GCW Snow Watch activities for improved snow data reporting and exchange on the Global Telecommunication System (GTS)

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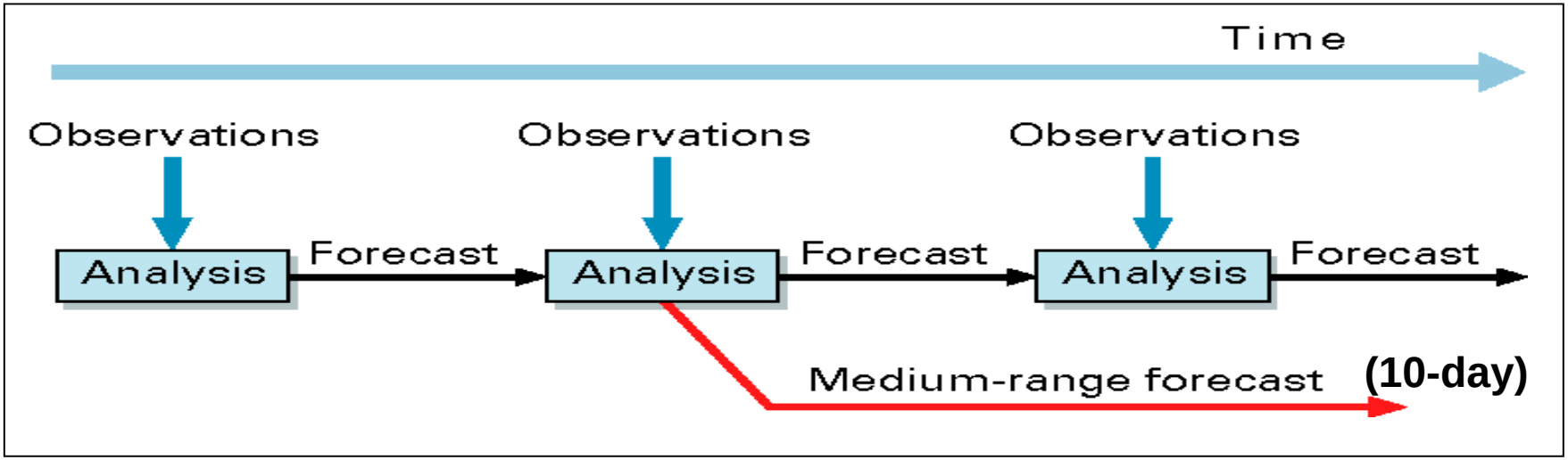
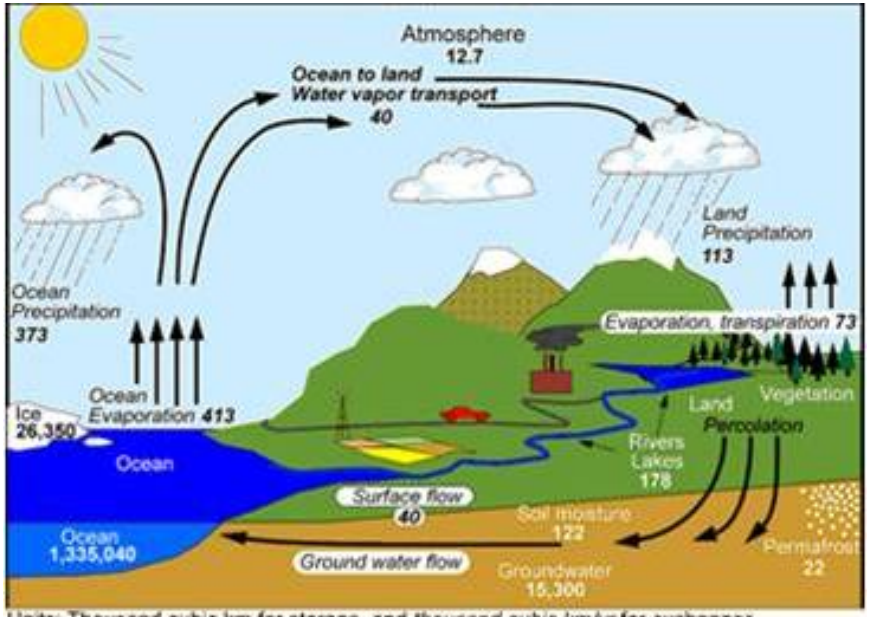
Thanks to: Ioannis Mallas, Enrico Fucile, Marijana Crepulja, Rodica Nitu, Charles Fierz

ECMWF Integrated Forecasting System (IFS)



- Forecast Model
- Data Assimilation



Units: Thousand cubic km for storage, and *thousand cubic km/yr* for exchanges

Snow in the ECMWF IFS for NWP

Snow Model: Component of H-TESSEL **(Dutra et al., JHM 2010, Balsamo et al JHM 2009)**

Single layer snowpack

- Snow water equivalent SWE (m)
- Snow Density ρ_s

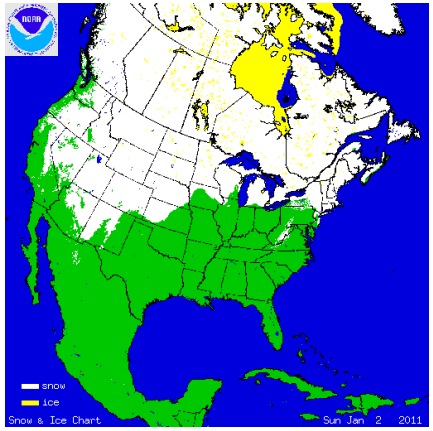
} **Prognostic variables**

Observations: **de Rosnay et al ECMWF Newsletter 2015**

- Conventional snow depth data from SYNOP
  - Conventional snow depth from additional national networks
- Snow cover extent: NOAA NESDIS/IMS daily product (4km)

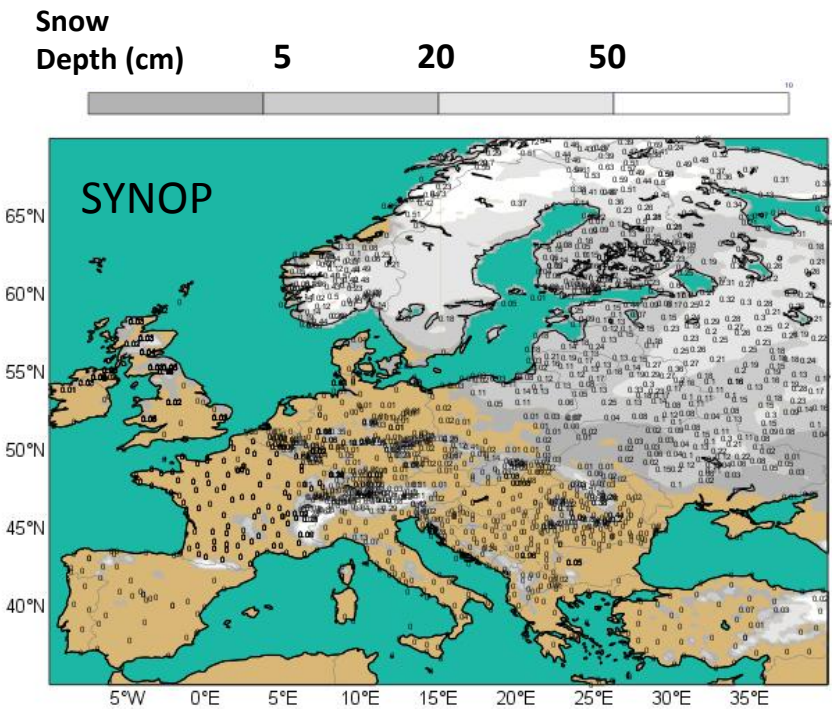
Data Assimilation: **de Rosnay et al SG 2014**

- Optimal Interpolation (OI) in NWP and in ERA5



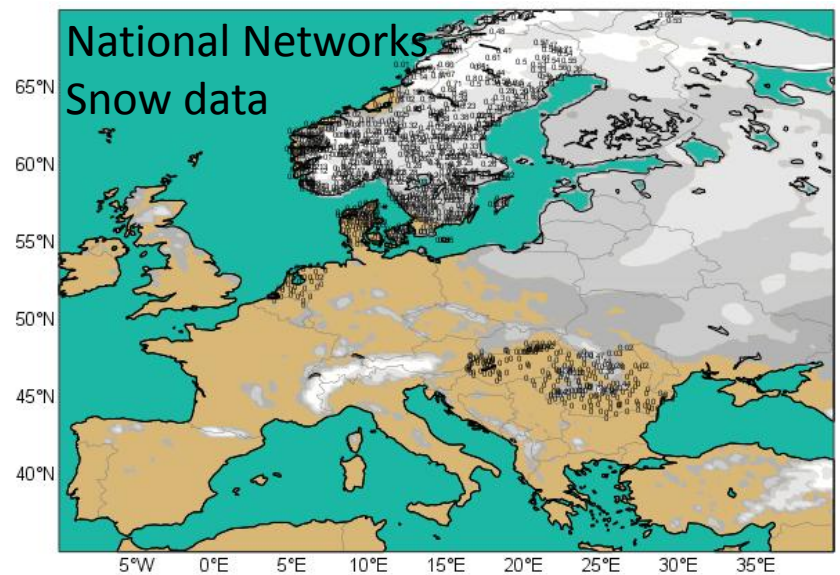
Snow Observations

Snow SYNOP and National Network data in Europe



Available on the **GTS** (Global Telecommunication System)

2016 01 15 at 06UTC



Additional data from national networks from up to 7 countries:

Sweden, Romania, The Netherlands, Denmark, Hungary, Norway, Switzerland.

→ **Dedicated BUFR for additional national data**

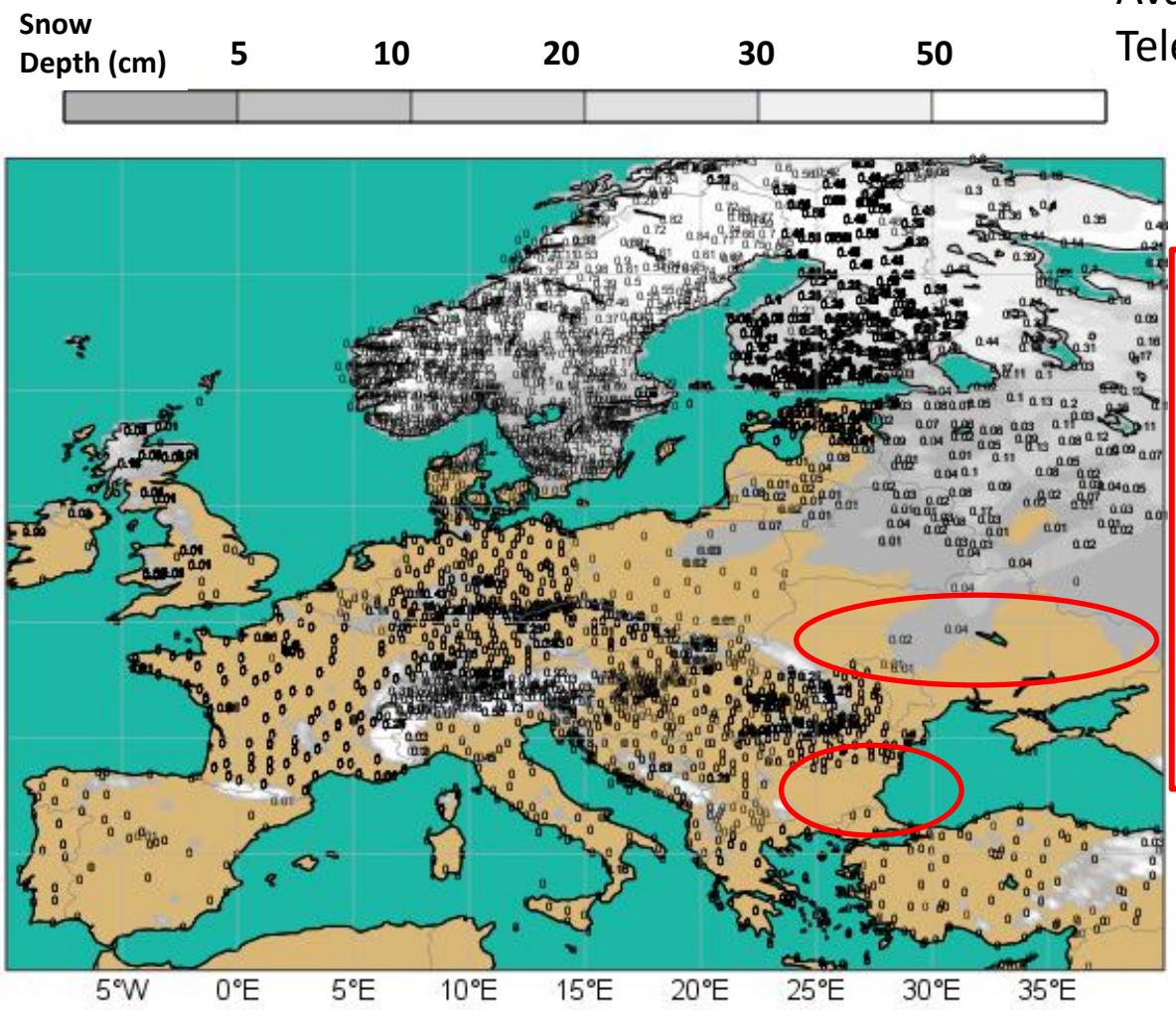
(de Rosnay et al. ECMWF Res. Memo, R48.3/PdR/1139, 2011)

Snow Observations

Snow SYNOP and National Network data in Europe

Available on the **GTS** (Global Telecommunication System)

15 Dec 2017



In general, good coverage in Europe, but …

- Bulgaria: more stations available but not on the GTS
- Zero snow depth reporting is still an issue (e.g. Ukraine)

Snow reports from Ukraine

Ukraine increased number of stations from 30 to more than 160, using BUFR SYNOP. Used in operations since June 2018 at ECMWF

https://www.ecmwf.int/en/about/media-centre/news/2018/extra-weather-station-data-improve-ecmwfs-forecasts

Snow reports from Bulgaria (NIMH)

HarmoSnow COST action ES1404 →contribute to improve in situ data exchange for NWP

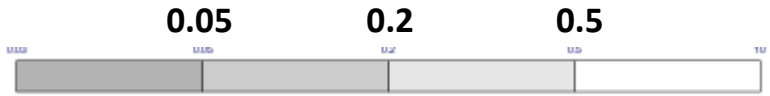
→ NIMH: 39 additional stations (BUFR format, routinely produced)

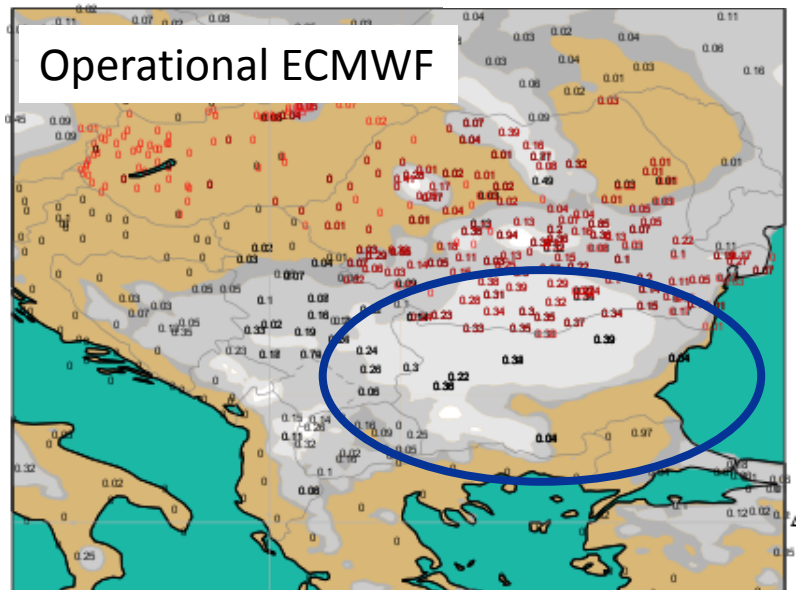
→ ECMWF data acquisition, 1-month assimilation test

→ Suitable for operational use

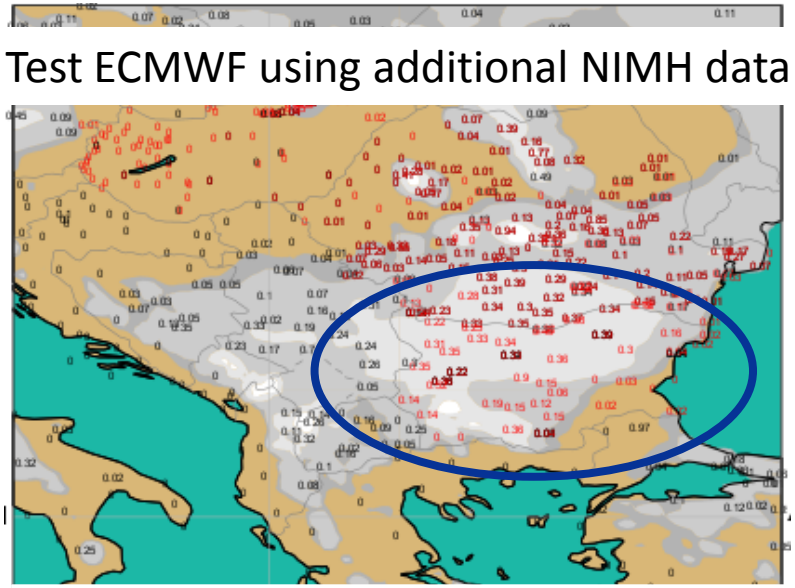
de Rosnay et al., RD16-178 2016

19 January 2016
Snow depth in m





Lack of observations in Bulgaria



39 more stations provided by NIMH

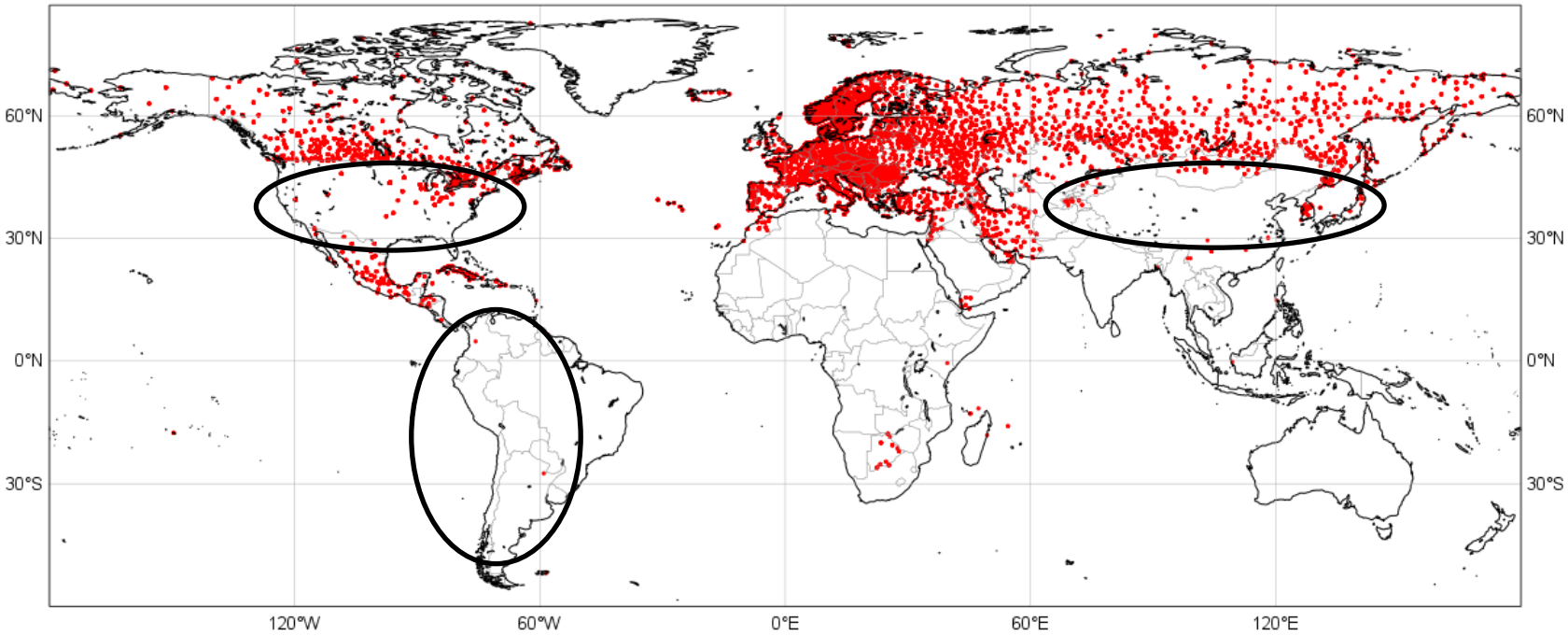
Technical aspects (data format, acquisition, assimilation) solved.
Waiting for NIMH to decide to make the data effectively available for NWP

In situ snow depth observations

GTS Snow depth availability

SYNOP TAC + SYNOP BUFR + national BUFR data

Status on 10-15 December 2013



In situ snow depth observations

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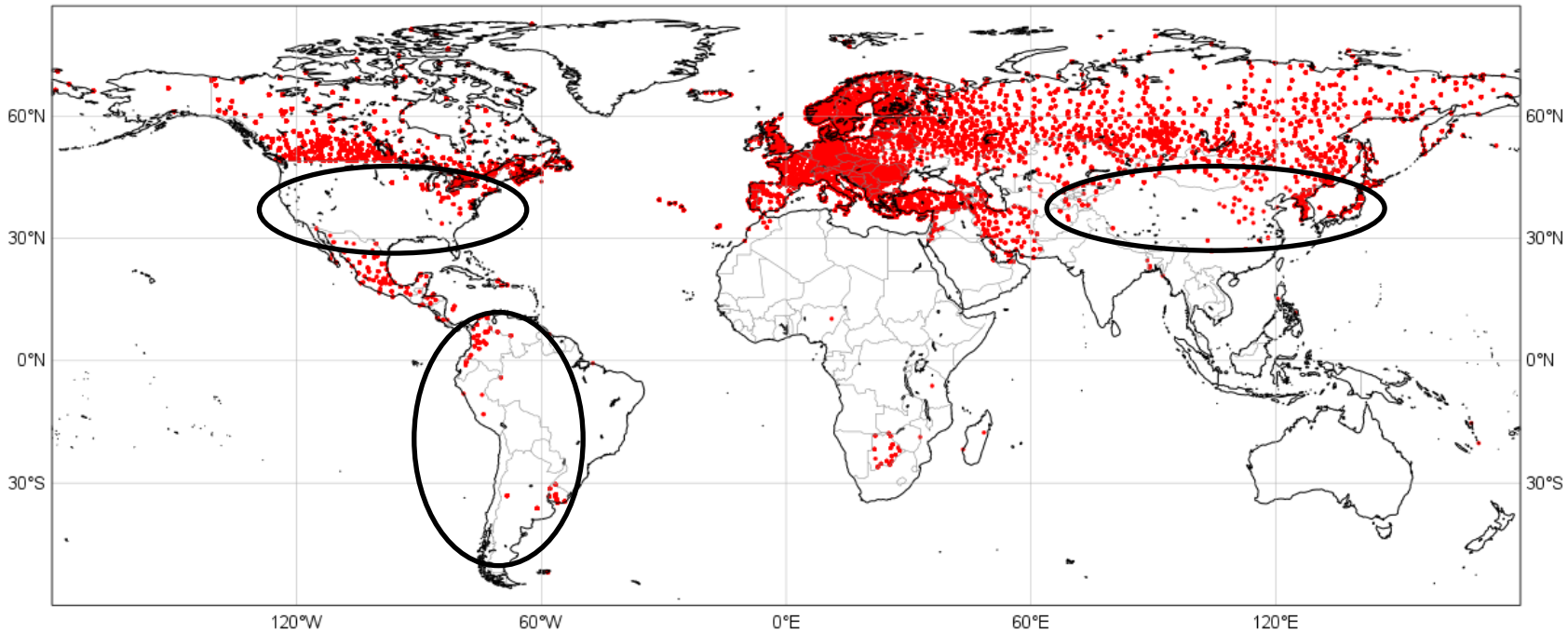
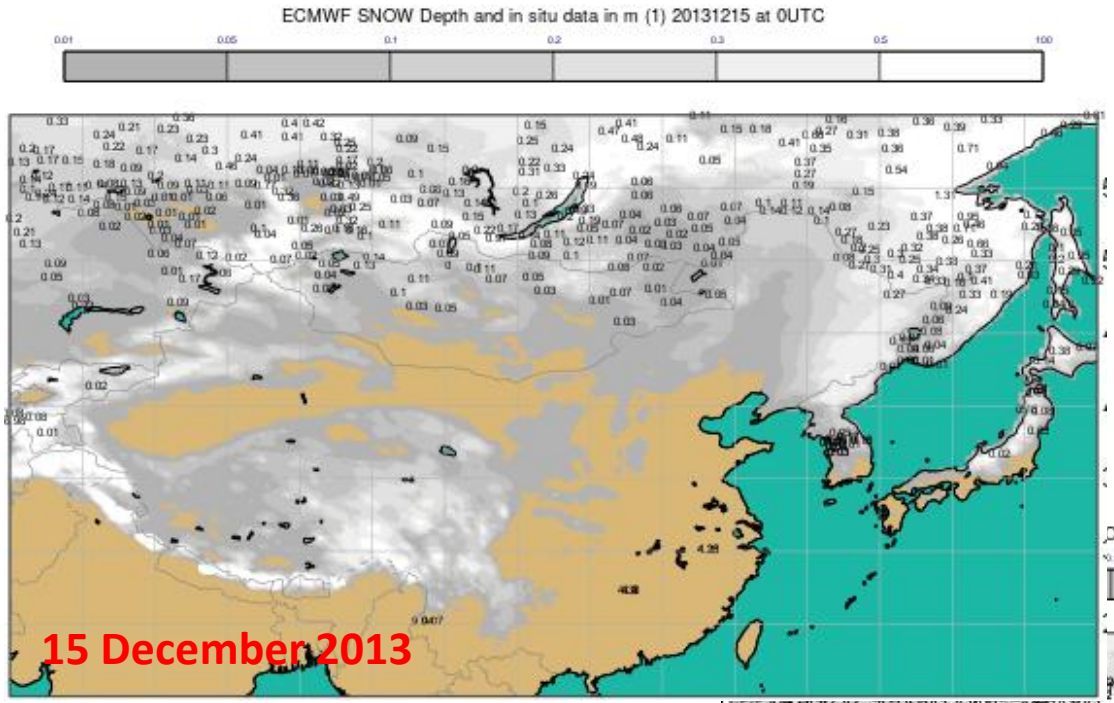
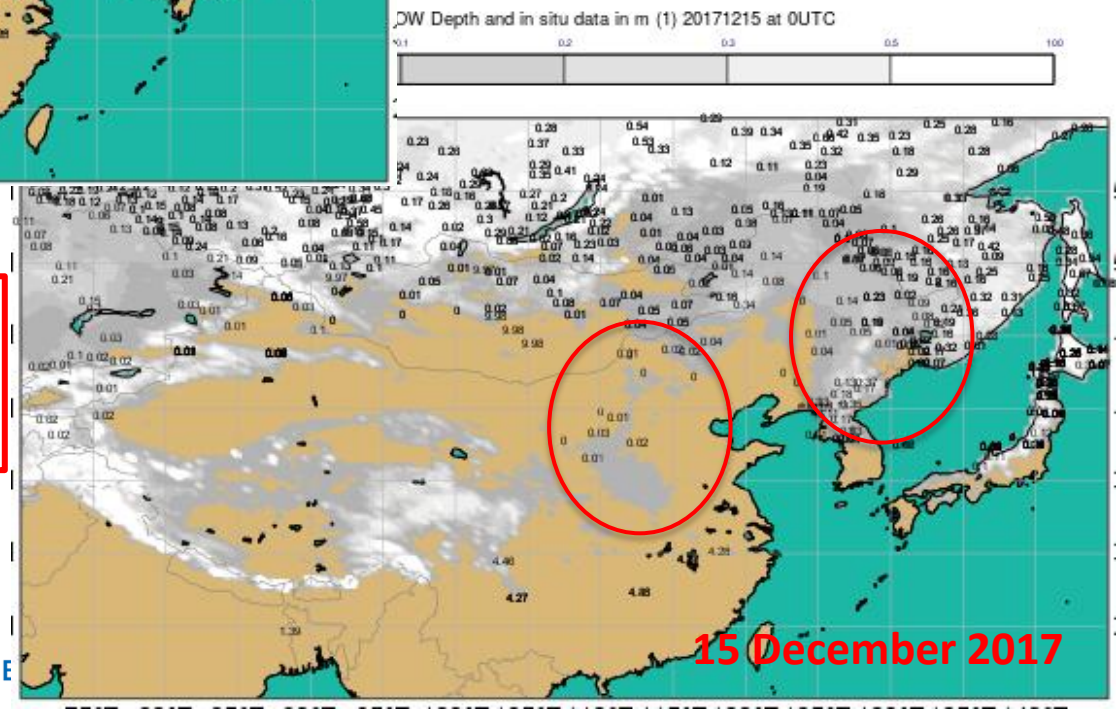


In situ snow depth observations

GTS Snow depth availability

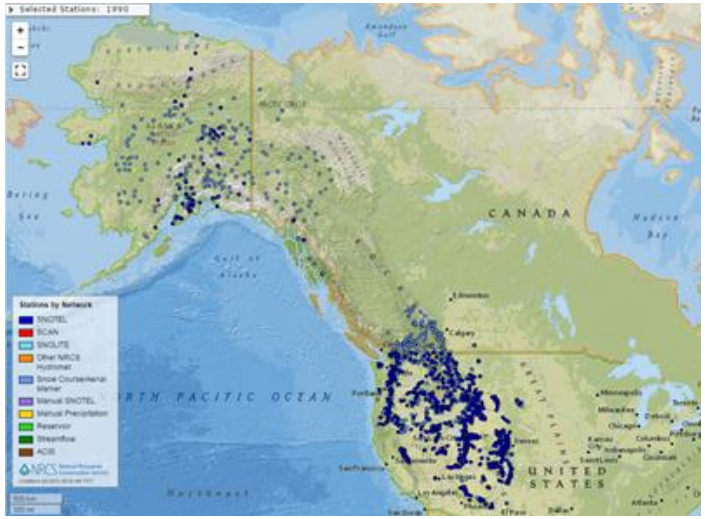




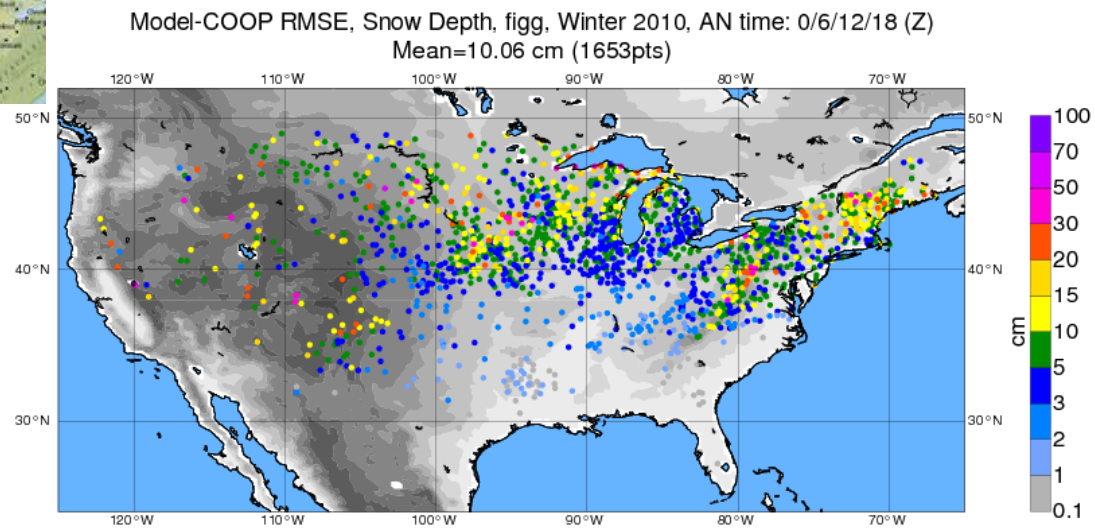
Improvement in China: About 200 new stations reporting (in snow conditions) in SYNOP BUFR

In situ snow depth observations in the US

More that 900 observations from the SNOTEL (Snow Telemetry) network



Other networks include National Weather Service Cooperative Observer Program (COOP), or Soil Climate Analysis Network (SCAN) that provide thousands of stations



NOAA working on WMO BUFR conversion of the US national networks to make them available on the GTS

GCW Snow Watch actions
International exchange of snow data

WMO EC-69 (2017), Abridged final report with resolutions and decisions
https://library.wmo.int/index.php?lvl=notice_display&id=19919#.W4AgERZG1e5

→ Resolution 15 on international exchange of snow data

"…zero snow depth (absence of snow) should be reported … "

" Requests Members to exchange in situ snow measurements in real time in BUFR through the Global Telecommunication System …"

On going: US SNOTEL, COOP, SCAN data on the GTS (NOAA) with support from ECMWF & SnowWatch, WMO resolution 15 used in support of required resources at NOAA (Sept 2018) – Role of GODEX (Global Obs data Exchange).

SWE in BUFR (2018): for NRT exchange of SWE data via GTS

- IPET-CM = Inter-programme expert team on code maintenance
- **New SWE BUFR**
  - **approved May 2018:**http://www.wmo.int/pages/prog/www/ISS/Meetings/IPET-CM_Offenbach2018/IPET-CM_DocPlan.html
  - **Available to WMO MSs November 2018**
  - **Presented at ECMWF TAC (Techn. Adv. Committee) in October 2018**

GCW Snow Watch actions
International exchange of snow data

WORLD METEOROLOGICAL ORGANIZATION
COMMISSION FOR BASIC SYSTEMS

SECOND MEETING OF
INTER-PROGRAMME EXPERT TEAM ON
CODES MAINTENANCE

OFFENBACH, GERMANY, 28 MAY - 1 JUNE 2018

IPET-CM-II / Doc. 2.4 (4)
09.05.2018

ITEM 2.4

ENGLISH ONLY

MANUAL ON CODES: TABLE-DRIVEN CODE FORMS

FM 94 BUFR/FM 95 CREX

New BUFR sequence for Snow Water Equivalent (SWE)

Submitted by Marijana Crepulja, Enrico Fucile and Patricia de Rosnay, all from (ECMWF)

Snow Water Equivalent BUFR

→ New BUFR sequence 3 07 103 & corresponding BUFR table B entries and code

Based on the existing 3-07-101 (snow observation) by adding the WIGOS Station Identifier and the required elements to report the Snow Water Equivalent

TABLE REFERENCE F X Y	TABLE REFERENCES	ELEMENT NAME
3 07 103		(Snow observation, snow density, snow water equivalent)
	3 01 150	WIGOS identifier
	3 07 101	Snow observation
	0 13 117	Snow density
	0 03 028	Method of snow water equivalent measurement
	0 13 163	Snow water equivalent

Code table 0 03 028 – Method of Snow Water Equivalent Measurement

Code figure	
0	MULTI POINT MANUAL SNOW SURVEY
1	SINGLE POINT MANUAL SNOW WATER EQUIVALENT MEASUREMENT
2	SNOW PILLOW OR SNOW SCALE
3	PASSIVE GAMMA
4	GNSS/GPS METHODS
5	COSMIC RAY ATTENUATION
6	TIME DOMAIN REFLECTOMETRY
7-62	Reserved
63	Missing

SWE: model prognostic variable
→ Relevant for data assimilation
→ Long term benefit for operational NWP & hydrology

Initiatives relevant to address snow observations availability on the Global Telecommunication System (GTS)