

KALE GWE
LOWOOZA OKIMANYI
EKIMYANSO



OKUKUNGANYA EBIKWATA **KU AMASANNYALAZE** AMASANNYALAZE!

EBIFULUMIZIDDWA BY...

Ronald L. Holle Omwui

w'amegezi, Vaisala, Inc.
Tucson, mu ssaza ly'e Arizona

Daile Zhang

eyeesimbyewo ku diguli eyookubiri, ekitongole ky'eby'amazzi ne ssaayansi w'empewo Yunivasite y'e
Arizona, Tucson, Arizona, Amerika

Ebisingawo bikyalire ku vaisala.com/lightning



Ng'omuwi w'amagezi ku by'obudde era omusomesa w'amasomo ga ssaayansi
ow'enjawulo mu yunivasite okumala emyaka mingi, abawandiisi bano bakung'aanyizza
ebibuuzo ebikwata ku kumyansa ebitera okubuuzibwa bakasitoma, abayizi n'emikwano.
Akatabo kano kaddamu ebibuuzo bino era kawa okumanya okulala okuyamba
abasomi okutegeera fizikisi y'omulabe omukulu n'obukuumi bw'okumyansa, awamu
n'okuzuula okumyansa.

Abawandiisi baagala okwebaza abantu bano wammanga (mu nsengeka y'ennukuta)
olw'okusoma akatabo kano: Hsin-I Chang, Brittany Ciancarelli, Mary Ann Cooper, John
Jensenius, Jessica Mackaro, James Moker, Melanie Scott, ne Sarah Warren.

Essuula I – Okulaba okumyansa 5 ſ Ekintu

ekirabika

ſ Fizikisi 21 ſ

Okugabanya 26. Ebiwandiiko

Essuula II – Obukuumi bw'okumyansa 34 ſ Omuntu

..... 35. Omuntu w'abantu

ſ Eby'obugagga 44. Omuntu w'abantu

Essuula III – Okuzuula okumyansa 48

Essuula IV – Emitwe egy'enjawulo egy'okumyansa 52 ſ

Sayansi

ſ Ebivaako 56 ſ Okukuba

ebifaananyi 58. Omuntu w'abantu



Essuula EMU

Ekintu ekisubirwa okuberawo

ÿ

Fizikisi

ÿ

Okusaansaanya

ÿ



OKULABA OKW'ENSIGO

Okumyansa kye ki?



Okumyansa kitera okubaawo mu masannyalaze mu bbanga. Ekibiina ekinoonyereza ku mbeera y'obudde ekya American Meteorological Society kinnyonnyola okumyansa nga "enkola z'amasannyalaze eziddiriyyana ezigenda mu maaso obutasalako nga muno omusannyalazo guyisibwa okuyita mu mikutu gy'okufulumya wakati w'amasekkati g'amasannyalaze ag'akabonero akalala."

AMAGEZI MU KU mpandiika:



Ebisengawo okusoma: Lang, TJ et al., 2017: WMO likodi y'ensi yonna ey'okumyansa okusukkiride: Ebanga erisinga obuwantu eryaloopebwa erya flash n'obudde obusinga obuwantu obwaloopebwa obw'okumasamasa. Bulletin y'ekibiina ky'Amerika ekikola ku by'obudde, 98, 1153-1168.



Ebika bya Flashes 2

Njawulo ki eriwo wakati w'okukuba, okusannyalala, n'okumasamasa?

Ekiwujjo (oba **ekire ekiwujjo**) kye kiwujjo
ky'omulabe ekigatta ebitundu ebirina polarity ey'enjawulo
(+/-) munda mu kire kimu oba wakati w'ebire ebingi .

Ekitangaala ekirimu ebiwujjo
by'ebire byokka kiyitibwa
okumasamasa kw'ekire.

Stroke (oba **stroke -to-ground stroke**) kwe kufulumya
kw'omulabe okugatta ekitundu kya chajingi mu kire ku ttaka.

Omusana ogulina waakiri
okukuba ekire ku
ttaka omulundi gumu
guyitibwa **okumasamasa**
kw'ekire ku ttaka, nga kino
kya bulabe nnyo eri
obulamu n'ebintu.

Okumyansa **kw'omulabe** kulimu **okuwuumma kw'ekire**
okumu oba okusingawo ne/oba **okukuba kw'ekire**
okudda ku ttaka okutera okubaawo mu sikonda emu.

Ebisengawo okusoma: Uman, MA, 1986: Byonna bikwata ku laddu. Ekitongole ky'amawulire ekyा Dover, 167 pp.

OKULABA KU LIGHTNING - EKIKOLA

Omulabe gutambula waggulu oba wansi?



Mu budde obutuufu, okumasamasa kw'ekire okudda ku ttaka kutandika n'omukutu ogugenda wansi, naye mu budde obutuufu tekulabika olw'obudde bwakwo obutono ennyo. Bwe kinaasemberera ettaka, kijja kuleeta omukutu ogugenda waggulu okuva ku ttaka. Omukutu guno ogw'okungulu gujja kuyungibwa ku mukutu ogusooka ogw'okukka wansi, era gukole omukutu omutangaavu (nga bwe tulaba bulijjo) ogugenda okudda waggulu okutuuka ku kire nga guyita mu kkubo lye limu.

Okwawukana ku ekyo, okumyansa kw'omulabe gw'ebire ogulimu ebiwijjo by'ebire byokka okusinga kutambula mu bbanga.

Ebisengawo okusoma: Rakov, VA, 2016: Emisingi gy'okumyansa. Ekitongole ky'amawulire ekya Cambridge University, 257 pp.





Polarity y'okumyansa eri etya?



Omulabe guyinza okuba nga gulina chajingi ya pozitivu ne negatiivu. Mu kibuyaga owa bulijo, waliwo okubwatuka kw'ebire okudda ku ttaka okubi okusinga okw'okubwatuka okulungi. Wabula mu Great Plains mu Amerika, okubwatuka kw'okubwatuka okutali kwa bulijo nga kulina stroke ezisingako obulungi kuzuuliddwa.

Ebisingawo okusoma: Rakov, VA, 2016: *Emisingi gy'okumyansa*. Ekitongole ky'amawulire ekya Cambridge University, 257 pp.

Okubwatuka kw'okubwatuka kye ki?

OKUSIIBA
AMAZIMA



Source credit: Obutonde bw'ensi n'enkyukakyuka y'obudde Canada

Ebisengawo okusoma: Uman, MA, 1984: Okumyansa. Ekitongole ky'amawulire ekya Dover, 298 pp.

Ebugumu

eriva mu

kumyansa

lireetera

empewo

okugaziwa amangu okwetooloo

Okugaziwa kuno

okw'empewo

okw'amangu

kuleeta ebbidde

ly'okuwuumma lye

tuwulira ng'okubwatuka.

KITUFU OBA BULIMBA?

“Okumyansa n’okubwatuka
bibaawo mu kiseera kye kimu.”

Lwaki tusooka kulaba kumyansa?

Sipiidi y’ekitangaala esinga nnyo sipiidi y’eddoboozi, n’olwekyo
ekitangaala kituuka nga eddoboozi terunnabaawo.

ÿ **Sipiidi y’ekitangaala:** mita 3 x 108 buli sikonda (m/
s) oba mayiro 2 x 105 buli sikonda (mi/s).

ÿ **Sipiidi y’eddoboozi:** 340 m/s oba 0.21 mi/s.



Nnyinza ntya okumanya bwe ndi wala okuva ku mulabe?

Bw’omala okulaba okumyansa, bala omuwendo gwa
sikonda okutuusa Iw’owulira okubwatuka. Laba ekyokulabirako
ekiri ku lupapula oluddako.

Eky'okulabirako

Bw'owulira okubwatuka kw'okubwatuka nga wayise
sekondi 5 ng'olaba okumyansa, obeera wala wa okuva ku kumyansa?

$$\begin{aligned} \text{Ebanga} &= \text{Sipiidi} \times \text{Ebbanga} = 340 \text{ m/s} \\ &\times 5 \text{ sec}^* \text{ oba} = 0.21 \text{ mi/s} \times 5 \text{ sec} \\ &= \text{Mita } 1,700 = \text{mayiro } 1.05 \end{aligned}$$

Oli kiromita emu n'ekitundu oba mayiro nga emu okuva ku mulabe.

Kitwala
sekondi 5
eddoboozi okutambula
mayiro emu.

*sec = ekyokubiri (s).

KITUFU OBA BULIMBA?



“Okubwatuka kw’okubwatuka kwokka kwe
kuvaamu okumyansa.”

Okumyansa era
kubaawo mu kubwatuka
kw’olusozi oluvuuma.
Okumyansa kubaawo
buli wabaawo ebitundu bibiri
ebirina emisanvu
egy’enjawulo wakati
wabyo, ka kibeere mu
kubwatuka kw’olusozi
olvuuma oba okubwatuka
kw’enkuba.



Ensonda: Olusozi Sakurajima Volcano, Japan olwawandiikiba Dr. Carrado Cimarelli, Ludwig-Maximilians-Yunivasite

Ebisengawo okusoma: Behnke, SA, ne EC Bruning, 2015: Enkyukakyuka mu kinematics ezitabuse ez’olusozi oluvuuma oluteeberezewwa
okuva mu data y’okumyansa. Ebbaluwa z’okunoonyereza ku by’obutonde bw’ensi, 42, 4232-4239.

OKULABA KU LIGHTNING - EKIKOLA

Owulira okubwatuka kw'okubwatuka mu mayiro
ezisoba mu 10 okuva we wali?



Wadde ng'okubwatuka kuyinza okuwulirwa mu bbanga erisukka
mu mayiro 10, ebanga ly'okuwulira litera okuba ettono singa
wabaawo amaloboozi g'ebidduka, ng'oli mu kizimbe oba ng'otunudde
wala okuva ku kibuyaga.

Bulijo wabaawo okubwatuka kw'okubwatuka ng'omulabe gukubye?

YEE. Bulijo okumyansa kuleeta okubwatuka kw'okubwatuka oba
okuwulira oba nedda.



Ebisengawo okusoma: Uman, MA, 1986: Byonna bikwata ku laddu. Ekitongole ky'amawulire ekya Dover, 167 pp.

KITUFU OBA BULIMBA?

“Ebitonde by’ettaka bisobola
okukwata ku kifo omulabe we gukubye.”



Okumyansa okuva ku kire okutuuka ku ttaka kusibuka ku buwanvu ennyo (mu ngeri entuufu waggulu wa kiromita 5-7). Omukutu gw’omulabe ogukka wansi munda mu kumyansa kw’omulabe okuva ku kire okutuuka ku ttaka TEGUkwatibwako butonde bwa ttaka.

Ebisingawo okusoma: Rakov, VA, 2016: Emisingi gy’okumyansa. Ekitongole ky’amawulire ekya Cambridge University, 257 pp.

OKULABA KU LIGHTNING - EKIKOLA

Okumyansa kw'ebbugumu kye ki?

OKUSIIBA
AMAZIMA



Okumyansa
okw'ebbugumu
kulabwa kwa
bulijjo - kuli
wala nnyo.

Ensibuko yaffe: © Ronald L. Holle

Ebisengawo okusoma: Uman, MA, 1984: Okumyansa. Ekitongole ky'amawulire ekya Dover, 298 pp.

KITUFU OBA BULIMBA?

“Ebbugumu ly’okumyansa liri...
okubuguma okusinga enjuba.”



Ebbugumu ly’omulabe liri nga 30,000 Kelvin (nga 53,500 °F). Ebbugumu eriri ku ngulu w’enjuba liri nga 6,000 Kelvin (nga 10,300 °F).

Lwaki okukubwa kw’omulabe tekuleeta nkola za kuyungibwa kwa nyukiliya (hydrogen-helium nuclear fusion reactions) (nga munda mu Njuba)?

Ebbugumu eriri ku musingi gw’enjuba liri waggulu nnyo okusinga ku ngulu yaayo. Okuyungibwa kwa nukiriya kwetaaga ebbugumu erisukka mu bukadde bwa Kelvin, erisangibwa ku musingi gw’enjuba yokka okusinga ku ngulu kwayo. Ebbugumu ly’omulabe teriri waggulu kimala okuleetawo okuyungibwa kuno okwa nukiriya.

Ebirala ebisomebwa: Uman, MA, 1984: Okumyansa. Ekitongole ky’amawulire ekya Dover, 298 pp.

Prueitt, ML, 1963: Ebbugumu ly’okusikirizibwa kw’omulabe. Journal of Okunoonyereza ku Geophysical, 68 (3): 803-811.

Mu bibuyaga n'embuyaga mulimu okumyansa?



YEE. Waliwo okumyansa mu kibuyaga.

Enkuba etonnya zikolebwa okubwatuka kw'okubwatuka
okulimu okumyansa. Kyokka emirundi gy'okumyansa gy'egwa
gyawukana.

YEE. Mu bibuyaga mulimu okumyansa.

Mu muyaga, okumyansa kutera kubaawo mu bitundu by'enkuba
eby'ebweru eby'enkulungo okusinga mu bbugwe w'amaaso
g'omuyaga awali empewo ezisinga amaanyi n'enkuba esinga
okutonnya.

Ebirala okusoma: Zheng, D., ne D. R. MacGorman, 2016: *Engeri y'okutandikawo flash mu kibinja kya supercell nga kiriko enkuba. Okunoonyereza ku bbanga*, 167, 249-264.

Stevenson, SN, KL Corbosiero, ne SF Abarca, 2016: *Okumyansa mu buvanjuba bwa North Pacific cyclones ez'obutiti: Okugeraageranya ku North Atlantic. Okuddamu okwetegereza embeera y'obudde buli mwezi*, 144, 225-239.



KITUFU OBA BULIMBA?

“Okumyansa tekugasa Nsi
n'abantu.”



Omulabe gukola kinene mu:

ÿ enzirukanya ya nayitrojeni mu bbanga nga
okufulumya ebiriisa ebiytibwa nitrate okuyamba okugimusa
ettaka.

ÿ Global Electric Circuit, ekwatagana wakati w'Ensi,
okubwatuka kw'enkuba, n'empewo eya waggulu.

ÿ enkola esoboka ey'ensibuko y'obulamu.

Okumyansa nakyo kisikiriza mu kulaba.

*Ebirala okusoma: Höller, H., U. Finke, H. Hunrieser, M. Hagen ne C. Feigl, 1999: Omulabe gwafulumya NOx (LINOX) - Enteekateeka y'okugezesza n'ebaya mu
kunoonyereza ku mbeera. Journal of Okunoonyereza ku by'obutonde, 104, D11, 13911-13922.*

Williams, ER, 2009: Enkulungo y'amasanneyalaze mu nsi yonna: Okuddamu okwetegereza. Okunoonyereza ku bbanga, 91 (2), 140-152.

Ebiwandiiko by'obudde n'obuwanvu bw'okumyansa kw'omulabe bye biruwa?



Mu budde obwabulijo, okumyansa kw'omulabe tekumala sikonda emu.

Kyokka, ebbanga erisinga obuwanvu ery'okumyansa kw'omulabe
kwawandiikibwa ku **sikonda 7.7**.

Mu budde obwabulijo, okumyansa kw'omulabe tekutambula mu

bbanga kusukka mayiro 20 (kiromita nga 30).

Kyokka, ebanga erisinga okuba ewala ennyo mu bbanga (horizontal
distance) flash gye yatambulanga lyawandiikibwa nga lya **mayiro 200** (kiromita 321).

*Ebisengawo okusoma: Lang, TJ et al., 2017: WMO likodi y'ensi yonna ey'okumyansa okusukkirimde: Ebanga erisinga obuwanvu
eryaloopebwa erya flash n'obudde obusinga obuwanvu obwaloopebwa obw'okumasamasa. Bulletin y'ekibina ky'Amerika ekikola ku by'obudde, 98, 1153-1168.*



KITUFU OBA BULIMBA?

“Emyaka giyaka kubanga
ebbugumu lyayo liri waggulu nnyo.”

Ebbugumu teririna
kakwate na
kuwuuma.

Okuwuuma kuno
kuva ku kukuba
ebire okutuuka ku
ttaka emirundi
mingi nga ekiseera
ekitali wansi wa kimu
kya kkumi ekya sikonda.



Ensibuko yaffe: © Ronald L. Holle

Amasoboza ki okumyansa kw'omulabe kwe kutera okufulumya?



Kizibu okubalirira amasoboza agafulumizibwa okumyansa kw'omulabe, naye ebanga erya bulijjo liri nga 109 ne 1010 Joules. Enjogera emanyiddwa ennyo eri nti amaanyi gano genkana n'amasoboza agakoleeza bbaatule eya bulijjo okumala emyezi egwerako.

Nga tufudde nti amasoboza g'okumyansa kw'omulabe gali 109 Joules ne bbaatule y'ettaala erina amaanyi ga watts 100 (Joules/sec), obudde bw'okumasamasa busobola okubalirirwa nga:

$$\begin{aligned} \text{Obudde} &= \text{Amasoboza/Amaanyi} = \text{Joules 109/watts 100} = \\ &\quad \text{sikonda 107} \\ &= \text{emyezi nga 4} \end{aligned}$$

Ebisinawo okusoma: Rakov, VA, 2016: Emisingi gy'okumyansa. Ekitongole ky'amawulire ekya Cambridge University, 257 pp.



KITUFU OBA BULIMBA?



“Ekibuyaga tekuba kifo kimu emirundi ebiri.”

Mu ttaka eriggule erya fulaati, tekiyinzika nnyo nti okumyansa kukuba ekifo kye kimu emirundi egisukka mu gumu mu bbanga eggwanvu. Naye ebintu eby'obutonde n'ebi'abantu (okugeza, emit, ebizimbe, n'eminaala) ebirabika obulungi okuva ku ttaka bitera okukubwa enfunda n'enfunda omulabe.

Ekizimbe kya Empire State kitera okukubwa omulabe era bwe kityo ssomo erisinga okwagalibwa mu kusoma ku laddu.

Ebisengawo okusoma: Uman, MA, 1986: Byonna bikwata ku laddu. Ekitongole ky'amawulire ekya Dover, 167 pp.

OKULABA KU LIGHTNING - PHYSICS

Tusobola okukung'aanya n'okukoza amaanyi agava mu kumyansa?



NEDDA.

1. Olw'okuba ekifo omulabe we gukubwa tekitegeerekeka (laba olupapula 51), tekikakasibwa wa we tulina okuteeka "ekibya."
2. Amasoboza mangi agakolebwaa okumyansa gajja mu ngeri y'ekitangaala, eddoboozi, n'ebbugumu ebitasobola kukungulwa mu nkola.
3. Tewali kibya kisobola kugumira kuwuuma kw'amaanyi okumpi bwe gutyo n'olvannyuma ne kitereka amaanyi gano nga "gabuze".
4. Omulabe gukyusa chajingi zombi eza pozitivu ne negativu.
Ne bwe twandibadde n'engeri y'okukung'aanyaamu amasoboza, emisanvu eg'yenjawulo gyandibadde gitera okutabulagana.
5. Tewali ngeri yonna gye tuyinza kutambuza maanyi gano okutuuka mu masannyalaze grid oba okukyusa amasoboza okudda mu kasasiro akyukakyuka (AC) oba kasasiro obutereevu (DC).



KITUFU OBA BULIMBA?

“Bulijo omulabe gukuba ebizimbe
ebisinga obuwanvu.”



Omulabe gutera okukuba ebizimbe ebiwanvu, naye guyinza okukuba ekimpi ekiriraanyewo mu mbeera ezimu. Ekifo ekisembayo okukuba kisalibwawo mu kaseera ako ng'omukutu gw'omulabe guli mita nga 30-50 waggulu w'ettaka oba ekintu. Singa ekizimbe ekiwanvu tekiba mu bbanga eryo erikoma, okumyansa kujja kukuba ekizimbe oba ekintu ekimpi mu kifo ky'ekyo.

Ebisengawo okusoma: Uman, MA, 1986: Byonna bikwata ku laddu. Ekitongole ky'amawulire ekya Dover, 167 pp.

OKULABA KU LIGHTNING - PHYSICS

Emirundi emeka okumyansa okwetooloola ensi yonna?

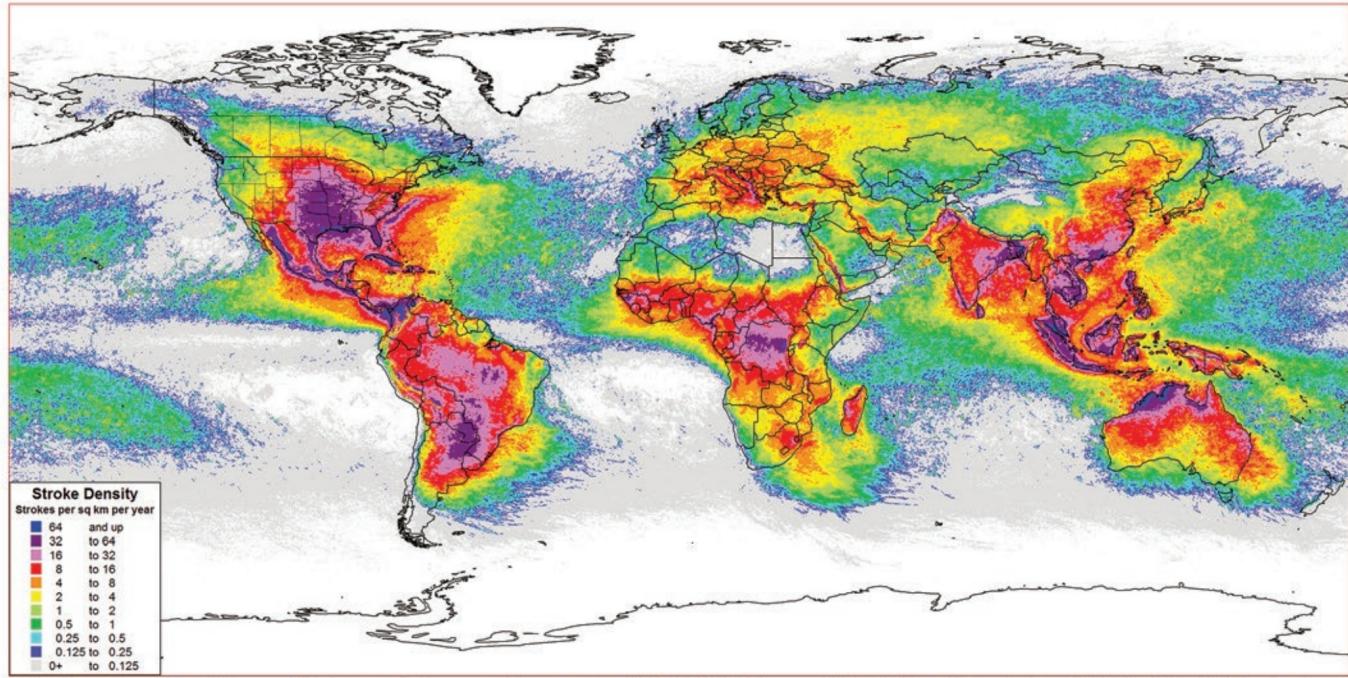
Omukutu gwa Vaisala ogwa Global Lightning Dataset GLD360 mu kiseera kino guzuula kumpi obuwumbi bubiri obw'okumyansa buli mwaka. Mu bino mulimu okukuba ebire okutuuka ku ttaka n'okukuba ebire.

Ebifo ebimu bibaamu okumyansa okusinga ebirala?

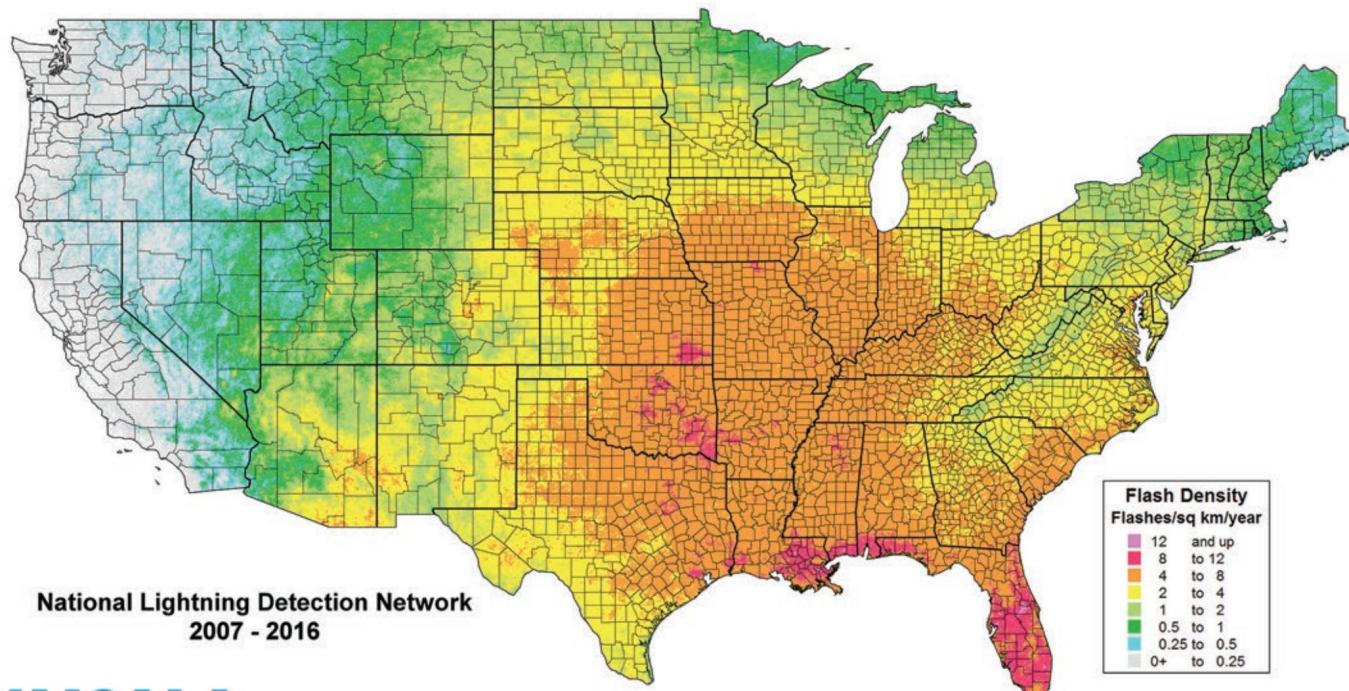
Yee. Omulabe tegusaasaanyizibwa kyenkanyi okwetoloola ensi yonna. Okumyansa kungi kubaawo ku lukalu okusinga ku nnyanja. Okumyansa era kusinga kubeera mu bitundu eby'obutiti okusinga awalala. Laba maapu y'okumyansa kwa GLD360 ku ddyo.

Ebisengawo okusoma: Holle, RL, 2016: Mu bufunze okunoonyereza okwakakolebwa ku mutendera gw'eggwanga ku kufa kw'omulabe.

Obudde, Embeera y'obudde, n'embeera z'abantu, 8, 35-42.



Emirundi emeka egy'okumasamasa kw'ebire okutuuka ku ttaka okukuba mu Amerika?



VAISALA

KITUFU OBA BULIMBA?

“Florida kye kibuga ekikulu eky’okumyansa ekya...
Amerika.”

Ebifo bisatu mu Florida bye bisingamu okumyansa kw’omulabe mu Amerika — okumpi ne Tampa, West Palm Beach, ne Daytona Beach.

Okumyansa kw’omulabe kumeka mu Amerika buli mwaka?

Ekitongole kya Vaisala ekya National Lightning Detection Network kizuuila ebire okutuuka ku ttaka obukadde 20 buli mwaka ku masaza 48 agaddirira. Laba maapu eri ku kkono. Okugatta ku ekyo, waliwo okumyansa kw’ebire okusinga emirundi nga 3-4 nga bwe waliwo okumasamasa kw’ebire okutuuka ku ttaka.



Ebirala ebisomeddwa: Holle, R. L., K. L. Cummins, ne WA Brooks, 2016: Ensaasaanya ya sizoni, buli mwezi, ne buli wiiki ey’okumyansa kw’ebire okuva ku ttaka okuva ku NLDN ne GLD360. Okuddamu okwetegereza embeera y’obudde buli mwezi, 144, 2855-2870.

Medici, G., K. L. Cummins, DJ Cecil, W. J. Koshak, ne S. D. Rudlosky, 2017: Ekitundu ky’omulabe ogw’omu kire mu Amerika ekwatagana. Okuddamu okwetegereza embeera y’obudde buli mwezi, 145, 4481-4499.

Emirundi emeka okumyansa okukuba ku ttaka?

OKUSIIBA
AMAZIMA



EBIRI EBITUNDU



EKIRE-KU-TTAKA

EBINTU EBIKWATA KU STROKES

Ku kigero, nga
1/3

wa laddu atuuka
ku ttaka ate
ebirala **2/3** ne
bisigala mu
kire.

Kyokka,
omuggerageranyo
gwennyini munda
mu buli kibuyaga ow'okubwatuka

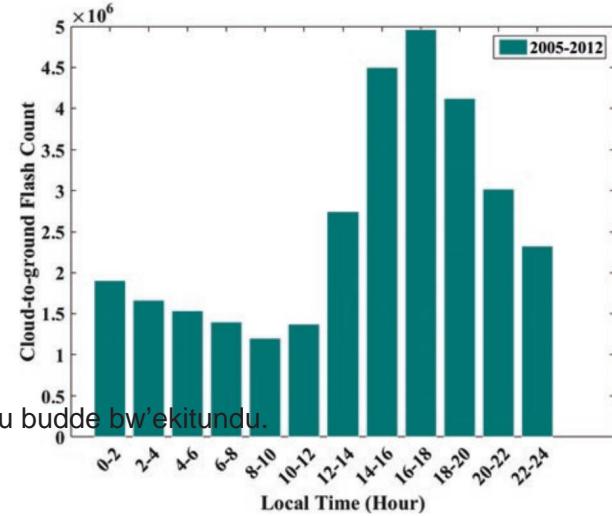
asobola okwawukana.

KITUFU OBA BULIMBA?



“Emyaka gy’amaanyi gisinga kubeera mu...
emisana.”

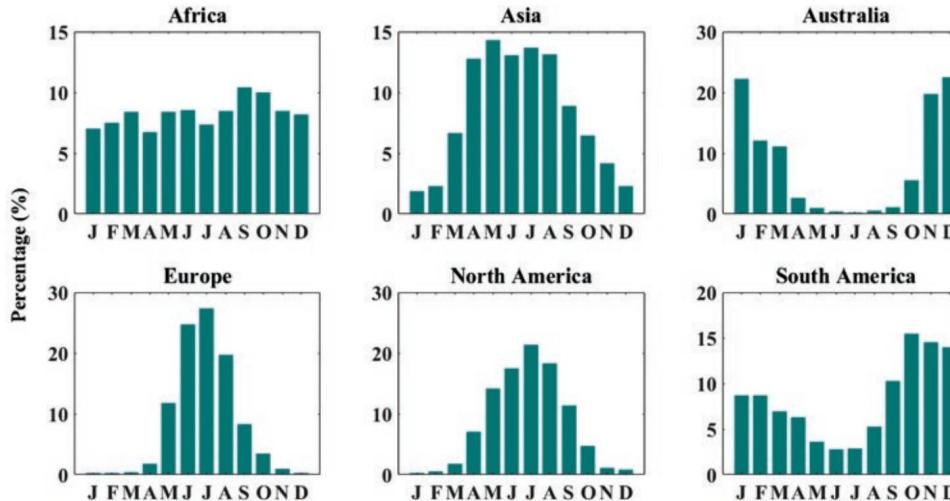
Ebitundu
nga 2/3
eby’okumyansa
kwonna ku ttaka
kubaawo
wakati w’emisana
n’essaawa
ez’emisana
ez’essaawa 16-18 mu budde bw’ekitundu.



Ebisigawo okusoma: Holle, RL, 2014: Enkyukakyuka z’emisana ez’okumyansa kw’ebire okudda ku ttaka okwaloopeewa NLDN mu Amerika. Okuddamu okwetegereza embeera y’obudde buli mwezi, 142, 1037-1052.

Engabanya y'omulabe mu sizoni ya njawulo okwetoloola ensi yonna?

**OKUSIIBA
AMAZIMA**



Ebisigawo okusoma: Holle, R., R. Said, ne M. Scott, 2017: Enkyukakyuka z'omulabe: Ekibiina ekinene eky'amawulire ekirimu ebikwata ku kuzuula okumyansa okw'emyaka etaano kiyamba okukuba okugeraageranya kw'ensi yonna.
Teknologiya w'embeera y'obudde ey'ensi yonna, September, 139-140.

YEE.

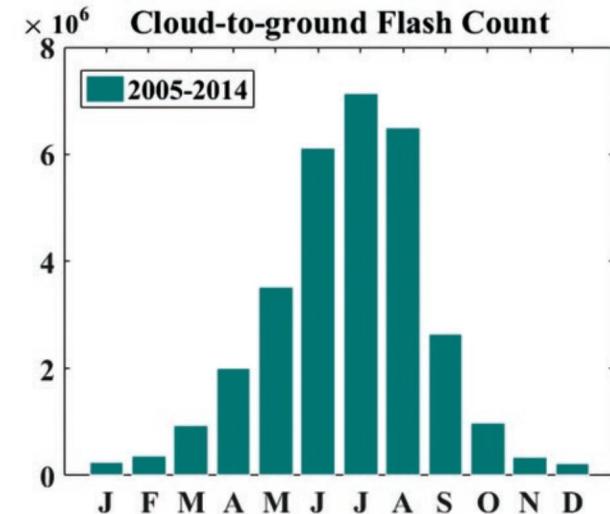
Laba
enjawulo mu
sizoni
z'okumyansa
okubeerawo
mu ssemazinga
ez'enjawulo.

KITUFU OBA BULIMBA?

“Mu Amerika, okumyansa kusinga
kubeera mu biseera by’obutiti.”



Ebitundu nga 2/3
eby’okumyansa ku
ttaka
okutuukawo
mu kiseera
ky’ebyo ebisatu
obudde bw’akasana
emyezi mu
Amerika



Ebisigawo okusoma: Holle, RL, KL Cummins, ne WA Brooks, 2016: Ensaasaanya ya sizoni, buli mwezi, ne buli wiiki eya NLDN ne GLD360 ebire okutuuka ku ttaka.
Okuddamu okwetegereza embeera y’obudde buli mwezi, 144, 2855-2870.



Essuula
BBIRI

Omuntu

ÿ

Eby'obwa nannyini

ÿ

KITUFU OBA BULIMBA?



“Okubwatuka bwe kuwuma, genda mu nnyumba.”

Mu Amerika ne mu nsi ezisinga ezaakulaakulana, nga ebizimbe ebizimbibwa obulungi bwe bibaawo era ebiseera ebisinga bituukirwa.

abantu tebalina bulabe mu bizimbe bino, n'olwekyo okugenda mu nnyumba kirungi okuteesa.

**Wabula mu nsi oba ebitundu ebimu ebikyakula,
ng'ebizimbe bizimbibwa bubi, gamba ng'ebyo ebiriko
obusolya obw'obusa n'ebisenge eby'ebitosi. Ebizimbe bino
tebirina bulabe bwa laddu, n'olwekyo, okugenda mu nnyumba kiyinza obuta*

Ebisengawo okusoma: www.lightningsafety.noaa.gov; www.ACLEN.org ku mukutu gwa yintaneeti

Roeder, WP, R. L. Holle, M. A. Cooper, ne S. Hodanish, 2011: Okuwuliziganya obulungi obukuumi bw'okumyansa.

Preprints, Olukungaana olw'omulundi ogw'okutaano ku nkokesa y'embeera y'obudde ey'ebiwandiiko by'omulabe, January 23-27, Seattle, Washington, American Meteorological Society, 18 pp.

Kiba kya bulabe okukozesa essimu mu kiseera ky'okubwatuka kw'enkuba?



YEE. Kozesa essimu yokka munda mu mmotoka oba ekizimbe ekitaliiko bulabe. Tekirina bulabe okukozesa essimu kasita oba munda mu kizimbe oba mmotoka etaliiko bulabe. Wabula si kya bulabe kukozesa ssimu ebweru mu kiseera ky'okubwatuka kw'enkuba, era kino kiri bwe kityo kubanga si kya bulabe okubeera ebweru. Obutabeera na bukuumi tebulina kakwate na ssimu yennyini kubanga essimu TEZIsikiriza laddu.



**Okutwalira awamu, okubeera ebweru mu kiseera ky'okubwatuka
kw'enkuba bulijjo kya bulabe! Weegendereze nti okukozesa
essimu eriko emiguwa mu kiseera ky'okubwatuka kw'enkuba nakyo kiyinza okuba eky'akabi!**

Ebisengawo okusoma: Cooper, MA, 2008: Kyabulabe okukozesa essimu mu kubwatuka kw'enkuba?
Amazima g'omulabe n'ebifumo. Ensonga enkulu ey'obuntu, 29, June 1, 13-14.

KITUFU OBA BULIMBA?

“Omuntu asobola okuwona
ng’akubwa laddu.”



Omulabe gutera okuba n’ekiseera ekitono ennyo (mu budde obutuufu nga teguwera 1/5 ya sikonda) era amaanyi agasinga gatera okutambula ku mubiri okusinga okuguyitamu. Eno y’ensonga Iwaki abantu abamu basobola okuwangaala. Wabula oluusi, kireeta obuvune obw’amaanyi (okusinga obw’obusimu) obuyinza okusaanyaawo ennyo era ne buvaako okunafuya obulamu bwonna.

Ebisengawo okusoma: www.lightning-strike.org

Cherington, M., J. Walker, J. Boyson, R. Glancy, H. Hedegaard, ne S. Clark, 1999: Okuziba ekituli ku muwendo gwennyini ogw’abaafiira n’okuifa olw’omulabe. Preprints, Olukungaana olw’omulundi ogwa 11 ku by’obudde ebikozeseewa, Dallas, TX, American Meteorological Society, 379-380.

Emipiira gyा kapiira giyinza okukutaasa okukubwa obutereevu ku mmotoka yo?



NEDDA. Ekisusunku ky'ekyuma eky'emmotoka, okusinga emipiira gyा kapiira, kye kiwa obukumi.

Omulabe bwe gukuba mmotoka, akasannyalazo kayita mu
kisusunku ky'ekyuma eky'ebweru eky'emmotoka
n'olvannyuma okutuuka ku ttaka nga kiyita mu bikondo n'emipiira.
N'olwekyo, omuntu ali munda mu mmotoka mu bujjuvu aija
kukuumibwa okuva ku masanyalaze.



Ebisengawo okusoma: Holle, RL, 2008: Okufa n'okulumwa abantu mu bitundu ebiriraanye mmotoka olw'okumyansa.
Preprints, Olukungaana olw'okusatu ku nkozesu y'obudde mu by'obudde ku biwandiiko by'omulabe,
January 20-24, New Orleans, Louisiana, American Meteorological Society, 10 pp.

KITUFU OBA BULIMBA?

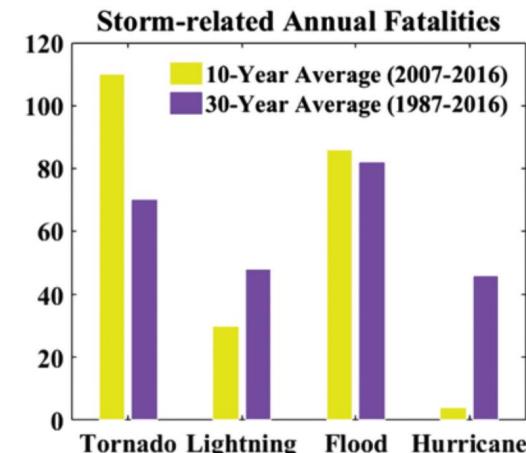


“Omuyaga gwe muyaga ogusinga okutta abantu
akabi mu Amerika”

Embuyaga n'amataba
byombi bisse abantu
bangi okusinga
okumyansa mu myaka 30
egiyise mu Amerika
Omuwendo gw'abantu mu
Amerika abafa
olw'okumyansa guli nga
30 buli mwaka mu myaka
kkumi egiyise.

Ebirala ebisomebwa: Lopez, R. D., ne R. L. Holle, 1998: Enkyukakyuka mu muwendo gw'abantu abaafa olw'omulabe mu Amerika mu kyasa eky'amakumi abiri. *Journal of Embeera y'obudde*, 11, 2070-2077.

Roeder, WP, 2012: Omulabe gugudde mu kifo eky'okusatu mu nsibuko y'okufa kw'abantu mu Amerika olw'omuyaga. *Preprints*, Olukiiko Iw'omwaka olw'ekibiina ekigatta embeera y'obudde mu ggwanga, Madison, Wisconsin, 9 pp.



Weema n'obuyumba obutonotono tebirina bulabe mu kiseera ky'okubwatuka kw'enkuba?



NEDDA. Weema tezirina fuleemu ya kyuma ey'ebweru enywevu ekimala okutwala omukka gw'omulabe oktuuka ku ttaka okukuma omuntu munda. Olina okuva mu weema n'onoonya ekizimbe ekitaliiko bulabe oba mmotoka mu kiseera ky'okubwatuka kw'enkuba.

Ebifo ebitonotono eby'okusulamu, gamba ng'ebifo omusana, ebifo eby'okubeera ku bbiici, ebifo eby'okuddukiramu mu bbaasi, ebifo eby'okuddukiramu enkuba, ebifo eby'okuwummuliram, ebifo eby'obulimi, n'amaduuka amatonotono agali ku mabbali g'enguudo tebirina bukuumi. Tezitera kuzimbibwa na bukuumi bwa laddu.

Ebisinawo okusoma: Holle, RL, 2010: Okulumwa kw'omulabe mu bifo n'okumpi n'amayumba n'ebizimbe ebirala. Preprints, Olukungaana Iw'ensi yonna olw'ebi'obudde olw'okumyansa, Vaisala, April 21-22, Orlando, Florida, 19 pp.



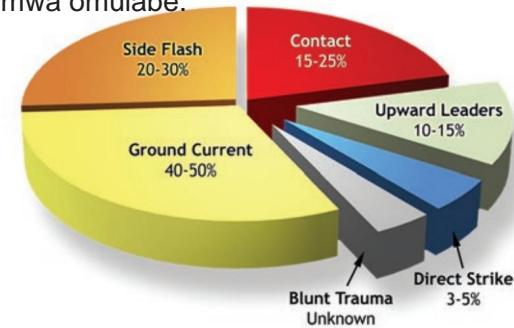
KITUFU OBA BULIMBA?



“Okukuba obutereevu y’engeri yokka omuntu gy’ayinza okulumwa omulabe

Amagezi agasinga agaweebwa ku by’okwerinda olw’okumyansa gassa essira ku kukuba obutereevu kwokka. Naye nga bwe kiragibwa mu kifaananyi kino, okukuba obutereevu y’engeri esinga obutono ey’okuttibwa oba okulumwa omulabe.

Wabula, ground current egenda okuleeta step voltage y’esinga okuvaako okufa n’okulumwa olw’omulabe.



Source credit: Obutonde bw’ensi n’enkyukakyuka y’obudde Canada (ECCC)

Ebisigawo okusoma: Cooper, MA ne R. L. Holle, 2010: Enkola z’okulumwa omulabe zirina okukosa obubaka bw’obukuumi bw’omulabe. Preprints, Olukungaana Iw’ensi yonna olw’ebi’obudde olw’okumyansa, Vaisala, April 21-22, Orlando, Florida, 5 pp.

Kiba kya bulabe okuyimirira wansi w'omuti mu kiseera ky'okubwatuka kw'enkuba?



NEDDA. Ebitundu 10% ku bantu bona abafa n'okulumwa olw'okumyansa mu nsi yonna byekuusa ku miti. Omuti bwe gukubwa omulabe, okumasamasa okw'ebbali kuyinza "okubuuka" mu ngeri ey'okwesimbye okuva ku kikolo ky'omuti okutuuka ku muntu ali okumpi n'omuti. Okugatta ku ekyo, omukka gw'omulabe gujja kukulukuta okuva ebweru okuva ku kikolo okusomoka ettaka okutuuka ku bantu oba ebisolo ebiyimiridde wansi w'omuti. Ate era, ebitundu by'ebikoola n'amatabi bisobola okubwatuka nga biwanvuye.



Ebisengawo okusoma: Holle, RL, 2012: Okufa n'okulumwa abantu mu bitundu ebiriraanye emiti olw'okumyansa. Preprints, Olukungaana Iw'ensi yonna ku kukuuma okumyansa, September 2-7, Vienna, Austria, 8 pp.

KITUFU OBA BULIMBA?

“Engatto eziriko emipiira zija kukekkereza
ggwe okuva mu kumyansa.”

Omupiira omugonvu wansi w'engatto zo tegusoboka
kukutaasa maanyi ga laddu okukubwa obutereeuvu.



Naye bw'oba oli wala ekimala okuva mu kifo
omulabe we gukubye, olwo oyinza okuba nga tolina
bulabe kubanga vvulovumenti ya ddaala ekendeera
n'ebanga. N'olwekyo, ebanga, okusinga engatto eziriko
kapiira ze ziyinga okukuwonya okubwatuka kw'omulabe.

Ebisengawo okusoma: Roeder, WP, R. L. Holle, M. A. Cooper, ne S. Hodanish, 2011: Okuwuliziganya obulungi obukuumi bw'okumyansa. Preprints, Olukungaana
ol'w'omulundi ogw'okutaano ku nkозesa y'embeera y'obudde ey'ebiwandiiko by'omulabe, January 23-27, Seattle, Washington, American Meteorological
Society, 18 pp.

OKUSIIBA
AMAZIMA

Emiggo gy'omulabe gikola gitya?

Emiggo gy'omulabe tegikuuma laddu kukuba kizimbe, wabula giwa
ekkubo eritali lya bulabe eri akasannyalazo okutuuka ku ttaka.

Waliwo ebitundu bisatu ku bukuumi obuweebwa emiggo gy'omulabe:

1. Omuggo oguwanvuwa waggulu w'akasolya (air terminal) .
2. Cable enzito okuva ku muggo okutuuka ku ttaka (down conductor) .
3. Omuggo omuzito ogukubiddwa mu ttaka (ground terminal) .

Omulabe bwe gukuba omulabe ku kizimbe, omusannyalazo guyita mu
waya okutuuka ku ttaka nga teguyingidde munda mu kizimbe. Enkola
z'okukuuma okumyansa zirina okuteekebwawo omukugu omutendeke
obulungi.

Emiggo
gy'omulabe giba nnyo

kya bulijjo
ku bikozesebwa
ebikulu

ng'amalwaliro
n'ebikozesebwa.

Ebisiningawo okusoma: Uman, MA, 2008: Obuyiiya ne ssaayansi w'okukuuma okumyansa. Ekitongole ky'amawulire ekya Cambridge University, 240 pp.



Ebintu ebikuuma amazzi agakulukuta bikola bitya?



Ebiseera ebisinga, amasannyalaze g'omulabe gayita mu waya z'amasannyalaze ne gayingira mu nnyumba oluvannyuma lw'okukuba ekikondo ky'amasannyalaze. Ebikuuma amazzi agakulukuta (surge protectors) bikoleddwa okukuma ebyuma byo eby'amasannyalaze obutayonoonebwa oba okusaanawo ng'okyusa amazzi agakulukuta.

Ebisingawo okusoma: Uman, MA, 2008: Obuyiyya ne ssaayansi w'okukuma okumyansa. Ekitongole ky'amawulire ekya Cambridge University, 240 pp.

Abasaabaze tebalina bulabe singa omulabe gukuba ennyonyi?



YEE. Abasaabaze abali munda mu nnyonyi y'ebibusuubuzi tebalina bulabe bwonna okuva ku laddu. Mu kifo ky'okugenda munda mu nnyonyi, omukka gw'omulabe gutambula okwetoloola ekyuma ekitambuza ebweru ne gusaasaana mu bbanga. Waliwo n'obukuumi obw'enjawulo obw'okumyansa ku ttanka z'amafuta n'ebuya eby'amasannyalaze.

Wadde kiri kityo, ennyonyi yeetaaga okwekebejjebwa nga buli ennyonyi tennabuuka n'olvannyuma lw'okugibuuka okukakasa nti tewali kwonooneka kwa maanyi okuva mu kuteeberezebwa okuba ng'omulabe gukubye.

*Ebisigawo okusoma: Mulvey, GJ, J. F. Miller, ne J. P. Moriarty, 2017: Ebantu ebibaawo mu masannyalaze mu bbanga:
Endowooza y'omugoba w'ennyonyi. Mu by'obudde, 70, 32-39*



KITUFU OBA BULIMBA?

“Okumyansa kw’amaanyi kwe kusinga okuvaako...
omuliro ogw’omu nsiko mu Amerika”



Olw’ebbugumu eringi ennyo ery’okumyansa okuva ku bire okutuuka ku ttaka, emit i n’ebintu ebirala ebiram u bisobola okukuma omuliro. Mu maserengeta ga Amerika, nga kimu kya kubiri ku muliro gwonna ogw’ebibira gutandikibwawo okumyansa, okusinga mu biseera by’obutiti nga ”omulabe omukalu” gutera okubaawo. ”Okumyansa okukalu” kitegeeza ekintu ekibaawo ng’enkuba etonnya okuva mu kibuyaga efuumuuka nga tennatuuka ku ttaka, n’olwekyo omuliro teguyinza kuzikizibwa.

Ebisengawo okusoma: www.nifc.gov/fireInfo/fireInfo_stats_lightng.html

www.ec.gc.ca/foudre-okumyansa/okusooka.asp?lang=Lu&n=48337EAE-1



Essuula
SSATU

KITUFU OBA BULIMBA?



“Tusobola okuzuula omulabe we gukubye.”

Omulabe gufulumya obubonero obw'enjawulo obw'amasantyalaze ku firikwensi ez'enjawulo (nga 1 Hz okutuuka ku 3×10^9 Hz). Sensulo z'omulabe bbiri oba okusingawo ezisinziiira ku ttaka bwe zizuula akabonero k'omulabe, data esindikibwa mu processor ey'omu makkati ng'ebiseera by'okulaba kw'omulabe n'enkoona ezikwatagana wakati w'omulabe ne sensa bikolebwako. Olwo ekifo ky'omulabe we kizuuilibwa okusinziiira ku kubalirira kw'emtitindo ne geometry.

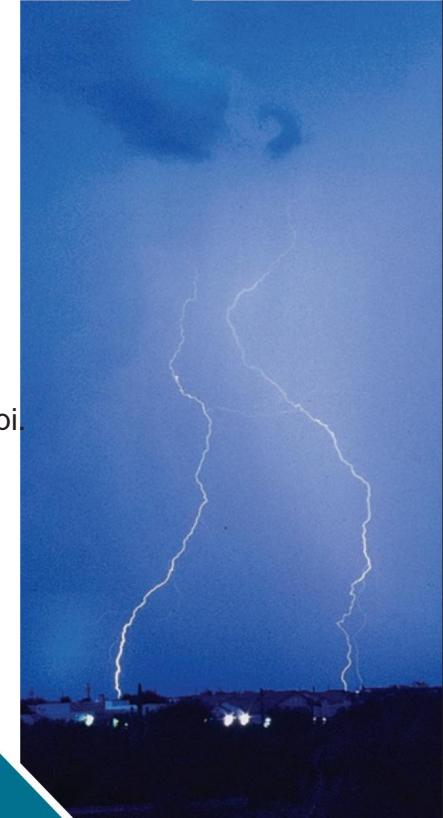
Ebirala ebisomeddwa: Cummins, KL, ne MJ Murphy, 2009: Okulaba enkola z'okuzuula laddu: Ebyafaayo, obukodyo, n'enkozesza ya data, nga tutunuulira mu bujujuv NLDN ya Amerika. IEEE Transaction ku kukwatagana kw'amasantyalaze, 51, 499-518.

Nag, A., MJ Murphy, W. Schulz, ne K. L. Cummins, 2015: Enkola z'okuzuula laddu: Okutegeera ku mpisa n'obukodyo bw'okukakasa. Sayansi w'Ensi n'Obwengula, 2.

Setilayiti zisobola okuzuula okumyansa okuva mu bwengula?



YEE. We bwazibidde mu mwaka gwa 2017,
ebikozesebwa bisatu ebya Amerika ebikozesebwa ku setilayiti
bibadde bikozesebwa, oba mu kiseera kino bikozesebwa
okwetegereza okumyansa kw'omulabe. Zitunuulira
okumyansa okuva waggulu w'okubwatuka okwawukana ku
mikutu gy'okuzuula okumyansa egyesigama ku ttaka.
Okusobola okulongoosa obutuufu bw'okuzuula, bakozesa
obubonero obufunda ennyo obw'obusannyalazo mu bbandi ya infrared okumpi.



Ebirala ebisomeddwa: Goodman, SJ, RJ Blakeslee, W. J. Koshak et al., 2013: Enkola ya GOES-R Geostationary Lightning Mapper (GLM). Okunoonyereza ku bbanga, 125:34-49.

Mach, D. M., H. J. Christian, R. J. Blakeslee et al., 2007: Okukebera emirimu gy'ekintu ekizuula ekiseera ekitono eky'amaaso ne Sensulo y'okukuba ebifaananyi by'omulabe. Journal of Okunoonyereza ku Geophysical - Empewo, 112, D09210.

KITUFU OBA BULIMBA?

“Tusobola okulagula ddala
omulabe w’egenda okukuba.”



Tewali nkola ekkirizibwa okulagula ddi ddala n’ekifo omulabe we gunaakuba, wadde ng’ekifo omuyaga we gugenda okubwatuka n’entambula yaago bisobola okulondoolebwa rada n’ebikozesebwa ebirala nga bimala eddakiika 10 ku 30 ez’okusika. Mu kiseera kino, tekisoboka kumanya kifo kituufu buli mulabe we gukubwa nga bukyali.

Essuula BANA



Sayansi

ÿ

Ebivaako obulwadde buno

ÿ

Okukuba ebifaananyi

ÿ



Fulgurite kye ki?



Fulgurites kintu
kyा ndabirwamu
ekikolebwa mu
butonde nga kikolebwa
okuva mu musenyu,
ettaka oba ensenke endala
ezikuba n'okusaanuuka
kw'omulabe. Zitera okuba
empanvu ate nga zirimu
ebituli, era osobola
okuzigula mu maduuka
g'ebey'obugagga eby'omu ttaka.



Ebisibuko yaffe: © Ronald L. Holle

Ebisiningawo okusoma: Wright, F. W. Jr., 2010: Ekizuuiliddwa kya fulgurite eky'ekitalo mu Florida. Mu by'obudde, 51, 27-31

Omulabe gw'omupiira kye ki?



Wabaddewo amawulire okuva mu nsi yonna ku kintu ky'amasannyalaze ekirabika mu ngeri y'omupiira era nga kimala sekondi ntono zokka. Omulabe guno ogw'omupiira gutera okubaawo munda mu kifo ekiggaddwa. Tewali ndowooza ezikkiriziganya ku ngeri omulabe gw'omupiira gye gukola mu kiseera kino.



Ebisengawo okusoma: Uman, MA, 1986: Byonna bikwata ku laddu. Ekitongole ky'amawulire ekya Dover, 167 pp.

KITUFU OBA BULIMBA?



“Okumyansa kwonna kubaawo
munda mu troposphere.”

Newankubadde ng’omulabe gwe tутera okulaba mu kiseera ky’okubwatuka gubeerawo gwonna munda mu troposphere, okubwatuka okunene kuyinza okuvaamu ebintu eby’amasannyalaze ebikuba waggulu waggulu w’omuyaga okuva mu troposphere okudda mu stratosphere, n’okusingawo waggulu mu mesosphere ne ionosphere. Ebintu bino ebirabika biyitibwa sprites ne jets.

Ebisengawo okusoma: Lyons, W., 2017: Okukuba ebifaananyi by’obudde mu nzikiza. Obulwadde bw’obudde, 70:4, 20-27, <http://dx.doi.org/10.1080>

Tusobola okusitula okumyansa okuva ku ttaka mu ngeri ey'ekikugu?



YEE. Emizinga emitonotono gikozesebw
bulungi okukuba omulabe mu bifo
eby'enjawulo okwetoloola ensi yonna.
Okumasamasa kuno okusindikibwa
kukozesebw okusoma fizikisi
y'okumyansa n'okugezesza enkola y'emikutu
gy'okuzuula okumyansa n'ebintu ebirala nga
layini z'amasantyalaze.



Ensonda: State Key Laboratory ku mbeera y'obudde ey'amaanyi, Chinese Academy of Meteorological Sciences.

Eweereddwa Dong Zheng

Ebirala ebisomebwa: Rakov, VA, 2016: Emisingi gy'okumyansa. Ekitongole ky'amawulire ekya Cambridge University, 257 pp.

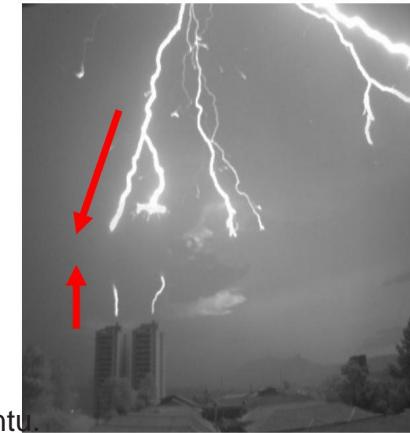
Yijun, Z, W. Lu, ne S. Chen, 2016: Okwekenenya enkulaakulana mu kwetegereza okumyansa mu myaka kkumi
egiyise mu Guangdong. Journal of Okunoonyereza ku mbeera y'obudde, 30 (5), 800-819.

KITUFU OBA BULIMBA?



“Ebintu ebiwanvu bisobola okutandika okumyansa.”

Ebintu ebiwanvu nga
antenna za ttivvi, ebyuma
ebikuba empewo,
n'ebizimbe ebiwanvu
bisobola okutandika okumyansa,
wadde nga kino tekitera kubaawo.
Ebintu bino byangu
okumanyibwa mu bifaananyi
okusinziira ku mikutu gyabyo
egy'okudda waggulu okuva ku bintu.



Ensonda zaayo: Sao Paulo, Brazil. Eweereddwa Dr. Marcelo Saba, ekitongole ky'eggwanga ekikola ku kunoonyereza ku bwengula, Brazil

Ebisiningawo okusoma: Saba, MMF, A. R. Paiva, C. Schuman et al. 2017: Enkola y'okusiba omulabe ku bizimbe ebya bulijjo. Ebbaluwa z'okunoonyereza ku by'ettaka, 44, doi:10.1002/2017/GLO72796.

Oyinza otya okukuba ebifaananyi by'omulabe?



Engeri emu kwe kukwata ekifaananyi ekiwanvu
ekija okubeeramu emikutu gy'okumyansa egiwerako
mu kifaananyi kye kimu. Engeri endala kwe kukwata vidiyo
n'oggyayo fuleemu nga waliwo okumyansa. Engeri
esembayo kwe kusonga kkamera eri omuyaga
ogw'okubwatuka ogukola n'okukuba ebifaananyi
obutasalako, naye subira ebifaananyi ebingi nga tewali kumyansa.

Source credit: Ekifaananyi ekiwanvu (eddakiika eziwera) eky'okumyansa mu Tucson, AZ. © Ralph H. Wetmore II, omuwandiisi w'ebitabo.

Ebisengawo okusoma: Wetmore, RA, 2010: Emyaka amakumi asatu eg'y'okukuba ebifaananyi by'omulabe mu bugwanjuba bwa Arizona.
ISBN10:0982566212, olupapula 112.



KITUFU OBA BULIMBA?



“Emyaka girina langi ez'enjawulo.”



KITUUFU

Emikutu gyonna egy'okumyansa gitandika nga njeru eyakaayakana.
Okusinziira ku kika ky'obutundutundu obuli mu mpewo wakati wa
kkamera n'omukutu gw'omulabe, okumyansa kuyinza okulabika nga kwa
bbululu, kakobe, emmyufu oba kiragala ng'ekitangaala kyayo kikutuuseeko.

Ebisengawo okusoma: Salanave, LE, 1980: Okumyansa n'ensengekera yaakyo: Atlas y'ebifaananyi, University of Arizona Press, 136 pp.

EMIRIMU GY'ENJAWULO KU LIGHTNING - EBIFAANANYI

Lwaki obugwanjuba bwa Arizona kye kimu ku bifo ebisinga obulungi mu Amerika okukuba ebifaananyi by'omulabe?



Wadde ng'obugwanjuba bwa Arizona si kye kibuga ekikulu eky'okumyansa, kye kibuga ekikulu eky'okukuba ebifaananyi by'omulabe w'okubwatuka kw'okubwatuka kwa Amerika okukolebwa mu sizoni y'omusana (July okutuuka ku ntandikwa ya September), era emisingi gy'ebire giba wagglu (ebiseera ebisinga mita nga 3,000, oba ffuuti 10,000). N'olwekyo, emikutu gy'omulabe osobola okugiraba ng'oli wala. Plus, southern Arizona eyooyooteddwa ne cacti, yeetooloddwa ensozi, era erina enjuba ezigwa eza langi (Laba ebifaananyi by'omulabe okuva e Tucson, Arizona ku mpapula 2 eziddako).



Ebisinawo okusoma: Wetmore, RA, 2010: Emyaka amakumi asatu egyptiokukuba ebifaananyi by'omulabe mu bugwanjuba bwa Arizona.
ISBN10:0982566212, olupapula 112.







ÿ Ekitongole ky'ebiyobulambuzi mu ggwanga ekya Amerika ekivunaanyizibwa ku by'okwerinda ku laddu
[obukuumi bw'omulabe.noaa.gov](http://obukuumi.bw'omulabe.noaa.gov)

ÿ Vaisala Inc.
vaisala.com/okumyansa

ÿ Ekitongole ky'amazzi ne ssaayansi w'empewo, Yunivasite
y'e Arizona has.arizona.edu



Obadde okimanyi?

- Bulijjo okubwatuka kukolebwa okumyansa, oba okiwulira oba nedda.
- Okumyansa kw'omulabe okusinga obuwanvu kubadde kupimiddwa nga kwa mayiro 200 (kiromita 321) obuwanvu.
- Ebbugumu ly'omulabe lyokya okusinga ku ngulu w'enjuba.
- Ensozi ezivuuma zisobola okuvaamu okumyansa.

VAISALA