Radiativeconvective equilibrium in a grey atmospher

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Complex systems in climate physics, 3 October 2023



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Radiative-convective equilibrium in a grey atmosphere

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Complex systems in climate physics, 3 October 2023

- A radiative-convective model is used to study a grey atmosphere.
- Comparison between numerical and analytical solutions is possible in radiative equilibrium.

-Introduction

-Introduction

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Introduction

• Average vertical temperature profile T(t, z) of atmosphere.

1. The analysed quantity is the atmospheric temperature profile averaged over all latitudes and longitudes.

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Introduction

- Average vertical temperature profile T(t, z) of atmosphere.
- Radiative Transfer Equation (RTE)

- 1. The analysed quantity is the atmospheric temperature profile averaged over all latitudes and longitudes.
- 2. RTE describes radiative processes.

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Introduction

• Average vertical temperature profile T(t,z) of atmosphere.

• Radiative Transfer Equation (RTE)

Fluid dynamics equations

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☐Introduction

Average vertical temperature profile T(t,z) of atmosphere.
 Radiative Transfer Equation (RTE)
 Fluid dynamics equations.

uid dynamics equations

☐Introduction

- 1. The analysed quantity is the atmospheric temperature profile averaged over all latitudes and longitudes.
- 2. RTE describes radiative processes.

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3. Fluid dynamics equations describe convective processes.

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Introduction

• Thermodynamic energy equation in Local Thermodynamic Equilibrium (LTE):

$$\frac{\partial T}{\partial t} = -\frac{1}{\rho c_P} \frac{\partial q}{\partial z} \quad . \tag{1}$$

Radiative-convective equilibrium in a grey atmosphere └─Introduction

☐ Main hypotheses

☐ Main hypotheses

Main hypotheses

Equilibrium (LTE):

Introduction

• Thermodynamic energy equation in Local Thermodynamic Equilibrium (LTE):

$$\frac{\partial T}{\partial t} = -\frac{1}{\rho c_P} \frac{\partial q}{\partial z} \quad . \tag{1}$$

• Radiative-convective equilibrium.

—Introduction

Main hypotheses

Main hypotheses

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• Thermodynamic energy equation in Local Thermodynamic Equilibrium (LTE):

$$\frac{\partial T}{\partial t} = -\frac{1}{\rho c_P} \frac{\partial q}{\partial z} \quad . \tag{1}$$

- Radiative-convective equilibrium.
- Grey atmosphere.

1. Quantities do not depend on the frequency of electromagnetic radiation.

Secondary hypotheses

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Secondary hypotheses

MC continue.

Secondary hypotheses

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MC continue.

Vertical coordinates

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└─Vertical coordinates

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Analytical solution

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Analytical solution

Analytical solution

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Numerical solution

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☐Numerical solution

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