# ATM S 431A  Atmospheric Physics

5 credits Autumn 2001  M-T-W-Th-F  9:30 - 10:20 AM
room 610 ATS


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Grading:  50% assignments (10 assignments)
25% quizes (two quizes)
25% final exam

Office Hours:  10:30 - 11:00 AM [after class]
Other hours by arrangement

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|---|---|
| Nov. 12 | Veterans' Day |
| Nov. 22-23 | Thanksgiving |
| Dec. 12 | Last Day of Instruction |
| Dec. 18 | Final Exam  8:30 - 10:20 AM |


Synopsis:  The sun's energy, arriving at the earth, is partially reflected, partially absorbed in the atmosphere, and partially absorbed at the surface.  Outgoing infrared radiance from the surface and atmosphere is absorbed and re-emitted by clouds, aerosols, and polar molecules.  The surface also transmits heat, water vapor, momentum, and other tracers to the atmosphere by noisy processes occurring in a near-surface boundary layer.  This course is concerned with the physics of these processes.

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room 610C ATS

**A. Boundary-Layer Meteorology:** **Oct. 1 - Nov. 2**

Halstead Harrison 318 ATS
(206)-543-4596 harrison@atmos.washington.edu

Text: "Introduction to Micrometeorology"
S. Pal Arya. Academic Press. ISBN 0-12-064490-8
Class Notes

Oct 1-5 Course mechanics. Solar power. Black-Body Emission. Wien's Law. Stefan-Boltzmann. Atmospheric reflection, absorption and scattering. Spectrum at the surface. Earth's emissions. Radiative flux divergence.

Oct 8-12 Latent and sensible heats. Bowen Ratio. Heating rates. Diffusion. Time-varying heat transfer to the sub-surface.

Oct 15-19 Thermodynamics. Buoyancy. Sheer. Richardson's number. Stabilities. Eddies. Scale-dependent diffusivities. Reynolds expansions.

Oct 22-26 Navier-Stokes equations. Viscous flows. The PBL.
` "OLE"s. Surface and microlayers.. Prandtl mixing lengths. Drag. Wind velocities profiles. Similarity theories. Monin-Obhukhov. Friction velocities and roughness lengths. "TKE" models.

Oct 29- Near-surface transfer of sensible and latent heats
Nov 1 Review.

Nov. 2 Quiz.

**B. Radiation Transfer** **Nov. 4 - Dec 12**

Qiang Fu 320 ATS
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Text: "An Introduction to Atmospheric Radiation"
K.N. Liou
Class notes

Introduction and basic terminology and concepts: The importance and relevance of the subject in the atmospheric sciences; The role of radiative transfer in the global energy balance; spectrum of radiation; solid angles, radiance and irradiance; scattering, absorption, and emission.

Thermal emission and simple aspects of radiative transfer: Blackbody radiation; Kirchhoff's law; absorption line formation and broadenings; Beer-Bouguer-Lambert law; Schwarzschild's equation; plane-parallel atmospheres; remote sensing applications.

Solar radiation at the TOA: The sun as an energy source; the Earth's orbit about the sun (seasonal effects and orbital effects); solar spectrum and solar constant; solar insolation.

Absorption process in the atmosphere: Absorption spectrum of the atmosphere, HITRAN data base; band models; solar heating rates; IR cooling rates; photochemical processes and O3 layer; CO2 and climate.

Scattering process in the atmosphere: Scattering phase function; Rayleigh scattering; Mie scattering; scattering and absorption by aerosol and cloud particles; general radiative transfer equation; two-stream formulation; cloud albedo versus greenhouse effects.

Nov. 23: Quiz II (tentative)

C. Summary and Review: HH and QF Dec. 11 and 12

D. Final Exam Dec. 18 8:30 - 10:20 AM