Technical note

To:	Norges forskningsråd
Attn.:	
Copy:	
From:	NGI
Date:	27 April 2011
Document No.:	20110116-00-1-TN
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The Ryggfonn 5m digital terrain model

Contents

BS EN ISO 9001
Certified by BSI
Reg. No. FS 32989

1 Introduction

This document describes how the 5m digital terrain model (DTM) for Ryggfonn has been made and how the data is formatted.

2 Construction of the DTM

The DTM has been generated from two data sources. The main part of the DTM is based on a high-resolution LiDAR scan while the edges of the DTM are based on a DTM generated from contour lines.

2.1 The DTM generated from the LiDAR scan

The data for the high-resolution DTM was acquired by Blom Geomatics. On 2010-09-01 a LiDAR scan was carried out from a helicopter over the Grasdalen valley from Ryggfonn in the southwest to Fonnbu in the northeast. Flying elevation was 400 m above ground and average point density is > 38 points per m^2. Blom delivered the raw LiDAR data, a generated DTM with 1 m resolution and ortophotos with 0.05 m resolution and resampled to 0.2 m resolution. From the raw data points we generated a triangulated irregular network (TIN) and from this all grid DTMs were generated and cut to the area of interest. A gridded DTM with 5 m resolution is the focus of this note.

The extent of the resulting 5 m DTM can be seen in Figure 1, showing a hillshade of the DTM. Note that the dam below the Ryggfonn avalanche path (along the text “Ryggfonna”) is resolved in the LiDAR data and thus is seen in the shading.

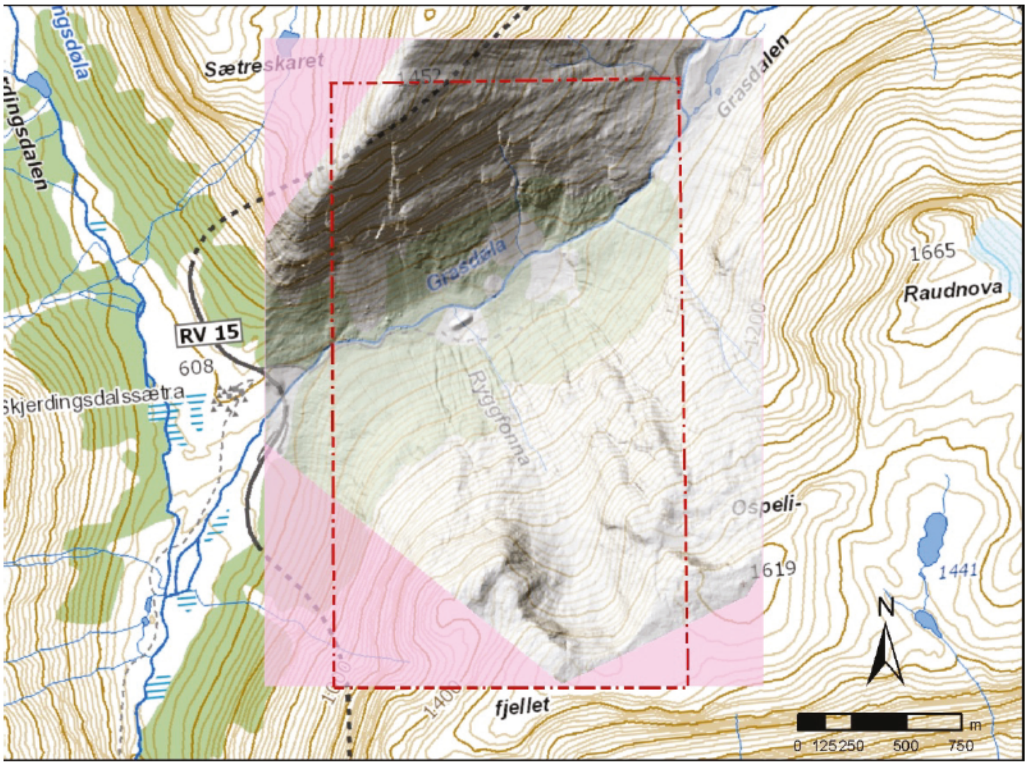

Figure 1: Hillshade of the 5m DTM generated from the LiDAR data as described in the text. Pink areas indicate NoData. The area of interest is indicated by a red dash-dotted line.

2.2 The DTM generated from contour lines

A DTM generated from 20 m contour lines from all of Norway. Elevation points and rivers were not included. The resolution of the grid covering the country was 15 m. A part of the DTM around Ryggfonn was clipped for further analyses.

Since this DTM was made in a different projection (WGS84, 33N) than the DTM generated from LiDAR data (WGS84, 32N), the clipped 15 m DTM was transformed to WGS84, 32N using bilinear sampling.

The clipped, transformed 15 m DTM was then resampled to 5 m grid cells using bilinear interpolation. The grid centers were adjusted to match the 5 m DTM generated from the LiDAR data.

In Figure 2 the hillshade of the DTM is shown. Note that the dam below the Ryggfonn avalanche path is not seen because it is not resolved by the 20 m contour lines.

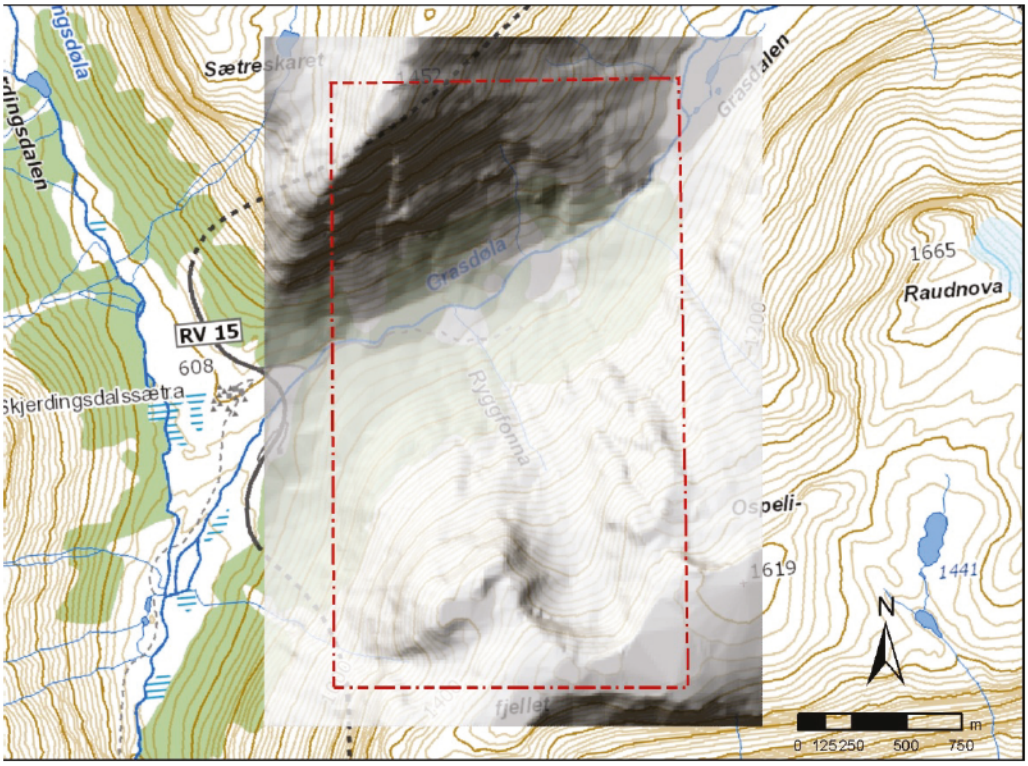

Figure 2: Hillshade of the 5 m DTM generated from the contour data as described in the text. Area of interest is indicated by a red dotted line.

2.3 Combining the DTMs

Visual comparison of the hillshades shown in Figure 1 and in Figure 2 clearly shows that the DTM generated from LiDAR data resolves more small-scale terrain features than the DTM generated from the contour lines, as expected. The absolute difference between the two DTMs is shown in Figure 3. While elevation differences of more than 50 m are present, differences are generally less than 5 m in the Ryggfonn avalanche path. Note that the dam below the Ryggfonn avalanche path shows up as a large positive elevation difference.

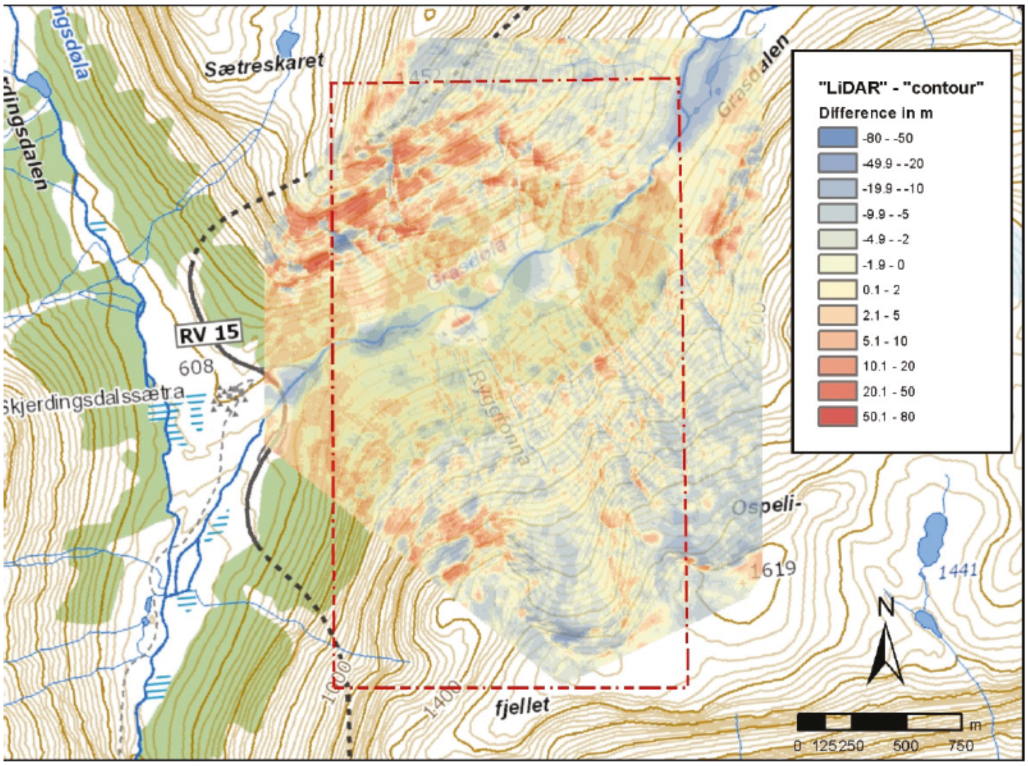

Figure 3: Difference in elevations between the DTM generated from LiDAR data and the DTM generated from contour data.

To generate a DTM that covers the full area of interest, the two DTMs described above were joined. In grid cells where the DTM generated from LiDAR data was present, this elevation was used, while outside this area the DTM generated from contours were used. A hillshade of the resulting DTM is shown in Figure 4. The differences in elevation between the two used DTMs along the edge of the DTM generated from LiDAR data (Figure 3) is clearly visible in the figure.

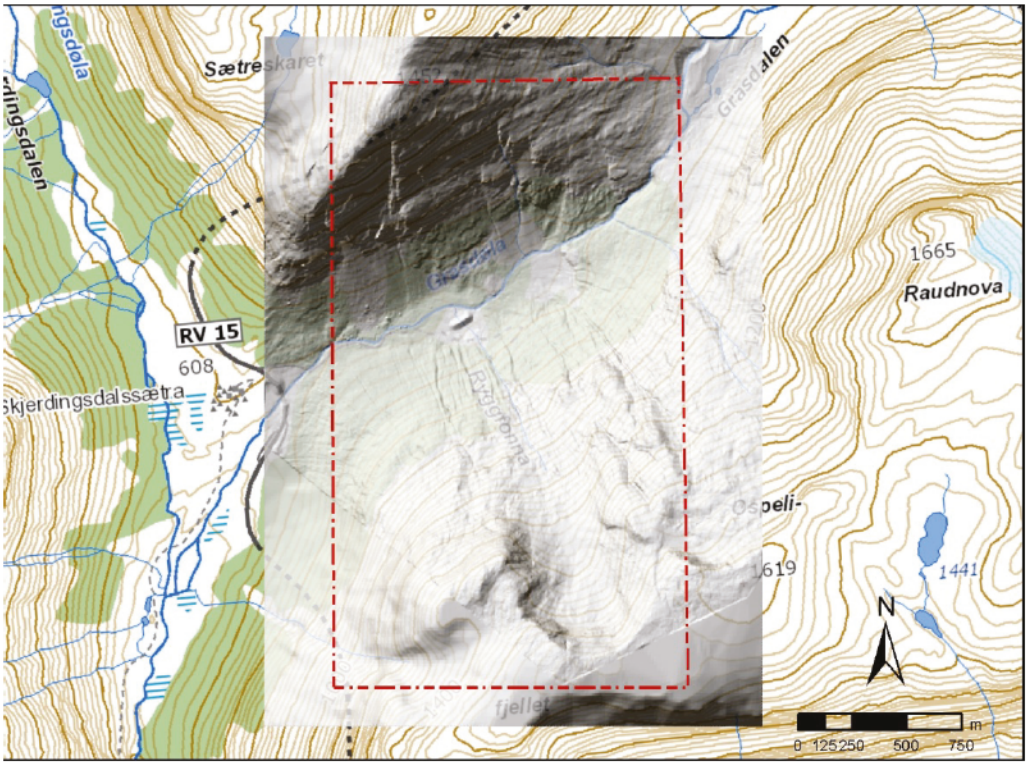

Figure 4: Hillshade of the full DTM for the Ryggfonn avalanche path.

There are different options for minimizing the abrupt change from one DTM to the other at the outer boundary of the DTM generated from LiDAR data. But since the area outside the LiDAR scanned area is not of interest for the dynamics of avalanches in the Ryggfonn avalanche path, we have chosen the simplest way of joining the two data sets.

3 Data format

The full DTM using the combined datasets as described above is exported to an ASCII grid in the ESRI format. The file is called “rgf_5m_dtm_20100901.asc” where 20100901 indicates the date of the LiDAR scan. The DTM covers the area of interest and includes a buffer zone as shown in Figure 4 above. Values are floating point with “.” as the comma separator, and “NoData” values are -9999. The first lines consist of a header describing the data. The following lines describe the elevation at each grid cell. Elevations are given in meters above sea level. The coordinates are in WGS 84 zone 32N. The file “rgf_5m_dtm_20100901.prj” describes the coordinate system.

Kontroll- og referanseside/ *Review and reference page*

NGI

Dokumentinformasjon/*Document information*

Dokumenttittel/*Document title* The Ryggfonn 5 m digital terrain model	**Dokument nr/*Document No.*** 20110116-00-1-TN
Dokumenttype/*Type of document* ☐ Rapport/*Report* ☒ Teknisk notat/*Technical Note* **Distribusjon/*Distribution*** ☐ Fri/*Unlimited* ☒ Begrenset/*Limited* ☐ Ingen/*None*	**Dato/*Date*** 2011-04-27 **Rev.nr./*Rev.No.***
Oppdragsgiver/*Client* Norges forskningsråd.	
Emneord/*Keywords* Digital terrain model, avalanche path, Ryggfonn	

Stedfesting/*Geographical information*

Land, fylke/*Country, County* Sogn og Fjordane	**Havområde/*Offshore area***
Kommune/*Municipality* Stryn	**Feltnavn/*Field name***
Sted/*Location* Ryggfonn, Grassdalen	**Sted/*Location***
Kartblad/*Map* Lodalskåpa	**Felt, blokknr./*Field, Block No.***
UTM-koordinater/*UTM-coordinates* UTM 32N E: 0409512, N: 6871639	

Dokumentkontroll/*Document control*

Kvalitetssikring i henhold til/*Quality assurance according to* NS-EN ISO9001

Rev./ *Rev.*	Revisjonsgrunnlag/*Reason for revision*	Egen-kontroll/ *Self review* av/*by:*		Sidemanns-kontroll/ *Colleague review* av/*by:*		Uavhengig kontroll/ *Independent review* av/*by:*		Tverrfaglig kontroll/ *Inter-disciplinary review* av/*by:*	
0	Original document	KaK	KaK	KST	KST				

Dokument godkjent for utsendelse/ *Document approved for release*	Dato/*Date*	Sign. Prosjektleder/*Project Manager*
	27/4 - 11	[signature]

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NGI was awarded Centre of Excellence status in 2002 and leads the International Centre for Geohazards (ICG).

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Sertifisert av/Certified by BSI, Reg. No. FS 32989