## WMO radiosonde intercomparison campaign UAII2022

UAII2022

Ruud Dirksen GRUAN Lead Centre, DWD

GRUAN Implementation and Coordination Meeting (ICM-14) Saint Denis, La Reunion 28 Nov 2 Dec 2022

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**Deutscher Wetterdienst** Wetter und Klima aus einer Hand



- > 1951 & 1956 Payerne
- 1984 Bracknell
- ➤ 1985 Wallops
- 1989 Dzhambul
- 1993 Tsukuba
- > 1995-1997 Moscow & Wallops
- 2001 Alcantara
- 2005 Mauritius



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- 2010 Yangjiang
- 2022 Lindenberg
  - Joint effort with MCH-Payerne

Lindenberg Meteorological Observatory

Richard-Aßmann-Observatory



## Objectives of WMO Radiosonde campaigns

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- To get overview of performance of various operational radiosounding systems
- > Provide information for NMHs, basis for decision-making
- Provides incentive to manufacturers to improve the quality and costeffectiveness of radiosounding systems









- GRUAN-philosophy
  - Laboratory measurements, SHC ground check, reference instruments
- Laboratory campaign
  - Auxiliary, help interpret results of radiosounding intercomparison
  - Mutual benefit manufacturers & GRUAN
  - Results NOT used in final assessment of the systems
- "Common working standard" based on GRUAN data products
  - Independent reference & transfer between rigs
  - Additional reference instrument: CFH (RH)
- Independent operators
  - Capacity building, evaluate user-friendliness of the radiosounding system
  - Independent comparison of radiosounding systems ("blind" intercomparison)









- Laboratory campaign Feb Nov 2022
  - Optimized measurement program to get overview of sensor performance and identify relevant issues.
- Radiosounding campaign August September 2022
- > 12 participants
  - Selected based on criteria such as product maturity, market share, BUFR capacity, compatibility
  - o Finland, France, Germany, Japan, South Africa
  - Russia, China (3), India (2), South Korea
  - First call for participation 2020, repeated in 2021
    - Include manufacturers from emerging markets

## Covid-19 & Ukraine









Manufacturer	Model	Country
Aerospace Newsky	CF-06AH	China
Azista Industries Pvt Ltd	ATMS-3710	India
Diel Met Systems (Pty) Ltd		
InterMet Africa	iMet-54-AA	South Africa
GRAW Radiosondes GmbH &		
Co. KG	DFM-17	Germany
JCC "Radiy"		Russia
Meisei	iMS-100	Japan
MODEM	M20	France
	OTC2	
	0155	Crinia
Tianjin Huayuntianyi	HT03G-1U	China
Vaisala Oyj	RS41-SG	Finland
Vikram Sarabhai Space Center	Pisharoty Sonde : PS-B3	India
WEATHEX	WxR-301D	Korea







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August 2022: Radiosonde types

Courtesy: B. Ingleby









1	Feb	b			N	lar					A	pr				Ma	ai				Jun					Jul					Aug							Se	р		1		C	Okt				1	Nov				
Week	5	6	7	7	8	9	10	11	12	1:	3 1	4 1	15	16	17	18	3 19	9 2	0	21	22	23	24	1	25	26	#	28	29	30	31	1	32			33	34	35	3	37	3	3 3	9	40 4	11	42 4	13	44	45	46	47	48	3 49
	31.1	1 7.2	14.2	2 21	.2 2	8.2	7.3	14.3	21.3	28.	3 4.	4 1:	1.4 1	18.4	25.4	2.5	5 9.5	5 16	.5 2	3.5	30.5	6.6	13.6	5 20	0.6	27.6	4.7	11.7	18.7	25.7	1.8	8	8.8	15	5.8		22.8	8 29.8	в 5.9	12.5	9 19.	9 26	.9 3	.10 10	1.10	7.10 2	4.10 31	.10	7.11	14.11	21.11	28.11	L 5.1
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- Optimized measurement program to get overview of sensor performance and identify relevant issues.
- Results will NOT be used in the final assessment of the systems
- Mutual benefit to manufacturers & organizers
- Radiosonde systems operated by manufacturer
  - Non-standard operation of system requires specialist-knowledge





## Characterisation - Laboratory measurements

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### 2 weeks, 6 measurement days



Radiation

ead Centre

PTU









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# Evaluation laboratory campaign





- > Laboratory measurements went very smooth.
- Very well-received by manufacturers
  - o Eager to perform additional measurements
  - $\circ~$  Adoption of characterisation practices?









# **Field campaign - preparatory**

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- Prior: operator-selection
  - >40 candidates
  - Zoom-interviews -> 10 selected
- $\succ$  Rig construction (80 pc)
- Analysis software (dvas)
- $\succ$  Documentation, policy, CoC,
  - Shipping, local logistics etc.







# Field campaign - Time line

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Aug						Sep					Okt	1			
31	32			33	34	35	36	37	38	39	40	41	42	43	- 44
1.8	8.8		15.8		22.8	29.8	5.9	12.9	19.9	26.9	3,10	10.10	17.10	24 10	31,10
Р	Manufact														
r				~80 Ballo	oon	asce	ents								
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р	<b>Testflights</b>	s		Reference	e - 1	CFH)	)	Ī							
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- > 8 August: Arrival of manufacturers & setting up systems
  - o Antenna locations
- Training of operators
  - Each operator trained to operate 2 systems (2 rigs)
  - $\circ~$  Allocation: no prior experience with system in question
  - $\circ$  5 parallel classes, operators + campaign staff
  - 1 last-minute cancellation -> replaced by Lindenberg staff
  - Test soundings
  - Concluded in 5 days (additional session during the weekend)
- Last minute preparations
  - Procedures for data collection & validation, metadata protocol, frequency allocation

## Logistical challenge







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<image>



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# Frequency allocation

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- > 10 participants + GDP sondes
- ➢ 0.2 MHz separation

- Discrete frequency selection
- Initial/default frequencies

DWD network

Order for switching-on sondes

402.0	402.1	402.2	402.3	402.4	402.5	402.6	402.7	402.8	402.9	
VIK	Mei		HGW	Rig1_3	Weath	Vais	Aeros	Tian	Rig2_2	
					Schl1		Kumbr			
403.0	403.1	403.2	403.3	403.4	403.5	403.6	403.7	403.8	403.9	
х	X	N	liltär Mob	oil	x	x	x	X		
404.0	404.1	404.2	404.3	404.4	404.5	404.6	404.7	404.8	404.9	
Rig1_2		Imet	Azist		LIN2		HGW2	Rig2_3	Graw	
			Schl2						Kumbr	
405.0	405.1	405.2	405.35	405.4	405.5	405.6	405.7	405.8	405.9	
	LIN1		GDP_V			GDP_M	Berg	Mod	Berg	
		9								







16 August – 13 September

Rig composition:

- > 5 participants
- Working standard, composed of 2 GRUAN Data Products Vaisala RS41-SGP, Meisei iMS-100 (separate radiosondes)
- 1-2 duplicate sondes

- Occasionally include descent data
- weekly CFH sounding with working standard only







- > 8h Weather briefing, rig trajectory [Supervisor]
  - Supervisor(s) determine rig composition, starttimes, assign frequencies, balloon lift
- > 9h operator briefing
  - $\circ~$  Sonde preparation, SHC check, protocolling, rig balancing, sonde attachment

Keynote 2 WMO Campaign

- 10h launch
  - o Burstpoint
  - Data collection & validation
- ➤ 14h 2<sup>nd</sup> briefing
- > 15h 2<sup>nd</sup> launch

Night shift (start 18h)







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- ➢ 79 soundings
- Per manufacturer
  - >18 daytime; > 4 twins
  - $\circ$  >16 nighttime; >3 twins

## Ample statistics

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### 0 Weather conditions

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- Lead by Frederic Vogt
- > DVAS analysis plots available to campaign staff & operators
- > Topic of the day
- Enhance campaign feeling







# Satellite overpasses

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## 22 overpasses within 72 mins of sounding

Satellite	Nadir	SEA	Overpass	Balloonlaunchtime
NOAA20	6.16	50.84	2022-08-17T11:37:35	2022-08-17T11:47:53
METOP-C	6.00	-12.57	2022-08-17T19:54:00	2022-08-17T19:32:14
METOP-C	16.95	-10.41	2022-08-18T19:33:16	2022-08-18T19:04:42
METOP-C	6.41	45.63	2022-08-19T09:24:45	2022-08-19T07:59:24
METOP-C	2.04	-13.75	2022-08-22T19:50:29	2022-08-22T19:03:13
METOP-C	20.36	-11.57	2022-08-23T19:29:45	2022-08-23T18:54:18
NOAA20	4.29	-20.76	2022-08-24T01:17:33	2022-08-24T00:58:32
METOP-C	23.60	-12.80	2022-08-28T19:26:14	2022-08-28T18:44:46
METOP-C	1.52	42.06	2022-08-29T09:17:42	2022-08-29T08:10:10
METOP-C	23.76	39.73	2022-08-30T08:56:54	2022-08-30T07:58:41
METOP-C	17.27	-18.42	2022-08-31T20:04:12	2022-08-31T18:51:21
NOAA20	14.65	44.85	2022-09-01T11:56:08	2022-09-01T11:05:05
METOP-C	5.90	-16.33	2022-09-01T19:43:26	2022-09-01T18:30:00
NOAA20	6.40	45.24	2022-09-02T11:37:16	2022-09-02T11:54:00
METOP-C	13.57	-19.83	2022-09-05T20:00:40	2022-09-05T19:04:18
NOAA20	20.97	42.64	2022-09-06T12:02:19	2022-09-06T12:52:23
METOP-C	9.78	-17.70	2022-09-06T19:39:53	2022-09-06T18:39:30
NOAA20	0.61	43.14	2022-09-07T11:43:26	2022-09-07T12:30:20
NOAA20	19.61	43.32	2022-09-08T11:24:37	2022-09-08T11:55:18
NOAA20	7.59	40.94	2022-09-12T11:49:36	2022-09-12T11:55:25
METOP-C	13.35	36.37	2022-09-13T09:07:03	2022-09-13T08:09:26
NOAA20	13.38	41.23	2022-09-13T11:30:46	2022-09-13T11:49:44









### Very successful

- Impact of global events
  Covid-19, Ukraine
- Ambitious goals
  - Laboratory campaign
  - o Independent operators
  - New data analysis system
  - o GDPs as working standard
  - o Remote sensing systems, satellite, aircraft

Independent operator concept successful

 $\circ~$  Well-received by manufacturers



Visit by presidents WMO/DWD & MCH

GRUAN-







- Laboratory campaign well-received
  - Optimal timing: after field campaign?
- Logistical issues
  - $\circ$  incomplete equipment, shipping

## Team effort

- Very good atmosphere in campaign team. Great willingness to cooperate & improvise when necessary
- Data release after publication of report (September 2023)









DWF

Half way mark

### Write Report

Meteoswiss/G.Romanens/22.11.2022















### Deutscher Wetterdienst

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### DWD in situ sounding group

Ruud Dirksen Michael Sommer Christoph von Rohden Tzvetan Simeonov Peter Oelsner

Susanne Körner Marion Fiedler-Krüger Rico Tietz Helge Friedrich Tatjana Naebert

### МСН

Alexander Haefele Gonzague Romanens Gianni Martucci Frederic Vogt Christian Felix DWD Jens Hülskötter Dirk Jantze Karsten Schwebe Robert Begbie Katrin Jantze Sabrina Konopka Madlen Kaminsky Norbert Hoche Michael Schwebe Kersting Wallro Jörg Karpinski

### Associate Stella Dietze

Holger Vömel

WMO Kruno Premec Isabelle Ruedi

### **Operators**

Savitri Gangadeen Zeinab Sayed Fahmy Wayne Pene Sonny Pajarilla Norman Duri Quyen Nguyen Thi Bassem Lajnef Josette Jhabeemissur Nontobeko Langa Sven-Olaf Körner

### https://www.gruan.org/community/campaigns/uaii2022





#### **Manufacturers**

**Benjamin Charpentier** Antoine Farah Christophe Raux **Rémy Gautier Benjamin Finot** Eden Evans Samuel Kingstone **Binilroy Thankappannair** Sumangalabai Matti Lehmuskero Arup Dey Hannu Jauhiainen Johannes Saarinen Tapio Tikkanen | Wenwu Peng Xiaojie Huang Meilin Kuai **Jiangiao Huang** Narendra Solanki Raghavendran Vedam Niraj Shah

Andrew Spencer Michael Talbot Jong Chen Yopme Panzer Alexander Kotik Johannes Frielingsdorf Jens Seifert Guido Cedrone Stefan Fellner Kensaku Shimizu Rorio Nagahama Jaewon Solanki Ujin Jeong

### https://www.gruan.org/community/campaigns/uaii2022