



# GEOS-5 Forecasting and Modeling in support of ABoVE Airborne Research

PI: Abhishek Chatterjee<sup>1,2</sup>

Co-Is: B. Poulter<sup>1</sup>, J. Masek<sup>1</sup>, L. Ott<sup>1</sup>, C. Miller<sup>3</sup>, E. Euskirchen<sup>4</sup>

Collaborators: J. Fisher<sup>3</sup>, B. Duncan<sup>1</sup>, S. Pawson<sup>1</sup>

Postdoctoral Scholars: Zhen Zhang<sup>5</sup>, TBD

<sup>1</sup> NASA Goddard Space Flight Center, Greenbelt, MD

<sup>2</sup> Universities Space Research Association, Columbia, MD

<sup>3</sup> Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA

<sup>4</sup> University of Alaska Fairbanks, Fairbanks, AK

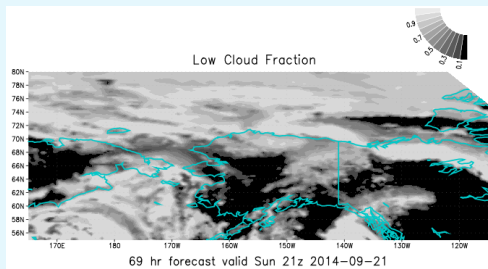
<sup>5</sup> Montana State University, Bozeman, MT



# Outline

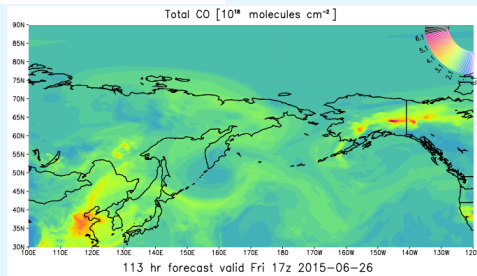
## GEOS-5 Forecasting

FY 2017 and FY 2019 airborne campaign support



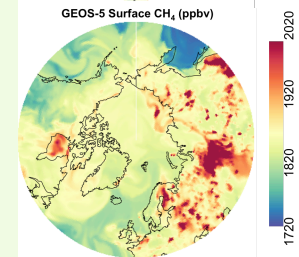
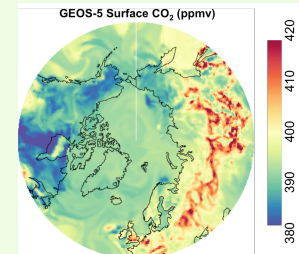
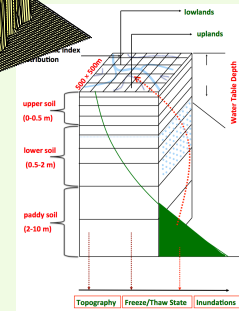
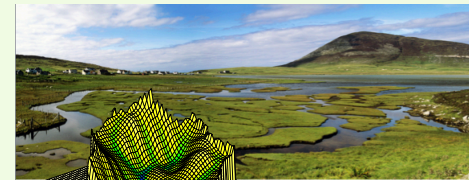
regular weather variables

aerosols & trace gases like  $\text{CO}_2$ , CO



## GEOS-5 Modeling

Targets science questions related to permafrost-carbon dynamics





# GEOS-5 operational forecast

- GMAO provides near real-time support to a number of NASA field campaigns each year –

[https://gs6101-gmao.gsfc.nasa.gov/field\\_campaigns/](https://gs6101-gmao.gsfc.nasa.gov/field_campaigns/)

Home

## Global Modeling and Assimilation Office

GMAO MISSION
WEATHER ANALYSIS & PREDICTION
SEASONAL-DECADAL ANALYSIS & PREDICTION
REANALYSIS
GLOBAL MESOSCALE MODELING
OBSERVING SYSTEM SCIENCE

Field Campaign Support

Weather Maps

2D Chem Weather Maps

3D Chem Weather Maps

Aerograms

Past Campaigns Supported

Related Science Snapshots

Requesting Field Campaign Support

### Previous Years' NASA Field Campaigns Supported by GMAO

The GMAO provides real-time support to a number of NASA field campaigns each year. Forecasts and data assimilation products generated from the GEOS-5 real-time production system, as well as web-based visuals, are made available to the campaign. Typically, these products and tools are used for flight planning and on-site and post-mission analysis of the field measurements.

To request **GMAO support** for a NASA field campaign, please follow the instructions on [this page](#).

2016	Campaign Name
<b>ATom-1</b>	— Atmospheric Tomography Mission
<b>AfriSAR</b>	— Synthetic Aperature Radar data over Africa
<b>CARAFE</b>	— CARbon Airborne Flux Experiment
<b>CORAL</b>	— COral Reef Airborne Laboratory - AUSTRALIA
<b>KORUS-AQ</b>	— An International Cooperative Air Quality Field Study in Korea
<b>ORACLES</b>	— ObseRvations of Aerosols above CLouds and their intERactionS
<b>ORCAS</b>	— O <sub>2</sub> /N <sub>2</sub> Ratio and CO <sub>2</sub> Airborne Southern Ocean
<b>POSIDON</b>	— Pacific Oxidants, Sulfur, Ice, Dehydration, and cONvection Experiment

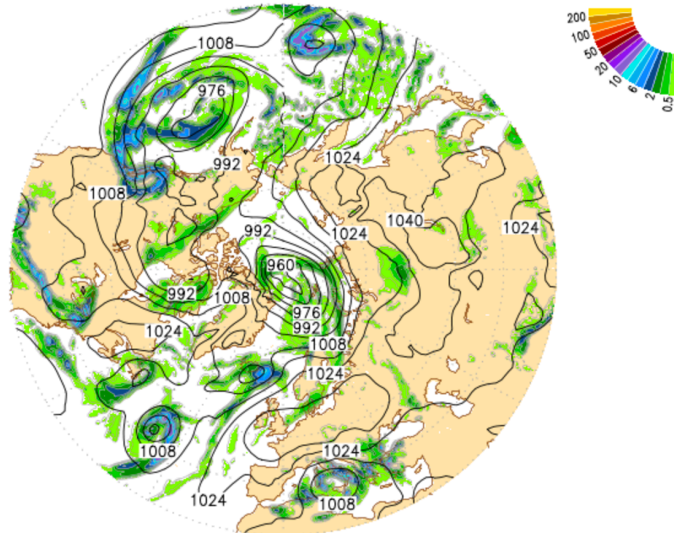
2015	Campaign Name
<b>7-SEAS</b>	— Seven Southeast Asian Studies-2015
<b>ATTREX-CAST</b>	— Airborne Tropical Tropopause EXperiment/CAST 2015
<b>CAL-WATER</b>	— California Water Studies
<b>SHOUT</b>	— Sensing Hazards with Operational Unmanned Technology



# Traditional forecast suite

- ❑ Weather variables, Chemical variables (CO, AOT, SO<sub>2</sub>, BC, OC)
- ❑ Regular maps and aerograms
- ❑ Previously for ARCTAS and ARISE campaigns over Alaska – combination of GEOS-5, Fairbanks NWS, NOAA's Alaska Aviation Weather Unit

NASA/GMAO – GEOS-5 Forecast Initialized Monday 16 January 2017 12UTC  
3-hr Accum Precip [mm] and SLP [mb]



33-hr Forecast Valid Tuesday 17 January 2017 21UTC

Map Regions

Europe

**GMAO  
WxMaps**

Forecast Initial Time

◀ 2017-Jan-16 12z ▶

Forecast Lead Hour

◀ 033 ▶

Models	Levels	Variables
<b>GEOS-5</b>	200	Vorticity
GFS	300	Temperature
	500	Vert Velocity
	700	Humidity
	850	Wind Speed

**Precip & SLP**

**Animate**

choose forecast  
initial time

choose forecast lead hour

customize list of  
variables

<https://gmao.gsfc.nasa.gov/forecasts/>



# A more customized forecast set ...

## ABOVE Regional Weather Briefing

Based on the GEOS-5 meteorological and aerologic forecast fields  
 Initialized 00z 19 July 2016

### Day-1 Forecast

Valid 1200z 20 July through 2359z 20 July

Weak high pressure will be located over the northern portion of the target box during this period with limited cloud cover and clean aerosol profiles. Multi-layer clouds and precipitation are expected further south, south of 66N. North of this parallel, GEOS-5 is forecasting a clear and clean region from approximately 150W east to the US/Canadian border. Some middle and high clouds are anticipated further east beyond the border with Canada. The clearest target may be the points immediately surrounding 68N and 145W. This will also be the zone of least aerosol optical depth. A large fire is seen to have high carbon aerosol concentrations well south of the target box (between 60-62N and 140-145W).

Low level (1.5km) temperatures are expected to be a few degrees on the warmer side of OC over the expected clear target zone with light northwesterly winds. Upper level winds (10km) will be northwest at 40-50 knots with temperatures in the -40C to -50C range here.

### Day-2 Forecast

Valid 1200z 21 July through 2359z 21 July

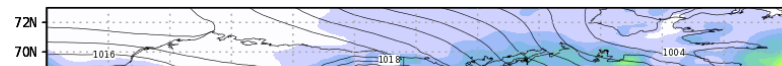
Conditions will deteriorate somewhat as a broad area of low pressure takes shape across much of interior Alaska. Multi-layer cloud cover and precipitation are expected for a majority of the target zone. However, along the northern periphery of the zone, there may still be some opportunity for clear and clean scenes. This will be the best chance of clear and clean profiles on this day expected between 68-70N and adjacent to the 150W longitude line. Points further south closer to 68N will start to pick up more cloud cover. Aerosol optical depths will remain low in the favorable cloudless regions as smoke from the large fire in the southeast part of the state remains well south.

### Day-3 Outlook

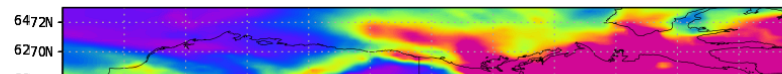
Valid 1200z 22 July through 2359z 22 July

Low pressure remains stubborn in the target areas. Clouds and precipitation further encroach on most of the region. Only a small window of opportunity possible for clear and clean scenes on the northwest edge of the target area near 69N and 150W. No issues from downstate fires.

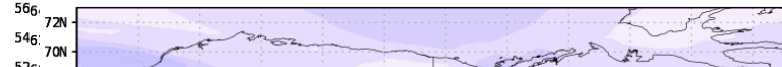
GEOS-5 Day1 SLP/Precipitation Forecast  
 made 19/00z



GEOS-5 Day1 Cloud Optical Depth Forecast  
 made 19/00z



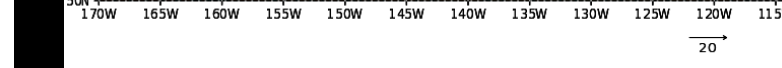
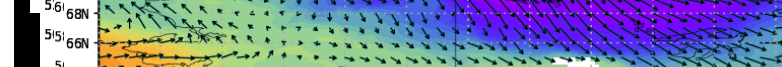
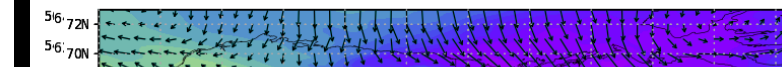
GEOS-5 Day1 Aerosol Optical Depth Forecast  
 made 19/00z



GEOS-5 Day1 10km TMPU/WIND Forecast  
 made 19/00z



GEOS-5 Day1 1.5km TMPU/WIND Forecast  
 made 19/00z



# Plans for 2017 aircraft campaign



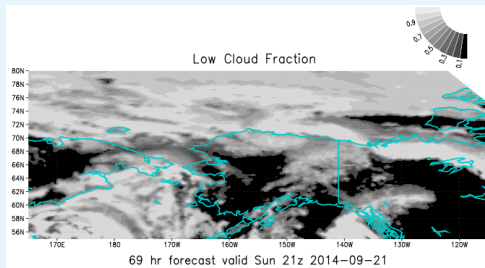
- What a forecast package may look like –
  - summary for instrumentalist on the go – weather and chemical forecasts
  - set of current conditions
  - day by day breakdown of temperature, cloud cover, and precipitation forecasts
  - air quality outlook
  - flight recommendations out ~3 days
  
- What else do YOU (LVIS, AVIRIS, CFIS teams, + others) need?
  
- Email specific requests to:
  - [abhishek.chatterjee@nasa.gov](mailto:abhishek.chatterjee@nasa.gov)
  - [steven.pawson-1@nasa.gov](mailto:steven.pawson-1@nasa.gov)



# Outline

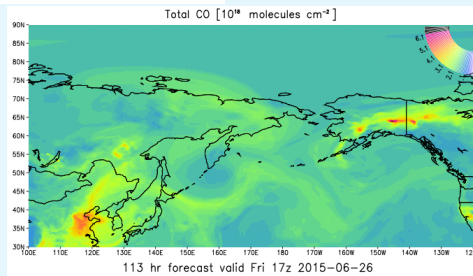
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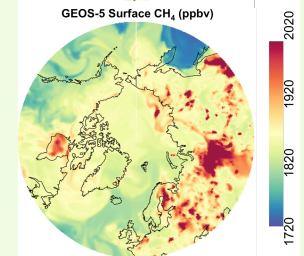
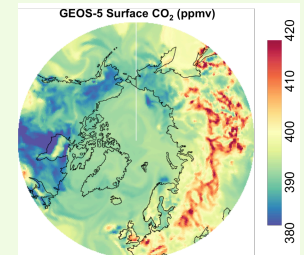
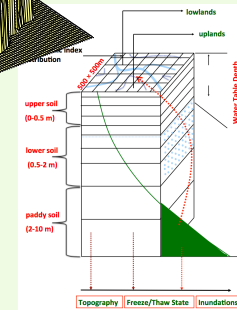
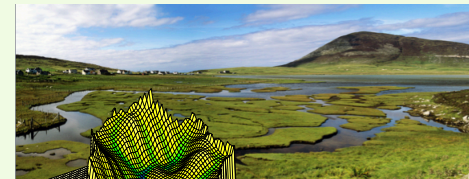
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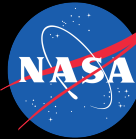
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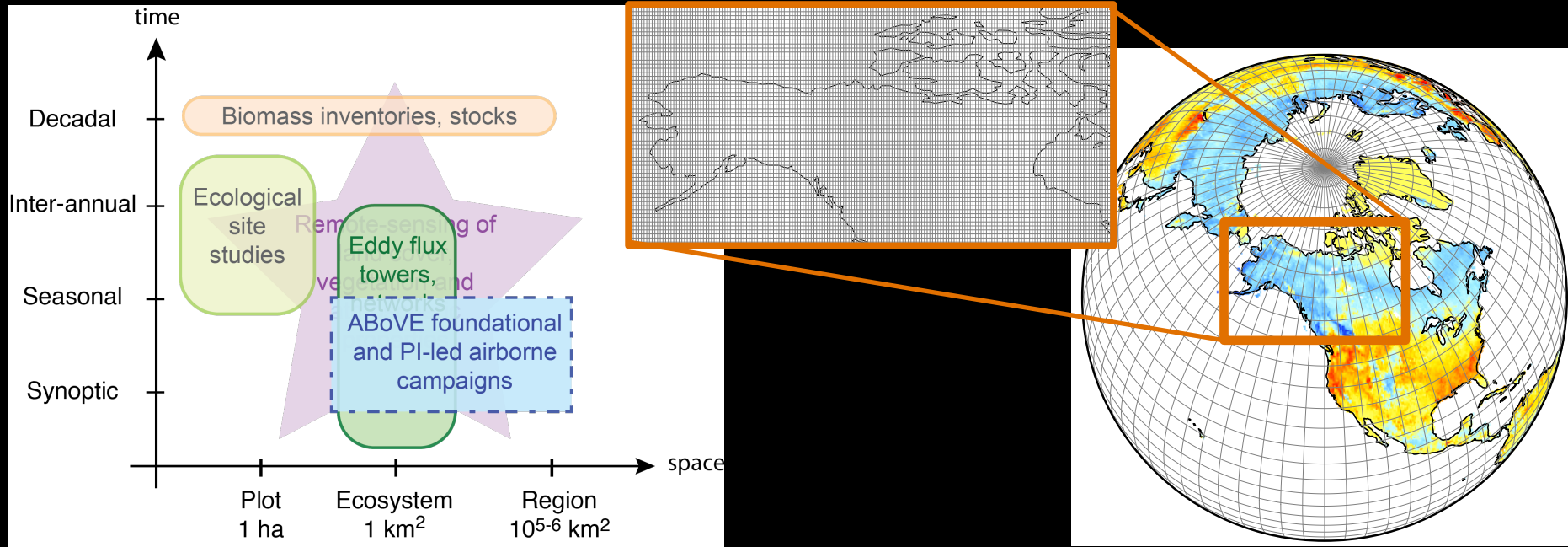
## GEOS-5 Modeling

Targets science questions related to permafrost-carbon dynamics





# Key Deliverable



We need a flexible global high-resolution modeling framework that can investigate ABoVE-specific science questions while placing them in the context of pan-Arctic and global carbon-climate system





# Science Objectives of the study

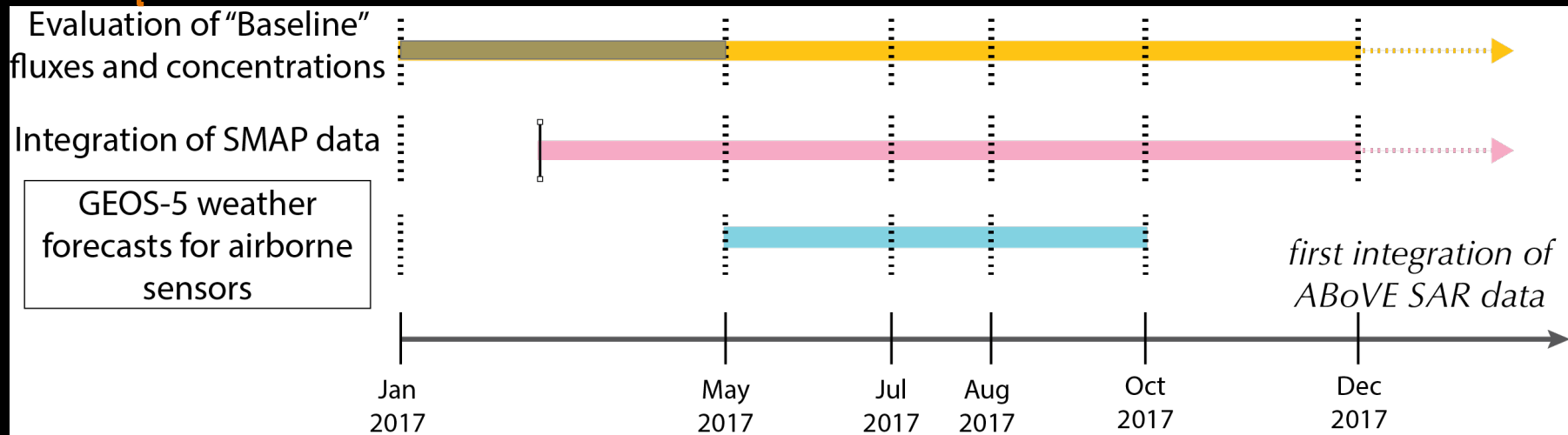
- ❑ **Objective 1** - What role does improved characterization of near-surface permafrost dynamics play in regulating the spatial and temporal variability of CH<sub>4</sub> fluxes?
- ❑ **Objective 2** - What are the interactions between permafrost thaw, surface hydrology and vegetation dynamics, and how do they control the partitioning of CO<sub>2</sub> and/or CH<sub>4</sub> fluxes?
- ❑ **Objective 3** - What are the current permafrost carbon (CO<sub>2</sub> and CH<sub>4</sub>) emissions at different spatial and temporal scales, and what are their future trajectories?

	Science Themes			Study Scale		Basis Space		Input Data
	Permafrost	Vegetation	Carbon Cycle	Spatial	Temporal	Flux	Concentration	
Obj. 1	✓		✓	ABOVE at ~9-25 km	3-hourly	✓ (CH <sub>4</sub> )		<ul style="list-style-type: none"> <li>• L2 geophysical (UAVSAR, AirMOSS, LVIS, AVIRIS-NG)</li> <li>• CARVE (benchmarking)</li> <li>• Satellites (SMAP, OCO-2, Landsat)</li> <li>• Flux towers</li> </ul>
Obj. 2	✓	✓	✓	ABOVE at ~9-25 km	3-hourly	✓ (CH <sub>4</sub> , CO <sub>2</sub> )		
Obj. 3			✓	Global at 1/4°	3-hourly to daily		✓ (CH <sub>4</sub> , CO <sub>2</sub> )	



# Current Status and FY17 Plans

carbon fluxes from towers (re: Turetsky, NGEA-Arctic),  
 atmospheric CO<sub>2</sub>, CH<sub>4</sub> conc. from in situ data (re: Sweeney, CARVE),  
 remote-sensing measurements (OCO-2)



2017 ABoVE  
 campaign



# QUESTIONS?

[abhishek.chatterjee@nasa.gov](mailto:abhishek.chatterjee@nasa.gov)