PNNL: Jingyi Chen, Xiang-Yu Li, and Hailong Wang

WRF Cloud Resolving Model (CRM) Simulations to Study Mesoscale Cloud Morphology and Organization

Real-case nested-domain WRF-CRM:

- Domain: 1650x1650 km^2, 450x450 km^2
- Resolution: 3 km, 1 km
- Vertical: 150 layers up to 16 km; 130 layers in the lower 6 km
- Realistic boundary conditions and SST (ERA5, FNL)

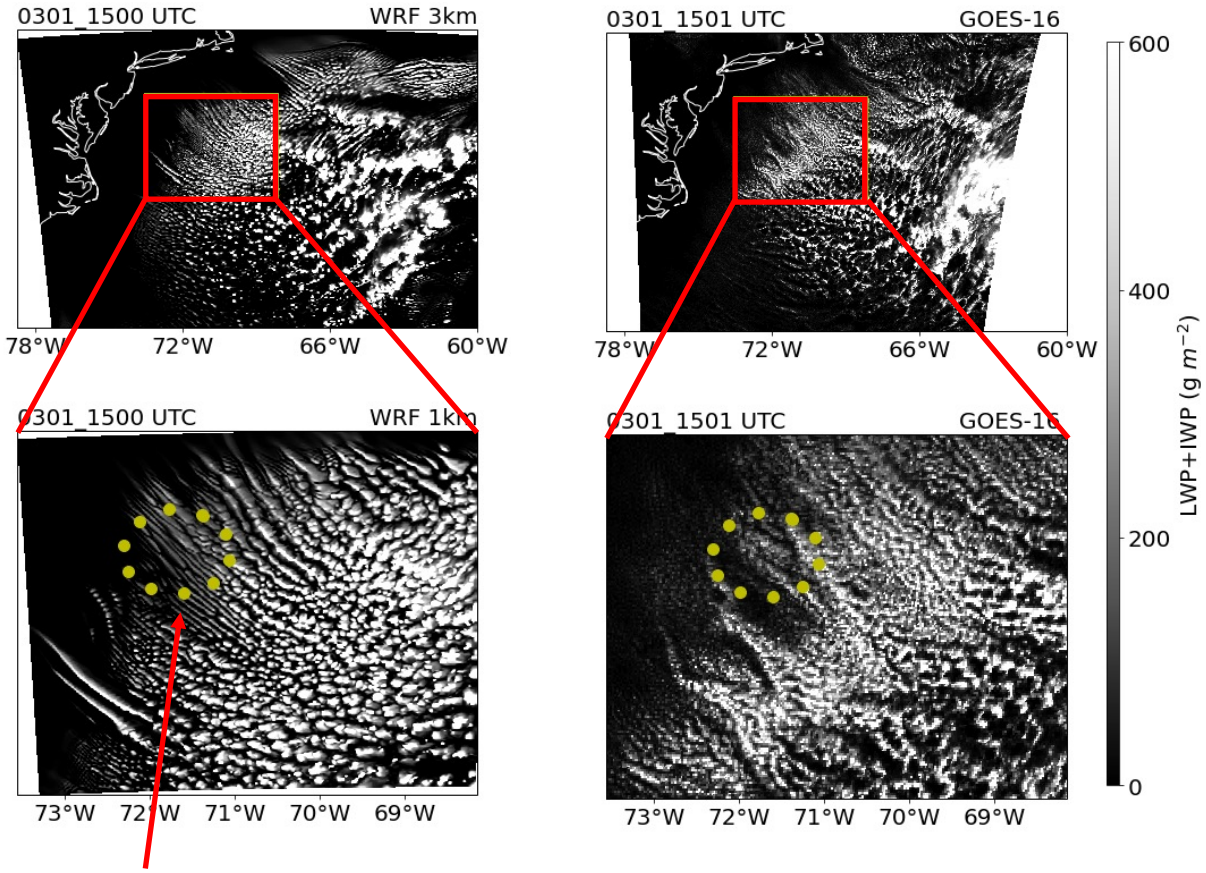
Science questions to answer:

- What are the meteorological factors that determine the CAO cloud morphology and control the transition from cloud streets to cellular clouds?
- What are the roles of aerosols and cloud microphysics?

1500UTC 03-01-2020

WRF model (3 km and 1 km)

GOES-16 Satellite (2 km)



Dropsondes released during 15-16UTC

(Chen et al., in prep)

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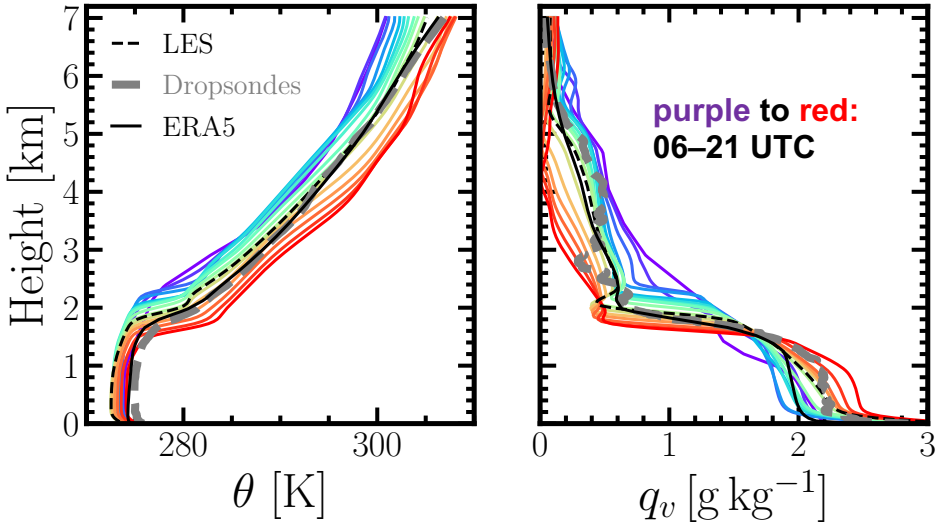
Idealized WRF Large-Eddy Simulations (LES) for Understanding ACI in the fast-evolving marine boundary layer associated with CAO

Idealized-case WRF-LES:

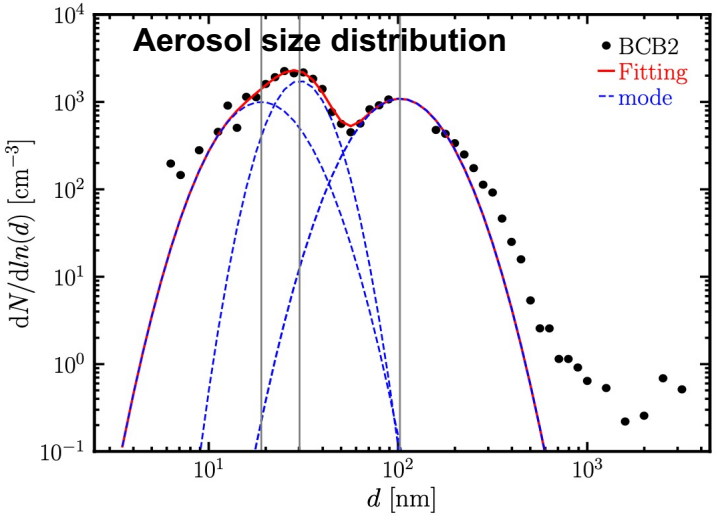
- Domain: 60x60 km^2 with periodic boundary conditions
- Resolution: 300 m, 152 layers (up to 7 km)
- Meteorological profiles, advective forgings and surface fluxes from ACTIVATE and/or ERA5
- N_a, N_c and other measurements from ACTIVATE

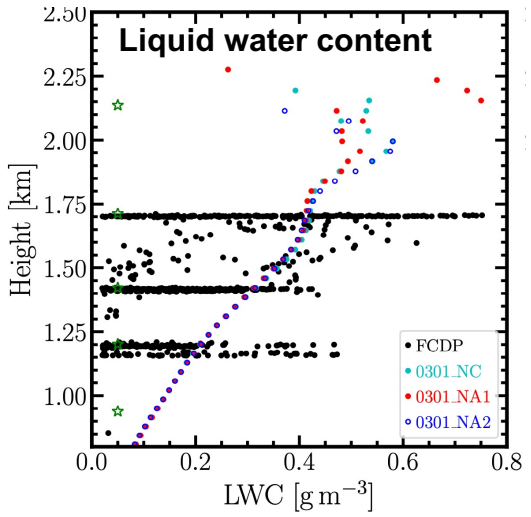


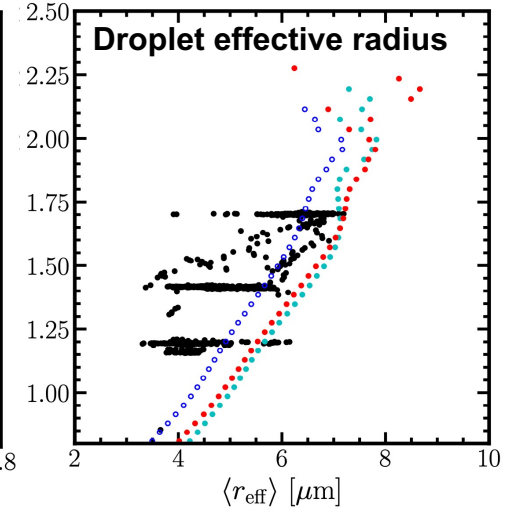
Science objectives:

- Quantify sensitivities of CAO clouds and BL to large-scale forcings
- Study the interactions between aerosols and CAO clouds

(Li et al., 2021a,b)







WRF LES and CRM process-study data available

- **Idealized-case WRF-LES**
  - Simulation cases: 28 February, 1 March 2020 (06–21 UTC)
  - Sensitivity tests with different large-scale forcings (Li et al., 2021a) and aerosol input (Li et al., 2021b)
- **Real-case WRF-CRM**
  - Simulation case: 1 March 2020 (06–00 UTC)
  - Sensitivity tests with different boundary conditions (ERA5 and FNL)
- **WRF output in netcdf**
  - State variables (T, P/Z, Q, U, V, W)
  - Shortwave and longwave radiative fluxes
  - Turbulent fluxes, cloud and other hydrometeors
  - Every 30 minutes
- **Welcome collaboration**
  - Use of the existing simulations
  - New process-study cases
  - Model intercomparison

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```
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        QVAPOR:FieldType = 104 ;
        QVAPOR:MemoryOrder = "XYZ" ;
        QVAPOR:description = "Water vapor mixing ratio" ;
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float QNCLOUD(Time, bottom_top, south_north, west_east) ;
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        QNCLOUD:coordinates = "XLONG XLAT XTIME" ;
```