Opportunity Title: Combining High Resolution Intelligence Satellite Images with Lower Resolution Climate Change Images
Opportunity Reference Code: IC-16-21

Organization Office of the Director of National Intelligence (ODNI)

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Complete your application – Enter the rest of the information required for the IC Postdoc Program Research Opportunity. The application itself contains detailed instructions for each one of these components: availability, citizenship, transcripts, dissertation abstract, publication and presentation plan, and information about your Research Advisor co-applicant.

Application Deadline 4/15/2016 6:00:00 PM Eastern Time Zone

Description Satellite sensors are used by the global climate change scientific community to collect the data needed to develop and evaluate models for the physics of climate change. Measurements range from relatively simple examples like measuring the terminal positions of glaciers to very complex hyperspectral measurements, often in the thermal infrared, intended to help unravel cloud and aerosol processes. The climate change sensors are constrained to relatively coarse spatial resolution by such realities as budgets, launch vehicle capabilities and the numbers of photons required for hyperspectral measurements. High resolution commercial satellite sensors, like those operated by Worldview, provide much higher spatial resolution in the Visible/Near Infrared and Short Wave Infrared. These sensors, being built for specific purposes, are optimized for spatial resolution, to cover the well-understood VNIR and SWIR spectral ranges and to provide rapid response at the expense of Mid-Wave and Long-Wave Infrared coverage and of area collection rates enabling rapid global coverage. The question is whether data from high resolution commercial sensors can be combined with data from low resolution civil and commercial sensors in such a way as to provide finesse comparable or even equivalent to the climate change sensors and spatial resolution similar to that of the high resolution commercial sensors.

It is not obvious that such combination is actually feasible, but there are some obvious examples, such as pan-sharpening (in which high resolution panchromatic imagery is used to impart higher spatial resolution to lower resolution multispectral data) to suggest that some degree of success is possible and to suggest avenues of approach.

Pan-sharpening works, at least in part, because the reflectivity in the panchromatic band is correlated with the reflectivity in the multispectral bands; will this always be the case for the more exotic spectral bands used in the climate change measurements? For example, how could high spatial

resolution imagery in the spectral region dominated by reflected sunlight be used to “sharpen” imagery in the thermal infrared or in cross-over regions where both reflected sunlight and thermal emission are important? The answer may lie in the facts that (1) Nearly all the remote sensing processes (even those in the thermal bands) are driven by solar radiation that supplies the energy re-emitted in the thermal infrared and (2) Images collected in reflected sunlight, together with radiative transfer models, provide a means to estimate the amounts of solar energy deposited within a given location in an image and the response, whether in the reflected solar spectral region or not, is expected to be proportional to the input power.

Example Approaches

Proposals may be based on theoretical, experimental or combined approaches to the problem of synergistically combining high spatial resolution satellite imagery with lower resolution imagery in ways such as to provide benefits similar to pan-sharpening to the climate change modeling community. These proposals need not be closely analogous to current pan-sharpening approaches.

- Development, characterization and demonstration of low resolution image products relevant to climate change combined with high resolution commercial satellite imagery from e.g. the Worldview 3 sensor. This would enable demonstration of techniques applicable to high resolution imagery in general. There are two cases of interest:
  - Reflectances in the two sets of spectral bands are strongly correlated.
  - Reflectances in the two sets of spectral bands are not expected to be strongly correlated.
- Development, characterization and demonstration of techniques to extend the high radiometric accuracy of climate sensors to other sensors with similar or dissimilar spectral bands.
- Both theoretical and experimental approaches to all of the foregoing are of interest.

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
  - **Business** (11 👁)
  - **Chemistry and Materials Sciences** (12 👁)
  - **Communications and Graphics Design** (6 👁)
  - **Computer, Information, and Data Sciences** (16 👁)

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- **Earth and Geosciences** (21 👁)
- **Engineering** (27 👁)
- **Environmental and Marine Sciences** (14 👁)
- **Life Health and Medical Sciences** (45 👁)
- **Mathematics and Statistics** (10 👁)
- **Other Non-Science & Engineering** (13 👁)
- **Physics** (16 👁)
- **Science & Engineering-related** (1 👁)
- **Social and Behavioral Sciences** (28 👁)