

FLDAS Noah-MP Snow Depth and SWE

August 10, 2023

Amman, Jordan

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¹ASRC Federal Data Solutions

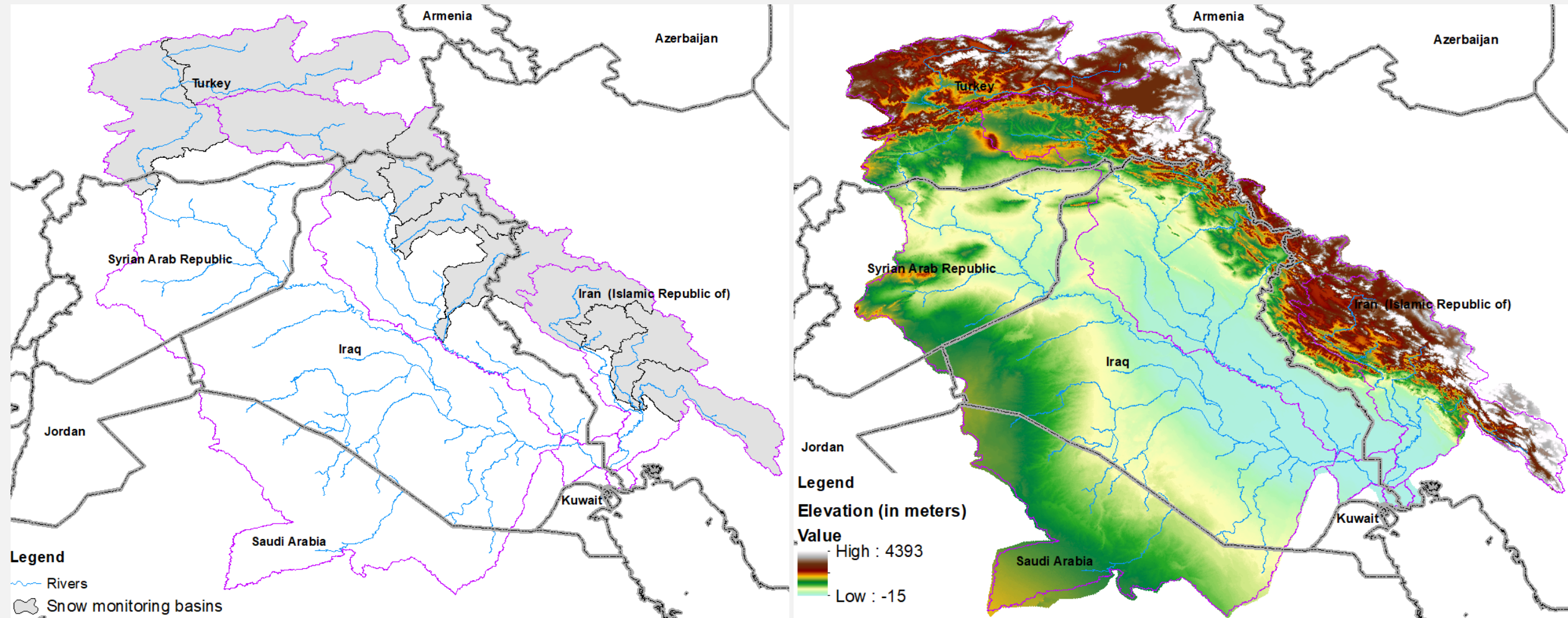
²U.S. Geological Survey

Outline:

Day 2 – Thursday, August 10, 2023

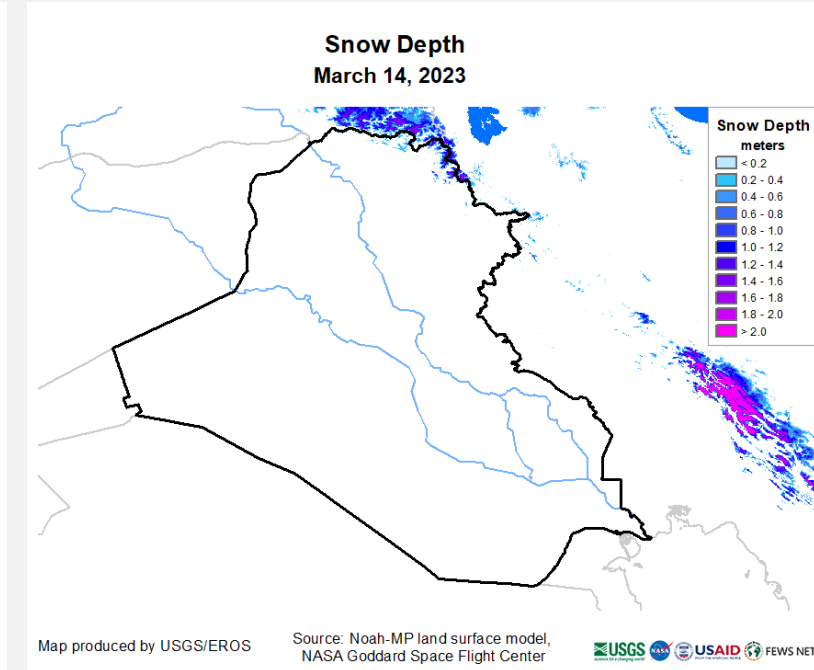
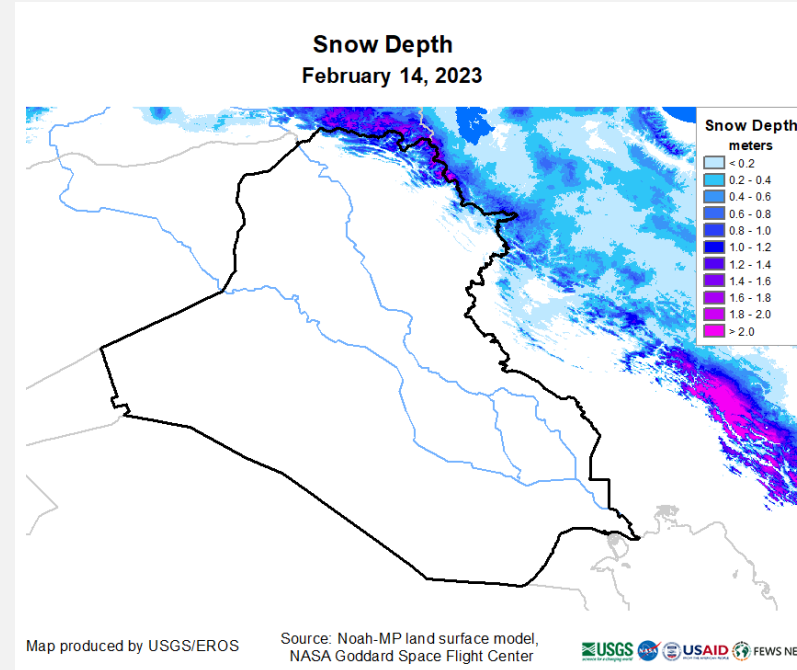
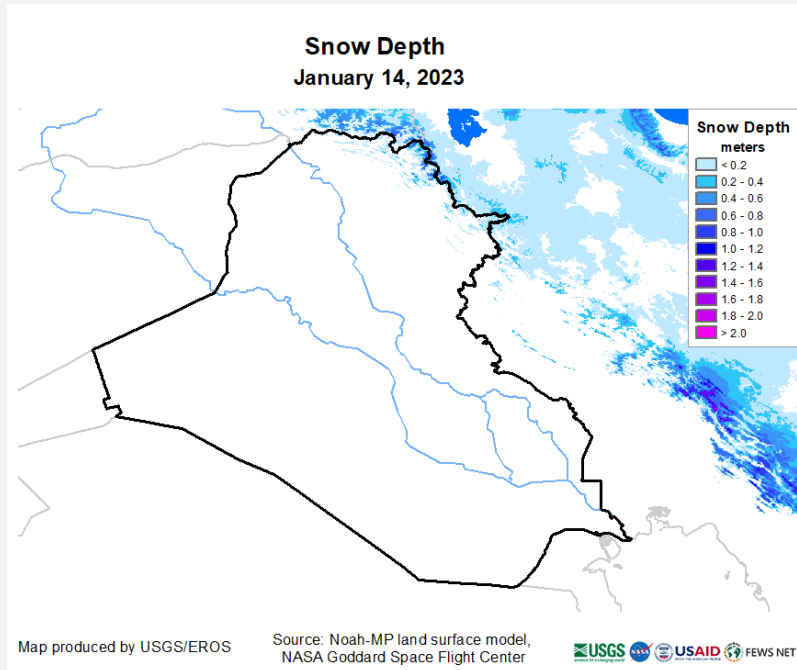
Topic	Estimated duration
Answer any questions about existing IA-PPG processes issues or code (Part 1)	3 hours
Set up IA-PPG Iraq daily FLDAS NoahMP Snow Depth and SWE process in server	1 hour
Introduction to daily FLDAs Noah-MP Snow Depth and SWE (Shahriar). Also, help to answering 2 science questions from Iraq workshop requests: <ol style="list-style-type: none"> 1. What is the relationship between SWE and SWE curves? 2. How to split the Silopi basin in 2 sub-basins? first subbasin for upstream Ilisu dam, which the amount of SWE (water melt) will store in the pool of the Ilisu dam, and the second subbasin for downstream Ilisu dam 	1.5 hours

Where Are the Snow in Tigris-Euphrates?



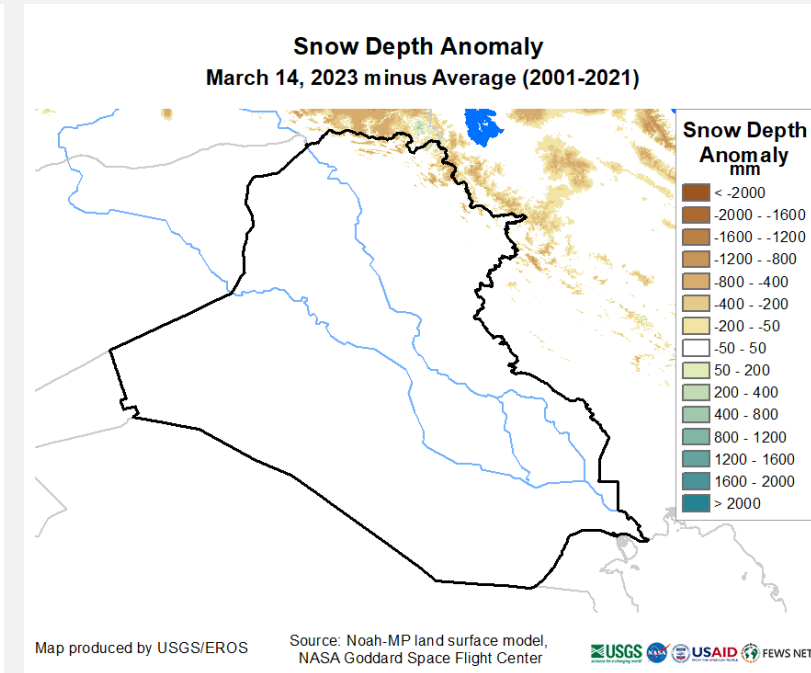
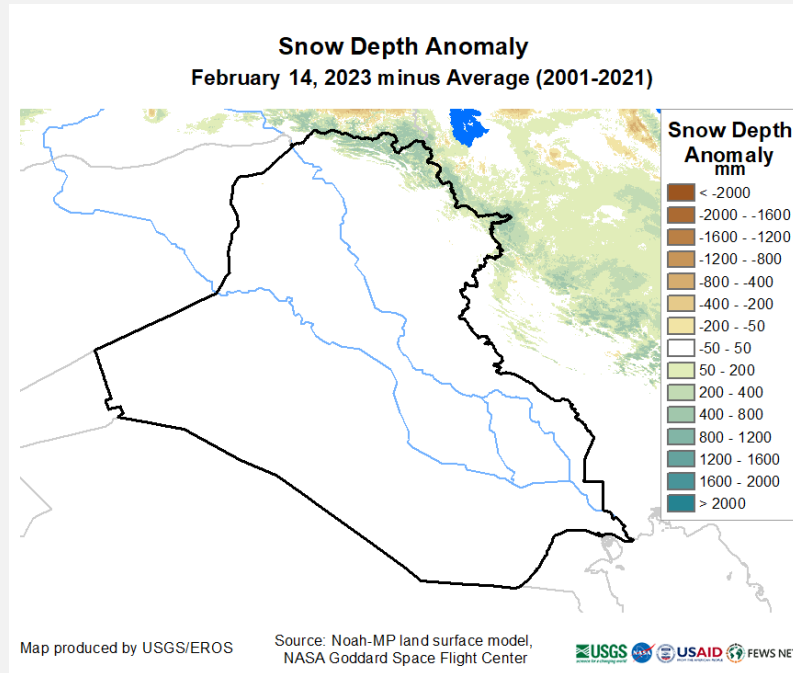
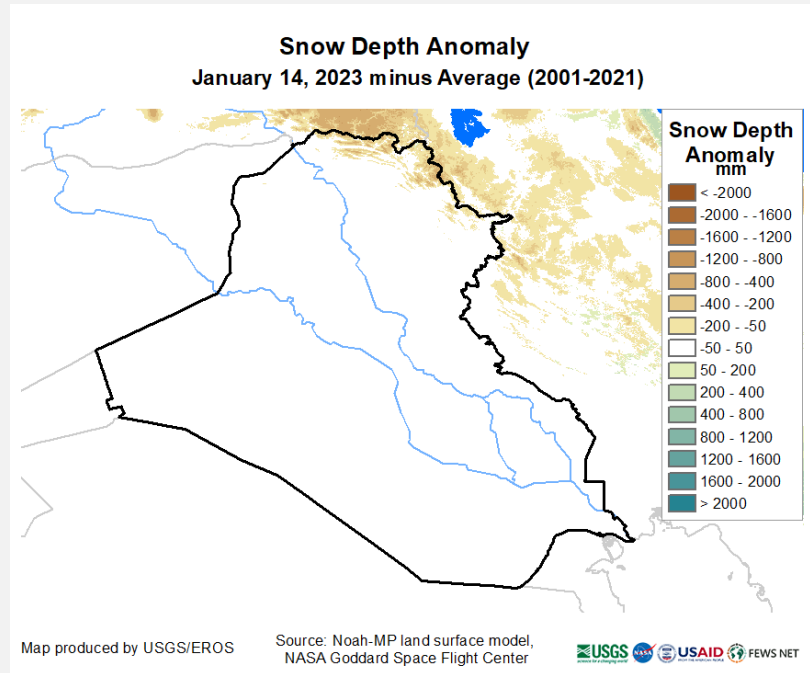
FLDAS Snow Products for Tigris-Euphrates

FLDAS : FEWS NET (Famine Early Warning Systems Network) Land Data Assimilation System



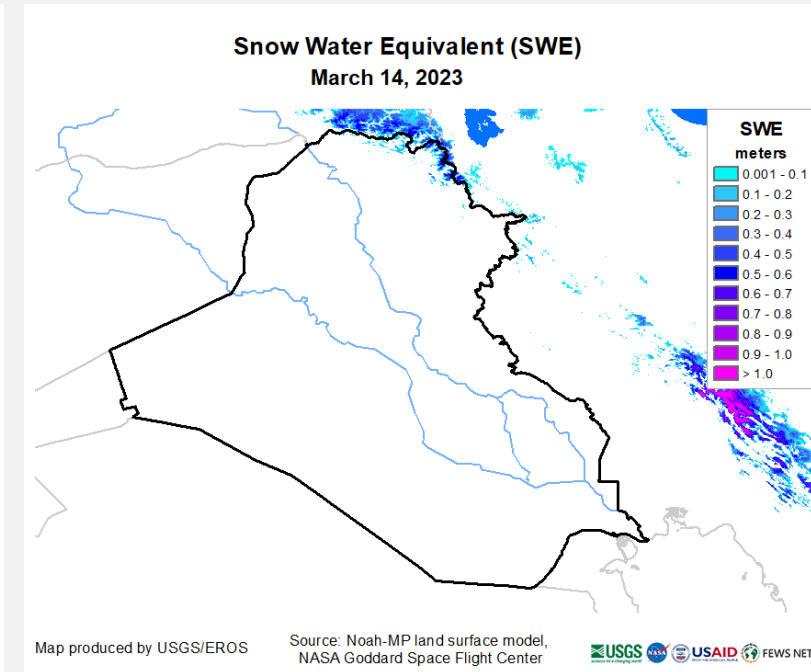
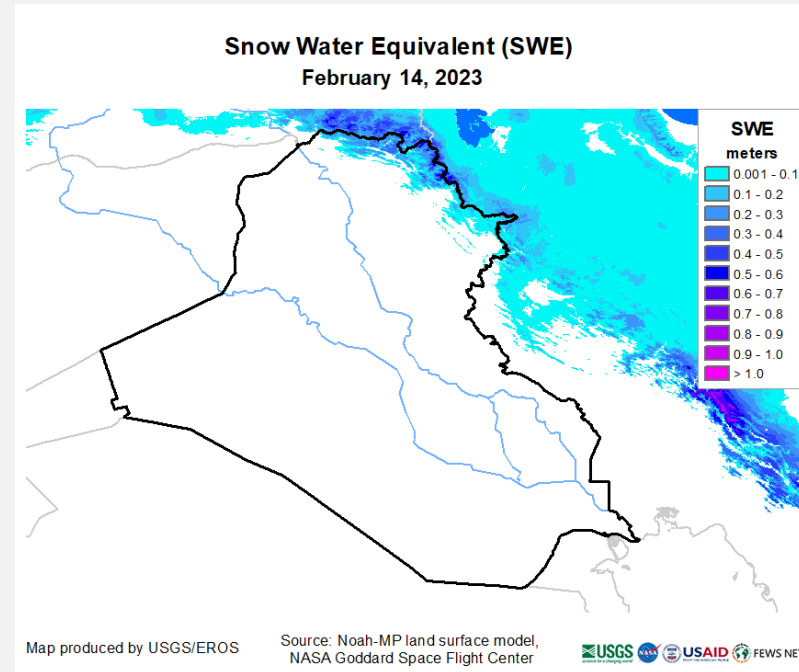
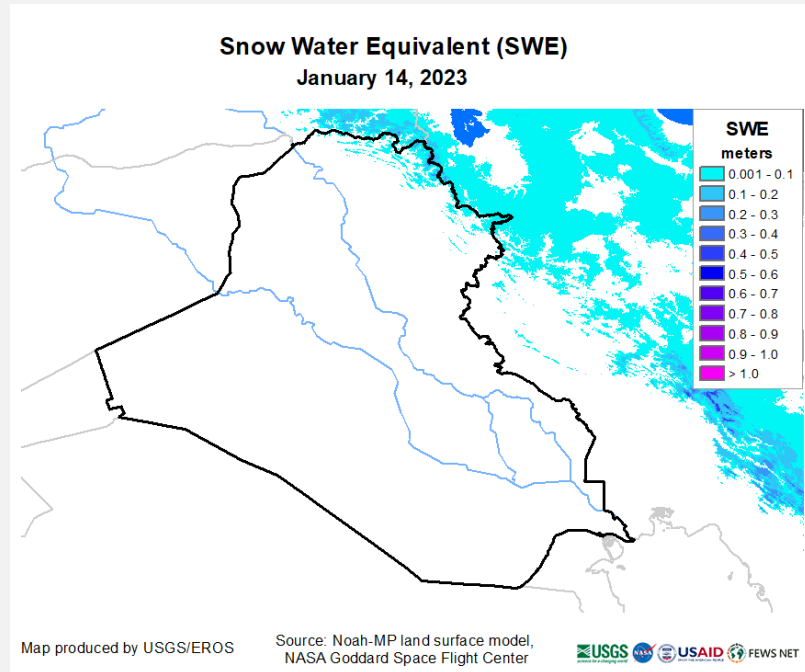
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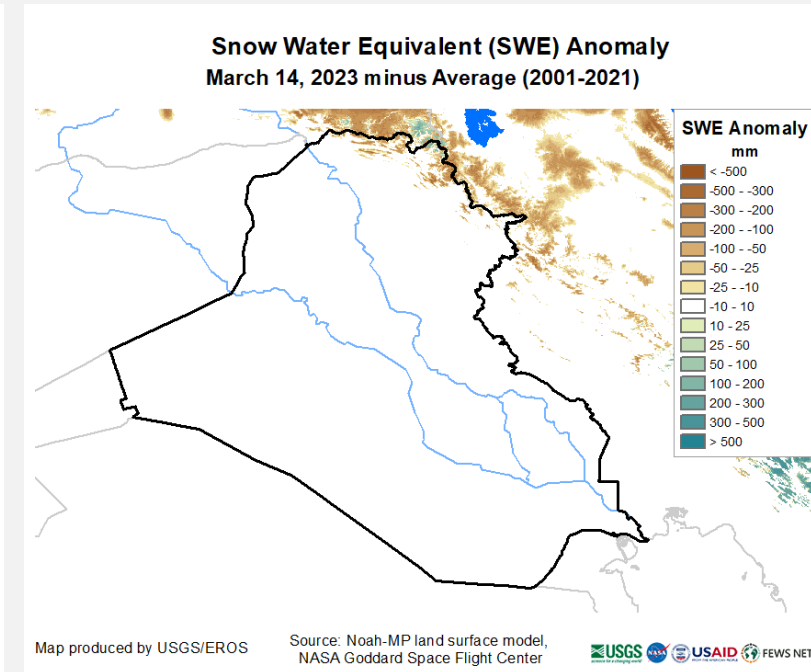
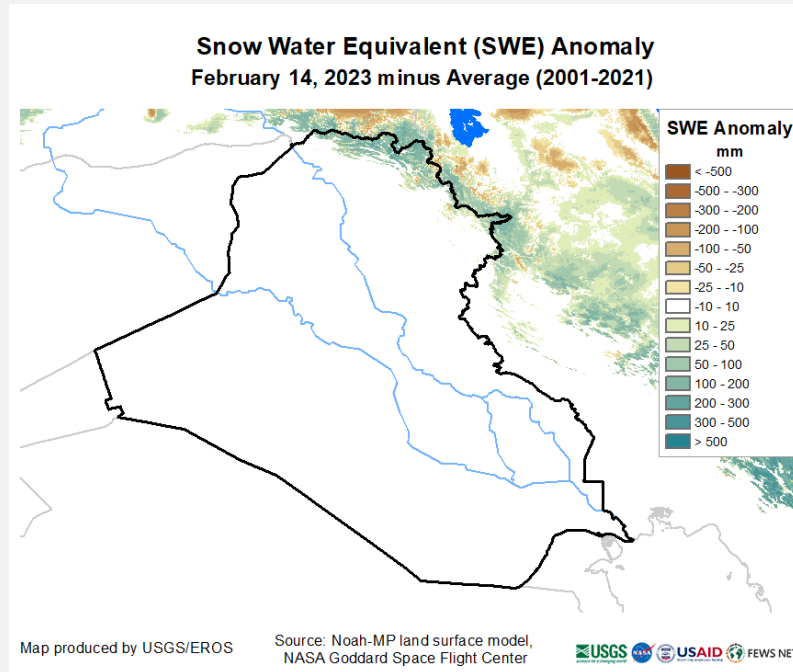
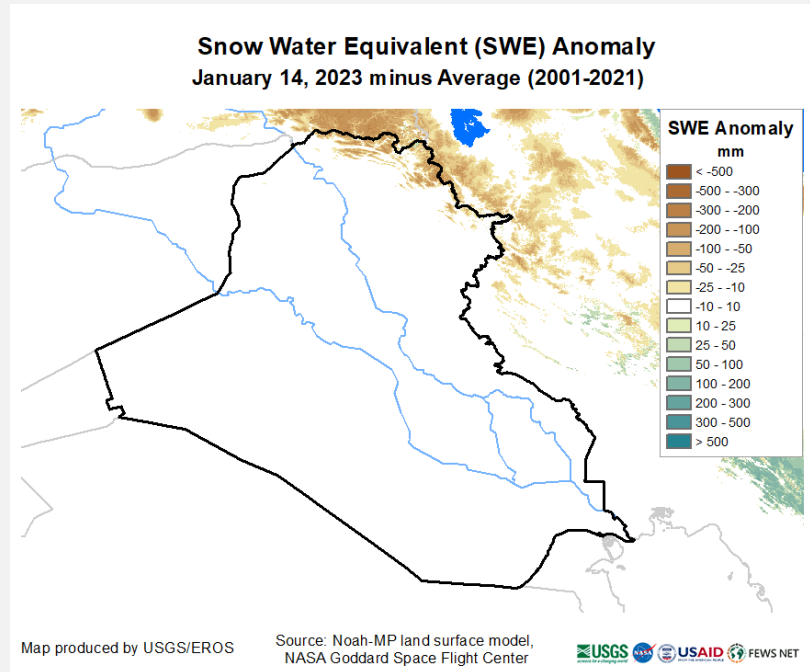
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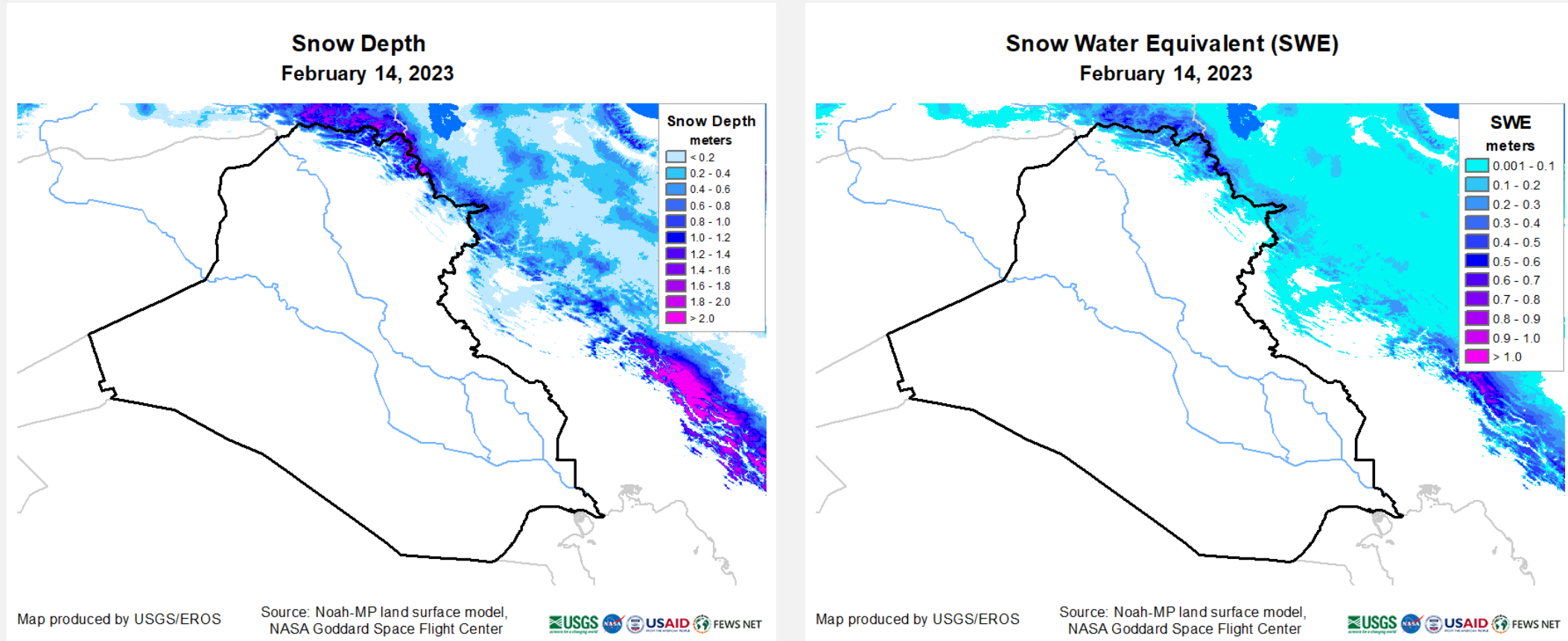


FLDAS Snow Products for Tigris-Euphrates

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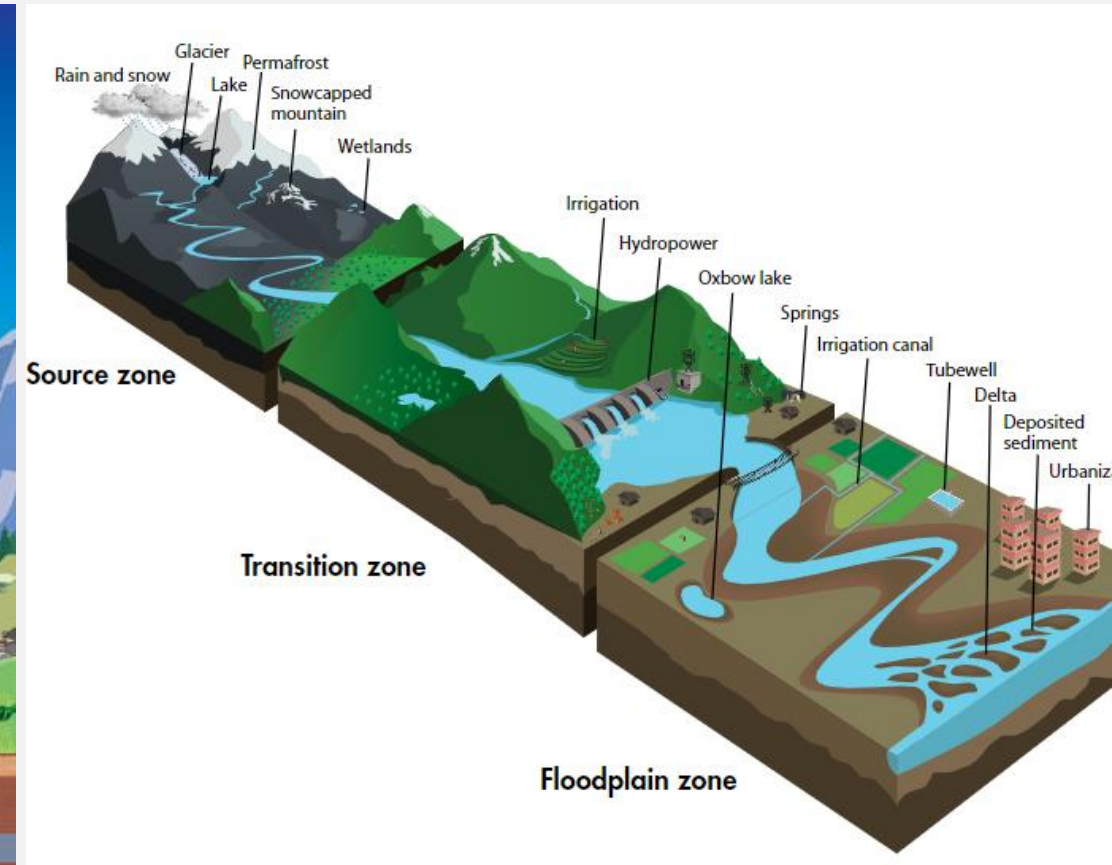
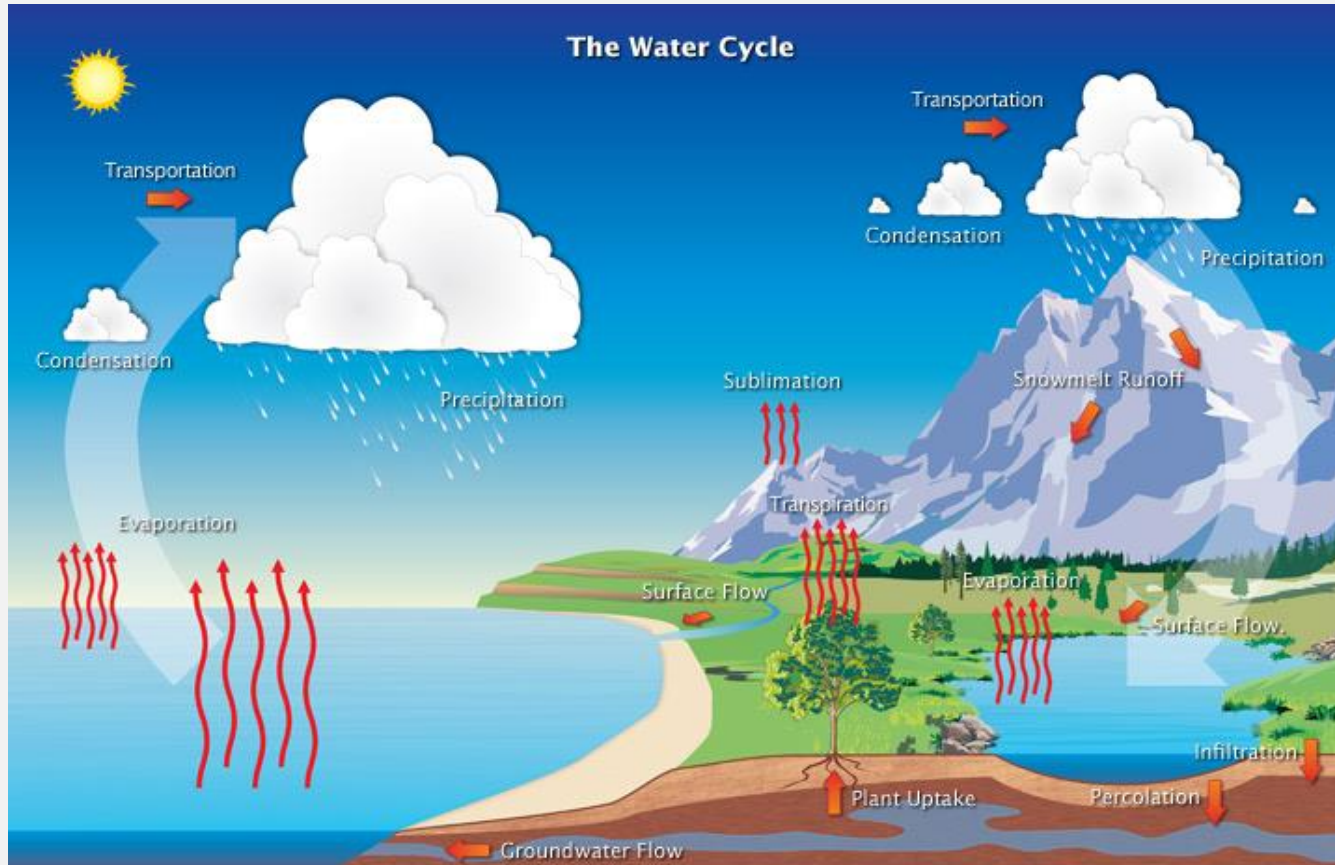


Difference Between Snow Depth and SWE



- Snow depth is the depth of snow on the ground. This is water in solid state.
- SWE is the amount of water available in the snow at a given time. This is water in liquid state.
- Note the difference in magnitude, both are in meters, but SWE is significantly lower than Snow Depth.

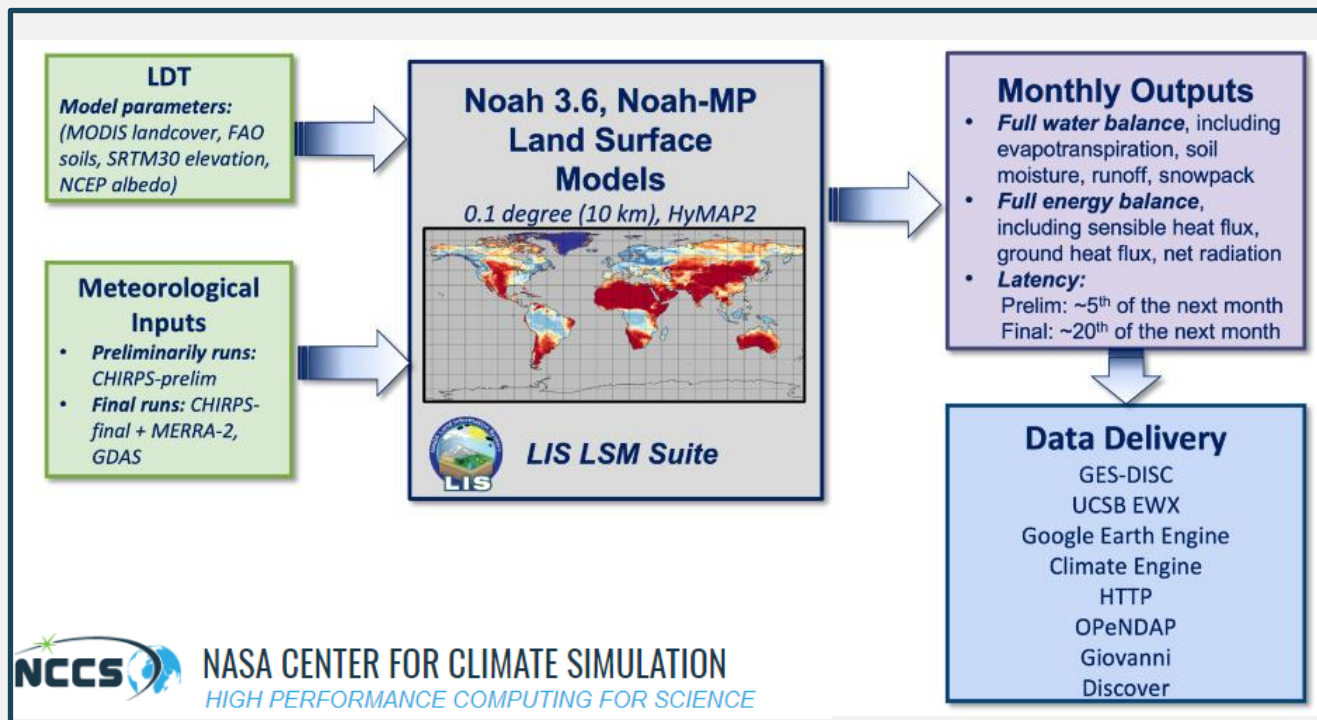
Let's Get into the Model



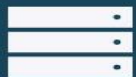
- Global water cycle

- Upstream, Midstream, and Downstream regions of a River catchment.

Land Surface Hydrology Modeling



NCCS NASA CENTER FOR CLIMATE SIMULATION
HIGH PERFORMANCE COMPUTING FOR SCIENCE



AGGREGATE

97,597 total cores
8.1 PetaFlop/S



FILE SYSTEM & STORAGE

IBM GPFS
49.5 PB Disk



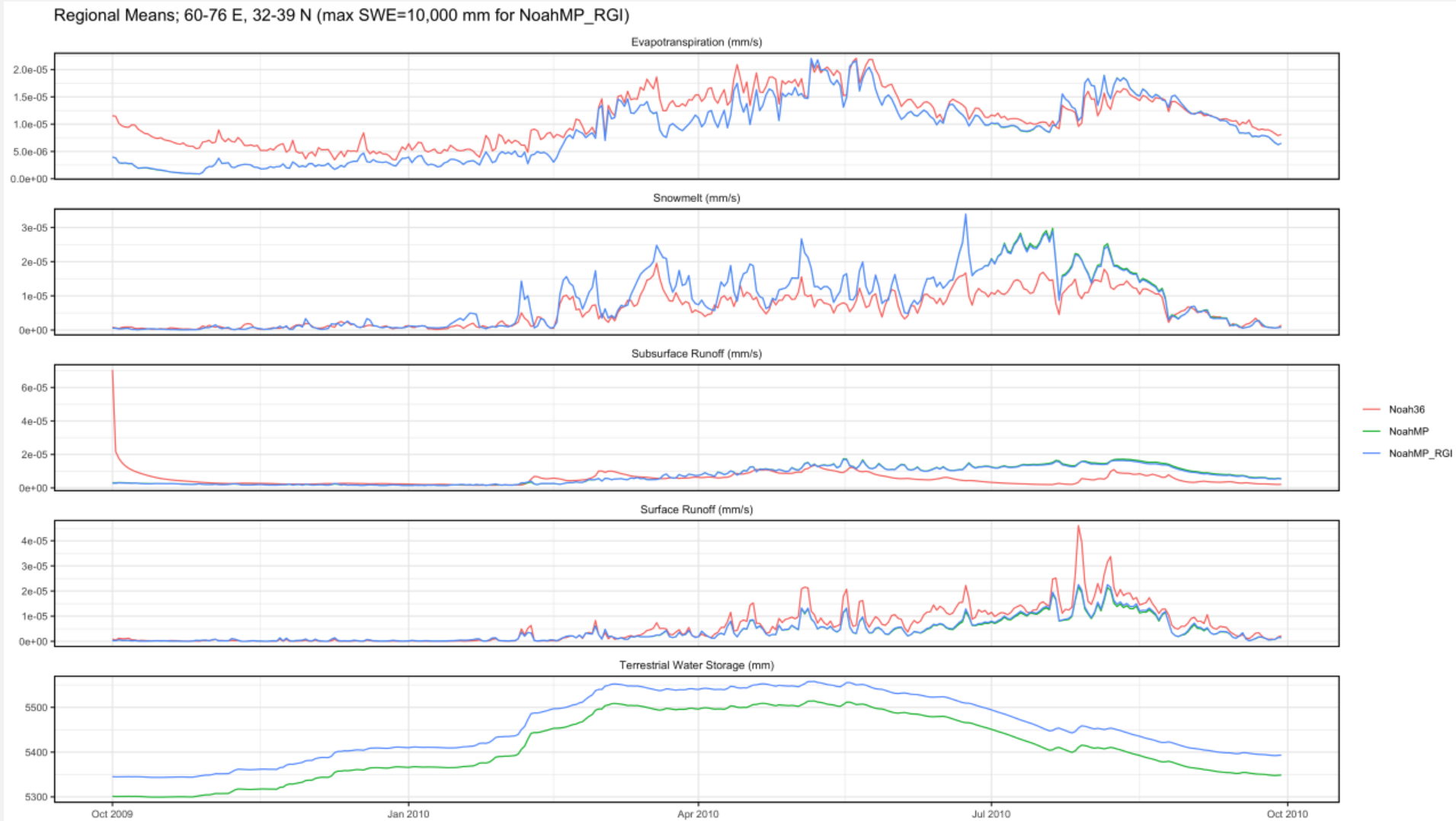
OPERATING ENVIRONMENT

Operating System: SLES
Job Scheduler: Slurm
Compilers: C, C++, Fortran
Analysis Apl: IDL, MatLab, R
and more

Discover

Central Asia Snow Modeling	LIS 7.3 Noah 3.6 and LIS7.4 Noah MP 4.0.1 daily runs
projection	Lat-Lon
Spatial extent	Central Asia Domain (30-100°E, 21-56°N)
Spatial Resolution*	0.01x0.01 degree (1km x 1 km)
Time Period	2001-01 to present
Temporal Resolution**	30-min
Forcing	Datasets derived from satellite measurements and atmospheric analyses (GDAS)
Forcing Heights	2 m for air temperature and specific humidity, 10 m for wind
Elevation Definition	SRTM
Vegetation Definition	IGBP-MODIS
Soil Texture	STATSGOFAO
Albedo	monthly climatology, NCEP_Native
Max Snow Albedo	Barlage_Native
Greenness	NCEP Greenness fraction
Land mask Definition	MOD44W
Soils Definition	Reynolds, Jackson, and Rawls [1999]
Land Surface Models	Noah3.6.1, NoahMP4.0.1
Soil layers	4 layers: 0-0.1 m, 0.1-0.4 m, 0.4-1.0 m, 1.0-2.0 m
Output format	NetCDF

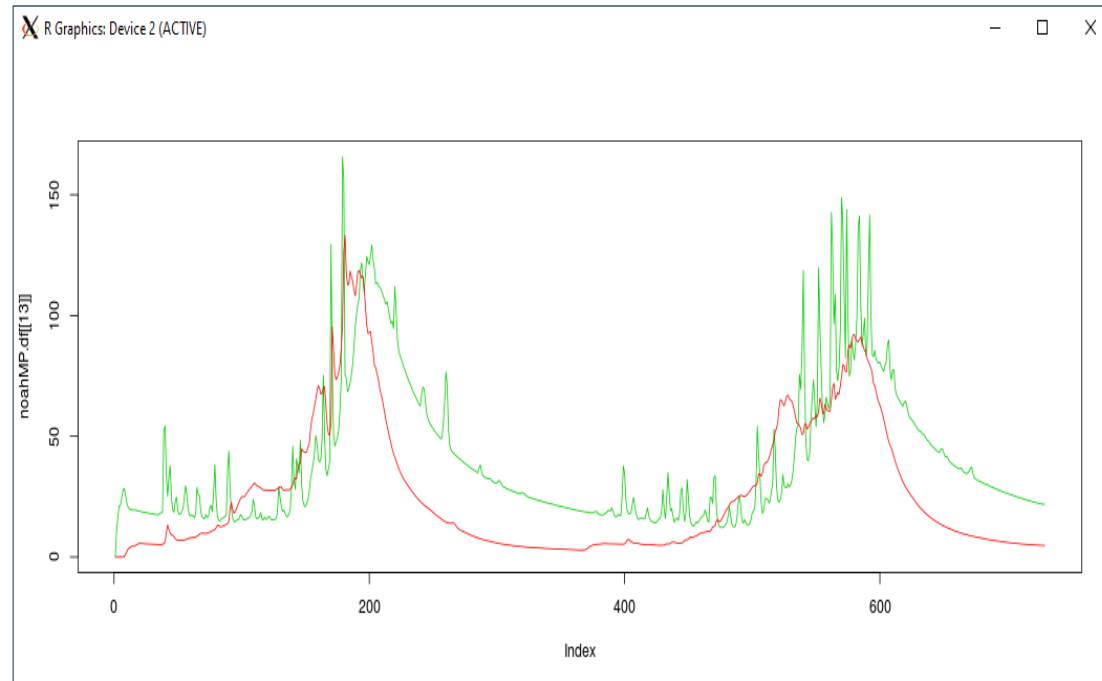
Why Did We Switch from Noah 3.6 to Noah-MP 4.0.1?



- Improved simulation of snow and snowmelt

Why Did We Switch from Noah 3.6 to Noah-MP 4.0.1?

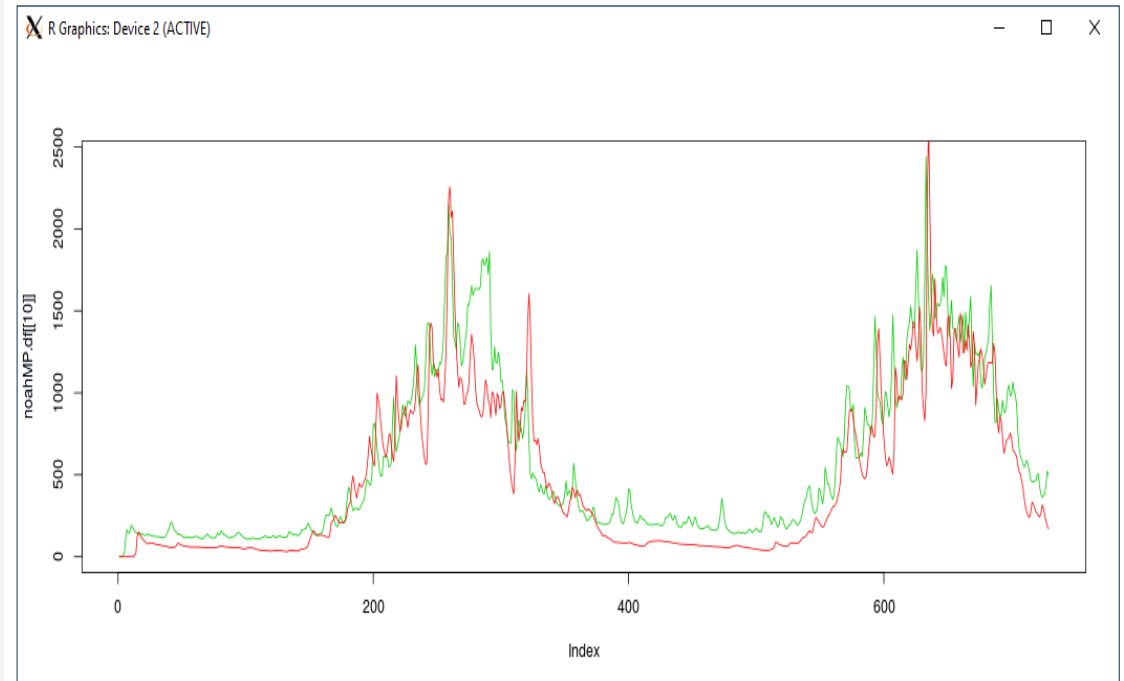
Khulm



2 years (00/01, 01/02)

— NoahMP 4.0.1
— Noah 3.6

Kabul-Indus East

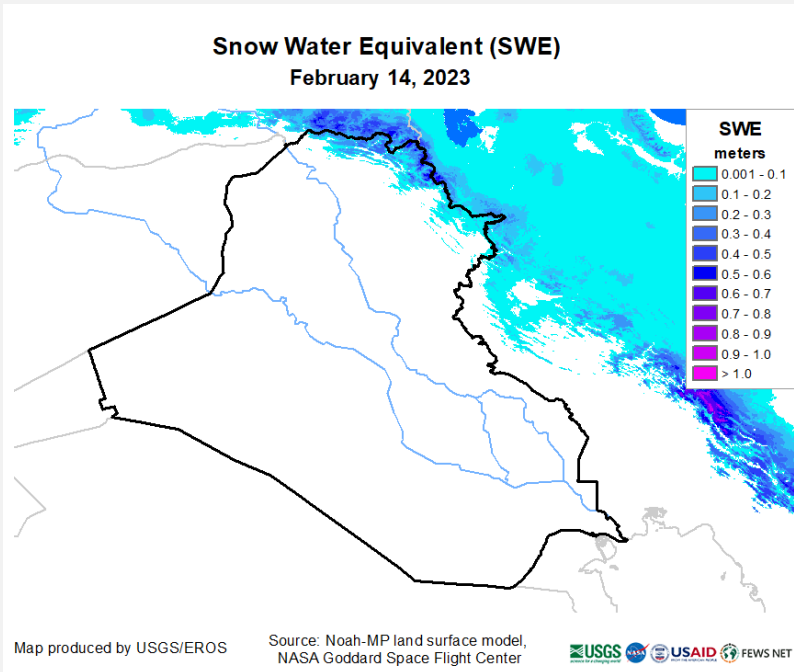


2 years (00/01, 01/02)

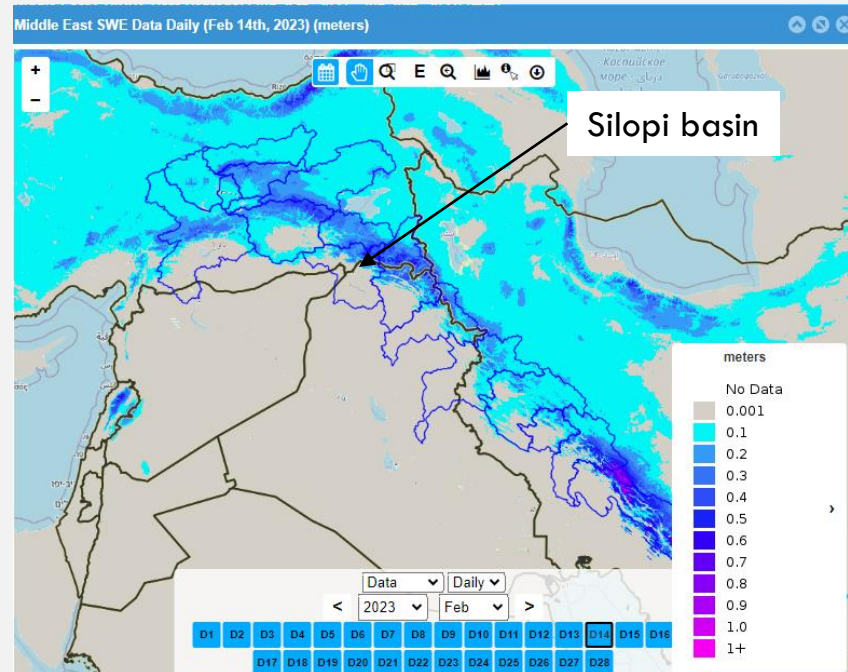
— NoahMP 4.0.1
— Noah 3.6

- Improved simulation of snowmelt and subsurface flow.

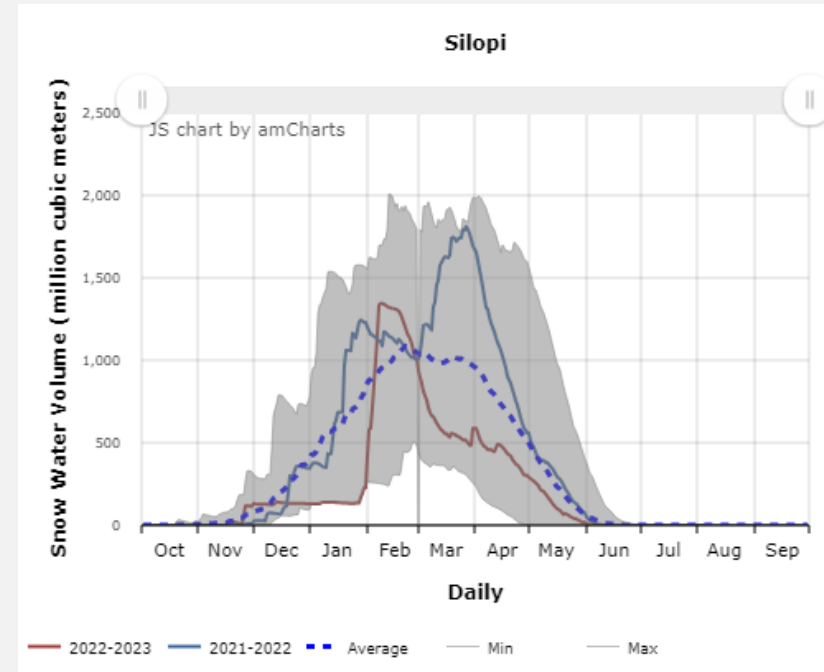
Difference Between SWE and SWE Curve



A map (png or pdf format) at <https://earlywarning.usgs.gov/fews/product/505> or at your web page



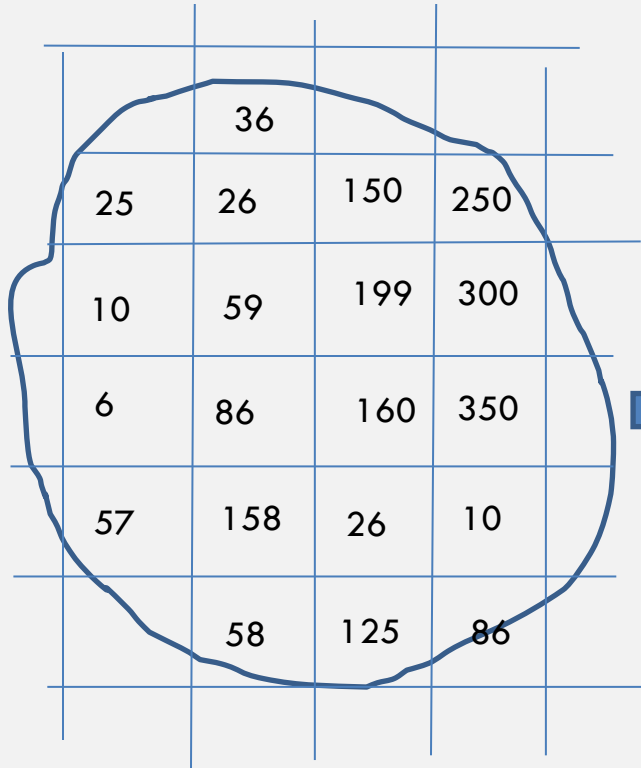
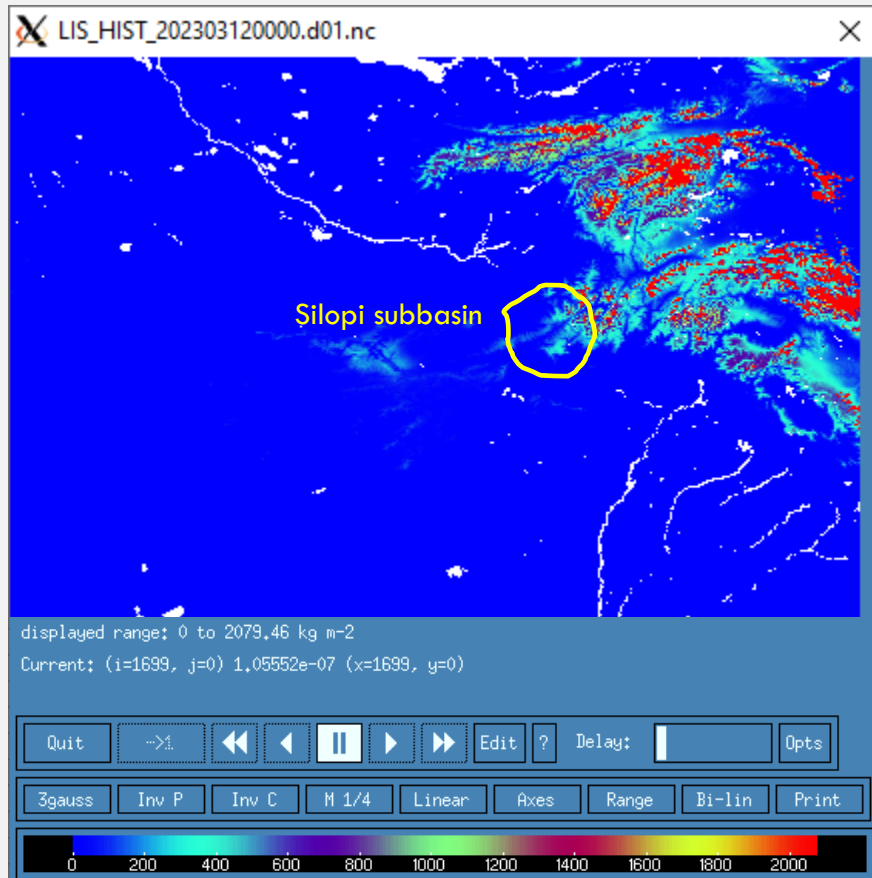
SWE actual data in raster format in EWX (Early Warning Explorer)
<https://earlywarning.usgs.gov/fews/ewx/index.html?region=me>



SWE curve

- SWE is the amount of water available in the snow at a given time. It is the output of the land surface model which is produced daily.
- SWE curve is the summary of SWE over a subbasin and presented as time series.

How Do We Go from SWE to SWE Curve



In Kg m⁻²

1. Average 180.3 kg m⁻²
or
180.3/1000 = 0.1803 m of water

2. Total area = 20 cells * cell resolution
3. Our cell resolution is 1 km x 1 km
or
1000 m x 1000 m

What was the total volume of water?

= 0.1803 m x 1000 m x 1000 m x 20
= 3,606,000 m³
= 3,606,000 / 1,000,000 million m³
= **3.6 million m³**

On Mar 12 of 2023

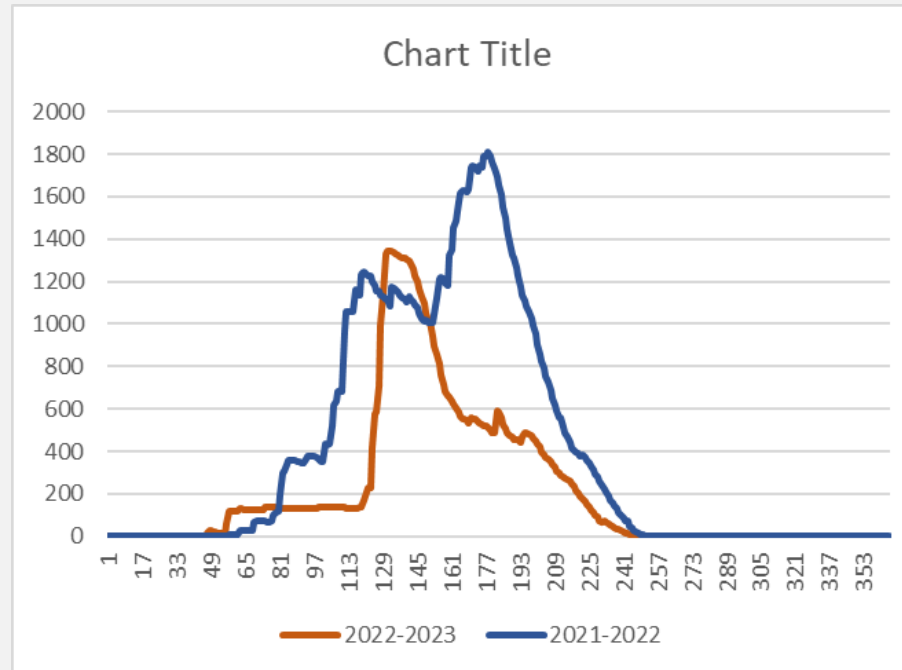
SWE is in Kg m⁻²

999.97246766225 or roughly 1000 Kg m⁻²

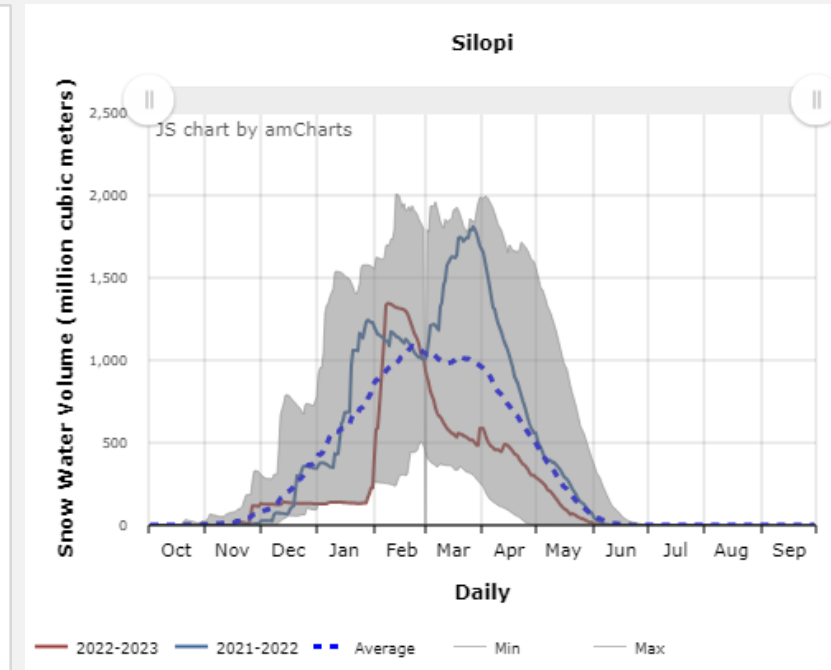
= 1 m of water

SWE Curve for Silopi Subbasin

	A	B	C	D	E	F	G	H
1	month	day	min	max	average	2022-2023	2021-2022	
92		30	94.048	723.465	375.787	131.002	347.918	
93		31	94.048	778.542	405.9904	131.002	344.263	
94	Jan	1	130.412	919.476	426.7708	130.412	363.289	
95		2	130.071	954.936	428.3656	130.071	376.599	
96		3	129.721	954.235	435.1218	129.721	376.865	
97		4	129.621	1045.57	447.1111	129.621	376.741	
98		5	129.34	1284.2	470.4954	129.34	374.591	
99		6	130.497	1333.805	488.0727	130.497	369.227	
100		7	136.044	1347.004	512.4445	136.044	362.508	
101		8	138.962	1384.649	537.5636	138.962	354.034	
102		9	139.75	1435.589	560.6326	139.75	349.022	
103		10	139.811	1534.862	570.5497	139.811	434.291	
104		11	139.616	1538.928	568.8694	139.616	430.696	
105		12	138.732	1537.96	567.2227	139.305	433.494	
106		13	133.355	1535.731	576.6101	138.794	522.781	
107		14	139.284	1531.609	585.5657	139.284	615.911	
108		15	138.145	1523.149	587.4271	138.145	634.66	
109		16	137.311	1515.629	588.9661	137.311	682.179	
110		17	136.353	1504.582	598.58	136.353	685.651	
111		18	135.641	1492.245	609.3603	135.641	684.164	
112		19	134.957	1469.165	645.5008	134.957	964.119	
113		20	134.441	1447.284	666.0388	134.441	1059.252	
114		21	134.053	1417.288	662.0803	134.053	1061.236	
115		22	133.677	1400.52	664.0906	133.677	1060.233	
116		23	133.294	1421.408	674.9227	133.294	1057.583	
117		24	132.875	1463.544	702.7801	132.875	1164.309	
118		25	133.084	1567.54	711.7506	133.084	1152.587	
119		26	135.705	1576.829	715.8132	135.705	1134.815	
120		27	135.565	1578.251	735.1404	135.565	1232.069	
121		28	169.581	1577.043	768.5665	169.581	1245.027	



- Draft plot in excel



- Finished plot in EWX

- Record the daily SWE as ASCII or in spreadsheet
- Plot them using any plotting software

Split Silopi into Two Subbasins



Current basin boundaries in use



Practice basin boundaries during 2019 training