

Snow cover delineation for Naryn basin from remote sensing information

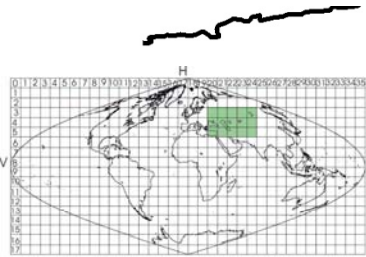
Cloud removal methodology from MODIS snow cover products

Abror Gafurov

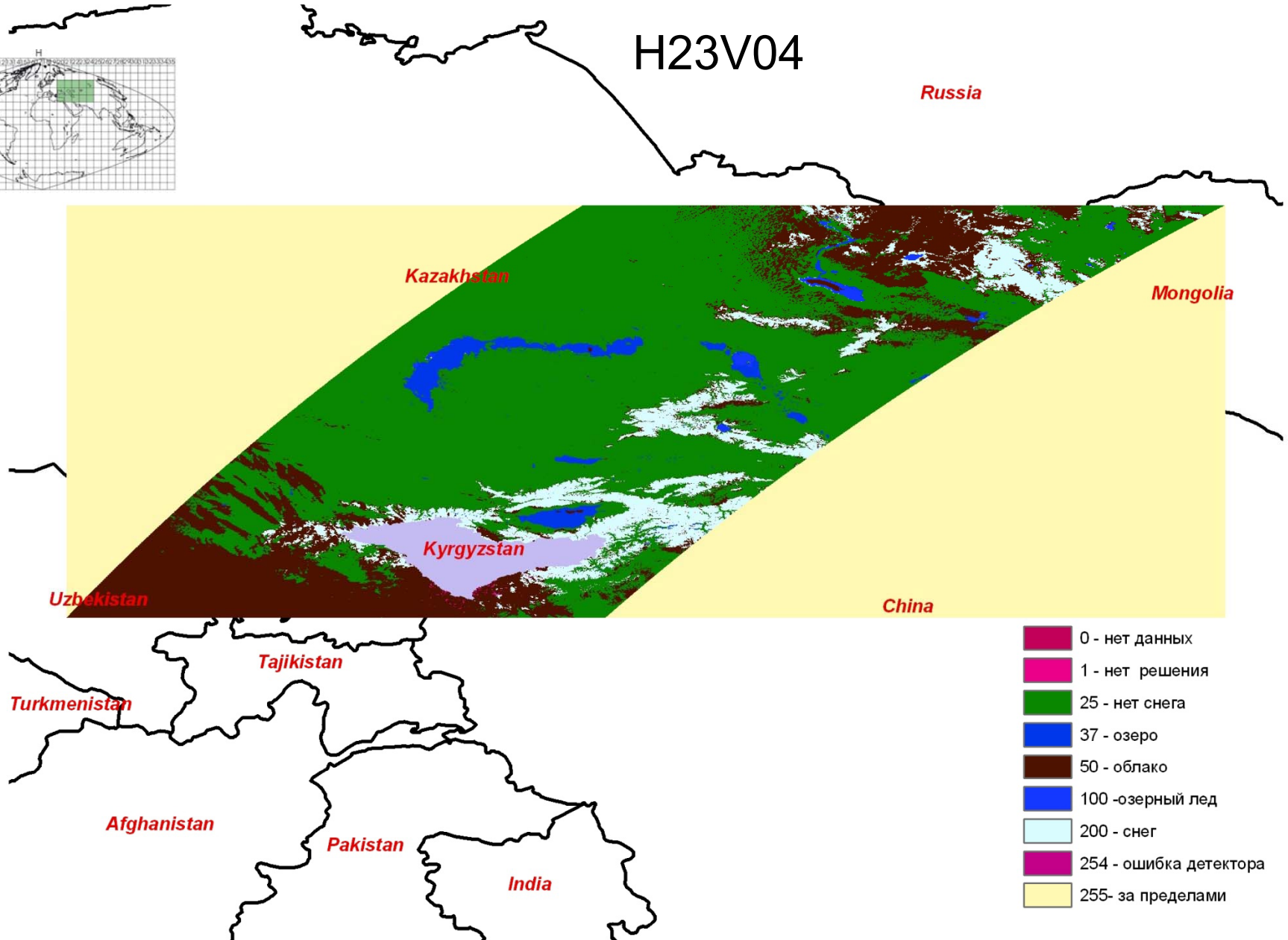
German Research Center for Geosciences (GFZ), Potsdam, Germany

MODIS

- MODIS installed onboard Terra and Aqua satellites
- Two times a day data collection
- Data from Feb 2000 (Terra) and 2002 (Aqua)
- Daily temporal resolution
- 500 meter spatial resolution
- Freely available data



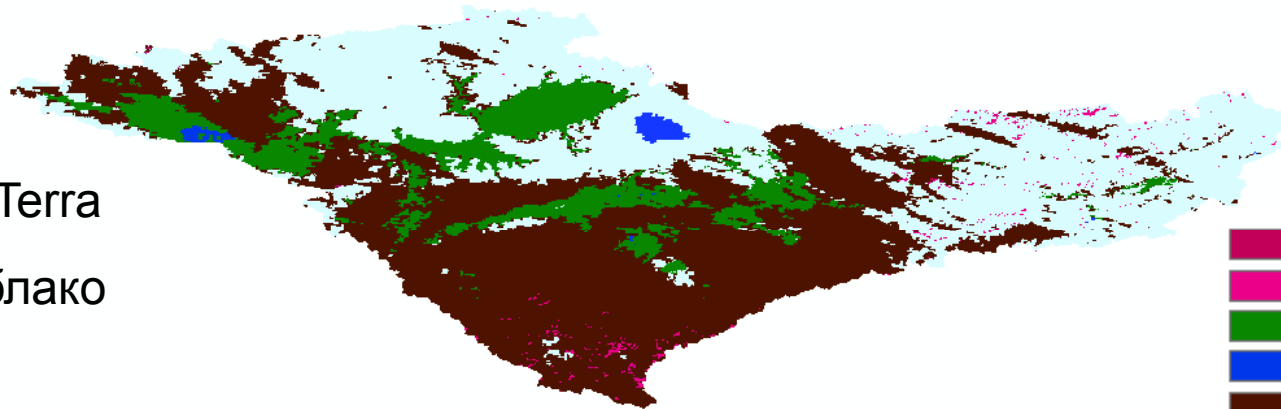
H23V04



Оригинальные данные снежного покрова

MODIS Terra

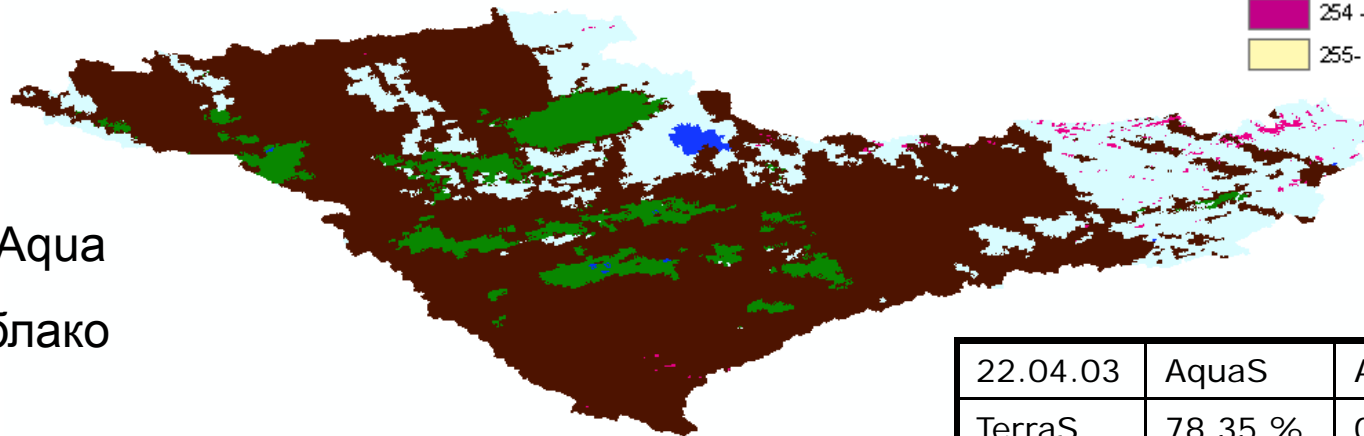
45 % Облако



- 0 - нет данных
- 1 - нет решения
- 25 - нет снега
- 37 - озеро
- 50 - облако
- 100 - озерный лед
- 200 - снег
- 254 - ошибка детектора
- 255- за пределами

MODIS Aqua

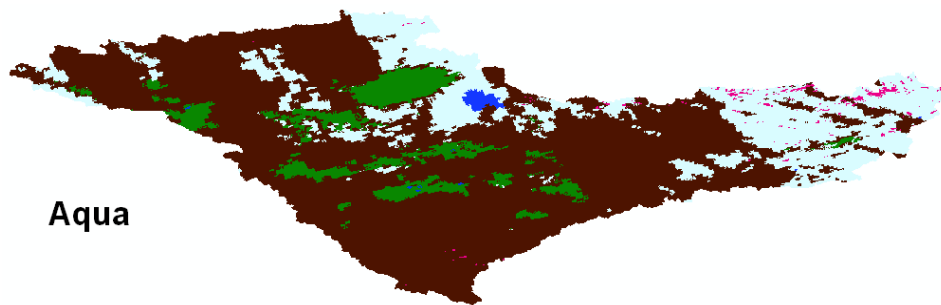
68 % Облако



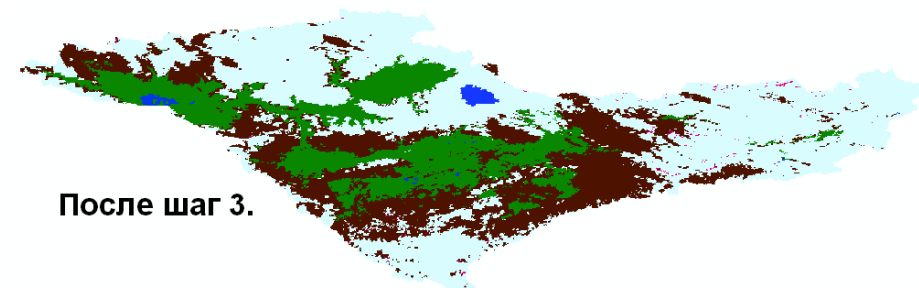
22.04.03	AquaS	AquaL
TerraS	78,35 %	0,86
TerraL	0,34	20,45

MODSNOW algorithm for cloud removal

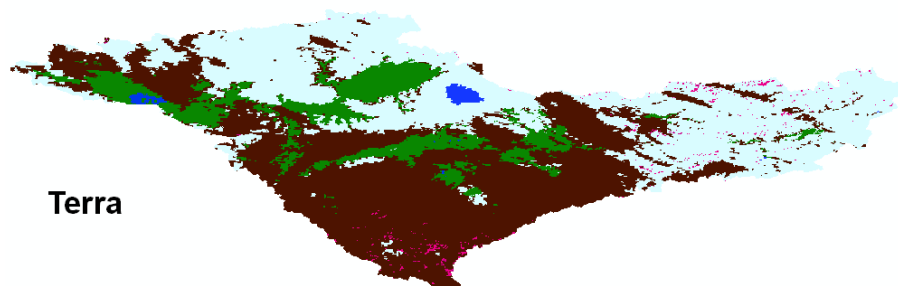
- Input data
 - Daily snow cover data in Ascii format
 - Digital elevation model in Ascii format
- Consists of 6 steps
 1. Combination of Terra and Aqua images
 2. Temporal combination of cloud covered pixels
 3. Minimum and maximum snow elevation lines
 4. Combination of neighboring pixels
 5. Combination of neighboring pixels and elevation between them
 6. Time series information of each pixel
- Each step removes some cloud cover and the results is used as an input for the next step



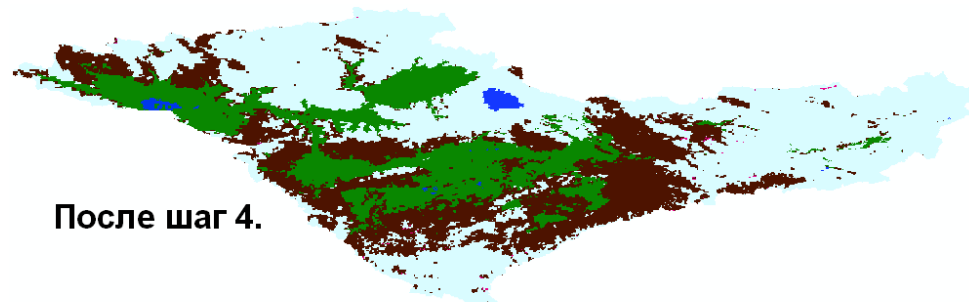
Aqua



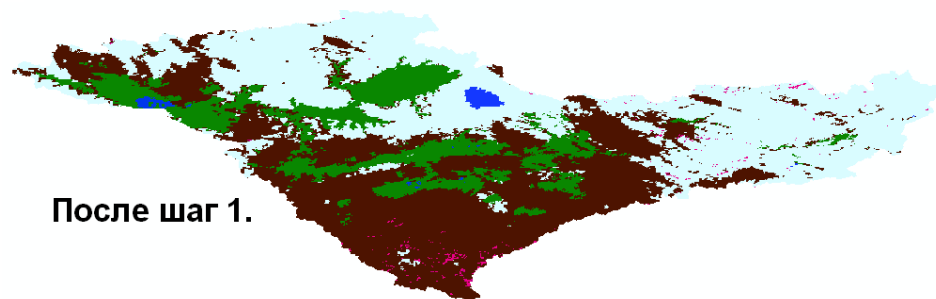
После шаг 3.



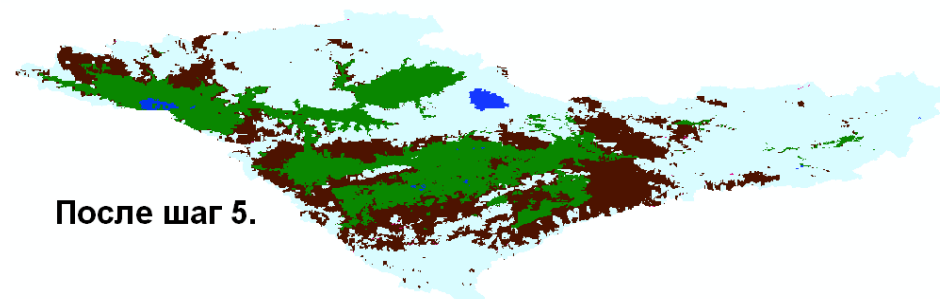
Terra



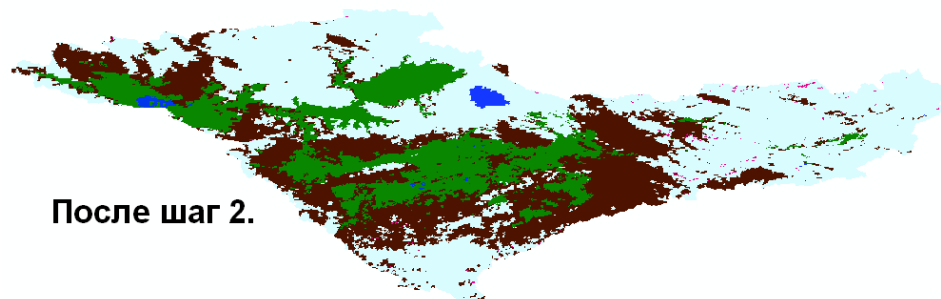
После шаг 4.



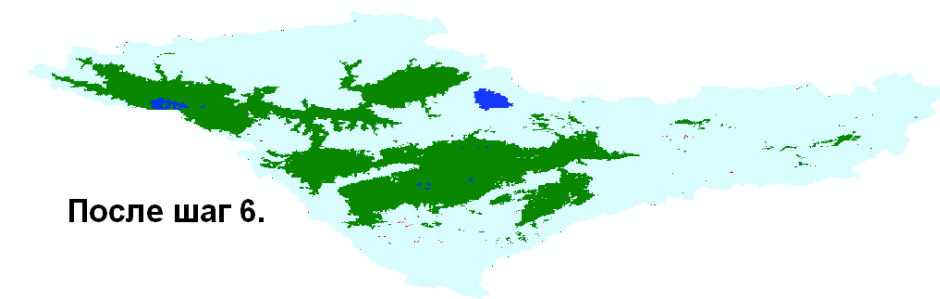
После шаг 1.



После шаг 5.



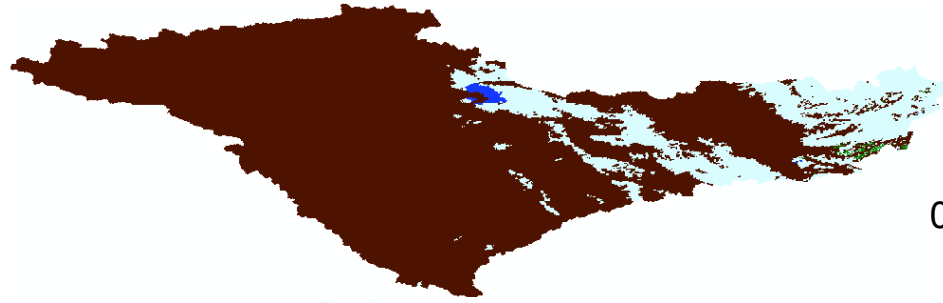
После шаг 2.



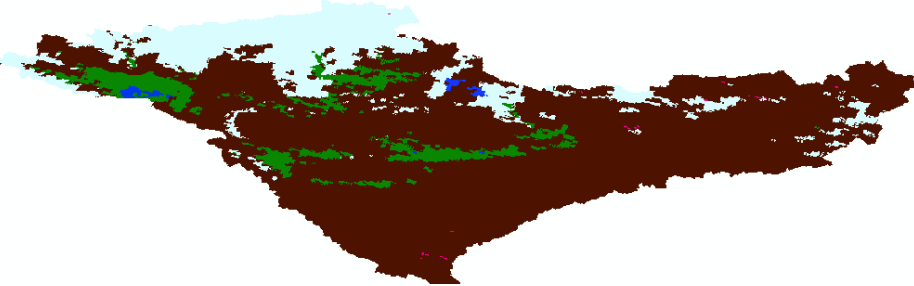
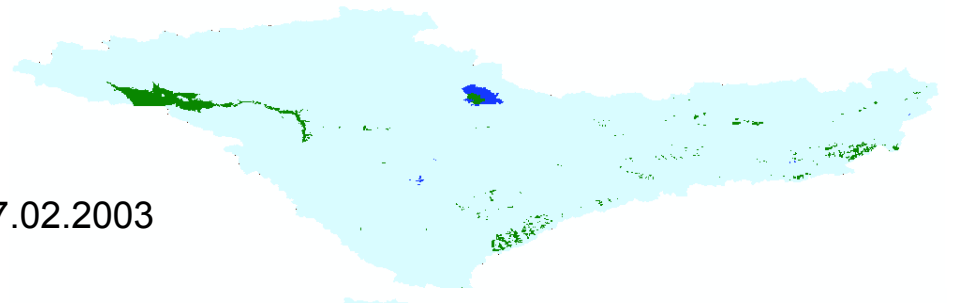
После шаг 6.

Original

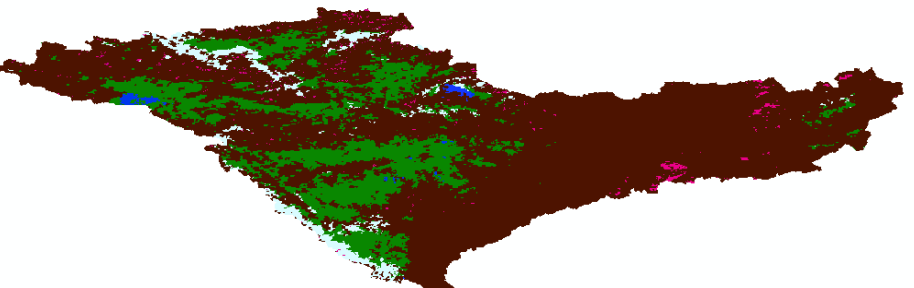
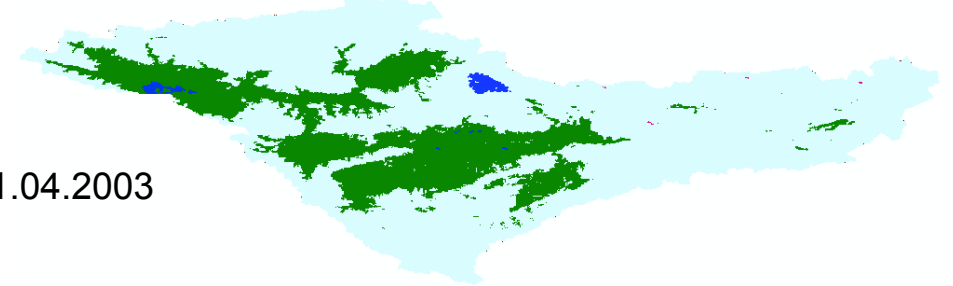
Processed



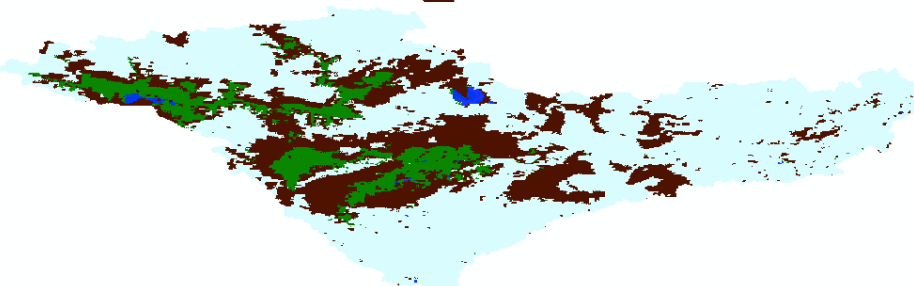
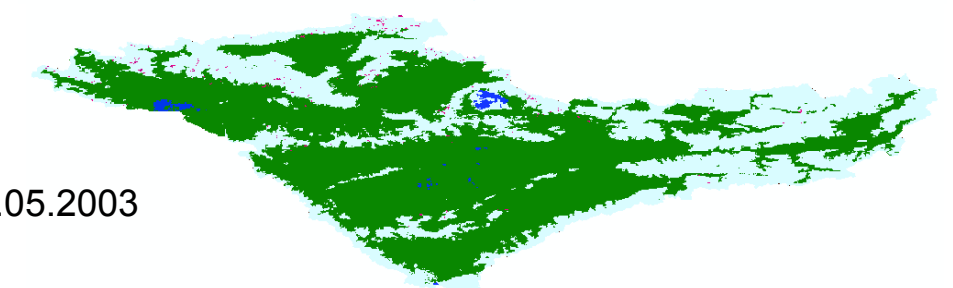
07.02.2003



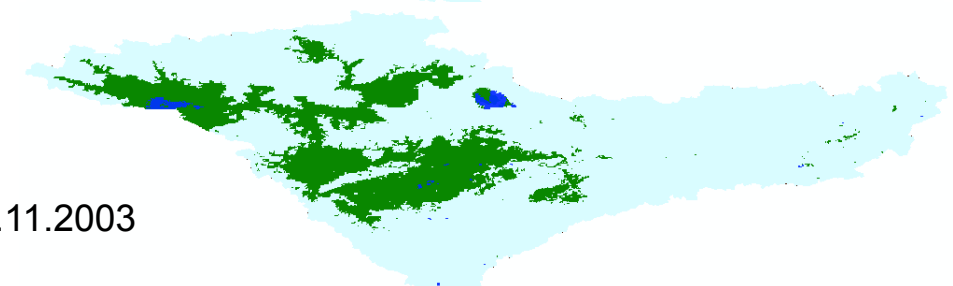
21.04.2003



15.05.2003



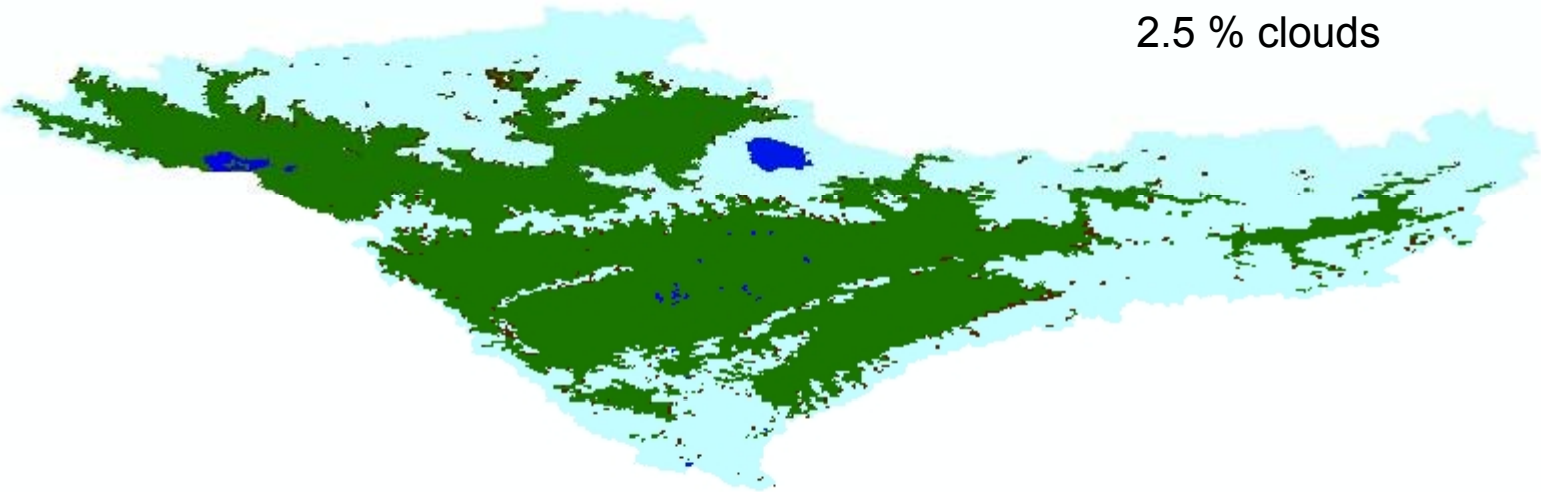
18.11.2003



Validation

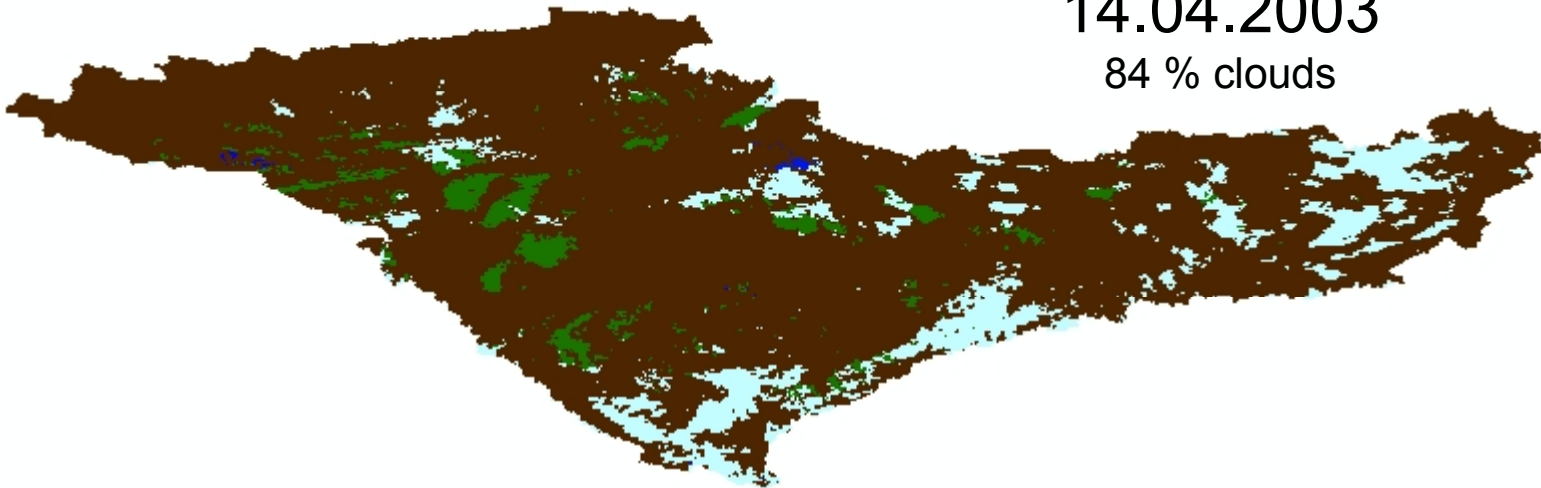
28.04.2003

2.5 % clouds



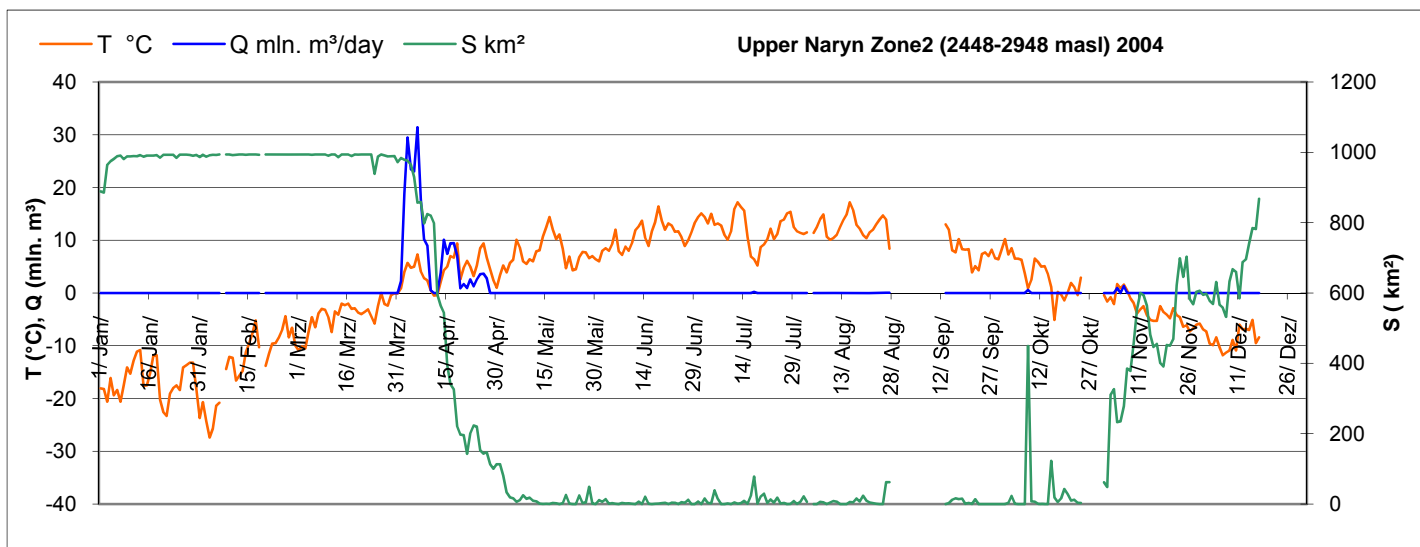
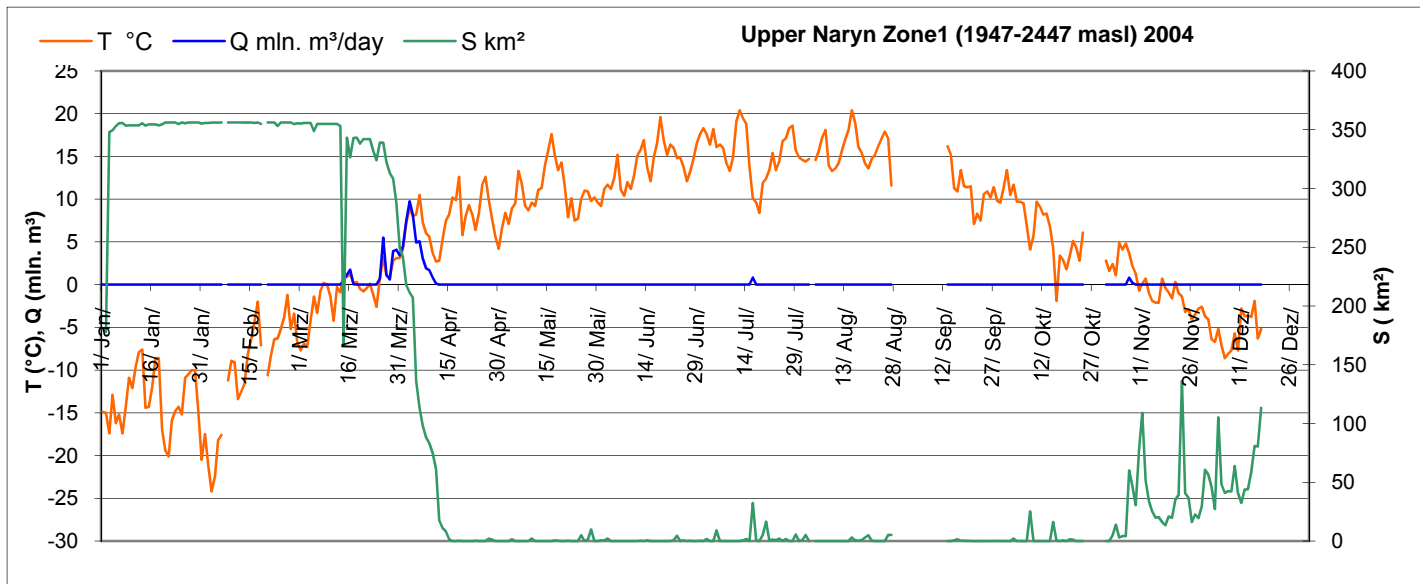
14.04.2003

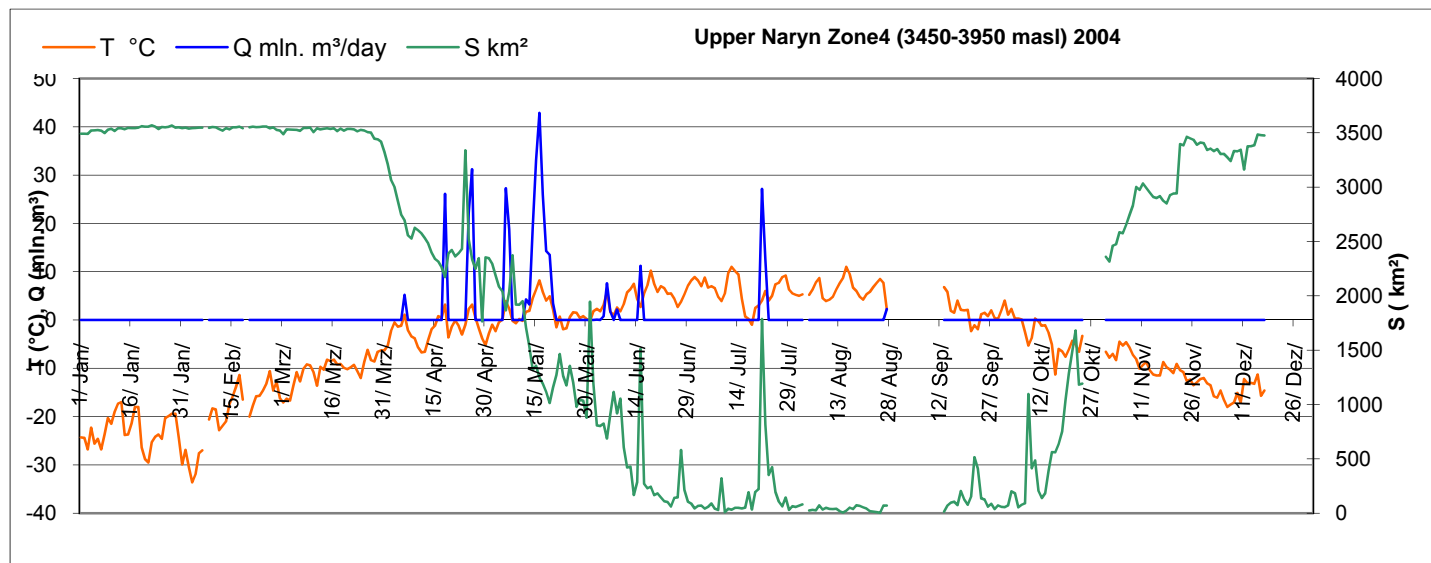
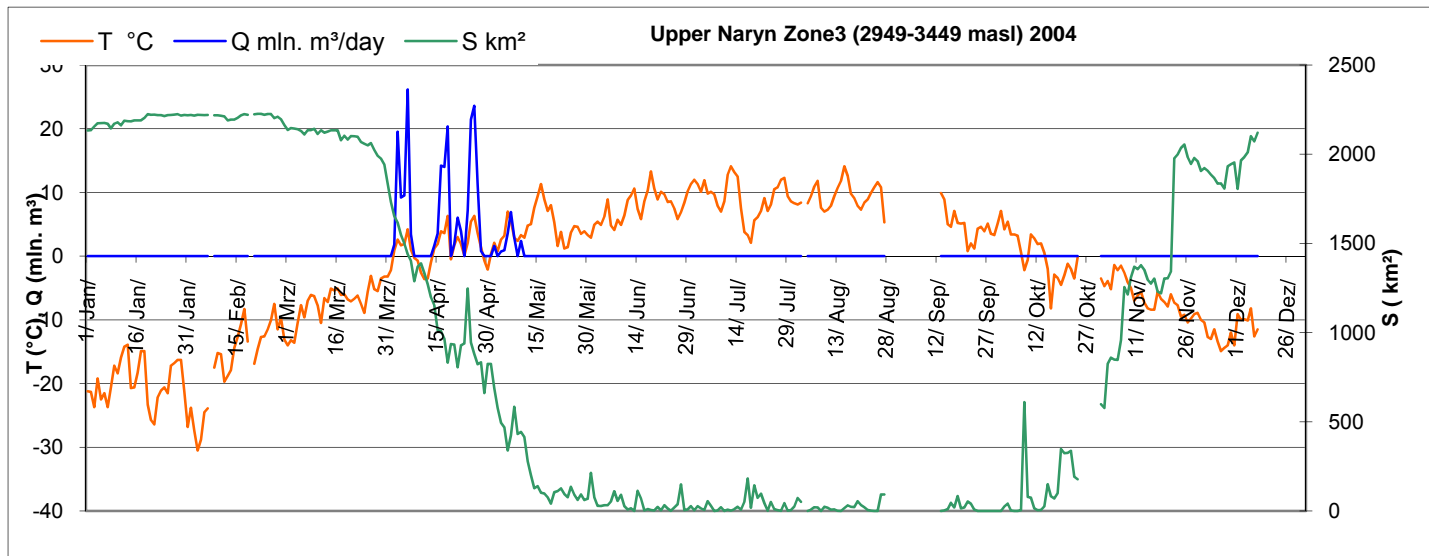
84 % clouds

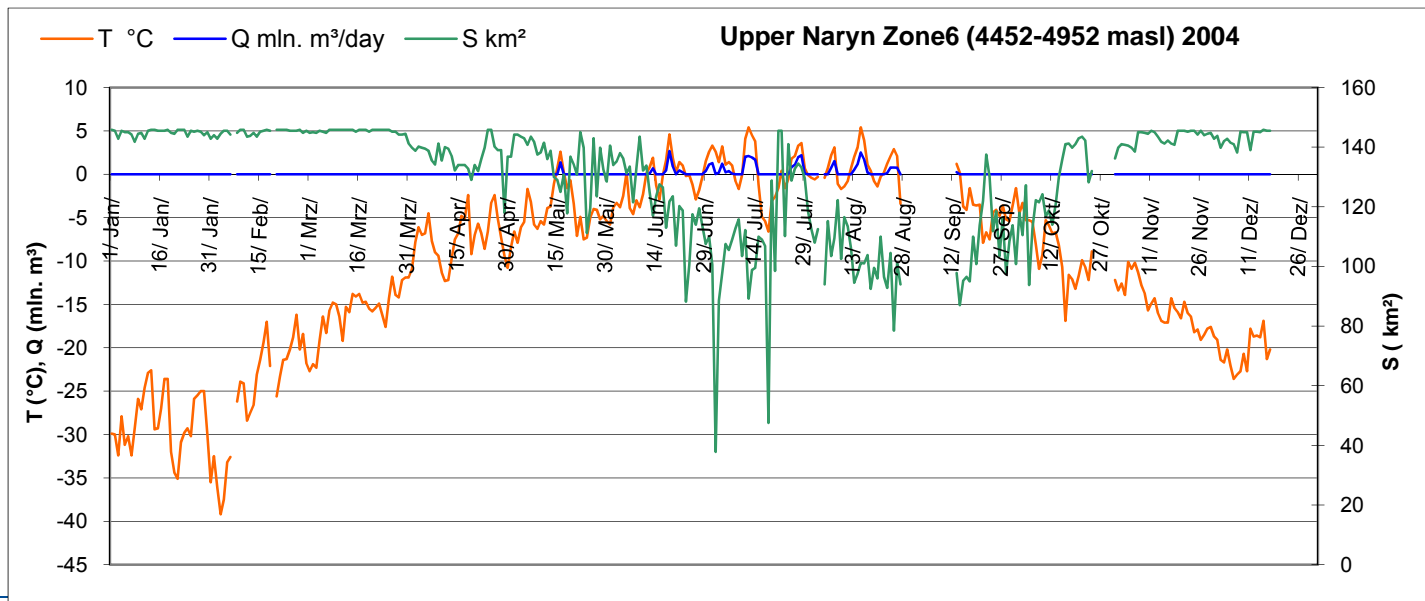
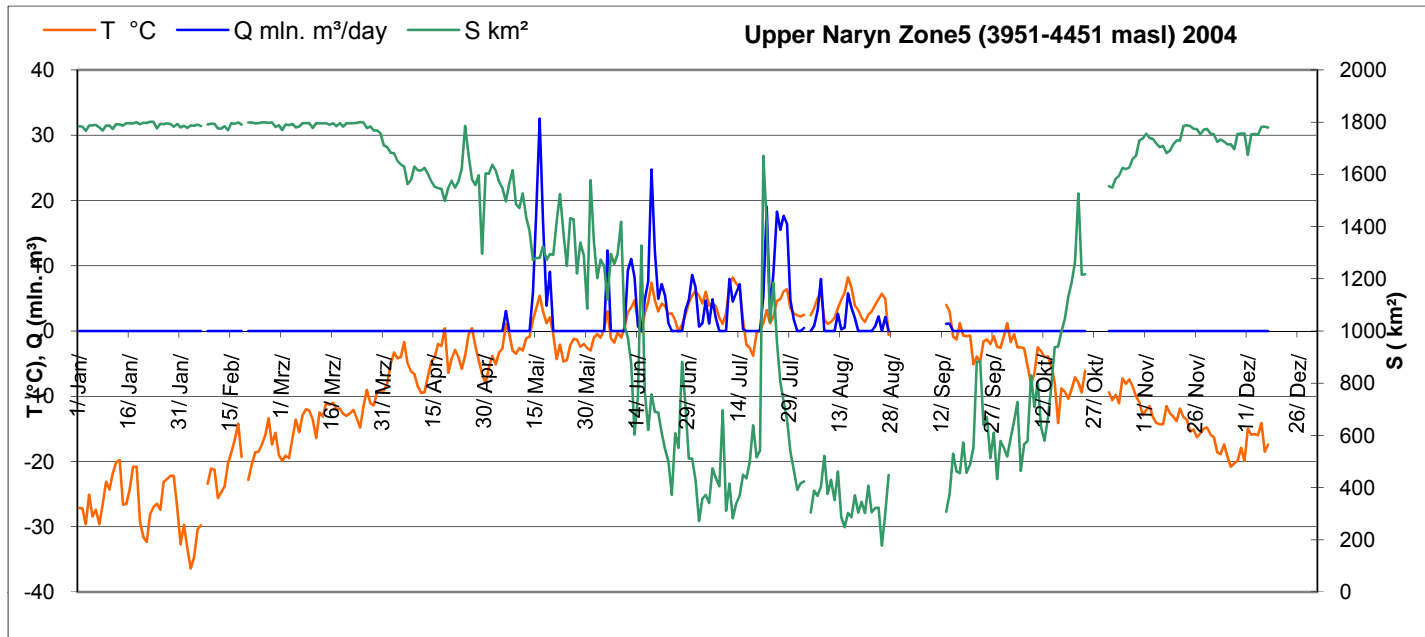


Validation

Days	Approaches	Total Cloud Elimination	TRUE	FALSE	Snow to Snow	Land to Land	Snow to Land	Land to Snow
February 9	2	55.91	55.03	0.56	38.59	16.44	0.29	0.27
	3	11.35	10.81	0.17	9.95	0.85	0.01	0.16
	4	1.66	1.57	0.06	1.23	0.34	0.01	0.05
	5	6.96	6.37	0.42	4.14	2.23	0.14	0.28
	6	24.12	19.33	4.29	7.48	11.85	3.57	0.72
March 6	2	64.03	63.70	0.02	56.02	7.68	0.01	0.01
	3	13.83	12.28	0.67	6.75	5.53	0.64	0.02
	4	1.22	1.14	0.06	0.93	0.22	0.05	0.00
	5	2.41	2.36	0.04	1.88	0.47	0.01	0.03
	6	18.52	13.22	5.19	13.18	0.04	0.00	5.18
May 6	2	78.13	73.94	3.51	26.55	47.39	2.70	0.81
	3	7.12	6.58	0.35	3.87	2.72	0.02	0.32
	4	1.38	1.24	0.10	0.55	0.68	0.08	0.03
	5	4.02	3.22	0.69	1.42	1.79	0.47	0.22
	6	9.36	6.69	2.56	3.48	3.21	1.02	1.54
November 28	2	5.94	5.40	0.49	1.28	4.12	0.21	0.28
	3	41.71	39.93	1.38	14.64	25.29	0.22	1.16
	4	1.18	1.04	0.12	0.46	0.59	0.04	0.07
	5	5.24	4.39	0.76	1.72	2.66	0.37	0.39
	6	45.93	38.69	6.90	16.57	22.12	3.72	3.18







Thank you