

Chapter 1 Introduction

1.1 Fundamental Laws

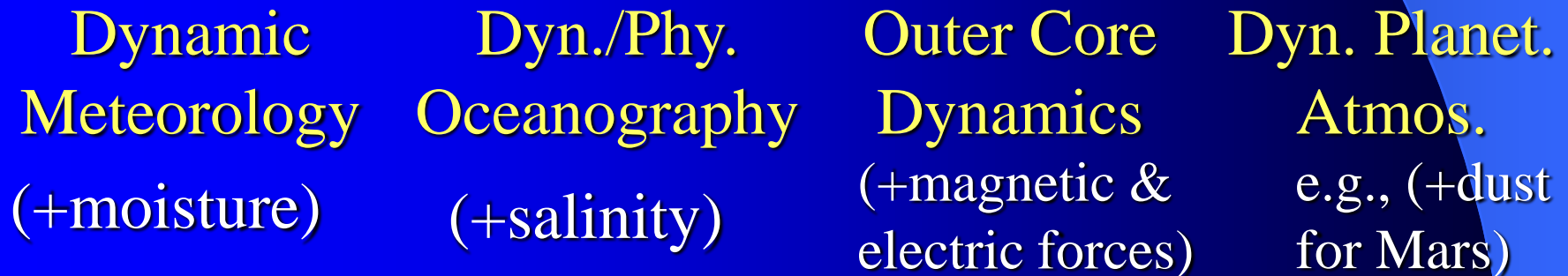
- Fundamental laws of geophysical fluid dynamics (GFD) and thermodynamics are applied to describe the
 - (a) atmospheric motions, (u, v, w) [Mechanics]
 - (b) states of the atmosphere, (ρ, p, T)
[Thermodynamics]

The relationship among different branches of Fluid Dynamics

Fluid Dynamics

+stratification ↓ +rotation

GFD



By assuming the atmosphere as a continuous fluid medium, a set of partial differential equations (PDE) governing the atmospheric motions are then derived.

Flow motion and states are then expressed by a set of PDE's:

flow motion: u, v, w (*velocities in $x, y, & z$ directions, resp.*)

fluid state: ρ, T, p (*density, temperature, & pressure*)

physical variables: humidity, water vapor, cloud water, rain,
ice, snow, hail, air pollutants, chemical species, etc.

➤ Objectives: to understand the mechanisms for atmospheric motions and processes and to help predict the weather.

➤ Approaches

➤ Solve PDEs analytically by making approx. →

Dynamic Meteorology

➤ Solve PDEs approximately by computers →

Numerical Weather Prediction

➤ Combination of the above approaches →

Synoptic-Dynamic Meteorology

The relationship among different branches of Atmospheric Sciences and Meteorology

