Chapter 1 Introduction

1.1 Fundamental Laws

- Fundamental laws of geophysical fluid dynamics (GFD) and thermodynamics are applied to describe the

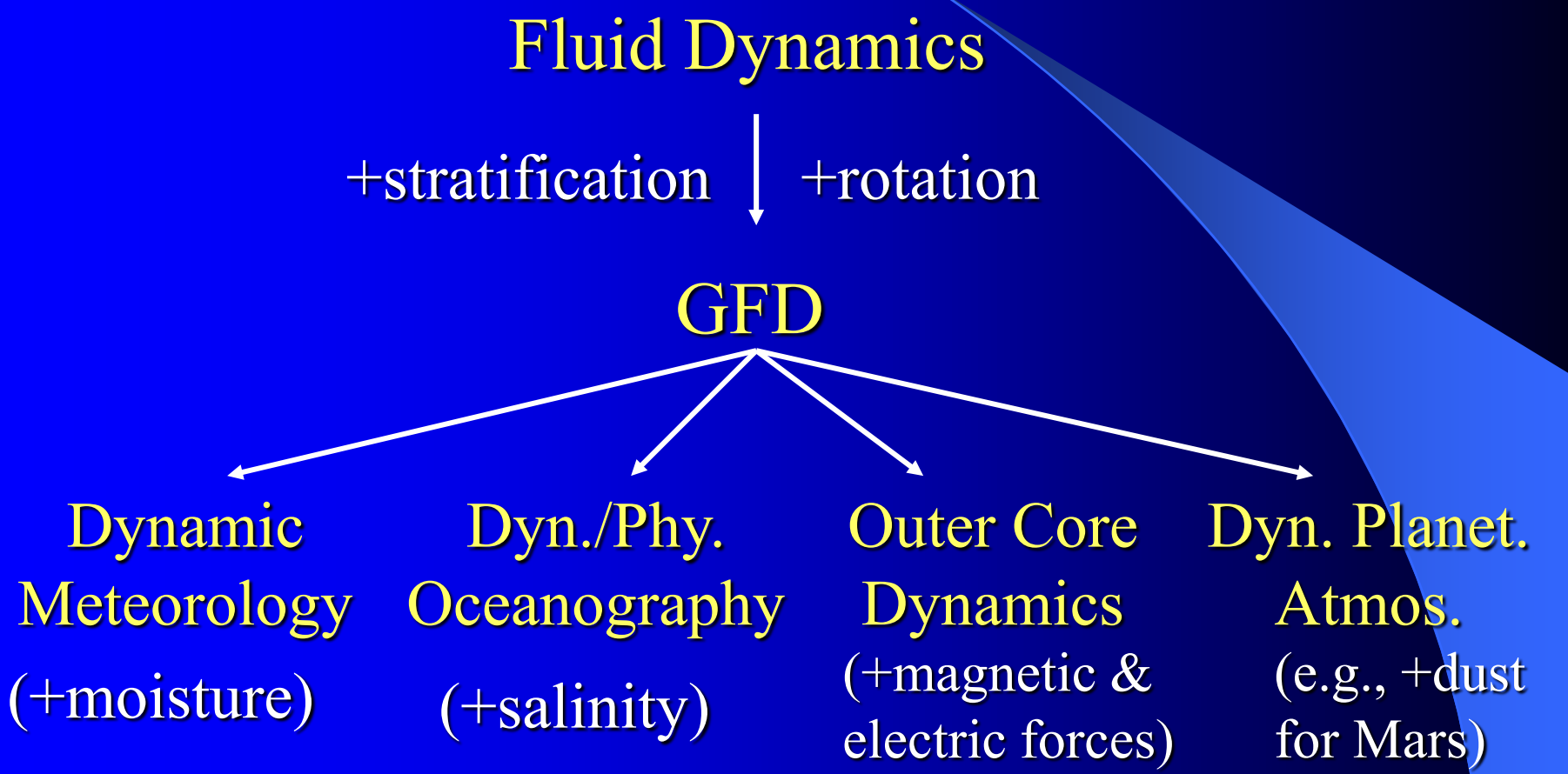
(a) atmospheric motions, (u, v, w)

[Mechanics]

(b) states of the atmosphere, (ρ, p, T)

[Thermodynamics]

The relationship among different branches of Fluid Dynamics



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 fluid 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)*

Other 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.

- Various approaches have been adopted to solve this set of PDE equations.
  - 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