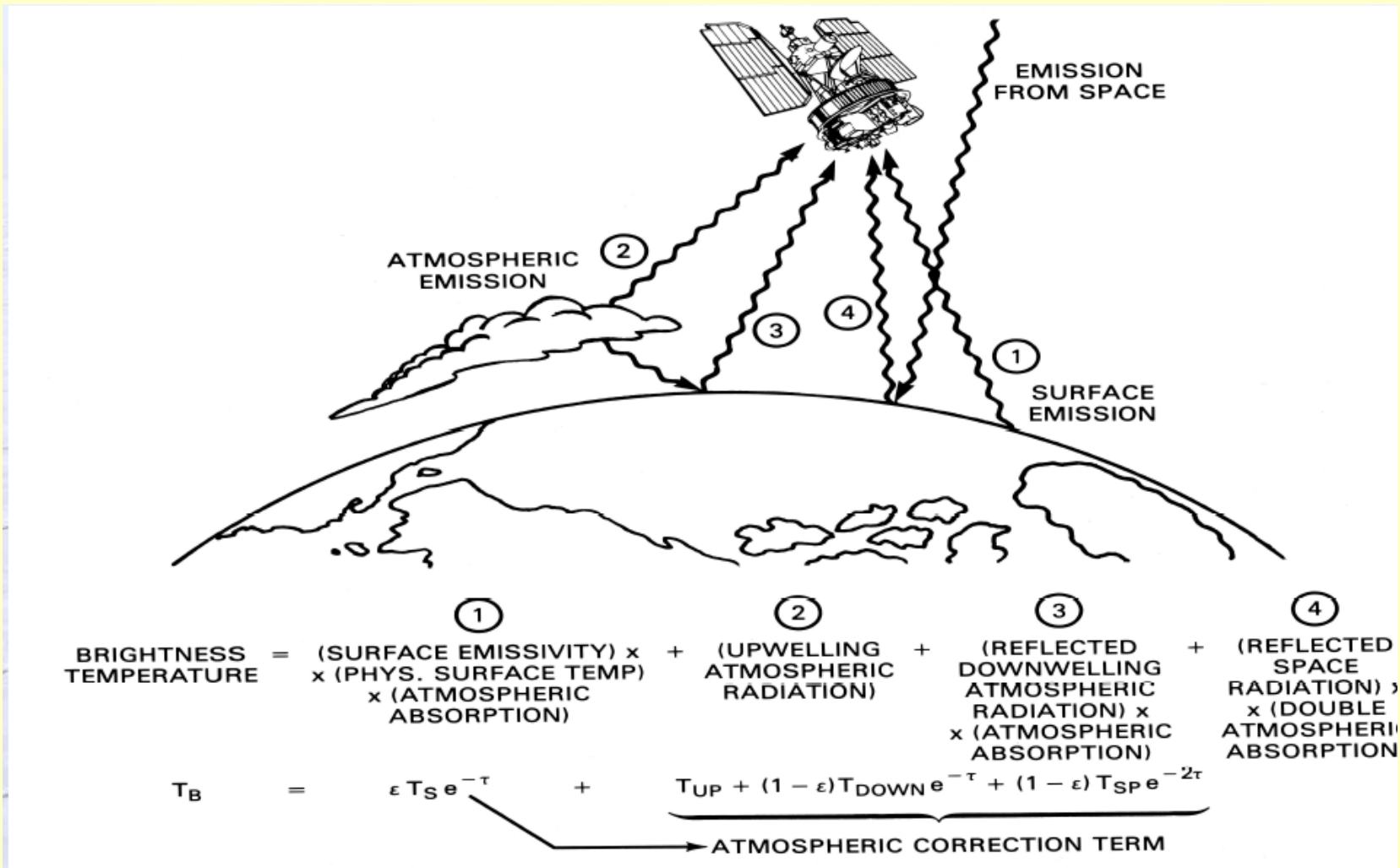


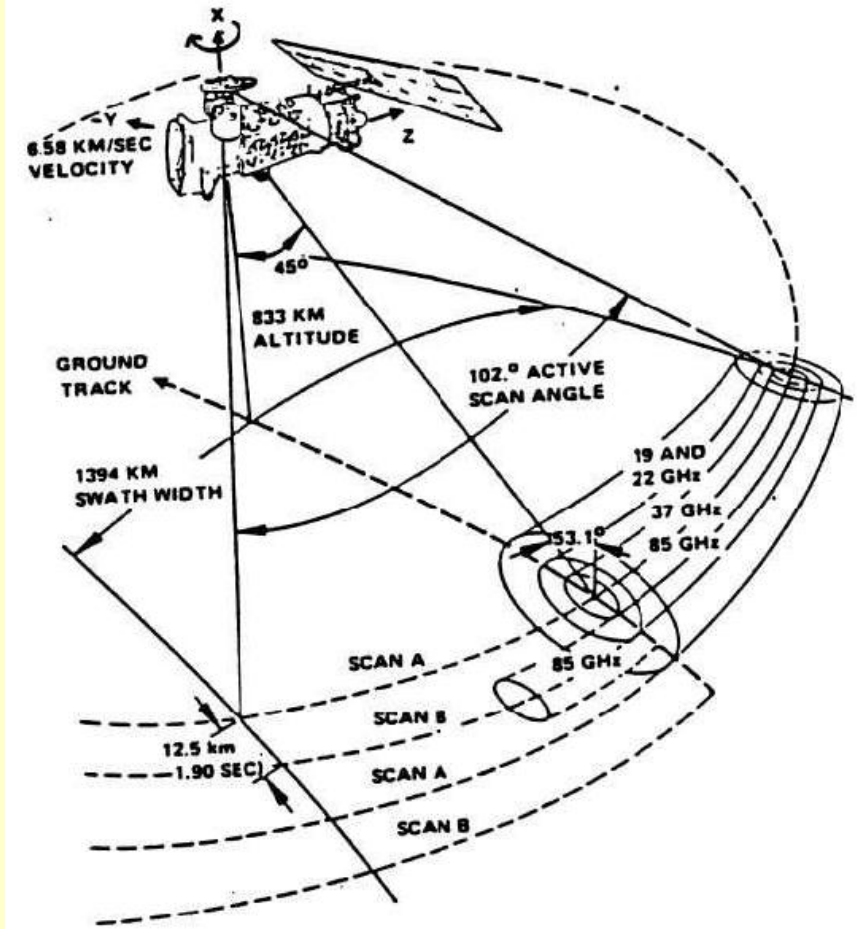
Lab1. Passive remote sensing of sea ice: Supplemental materials

Concept of the passive microwave remote sensing:

the main components of the brightness temperature observed by a passive microwave radiometer



The Special Sensor Microwave Imager (SSM/I)



1987-present, flown on multiple NOAA and DoD satellites

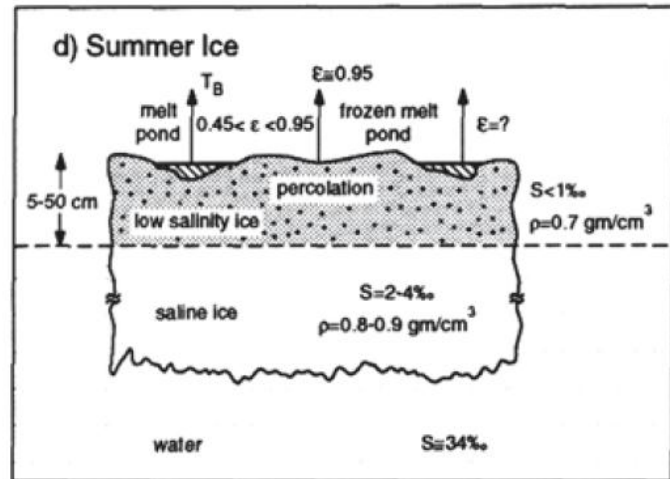
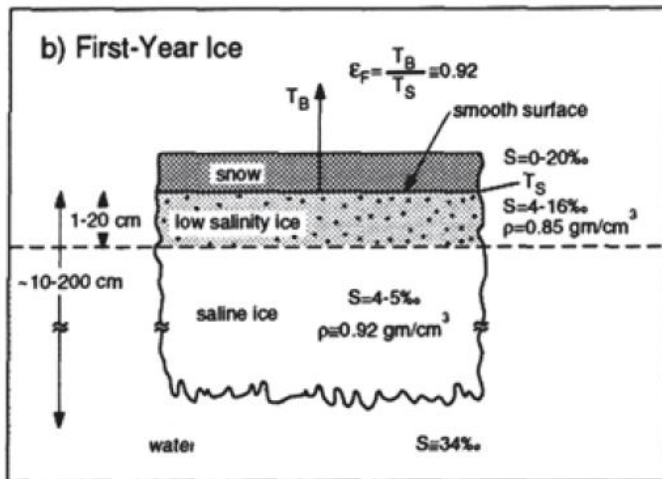
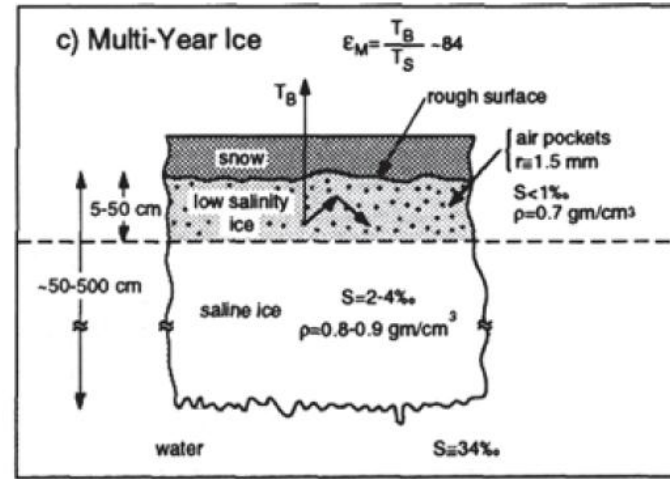
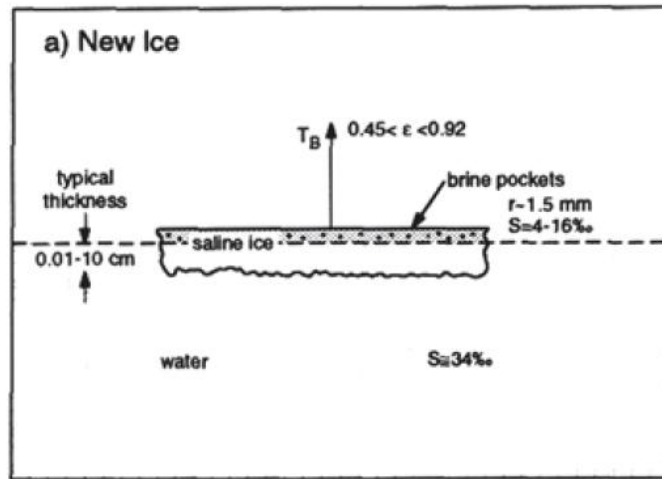
SSM/I is a seven channel passive microwave radiometer operating at four frequencies (19.35, 22.235, 37.0, and 85.5 GHz) and dual-polarization (except at 22.235 GHz which is V-polarization only)

The scanning geometry of SSM/I flown on a DMSP satellite in circular or near-circular Sun-synchronous and near-polar orbits at altitudes of 833 km with inclinations of 98.8° and orbital periods of 102.0 minutes, each making 14.1 full orbits per day. The scan direction is from the left to the right with the active scene measurements lying ± 51.2 degrees about when looking in the forward or aft direction of the spacecraft travel. A nominal swath width of 1394 km allows for frequent ground coverage, especially at higher latitudes. All parts of the globe at latitudes greater than 58° are covered at least twice daily, with the exception for small unmeasured circular sectors of 2.4° about the poles. Polar regions (> 72° N or S) receive coverage from two or more overpasses from both the ascending and descending orbits each day.

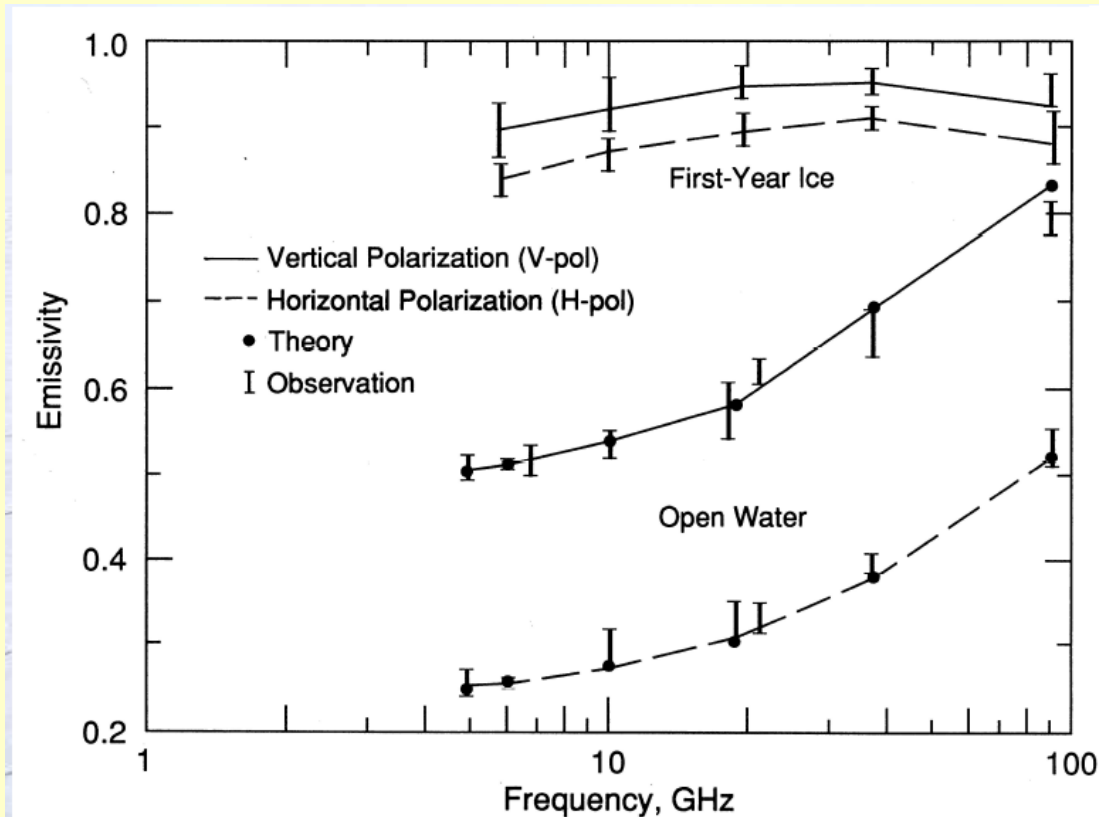
Frequency (GHz)	Polarization	Along track resolution (km)	Cross-track resolution (km)	Spatial Sampling (km)
19.35	horizontal	69	43	25
19.35	vertical	69	43	25
22.235	vertical	50	40	25
37.0	horizontal	37	28	25
37.0	vertical	37	28	25
85.5	horizontal	15	13	12.5
85.5	vertical	15	13	12.5

Four different sea ice types and the physical factors that have impact on the microwave properties that determine the brightness temperature (from Source: Zwally et al. 1983)

T_B : brightness temperature; S: salinity; ϵ : emissivity; D : density.



Example of microwave surface emissivity as a function of frequency



Open water: High dielectric constants & high reflectivity => low emissivity; Large differences between V and H polarization (shown for incident angle 50°)

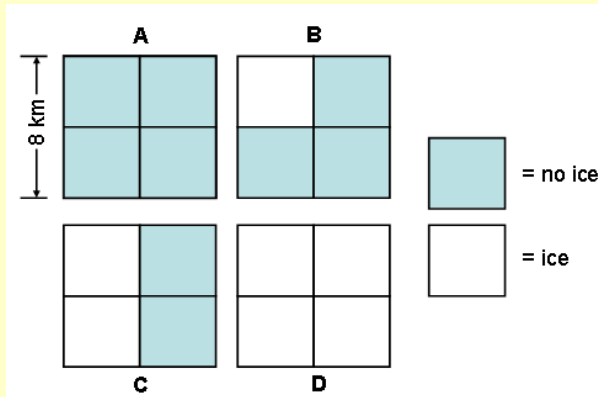
FY Sea: Low dielectric constants & low reflectivity => high emissivity; Low difference between V and H polarization (shown for incident angle 50°)

From Carsey (1992)

Retrieved parameters:

sea ice concentration (areal fraction covered by sea ice), area and extent

(see <http://nsidc.org/cryosphere/seaice/data/terminology.html>)



Sea ice property for a 8 km ² (3 mi ²) cell	A	B	C	D
Ice-Covered Area	0 km ²	16 km ²	32 km ²	64 km ²
Concentration (%)	0%	25%	50%	100%
Concentration (fraction)	0	0.25	0.5	1.0
Extent				
No units, 30% concentration threshold	0	0	1	1
Extent				
30% concentration threshold	0 km ²	0 km ²	64 km ²	64 km ²
Area anomaly (%)				
Average area is 48 km ² (18.5 mi ²)	-48 km ²	-32 km ²	-16 km ²	+16 km ²
Concentration anomaly (%)				
Average concentration is 48 km ² /64 km ² = 75%	-75%	-50%	-25 %	+25 %