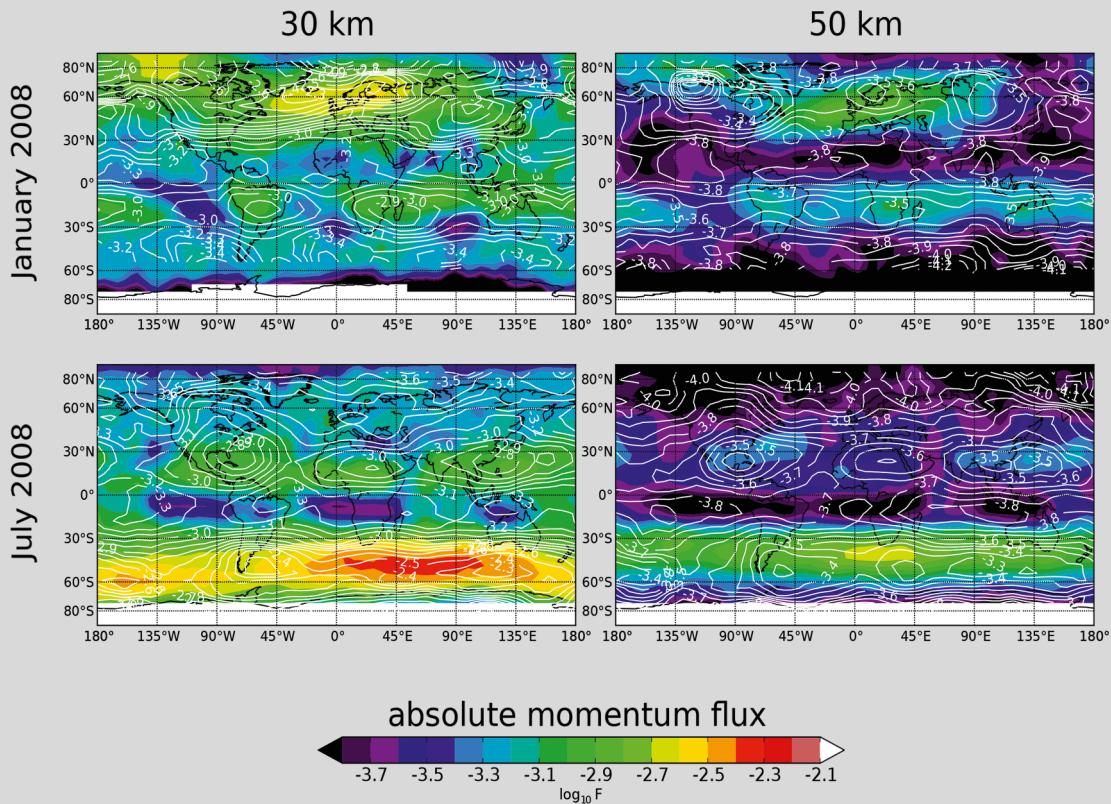


Three-dimensional ray-tracing simulations of convective gravity waves

Silvio Kalisch



Energie & Umwelt /
Energy & Environment
Band / Volume 253
ISBN 978-3-95806-040-1

 JÜLICH
FORSCHUNGSZENTRUM

Forschungszentrum Jülich GmbH
Institute of Energy and Climate Research
Stratosphere (IEK-7)

Three-dimensional ray-tracing simulations of convective gravity waves

Silvio Kalisch

Schriften des Forschungszentrums Jülich
Reihe Energie & Umwelt / Energy & Environment

Band / Volume 253

ISSN 1866-1793

ISBN 978-3-95806-040-1

Contents

1. Introduction	1
2. Gravity wave physics and observations	15
2.1. Theoretical basics	15
2.2. Limb-sounding measurements	22
3. Gravity wave ray-tracing	27
3.1. Introduction	27
3.2. Mathematical background	28
3.3. The GROGRAT gravity wave ray-tracer	31
3.4. The non-orographic launch distribution	34
3.5. Comparison with satellite measurements	37
4. Oblique vs. vertical propagation of gravity waves	43
4.1. Introduction	43
4.2. Model setup	46
4.3. Results	49
4.4. Differences between oblique and vertical propagation	54
4.5. Meridional drag	57
4.6. Poleward propagation	60

Contents

4.7.	Influence of wind filtering and the Coriolis effect	64
4.8.	Further potential mechanisms: local Coriolis and remote recoil effect	72
4.9.	Summary and Discussion	74
5.	Ray-tracing simulations of convective gravity waves	81
5.1.	The Yonsei convective gravity wave source model	81
5.1.1.	Overview	81
5.1.2.	Mathematical description	84
5.1.3.	Implementation and coupling with GROGRAT	89
5.1.4.	Application using the Merra dataset	93
5.1.5.	Source level momentum flux	98
5.2.	Ray-tracing of convective gravity waves	100
5.3.	Simulated convective gravity waves in comparison to satellite measurements	119
5.3.1.	Limitations due to the observational filter	119
5.3.2.	Results	122
5.3.3.	Comparison of global ray-tracing and satellite data	129
5.4.	Summary and Outlook	136
6.	Summary and Outlook	139
A.	Appendices	149
A.1.	Wind filtering of gravity waves	149
A.2.	Timeseries of convective gravity waves	151

Contents

A.3. Gravity wave ray-tracing as a parametrization for atmospheric circulation models	157
A.3.1. Overview of the HAMMONIA GCM	157
A.3.2. Technical implementation	158
Bibliography	162

**Energie & Umwelt /
Energy & Environment
Band / Volume 253
ISBN 978-3-95806-040-1**

