

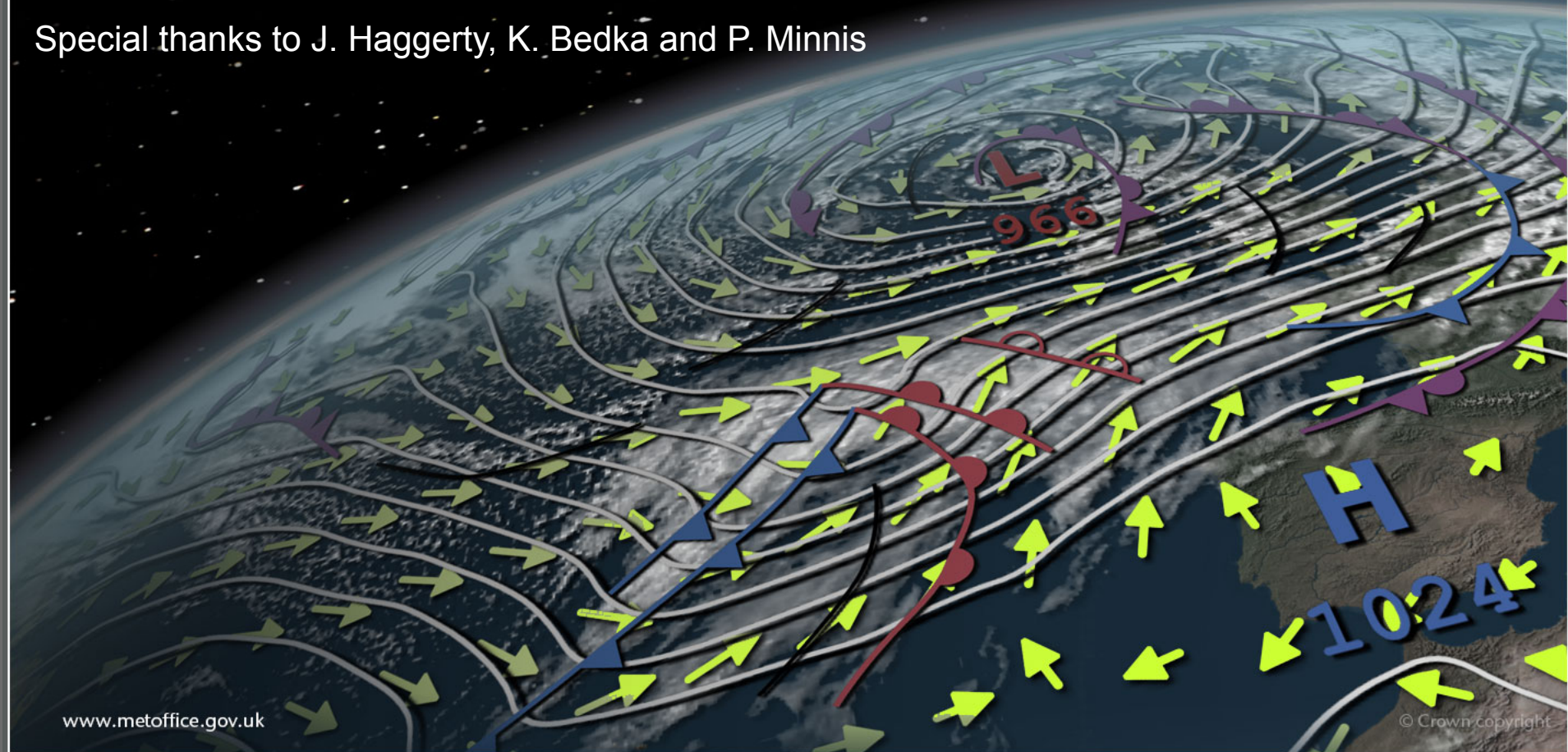


# Detection and nowcasting of High Ice Water Content regions at the Met Office

Lorenzo Labrador, Pete Francis and Claire Bartholomew  
Met Office

HAIC-HIWC Satellite and Nowcasting Breakout Session, Capua, Italy, 12/2016

Special thanks to J. Haggerty, K. Bedka and P. Minnis



# HIWC work at the Met Office

- Develop satellite product to identify HIWC regions
- Develop an object-orientated nowcast tool using the satellite product for short-range forecasts of HIWC regions

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# Developing a satellite imagery-based detection tool

## Two avenues chosen:

- NCAR “ALPHA” scheme
  - Satellite only (2D)
- NASA Langley Infrared-W scheme





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# ALPHA 2-Input Algorithm

## Satellite

Find highest, coldest,  
thickest clouds from Total  
Water Path, Cloud Top  
Height and Cloud Top  
Temperature – *2D field*  
**Total Satellite Interest**

Blend  
individual  
fields using  
algebraic  
and  
geometric  
weighting  
schemes

## Model

Find deep cloud layer,  
heavy precipitation, high  
condensate, updrafts,  
temperature below  $-15^{\circ}\text{C}$   
– *3D field*  
**Total Model Interest**

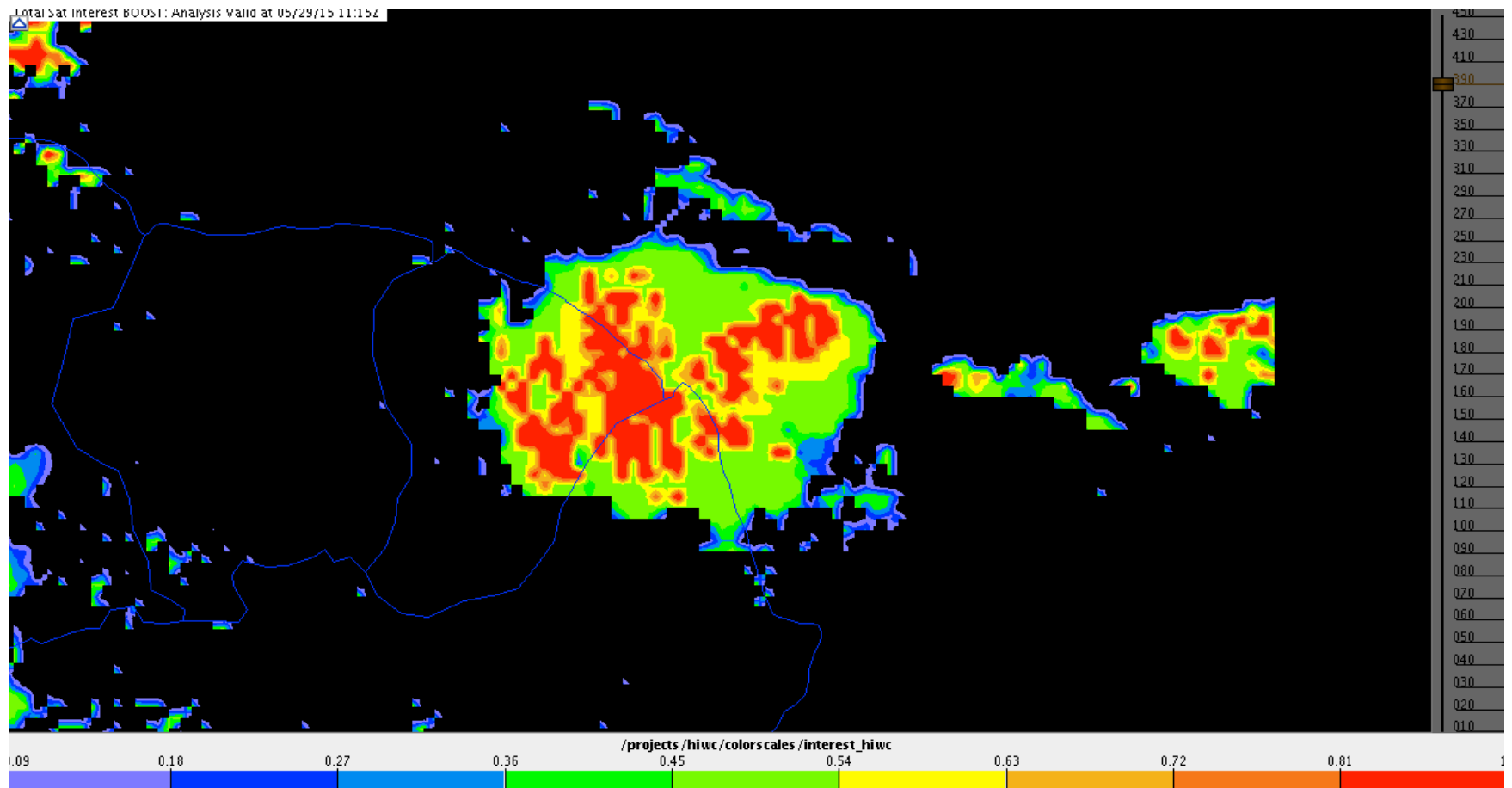
## Calculate Total HIWC Interest

If Total Satellite Interest is  $> 0$

Model 3D Temperature Interest \* [ 75% Total Satellite Interest + 25% Total  
Model Interest ]  
**= Total HIWC Interest**

# NCAR ALPHA Version 1:

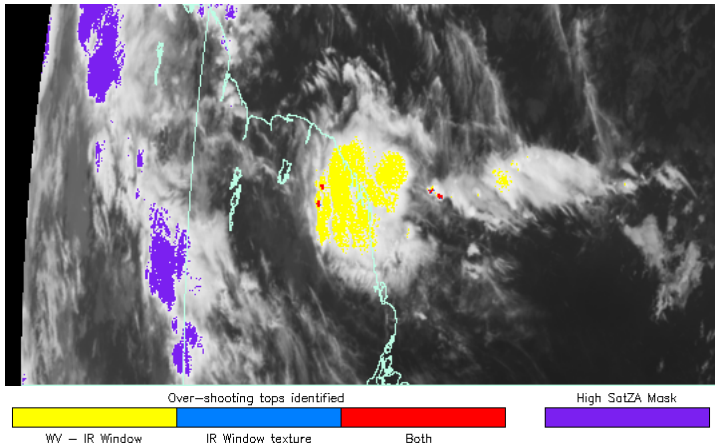
## Total Satellite Interest: 1115Z 20150529



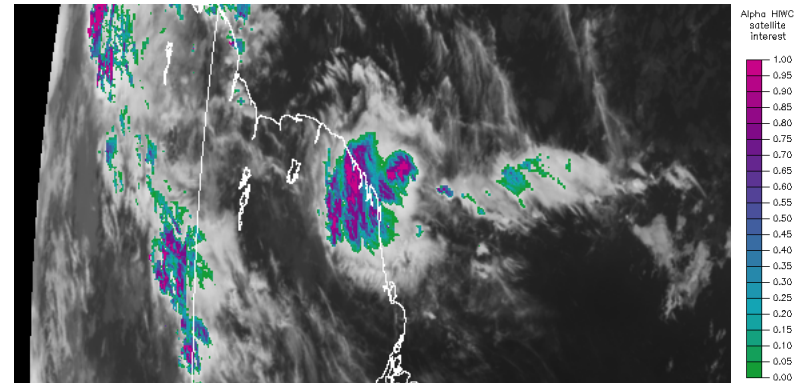
Courtesy of Jennifer Black (NCAR) - NOT FOR RE-DISTRIBUTION



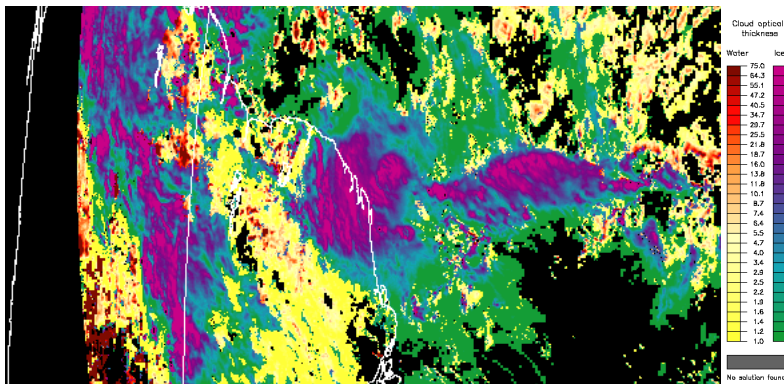
# Met Office “ALPHA-like” imagery (29/5/2015, 1115 UTC)



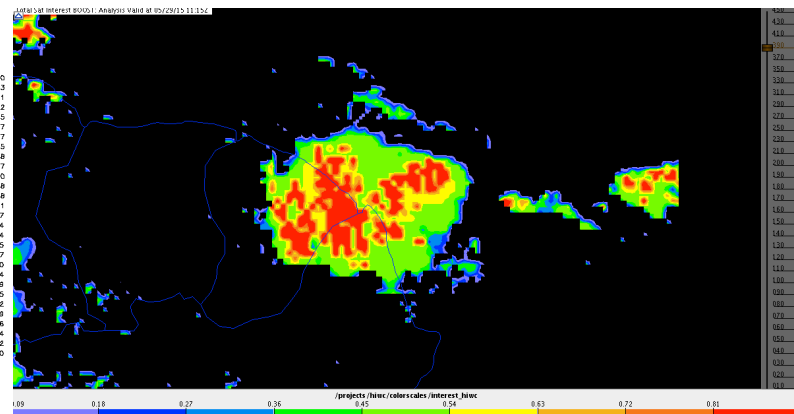
Severe convection/OTs



MetO HIWC Total Satellite Interest



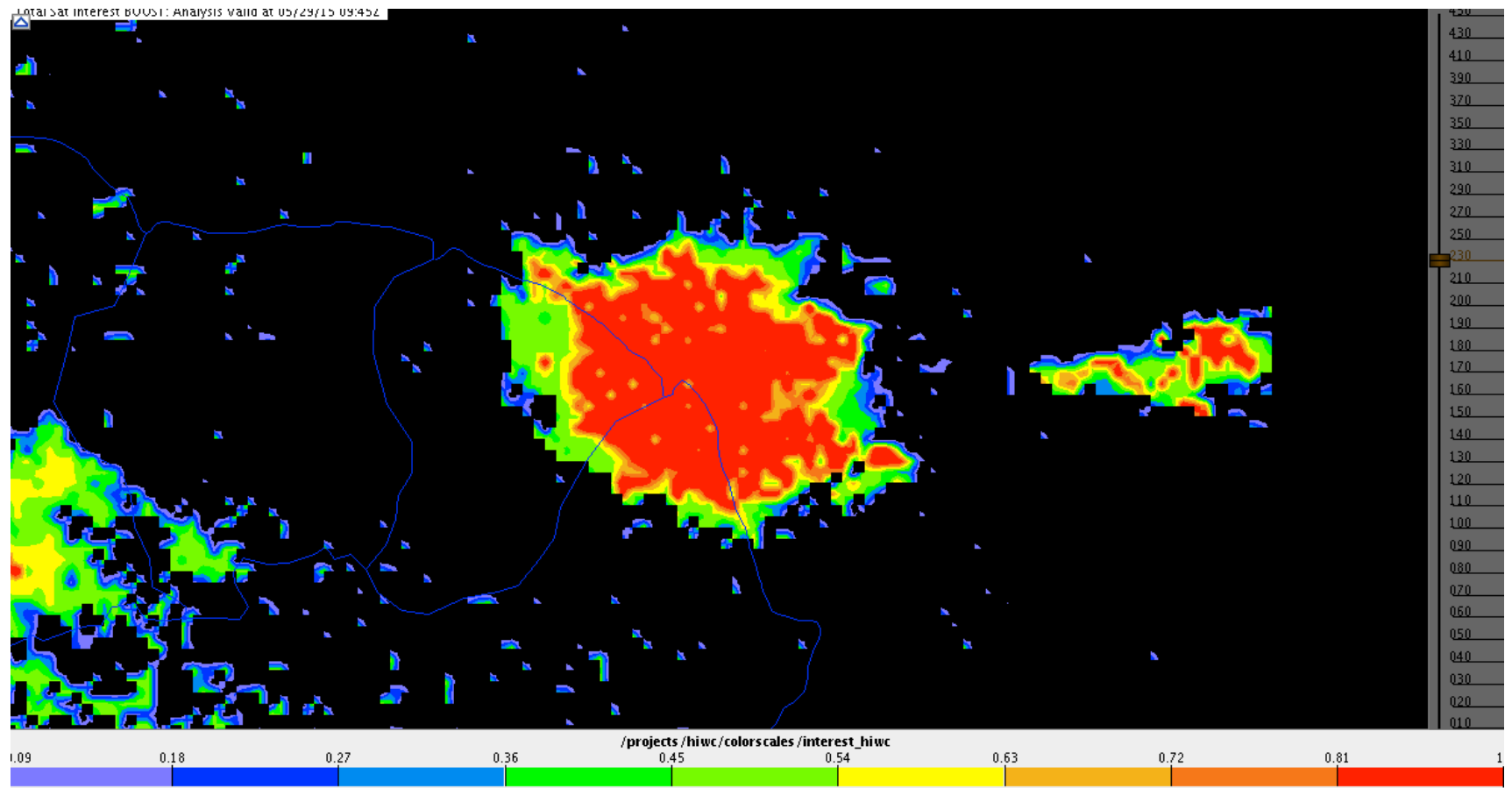
Cloud phase/optical thickness/  
effective radius



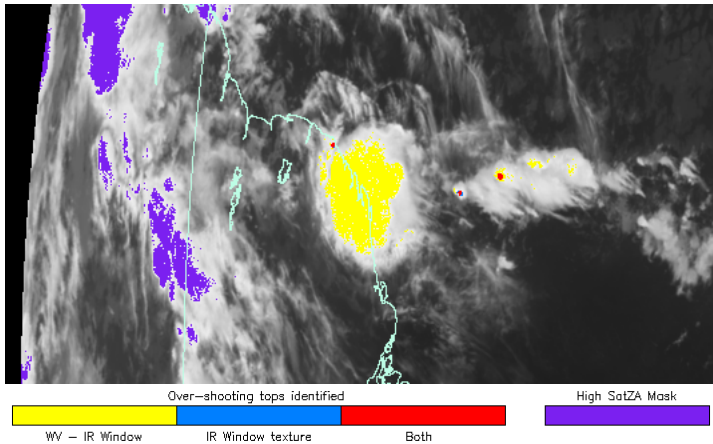
NCAR  
ALPHA V1  
Total  
Satellite  
Interest

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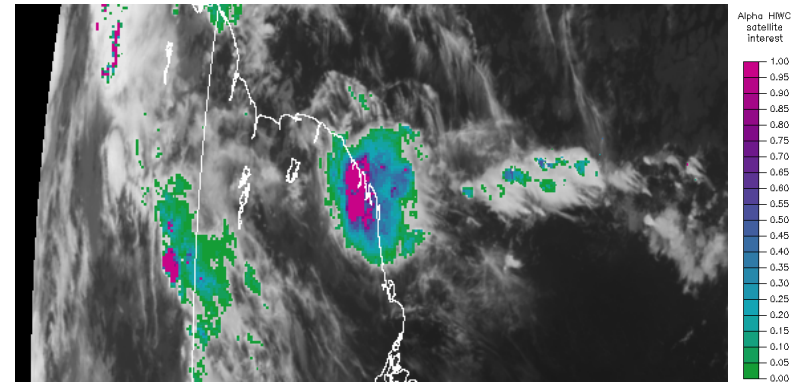
## Total Satellite Interest: 0945Z 20150529



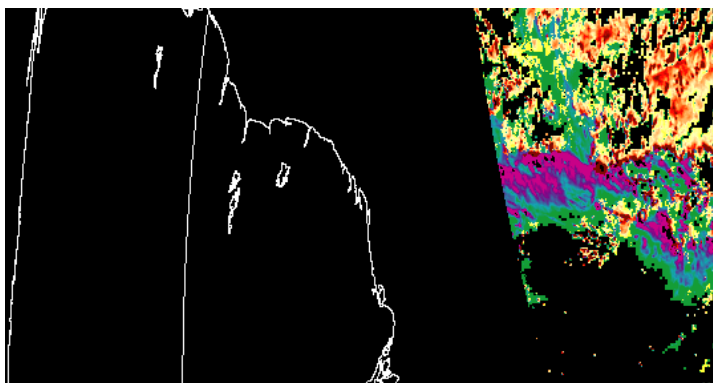
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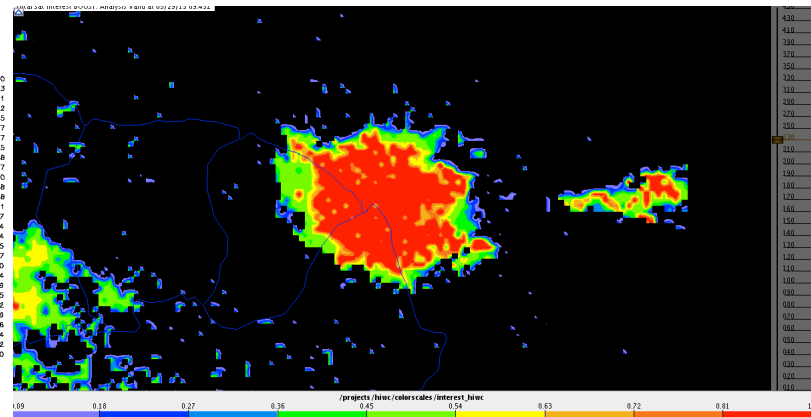
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MetO HIWC Total Satellite Interest



Cloud phase/optical thickness/  
effective radius



NCAR  
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Total  
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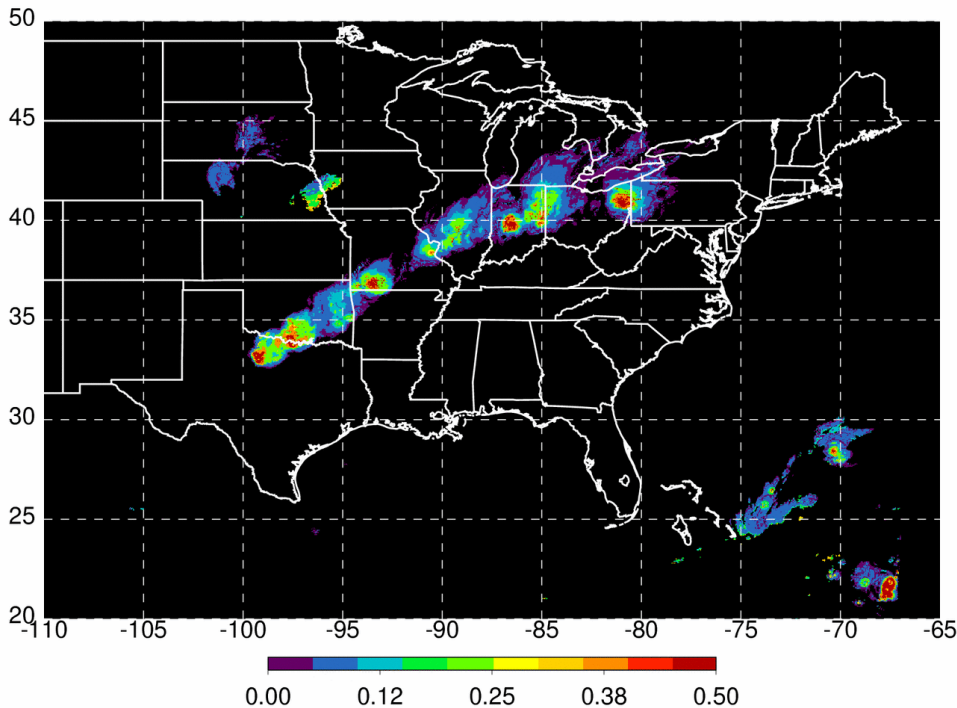


# Met O's NASA Langley IR-window scheme

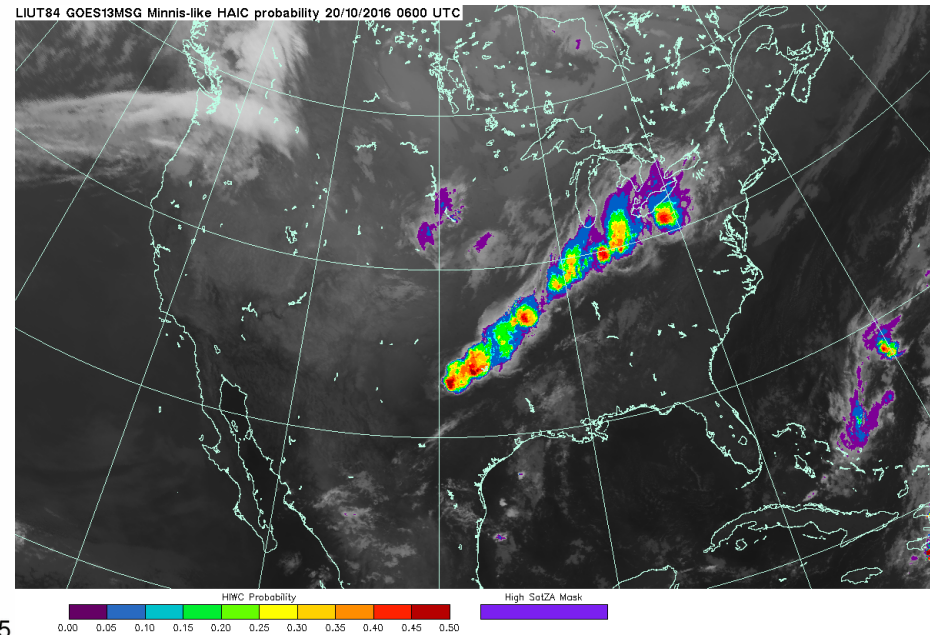
- Uses three drivers:
  - i. WV – IRW BTD
  - ii. IRW BT threshold
  - iii. Model-derived tropopause temperature

# Case from 2016/10/20

HIWC Probability  
Day: 2016294 0545 UTC



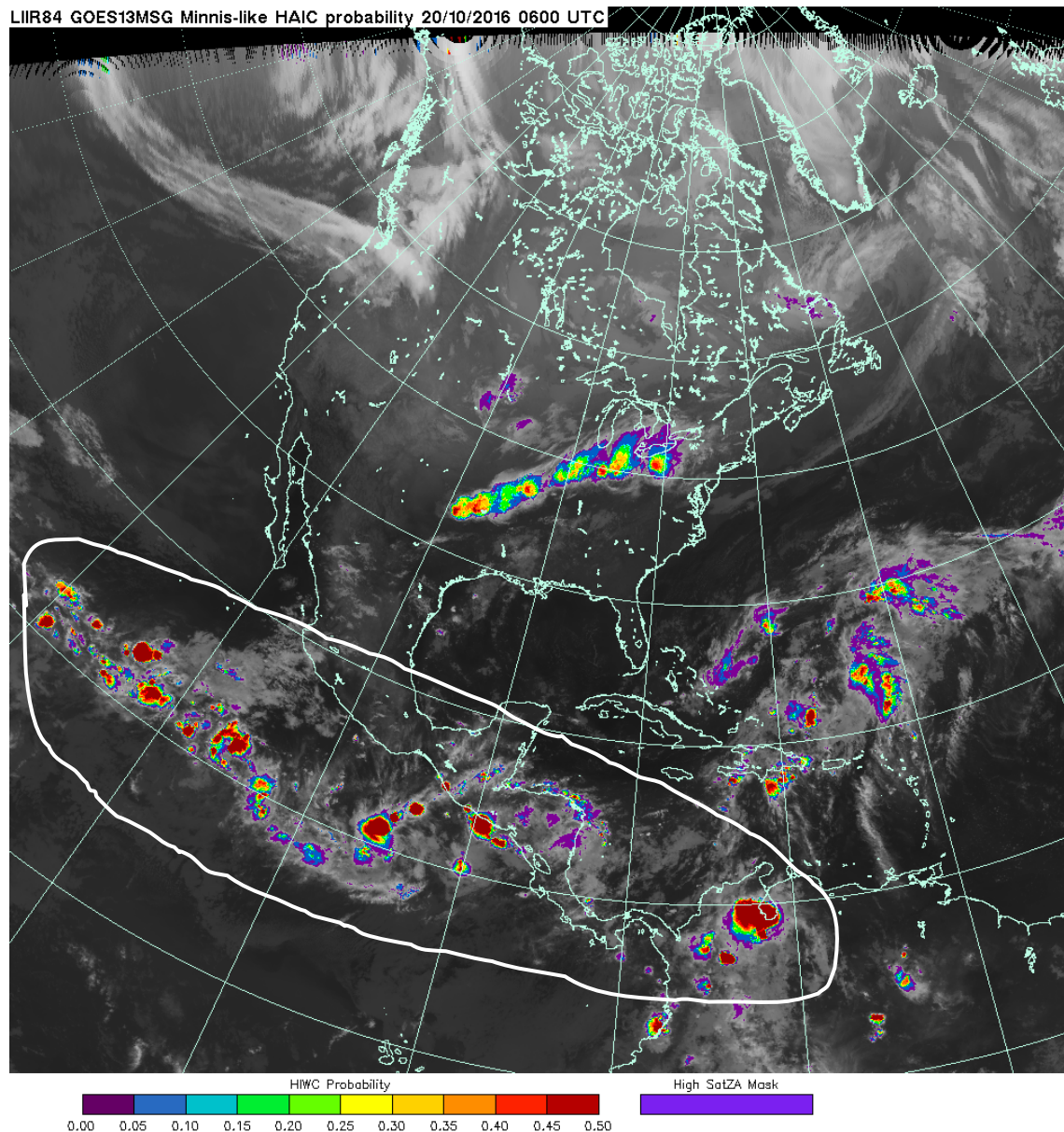
NASA Langley product  
Image courtesy of P. Minnis



Met Office dev product  
(WV-IRW BTD + IRw BTs)

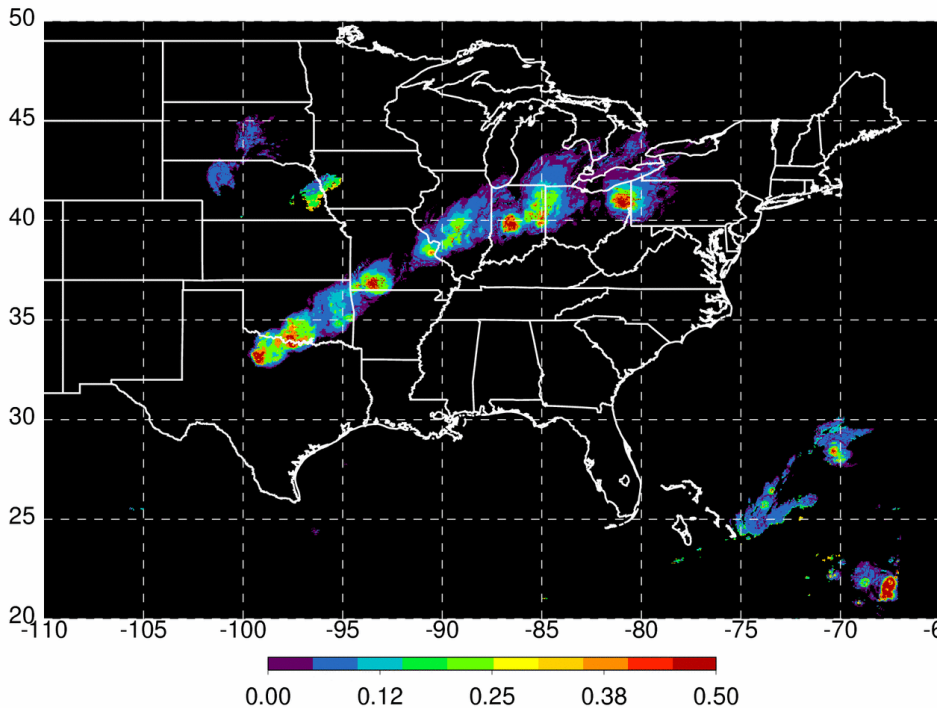
# Case from 2016/10/20

Met Office dev  
product (WV-IRW  
BTD + IRW BTs)

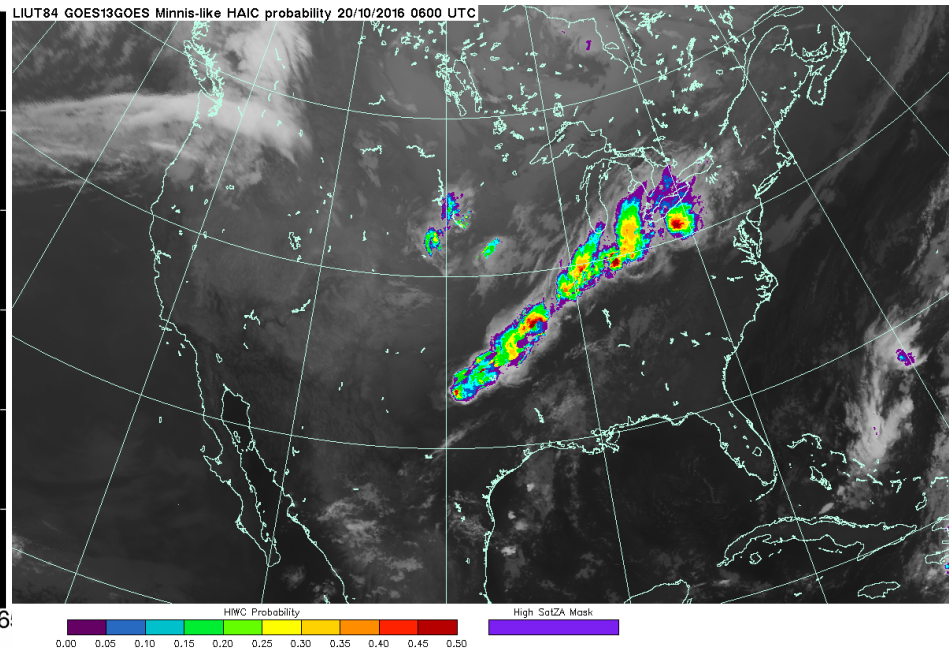


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HIWC Probability  
Day: 2016294 0545 UTC



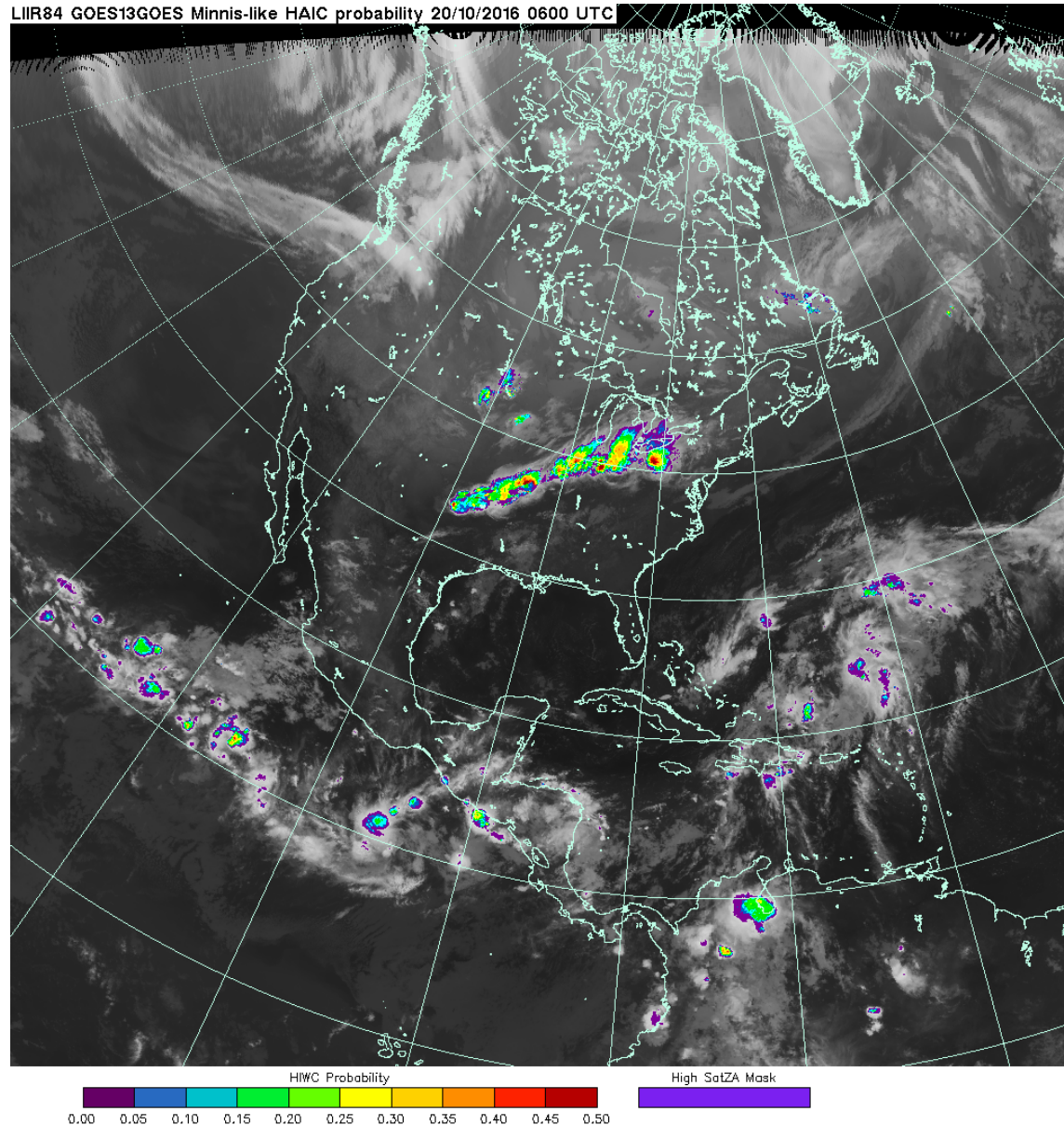
NASA Langley product  
Image courtesy of P. Minnis



Met Office dev product  
(WV-IRW BTD + IRW BTs +  
model-derived trop. temperature)



# Case from 2016/10/20

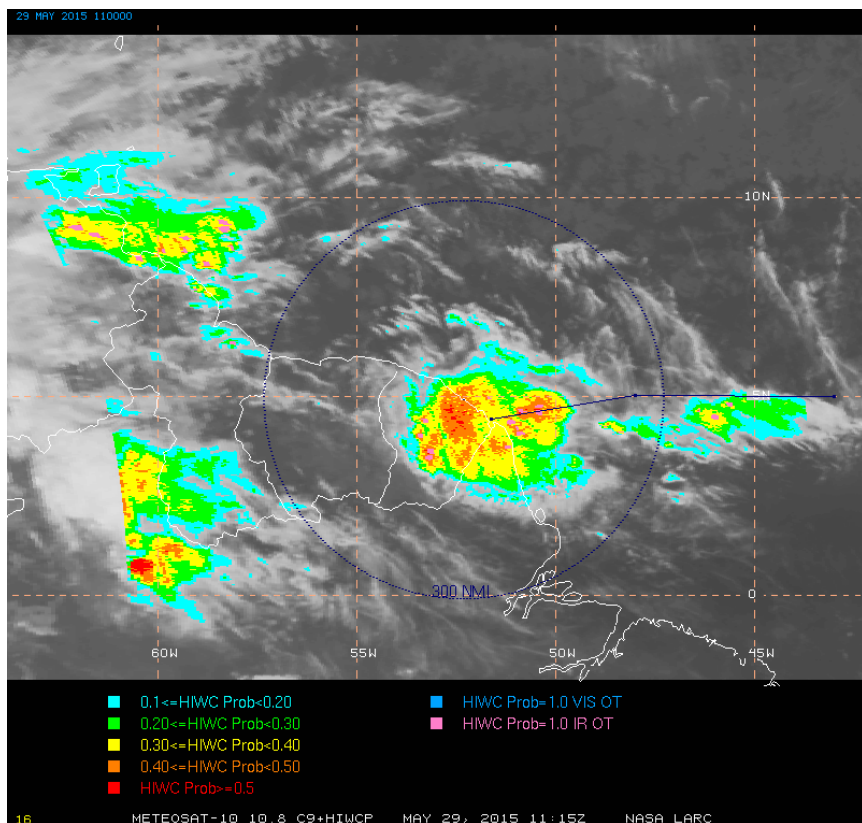


Met Office dev product  
(WV-IRW BTD + IRW  
BTs +  
model-derived trop.  
temperature)

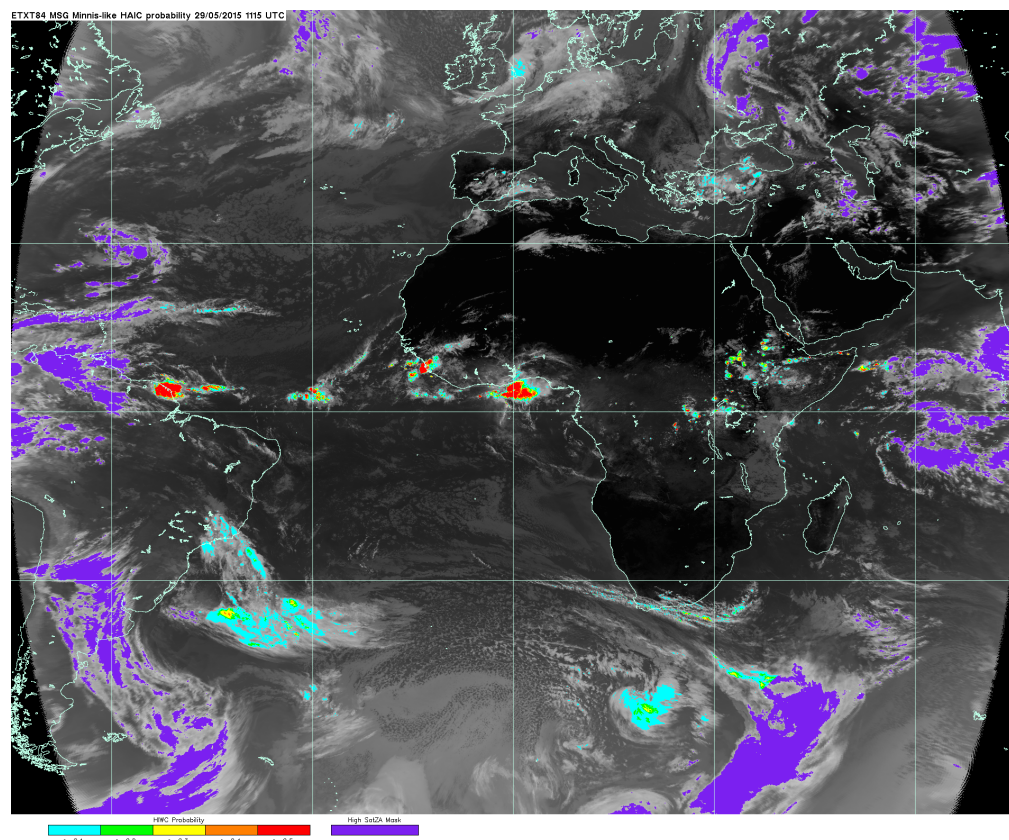


# Case from HIWC-HAIC field campaign

## 1115 UTC, 2015/05/29



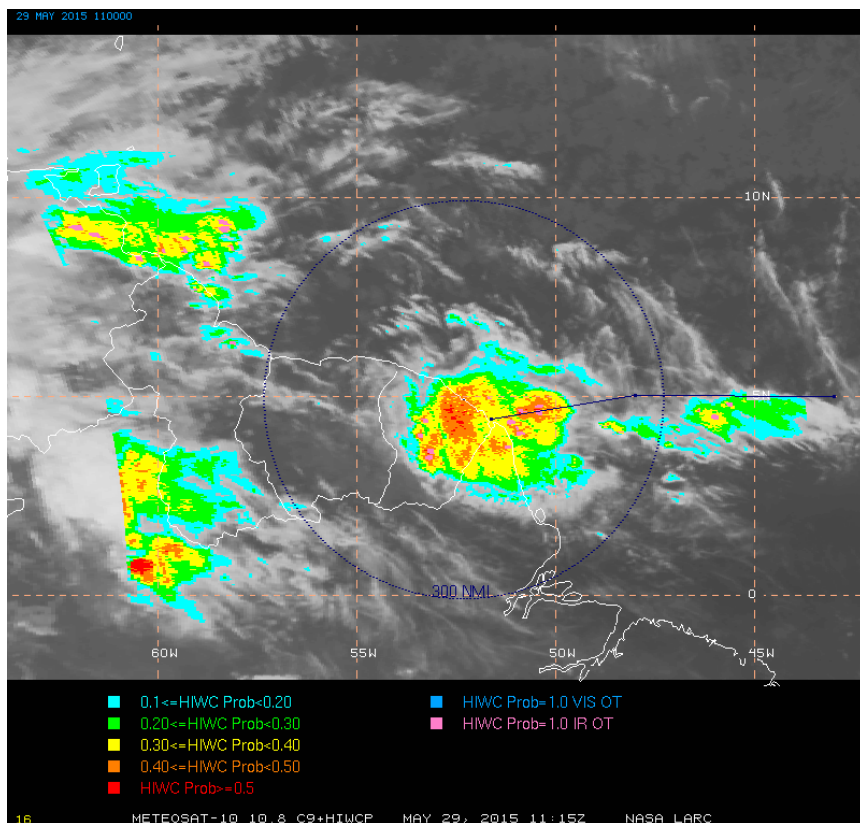
NASA Langley product  
Image courtesy of P. Minnis



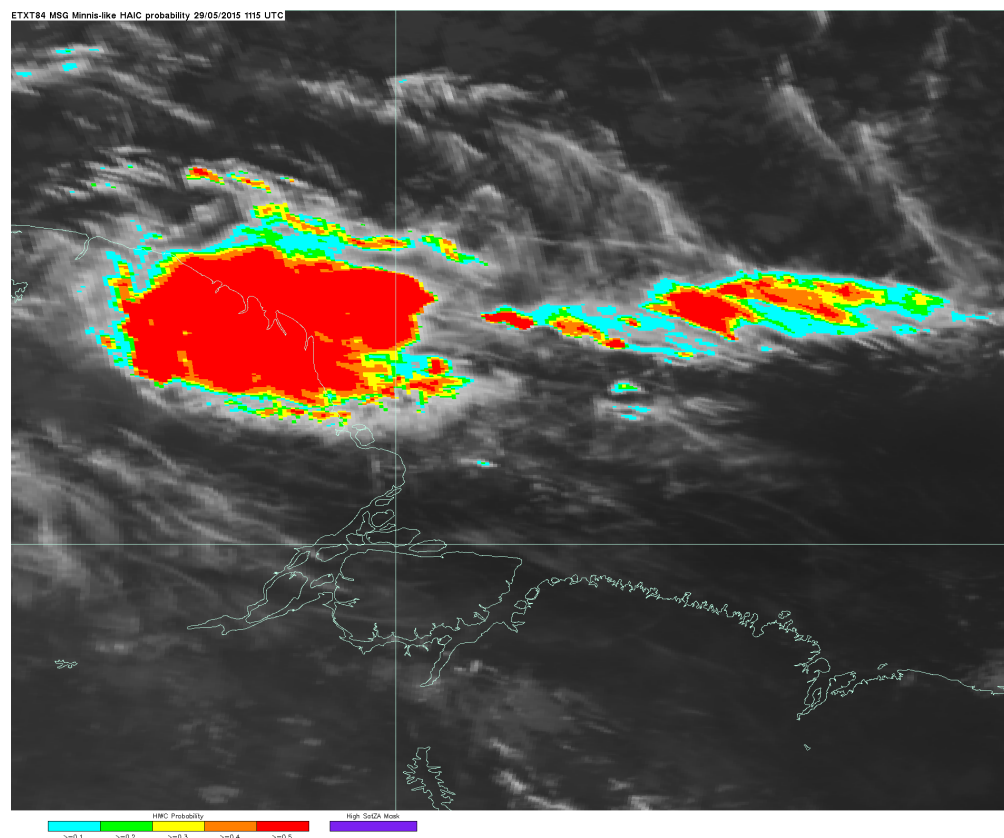
Met Office dev product  
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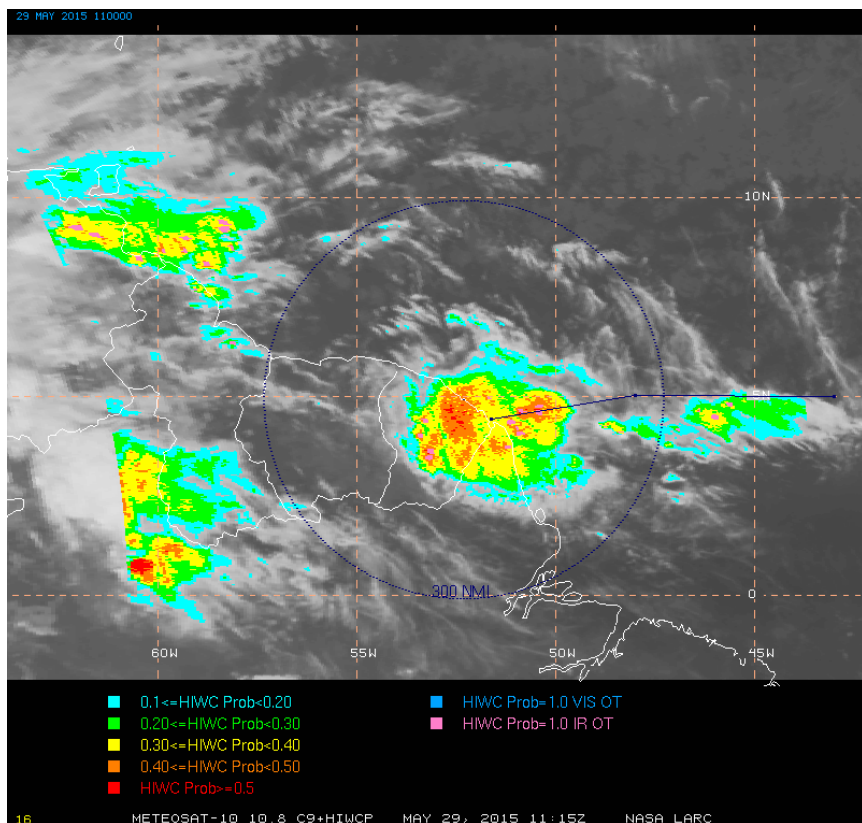


Met Office dev product  
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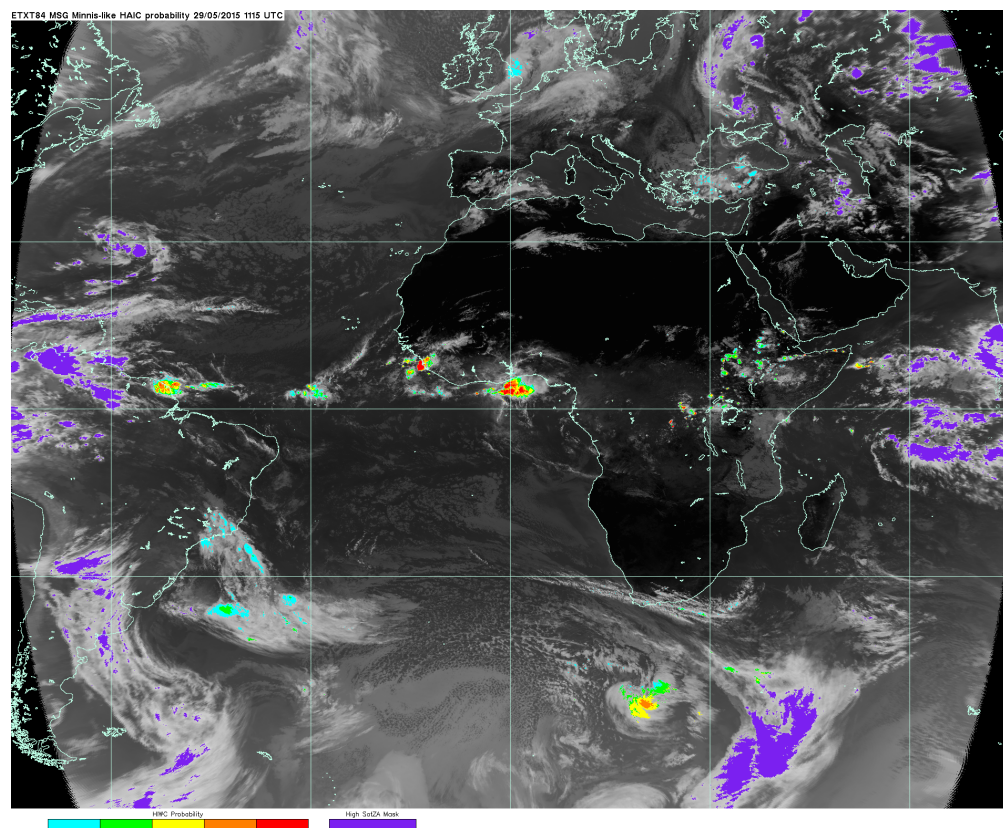


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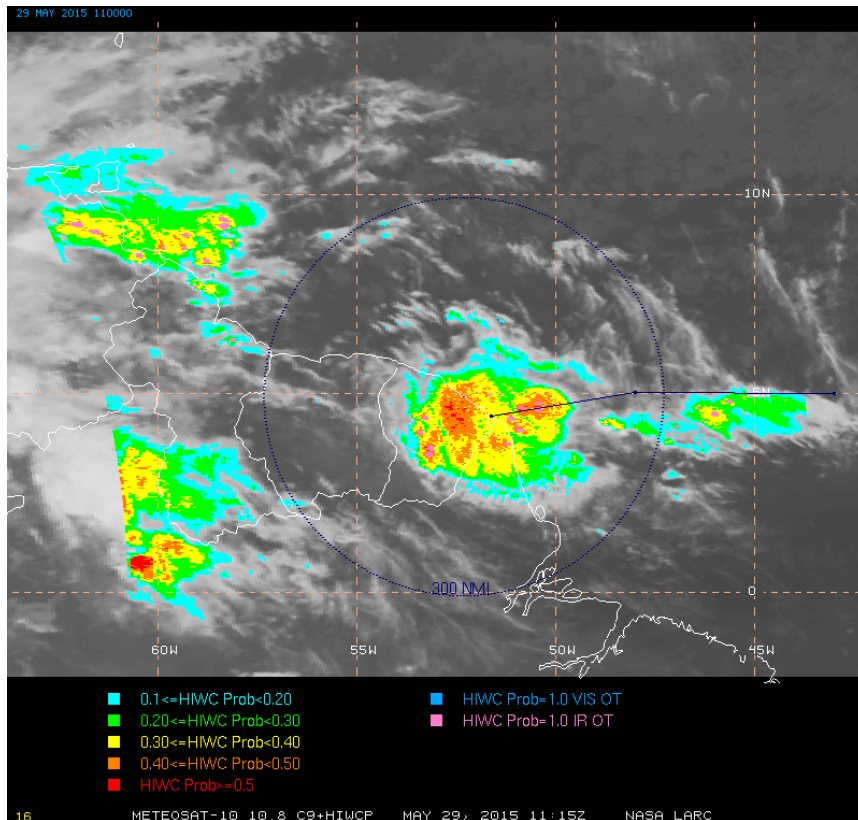


NASA Langley product  
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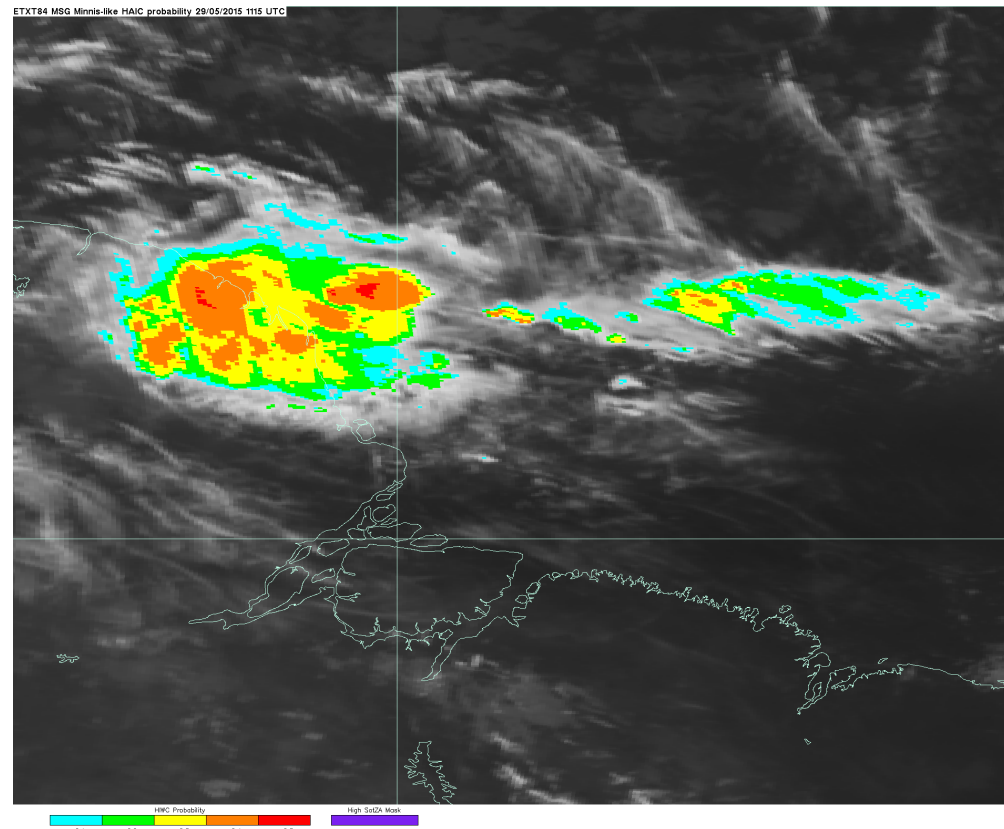


Met Office dev product  
(WV-IRW BTD + IRW BTs +  
model-derived trop. temperature)

# Case from HIWC-HAIC field campaign 1115 UTC, 2015/05/29



NASA Langley product  
Image courtesy of P. Minnis



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# Nowcast product development

- Early stages of development of object-orientated nowcast tool:
  - Define objects based on HIWC regions identified by satellite product
  - Advect these objects forward to produce a short-term forecast of HIWC regions
- Initial focus on the 0-1 hour timescale
- Aim to capture motion of the HIWC regions + their evolution as they grow and/or decay.



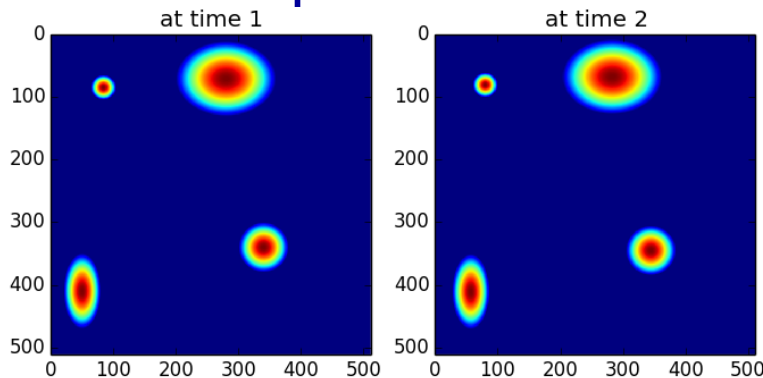
# Methods

- Initial work looking into the potential application of the method used in STEPS (Bowler et al. 2006):
  - The STEPS system provides nowcasts of precipitation for the next 6 hours
  - Uses input fields to create velocity fields via an optical flow method (similar to tracking a cell through subsequent observations)
  - Uses these velocity fields to advect objects forward

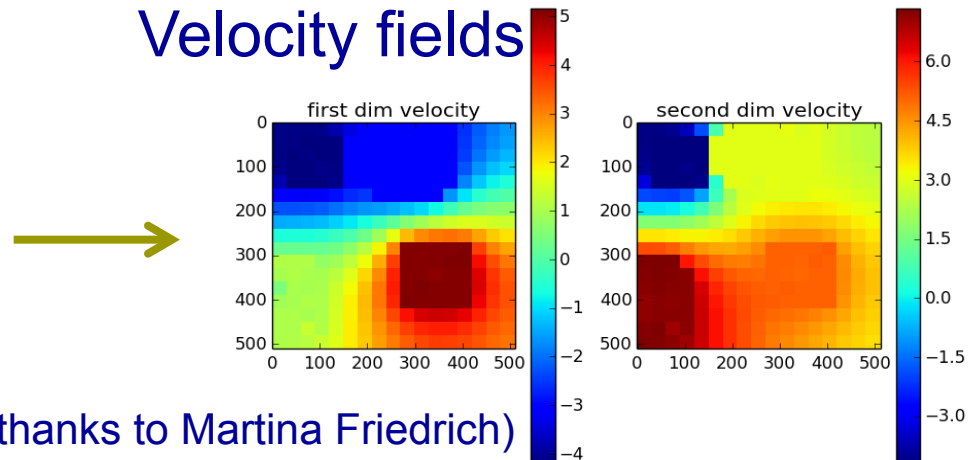
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## Input fields



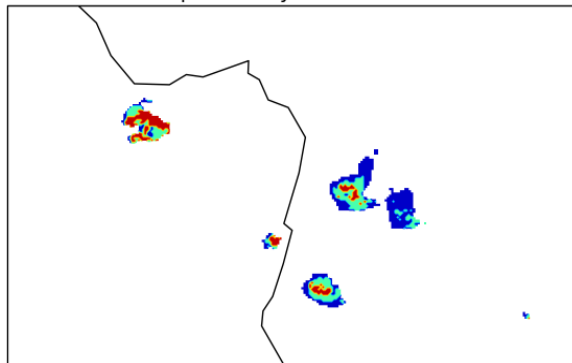
## Velocity fields



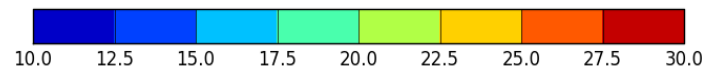
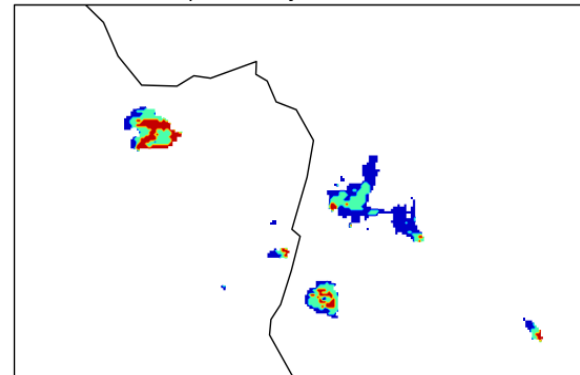
(thanks to Martina Friedrich)

# Input fields

Satellite HAIC probability at: 2016-12-01 10:30:00

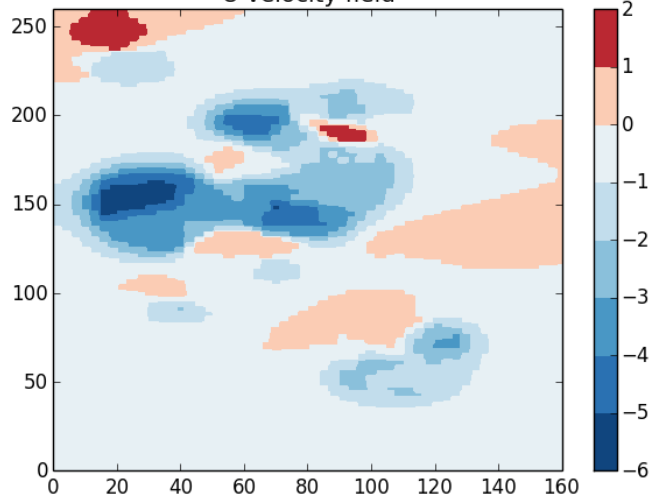


Satellite HAIC probability at: 2016-12-01 11:00:00

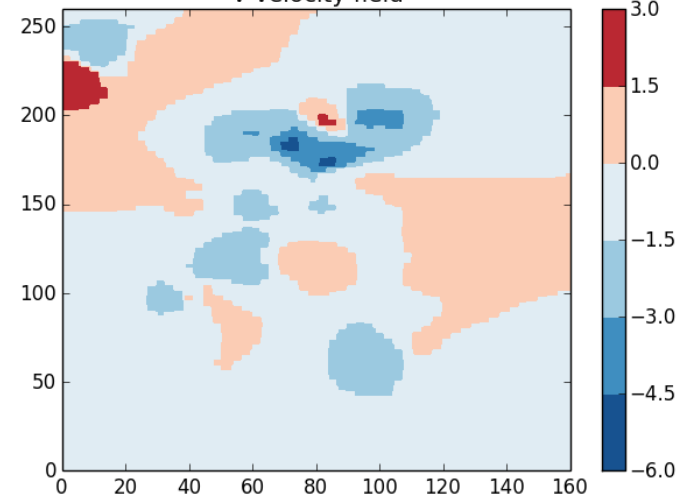


## Velocity fields

U velocity field



V velocity field



# Ongoing work

- Evaluation of how applicable/accurate the method is for a non-precipitation field and considering very different scales
  - Currently tuning and testing the optical flow method
  - Need for more formal verification against satellite data to identify strengths/weaknesses of this method
- Possible future work:
  - Assess if NWP model can provide additional useful information to input into the product
  - Develop longer term forecasts, depending on performance

## Ongoing & future work

- Continue calibration of ALPHA-like and NASA Langley schemes using case studies
- Continue development of object-orientated nowcast tool
- Processing of IAGOS observations to evaluate satellite and nowcasting products
- Improve understanding of physical processes and assess NWP model forecast performance in capturing HIWC conditions



Met Office

Any questions?

