Snow depth from GCOM-W1 AMSR2 Instrument – experience gained from the last four winters

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Presentation outline:

- GCOM-W1 snow depth product,
- Snow depth products – last 4 winters.
- SND Version1 vs. Version2,
- Melting snow problem,
- Conclusions
GCOM-W1 data and products availability:

Global Change Observation Mission 1st – Water “SHIZUKU” (GCOM-W1) launched on May 18, 2012.

How to get data: please register at the SHIZUKU data provision website:
https://gcom-w1.jaxa.jp

Data archive for entire live of AMSR type instruments
sftp://gcom-w1.jaxa.jp:2051

AMSR-2 - July 2012 – now

SD = Rc* (Tb19V-Tb37V )
Over forested areas also used:
Tb10V-Tb37V
Example of the product presented at IMWM intranet. Image generated from Level 2 SND product.
Winter 1.10.2014-31.05.2015 – Snow depth over Eu-Asia
Only Descending passes
Last winter 1.10.2014-31.05.2015 – Snow depth over Eu-Asia
Both Ascending and Descending passes
Comparison of snow depth distribution retrieved from ascending and descending pass - 4.04.2015

Snow volume [m3] - Descending Pass
Ascending vs. Descending pass – Northern Hemisphere 20-85N – phases of snow development!

2012/13

2013/14

2014/15

2015/16
Comparison of snow volume for North America (20-85N) for 3 winters
Ascending and Descending pass

Ascending passes

Descending passes
Difference between Snow volume from Descending Pass vs. Ascending Pass (Dsc-Asc)/Asc [%]

- 2012/13_dif [%]
- 2013/14_dif [%]
- 2014/15_dif [%]
## GCOM-W1 SND „Climatology”

Sum of Volume*days for period s: 1 Oct. – 31 May

<table>
<thead>
<tr>
<th></th>
<th>Asc</th>
<th>Dsc</th>
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<tr>
<td>Value</td>
<td>1.50E+15</td>
<td>2.00E+15</td>
<td>1.50E+15</td>
<td>1.00E+15</td>
<td>5.00E+14</td>
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</table>
Correlation coefficient: GCOM-W1 SSS vs. Ground observations
RMSE [cm] for all analyzed Synop stations

[cm]

Ascending Pass
Descending Pass

Synop station WMO number
Differences between Version 1 and Version 2 of SND Level 3 Product.

In V2, Globe has 3% more land than in V1 !!!
Differences between Version 1 and Version 2 of SND Level 3 Product.

Significantly smaller snow covered area, especially close to the sea coast.

Version 2 has problem with snow at the coastal region.

23.12.2012 – area of Poland

V1

V2
Comparison of snow volume calculated from G-COM-W1 SND product version 1 and 2
Winter 2012/2013
What we can do with wet snow and melting conditions?
We do not see snow when it’s wet or melting !!! Example for Lublin Synop station (WMO No. 12495).
From point observations to catchment values:

- Hydrologists require information over the catchment,
- Runoff is generated from snow melting in the whole catchment,
- Specific features for selected point could be minimized,

Wieprz river catchment selected for further analysis:

- Located in Central/ Eastern Poland,
- No reservoirs,
- No mountains,
- Suffered snow melt flood at spring 2013.
From point to catchment observations.
Wieprz river catchment selected - ~10 000 km², South East Poland.
GCOM-W1 data reprojected (and interpolated) to UTM projection with 1 km resolution

GCOM-W1 snow depth distribution for selected catchment (Wieprz) Example from 20.01.2013.

Calculation of snow volume for the whole catchment
For the whole winter 2012/2013 (1.10.2012- 30.04.2013) were calculated:

- Snow volume from interpolated ground observations [m$^3$],
- Snow volume from JAXA SND product (separately for ascending and descending pass) [m$^3$],
- Volume under the surface T10V-T10H - supposed to be indicator of water from melting snow [deg. K * m$^2$],
Comparison of snow Snow volume from ground observations and from GCOM-W1 SND.
Snow volume from ground observations vs. River gage and calculated discharge and from catchment

Snow Volume [m$^3$] vs. Water level [cm] vs. Discharge *3 [m$^3$/s]

Graph showing trends in snow volume, water level, and discharge over time.
Could we make parametrisation of relations between snow volume, snow water equivalent and estimated water amount in melting snow/soil surface layer?

Water amount = A \times (T_{18V} - T_{37V}) + B \times (T_{10V} - T_{10H}) + C

Water in snow

Liquid water

Term C is necessary to compensate background value of T_{10V} - T_{10H} not equal zero in snow free conditions

A = ?
B = ?
C = ?
Example of such parametrisation representing volume of water in snow/upper soil (both frozen and melted)
Conclusions:

1. GCOM-W1 Snow Depth product is much more realistic for European conditions of snow (depth 0-50 cm).

2. Hydrological applications not possible before solving a problem with Ascending/Descending pass differences.

3. Above problem require better modelling of wet and melting snow – direction of work shown.

4. Wet and melting snow is dispepearising from satellite data retrieval methods – gap between volume of water stored in dry snow and river discharge.

5. Presented material could be an inspiration for further studies.

6. Differences between V1 and V2 SND: more land, less snow.

7. Version 1 deleted from JAXA server after reprocessing to Version2! Why ???

8. We are waiting for GCOM-W1 SND Version 3 !!!
Thank you for your attention.