# **Global Assimilation of Loon Stratospheric Balloon Observations**



Poster Number 1542

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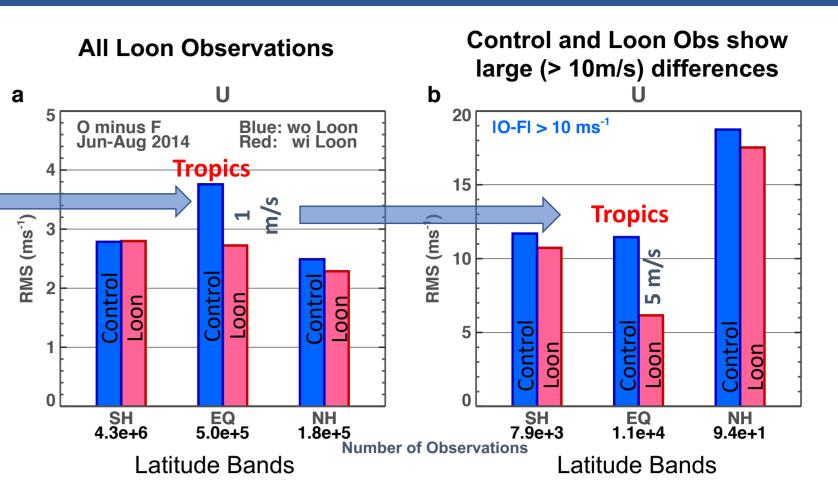
#### The Problem

Verification of global data assimilation system (DAS) output fields by independent observations insures the quality of these products for scientific studies and can highlight the need for additional observations to improve the quality. This is especially important for middle atmosphere winds where there are few "in situ" observations available to constrain the DAS. Here we use constant pressure balloon derived winds to evaluate the lower stratospheric winds in the NASA GEOS DAS.

## **Forecast Improvement (o-f) RMS Summary**

Analysis Improvement (o-a) RMS Example

Assimilated Loon Balloon Winds greatly improves the tropical background forecast Note: o-f denotes the difference between the observation and the short background forecast



#### Loon Balloons



https://loon.co/

**Goal:** launch and maintain a fleet of

balloons to provide Internet coverage to users on the ground.

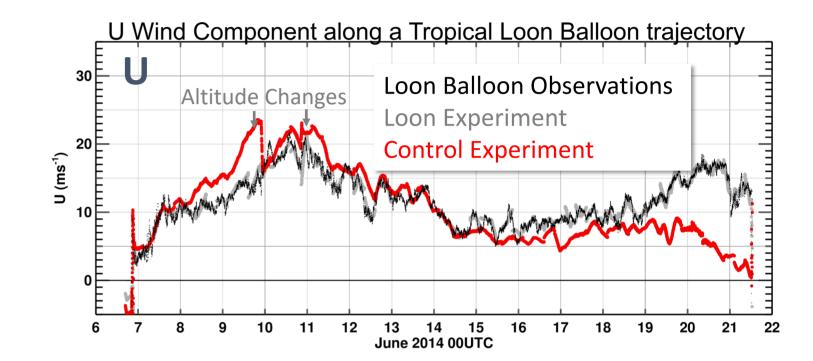
**Status:** over 25 million km of test flights since the project began.

Flight Duration: up to 190 days in the stratosphere.

**Winds:** Derived from Loon Balloon GPS determined locations.

#### Analysis winds interpolated by the DAS in space and time to the Loon position

Note: o-a denotes the difference between the observation and the DAS analysis



Large differences occur between the Control Experiment Analysis and Loon Observations that are corrected in the Loon Experiment Analysis. (Black and gray are on top of each other.)

# Methodology

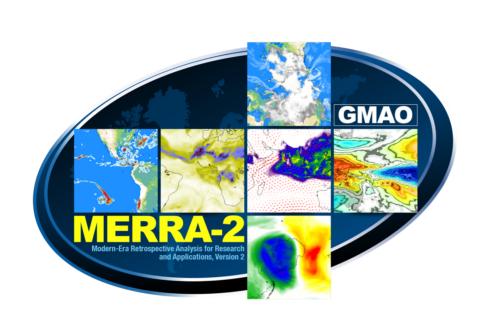
#### NASA GMAO MERRA-2 Data Assimilation System

Two Experiments:

**1. Control Experiment** (assimilation of standard observation set)

**2. Loon Experiment** (assimilation of Loon balloon derived winds + standard observation set)

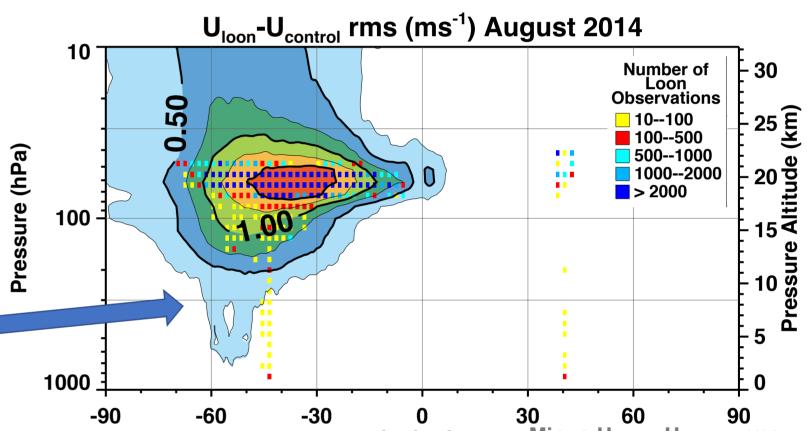
Test Time Period: June-August 2014 (large number of



# Analysis Differences (RMS) August 2014

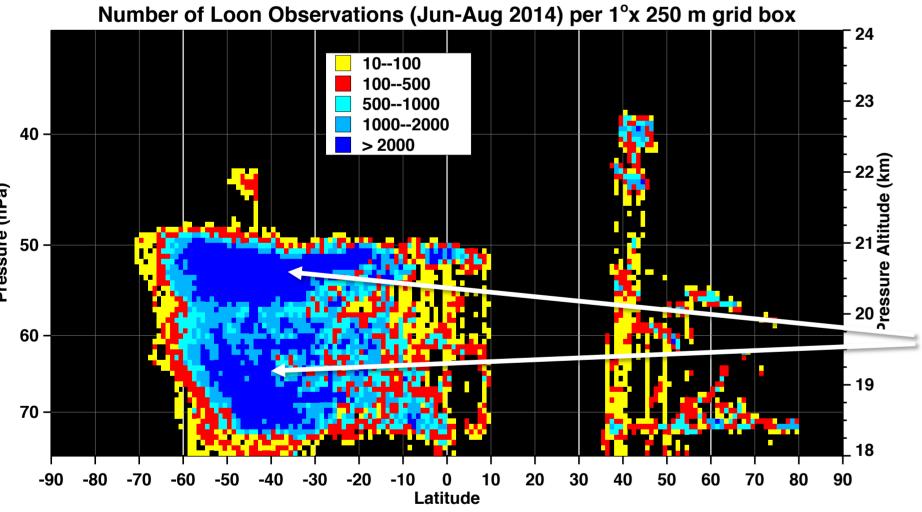
**Control and Loon Balloon** differences found mainly at Loon **Balloon Altitudes** Evidence of some influence

extending into the troposphere, below the Loon Balloon altitude.



# Southern Hemisphere Loon Balloons)

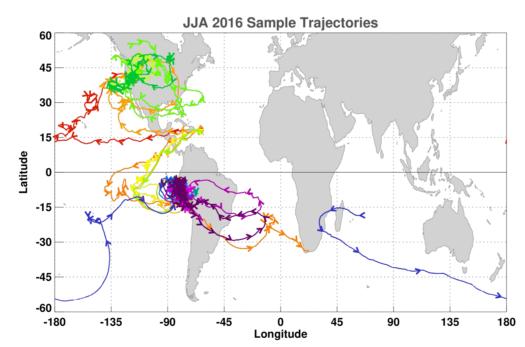
# Loon Balloon Distribution (June-August 2014)



**Southern Hemisphere** Loon Balloons 70-50 hPa (18-21 Km) Altitude 60°S to 10°N Latitude

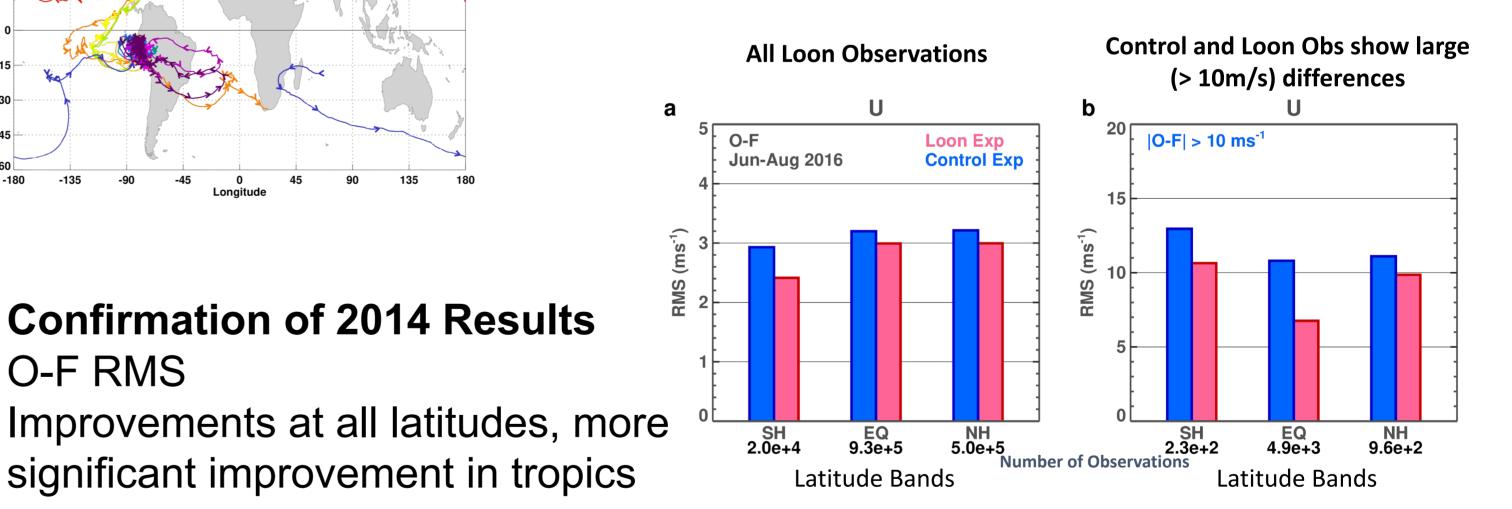
**Balloon Altitudes are** adjusted while in flight

## Additional Test Time Period (June-August 2016)

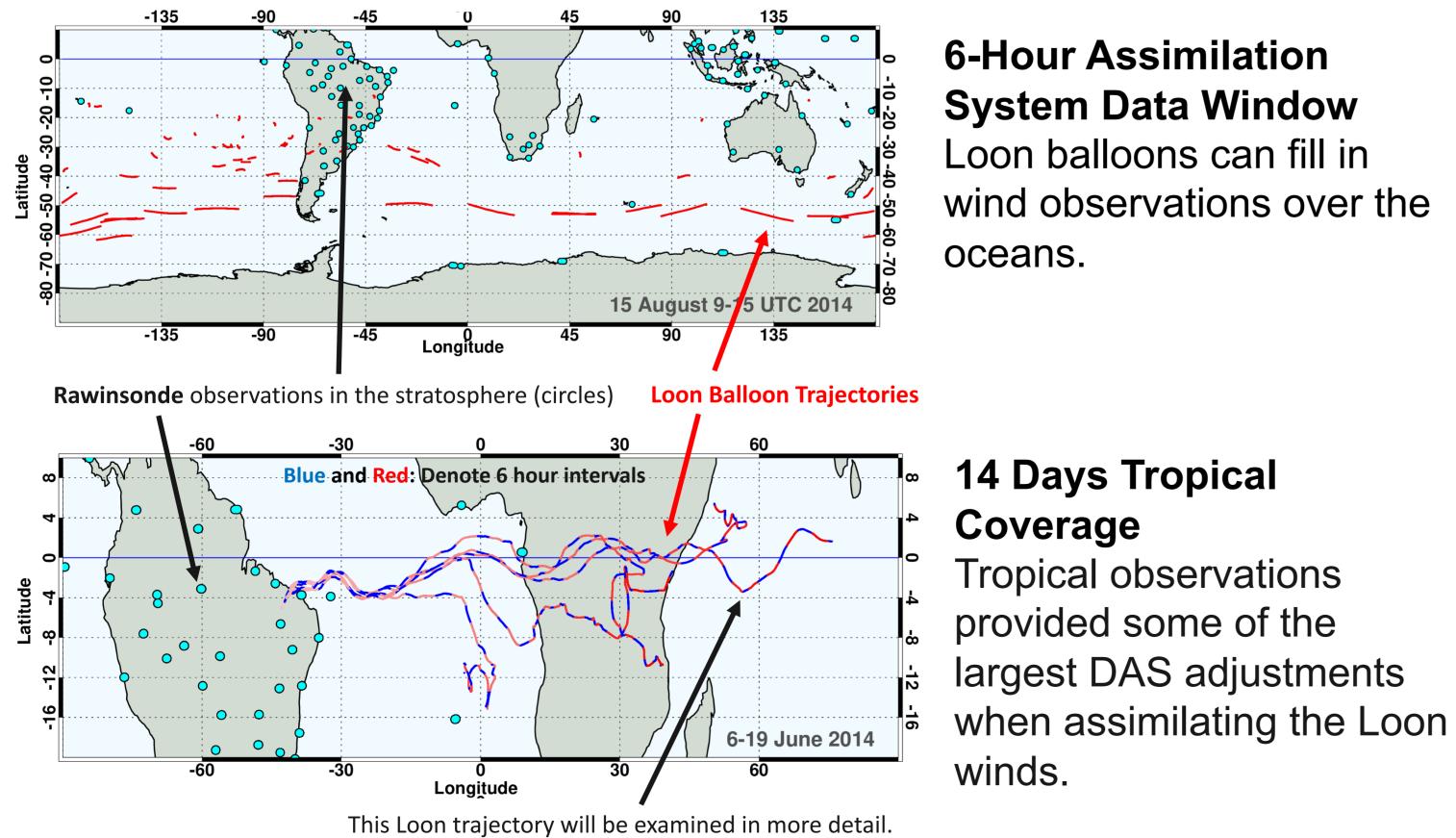


**Confirmation of 2014 Results** 

**Sample Trajectories** (~100-70 hPa Altitude Range) Western Hemisphere Concentration



## **Examples of Loon Balloon Coverage**



**6-Hour Assimilation** System Data Window Loon balloons can fill in wind observations over the

## Conclusions

O-F RMS

- Additional wind observations can improve data assimilation products in the lower stratosphere, especially in the tropics
- Current tropical wind analyses in the lower stratosphere can have errors larger than 10 ms<sup>-1</sup>
- Some of the stratospheric wind analysis improvement may be 3. accompanied by improvements in the upper troposphere wind analysis (further investigation is planned)

Coy, L, M. R. Schoeberl, S. Pawson, S. Candido, & R. Carver, 2018, Global assimilation of X Project Loon stratospheric balloon observations, Submitted to J. Geophys. Res.

