

UAS BASED CALVAL ACTIVITIES

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• SCIENTIFIC RATIONALE

Thematic area: CAL-VAL

- Flights with thermal camera equipped UAS:
 - to be performed together with nightly satellite passages
 - calibration and validation of satellite data.
- Flights with RTK positioned UAS and high resolution visible camera:
 - high resolutions DTMs as aid for satellite acquisitions.
- Flights with UAS equipped with gas sensors:
 - calibration of satellite data
 - still in development

• OBSERVATIONAL INFRASTRUCTURE

- Intermediate step between field and plane/satellite data:
 - “Proximal remote sensing”
- At INGV-OV there are 3 operators and 4 vehicles:
 - 1 hexacopter FlySmart
 - 1 quadcopter SR-T4
 - 1 quadcopter SR-X4 (Mini class)
 - georeferencing system of the RTK / PPK dataset
 - 1 quadcopter Micro class
 - All equipped with visible and thermal camera(s)
- INGV fleet counts about 40 vehicles and 50 operators:
 - mostly multicopter ranging from $\lesssim 1\text{kg}$ to $\gtrsim 10\text{kg}$
 - allowed payloads may arrive up to few kg.



• TECHNOLOGICAL LABORATORIES

- “Laboratorio SAPR OV”
 - vehicle maintenance
 - batteries load/unload
 - log and mission data acquisition for each measurement campaign
 - log book storage
- Other comparable structures will be activated in other INGV sections
 - a network will be created among all sections

• INFRASTRUCTURE FOR DATA MANAGEMENT

- Data are currently stored on OV data infrastructure:
 - 2 x 81Tb NAS (shared with other section data)
 - 1st and 2nd tier: direct storage and duplication
 - 1 x 88Tb (shared)
 - 3rd tier: geographical duplication
 - daily backup on LTO-6 tapes

• INFRASTRUCTURE FOR DATA PROCESSING

- Dedicated workstation for thermal and visible image analysis and model reconstruction
 - Dual Xeon 2.2GHz, 10 cores/CPU
 - 128GB DDR4 RAM
 - 2x512GB SSD NVMe in RAID1
 - 6x2TB SATA HDD in RAID6
 - Pix4d, Analyst and ArcGIS
- 2x field laptop for UAV management and data download.
 - different architectures

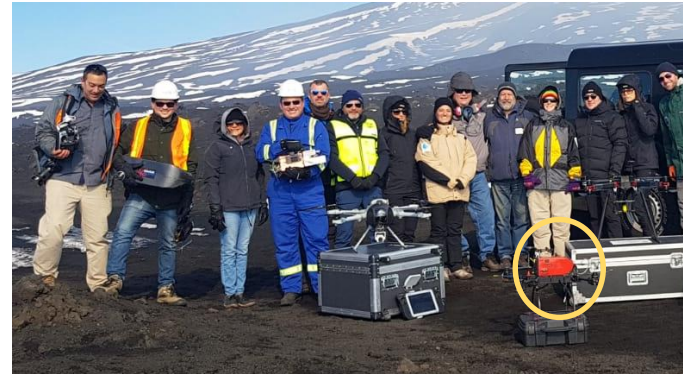
• PRODUCTS AVAILABLE (1)

- Terrain maps from visible surveys
 - single images
 - composed visible maps
 - DTMs
 - Used for support to satellite data
- Temperature distribution from thermal surveys
 - single images
 - composed thermal maps
 - CAL/VAL of satellite data
- Soil temperature from field measurements
 - thermal camera and thermocouple
 - maps of soil temperature

• PRODUCTS AVAILABLE (2)

- Gas composition profiles in hydrothermal plumes

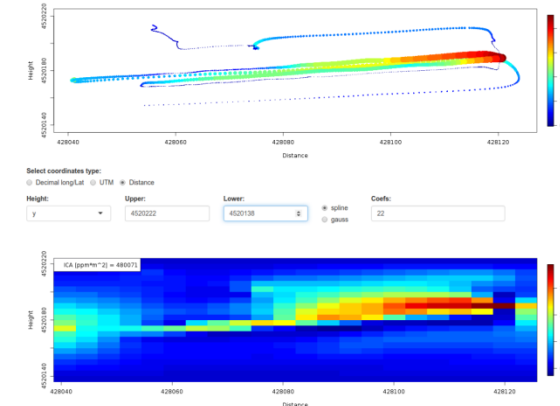
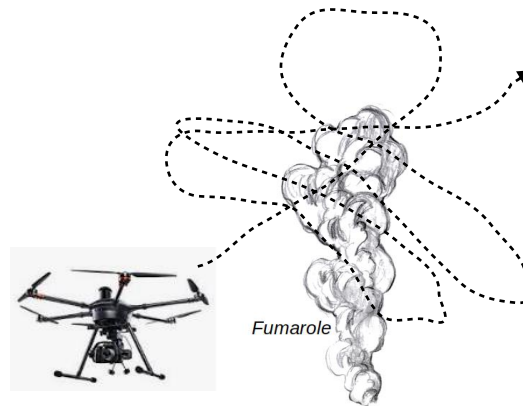
- Columnar data
- CAL/VAL of satellite data
- testing phase



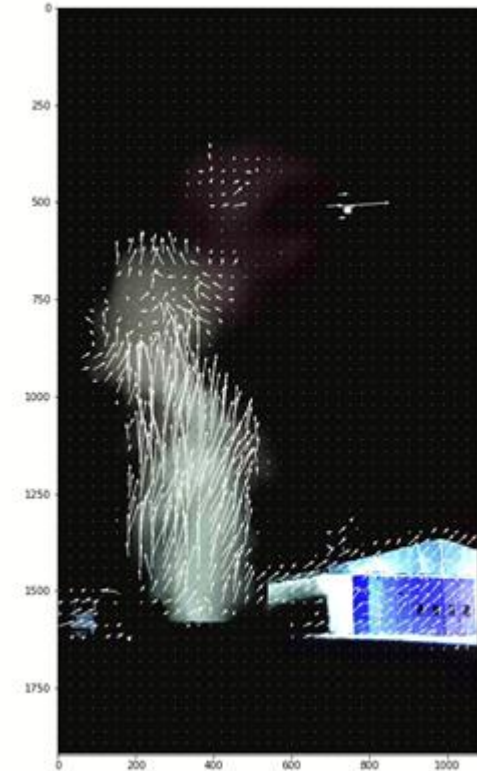
Multi-sensor board with diffusive gas sensors:

- CO₂ infrared 0-5000 ppm
- SO₂ e H₂S electrochemical 0-20 ppm
- Rh, T, P sensors for H₂O calculation

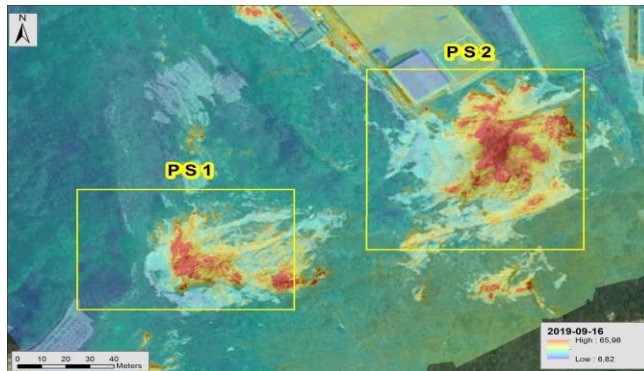
Payload < 300 g



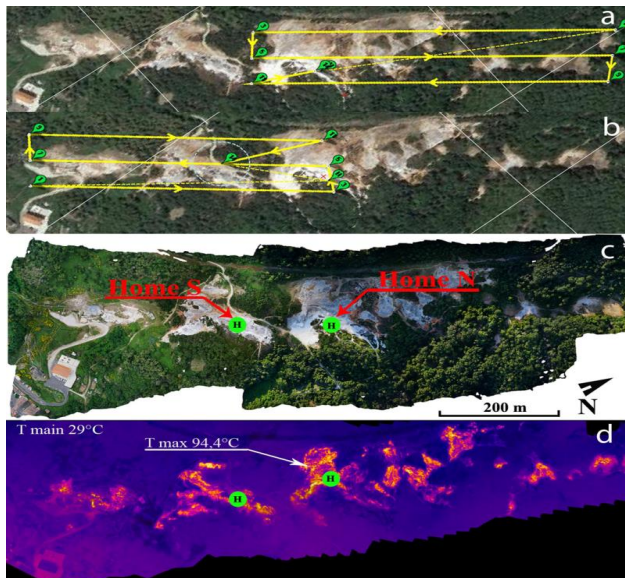
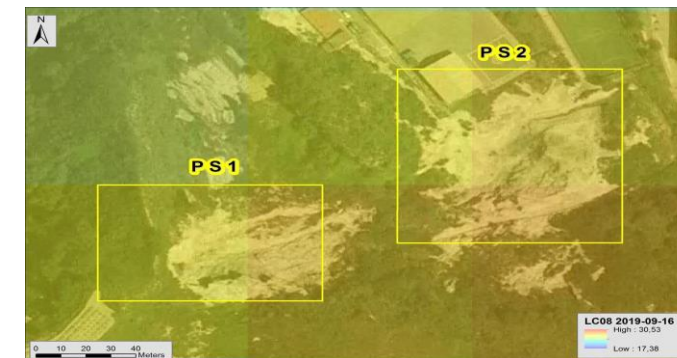
concentration transept



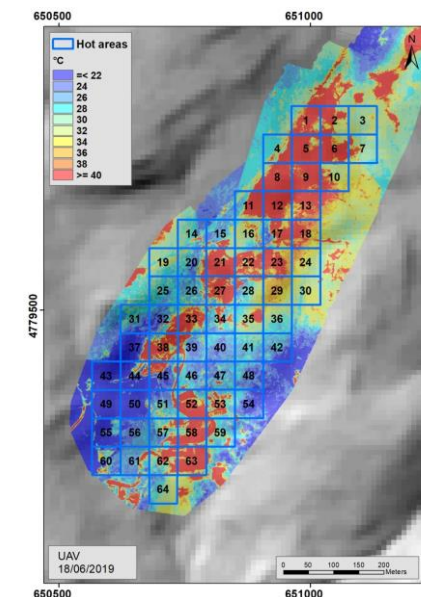
- PRODUCTS AVAILABLE (Integration with satellite images)



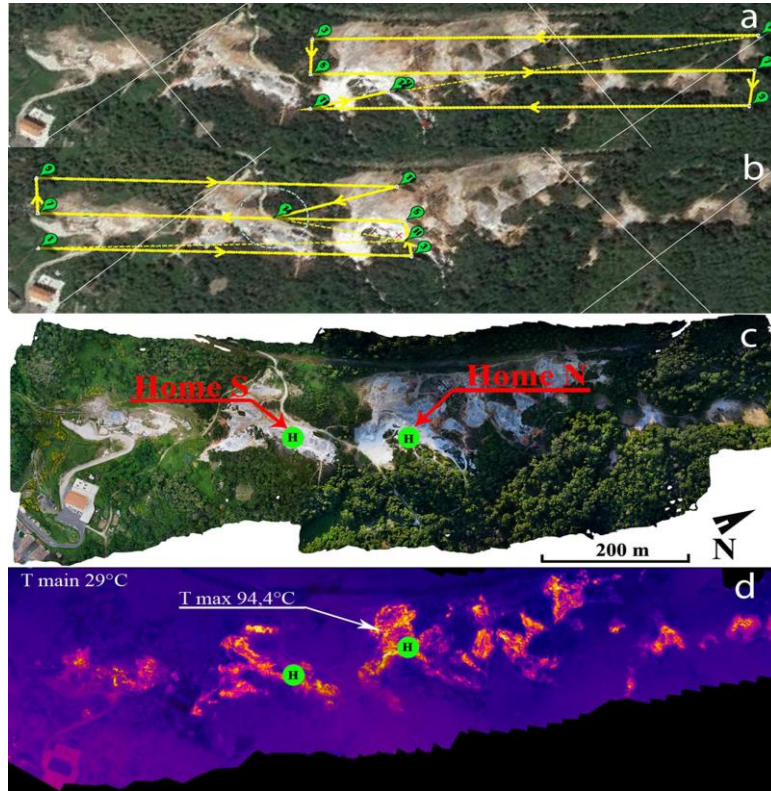
Pisciarelli CF



Parco delle Biancane
Lardarello



• PRODUCTS AVAILABLE (Examples)



NOME AREA	TIPO ACQUISIZIONE	N. PIXEL	AREA	T_MIN	T_MAX	RANGE	T_MEAN	DATA
PS2	DRONE	303050	8106,16	1,79	73,89	72,09	10,82	07/02/2020
PS1	DRONE	194714	5208,33	2,50	47,00	44,50	10,94	07/02/2020
PS2	L8	9	8100,00	7,00	8,35	1,34	7,58	07/02/2020
PS1	L8	6	5400,00	8,81	9,00	0,19	8,90	07/02/2020
PS2	DRONE	349281	8101,67	18,25	84,70	66,45	36,62	29/05/2020
PS1	DRONE	232854	5401,12	12,05	75,53	63,48	34,96	29/05/2020
PS2	L8	9	8100,00	37,71	40,32	2,61	38,81	29/05/2020
PS1	L8	6	5400,00	35,39	36,83	1,44	36,15	29/05/2020
PS2	DRONE	342815	8099,61	21,60	69,30	47,70	28,22	17/07/2020
PS1	DRONE	115231	2722,54	24,37	76,63	52,25	32,26	17/07/2020
PS2	L8	9	8100,00	26,16	26,76	0,61	26,45	16/07/2020
PS1	L8	6	5400,00	25,22	25,88	0,66	25,57	16/07/2020
PS2	DRONE	375769	8102,33	4,85	58,56	53,71	14,80	20/10/2020
PS1	DRONE	241253	5201,89	8,63	61,70	53,07	18,71	20/10/2020
PS2	L8	9	8100,00	14,87	15,84	0,97	15,30	20/10/2020
PS1	L8	6	5400,00	15,66	15,92	0,27	15,78	20/10/2020

• CURRENT DISTRIBUTION OF PRODUCTS

- Manually distributed, no automatic method or network access
 - email
 - google drive
 - ecc.
- Data are shared on request to interested people inside INGV
- Looking for a way to implement an efficient distribution process
 - [ERDDAP](#)? In test

• PROGRAMS/PROJECTS OF REFERENCE

- Convenzione INGV-DPC Allegato B2 2019-2021, WP2, Task 5
“Determinazione del flusso di calore tramite termocamera mobile, drone e satellite: applicazione ai Campi Flegrei”
- Convenzione INGV-DPC Allegato A 2021-2022 (WP 5.4; 5.9; 5.14)
- FIRST - “Forecasting eruptive activity at Stromboli volcano: Timing, eruptive style, size, intensity, and duration” - Progetto Interdipartimentale

• TEAM AND AFFILIATIONS

- Marotta Enrica - OV-INGV
- Avino Rosario - OV-INGV
- Avvisati Gala - OV-INGV
- Bellucci Sessa Eliana - OV-INGV
- Belviso Pasquale - OV-INGV
- Cirillo Francesca - OV-INGV
- Peluso Rosario - OV-INGV
- Tamburello Giancarlo - INGV-BO