

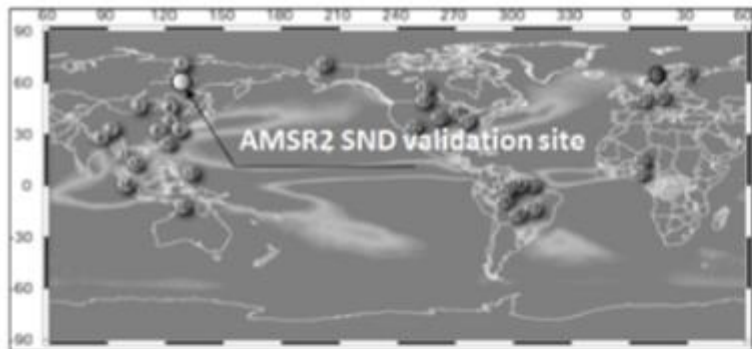
Snow depth observation at Siberia site and applied research on passive microwave remote sensing

International Centre for Water Hazard and Risk Management (ICHARM)

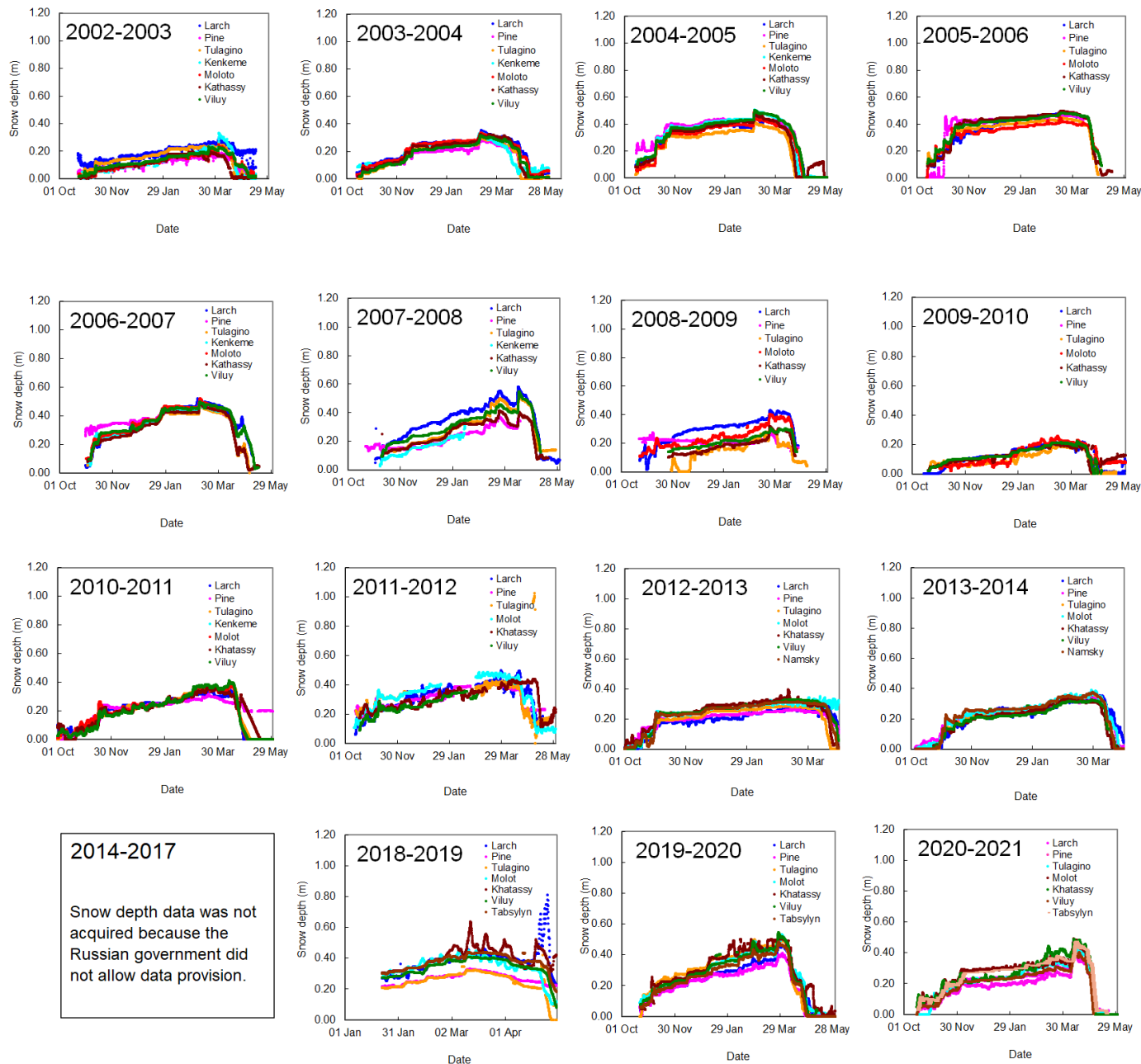
Public Works Research Institute (PWRI)

Hiroyuki Tsutsui

Snow depth observation at the seven Siberia AMSR2 snow depth validation site



Snow depth data has been acquired since 2002



Cooperation and activities of the Institute for Biological Problems of Cryolithozone

Institute for Biological Problems of Cryolithozone Siberian Branch of RAS (IBPC)



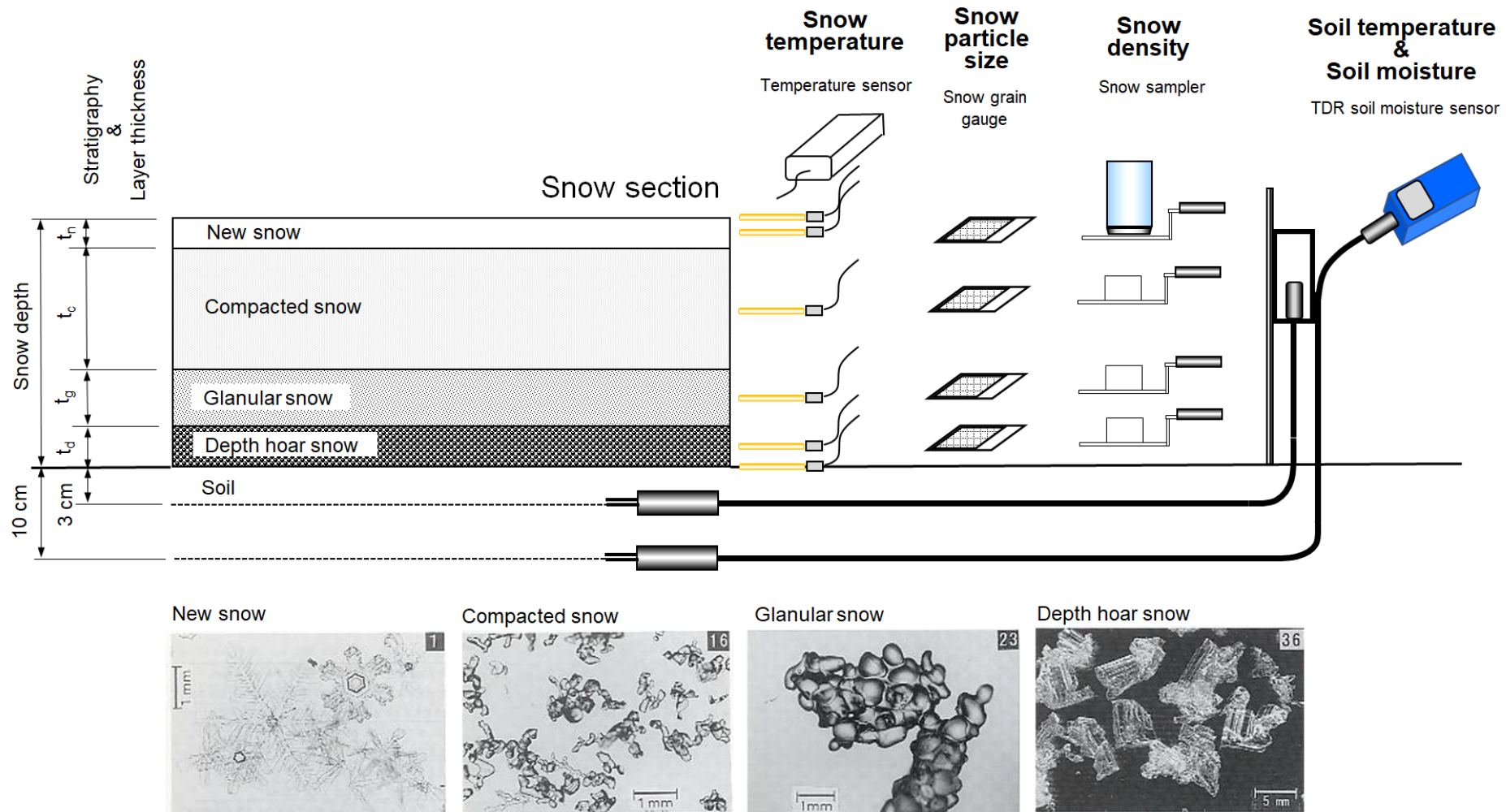
IBPC SB RAS
41, Lenina ave., Yakutsk, Russia, 677000
Phone: +7(411-2) 33-56-90
Fax: +7(411-2) 33-58-12
E-mail: ibpc@ibpc.ysn.ru
WWW: <http://ibpc.ysn.ru/>
Date of editing information: 23.01.2019



<http://ibpc.ysn.ru/>

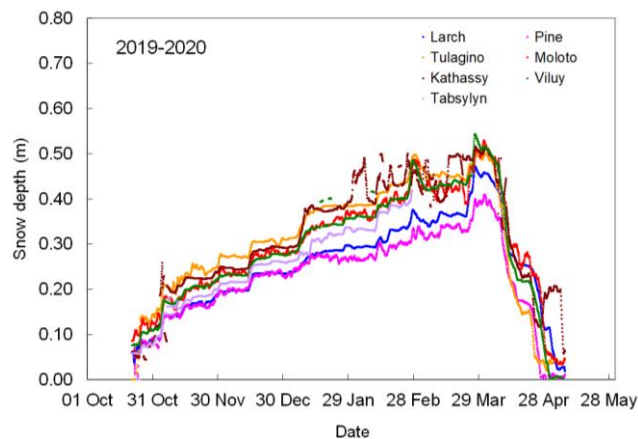
Current observation situation

Cancellation of expansion plan for observation framework due to COVID-19

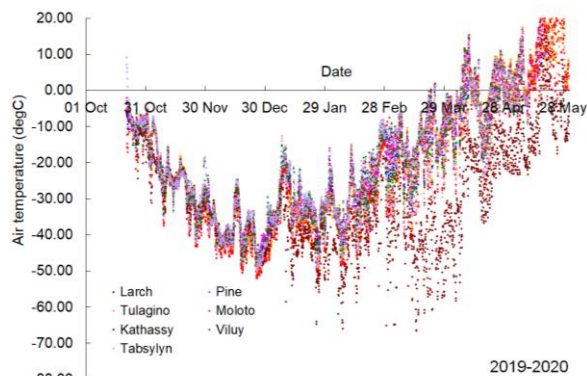


2019.10-2020.5

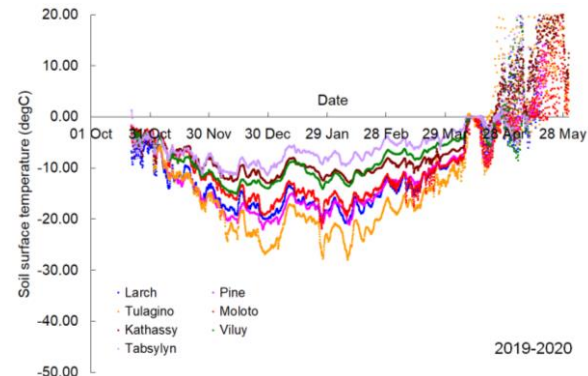
Snow depth



Snow surface temperature

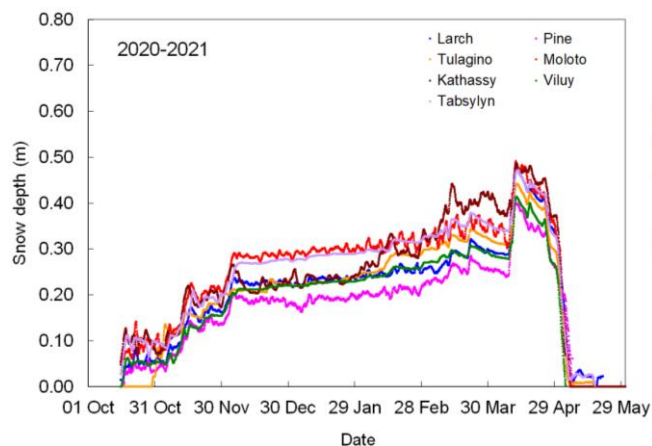


Soil surface temperature

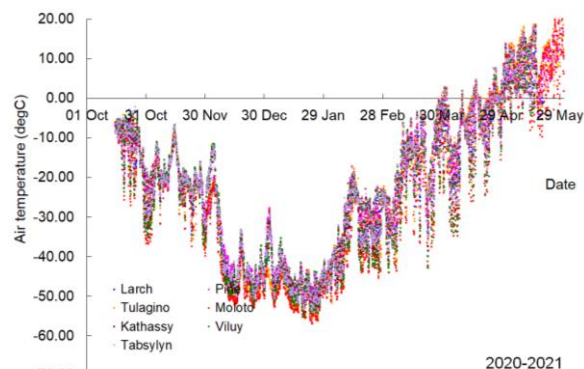


2020.10-2021.5

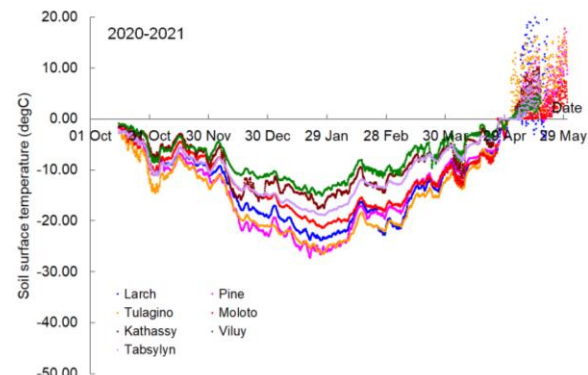
Snow depth



Snow surface temperature

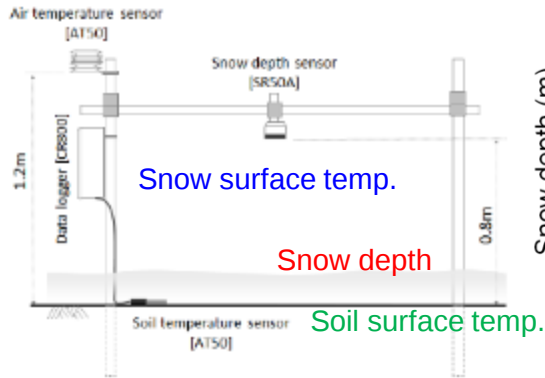


Soil surface temperature



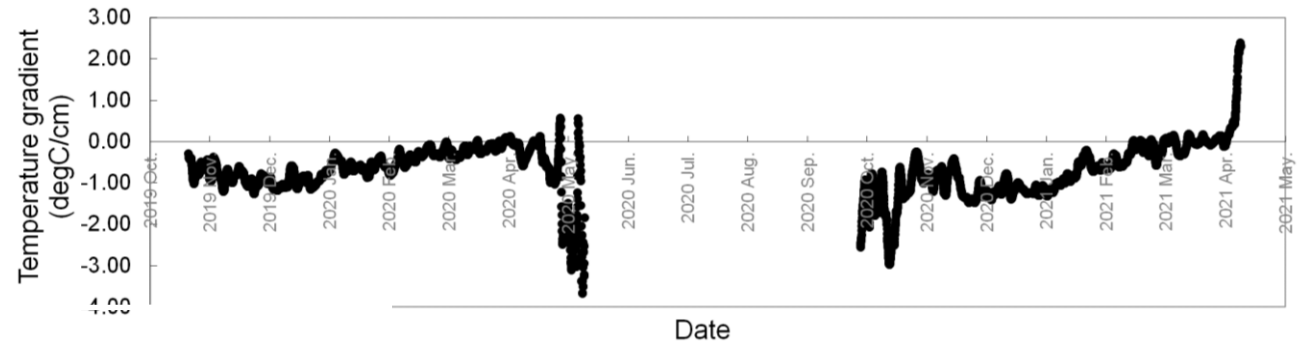
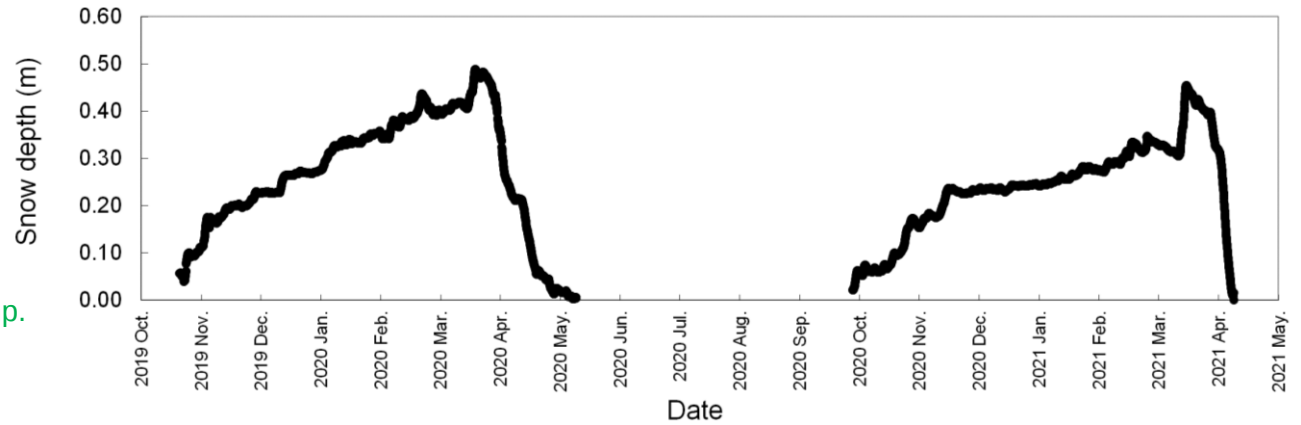
Snow temperature gradient

6



2019.10-2020.5

2020.10-2021.5

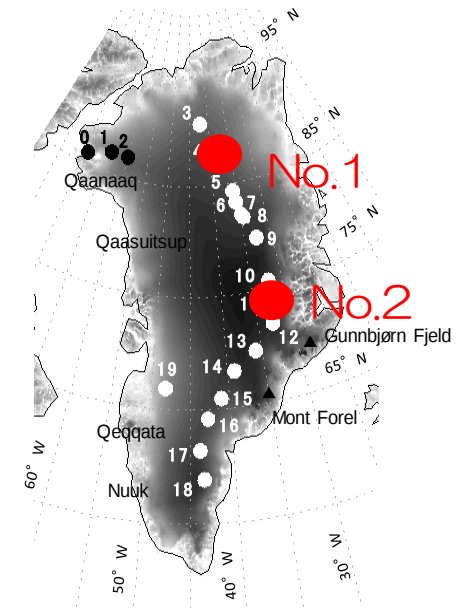


$$\text{Temperature gradient} = \frac{\text{Snow surface temperature} - \text{Soil surface temperature}}{\text{Snow depth}}$$

Study on the estimation of snow depth on the ice sheet using the passive microwave remote sensing

Effectivity of the microwave radiative transfer model for snowpack on ice sheet

López Moreno et al. (2016)



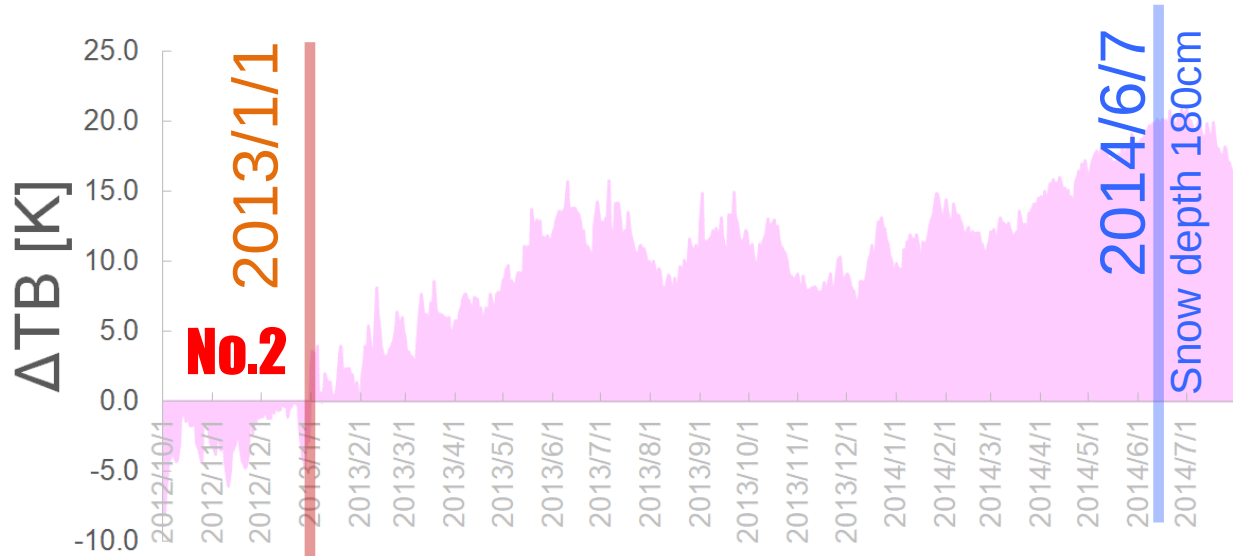
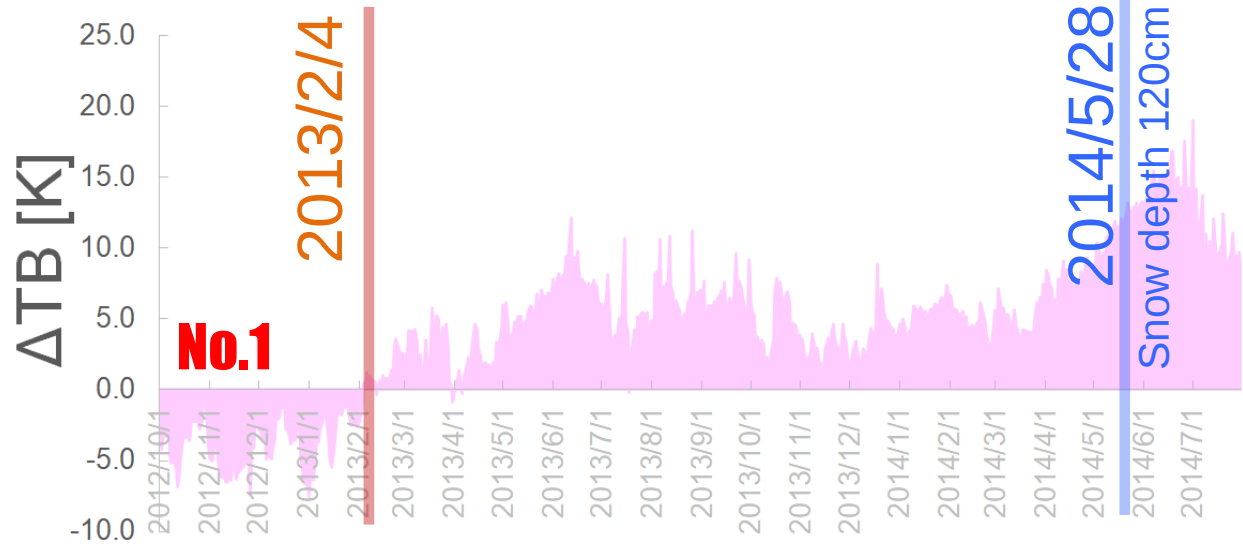
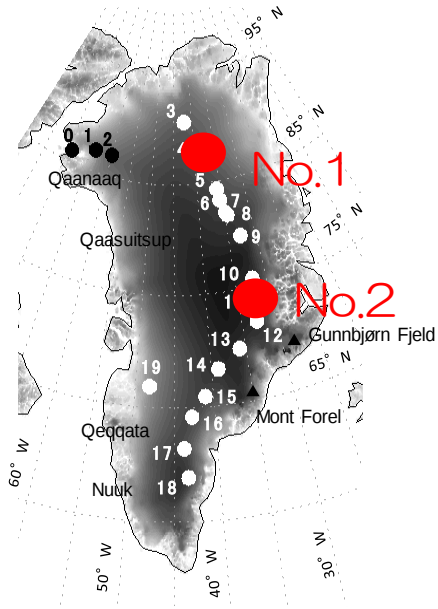
J. I. López Moreno, M. Olivera-Marañón, J. Zabalza, R. H. de Larramendi: Snowpack observations from a circumnavigation of the Greenland ice sheet (Spring 2014), CUADERNOS de INVESTIGACIÓN GEOGRÁFICA, Vol 42, No2, pp.369-381, 2016.
 INUIT WINDSLED <http://greenland.net/windsled/expedition-diary/>

Target points

	Site No	Project	Date		Latitude	Longitude	LAT	LON	Snow depth [cm]
No.1	4	INUIT WINDSLED	May 28	,2014	77 ° 70 ' 0 "N	38 ° 7 ' 0 "W	78.1666	38.1166	120 - 180
No.2	11	INUIT WINDSLED	June 7	,2014	71 ° 19 ' 0 "N	32 ° 14 ' 0 "W	71.3166	32.2333	180 - 240

Investigation and setting of the beginning date of snow accumulation based on the difference between 19 and 37 GHz(ΔTB)

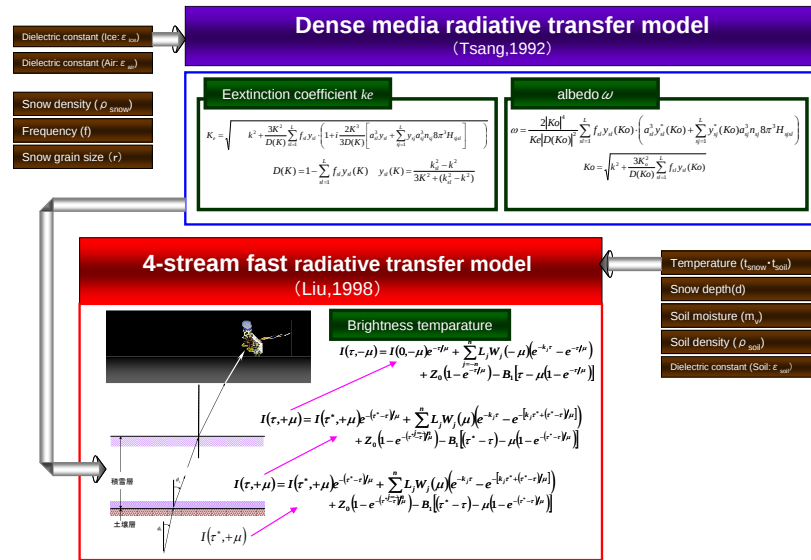
8



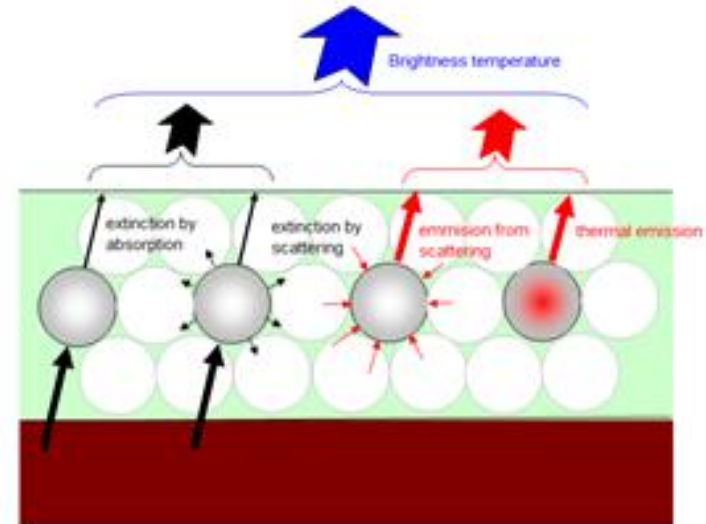
Assumption of snow physical parameter

9

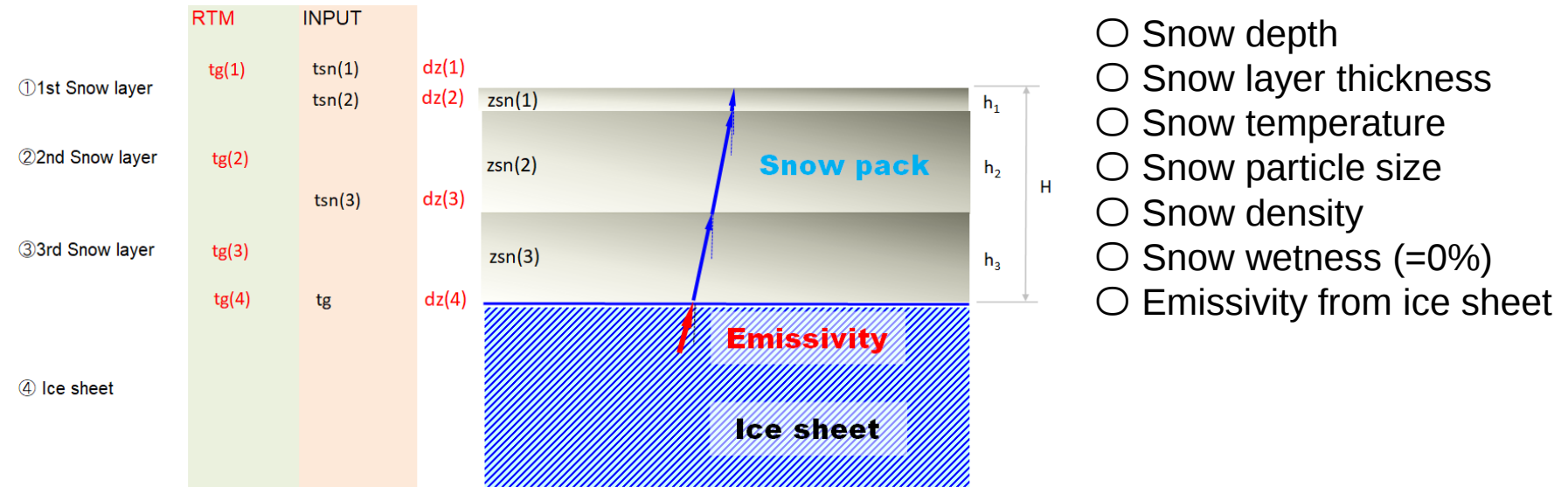
Current our microwave radiative transfer model



Single snow layer model

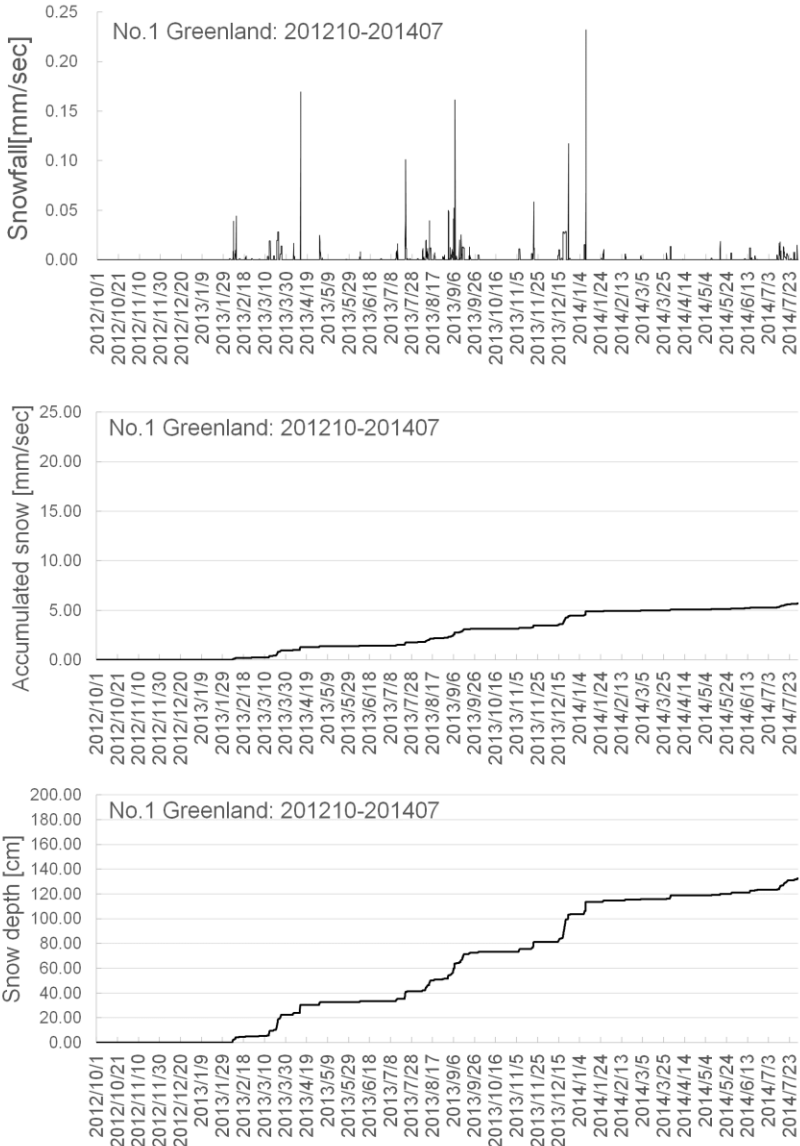


3 snow layer model

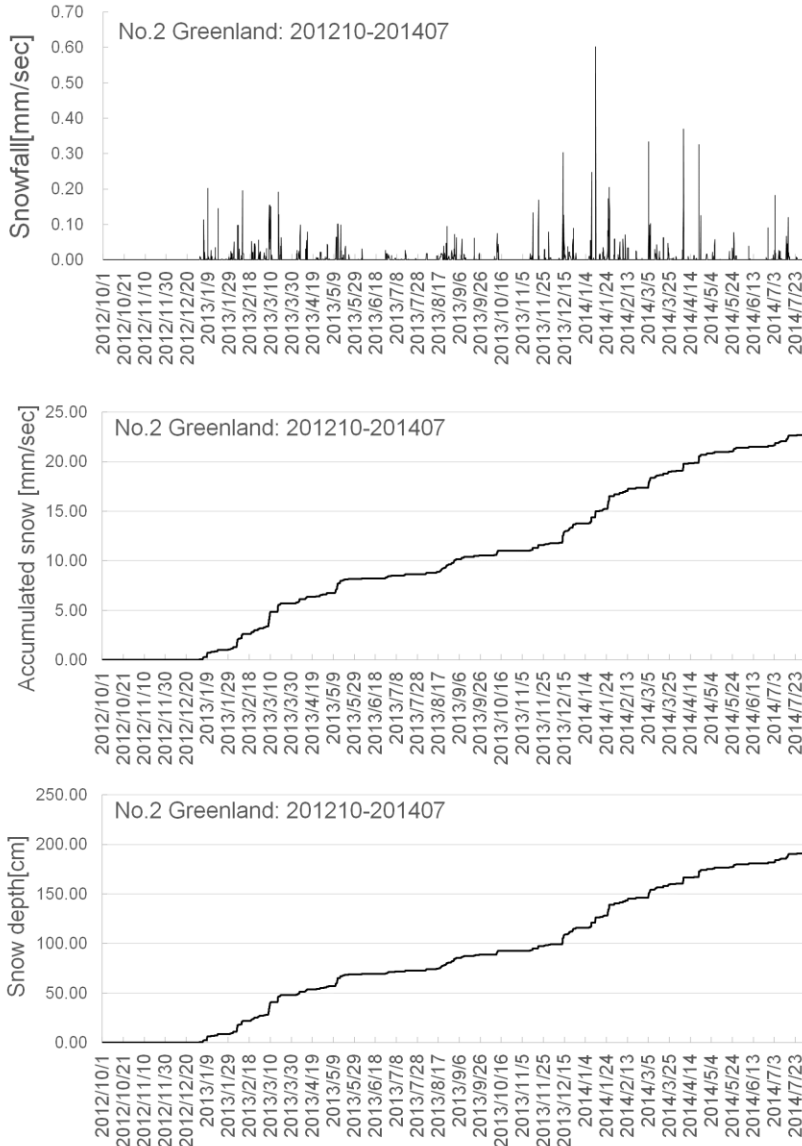


Snowfall
Accumulated
snowfall
Assumed
snow depth

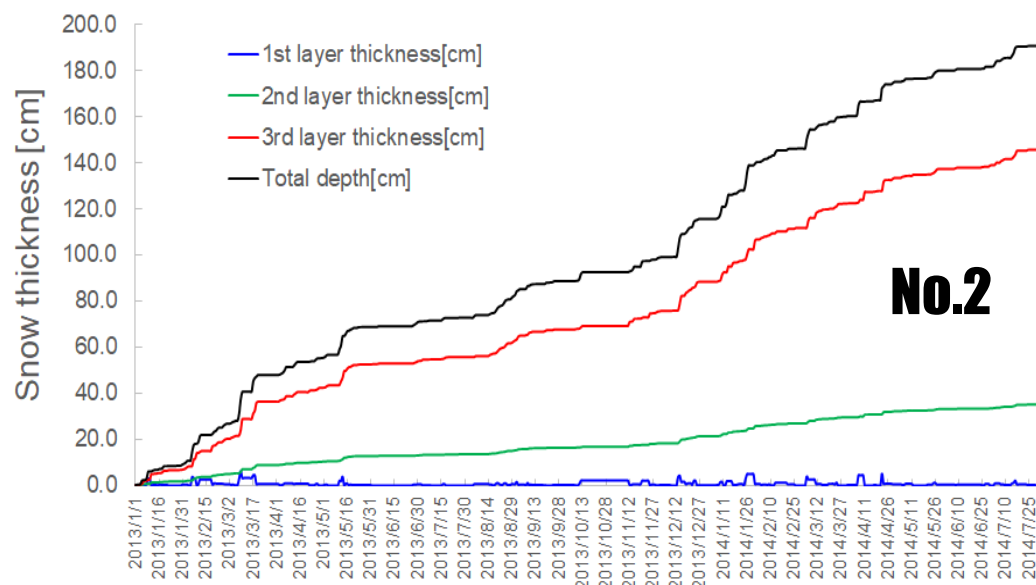
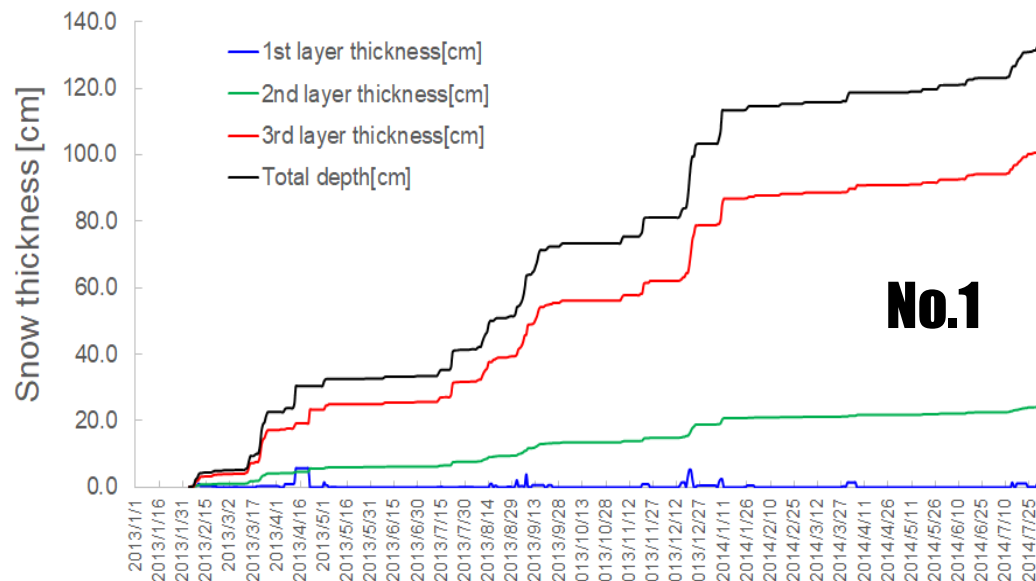
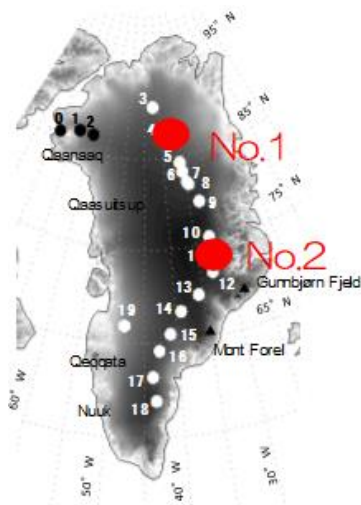
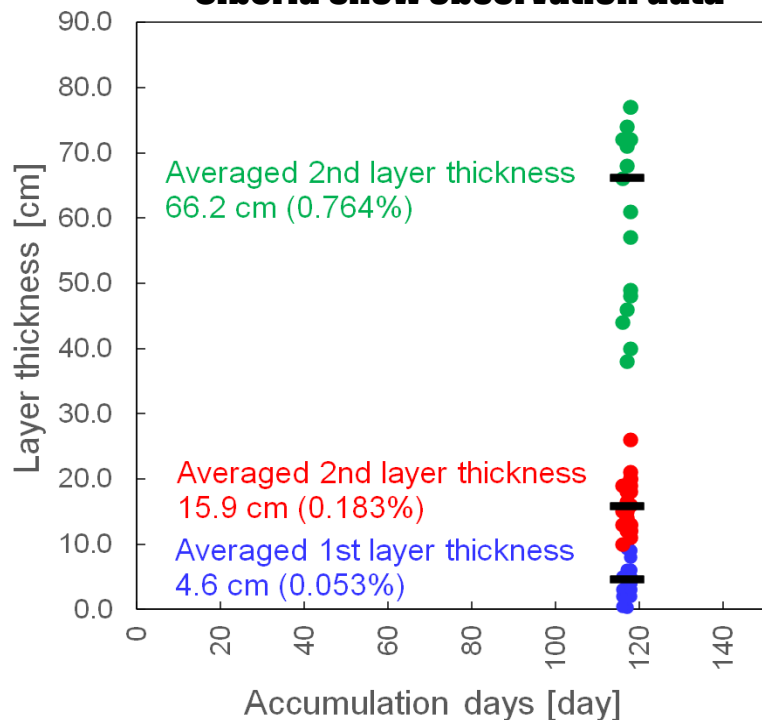
No.1



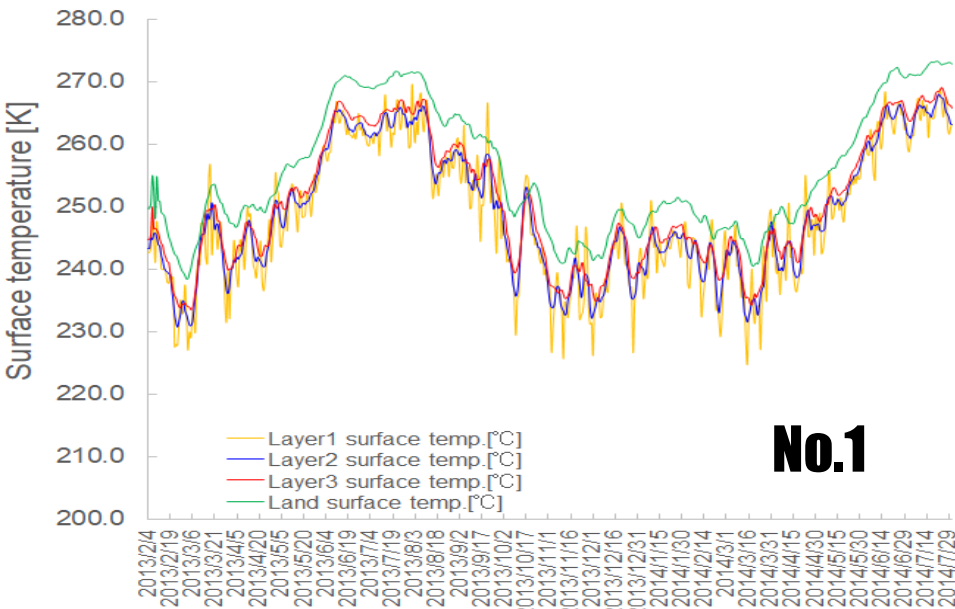
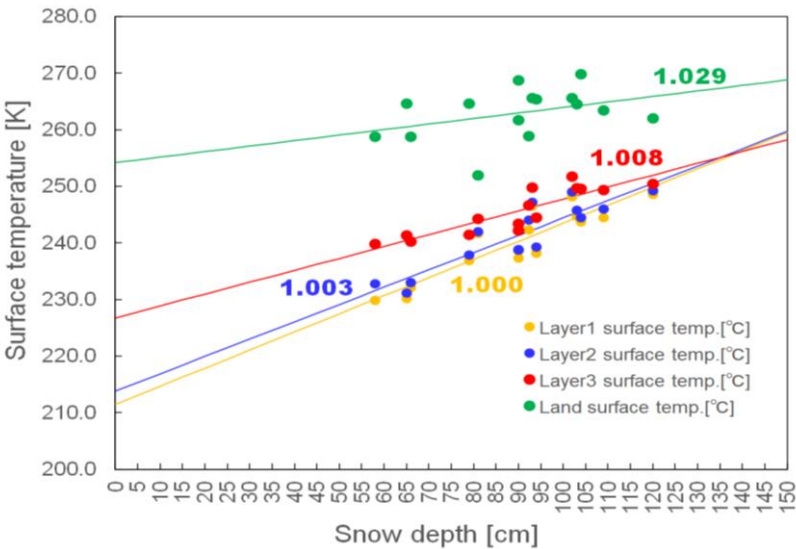
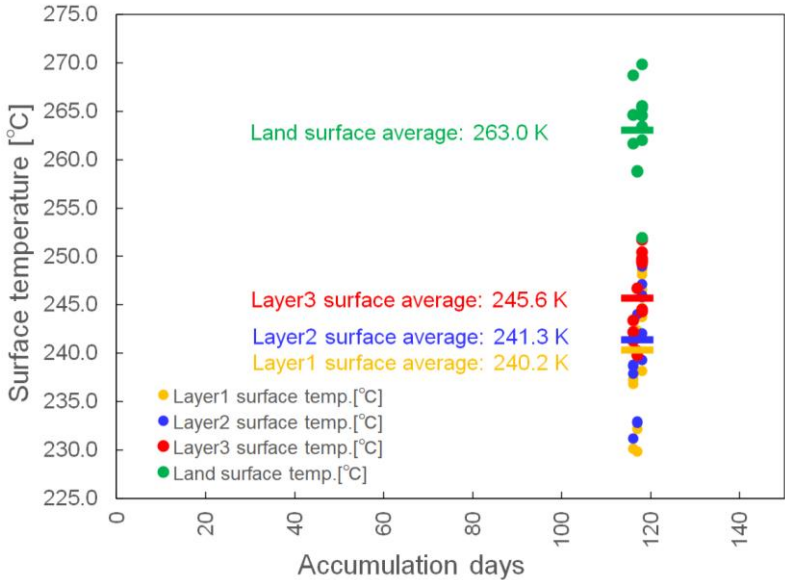
No.2



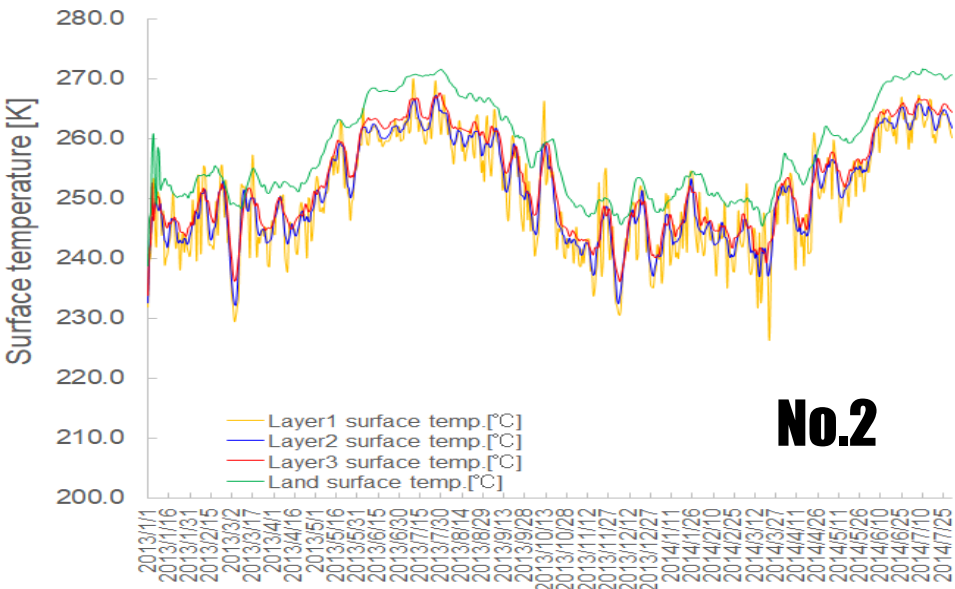
Siberia snow observation data



Siberia snow observation data



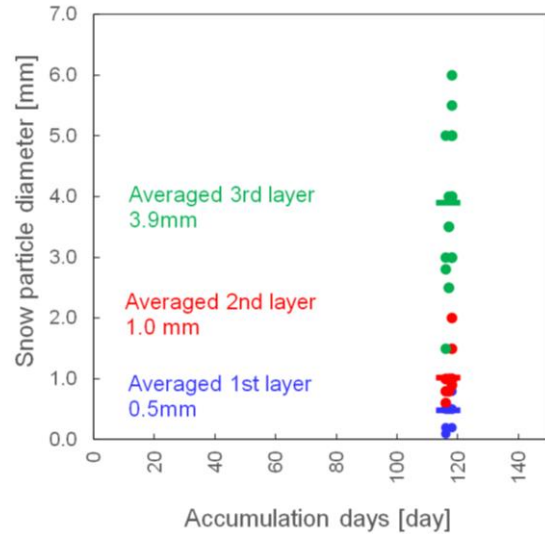
No.1



No.2

Investigation and assumption of snow particle size

Siberia snow observation data



Sturm, M., and C. S. Benson (1997)

$$r(t) = r_{\infty} - (r_{\infty} - r_0)e^{-\alpha t}$$

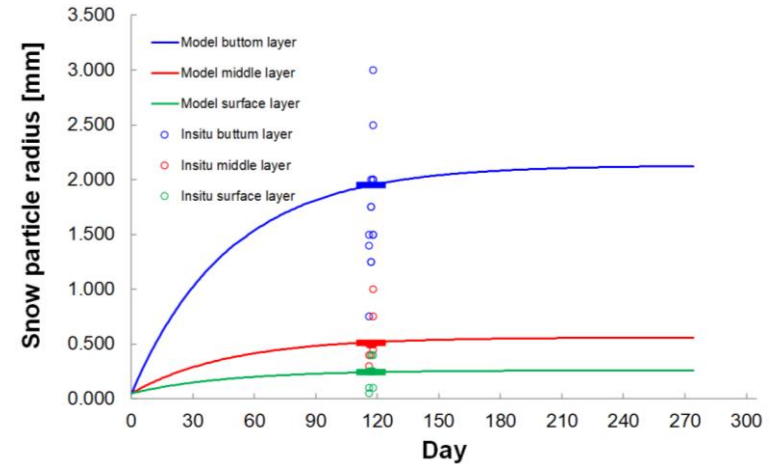
1st layer : $r_{\infty} = 0.56$

2nd layer : $r_{\infty} = 1.93$

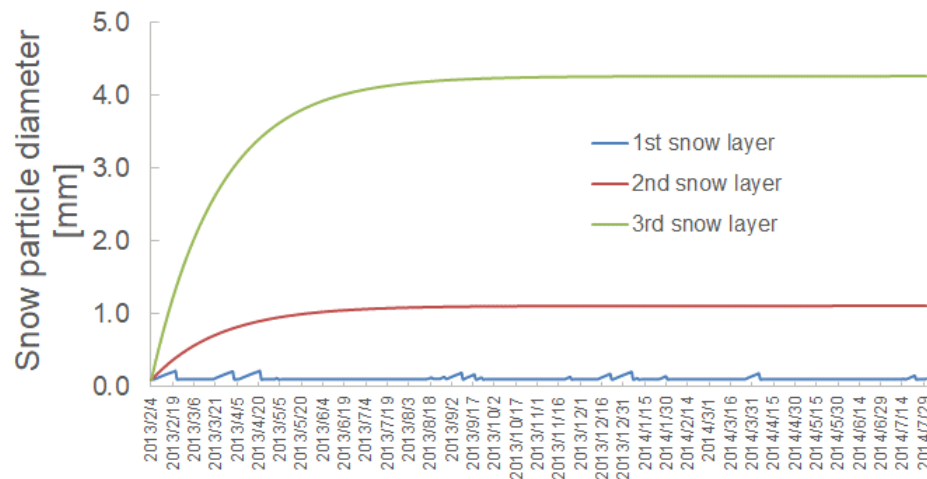
3rd layer : $r_{\infty} = 2.13$

$r_0 = 0.05$

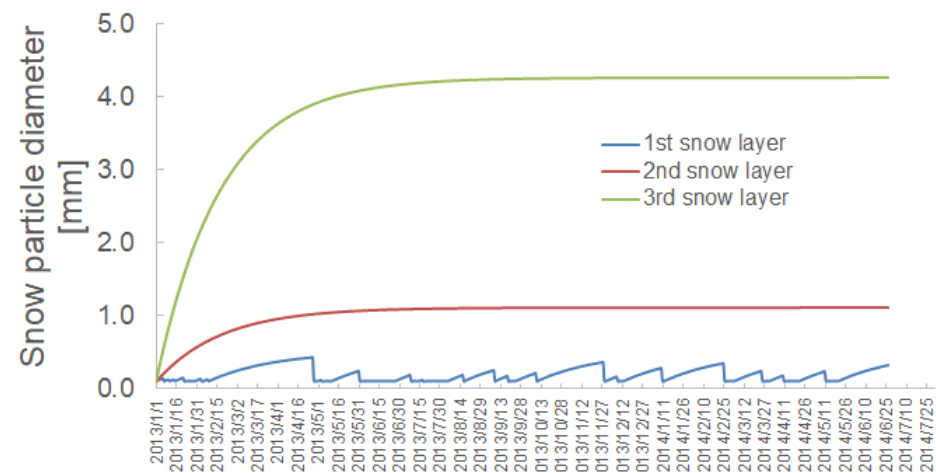
$\alpha = -0.0209$



No.1



No.2



Snow density

Sturm, M., and C. S. Benson (1997)

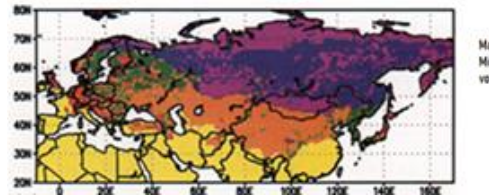
$$\rho = \rho_{\max} - (\rho_{\max} - \rho_{\min}) \times \exp(-\text{volgr} \times d)$$

ρ : Snow density

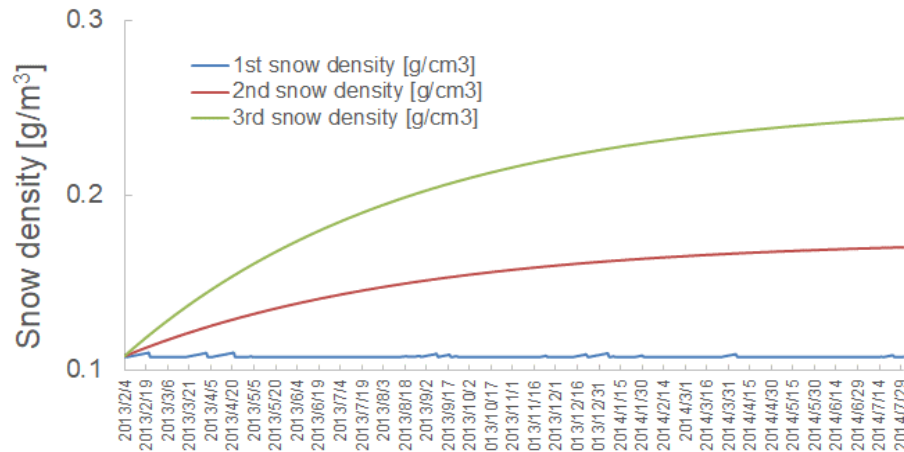
$\rho_{\max}$: Maximum density

$\rho_{\min}$: Minimum density

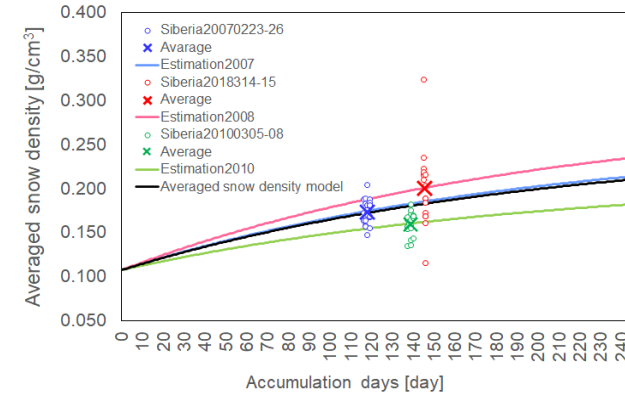
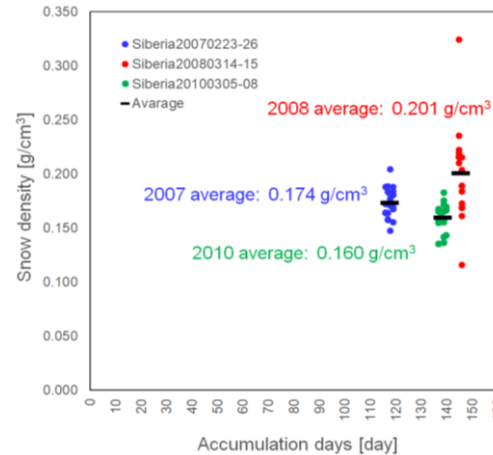
d : Snow days
 volgr : constant



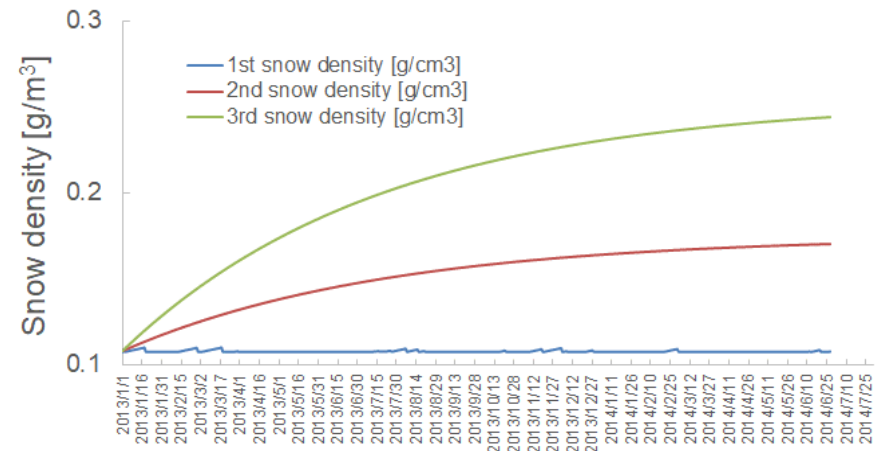
No.1



Siberia snow observation data



No.2

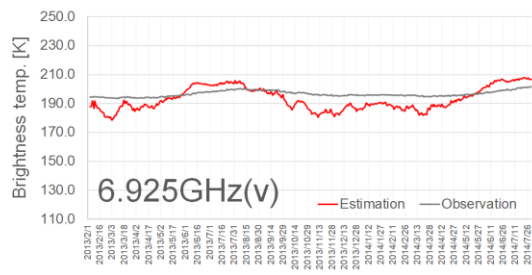


No.1

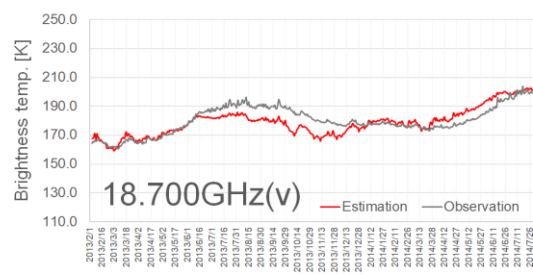
Vertical

Horizontal

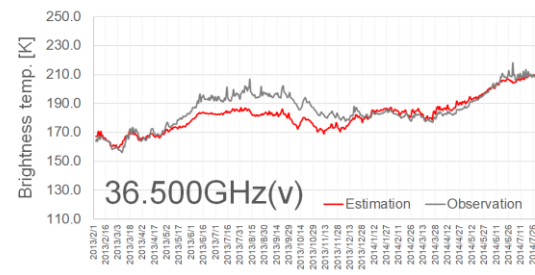
RMSE= 7.17 [K]



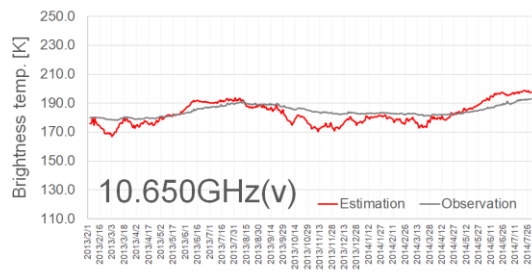
RMSE= 6.10 [K]



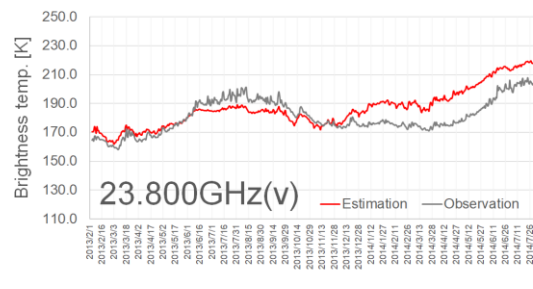
RMSE= 7.39 [K]



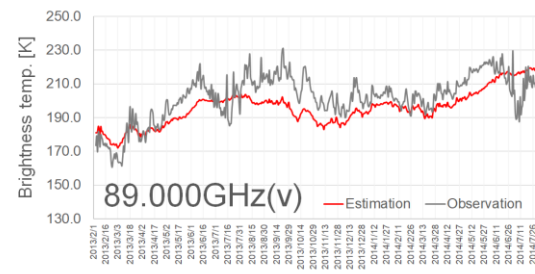
RMSE= 5.31 [K]



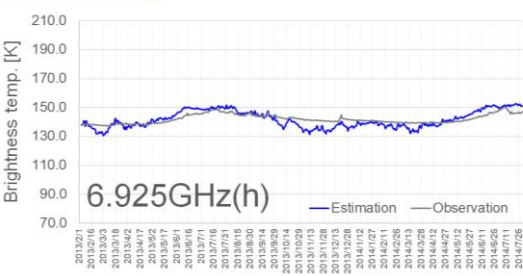
RMSE= 10.76 [K]



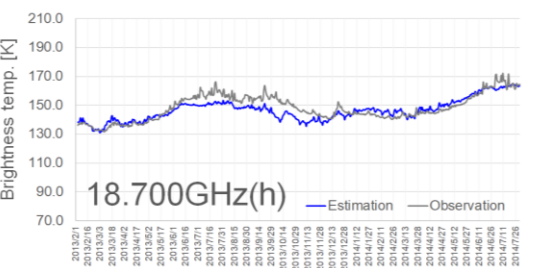
RMSE= 11.00 [K]



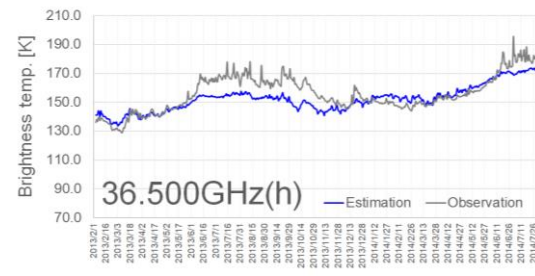
RMSE= 3.62 [K]



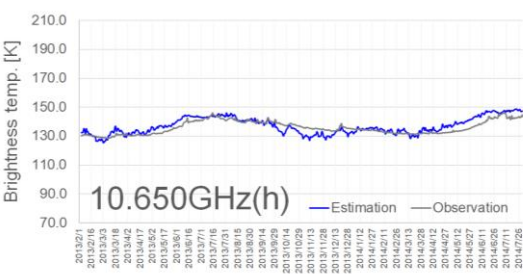
RMSE= 4.91 [K]



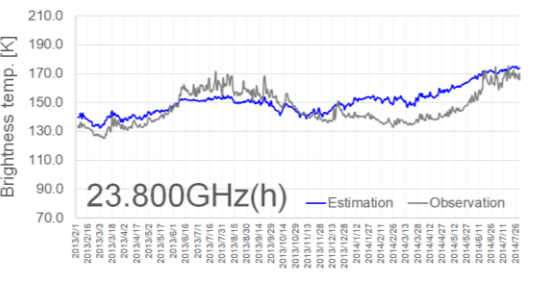
RMSE= 8.01 [K]



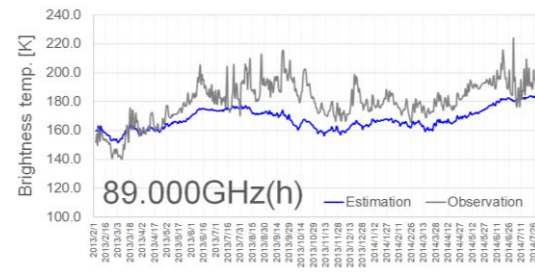
RMSE= 3.41 [K]



RMSE= 9.74 [K]



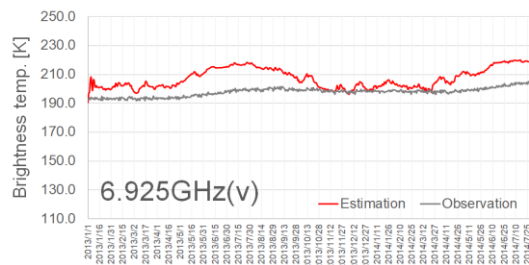
RMSE= 15.72 [K]



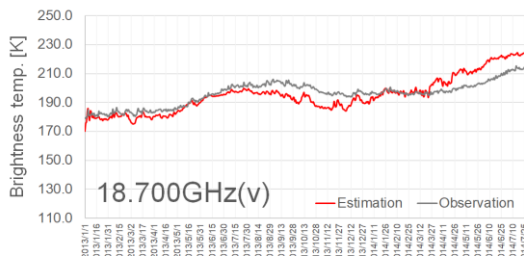
No.2

Vertical

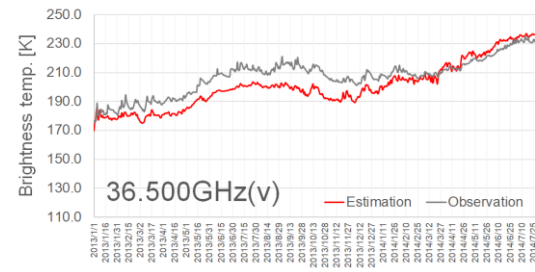
RMSE= 11.05 [K]



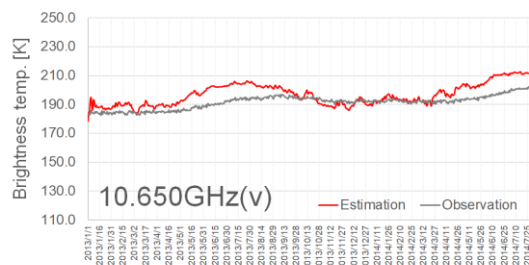
RMSE= 6.76 [K]



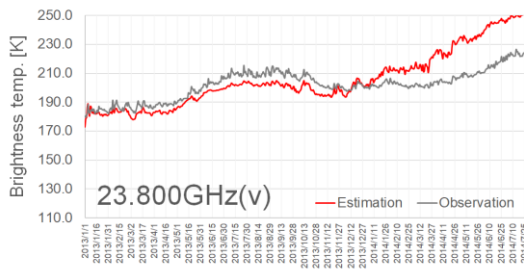
RMSE= 9.42 [K]



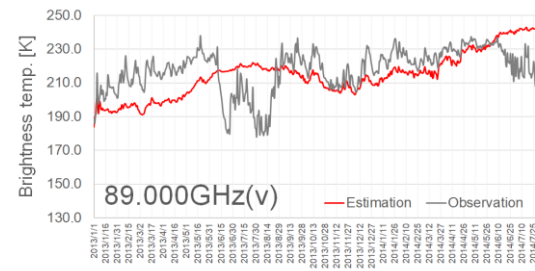
RMSE= 7.27 [K]



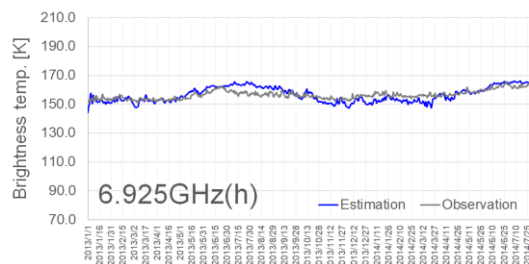
RMSE= 13.32 [K]



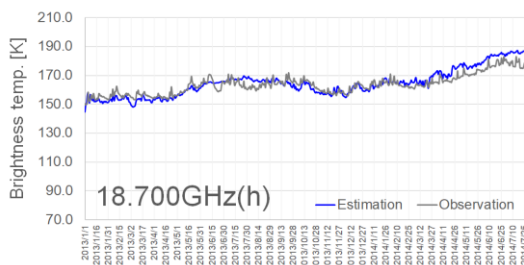
RMSE= 15.56 [K]



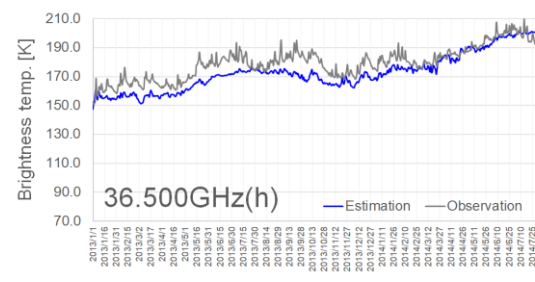
RMSE= 3.39 [K]



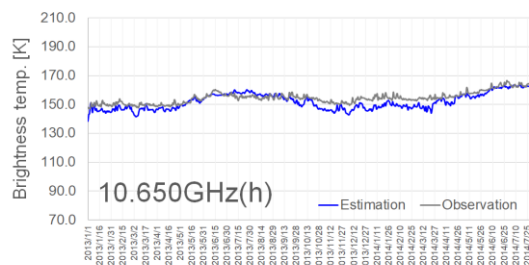
RMSE= 4.21 [K]



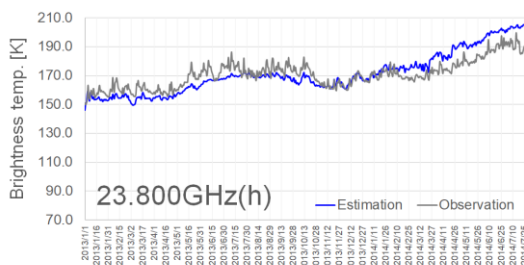
RMSE= 8.47 [K]



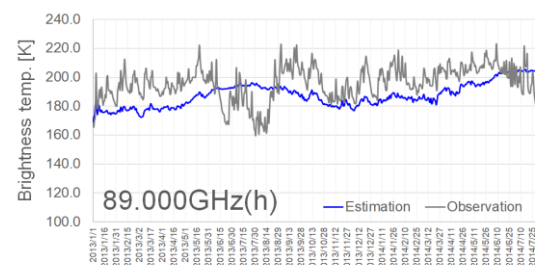
RMSE= 3.99 [K]



RMSE= 7.47 [K]

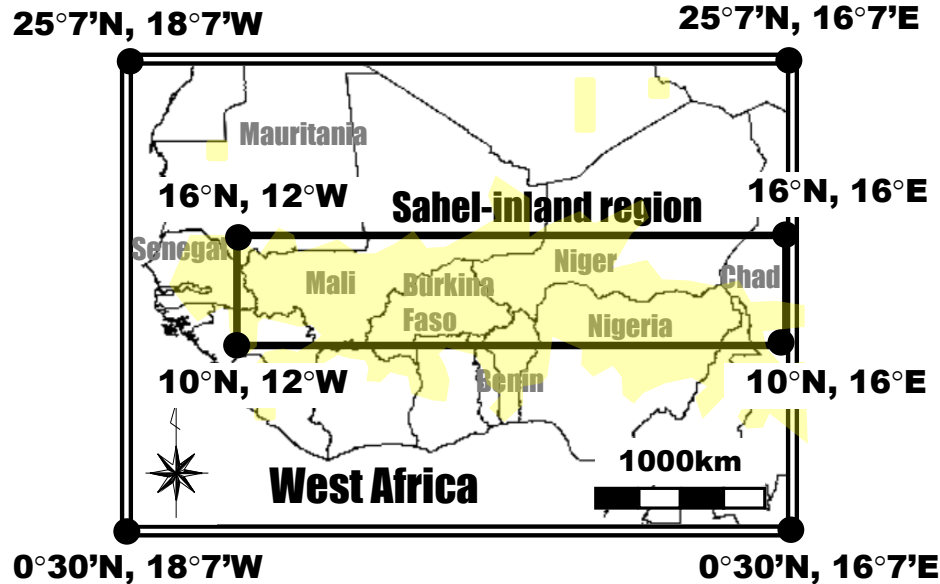


RMSE= 15.22 [K]



Horizontal

Agricultural drought assessment over West Africa using the Coupled Land and Vegetation Data Assimilation System (CLVDAS)



1914 : Widespread famine caused by drought occurred.

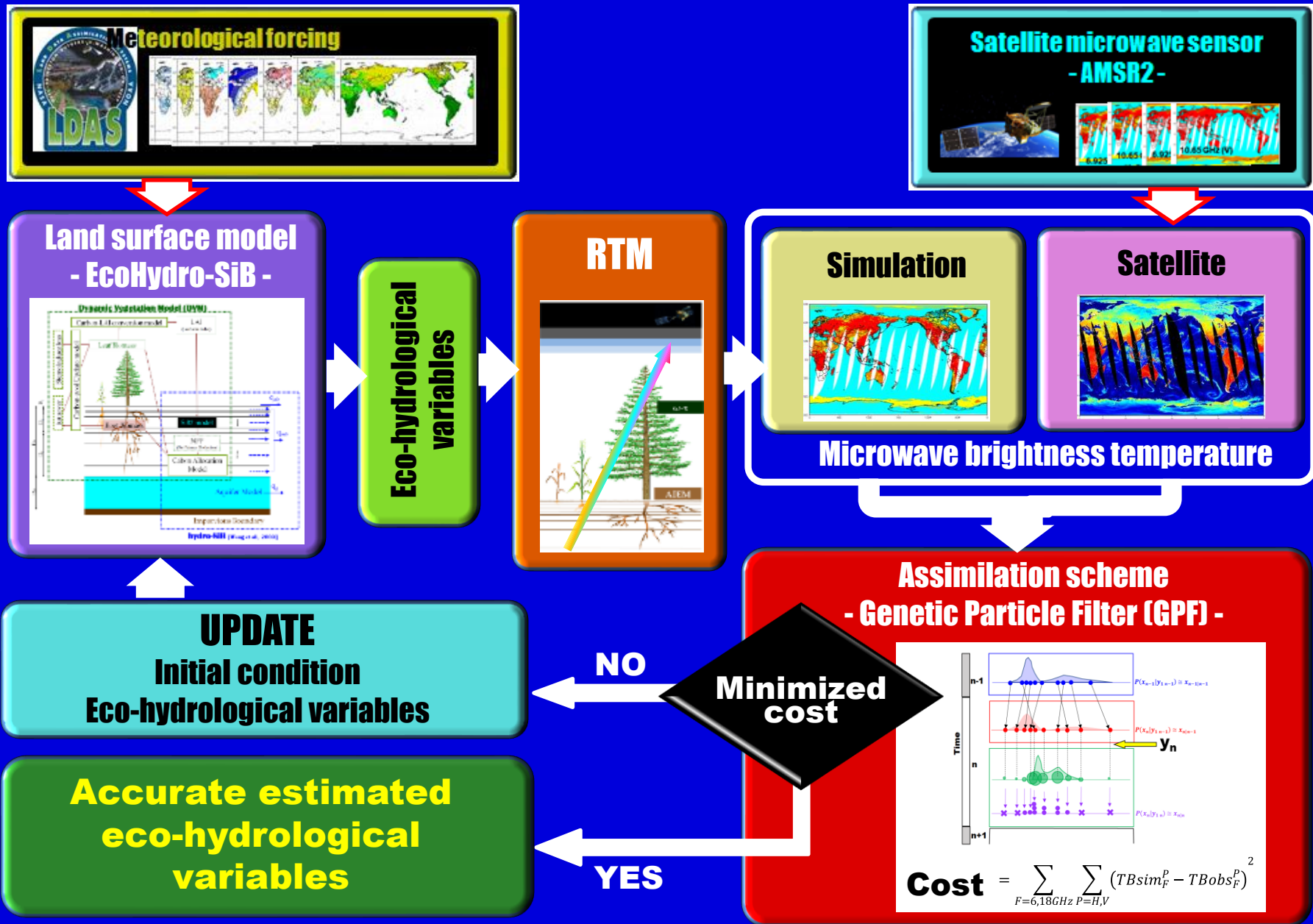
1968-73: One million people have died in Mauritania, Mali, Chad, Niger and Burkina Faso.

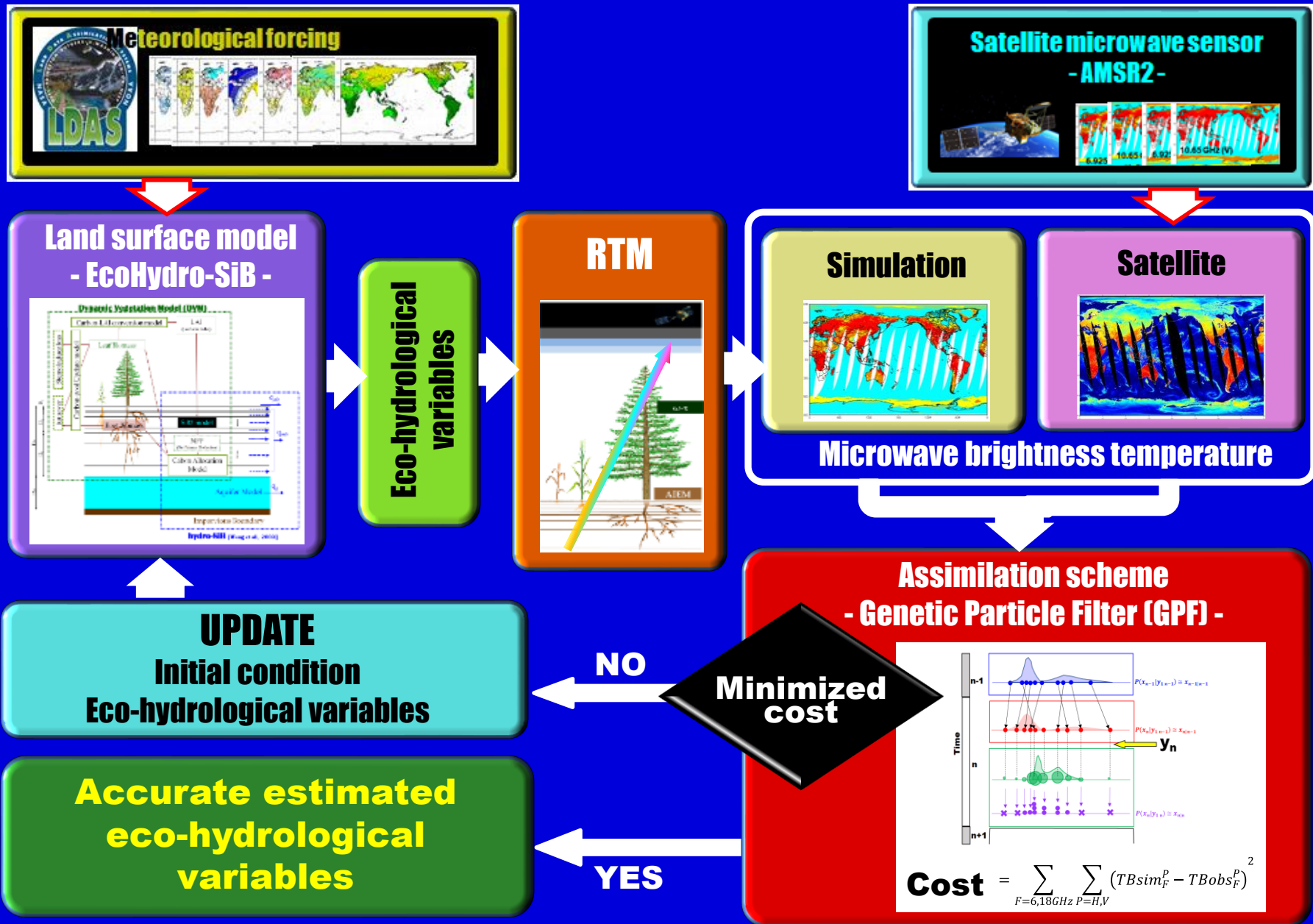
1982-84: Famine killed 3 million people in the Sahel region.

2017: Drought broke out in the Sahel region, damaging livestock and crops

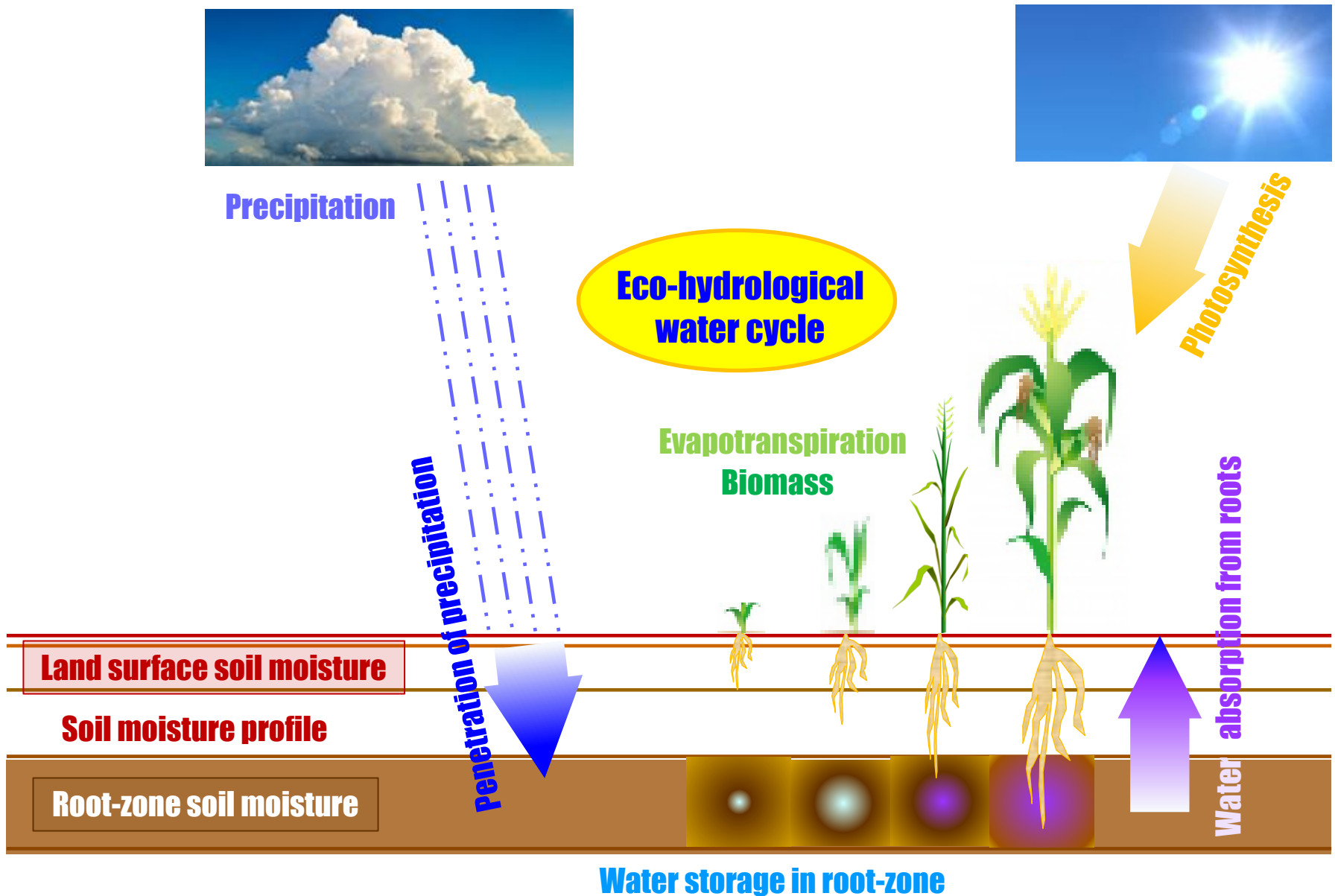
2020: Drought caused more than 3 million people to face hunger in Burkina Faso.

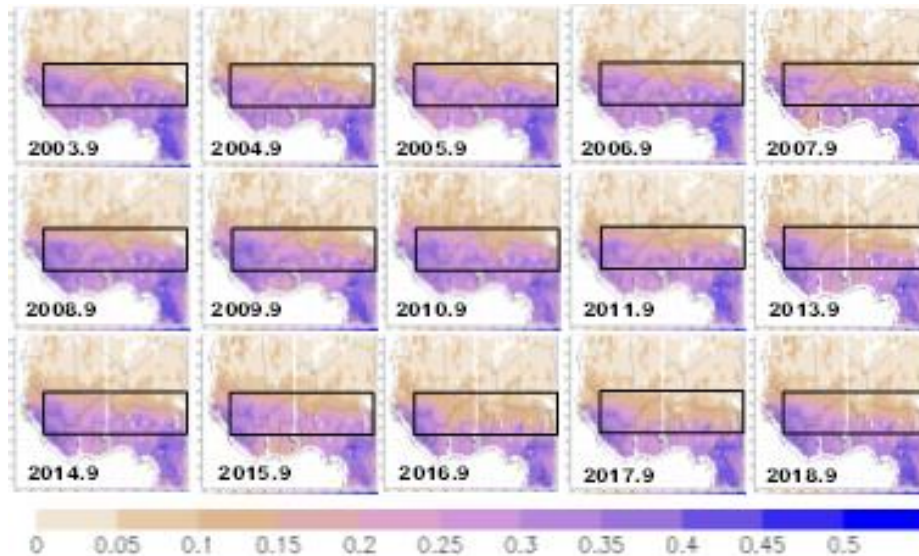




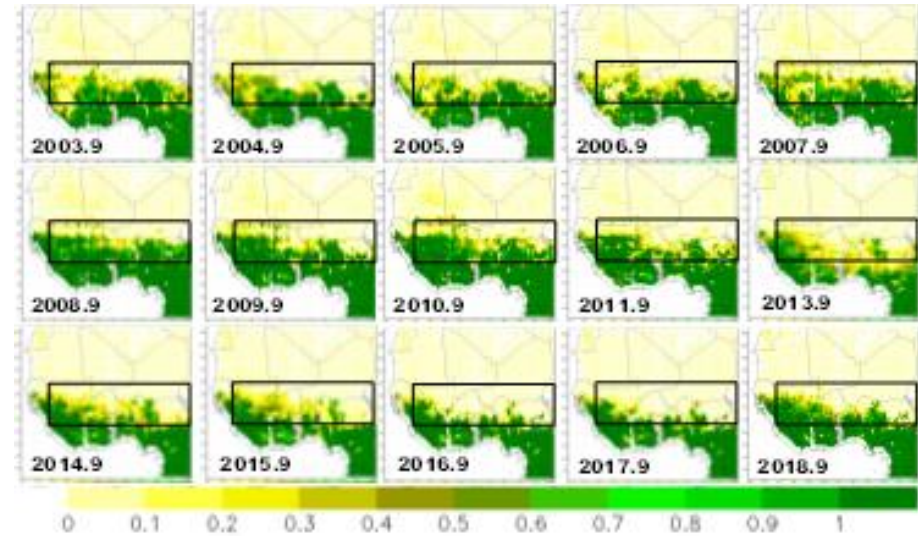


Land surface model : Eco-HydroSiB

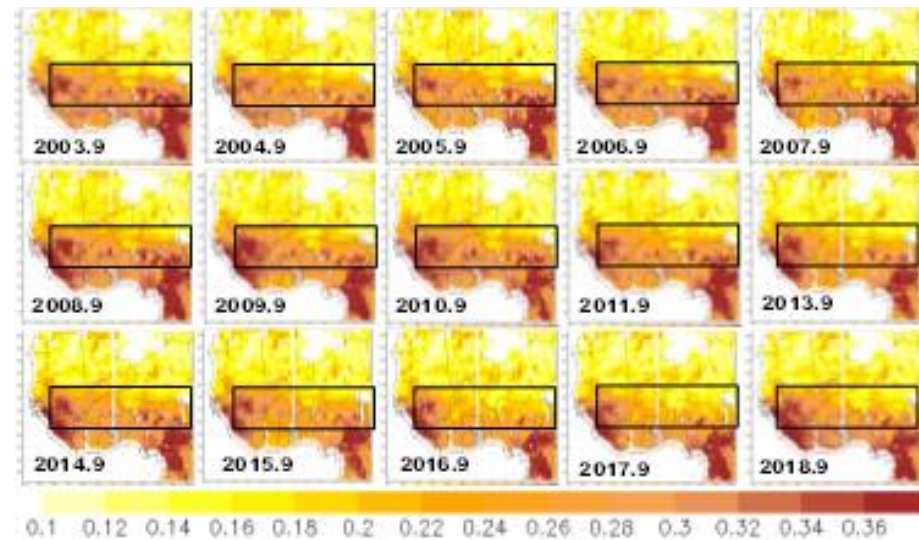




Land surface soil moisture content

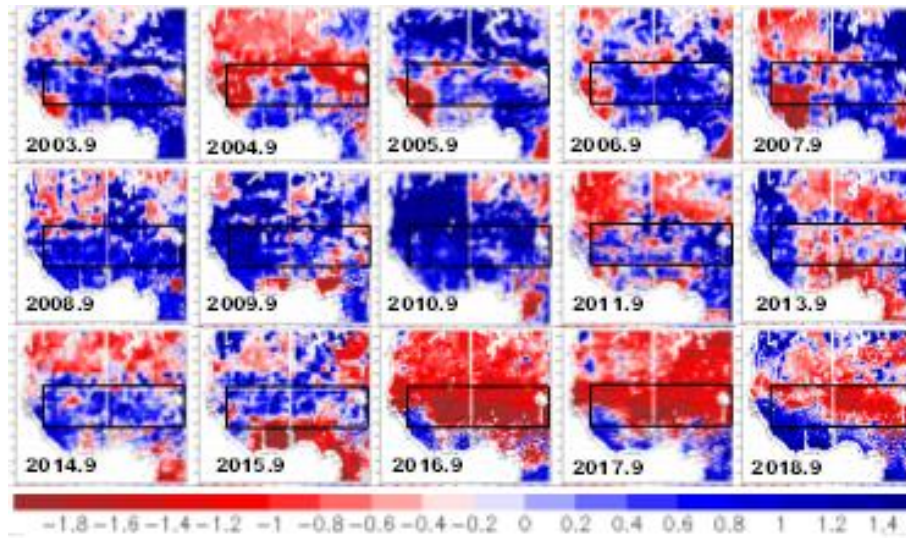


Vegetation water content

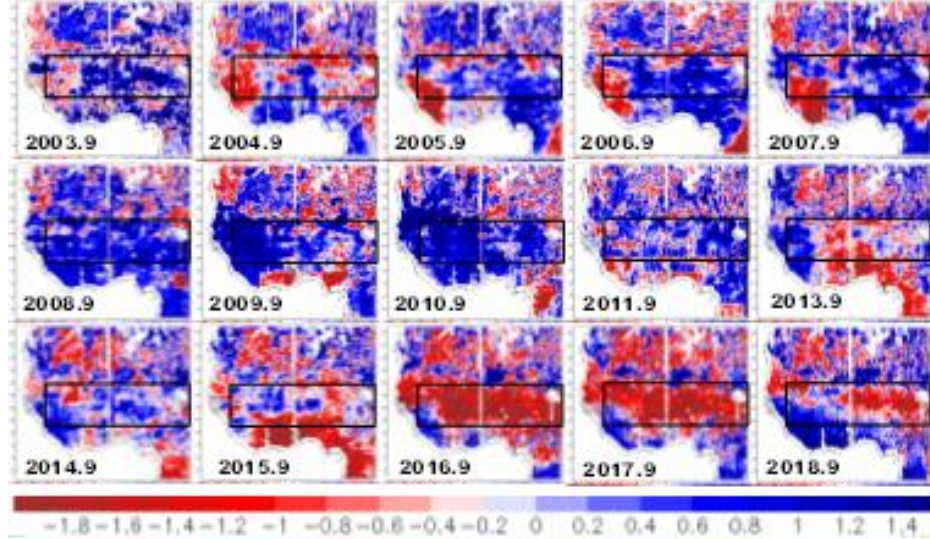


Root-zone soil moisture content

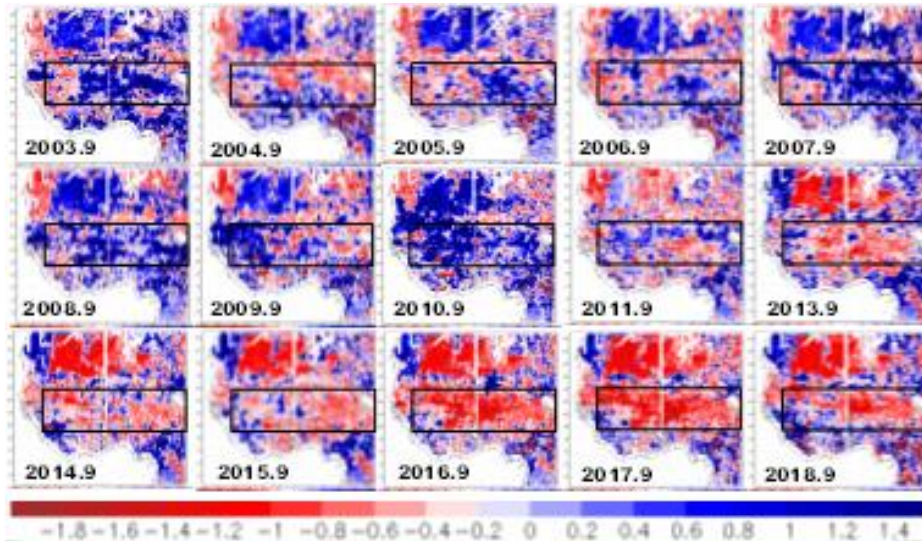
Normalized index (NI_i) based on Z-score theory



Land surface soil moisture content



Vegetation water content



Root-zone soil moisture content

Normalized index (NI_i) based on Z-score theory

$$NI_i = \frac{x_i - \mu}{\sigma},$$

Where, x_i is the variable on an arbitrary date (i), μ and σ are the average and standard deviation for x_i on an arbitrary date (i).

Agriculture in West Africa



Major crop

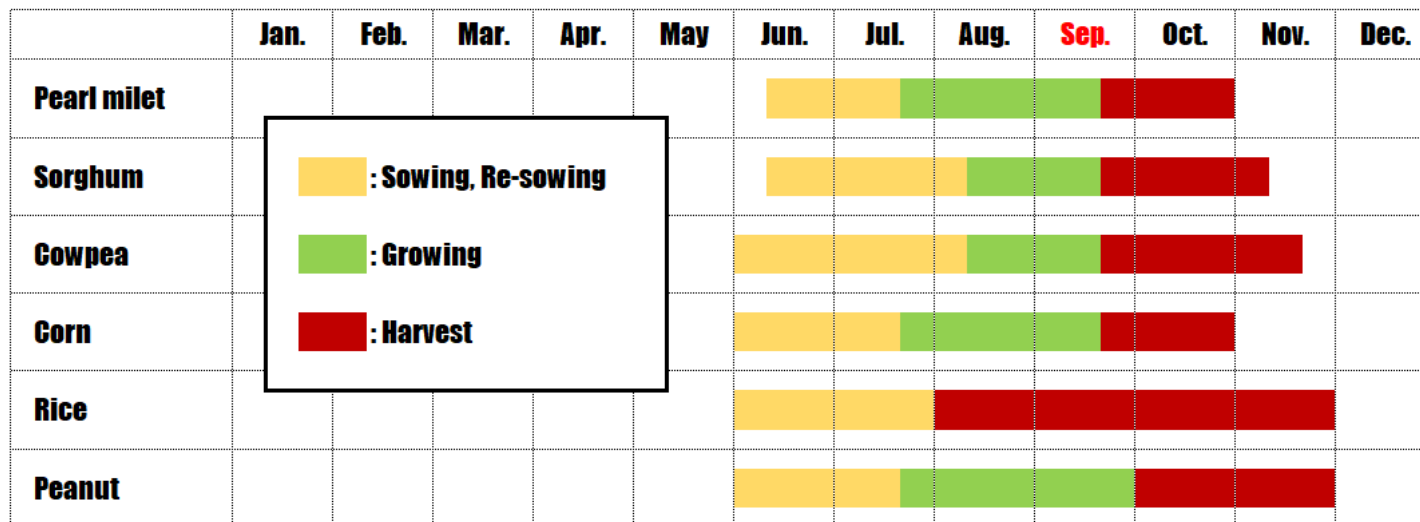
Main crop in West Africa

Pearl millet



Crop calendar

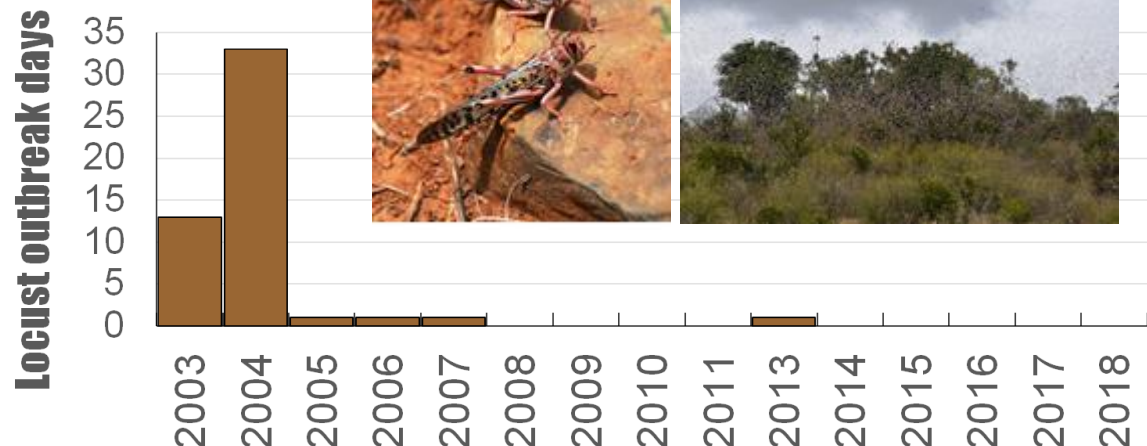
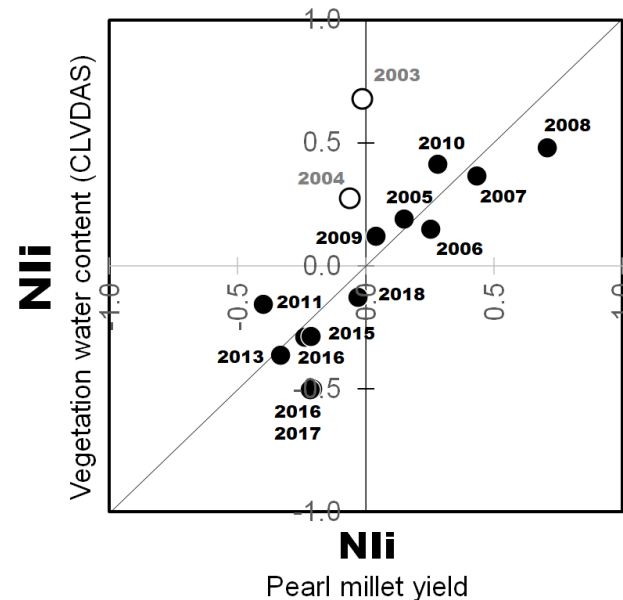
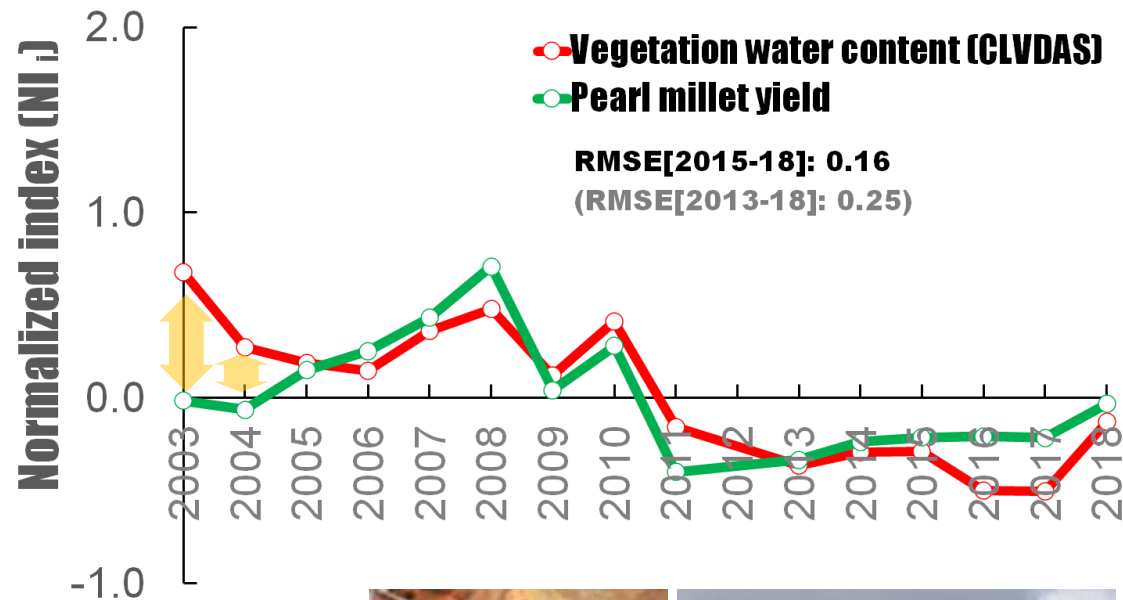
Agricultural calendar in West Africa



Source: Référentiel commenté des prix des produits agricoles du Niger, Août 1999

Comparison result between vegetation water content in September and pearl millet yield

24



Food and Agriculture Organization of the United Nations

Locust watch

Desert Locust

Information Locust Risk Activities Publications Archives

Desert Locust situation update 23 December 2021

SMALL SWARMS FORM IN NE SOMALIA

OVERVIEW: As late inter-hopper bands continue to fledge, more new small immature swarms are forming in northeast Somalia where aerial and ground control operations are in progress north of Garowe. Limited aerial control operations continue against a few small immature and mature swarms that persist in the Rift valley of SHDP near the Kenya border. Low numbers of notorious locusts are present in winter breeding areas along both sides of the Red Sea and on the Gulf of Aden coast of northwest Somalia, and limited breeding has started in a few places.

KEY 27 MATTERS: The current success of control operations in northeast Somalia is limiting the number and size of immature swarms that will form in the next two weeks. By the end of this month, nearly all hopper bands will have fledged. Consequently, a few more small swarms will form. So far, the new swarms have not moved much from the breeding areas; however, this will change as they become stronger and vegetation dries out, giving rise to a southwards migration that passes over central Somalia and eastern Ethiopia to reach southern Ethiopia, northeast Kenya, and southern Somalia at any time in the coming weeks. Upon arrival, the swarms should continue further west in Juba, Harardib, Samsir, and Tanaa cities of Kenya and southern parts of Oromia and SHDP regions in Ethiopia. The threat of swarm arrival in these areas should subside by mid-January. It will take at least one month for the swarms to mature and be ready to lay eggs. By that time, however, conditions in southern Ethiopia and northern Kenya are unlikely to be favourable since it will be the dry season. Consequently, the swarms may remain immature until the long rains arrive in April/May, which would allow maturation and egg laying. Given this scenario, field teams are expected to have the necessary resources, experience, and time to control the swarms before April and bring the current upsurge to an end.

CONTEXT: New swarms form in northeast Somalia but have yet to start migrating southwards.

- SOMALIA:** Control operations continue against small late inter-hopper bands and newly formed immature swarms in the NE; scattered adults in the northwest with limited breeding.
- ETHIOPIA:** Control continues against a few small swarms that persist in the Rift Valley of southern SHDP near the Kenya border.
- KENYA:** No locusts seen, but limited breeding could be underway along the northern border.
- RED SEA:** Scattered adults on the coast of Yemen, Sudan, and SE Egypt while limited breeding started in Egypt and Yemen; no locusts on the coast of South Arabia and Eritrea.

TAKEAWAY: Maintain current efforts to reduce swarm formation in the Horn of Africa.

- Central Region (SERODS) – maintain operations (Ethiopia, Somalia); increase vigilance (N. Kenya)
- Western Region (CAUP) – no significant activities
- Eastern Region (CAUP) – no significant activities

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