P1.8 SOUTHERN HEMISPHERE PRECIPITATION: A STUDY OF MODEL SENSITIVITY TO PARAMETER SETTINGS

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1. INTRODUCTION

The Southern Alps, rising quite abruptly from the ocean on the western side of southern New Zealand, represent a substantial barrier to the predominantly north-westerly mid-latitude winds. Precipitation development associated with the resulting orographic flow has important impacts for New Zealand. This precipitation development has been studied, using observational and modelling data, as part of the research campaign SALPEX (Wratt et al., 1996).

Earlier numerical modelling has been unable to reproduce the observed precipitation amounts and distribution. Verification of the conditions used as input to the models, particularly the RAMS model (Walko et al., 1995) which is widely used for mesoscale modelling, was therefore one of the goals of SALPEX.

2. FIELD MEASUREMENTS

During the SALPEX field campaign, in-cloud measurements of cloud microphysics and dynamics were made using a research aircraft. These measurements suggest the clouds off the coast west of New Zealand differ significantly from those (generally North American) used to establish the default parameterisation of the cloud and precipitation microphysics in RAMS.

The observed aged cloud drop size distributions are consistent with our 'underfeeding' conceptual model for precipitation growth at the Alps (Larsen et al., 1998). Based on the measurements and the conceptual model we expect rather more, and smaller, raindrop-sized hydrometeors over much of the domain than are assumed by the RAMS default parameterisation. In the heavy rain areas upwind of the divide where there is substantial orographic lifting there will be a tendency for fewer precipitation particles than at equivalent rain rates elsewhere, and at the model default settings, as newly-formed cloud feedstock leads to rapid precipitation growth.

3. PARAMETERS

Revised microphysical parameter settings were therefore derived and used as the basis for further numerical modelling using RAMS Version 3B. Two examples of the new settings are listed in Table 1

Table 1: Microphysical parameterisations used for modelling SALPEX case studies using RAMS 3B (see text). The size distribution of each hydrometeor species is described by a two-parameter gamma distribution: 'gnu' is the shape parameter; 'fix' identifies the second parameter used to specify the distribution which may be the total number of hydrometeors (Nt), the mean diameter (Dm), or in the special case when gnu is 1 can be the y-axis intercept (No).

	RAMS default			20/21 October			28 October		
Category:	*gnu*	*fix*	*value*	*gnu*	*fix*	*value*	*gnu*	*fix*	*value*
cloud droplets	1	Nt	3e8	10	Nt	2.45e7	10	Nt	4.4e6
rain drops	1	Dm	1e-3	1	No	1e6	1	No	1e6
pristine ice	1	prog	-	1	Nt	2.5e4	1	Nt	2.5e4
snow	1	Dm	1e-3	1	Dmc	2.5e3	1	Dmc	2.5e3
aggregates	1	Dm	1e-3	1	No	2.5e3	1	No	2.5e3
graupel	1	Dm	1e-3	1	No	2.5e2	1	No	2.5e2
hail	0	-	-	1	Dm	4e-3	1	Dm	4e-3

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along with the default values used in the earlier model runs.

4. RESULTS

With these new parameter settings the model produces more rain over the Alps and slightly less at the coast, and a more extensive downwind cloud shield. This brings its output closer to the observations. A high-resolution network of precipitation gauges was available for SALPEX in the alpine regions of the Southern Alps and the correlation between the modelled and the measured precipitation at these sites was increased significantly (Table 2).

Table 2: Correlation between the modelled and observed precipitation at the alpine sites. The columns show the correlation for model runs at 20 km grid with the default (def20) and revised (rev20) parameterisations.

	20 Oct 1996		28 Oct 1996	
	def20	*rev20*	*def20*	*rev20*
total rain (bias)	0.73	0.88	0.33	0.54
spatial correlation	0.65	0.77	0.78	0.84
temporal correlation	0.59	0.60	0.54	0.57

Even greater improvements for these alpine sites were obtained when the model was run at a higher spatial resolution (5km instead of 20 km) but the new parameter settings still made a useful contribution, as shown in Table 3.

Table 3: Correlation between the modelled and observed precipitation at the alpine sites for the 20 October 1996 case study, at different grid resolutions. Model runs were on a 20 km grid with the default (def20) parameterisation and 5 km grid with both default (def05) and revised (rev05) parameterisations.

	def20	*def05*	*rev05*
total rain (bias)	0.73	0.81	0.96
spatial correlation	0.65	0.96	0.96
temporal correlation	0.59	0.62	0.64

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