2. Radiative Transfer in the atmosphere

The electromagnetic spectrum
Where do photons come from?
“Longwave” (aka infrared, terrestrial)
“Shortwave” (aka visible, solar)

Spectroscopy
Quantum transition types / line sources
Orbital
Vibration
Rotation, vib·rot
Photochemical
Photoionization
Line breadth
Bands of lines
Continuum

Describing a radiation field
Radiant flux \( W \)
Irradiance (flux) \( E \ (F) \ \text{Wm}^{-2} \)
Radiance \( L \ (I) \ \text{Wm}^{-2}\text{ster}^{-1} \)
Total vs. broadband vs. monochromatic
\( E_\nu \) and \( L_\nu \) vs. \( E \) and \( L \)
Zenith and azimuth angle
Direct vs. diffuse radiation

Measuring radiation
Pyranometers and pyrgeometers

Black-body radiation, quantified
Planck’s law
Wein displacement law
Stefan-Boltzmann power law
Emissivity, grey-body radiation, and Kirchoff’s law
A simple climate model

Basic scattering physics

Cross sections $A (\sigma)$
Scattering efficiency factor $K (Q)$
Geometric Optics, Mie, and Rayleigh regimes
Diffraction, refraction, and rainbows
Why the sky is blue

The radiative transfer equation

Beer's (Beer-Lambert-Bouger) law
Full + Schwarzchild's equations
Elementary solution: decaying/growing beam

Satellite images of the Earth and their interpretation

Infrared
Visible
Near-IR
"Water vapor" infrared