# CYMS webinar

Foreword:

The following document gathers the questions and answers asked during the Webinar. The questions from the participants are the same but we have sometimes enriched the answers with respect to the Webinar in order to give more details to the participants.

1. **CYMS project presentation: context, objectives, data processing, description, distribution & perspectives:** *Romain Husson, CLS*

**Rémi Gandoin (C2Wind):** Hello Romain, thank you for your presentation. My question is: To which time averaging period correspond these SAR-derived wind speeds (1, 10 minutes for instance)? Thanks

--> Romain Husson (CLS):

Originally, the SAR-derived wind products such as the Sentinel-1 Level-2 Ocean Products made available on the ESA Scihub platforms are estimated using Geophysical Model Functions (GMF) such as CMOD-IFR2 or currently CMOD-5N. This latter was developed and validated for wind mainly ranging between [0-20] m/s using co-locations against in situ measurements or Numerical Weather Prediction (NWP) model outputs whose definition are 10 meters height above sea level (a.s.l) and averaged over a 10 min period. NDBC buoys used for CMOD-5N validation in [Herbasch 2008] are 8-min average for instance (thus almost equivalent to 10-min averaged).

Examples of validation of these Level-2 Ocean Sentinel-1 products against NCEP and ECWMF models are available and performed routinely (https://sentinel.esa.int/documents/247904/4776203/DI-MPC-APR-523-1-1-Annual+Performance+Report+2021.pdf/9a5bf9a7-b8b7-4b6b-e3c0-ce23bdb565b8?t=1646808727067)/.

In CYMS, we have developed high-wind retrieval algorithm. For more extreme winds and up to 80 m/s, the main reference for surface winds is the SFMR measurements performed by NOAA while flying through tropical cyclones. Latest CYMS products have been developed and validated against these measurements [Mouche et al. 2019].

Even though the SFMR measurements have 1 s sampling, comparisons against SAR are performed at 3km. For the strongest wind speeds (~60m/s), the **3-km** spatially averaged CYMS products corresponds to a time scale of approximately **1 minute**. Please note that CYMS products are available with a **1 km pixel spacing**. For such intense winds, Météo-France La Réunion forecasters use conversion coefficient to compare 1' to 10' average winds.

**Davide Merli (ENSER):** There are literature correlations to derive the wind gust speed for different reference time intervals. Could it be an objective of CYMS to derive new empirical tools for that? E.g. below from Vellozi 1968, Flory 1977.

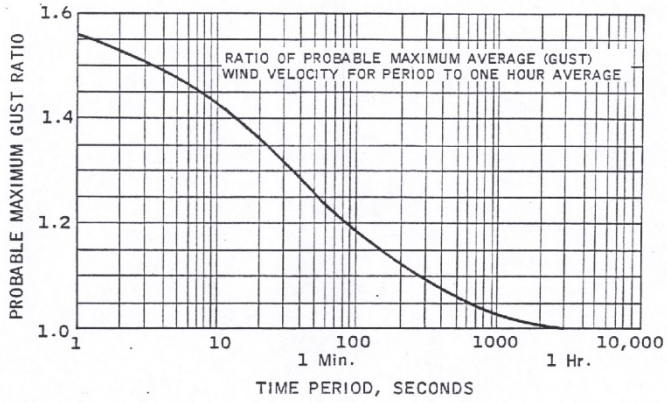



**Figure D-2 Adjustment of Wind Speed for Duration**
**(Vellozi - 1968, Flory -1977)**

--> Romain Husson (CLS): Based on the feedbacks from previous end-users, identified short terms objectives of CYMS in terms of R&D improvements are:

- a better detection of rain-related signatures in SAR signal, including at high wind speeds,
- more robust wind field estimation over various incidence angles,
- more consistent between SAR sensors and with comparable performances at all wind speed ranges.

From the SAR data, the wind estimations are performed independently at each 1km pixel with 3-km averaging. However, the SAR images do contain spatial and texture information that has been used in the past to classify [Wang et al. 2019] or segment [Colin et al. 2022] some oceanic/meteorological processes. New methodologies trying to exploit the SAR spatial scales and texture could be performed to try to derive additional information on wind gust. We have some preliminary tests undergoing using NDBC wind gust measurements, but they bring little information with respect to a simple multiplication coefficient applied to the measured wind speed.

**Khan, Salman Saeed (O&A, Aspendale):** Hi Romain, thanks for the presentation. Wondering how the Sentinel-1 B recent situation has affected the service or data acquisition?

--> Romain Husson (CLS): Thanks for your question.

Basically, we have 33% less observations over Tropical Cyclones while the observations over Europe are affected at 50% since most of them were performed with S1-A and -B only.

To be able to face this situation, we are supported by ESA in having access to more RS2 data acquisitions as a collaborative mission. This process would be even facilitated if CYMS becomes a Copernicus service in the future. So, your support is crucial (letter of support, feedback on data usefulness).

Though, the compensation with RS-2 is only partial and will not enable the same number of observations. Also, as satellite missions have different orbits, they enable a good complementarity in terms of chances to catch a given event. So, less satellite missions also mean less chances to catch a given event at a given time.

For the record, here are the latest news concerning S1B status: https://tinyurl.com/bdejfnr4

**Fernando Prates (ECMWF):** The current format available to the CYMS wind maps is NetCDF. Are there any binary format files also that would be available? This format is quite mandatory to be able to be used by the meteorological services.

--> Romain Husson (CLS): The current NetCDF format was selected after gathering end-users requirements during the first phase of the CYMS project. With increasing number of end-users, we could develop additional formats for these products. Your experience with Grib files will be very beneficial to help proposing and distributing this additional format to a wider community (e.g. GRIB or BUFR format).

2. **Demonstration (data access & visualization tools):** *Vinca Rosmorduc, CLS*

**RAPP Jocelyn (CMA-CGM):** is wave height measurements are planned to be added in NRT product

--> Romain Husson (CLS): There are indeed some existing measurements of wave heights in the literature based on S1 TOPS data [Pleskachevsky et al. 2019]. Such algorithms are not planned to be implemented at least in the mid-term development of CYMS but is of course of interest for the simultaneous retrieval and use of wind and wave parameters. Main objectives are on wind-related variables for short-, mid-term but such developments could be incorporated on a longer-term basis. They are of course of interest to better understand the end-users needs.

3. **USECASE #1: Use of CYMS tropical cyclones measurements by meteorological forecasters:** *With Météo France La Réunion*

**Jean Bidlot:** When do you expect the foreseen improvements just mentioned to be used in the reprocessing?

--> Romain Husson (CLS): As exposed during the presentation, a new GMF in under development and validation using the latest and largest reprocessed CYMS archive, leading to a much better consistency of the retrieved wind speeds among the different sensors and at various incidence angles. The GMF re-assessment is dedicated to all RS-2 products and Sentinel-1 products processed with IPF version 3.1 and after (from 2019-06-26 onward).

The associated products will be reprocessed with these new GMFs. They should be made available by next September. The quality of the CYMS L2 products inherits from the quality of the Level-1 products (including its calibration), which is not completely homogeneous throughout the processor versions.

**Sean Healy:** Do you provide an uncertainty estimate with each retrieved wind speed value? I guess the GMF errors introduce horizontally correlated errors. Any estimate of horizontal error correlation scale length?

--> Romain Husson (CLS): Currently, the only uncertainty provided in the CYMS products is associated with the wind orientation estimation, directly derived from the SAR image (variable:

"wind_streaks_orientation" and its standard deviation "wind_streaks_orientation_stddev"). It is provided for each pixel at 1 km pixel spacing (Although, this methodology is based on the gradient analysis of the SAR image over patches of 8x8 km2, then downsampled at 1x1 km2).

Presently, average standard deviations are available for the wind speed variable using statistical comparisons with source references, but they are not available at each pixel. With future improvements of the wind inversion process, we will be interested in estimating additional uncertainty for the wind speed at each pixel within each SAR image. Further discussions with your team and other assimilation teams are welcome to further define this need.

4. **USECASE #2: Assimilation of CYMS tropical cyclones measurements in AROME**

   *With LACy*

**Sean Healy:** Is the wind information assimilated as ambiguous wind vectors or wind speed or …?

--> Quoc-Phi (LACy): The wind information is assimilated in terms of zonal and meridional wind speeds, using the following variables in the CYMS products: wind speed ("wind_speed") and wind streaks orientation ("wind_streaks_orientation")
--> Complement from Romain Husson (CLS): The wind streaks orientation by definition, has a 180° ambiguity. However, we propose in the "wind_streaks_orientation" variable, an ambiguity-free version of this parameter using the information provided by the ECMWF model. This ambiguity removal could also be re-estimated using other sources.

**Giovanna De Chiara:** Do you provide one solution only to the 3D-Var?

--> Quoc-Phi (LACy): Yes, there is only one solution provided in the tested 3D-Var.

5. **USECASE #3: Assimilation of CYMS polar lows measurements in AROME**

   *With Met No*

--> Per Dahlgren (MetNo): The assimilation system is also a 3D-Var.

--> Roger Randriamampianina (MetNo): It is a good idea to let the model decide whose direction is most probable among the two possible ones for the wind streaks orientation.

6. **Question & Answers**

**Jean Bidlot (ECMWF):** Apart from the wind information from the model, are there any other model information that is used to derive the product?

--> Romain Husson (CLS): We use both the model wind speed and the model wind direction. They are used as part of a Bayesian inversion taking also into account the SAR Sigma0 and a Geophysical Model Function, both for the two co- and cross-pol channels.

The way the Bayesian is parameterized, the model wind speed has little influence on the retrieved wind estimate. It is mostly the direction that influences it.

**Jean Bidlot (ECMWF):** If the model is modified in a way that the high wind speed distribution changes (larger winds due to a modification of the drag specification over strong winds), would there be a need to re-tune the SAR inversion using it as an a priori.

--> Romain Husson (CLS): There would be very small impact on the SAR inversion:

The way the successive cross-pol GMFs were developed (MS1A, Mouche et al. 2017; MS1AHW, Mouche et al 2019), they do not rely on any wind direction information potentially given by a model as these GMF have no dependency to the wind direction. Additionally, they are validated against wind speed measurements from SFMR and also SMOS/SMAP (at reduced resolution) but never use the model wind speed.

--> Jean Bidlot (ECMWF): There is then some interest in using the CYMS data to add extra validation to the model improvements under developments.

--> Romain Husson (CLS): The tropical cyclones archive is quite exhaustive. As for the polar lows, it relies on [Rojo et al 2019]. For the other phenomena, like the medicanes, the winter storms, we can also dig into the ESA SAR archive of Level-1 data to reprocess some events of interest for end-users so feel free to come back to us and point us some events you would like to work on.

**Rémi Gandoin (C2Wind):** When the winds blow from the coast, as opposed to other situations shown for instance in deep ocean, the SAR may pick up some additional sea surface roughness with respect to just horizontal winds, e.g. extra turbulence or other artefacts due to wave breaking in coastline areas. How much of this do plan to look into? How much does it bias the wind estimation?

--> Romain Husson (CLS): I have illustrated a case of strong Bora wind below.

The current dual-polarization SAR inversion used for CYMS is indeed sensitive to wave breaking thanks to the use of the cross-pol channel. This is the main process that enables observing highest wind regimes. See for instance [Hwang et al. 2010, Hwang et al. 2015]. The potential issue I see for very coastal areas is that extra wave breaking may take place due to shallow waters and wave shoaling. We have not performed any depth dependency study within our team, but this is a sensitivity that we should tackle. The issue I see for this investigation is the capability to co-locate the SAR measurements with enough in situ measurements under high-wind conditions and shallow waters or coastal regions. Using large in situ networks such as those provided by CMEMS could be a solution.

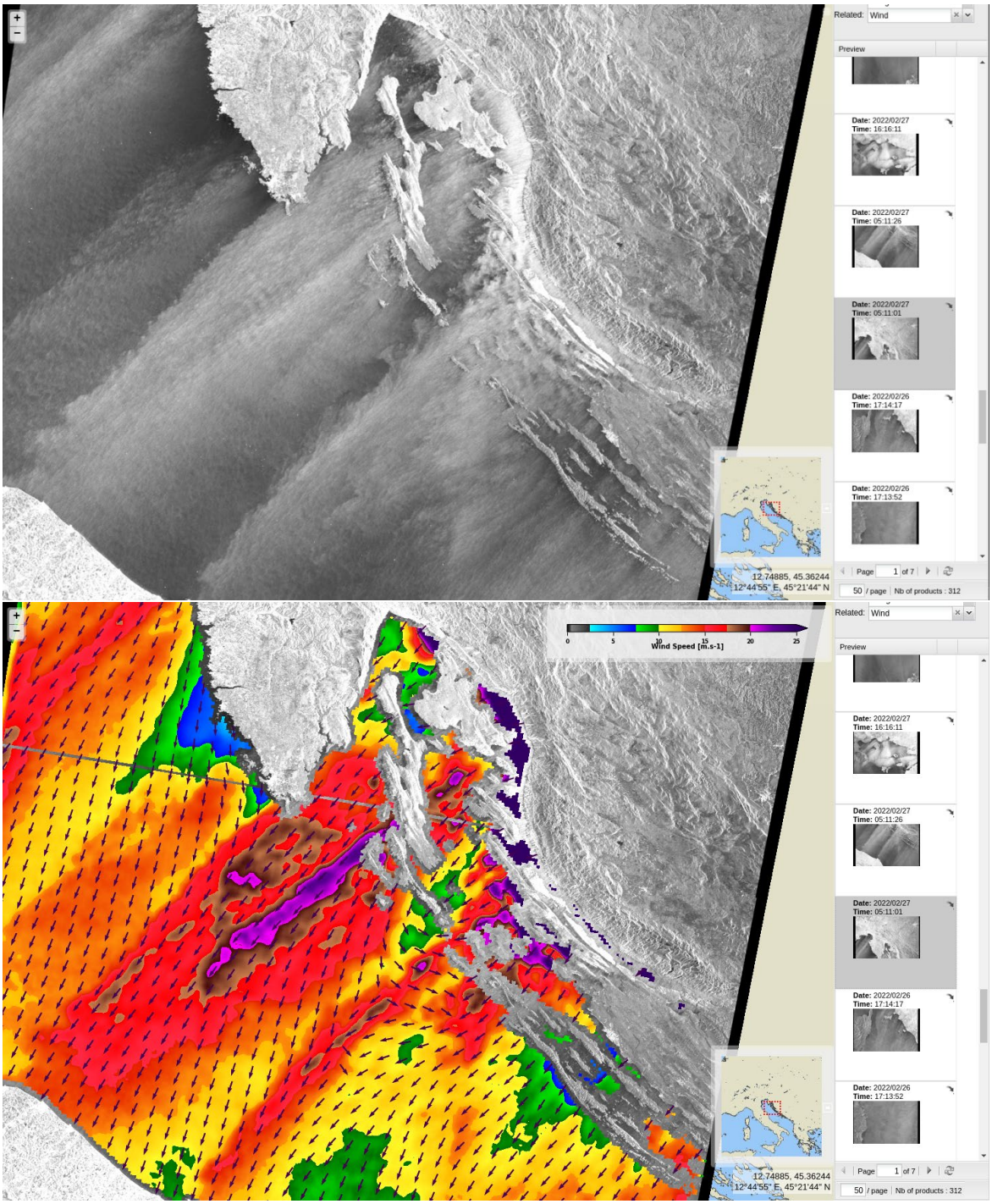



Figure: Caption of a case of Bora winds off the coasts of Croatia by Sentinel-1A on 2022-02-27 at 05h11 UTC with Nice display from co-pol (VV) on top and CYMS-derived winds on bottom. Maximum wind speeds in the close coastline vicinity reach 38 m/s.

**Sean Healy (ECMWF):** If looking forward at assimilating CYMS data in the model, in order not to be influenced by any ECMWF a priori that would reinforce the model, what would be advised? E.g. one of the problems with scatterometers, if you misplace the Tropical cyclones, you can reinforce the forecast error because picking up the wrong winds.

--> Romain Husson (CLS): Right now, within the current products, the geophysical information that are completely independent from the model are the wind streaks orientation. Only is the 180°

ambiguity removed using the model direction, but this can be re-estimated with any other model information or update.

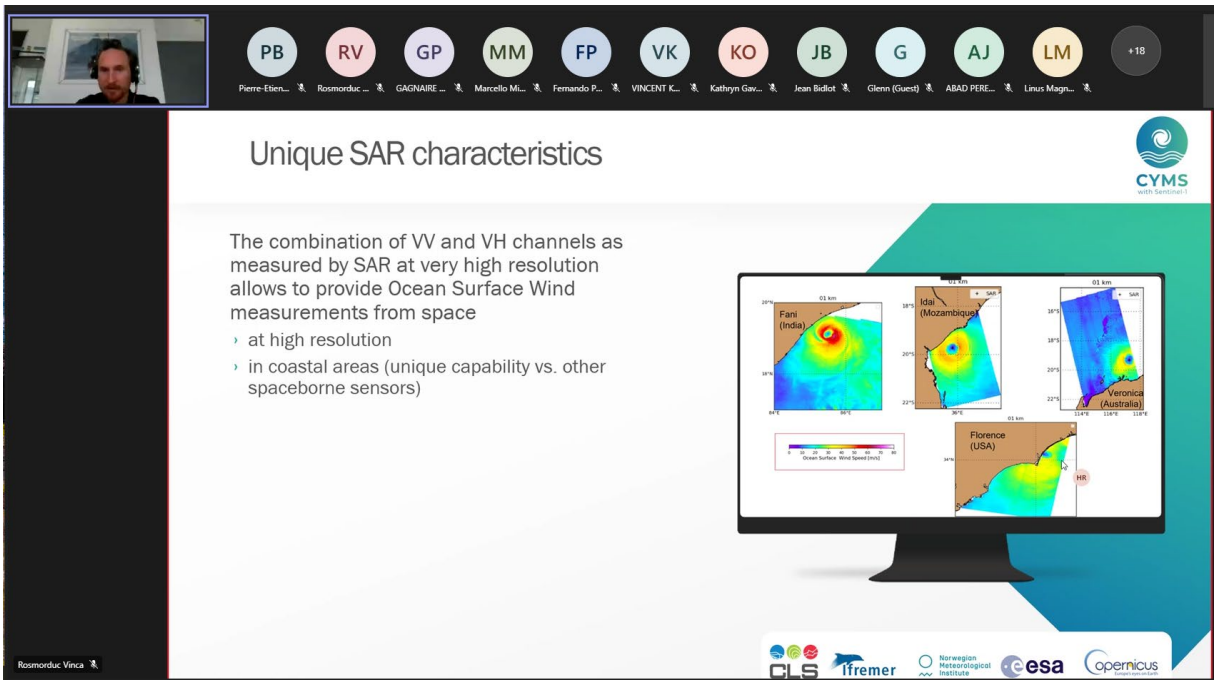
The wind speed itself is mostly influenced by the SAR Sigma0 but can slightly vary: To make things simple: for winds between [0-20] m/s, the wind speed estimate is mainly influenced by the co-pol GMF which is wind direction dependent. Thus, an error on the model direction can slightly impact the SAR retrieved wind speed. For larger wind speeds, the wind becomes more influenced by the cross-pol GMF which is not wind dependent. So, any error on the wind direction does not impact the wind speed estimate.

For future evolutions, we could think of providing not only the most probable solution, but possibly additional information. Several evolutions are possible to provide more intermediate information (with impact on data size as well). One idea is to provide the whole GMF cost function for co- and cross-pol channels over the whole range of wind potential speed/direction.

**References:**


- Colin, Aurélien, Ronan Fablet, Pierre Tandeo, Romain Husson, Charles Peureux, Nicolas Longépé, and Alexis Mouche. "Semantic Segmentation of Metoceanic Processes Using SAR Observations and Deep Learning." *Remote Sensing* 14, no. 4 (January 2022): 851. https://doi.org/10.3390/rs14040851.
- Hersbach, Hans. "CMOD5.N: A C-Band Geophysical Model Function for Equivalent Neutral Wind.," 2008.
- Hwang, Paul A., Biao Zhang, and William Perrie. "Depolarized Radar Return for Breaking Wave Measurement and Hurricane Wind Retrieval." *Geophysical Research Letters* 37 (January 1, 2010): L01604. https://doi.org/10.1029/2009GL041780.
- Hwang, Paul A., Ad Stoffelen, Gerd-Jan Zadelhoff, William Perrie, Biao Zhang, Haiyan Li, and Hui Shen. "Cross-Polarization Geophysical Model Function for C-Band Radar Backscattering from the Ocean Surface and Wind Speed Retrieval." *Journal of Geophysical Research: Oceans* 120, no. 2 (2015): 893–909. http://onlinelibrary.wiley.com/doi/10.1002/2014JC010439/full.
- Mouche, Alexis A., Bertrand Chapron, Biao Zhang, and Romain Husson. "Combined Co-and Cross-Polarized SAR Measurements under Extreme Wind Conditions." *IEEE Transactions on Geoscience and Remote Sensing* 55, no. 12 (2017): 6746–6755.
- Mouche Alexis, Chapron Bertrand, Knaff John, Zhao Yuan, Zhang Biao, Combot Clement (2019). Copolarized and Cross-Polarized SAR Measurements for High-Resolution Description of Major Hurricane Wind Structures: Application to Irma Category 5 Hurricane. Journal Of Geophysical Research-oceans, 124(6), 3905-3922. https://doi.org/10.1029/2019JC015056
- Rojo, M., C. Claud, G. Noer, and A. M. Carleton. "In Situ Measurements of Surface Winds, Waves, and Sea State in Polar Lows Over the North Atlantic." *Journal of Geophysical Research: Atmospheres* 124, no. 2 (2019): 700–718. https://doi.org/10.1029/2017JD028079.
- Pleskachevsky, Andrey, Sven Jacobsen, Björn Tings, and Egbert Schwarz. "Estimation of Sea State from Sentinel-1 Synthetic Aperture Radar Imagery for Maritime Situation Awareness." *International Journal of Remote Sensing* 40, no. 11 (June 3, 2019): 4104–42. https://doi.org/10.1080/01431161.2018.1558377.
- Wang, Chen, Alexis Mouche, Pierre Tandeo, Justin Stopa, Nicolas Longépé, Guillaume Erhard, Ralph C. Foster, Douglas Vandemark, and Bertrand Chapron. "A Labelled Ocean SAR Imagery

Dataset of Ten Geophysical Phenomena from Sentinel-1 Wave Mode." *Geoscience Data Journal* 6, no. 2 (November 1, 2019): 105–15. https://doi.org/10.1002/gdj3.73.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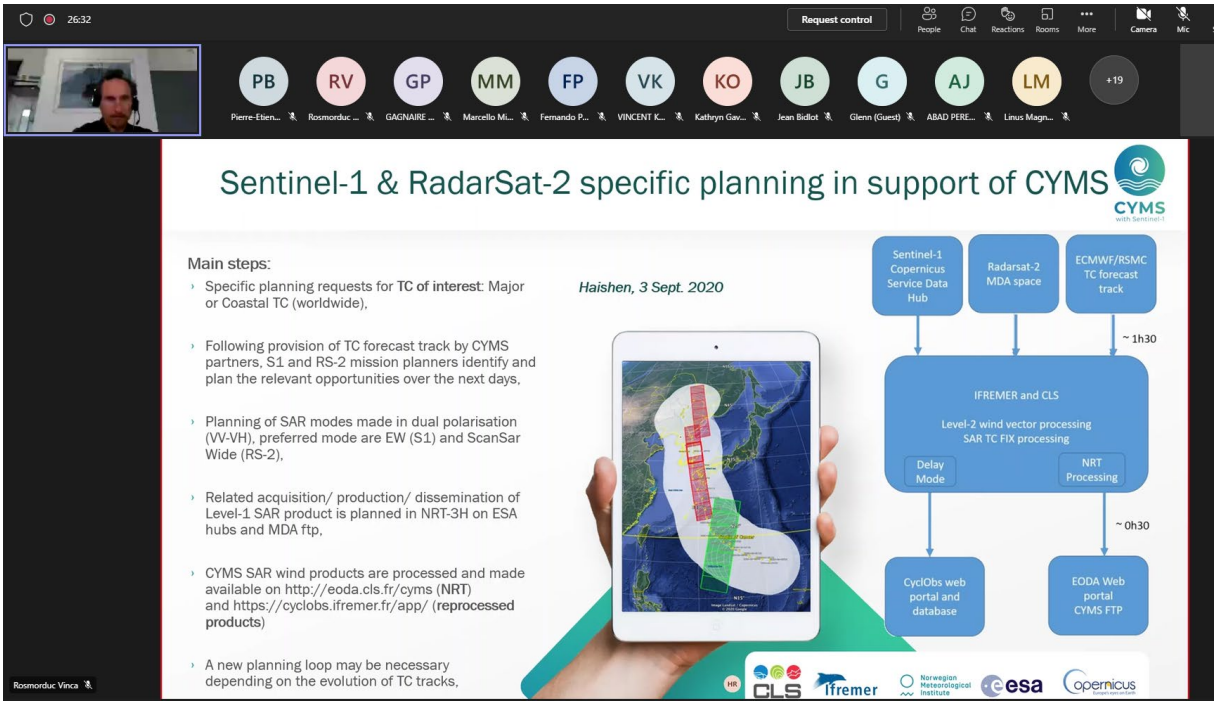
Unique SAR characteristics
CYMS
The combination of VV and VH channels as measured by SAR at very high resolution allows to provide Ocean Surface Wind measurements from space
› at high resolution
› in coastal areas (unique capability vs. other spaceborne sensors)
Fani (India)
Idai (Mozambique)
Veronica (Australia)
Florence (USA)
Rosmorduc Vinca
CLS
Ifremer
esa
Copernicus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Sentinel-1 & RadarSat-2 specific planning in support of CYMS
CYMS
Main steps:
› Specific planning requests for TC of interest: Major or Coastal TC (worldwide),
› Following provision of TC forecast track by CYMS partners, S1 and RS-2 mission planners identify and plan the relevant opportunities over the next days,
› Planning of SAR modes made in dual polarisation (VV-VH), preferred mode are EW (S1) and ScanSar Wide (RS-2),
› Related acquisition/ production/ dissemination of Level-1 SAR product is planned in NRT-3H on ESA hubs and MDA ftp,
› CYMS SAR wind products are processed and made available on http://eoda.cls.fr/cyms (NRT) and https://cyclobs.ifremer.fr/app/ (reprocessed products)
› A new planning loop may be necessary depending on the evolution of TC tracks,
Haishen, 3 Sept. 2020
Sentinel-1 Copernicus Service Data Hub
Radarsat-2 MDA space
ECMWF/RSMC TC forecast track
~ 1h30
IFREMER and CLS
Level-2 wind vector processing
SAR TC FIX processing
Delay Mode
NRT Processing
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CyclObs web portal and database
EODA Web portal CYMS FTP
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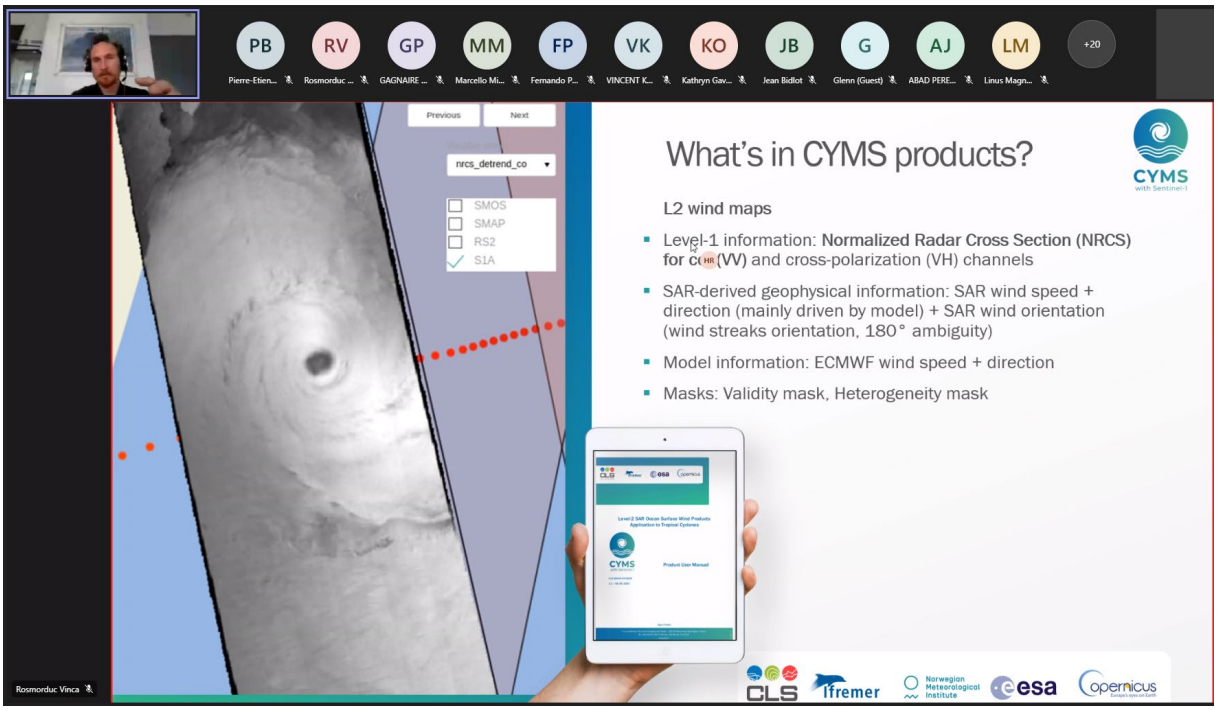
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Previous
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What's in CYMS products?
CYMS
with Sentinel-1
L2 wind maps
Level-1 information: Normalized Radar Cross Section (NRCS) for co-(VV) and cross-polarization (VH) channels
SAR-derived geophysical information: SAR wind speed + direction (mainly driven by model) + SAR wind orientation (wind streaks orientation, 180° ambiguity)
Model information: ECMWF wind speed + direction
Masks: Validity mask, Heterogeneity mask
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esa
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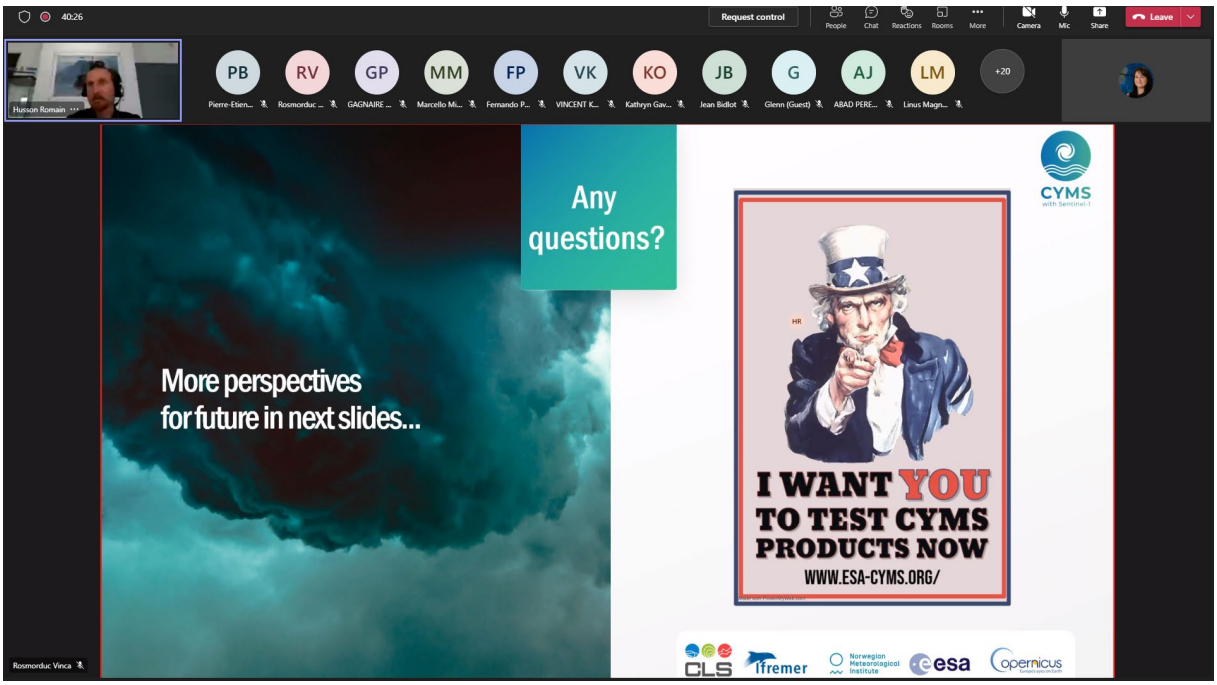
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questions?
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with Sentinel-1
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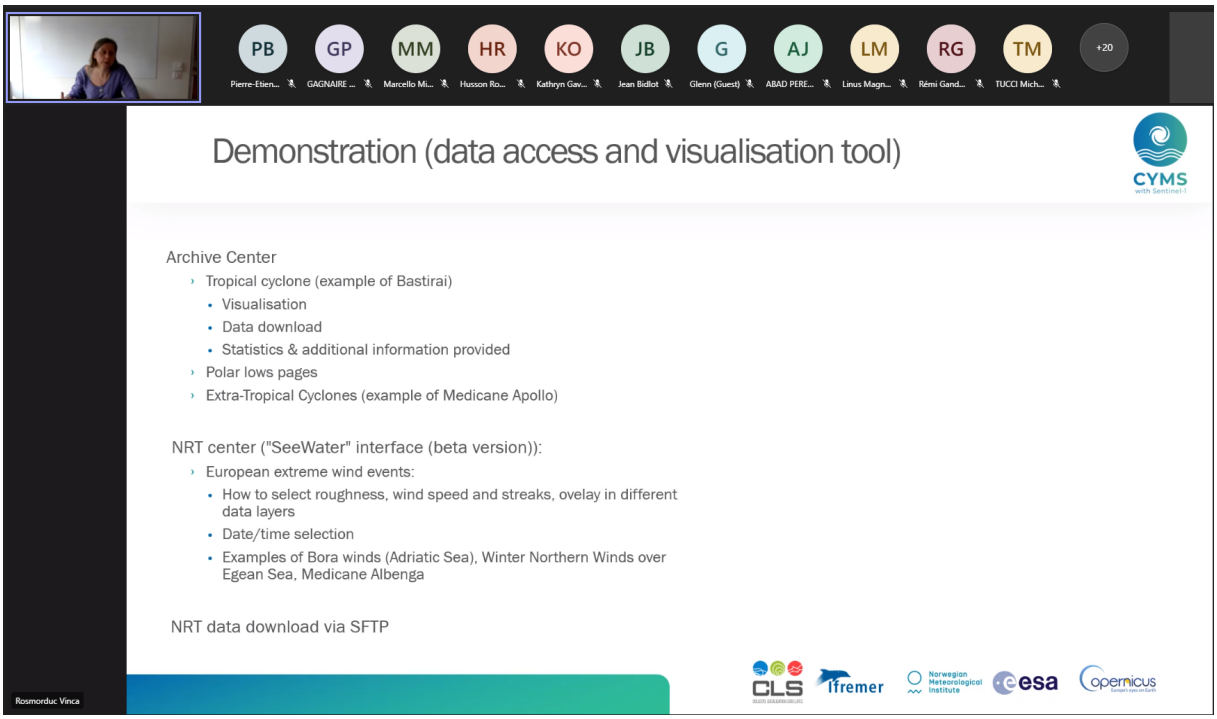
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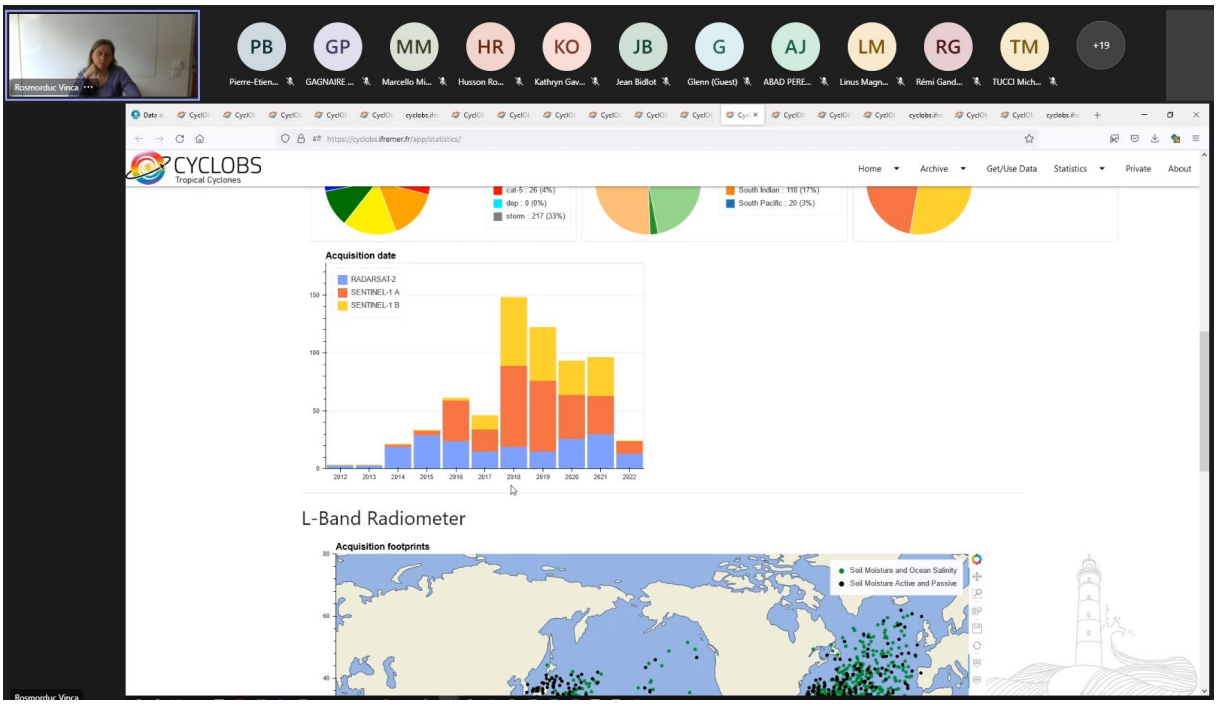
Pierre-Etien... GAGNAIRE ... Marcello Mi... Husson Ro... Kathryn Gav... Jean Bidlot Glenn (Guest) ABAD PERE... Linus Magn... Rémi Gand... TUCCI Mich...
Demonstration (data access and visualisation tool)
CYMS
Archive Center
Tropical cyclone (example of Bastirai)
Visualisation
Data download
Statistics & additional information provided
Polar lows pages
Extra-Tropical Cyclones (example of Medicane Apollo)
NRT center ("SeeWater" interface (beta version)):
European extreme wind events:
How to select roughness, wind speed and streaks, ovelay in different data layers
Date/time selection
Examples of Bora winds (Adriatic Sea), Winter Northern Winds over Egean Sea, Medicane Albenga
NRT data download via SFTP
Rosmorduc Vinca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CYCLOBS
Tropical Cyclones
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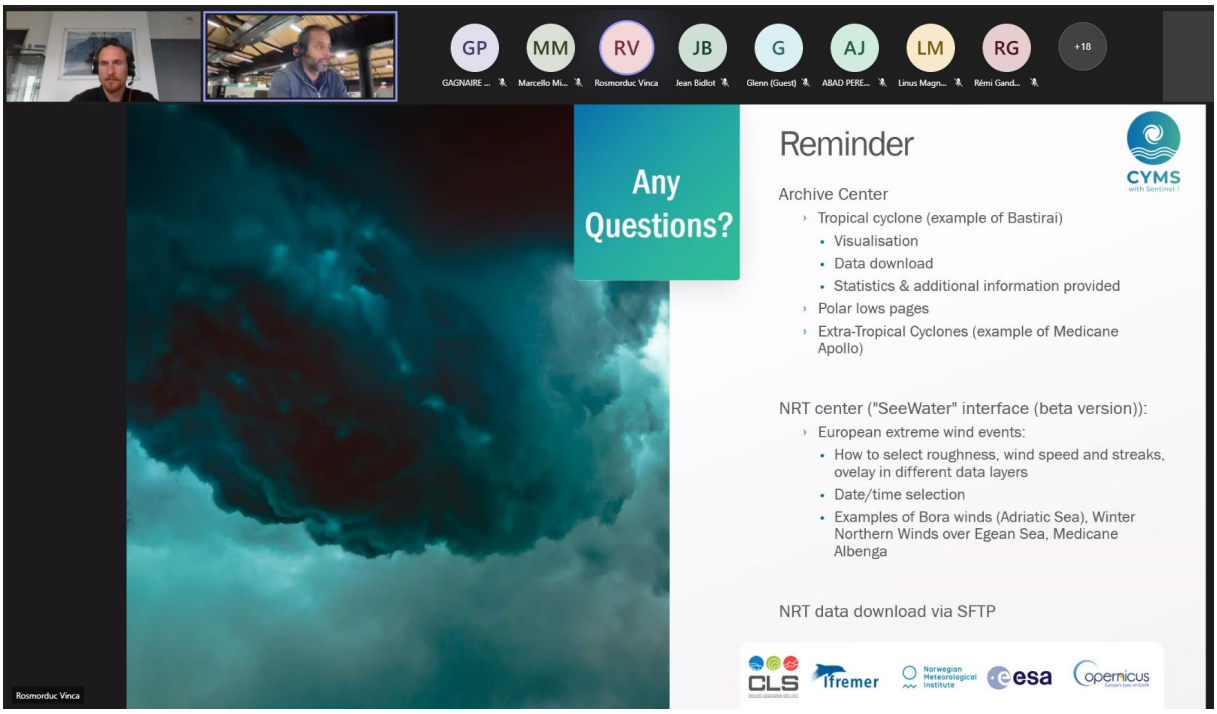
Soil Moisture Active and Passive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Any Questions?
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Archive Center
Tropical cyclone (example of Bastirai)
Visualisation
Data download
Statistics & additional information provided
Polar lows pages
Extra-Tropical Cyclones (example of Medicane Apollo)
NRT center ("SeeWater" interface (beta version)):
European extreme wind events:
How to select roughness, wind speed and streaks, ovelay in different data layers
Date/time selection
Examples of Bora winds (Adriatic Sea), Winter Northern Winds over Egean Sea, Medicane Albenga
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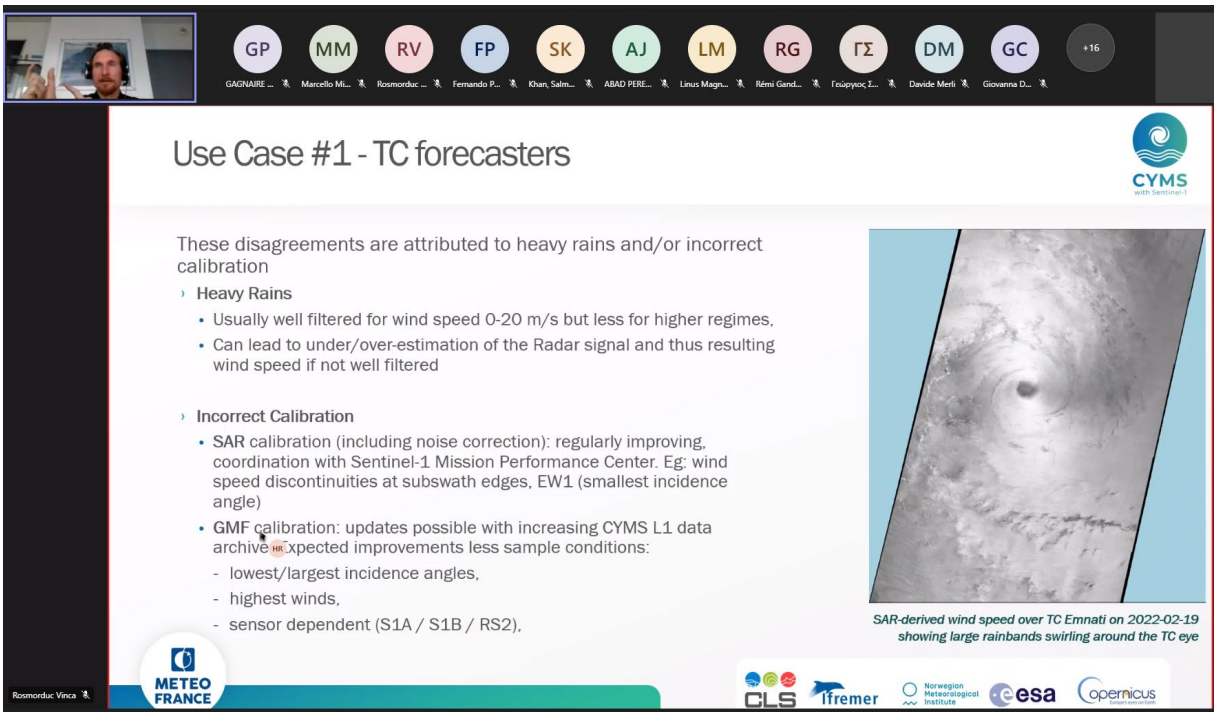
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Use Case #1 - TC forecasters
CYMS
These disagreements are attributed to heavy rains and/or incorrect calibration
Heavy Rains
Usually well filtered for wind speed 0-20 m/s but less for higher regimes,
Can lead to under/over-estimation of the Radar signal and thus resulting wind speed if not well filtered
Incorrect Calibration
SAR calibration (including noise correction): regularly improving, coordination with Sentinel-1 Mission Performance Center. Eg: wind speed discontinuities at subswath edges, EW1 (smallest incidence angle)
GMF calibration: updates possible with increasing CYMS L1 data archive. Expected improvements less sample conditions:
lowest/largest incidence angles,
highest winds,
sensor dependent (S1A / S1B / RS2),
SAR-derived wind speed over TC Emnati on 2022-02-19 showing large rainbands swirling around the TC eye
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CLS
Ifremer
esa
Rosmorduc Vinca

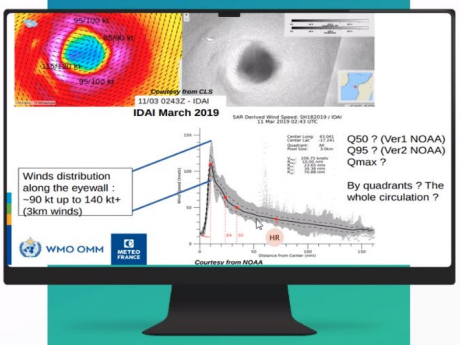
GP MM RV FP SK AJ LM RG ΓΣ DM GC +16

GAGNAIRE ... Marcello Mi... Rosmorduc ... Fernando P... Khan, Salm... ABAD PERE... Linus Magn... Rémi Gand... Γεώργιος Σ... Davide Merli Giovanna D...

CYMS with Sentinel-1

# Use Case #1 - TC forecasters

## Issues at RSMC La Réunion
## Intensity definition with SAR




How to compare CYMS products wrt. to other information ?

- Estimation of MSW from S1A product can be sensitive to its definition, partly also due to the SAR high resolution
  - Is the information used at 1 km resolution or down-sampled ?
  - How does it compare with 1min vs. 10min average winds?
- Depending on the estimation
  - Sub/Obj guidance at **100kt ± 5 kt** (1' winds).
  - S1-A at **123 kt** (3 km winds -Q50 max by quadrant)

--> Leads to a re-estimation to 10 kts higher value of the MSW

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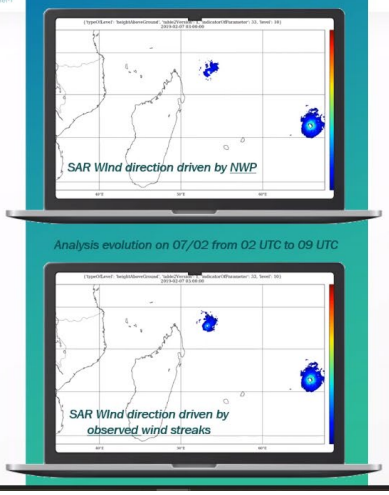
Tarik Kriat - ... Fernando P... Rosmorduc ... Marcello Mi... GAGNAIRE ... ABAD PERE... Linus Magn... Rémi Gand... Γεώργιος Σ... Davide Merli Giovanna D...

CYMS with Sentinel-1

# Use Case #2 - TC assimilation

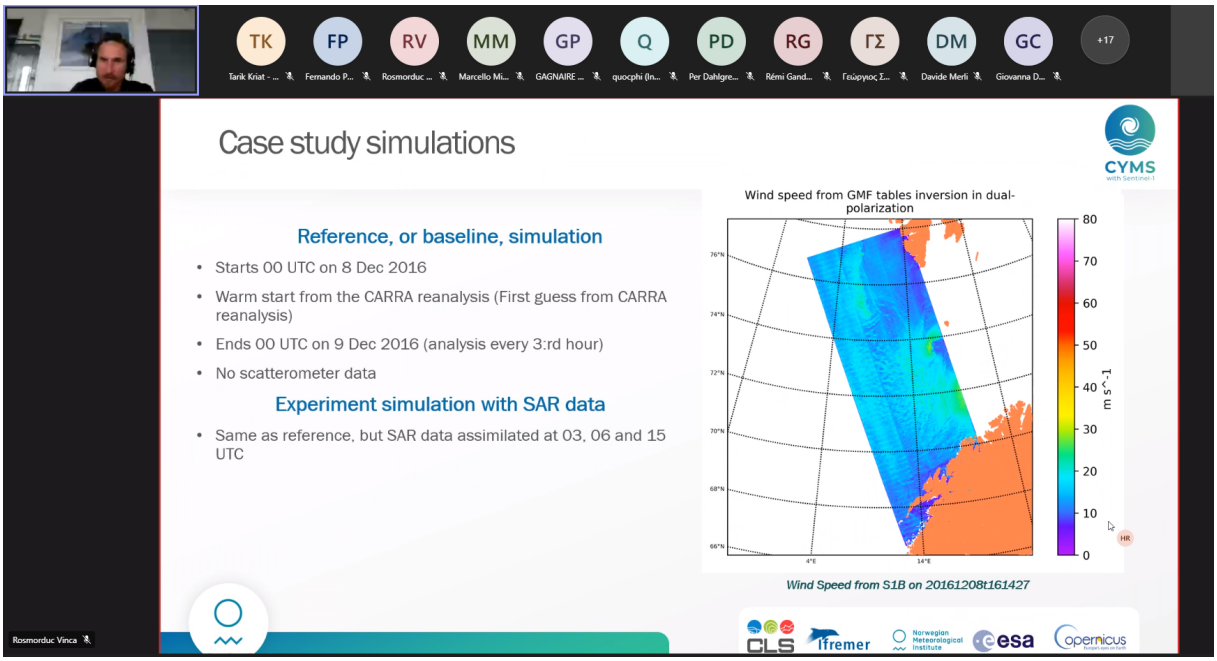



- In TC GELENA case, it leads to a **better TC positioning** and an improved representation of **inner and outer vortex** structures. The TC intensity reduction in the analysis **propagates** through subsequent analyses and it has an impact on forecasts for around 12 h.
- Using **wind streaks orientation** (derived from the SAR image) rather that from an a priori information such as a NWP model better preserves the TC structure and impacts the assimilation for a much longer time period.
- On top of the wind field modification, SAR data assimilation is also responsible for analysis increments of **pressure, temperature and humidity** at sea surface and upper levels in the eye and eye-wall area.

LACy

CLS Ifremer Norwegian Meteorological Institute esa Copernicus

Rosmorduc Vinca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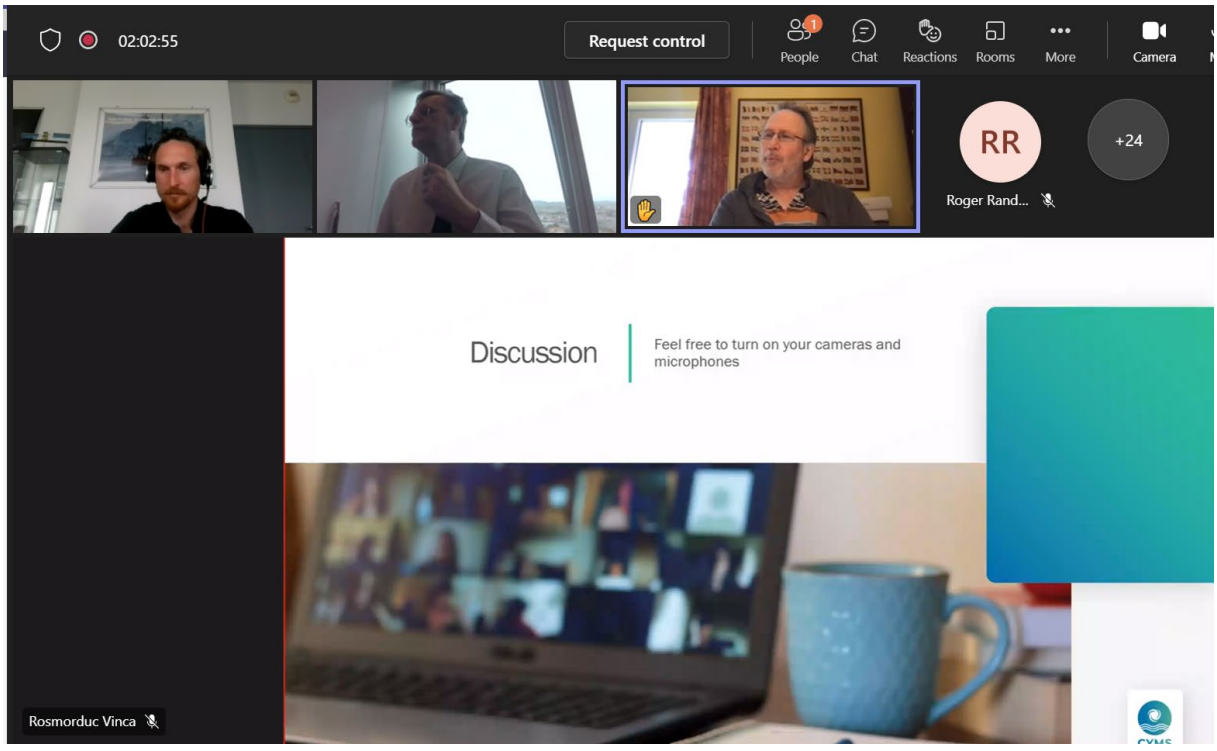
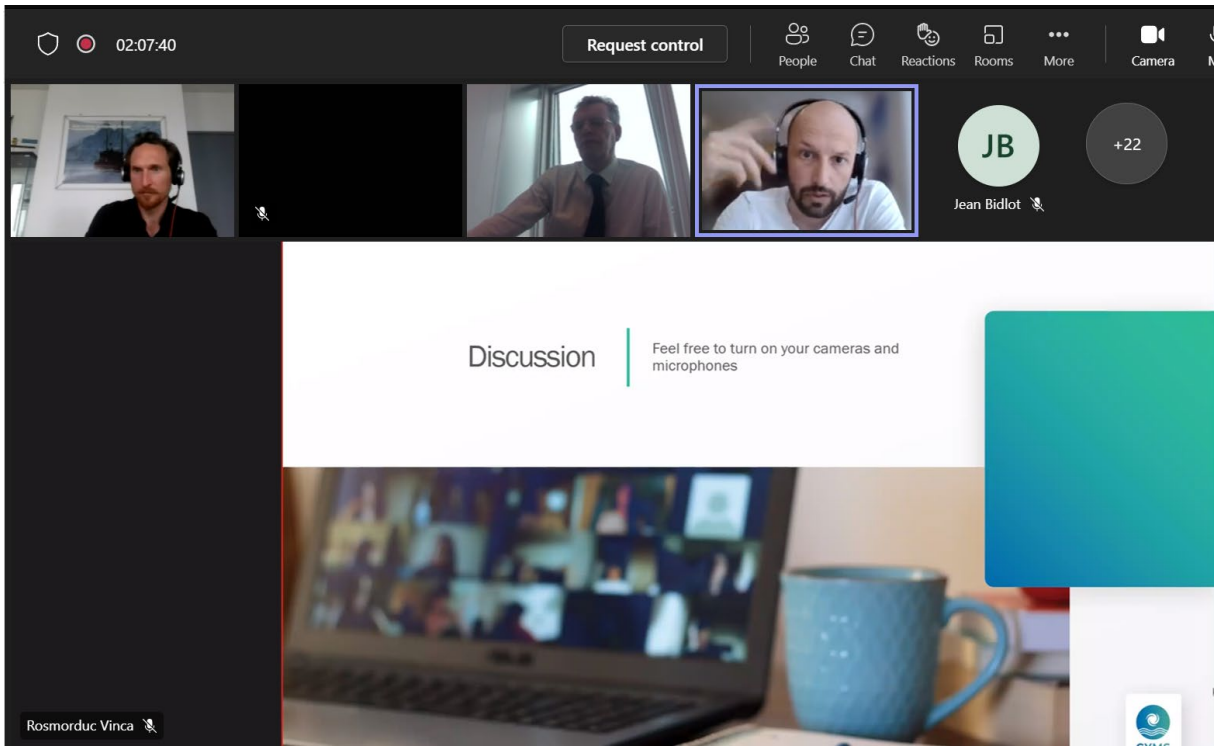
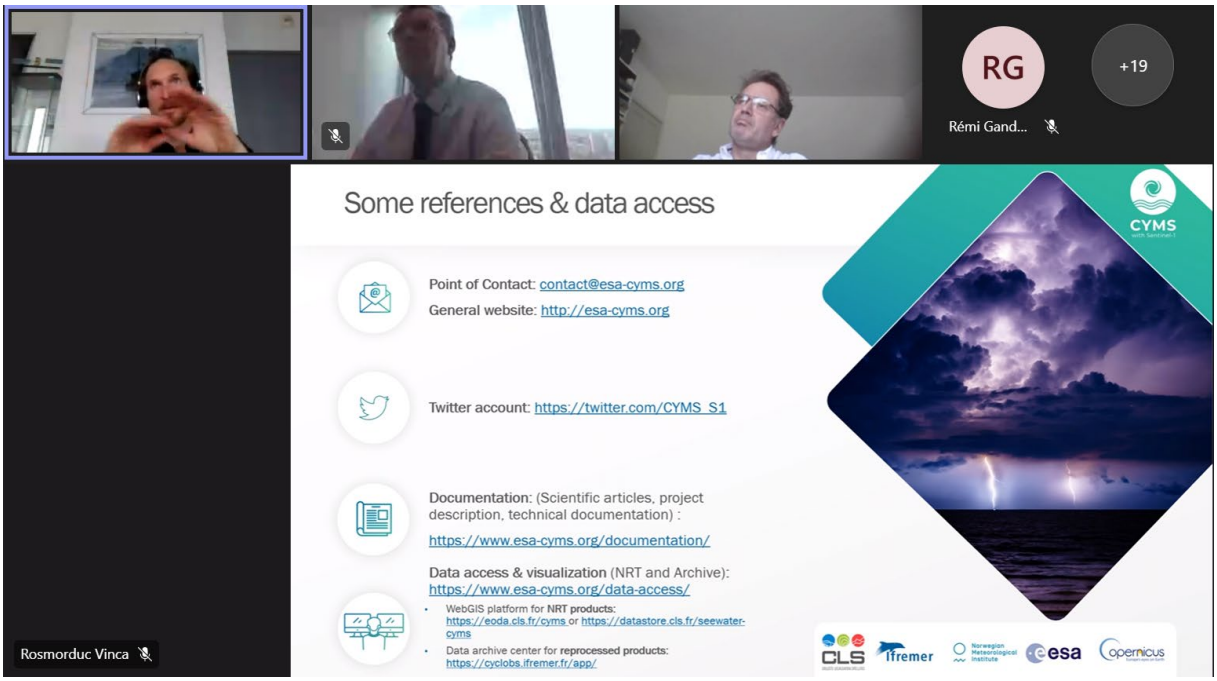
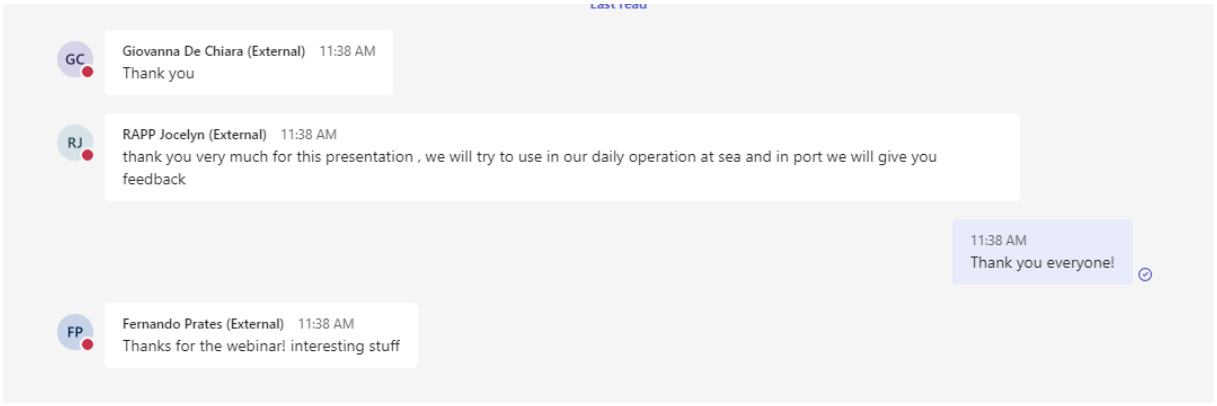
PD
RG
ΓΣ
DM
GC
+17
Case study simulations
CYMS
Reference, or baseline, simulation
Starts 00 UTC on 8 Dec 2016
Warm start from the CARRA reanalysis (First guess from CARRA reanalysis)
Ends 00 UTC on 9 Dec 2016 (analysis every 3:rd hour)
No scatterometer data
Experiment simulation with SAR data
Same as reference, but SAR data assimilated at 03, 06 and 15 UTC
Wind speed from GMF tables inversion in dual-polarization
m s^-1
Wind Speed from S1B on 20161208t161427
Rosmorduc Vinca


02:02:55
Request control
People
Chat
Reactions
Rooms
More
Camera
RR
+24
Roger Rand...
Discussion
Feel free to turn on your cameras and microphones
Rosmorduc Vinca


02:07:40
Request control
People
Chat
Reactions
Rooms
More
Camera
JB
Jean Bidlot
+22
Discussion
Feel free to turn on your cameras and microphones
Rosmorduc Vinca


RG
Rémi Gand...
+19
Some references & data access
Point of Contact: contact@esa-cyms.org
General website: http://esa-cyms.org
Twitter account: https://twitter.com/CYMS_S1
Documentation: (Scientific articles, project description, technical documentation) :
https://www.esa-cyms.org/documentation/
Data access & visualization (NRT and Archive):
https://www.esa-cyms.org/data-access/
WebGIS platform for NRT products:
https://eoda.cls.fr/cyms or https://datastore.cls.fr/seewater-cyms
Data archive center for reprocessed products:
https://cyclobs.ifremer.fr/app/
CYMS
CLS
Ifremer
esa
Copernicus
Rosmorduc Vinca


GC
Giovanna De Chiara (External) 11:38 AM
Thank you
RJ
RAPP Jocelyn (External) 11:38 AM
thank you very much for this presentation , we will try to use in our daily operation at sea and in port we will give you feedback
11:38 AM
Thank you everyone!
FP
Fernando Prates (External) 11:38 AM
Thanks for the webinar! interesting stuff